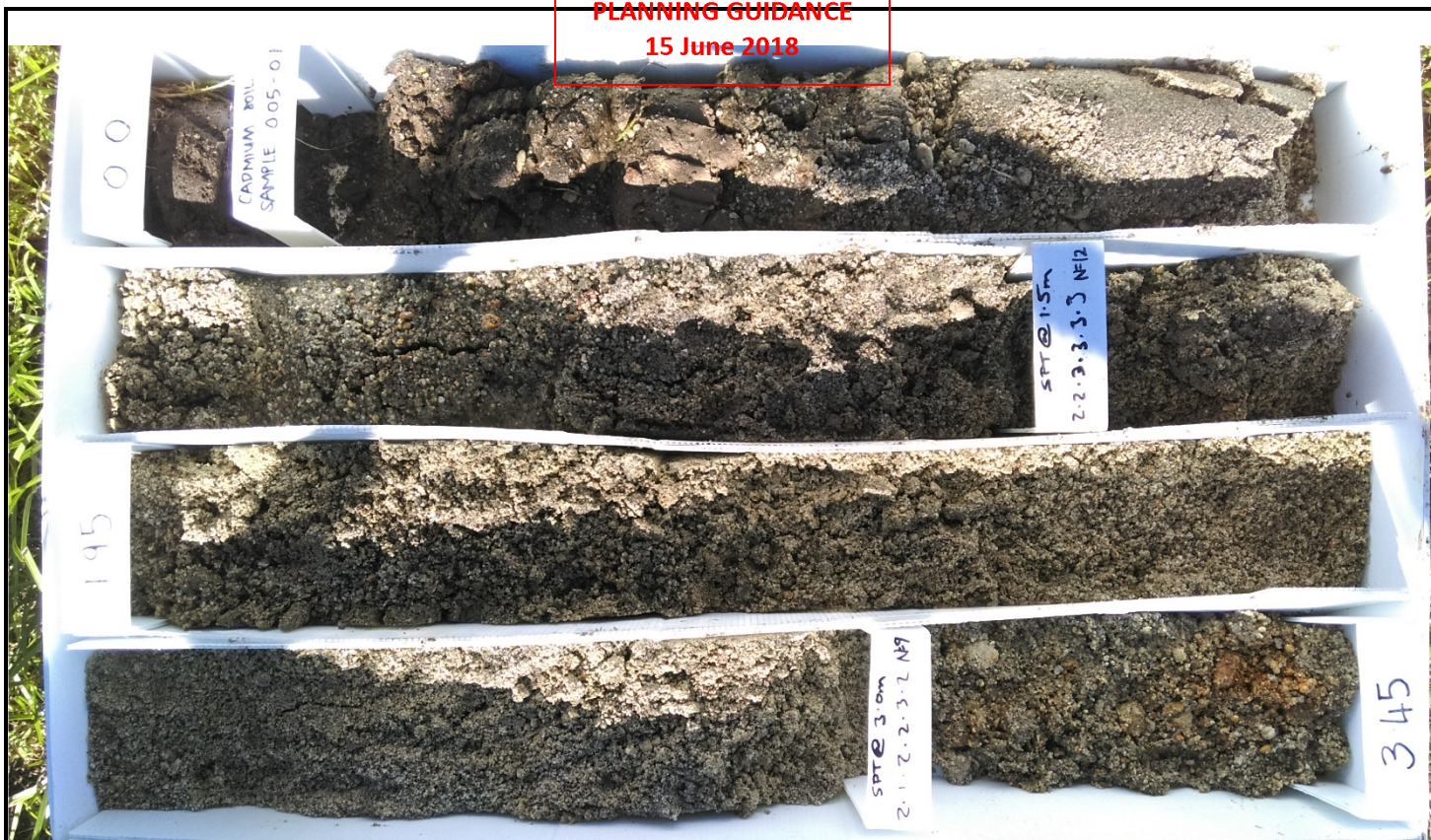
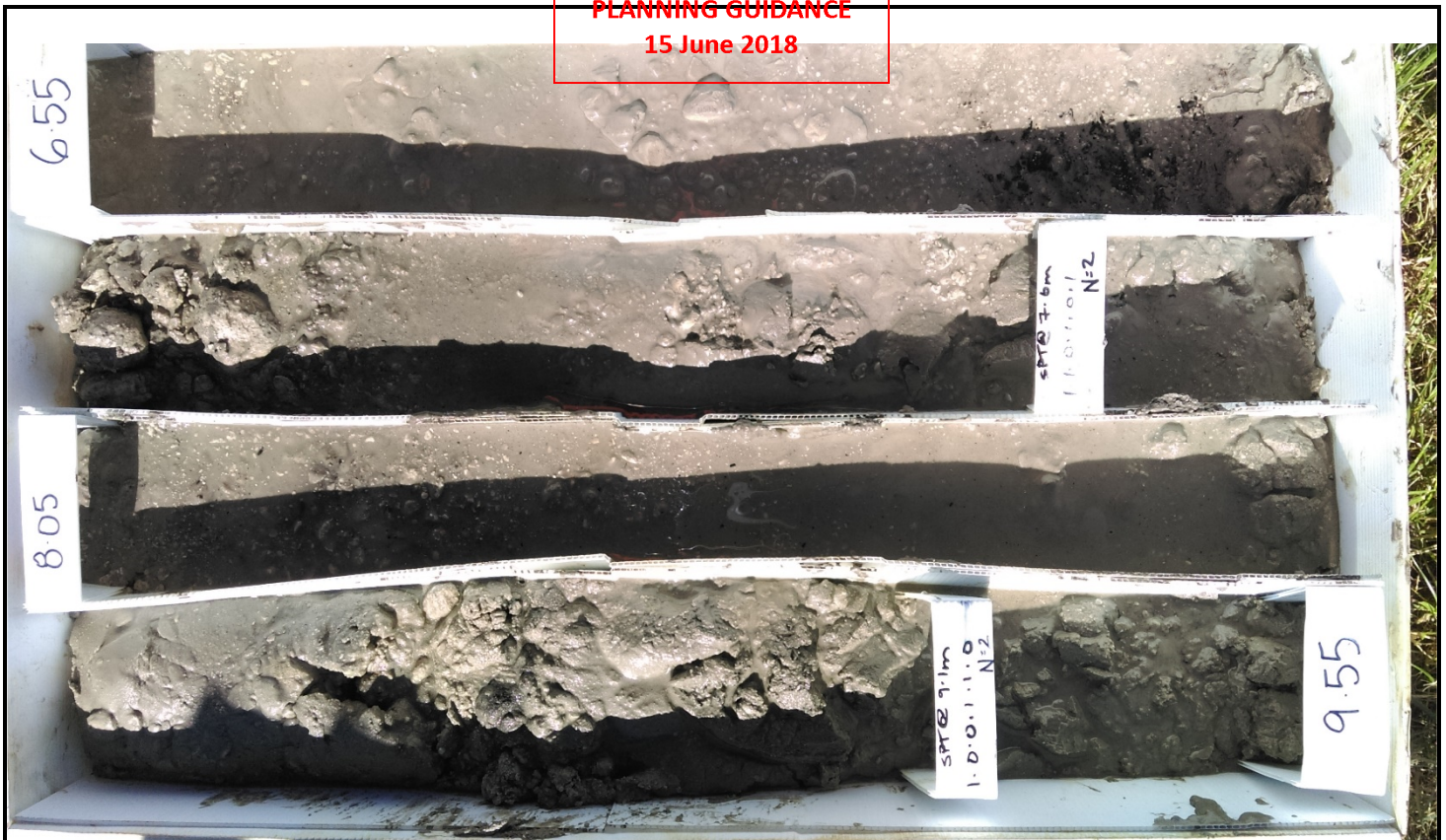




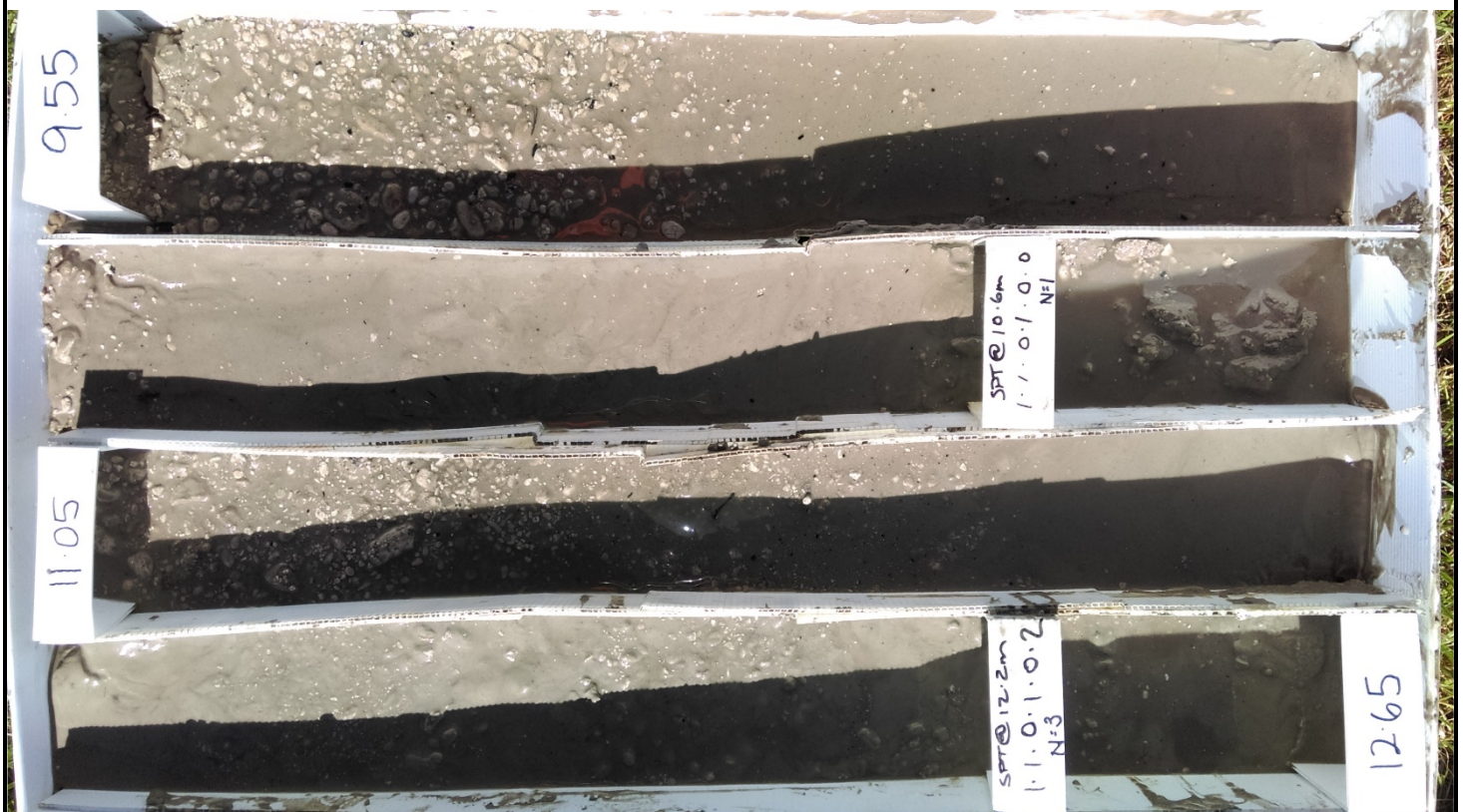
Borehole MBH11: 0.0 m to 3.45 m



Borehole MBH11: 3.45 m to 6.55 m



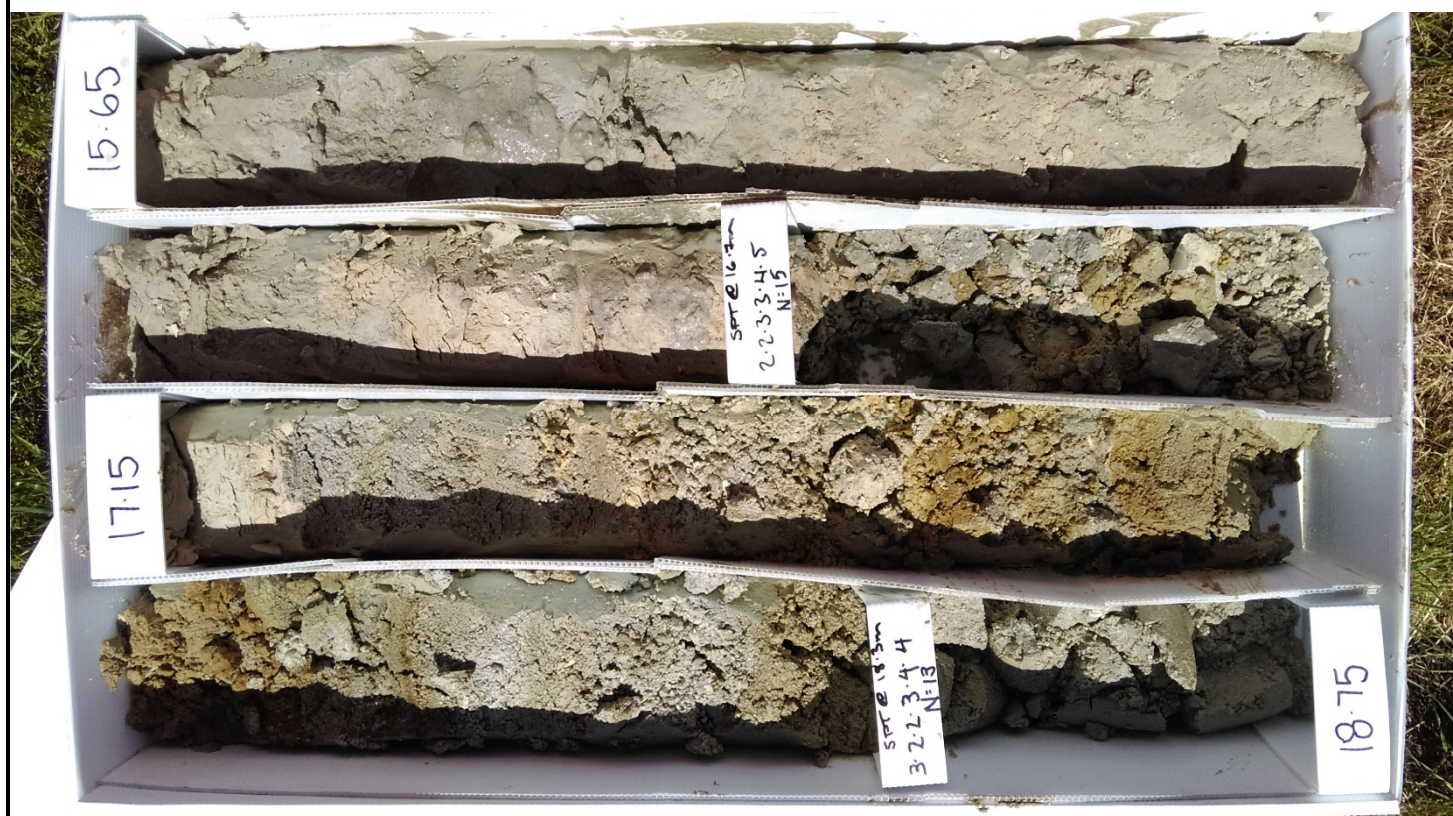
Borehole MBH11: 6.55 m to 9.55 m



Borehole MBH11: 9.55 m to 12.65 m



Borehole MBH11: 12.65 m to 15.65 m



Borehole MBH11: 15.65 m to 18.75 m

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Borehole MBH11: 18.75 m to 20.25 m



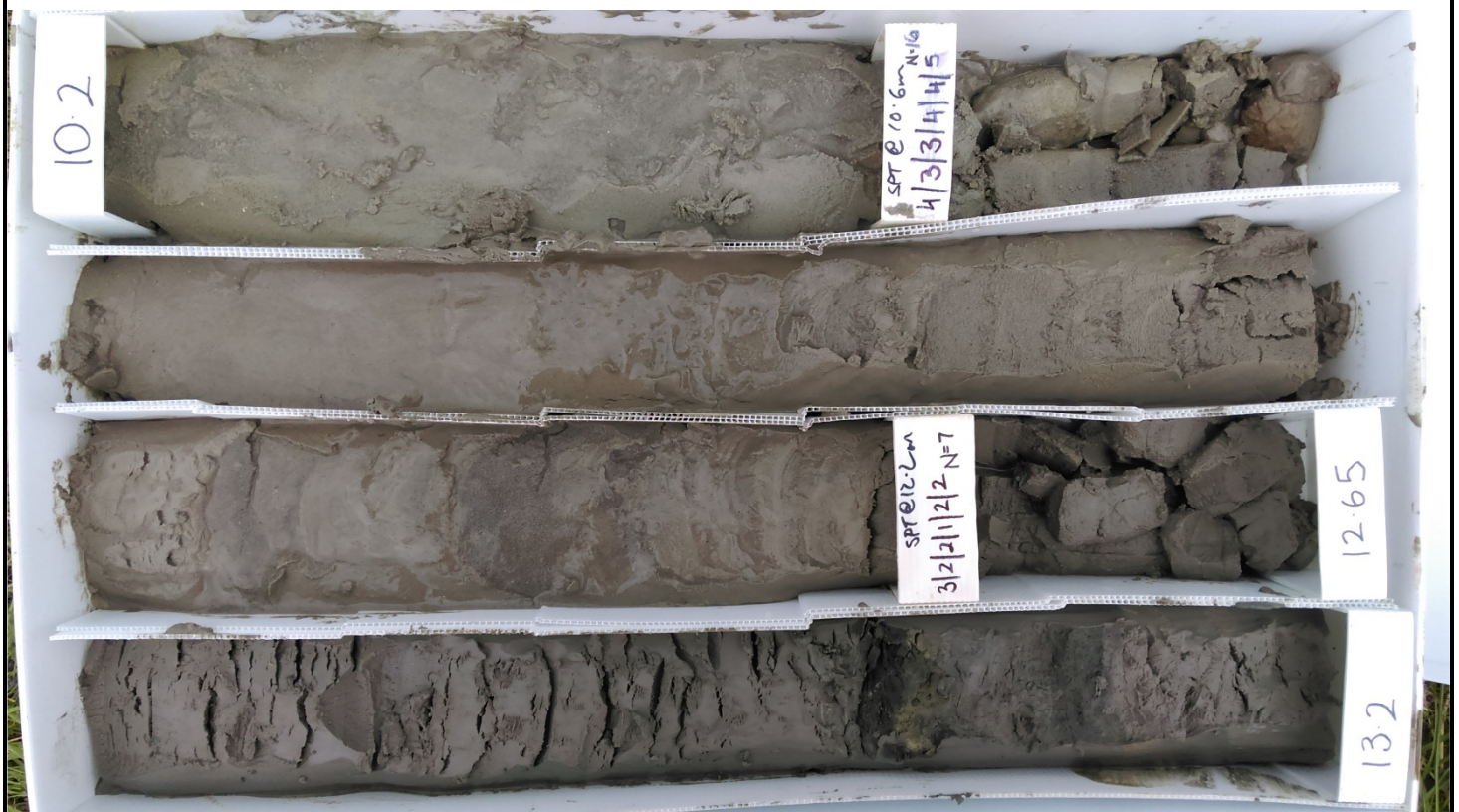
Borehole MBH12: 0.0 m to 3.45 m



Borehole MBH12: 3.45 m to 7.05 m



Borehole MBH12: 7.05 m to 10.2 m



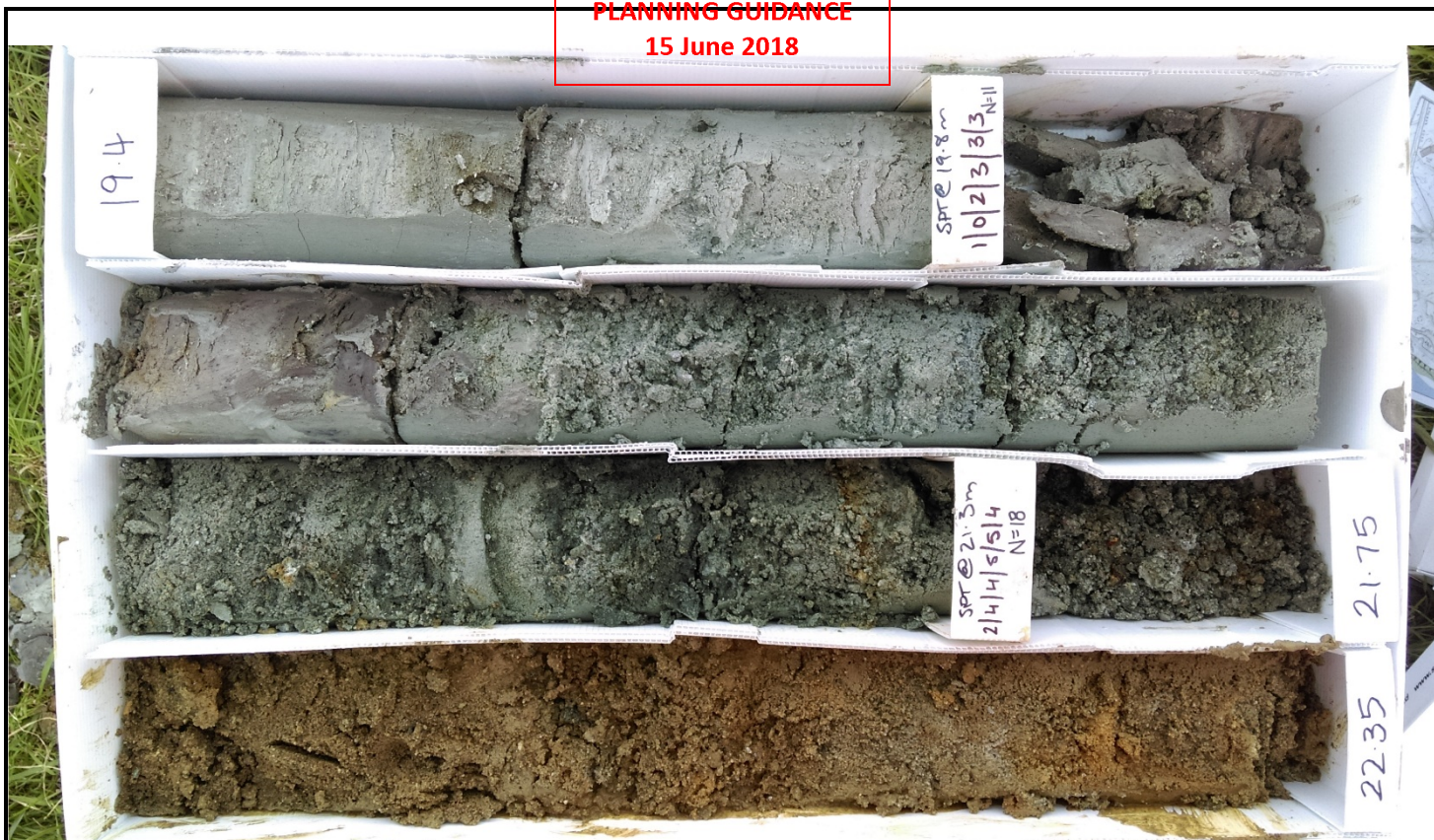
Borehole MBH12: 10.2 m to 13.2 m



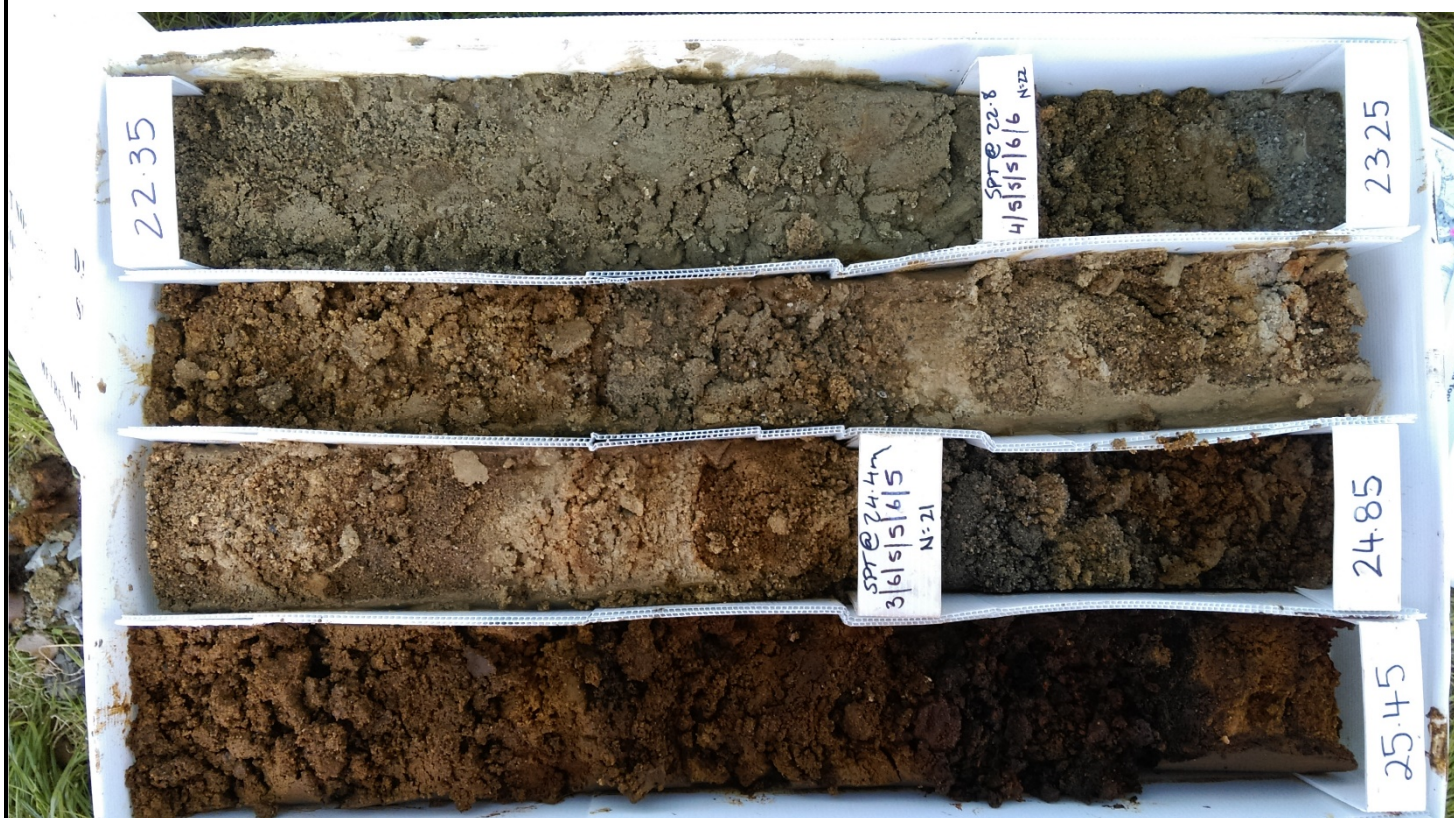
Borehole MBH12: 13.2 m to 16.2 m



Borehole MBH12: 16.2 m to 19.4 m



Borehole MBH12: 19.4 m to 22.35 m



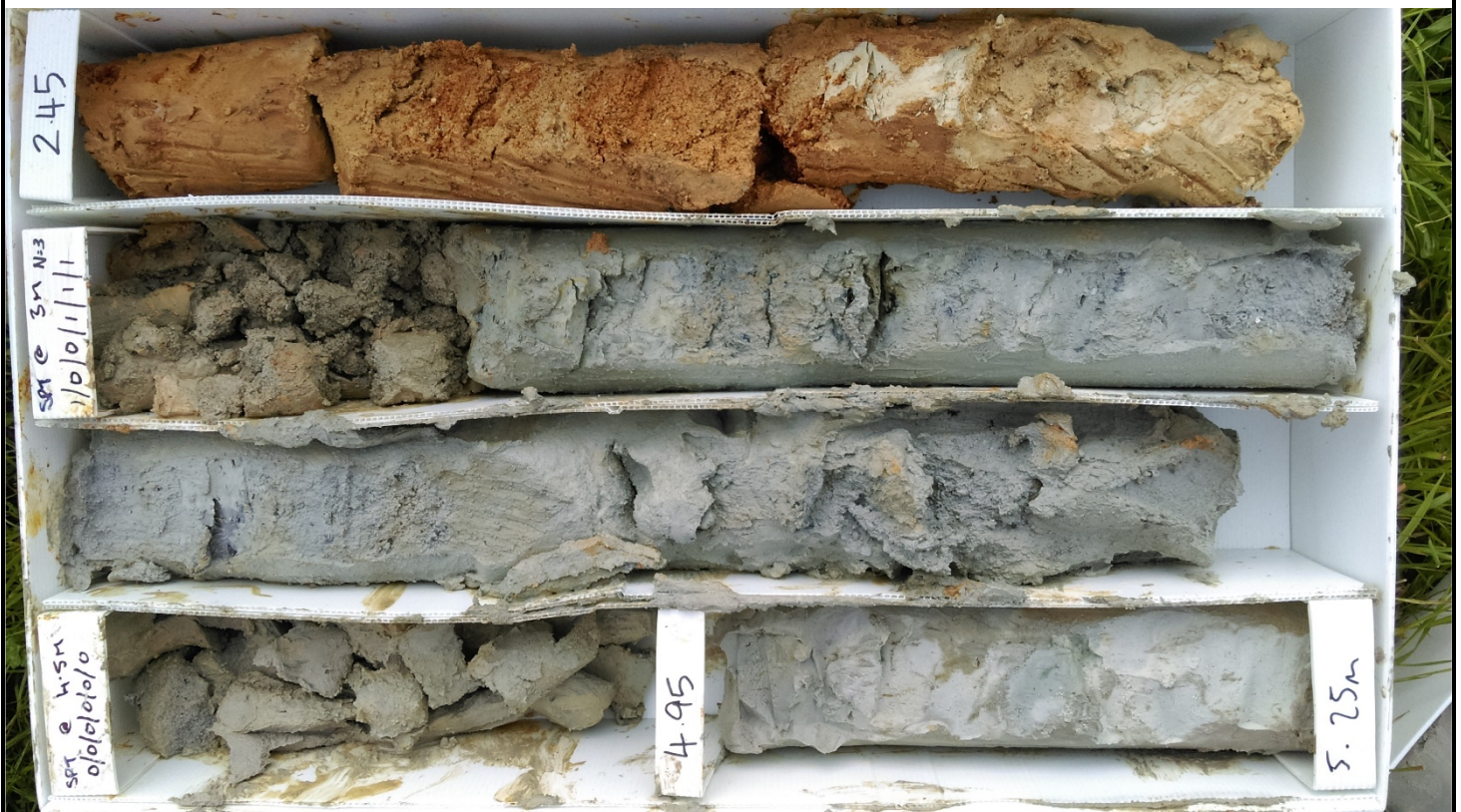
Borehole MBH12: 22.35 m to 25.45 m



Borehole MBH12: 25.45 m to 27.85 m



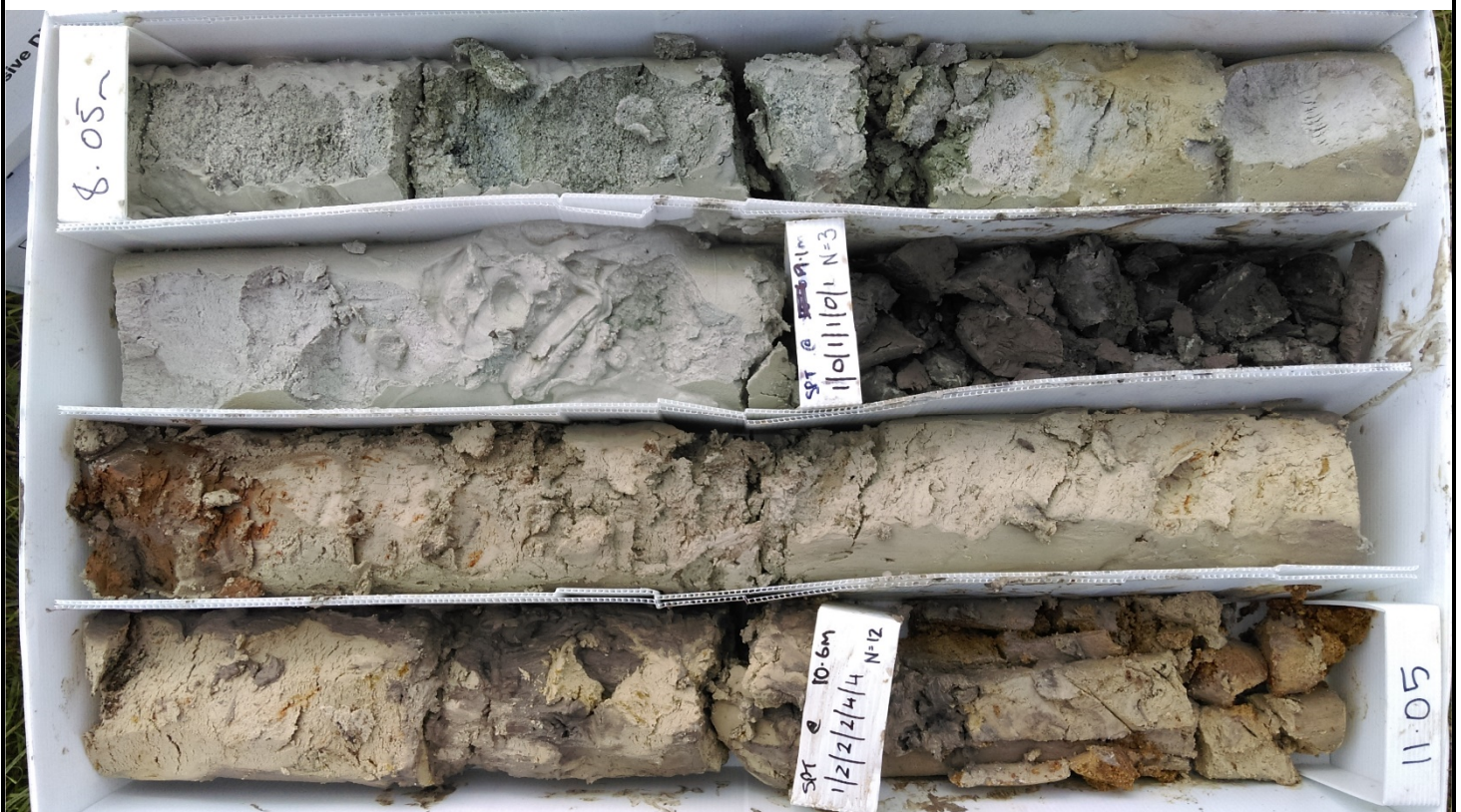
Borehole MBH13: 0.0 m to 2.45 m



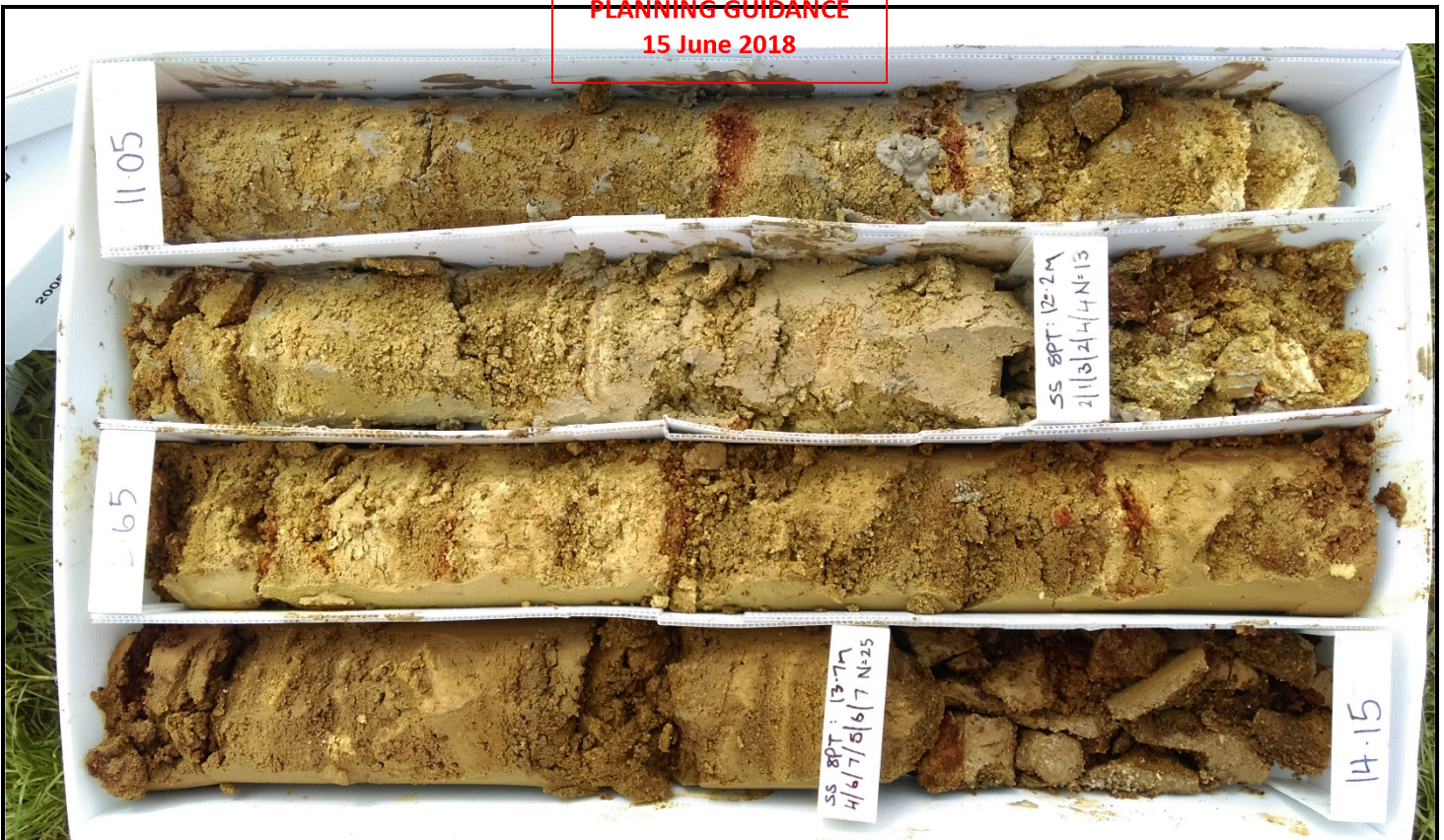
Borehole MBH13: 2.45 m to 5.25 m



Borehole MBH13: 5.25 m to 8.05 m



Borehole MBH13: 8.05 m to 11.05 m



Borehole MBH13: 11.05 m to 14.15 m



Borehole MBH13: 14.15 m to 17.15 m



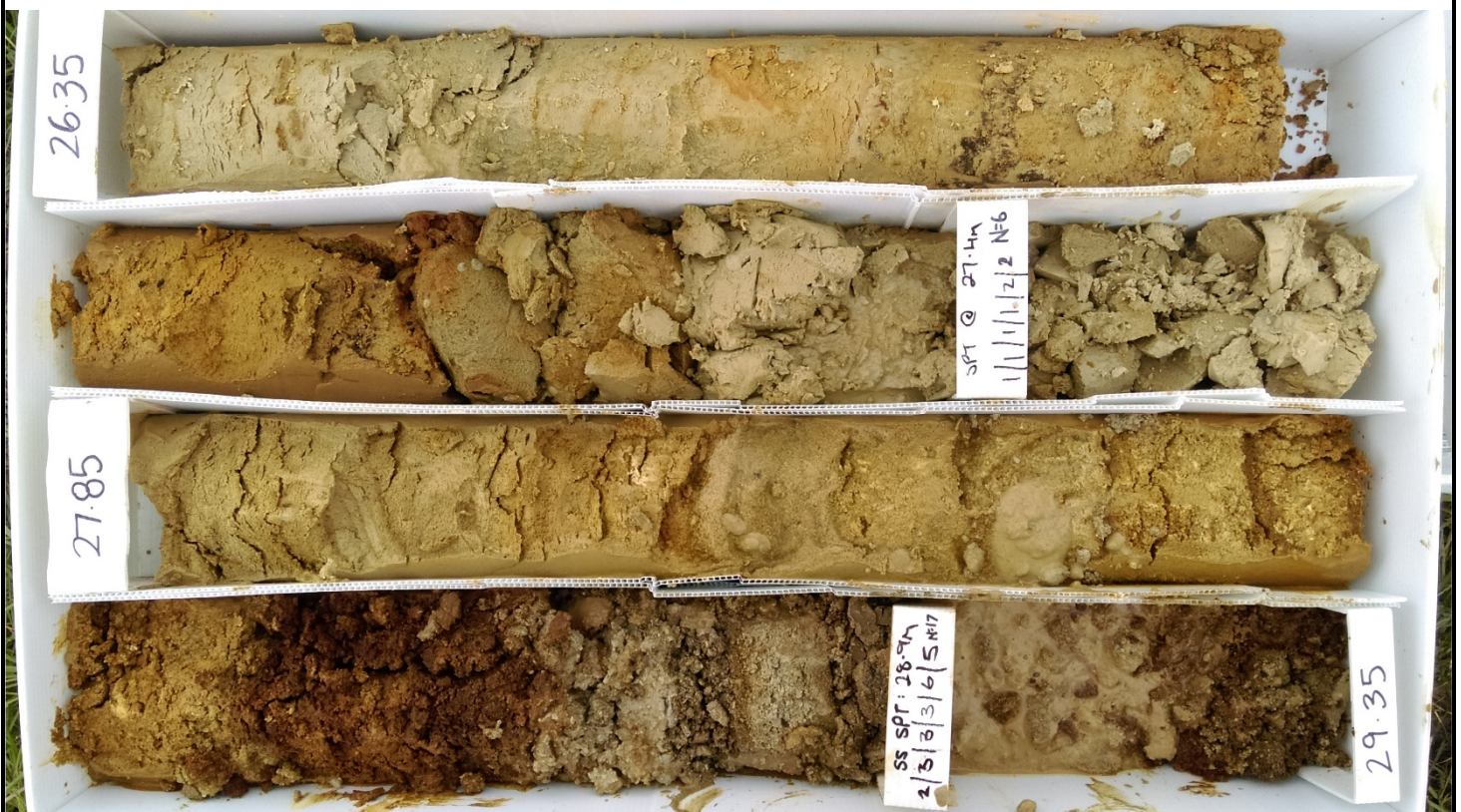
Borehole MBH13: 17.15 m to 20.25 m



Borehole MBH13: 20.25 m to 23.25 m



Borehole MBH13: 23.25 m to 26.35 m



Borehole MBH13: 26.35 m to 29.35 m

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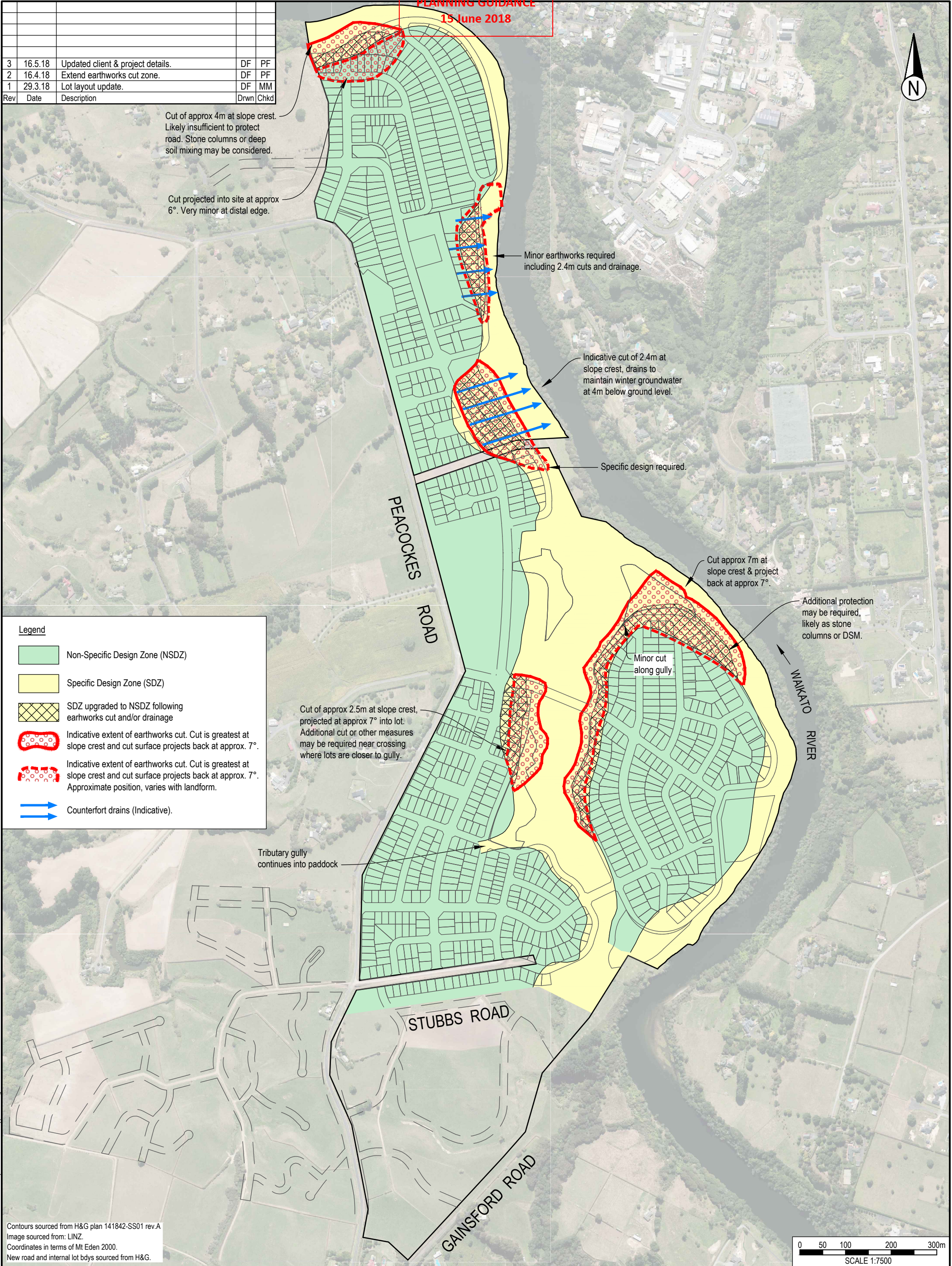


Borehole MBH13: 29.35 m to 30.95 m

APPENDIX 3:
Geotechnical Constraints Plan

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3	16.5.18	Updated client & project details.	DF	PF	
2	16.4.18	Extend earthworks cut zone.	DF	PF	
1	29.3.18	Lot layout update.	DF	MM	
Rev	Date	Description	Drwn	Chkd	



Contours sourced from H&G plan 141842-SS01 rev.A
Image sourced from: LINZ.
Coordinates in terms of Mt Eden 2000.
New road and internal lot bdys sourced from H&G.



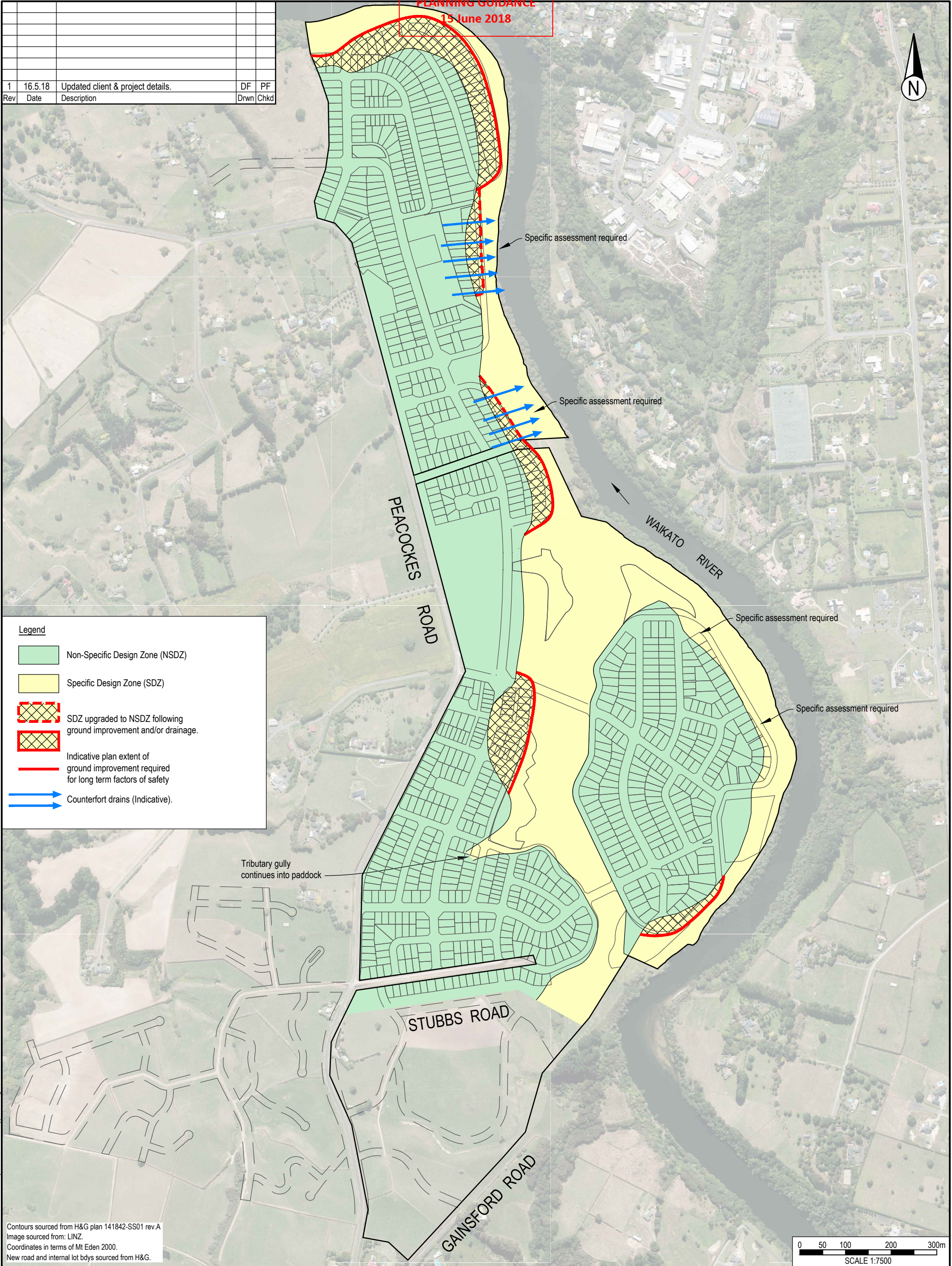
Auckland Office
6 Antares Place, Rosedale
North Shore City 0632, Auckland
Tel: 09 972 2205
www.enggeo.co.nz

GEOTECHNICAL CONSTRAINTS PLAN
- EXISTING CONTOURS

Client:	WESTON LEA LIMITED		Appendix No:
Project:	AMBERFIELD SUBDIVISION HAMILTON	Designed:	PF
		Drawn:	DF
		Checked:	-
		Date:	13.02.18
Proj No:	14280.000.000	Scale:	1:7500
		Size:	A3
		Rev:	3

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1	16.5.18	Updated client & project details.	DF	PF	
Rev	Date	Description	Drwn	Chkd	



Legend

- Non-Specific Design Zone (NSDZ)
- Specific Design Zone (SDZ)
- SDZ upgraded to NSDZ following ground improvement and/or drainage.
- Indicative plan extent of ground improvement required for long term factors of safety
- Counterfort drains (Indicative).

Contours sourced from H&G plan 141842-SS01 rev.A
Image sourced from: LINZ.
Coordinates in terms of Mt Eden 2000.
New road and internal lot bdys sourced from H&G.

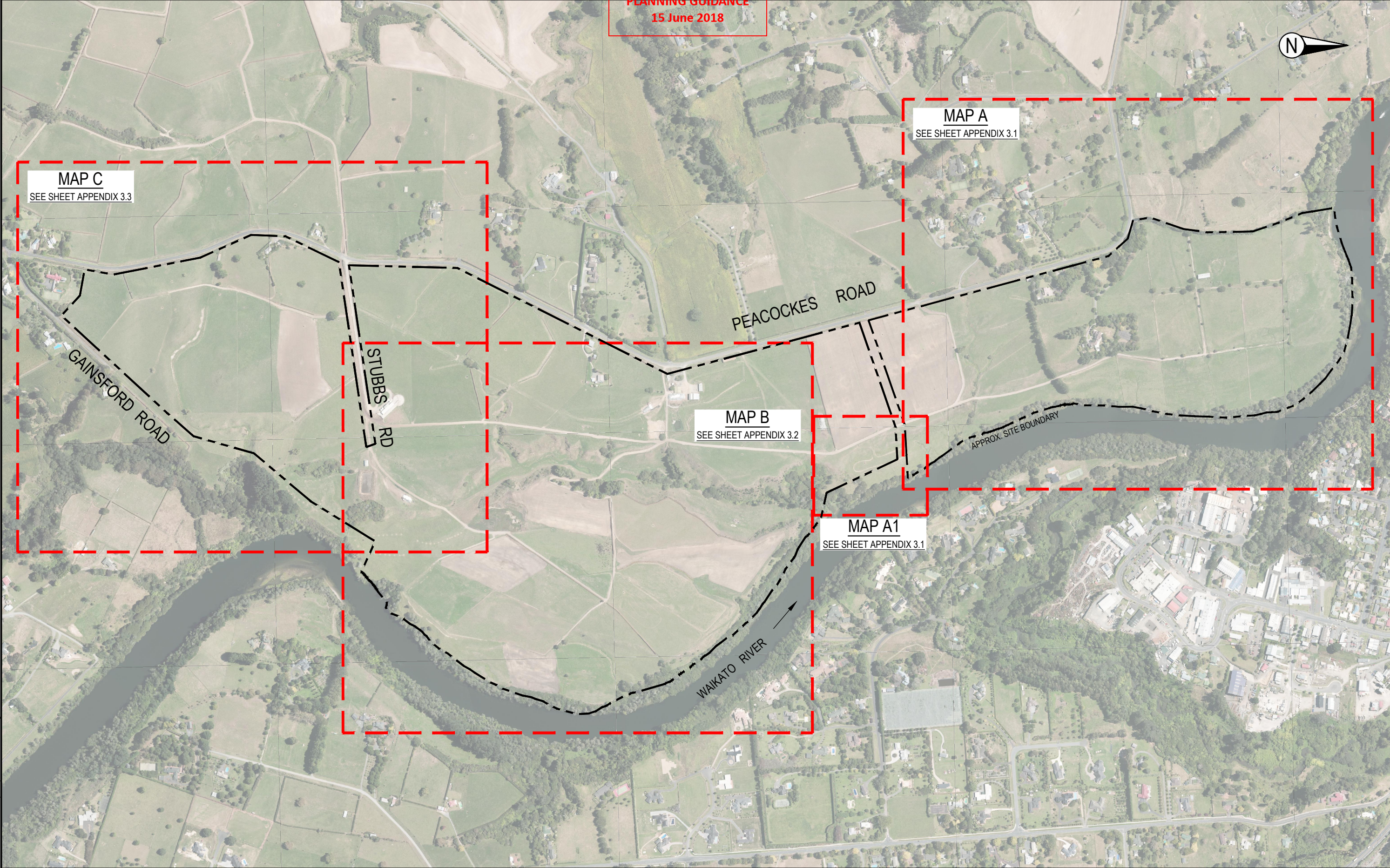
XREFs: X-14280-Contours: hamilton-01-mrban-aerial-photos-2015; X-14280-Bdys: X-14280-SchemePlan; 141842-XREF-D-BASE MPLAN; 180329
CAD File: Z:\Drawing\14001 to 15000\14280 - Peacockes Road\14280-GeoConstraintsMap-PeacockesRd-0218-Append3B.dwg

	Auckland Office 6 Antares Place, Rosedale North Shore City 0632, Auckland Tel: 09 972 2205 www.enggeo.co.nz	Title: GEOTECHNICAL CONSTRAINTS PLAN - PROPOSED CONTOURS	Client: WESTON LEA LIMITED		Appendix No: 3B Size: A3
			Project: AMBERFIELD SUBDIVISION HAMILTON	Designed: MM	
				Drawn: DF	
				Checked: -	
			Date: 29.3.18		
Proj No: 14280.000.000			Scale: 1:7500	Rev: 1	

APPENDIX 4:
Geomorphological Plans

DATE PLOTTED: 16 May 2018 1:41 p.m. BY: DOUG FINLAY

Received
PLANNING GUIDANCE
15 June 2018



3	16.5.18	Updated client & project details.	DF	PF	
2	29.3.18	Update cross section locations.	DF	MM	
1	10.01.18	Add test & cross section locations	DF	PF	
Rev	Date	Description	Drwn	Chkd	



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North Shore City 0632, Auckland
Tel: 09 972 2205
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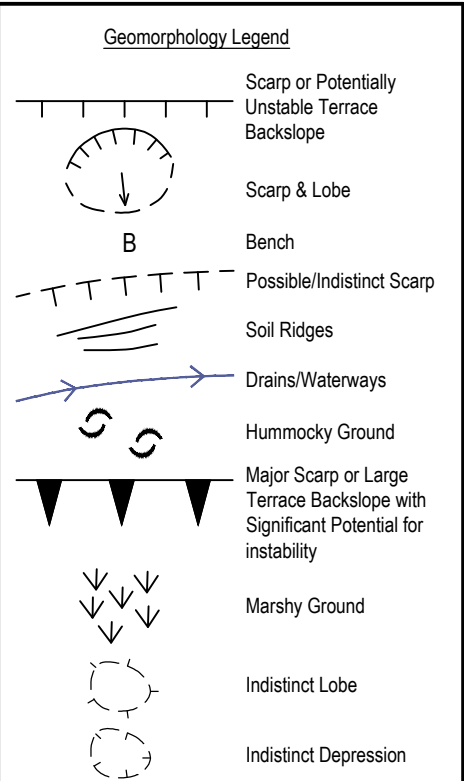
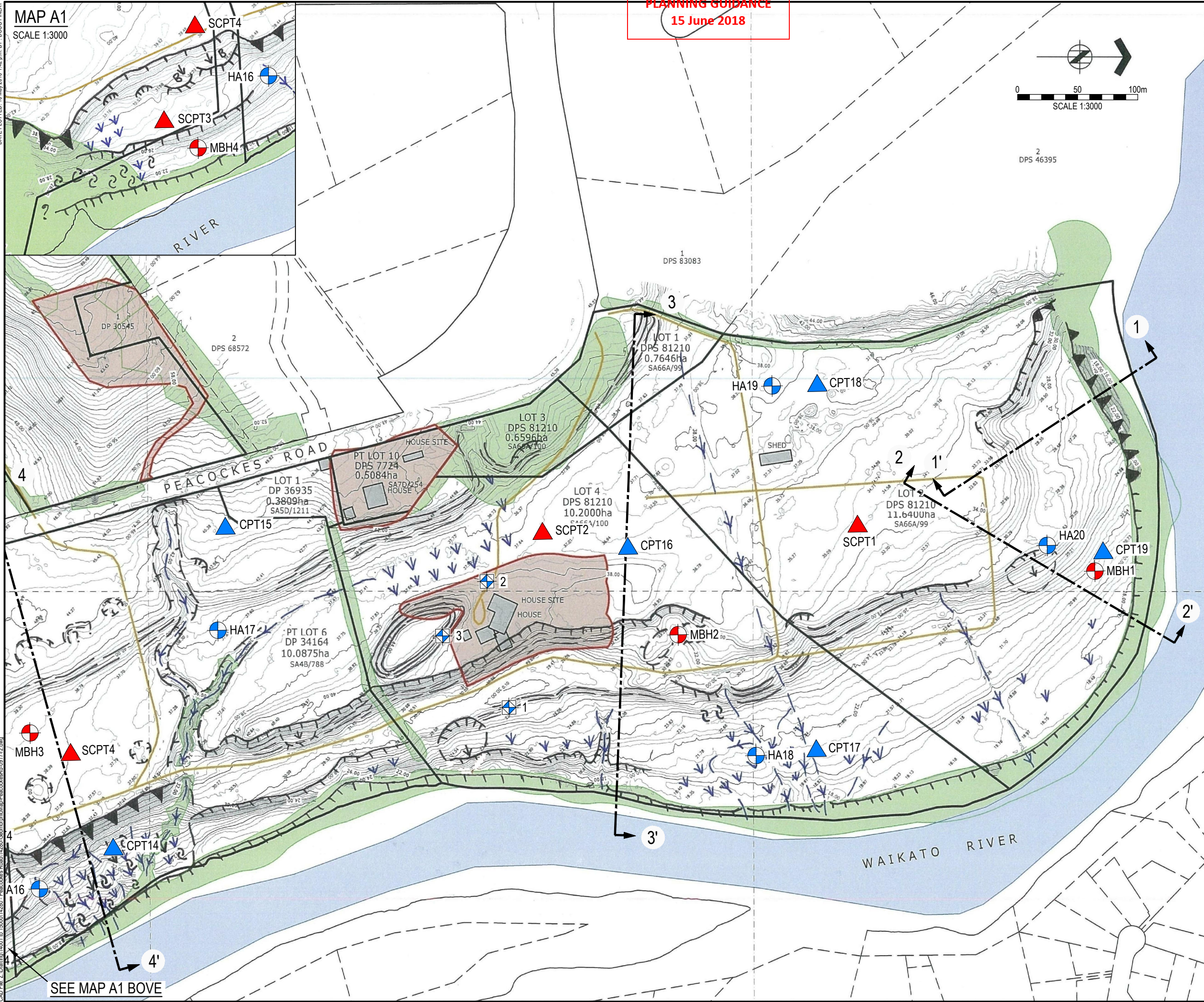
Title:

GEOMORPHIC MAP INDEX

Client: WESTON LEA LIMITED		Appendix No: 4
Project: AMBERFIELD SUBDIVISION HAMILTON	Designed: MM	
	Drawn: DF	
		Checked: -
		Date: 05.09.17
Proj No: 14280.000.000		Size: A3
		Rev: 3
		Scale: 1:7500

XREFs: hamilton01m-urban-aerial-photos-2015
CAD File: Z:\Drawing\14280 to 15000\14280 - Peacockes Road\14280-GeomorphMap-PeacockesRd-0917-2.dwg

Received
PLANNING GUIDANCE
15 June 2018



- Testing Legend
- 1 Soakage Test (Aug 2017)
 - HA01 Hand Auger Test (Aug 2017)
 - CPT01 Cone Penetrometer Test (Aug 2017)
 - MBH1 Machine Borehole Test (Dec 2017)
 - SCPT1 Seismic Cone Penetrometer Test (Dec 2017)



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Tel: 09 972 2205, www.enggeo.co.nz

Rev	Date	Description	Drwn	Chkd
3	16.5.18	Updated client & project details.	DF	PF
2	29.3.18	Update cross section locations.	DF	MM
1	10.01.18	Add test & cross section locations	DF	PF

Title: **GEOMORPHIC MAP A**

Base drawing source: H&G drawing 141842-SS02A.

Client: WESTON LEA LIMITED		Appendix No:
Project: AMBERFIELD SUBDIVISION HAMILTON	Designed: MM	4.1
	Drawn: DF	
	Checked: -	
Project No: 14280.000.000	Date: 05.09.17	Size: A3
	Scale: 1:3000	Rev: 3

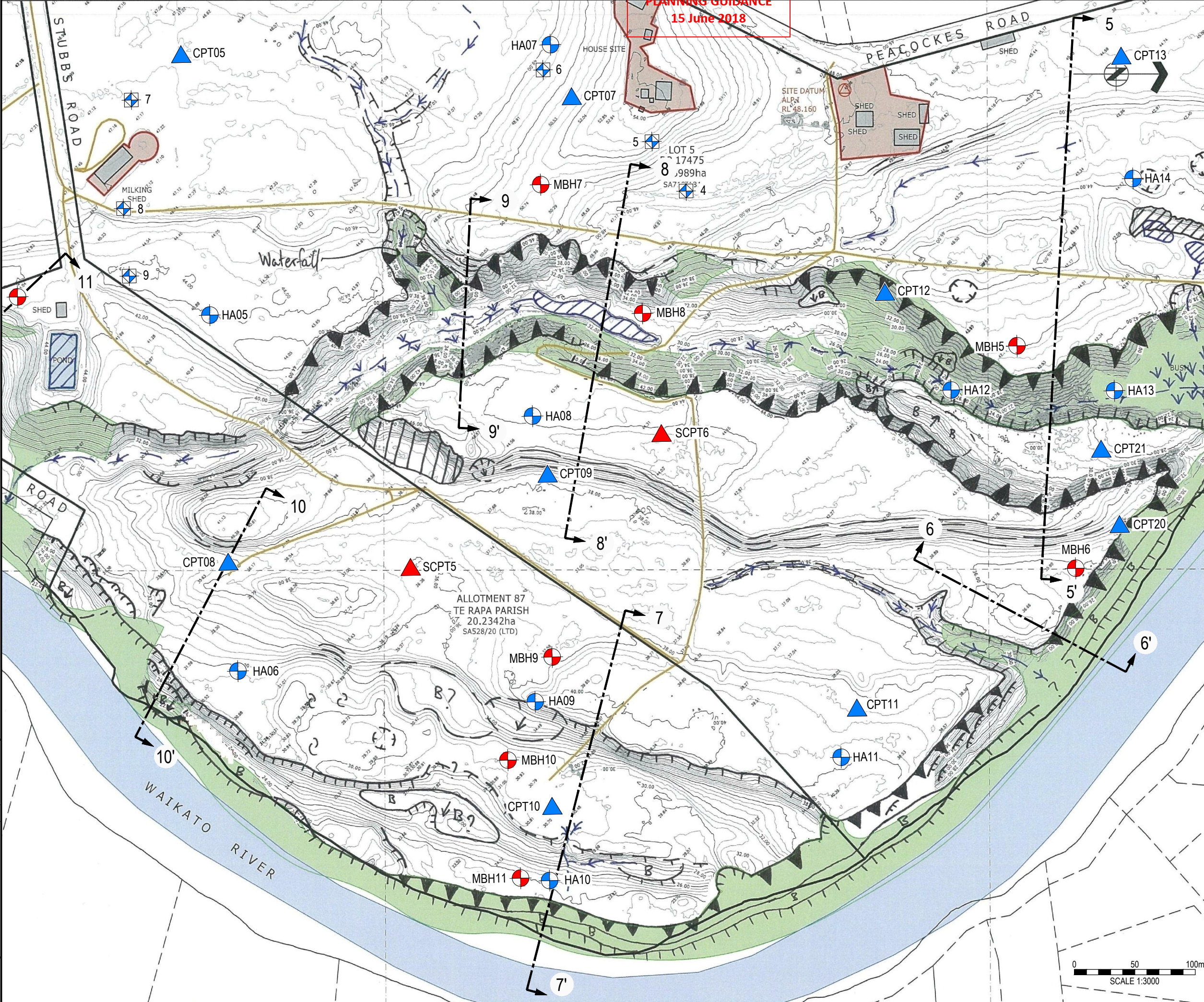
DATE PLOTTED: 16 May 2018 1:42 p.m. BY: DOUG FINLAY
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DATE PLOTTED: 16 May 2018 1:43 p.m. BY: DOUG FINLAY

XREFs: hamilton01m-urban-vernal-photos-2015
CAD File Z:\Drawings\14001 to 15000\14280 - Peacocks Road\14280-GeomorphMap-PeacocksRd-0917-2.dwg

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15 June 2018



Geomorphology Legend

- Scarp or Potentially Unstable Terrace Backslope
- Scarp & Lobe
- Bench
- Possible/Indistinct Scarp
- Soil Ridges
- Drains/Waterways
- Hummocky Ground
- Major Scarp or Large Terrace Backslope with Significant Potential for instability
- Marshy Ground
- Indistinct Lobe
- Indistinct Depression

Testing Legend

- 1 Soakage Test (Aug 2017)
- HA01 Hand Auger Test (Aug 2017)
- CPT01 Cone Penetrometer Test (Aug 2017)
- MBH1 Machine Borehole Test (Dec 2017)
- SCPT1 Seismic Cone Penetrometer Test (Dec 2017)

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Rev	Date	Description	Drwn	Chkd
3	16.5.18	Updated client & project details.	DF	PF
2	29.3.18	Update cross section locations.	DF	MM
1	10.01.18	Add test & cross section locations	DF	PF

Title:
GEOMORPHIC MAP B

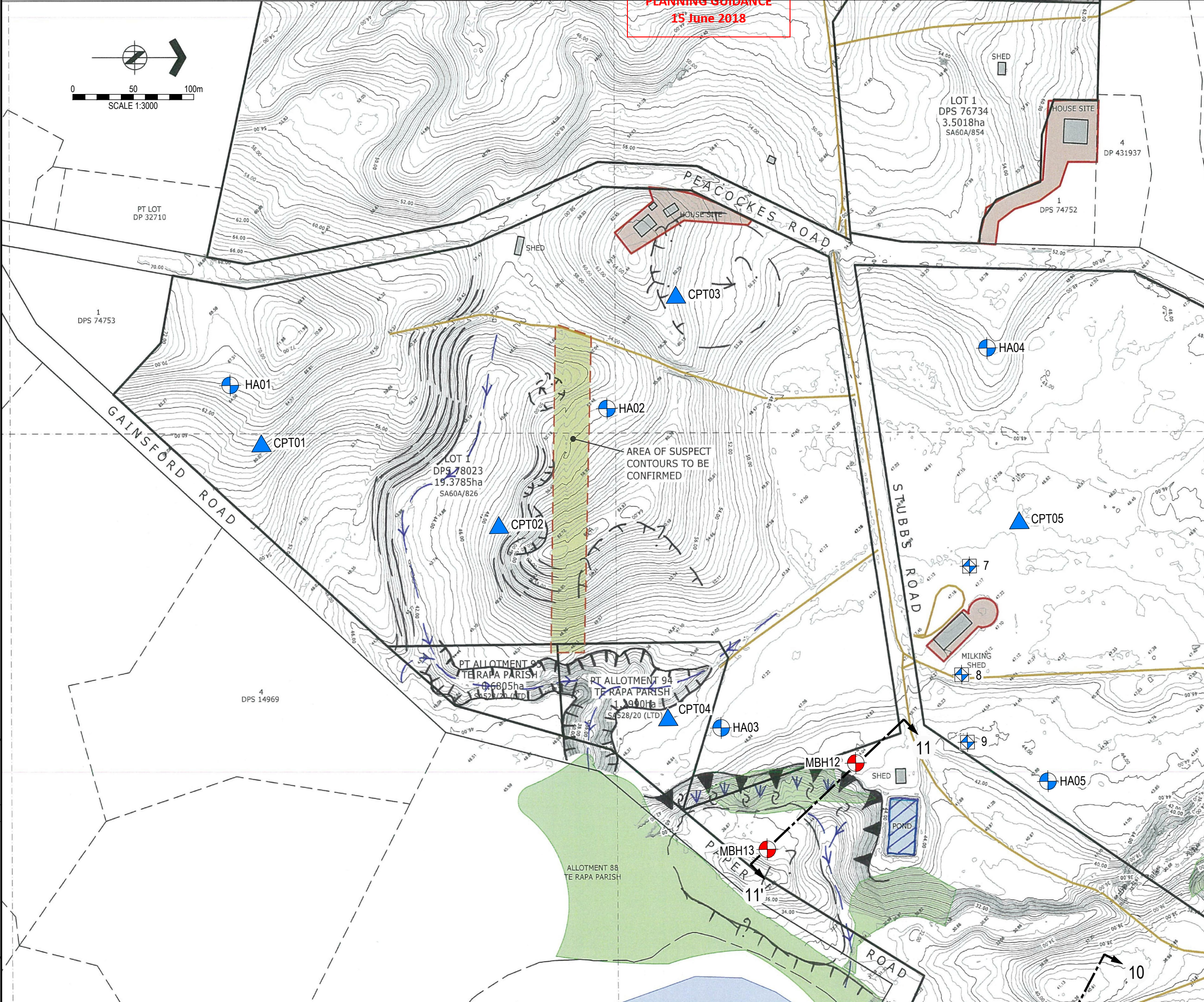
Client: WESTON LEA LIMITED		Appendix No:
Project: AMBERFIELD SUBDIVISION HAMILTON	Designed: MM	4.2
	Drawn: DF	
	Checked: -	
	Date: 05.09.17	
Project No: 14280.000.000	Scale: 1:3000	Size: A3 Rev: 3



DATE PLOTTED: 16 May 2018 1:45 p.m. BY: DOUG FINLAY

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PLANNING GUIDANCE
15 June 2018



Geomorphology Legend

- Scarp or Potentially Unstable Terrace Backslope
- Scarp & Lobe
- Bench
- Possible/Indistinct Scarp
- Soil Ridges
- Drains/Waterways
- Hummocky Ground
- Major Scarp or Large Terrace Backslope with Significant Potential for instability
- Marshy Ground
- Indistinct Lobe
- Indistinct Depression

Testing Legend

- 1 Soakage Test (Aug 2017)
- HA01 Hand Auger Test (Aug 2017)
- CPT01 Cone Penetrometer Test (Aug 2017)
- MBH1 Machine Borehole Test (Dec 2017)
- SCPT1 Seismic Cone Penetrometer Test (Dec 2017)



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Rev	Date	Description	Drwn	Chkd
3	16.5.18	Updated client & project details.	DF	PF
2	29.3.18	Update cross section locations.	DF	MM
1	10.01.18	Add test & cross section locations	DF	PF

Title:
GEOMORPHIC MAP C

Base drawing source: H&G drawing 141842-SS05A.

Client: WESTON LEA LIMITED		Appendix No:
Project: AMBERFIELD SUBDIVISION HAMILTON	Designed: MM	4.3
	Drawn: DF	
	Checked: -	
	Date: 05.09.17	
Project No: 14280.000.000	Scale: 1:3000	Size: A3 Rev: 3

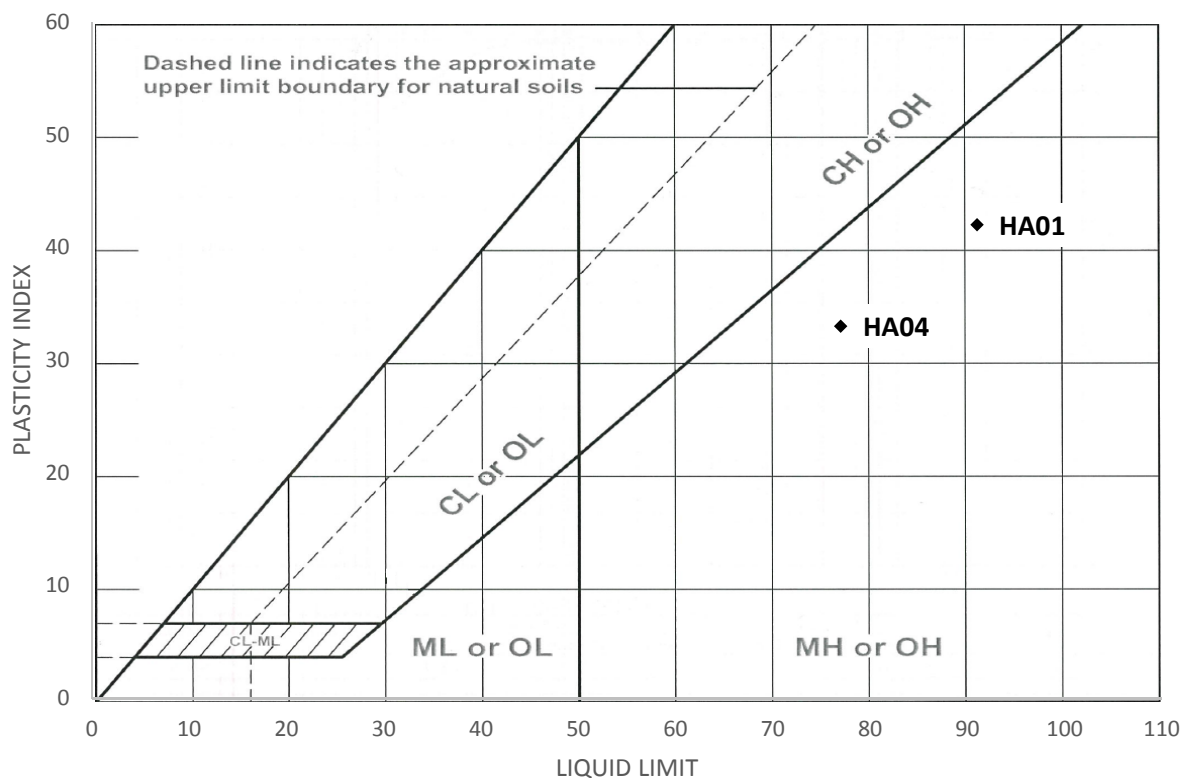
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CAD File Z:\Drawing\14001 to 15001\4280 - Peacocks Road\14280-GeomorphMap-PeacocksRd-0917-2.dwg

APPENDIX 5: Laboratory Test Results



Project : 14280.000.000
Location : Peacockes Road, Hamilton
Client: Weston Lea Limited
Date Tested: 14/09/2017 **Tested By:** NB

LIQUID AND PLASTIC LIMITS TEST REPORT

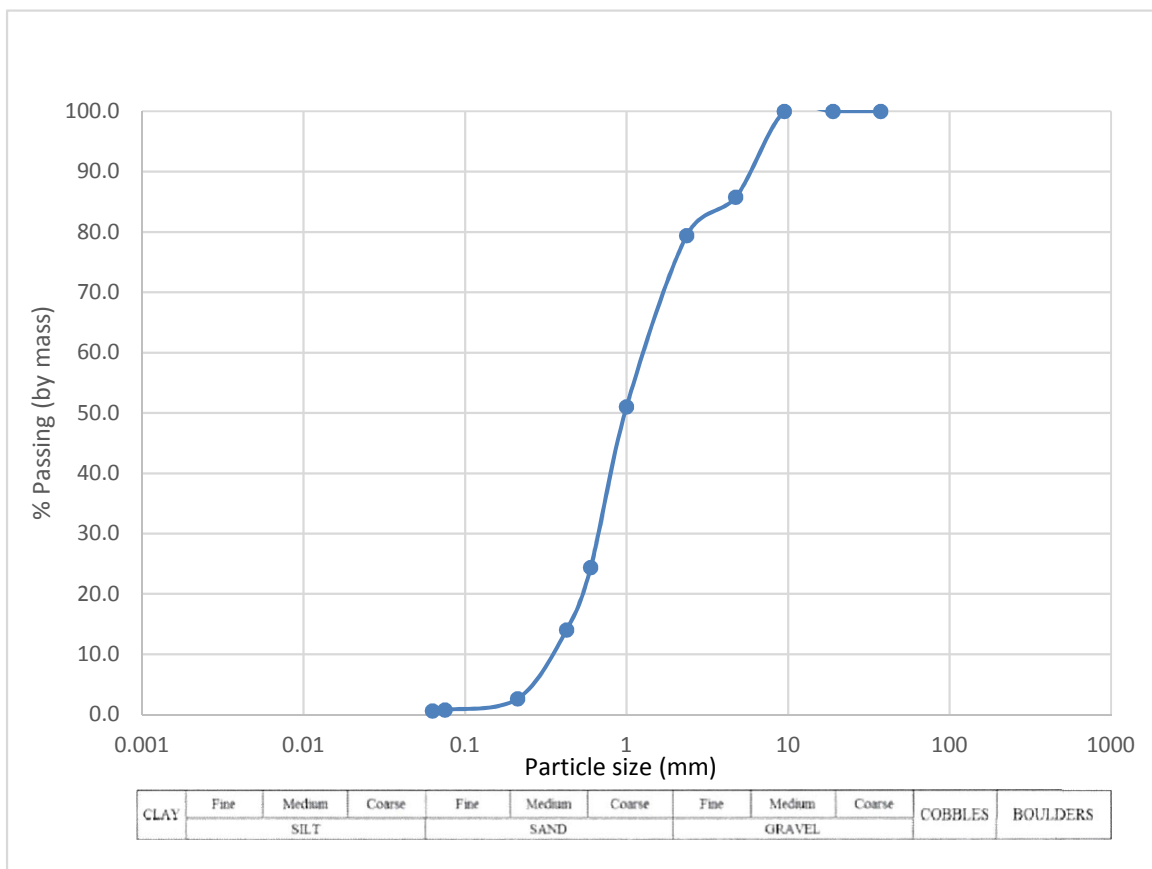


Summary of Testing

Investigation Name	Sample Depth (m)	Sample Water Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	Linear Shrinkage	USCS
HA01	0.7-0.9	55	91	49	42	21	MH or OH
HA04	0.6-0.8	46	77	44	33	17	MH or OH
HA15	0.9-1.1	Testing not carried out due to material being non-plastic					
HA17	0.8-1.0	Testing not carried out due to material being non-plastic					



Client:	Weston Lea Limited	
Project:	Amberfield Development	
Project Number:	14280.000.000	
Date:	18/09/2017	
Sample Number:	HA05	
Depth:	1.5 m - 1.8 m	By: NB



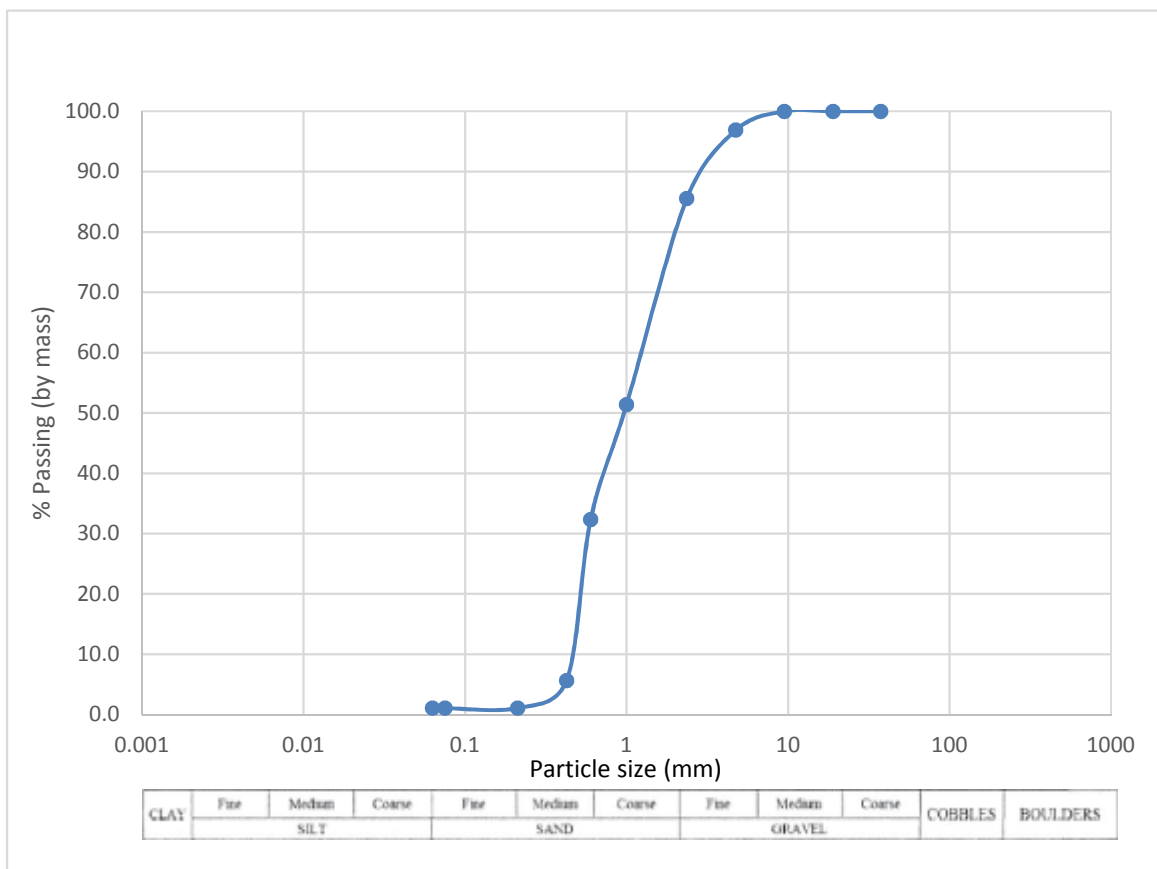
PARTICLE SIZE ANALYSIS	
SIEVE SIZE (mm)	% PASSING (BY MASS)
37.5	100.0
19	100.0
9.5	100.0
4.75	85.8
2.36	79.4
1	51.0
0.6	24.4
0.425	14.0
0.212	2.6
0.075	0.8
0.063	0.6

Material Description

Notes:



Client:	Weston Lea Limited	
Project:	Amberfield Development	
Project Number:	14280.000.000	
Date:	18/09/2017	
Sample Number:	HA06	
Depth:	0.2 m - 0.7 m	By: NB



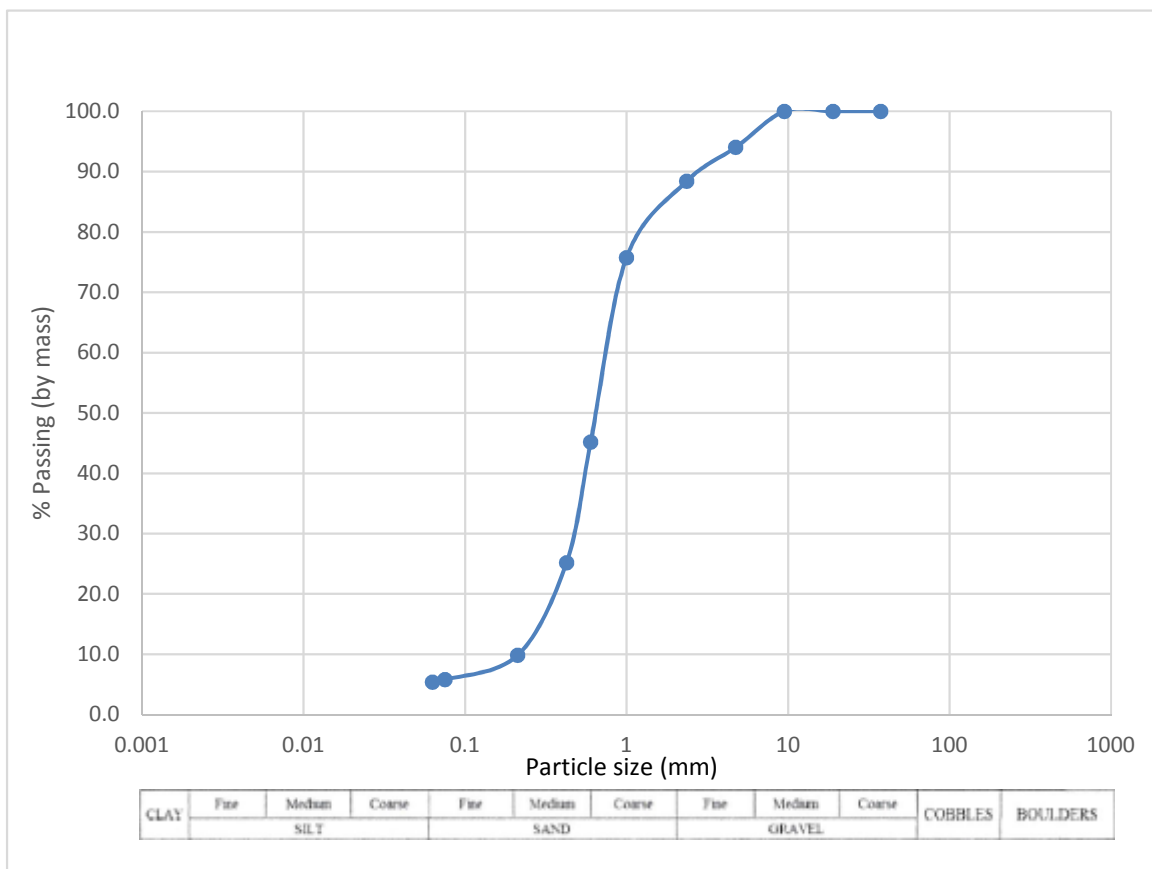
PARTICLE SIZE ANALYSIS	
SIEVE SIZE (mm)	% PASSING (BY MASS)
37.5	100.0
19	100.0
9.5	100.0
4.75	96.9
2.36	85.5
1	51.4
0.6	32.3
0.425	5.7
0.212	1.1
0.075	1.1
0.063	1.1

Material Description

Notes:



Client:	Weston Lea Limited
Project:	Amberfield Development
Project Number:	14280.000.000
Date:	18/09/2017
Sample Number:	HA10
Depth:	0.1 m - 0.7 m By: NB



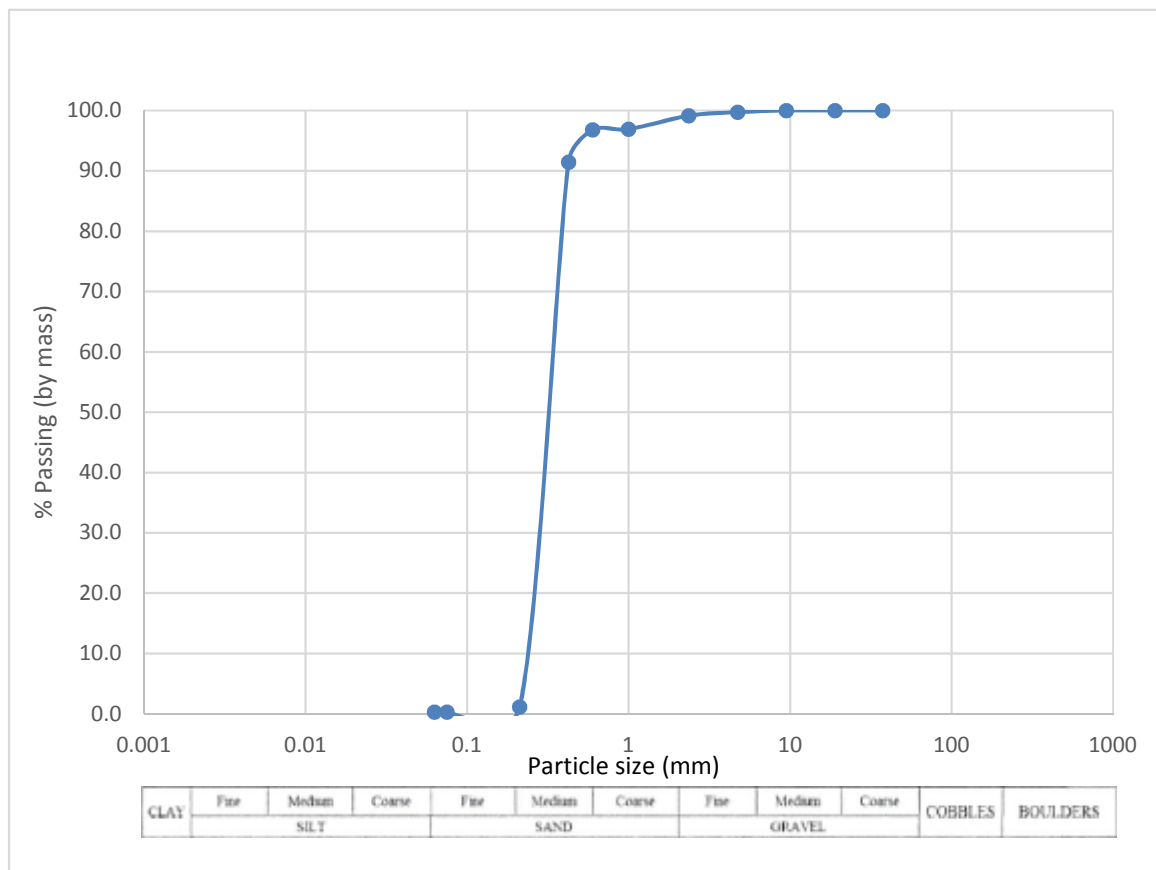
PARTICLE SIZE ANALYSIS	
SIEVE SIZE (mm)	% PASSING (BY MASS)
37.5	100.0
19	100.0
9.5	100.0
4.75	94.0
2.36	88.4
1	75.8
0.6	45.2
0.425	25.2
0.212	9.8
0.075	5.8
0.063	5.4

Material Description

Notes:



Client:	Weston Lea Limited		
Project:	Amberfield Development		
Project Number:	14280.000.000		
Date:	18/09/2017		
Sample Number:	HA12		
Depth:	0.8 m	1.8 m	By: NB



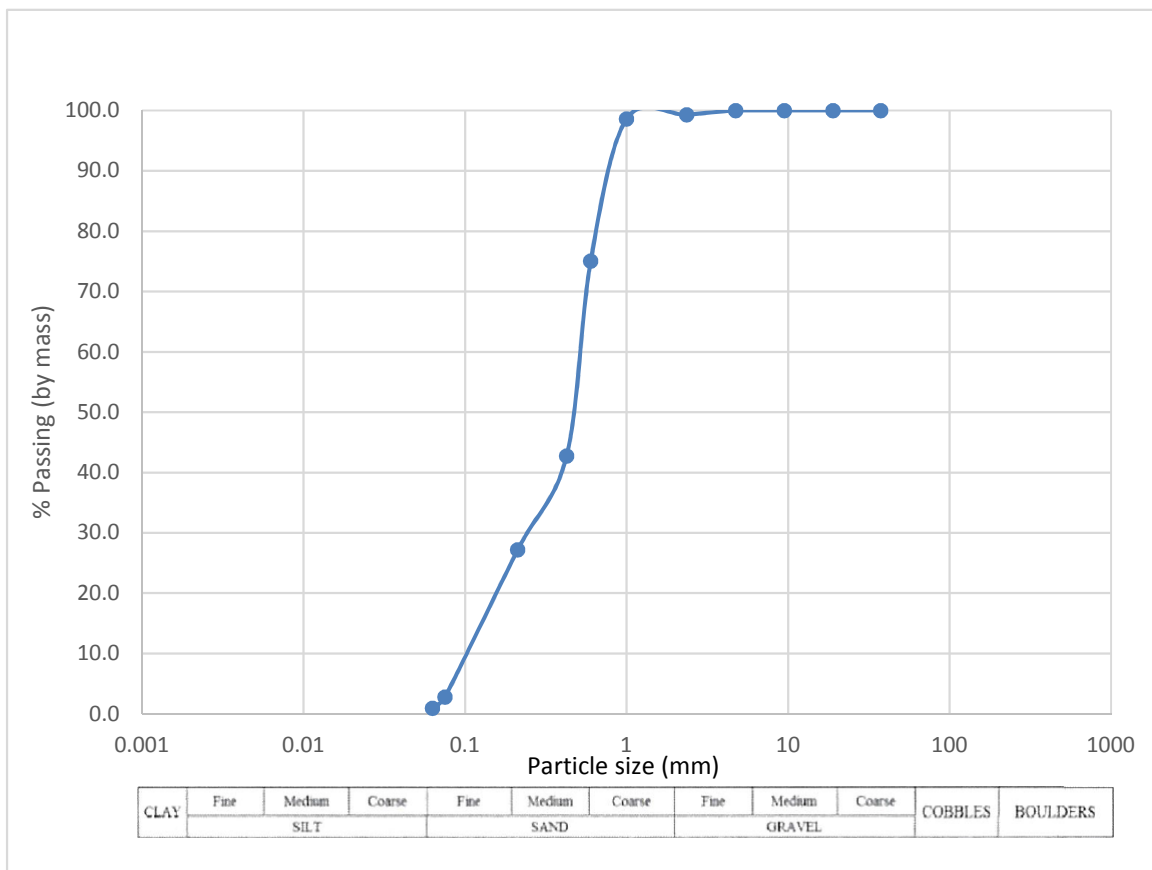
PARTICLE SIZE ANALYSIS	
SIEVE SIZE (mm)	% PASSING (BY MASS)
37.5	100.0
19	100.0
9.5	100.0
4.75	99.7
2.36	99.1
1	96.9
0.6	96.8
0.425	91.5
0.212	1.1
0.075	0.3
0.063	0.3

Material Description

Notes:



Client:	Weston Lea Limited
Project:	Amberfield Development
Project Number:	14280.000.000
Date:	18/09/2017
Sample Number:	HA13
Depth:	2.4 m - 2.7 m
By:	NB



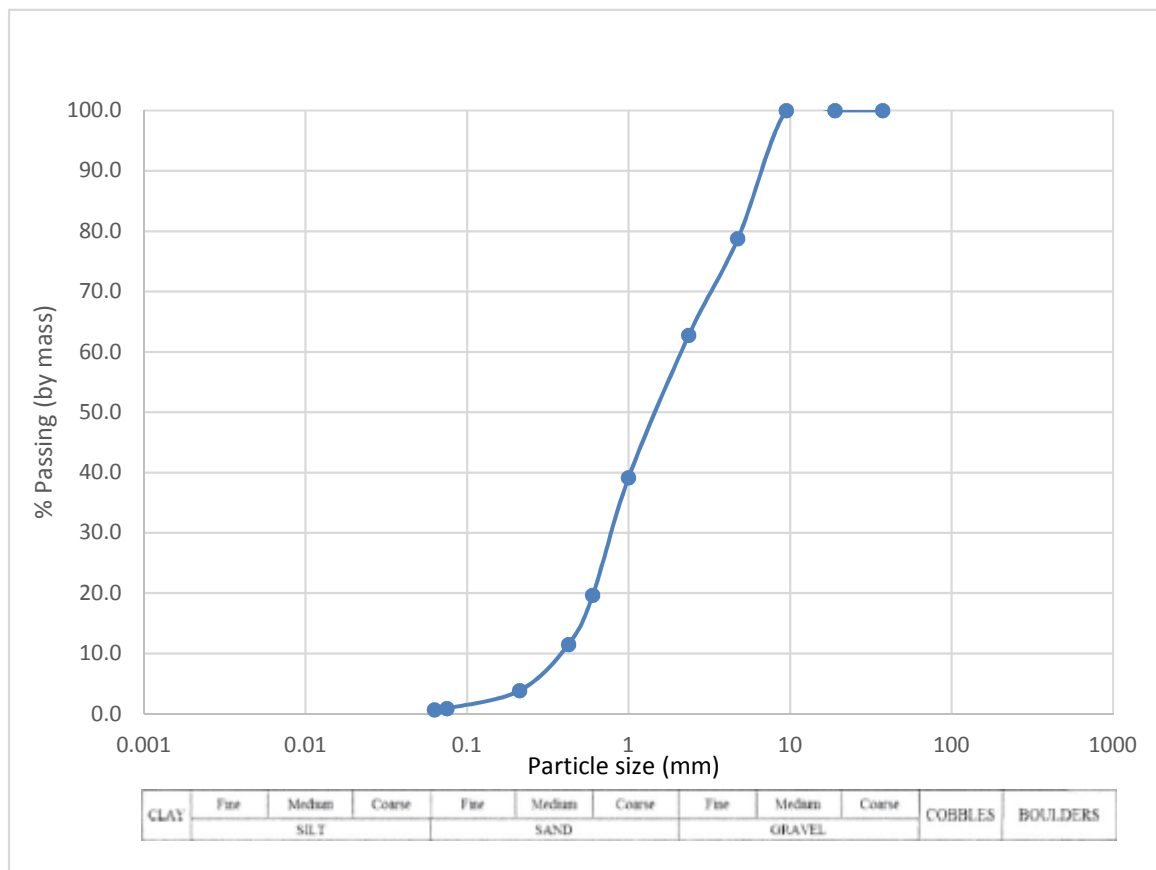
PARTICLE SIZE ANALYSIS	
SIEVE SIZE (mm)	% PASSING (BY MASS)
37.5	100.0
19	100.0
9.5	100.0
4.75	100.0
2.36	99.3
1	98.6
0.6	75.1
0.425	42.7
0.212	27.2
0.075	2.8
0.063	0.9

Material Description

Notes:



Client:	Weston Lea Limited		
Project:	Amberfield Development		
Project Number:	14280.000.000		
Date:	18/09/2017		
Sample Number:	HA17		
Depth:	1.3 m - 1.7 m	By:	NB



PARTICLE SIZE ANALYSIS	
SIEVE SIZE (mm)	% PASSING (BY MASS)
37.5	100.0
19	100.0
9.5	100.0
4.75	78.7
2.36	62.8
1	39.1
0.6	19.6
0.425	11.5
0.212	3.9
0.075	0.9
0.063	0.6

Material Description

Notes:



Babbage Geotechnical Laboratory

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Babbage Geotechnical Laboratory
Level 4

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E-mail

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New Zealand
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Please reply to: W.E. Campton

Page 1 of 1

ENGEO
PO Box 305 136
Triton Plaza
Auckland 0757

Job Number: 61326#L
BGL Registration Number: 2521
Checked by: WEC

Attention: **PAUL FLETCHER**

20th February 2018

DETECTION OF THE PRESENCE OF ALLOPHANE

Dear Sir,

Re: ADARE DEVELOPMENT
Report Number: 61326#L/ALLOPHANE

The following table presents the results of 'Detection of the Presence of Allophane in Soils' testing of soil samples delivered to this laboratory on the 14th of February 2018.

The samples were tested in accordance with the following standards:

Detection of Presence of Allophane in Soils: NZS4402:1986:Test 3.4

Borehole Number	Sample Number	Depth (m)	Allophane Content
MBH02	BAG	3.95 – 4.05	< 5%
HA21	BAG	3.50	> 7%
HA23	BAG	1.30 – 1.60	< 5%
HA27	BAG	1.20	< 5%

Please note that the test results relate only to the samples under test. Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report, please contact the undersigned at your convenience.

Yours faithfully,

Justin Franklin
Signatory (Assistant Laboratory Manager)
Babbage Geotechnical Laboratory



All tests reported herein have been performed in accordance with the laboratory's scope of accreditation. This report may not be reproduced except in full & with written approval from BGL.



Babbage Geotechnical Laboratory

Received
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15 June 2018

Babbage Geotechnical Laboratory
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E-mail

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New Zealand
64-9-367 4954
wec@babbage.co.nz

Please reply to: W.E. Campton

Page 1 of 7

ENGEO
PO Box 305 136
Triton Plaza
Auckland 0757

Job Number: 61326#L
BGL Registration Number: 2521
Checked by: WEC

Attention: **PAUL FLETCHER**

28th February 2018

CONSOLIDATED, UNDRAINED (CU), MULTI-STAGE TRIAXIAL COMPRESSIVE STRENGTH TESTING

Dear Sir,

Re: ADARE DEVELOPMENT

Report Number: 61326#L/CU Triaxial MBH02 3.00 – 3.50m

Borehole No: MBH02

Sample No: TUBE

Depth: 3.00 – 3.50m

The following report presents the results of triaxial compressive strength testing of a 60mm diameter undisturbed push-tube soil sample delivered to this laboratory on the 14th of February 2018. The client request was to measure the consolidated, undrained compression of the sample in a triaxial apparatus under known conditions of effective stress, with measurement of porewater pressure. We were instructed to test a single sample at effective pressures of 50kPa, 100kPa, and 200kPa by carrying out a 3-point multi-stage test.

Please note that the multi-stage method described below is commonly carried out by soils testing laboratories, but is not part of BS1377:1990: Part 8: Section 7 (*in which a number of specimens taken from one soil sample are each tested to failure at different effective pressures*). The method described below is therefore a departure from BS1377:1990: Part 8: Section 7.

Test standards used were:

Water Content:	NZS4402: 1986: Test 2.1
Preparation of specimen:	BS1377: 1990: Part 8: Section 4
Saturation:	BS1377: 1990: Part 8: Section 5
Consolidation:	BS1377: 1990: Part 8: Section 6
Consolidated-undrained triaxial compression test with measurement of pore pressure:	BS1377: 1990: Part 8: Section 7

Test Procedure

The sample was extruded from the push-tube and trimmed to length. The sample was then set up in a triaxial cell & saturation was achieved in distinct stages by 50kPa increments of cell pressure and back pressure, with a differential pressure of 10kPa (*cell pressure 10kPa greater than back pressure*) in order to maintain a small positive effective stress.



Babbage Geotechnical Laboratory

Job Number: 61326#L

28th February 2018

Page 2 of 7

The final saturation stage used a cell pressure of 400kPa and a back pressure of 390kPa. Saturation was then confirmed by increasing the cell pressure to 440kPa, and observing the increase in porewater pressure. A porewater pressure coefficient (B) of 1.01 was achieved, confirming saturation of the sample.

Excess porewater pressure was then dissipated during the first consolidation cycle, resulting in an effective stress of 50kPa. The sample was then compressed at a set rate of 0.012mm per minute (actual rate of 0.014mm per minute) until the stress ratio was close to maximum.

Compression was then stopped and the load taken off the sample. Cell pressure was increased to 490kPa and the resulting increased porewater pressure was dissipated in the second consolidation cycle, resulting in an effective pressure of 100kPa acting on the same sample. Once consolidated, the 2nd compression cycle was compressed at a set rate of 0.012mm per minute (actual rate of 0.012mm per minute) until the stress ratio was close to maximum.

Compression was again stopped and the load taken off the sample. Cell pressure was increased to 590kPa and the resulting increased porewater pressure was dissipated in the third consolidation cycle, resulting in an effective pressure of 200kPa acting on the same sample. Once consolidated, the 3rd compression cycle was compressed at a set rate of 0.012mm per minute (actual rate of 0.011mm per minute) until complete failure of the sample had occurred.

Mohr circle plots for each cycle are presented on page 4 of this report. We leave the determination of the angle of resistance and the cohesion to our clients, but as a guide to this we tabulate each tangent to sets of circles on the graph.

This test was carried out in a laboratory in which the temperature is controlled between 18°C and 22°C. Each test result is data obtained at a specific test location. The nature and continuity of subsoil conditions away from the test area could vary from the data recovered during this testing.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the undersigned at your convenience.

Yours faithfully,

Justin Franklin

Signatory (Assistant Laboratory Manager)
Babbage Geotechnical Laboratory



All tests reported herein have been performed in accordance with the laboratory's scope of accreditation. This report may not be reproduced except in full & with written approval from BGL.



BGL

Babbage Geotechnical Laboratory

Received

PLANNING GUIDANCE

15 June 2018

Registration No.

2521

Job Number:

61326#L

Report No:

61326#L/OU

Page 3 of 7

Version No:

4

Issue Date:

Aug-17

Auth. By:

WEC

ADARE DEVELOPMENT

CU MULTI-STAGE TRIAXIAL COMPRESSION TEST

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained triaxial compression test with measurement of pore pressure / NZS4402:1986: Test 2.1 - Water Content

Tested By:

JF

Feb 2018

Compiled By:

JF

27-Feb-18

Checked By:

WEC

28-Feb-18

Borehole:

MBH02

Sample No:

TUBE

Depth:

3.00 - 3.50m

Sample History:

undisturbed / remoulded / compacted / other

Sample Description

(not part of BGL IANZ accreditation):

SILT, soft to firm, moderately plastic, light grey with faint black flecks, moist to very moist.

Test Procedure:

single sample with side drains at different effective consolidation pressures.

SAMPLE DETAILS

Initial Diameter:	60.0 mm	Initial Moisture Content:	52.3 %
Initial Length:	121.0 mm	Final Moisture Content:	48.2 %
Initial Mass:	614.60 g	Initial Dry Density:	1.18 t/m ³
Initial Bulk Density:	1.80 t/m ³	Final Dry Density:	1.23 t/m ³

SATURATION CYCLE

Saturation Procedure:

50kPa increments of cell pressure and back pressure, differential pressure of 10kPa. Saturated from top and base of sample.

At End of Saturation:

Cell Pressure Increase:	40.0 kPa	Final Cell Pressure:	440 kPa
Resulting Increase in Pore Pressure:	40.5 kPa	Final Pore Pressure:	430.9 kPa
Pore Pressure Coefficient B:	1.01		

Test Cycles:

	1	2	3	
CONSOLIDATION CYCLES				
Cell Pressure	kPa	440	490	590
Back Pressure	kPa	390	390	390
Effective Pressure	kPa	50	100	200
Pore Pressure at Start of Consolidation	kPa	431.2	467.2	527.8
Pore Pressure to Dissipate	kPa	41.2	77.2	137.8
Dissipation	%	98.5	98.6	97.9
Pore Pressure at End of Consolidation	kPa	390.6	391.1	392.9

COMPRESSION CYCLES

Rate of Strain (set)	mm/min	0.012	0.012	0.012
Rate of Strain (actual)	mm/min	0.014	0.012	0.011
Pore Pressure at Start of Compression	kPa	390.6	391.1	392.9
Effective Major Principal Stress at Start of Compression	kPa	49.4	98.9	197.1

FAILURE CONDITIONS

Criteria Used to Determine Failure:	maximum deviator stress / maximum effective principal stress ratio			
Axial Strain at Failure (*cumulative)	%	3.00	* 5.62	* 8.37
Axial Strain at Failure (*cumulative)	mm	3.61	* 6.66	* 9.76
Deviator Stress at Failure	kPa	118.4	240.7	408.5
Pore Pressure at Failure	kPa	390.7	391.7	415.6
Effective Major Principal Stress at Failure	kPa	167.7	339.0	582.9
Effective Minor Principal Stress at Failure	kPa	49.3	98.3	174.4
Effective Principal Stress Ratio at Failure		3.400	3.448	3.343

Failure Type:

planar / plastic

CORRECTIONS APPLIED TO MEASURED DEVIATOR STRESS

Membrane Restraining Effect Correction	kPa	0.3	0.5	0.7
Vertical Side Drain Correction	kPa	6.0	6.0	6.0

28/02/2018

Adare Development Triaxial MBH02 3.00 - 3.50m.xlsx

3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

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Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
Tested By:	JF
Plotted By:	JF
Checked By:	WEC
	Feb 2018
	27-Feb-18
	28-Feb-18

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained with Porewater Pressure Measurement

PROJECT:	ADARE DEVELOPMENT		
Job No:	61326#L	Borehole Number:	MBH02
Reg. No:	2521	Sample Number:	TUBE
		Depth:	3.00 - 3.50m

Mohr Circle Plot:

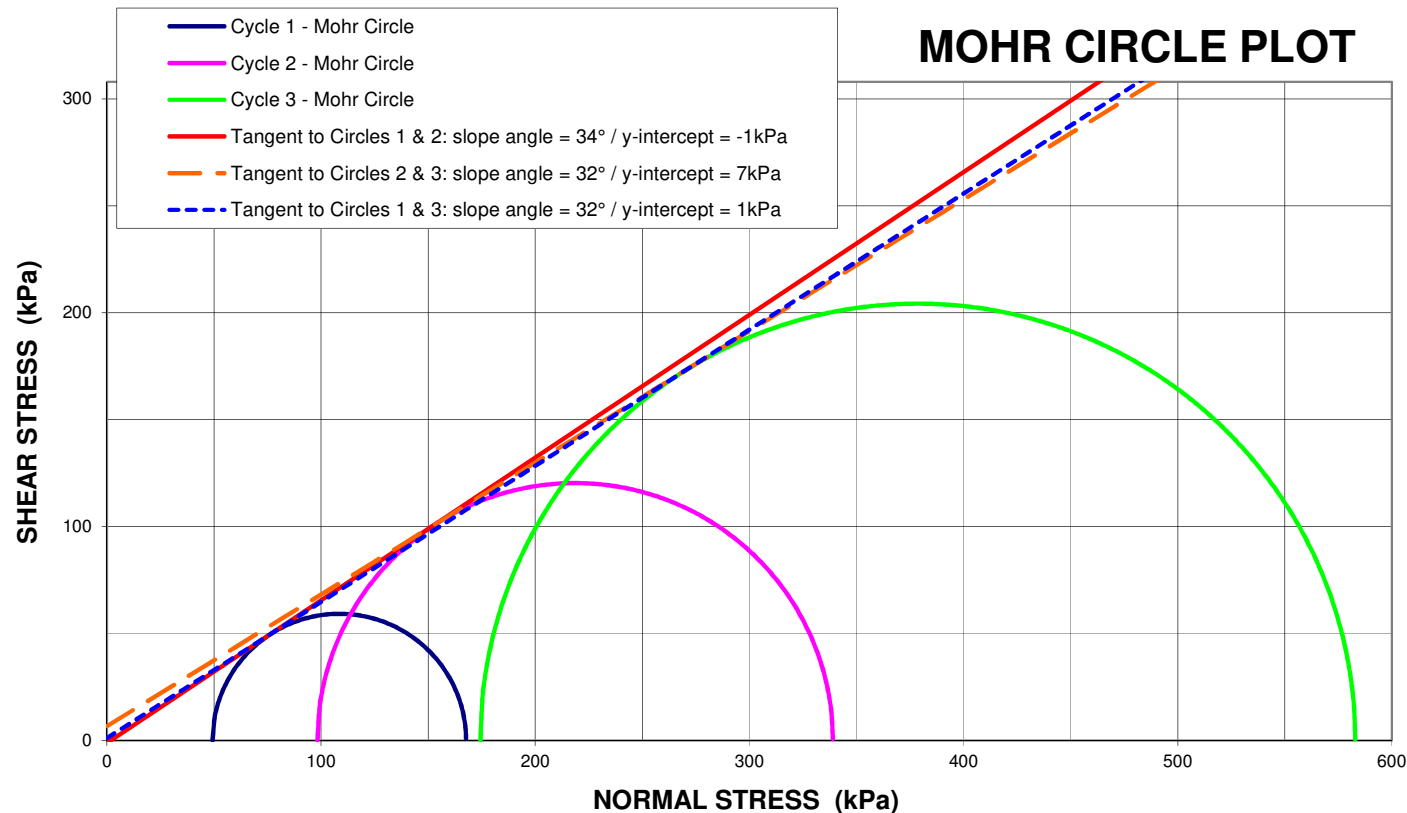
cycle	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Stress Path Parameters	
	(σ_1') kPa	(σ_3') kPa	s' ($\sigma_1' + \sigma_3'$)/2 kPa	t' ($\sigma_1' - \sigma_3'$)/2 kPa
1	168	49	109	59
2	339	98	219	120
3	583	174	379	204

From Graph Below:

Angle of Shear Resistance $\phi' =$ degrees

Cohesion $c' =$ kPa

(Values to be decided upon by Geotechnical Engineer)



3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

Page 5 of 7

Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
Tested By:	JF Feb 2018
Plotted By:	JF 27-Feb-18
Checked By:	WEC 28-Feb-18

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained with Porewater Pressure Measurement

PROJECT:

ADARE DEVELOPMENT

Job No: 61326#L

Borehole Number: MBH02

Depth: 3.00 - 3.50m

Reg. No: 2521

Sample Number: TUBE

Tested By:

JF

Feb 2018

Plotted By:

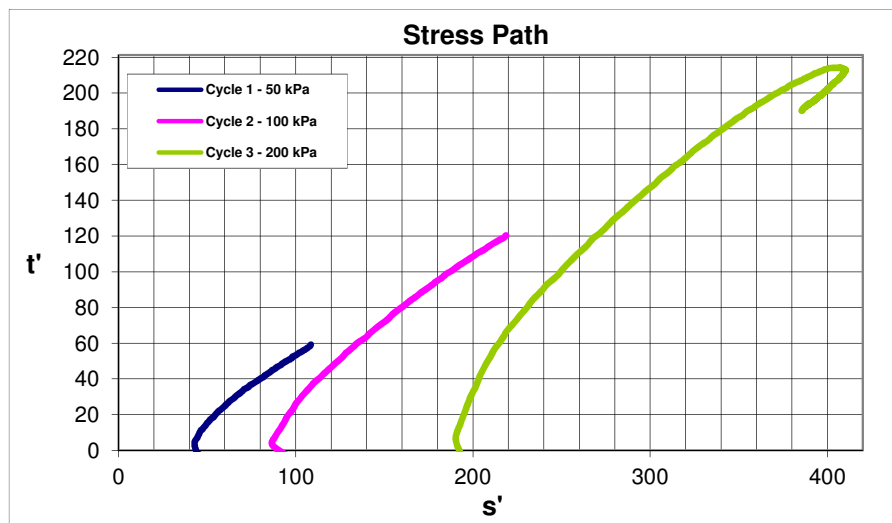
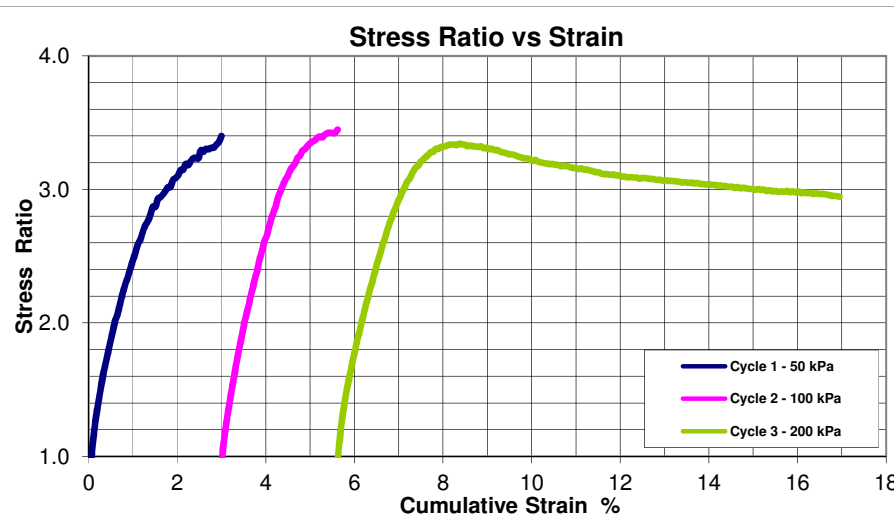
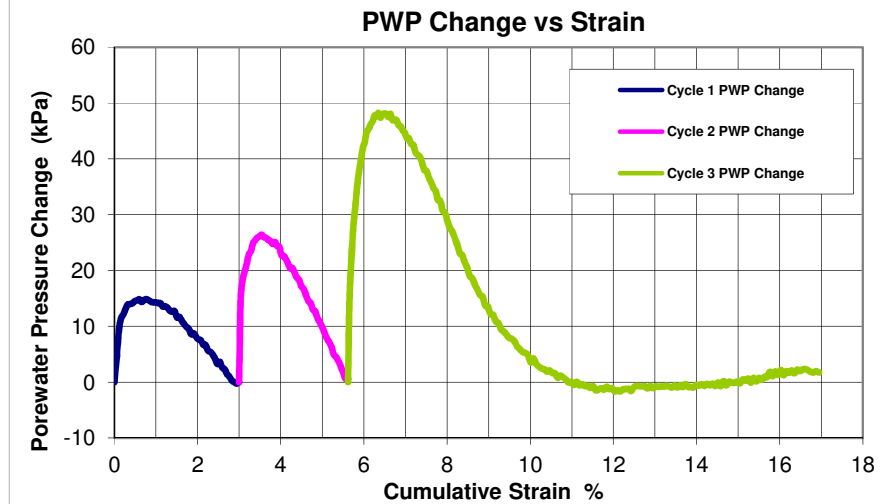
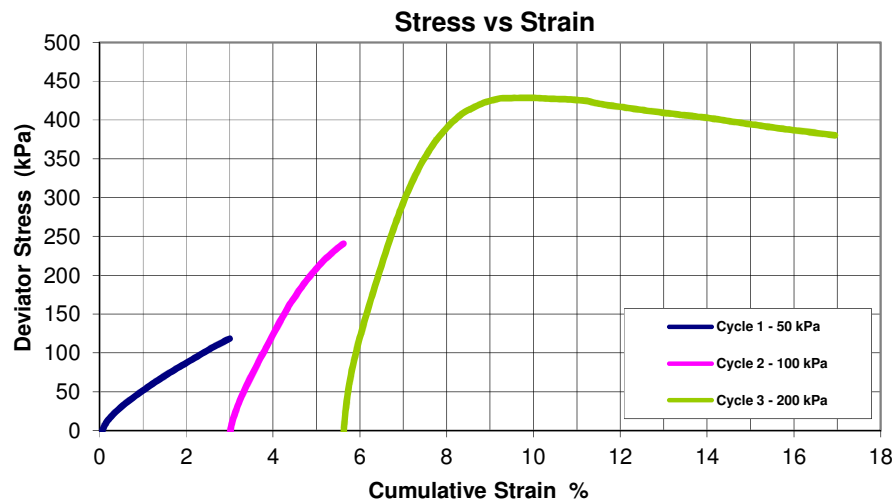
JF

27-Feb-18

Checked By:

WEC

28-Feb-18



3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

Page 6 of 7

Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
JF	Feb 2018
JF	27-Feb-18
WEC	28-Feb-18

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained with Porewater Pressure Measurement

PROJECT:

ADARE DEVELOPMENT

Job No:

61326#L

Borehole Number:

MBH02

Depth:

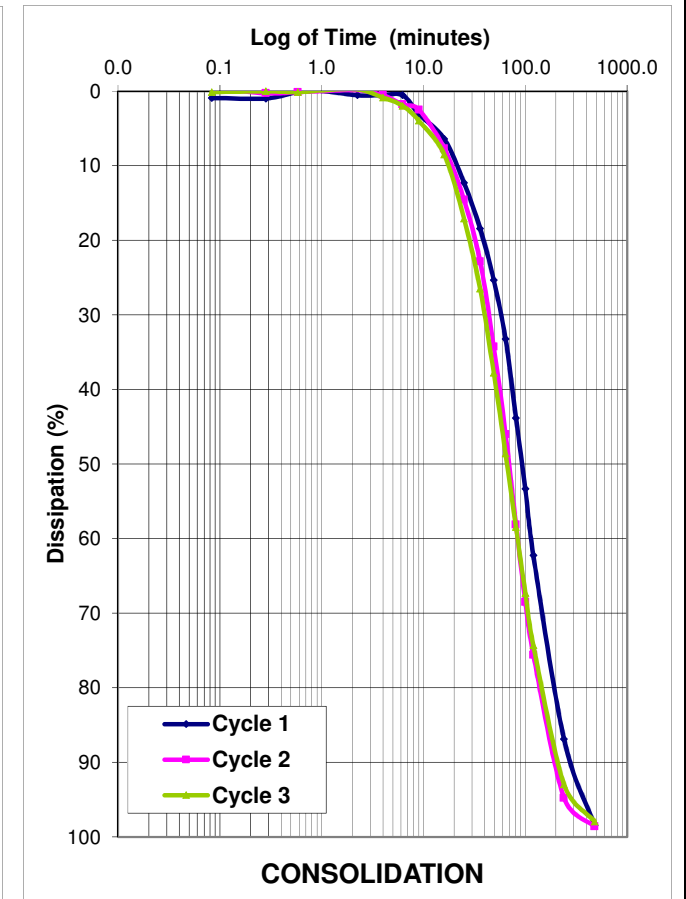
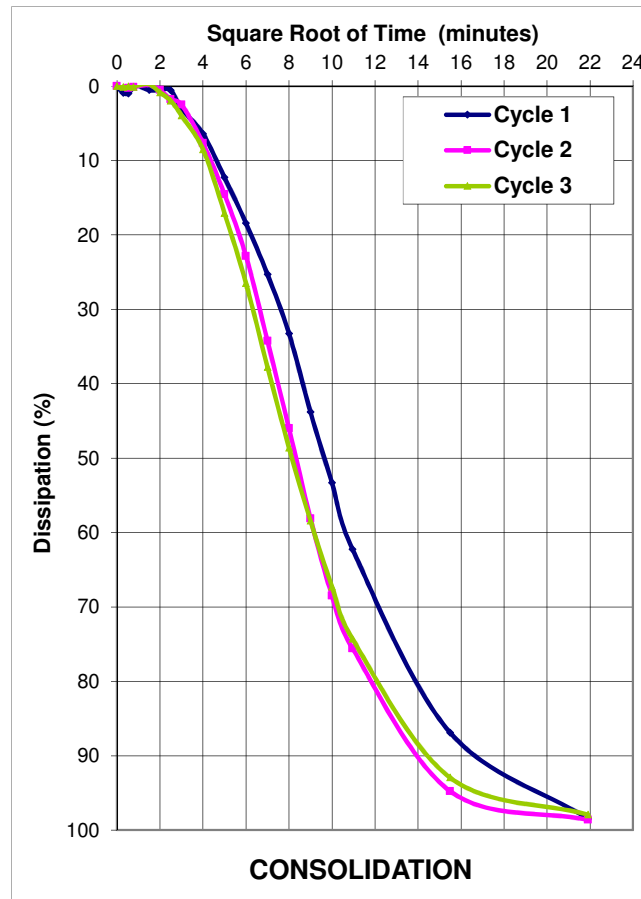
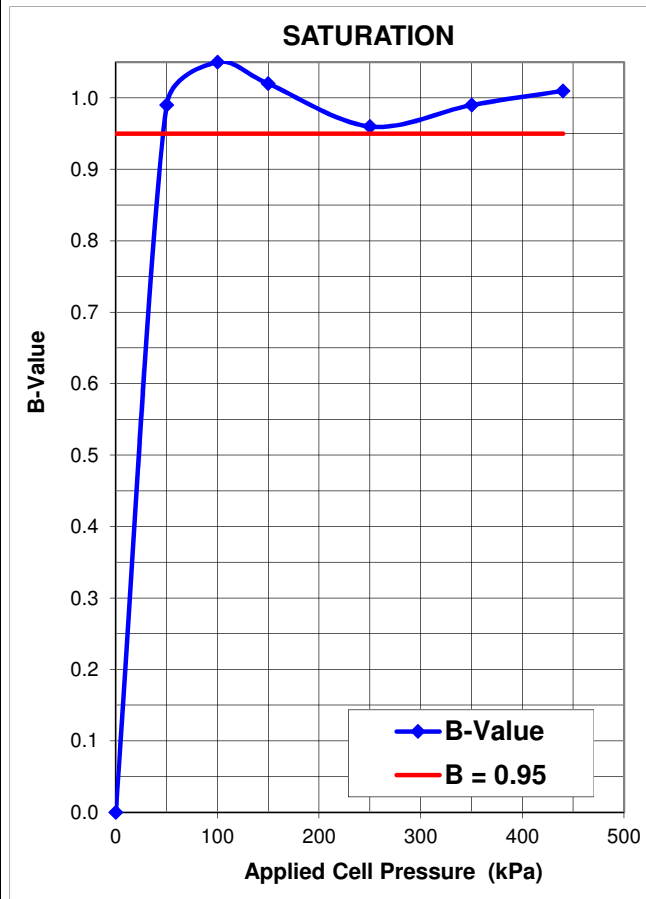
3.00 - 3.50m

Reg. No:

2521

Sample Number:

TUBE



15 June 2018

3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

Page 7 of 7

Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
Tested By:	JF
Plotted By:	JF
Checked By:	WEC

BS 1377:1990: Test 8: Section 7: Consolidated Undrained with Porewater Pressure Measurement

PROJECT:

ADARE DEVELOPMENT

Job No: 61326#L

Borehole Number: **MBH02**Depth: **3.00 - 3.50m**

Reg. No: 2521

Sample Number: **TUBE****SAMPLE BEFORE TEST****SAMPLE AFTER TEST**



Babbage Geotechnical Laboratory

Received
PLANNING GUIDANCE
15 June 2018

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wec@babbage.co.nz

Please reply to: W.E. Campton

Page 1 of 7

ENGEO
PO Box 305 136
Triton Plaza
Auckland 0757

Job Number: 61326#L
BGL Registration Number: 2521
Checked by: WEC

Attention: **PAUL FLETCHER**

8th March 2018

CONSOLIDATED, UNDRAINED (CU), MULTI-STAGE TRIAXIAL COMPRESSIVE STRENGTH TESTING

Dear Sir,

Re: ADARE DEVELOPMENT

Report Number: 61326#L/CU Triaxial MBH03 10.60 – 11.10m

Borehole No: MBH03

Sample No: TUBE

Depth: 10.60 – 11.10m

The following report presents the results of triaxial compressive strength testing of a 60mm diameter undisturbed push-tube soil sample delivered to this laboratory on the 14th of February 2018. The client request was to measure the consolidated, undrained compression of the sample in a triaxial apparatus under known conditions of effective stress, with measurement of porewater pressure. We were instructed to test a single sample at effective pressures of 100kPa, 200kPa, and 400kPa by carrying out a 3-point multi-stage test.

Please note that the multi-stage method described below is commonly carried out by soils testing laboratories, but is not part of BS1377:1990: Part 8: Section 7 (*in which a number of specimens taken from one soil sample are each tested to failure at different effective pressures*). The method described below is therefore a departure from BS1377:1990: Part 8: Section 7.

Test standards used were:

Water Content:	NZS4402: 1986: Test 2.1
Preparation of specimen:	BS1377: 1990: Part 8: Section 4
Saturation:	BS1377: 1990: Part 8: Section 5
Consolidation:	BS1377: 1990: Part 8: Section 6
Consolidated-undrained triaxial compression test with measurement of pore pressure:	BS1377: 1990: Part 8: Section 7

Test Procedure

The sample was extruded from the push-tube and trimmed to length. The sample was then set up in a triaxial cell & saturation was achieved in distinct stages by 50kPa increments of cell pressure and back pressure, with a differential pressure of 10kPa (*cell pressure 10kPa greater than back pressure*) in order to maintain a small positive effective stress.



Babbage Geotechnical Laboratory

Job Number: 61326#L

8th March 2018

Page 2 of 7

The final saturation stage used a cell pressure of 400kPa and a back pressure of 390kPa. Saturation was then confirmed by increasing the cell pressure to 490kPa, and observing the increase in porewater pressure. A porewater pressure coefficient (B) of 1.02 was achieved, confirming saturation of the sample.

Excess porewater pressure was then dissipated during the first consolidation cycle, resulting in an effective stress of 100kPa. The sample was then compressed at a set rate of 0.015mm per minute (actual rate of 0.015mm per minute) until the deviator stress was close to maximum.

Compression was then stopped and the load taken off the sample. Cell pressure was increased to 590kPa and the resulting increased porewater pressure was dissipated in the second consolidation cycle, resulting in an effective pressure of 200kPa acting on the same sample. Once consolidated, the 2nd compression cycle was compressed at a set rate of 0.015mm per minute (actual rate of 0.014mm per minute) until the deviator stress was close to maximum.

Compression was again stopped and the load taken off the sample. Cell pressure was increased to 790kPa and the resulting increased porewater pressure was dissipated in the third consolidation cycle, resulting in an effective pressure of 400kPa acting on the same sample. Once consolidated, the 3rd compression cycle was compressed at a set rate of 0.015mm per minute (actual rate of 0.014mm per minute) until complete failure of the sample had occurred.

Mohr circle plots for each cycle are presented on page 4 of this report. We leave the determination of the angle of resistance and the cohesion to our clients, but as a guide to this we tabulate each tangent to sets of circles on the graph.

This test was carried out in a laboratory in which the temperature is controlled between 18°C and 22°C. Each test result is data obtained at a specific test location. The nature and continuity of subsoil conditions away from the test area could vary from the data recovered during this testing.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the undersigned at your convenience.

Yours faithfully,

Justin Franklin

Signatory (Assistant Laboratory Manager)
Babbage Geotechnical Laboratory



All tests reported herein have been performed in accordance with the laboratory's scope of accreditation. This report may not be reproduced except in full & with written approval from BGL.



Babbage Geotechnical Laboratory

Received

Registration No. 2521

15 June 2018

Job Number: 61326#L

Report No: 61326#L/CU Triaxial MBH03 10.60 - 11.10m

PLANNING GUIDANCE

Page 3 of 7

Version No: 4

Issue Date: Aug-17

Auth. By: WEC

ADARE DEVELOPMENT

CU MULTI-STAGE TRIAXIAL COMPRESSION TEST

Tested By: JF

Feb 2018

Compiled By: JF

6-Mar-18

Checked By: WEC

8-Mar-18

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained triaxial compression test with measurement of pore pressure / NZS4402:1986: Test 2.1 - Water Content

Borehole: MBH03

Sample No: TUBE

Depth: 10.60 - 11.10m

Sample History: undisturbed / remoulded / compacted / other

Sample Description (not part of BGL IANZ accreditation):

Intermixed PEAT, amorphous, plastic, dark blackish brown, slightly moist, & SILT, slightly plastic, light grey, very moist to wet, small pocket of coarse sand near top of sample.

Test Procedure: single sample with side drains at different effective consolidation pressures.

SAMPLE DETAILS

Initial Diameter:	61.0 mm	Initial Moisture Content:	110.0 %
Initial Length:	120.0 mm	Final Moisture Content:	73.7 %
Initial Mass:	479.09 g	Initial Dry Density:	0.65 t/m ³
Initial Bulk Density:	1.37 t/m ³	Final Dry Density:	0.86 t/m ³

SATURATION CYCLE

Saturation Procedure: 50kPa increments of cell pressure and back pressure, differential pressure of 10kPa. Saturated from top and base of sample.

At End of Saturation:

Cell Pressure Increase:	90.0 kPa	Final Cell Pressure:	490 kPa
Resulting Increase in Pore Pressure:	91.5 kPa	Final Pore Pressure:	481.8 kPa
Pore Pressure Coefficient B:	1.02		

Test Cycles:

	1	2	3
--	---	---	---

CONSOLIDATION CYCLES

Cell Pressure	kPa	490	590	790
Back Pressure	kPa	390	390	390
Effective Pressure	kPa	100	200	400
Pore Pressure at Start of Consolidation	kPa	482.1	519.0	701.4
Pore Pressure to Dissipate	kPa	92.1	129.0	311.4
Dissipation	%	96.3	95.8	99.1
Pore Pressure at End of Consolidation	kPa	393.4	395.4	392.7

COMPRESSION CYCLES

Rate of Strain (set)	mm/min	0.015	0.015	0.015
Rate of Strain (actual)	mm/min	0.015	0.014	0.014
Pore Pressure at Start of Compression	kPa	393.4	395.4	392.7
Effective Major Principal Stress at Start of Compression	kPa	96.6	194.6	397.3

FAILURE CONDITIONS

Criteria Used to Determine Failure:	maximum deviator stress / maximum effective principal stress ratio			
Axial Strain at Failure (*cumulative)	%	4.77	* 9.65	* 18.54
Axial Strain at Failure (*cumulative)	mm	5.54	* 10.76	* 19.56
Deviator Stress at Failure	kPa	68.3	159.2	306.8
Pore Pressure at Failure	kPa	458.3	530.6	691.5
Effective Major Principal Stress at Failure	kPa	100.0	218.6	405.2
Effective Minor Principal Stress at Failure	kPa	31.7	59.4	98.5
Effective Principal Stress Ratio at Failure		3.153	3.681	4.116

Failure Type: PLANAR / PLASTIC

CORRECTIONS APPLIED TO MEASURED DEVIATOR STRESS

Membrane Restraining Effect Correction	kPa	0.4	0.7	1.2
Vertical Side Drain Correction	kPa	5.9	5.9	5.9

8/03/2018

Adare Development Triaxial MBH03 10.60 - 11.10m.xlsx

3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

Page 4 of 7

Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
Tested By:	JF
Plotted By:	JF
Checked By:	WEC
	Feb 2018
	6-Mar-18
	8-Mar-18

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained with Porewater Pressure Measurement

PROJECT:	ADARE DEVELOPMENT			
Job No:	61326#L	Borehole Number:	MBH03	Depth:
Reg. No:	2521	Sample Number:	TUBE	10.60 - 11.10m

Mohr Circle Plot:

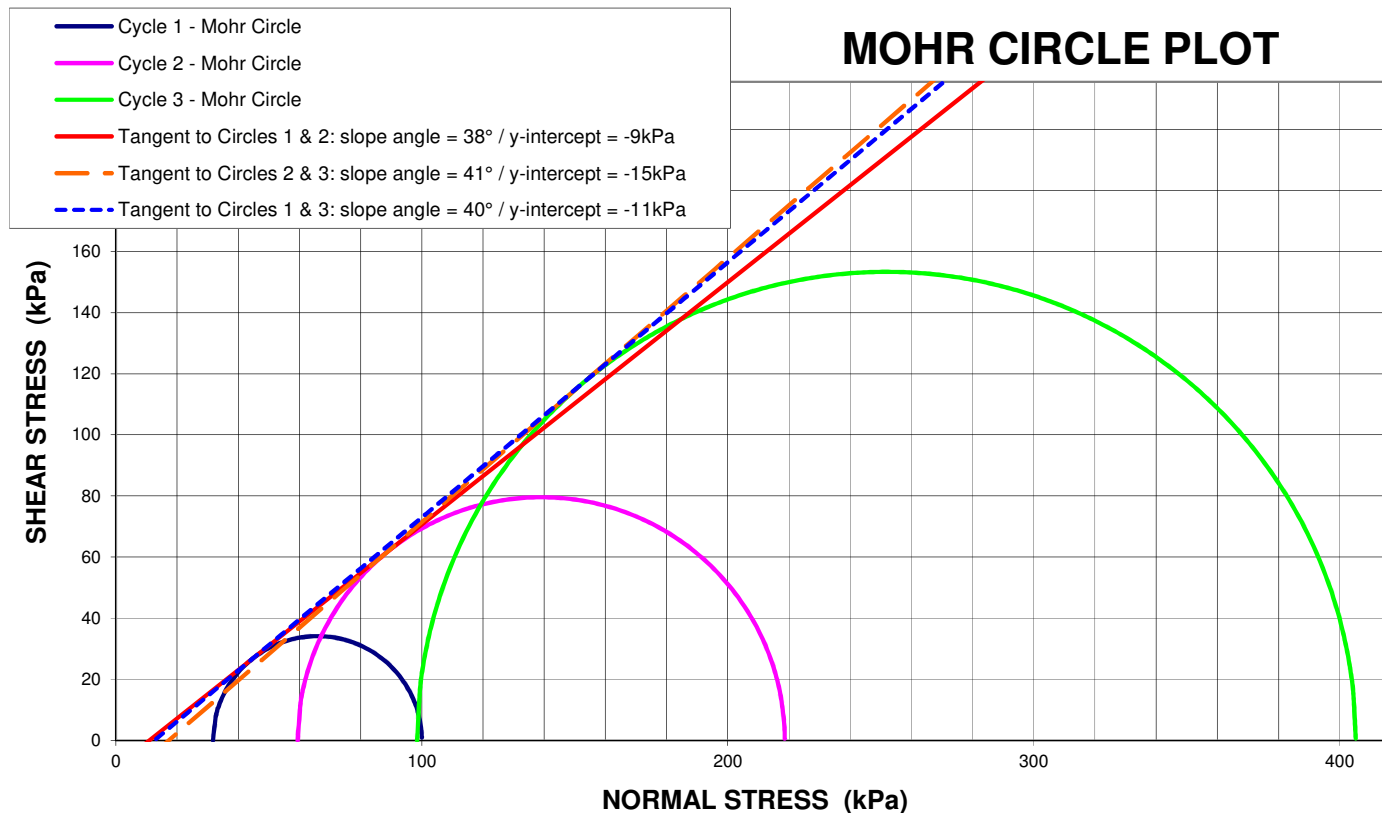
cycle	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Stress Path Parameters	
	(σ_1') kPa	(σ_3') kPa	s' ($\sigma_1' + \sigma_3'$)/2 kPa	t' ($\sigma_1' - \sigma_3'$)/2 kPa
1	100	32	66	34
2	219	59	139	80
3	405	98	252	153

From Graph Below:

Angle of Shear Resistance $\phi' =$ degrees

Cohesion $c' =$ kPa

(Values to be decided upon by Geotechnical Engineer)



3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

Page 5 of 7

Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
Tested By:	JF
Plotted By:	JF
Checked By:	WEC
	Feb 2018
	6-Mar-18
	8-Mar-18

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained with Porewater Pressure Measurement

PROJECT:

ADARE DEVELOPMENT

Job No: 61326#L

Borehole Number: MBH03

Depth: 10.60 - 11.10m

Reg. No: 2521

Sample Number: MBH03 TUBE

Tested By:

JF

Plotted By:

JF

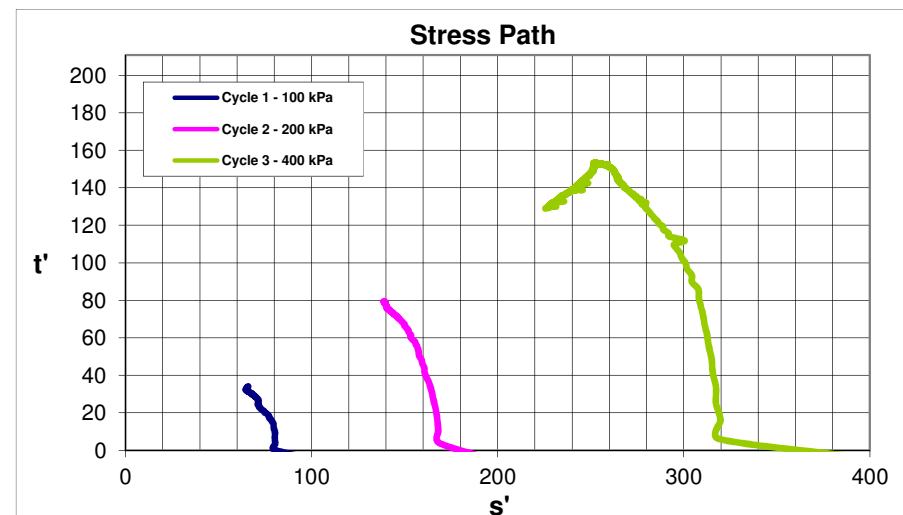
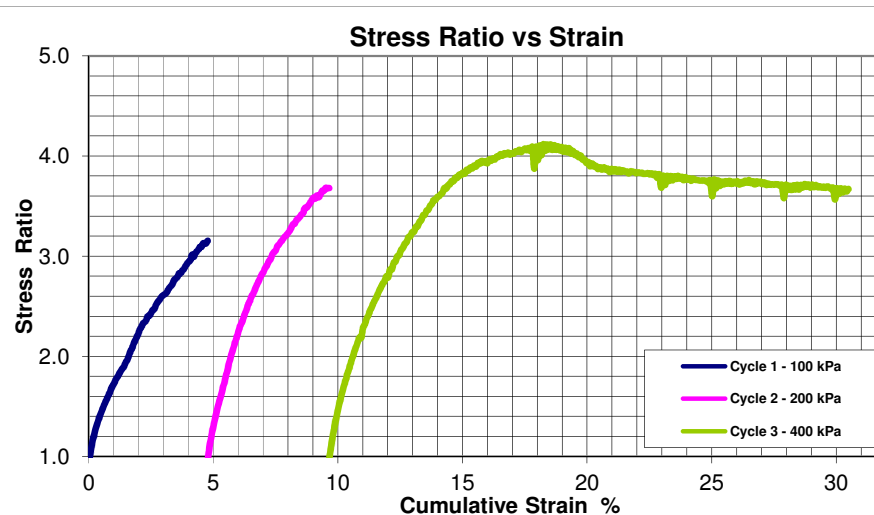
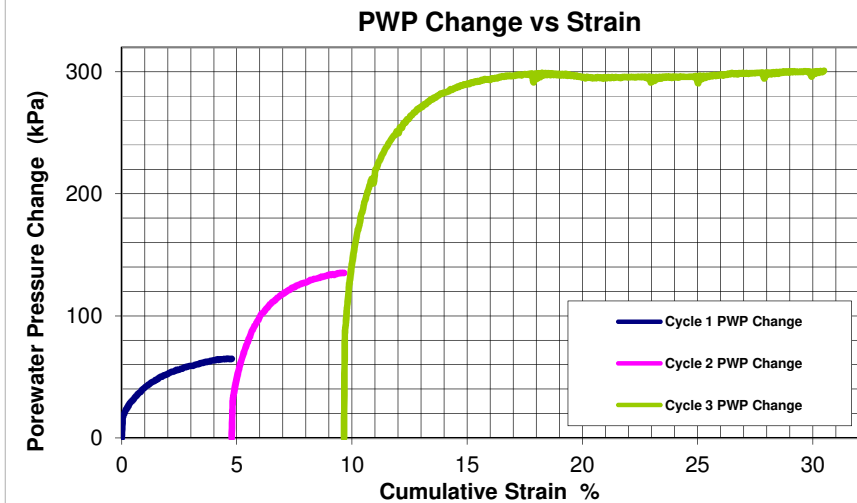
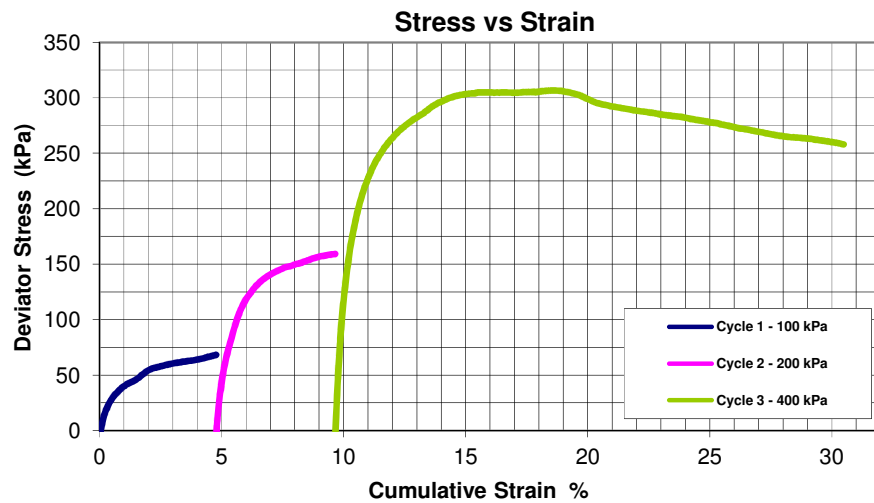
Checked By:

WEC

Feb 2018

6-Mar-18

8-Mar-18



3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

Page 6 of 7

Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
JF	Feb 2018
JF	6-Mar-18
WEC	8-Mar-18

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained with Porewater Pressure Measurement

PROJECT:

ADARE DEVELOPMENT

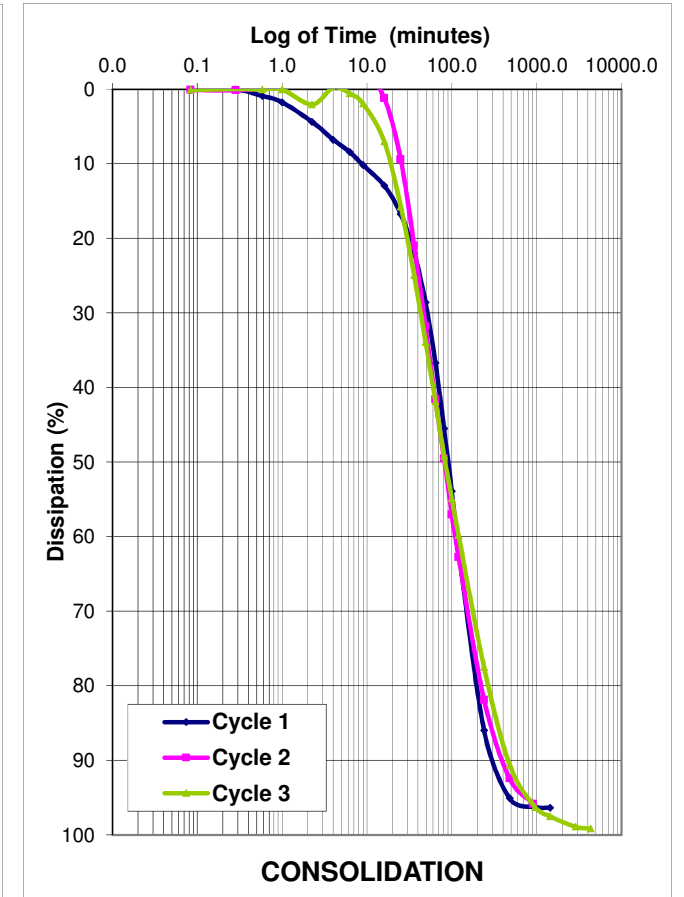
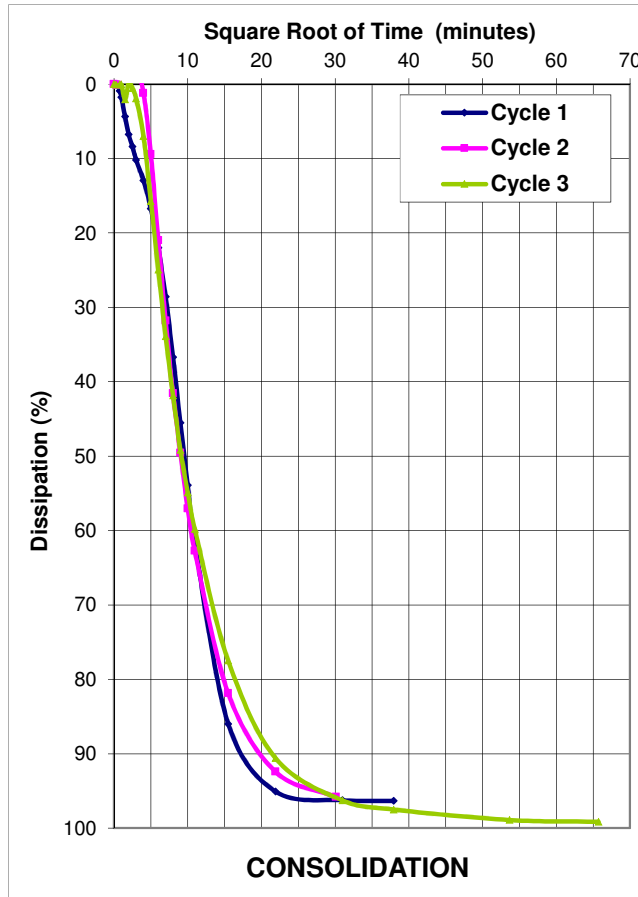
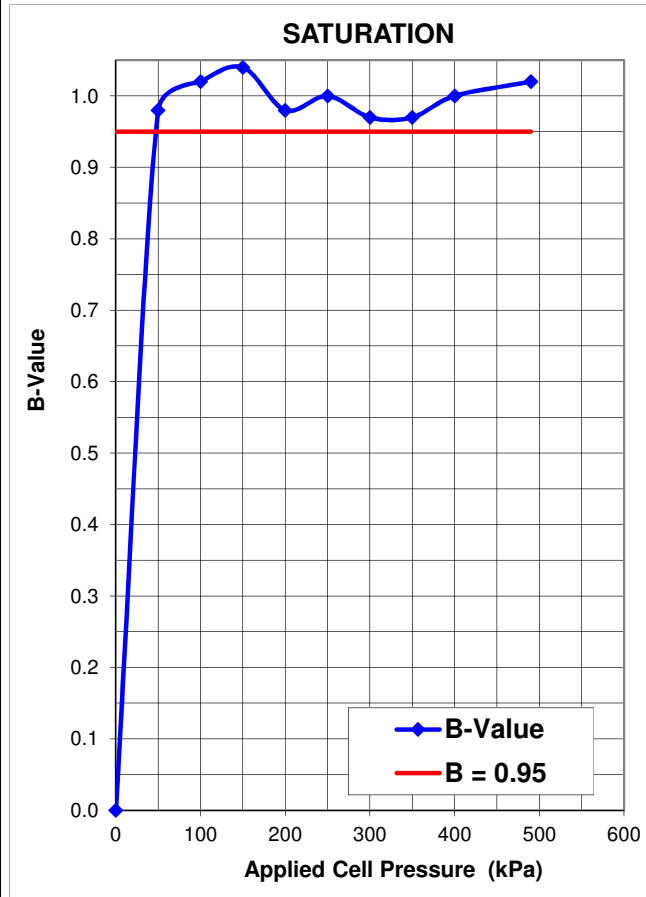
Job No: 61326#L

Borehole Number: **MBH03**

Depth: **10.60 - 11.10m**

Reg. No: 2521

Sample Number: **TUBE**



15 June 2018

3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

Page 7 of 7

Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
Tested By:	JF
Plotted By:	JF
Checked By:	WEC
	Feb 2018
	6-Mar-18
	8-Mar-18

BS 1377:1990: Test 8: Section 7: Consolidated Undrained with Porewater Pressure Measurement

PROJECT: **ADARE DEVELOPMENT**

Job No: 61326#L

Borehole Number: **MBH03**

Depth: **10.60 - 11.10m**

Reg. No: 2521

Sample Number: **TUBE**

SAMPLE BEFORE TEST



SAMPLE AFTER TEST





Babbage Geotechnical Laboratory

Received
PLANNING GUIDANCE
15 June 2018

Babbage Geotechnical Laboratory
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E-mail

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wec@babbage.co.nz

Please reply to: W.E. Campton

Page 1 of 7

ENGEO
PO Box 305 136
Triton Plaza
Auckland 0757

Job Number: 61326#L
BGL Registration Number: 2521
Checked by: WEC

Attention: **PAUL FLETCHER**

8th March 2018

CONSOLIDATED, UNDRAINED (CU), MULTI-STAGE TRIAXIAL COMPRESSIVE STRENGTH TESTING

Dear Sir,

Re: ADARE DEVELOPMENT

Report Number: 61326#L/CU Triaxial MBH06 4.50 – 5.00m

Borehole No: MBH06

Sample No: TUBE

Depth: 4.50 – 5.00m

The following report presents the results of triaxial compressive strength testing of a 60mm diameter undisturbed push-tube soil sample delivered to this laboratory on the 14th of February 2018. The client request was to measure the consolidated, undrained compression of the sample in a triaxial apparatus under known conditions of effective stress, with measurement of porewater pressure. We were instructed to test a single sample at effective pressures of 50kPa, 100kPa, and 200kPa by carrying out a 3-point multi-stage test.

Please note that the multi-stage method described below is commonly carried out by soils testing laboratories, but is not part of BS1377:1990: Part 8: Section 7 (*in which a number of specimens taken from one soil sample are each tested to failure at different effective pressures*). The method described below is therefore a departure from BS1377:1990: Part 8: Section 7.

Test standards used were:

Water Content:	NZS4402: 1986: Test 2.1
Preparation of specimen:	BS1377: 1990: Part 8: Section 4
Saturation:	BS1377: 1990: Part 8: Section 5
Consolidation:	BS1377: 1990: Part 8: Section 6
Consolidated-undrained triaxial compression test with measurement of pore pressure:	BS1377: 1990: Part 8: Section 7

Test Procedure

The sample was extruded from the push-tube and trimmed to length. The sample was then set up in a triaxial cell & saturation was achieved in distinct stages by 50kPa increments of cell pressure and back pressure, with a differential pressure of 10kPa (*cell pressure 10kPa greater than back pressure*) in order to maintain a small positive effective stress.



Babbage Geotechnical Laboratory

Job Number: 61326#L

8th March 2018

Page 2 of 7

The final saturation stage used a cell pressure of 400kPa and a back pressure of 390kPa. Saturation was then confirmed by increasing the cell pressure to 440kPa, and observing the increase in porewater pressure. A porewater pressure coefficient (B) of 0.96 was achieved, confirming saturation of the sample.

Excess porewater pressure was then dissipated during the first consolidation cycle, resulting in an effective stress of 50kPa. The sample was then compressed at a set rate of 0.012mm per minute (actual rate of 0.015mm per minute) until the deviator stress was close to maximum.

Compression was then stopped and the load taken off the sample. Cell pressure was increased to 490kPa and the resulting increased porewater pressure was dissipated in the second consolidation cycle, resulting in an effective pressure of 100kPa acting on the same sample. Once consolidated, the 2nd compression cycle was compressed at a set rate of 0.012mm per minute (actual rate of 0.013mm per minute) until the deviator stress was close to maximum.

Compression was again stopped and the load taken off the sample. Cell pressure was increased to 590kPa and the resulting increased porewater pressure was dissipated in the third consolidation cycle, resulting in an effective pressure of 200kPa acting on the same sample. Once consolidated, the 3rd compression cycle was compressed at a set rate of 0.012mm per minute (actual rate of 0.012mm per minute) until complete failure of the sample had occurred.

Mohr circle plots for each cycle are presented on page 4 of this report. We leave the determination of the angle of resistance and the cohesion to our clients, but as a guide to this we tabulate each tangent to sets of circles on the graph.

This test was carried out in a laboratory in which the temperature is controlled between 18°C and 22°C. Each test result is data obtained at a specific test location. The nature and continuity of subsoil conditions away from the test area could vary from the data recovered during this testing.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the undersigned at your convenience.

Yours faithfully,

Justin Franklin

Signatory (Assistant Laboratory Manager)
Babbage Geotechnical Laboratory



All tests reported herein have been performed in accordance with the laboratory's scope of accreditation. This report may not be reproduced except in full & with written approval from BGL.



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Received

PLANNING GUIDANCE

15 June 2018

Registration No:

2521

Job Number:

61326#L

Report No:

61326#L/OU Triaxial MBH06 4.50 - 5.00m

Page 3 of 7

Version No:

4

Issue Date:

Aug-17

Auth. By:

WEC

ADARE DEVELOPMENT

CU MULTI-STAGE TRIAXIAL COMPRESSION TEST

Tested By:

JF

Feb 2018

Compiled By:

JF

6-Mar-18

Checked By:

WEC

8-Mar-18

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained triaxial compression test with measurement of pore pressure / NZS4402:1986: Test 2.1 - Water Content

Borehole:

MBH06

Sample No:

TUBE

Depth:

4.50 - 5.00m

Sample History:

undisturbed / remoulded / compacted / other

Sample Description

(not part of BGL IANZ accreditation):

SILT, fine to coarse sandy, pumiceous, firm to stiff, slightly plastic, orangish yellow with black & white speckles, moist.

Test Procedure:

single sample with side drains at different effective consolidation pressures.

SAMPLE DETAILS

Initial Diameter:	60.0 mm	Initial Moisture Content:	49.5 %
Initial Length:	120.0 mm	Final Moisture Content:	49.9 %
Initial Mass:	555.63 g	Initial Dry Density:	1.10 t/m ³
Initial Bulk Density:	1.64 t/m ³	Final Dry Density:	1.17 t/m ³

SATURATION CYCLE

Saturation Procedure:

50kPa increments of cell pressure and back pressure, differential pressure of 10kPa. Saturated from top and base of sample.

At End of Saturation:

Cell Pressure Increase:

40.0 kPa

Final Cell Pressure:

440 kPa

Resulting Increase in Pore Pressure:

38.5 kPa

Final Pore Pressure:

428.4 kPa

Pore Pressure Coefficient B:

0.96

Test Cycles:	1	2	3
--------------	---	---	---

CONSOLIDATION CYCLES

Cell Pressure	kPa	440	490	590
Back Pressure	kPa	390	390	390
Effective Pressure	kPa	50	100	200
Pore Pressure at Start of Consolidation	kPa	428.6	460.9	541.4
Pore Pressure to Dissipate	kPa	38.6	70.9	151.4
Dissipation	%	99.0	100.2	99.1
Pore Pressure at End of Consolidation	kPa	390.4	389.8	391.3

COMPRESSION CYCLES

Rate of Strain (set)	mm/min	0.012	0.012	0.012
Rate of Strain (actual)	mm/min	0.015	0.013	0.012
Pore Pressure at Start of Compression	kPa	390.4	389.8	391.3
Effective Major Principal Stress at Start of Compression	kPa	49.6	100.2	198.7

FAILURE CONDITIONS

Criteria Used to Determine Failure:	maximum deviator stress / maximum effective principal stress ratio
Axial Strain at Failure (*cumulative)	%
Axial Strain at Failure (*cumulative)	mm
Deviator Stress at Failure	kPa
Pore Pressure at Failure	kPa
Effective Major Principal Stress at Failure	kPa
Effective Minor Principal Stress at Failure	kPa
Effective Principal Stress Ratio at Failure	

Failure Type: PLASTIC

CORRECTIONS APPLIED TO MEASURED DEVIATOR STRESS

Membrane Restraining Effect Correction	kPa	0.3	0.4	0.6
Vertical Side Drain Correction	kPa	6.0	6.0	6.0

 BGL Babbage Geotechnical Laboratory	3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST				Page 4 of 7	Version No: 4
	BS 1377: 1990: Part 8: Section 7: Consolidated-undrained with Porewater Pressure Measurement					Issue Date: Aug-17
	PROJECT: ADARE DEVELOPMENT				Auth. By: WEC	
					Initials: Date:	
					Tested By: JF Feb 2018	
Job No: 61326#L	Borehole Number: MBH06			Depth: 4.50 - 5.00m	Plotted By: JF 6-Mar-18	
Reg. No: 2521	Sample Number: TUBE				Checked By: WEC 8-Mar-18	

Mohr Circle Plot:

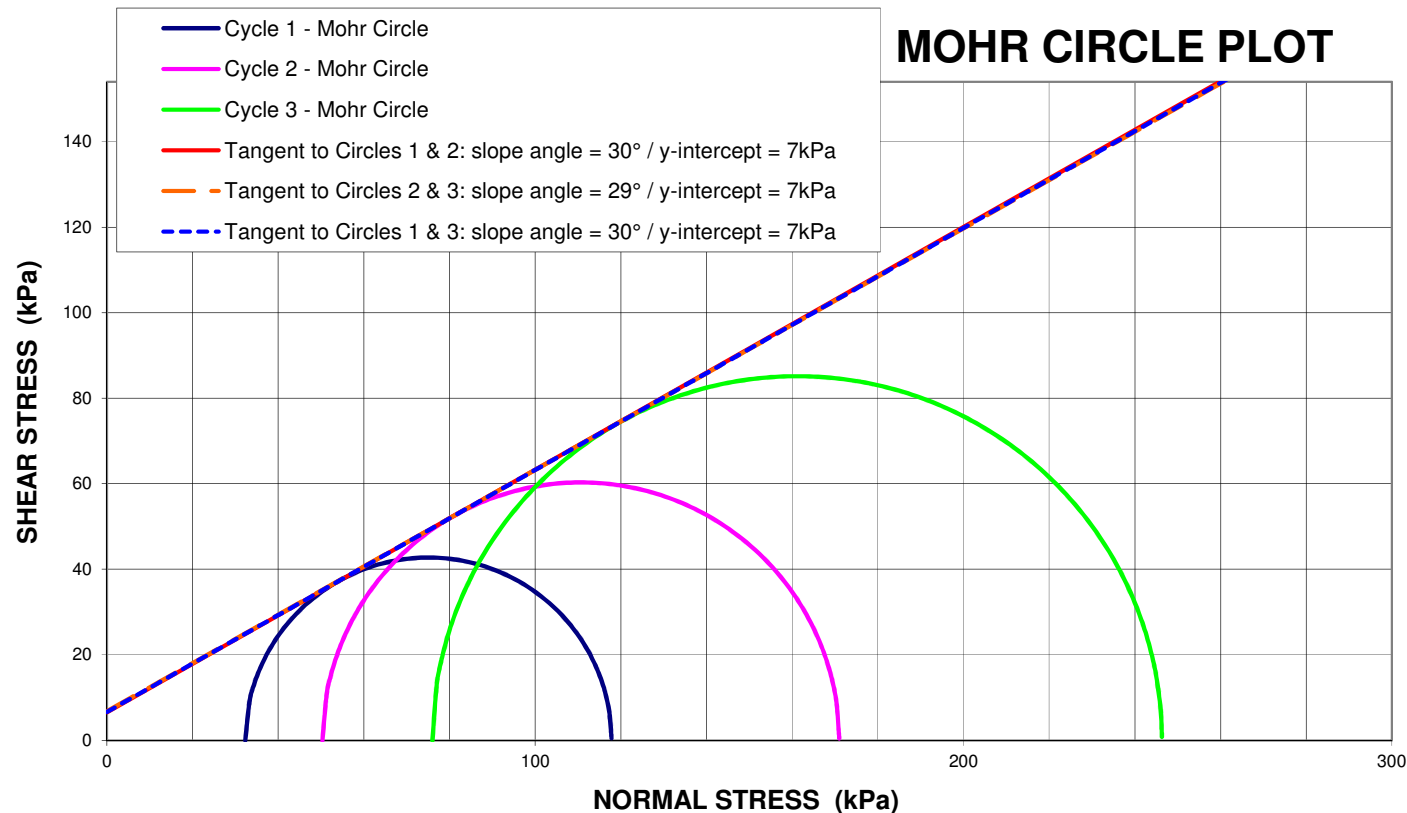
	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Stress Path Parameters	
			s'	t'
	(σ_1') kPa	(σ_3') kPa	($\sigma_1' + \sigma_3'$)/2 kPa	($\sigma_1' - \sigma_3'$)/2 kPa
cycle				
1	118	32	75	43
2	171	50	111	60
3	246	76	161	85

From Graph Below:

Angle of Shear Resistance $\phi' =$ degrees

Cohesion $c' =$ kPa

(Values to be decided upon by Geotechnical Engineer)



3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

Page 5 of 7

Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
Tested By:	JF
Plotted By:	JF
Checked By:	WEC
	Feb 2018
	6-Mar-18
	8-Mar-18

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained with Porewater Pressure Measurement

PROJECT:

ADARE DEVELOPMENT

Job No: 61326#L

Borehole Number: MBH06

Depth: 4.50 - 5.00m

Reg. No: 2521

Sample Number: TUBE

Tested By:

JF

Plotted By:

JF

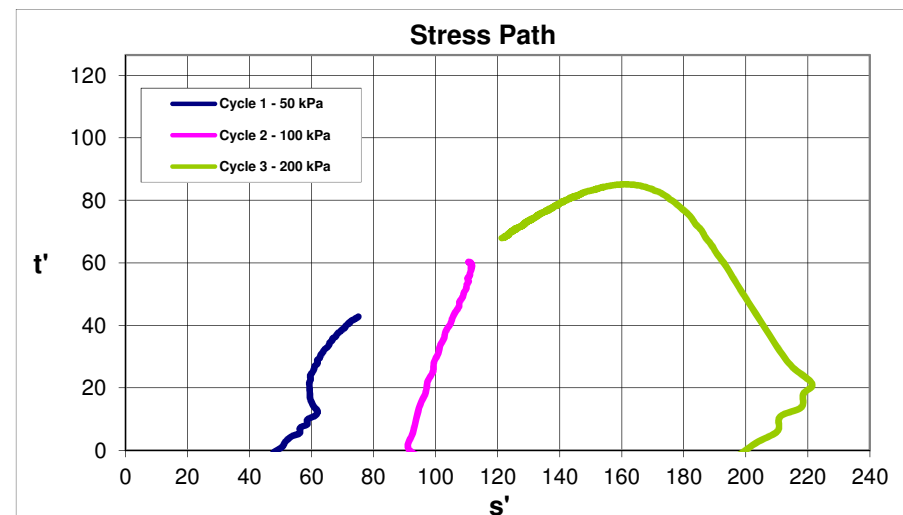
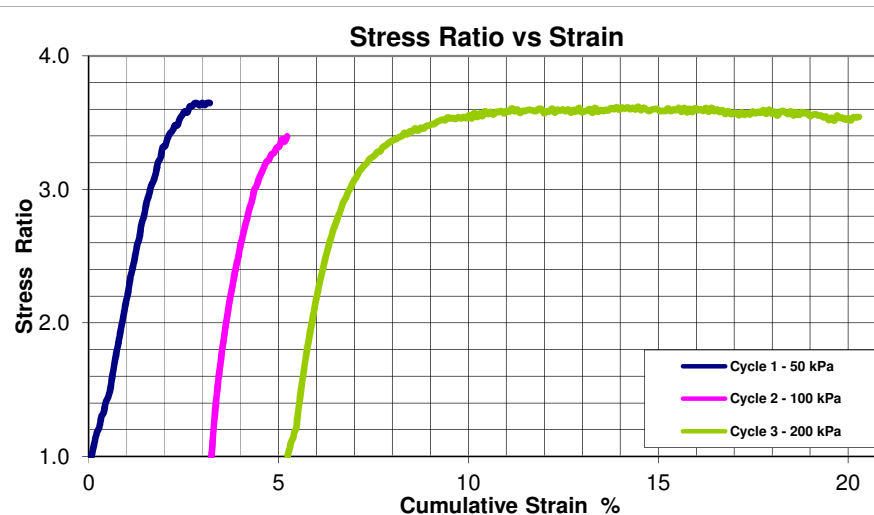
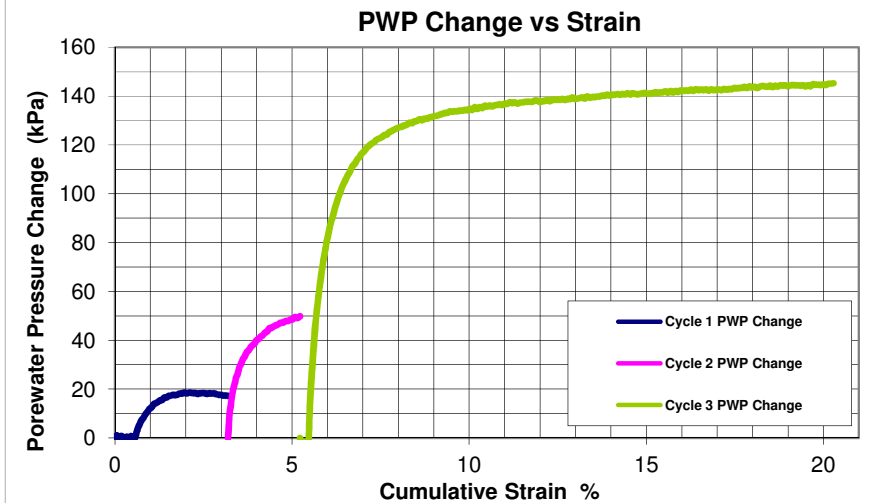
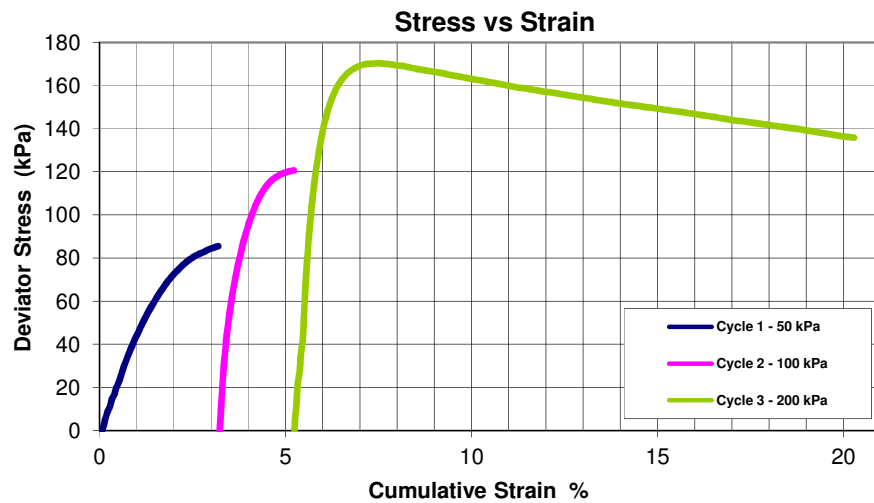
Checked By:

WEC

Feb 2018

6-Mar-18

8-Mar-18



3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

Page 6 of 7

Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
JF	Feb 2018
JF	6-Mar-18
WEC	8-Mar-18

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained with Porewater Pressure Measurement

PROJECT:

ADARE DEVELOPMENT

Job No: 61326#L

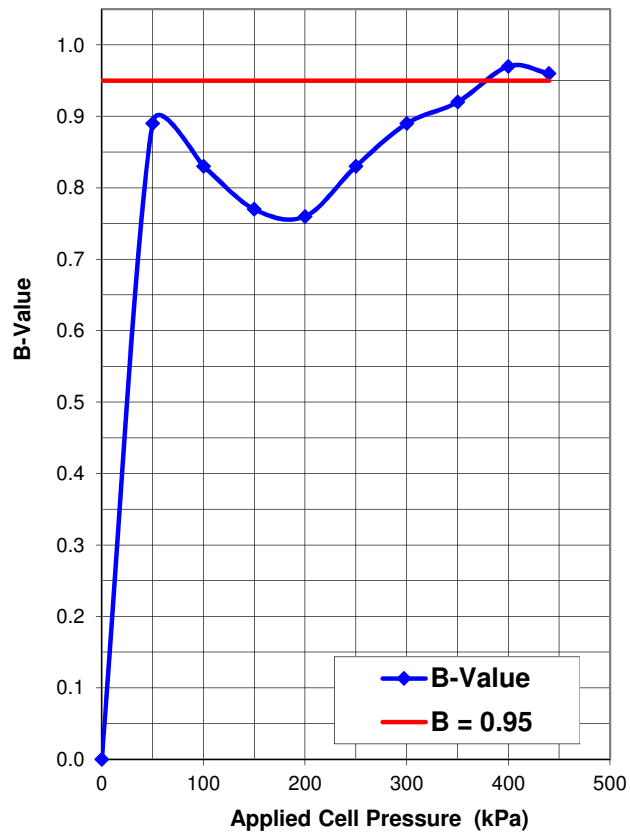
Borehole Number: **MBH06**

Depth: **4.50 - 5.00m**

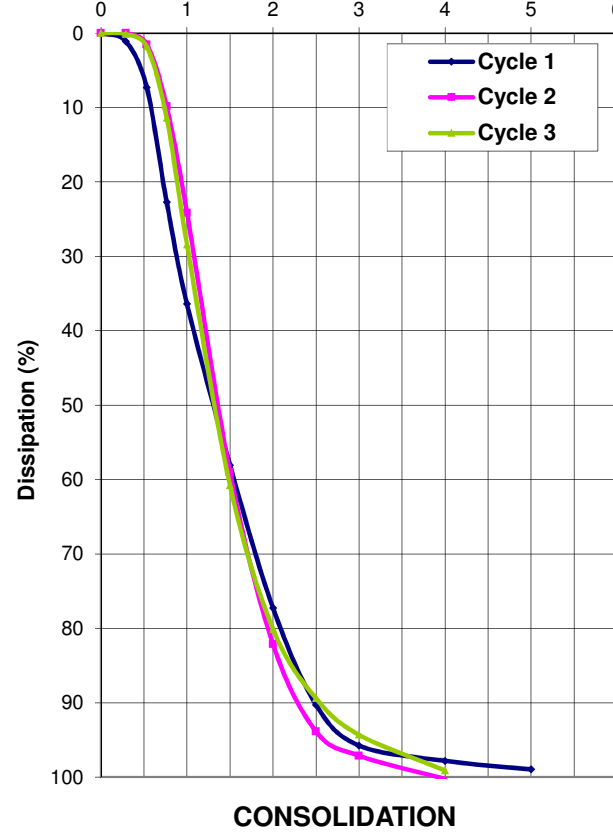
Reg. No: 2521

Sample Number: **TUBE**

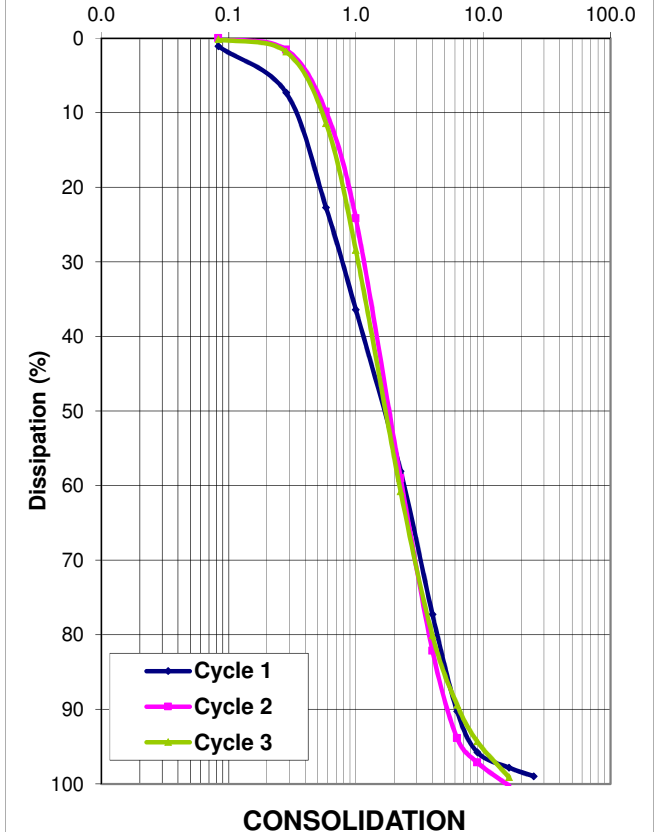
SATURATION



Square Root of Time (minutes)



Log of Time (minutes)



Received
PLANNING GUIDANCE
15 June 2018

3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

Page 7 of 7

Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
JF	Feb 2018
JF	6-Mar-18
WEC	8-Mar-18

BS 1377:1990: Test 8: Section 7: Consolidated Undrained with Porewater Pressure Measurement

PROJECT: **ADARE DEVELOPMENT**

Job No: 61326#L

Borehole Number: **MBH06**

Depth: **4.50 - 5.00m**

Reg. No: 2521

Sample Number: **TUBE**

SAMPLE BEFORE TEST



SAMPLE AFTER TEST





Babbage Geotechnical Laboratory

Received
PLANNING GUIDANCE
15 June 2018

Babbage Geotechnical Laboratory
Level 4

68 Beach Road
Auckland 1010
Telephone
E-mail

P O Box 2027
New Zealand
64-9-367 4954
wec@babbage.co.nz

Please reply to: W.E. Campton

Page 1 of 7

ENGEO
PO Box 305 136
Triton Plaza
Auckland 0757

Job Number: 61326#L
BGL Registration Number: 2521
Checked by: WEC

Attention: **PAUL FLETCHER**

9th March 2018

CONSOLIDATED, UNDRAINED (CU), MULTI-STAGE TRIAXIAL COMPRESSIVE STRENGTH TESTING

Dear Sir,

Re: ADARE DEVELOPMENT

Report Number: 61326#L/CU Triaxial MBH06 9.10 – 9.60m

Borehole No: MBH06

Sample No: TUBE

Depth: 9.10 – 9.60m

The following report presents the results of triaxial compressive strength testing of a 60mm diameter undisturbed push-tube soil sample delivered to this laboratory on the 14th of February 2018. The client request was to measure the consolidated, undrained compression of the sample in a triaxial apparatus under known conditions of effective stress, with measurement of porewater pressure. We were instructed to test a single sample at effective pressures of 100kPa, 200kPa, and 400kPa by carrying out a 3-point multi-stage test.

Please note that the multi-stage method described below is commonly carried out by soils testing laboratories, but is not part of BS1377:1990: Part 8: Section 7 (*in which a number of specimens taken from one soil sample are each tested to failure at different effective pressures*). The method described below is therefore a departure from BS1377:1990: Part 8: Section 7.

Test standards used were:

Water Content:	NZS4402: 1986: Test 2.1
Preparation of specimen:	BS1377: 1990: Part 8: Section 4
Saturation:	BS1377: 1990: Part 8: Section 5
Consolidation:	BS1377: 1990: Part 8: Section 6
Consolidated-undrained triaxial compression test with measurement of pore pressure:	BS1377: 1990: Part 8: Section 7

Test Procedure

The sample was extruded from the push-tube and trimmed to length. The sample was then set up in a triaxial cell & saturation was achieved in distinct stages by 50kPa increments of cell pressure and back pressure, with a differential pressure of 10kPa (*cell pressure 10kPa greater than back pressure*) in order to maintain a small positive effective stress.



Babbage Geotechnical Laboratory

Job Number: 61326#L

9th March 2018

Page 2 of 7

The final saturation stage used a cell pressure of 400kPa and a back pressure of 390kPa. Saturation was then confirmed by increasing the cell pressure to 490kPa, and observing the increase in porewater pressure. A porewater pressure coefficient (B) of 1.00 was achieved, confirming saturation of the sample.

Excess porewater pressure was then dissipated during the first consolidation cycle, resulting in an effective stress of 100kPa. The sample was then compressed at a set rate of 0.012mm per minute (actual rate of 0.014mm per minute) until the stress ratio was close to maximum.

Compression was then stopped and the load taken off the sample. Cell pressure was increased to 590kPa and the resulting increased porewater pressure was dissipated in the second consolidation cycle, resulting in an effective pressure of 200kPa acting on the same sample. Once consolidated, the 2nd compression cycle was compressed at a set rate of 0.012mm per minute (actual rate of 0.011mm per minute) until the stress ratio was close to maximum.

Compression was again stopped and the load taken off the sample. Cell pressure was increased to 790kPa and the resulting increased porewater pressure was dissipated in the third consolidation cycle, resulting in an effective pressure of 400kPa acting on the same sample. Once consolidated, the 3rd compression cycle was compressed at a set rate of 0.012mm per minute (actual rate of 0.012mm per minute) until complete failure of the sample had occurred.

Mohr circle plots for each cycle are presented on page 4 of this report. We leave the determination of the angle of resistance and the cohesion to our clients, but as a guide to this we tabulate each tangent to sets of circles on the graph.

This test was carried out in a laboratory in which the temperature is controlled between 18°C and 22°C. Each test result is data obtained at a specific test location. The nature and continuity of subsoil conditions away from the test area could vary from the data recovered during this testing.

Thank you for the opportunity to carry out this testing. If you have any queries regarding the content of this report please contact the undersigned at your convenience.

Yours faithfully,

Justin Franklin

**Signatory (Assistant Laboratory Manager)
Babbage Geotechnical Laboratory**



All tests reported herein have been performed in accordance with the laboratory's scope of accreditation. This report may not be reproduced except in full & with written approval from BGL.



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Received

PLANNING GUIDANCE

15 June 2018

Registration No.

2521

Job Number:

61326#L

Report No:

61326#L/OU Triaxial MBH06 9.10 - 9.60m

Page 3 of 7

Version No:

4

Issue Date:

Aug-17

Auth. By:

WEC

ADARE DEVELOPMENT

CU MULTI-STAGE TRIAXIAL COMPRESSION TEST

Tested By:

JF

Feb / Mar 2018

Compiled By:

JF

9-Mar-18

Checked By:

WEC

9-Mar-18

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained triaxial compression test with measurement of pore pressure / NZS4402:1986: Test 2.1 - Water Content

Borehole:

MBH06

Sample No:

TUBE

Depth:

9.10 - 9.60m

Sample History:

undisturbed / remoulded / compacted / other

Sample Description

(not part of BGL IANZ accreditation):

CLAY, very silty, very stiff, moderately to highly plastic, grey & light grey, slightly moist.

Test Procedure:

single sample with side drains at different effective consolidation pressures.

SAMPLE DETAILS

Initial Diameter:	60.0 mm	Initial Moisture Content:	57.4 %
Initial Length:	120.0 mm	Final Moisture Content:	55.3 %
Initial Mass:	575.43 g	Initial Dry Density:	1.08 t/m ³
Initial Bulk Density:	1.70 t/m ³	Final Dry Density:	1.13 t/m ³

SATURATION CYCLE

Saturation Procedure:

50kPa increments of cell pressure and back pressure, differential pressure of 10kPa. Saturated from top and base of sample.

At End of Saturation:

Cell Pressure Increase:

90.0 kPa

Final Cell Pressure:

490 kPa

Resulting Increase in Pore Pressure:

90.3 kPa

Final Pore Pressure:

480.9 kPa

Pore Pressure Coefficient B:

1.00

Test Cycles:	1	2	3
--------------	---	---	---

CONSOLIDATION CYCLES

Cell Pressure	kPa	490	590	790
Back Pressure	kPa	390	390	390
Effective Pressure	kPa	100	200	400
Pore Pressure at Start of Consolidation	kPa	480.6	531.1	634.3
Pore Pressure to Dissipate	kPa	90.6	141.1	244.3
Dissipation	%	95.5	100.1	97.4
Pore Pressure at End of Consolidation	kPa	394.0	399.6	396.2

COMPRESSION CYCLES

Rate of Strain (set)	mm/min	0.012	0.012	0.012
Rate of Strain (actual)	mm/min	0.014	0.011	0.012
Pore Pressure at Start of Compression	kPa	394.0	399.6	396.2
Effective Major Principal Stress at Start of Compression	kPa	96.0	190.4	393.8

FAILURE CONDITIONS

Criteria Used to Determine Failure:	maximum deviator stress / maximum effective principal stress ratio			
Axial Strain at Failure (*cumulative)	%	3.10	* 4.33	* 7.93
Axial Strain at Failure (*cumulative)	mm	3.70	* 5.12	* 9.18
Deviator Stress at Failure	kPa	113.7	225.9	324.6
Pore Pressure at Failure	kPa	445.7	488.0	622.8
Effective Major Principal Stress at Failure	kPa	158.0	328.0	491.7
Effective Minor Principal Stress at Failure	kPa	44.3	102.0	167.2
Effective Principal Stress Ratio at Failure		3.568	3.214	2.942

Failure Type: PLANAR / PLASTIC

CORRECTIONS APPLIED TO MEASURED DEVIATOR STRESS

Membrane Restraining Effect Correction	kPa	0.3	0.4	0.6
Vertical Side Drain Correction	kPa	6.0	6.0	6.0

3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

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Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
Tested By:	JF
Plotted By:	JF
Checked By:	WEC

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained with Porewater Pressure Measurement

PROJECT:	ADARE DEVELOPMENT		
Job No:	61326#L	Borehole Number:	MBH06
Reg. No:	2521	Sample Number:	TUBE
		Depth:	9.10 - 9.60m

Mohr Circle Plot:

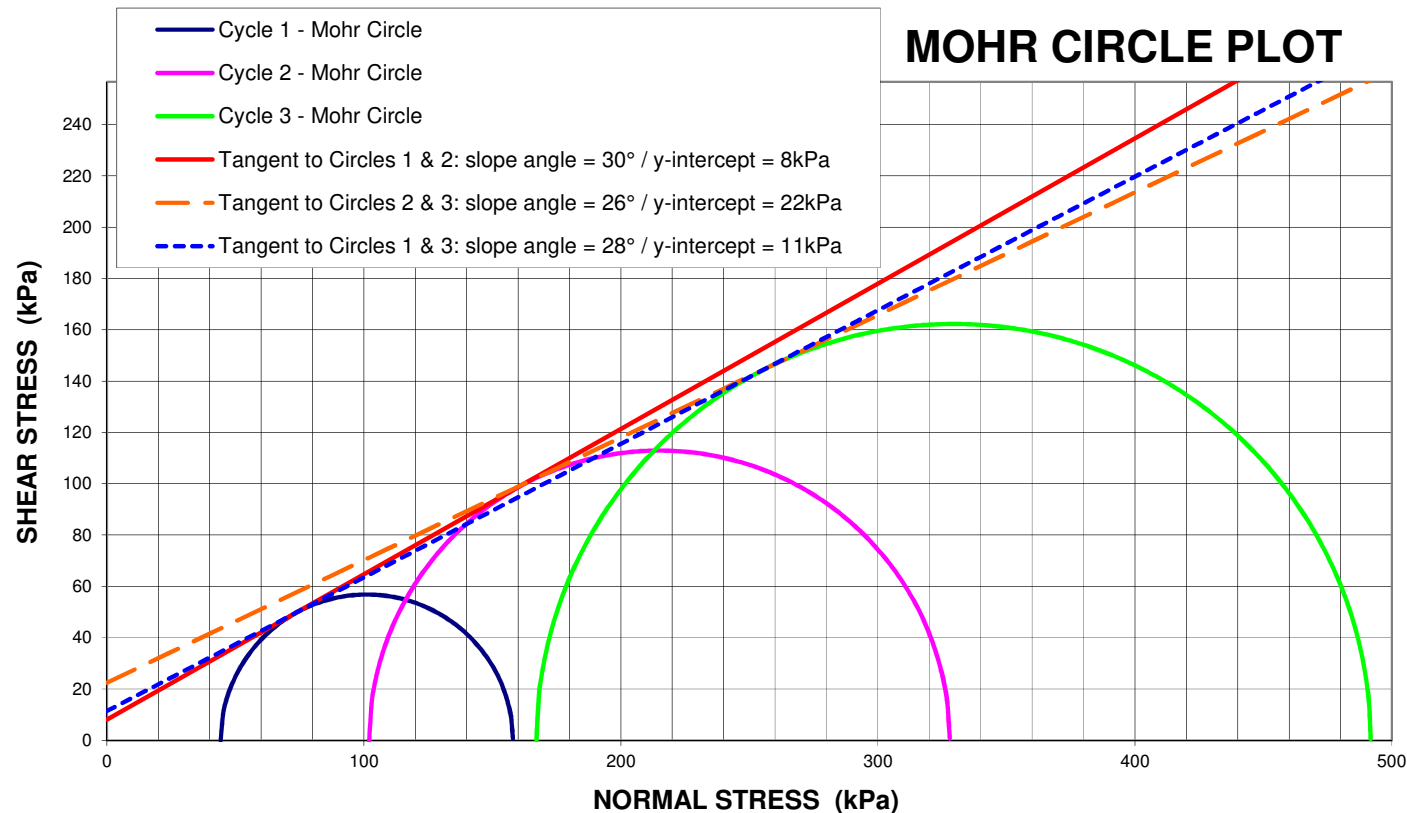
cycle	Effective Major Principal Stress	Effective Minor Principal Stress	Effective Stress Path Parameters	
	(σ_1') kPa	(σ_3') kPa	s' ($\sigma_1' + \sigma_3'$)/2 kPa	t' ($\sigma_1' - \sigma_3'$)/2 kPa
1	158	44	101	57
2	328	102	215	113
3	492	167	329	162

From Graph Below:

Angle of Shear Resistance $\phi' =$ degrees

Cohesion $c' =$ kPa

(Values to be decided upon by Geotechnical Engineer)



3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

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Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
JF	Feb / Mar 2018
JF	9-Mar-18
WEC	9-Mar-18

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained with Porewater Pressure Measurement

PROJECT: **ADARE DEVELOPMENT**

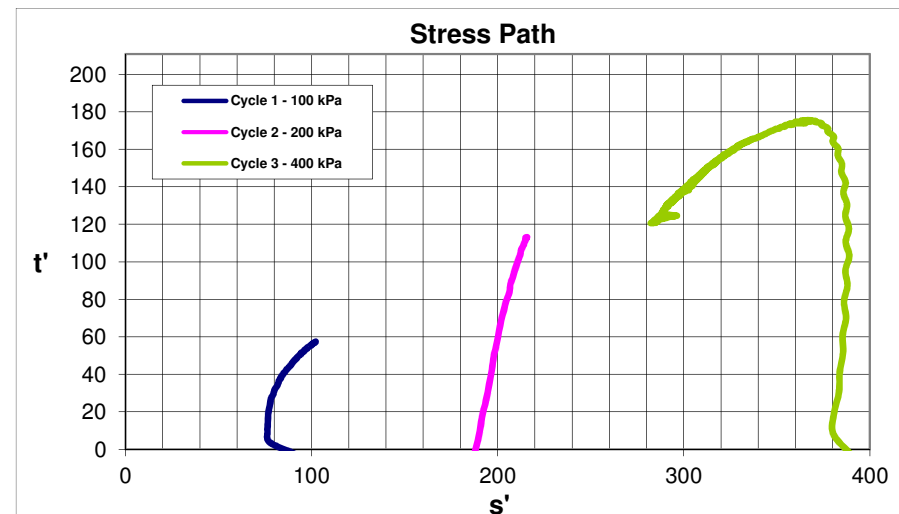
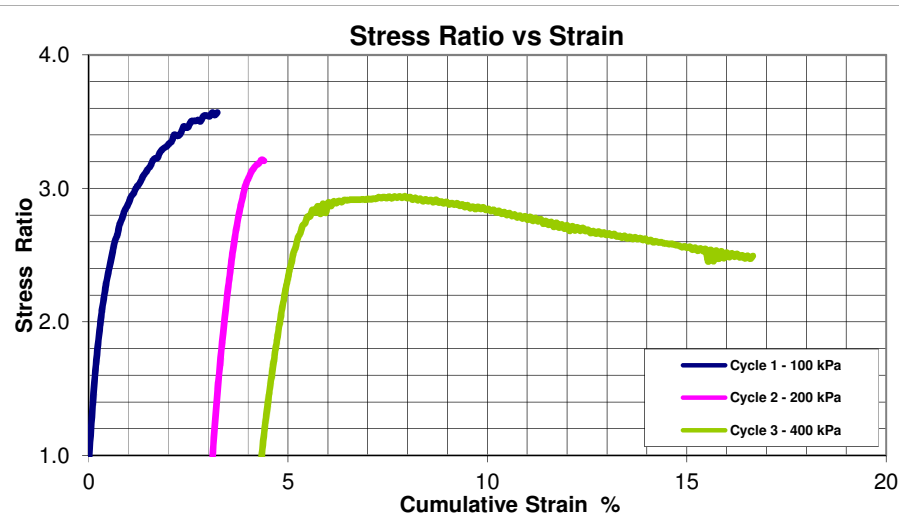
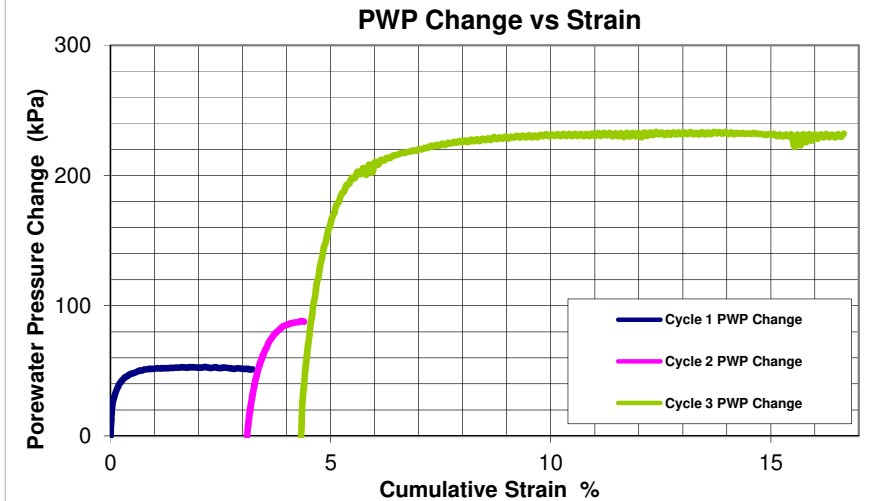
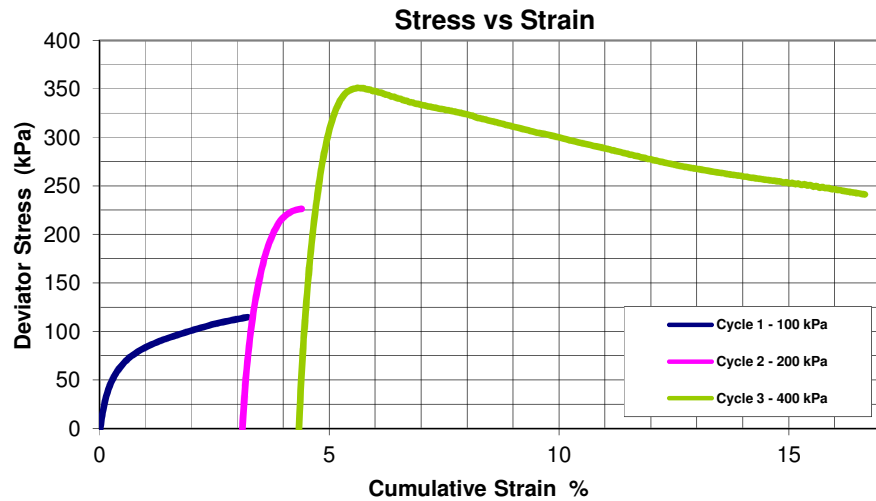
Job No: 61326#L

Borehole Number: MBH06

Depth: 9.10 - 9.60m

Reg. No: 2521

Sample Number: TUBE



3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

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Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
JF	Feb / Mar 2018
JF	9-Mar-18
WEC	9-Mar-18

BS 1377: 1990: Part 8: Section 7: Consolidated-undrained with Porewater Pressure Measurement

PROJECT:

ADARE DEVELOPMENT

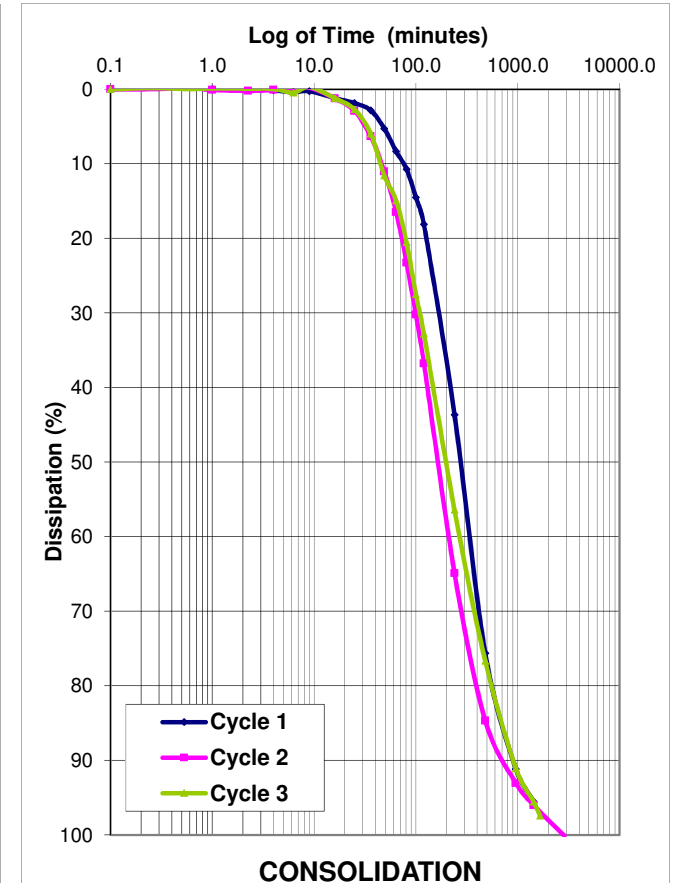
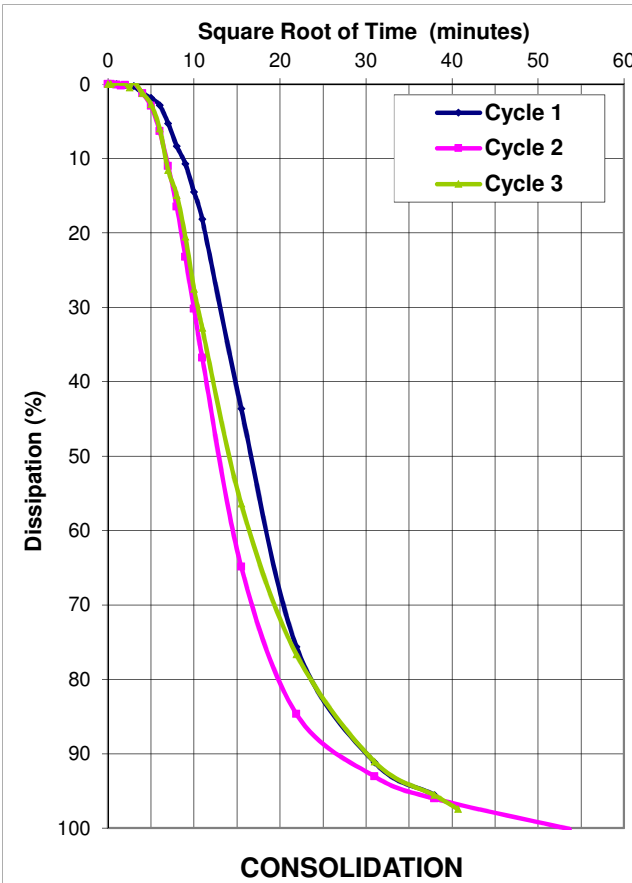
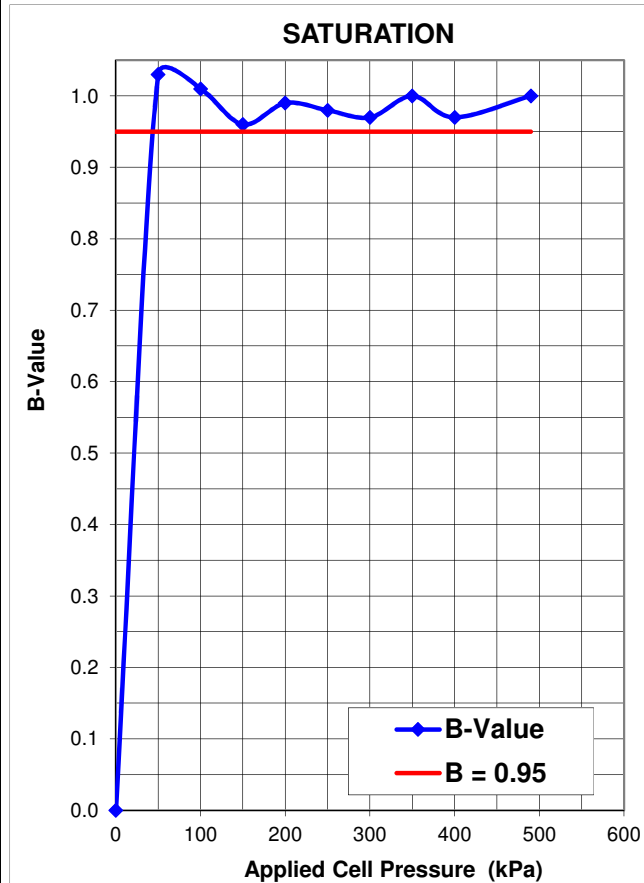
Job No: 61326#L

Borehole Number: **MBH06**

Depth: **9.10 - 9.60m**

Reg. No: 2521

Sample Number: **TUBE**



15 June 2018

3-POINT MULTI-STAGE TRIAXIAL COMPRESSION TEST

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Version No:	4
Issue Date:	Aug-17
Auth. By:	WEC
Initials	Date
JF	Feb / Mar 2018
JF	9-Mar-18
WEC	9-Mar-18

BS 1377:1990: Test 8: Section 7: Consolidated Undrained with Porewater Pressure Measurement

PROJECT:

ADARE DEVELOPMENT

Job No: 61326#L

Borehole Number: MBH06

Depth: 9.10 - 9.60m

Reg. No: 2521

Sample Number: TUBE

SAMPLE BEFORE TEST

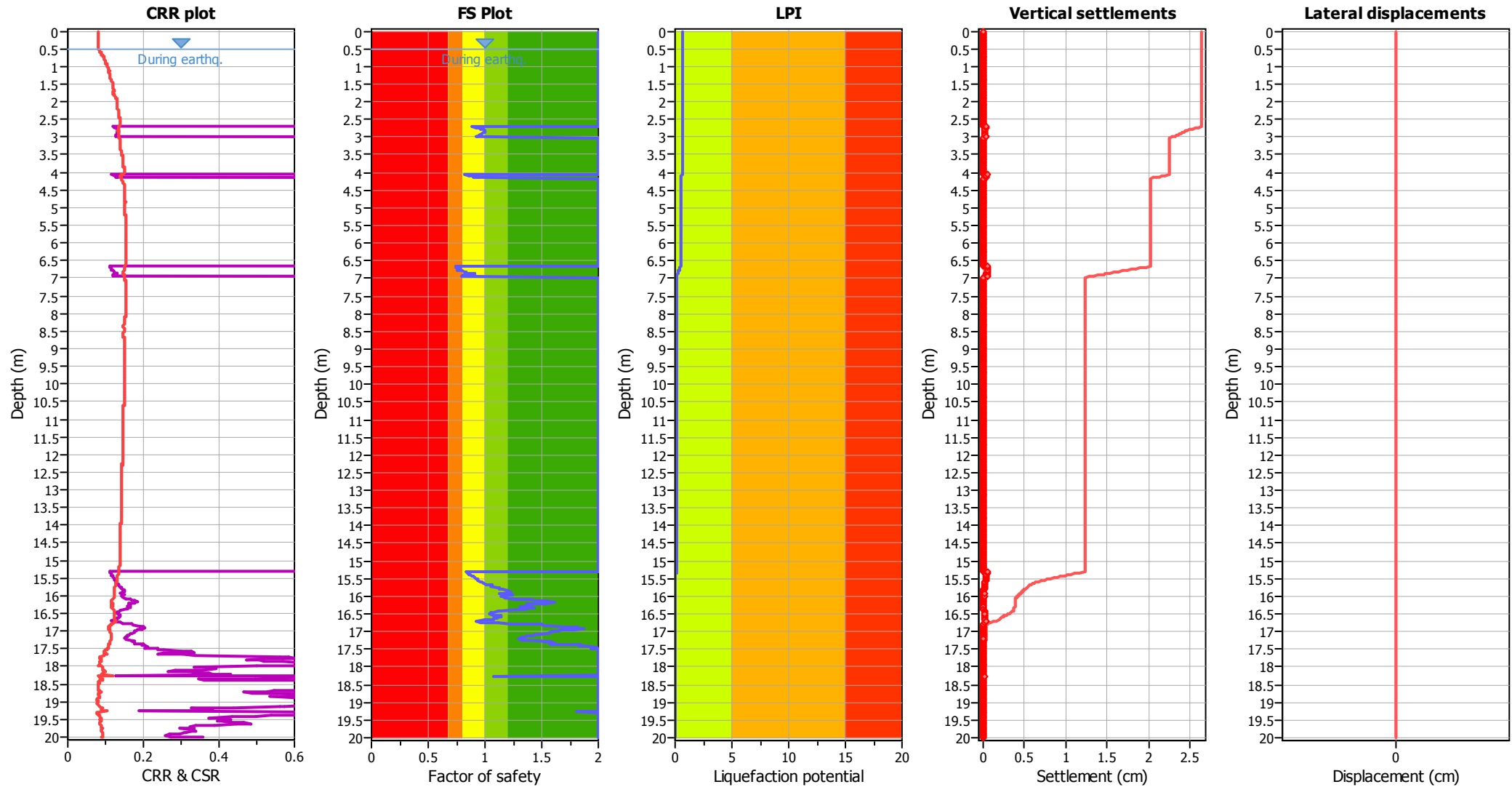


SAMPLE AFTER TEST



APPENDIX 6:
Liquefaction Analysis Results

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	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 :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

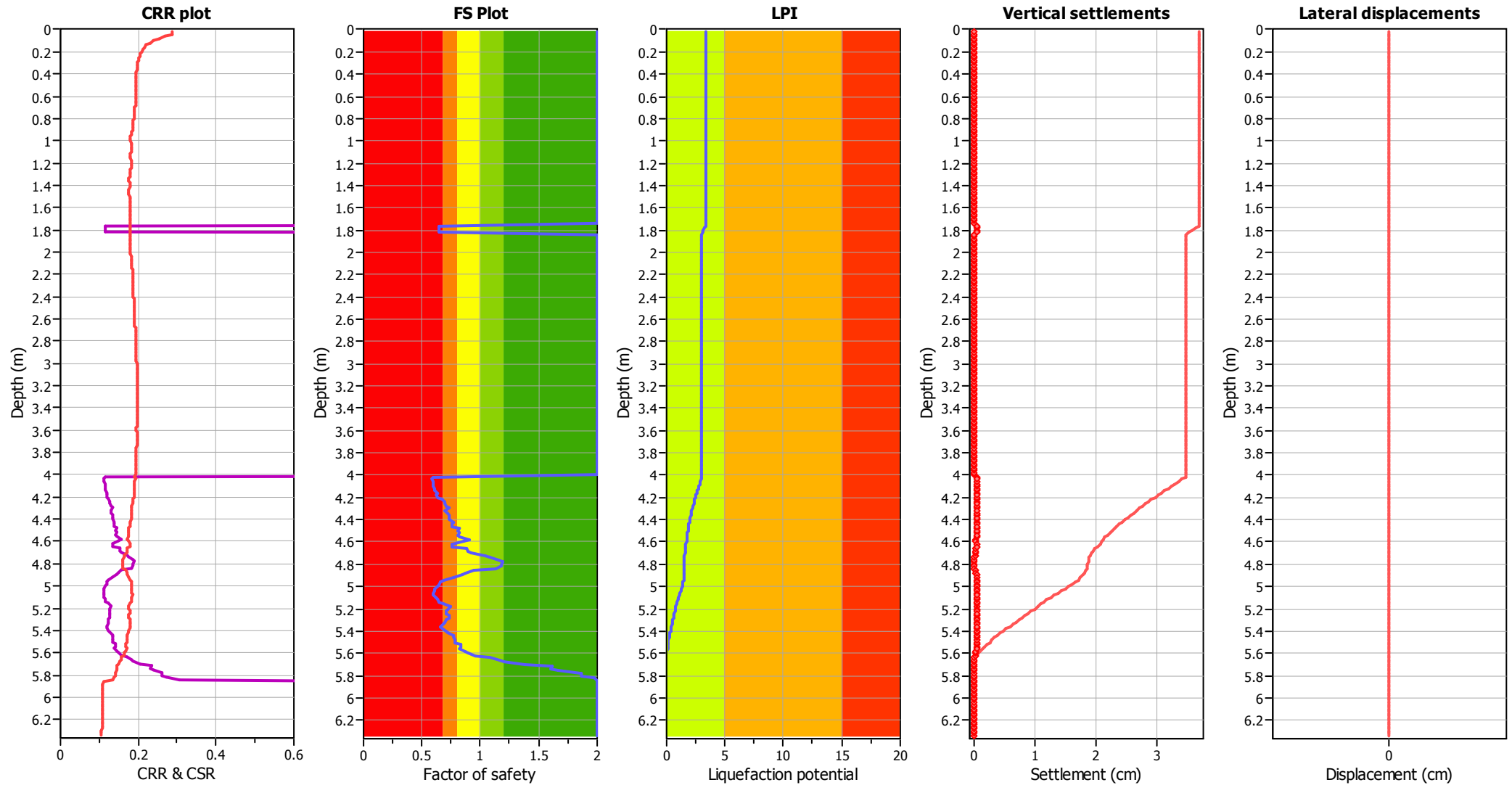
F.S. color scheme

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

LPI color scheme

Red	Very high risk
Orange	High risk
Yellow	Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	0.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.00 m	Fill height:	N/A	Limit depth:	N/A

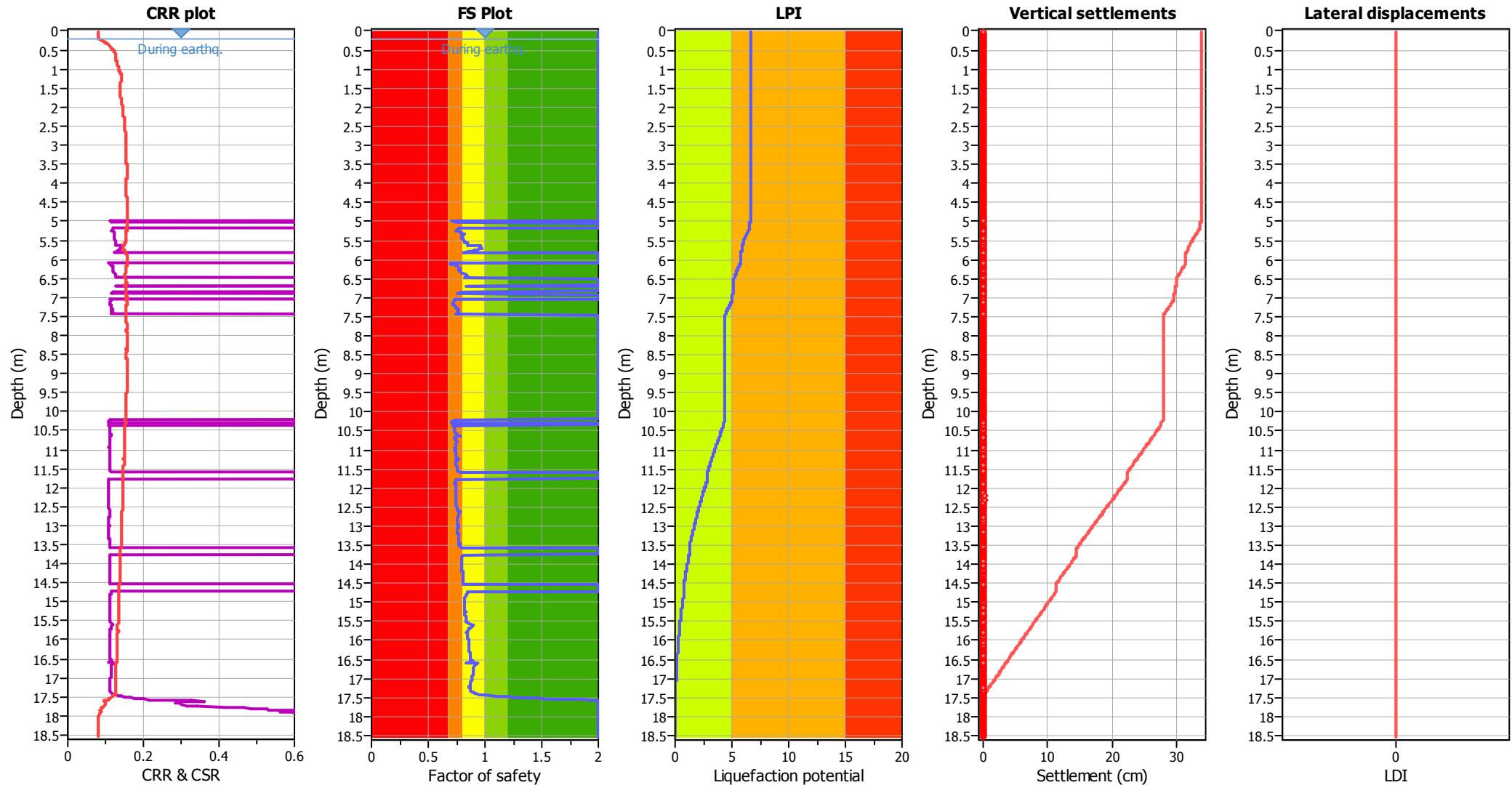
F.S. color scheme

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

LPI color scheme

Red	Very high risk
Orange	High risk
Yellow	Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	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 :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.20 m	Fill height:	N/A	Limit depth:	N/A

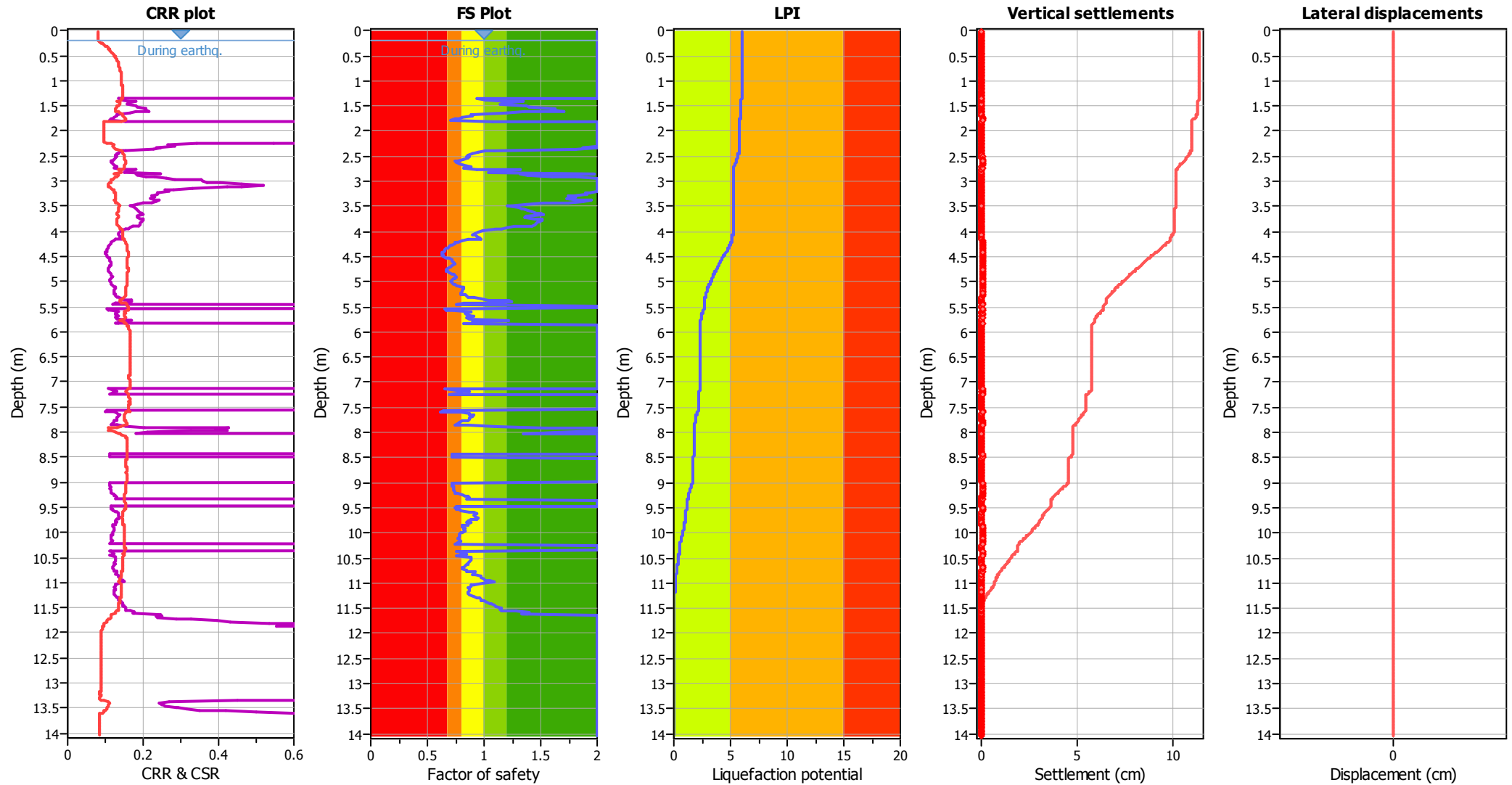
F.S. color scheme

■	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.):	0.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	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 :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.20 m	Fill height:	N/A	Limit depth:	N/A

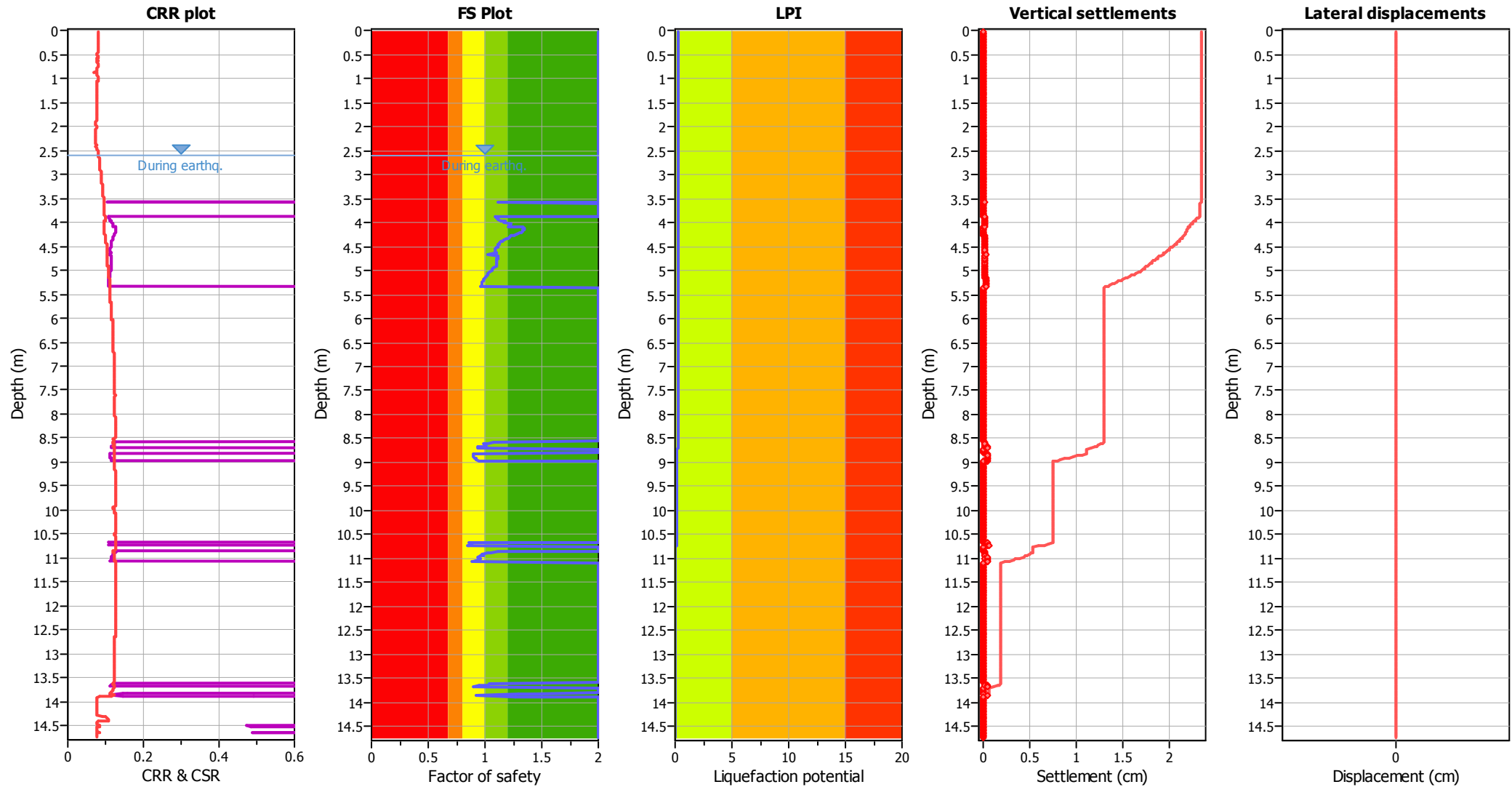
F.S. color scheme

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

LPI color scheme

Red	Very high risk
Orange	High risk
Yellow	Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	2.60 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_0 applied:	Yes
Earthquake magnitude M_w :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.60 m	Fill height:	N/A	Limit depth:	N/A

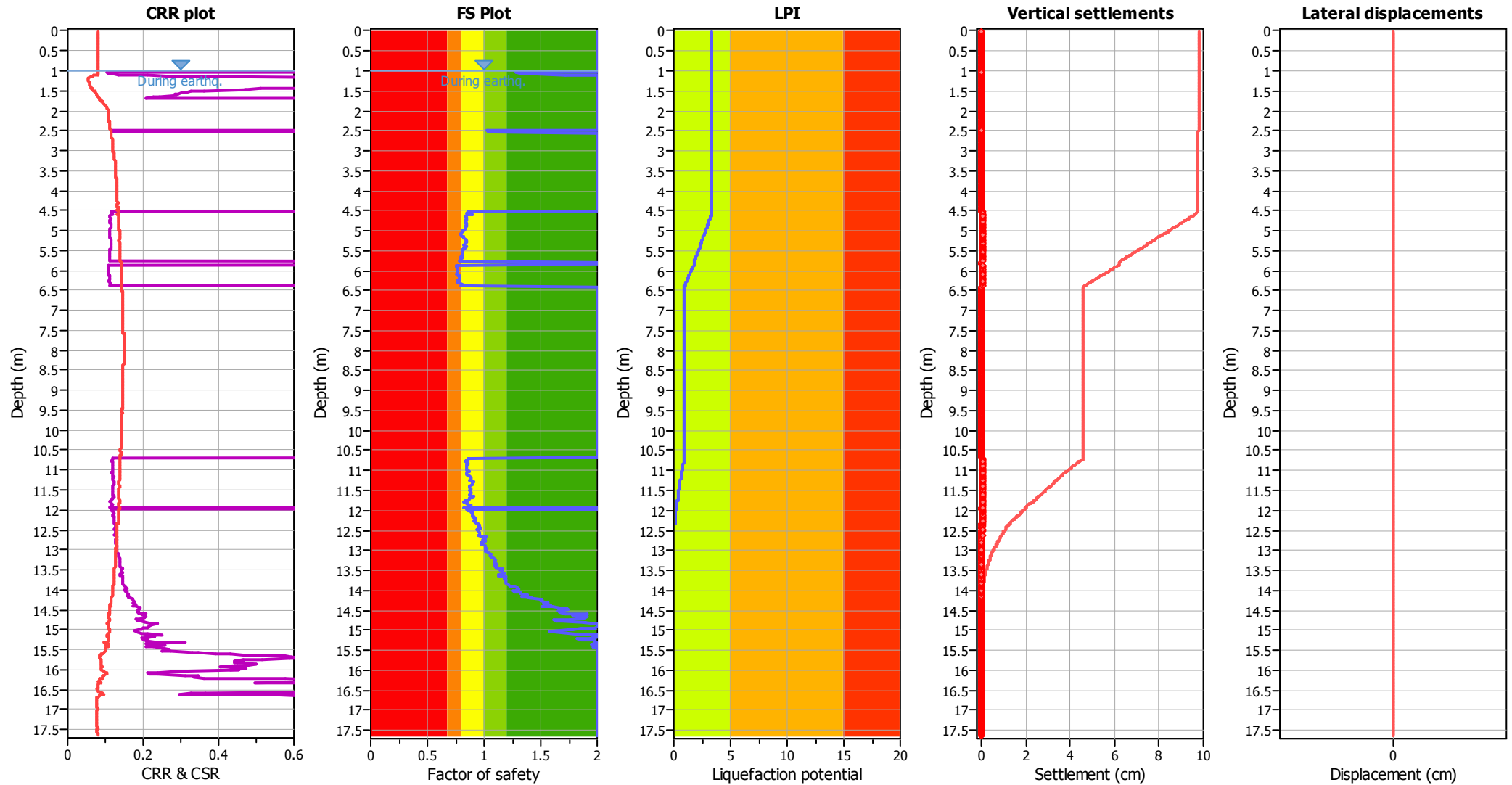
F.S. color scheme

■	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)
 Fines correction method: B&I (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 5.90
 Peak ground acceleration: 0.15
 Depth to water table (insitu): 1.00 m

Depth to GWT (earthq.): 1.00 m
 Average results interval: 5
 I_c cut-off value: 2.60
 Unit weight calculation: Based on SBT
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: No
 K_σ applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

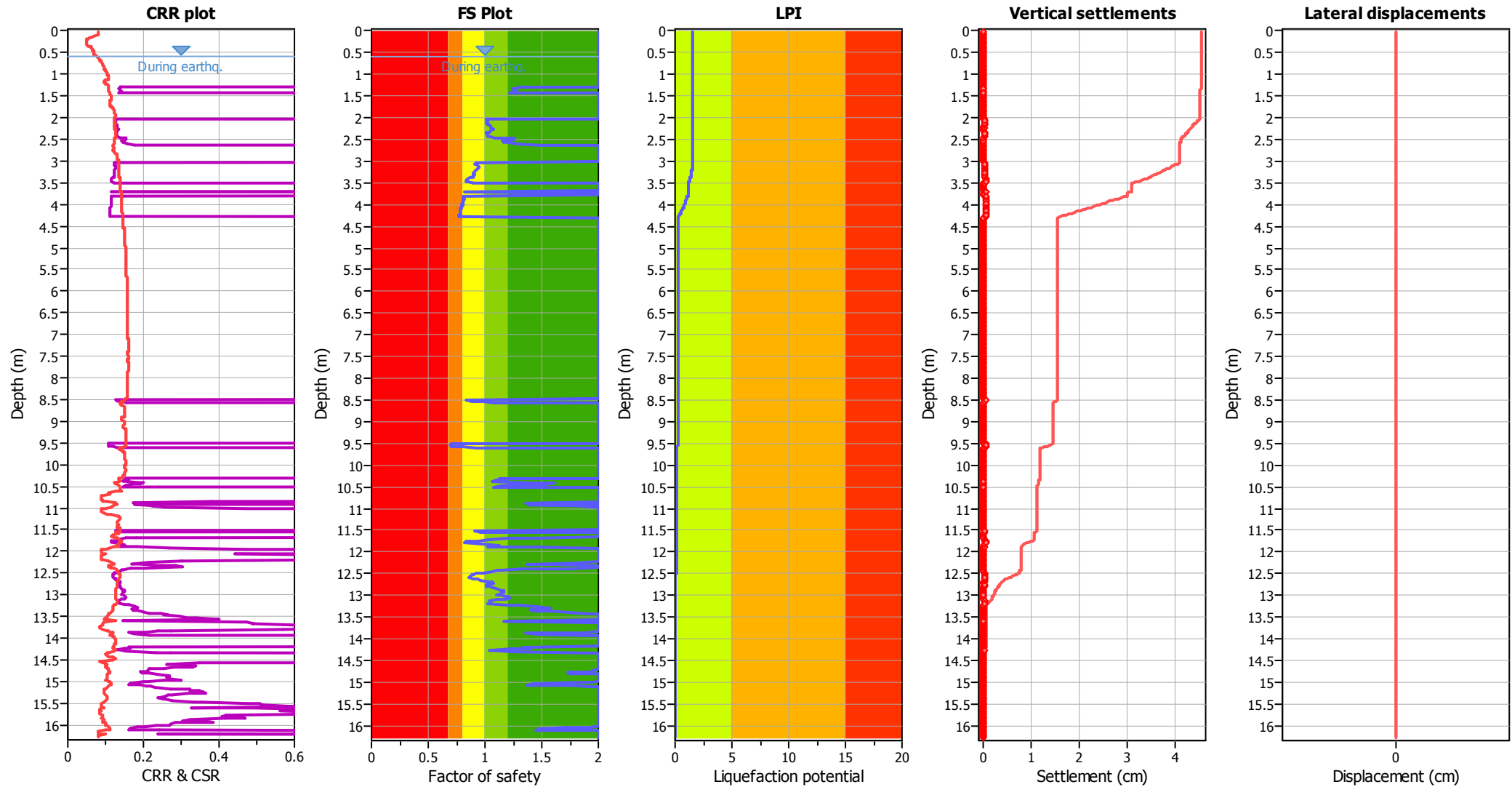
F.S. color scheme

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.):	0.60 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.60 m	Fill height:	N/A	Limit depth:	N/A

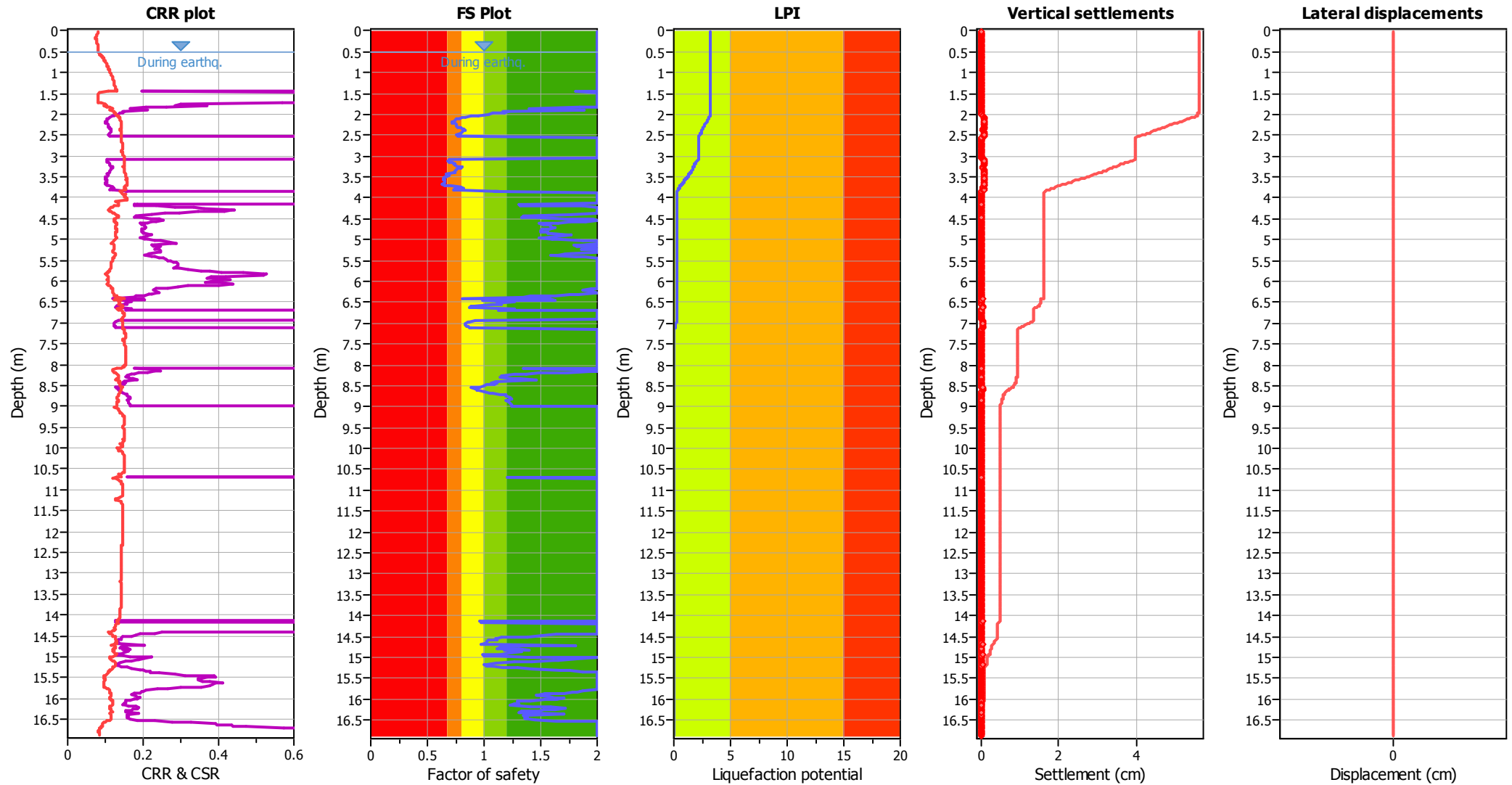
F.S. color scheme

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

LPI color scheme

Red	Very high risk
Orange	High risk
Yellow	Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_g applied:	Yes
Earthquake magnitude M_w :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

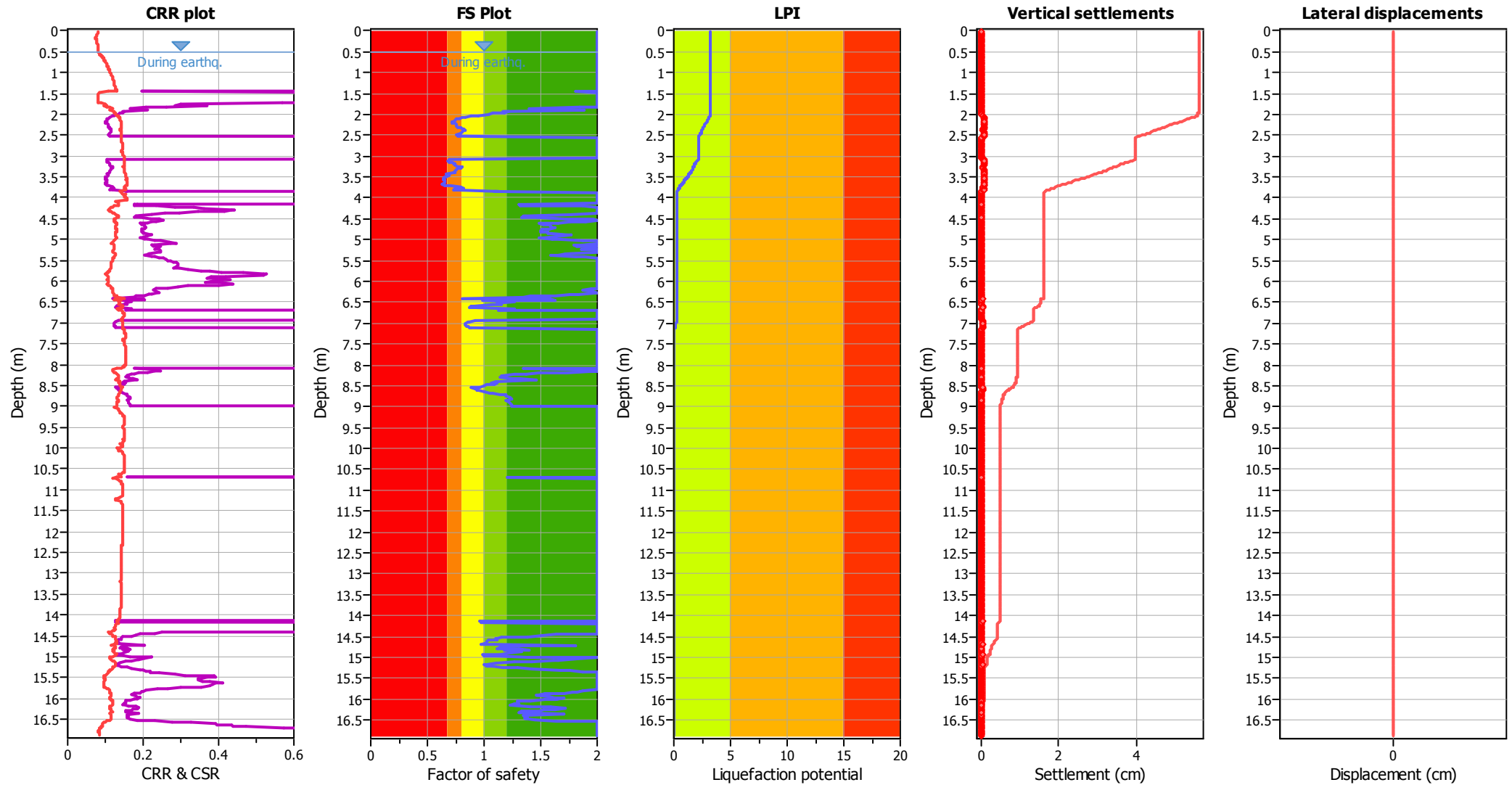
F.S. color scheme

■	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)
 Fines correction method: B&I (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 5.90
 Peak ground acceleration: 0.15
 Depth to water table (insitu): 0.50 m

Depth to GWT (earthq.): 0.50 m
 Average results interval: 5
 I_c cut-off value: 2.60
 Unit weight calculation: Based on SBT
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: Yes
 K_0 applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

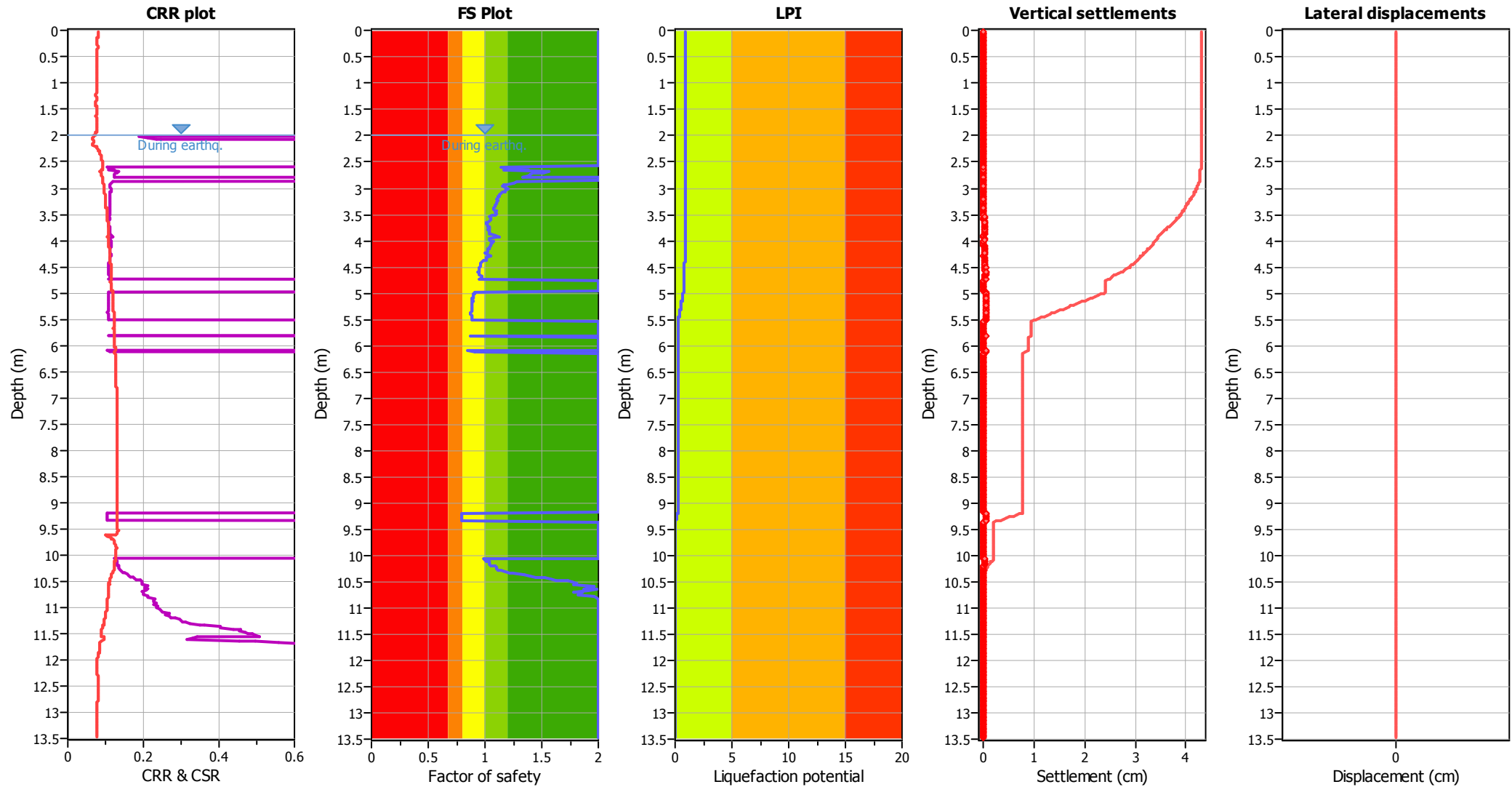
F.S. color scheme

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.):	2.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_0 applied:	Yes
Earthquake magnitude M_w :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.00 m	Fill height:	N/A	Limit depth:	N/A

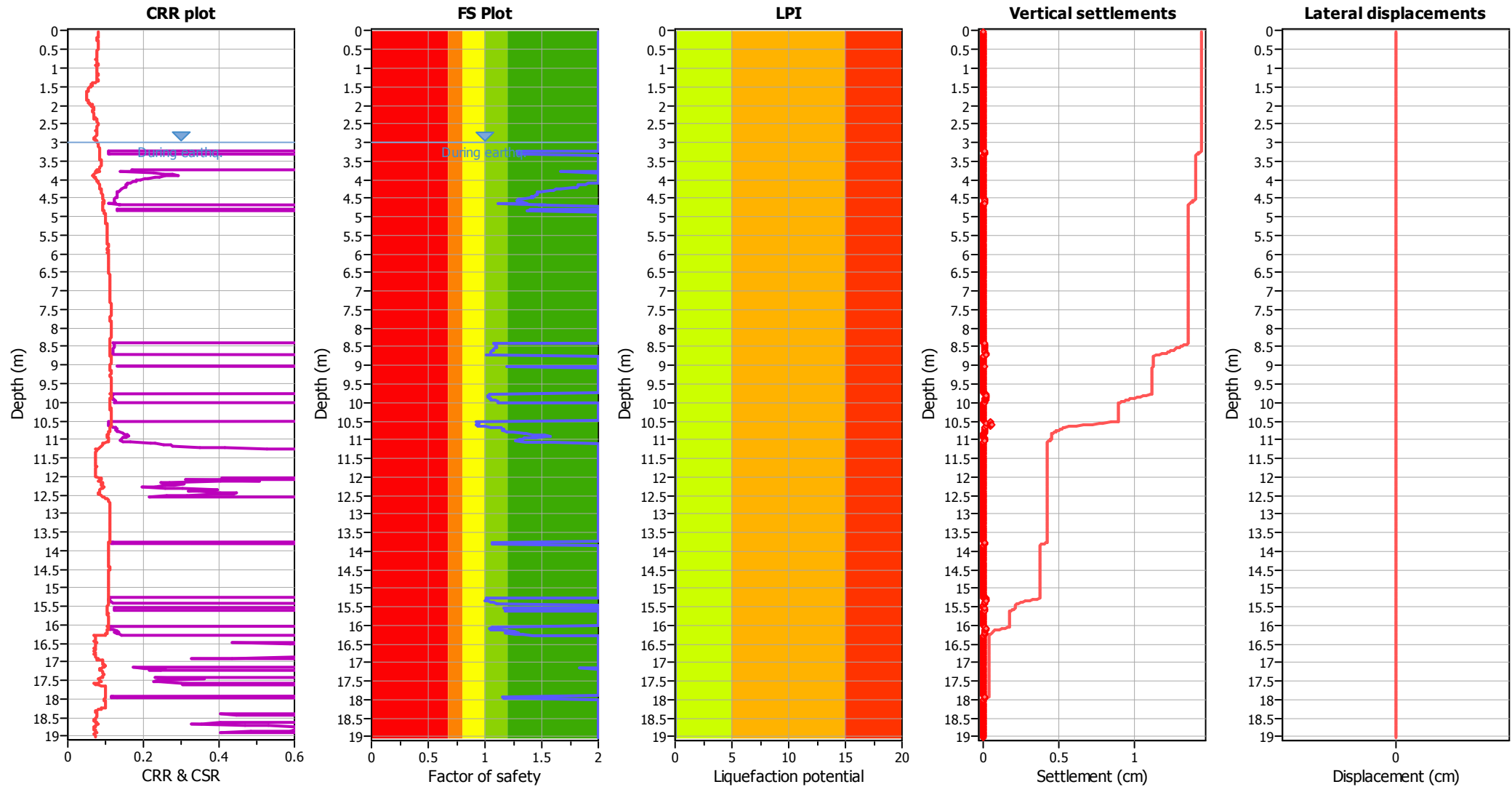
F.S. color scheme

■	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 (erthq.):	3.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.00 m	Fill height:	N/A	Limit depth:	N/A

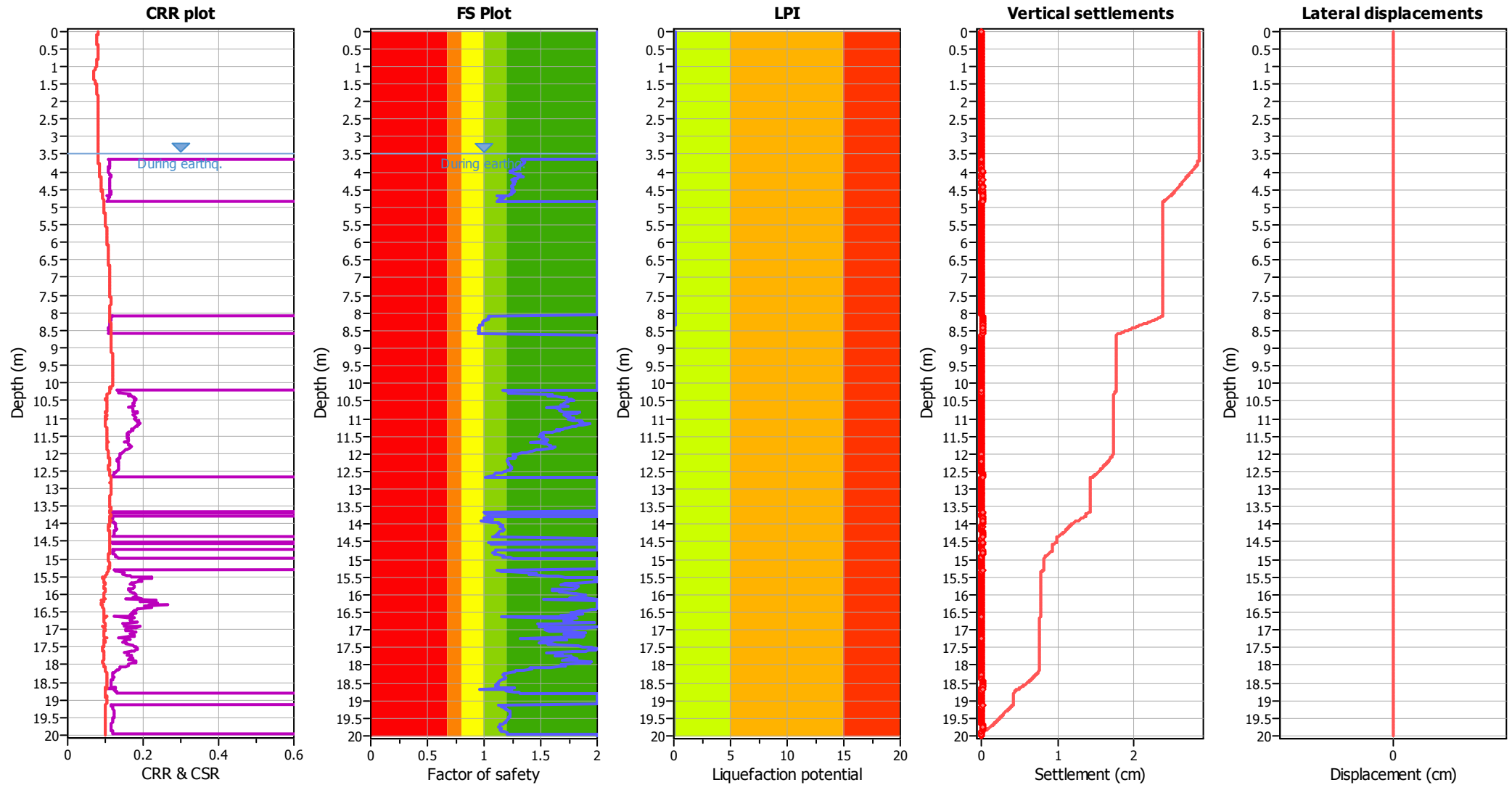
F.S. color scheme

■	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.):	3.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _g applied:	Yes
Earthquake magnitude M _w :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	3.50 m	Fill height:	N/A	Limit depth:	N/A

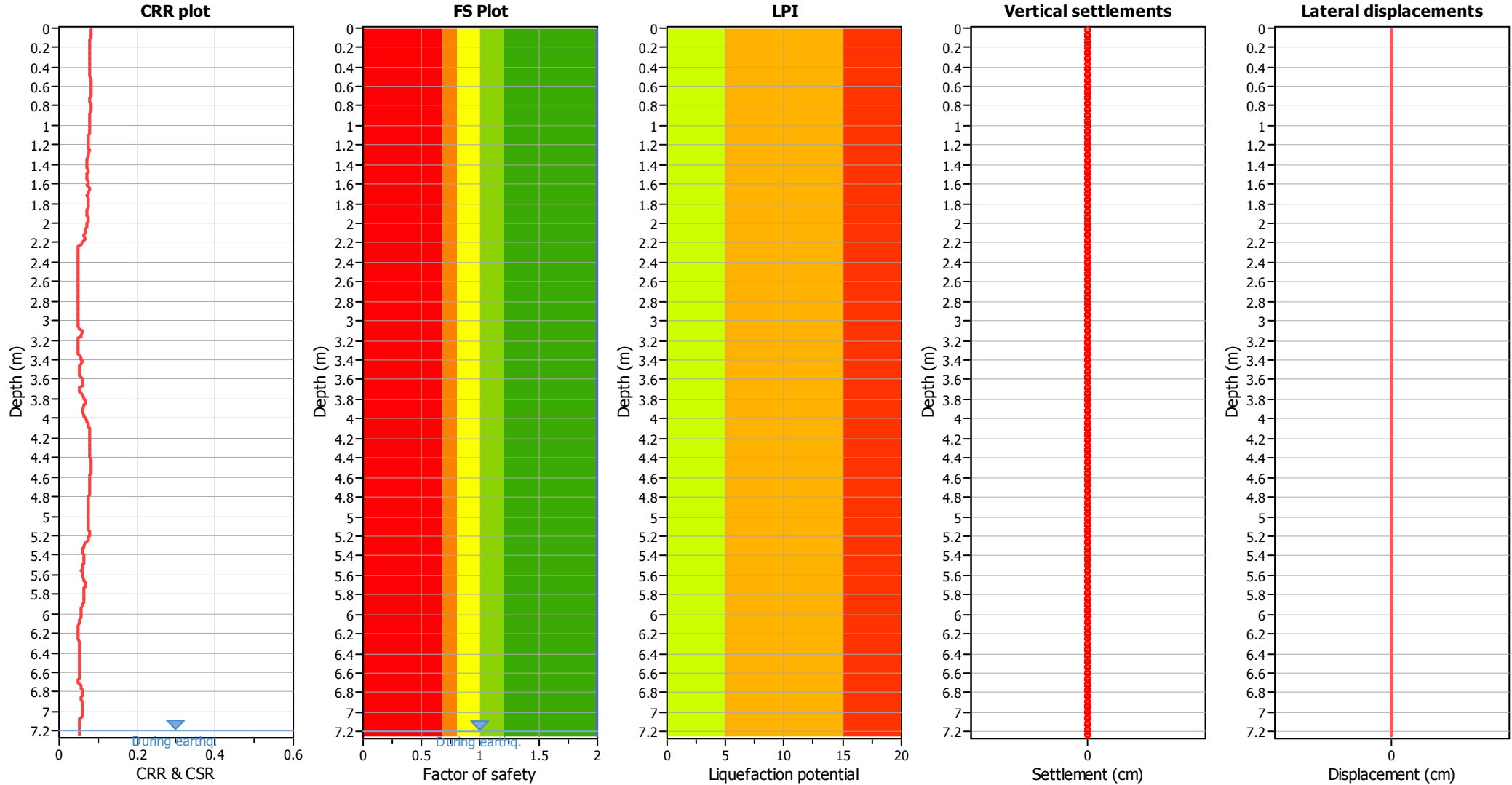
F.S. color scheme

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

LPI color scheme

Red	Very high risk
Orange	High risk
Yellow	Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	7.20 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	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 :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	7.20 m	Fill height:	N/A	Limit depth:	N/A

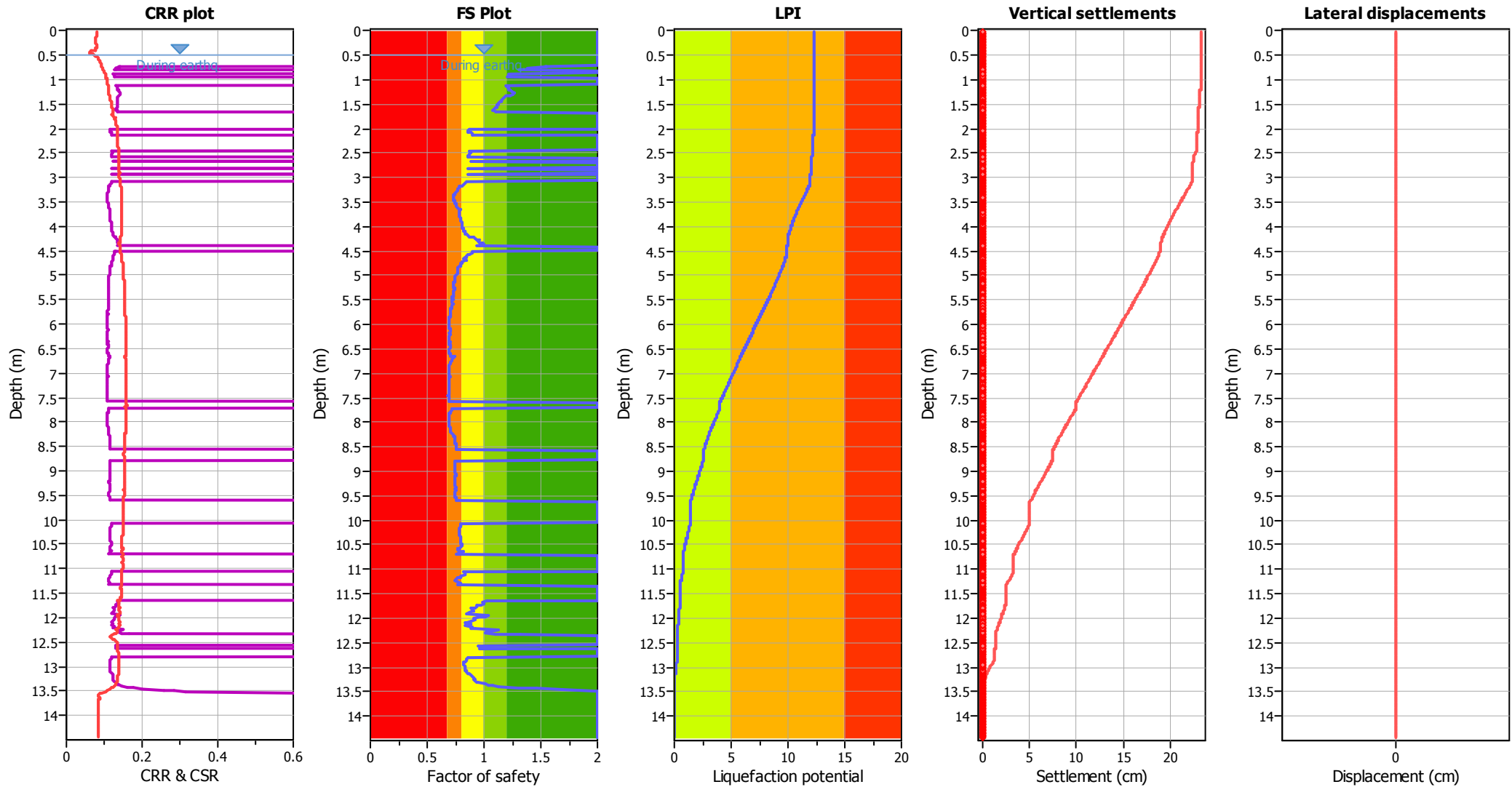
F.S. color scheme

- 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.):	0.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	0.50 m	Fill height:	N/A	Limit depth:	N/A

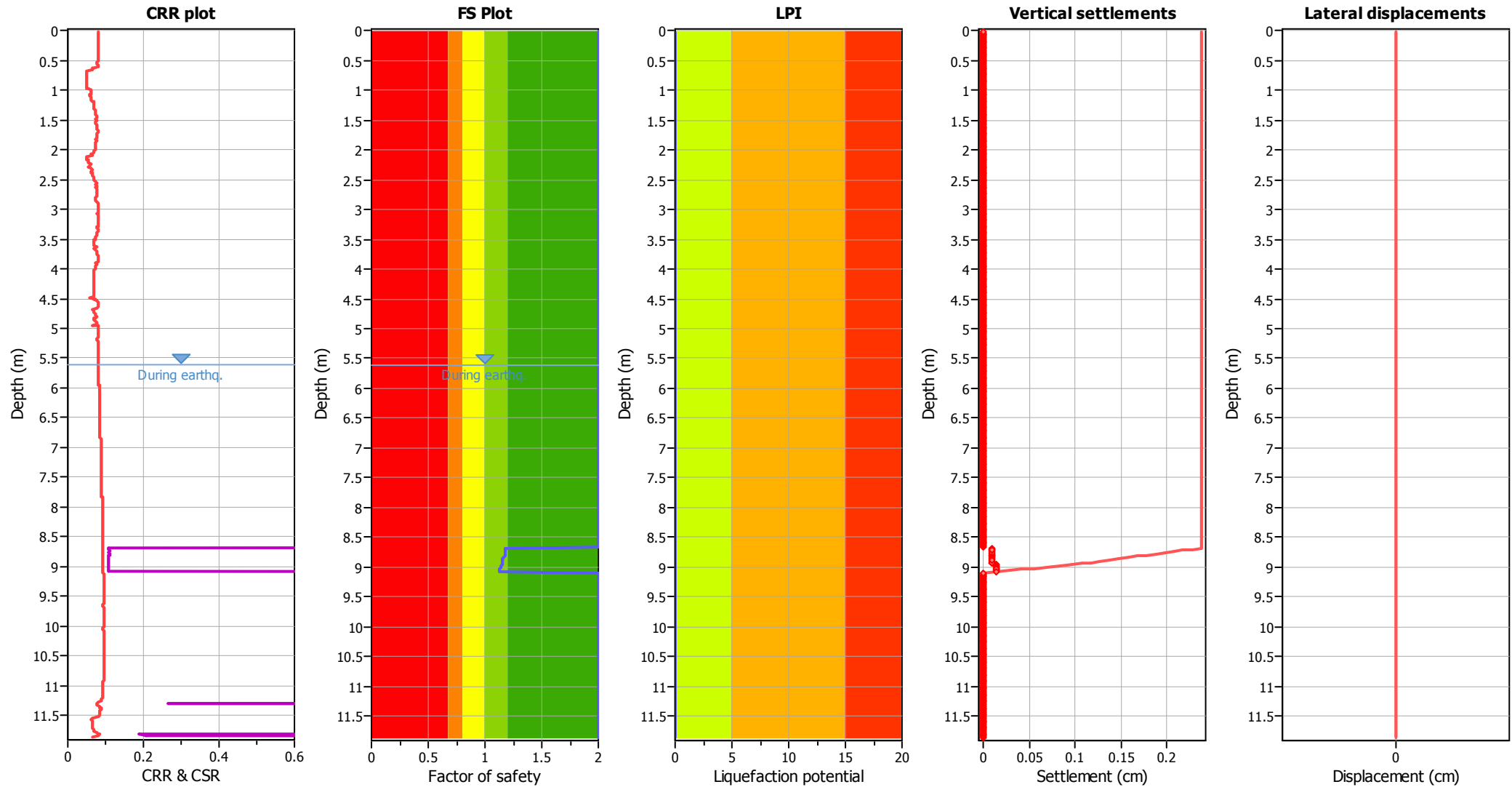
F.S. color scheme

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

LPI color scheme

Red	Very high risk
Orange	High risk
Yellow	Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	5.60 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K _g applied:	Yes
Earthquake magnitude M _w :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.60 m	Fill height:	N/A	Limit depth:	N/A

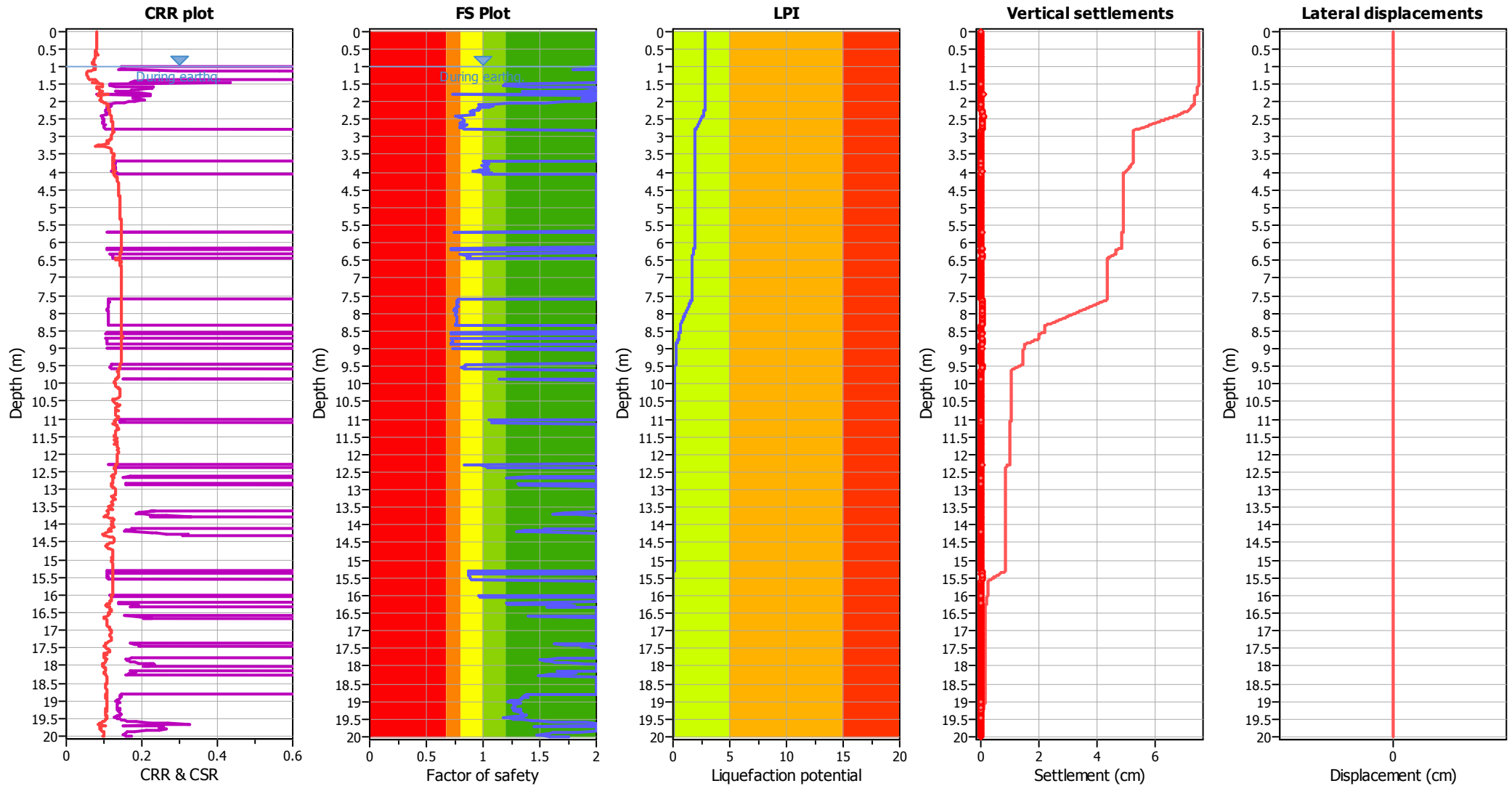
F.S. color scheme

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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

LPI color scheme

Red	Very high risk
Orange	High risk
Yellow	Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

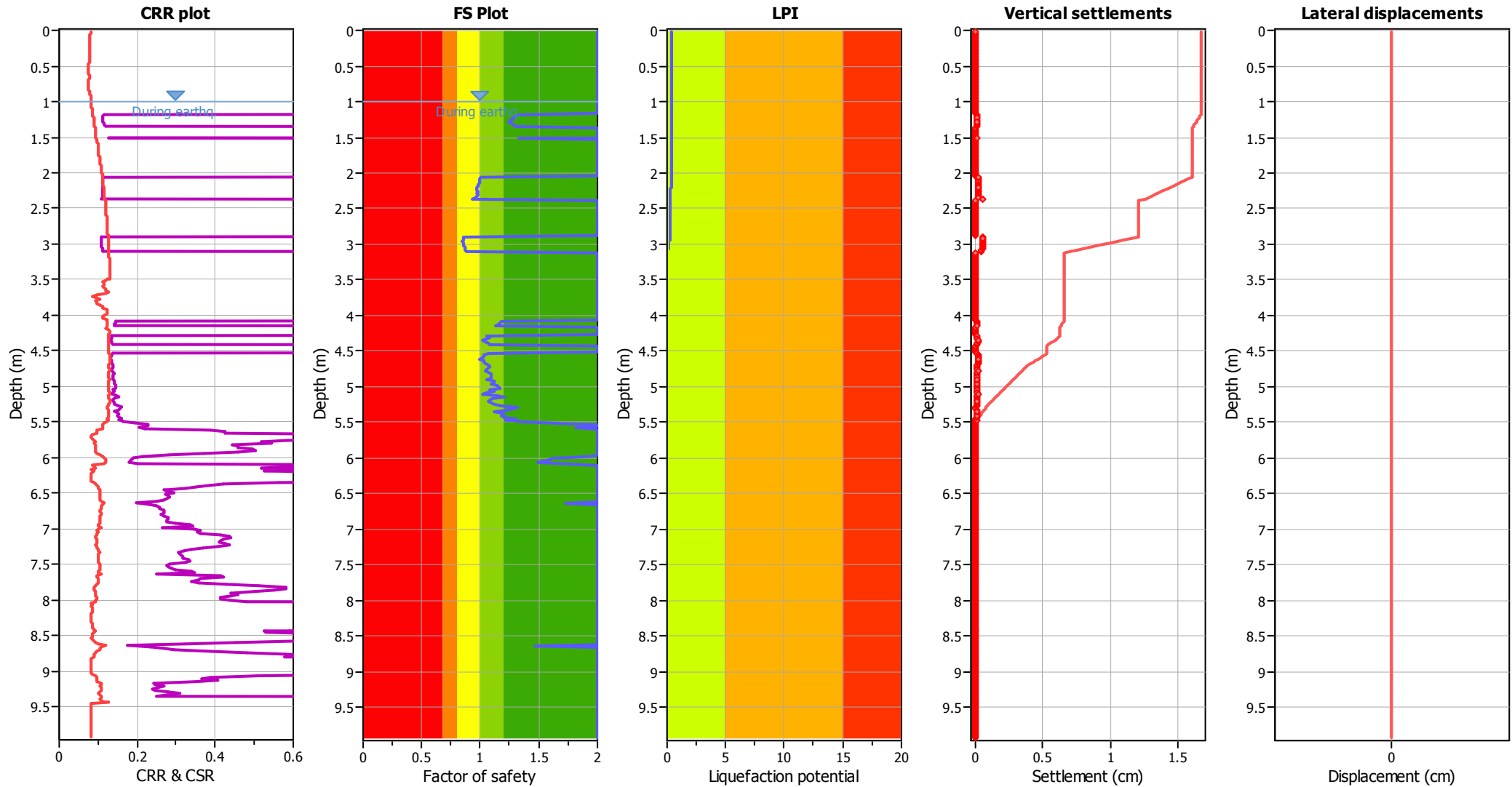
F.S. color scheme

■	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.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_0 applied:	Yes
Earthquake magnitude M_w :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

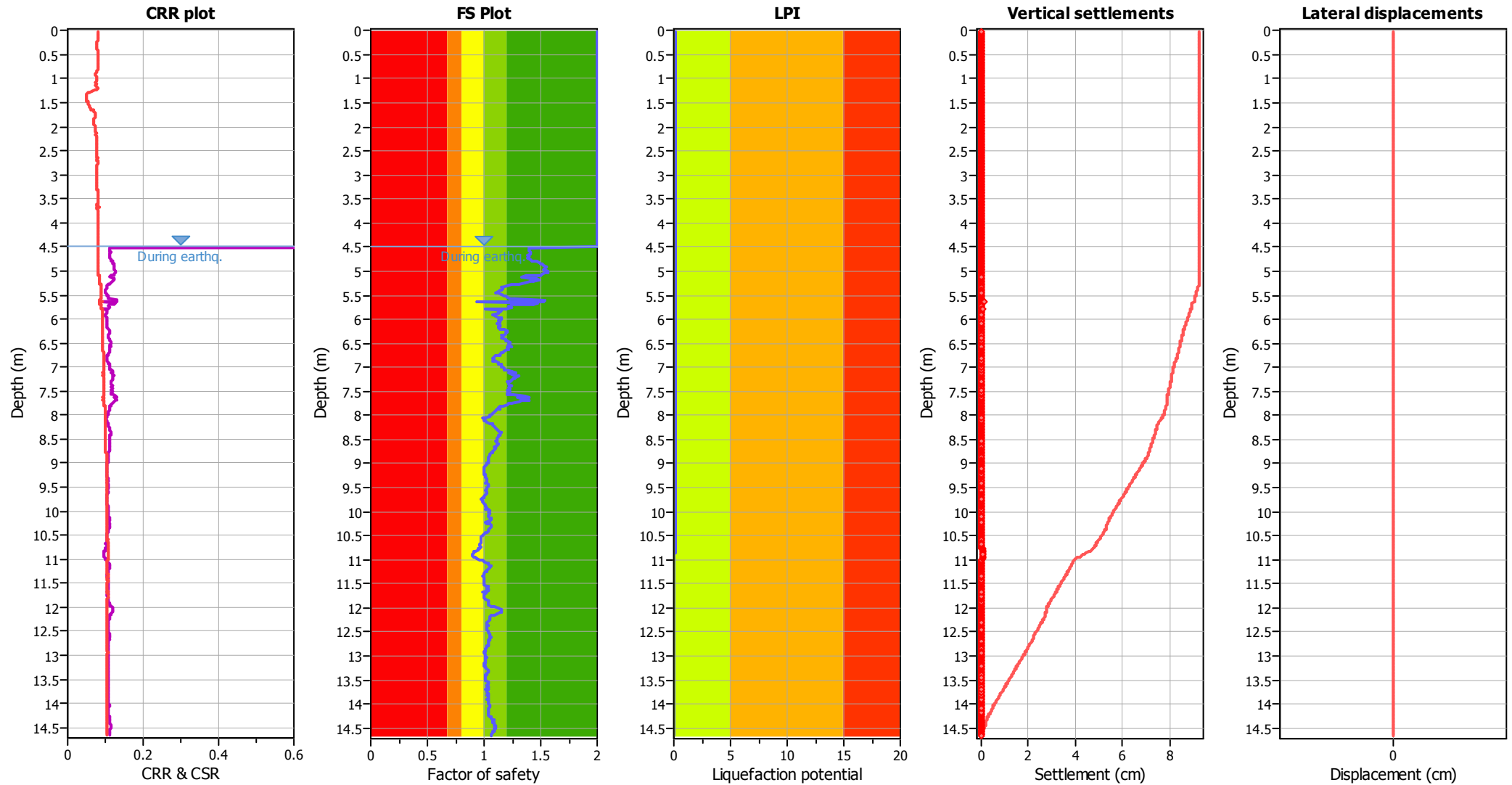
F.S. color scheme

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

LPI color scheme

Red	Very high risk
Orange	High risk
Yellow	Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (earthq.):	4.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	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 :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.50 m	Fill height:	N/A	Limit depth:	N/A

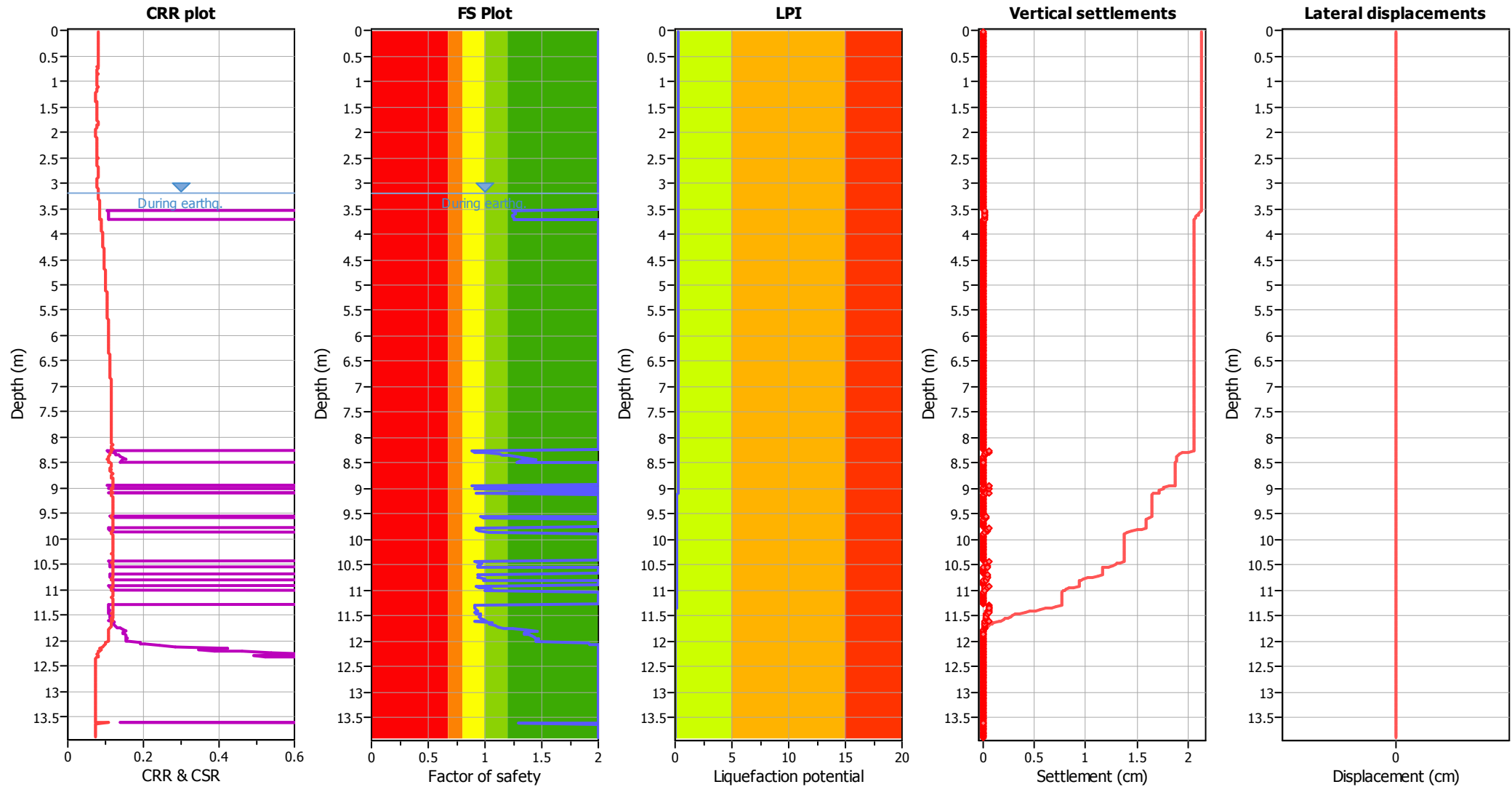
F.S. color scheme

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

LPI color scheme

Red	Very high risk
Orange	High risk
Yellow	Low risk

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
 Fines correction method: B&I (2014)
 Points to test: Based on I_c value
 Earthquake magnitude M_w : 5.90
 Peak ground acceleration: 0.15
 Depth to water table (insitu): 3.20 m

Depth to GWT (earthq.): 3.20 m
 Average results interval: 5
 I_c cut-off value: 2.60
 Unit weight calculation: Based on SBT
 Use fill: No
 Fill height: N/A

Fill weight: N/A
 Transition detect. applied: No
 K_σ applied: Yes
 Clay like behavior applied: Sands only
 Limit depth applied: No
 Limit depth: N/A

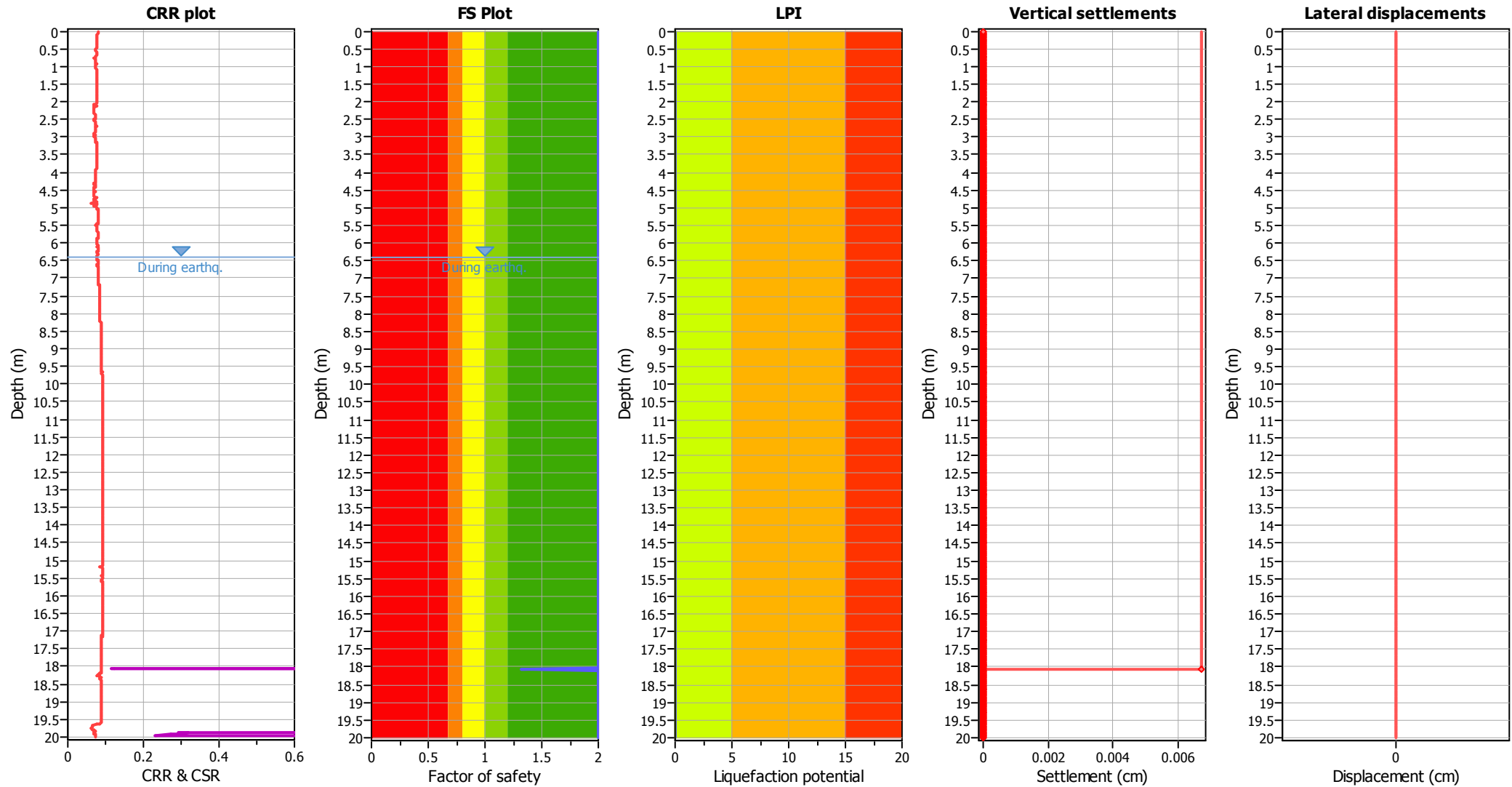
F.S. color scheme

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.):	6.40 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_f applied:	Yes
Earthquake magnitude M_w :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.40 m	Fill height:	N/A	Limit depth:	N/A

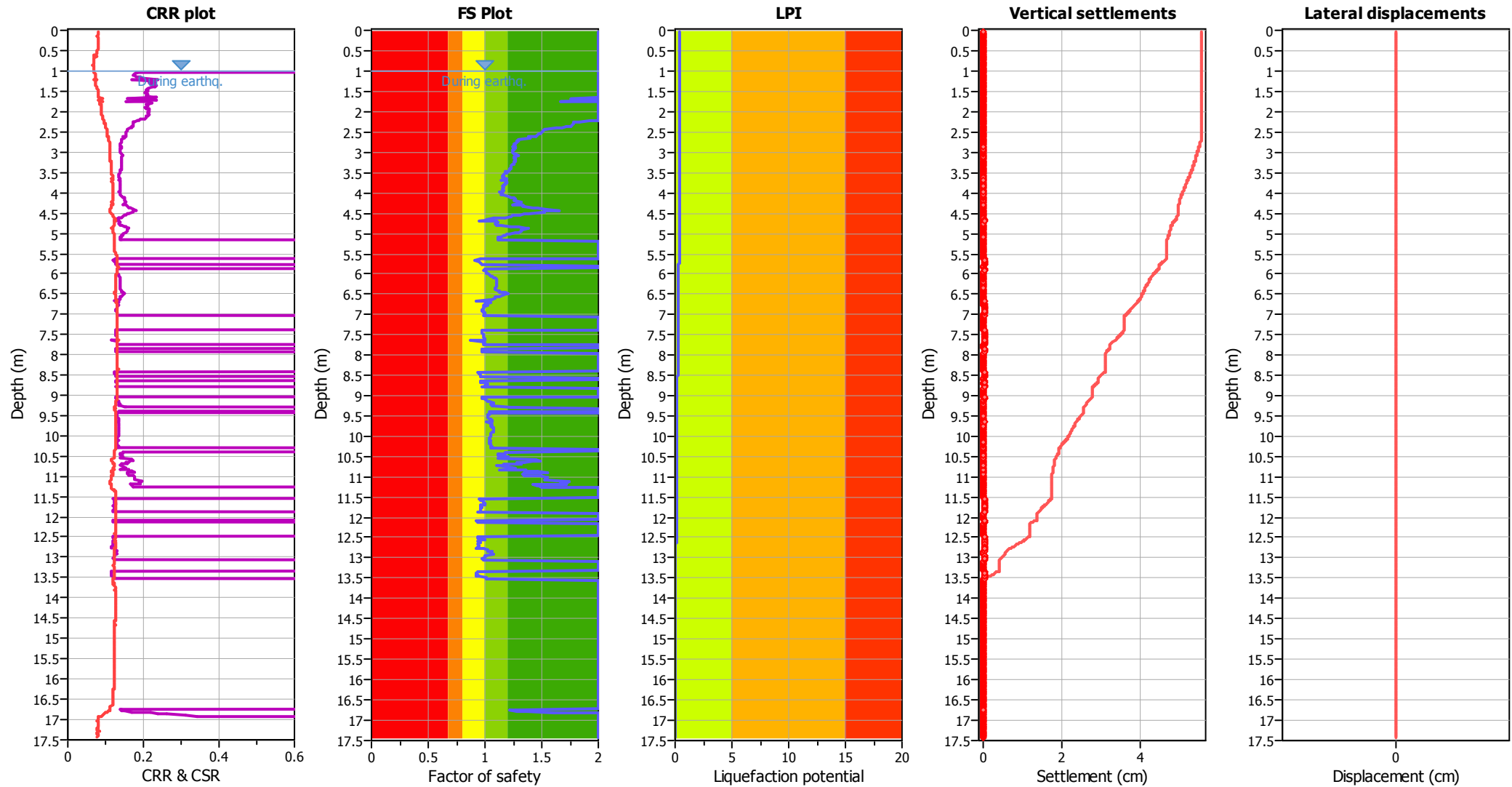
F.S. color scheme

■	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 (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	5	Transition detect. applied:	Yes
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K ₀ applied:	Yes
Earthquake magnitude M _w :	5.90	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.15	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	9.20 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

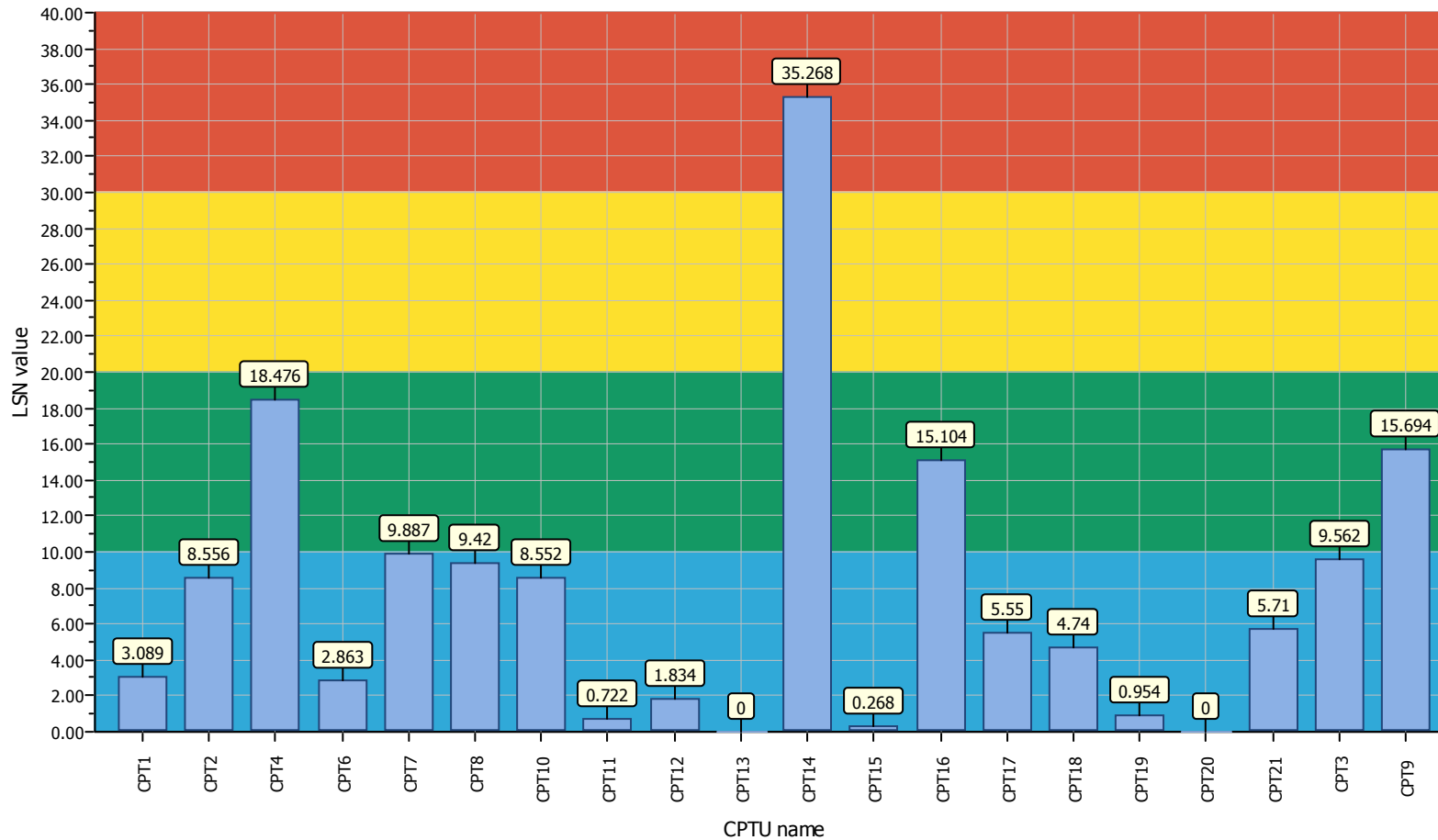
LPI color scheme

Red	Very high risk
Orange	High risk
Yellow	Low risk

Project title : Liquefaction Analyses

Location : Peacockes Road, Hamilton East

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

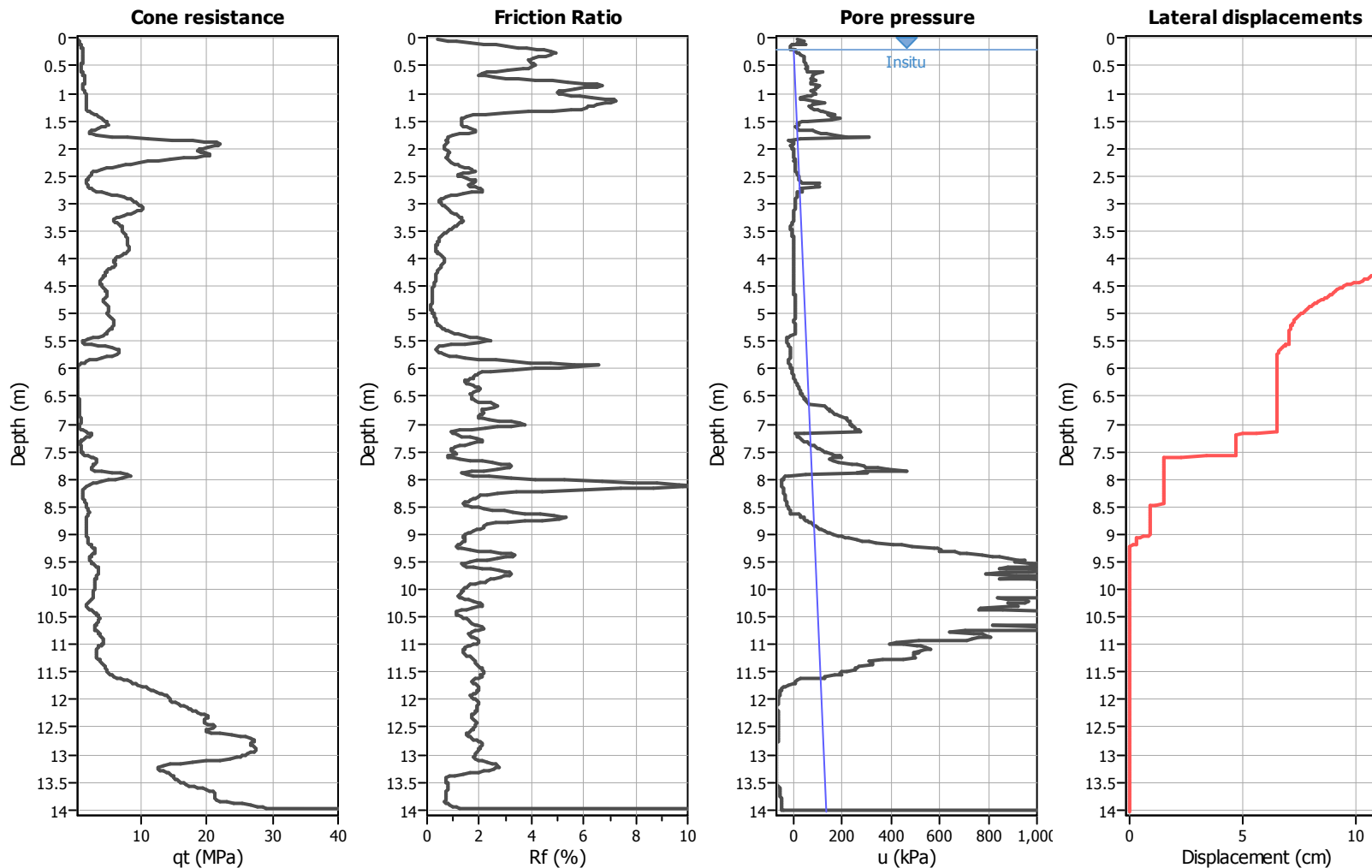
Total CPT number: 20
 80.00% little liquefaction
 15.00% minnor liquefaction
 0.00% moderate liquefaction
 5.00% moderate to major liquefaction
 0.00% major liquefaction
 0.00% severe liquefaction

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT4

Total depth: 14.04 m



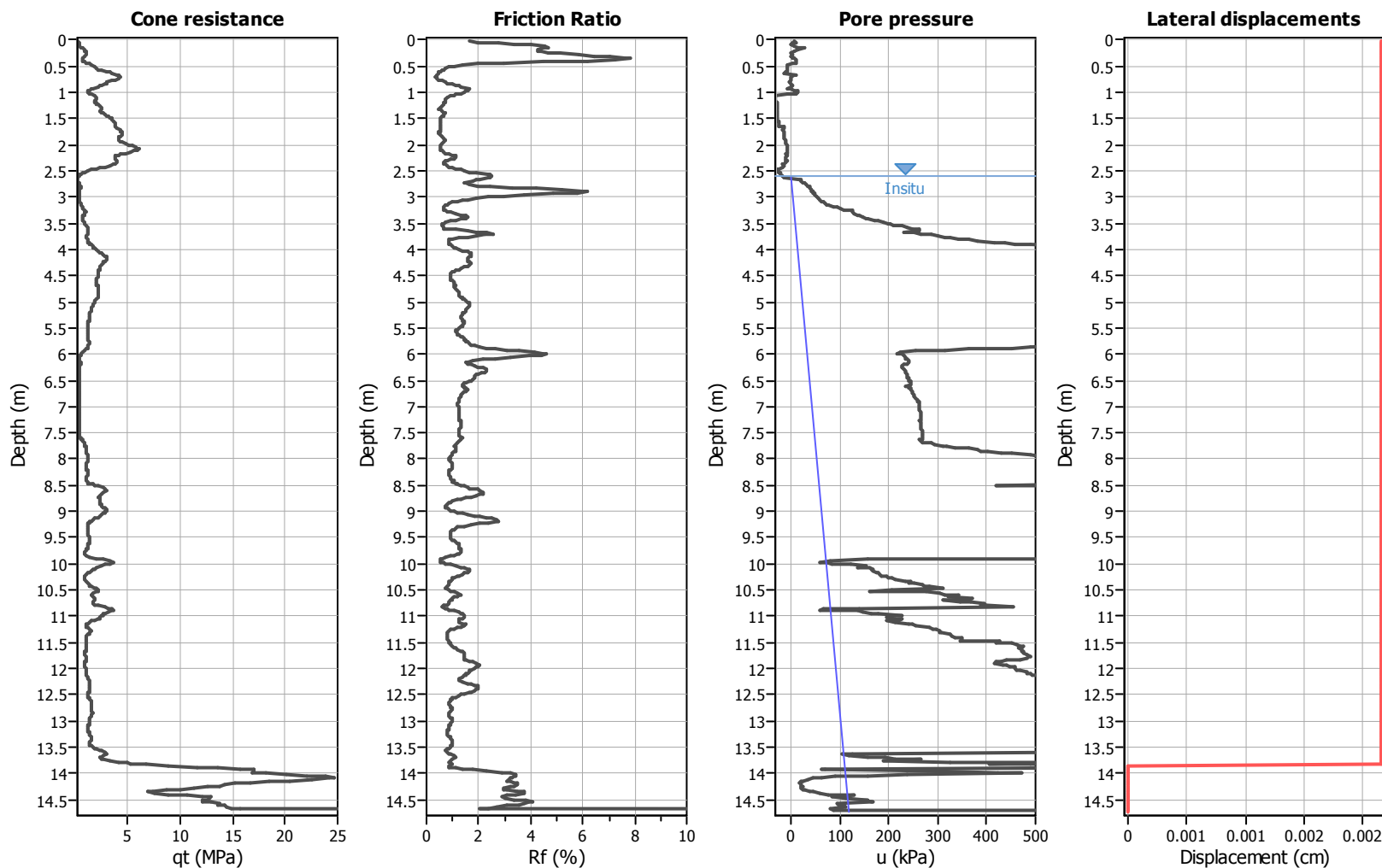
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	0.20 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	0.20 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_0 applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT6

Total depth: 14.74 m



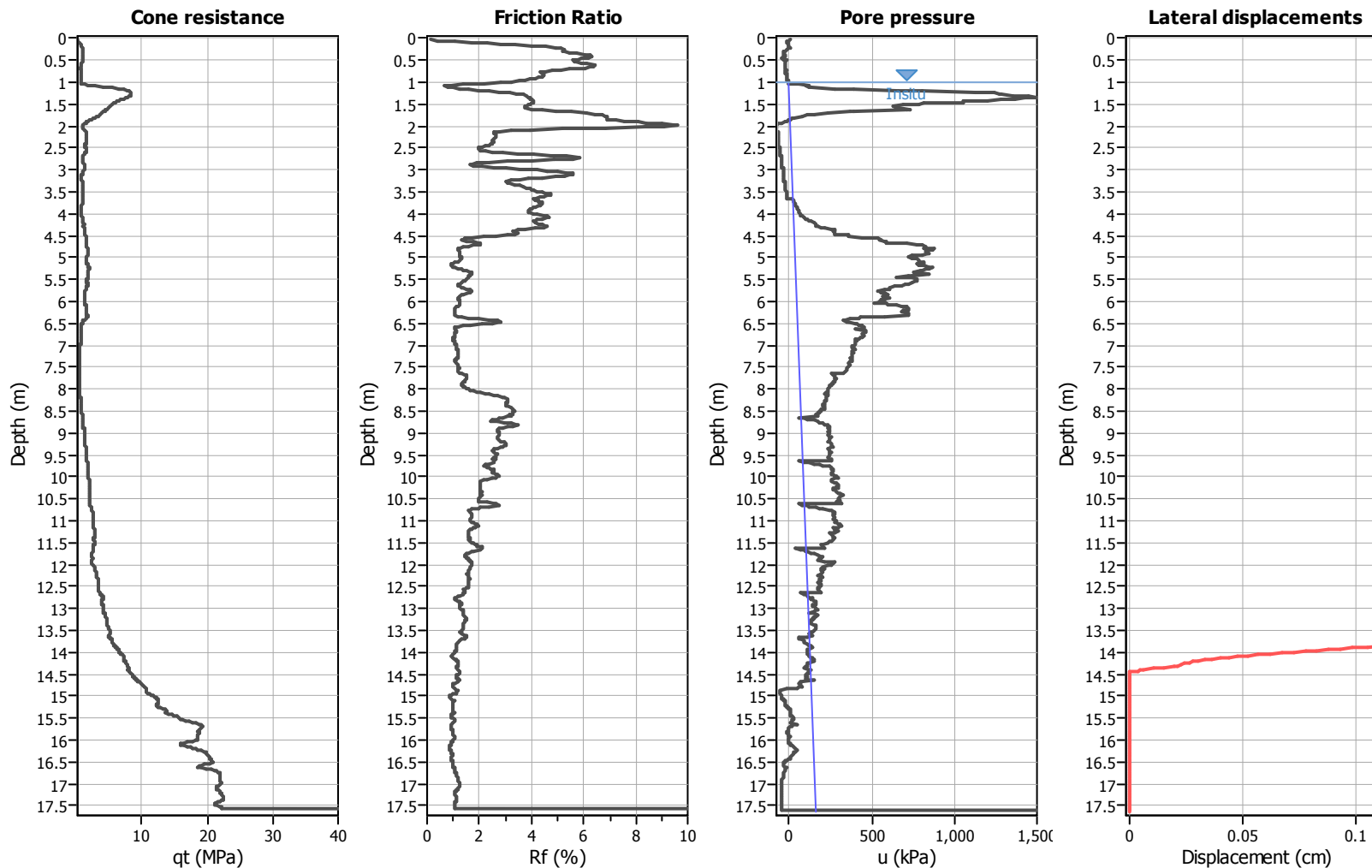
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	2.60 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	2.60 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_0 applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT7

Total depth: 17.64 m



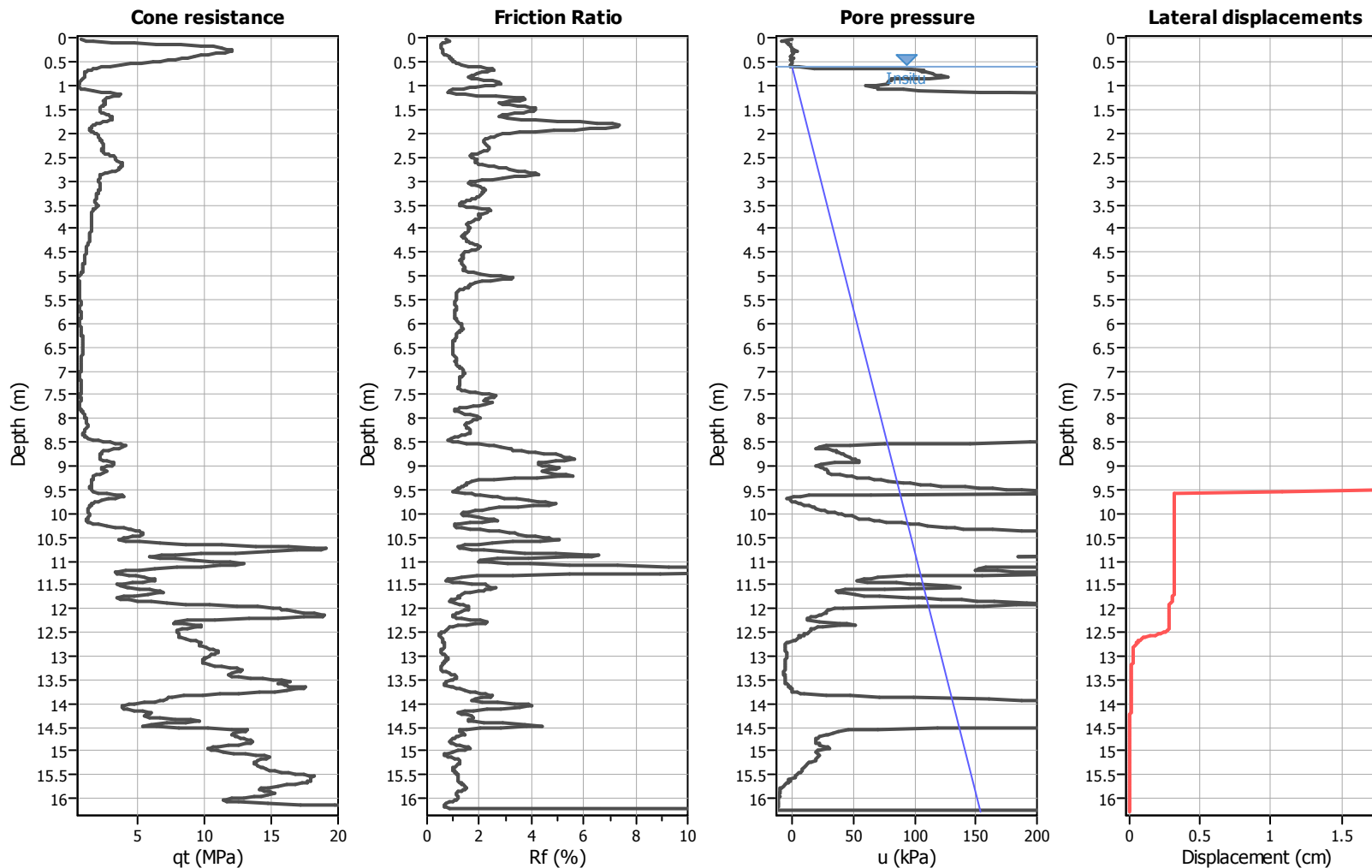
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_0 applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT8

Total depth: 16.28 m



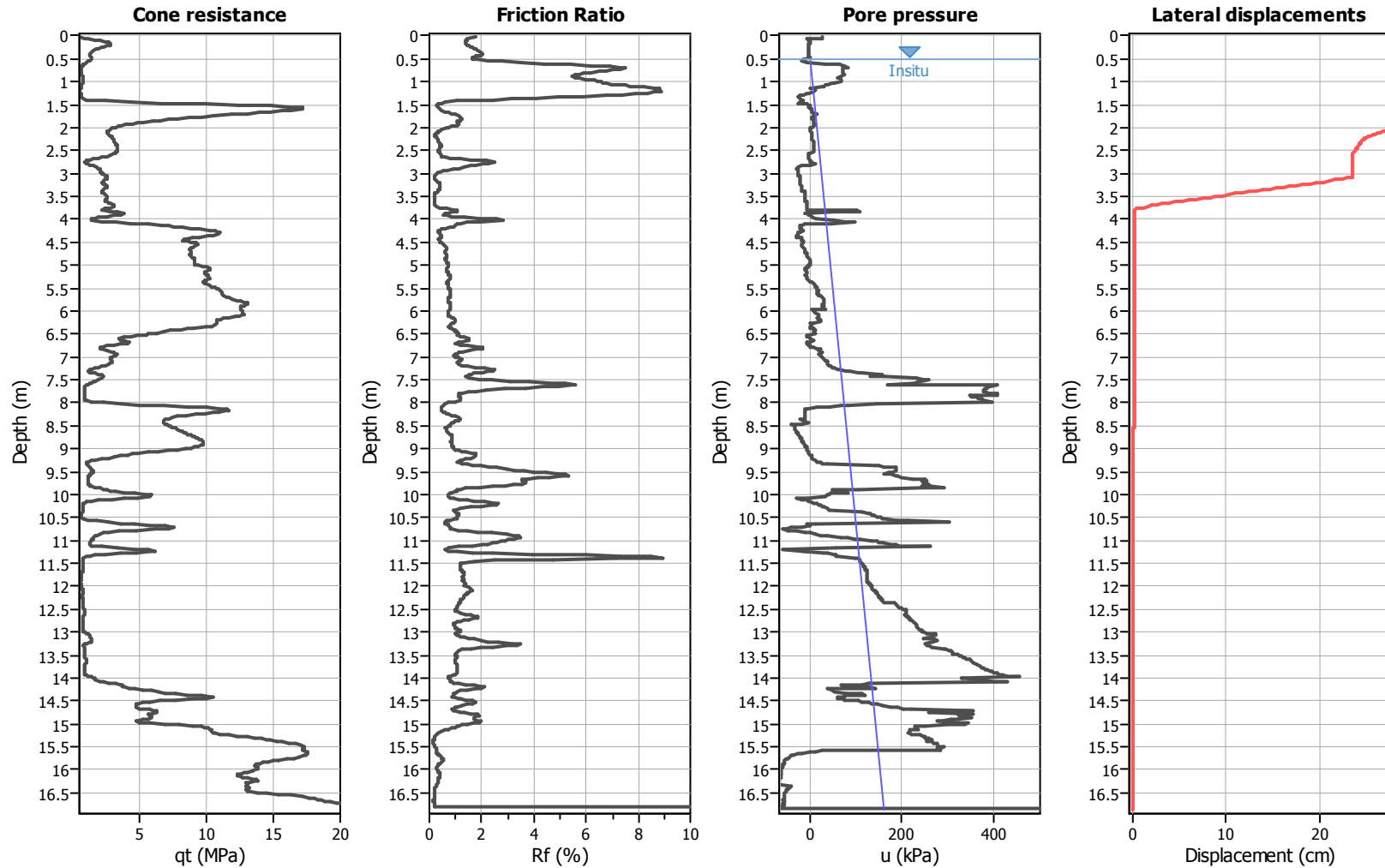
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	0.60 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	0.60 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT9 Valley

Total depth: 16.88 m



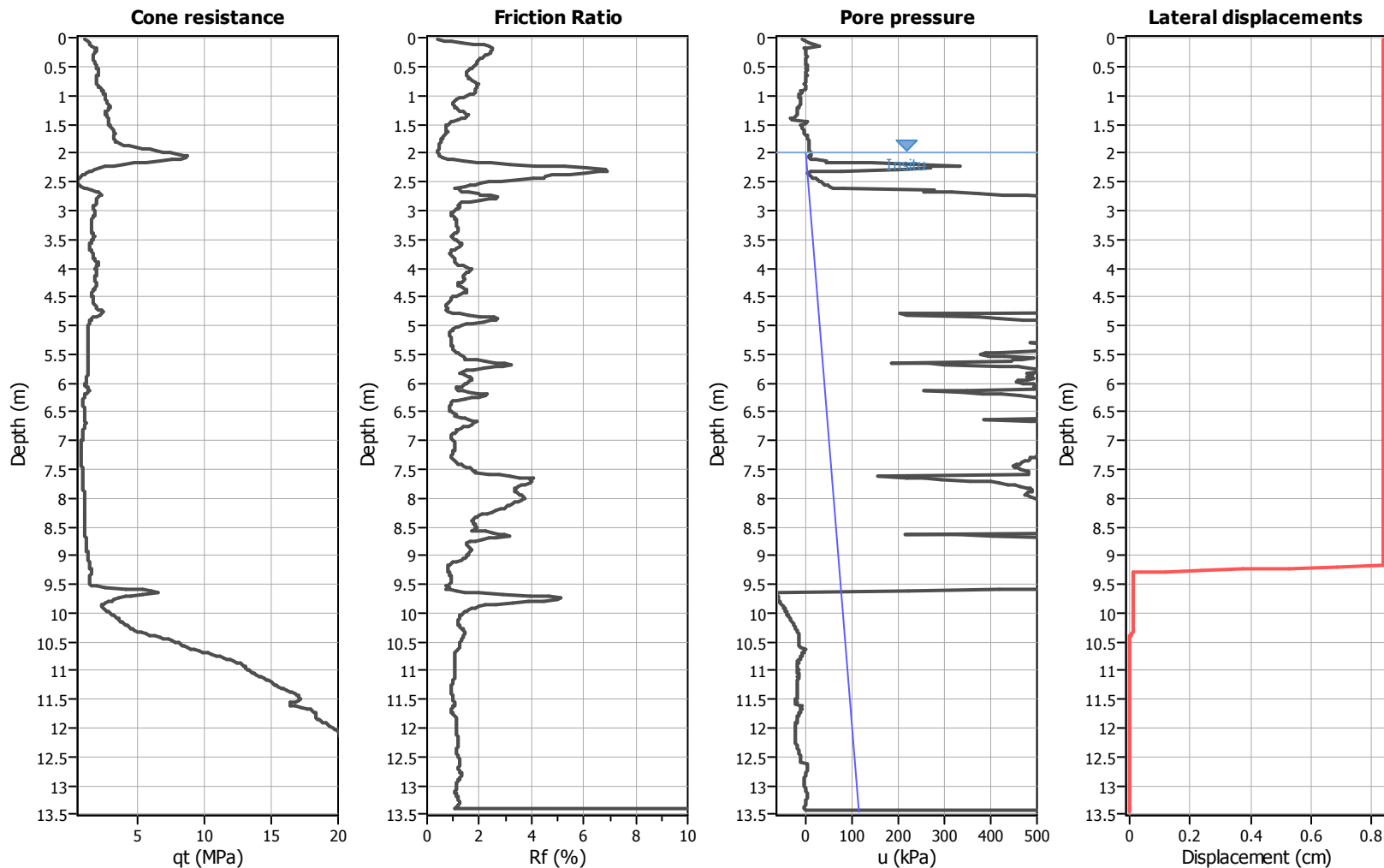
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	0.50 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT10

Total depth: 13.46 m



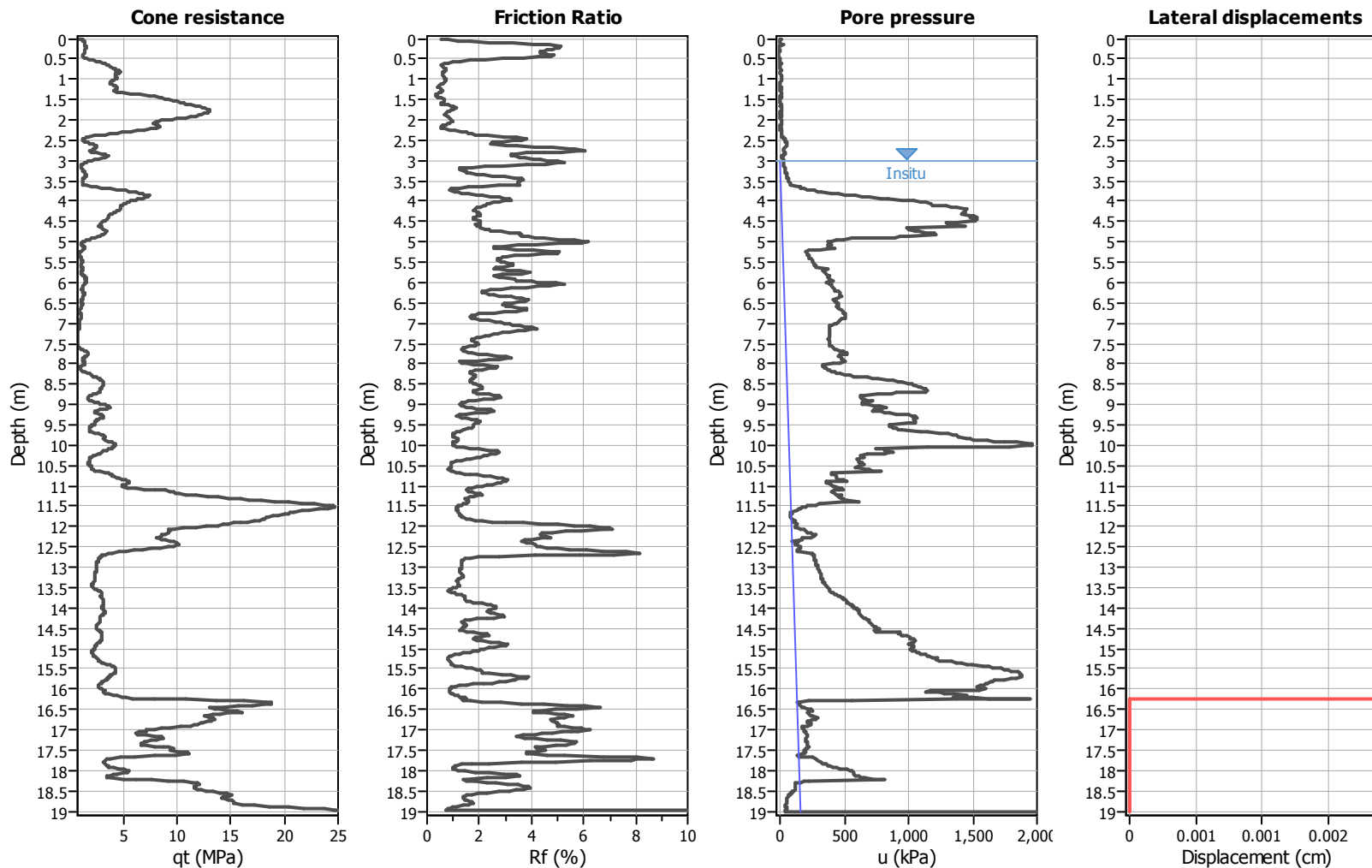
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	2.00 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_0 applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT11

Total depth: 19.02 m



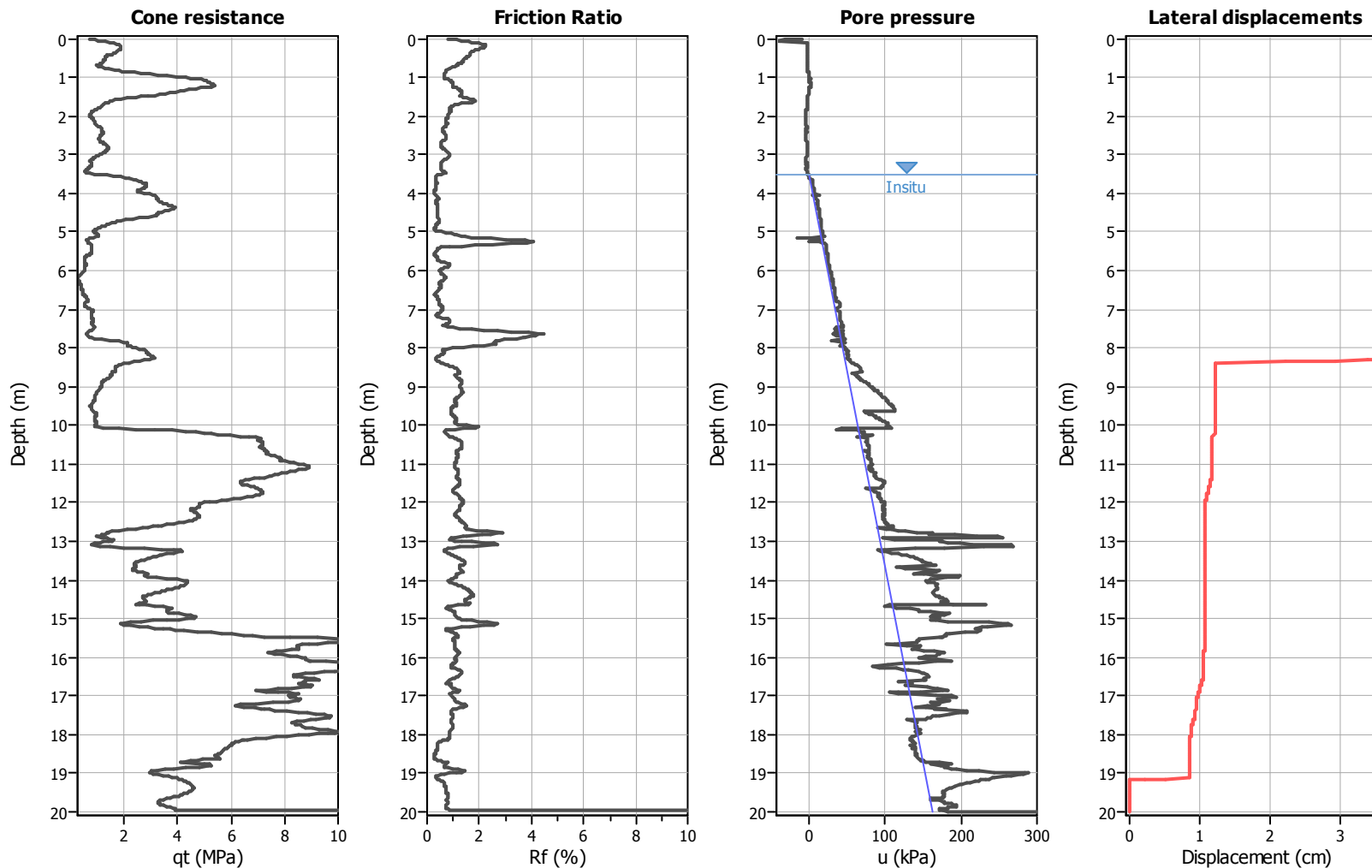
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	3.00 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT12

Total depth: 20.00 m



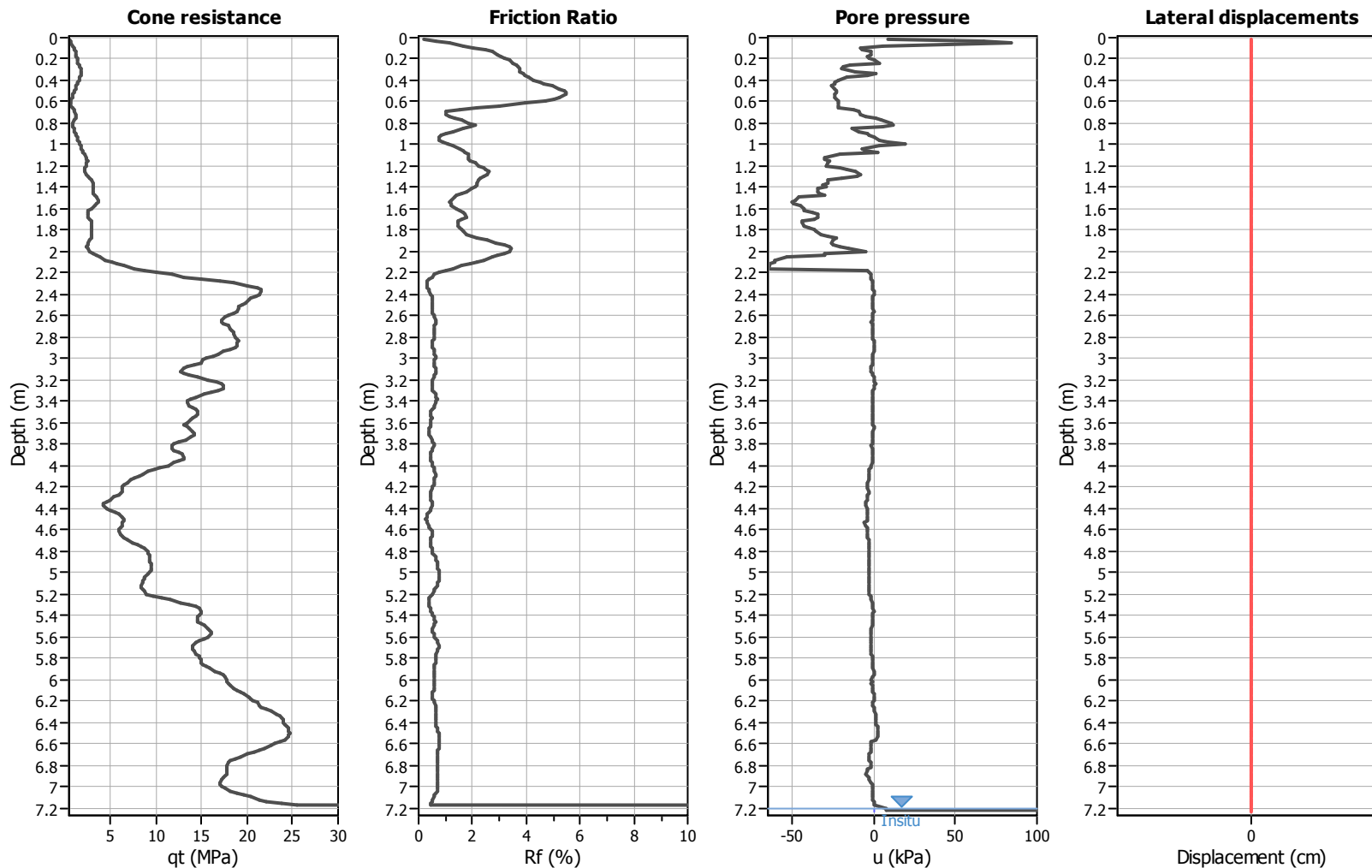
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	3.50 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	3.50 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_0 applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT13

Total depth: 7.24 m



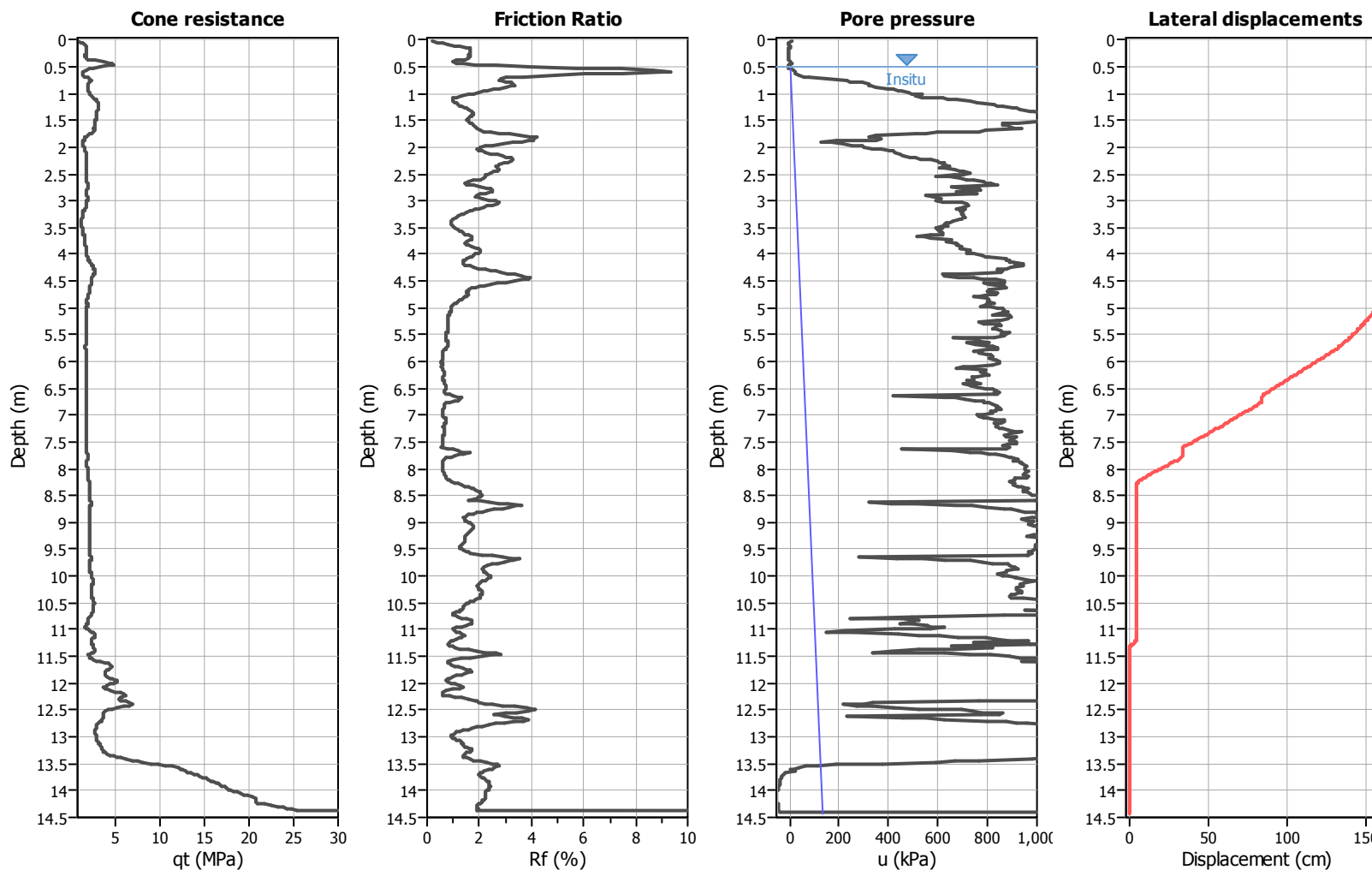
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	7.20 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	7.20 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT14

Total depth: 14.44 m



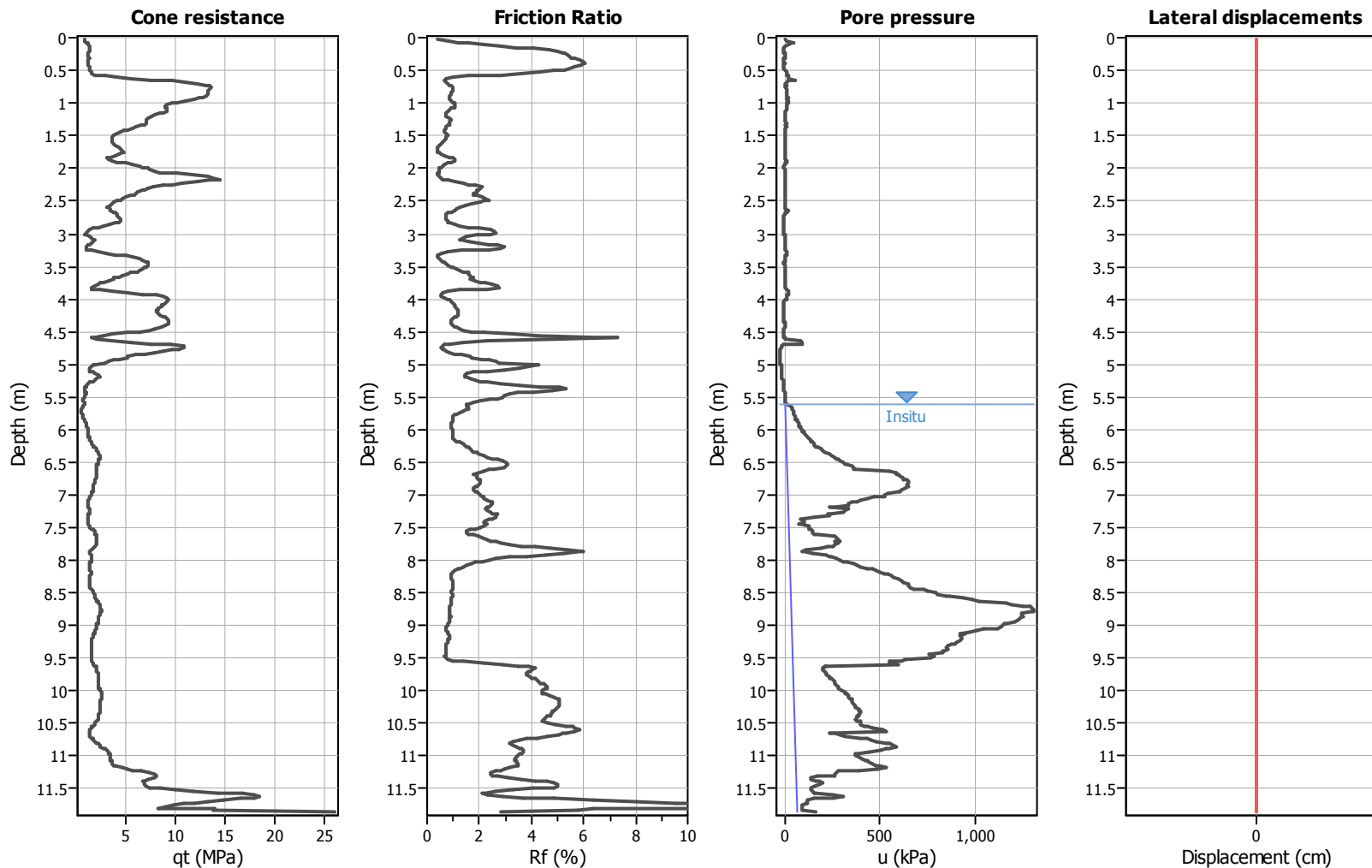
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	0.50 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	0.50 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_0 applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT15

Total depth: 11.86 m



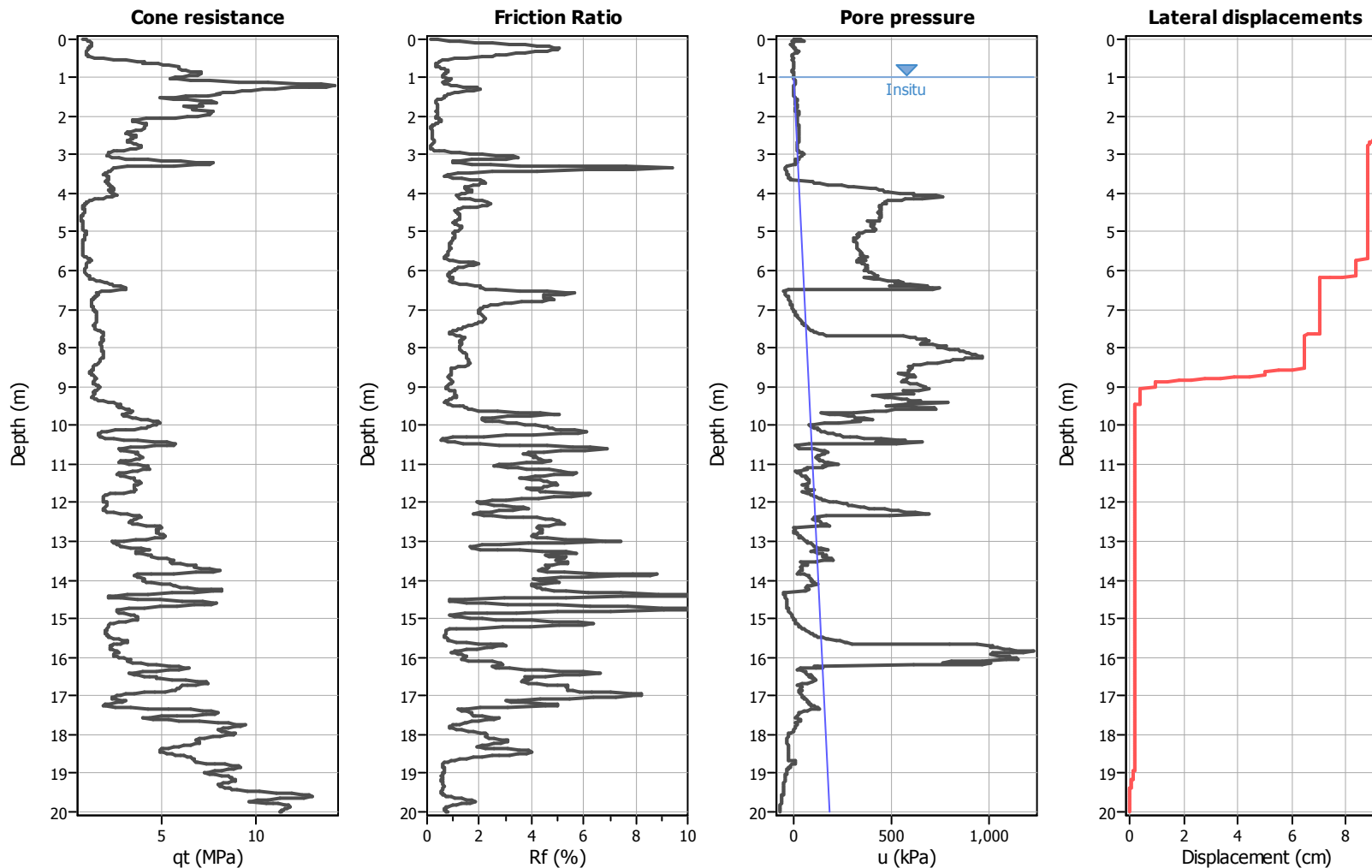
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	5.60 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	5.60 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_0 applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT16

Total depth: 20.00 m



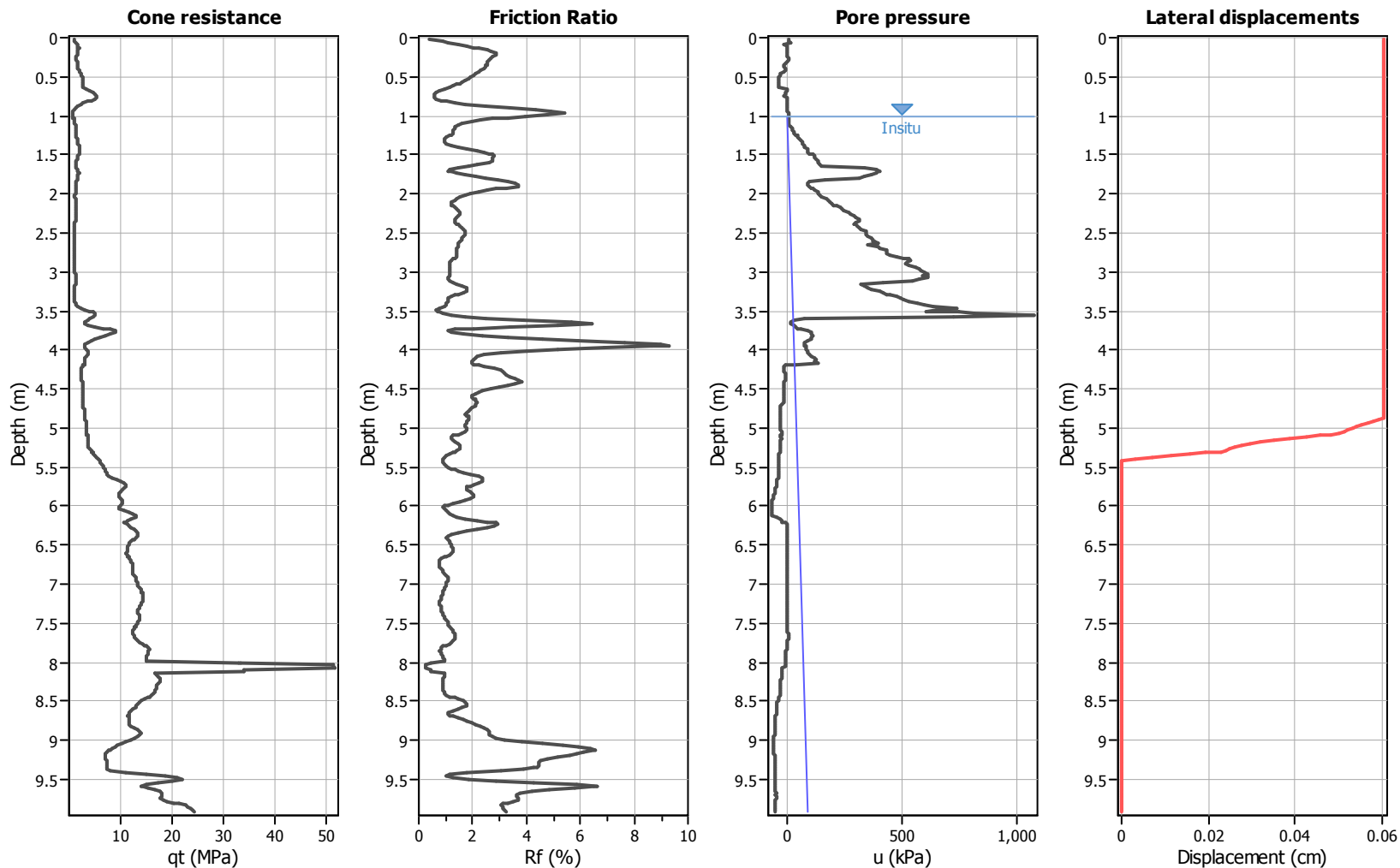
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_0 applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT17

Total depth: 9.92 m



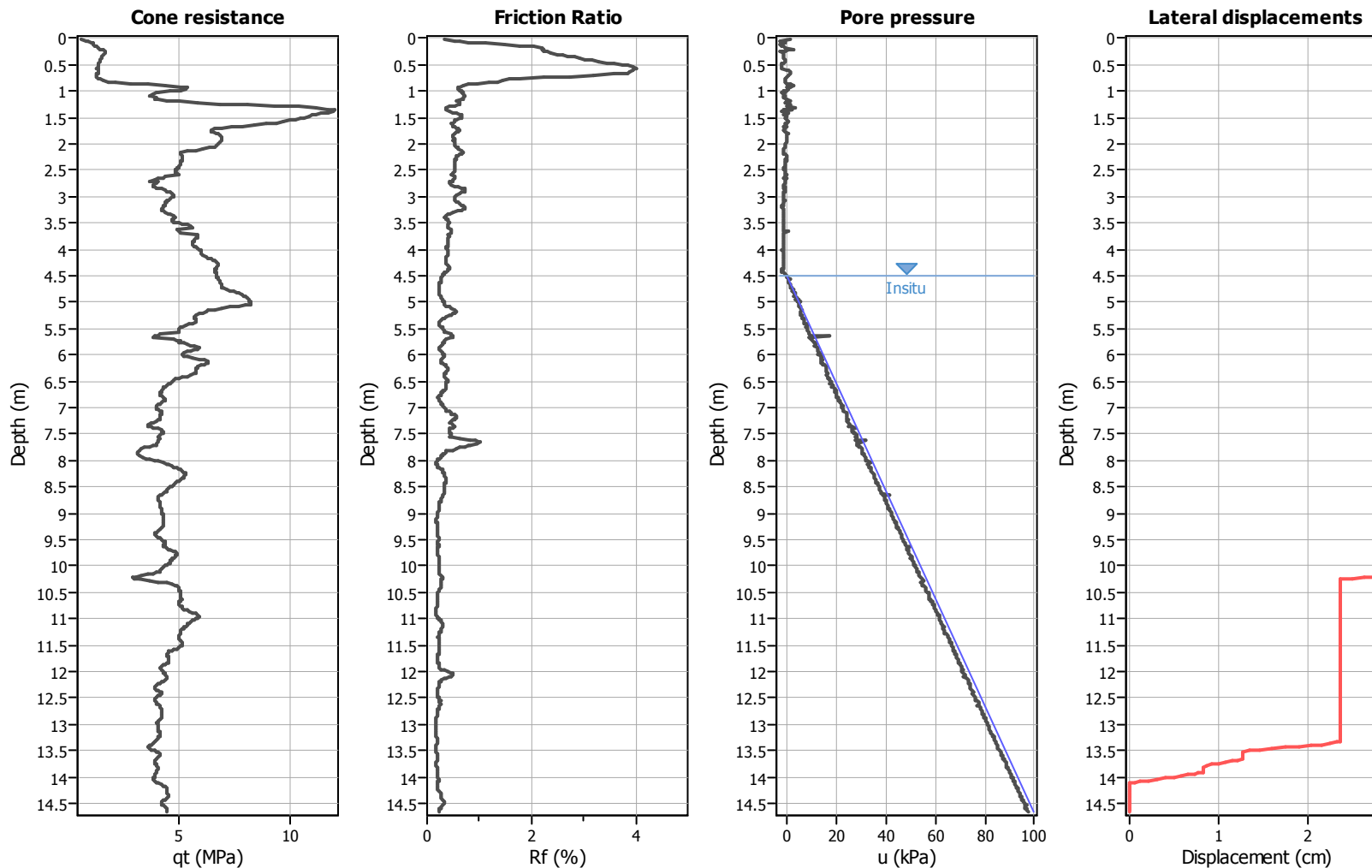
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_σ applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT18

Total depth: 14.66 m



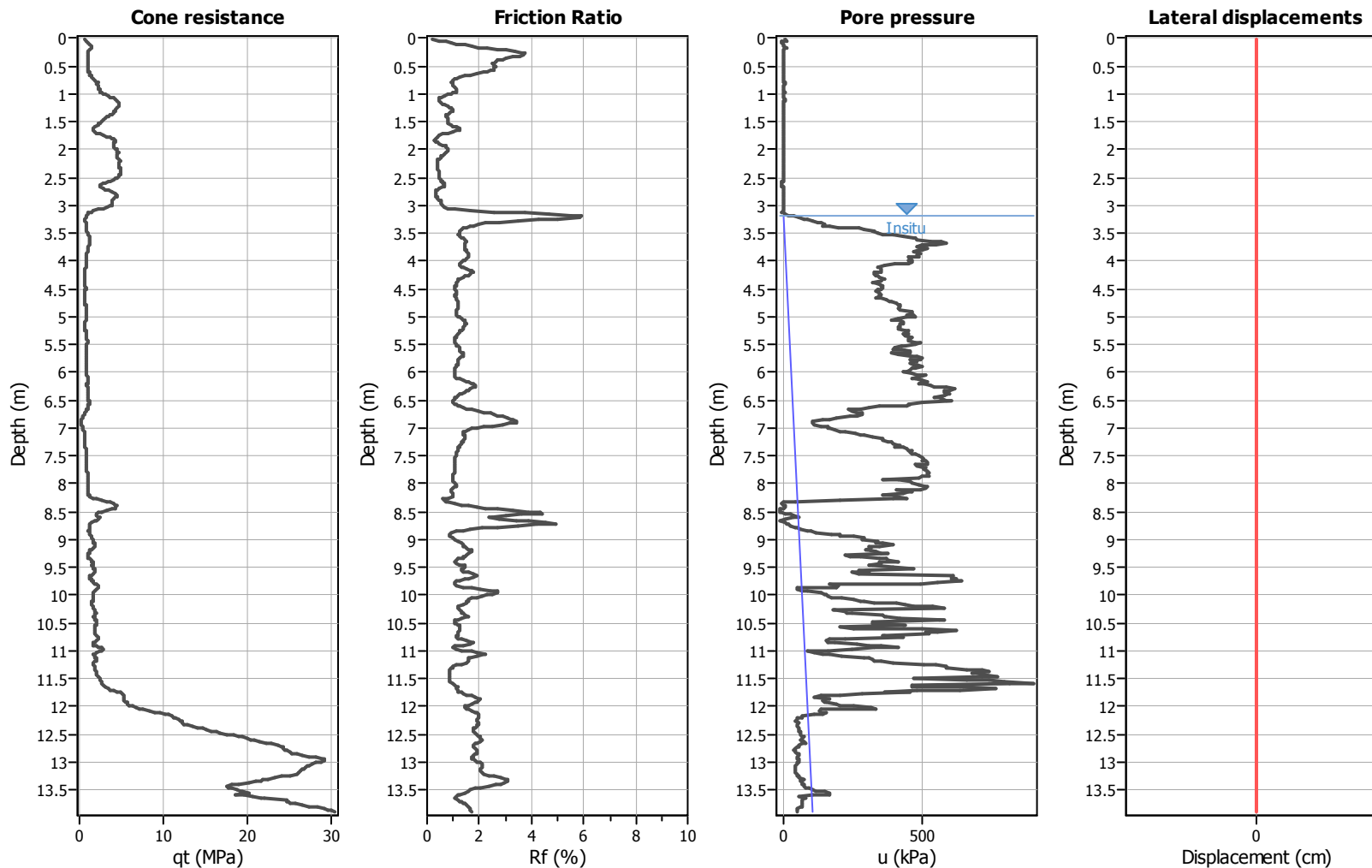
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	4.50 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	4.50 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_0 applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT19

Total depth: 13.90 m



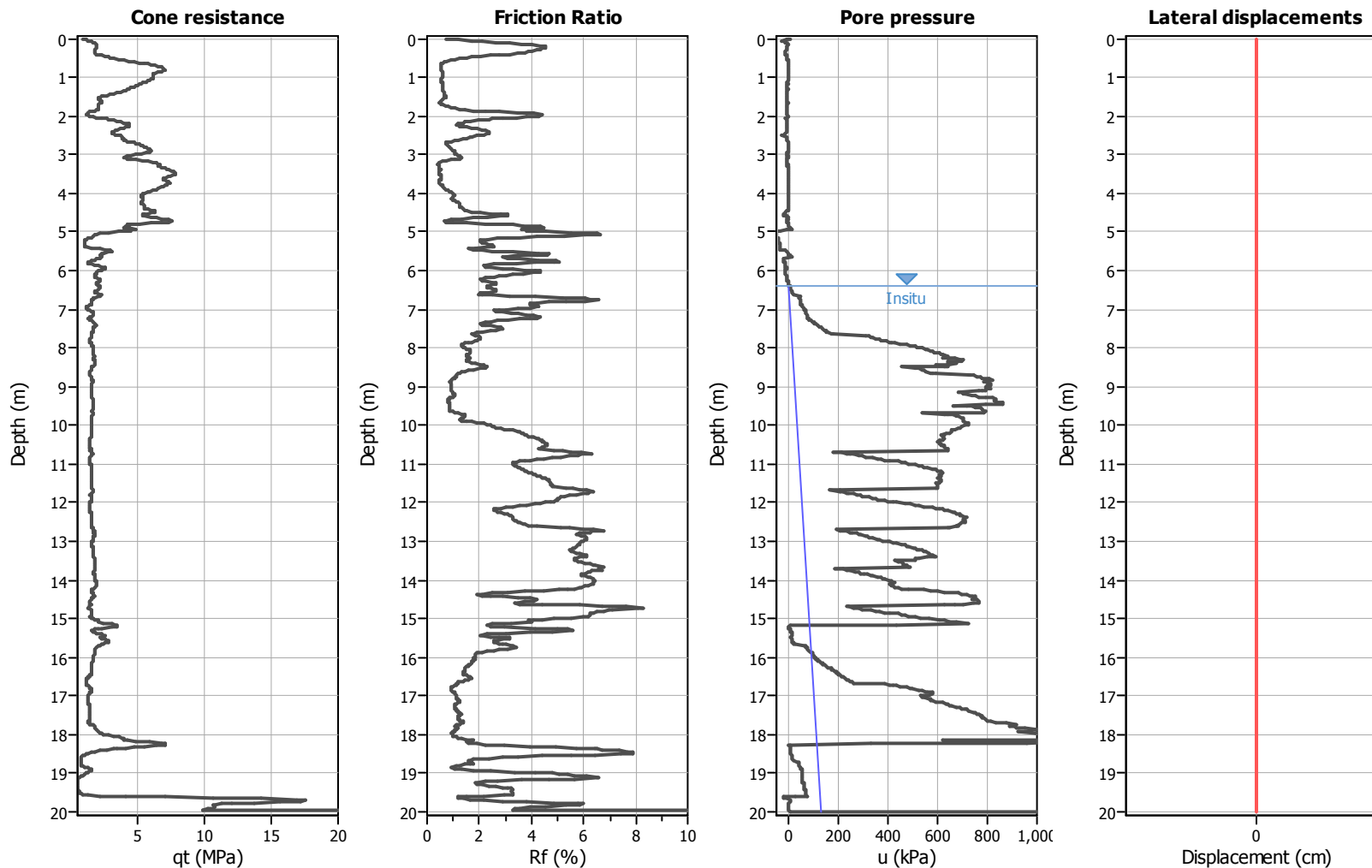
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	3.20 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	3.20 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_0 applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT20

Total depth: 20.00 m



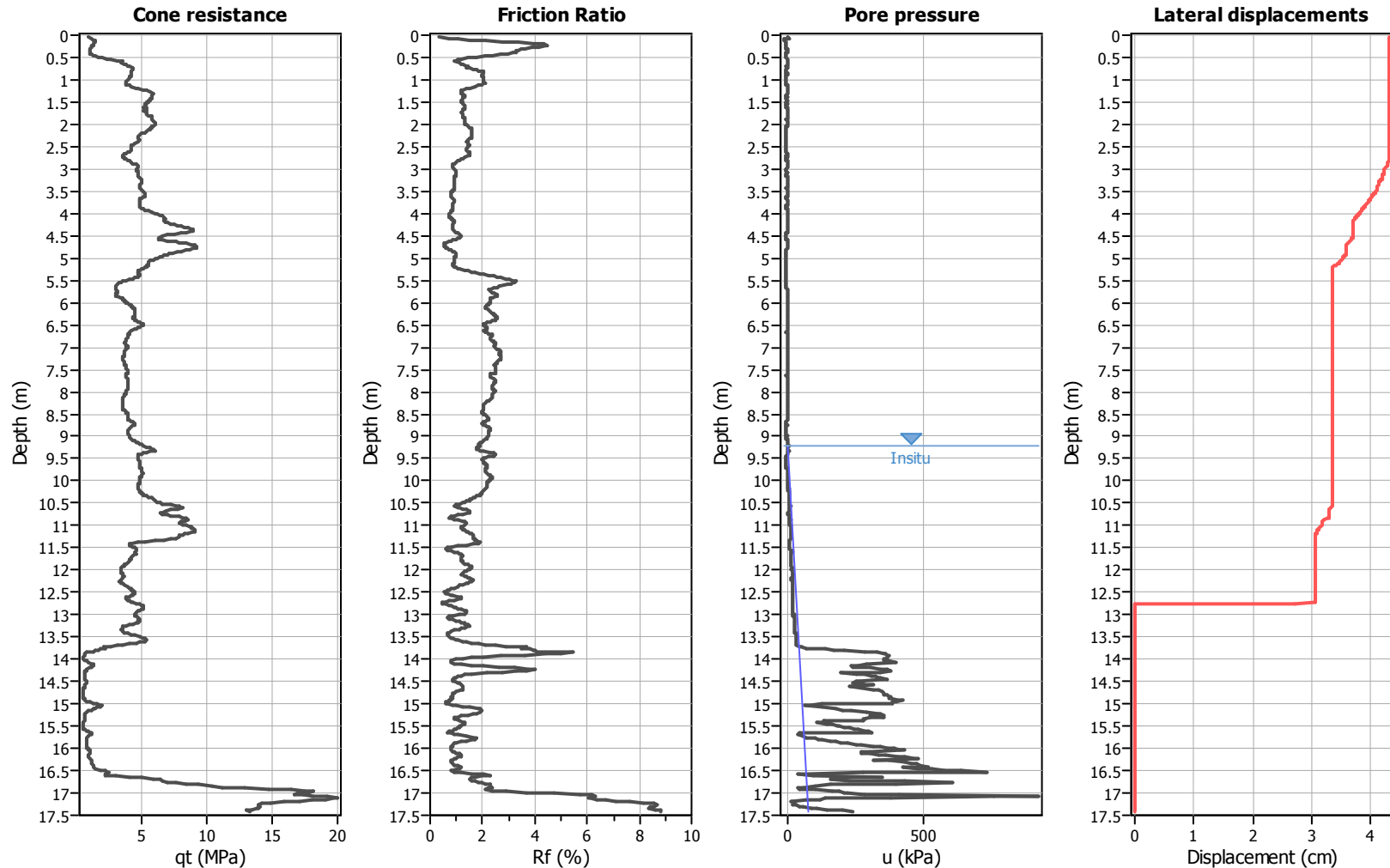
Analysis method:	NCEER (1998)	G.W.T. (in-situ):	6.40 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	6.40 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_0 applied:	Yes	MSF method:	Method based

Project: Lateral Spread Analyses

Location: Peacockes Road, Hamilton East

CPT: CPT21

Total depth: 17.44 m



Analysis method:	NCEER (1998)	G.W.T. (in-situ):	9.20 m	Use fill:	No	Clay like behavior	
Fines correction method:	NCEER (1998)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	applied:	Sands only
Points to test:	Based on Ic value	Average results interval:	5	Fill weight:	N/A	Limit depth applied:	No
Earthquake magnitude M_w :	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	Yes	Limit depth:	N/A
Peak ground acceleration:	0.15	Unit weight calculation:	Based on SBT	K_0 applied:	Yes	MSF method:	Method based