REPORT

Tonkin+Taylor

Preliminary Geotechnical Assessment Report

Brymer Farms, 584 Whatawhata Road, Hamilton

Prepared for
Brymer Farms Ltd
Prepared by
Tonkin & Taylor Ltd
Date
July 2021
Job Number
1017075

Exceptional thinking together
www.tonkintaylor.co.nz

Document Control

Title: Preliminary Geotechnical Assessment Report					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
02/07/21	1	Final issue to client	D. Mills	G. McDougall	C. Davanna

Distribution:

Brymer Farms Ltd	1 electronic copy
Tonkin & Taylor Ltd (FILE)	1 electronic copy

Table of contents

1 Introduction

Tonkin & Taylor Ltd (T+T) was engaged by Brymer Farms Ltd to conduct geotechnical investigations and provide a high-level geotechnical assessment for a proposed large (2000 lot) residential subdivision development at the Brymer Farms site located at 584 Whatawhata Road, Hamilton.

This report was prepared in accordance with our letter of engagement, dated 22 April 2021, specifically for the Stage 1 (Geotechnical Constraints Reporting) scope of works. The purpose of this report is to provide an outline of the geotechnical risks at the site and comment on preliminary foundation recommendations for a residential development.

This report has been prepared as a high-level assessment for due diligence purposes and is not considered suitable as supporting a resource consent application.

2 Scope of work

Geotechnical services in accordance with our engagement (Stage 1 only) are provided below.

- Project management and administration, health and safety paperwork.
- Review of existing information including available geotechnical information and contour data.
- Underground service location to identify buried services.
- Engineering geologist site walkover and fieldwork supervision / logging.
- Fieldwork: 16 to 20 No. cone penetration tests (CPTs), 3 No. machine boreholes, 10 No. trial pits.
- Processing of fieldwork data and preparation of representative geological sections.
- Preliminary geotechnical analyses to include liquefaction susceptibility, static settlements, slope stability assessment.
- Geotechnical report and plan outlining geotechnical constraints on the development and work out where additional testing is required for subsequent stages.

3 Site description

3.1 General

The subject site is a large rural plot of land, approximately 81 hectares (810,650 m^2) in area, located within the Waikato District, immediately west of the Hamilton City Council boundary line.

The site can be accessed from Whatawhata Road to the south and Brymer Road to the north and is generally bound by rural pasture, but residential development bounds the site to the north-east.

The site comprises the following key characteristics:

- The southern portion of the site, to the immediate north of Whatawhata Road, comprises an isolated raised knoll, which forms part of the rolling hill topography observed across much of the Hamilton basin. Ground levels vary from approximately RL34 m from road level up to RL50 m (16 m elevation change). The slopes are gentle to moderately steep.
- To the north of the knoll, and within the central portions of the site, the topography is typically level at an elevation of approximately RL25 m. A series of farm drains run both north to south, and east to west across the low-lying areas, where a series of culvert and bridge crossings provide access around these areas.

- The northern portions of the site comprise gully incised, rolling hill topography, which is typical for the area. Elevations change from approximately RL25 m in the low-lying regions, up to RL55 m in the elevated portions of the site, with slope gradients ranging from moderate (approximately 20 degrees) to moderately steep (approximately 50 degrees). A series of gully fed ephemeral (rainfall triggered) streams also appear to be present on the site with a pond observed in aerial photographs around RL31 m, which is likely fed by the gully borne streams.
- A lower-lying area to the north of the site lies at a relatively level gradient at an elevation around RL30 m.

The existing site layout and key site features are presented on Figure 01, which is appended to this report.

3.2 Historic site use

A brief history of the site is summarised below based on available historic aerial photography[1,2]:

- 1943: majority of the site is in pasture, with dense patches of vegetation within the gully heads. Some isolated farm buildings are present across the site, with the structures particularly prevalent adjacent to Whatawhata Road within the southern portion of the site.
- 1979: increase in residential development to the east of the site as part of Hamilton City expansion.
- 2008: Increased residential development observed at the northwest boundary of the site.

The site is likely to have undergone minor earthworks as part of historical rural developments, which may comprise fill pits, drains, and fill piles.

4 Proposed development

Due to the high-level nature of the report and the early stages of the development no concept plans or sketches are currently available for the project.

Based on phone conversations with yourself, the client, we understand that the proposed development will comprise up to 2000 residential lots with associated access roads, and parking. In addition, a wastewater treatment plant is also proposed to be located on the site.

For assessment purposes the residential developments are standard lightweight, one or two-storey dwellings.

5 Ground conditions

5.1 Geology and faulting

The published geological information[3] indicates the site is predominantly underlain by the following two units:

- Lower lying plains: Swamp deposits consisting of soft, dark brown to black, organic-rich mud, muddy peat and woody peat (Q1a) of the Piako Subgroup of the Holocene age (<12 ka).

[1] Retrolens Website, Historical Image Resource, https://retrolens.co.nz/map.
[2] Google Earth Pro, Historic Aerial Image Tool
[3] Edbrooke, S.W. (compiler) 2005: Geology of the Waikato area. Institute of Geological & Nuclear Sciences 1:250,000 geological map 4. 1 sheet + 68 p. Lower Hutt, New Zealand. Institute of Geological & Nuclear Sciences Limited.

- Elevated Landform: Pumiceous alluvium and colluvium dominated by primary and reworked, non-welded ignimbrite (eQa), of the early Pleistocene era (.128 ka to 1.8 ma).

The site location with respect to the published geological information is presented on Figure 5.1 below.

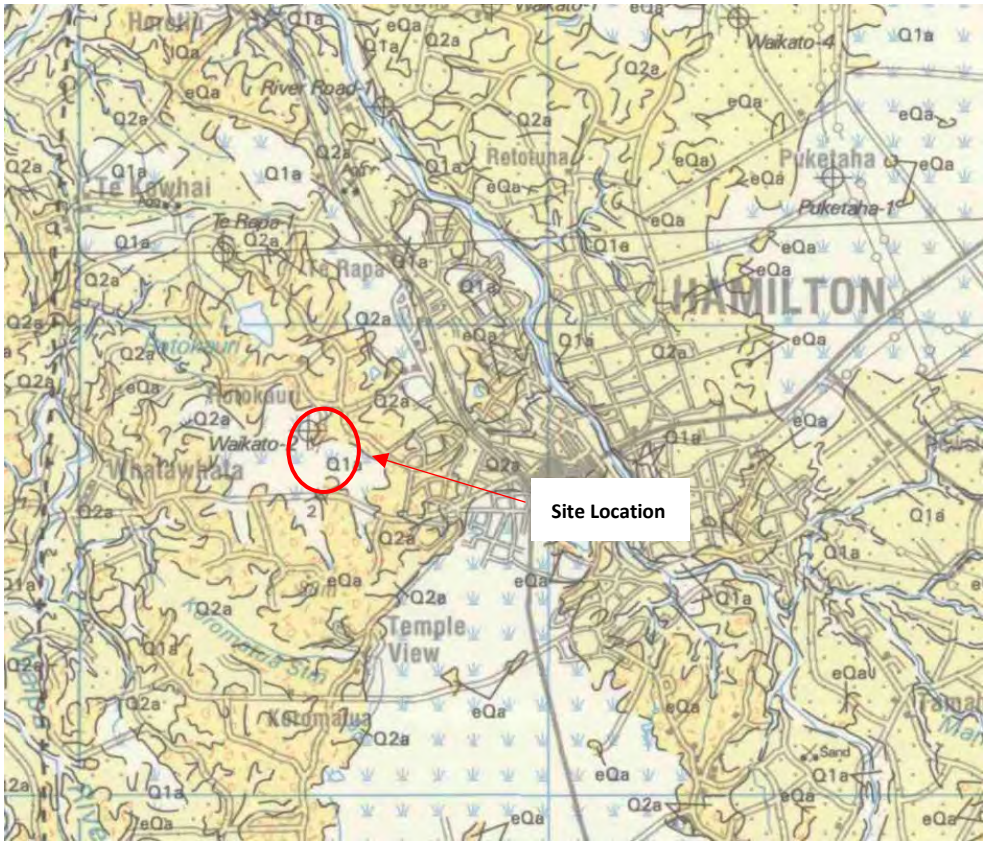


Figure 5.1: Published geology of the site and surrounding area[3]

5.2 Geomorphology

5.2.1 Regional setting

The Hamilton basin is a large tectonic depression (down-thrown block or graben), approximately 2,000 km^2 in area, centred on Hamilton[3]. The basin is bound to the west and east by up-thrown Mesozoic basement rocks[4] which form the 400 m high hills of the Hakarimata and Pakaroa Ranges. The Hamilton basin is infilled with a sequence of younger Pleistocene volcanically derived sediments of the Tauranga Group sediments deposited by a pre-existing form of the Waikato River. These basin sediments thicken as a wedge from east to west with maximum thicknesses ranging between 1,000 m and 1,500 m.

5.2.2 Subject site area setting

The landforms across the site can be split into the three main areas, as described below:

- **Landform Zone 1**: Low-lying plains at RL 25m, with minor undulations and hummocky ground observed. These low-lying landforms are likely to comprise recent alluvial and fluvial / colluvial derived deposits.

- **Landform Zone 2**: Elevated portions comprise rolling hill topography, with slope gradients up to approximately 50 degrees, however were typically around 15 to 35 degrees. Erosional gully features were observed with crests typically between 20 m and 30 m in length. Very shallow instability features were observed as terrace sets, which may have been exaggerated through cattle grazing within the elevated portions of the site. No large-scale historical slips or evidence of other shallow rotational features were observed during the site walkover or from historical aerial photographs.
- **Landform Zone 3:** this represents the transition between the elevated portions of the site and the lower-lying plains. This area is likely to have been formed from sediments being transported from the erosional gully heads to the low-lying portions of the site. This area of the site is very gently graded, forming a gently sloping fan of deposits form the toe of the Landform 1 towards Landform Zone 2.

5.3 Geotechnical investigations

Geotechnical investigations were carried out between 17 May 2021 and 1 June 2021 under the direction of T+T to specifically address the objectives and scope defined in this report. The investigation included:

- Ten trial pits, denoted TP101-TP110 were undertaken using an 8-tonne excavator to assess shallow ground conditions. The trial pits were advanced to between 1.8 m and 4.4 m below ground level (bgl) where they were terminated at either the machine limit or upon reaching target stratum below the peat.
- Fourteen Cone Penetration Tests (CPT), denoted CPT101 to CPT114 pushed to depths of between 7.12 m and 29 mbgl to assess deeper soil units and liquefaction susceptibility below the site.
- Three machine boreholes (BHs) were drilled using a tractor mounted rotary machine borehole rig with samples collected using triple tube HQ barrels down to depths between 15.0 m and 27.45 m.

The CPTs and machine boreholes were carried out by Drillcore Ltd under T+T's instruction. The trial pits and the machine borehole logs were logged by a T+T geotechnical engineer. The investigation locations were surveyed using a handheld GPS. Test locations are presented on Figure 01 in Appendix A. The logs from the site investigation are presented in Appendix B.

The logging has been undertaken in accordance with the NZGS Soil and Rock logging guidelines[4] (2005).

5.4 Soil stratigraphy

The soil stratigraphy has been derived from the CPT, machine borehole and trial pit logs, the published geological maps, and experience with similar soils, and are summarised on Figure 02 in Appendix A with further descriptions provided in Table 5.1 and Table 5.2 below.

In general, the site comprises recent alluvial and swamp deposits within the low-lying areas (Landform Zone 1), older ash and fluvially re-worked deposits of the Walton Subgroup within the elevated regions of the site (Landform Zone 2), and a transition zone where colluvial and recent

[4] Field Description of Soil and Rock – Guideline for the field classification and description of soil and rock for engineering purposes, NZ Geotechnical Society Inc, December 2005.

deposits have been eroded from the elevated areas and transported to the toe of the slopes (Landform Zone 3).

Table 5.1: Landform Zone 1 and 3 (low-lying recent deposits)

Unit No.	Inferred Soil Description	Depth to top of layer (mbgl)	Layer thickness (m)	Cone Resistance q_c (MPa)
1	SILT with varying subordinates of clay and sand; firm. [Topsoil]	0.0	0.1 to 0.4	-
2	Silty CLAY/Clayey SILT; firm. [Colluvium] *	0.1 to 0.4	1.5 to 5.0	0.3 to 1.0
3	PEAT (Fibrous and Amorphous); soft. [Piako Subgroup]	0.1 to 0.4	0.4 to 2.3	0.1 to 0.2
4	Estuarine SILT with varying subordinates of sands, peat and gravels; soft to firm. [Piako Subgroup]	0.8 to 2.5	7.1 to 12	0.1 to 2.0
5	Medium dense to dense SAND with varying subordinates of silts and gravels [Hinuera Fm] **	12.3 to 14.5	3.0 +	3 to 14

* Only present in boundary areas between Landform Zone 1 and Landform Zone 2.
** Bottom of layer not encountered in these investigations.

Table 5.2: Landform Zone 2 (elevated deposits)

Unit No.	Inferred Soil Description	Depth to top of layer (mbgl)	Layer thickness (m)	Cone Resistance q_c (MPa)
1	SILT with varying subordinates of clay and sand; firm. [Topsoil]	0.0	0.3	-
2	Silty CLAY/Clayey SILT; firm to very stiff. [Hamilton Ash]	0.3	5	1.3 to 4.5
3	Silty CLAY/Clayey SILT with varying subordinates of silt, sand and peat; firm to very stiff. [Walton Subgroup]*	4.5	20 +	1 to 4
4	Medium dense to dense SAND (Walton Subgroup) – not encountered in CPT-1	10 to 12	5+	8 to 28

* Bottom of layer not encountered in these investigations.

These Landform Zones are presented on Figure 02 in Appendix A, which should be referred to in conjunction with this report text.

The thickness of soft soil deposits encountered within Landform Zone 1, has been presented on the soft soil contour plan appended to this report - Figure 03 (Appendix A).

5.5 Groundwater

5.5.1 Landform Zone 1 & 3

Groundwater levels were measured following the drilling of the boreholes, during the trial pit excavations and were dipped after withdrawal of the CPT cones. Groundwater was typically measured within the low-lying portions of the site to be between 0.4 m and 0.7 mbgl, which is at an equivalent elevation of between 24.5 m and 24.8 m RL.

Artesian groundwater was also encountered within the low-lying areas of the site during drilling and advancement of the CPTs. This artesian pressure was encountered in CPT103, BH 102 and BH103, at depths of between 15 m and 18 mbgl.

The groundwater measurements results have been summarised for each investigation location and presented in Appendix C.

5.5.2 Landform Zone 2

Groundwater information within the CPTs was difficult to assess due to the holes collapsing dry upon withdrawal of the cone. Groundwater was however dipped within BH101 at a depth of 15 mbgl, which is equivalent to an elevation of RL30.5 m. Due to the sloping nature of the site, we would anticipate that the groundwater table grades towards the low-lying plains to reflect the change in landform at ground surface.

Groundwater seepages were not encountered in this zone during our site visit, however aerial photographs clearly show ponding water and ephemeral streams, which are likely to have formed the gully head features observed within the elevated terraces. Perched groundwater tables should therefore be anticipated within the elevated portions of the site.

The groundwater measurements results have been summarised for each investigation location and are presented in Appendix C.

6 Seismic shaking hazard

6.1 Seismic site subsoil class

The following seismic subsoil classes in accordance with NZS 1170.5:2004 Section 3.1.3 are recommended based on our site investigation results, published geological information, and experience on projects within this area:

- Subsoil Class E: for developments in and adjacent to CPT102, CPT103, CPT104 within the low-lying recent alluvial deposits, where soft soils were encountered to be at least 10 m thick and estimated shear wave velocities less than 150 m/s based on Robertson (2009)[5].
- Subsoil Class D: for the remainder of the site where soft soils were less than 10 m thick, and although depth to rock was not proven during the geotechnical investigations, published geology[3] indicates depth to bedrock exceeds the limits for site subsoil Class C – Shallow Soil.

For preliminary assessment purposes we would recommend a Subsoil Class E for Landform Zone 1 and 3, and a Subsoil Class D for Landform Zone 2 as shown on Figure 02 in Appendix A.

[5] Robertson, PK (2009). Interpretation of cone penetration tests – a unified approach, Canadian Geotech. J., 46(11):1337=1355

Additional investigations to further assess the extent of the subsoil class should be undertaken as part of the resource consenting phase to further refine these zones, which are subject to change.

6.2 Ground shaking hazard

New Zealand Standard, NZS1170.5:2004 Structural Design Actions Part 5 Earthquake Actions, clause 2.1.4 specifies that to meet the requirements of the New Zealand Building Code, design of structures must allow for two earthquake scenarios:

1 (ULS) "Ultimate limit state for earthquake loading shall provide for... avoidance of collapse of the structural system... or loss of support to parts... damage to non-structural systems necessary for emergency building evacuation that renders them inoperative."

2 (SLS) "Serviceability limit states for earthquake loading are to avoid damage to... the structure and non-structural components that would prevent the structure from being used as originally intended without repair after the SLS earthquake...".

The seismic hazard in terms of peak ground acceleration (PGA) for the site has been assessed based on Bridge Manual SP/M/022 Third Edition. Table 6.1 presents the return periods for earthquakes with various 'unweighted' peak ground accelerations (PGA) with a corresponding earthquake magnitude. The seismic hazard determined below is for geotechnical design purposes only (liquefaction, slope stability). Structural design may require determination of the seismic hazard (PGA, M) using other standards or methods.

As the proposed development could comprise both residential dwellings and a wastewater treatment plant, the ULS seismic event has been considered for both IL2 and IL3 return periods.

Table 6.1: Ground seismic hazard

NZS 1170.5 Limit State	PGA (g)	Effective magnitude M_{eff}	Return period (years)
Ultimate limit state (ULS – IL3)	0.280	5.9	500
Ultimate limit state (ULS – IL2)	0.215	5.9	500
Serviceability limit state (SLS)	0.054	5.9	25

Note:

PGA and effective magnitude have been assessed based on Bridge Manual SP/M/022 Third Edition for the following:

Building design life	50 years – assumed
Building importance level	3 & 2 (NZS 1170.0:2004, Table 3.2)
Return period factor, Ru	1.3 for 1000 yr, 1.0 for 500 yr and 0.25 for 25yr return period (NZS 1170.5:2004, Table 3.5)
Subsoil class	D (deep soil) & E (soft soil) – refer Section 3.4.1
Return period PGA coefficient, $C_{0,1000}$	0.28 (Bridge Manual Table 6A.1)
Site subsoil class factor, f	1.0 (Bridge Manual Section 6.2)
PGA	$C_{0,1000}$ x Ru/1.3 x f x g (Bridge Manual Section 6.2)
Effective Magnitude, M_{eff}	5.9 for 1000yr, 500 yr and 25 yr return period (Bridge Manual Table 6A.1)

7 Liquefaction assessment

7.1 General

Liquefaction occurs when loose granular soils below groundwater level experience strength loss in response to an applied cyclic load, such as those generated from earthquake shaking. Liquefaction can cause damage to land, buildings and infrastructure.

Soils which are susceptible to liquefaction require a certain level of earthquake shaking (trigger) to cause them to liquefy. Liquefaction trigger analyses were completed using the simplified method outlined by Boulanger & Idriss (2014)[6]. Analyses have been undertaken utilising CPT data with design ground water level as per Section 5.5. A sensitivity check on the groundwater levels with respect to liquefaction susceptibility / triggering, has also been undertaken.

The liquefaction assessment has been completed for both SLS and ULS design seismic events previously summarised in Table 6.1, and as per MBIE Guidance in relation to the soil fabric, age, and following considerations:

- Non-liquefied crust thickness;
- Liquefaction induced settlements; and
- Liquefaction Severity Number (LSN).

7.2 Assessment results

The results of the analyses indicate that liquefaction is not triggered under an SLS event and therefore the effects of liquefiable soils for the proposed development are negligible for this seismic case. Liquefaction is expected in some areas of the site following a ULS seismic event (both IL2 and IL3) with the results of the analyses presented in Table 7.1 below.

The PGA sensitivity analysis indicated that liquefaction triggering is expected to begin at a PGA range between 0.08 g to 0.15 g. Full liquefaction triggering is likely to develops at a range between 0.25 g and 0.3 g.

Numerical liquefaction analysis has not been carried out on CPTs located within elevated portions of the site (Landform Zone 2). Given the depth to groundwater and therefore the non-liquefiable crust thickness, and the age of the soils with respect to the geomorphology of the site (i.e. no observed evidence of past lateral spread events with respect to the return period interval), we anticipate the effects of liquefaction within these areas to be negligible for at least the 1,000 year return period considered.

[6] Boulanger, R.W. & Idriss, I.M (2014) "CPT and SPT Based Liquefaction Triggering Procedures" UCD/CGM-14/01

Table 7.1: Summary of CPT-based ULS liquefaction analysis

Landform Zone	Test Location	Crust thickness (m)[1]		Liquefaction Severity Number (LSN)		Free-field surface settlement (mm) - 15% exceedance probability	
		ULS (IL2)	ULS (IL3)	ULS (IL2)	ULS (IL3)	ULS (IL2)	ULS (IL3)
1	CPT103	7.2	7.2	11	11	130	130
	CPT104	2.5	2.5	13	13	97	101
	CPT106	1.2	1.2	42	45	179	202
	CPT107	3.5	3.5	27	37	74	88
	CPT108	1.1	1.1	20	24	42	54
	CPT109	0.9	0.9	38	38	103	105
	CPT110	5	5	21	22	99	107
	CPT111	4.5	4.5	13	22	32	43
3	CPT102	29	29	31	32	221	241
	CPT105	10.5	6.7	28	29	89	90

7.2.1 Landform Zone 1 Results

The results of the analyses indicate that the silty sand / sand layers within the recent low-lying Piako Subgroup deposits are susceptible to liquefaction, where encountered below the groundwater table. The estuarine silts and peat soils are not considered susceptible to liquefaction.

Between 30 mm and 180 mm of liquefaction-induced settlement was predicted for an IL2 event (500 yr return period), and 40 mm to 200 mm predicted for an IL3 event (1,000 yr return period).

The non-liquefiable crust across the lower lying landform has varying thicknesses from 0.9 m thick to 10 m thick.

Liquefiable layers for CPT103 and CPT104 were also predominantly below 10 m depth, so the effects of liquefaction manifestation or damage at ground surface is likely to be negligible.

Foundation recommendations to address the liquefaction-induced settlements are provided in section 10.

7.2.2 Landform Zone 3 Results

The CPTs undertaken within this unit generally indicate settlements to be between 90 and 220 mm for an IL2 event and 90 to 240 mm for an IL3 event, with crust thicknesses between 6.7 and 29 m. Most of the settlement would be anticipated to be below 10 m and therefore the effects of liquefaction at surface are likely negligible.

Further global settlement may occur on a regional scale, which will have negligible effect on the structural integrity of the building.

Foundation recommendations to address the liquefaction-induced settlements are provided in section Table 10.1.

7.3 Lateral spread

Lateral spread has not been assessed at this stage due to the preliminary nature of the development. As the risk from liquefaction for the elevated portions of the site is considered to be low, particularly with reference to the current geomorphology and lack of evidence to suggest large future seismic displacement, then the risk of lateral spread is also likely to be low.

Due consideration will however be required for the following and may require:

- Distance of development to open drains or channels.
- Displacement of fill batters within the low-lying portions of the site.

8 Static settlement

8.1 General

Application of a load, such as from building foundations or fill placement, onto the ground surface will cause the underlying soils to vertically displace as the volume between the soil particles decreases. The degree of settlement will depend on the magnitude and extent of the applied load, as well as the stiffness and fabric of the underlying soils.

Static settlement has been assessed at the site using the CPET-IT analysis software, with the constrained modulus (stiffness) parameters derived from the CPT traces. Foundation loads are not currently known for the site as the project is still in the early stages, however the following simplistic residential foundation systems have been assessed:

- 5 kPa widespread load over a 10 x 15 m footprint (flexible foundation).
- 7.5 kPa widespread load over a 10 x 15 m footprint (flexible foundation).
- 75 kPa strip footing (0.3 m wide and 15 m long).
- 100 kPa strip footing (0.3 m wide and 15 m long).

The results of the static settlement for the above foundation design scenarios are summarised in Table 8.1 below.

Table 8.1: Settlement prediction summary

Landform Zone	Total Primary Consolidation (mm)				
	CPT #	**5 kPa UDL (10 m x 15 m)**	**7.5 kPa UDL (10 m x 15 m)**	**75 kPa strip (0.3 m wide and 15 m long)**	**100 kPa strip (0.3 m wide and 15 m long)**
1	CPT103	150	225	160	215
	CPT104	90	135	85	115
	CPT106	<10	10	30	35
	CPT107	<5	<5	<5	<5
	CPT108	<5	<5	<5	10
	CPT109	<5	<5	15	25
	CPT110	20	30	45	60
	CPT111	<5	<5	<5	<5

Landform Zone	Total Primary Consolidation (mm)				
	CPT #	5 kPa UDL (10 m x 15 m)	7.5 kPa UDL (10 m x 15 m)	75 kPa strip (0.3 m wide and 15 m long)	100 kPa strip (0.3 m wide and 15 m long)
2	CPT101	< 5	<5	<5	<5
	CPT112	<5	<5	<5	<5
	CPT113	<5	<5	<5	<5
	CPT114	<5	<5	<5	<5
3	CPT102	<20	35	25	35
	CPT105	<5	<5	<5	10

The table above only considers immediate and primary settlement as an indicator of likely total settlements at the stie. It is however likely that creep settlement will occur within the peat deposits within Landform Zone 1 and will be in addition to the totals given above. Creep settlement will need to be considered in future stages should it remain in-situ, and has been considered as part of the foundation recommendations presented in section 10.1.

8.2 Foundation Performance

The results summarised in Table 8.1 above indicate that the static settlements within the elevated portions of the site (Landform Zone 2) are generally considered to be within Building Code guidelines and likely not governing the foundation recommendations, provided that only minor filling is undertaken.

Shallow building foundations, such as those stipulated by NZ3604:2011, are not likely to be suitable within the lower-lying portions of the site (Landform Zone 1), without some form of remediation being required. This is particularly prevalent for future buildings located around CPT102, CPT103, CPT106, and CPT110, where the deeper soft soils are present. Suitable remedial strategies are likely to vary due to the varying nature of the soil conditions across this portion of the site, with preliminary foundation recommendations presented in Section 10 below.

8.2.1 Fill Placement

The above settlements presented within Table 5.1 are considered suitable where foundations are constructed at-grade. Placement of fill, particularly within the low-lying areas could significantly affect settlement of the foundations and will need to be carefully considered and is likely to require preloading particularly in the areas where the deeper soft soils are present.

For a guide, placement of 500 mm of additional filling on the low-lying portions of the site (Landform Zone 1) would incur an additional 35 mm to 300 mm of primary settlement for the worst case CPTs (CPT103, CPT104, CPT110). Elsewhere in this zone (CPT106, CPT107, CPT108, CPT109, CPT111), primary settlements would be anticipated to be approximately 10 mm to 20 mm. Creep settlements will also need to be considered for fills placed over peat soils.

Further information will be required to assess the fill-induced settlements at the site.

9 Slope stability

During the site walkover only very shallow surface creep movements within the elevated regions (Landform Zone 2), in the form of terrace-sets, were observed. No evidence of rotational slips was observed during the site walkover or following a review of aerial photography.

As no scheme has been provided at this stage, detailed numerical analyses are not considered appropriate, and so a qualitative approach has been taken to assess the global stability risk at the site.

The gully crests are constantly being undermined because of erosion caused by ephemeral springs / streams and therefore construction of buildings adjacent to these steeper gully escarpment slopes will likely require detailed investigations and assessment. Conservatively, slopes greater than 25 degrees have been selected as generally being unsuitable for residential development without further investigation and specific design considerations.

In general, where light-weight buildings are proposed, slope stability issues are not likely to require significant setbacks, particularly where the slope gradients are less than 25 degrees (1 v : 2 h), which is based on walkover observations and previous work undertaken within the rolling hill topography of the Waikato Basin. This assumes that only minor modifications to the landform are required to form suitable building platforms.

Any significant cuts and fills (generally greater than 0.5 m to 1.0 m) to the existing landform will however require further assessment on account of potential global and local stability issues even in areas where the slopes are less than 25 degrees.

Sloping topography greater than 25 degrees has been presented on the Figure 04 in Appendix A.

10 Geotechnical constraints and foundation recommendations

10.1 Residential foundations

Table 10.1 summarises the key geotechnical risks for the site and presents some preliminary foundation options for the relevant areas. This is not considered to document all ground risk in relation to the development. However, it is considered to identify the risks unique and most important to this site. The areas to which this table refers to are presented on Figure 04 in Appendix A, and should be viewed in conjunction with this report.

Table 10.1: Geotechnical risks for the site

Designated Area	Landform	Risks	Mitigation / preliminary foundation recommendation
A (orange)	1 and 3	Deep compressible soils and highly liquefiable soils under a ULS event.	1 Preload (with wick drains) to mitigate the soft compressible soils and construct a TC2[Note 1] type slab at the ground surface to mitigate liquefaction issues. OR 2 Deep piled / ground improvement solution with specifically designed raft foundation. Ground improvement likely to extend at least 15 m bgl with piles 20 m to 25 m.

Designated Area	Landform	Risks	Mitigation / preliminary foundation recommendation
B (blue)	1 and 2	Localised compressible peat and silts with potentially liquefiable soils under a ULS event.	1 Undercut this area by up to 2 m and replace with compacted engineered fill and construct a TC2[Note 1] or equivalent foundation at surface. Residual risks for this include the effect of dewatering on neighbouring properties, which will require careful consideration.
C (green)	3	Possible liquefiable soils and static settlement risk.	Shallow ground improvement not likely to be required however a TC2 [Note 1] type raft system should be adopted to accommodate the ULS seismic settlements. A reduced ultimate bearing capacity is recommended for this area and a preliminary Geotechnical Ultimate Bearing Capacity 210 kPa for strip and pads or 5 kPa for uniformly loaded slabs should be adopted.
D (no colour)	2	Low risk of liquefaction and soft soil settlement, however slope stability will need to be addressed, particularly in areas where the slopes are greater than 25 degrees (marked pale blue on plan).	Standard NZS:3604 2011 foundation systems or a proprietary raft. Building platform to be confirmed following scheme development. Deepening of foundations should be allowed for in line with section 10.4 below to reflect the possible nature of expansive soils at the site.

Note 1: 'TC2' refers to the Technical Category 2 concrete slab foundation options (1-4) presented within the MBIE Canterbury Guidance Documents.

The units presented in Table 10.1 above and on Figure 04 in Appendix A represent our best estimate of the geotechnical risks at the site based on the limited data. The boundaries provided are subject to change following the results of additional investigations.

10.2 Wastewater treatment plant foundations

It is proposed to construct a wastewater treatment plant on the site, which will involve cutting into the existing landform and installing buried tanks (say 2 m deep) as well as associated buildings and infrastructure.

The wastewater treatment plant foundations are subject to the same geotechnical constraints as the residential foundations presented in Table 10.1, and therefore given the importance level of the structure (IL3), should not be constructed within Landform Zone 1 or 3 due to the high groundwater table and possible settlement and liquefaction issues, without consideration to deeper piled foundations.

Two locations for the wastewater treatment plant have been suggested solely from a geotechnical perspective and presented on Figure 04 in Appendix A, which appear to be geotechnically suitable. These areas are at the toe of the gently sloping elevated regions (Landform Zone 2), where the risk of liquefaction, high-groundwater table, and soft compressible soils is low.

These locations do not preclude the use of a wastewater treatment plant elsewhere on the site, however more specific investigations and recommendations will be required to advise on this.

10.3 Non-residential areas

The geotechnical constraints map (Figure 04 in Appendix A) has been primarily prepared to accommodate the proposed residential development and wastewater treatment plant. However, areas that are less suitable for residential development may be suitable for other types of lower risk development, such as landscape areas, parks and greenspaces, or car parking.

10.4 Expansive soils

Published literature[7] has shown that Hamilton Ash soils generally contain Halloysite and Allophane dominated clays. These clays generally have little to no swelling potential when compacted well. However, Halloysite rich soils indicate to exhibit some shrinkage potential when dehydrated.

Based on this and the results of our site investigations, the risk of soil expansivity impacting our foundations has been classified as 'low'.

To account for potential shrinkage behaviour in the soils encountered, and without the availability of laboratory testing, we conservatively recommend adopting at least a 450 mm embedment for foundations.

Further laboratory testing is recommended to confirm the assumptions made above.

11 Further work

As discussed above, this report is suitable only to provide preliminary recommendations and apprise a concept design for the proposed development. As such, the following work is required to support a resource consent application:

- Additional ground investigations comprising CPTs, machine boreholes, and trial pits to refine the foundation areas presented on Figure 04 in Appendix A and refine our assessment for a proposed scheme. The investigations will be targeted to suit specific areas of development.
- Laboratory testing to include 1D consolidation tests to assess settlement parameters and linear shrinkage / Atterberg limit testing to address soil expansivity.
- Update analyses based on scheme development including quantitative slope stability assessment.
- Preparation of a geotechnical investigation report addressing the geotechnical risks at the site suitable for a resource consent application.

Following the receipt of a successful resource consent application bid, additional design and reporting will be required for building consent. In addition, construction observations, certification, and provision of a PS4 will also be required as part of future stages.

[7] Kuman D. University of Waikato 2015. Determination of Optimum Moisture Content and degradation of shear strength overtime for Hamilton ash materials

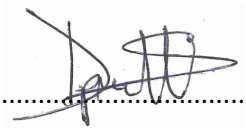
12 Applicability

This report has been prepared for the exclusive use of our client Brymer Farms Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Recommendations and opinions in this report are based on data from discrete investigation locations. The nature and continuity of subsoil away from these locations are inferred but it must be appreciated that actual conditions could vary from the assumed model.

Tonkin & Taylor Ltd

Report prepared by:



.....

Daniel Mills
Senior Geotechnical Engineer

Authorised for Tonkin & Taylor Ltd by:

.....

Craig Davanna
Project Director

Technical review by:

.....

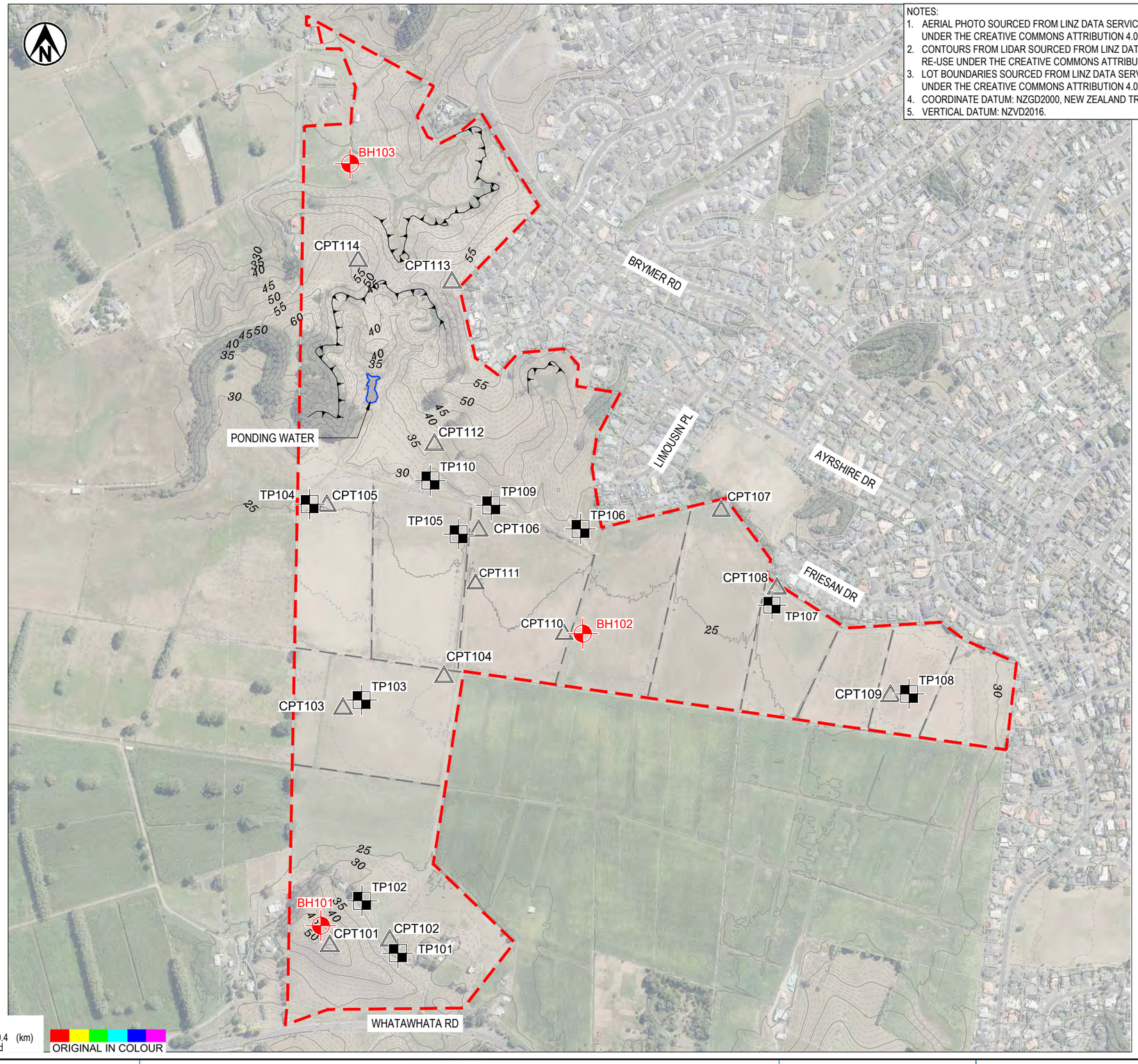
Guy McDougall
Senior Geotechnical Engineer

2-Jul-21
\\ttgroup.local\files\tgaprojects\1017355\issueddocuments\20210702 gar\20210702_brymer farms geotechnical assessment report_dami.docx

Appendix A: Figures

- **Figure 01 – Site Investigation Plan**
- **Figure 02 – Landform Zone Plan**
- **Figure 03 – Soft Soil Contour Plan**
- **Figure 04 – Geotechnical Constraints Plan**

NOTES:
1. AERIAL PHOTO SOURCED FROM LINZ DATA SERVICE <https://data.linz.govt.nz/x/LSSb8X>, LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 26/05/2021.
2. CONTOURS FROM LIDAR SOURCED FROM LINZ DATA SERVICE <https://data.linz.govt.nz/x/FarhCG>, LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 26/05/2021.
3. LOT BOUNDARIES SOURCED FROM LINZ DATA SERVICE <https://data.linz.govt.nz/x/cC4fV2>, LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 26/05/2021.
4. COORDINATE DATUM: NZGD2000, NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).
5. VERTICAL DATUM: NZVD2016.



A3 SCALE 1:7500
0 0.1 0.2 0.3 0.4 (km)
ORIGINAL IN COLOUR

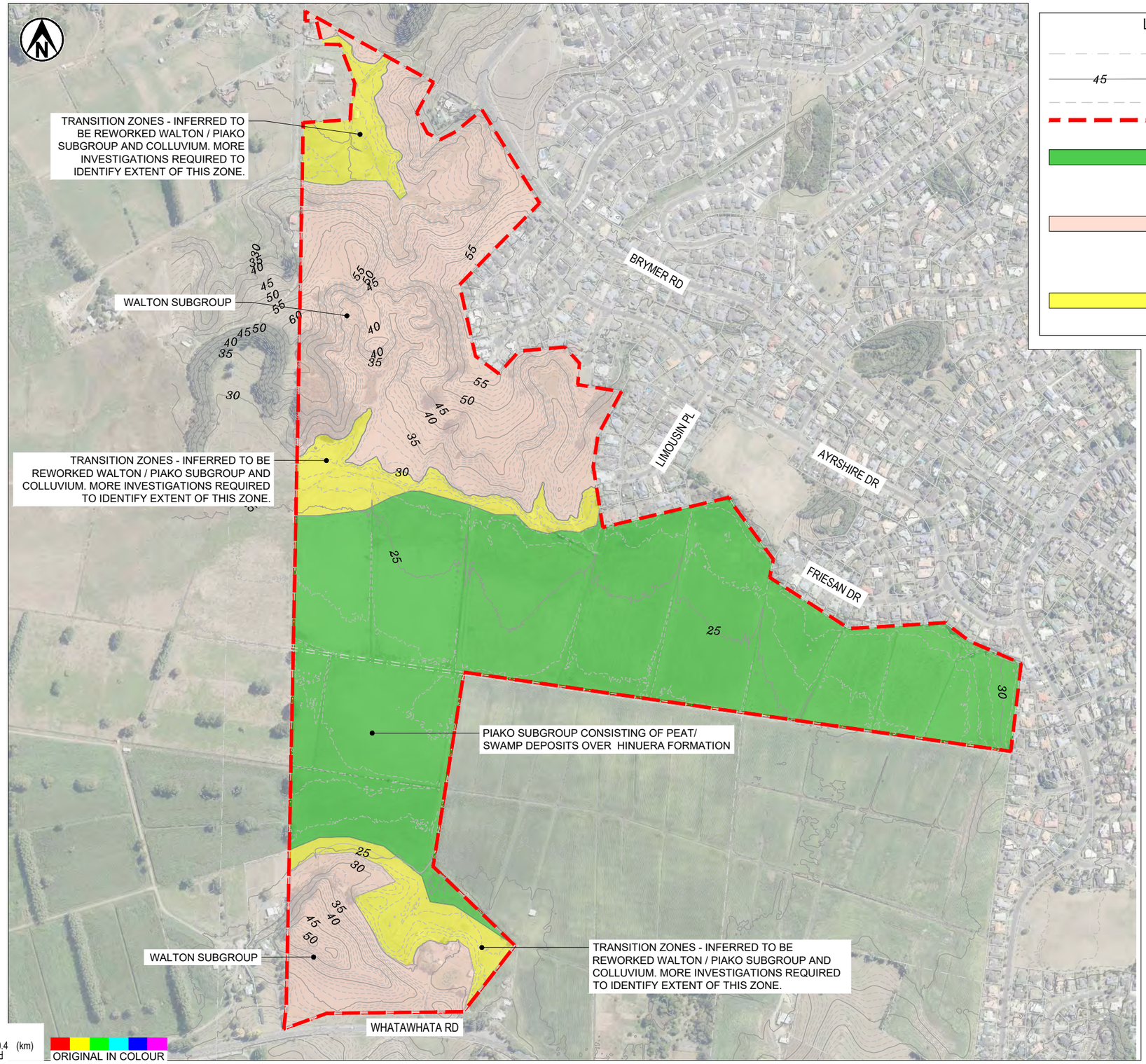
LEGEND
- LOT BOUNDARIES
- 45 EXISTING MAJOR CONTOURS
- EXISTING MINOR CONTOURS
- SITE BOUNDARY
- FARM DRAINS
- GULLY HEAD CREST
- CPT100 CPT LOCATION (SOFT SOIL THICKNESS)
- TP0100 TRIAL PIT LOCATION (SOFT SOIL THICKNESS)
- BH100 BORE HOLE TEST LOCATION (SOFT SOIL THICKNESS)

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

PROJECT No.	1017355	
DESIGNED	DAMI	Jul.21
DRAWN	DDAL	Jul.21
CHECKED	RBS	Jul.21
PRELIMINARY DRAFT		
APPROVED	DATE	

CLIENT **BRYMER FARMS LTD.**
PROJECT **BRYMER SUBDIVISION DEVELOPMENT, HAMILTON**
TITLE SITE INVESTIGATION PLAN LAYOUT
SCALE (A3) 1:7500 FIG No. FIGURE 01 REV 1

\\ttgroup.local\corporate\Tauranga\Projects\1017355\WorkingMaterial\4.CAD\FIG\FIGURE-02-LandformZonePlan.dwg 2021-Jul-02 3:59:48 PM Plotted By: ROSEMARY SUTTON



Tonkin+Taylor

Exceptional thinking together www.tonkintaylor.co.nz

PROJECT No.	1017355	
DESIGNED	DAMI	Jul.21
DRAWN	DDAL	Jul.21
CHECKED	RBS	Jul.21
PRELIMINARY DRAFT		
APPROVED	DATE	

CLIENT **BRYMER FARMS LTD.**

PROJECT **BRYMER SUBDIVISION DEVELOPMENT, HAMILTON**

TITLE LANDFORM ZONE PLAN LAYOUT

SCALE (A3) 1:7500 FIG No. FIGURE 02 REV 1

\\ttgroup.local\corporate\Tauranga\Projects\1017355\WorkingMaterial\4.CAD\FIG\FIGURE-03-SoftsoilThicknessPlan.dwg 2021-Jul-02 4:00:22 PM Plotted By: ROSEMARY SUTTON

NOTES:
1. AERIAL PHOTO SOURCED FROM LINZ DATA SERVICE <https://data.linz.govt.nz/x/LSSb8X>, LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 26/05/2021.
2. CONTOURS FROM LIDAR SOURCED FROM LINZ DATA SERVICE <https://data.linz.govt.nz/x/FarhCG>, LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 26/05/2021.
3. LOT BOUNDARIES SOURCED FROM LINZ DATA SERVICE <https://data.linz.govt.nz/x/cC4fV2>, LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 26/05/2021.
4. COORDINATE DATUM: NZGD2000, NEW ZEALAND TRANSVERSE MERCATOR (NZTM2000).

BRYMER RD
LIMOUSIN PL
AYRSHIRE DR
FRIESAN DR
WHATAWHATA RD

TP105 (1.6 m)
CPT106 (1.2 m)
TP106 (0.8 m)
CPT107 (2.4 m)
CPT108 (1.2 m)
TP107 (1.2 m)
CPT110 (4.5 m)
BH102 (4.5 m)
CPT104 (10 m)
TP103 (2.5m)
CPT103 (11.5 m)
CPT109 (1.1 m)
TP108 (1.1 m)

LEGEND
- LOT BOUNDARIES
- EXISTING MAJOR CONTOURS
- EXISTING MINOR CONTOURS
- INDICATIVE SOFT SOIL CONTOURS
- SITE BOUNDARY
- CPT100(1.0m) — CPT LOCATION (SOFT SOIL THICKNESS)
- TP100(1.0m) — TRIAL PIT LOCATION (SOFT SOIL THICKNESS)
- BH100(1.0m) — BORE HOLE TEST LOCATION (SOFT SOIL THICKNESS)

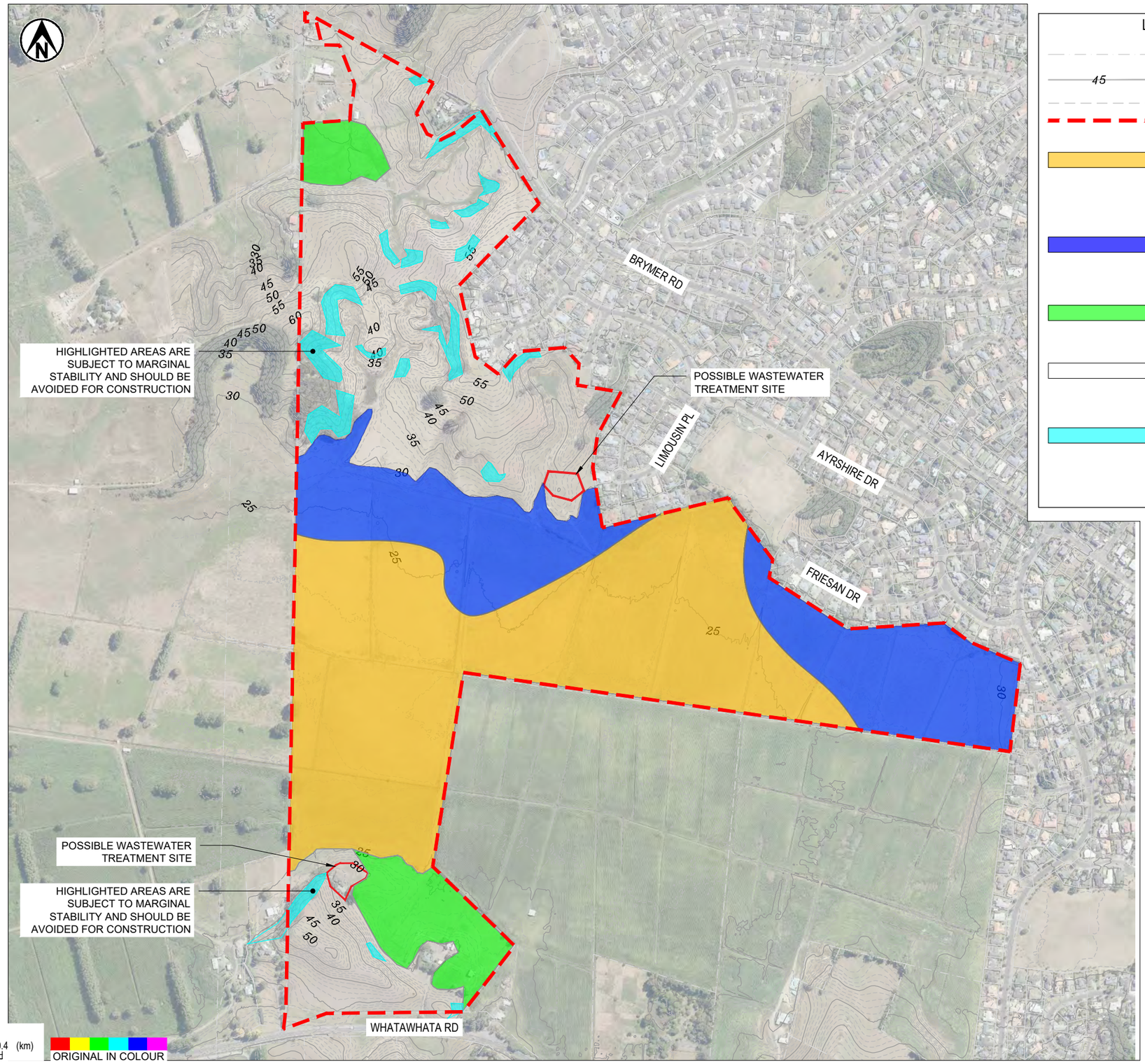
A3 SCALE 1:7500
0 0.1 0.2 0.3 0.4 (km)
ORIGINAL IN COLOUR

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

PROJECT No.	1017355	
DESIGNED	DAMI	Jul.21
DRAWN	DDAL	Jul.21
CHECKED	RBS	Jul.21
PRELIMINARY DRAFT		
APPROVED	DATE	

CLIENT BRYMER FARMS LTD.
PROJECT BRYMER SUBDIVISION DEVELOPMENT, HAMILTON
TITLE SOFT SOIL THICKNESS CONTOURS PLAN LAYOUT
SCALE (A3) 1:7500 FIG No. FIGURE 03 REV 1

\\ttgroup.local\corporate\Tauranga\Projects\1017355\WorkingMaterial\4.CAD\FIG\FIGURE-04-GeotechConstraints.dwg 2021-Jul-02 4:01:03 PM Plotted By: ROSEMARY SUTTON



LEGEND

- LOT BOUNDARIES
- EXISTING MAJOR CONTOURS (45)
- EXISTING MINOR CONTOURS
- SITE BOUNDARY
- AREA A: SOFT SOIL AND LIQUEFIABLE SOILS PRESENT. WILL REQUIRE EXTENSIVE REMEDIAL WORKS SUCH AS PRELOADING WITH A TC2 SLAB OR OR DEEP PILES (MIN 20M) TO SUPPORT RESIDENTIAL FOUNDATIONS
- AREA B: SHALLOW SOFT SOILS (PEAT) AND POTENTIALLY LIQUEFIABLE SOILS. AREA REQUIRES UNDERCUTS UP TO 2M TO PROVIDE A NON-LIQUEFIABLE CRUST AND REMOVE PEATS, WITH A TC2 SLAB
- AREA C: LOWER RISK FOR LIQUEFACTION SUSCPETIBILITY AND SOFT SOILS - TC2 FOUNDATION OPTIONS SUCH AS A WAFFLE SLAB, LIKELY APPROPRIATE.
- AREA D: AREAS NOT SHADING WITHIN THE ELEVATED PORTIONS MAY COMPRISE STANDARD NZS3604 FOUNDATION SYSTEMS SUITABLE PROVIDED BUILDINGS ARE SUITABLE SET BACK - TO BE DETERMINED THROUGH QUANTITATIVE STABILITY ANALYSES.
- SLOPES GREATER THAN 25 DEGREES REQUIRING SLOPE STABILITY ANALYSES. DEVELOPMENT SHOULD BE AVOIDED ABOVE AND BELOW THESE STEEPER SLOPES UNTIL FURTHER STABILITY ANALYSIS HAS BEEN UNDERTAKEN.

NOTES:
BOUNDARIES ARE INDICATIVE ONLY BASED ON THE TESTING, MAPPING, AND ANALYSES UNDERTAKEN TO DATE. THESE BOUNDARIES WILL REQUIRE REFINING ONCE SCHEME PLANS ARE AVAILABLE.

Tonkin+Taylor
Exceptional thinking together www.tonkintaylor.co.nz

PROJECT No.	1017355		
DESIGNED	DAMI	Jul.21	
DRAWN	DDAL	Jul.21	
CHECKED	RBS	Jul.21	
PRELIMINARY DRAFT		APPROVED	DATE

CLIENT **BRYMER FARMS LTD.**
PROJECT **BRYMER SUBDIVISION DEVELOPMENT, HAMILTON**
TITLE GEOTECHNICAL CONSTRAINTS PLAN LAYOUT
SCALE (A3) 1:7500 FIG No. FIGURE 04 REV 1

Appendix B: Ground investigation results

- **Machine Boreholes (MHs)**
- **Cone Penetration Tests (CPTs)**
- **Trial Pits (TPs)**

BOREHOLE LOG

BOREHOLE No.: **BH101**

Hole Location: Southern hill

SHEET: 1 OF 6

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5814995.96 mN 1795095.18 mE	DRILL TYPE: Tractor Rig	HOLE STARTED: 18/05/2021
		DRILL METHOD: RC	HOLE FINISHED: 19/05/2021
R.L.:	45.24m		DRILLED BY: Drillcore
DATUM:	NZVD2016	DRILL FLUID: WATER	LOGGED BY: CAND CHECKED: RWOT

GEOLOGICAL																ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Weathered Volcanic Ash (HAMILTON ASH)			100	HQTT				45	0.5	TS	M	F				*0.00m:* Clayey SILT, trace organics and trace sand; dark brown. Firm, moist, low plasticity. Sand, fine; organics, rootlets. Topsoil.
												St				*0.30m:* Clayey SILT; brown. Stiff, moist, low plasticity. Suspected small fragments of charcoal.
			100	SPT		● 86/39 kPa 1/2 2/2 2/2 **N=8**		44	1.0							*1.00m:* Silty CLAY; brown. Stiff, moist, medium plasticity.
									1.5							*1.60m:* Clayey SILT; brown. Stiff, moist, low plasticity. Silt, slow dilatancy.
			80	HQTT				43	2.0							*1.95m:* CORE LOSS. 1.95 - 2.25.
									2.5							*2.25m:* Clayey SILT; brown. Stiff, moist, low plasticity.
												VSt				*2.60m:* Clayey SILT; yellowish brown. Very stiff, moist, low to medium plasticity.
			100	SPT		● 117/31 kPa 1/1 1/1 1/0 **N=3**		42	3.0							
Box 1, 0.0-3.6m									3.5							*3.30m:* Clayey SILT; light brown. Very stiff, moist, medium plasticity. Suspected small fragments of charcoal.
			100	HQTT				41	4.0							
Walton Subgroup			100	SPT		● 33/11 kPa 1/1 0/1 0/2 **N=3**			4.5			F				*4.50m:* Silty CLAY; light brown mottled black. Firm, moist, medium plasticity. Suspected small fragments of charcoal.

COMMENTS: Hole backfilled with bentonite

Hole Depth 27.45m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH101**

Hole Location: Southern hill

SHEET: 2 OF 6

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5814995.96 mN 1795095.18 mE	DRILL TYPE: Tractor Rig	HOLE STARTED: 18/05/2021
		DRILL METHOD: RC	HOLE FINISHED: 19/05/2021
R.L.:	45.24m		DRILLED BY: Drillcore
DATUM:	NZVD2016	DRILL FLUID: WATER	LOGGED BY: CAND CHECKED: RWOT

GEOLOGICAL																ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		FLUID LOSS (%) 25 50 75	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (cm) 20 60 200 600 2000	Description and Additional Observations
									40			M	F				*5.00m:* Silty CLAY; light brown mottled black. Firm, moist, medium plasticity. Suspected small fragments of charcoal.
																	5.30 - 5.40m: Minor sand, fine to coarse.
				100	HQTT					5.5			St				*5.40m:* Silty CLAY; reddish brown mottled black. Stiff, moist, medium plasticity. Suspected small fragments of charcoal.
							● 75/25 kPa 1/1 1/1 1/2 **N=5**			6.0							*5.70 - 5.90m:* Becomes wet, very soft. light greyish brown. Grades to stiff.
				100	SPT				39								
										6.5							*6.40m:* Silty CLAY; brownish orange mottled black. Stiff, moist, medium plasticity. Suspected small fragments of charcoal.
	Box 2, 3.6-7.1m			100	HQTT					7.0							
									38								
Walton Subgroup							● 42/14 kPa 0/0 0/0 0/0 **N=0**			7.5			S-F				*7.50m:* Clayey SILT; yellowish brown mottled black. Soft to firm, moist, low plasticity. Suspected small fragments of charcoal.
				100	SPT												
										8.0							
				100	HQTT				37								
										8.5			F				*8.50m:* Sandy SILT, minor clay; light brown mottled black. Firm, moist, low plasticity.
													St				*8.90m:* Clayey SILT; light brown mixed with some black. Stiff, moist, low plasticity. Suspected small fragments of charcoal.
				100	PT				36	9.0							*9.00m:* Pushtube. Material observed as Clayey SILT as above.
				100	SPT		2/1 2/2 1/3 **N=8**			9.5							*9.50m:* Silty CLAY; light yellowish brown. Stiff, moist, high plasticity.

COMMENTS: Hole backfilled with bentonite

Hole Depth 27.45m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH101**

Hole Location: Southern hill

SHEET: 3 OF 6

PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: (NZTM2000) 5814995.96 mN, 1795095.18 mE

R.L.: 45.24m

DATUM: NZVD2016

DRILL TYPE: Tractor Rig

DRILL METHOD: RC

DRILL FLUID: WATER

HOLE STARTED: 18/05/2021

HOLE FINISHED: 19/05/2021

DRILLED BY: Drillcore

LOGGED BY: CAND CHECKED: RWOT

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	Box 3, 7.1-11.4m	Description and Additional Observations
		10.00m: Silty CLAY; light brown. Stiff, moist, high plasticity.
		10.95m: Silty CLAY; light brown mottled orange. Firm, moist, medium plasticity.
		11.70m: Clayey SILT; light brown mottled orange. Firm, moist, medium plasticity.
Walton Subgroup		*12.00m:* SILT, some clay, minor sand; brown mixed with some greyish red. Stiff, moist, low plasticity.
		12.45m: CORE LOSS. 12.45 - 12.80.
		12.80m: SILT, some clay, minor sand; brown mixed with some greyish red. Stiff, moist, low plasticity.
		13.40m: Sandy SILT; dark brown. Medium dense, moist, dilatant - rapid. Sand, fine to coarse.
		13.50m: Pushtube, Material observed to be Sandy SILT as above.
		14.00m: CORE LOSS. 14.0 - 14.1m.
		14.10m: Sandy SILT; brown. Medium dense, moist, dilatant - rapid. Sand, fine to coarse.
		14.70m: SILT, some clay, minor sand; light brown mottled black. Stiff, moist, low plasticity.
		14.90 - 15.00m: Becomes wet, very soft.

TESTS	CORE RECOVERY (%)	METHOD	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION
	100	HQTT		35			M	St
● 56/28 kPa 1/1 1/1 0/2 **N=4**	100	SPT			10.5			
	100	HQTT		34	11.0			F
					11.5			
1/2 1/3 4/4 **N=12**	100	SPT		33	12.0			St
	66	HQTT		32	12.5			
					13.0			
	100	PT			13.5			MD
2/2 3/3 3/4 **N=13**	77	SPT		31	14.0			
	100	HQTT			14.5			St
								VS

SHEAR STRENGTH (kPa): 10, 25, 50, 100, 200

COMPRESSIVE STRENGTH (MPa): 1, 5, 20, 50, 100, 250

DEFECT SPACING (cm): 20, 60, 200, 600, >2000

FLUID LOSS (%): 25, 50, 75

WATER: 18/05/2021

CASING

COMMENTS: Hole backfilled with bentonite

Hole Depth 27.45m

Scale 1:25

Rev.: A

BoreLog 28/06/2021 12:40:44 pm - Produced with Core-GS by GeRoc

BOREHOLE LOG

BOREHOLE No.: **BH101**

Hole Location: Southern hill

SHEET: 4 OF 6

PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: (NZTM2000) 5814995.96 mN, 1795095.18 mE

R.L.: 45.24m

DATUM: NZVD2016

DRILL TYPE: Tractor Rig

DRILL METHOD: RC

DRILL FLUID: WATER

HOLE STARTED: 18/05/2021

HOLE FINISHED: 19/05/2021

DRILLED BY: Drillcore

LOGGED BY: CAND | CHECKED: RWOT

GEOLOGICAL															ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
			100	PT				30								*15.00m:* Pushtube, Material observed to be SILT, some clay, minor sand; light brown motted black. Moist, low plasticity.
			100	SPT		1/1 0/1 2/2 **N=5**			15.5		W	F				*15.50m:* SILT, some clay, minor sand; greyish white mottled black. Firm, wet, low plasticity. Suspected small fragments of charcoal.
Box 4, 11.4-16.3m			100	HQTT				29	16.0							
			11	SPT		1/1 3/0 1/1 **N=5**			16.5							*16.50m:* CORE LOSS. 16.5 - 16.9m.
Walton Subgroup			100	HQTT				28	17.0			L				*16.90m:* SILT, minor sand; light brown mottled black. Loose, wet, dilatant - rapid. Sand, fine. Suspected small fragments of charcoal.
									17.5			F				*17.70m:* SILT, some clay, minor sand; greyish white mottled black. Firm, wet, low plasticity. Suspected small fragments of charcoal.
			100	SPT		● 39/6 kPa 0/0 0/0 0/0 **N=0**		27	18.0							*17.80m:* Clayey SILT; greyish white mottled black. Firm, wet, medium plasticity. Silt, slow dilatancy.
									18.5			S-F				*18.10m:* SILT, some clay, minor sand; brown. Soft to firm, wet, medium plasticity. Sand, fine to coarse. Pumiceous.
Box 5, 16.3-19.5m			100	HQTT				26	19.0							
			100	SPT		● 98/25 kPa 1/2 2/2 2/5 **N=11**			19.5			St				*19.40m:* Clayey SILT; greyish white mottled black. Stiff, wet, medium plasticity.
												MD				*19.60m:* SILT, some clay, minor sand; light brown mottled black. Medium dense, wet, dilatant - rapid. Sand, fine to coarse, pumiceous.

COMMENTS: Hole backfilled with bentonite

Hole Depth 27.45m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH101**

Hole Location: Southern hill

SHEET: 5 OF 6

PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: 5814995.96 mN, 1795095.18 mE (NZTM2000)
R.L.: 45.24m
DATUM: NZVD2016

DRILL TYPE: Tractor Rig
DRILL METHOD: RC
DRILL FLUID: WATER

HOLE STARTED: 18/05/2021
HOLE FINISHED: 19/05/2021
DRILLED BY: Drillcore
LOGGED BY: CAND CHECKED: RWOT

GEOLOGICAL															ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Walton Subgroup			100	HQTT				25	20.0		W	St				*20.00m:* SILT, some clay, trace sand; greyish white mottled black. Stiff, wet, low plasticity. Sand, fine to coarse. Pumiceous.
									20.5			F				*20.40m:* SILT, some clay; greyish white mottled with some black. Firm, wet, low plasticity.
			100	SPT		● 64/11 kPa 2/3 2/3 5/7 **N=17**		24	21.0			St				*21.00m:* SILT, some clay; grey. Stiff, wet, low plasticity.
			100	HQTT					21.5							
								23	22.0		M					*22.10m:* SILT, minor sand; light brown mottled orange. Stiff, moist, low plasticity. Silt, rapid dilatancy; sand, fine to coarse, pumiceous.
			100	SPT		● 84/14 kPa 1/1 0/0 0/0 **N=0**			22.5							*22.50m:* CORE LOSS. 22.5 - 22.8m.
											W	VS				*22.80m:* SILT, minor sand and minor gravel; light brown mottled orange. Very soft, wet, low plasticity. Silt, rapid dilatancy; sand, fine to coarse, pumiceous; gravel, fine, sub-rounded to sub-angular.
									23.0							*22.95m:* CORE LOSS. 22.95 - 23.1m.
Box 6, 19.5-23.5m			85	HQTT				22								*23.10m:* SILT, trace sand; light brown mottled orange. Very soft, wet, low plasticity. Silt, rapid dilatancy; sand, fine, pumiceous.
									23.5			F				*23.50m:* SILT, minor sand, trace gravel; light brown mottled orange. Firm, wet, low plasticity. Silt, rapid dilatancy; sand, fine to coarse, pumiceous; gravel, fine, sub-rounded to sub-angular.
			100	SPT		1/0 0/0 0/0 **N=0**		21	24.0							
			100	HQTT					24.5							*24.50 - 24.70m:* Becomes sandy.

COMMENTS: Hole backfilled with bentonite

Hole Depth 27.45m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH101**

Hole Location: Southern hill

SHEET: 6 OF 6

PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: (NZTM2000) 5814995.96 mN, 1795095.18 mE

R.L.: 45.24m

DATUM: NZVD2016

DRILL TYPE: Tractor Rig

DRILL METHOD: RC

DRILL FLUID: WATER

HOLE STARTED: 18/05/2021

HOLE FINISHED: 19/05/2021

DRILLED BY: Drillcore

LOGGED BY: CAND | CHECKED: RWOT

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	Box 7, 23.5-27.0m / Box 8, 27.0-27.5m	TESTS	RL (m)	DEPTH (m)	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	Description and Additional Observations
Walton Subgroup	CORE RECOVERY (%): 100 (HQTT); 44 (SPT); 100 (HQTT); 77 (SPT)	4/6, 6/4, 5/5, **N=20**; 4/3, 5/5, 5/5, **N=20**	20; 19; 18; 17; 16	25.5; 26.0; 26.5; 27.0; 27.5; 28.0; 28.5; 29.0; 29.5	W	F; VSt; St; MD; VSt; MD	*25.00m:* SILT, minor sand, trace gravel; light brown mottled orange. Firm, wet, low plasticity. Silt, rapid dilatancy; sand, fine to coarse, pumiceous; gravel, fine, sub-rounded to sub-angular. *25.40m:* PEAT (AMORPHOUS); dark brownish black. Very stiff, wet. Organics, wood fragments. *25.50m:* CORE LOSS. 25.50 - 25.75m. *25.75m:* PEAT (AMORPHOUS); dark brownish black. Very stiff, wet. Organics, wood fragments. *26.40m:* Clayey SILT; light greenish grey. Stiff, wet, medium to high plasticity. *26.60m:* SILT, minor sand. Medium dense, wet, dilatant - rapid. Sand, fine to medium. *26.90m:* Clayey SILT, trace sand; brown. Very stiff, wet, medium plasticity. Sand, fine. *27.00m:* CORE LOSS. 27.0 - 27.1m. *27.10m:* Clayey SILT, minor gravel; brown. Very stiff, wet, medium plasticity. Gravel, fine to medium, sub-rounded to angular, brown. Gravel clasts. *27.30m:* SILT, minor sand. Medium dense, wet, dilatant - rapid. Sand, fine to medium. 27.45m: Target depth

COMMENTS: Hole backfilled with bentonite

Hole Depth 27.45m

Scale 1:25

Rev.: A

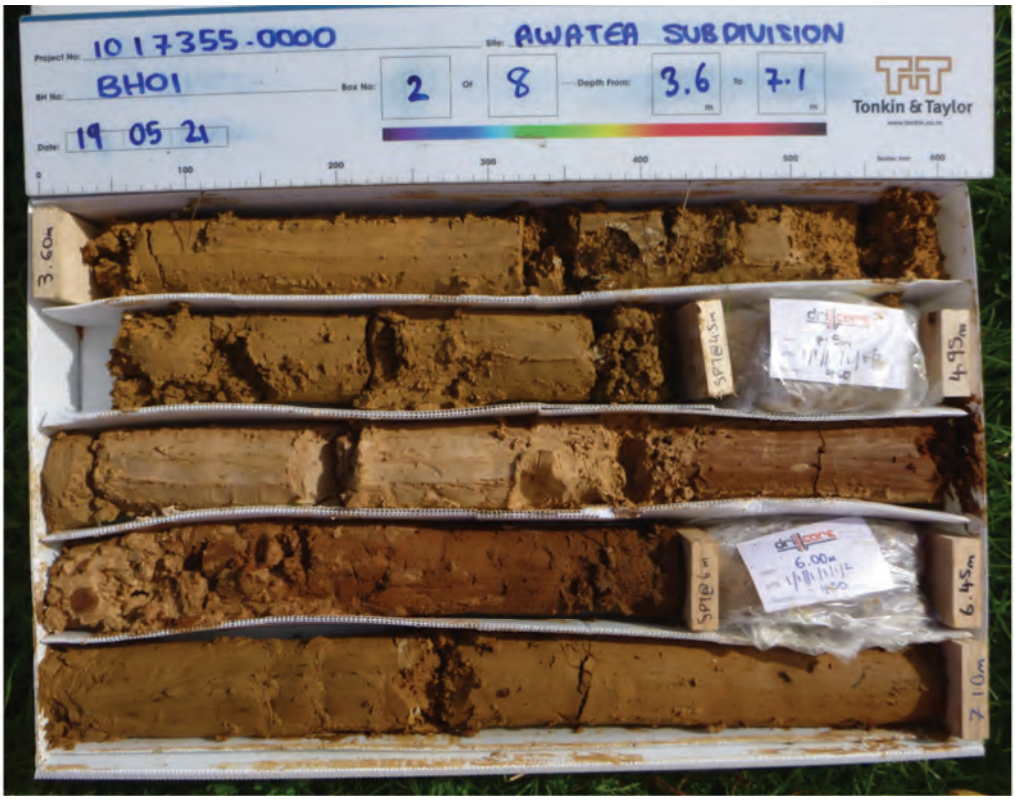
CORE PHOTOS

BOREHOLE No.: **BH101**

Hole Location: Southern hill

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5814995.96 mN 1795095.18 mE	DRILL TYPE: Tractor Rig	HOLE STARTED: 18/05/2021
		DRILL METHOD: RC	HOLE FINISHED: 19/05/2021
R.L.:	45.24m		DRILLED BY: Drillcore
DATUM:	NZVD2016	DRILL FLUID: WATER	LOGGED BY: CAND CHECKED: RWOT

0.00-3.60m



3.60-7.10m

Tonkin+Taylor

CORE PHOTOS

BOREHOLE No.: **BH101**

Hole Location: Southern hill

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5814995.96 mN 1795095.18 mE	DRILL TYPE: Tractor Rig	HOLE STARTED: 18/05/2021
		DRILL METHOD: RC	HOLE FINISHED: 19/05/2021
R.L.:	45.24m		DRILLED BY: Drillcore
DATUM:	NZVD2016	DRILL FLUID: WATER	LOGGED BY: CAND CHECKED: RWOT

7.10-11.40m

11.40-16.30m

CORE PHOTOS

BOREHOLE No.: **BH101**

Hole Location: Southern hill

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5814995.96 mN 1795095.18 mE	DRILL TYPE: Tractor Rig	HOLE STARTED: 18/05/2021
R.L.:	45.24m	DRILL METHOD: RC	HOLE FINISHED: 19/05/2021
DATUM:	NZVD2016	DRILL FLUID: WATER	DRILLED BY: Drillcore
			LOGGED BY: CAND CHECKED: RWOT

16.30-19.50m

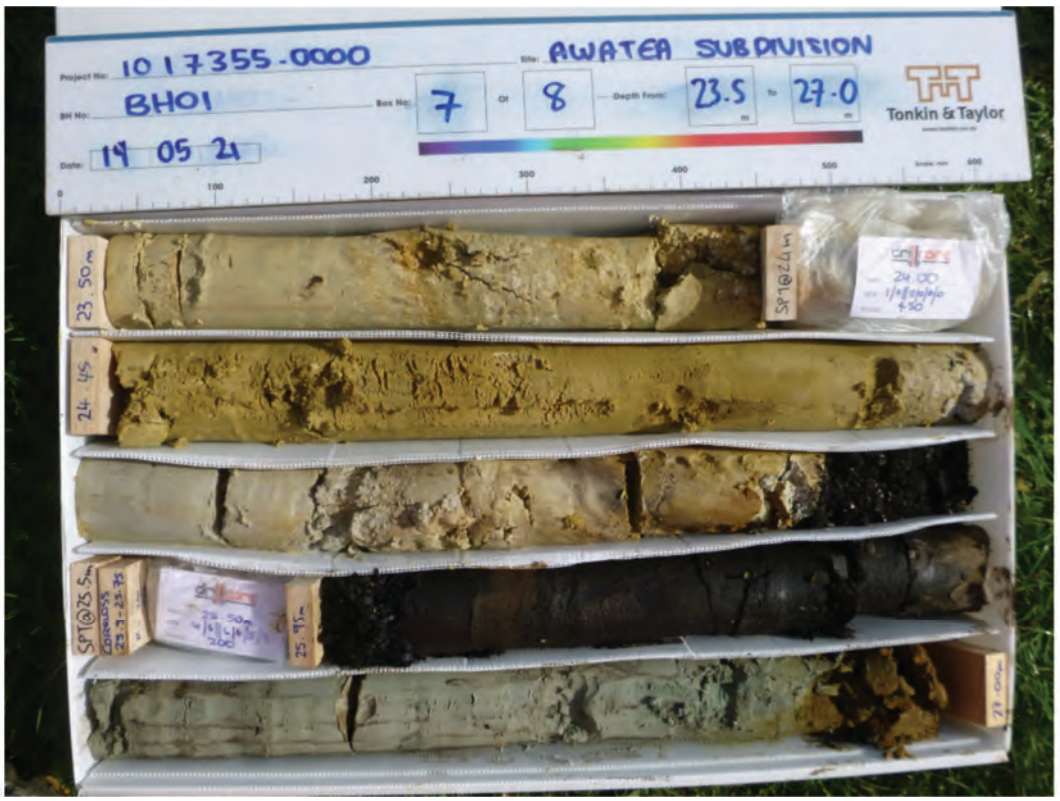
19.50-23.50m

CORE PHOTOS

BOREHOLE No.: **BH101**

Hole Location: Southern hill

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5814995.96 mN 1795095.18 mE	DRILL TYPE: Tractor Rig	HOLE STARTED: 18/05/2021
		DRILL METHOD: RC	HOLE FINISHED: 19/05/2021
R.L.:	45.24m		DRILLED BY: Drillcore
DATUM:	NZVD2016	DRILL FLUID: WATER	LOGGED BY: CAND CHECKED: RWOT



23.50-27.00m

27.00-27.45m

BOREHOLE LOG

BOREHOLE No.: **BH102**

Hole Location: Central lying low lands

SHEET: 1 OF 4

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5815510.15 mN 1795556.13 mE	DRILL TYPE: Tractor Rig	HOLE STARTED: 17/05/2021 HOLE FINISHED: 18/05/2021
R.L.:	26.99m	DRILL METHOD: RC	DRILLED BY: Drillcore
DATUM:	NZVD2016	DRILL FLUID: WATER	LOGGED BY: CAND CHECKED: RWOT

GEOLOGICAL																ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
			16	HQTT					0.5		M-W	L				*0.00m:* SILT, minor organics and minor sand, trace gravel; dark brown. Loosely packed, moist to wet, dilatant - rapid. Sand, fine; gravel, fine, sub-rounded to sub-angular; organics, rootlets. Topsoil.
																0.10m: CORE LOSS. 0.1 - 1.5m.
			0	HQTT				26	1.0							
						● 95/17 kPa			1.5							*1.50m:* NOT LOGGED. Attempted push tube. No Recovery.
			0	PT												
						0/0 0/0 0/0 **N=0**		25	2.0		S	VS				*2.00m:* CORE LOSS. 2.0 - 2.1m.
			77	SPT												*2.10m:* PEAT (FIBROUS); dark brownish black. Very soft, saturated. Organics, wood fragments.
Piako Subgroup			100	HQTT					2.5		W	VL				*2.40m:* Sandy SILT; light greenish grey. Very loose, wet, dilatant - rapid. Sand, fine to coarse, well graded. *2.60 - 2.90m:* Minor clay, low plasticity. *2.80 - 2.90m:* Minor organics; light greenish grey. Medium plasticity. Organics, wood fragments.
								24	3.0			L			*2.90m:* SILT, trace organics; grey. Very loose, wet, dilatant - rapid.
			100	PT												*3.00m:* NOT LOGGED - Push tube.
			100	SPT		0/0 0/0 0/0 **N=0**			3.5			VS				*3.50m:* Silty CLAY, trace organics; grey. Very soft, wet, medium plasticity. Organics, wood fragments.
			100	HQTT				23	4.0							
						● 137/25 kPa			4.5			VSt				*4.50 - 4.90m:* Becomes very stiff.
			100	SPT		2/3 5/6 8/10 **N=29**										

COMMENTS: Low pressure aquifer with flowing water encountered in BH at 16.mgl. Water pressure measured to at approximately 1m above ground level.

Hole Depth 18.45m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH102**

Hole Location: Central lying low lands

SHEET: 2 OF 4

PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: (NZTM2000) 5815510.15 mN, 1795556.13 mE

R.L.: 26.99m

DATUM: NZVD2016

DRILL TYPE: Tractor Rig

DRILL METHOD: RC

DRILL FLUID: WATER

HOLE STARTED: 17/05/2021

HOLE FINISHED: 18/05/2021

DRILLED BY: Drillcore

LOGGED BY: CAND CHECKED: RWOT

GEOLOGICAL															ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		FLUID LOSS (%) 25 50 75	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (cm) 20 60 200 600 2000	Description and Additional Observations
Box 1, 0.0-5.5m				100	HQTT		● 86/25 kPa			5.5		W	VSt				*5.00m:* Clayey SILT; light greenish grey. Very stiff, wet, medium to high plasticity.
				100	HQTT								MD				*5.50m:* SILT, minor sand; light greenish grey. Medium dense to dense, wet, dilatant - rapid. Sand, fine.
				100	SPT		3/6 7/8 8/7 **N=30**		21	6.0							
				100	HQTT					6.5							*6.60m:* Fine to coarse SAND, minor silt; light greenish grey. Medium dense to dense, wet. Sand, well graded.
Piako Subgroup				100	HQTT				20	7.0							*7.00m:* SILT, minor sand; light grey. Medium dense to dense, wet, dilatant - rapid. Sand, fine.
													VSt				*7.10m:* PEAT (AMORPHOUS); dark brownish black. Very stiff, wet. Organics, wood fragments.
													MD				*7.30m:* SILT, trace sand; light grey. Medium dense to dense, wet, dilatant - rapid. Sand, fine.
				66	SPT		7/11 11/11 11/11 **N=44**			7.5							*7.50m:* CORE LOSS. 7.5 - 7.65m.
									19				D				*7.65m:* SILT, minor sand; light grey. Dense, wet, dilatant - rapid. Sand, fine.
				100	HQTT					8.0			VSt				*8.10m:* Clayey SILT, minor organics; dark brownish black. Very stiff, wet, low to medium plasticity. Organics, wood fragments. Amorphous.
Box 2, 5.5-8.8m										8.5							*8.50m:* PEAT (AMORPHOUS); dark brownish black. Very stiff, wet. Fine to coarse sand observed at top and bottom of layer. Brown in colour.
												M	D				*8.70m:* SILT, minor sand; light grey. Dense, moist, dilatant - rapid. Sand, fine.
				100	SPT		4/6 10/10 10/10 **N=40**		18	9.0		W					*9.00m:* SILT, some organics, minor sand; dark brownish black. Dense, wet, dilatant - rapid. Sand, fine to medium; organics, wood fragments. Amorphous.
													VSt				*9.30m:* PEAT (AMORPHOUS); dark brownish black. Very stiff, wet. Organics, wood fragments. F-C Sand observed at top and bottom of layer. Brown.
										9.5			D				*9.50m:* SILT, minor sand; light grey. Dense, wet, non-plastic. Silt, rapid dilatancy; sand, fine.
Hinuera Formation				100	HQTT		● 150/28 kPa					M	VSt				*9.70m:* Clayey SILT; light greenish grey. Very stiff, moist, medium plasticity.

COMMENTS: Low pressure aquifer with flowing water encountered in BH at 16.mgl. Water pressure measured to at approximately 1m above ground level.

Hole Depth 18.45m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH102**

Hole Location: Central lying low lands

SHEET: 3 OF 4

PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: (NZTM2000) 5815510.15 mN, 1795556.13 mE

R.L.: 26.99m

DATUM: NZVD2016

DRILL TYPE: Tractor Rig

DRILL METHOD: RC

DRILL FLUID: WATER

HOLE STARTED: 17/05/2021

HOLE FINISHED: 18/05/2021

DRILLED BY: Drillcore

LOGGED BY: CAND | CHECKED: RWOT

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
			100	HQTT					10.5		W	D				*10.00m:* SILT, minor sand; light grey. Dense, wet, dilatant - rapid. Sand, fine.
												VSt				*10.40m:* Clayey SILT; light grey. Very stiff, wet, medium plasticity.
			100	SPT		1/5 4/6 5/7 **N=22**						D				*10.50m:* Sandy SILT; light grey. Dense, wet, dilatant - rapid. Sand, fine.
								16	11.0							*11.10 - 11.50m:* Minor sand, fine.
			100	HQTT					11.5			VSt				*11.50m:* SILT, some clay; light grey. Very stiff, wet, medium plasticity.
Box 3, 8.8-12.5m Hinuera Formation			100	SPT		● 195/31 kPa 2/3 3/4 6/6 **N=19**		15	12.0							
									12.5							*12.45m:* CORE LOSS. 12.45 - 12.70m.
			76	HQTT				14	13.0			MD				*12.70m:* Fine to coarse SAND, minor silt. Medium dense, wet. Sand, well graded.
			100	SPT		2/1 1/3 4/6 **N=14**			13.5							
			100	HQTT				13	14.0							*13.95m:* Silty fine to coarse SAND. Medium dense, wet. Sand, well graded. *14.20 - 14.50m:* Sand grades to fine. Poorly graded.
									14.5			St				*14.50m:* Clayey SILT; light grey. Stiff, wet, medium plasticity.
Walton Subgroup																*14.90 - 15.00m:* Colour changes to greyish black, organics, wood fragments (decomposed).

COMMENTS: Low pressure aquifer with flowing water encountered in BH at 16.mgl. Water pressure measured to at approximately 1m above ground level.

Hole Depth 18.45m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH102**

Hole Location: Central lying low lands

SHEET: 4 OF 4

PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: (NZTM2000) 5815510.15 mN, 1795556.13 mE

R.L.: 26.99m

DATUM: NZVD2016

DRILL TYPE: Tractor Rig

DRILL METHOD: RC

DRILL FLUID: WATER

HOLE STARTED: 17/05/2021

HOLE FINISHED: 18/05/2021

DRILLED BY: Drillcore

LOGGED BY: CAND CHECKED: RWOT

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Box 4, 12.5-16.2m			100	SPT		2/4 6/5 5/7 **N=23**			15.5		W	VSt-H				*15.00m:* Clayey SILT, minor organics; greyish black. Very stiff to hard, wet, low to medium plasticity. Organics, wood fragments. Amorphous.
			100	HQTT				11	16.0			MD				*15.90m:* Fine to coarse SAND, minor silt; light grey. Medium dense, wet. Sand, well graded.
Walton Subgroup			0	SPT		5/6 8/9 10/10 **N=37**			16.5							*16.50m:* CORE LOSS. 16.5 - 16.95m.
								10	17.0							*16.95m:* CORE LOSS. 16.95 - 17.15m.
			80	HQTT								D				*17.15m:* Fine to coarse SAND, trace gravel; greenish grey. Dense, wet. Sand, well graded; gravel, fine, pumiceous. Weakly cemented.
Box 5, 16.2-18.5m			22	SPT		10/18 15/15 15/5 **N>=50**		9	18.0							*18.00m:* CORE LOSS. 18.0 - 18.35m.
									18.5			VD				*18.35m:* Fine to coarse SAND, trace gravel; greenish grey. Very dense, wet. Sand, well graded; gravel, fine, pumiceous. Weakly cemented.
								8	19.0							18.45m: Target depth
									19.5							

COMMENTS: Low pressure aquifer with flowing water encountered in BH at 16.mgl. Water pressure measured to at approximately 1m above ground level.

Hole Depth 18.45m

Scale 1:25

Rev.: A

Tonkin+Taylor

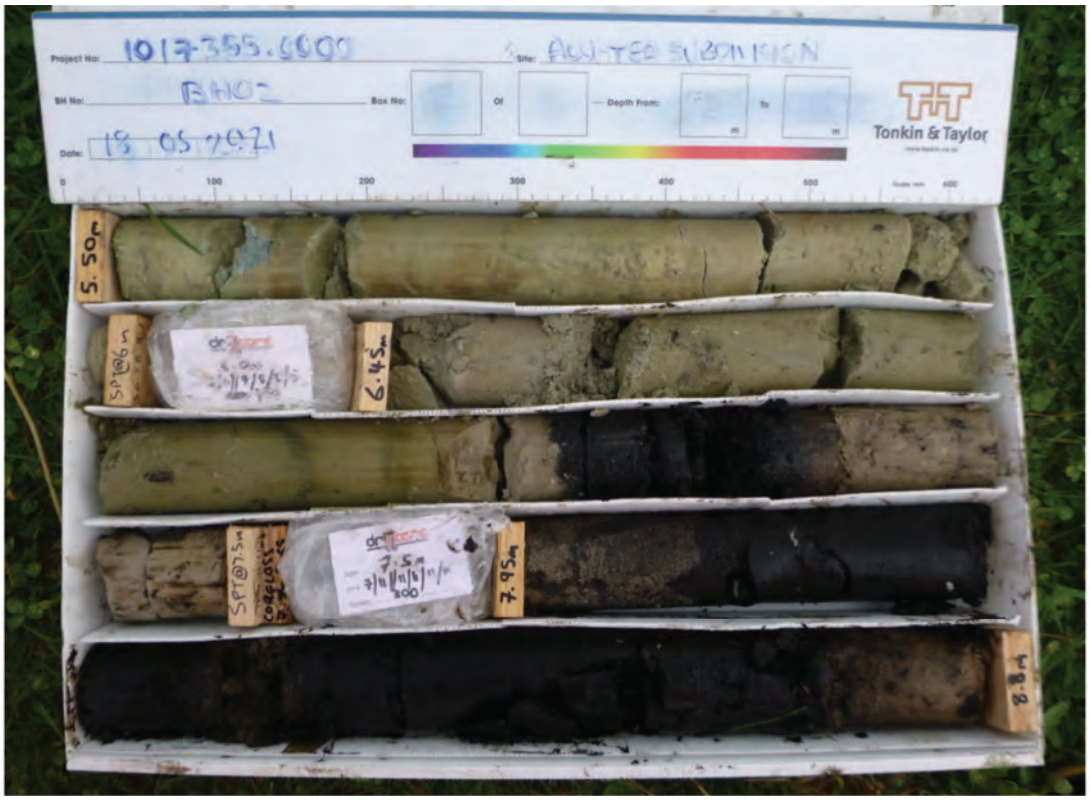
CORE PHOTOS

BOREHOLE No.: **BH102**

Hole Location: Central lying low lands

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5815510.15 mN 1795556.13 mE	DRILL TYPE: Tractor Rig	HOLE STARTED: 17/05/2021
		DRILL METHOD: RC	HOLE FINISHED: 18/05/2021
R.L.:	26.99m		DRILLED BY: Drillcore
DATUM:	NZVD2016	DRILL FLUID: WATER	LOGGED BY: CAND CHECKED: RWOT

0.00-5.50m



5.50-8.80m

CORE PHOTOS

BOREHOLE No.: **BH102**

Hole Location: Central lying low lands

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5815510.15 mN 1795556.13 mE	DRILL TYPE: Tractor Rig	HOLE STARTED: 17/05/2021
		DRILL METHOD: RC	HOLE FINISHED: 18/05/2021
R.L.:	26.99m		DRILLED BY: Drillcore
DATUM:	NZVD2016	DRILL FLUID: WATER	LOGGED BY: CAND CHECKED: RWOT

8.80-12.45m

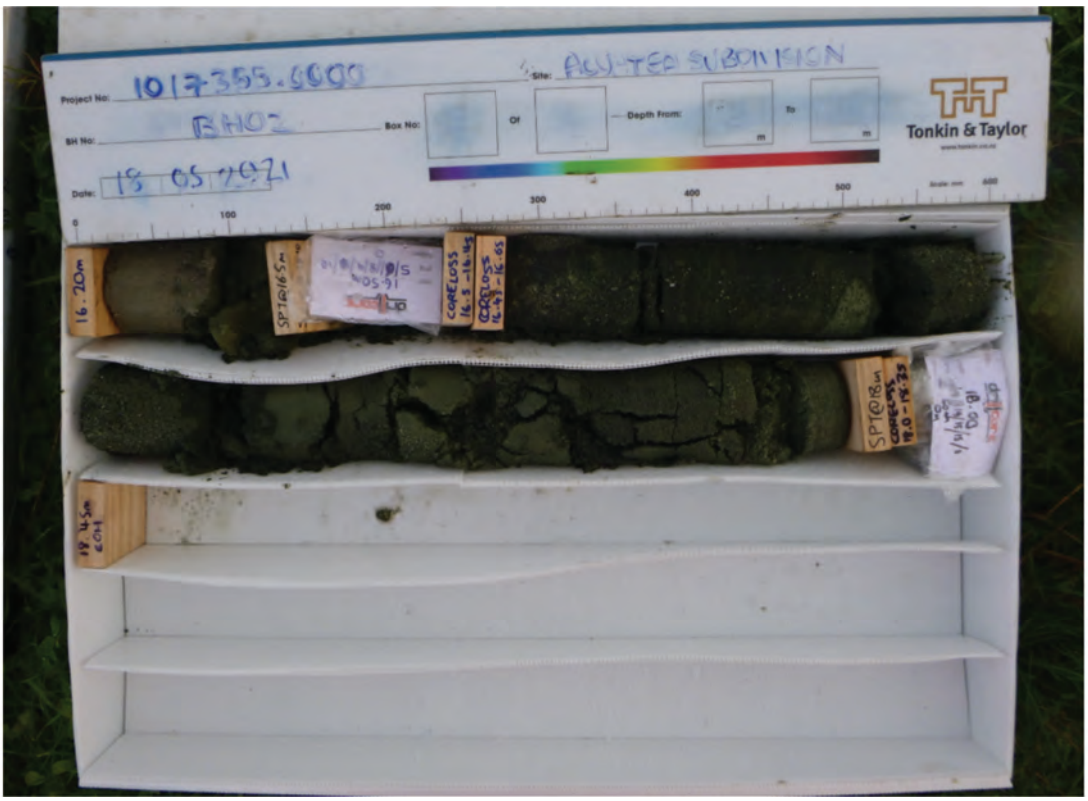
12.45-16.20m

CORE PHOTOS

BOREHOLE No.: **BH102**

Hole Location: Central lying low lands

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5815510.15 mN 1795556.13 mE	DRILL TYPE: Tractor Rig	HOLE STARTED: 17/05/2021
		DRILL METHOD: RC	HOLE FINISHED: 18/05/2021
R.L.:	26.99m		DRILLED BY: Drillcore
DATUM:	NZVD2016	DRILL FLUID: WATER	LOGGED BY: CAND CHECKED: RWOT



16.20-18.45m

BOREHOLE LOG

BOREHOLE No.: **BH103**

Hole Location: Northern end of site

SHEET: 1 OF 3

PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: (NZTM2000) 5816337.35 mN, 1795146.62 mE

R.L.: 30.74m

DATUM: NZVD2016

DRILL TYPE: Tractor Rig

DRILL METHOD: RC

DRILL FLUID: WATER

HOLE STARTED: 19/05/2021

HOLE FINISHED: 19/05/2021

DRILLED BY: Drillcore

LOGGED BY: CAND CHECKED: RWOT

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Colluvium Deposits			100	HQTT				30	0.0	TS	M	F				*0.00m:* Clayey SILT, minor organics; dark brown. Firm, moist, low plasticity. Organics, rootlets.
									0.5							*0.30m:* Clayey SILT, minor sand, trace gravel; brown. Firm, moist, medium plasticity. Sand, fine to coarse; gravel, fine.
			100	HQTT		● 45/17 kPa			1.0							*0.70m:* Silty CLAY; brown mottled grey. Firm, moist, high plasticity.
																0.80 - 1.50m: Grades to low plasticity, some sand. Sand is fine to coarse.
									1.5							*1.40 - 1.50m:* Observed as minor clay, wet, rapid dilatancy. Grades to very soft.
			60	PT				29								*1.50m:* Pushtube. Material observed as Silty CLAY as above.
																1.80m: CORE LOSS. 1.8m - 2.0m.
			100	SPT		0/0 0/0 0/0 **N=0**			2.0		W	VS				*2.00m:* Clayey SILT, minor sand; grey. Very soft, wet, medium plasticity. Sand, fine to medium.
			100	HQTT				28	2.5							*2.60 - 2.80m:* Grades to greenish grey.
Box 1, 0.0-3.0m												F				*2.80m:* Clayey SILT, trace sand; greenish grey. Firm, wet, low to medium plasticity. Sand, fine to coarse.
			100	SPT		● 36/3 kPa 1/1 0/1 1/1 **N=3**			3.0							
									3.5							
			100	HQTT				27			M					*3.80m:* Silty CLAY; greenish grey. Firm, moist, medium to high plasticity.
									4.0							
			100	SPT		● 86/25 kPa 1/0 1/0 1/0 **N=2**		26	4.5			St				*4.50 - 5.00m:* Becomes stiff.

COMMENTS: Low pressure aquifer with flowing water encountered in BH at 15.mgl. Water pressure measured to at approximately 1m above ground level. Hole Backfilled and sealed with bentonite.

Hole Depth 15m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH103**

Hole Location: Northern end of site

SHEET: 2 OF 3

PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: (NZTM2000) 5816337.35 mN, 1795146.62 mE | DRILL TYPE: Tractor Rig | HOLE STARTED: 19/05/2021

R.L.: 30.74m | DRILL METHOD: RC | HOLE FINISHED: 19/05/2021 | DRILLED BY: Drillcore

DATUM: NZVD2016 | DRILL FLUID: WATER | LOGGED BY: CAND | CHECKED: RWOT

GEOLOGICAL														ENGINEERING DESCRIPTION
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Piako Subgroup			100	HQTT				25	5.5		W	VL				*5.00m:* Sandy SILT; light greenish grey. Very loose, wet. Silt, rapid dilatancy; sand, fine to medium.
			100	SPT		1/1 3/4 3/5 **N=15**			6.0			MD				*6.00m:* Becomes medium dense.
Box 2, 3.0-6.9m			100	HQTT				24	6.5							*6.20m:* Fine to coarse SAND, trace silt; light greenish grey. Medium dense, wet. Sand, well graded.
			100	SPT		3/6 8/8 14/15 **N=45**		23	7.0			D				*7.20m:* Sandy SILT; greenish grey. Dense, wet. Silt, rapid dilatancy; sand, fine to coarse, well graded.
Hinuera Formation			100	HQTT					7.5							*8.00m:* Sandy fine GRAVEL; light greenish grey. Dense, wet. Gravel, sub-rounded to sub-angular, green; sand, medium to coarse.
								22	8.0							*8.80 - 9.00m:* Becomes brown, pumiceous.
			77	SPT		4/5 6/5 5/6 **N=22**			8.5			MD				*9.00m:* CORE LOSS. 9.0m - 9.1m.
								21	9.0							*9.10m:* Sandy fine GRAVEL; brown. Medium dense, wet. Gravel, sub-rounded to sub-angular, green; sand, medium to coarse. Pumiceous.
									9.5							*9.45m:* CORE LOSS. 9.45m - 9.7m.
																9.70m: Sandy fine GRAVEL; brown. Medium dense, wet. Gravel, sub-rounded to sub-angular, green; sand, medium to coarse. Pumiceous.

COMMENTS: Low pressure aquifer with flowing water encountered in BH at 15.mgl. Water pressure measured to at approximately 1m above ground level. Hole Backfilled and sealed with bentonite.

Hole Depth 15m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.: **BH103**

Hole Location: Northern end of site

SHEET: 3 OF 3

PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: (NZTM2000) 5816337.35 mN 1795146.62 mE

R.L.: 30.74m

DATUM: NZVD2016

DRILL TYPE: Tractor Rig

DRILL METHOD: RC

DRILL FLUID: WATER

HOLE STARTED: 19/05/2021

HOLE FINISHED: 19/05/2021

DRILLED BY: Drillcore

LOGGED BY: CAND CHECKED: RWOT

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	FLUID LOSS (%)	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (cm)	Description and Additional Observations
Box 3, 6.9-11.0m			76	HQTT					10.5		W	MD				*10.00m:* Sandy fine GRAVEL; brown. Medium dense, wet. Gravel, sub-rounded to sub-angular, green; sand, medium to coarse. Pumiceous.
			100	SPT		4/7 8/8 8/8 **N=32**		20				D				*10.50 - 10.90m:* Becomes Dense.
									11.0			VSt				*10.90m:* SILT, some clay; green. Very stiff, wet, low plasticity.
			76	HQTT												*10.95m:* CORE LOSS. 10.95m - 11.2m.
																11.20m: SILT, some clay; green. Very stiff, wet, low plasticity.
									11.5		M	D				*11.40m:* SILT; light grey. Dense, moist, dilatant - rapid. Weakly cemented.
								19								
									12.0			MD				*12.00m:* Becomes medium dense.
			100	SPT		1/2 6/6 7/7 **N=26**					W					
Hinuera Formation									12.5							*12.30m:* Sandy fine GRAVEL; brown. Medium dense, wet. Gravel, sub-rounded to sub-angular, green; sand, medium to coarse. Pumiceous.
																12.45m: CORE LOSS. 12.45m - 12.65m.
								18								*12.65m:* Sandy fine GRAVEL; brown. Medium dense, wet. Gravel, sub-rounded to sub-angular, green; sand, medium to coarse. Pumiceous.
			80	HQTT					13.0							*12.85m:* Fine to coarse SAND, some gravel; brown. Medium dense, wet. Gravel, fine to medium, sub-rounded to sub-angular. Pumiceous.
									13.5			D				*13.50 - 13.95m:* Becomes dense.
			100	SPT		4/4 6/7 8/10 **N=31**		17								
									14.0							*13.95m:* CORE LOSS. 13.95m - 15.00m.
Box 4, 11.0-15.0m			0	HQTT				16	14.5							15m: Target depth

COMMENTS: Low pressure aquifer with flowing water encountered in BH at 15.mgl. Water pressure measured to at approximately 1m above ground level. Hole Backfilled and sealed with bentonite.

Hole Depth 15m

Scale 1:25

Rev.: A

BoreLog _ 28/06/2021 12:40:49 pm - Produced with Core-GS by GeRoc

CORE PHOTOS

BOREHOLE No.: **BH103**

Hole Location: Northern end of site

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5816337.35 mN 1795146.62 mE	DRILL TYPE: Tractor Rig DRILL METHOD: RC DRILL FLUID: WATER	HOLE STARTED: 19/05/2021 HOLE FINISHED: 19/05/2021 DRILLED BY: Drillcore LOGGED BY: CAND CHECKED: RWOT
R.L.:	30.74m		
DATUM:	NZVD2016		

0.00-3.00m

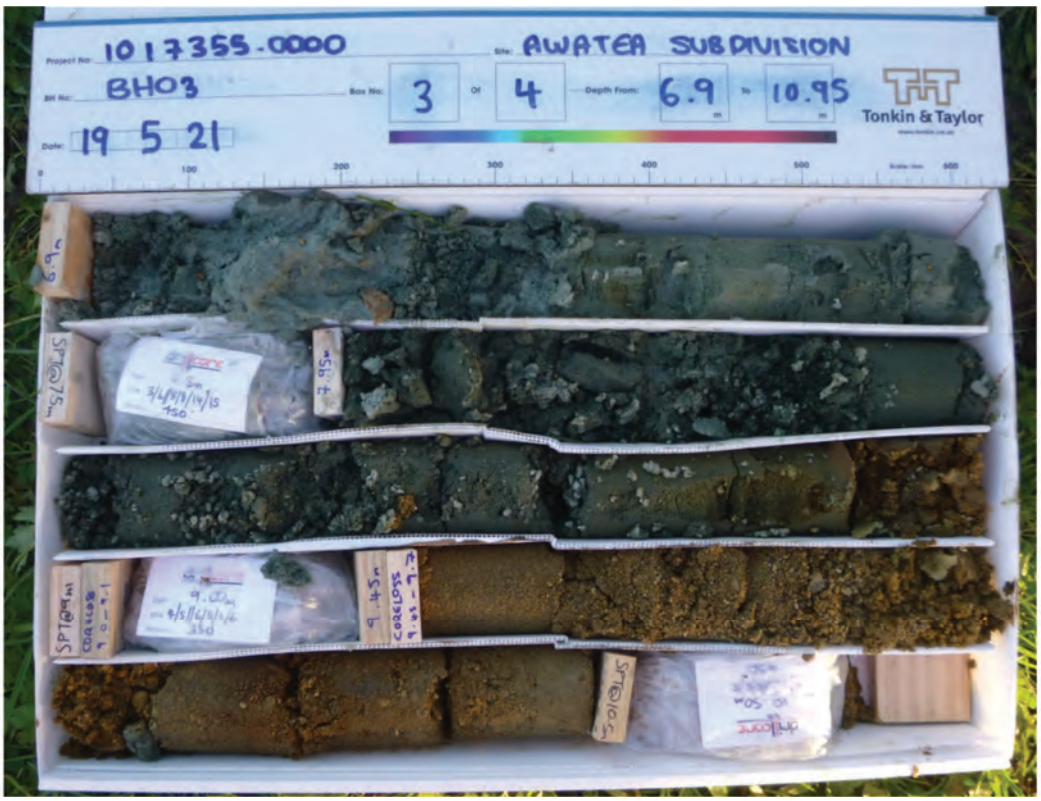
3.00-6.90m

CORE PHOTOS

BOREHOLE No.: **BH103**

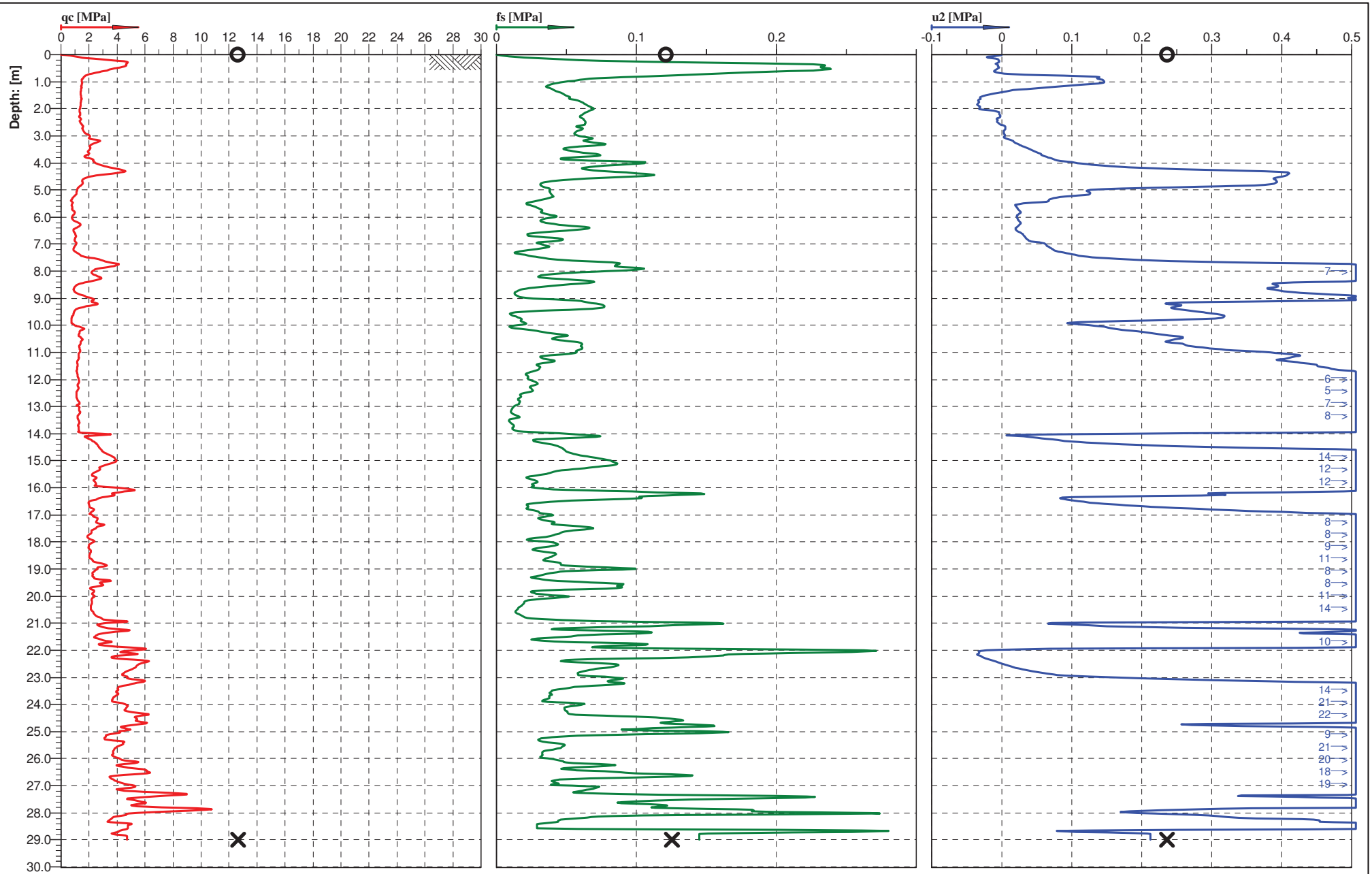
Hole Location: Northern end of site

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5816337.35 mN 1795146.62 mE	DRILL TYPE: Tractor Rig	HOLE STARTED: 19/05/2021
		DRILL METHOD: RC	HOLE FINISHED: 19/05/2021
R.L.:	30.74m		DRILLED BY: Drillcore
DATUM:	NZVD2016	DRILL FLUID: WATER	LOGGED BY: CAND CHECKED: RWOT



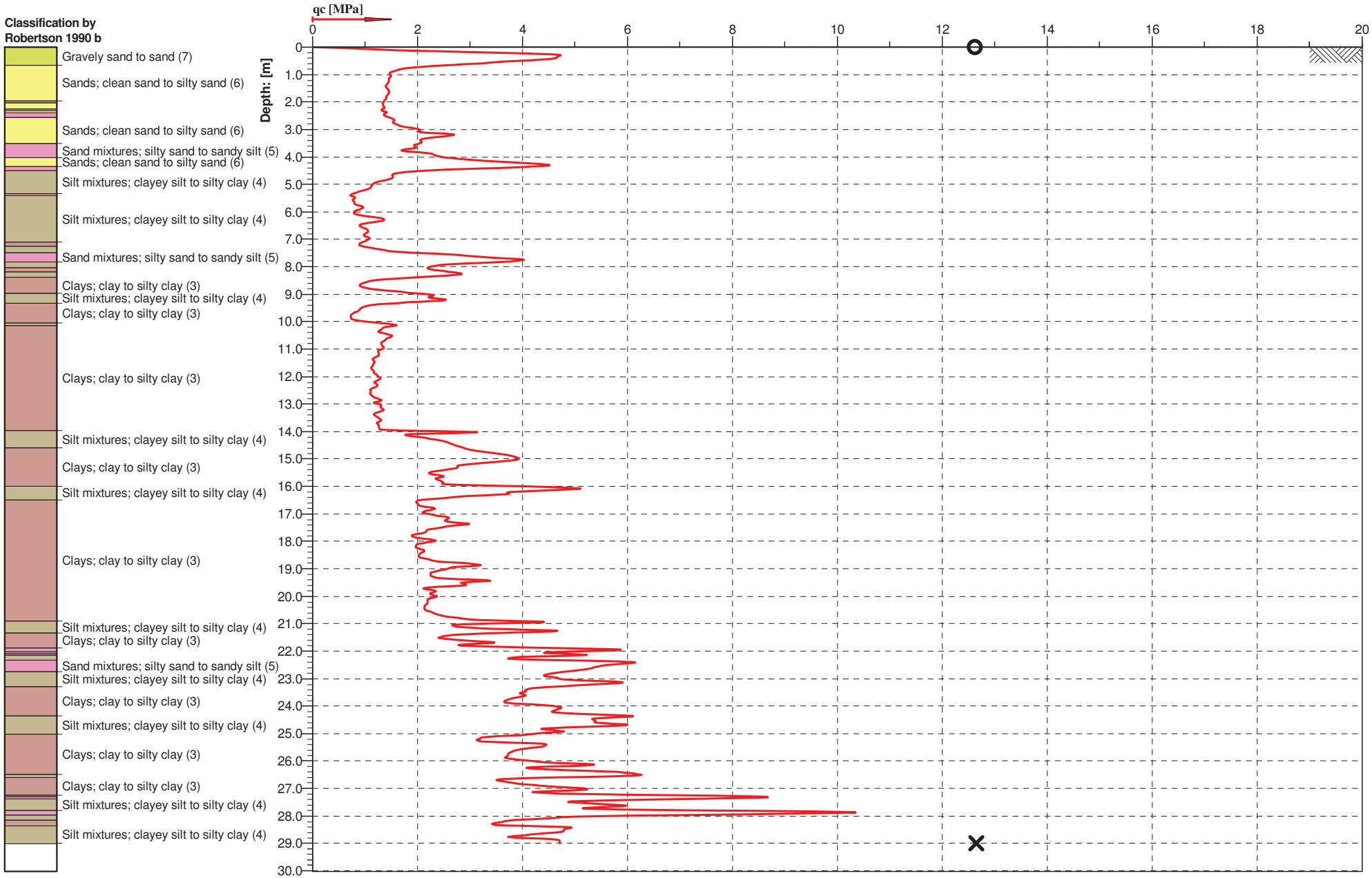
6.90-10.95m

10.95-15.00m



Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

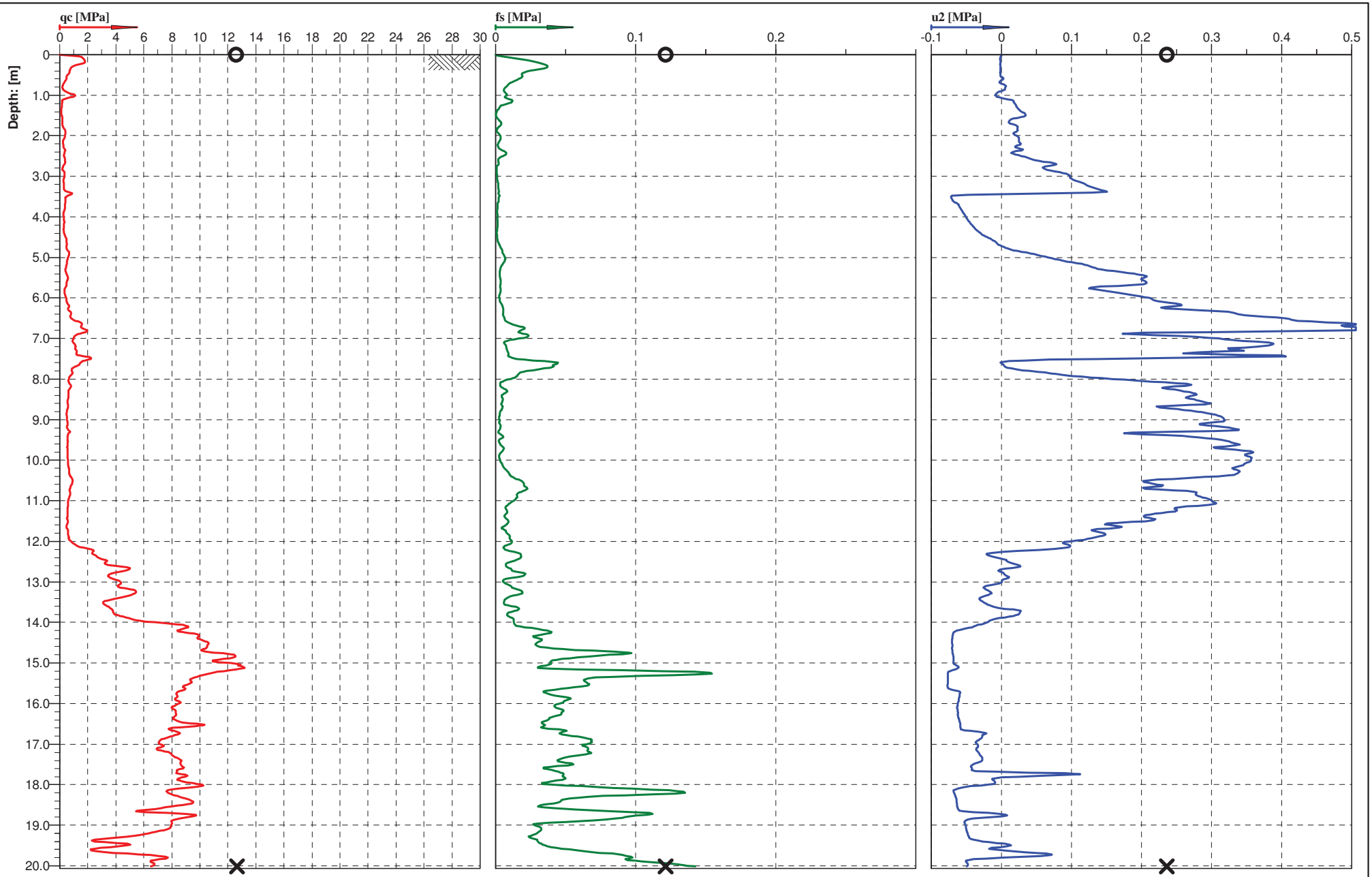
Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT101
Project ID: E1795111 N5814959	Client: Tonkin & Taylor	Date: 17/05/2021	Scale: 1 : 190
Project: 584 WHATAWHATA ROAD		Page: 1/2	Fig.:
Target depth 20m. Tilt out at 27m. Lost signal at 29m. hole dipped and collapsed back to 0.25m.		File: CPT101 .cpt	



u2

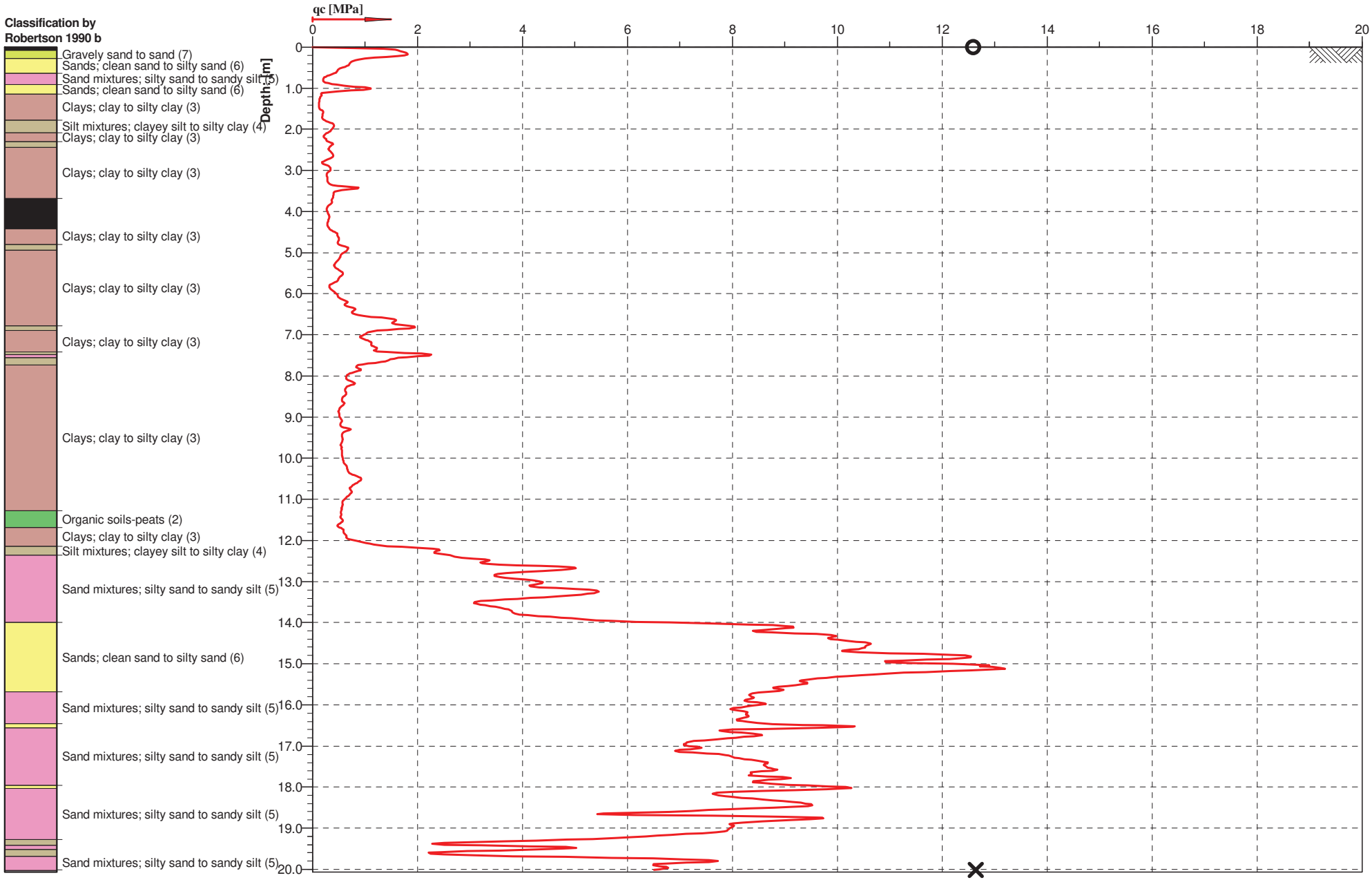
Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT101
Project ID: E1795111 N5814959	Client: Tonkin & Taylor	Date: 17/05/2021	Scale: 1 : 190
Project: 584 WHATAWHATA ROAD		Page: 2/2	Fig.:
Target depth 20m. Tilt out at 27m. Lost signal at 29m. hole dipped and collapsed back to 0.25m.		File: CPT101 .cpt	



Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT102
Project ID: E1795217 N5814969	Client: Tonkin & Taylor	Date: 17/05/2021	Scale: 1 : 127
Project: 584 WHATAWHATA ROAD		Page: 1/2	Fig.:
Target depth 20m. Hole dipped and collapsed back to 0.35m.		File: CPT102 .cpt	

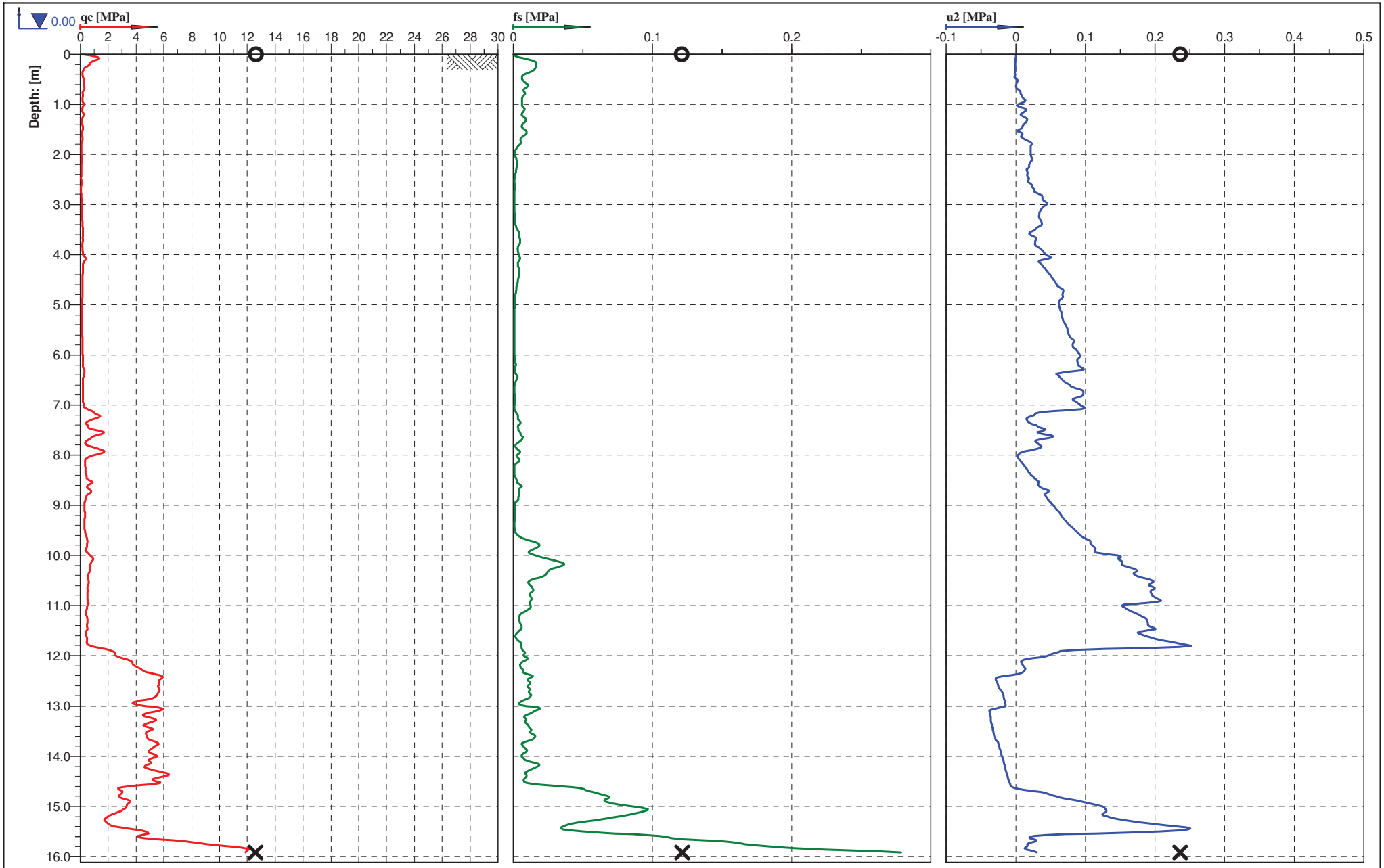


drillcore

u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

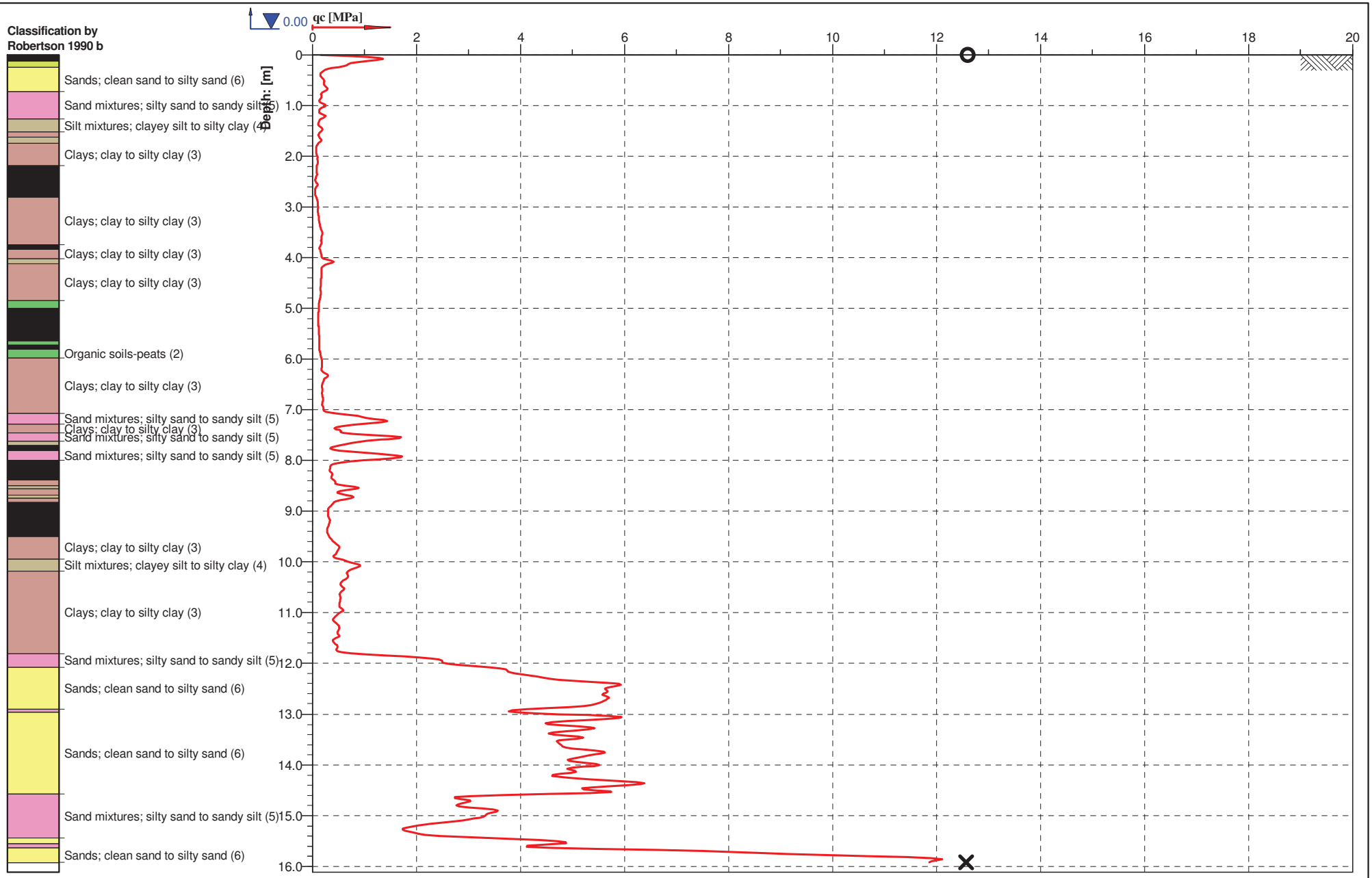
Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT102
Project ID: E1795217 N5814969	Client: Tonkin & Taylor	Date: 17/05/2021	Scale: 1 : 127
Project: 584 WHATAWHATA ROAD		Page: 2/2	Fig.:
Target depth 20m. Hole dipped and collapsed back to 0.35m.		File: CPT102 .cpt	



u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT103
Project ID: E1795134 N5815377	Client: Tonkin & Taylor	Date: 17/05/2021	Scale: 1 : 102
Project: 584 WHATAWHATA ROAD		Page: 1/2	Fig.:
Target depth 20m. Refused 15.92m. Water level at grounbd level due to Artesian.		File: CPT103 .cpt	

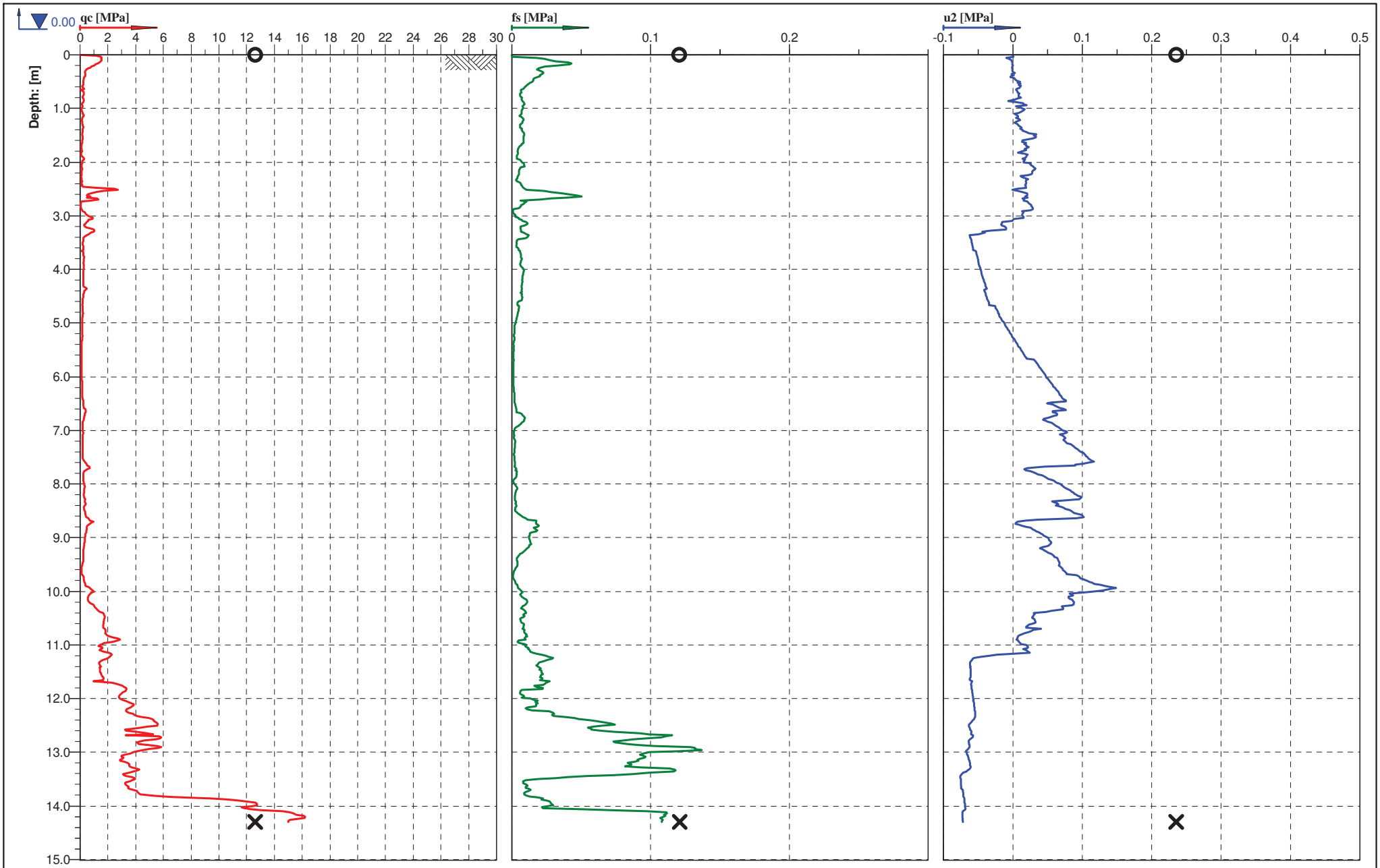


drillcore

u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

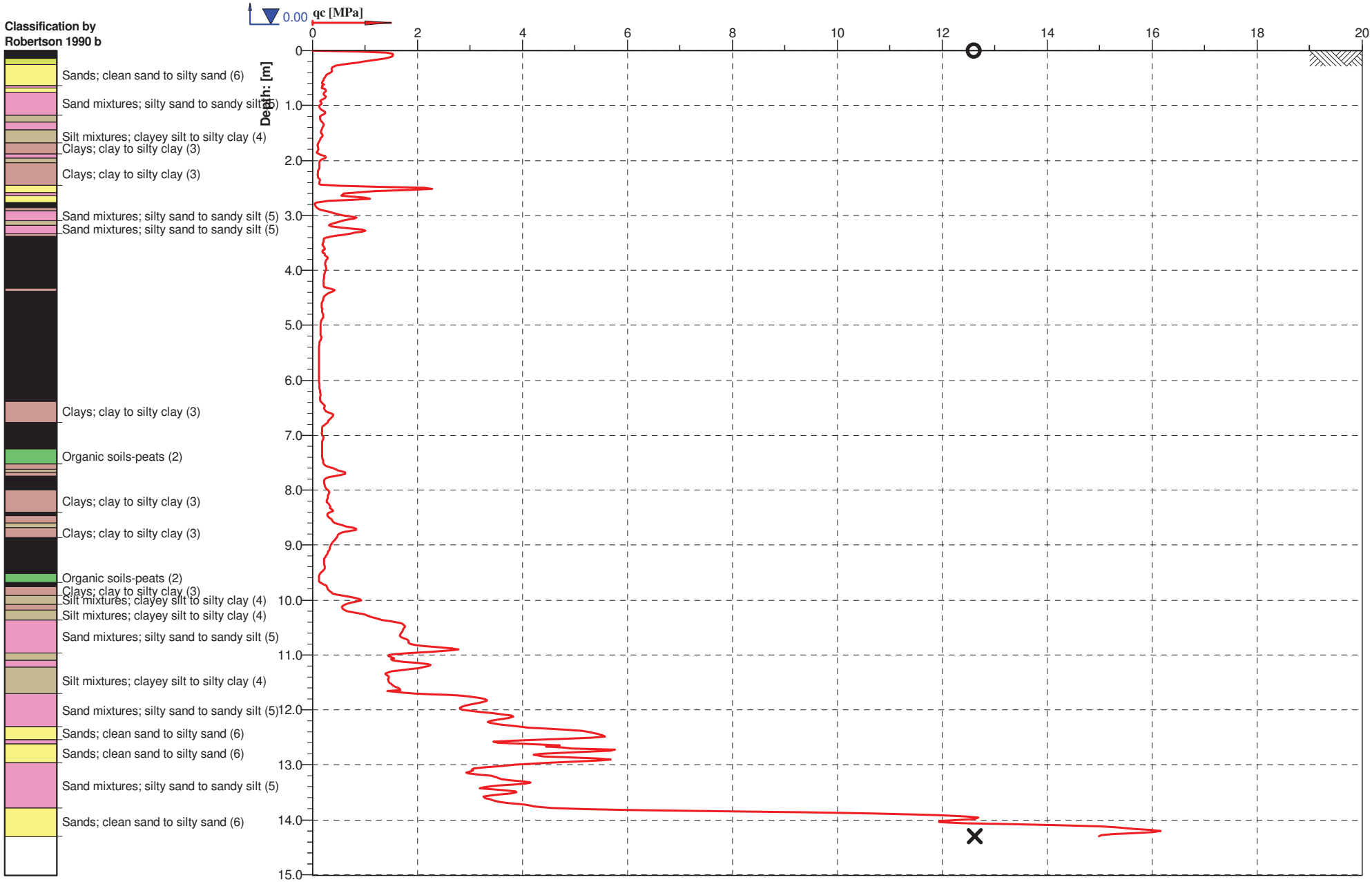
Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT103
Project ID: E1795134 N5815377	Client: Tonkin & Taylor	Date: 17/05/2021	Scale: 1 : 102
Project: 584 WHATAWHATA ROAD		Page: 2/2	Fig.:
Target depth 20m. Refused 15.92m. Water level at grounbd level due to Artesian.		File: CPT103 .cpt	



u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

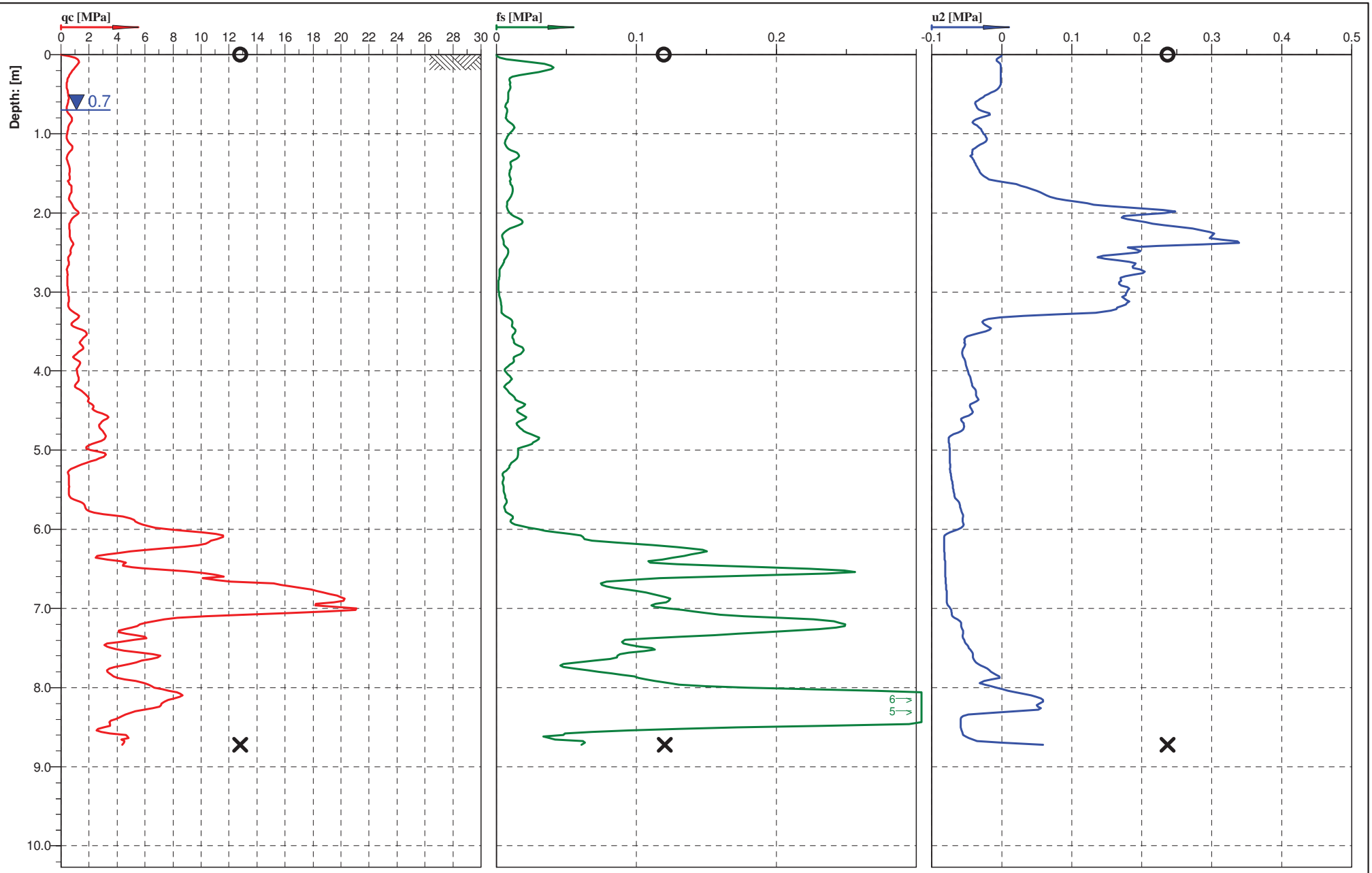
Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT104
Project ID: E1795312 N5815433	Client: Tonkin & Taylor	Date: 17/05/2021	Scale: 1 : 95
Project: 584 WHATAWHATA ROAD		Page: 1/2	Fig.:
Target depth 20m. Refused 14.30m. Water at Ground Level due to Artesian.		File: CPT104 .cpt	



Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT104
Project ID: E1795312 N5815433	Client: Tonkin & Taylor	Date: 17/05/2021	Scale: 1 : 95
Project: 584 WHATAWHATA ROAD		Page: 2/2	Fig.:
Target depth 20m. Refused 14.30m. Water at Ground Level due to Artesian.		File: CPT104 .cpt	

u2

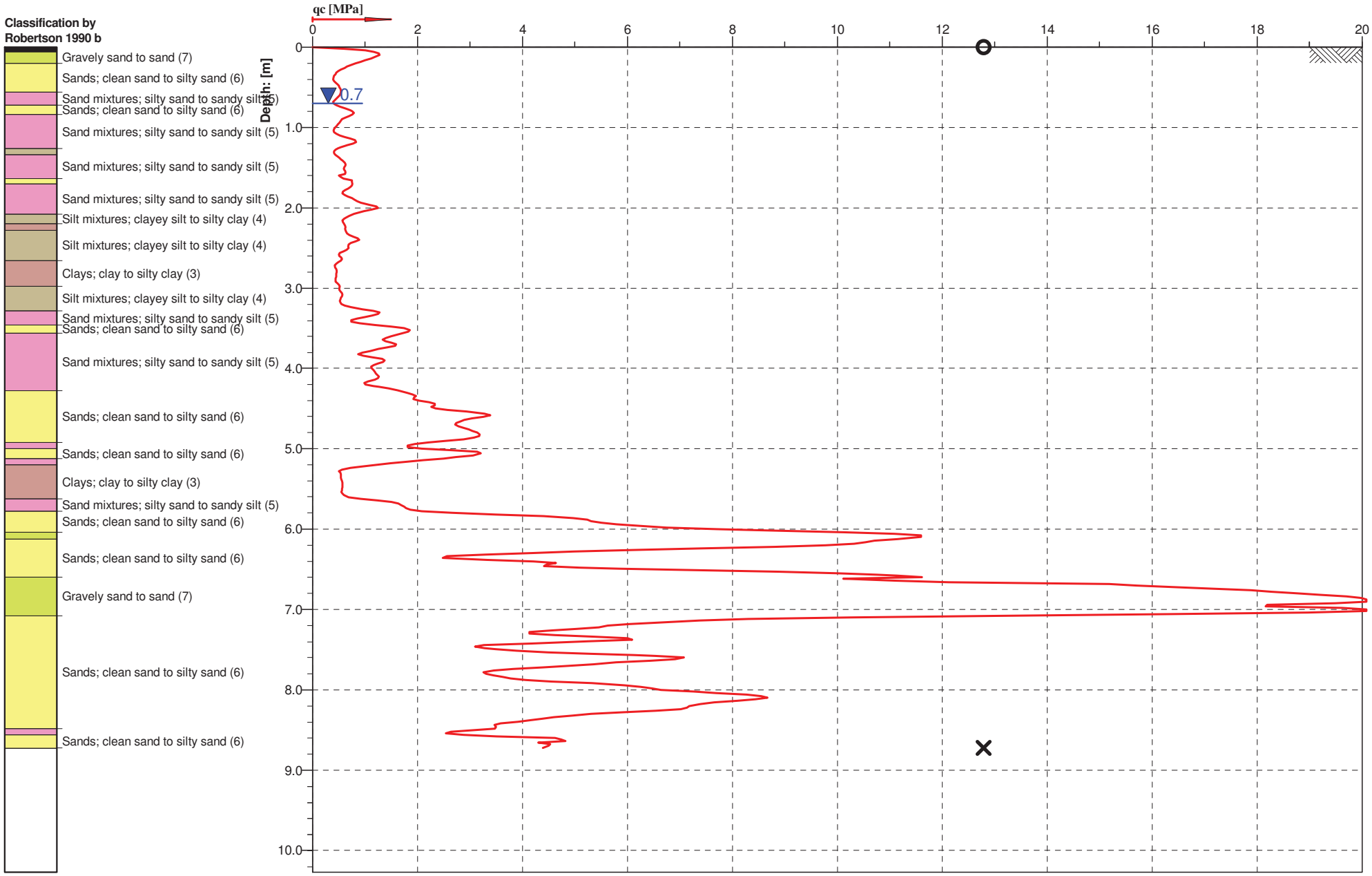
Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150



u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

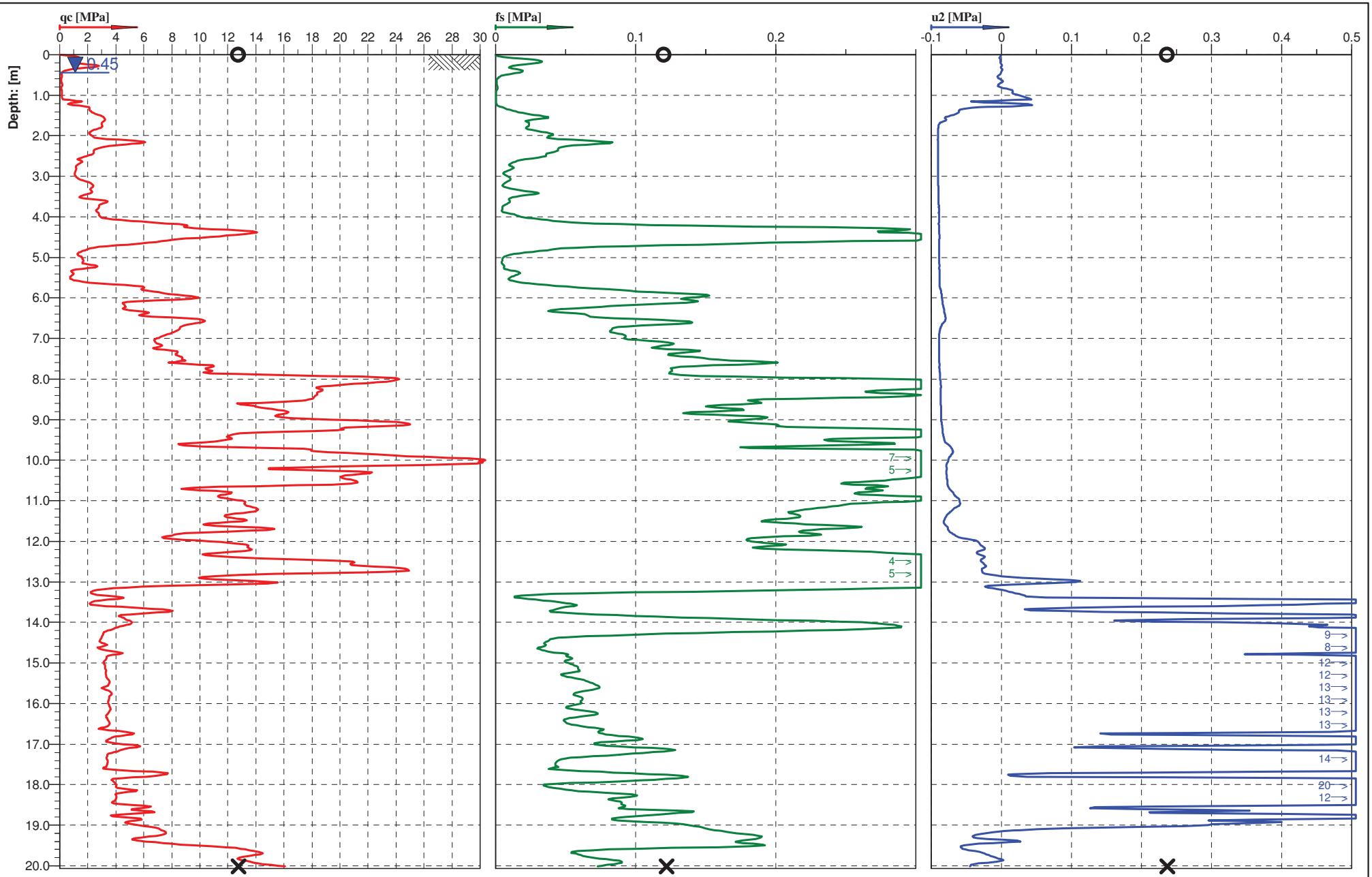
Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT105
Project ID: E1795079 N5815738	Client: Tonkin & Taylor	Date: 18/05/2021	Scale: 1 : 65
Project: 584 WHATAWHATA ROAD		Page: 1/2	Fig.:
Target depth 20m. Refused 8.72m.		File: CPT105 .cpt	



Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m		Ground level: 0.00	Test No.: CPT105
Project ID: E1795079 N5815738	Client: Tonkin & Taylor		Date: 18/05/2021	Scale: 1 : 65
Project: 584 WHATAWHATA ROAD			Page: 2/2	Fig.:
Target depth 20m. Refused 8.72m.			File: CPT105 .cpt	

u2

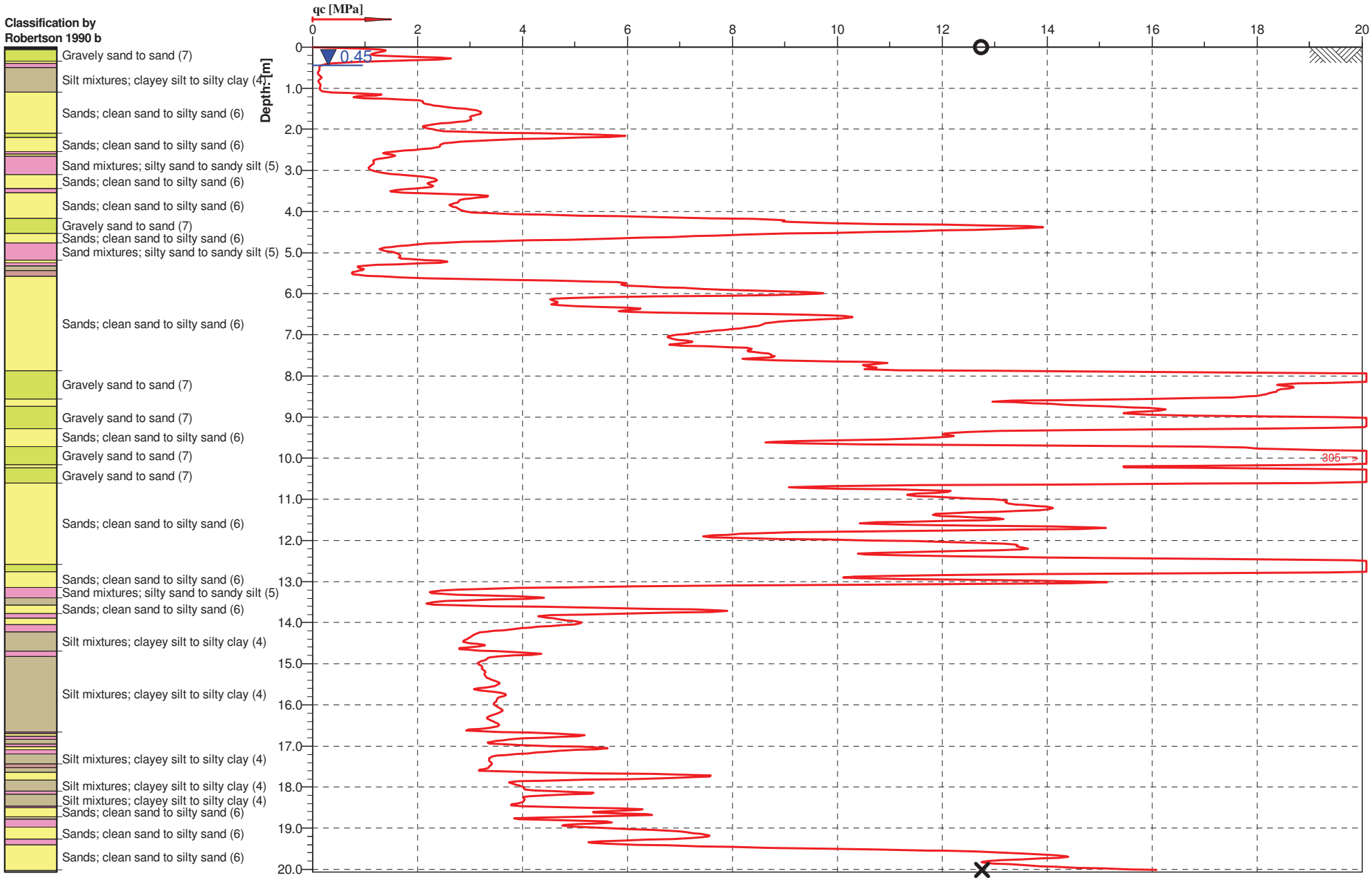
Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150



Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m		Ground level: 0.00	Test No.: CPT106
Project ID: E1795345 N5815691	Client: Tonkin & Taylor		Date: 18/05/2021	Scale: 1 : 127
Project: 584 WHATAWHATA ROAD			Page: 1/2	Fig.:
Target depth 20m.			File: CPT106 .cpt	

u2

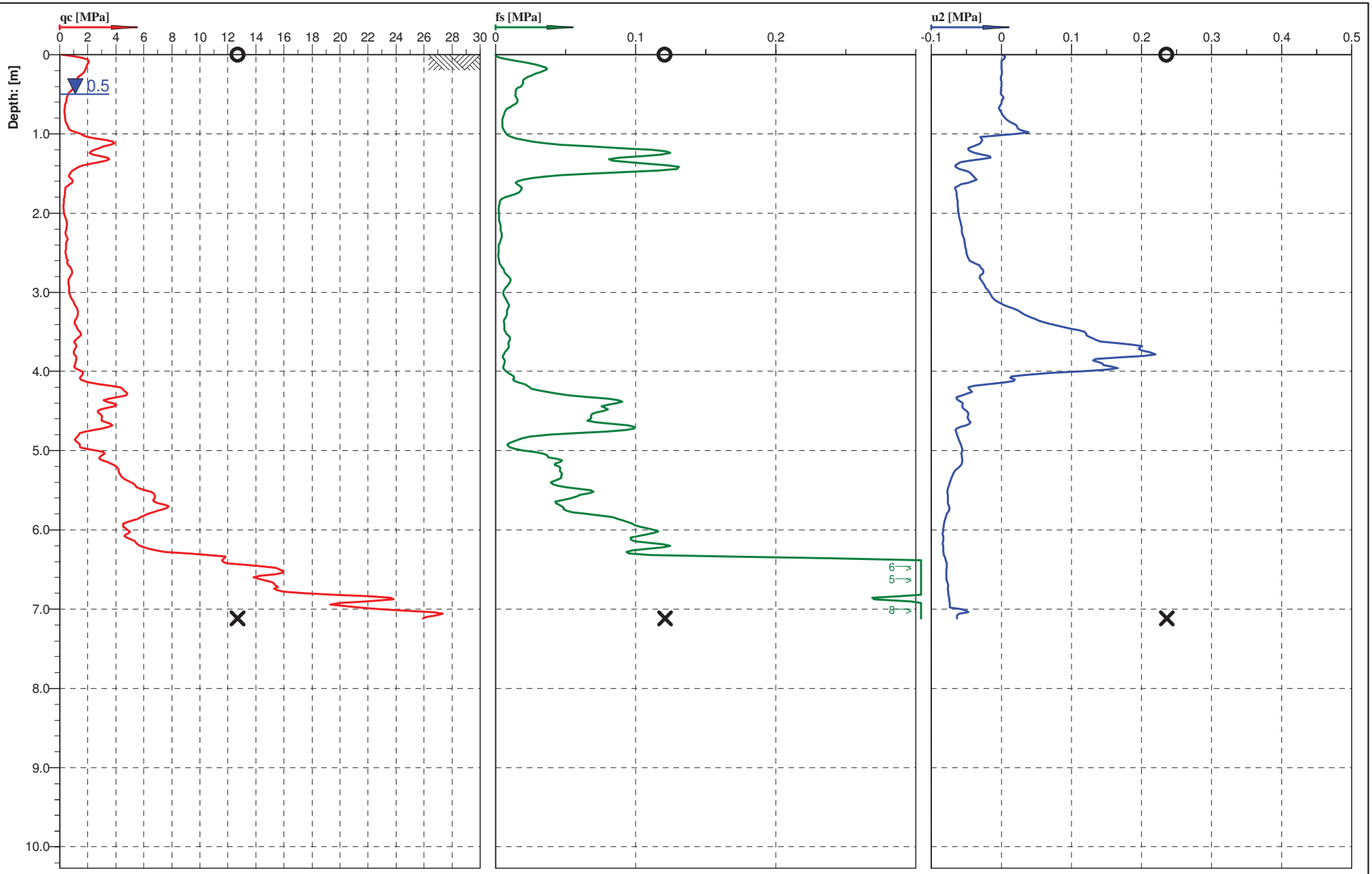
Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150



u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT106
Project ID: E1795345 N5815691	Client: Tonkin & Taylor	Date: 18/05/2021	Scale: 1 : 127
Project: 584 WHATAWHATA ROAD		Page: 2/2	Fig.:
Target depth 20m.		File: CPT106 .cpt	

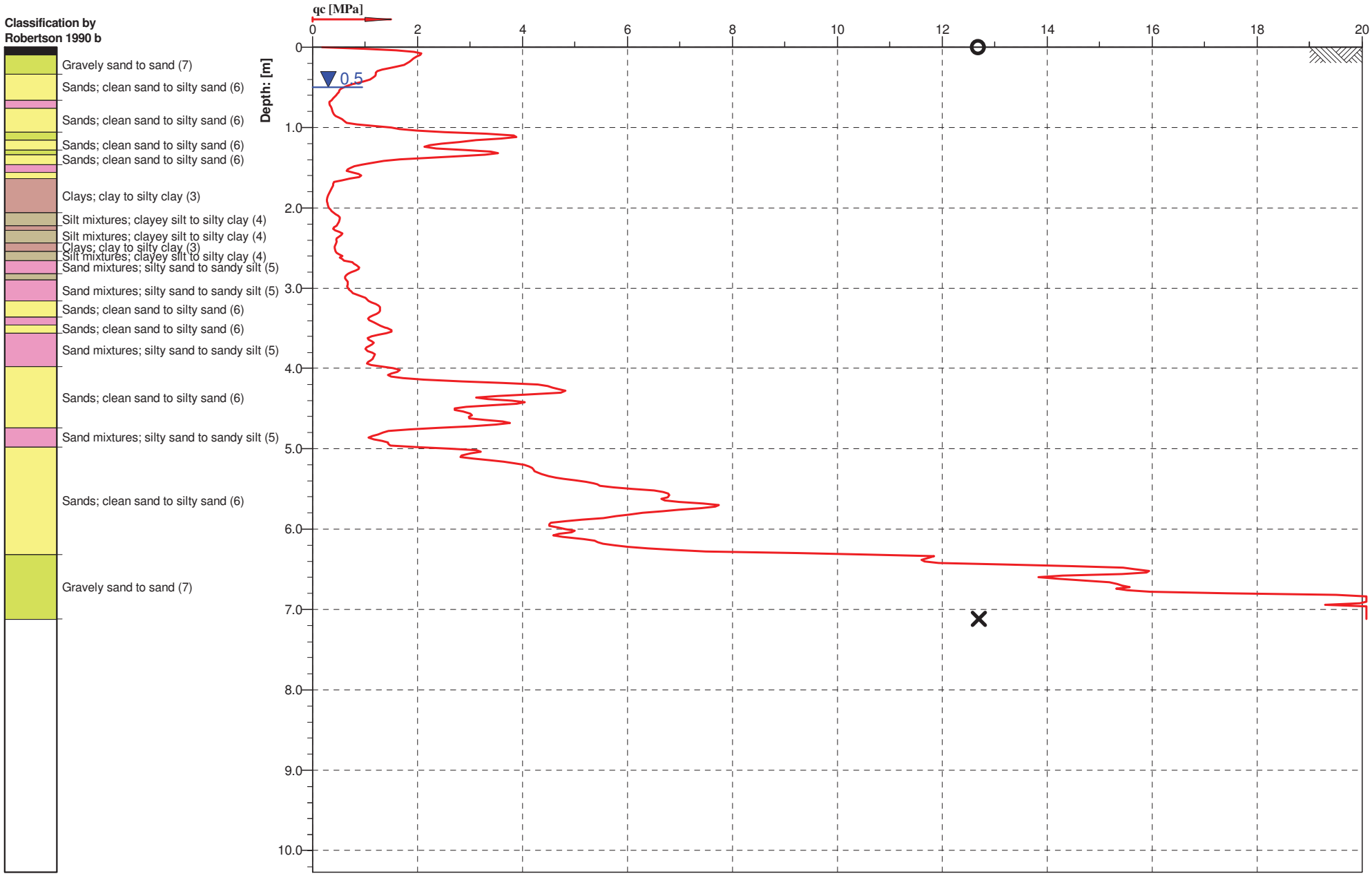


drillcore

u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

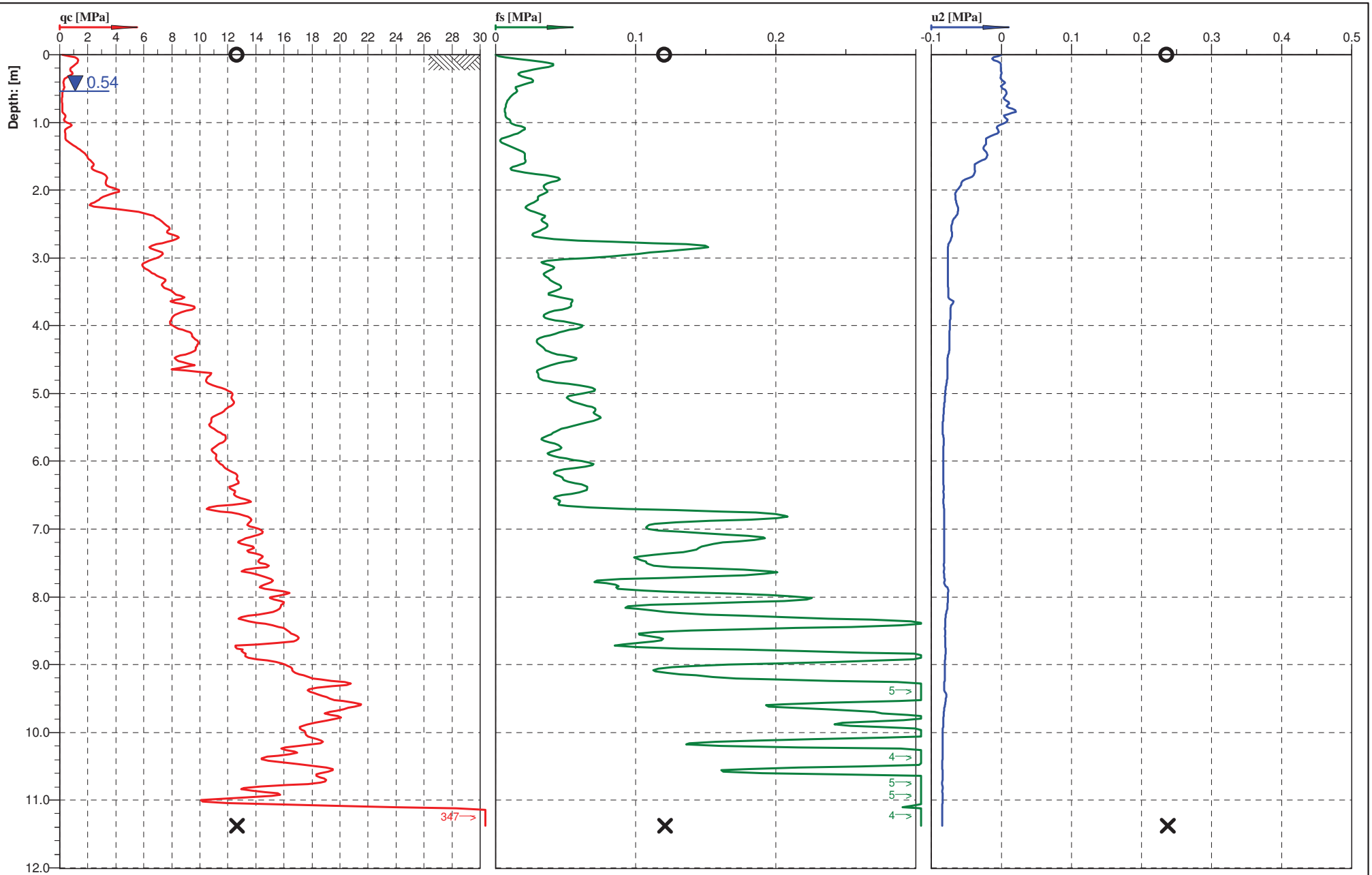
Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT107
Project ID: E1795800 N5815725	Client: Tonkin & Taylor	Date: 18/05/2021	Scale: 1 : 65
Project: 584 WHATAWHATA ROAD		Page: 1/2	Fig.:
Target depth 20m. Refused 7.12m.		File: CPT107 .cpt	



Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT107
Project ID: E1795800 N5815725	Client: Tonkin & Taylor	Date: 18/05/2021	Scale: 1 : 65
Project: 584 WHATAWHATA ROAD		Page: 2/2	Fig.:
Target depth 20m. Refused 7.12m.		File: CPT107 .cpt	

u2

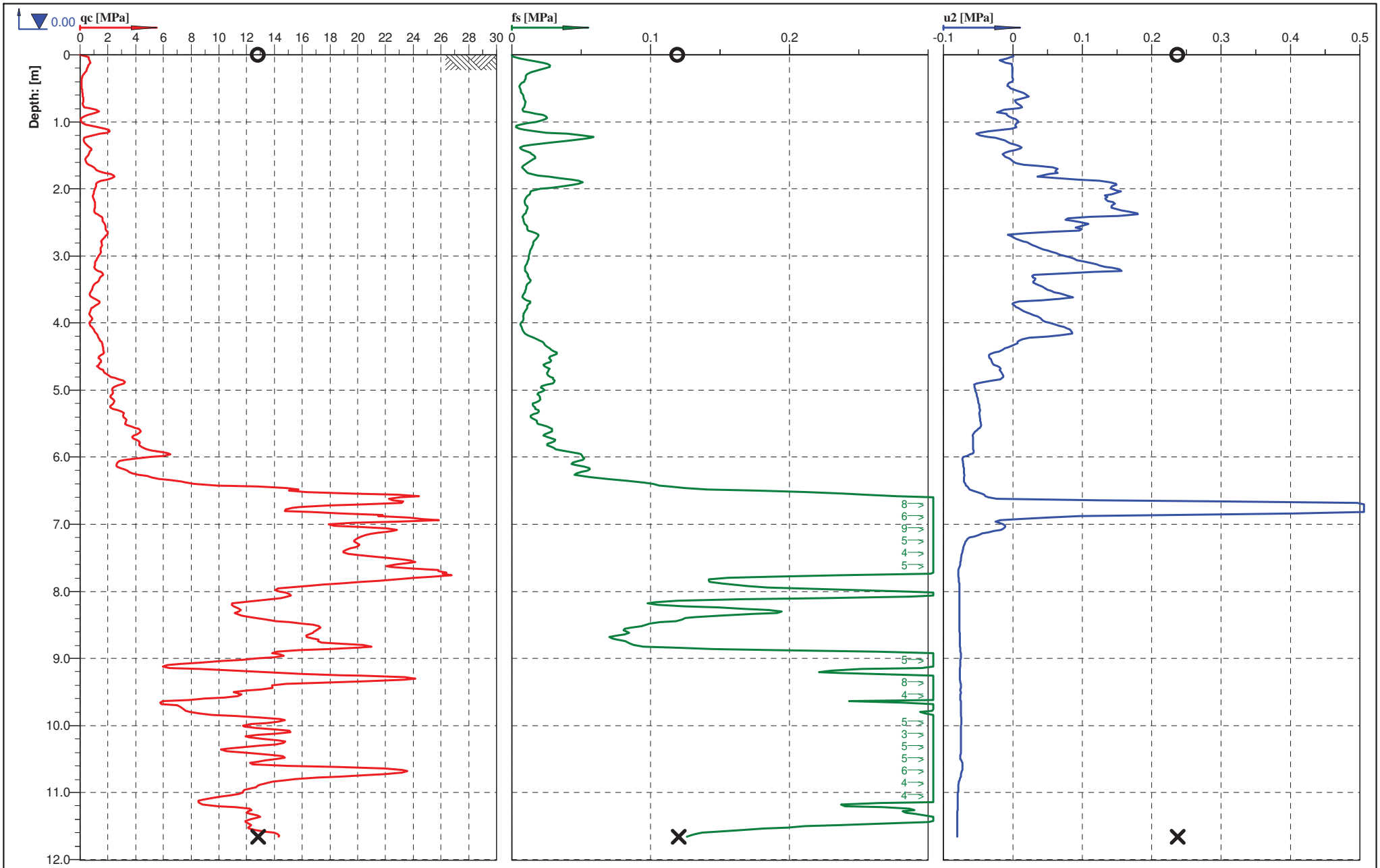
Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150



Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT08
Project ID: E1795895 N5815575	Client: Tonkin & Taylor	Date: 18/05/2021	Scale: 1 : 76
Project: 584 WHATAWHATA ROAD		Page: 1/2	Fig.:
Target depth 20m. Refused 11.38m.		File: CPT08.cpt	

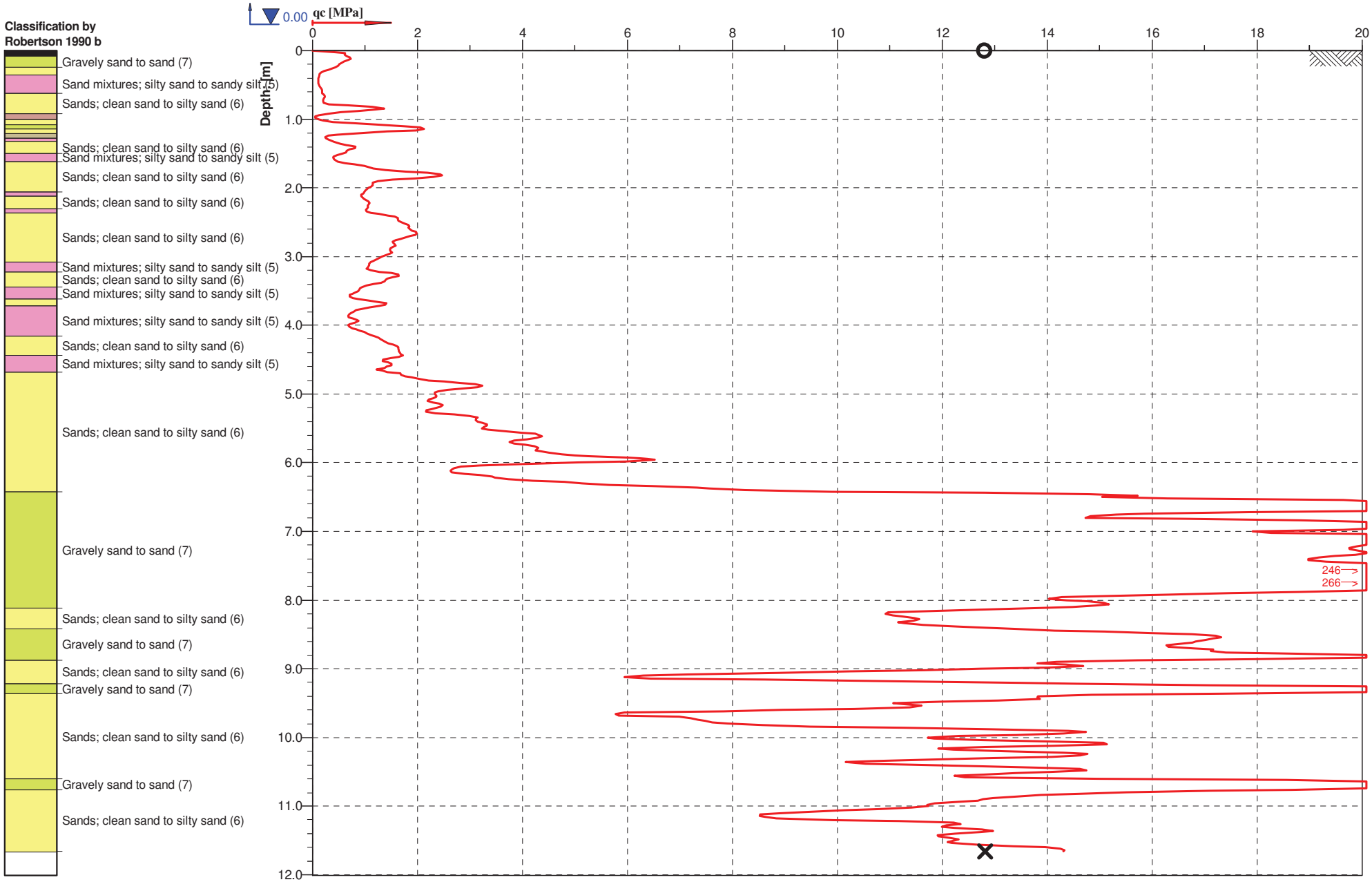
u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150



Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

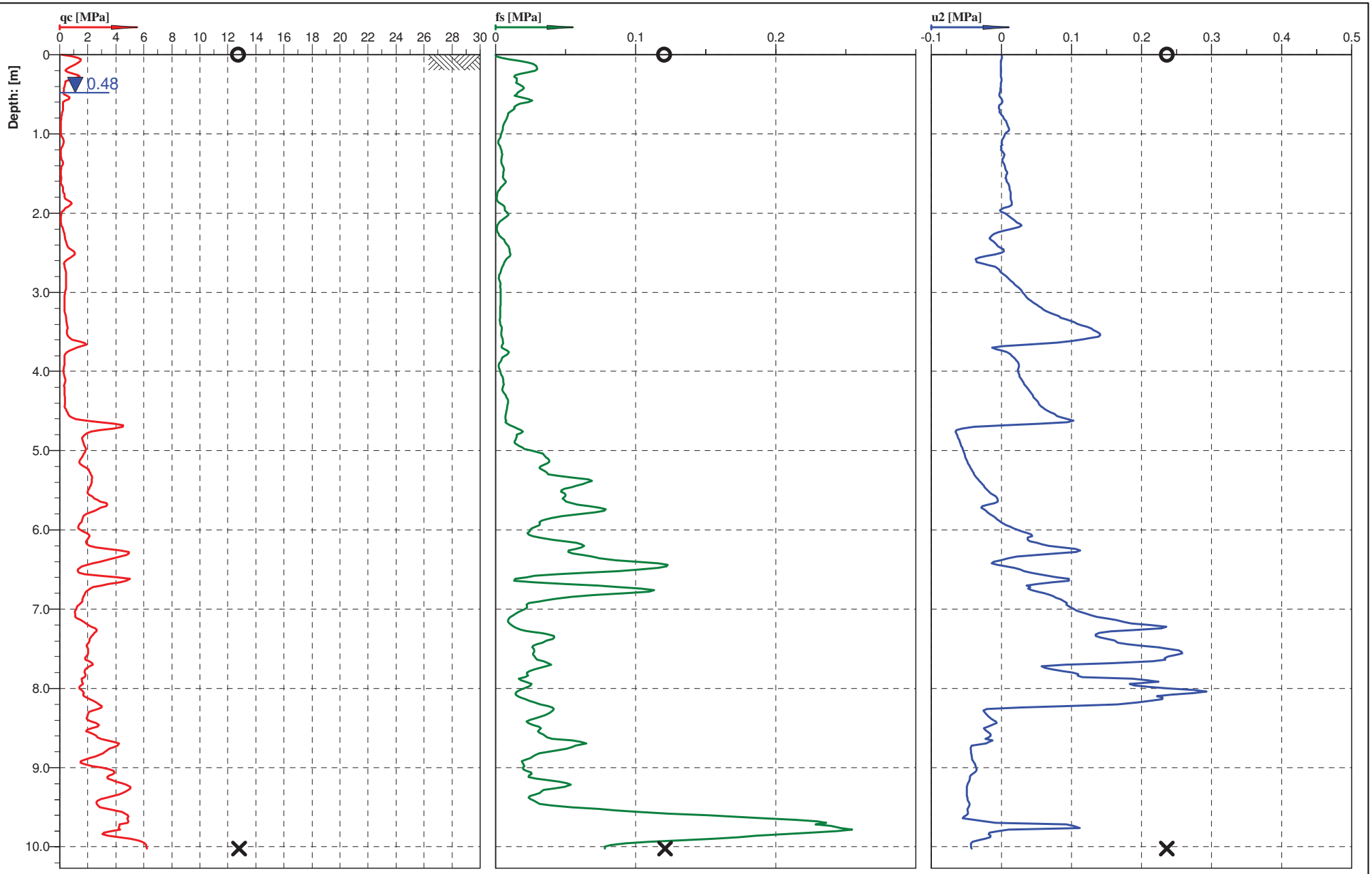
Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT109
Project ID: E1796127 N5815399	Client: Tonkin & Taylor	Date: 18/05/2021	Scale: 1 : 76
Project: 584 WHATAWHATA ROAD		Page: 1/2	Fig.:
Target depth 20m. Refused 11.66m.		File: CPT109 .cpt	



Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT109
Project ID: E1796127 N5815399	Client: Tonkin & Taylor	Date: 18/05/2021	Scale: 1 : 76
Project: 584 WHATAWHATA ROAD		Page: 2/2	Fig.:
Target depth 20m. Refused 11.66m.		File: CPT109 .cpt	

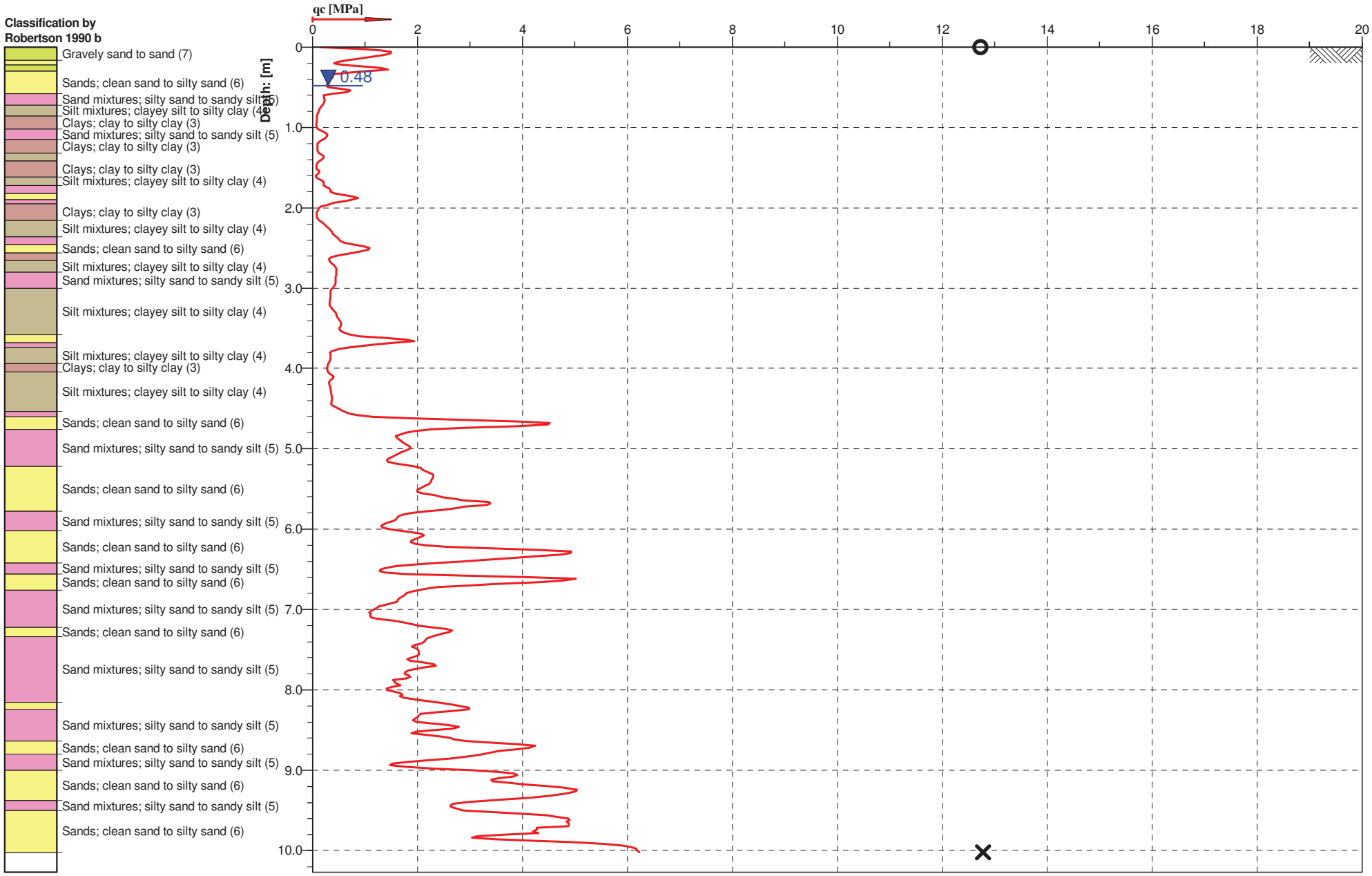
u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150



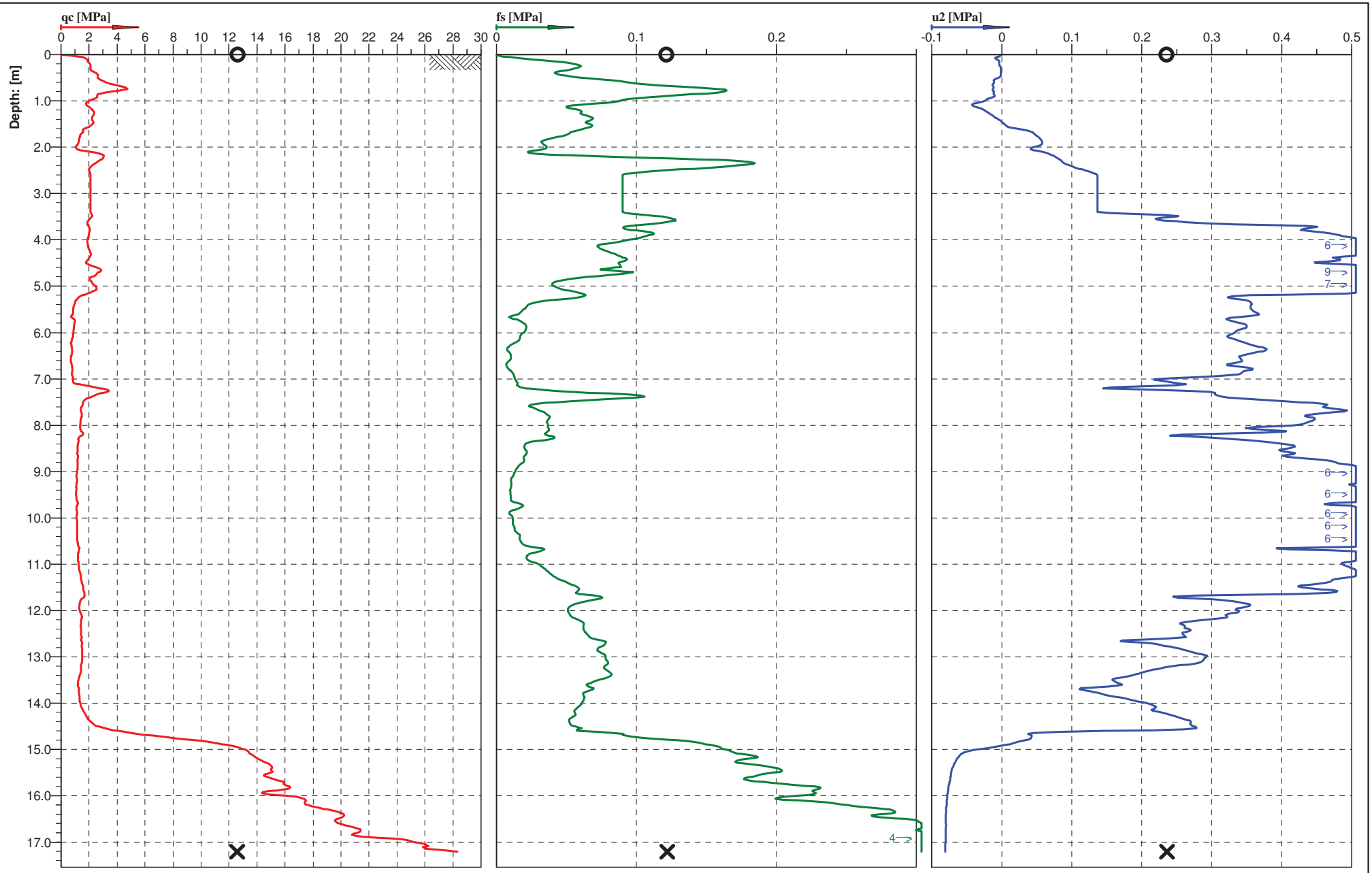
Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT110
Project ID: E1795560 N5815509	Client: Tonkin & Taylor	Date: 18/05/2021	Scale: 1 : 65
Project: 584 WHATAWHATA ROAD		Page: 1/2	Fig.:
Target depth 20m. Refused 10.02m. Poor Anchoring.		File: CPT110 .cpt	

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150



drillcore

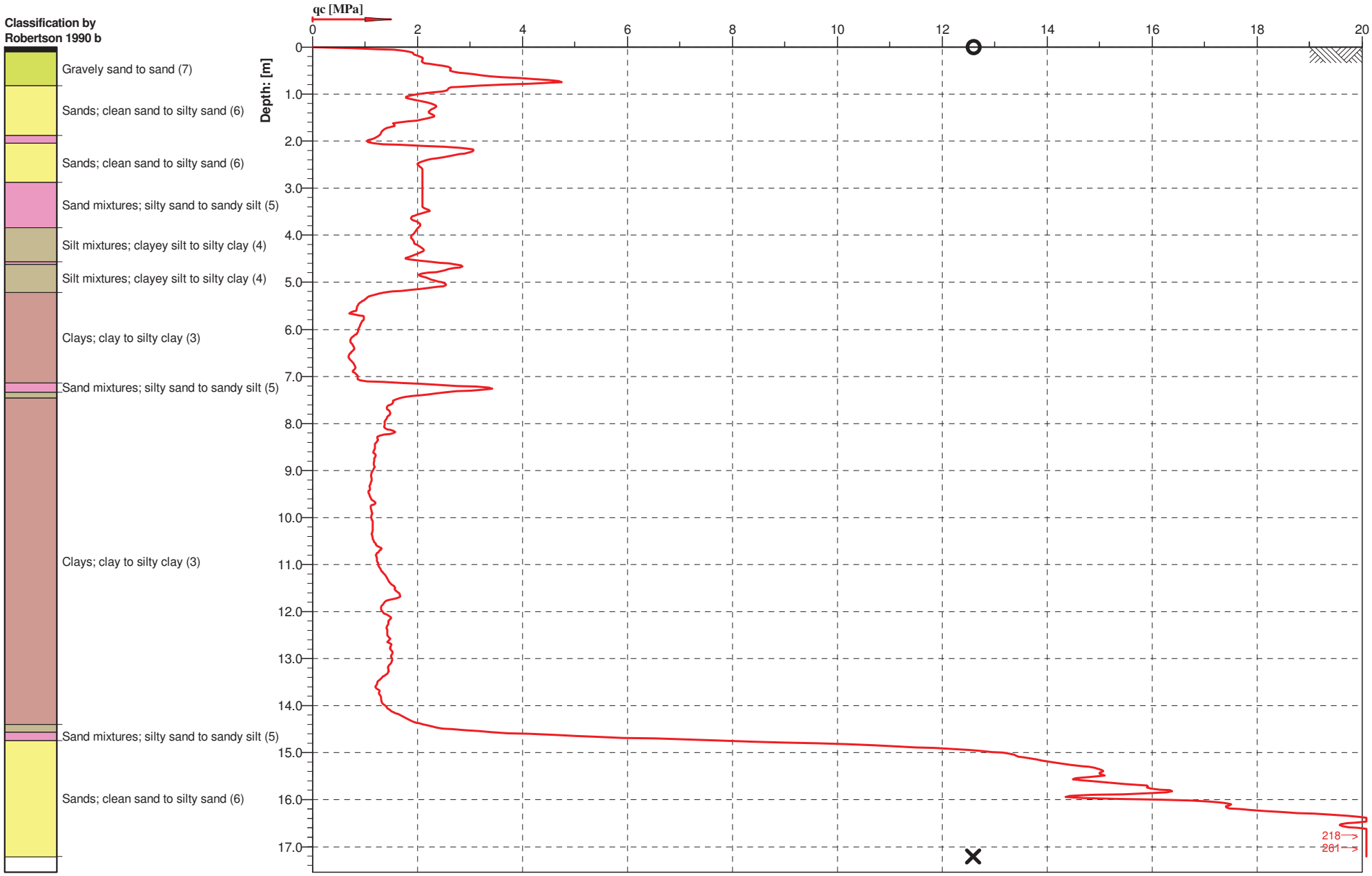
Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT110
Project ID: E1795560 N5815509	Client: Tonkin & Taylor	Date: 18/05/2021	Scale: 1 : 65
Project: 584 WHATAWHATA ROAD		Page: 2/2	Fig.:
Target depth 20m. Refused 10.02m. Poor Anchoring.		File: CPT110 .cpt	



drillcore

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

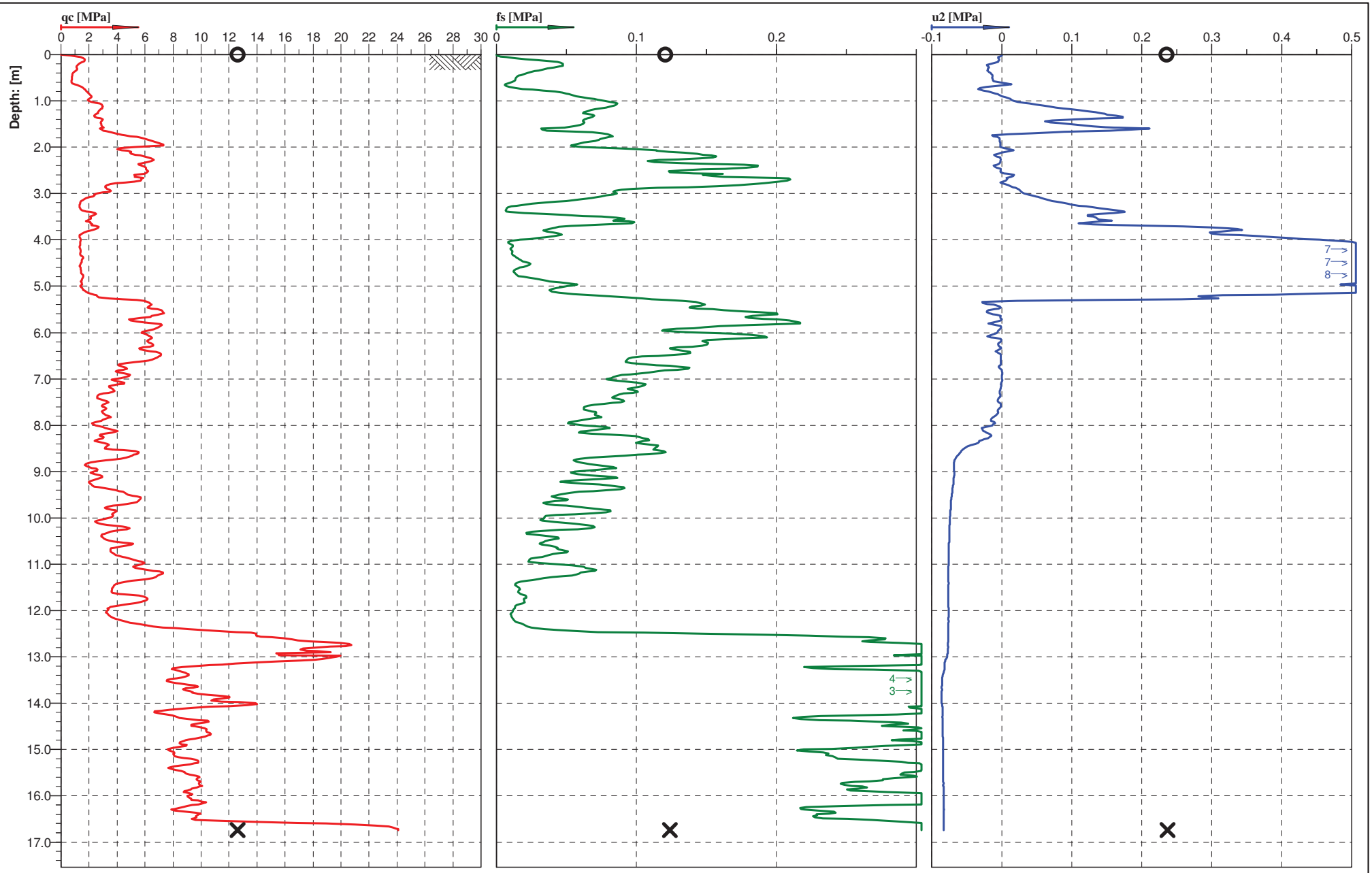
Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT111
Project ID: E1795368 N5815597	Client: Tonkin & Taylor	Date: 17/05/2021	Scale: 1 : 111
Project: 584 WHATAWHATA ROAD		Page: 1/2	Fig.:
Target depth 20m. Refused 17.20m. Hole dipped and collapsed back to 12.80m.		File: CPT111 .cpt	



u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT111
Project ID: E1795368 N5815597	Client: Tonkin & Taylor	Date: 17/05/2021	Scale: 1 : 111
Project: 584 WHATAWHATA ROAD		Page: 2/2	Fig.:
Target depth 20m. Refused 17.20m. Hole dipped and collapsed back to 12.80m.		File: CPT111 .cpt	

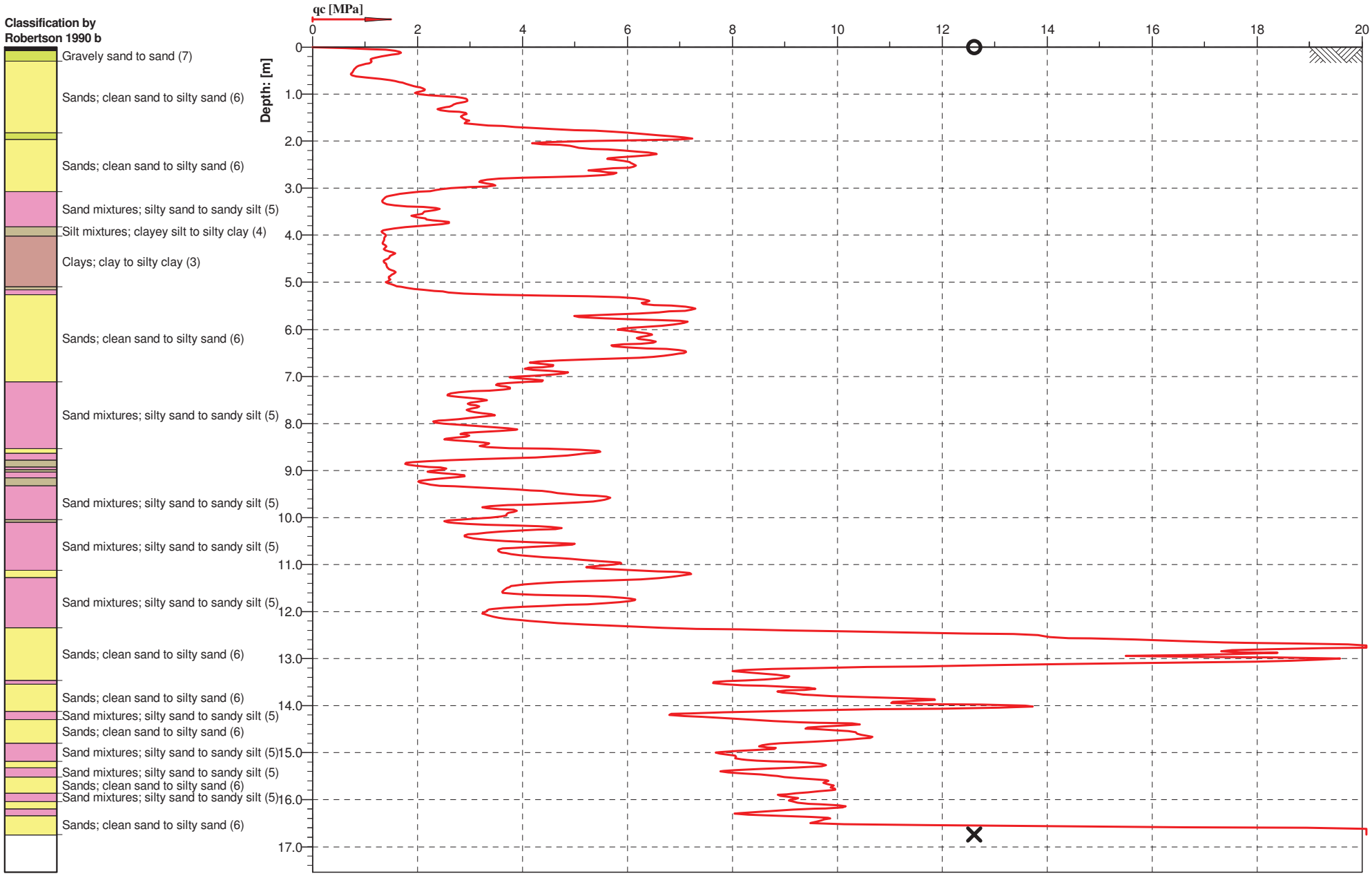


drillcore

u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

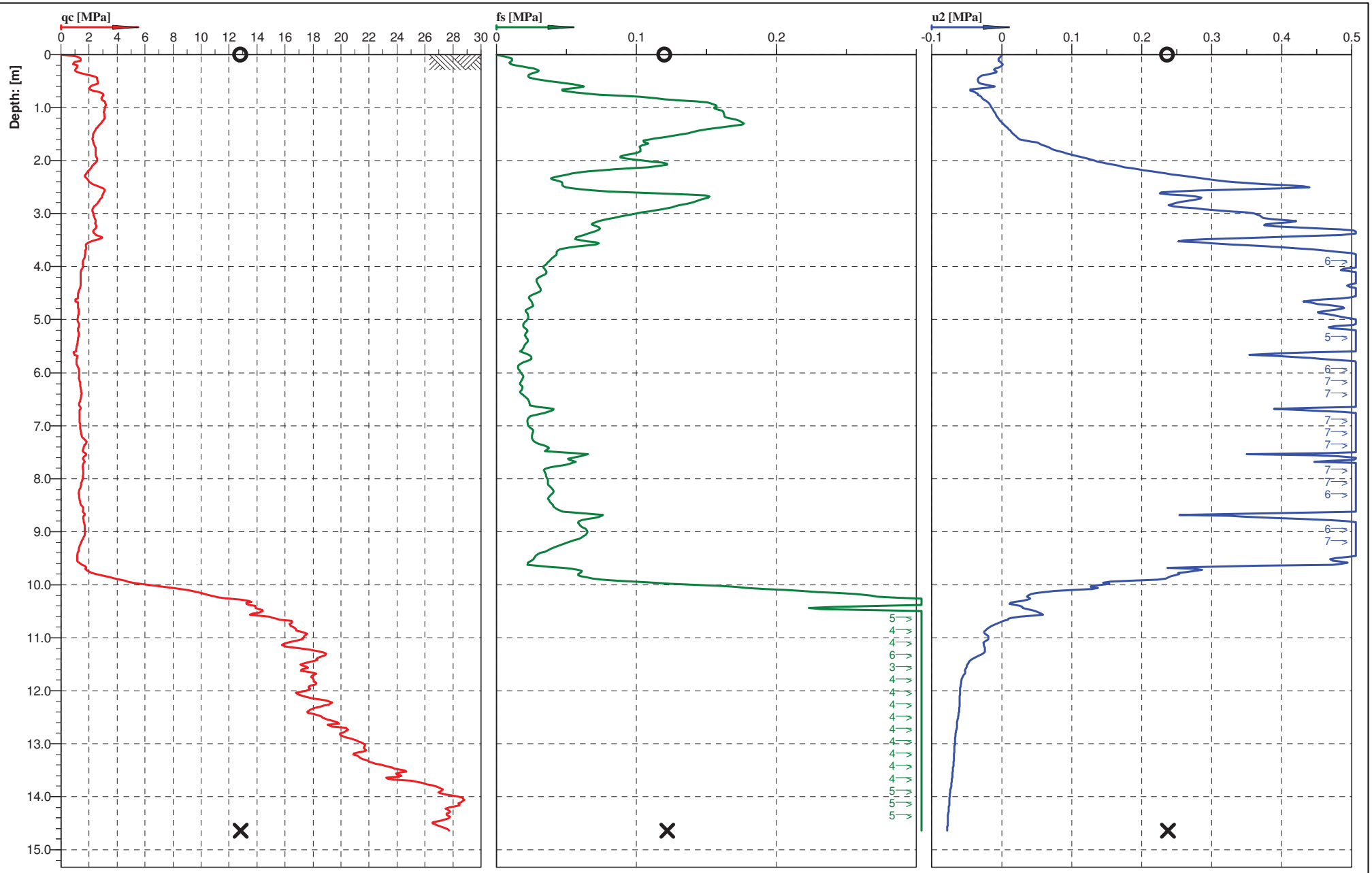
Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT112
Project ID: E1795295 N5815842	Client: Tonkin & Taylor	Date: 17/05/2021	Scale: 1 : 111
Project: 584 WHATAWHATA ROAD		Page: 1/2	Fig.:
Target depth 20m. Refused 16.74m. Hole dipped and collapsed back to 1.80m.		File: CPT112 .cpt	



Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT112
Project ID: E1795295 N5815842	Client: Tonkin & Taylor	Date: 17/05/2021	Scale: 1 : 111
Project: 584 WHATAWHATA ROAD		Page: 2/2	Fig.:
Target depth 20m. Refused 16.74m. Hole dipped and collapsed back to 1.80m.		File: CPT112 .cpt	

u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

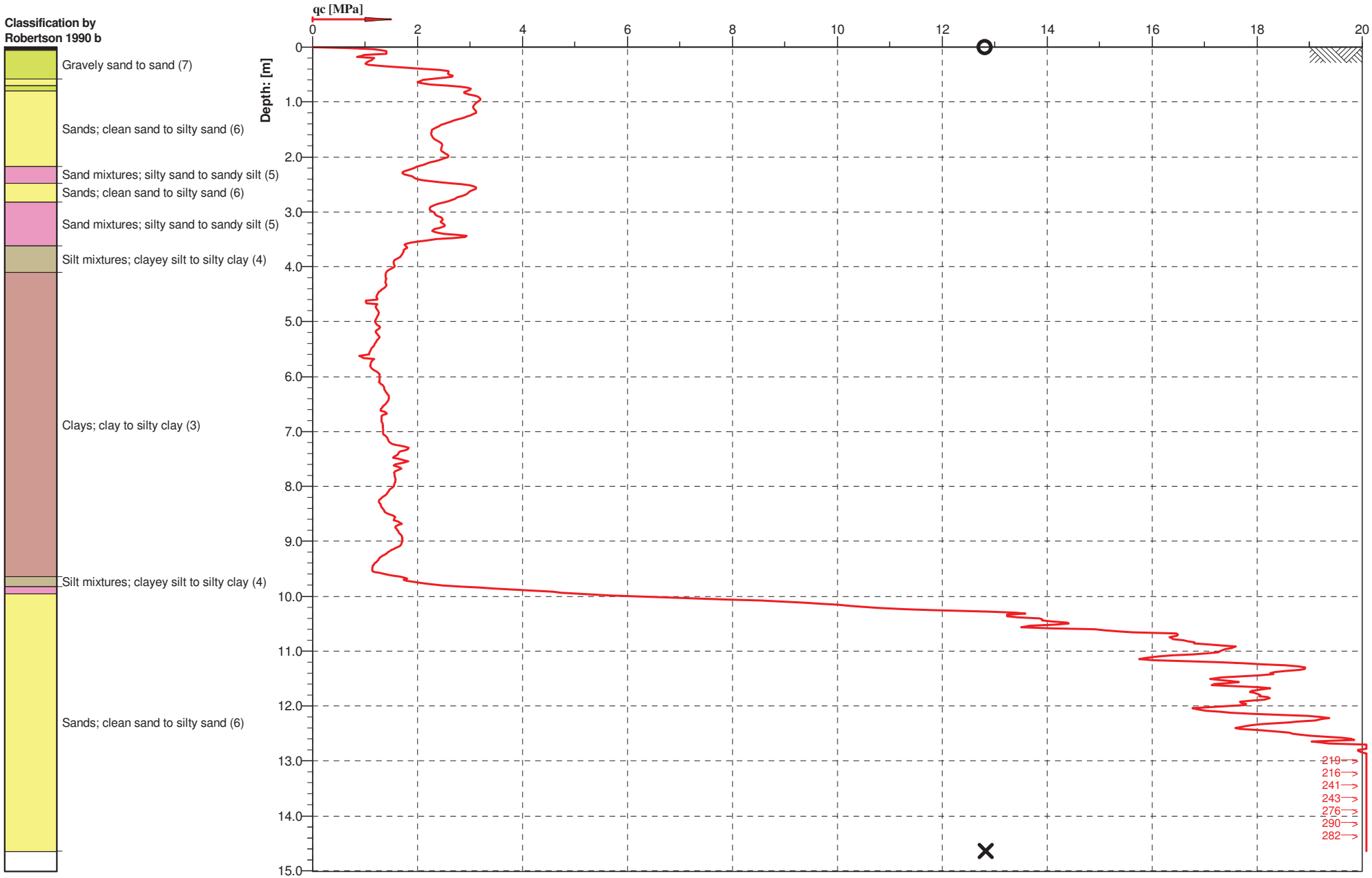


drillcore

u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

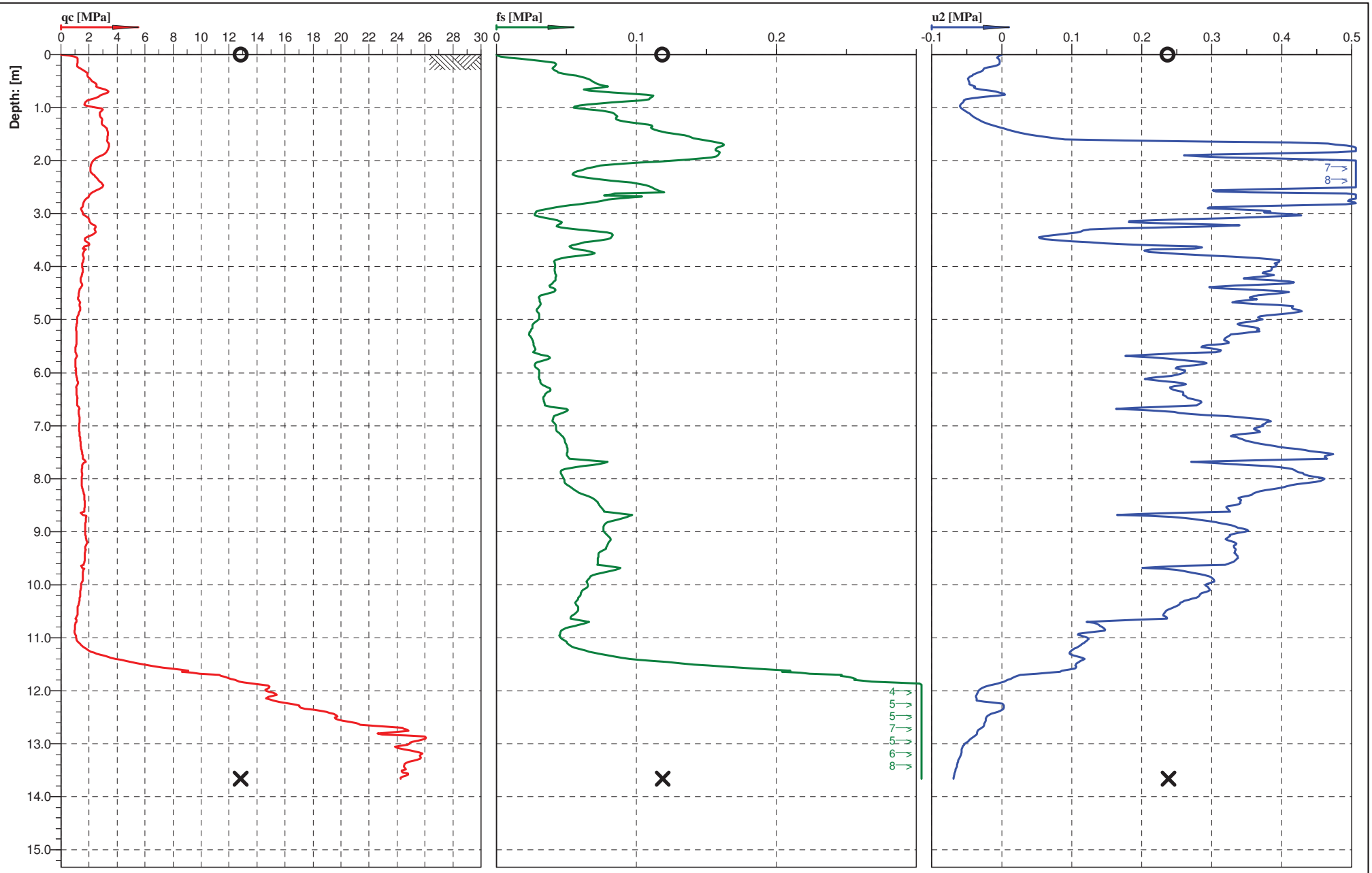
Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT113
Project ID: E1795326 N5816127	Client: Tonkin & Taylor	Date: 18/05/2021	Scale: 1 : 97
Project: 584 WHATAWHATA ROAD		Page: 1/2	Fig.:
Target depth 20m. Refused 14.64m. Hole dipped anc ollapsed back to 0.67m.		File: CPT113 .cpt	



u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT113
Project ID: E1795326 N5816127	Client: Tonkin & Taylor	Date: 18/05/2021	Scale: 1 : 95
Project: 584 WHATAWHATA ROAD		Page: 2/2	Fig.:
Target depth 20m. Refused 14.64m. Hole dipped anc ollapsed back to 0.67m.		File: CPT113 .cpt	

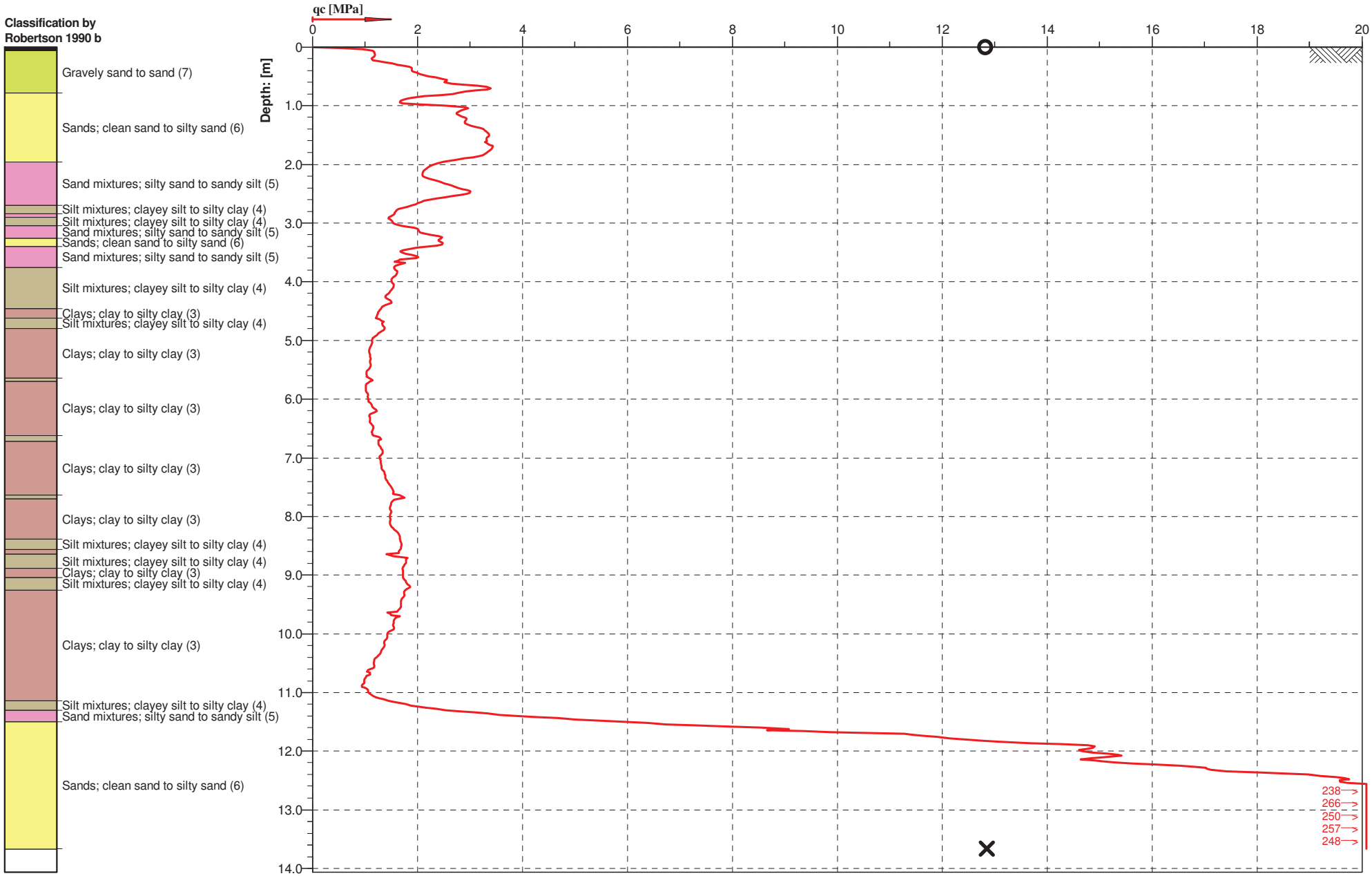


drillcore

u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT114
Project ID: E1795161 N5816165	Client: Tonkin & Taylor	Date: 18/05/2021	Scale: 1 : 97
Project: 584 WHATAWHATA ROAD		Page: 1/2	Fig.:
Target depth 20m. Refused 13.66m. Hole dipped and collapsed back to 2.4m.		File: CPT114 .cpt	



Location: Hamilton	Position: X: 0.00 m, Y: 0.00 m	Ground level: 0.00	Test No.: CPT114
Project ID: E1795161 N5816165	Client: Tonkin & Taylor	Date: 18/05/2021	Scale: 1 : 89
Project: 584 WHATAWHATA ROAD		Page: 2/2	Fig.:
Target depth 20m. Refused 13.66m. Hole dipped and collapsed back to 2.4m.		File: CPT114 .cpt	

u2

Cone No: 5465
Tip area [cm2]: 10
Sleeve area [cm2]: 150

EXCAVATION LOG

Excavation Id.: **TP101**

Hole Location: Southern foot hills

SHEET: 1 OF 1

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5814947.62 mN 1795230.76 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 28/05/2021
		EQUIPMENT: 8T Digger	EXCAV. FINISHED: 28/05/2021
R.L.:	28.14m	OPERATOR: Drillcore	LOGGED BY: CAND
DATUM:	NZVD2016	DIMENSIONS: 4.7m by 1.9m	CHECKED BY: RWOT

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3											10 25 50 100 200		
	No Support Required		78/39 kPa		28	0.5	TS	*0.00m:* SILT, some clay, minor organics and minor sand; dark brown. Firm, moist, low plasticity. Sand, fine; organics, rootlets. Topsoil.	M	F			Colluvium Deposits
								0.30m: Clayey SILT; brownish grey mottled orange. Stiff, moist, medium plasticity. *0.50 - 1.00m:* Brownish orange		St			
			56/36 kPa			1.0							
			50/33 kPa		27			*1.00m:* Clayey SILT, minor organics; grey. Firm to stiff, moist, low to medium plasticity. Organics, wood fragments		F-St			
			95/45 kPa			1.5		*1.50 - 1.70m:* Grades to stiff.		St			
								1.70m: Silty CLAY; brownish orange. Very stiff, moist, high plasticity.		VSt			
			178/56 kPa		26	2.0						2.10m: , Water seepage observed.	Walton Subgroup
						2.5							
								2.80m: Silty CLAY; light brown. Stiff, moist, high plasticity.		St			
			81/50 kPa		25	3.0		*3.20 - 3.80m:* Grades to light brown, mottled grey. Pumiceous.					
						3.5							
			111/42 kPa					*3.80m:* SILT, some clay, trace sand; greyish white. Very stiff, moist, low plasticity. Sand, fine to medium, pumiceous		VSt			
					24	4.0							
								4.3m: Machine limit				4.30m: , Water seepage observed	
						4.5							

SKETCH / PHOTO:

COMMENTS:

Hole Depth 4.3m

Scale 1:42

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP102**

Hole Location: Southern foot hills

SHEET: 1 OF 1

PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: (NZTM2000)	5815039.72 mN 1795167.56 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	28/05/2021
		EQUIPMENT:	8T Digger	EXCAV. FINISHED:	28/05/2021
R.L.:	28.14m	OPERATOR:	Drillcore	LOGGED BY:	CAND
DATUM:	NZVD2016	DIMENSIONS:	4.7m by 1.9m	CHECKED BY:	RWOT

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3											10 25 50 100 200		
	No Support Required		125/53 kPa		28	0.5	TS	*0.00m:* SILT, some clay, minor organics, trace sand; dark brown. Firm, moist, low plasticity. Sand, fine to medium; organics, roots greater than 2mm diameter. Topsoil.	M	F			Colluvium Deposits
								0.20m: Clayey SILT, minor organics; brownish grey mottled orange. Very stiff, moist, medium plasticity. Organics, roots greater than 2mm diameter.		VSt			
			109/39 kPa		27	1.0		*0.50 - 1.00m:* Brownish orange.					
			195/81 kPa			1.5		*1.30m:* Silty CLAY; brownish orange. Very stiff, moist, medium to high plasticity.					
			139/59 kPa		26	2.0		*1.90m:* SILT, some clay, minor organics; grey orange. Very stiff, moist, low plasticity. Organics, wood fragments.					
		◀	72/64 kPa			2.5		*2.50m:* Organic SILT, minor clay; grey mottled black. Stiff, moist, medium plasticity. Organics, wood fragments.		St		2.60m: , Water seepage observed.	
			66/36 kPa		25	3.0		*2.80m:* Silty CLAY; light brown mottled grey. Stiff, moist, medium to high plasticity.					Walton Subgroup
			53/31 kPa			3.5		*3.60 - 4.10m:* Grades to brownish orange.					
						4.0		*3.90 - 4.10m:* Reddish orange mottling.					
			75/42 kPa		24			*4.10m:* SILT, some clay, trace sand; greyish white mottled orange. Stiff, moist, low plasticity. Sand, fine to medium, pumiceous.					
						4.5		4.4m: Machine limit					

SKETCH / PHOTO:

COMMENTS:

Hole Depth 4.4m

Scale 1:42

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP103**

Hole Location: Central low lying lands

SHEET: 1 OF 1

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5815393.95 mN 1795147.06 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 28/05/2021
		EQUIPMENT: 8T Digger	EXCAV. FINISHED: 28/05/2021
R.L.:	23.24m	OPERATOR: Drillcore	LOGGED BY: CAND
DATUM:	NZVD2016	DIMENSIONS: 4m by 1.9m	CHECKED BY: RWOT

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3												10 25 50 100 200		
	No Support Required		33/28 kPa		23	0.5	TS	*0.00m:* Sandy SILT, minor organics; dark brown. Firm, moist, dilatant - slow. Sand, fine to medium; organics, rootlets.	M		F			
									S		S-F			
						1.0		*0.20m:* PEAT (FIBROUS AND AMORPHOUS), minor silt; brownish black. Soft to firm, saturated. Spongy. Tree branches up to 200mm in diameter.					1.00m: , Water seepage observed.	
					22	1.5								
			28/05/2021										1.70m: , Water seepage observed.	
					21	2.0								
						2.5		*2.50m:* SILT, some clay, minor organics; light grey. Very soft, wet, low plasticity. Organics, rootlets.	W		VS			
			86/31 kPa			3.0		*3.10m:* Becomes stiff.			St		2.80m: , Relatively rapid water seepage observed.	
					20									
						3.5		3.4m: Machine limit						
					19	4.0								
						4.5								

SKETCH / PHOTO:

COMMENTS: Hole in danger of collapse. Excess water ponding at the base.

Hole Depth 3.4m

Scale 1:42

Rev.: A

EXCAVATION LOG

Tonkin+Taylor

Excavation Id.: **TP104**

Hole Location: Northern foot hills

SHEET: 1 OF 1

PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: (NZTM2000)	5815738.07 mN 1795075.30 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	28/05/2021
		EQUIPMENT:	8T Digger	EXCAV. FINISHED:	28/05/2021
R.L.:	25.24m	OPERATOR:	Drillcore	LOGGED BY:	CAND
DATUM:	NZVD2016	DIMENSIONS:	4.7m by 1.9m	CHECKED BY:	RWOT

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3											10 25 50 100 200		
	No Support Required		67/45 kPa		25	0.5	TS	*0.00m:* SILT, some clay, minor sand; dark brown. Firm, moist, low plasticity. Sand, fine. Topsoil.	M	F			
								0.30m: Silty CLAY; light brown mottled orange. Stiff, moist, medium to high plasticity.		St			
			106/28 kPa		24	1.0		*1.20m:* Becomes very stiff.		St-VSt			Colluvium Deposits
						1.5		*1.70m:* Sandy SILT; light greenish grey. Loosely packed, wet, dilatant - rapid. Sand, fine to coarse, pumiceous. Interbedded clay lenses up 100mm .	W	L			
			137/53 kPa		23	2.0		*2.10m:* Silty CLAY; light grey. Very stiff, wet, medium plasticity.		VSt			
						2.5		*2.60m:* Sandy SILT; light greenish grey. Loosely packed, wet, dilatant - rapid. Sand, fine to coarse, pumiceous. Interbedded clay lenses up 100mm .		L			Piako Subgroup
		28/05/2021			22	3.0							
						3.5		3.5m: Target depth					
					21	4.0							
						4.5							

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3.5m

Scale 1:42

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP105**

Hole Location: Central low lying lands

SHEET: 1 OF 1

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5815685.10 mN 1795337.69 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 28/05/2021
		EQUIPMENT: 8T Digger	EXCAV. FINISHED: 28/05/2021
R.L.:	25.84m	OPERATOR: Drillcore	LOGGED BY: CAND
DATUM:	NZVD2016	DIMENSIONS: 4m by 1.9m	CHECKED BY: RWOT

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3	No Support Required	28/05/21	31/25 kPa		25	0.5	TS	*0.00m:* Sandy SILT, some clay, minor organics; dark brown. Firm, moist, low plasticity. Sand, fine; organics, rootlets. Topsoil.	M	F	10 25 50 100 200		
						0.5		*0.40m:* PEAT (FIBROUS AND AMORPHOUS); dark brownish black. Soft to firm, wet. Tree Branches up to 300mm in diameter.	W	S-F		0.80m: , Rapid water seepage observed 1.10m: , Rapid water seepage observed.	Piako Subgroup
						1.0							
			53/28 kPa			1.5		*1.60m:* SILT, some sand, minor organics; light grey. Loosely packed, saturated, dilatant - rapid. Sand, fine to medium; organics, rootlets.	S	L			
					24	2.0		1.8m: Other - see notes					
						2.5							
					23	3.0							
						3.5							
					22	4.0							
						4.5							
					21								

SKETCH / PHOTO:

COMMENTS: Target stratum reached. Excess water ponding at the base of hole.

Hole Depth 1.8m

Scale 1:42

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP106**

Hole Location: Central eastern low lying lands

SHEET: 1 OF 1

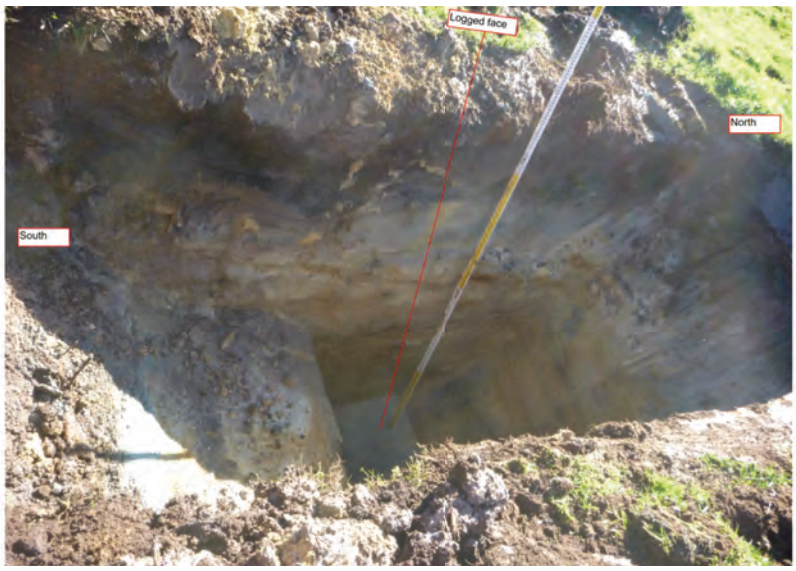
PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: (NZTM2000)	5815694.55 mN 1795552.22 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	01/06/2021
		EQUIPMENT:	8T Digger	EXCAV. FINISHED:	01/06/2021
R.L.:	27.24m	OPERATOR:	Drillcore	LOGGED BY:	CAND
DATUM:	NZVD2016	DIMENSIONS:	4.5m by 1.9m	CHECKED BY:	RWOT

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION \ WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3											10 25 50 100 200		
	No Support Required	01/06/2021	● 31/25 kPa		27	0.5	TS	*0.00m:* SILT, some clay, minor organics. Firm, moist, low plasticity. Organics, rootlets. Topsoil.	M	F			Piako Subgroup
								0.40m: PEAT (FIBROUS AND AMORPHOUS); dark brown. Soft to firm, wet. Organics, wood fragments. Tree branches up to 300mm diameter.	W	S-F		0.50m: , Visual assessment of PEAT indicated soft to firm.	
					26	1.0		*0.80m:* Sandy SILT, trace organics; light greenish grey. Loosely packed, wet, dilatant - rapid. Organics, rootlets.		L		0.80m: , Water seepage observed.	
						1.5		*1.70m:* Minor gravelly, fine.					
					25	2.0		*1.80m:* Gravelly fine to coarse SAND, minor silt; light brown mottled orange. Loosely packed, wet. Sand, pumiceous; gravel, fine to coarse, sub-rounded to sub-angular.					
						2.5		*2.50m:* Sandy SILT; light brown mottled orange. Loosely packed, wet, dilatant - rapid. Sand, fine to coarse. Interbedded silt lenses. Pumiceous.					
		01/06/2021 ▼			24	3.0							
						3.5		3.5m: Target depth					
					23	4.0							
						4.5							

SKETCH / PHOTO:



COMMENTS:

Hole Depth 3.5m

Scale 1:42

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP107**

Hole Location: Eastern low lying lands

SHEET: 1 OF 1

PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: (NZTM2000)	5815568.47 mN 1795891.13 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	01/06/2021
		EQUIPMENT:	8T Digger	EXCAV. FINISHED:	01/06/2021
R.L.:	26.64m	OPERATOR:	Drillcore	LOGGED BY:	CAND
DATUM:	NZVD2016	DIMENSIONS:	4.7m by 2m	CHECKED BY:	RWOT

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3	No Support Required	01/06/2021	● 41/28 kPa		26 25 24 23 22	0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5	TS	*0.00m:* SILT, some clay, minor organics; dark brown. Firm, moist, low plasticity. Organics, rootlets. Topsoil.	M	F	10 25 50 100 200		
								0.30m: PEAT (FIBROUS AND AMORPHOUS); dark brown. Soft to firm, wet. Organics, wood fragments. Tree branches up to 200mm observed.	W	S-F		0.60m: , Visual assessment of PEAT indicated soft to firm.	
								1.20m: Sandy SILT, minor organics; light greenish grey. Loosely packed, wet, dilatant - rapid. Sand, fine to medium; organics, rootlets. Tree branches up to 200mm in diameter..		L		1.20m: , Water seepage observed.	
								1.70m: Silty fine to medium SAND; light greenish grey. Loosely packed, wet. Sand, well graded. Interbedded silt lenses.				1.70m: , Water seepage observed.	Piako Subgroup
								2.40m: Colour grades to greenish grey. Sand grades to fine to coarse. Minor gravel, fine. Pumiceous.					
								3m: Target depth					

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3m

Scale 1:42

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP108**

Hole Location: Eastern low lying lands

SHEET: 1 OF 1

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5815403.99 mN 1796130.68 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 01/06/2021
		EQUIPMENT: 8T Digger	EXCAV. FINISHED: 01/06/2021
R.L.:	26.99m	OPERATOR: Drillcore	LOGGED BY: CAND
DATUM:	NZVD2016	DIMENSIONS: 4.7m by 2m	CHECKED BY: RWOT

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3	No Support Required	01/06/2021	28/19 kPa 72/16 kPa 125/34 kPa 97/44 kPa		26 25 24 23	0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5	TS	*0.00m:* SILT, some clay, minor organics; dark brown. Firm, moist, low plasticity. Organics, rootlets. Topsoil.	M	F	10 25 50 100 200		
								0.30m: PEAT (FIBROUS AND AMORPHOUS); dark greyish black. Soft, wet. Organics, wood fragments. Spongy, tree branches up to 300mm diameter.	W	S		0.70m: , Water seepage observed.	
								1.10m: Silty CLAY, minor organics; light greenish grey. Stiff, wet, medium to high plasticity. Organics, rootlets.		St			
								1.80 - 2.30m: Grades to very stiff.		VSt			
								2.30m: Tree branches up to 50mm diameter observed.					
								2.80m: Sandy SILT, minor gravel; light greenish grey, bedded. Loosely packed, wet, dilatant - rapid. Sand, fine to coarse, well graded; gravel, fine, sub-rounded to sub-angular, pumiceous.		L			
								3.30m: Gravel becomes trace gravel.		L			
												4.00m: , Ponding water observed.	
								4.3m: Target depth					

SKETCH / PHOTO:

COMMENTS:

Hole Depth
4.3m

Scale 1:42

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP109**

Hole Location: Northern foot hillls

SHEET: 1 OF 1

PROJECT: Brymer Farms Subdivision | LOCATION: 584 Whatawhata Rd, Temple View | JOB No.: 1017355.0000

CO-ORDINATES: (NZTM2000)	5815735.93 mN 1795395.12 mE	EXPOSURE METHOD:	TP	EXCAV. STARTED:	01/06/2021
		EQUIPMENT:	8T Digger	EXCAV. FINISHED:	01/06/2021
R.L.:	26.99m	OPERATOR:	Drillcore	LOGGED BY:	CAND
DATUM:	NZVD2016	DIMENSIONS:	4.7m by 1.9m	CHECKED BY:	RWOT

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3											10 25 50 100 200		
	No Support Required		53/41 kPa			0.5	TS	*0.00m:* SILT, some clay; dark brown. Firm, moist, low plasticity.	M	F-St			Colluvium Deposits
								0.20m: Clayey SILT, minor organics; dark brown. Stiff, moist, medium plasticity. Organics, wood fragments. Rootlets. Light brown sand lense up to 100mm.		St			
			34/19 kPa		26	1.0		*0.70m:* SILT, some clay, trace organics; light brown mottled orange. Firm, wet, low plasticity. Organics, rootlets. Rootlets, light brown sand lense up to 100mm.	W	F			
			47/34 kPa			1.5		*1.10m:* SILT, some clay, trace organics; light greenish grey. Firm, wet, low plasticity. Organics, rootlets.					
			82/41 kPa		25	2.0		*1.70m:* Silty CLAY; light greenish grey mottled orange. Stiff, wet, medium to high plasticity. Silt, non dilatant. *2.00m:* Trace sand, fine to coarse.		St		2.00m: , Water seepage observed.	
						2.5		*2.30m:* Sandy SILT; greenish grey. Loosely packed, wet, dilatant - rapid. Sand, fine to coarse. *2.70m:* Colour changes to brown. Interbedded silt layers.		L		2.80m: , Water seepage observed.	Piako Subgroup
					24	3.0						3.20m: , Water seepage observed.	
						3.5		3.3m: Target depth					
					23	4.0							
						4.5							

SKETCH / PHOTO:

COMMENTS:

Hole Depth 3.3m

Scale 1:42

Rev.: A

EXCAVATION LOG

Excavation Id.: **TP110**

Hole Location: Northern foot hillls

SHEET: 1 OF 1

PROJECT: Brymer Farms Subdivision		LOCATION: 584 Whatawhata Rd, Temple View	JOB No.: 1017355.0000
CO-ORDINATES: (NZTM2000)	5815779.66 mN 1795287.86 mE	EXPOSURE METHOD: TP	EXCAV. STARTED: 01/06/2021
		EQUIPMENT: 8T Digger	EXCAV. FINISHED: 01/06/2021
R.L.:	27.74m	OPERATOR: Drillcore	LOGGED BY: CAND
DATUM:	NZVD2016	DIMENSIONS: 4.8m by 1.9m	CHECKED BY: RWOT

EXCAVATION TESTS | ENGINEERING DESCRIPTION | GEOLOGICAL

PENETRATION	SUPPORT	WATER	SAMPLES, TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE \ WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	ESTIMATED SHEAR STRENGTH (kPa)	DEFECTS, STRUCTURE, COMMENTS	UNIT
-1 -2 -3											10 25 50 100 200		
	No Support Required		● 94/38 kPa		27	0.5	TS	*0.00m:* SILT, some clay, minor organics; dark brown. Firm, moist, low plasticity. Organics, rootlets.	M	F			Colluvium Deposits
			● 113/44 kPa					*0.30m:* Silty CLAY, minor organics; light grey mottled orange. Stiff, moist, medium plasticity. Organics, wood fragments. Tree branches up to 50mm in diameter.		St			
			● 213/44 kPa			1.0		*0.70 - 0.90m:* Becomes brownish orange, very stiff.		VSt			
			● 169/32 kPa					*0.90m:* SILT, some clay, minor organics; grey mottled brown. Very stiff to hard, moist, low plasticity. Organics, wood fragments.		VSt-H			
						1.5		*1.40m:* Grades to very stiff.		VSt			
					26			*1.50m:* Sandy SILT; light greenish grey mottled brown. Loosely packed, wet, dilatant - rapid. Sand, fine to coarse, well graded.	W	L			Piako Subgroup
						2.0		*2.00m:* Colour changes to light brown mottled orange. Interbedded silt lenses.					
						2.5						2.50m: , Water seepage observed.	
					25	3.0		*3.10 - 3.60m:* Colour changes to brown.				3.10m: , Water seepage observed.	
		01/06/2021				3.5							
					24			3.8m: Target depth					
						4.0							
						4.5							
					23								

SKETCH / PHOTO:

COMMENTS:

Hole Depth
3.8m

Scale 1:42

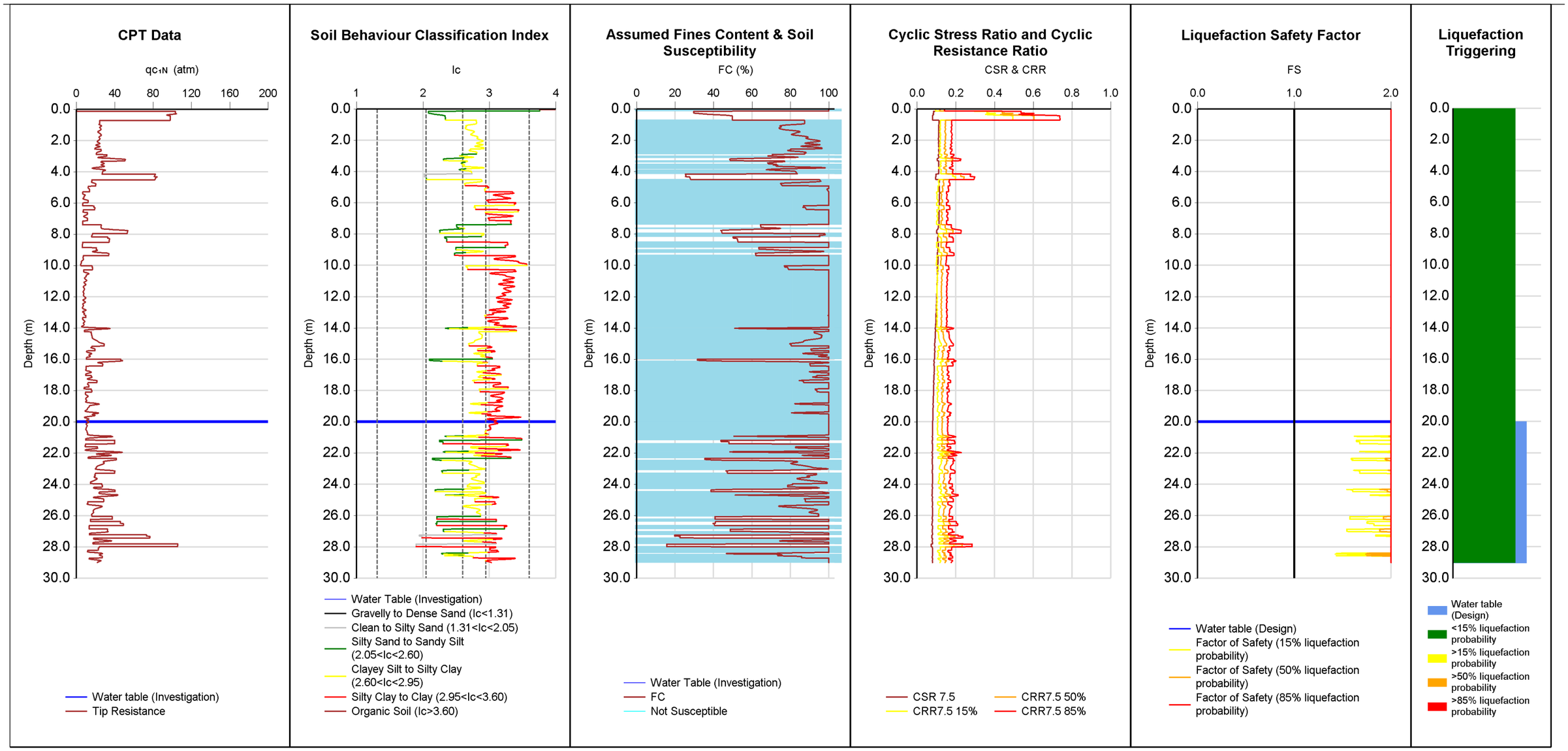
Rev.: A

Appendix C: Groundwater Summary

	Investigation ID	Investigation RL (Moturiki 1953)	Measured GWL (m bgl)	Measured GWL (m RL)
Low lying Landforms	CPT102	27.25	Collapsed 0.35	-
	CPT103	24	Artesian	-
	CPT104	24.5	Artesian	-
	CPT105	25.5	0.7	24.8
	CPT106	26	0.45	25.55
	CPT107	27.5	0.5	27
	CPT108	27	0.54	26.46
	CPT109	27	0	27
	CPT110	25	0.48	24.52
	CPT111	25.5	Collapsed 12.8	-
	BH102	27.25	Artesian	-
	BH103	31	Artesian	-
Elevated Landforms	BH101	45.5	15.01	30.49
	CPT101	50.5	Collapsed 0.25	-
	CPT112	36.5	Collapsed 1.8	-
	CPT113	57.8	Collapsed 0.67	-
	CPT114	56.5	Collapsed 2.4	

Appendix D: Analysis Results

- **Liquefaction assessment**
- **Static settlement predictions**



Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT101	178990	17/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	3	0	0	0	29	0
	50%	0	0	0	0	29	0
	85%	0	0	0	0	29	0

Reviewed by:

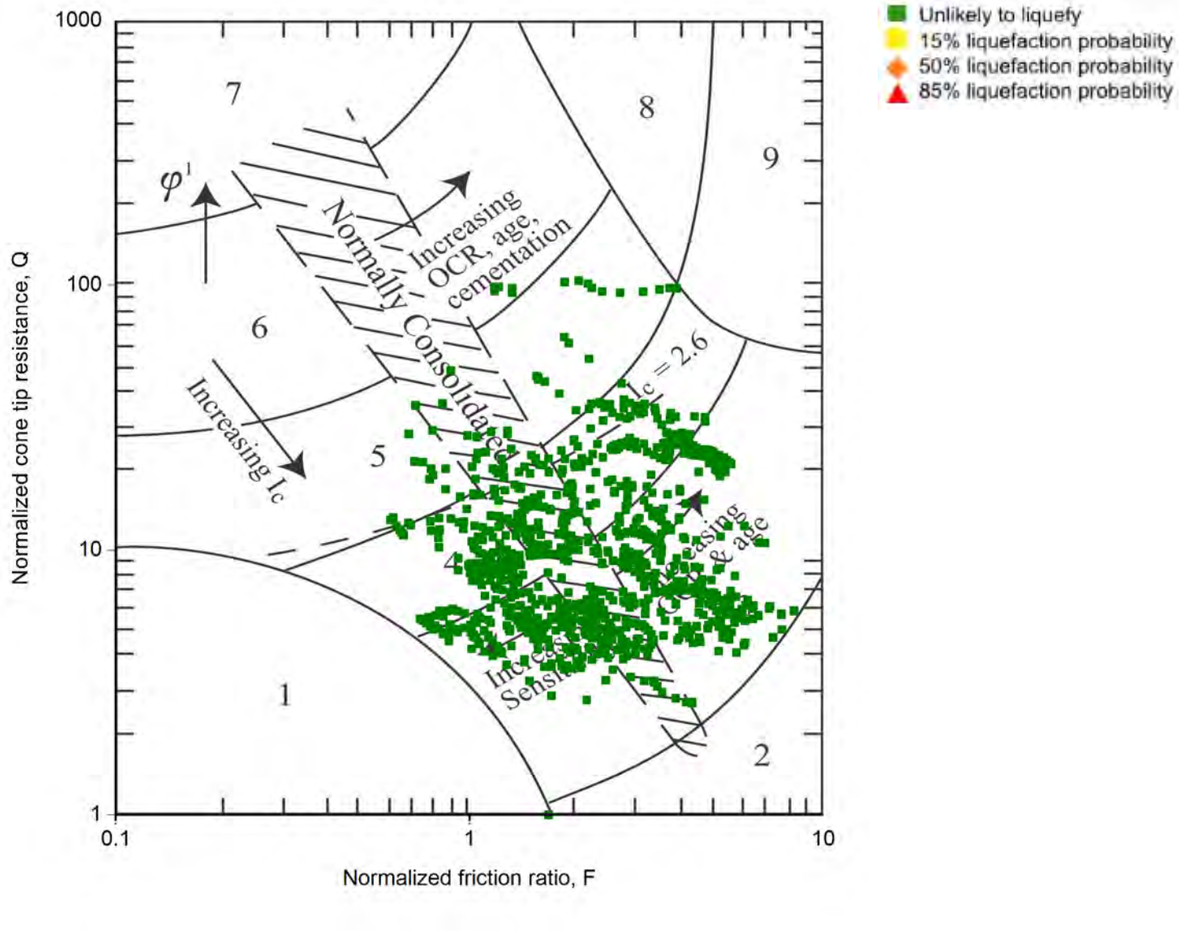
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc

Tonkin + Taylor

Exceptional thinking together

V2.4.15

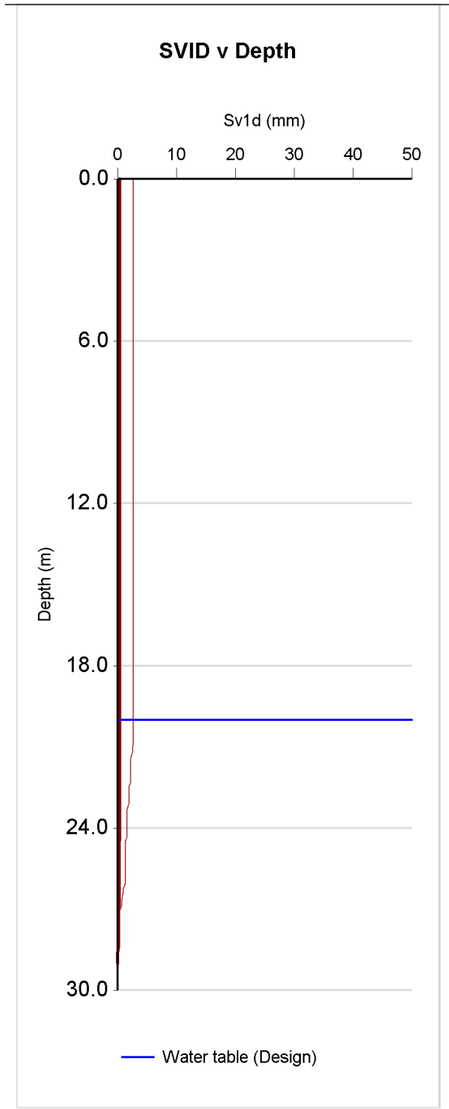
CLIENT	**Brymer Farms Ltd**	LOCATION	Hamilton
PROJECT	**Brymer Farms Subdivision**	DATE	24/06/2021
TITLE	**Liquefaction Analyses**	ANALYSED	cand
COMMENT	1 in 500 Year Event - ULS IL2	JOB NUMBER	**1017355.0000**
		PAGE	1 of 47 pages

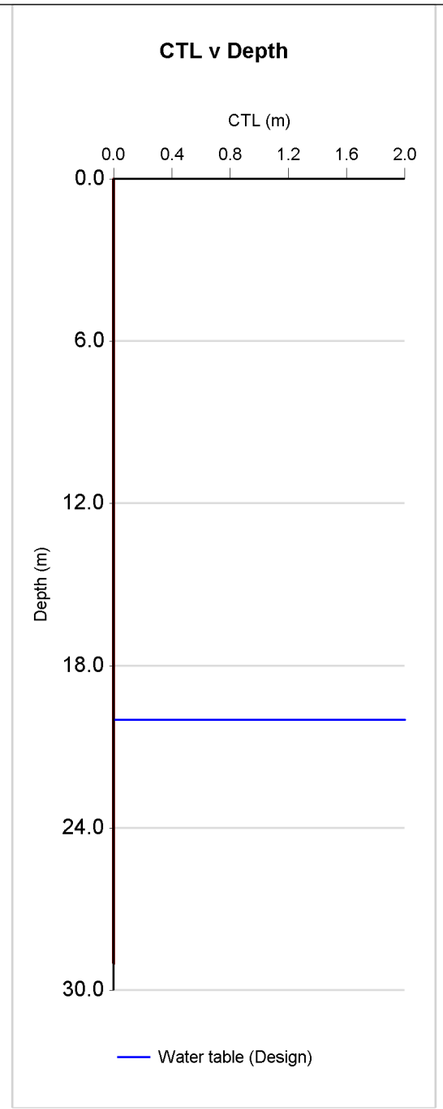


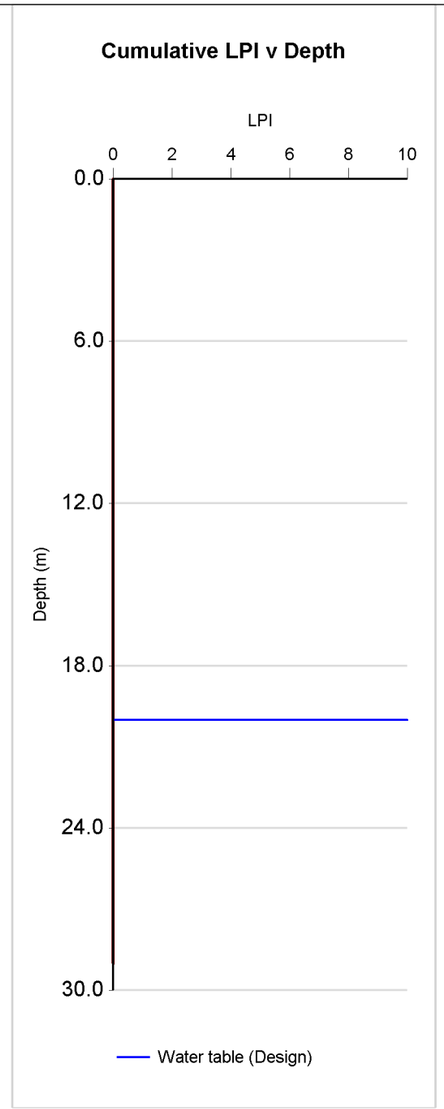
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

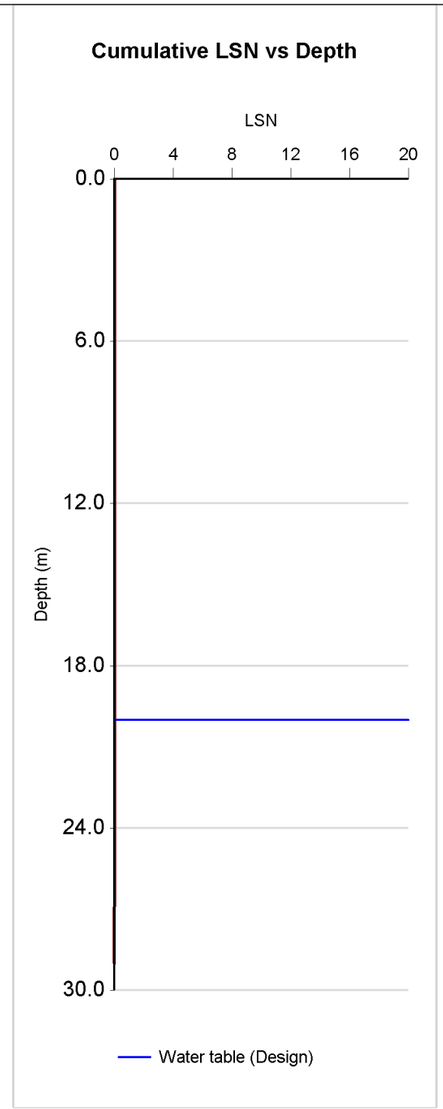
*Heavily overconsolidated or cemented

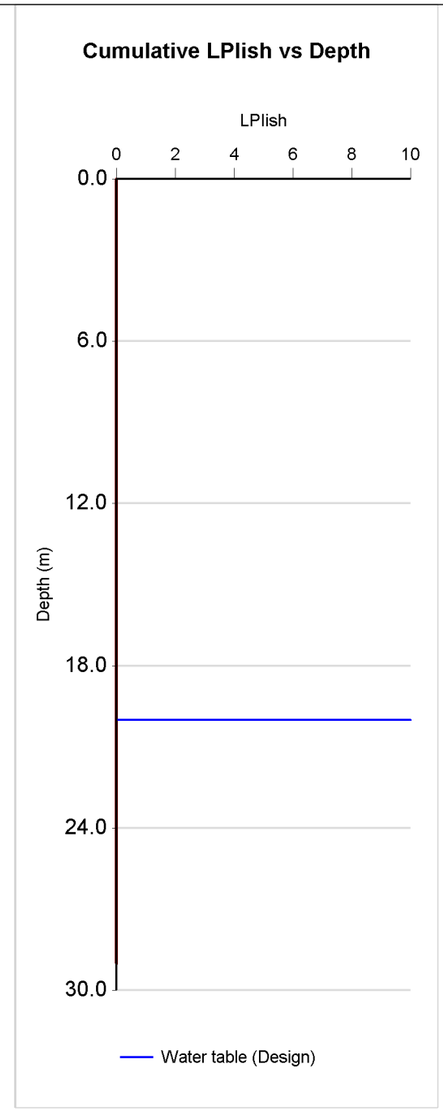
CPT-based soil behavior type classification chart by Robertson (1990)



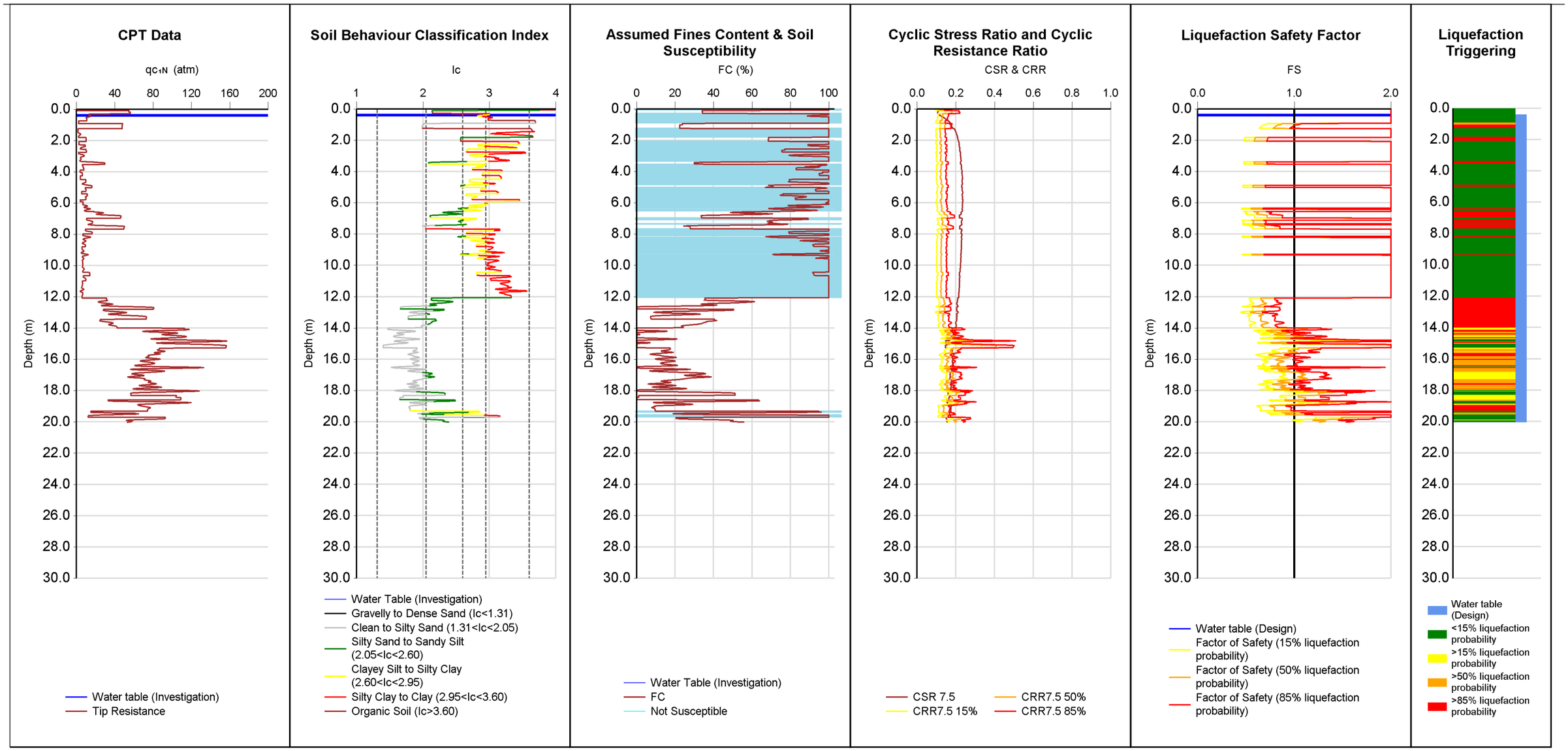








	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT101	178990	17/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	



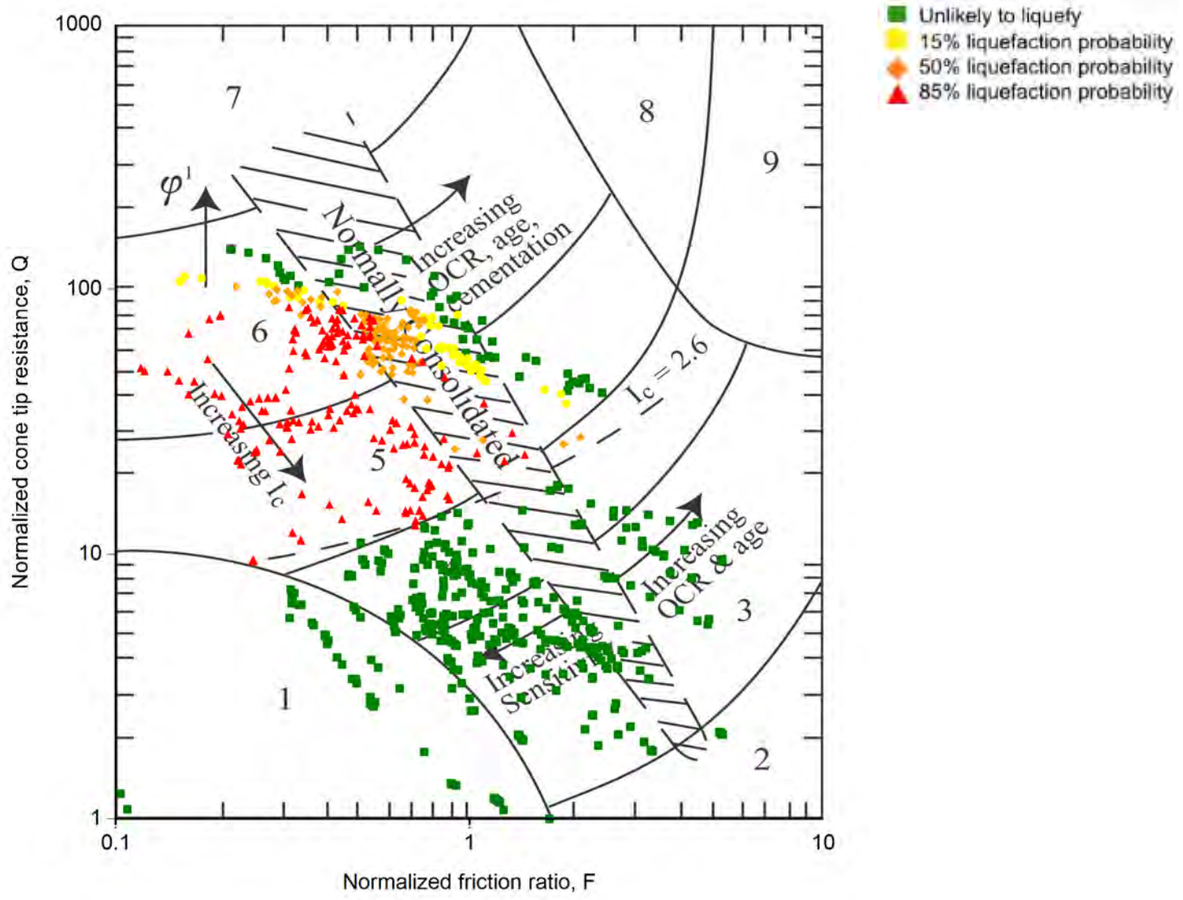
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT102	178991	17/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	221	8.5	12	31	1	11
	50%	192	7.1	8	28	1	7
	85%	143	4.9	4	21	1.1	3

Reviewed by:

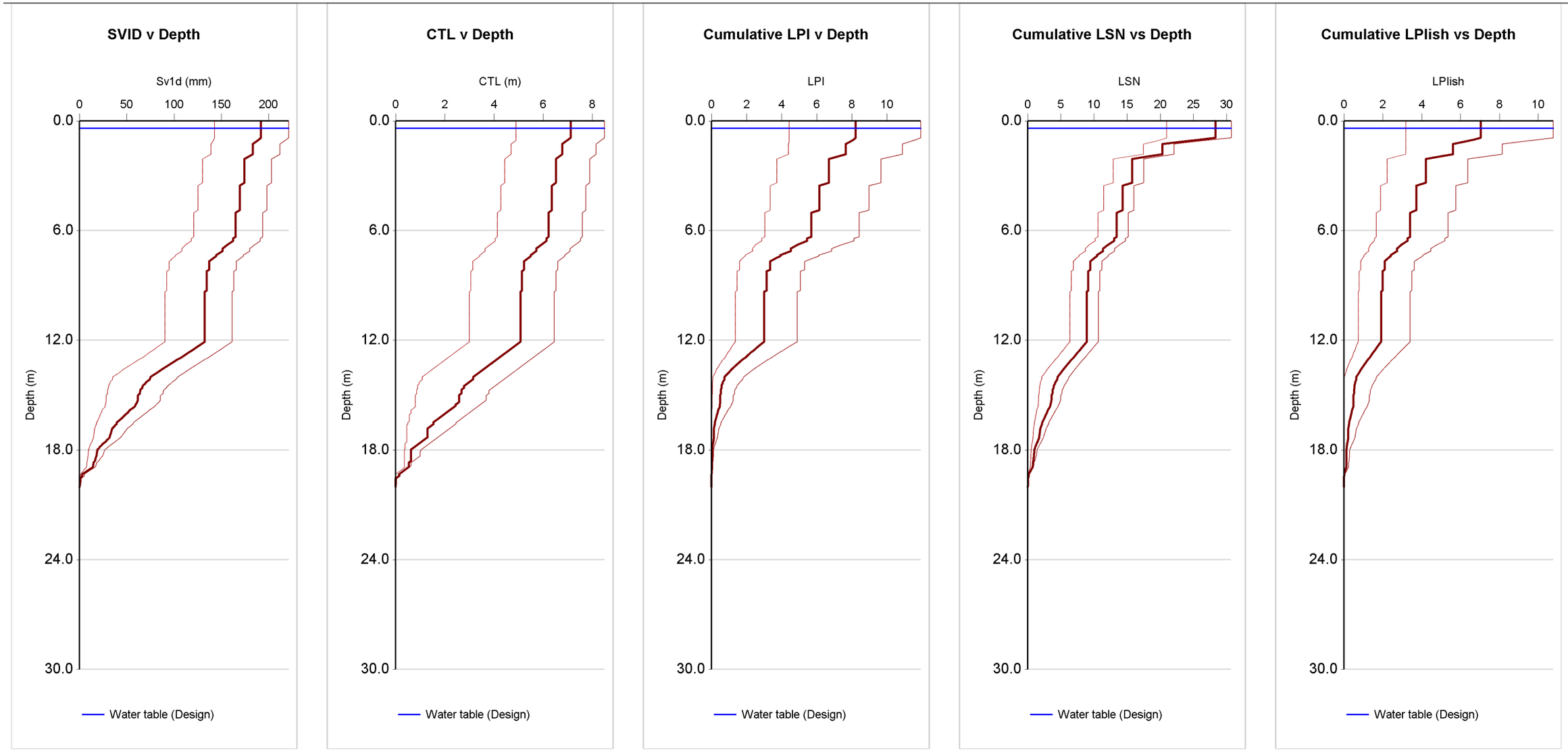
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



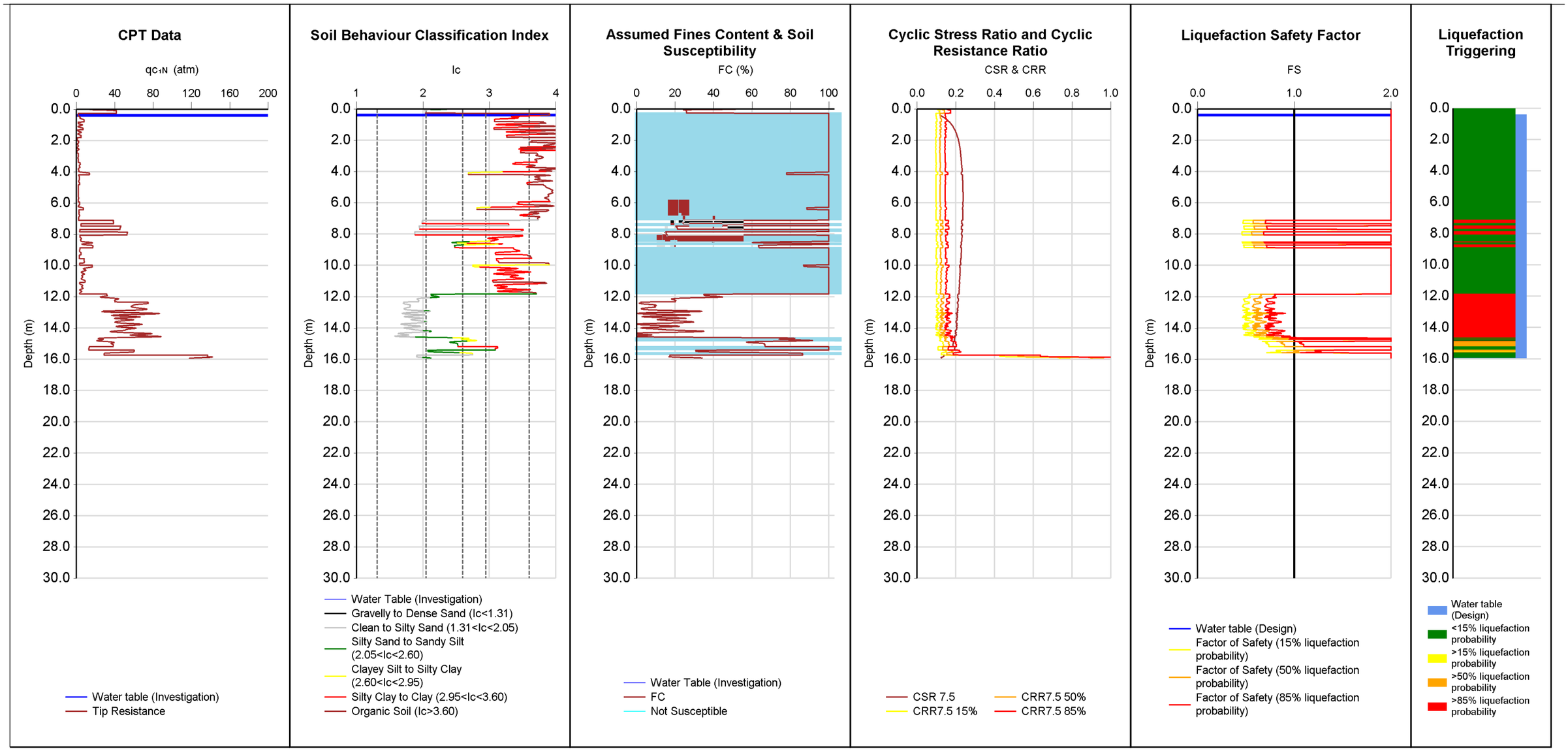
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT102	178991	17/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	



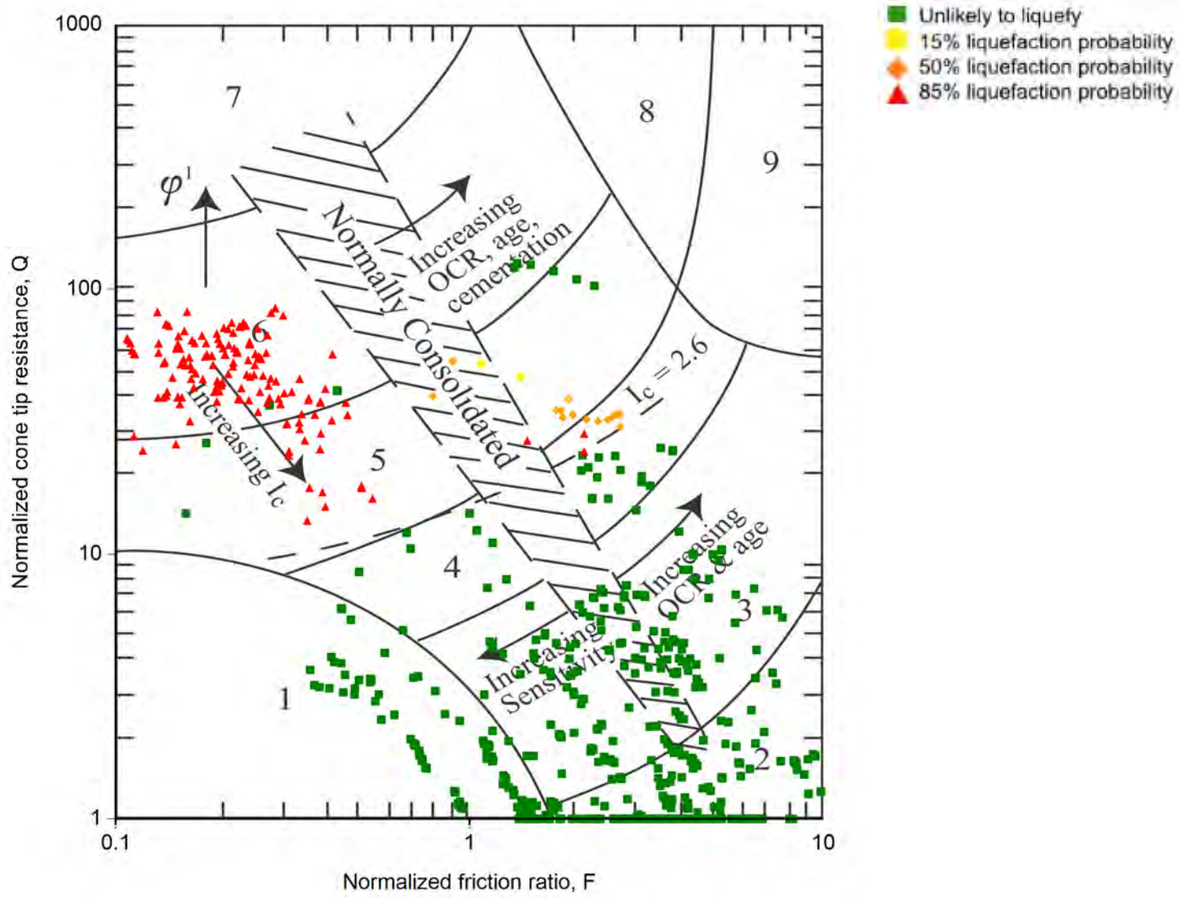
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT103	178992	17/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	130	4.2	8	11	7.2	0
	50%	126	4.2	6	11	7.2	0
	85%	118	3.7	4	10	7.2	0

Reviewed by:

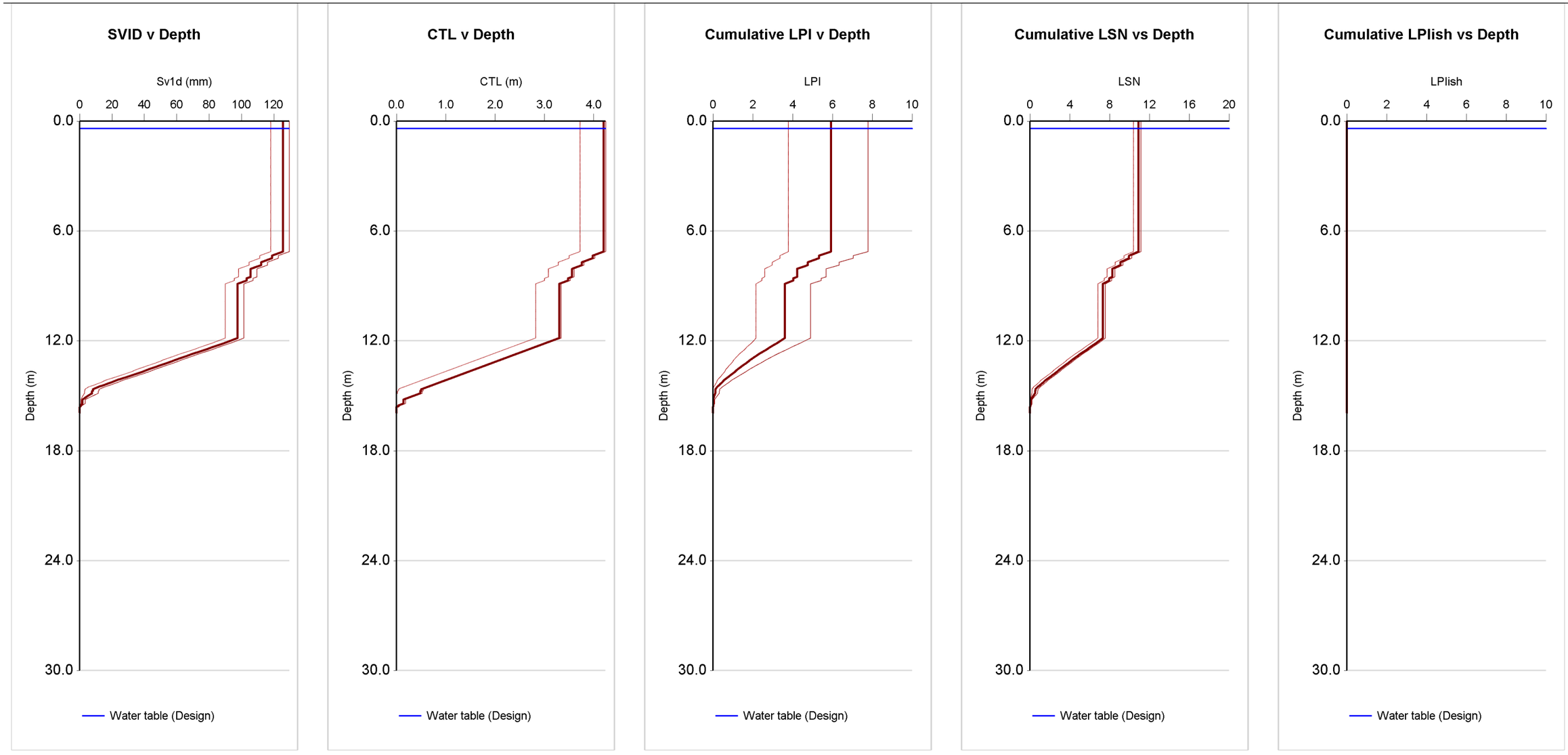
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



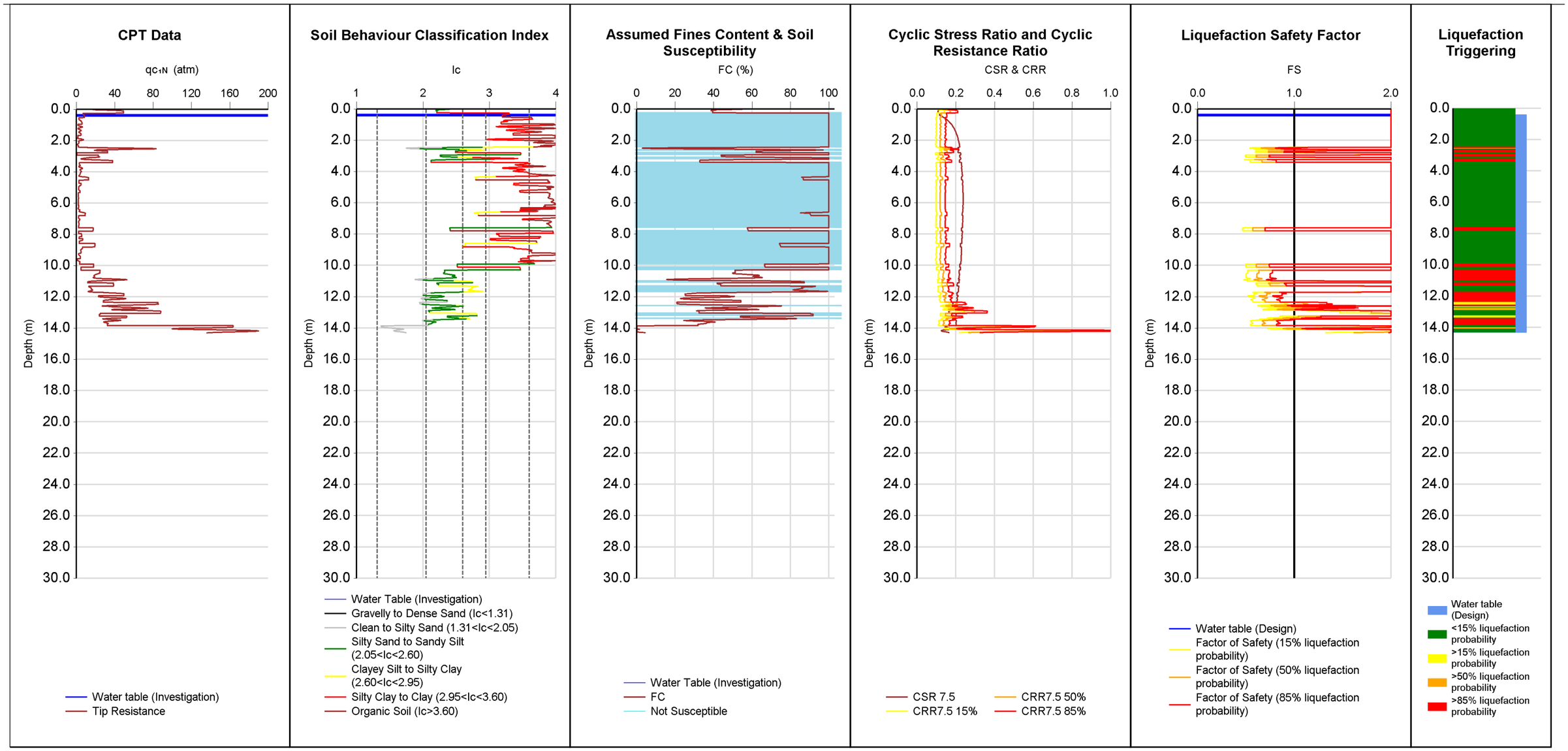
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT103	178992	17/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	



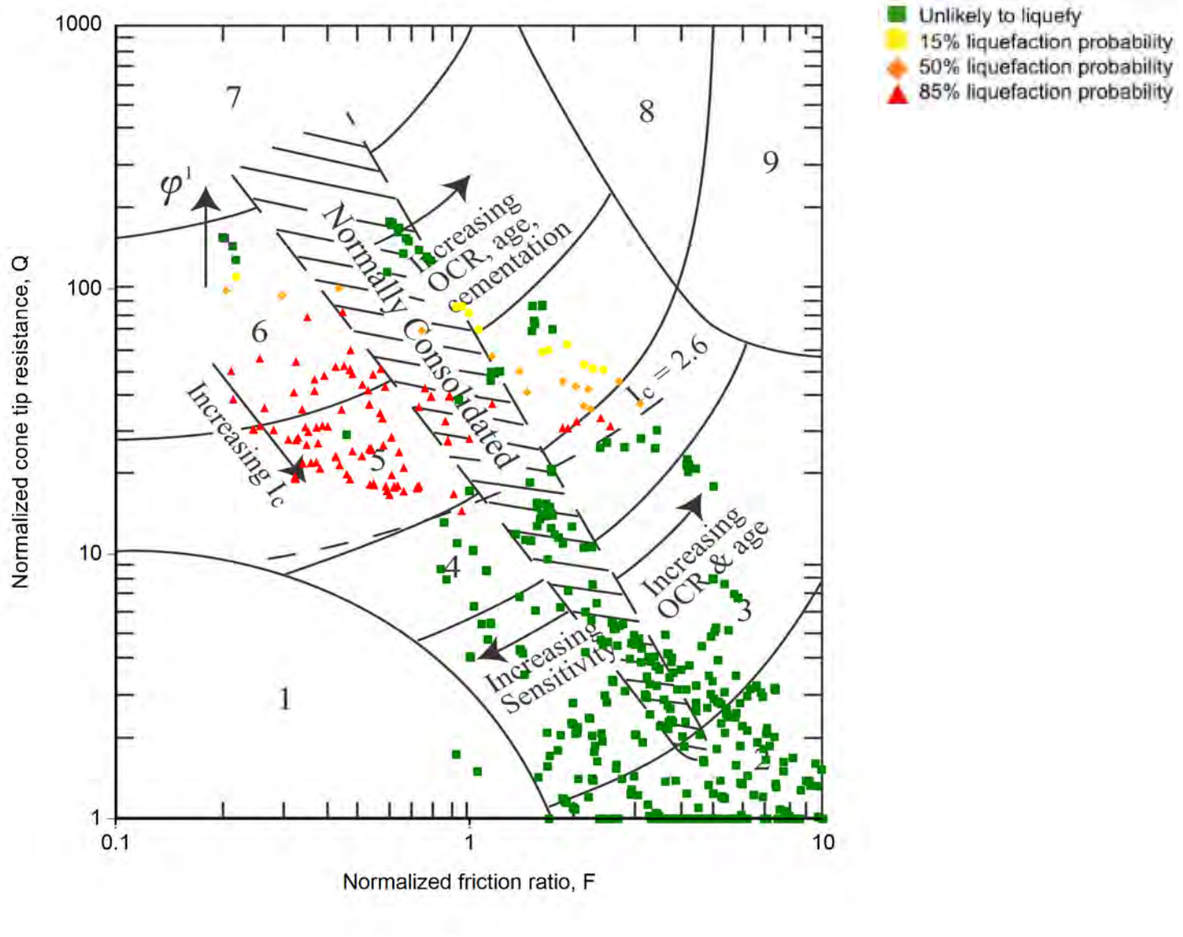
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT104	178993	17/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	97	3.6	8	13	2.5	5
	50%	92	3.3	5	12	2.5	4
	85%	81	3	3	11	2.6	2

Reviewed by:

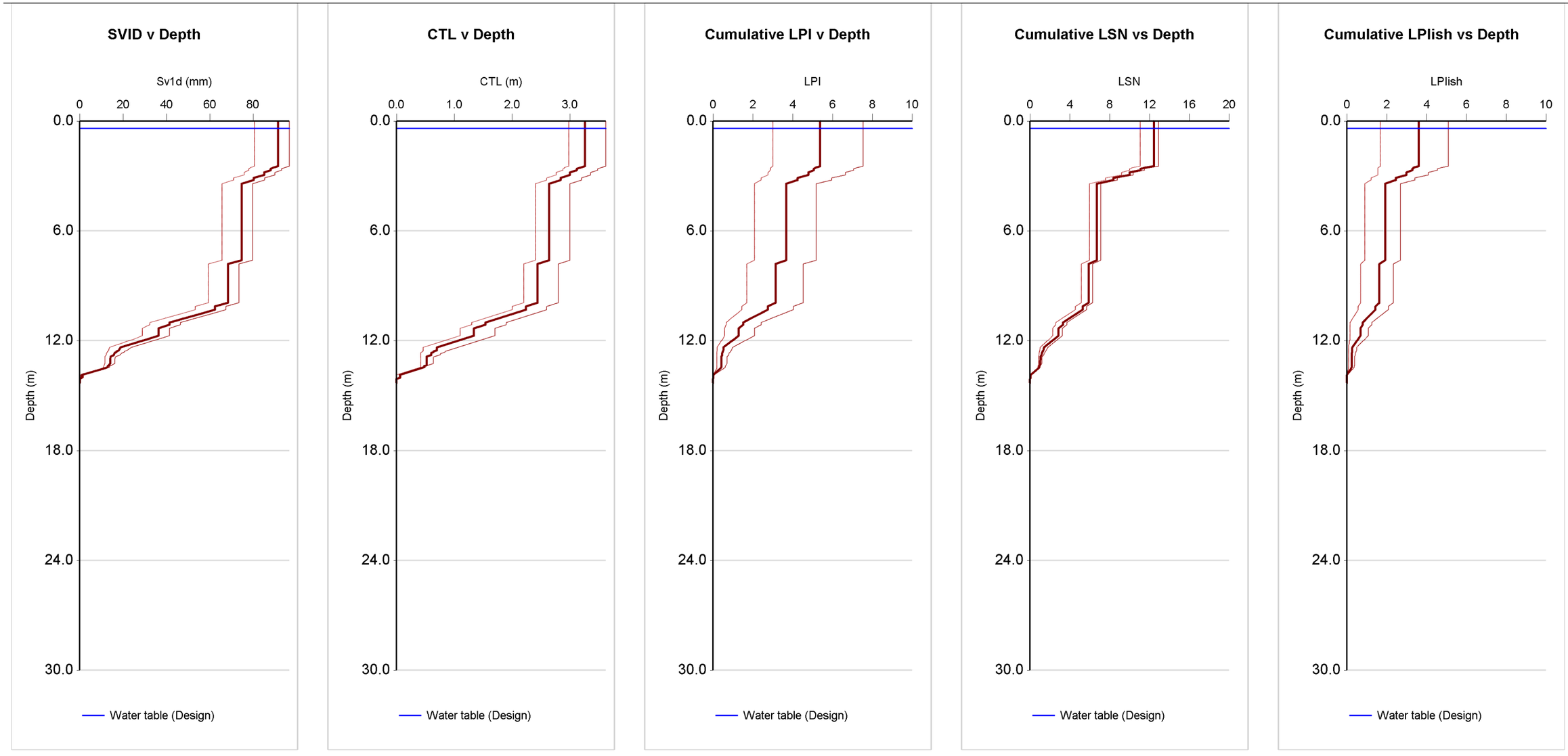
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



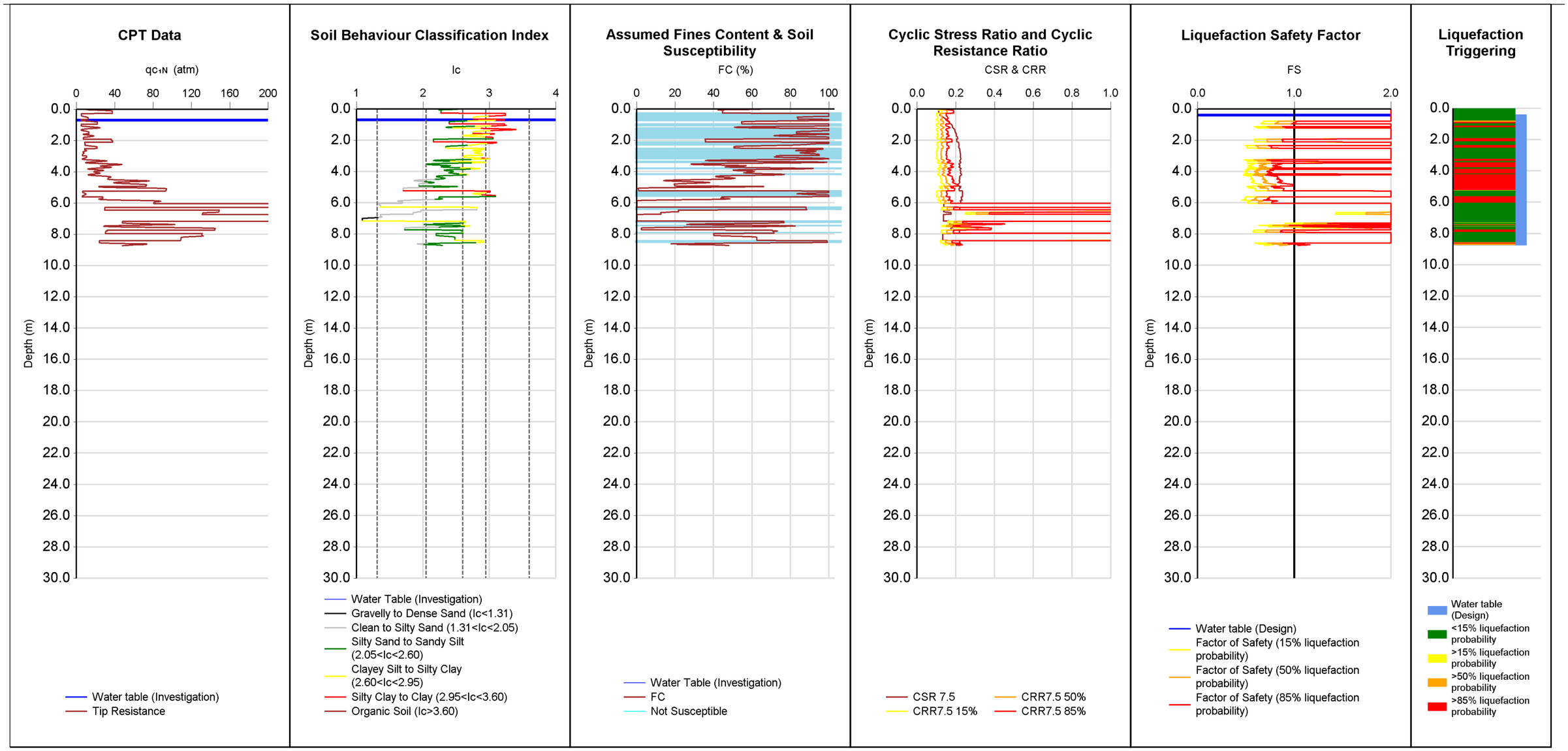
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT104	178993	17/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	



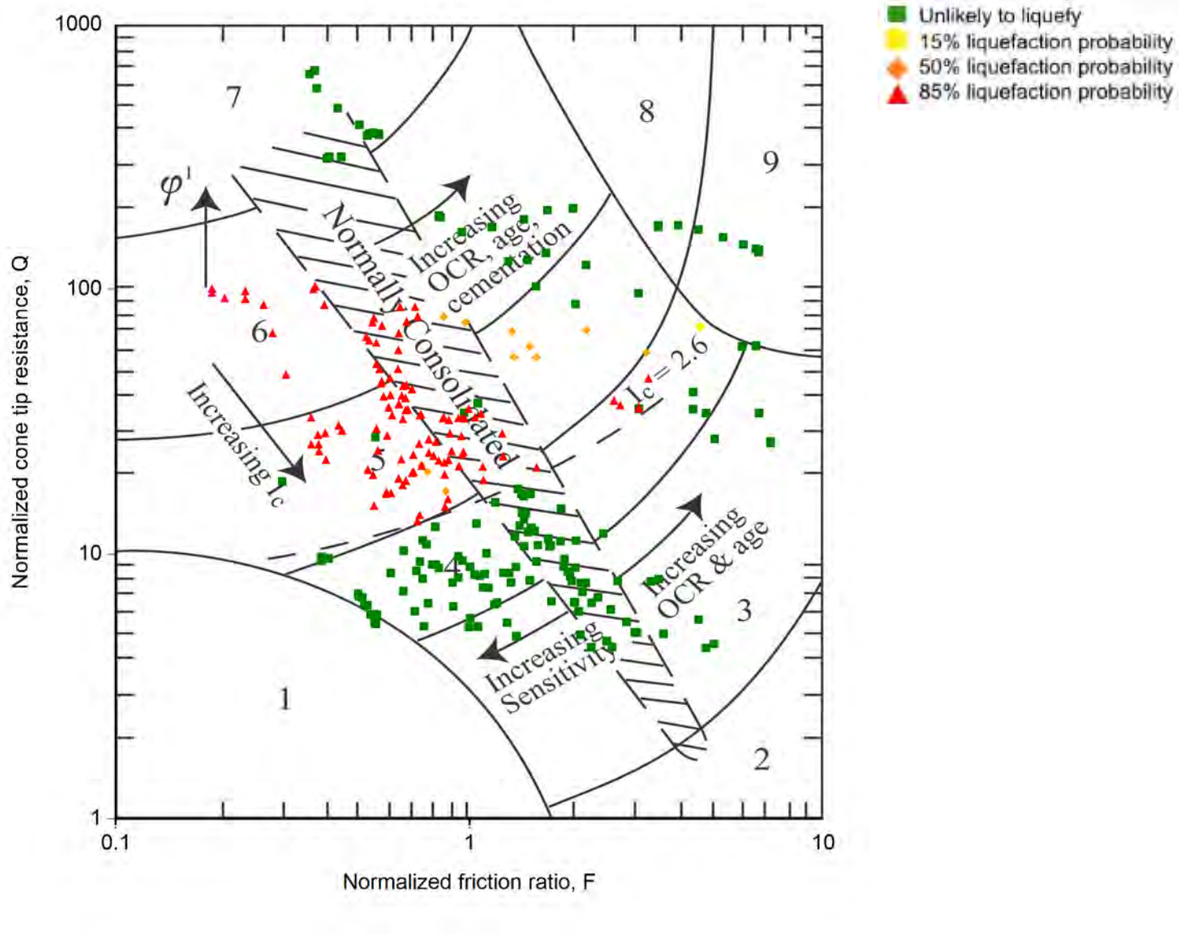
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT105	178994	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	89	3.3	11	28	0.9	11
	50%	86	3.2	8	28	0.9	7
	85%	72	3	4	21	1.1	3

Reviewed by:

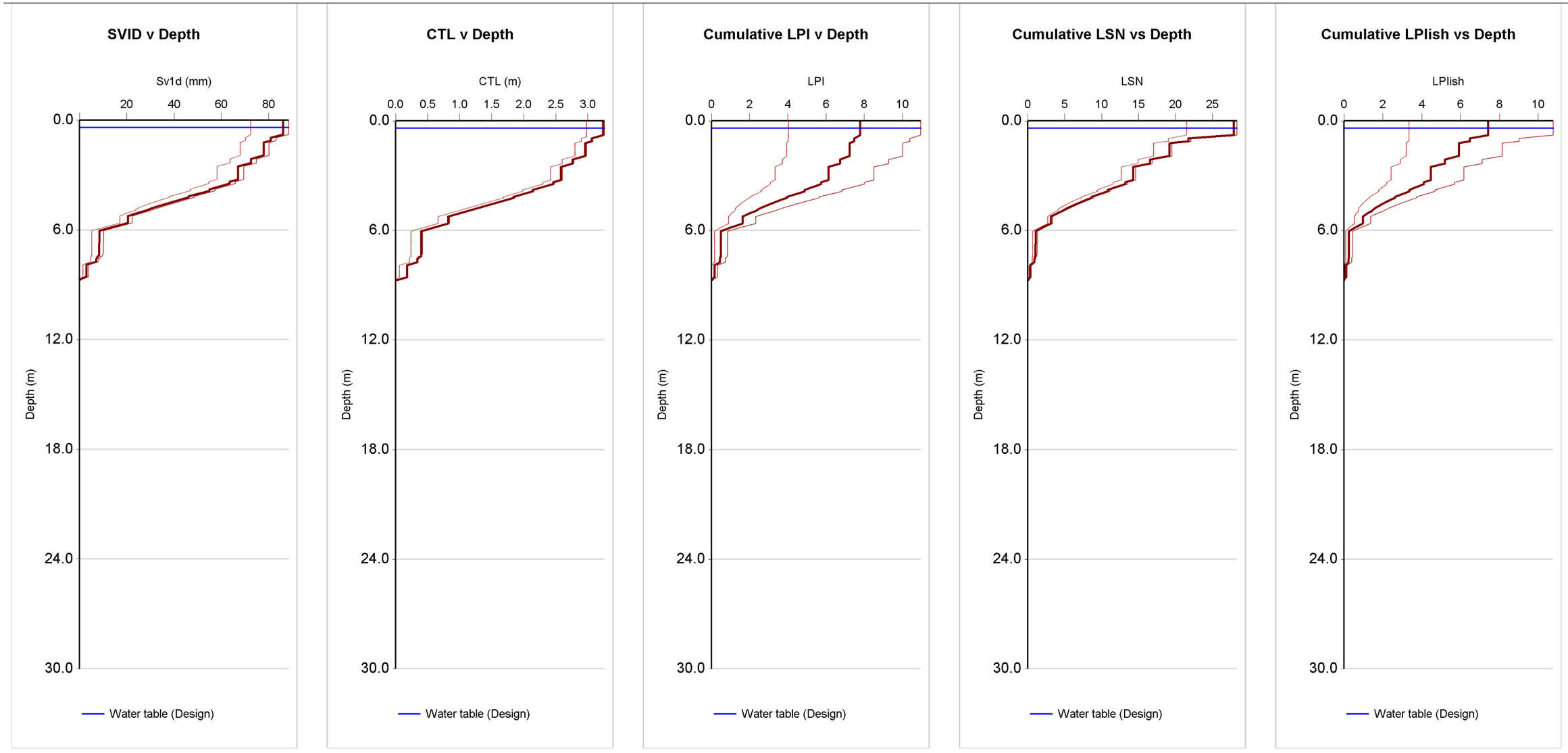
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



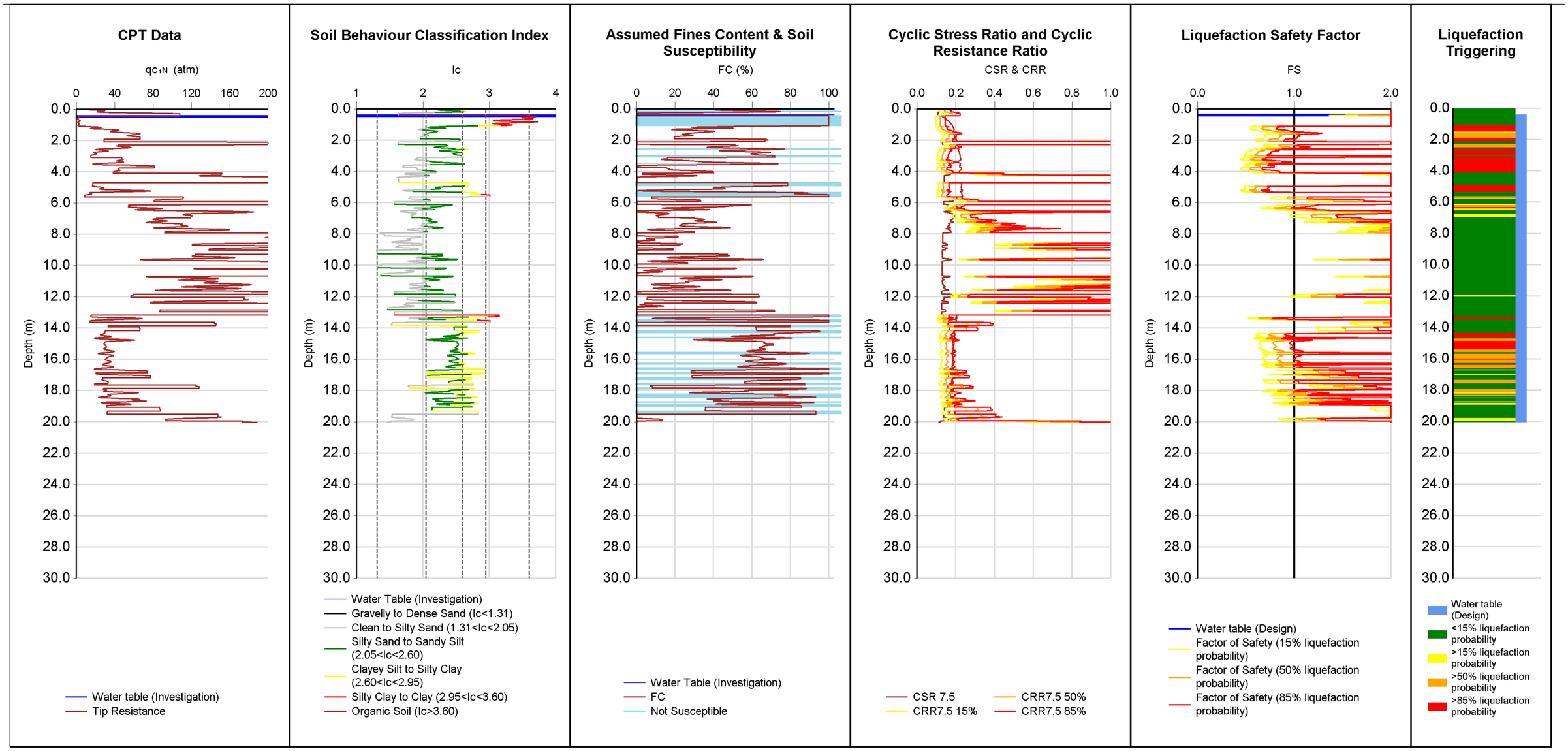
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT105	178994	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	



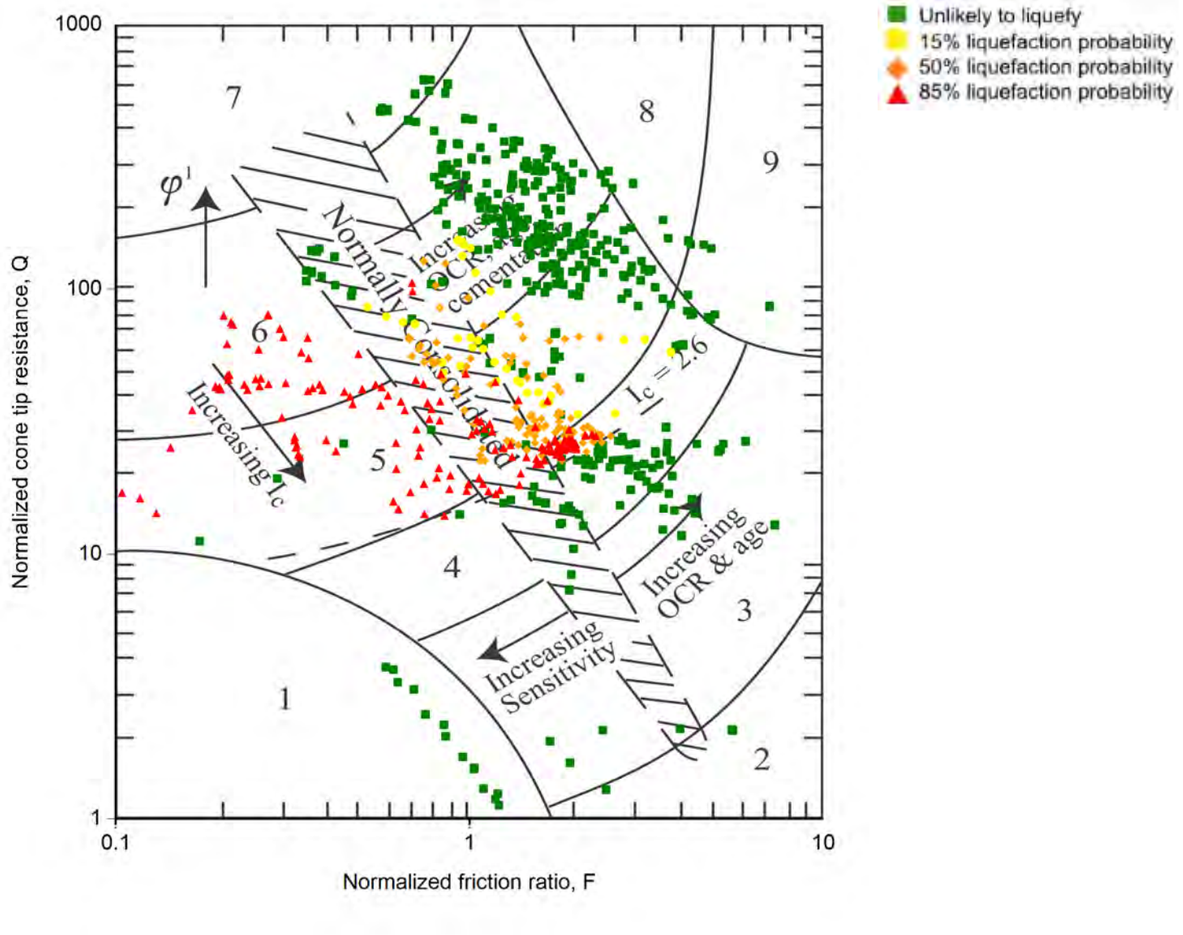
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT106	178995	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	179	7.1	14	42	1.2	15
	50%	151	6	9	37	1.2	9
	85%	102	3.5	4	28	1.2	4

Reviewed by:

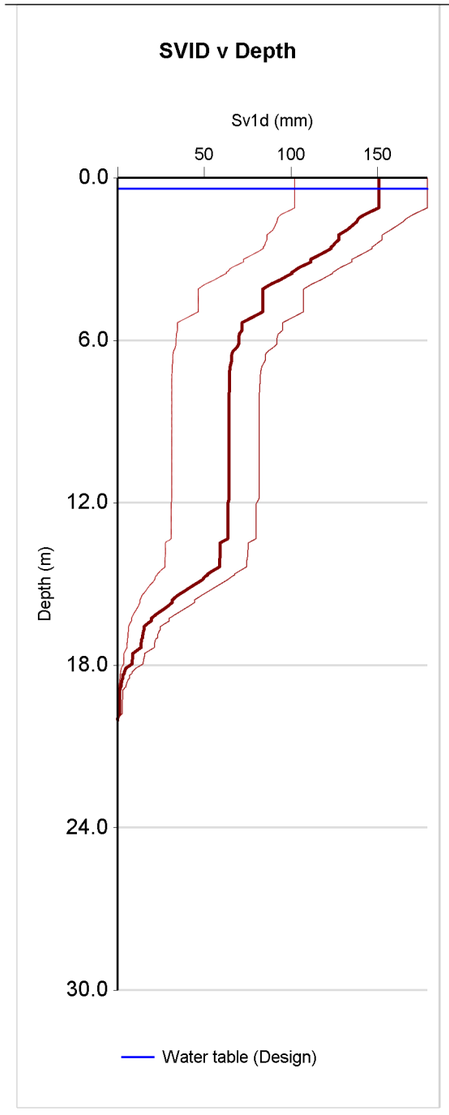
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc

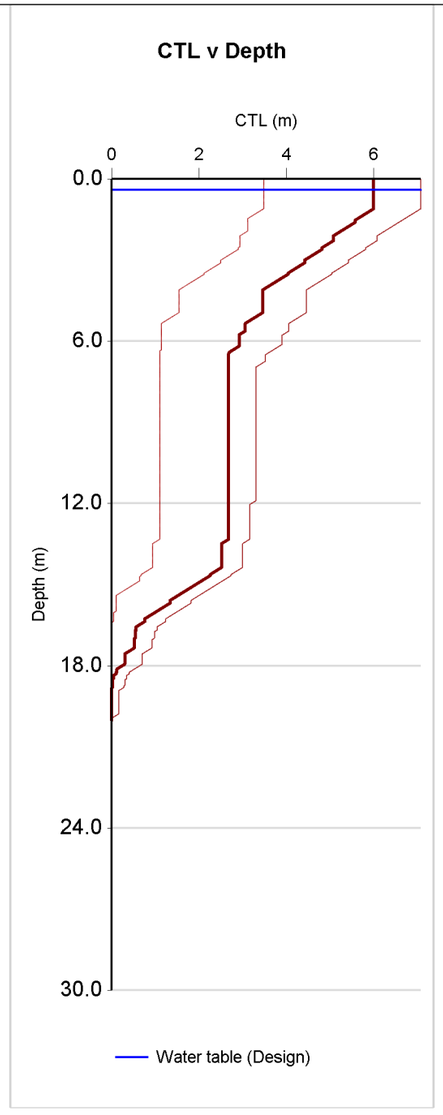


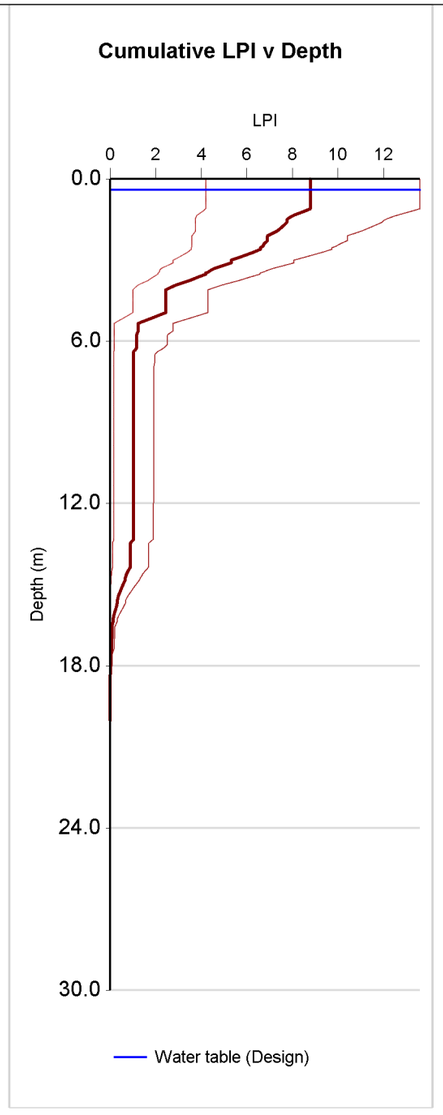
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

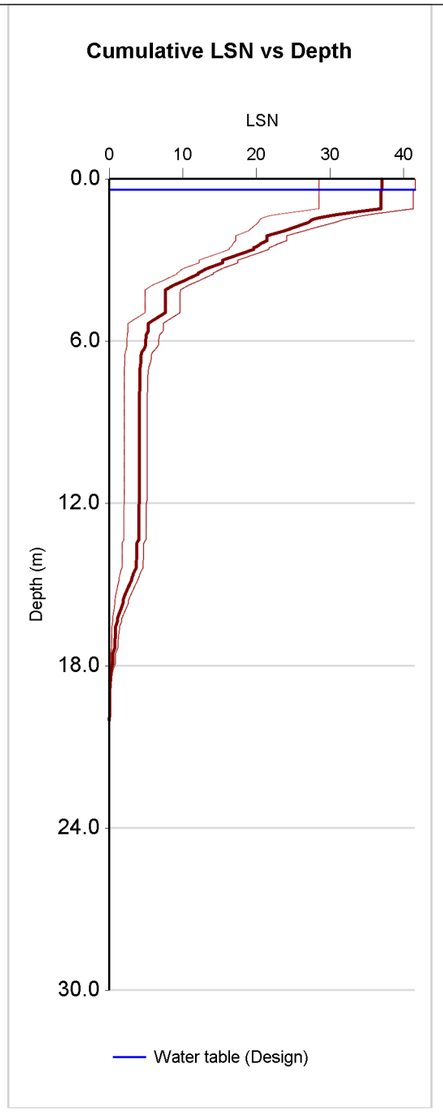
*Heavily overconsolidated or cemented

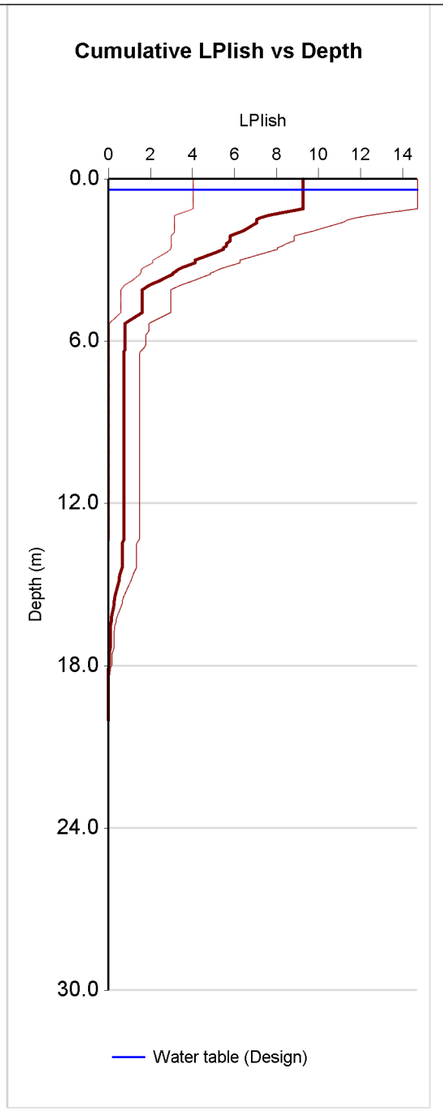
CPT-based soil behavior type classification chart by Robertson (1990)



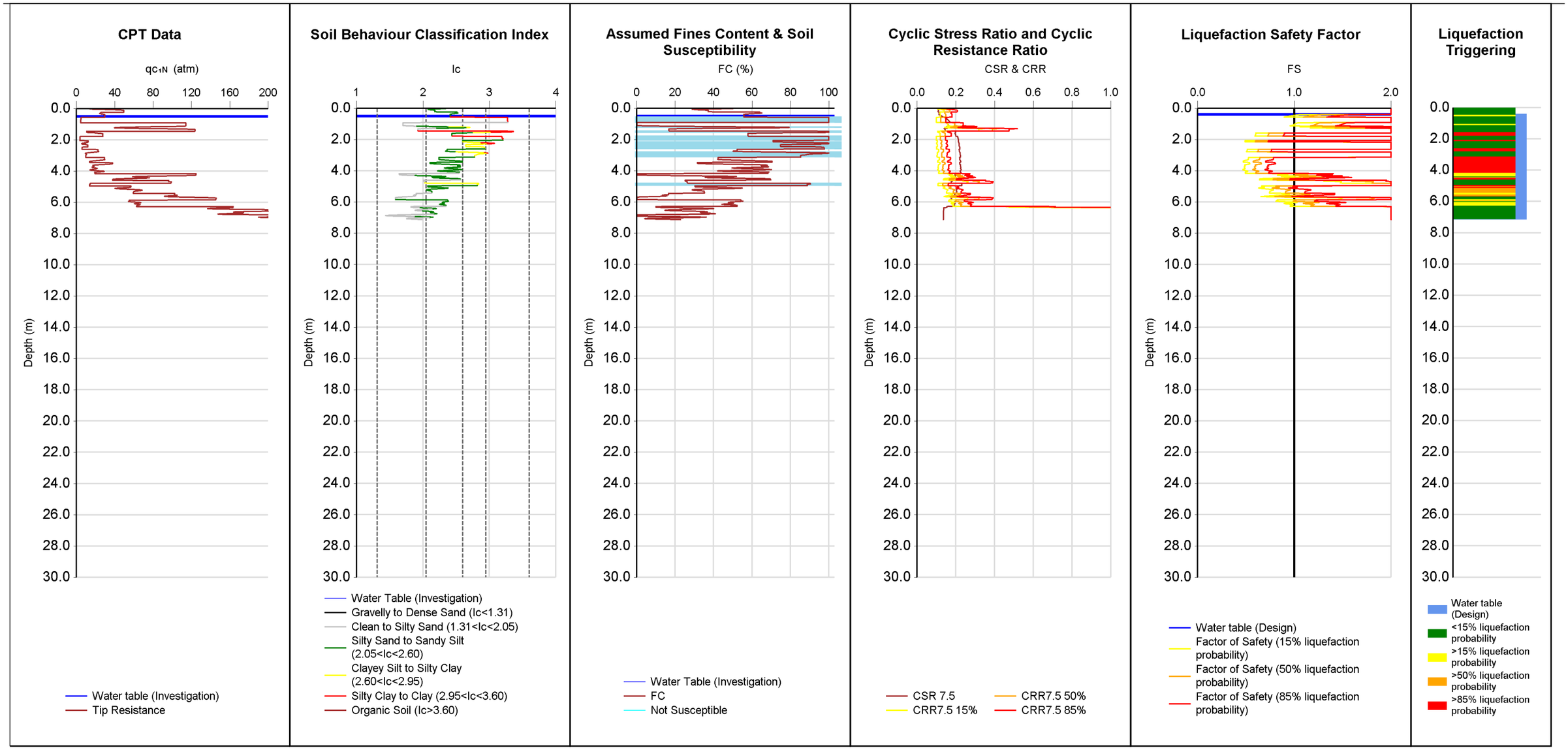








	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT106	178995	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	



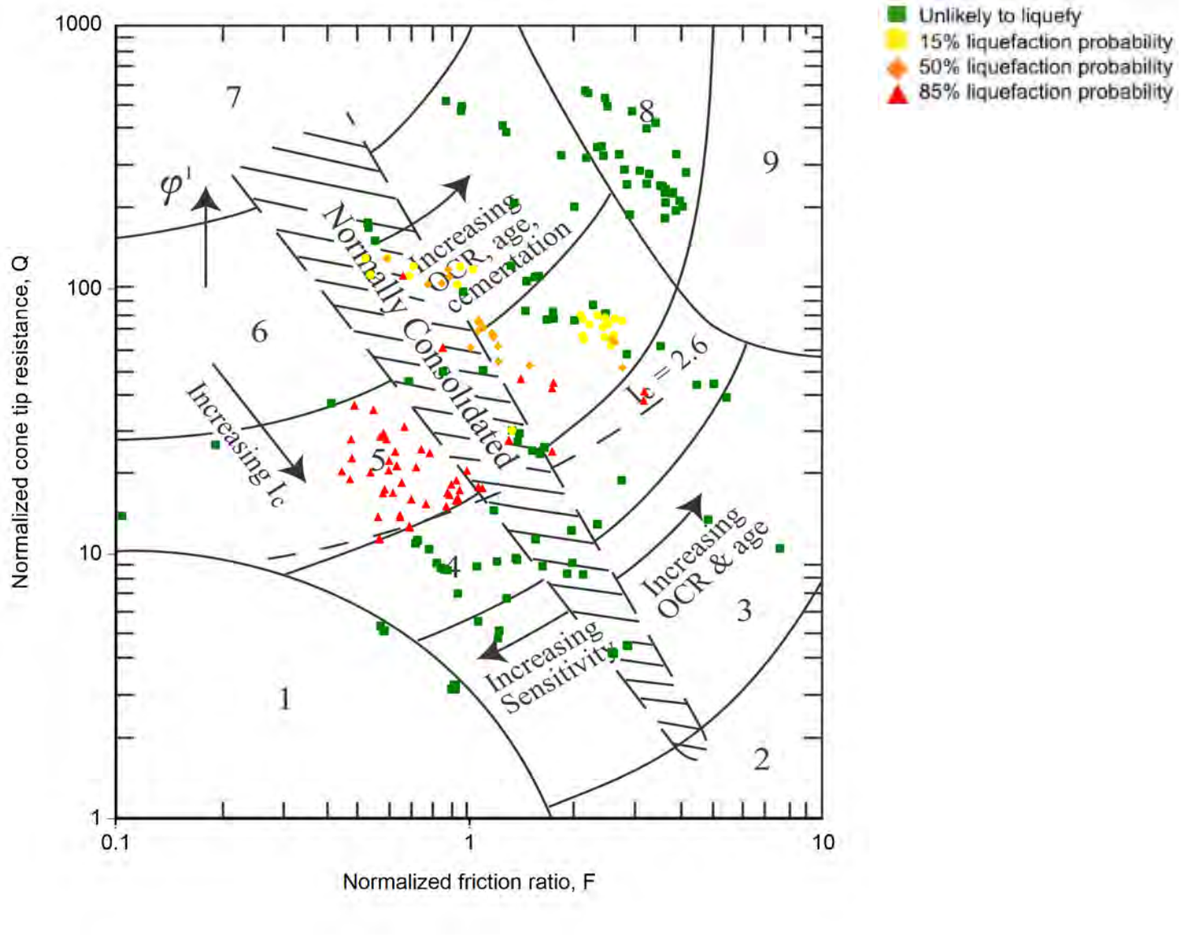
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT107	178996	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	74	3.2	8	27	0.5	8
	50%	63	2.3	5	21	1.7	5
	85%	52	1.8	3	18	1.7	3

Reviewed by:

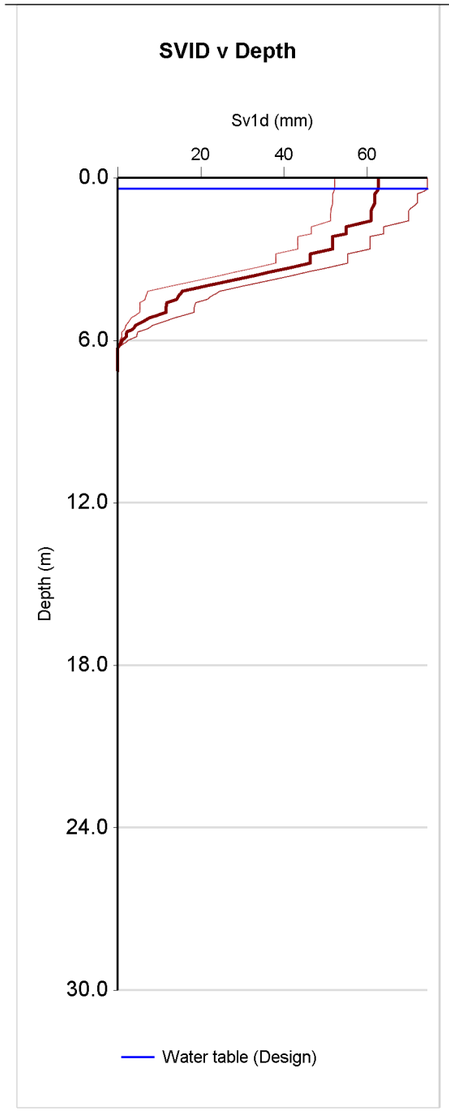
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc

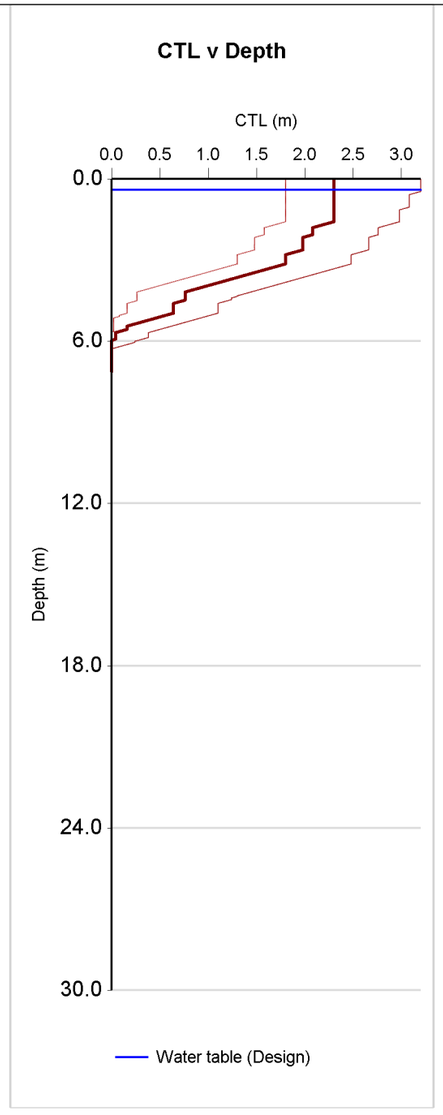


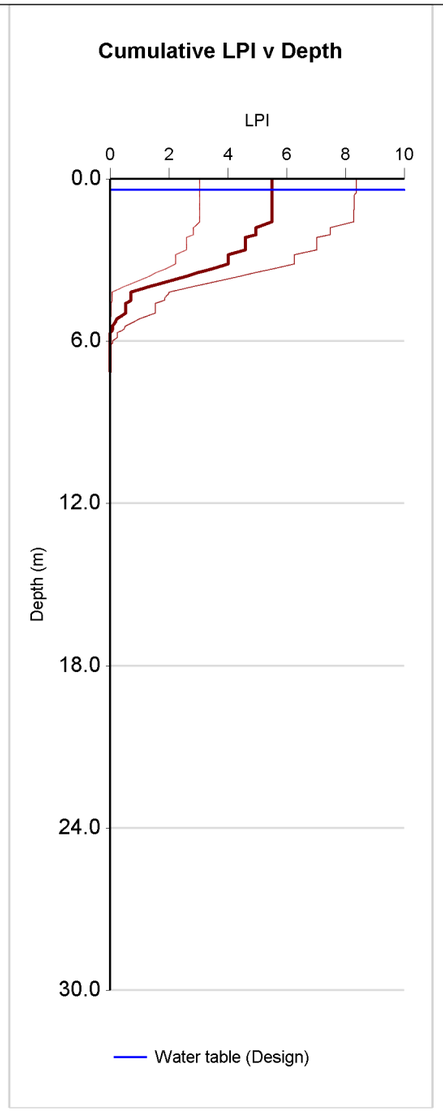
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

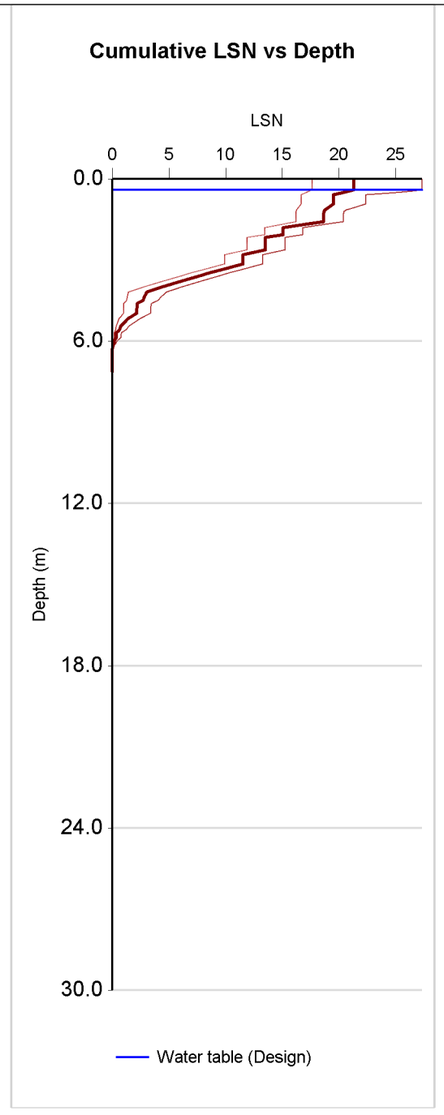
*Heavily overconsolidated or cemented

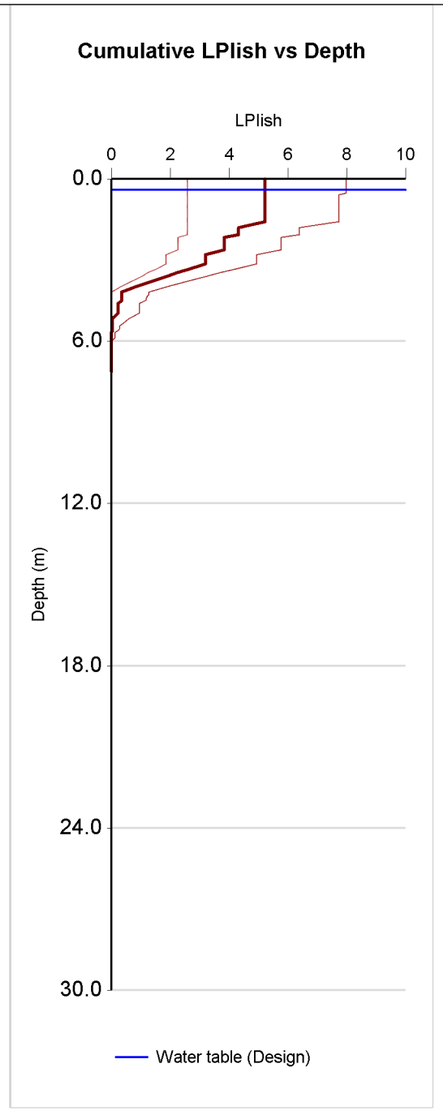
CPT-based soil behavior type classification chart by Robertson (1990)



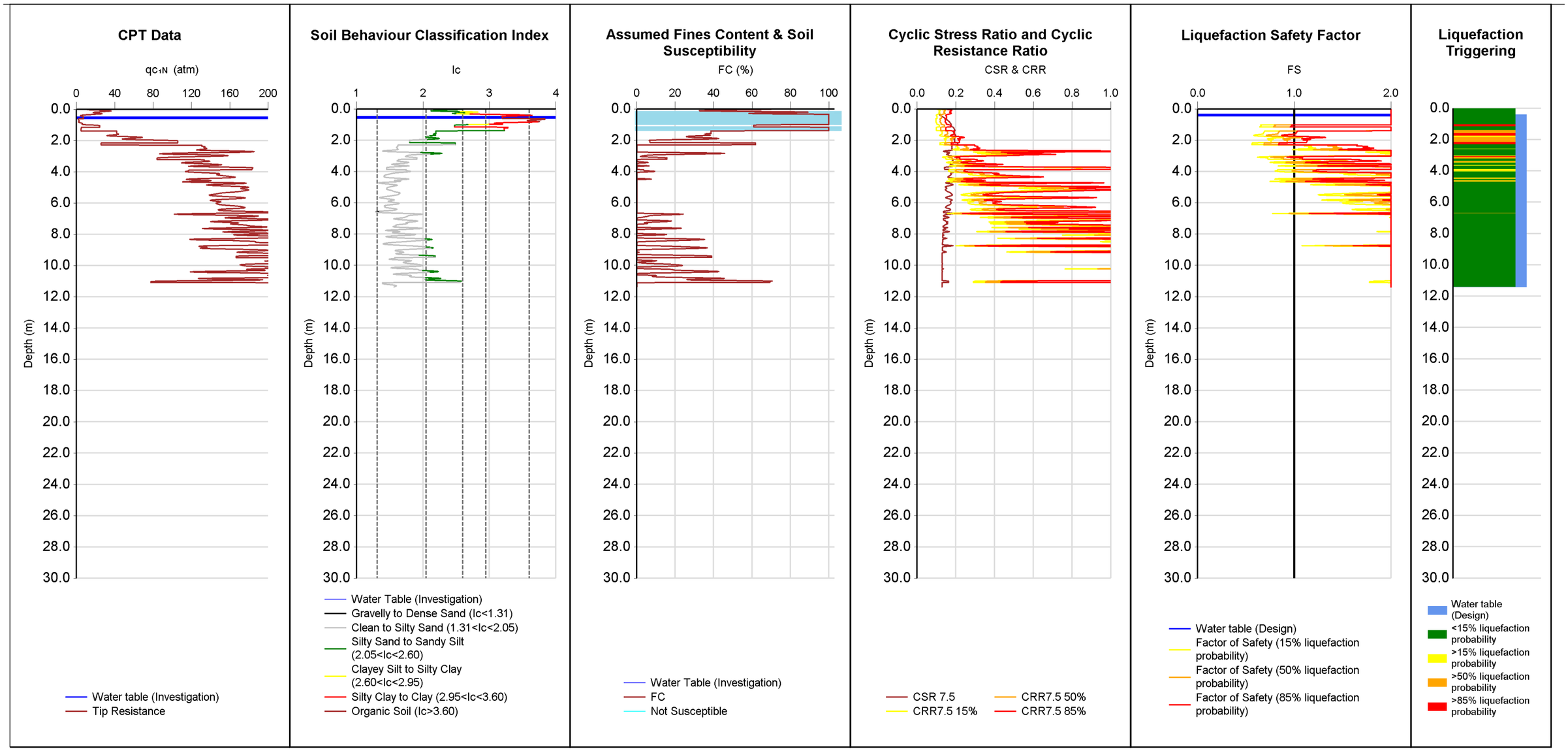








	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT107	178996	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	



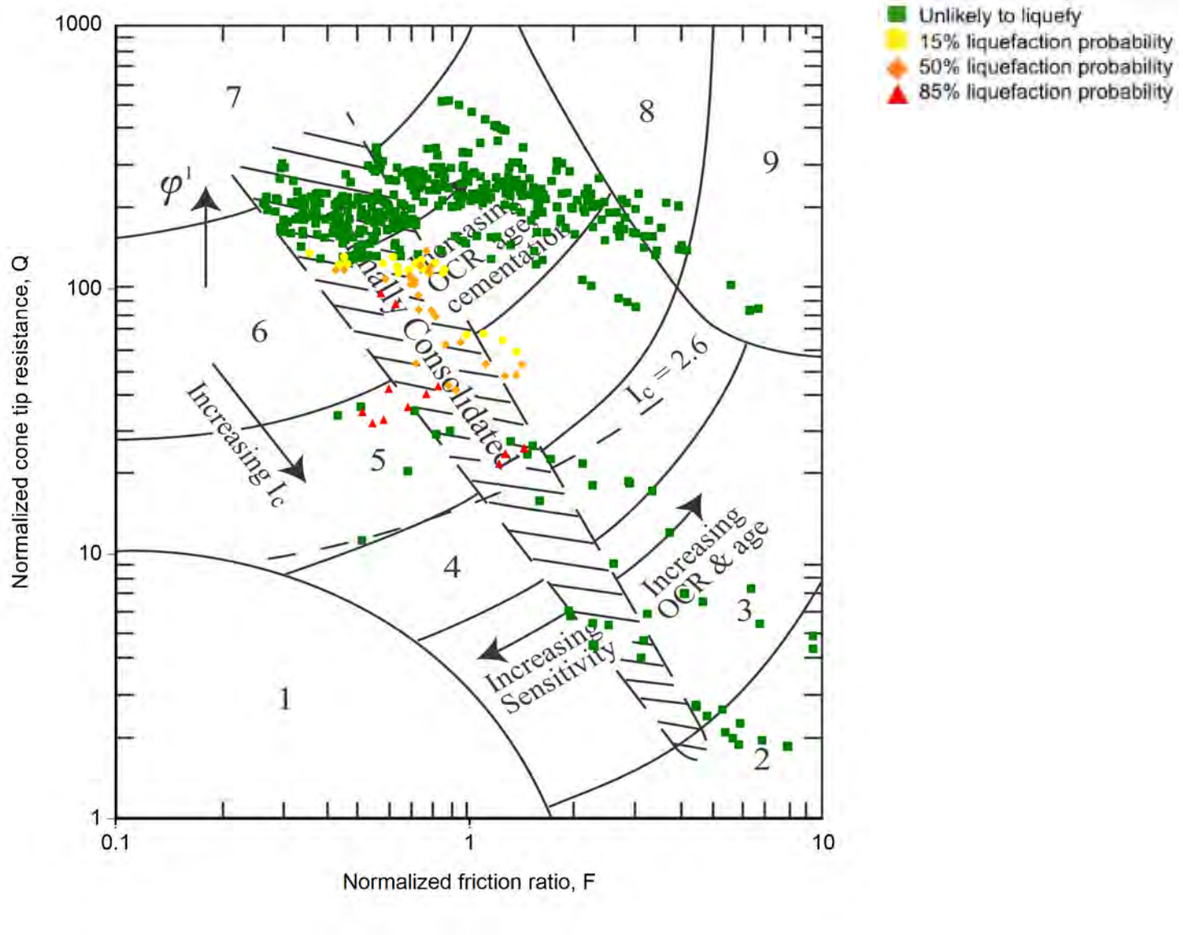
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT108	178997	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	42	1.8	4	20	1.1	6
	50%	30	1.3	2	16	1.1	3
	85%	16	0.5	0	8	1.1	0

Reviewed by:

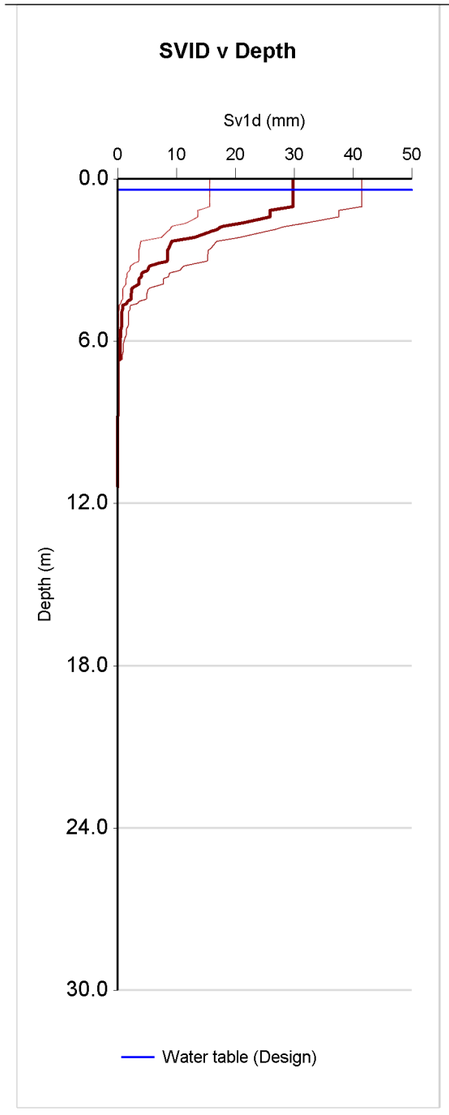
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc

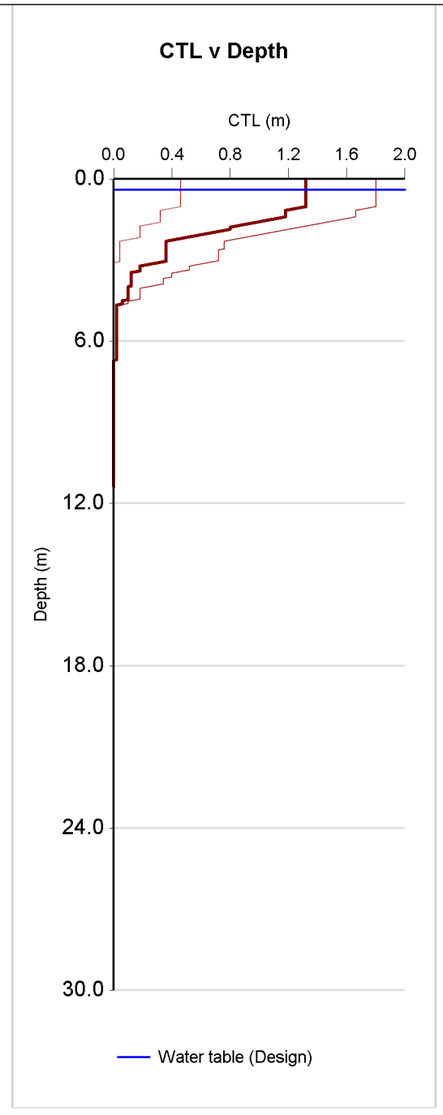


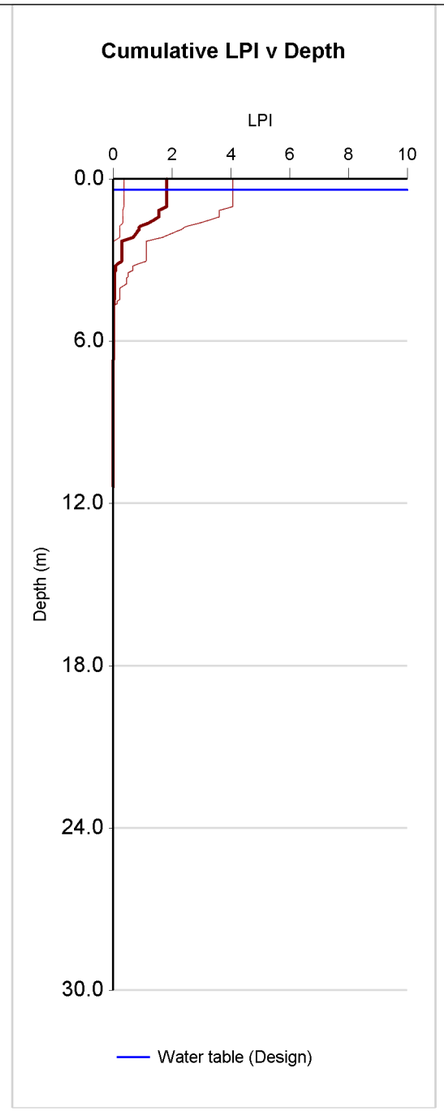
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

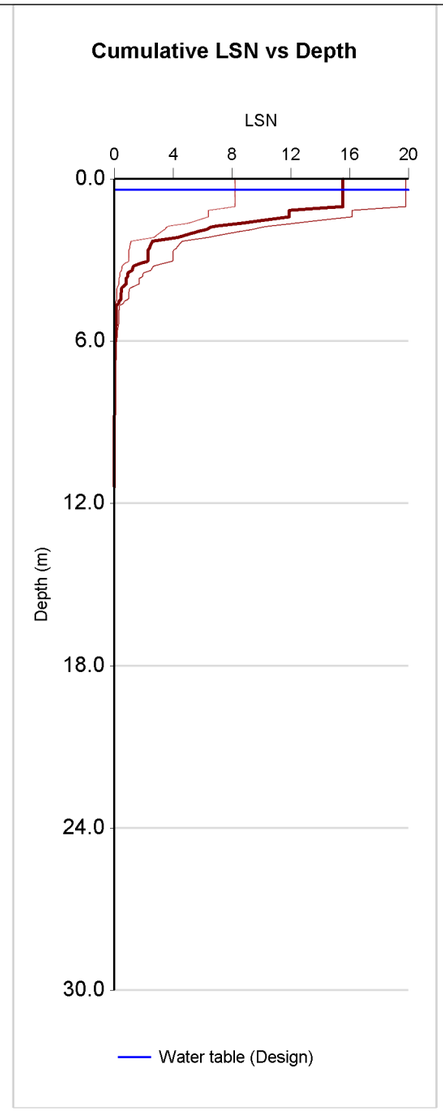
*Heavily overconsolidated or cemented

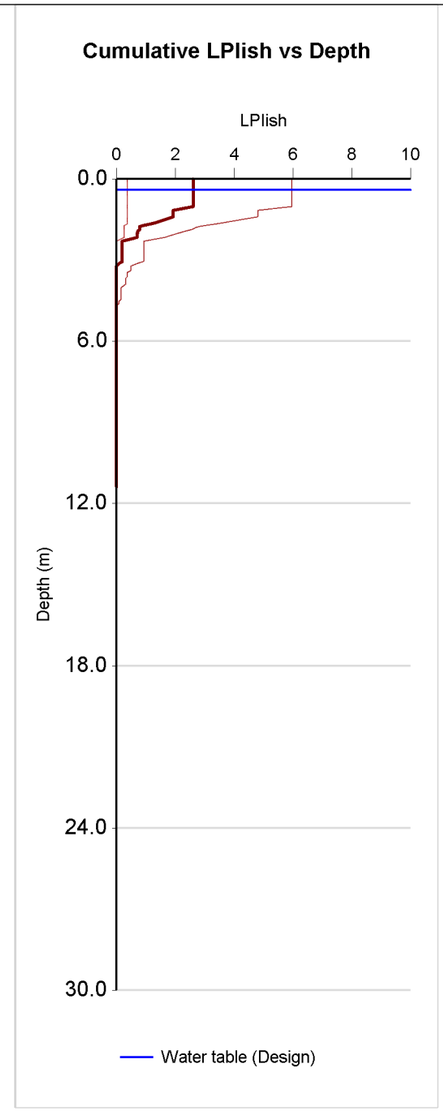
CPT-based soil behavior type classification chart by Robertson (1990)



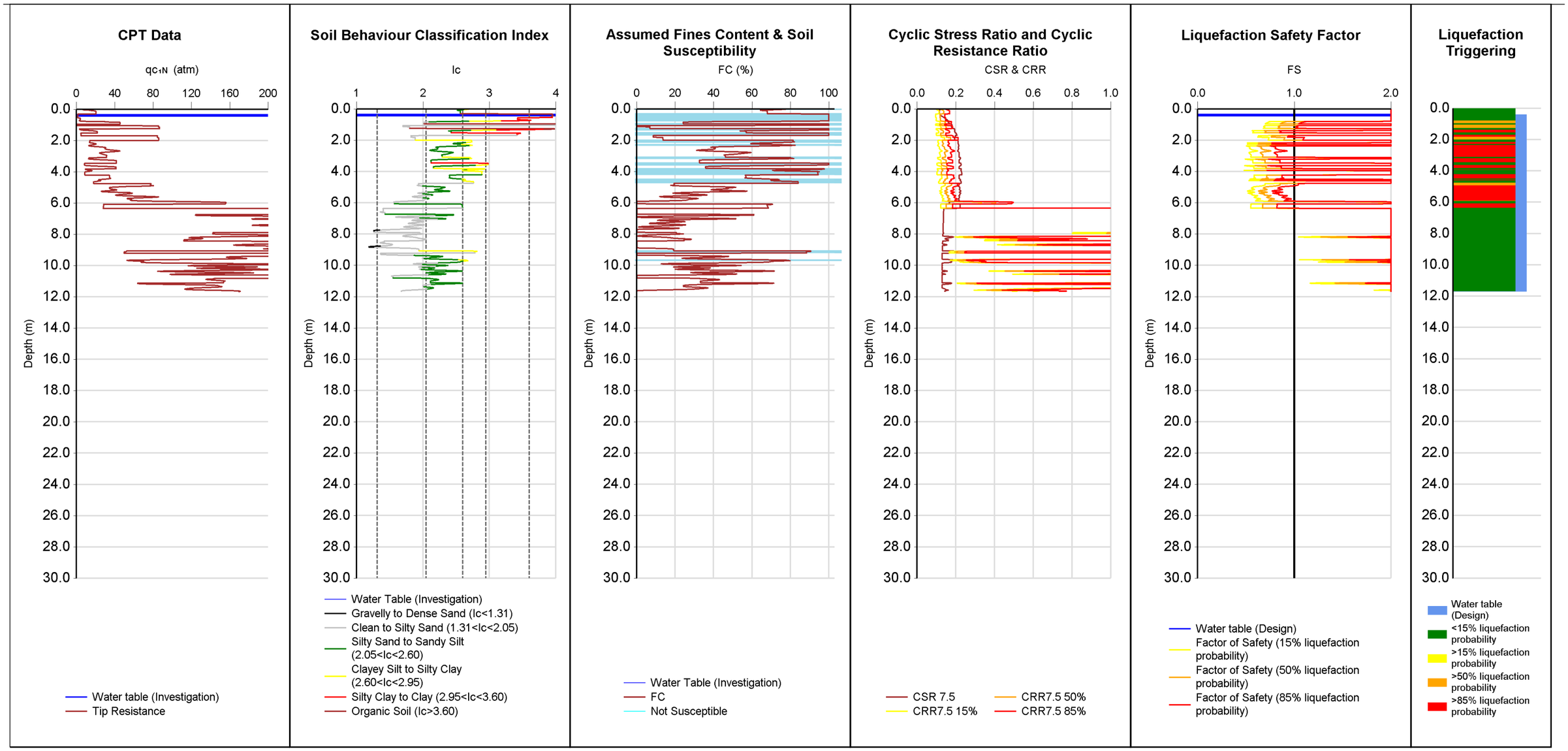








	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT108	178997	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	



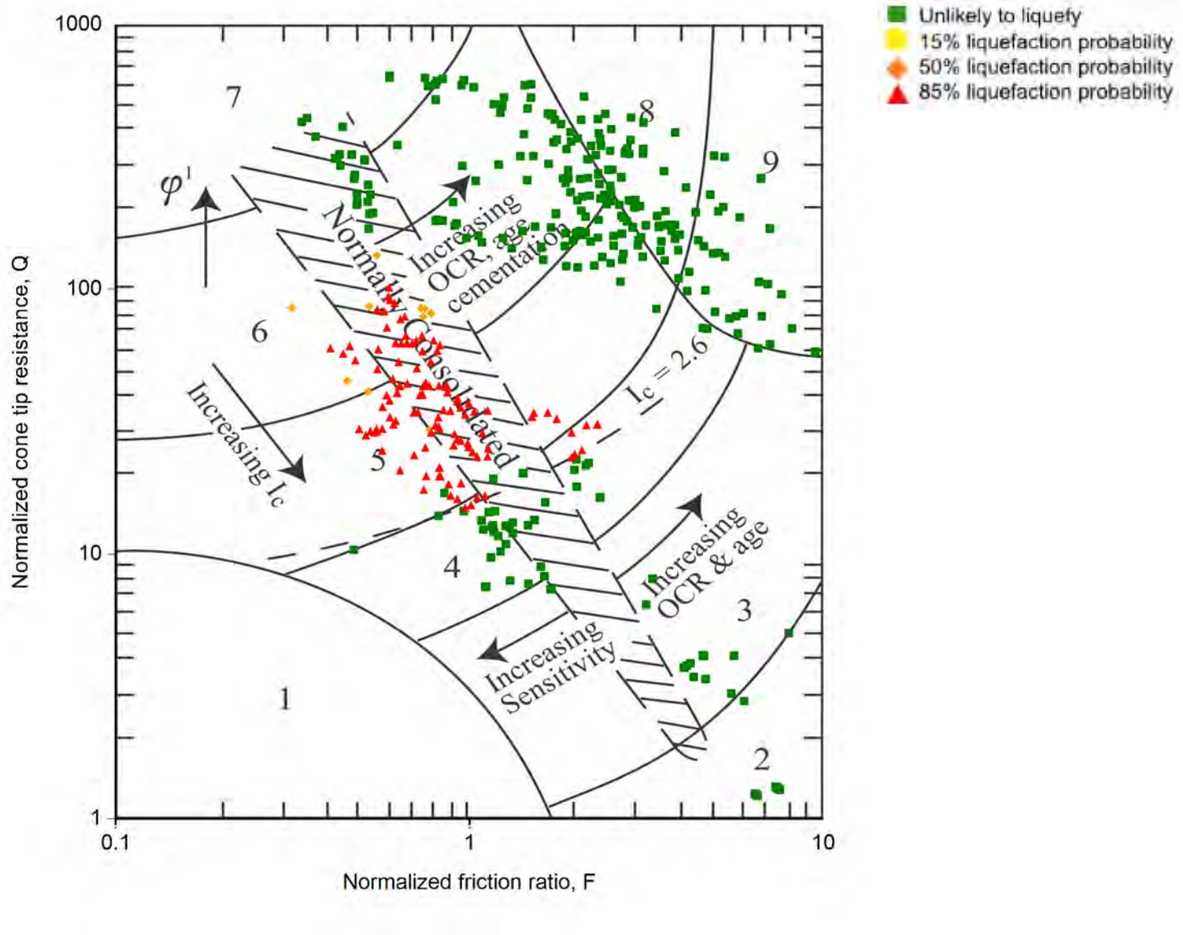
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT109	178998	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	103	3.9	13	38	0.9	14
	50%	98	3.9	9	35	0.9	9
	85%	78	3.2	4	26	1.5	3

Reviewed by:

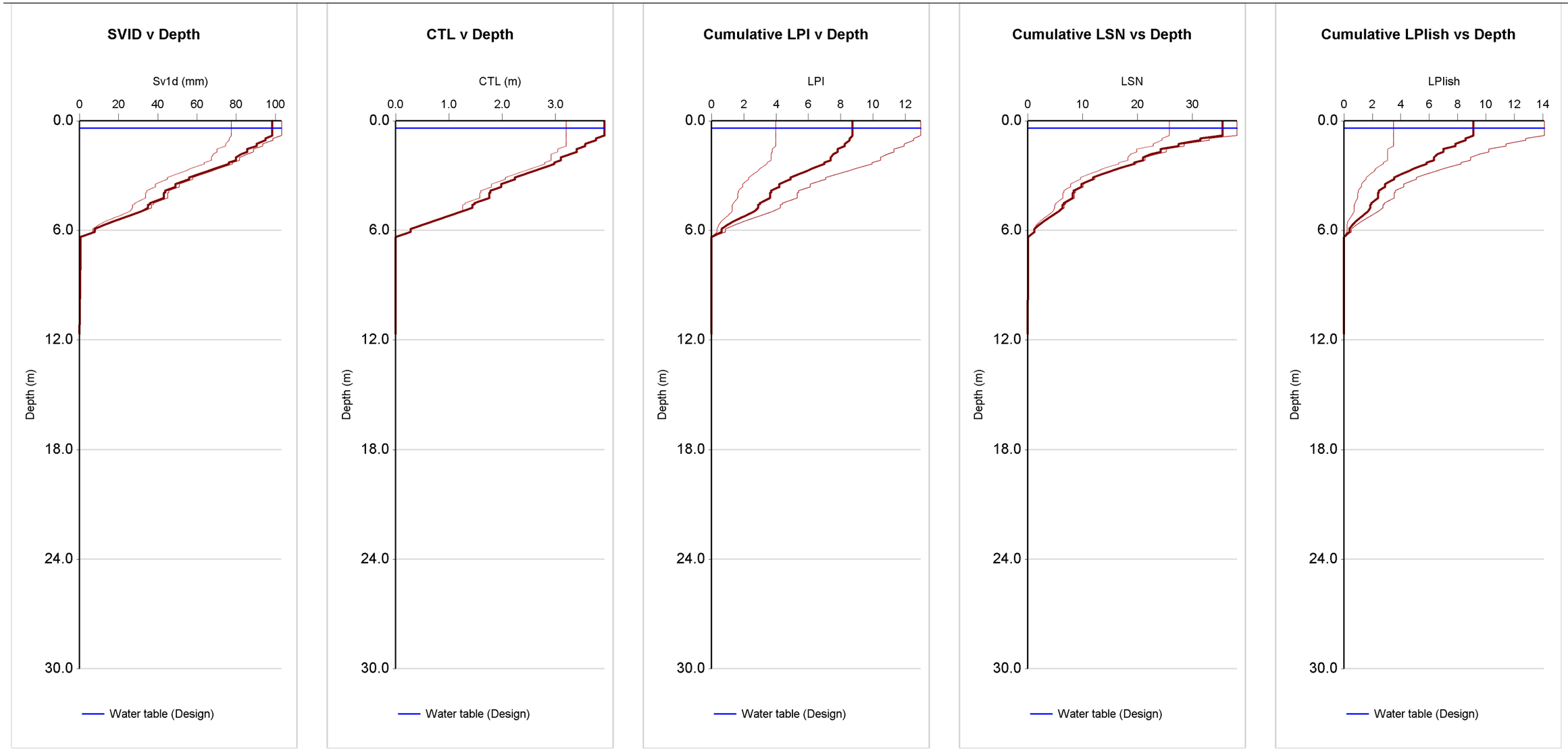
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



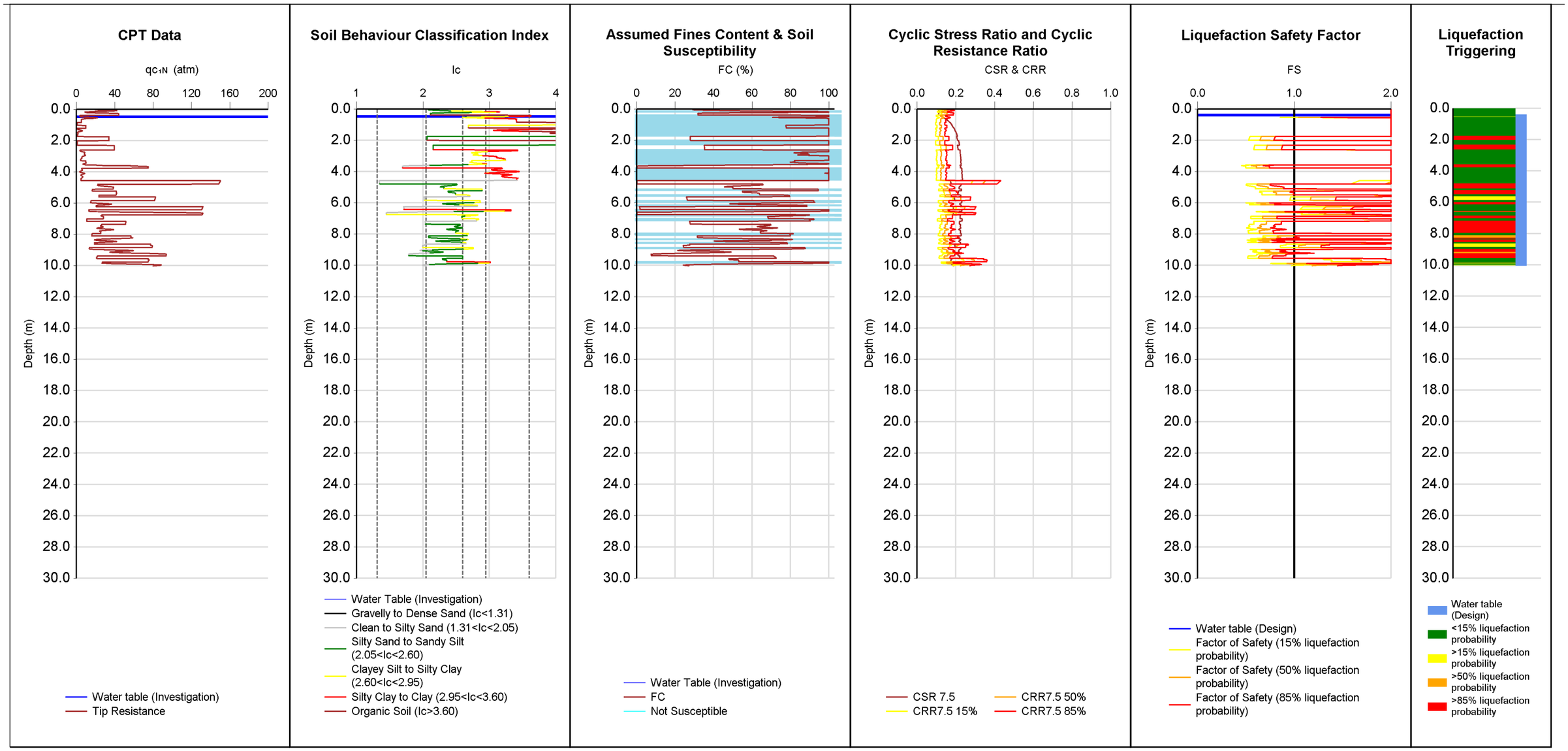
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT109	178998	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	



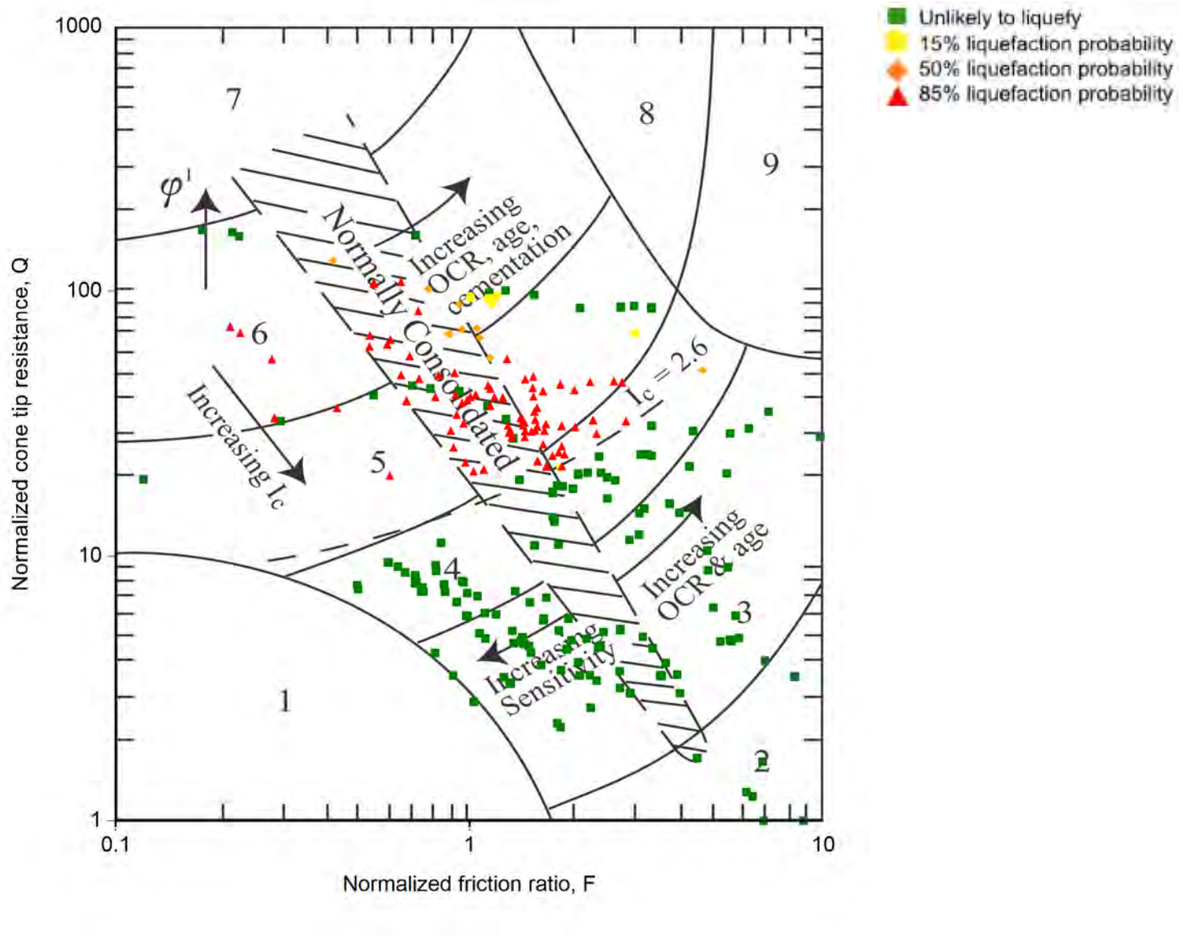
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT110	178999	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	99	4	10	21	1.8	8
	50%	91	3.4	7	19	1.8	5
	85%	76	3.2	4	16	1.8	2

Reviewed by:

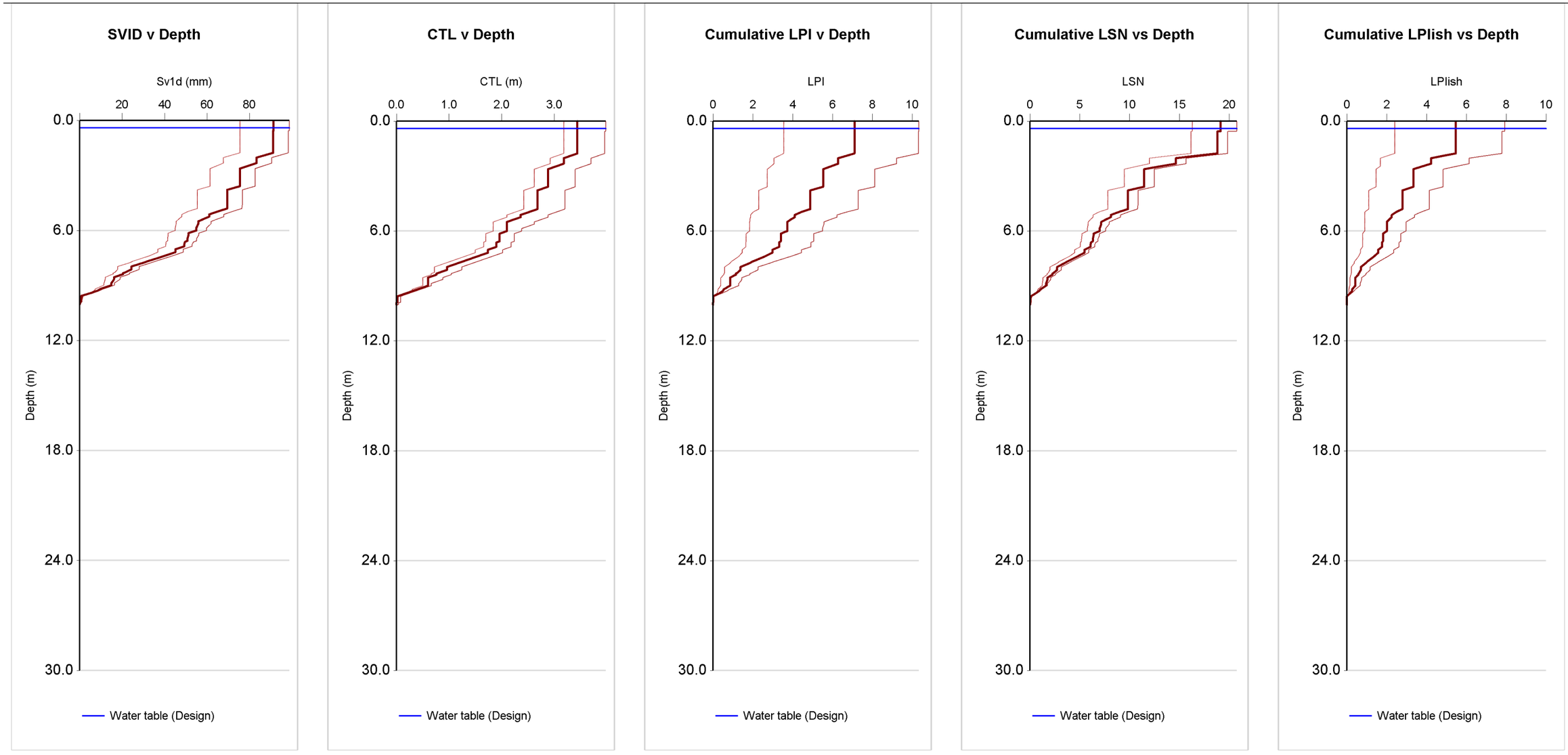
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



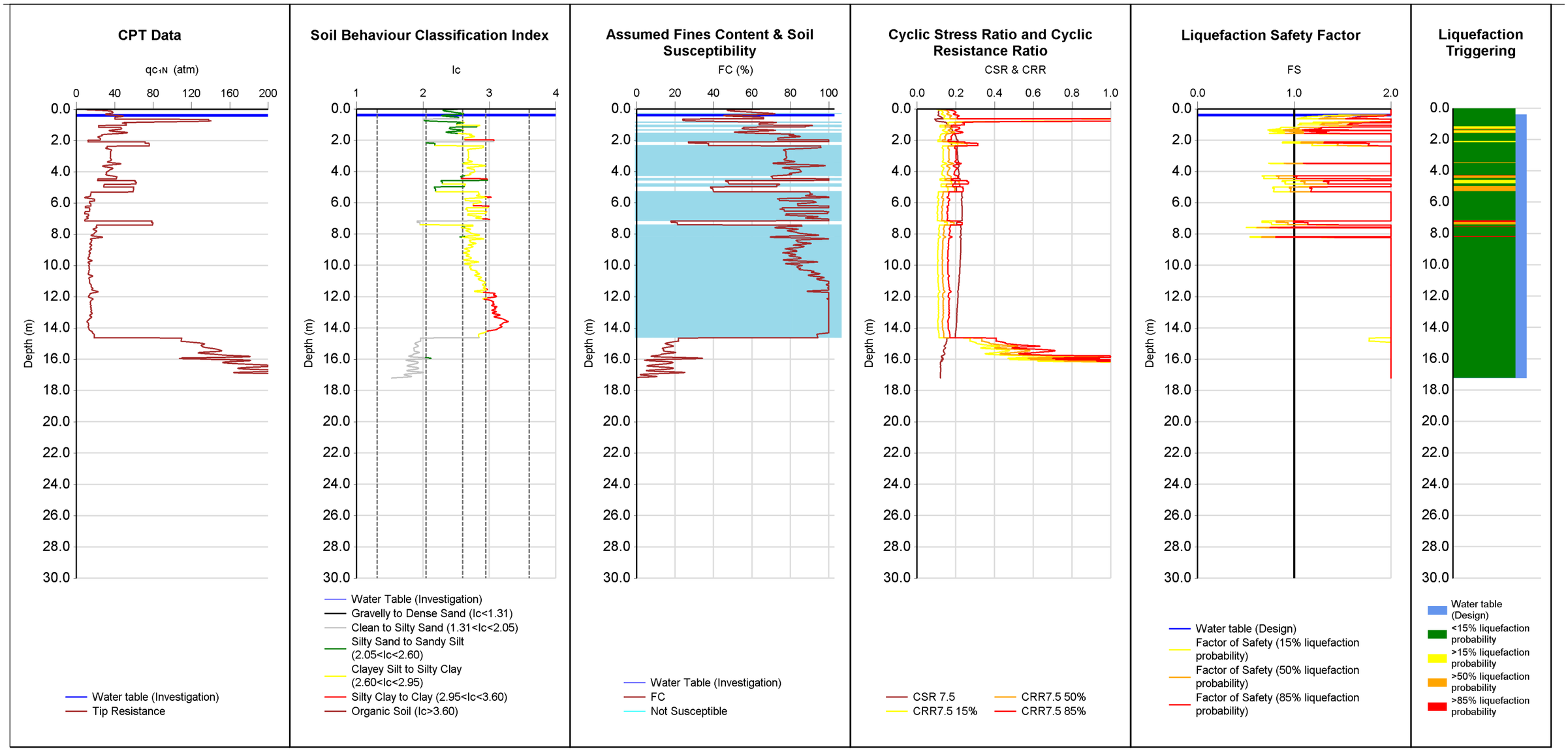
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT110	178999	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	



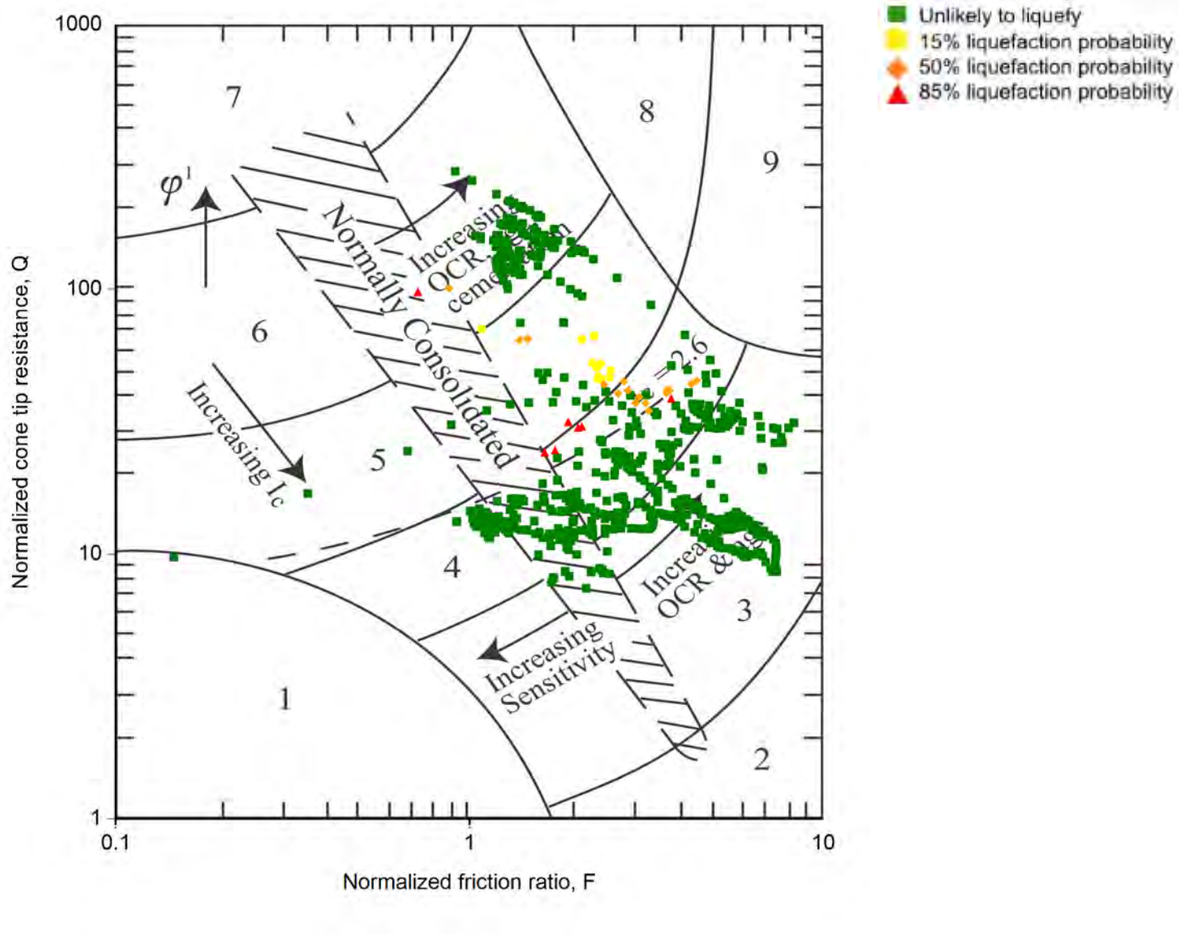
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT111	179000	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	32	1.6	3	13	1.2	3
	50%	20	1.1	1	7	1.4	0
	85%	10	0.2	0	3	7.2	0

Reviewed by:

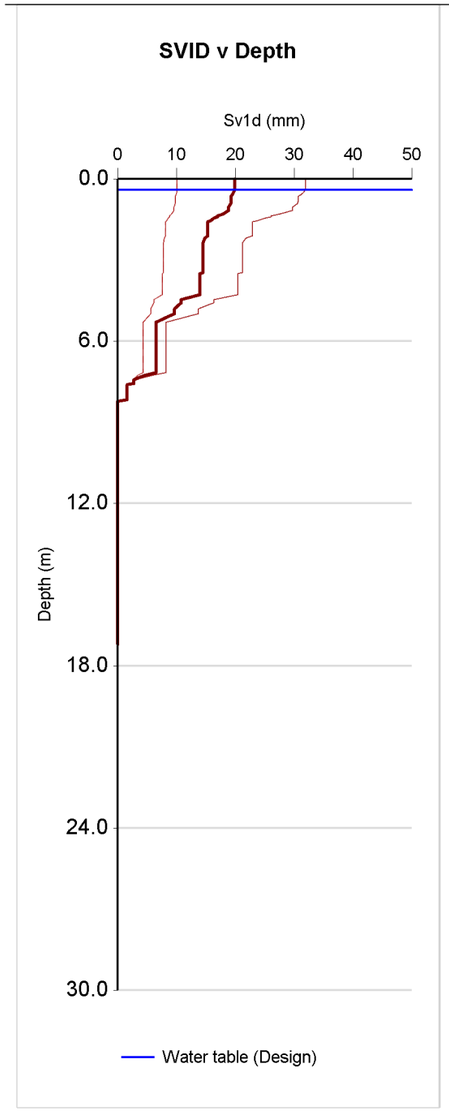
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc

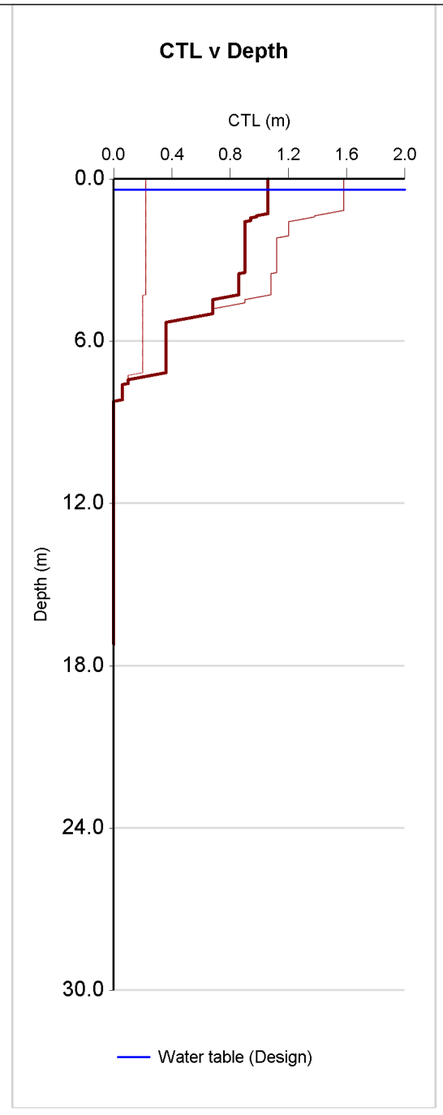


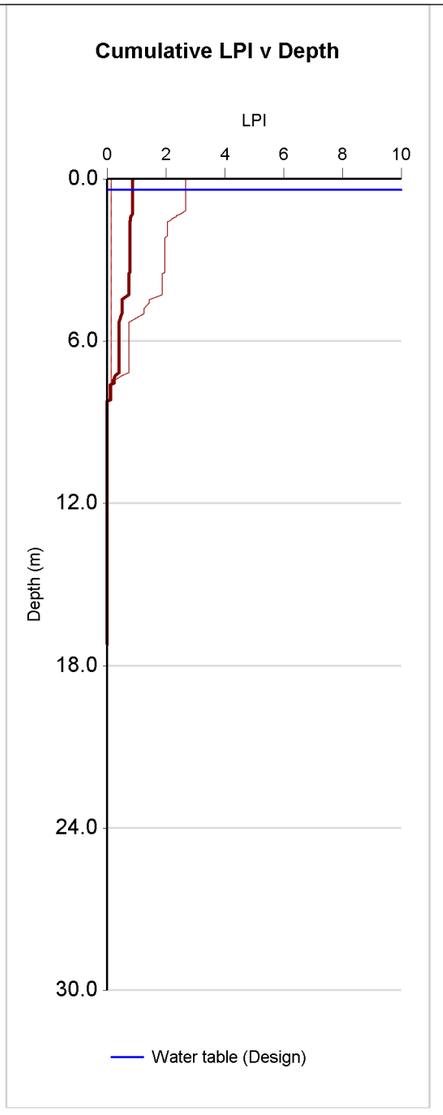
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

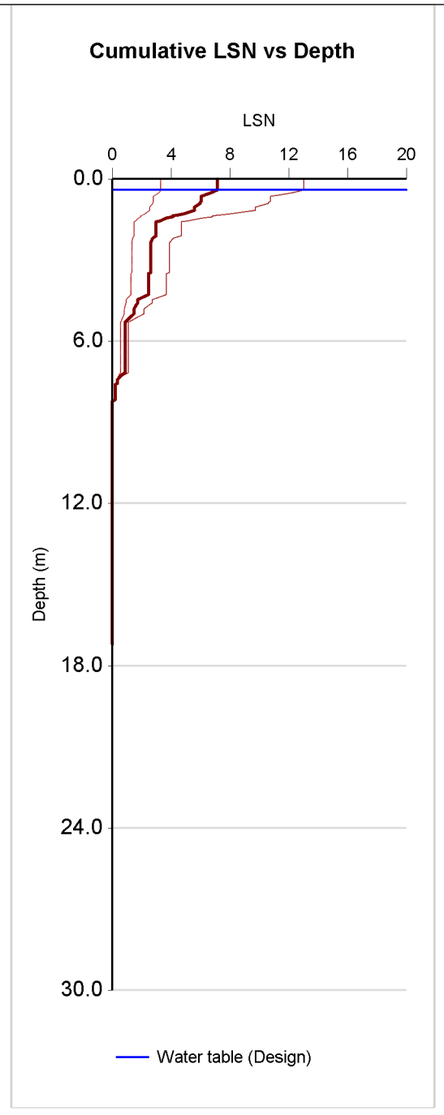
*Heavily overconsolidated or cemented

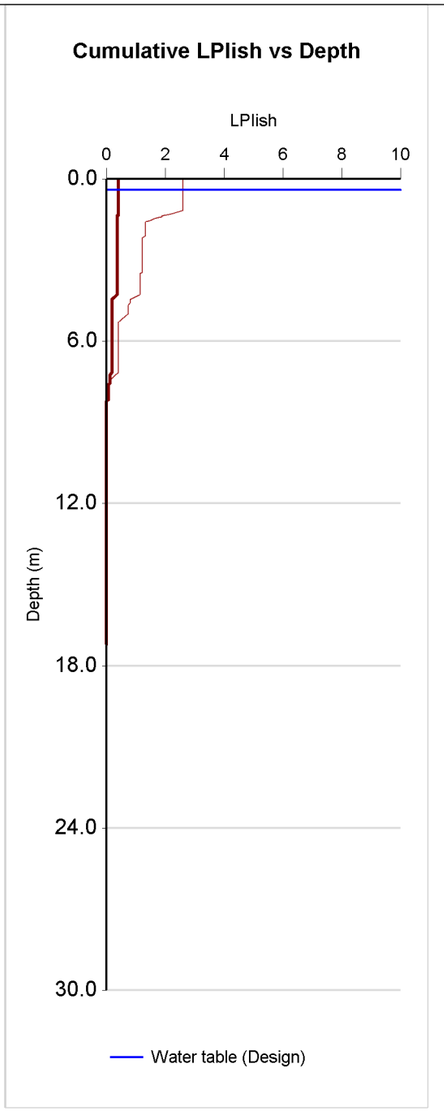
CPT-based soil behavior type classification chart by Robertson (1990)



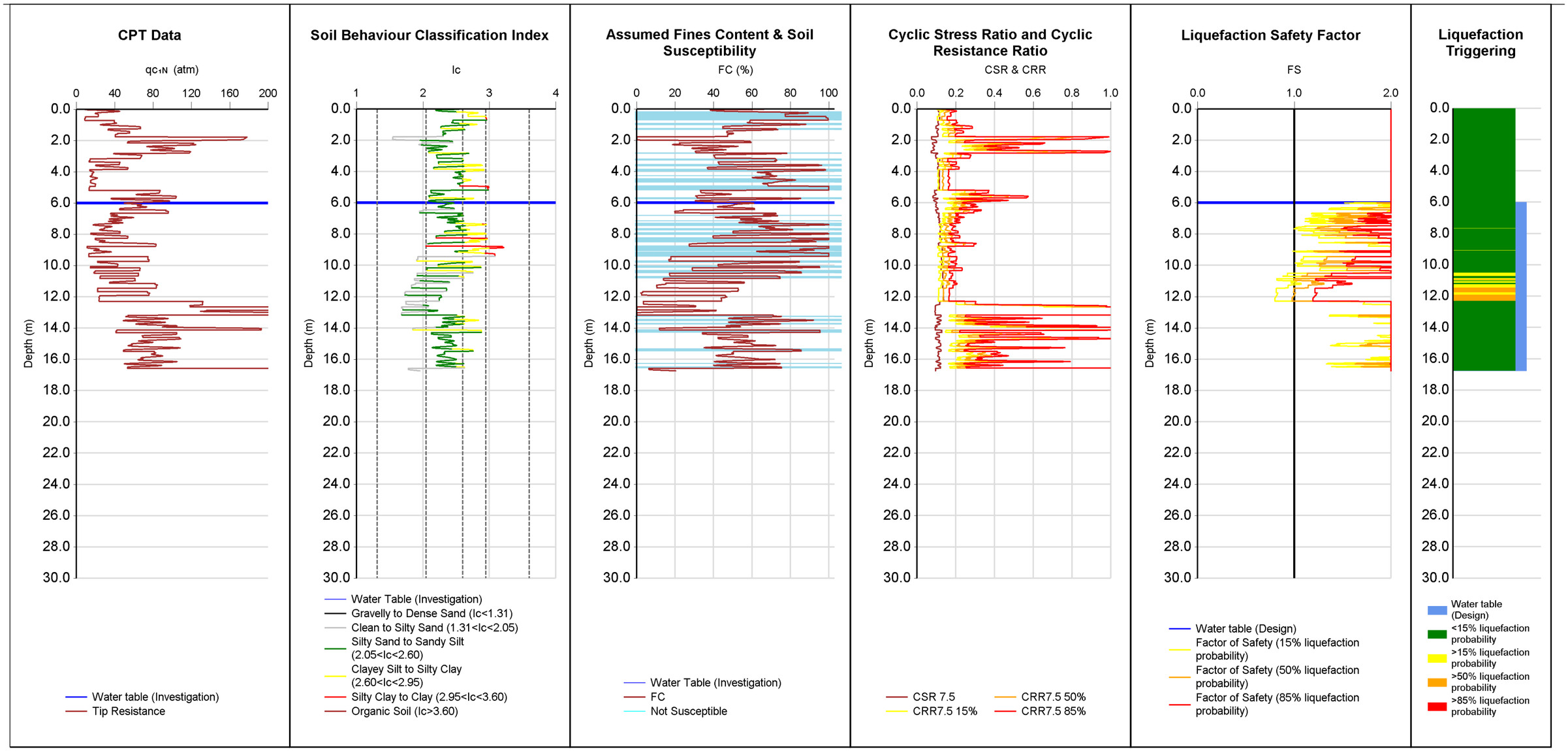








	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT111	179000	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	



Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT112	179001	17/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	51	1.6	1	5	10.5	0
	50%	21	0.7	0	2	11.5	0
	85%	9	0	0	1	16.7	0

Reviewed by:

CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc

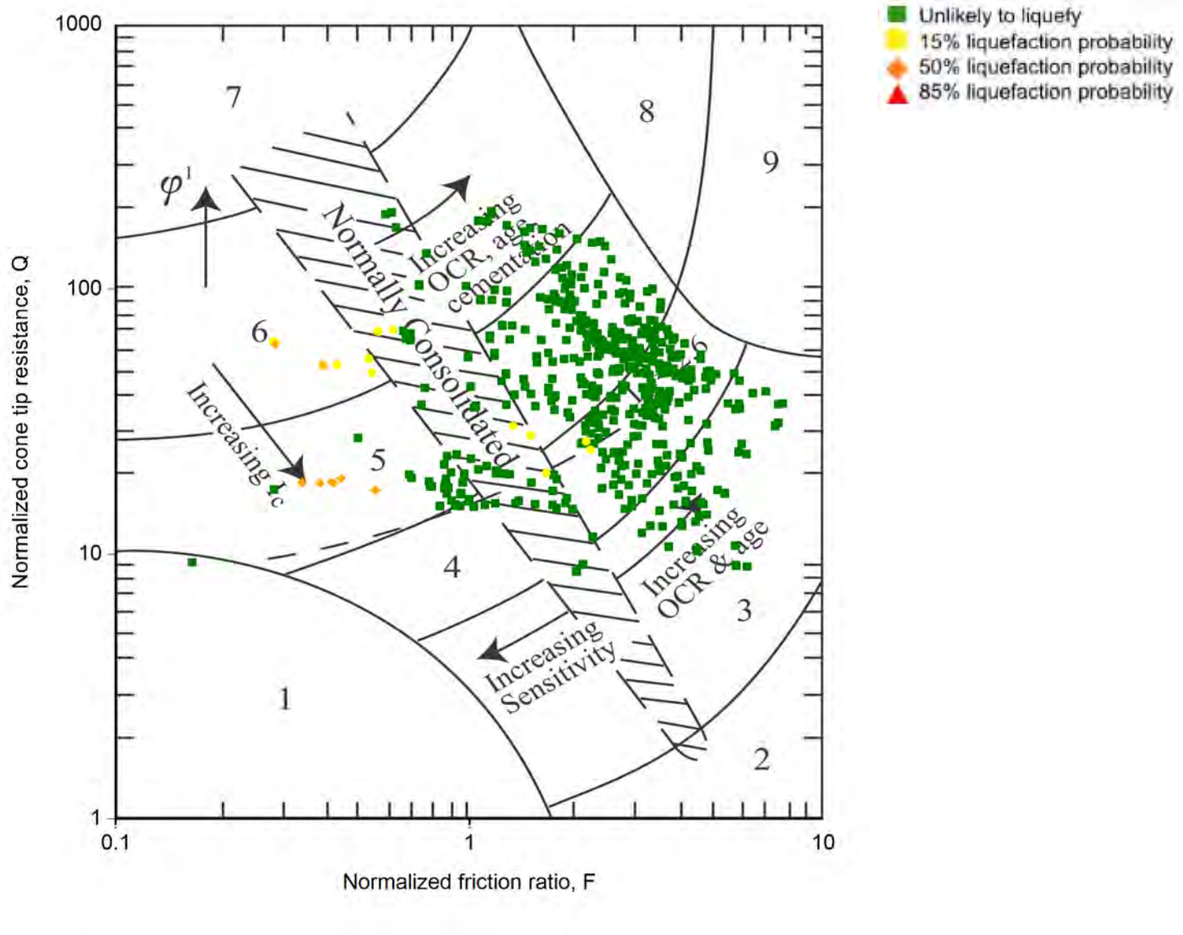
Tonkin + Taylor

Exceptional thinking together

V2.4.15

CLIENT	**Brymer Farms Ltd**	LOCATION	Hamilton
PROJECT	**Brymer Farms Subdivision**		
TITLE	**Liquefaction Analyses**	JOB NUMBER	**1017355.0000**
COMMENT	1 in 500 Year Event - ULS IL2		

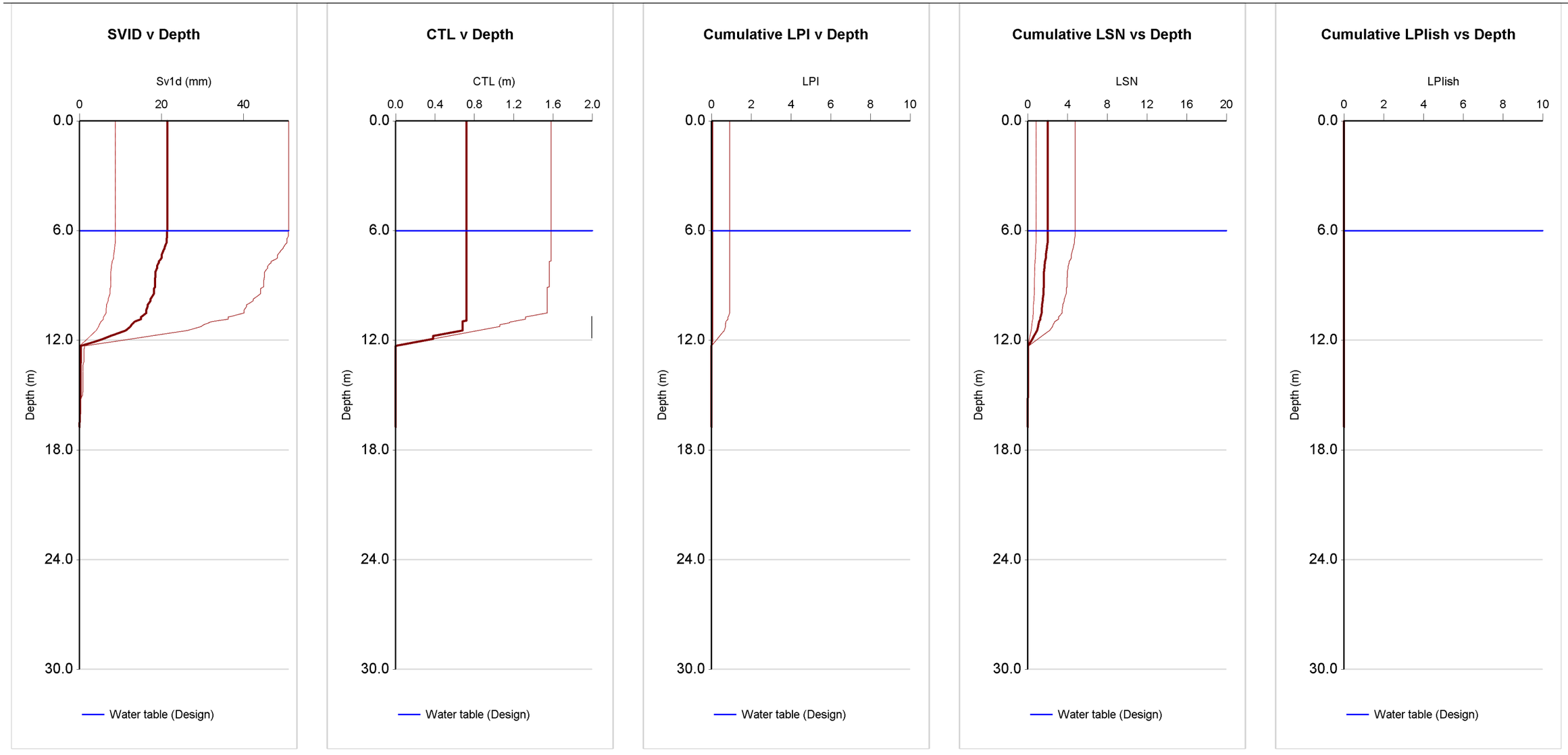
DATE	24/06/2021
ANALYSED	cand
PAGE	34 of 47 pages



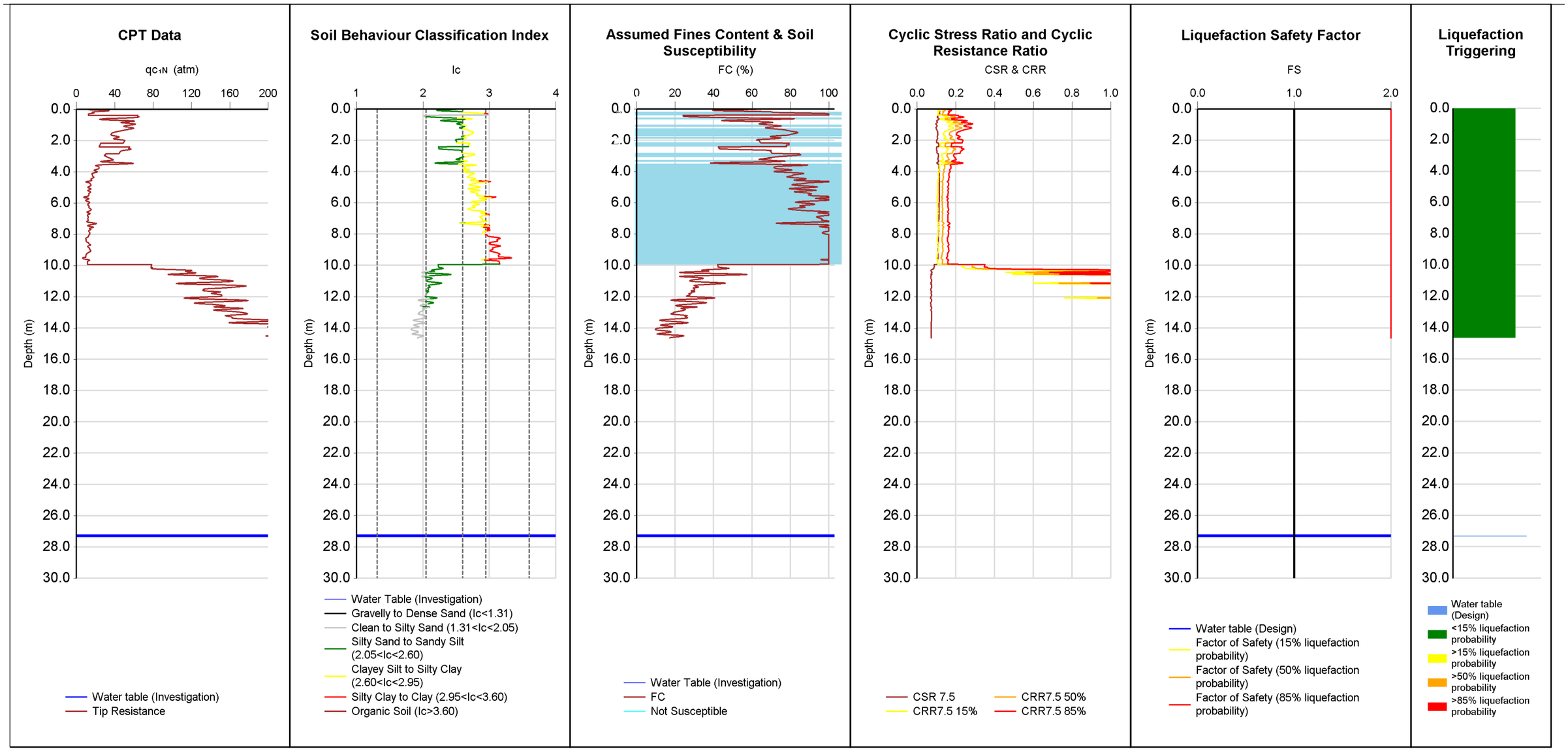
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT112	179001	17/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	



Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT113	179002	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	0	0	0	0	14.6	0
	50%	0	0	0	0	14.6	0
	85%	0	0	0	0	14.6	0

Reviewed by:

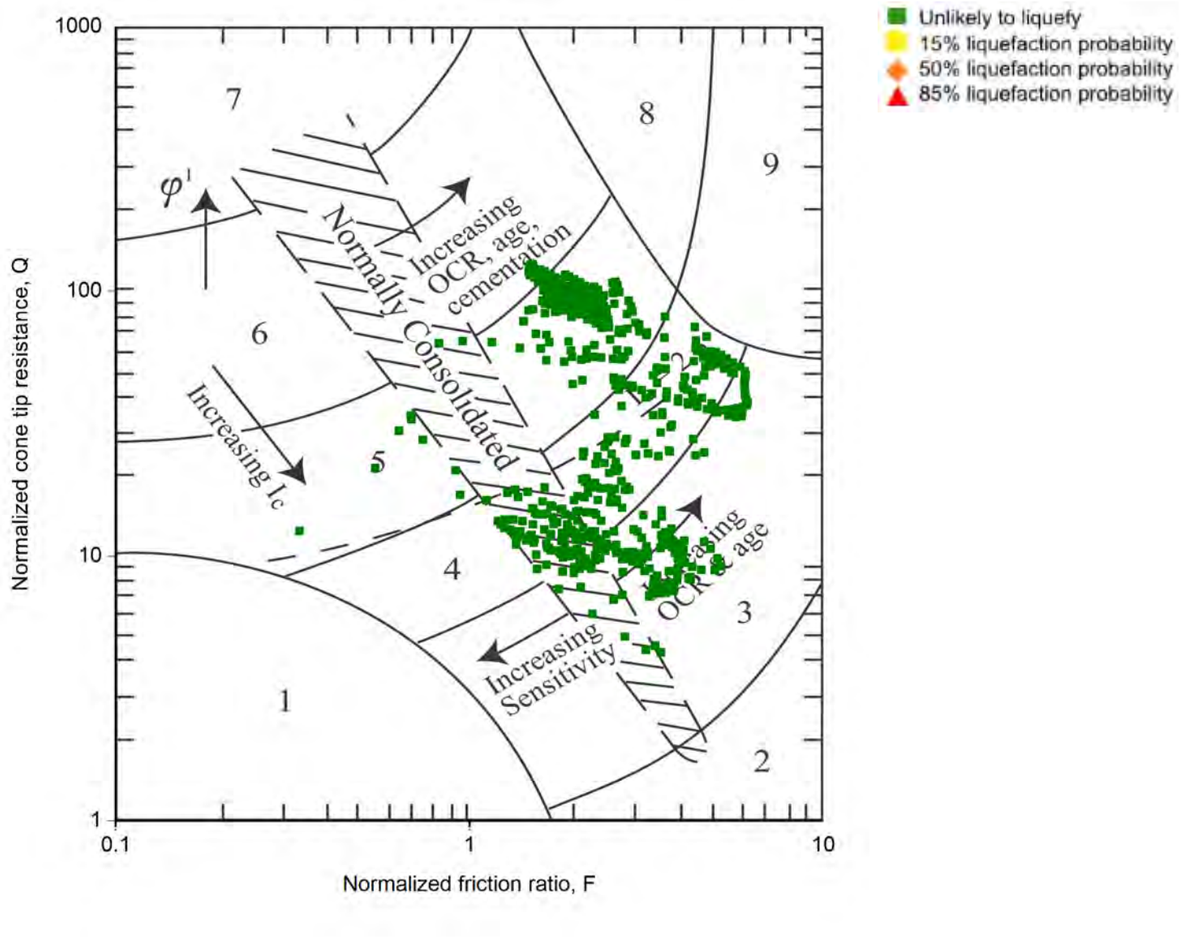
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc

Tonkin + Taylor

Exceptional thinking together

V2.4.15

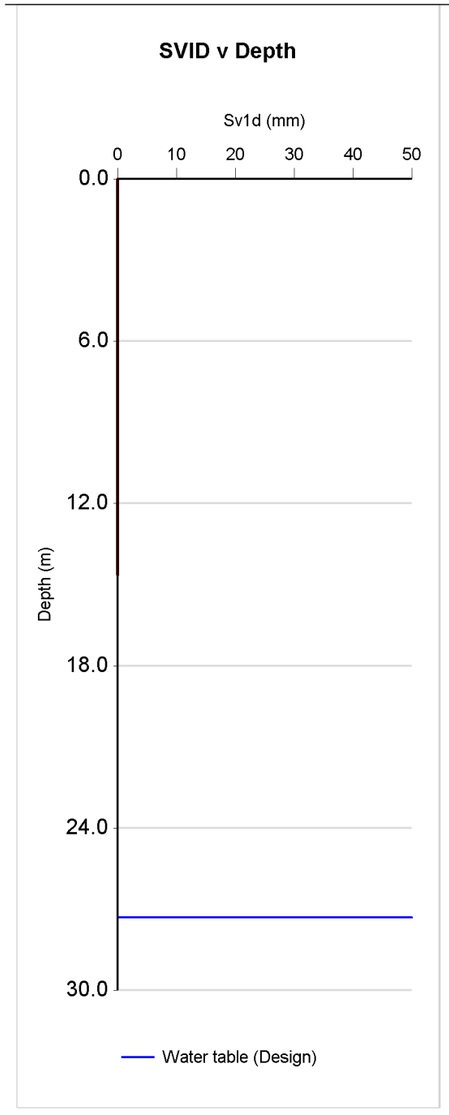
CLIENT	**Brymer Farms Ltd**	LOCATION	Hamilton
PROJECT	**Brymer Farms Subdivision**	DATE	24/06/2021
TITLE	**Liquefaction Analyses**	ANALYSED	cand
COMMENT	1 in 500 Year Event - ULS IL2	JOB NUMBER	**1017355.0000**
		PAGE	37 of 47 pages

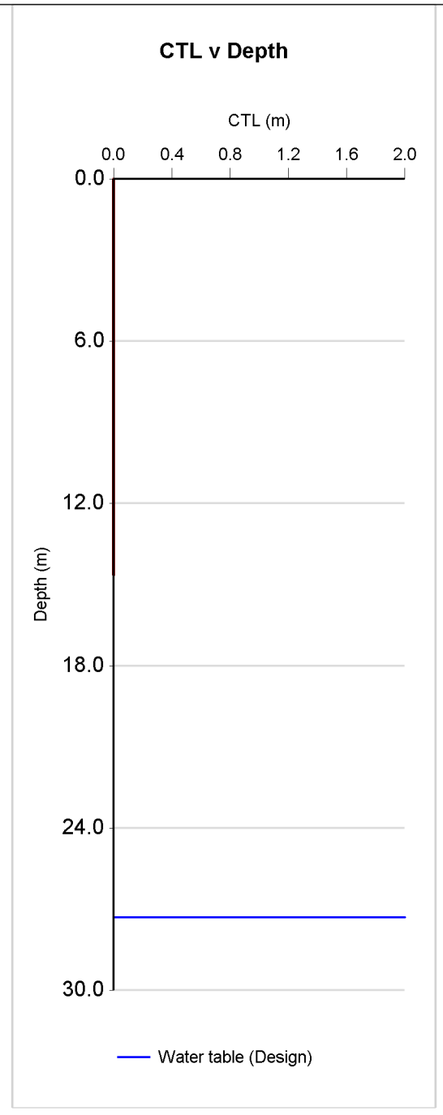


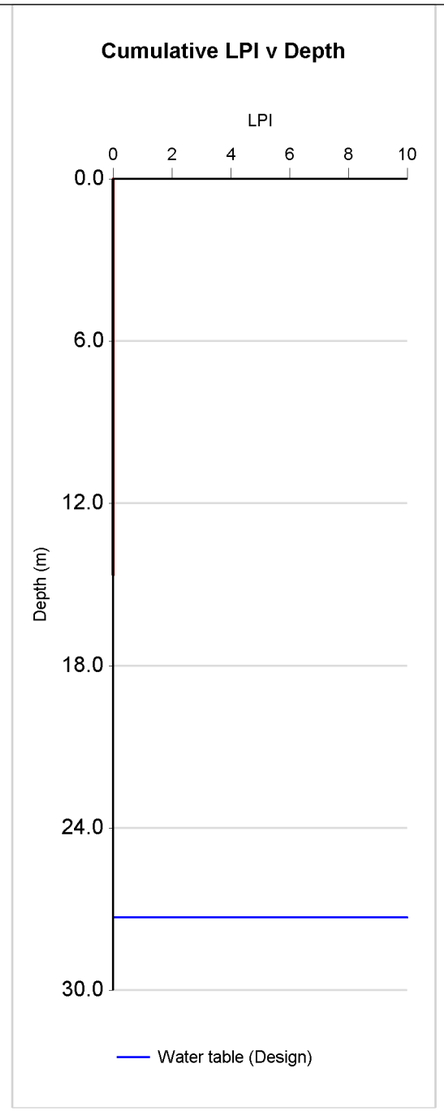
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

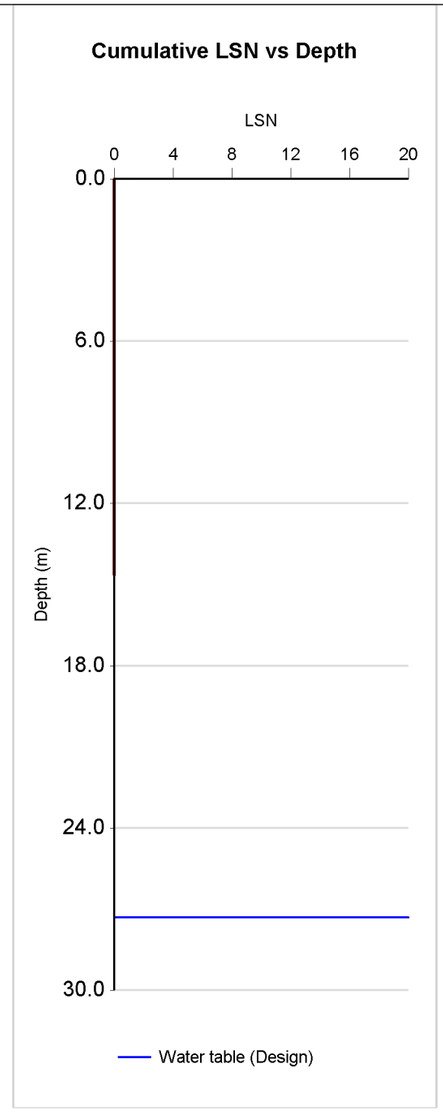
*Heavily overconsolidated or cemented

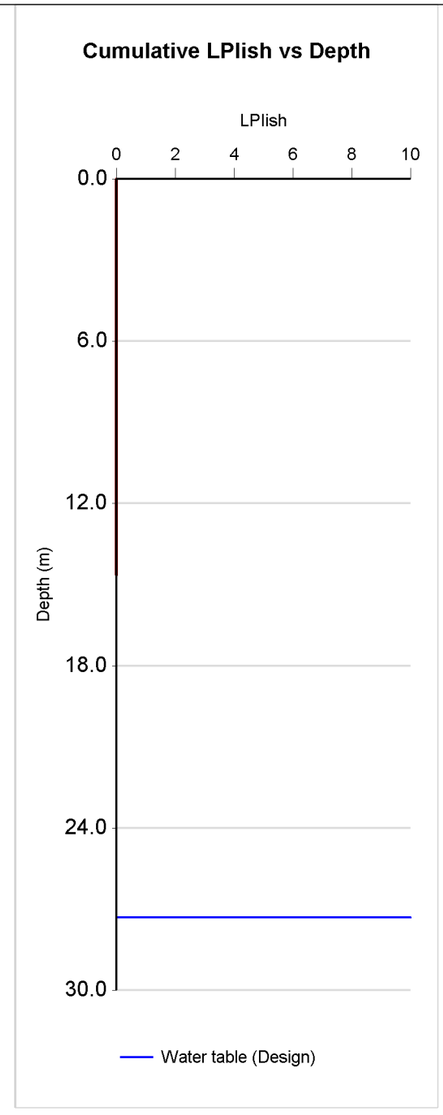
CPT-based soil behavior type classification chart by Robertson (1990)



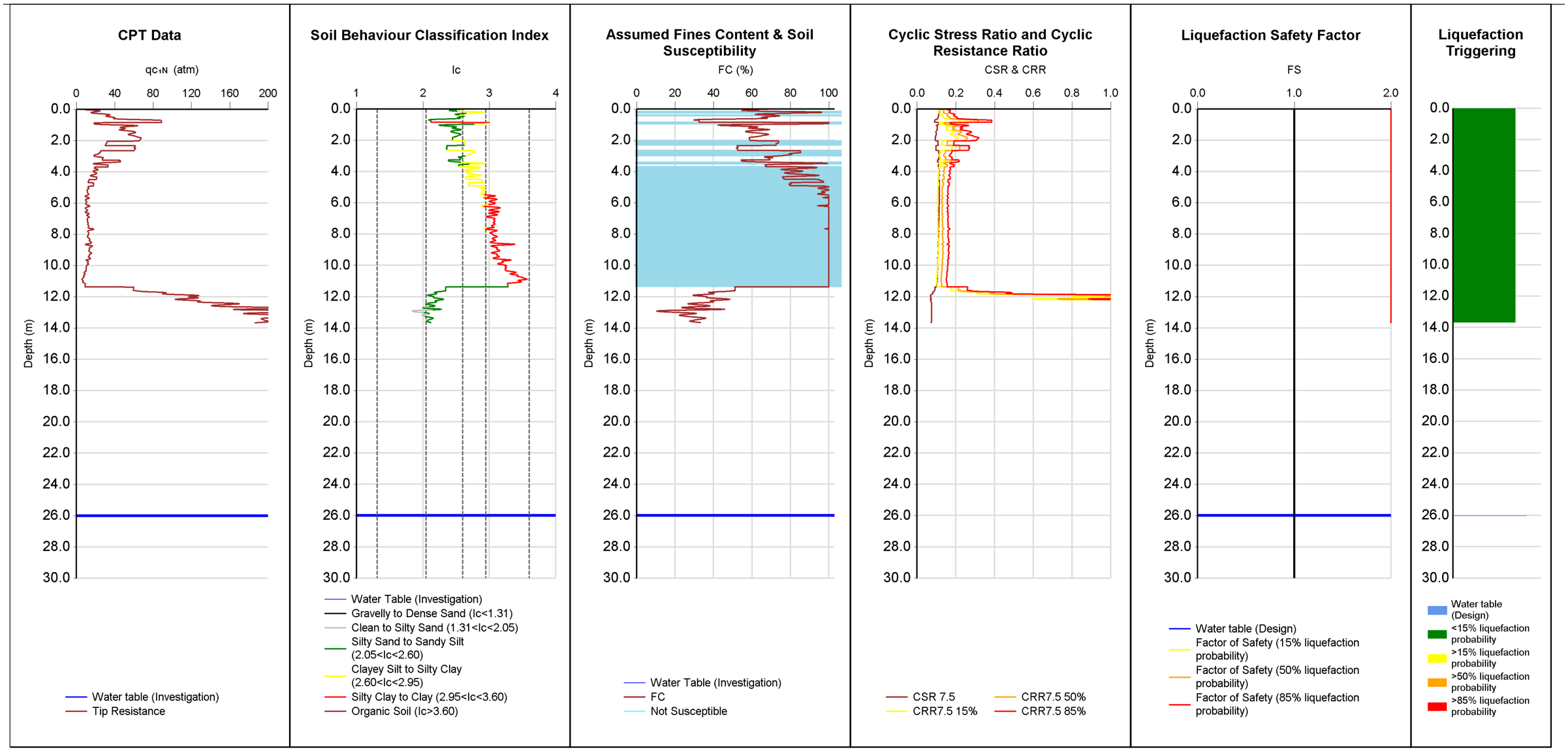








	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT113	179002	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	



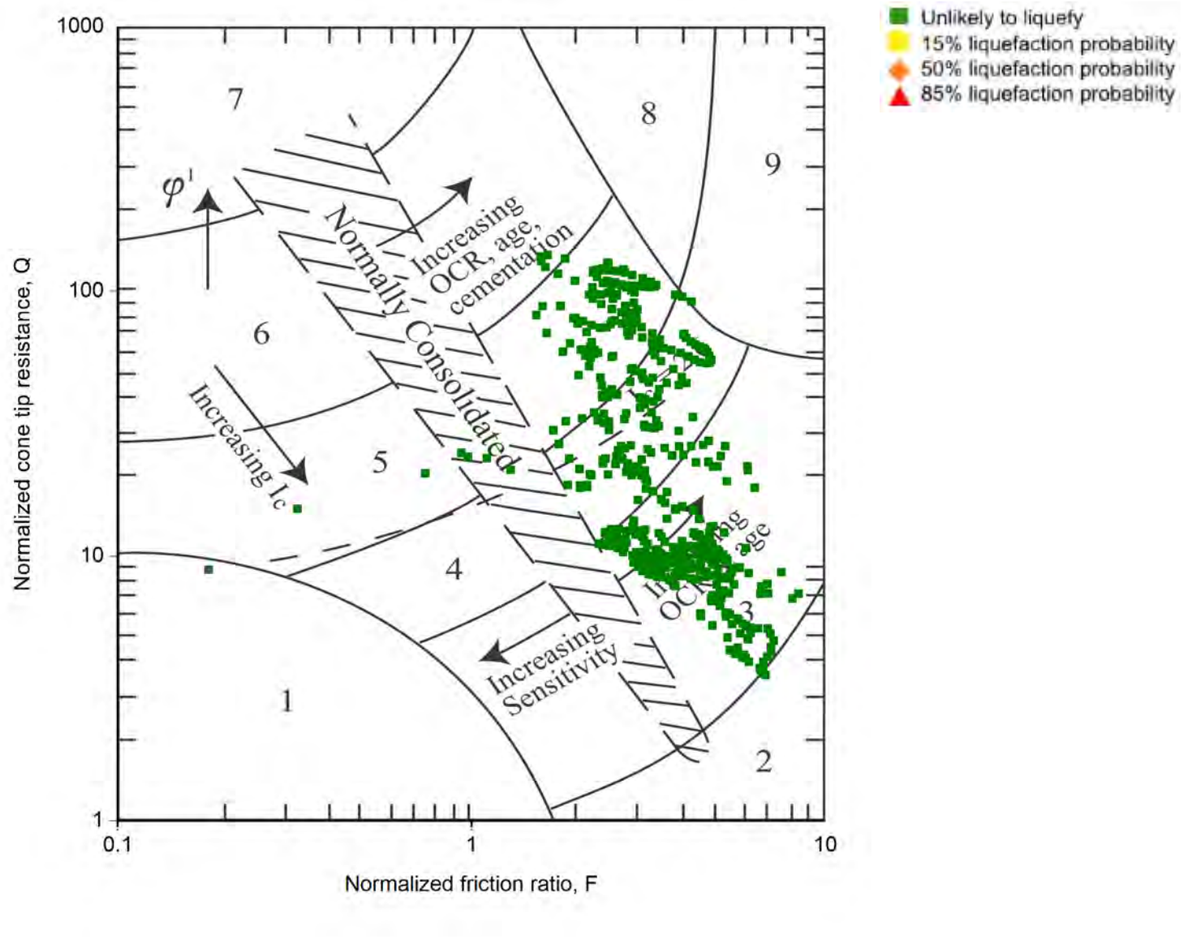
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT114	179003	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	0	0	0	0	13.7	0
	50%	0	0	0	0	13.7	0
	85%	0	0	0	0	13.7	0

Reviewed by:

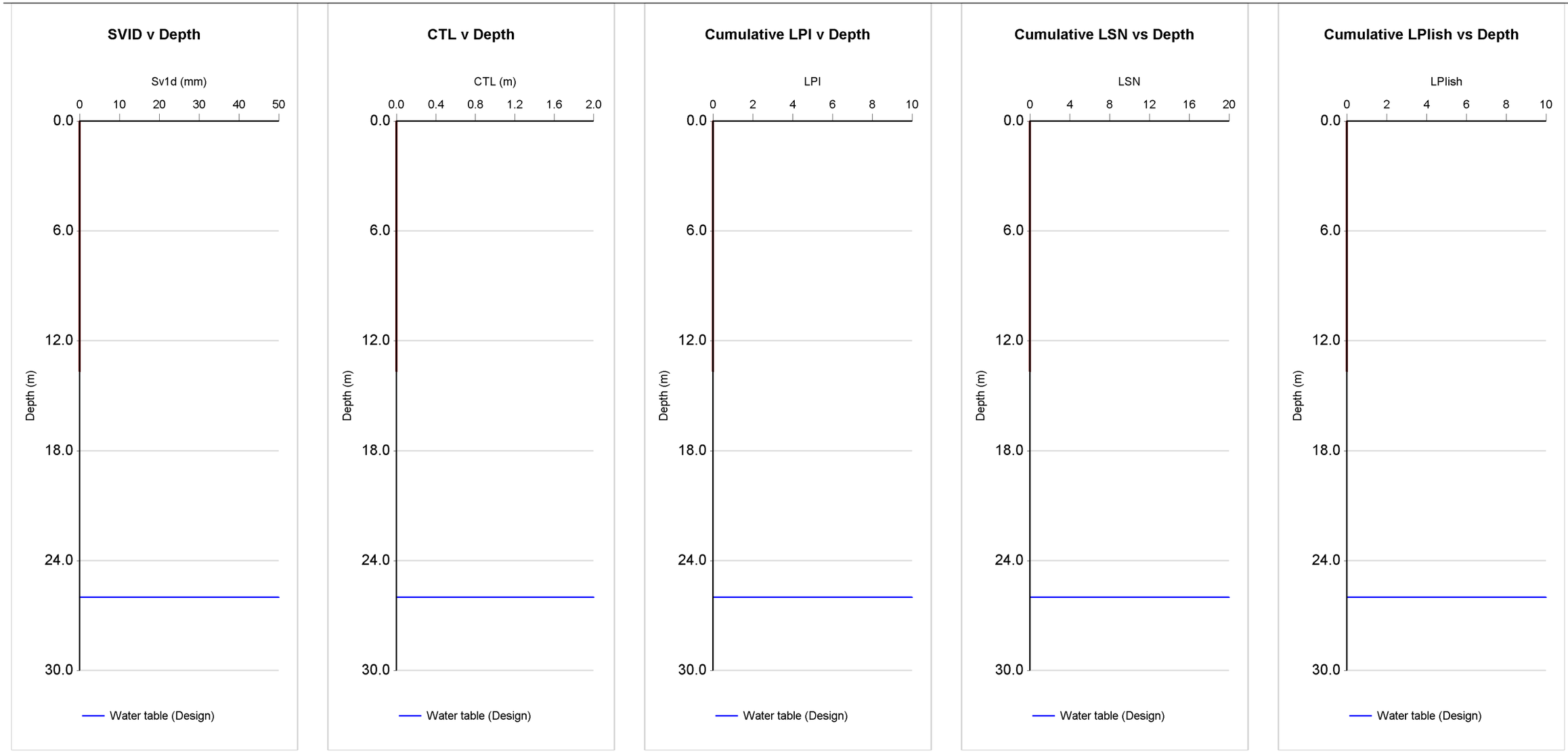
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT114	179003	18/05/2021	0	5.9	0.215	BI-2014	ZRB-2002	17		0	

Error: Subreport could not be shown.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

ID	TTGD 178990	TTGD 178991	TTGD 178992	TTGD 178993	TTGD 178994	TTGD 178995
CPT Name	CPT01, 584 Whatawhata Road, Hamilton	CPT02, 584 Whatawhata Road, Hamilton	CPT03, 584 Whatawhata Road, Hamilton	CPT04, 584 Whatawhata Road, Hamilton	CPT05, 584 Whatawhata Road, Hamilton	CPT06, 584 Whatawhata Road, Hamilton
Run description	CPT101	CPT102	CPT103	CPT104	CPT105	CPT106
PGA	0.215g	0.215g	0.215g	0.215g	0.215g	0.215g
Magnitude	5.9	5.9	5.9	5.9	5.9	5.9
Depth to groundwater at time of Investigation (m)	20	0.4	0.4	0.4	0.7	0.45
Depth to groundwater for design (m)	20	0.4	0.4	0.4	0.4	0.4
Predrill depth (m)	0	0	0	0	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002	ZRB-2002	ZRB-2002	ZRB-2002	ZRB-2002
Total depth of CPT (m)	29	20.02	15.92	14.3	8.72	20.02
Minimum depth of analysis (m)	0	0	0	0	0	0
Maximum depth of analysis (m)	30	30	30	30	30	30
Inverse Filtering applied?	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
TTGD 178990	CPT101	0	0	0
TTGD 178990	CPT101	0	0.01	0
TTGD 178990	CPT101	0.01	30	2.6
TTGD 178991	CPT102	0	0	0
TTGD 178991	CPT102	0	0.01	0
TTGD 178991	CPT102	0.01	30	2.6
TTGD 178992	CPT103	0	0	0
TTGD 178992	CPT103	0	0.01	0
TTGD 178992	CPT103	0.01	30	2.6
TTGD 178993	CPT104	0	0	0
TTGD 178993	CPT104	0	0.01	0
TTGD 178993	CPT104	0.01	30	2.6
TTGD 178994	CPT105	0	0	0
TTGD 178994	CPT105	0	0.01	0
TTGD 178994	CPT105	0.01	30	2.6
TTGD 178995	CPT106	0	0	0
TTGD 178995	CPT106	0	0.01	0
TTGD 178995	CPT106	0.01	30	2.6
TTGD 178996	CPT107	0	0	0
TTGD 178996	CPT107	0	0.01	0
TTGD 178996	CPT107	0.01	30	2.6
TTGD 178997	CPT108	0	0	0
TTGD 178997	CPT108	0	0.01	0
TTGD 178997	CPT108	0.01	30	2.6
TTGD 178998	CPT109	0	0	0

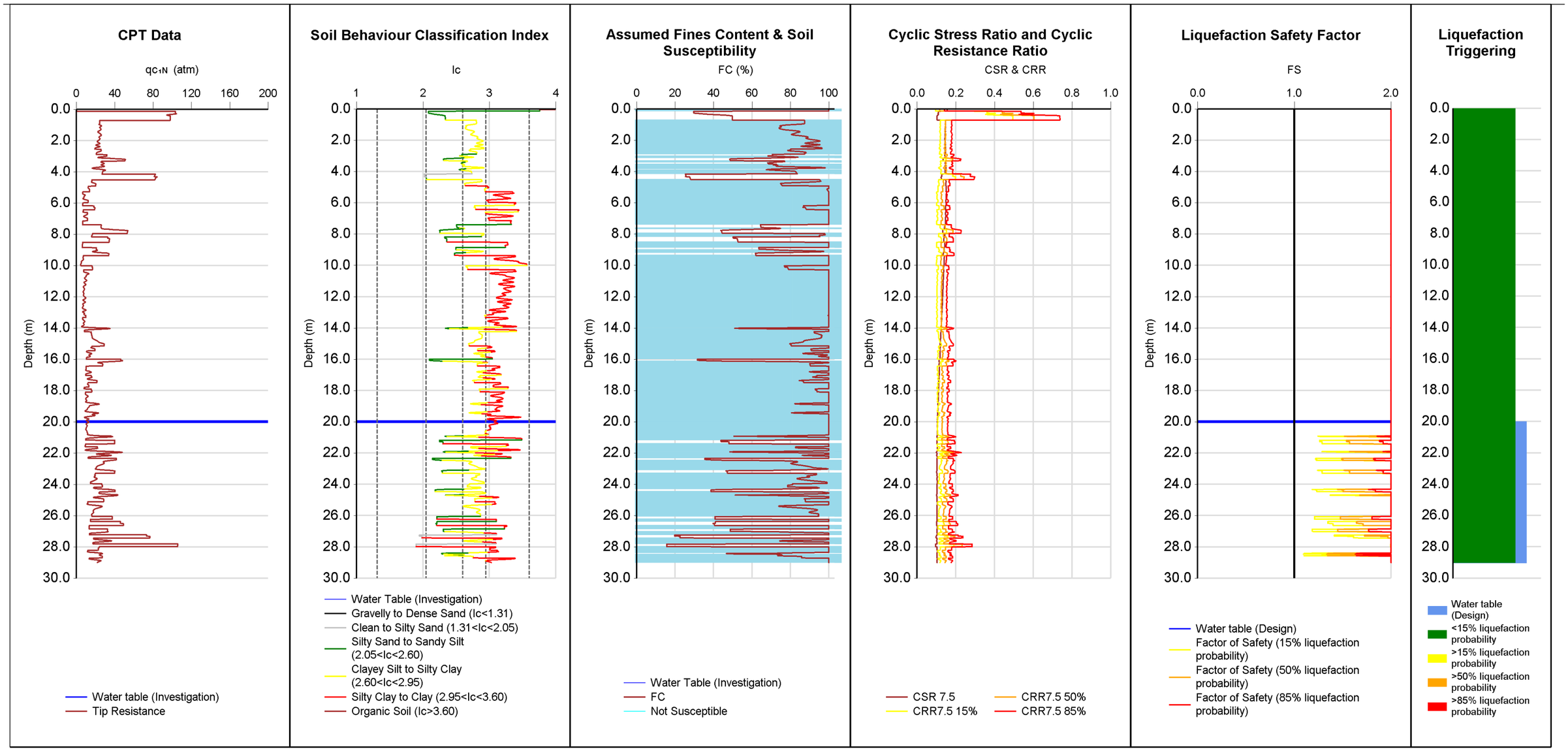
Table 1.1-3 Summary of Fc inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Fc
TTGD 178990	CPT101	0.01	30	0 CFC
TTGD 178991	CPT102	0	30	0 CFC
TTGD 178992	CPT103	0	30	0 CFC
TTGD 178993	CPT104	0	30	0 CFC
TTGD 178994	CPT105	0	30	0 CFC
TTGD 178995	CPT106	0	30	0 CFC
TTGD 178996	CPT107	0	30	0 CFC
TTGD 178997	CPT108	0	30	0 CFC
TTGD 178998	CPT109	0	30	0 CFC
TTGD 178999	CPT110	0	30	0 CFC
TTGD 179000	CPT111	0	30	0 CFC
TTGD 179001	CPT112	0	30	0 CFC
TTGD 179002	CPT113	0	30	0 CFC
TTGD 179003	CPT114	0	30	0 CFC

TTGD 178996	TTGD 178997	TTGD 178998	TTGD 178999	TTGD 179000	TTGD 179001	TTGD 179002
CPT07, 584 Whatawhata Road, Hamilton	CPT08, 584 Whatawhata Road, Hamilton	CPT09, 584 Whatawhata Road, Hamilton	CPT10, 584 Whatawhata Road, Hamilton	CPT11, 584 Whatawhata Road, Hamilton	CPT12, 584 Whatawhata Road, Hamilton	CPT13, 584 Whatawhata Road, Hamilton
CPT107	CPT108	CPT109	CPT110	CPT111	CPT112	CPT113
0.215g	0.215g	0.215g	0.215g	0.215g	0.215g	0.215g
5.9	5.9	5.9	5.9	5.9	5.9	5.9
0.5	0.54	0.4	0.48	0.4	6	27.3
0.4	0.4	0.4	0.4	0.4	6	27.3
0	0	0	0	0	0	0
qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
ZRB-2002	ZRB-2002	ZRB-2002	ZRB-2002	ZRB-2002	ZRB-2002	ZRB-2002
7.12	11.38	11.66	10.02	17.2	16.74	14.64
0	0	0	0	0	0	0
30	30	30	30	30	30	30
Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)

TTGD 179003
CPT14, 584 Whatawhata Road, Hamilton
CPT114
0.215g
5.9
26
26
0
qc= 2 MPa & Fs= 0.01 MPa
Boulanger & Idriss (2014)
ZRB-2002
13.66
0
30
Yes (10 cm^2)

TTGD 178998	CPT109	0	0.01	0
TTGD 178998	CPT109	0.01	30	2.6
TTGD 178999	CPT110	0	0	0
TTGD 178999	CPT110	0	0.01	0
TTGD 178999	CPT110	0.01	30	2.6
TTGD 179000	CPT111	0	0	0
TTGD 179000	CPT111	0	0.01	0
TTGD 179000	CPT111	0.01	30	2.6
TTGD 179001	CPT112	0	0	0
TTGD 179001	CPT112	0	0.01	0
TTGD 179001	CPT112	0.01	30	2.6
TTGD 179002	CPT113	0	0	0
TTGD 179002	CPT113	0	0.01	0
TTGD 179002	CPT113	0.01	30	2.6
TTGD 179003	CPT114	0	0	0
TTGD 179003	CPT114	0	0.01	0
TTGD 179003	CPT114	0.01	30	2.6



Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT101	178990	17/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	6	0	0	0	29	0
	50%	3	0	0	0	29	0
	85%	1	0	0	0	29	0

Reviewed by:

CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc

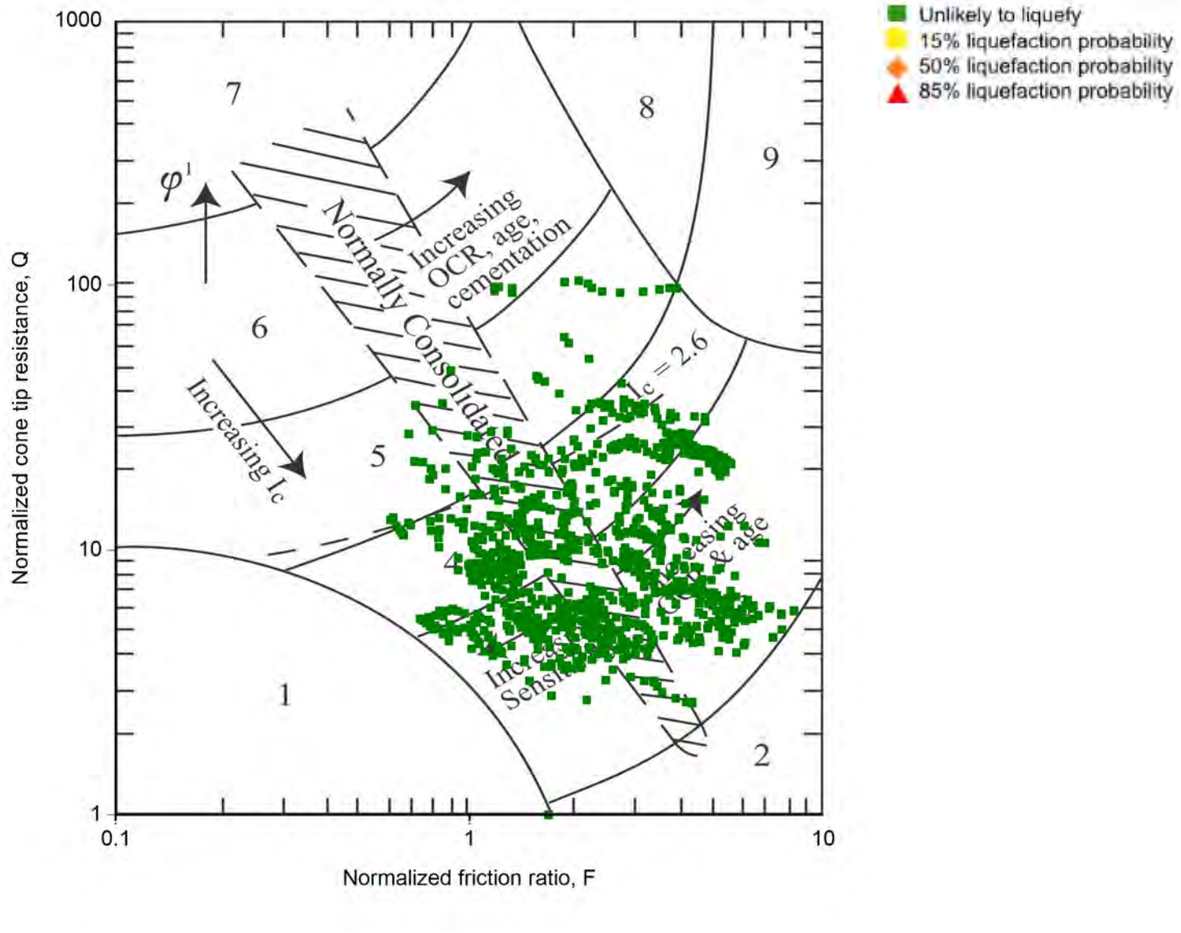
Tonkin + Taylor

Exceptional thinking together

V2.4.15

CLIENT	**Brymer Farms Ltd**	LOCATION	Hamilton
PROJECT	**Brymer Farms Subdivision**		
TITLE	**Liquefaction Analyses**	JOB NUMBER	**1017355.0000**
COMMENT	1 in 1000 Year Event - ULS IL3		

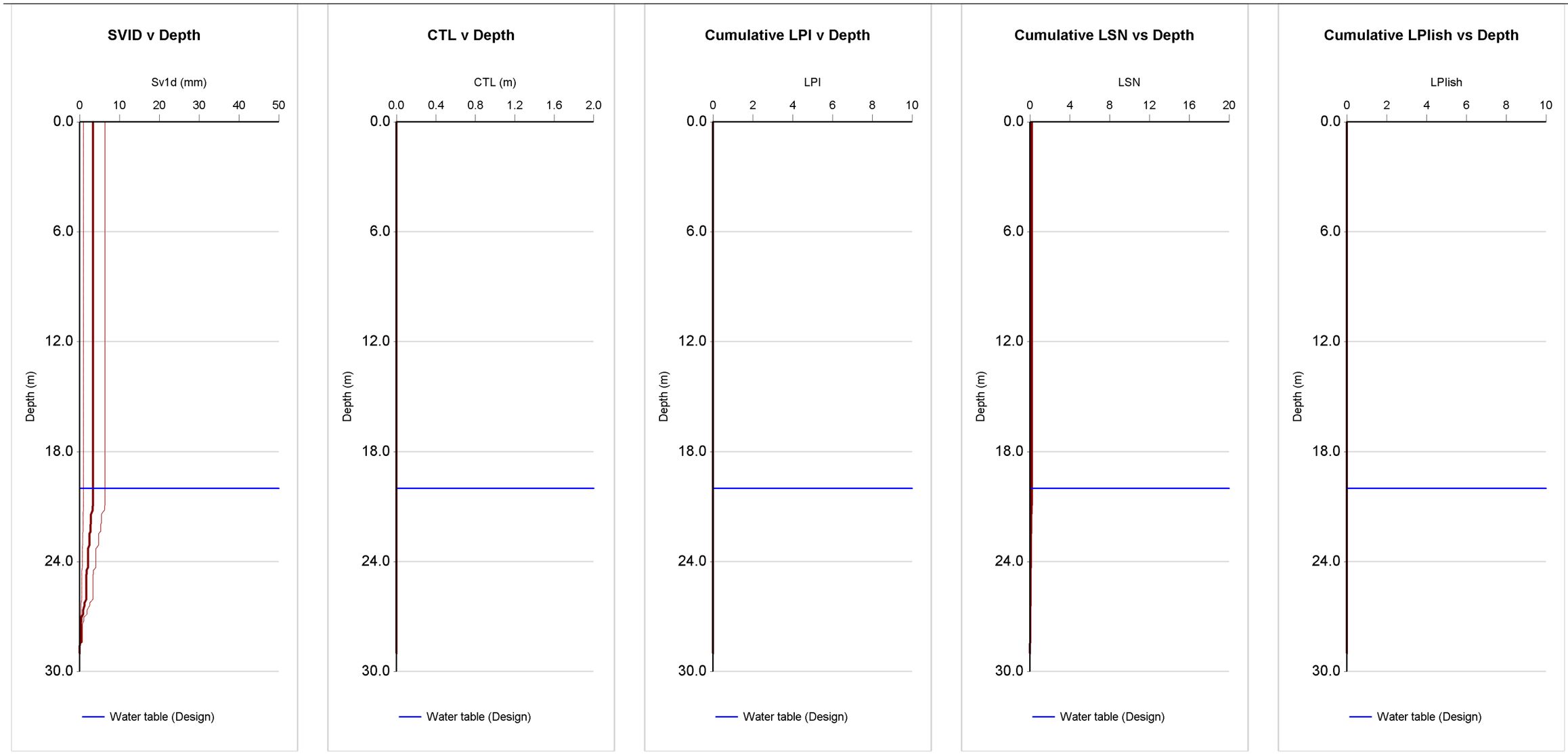
DATE	24/06/2021
ANALYSED	cand
PAGE	1 of 47 pages



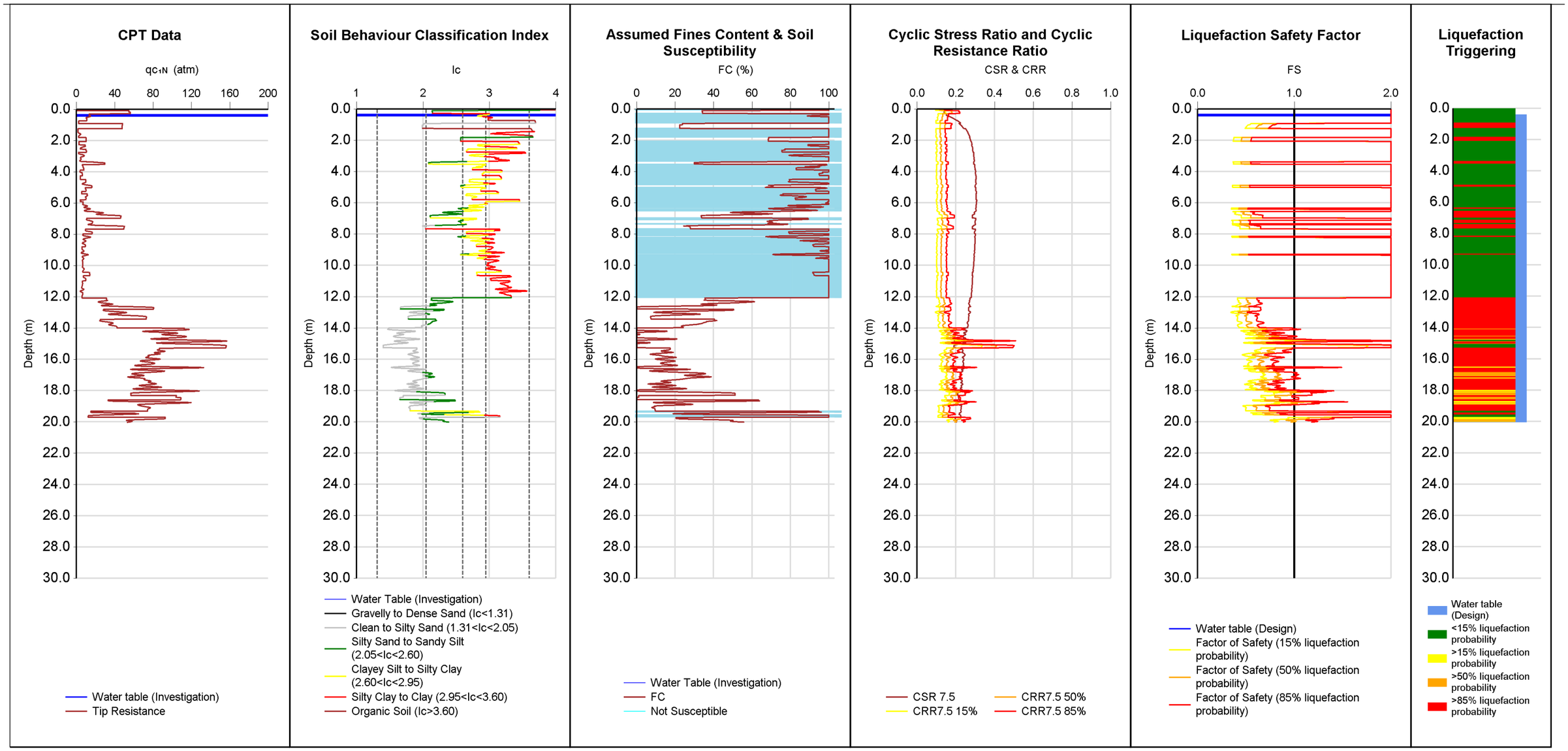
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT101	178990	17/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	



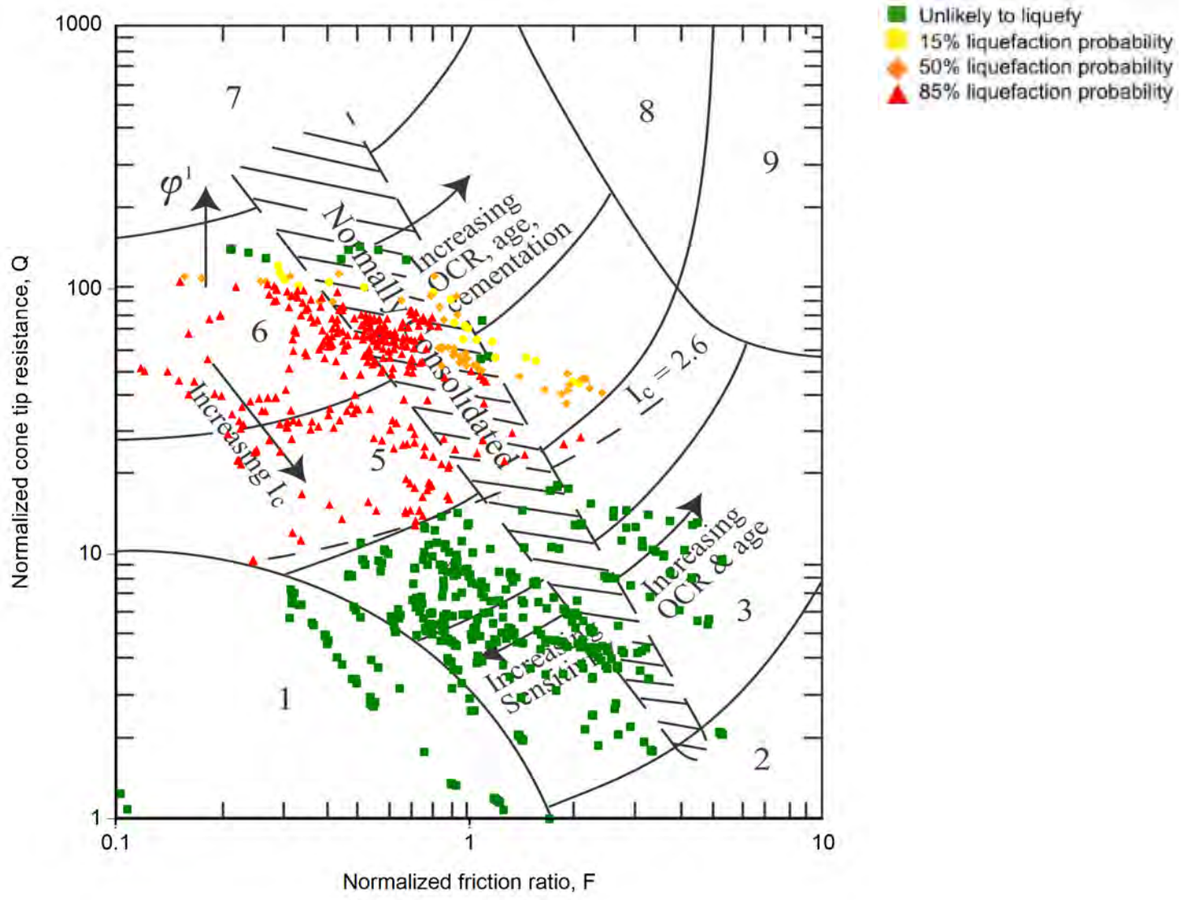
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT102	178991	17/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	241	9.4	16	32	1	15
	50%	227	8.9	13	31	1	12
	85%	203	7.7	9	29	1	8

Reviewed by:

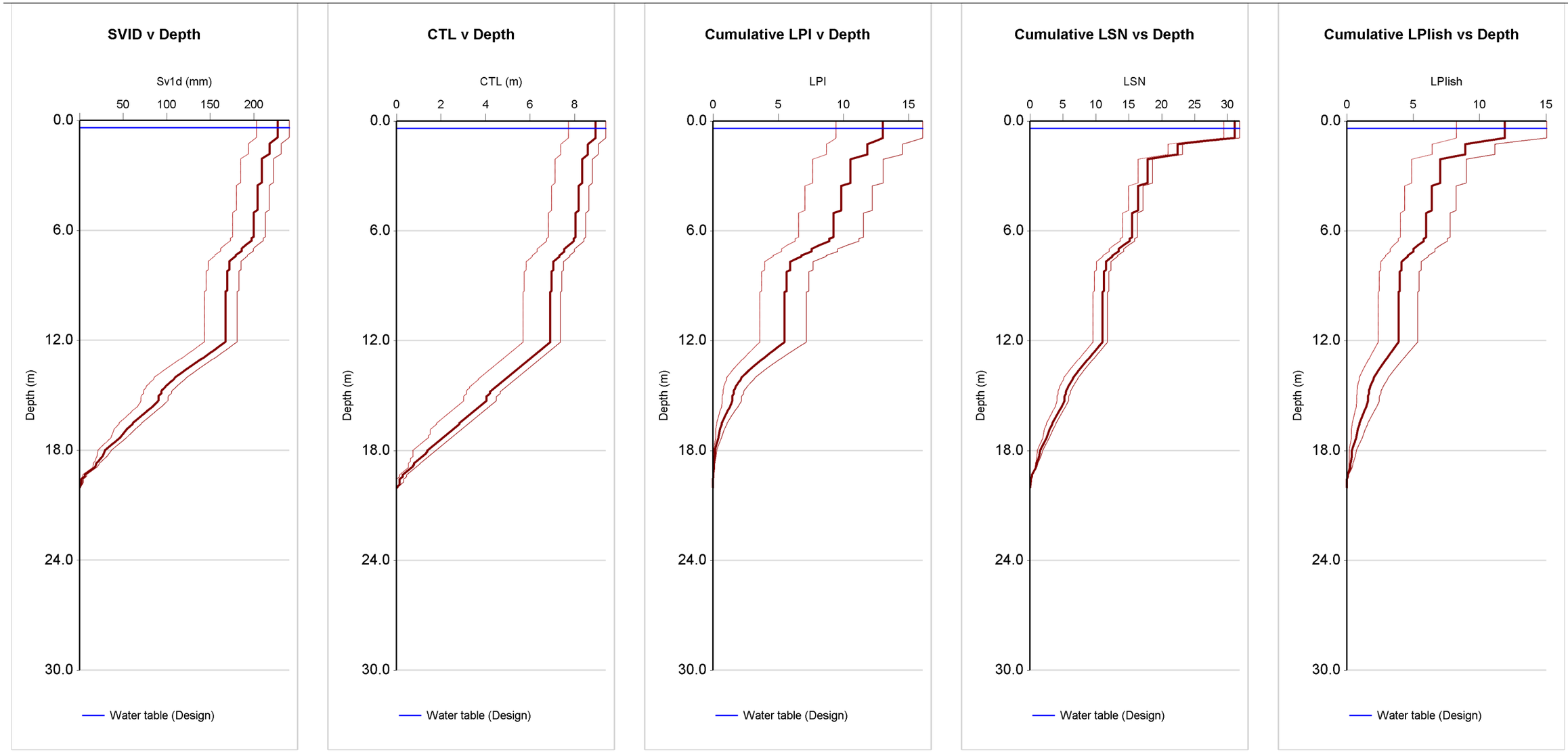
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



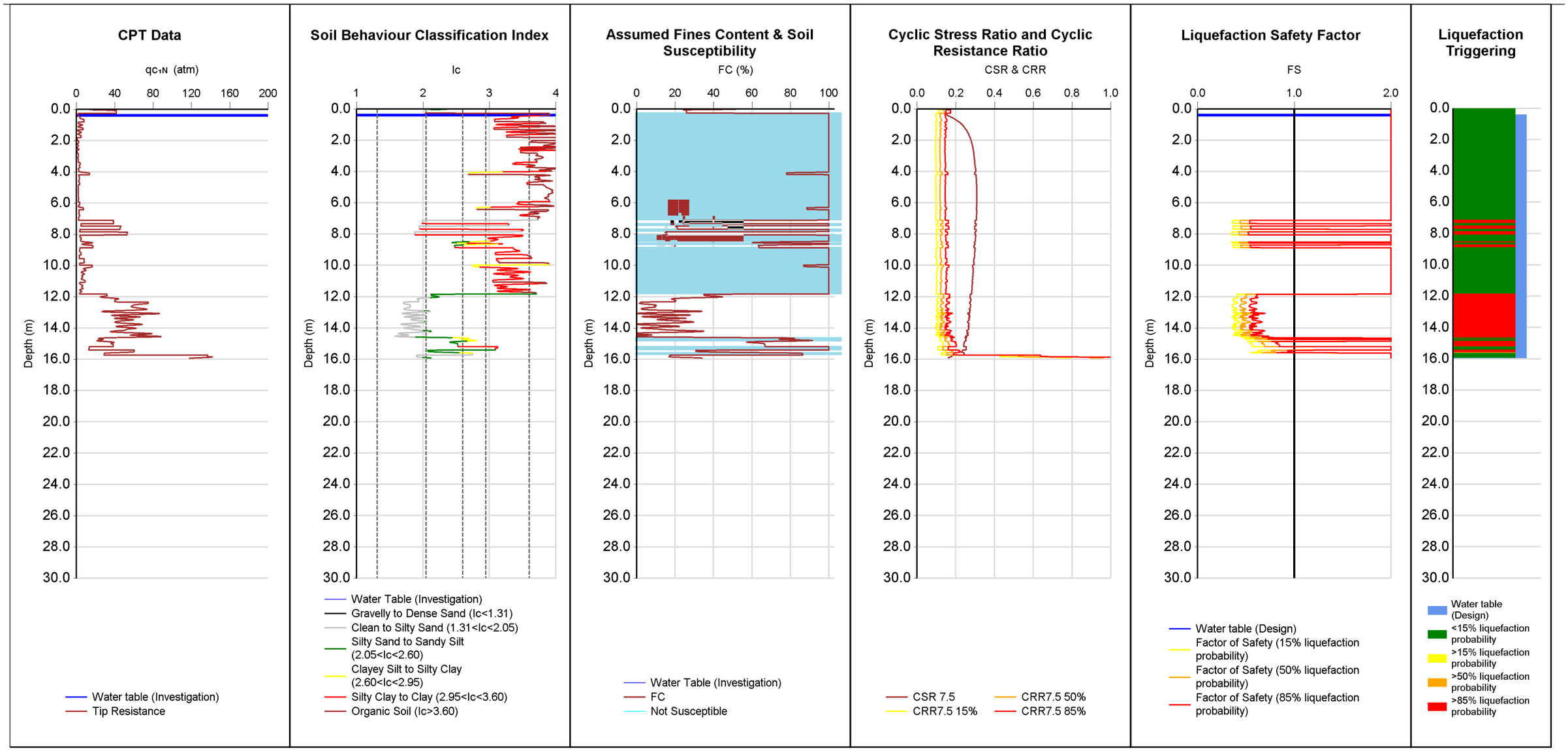
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT102	178991	17/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	



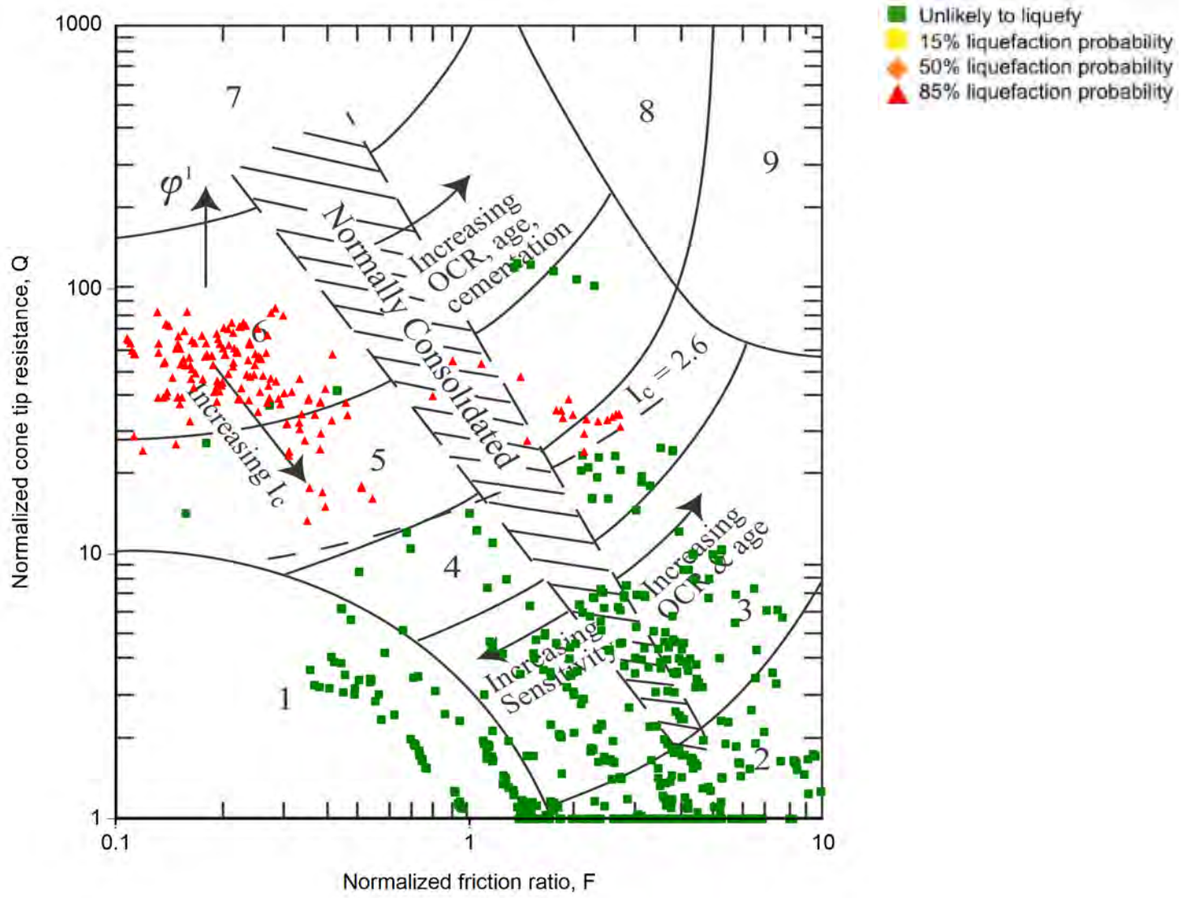
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT103	178992	17/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	130	4.2	10	11	7.2	0
	50%	130	4.2	8	11	7.2	0
	85%	127	4.2	7	11	7.2	0

Reviewed by:

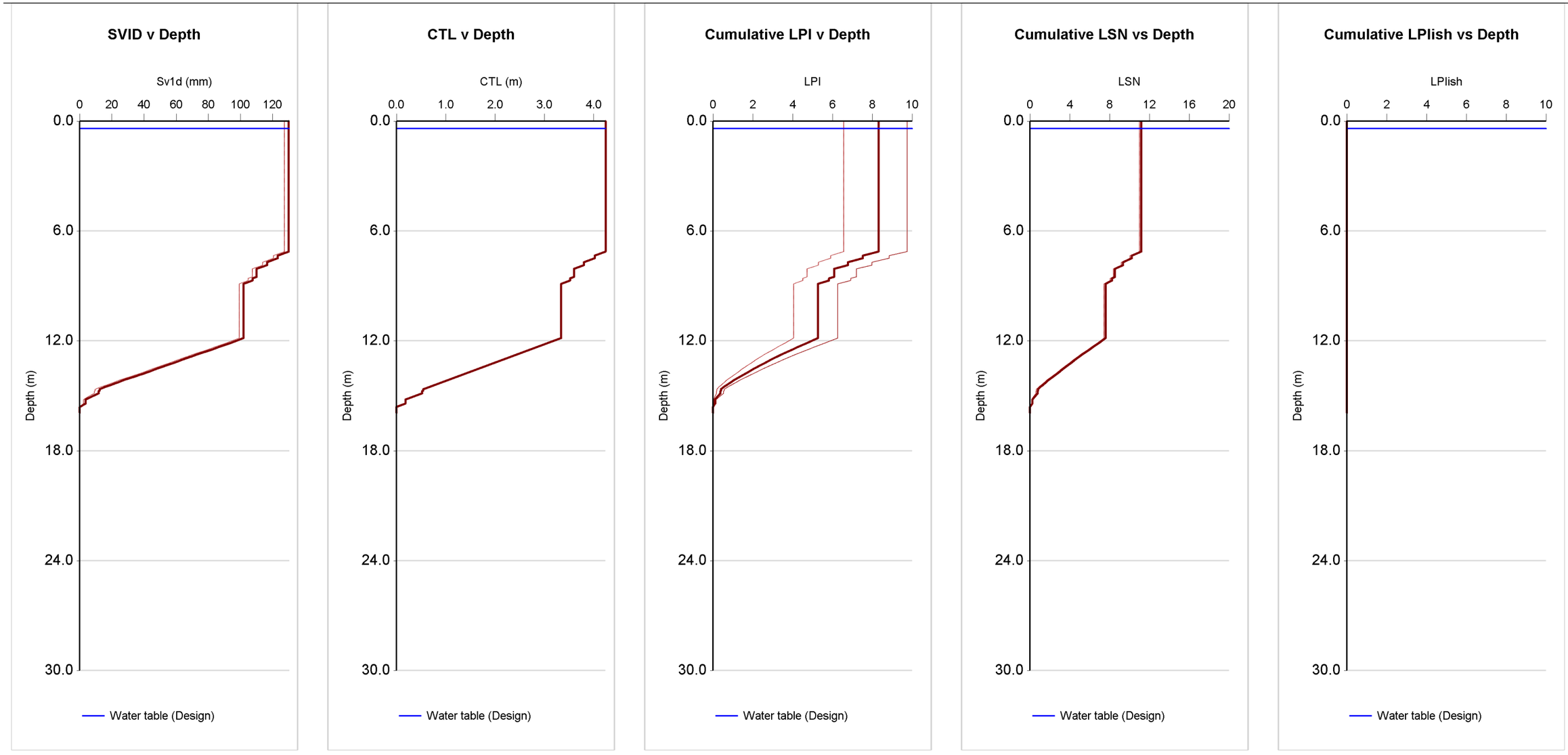
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



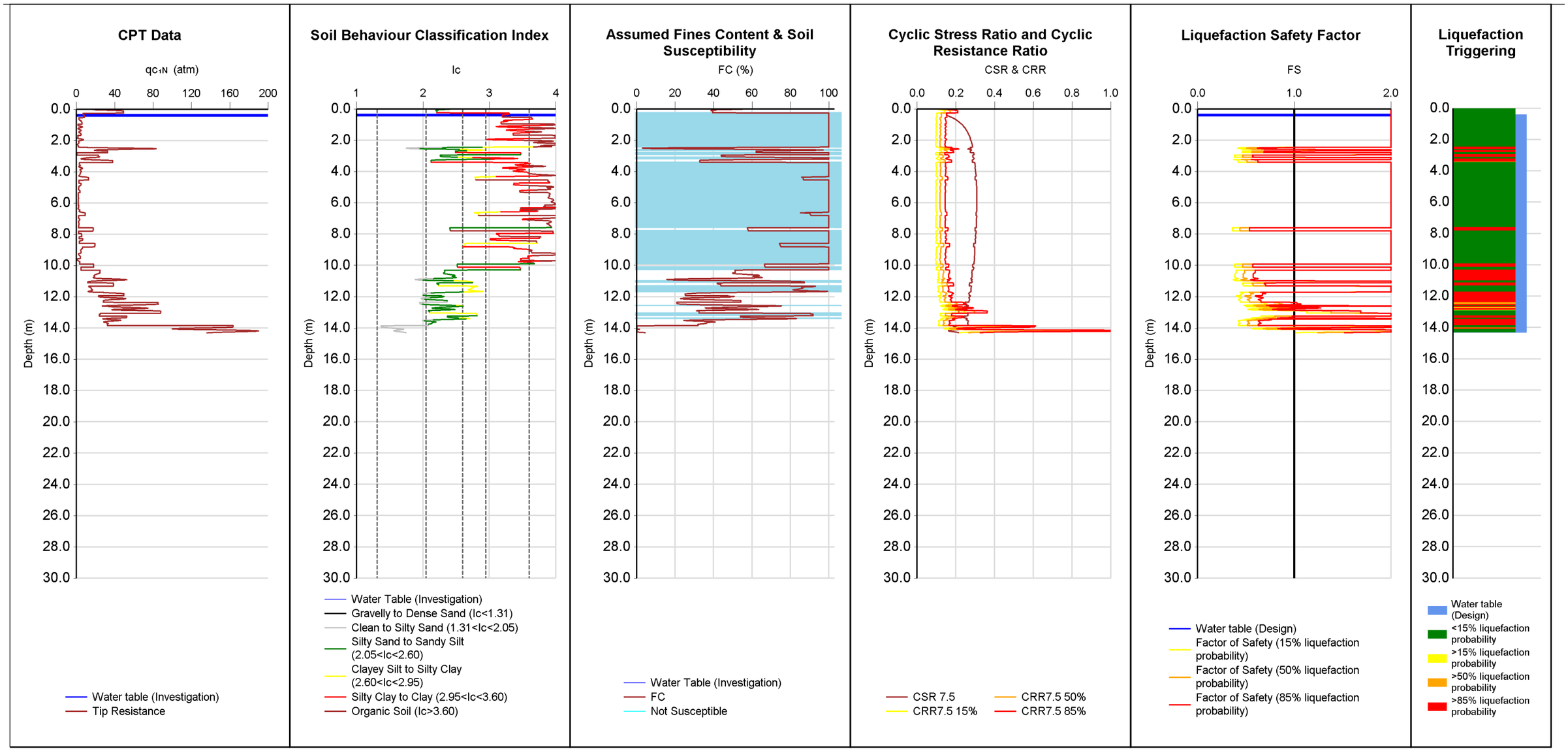
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT103	178992	17/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	



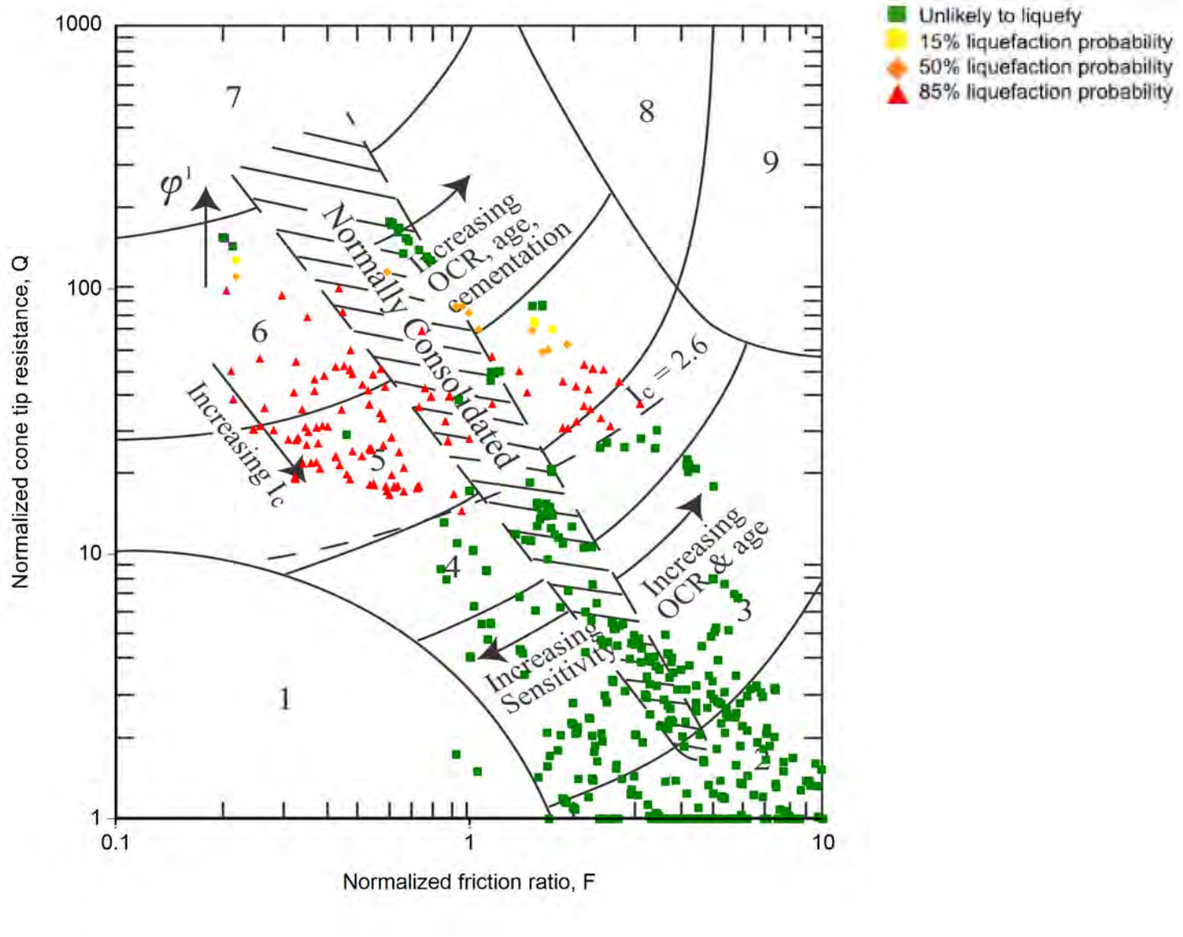
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT104	178993	17/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	101	3.7	10	13	2.5	7
	50%	98	3.7	8	13	2.5	6
	85%	93	3.4	6	13	2.5	4

Reviewed by:

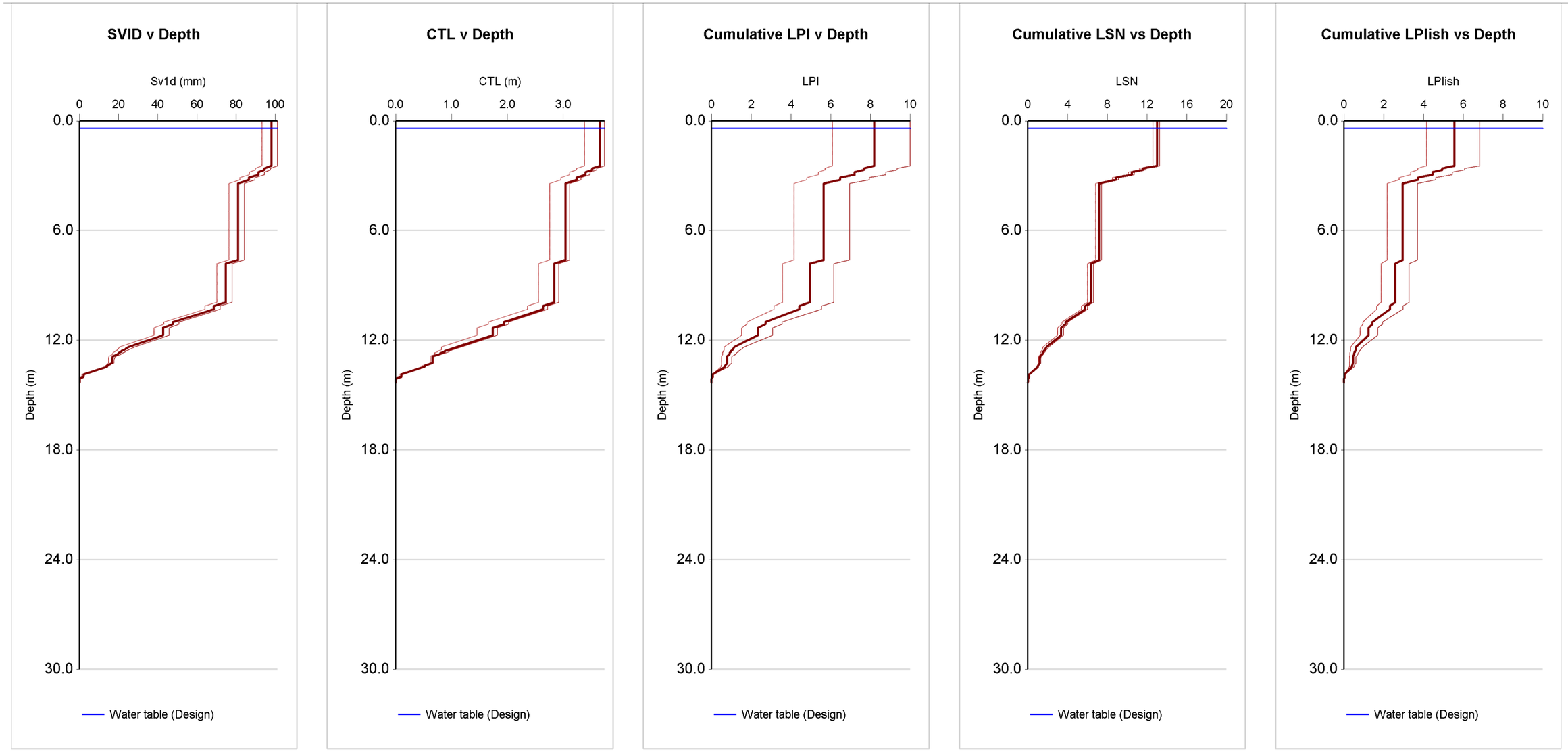
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



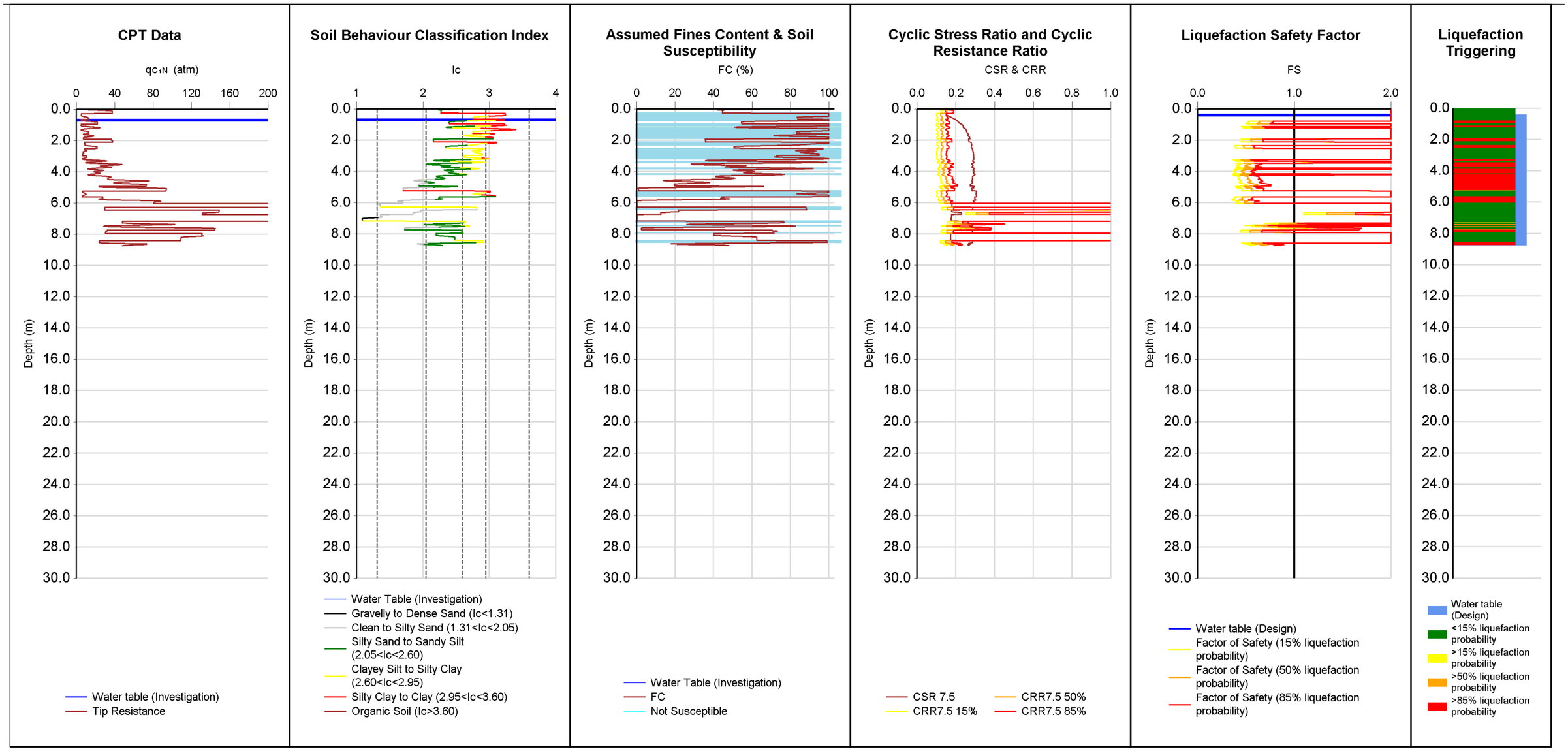
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT104	178993	17/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	



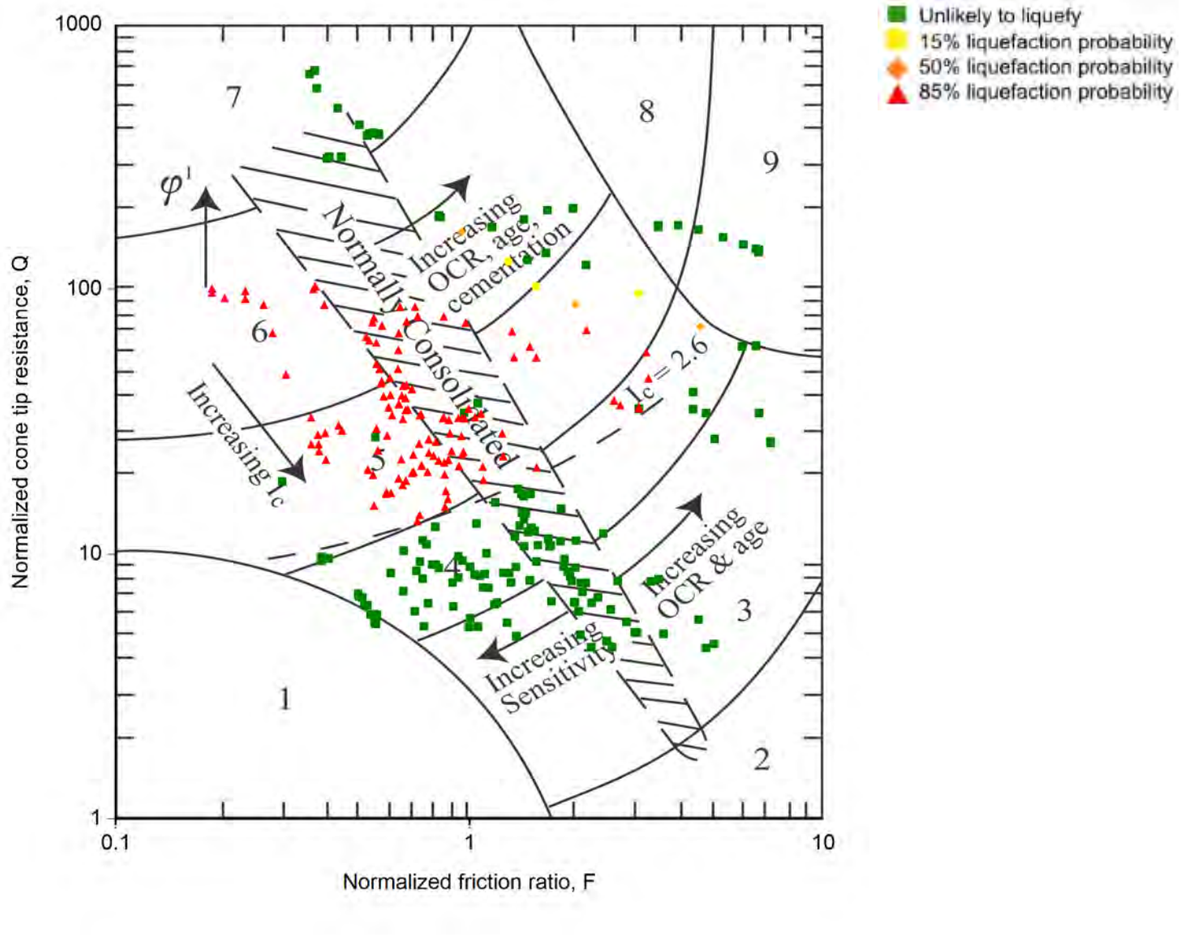
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT105	178994	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	90	3.4	14	29	0.9	14
	50%	89	3.3	12	28	0.9	12
	85%	87	3.2	9	28	0.9	9

Reviewed by:

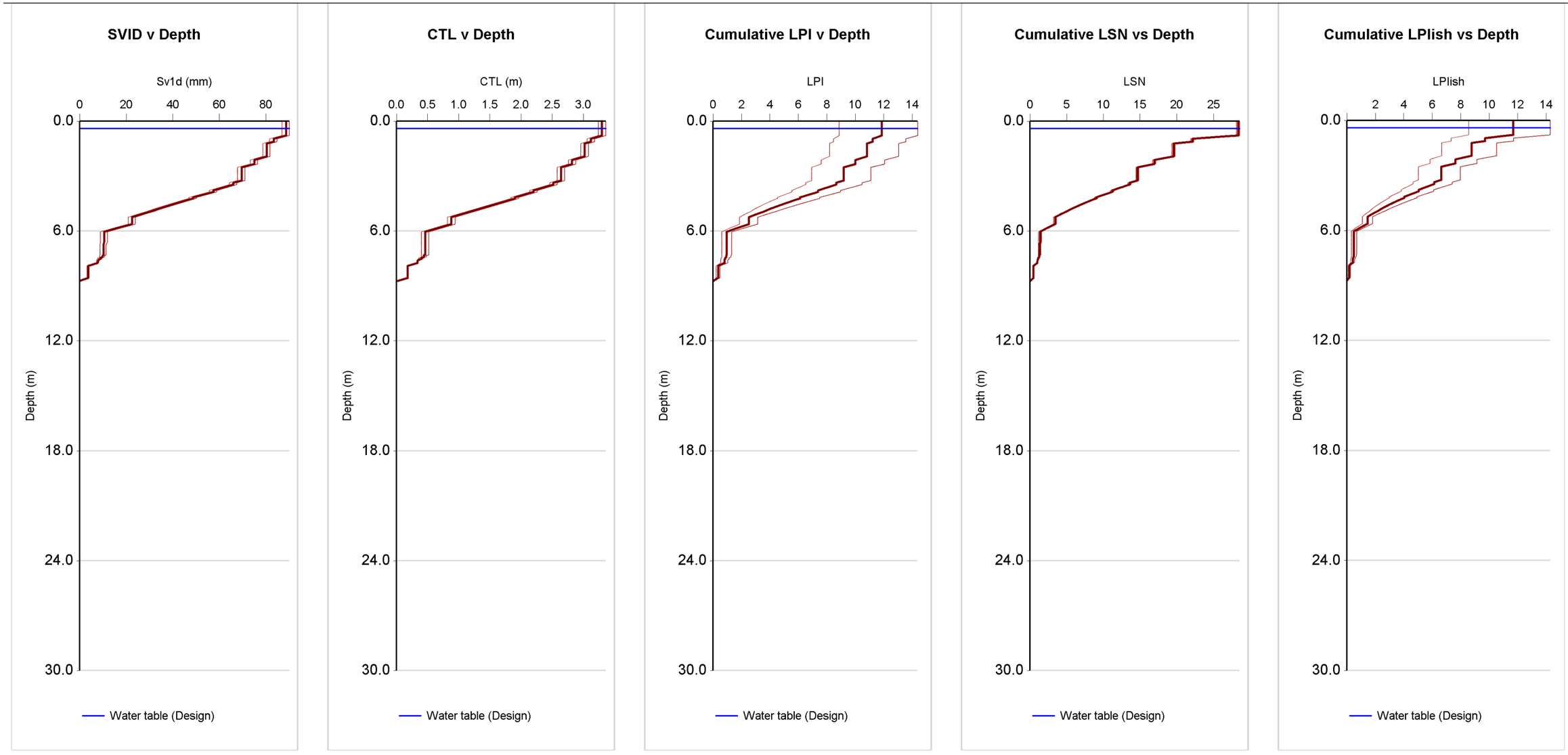
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



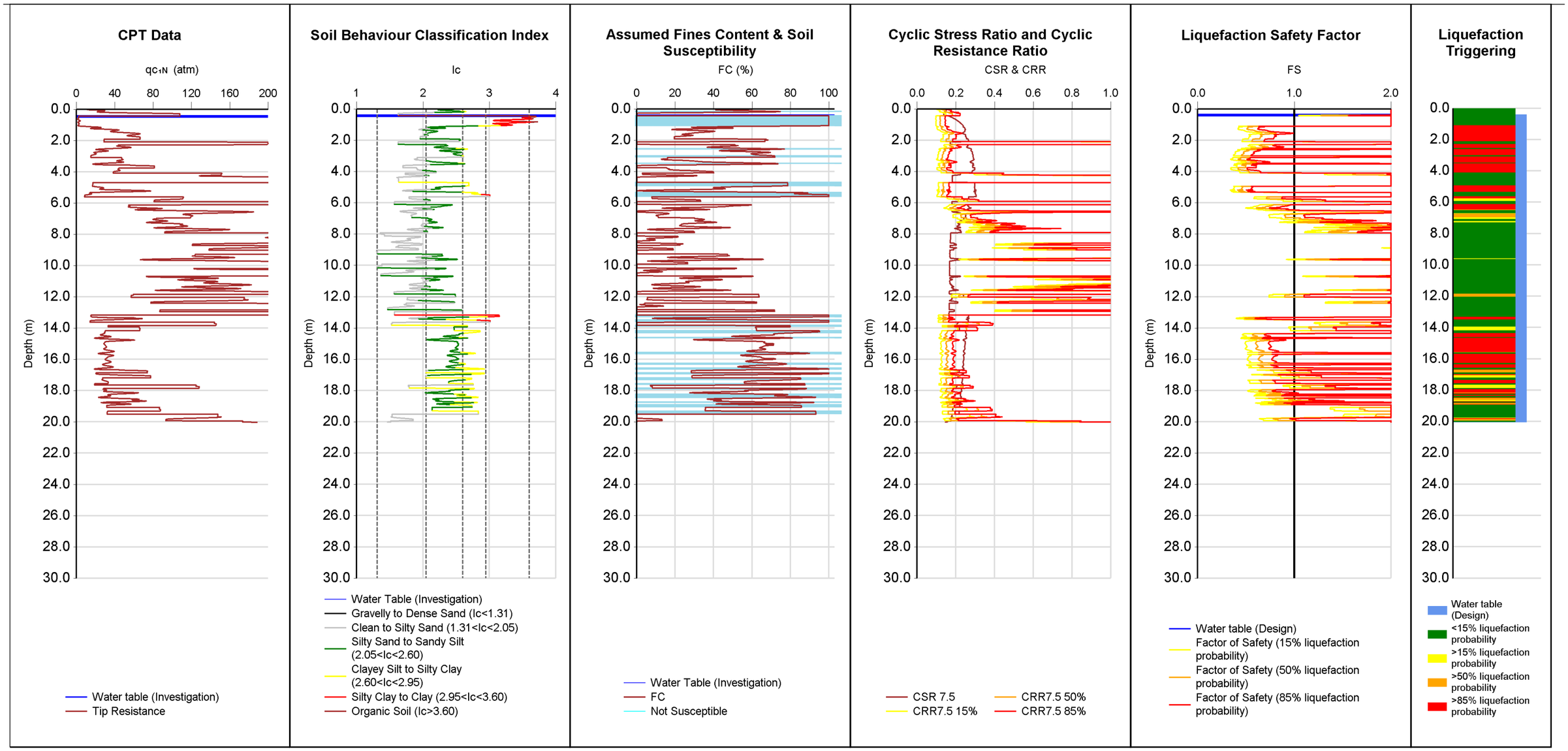
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT105	178994	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	



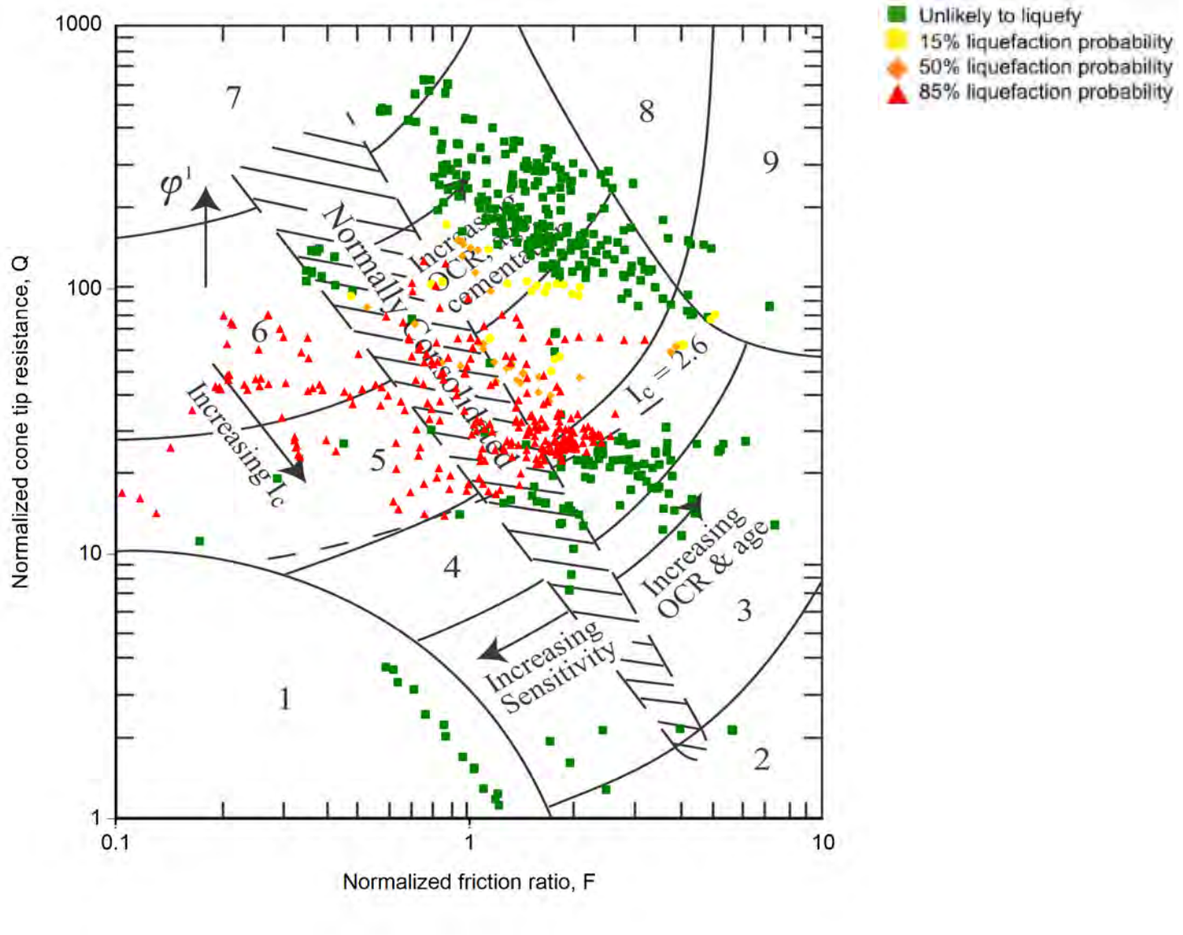
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT106	178995	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	202	8.5	20	45	1.2	21
	50%	185	7.4	15	42	1.2	16
	85%	162	6.3	10	39	1.2	11

Reviewed by:

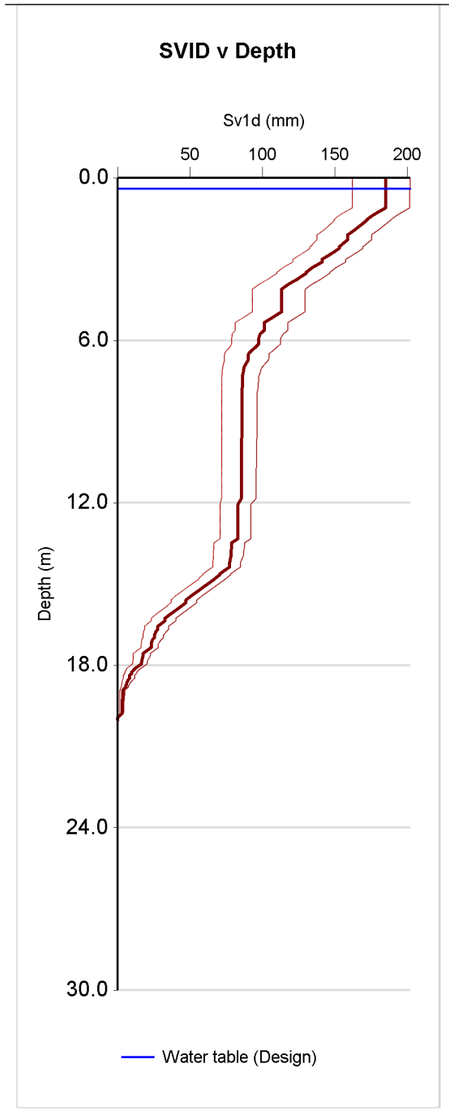
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc

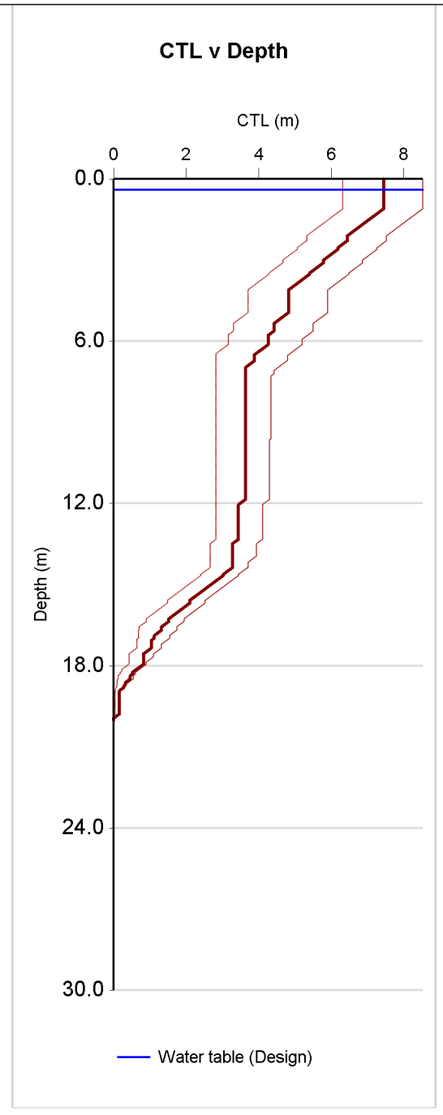


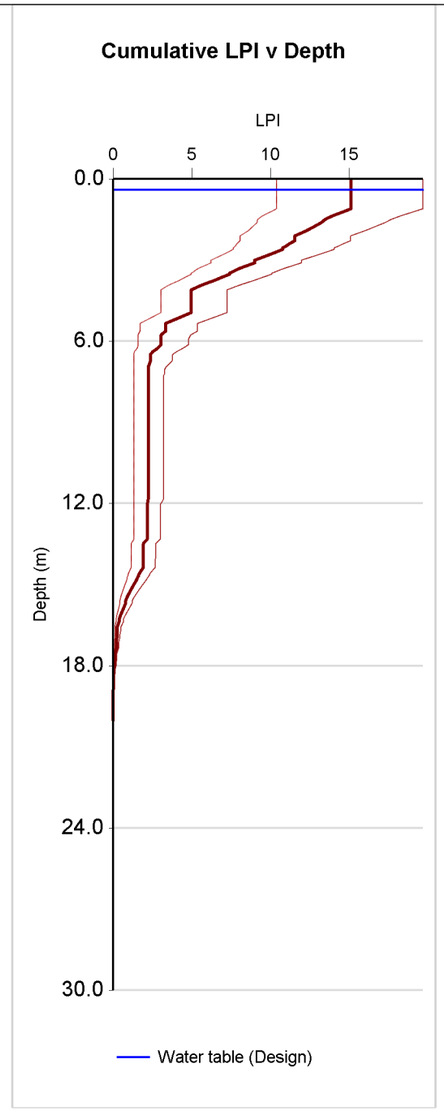
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

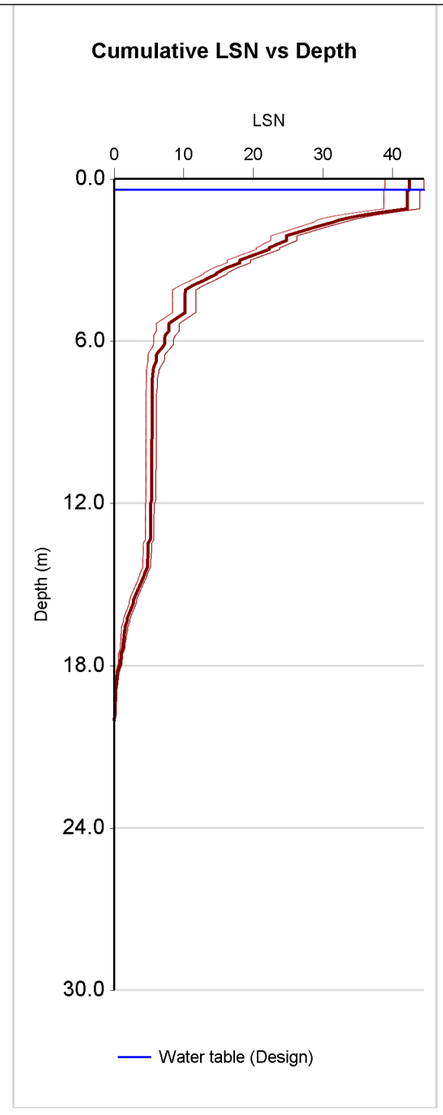
*Heavily overconsolidated or cemented

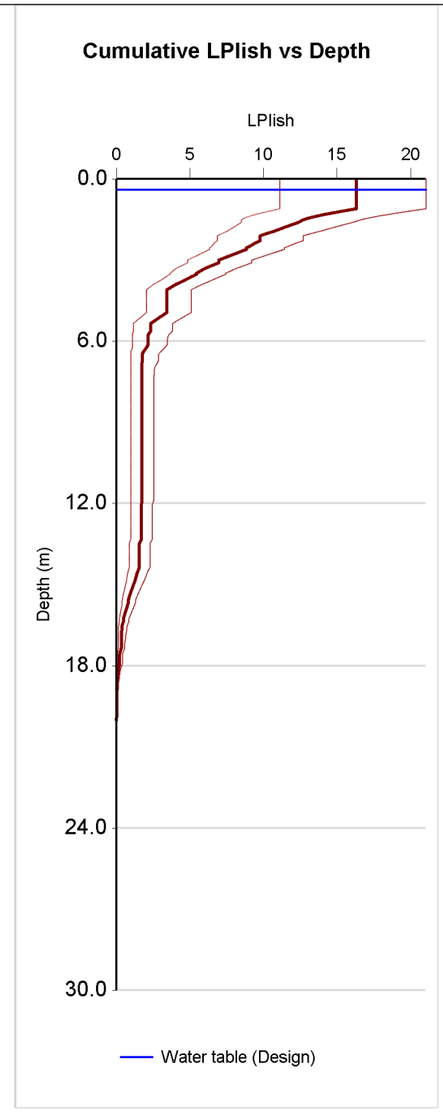
CPT-based soil behavior type classification chart by Robertson (1990)



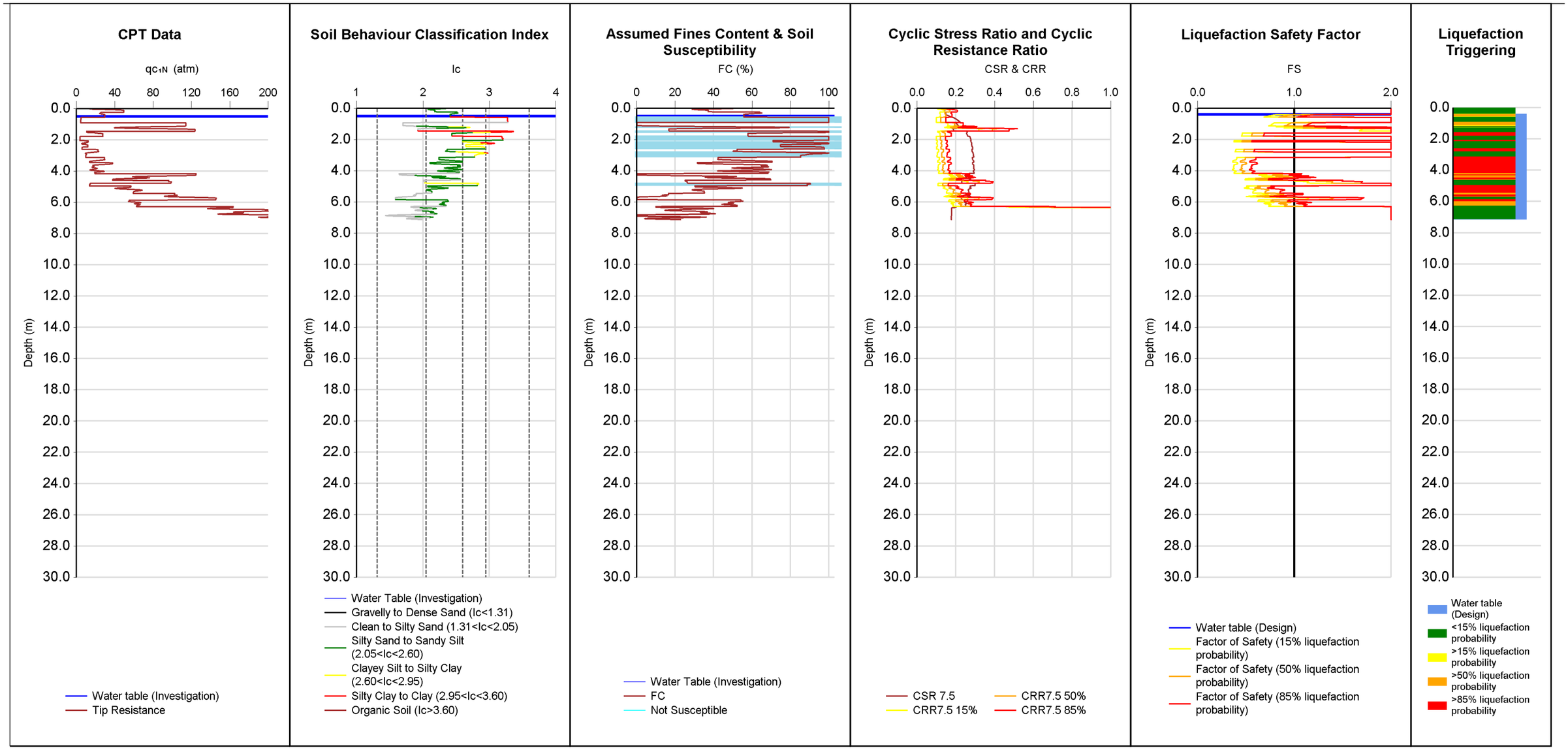








	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT106	178995	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	



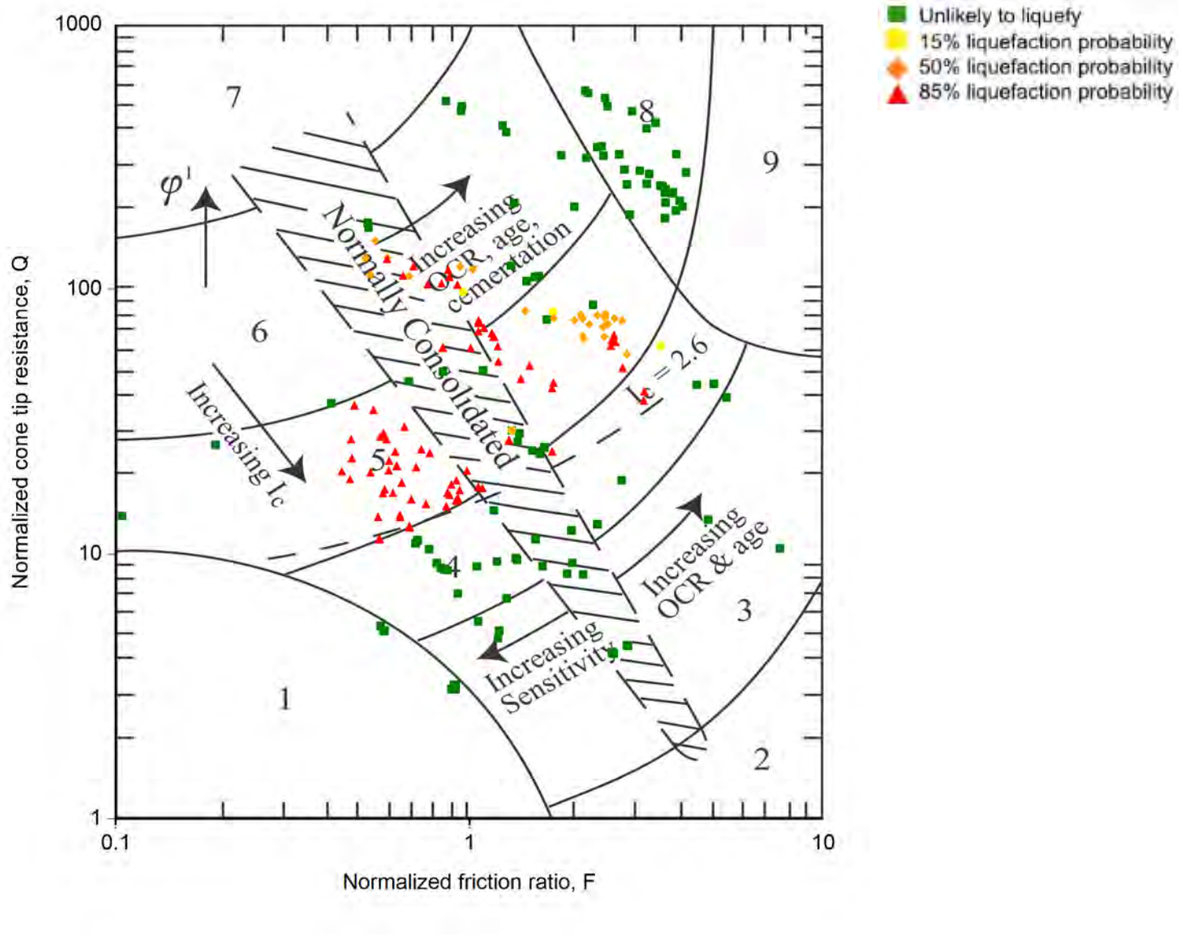
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT107	178996	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	88	3.6	13	37	0.5	15
	50%	79	3.5	10	30	0.5	10
	85%	66	2.4	6	23	1.7	6

Reviewed by:

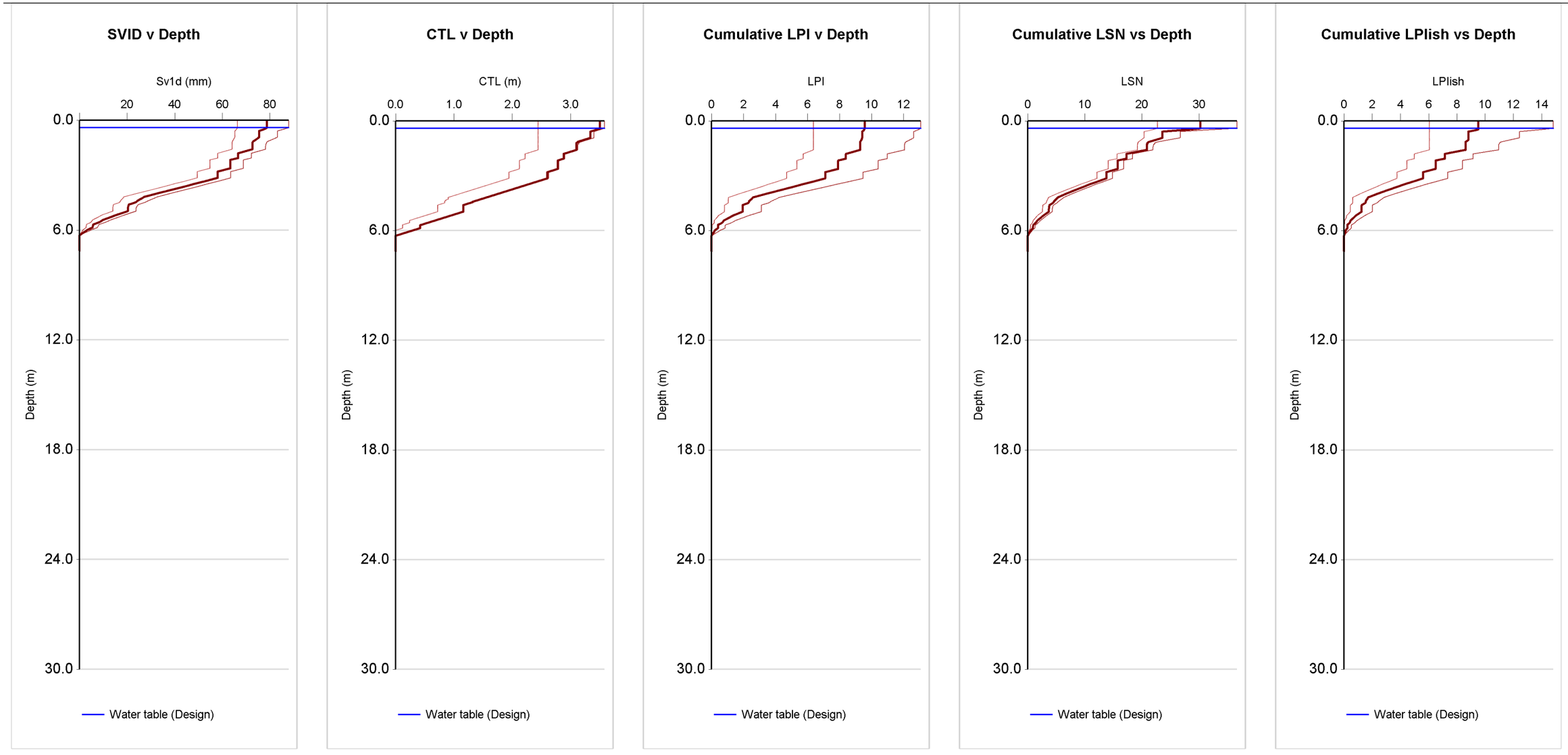
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



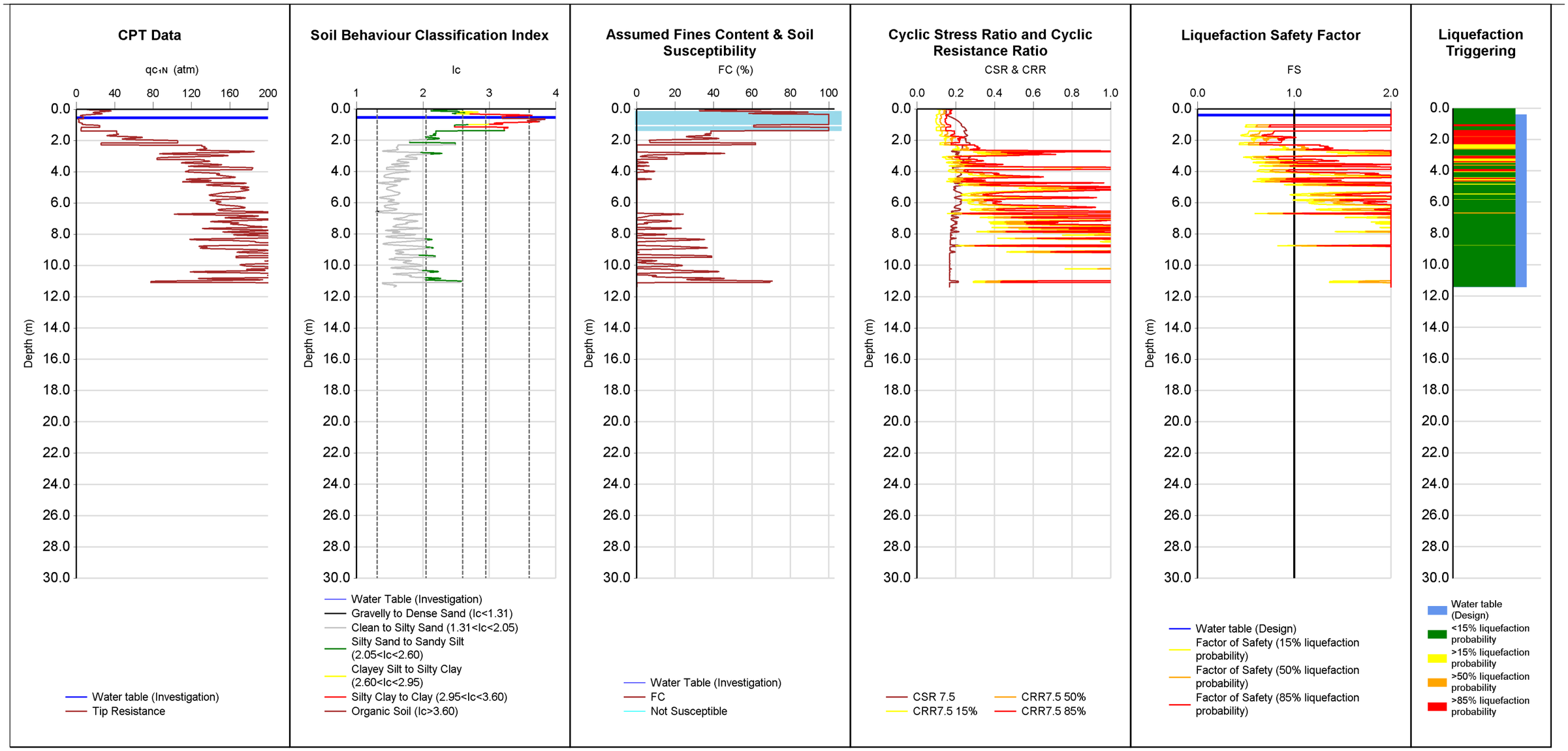
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT107	178996	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	



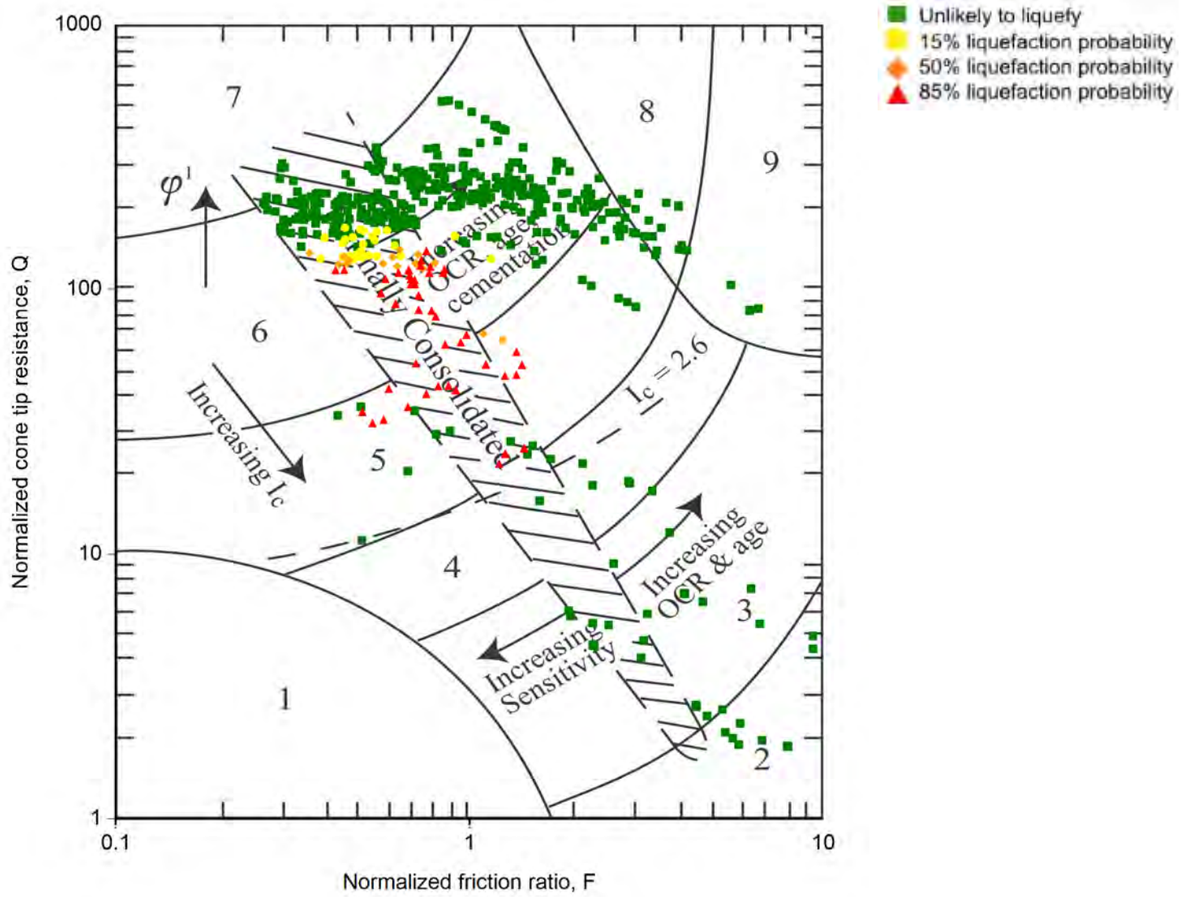
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT108	178997	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	54	2.6	7	24	1.1	10
	50%	45	1.9	5	21	1.1	7
	85%	34	1.5	3	17	1.1	4

Reviewed by:

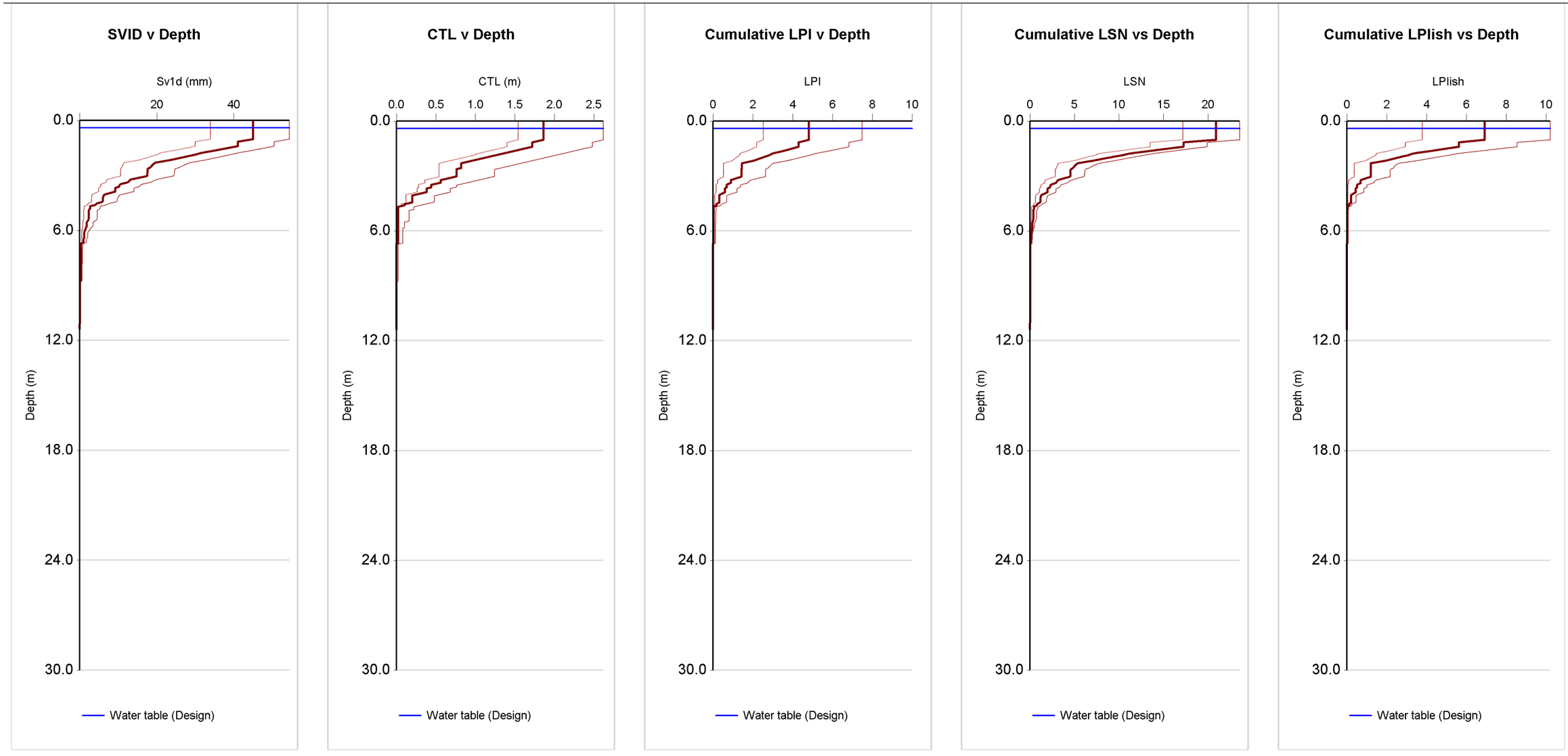
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



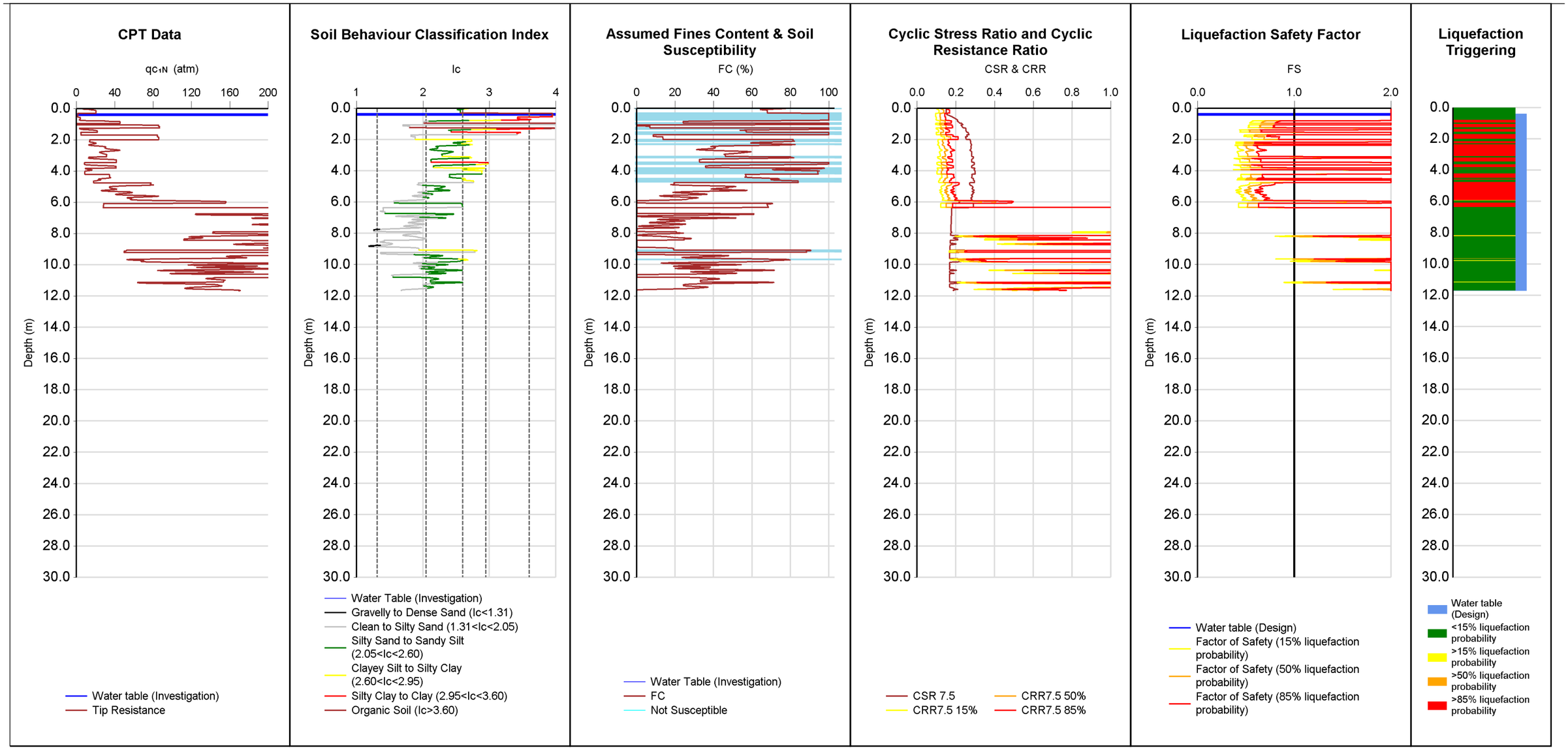
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT108	178997	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	



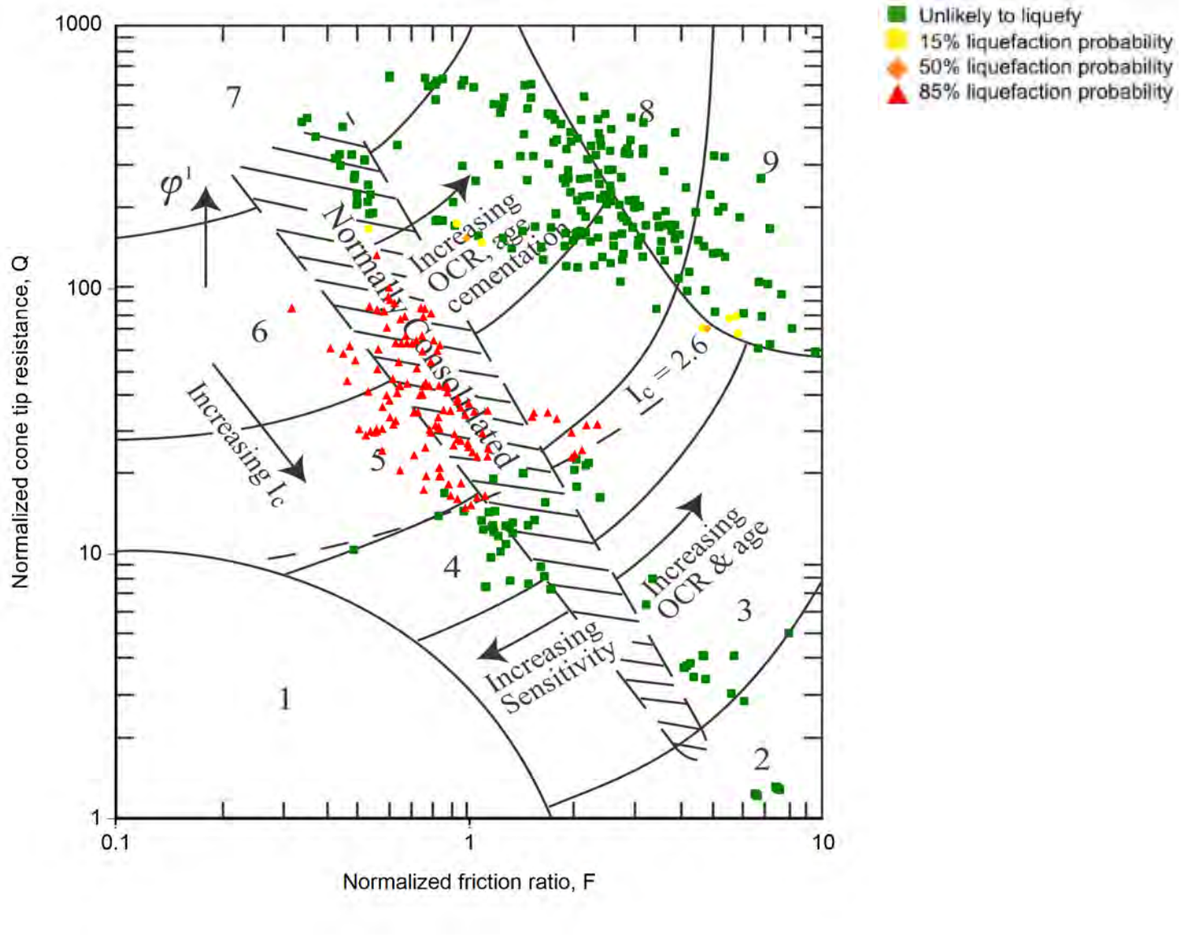
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT109	178998	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	105	4.1	17	38	0.9	19
	50%	104	4	14	38	0.9	16
	85%	101	3.9	10	37	0.9	11

Reviewed by:

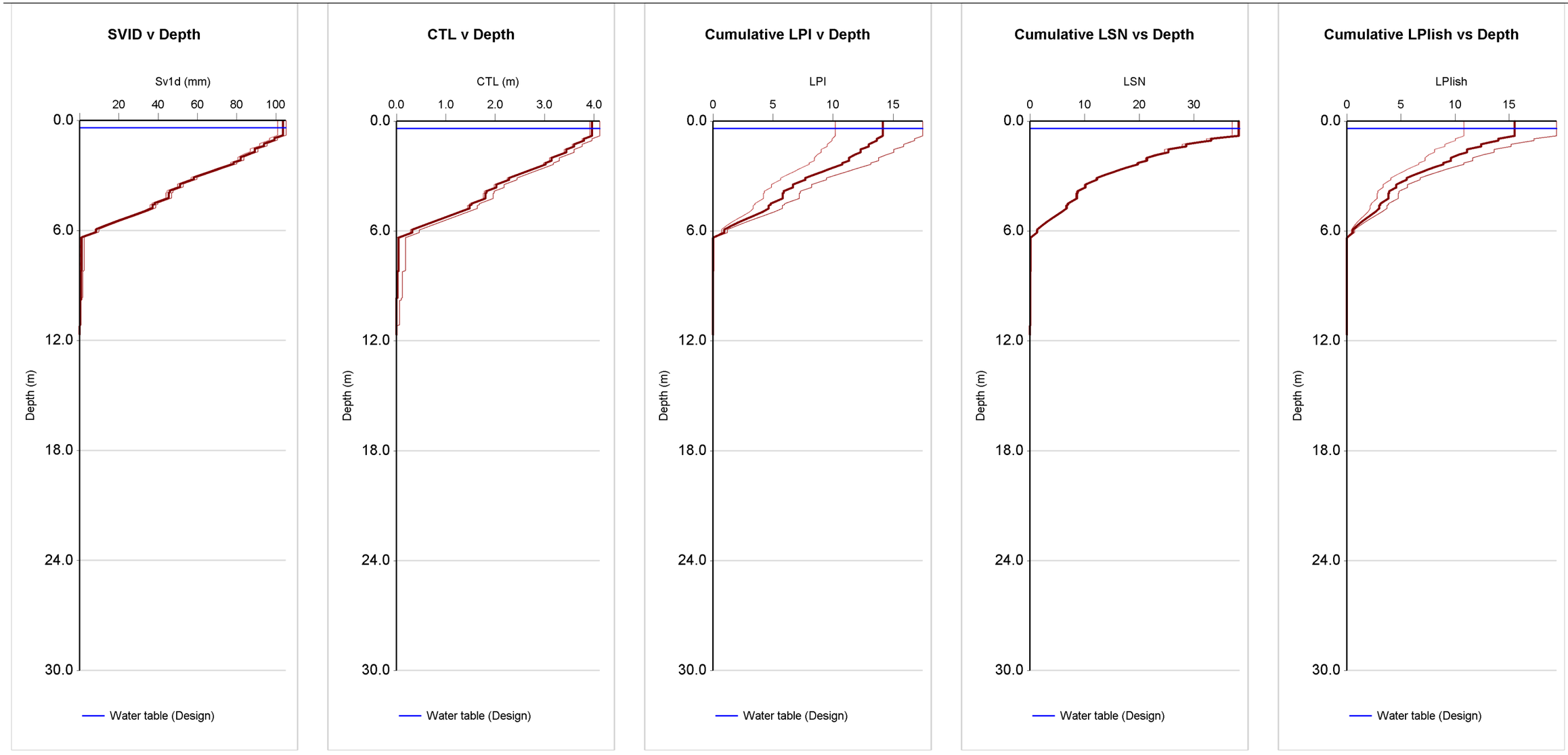
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



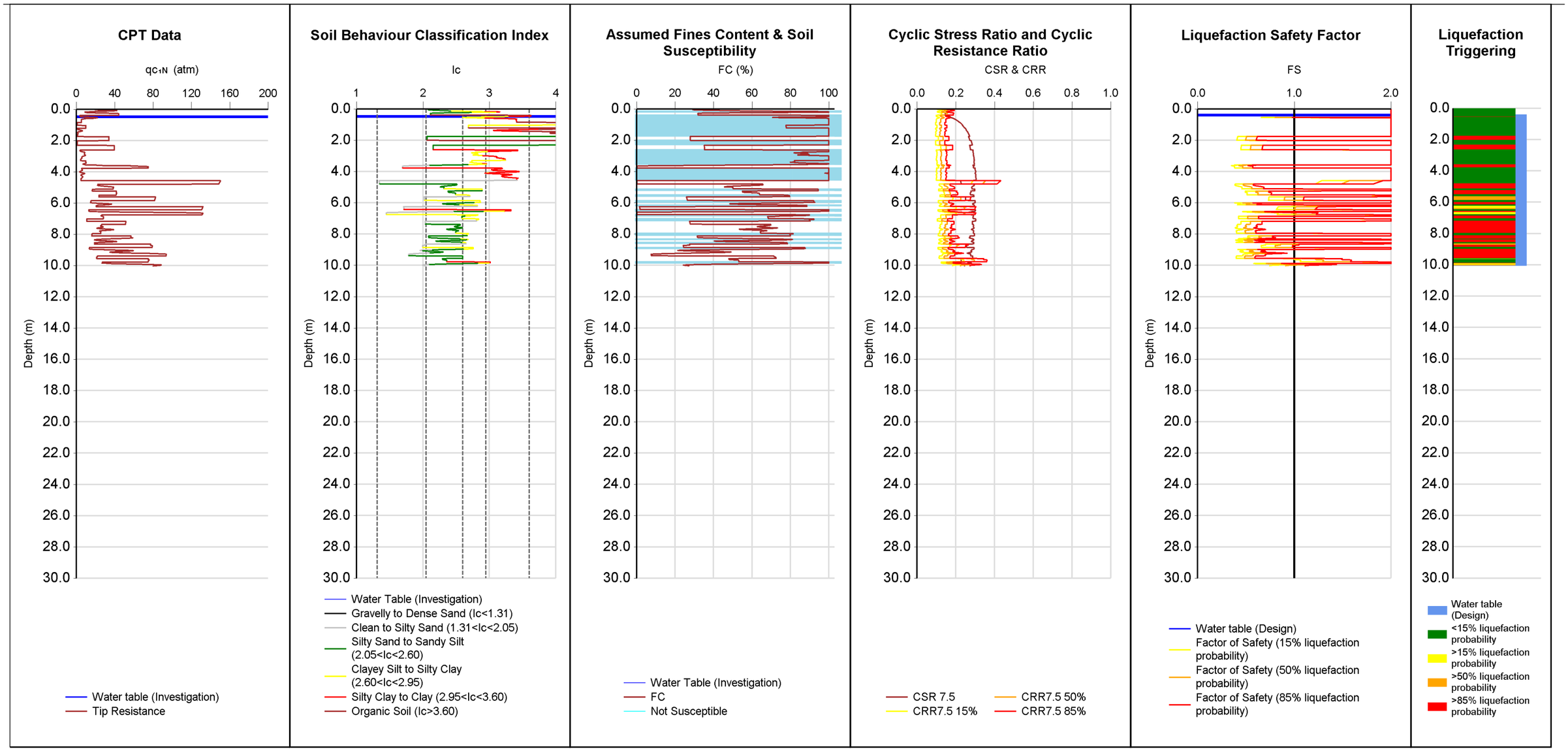
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT109	178998	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	



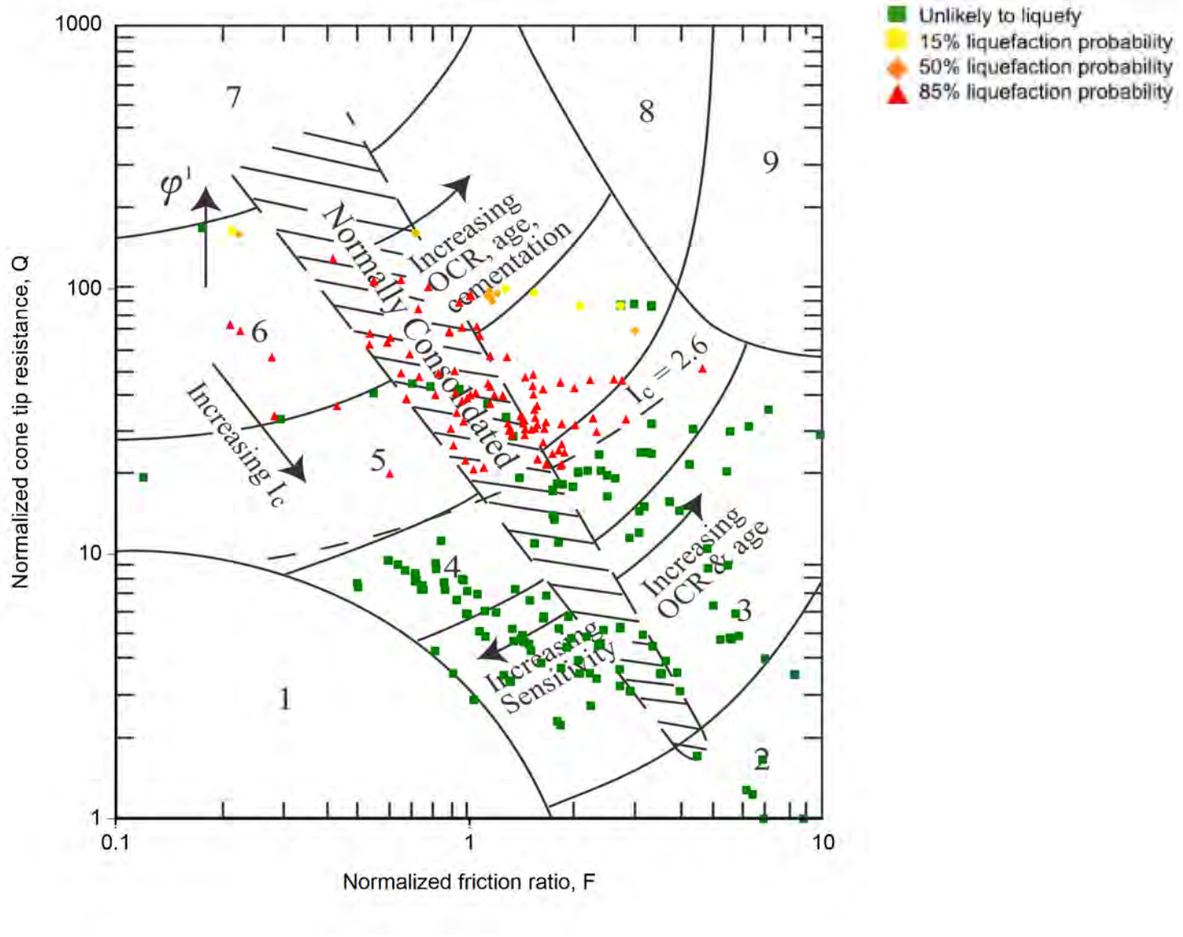
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT110	178999	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	107	4.4	15	22	1.8	11
	50%	101	4.1	11	21	1.8	9
	85%	94	3.6	8	20	1.8	6

Reviewed by:

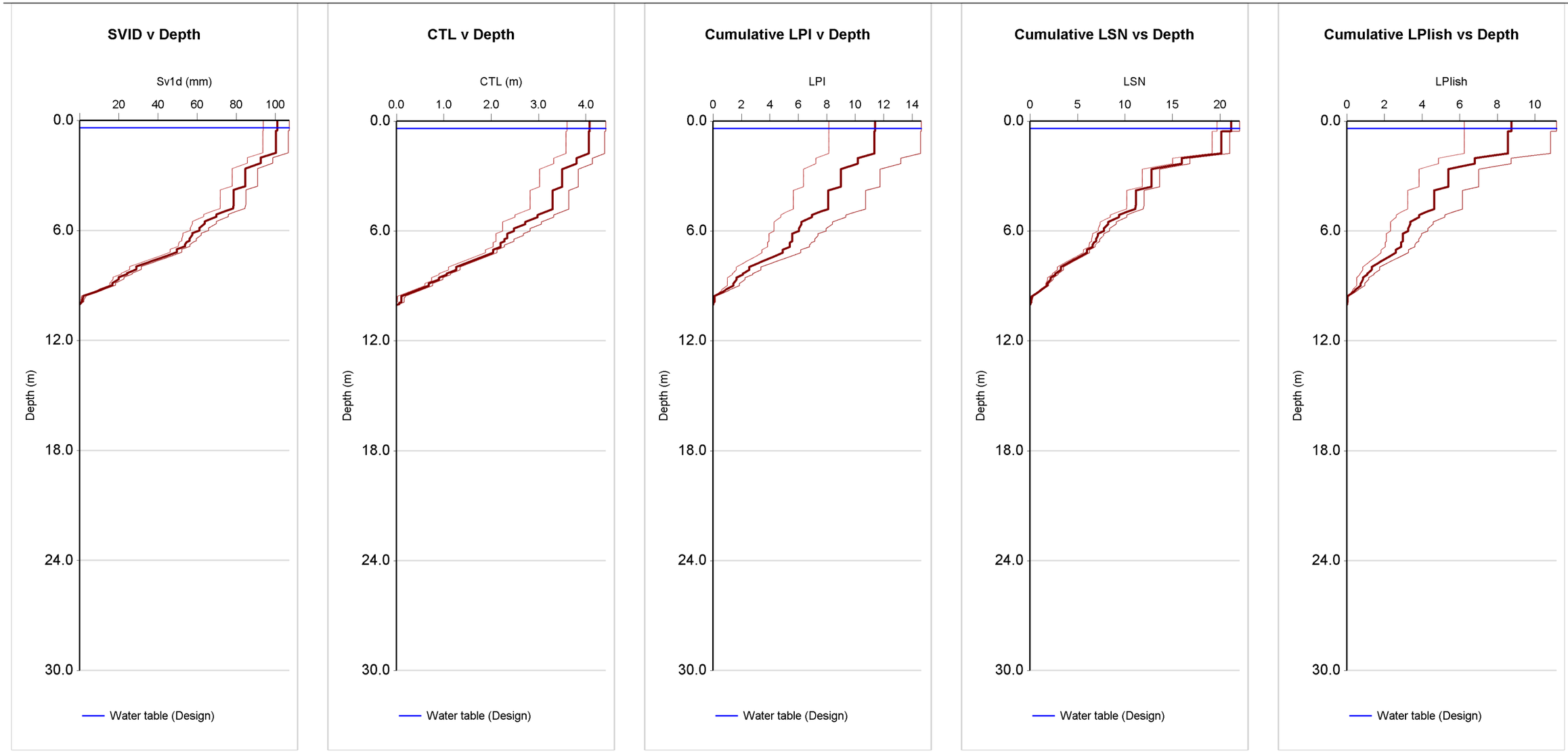
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



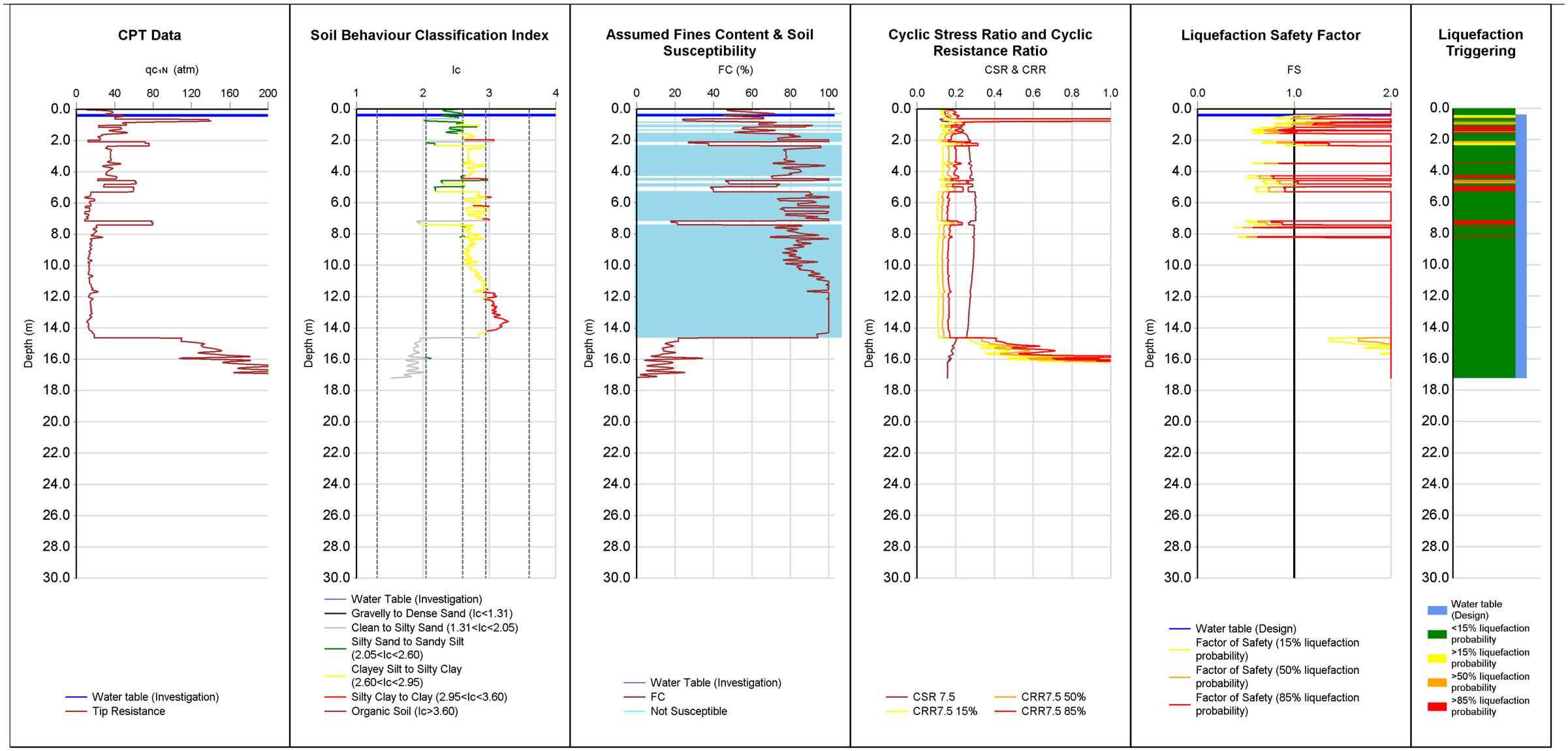
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT110	178999	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	



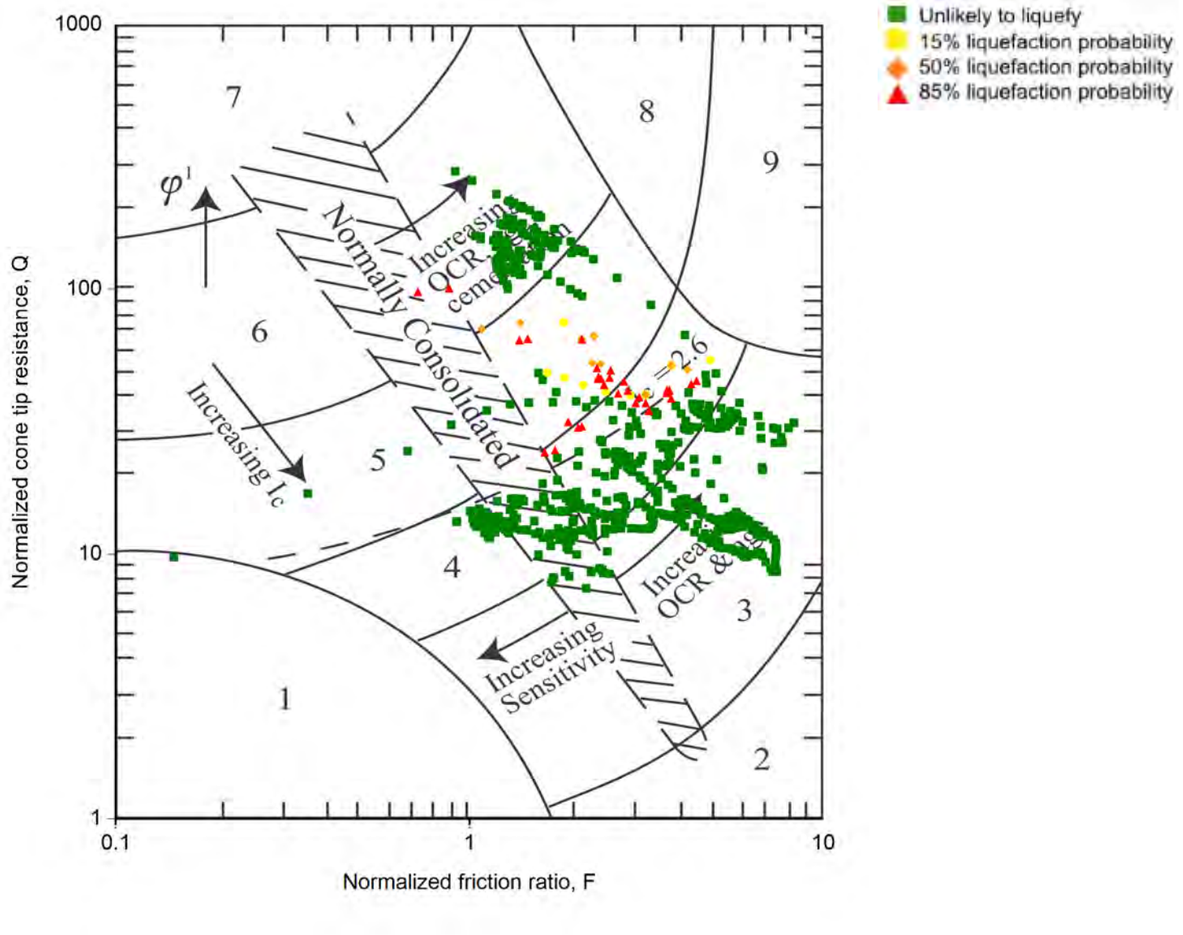
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT111	179000	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	43	2.1	6	22	0.5	7
	50%	35	1.8	3	15	0.9	3
	85%	24	1.3	1	9	1.2	1

Reviewed by:

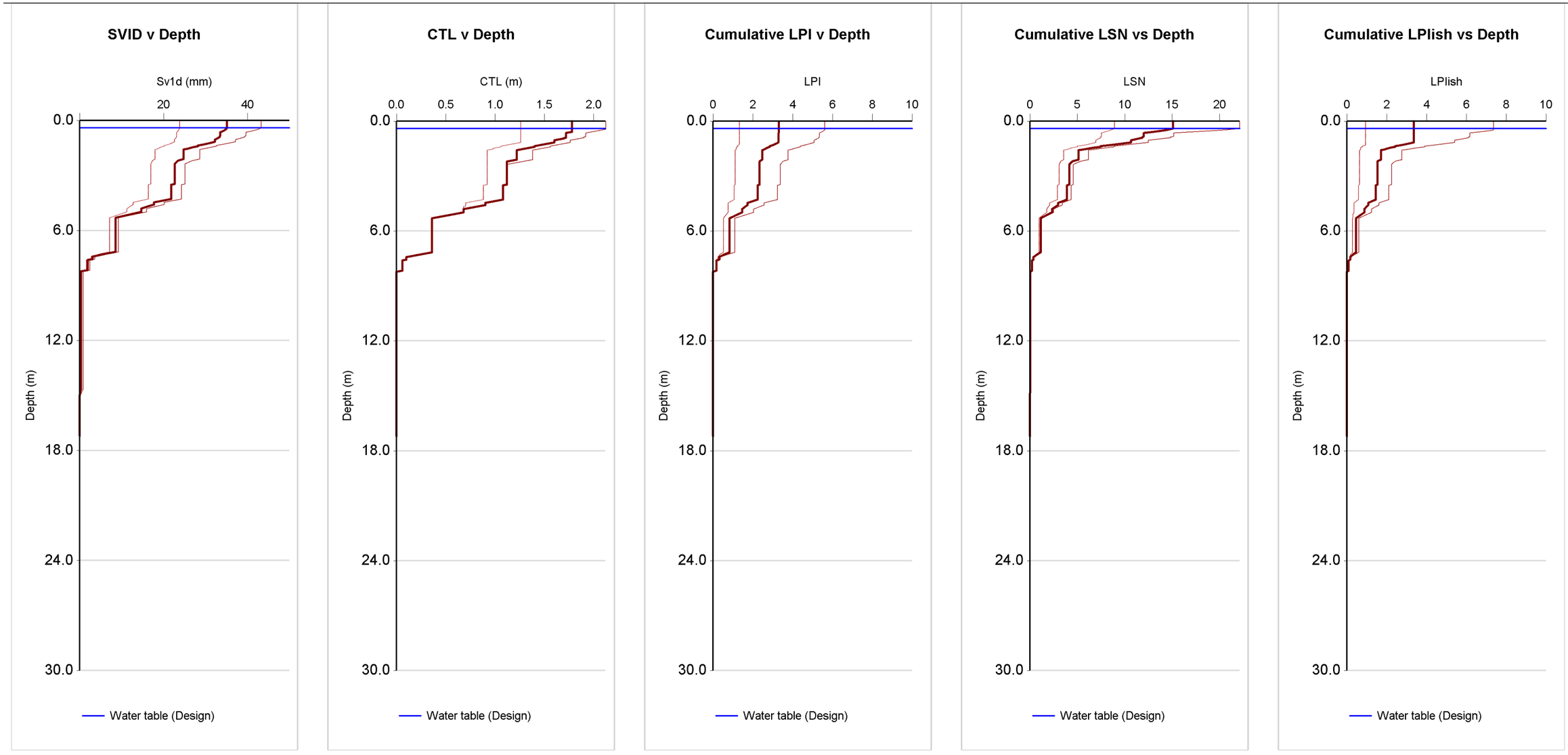
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



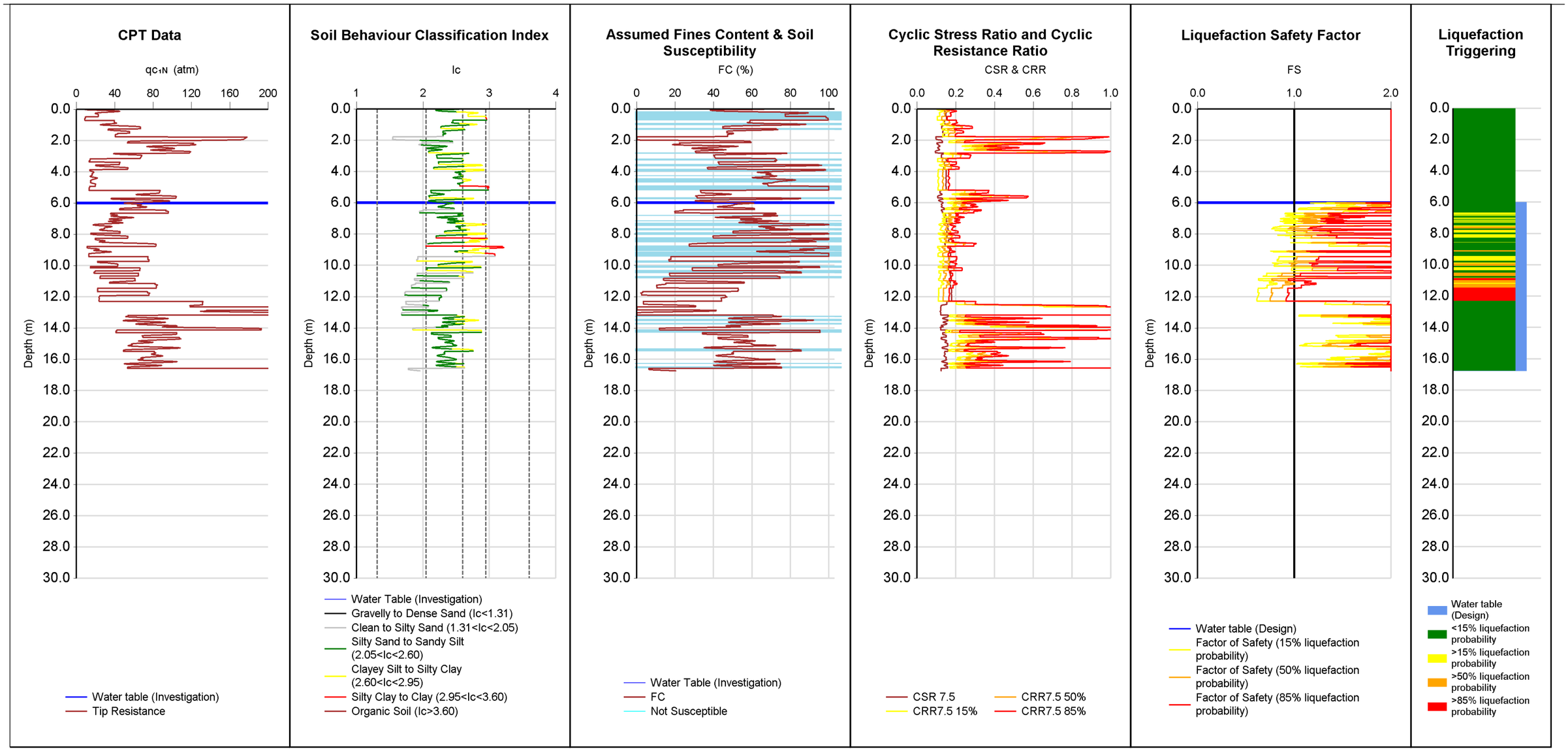
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT111	179000	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	



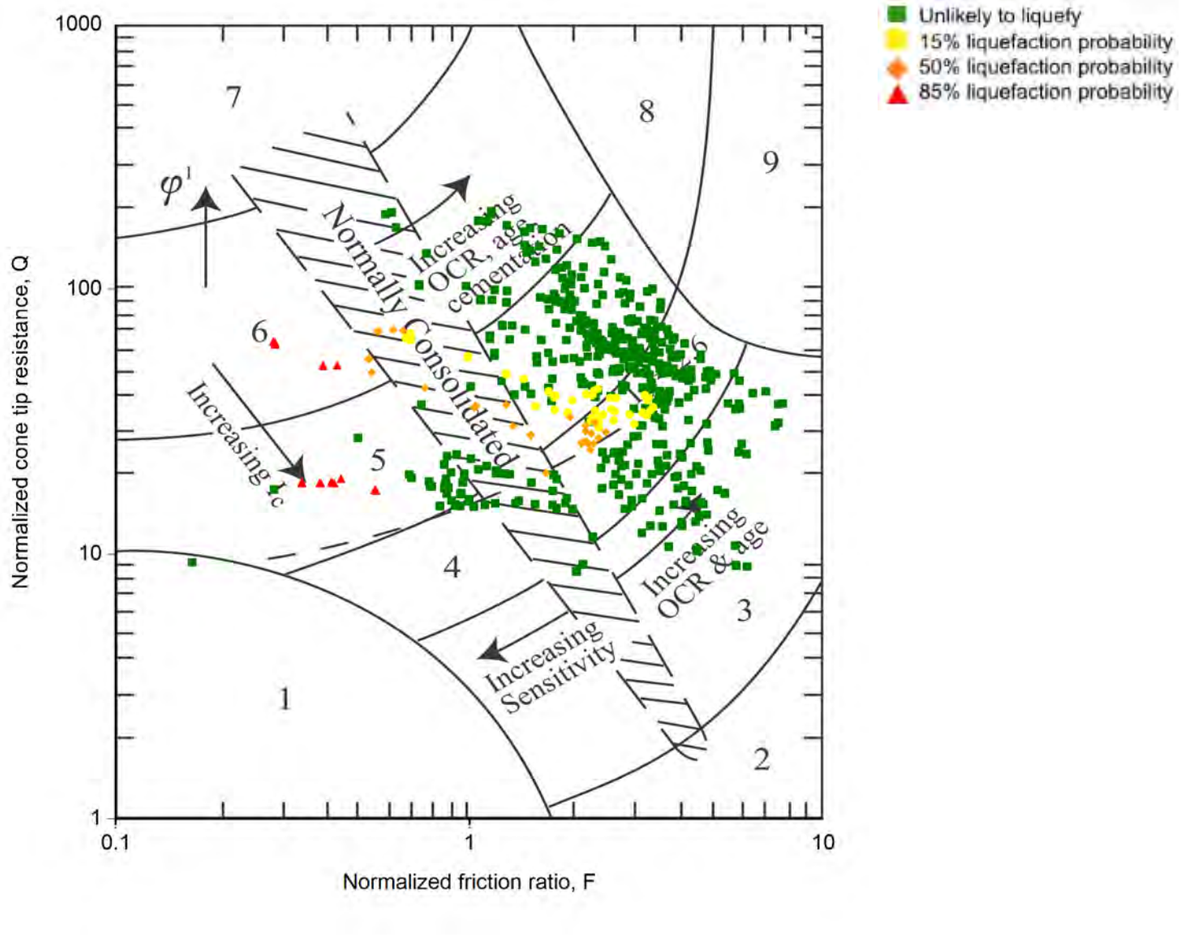
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT112	179001	17/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	84	3.5	4	8	6.7	0
	50%	59	2	1	6	7.6	0
	85%	32	1	0	3	10.9	0

Reviewed by:

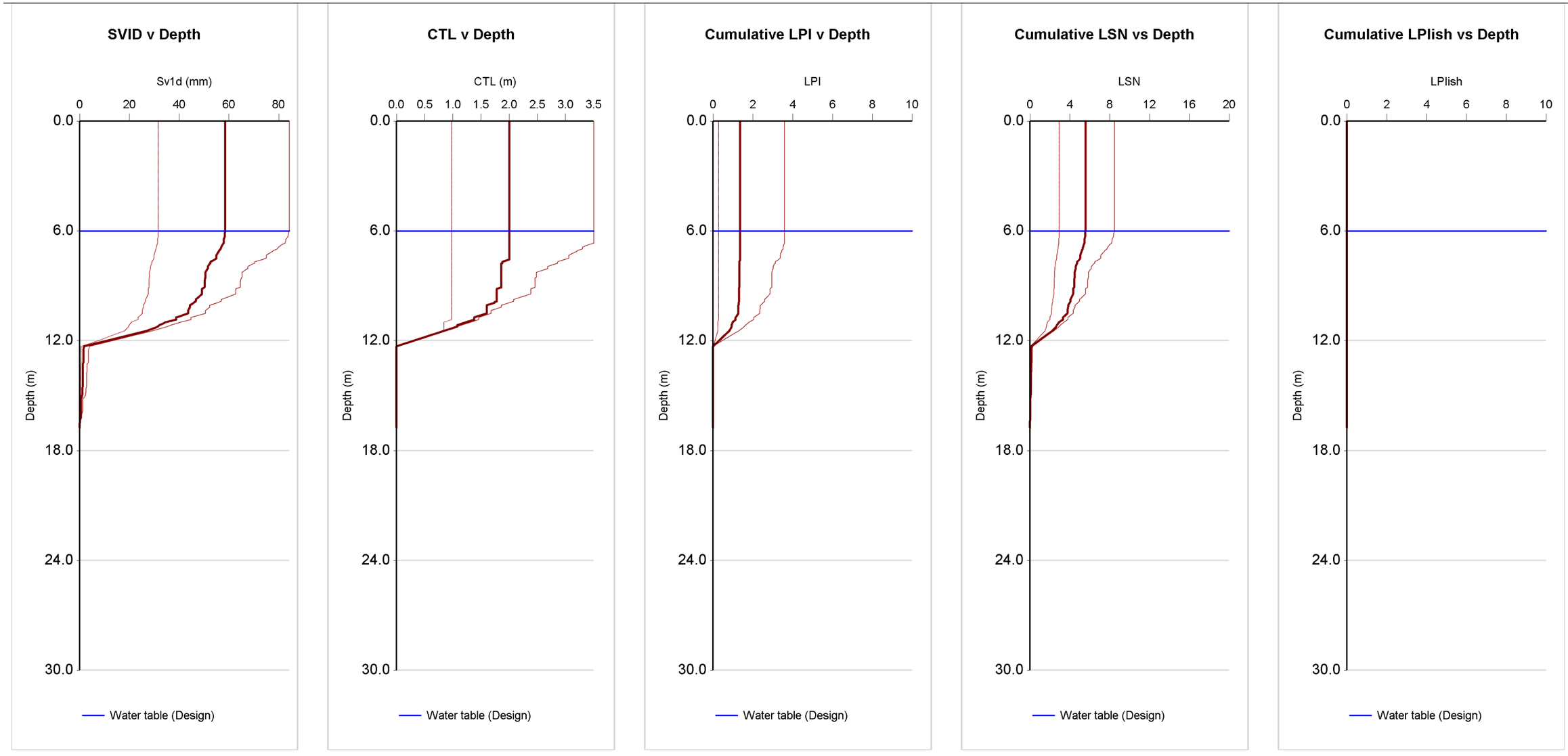
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc



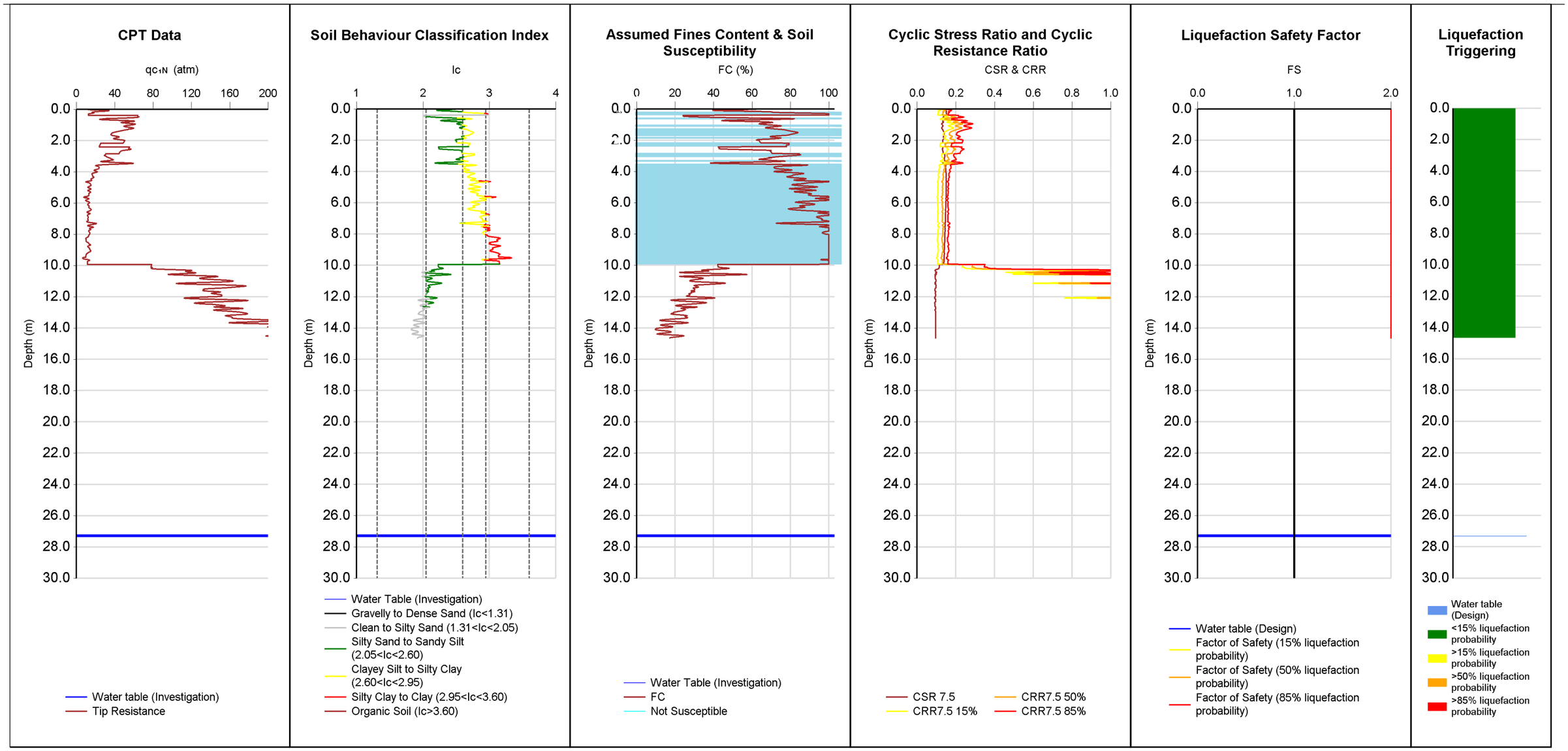
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

*Heavily overconsolidated or cemented

CPT-based soil behavior type classification chart by Robertson (1990)



	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT112	179001	17/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	



Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT113	179002	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	0	0	0	0	14.6	0
	50%	0	0	0	0	14.6	0
	85%	0	0	0	0	14.6	0

Reviewed by:

CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc

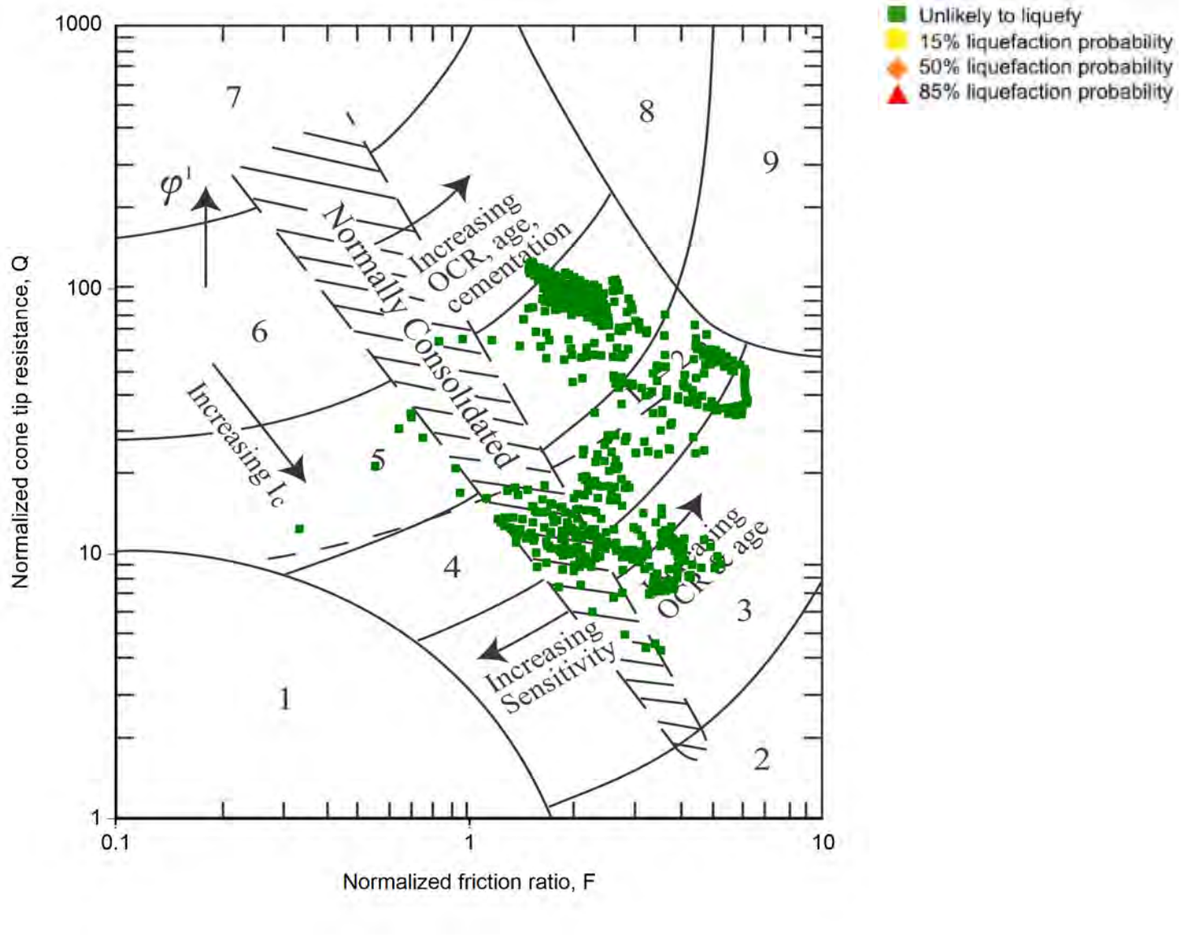
Tonkin + Taylor

Exceptional thinking together

V2.4.15

CLIENT	**Brymer Farms Ltd**	LOCATION	Hamilton
PROJECT	**Brymer Farms Subdivision**		
TITLE	**Liquefaction Analyses**	JOB NUMBER	**1017355.0000**
COMMENT	1 in 1000 Year Event - ULS IL3		

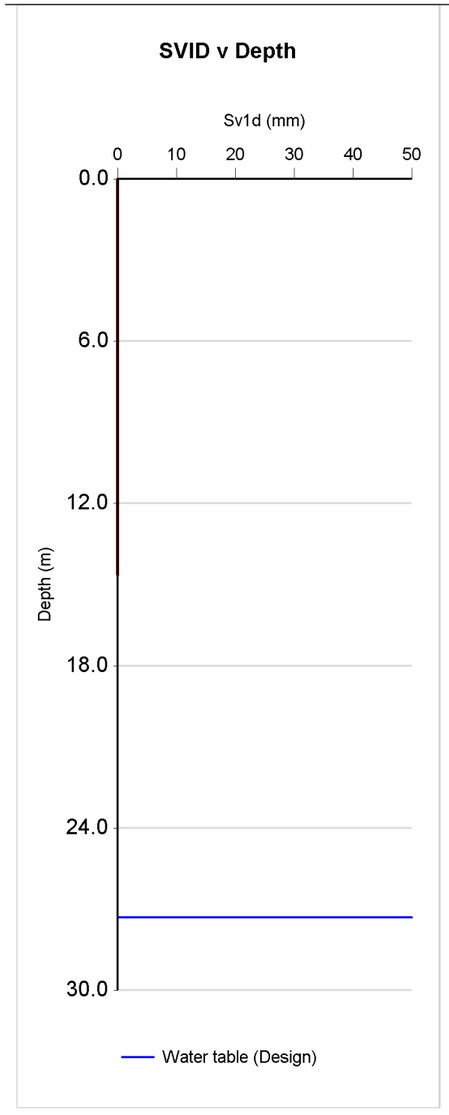
DATE	24/06/2021
ANALYSED	cand
PAGE	37 of 47 pages

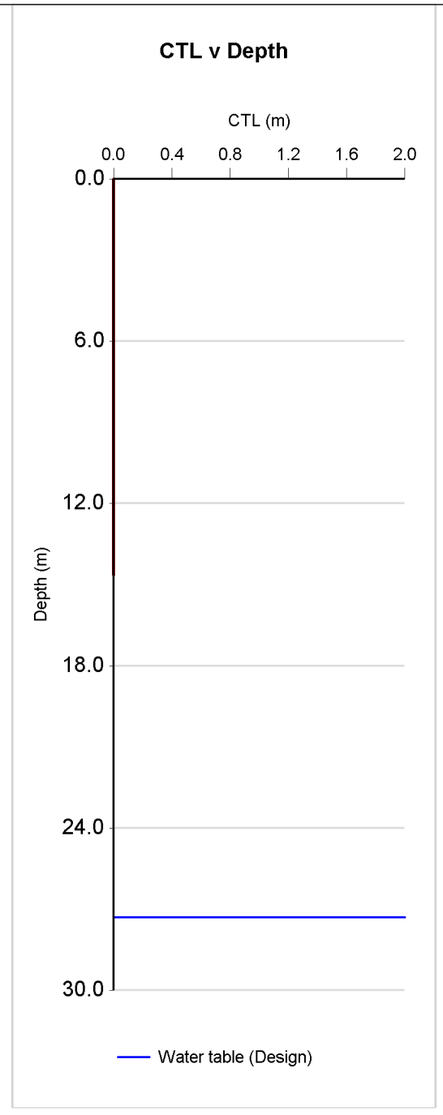


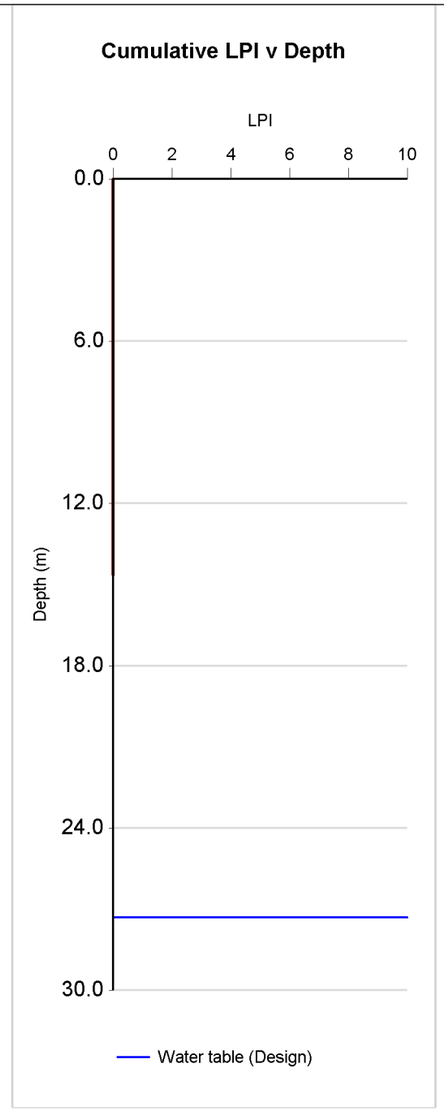
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

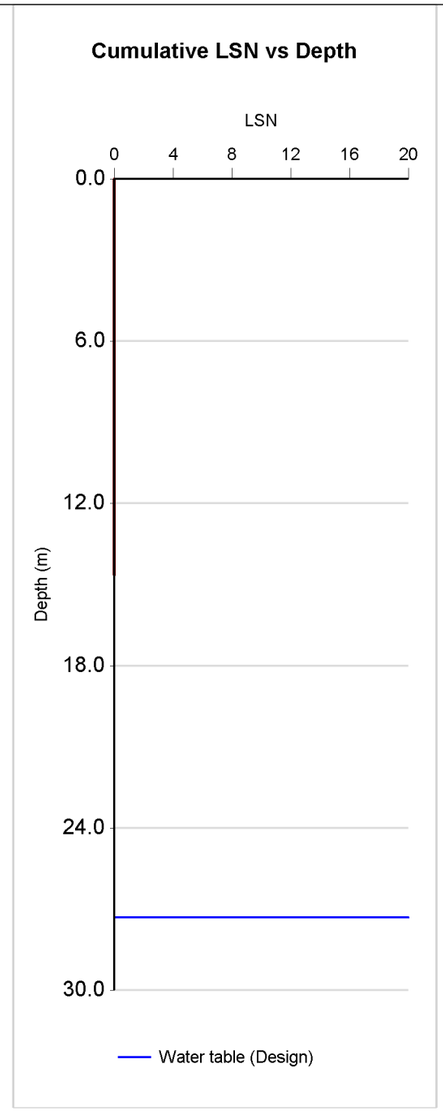
*Heavily overconsolidated or cemented

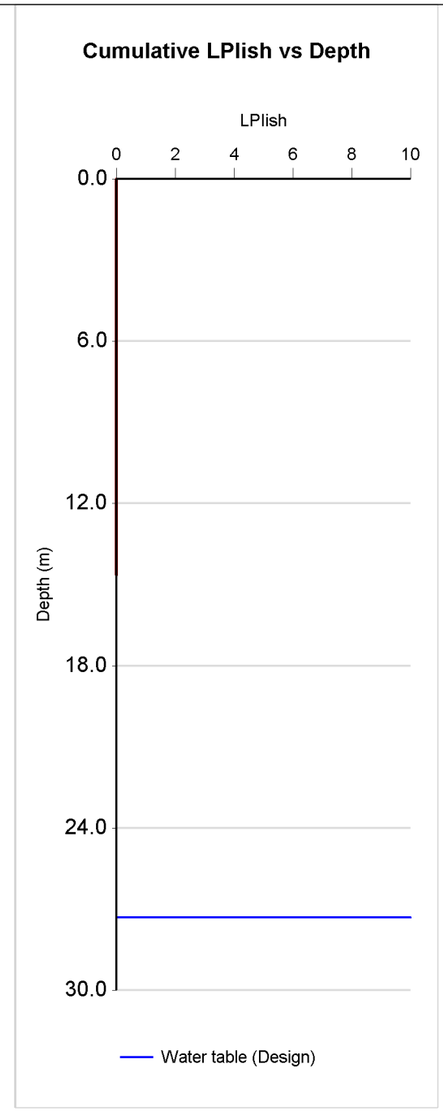
CPT-based soil behavior type classification chart by Robertson (1990)



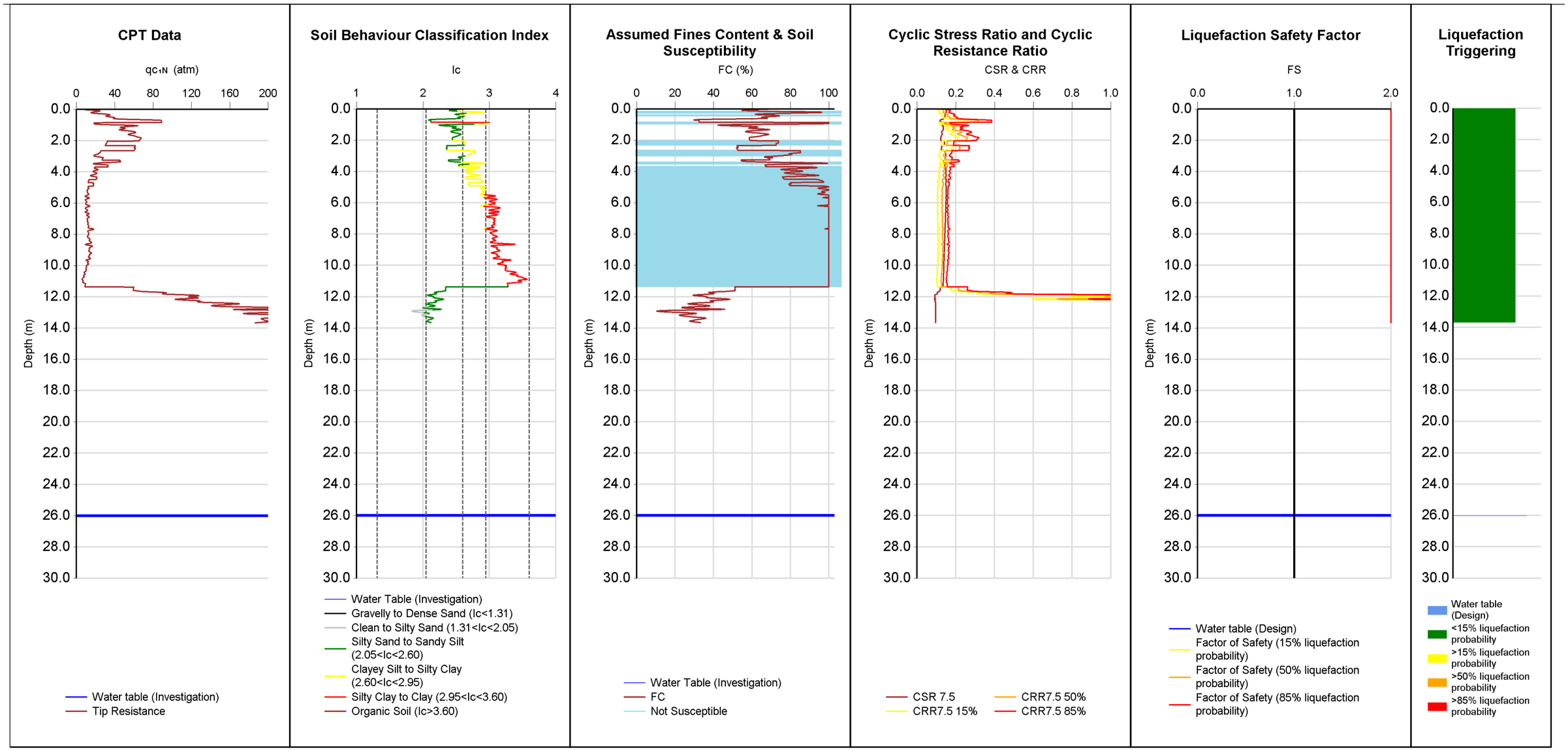








	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT113	179002	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	



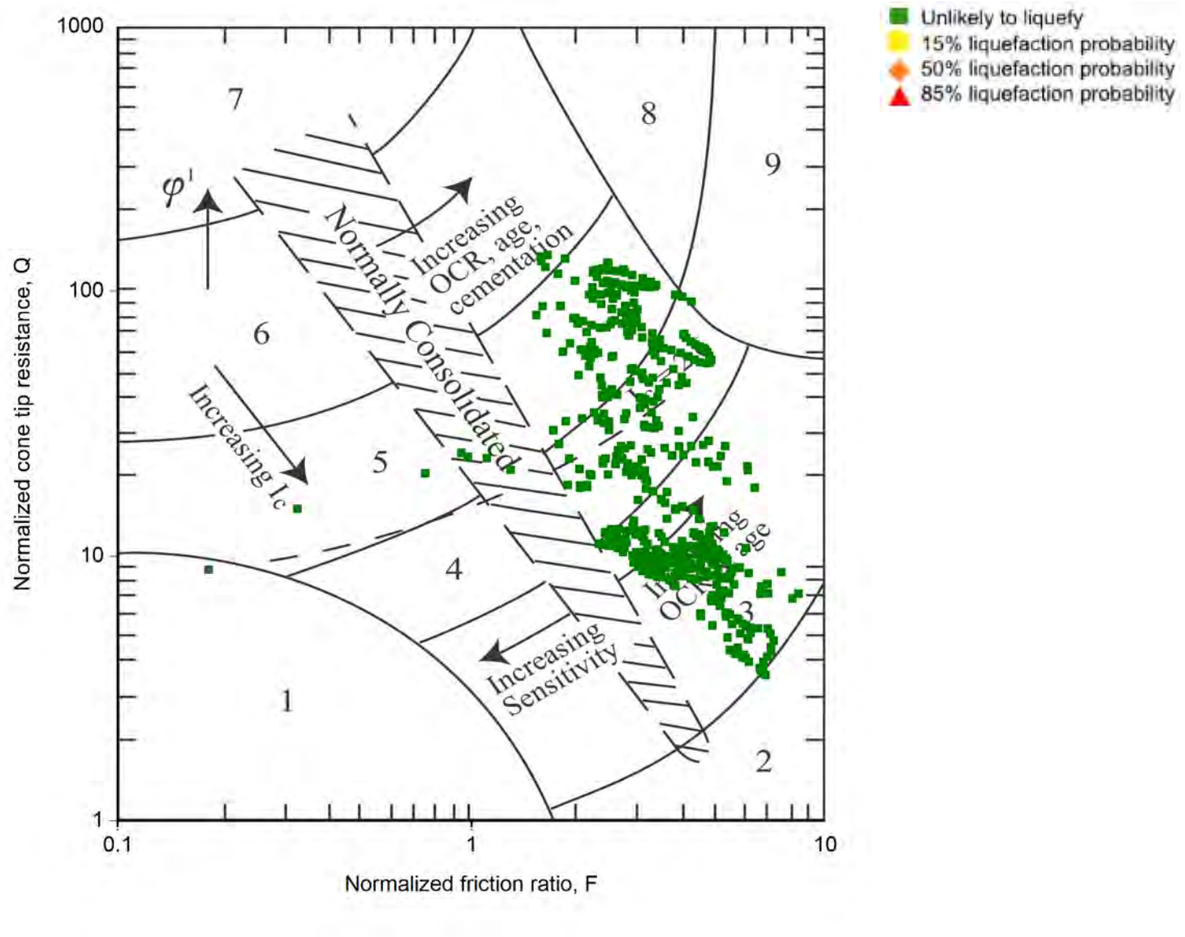
Note: Inverse filtered Qc/Fs data (10 cm²) used.

	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	ɣ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT114	179003	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

	PL	SV1D (mm)	CTL (m)	LPI	LSN	CT (m)	LPIish
OUTPUT	15%	0	0	0	0	13.7	0
	50%	0	0	0	0	13.7	0
	85%	0	0	0	0	13.7	0

Reviewed by:

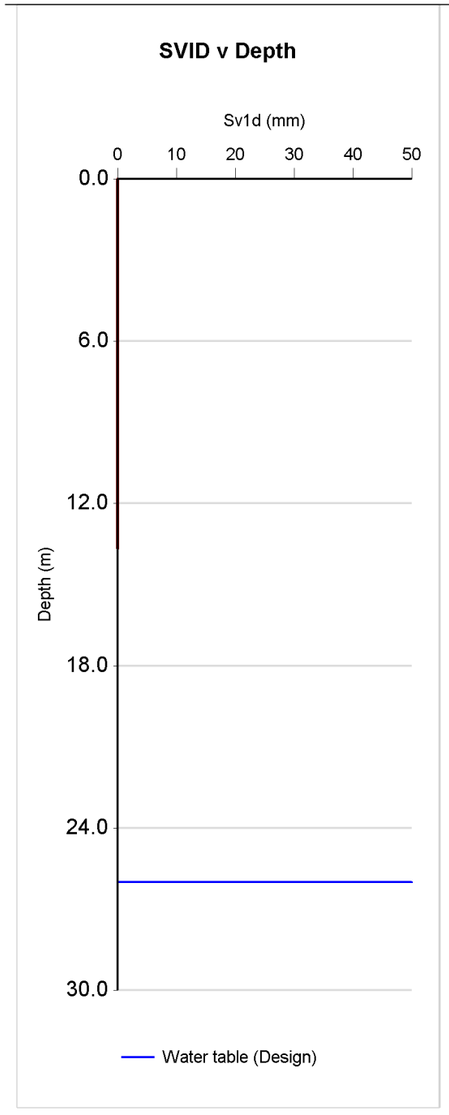
CPT Inversion	gumc
Groundwater	gumc
Susceptibility	gumc
Triggering	gumc
Consequence	gumc

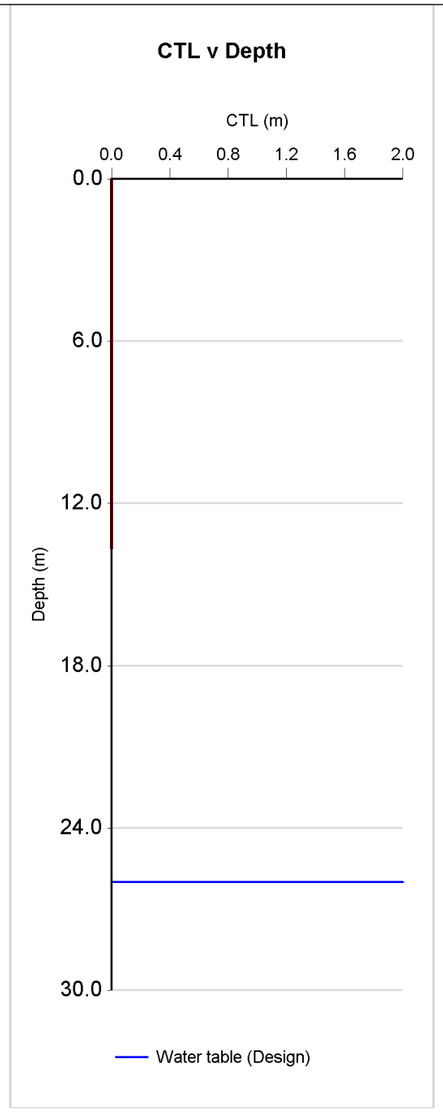


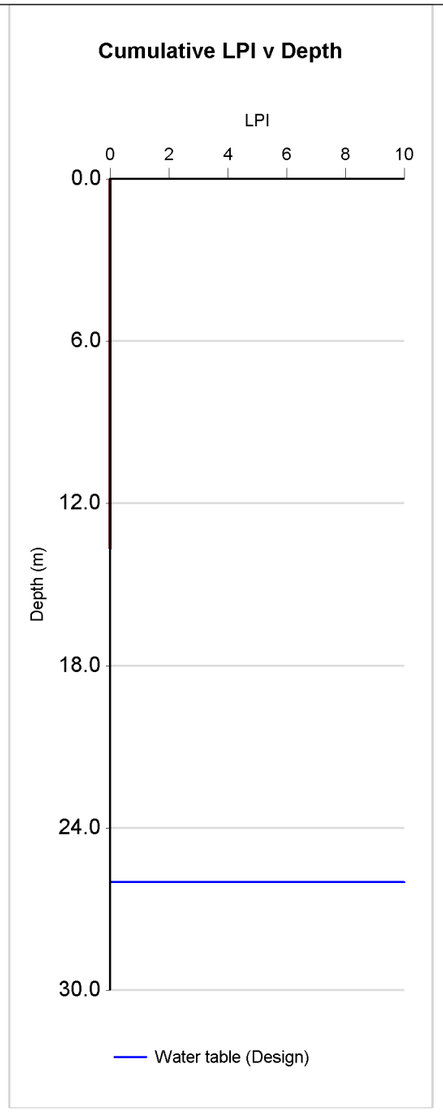
1. Sensitive, fine grained
2. Organic soils - peats
3. Clays - silty clay to clay
4. Silt mixtures - clayey silt to silty clay
5. Sand mixtures - silty sand to sandy silt
6. Sands - clean sand to silty sand
7. Gravelly sand to dense sand
8. Very stiff sand to clayey sand *
9. Very stiff, fine grained *

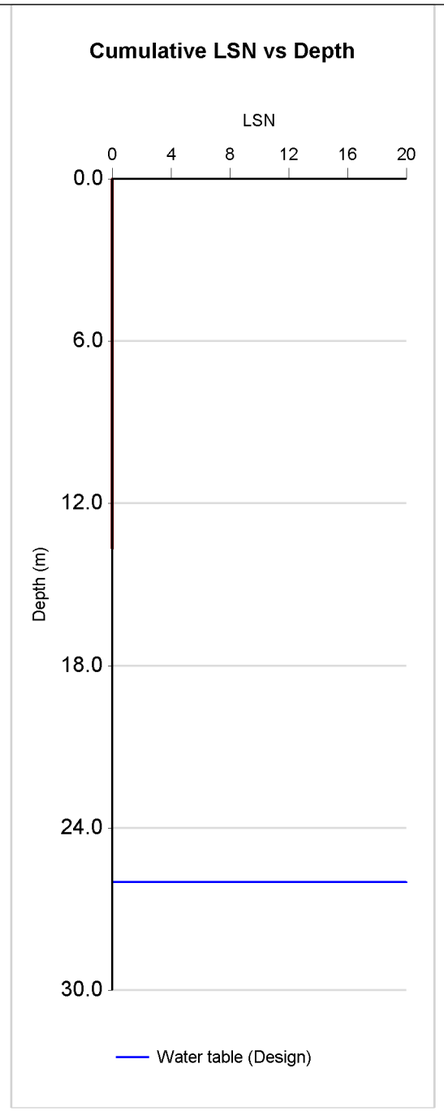
*Heavily overconsolidated or cemented

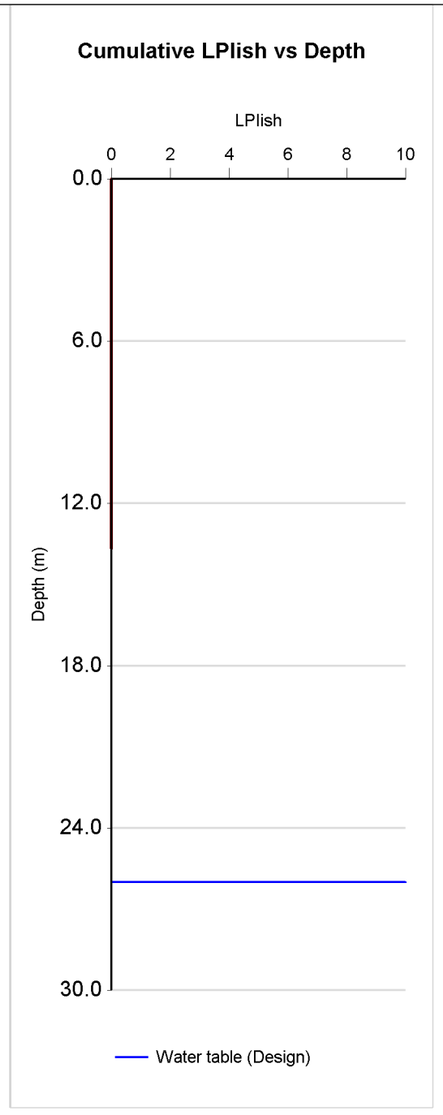
CPT-based soil behavior type classification chart by Robertson (1990)











	Run Description	TTGD ID	Investigation Date	Pre-drill (m)	Magnitude	PGA (g)	Trigger Method	Settlement Method	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
INPUT	CPT114	179003	18/05/2021	0	5.9	0.28	BI-2014	ZRB-2002	17		0	

Error: Subreport could not be shown.

The inputs listed in Table 1.1-1 below have been adopted for the liquefaction analysis.

Table 1.1-1 Summary of inputs for liquefaction analysis

ID	TTGD 178990	TTGD 178991	TTGD 178992	TTGD 178993	TTGD 178994	TTGD 178995
CPT Name	CPT01, 584 Whatawhata Road, Hamilton	CPT02, 584 Whatawhata Road, Hamilton	CPT03, 584 Whatawhata Road, Hamilton	CPT04, 584 Whatawhata Road, Hamilton	CPT05, 584 Whatawhata Road, Hamilton	CPT06, 584 Whatawhata Road, Hamilton
Run description	CPT101	CPT102	CPT103	CPT104	CPT105	CPT106
PGA	0.28g	0.28g	0.28g	0.28g	0.28g	0.28g
Magnitude	5.9	5.9	5.9	5.9	5.9	5.9
Depth to groundwater at time of Investigation (m)	20	0.4	0.4	0.4	0.7	0.45
Depth to groundwater for design (m)	20	0.4	0.4	0.4	0.4	0.4
Predrill depth (m)	0	0	0	0	0	0
Assumed predrill tip resistance and skin friction	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Trigger method	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
Settlement method	ZRB-2002	ZRB-2002	ZRB-2002	ZRB-2002	ZRB-2002	ZRB-2002
Total depth of CPT (m)	29	20.02	15.92	14.3	8.72	20.02
Minimum depth of analysis (m)	0	0	0	0	0	0
Maximum depth of analysis (m)	30	30	30	30	30	30
Inverse Filtering applied?	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)

Table 1.1-2 Summary of Ic inputs for liquefaction analysis

ID	Run description	From (m)	To (m)	Ic
TTGD 178990	CPT101	0	0	0
TTGD 178990	CPT101	0	0.01	0
TTGD 178990	CPT101	0.01	30	2.6
TTGD 178991	CPT102	0	0	0
TTGD 178991	CPT102	0	0.01	0
TTGD 178991	CPT102	0.01	30	2.6
TTGD 178992	CPT103	0	0	0
TTGD 178992	CPT103	0	0.01	0
TTGD 178992	CPT103	0.01	30	2.6
TTGD 178993	CPT104	0	0	0
TTGD 178993	CPT104	0	0.01	0
TTGD 178993	CPT104	0.01	30	2.6
TTGD 178994	CPT105	0	0	0
TTGD 178994	CPT105	0	0.01	0
TTGD 178994	CPT105	0.01	30	2.6
TTGD 178995	CPT106	0	0	0
TTGD 178995	CPT106	0	0.01	0
TTGD 178995	CPT106	0.01	30	2.6
TTGD 178996	CPT107	0	0	0
TTGD 178996	CPT107	0	0.01	0
TTGD 178996	CPT107	0.01	30	2.6
TTGD 178997	CPT108	0	0	0
TTGD 178997	CPT108	0	0.01	0
TTGD 178997	CPT108	0.01	30	2.6
TTGD 178998	CPT109	0	0	0

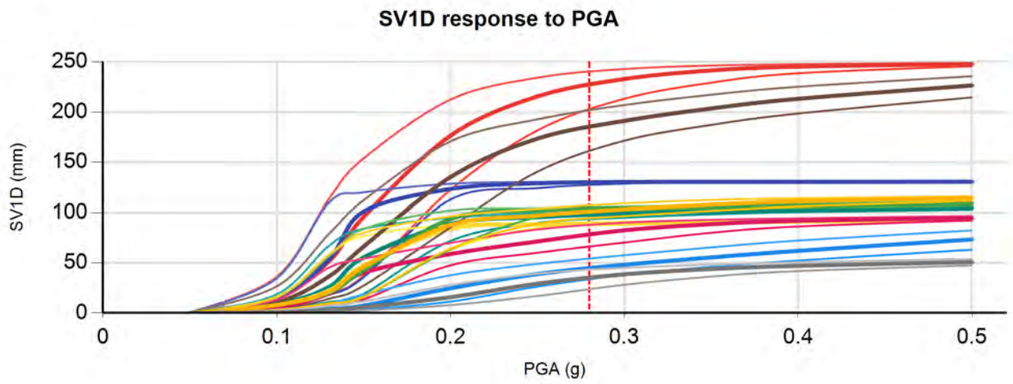
Table 1.1-3 Summary of Fc inputs for liquefaction analysis

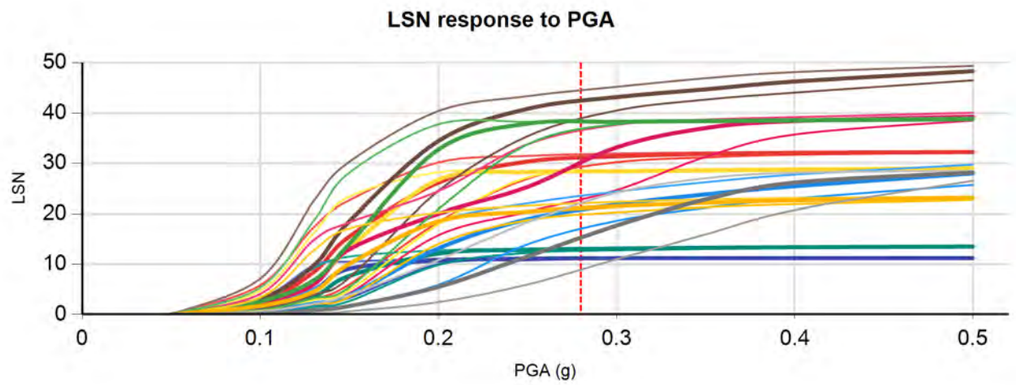
ID	Run description	From (m)	To (m)	Fc
TTGD 178990	CPT101	0.01	30	0 CFC
TTGD 178991	CPT102	0	30	0 CFC
TTGD 178992	CPT103	0	30	0 CFC
TTGD 178993	CPT104	0	30	0 CFC
TTGD 178994	CPT105	0	30	0 CFC
TTGD 178995	CPT106	0	30	0 CFC
TTGD 178996	CPT107	0	30	0 CFC
TTGD 178997	CPT108	0	30	0 CFC
TTGD 178998	CPT109	0	30	0 CFC
TTGD 178999	CPT110	0	30	0 CFC
TTGD 179000	CPT111	0	30	0 CFC
TTGD 179001	CPT112	0	30	0 CFC
TTGD 179002	CPT113	0	30	0 CFC
TTGD 179003	CPT114	0	30	0 CFC

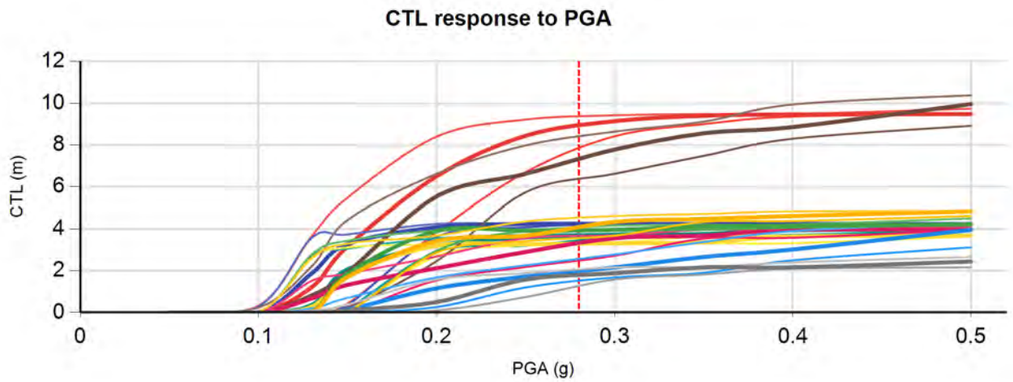
TTGD 178996	TTGD 178997	TTGD 178998	TTGD 178999	TTGD 179000	TTGD 179001	TTGD 179002
CPT07, 584 Whatawhata Road, Hamilton	CPT08, 584 Whatawhata Road, Hamilton	CPT09, 584 Whatawhata Road, Hamilton	CPT10, 584 Whatawhata Road, Hamilton	CPT11, 584 Whatawhata Road, Hamilton	CPT12, 584 Whatawhata Road, Hamilton	CPT13, 584 Whatawhata Road, Hamilton
CPT107	CPT108	CPT109	CPT110	CPT111	CPT112	CPT113
0.28g	0.28g	0.28g	0.28g	0.28g	0.28g	0.28g
5.9	5.9	5.9	5.9	5.9	5.9	5.9
0.5	0.54	0.4	0.48	0.4	6	27.3
0.4	0.4	0.4	0.4	0.4	6	27.3
0	0	0	0	0	0	0
qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa	qc= 2 MPa & Fs= 0.01 MPa
Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)	Boulanger & Idriss (2014)
ZRB-2002	ZRB-2002	ZRB-2002	ZRB-2002	ZRB-2002	ZRB-2002	ZRB-2002
7.12	11.38	11.66	10.02	17.2	16.74	14.64
0	0	0	0	0	0	0
30	30	30	30	30	30	30
Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)	Yes (10 cm^2)

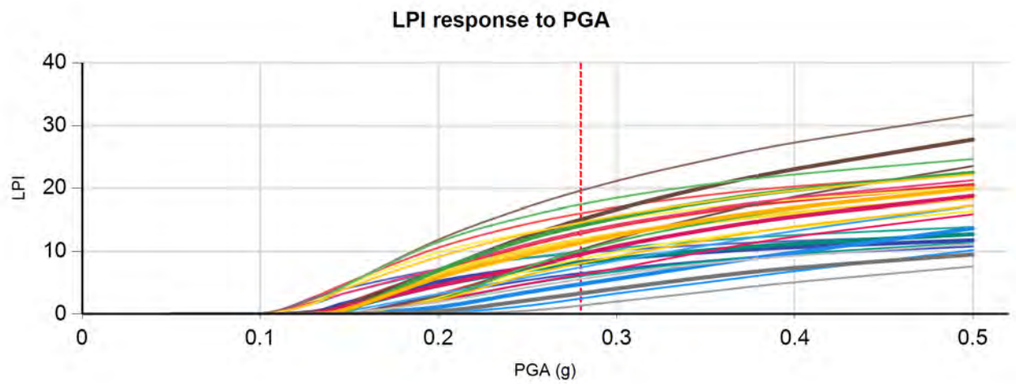
TTGD 179003
CPT14, 584 Whatawhata Road, Hamilton
CPT114
0.28g
5.9
26
26
0
qc= 2 MPa & Fs= 0.01 MPa
Boulanger & Idriss (2014)
ZRB-2002
13.66
0
30
Yes (10 cm^2)

TTGD 178998	CPT109	0	0.01	0
TTGD 178998	CPT109	0.01	30	2.6
TTGD 178999	CPT110	0	0	0
TTGD 178999	CPT110	0	0.01	0
TTGD 178999	CPT110	0.01	30	2.6
TTGD 179000	CPT111	0	0	0
TTGD 179000	CPT111	0	0.01	0
TTGD 179000	CPT111	0.01	30	2.6
TTGD 179001	CPT112	0	0	0
TTGD 179001	CPT112	0	0.01	0
TTGD 179001	CPT112	0.01	30	2.6
TTGD 179002	CPT113	0	0	0
TTGD 179002	CPT113	0	0.01	0
TTGD 179002	CPT113	0.01	30	2.6
TTGD 179003	CPT114	0	0	0
TTGD 179003	CPT114	0	0.01	0
TTGD 179003	CPT114	0.01	30	2.6









Vertical dotted line/s indicate user specified PGA at the CPT locations. (actual PGA)

Note: Inverse filtered Qc/Fs data (10 cm²) used.

Run Description	TTGD ID	Investigation Date	Magnitude	PGA (g)	Trigger Method	Settlement Method	CFC	γ (kN/m³)	Surcharge/Cut/Fill	Surcharge (kPa)	Cut/Fill Height (m)
CPT102	178991	17/05/2021	5.9	0.28	BI-2014	ZRB-2002		17		0	
CPT103	178992	17/05/2021	5.9	0.28	BI-2014	ZRB-2002		17		0	
CPT104	178993	17/05/2021	5.9	0.28	BI-2014	ZRB-2002		17		0	
CPT105	178994	18/05/2021	5.9	0.28	BI-2014	ZRB-2002		17		0	
CPT106	178995	18/05/2021	5.9	0.28	BI-2014	ZRB-2002		17		0	
CPT107	178996	18/05/2021	5.9	0.28	BI-2014	ZRB-2002		17		0	
CPT108	178997	18/05/2021	5.9	0.28	BI-2014	ZRB-2002		17		0	
CPT109	178998	18/05/2021	5.9	0.28	BI-2014	ZRB-2002		17		0	
CPT110	178999	18/05/2021	5.9	0.28	BI-2014	ZRB-2002		17		0	
CPT111	179000	18/05/2021	5.9	0.28	BI-2014	ZRB-2002		17		0	
Thicker lines represent the 50% probability of exceedence case and the thinner lines to the bottom and top of the thicker lines represent the 85% and 15% probability of exceedance cases respectively.											

www.tonkintaylor.co.nz