IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER **Kapiti Coast District Council** Proposed Plan Change 2: Intensification (PPC2) to the Kapiti Coast District Plan.

STATEMENT OF EVIDENCE OF CAMERON WYLIE ON BEHALF OF THE MANSELL FAMILY SUBMITTER No. #S023

1. INTRODUCTION

Qualifications

1.1 My full name is Cameron Andrew Wylie.

1.2 My qualifications are Master of Science (Geology) from University of Auckland (1989), and I am a Chartered Professional Engineer (CPEng) practicing in the Geotechnical Engineering. I am a Chartered Member of Engineering New Zealand (CMIPENZ) and member of the NZ Geotechnical Society.

Experience

1.3 I am employed by Resource Development Consultants Limited ("RDCL") as the Managing Director. I am also the Principal Geotechnical Engineer of that firm where I have been involved in a large number of commercial and residential geotechnical projects since 2007.

1.4 Prior to RDCL my most recent appointments include Managing Director of leading international consultancy, Golder Associates (NZ) Ltd (2001-2006) and Country Manager, Coffey Philippines Inc (1997-2001). In both cases I was responsible for delivery of geotechnical engineering of large mining and civil developments

1.5 I have been involved in geotechnical engineering for 34 years.

2. CODE OF CONDUCT

2.1 Although not necessary in respect of council hearings, I can confirm I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2014. I have complied with the Code of Conduct in preparing this evidence and I agree to comply with it while giving oral evidence before the hearing committee. Except where I state that I am relying on the evidence of another person, this written evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

3.0 BACKGROUND

2.2 I understand that as part of Proposed Plan Change 2 (PPC2) the Mansell Family have made a request to re-zone their land at Otaihanga as part of their submission. This includes a request to rezone the site from Rural Lifestyle to General Residential and amend plans and any relevant provisions.

2.3 I confirm that I have previously provided advice and undertaken assessment in support of the Mansell's subdivision of that site in 46 residential lots (RM210147) as a non-complying resource consent application. That application was publicly notified and went through a hearing process. It is described in more detail in the evidence of the submitters planning expert Mr Hansen. The Mansell family obtained subdivision consent with conditions from Kapiti Coast District Council dated 2nd November 2022, which was appealed by a submitter to the Environment Court.

2.4 The Mansell family also obtained non-notified non-complying consents from Greater Wellington Regional Council in October 2021 and an Archaeological Authorisation for earthworks from Heritage New Zealand in January 2020 and has applied for lizard relocation permits from the Department of Conservation under the Wildlife Act.

2.5 I was involved in providing Geotechnical advice on those consents. Specifically, this has involved :

(a) Geotechnical investigations for the site as set out in the report and including: Site walkover and Engineering Geological Mapping; 17 no. test pits; 16 no. Dynamic Cone Penetrometer (DCP) tests and 11 no. Cone Penetrometer Tests (CPT).

(b) Co-Authoring the Report on Geotechnical Investigation for the Mansell Farm Subdivision in Otaihanga Road dated 16th August 2019 with my colleague Jethro Neeson setting out the Geotechnical assessment for the proposal.

(c) Assisted the Applicant to respond to Further information Requests by Council dated 8 April 2022. This included updating stability analyses to include revised ground accelerations developed as part of the NZ seismic hazard model and as advised by MBIE (2021) and reissuing an updated report dated 10 March 2022.

(d) Assisting the Applicants planner Mr Hansen with advice on and input to development of suitable conditions.

(e) Attended the resource consent hearing and gave evidence on behalf of the Mansell Family.

2.6 As a result of my very recent prior involvement in the resource consent project, I have a very good understanding of the site and surrounds and the site and potential effects of residential development in this location.

2.7 These are covered in detail in my assessment report (RDCL report ref. R-195340402_03 dated 10 March 2022) which I authored for the resource consent application. The findings of that report were accepted by the Council's peer review and in the Hearing Panels decision. A copy of this is attached at **Appendix 1.** My evidence will cross refer to that document.

2.8 In preparation for my evidence on PPC2 I have read:

(a) The Mansell's submission and further submission;

(b) Relevant part of the Officers Report and

(c) NPS-UD May 2022 Update.

(d) KCDC proposed Plan Change 2 – Intensification and the accompanying s.32 Evaluation Report and appendices; and

(e) Further submissions relevant to the Mansell's submission.

Description of the site

2.9 The proposed subdivision is located within sand dunes in the centre of Otaihanga.The site is currently grazed/vacant.

EXECUTIVE SUMMARY

2.10 Geotechnical assessment and testing was undertaken for the proposed development by RDCL to assess the site for liquification risk and determine the geotechnical suitability of the site for residential use

2.11 At that time this was for 49 lots comprising 22 lifestyle and 27 residential lots.

2.12 The results of the Geotechnical assessment indicate that there is little to no risk of liquification for the site, that shallow foundations in accordance with NZS3604:2011 are appropriate and that a nominal setback of 5.0m from slopes >15º is required to protect against the potential for shallow slope instability.

2.13 The site is considered suitable for General Residential use. There are no geotechnical considerations at all that would prevent intensification of the development of the site associated with the rezone.

3. SCOPE AND STRUCTURE OF EVIDENCE

3.1 I have structured my evidence as follows:

(a) Summary of my report and key conclusions as to effects

(b) Response to matters raised by submitters.

(c) Response to Officers' Report 42A and peer review report (relevant to Geotech)

(d) Conclusion.

4. SUMMARY OF GEROTECHNICAL REPORT

4.1 Geotechnical assessment and testing was undertaken by RDCL to assess the site for liquification risk and determine the geotechnical suitability of the site for residential use.

4.2 These included Site walkover and Engineering Geological Mapping; 17 no. test pits; 16 no. Dynamic Cone Penetrometer (DCP) tests and 11 no. Cone Penetrometer Tests (CPT), analytical assessment of liquefaction potential based on site test results and analytical assessment of slope stability to guide the design of the subdivision.

4.3 The generalised soil profile includes Silty/sandy TOPSOIL to ~0.25m bgl; overlying Loose to dense silty SAND to 16m bgl.

4.4 The results of the Geotechnical assessment indicate that:

4.5 Ultimate Bearing Capacity of 300kPa is generally available between 0.3m and 1.7m below existing ground level.

4.6 Little to no risk of liquification.

4.7 NZS3604:2011 shallow foundations are considered suitable for the overall site.

4.8 A nominal setback of 5.0m from slopes >15º is required to protect against the potential for shallow slope instability. This is a standard recommendation for remnant dunes.

5. KEY FINDINGS

5.1 Key findings of the report are:

5.2 Based on the results of our investigation, I consider the proposed development is suitable for General Residential development from a geotechnical perspective with:

5.3 Building restriction zones are required 5.0m from the top and bottom of natural slopes. This would be something that was considered in detail in any future project design.

5.4 Shallow foundations in accordance with NZS3604:2011 foundations are appropriate.

5.5 There are no significant geotechnical constraints for this site, for General Residential Zone development to the extent permitted under the MDRS.

6. RESPONSE TO FURTHER SUBMITTERS

6.1 There are no geotechnical concerns raised by submitters.

6.2 **RESPONSE TO OFFICERS REPORT**

6.3 There are no geotechnical concerns raised in officers reports for the proposed rezoning.

9. CONCLUSION

9.1 Based on appropriate, peer reviewed Geotechnical Assessment, the site is clear of liquefaction risk and suitable for residential development using shallow NZS3604:2011 compliant foundations, with buildings setback 5m from crest of slope.

6.4 In regards to the Mansell's rezoning request for the land to be included as part of PPC2 there are no geotechnical constraints to rezoning the property General Residential and use for that purpose.

Cameron Wylie

9 March 2023

REPORT ON:
GEOTECHNICAL INVESTIGATION

PROJECT:

MANSELL FARM SUBDIVISION
OTAIHANGA RD, PARAPARAUMU

CLIENT: MR RICHARD & MR ALASTAIR MANSELL

C/- CHRIS HANSEN CONSULTANTS LTD
220 ROSS RD
RD 7 WHAKAMARAMA
TAURANGA 3179

R-195340402-03

EXECUTIVE SUMMARY

Chris Hansen Consultants Ltd (CHC), on behalf of Mr Richard and Mr Alastair Mansell, engaged Resource Development Consultants Ltd (RDCL) to complete a geotechnical investigation at 131 Otaihanga Rd, Paraparaumu.

We understand the intent is to subdivide the site into forty-nine (49) rural lifestyle and residential lots. Currently the land is being used as farmland. Our geotechnical investigation and reporting are required to support resource consent application. For geotechnical assessment, the proposed development is assumed to be of Importance Level (IL) 2.

Based on results from this investigation we have developed the following generalised soil profile:

- Silty/sandy TOPSOIL to ~0.25m bgl; overlying
- Loose to dense silty SAND to 16m bgl.

Ultimate Bearing Capacity of 300kPa is generally available:

- Between 0.3m and 1.7m bgl.

Liquefaction assessment results indicate little to no risk of liquefaction hazards across the site, including free field settlement and lateral spreading.

Based on the results of our investigation, we consider the proposed development is suitable from a geotechnical perspective following:

- Building setback of 5m is maintained from slopes > 15°;
    - Specific engineering design of foundations is required to build within the set-back zone.
- NZS3604:2011 foundations are appropriate outside of the setback zone.

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FIGURES

APPENDICES

1 OVERVIEW

Chris Hansen Consultants Ltd (CHC), on behalf of Mr Richard and Mr Alastair Mansell, engaged Resource Development Consultants Ltd (RDCL) to complete a geotechnical investigation at 131 Otaihanga Rd, Paraparaumu.

The legal description of the site is LOT 6 DP 53191, SEC 31 SO 505428, PT LOT 5 DP 84524, LOT 1 & LOT 3 DP 303764, LOT 4 DP 84524, LOT 3 DP 84524, LOT 2 DP 84524.

This geotechnical investigation report is to meet the requirements for:

- Resource consent application, including:
  - Confirmation of site suitability; and
  - Recommendations for foundations and earthworks.

1.1 UNDERSTANDING OF THE PROJECT

RDCL have been supplied with scheme plans for the proposed subdivision, prepared by Cuttriss Consultants Ltd (Ref. 22208 SCH1, Revision C, dated November 2020).

We understand the intent is to subdivide the site into forty-nine (49) rural lifestyle and residential lots. A detailed Project Description is provided in Section 3 of the AEE accompanying the resource consent applications.

In summary, the proposal involves the subdivision of 17ha (western) portion of the Mansell Farm into 49 lots: 22 rural lifestyle lots in the northern part of the site, and 27 residential lots adjacent to Otaihanga Road in the south of the site. Access to 19 of the rural lifestyle lots in the north will be via Tieko Street, and the remainder of the rural-lifestyle and residential lots will be accessed via Otaihanga Road.

The proposed subdivision of this area involves earthworks, construction of roads, installation of services and identification of notional 20m building circle areas on the rural lifestyle lots.

1.2 SCOPE OF WORK

This work was completed in general accordance with RDCL proposal 19534, issued to the client on 16th August 2019 and which has been reported:

- RDCL report No. R-195340402-02_Rev01; "Geotechnical Investigation at Otaihanga Road, Paraparaumu", issued 25 April 2021 (project); and

- RDCL report No. R-195340402-03; "Geotechnical Investigation at Otaihanga Road, Paraparaumu", issued 10 March 2022 (this report).

2 SITE DESCRIPTION

The proposed subdivision is located within sand dunes in the centre of Otaihanga.

The site is currently farmland comprising:

- Predominantly gently to steeply sloping rolling dunes (approximately 18.15ha).

2.1 REGIONAL GEOLOGICAL MAPPING

GNS maps indicate the proposed subdivision is underlain by:

- Holocene windblown sand deposits (inactive sand dunes).

2.2 GEOHAZARDS

2.2.1 ACTIVE FAULTS

No active faults directly impacting the site have been identified in the New Zealand Active Faults Database (GNS Science, 2018).

The Wairau Fault is approximately 17km east of the site. This fault requires a near fault factor in accordance with NZS1170.5:2004.

2.2.2 FLOODING

The KCDC natural hazard maps indicate the proposed subdivision site is:

- Susceptible to ponding within low lying areas.

2.2.3 LIQUEFACTION RISK

GWRC hazard mapping for this region indicates that the proposed development has:

- A liquefaction risk category of "high";
- A ground shaking hazard rating of "moderate"; and
- A combined hazard rating of "moderate-high".

3 SITE INVESTIGATION

RDCL carried out a general site walkover and subsurface field testing (Figure 1), which comprised:

- Seventeen (17) test pits;
  - Terminated between 1.7-3.0m bgl;
- Sixteen (16) Dynamic Cone Penetrometer (DCP) tests;
  - Terminated between 0.5-2.4m bgl, and
- Eleven (11) CPT tests,
  - Terminated between 4.5-16.6m bgl.

Test pits and DCPs were completed in dry summer conditions.

CPTs were carried out in spring conditions.

Site investigation logs are in Appendix A.

3.1 SUBSURFACE CONDITIONS

We have developed several simplified soil profiles based on our investigations. Shallow profiles were developed based on results of test pit investigations. Deep soil profiles were developed based on results from CPT testing.

Full investigation logs are available in Appendix A.

3.1.1 SHALLOW SOIL PROFILE

Test pit investigations show that shallow conditions generally comprise:

- Silty/sandy TOPSOIL to ~0.25 – 0.6m bgl; underlain by
- Loose to dense silty SAND to at least 3.0m bgl.

Test locations fell into categories; dune crests, or low-lying dune edges and valleys.

- Dune crest materials generally comprise dry, silty, sand (fine) that is loose at surface and becomes denser with depth.
- Low lying dune edges and valleys generally comprise medium dense to dense, silty sand that is wet to saturated and tends to be dilatant.
- Topsoil in TP03 was deep (0.6m bgl) and highly peaty.

3.1.2 Deep Soil Profile

Deep soil testing comprised CPT testing. A simplified soil profile correlated to Soil Behaviour Type (SBT) indicate the site is generally underlain by:

- Sand and silty sand (sands) interbedded with silty sand to sandy silt (sand mixtures) to at least 16.62m bgl.

3.2 Groundwater

Groundwater levels encountered during site investigations are in Table 1.

Table 1:Depth to Groundwater as Encountered During Site Investigations

Test ID	Test Pit Elevation	Test Pit Depth	Groundwater Level (m bgl)	Groundwater Level (RL, m)
TP01	8	2.1	1.7	6.3
TP02	7	2.5	2.5	4.5
TP03	7	2.2	1.6	5.4
TP04	13	2.3	-	-
TP05	9	2.6	-	-
TP06	7	1.9	1.6	5.4
TP07	17	3.0	-	-
TP08	20	1.8	-	-
TP09	19	1.7	-	-
TP10	6	2.2	1.8	4.2
TP11	5	2.0	1.4	3.6
TP12	5	2.1	2.1	2.9
TP13	6	2.9	2.9	3.1
TP14	14	1.8	-	-
TP15	10	1.9	-	-
TP16	13	2.9	-	-
TP17	19	2.5	-	-

4 GEOTECHNICAL ASSESSMENT

4.1 SHALLOW BEARING CAPACITY

We identified no significant peat or organic soil deposits in this investigation regarding potential for static settlements.

DCP test results have been correlated to Ultimate Bearing Capacity (UBC) in accordance with Stockwell (1977) (Table 2).

Depth to 200kPa ultimate soil bearing capacity was identified:

- Between 0.2m and 1.3m below current ground level (m bgl).

Depth to 300kPa ultimate soil bearing capacity was identified:

- Between 0.3m and 1.7m bgl.

TABLE 2:SUMMARY OF SHALLOW ULTIMATE BEARING CAPACITY

Test ID		200 kPa UBC		300 kPa UBC	
Test ID	**Collar RL (m)**	**Depth (m bgl)**	**~RL (m)**	**Depth (m bgl)**	**~RL (m)**
DCP01	9	0.2	8.8	0.3	8.7
DCP02	13	1.3	11.7	1.7	11.3
DCP03	14	1.1	12.9	1.4	12.6
DCP04	7	0.6	6.4	0.7	6.3
DCP05	7	0.4	6.6	0.4	6.6
DCP06	7	0.4	6.6	0.9	6.1
DCP07	7	0.3	6.7	0.9	6.1
DCP08	17	0.7	16.3	1.1	15.9
DCP09	19	0.3	18.7	1.2	17.8
DCP10	21	0.4	20.6	0.9	20.1
DCP11	19	0.2	18.8	0.8	18.2
DCP12	6	0.4	5.6	1.1	4.9
DCP13	6	0.2	5.8	1.1	4.9
DCP14	5	0.9	4.1	1	4
DCP15	6	1.1	4.9	1.1	4.9
DCP16	14	0.4	13.6	0.9	13.1

4.2 SEISMIC SOIL CLASS

The site is classified as site subsoil "Class D Site" in accordance with NZS1170.5:2004, part 5: Earthquake Actions – New Zealand; based on

- NZGD borehole record BH_76860 to a depth of 63m bgl, roughly 150m southeast of the south corner of the site.

4.3 LIQUEFACTION ASSESSMENT

4.3.1 LIQUEFACTION POTENTIAL

A liquefaction assessment was carried out on the results of the CPT investigation, which indicates:

- Low risk of liquefaction during Serviceability Limit State (SLS) design seismic event, with
  - LSN of 0, indicating little to no expression of liquefaction; and
- Low risk of liquefaction during Ultimate Limit State (ULS) design seismic event, with
  - LSN of 0 to 0.461, indicating little to no expression of liquefaction.

Results are in Appendix B.

4.3.2 VERTICAL SETTLEMENT

The settlements presented in Table 3 are estimates of the free field settlement, which is the amount of vertical settlement anticipated in the site. These values do not necessarily represent actual building settlement resulting from structural loading. Estimated vertical settlement during SLS and ULS design seismic events is in Table 3.

TABLE 3:ESTIMATED VERTICAL SETTLEMENT DURING SLS AND ULS DESIGN SEISMIC EVENTS

Design Seismic Event	Test ID	Vertical Settlement (cm)	LSN
SLS	CPT01	0	0
	CPT02	0.02	0.04
	CPT03	0	0
	CPT04	0	0
	CPT05	0	0
	CPT06	0	0
	CPT07	0	0
	CPT08	0	0
	CPT09	0	0
	CPT10	0	0
	CPT11	0.05	0.07
ULS	CPT01	0.8	3.7
	CPT02	3.1	12.0
	CPT03	0.8	1.0
	CPT04	0.7	3.2
	CPT05	0.05	0.09
	CPT06	0.06	0.3
	CPT07	0.6	2.3
	CPT08	1.0	1.7
	CPT09	0.9	3.1
	CPT10	1.5	6.7
	CPT11	3.5	12.7

4.3.3 LATERAL SPREAD ASSESSMENT – NATURAL TOPOGRAPHY

Lateral spreading occurs on sites which have un-retained free faces or slopes combined with liquefaction risk. When the site liquefies, soil moves towards the free face or slope resulting in cracks developing as the soil displaces.

Estimated lateral spread during SLS and ULS design seismic events is in Table 4.

TABLE 4:ESTIMATED LATERAL SPREAD DURING SLS AND ULS DESIGN SEISMIC EVENTS

Design Seismic Event	Test ID	Lateral Spread (cm)	LSN
SLS	CPT01	0	0
	CPT02	0	0.04
	CPT03	0	0
	CPT04	0	0
	CPT05	0	0
	CPT06	0	0
	CPT07	0	0
	CPT08	0	0
	CPT09	0.2	0
	CPT10	0	0
	CPT11	0.4	0.07
ULS	CPT01	10.4	3.7
	CPT02	31.5	12.0
	CPT03	12.6	1.0
	CPT04	6.2	3.2
	CPT05	3.6	0.09
	CPT06	0.7	0.3
	CPT07	8.5	2.3
	CPT08	15.6	1.7
	CPT09	9.2	3.1
	CPT10	12	6.7
	CPT11	36.4	12.7

4.3.4 Lateral Spread Assessment Earthworked Topography

Lateral spread has been checked against the effect of earthworks on the changed topography as in Table 5.

Table 5: Table 5 Lateral Spread – Earthworked Topography

Design Seismic Event	Test ID	Original Ground (RL)	Finished Level (RL)	Earthworks		Lateral Spread (cm)
				Cut (m)	Fill (m)	
SLS	CPT01		1.35		1.35	0
	CPT02		1.6		1.6	00.06
	CPT03		1.7		1.7	0.2
	CPT06		1.3		1.3	0.13
	CPT07	5.0		5.0		0.3
	CPT08	0.9		0.9		0.6
ULS	CPT01		1.35		1.35	9.0
	CPT02		1.6		1.6	17.2
	CPT03		1.7		1.7	10.4
	CPT06		1.3		1.3	11.9
	CPT07	5.0		5.0		15
	CPT08	0.9		0.9		11.3

4.3.5 Basis of Assessment

The liquefaction assessment for the site was carried out using CLiq (accepted industry software package), CPT data of current ground conditions and the following input parameters (NZTA Bridge Manual v.3.2 section 5 [NZ Transport Agency, 2013]) including updated PGA and Earthquake Magnitude in accordance with MBIE Guidance Earthquake Engineering Practice Module 1, November 2021:

- Magnitude (M) = 6.5 SLS & 7.7 ULS;
- PGA = 0.13g (SLS) & 0.68g (ULS), based on:
  - $C_{0,\,1000}$ = 0.44 (map 6.1a),
  - f = 1.0 (Class D Soil), and
  - R = 0.25 (SLS) & 1 (ULS)

Lateral spreading assessment was carried out for a generic model of gently sloping ground with a slope grade of S (%) = 1.00.

The design earthquake was chosen based on probability of recurrence, which is based on historical earthquakes. A 50 year design life was assigned. For an importance level 2 building, this correlates with a 25 year return period (SLS) and 500 year return period (ULS).

4.4 BORROW FOR STRUCTURAL FILL

4.4.1 SUITABILITY FOR USE

Test pit investigations and visual / tactile assessment suggests:

- Site won material excluding topsoil and organic materials will be suitable for use as structural fill;
- Topsoil, organic and deleterious materials are not suitable for use as structural fill.
  - This material should be stripped from 0.6m below ground in the locations tested and could be deeper in some areas.
  - Organic and non-structural fill should likely be stockpiled to help revegetate stripped and filled surfaces.

4.4.2 GEOTECHNICAL PARAMETERS

Geotechnical parameters for structural fill placed in accordance with the general specifications set out in Section 5.5 are expected to be as in Table 6:

TABLE 6:ESTIMATED EFFECTIVE SOIL PARAMETERS (DRAINED)

Condition	Soil Type	Friction Angle, ϕ' (°)	Cohesion, c' (kPa)	Density (kN/m^3)
Natural	Loose Silty Sand	30	0	15
Natural	Dense Silty Sand	40	0	20
Structural Fill	Dense Silty Sand	40	0	20

4.5 SLOPE STABILITY FOR SETBACKS

4.5.1 DESIGN CASES

Slope stability numerical assessment has been undertaken to assess the setback for natural and fill slopes (Appendix C) by:

- Limit equilibrium analyses; using
  - Industry standard software SLIDE 9.0 by Rocscience Inc; and
  - Bishops Simplified method.
- Seismic induced displacement has been assessed using industry standard:
  - Finite element (FEM) methods using program RS2 by Rocscience Inc.

Design cases assessed are for:

- Natural Slopes;
- Fill Slopes;

Considering earthquake scenarios:

- Static
- Serviceability and Ultimate Limit States;
- Design values calculated as in Section 4.3.5; and
- Applying pseudo-static loads

4.5.2 GROUNDWATER LEVELS

Groundwater levels have been conservatively taken at 1.4m below current ground as indicated only in TP11 in the lower part of the development at ~5m RL.

4.5.3 RESULT OF ASSESSMENT

Results of stability analyses are in Table 7.

TABLE 7: RESULTS OF STABILITY ANALYSES

Slope	Groundwater (m bgl)	Load Condition	Regional PGA (MBIE, 2021)	Applied PGA (g)	Limit Equilibrium Factor of Safety	FEM	
						Critical SRF	Slope Displacement (m)
Natural	1.4	Static	0	0	1.5	1.2	< 0.05
	1.4	SLS	0.13	0.13	1.3	0.9	
	1.4	ULS	0.68	0.34*	0.9	0.6	< 0.5
Fill	1.4	Static	0	0	1.5	1.5	< 0.05
	1.4	SLS	0.13	0.13	1.2	1.1	
	1.4	ULS	0.68	0.34*	0.9	0.7	

* Applied PGA for ULS slope stability is ½ Recommended PGA (MBIE, 2021)

4.5.4 DISCUSSION

Stability modelling (Appendix C) has been undertaken using conservative groundwater levels at 1.4m below ground level suggest for:

Limit Equilibrium Methods

- Acceptable Factor of Safety for static and SLS conditions; and
- Marginal Factors of Safety for ULS conditions.

FEM displacement modelling

- Natural slopes with loose material in place displacement:
  - < 0.5m in outer slope, and
  - < 0.05m within 5m setback.
- Cut natural slopes (loose material removed) and fill materials displacement:
  - < 0.05m for all conditions except for all conditions.

5 GEOTECHNICAL RECOMMENDATIONS

5.1 GEOTECHNICAL SITE SUITABILITY

Results of our liquefaction assessment indicate little to no risk of liquefaction for this site.

Based on the results of this investigation, we consider the proposed development is suitable from a geotechnical perspective, following our recommendations below.

5.2 FOUNDATION RECOMMENDATIONS

5.2.1 CUT AND NATURAL GROUND

Within cut and natural ground, NZS3604:2011 shallow foundations are considered suitable for the overall site from a level:

- Cleared of topsoil, organic and deleterious materials.

Building platforms will require testing to confirm site requirements in accordance with NZS3604:2011.

5.2.2 FILL SURFACES

Fills are expected to be placed in accordance with general specifications as set out in Section 5.5.

5.3 BUILDING PLATFORM SETBACKS FROM SLOPES

5.3.1 NATURAL SLOPES

Shallow slope instability localised to the loose layer that mantles the topography was observed in a single dune, with no other obvious indication of deep instability.

- A setback of 5m from slopes > 15° is recommended to protect against the potential for shallow slope instability.
  - Outside of the setback zone, foundations may be in accordance with NZS3604:2011;
  - Within the set-back zone, specific engineering design of foundations is required considering the risk of shallow instability.

5.3.2 Fill and Cut Slopes

Slopes in fill will be formed at 1Vertical (V) : 2 Horizontal (H) (Section 5.4.2) with fill placed in accordance with the general specifications in Section 5.5.

Cut slopes will be excavated in all cases sufficient depth to remove the loose and organic materials that mantle the natural slopes.

- A setback of 5m from slopes > 15° is recommended to protect against the potential for shallow slope instability.
  - Outside of the setback zone, foundations may be in accordance with NZS3604:2011;
  - Within the set-back zone, specific engineering design of foundations is required considering the risk of shallow instability.

5.4 Geotechnical Parameters for Earthworks

5.4.1 Cut Slopes

We recommend the following slope limits for earthworks design; for:

- Unsupported Permanent batters in:
  - Loose material 1V:2H; and
  - Dense material 1V:1.5H.
- Unsupported Temporary batters in:
  - Loose Material 1V:1.5H; and
  - Dense material 1V:1H.

5.4.2 Fill Slopes

Fill slopes should be finished at 1V: 2H.

5.4.3 GEOTECHNICAL PARAMETERS FOR DESIGN

We recommend the following geotechnical parameters are adopted for retaining wall design as in Table 6 (repeated here).

TABLE 6: ESTIMATED EFFECTIVE SOIL PARAMETERS (DRAINED)

Condition	Soil Type	Friction Angle, ϕ' (°)	Cohesion, c' (kPa)	Density (kN/m^3)
Natural	Loose Silty Sand	30	0	15
Natural	Dense Silty Sand	40	0	20
Structural Fill	Dense Silty Sand	40	0	20

5.5 GENERAL SPECIFICATIONS FOR ENGINEERED FILLS

5.5.1 ENGINEERED FILL

Earthwork drawings provided indicate significant cut and fill using site-won materials.

- Cut is suitable for use as structural fill with topsoil, organic and deleterious materials removed.
- All topsoil, organic or weak materials classified as being unsuitable shall be excavated and cut to waste prior to filling commencement.
- All fills will be placed under engineering control of a Chartered Professional Geotechnical Engineer.

Site materials are expected to be suitable with confirmation of parameters including but not necessarily limited to:

- Grading (Particle Size Distribution);
- Atterberg Limit testing;
- Compaction testing.

Engineering testing during earthworks will be undertaken in accordance with NZS 4431:1989 with testing including but not necessarily limited to:

- Soil moisture content during filling:
  - Nominal target 2% of optimum moisture content.
- Dry density achieved by compaction:
  - Nominal target 98% of Maximum Dry Density (MDD).

5.6 ROAD CONSTRUCTION

Results of DCP testing have been correlated with California Bearing Ratio (CBR).

For loose silty sands, we recommend an average of 7% CBR for roading construction.

CBR values presented here are based on test results at the time of our investigations and should be re-evaluated once the project enters the building consent stage.

6 FURTHER GEOTECHNICAL INPUT

We recommend a suitably qualified geotechnical professional be engaged:

- To confirm bearing for specific house foundations at the time of construction;
- To provide construction monitoring and issue a Statement of Professional Opinion on Suitability of Land for Construction; and/or
- Should ground conditions be found to differ from those contained in this report.

7 REFERENCES

1. Dellow, G.D.; Abbott, E.R.; Heron, D.W.; Scott, B.J.; Ries, W.F.; Lukovic, B. 2016. *Update of hazard Information for 2015 Lifelines Risk & Responsibilities Report, GNS Science Consultancy Report 2016/40*. 33 p.
2. GNS Science. 2000. WELLINGTON. *Institute of Geological and Nuclear Sciences, 1:250,000 Geological Map 10*. (Begg, J.G.; Johnston, M.R., Compilers) GNS Science.
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4. Ministry of Business, Innovation and Employment. 2012. *Guidance: Repairing and rebuilding houses affected by the Canterbury earthquakes (Part A: Technical Guidance)*. Wellington: Ministry of Business, Innovation and Employment.
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7. Standards New Zealand. 2011. *Timber-framed Buildings*. NZS3604:2011. Wellington: Standards New Zealand.
8. Standards New Zealand. 1989. *Code of Practice for Earthfill for Residential Development. NZS4431:1989*. Wellington: Standards New Zealand.
9. Stockwell, M. 1977. *Determination of allowable bearing pressure under small structures*. New Zealand Engineering, 32(6), pp.132-135.

8 LIMITATIONS

- This report has been prepared for the particular purpose outlined in the project brief and no responsibility is accepted for the use of any part in other contexts or for any other purpose.
- Ground conditions assessed in this report are inferred from published sources, site inspection and the investigations described. Variations from the interpreted conditions may occur, and special conditions relating to the site may not have been revealed by this investigation, and which are therefore not taken into account. No warranty is included either expressed or implied that the actual conditions will conform to the interpretation contained in this report.
- No responsibility is accepted by Resource Development Consultants Ltd for inaccuracies in data supplied by others. Where data has been supplied by others, it has been assumed that this information is correct.
- Groundwater conditions can vary with season or due to other events. Any comments on groundwater conditions are based on observations at the time.
- This report is provided for sole use by the client and Kāpiti Coast District Council (KCDC) and is confidential to the client and their professional advisors. No responsibility whatsoever for the contents of this report shall be accepted for any person other than the client.

9 CLOSURE

We trust this meets your current needs. Should you wish to discuss any aspect of the contents of this document please contact the undersigned on 06 877-1652.

Sincerely,

Jethro Neeson	Cam Wylie
BEng, NZGS	MSc; MIPENZ; CPEng
Geotechnical Engineer	Principal

FIGURE 1: SITE INVESTIGATION LAYOUT

1770120 1770220 1770320 1770420 1770520 1770620 1770720 1770820

5472500 5472400 5472300 5472200 5472100 5472000 5471900 5471800 5471700 5471600

N

TP15 TP14 CPT11 TP13 CPT10 DCP15 CPT09 CPT08 TP12 TP11 DCP12 DCP11 TP09 CPT07 CPT05 TP08 CPT06 DCP13 DCP09 TP17 DCP08 TP07 CPT04 DCP07 TP06 DCP01 TP05 CPT02 TP16 DCP02 TP04 TP02 DCP06 CPT03 DCP04 TP03 DCP05 CPT01 TP01

0 50 100 150 200 250 m

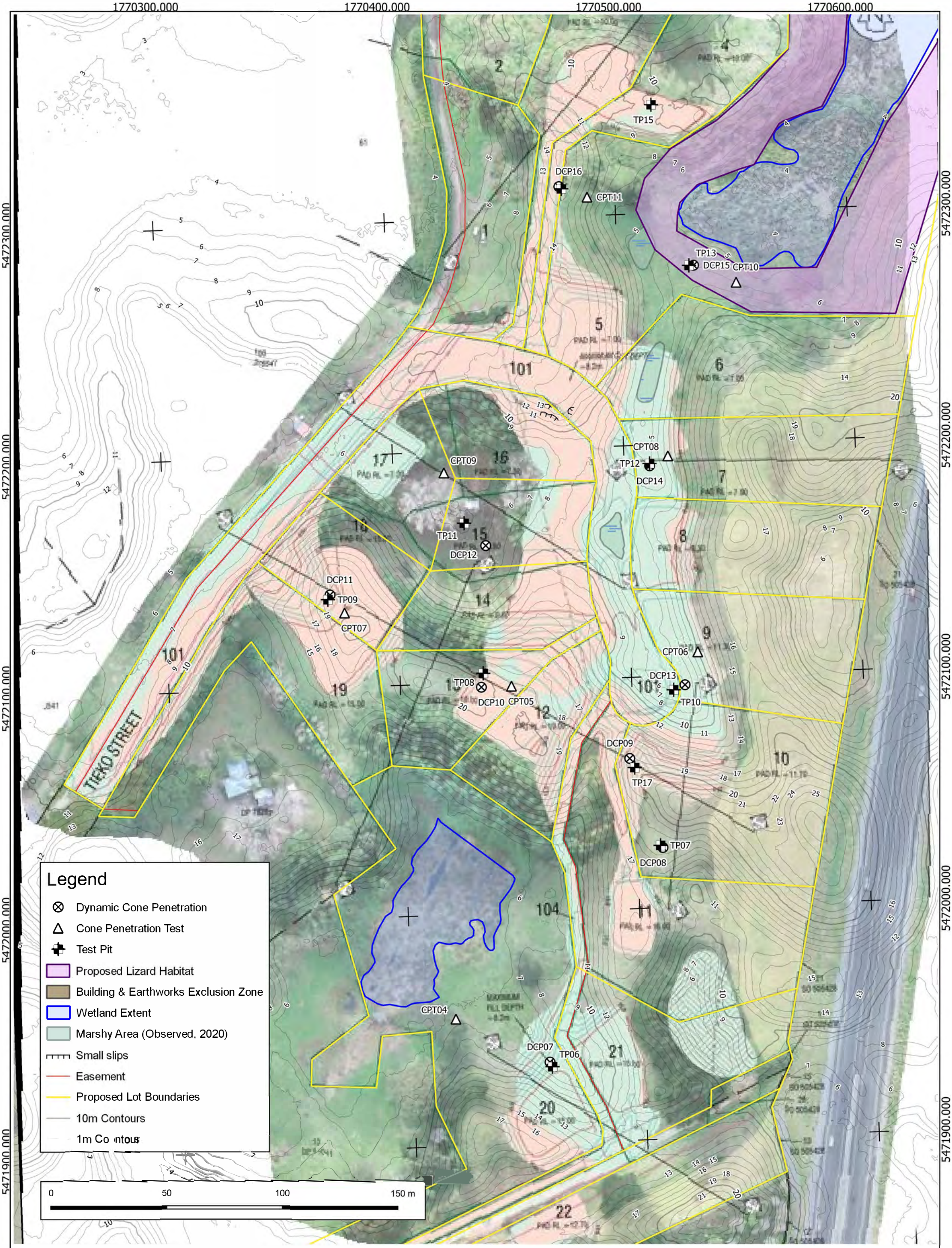
Legend

- Dynamic Cone Penetration
- Cone Penetration Test
- Test Pit
- Proposed Lizard Habitat
- Building & Earthworks Exclusion Zone
- Wetland Extent
- Marshy Area (Observed, 2020)
- Small slips
- Easement
- Proposed Lot Boundaries
- 10m Contours
- 1m Contours

RDCL
PO Box 28057
8/308 Queen St East
Hastings, NZ
Tel: +64 6 8771652
Fax: +64 6 877 5015
Email: info@rdcl.co.nz

Title	Investigation Layout	Drawn By	RD	Date	22/02/21	A3
Project	195340402 - 131 Otaihanga Rd	Checked By	JJN	Date	22/02/21	Figure 1
Client	Mr Richard & Mr Alastair Mansell	Approved By	JJN	Date	22/02/21	Rev. 3

FIGURE 2: SITE INVESTIGATION AGAINST EARTHWORKS PLANS



RDCL PO Box 28057 8/308 Queen St East Hastings, NZ Tel: +64 6 8771652 Fax: +64 6 877 5015 Email: info@rdcl.co.nz	Title	Test Location Against Earthworks	Drawn By	TT	Date 22/02/21	A3
	Project	195340402 - 131 Otaihanga Rd	Checked By	BB	Date 22/02/21	Figure2A
	Client	Mr Richard & Mr Alastair Mansell	Approved By	CW	Date 22/02/21	Rev. 3

1770300.000 1770400.000 5471900.000

5471900.000 5471800.000 5471700.000 5471600.000 1770200.000

BOUNDARY
EASEMENT
EXISTING CONTOURS
PROPOSED CONTOURS
PROPOSED CUT - 70,000m³
PROPOSED FILL = 54,000m³
EARTHWORKS & BUILDING EXCLUSION AREA
PROPOSED FILL AREA (UNSUITABLE MATERIAL)

ISSUED

DCP01 TP05 CPT02 DCP02 TP16 TP04 DCP03 DCP06 TP02 CPT03 TP03 DCP04 DCP05 CPT01 TP01

20 22 104 105 13 DP 51041 23 PAD RL =10.60 24 PAD RL =10.55 109 PAD RL =10.60 48 PAD RL =10.55 25 PAD RL =10.35 26 PAD RL =10.05 27 PAD RL =9.90 47 PAD RL =10.45 46 PAD RL =10.35 45 PAD RL =10.35 100 28 PAD RL =9.75 29 PAD RL =9.70 43 PAD RL =10.15 42 PAD RL =9.90 44 PAD RL =10.30 30 PAD RL =9.70 41 PAD RL =9.60 31 PAD RL =9.55 40 PAD RL =9.55 200 32 PAD RL =9.30 39 PAD RL =9.40 33 38 PAD RL =9.35 34 PAD RL =9.10 35 PAD RL =9.25 37 PAD RL =9.35 36 PAD RL =9.10 102 103 OTAIHANGA ROAD 24 SO 505428 9 SO 505428 26 SO 505

NOTES:
1. THIS PLAN IS FOR RESOURCE CONSENT PURPOSES AND IS NOT TO BE RELIED UPON FOR ANY OTHER PURPOSES WITHOUT THE

Legend

- Dynamic Cone Penetration
- Cone Penetration Test
- Test Pit
- Proposed Lizard Habitat
- Building & Earthworks Exclusion Zone
- Wetland Extent
- Marshy Area (Observed, 2020)
- Small slips
- Easement
- Proposed Lot Boundaries
- 10m Contours
- 1m Contours

B	EW EXCLUSION ZONES ADDED	GAW	09/19
C	REVISED DESIGN, CROSS SECTIONS ADDED	JLG	01/22

0 50 100 150 m

Surveyors. Engineers. Planners.

OTAIHANGA ROAD, OTAIHANGA
PRELIMINARY EARTHWORKS DESIGN

SCALE A1 1:500 REDUCED SCALE 1:1000 - A3
FIELDWORK NHT 07/19 DRAWING NUMBER 22208 EW

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PO Box 28057
8/308 Queen St East
Hastings, NZ
Tel: +64 6 8771652
Fax: +64 6 877 5015
Email: info@rdcl.co.nz

Title	Test Location Against Earthworks	Drawn By	TT	Date	22/02/21	A3
Project	195340402 - 131 Otaihanga Rd	Checked By	BB	Date	22/02/21	Figure2B
Client	Mr Richard & Mr Alastair Mansell	Approved By	CW	Date	22/02/21	Rev. 3

APPENDIX A: SITE INVESTIGATION LOGS

TEST PIT LOG

TP01

SHEET 1 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	27-02-2020
PROJECT:	195340402	EASTING:	1770357.00	FINISHED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5471613.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	8	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0.0	8.0		TS	Silty TOPSOIL, with trace sand; dark brown. Moist; sand, fine; rootlets.	M					
				Silty SAND, with trace clay; brown; blocky. Soft to firm; non-plastic; moist; sand, fine; rootlets.		S - FM				
0.5	7.5			Silty SAND, with trace rootlets; dark brown. Loose; wet; sand, fine; becoming blocky and tannish grey with depth.	W	L				
1.0	7.0									
				Silty SAND; blue; blocky. Medium dense; dilatant; saturated; sand, fine.	S	MD				
1.5	6.5	▼								
2.0	6.0			EOH: 2.10m						
2.5	5.5									

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock

SYMBOLS

▼ Standing Water Level

◁ Out flow

▷ In flow

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8/308 QUEEN ST EAST, HASTINGS PO BOX 28057, HAVELOCK NORTH 4130 NEW ZEALAND
Ph: +64 6 8771652 | Email: info@rdcl.co.nz

TEST PIT LOG

TP02

SHEET 2 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	27-02-2020
PROJECT:	195340402	EASTING:	1770397.00	FINISHED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5471725.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	7	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0.0	7.0		TS	Silty TOPSOIL, with some clay, with trace sand; brown. Moist; sand, fine; rootlets.	M					
0.5	6.5			Silty SAND, with some rootlets; tan; blocky. Loose to medium dense; moist becoming wet; sand, fine; becoming yellowish tan with trace iron staining with depth.	M becoming W	L - MD				
1.0	6.0									
1.5	5.5			Silty SAND; greyish blue. Medium dense; dilatant; wet; sand, fine.	W	MD				
2.0	5.0									
2.5	4.5	▼		EOH: 2.50m						

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock

SYMBOLS

▼ Standing Water Level

◁ Out flow

▷ In flow

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TEST PIT LOG

TP03

SHEET 3 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	27-02-2020
PROJECT:	195340402	EASTING:	1770327.00	FINISHED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5471682.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	7	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0.0	7.0		TS	TOPSOIL (PEATY), with trace sand; very dark brown. Soft; moist to dry; peat, fibrous; sand, fine; trace logs up to 1.0m long; eggy odour; rootlets.	M - D	S				
0.5	6.5		TS							
			TS							
				Silty SAND, with trace rootlets; dark brown; blocky. Medium dense; non-plastic; wet; sand, fine.	W	MD				
1.0	6.0									
				Silty SAND; blueish grey. Medium dense; wet; sand, fine.						
1.5	5.5	▼								
				Silty SAND, with trace rootlets; greyish blue becoming blue; blocky. Medium dense; wet to saturated; sand, fine.	W - S					
2.0	5.0			EOH: 2.20m						
2.5	4.5									

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock

SYMBOLS

▼ Standing Water Level

◁ Out flow

▷ In flow

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TEST PIT LOG

TP04

SHEET 4 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	27-02-2020
PROJECT:	195340402	EASTING:	1770292.00	FINISHED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5471728.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	13	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0.0	12.5	Groundwater Not Encountered	TS	Silty TOPSOIL, with some sand; dark brown. Moist; sand, fine; rootlets.	M	L				
0.5				Silty SAND; yellowish tan. Loose; moist; sand, fine; becoming greyish tan at 1.1m bgl.						
1.0	12.0									
1.5	11.5									
2.0	11.0			EOH: 2.30m						
2.5	10.5									

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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TEST PIT LOG

TP05

SHEET 5 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	27-02-2020
PROJECT:	195340402	EASTING:	1770271.00	FINISHED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5471789.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	9	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0.0	9.0	Groundwater Not Encountered	TS	Silty TOPSOIL, with trace sand; dark brown. Moist; sand, fine; rootlets.	M					
0.5	8.5			Silty SAND; tan. Very loose; non-plastic; dry becoming moist; sand, fine.	D becoming M	VL				
1.0	8.0									
1.5	7.5									
2.0	7.0									
2.5	6.5			EOH: 2.60m						

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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TEST PIT LOG

TP06

SHEET 6 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	27-02-2020
PROJECT:	195340402	EASTING:	1770460.00	FINISHED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5471933.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	7	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
			TS	Silty TOPSOIL, with trace sand; dark brown. Dry to moist; sand, fine; rootlets.	D - M					
0.5	6.5			Sandy SILT; tan; blocky. Loose to medium dense; moist; sand, fine; rootlets.	M	L - MD				
1.0	6.0			Silty SAND; blueish grey. Medium dense; wet; sand, fine.	W	MD				
1.5	5.5	▼		EOH: 1.90m						
2.0	5.0									
2.5	4.5									

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock

SYMBOLS

▼ Standing Water Level
◁ Out flow
▷ In flow

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TEST PIT LOG

TP07

SHEET 7 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	27-02-2020
PROJECT:	195340402	EASTING:	1770510.00	FINISHED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472027.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	17	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0.0	17.0	Groundwater Not Encountered	TS	Silty TOPSOIL, with trace sand; brown. Moist to dry; sand, fine; rootlets.	M - D					
0.5	16.5			Sandy SILT, with some roots; tan/greyish brown. Loose; dry; sand, fine.	D	L				
1.0	16.0			Silty SAND; yellowish tan; blocky. Loose to dense; dry; sand, fine; becoming moist with depth.		L - D				
1.5	15.5									
2.0	15.0									
2.5	14.5			EOH: 3.00m						

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock
Pine roots throughout.

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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TEST PIT LOG

TP08

SHEET 8 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	28-02-2020
PROJECT:	195340402	EASTING:	1770436.00	FINISHED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472104.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	20	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0.0	20.0	Groundwater Not Encountered	TS	Sandy TOPSOIL, with some silt; dark brown. Dry to moist; sand, fine; rootlets.	D - M	L				
0.5	19.5			Silty SAND; tan. Loose; dry to moist; sand, fine; becoming moist with depth.						
1.0	19.0									
1.5	18.5			EOH: 1.80m						
2.0	18.0									
2.5	17.5									

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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TEST PIT LOG

TP09

SHEET 9 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	28-02-2020
PROJECT:	195340402	EASTING:	1770370.00	FINISHED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472138.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	19	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0.0	18.5	Groundwater Not Encountered	TS	Sandy TOPSOIL, with some silt; dark brown. Dry to moist; sand, fine; rootlets.	D - M					
0.5				Silty SAND; tan. Loose; dry; sand, fine; rootlets.	D	L				
1.0	18.0									
1.5	17.5			EOH: 1.70m						
2.0	17.0									
2.5	16.5									

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock
Pine roots throughout.

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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TEST PIT LOG

TP10

SHEET 10 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	28-02-2020
PROJECT:	195340402	EASTING:	1770518.00	FINISHED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472094.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	6	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0.0	6.0		TS	Sandy TOPSOIL, with trace silt; dark brown. Moist to dry; sand, fine; rootlets.	M - D					
0.5	5.5			Silty SAND, with trace rootlets; tan. Loose to medium dense; moist; sand, fine.	M	L - MD				
1.0	5.0			Silty SAND; grey with orange mottle. Medium dense; dilatant; saturated; sand, fine; orange mottle inferred to be iron staining.	S	MD				
1.5	4.5	▼								
2.0	4.0			EOH: 2.20m						
2.5	3.5									

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock

SYMBOLS

▼ Standing Water Level
◁ Out flow
▷ In flow

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TEST PIT LOG

TP11

SHEET 11 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	28-02-2020
PROJECT:	195340402	EASTING:	1770430.00	FINISHED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472169.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	5	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0.0	5.0		TS	Sandy TOPSOIL, with trace silt; dark brown; blocky. Moist; sand, fine.						
0.5	4.5			Silty SAND; reddish brown. Loose; moist; sand, fine.	M	L				
1.0	4.0			Silty SAND, with trace rootlets; grey; blocky. Medium dense; wet; sand, fine.	W	MD				
1.5	3.5	▼								
2.0	3.0			EOH: 2.00m						
2.5	2.5									

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock
Roots throughout.

SYMBOLS

▼ Standing Water Level
◁ Out flow
▷ In flow

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TEST PIT LOG

TP12

SHEET 12 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	28-02-2020
PROJECT:	195340402	EASTING:	1770511.00	FINISHED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472192.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	5	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
			TS	Sandy TOPSOIL, with some silt, with trace clay; dark brown. Moist; sand, fine; rootlets.						
0.5	4.5			Silty SAND, with trace iron stain; tan. Loose to medium dense; moist; sand, fine.	M	L - MD				
1.0	4.0			Silty SAND, with trace iron stain; grey. Medium dense; wet; sand, fine.						
1.5	3.5				W	MD				
2.0	3.0	▼		EOH: 2.10m						
2.5	2.5									

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock

SYMBOLS

▼ Standing Water Level

◁ Out flow

▷ In flow

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TEST PIT LOG

TP13

SHEET 13 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	28-02-2020
PROJECT:	195340402	EASTING:	1770531.00	FINISHED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472277.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	6	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0			TS	Sandy TOPSOIL, with trace silt; dark brown. Moist; sand, fine; rootlets.	M					
0.5	5.5			Silty SAND; tan. Loose; moist to dry; sand, fine.	M - D	L				
1.0	5.0			Silty SAND; dark tan. Loose to medium dense; moist; sand, fine; becoming wet and greyish tan from 1.9m bgl.	M	L - MD				
1.5	4.5									
2.0	4.0									
2.5	3.5	▼		EOH: 2.90m						

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock

SYMBOLS

▼ Standing Water Level

◁ Out flow

▷ In flow

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TEST PIT LOG

TP14

SHEET 14 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	28-02-2020
PROJECT:	195340402	EASTING:	1770477.00	FINISHED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472312.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	14	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0.0	14.0	Groundwater Not Encountered	TS	Silty TOPSOIL, with trace sand; dark brown. Dry; sand, fine; rootlets.	D	L				
0.5	13.5			Silty SAND, with trace rootlets; tan. Loose; dry; sand, fine; some iron staining starting at 0.9m bgl.						
1.0	13.0									
1.5	12.5			EOH: 1.80m						
2.0	12.0									
2.5	11.5									

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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TEST PIT LOG

TP15

SHEET 15 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	28-02-2020
PROJECT:	195340402	EASTING:	1770517.00	FINISHED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472347.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	10	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0.0	10.0	Groundwater Not Encountered		Sandy TOPSOIL, with some silt; light brown. Dry; sand, fine; rootlets.	D					
0.5	9.5			Silty SAND; tan. Loose becoming medium dense; dry becoming moist; sand, fine; rootlets.	D becoming M	L becoming MD				
1.0	9.0									
1.5	8.5			EOH: 1.90m						
2.0	8.0									
2.5	7.5									

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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TEST PIT LOG

TP16

SHEET 16 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	27-02-2020
PROJECT:	195340402	EASTING:	1770345.00	FINISHED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5471775.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	13	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0	13.0	Groundwater Not Encountered	TS	Silty TOPSOIL, with trace sand; dark brown. Moist to dry; sand, fine.	M - D					
0.5	12.5			Silty SAND, with trace rootlets; tan. Loose; dry to moist; sand, fine.	D - M	L				
1.0	12.0			Silty SAND, with trace iron stain; tan; blocky. Loose to medium dense; moist; sand, fine; trace rootlets.	M	L - MD				
1.5	11.5									
2.0	11.0									
2.5	10.5			EOH: 2.90m						

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock
Buried topsoil (likely ancient) at 0.6m bgl.

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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TEST PIT LOG

TP17

SHEET 17 OF 17

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	STARTED:	27-02-2020
PROJECT:	195340402	EASTING:	1770500.00	FINISHED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472061.00		
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	19	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		DIMENSIONS:	m x m	STATUS:	Final data
CONTRACTOR:		MACHINE TYPE & MODEL:			

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	ROCK / SOIL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY / DENSITY	CLASSIFICATION	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0.0	19.0	Groundwater Not Encountered	TS	Sandy TOPSOIL, with trace silt; dark brown. Moist; sand, fine; rootlets.	M					
0.5	18.5			Silty SAND; tan. Dry to moist; sand, fine; trace blocky iron-pan inclusions.	D - M					
1.0	18.0									
1.5	17.5									
2.0	17.0									
2.5	16.5			EOH: 2.50m						

REMARKS

Soils logged in accordance with NZGS (2005) Field Description of Soil and Rock

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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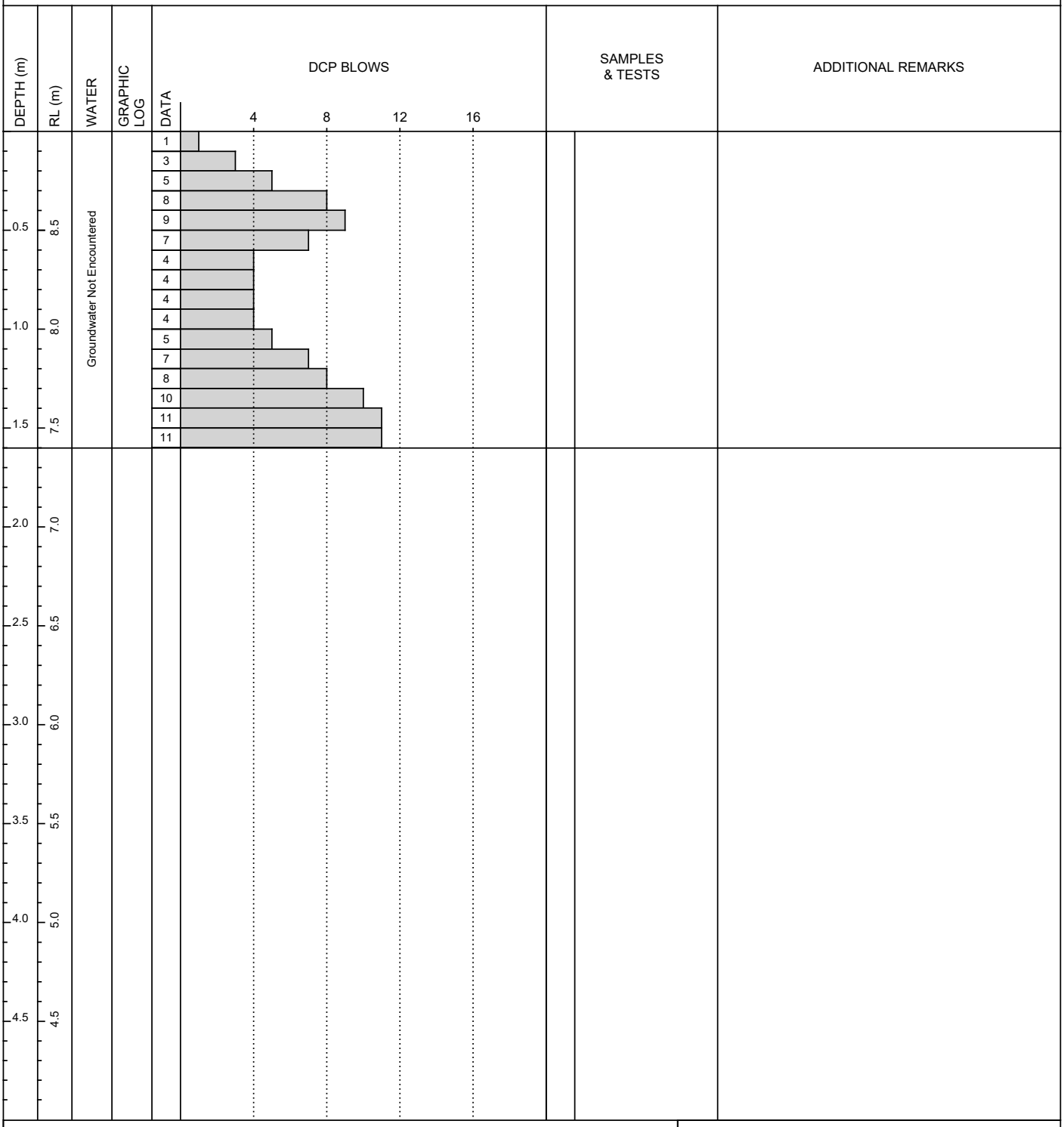
DCP LOG

DCP01

SHEET 1 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770274.00	STARTED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5471793.00	FINISHED:	27-02-2020
		DATUM:	NZVD2016	LOGGED BY: MT/RD	DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	9	CHECKED BY: JJN	DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS: Final data	



REMARKS

Soils tested in accordance with NZGS

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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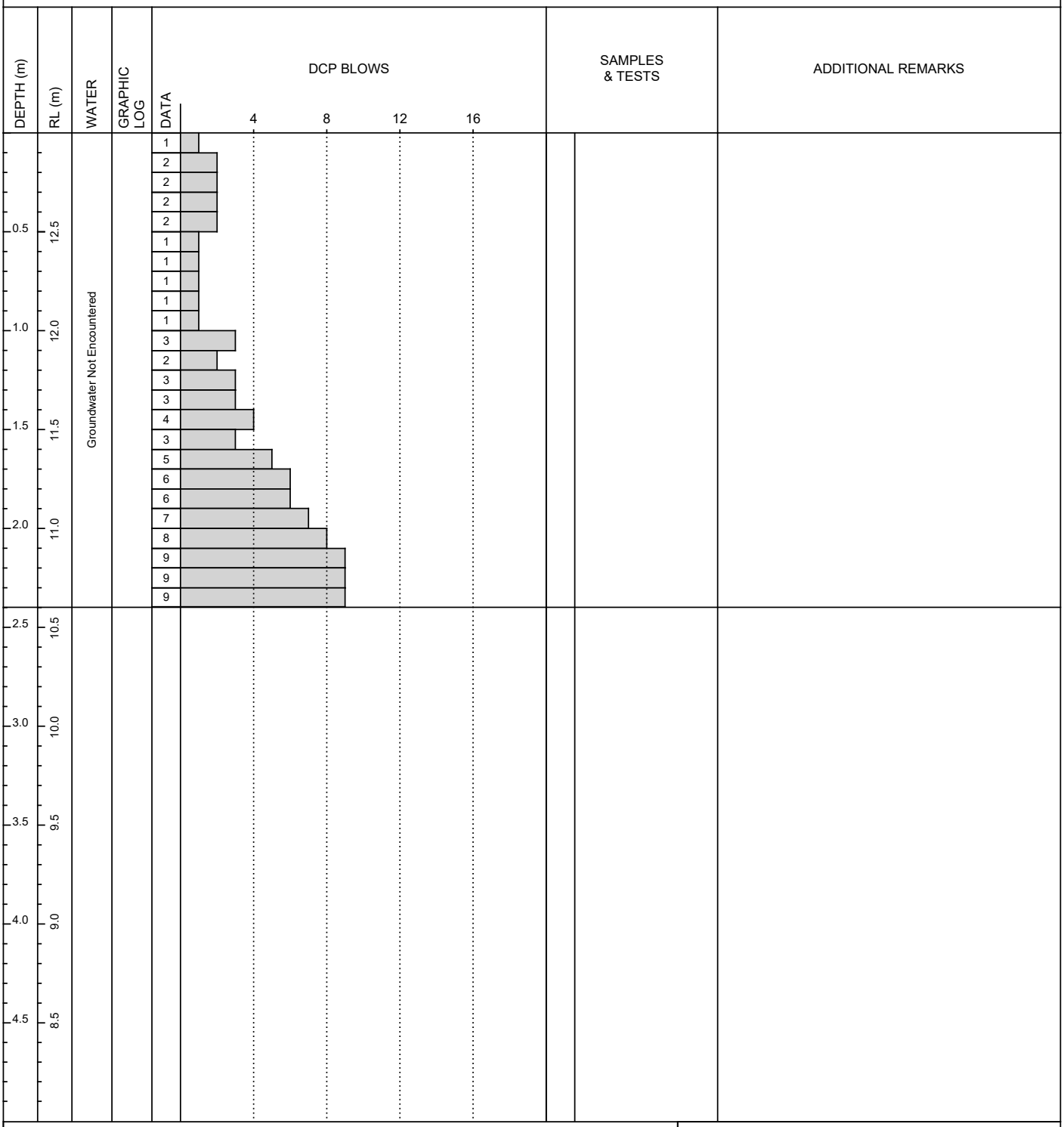
DCP LOG

DCP02

SHEET 2 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770349.00	STARTED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5471779.00	FINISHED:	27-02-2020
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	13	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS:	Final data



REMARKS

Soils tested in accordance with NZGS

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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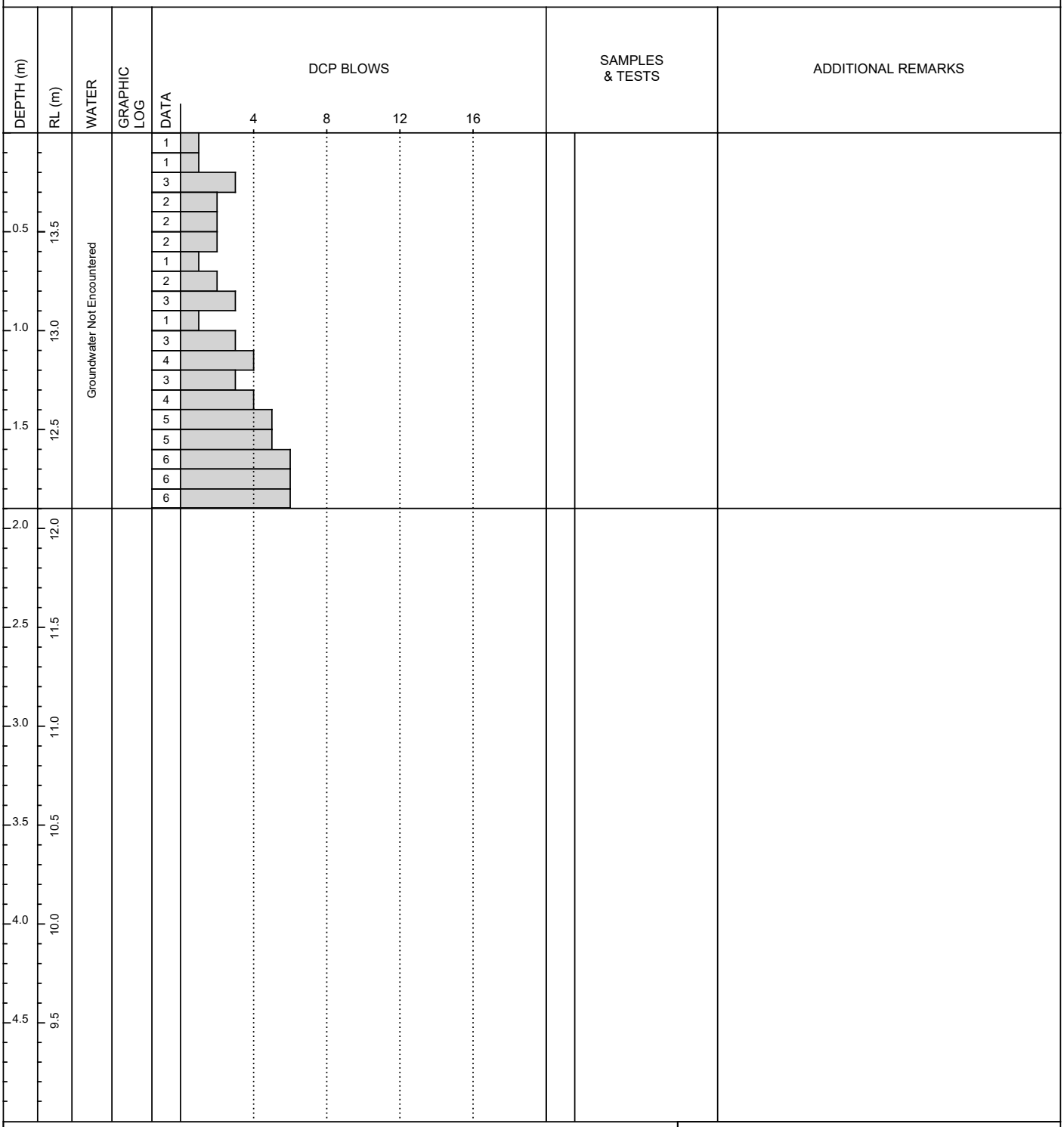
DCP LOG

DCP03

SHEET 3 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770307.00	STARTED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5471732.00	FINISHED:	27-02-2020
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	14	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS:	Final data



REMARKS

Soils tested in accordance with NZGS

SYMBOLS

- Standing Water Level
- Out flow
- In flow

RDCL

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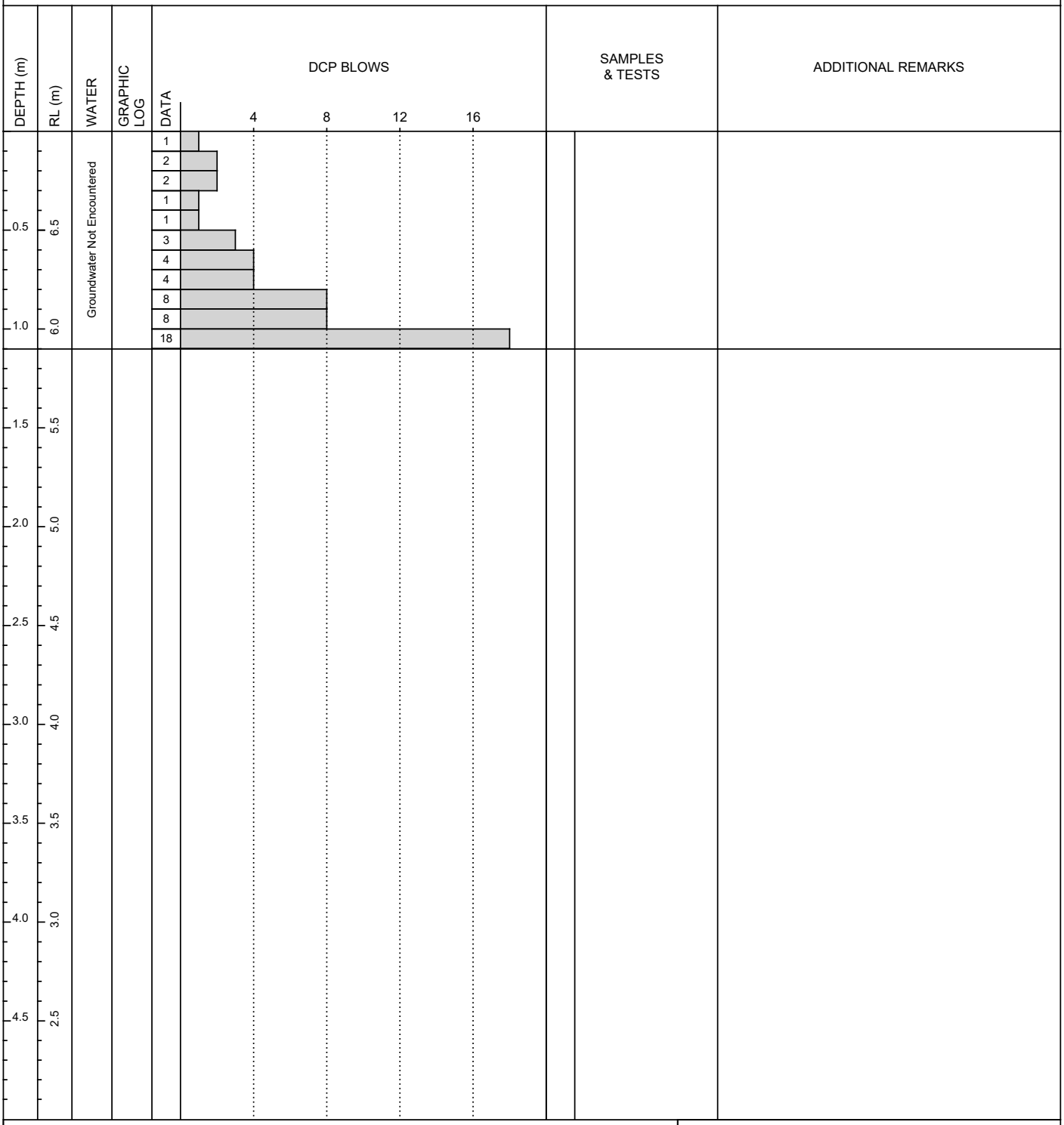
DCP LOG

DCP04

SHEET 4 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770331.00	STARTED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5471682.00	FINISHED:	27-02-2020
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	7	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS:	Final data



REMARKS

Soils tested in accordance with NZGS

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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DCP LOG

DCP05

SHEET 5 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770353.00	STARTED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5471629.00	FINISHED:	27-02-2020
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	7	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS:	Final data

DEPTH (m)	RL (m)	WATER	GRAPHIC LOG	DATA	DCP BLOWS	SAMPLES & TESTS	ADDITIONAL REMARKS
0.5	6.5	dwater Not Encoun		2 2 2 7 13	4 8 12 16 Double bounce		
1.0	6.0						
1.5	5.5						
2.0	5.0						
2.5	4.5						
3.0	4.0						
3.5	3.5						
4.0	3.0						
4.5	2.5						

REMARKS
Soils tested in accordance with NZGS

SYMBOLS
- Standing Water Level
- Out flow
- In flow

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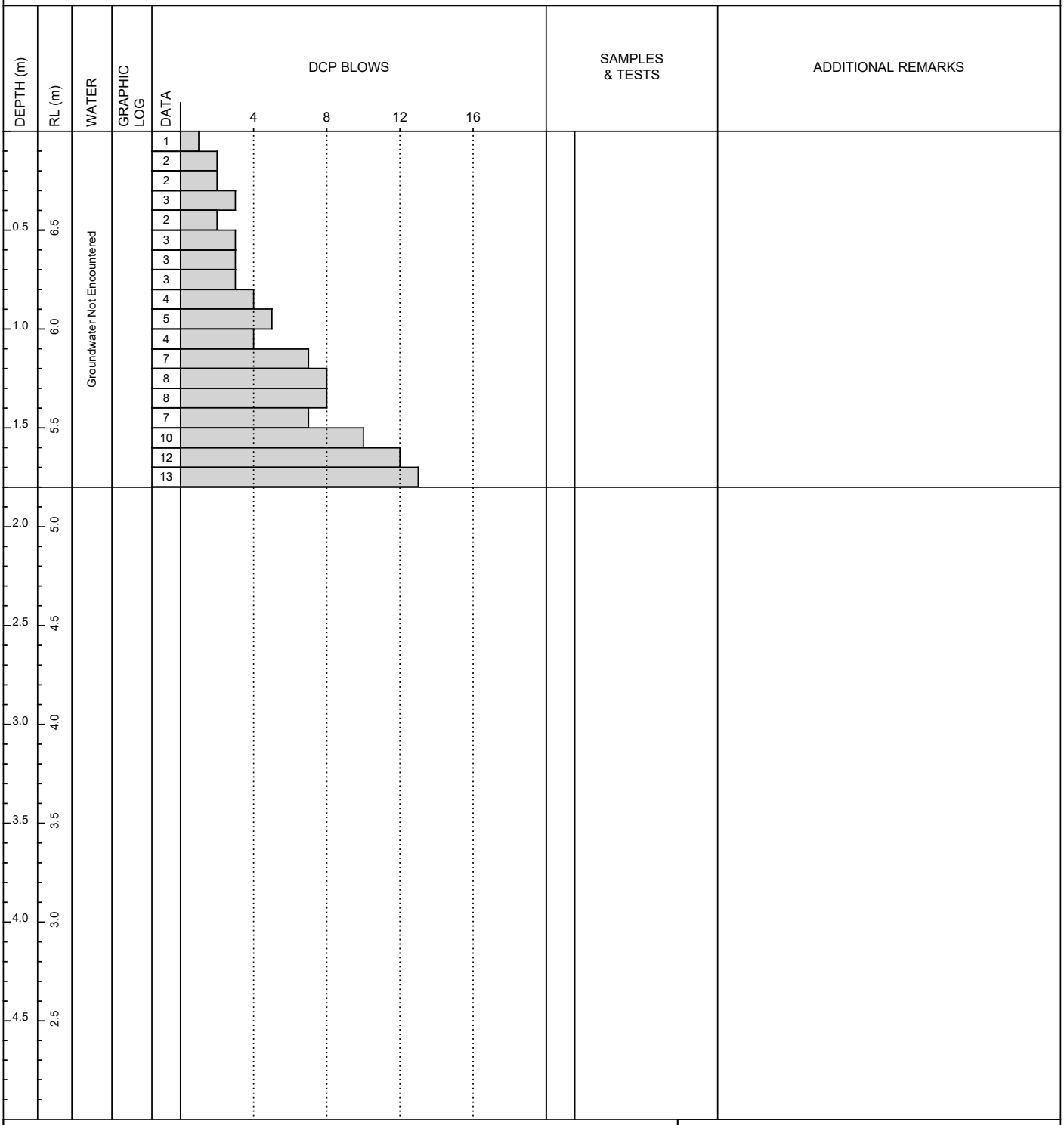
DCP LOG

DCP06

SHEET 6 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770387.00	STARTED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5471725.00	FINISHED:	27-02-2020
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	7	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS:	Final data



REMARKS

Soils tested in accordance with NZGS

SYMBOLS

- Standing Water Level
- Out flow
- In flow

RDCL

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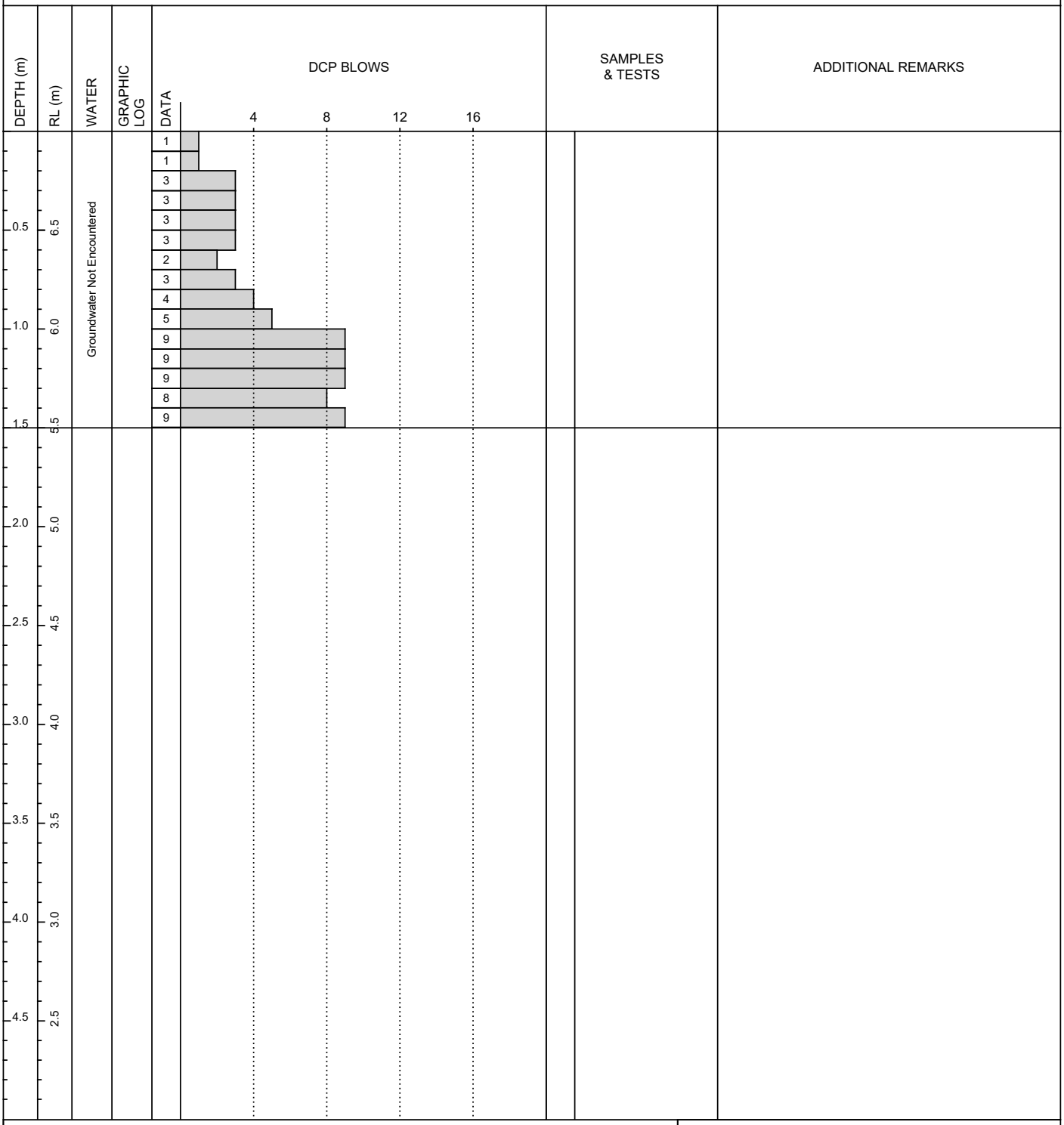
DCP LOG

DCP07

SHEET 7 OF 16

CLIENT: Richard Mansell	PROJECTION: NZTM2000	SUB-LOCATION:
PROJECT: 195340402	EASTING: 1770459.00	STARTED: 27-02-2020
LOCATION: 131 Otaihanga Rd	NORTHING: 5471935.00	FINISHED: 27-02-2020
	DATUM: NZVD2016	LOGGED BY: MT/RD DATE: 27-02-2020
OFFICE: RDCL - Hastings	ELEVATION: 7	CHECKED BY: JJN DATE: 14-04-2020
ENGINEER:	AZIMUTH: PLUNGE: 90°	STATUS: Final data



REMARKS
Soils tested in accordance with NZGS

SYMBOLS
- Standing Water Level
- Out flow
- In flow

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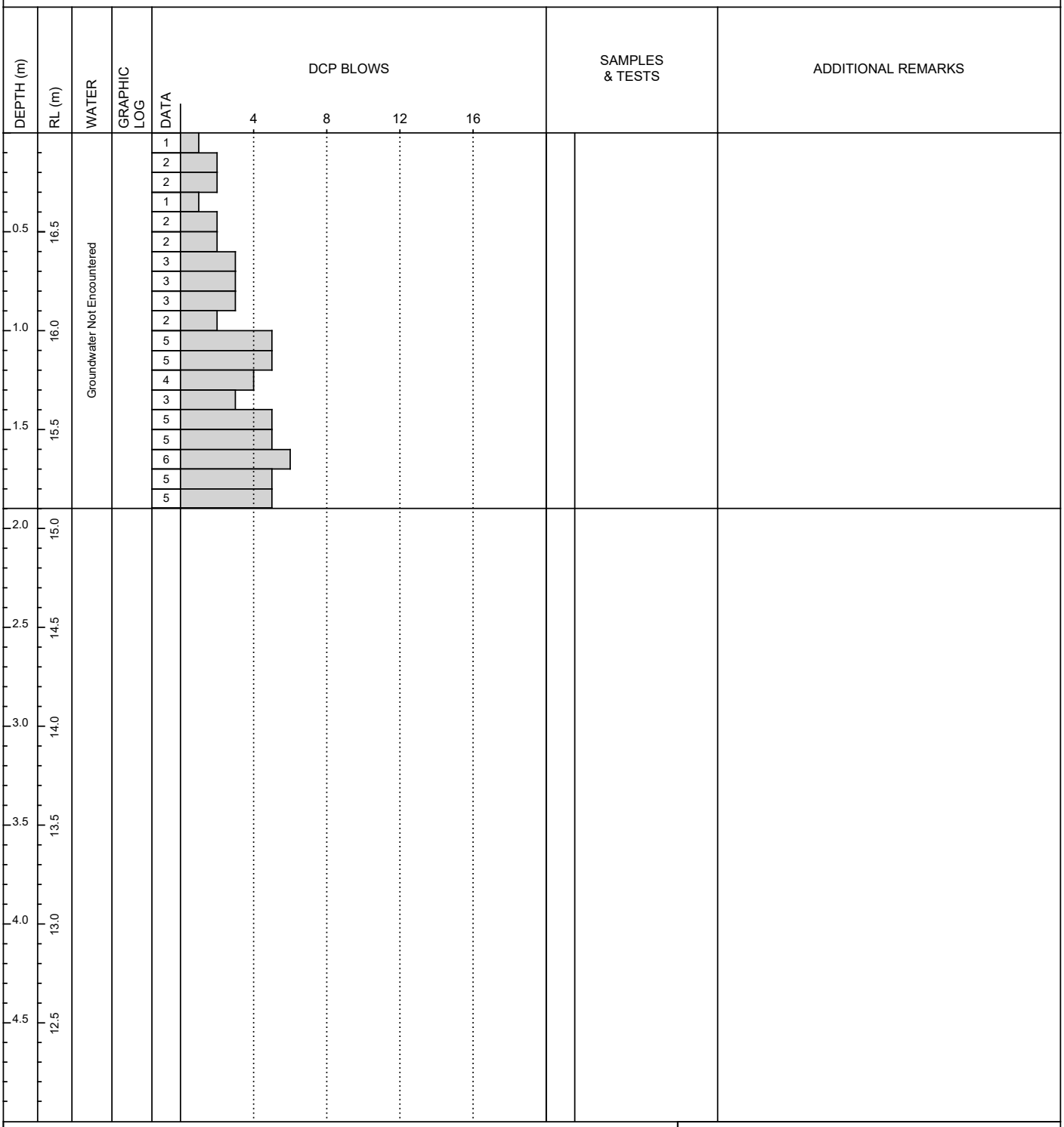
DCP LOG

DCP08

SHEET 8 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770511.00	STARTED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472026.00	FINISHED:	27-02-2020
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	17	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS:	Final data



REMARKS
Soils tested in accordance with NZGS

SYMBOLS
- Standing Water Level
- Out flow
- In flow

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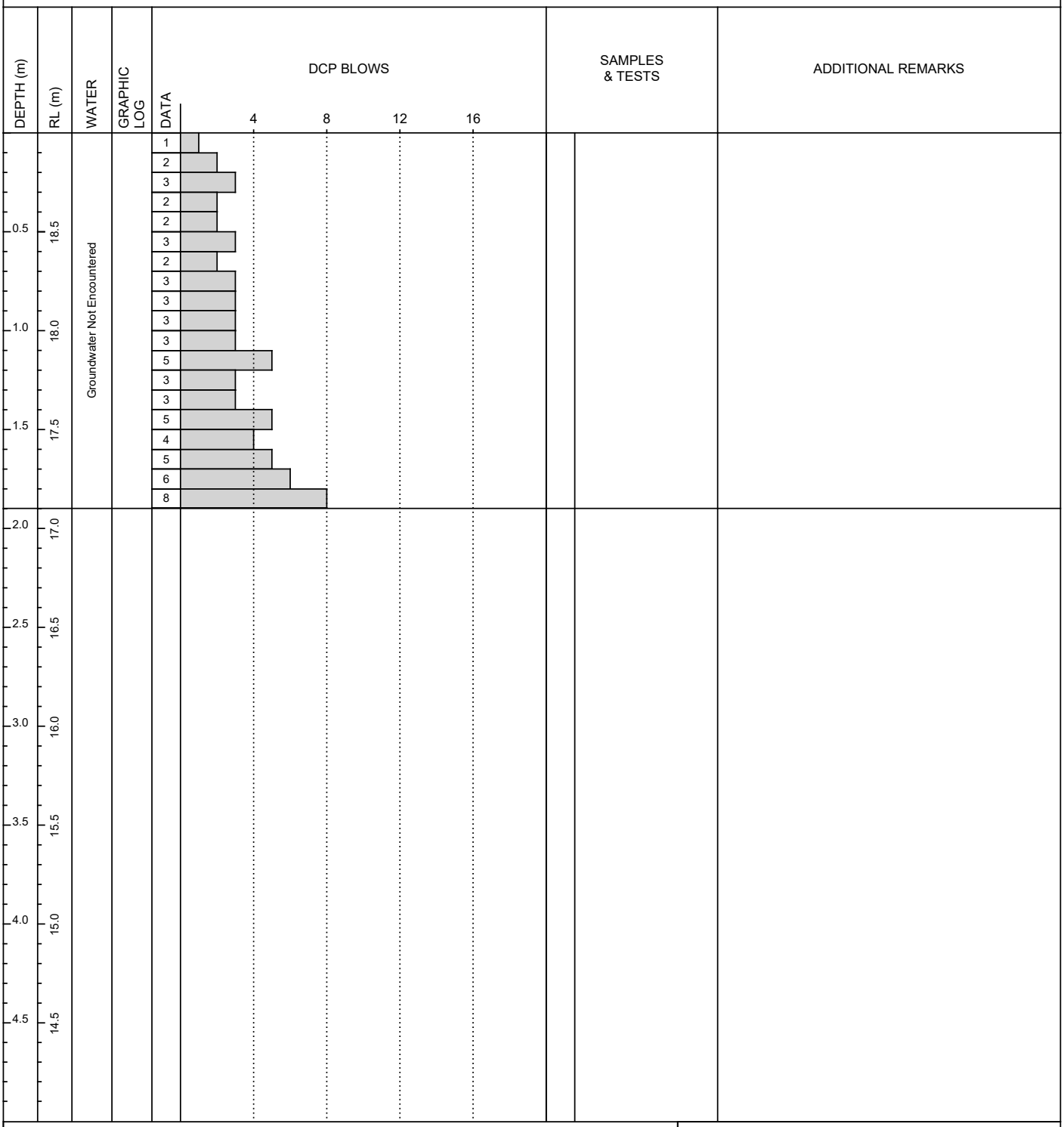
DCP LOG

DCP09

SHEET 9 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770498.00	STARTED:	27-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472065.00	FINISHED:	27-02-2020
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 27-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	19	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS:	Final data



REMARKS

Soils tested in accordance with NZGS

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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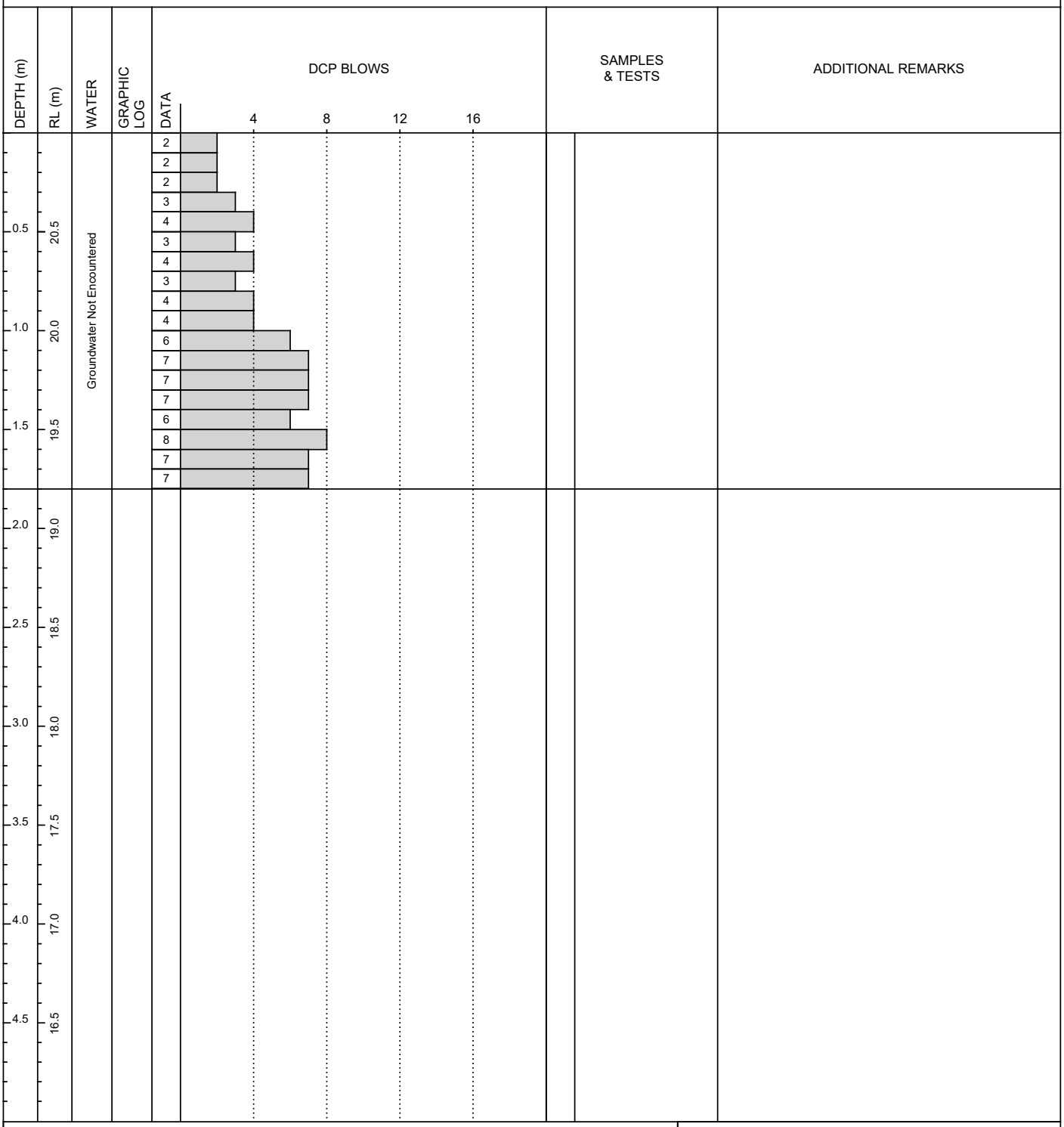
DCP LOG

DCP10

SHEET 10 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770435.00	STARTED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472098.00	FINISHED:	28-02-2020
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	21	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS:	Final data



REMARKS

Soils tested in accordance with NZGS

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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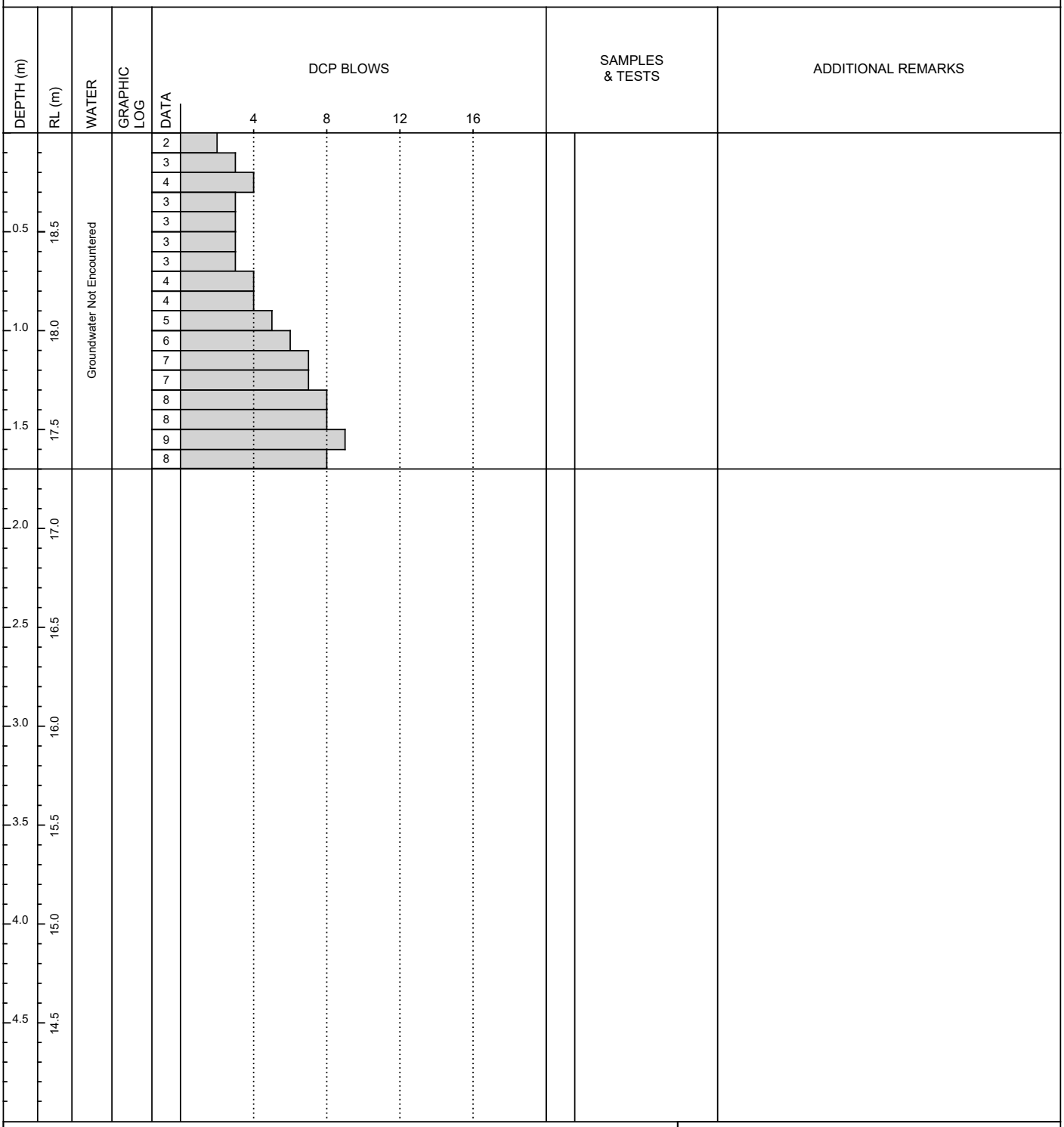
DCP LOG

DCP11

SHEET 11 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770371.00	STARTED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472140.00	FINISHED:	28-02-2020
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	19	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS:	Final data



REMARKS

Soils tested in accordance with NZGS

SYMBOLS

- Standing Water Level
- Out flow
- In flow

RDCL

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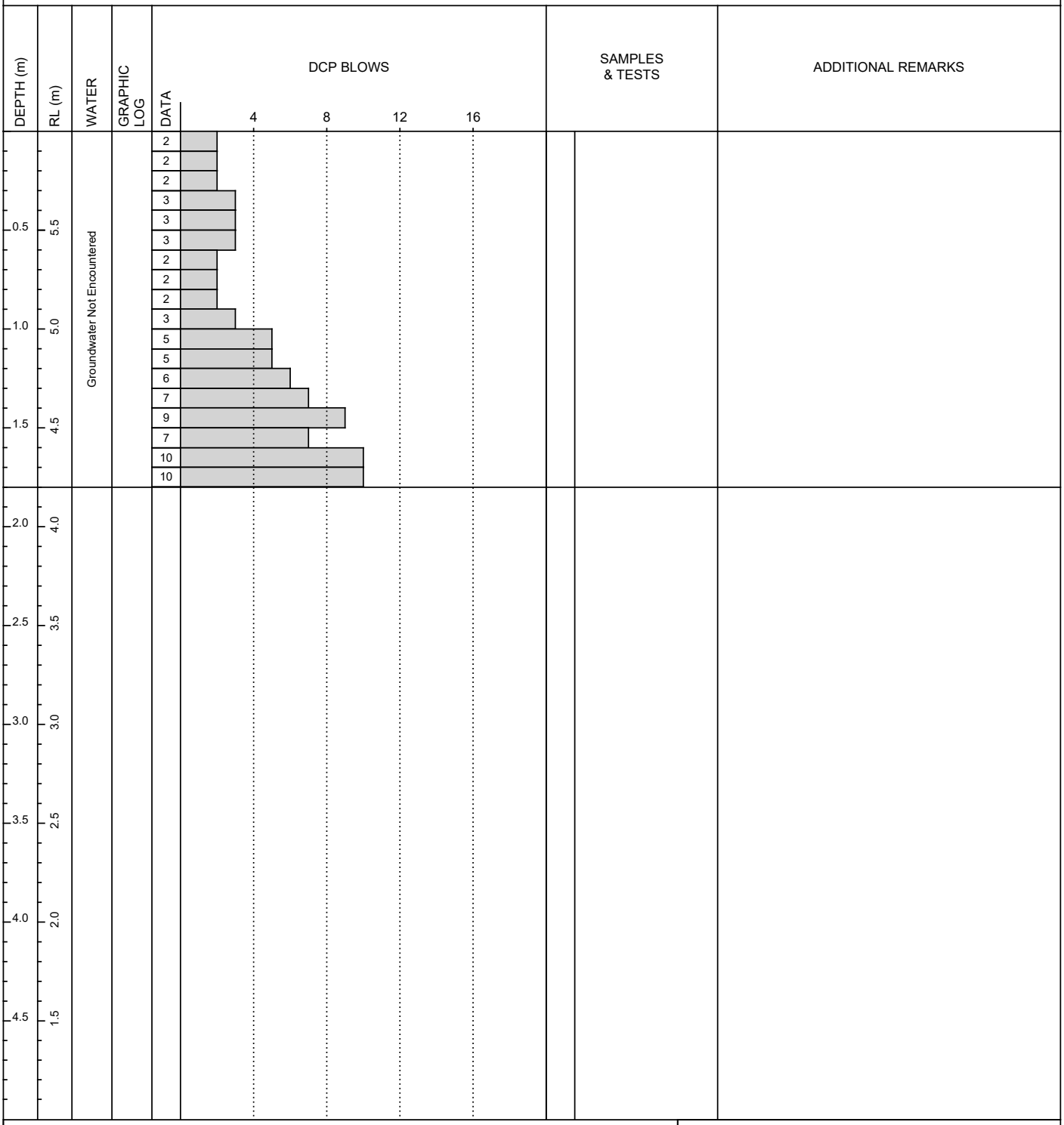
DCP LOG

DCP12

SHEET 12 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770439.00	STARTED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472159.00	FINISHED:	28-02-2020
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	6	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS:	Final data



REMARKS

Soils tested in accordance with NZGS

SYMBOLS

- Standing Water Level
- Out flow
- In flow

RDCL

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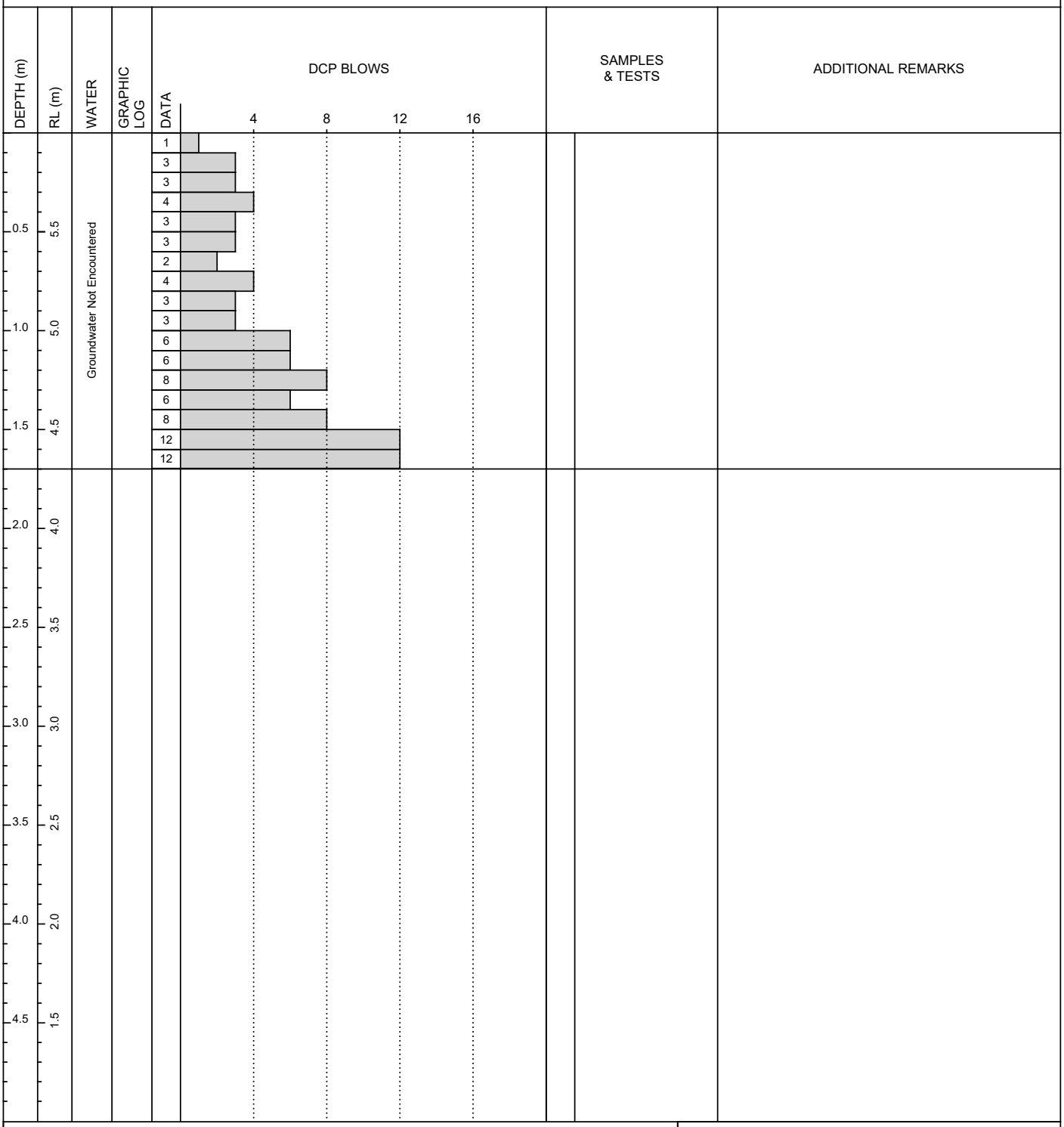
DCP LOG

DCP13

SHEET 13 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770523.00	STARTED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472096.00	FINISHED:	28-02-2020
		DATUM:	NZVD2016	LOGGED BY: MT/RD	DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	6	CHECKED BY: JJN	DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS: Final data	



REMARKS

Soils tested in accordance with NZGS

SYMBOLS

- Standing Water Level
- Out flow
- In flow

RDCL

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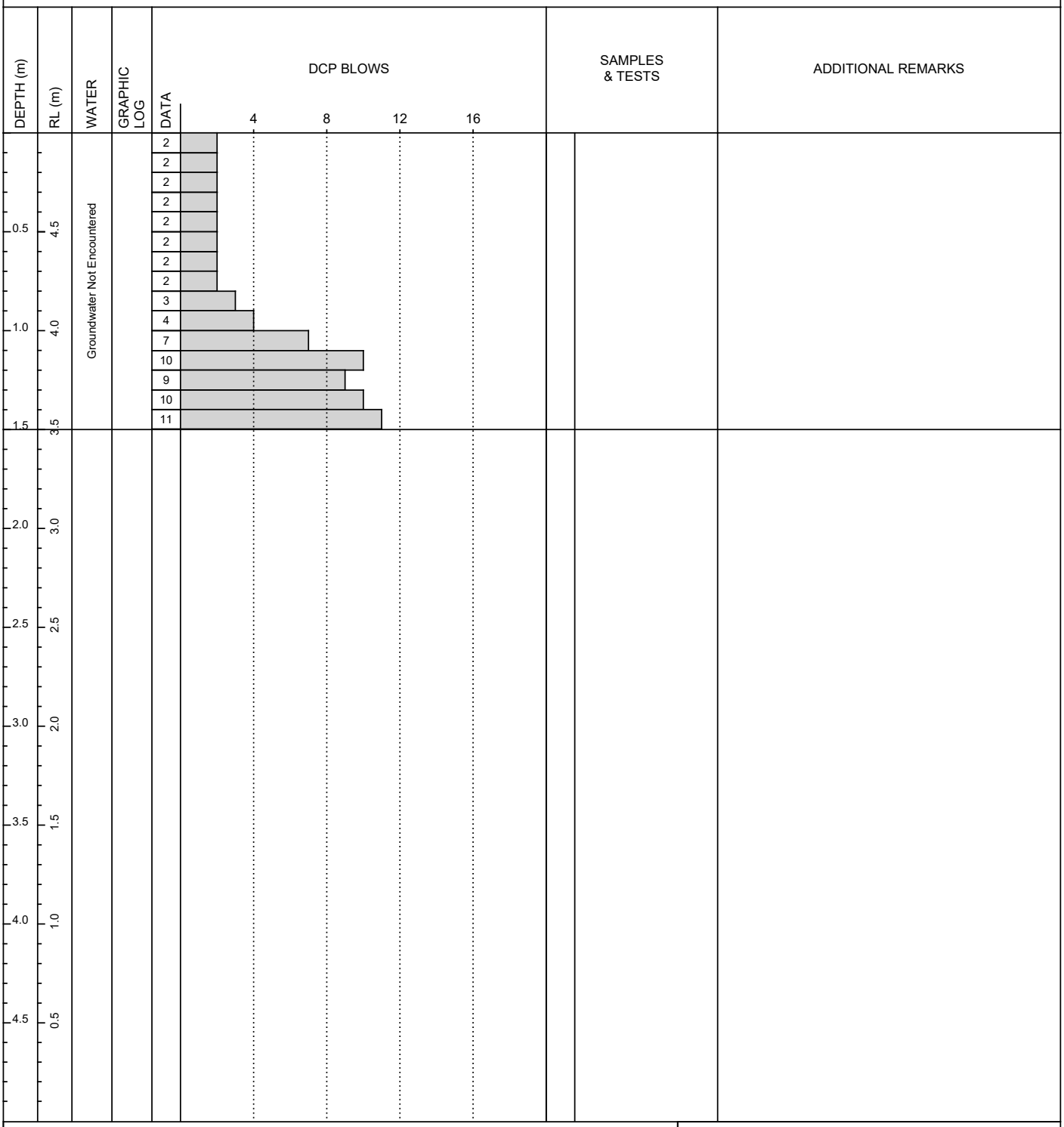
DCP LOG

DCP14

SHEET 14 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770511.00	STARTED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472191.00	FINISHED:	28-02-2020
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	5	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS:	Final data



REMARKS

Soils tested in accordance with NZGS

SYMBOLS

- Standing Water Level
- Out flow
- In flow

RDCL

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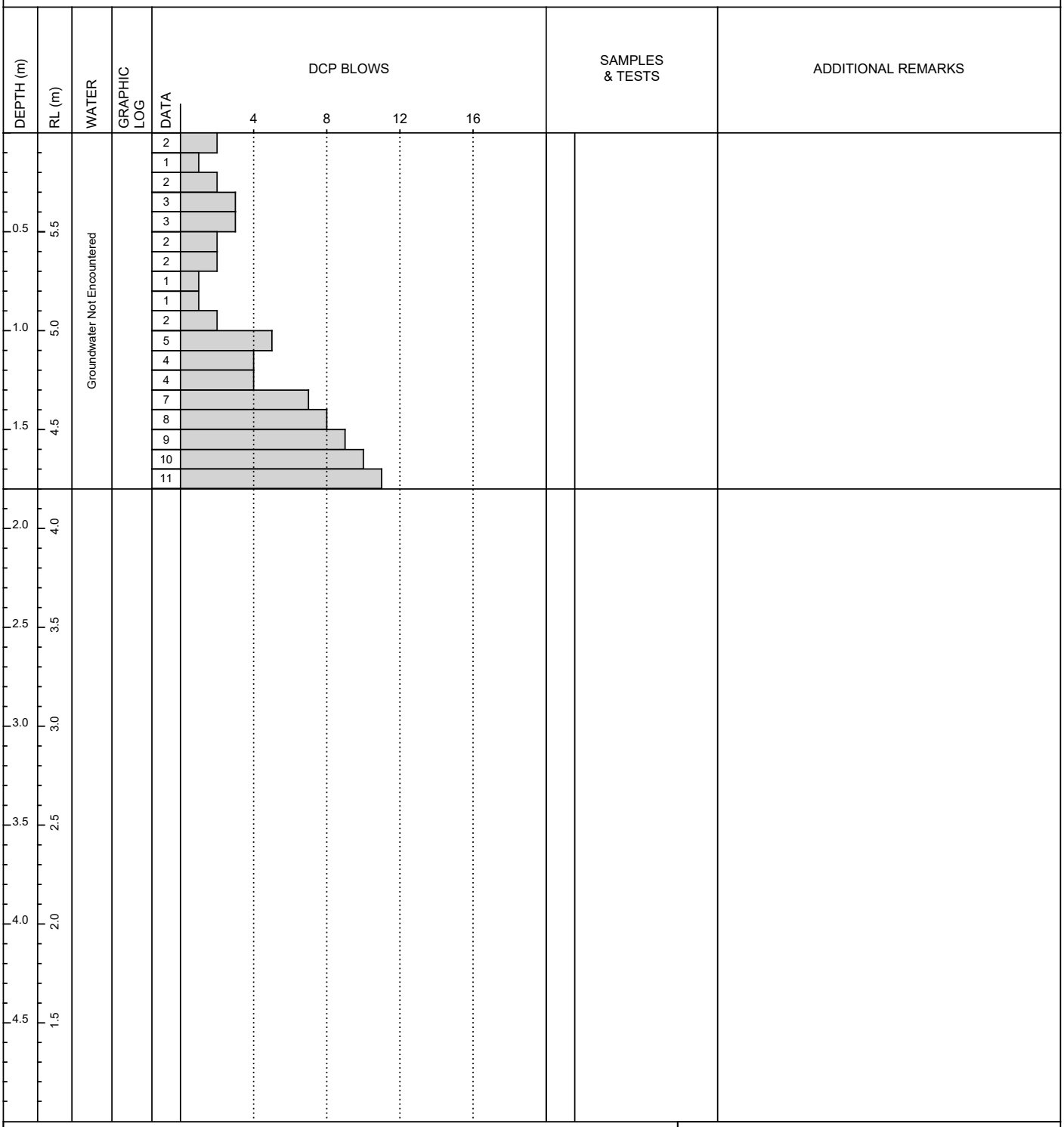
DCP LOG

DCP15

SHEET 15 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770533.00	STARTED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472277.00	FINISHED:	28-02-2020
		DATUM:	NZVD2016	LOGGED BY:	MT/RD DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	6	CHECKED BY:	JJN DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS:	Final data



REMARKS

Soils tested in accordance with NZGS

SYMBOLS

- Standing Water Level
- Out flow
- In flow

RDCL

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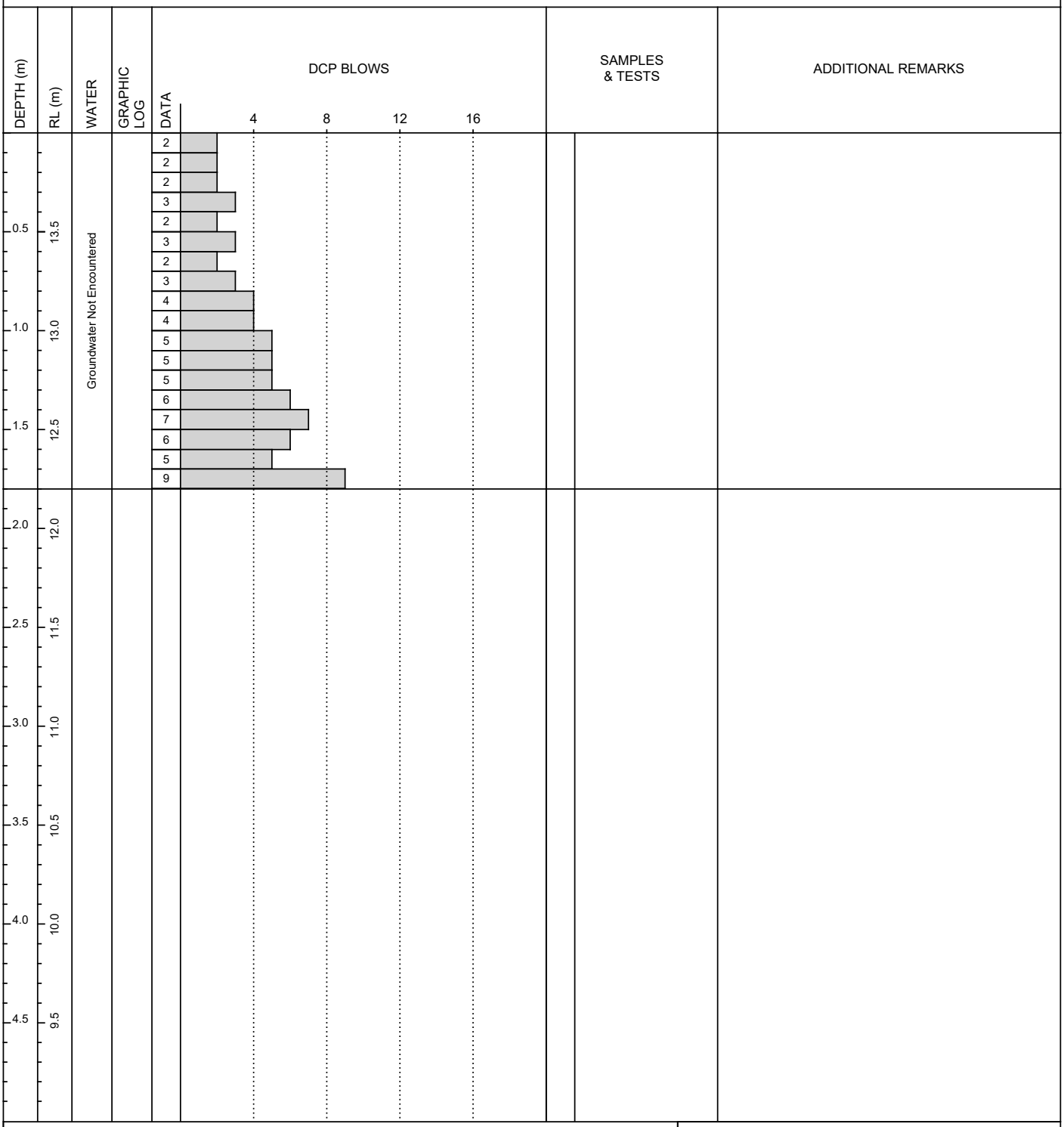
DCP LOG

DCP16

SHEET 16 OF 16

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770476.00	STARTED:	28-02-2020
LOCATION:	131 Otaihanga Rd	NORTHING:	5472313.00	FINISHED:	28-02-2020
		DATUM:	NZVD2016	LOGGED BY: MT/RD	DATE: 28-02-2020
OFFICE:	RDCL - Hastings	ELEVATION:	14	CHECKED BY: JJN	DATE: 14-04-2020
ENGINEER:		AZIMUTH:	PLUNGE: 90°	STATUS: Final data	



REMARKS

Soils tested in accordance with NZGS

SYMBOLS

- Standing Water Level
- Out flow
- In flow

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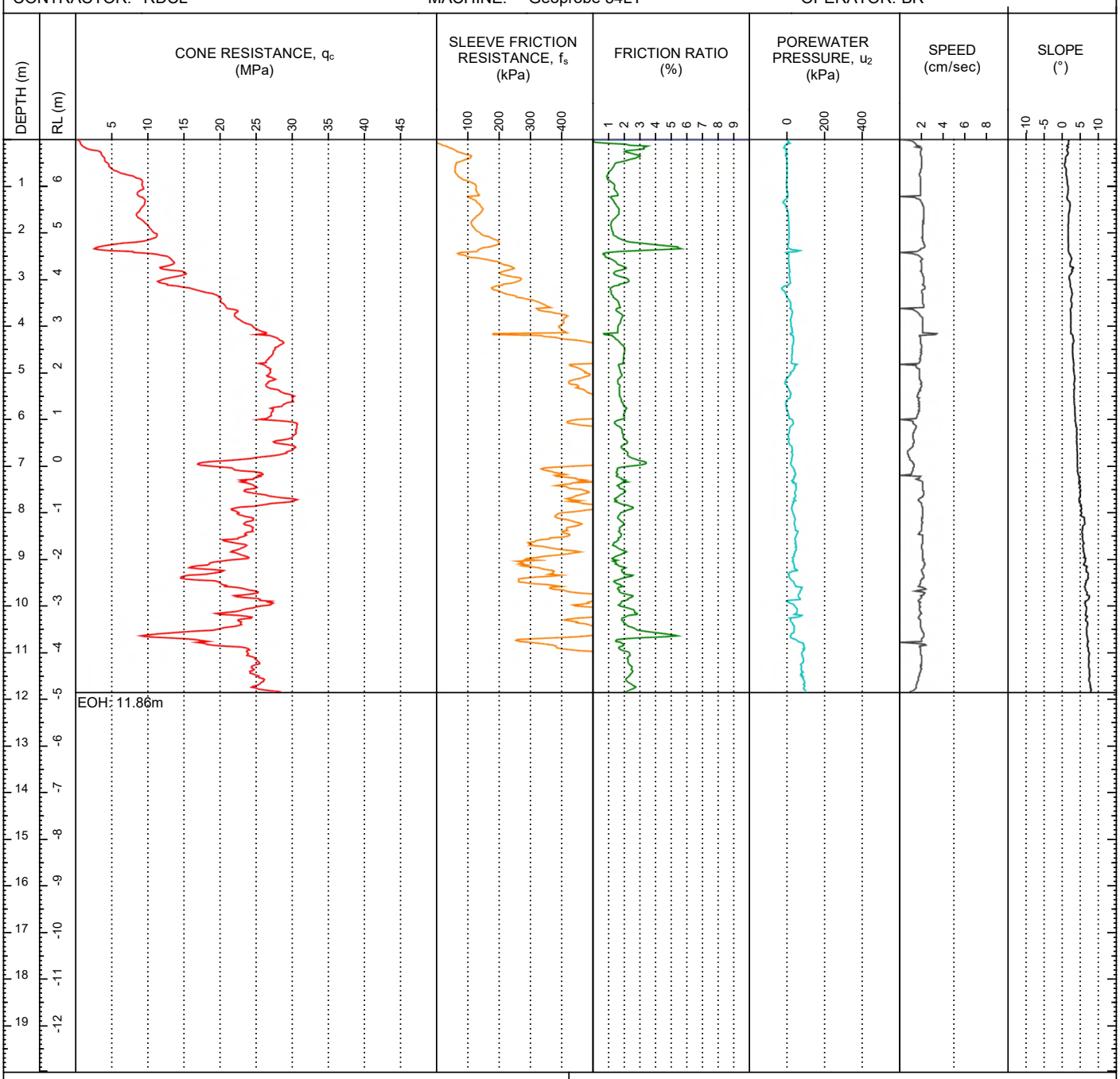
CONE PENETRATION TEST LOG

CPT01

SHEET 1 OF 1

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770350.00	LOGGED ON:	11-Sep-19 12:00:00 AM
LOCATION:	131 Otaihanga Rd	NORTHING:	5471622.00	PREPARED BY:	BR DATE: 01-10-2019
		ELEVATION:	7.00	CHECKED BY:	JJN DATE: 14-04-2020
OFFICE:	RDCL - Hastings	DATUM:	NZVD2016	STATUS:	Final data

CONTRACTOR: RDCL MACHINE: Geoprobe 54LT OPERATOR: BR



REMARKS

CONE INFORMATION

CONE ID: 4483 CONE TYPE: -

	INITIAL	FINAL
CONE RESISTANCE:	6.8193	-0.038
SLEEVE FRICTION RESISTANCE:	128.8	-3
POREWATER PRESSURE:	264.2	-2.5

SYMBOLS

▼ Water level

RDCL

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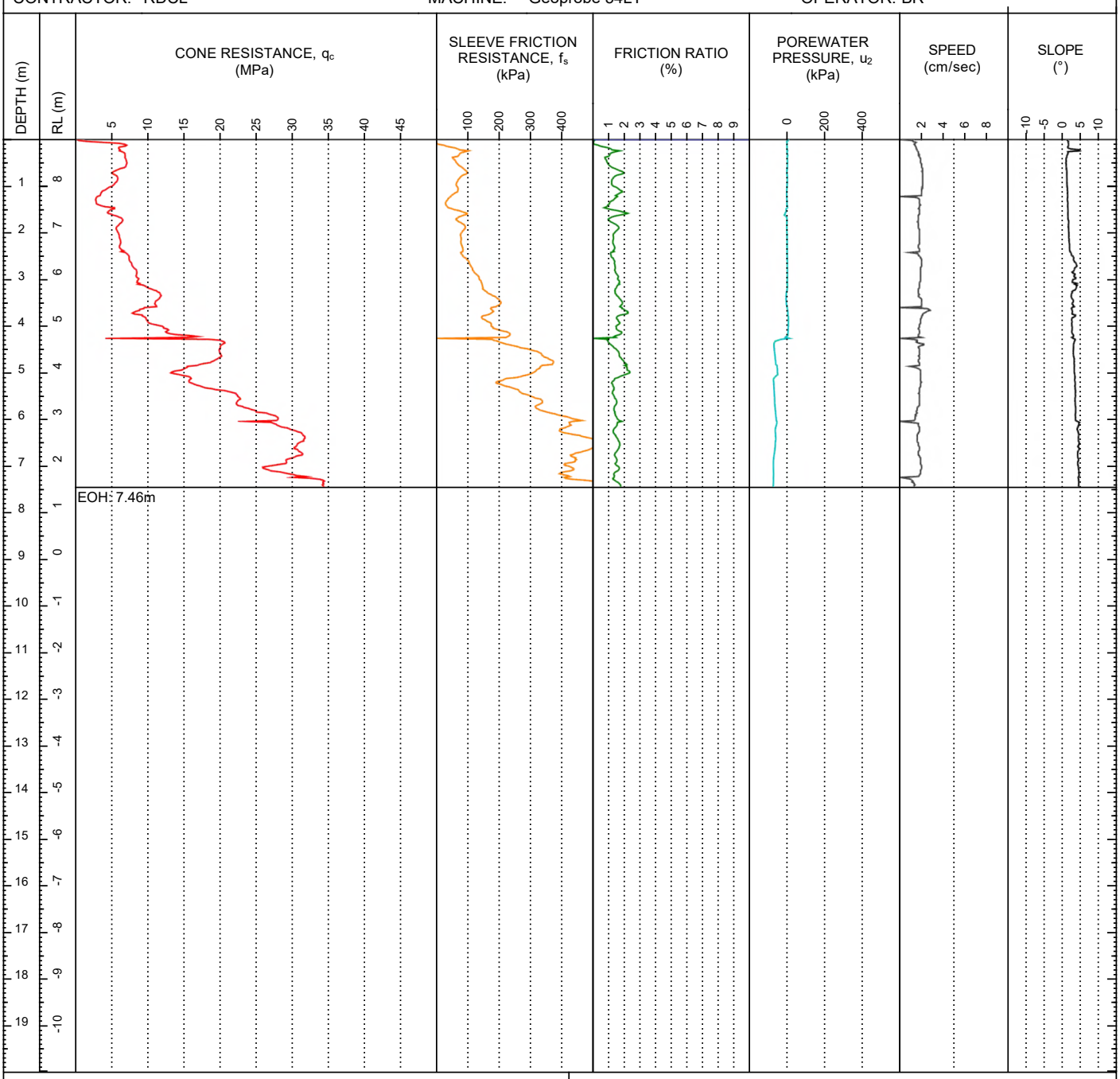
CONE PENETRATION TEST LOG

CPT02

SHEET 1 OF 1

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770302.00	LOGGED ON:	11-Sep-19 12:00:00 AM
LOCATION:	131 Otaihanga Rd	NORTHING:	5471783.00	PREPARED BY:	BR DATE: 01-10-2019
		ELEVATION:	9.00	CHECKED BY:	JJN DATE: 14-04-2020
OFFICE:	RDCL - Hastings	DATUM:	NZVD2016	STATUS:	Final data

CONTRACTOR: RDCL MACHINE: Geoprobe 54LT OPERATOR: BR



REMARKS

CONE INFORMATION

CONE ID: 4483 CONE TYPE: -

	INITIAL	FINAL
CONE RESISTANCE:	6.8429	-0.0173
SLEEVE FRICTION RESISTANCE:	126.6	-1
POREWATER PRESSURE:	263.4	-1.4

SYMBOLS

▼ Water level

RDCL
8/308 QUEEN ST EAST, HASTINGS PO BOX 28057, HAVELOCK NORTH 4130 NEW ZEALAND
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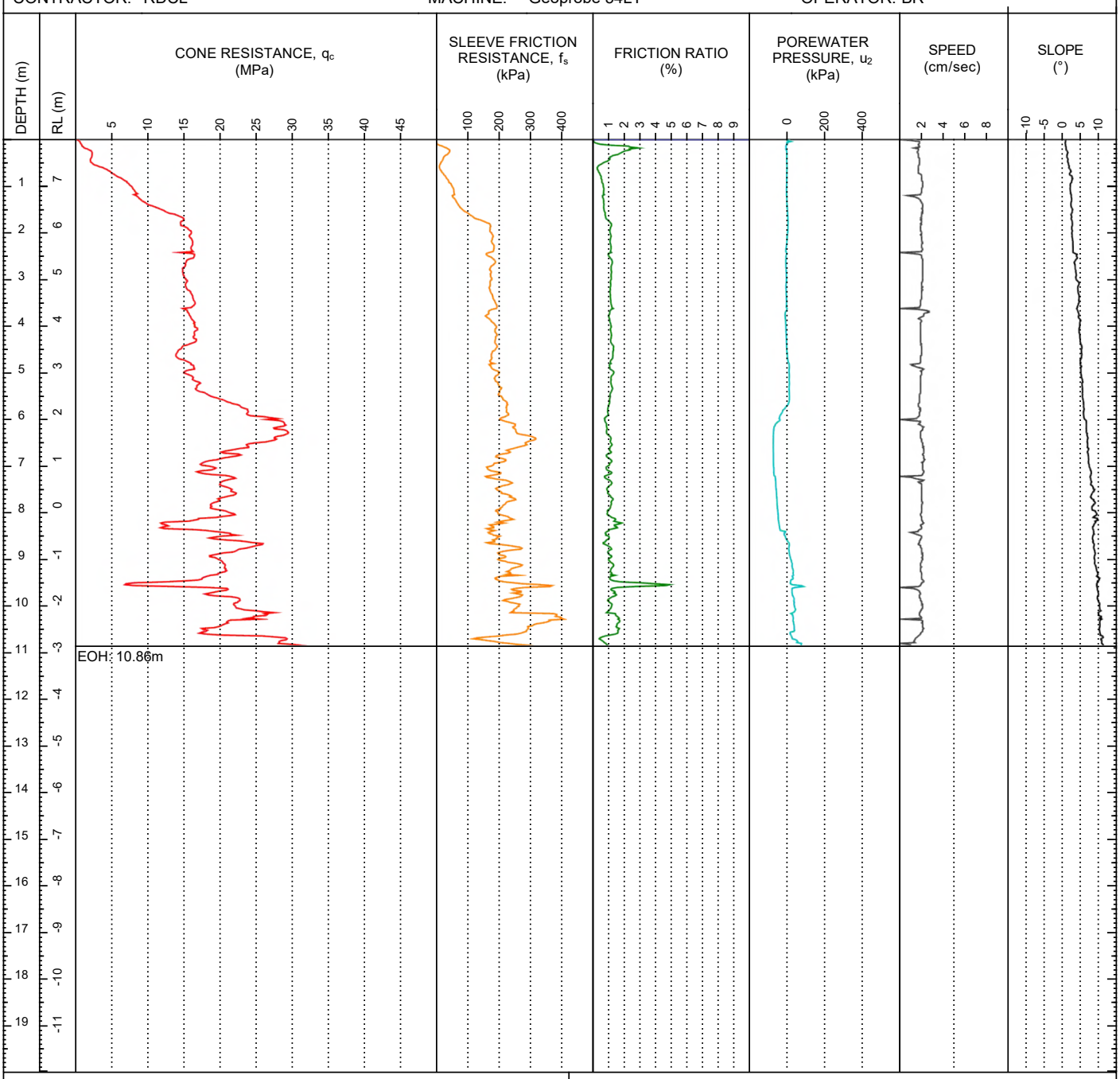
CONE PENETRATION TEST LOG

CPT03

SHEET 1 OF 1

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770388.00	LOGGED ON:	11-Sep-19 12:00:00 AM
LOCATION:	131 Otaihanga Rd	NORTHING:	5471703.00	PREPARED BY:	BR DATE: 01-10-2019
		ELEVATION:	8.00	CHECKED BY:	JJN DATE: 14-04-2020
OFFICE:	RDCL - Hastings	DATUM:	NZVD2016	STATUS:	Final data

CONTRACTOR: RDCL MACHINE: Geoprobe 54LT OPERATOR: BR



REMARKS

CONE INFORMATION

CONE ID: 4483 CONE TYPE: -

	INITIAL	FINAL
CONE RESISTANCE:	6.836	-0.0317
SLEEVE FRICTION RESISTANCE:	128.2	-2.2
POREWATER PRESSURE:	263.9	-2.2

SYMBOLS

▼ Water level

RDCL
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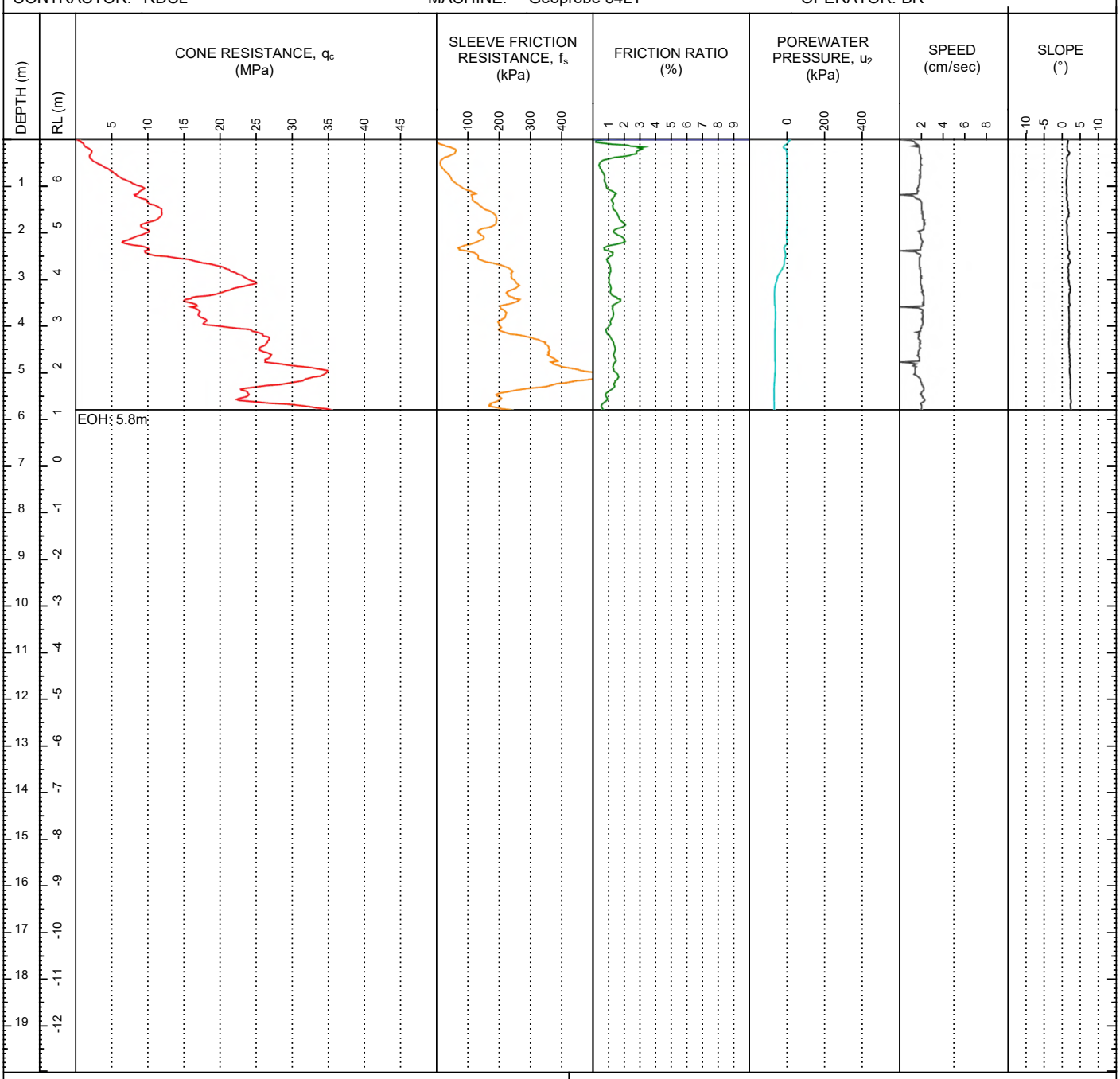
CONE PENETRATION TEST LOG

CPT04

SHEET 1 OF 1

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770419.00	LOGGED ON:	11-Sep-19 12:00:00 AM
LOCATION:	131 Otaihanga Rd	NORTHING:	5471955.00	PREPARED BY:	BR DATE: 01-10-2019
		ELEVATION:	7.00	CHECKED BY:	JJN DATE: 14-04-2020
OFFICE:	RDCL - Hastings	DATUM:	NZVD2016	STATUS:	Final data

CONTRACTOR: RDCL MACHINE: Geoprobe 54LT OPERATOR: BR



REMARKS

CONE INFORMATION

CONE ID: 4483 CONE TYPE: -

	INITIAL	FINAL
CONE RESISTANCE:	6.8337	0.0017
SLEEVE FRICTION RESISTANCE:	127.2	-0.9
POREWATER PRESSURE:	263	-1

SYMBOLS

▼ Water level

RDCL
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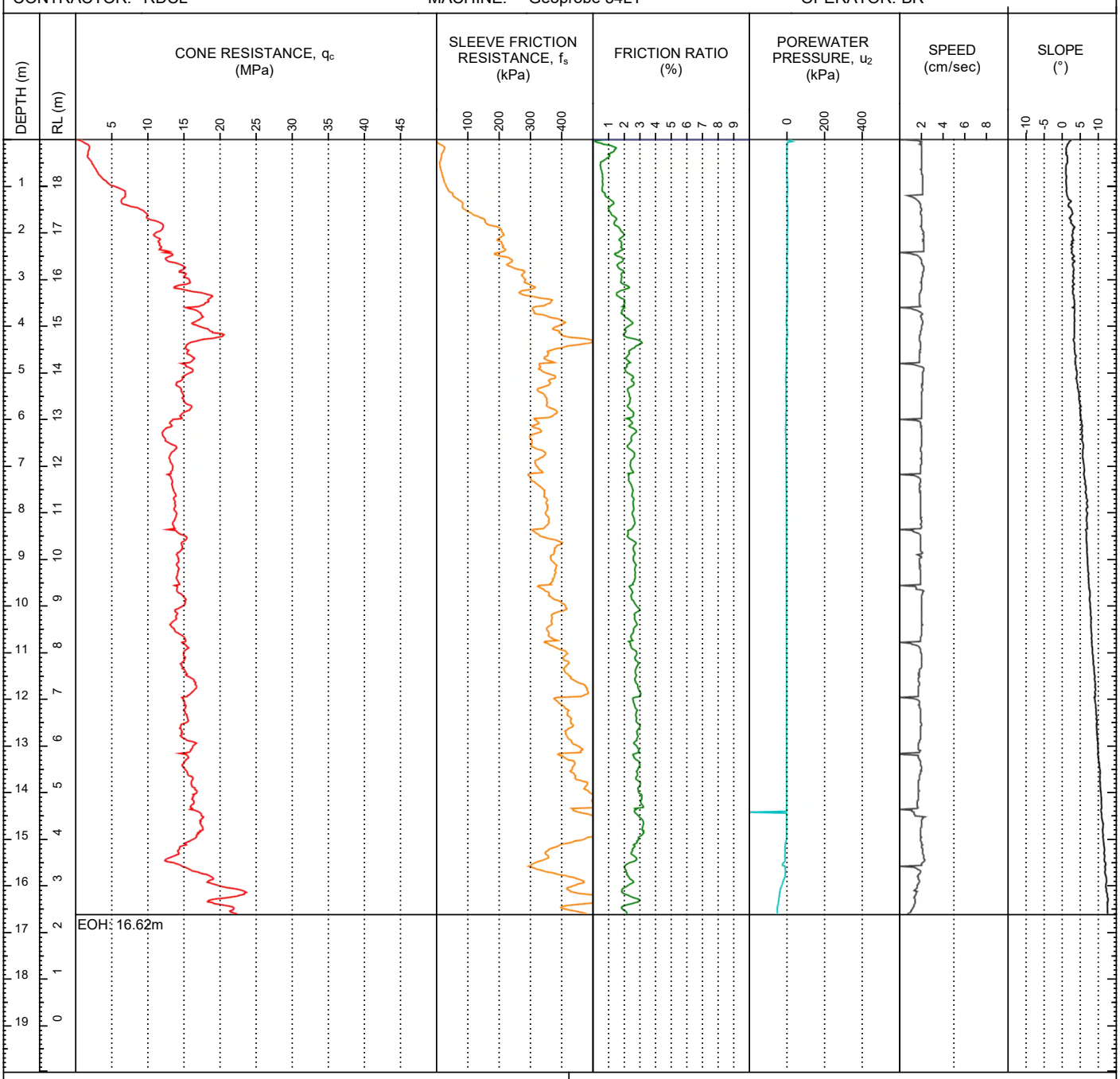
CONE PENETRATION TEST LOG

CPT05

SHEET 1 OF 1

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770448.00	LOGGED ON:	11-Sep-19 12:00:00 AM
LOCATION:	131 Otaihanga Rd	NORTHING:	5472098.00	PREPARED BY:	BR DATE: 01-10-2019
		ELEVATION:	19.00	CHECKED BY:	JJN DATE: 14-04-2020
OFFICE:	RDCL - Hastings	DATUM:	NZVD2016	STATUS:	Final data

CONTRACTOR: RDCL MACHINE: Geoprobe 54LT OPERATOR: BR



REMARKS

CONE INFORMATION

CONE ID: 4483 CONE TYPE: -

	INITIAL	FINAL
CONE RESISTANCE:	6.836	-0.0455
SLEEVE FRICTION RESISTANCE:	127.9	-0.2
POREWATER PRESSURE:	264.4	-2.7

SYMBOLS

▼ Water level

RDCL
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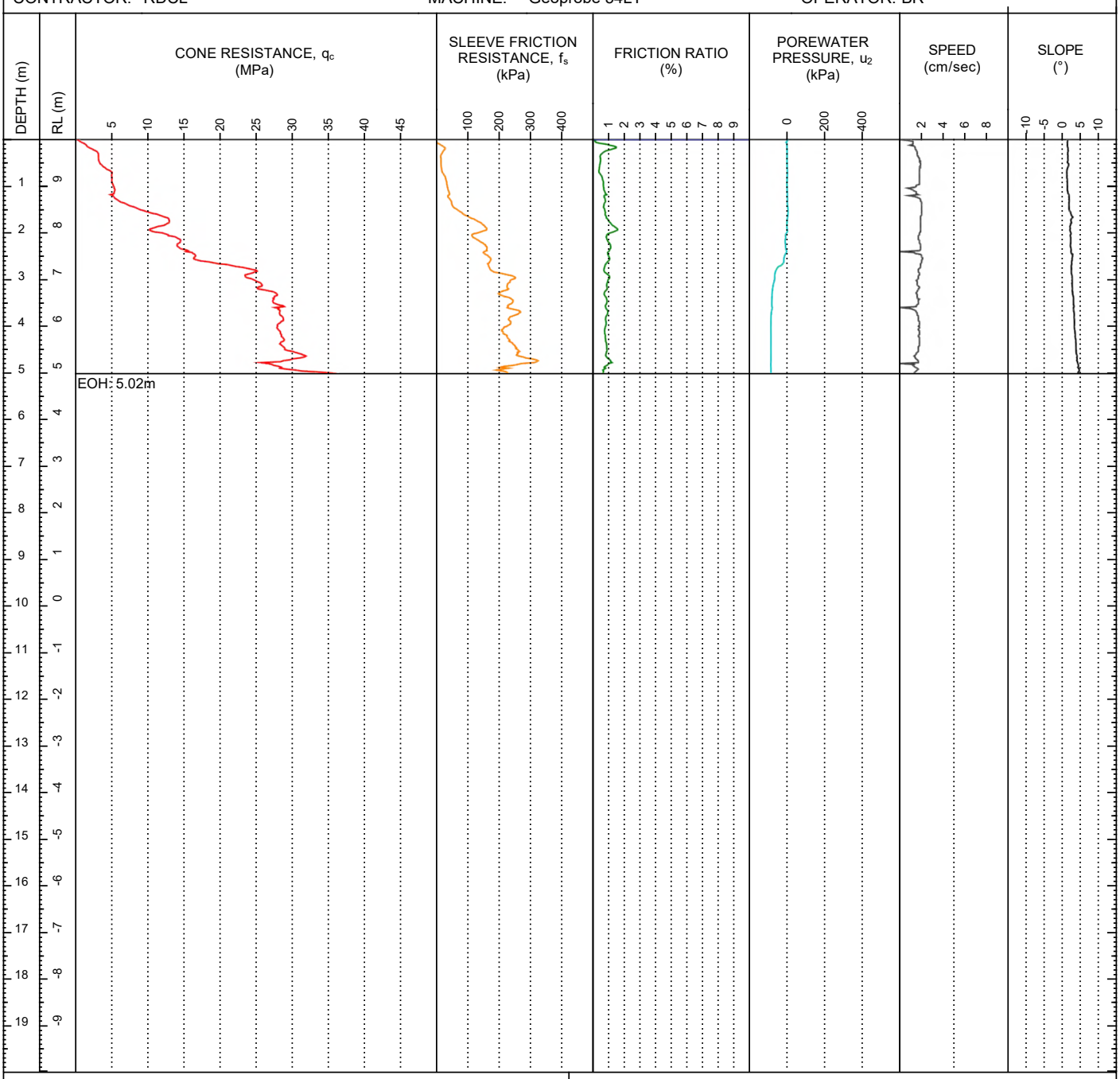
CONE PENETRATION TEST LOG

CPT06

SHEET 1 OF 1

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770529.00	LOGGED ON:	11-Sep-19 12:00:00 AM
LOCATION:	131 Otaihanga Rd	NORTHING:	5472110.00	PREPARED BY:	BR DATE: 01-10-2019
		ELEVATION:	10.00	CHECKED BY:	JJN DATE: 14-04-2020
OFFICE:	RDCL - Hastings	DATUM:	NZVD2016	STATUS:	Final data

CONTRACTOR: RDCL MACHINE: Geoprobe 54LT OPERATOR: BR



REMARKS

CONE INFORMATION

CONE ID: 4483 CONE TYPE: -

	INITIAL	FINAL
CONE RESISTANCE:	6.8383	-0.004
SLEEVE FRICTION RESISTANCE:	128.1	-1.4
POREWATER PRESSURE:	263.4	-1.6

SYMBOLS

▼ Water level

RDCL
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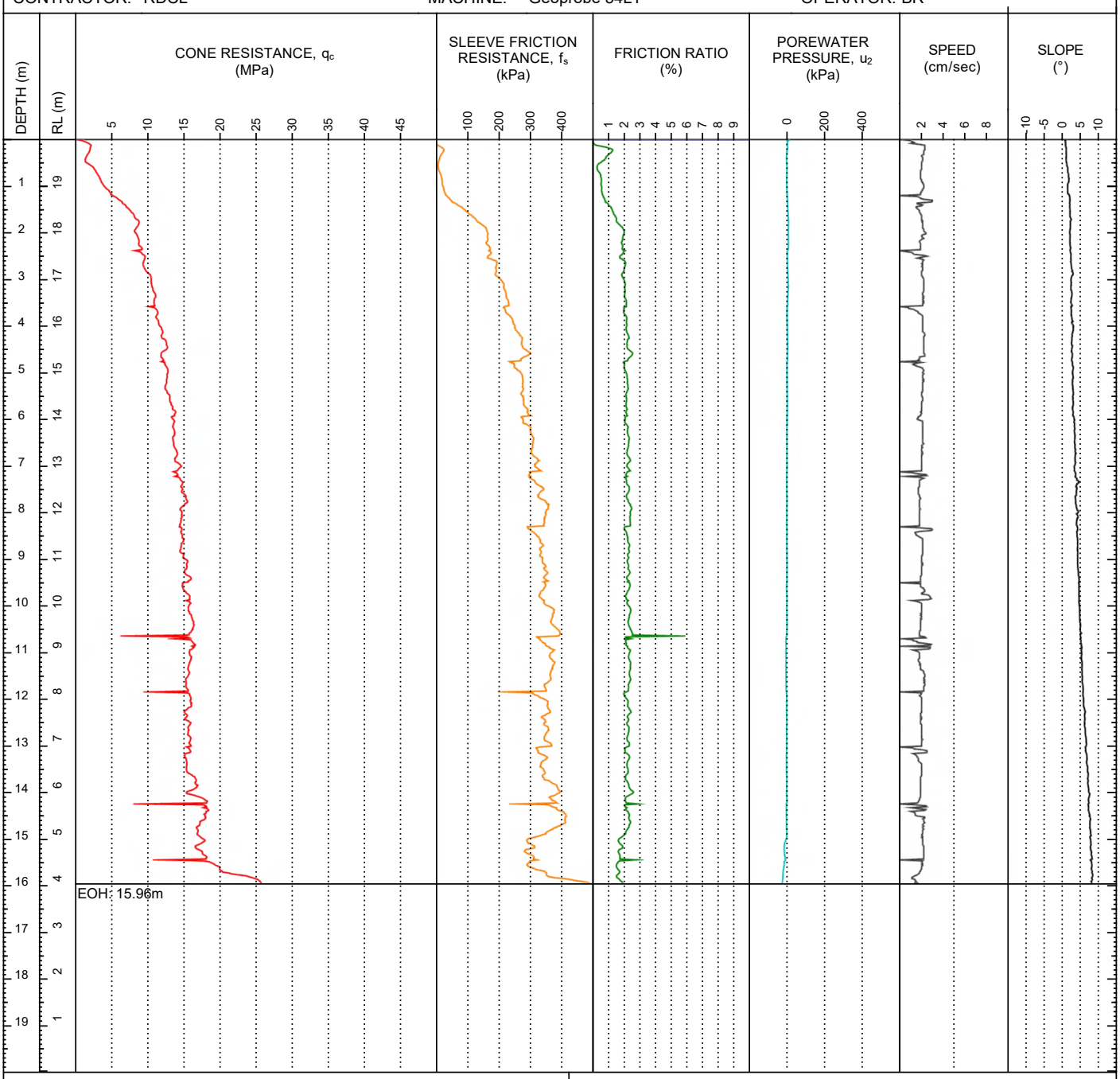
CONE PENETRATION TEST LOG

CPT07

SHEET 1 OF 1

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770377.00	LOGGED ON:	11-Sep-19 12:00:00 AM
LOCATION:	131 Otaihanga Rd	NORTHING:	5472132.00	PREPARED BY:	BR DATE: 01-10-2019
		ELEVATION:	20.00	CHECKED BY:	JJN DATE: 14-04-2020
OFFICE:	RDCL - Hastings	DATUM:	NZVD2016	STATUS:	Final data

CONTRACTOR: RDCL MACHINE: Geoprobe 54LT OPERATOR: BR



REMARKS

CONE INFORMATION

CONE ID: 4483 CONE TYPE: -

	INITIAL	FINAL
CONE RESISTANCE:	6.8199	-0.0478
SLEEVE FRICTION RESISTANCE:	128.7	-0.2
POREWATER PRESSURE:	264	-2.8

SYMBOLS

▼ Water level

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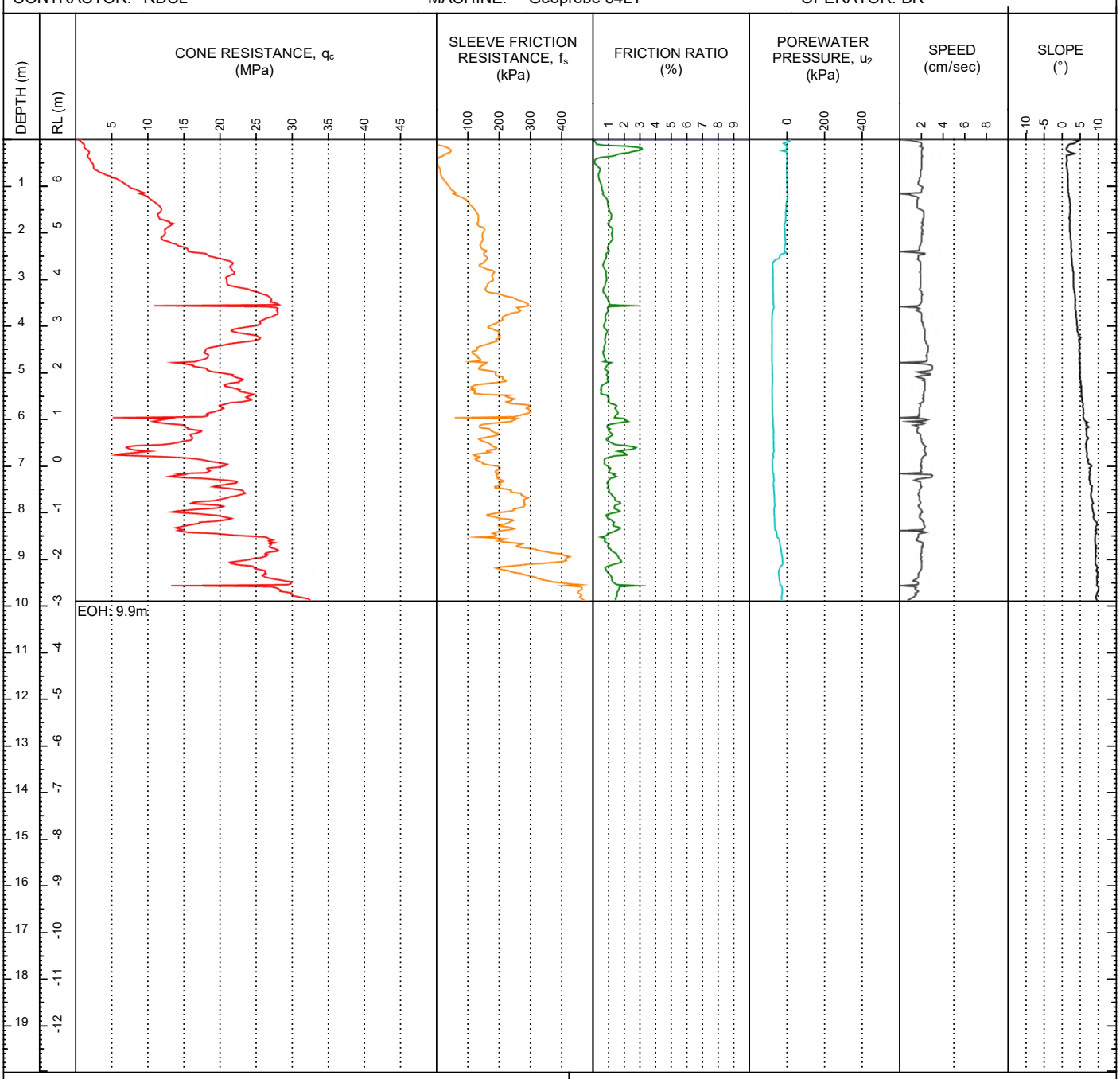
CONE PENETRATION TEST LOG

CPT08

SHEET 1 OF 1

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770519.00	LOGGED ON:	11-Sep-19 12:00:00 AM
LOCATION:	131 Otaihanga Rd	NORTHING:	5472195.00	PREPARED BY:	BR DATE: 01-10-2019
		ELEVATION:	7.00	CHECKED BY:	JJN DATE: 14-04-2020
OFFICE:	RDCL - Hastings	DATUM:	NZVD2016	STATUS:	Final data

CONTRACTOR: RDCL MACHINE: Geoprobe 54LT OPERATOR: BR



REMARKS

CONE INFORMATION

CONE ID: 4483 CONE TYPE: -

	INITIAL	FINAL
CONE RESISTANCE:	6.7773	0.0063
SLEEVE FRICTION RESISTANCE:	129	-0.6
POREWATER PRESSURE:	263.9	-2.2

SYMBOLS

▼ Water level

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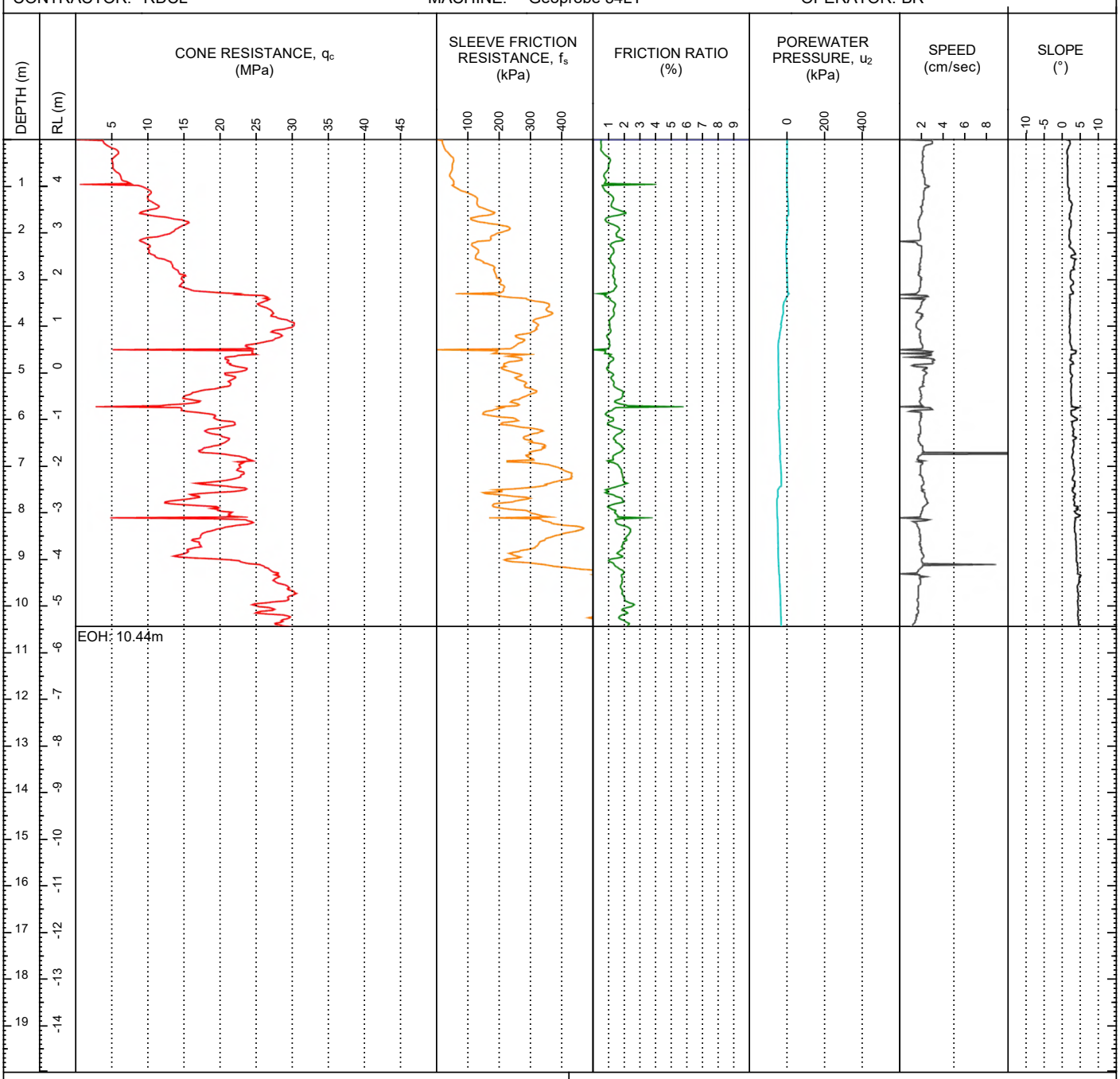
CONE PENETRATION TEST LOG

CPT09

SHEET 1 OF 1

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770422.00	LOGGED ON:	11-Sep-19 12:00:00 AM
LOCATION:	131 Otaihanga Rd	NORTHING:	5472191.00	PREPARED BY:	BR DATE: 01-10-2019
		ELEVATION:	5.00	CHECKED BY:	JJN DATE: 14-04-2020
OFFICE:	RDCL - Hastings	DATUM:	NZVD2016	STATUS:	Final data

CONTRACTOR: RDCL MACHINE: Geoprobe 54LT OPERATOR: BR



REMARKS

CONE INFORMATION

CONE ID: 4483 CONE TYPE: -

	INITIAL	FINAL
CONE RESISTANCE:	6.8302	-0.0368
SLEEVE FRICTION RESISTANCE:	127.3	-0.7
POREWATER PRESSURE:	263.1	-2

SYMBOLS

▼ Water level

RDCL
8/308 QUEEN ST EAST, HASTINGS PO BOX 28057, HAVELOCK NORTH 4130 NEW ZEALAND
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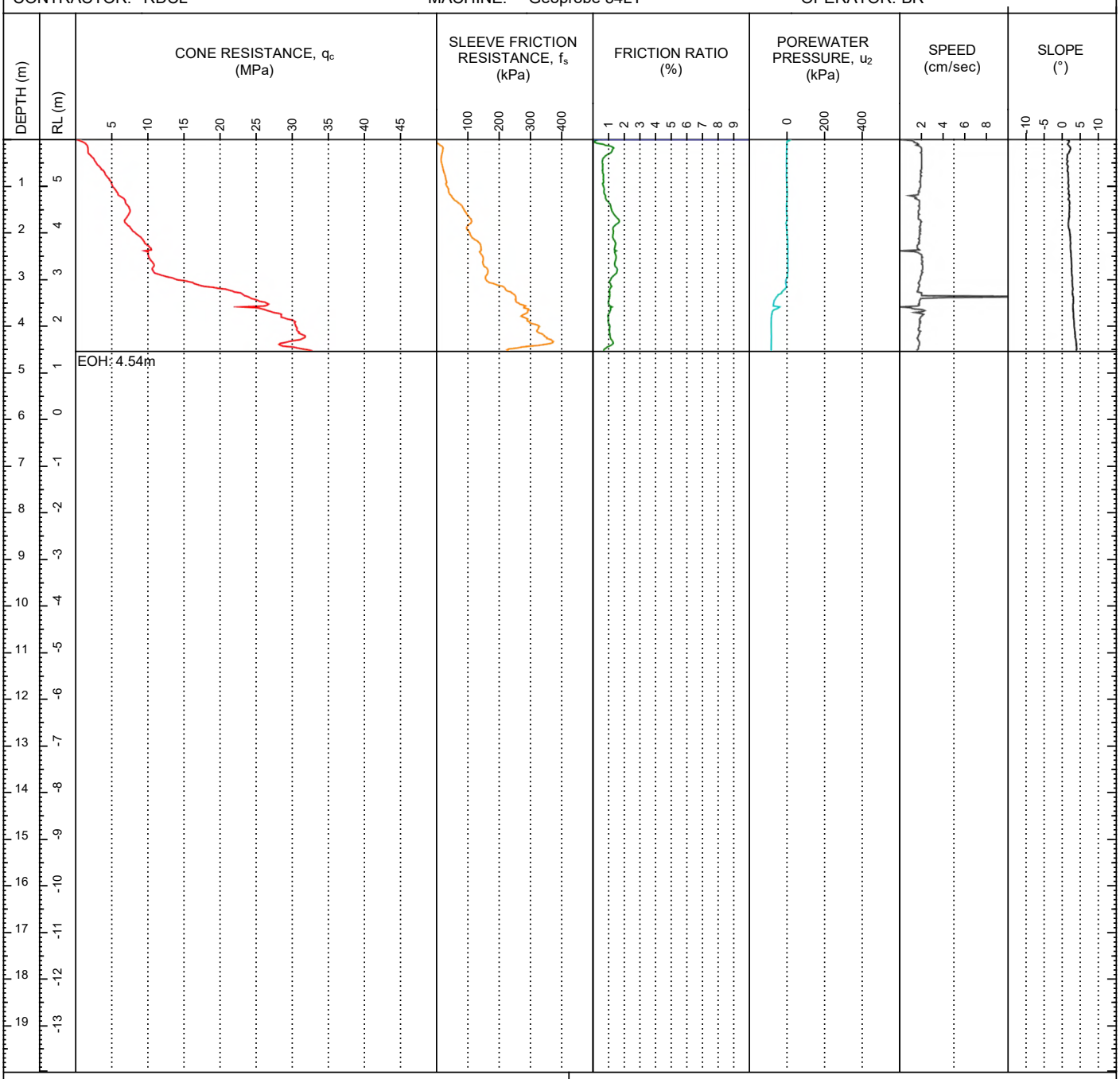
CONE PENETRATION TEST LOG

CPT10

SHEET 1 OF 1

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770551.00	LOGGED ON:	11-Sep-19 12:00:00 AM
LOCATION:	131 Otaihanga Rd	NORTHING:	5472269.00	PREPARED BY:	BR DATE: 01-10-2019
		ELEVATION:	6.00	CHECKED BY:	JJN DATE: 14-04-2020
OFFICE:	RDCL - Hastings	DATUM:	NZVD2016	STATUS:	Final data

CONTRACTOR: RDCL MACHINE: Geoprobe 54LT OPERATOR: BR



REMARKS

CONE INFORMATION

CONE ID: 4483 CONE TYPE: -

	INITIAL	FINAL
CONE RESISTANCE:	6.7986	0.004
SLEEVE FRICTION RESISTANCE:	129.3	0
POREWATER PRESSURE:	264.2	-1.8

SYMBOLS

▼ Water level

RDCL
8/308 QUEEN ST EAST, HASTINGS PO BOX 28057, HAVELOCK NORTH 4130 NEW ZEALAND
Ph: +64 6 8771652 | Email: info@rdcl.co.nz

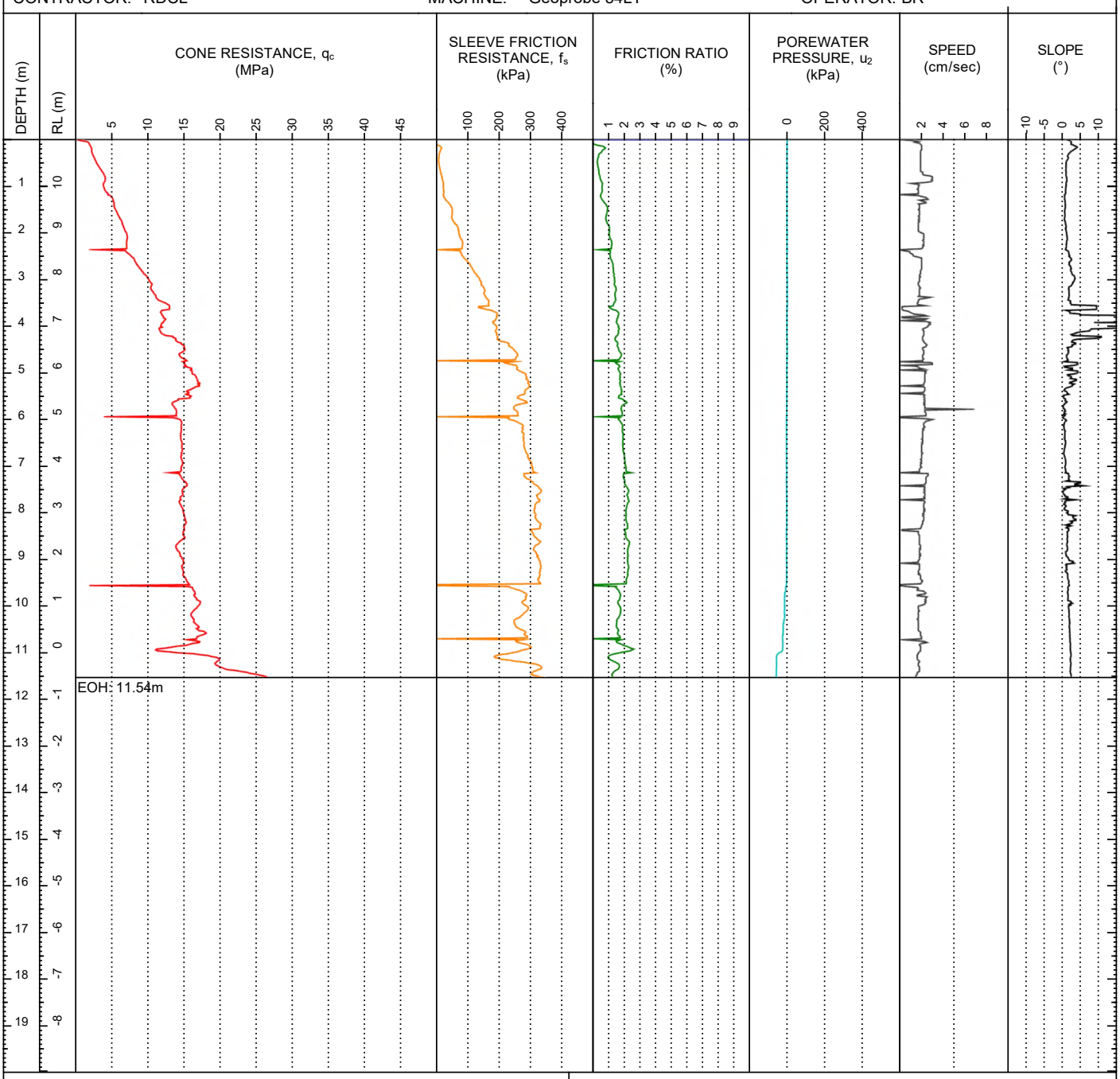
CONE PENETRATION TEST LOG

CPT11

SHEET 1 OF 1

CLIENT:	Richard Mansell	PROJECTION:	NZTM2000	SUB-LOCATION:	
PROJECT:	195340402	EASTING:	1770488.00	LOGGED ON:	11-Sep-19 12:00:00 AM
LOCATION:	131 Otaihanga Rd	NORTHING:	5472308.00	PREPARED BY:	BR DATE: 01-10-2019
		ELEVATION:	11.00	CHECKED BY:	JJN DATE: 14-04-2020
OFFICE:	RDCL - Hastings	DATUM:	NZVD2016	STATUS:	Final data

CONTRACTOR: RDCL MACHINE: Geoprobe 54LT OPERATOR: BR



REMARKS

CONE INFORMATION

CONE ID: 4483 CONE TYPE: -

	INITIAL	FINAL
CONE RESISTANCE:	6.7813	0.0092
SLEEVE FRICTION RESISTANCE:	129.1	-4.6
POREWATER PRESSURE:	262.9	-1.3

SYMBOLS

▼ Water level

RDCL
8/308 QUEEN ST EAST, HASTINGS PO BOX 28057, HAVELOCK NORTH 4130 NEW ZEALAND
Ph: +64 6 8771652 | Email: info@rdcl.co.nz

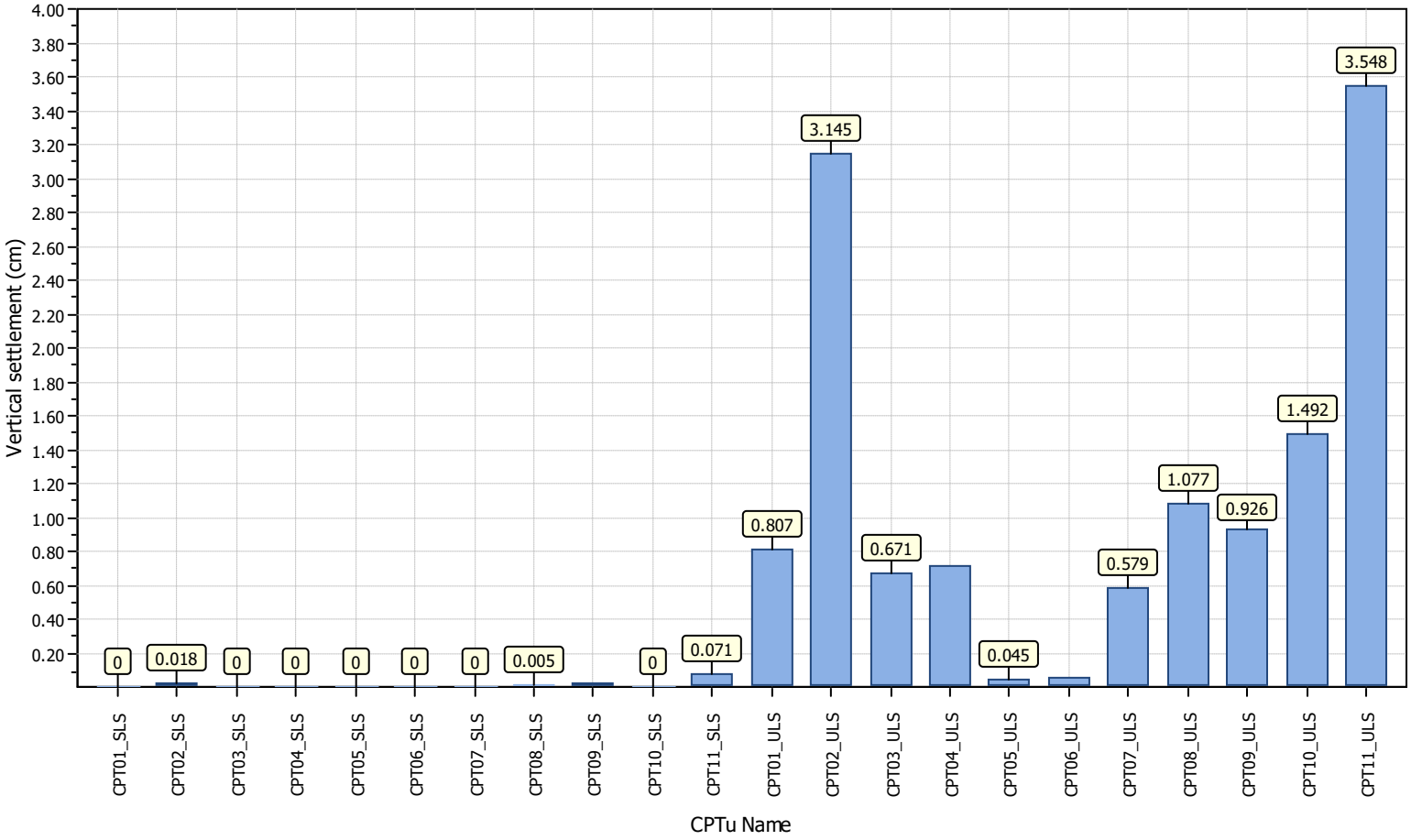
APPENDIX B: LIQUEFACTION ASSESSMENT RESULTS

RDCL
Geotechnical Engineers
2/182 Main Rd Tawa
www.rdcl.co.nz

Project title : 195340402

Location : 131 Otaihanga Rd, Paraparaumu

Overall vertical settlements report

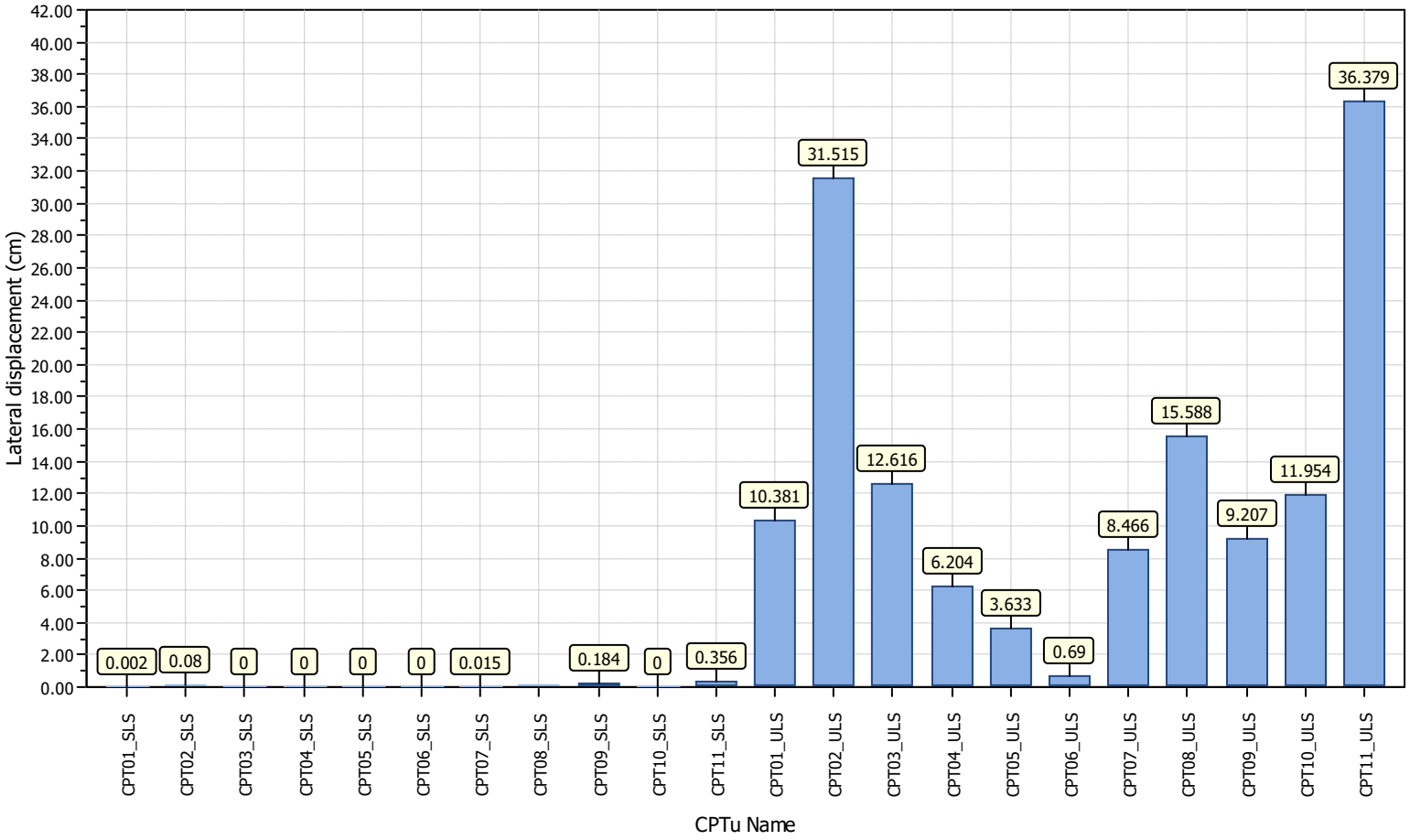


RDCL
Geotechnical Engineers
2/182 Main Rd Tawa
www.rdcl.co.nz

Project title : 195340402

Location : 131 Otaihanga Rd, Paraparaumu

Overall lateral displacements report



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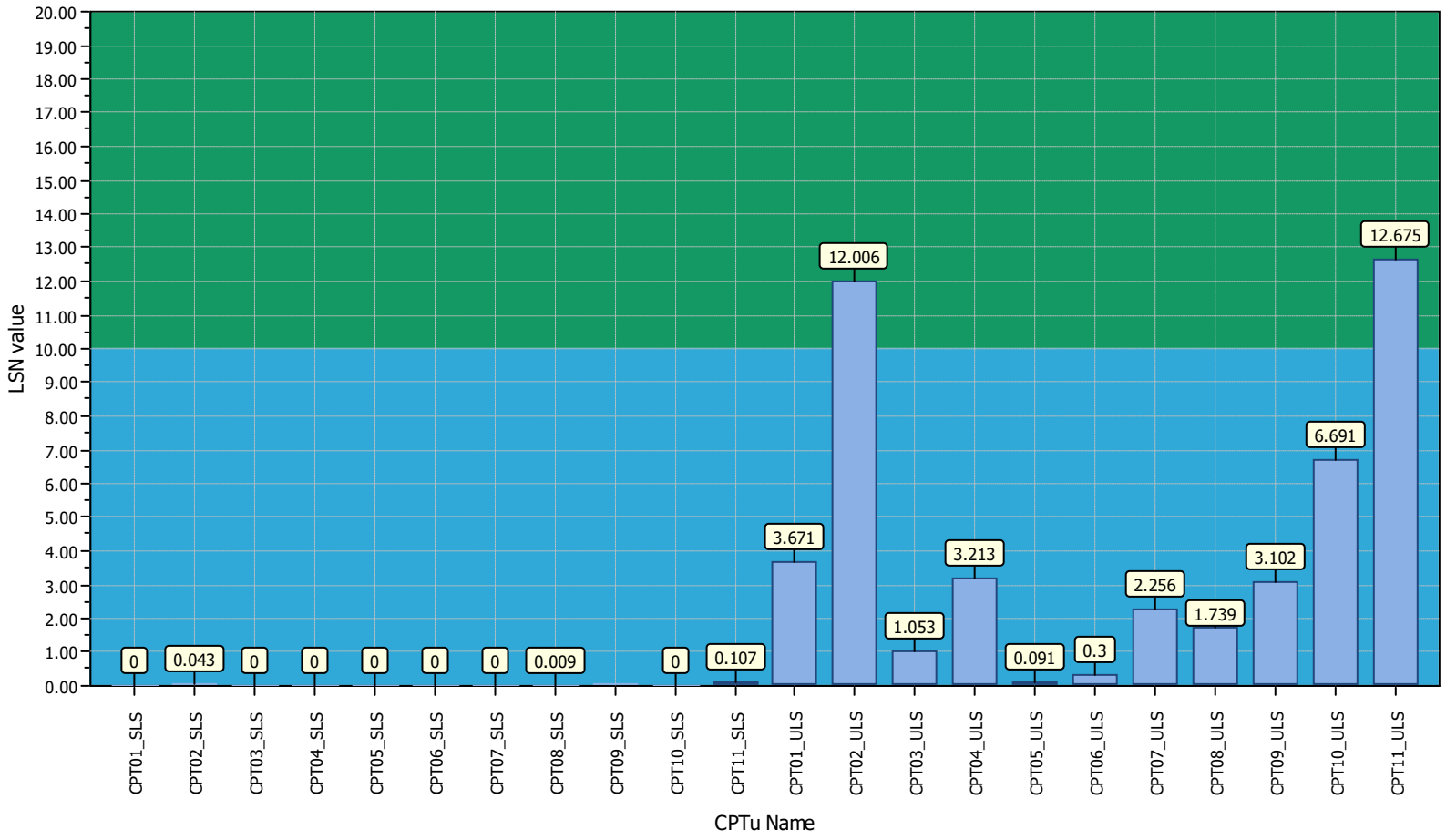
Project title : 195340402

Location : 131 Otaihanga Rd, Paraparaumu

Overall Liquefaction Severity Number report



LSN color scheme

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

Basic statistics

Total CPT number: 22

91% little liquefaction

9% minor liquefaction

0% moderate liquefaction

0% moderate to major liquefaction

0% major liquefaction

0% severe liquefaction

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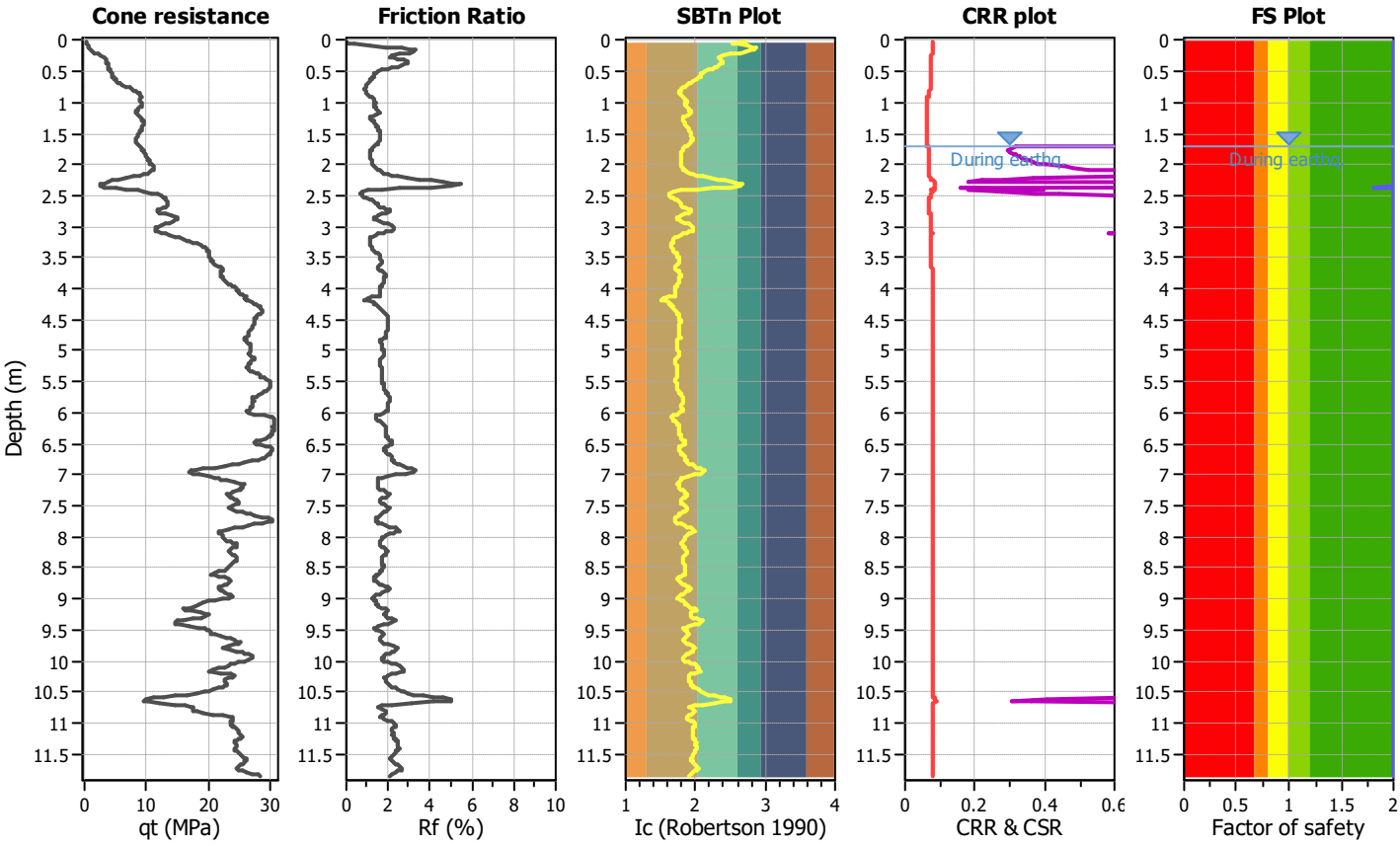
LIQUEFACTION ANALYSIS REPORT

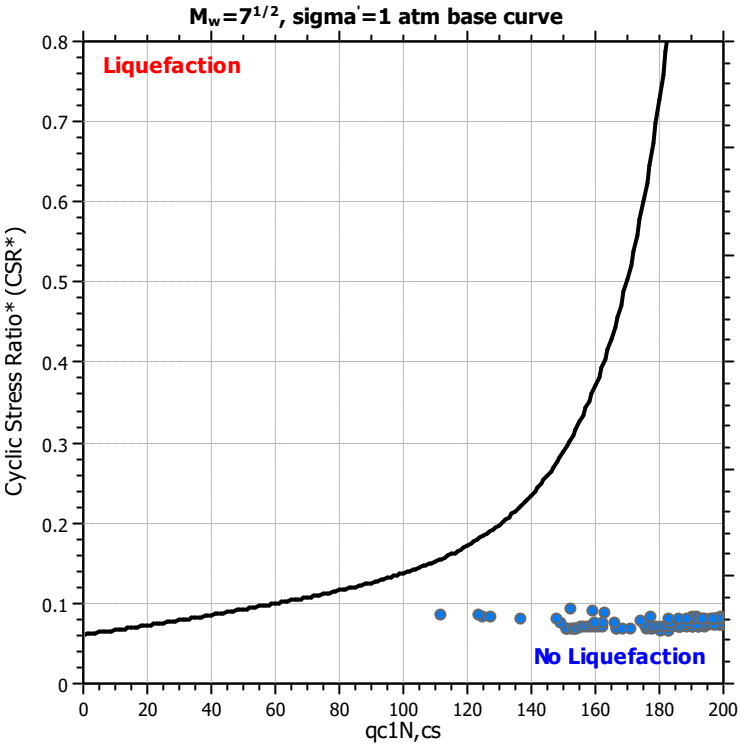
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

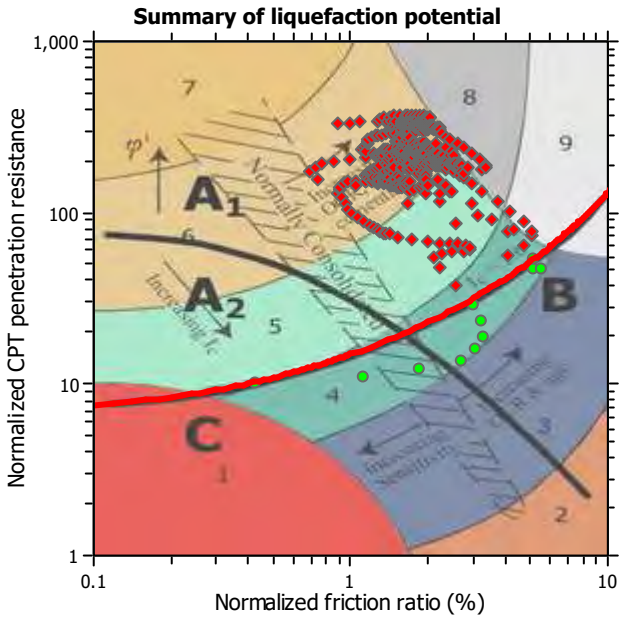
CPT file : CPT01_SLS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	No		

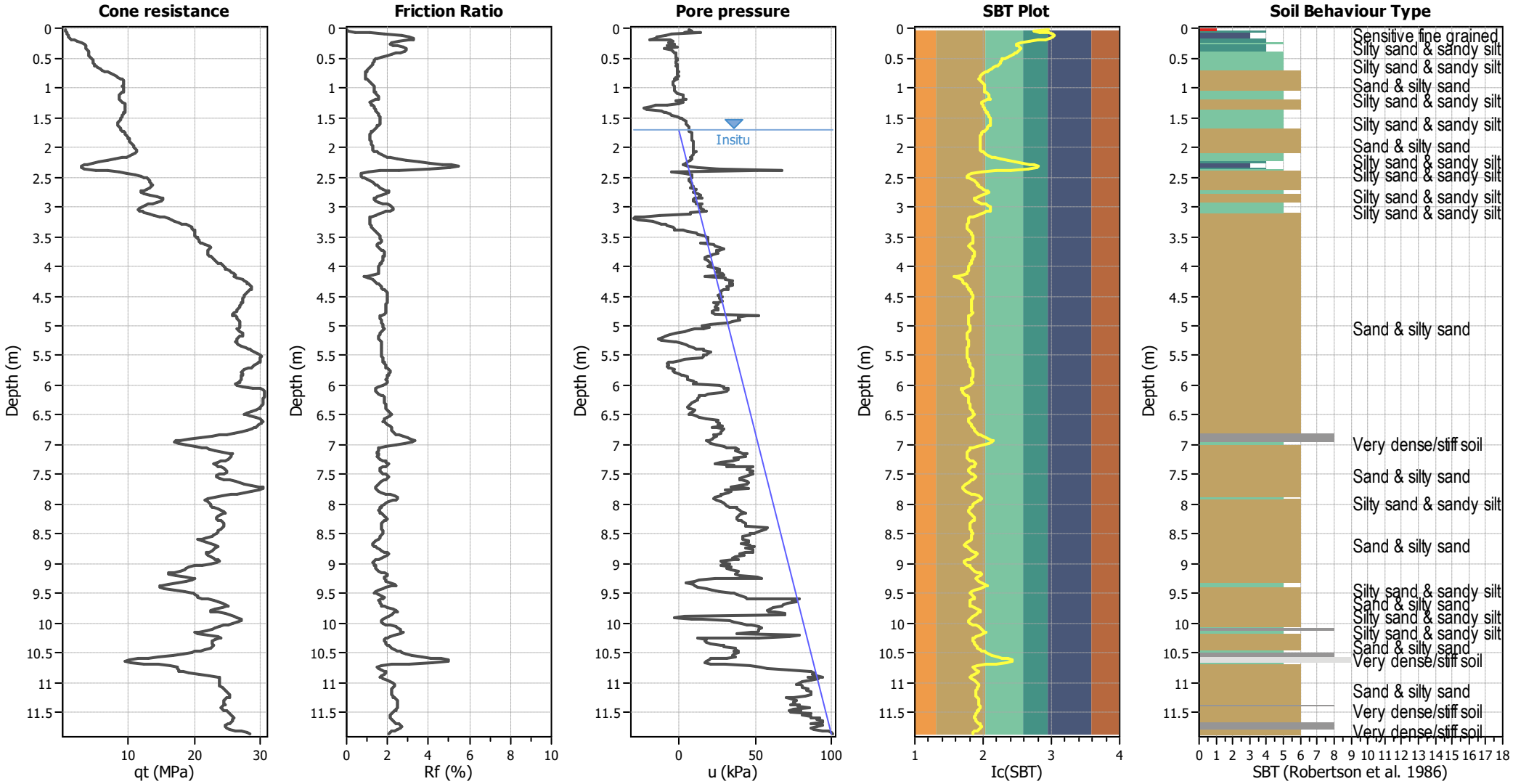






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



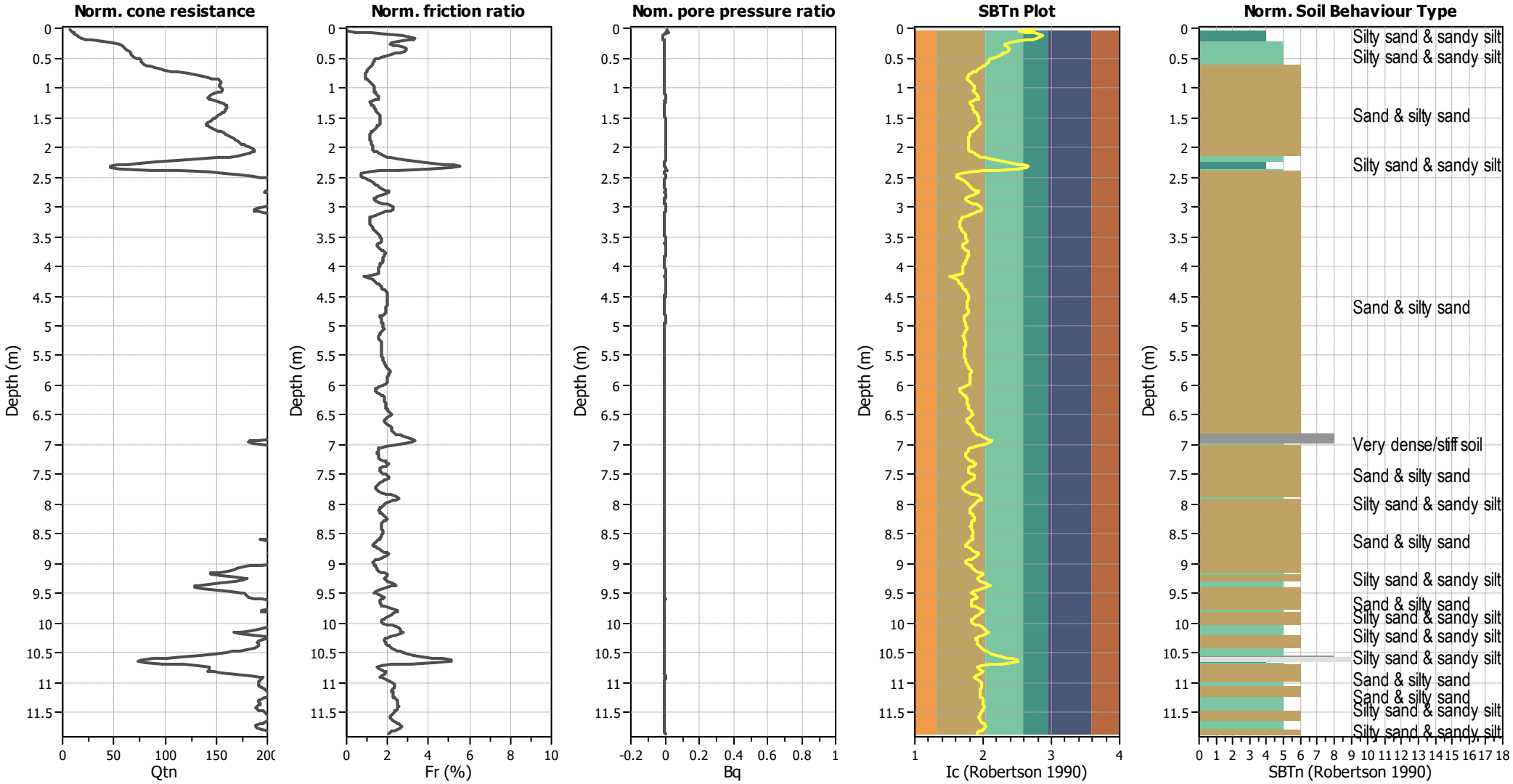
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



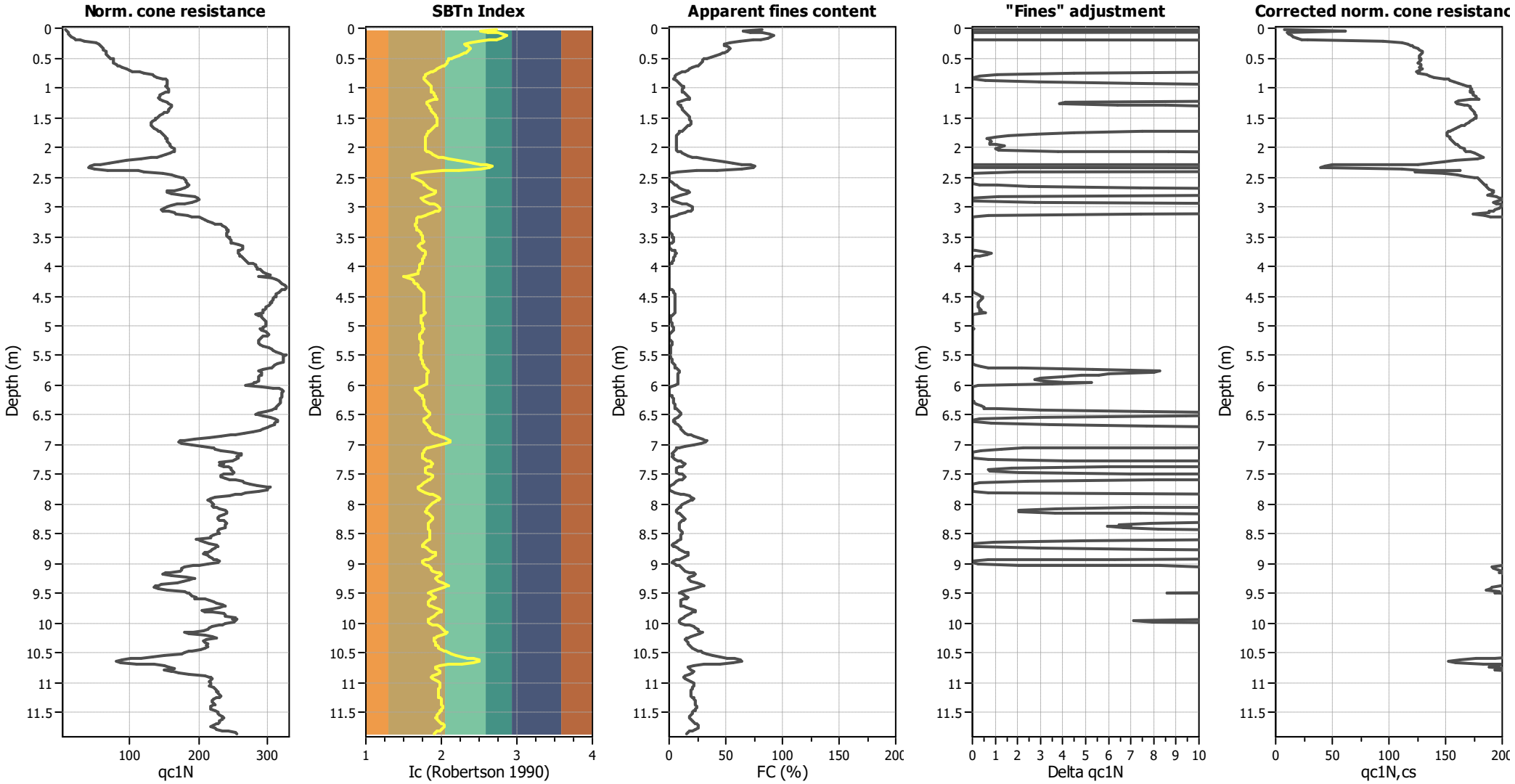
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

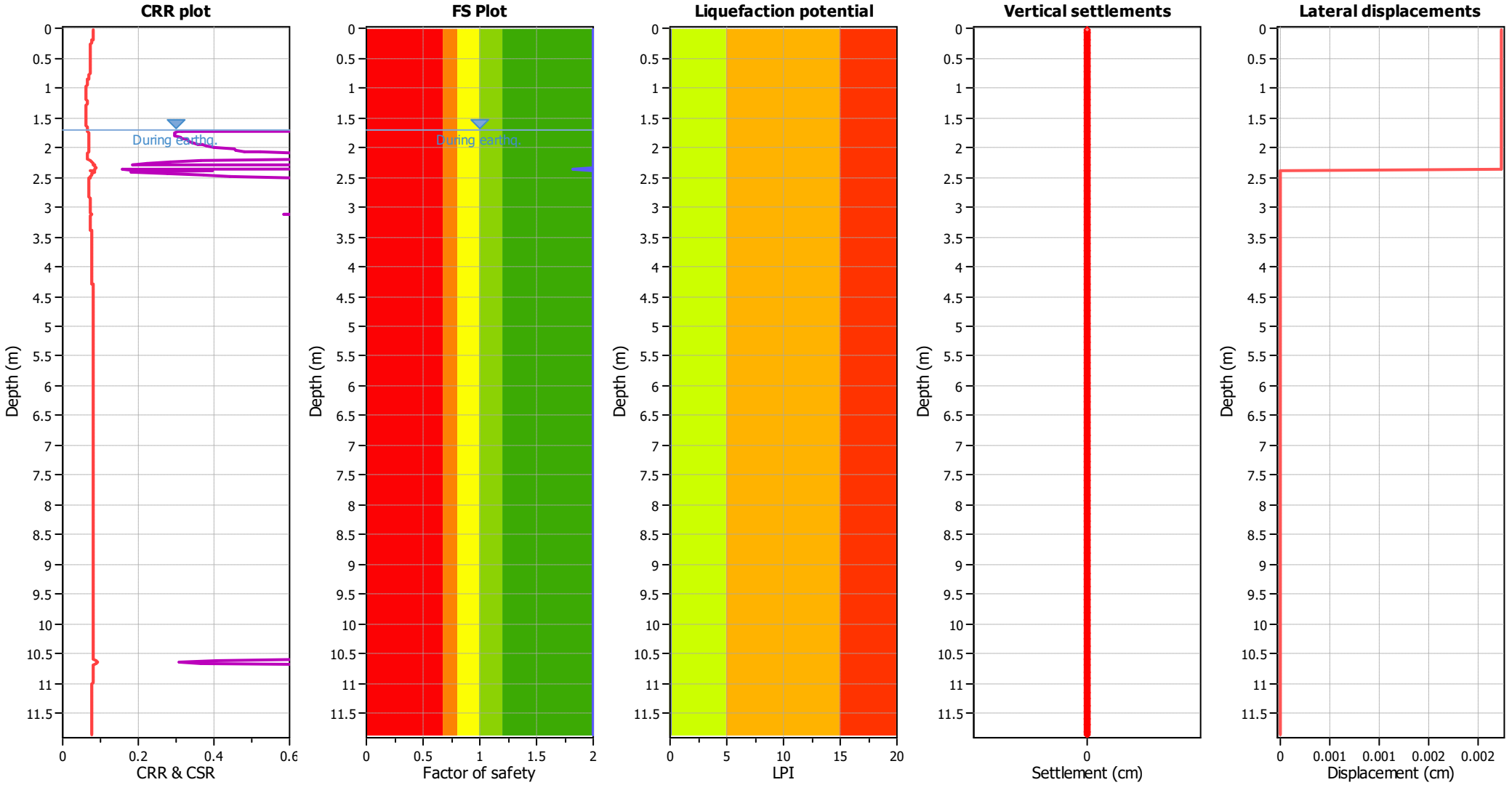
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

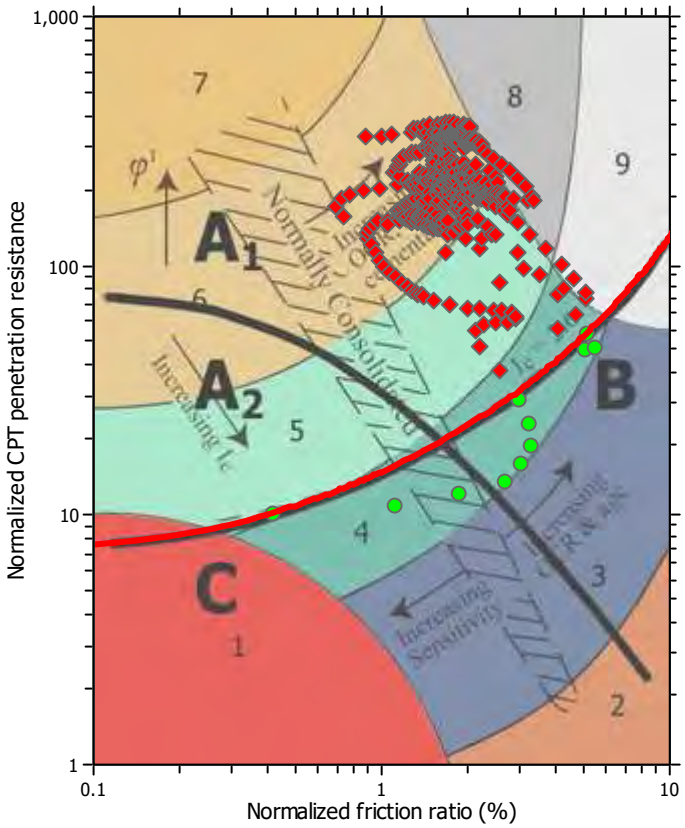
F.S. color scheme

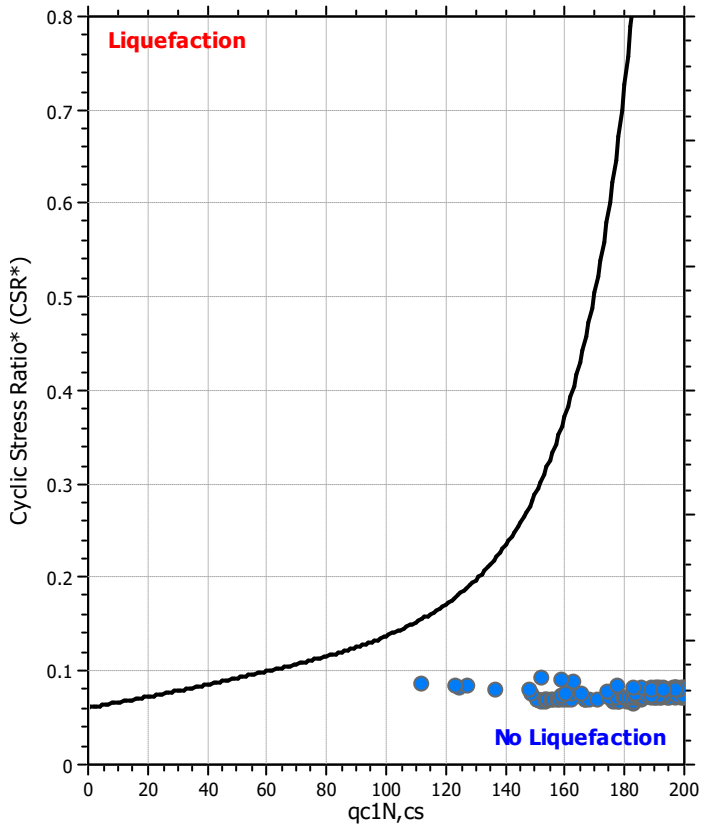
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

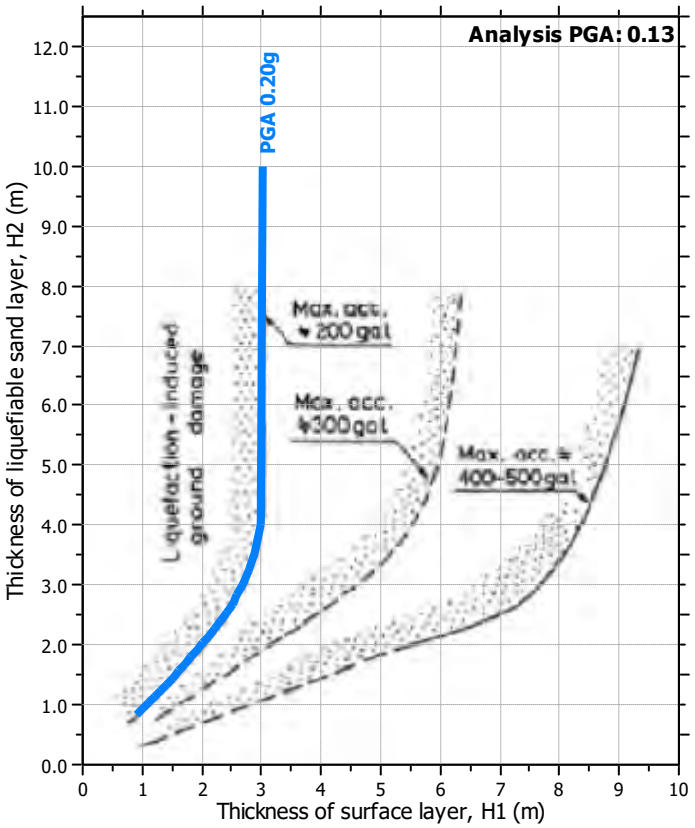
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



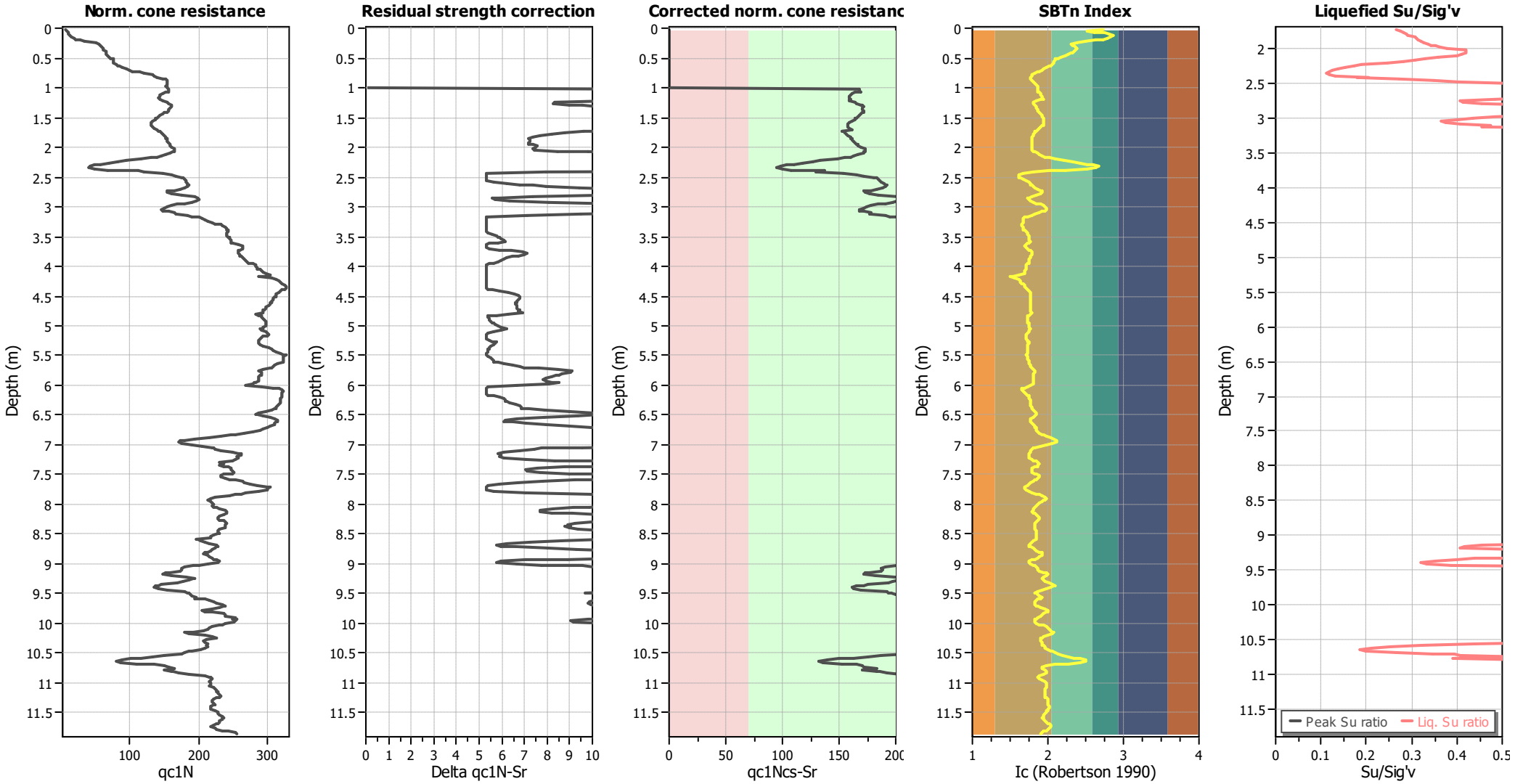




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

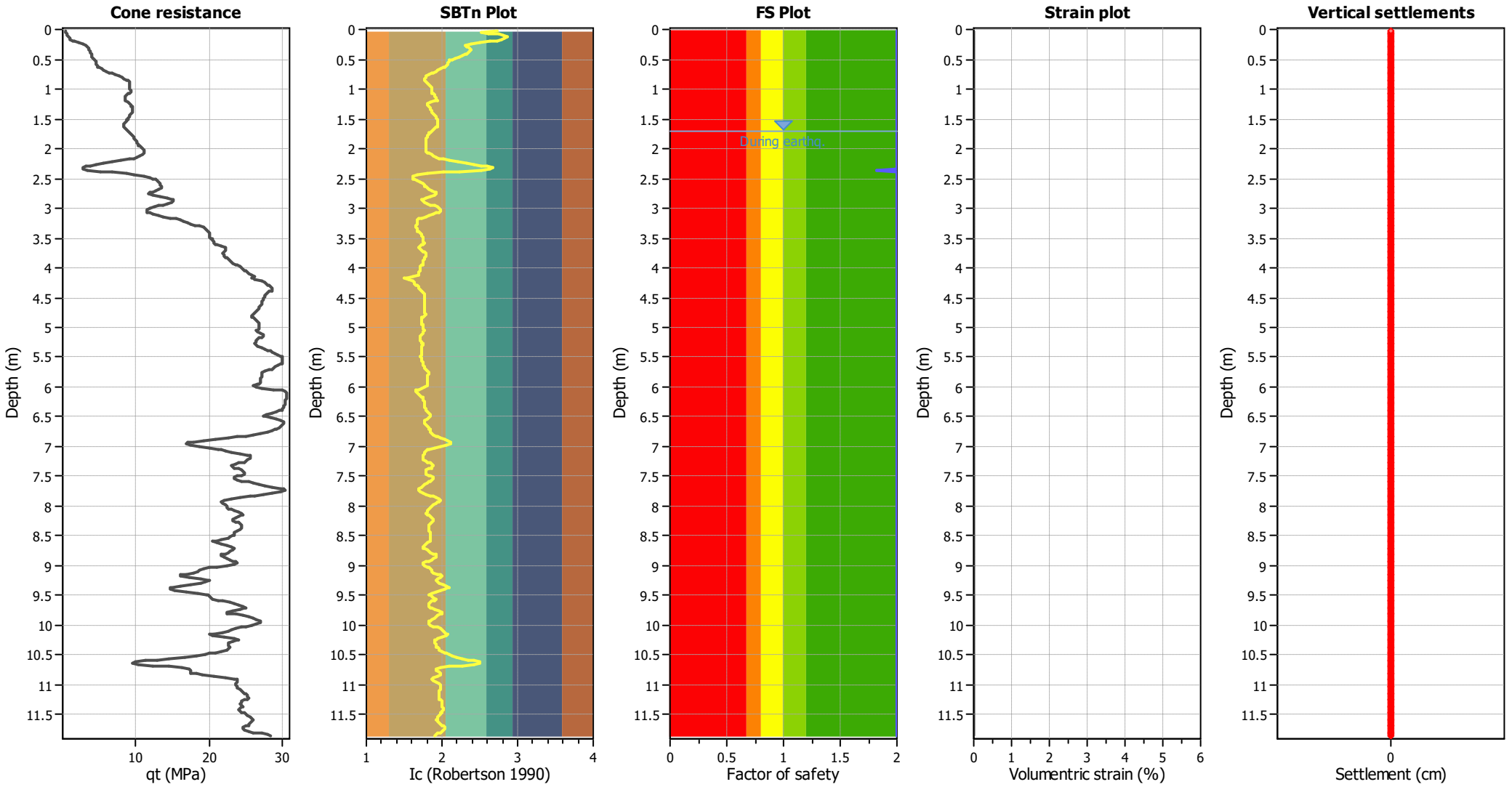
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

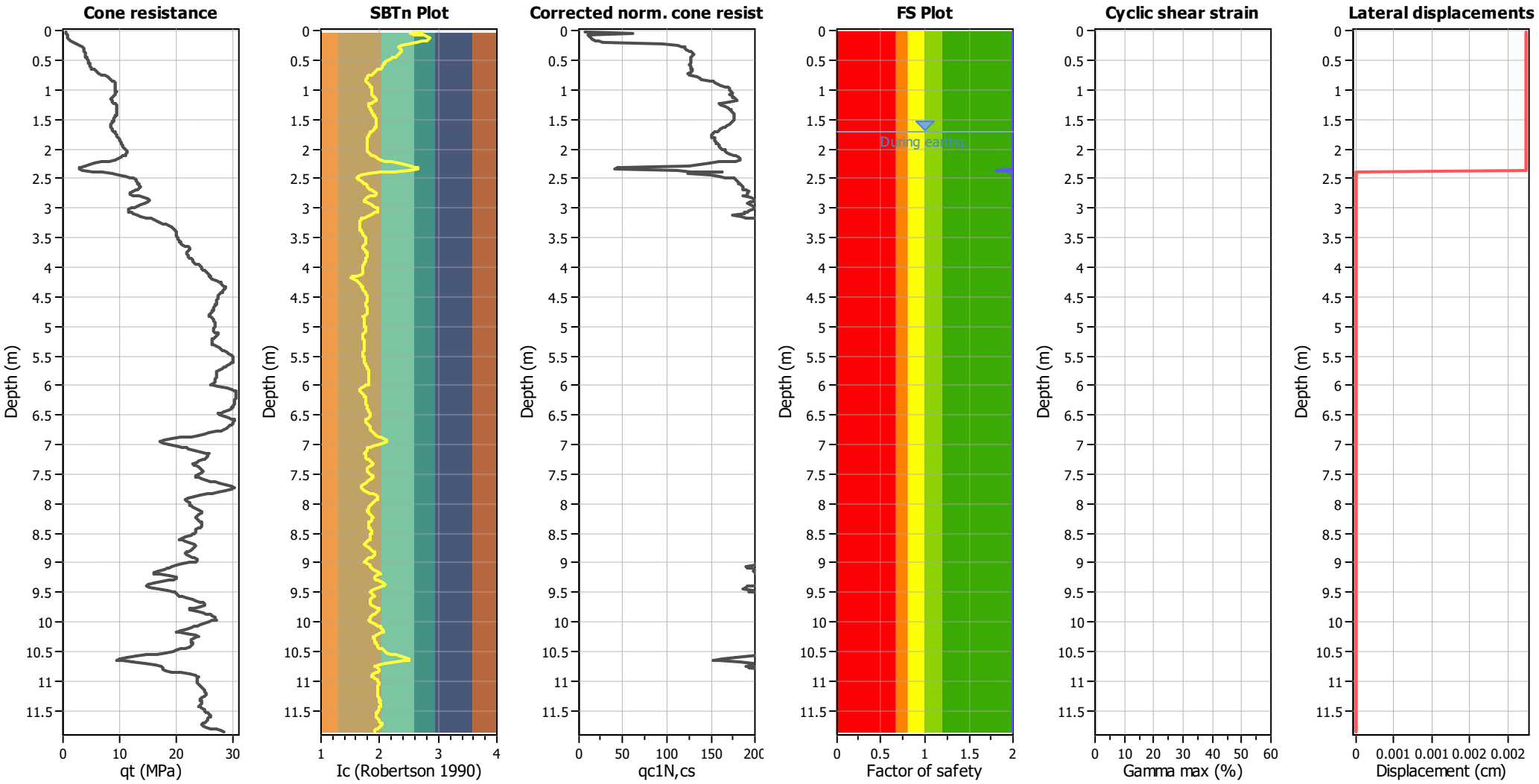
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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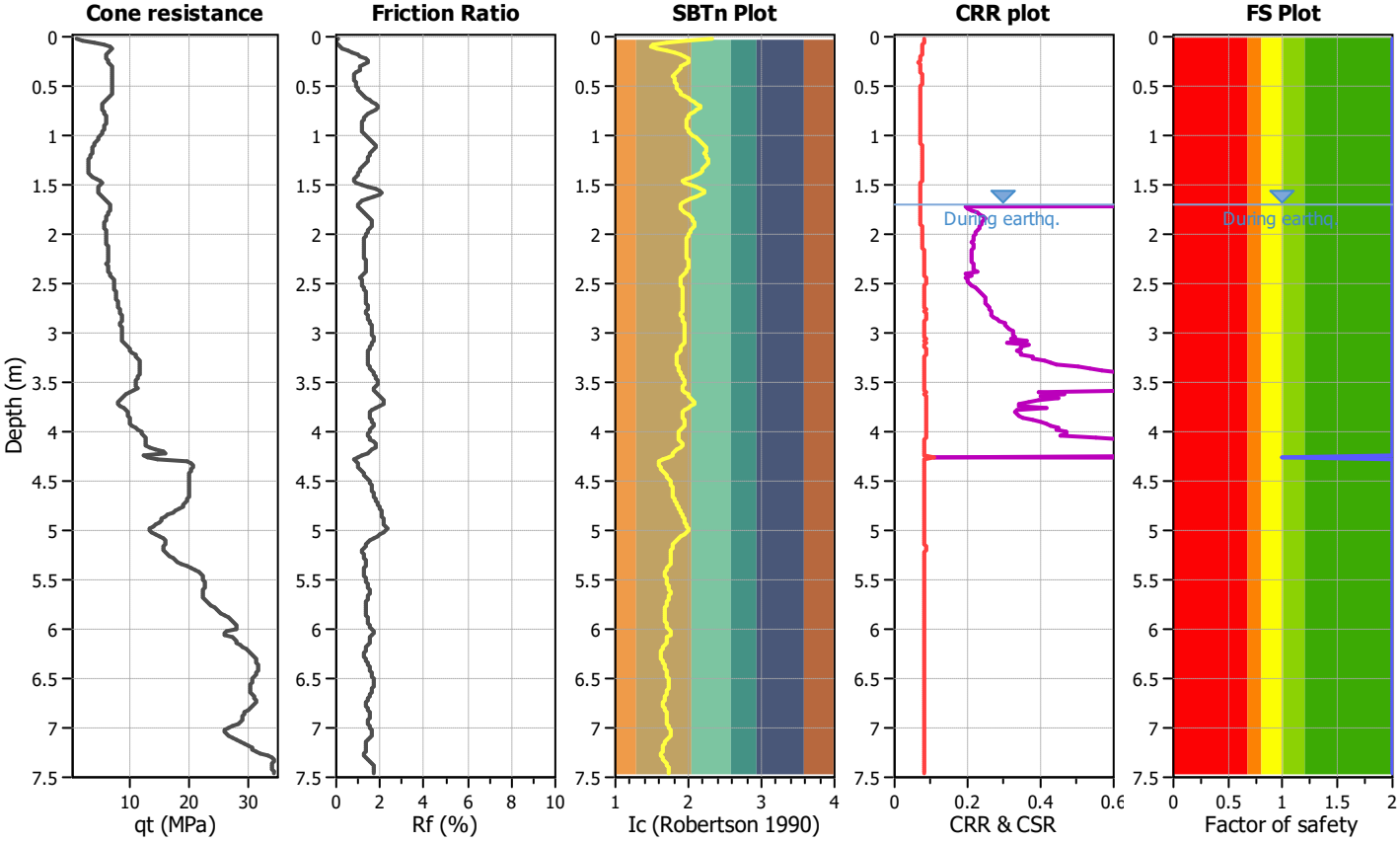
LIQUEFACTION ANALYSIS REPORT

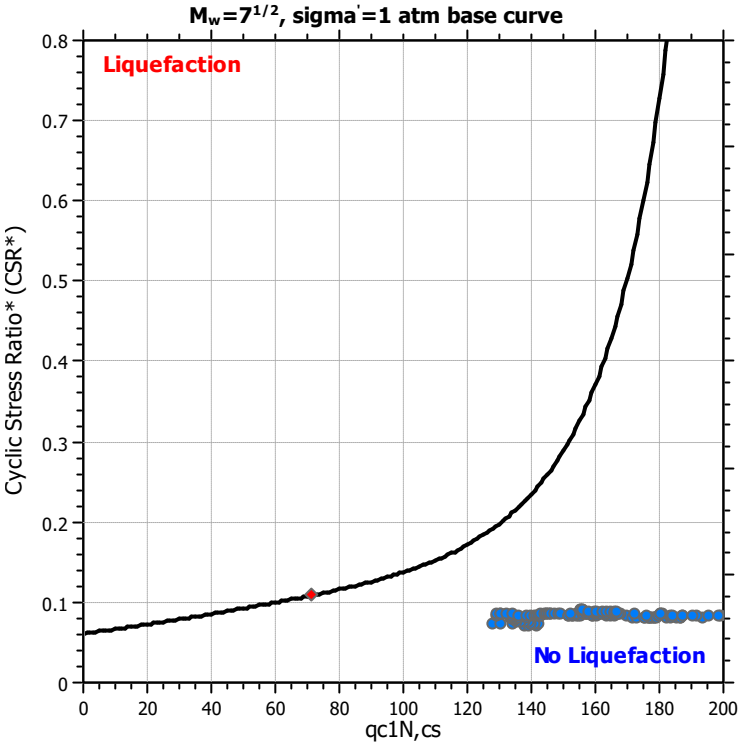
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

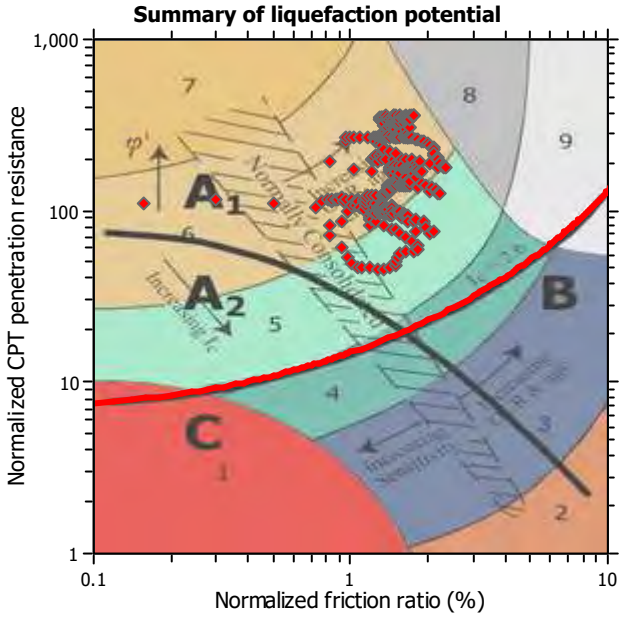
CPT file : CPT02_SLS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	No		

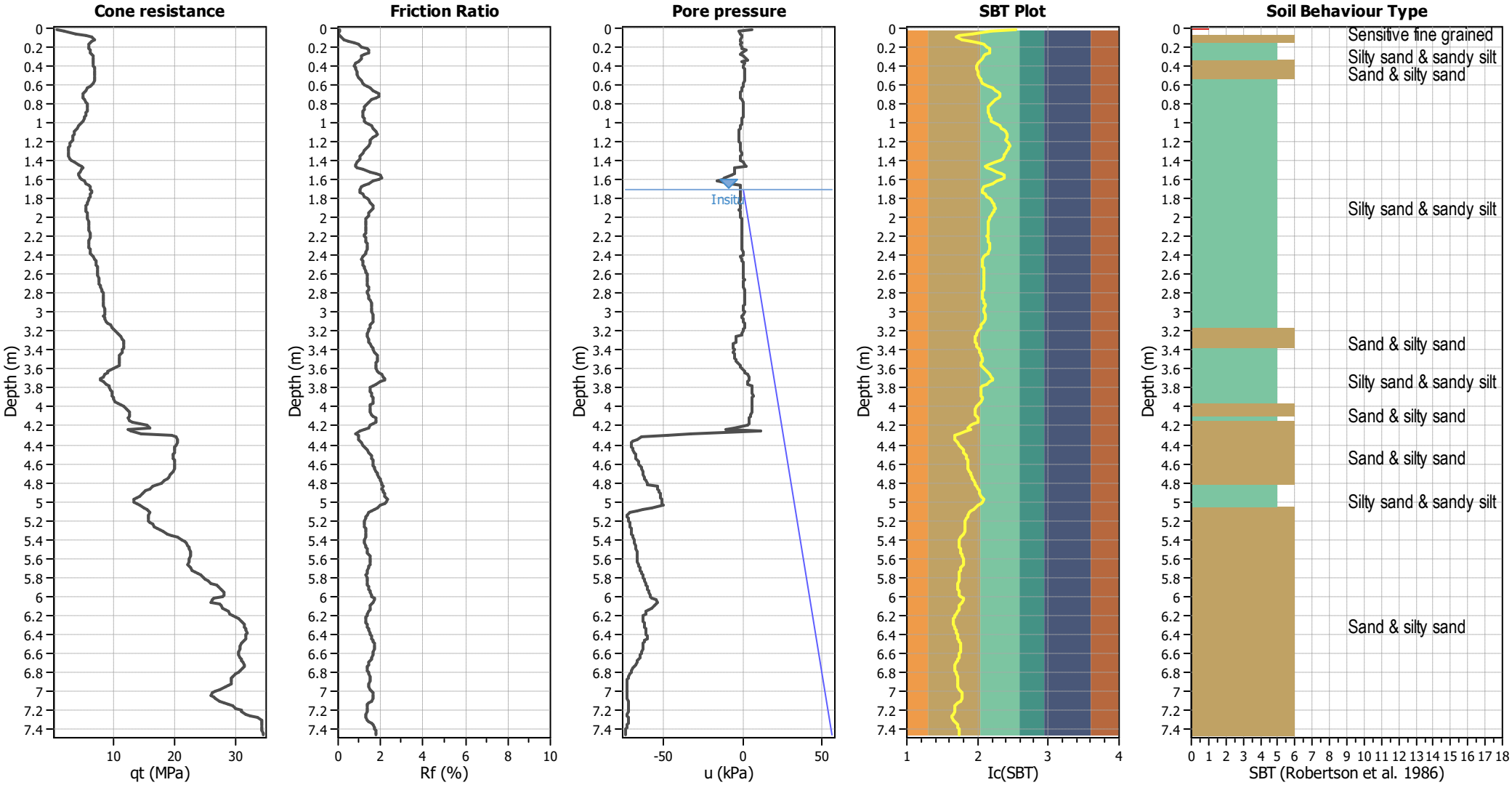






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



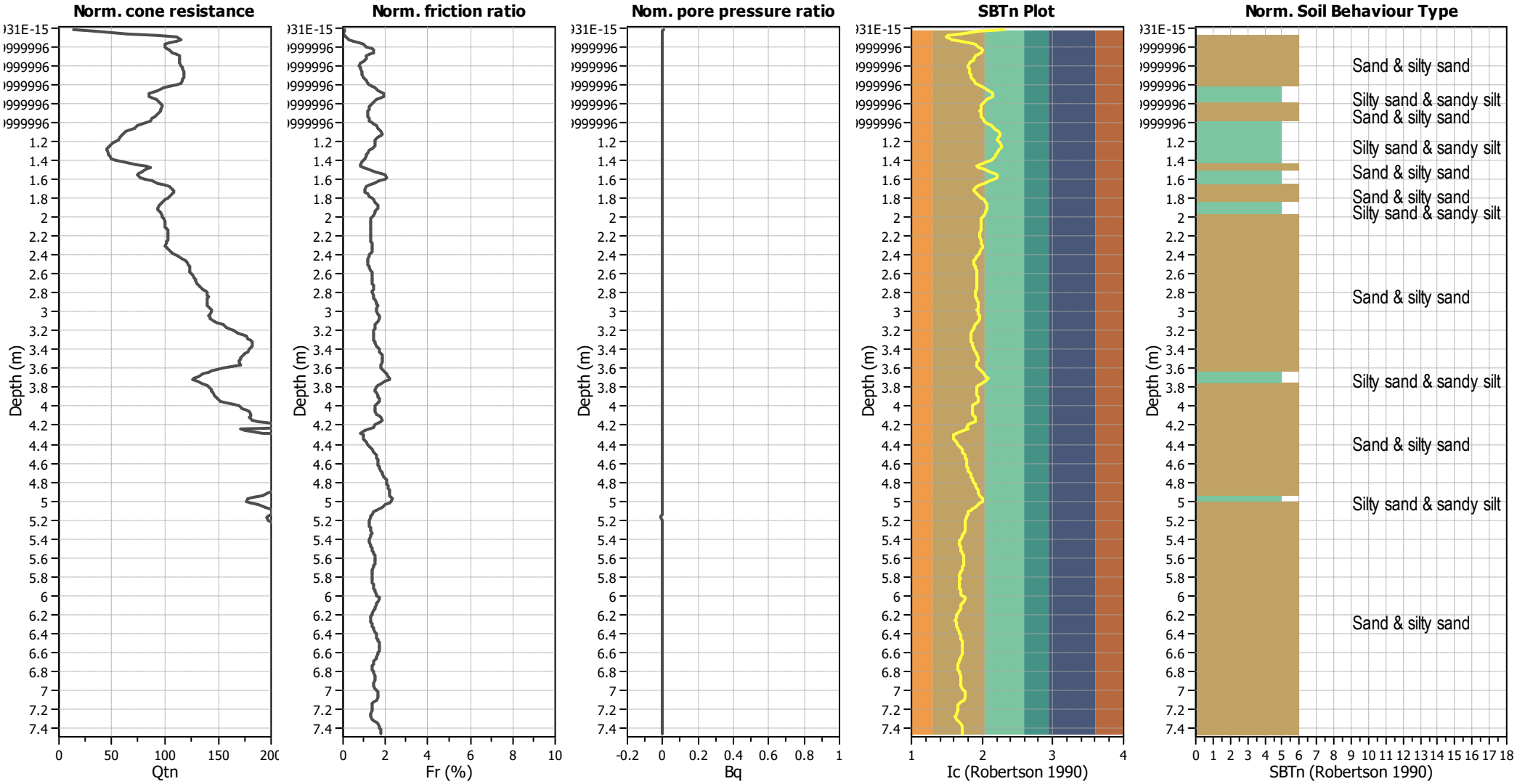
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



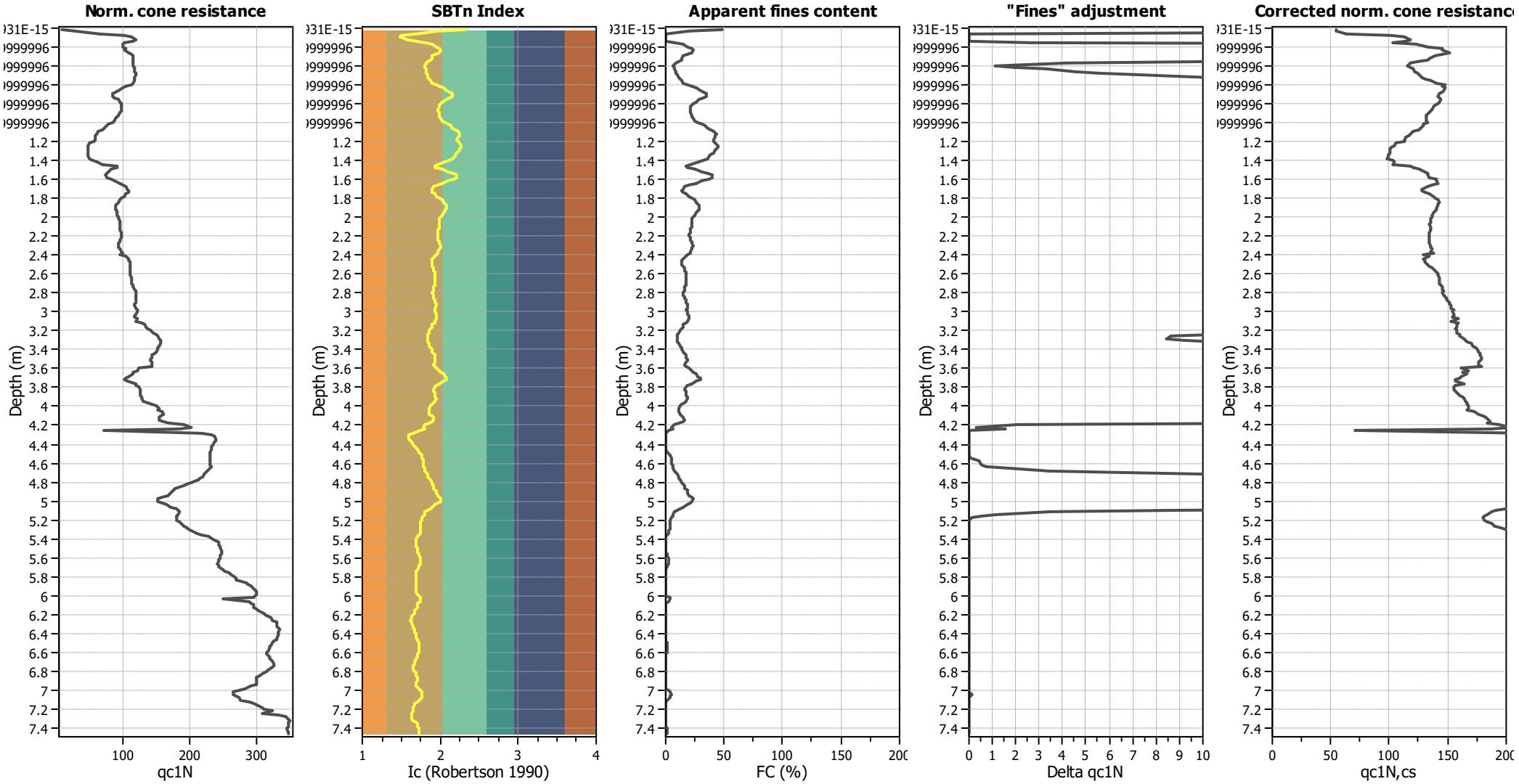
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

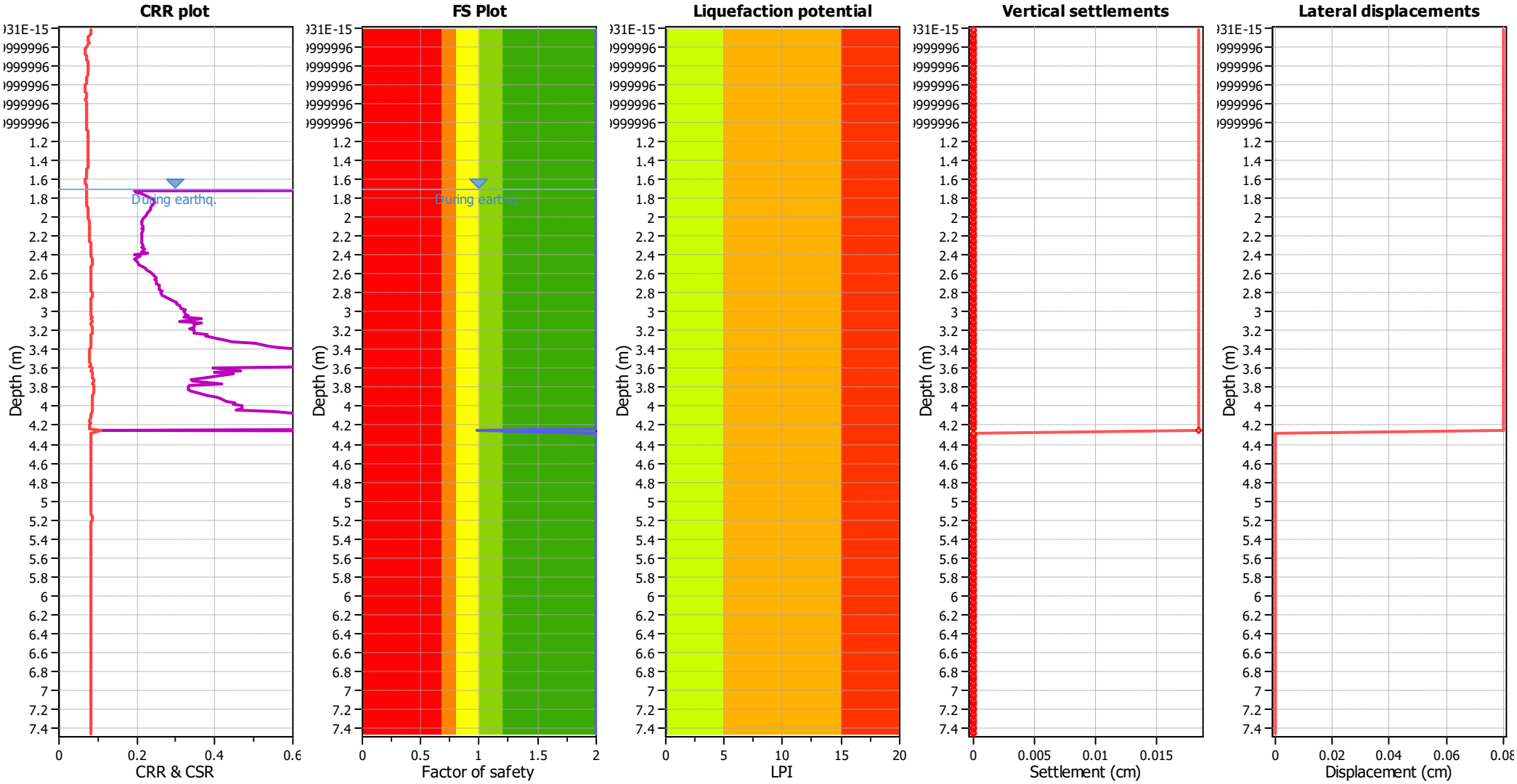
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

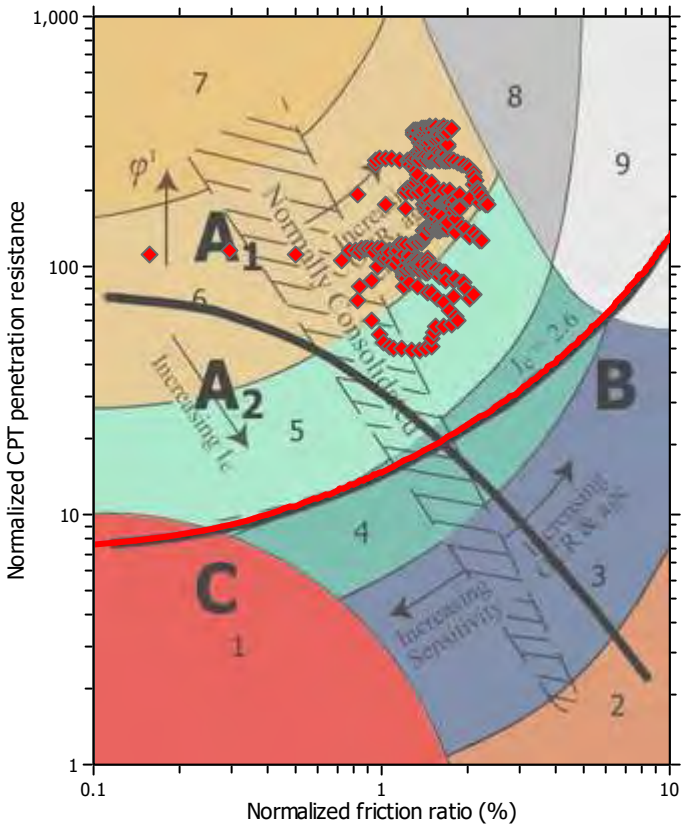
F.S. color scheme

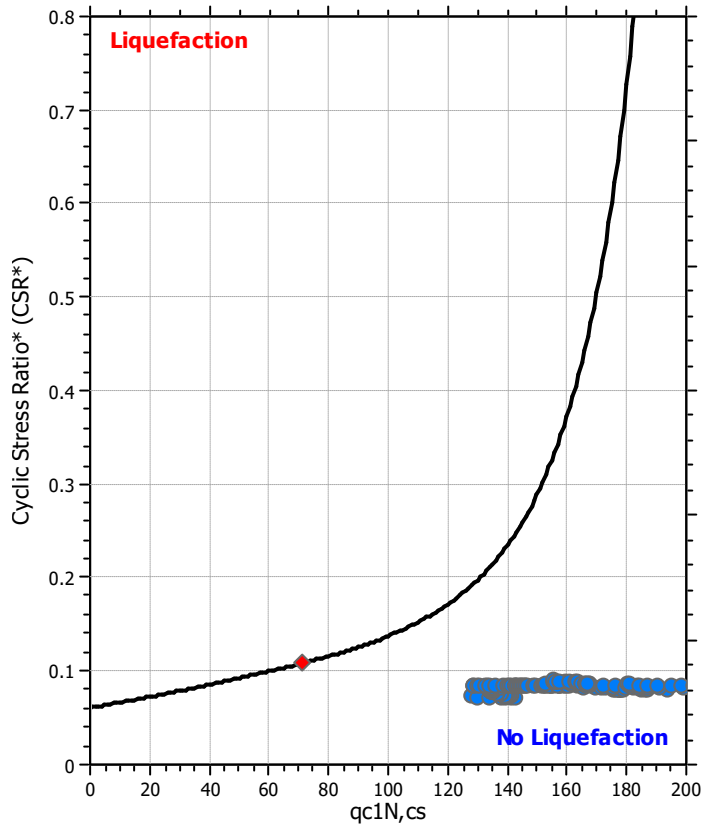
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

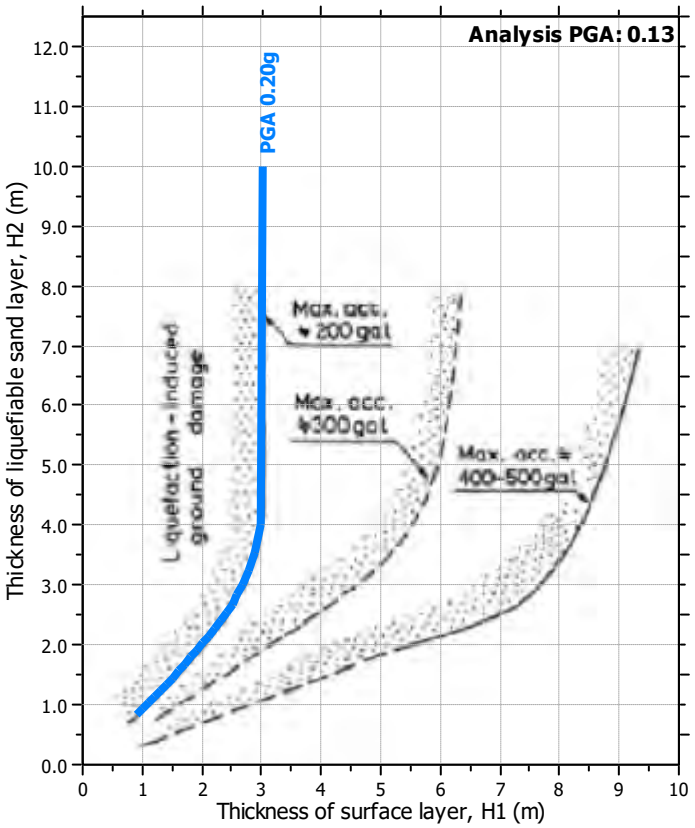
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



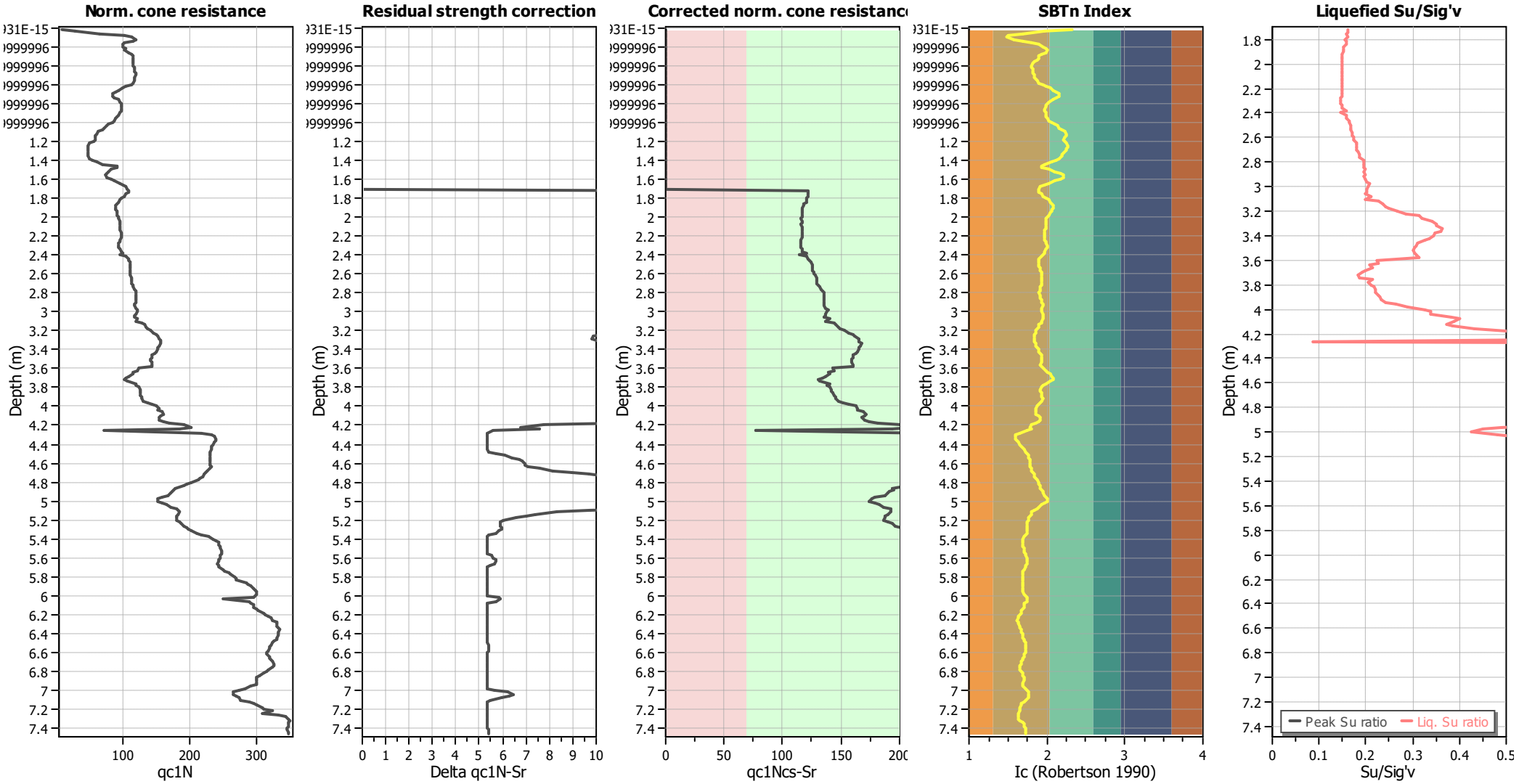




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

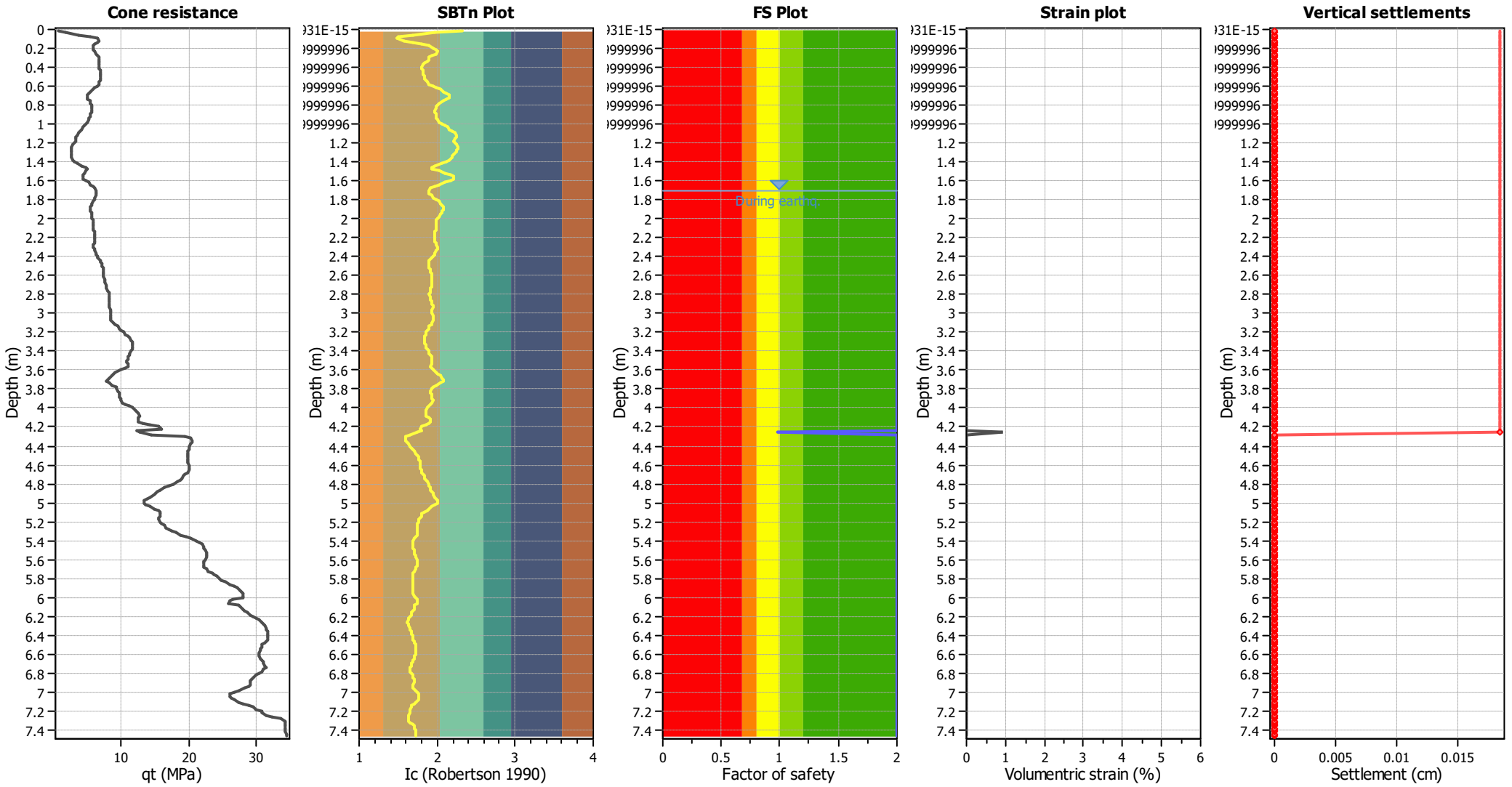
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

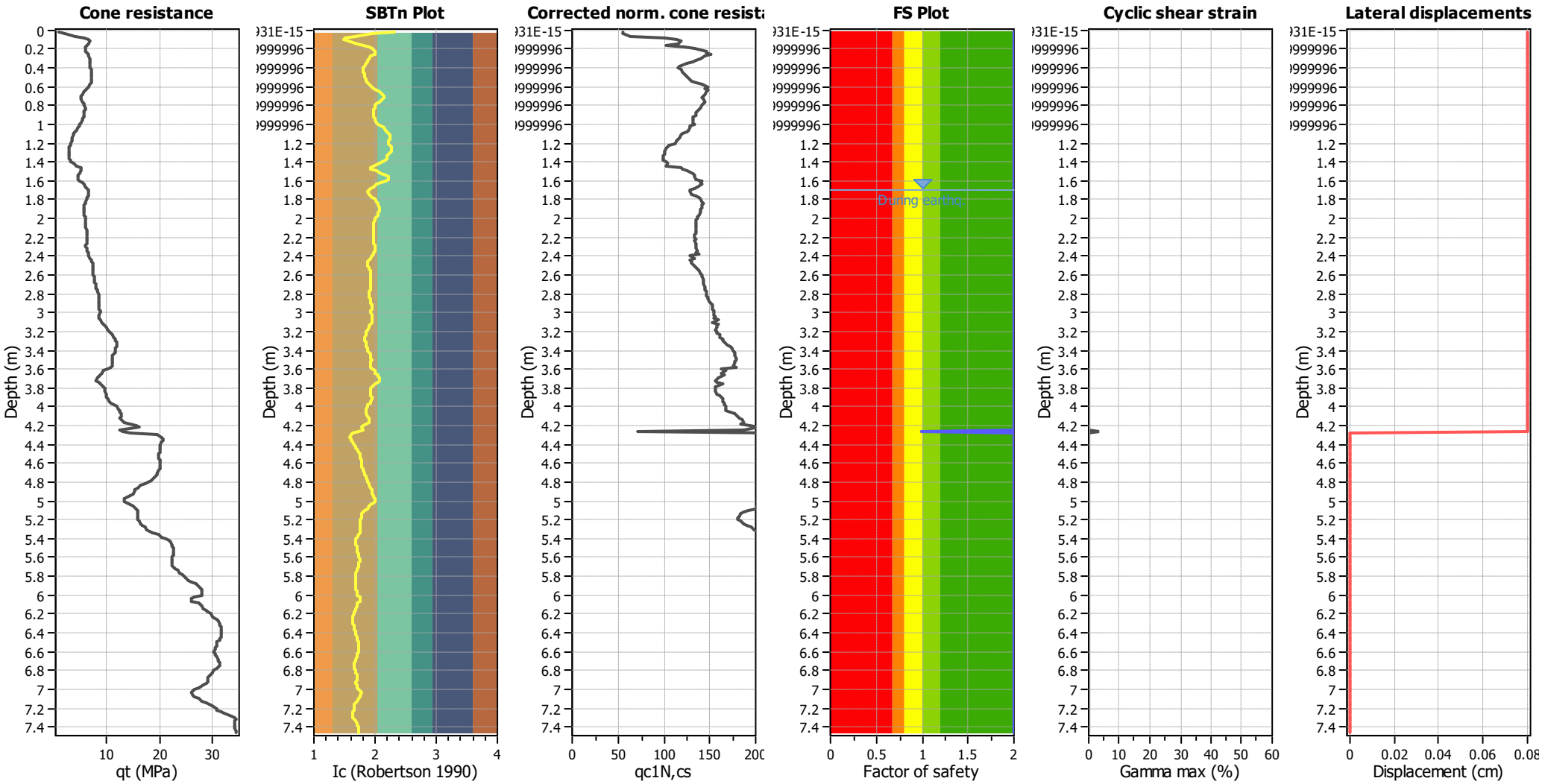
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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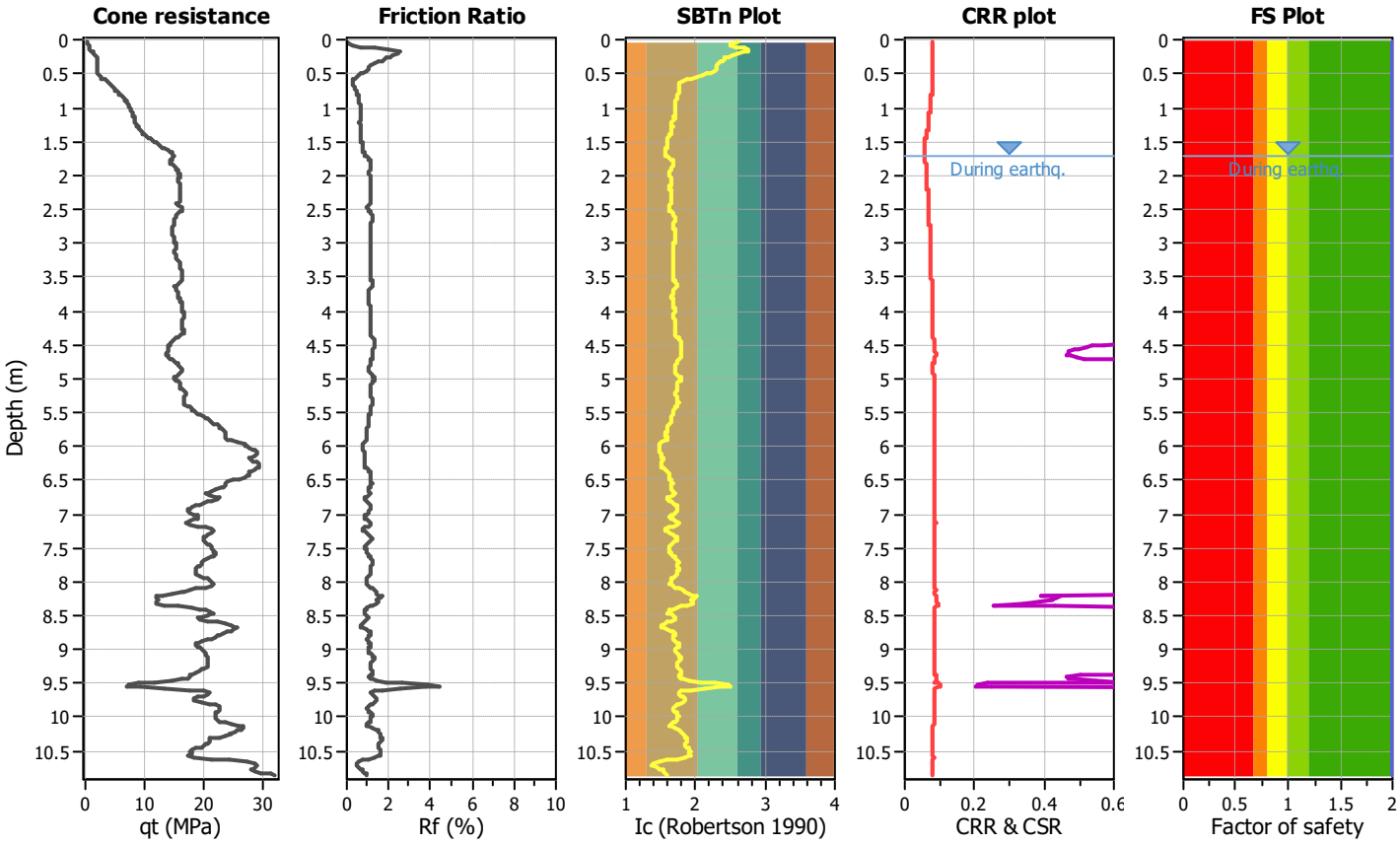
LIQUEFACTION ANALYSIS REPORT

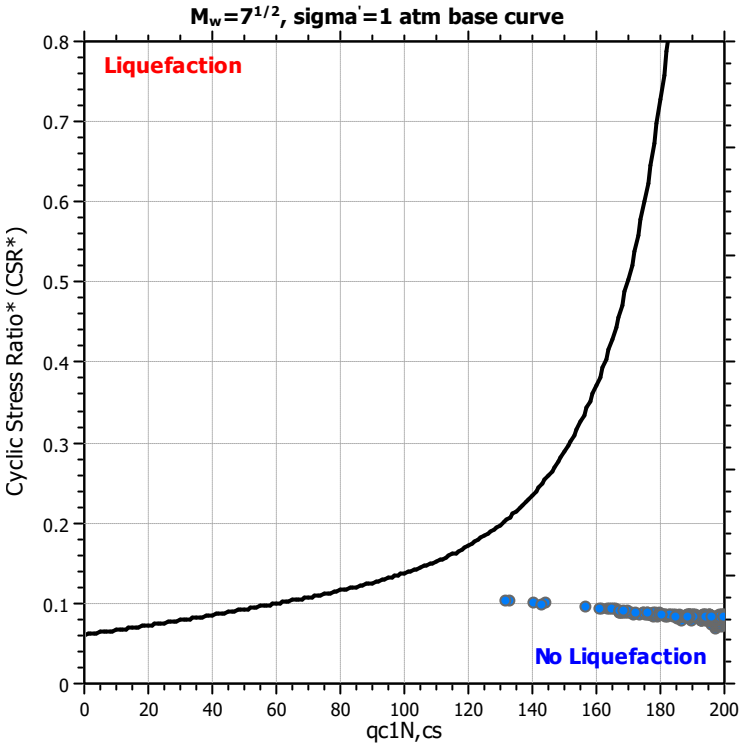
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

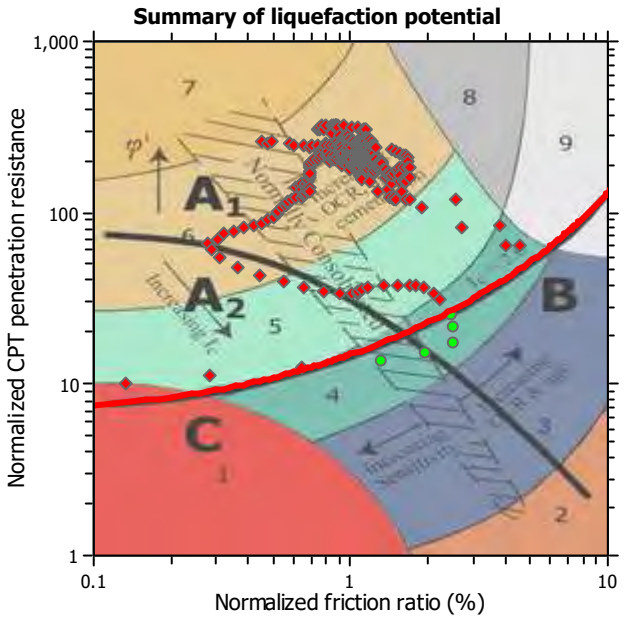
CPT file : CPT03_SLS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	No		

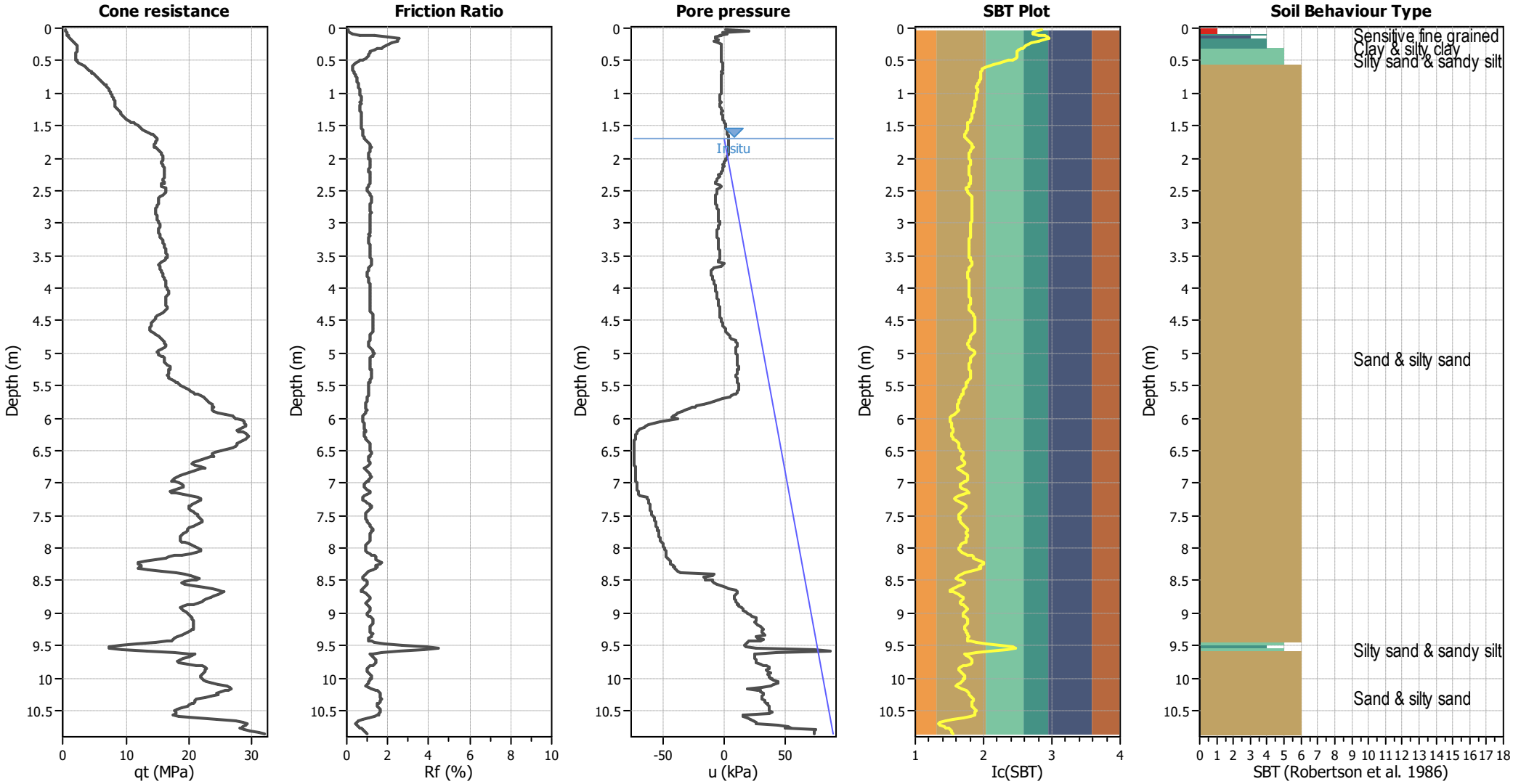






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



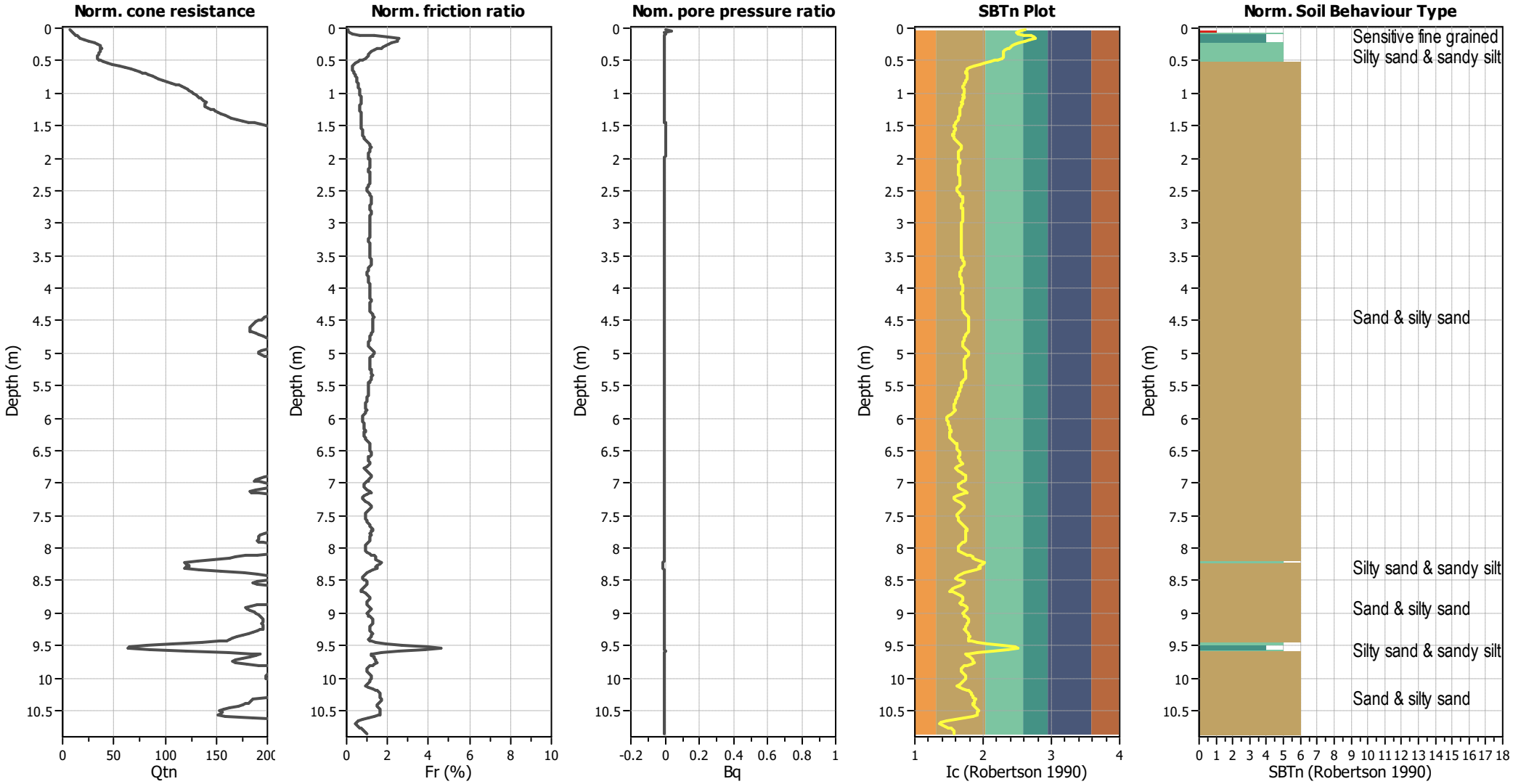
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



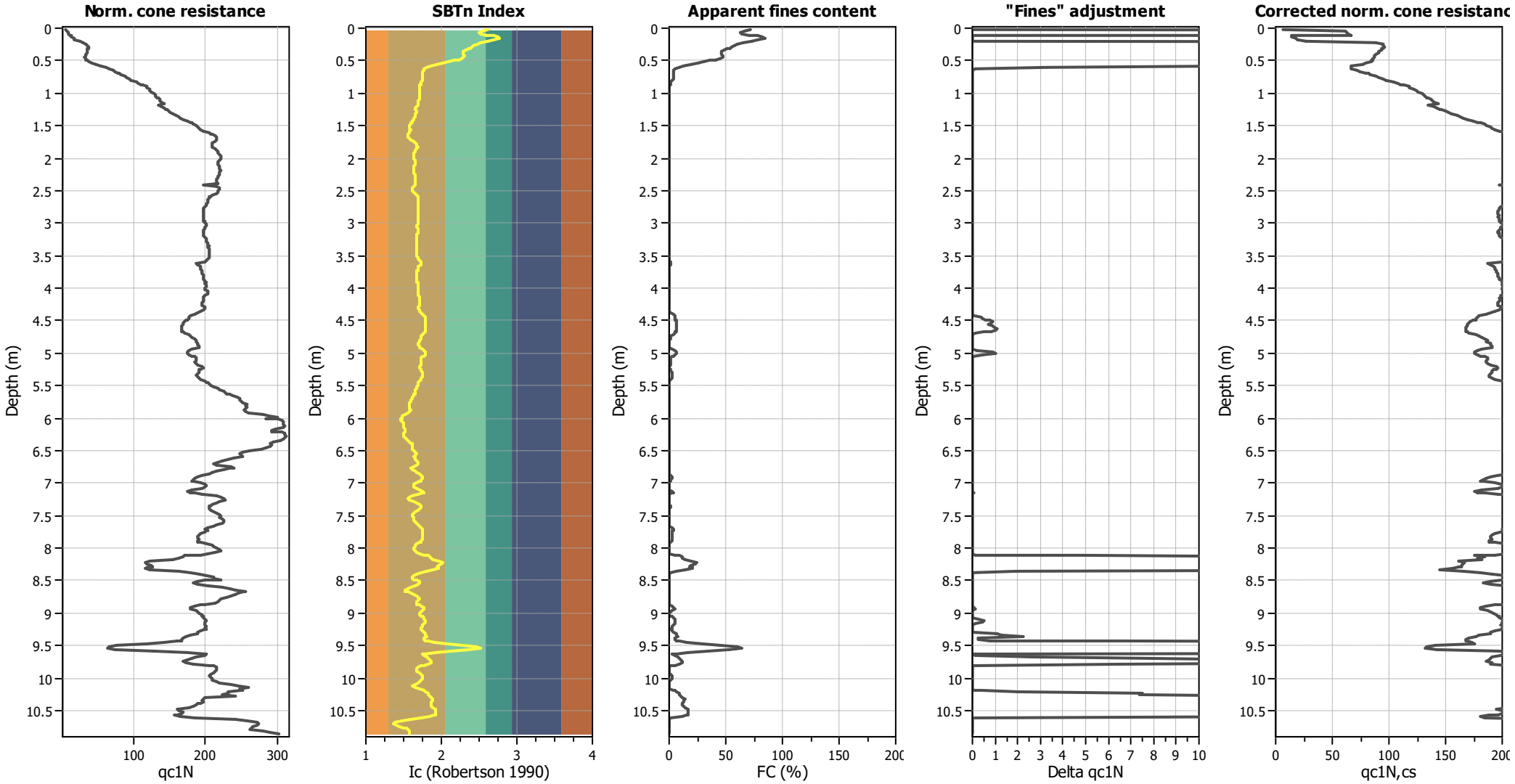
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

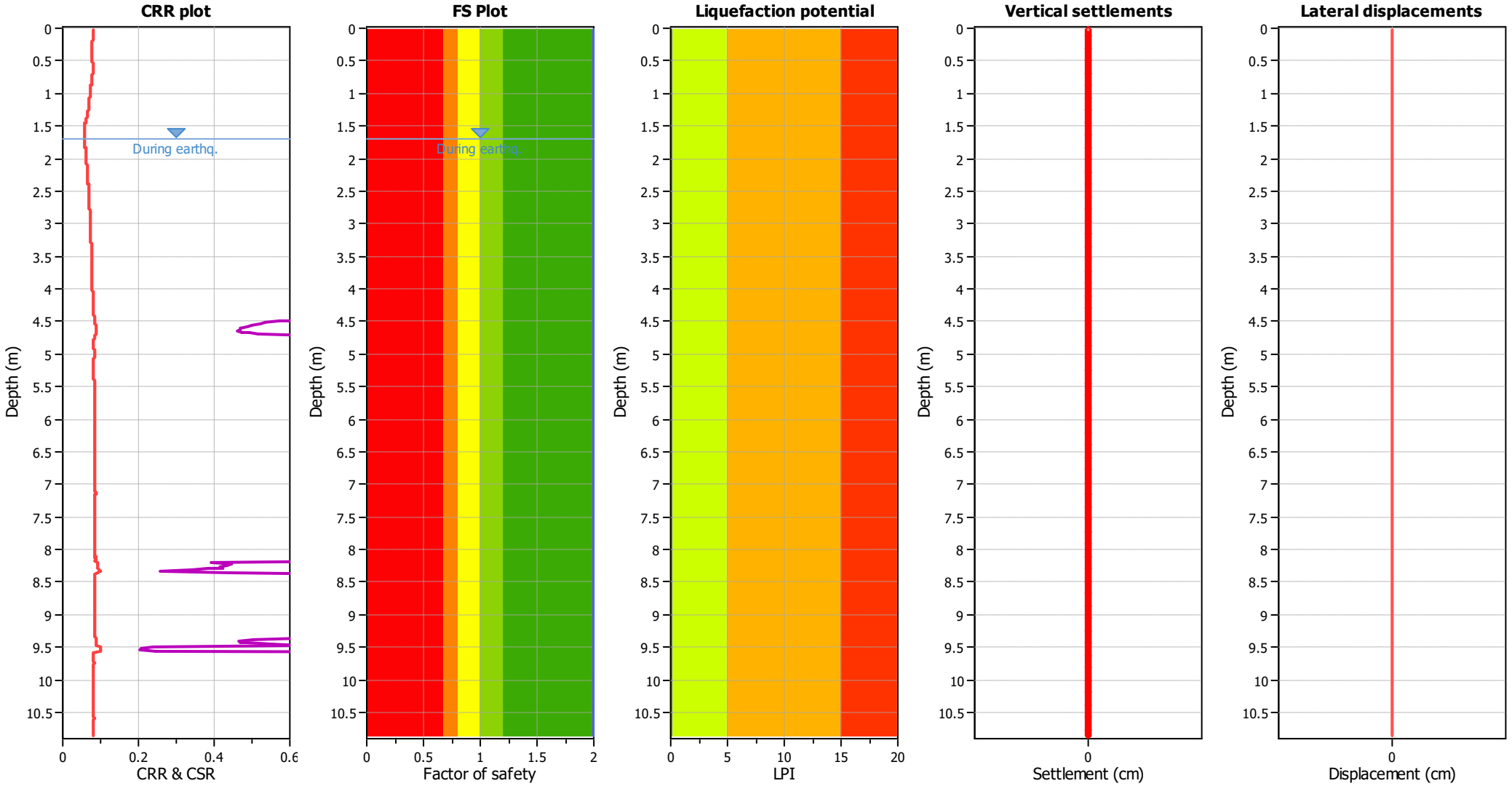
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

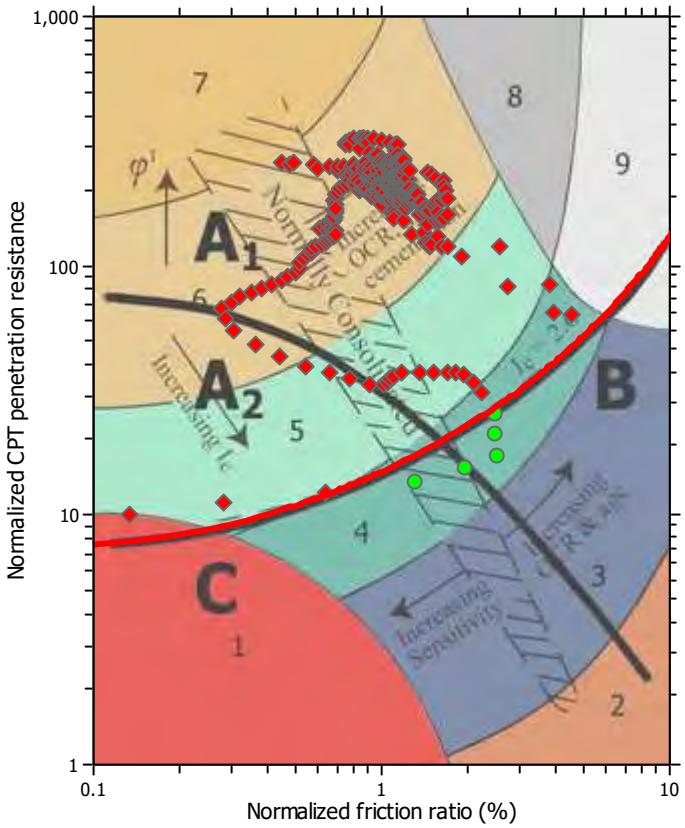
F.S. color scheme

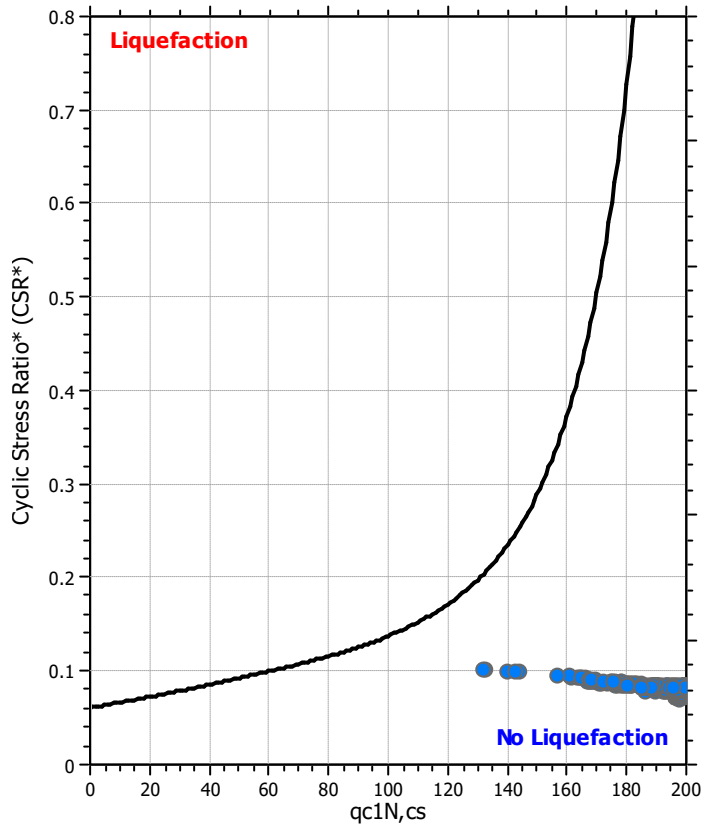
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

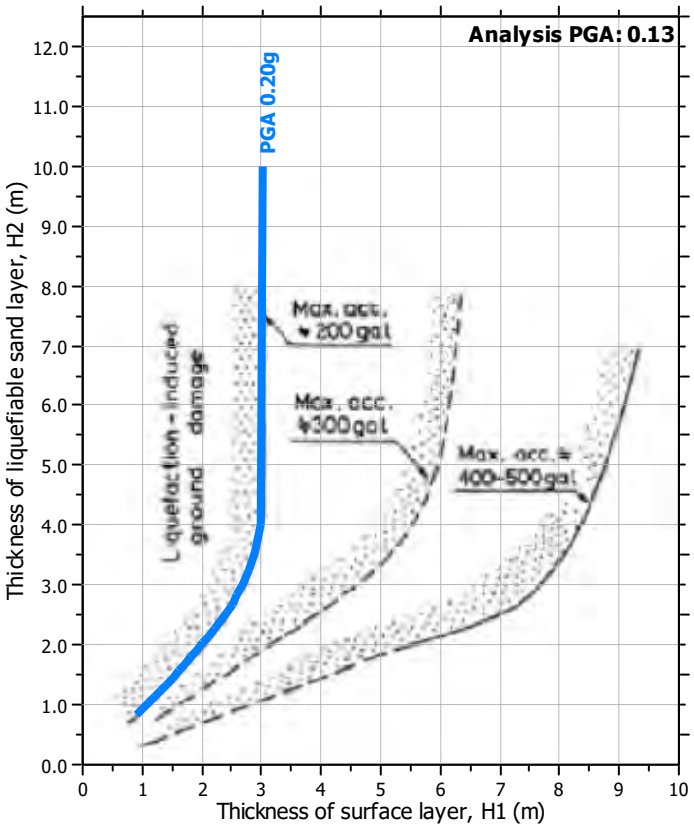
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



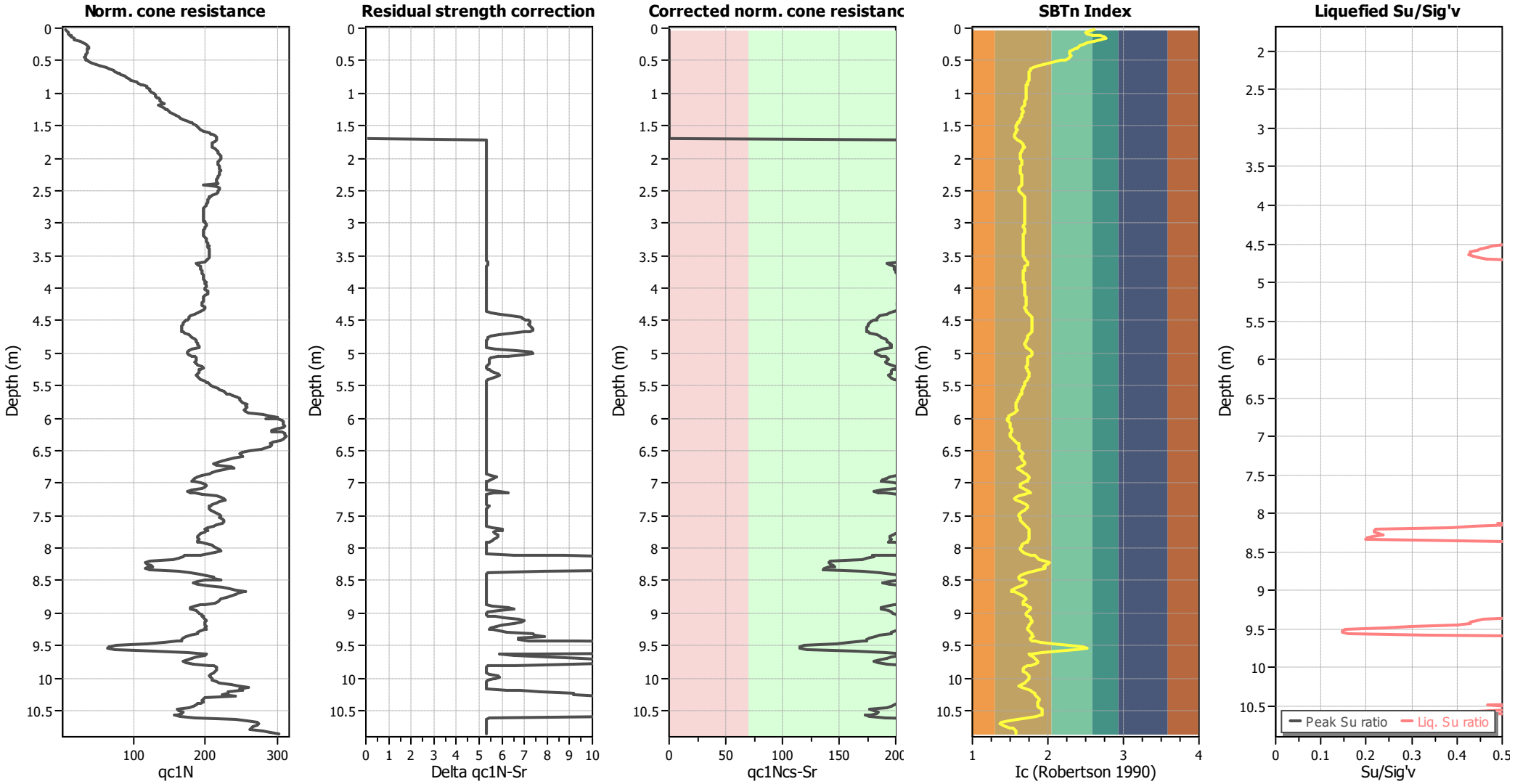




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

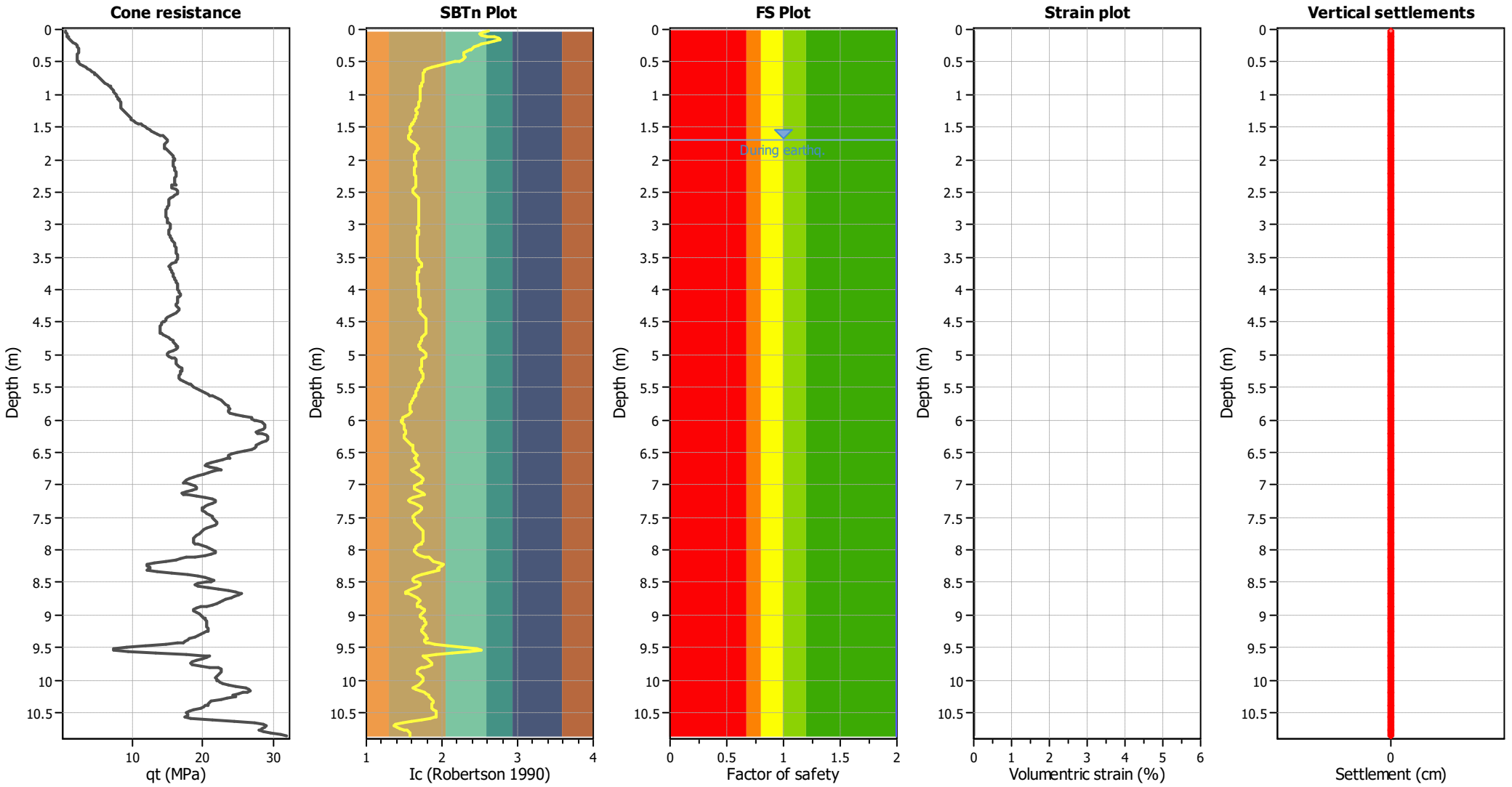
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

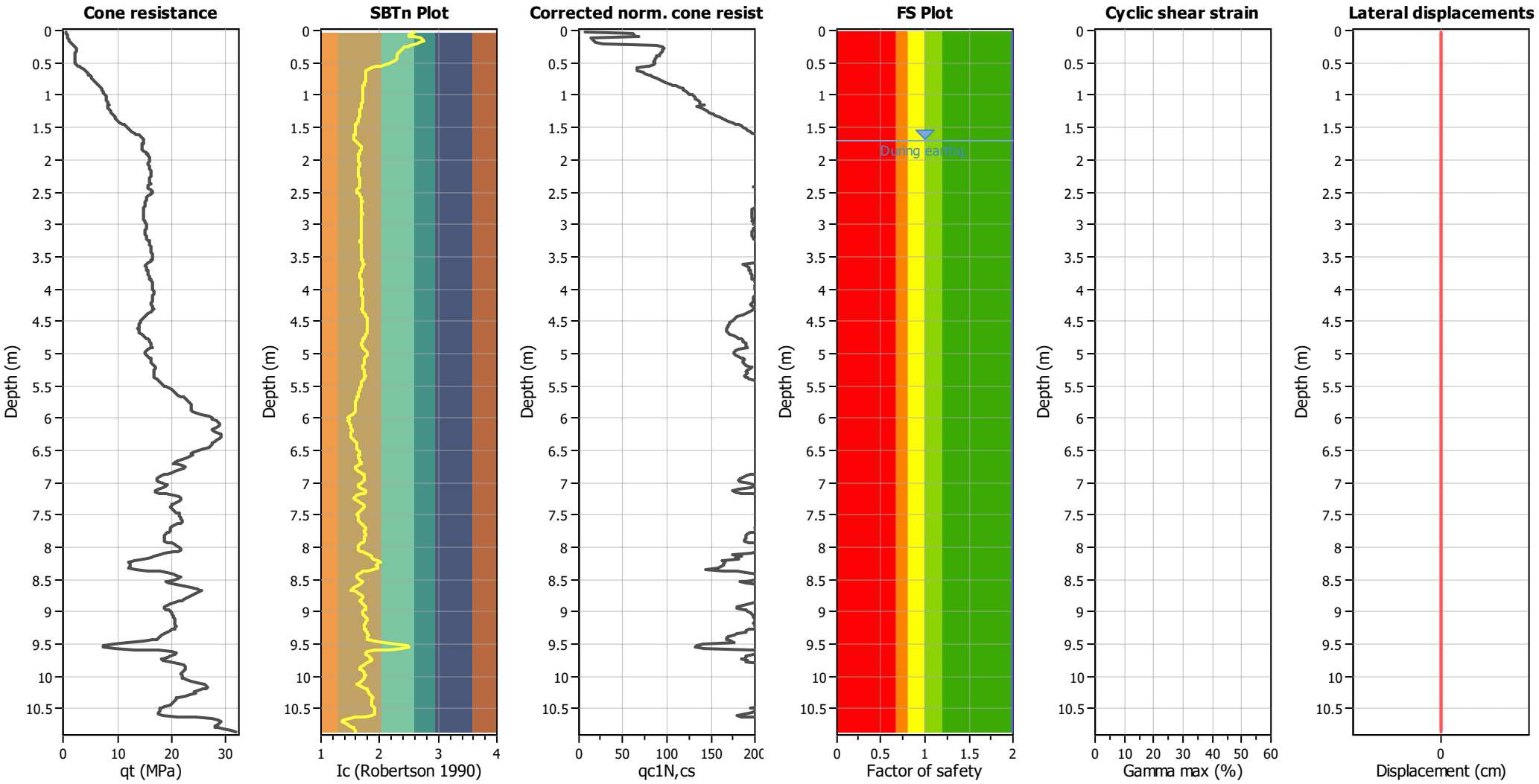
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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2/182 Main Rd Tawa
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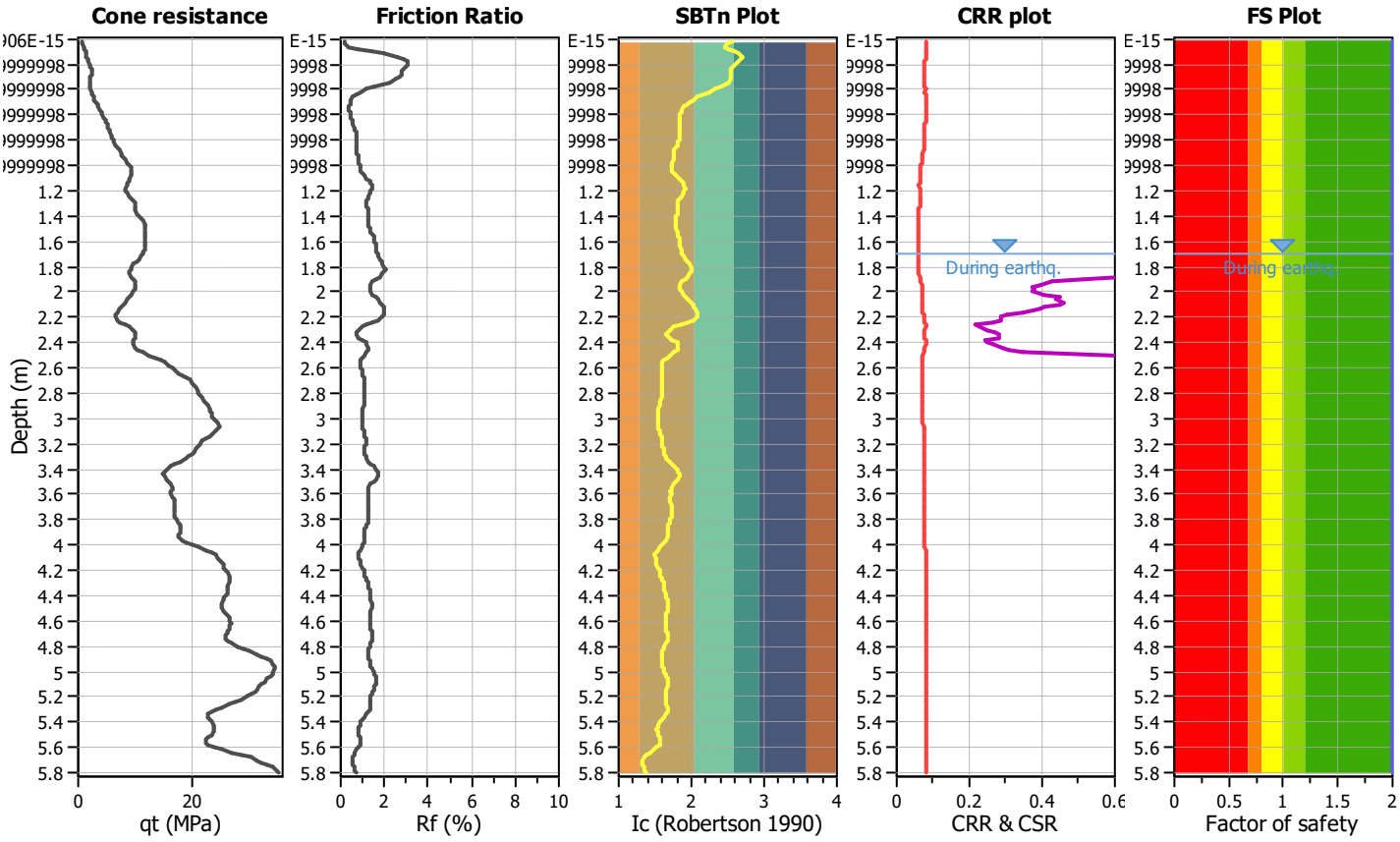
LIQUEFACTION ANALYSIS REPORT

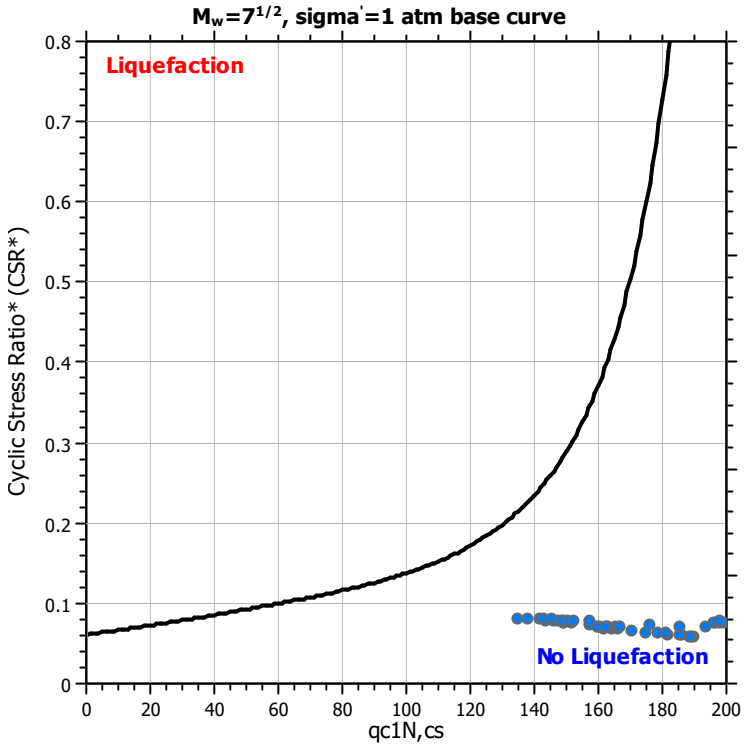
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

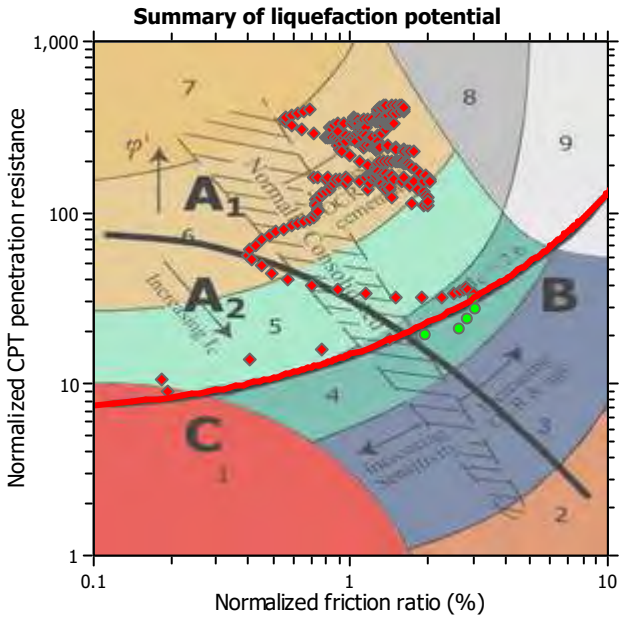
CPT file : CPT04_SLS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	No		

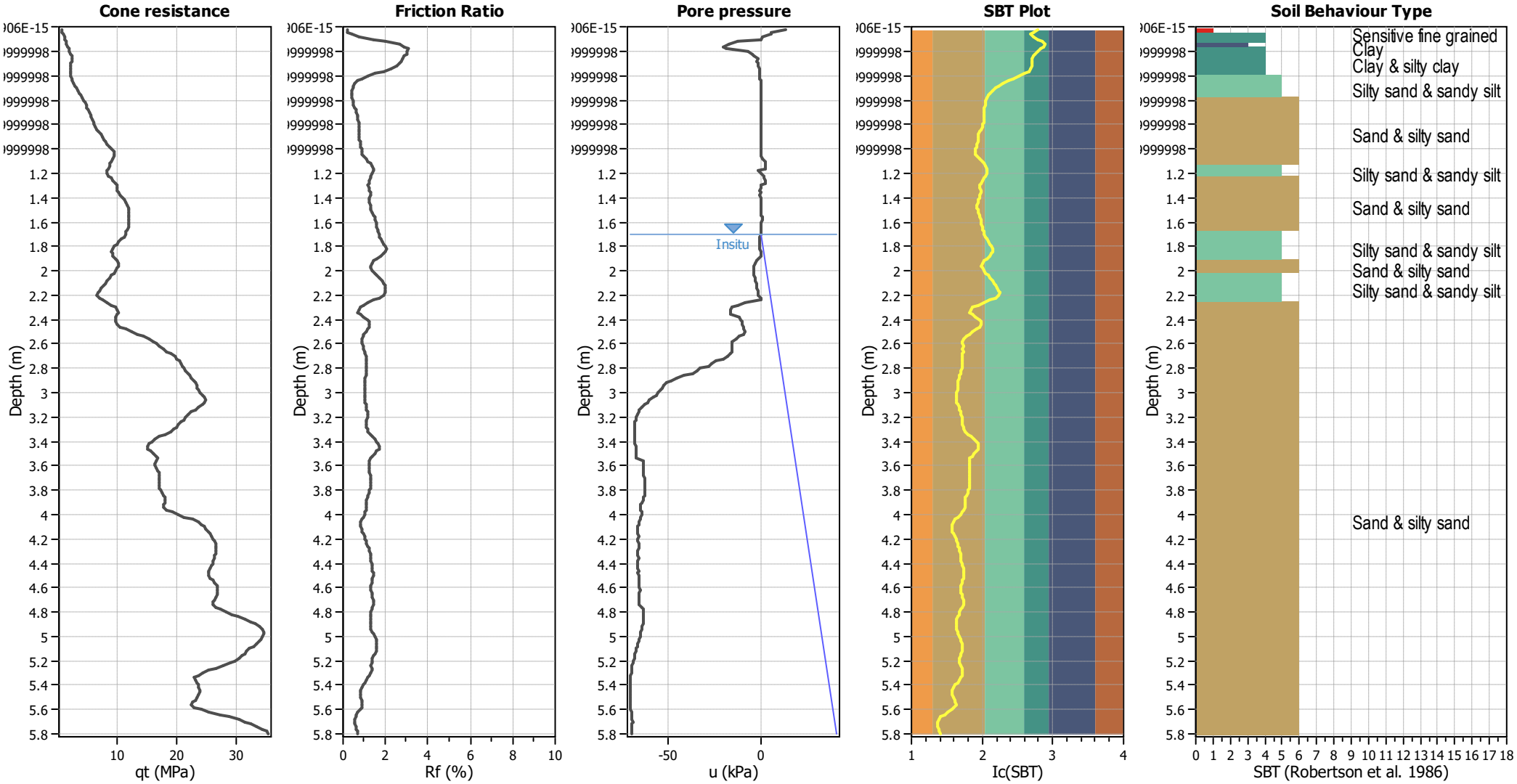






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



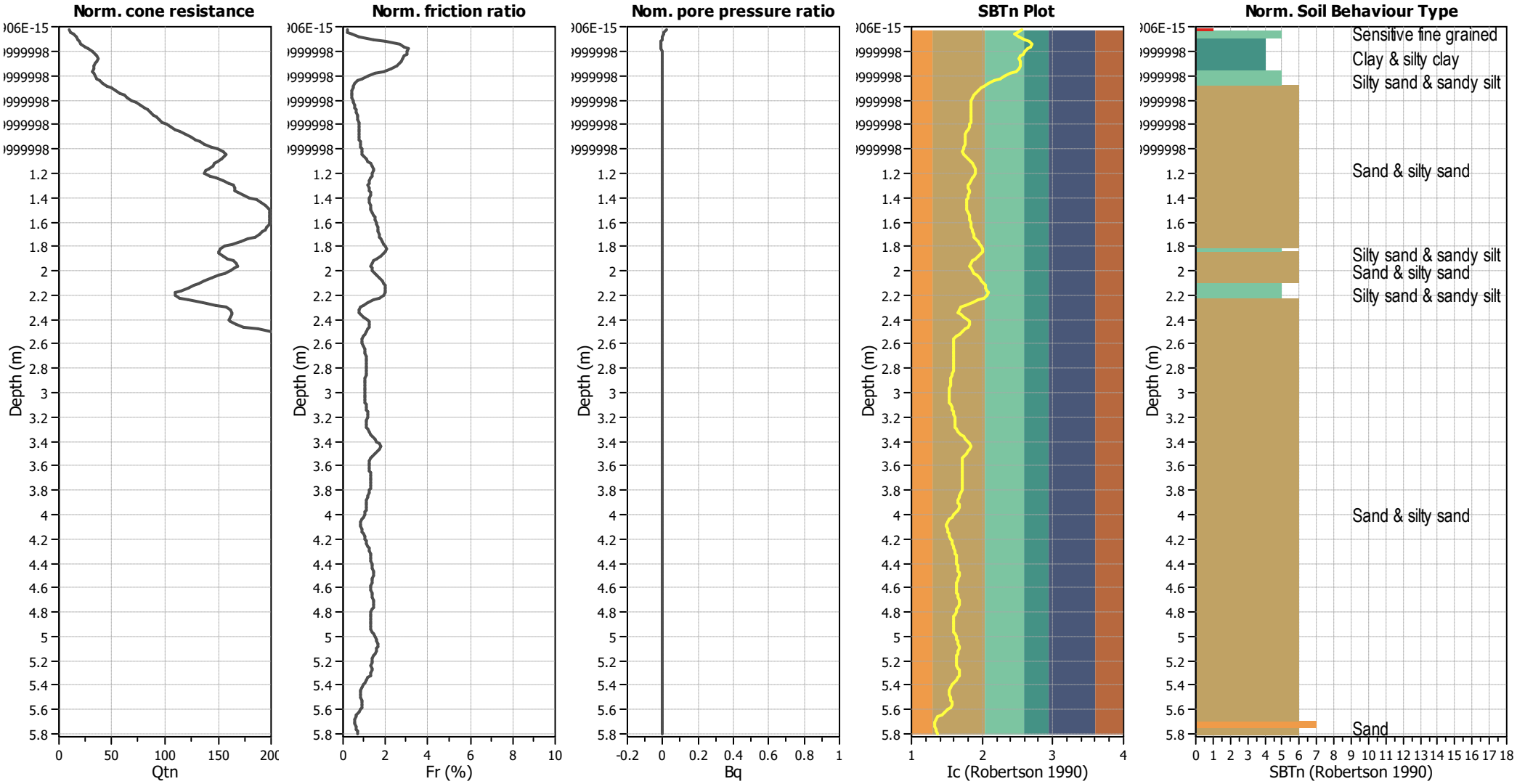
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



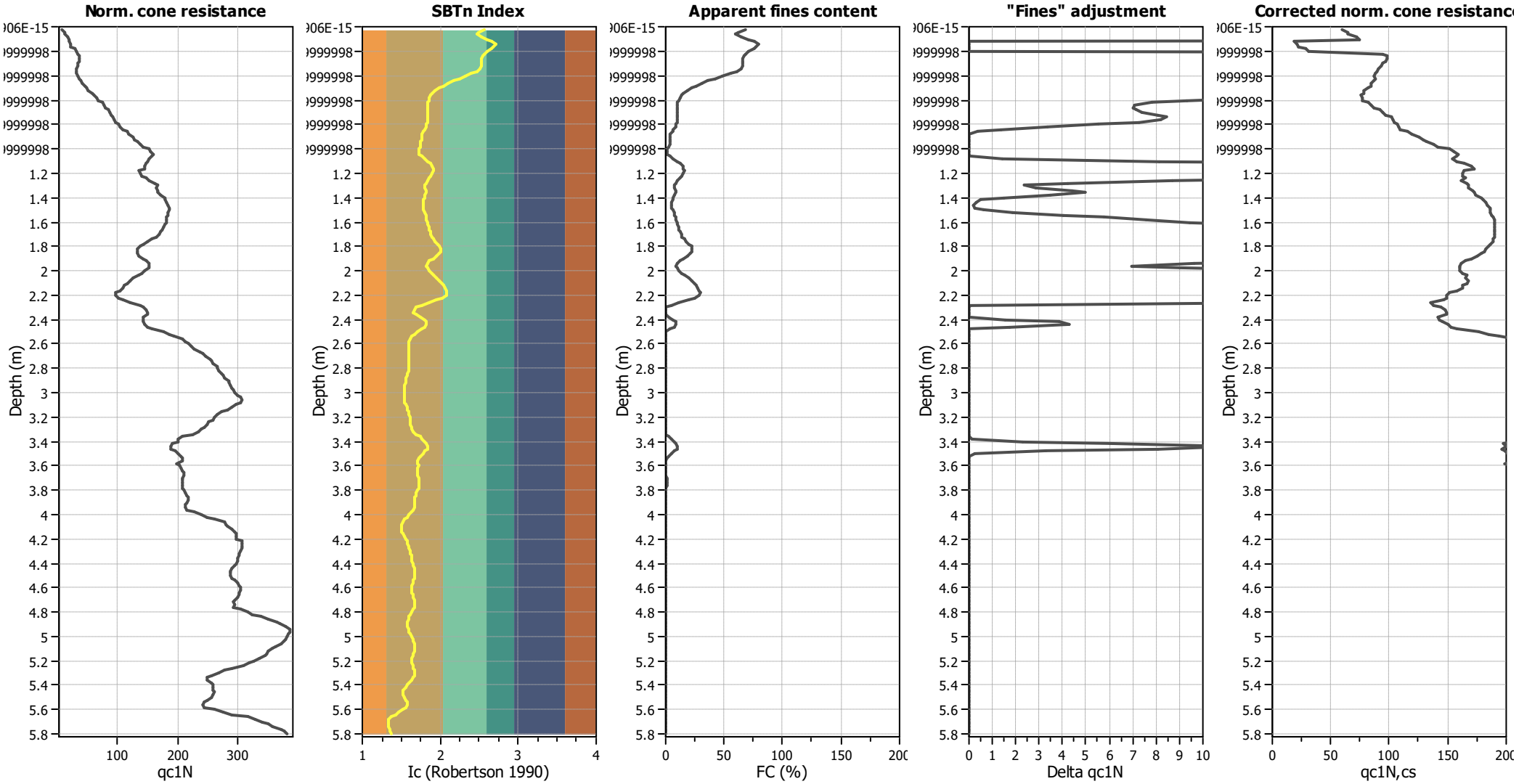
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

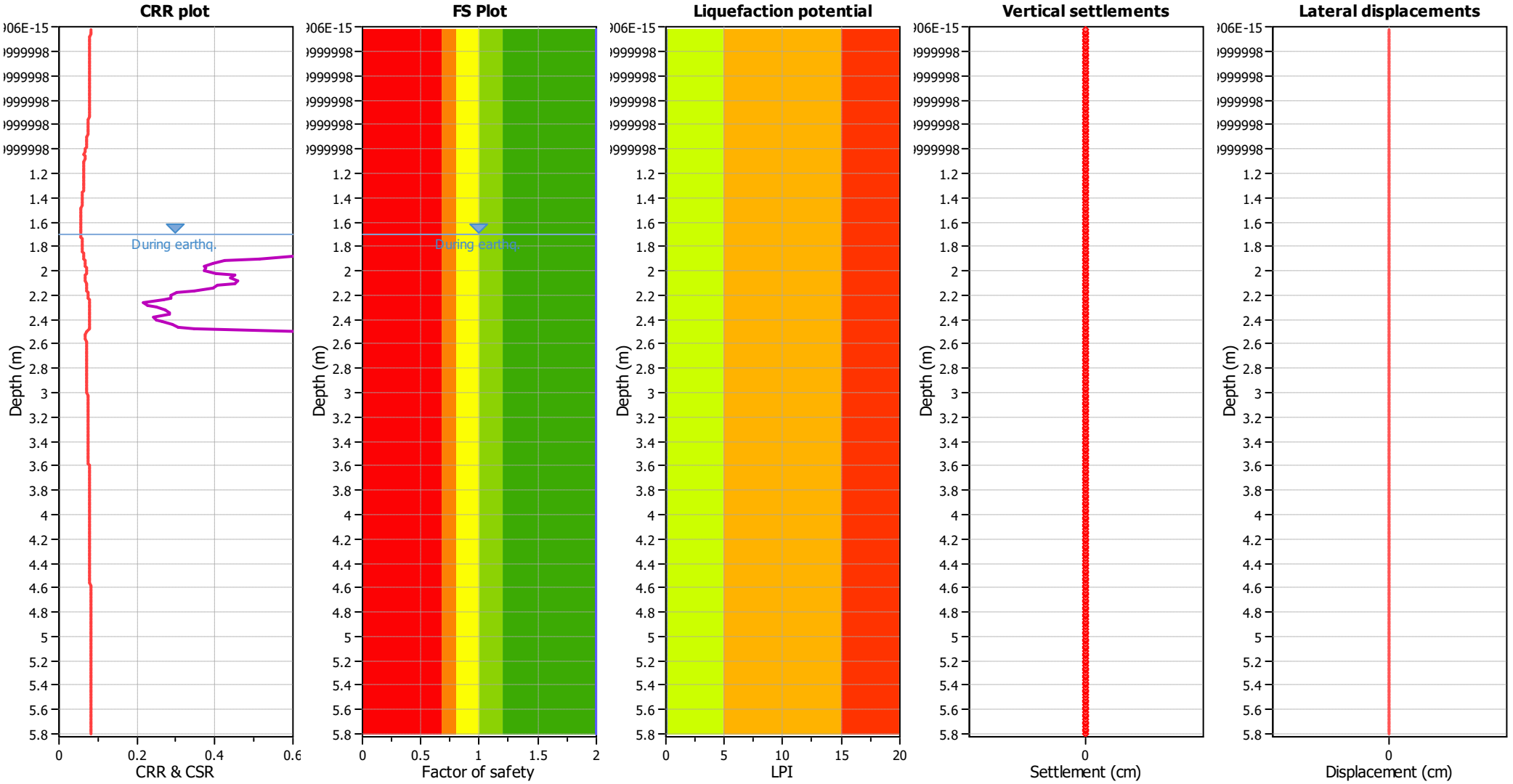
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

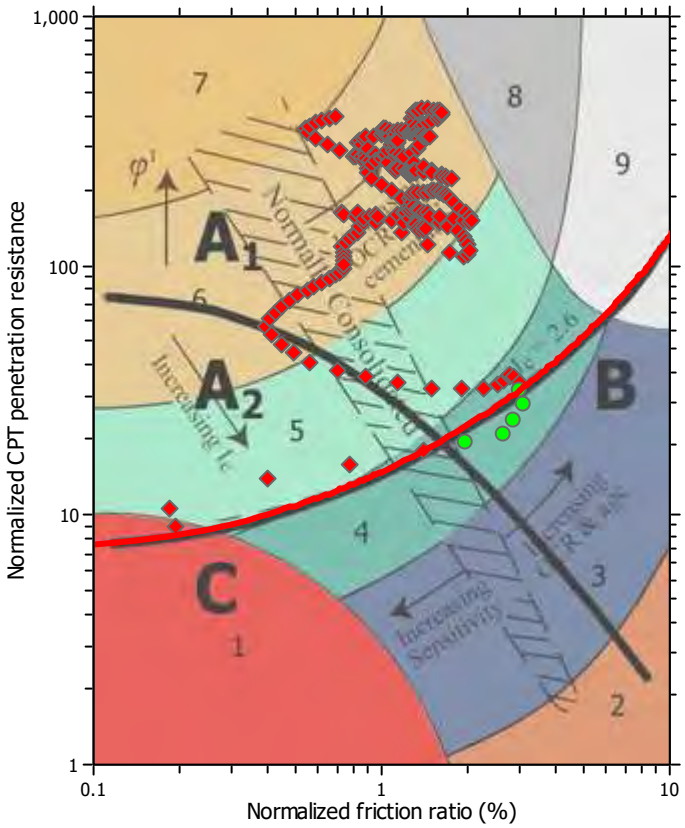
F.S. color scheme

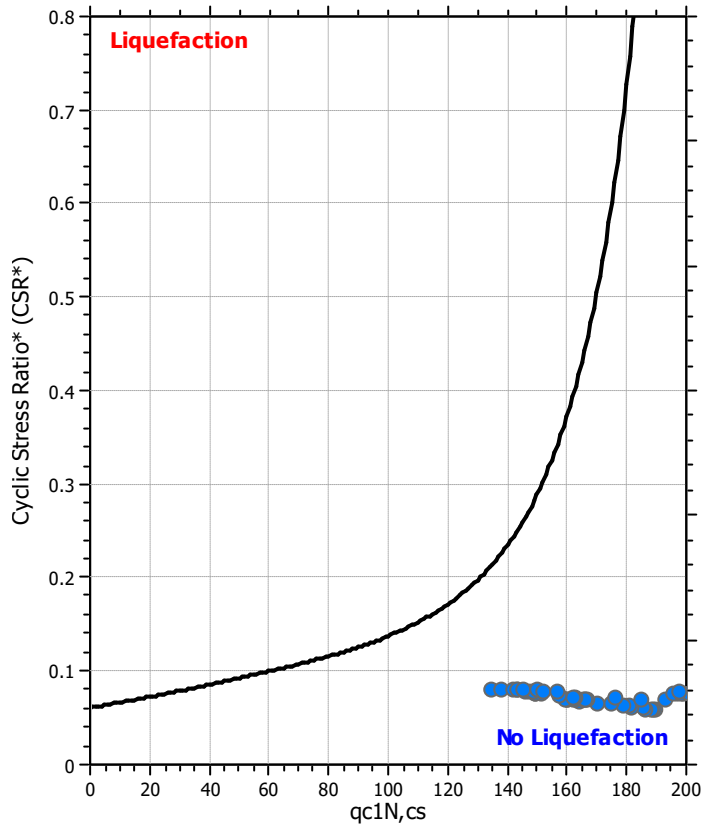
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

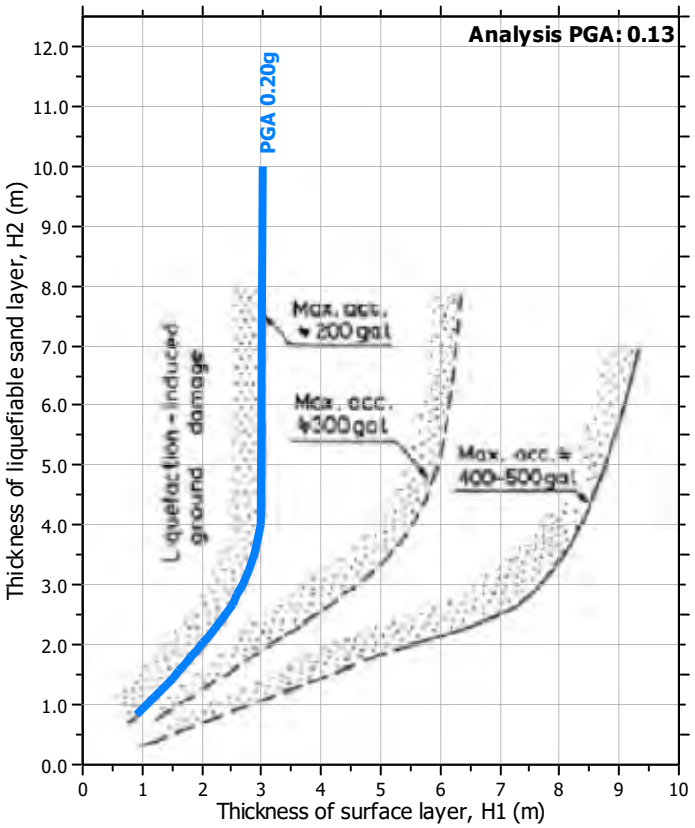
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



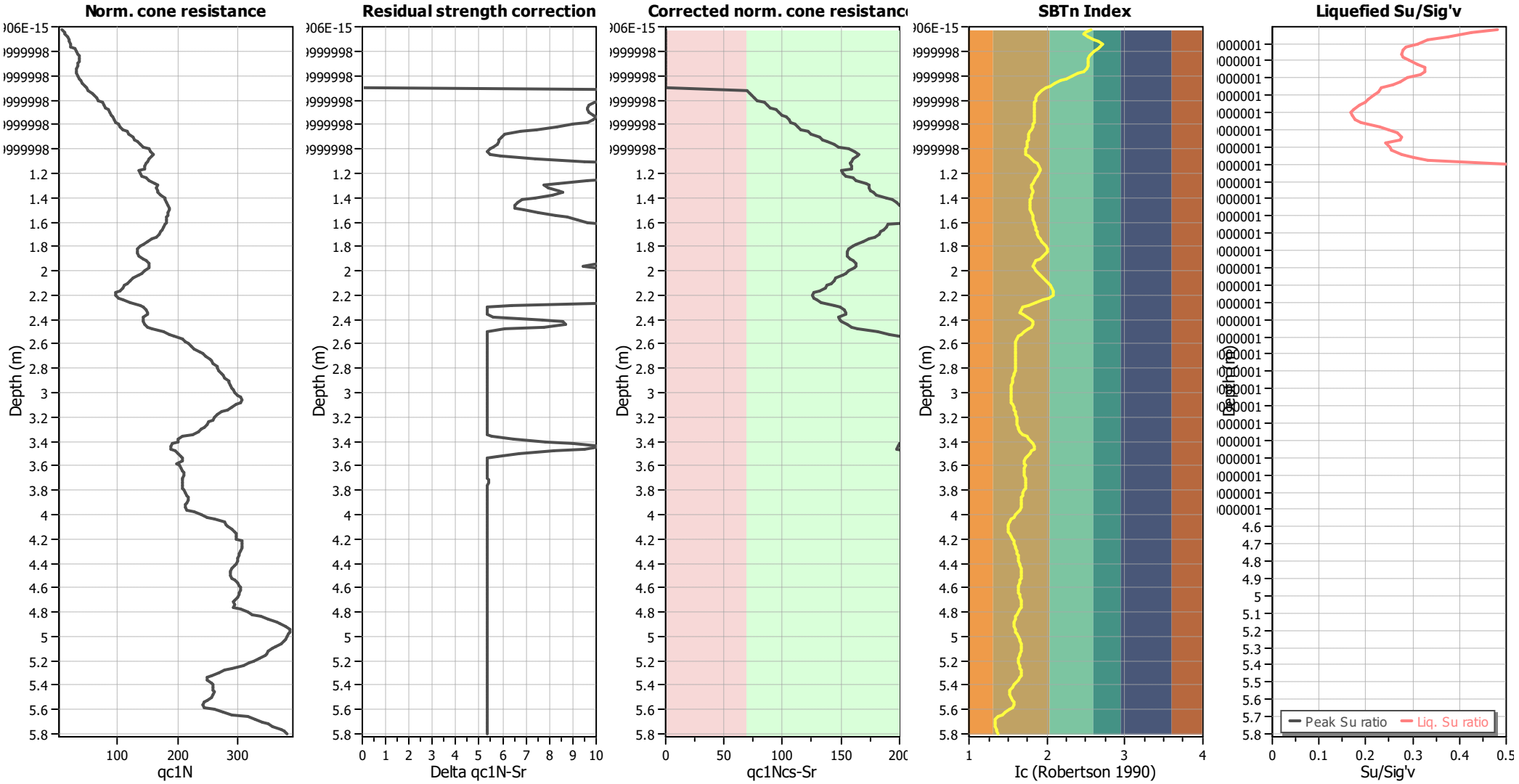




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

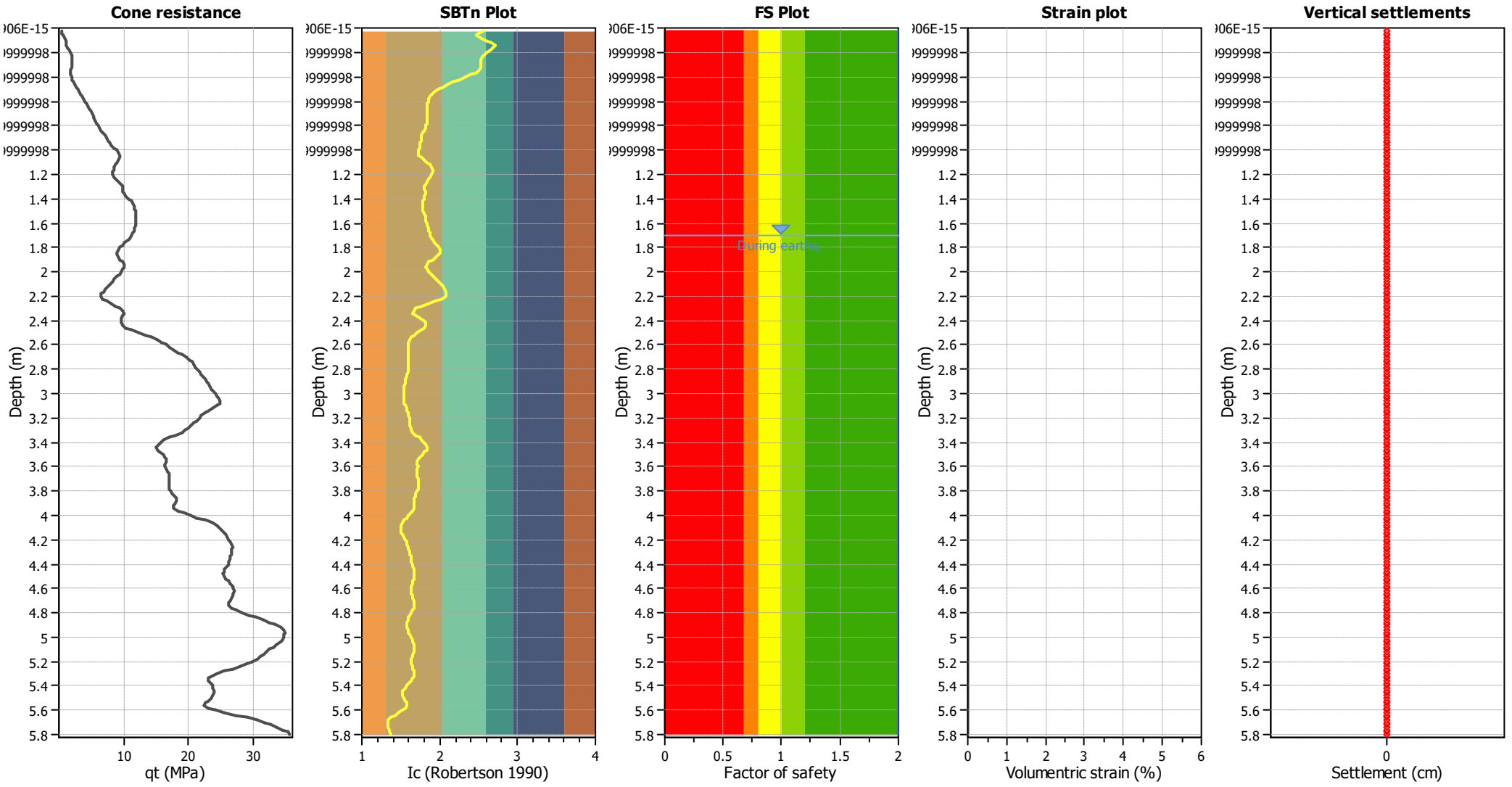
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

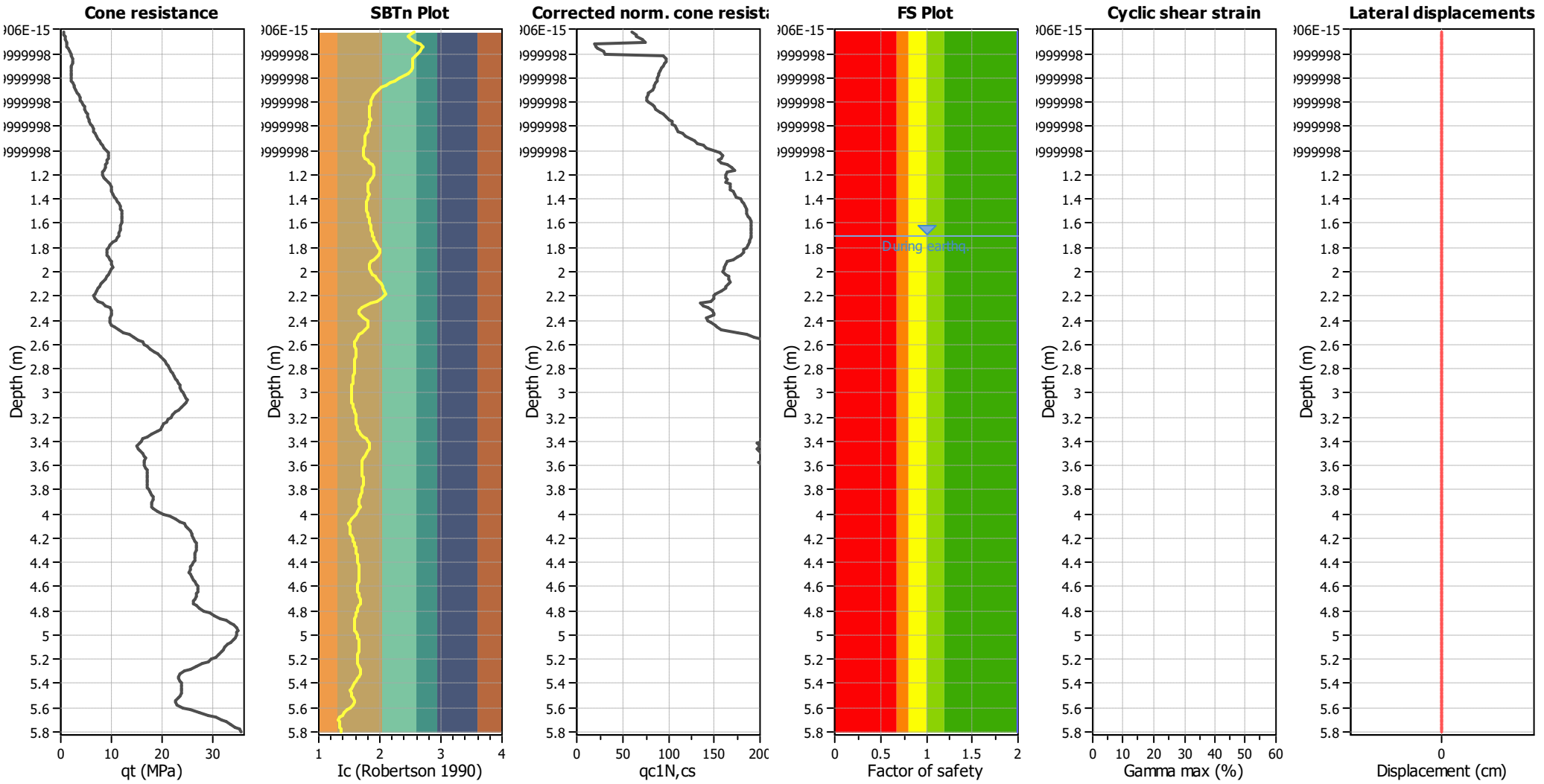
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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Geotechnical Engineers
2/182 Main Rd Tawa
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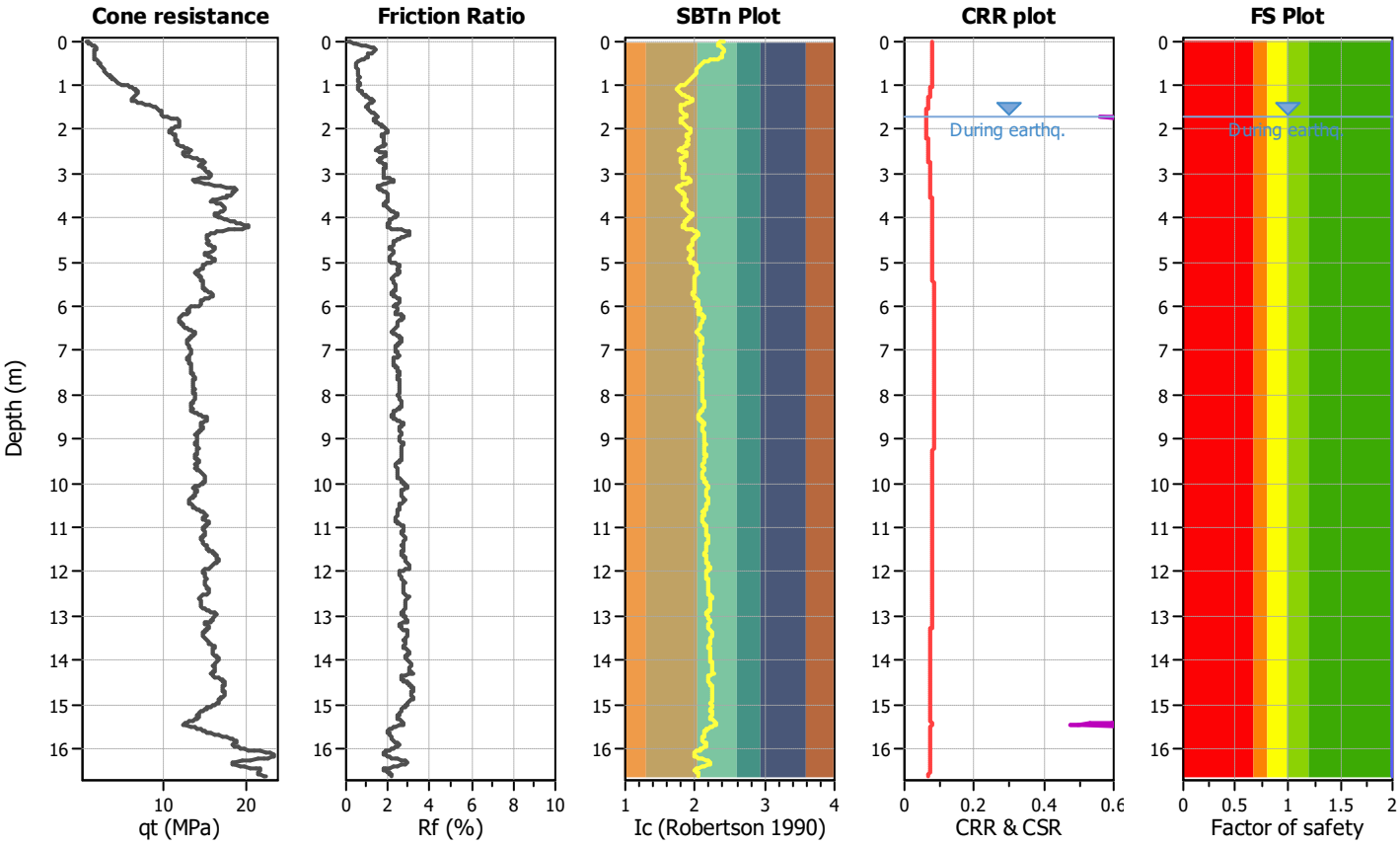
LIQUEFACTION ANALYSIS REPORT

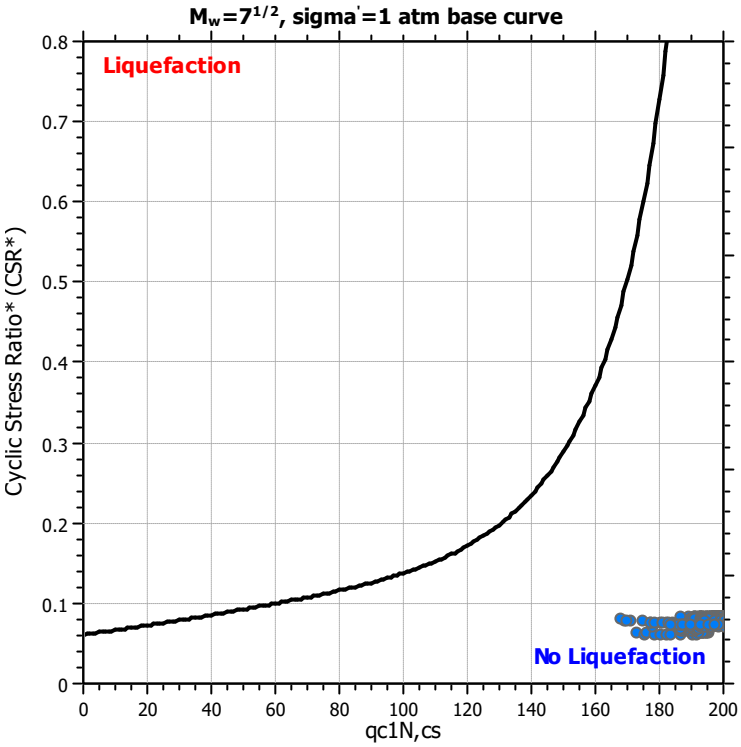
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

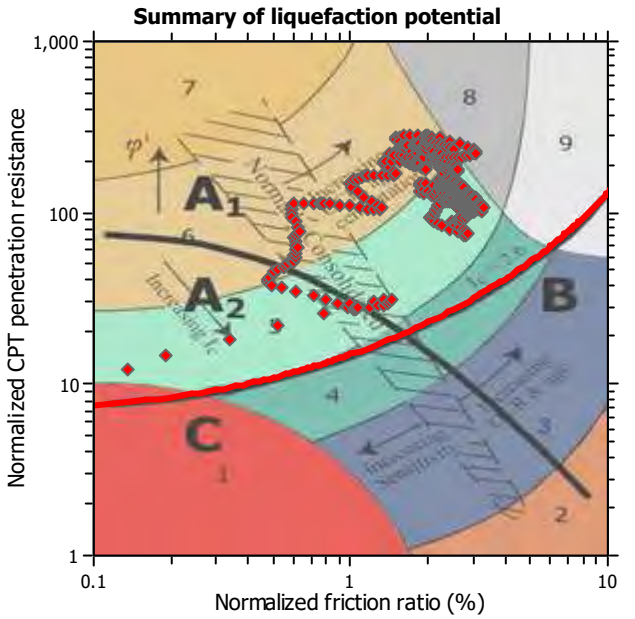
CPT file : CPT05_SLS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	No		

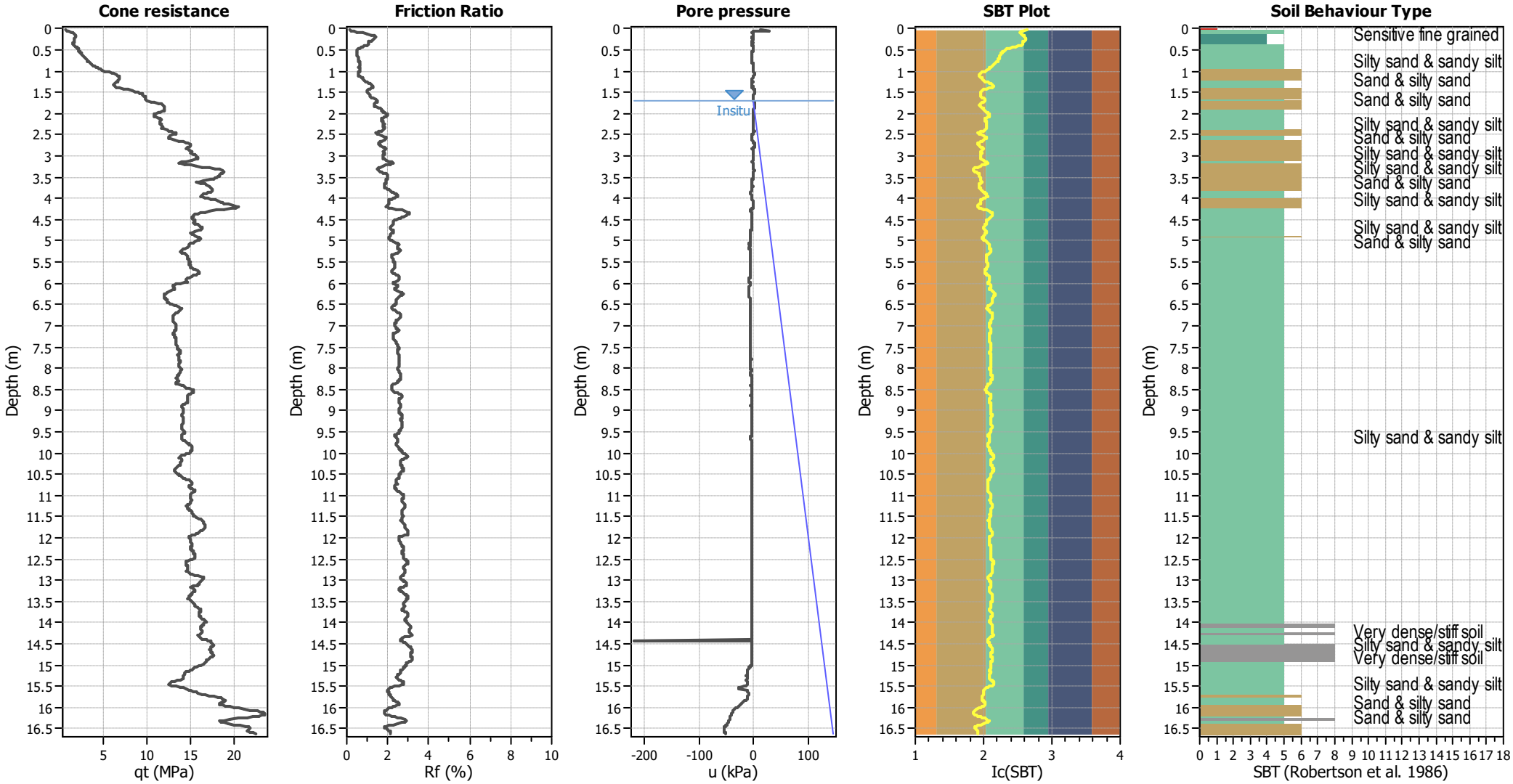






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



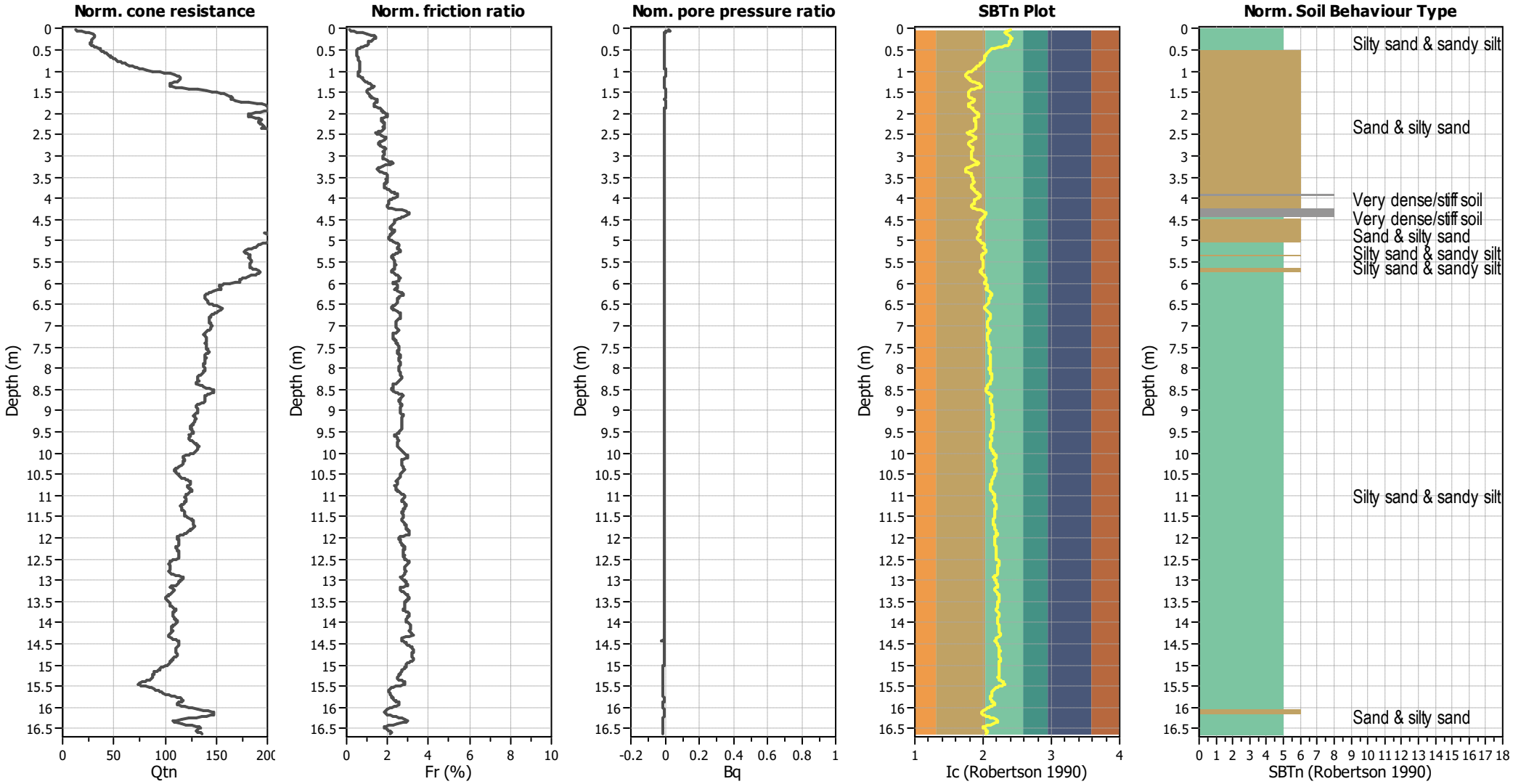
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



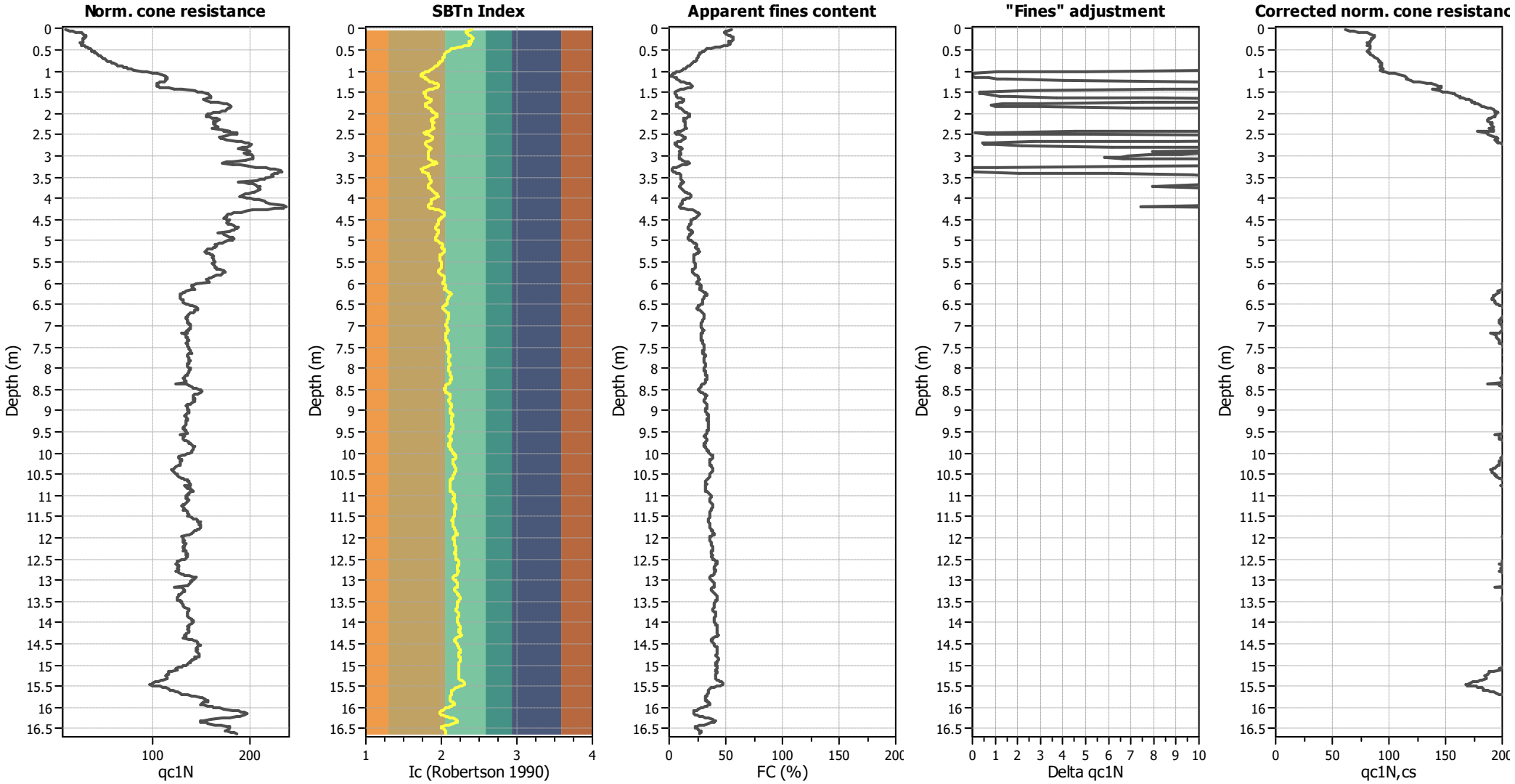
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

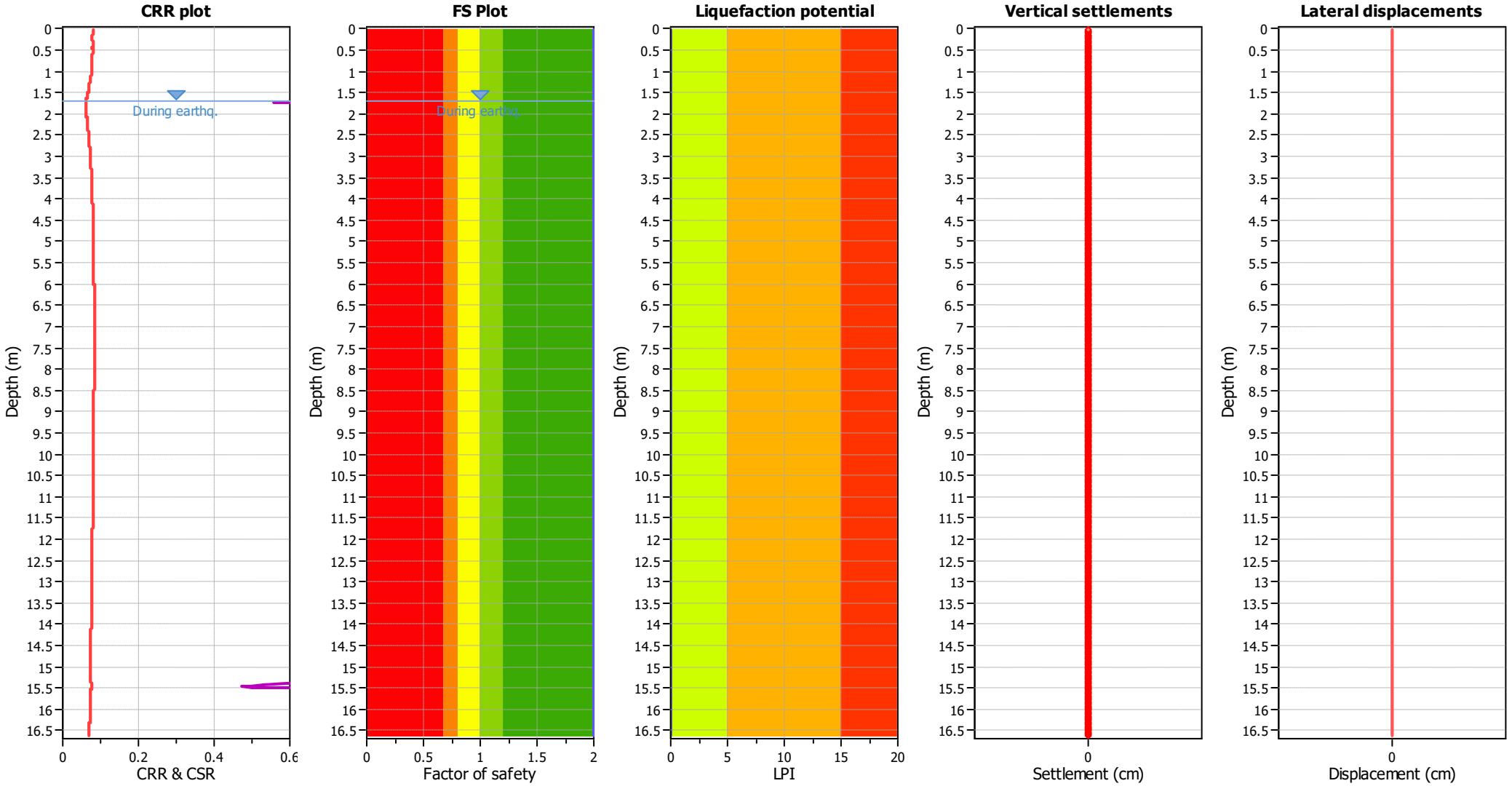
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

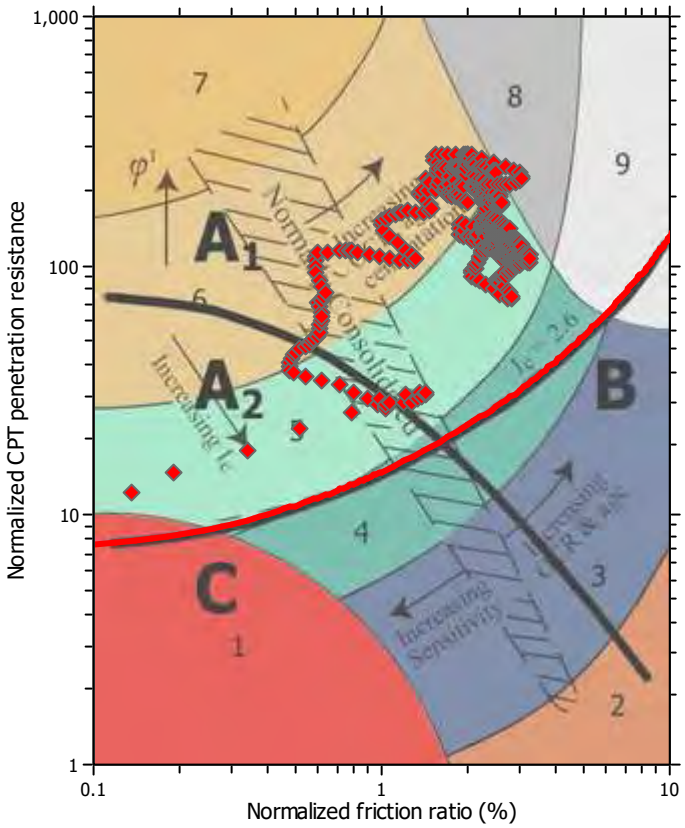
F.S. color scheme

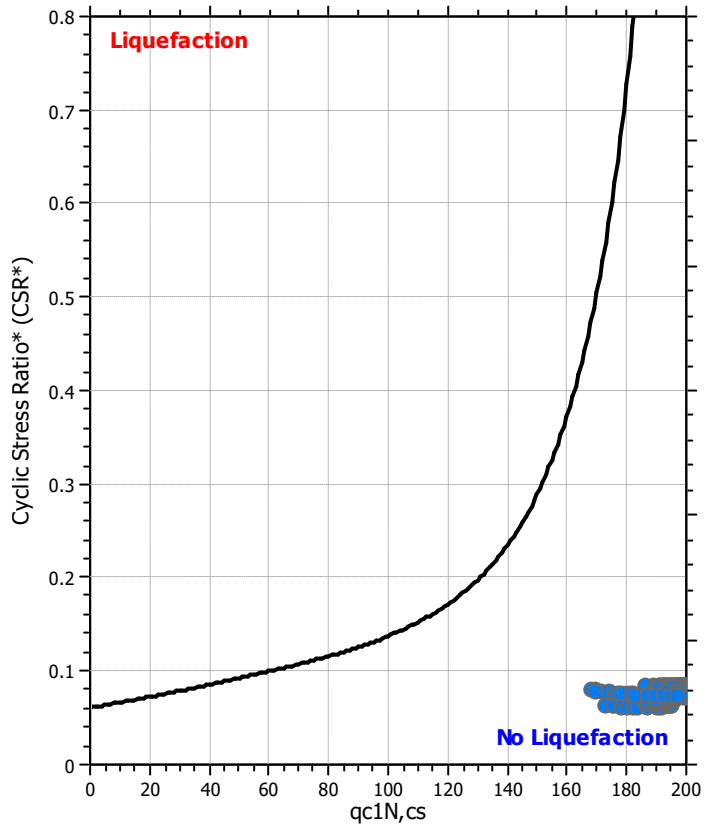
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

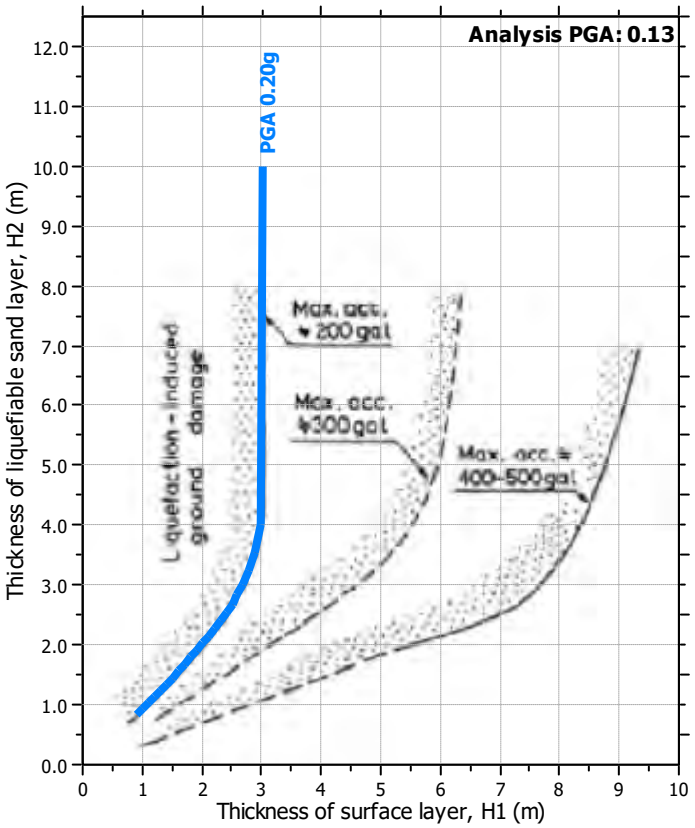
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



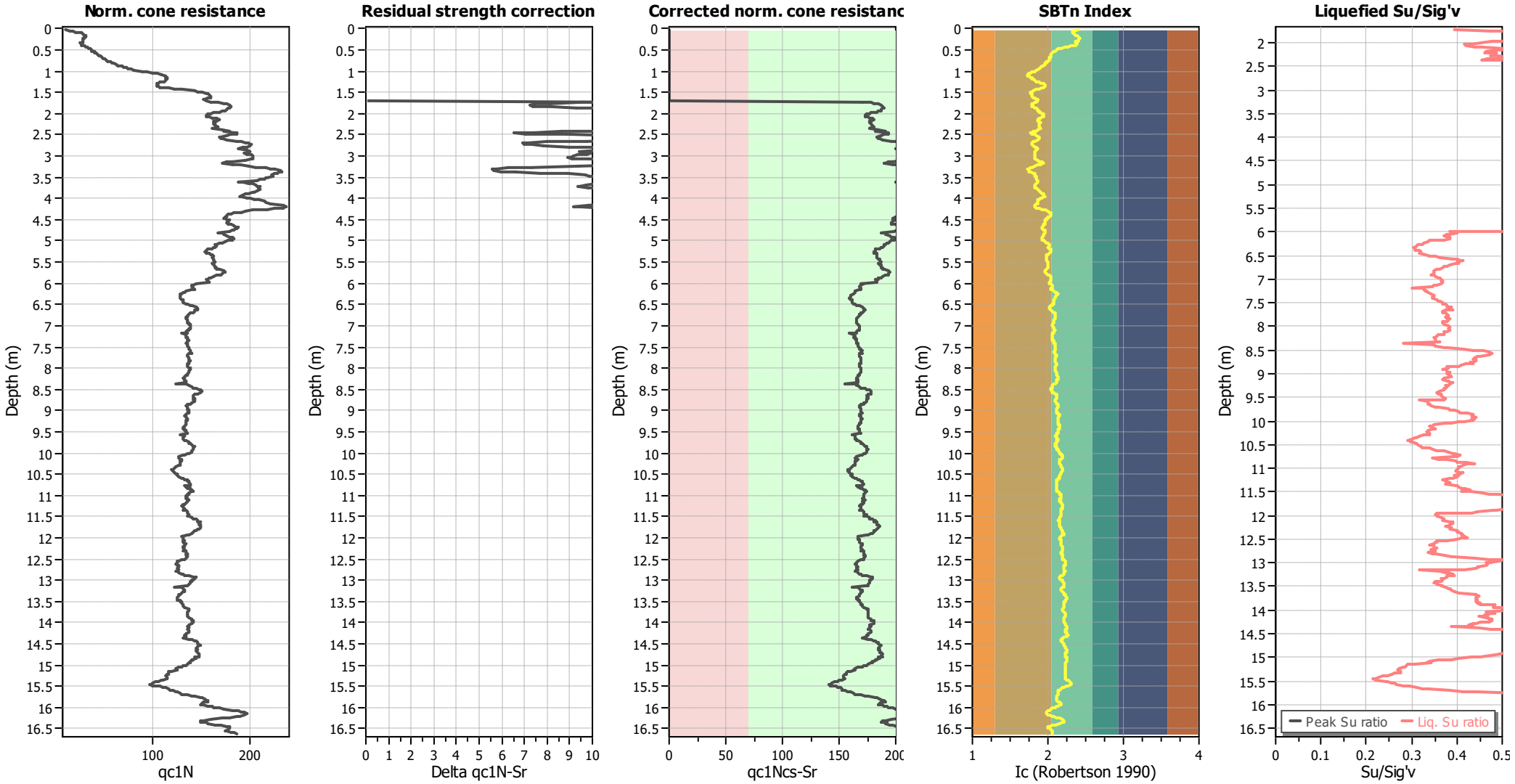




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

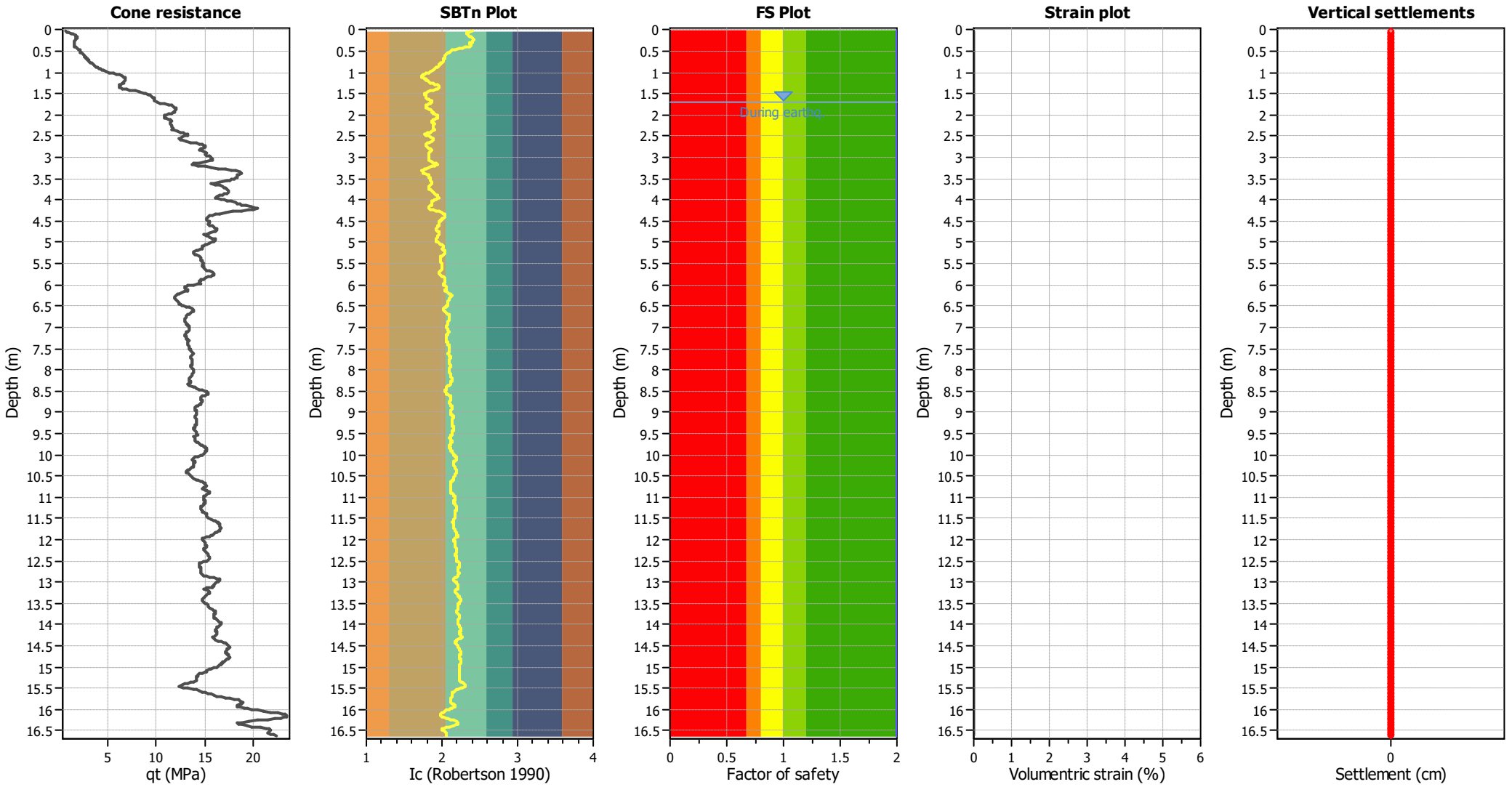
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

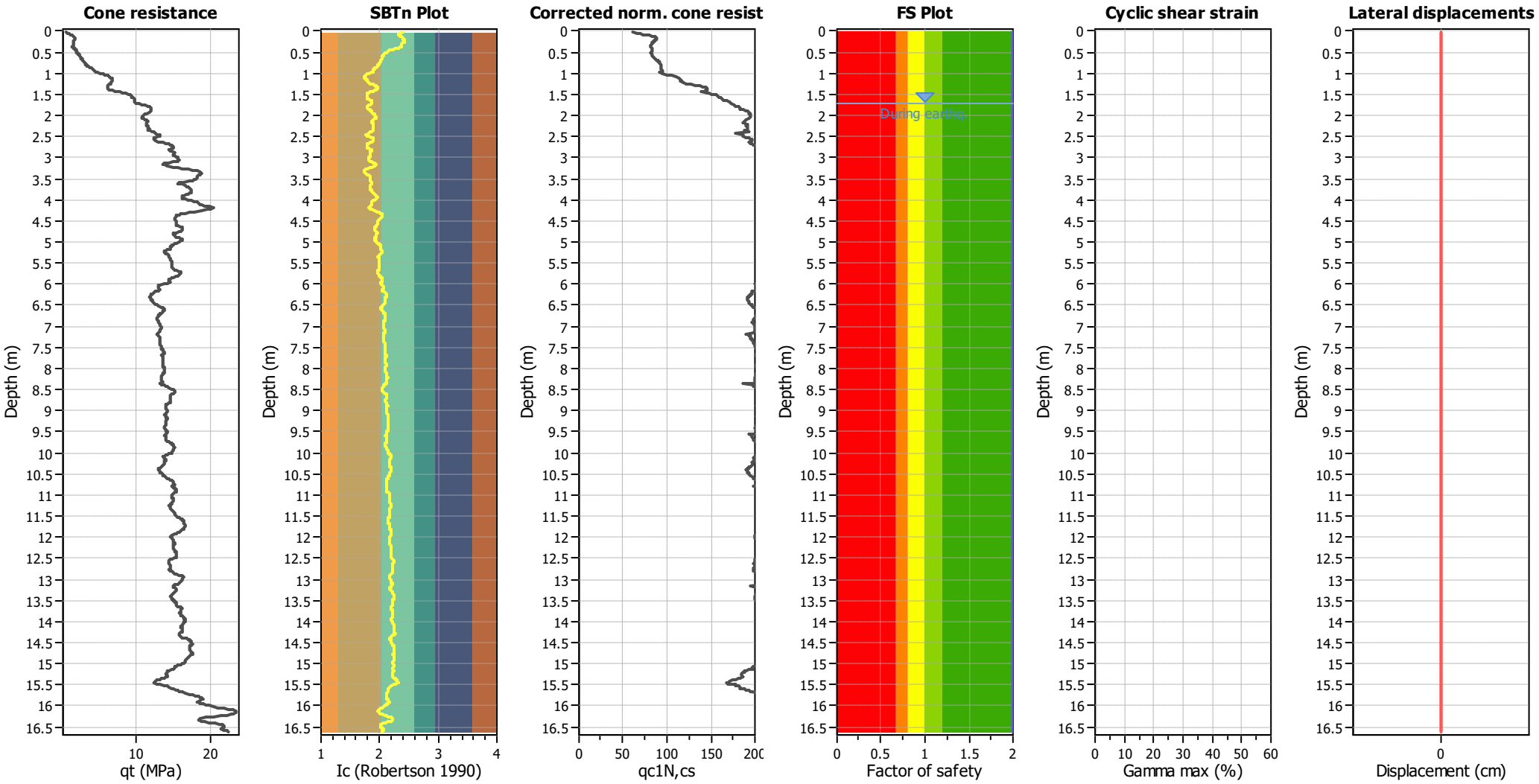
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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2/182 Main Rd Tawa
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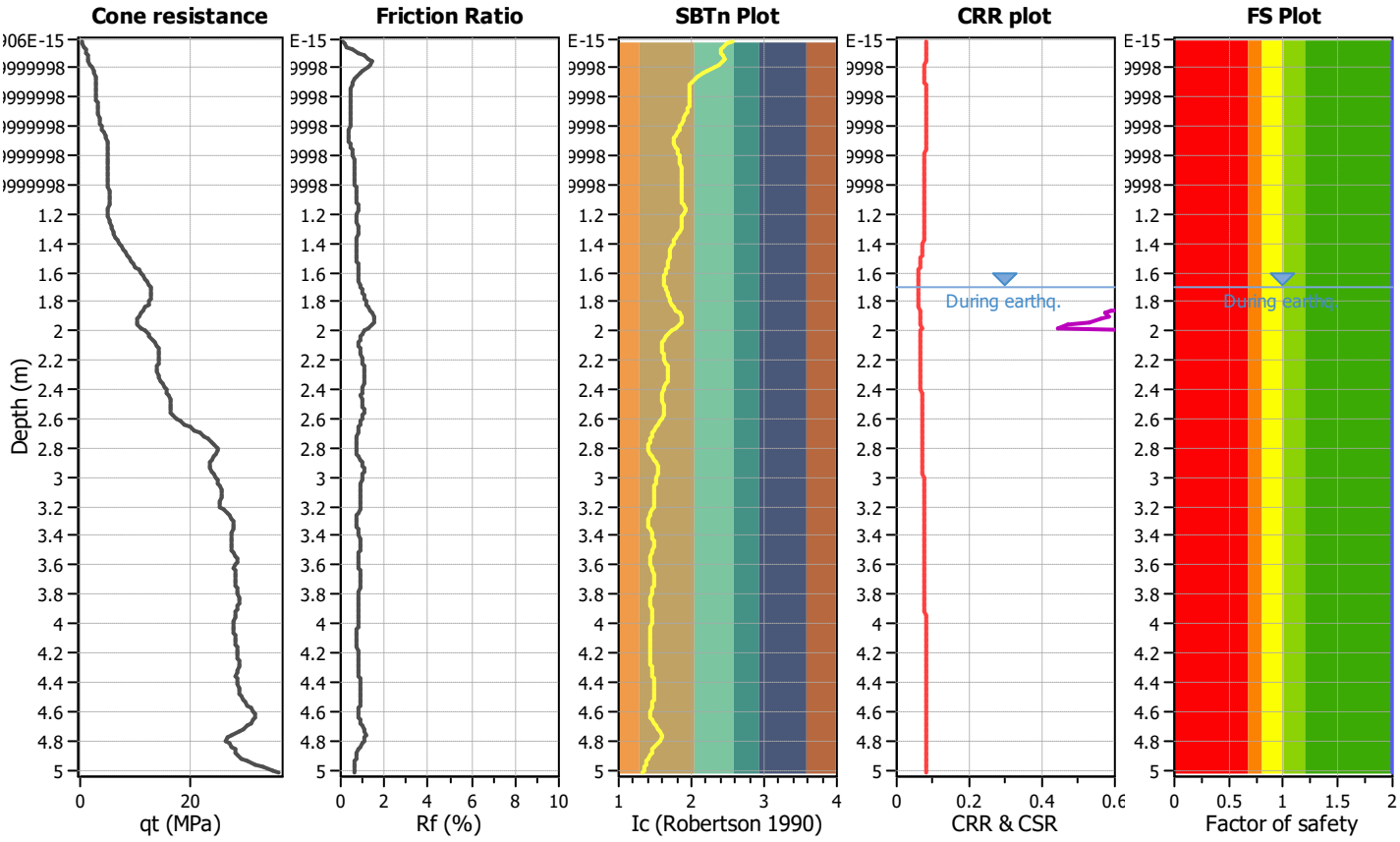
LIQUEFACTION ANALYSIS REPORT

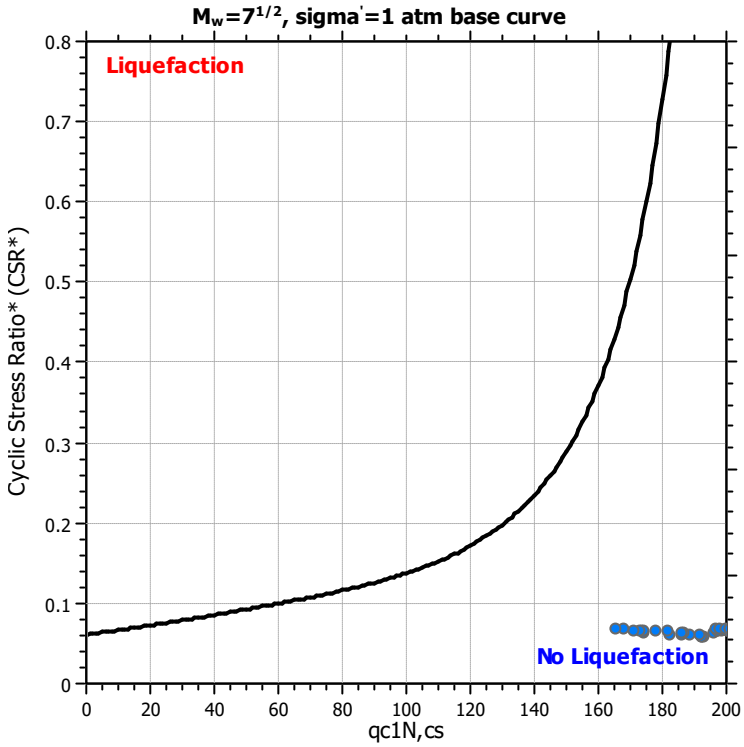
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

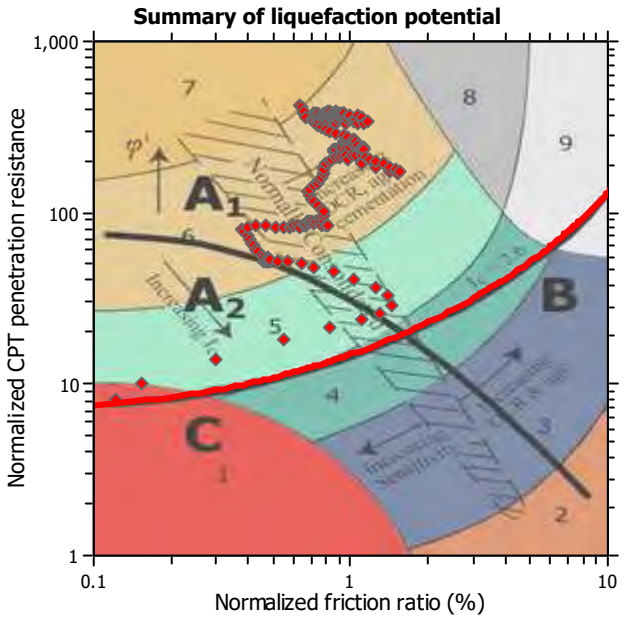
CPT file : CPT06_SLS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	No		

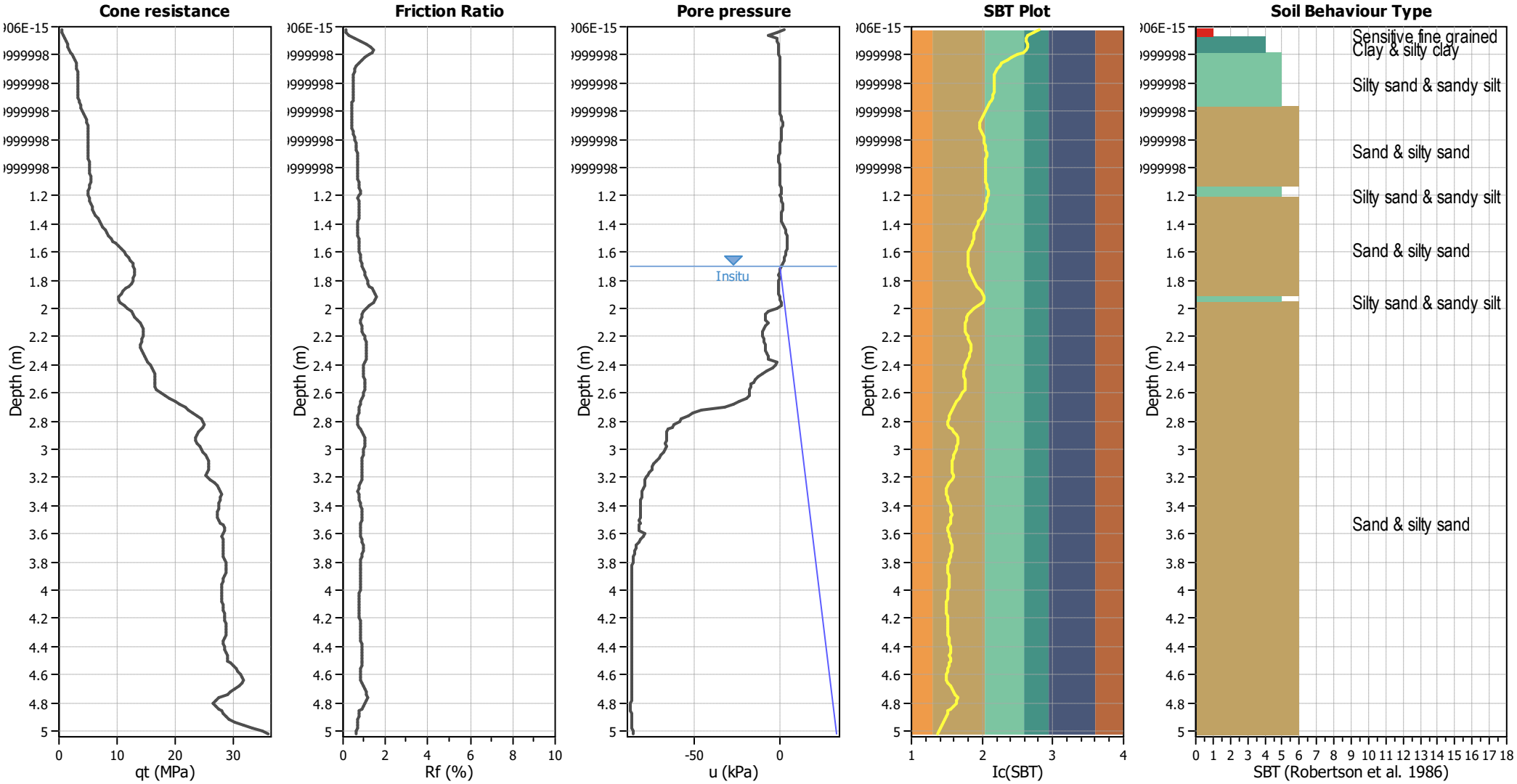






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



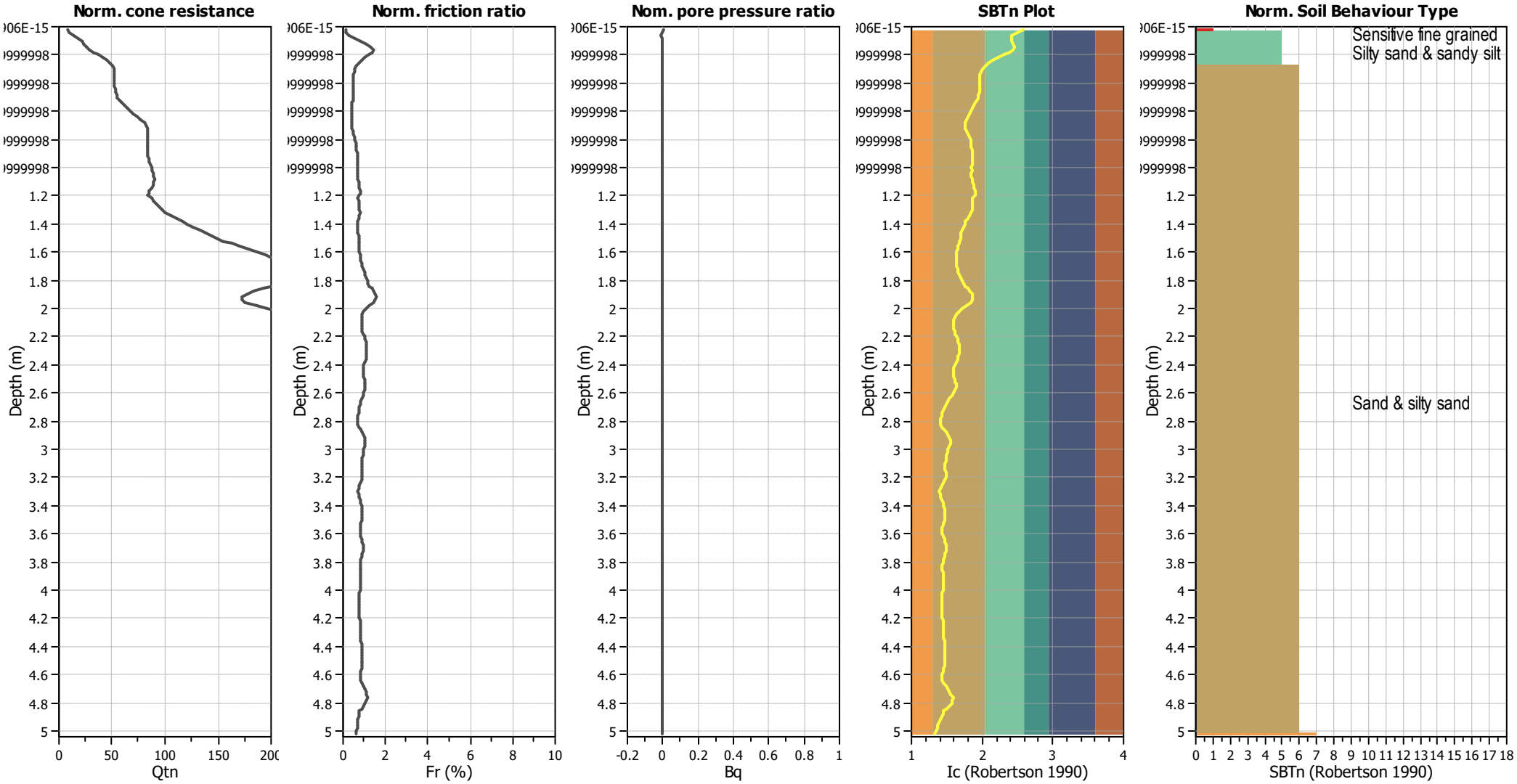
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



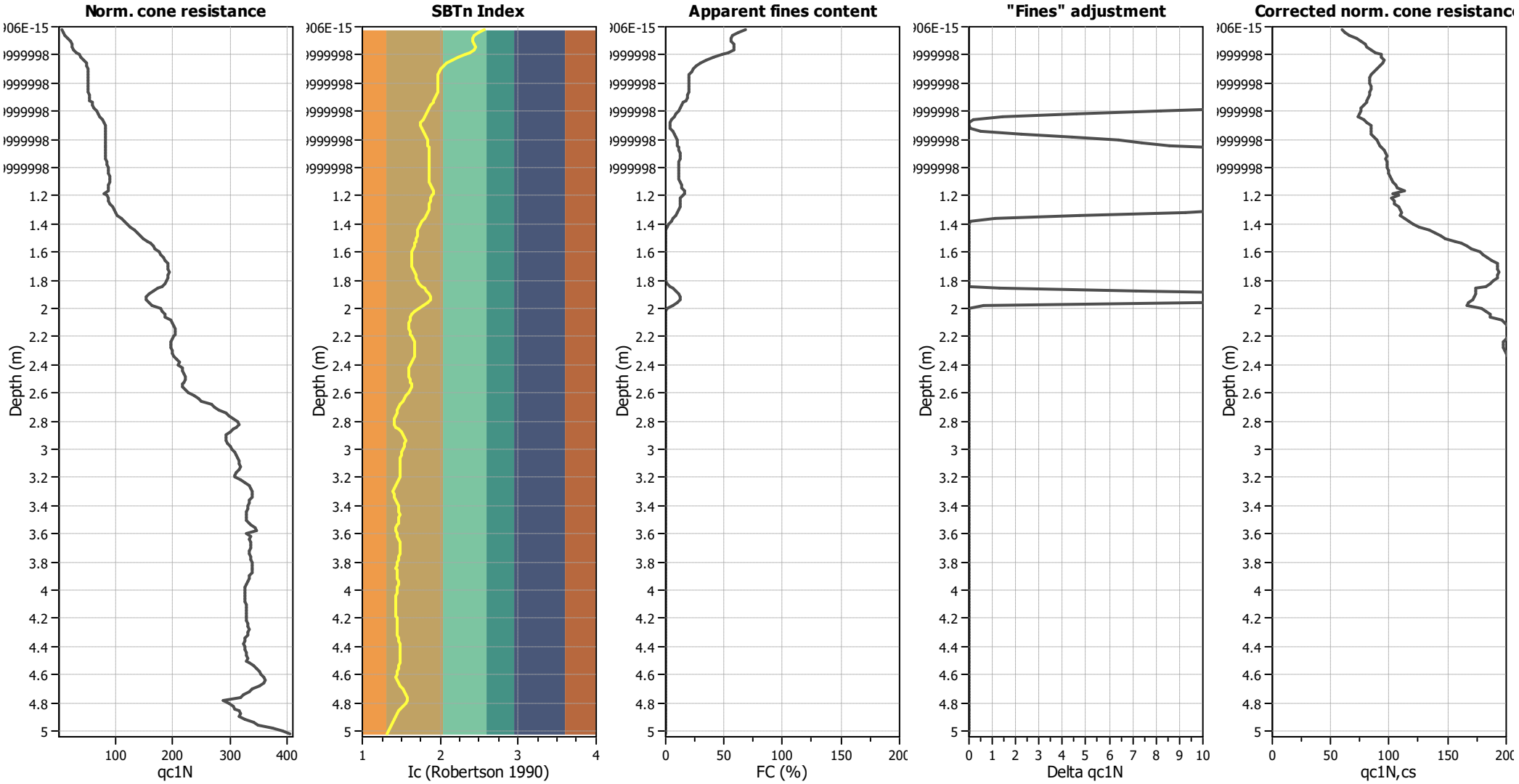
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

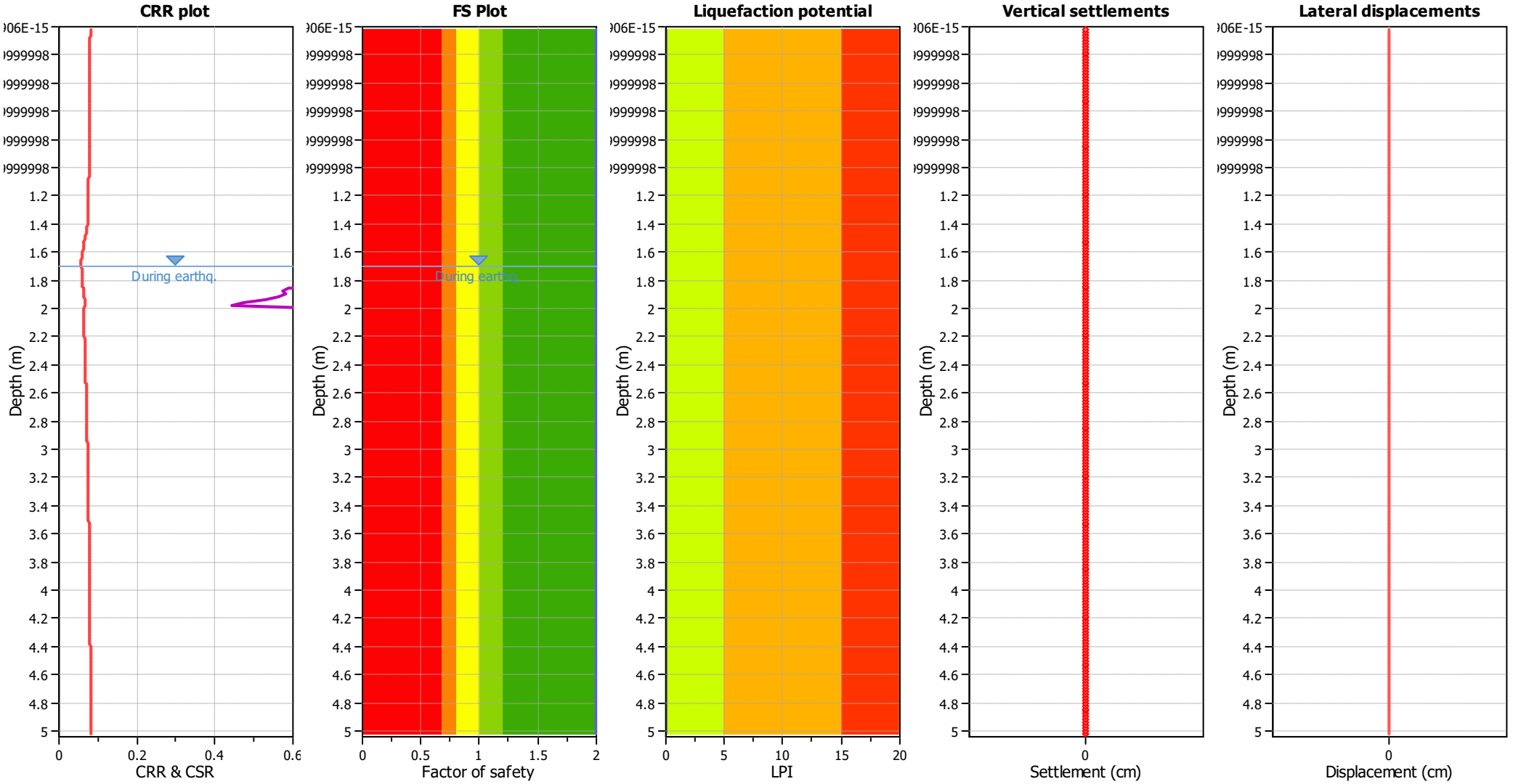
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

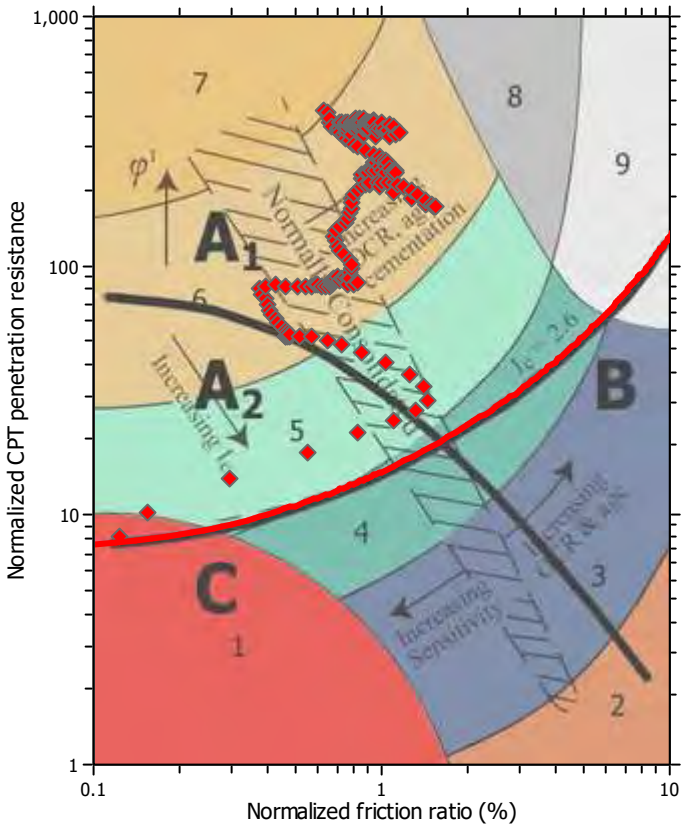
F.S. color scheme

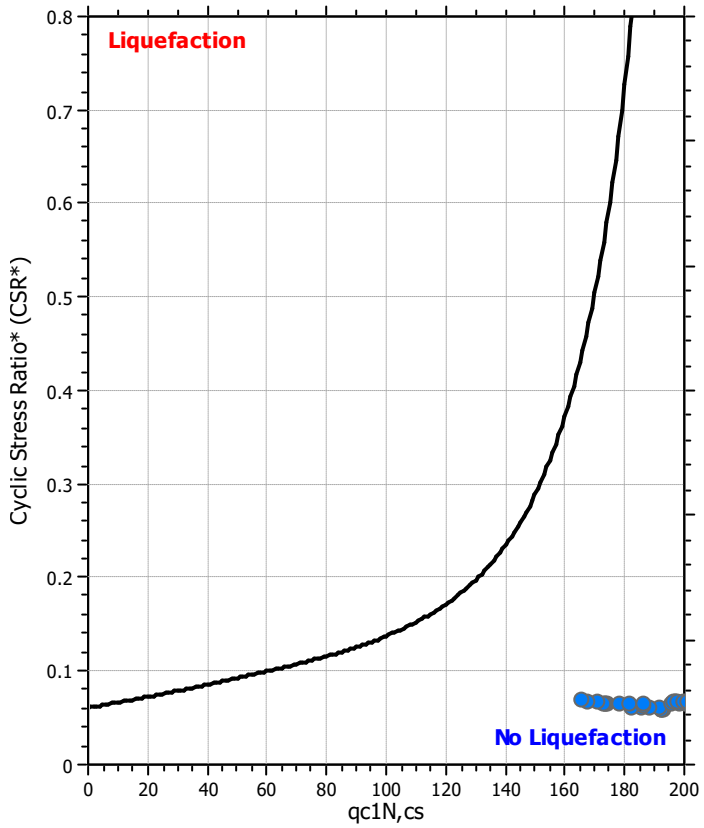
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

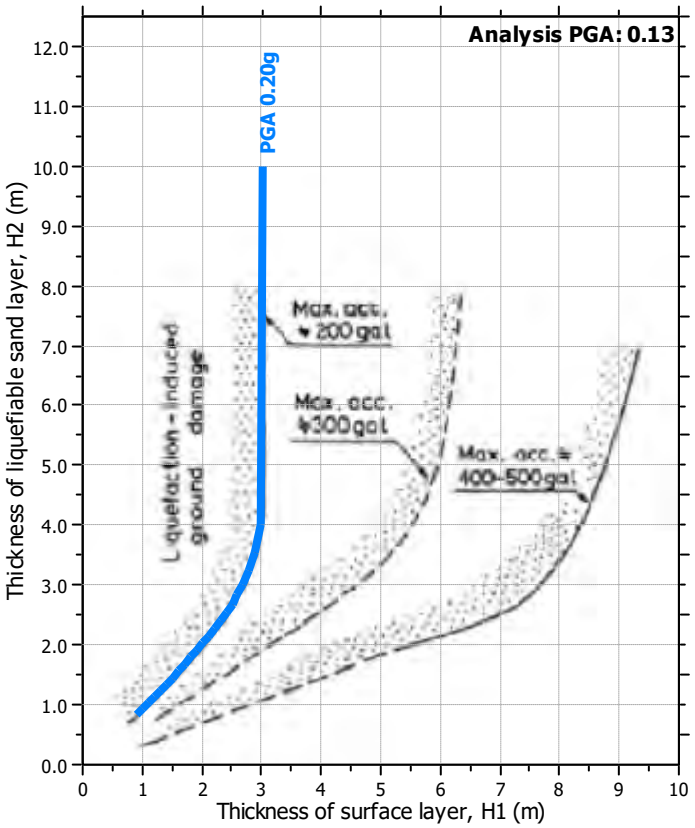
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



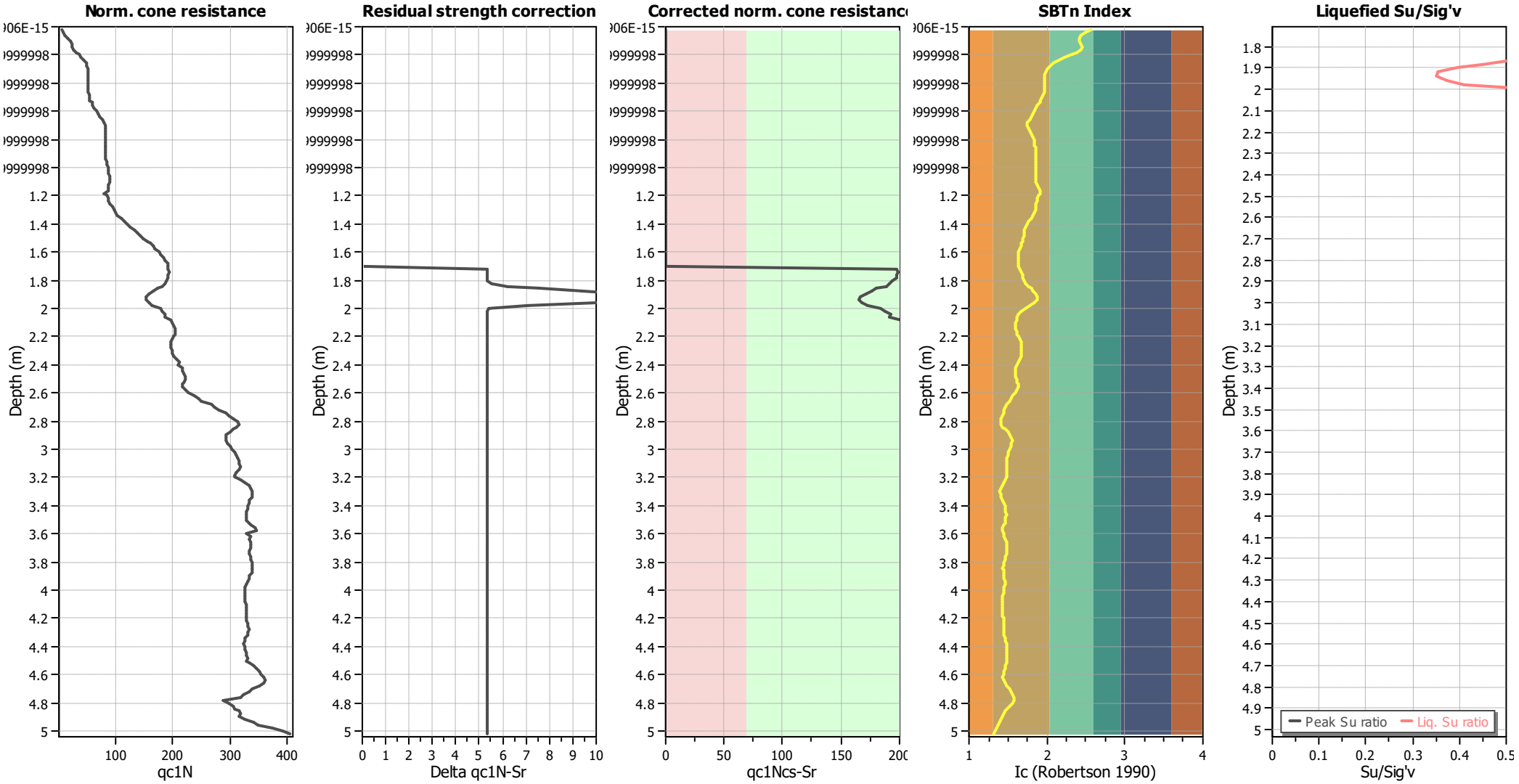




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

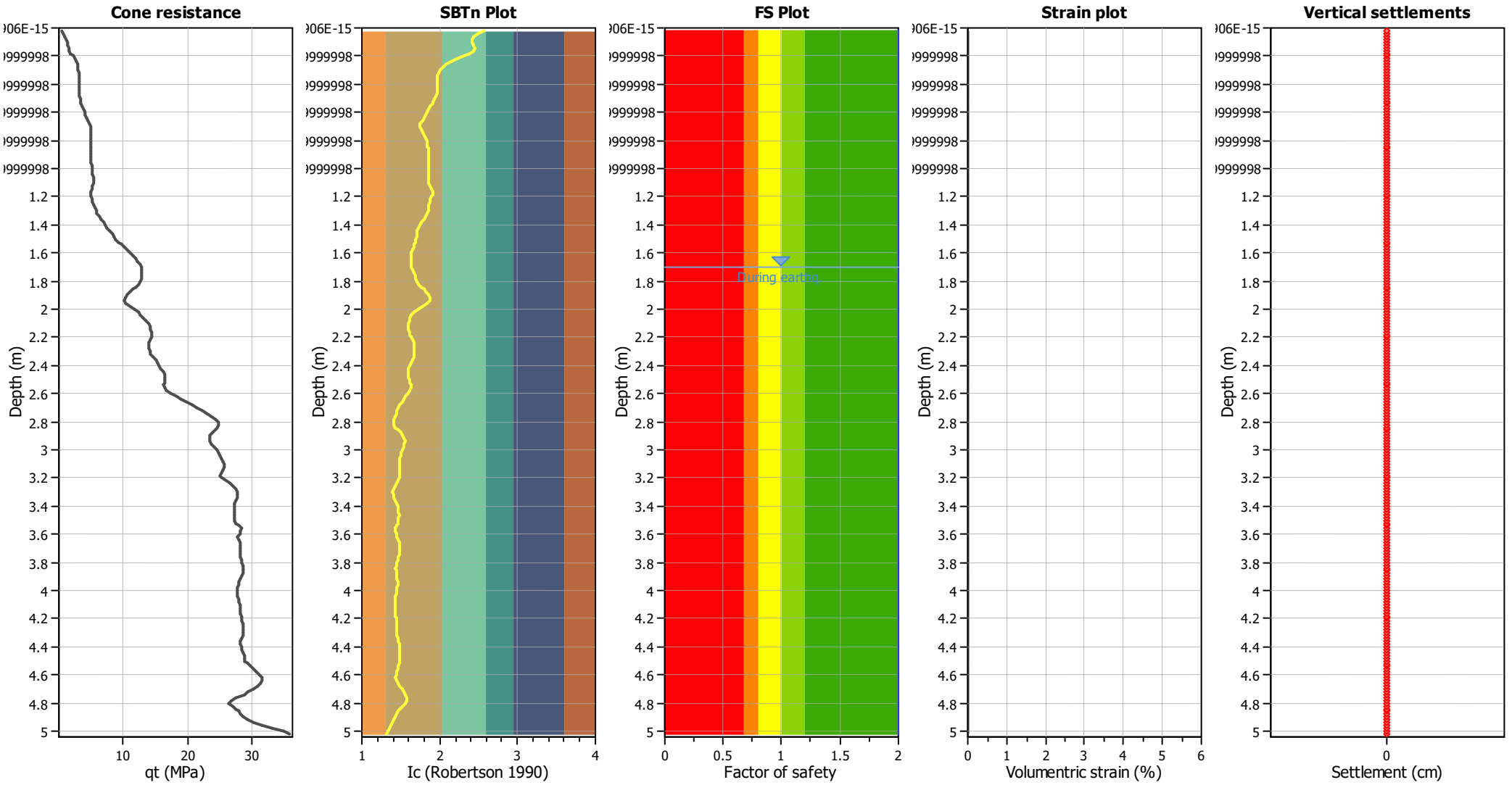
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

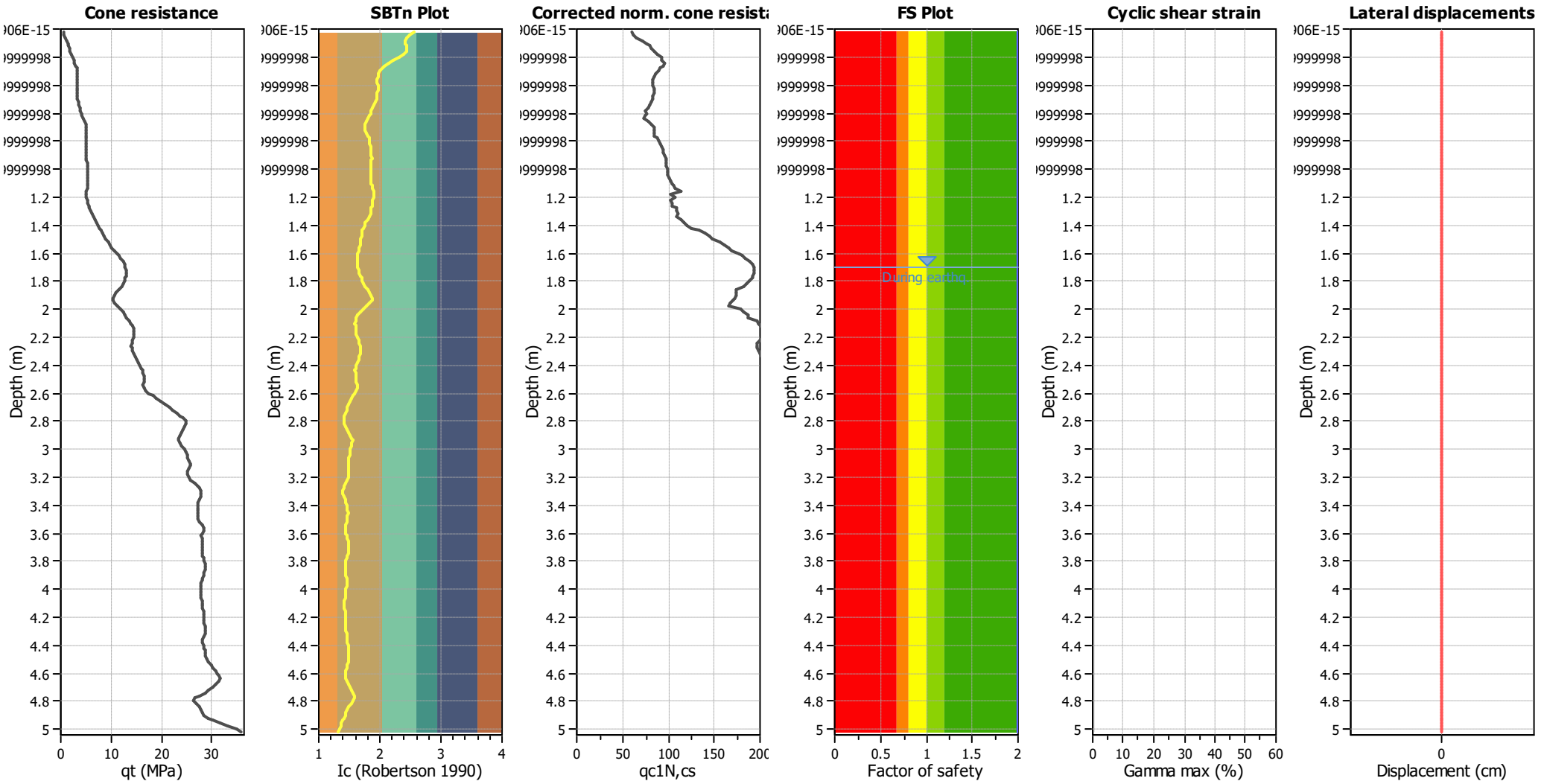
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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2/182 Main Rd Tawa
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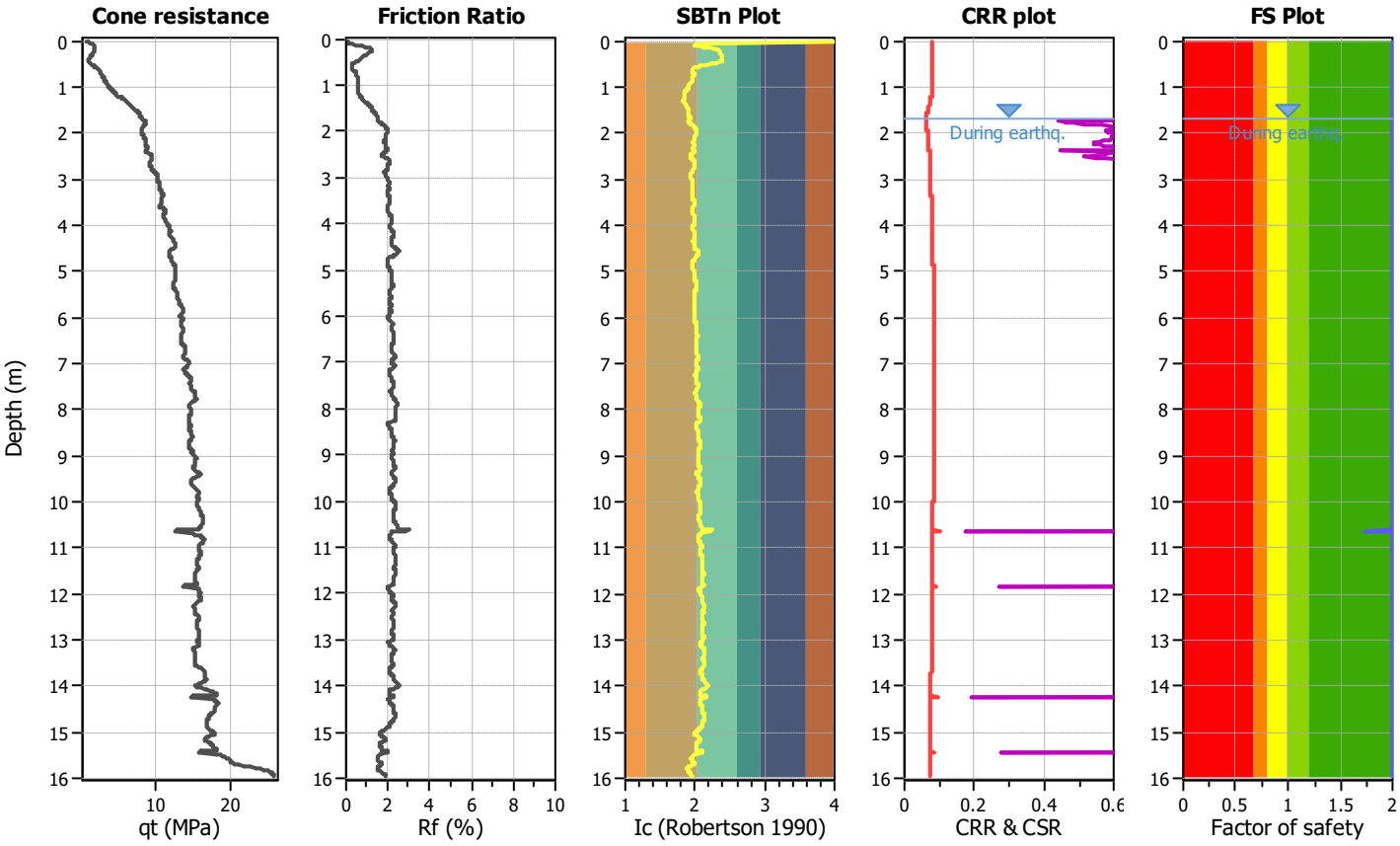
LIQUEFACTION ANALYSIS REPORT

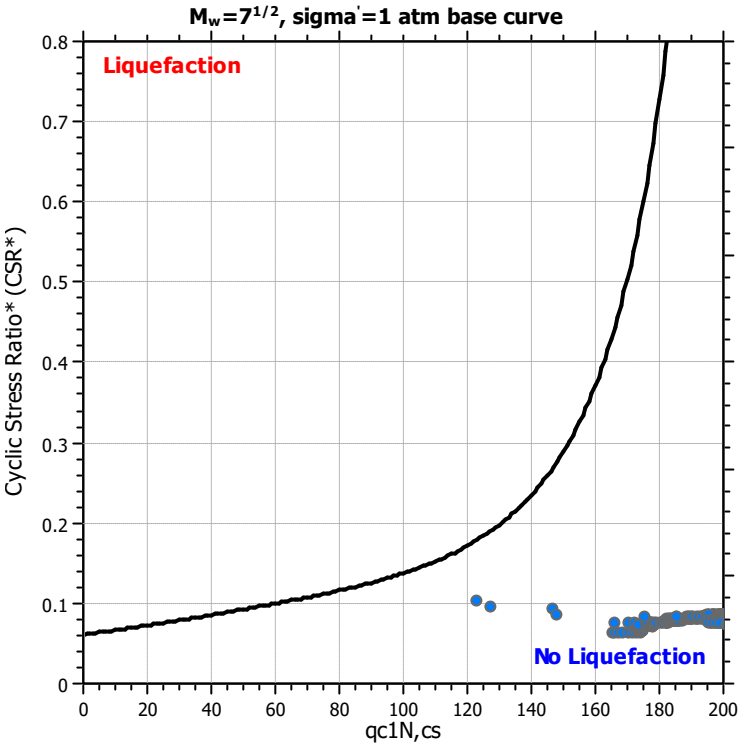
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

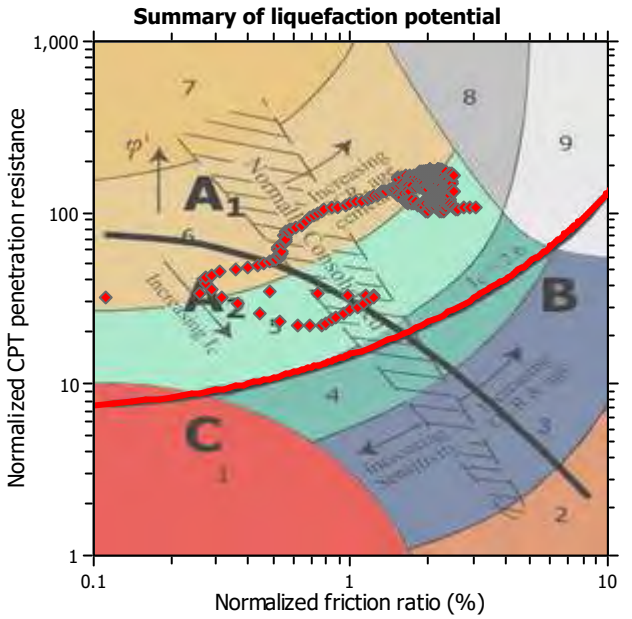
CPT file : CPT07_SLS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	No		

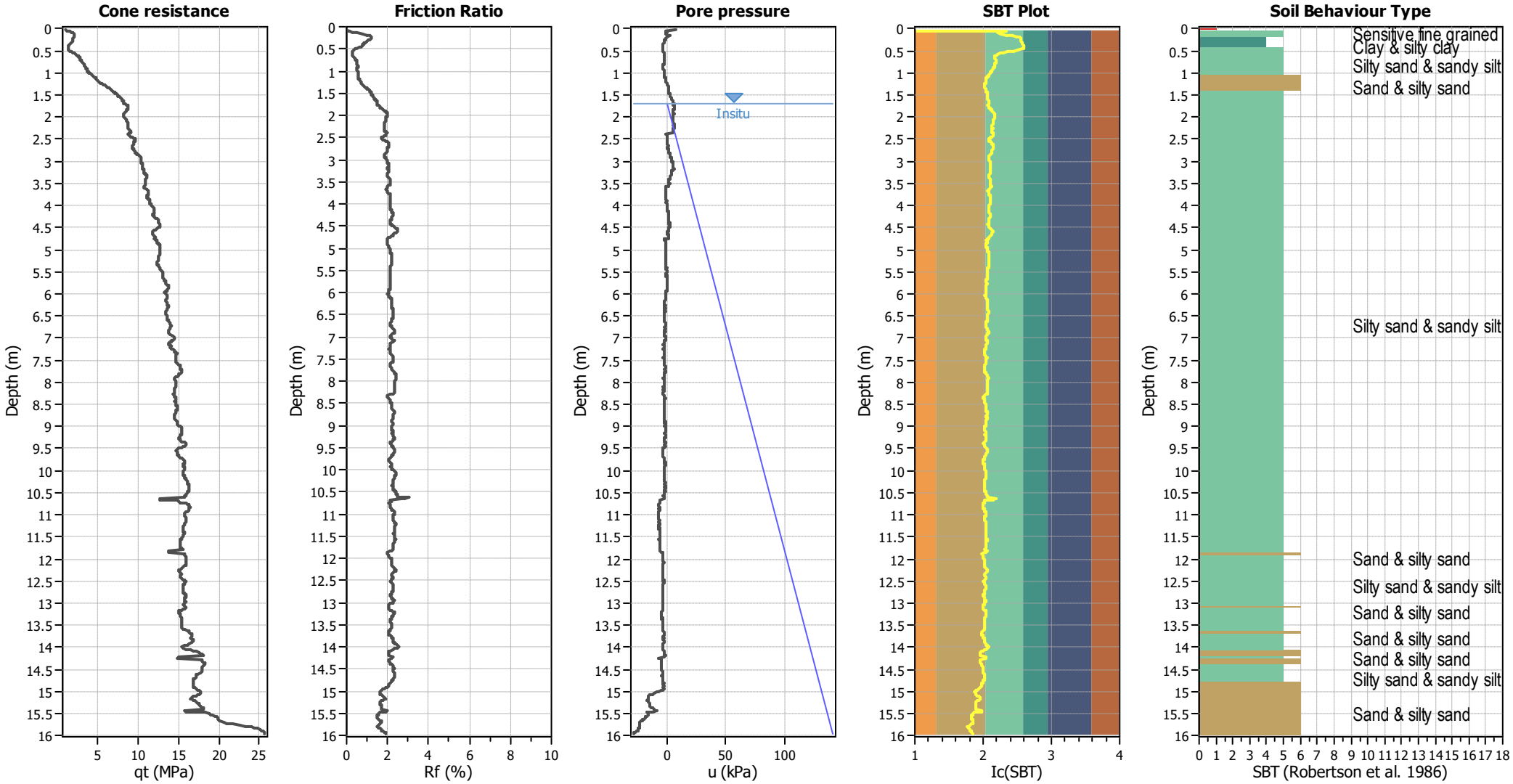






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



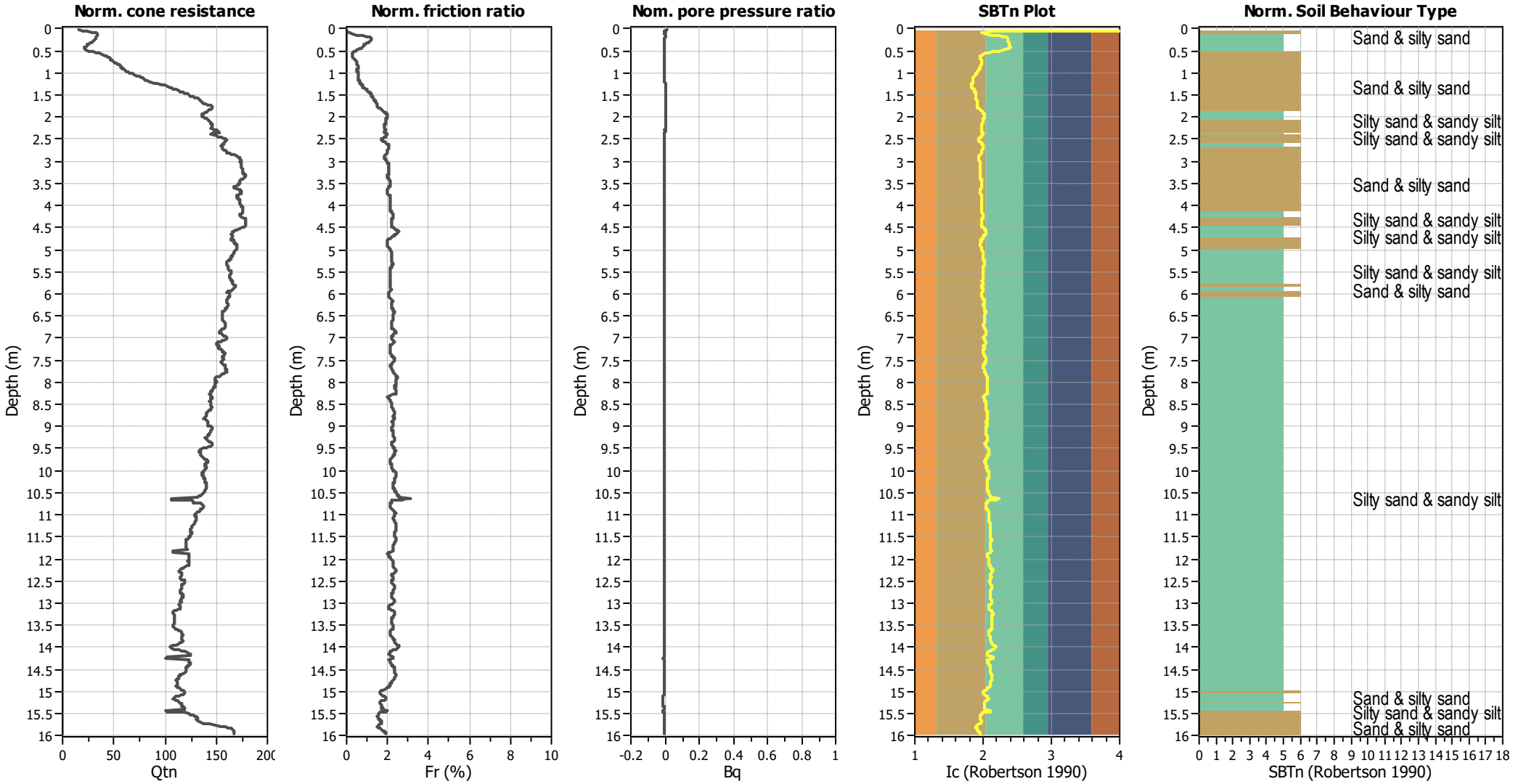
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



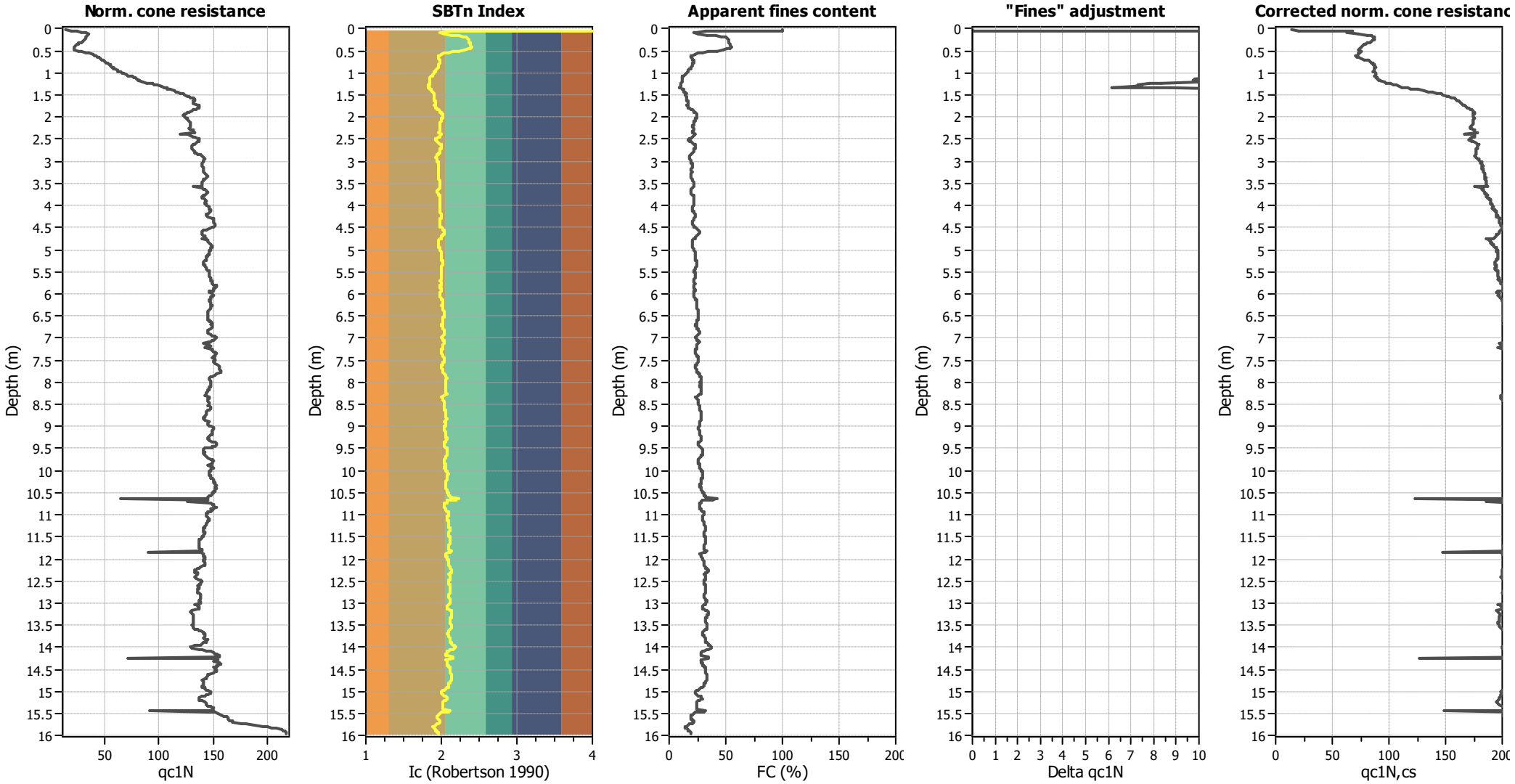
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

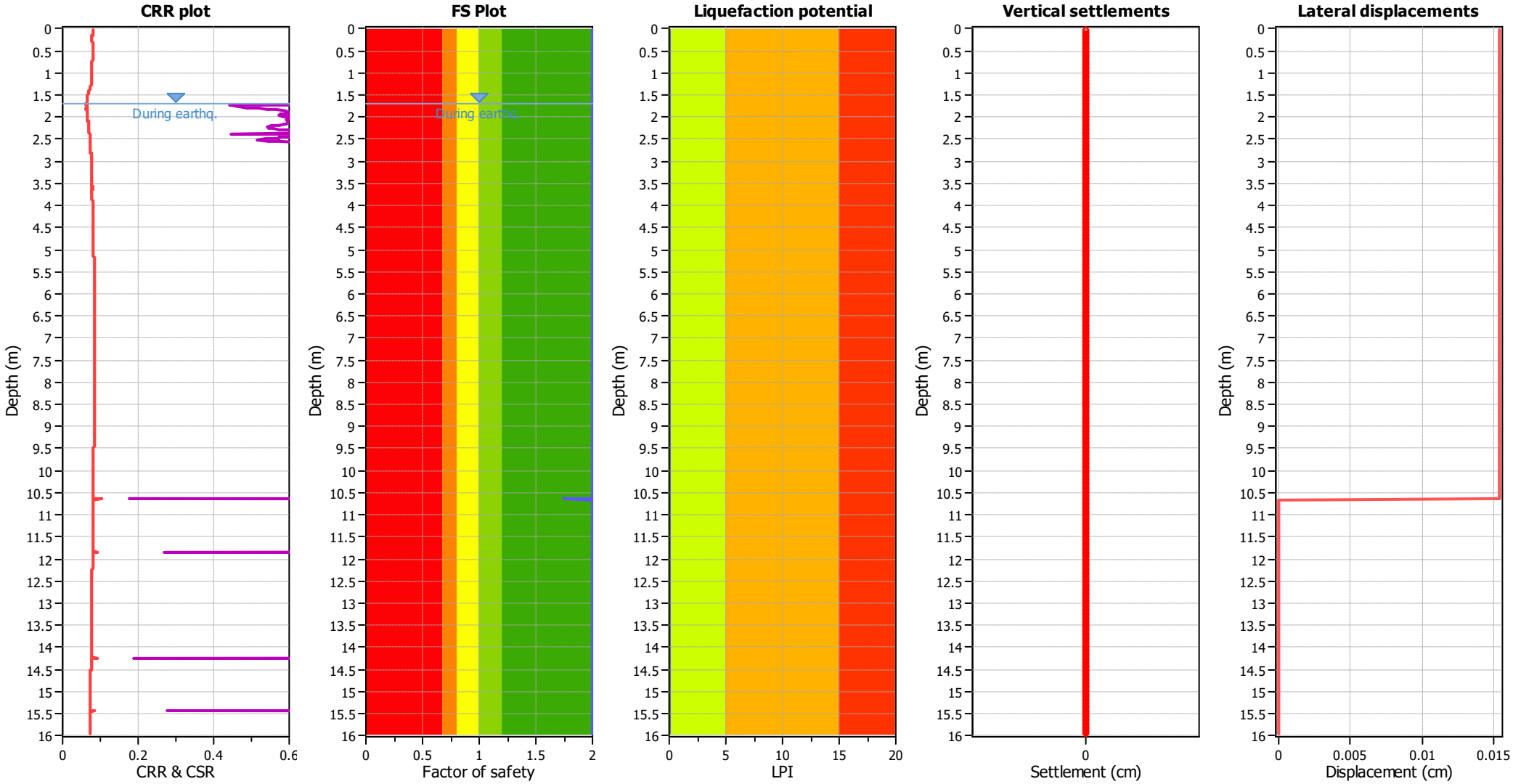
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

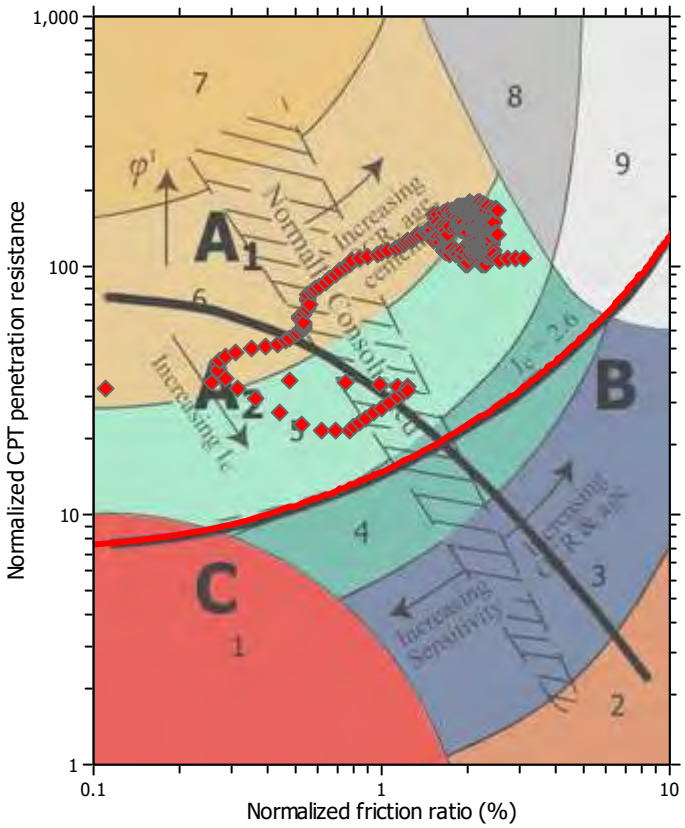
F.S. color scheme

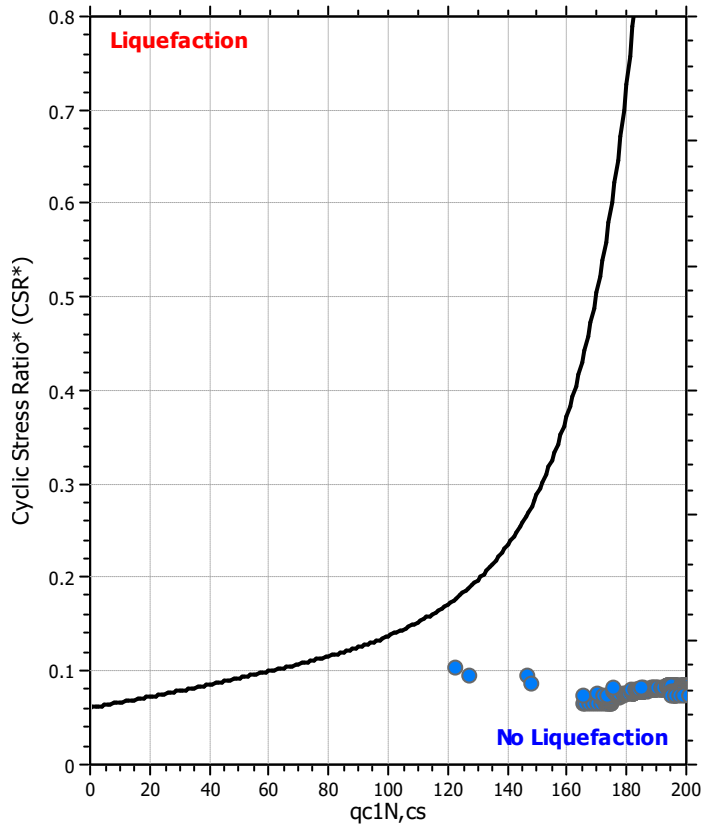
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

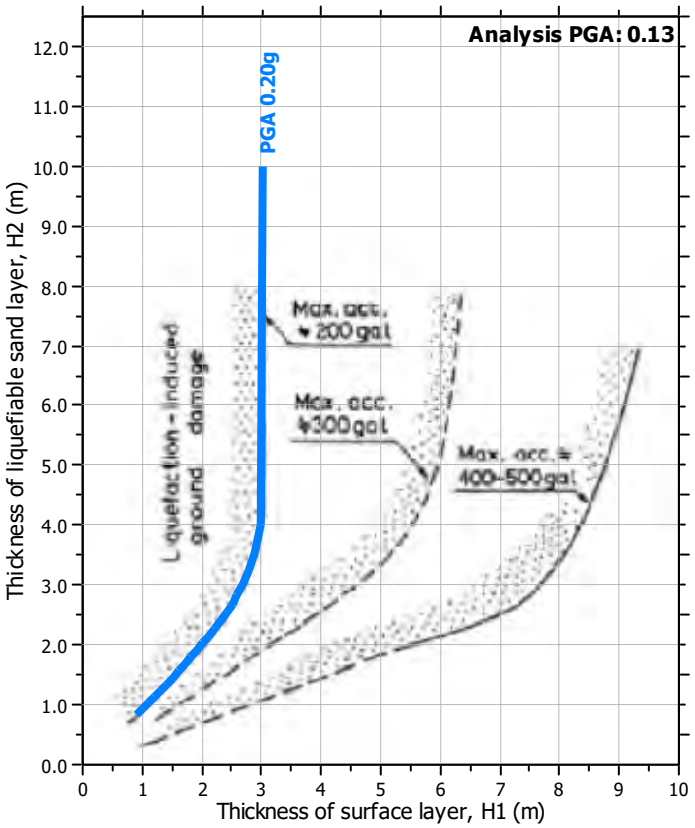
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



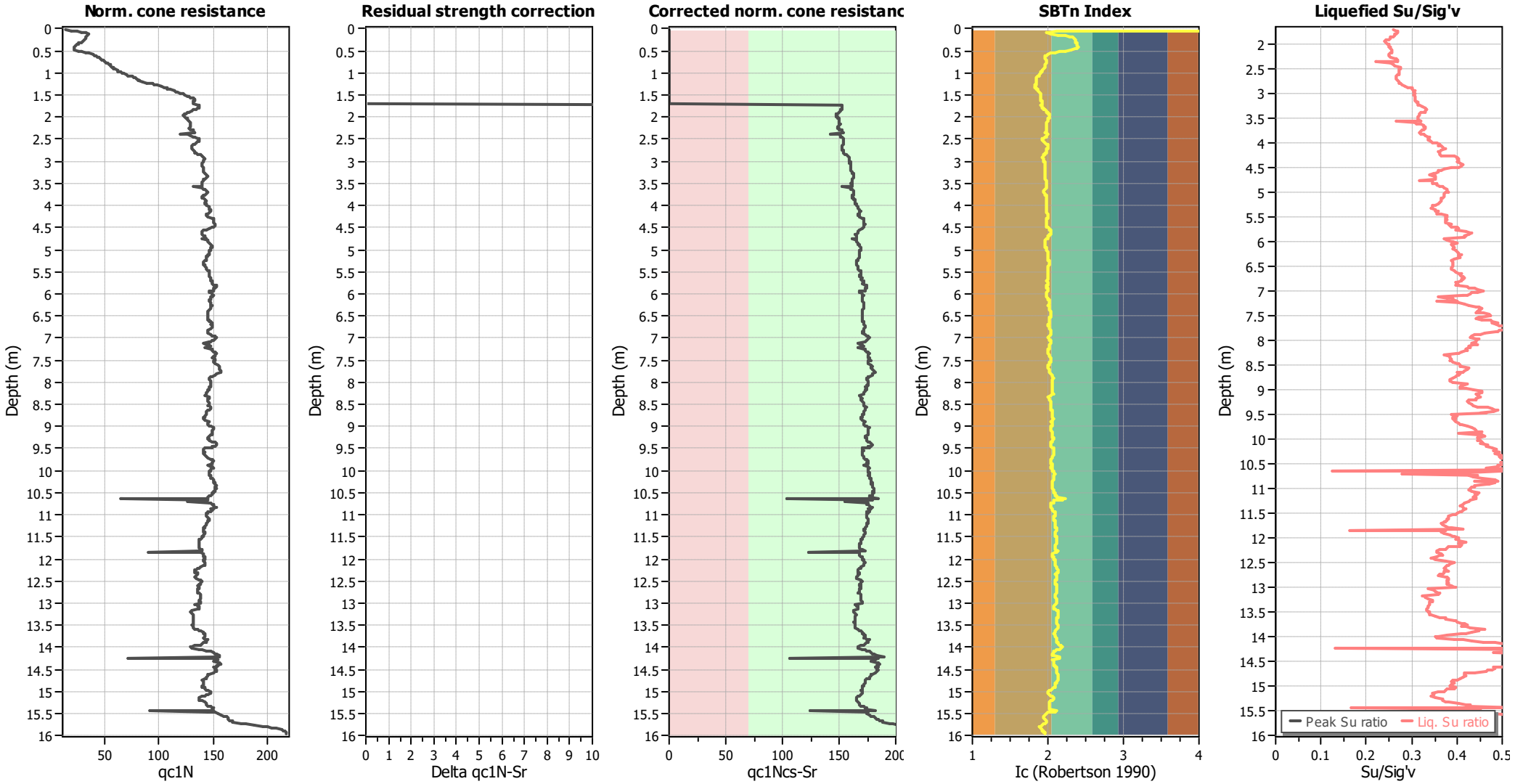




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

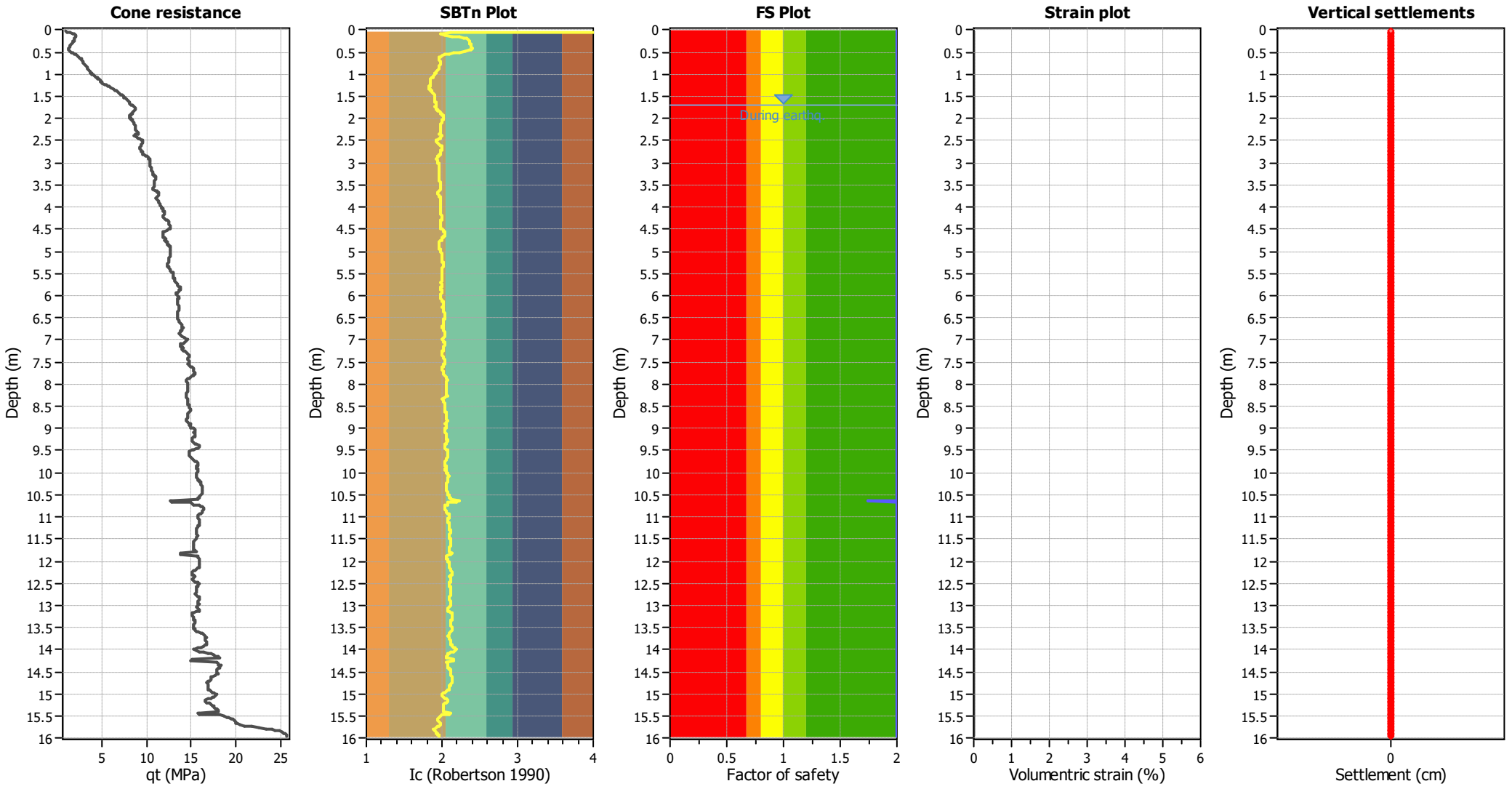
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

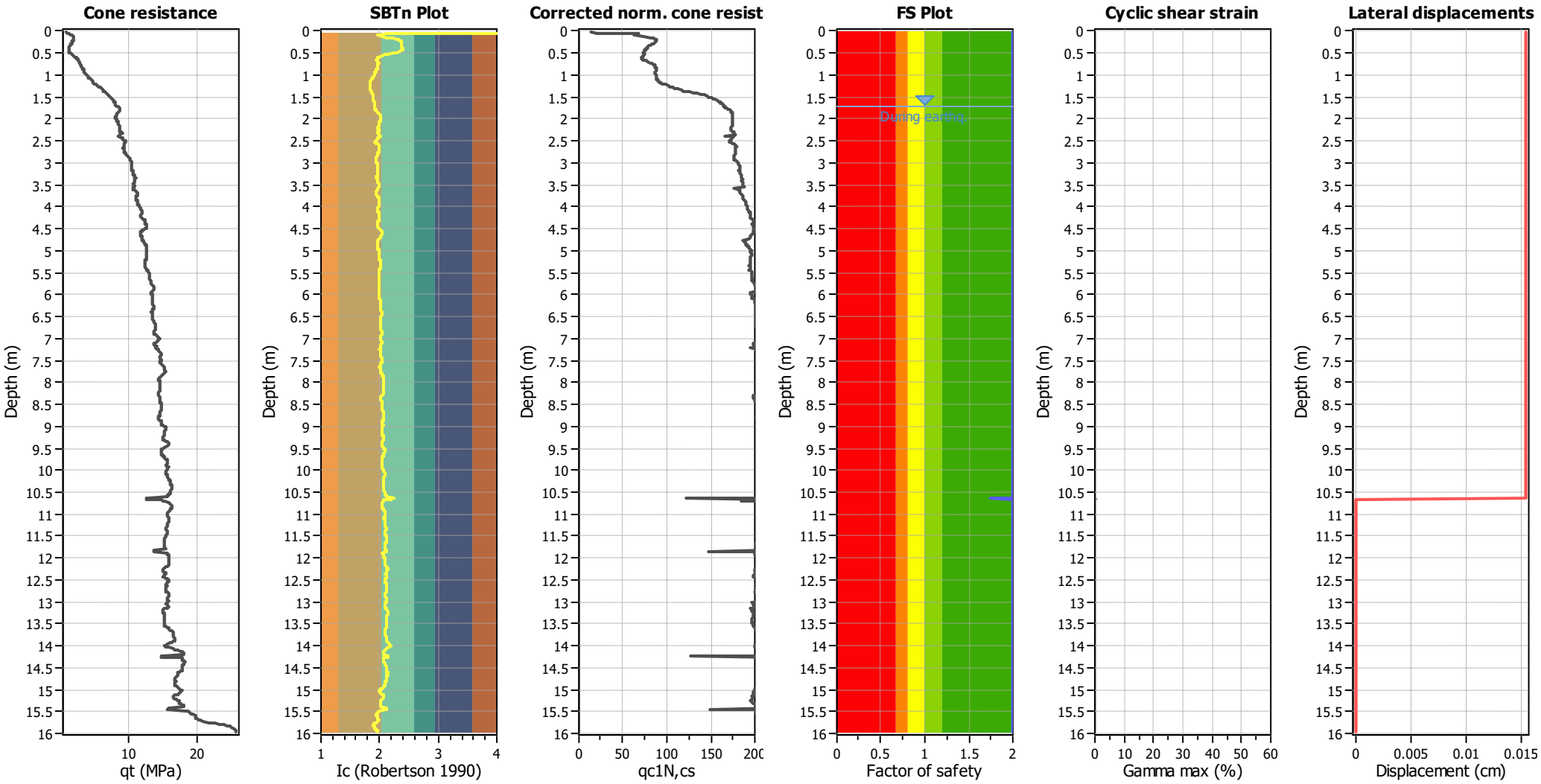
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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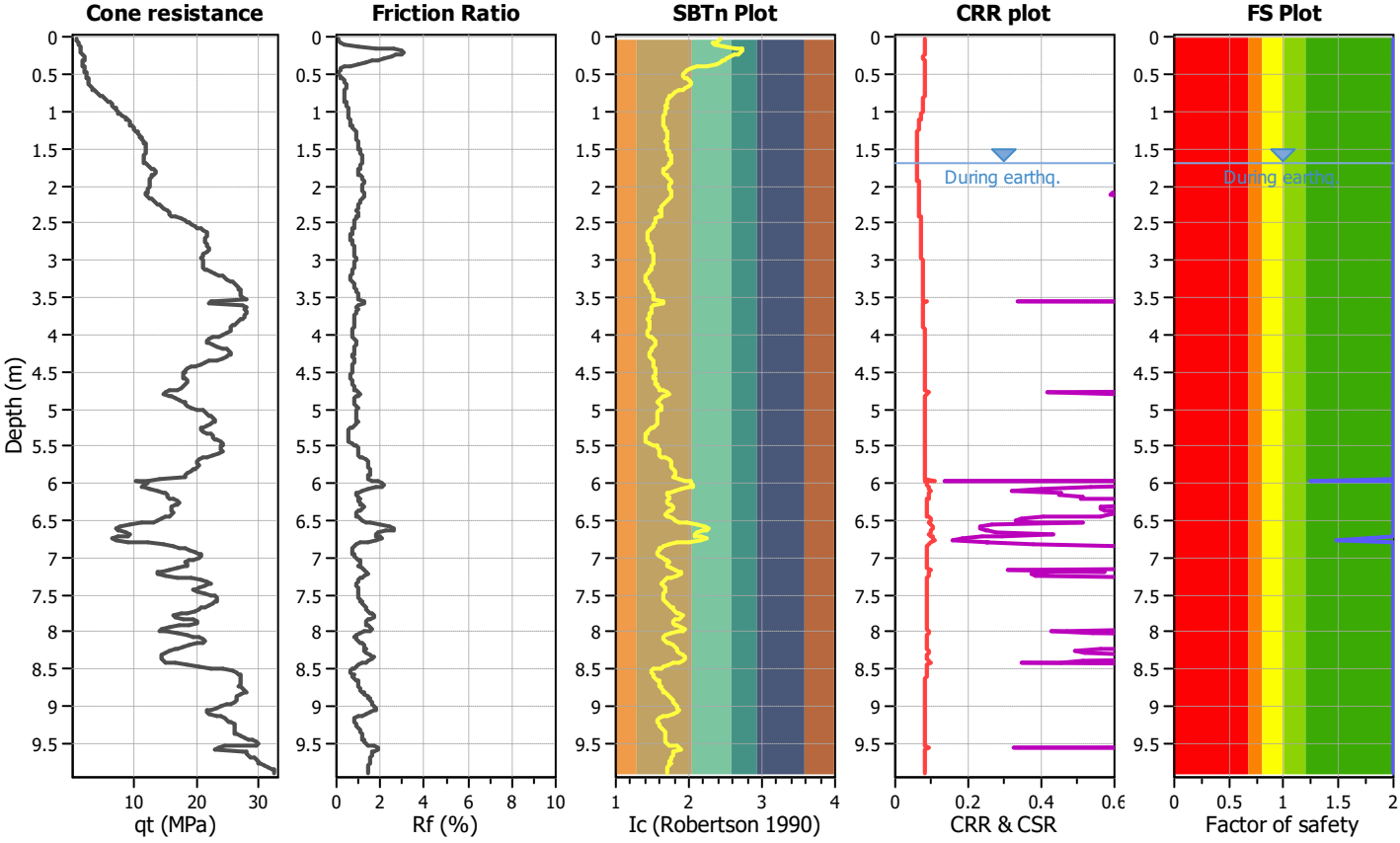
LIQUEFACTION ANALYSIS REPORT

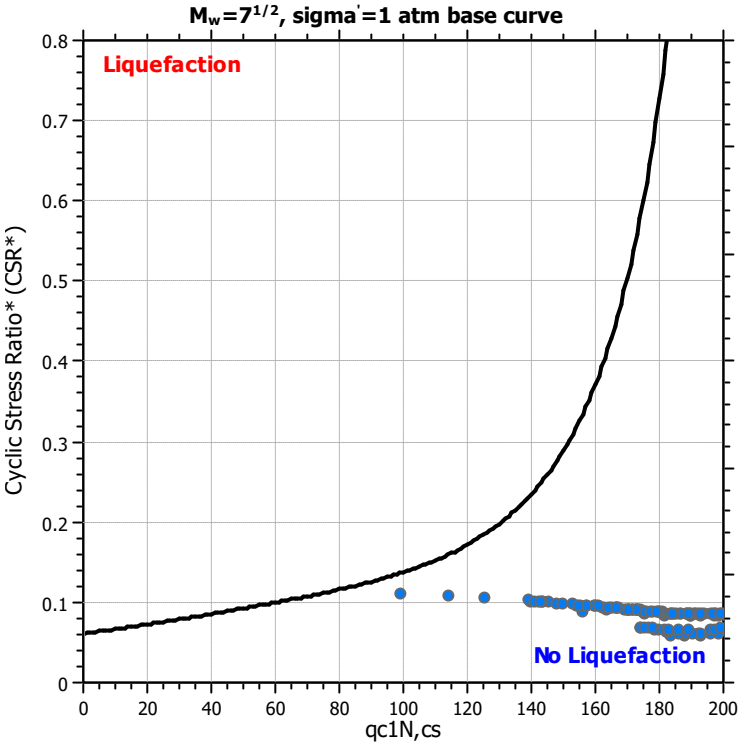
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

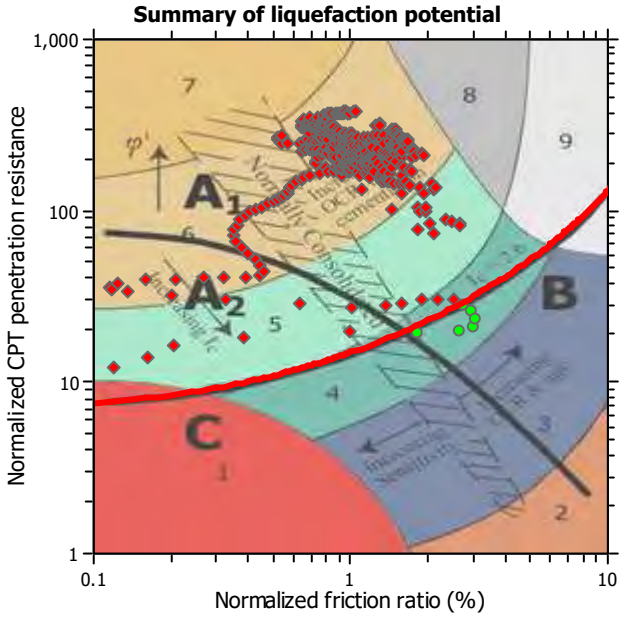
CPT file : CPT08_SLS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	No		

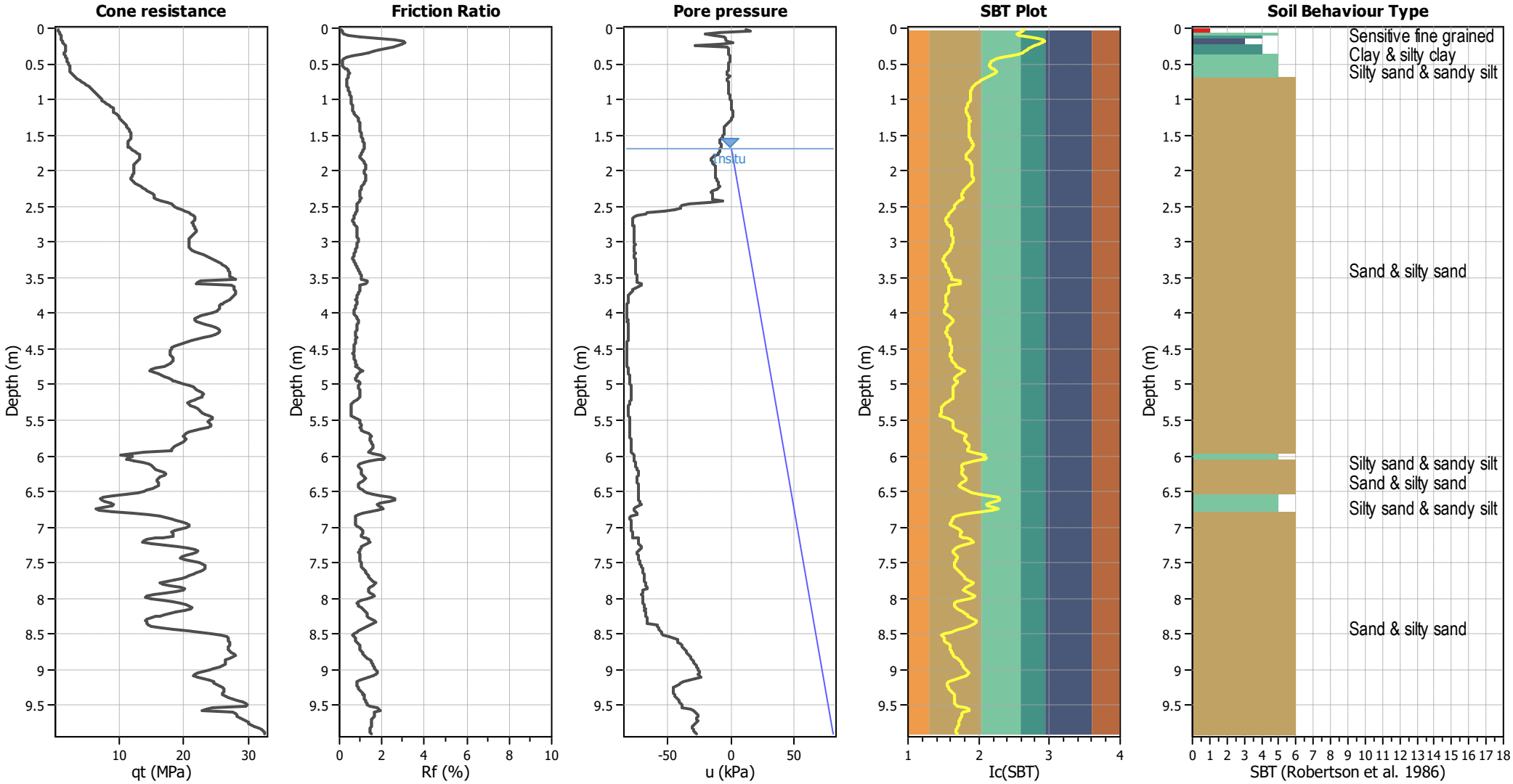






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



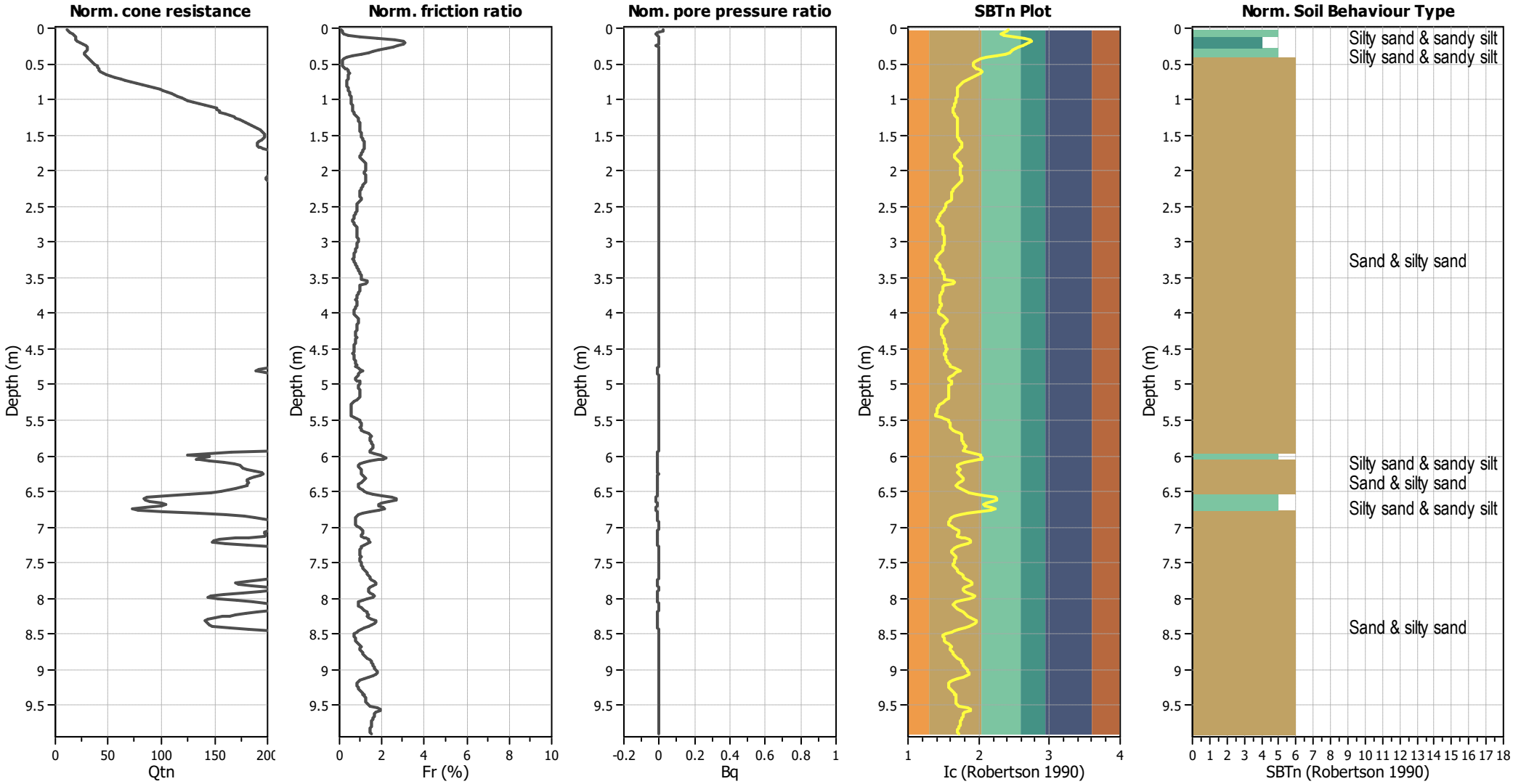
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



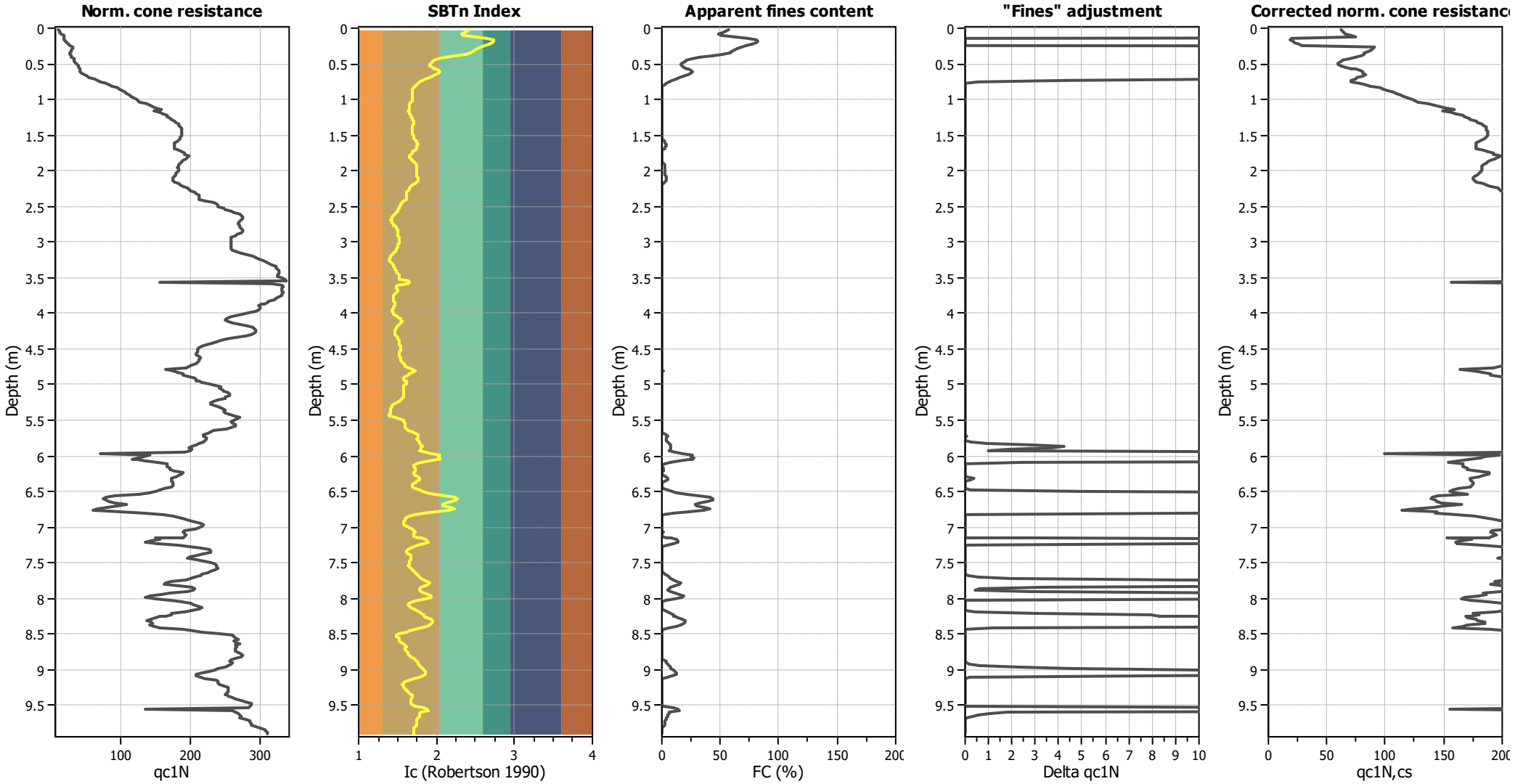
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

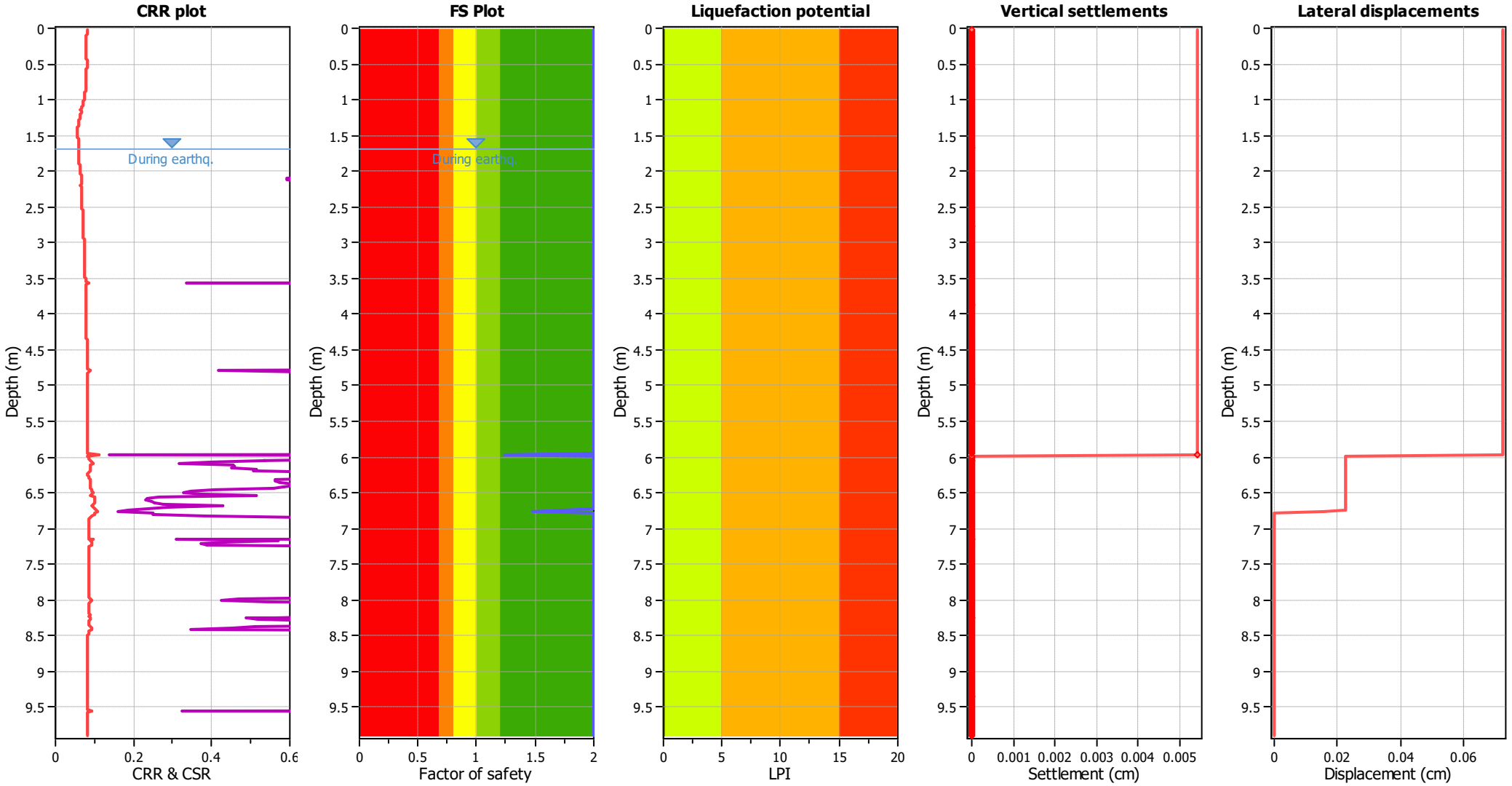
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

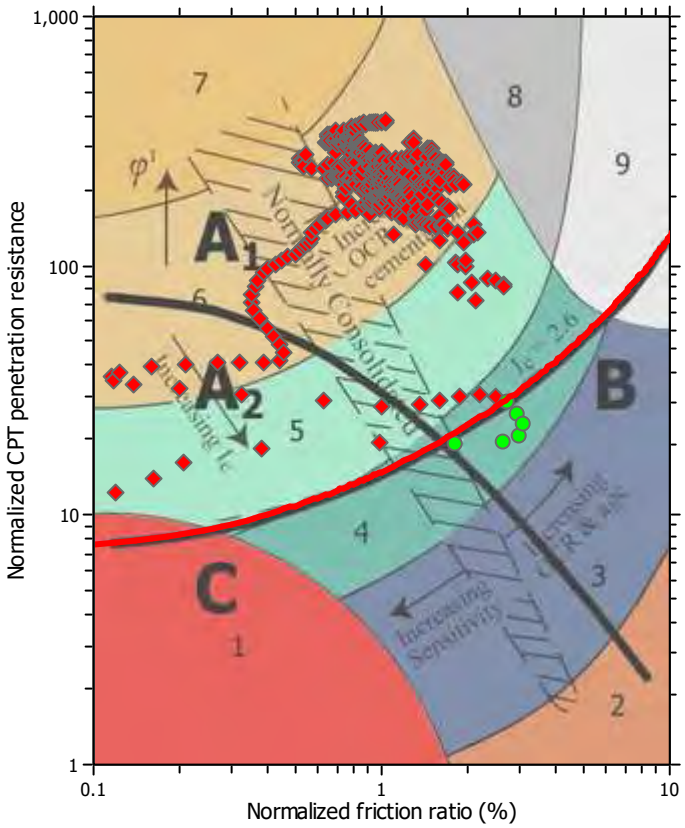
F.S. color scheme

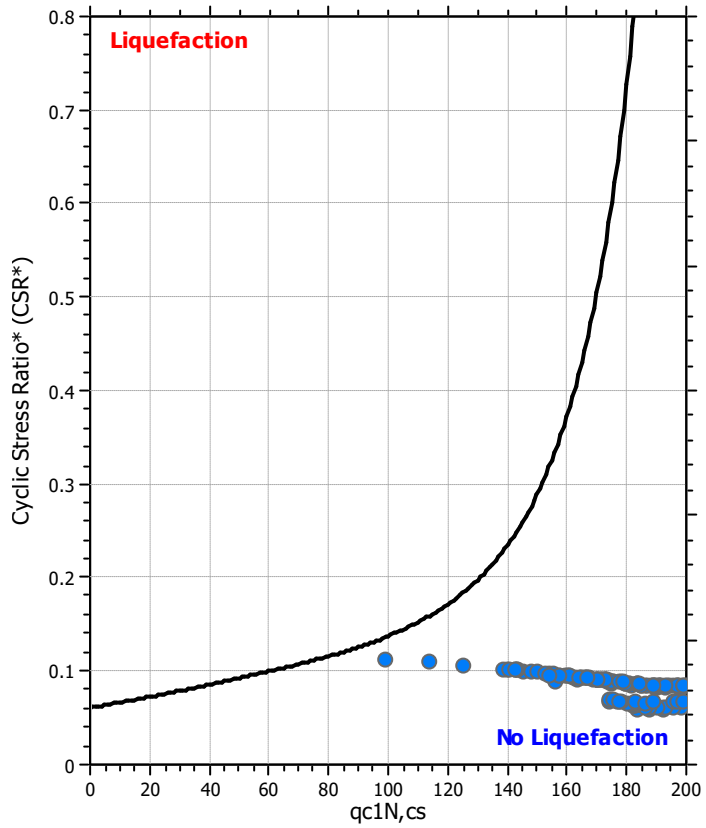
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

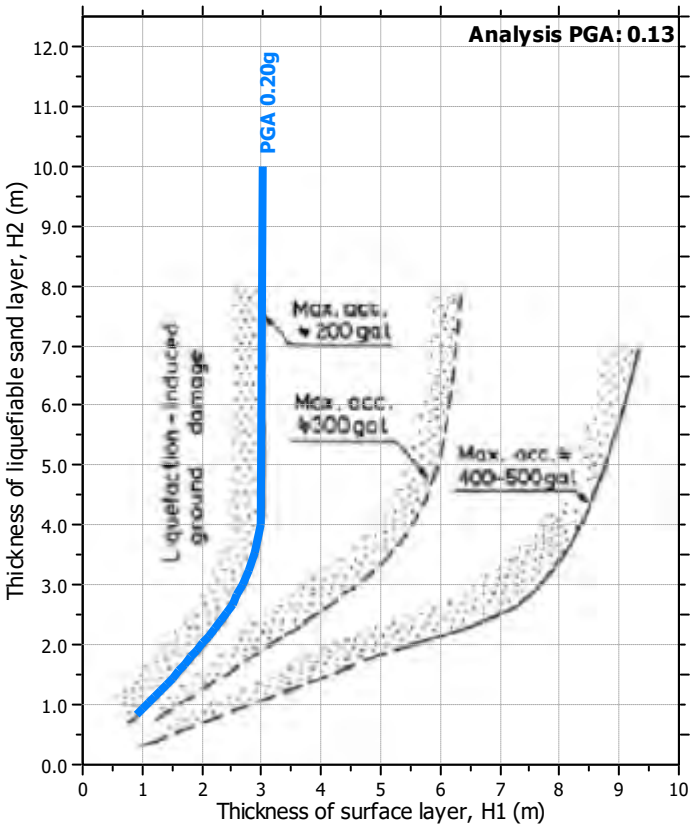
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



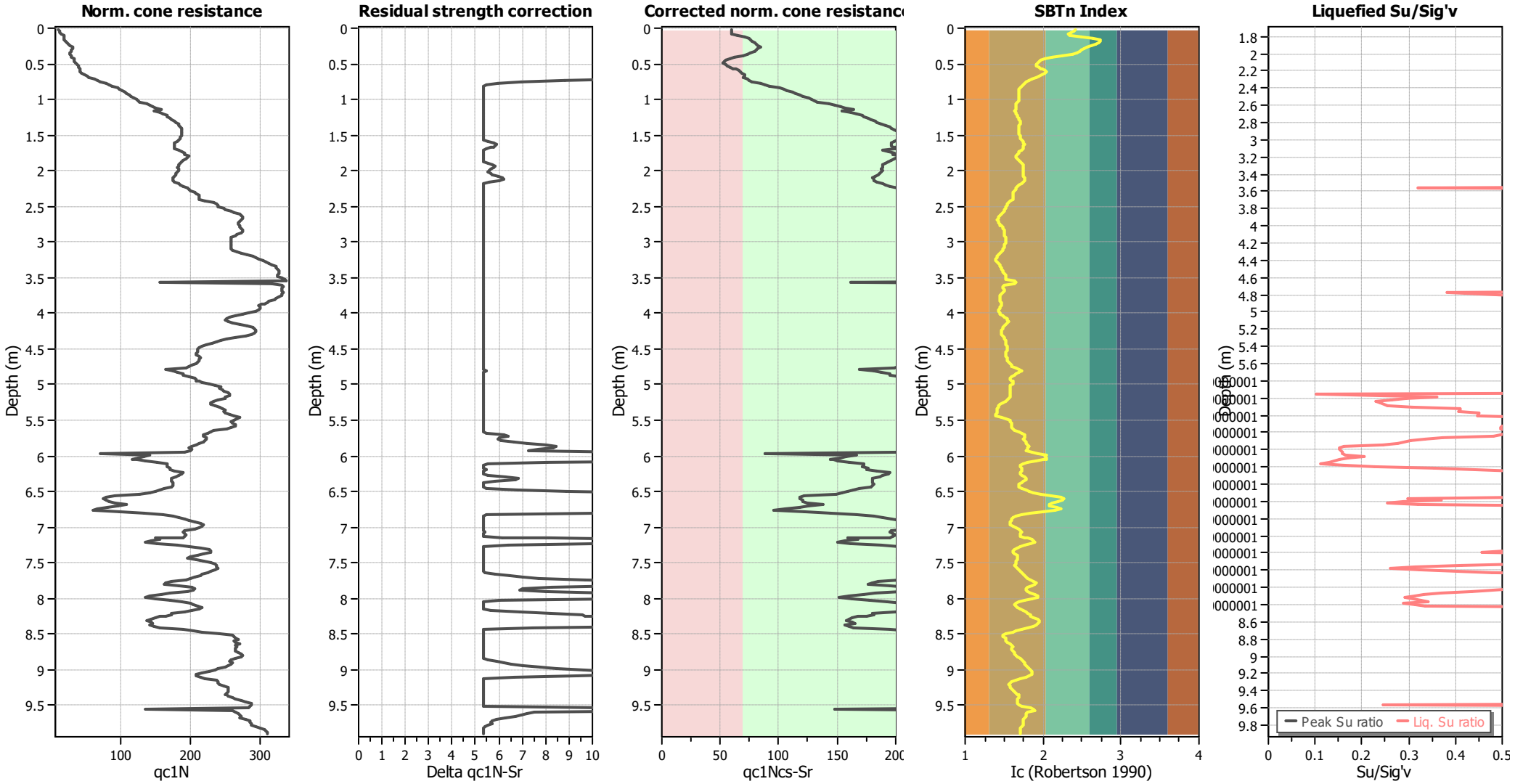




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

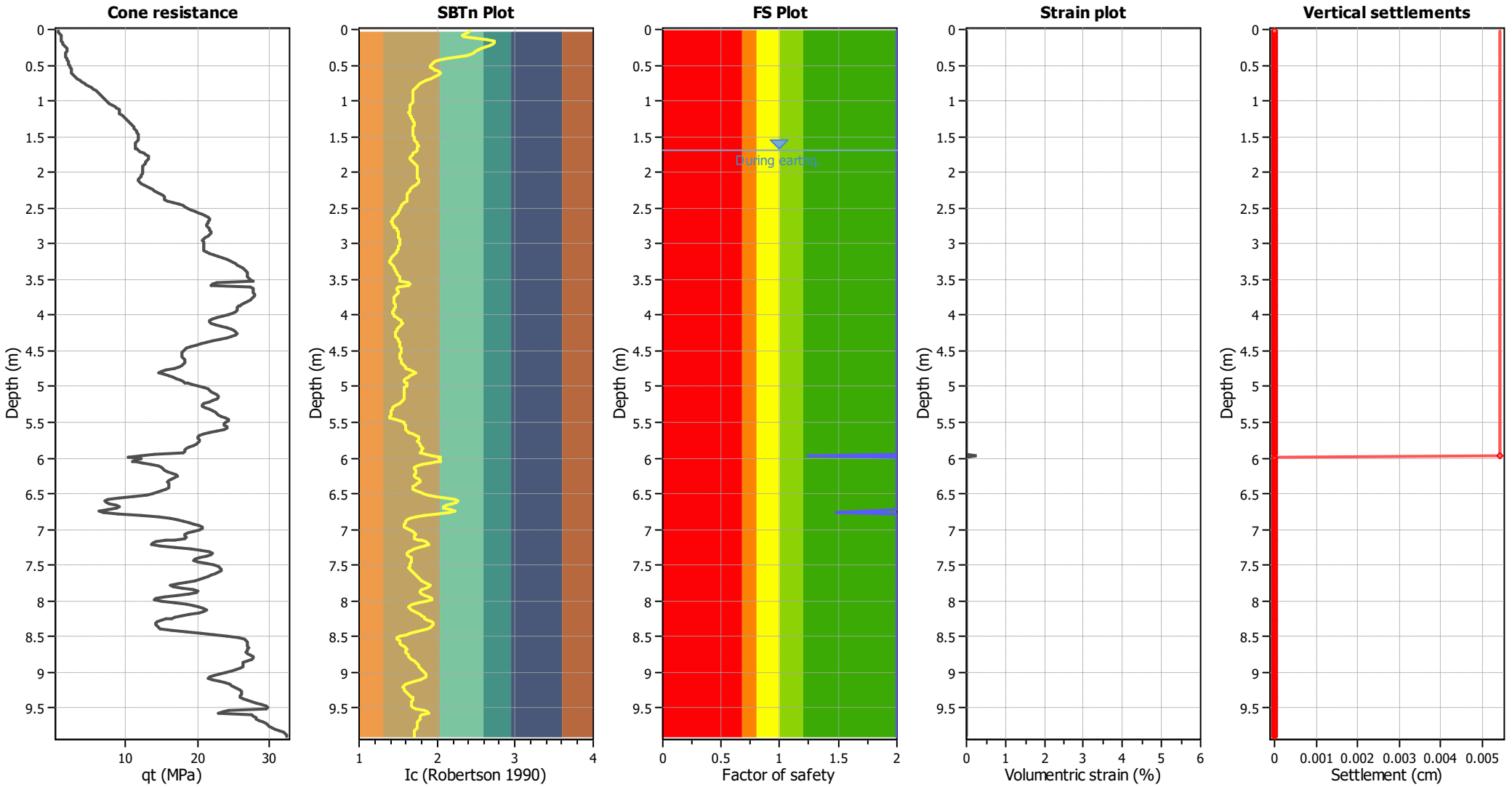
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

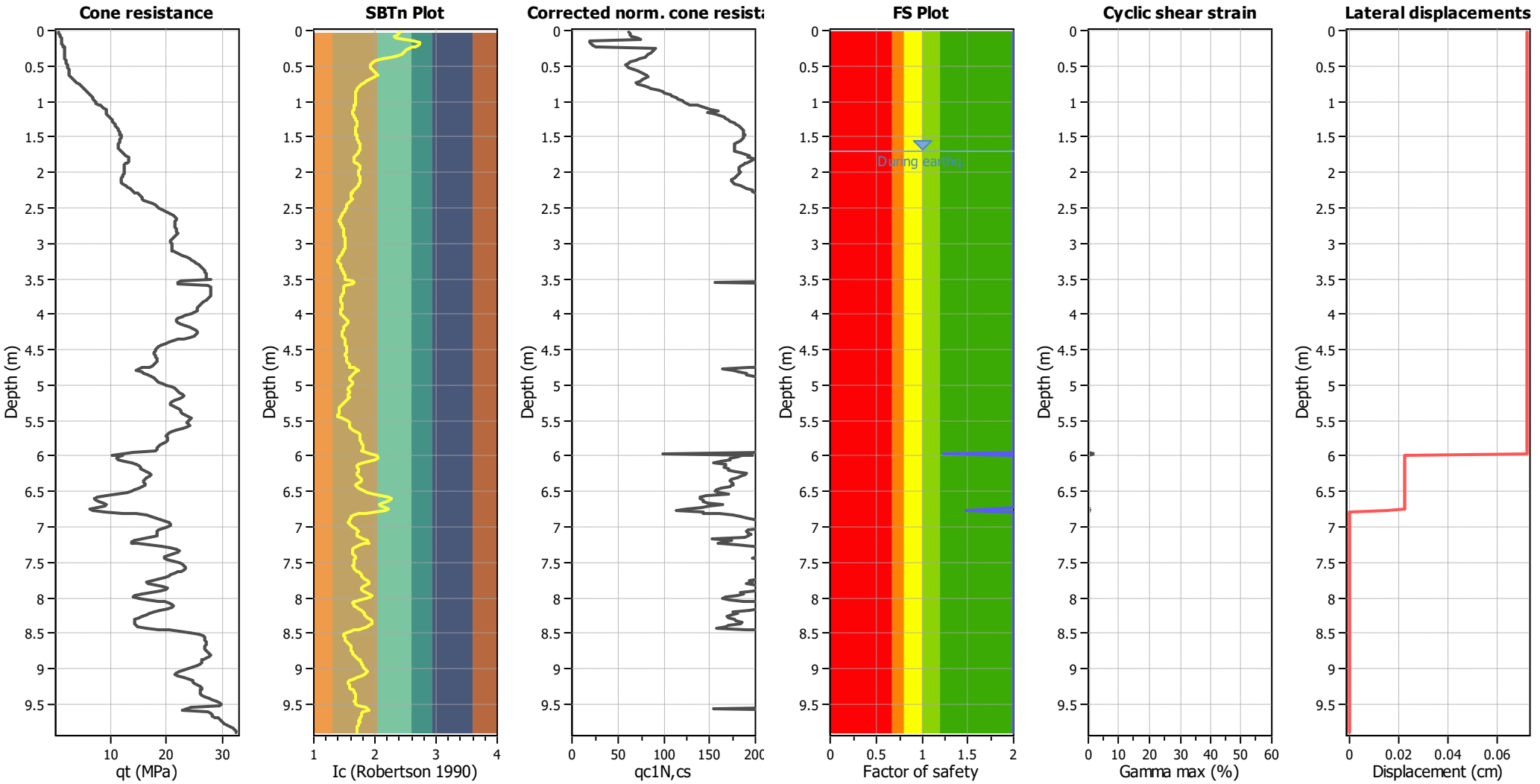
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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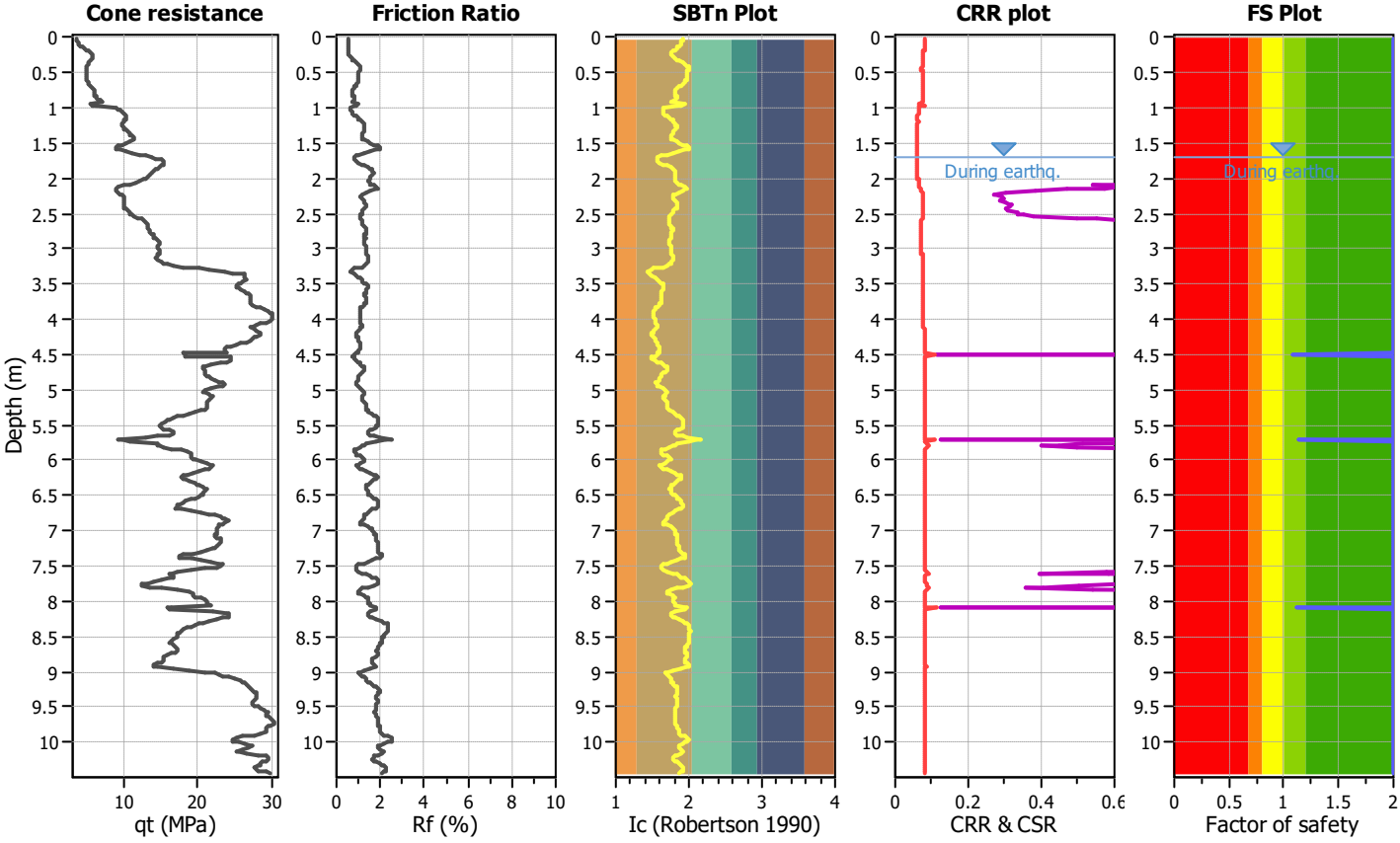
LIQUEFACTION ANALYSIS REPORT

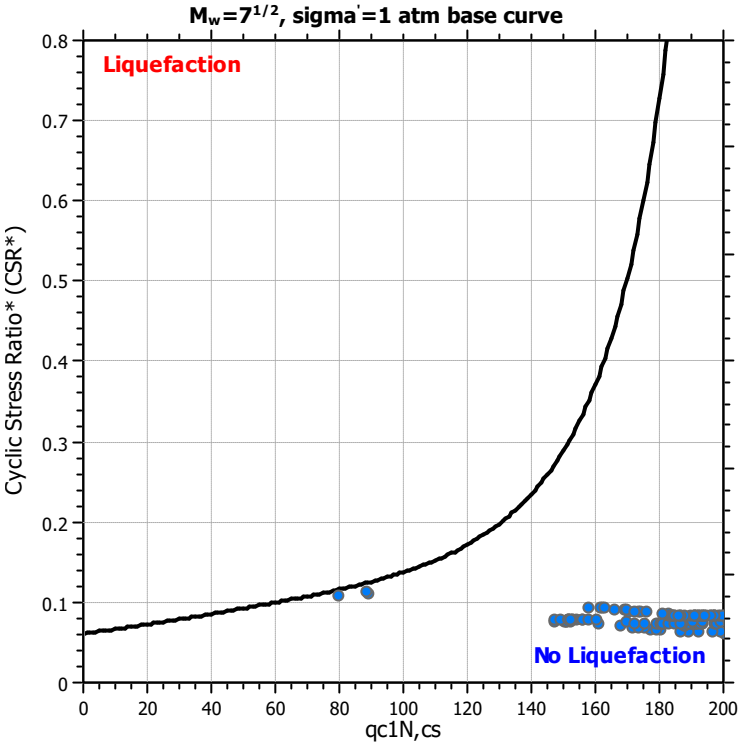
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

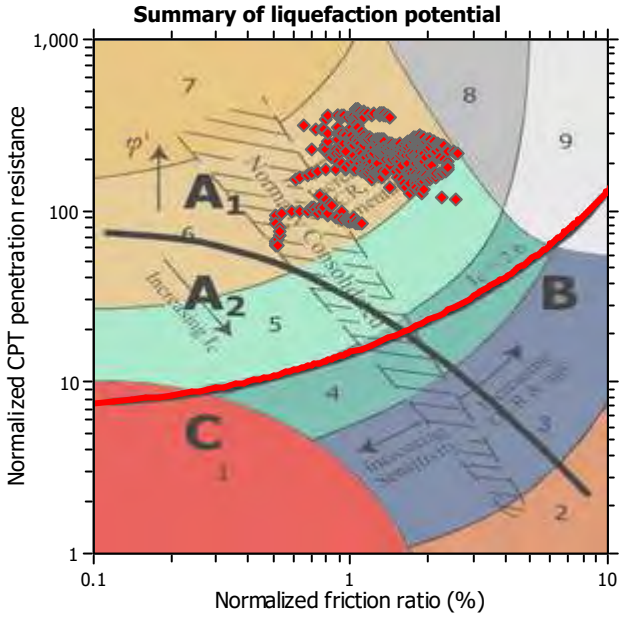
CPT file : CPT09_SLS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	No		

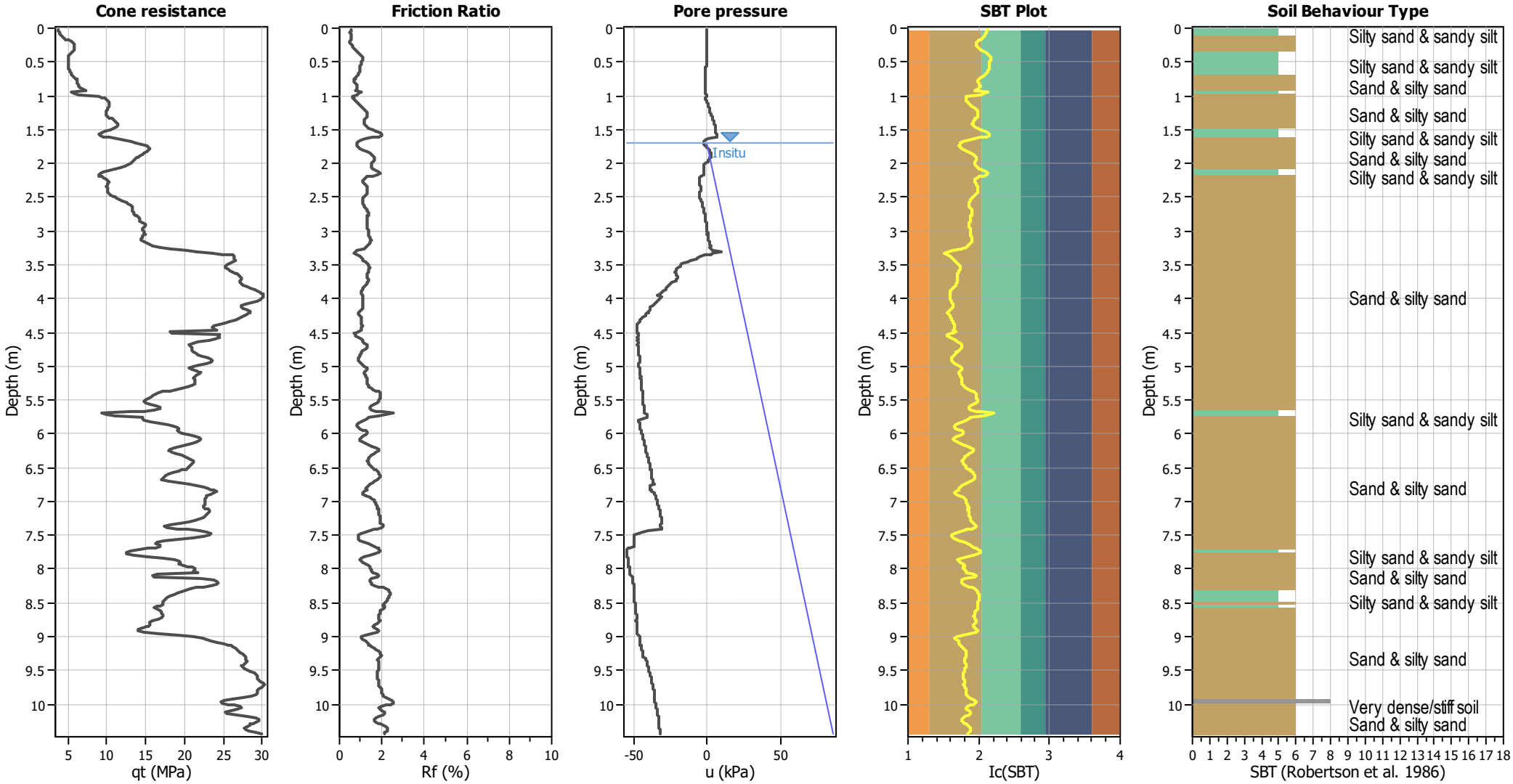






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



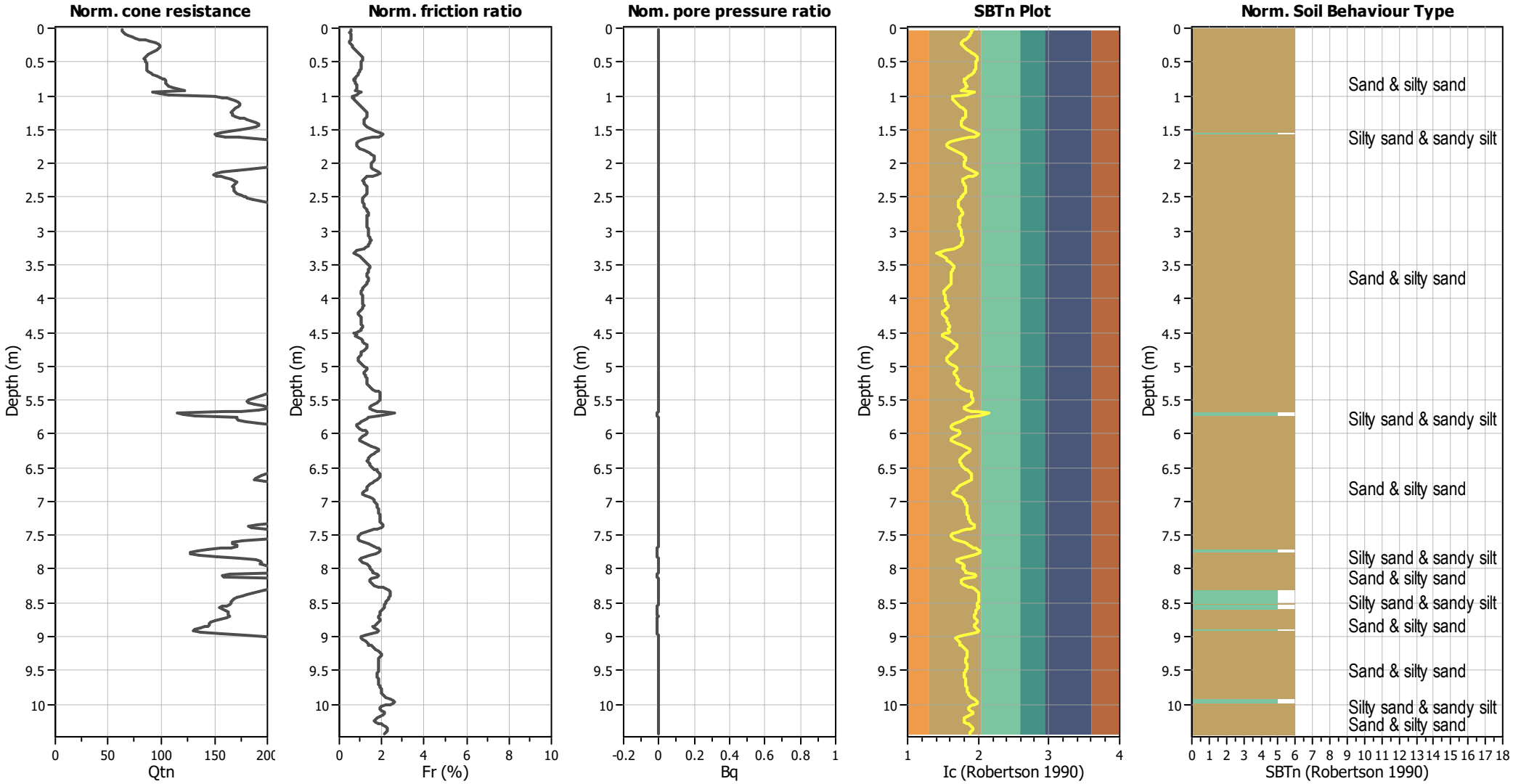
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



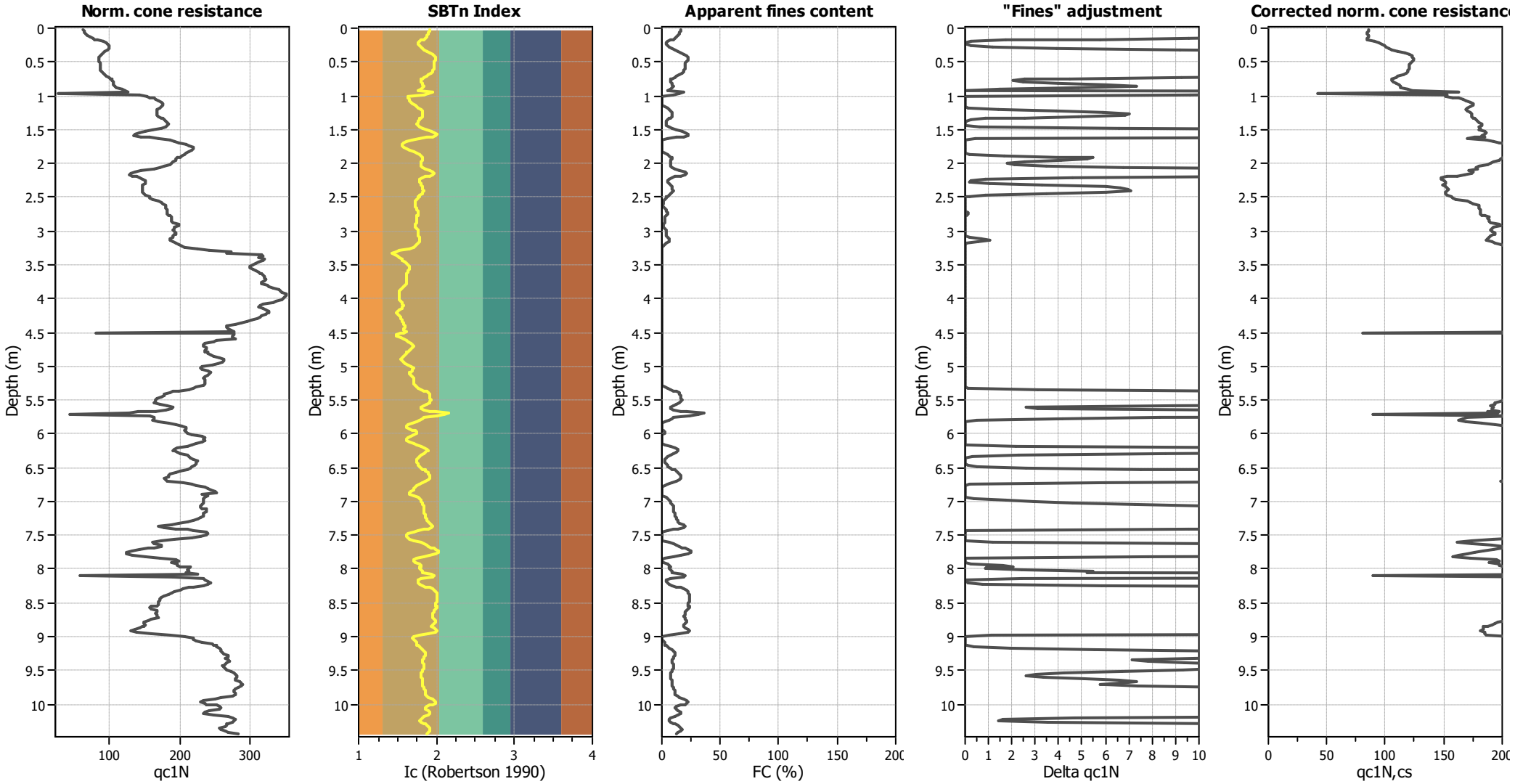
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

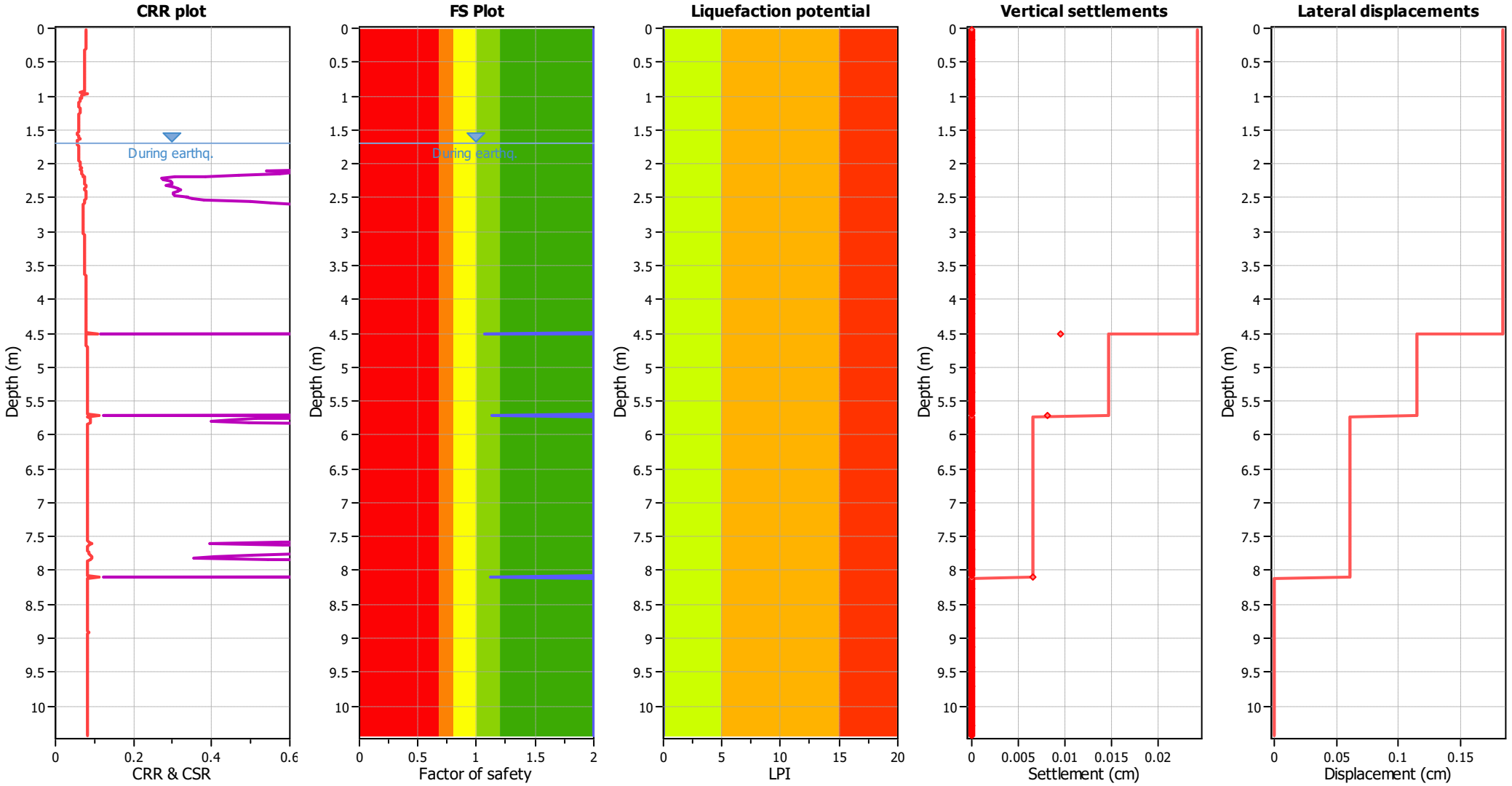
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

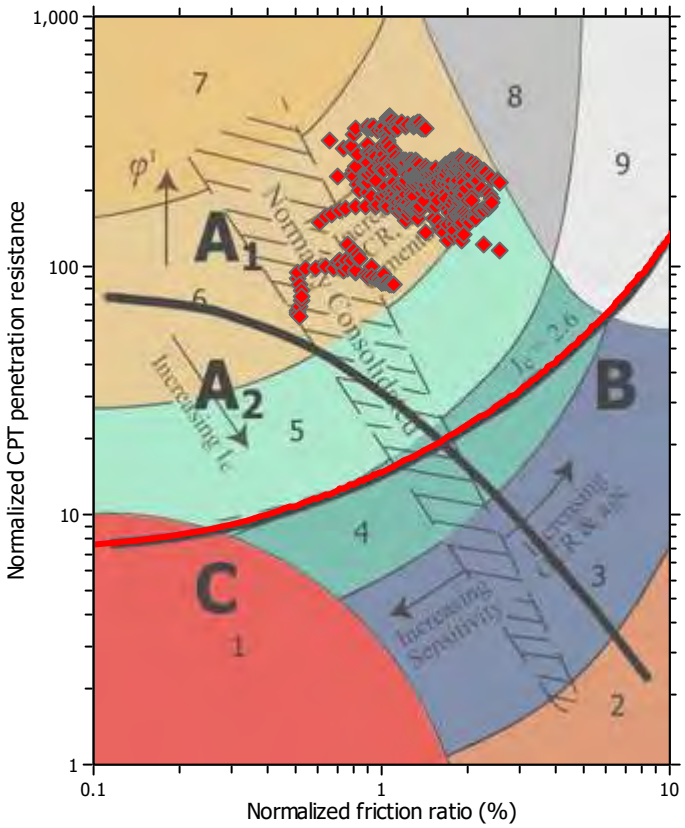
F.S. color scheme

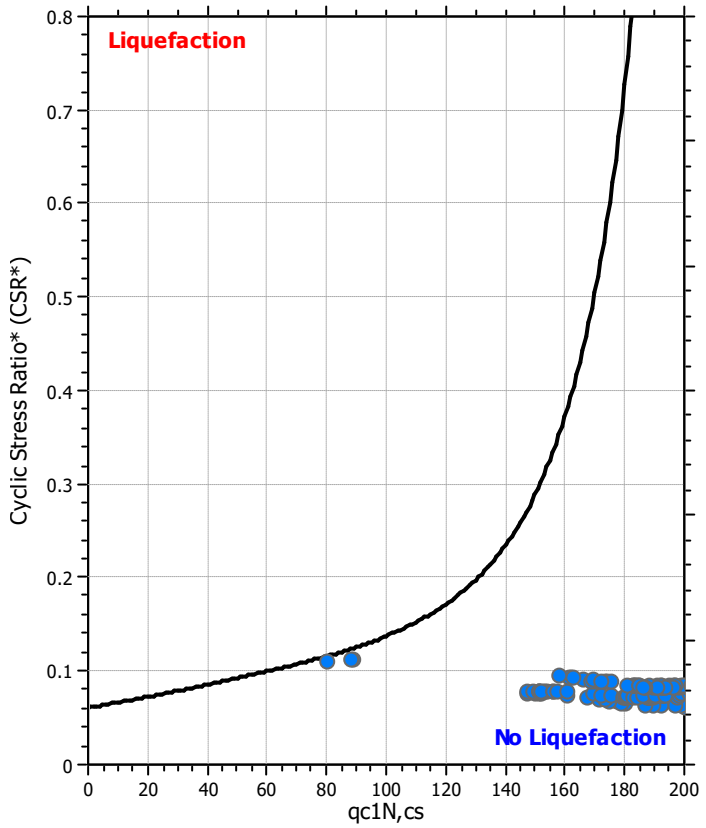
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

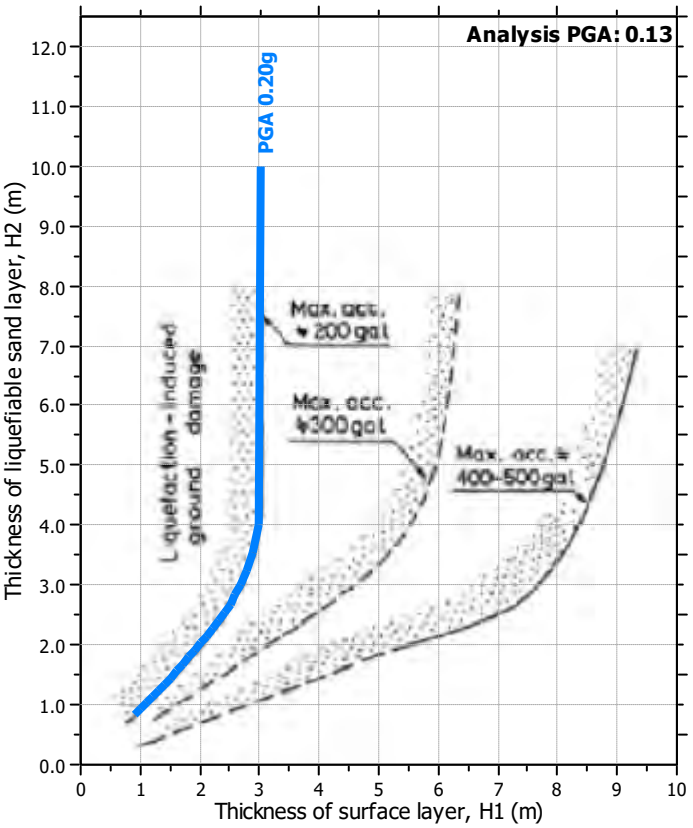
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



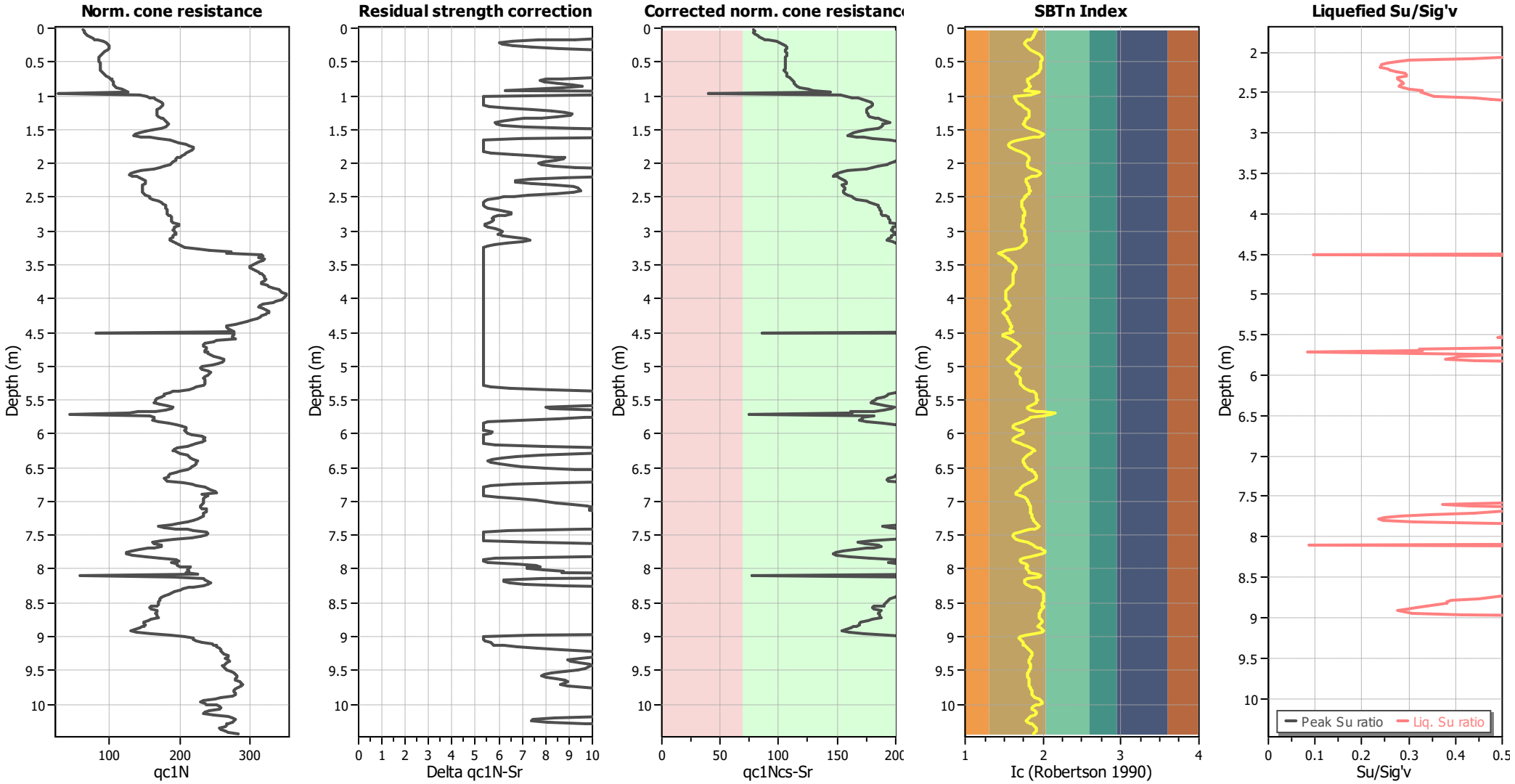




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

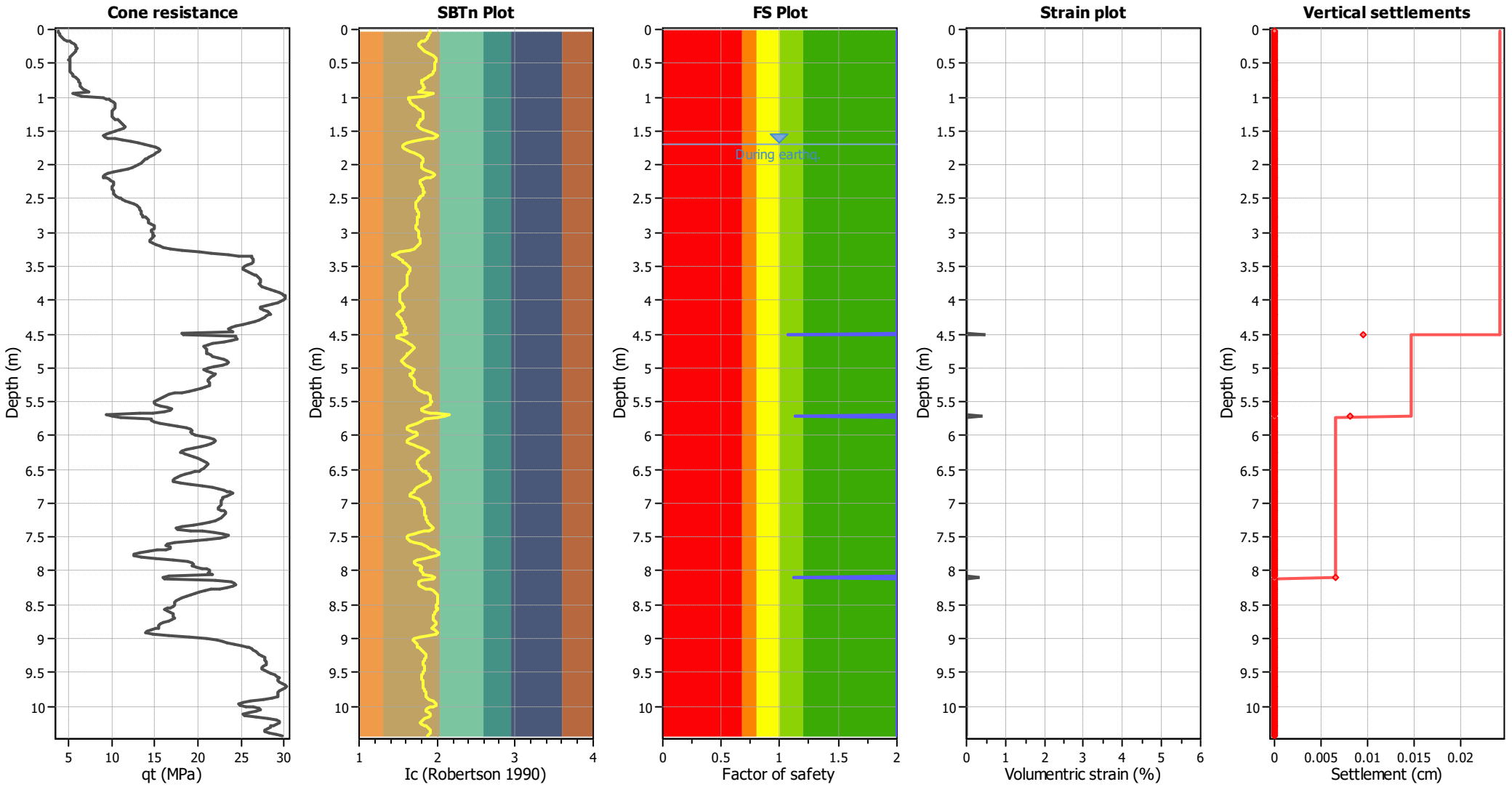
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

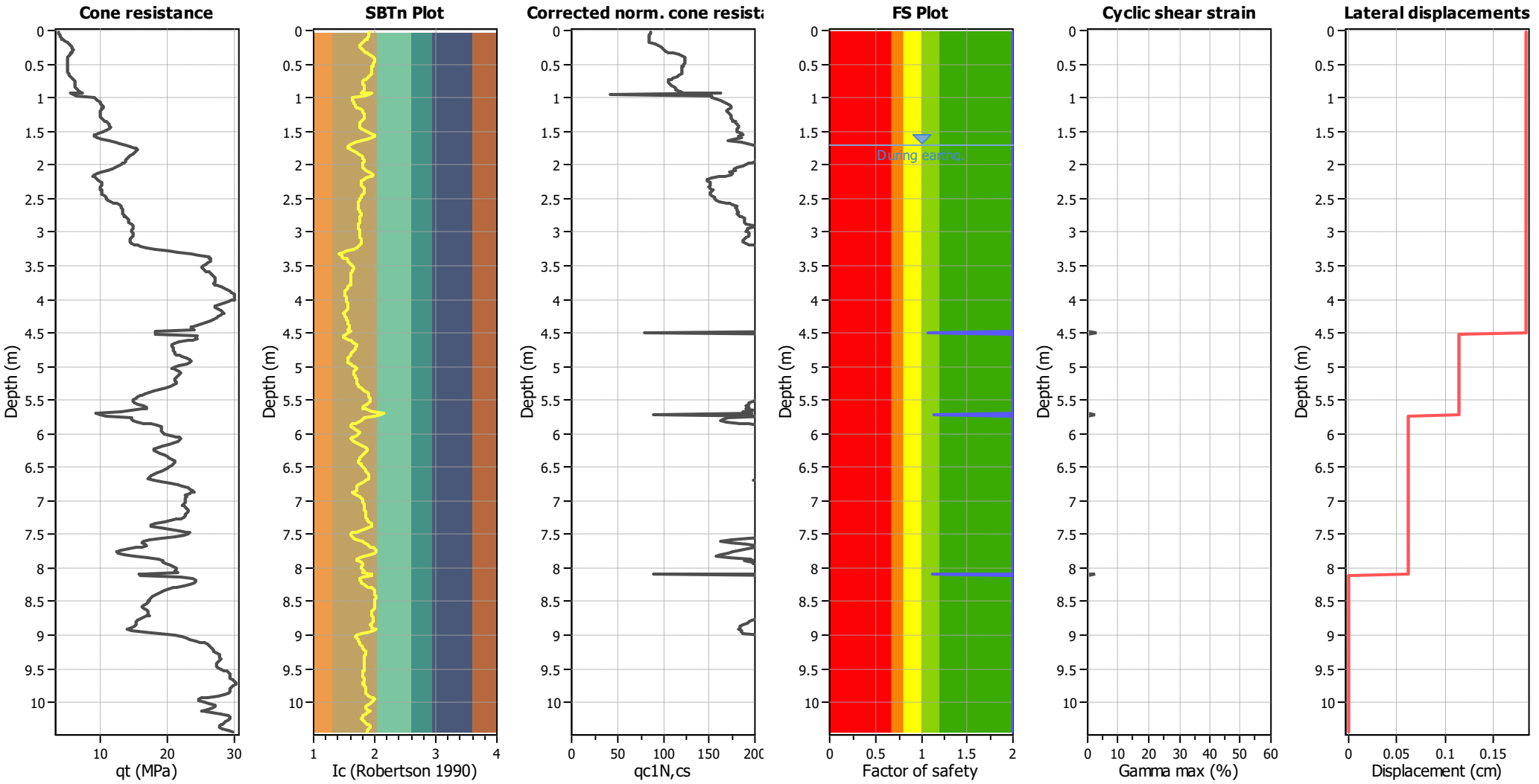
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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2/182 Main Rd Tawa
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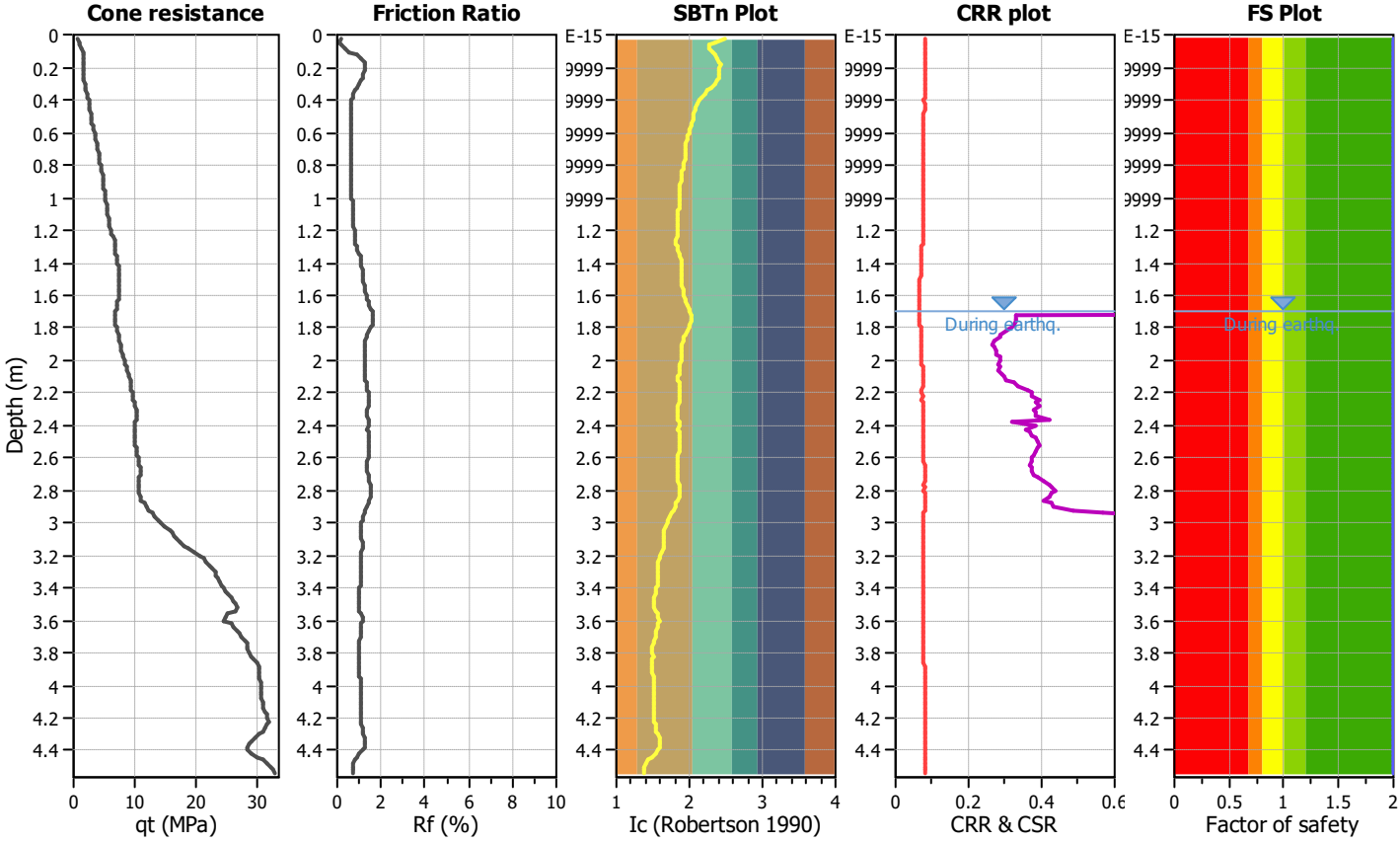
LIQUEFACTION ANALYSIS REPORT

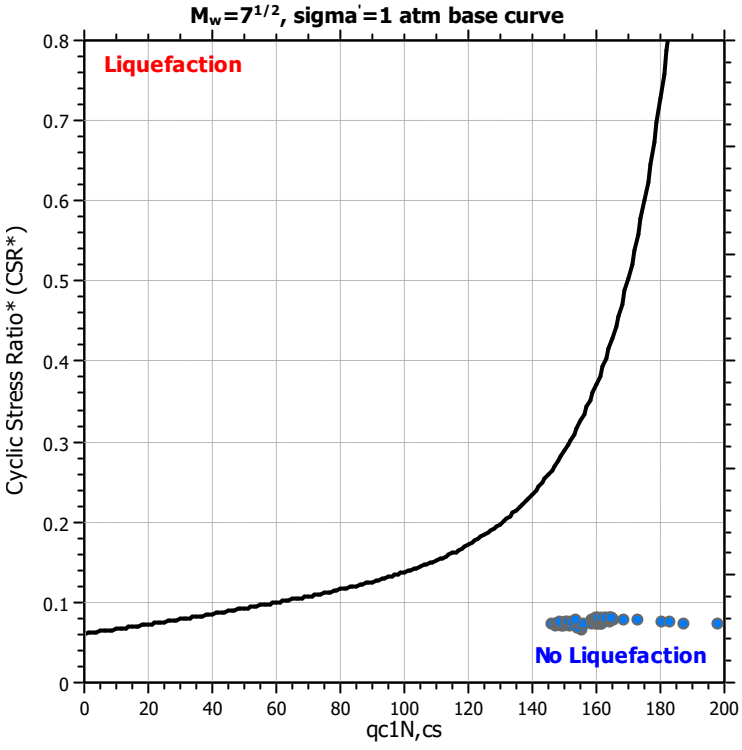
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

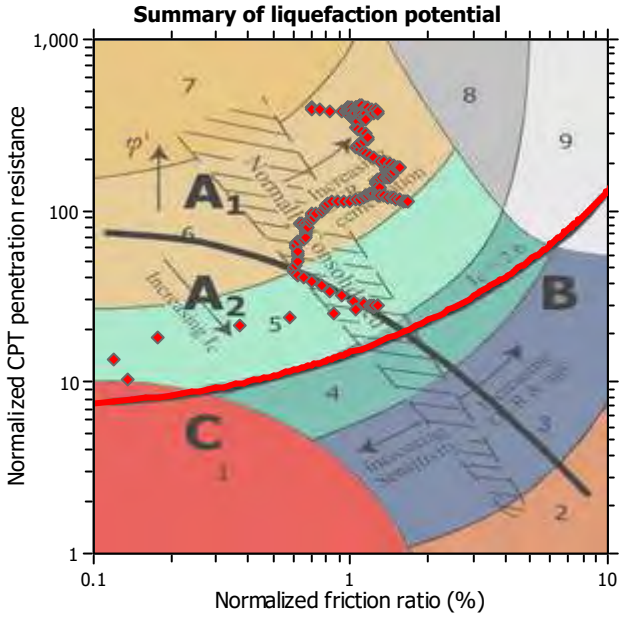
CPT file : CPT10_SLS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	No		

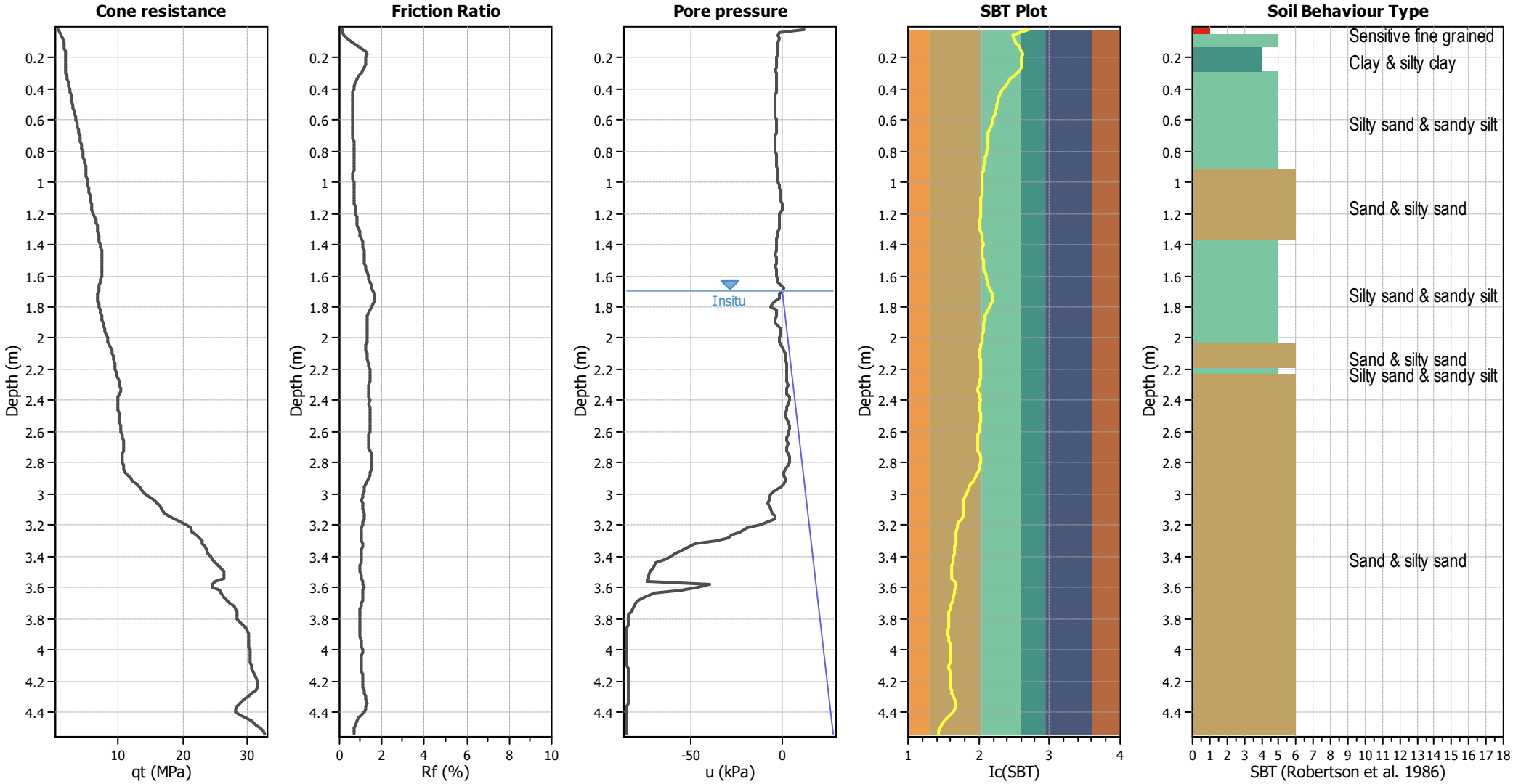






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



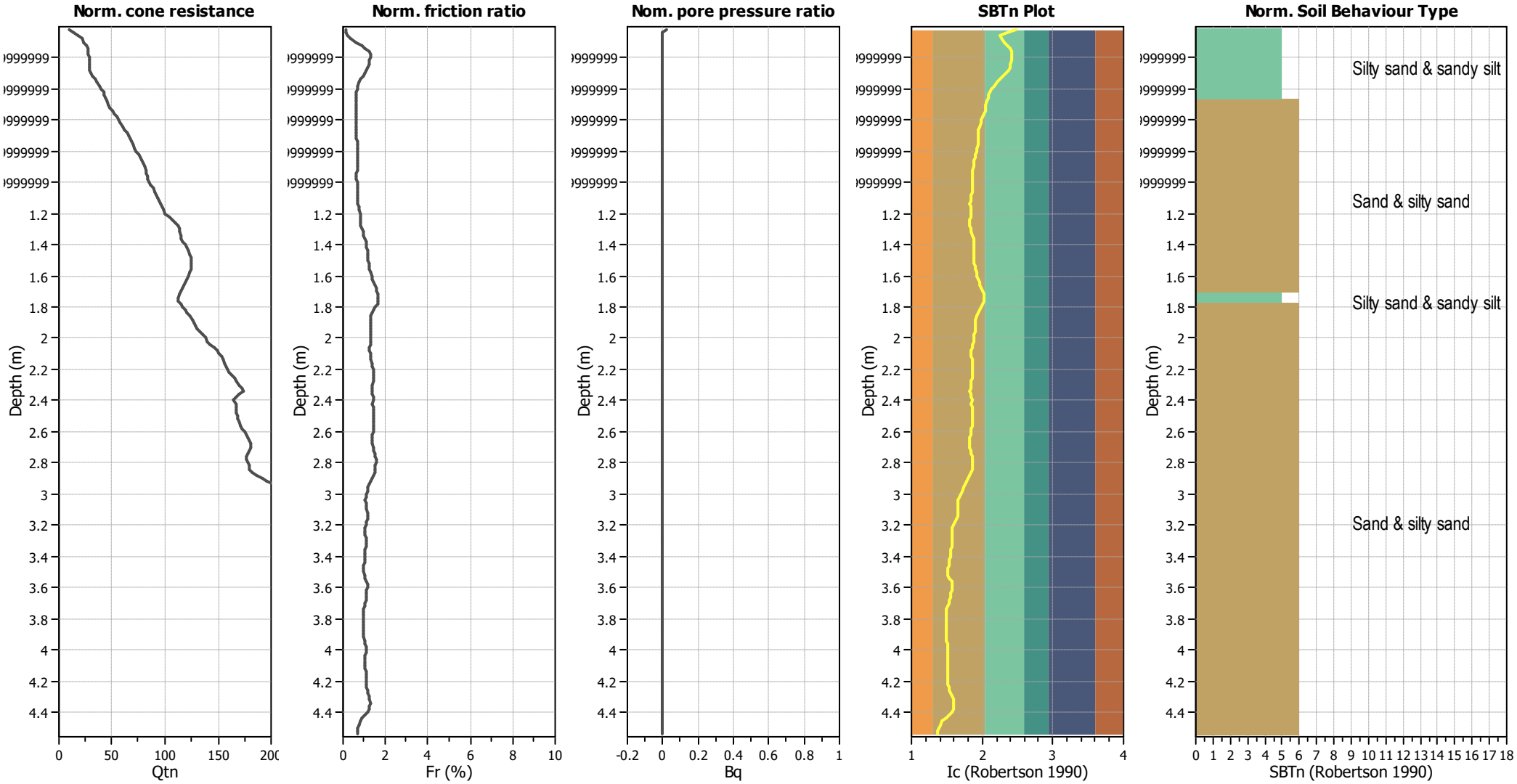
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



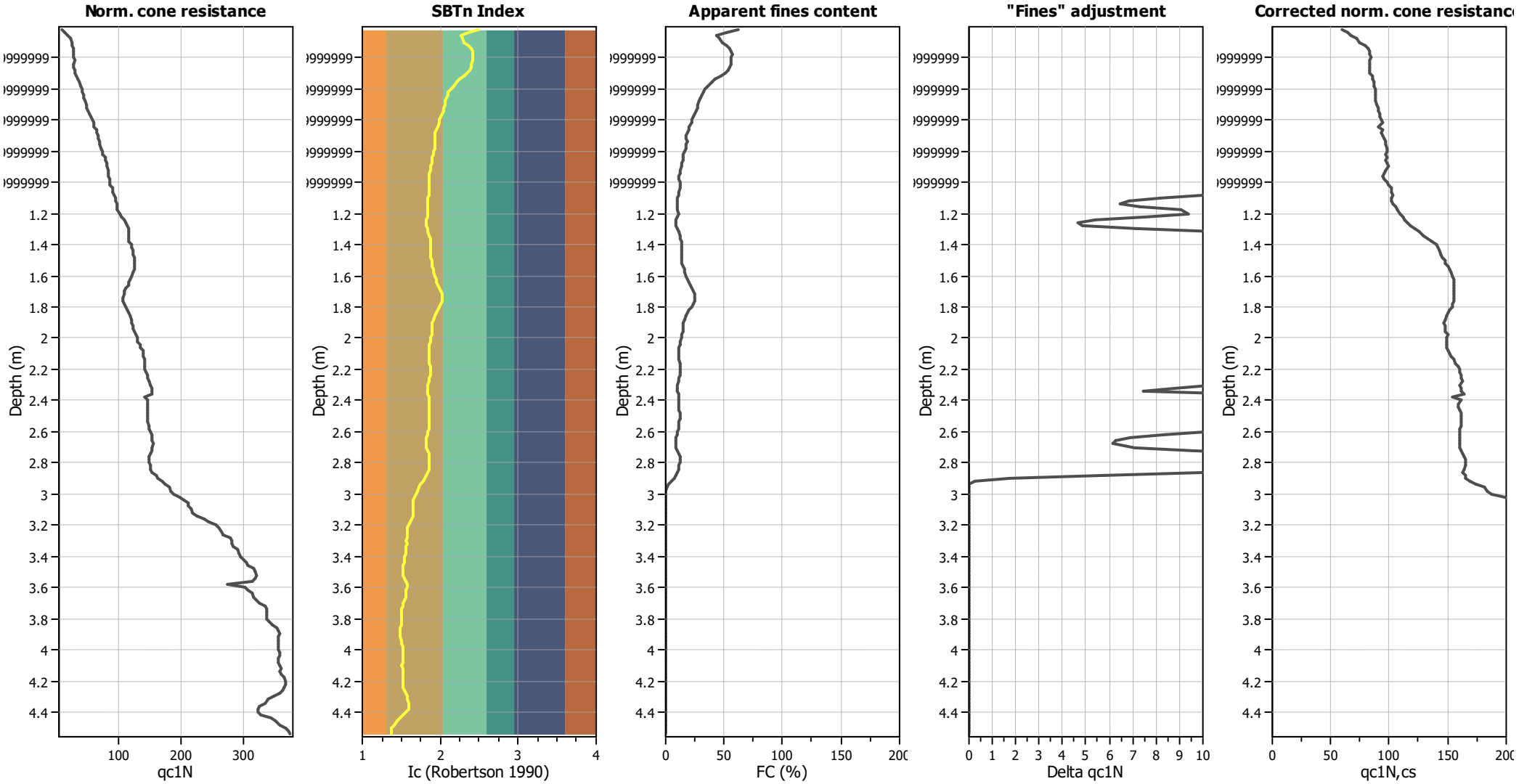
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

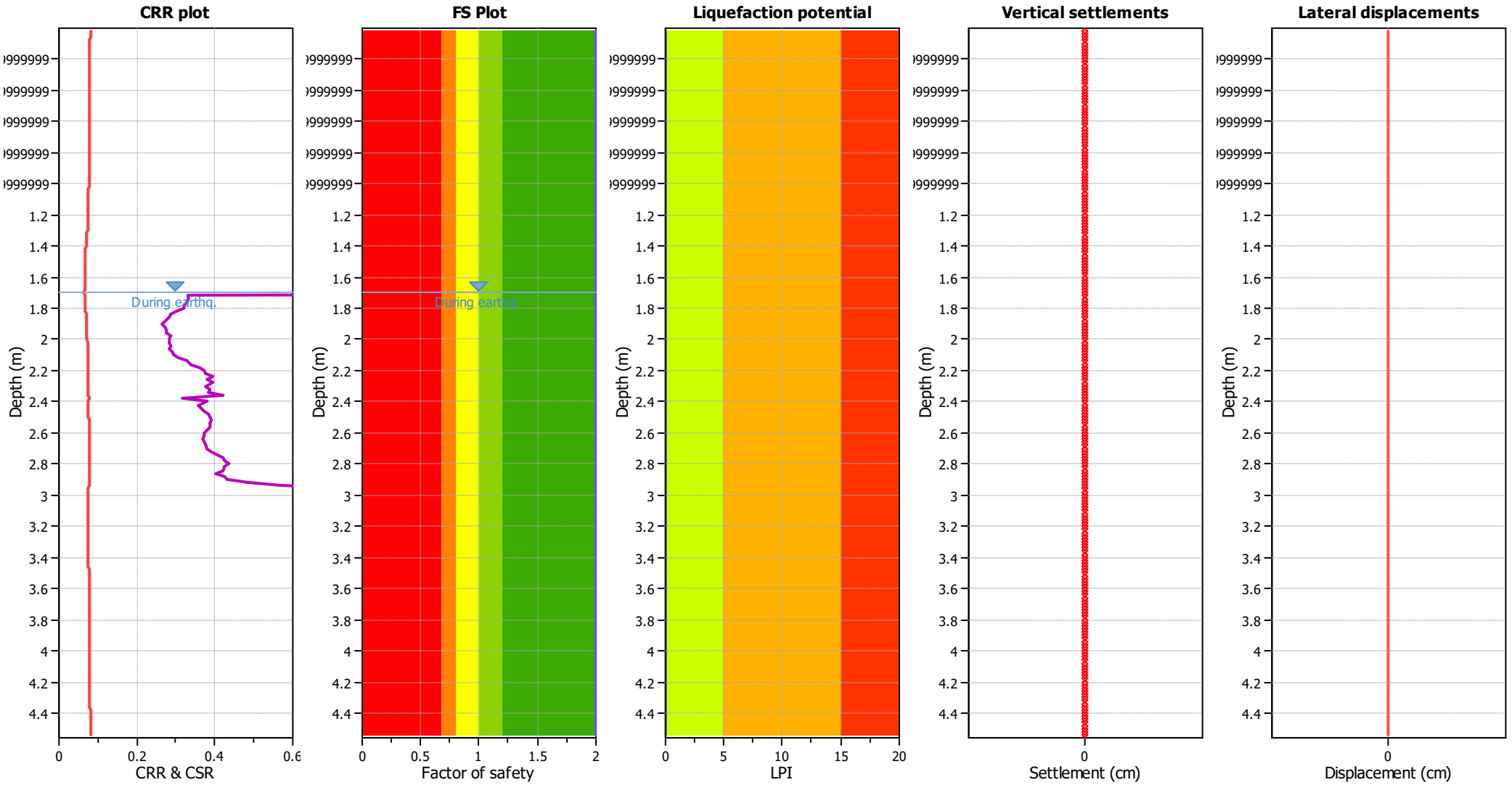
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

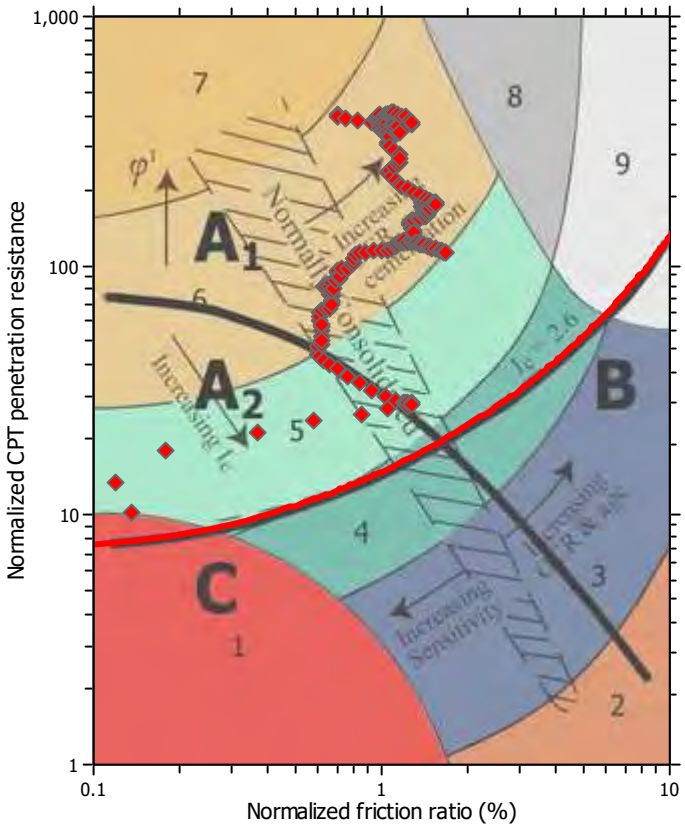
F.S. color scheme

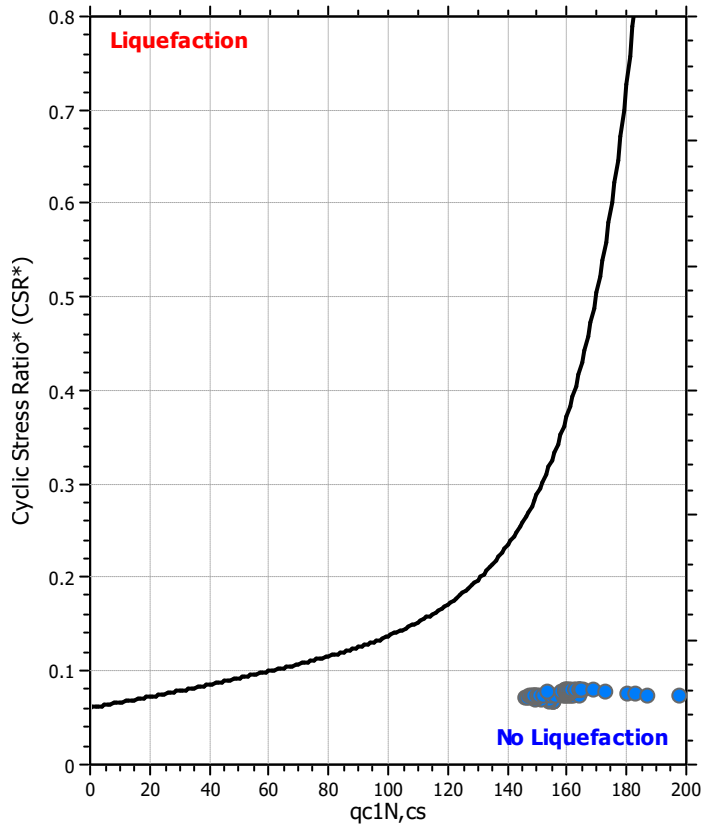
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

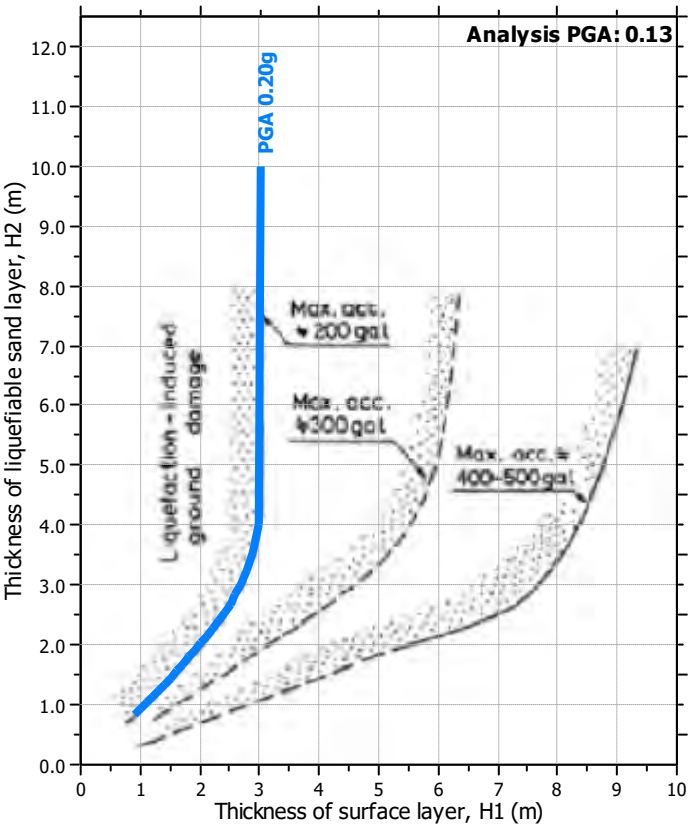
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



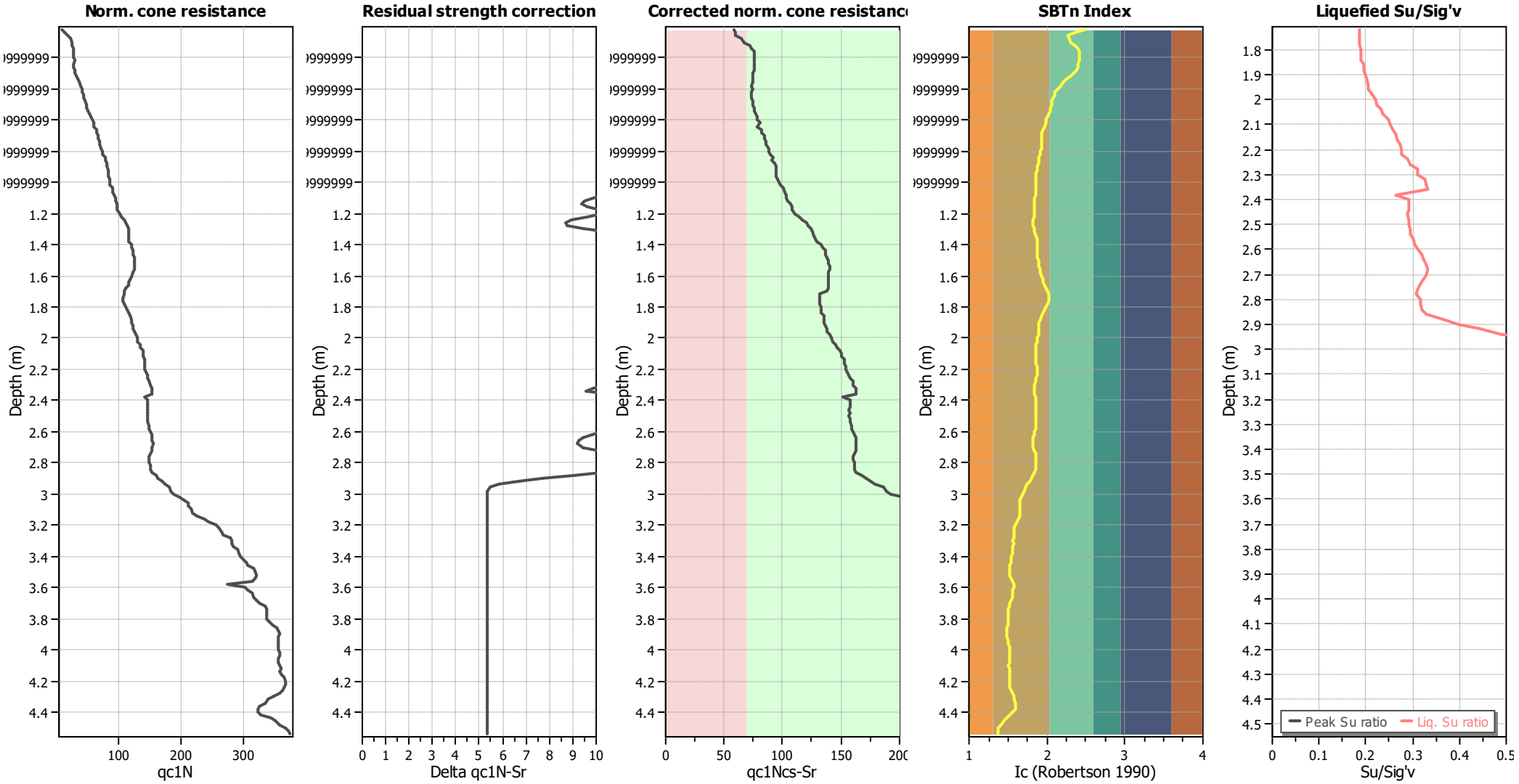




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

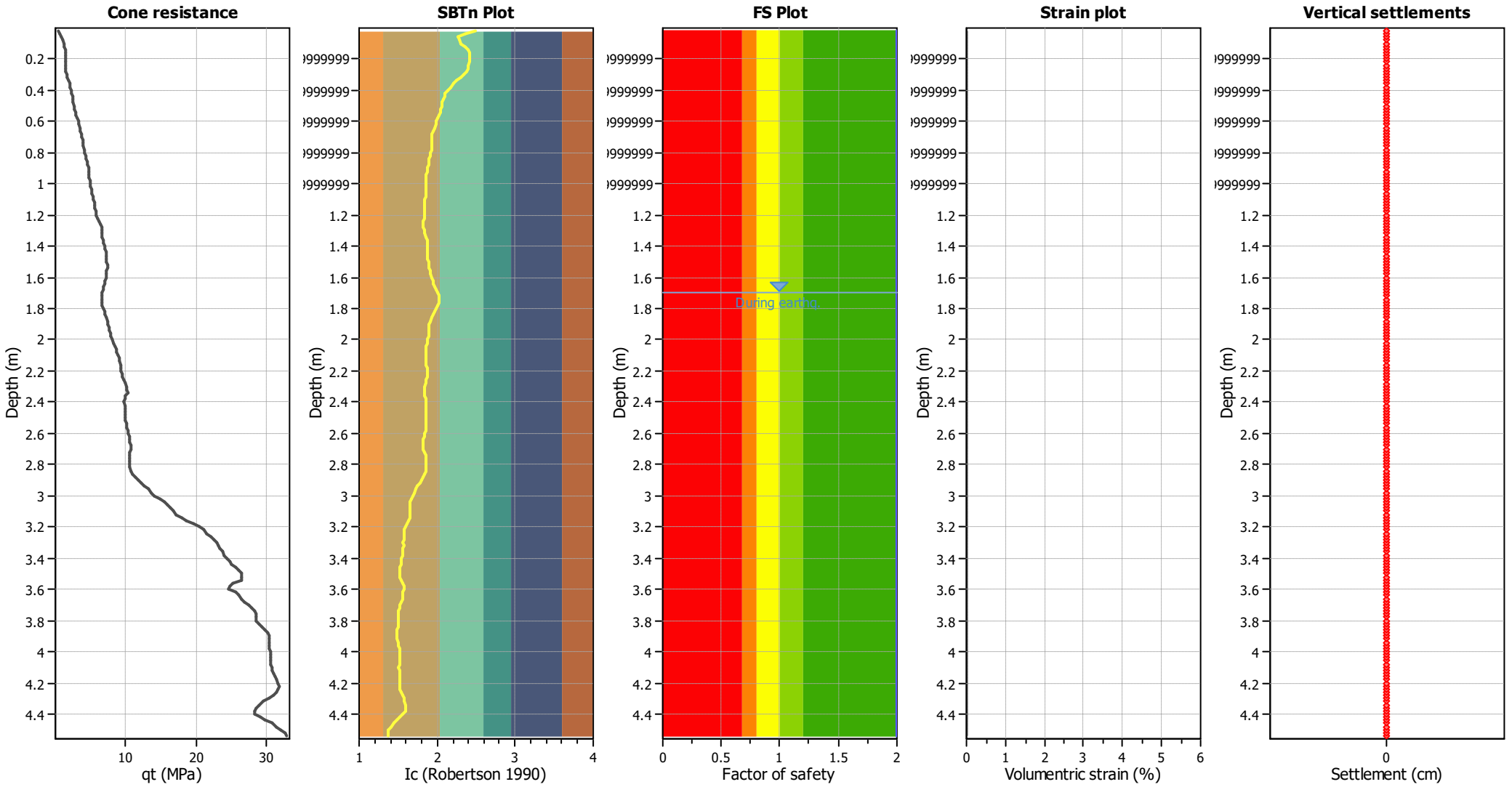
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

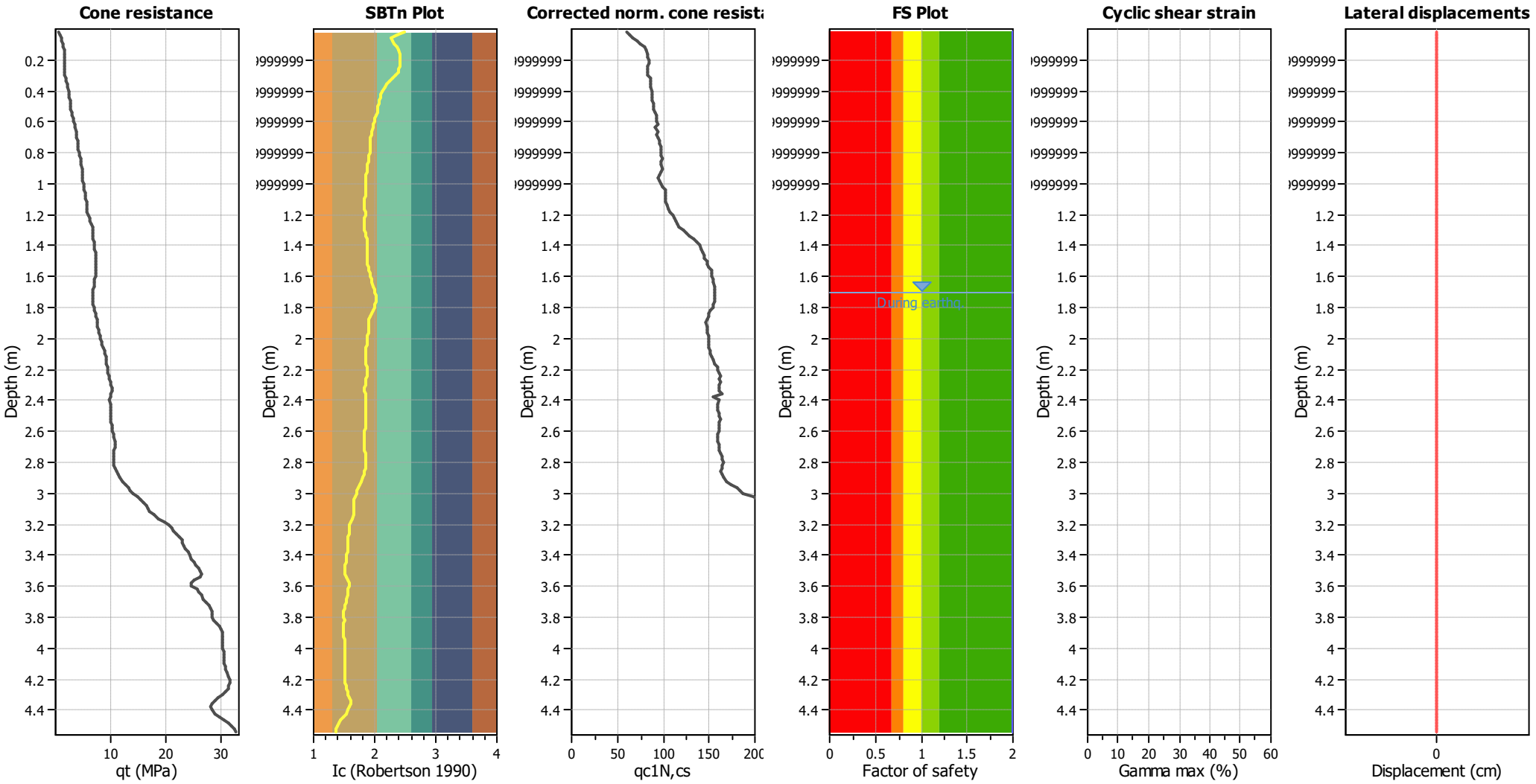
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
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$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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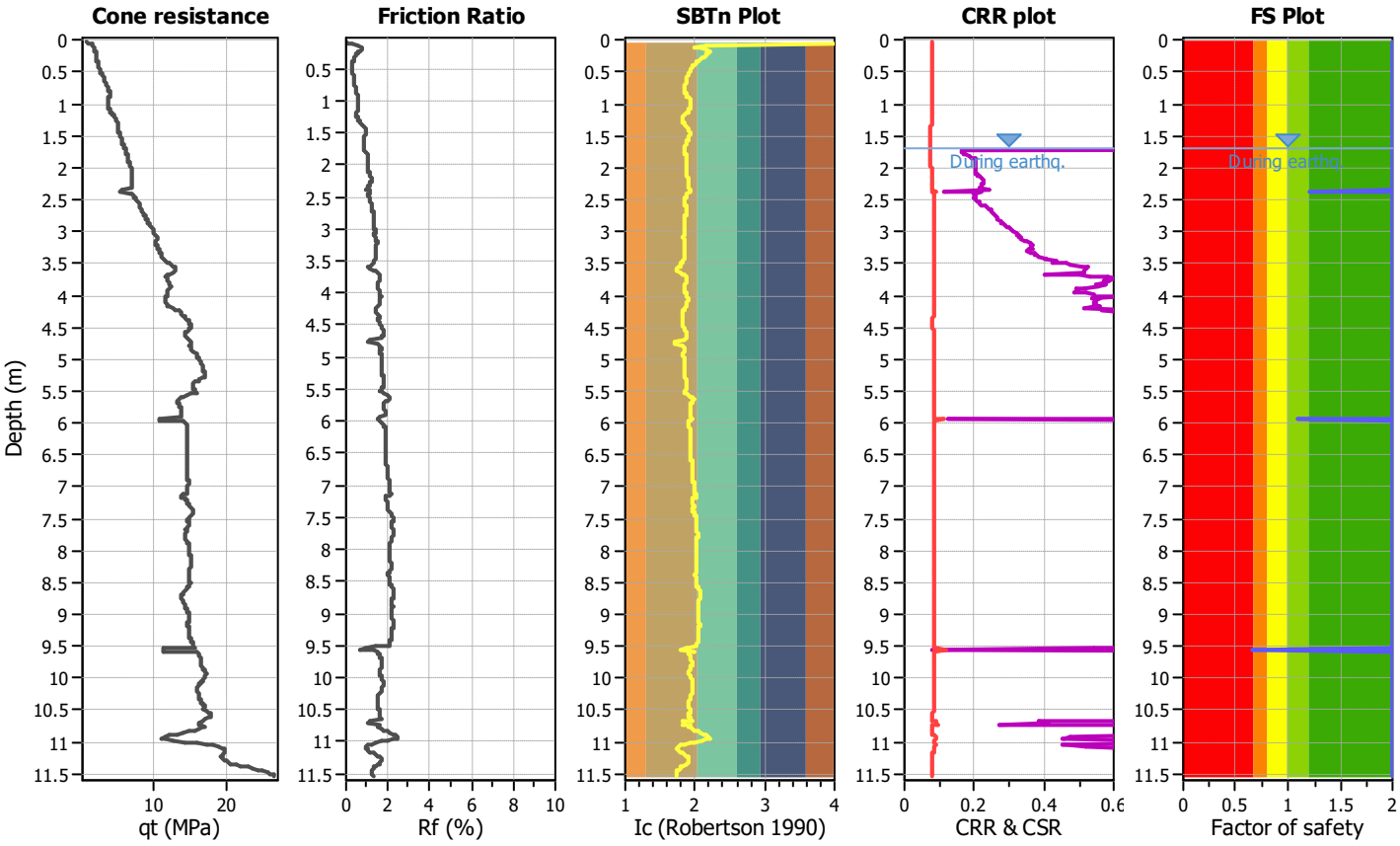
LIQUEFACTION ANALYSIS REPORT

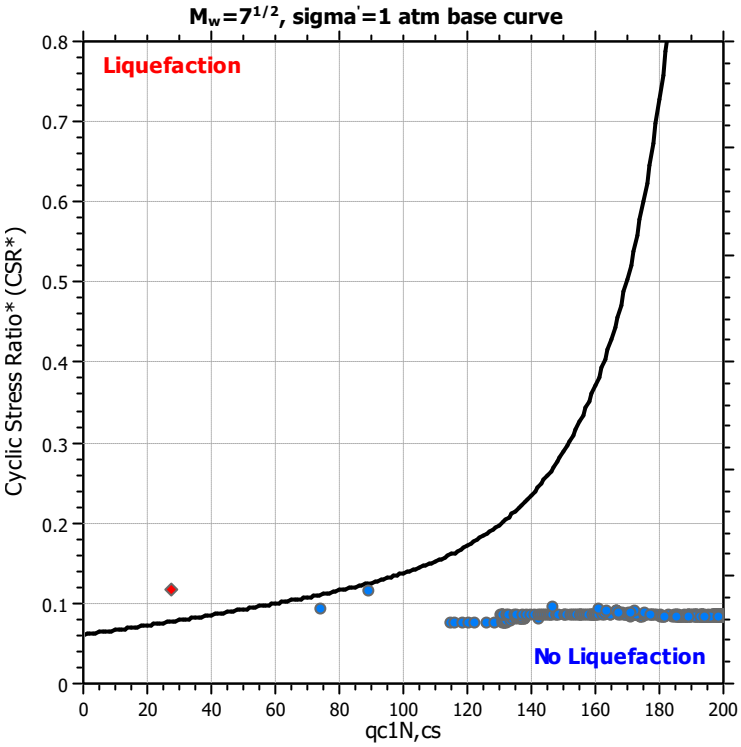
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

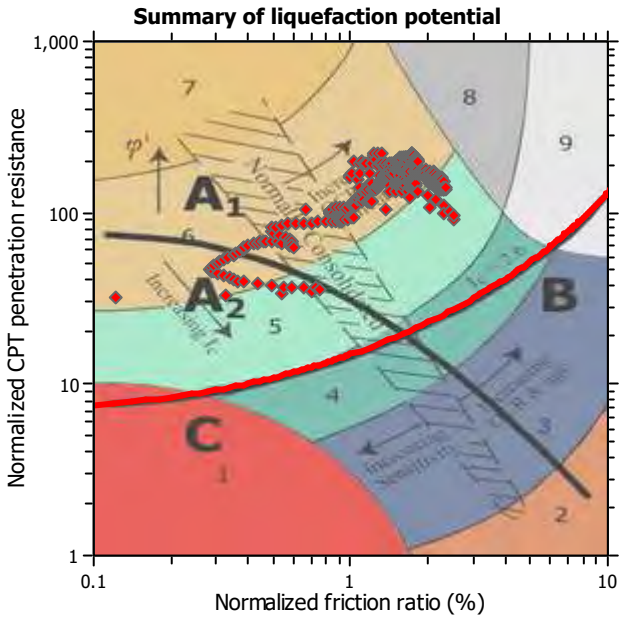
CPT file : CPT11_SLS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	6.50	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.13	Unit weight calculation:	Based on SBT	K_σ applied:	No		

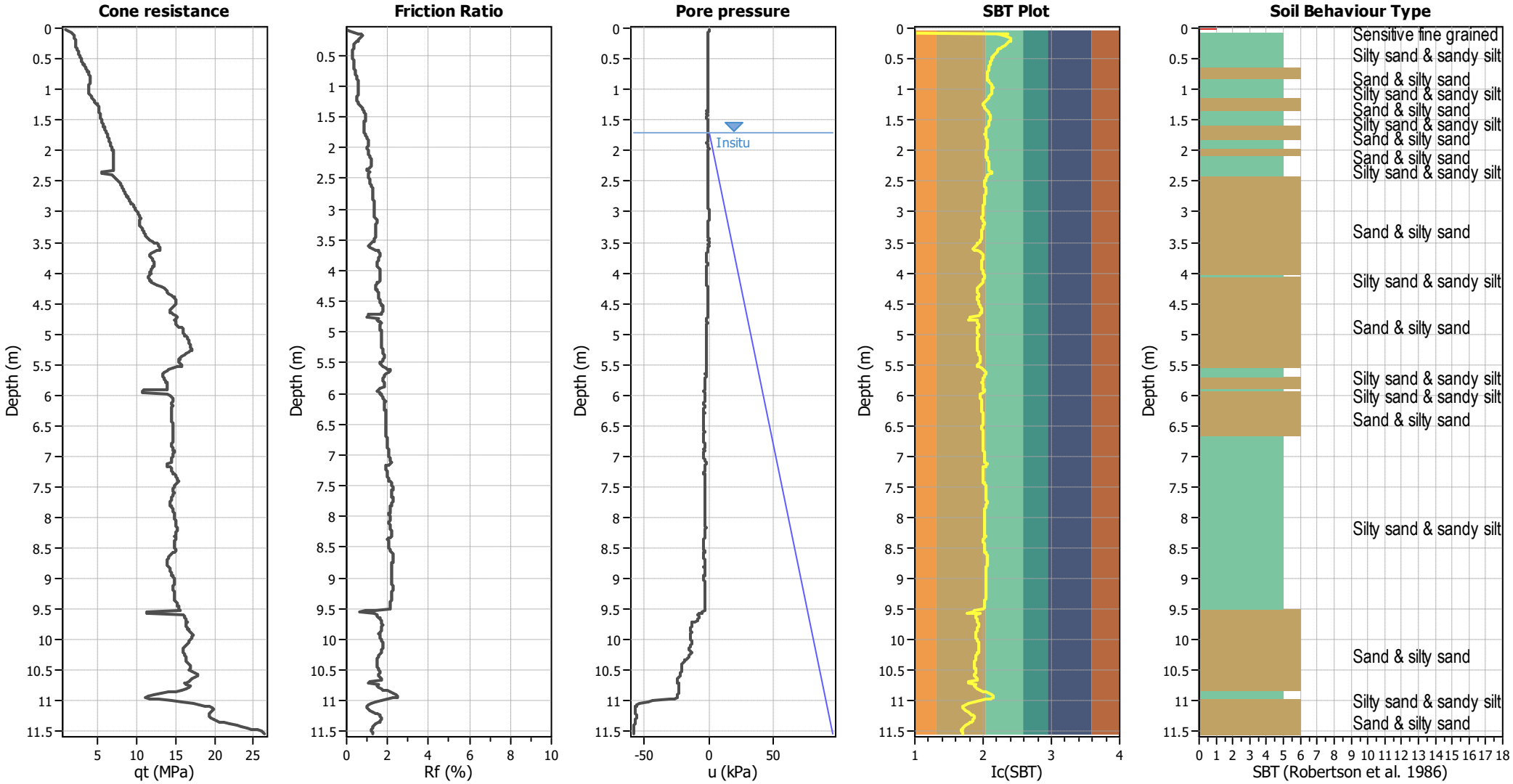






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



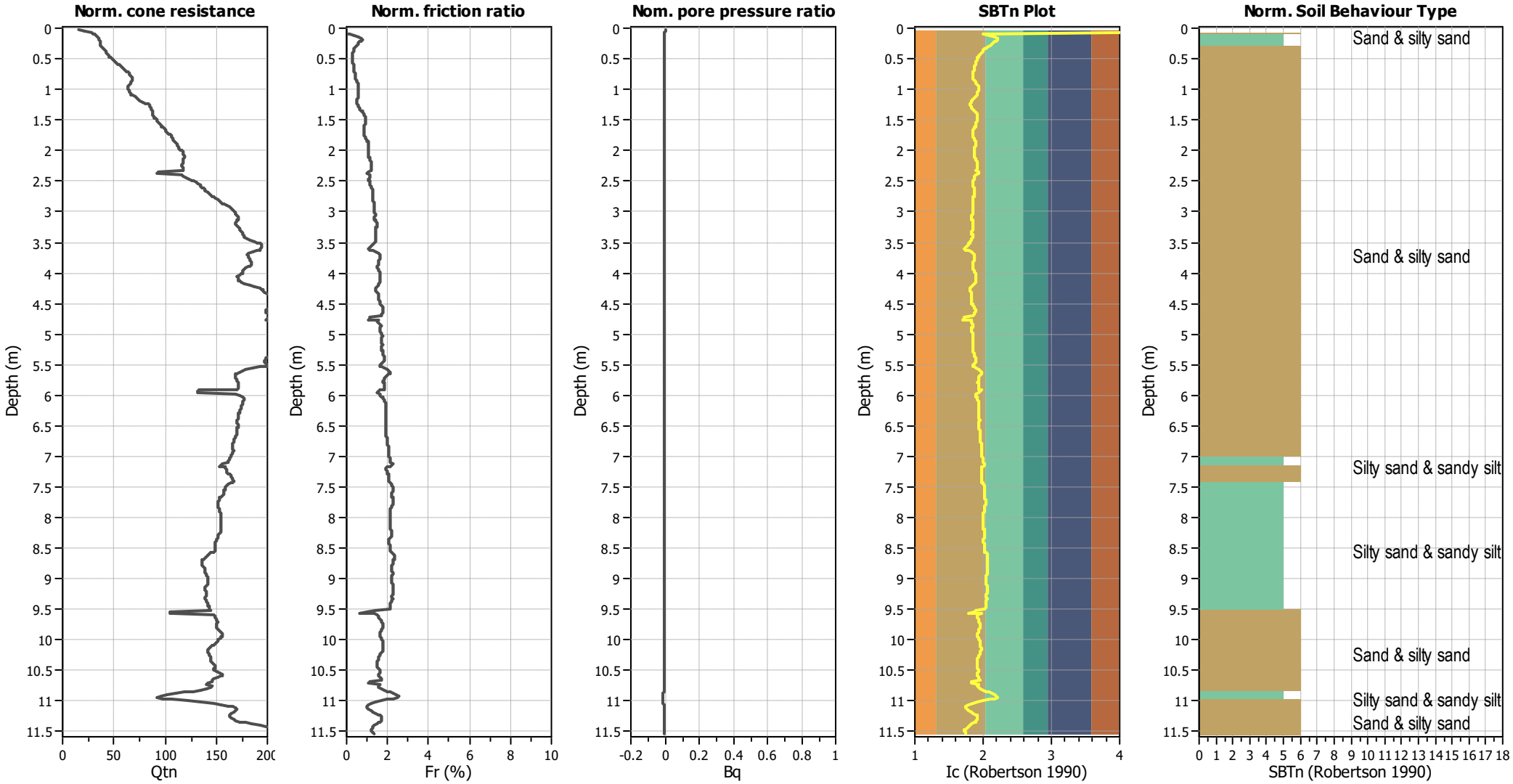
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
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3. Clay to silty clay
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5. Silty sand to sandy silt
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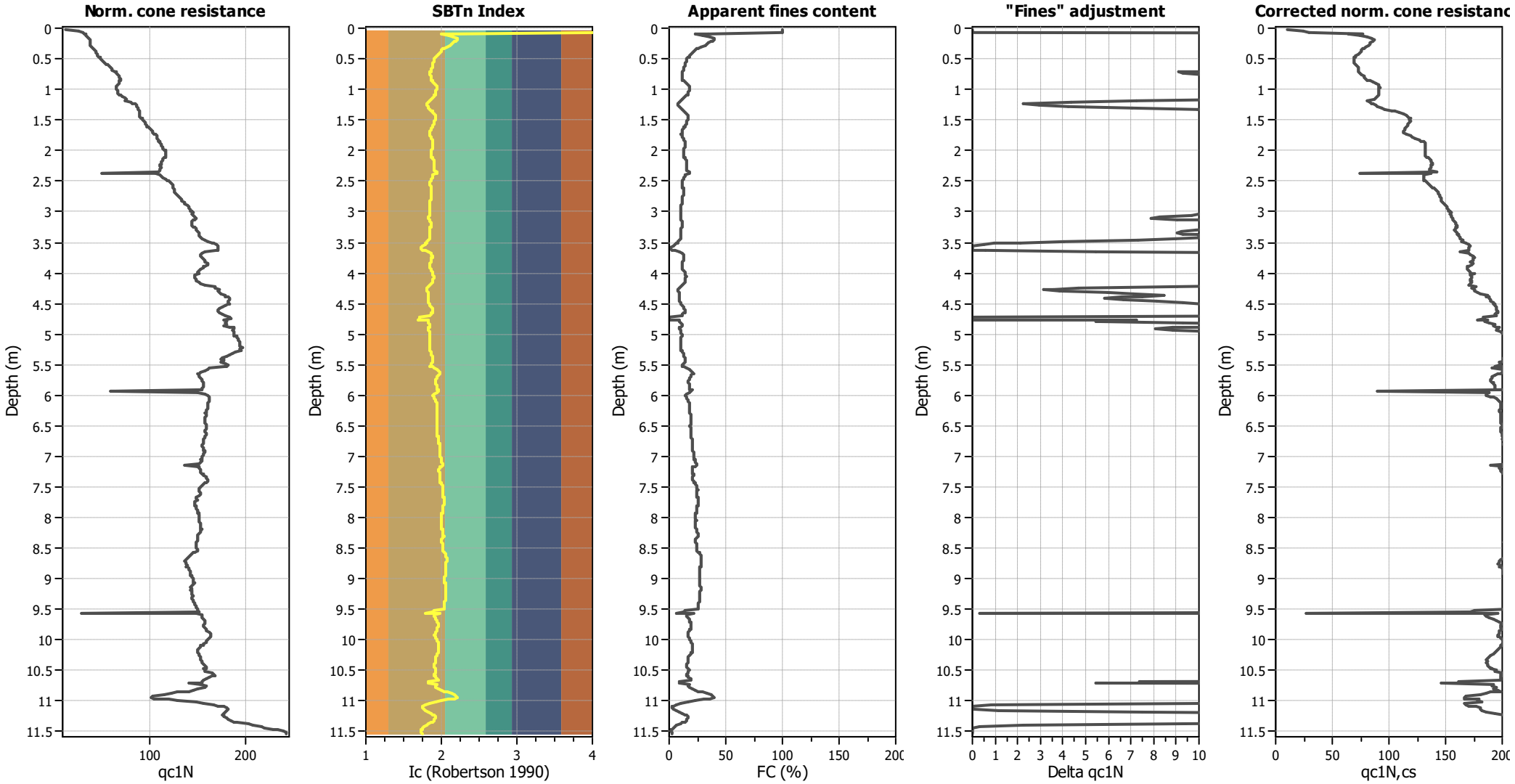
8. Very stiff sand to
9. Very stiff fine grained

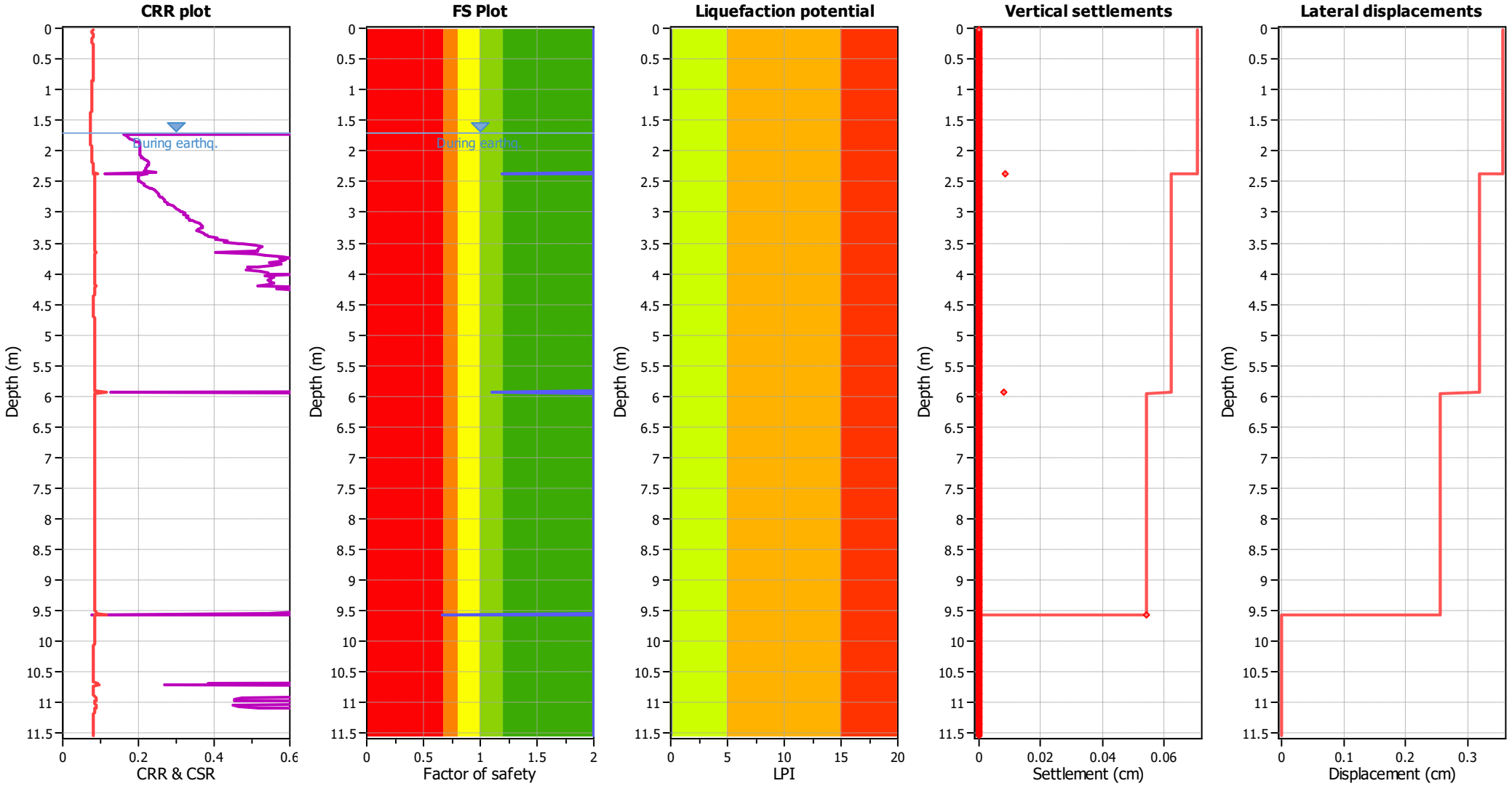
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

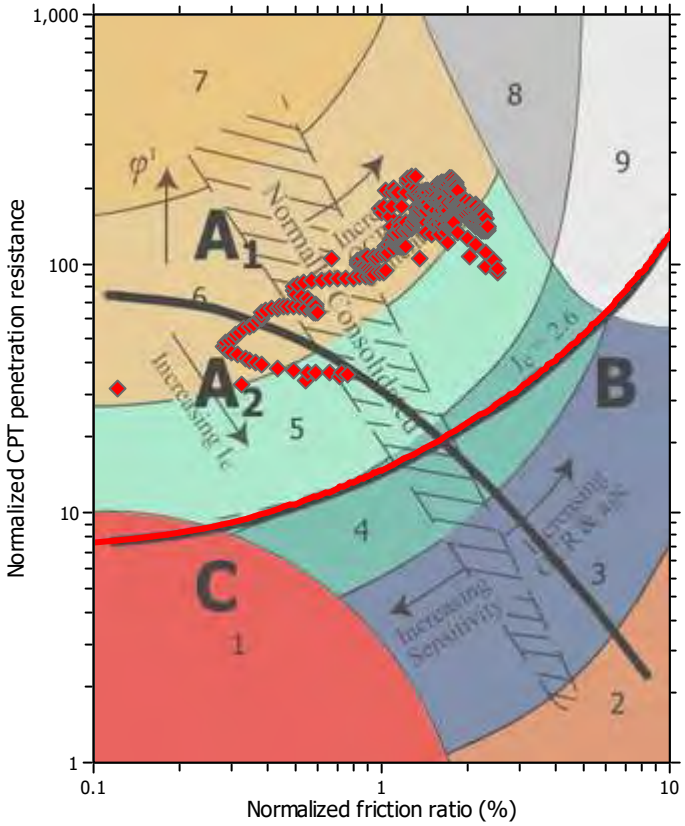
F.S. color scheme

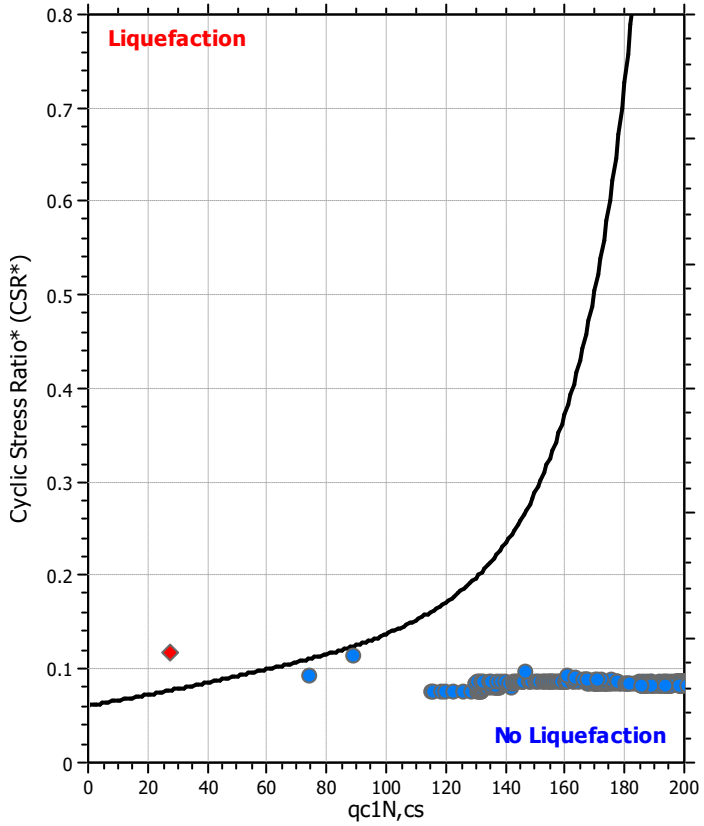
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

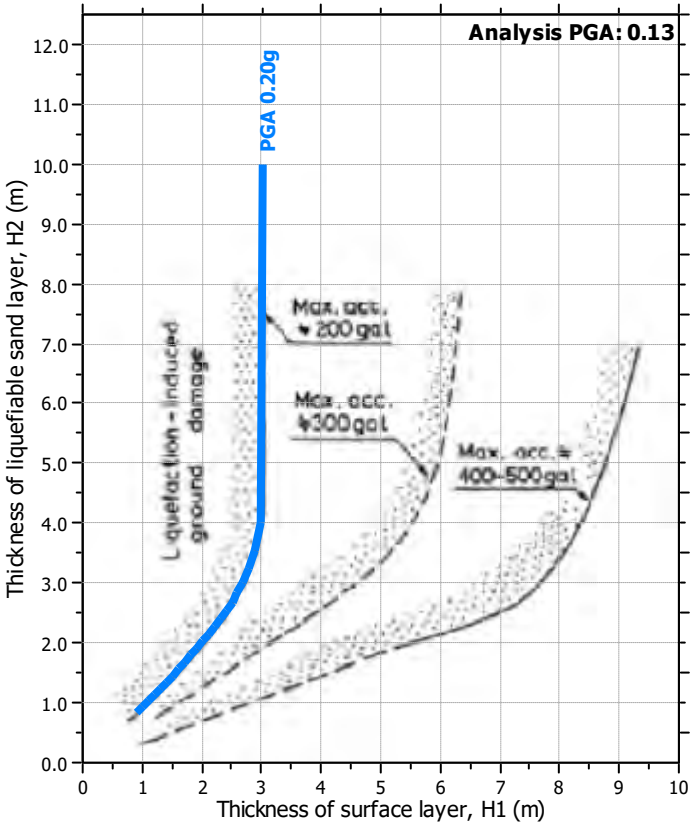
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



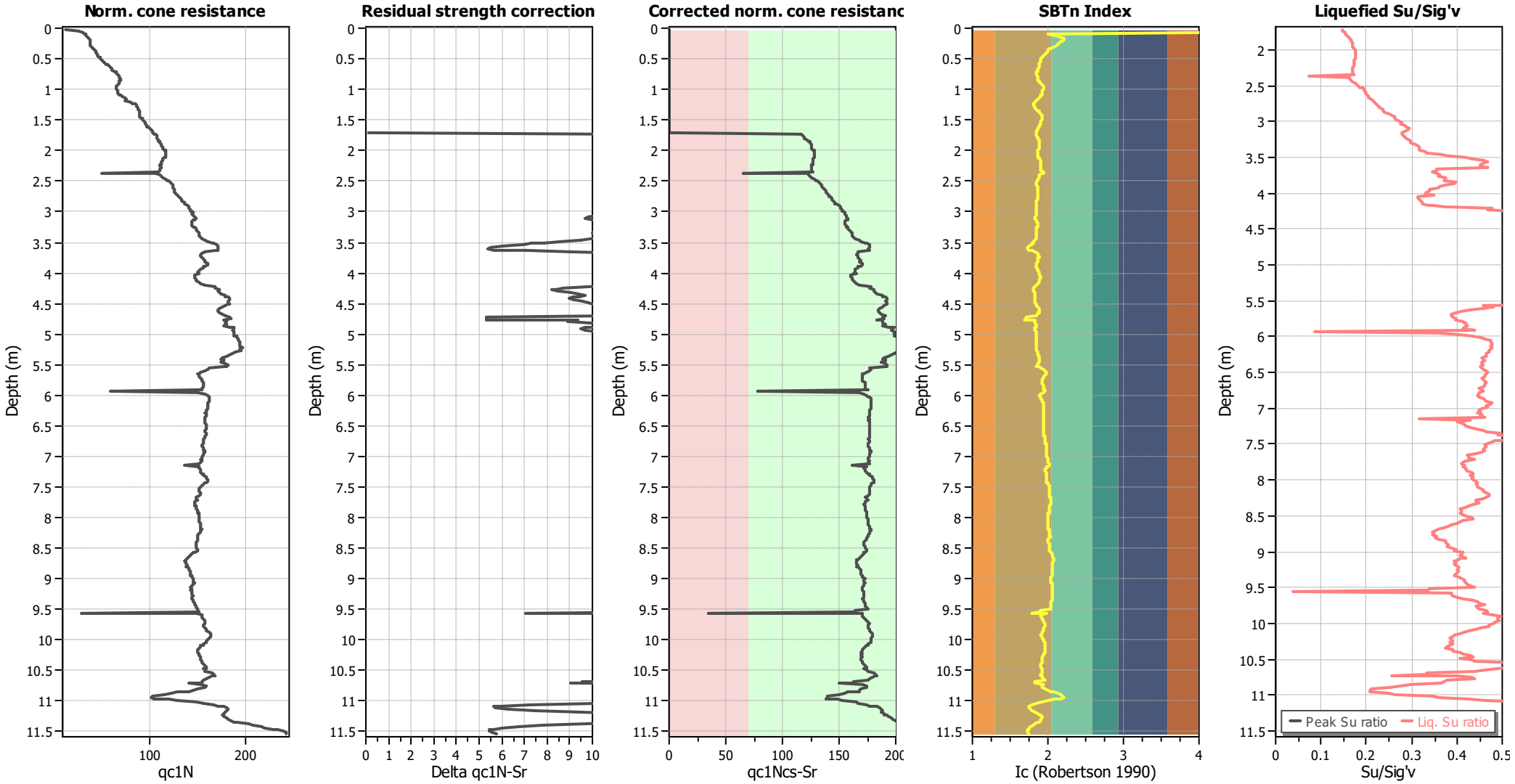




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

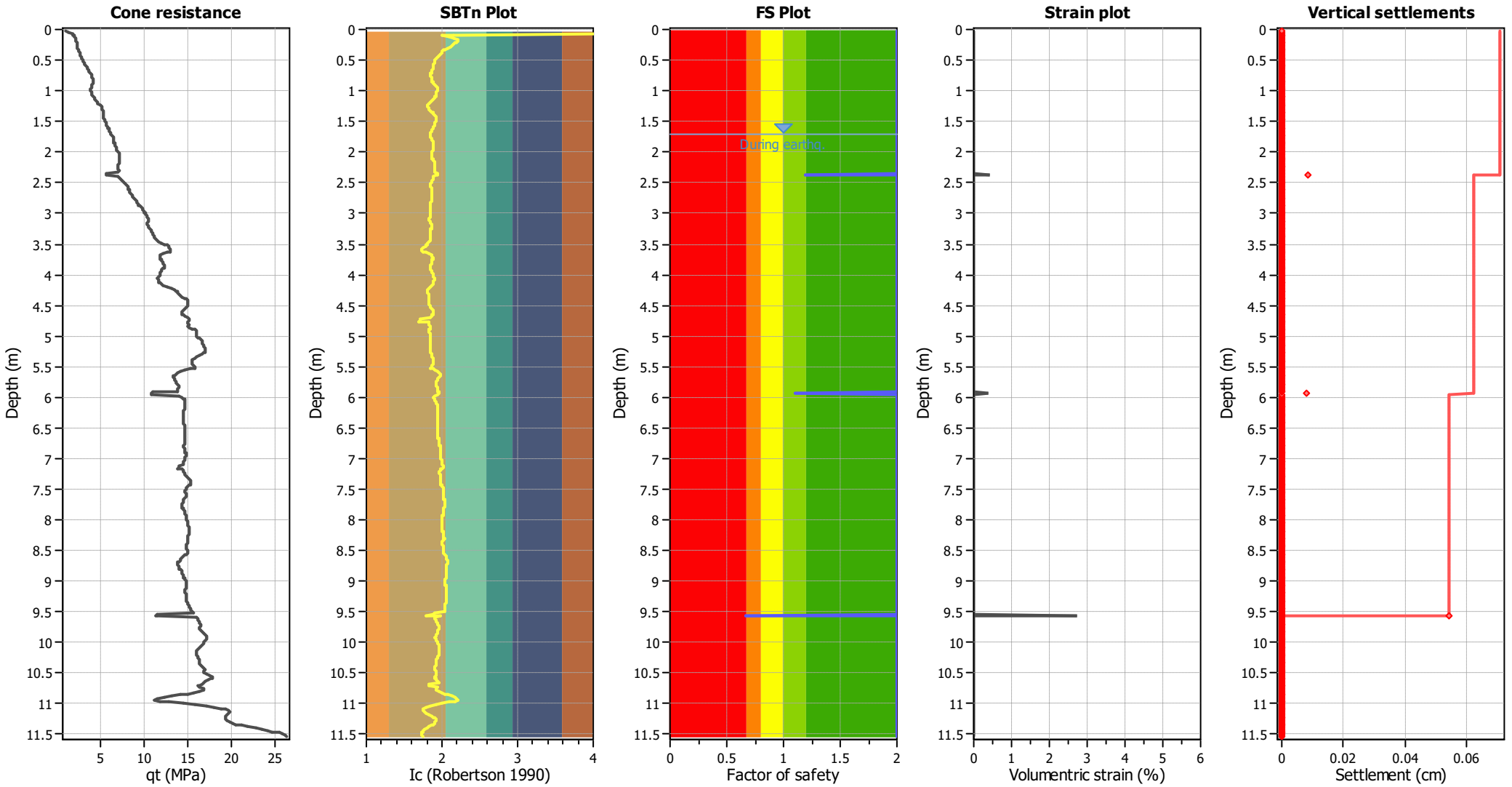
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	6.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

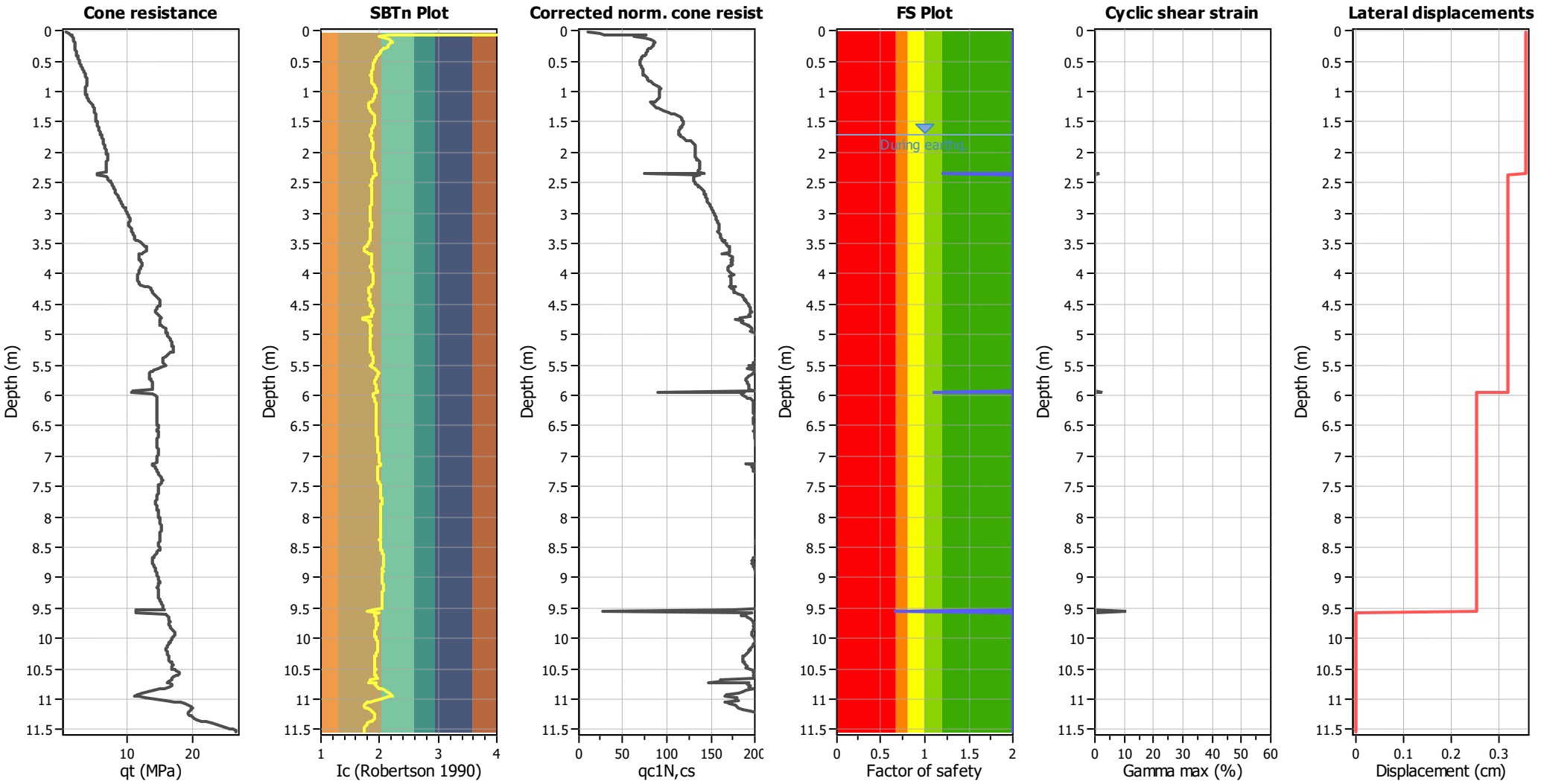
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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2/182 Main Rd Tawa
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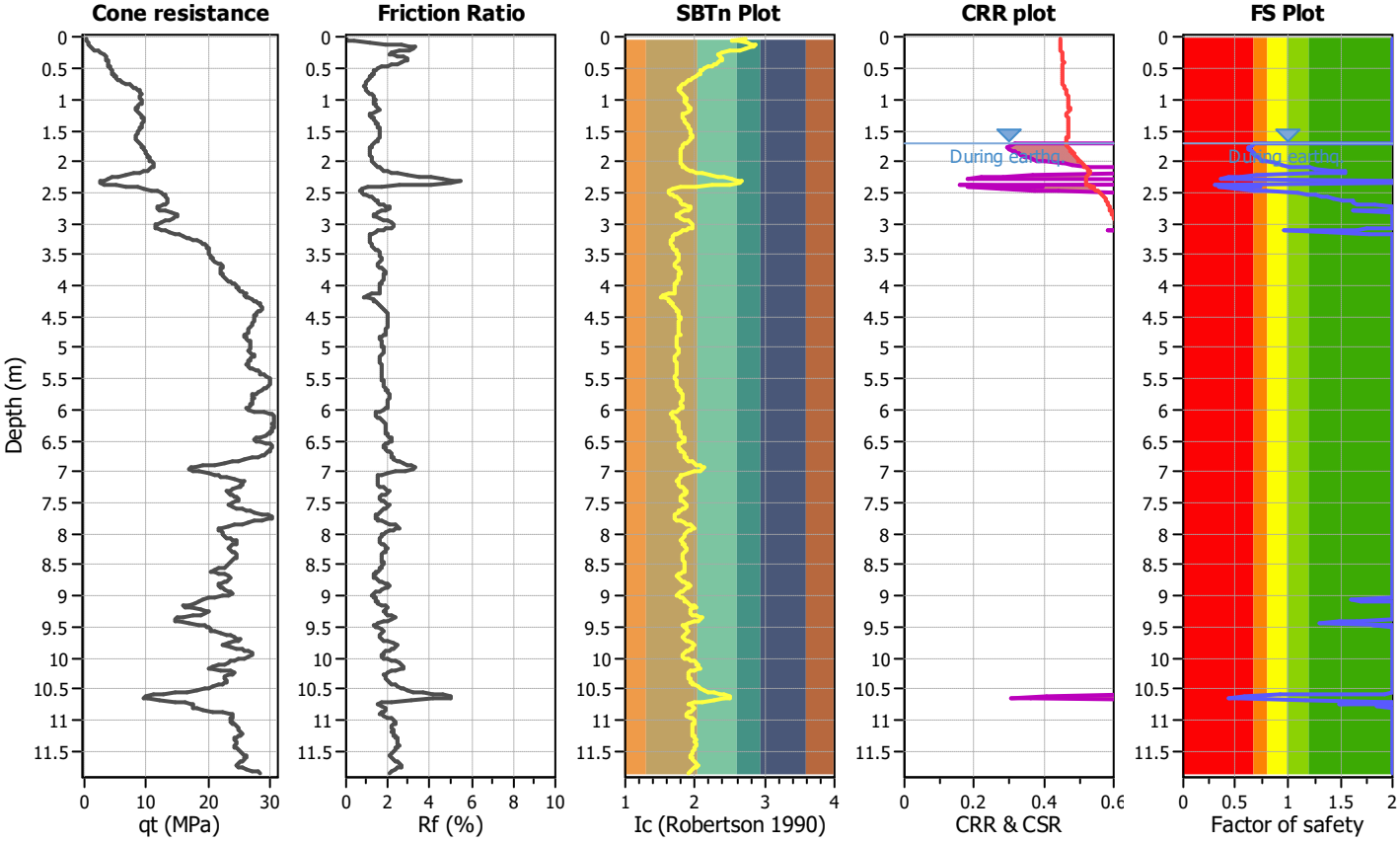
LIQUEFACTION ANALYSIS REPORT

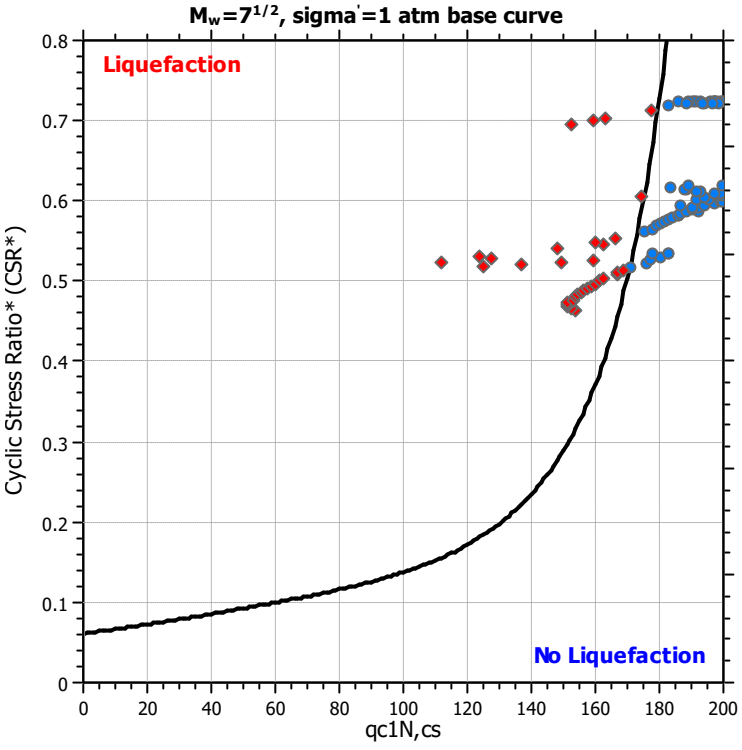
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

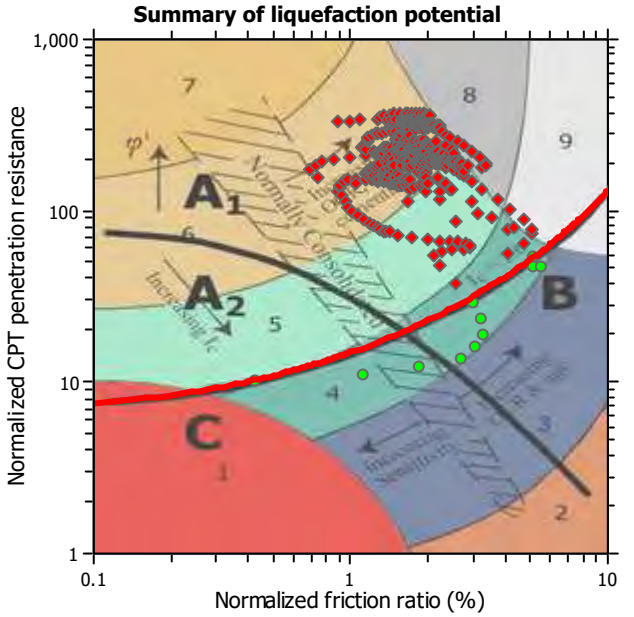
CPT file : CPT01_ULS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	7.70	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.68	Unit weight calculation:	Based on SBT	K_σ applied:	No		

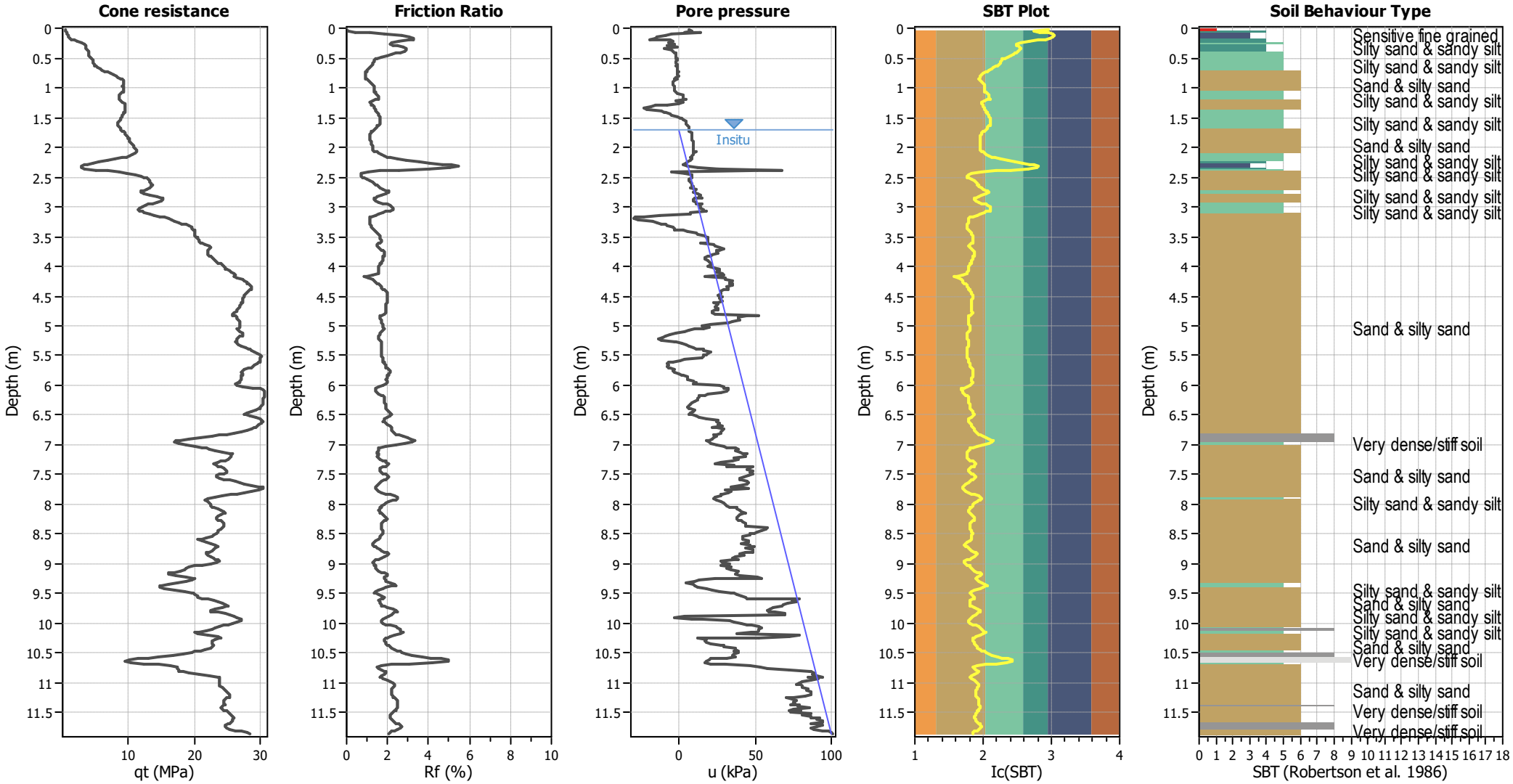






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



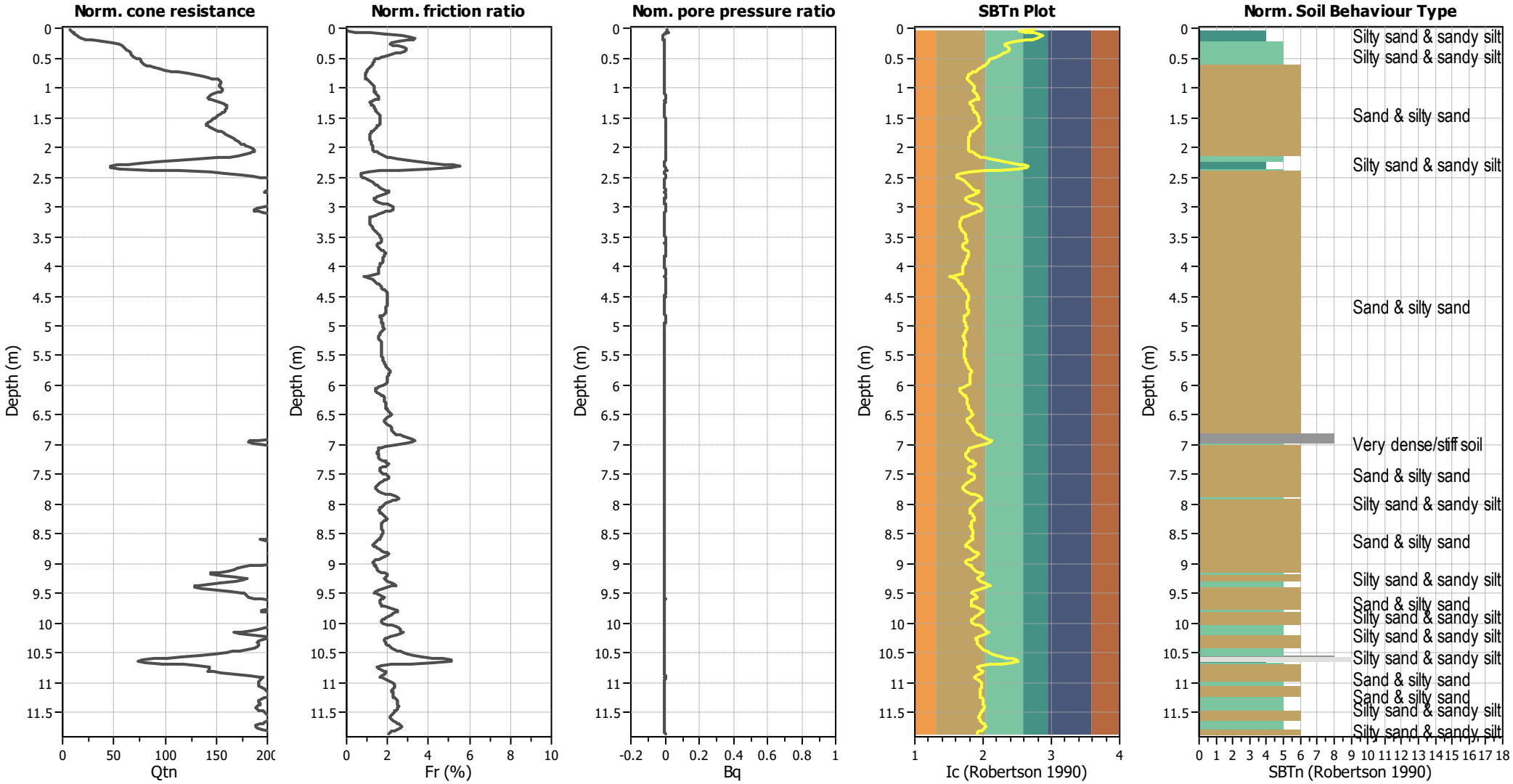
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



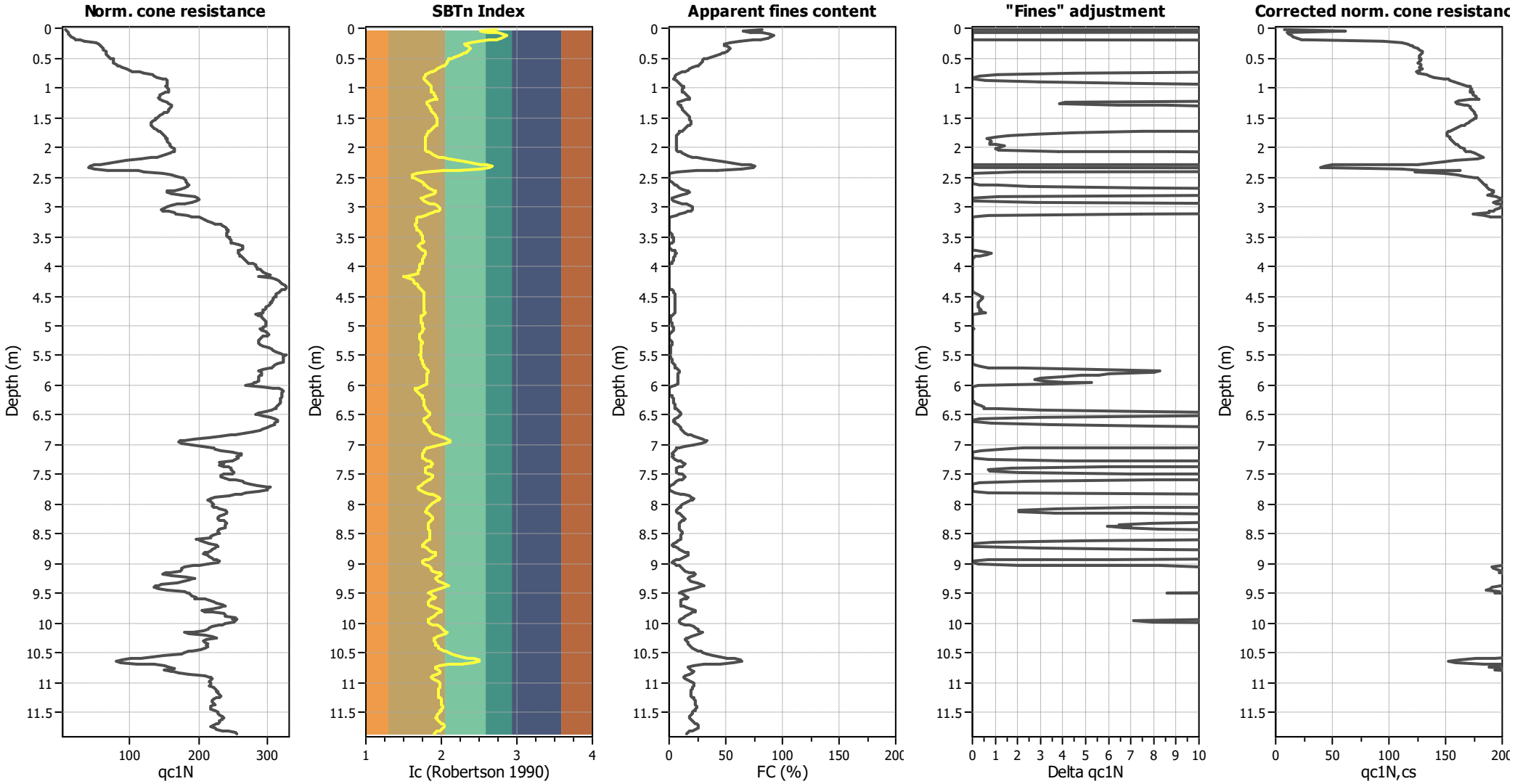
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

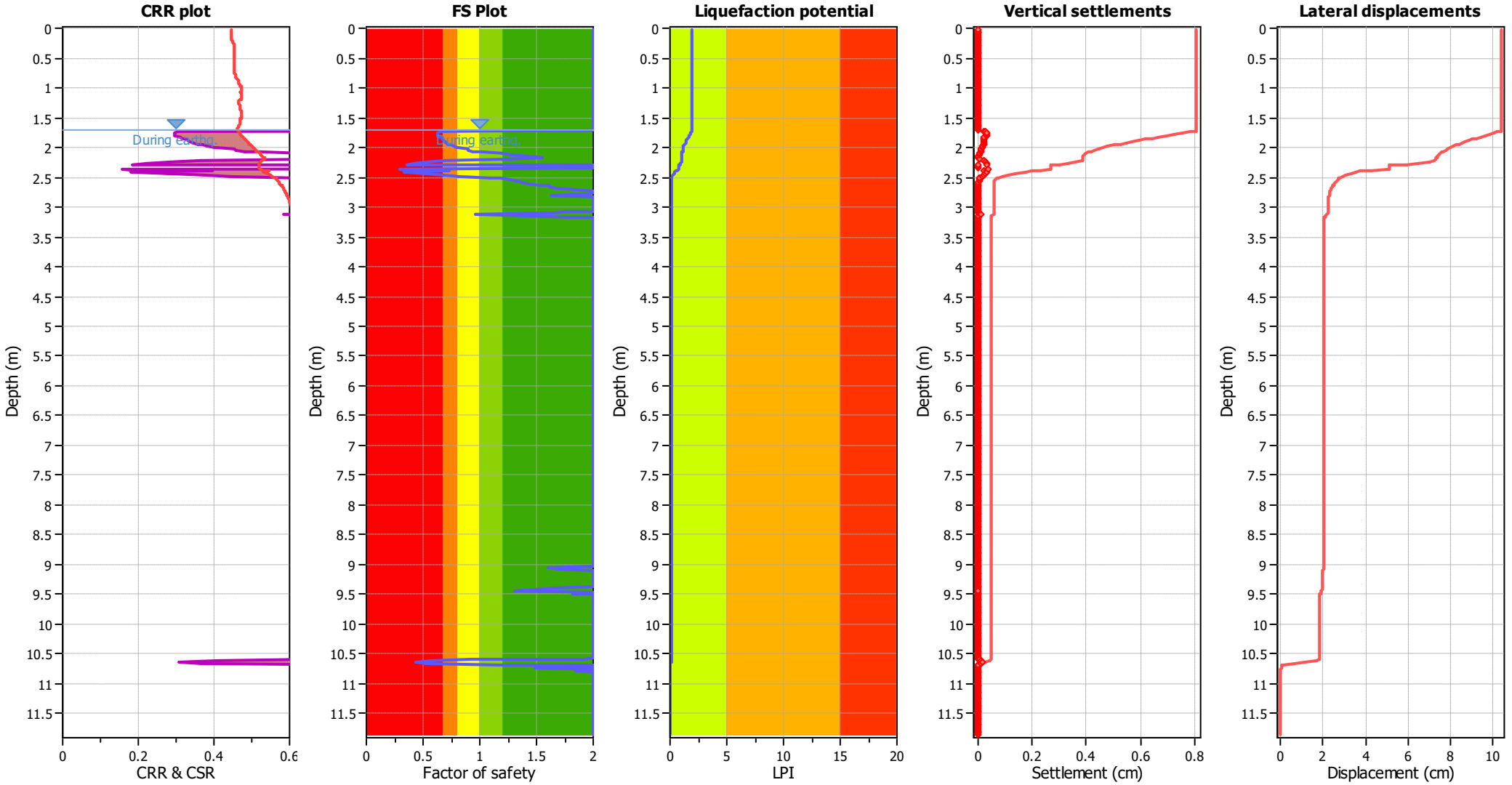
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

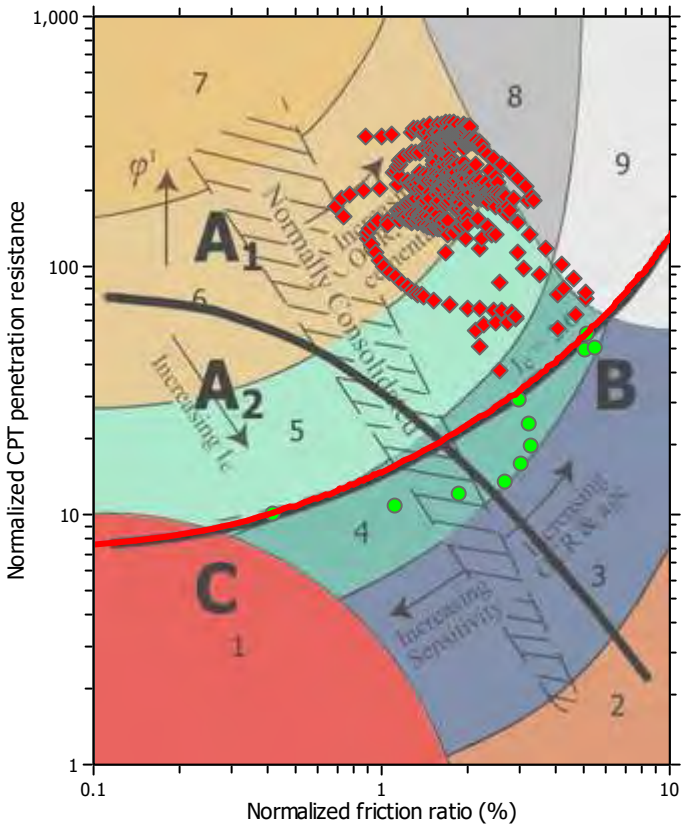
F.S. color scheme

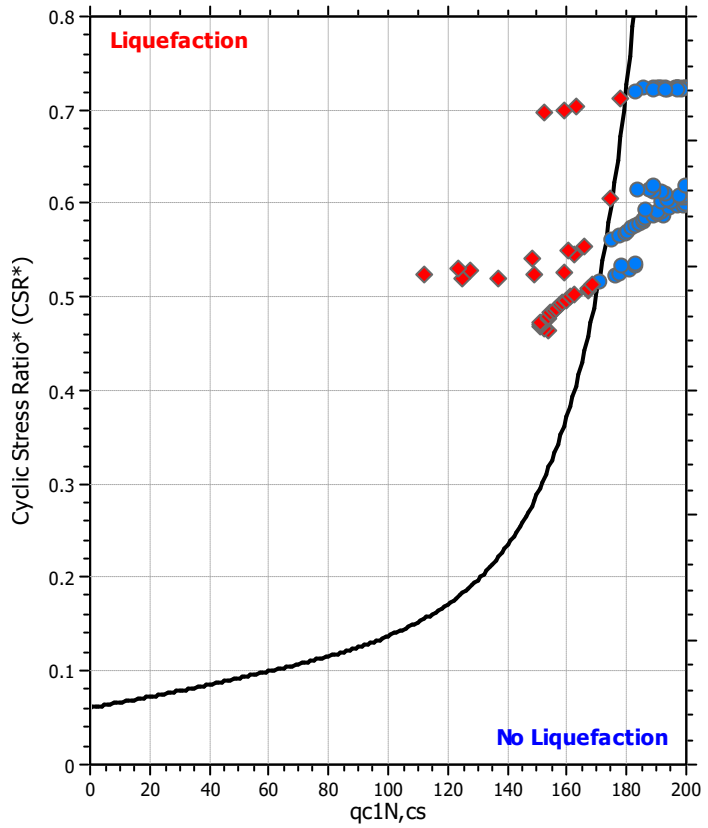
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

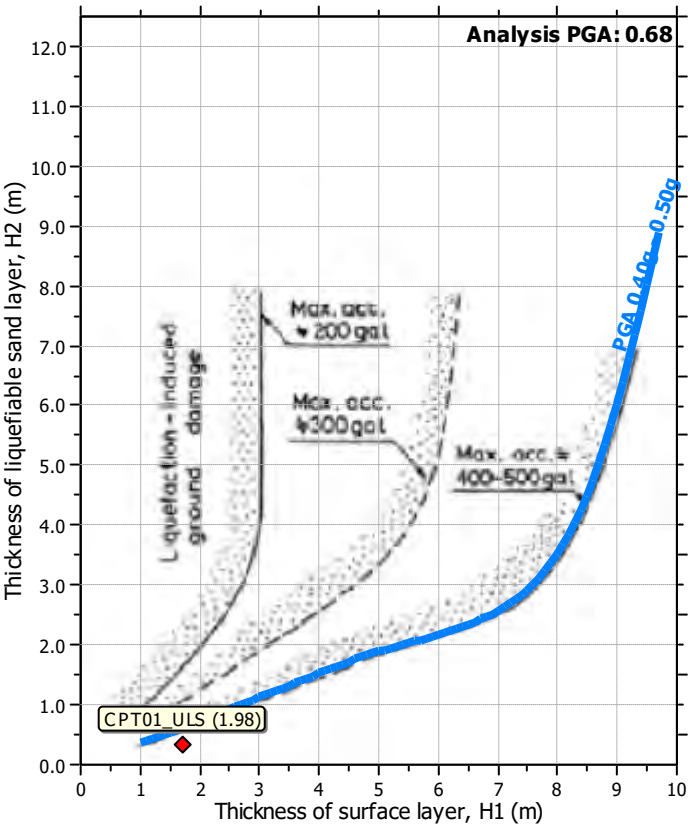
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



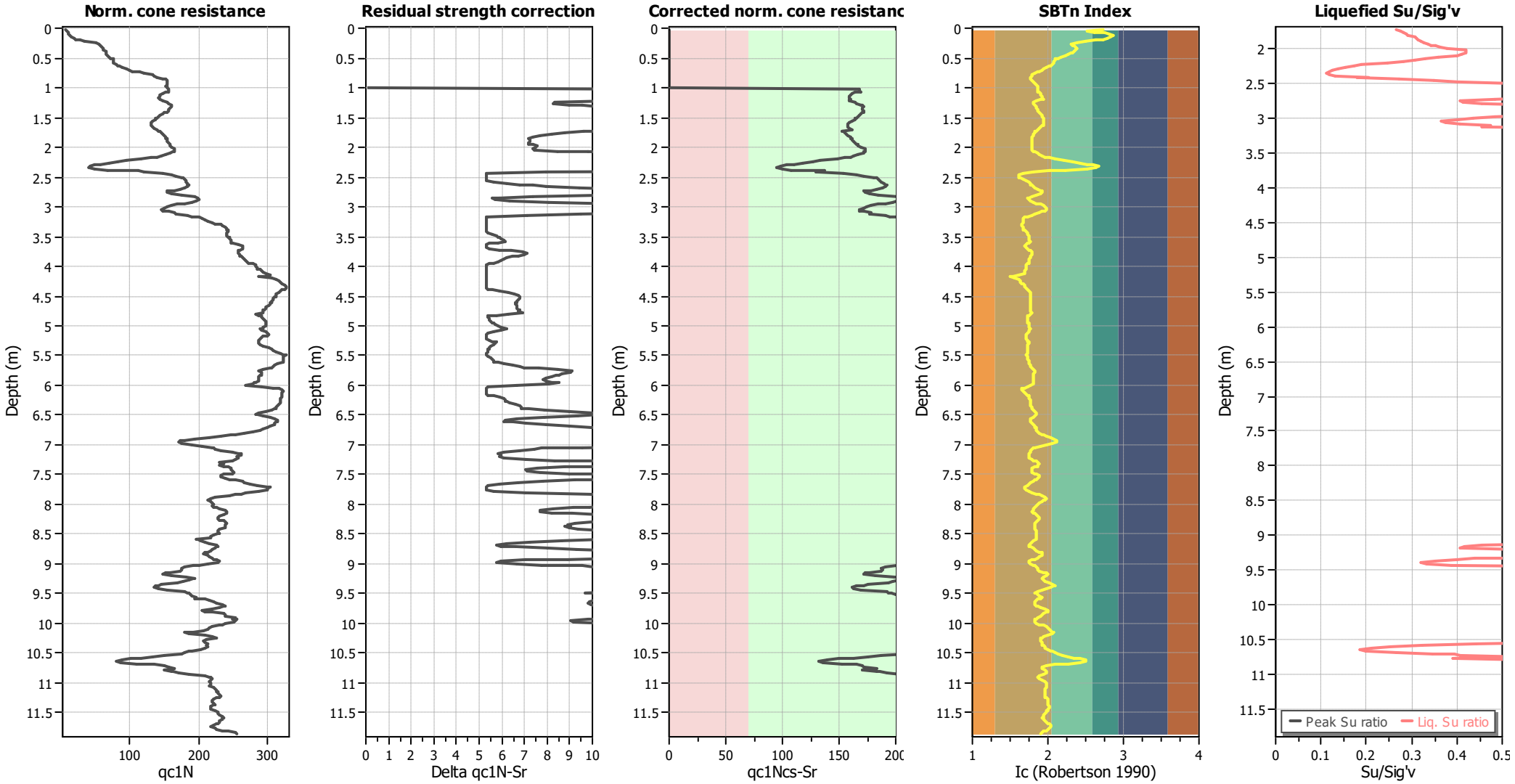




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

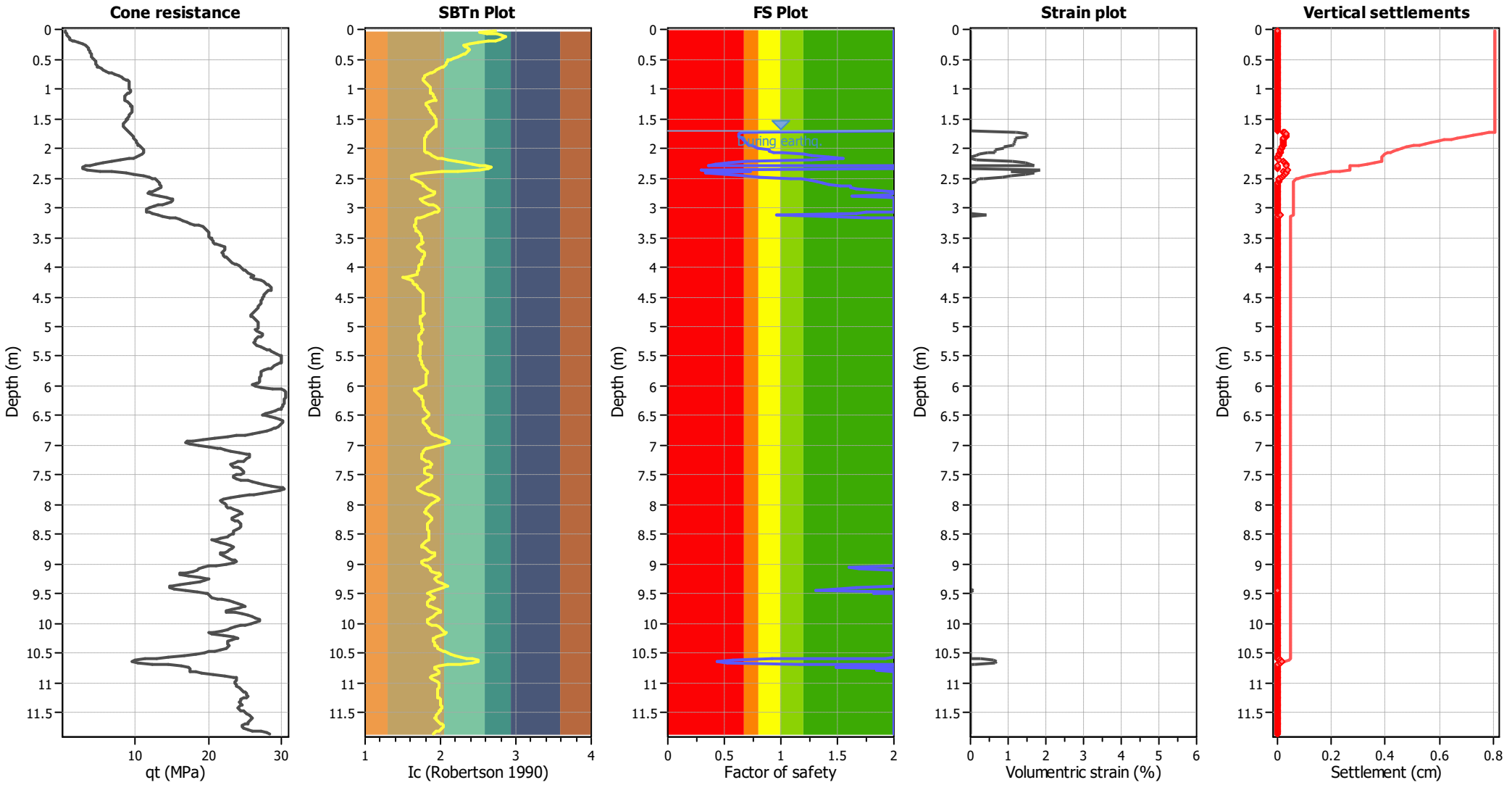
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

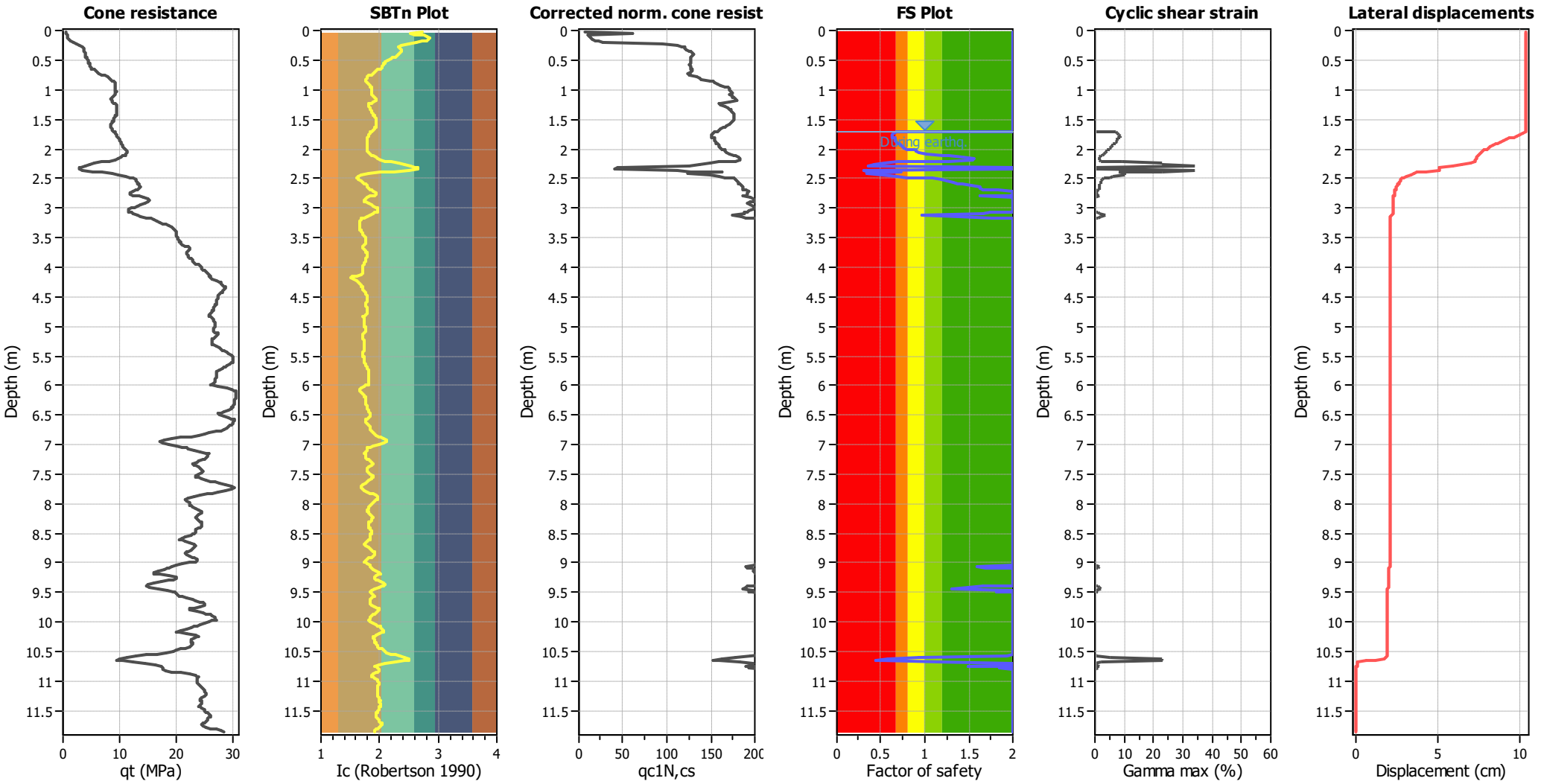
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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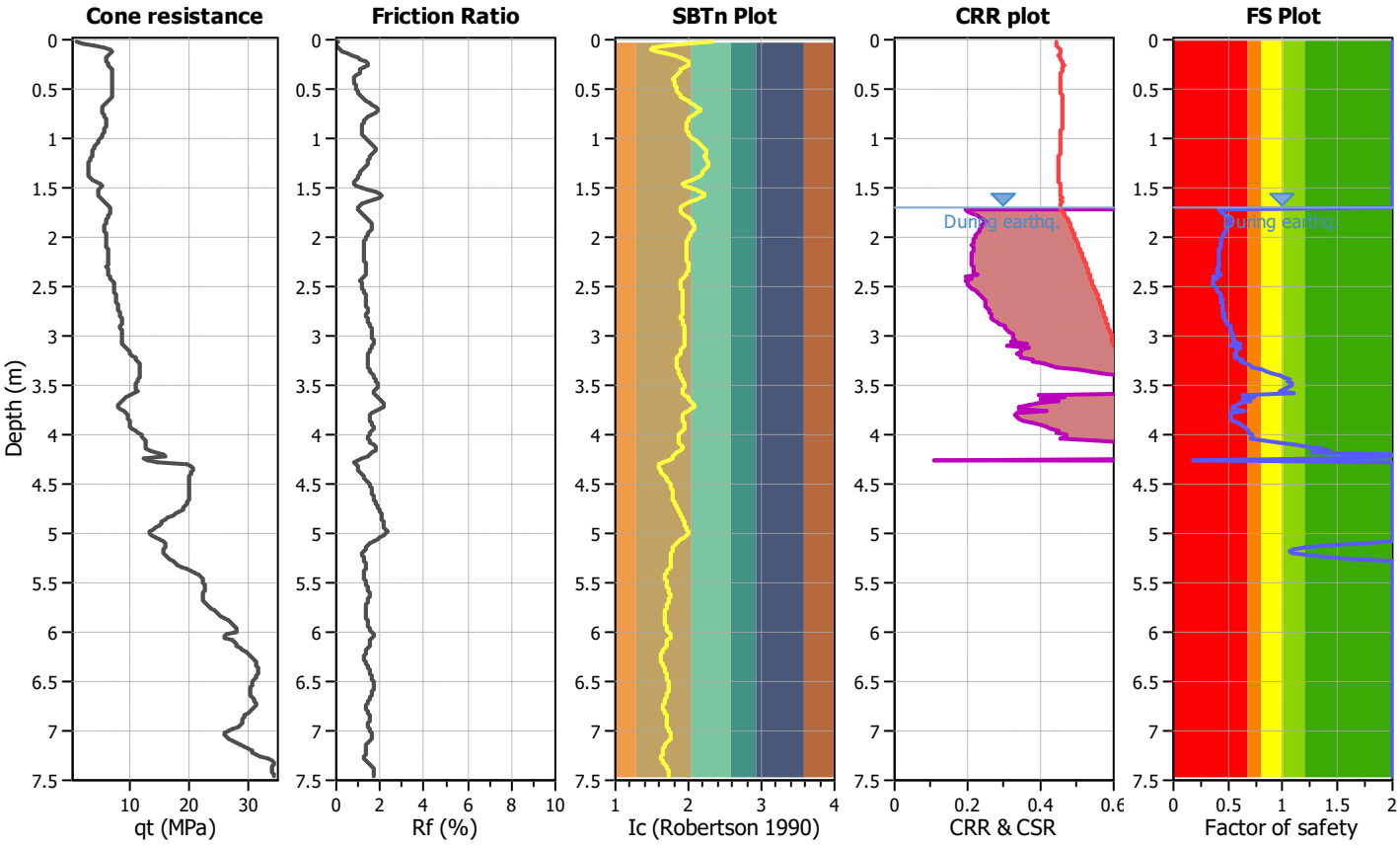
LIQUEFACTION ANALYSIS REPORT

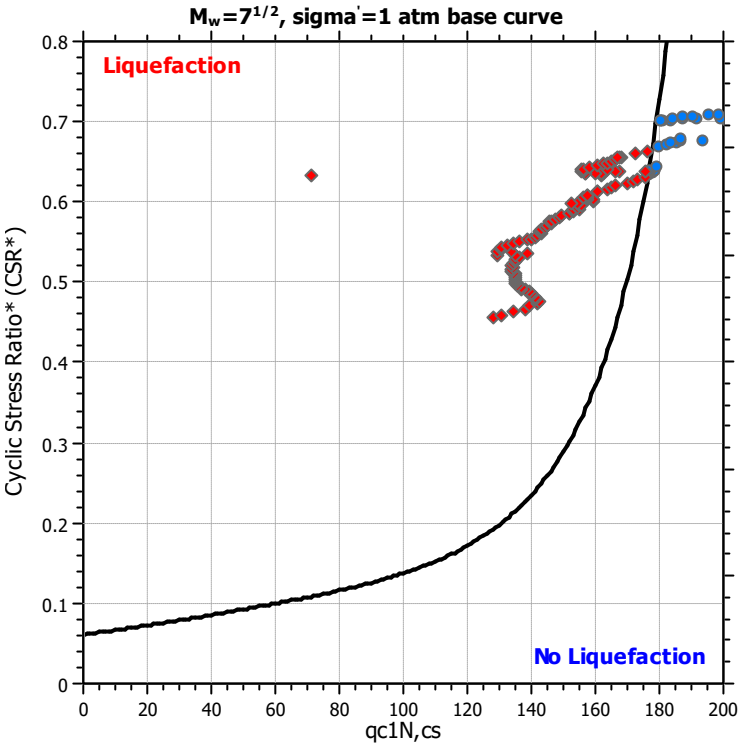
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

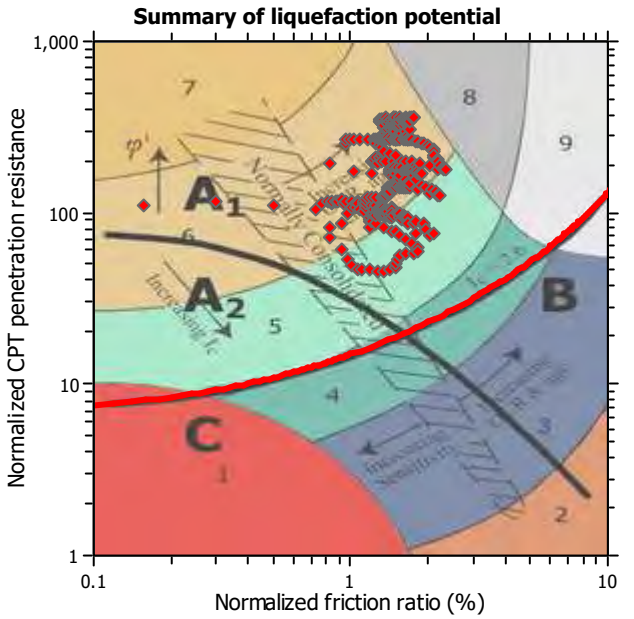
CPT file : CPT02_ULS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	7.70	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.68	Unit weight calculation:	Based on SBT	K_σ applied:	No		

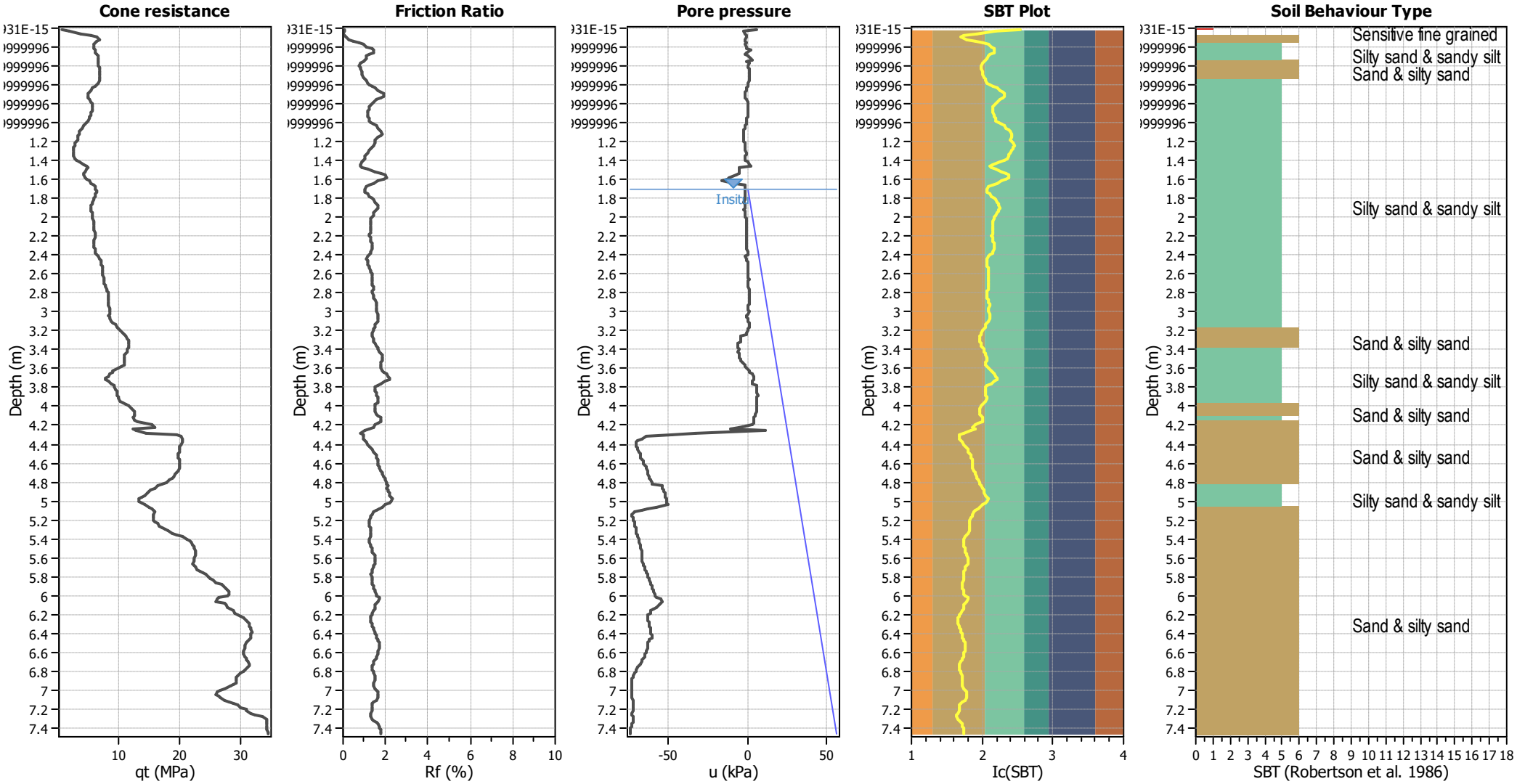






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



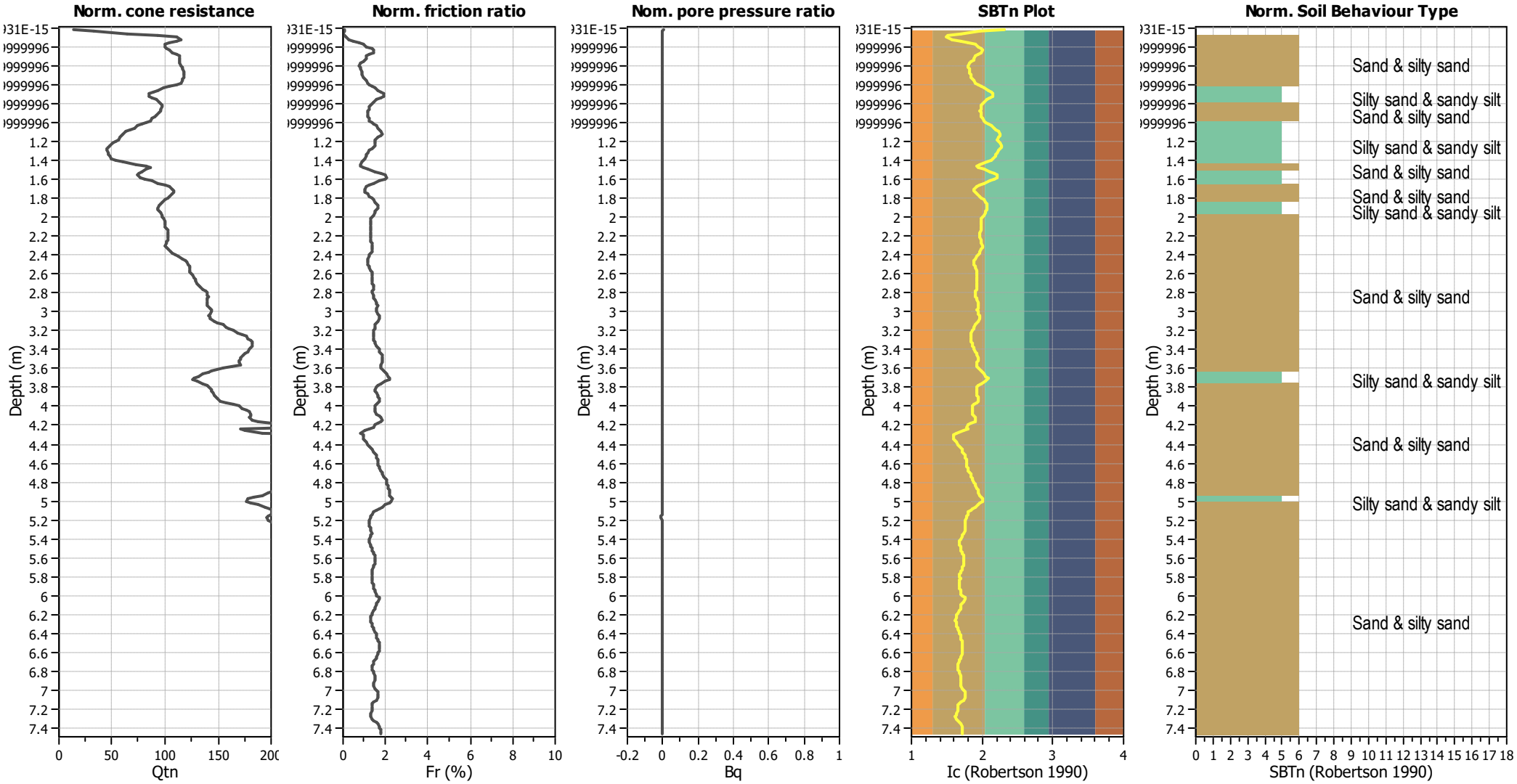
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



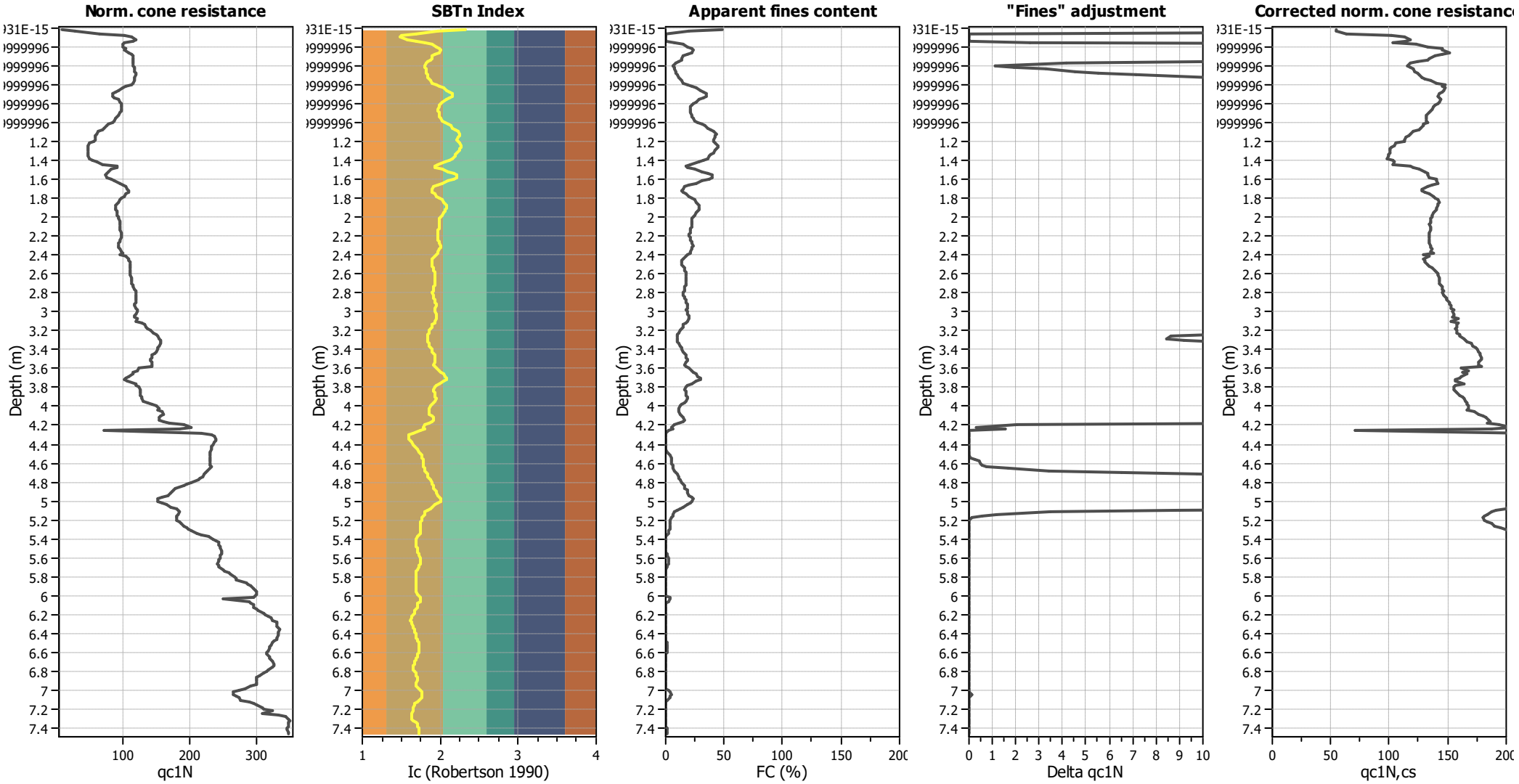
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

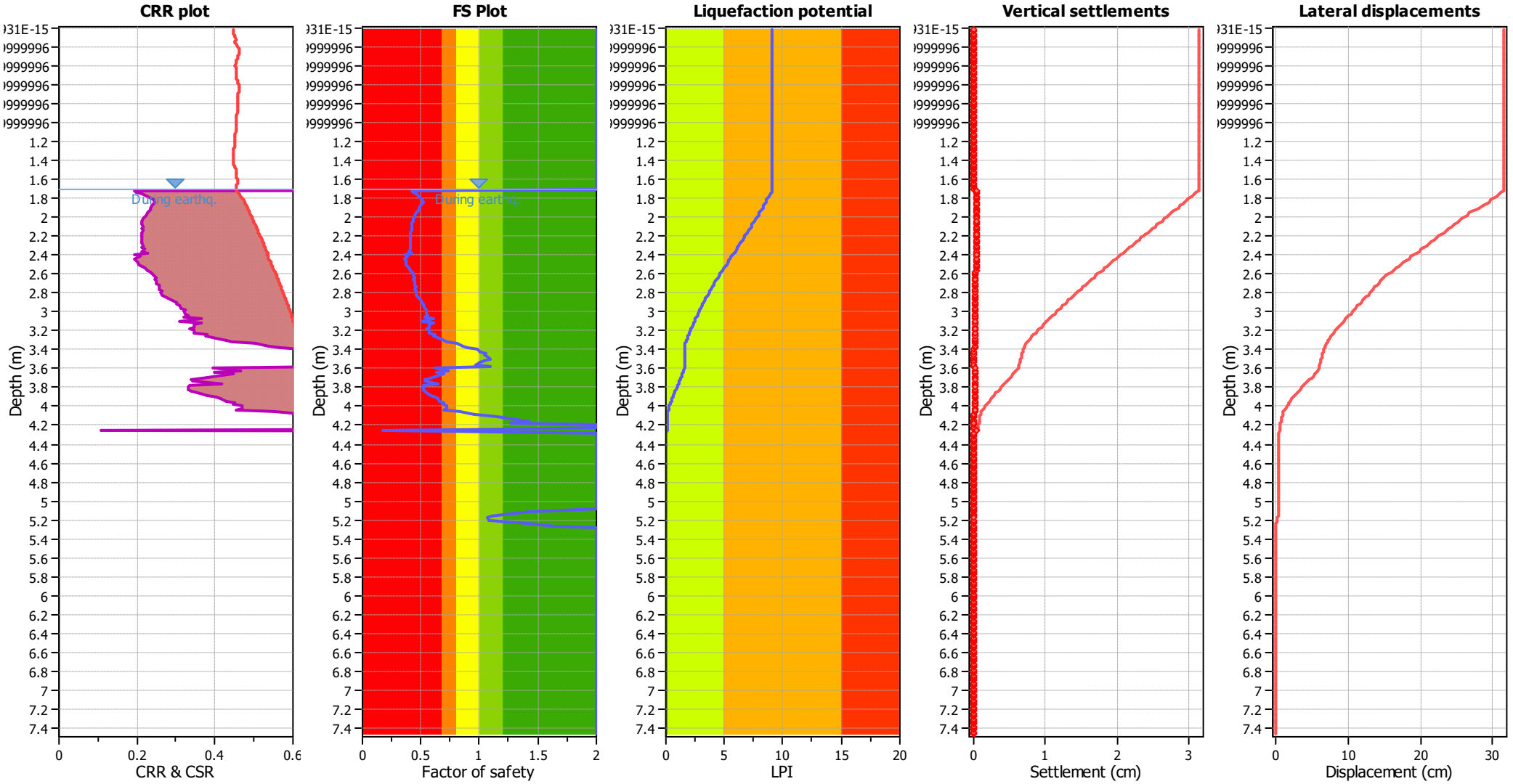
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

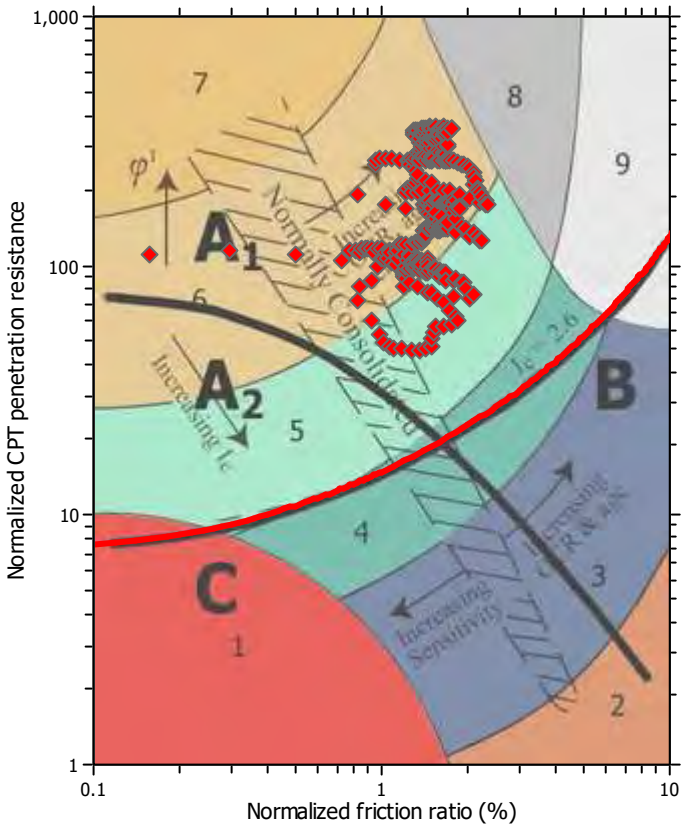
F.S. color scheme

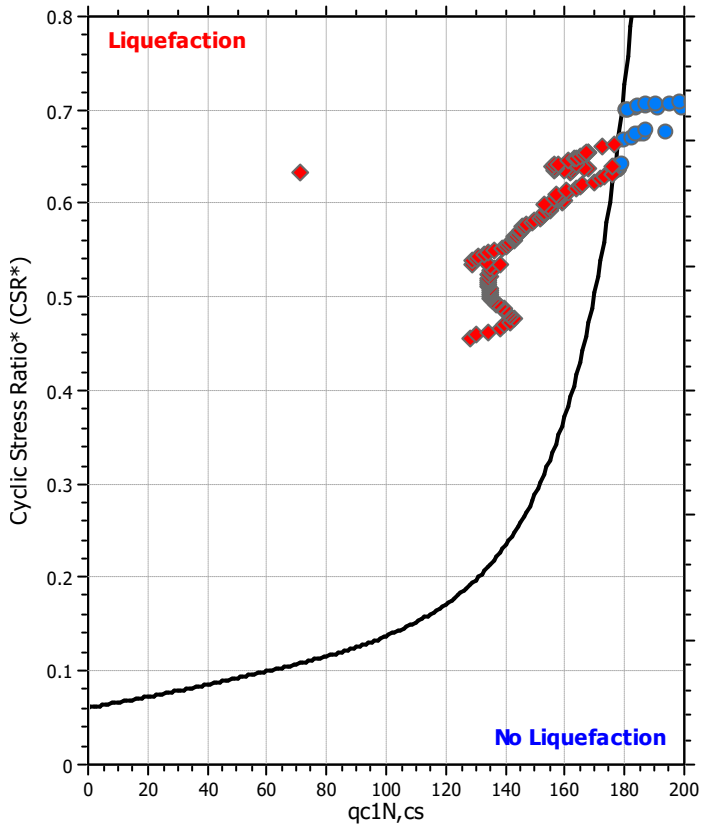
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

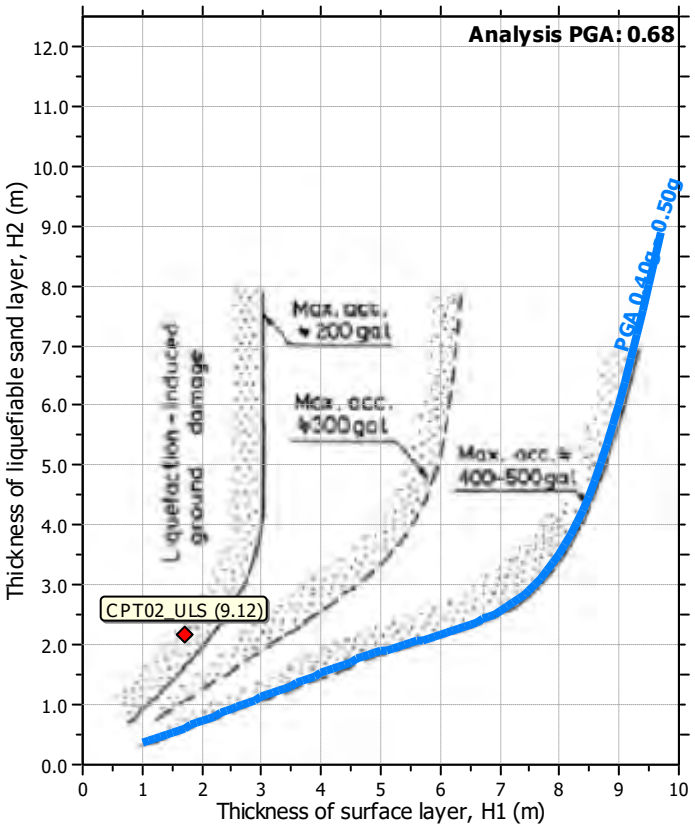
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



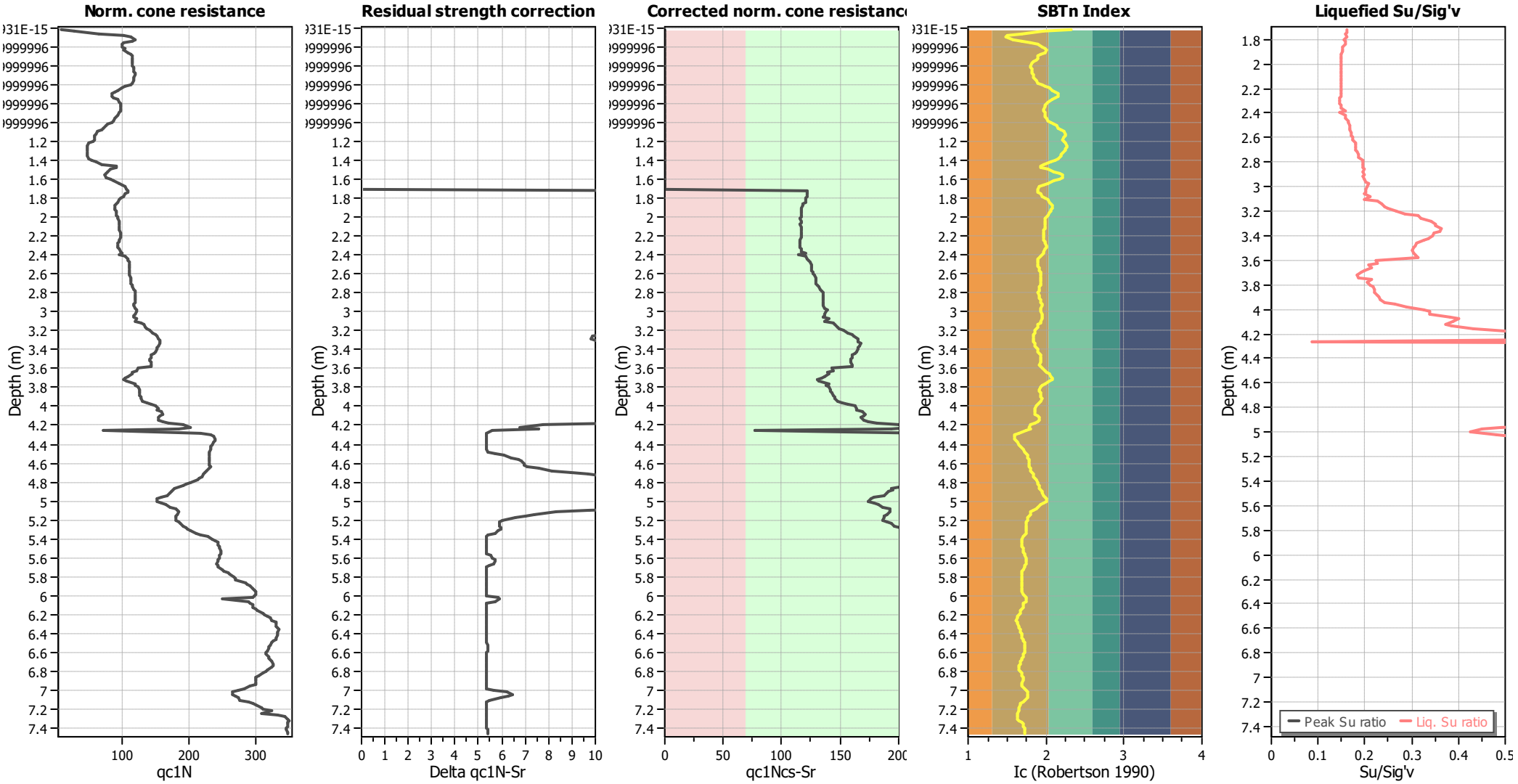




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

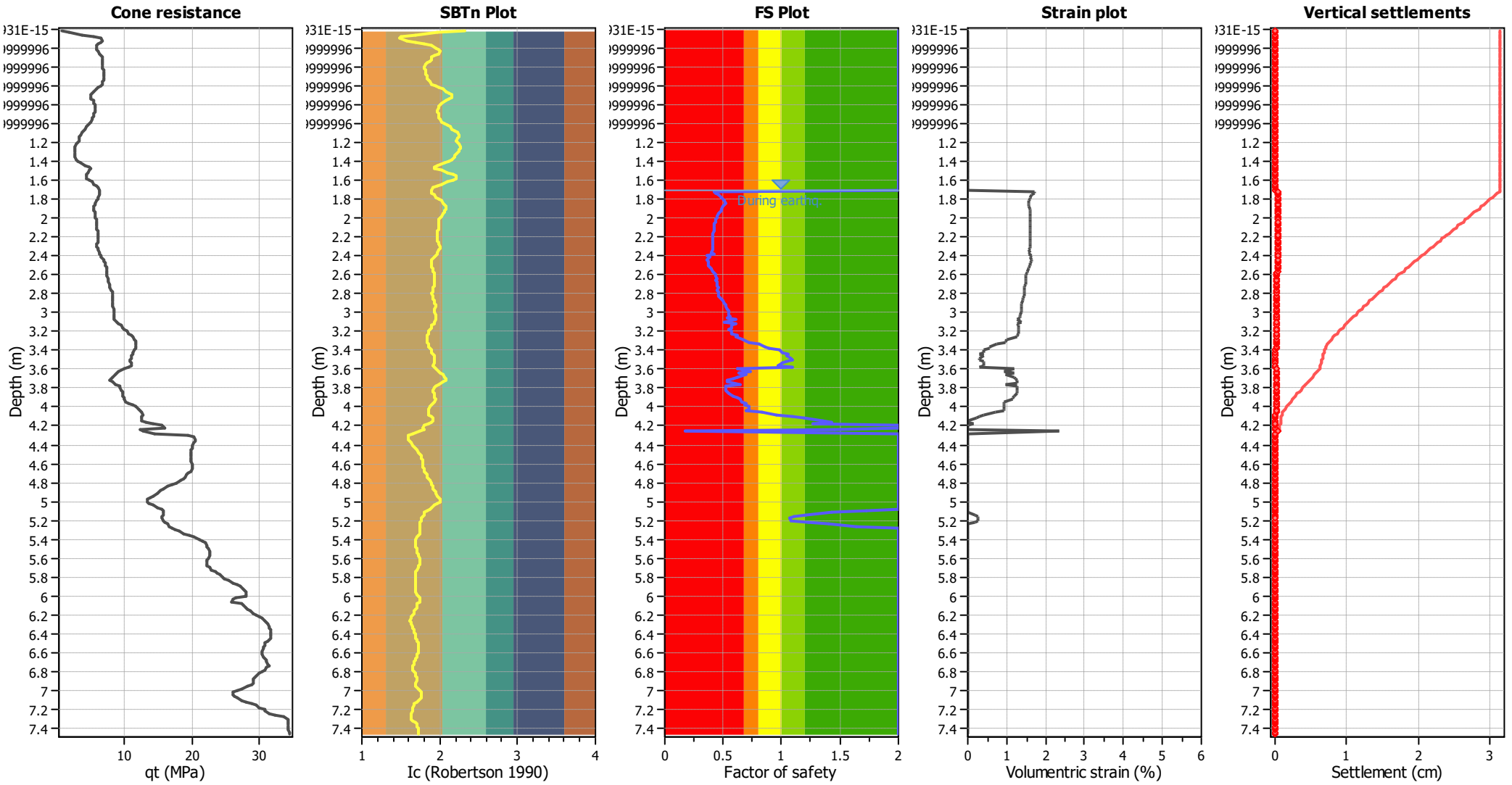
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

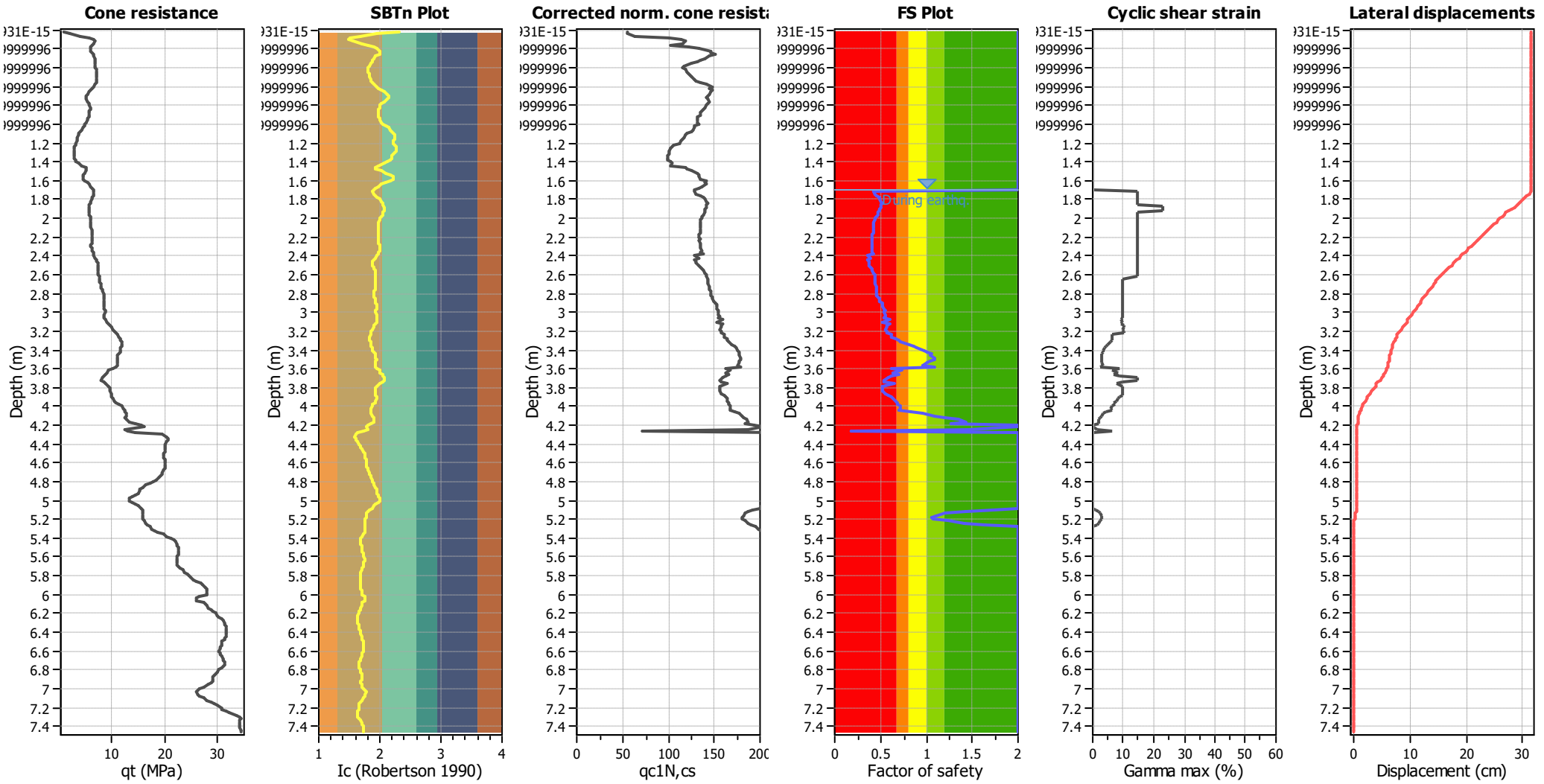
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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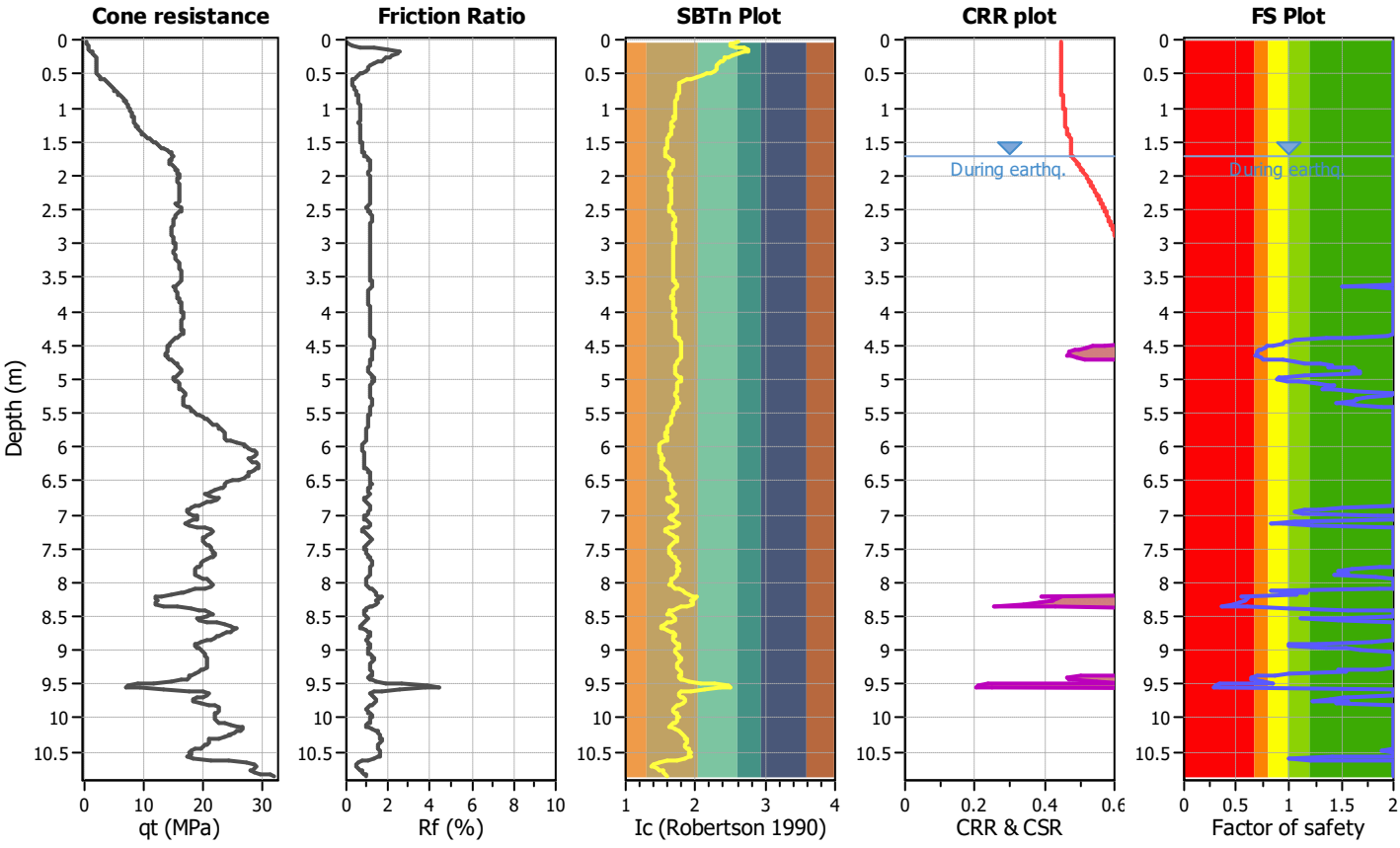
LIQUEFACTION ANALYSIS REPORT

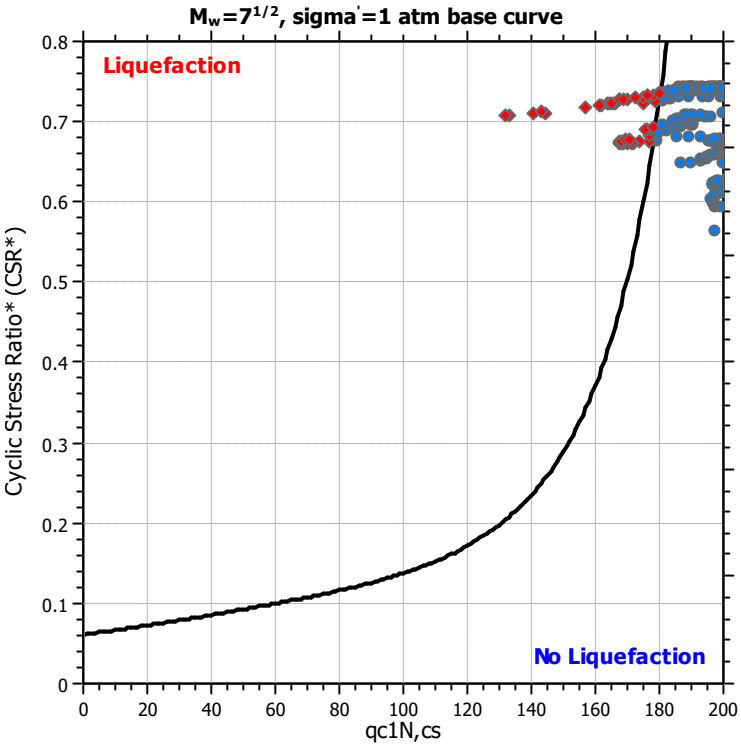
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

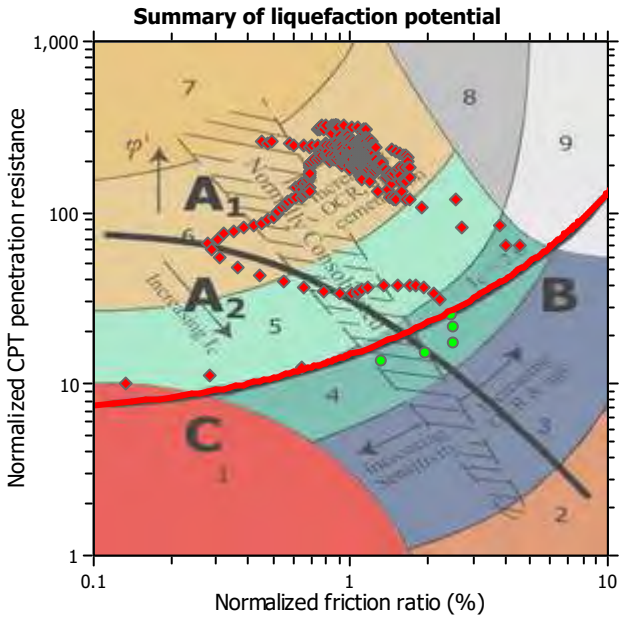
CPT file : CPT03_ULS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	7.70	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.68	Unit weight calculation:	Based on SBT	K_σ applied:	No		

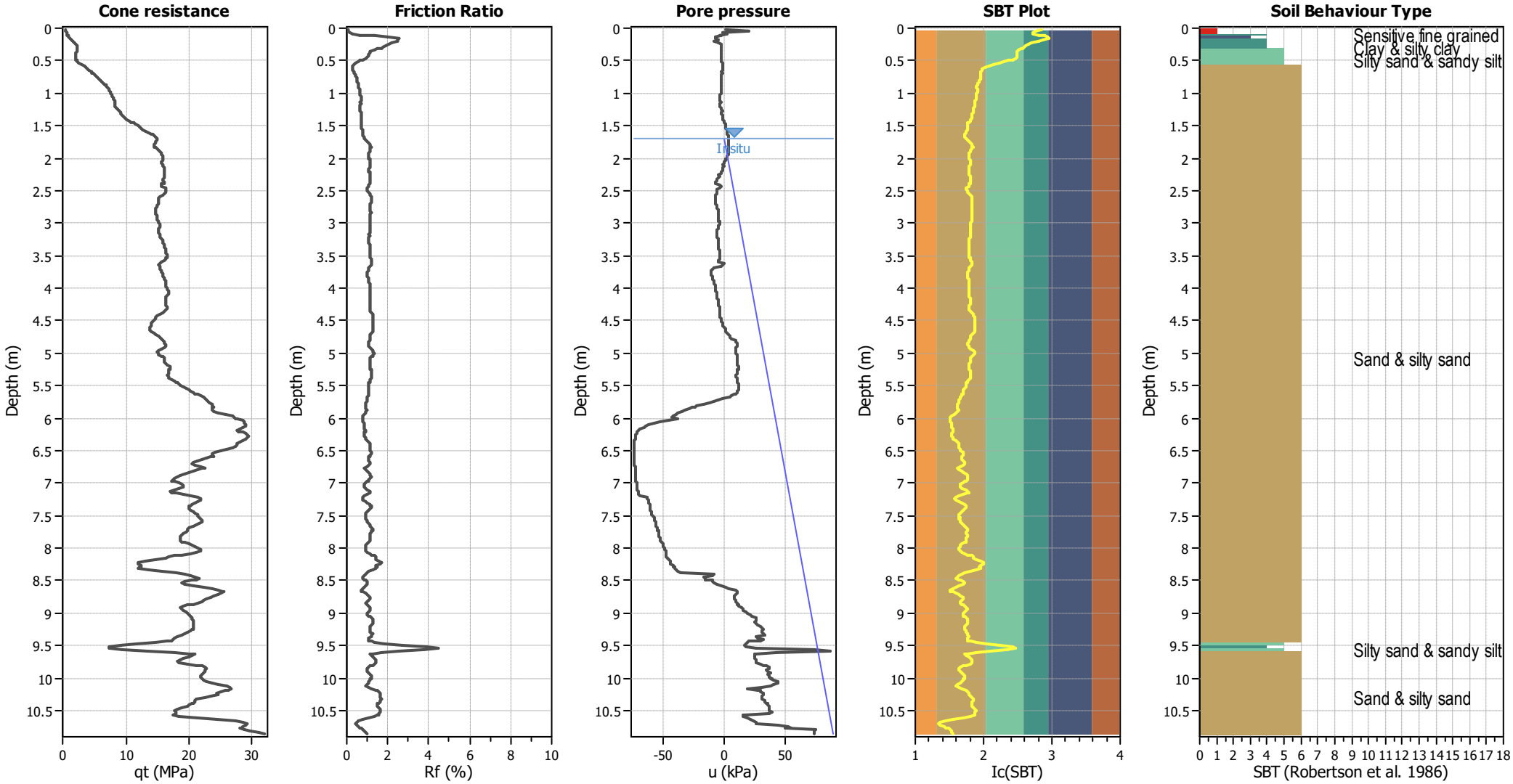






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



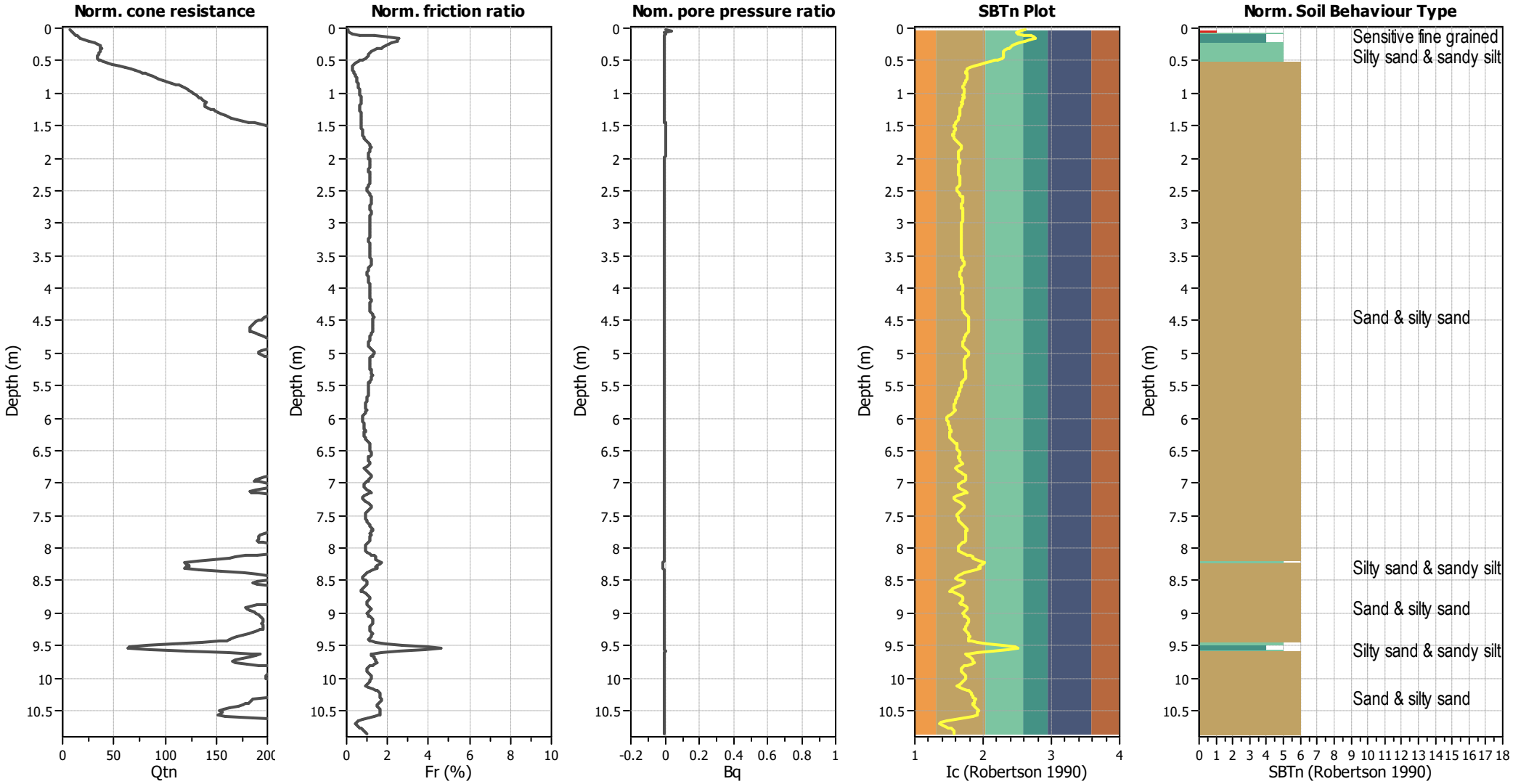
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



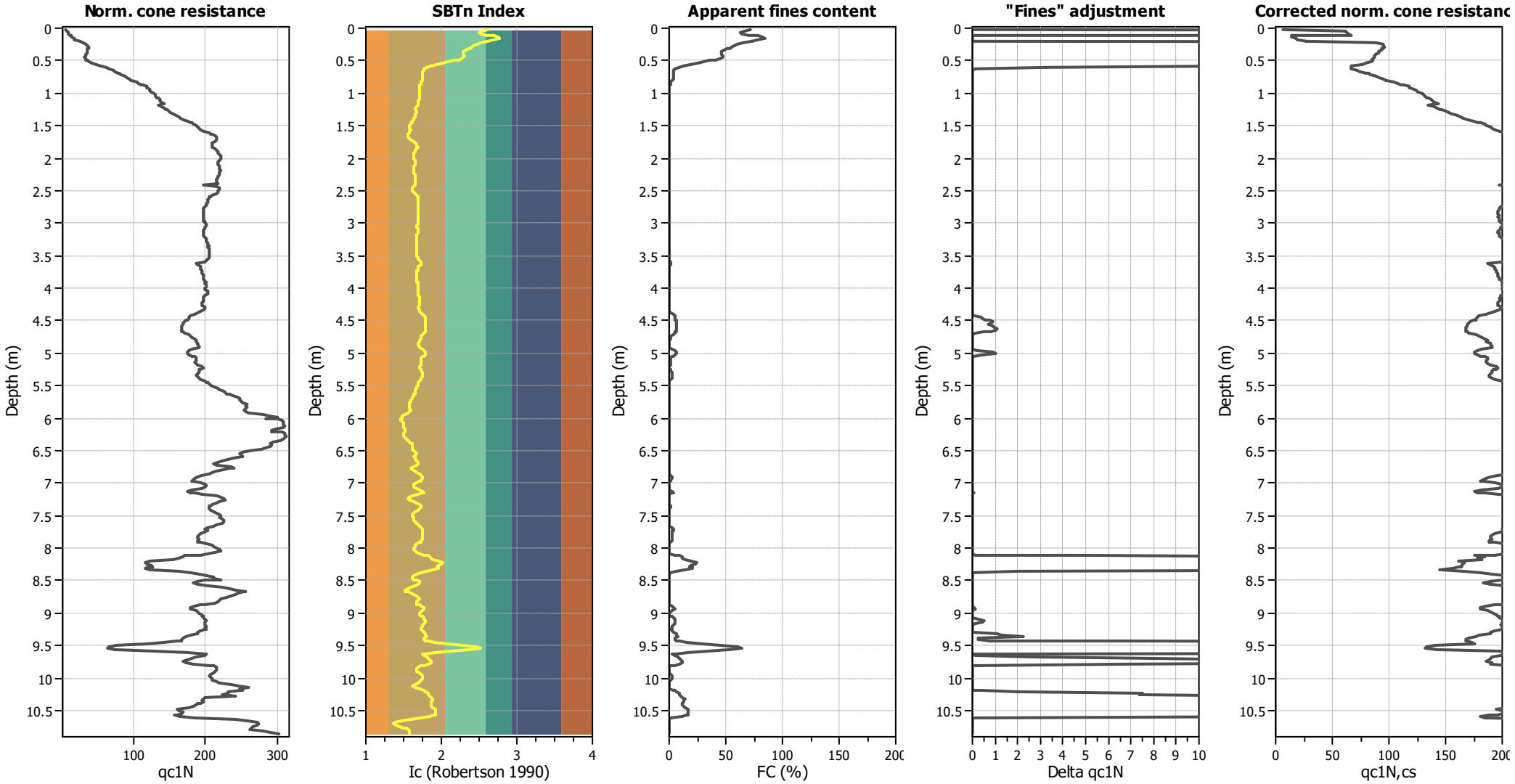
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

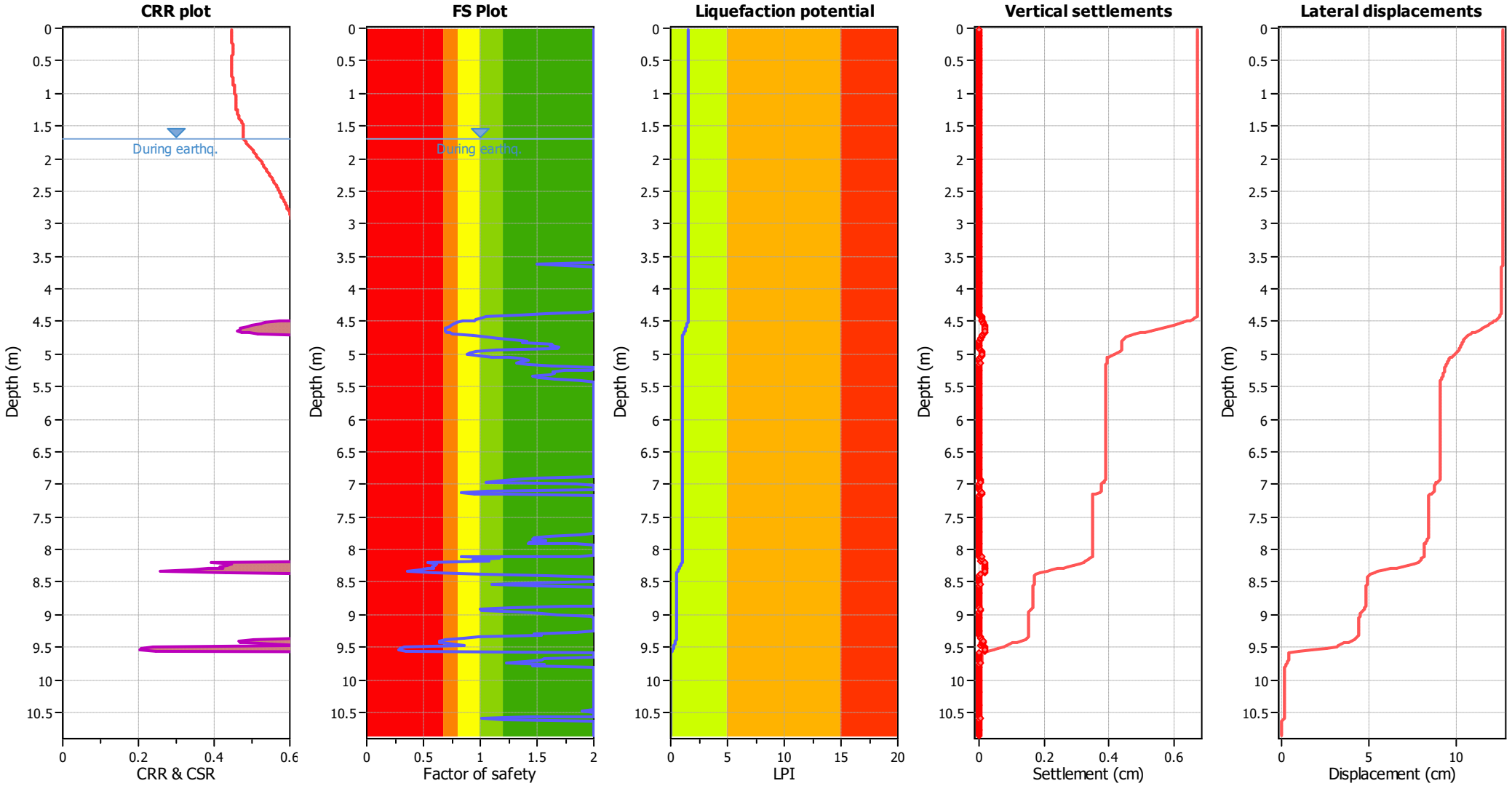
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

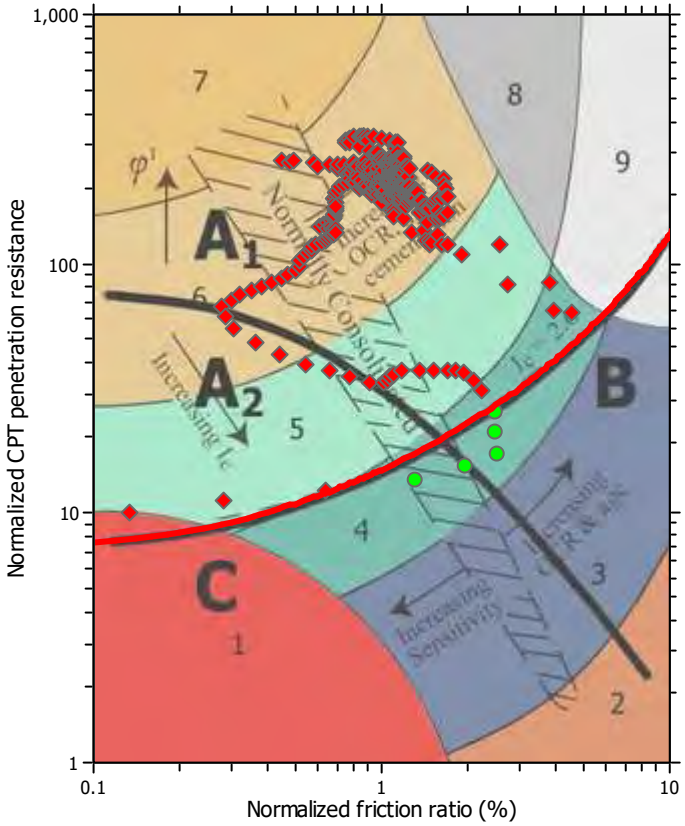
F.S. color scheme

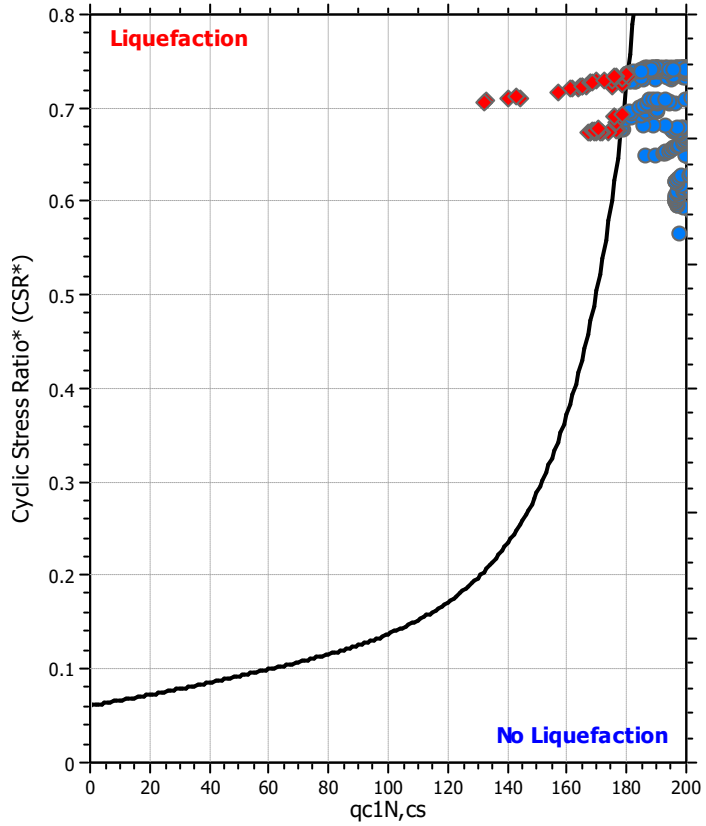
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

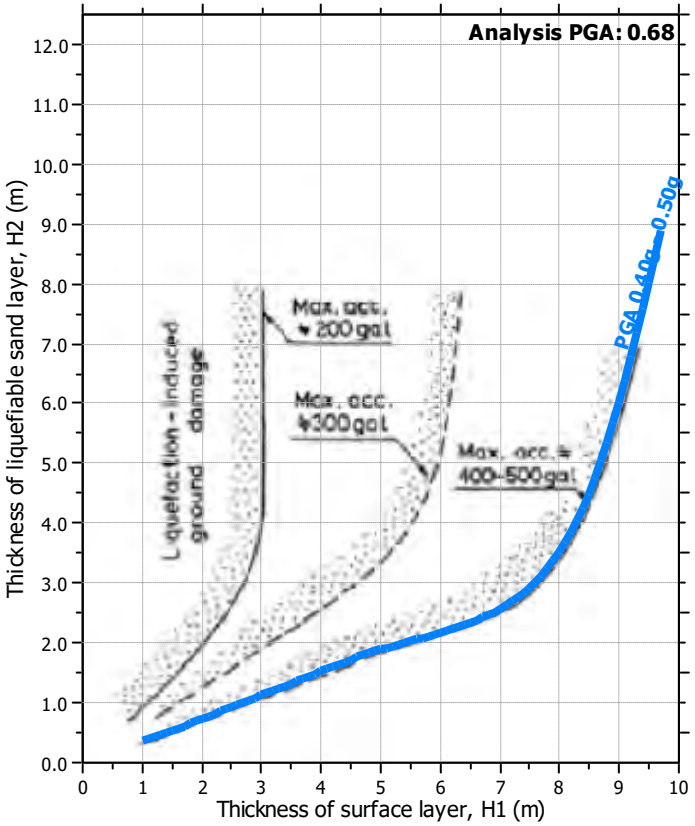
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



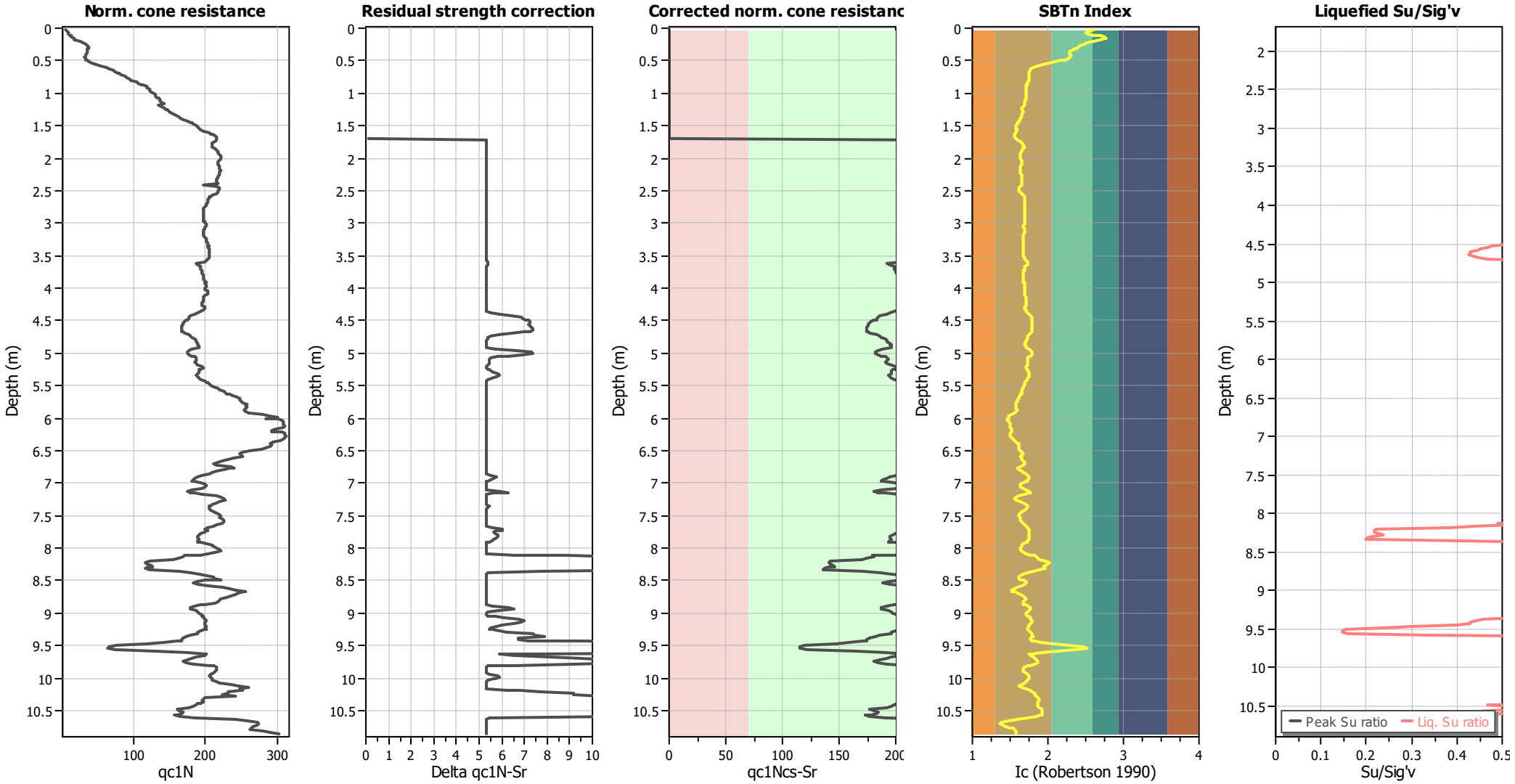




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

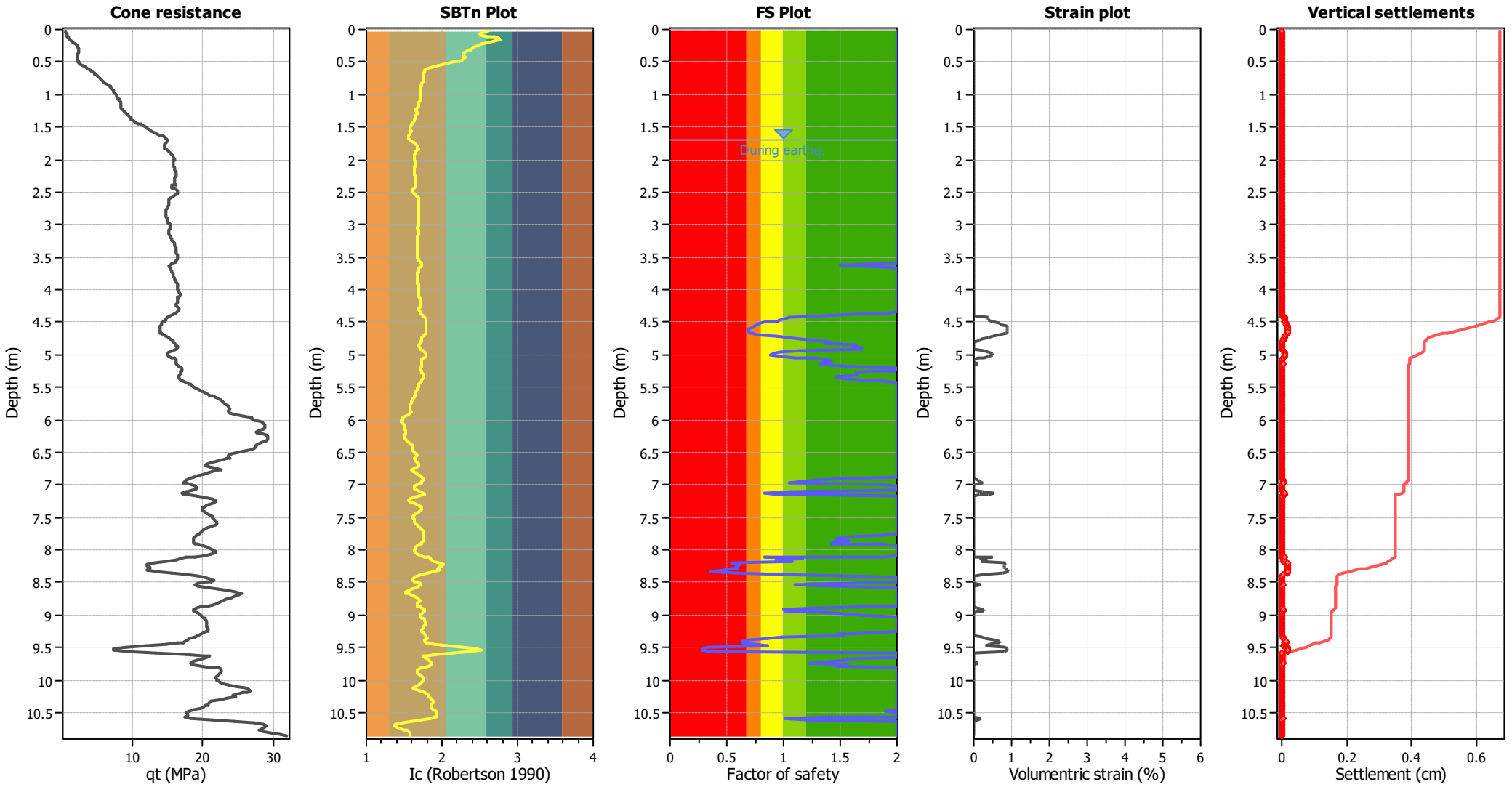
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

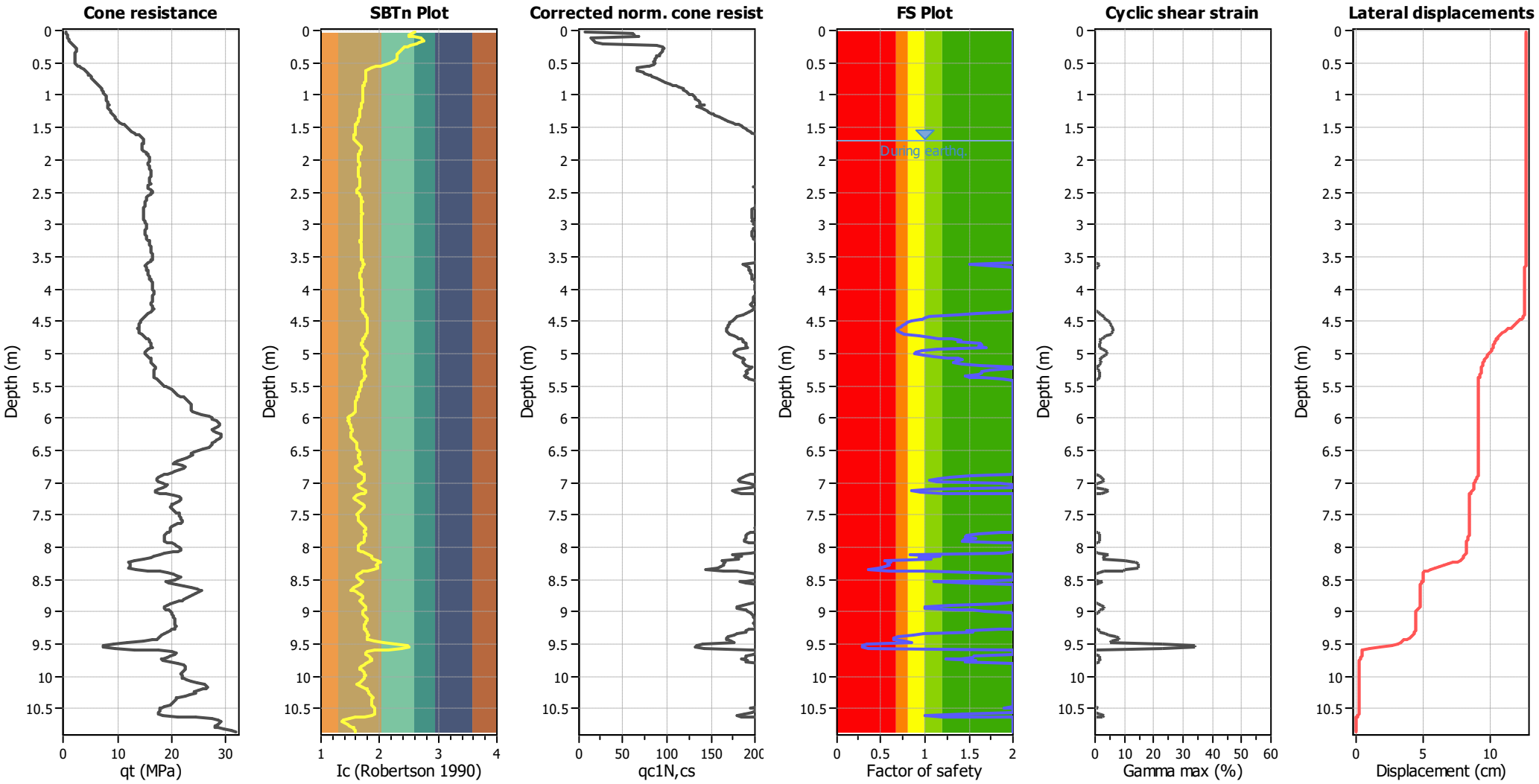
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
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$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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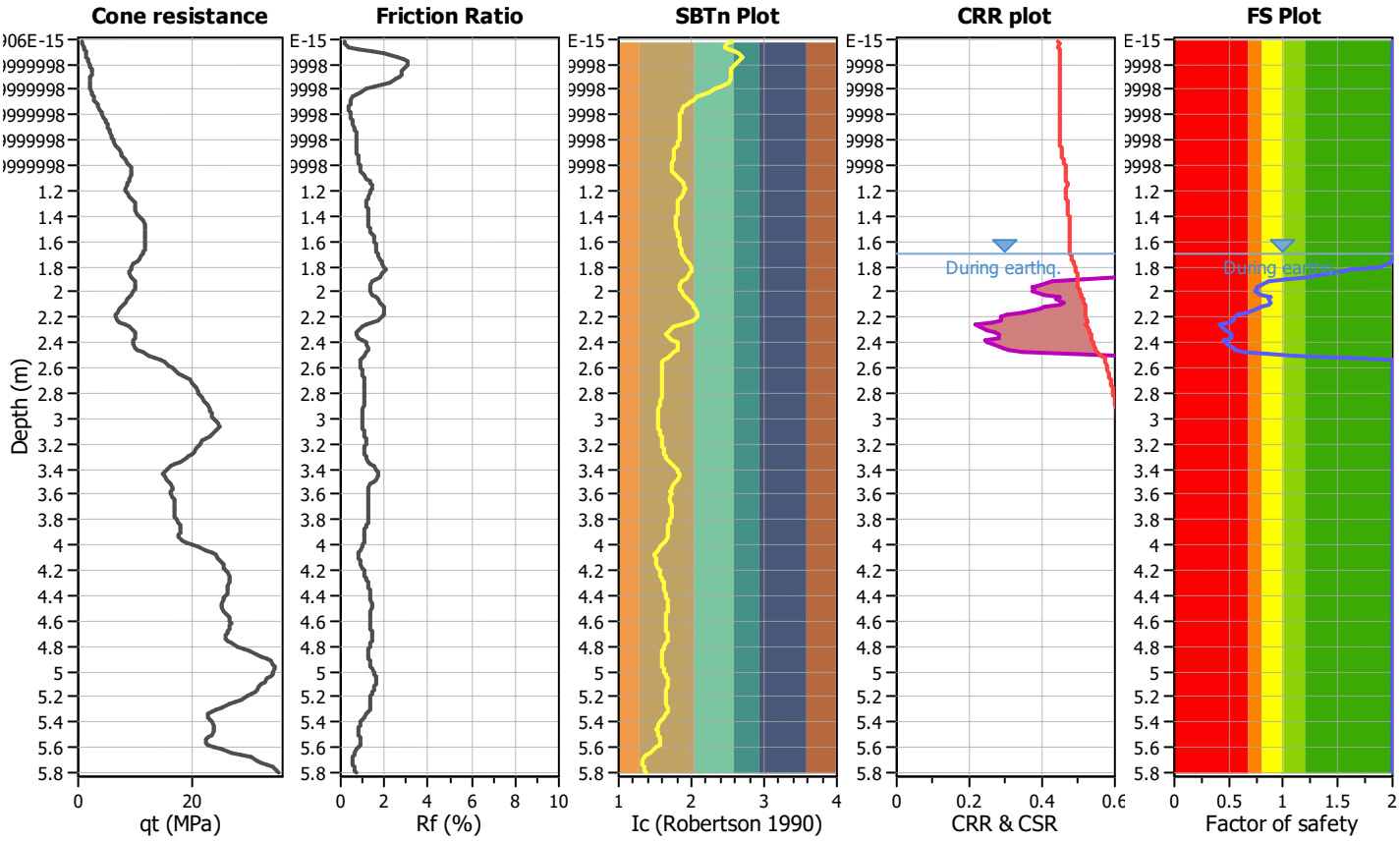
LIQUEFACTION ANALYSIS REPORT

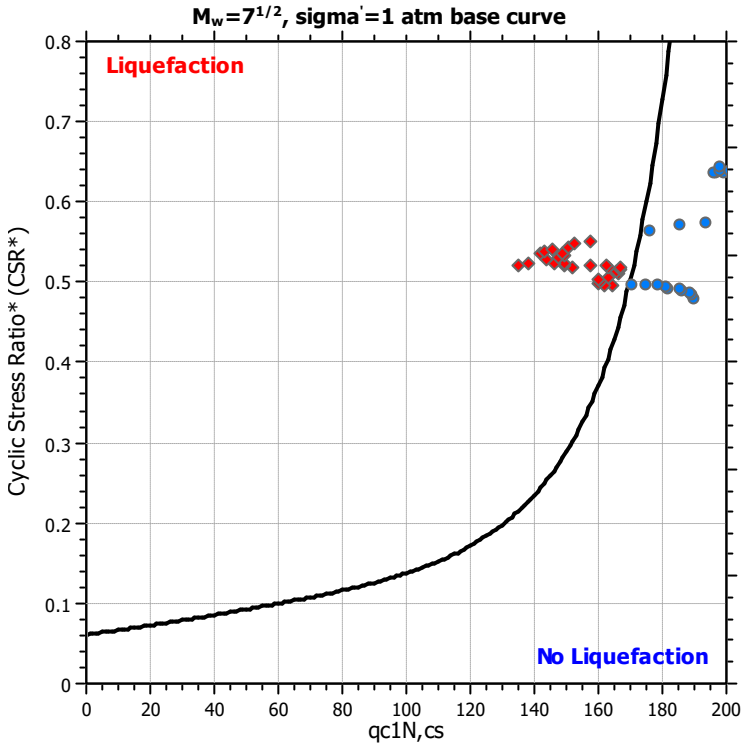
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

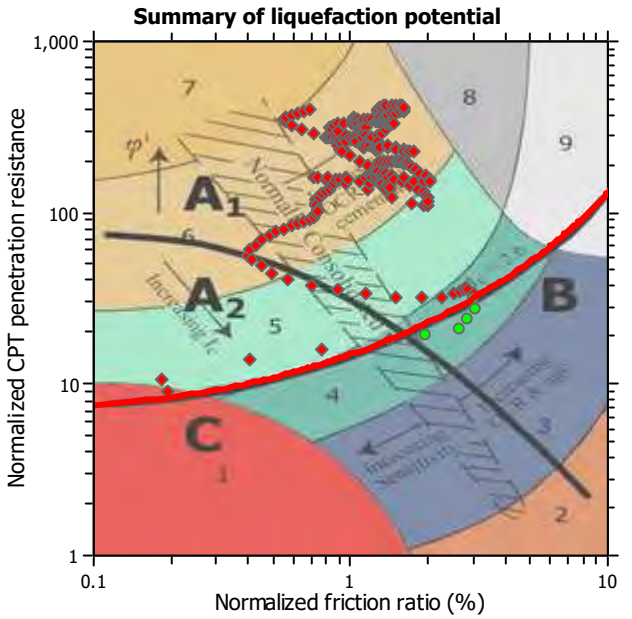
CPT file : CPT04_ULS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	7.70	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.68	Unit weight calculation:	Based on SBT	K_σ applied:	No		

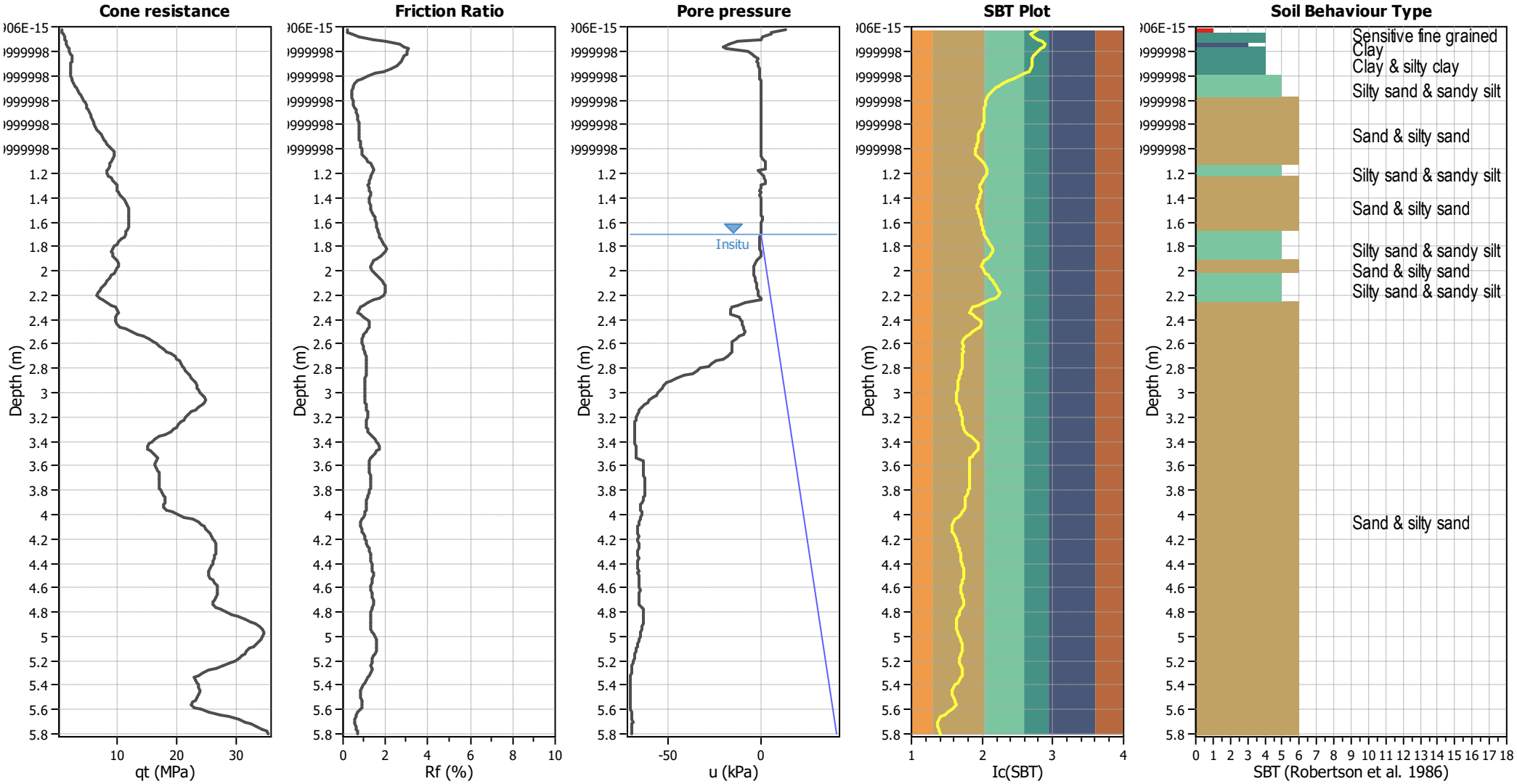






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



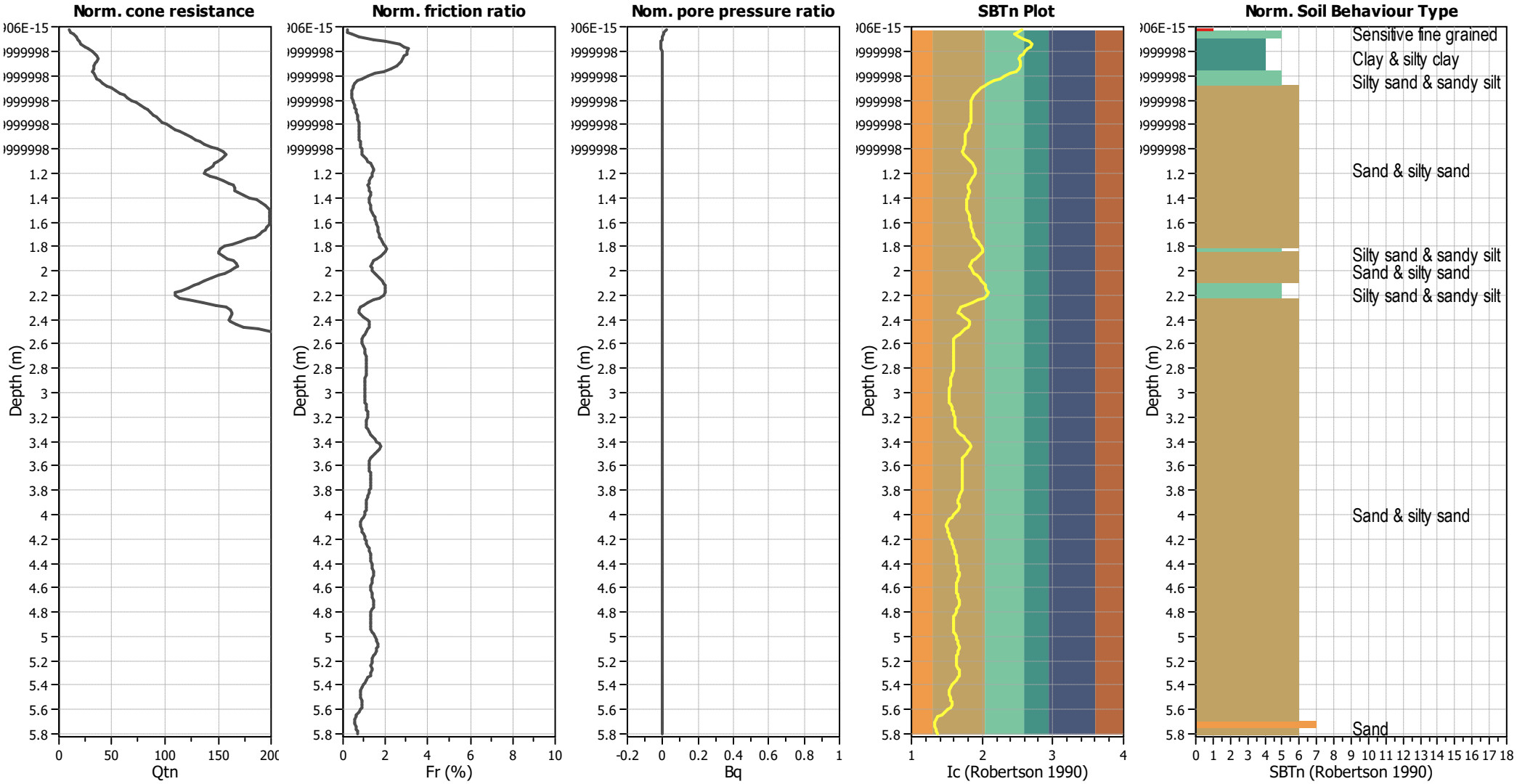
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



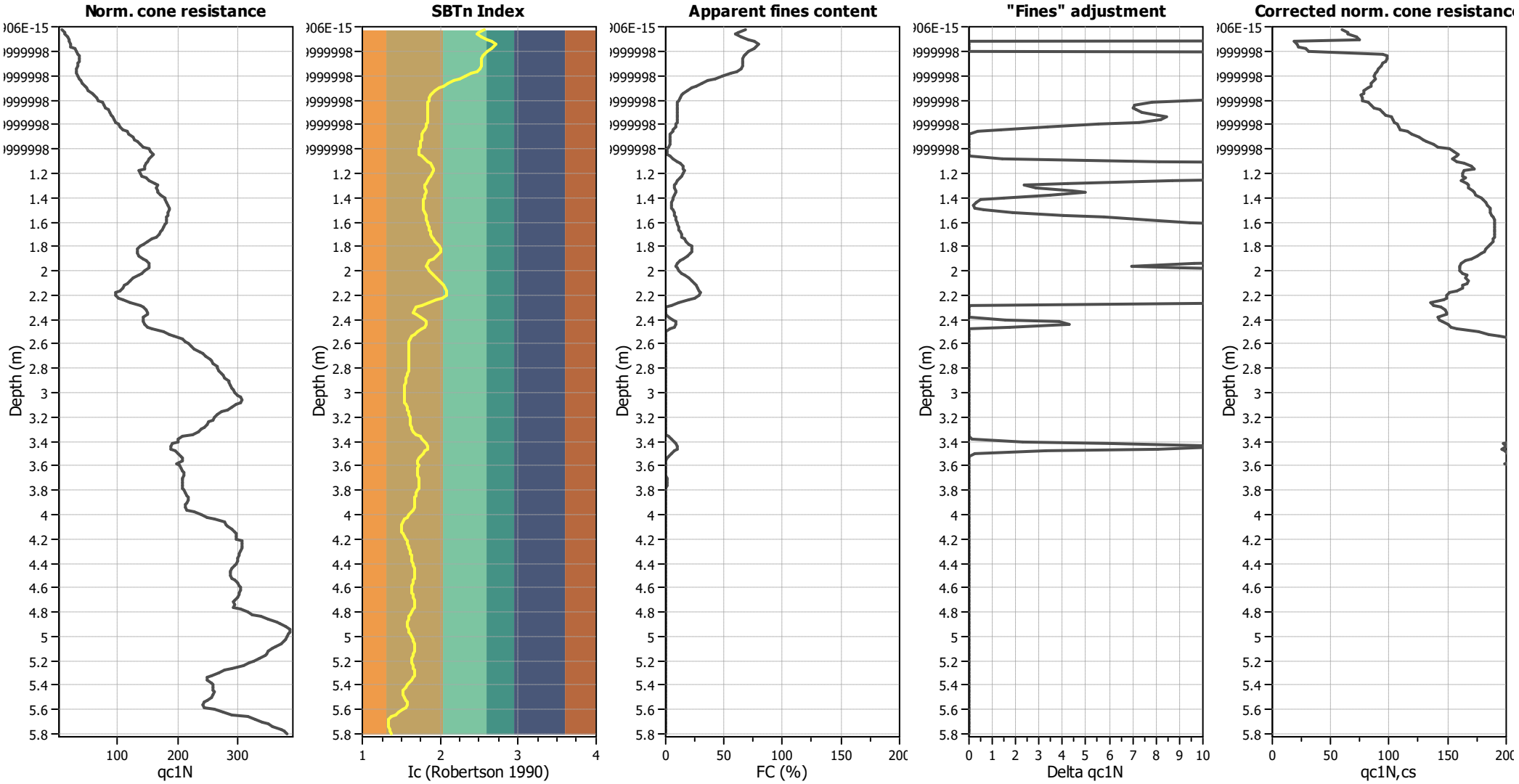
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

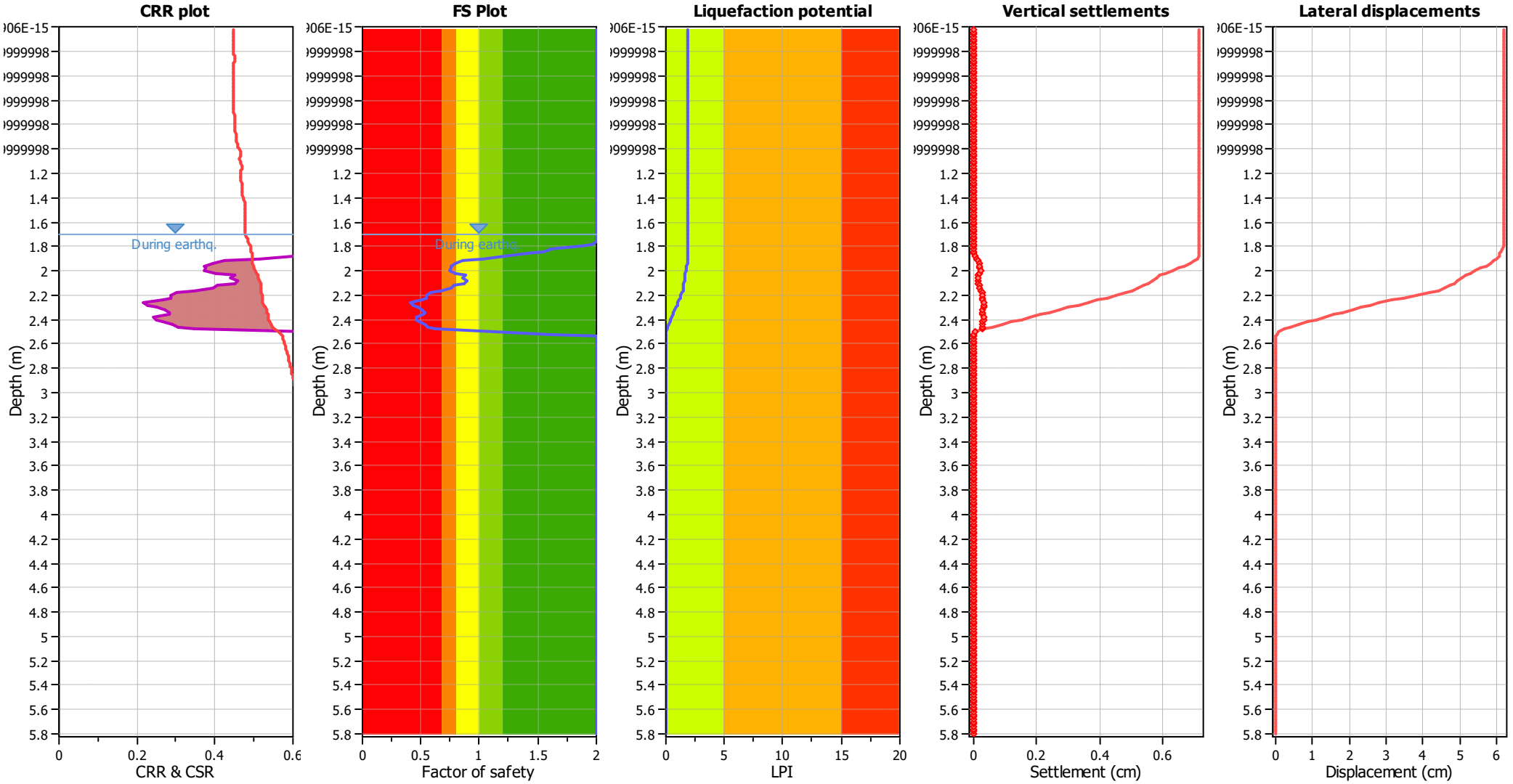
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

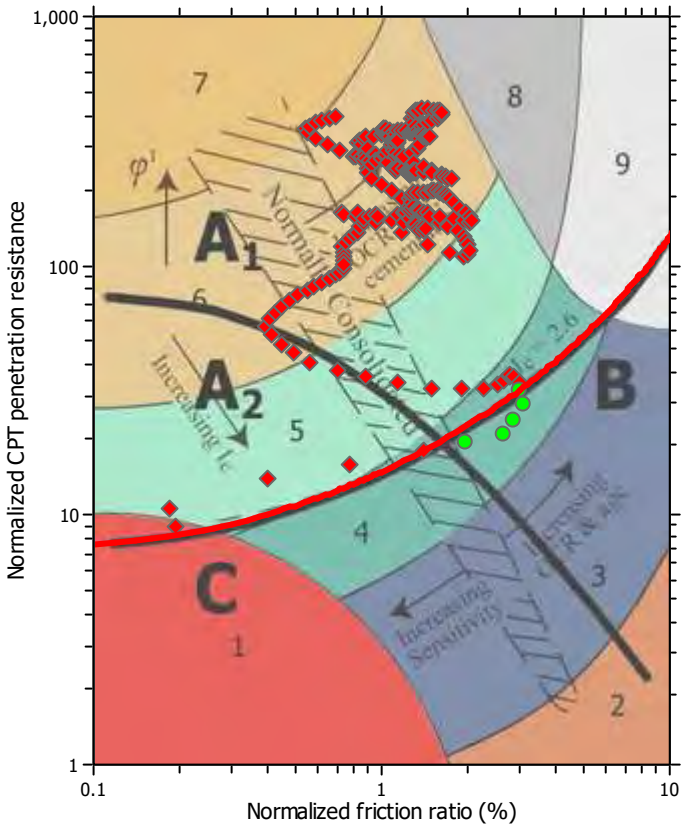
F.S. color scheme

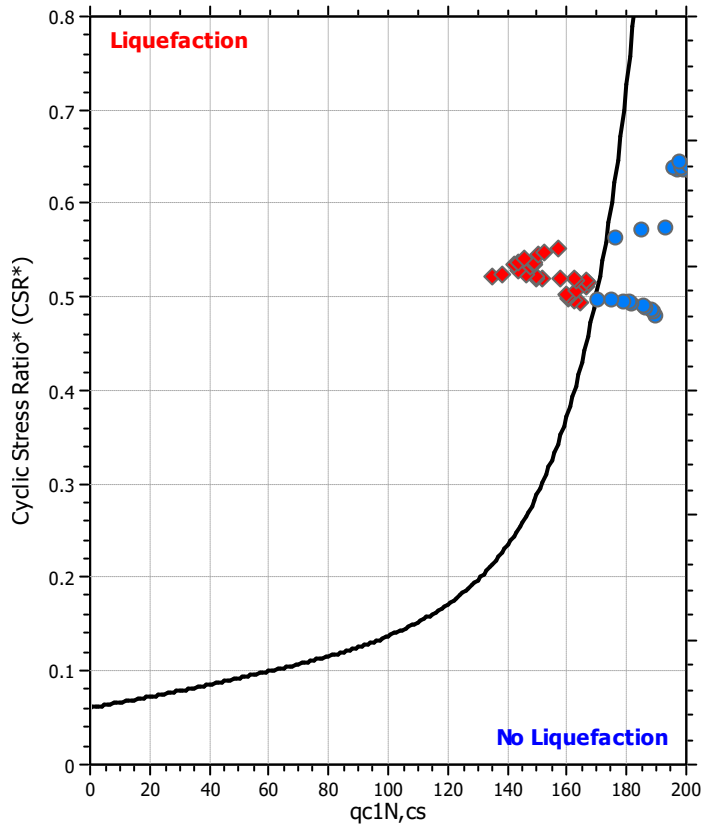
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

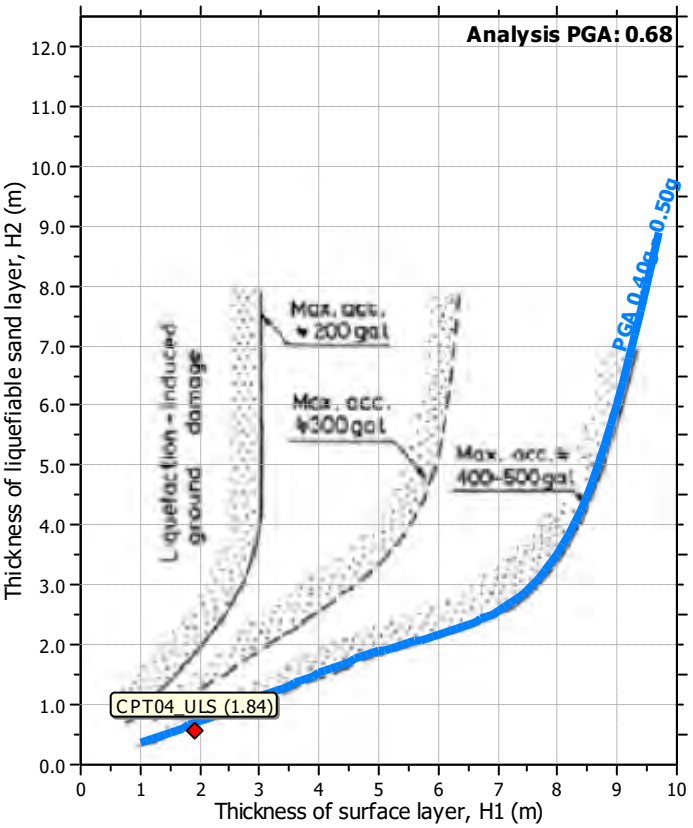
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



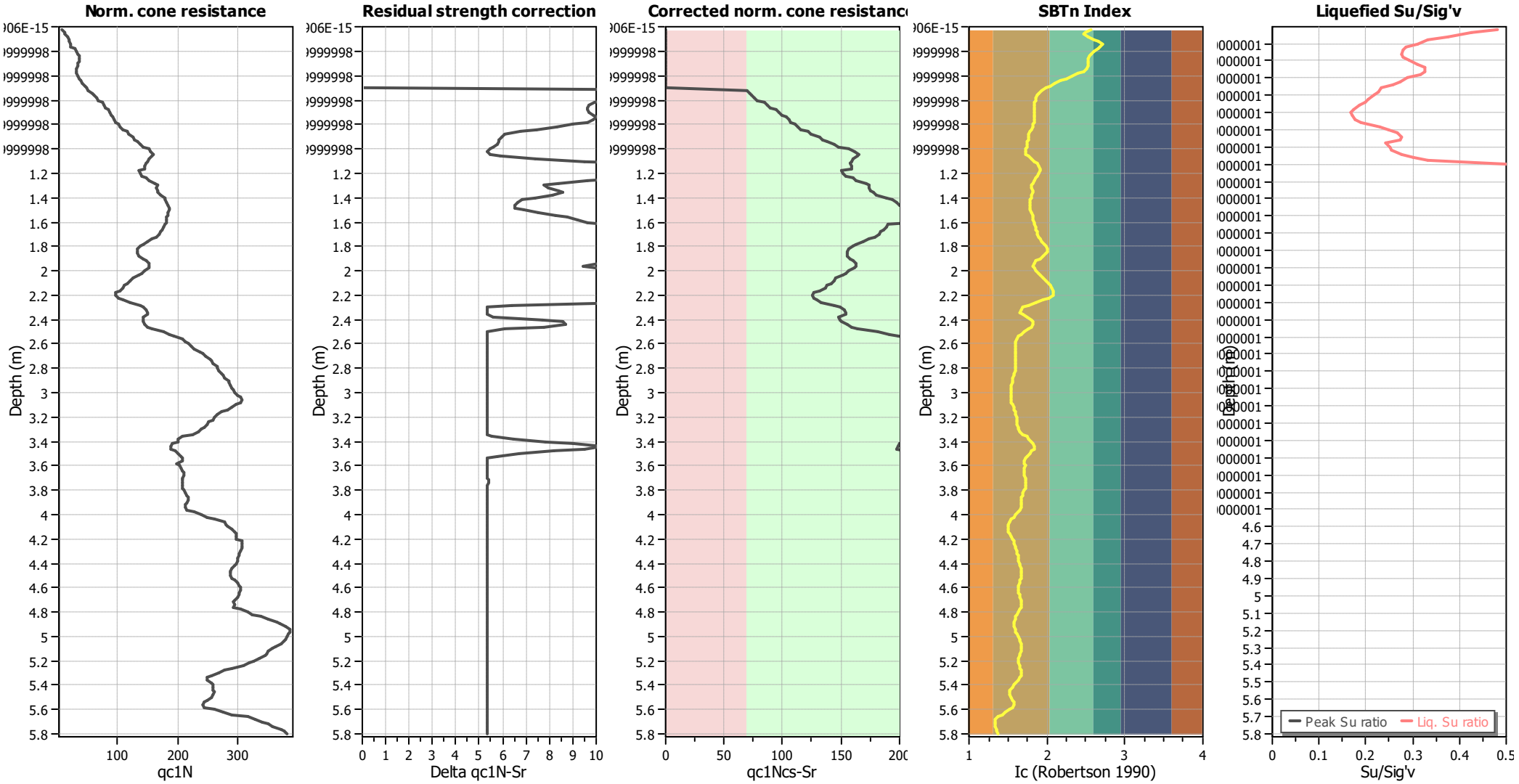




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

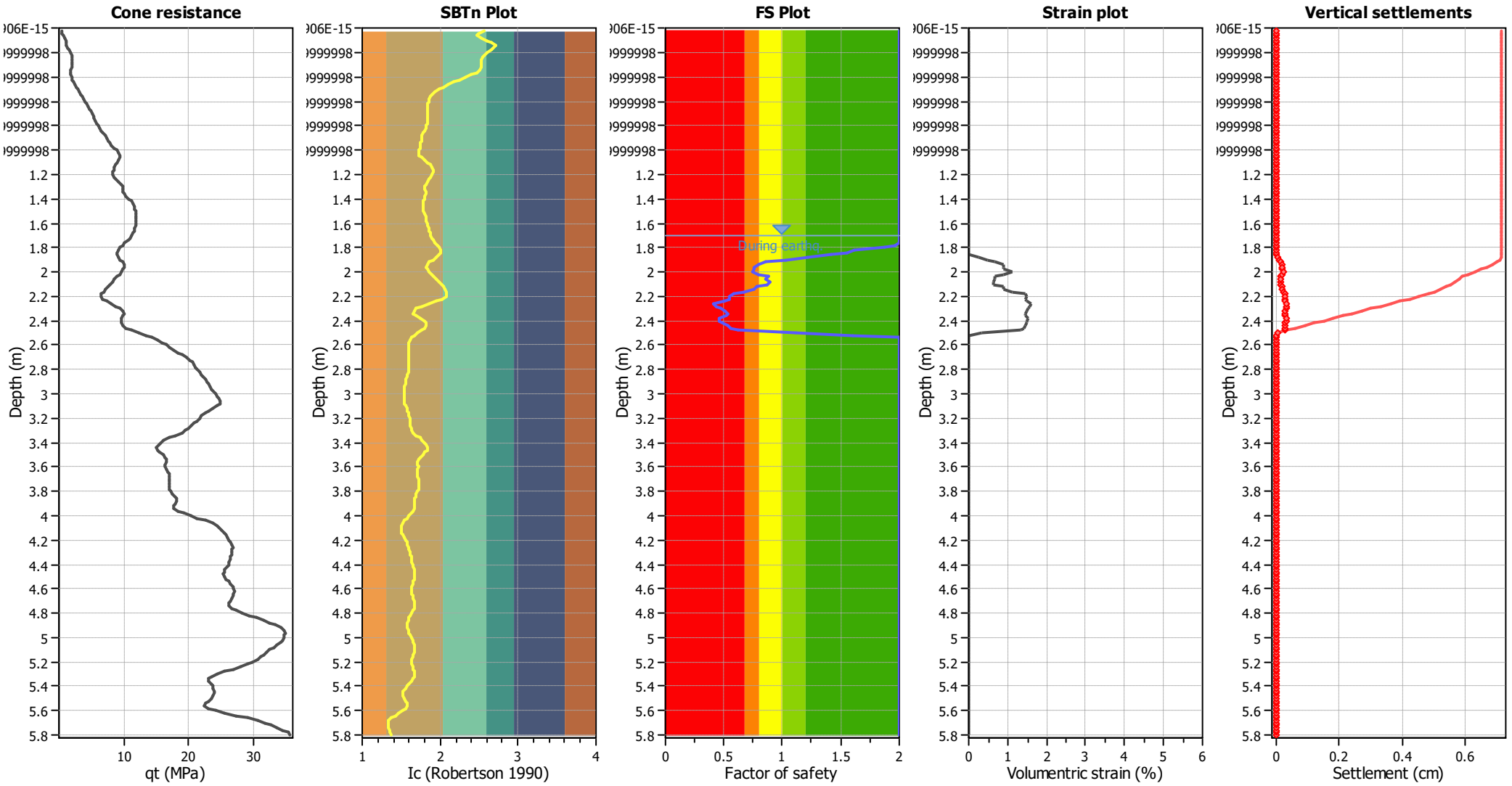
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Estimation of post-earthquake settlements



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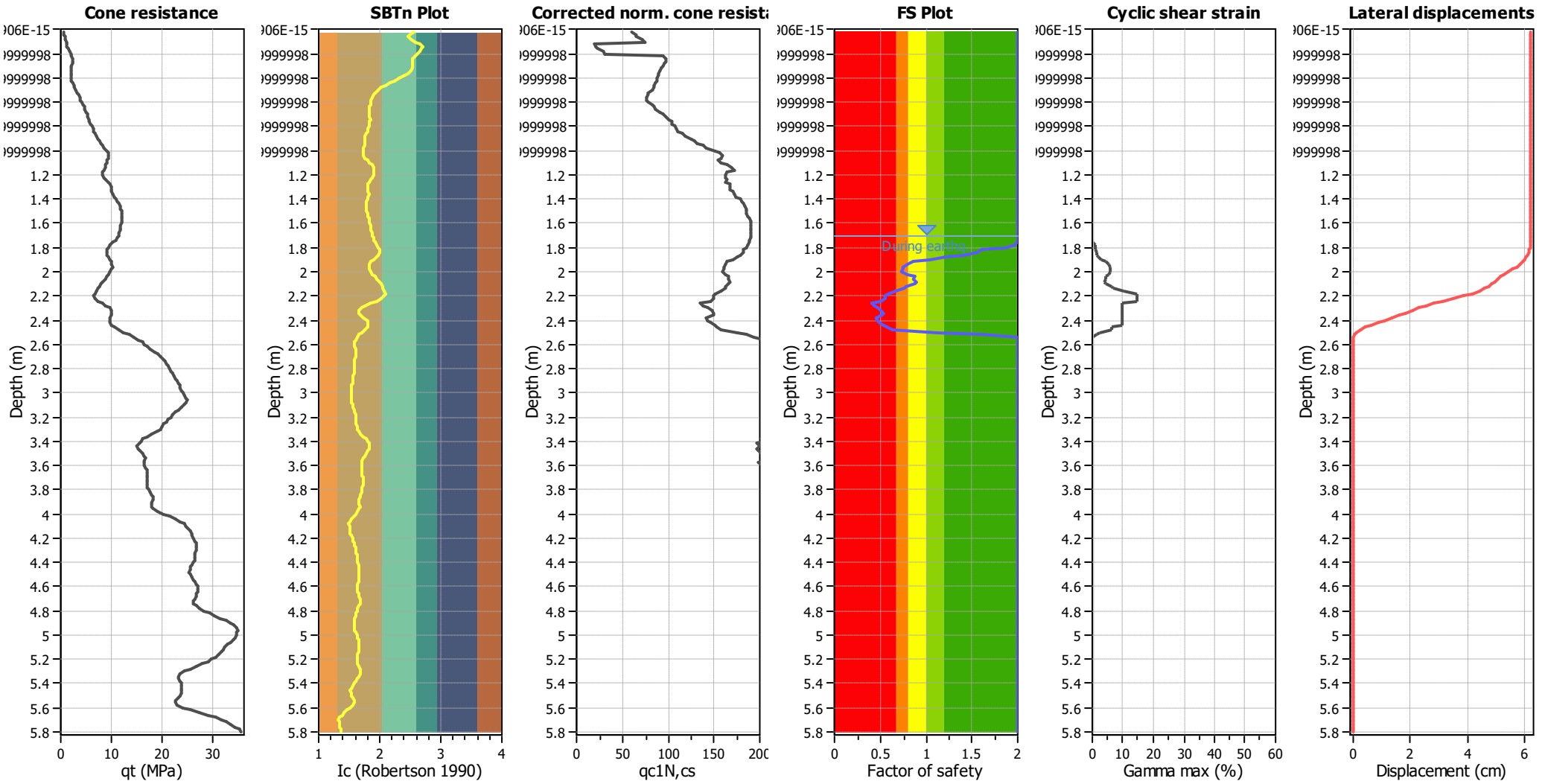
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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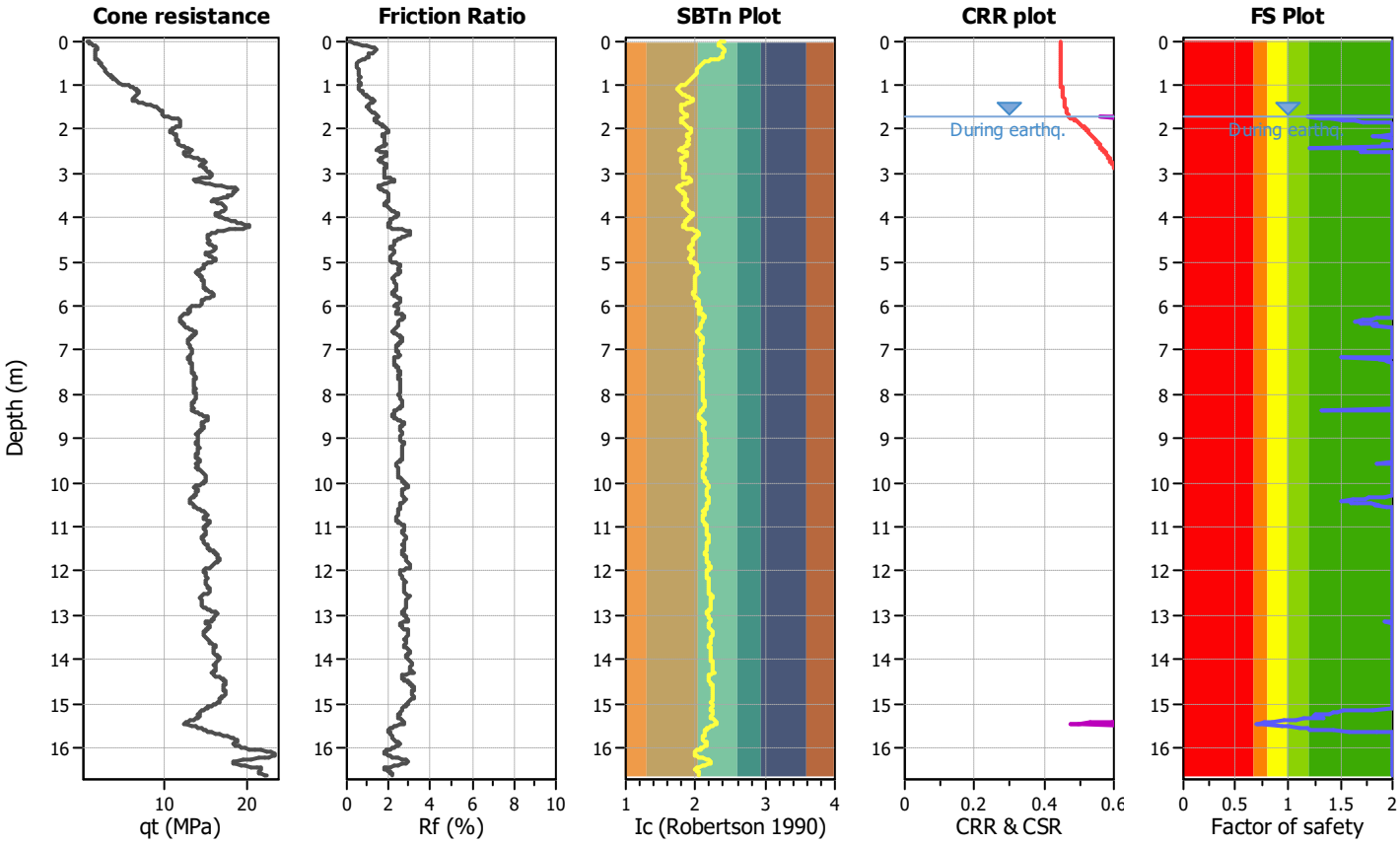
LIQUEFACTION ANALYSIS REPORT

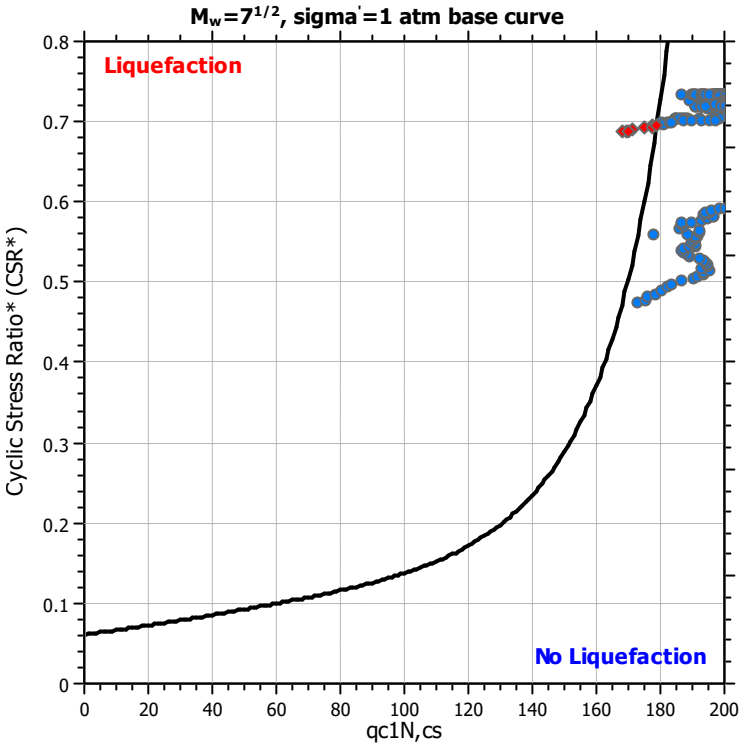
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

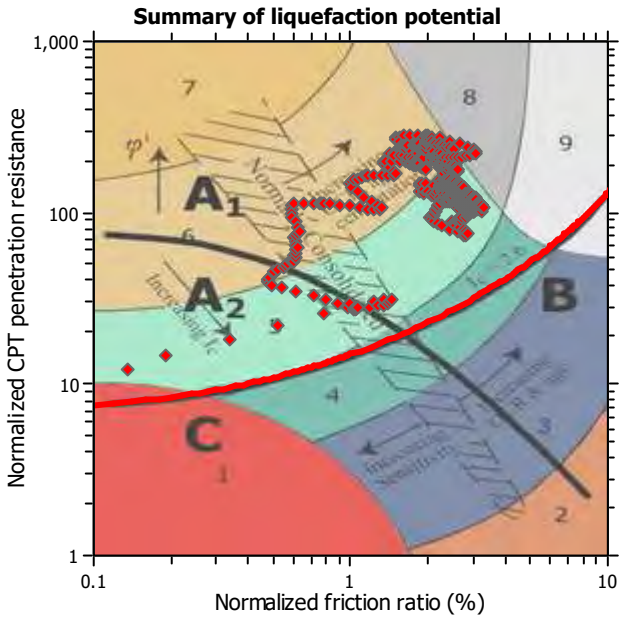
CPT file : CPT05_ULS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	7.70	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.68	Unit weight calculation:	Based on SBT	K_σ applied:	No		

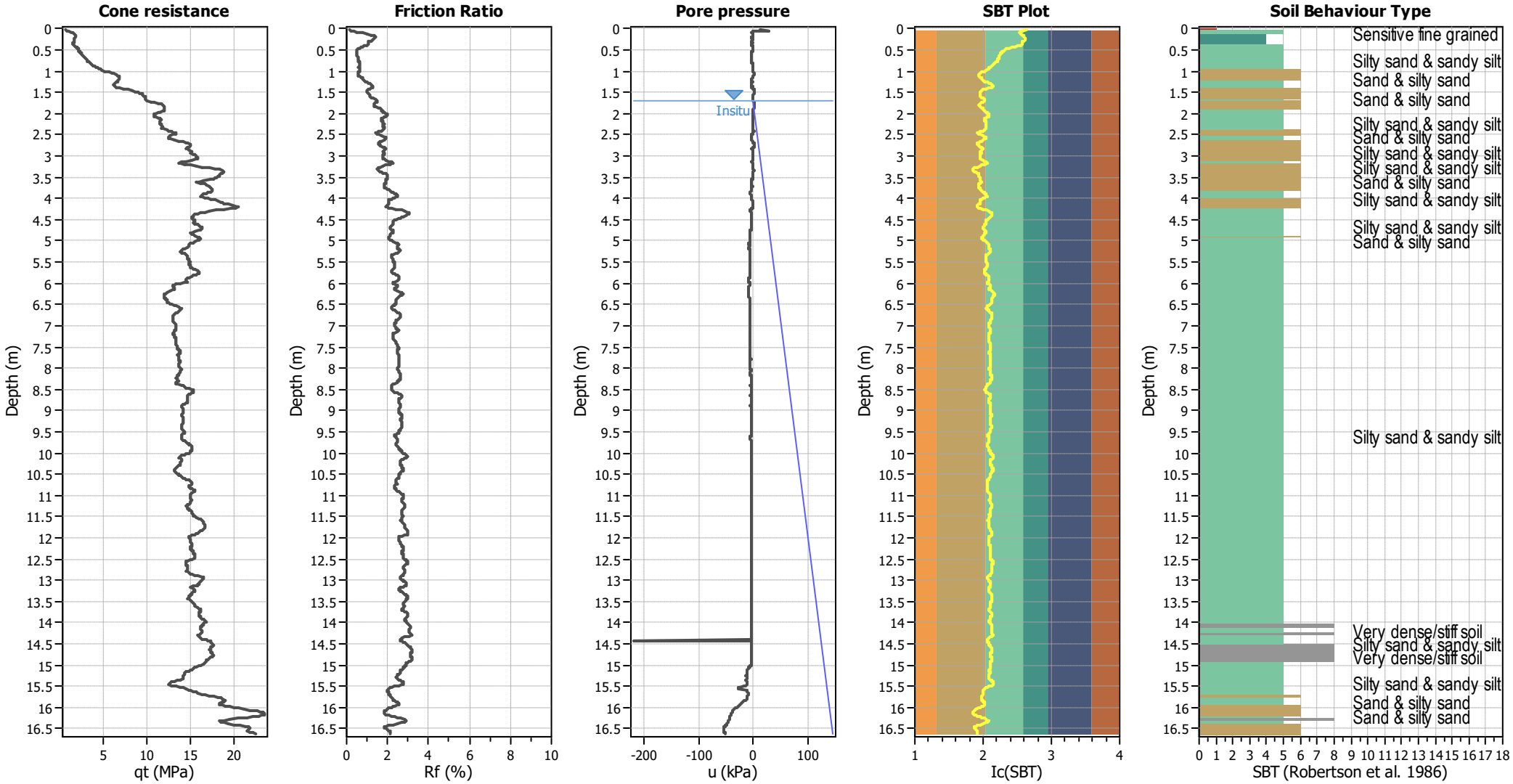






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



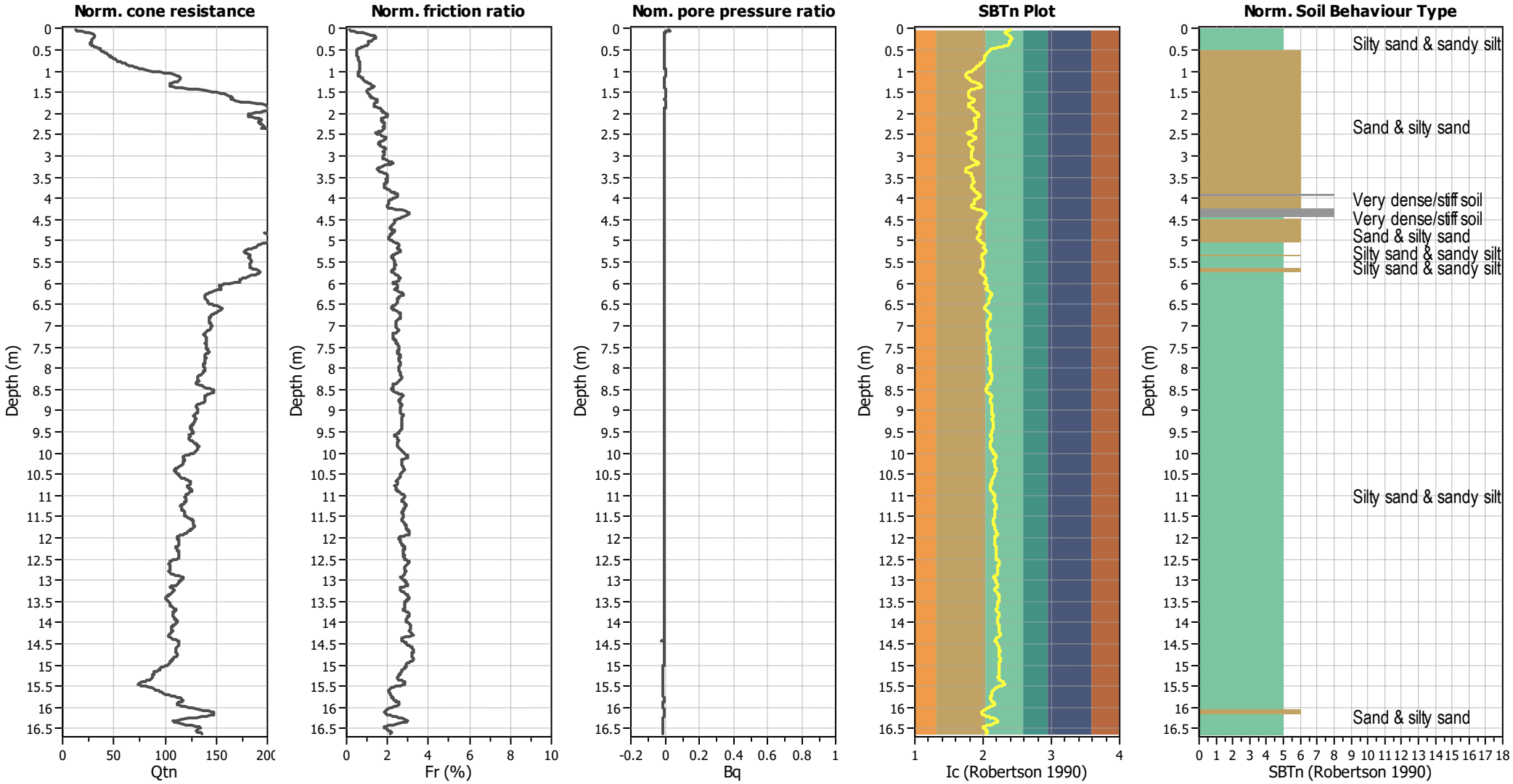
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



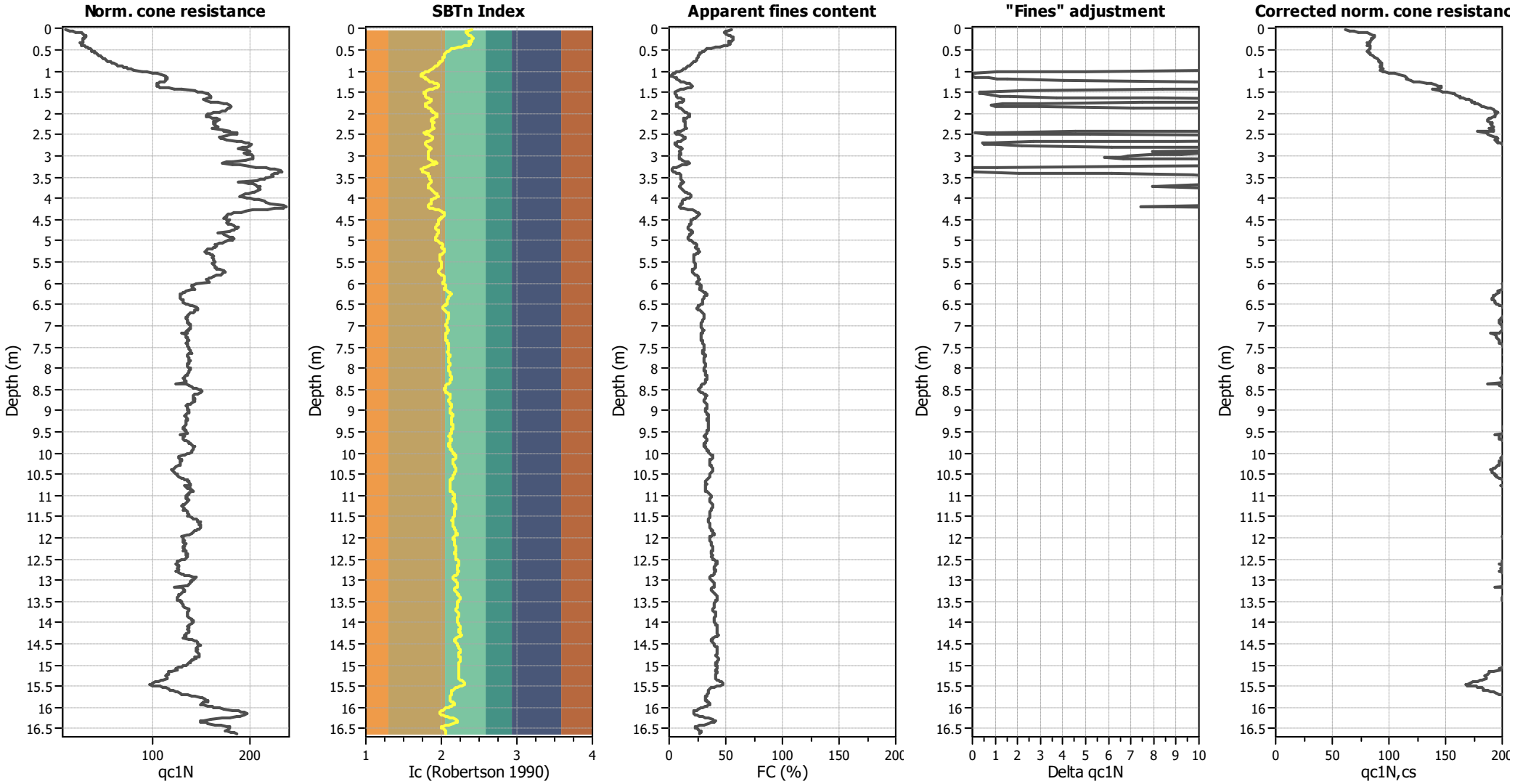
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

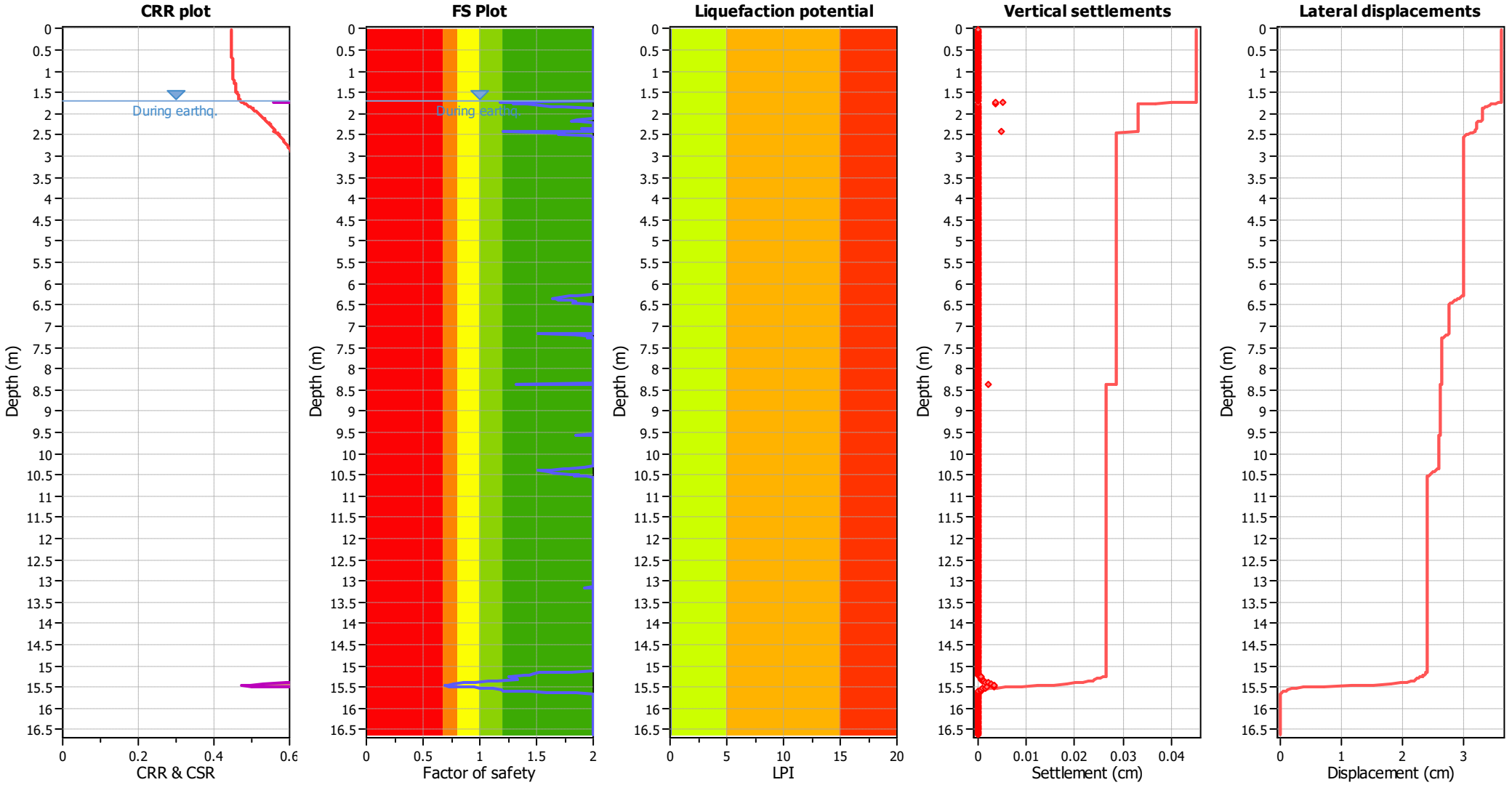
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

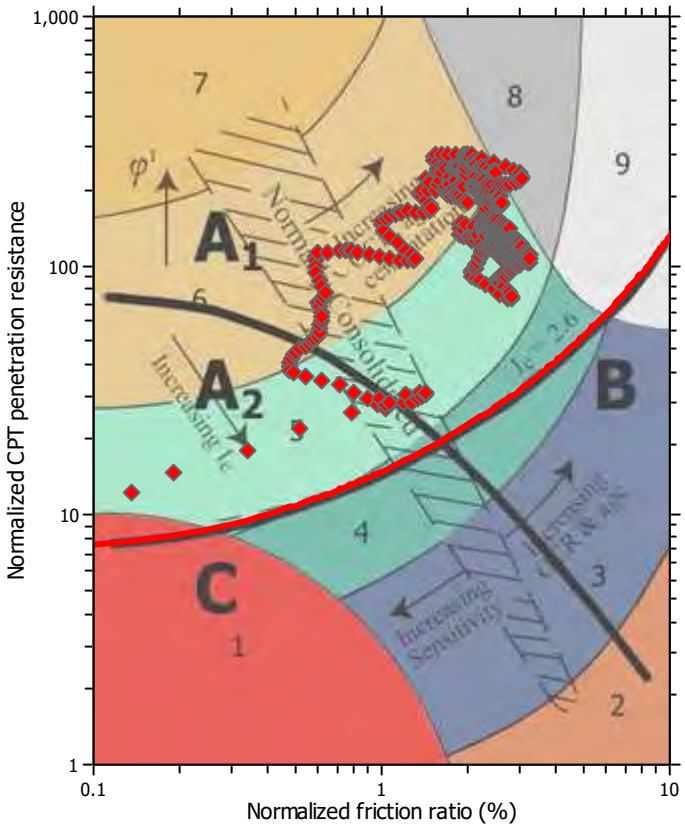
F.S. color scheme

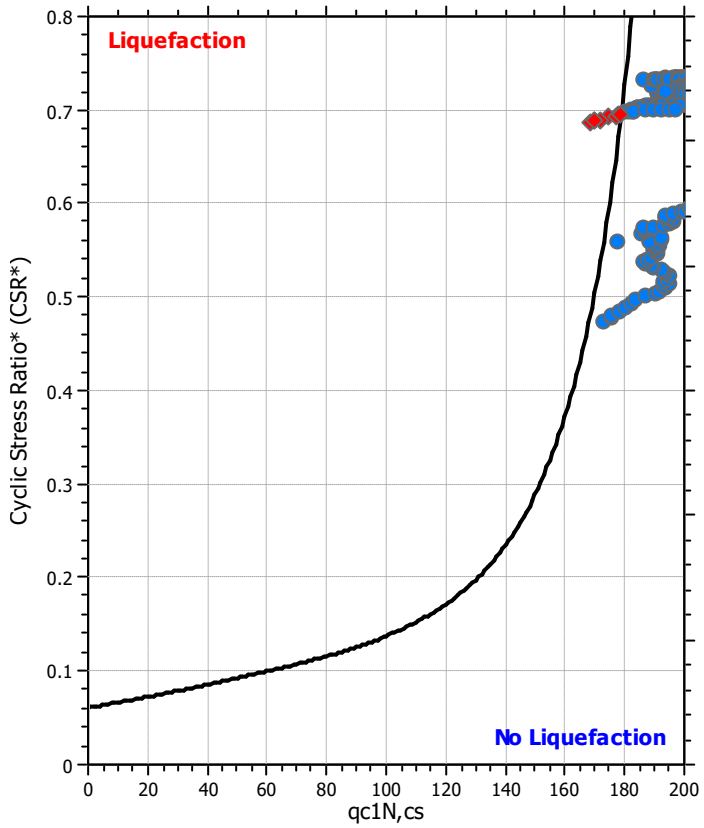
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

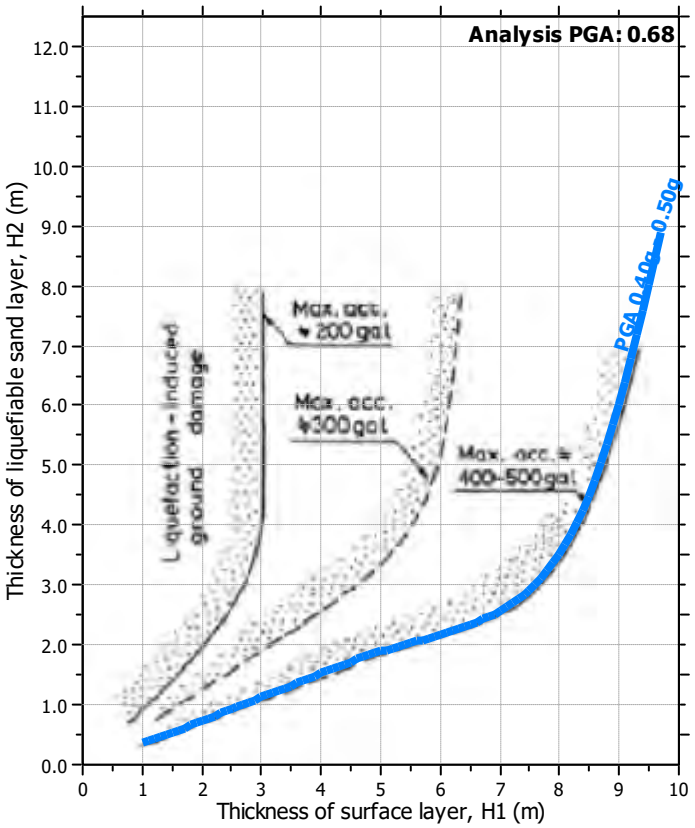
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



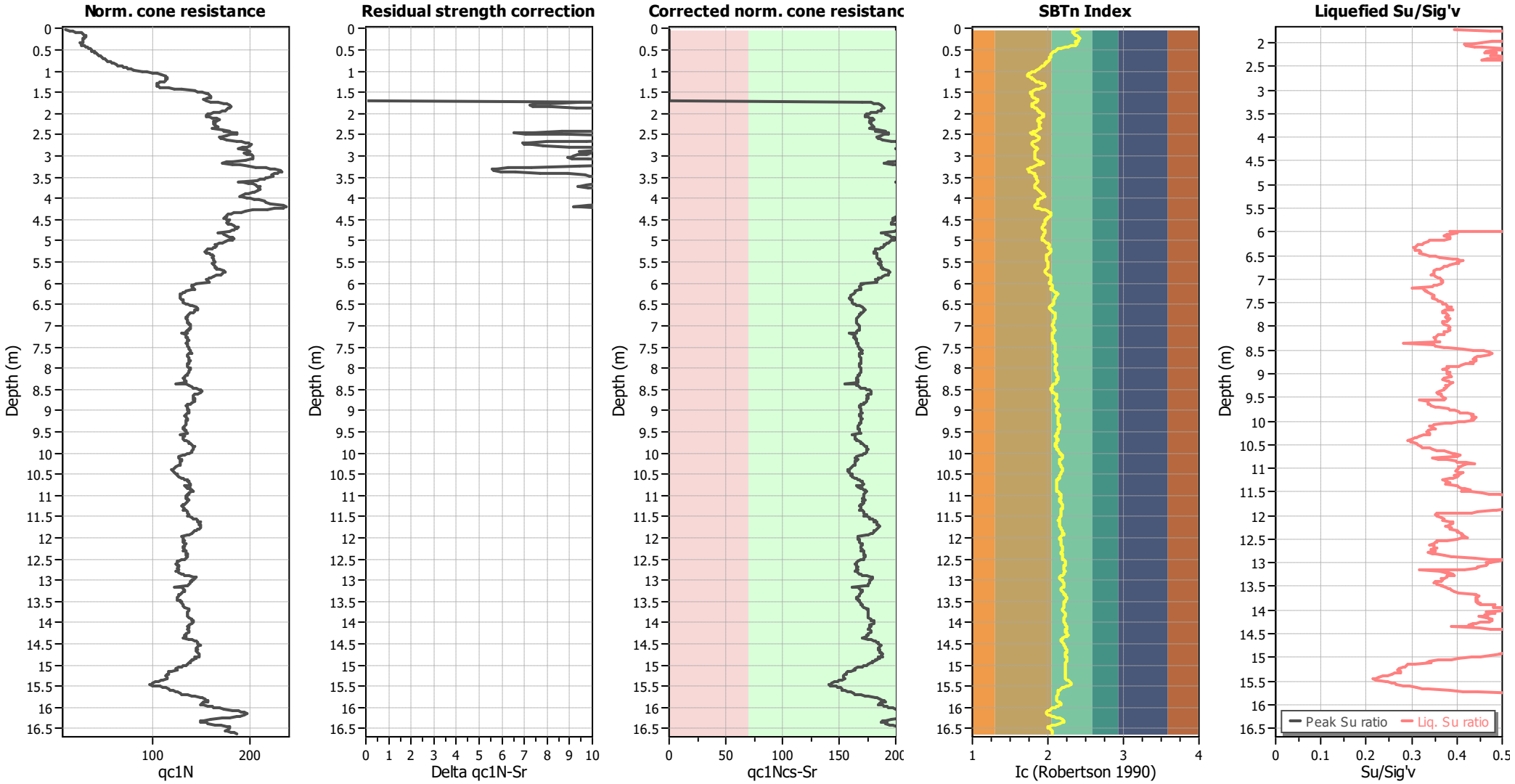




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

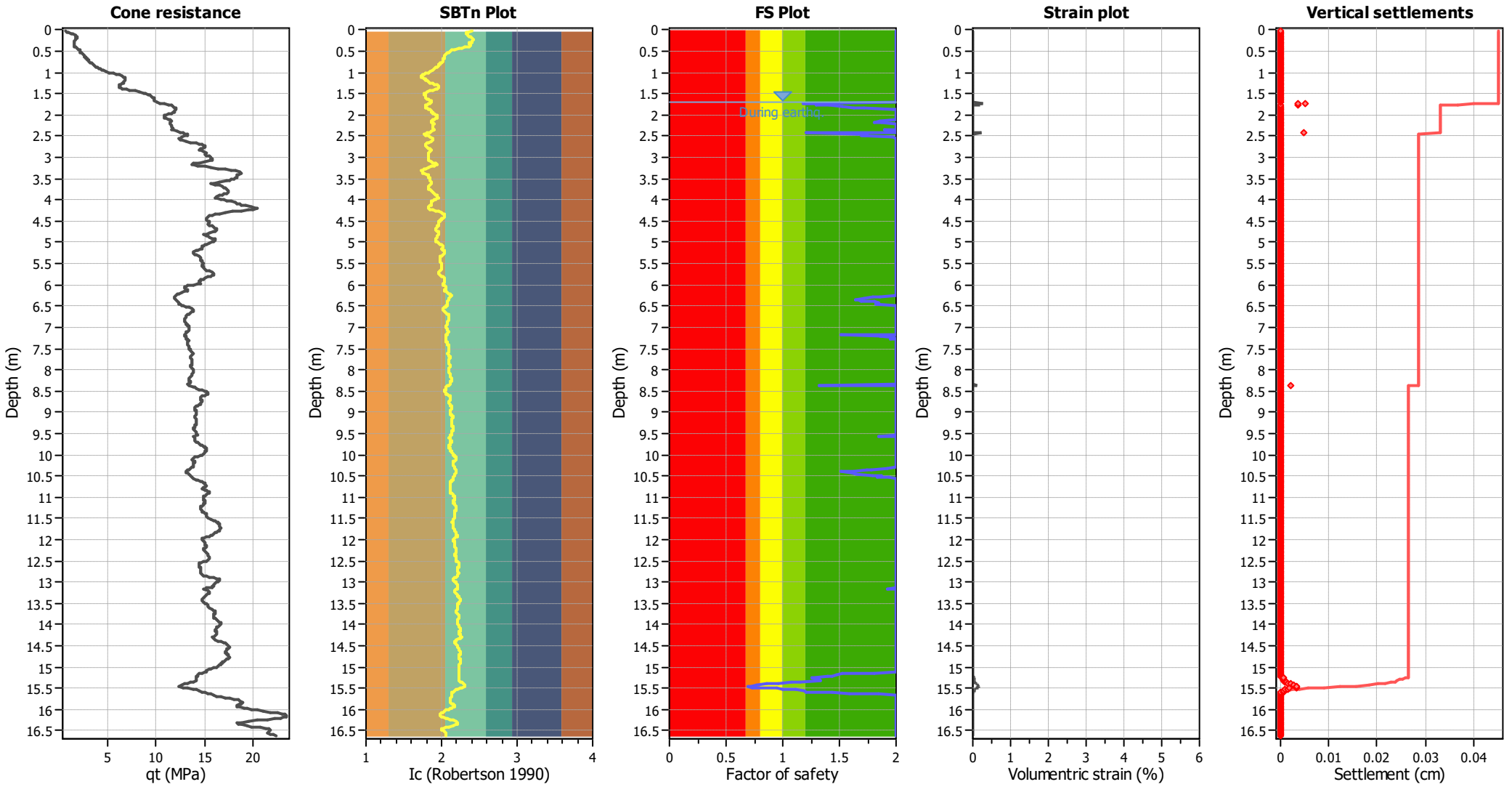
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

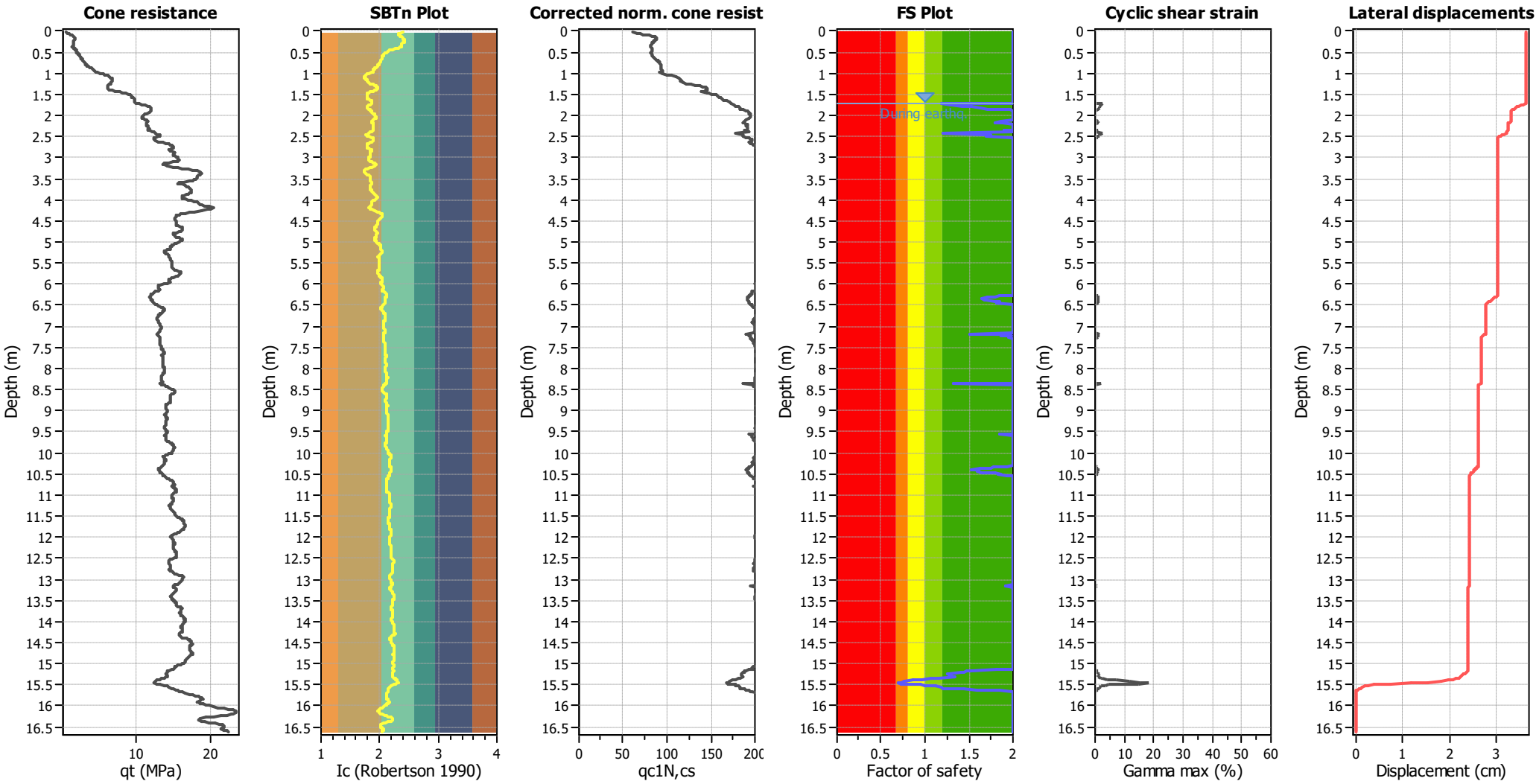
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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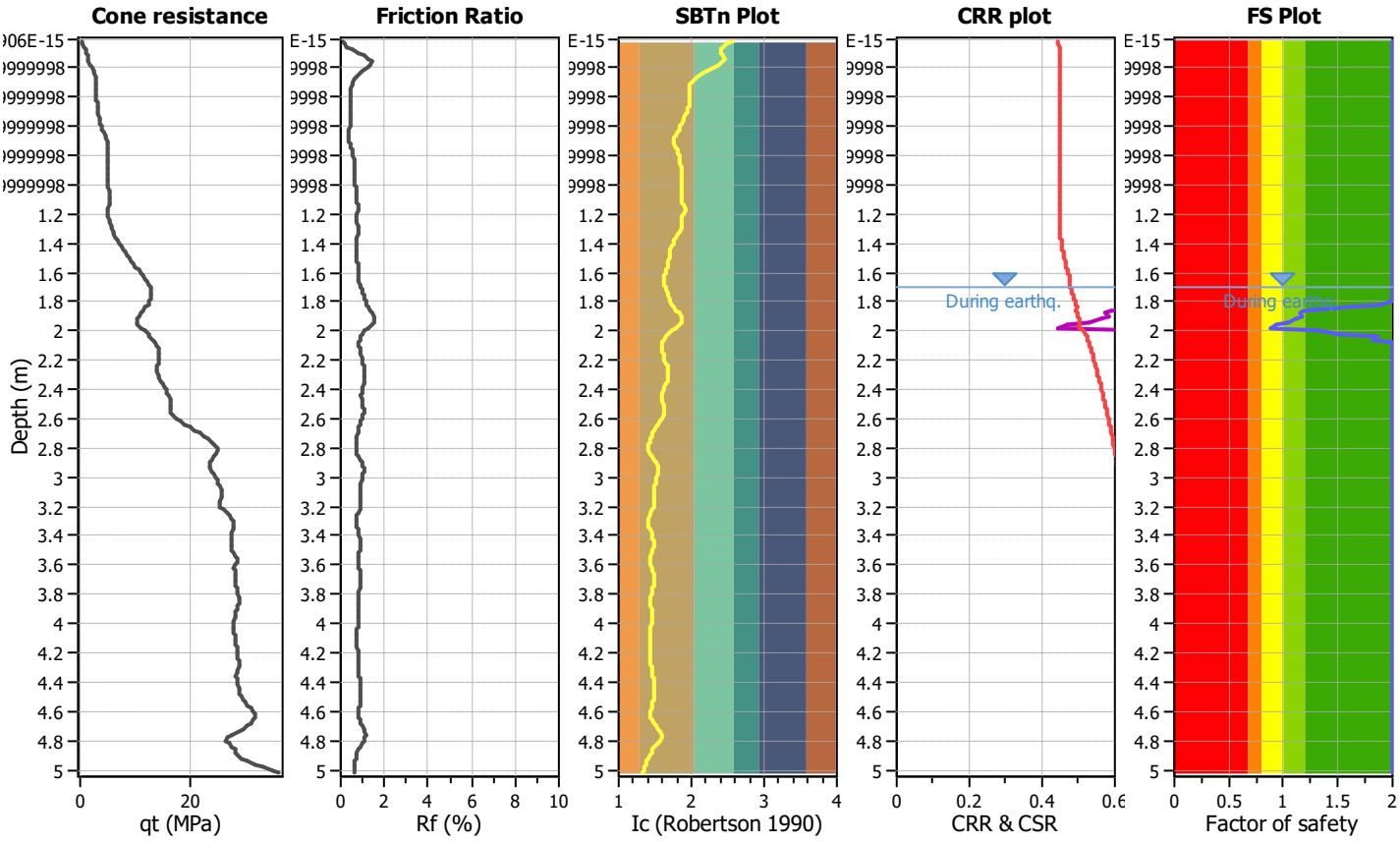
LIQUEFACTION ANALYSIS REPORT

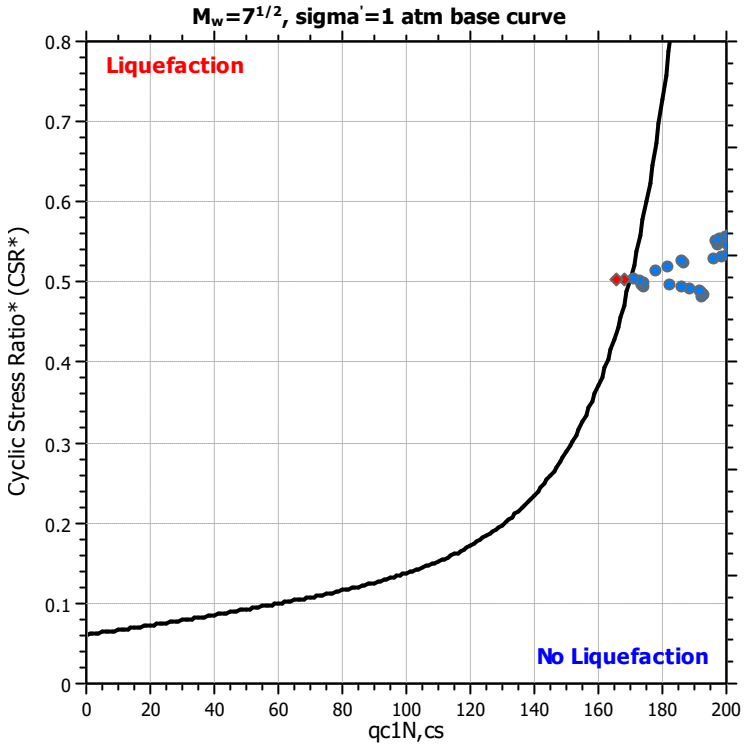
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

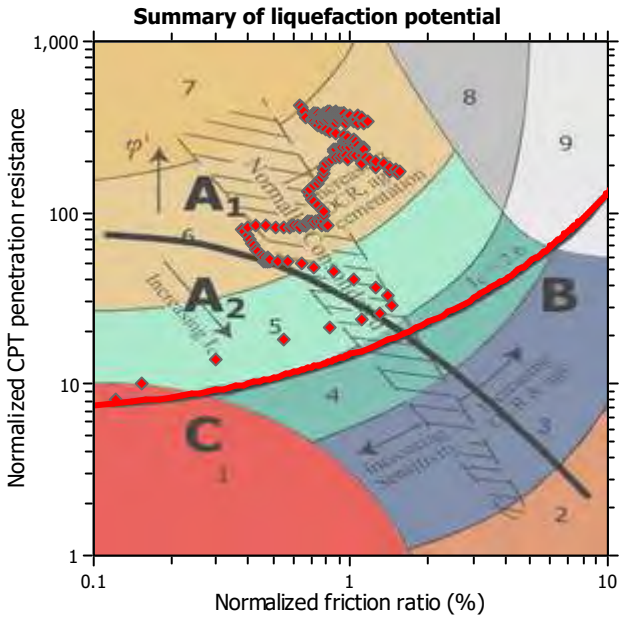
CPT file : CPT06_ULS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	7.70	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.68	Unit weight calculation:	Based on SBT	K_σ applied:	No		

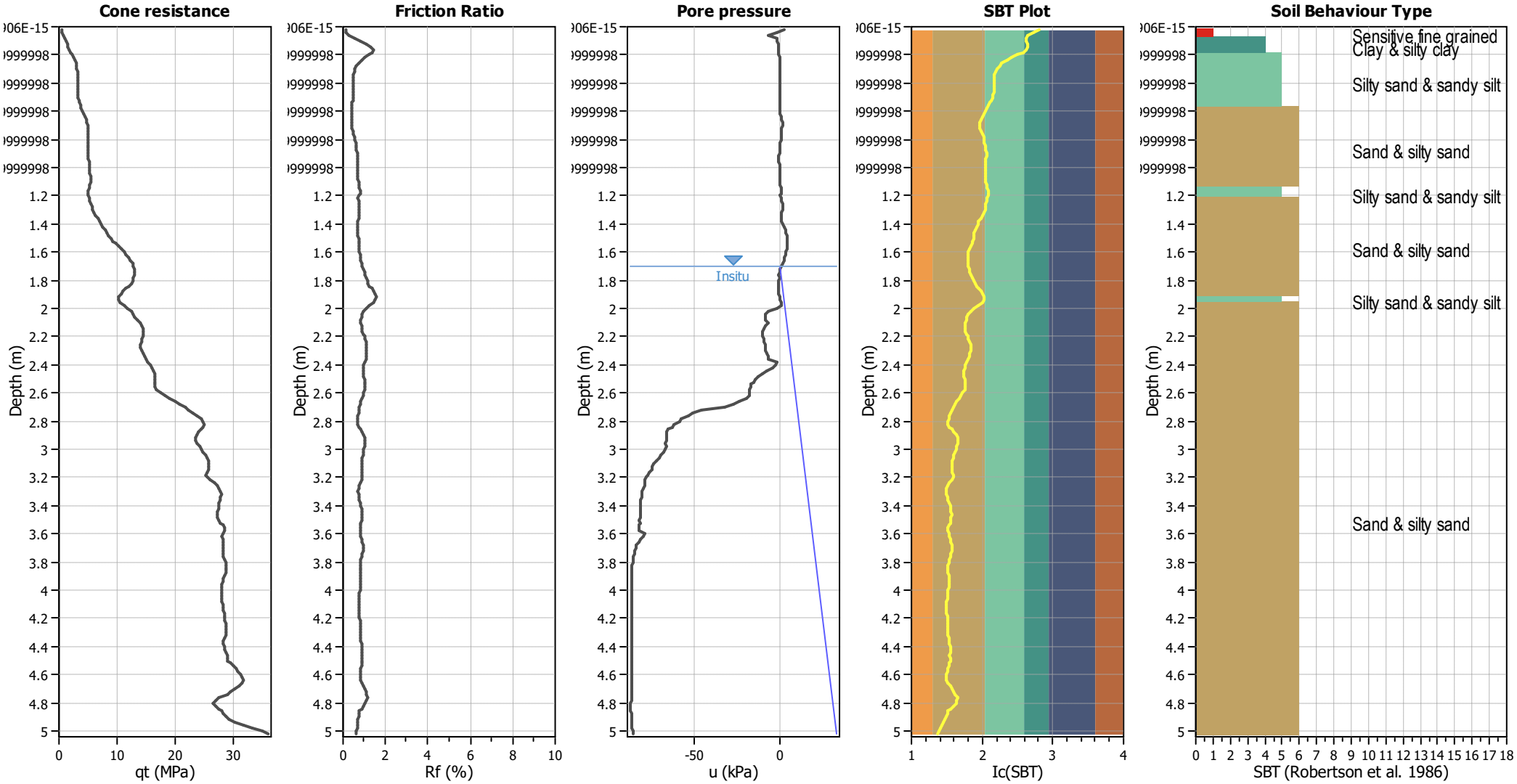






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



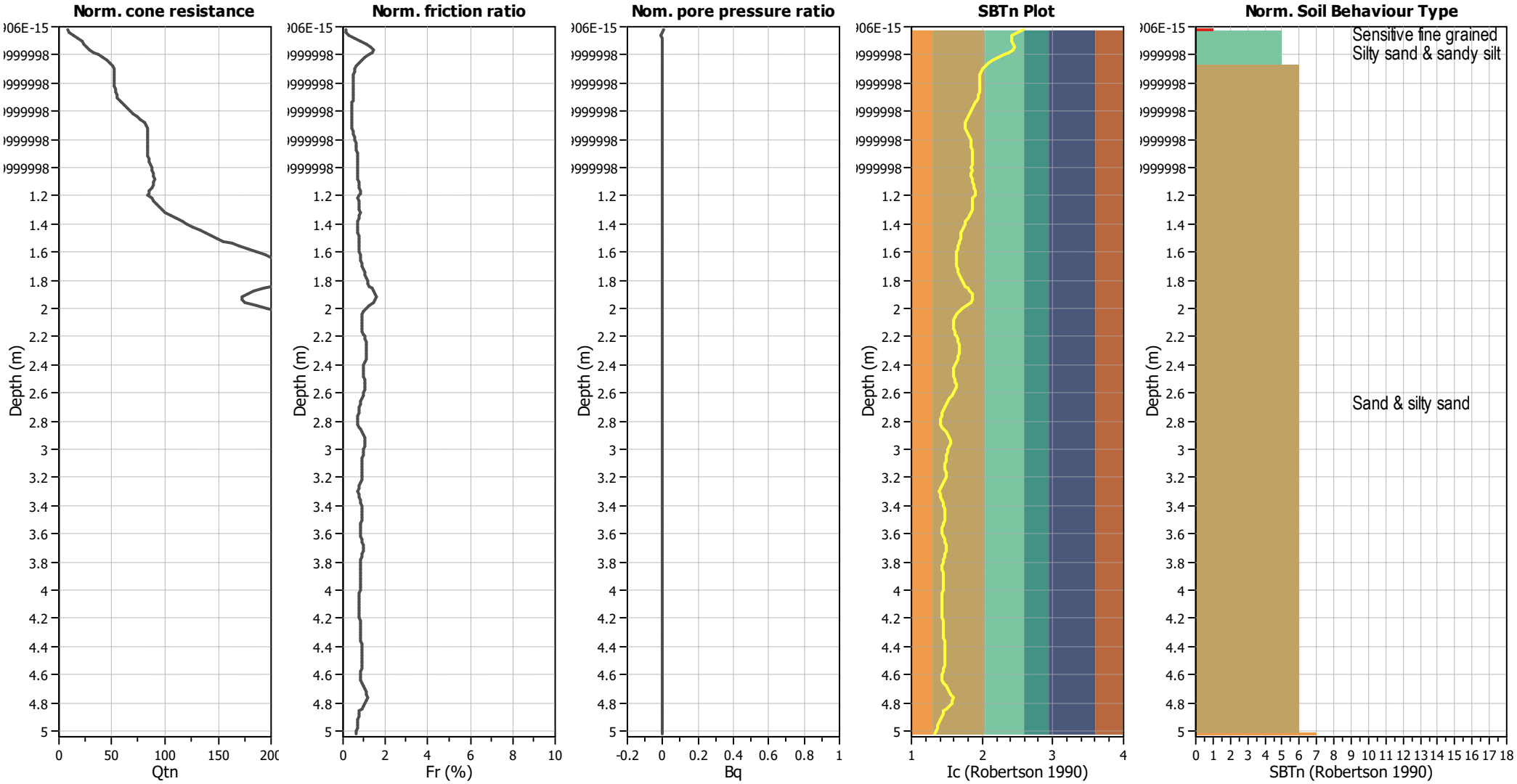
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



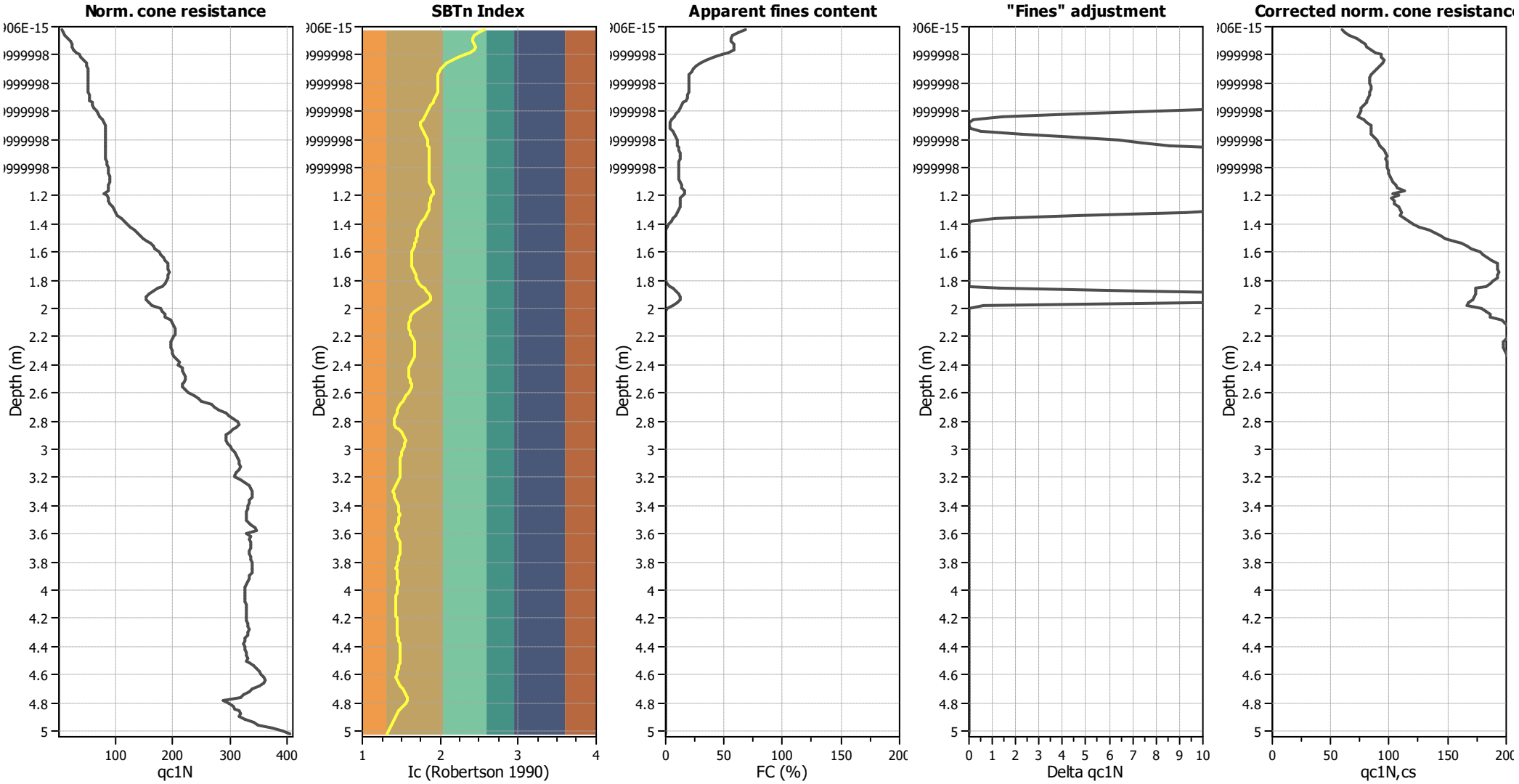
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

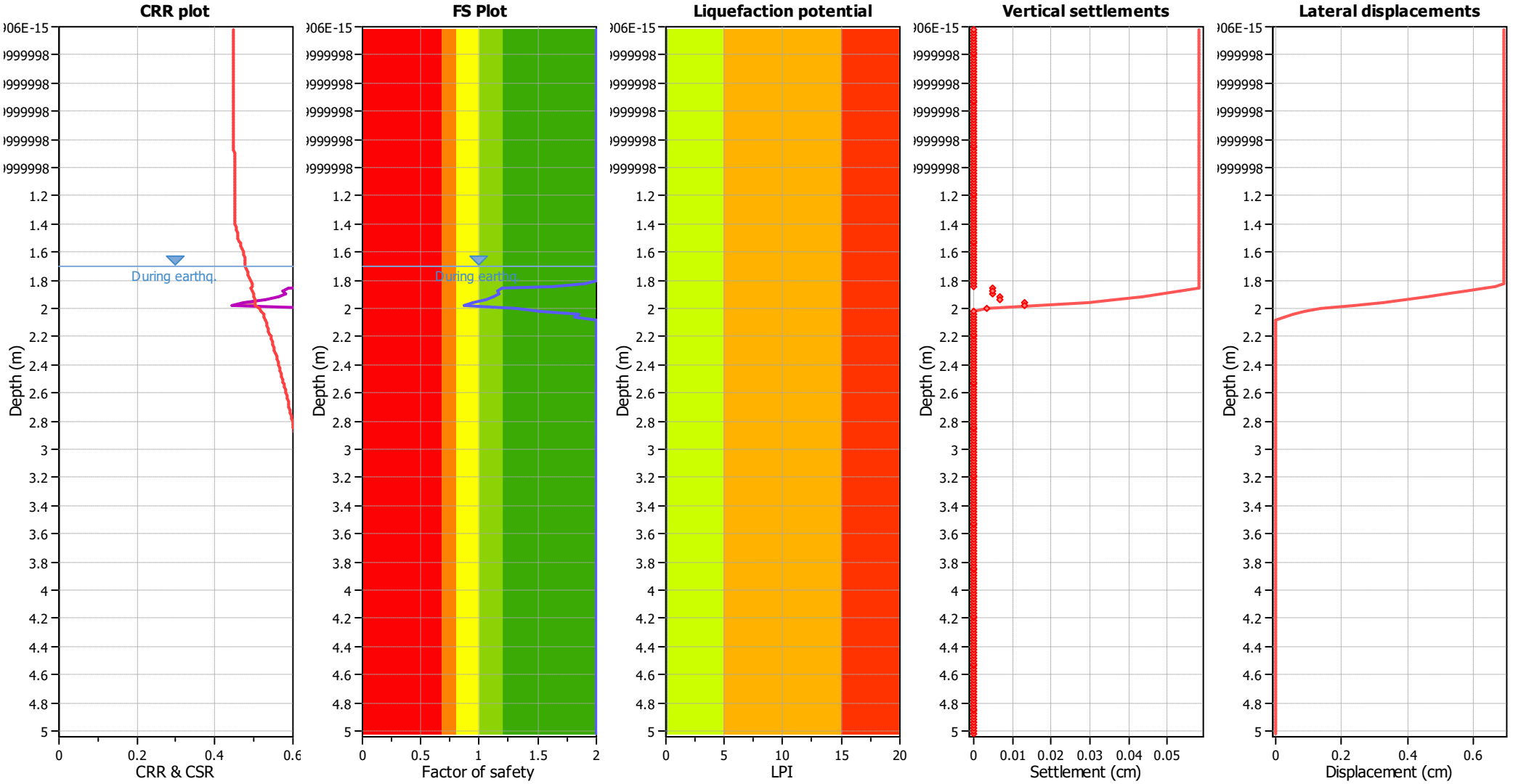
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

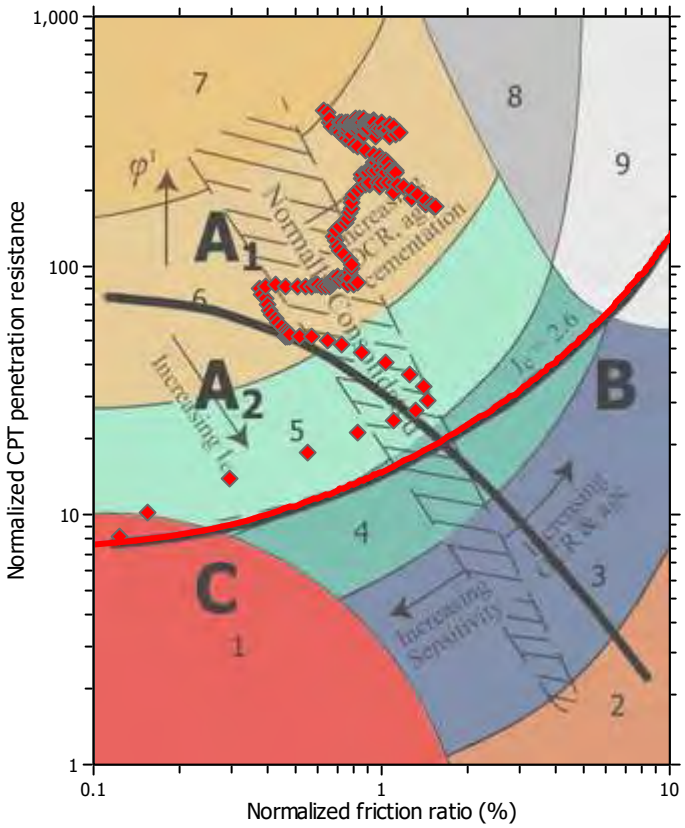
F.S. color scheme

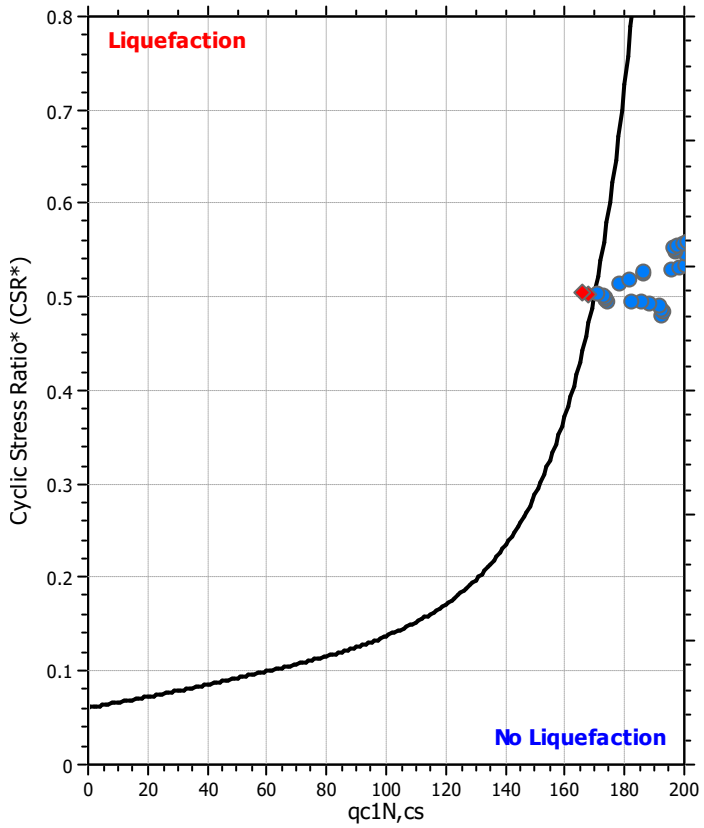
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

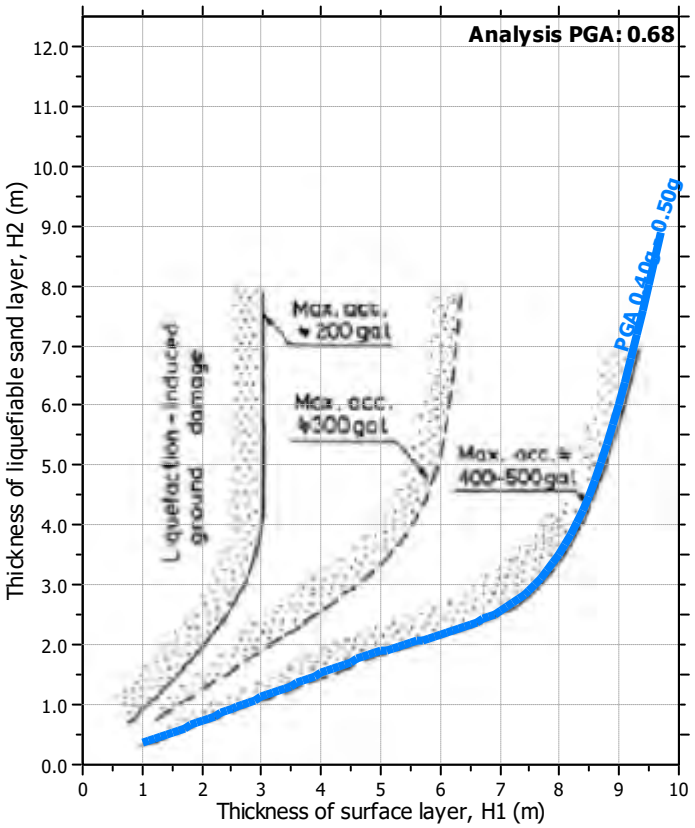
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



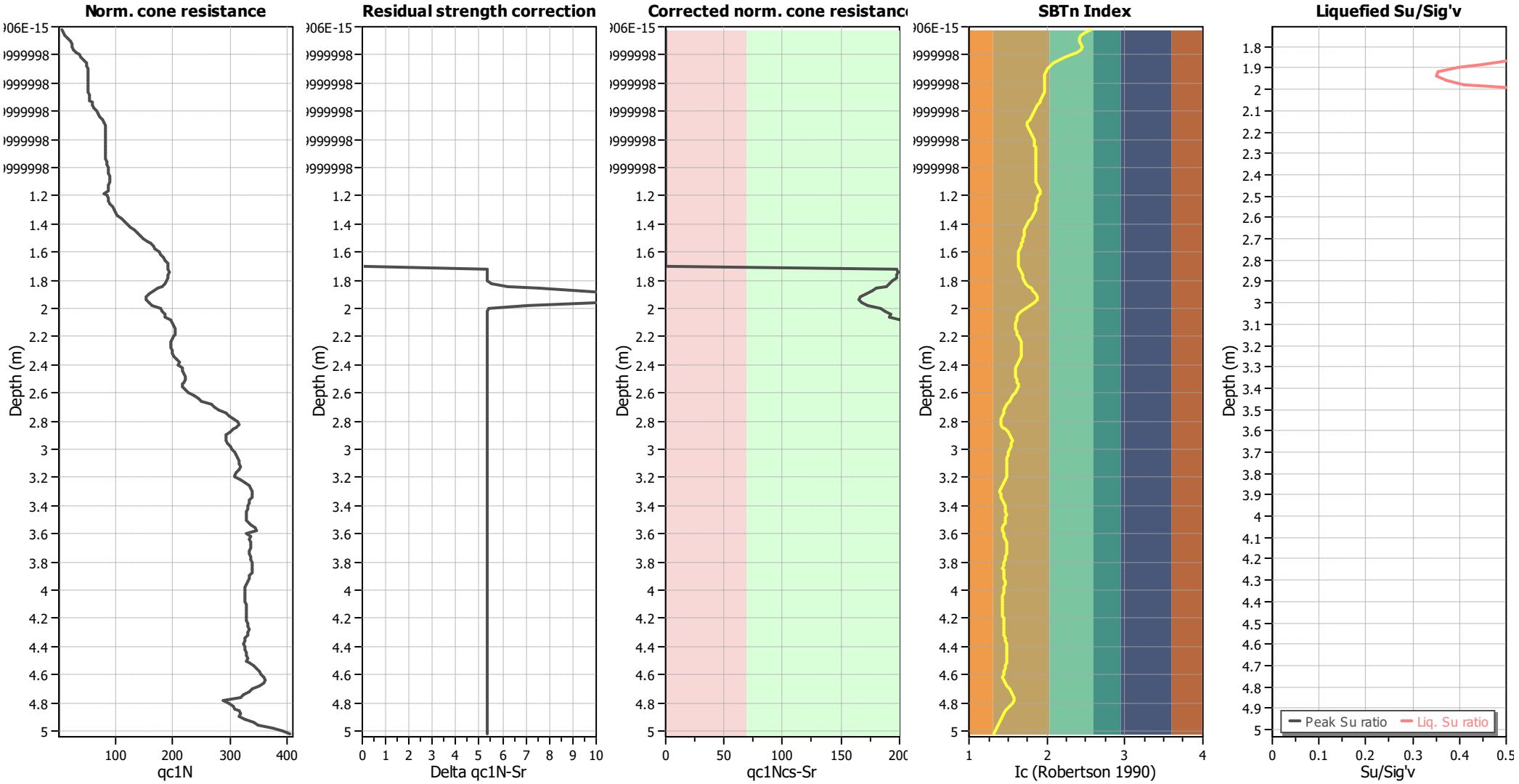




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

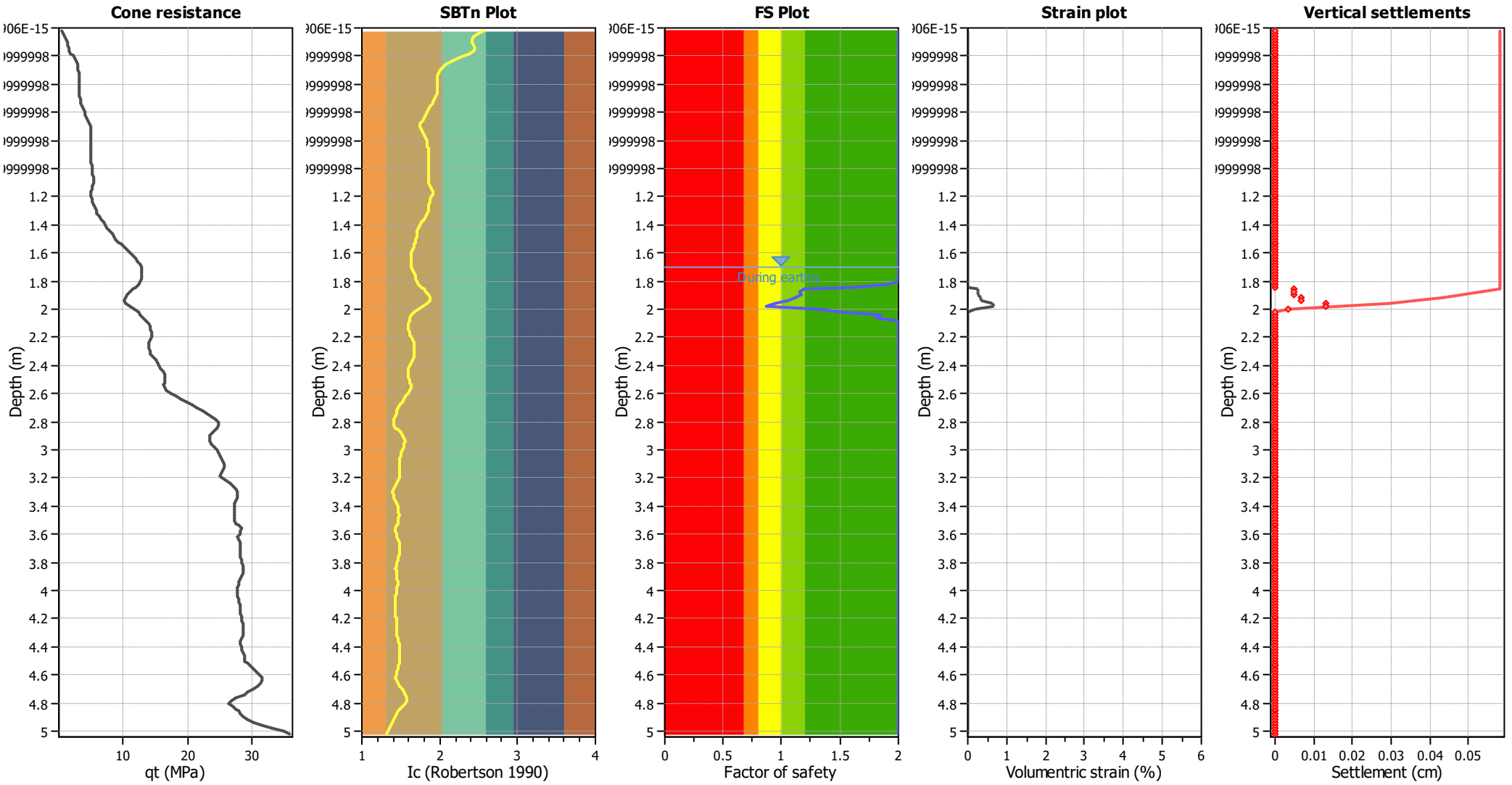
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

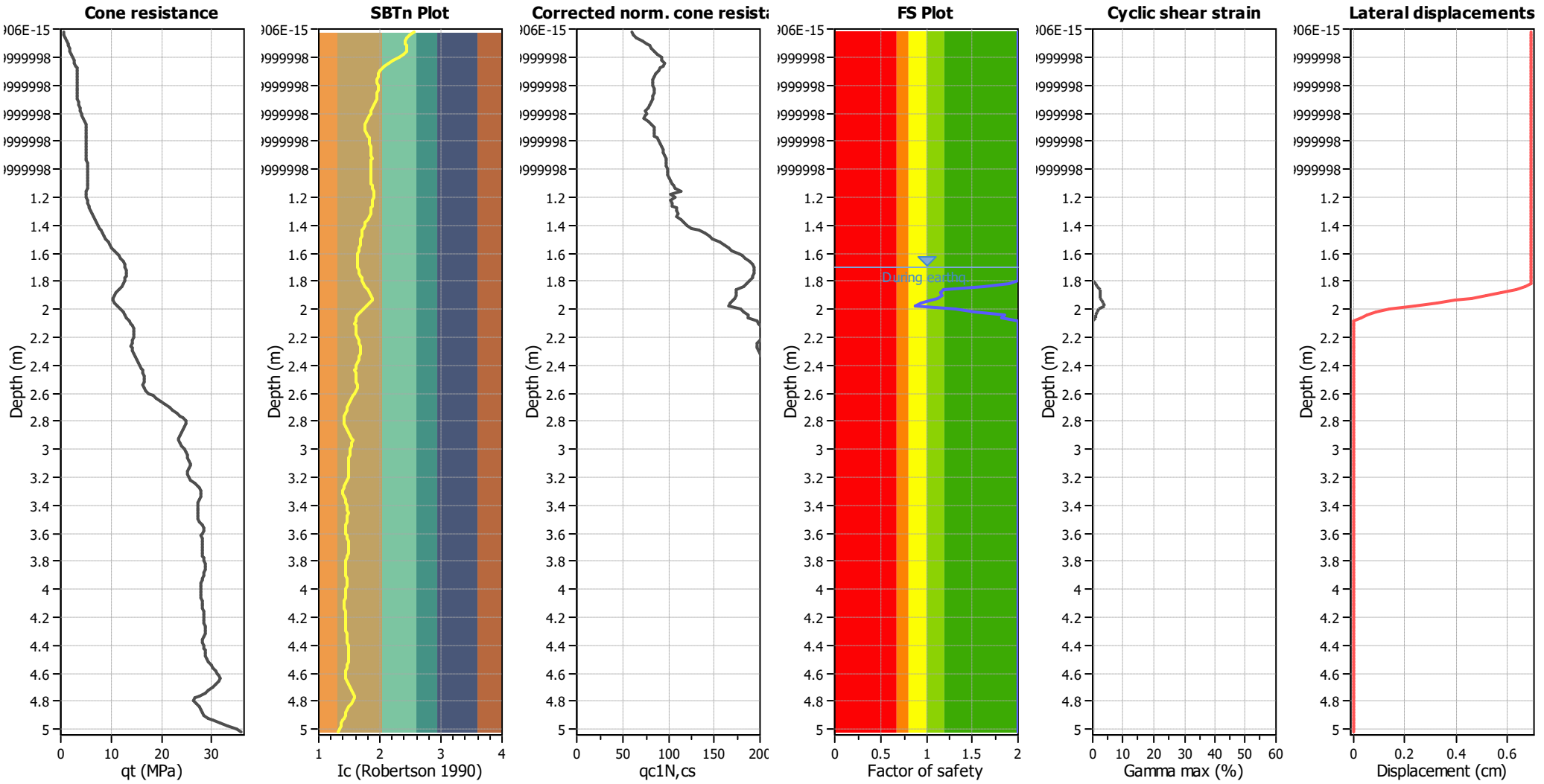
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

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F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
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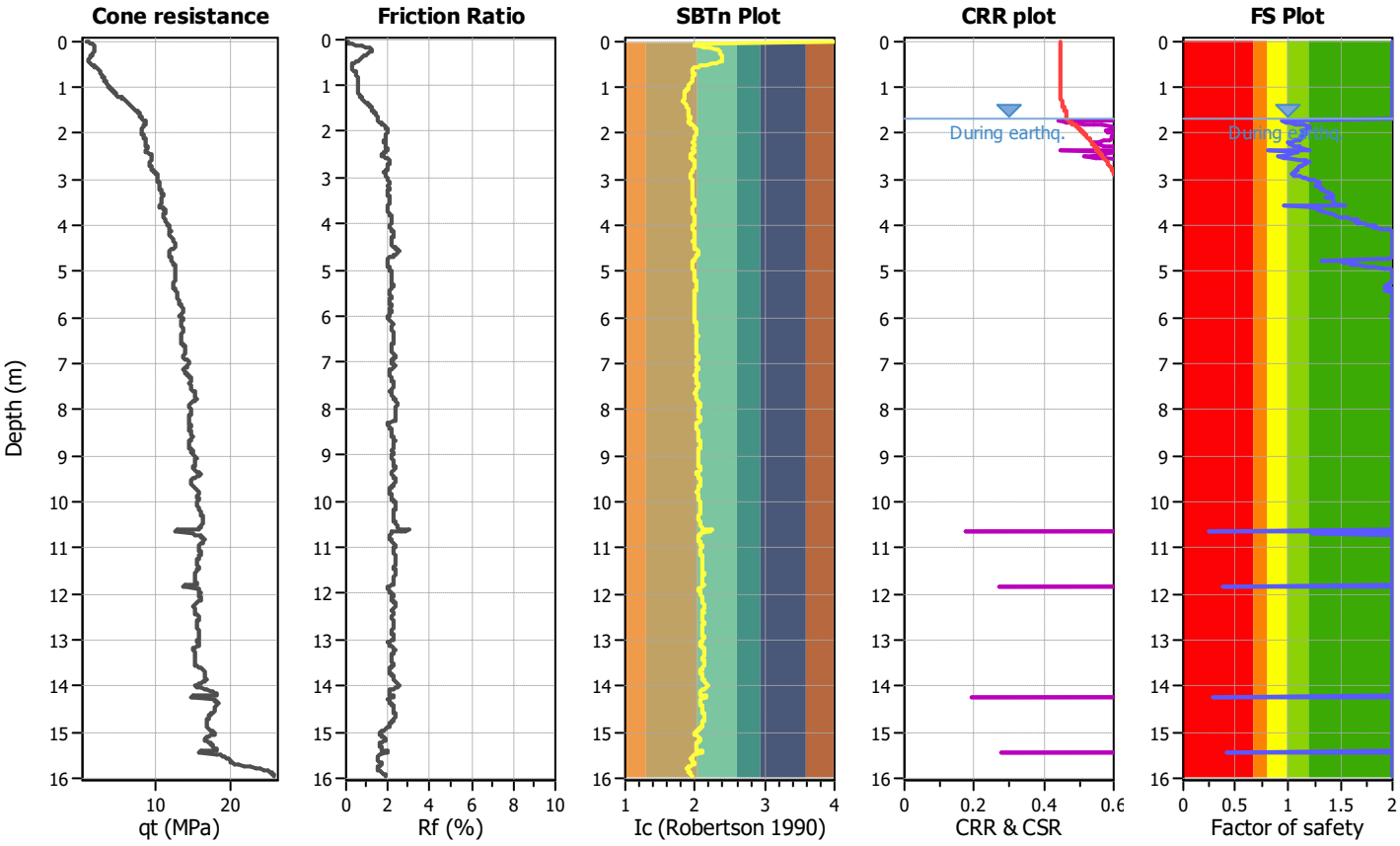
LIQUEFACTION ANALYSIS REPORT

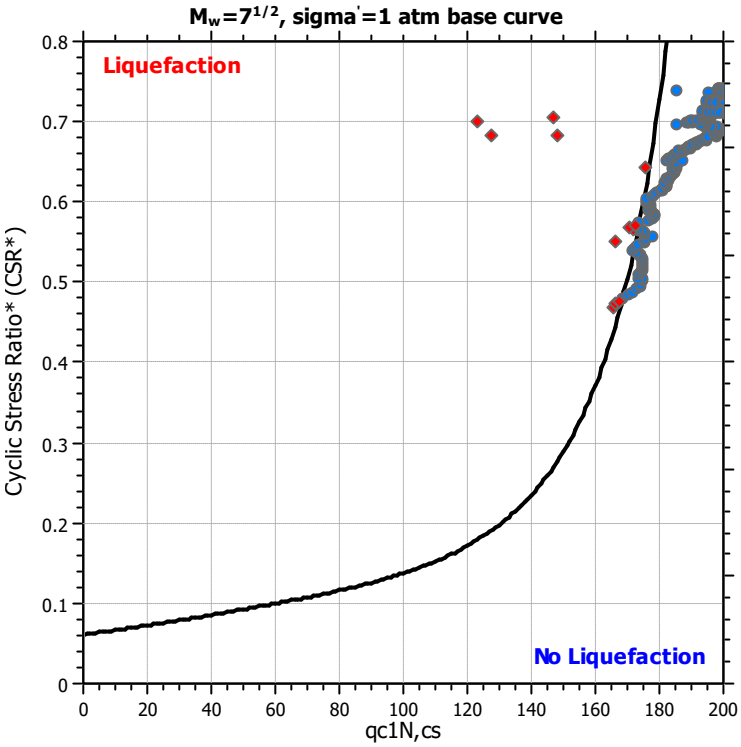
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

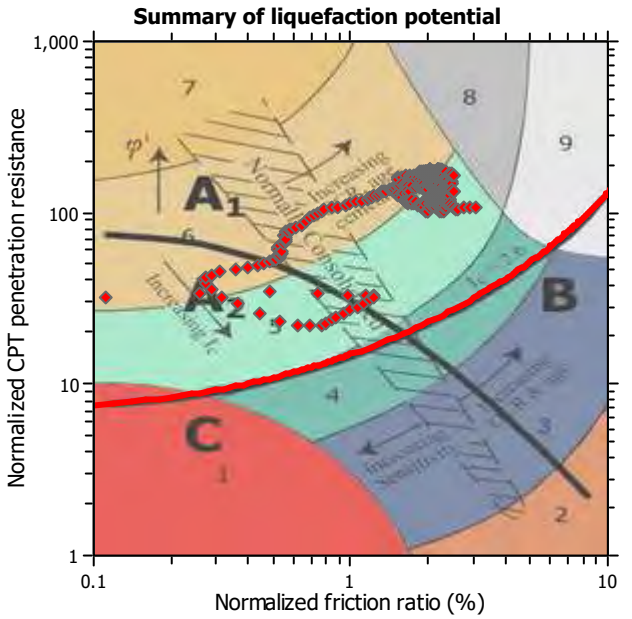
CPT file : CPT07_ULS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	7.70	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.68	Unit weight calculation:	Based on SBT	K_σ applied:	No		

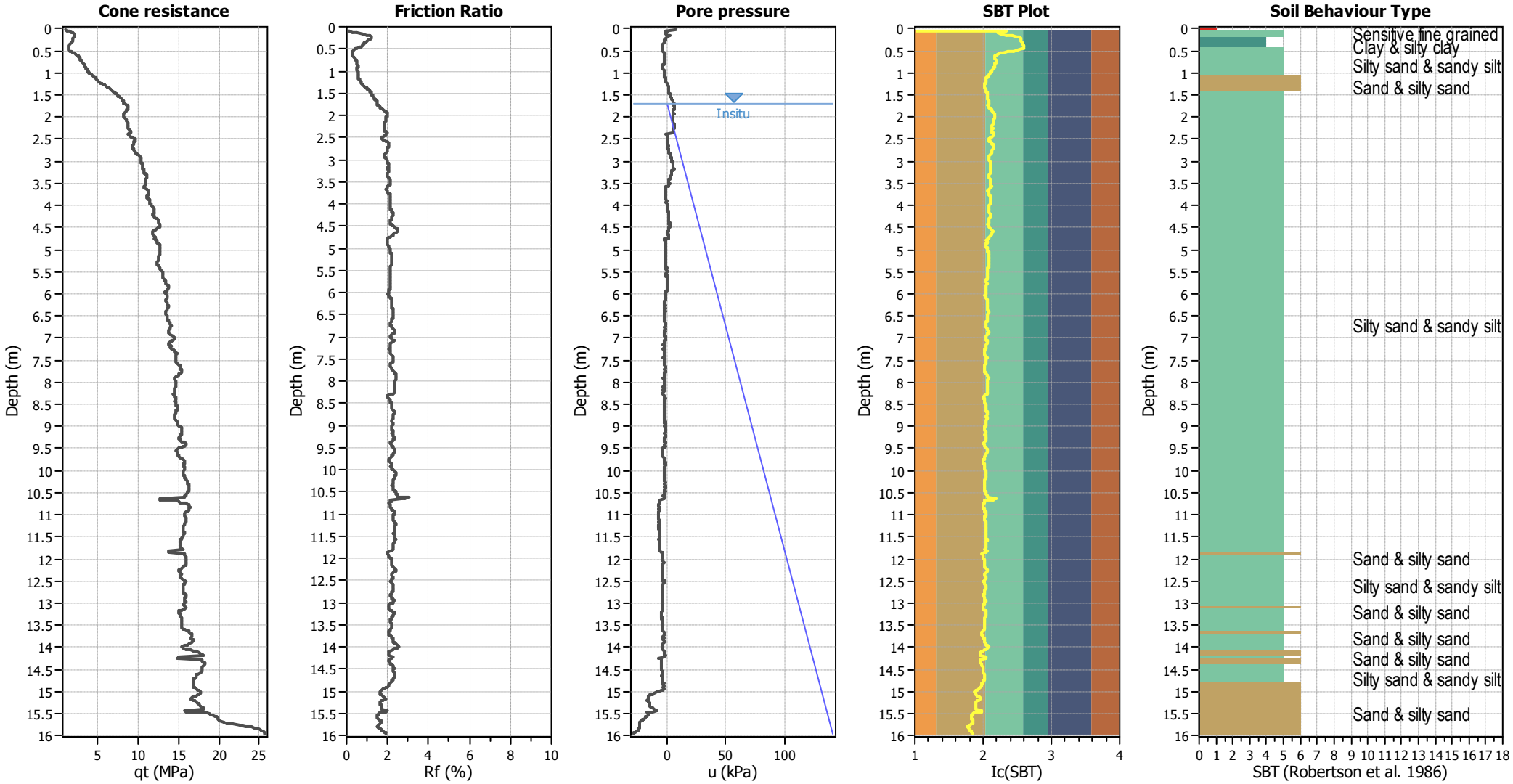






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



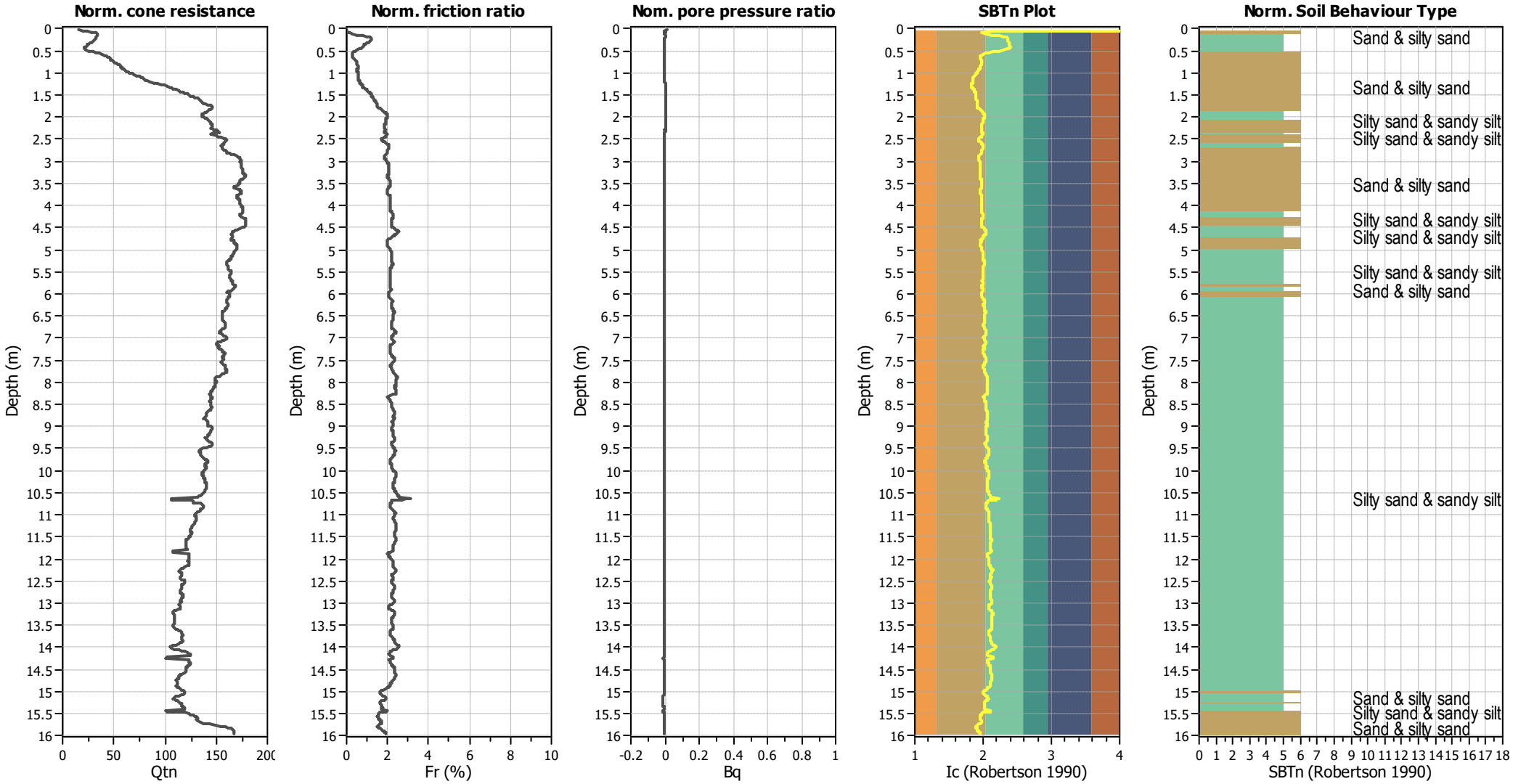
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



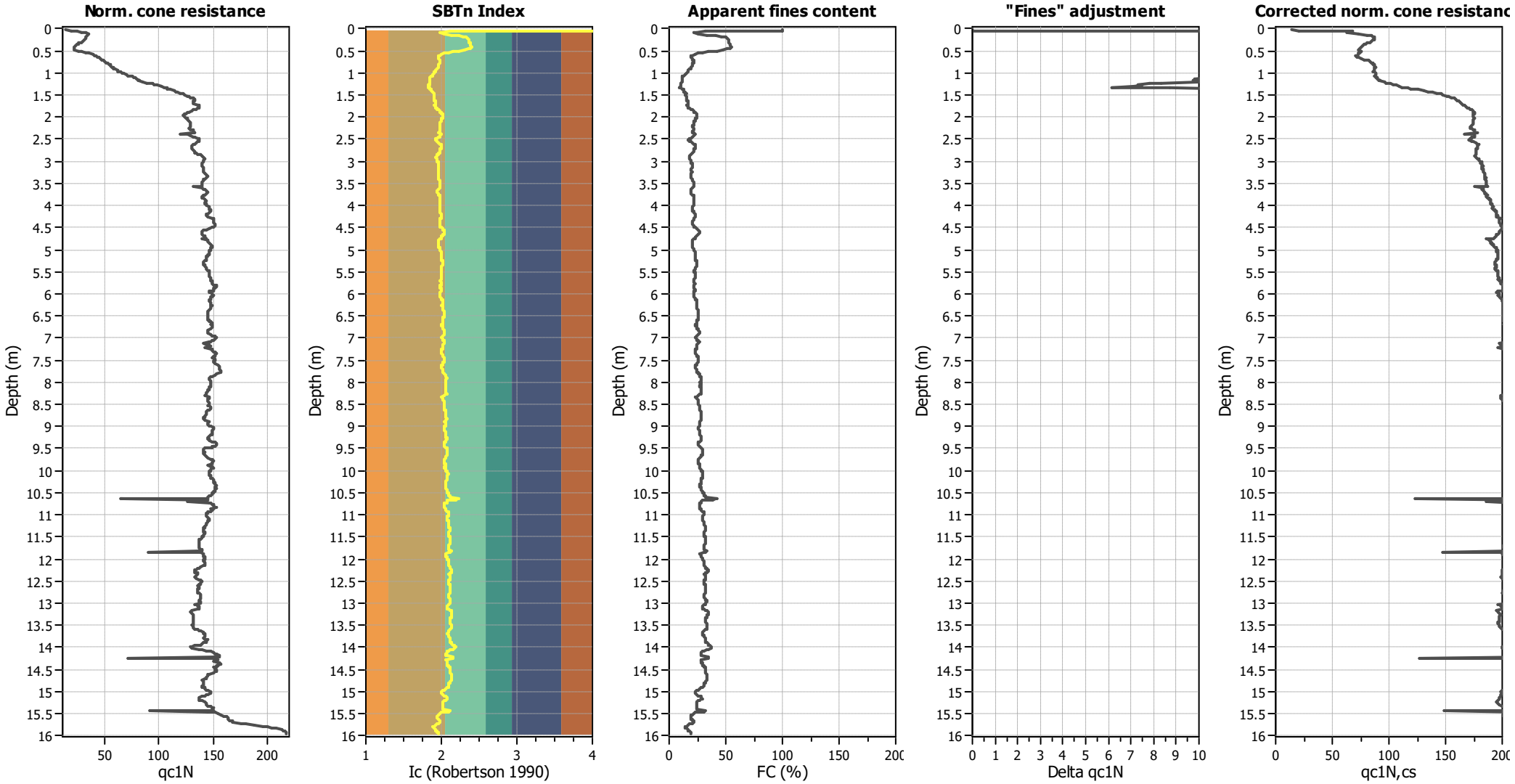
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

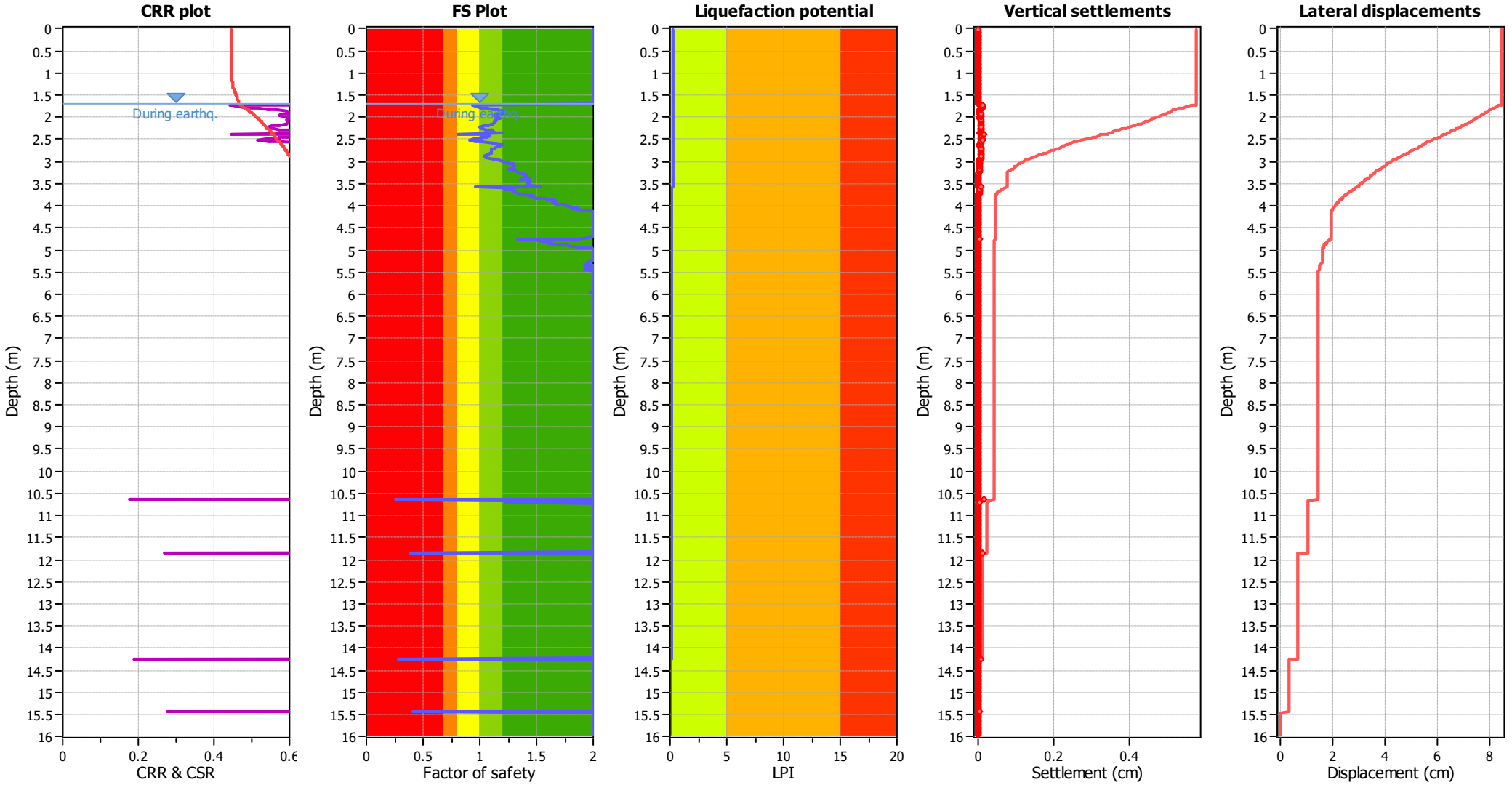
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

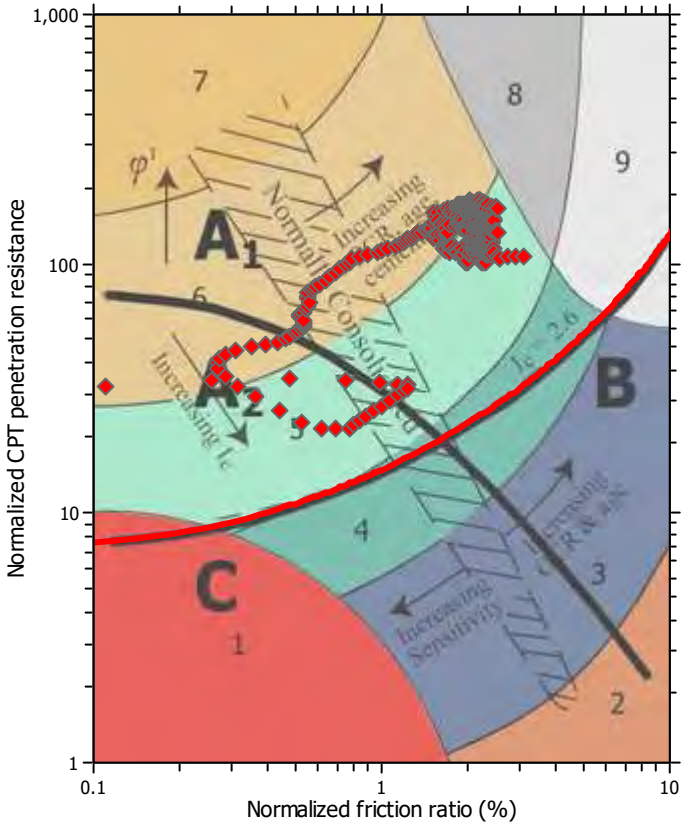
F.S. color scheme

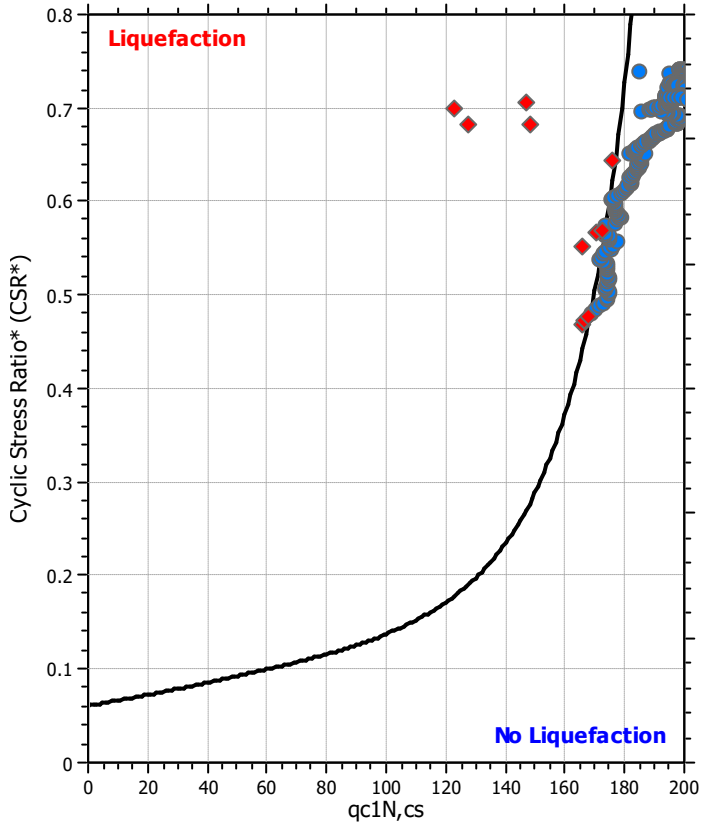
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

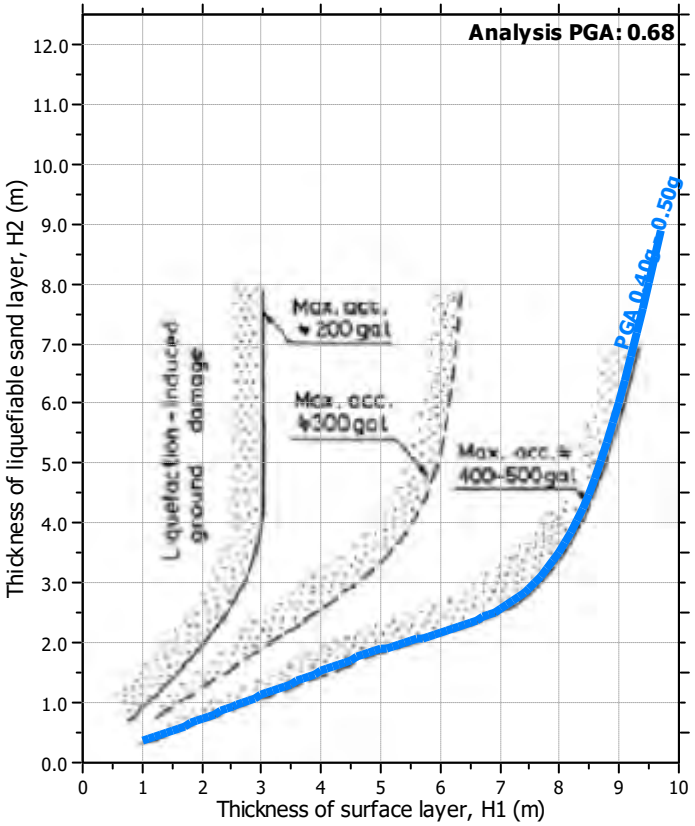
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



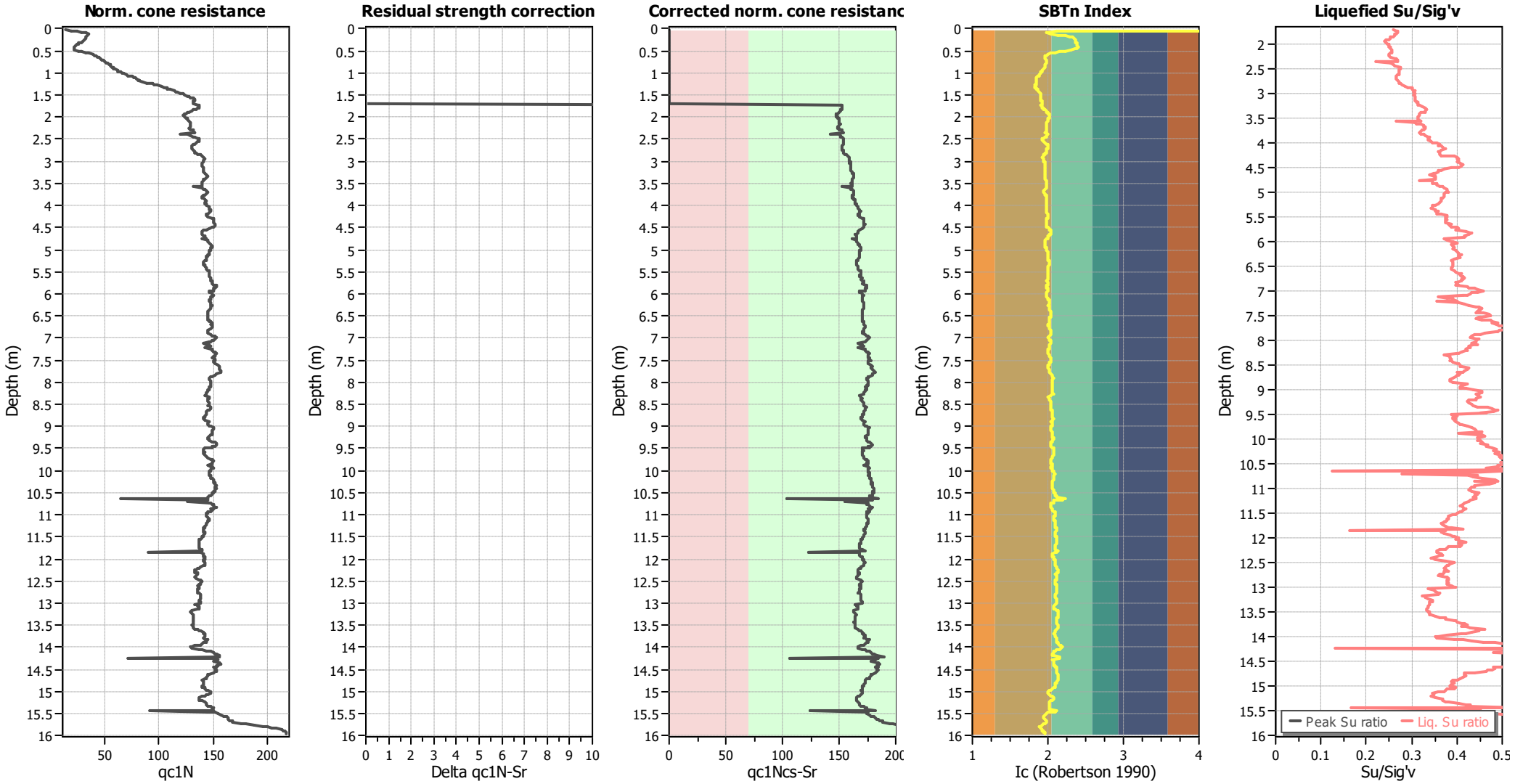




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

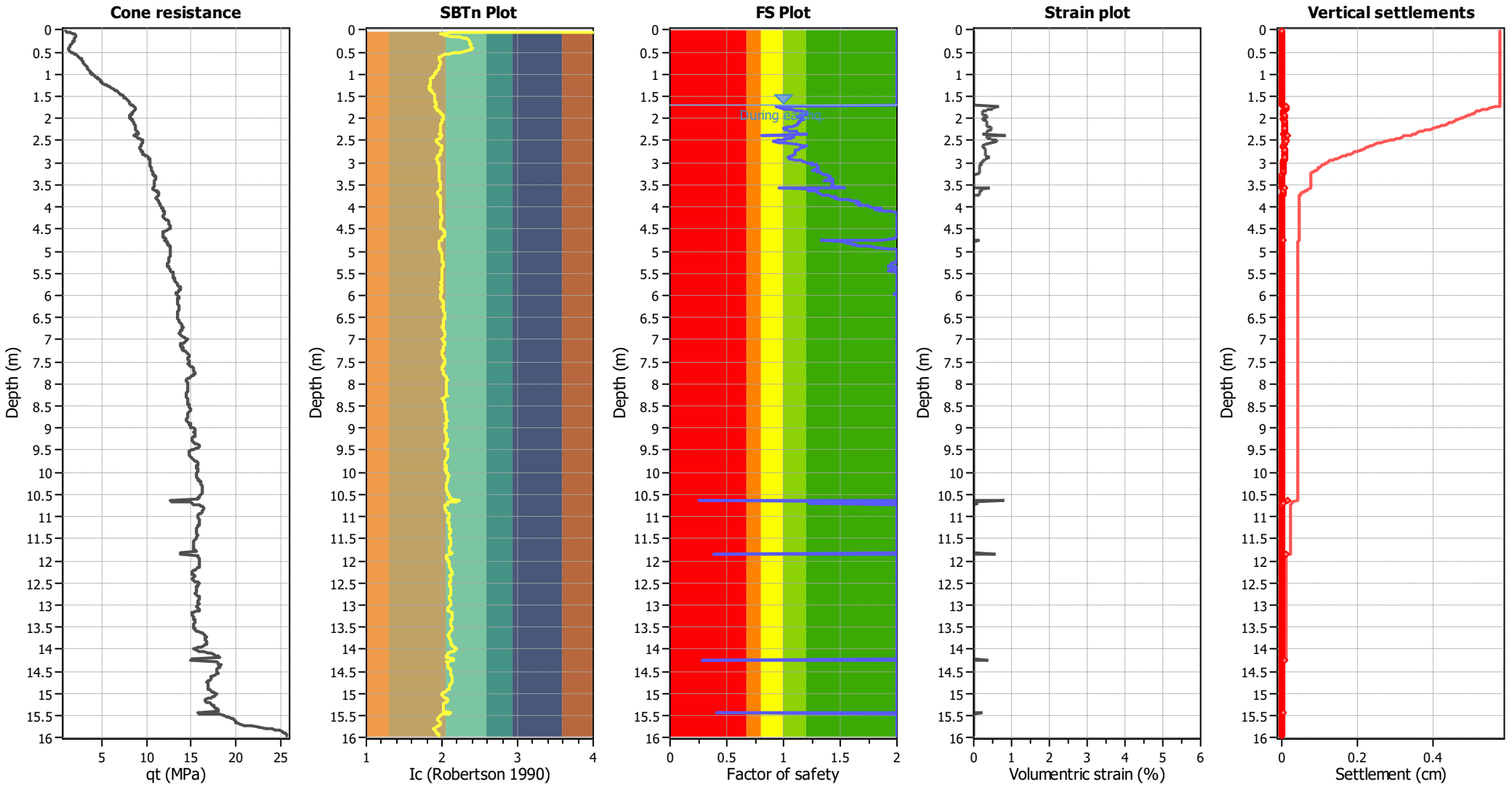
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

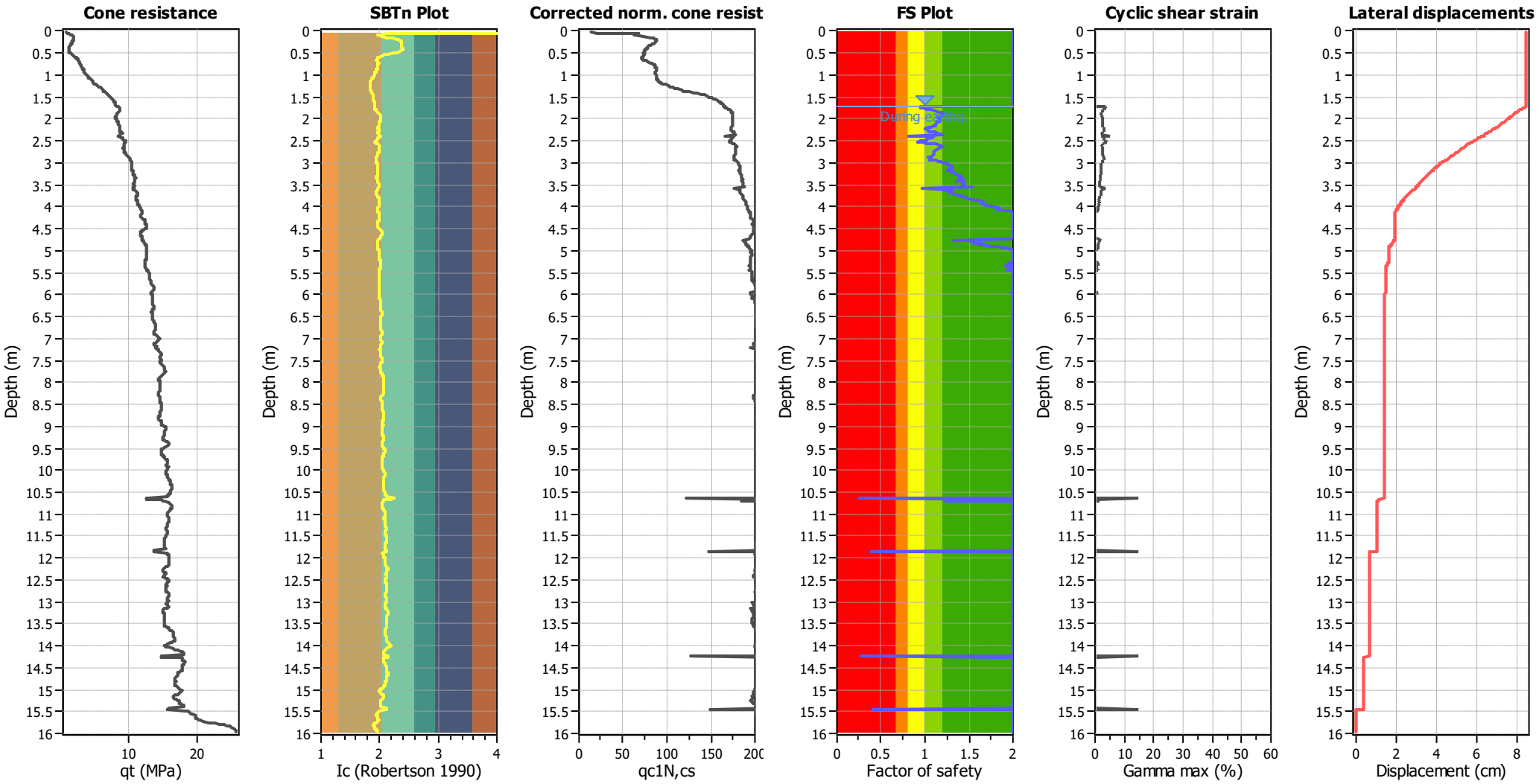
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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2/182 Main Rd Tawa
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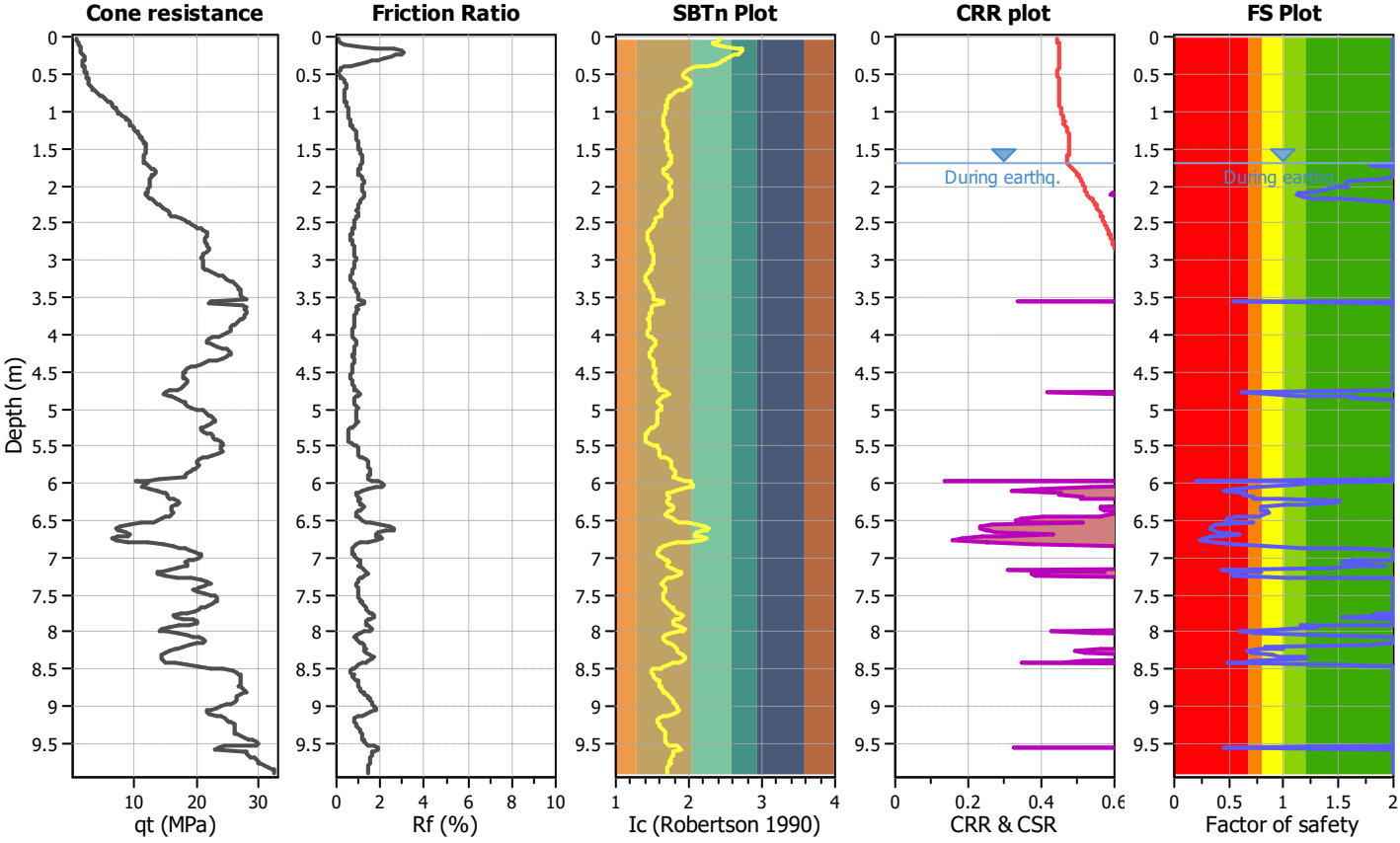
LIQUEFACTION ANALYSIS REPORT

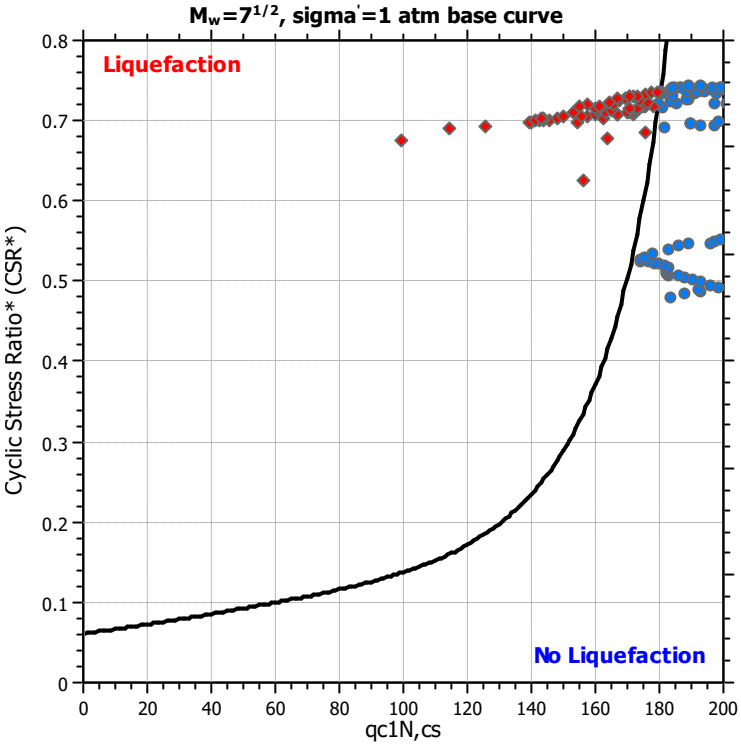
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

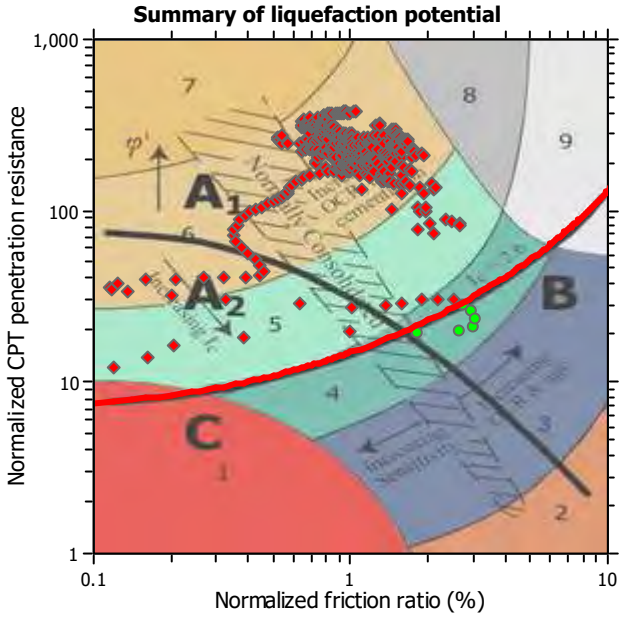
CPT file : CPT08_ULS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	7.70	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.68	Unit weight calculation:	Based on SBT	K_σ applied:	No		

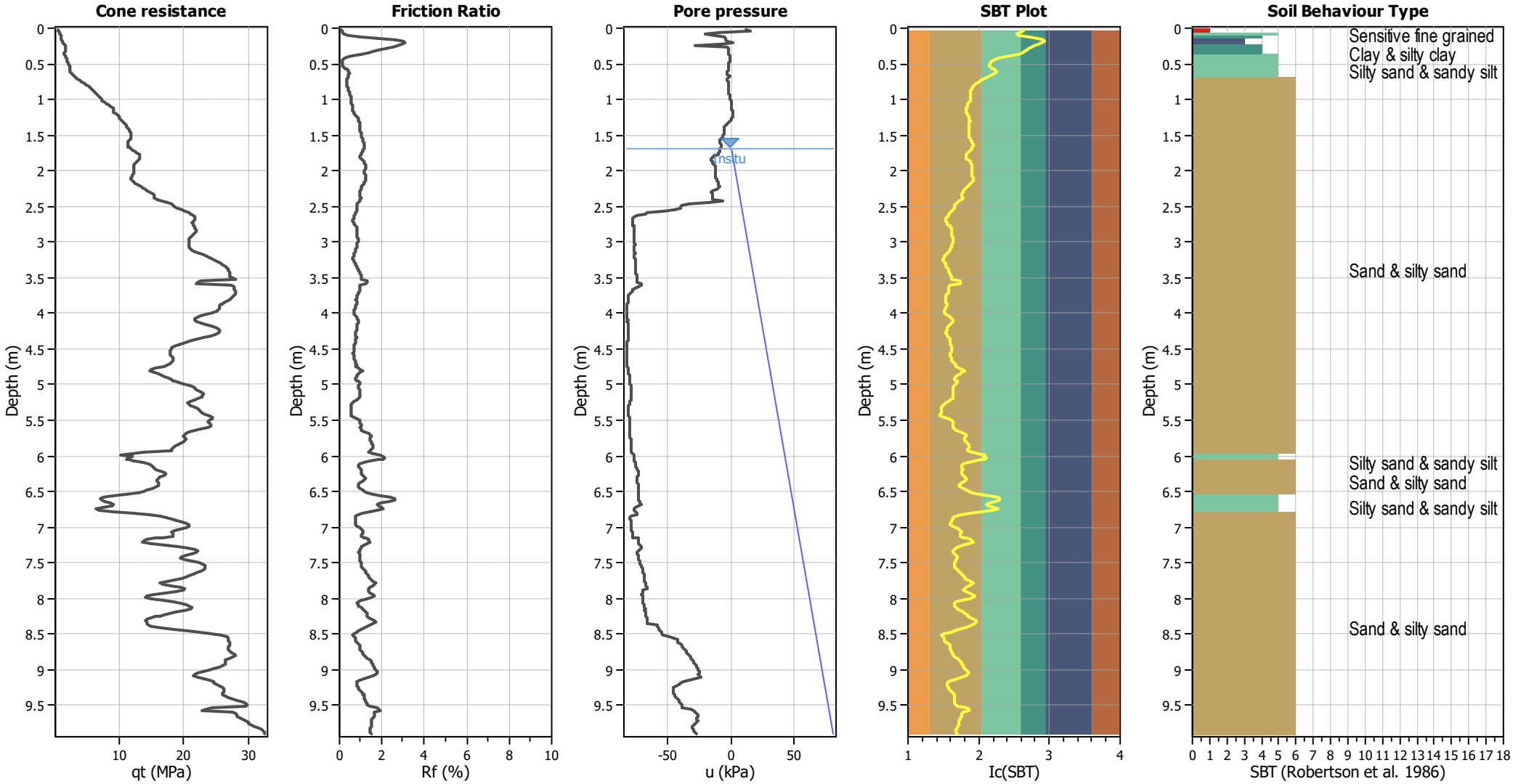






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



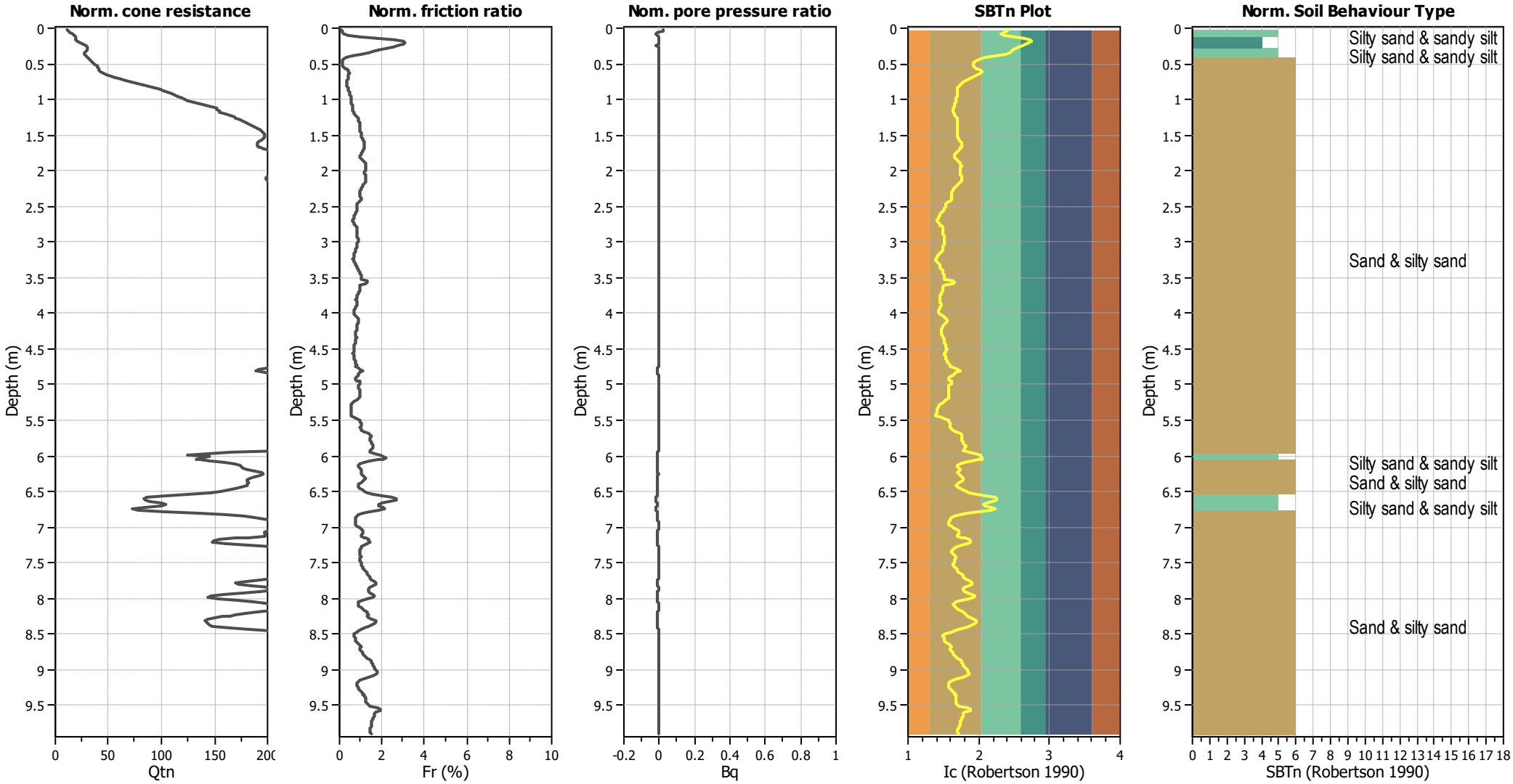
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



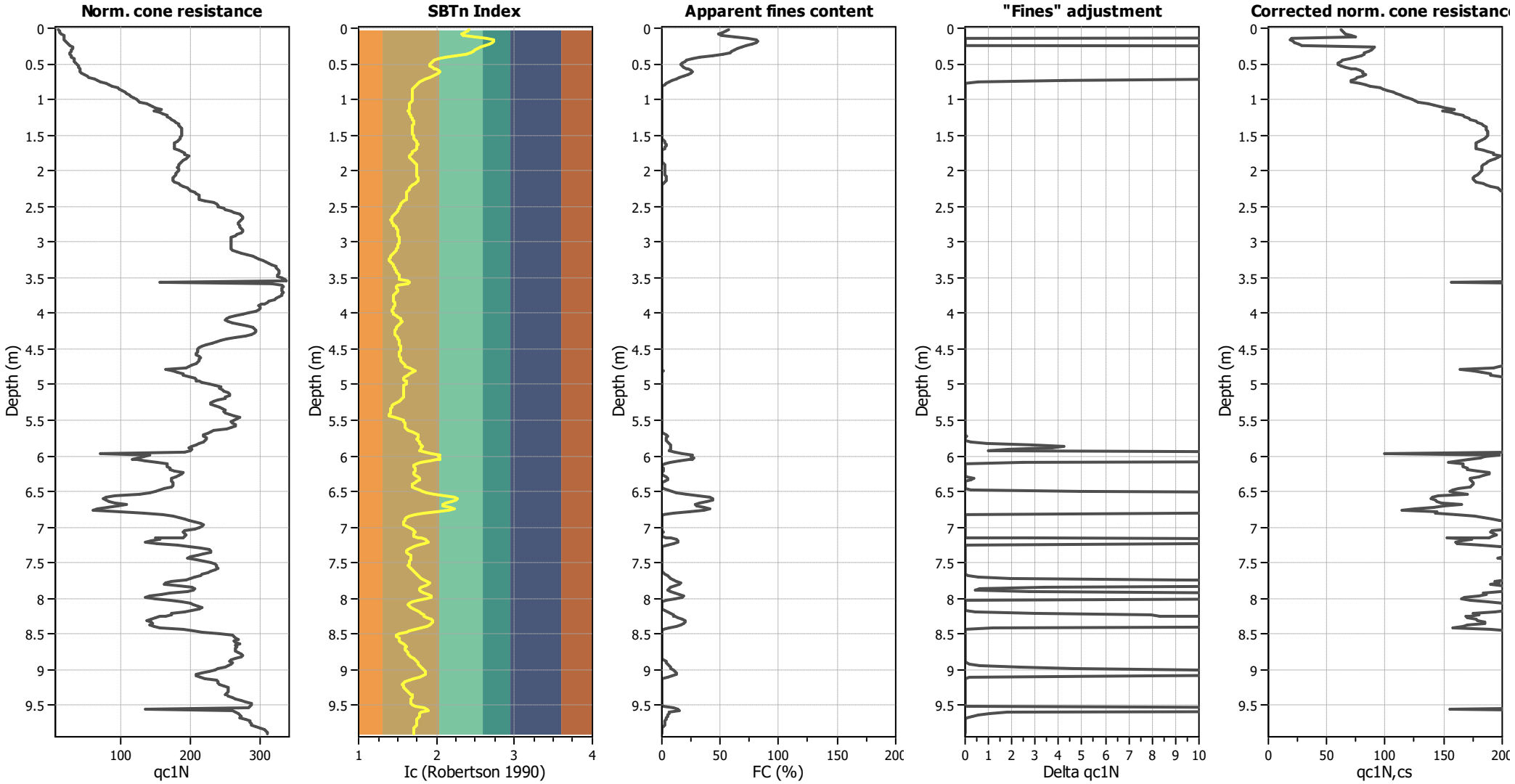
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

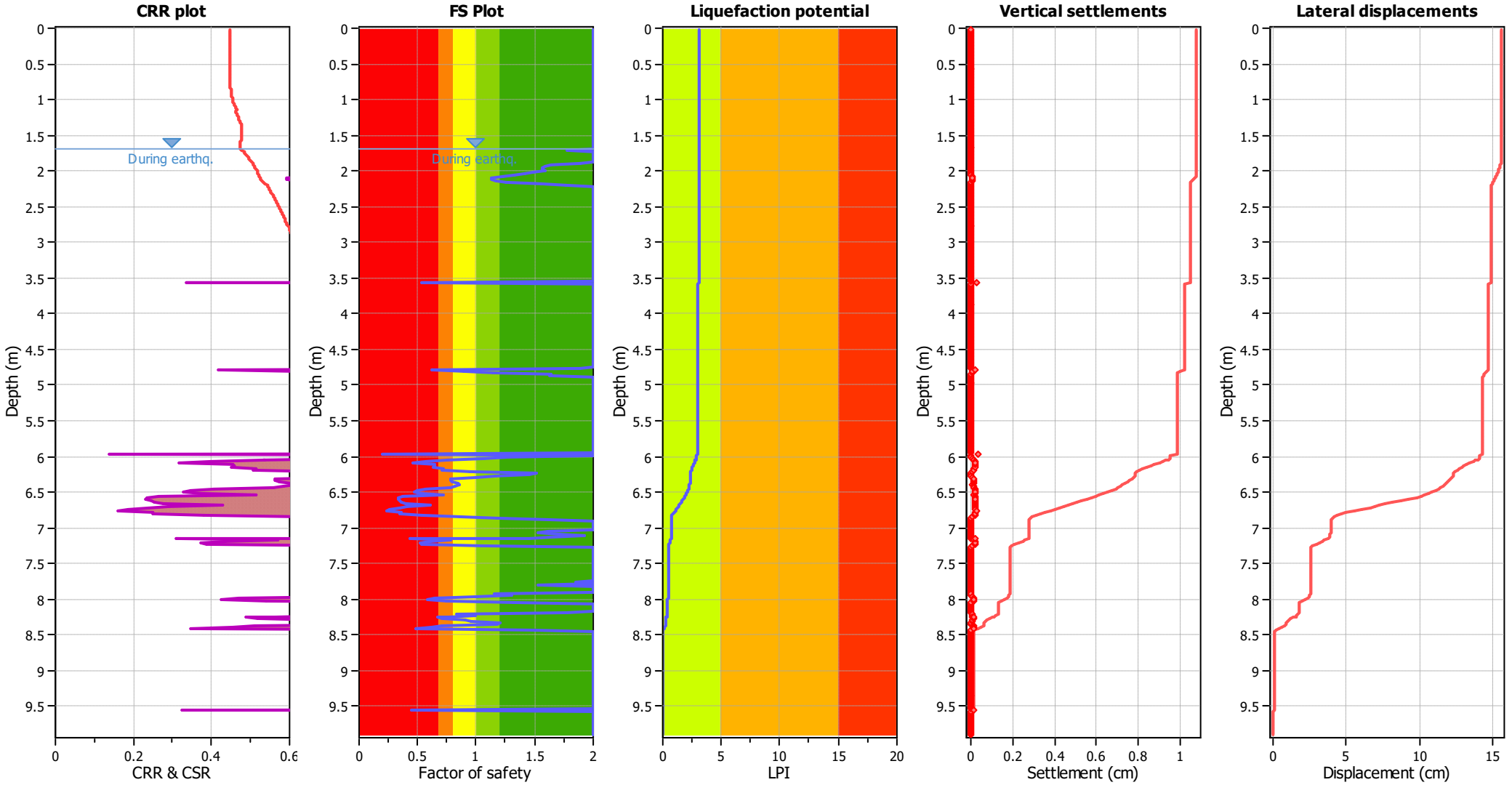
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

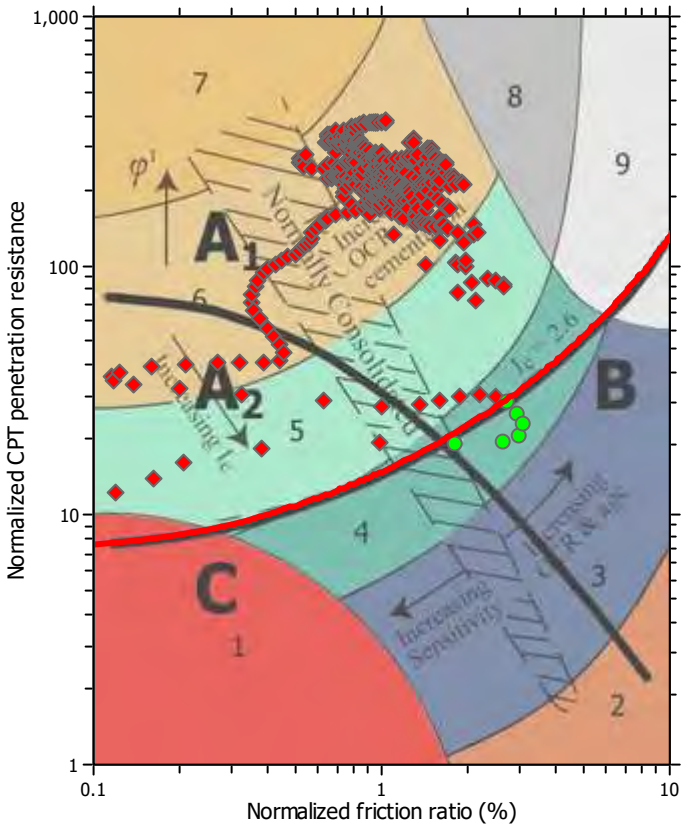
F.S. color scheme

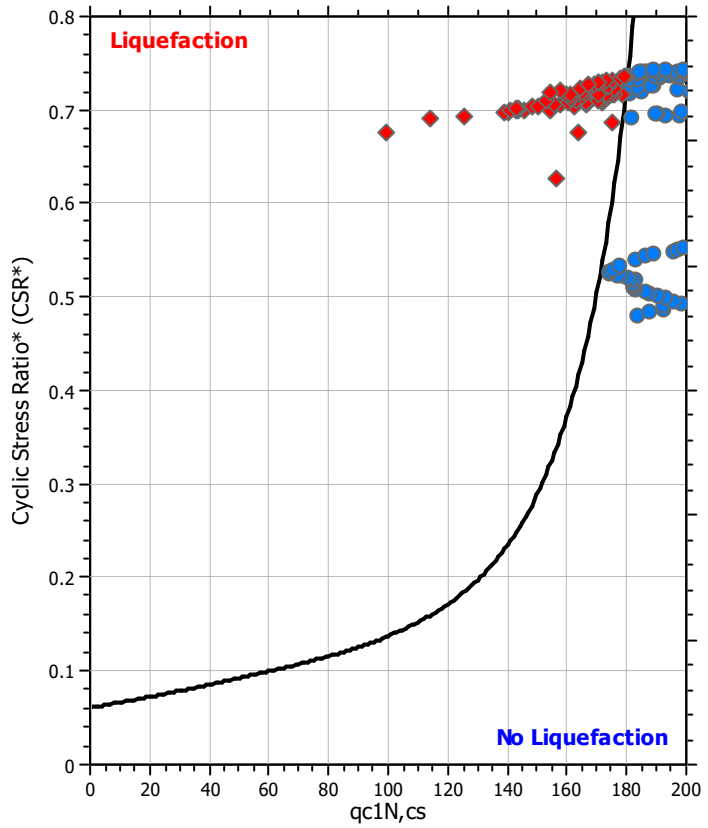
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

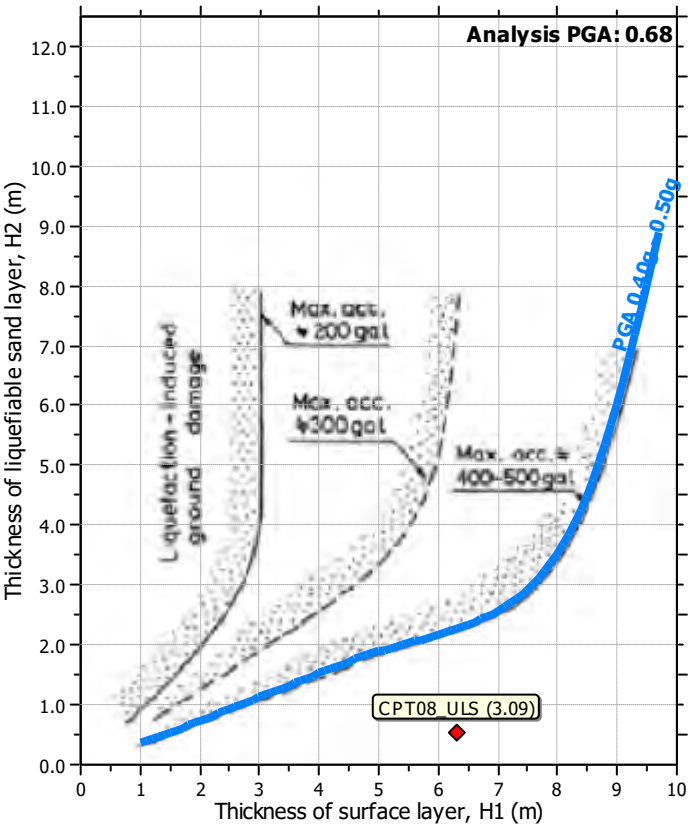
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



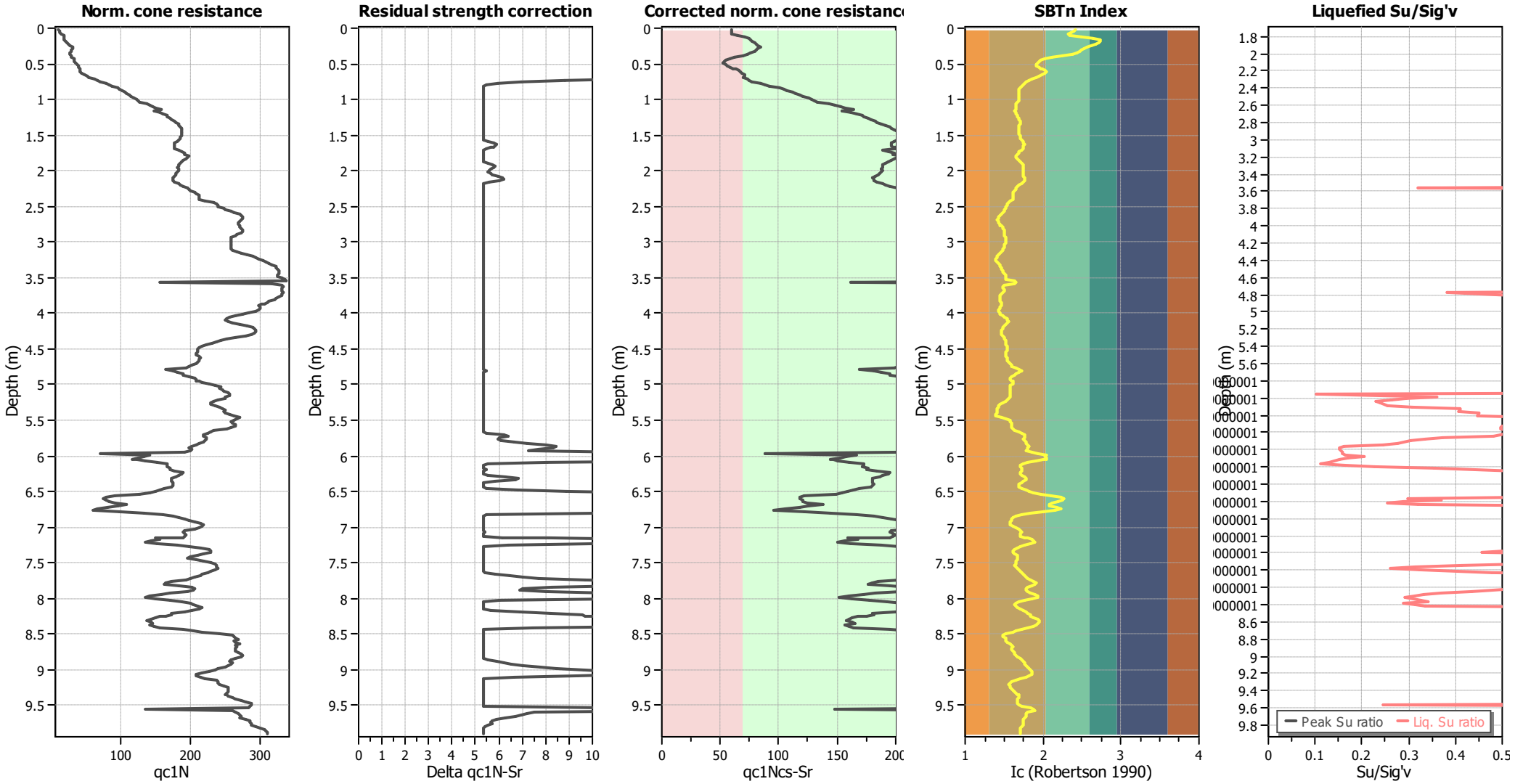




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

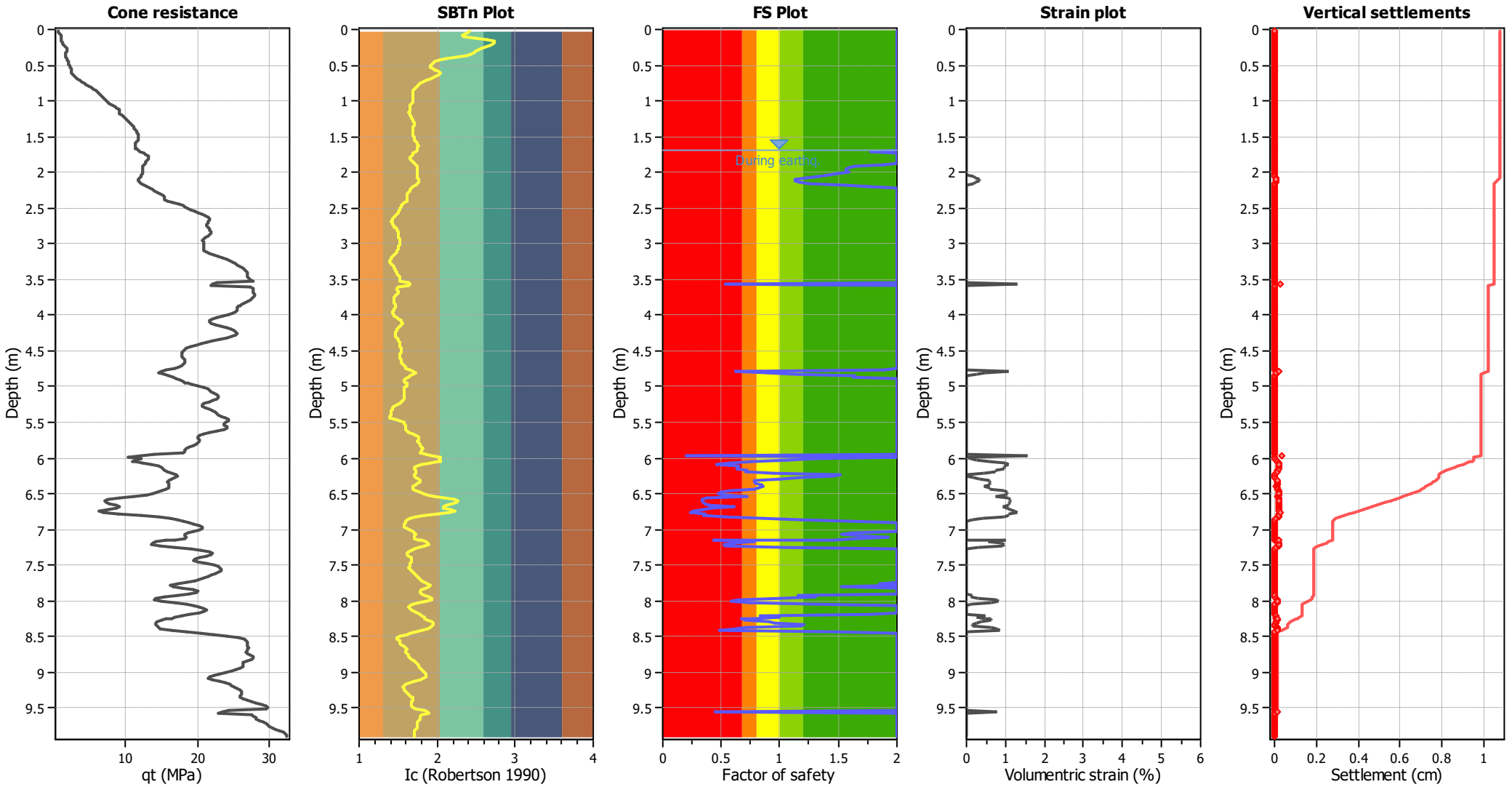
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

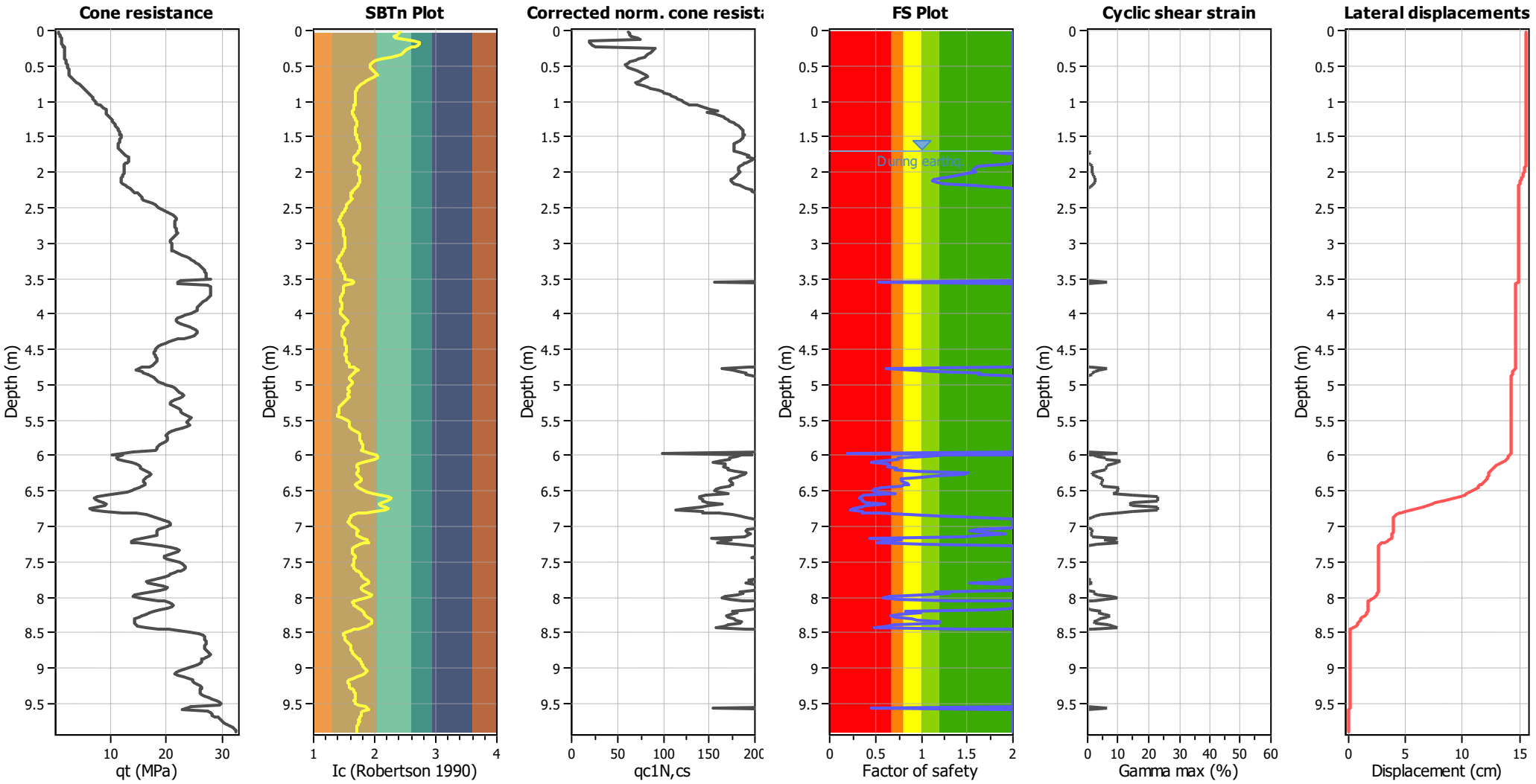
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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Geotechnical Engineers
2/182 Main Rd Tawa
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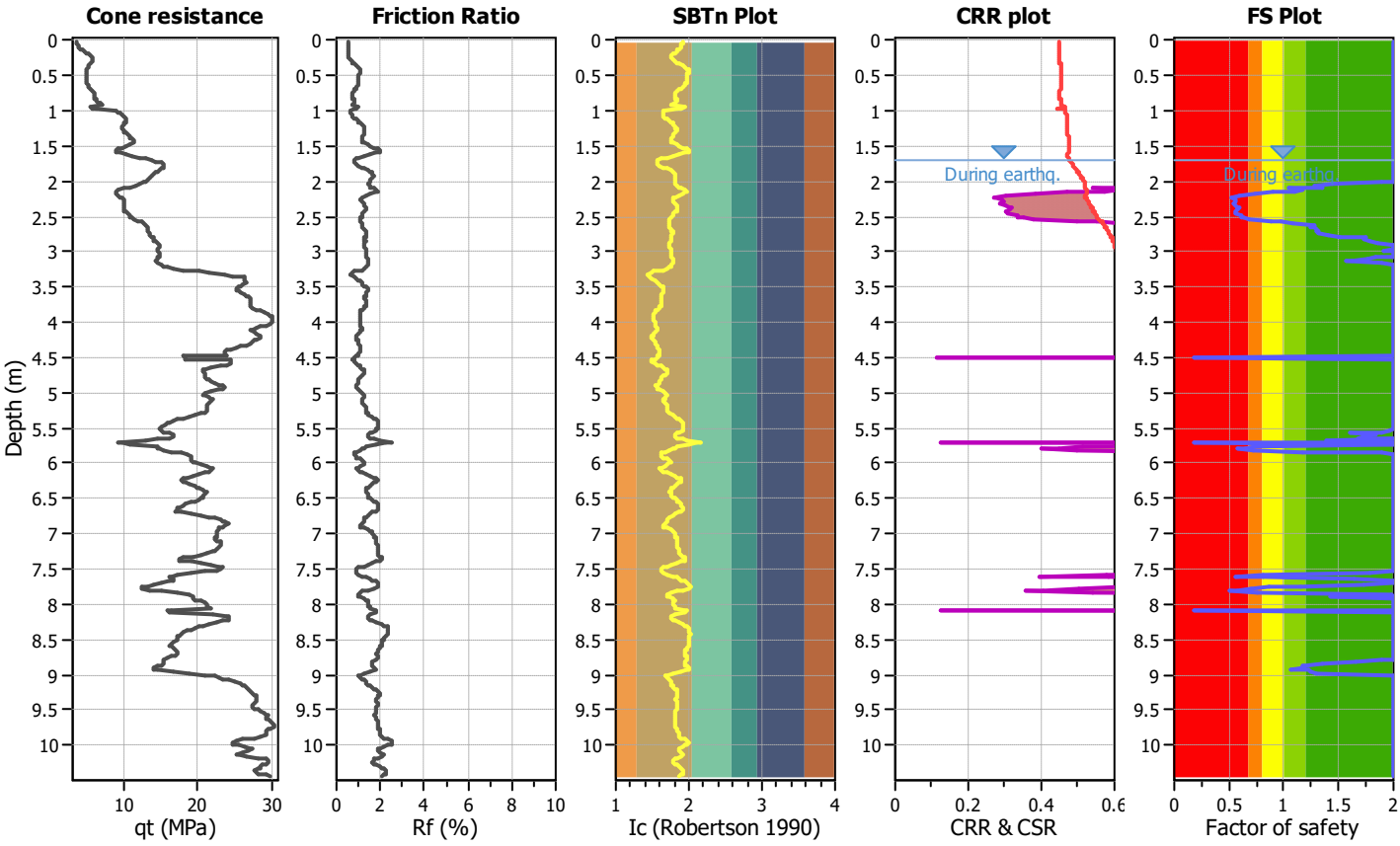
LIQUEFACTION ANALYSIS REPORT

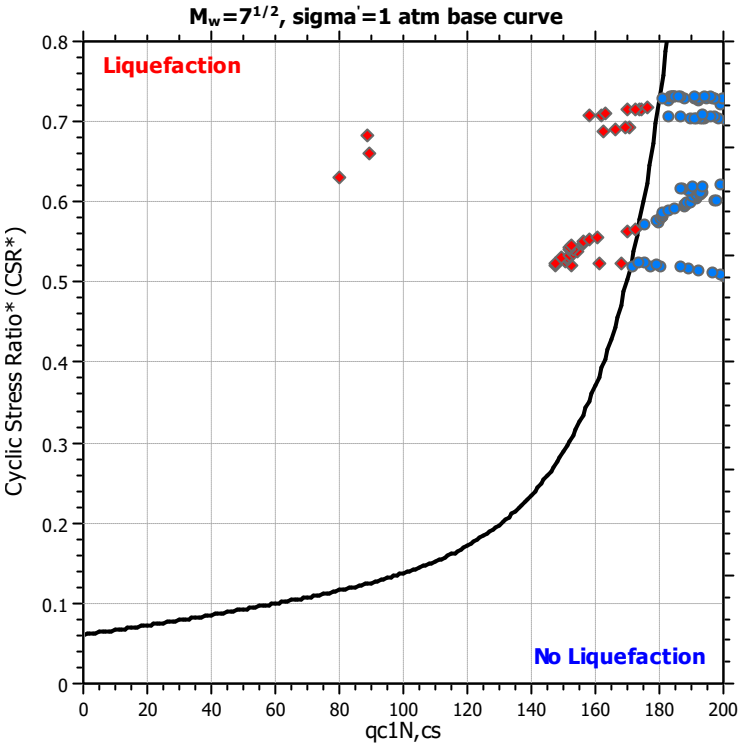
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

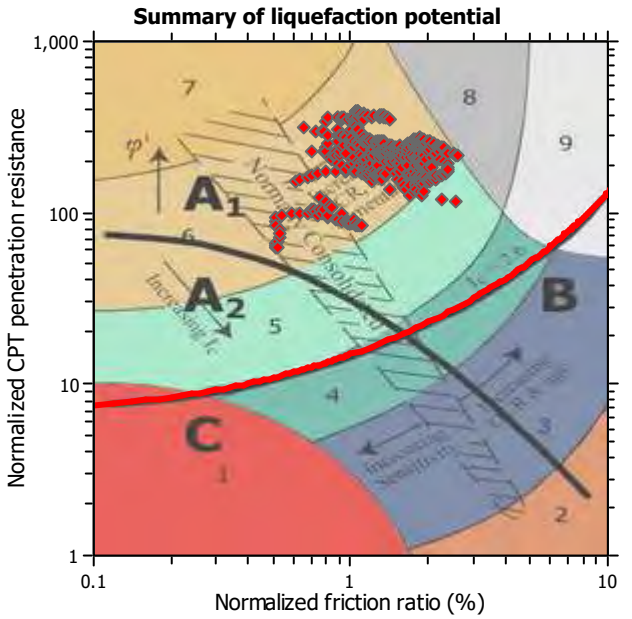
CPT file : CPT09_ULS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	7.70	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.68	Unit weight calculation:	Based on SBT	K_σ applied:	No		

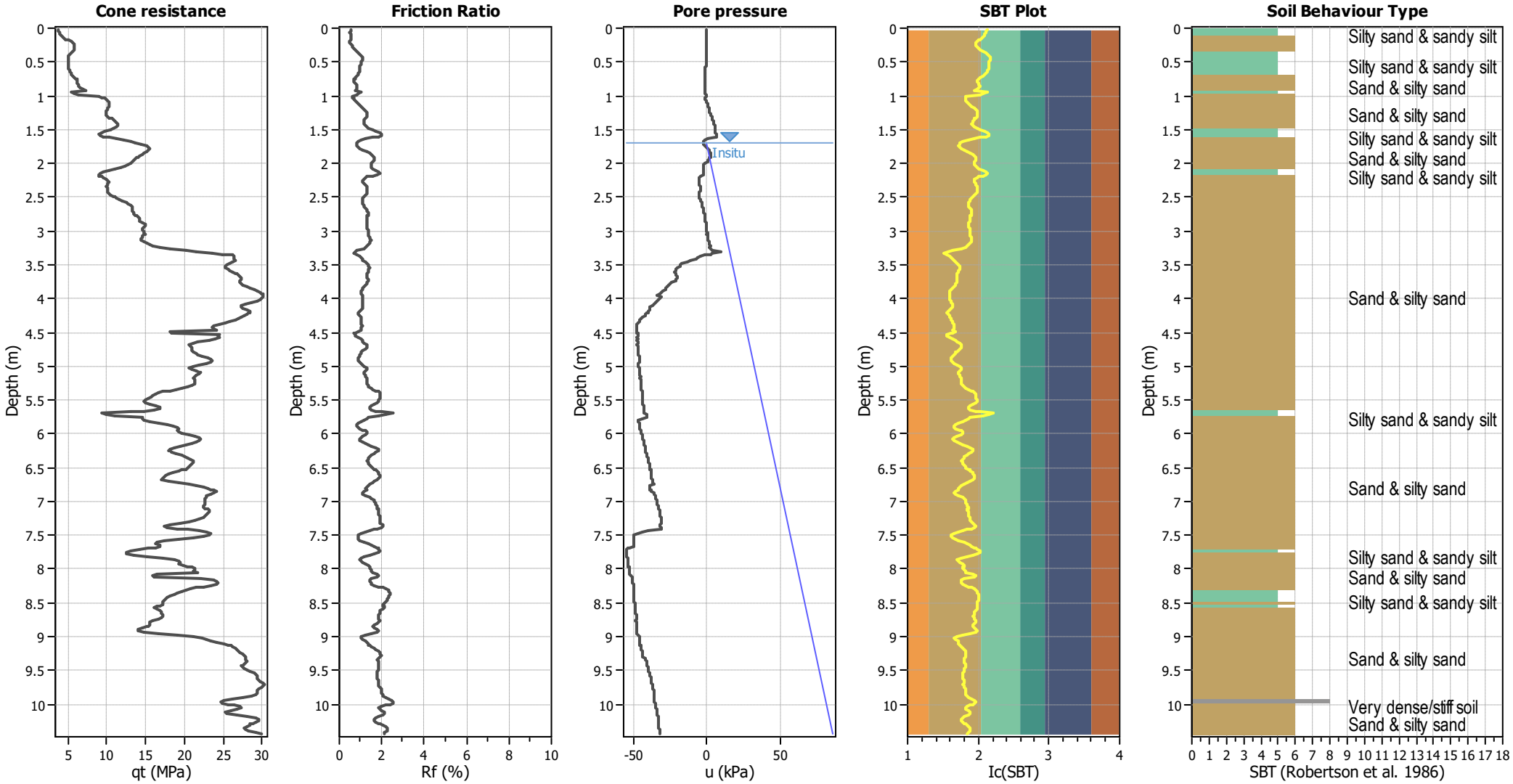






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



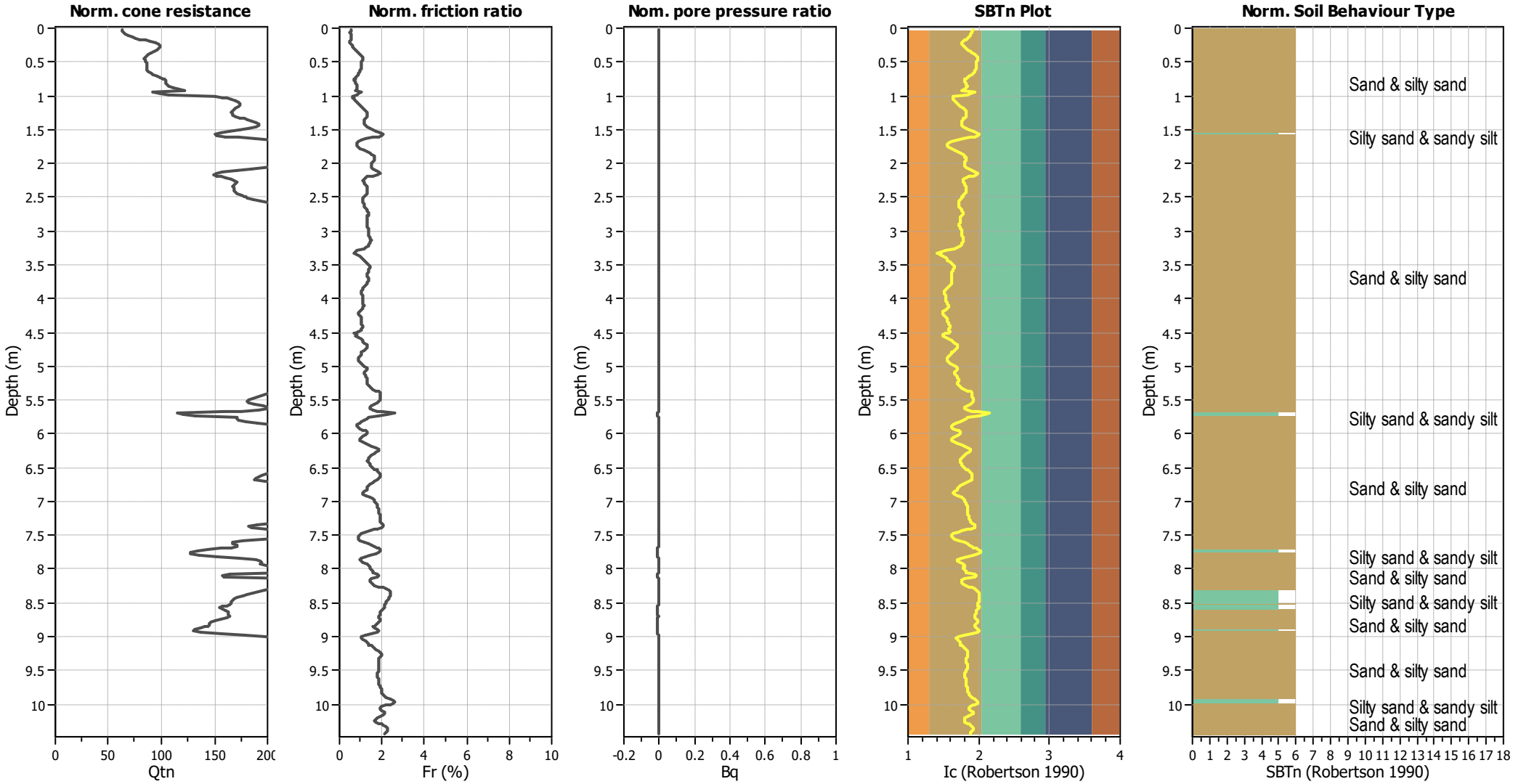
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



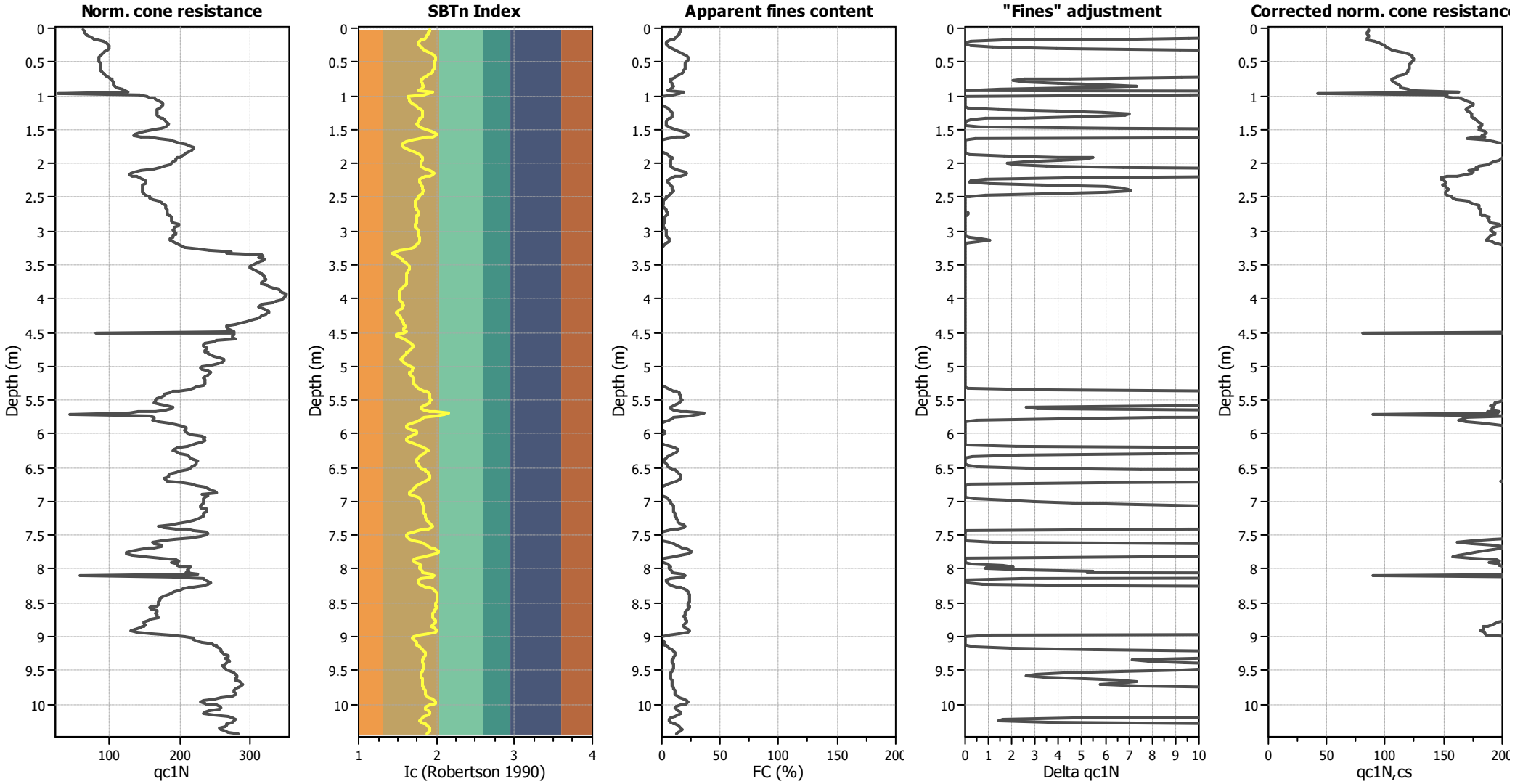
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

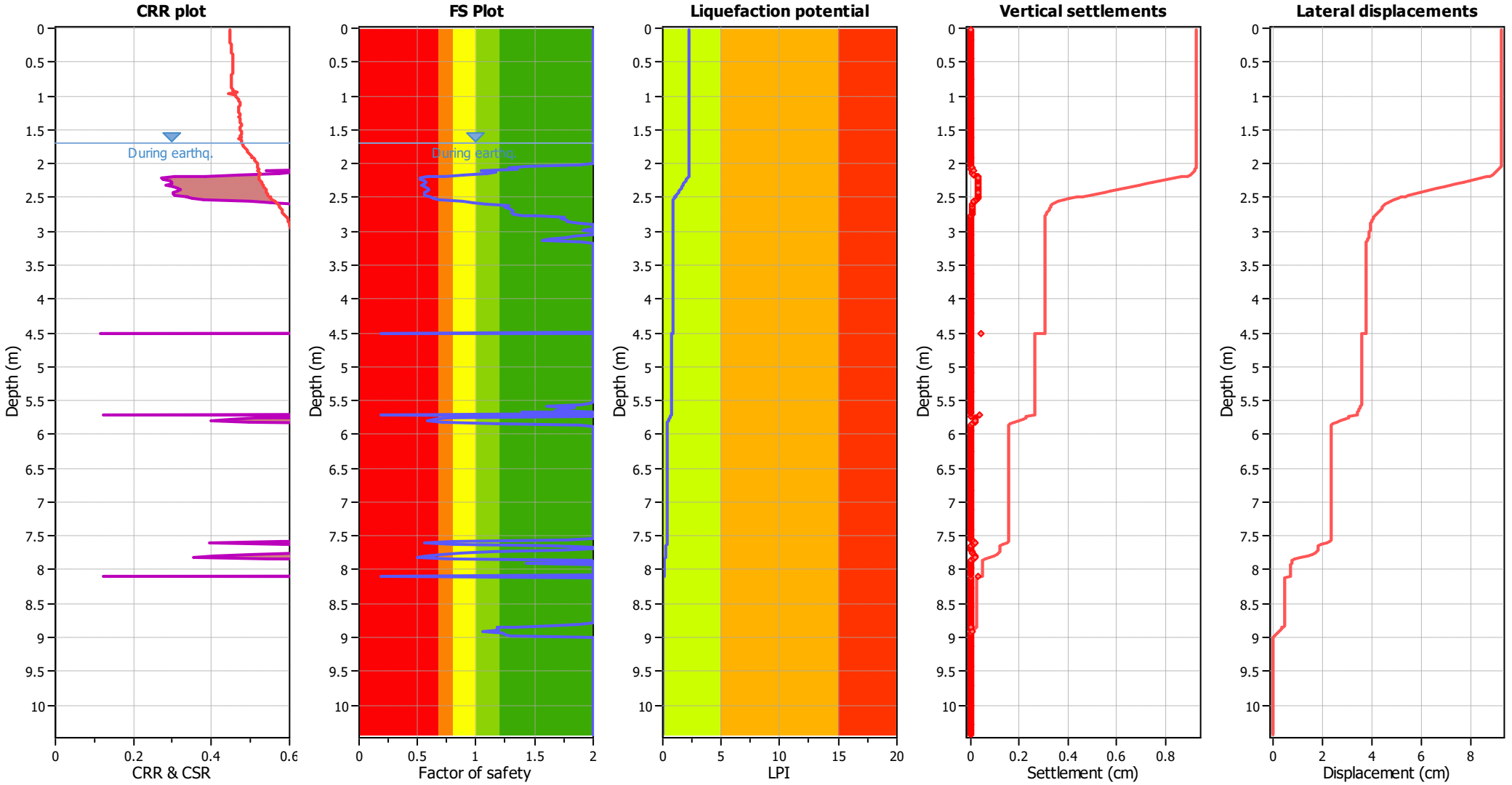
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

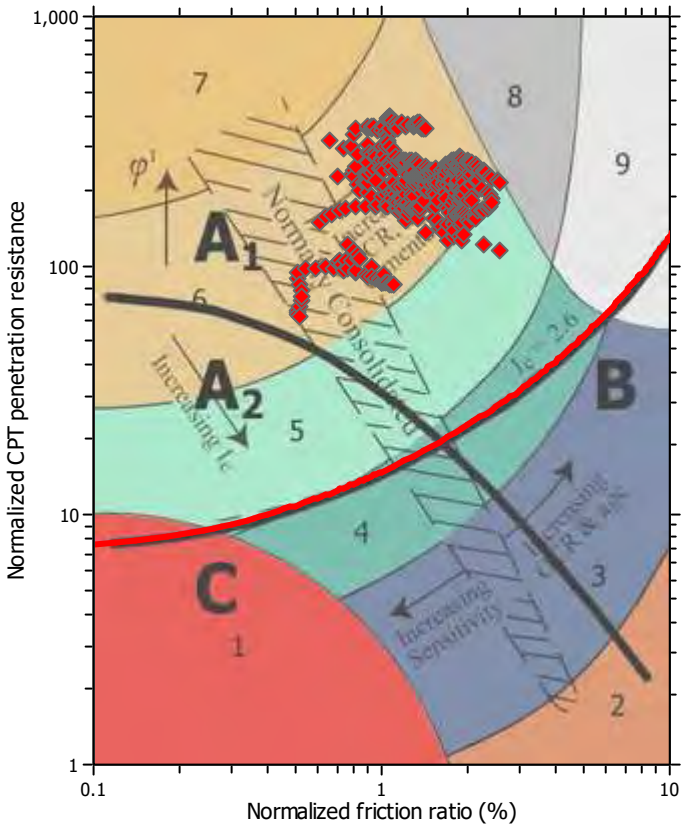
F.S. color scheme

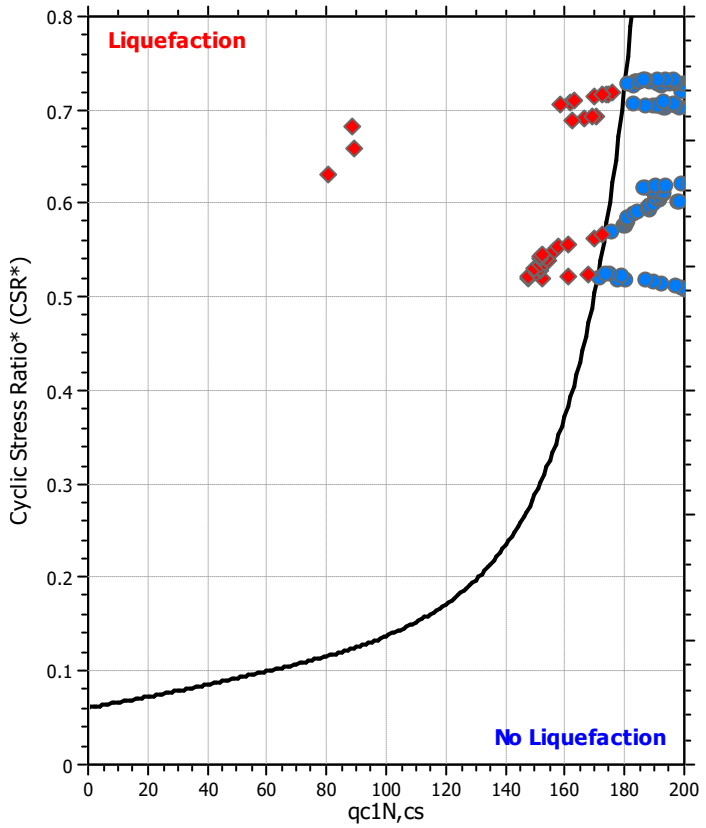
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

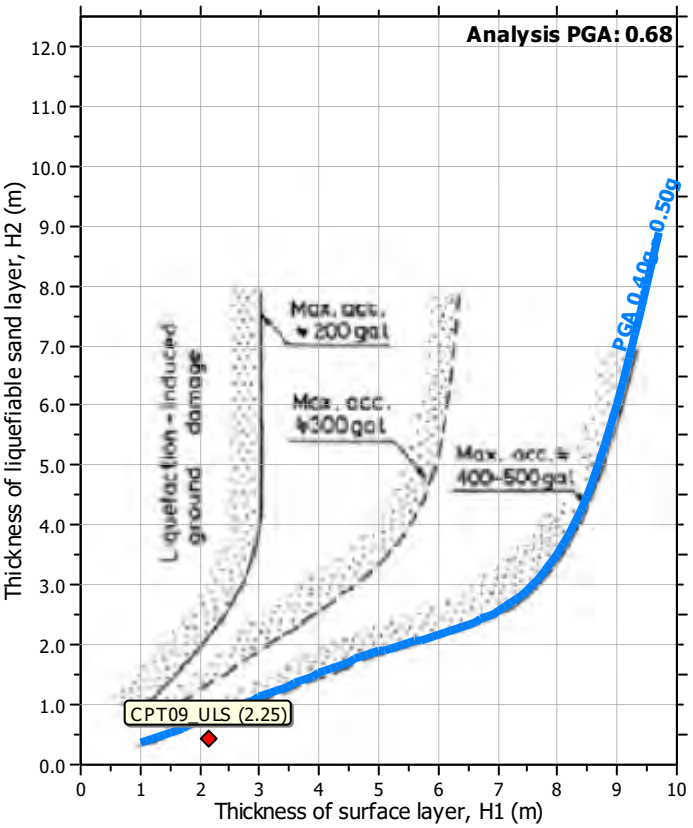
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



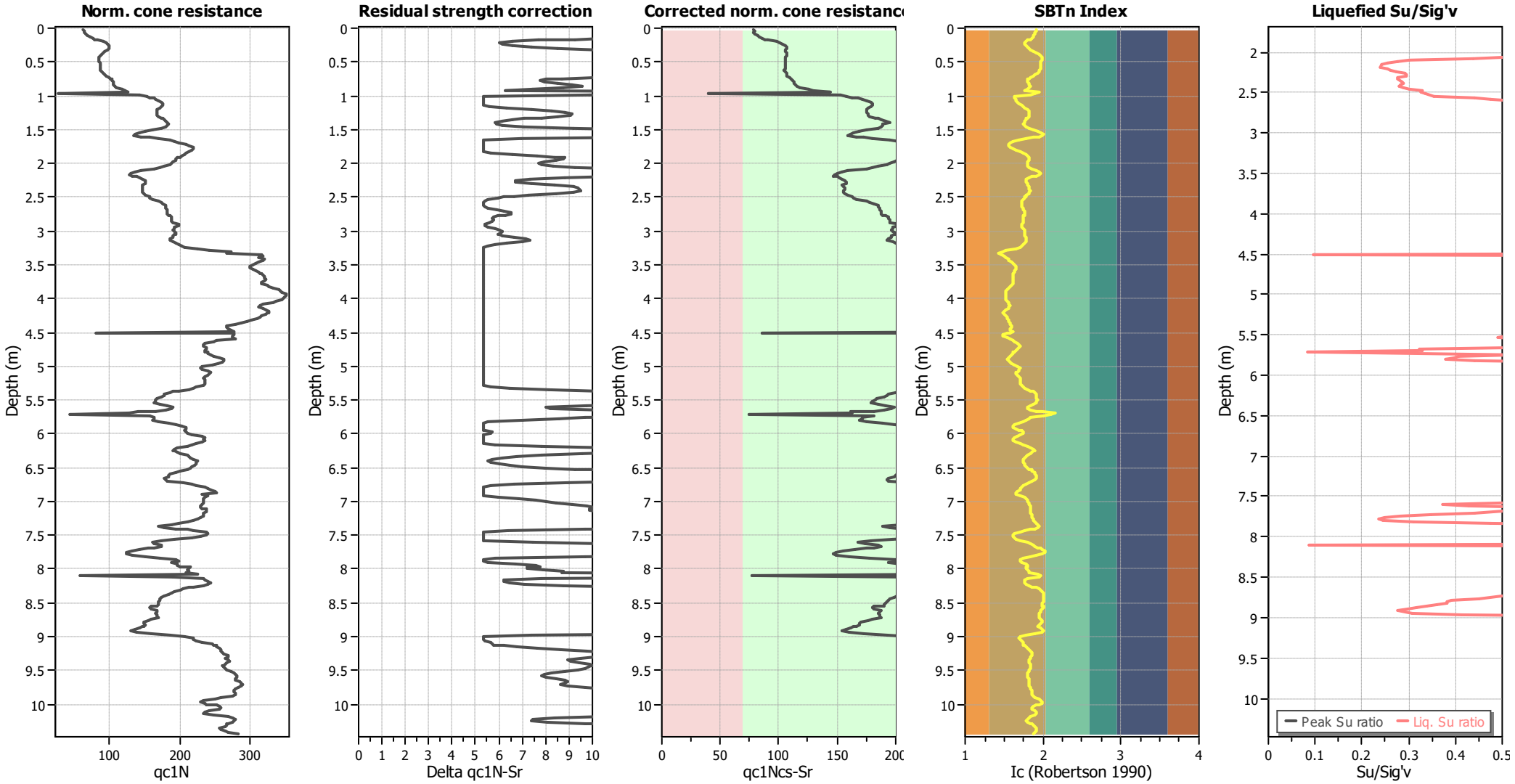




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

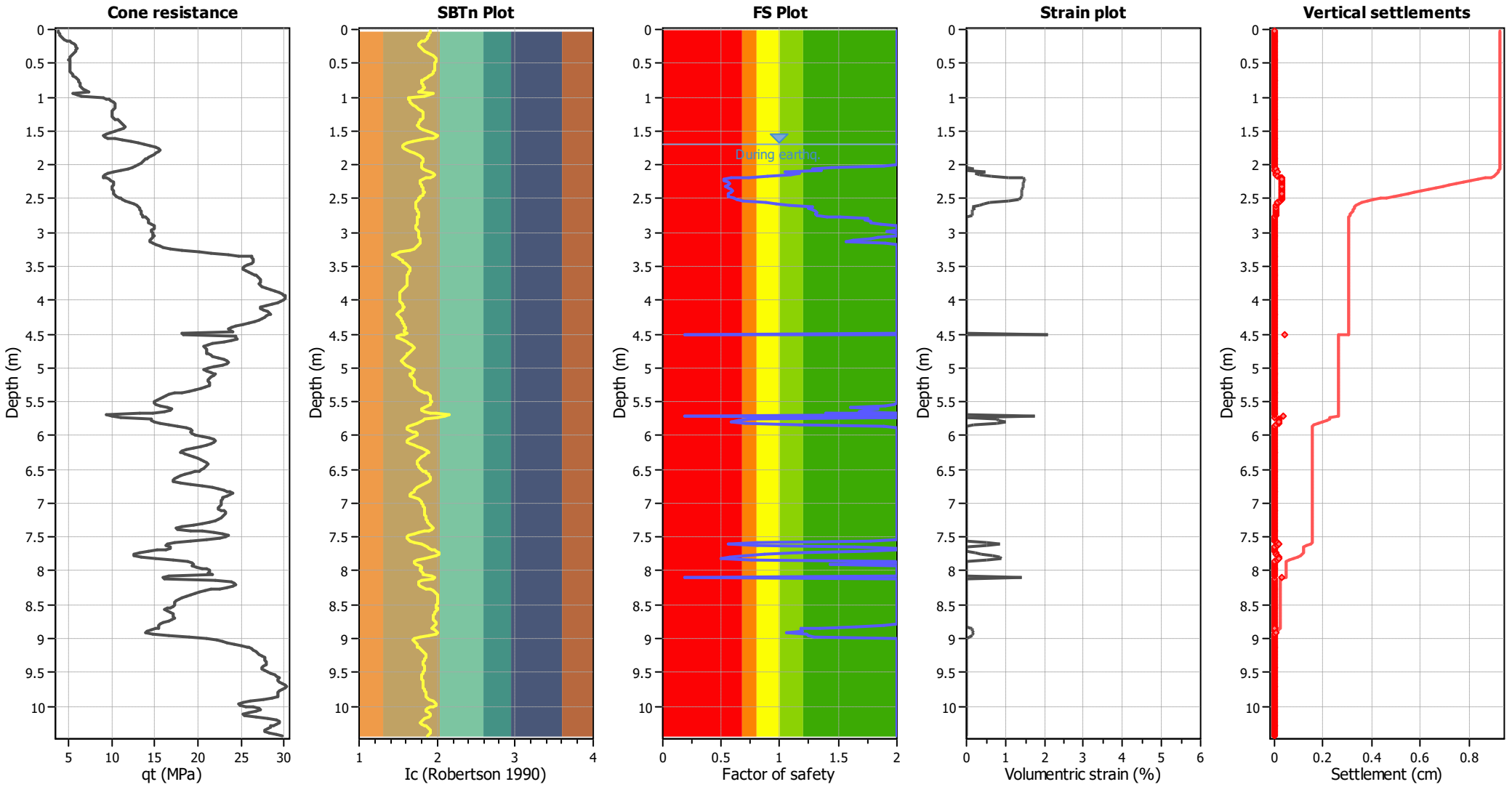
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

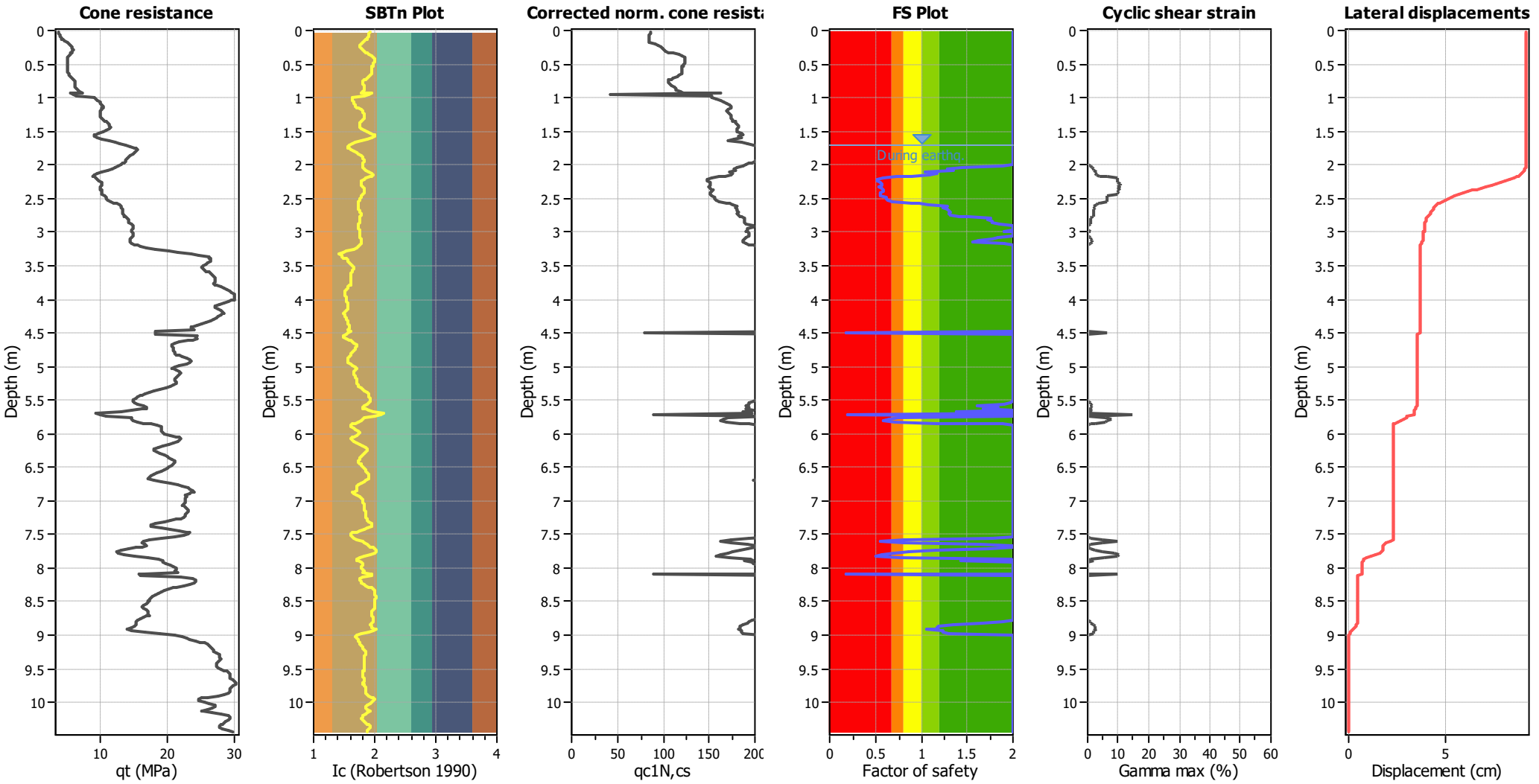
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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2/182 Main Rd Tawa
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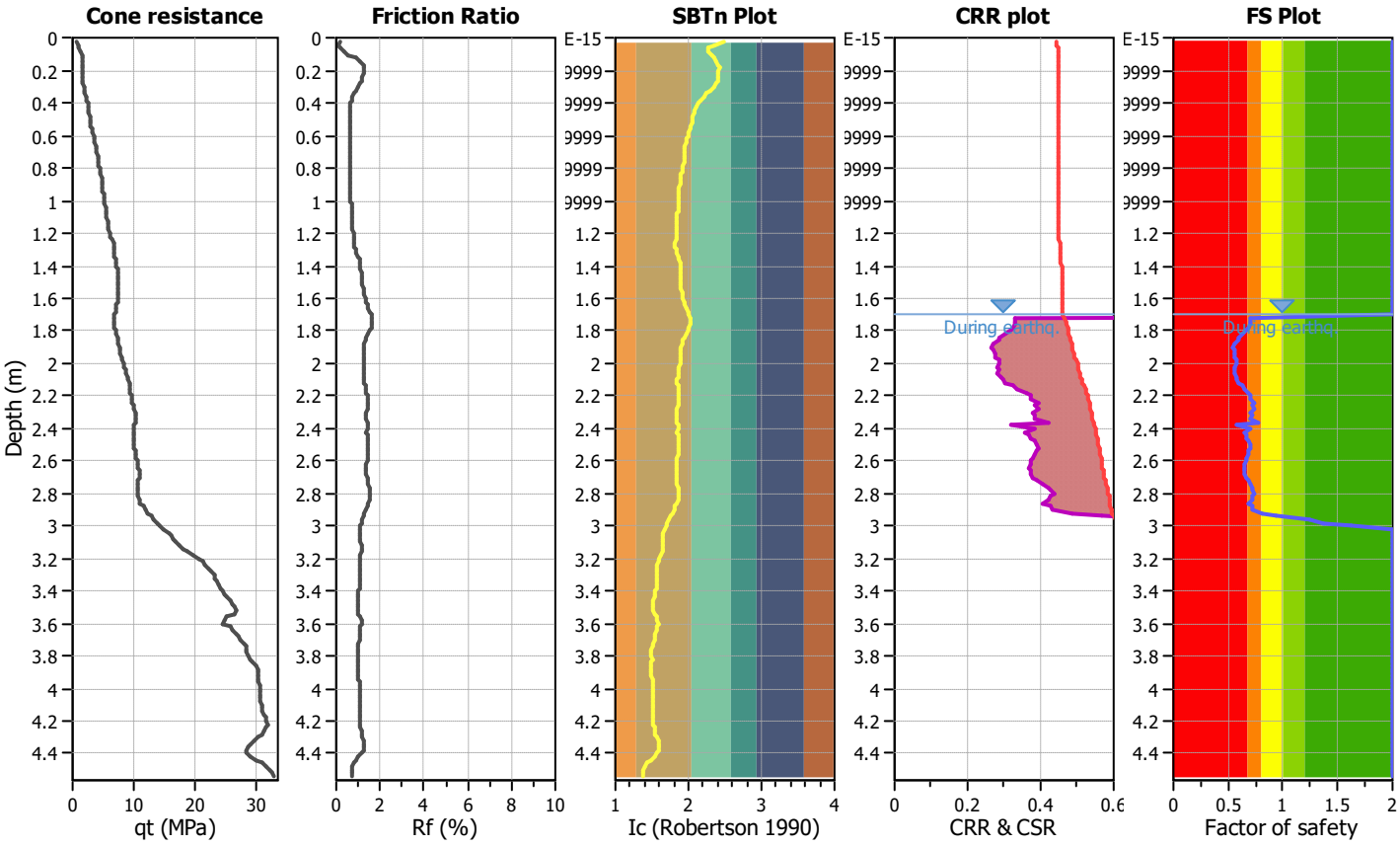
LIQUEFACTION ANALYSIS REPORT

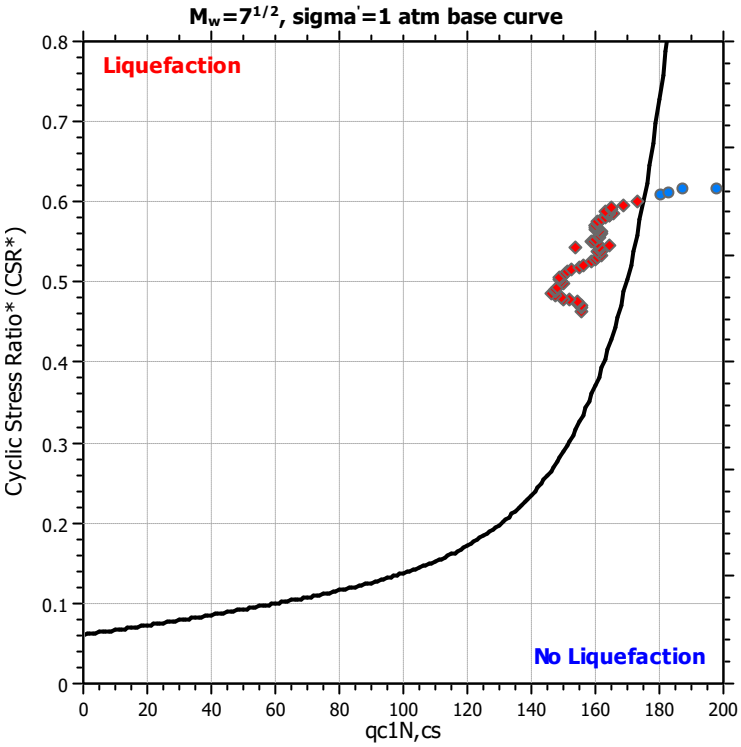
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

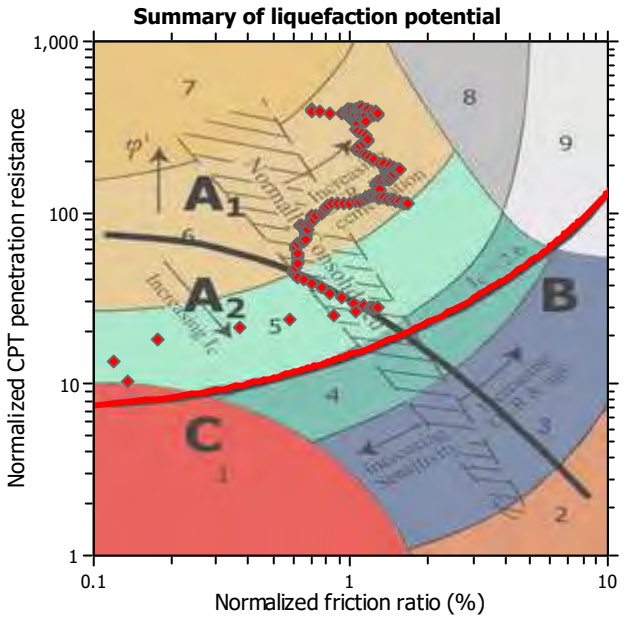
CPT file : CPT10_ULS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	7.70	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.68	Unit weight calculation:	Based on SBT	K_σ applied:	No		

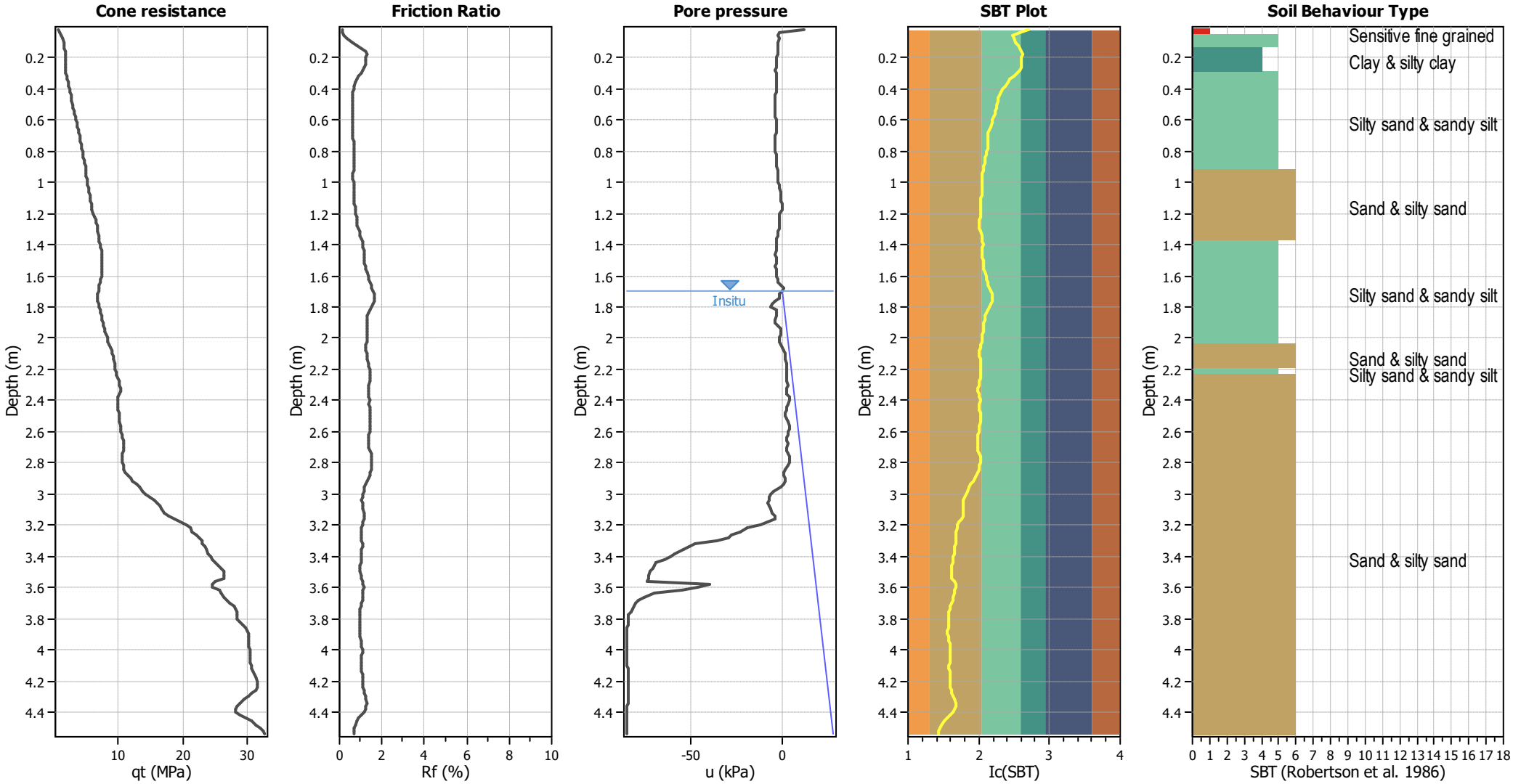






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



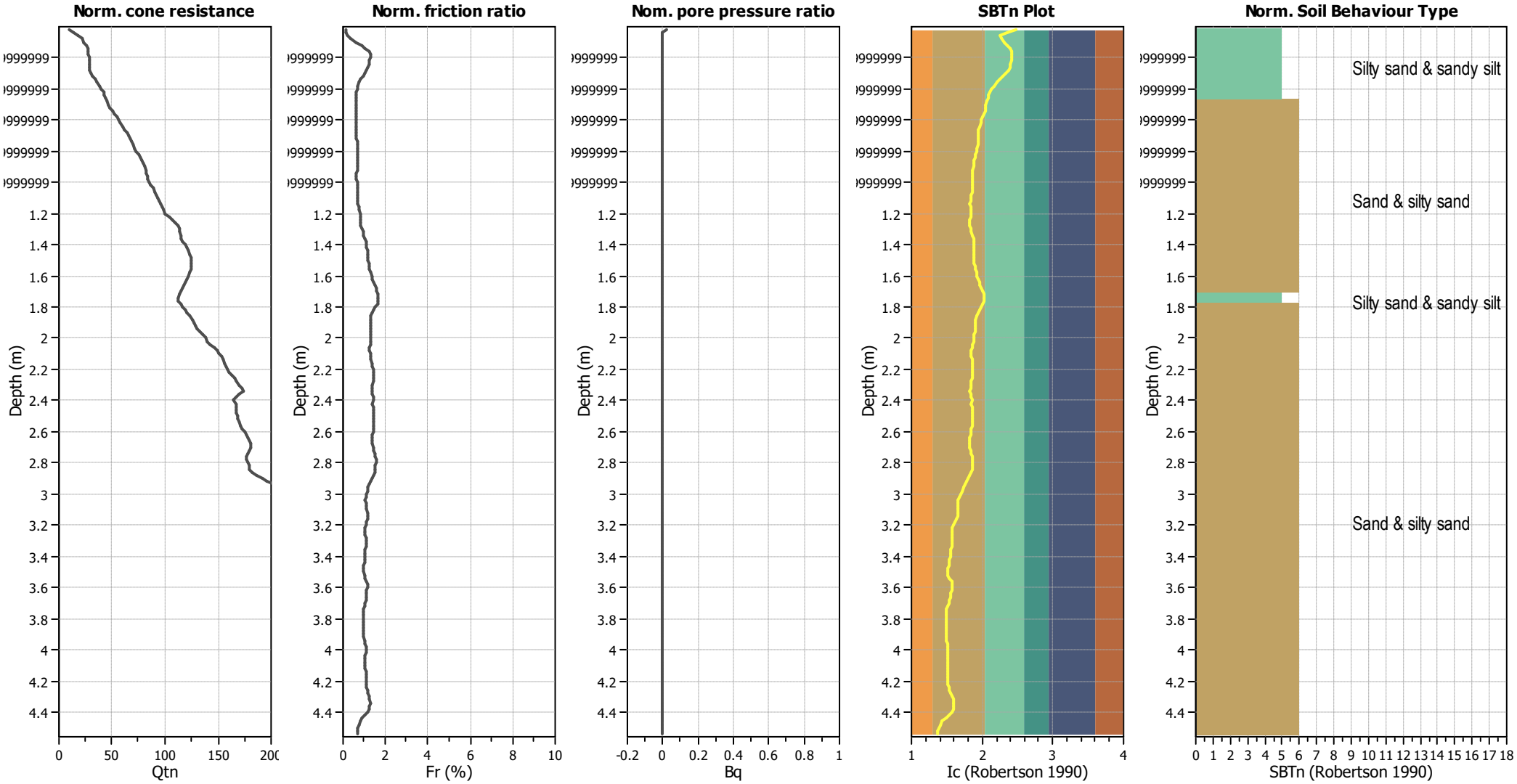
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



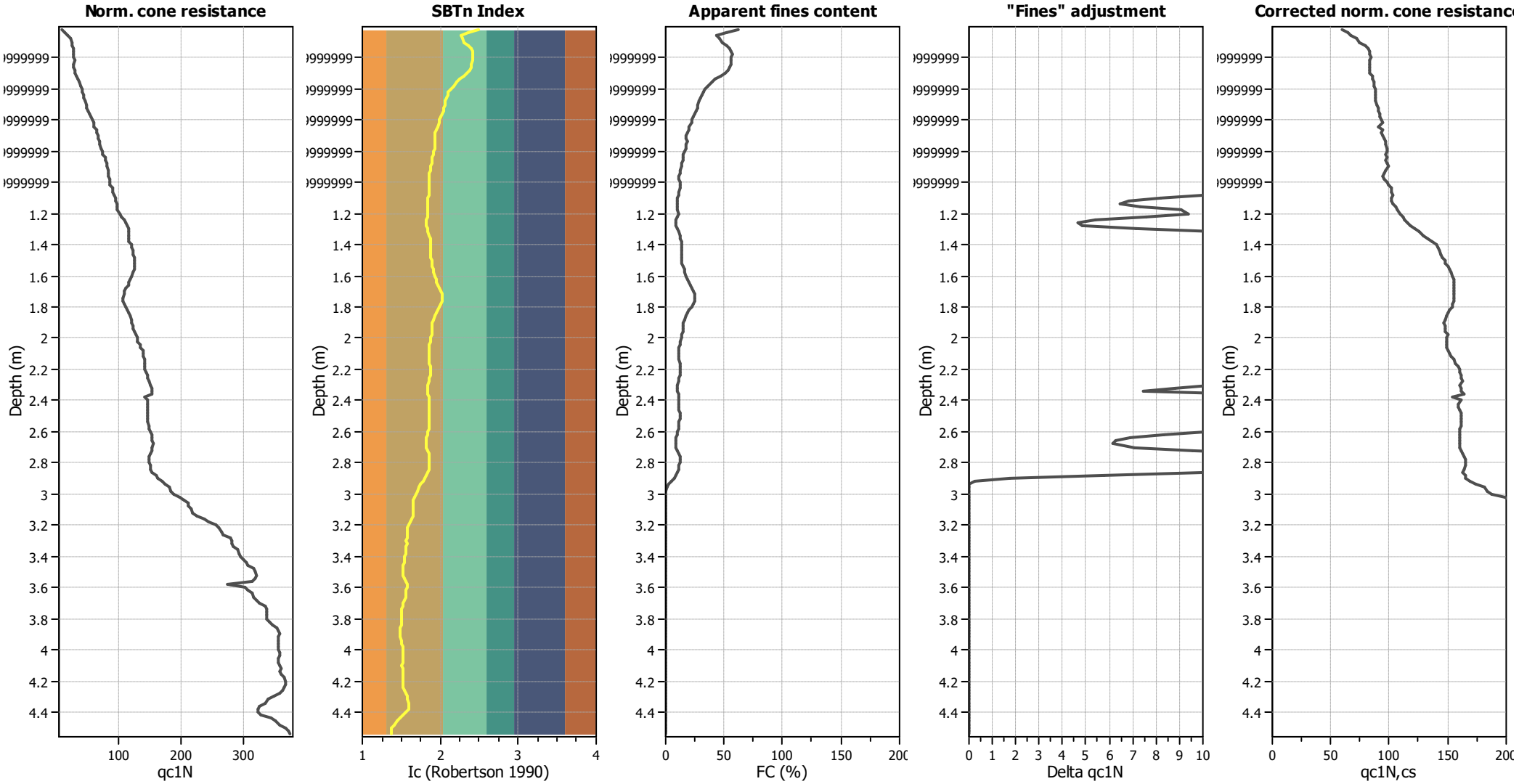
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

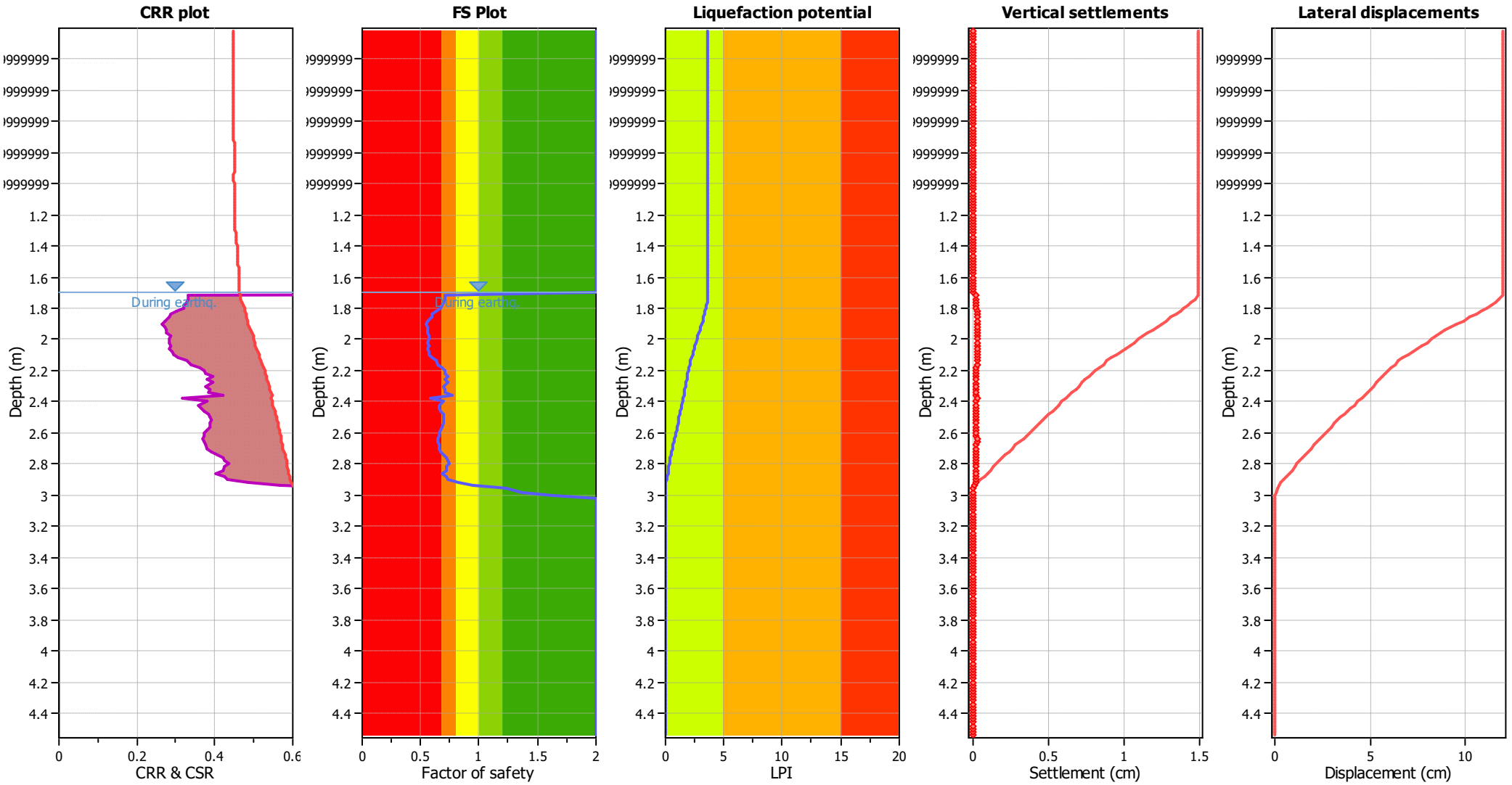
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

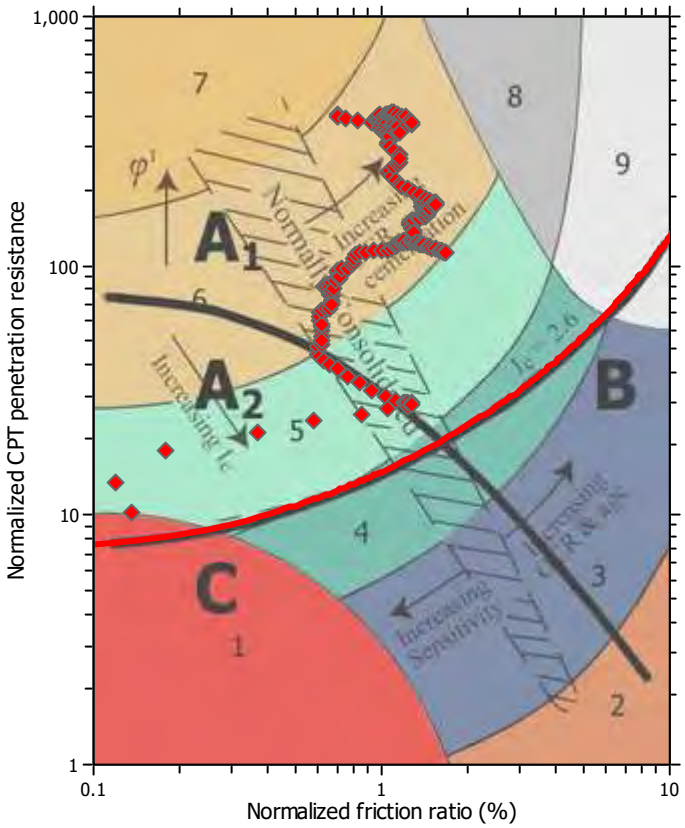
F.S. color scheme

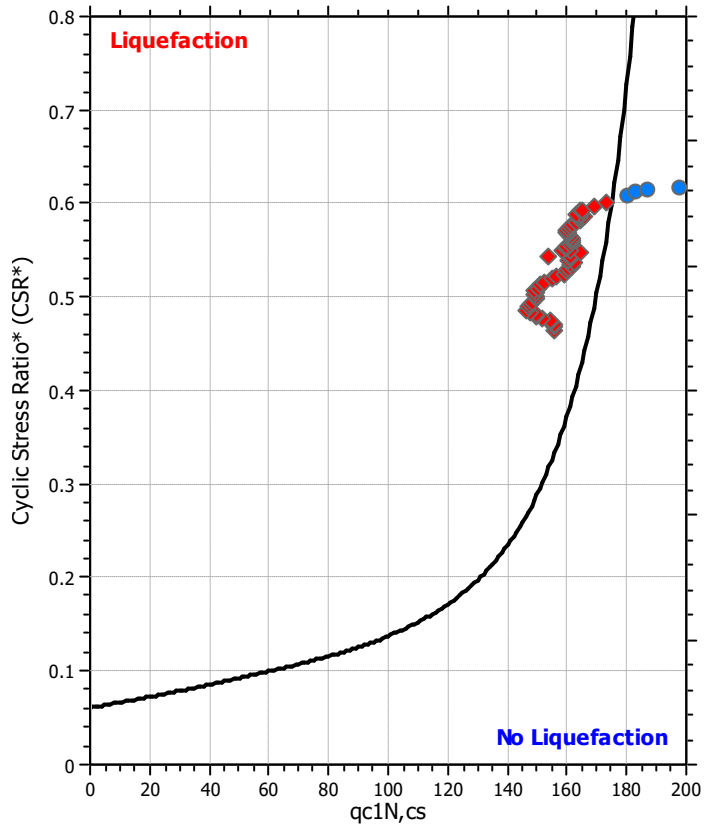
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

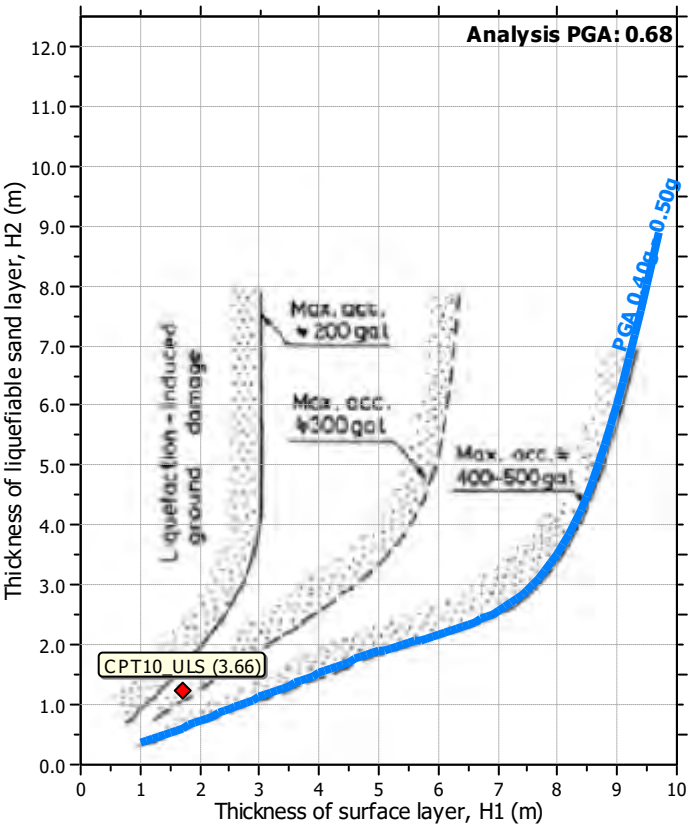
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



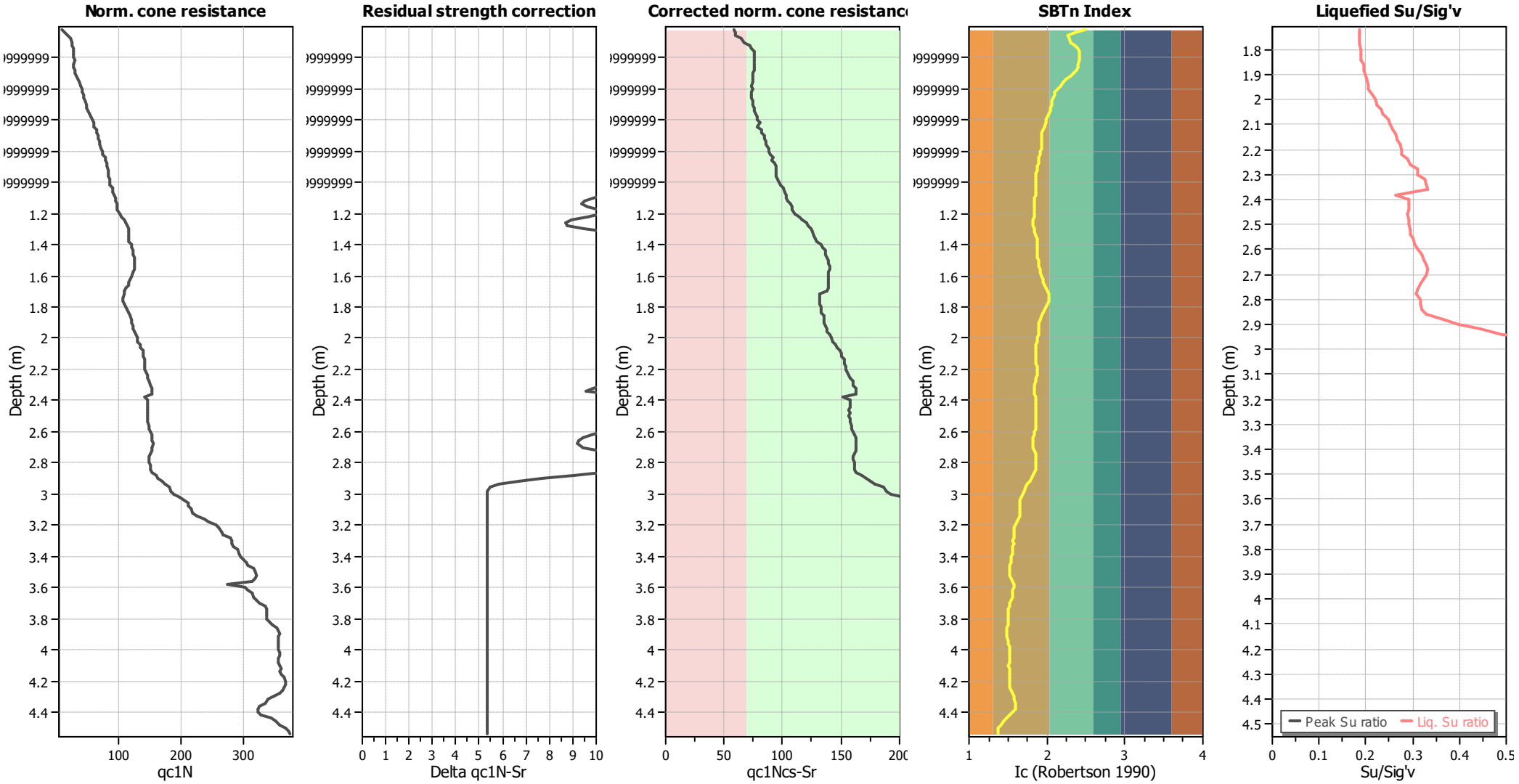




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

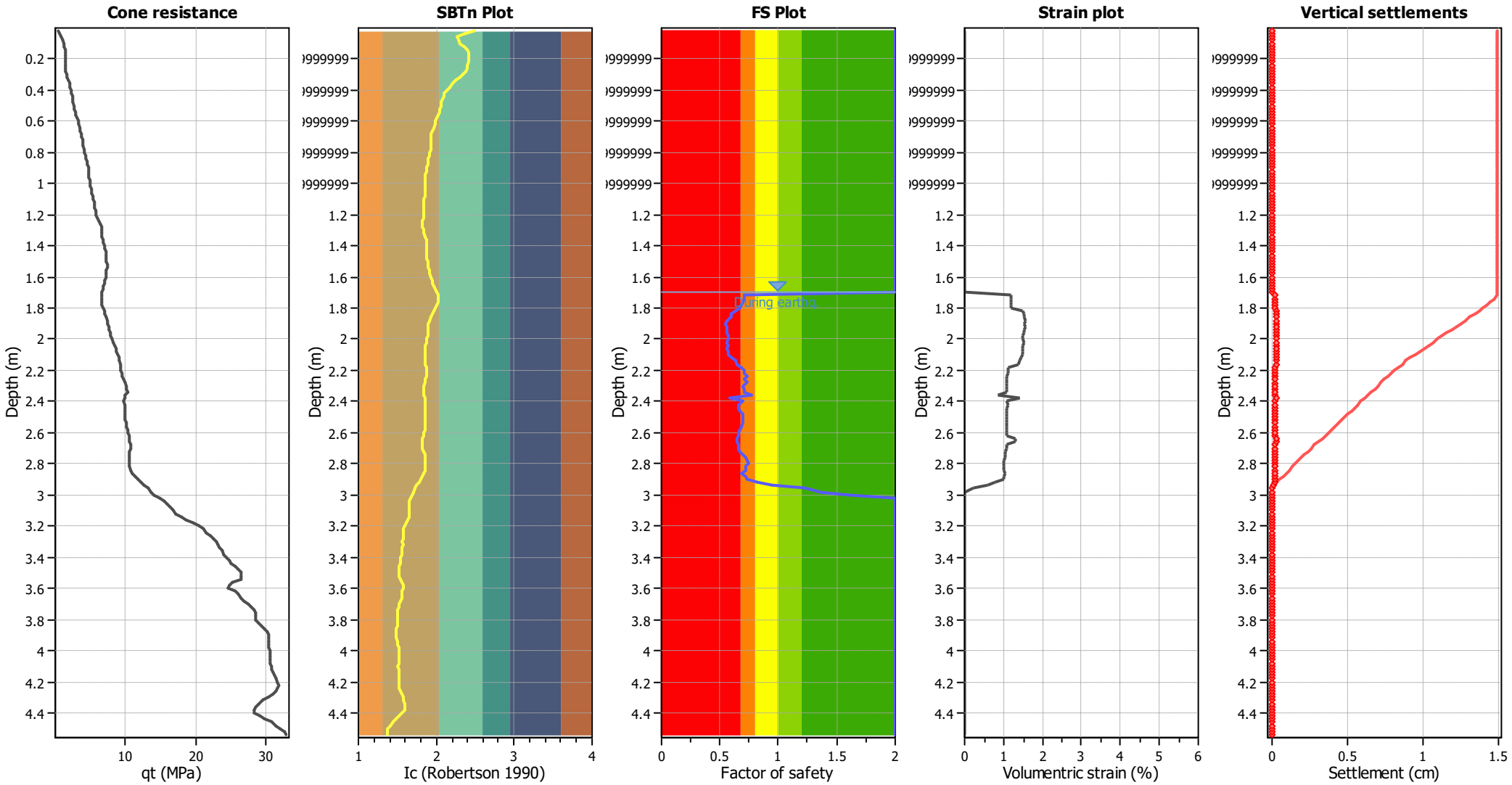
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

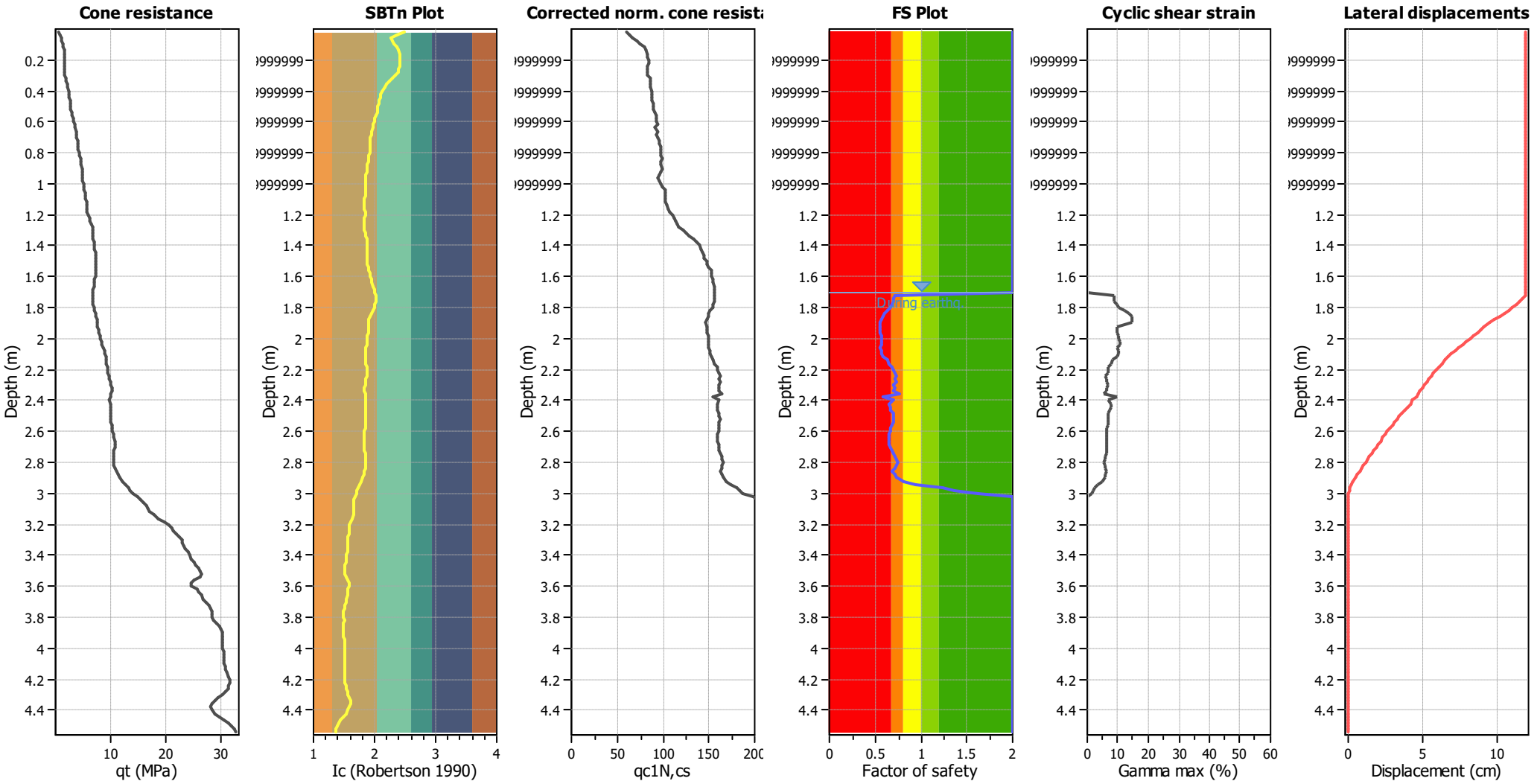
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
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F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

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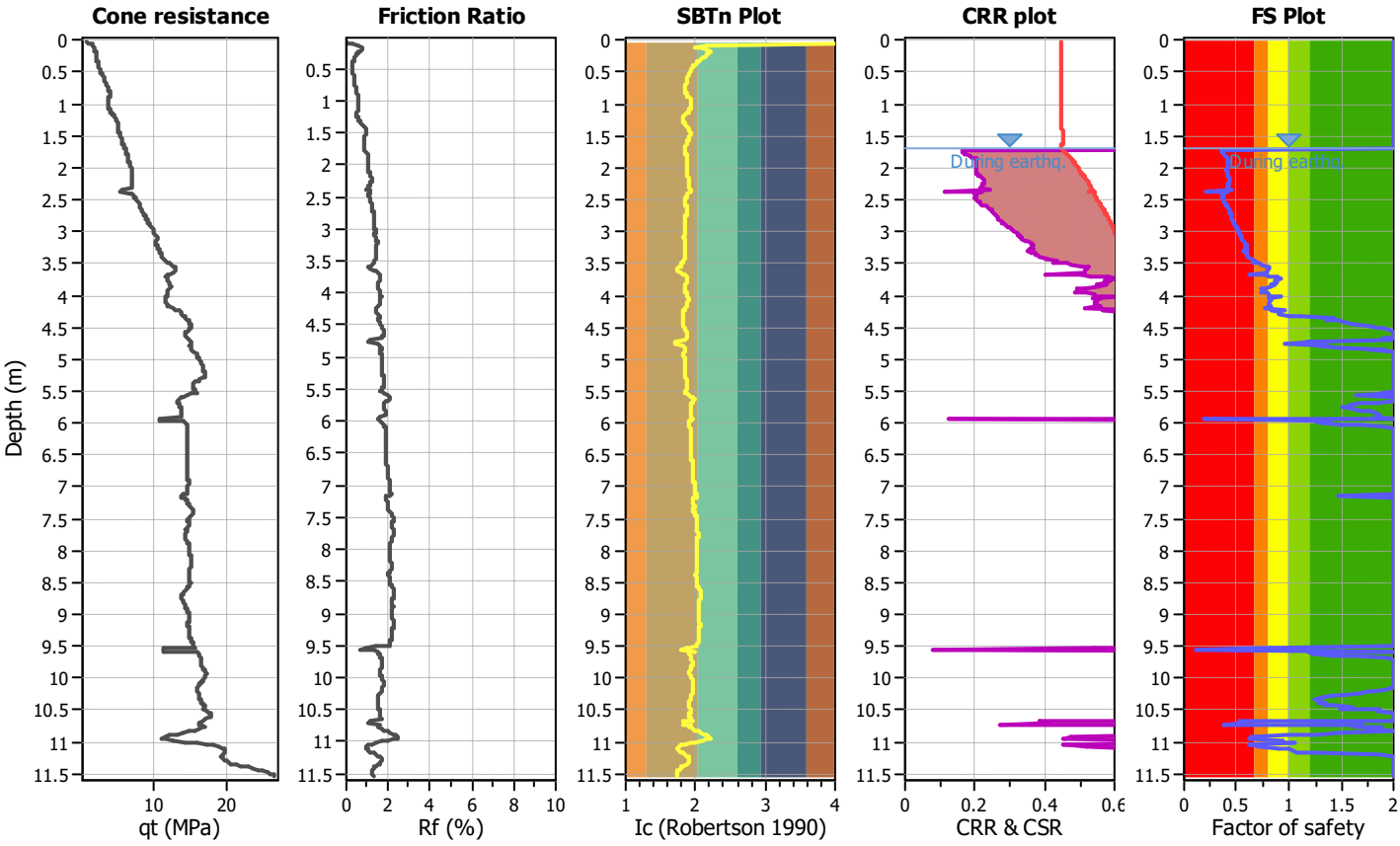
LIQUEFACTION ANALYSIS REPORT

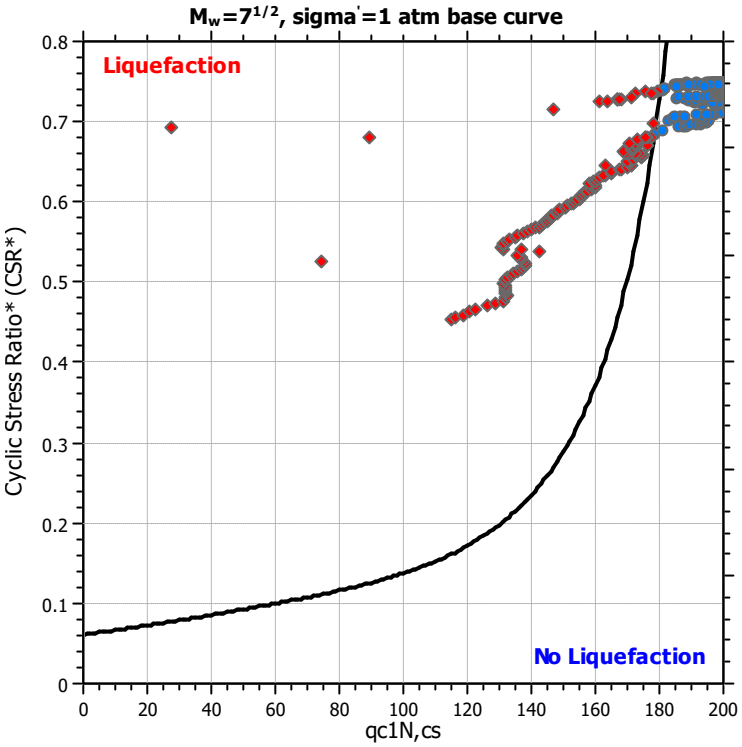
Project title : 195340402 **Location : 131 Otaihanga Rd, Paraparaumu**

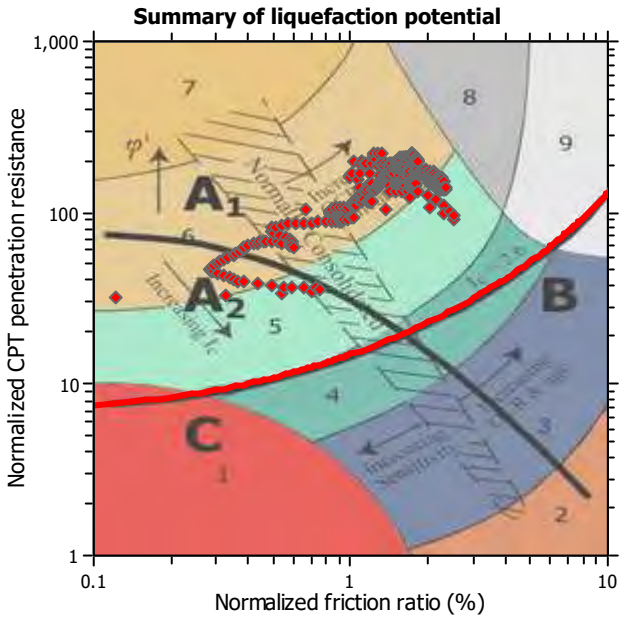
CPT file : CPT11_ULS

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.70 m	Use fill:	No	Clay like behavior applied:	Sands only
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.70 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	7.70	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method
Peak ground acceleration:	0.68	Unit weight calculation:	Based on SBT	K_σ applied:	No		

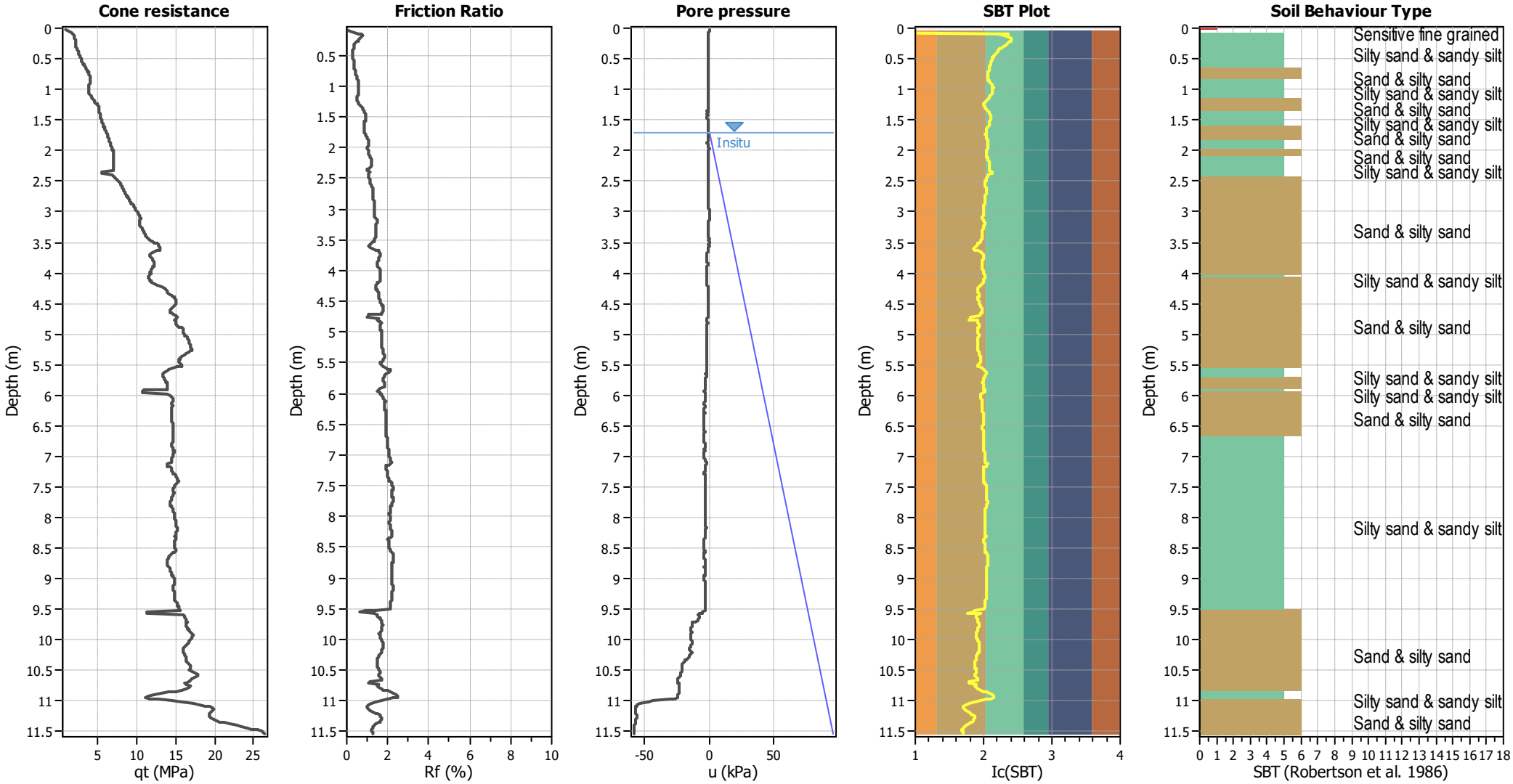






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots



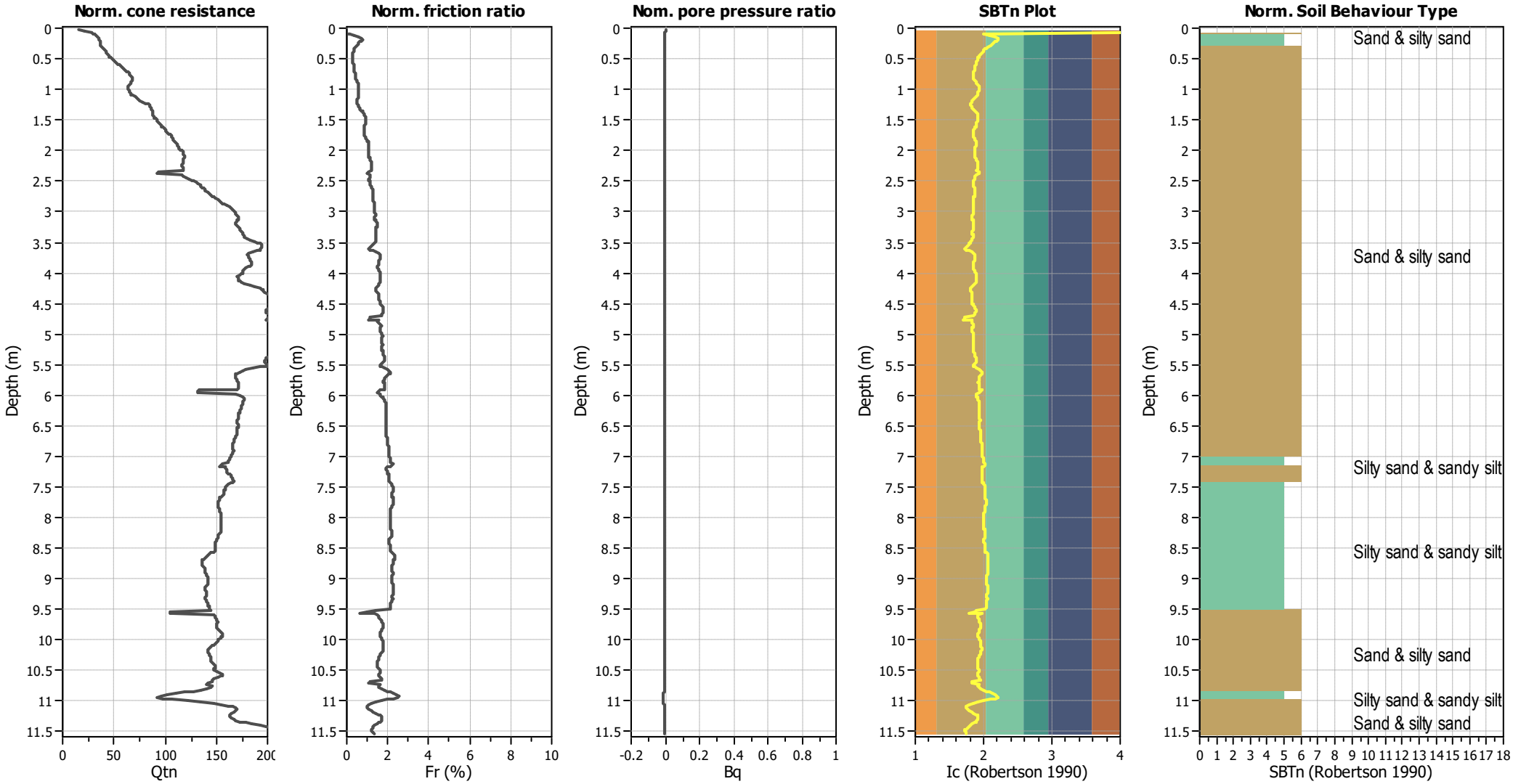
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

CPT basic interpretation plots (normalized)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

SBTn legend

1. Sensitive fine grained
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4. Clayey silt to silty
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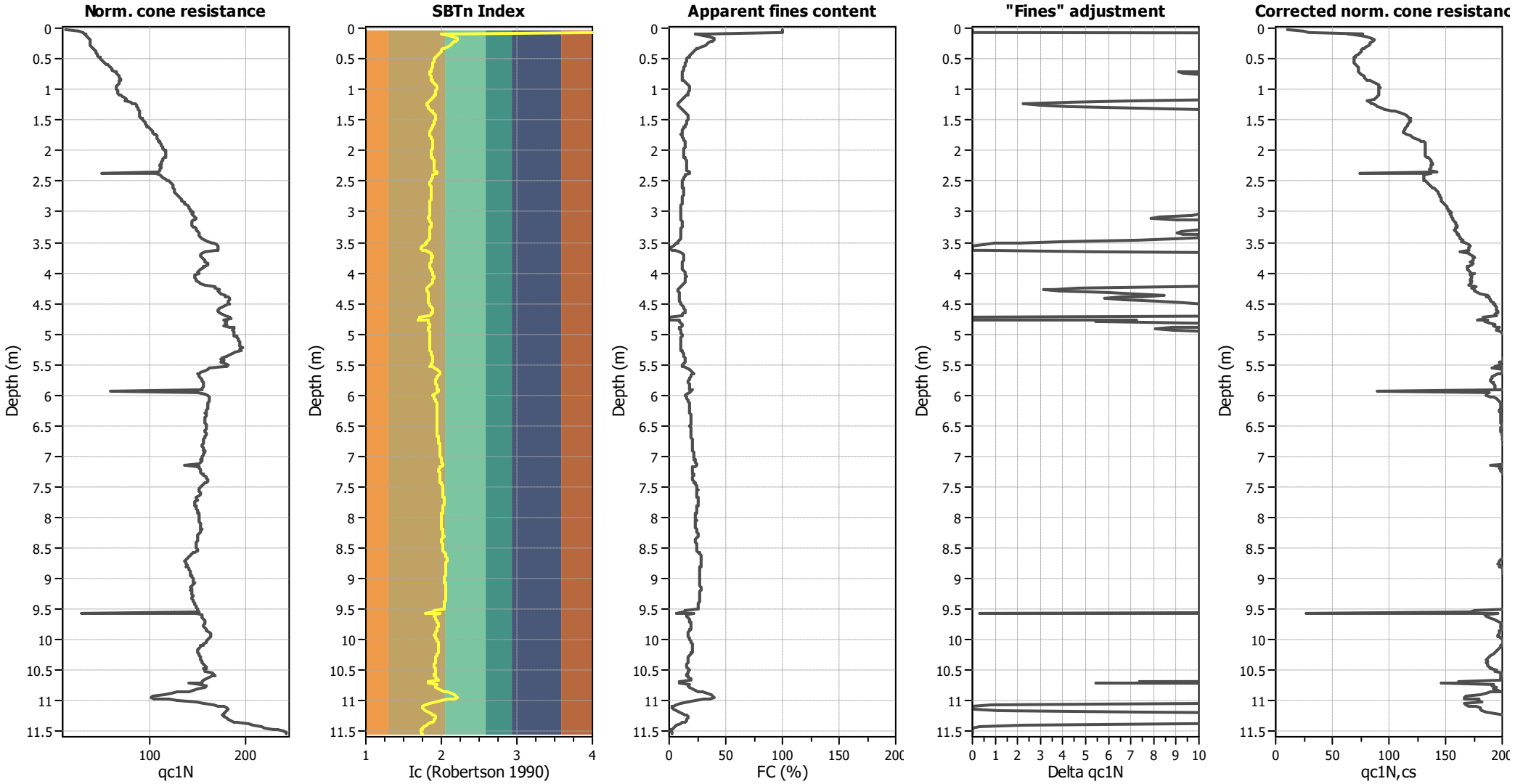
7. Gravely sand to sand
8. Very stiff sand to
9. Very stiff fine grained

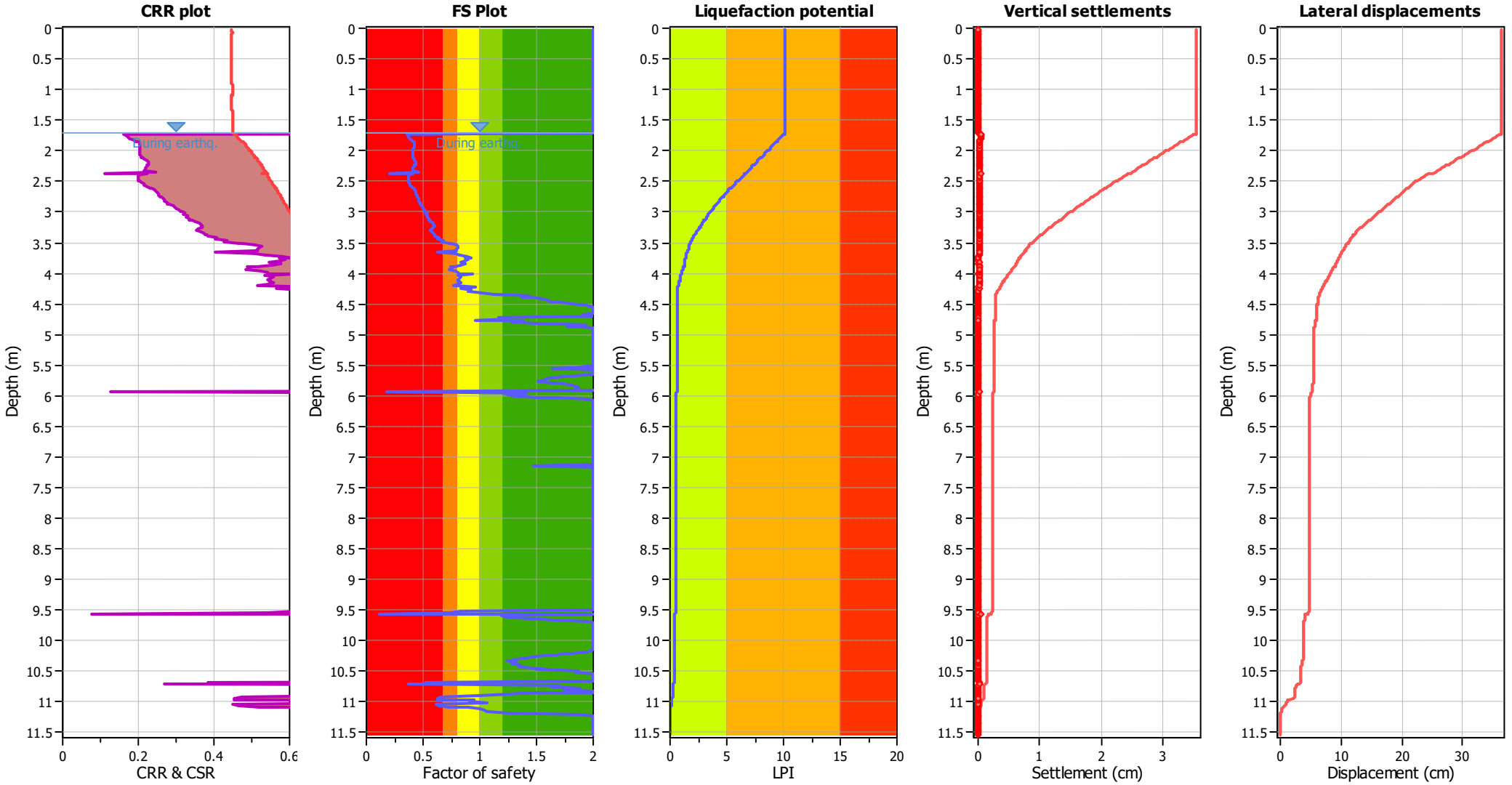
Liquefaction analysis overall plots (intermediate results)



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

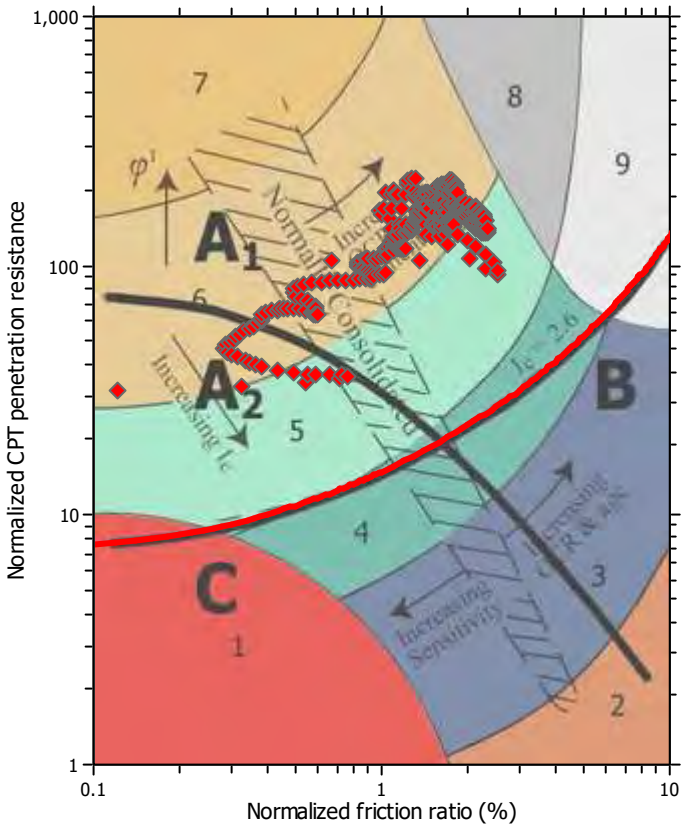
F.S. color scheme

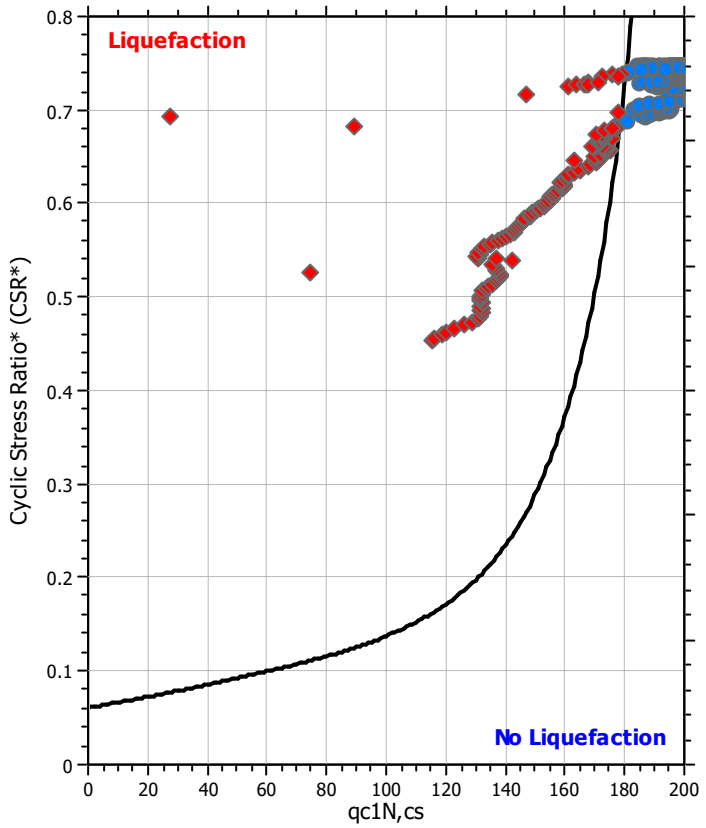
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

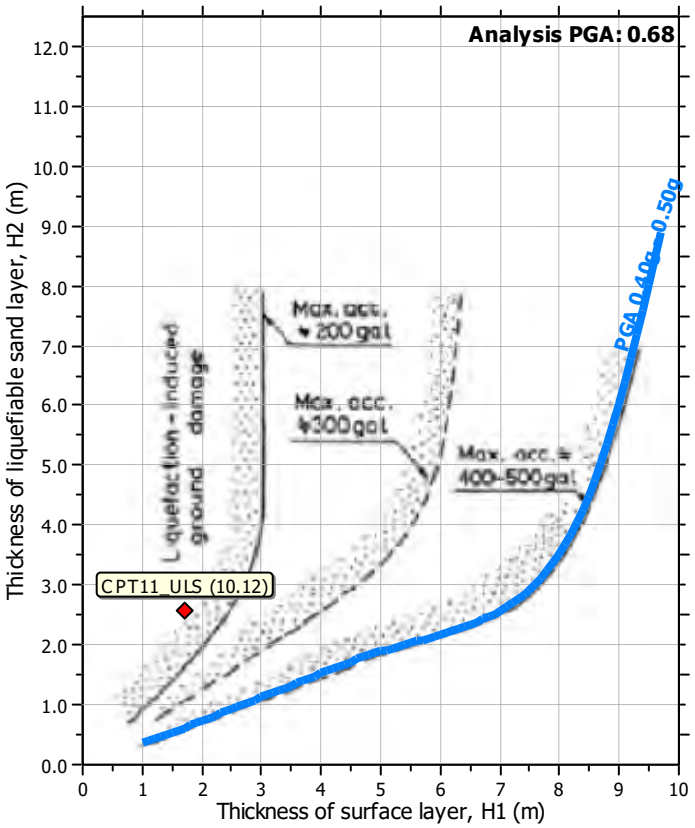
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



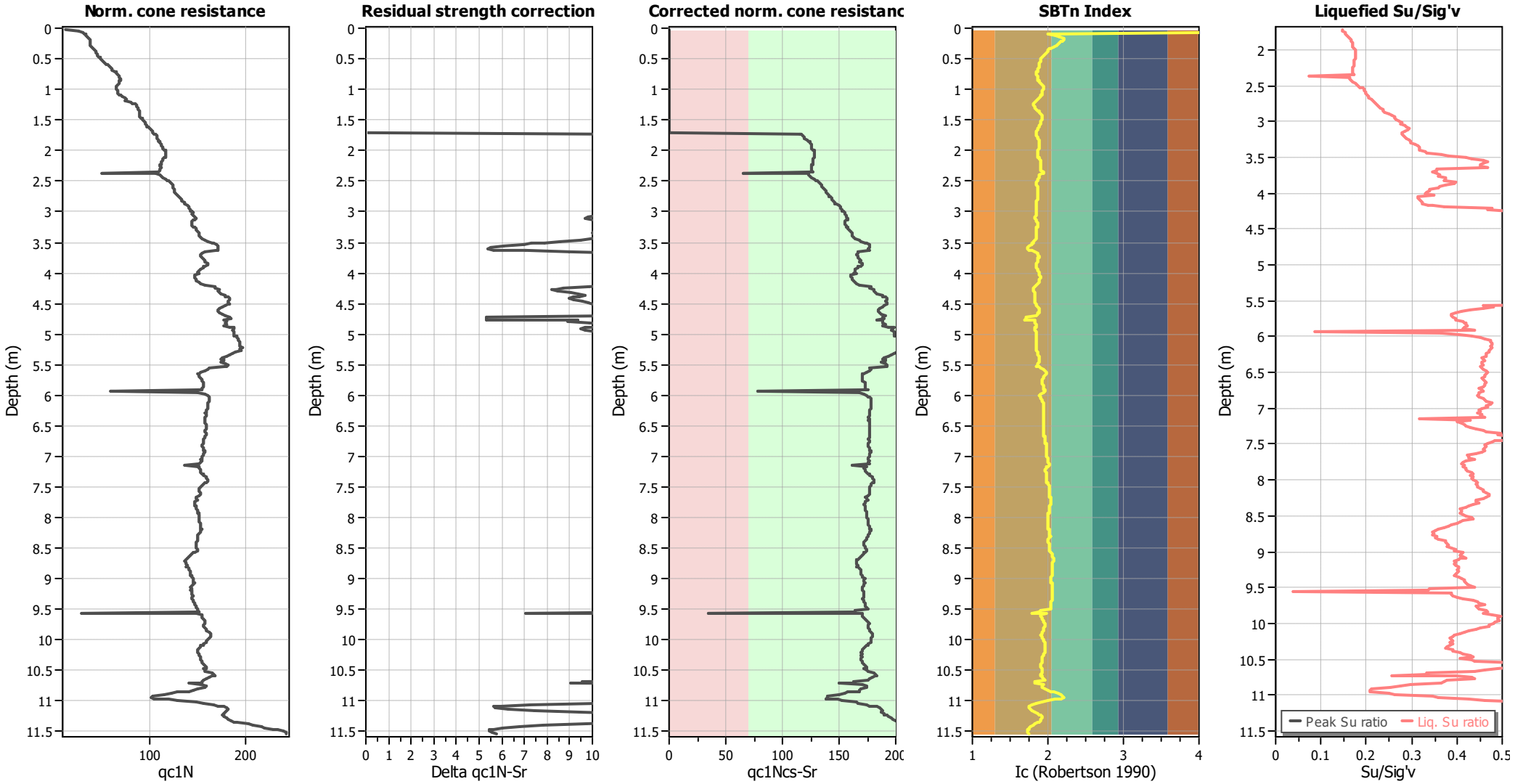




Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

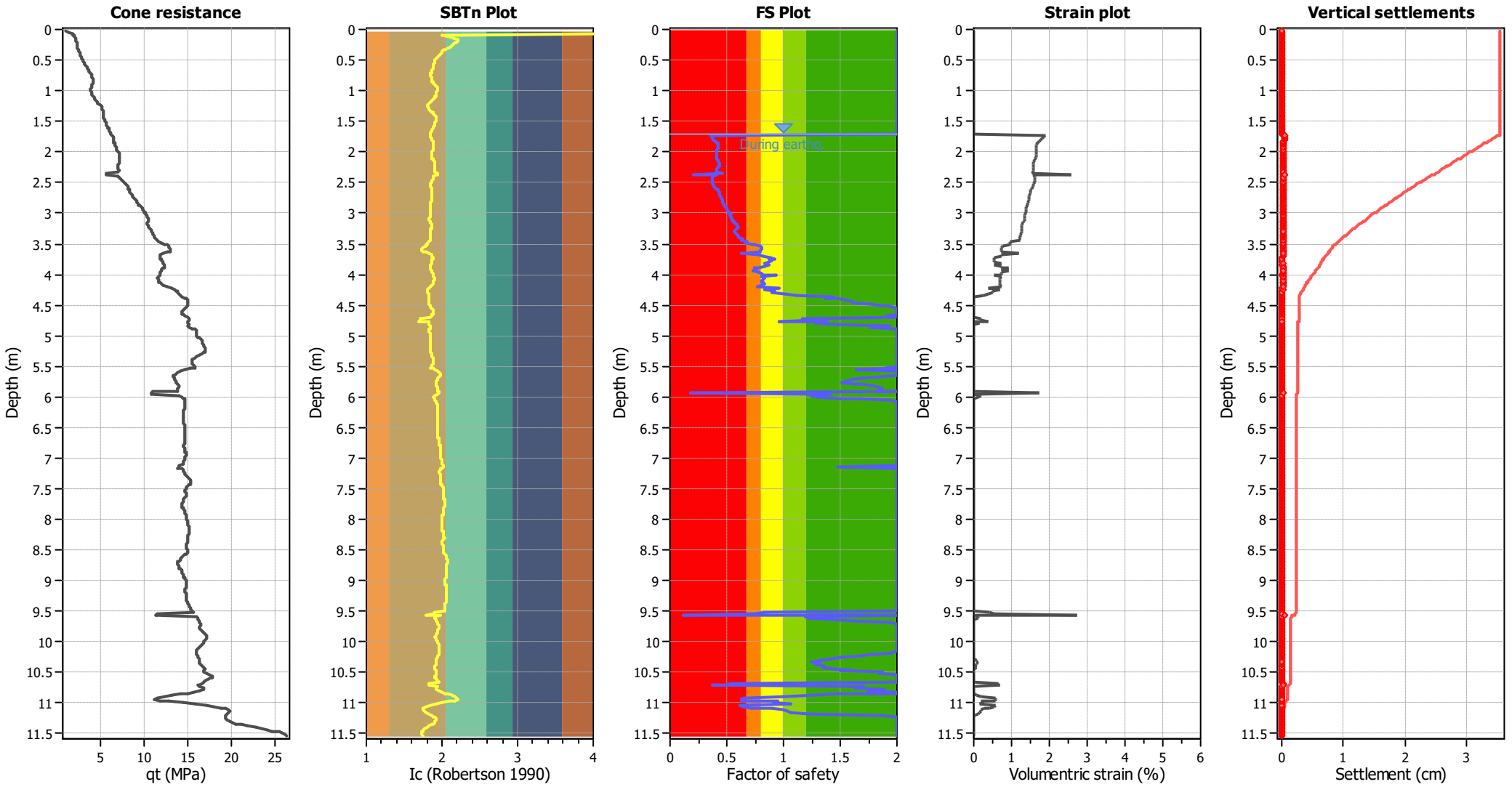
Check for strength loss plots (Idriss & Boulanger (2008))



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	No
Earthquake magnitude M_w:	7.70	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.68	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	20.00 m

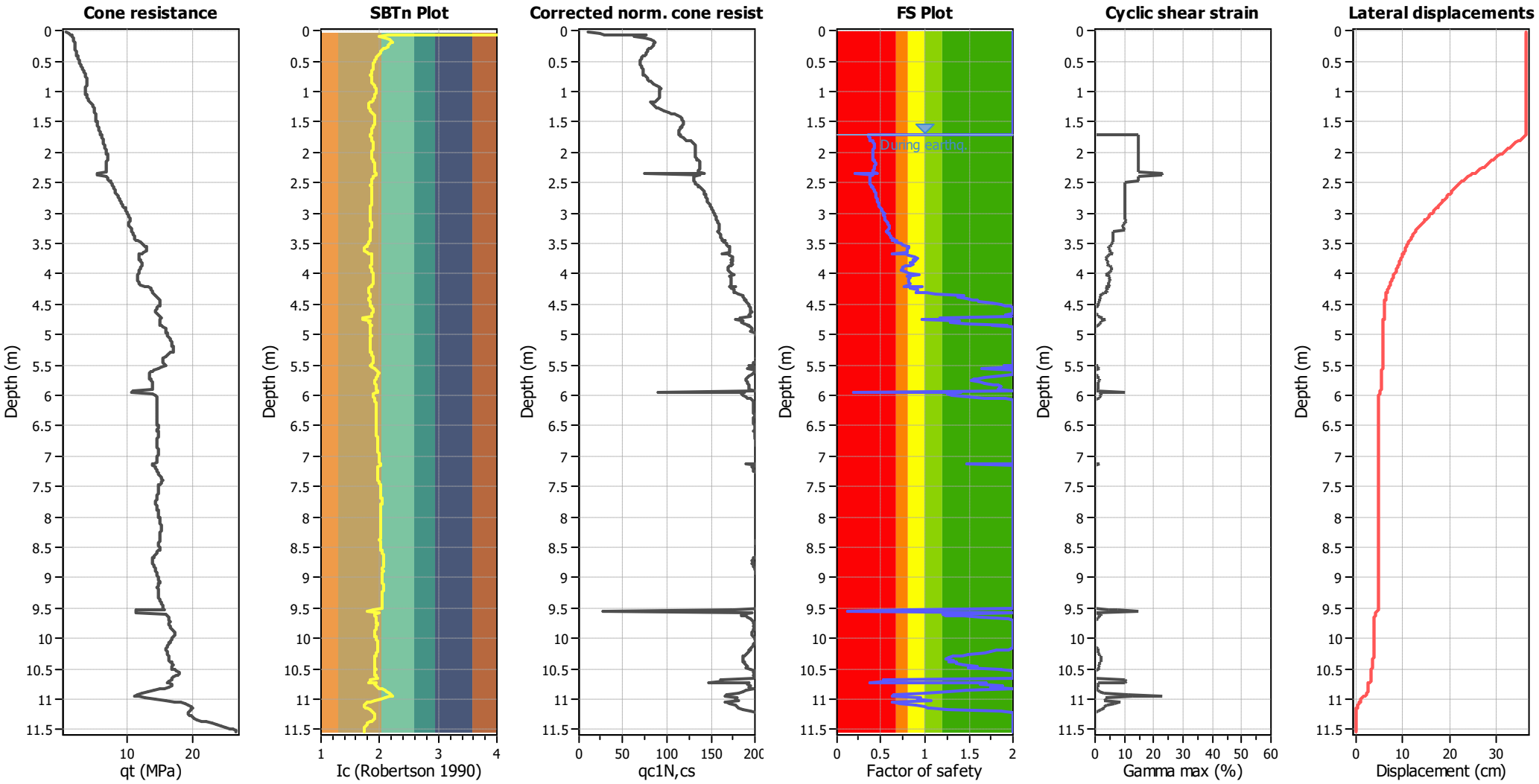
Estimation of post-earthquake settlements



Abbreviations

q_t:	Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c:	Soil Behaviour Type Index
FS:	Calculated Factor of Safety against liquefaction
Volumentric strain:	Post-liquefaction volumentric strain

Estimation of post-earthquake lateral Displacements



Abbreviations

q_t: Total cone resistance (cone resistance q_c corrected for pore water effects)
I_c: Soil Behaviour Type Index
$q_{c1N,cs}$: Equivalent clean sand normalized CPT total cone resistance
F.S.: Factor of safety
γ_{max}: Maximum cyclic shear strain
LDI: Lateral displacement index

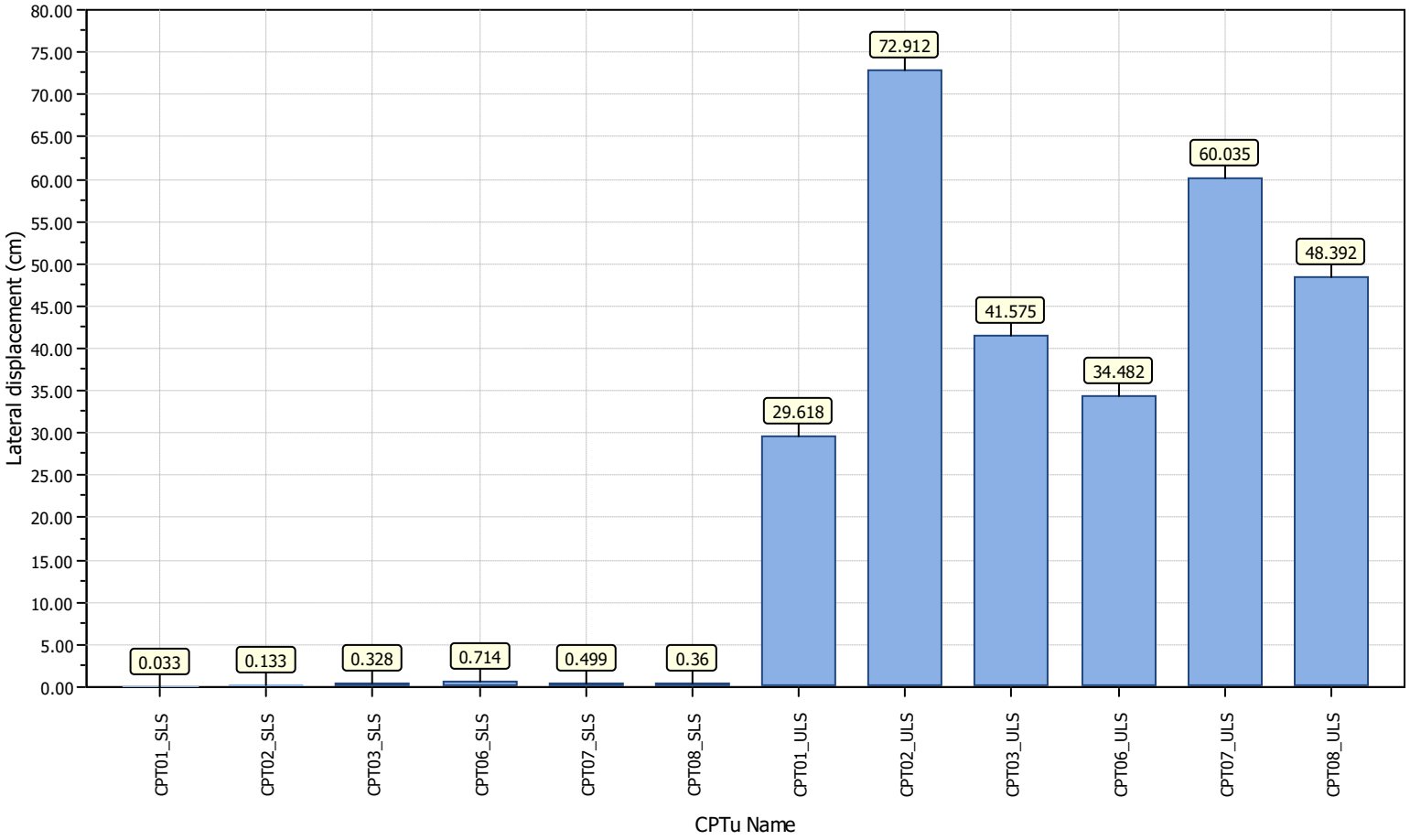
EARTHWORKED LATERAL SPREAD ASSESSMENT

RDCL
Geotechnical Engineers
2/182 Main Rd Tawa
www.rdcl.co.nz

Project title : 195340402 - Earthworked Topography

Location : 131 Otaihanga Rd, Paraparaumu

Overall lateral displacements report

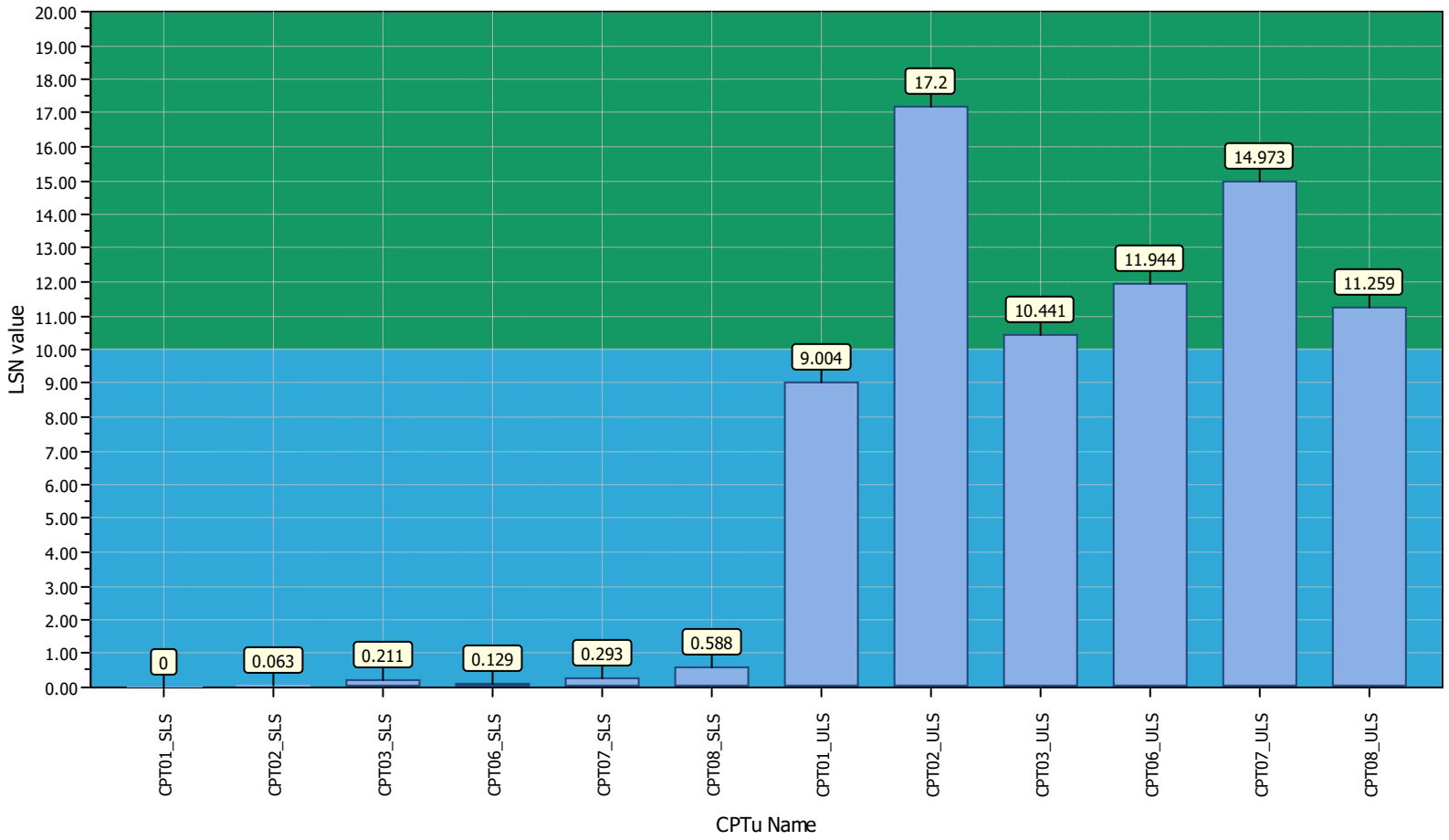


RDCL
Geotechnical Engineers
2/182 Main Rd Tawa
www.rdcl.co.nz

Project title : 195340402 - Earthworked Topography

Location : 131 Otaihanga Rd, Paraparaumu

Overall Liquefaction Severity Number report



LSN color scheme

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

Basic statistics

Total CPT number: 12

58% little liquefaction

42% minor liquefaction

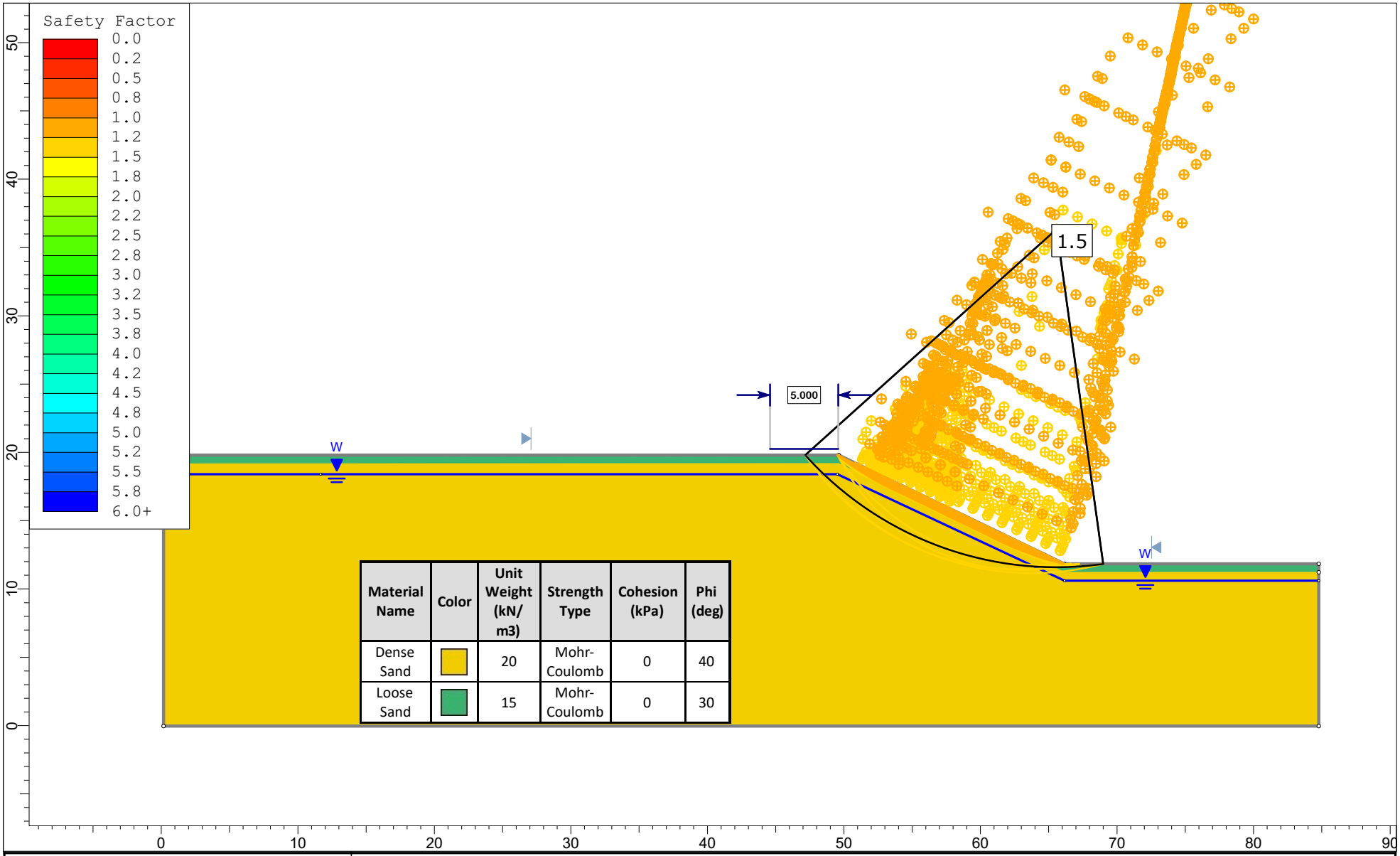
0% moderate liquefaction

0% moderate to major liquefaction

0% major liquefaction

0% severe liquefaction

APPENDIX C: SLOPE STABILITY OUTPUTS

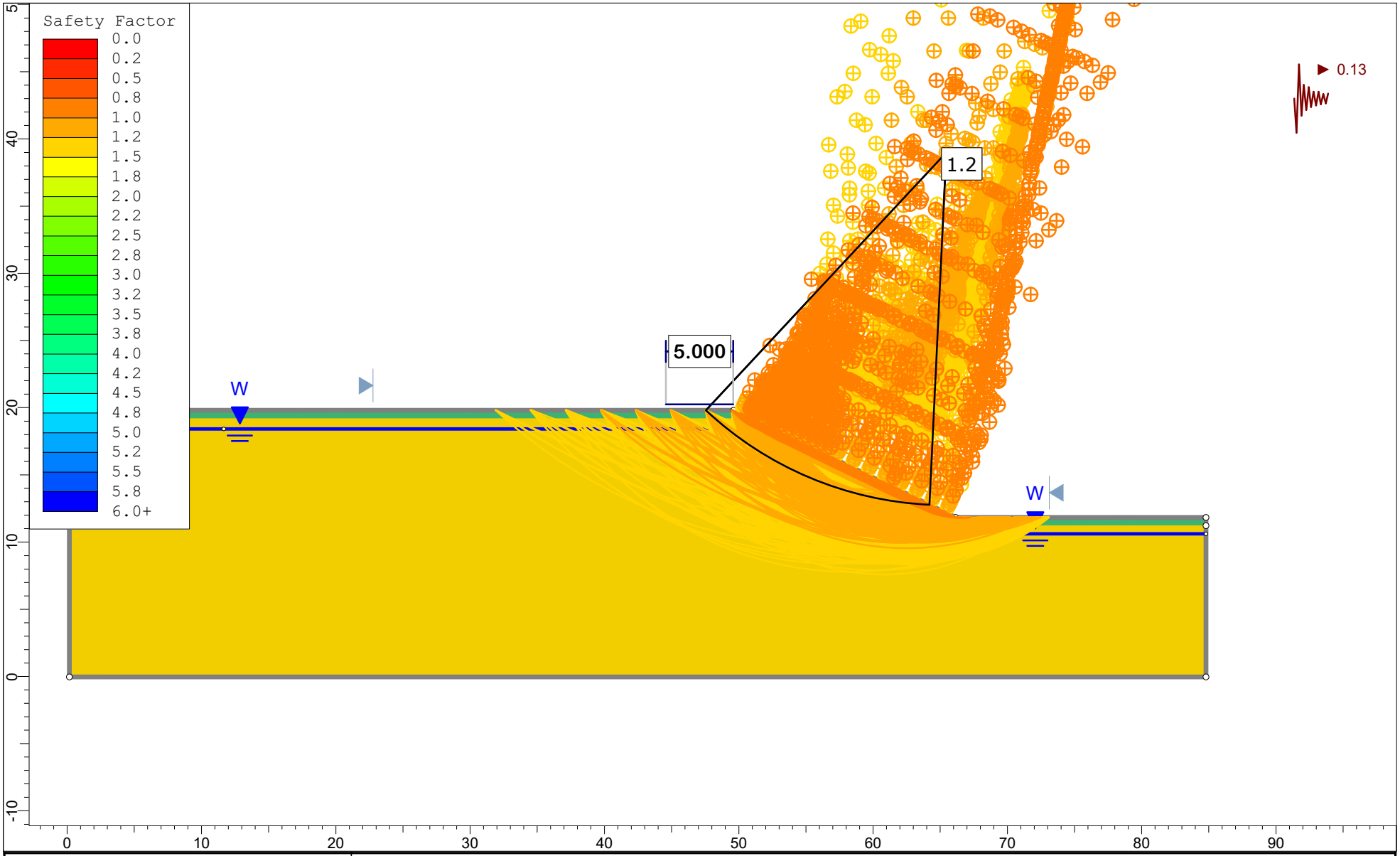


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Dense Sand		20	Mohr-Coulomb	0	40
Loose Sand		15	Mohr-Coulomb	0	30

RDCL

SLIDEINTERPRET 9.009

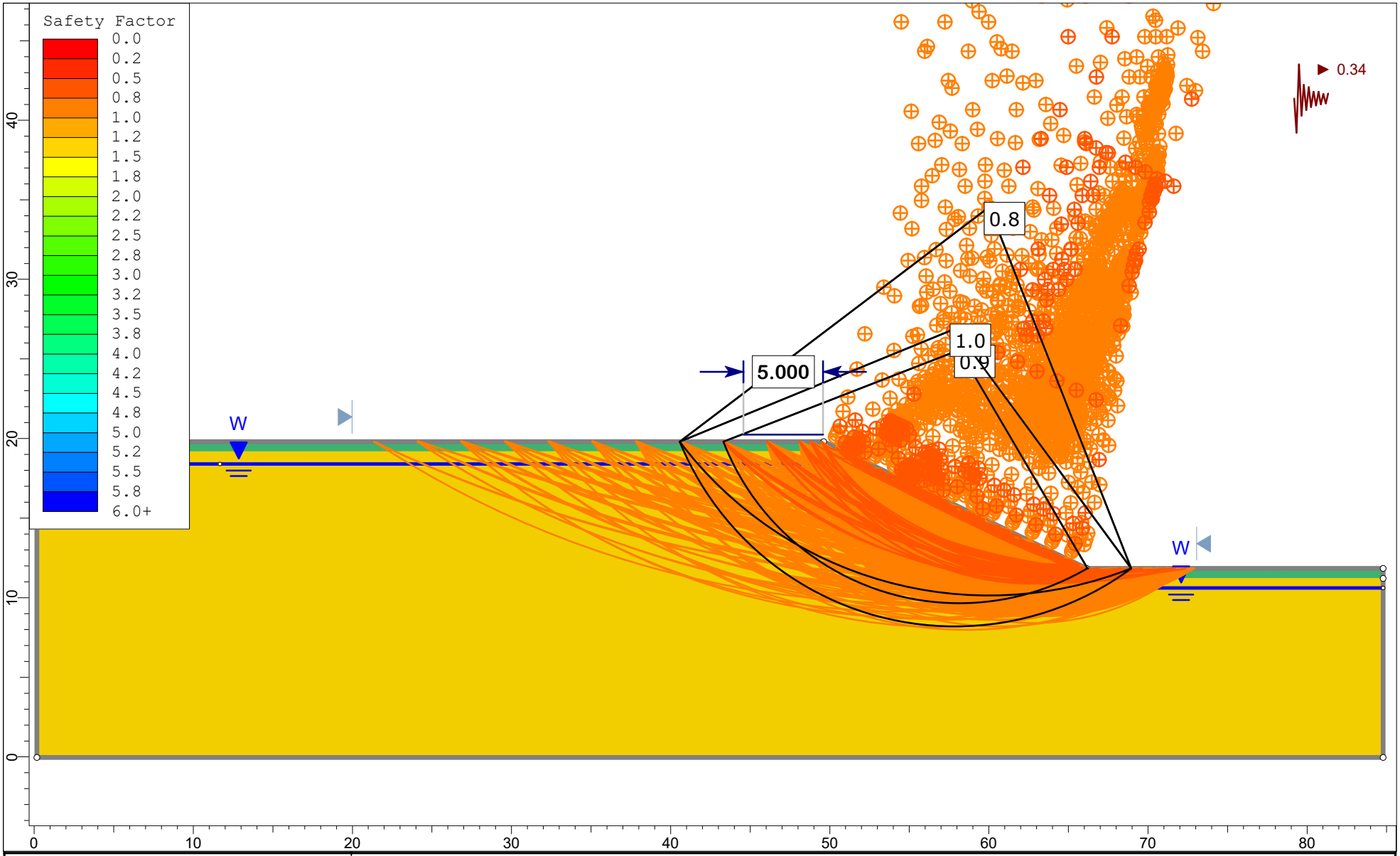
Project	Otainhanga Rd		
	Natural Slope_Static		
Drawn By	CAW	*Company*	Mr Mansell
Date	10/03/2022	*File Name*	Cross sections_Natural.slmd



RDCL

SLIDEINTERPRET 9.009

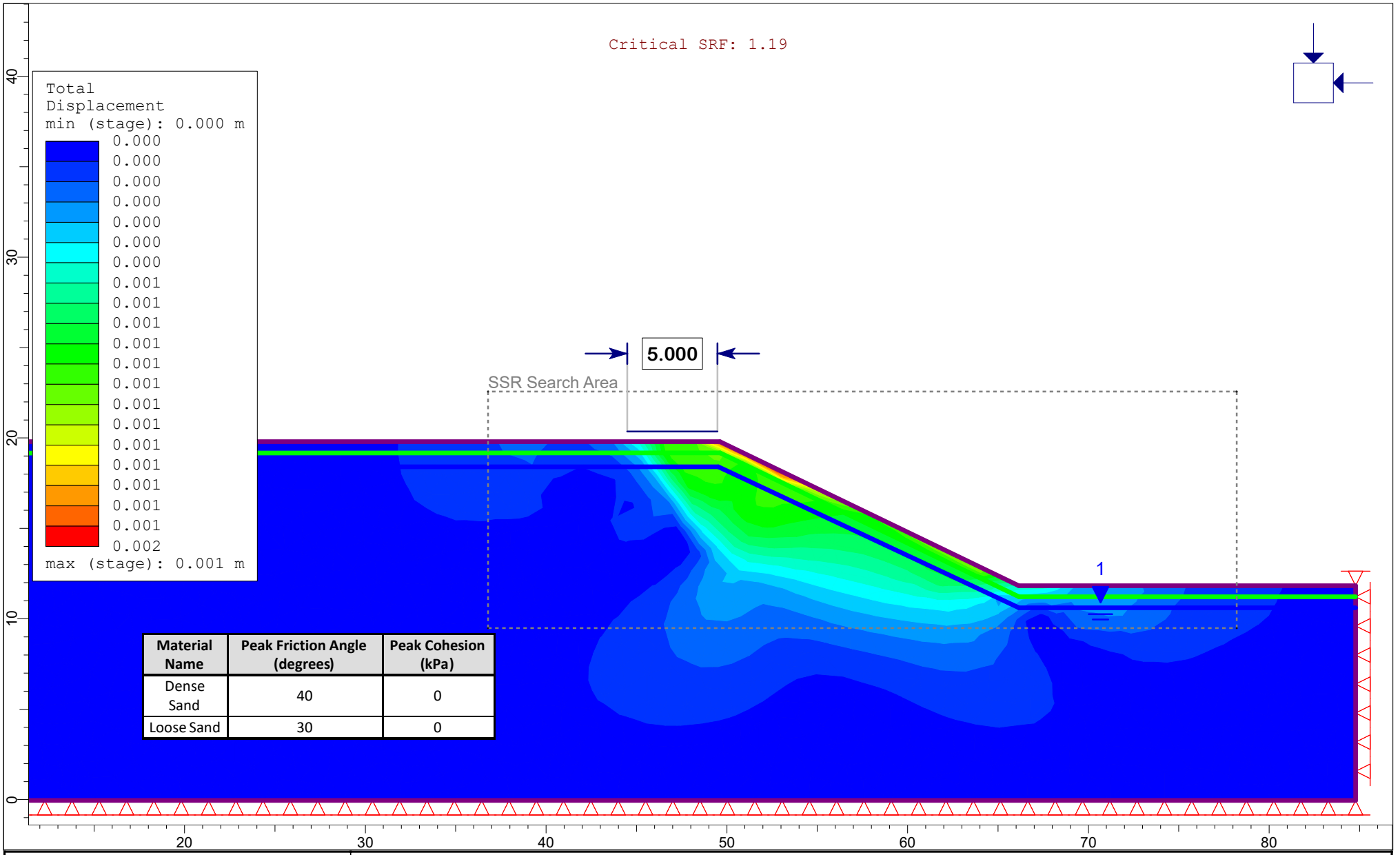
Project	Otainhanga Rd		
	Natural Slope_SLS		
Drawn By	CAW	*Company*	Mr Mansell
Date	10/03/2022	*File Name*	Cross sections_Natural.slmd



RDCL

SLIDEINTERPRET 9.009

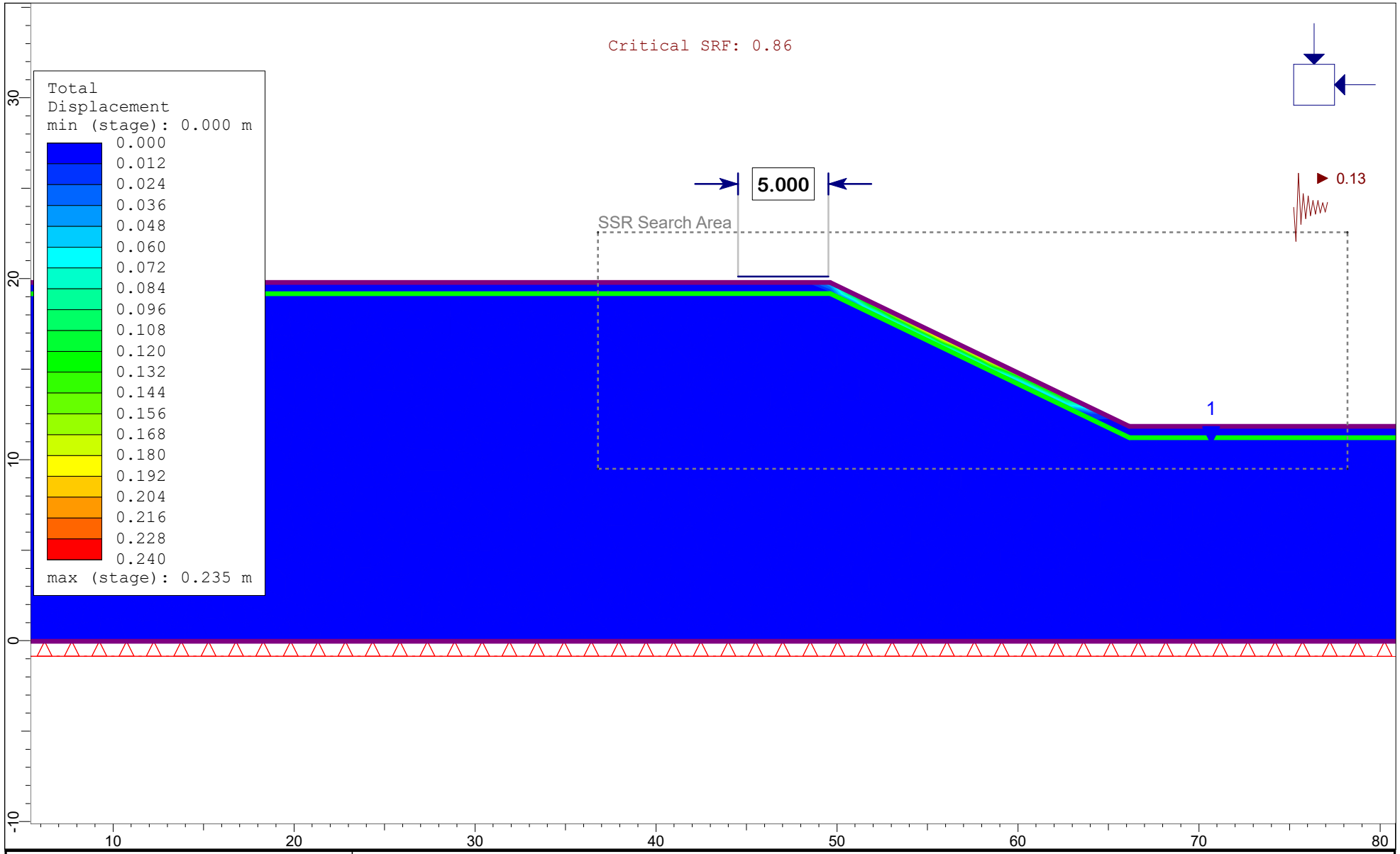
Project	Otainhanga Rd		
	Natural Slope_ULS		
Drawn By	CAW	*Company*	Mr Mansell
Date	10/03/2022	*File Name*	Cross sections_Natural.slmd



Material Name	Peak Friction Angle (degrees)	Peak Cohesion (kPa)
Dense Sand	40	0
Loose Sand	30	0

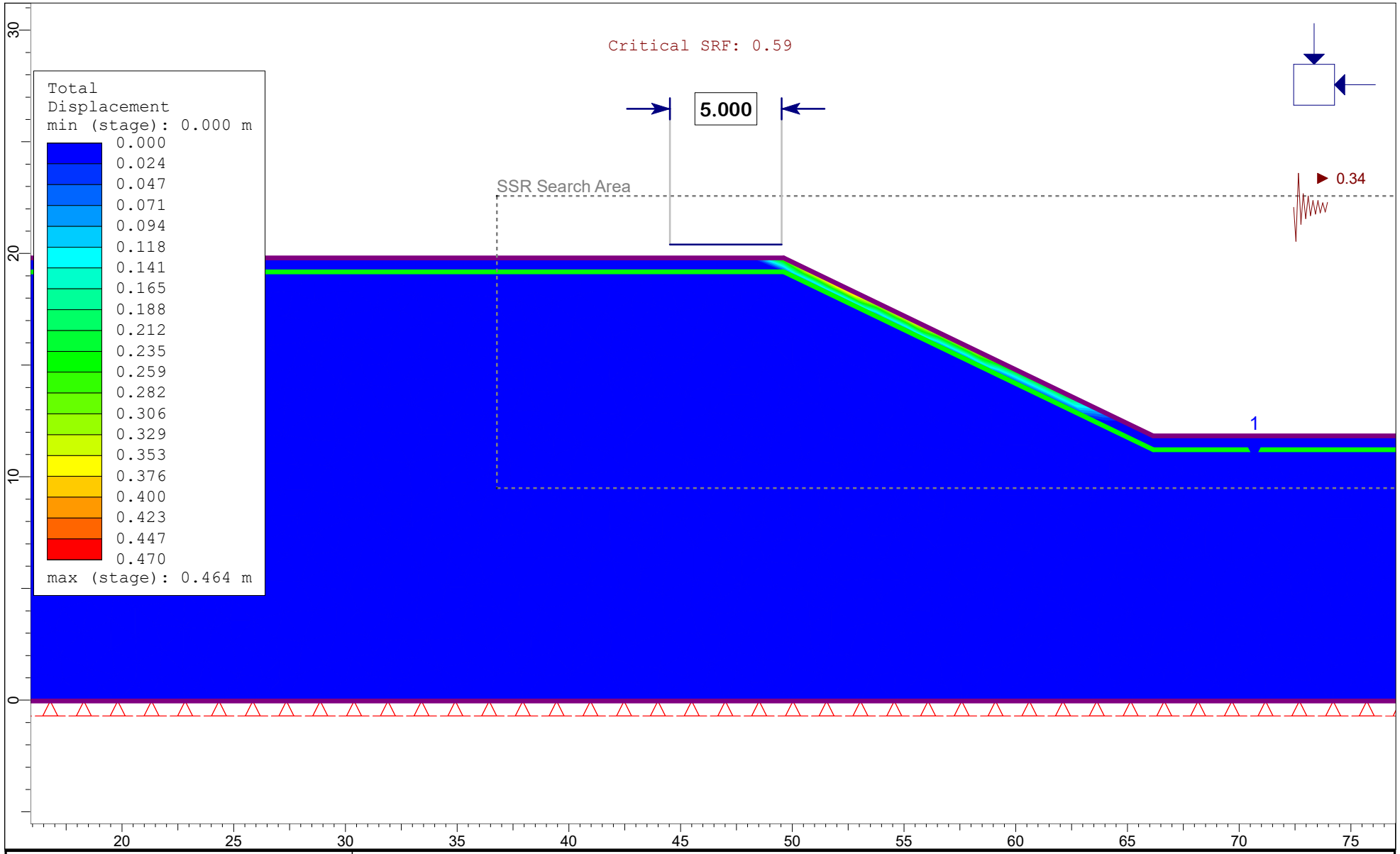
RDCL

Project	131 Otaihanga Rd				
Analysis Discription	Natural_Displacement_Static				
Drawn By	BB	Scale	1:288	Company	RDCL
Date	Converted 04-Mar-22, 4:09:25 PM			File Name	Converted from Slide v9.009 with RS2 11.007



RDCL	*Project*	131 Otaihnaga Rd		
	Analysis Description	Natural Slope_SLS.fez		
	Drawn By	CAWylie	*Scale* 1:296	*Company* Resource Development Consultants Ltd
	Date	10/03/2022		*File Name* Natural Slope_SLS.fez

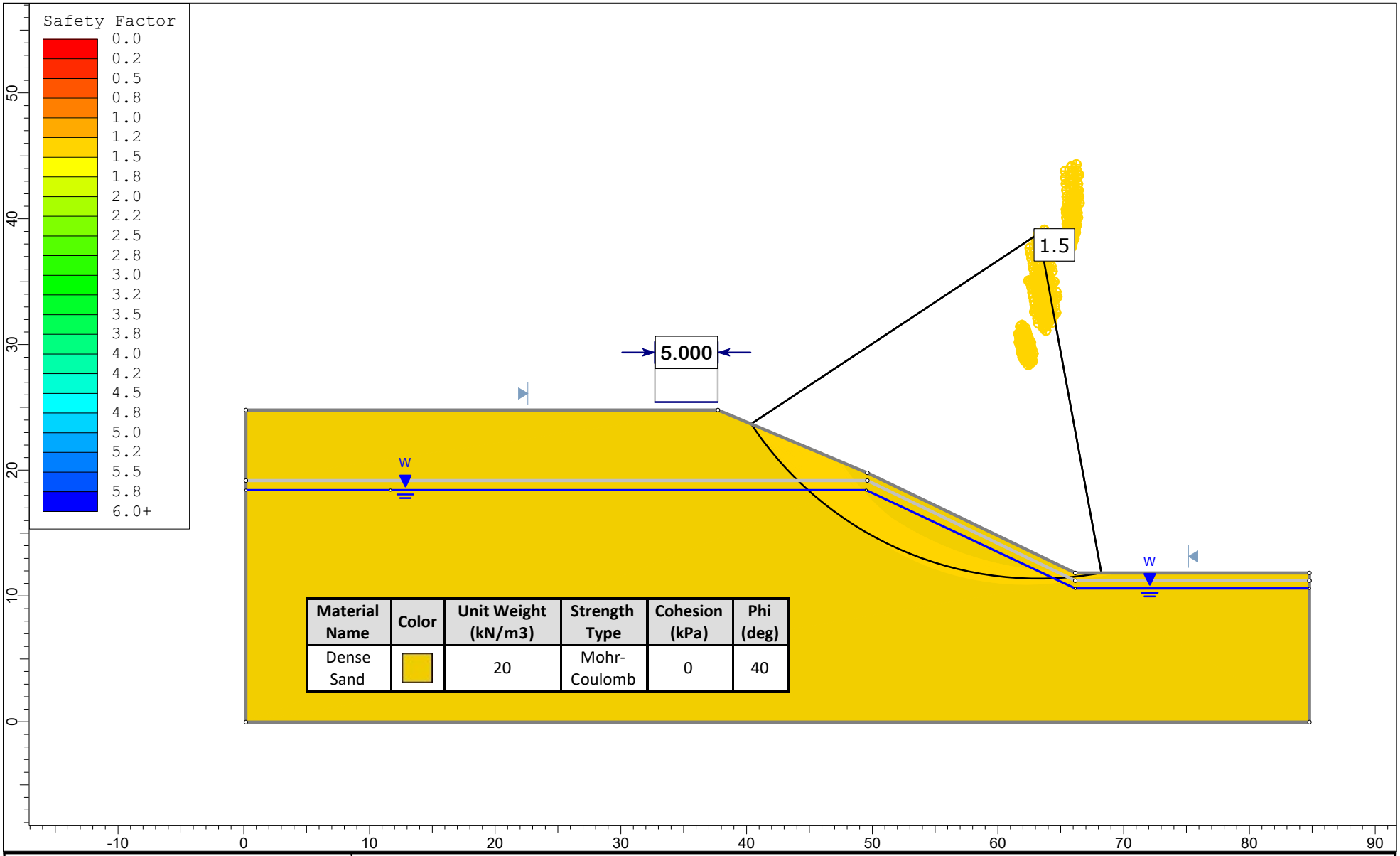
INTERPRET 11.007



RDCL

INTERPRET 11.007

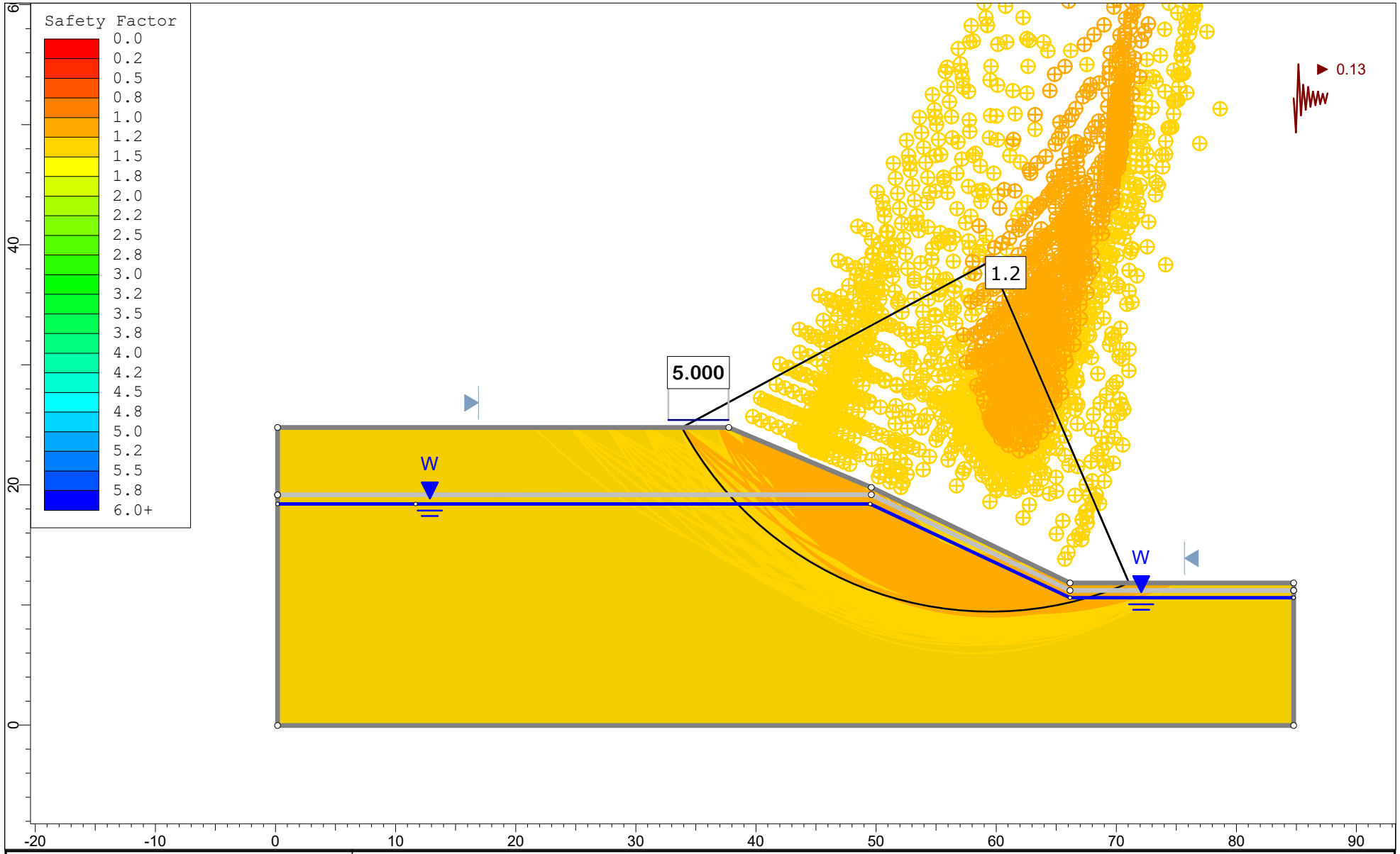
Project	131 Otaihnaga Rd			
Analysis Description	Natural Slope_ULS.fez			
Drawn By	CAWylie	*Scale*	1:240	*Company* Resource Development Consultants Ltd
Date	10/03/2022			*File Name* Natural Slope_ULS.fez



RDCL

SLIDEINTERPRET 9.009

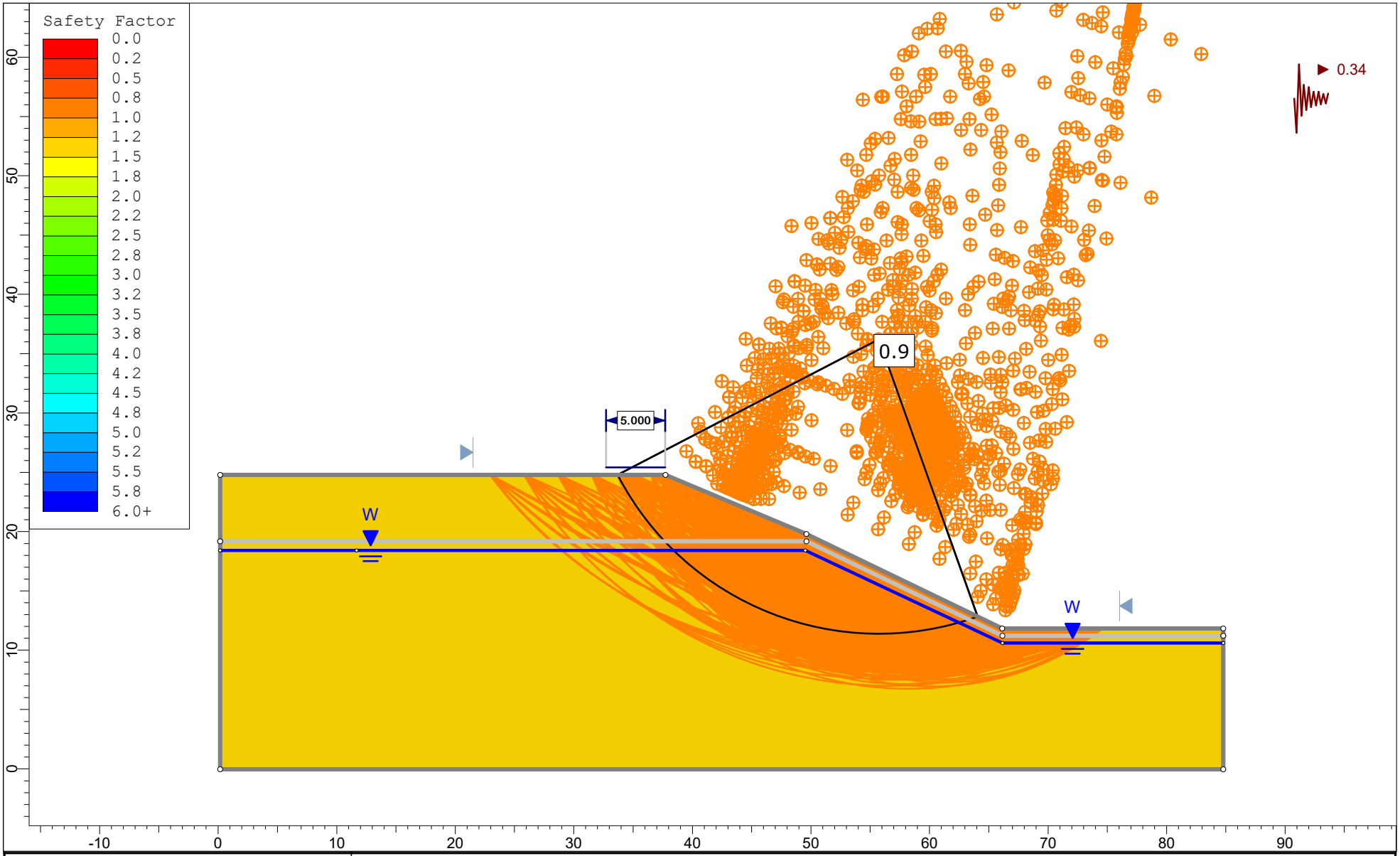
Project	Otainhanga Rd		
	Fill Slope_Static		
Drawn By	CAW	*Company*	Mr Mansell
Date	9/03/2022	*File Name*	Cross sections_Natural_Fill.slmd



RDCL

SLIDEINTERPRET 9.009

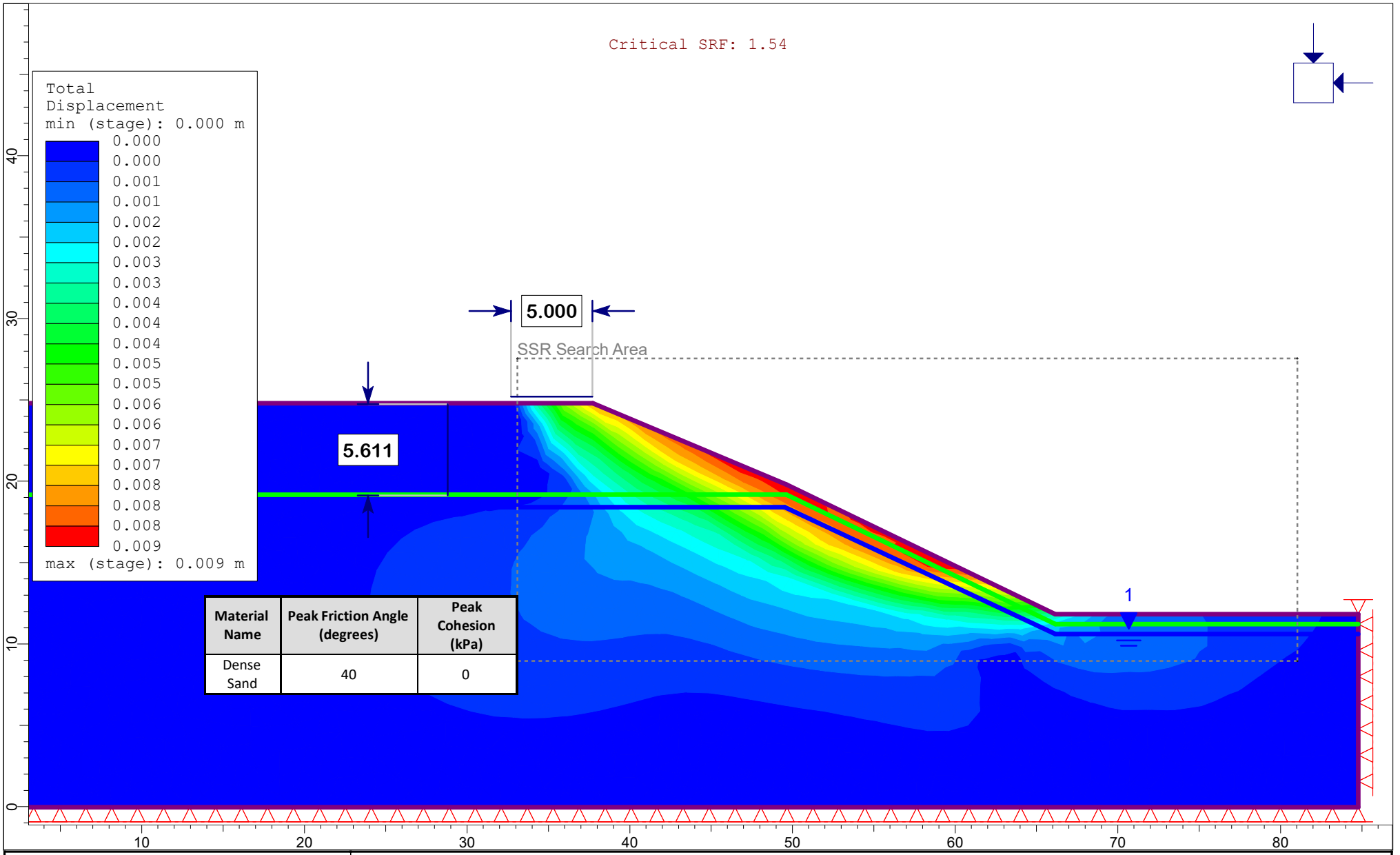
Project	Otainhanga Rd		
	Fill Slope_SLS		
Drawn By	CAW	*Company*	Mr Mansell
Date	9/03/2022	*File Name*	Cross sections_Natural_Fill.slmd



RDCL

SLIDEINTERPRET 9.009

Project	Otainhanga Rd		
	Fill Slope_ULS		
Drawn By	CAW	*Company*	Mr Mansell
Date	9/03/2022	*File Name*	Cross sections_Natural_Fill.slmd



RDCL

Project	131 Otaihanga Rd		
Analysis Discription	Fill_Displacement_Static		
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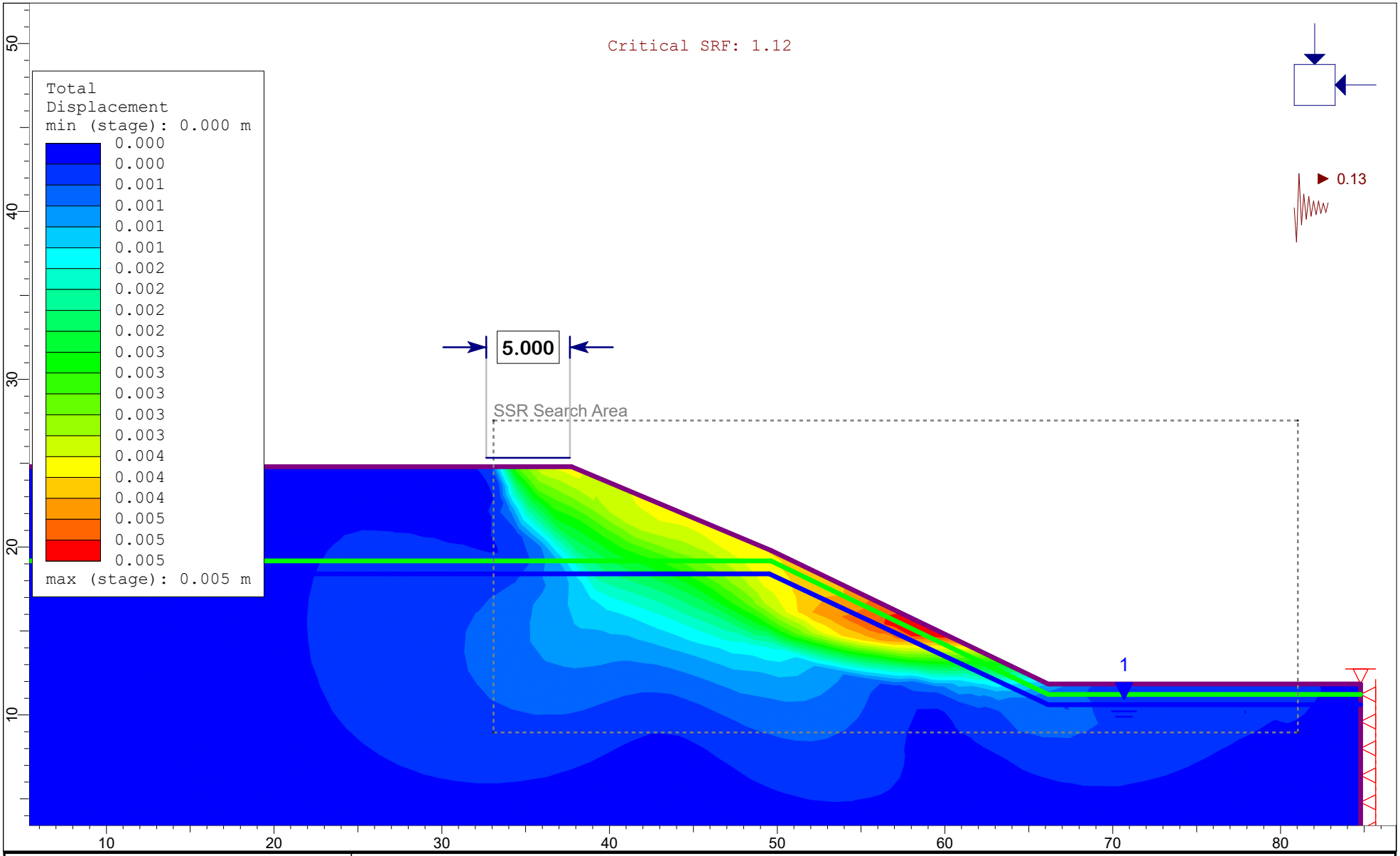
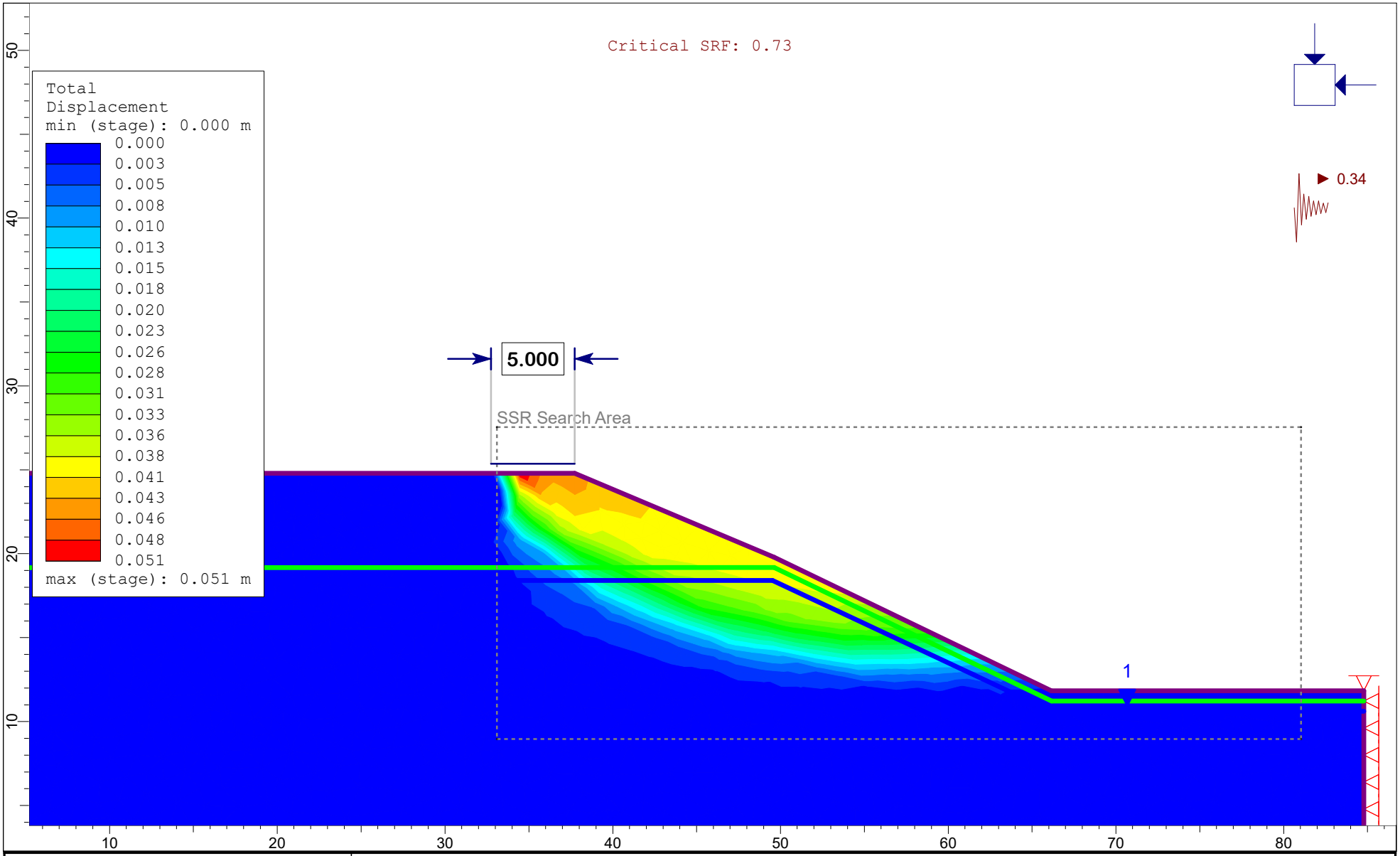
Date	Converted 07-Mar-22, 4:37:55 PM		File Name Converted from Slide v9.009 with RS2 11.007



RDCL	Project	131 Otaihnaga Rd		
	Analysis Description	Fill Slope_SLS.fez		
	Drawn By	CAWylie	Scale 1:320	Company Resource Development Consultants Ltd
	Date	10/03/2022		File Name Fill Slope_SLS.fez

INTERPRET 11.007



RDCL	*Project*	131 Otaihnaga Rd		
	Analysis Description	Fill Slope_ULS.fez		
	Drawn By	CAWylie	*Scale* 1:320	*Company* Resource Development Consultants Ltd
	Date	10/03/2022		*File Name* Fill Slope_ULS.fez

INTERPRET 11.007

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org