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Project Number 18634.000.001

Geotechnical Investigation

234 Rangiuuru Road, Ōtaki, Kāpiti Coast

Submitted to:
Classic Developments NZ Ltd
1 Tradewinds Drive
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Porirua

ENGEO Document Control:

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1 Introduction

ENGEO Ltd was initially requested by Classic Developments NZ Ltd to undertake a geotechnical investigation of the property at 234 Rangiorua Road, Ōtaki, Kāpiti Coast (herein referred to as 'the site'). The work was carried out in accordance with the signed agreement dated 13 April 2021 (reference P2021.000.863_01).

Our scope of work in 2021 included the following:

- Review of published geotechnical and geological information relevant to the site.
- Site assessment by an experienced ground engineering professional.
- Coordination of local buried services location contractor.
- Coordination and technical supervision of the excavation of 12 test pits, with associated strength testing, to a maximum depth of 2.3 m.
- Production of a geotechnical report.

Since our 2021 investigation, investigations by others in the vicinity of the site encountered potentially liquefiable soil. In 2025 our scope was extended to carry out a liquefaction assessment for the site. The work was carried out in accordance with our signed Short Form Agreement Variation dated 21 May 2024. Our updated scope of work included the following:

- Coordination of local buried services location contractor.
- Coordination and supervision of the drilling of one machine borehole to a depth of 15 m.
- Coordination and supervision of ten cone penetration tests (CPTs).
- Analysis of field data and refinement of the conceptual geological site model.
- Computational liquefaction analysis.
- Update the geotechnical report to include results of liquefaction analysis and recommendations regarding liquefaction potential.

2 Site and Project Description

The site at 234 Rangiorua Road is located on generally flat, grassed land in Ōtaki, Kāpiti Coast. The site is currently being used for grazing for livestock and has an access track running through the west boundary with storage containers located along the eastern periphery of the access track. The site is bounded by residential and lifestyle blocks in each direction with Rangiorua Road to the immediate south of site. To the north of the site is an unnamed stream with Te Kura-ā-Iwi O Whakatupuranga Rua Mano (School) and Nga Purapura beyond this.

The proposed development is a residential subdivision comprising 43 lots as shown by the Envelope subdivision scheme plan reference 1678-02/1000/P1 dated 2 December 2025.

A site location plan is shown in Figure 1.

Figure 1: Site Location Plan

3 Geology and Geohazards

3.1 Geology

The GNS geological map and associated text of the area indicates the site is underlain by Holocene alluvium comprising well sorted floodplain gravels.

3.2 Regional Seismic Hazard

The Greater Wellington Regional Council Hazard maps for the site area indicate a “moderate” combined earthquake hazard rating. This rating is derived from a moderate ground shaking hazard and low susceptibility to slope failure. No information was available for liquefaction potential.

The site is not within the zone mapped by Greater Wellington Regional Council for potential flooding hazard or likelihood of tsunami inundation. It should be noted that the maps are regional in nature and the hazard potentials indicated on the maps do not necessarily apply to any specific site.

3.3 Faults

Reference to the GNS New Zealand Active Faults Database indicates that the site is located within 20 km of five active faults:

- **Northern Ohariu Fault:** Approximately 4.4 km southeast.
- **Ohariu Fault:** Approximately 8.8 km south.
- **Gibbs Fault:** Approximately 12.5 km southeast.
- **SE Reikorangi Fault:** Approximately 11.8 km southeast.
- **Ōtaki Forks Fault:** Approximately 16.5 km southeast.

3.4 Previous Investigations

ENGEO has previously completed geotechnical investigations at a site approximately 170 m to the northeast.

Investigations comprising boreholes, test pits, and hand augers encountered topsoil underlain by silt alluvium to a depth of approximately 1.5 m. Beneath the silt was dense sand and gravel to a maximum depth of 15.5 m. Groundwater was encountered at depths of between 1.3 and 1.9 m. A summary of the ground conditions encountered in the borehole is provided in Table 1.

Table 1: Summary of Ground Conditions at Borehole 170 m Northeast of Site

Unit	Description	Depth to top of layer (m)	Depth to bottom of layer (m)	Consistency / Density
Topsoil	Organic SILT	0.0	0.4	N/A
Alluvium	SILT	0.4	1.05	
	Silty SAND	1.05	1.8	Medium Dense
	Sandy GRAVEL / GRAVEL	1.8	6.1	
	Sandy GRAVEL / GRAVEL	6.1	NP	Dense to Very Dense

NP = Not proven. N/A = No strength data available.

4 Site Investigation

ENGEO visited the site on 15 April 2021 and supervised 12 test pits to a maximum target depth of 2.3 m. The material encountered in the subsurface was found to be generally consistent across the site with a layer of fill or topsoil which is underlain by alluvium. This alluvium comprised silt which is underlain by alternating layers of medium to dense sand and gravel to a maximum depth of 2.3 m. Ground conditions from the test pit site investigation are summarised in Table 2.

Table 2: Summary of Ground Conditions of Site Investigation

Unit	Description	Typical Depth to top of layer (m)	Typical Depth to bottom of layer (m)	Consistency / Density
Fill*	Silty SAND	0.0	0.4	Loose
	Sandy GRAVEL	0.0	0.4	Dense
Topsoil	Silty SAND	0.0	0.3	Loose to Medium Dense
Alluvium	SILT	0.2	1.8	Very Stiff to Hard
	Sandy SILT	1.2	NP	
	Clayey SILT	1.2	1.9	
	Silty gravelly SAND	1.3	NP	Medium Dense to Dense
	Silty sandy GRAVEL	1.2	NP	

NP = Not proven. * = TP01 – TP04 only

4.1 2025 Investigation

Additional investigations by others in the vicinity of the site encountered potentially liquefiable soil, therefore a borehole and CPTs were undertaken. ENGEO returned to the site to complete the following intrusive investigation:

- One machine borehole (BH01), to a maximum depth of 15.35 m. The borehole was drilled on 4 October 2025 and was supervised on-site by an experienced ground engineering professional from ENGEO.
- Ten Cone Penetration Tests (CPTs), to a maximum depth of 7.52 m. The CPT testing was completed by Ground Investigation Ltd on 25 November 2025.

A summary of the ground conditions encountered in BH01 is summarised in Table 3.

Table 3: Summary of Ground Conditions in BH01

Unit	Description	Typical Depth to top of layer (m)	Typical Depth to bottom of layer (m)	Consistency / Density
Alluvium	Sandy SILT	0.0	1.35	Soft
	SAND	1.35	3.1	Loose
	Sandy GRAVEL	3.1	8	Medium Dense to Very Dense
	SAND	8	11.8	Loose to Dense
	Sandy GRAVEL	11.8	NP	Dense to Very Dense

4.2 Groundwater

Groundwater was encountered in ten of the twelve test pits (not in TP01 and TP02) and in BH01 between of between 1.5 m and 2.1 m. In each case groundwater was encountered at or just below the base of the silt layer.

Groundwater was measured in eight of the ten CPT test locations between 1.4 m to 1.9 m.

5 Liquefaction and Lateral Spreading

5.1 General Comments on Liquefaction

The soils at the site comprise loose sand layers below the water table which may be susceptible to liquefaction during earthquake events.

We have therefore completed a detailed liquefaction assessment as described in this section.

5.2 Design Ground Motions

The New Zealand Geotechnical Society (NZGS) and Ministry of Business, Innovation and Employment (MBIE) Geotechnical Guidance Modules 1 and 3 (2021) provide recommendations for the assessment of liquefaction and lateral spreading.

We understand that the proposed buildings will be Importance Level 2 with a design life of 50 years. According to NZS 1170.0:2002, such a building is required to be designed to resist earthquake shaking with an annual probability of exceedance of 1/500 (i.e., a 500-year return period). This is the Ultimate Limit State (ULS) design seismic loading. Buildings must be designed to tolerate ULS deformations without collapse or endangering life. Furthermore, IL2 buildings should sustain little or no structural damage under a Serviceability Limit State (SLS) design load case, which is based on earthquake shaking with a 25-year return period.

Peak horizontal ground accelerations (a_{max}) are based on Module 1, as summarised in Table 4.

Table 4: Design Ground Motions

Design Case	Moment Magnitude (M_w)	Acceleration (a_{max})
SLS	6.4	0.13
ULS	7.5	0.55

5.3 Liquefaction Analysis

The following methods and parameters were utilised for the analysis:

- Liquefaction triggering method: Boulanger and Idriss (2014) as recommended by Module 3.
- Ground motions as shown in Table 4.
- A threshold probability of liquefaction (P_L) of 16% as recommended by Module 3.
- Estimated fines content based on CPT data methods outlined by Boulanger and Idriss (2014).

- A soil behaviour type index (I_c) cut-off value of 2.6 to differentiate between susceptible and non-susceptible to liquefaction soils for the CPT analysis.
- The Zhang, Robertson, and Brachman (2002) procedure for estimating volumetric strain and vertical settlement for the CPT analysis.
- The Boulanger and Idriss relationship between fines content and I_c with a fitting parameter (C_{FC}) of 0.0 for the CPT analysis.
- An earthquake groundwater depth of between 1.4 m and 1.9 m based on the recorded depth to groundwater at each CPT location.

A summary of the calculated free-field settlements is presented in Table 5, with full results presented in Appendix 3. Settlements could be greater than this under buildings if no mitigation is carried out.

Table 5: Liquefaction Induced Free Field Settlement

CPT/BH Identifier	Calculated Settlement	
	SLS	ULS
CPT01	0 mm	<10 mm
CPT01a	0 mm	<10 mm
CPT02	0 mm	<15 mm
CPT03	0 mm	<1 mm
CPT03a	0 mm	<10 mm
CPT04	<1 mm	<15 mm
CPT05	<1 mm	<10 mm
CPT05a	<1 mm	<15 mm
CPT06	0 mm	<10 mm
CPT06a	0 mm	<1 mm
BH01	50 mm	100 mm

To assess the general performance level of the land due to liquefaction, we have calculated the Liquefaction Severity Number (LSN) for each of the test locations, as shown in Table 6.

Table 6: Liquefaction Severity Number

CPT Identifier	Calculated LSN	
	SLS	ULS
CPT01	0	<1.0
CPT01a	0	<1.0
CPT02	0	6.7
CPT03	0	<1.0
CPT03a	0	2.8
CPT04	<1.0	5.3
CPT05	<1.0	2.7
CPT05a	<1.0	3.7
CPT06	0	3.0
CPT06a	0	<1.0
BH01	5.8	12.5

In accordance with the MBIE / NZGS Module 3, the following performance is suggested for varying LSN values. As the values in Module 3 overlap, we have coloured Table 6 with the values shown in brackets.

- Less than 10 - Insignificant: No liquefaction (values less than 5 highlighted blue).
- Between 5 and 15 - Mild: Negligible deformation of the ground and small settlements (values between 5 and 12.5 highlighted green).
- Between 10 and 25 - Moderate: Ground deformation resulting in relatively small differential settlements (values between 12.5 and 20 highlighted yellow).

LSN values are only indicative of likely performance.

5.4 Expectation of Ground Performance Without Mitigation

Under SLS and ULS ground motions, potentially liquefiable materials are encountered between 1.5 m and 5.0 m depth; however the anticipated settlements from these layers are very small, and the effects are expected to be minor.

Liquefiable material was identified in BH01 between 8.0 m and 11.0 m (below the maximum depth of CPT investigations). Under SLS ground motions up to 50 mm of settlement is expected and under ULS ground motions vertical settlements of up to 100 mm are expected. For characterisation and consequence of liquefaction under this event, the performance of the site can be classified as Moderate in accordance with Module 3, with “relatively small differential settlements” expected.

Given the depth of this liquefiable layer, the moderate liquefaction risk associated with it, and only mild liquefaction risk within the surficial ~8 m of the soil profile, we anticipate this level of settlement to have a minor expression at the surface.

6 Geotechnical Considerations

Based on our site investigations and review of the proposed subdivision plan, we consider the site is suitable for the proposed development from a geotechnical perspective if the following recommendations are considered.

6.1 Seismic Site Subclass

Based on the soil profile encountered in our investigations and knowledge of the surrounding area, we consider seismic subsoil Class D (deep soil) to be appropriate for the site (in accordance with the NZS 1170.5:2004).

6.2 Liquefaction Discussion

Despite the groundwater encountered at depths of between 1.5 m to 2.1 m, and layers of soil that could be prone to liquefaction, our analysis confirms that the risk of liquefaction induced settlement at the site is low.

6.3 Shallow Foundations

We consider shallow rib raft foundations to be suitable for this site. We anticipate that any new foundations can be designed for an ultimate rupture bearing capacity of at least 300 kPa, and bear into the natural alluvium below any topsoil or uncertified fill (see Table 2 for indicative depths of topsoil and fill).

The ultimate rupture bearing capacity provided above should be multiplied by the following capacity reduction factors:

- | | |
|---|------|
| • All ULS load combinations (including earthquakes) | 0.5 |
| • Serviceability Limit State cases | 0.33 |

Increases in the recommended bearing capacity and / or capacity reduction factors may be possible if load testing is carried out.

Topsoil and uncontrolled fill observed within our investigation should be removed and the sub-excavation should be built back up with suitable, well-compacted (Engineer certified) fill between the natural alluvium and the underside of the foundation. All filling works should be completed in accordance with NZS 4431:2022. A ground engineering professional should be engaged to observe the base of the excavation to confirm that the footings will be founded within appropriate natural material.

Assuming the above criteria are met, total settlements beneath the building foundation should not exceed 25 mm. Differential settlement across the building platform may be up to half of the total settlement.

6.4 Additional Considerations

- Foundations should be designed by a Chartered Professional Engineer practising in foundation design;
- ENGEO should be given the opportunity to review the foundation design drawings prior to submitting for Building Consent in order to ensure that the recommendations presented in this report have been interpreted as intended; and
- The exposed subgrade for foundations shall be assessed by a geotechnical professional during construction to confirm that adequate founding has been achieved and that no soft material remains.

7 Limitations

- i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Classic Developments NZ Ltd, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.
- ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.
- iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.
- iv. This Limitation should be read in conjunction with the Engineering NZ / ACENZ Standard Terms of Engagement.
- v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (04) 472 0820 if you require any further information.

Report prepared by



Callum Whitten

Engineering Geologist

Report reviewed by



Karen Jones, CEnvP, CMEngNZ (PEngGeol)

Principal Engineering Geologist

8 References

- Begg, J. G. and Mazengarb, C. (1996). "Geology of the Wellington Area", scale 1:50 000, Institute of Geological and Nuclear Sciences Geological Map 22. 1 sheet + 128 p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited
- Begg, J. G. and Johnston, M. R. (2000) (compilers). "Geology of the Wellington Area", Institute of Geological and Nuclear Sciences 1:250 000 Geological Map 10. 1 sheet + 64p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited
- Boon, D.P., Perrin, N.D., Dellow, G.D., Lukovic, B. (2010). It's Our Fault – Geological and Geotechnical Characterisation and Site Subsoil Class revision of the Lower Hutt Valley, *GNS Science Consultancy Report 2010/163*. 60p
- NZGS (2005). "Guidelines for the Classification and Field Description of Soils and Rocks in Engineering". NZ Geotechnical Society Inc, Wellington, New Zealand
- NZGS (2010). "Geotechnical earthquake engineering practice. Module 1 – Guideline for the identification, assessment and mitigation of liquefaction hazards". NZ Geotechnical Society Inc, Wellington, New Zealand
- NZGS & MBIE (2016). "Earthquake geotechnical engineering practice – Module 1: Overview of the guidelines". Rev 0. Issue date March 2016
- NZGS & MBIE (2016). "Earthquake geotechnical engineering practice – Module 3: Identification, Assessment and Mitigation of Liquefaction Hazards" Rev 0. Issue date May 2016
- NZGS & MBIE (2016). "Earthquake geotechnical engineering practice – Module 4: Earthquake Resistant Foundation Design" Rev 0. Issue date November 2016
- NZS1170.0:2004. Australia / New Zealand Standard, Structural Design Actions, Part 0: General Principles. Standards New Zealand, Wellington, New Zealand
- NZS1170.5:2004. Australia / New Zealand Standard, Structural Design Actions, Part 5: Earthquake Actions – New Zealand. Standards New Zealand, Wellington, New Zealand
- NZS 3604:2011. New Zealand Standard, Timber Framed Buildings. Standards New Zealand, Wellington, New Zealand
- Semmens, S.; Perrin, N.D.; Dellow, G. (2010). "It's Our Fault – Geological and Geotechnical Characterisation of the Wellington Central Business District", GNS Science Consultancy Report 2010/176, 52p
- Van Dissen et al (2010). "It's our fault: Better defining earthquake risk in Wellington". *Geologically Active – Williams et al (editors)*



Appendix 1: Investigation Location Plan



Legend

- ▲ CPTs
- Borehole
- Test Pits
- Site Boundary

0 10 m 20 m
© Nearmap

ENGEEO

Produced by **Datanest.earth**

Title: Investigation Location Plan

Client:
Classic Developments NZ Ltd

Size: A3

Project:
234 Rangiorua
Road

Drawn: KJ

Figure No.: 1

Date: 15-12-2025

Checked:
CW

Proj No:
18634.000.001

Scale: 1:1000

Version: 1



Appendix 2: Investigation Logs

LOG OF TEST PIT TP01

Geotechnical Investigation

234 Rangiuru Road
Otaki, Kapiti Coast
18634.000.001

Client : Classic Developments NZ **Shear Vane No** : 1371
Date : 15/04/2021 **Logged By** : CM
Max Test Pit Depth : 1.8 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -40.753266
Bucket Type/Size : Toothed / 600 mm wide **Longitude** : 175.131759

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.5	FILL		GW	Sandy fine to coarse GRAVEL with some silt and minor cobbles; brown. Well graded, angular to subangular, greywacke; sand is fine to coarse; cobbles are angular, up to 110 mm, greywacke. Contains organics and ceramic. [FILL] 0.2 m - Cobble content increases to some.					Dense		
1.0	HOLOCENE ALLUVIUM		ML	SILT with minor sand; brownish grey mottled orange. Low plasticity; sand is fine to medium. Contains organics for 200 mm.				M	Very Stiff	130/37	
1.5			ML	Sandy SILT; brownish grey mottled orange. Low plasticity; sand is fine to medium.						153/37	
			SW	Gravelly fine to coarse SAND with minor silt; bluish grey mottled orange. Well graded; gravel is fine to coarse, subrounded to rounded, greywacke.				W	Medium Dense		
			GW	Sandy fine to coarse GRAVEL with minor cobbles; grey. Well graded, subrounded to rounded, greywacke; sand is fine to coarse; cobbles are rounded, up to 160 mm.					Dense		
2.0				Depth of Excavation: 1.8 m Termination Condition: Practical refusal							
2.5											

GEOTECH TEST PIT LOG - PHOTOS RANGIURU TP LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 4/16/21



Bucket excavator met practical refusal. at 1.8 m depth .
Scala Penetrometer met practical refusal at 1.8 m depth.
Standing groundwater was not encountered.

LOG OF TEST PIT TP02

Geotechnical Investigation

234 Rangiuru Road
Otaki, Kapiti Coast
18634.000.001

Client : Classic Developments NZ **Shear Vane No** : 1371
Date : 15/04/2021 **Logged By** : CM
Max Test Pit Depth : 2.3 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -40.753099
Bucket Type/Size : Toothed / 600 mm wide **Longitude** : 175.1317

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer
		Easier	Harder								Blows per 100mm
											2 4 6 8 10 12
	FILL		GW	Sandy fine to coarse GRAVEL; grey mixed brown. Well graded, angular to subangular, greywacke; sand is fine to coarse. [FILL]					Dense		
0.5				SILT with minor sand; brownish grey mottled orange. Low plasticity; sand is fine to medium. Contains organics for top 200 mm.					Stiff		
1.0	HOLOCENE ALLUVIUM		ML	0.7 m - Colour changes to brown.				M		181/52	
1.5				1.4 m - Colour changes to grey mottled orange.					Very Stiff to Hard		
2.0			ML	Sandy SILT with minor gravel; bluish grey mottled orange. Low plasticity; sand is fine to medium; gravel is fine to coarse, rounded, greywacke.				W			
2.5				Depth of Excavation: 2.3 m Termination Condition: Practical refusal							

GEOTECH TEST PIT LOG - PHOTOS RANGIURU TP LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 4/16/21



Bucket excavator met practical refusal. at 2.3 m depth .
Scala Penetrometer met practical refusal at 2.1 m depth.
Standing groundwater was not encountered.

LOG OF TEST PIT TP03

Geotechnical Investigation

234 Rangiuru Road
Otaki, Kapiti Coast
18634.000.001

Client : Classic Developments NZ **Shear Vane No** : 1371
Date : 15/04/2021 **Logged By** : CM
Max Test Pit Depth : 1.8 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -40.75261
Bucket Type/Size : Toothed / 600 mm wide **Longitude** : 175.131655

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer
		Easier	Harder								Blows per 100mm
											2 4 6 8 10 12
	FILL		SM	Silty fine to medium SAND with minor gravel; dark brown. Poorly graded; gravel is fine to medium, angular to subangular, greywacke. Contains organics, rootlets, metal, glass and wood. [FILL]				M	Loose		
0.5								D			
	HOLOCENE ALLUVIUM		ML	SILT with minor sand; brownish grey mottled orange. Low plasticity; sand is fine to medium. Contains organics for top 200 mm.				M	Very Stiff	125/34	
1.0											
1.5											
			GW	Sandy fine to coarse GRAVEL with minor cobbles; grey. Well graded, subrounded to rounded, greywacke; sand is fine to coarse; cobbles are rounded, up to 155 mm.			W	Dense			
2.0				Depth of Excavation: 1.8 m Termination Condition: Practical refusal			S				
2.5											

GEOTECH TEST PIT LOG - PHOTOS RANGIURU TP LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 4/16/21



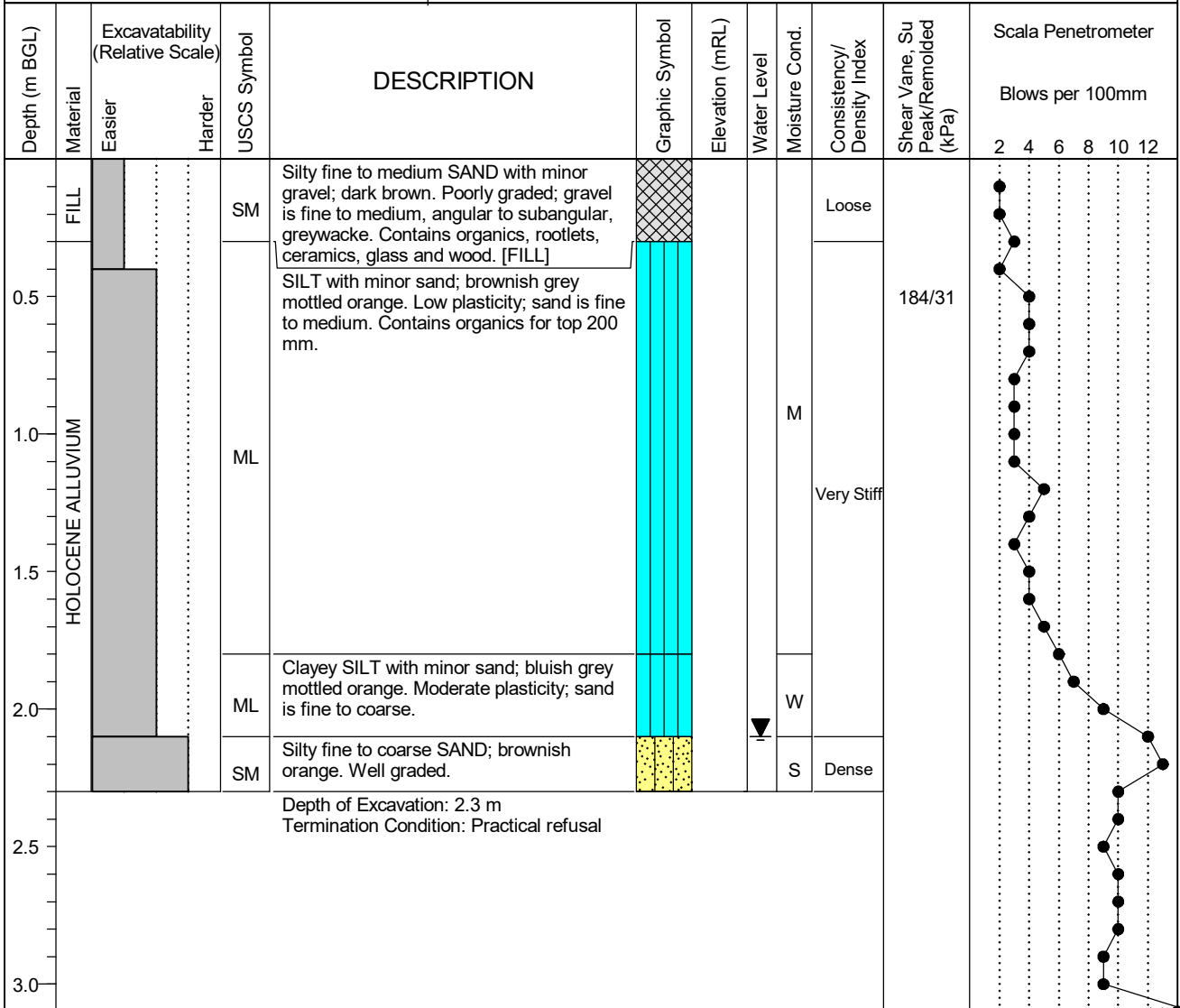
Bucket excavator met practical refusal. at 1.8 m depth .
Scala Penetrometer met practical refusal at 1.7 m depth.
Standing groundwater was encountered at 1.7 m.

LOG OF TEST PIT TP04

Geotechnical Investigation

234 Rangiuru Road
Otaki, Kapiti Coast
18634.000.001

Client : Classic Developments NZ **Shear Vane No** : 1371
Date : 15/04/2021 **Logged By** : CM
Max Test Pit Depth : 2.3 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -40.752339
Bucket Type/Size : Toothed / 600 mm wide **Longitude** : 175.131511



GEOTECH TEST PIT LOG - PHOTOS RANGIURU TP LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 4/16/21



Bucket excavator met practical refusal. at 2.3 m depth .
Scala Penetrometer met practical refusal at 3.1 m depth.
Standing groundwater was encountered at 2.1 m.

LOG OF TEST PIT TP05

Geotechnical Investigation

234 Rangiuru Road
Otaki, Kapiti Coast
18634.000.001

Client : Classic Developments NZ **Shear Vane No** : 1371
Date : 15/04/2021 **Logged By** : CM
Max Test Pit Depth : 1.8 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -40.752447
Bucket Type/Size : Toothed / 600 mm wide **Longitude** : 175.131903

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
	TS		SM	Silty fine to medium SAND; dark brown. Poorly graded. Contains organics and rootlets. [TOPSOIL]					Loose		
0.5			ML	SILT with minor sand; brownish grey mottled orange. Low plasticity; sand is fine to medium. Contains organics for top 200 mm.				M		UTP	
1.0			ML						Very Stiff to Hard	214+	
1.5			ML SM	Clayey SILT with minor sand; bluish grey mottled orange. Moderate plasticity; sand is fine to coarse.			W				
2.0				Silty fine to coarse SAND; brownish orange. Well graded. Depth of Excavation: 1.8 m Termination Condition: Practical refusal			S		Medium Dense		
2.5											

GEOTECH TEST PIT LOG - PHOTOS RANGIURU TP LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 4/16/21



Bucket excavator met practical refusal. at 1.8 m depth .
Scala Penetrometer met practical refusal at 2 m depth.
Standing groundwater was encountered at 1.7 m.

TS = Topsoil, UTP = Unable to Penetrate.

LOG OF TEST PIT TP06

Geotechnical Investigation

234 Rangiuru Road
Otaki, Kapiti Coast
18634.000.001

Client : Classic Developments NZ **Shear Vane No** : 1371
Date : 15/04/2021 **Logged By** : CM
Max Test Pit Depth : 2.1 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -40.753022
Bucket Type/Size : Toothed / 600 mm wide **Longitude** : 175.131949

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer
		Easier	Harder								Blows per 100mm
											2 4 6 8 10 12
	TS		SM	Silty fine to medium SAND; dark brown. Poorly graded. Contains organics and rootlets. [TOPSOIL]					Loose to Medium Dense		
0.5			ML	SILT with minor sand; brownish grey mottled orange. Low plasticity; sand is fine to medium. Contains organics for top 200 mm.				M		214+	
1.0									Very Stiff		
1.5											
2.0			ML	Clayey SILT with minor sand; bluish grey mottled orange. Moderate plasticity; sand is fine to coarse.				W			
			SM	Silty gravelly fine to coarse SAND; brownish orange. Well graded; gravel is fine to coarse, rounded, greywacke.				S	Medium Dense to Dense		
				Depth of Excavation: 2.1 m Termination Condition: Practical refusal							
2.5											

GEOTECH TEST PIT LOG - PHOTOS RANGIURU TP LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 4/16/21



Bucket excavator met practical refusal. at 2.1 m depth .
Scala Penetrometer met practical refusal at 2.1 m depth.
Standing groundwater was encountered at 2 m.

TS = Topsoil.

LOG OF TEST PIT TP07

Geotechnical Investigation

234 Rangiuru Road
Otaki, Kapiti Coast
18634.000.001

Client : Classic Developments NZ **Shear Vane No** : 1371
Date : 15/04/2021 **Logged By** : CM
Max Test Pit Depth : 2.2 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -40.753367
Bucket Type/Size : Toothed / 600 mm wide **Longitude** : 175.132164

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.0	TS		SM	Silty fine to medium SAND; dark brown. Poorly graded. Contains organics and rootlets. [TOPSOIL]				D	Medium Dense		
0.5			ML	SILT with minor sand; brownish grey mottled orange. Low plasticity; sand is fine to medium. Contains organics for top 200 mm.				M	Very Stiff	163/12	
1.0			ML	Clayey SILT with minor sand and gravel; bluish grey mottled orange. Moderate plasticity; sand is fine to coarse; gravel is fine to coarse, rounded, greywacke.				W			
1.5			GM	Silty sandy fine to coarse GRAVEL; brownish orange. Well graded, rounded, greywacke; sand is fine to coarse.				S	Tightly Packed		
2.0				Depth of Excavation: 2.2 m Termination Condition: Practical refusal							
2.5											

GEOTECH TEST PIT LOG - PHOTOS RANGIURU TP LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 4/16/21



Bucket excavator met practical refusal. at 2.2 m depth .
Scala Penetrometer met practical refusal at 1.7 m depth.
Standing groundwater was encountered at 1.9 m.

TS = Topsoil.

LOG OF TEST PIT TP08

Geotechnical Investigation

234 Rangiuru Road
Otaki, Kapiti Coast
18634.000.001

Client : Classic Developments NZ **Shear Vane No** : 1371
Date : 15/04/2021 **Logged By** : CM
Max Test Pit Depth : 2.1 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -40.753268
Bucket Type/Size : Toothed / 600 mm wide **Longitude** : 175.132759

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.0	TS		SM	Silty fine to medium SAND; dark brown. Poorly graded. Contains organics and rootlets. [TOPSOIL]				D	Loose		
0.5			ML	SILT with minor sand; brownish grey mottled orange. Low plasticity; sand is fine to medium. Contains organics for top 200 mm.				M	Very Stiff to Hard		
1.0											
1.5											
2.0			ML	Clayey SILT with minor sand; bluish grey mottled orange. Moderate plasticity; sand is fine to coarse.				W			
			GM	Silty sandy fine to coarse GRAVEL; brownish orange. Well graded, rounded, greywacke; sand is fine to coarse.				S	Dense		
				Depth of Excavation: 2.1 m Termination Condition: Practical refusal							
2.5											



Bucket excavator met practical refusal. at 2.1 m depth .
Scala Penetrometer met practical refusal at 2.1 m depth.
Standing groundwater was encountered at 2 m.

TS = Topsoil, UTP = Unable to Penetrate.

LOG OF TEST PIT TP09

Geotechnical Investigation

234 Rangiuru Road
Otaki, Kapiti Coast
18634.000.001

Client : Classic Developments NZ **Shear Vane No** : 1371
Date : 15/04/2021 **Logged By** : CM
Max Test Pit Depth : 2.1 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -40.752767
Bucket Type/Size : Toothed / 600 mm wide **Longitude** : 175.133455

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.0	TS		SM	Silty fine to medium SAND; dark brown. Poorly graded. Contains organics and rootlets. [TOPSOIL]				D	Medium Dense		
0.5			ML	SILT with minor sand; brownish grey mottled orange. Low plasticity; sand is fine to medium. Contains organics for top 200 mm.				M	Very Stiff to Hard	214+	
1.0			ML	Clayey SILT with minor sand; bluish grey mottled orange. Moderate plasticity; sand is fine to coarse.						UTP	
1.5			SM	Silty gravelly fine to coarse SAND; brownish orange. Well graded; gravel is fine to coarse, rounded, greywacke.				W	Medium Dense		
2.0			GM	Silty sandy fine to coarse GRAVEL; brownish orange. Well graded, rounded, greywacke; sand is fine to coarse.					Medium Dense to Dense		
2.1				Depth of Excavation: 2.1 m Termination Condition: Practical refusal				S			

GEOTECH TEST PIT LOG - PHOTOS RANGIURU TP LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 4/16/21



Bucket excavator met practical refusal. at 2.1 m depth .
Scala Penetrometer met practical refusal at 2 m depth.
Standing groundwater was encountered at 2 m.

TS = Topsoil, UTP = Unable to Penetrate.

LOG OF TEST PIT TP10

Geotechnical Investigation

234 Rangiuru Road
Otaki, Kapiti Coast
18634.000.001

Client : Classic Developments NZ **Shear Vane No** : 1371
Date : 15/04/2021 **Logged By** : CM
Max Test Pit Depth : 1.7 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -40.752142
Bucket Type/Size : Toothed / 600 mm wide **Longitude** : 175.133093

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.0	TS		SM	Silty fine to medium SAND; dark brown. Poorly graded. Contains organics and rootlets. [TOPSOIL]				D	Loose to Medium Dense		
0.5			ML	SILT with minor sand; brownish grey mottled orange. Low plasticity; sand is fine to medium. Contains organics for top 200 mm.				M	Very Stiff to Hard	214+	
1.0										UTP	
1.5			GM	Silty sandy fine to coarse GRAVEL with some cobbles; bluish grey mixed brownish orange. Well graded, rounded, greywacke; sand is fine to coarse; cobbles are rounded, up to 100 mm.			W		Medium Dense to Dense		
							S				
2.0				Depth of Excavation: 1.7 m Termination Condition: Practical refusal							
2.5											

GEOTECH TEST PIT LOG - PHOTOS RANGIURU TP LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 4/16/21



Bucket excavator met practical refusal. at 1.7 m depth .
Scala Penetrometer met practical refusal at 1.5 m depth.
Standing groundwater was encountered at 1.5 m.

TS = Topsoil, UTP = Unable to Penetrate.

LOG OF TEST PIT TP11

Geotechnical Investigation

234 Rangiuru Road
Otaki, Kapiti Coast
18634.000.001

Client : Classic Developments NZ **Shear Vane No** : 1371
Date : 15/04/2021 **Logged By** : CM
Max Test Pit Depth : 1.7 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -40.752424
Bucket Type/Size : Toothed / 600 mm wide **Longitude** : 175.132303

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.0	TS		SM	Silty fine to medium SAND; dark brown. Poorly graded. Contains organics and rootlets. [TOPSOIL]				D	Loose		
0.5			ML	SILT with minor sand; brownish grey mottled orange. Low plasticity; sand is fine to medium. Contains organics for top 200 mm.				M	Very Stiff to Hard		
1.0											
1.5			ML	Clayey SILT with minor sand; bluish grey mottled orange. Moderate plasticity; sand is fine to coarse.				W			
			GM	Silty sandy fine to coarse GRAVEL with some cobbles; bluish grey mixed brownish orange. Well graded, rounded, greywacke; sand is fine to coarse; cobbles are rounded, up to 100 mm.				S	Dense		
2.0				Depth of Excavation: 1.7 m Termination Condition: Practical refusal							
2.5											

UTP

GEOTECH TEST PIT LOG - PHOTOS RANGIURU TP LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 4/16/21



Bucket excavator met practical refusal. at 1.7 m depth .
Scala Penetrometer met practical refusal at 1.6 m depth.
Standing groundwater was encountered at 1.6 m.

TS = Topsoil, UTP = Unable to Penetrate.

LOG OF TEST PIT TP12

Geotechnical Investigation

234 Rangiuru Road
Otaki, Kapiti Coast
18634.000.001

Client : Classic Developments NZ **Shear Vane No** : 1371
Date : 15/04/2021 **Logged By** : CM
Max Test Pit Depth : 1.7 m **Reviewed By** : CC
Digger Type/Size : Bucket Excavator **Latitude** : -40.752836
Bucket Type/Size : Toothed / 600 mm wide **Longitude** : 175.132557

Depth (m BGL)	Material	Excavatability (Relative Scale)	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane, Su Peak/Remolded (kPa)	Scala Penetrometer Blows per 100mm
		Easier	Harder								2 4 6 8 10 12
0.0	TS		SM	Silty fine to medium SAND; dark brown. Poorly graded. Contains organics and rootlets. [TOPSOIL]				D	Loose to Medium Dense		
0.5			ML	SILT with minor sand; brownish grey mottled orange. Low plasticity; sand is fine to medium. Contains organics for top 200 mm.				M	Very Stiff to Hard	214+	
1.0											
1.5			GM	Silty sandy fine to coarse GRAVEL with some cobbles; bluish grey mixed brownish orange. Well graded, rounded, greywacke; sand is fine to coarse; cobbles are rounded, up to 100 mm.			W S		Dense		
2.0				Depth of Excavation: 1.7 m Termination Condition: Practical refusal							
2.5											

GEOTECH TEST PIT LOG - PHOTOS RANGIURU TP LOGS.GPJ NZ MASTER DATA TEMPLATE.GDT 4/16/21



Bucket excavator met practical refusal. at 1.7 m depth .
Scala Penetrometer met practical refusal at 1.5 m depth.
Standing groundwater was encountered at 1.6 m.

TS = Topsoil.



LOG OF BORING BH01

Geotechnical Investigation
234 Rangioru Road
Otaki
18634.000.001

Client : Classic Developments NZ Ltd Core Diameter : 83 mm
Date : 04/11/2025 Energy Transfer Ratio : 74 %
Hole Depth : 15.345 m Logged By/Reviewed By : CW / KJ
Drilling Method : Rotasonic Latitude : 5486530
Drilling Contractor : Pro-Drill Ltd Longitude : 1780006

Depth (m BGL)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Elevation (mRL)	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Torvane Shear (kPa)	Total Core Recovery (%)	Notes
0.5			ML	Sandy SILT with trace rootlets and organics; greyish brown. Low plasticity. Sand is fine to medium; with trace charcoal. 0.35 m - Becomes mottled light brown. 0.6 m - Becomes grey banded light brown.					So				
1.0													
1.5			SP	Fine to medium SAND with minor silt; grey. Uniformly graded.						1/1/1/0/1/2 N=4			
2.0			ML SP	Sandy SILT; greyish brown. Low plasticity. Sand is fine to medium. Fine to medium SAND with minor silt; grey. Uniformly graded. 1.90 m to 2.05 m - Fine to coarse SAND. Well graded.									
2.5				2.40 m to 2.50 m - Fine to coarse SAND. Well graded. 2.60 m to 3.10 m - Fine to coarse SAND. Well graded.						1/1/1/1/1/1 N=4			
3.0													
3.5			GW	Sandy fine to coarse GRAVEL; grey. Well graded. Gravel is angular to subrounded, moderately strong to strong, slightly weathered to unweathered, Greywacke sandstone and quartz.						1/7/6/5/5/5 N=21			
4.0				3.90 m - With trace cobbles; maximum measured cobble size 70 mm, subangular to subrounded, strong, slightly weathered, Greywacke sandstone.									
4.5													
5.0													
5.5										5/9/9/19/11/11 N=50+ for 75mm			

Borehole met target depth at 13.345 m depth.

Coordinates (NZTM) spatially estimated from aerial imagery, accuracy +/- 1m.

Dip test showed standing water at 1.6 m depth.

N/A = Not Applicable, M = Moist, W = Wet, S = Saturated, So = Soft L = Loose, MD = Medium Dense, D = Dense, VD = Very Dense



LOG OF BORING BH01

Geotechnical Investigation
234 Rangioru Road
Otaki
18634.000.001

Client : Classic Developments NZ Ltd Core Diameter : 83 mm
Date : 04/11/2025 Energy Transfer Ratio : 74 %
Hole Depth : 15.345 m Logged By/Reviewed By : CW / KJ
Drilling Method : Rotasonic Latitude : 5486530
Drilling Contractor : Pro-Drill Ltd Longitude : 1780006

Depth (m BGL)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Elevation (mRL)	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Torvane Shear (kPa)	Total Core Recovery (%)	Notes
6.0			GW	Sandy fine to coarse GRAVEL; grey. Well graded. Gravel is angular to subrounded, moderately strong to strong, slightly weathered to unweathered, Greywacke sandstone and quartz.						9/9//11/9/7/9 N=36			
6.5									D-VD				
7.0										7/10//11/11/11/11 N=44			
7.5													
8.0			SW	Fine to coarse SAND with trace gravel; brownish grey. Well graded. Gravel is medium to coarse, subrounded, strong, slightly weathered to unweathered, Greywacke sandstone; upwards coarsening.				W		1/0//0/0/2/4 N=6			
8.5	ALLUVIUM								L				
9.0				9.0 m - Singular cobble, 65 mm x 50 mm x 25 mm, subrounded, strong, unweathered, Greywacke sandstone.						1/1//1/4/4/6 N=15			
9.5				9.4 m to 9.75 m - Fine to medium SAND. Uniformly graded.									
10.0									MD				
10.5				10.2 m - Lens of organic material; 15 mm to 20 mm thick; dark brown and black. Organics are amorphous (wood fragments <5 mm); iron oxide staining in sands above and below organic layer.						3/3//6/5/7/7 N=25			
11.0													

Borehole met target depth at 13.345 m depth.

Coordinates (NZTM) spatially estimated from aerial imagery, accuracy +/- 1m.

Dip test showed standing water at 1.6 m depth.

N/A = Not Applicable, M = Moist, W = Wet, S = Saturated, So = Soft L = Loose, MD = Medium Dense, D = Dense, VD = Very Dense

GEOTECH MACHINE BORING 234 RANGIORU BH01.GPJ NZ DATA TEMPLATE 2.GDT 5/11/25



LOG OF BORING BH01

Geotechnical Investigation
234 Rangioru Road
Otaki
18634.000.001

Client : Classic Developments NZ Ltd Core Diameter : 83 mm
Date : 04/11/2025 Energy Transfer Ratio : 74 %
Hole Depth : 15.345 m Logged By/Reviewed By : CW / KJ
Drilling Method : Rotasonic Latitude : 5486530
Drilling Contractor : Pro-Drill Ltd Longitude : 1780006

Depth (m BGL)	Material	Sample Type	USCS Symbol	DESCRIPTION	Log Symbol	Elevation (mRL)	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Torvane Shear (kPa)	Total Core Recovery (%)	Notes
11.5			SW	Fine to coarse SAND with trace gravel; brownish grey. Well graded. Gravel is medium to coarse, subrounded, strong, slightly weathered to unweathered, Greywacke sandstone; upwards coarsening.					D	2/2//3/6/11/16 N=36			
12.0			GW	Sandy fine to coarse GRAVEL with minor cobbles and trace silt; brownish grey. Well graded. Gravel is angular to rounded, moderately strong to very strong, slightly weathered to unweathered, Greywacke sandstone; sand is fine to coarse; maximum measured cobble size 75 mm, subrounded, strong, unweathered, Greywacke sandstone.						12/15//15/34/1 N=50+ for 0 mm			
12.5													
13.0								W		16/18//14/12/14/8 N=48			
13.5									D-VD				
14.0				13.75 m - With some cobbles.						5/5//14/36 N=50+ for 50mm			
14.5													
15.0										7/11//15/26/9 N=50+ for 45mm			

End of Hole Depth: 15.345 m
Termination: Target depth

Cobble
lodged in
end of
barrel - no
core loss.

GEOTECH MACHINE BORING 234 RANGIORU BH01.GPJ NZ DATA TEMPLATE 2.GDT 5/11/25

Borehole met target depth at 13.345 m depth.
Coordinates (NZTM) spatially estimated from aerial imagery, accuracy +/- 1m.
Dip test showed standing water at 1.6 m depth.

N/A = Not Applicable, M = Moist, W = Wet, S =
Saturated, So = Soft L = Loose, MD = Medium
Dense, D = Dense, VD = Very Dense



BH01 0.0 m – 3.45 m



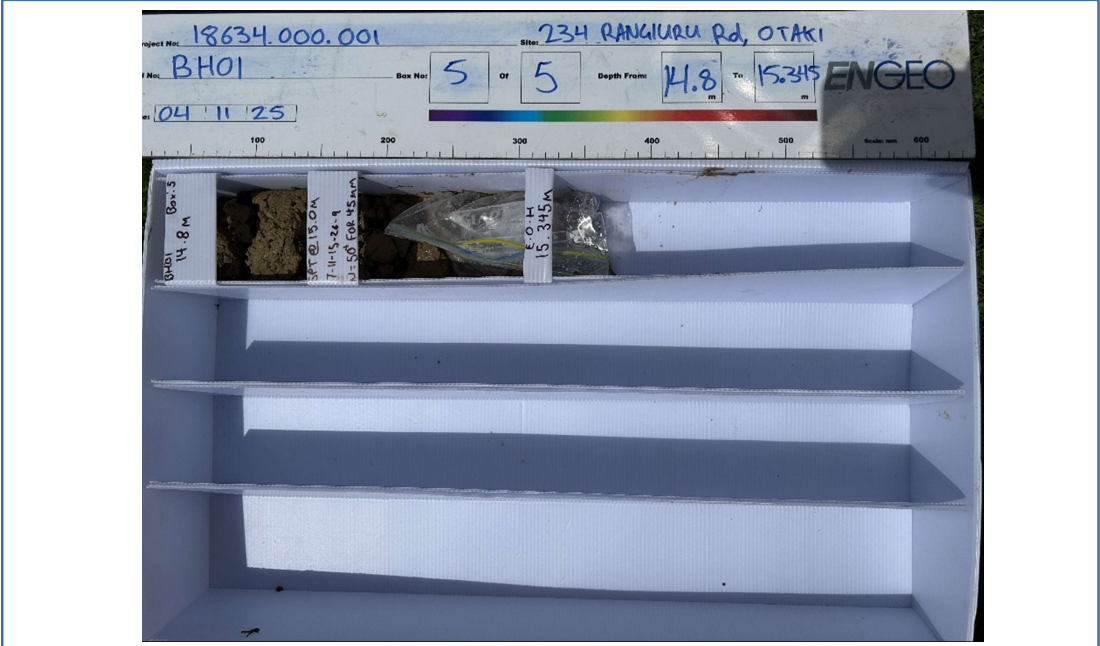
BH01 3.45 m – 7.45 m



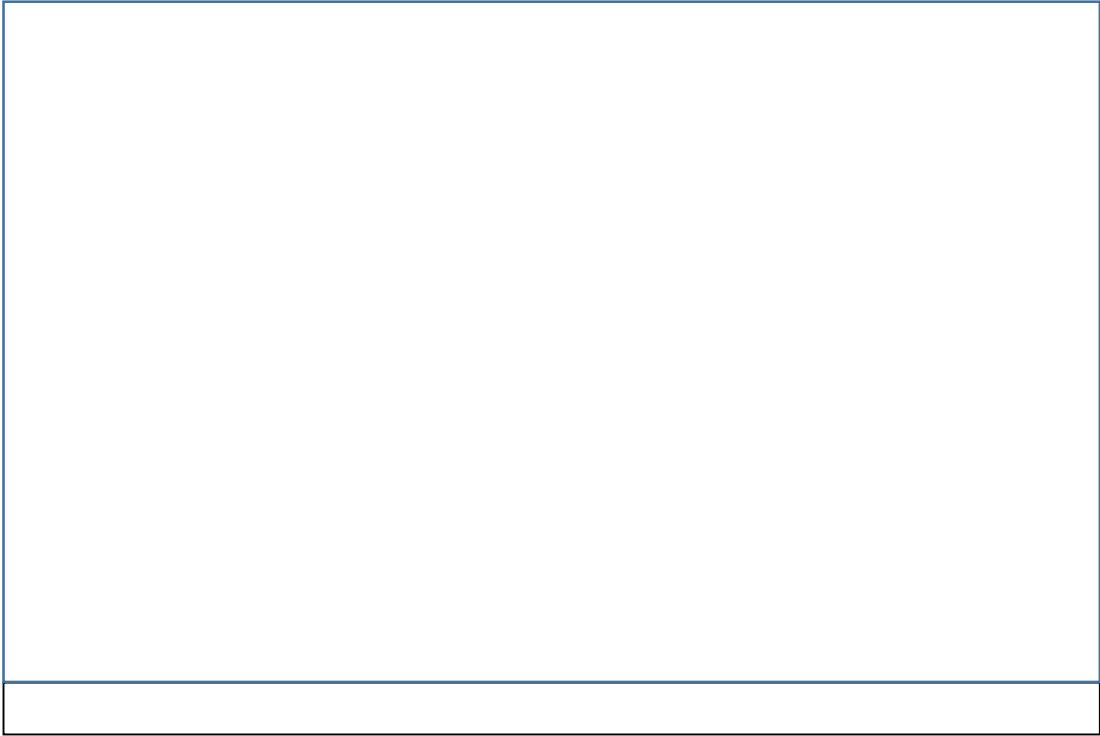
BH01 7.45 m – 11.45 m



BH01 11.45 m – 14.8 m



BH01 14.8 m – 15.345 m



**Geotechnical Investigation
Borehole Photos**

Client: Classic Developments Ltd

Page No:

Project: 234 Rangioru Road

Drawn:

3

Date: 04/11/2025

Checked:

Size: A4

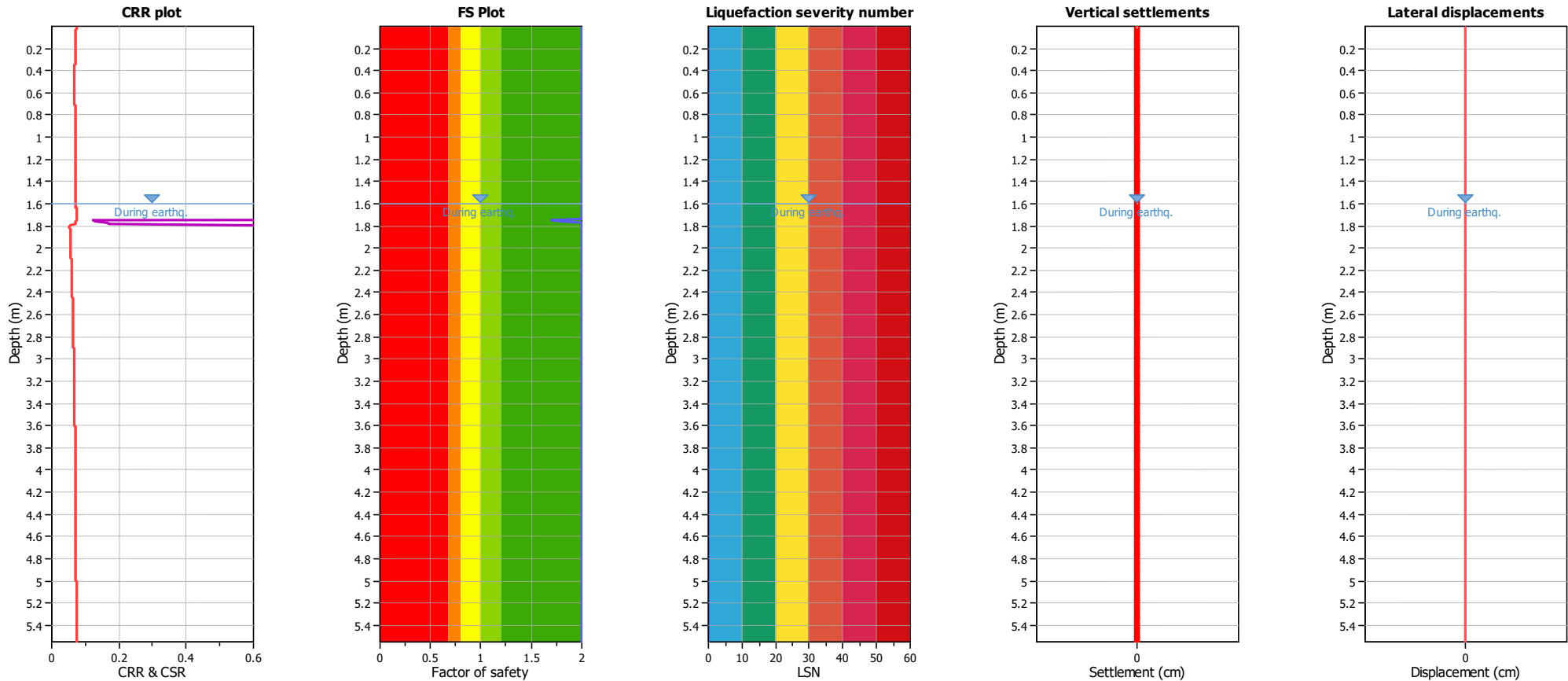
Proj No: 18634

Scale: NTS

Revision: 0

Appendix 3: Liquefaction Analysis

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.60 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _σ applied:	Yes
Earthquake magnitude M _w :	6.40	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

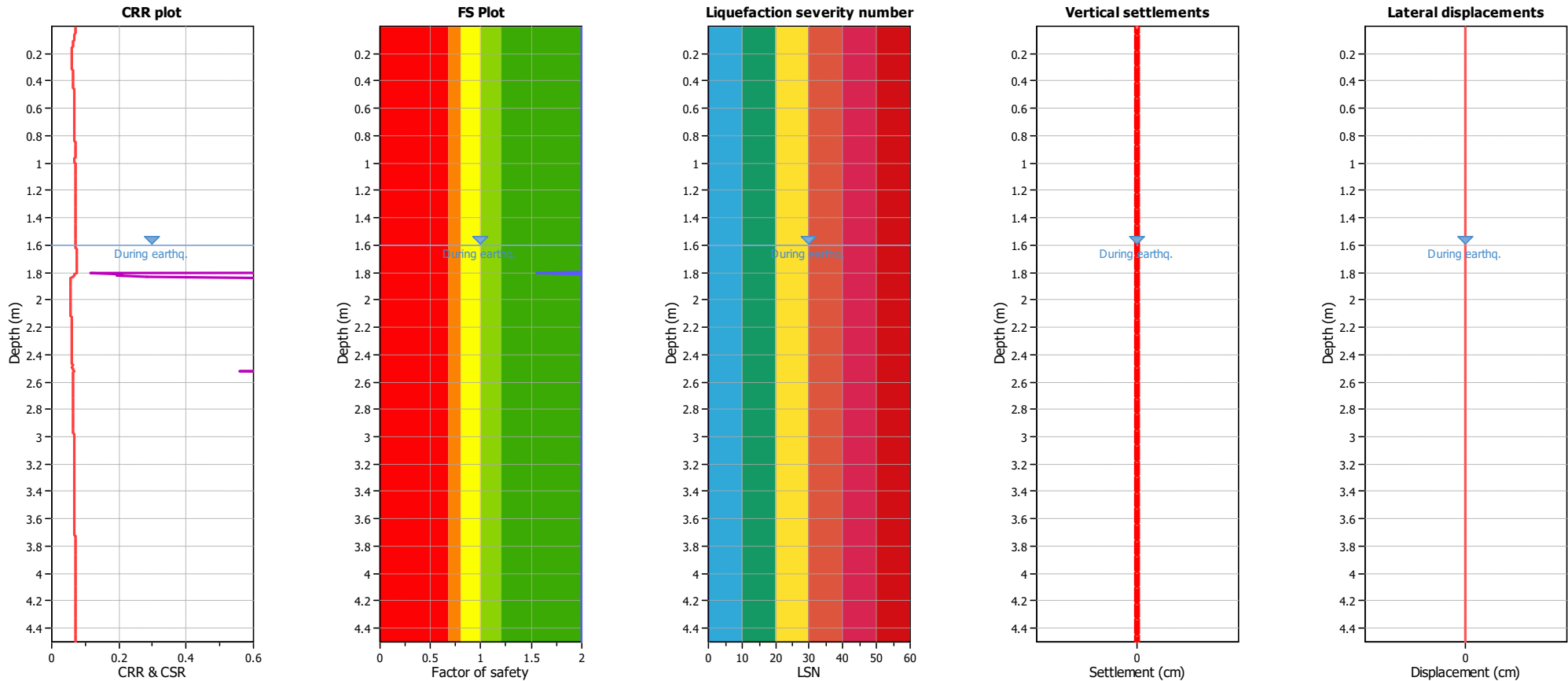
F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Light Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

LSN color scheme

Red	Severe damage
Dark Red	Major expression of liquefaction
Orange	Moderate to severe exp. of liquefaction
Yellow	Moderate expression of liquefaction
Light Green	Minor expression of liquefaction
Blue	Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.60 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _σ applied:	Yes
Earthquake magnitude M _w :	6.40	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

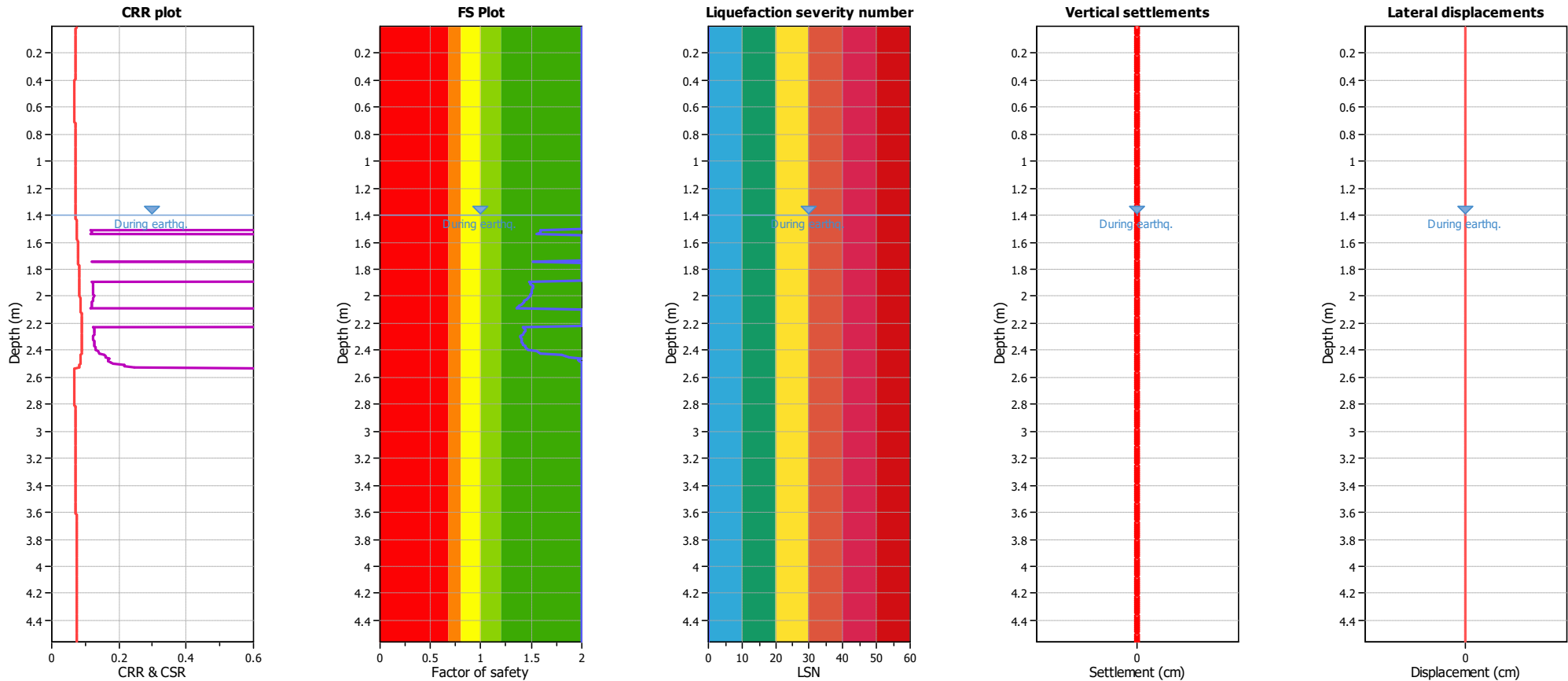
F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Light Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

LSN color scheme

Red	Severe damage
Dark Red	Major expression of liquefaction
Orange	Moderate to severe exp. of liquefaction
Yellow	Moderate expression of liquefaction
Light Green	Minor expression of liquefaction
Blue	Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.40 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _σ applied:	Yes
Earthquake magnitude M _w :	6.40	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.40 m	Fill height:	N/A	Limit depth:	N/A

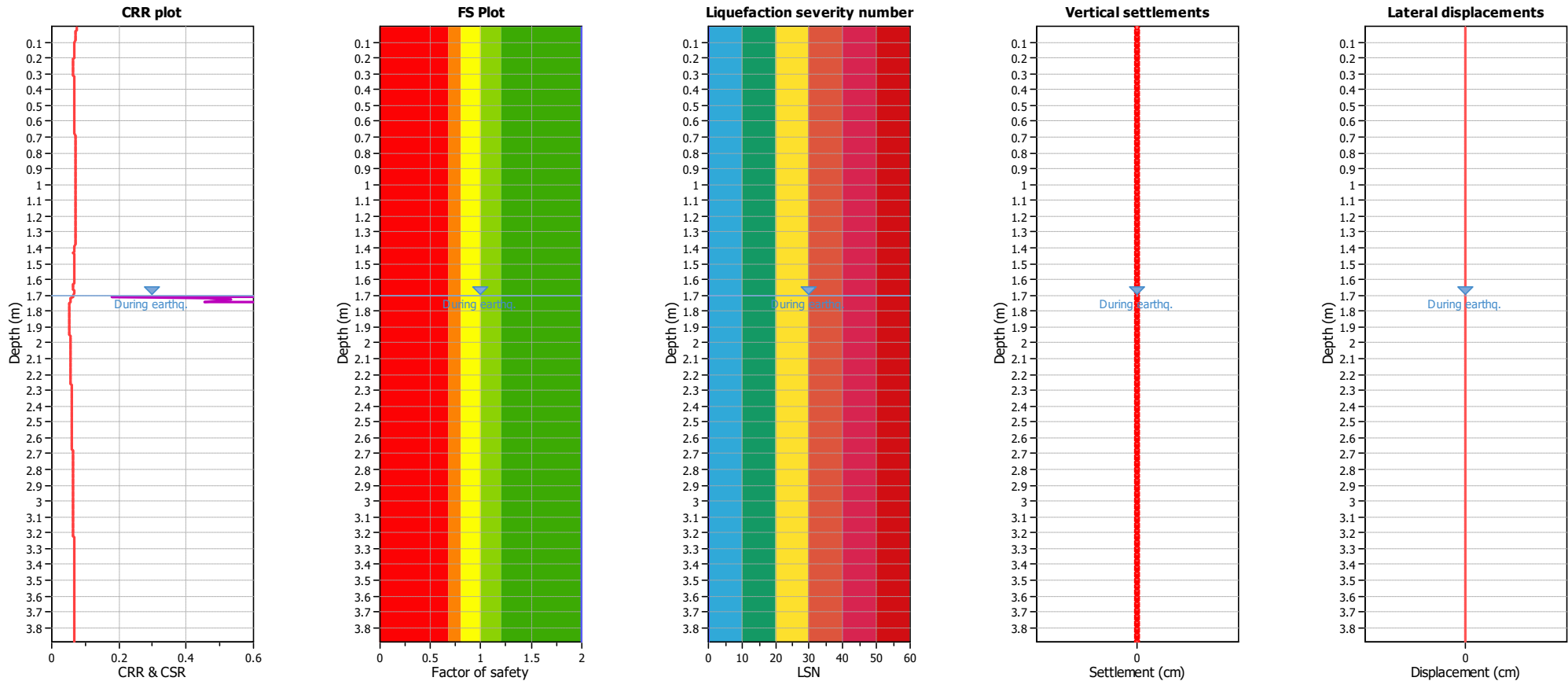
F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Light Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

LSN color scheme

Red	Severe damage
Dark Red	Major expression of liquefaction
Orange	Moderate to severe exp. of liquefaction
Yellow	Moderate expression of liquefaction
Light Green	Minor expression of liquefaction
Blue	Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	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 _g applied:	Yes
Earthquake magnitude M _w :	6.40	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

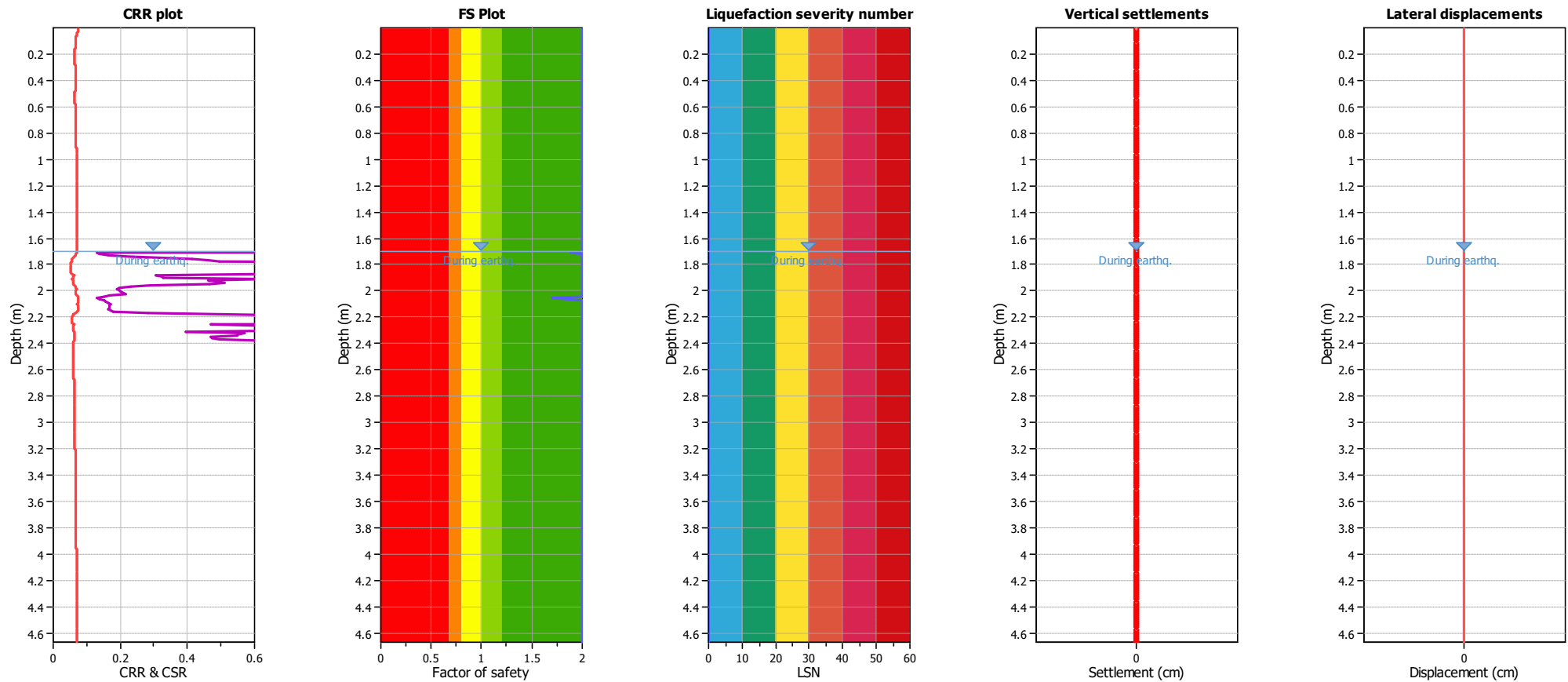
F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Light Green	Unlike to liquefy
Dark Green	Almost certain it will not liquefy

LSN color scheme

Red	Severe damage
Dark Red	Major expression of liquefaction
Orange	Moderate to severe exp. of liquefaction
Yellow	Moderate expression of liquefaction
Light Green	Minor expression of liquefaction
Blue	Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	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:	Yes
Earthquake magnitude M _w :	6.40	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

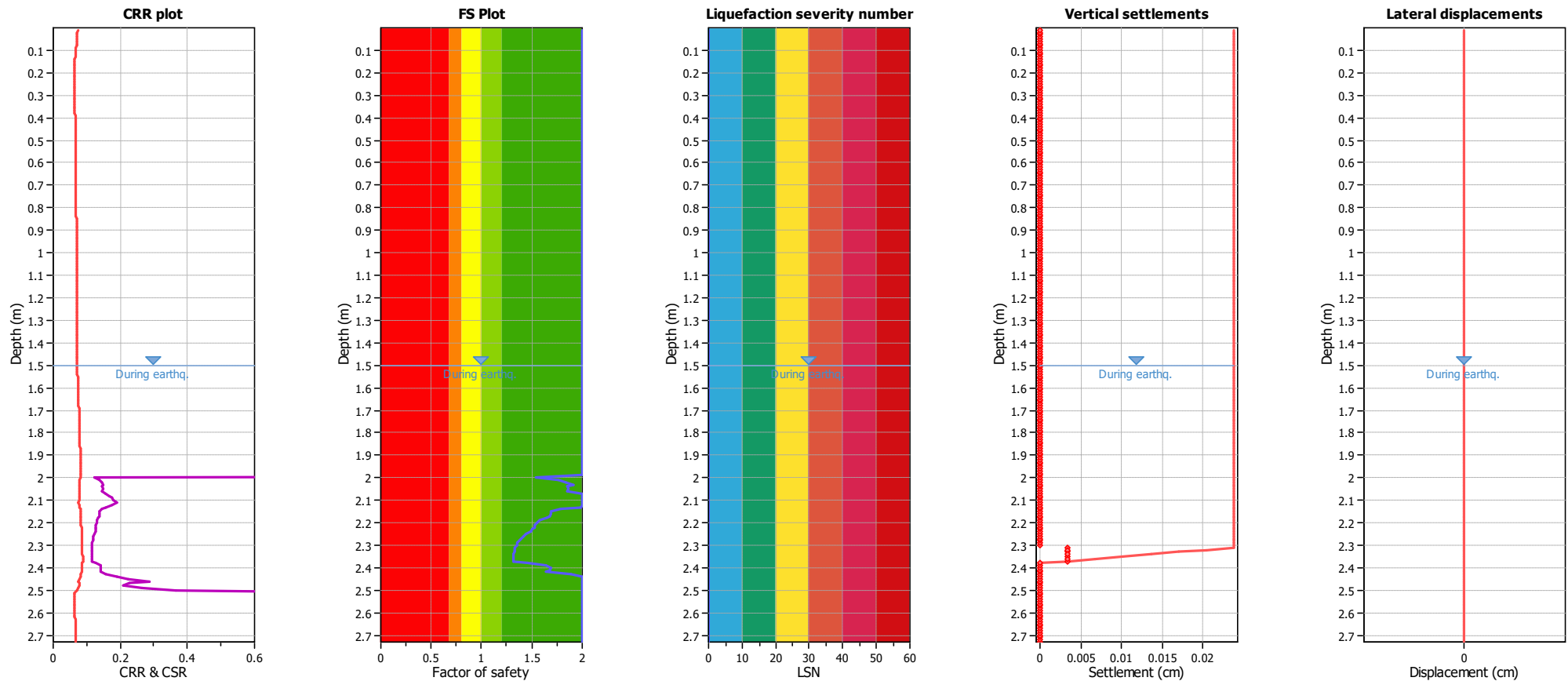
F.S. color scheme

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

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _σ applied:	Yes
Earthquake magnitude M _w :	6.40	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.50 m	Fill height:	N/A	Limit depth:	N/A

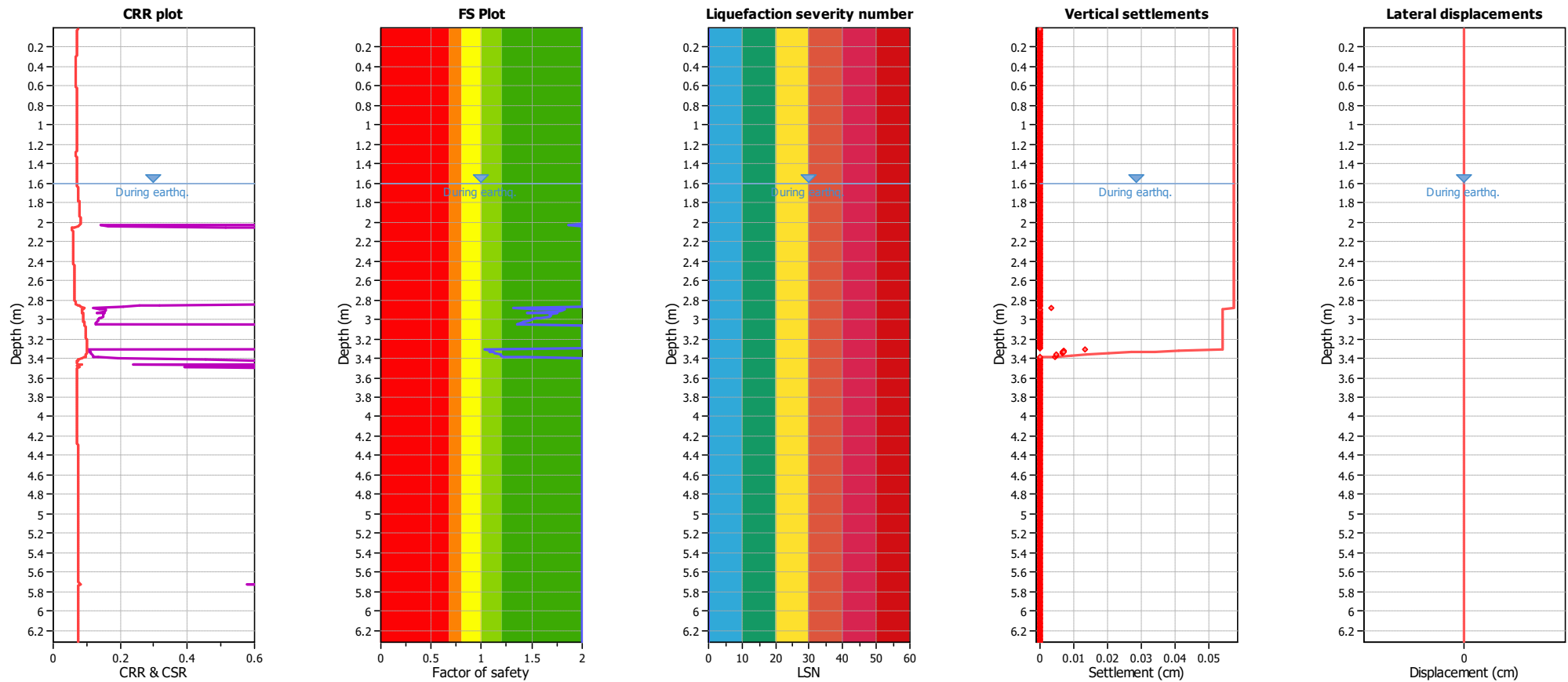
F.S. color scheme

Red	Almost certain it will liquefy
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LSN color scheme

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Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.60 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 ₀ applied:	Yes
Earthquake magnitude M _w :	6.40	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

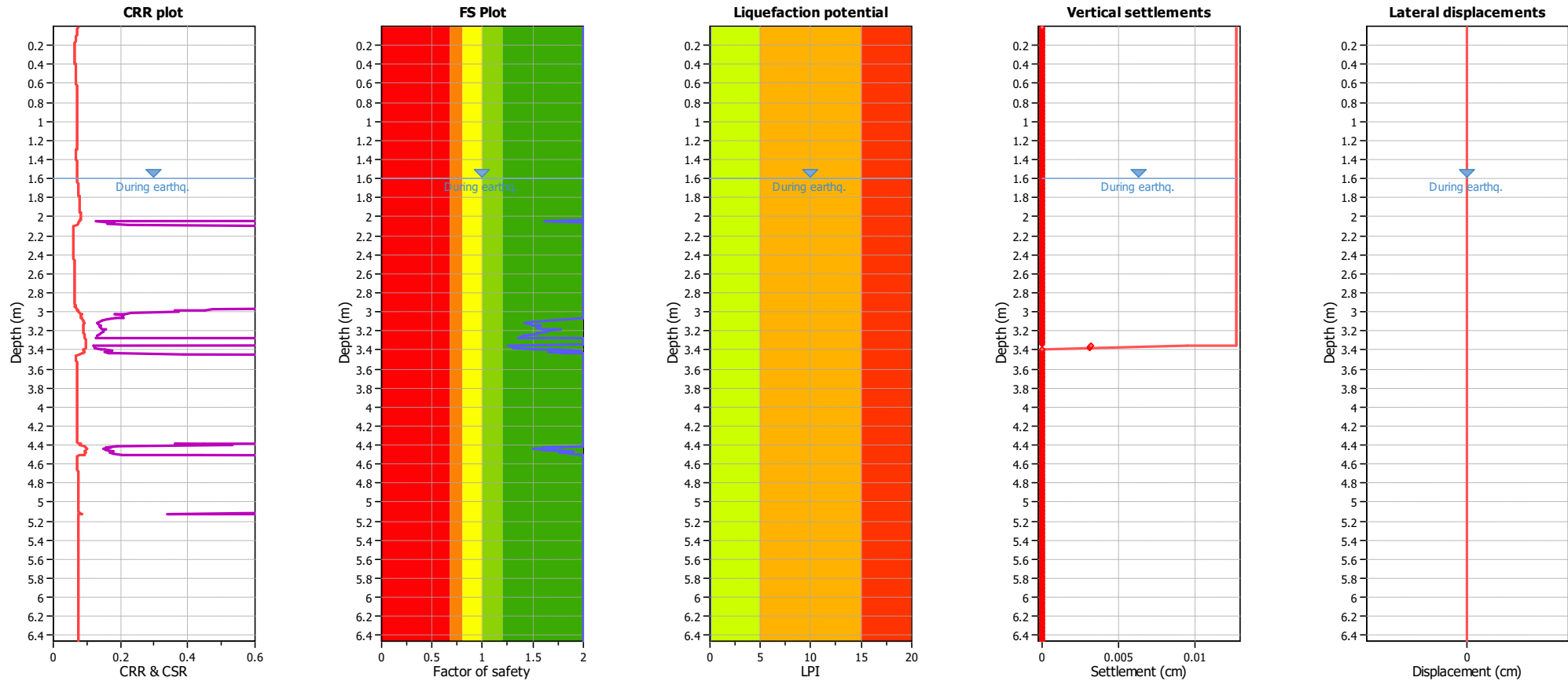
F.S. color scheme

Red	Almost certain it will liquefy
Orange	Very likely to liquefy
Yellow	Liquefaction and no liq. are equally likely
Green	Unlike to liquefy
Blue	Almost certain it will not liquefy

LSN color scheme

Red	Severe damage
Orange	Major expression of liquefaction
Yellow	Moderate to severe exp. of liquefaction
Green	Moderate expression of liquefaction
Blue	Minor expression of liquefaction
Light Blue	Little to no expression of liquefaction

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.60 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _σ applied:	Yes
Earthquake magnitude M _w :	6.40	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

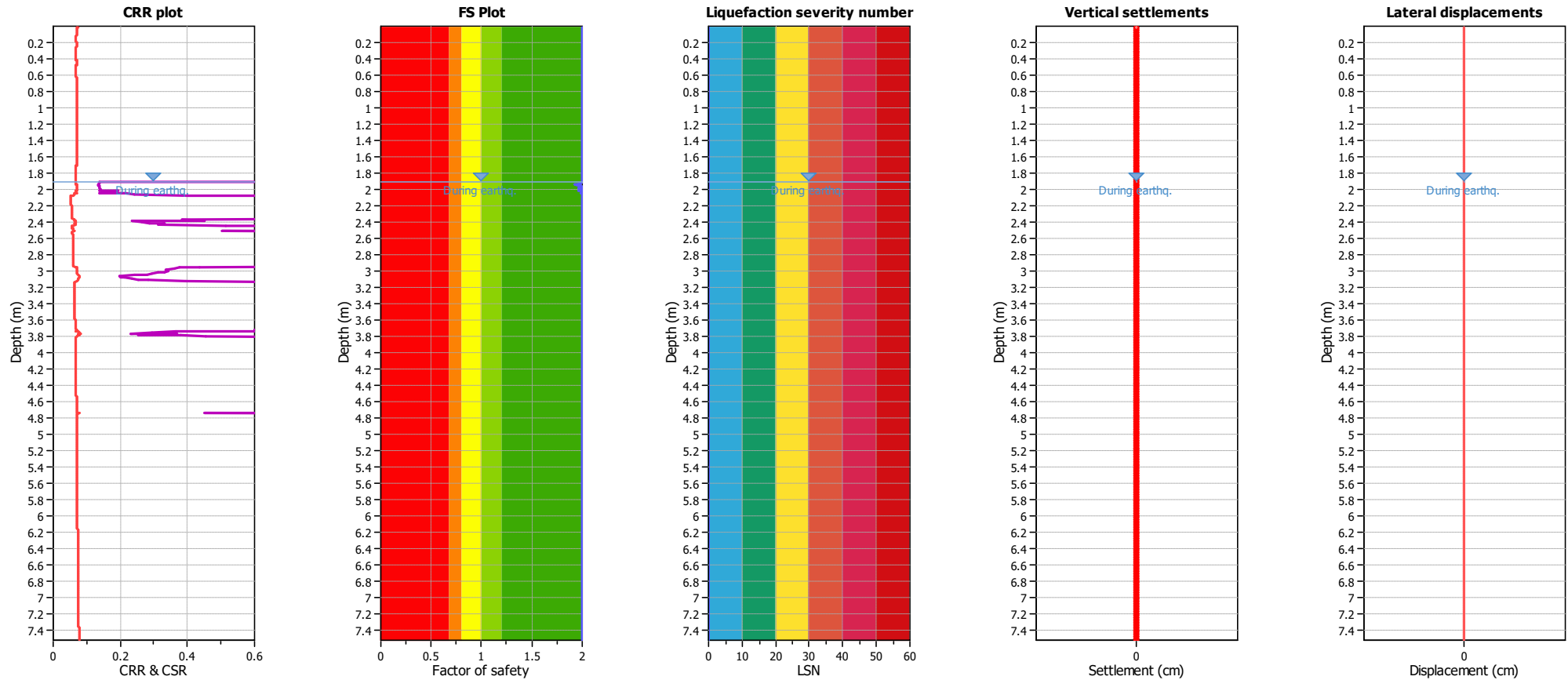
F.S. color scheme

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

LPI color scheme

■	Very high risk
■	High risk
■	Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.90 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 ₀ applied:	Yes
Earthquake magnitude M _w :	6.40	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.90 m	Fill height:	N/A	Limit depth:	N/A

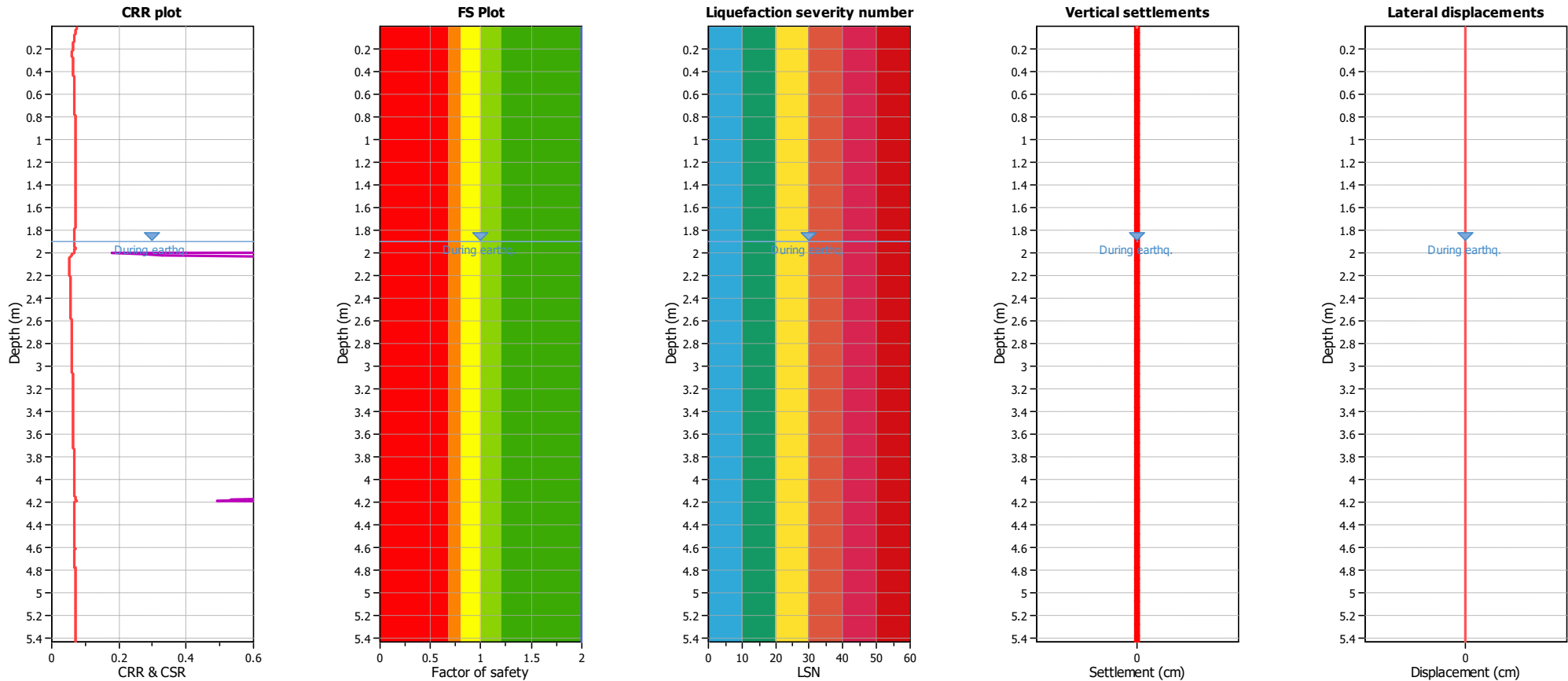
F.S. color scheme

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

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.90 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
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Earthquake magnitude M _w :	6.40	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.13	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.90 m	Fill height:	N/A	Limit depth:	N/A

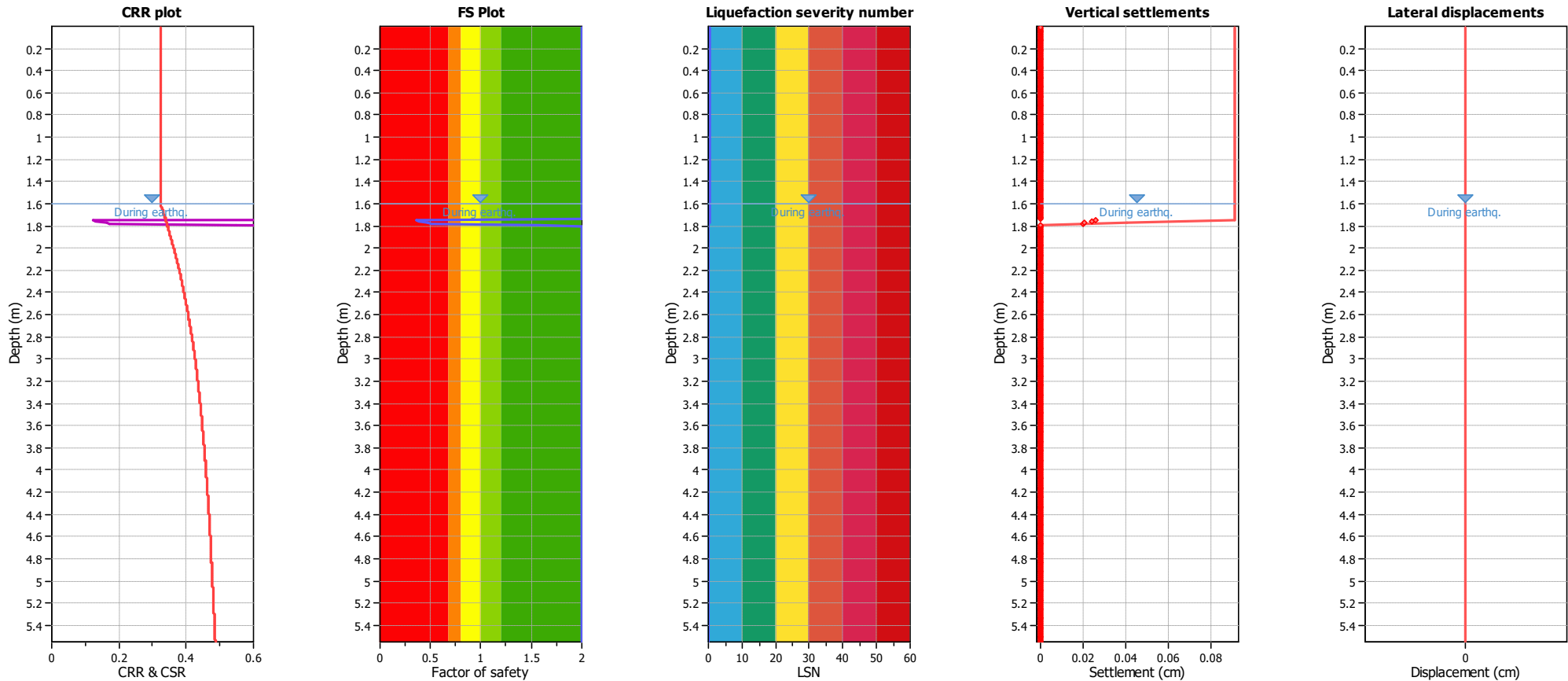
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Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.60 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _σ applied:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

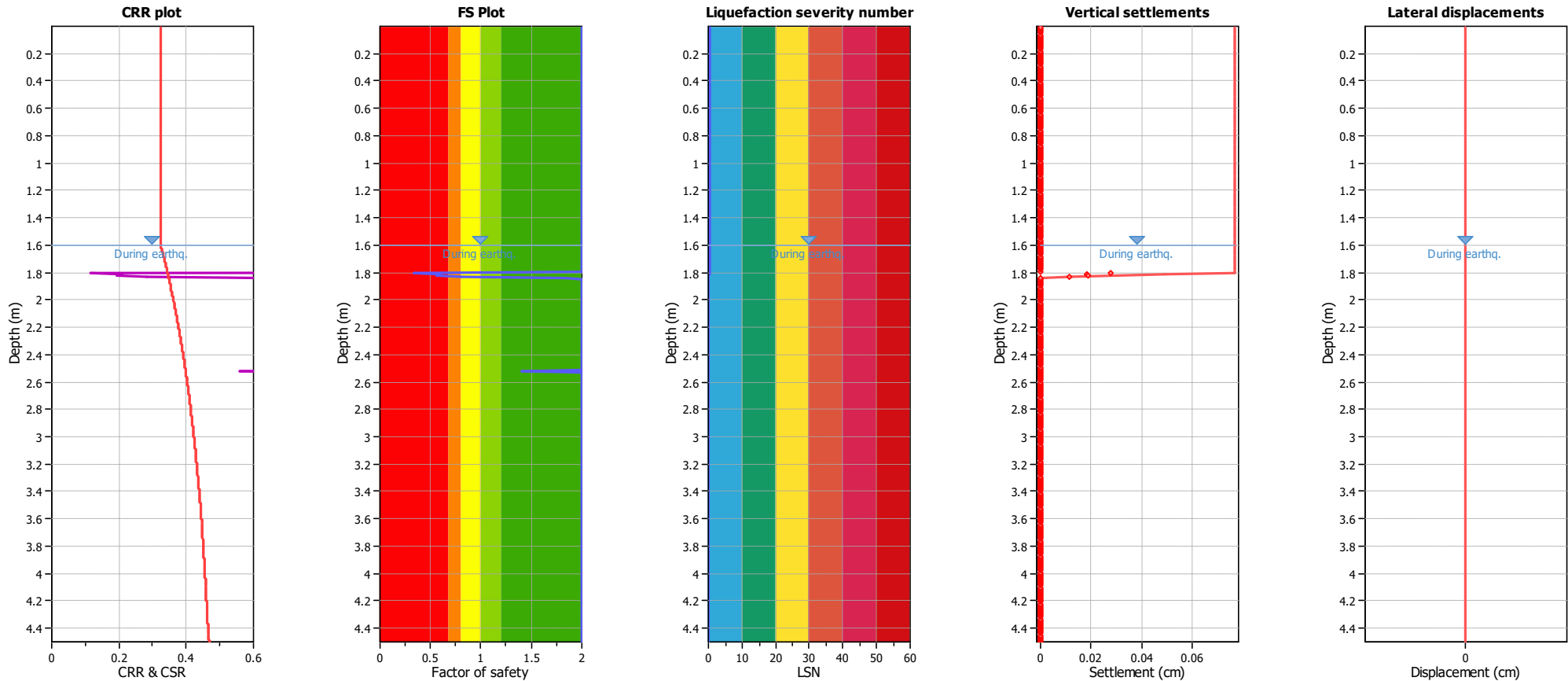
F.S. color scheme

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Liquefaction analysis overall plots



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Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.60 m	Fill weight:	N/A
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Peak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

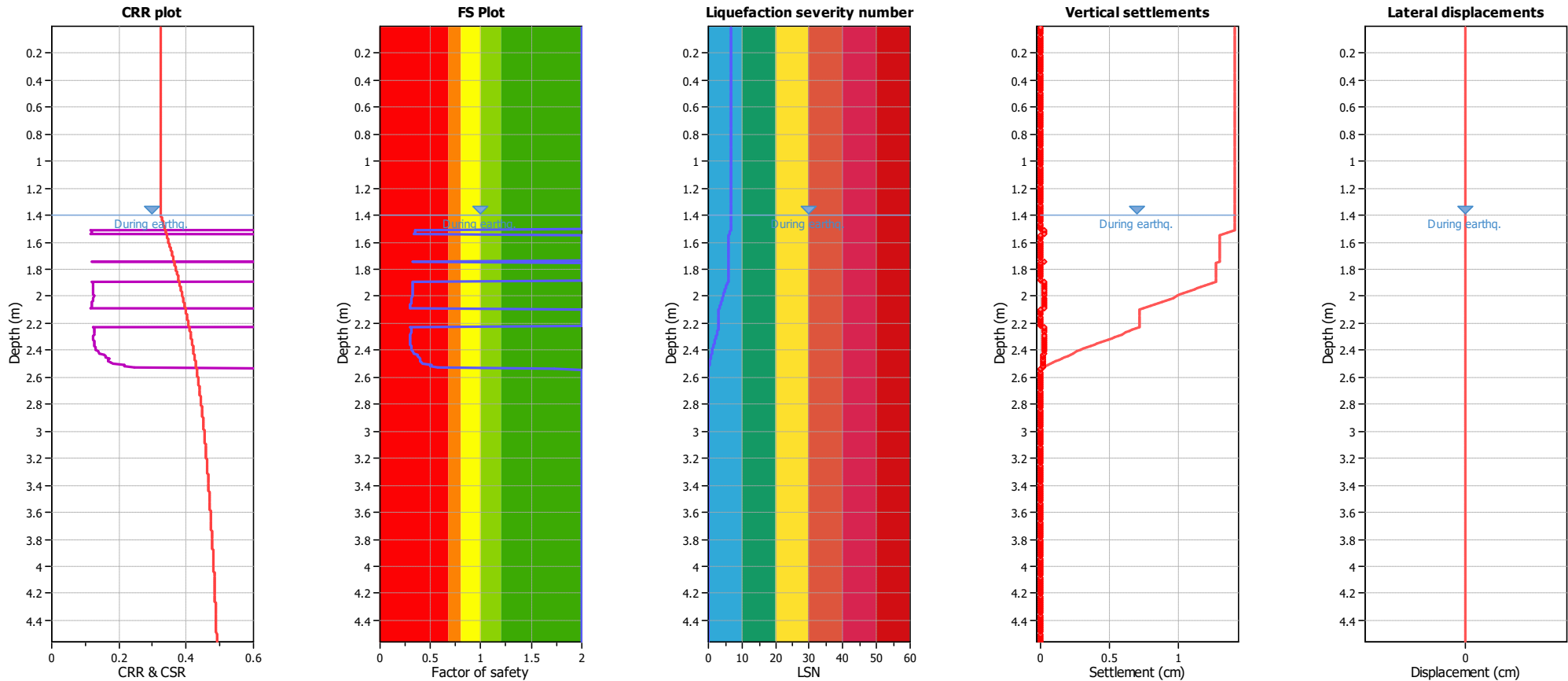
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Liquefaction analysis overall plots



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Peak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.40 m	Fill height:	N/A	Limit depth:	N/A

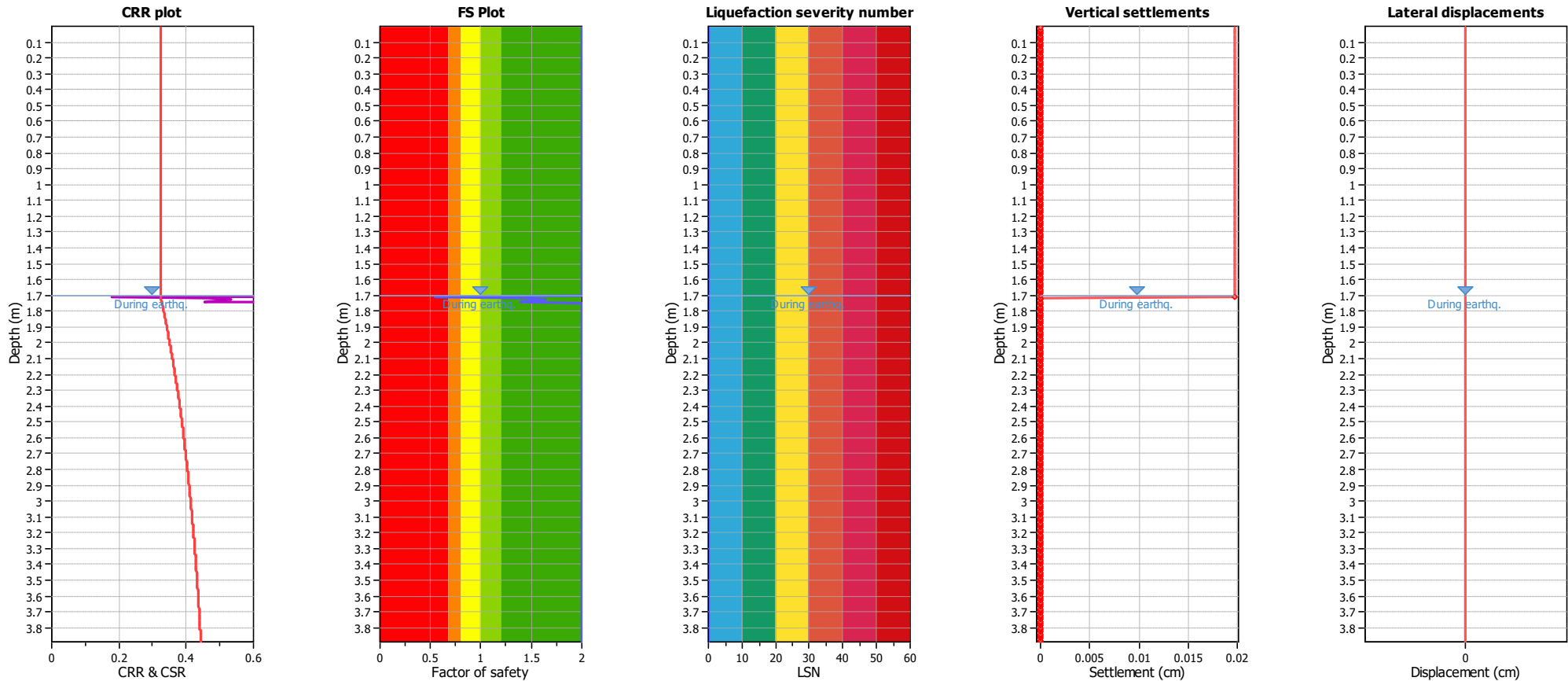
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Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	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:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

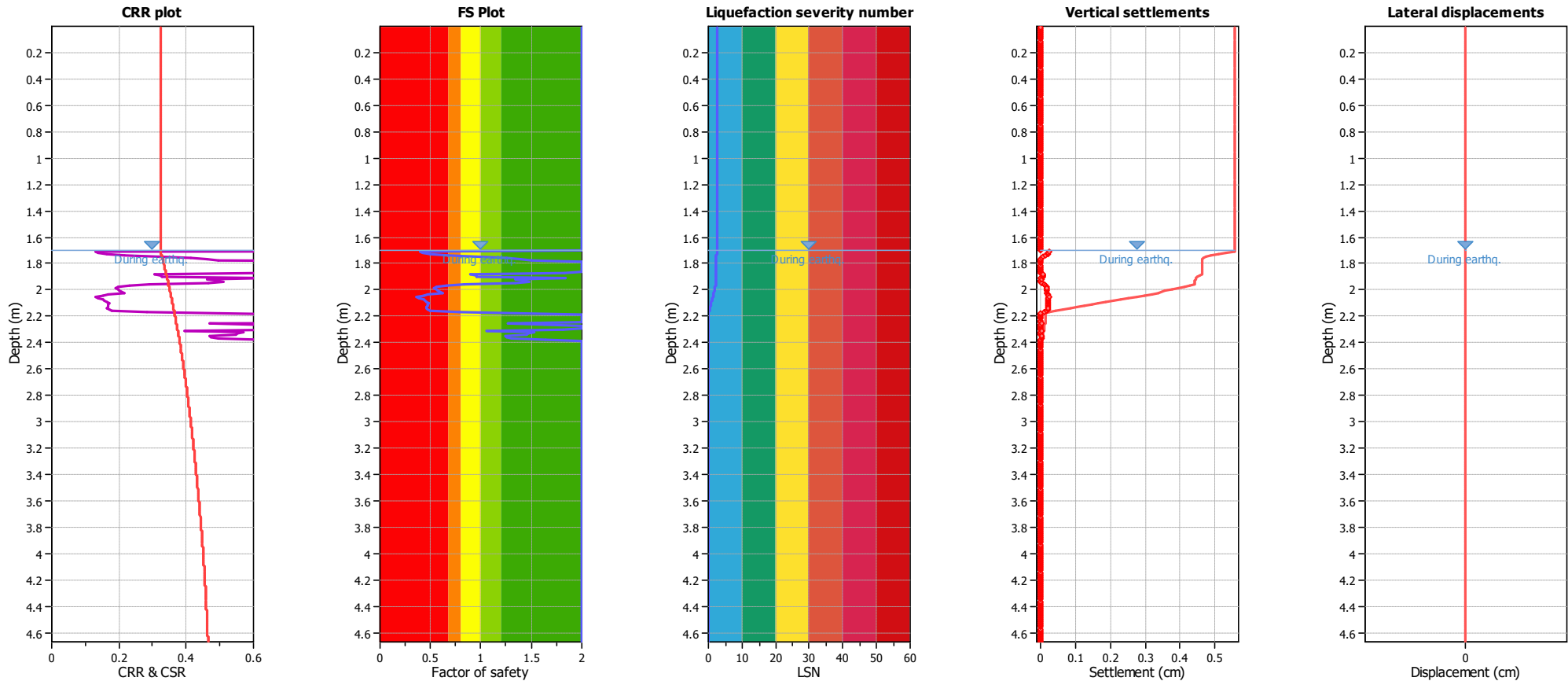
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Liquefaction analysis overall plots



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Analysis method:	B&I (2014)	Depth to GWT (earthq.):	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:	Yes
Earthquake magnitude M _w :	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.70 m	Fill height:	N/A	Limit depth:	N/A

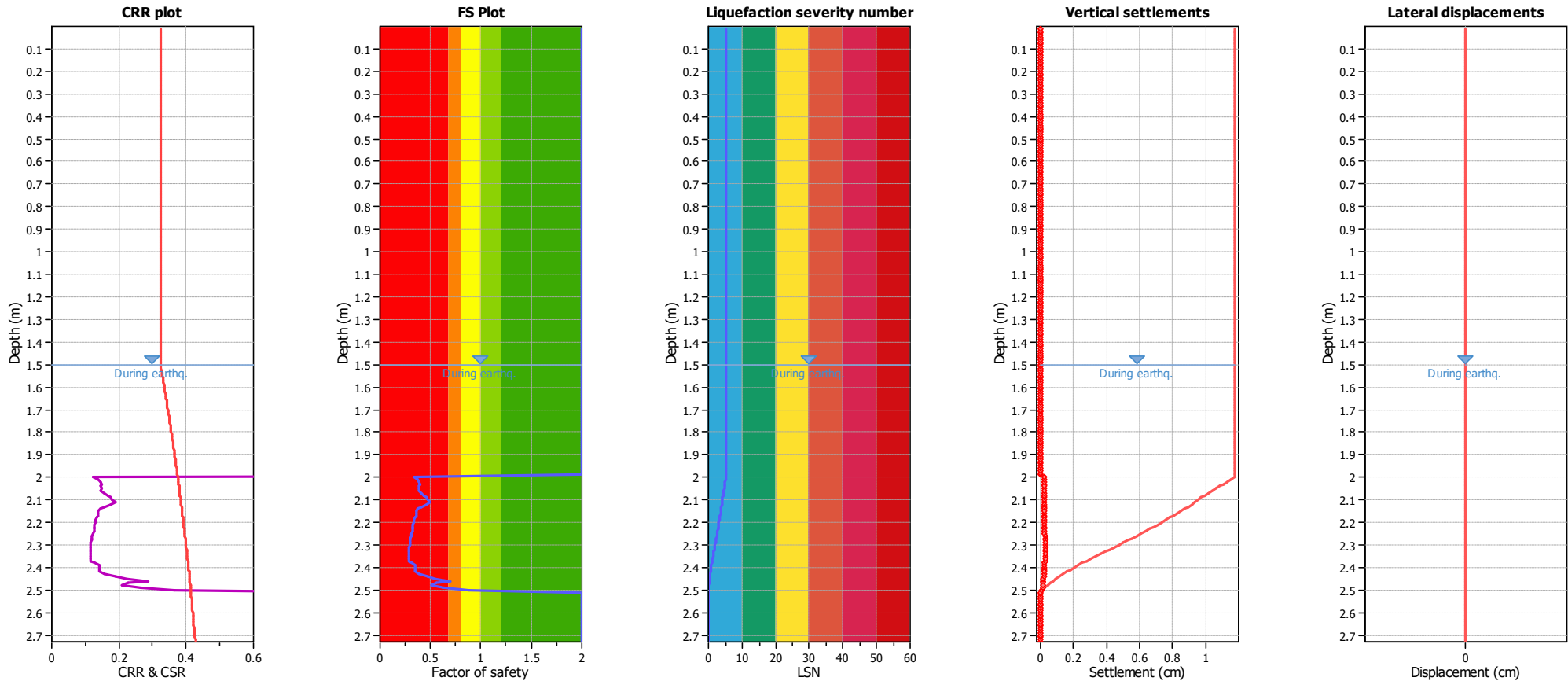
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Liquefaction analysis overall plots



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Peak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.50 m	Fill height:	N/A	Limit depth:	N/A

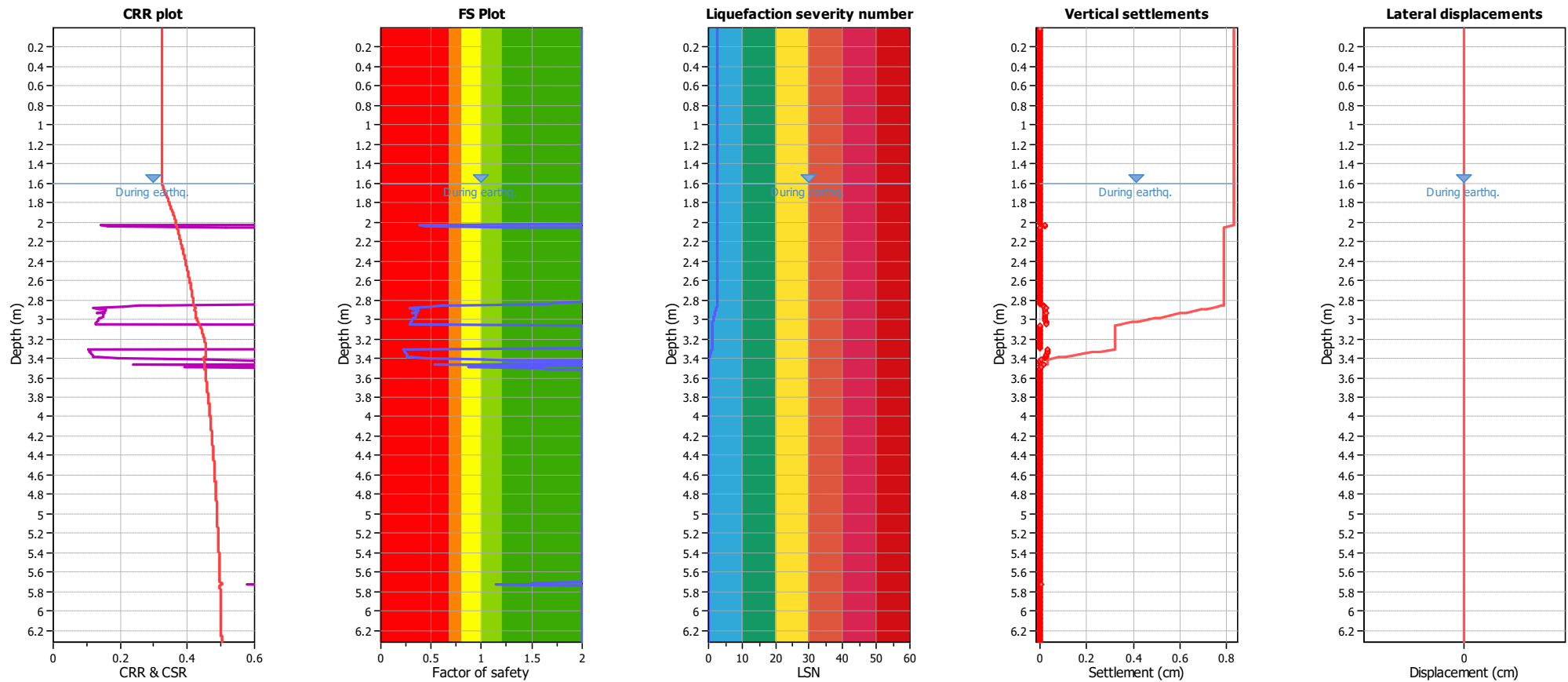
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Liquefaction analysis overall plots



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Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.60 m	Fill weight:	N/A
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Peak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.60 m	Fill height:	N/A	Limit depth:	N/A

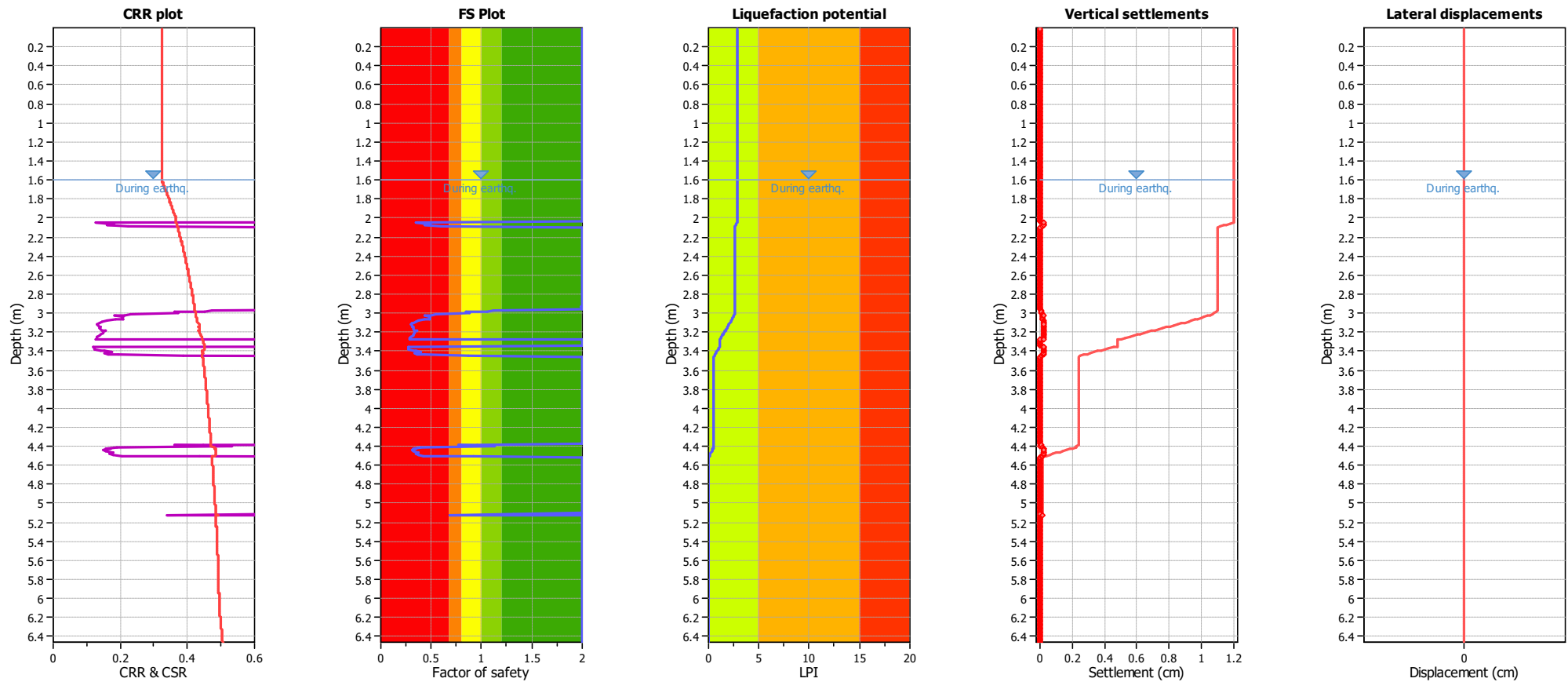
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Liquefaction analysis overall plots



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Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.60 m	Fill weight:	N/A
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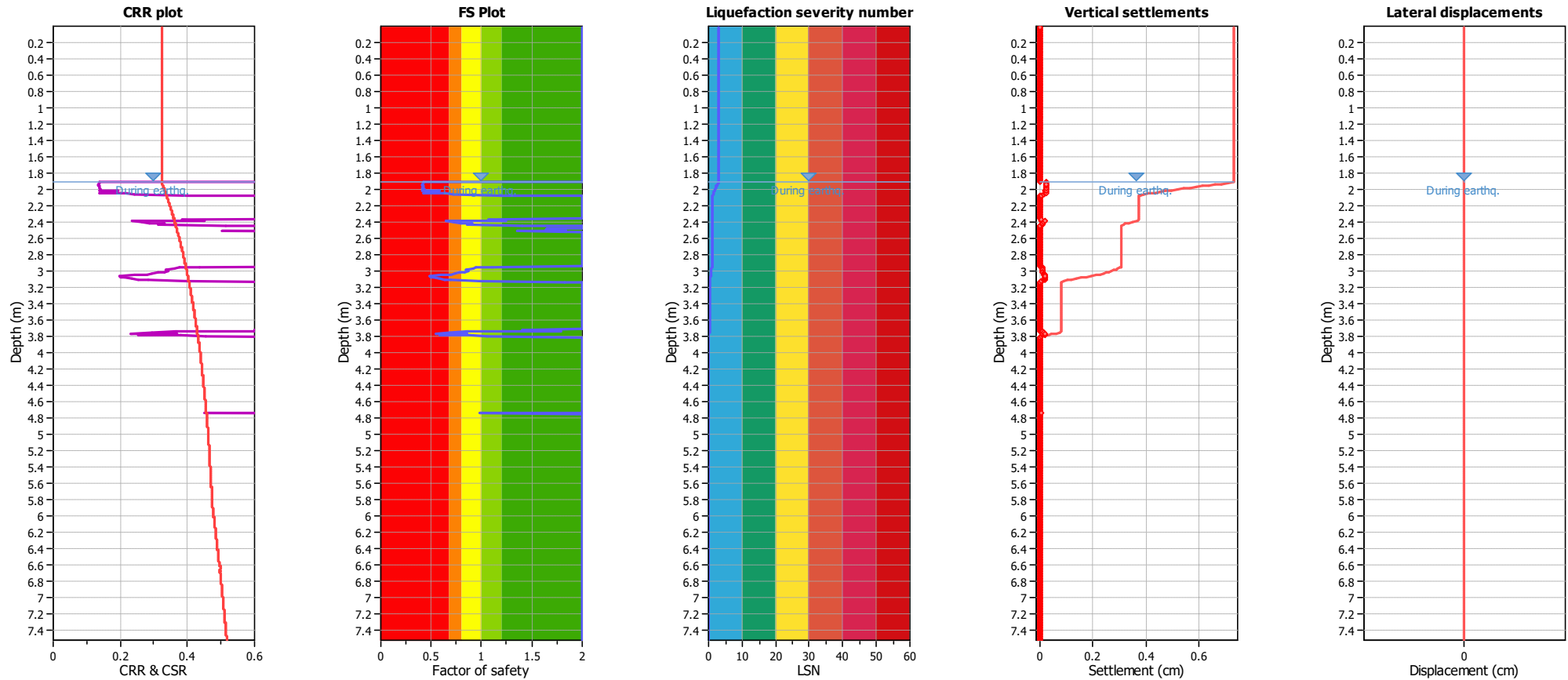
F.S. color scheme

■	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 overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	1.90 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 ₀ applied:	Yes
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Peak ground acceleration:	0.55	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.90 m	Fill height:	N/A	Limit depth:	N/A

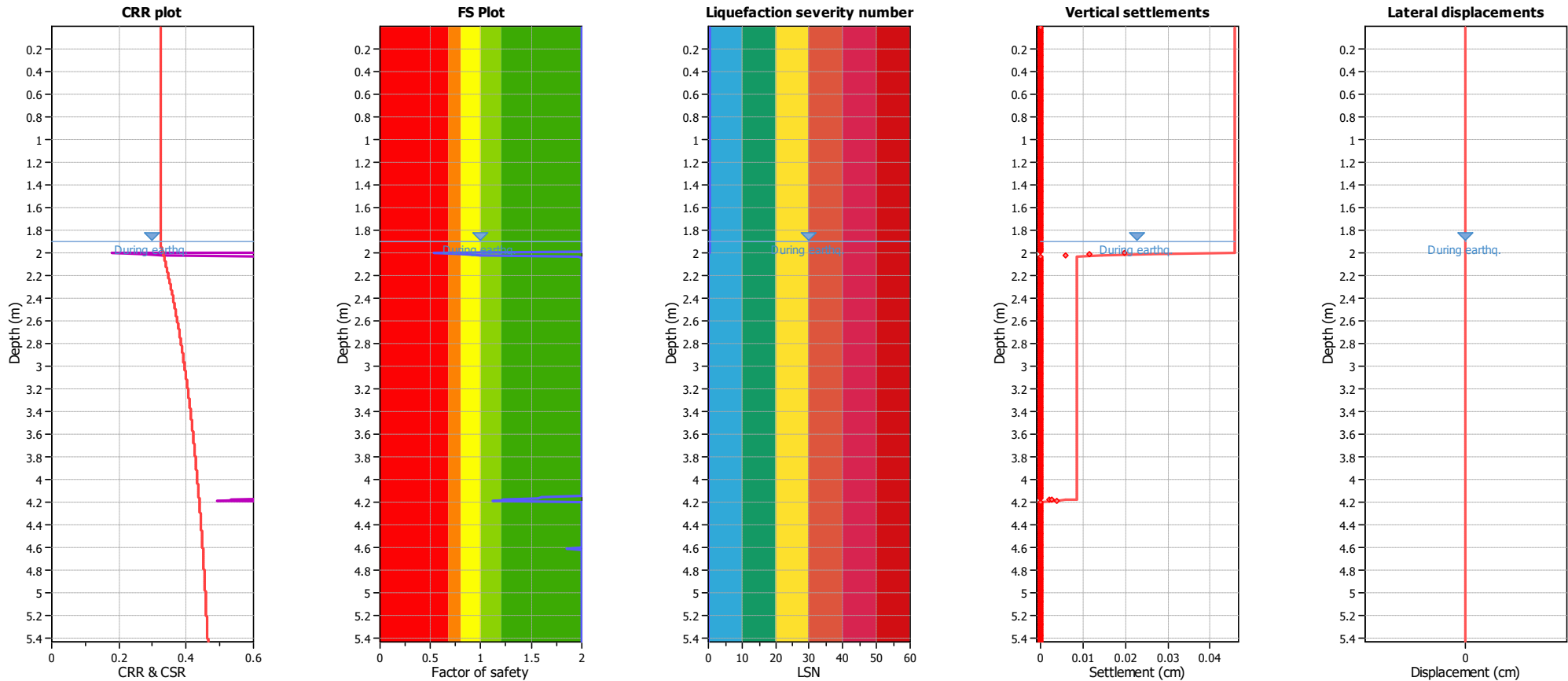
F.S. color scheme

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LSN color scheme

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■	Major expression of liquefaction
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Liquefaction analysis overall plots



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