Stages 5B & 6A, Waiotahe Drifts Subdivision, Opotiki

Geotechnical Completion Report

Prepared for Maven Associates Ltd.

Project 48749 - Rev.0 - 24/11/2022

Engineering Design Consultants Ltd
W: www.edc.co.nz
E: team@edc.co.nz
Christchurch: 15b Leslie Hills Drive, Riccarton Ph (03) 355 5559 PO Box 9016, Tower Junction, 8011
Auckland: 1st Floor, Unit 1, 100 Bush Rd, Albany Ph (09) 451 9044 PO Box 118, Albany, 0752
Bay of Plenty: Suite 5, 202 The Strand, Whakatane Ph (07) 922 0075 PO Box 855, Whakatane, 3158

Revision	Date	Engineer	Description
0	24/11/2022	DT	Final

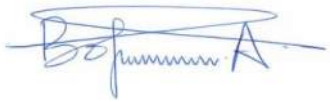
REPORT PREPARED BY:

Delane Traber

BEng Tech

Geotechnical Team Leader - Canterbury

REPORT CHECKED BY:



Dr. Ademola Bolarinwa

MEng, PhD, MEngNZ, MNZGS

Senior Geotechnical Engineer

Team Leader - Whakatane

Limitations of Report

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Our opinions and recommendations are based on our comprehension of the current regulatory standards and must not be considered legal opinions. For legal advice, please consult your solicitor. This opinion is not intended to be advice that is covered by the Financial Advisors Act 2010.

The recommendations and opinions contained in this report are based on our visual reconnaissance of the site, information from geological maps and upon data from the field investigation as well as the results of in situ testing of soil. Inferences are made about the nature and continuity of subsoils away from and beyond the exploratory holes which cannot be guaranteed. The descriptions detailed on the exploratory hole logs are based on the field descriptions of the soils encountered.

This report includes Appendices. These appendices should be read in conjunction with the main part of the report and this report should not be considered complete without them.

CONTENTS

1.0 INTRODUCTION

Engineering Design Consultants Ltd (EDC) was engaged by Maven Associates Limited (Maven) to monitor the subdivision earthworks and provide a Geotechnical Completion Report (GCR) as part of the development of the subdivision site at Waiotahe Drifts.

It is proposed to subdivide the existing land parcel into 107 new residential lots, consisting of 3 stages (Stage 5 – 7) with road and reserves to vest. To date Stage 5A has been completed and sign off by EDC's Waiotahe Drifts Subdivision, Stage 5a Geotechnical Completion Report (EDC File: 48749, dated 25/05/2022). This report relates to the combined Stages 5b and 6a, referred to below as 'the site' whose perimeter is marked up (in red) in Figure 1.

The proposed development plans, provided by Maven Associates forms Appendix A.

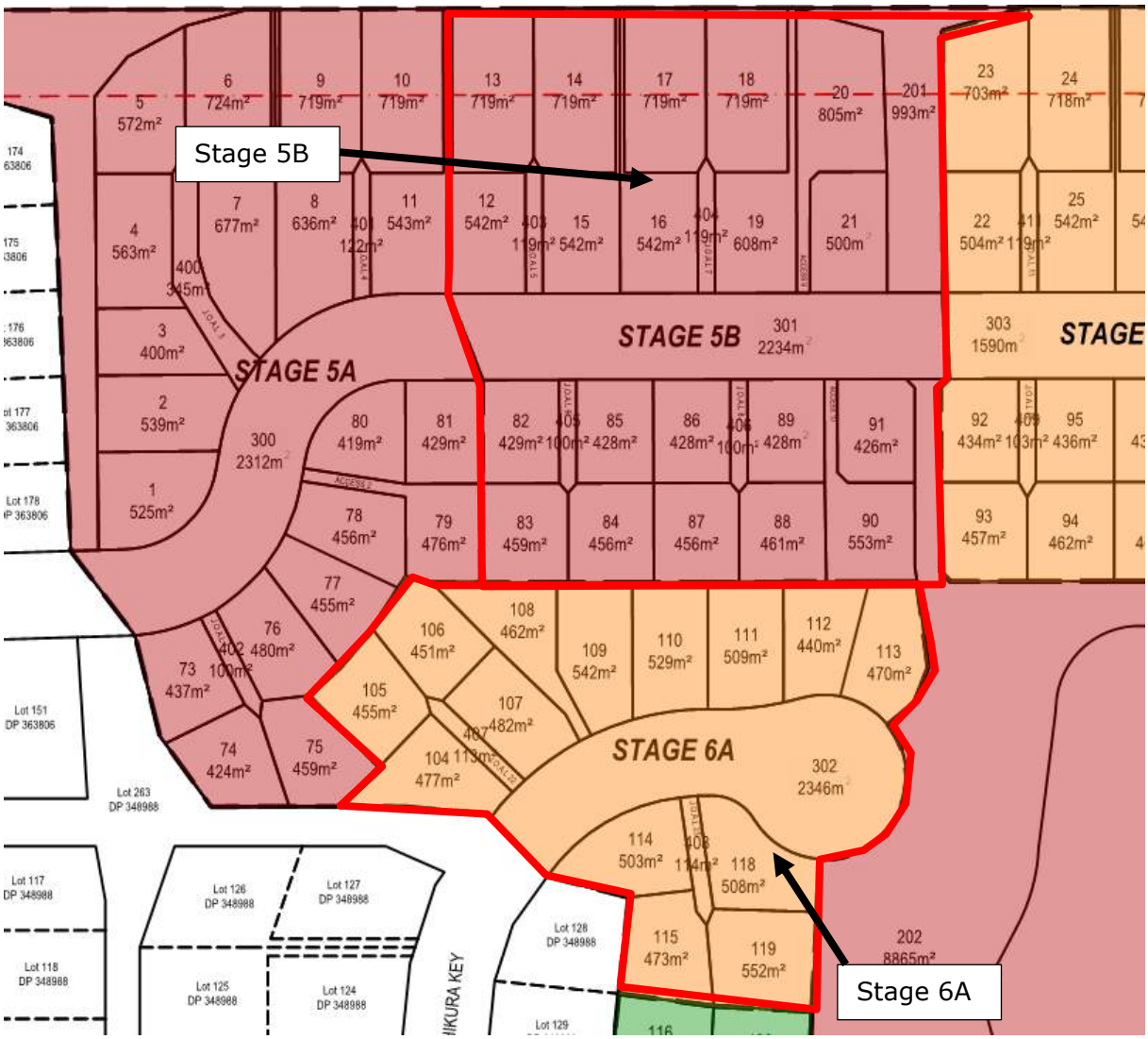


Figure 1: Subdivision plan for Stage 6A

To our understanding no geotechnical investigation or reporting has been undertaken in this area or the subdivision to attain resource consent in the past.

1.1 Legal Description & Topography

The greater site is located at the eastern end of Waiotahe Drifts Boulevard, with a legal description of Lot 315 DPS 363806 with an area of 11.5620ha. It is an undulating coastal zone site with dunes.

The greater site location and an aerial image are included in the following figures.

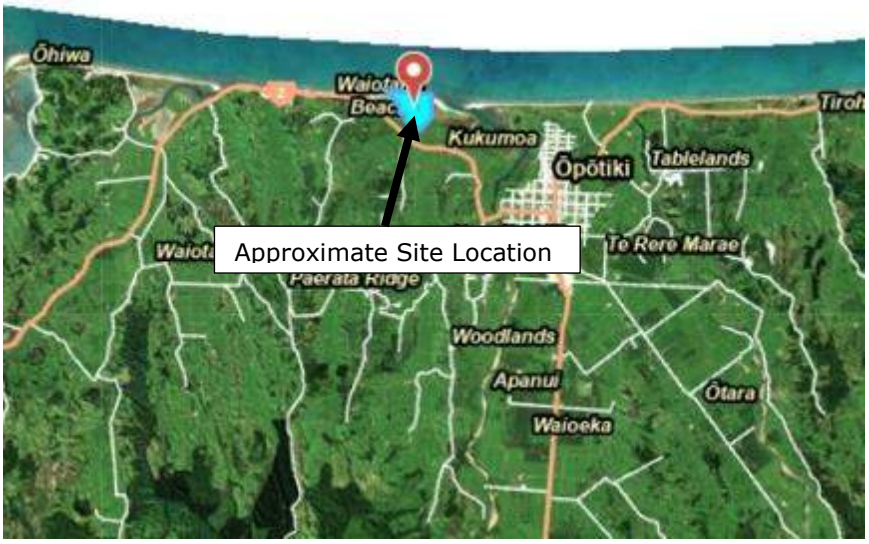


Figure 2: Site Location (Courtesy of BOPRC Maps)

Figure 3: Aerial Photo of the Greater Subdivision (Courtesy of BOPRC Maps)

1.2 Site Geology

The GNS published geological maps indicated that the site is located in an area of Holocene shoreline deposits, consisting of beach deposits including 'marine gravel, sand, and mud on modern beaches'.

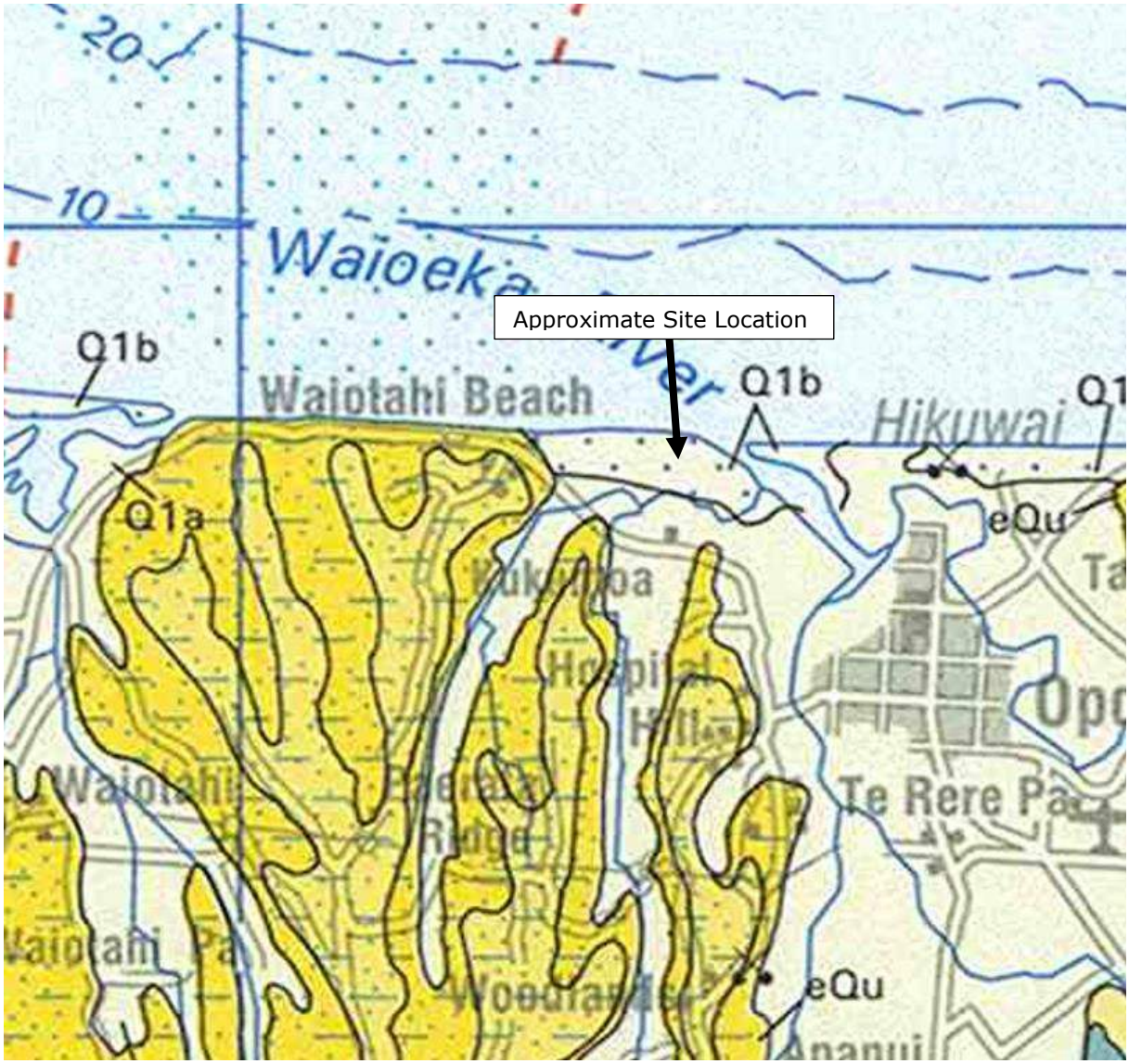


Figure 4: GNS Geology Map

2.0 DEVELOPMENT OVERVIEW

The development undertaken has resulted in the formation of 107 new lots. Stage 5b consist of 20 new residential lots and Stage 6a consists of 14 new residential available lots.

Earthworks were undertaken to re-shape the land to allow the formation of suitable residential lots (Stage 5b) 12 – 21 and (Stage 6a) lots 82 - 91 104 – 115, 118 and 119. The earthworks involved removal of the topsoil/organics and forming level platforms by cutting the high ground and using it as fill for the low-lying areas. The As Built cut & fill plan by Maven have also been included in Appendix A.

At the time of preparing this GCR, all bulk earthworks for both of the stages have been completed.

2.1 Earthworks Specification

The 'Project Specification – Waiotahe Dunes' Document produced by Maven forms the basis of the Earthworks Specification and forms Appendix B. Several changes to the Project Specification have been approved by Maven to adapt to site conditions and due to specialist contractor availability as follows:

1. All earth fill consists of clean beach sand, and as such compaction testing was undertaken using a Scala Penetrometer. The target fill compaction is 'Good Ground' in accordance with NZS3604:2011.
2. Basecourse compaction for jointly-owned access lot's (JOAL's) and road carriageways was undertaken using a Clegg Hammer. Target Clegg Impact Values (CIV) were provided by Maven:
    2.1. JOAL AP65 basecourse CIV minimum value of 25 and an average of >28.
    2.2. Road Carriageway AP65 Subbase CIV minimum value 35 and an average of >38.
3. Benkelman beam testing was undertaken on the finished AP40 road basecourse, with a maximum defection of 1.2mm.

3.0 EARTHWORKS DETAILS

The bulk earthworks and civil works were undertaken by Delta Contracting from April 2022 to November 2022. The earthworks consisted of stripping the topsoil from across the site and cutting the high ground located near the northern and southern boundary of the site, including cutting into a slope south of the pond and using the clean sand material as fill for the low-lying areas to create flat individual subdivided lots.

The earthworks contractor was required to compact the soils as set out in NZS4431 in order to provide a geotechnical Ultimate Bearing Capacity of 300kPa (150kPa Dependable) for all cut & fill areas on-site. The JOAL's and road subgrade were designed based on an assumed subgrade CBR of 5% & 7% respectively.

Earthworks volumes f Stages 5b & 6a included approximately 4526m^3 of stripped topsoil which has been respread. An estimated total fill volume of 23456m^3 has been placed. The cut material (reused as fill) was mainly dune sand. No lime or cement stabilisation was used during filling.

The following earthworks equipment was used by Delta Contracting Ltd. on-site during the construction period:

- 2 x 14 tonne excavators
- 1 x 5 tonne excavator
- 1 x 12 tonne vibrating roller
- 1 x 5 tonne vibrating roller
- 1 x Jumping jack compactor
- 3 x 10m^3 tip trucks
- 1 x 14,000-liter water truck plus sprinklers

The bulk filling was conducted in a controlled manner, including moisture control by visual assessment before compacting with a vibrating smooth roller in layers of generally 150 – 200mm thickness.

The As-Built Cut and fill plan, by Maven Associates forms Appendix A.

4.0 CONSTRUCTION SUPERVISION

4.1 EDC Site Visits

EDC conducted a total of seventeen site inspections during the subdivision earthworks for Stage 5b & 6a between 19/04/2022 to 01/11/2022. In addition to visual inspection, compaction testing was undertaken using Scala Penetrometer, and Clegg Hammer. Our observations during the construction confirm an earth-fill complying with NZS:4431, and the fill is considered suitable for residential development subject to a site-specific bearing capacity assessment.

4.1.1 Stage 5b

The new public road and JOAL's 5-8 subgrade in Stage 5B was formed by cutting and filling using sands from other sections of the site. Civil engineering design required a minimum CBR of 7%. Testing conducted on the subgrade indicates this subgrade achieved this target CBR in both cut and fill areas below the road and this will increase further over time.

Below is a summary of all EDC's site visits during the construction supervision of Stage 5b.

Date	Lot/s Investigated	Formation Inspection	Compaction SC/CBR	Comment
14/04/2022	Stage 5b	Fail	-	Organics encountered across majority of Stage 5b. Removal required.
14/04/2022	106	Pass	-	-
09/05/2022	12, 13 & 15-21	Pass	-	-
	14	Hold	-	Archaeological inspection required. Lot 14 was later declared free from any archaeological finding
08/06/2022	12-21	-	Pass	Pass. Lots 12, 16, 15 19 & 20 require further fill and re inspection.
27/06/2022	82-91	Pass	-	-
05/08/2022	12, 16, 15 19 & 20	-	Pass	-
	21	-	Fail	21 – Fail, re-compaction & inspection required.
	82, 85, 86, 89 & 91	-	Pass	Further fill and reinspection required.
11/08/2022	Road	-	-	Results supplied to Maven & Geogrid added to basecourse design.
	21, 82-91	-	Pass	Additional compaction run to be undertaken prior to topsoiling.

02/09/2022	JOAL 5-8	Pass	-	-
12/09/2022	JOAL 5-8	-	Pass	-
16/09/2022	Road	-	Conditional Pass	Results approved by MAVEN.

Table 1: Summary of EDC's site visits during Stage 5A

4.1.2 Stage 6A

The new public road ending at a cul-de-sac and JOAL's 22 and 23 subgrade in Stage 6A was formed by cutting and filling using sands from other sections of the site. Civil engineering design required a minimum CBR of 7%. Testing conducted on the subgrade indicates this subgrade achieved this target CBR in both cut and fill areas below the road and this will increase further over time.

Below is a summary of all EDC's site visits during the construction supervision of Stage 5b.

Date	Lot/s Investigated	Formation Inspection	Compaction SC/CBR	Comment
19/07/2022	Stage 6A	Fail	-	Organics encountered in Lots 110 – 111 and Lots 118 - 119
02/09/2022	Road & Cul-de-sac	-	Conditional Pass	Inconsistent bearing capacity was noted across the road area.*
05/09/2022	104 – 110, 114, 115, 118 and 119	-	Pass	Pass, Lot 115 require further inspection.
	111 - 113	-	Hold	Not tested as compaction was not completed
08/09/2022	111 - 113	-	Pass	Compaction acceptable.
	Joal's 22 & 23	-	Pass	Joal 23 requires further inspection.
12/09/2022	Joal's 22 & 23	-	Pass	An average CIV reading 30
19/09/2022	Road and Cul-de-sac	-	Pass	An average CIV reading 38
1/11/2022	104 – 115, 118 and 119	-	Pass	Compaction acceptable.

Table 2: Summary of EDC's site visits during Stage 5A

*Maven Associates later reviewed our inspection data and determined that the addition of geogrid reinforcement on the basecourse would be more efficient than further excavation to meet the CBR target.

4.2 EDC Inspection Summary

The compaction methodology for the above-mentioned Lots, roading subgrade and base coarse for Stages 5b and 6a are considered to meet the Maven Fill Specification. EDC's Site Inspection Notes are annexed as Appendix C.

4.3 Benkelman Beam Testing

Benkelman Beam testing on the public road has been conducted by IANZ accredited Laboratory (GeoLab Ltd.) on the compacted basecourse surface. Acceptable deflections of less than 1.2mm have been recorded by the Benkelman Beam testing. The test results are included in Appendix D.

4.4 Imported Material

Imported hardfill was required for construction on of the JOAL's and road. Both AP65 & TNZ M4 AP40 were used in accordance with the Project Specification. Laboratory test results for these materials form Appendix E.

4.5 Site Photographs

4.5.1 Stage 5B

Figure 5: 1st Formation inspection for stage 5B

Figure 6: 2nd Formation inspection for stage 5B

Figure 7: 1st Compaction Inspection for Stage 5B

Figure 8: 2nd Compaction Inspection for Stage 5B

Figure 9: Subgrade and subbase for the RoW and road for Stage 5B

4.5.2 Stage 6A

Figure 10: Formation inspection for Stage 6A

Figure 11: Compaction Inspection for Stage 6A

Figure 12: Subbase investigation for Stage 6A

5.0 SITE CLASSIFICATION

5.1 Post Construction Testing

5.1.1 Deep Testing

The current MBIE guidance requires deep testing to assess the risk from earthquake induced soil liquefaction. As a result, CPT's have been undertaken with Stage 5b & 6a to assess the liquefaction susceptibility.

Cone Penetration Testing (CPT), comprising 2 holes for Stage 5b (CPT's 201 & 202) and 1 hole for Stage 6a (CPT301), were undertaken by Topdrill on 17/08/2022 & 02/11/2022, respectively. In addition, to gain a spread of testing across the site, CPT03 from Stage 5A, undertaken by Topdrill on 15/03/2022 has also been included in this assessment. CPT03, CPT201 & CPT301 reached their target depth of 20.0m, while CPT202 refused at 9.8m due to tip refusal.

Groundwater was dipped by the CPT contractor. Where hole collapse above the groundwater table, inferences made from the CPT data (see Table 3). However, ground water in this area will be tidally influenced.

The approximate locations of the CPT's are indicated in Figures 13 & 14. Logs of the Normalised Soil Behaviour Type (SBT) for the CPT results are shown in Appendix F.

Test Ref.	Date	Location	Depth (m)	Comment
CPT03	02/05/2022	Lot 81 (Adjacent to the site, on Stage 5A)	20m	CPT Hole collapsed (dry) at 4.5m. Estimated groundwater depth of 5.5m begl.
CPT201	17/08/2022	Lot 90	20m	CPT Hole collapsed (dry) at 2.8m. Estimated groundwater depth of 6.2m begl.
CPT202	17/08/2022	Lot 21	9.8m	Tip Refusal at 9.8m. Groundwater dipped at 6.4m.
CPT301	02/11/2022	Lot 115	20m	Groundwater dipped at 2.1m

Table 3: Intrusive Investigation Summary for Stage 5b

5.1.2 Stage 5b Shallow Testing

Post construction testing consisted of Scala Penetrometer (SC) testing in each individual lot. The approximate locations of the SC's are indicated in Figure 13.

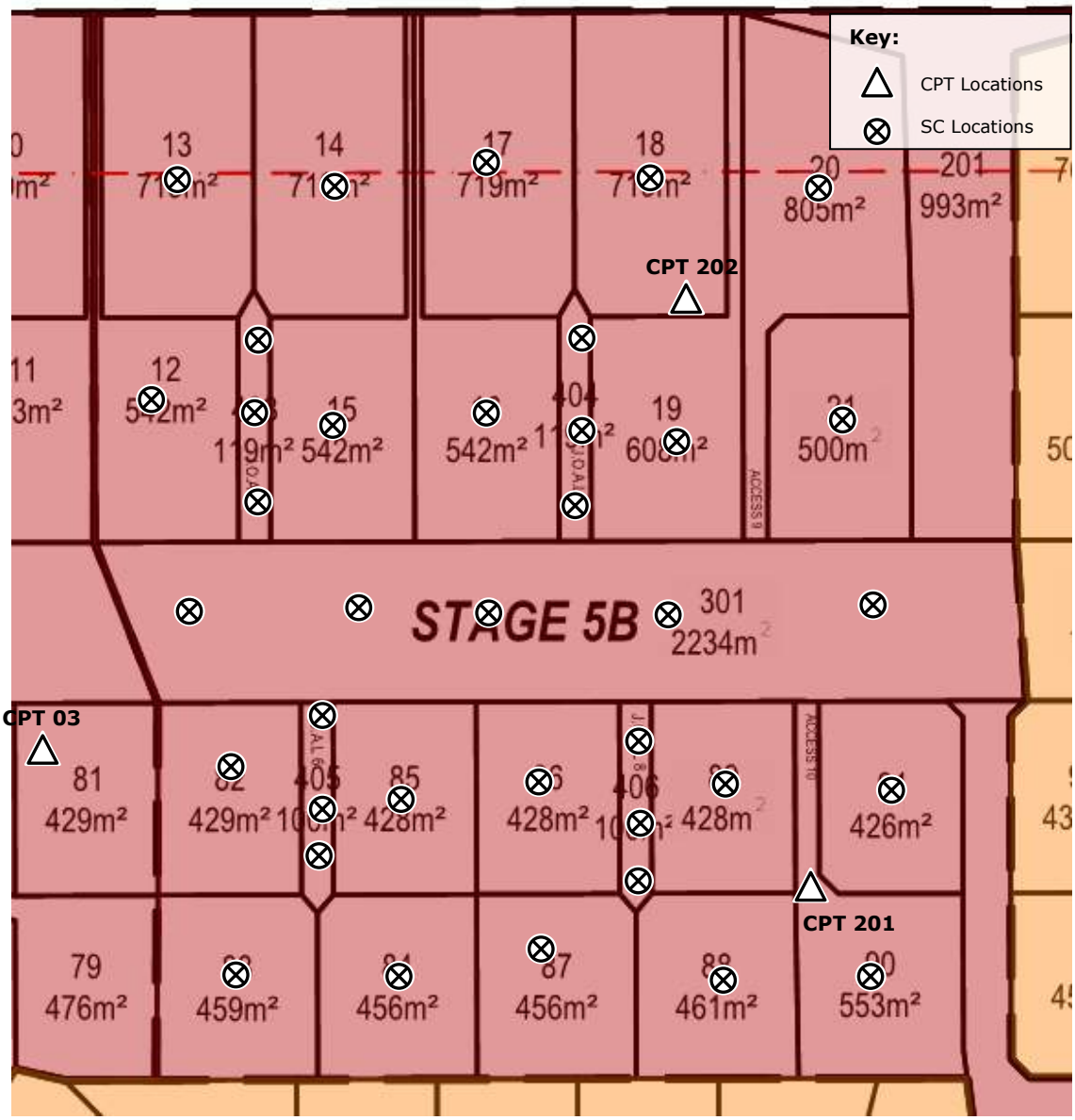


Figure 13: Intrusive Investigation Approximate Locations Stage 5b

5.1.3 Stage 6A Shallow Testing

Post construction testing consisted of Scala Penetrometer (SC) testing in each individual lot. The approximate locations of the SC's are indicated in Figure 14.

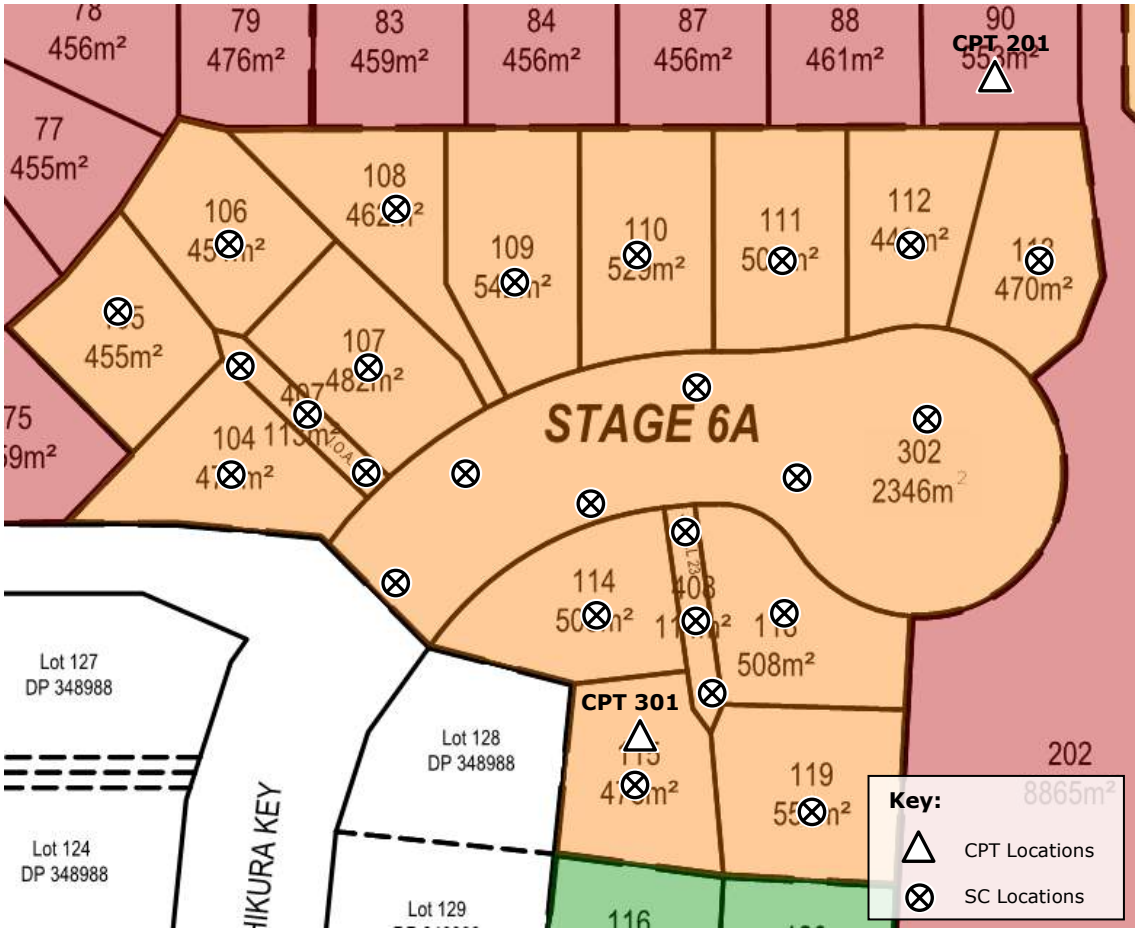


Figure 14: Intrusive Investigation Approximate Locations for Stage 6a

5.2 Quantitative Liquefaction Analysis

In accordance with the 'Planning and engineering guidance for potentially liquefaction-prone land' (MBIE/MfE, November 2021), we have undertaken a quantitative liquefaction analysis based on our on-site deep testing.

5.2.1 Calculation Methods

Liquefaction analysis to assess estimated free-field ground settlement (i.e., not including shear-induced deformations in the soil relating to structural loads) has been undertaken using the data from the CPT's and the following methods with the Geologismiki Software (CLIQ):

Assessment	Method
Liquefaction triggering & lateral spreading	Boulanger & Idriss (2014)
Fines Correction	Robertson & Wride (1998)
Post liquefaction settlements	Zhang et al (2002)

Table 4: Liquefaction Analysis Methods

5.2.1 Analysis Scenarios

The following seismic scenarios have been analysed for the purpose of assessing future ground performance, in accordance with NZS1170 and the MBIE Guidance:

NZS1170 Serviceability Limit State (SLS) – The SLS design case is a load, or combination of loads, that a building or structure is likely to be subjected to more frequently during its design life. If properly designed and constructed, there may be minor damage to building fabric that is readily repairable, possibly including minor cracking, defection and settlement that do not affect the structural, fire or weathertightness performance of the building.

MBIE Guidance - 'Planning and engineering guidance for potentially liquefaction-prone land', recommends that estimated ground damage in a 100-year return period earthquake is used to help determine the site liquefaction susceptibility category.

NZS1170 Ultimate Limit State (ULS) - The ULS design case is an extreme action, or extreme combination of actions, that the building needs to withstand. A building is expected to suffer moderate to significant structural damage, but not to collapse, when it is subjected to a ULS load.

The parameters used in these analyses are shown on Table 7:

Seismic Scenario	Return Period (years)	Earthquake Magnitude (Mw)	Peak Ground Acceleration (g)
SLS	25	6.1	0.11
MBIE	100	6.1	0.22
ULS	500	6.1	0.44

Table 5: Liquefaction Analysis

Groundwater depths for the liquefaction analysis have been based on both dipped groundwater readings, and inferences made from the CPT data (see Table 3). However, ground water in this area will be tidally influenced. A groundwater increase of 0.5m has been assumed during an earthquake scenario for the liquefaction analyses.

5.2.1 Estimated Free-Field Ground Settlement

The graphical results sheets for each of the analyses are included in Appendix F. The following table summarises the results of estimated free-field settlements (Index Settlement refers to the upper 10m of the subsoil only):

CPT Test Ref.	CPT Depth (m)	Estimated Free-Field Settlement (mm)					
		SLS Scenario		100 Year return period		ULS Scenario	
		Index	Full CPT Depth	Index	Full CPT Depth	Index	Full CPT Depth
CPT03	20.0	0	0	25	63	67	158
CPT201	20.0	0	0	30	91	81	169
CPT202	9.8	0	<1	5	5	42	42
CPT301	20.0	2	4	56	89	92	159

Table 6: Summary of Estimated Liquefaction-Induced Settlement

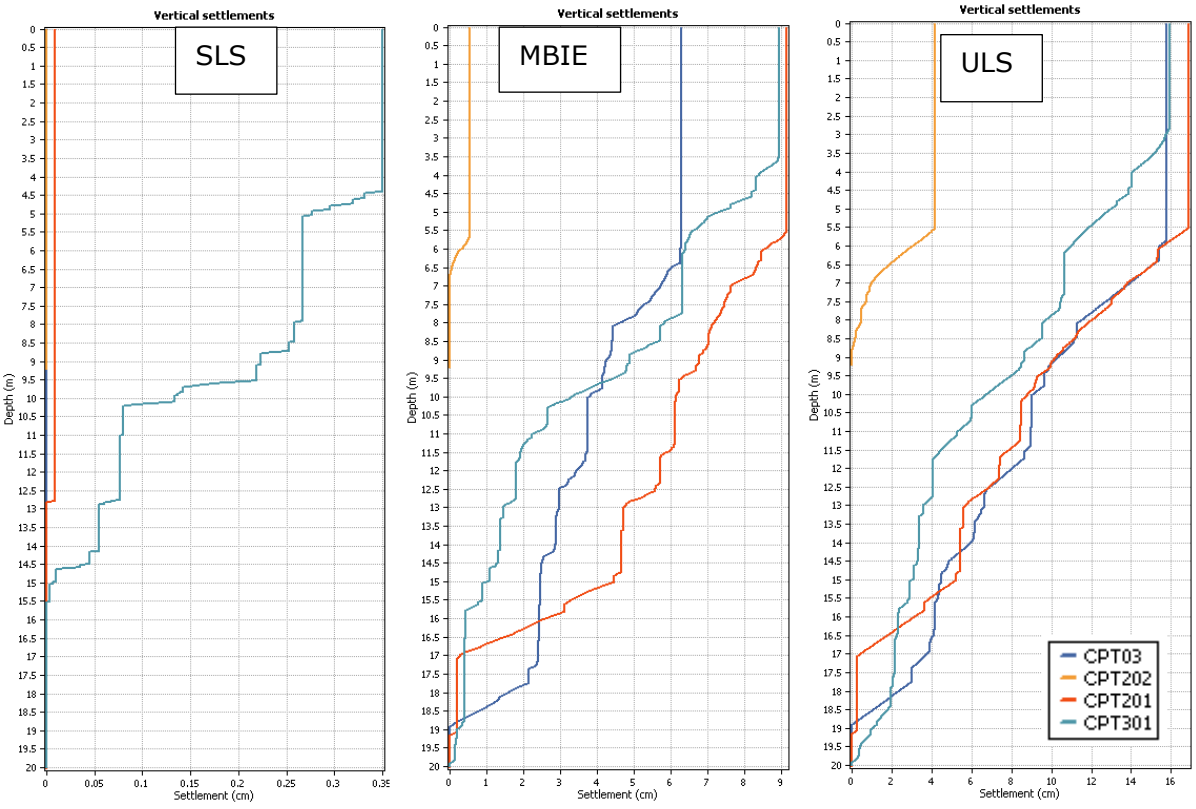


Figure 15: Estimated Total Vertical Settlement under SLS, MBIE 100yr and ULS Conditions

The on-site CPT analyses indicate:

Under SLS conditions, negligible settlement is to be expected, under MBIE conditions variable liquefaction induced settlement up to 91mm is to be expected and up to 169mm of settlement is to be expected under ULS conditions.

The soils from analysed ground water depth (decreasing to the south) are generally liquefiable to a depth of 17-19m, with the exception of CPT202, located on the northern sand dune which was non liquefiable from 9m and refused at approximately 10m.

5.2.1 Ground Damage

The Liquefaction Severity Number (LSN) is a parameter that predicts the occurrence of damaging liquefaction by recognising that damaging liquefaction is related to the depth at which liquefaction occurs. The LSN's for the CPT analyses are shown below:

CPT ref.	Estimated LSN		
	SLS Scenario	MBIE Scenario	ULS Scenario
CPT03	0	5	15
CPT201	0	8	17
CPT202	0	1	7
CPT301	1	12	21

LSN Key
0 – 10 = Little to no expression of liquefaction,
10 – 20 = Minor expression of liquefaction,
20 – 30 = Moderate expression of liquefaction,
30 – 40 = Moderate to severe expression of liquefaction,
40 – 50 = Major expression of liquefaction,
>50 = Severe damage.

Table 7: Summary of Estimated Liquefaction-Induced Ground Damage

The above indicates that in an SLS event, no expression of liquefaction expected. Under the MBIE 100-year return period scenario little to no liquefaction ejecta is expected and under ULS conditions, minor expression of liquefaction is anticipated.

5.2.2 MBIE Technical Foundation Category

Foundation Technical Category	Future land performance expectations from liquefaction	Nominal SLS land settlement (mm)	Nominal ULS land settlements (mm)	Nominal lateral stretch (mm)
TC1	Liquefaction damage is unlikely in a future large earthquake.	0-15	0-25	Generally not expected
TC2	Liquefaction damage is possible in a future large earthquake.	0-50	0-100	<50
TC3	Liquefaction damage is possible in a future large earthquake	>50	>100	>50

Table 8: MBIE Technical Foundation Category

Based on the analysis of the likely settlements following a design earthquake event, we consider that the land falls within the TC2 Foundation Technical Category.

5.2.3 Lateral Spreading

The site is located >100m from any significant water course with no evidence of lateral movement on-site and as such, in accordance with the MBIE Canterbury Earthquake Recovery Guidance, lateral spreading analysis has not been undertaken.

5.3 Liquefaction Susceptibility

In accordance with the 'Planning and engineering guidance for potentially liquefaction-prone land' (MBIE/MfE, 2021), we have undertaken a risk-based liquefaction risk assessment. Please refer to Appendix G for the assessment matrix and further information.

Based on the desk-based information, deep intrusive investigation, and area wide Liquefaction assessment, we make the following assessment of the site using Table 3.7 of the MBIE/MfE Guidance:

- The site falls within the 'Urban Residential Development' category;
- Although the liquefaction assessment indicates up to 170mm of liquefaction induced settlement is estimated to occur on-site under ULS conditions, this settlement generally occurs at depth and is unlikely to result in significant surface deformation. This risk increases in Stage 6a, where shallower groundwater was encountered.
- As such, the liquefaction vulnerability category for Stage 5b is considered to be 'Low' - "There is a probability of more than 85 percent, that liquefaction-induced ground damage will be none to minor for 500-year shaking".
- The CPT undertaken in Stage 6a, suggests the liquefaction vulnerability category is likely to be 'Medium' - "There is a probability of more than 50 percent, that liquefaction-induced ground damage will be: Minor to moderate (or Less) for 500-year shaking; and None to minor for 100-year shaking".

Based on this and the MBIE Foundation Technical Category criteria we recommend a TC2 foundation systems (Ministry of Business, Innovation and Employment, 2015) for both Stage 5b & 6a.

5.4 NZS 3604 "Good Ground" Assessment

In accordance with NZS 3604: 2011 "Good Ground" is defined as *"Any soil or rock capable of permanently withstanding an ultimate bearing capacity of 300kPa (i.e. an allowable bearing pressure of 100kPa using a factor of safety 3.0)".* It excludes expansive soils, topsoil or organic rich soils, uncompacted loose gravel and any ground likely to experience ground movements of 25mm or more.

The soils at the site do not meet the NZS 3604 definition of 'Good Ground' due to the potential for liquefaction induced settlement.

6.0 CONCLUSIONS

The subdivision earthworks for Stage 5b and 6a of the Waiotahe Drifts Subdivision were undertaken by Delta Contracting from April 2022 to November 2022 and consisted of stripping the topsoil/organics across the site and cutting/filling to create flat individual subdivided lots. The cut material (reused as fill) was dune sand.

The bulk filling was conducted in a controlled manner and compacted with a smooth vibrating roller in layers of generally 150 – 200mm thickness. EDC supervised the earthworks and undertook compaction testing using Scala Penetrometer and Mexe Probe testing. Our observations during the construction confirm the earth fill complies with the Maven Fill Specification (taking into account the amendments discussed in Section 2.1).

Based on the desk-based information, intrusive investigation, and area wide liquefaction assessment, we consider the MBIE liquefaction vulnerability category to be 'Low' for Stage 5b, likely increasing to 'Medium' for Stage 6a.

The soils at the site do not meet the NZS 3604 definition of 'Good Ground' due to the potential for liquefaction induced settlement.

Based on this and the MBIE Foundation Technical Category criteria, we recommend TC2 foundation systems (Ministry of Business, Innovation and Employment, 2015) for each of the individual lots, subject to a building consent stage Geotechnical Investigation.

The subdivision earthworks are considered suitable for residential development subject to a site-specific bearing capacity assessment on each individual lot for Building Consent. An individual Lot Summary forms Appendix H.

In addition, the JOAL and roading subgrade and basecoarse in Stage 5b and Stage 6a are considered to meet the Maven Specification.

APPENDIX A

SUBDIVISION SCHEME PLAN & AS BUILD CUT AND FILL PLAN BY MAVEN ASSOCIATES

PUBLIC ROAD
LEGAL ROAD
(20.12m)

RIMU RIMU KEY

WAIOTAHI DRIFTS BLVD

KUKUMOA KEY

PAKIHIKURA KEY

ARAKOTIPU BLVD

ESPLANADE RESERVE

HUNTRESS CREEK

STAGE 5A

STAGE 5B

STAGE 6A

STAGE 6B

STAGE 6C

STAGE 7A

STAGE 7B

Crown Land
(under action)
Survey Office Plan 2809
121940m²

Notes

1. All areas, easements and dimensions are subject to a full legal survey and approval by Land Information NZ.

Legend

- EX BDY
- PR BDY
- BUILDING LINE RESTRICTION

E	RC - Update Pack	GS	04/2021
D	RFI SEC 127	RK	03/2019
C	RC	CA	01/2019
B	S.127	CA	12/2018
Ref	Revisions	By	Date

	By	Date
Survey	-	-
Design	RK	07/18
Drawn	RM	12/2018
Checked	BV	07/18

Maven Associates
09 571 0050
info@maven.co.nz
www.maven.co.nz
12 -14 Walls Road, Penrose

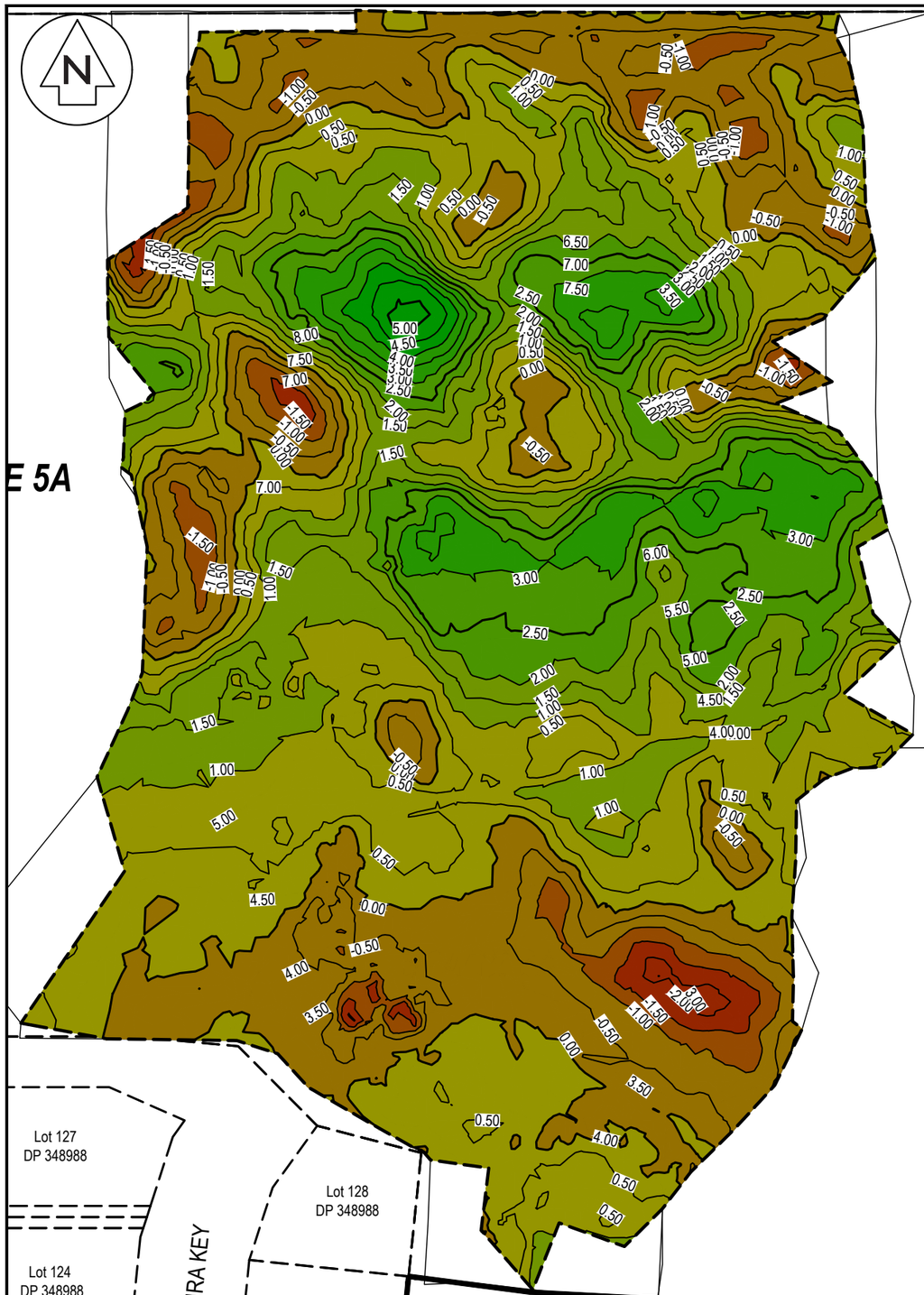
Project
WAIOTAHE DUNES DEVELOPMENT
WAIOTAHE
FOR
EQUINOX

Title
SCHEME PLAN OVERVIEW

Project no.	105006		
Scale	Not To Scale		
Cad file	105006-150 scheme		
Drawing no.	C150	Rev	E

DATE: 10/02/22

FILE: 105006-150 Scheme.dwg



INITIAL SURFACE SURVEYED BY MAVEN
FINAL SURFACE PROVIDED BY EAST BAY SURVEYORS AS COMPLETED CIVIL WORKS ASBUILT 20/10/22
- DOES NOT INCLUDE 40MM HOTMIX TO THE ROAD SURFACE

Notes
1. LEVELS ARE IN TERMS OF MOTURIKI DATUM ORIGIN OF LEVELS BMGA19 (ABW8) RL 2.67
2. COORDINATES ARE IN TERMS NZGD2000, POVERTY BAY CIRCUIT
3. BOUNDARIES SHOWN ON THIS PLAN ARE FROM LAND INFORMATION NZ DCDB AND HAVE NOT BEEN SURVEYED, A BOUNDARY DEFINITION SURVEY SHOULD BE CARRIED OUT TO ESTABLISH EXACT BOUNDARY POSITIONS ON SITE.
4. SURVEY DATA COLLECTED BY GPS METHOD AND AS SUCH. ACCURACY +/- 0.02m POSITION +/- 0.03M LEVEL

Legend
- EX BDY
- AB BDY
- AB WORK EXTENT

Elevations Table

Number	Minimum Elevation	Maximum Elevation	Area	Color
1	-2.23	-2.00	54.98	
2	-2.00	-1.50	288.13	
3	-1.50	-1.00	907.93	
4	-1.00	0.00	6817.39	
5	0.00	1.00	8574.70	
6	1.00	2.00	4810.96	
7	2.00	3.00	2949.96	
8	3.00	4.00	1272.18	
9	4.00	5.00	191.28	
10	5.00	5.25	26.14	

EARTH WORKS (SURFACE AS-BUILT GROUND LEVEL COMPARISON WITH SURFACE EXISITING GROUND LEVEL)

CUT VOLUME	4525.68 m³
FILL VOLUME	23455.59 m³
NET FILL	18929.91 m³
EARTHWORKS AREA	= 25894 m² / 2.59 Ha

NOTE: NO ALLOWANCE FOR SERVICES TRENCHES, VOLUMES AREA UNFACTORED AND IN SITU

Rev	Description	By	Date
A	AS-BUILT	AFC	10/2022

	By	Date
Survey		
Design	AFC	10/2022
Drawn	AFC	10/2022
Checked	GS	10/2022

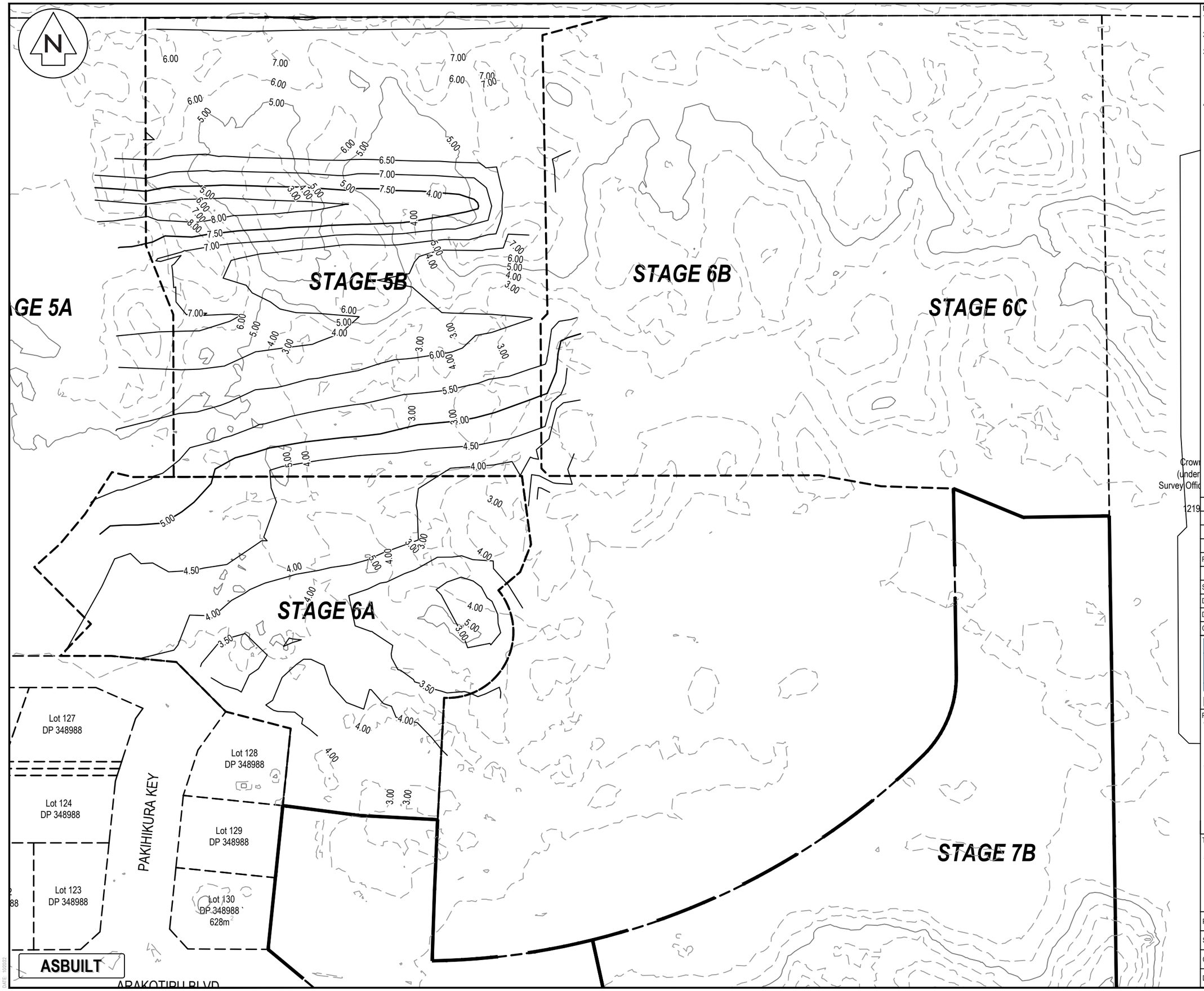
Maven Associates
09 571 0050
info@maven.co.nz
www.maven.co.nz
5 Owens Road, Epsom
Auckland 1023

Project
WAIOTAHE DUNES DEVELOPMENT
WAIOTAHE STAGE 5B, 6A
FOR
EQUINOX

Title
AS-BUILT CUT/FILL PLAN

Project no.	105006
Scale	1:1000 @ A3
Cad file	105006 - STAGE 5B, 6A GROUND LEVEL AS BUILT.DWG
Drawing no.	C921 Rev A

DATE: 10/2022



Notes

1. LEVELS ARE IN TERMS OF MOTURIKI DATUM ORIGIN OF LEVELS BMGA19 (ABW8) RL 2.67
2. COORDINATES ARE IN TERMS NZGD2000, POVERTY BAY CIRCUIT
3. BOUNDARIES SHOWN ON THIS PLAN ARE FROM LAND INFORMATION NZ DCDB AND HAVE NOT BEEN SURVEYED, A BOUNDARY DEFINITION SURVEY SHOULD BE CARRIED OUT TO ESTABLISH EXACT BOUNDARY POSITIONS ON SITE.
4. SURVEY DATA COLLECTED BY GPS METHOD AND AS SUCH. ACCURACY +/- 0.02m POSITION +/- 0.03M LEVEL

Legend

- EX BDY
- AB BDY
- EX MAJOR CONTOUR
- EX MINOR CONTOUR
- AB MAJOR CONTOUR
- AB MINOR CONTOUR
- AB EXTENT WORK

Crown
(under
Survey Offic

1219

Rev	Description	By	Date
A	AS-BUILT	AFC	10/2022

	By	Date
Survey		
Design	AFC	10/2022
Drawn	AFC	10/2022
Checked	GS	10/2022

Maven Associates
09 571 0050
info@maven.co.nz
www.maven.co.nz
5 Owens Road, Epsom
Auckland 1023

Project

WAIOTAHE DUNES DEVELOPMENT
WAIOTAHE STAGE 5B, 6A
FOR
EQUINOX

Title

ASBUILT CONTOURS PLAN

Project no.	105006
Scale	1:1000 @ A3
Cad file	105006 - STAGE 5B, 6A GROUND LEVEL AS BUILT.DWG
Drawing no.	C922 Rev A

DATE: 10/2022

APPENDIX B

PROJECT SPECIFICATION BY MAVEN ASSOCIATES

Appendix D

PROJECT SPECIFICATIONS

WAIOTAHE DUNES

PROJECT SPECIFIC SPECIFICATIONS AND STANDARDS.

Unless otherwise identified in the Drawings provided for Construction, the Contractor shall adhere to the following Specifications:

- Opotiki District Council Code of Practice – Subdivision and Development, Version 1.0 Sept 2001

GENERAL SPECIFICATIONS AND STANDARDS.

Other requirements that the Contractor shall adhere to include, but are not limited to:

- Health and Safety at Work Act 2015
- Health and Safety in Employment Act 2015
- Health and Safety in Employment Regulations 2015
- Department of Labour codes of practice, approved codes of practice and guidance publications
- Resource Management Act (RMA)
- Best Management Practice guidelines on Sediment and Dust Management, Spills and
- Emergency Management, Works Within Watercourses, Working in and around Trees, and Dewatering.
- Construction Contracts Act
- Utilities Access Act
- NZUAG National Code of Practice for Utilities' Access to Transport Corridors
- NZTA Code of Practice for Temporary Traffic Management
- New Zealand Standards referred to within the Contract Document
- Land Development and Subdivision NZS 4404
- Regional/ District Plans
- New Zealand Building Code

Where not expressly identified in the Project Specific Specifications and Standards above, all materials and workmanship shall comply with the following standards and documents:

NZS 4404:2010	LAND DEVELOPMENT AND SUBDIVISION ENGINEERING
NZS 4402.4.1.1:1986	METHODS OF TESTING SOILS FOR CIVIL ENGINEERING PURPOSES.
NZS 4431:1989	CODE OF PRACTICE FOR EARTHFILL FOR RESIDENTIAL DEVELOPMENTS
NZTA F/2:2013	SPECIFICATION FOR PIPE SUBSOIL DRAIN CONSTRUCTION.
NZS 4404:2010	LAND DEVELOPMENT AND SUBDIVISION ENGINEERING
NZS3109	CONCRETE CONSTRUCTION
NZS3116	CONCRETE SEGMENTAL PAVING
TNZ B/02	CONSTRUCTION OF UNBOUND GRANULAR PAVEMENT LAYER
TNZ M/01	ROADING BITUMEN

TNZ M/4	SPECIFICATION FOR BASECOURSE AGGREGATE
TNZ M/10	ASPHALTIC CONCRETE
TNZ M/13	ADHESION AGENTS
TNZ P/9	CONSTRUCTION OF ASPHALTIC CONCRETE PAVING
TNZ P/3	FIRST COAT CHIPSEAL
TNZ P/4	RESEALING
TNZ T/1	PAVEMENT MARKING
TNZ P/12	BENKELMAN BEAM DEFLECTION MEASUREMENTS
TNZ F/2	PIPE SUBSOIL CONSTRUCTION
AS/NZS 4058:2007-	PRECAST CONCRETE PIPES (PRESSURE AND NON-PRESSURE)
NZS 4442:1988-	WELDED STEEL PIPES AND FITTINGS FOR WATER, SEWAGE AND MEDIUM PRESSURE GAS.
AS/NZS 2032:2006 -	INSTALLATION OF PVC PIPE SYSTEMS
NZS 7643:1979-	CODE OF PRACTICE FOR THE INSTALLATION OF UNPLASTICIZED PVC PIPE SYSTEMS
AS/NZS 1254:2002	PVC PIPES AND FITTINGS FOR STORMWATER AND SURFACE WATER APPLICATIONS
AS/NZS 1260:2002	PVC PIPES AND FITTINGS FOR DRAIN, WASTE AND VENT APPLICATIONS
BS 437:1978-	SPECIFICATION FOR CAST IRON SPIGOT AND SOCKET DRAIN PIPES AND FITTINGS
AS/NZS 2033:2008	INSTALLATION OF POLYETHYLENE PIPE SYSTEMS
AS/NZS 4130:2003	POLYETHYLENE (PE) PIPES FOR PRESSURE APPLICATIONS
AS/NZS 4129:2008	FITTINGS FOR POLYETHYLENE (PE) PIPES FOR PRESSURE APPLICATIONS.
WIS 4-32-08	FUSION JOINTING POLYETHALENE PRESSURE PIPELINE SYSTEMS USING PE80 AND PE100 MATERIALS AND WIS 4-32-11, 16 AND 18 AS APPLICABLE
AS/NZS 1477:2006	PVC PIPES AND FITTINGS FOR PRESSURE APPLICATIONS.
BS 5154:1991-	SPECIFICATION FOR COPPER ALLOY GLOBE, GLOBE STOP AND CHECK AND GATE VALVES.
BS 5163-1 & 2:2004-	VALVES FOR WATERWORKS PURPOSES

Special Technical Specifications

Where not expressly identified in the Project Specific Specifications and Standards above or the General Specifications and Standards, all materials and workmanship shall comply with the following standards and documents identified below.

Site Clearance and Earthworks

Earthworks General

Once site clearance and topsoil stripping has been undertaken within the earthworks area the ground shall be inspected by the Engineer to identify any unsuitable materials/areas. Unsuitable areas shall be excavated and backfilled with approved material as part of the bulk filling. Allowance of screening up to 20mm in size of tree roots is to be allowed. The Contractor shall under no circumstances remove unsuitable material without first obtaining approval from the Engineer.

All materials apart from that classed as unsuitable by the Engineer, shall be placed and compacted to the standards specified including any drying/mixing work required to meet this standard. Any areas disturbed to depth (ie stump removal) shall be worked and compacted to standard before any fill is placed above.

Work over or near existing drains/services shall be undertaken carefully to ensure they are not damaged; open culverts/manholes/service pits shall have mesh screens to prevent to entry of debris into the system.

Earthworks Classification of Materials

Materials to be excavated shall be classified as one of the types below:

Should the contractor want material to be classified as other than “Soil” adequate notice shall be given to the Engineer so that a classification may be determined.

Unsuitable Material

Material that due to excessive natural water content, soil type and/or organic content is determined by the Engineer as unsuitable for use as compacted earth fill material.

Soils and Rock

Soils applicable for use as certified earth fill are defined as material which can be excavated with feasible efficiency by current excavating plant.

Soft rock shall be defined as material which requires loosening by means of ripping equipment which can be subsequently removed by excavating plant.

Hard rock shall be defined as solid material which cannot be reasonably loosened and prepared for excavation by means of a heavy duty ripper and which requires to be broken up by means of explosives or heavy duty rock breakers before it can be handled by mechanical equipment.

Where hard rock is encountered, extra payment will be made for its excavation. Rock shall be defined as solid unfractured material which cannot be excavated by normal machine methods but requires blasting or the use of rock breakers. Boulders of less than one quarter of a cubic metre in size will not be considered as rock.

Should agreement on classification of soft rock and hard rock material not be reached, ripping trials shaft be carried out using suitable plant, to establish the classification as described above. If the Contractor does not have suitable plant onsite, the cost for transporting plant to site shall be reimbursed if the classification claimed by the Contractor is correct.

Mass Earthmoving

Cut and fill operation shall be planned to make best use of the materials available onsite including mixing and drying of less suitable materials with good "soil" to the satisfaction of the Engineer. Work shall be completed in accordance with the drawings and formation levels required.

Material onsite shall be worked to the optimum moisture content prior to compaction by drying and/or blending. Large lumps of material shall be broken down to less than 100mm size and spread uniformly before being compacted to the specified density and strength. With the approval of Engineer crushed material to a certain size may be disposed of within the Contract area.

Compaction equipment for fill placement shall comprise of "Sheepsfoot Rollers" unless specified otherwise, spreading and transportation equipment is not considered compaction equipment. The contractor shall uniformly compact each layer of material placed, the roller shall make sufficient passes to achieve the required specification for strength and density. The thickness of each layer shall also be limited and even to ensure adequate compaction is achieved for the full depth of layer.

The Contractor shall interrupt his operations as necessary to permit the Engineer to carry out, with safety, content tests on the fill. Should wet weather be forecast the earthworks area shall be sealed to prevent saturation of soil.

If drying of material is required to achieve compaction, the full depth of layer shall be disc allowing it to dry evenly. Contractor shall ensure that this is only done as weather allows with sufficient time to compact and seal before precipitation. If material is too dry either water truck and/or sprinkler system shall be used to increase moisture content, no pooling of water shall occur. Contractor shall mix and disc before compacting in place.

The Contractor shall familiarise itself with soil and moisture conditions and no extra payment shall be made for drying wet material or wetting dry material unless agreed to by the Engineer before work is carried out.

Works shall be completed by the Contractor to the designated profiles provided, should over excavation occur the Contractor shall make good under direction from the Engineer at his cost. The finished surface levels and location shall be in accordance with provided drawings/construction setout data issued. The surface should be free from depressions that hold water.

Roadway reserves shall be trimmed to subgrade level in accordance with design information provided, road subgrade shall be trimmed 500mm behind the kerb face.

Tolerances

Final tolerances shall be the following:

- Road Reserve: Plus 0mm minus 10mm (10mm over 3m Straight Edge)
- Building Platforms: Plus 0mm minus 10mm (10mm over 3m Straight Edge)
- General Earthworks: Plus 0mm minus 50mm. (No area shall hold water)

Haul Roads

No haul road shall be constructed without the approval of Engineer and located such that they will not be cut/filled over later in the project. Haul roads shall be maintained in good condition and included within the site Environmental Management Plan.

Benching

Slopes with gradients steeper than 1 in 3 shall be benched prior to bulk filling. Benches shall as far as possible be the width of a machine (but not less than 2.5m); shall have a slight fall inwards to allow for the control of water, and shall have a longitudinal fall that will ensure adequate drainage and discharge of crater. The rate for bulk earthmoving shall include all such preparatory beaching and the Contractor shall allow for such in his bulk earthworks rates.

Batters

All batters constructed in fillings more than six metres high or otherwise directed shall be benched at approximately the levels indicated on the Drawings (as per above note). While constructing the filling, the Contractor shall endeavour to use the hardest material available at bench levels to help reduce erosion. Should the batter be deemed prone to erosion or shallow scale instability the engineer may direct the Contractor to protect the face with Polythene Sheeting.

The face of every fill batter shall be compacted by rolling/tracking with an approved machine to the satisfaction of the Engineer. Upon completion of batter construction, the Contractor shall sow grass and/or mulch as directed by the Engineer.

Cuttings

All formation of cuttings shall be true to grade and cross section as shown in drawings and no steeper than that detailed. The Contractor shall be responsible for maintaining this batter until end of maintenance period has expired. If large movements/slips occur beyond the control of Contractor work shall be remediated under contract rates as an extra.

Site Visits

During the earthworks, site visits shall be undertaken by the nominated geotechnical testing company on a regular basis to assess compliance with NZS 4431 and any project specific recommendations and specifications including:

- Adequate topsoil stripping;
- Removal of organic materials;
- Placement and compaction of earth fills.

Quality Control Criteria

Due to the varying soil types being used for engineered fills, the compaction control criteria of minimum allowable shear strength, maximum allowable air voids and maximum dry density shall be used for quality assurance purposes. Approved compacting machinery shall be used and achieve the following specification unless specified otherwise by the engineer:

Maximum Dry density (measured by Nuclear densometer – NZS 4402)

Soil Type	% Compaction Required	Fill Areas	Road Reserves
Clay and Silty Clays		95%	98%

Sands and Gravels	97%	100%

Minimum Shear Strength (Measured by hand held shear vane - calibrated using NZGS 2001 method) and Maximum Air Voids Method (As defined in NZS 4402)

	Fill Areas	Road Reserves:
Air Voids Percentage average value* less than	10 %	8 %
Air Voids Percentage maximum single value	12 %	10 %
Undrained Shear Strength average value* not less than	170 kPa	140 kPa
Undrained Shear Strength minimum single value	140 kPa	110 kPa

*The average value is determined over any ten consecutive tests

Typical water content shall be in accordance with the below and any specific recommendations from the geotechnical engineer:

Soil Type	Allowable Variations	Below	Above
Heavy & Silty Clay		4%	2%
Sandy Clay		3%	2%
Sandy Silts & Silty Sands		2%	1%
Gravel/Sand/Clay/Silt Mixtures		3%	Nil

Volcanic Ash/Clays - To be determined for each project by geotechnical Engineer

Filling material shall be compacted within the above water content criteria to ensure efficient compaction. Should the engineer in control of the site find that material is outside the above criteria works shall stop until the moisture content has been corrected.

Where drying is required the full depth of top layer shall be disc allowing the layer to dry uniformly, this shall only be carried out if weather permits and re-compacted and shaped before rainfall.

Should material become too dry to achieve optimum compaction wetting using sprinkling equipment (ensuring uniform distribution of water) shall be carried out. Contractor shall ensure that no ponding or saturation occurs in specific areas, upon completion and before compaction material shall be disked to provide and even distribution of water through the layer.

Once wetting or drying has been completed the material shall be re-compacted and reshaped, no extra payment will be made for drying wet material or wetting dry material unless instruction has been issued by the Engineer before completing the work.

Quality Assurance Testing

Regular in situ density, strength and water content tests shall be carried out on all areas of the engineered filling at or in excess of the frequency recommended by NZS 4431. Where test results do not meet the specification outlined above, retests shall be carried out at the same level. These areas shall be clearly recorded and marked on plans.

Drainage lines and any other excavations requiring backfill shall also be tested in compliance with the above specification.

Topsoil - Strip Existing to Stockpile

Topsoil shall be defined as the layer of material, which may include vegetation, turf and other organic matter immediately below the ground surface and which is unsuitable for use in compacted earth fills.

All topsoil as defined by the Engineer including grass within the earthworks area shall be removed and stockpiled in a planned manner (location approved by Engineer). All areas with heavy grass vegetation shall be placed on the bottom of stockpiles, with clean material being placed on top. During sorting all unsuitable material i.e. concrete, stumps etc shall be stockpiled as directed by Engineer. No extra payment will be made to the contractor for double handling material.

Topsoil - Re-spread from stockpile

On completion of earthworks to the satisfaction of the Engineer including subgrade surface such that water does not pond, topsoil shall be re-spread from stockpiles to a minimum depth of 150mm, or other such depths as the Engineer may direct.

The topsoil shall be prepared so that the top 20mm in free of clods and is open textured and ready for the application of the seed mixture. The remaining topsoil layer should be firmly compacted.

Final finished levels shall be plus or minus 50mm but overall thickness shall not be less than 100mm, topsoil shall be sufficiently compacted to the satisfaction of Engineer.

Cut to Fill / Landscape Fill / Existing Selected Pavement Material

The standard of compaction and method of determination shall be as set out in NZS 4431. Where NZS 4431 is not applicable, the methods and standards of compaction shall be specified by the Engineer.

Stabilise Fill

Prior to works onsite the existing material shall be tested to confirm its strength in order to determine application rates of stabilization agents, testing will be either shear strength, Maximum Dry Density, Air voids, CBR testing or beam testing as directed by the Engineer.

All work shall be in accordance with TNZ B/5:2008 Specification for In-Situ Stabilisation of Modified Pavement Layers.

The Contractor shall inform the Engineer of the nominated type of equipment to be used and insure that weather conditions are suitable for application of stabilization agents this includes precipitation, wind and temperature. If conditions are not suitable work shall be stopped until conditions improve.

Stabilised material must be compacted within the following timeframes

- Cement 2hours
- Lime 4hours

The stabilising agent shall be uniformly spread at the specified application rate, with Mat tests (1m2 canvas) completed every 400m2. The test results shall be within 0.5kg/m2 of the specified rate. The contractor shall provide these test results to Engineer upon completion of work. Slacking of burnt lime shall be completed ensuring thorough water penetration, precautionary measure should be taken to ensure that public will not be exposed to blown agents. Should any discharge occur to the stormwater system the Engineer and the environmental authority for the region shall be notified immediately.

The Contractor shall ensure the depth of stabilising is as requested by the Engineer, depth of cut shall be measured on the drum at 200m intervals or if less than this distance the start and finish. The depth shall not vary by more than plus 15mm minus 5mm. Longitudinal joins shall be overlapped minimum 100mm of half the layer thickness using whichever is greater.

All joints including those to existing unstabilised pavement shall be mixed, compacted and finished so the final surface does not have permeable or loss patches. Upon completion of stabilising the material shall be compacted ensuring the layer is in a uniform, dense, stable condition. The final compaction targets shall be determined by completing laboratory tests in accordance NZS 4402: test 4.1.3 from representative sample onsite. During construction the maximum dry density (MDD) and optimum water content established from Lab testing shall be used to check compaction. The Contractor shall achieve 92 to 95% MDD on Subbase and 95 to 98% on basecourse layers.

The final surface finish shall present a tightly consolidated surface when swept which, the large aggregate is held in place with a matrix of smaller aggregates. The smaller aggregates are held firmly in place by fine material, and the matric does not displace under normal trafficking or sweeping. The standard of sweeping shall be sufficient to remove all loose aggregate, dirt, dust, silt and other deleterious material. The completed surface profile shall be in accordance with design documents and provide no more than 10mm over 3m straight edge, longitudinal profile shall match into any existing pavement.

Cut to Waste / Surplus Material from Stockpile

The tendered rate shall allow for identification of all material in cut areas, access and haul roads, uplifting (including top loading) of the cut material, benching, loading of material for removal offsite, carting to certified cleanfill site.

The Engineer shall determine which materials are “unsuitable” as noted under General Earthworks section, where any material has become unsuitable due to Contractor neglectful operation of the site i.e. poor surface drainage or excess tracking the excavation and disposal along with backfilling shall be completed at the contractor’s expense. Materials classified by the Engineer as being unsuitable and not suitable for use onsite shall be disposed of to an approved, authorized tip site.

All unsuitable material located within areas to be filled shall be removed prior to commencement of filling, the extent and measure up of material shall be confirmed onsite by the Engineer. No unsuitable material shall be buried or deposited on the Contract site unless agreed with the Engineer. The Contractor shall pay careful attention shall be made to mucking out gullies and old watercourses, ensuring that unsuitable material is not mixed with fill material.

Material which is unsuitable due to high water content only shall be spread, dried, mixed and placed as fill, if full specification can’t be achieved this material can be placed in general reserve areas with agreement from the Engineer.

Roading

Roading General

This Specification applies to flexible pavements construction which shall be carried out to the alignments and standards detailed in the approved drawings and with the specified materials so as to provide the intended design life. This includes conventional metal sub-base and basecourse material, Bitumen, Chipseal, Asphaltic Concrete, concrete pavers, kerb and channels, ducts, cables, driveways,

footpaths, road berms and streetlights. This specification refers to multiple standards and TNZ specifications in all cases the latest revisions or amendments at time of tender shall be used.

The Contractor shall ensure all existing features are protected and not damaged during construction, any damage that does occur shall be repaired at the Contractors cost. Construction of the roadway excavation to subgrade level shall be incorporated into the overall site bulk earthworks, and any soft spots made good to specification. Scala penetrometer and Benkelman Beam testing shall be completed along with a site walkover with Engineer present to inspect the trimmed subgrade. Trimming material shall be disposed of onsite under direction from Engineer. Areas below design specification strength shall be improved and re-tested before final inspection of the completed subgrade surface is carried out.

The subgrade shall be prepared with suitable equipment to a smooth consistent surface with care taken around any sensitive soils, the finish tolerance shall be plus 0mm minus 10mm (10mm over 3m straight edge). The Contractor is responsible for the protection and maintenance of the subgrade throughout the construction of the pavement layers. Under no circumstances shall the subgrade be left exposed to suffer damage by weather, construction traffic or any other cause. Should any weakness develop within the pavement the Contractor under instruction from the Engineer shall repair at his cost.

Underchannel drains shall be installed and connected to stormwater reticulation under no circumstances shall they be left unconnected to saturate subgrade in the event of rainfall. Drains to be bedded in free draining drainage media and wrapped in geotextile cloth unless noted otherwise.

Ducts shall be installed and where crossing carriageway hardfill backfilled with well compacted GAP65 material, asbuilt data shall be recorded and supplied to the engineer of their locations along with markings on the kerb. The Contractor shall be responsible for any costs to locate and expose ducts incorrectly marked/recorded. Clearance between ducts and other services shall be in accordance with local/regional/service provider specifications. The ends of all ducts shall be temporary plugged to stop egress of water/sediment and an approved draw cable installed.

Trim and Prepare Subgrade

Before any subbase material is placed onsite the trimmed subgrade surface shall be inspected by the Engineer and Local/Regional authority, the contractor shall supply a copy of scala penetrometer testing and beam testing completed. Should the material not meet the required specification the engineer will instruct improvement works.

Undercut and Backfill with Granular Material (Pavement).

The Engineer shall determine which materials are “unsuitable” as noted under General Earthworks section, where any material has become unsuitable due to Contractor neglectful operation of the site i.e. poor surface drainage or inadequate protection of the subgrade the disposal along with backfilling shall be completed at the contractor’s expense. Materials classified by the Engineer as being unsuitable and not suitable for use onsite shall be disposed of to an approved, authorised tip site.

All unsuitable material located within the identified soft spots within the subgrade shall be removed to the depth specified by the Engineer, and either disposed of onsite or removed to waste as directed by the Engineer. The extents shall be clearly measured and recorded along with copy of subgrade testing completed.

Geogrid and Geotextile

Fabric shall be free of rips and laid smooth on the surface, joins shall have minimum of 1m overlap with Bidium A19 geotextile or similar.

Grid shall be free of rips and laid smooth on the surface, joins shall have minimum of 1m overlap with TX160 (or similar approved) as directed by the Engineer.

Pavement Construction, Parking Bays, Turnarounds - Subbase

Unless specified otherwise GAP65 which complies with local/regional authority requirements shall be used. Compaction shall be achieved to minimum/maximum of 92-95% Dry Density or better, the Engineer may also request further testing either using Clegg Impact or Benkelman Beam testing. The finished tolerance shall be plus 0mm minus 10mm (10mm over 3m straight edge). Contractor shall not proceed with next layer until Engineer has given written instruction.

Pavement Construction, Parking Bays, Turnarounds - Basecourse

Unless specified otherwise TNZ M4 which complies with local/regional authority requirements shall be used. Compaction shall be achieved to minimum/maximum of 95-98% Dry Density or better, the Engineer may also request further testing either using Clegg Impact or Benkelman Beam testing. The finished tolerance shall be plus 0mm minus 10mm (10mm over 3m straight edge). Contractor shall not proceed with next layer until Engineer has given written instruction.

General Paving Guidelines

The finished surface of new roads shall have a NAASRA roughness satisfying the Local Authorities standards at the time of construction. No abrupt or abnormal deviations shall occur and no areas shall pond water. The surface shall be of uniform texture expected by best trade practice and satisfy density standards applicable to the surfacing being used. The skid resistance and surface texture of roads where design speeds exceed 70 km/h, shall comply with NZTA specification T/10 and its accompanying notes. Finished surface profile shall have no more than 10mm difference over a 3m straight edge.

Where hard surfacing is required for areas that are not movement lanes, alternative materials and porous pavements that achieve the durability, maintenance, and amenity requirements are acceptable with the approval of the Local Authority.

Road Surfacing Materials

All materials used in road surfacing shall comply with the appropriate NZTA specifications. The following surfacing options will be acceptable for roads covered by the Standard.

<u>First and second coat chip seals</u>

For first coat seals the chip size shall generally be grade 3 on all roads unless specified otherwise by Engineer.

For second coat seals the chip size shall generally be grade 4. Cycle and parking lanes shall be grade 6 unless specified otherwise by Engineer.

Double wet lock coat

First and second seals may be constructed in one operation with asphaltic cutback to NZTA M/1 and P/3 specifications.

The binder application rate for the seals shall be designed to suit the conditions and chip size.

Acceptable and compatible chip sizes are:

Local roads

First coat: grade 4, second coat: grade 6

Other roads

First coat: grade 3, second coat: grade 5 or 6.

Contractor shall ensure before placement that the engineer has inspected the basecourse surface, and that the finish, moisture content and temperature are suitable. The waterproofing seal coat, using asphaltic binder or emulsion, and grade 4/6 (first coat/second coat) chip, with the requirement that the seal coat comprises a minimum of 1.0 L/m2 of residual penetration grade bitumen, shall be laid prior to surfacing with asphaltic concrete of 50 mm or lesser thickness.

Hot laid asphaltic concrete surfacing

Hot laid asphaltic concrete surfacing shall comply with NZTA specification M/10 or equivalent approved by the TA. The mix used shall be appropriate to the end use and thickness being placed. A waterproofing seal coat, using asphaltic binder or emulsion, and grade 5 chip, with the requirement that the seal coat comprises a minimum of 1.0 L/m2 of residual penetration grade bitumen, shall be laid prior to surfacing with asphaltic concrete of 50 mm or lesser thickness. No cut back shall be used in such coats as it can cause lushing of the asphalt overlay. When using NZTA specification M/10 compliant mixes on roads of connector/collector class, NZTA guidelines on skid resistance and surface texture shall be incorporated in the mix design.

Contractor shall ensure before placement that the engineer has inspected the chipseal surface, and that the finish, moisture content and temperature are suitable. The final finish shall be smooth, to grade and not hold any water (ponding), and surface defects shall be remedied at the contractor's cost. The final mix and thickness shall be specified on the construction drawings.

Other asphaltic mixes

For special uses other asphalt-based hot mixes may be used such as open grade porous asphalt or macadam wearing mix. When used they shall be placed over a waterproof under layer and shall be designed according to current specifications and guides. In no case shall the laid thickness be less than 25 mm.

Concrete

All concrete for roads shall come from a special grade plant as defined in NZS 3109. Concrete of not less than 30 MPa 28-day strength shall be used for any road or crossing slabs. Concrete for kerbs and channel shall be of not less than 20 MPa, 28-day strength.

Concrete pavers

Design and material standards shall comply with NZS 3116. Paver thickness shall be as defined in NZS 3116 for the appropriate traffic loading classification.

When used in roads the basecourse underlayer shall be given a waterproofing seal coat before the sand and pavers are laid, except where part of a porous pavement is approved by the TA.

When used for bus stops or at raised crossings the basecourse shall be cement stabilised under the raised zone and for at least 3 m on either side of the raised zone.

Pavers shall be laid to 5 mm above the lips of channels and other draining features.

KERBING

Kerb and channel may be either cast in situ or extruded. For cast in situ kerb and channel, formwork shall be clean dressed timber or steel sections adequately oiled or otherwise treated to allow ease of striking without staining or damaging of the stripped concrete surface. No formwork shall be stripped until at least 2 days have elapsed from time of pouring concrete.

For extruded kerb and channel, concrete used shall be of such consistency that after extrusion it will maintain the kerb shape without support. The extrusion machine shall be operated to produce a well compacted mass of concrete free from surface pitting. The contractor shall allow within his rate to construct vehicle crossing dropdowns, pram crossings and stormwater cesspit aprons and surrounds.

Concrete used in kerbs and channels shall be of at least 20 MPa, 28-day strength. Finished tolerances and standards shall satisfy the design standards. Kerbs less than 1% gradient shall be setout with an electronic theodolite.

All curves both horizontal and vertical shall be tangential to straights and the lines and levels of kerbs shall be such as to give the finished kerbs smooth lines free of kinks and angles. Construction joints shall be placed in all unreinforced kerb and channel at 10 m centres.

Workmanship standards shall be such that, on straights, kerbing shall not deviate from a straight line by more than 6 mm in any length of 3 m. Similar standards shall apply to the gradient line. No visible ponding in new channels shall occur.

The exposed faces of the kerb and channel shall present smooth, uniform appearance free from honey-combing or other blemishes to at least U3 standard in NZS 3114.

UNDERCHANNEL DRAIN

Subsoils shall be constructed in accordance with NZTA F/2:2013 with High Density Polyethylene smooth bore perforated corrugated drainage pipe complying with requirements specified in NZS 7604:1981 “High Density Polyethylene Drain and Sewer Pipe and Fittings”. Pipes shall be class 500 and identifiable by either a visible continuous red line or legible lettering on both sides at approximately 1m intervals specifying brand name and TNZ F/2 Class 500. The drain shall be encased with a geotextile which complies with the following performance requirements of NZTA F7.

The manufacturers jointing system shall be used and terminated to either piped stormwater systems, or open air and set in concrete collar such that sedimentation/blockage of outlet does not occur.

Trenches shall be cut in such manner that pipes are laid true to the depths, grades and lines shown on drawings. The width shall not exceed the specified dimensions, unless otherwise specified the trenches shall have:

- trenches shall have gradient of not less than 1:100
- Vertical sides from trench bottom to a minimum of 300mm above the pipe
- minimum depth of 750mm for unsealed roads/embankment conditions/construction equipment, 600mm for sealed roads and 450mm for areas not within roadways (as per AS/NZS 2566:1998)
- surplus material shall be placed at least the excavation depth away from trench and surplus material shall be disposed of as directed by engineer

Pipes shall be bedded on a continuous cushion of the filter material with no less than 75mm under the pipe, and a minimum of 150mm above the pipe or as specified in contract drawings. Bedding material shall be in accordance with NZS 3111.1986, and grading curve shall comply with NZS4402, Part 2:1986.

Footpaths, Accessways, Paving

The finished depth, finish and concrete strength shall be in accordance with the local/regional standards or those specified within the construction drawings.

The concrete paths shall be laid with construction joints at intervals of not greater than 3m. If paths are constructed by continuous pour techniques, clean, true, well-oiled 5 mm thick steel strips at least 40mm deep shall be inserted at 3 m intervals to facilitate controlled cracking. These strips shall be carefully removed after the concrete has set. Alternatively, the joints may be cut by means of a concrete-cutting saw. In this case the cutting shall be carried out not more than 48 hours after pouring and shall be to a depth of 40 mm. These joints may also be typically tooled into the concrete when the concrete is still plastic.

Concrete used in footpaths shall be of at least 20 MPa, 28-day strength. Concrete for crossings shall be 30 MPa, 28-day strength.

Where required, vehicle and pedestrian crossings shall be constructed in accordance with the local/regional authority standard details. Tactile pads may be required at pedestrian kerb crossings.

Concrete paths and accessways shall be finished with a crossfall to shed water and an even non-skid brush surface to finish U5 in NZS 3114. The surface of other paths/accessways shall be of uniform texture as would be expected from best trade standards for the surfacing used. Crossfalls of 2% shall be provided.

The surface of all paths/accessways shall not deviate by more than 6 mm from a 3 m straight edge at any point and no abrupt changes in line or level shall occur. No path/ accessway shall pond water.

Marking

Prior to commencing work under this contract, the contractor shall nominate in the Contractor's QA plan, the brand and designation of the material intended for use. A type and class of material may be nominated by the Engineer in the specific contract documents. TNZ P/12:2000 SP/SP12:010201 SPECIFICATION FOR PAVEMENT MARKING Page 3 of 18 Pages The material used shall not be changed from that nominated in the QA plan without the written approval of the Engineer.

Before commencing roadmarking the contractor shall set out all markings with paint spots or other appropriate methods to ensure start, finish, and orientation is defined. These spots shall be at a spacing of 10 m or less.

Freshly completed markings shall be protected by cones or other markers approved by the Engineer until the roadmarking is dry, and the beads securely held. Any markings on adjoining pavement caused by mishap, or the transfer of wet marking material by tyres of passing vehicles shall be removed, with the Contractor being fully responsible for their removal.

Drainage

General

All drainage work to comply with current Local/ Regional authority standards. Contractor to ensure that all Engineering and Local/ Regional authority inspections required for compliance are completed.

The construction of pipelines shall be carried out in accordance with the requirements of AS/NZS 2032 (PVC), AS/NZS 2033 (PE), AS/NZS 2566 Parts 1 and 2 (all buried flexible pipelines), or AS/NZS 3725 (concrete pipes).

The Contractor shall be responsible for the correct setting out of all the Works from the survey reference information provided in accordance with the Contract. No alterations in the alignment, level or location of the drains are to be undertaken unless authorised by the Engineer.

All materials to comply with current Local/ Regional authority standards.

Unless otherwise specified, all concrete used in drainage works shall comply with the requirements of NZS3209 and shall have a minimum compressive strength of 20.0Mpa at 28 days.

Undercut and Backfill with Granular Material

Depth of undercut specified below: (To meet 'good ground' conditions)

- CBR 1 – 400mm
- CBR 2 – 300mm
- CBR 3 – 200mm
- CBR > 3 will not require undercut.

Hardfill Backfill

Hardfill backfill to be GAP65 or similar. The minimum thickness of Hardfill backfill shall be 200mm. Trench width (D+300mm) solid measure.

Extra over item to Pipe laying used under road/accessway carriageways and at pipe crossovers as shown within the Contract Drawings or as directed or specified by the Engineer.

Pipe Laying and Jointing – Open Cut

Contractor to allow for the setting aside of surplus material for reuse or disposal onsite as directed by the Engineer. (to be placed in bulk fill areas) If material is unsuitable/ not required onsite it shall be removed from sit as per unsuitable material from trenches.

Pipeline quantities noted in the Schedule are measured from edge of manhole to edge of manhole, and the final measure-up and payment shall be on this basis.

All pipes shall be laid in accordance with pipe manufacturers recommendation for the class and type of pipe being used at the alignment, level and location within the Contract Drawings. All pipelines shall always during the contract be kept clean and free of all dirt, rubbish, and water.

Minimum cover for pipes and separation distance between crossing pipes and services shall be as per Local/ Regional authority standards or as described in AS/NZS 2566.2 (for buried flexible pipelines) or AS/NZS 3725 (for buried concrete pipes) if not specified.

No backfilling shall be carried out until the section to be backfilled has been approved by the Engineer as passing all the necessary tests and all junctions and house connections have been located by measurement for record purposes.

Backfilling around and above pipes shall be in accordance with the standard drawings in terms of fine material used and depth above pipe. Backfill should be consolidated in 200mm layers.

Trench Improvement

Excavations shall be of sufficient width and depth to permit effective bedding, laying of pipes and installation of manholes and other structures. Excavated materials shall be stacked at least 450mm clear of the edge of any excavation or outside a 45-degree angle from invert of trench. No trenches shall be opened more than 120m ahead.

All pipes shall be laid upon the type of bedding specified or shown on the Contract Drawings, in compliance with the Local/ Regional authority standards. In trenches where good ground is not encountered (CBR < 3) trench improvements are to be completed as directed or specified by the Engineer.

Manhole, Catchpit & Chambers

Contractor shall allow for the setting aside of surplus material for reuse or disposal onsite as directed by the engineer. (to be placed in bulk fill areas) If material is unsuitable/ not required onsite it shall be removed from sit as per unsuitable material from trenches.

Contractor to allow for the connection of all inlet and outlet pipes (excluding existing manholes). All inlet and outlet pipes shall have a flexible joint not more than 600mm outside the manhole wall. Soffits of inlet pipes shall not be lower than the soffit of the outlet pipe.

Manholes, catchpits and chambers shall be constructed as per the Standard Details in the Contract Drawings which are also located within the Local/ Regional authority standards. Standard details are included for manhole base, benching and wall construction.

All benching and haunching to be a smooth finish to accommodate all inlet and outlet pipes. New inlet pipes shall be cut back to the inside face of the MH and provided with a smooth finish. All chambers are to be made watertight with mortar around all openings.

Chamber internal diameter sizes and fall through chambers are as per the Local/ Regional authority standards.

All chambers shall be left with their lids set at a level that is flush with the surrounding ground unless otherwise specified in the drawings.

Drop connections shall be internal drops in accordance with the standard drawings, unless specified otherwise.

Connections - Laterals

Where shown on the plans or directed by the Engineer, junctions shall be provided for house connections, refer to local authority standards for type of junction required. Care shall be taken to ensure that no part of the junction pipe, reinforcing or plastered finish projects into the barrel of the main pipe.

Unless otherwise specified, all house connections shall be constructed at right angles to the main drain and shall be ramped at 45 degrees to within one metre of the ground surface. All connections must extend a minimum of one metre into the relevant lot.

Connections to Existing

The Contractor should allow for all costs to connect the new drainage reticulation to the existing network, by either the Controlling Authority or by the Contractor under Council supervision, as specified in the contract drawings. The new drainage reticulation shall be tested and accepted by the Controlling Authority before connection.

Where the Contractor is to make this connection, they shall be responsible for all required excavation, laying, fittings, backfilling and removal of surplus materials.

Where the Controlling Authority is to make the connection, the Contractor shall lay the pipes to within 1 metre of the connection point and organise the connection directly. Contractor to allow all liaison / applications required for any connection made by the controlling authority. Payment for connection will be made directly to the Controlling Authority by the Developer

The connection of new mains to existing shall be carried out to the methodology and procedural requirements of the Regional/ Territorial Authority.

Water Reticulation

General

that all Engineering and Local/ Regional authority inspections required for compliance are completed.

All parts of the water supply system in contact with drinking water shall be designed using components and materials that comply with AS/NZS 4020.

The Contractor shall be responsible for the correct setting out of all the Works from the survey reference information provided in accordance with the Contract. No alterations in the alignment, level or location of the drains are to be undertaken unless authorised by the Engineer.

All materials to comply with current Local/ Regional authority standards as set out in NZS 4404:201 APPENDIX A – ACCEPTABLE PIPE AND FITTING MATERIALS.

Pipe Laying and Jointing

The Contractor shall allow for the supply, excavation, lay of each length of water supply pipe, trench supports/shield, bedding, joints, backfilling and compaction of that backfill to the required standard and the installation of detector tape.

Contractor to allow for the setting aside of surplus material for reuse or disposal onsite as directed by the engineer. (to be placed in bulk fill areas) If material is unsuitable/ not required onsite it shall be removed from sit as per unsuitable material from trenches.

All pipes shall be laid in accordance with the manufacturer's recommendation for the class and type of pipe being used. Joints shall be tightened sufficiently to provide a watertight seal but not overtightened producing high stresses.

Minimum cover for pipes and separation distance between crossing pipes and services shall be as per Local/ Regional authority standards or as described in AS/NZS 2566.2 (for buried flexible pipelines) or AS/NZS 3725 (for buried concrete pipes) if not specified.

Trenches shall be evenly graded at a sufficient depth to allow sufficient cover from finished ground surface level to the top of the pipes as required by the relevant Regional/ Territorial Authority.

No backfilling shall be carried out until the section to be backfilled has been approved by the Engineer as passing all the necessary tests and all junctions have been located by measurement for record purposes.

Backfilling around and above pipes shall be in accordance with the standard drawings in terms of fine material used and depth above pipe. Backfill should be consolidated in 200mm layers.

Detector tape shall be laid above all trenched watermains constructed from a non-metallic material 150mm above all watermain pipes and rider main pipes, a metallic detector tape marked "Watermain Below"

Tracer wire in the form of a continuous four-millimetre multi strand (minimum 4) polythene sleeved copper cable, shall be installed with all non-metallic pipes to allow detection.

Valves

Sluice and Peet valves shall be resilient seated gate valves which comply with AS 2638.2 2006 "Sluice valves for waterworks purposes" shall be used, and AS 4158 "Thermal-bonded polymeric coatings on valves & fittings" shall be used.

Hydrants

Hydrants shall be mounted on approved types of hydrant tees with risers if necessary, so that the top of each hydrant is no less than 300mm from finished ground level. Each hydrant strait be covered with an approved type of hydrant box and painted lid painted on the top. The Hydrant symbol shall be marked on the road surface opposite the hydrant in accordance with Local Fire Authority requirements.

Meters and Connections

Unless otherwise specified, all house connections should be installed as part of the house construction (not part of the subdivision) and will be undertaken by the Local/ Regional authority.

All house connections shall terminate at a water meter or service valve, shall be constructed at right angles to the principle main, shall extend a minimum of one metre into the relevant lot, shall be laid a minimum of 450mm cover, rising to 250mm cover immediately adjacent to the meter box.

Connections shall be sized in accordance with NZS/AS 3500.1.2003 "Plumbing & Drainage Part 1 Water Services Clause 3.2.2

Connections to Existing

The Contractor should allow for all costs to connect the new drainage reticulation to the existing network, by either the Controlling Authority or by the Contractor under Council supervision, as specified in the contract drawings. The new drainage reticulation shall be tested and accepted by the Controlling Authority before connection.

Where the Contractor is to make this connection, they shall be responsible for all required excavation, laying, fittings, backfilling and removal of surplus materials.

Where the Controlling Authority is to make the connection, the Contractor shall lay the pipes to within 1 metre of the connection point and organise the connection directly. Contractor to allow all liaison /

applications required for any connection made by the controlling authority. Payment for connection will be made directly to the Controlling Authority by the Developer

The connection of new mains to existing shall be carried out to the methodology and procedural requirements of the Regional/ Territorial Authority.

SERVICES

SERVICE TRENCH

Trench width shall be identified within the Contract Drawings or as directed or specified by the Engineer. Common trench width shall be sufficient to install all services meeting clearance requirements as specified by the service authorities.

Placement of fines/shading around services shall be completed to provider specifications.

DUCTING

Ducting for water pipes shall be uPVC. All ducts shall be laid in a straight line with no angles or bends. Joints shall be made in such a manner that the ends of the pipes are prevented from moving.

Trenches shall be evenly graded at a sufficient depth to allow sufficient cover from finished ground surface level to the top of the pipes as required by the relevant Regional / Territorial Authority. A clearance of at least 150mm below the underside of any future watermains should be allowed. Ducts across paths and vehicle crossing shall have a minimum clearance of 50mm below the underside of the concrete.

LANDSCAPING

HYDROSEEDING / GRASSING

Grass establishment shall be timed to take advantage of the local optimum growth period as soon as possible after completion of works. In the absence of other specifications within the Contract documents the following shall be applied or as specified by the Engineer:

Grass Type:

- Perennial Rye Grass 250kg/ha
- Chewings Fescue 300kg/ha
- Browntop/Bent Grass 300kg/ha

Ground preparation shall be in accordance with item 240 and grass shall achieve 90% or better strike, if not achieved the Contractor shall supply and sow additional seed until 90% strike is achieved. Contactor shall allow once growth is sufficient to mow and weed along with making good any depressions which have developed due to insufficient compaction. The Contractor shall allow to maintain the berms and complete a final mowing within 5days of the end of maintenance period.

APPENDIX C

EDC SITE INSPECTION NOTES

ENGINEERING DESIGN CONSULTANTS

SITE REPORT		HEALTH & SAFETY
EDC File No: 48749	Date: 5/8/2022	Are you entering site alone? Yes/No (If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)
BC/EPA No:		Induction completed? Yes/No (If 'no' please give reason.....)
Time: 08:30	Weather: fine	Signed in? Yes/No Signed out? Yes/No
Inspected by: JB	Site Manager: Paul	Carry out 5 x 5 check? Yes/No (Please refer overleaf for instructions. Identify potential hazards and note below.)

Site Address: Waiotahi Drifs

Findings

Scala Penetrometer tests were conducted on the following completed lots:

Lot 12, 15, 16, 19 and 21.

The results indicated that 5 blows per 100mm was achieved generally from 400mm begl. Due to the nature of the sand we expect the top 300mm - 400mm to be Loose, however, Lot 21 only achieved 5 blows per 100mm from 600mm begl.

The following lots were also tested:

Lot 41, 89, 86, 85 and 82.

The Scala results indicated that 5 blows per 100mm was generally achieved from 350mm begl. These lots will be tested again as they require another 500mm of fill.

Recommendation

The top 400mm of sand for Lot 21 must be scrapped off and recompacted.

5/8/22

H & S Comments: See Over For Limitations and 5 x 5 Instructions

Photos:

EDC

ADDRESS		P/N	
Waiotahe Drifts	5/8/22		

SCALA PENETROMETER TEST FIELD RECORD

	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8
50	X	X	X	X	X			
100	X	X	X	X	X			
150	1	1	.5	.3	.3			
200	1	1	.5	.3	.5			
250	2	2	2	.3	1			
300	3	2	2	2	1			
350	4	3	3	2	2			
400	5	4	3	3	2			
450	4	4	4	3	3			
500	5	5	5	4	3			
550	7	5	5	5	4			
600	6	6	6	5	5			
650	7	7	7	6	5			
700	7	7	8	7	6			
750	10	9	8	7	5			
800	10	—	8	7	6			
850	—		8	9	6			
900			9	10	7			
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EDC

ADDRESS		P/N	
Waiotahi drifts	5/8/22		

SCALA PENETROMETER TEST FIELD RECORD

	SC1 12	SC2 15	SC3 16	SC4 19	SC5 21	SC6	SC7	SC8
50	1	X	V	X	X			
100	X	X	X	X	X			
150	-5	-3	X	1	-3			
200	-5	-3	-5	1	-3			
250	2	-3	-5	2	-3			
300	2	1	1	2	1			
350	2	1	2	2	1			
400	2	2	2	3	1			
450	3	2	3	2	1			
500	4	3	3	3	2			
550	4	3	3	3	2			
600	5	3	3	3	2			
650	6	4	4	3	3			
700	7	4	5	4	3			
750	7	4	6	5	4			
800	5	5	6	6	5			
850	7	6	7	7	7			
900	8	6	7	7	7			
950	—	7	7	8	7			
1000		5	8	9	7			
1050		7	—	—	8			
1100		8			9			
1150		—			—			
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ENGINEERING DESIGN CONSULTANTS

SITE REPORT

EDC File No: 48749 Date: 11/8/22

BC/EPA No:

Time: 08:30 Weather: Fine

Inspected by: JGB Site Manager: Paul

Site Address: Waiotahi Drifs

HEALTH & SAFETY

Are you entering site alone? Yes/No
(If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)

Induction completed? Yes/No
(If 'no' please give reason.....)

Signed in? Yes/No Signed out? Yes/No

Carry out 5 x 5 check? Yes/No
(Please refer overleaf for instructions. Identify potential hazards and note below.)

Findings

- The sub grade of Stage 5B road was tested using Scala Penetrometer (SC) tests. Each test was carried out in the centre of the road and approximately in the centre of Lots 82, 85, 86, 89 and 91.
- The results from the SC indicate that 5 blows per 100mm was achieved 250mm begl.
- The final compaction tests were carried out on Lots 82 - 91. The Scala Penetrometer test indicates that 5 blows per 100mm can be achieved from between 300mm - 400mm begl. The reason for the lower SC readings for Lot 82, 83, 84 and 83 is that they were backfilled while testing was conducted on the road, and more compaction will be carried out.

Recommendation

- Lots 82 - 85 require more compaction.
- Once completed, topsoil can be placed on Lots 82-91

11/8/22

H & S Comments:

See Over For Limitations and 5 x 5 Instructions

Photos:

EDC

ADDRESS		P/N	
Waiotahe	11/8/22		Stage 5B Road sub-grade

SCALA PENETROMETER TEST FIELD RECORD

	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8
	Rd 91	Rd 99	Rd 86	Rd 85	Rd 82			
50	X	X	X	X	X			
100	X	X	X	X	X			
150	=	1	.5	1	.5			
200	<	1	.5	1	.5			
250	2	=	2	2	2			
300	3	3	3	2	3			
350	3	4	4	2	4			
400	4	6	4	3	4			
450	[illegible]	5	4	4	5			
500	6	6	6	4	6			
550	7	7	6	6	7			
600	7	7	7	7	7			
650	X	8	9	7	7			
700	10	9	8	9	8			
750	—	10	10	10	11			
800		=	=	=	=			
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EDC

ADDRESS		P/N	
Waidoho	11/8/22		Lots 82-91 Stage 5B

SCALA PENETROMETER TEST FIELD RECORD

	SC1 82	SC2 85	SC3 86	SC4 89	SC5 91	SC6 90	SC7 88	SC8 87
50	x	x	x	x	x	x	x	x
100	x	x	x	x	x	x	x	x
150	.5	.3	.5	.5	.5	x	x	x
200	.5	.3	.5	.5	.5	0.5	.5	.5
250	1	.3	1	2	1	0.5	.5	.5
300	1	1	1	2	1	1	1	1
350	1	1	1	2	2	2	2	1
400	8	1	8	2	2	2	2	5
450	3	2	2	3	3	2	3	2
500	3	2	4	4	2	3	4	2
550	4	3	4	4	3	4	4	4
600	5	3	4	5	4	5	5	5
650	5	3	5	5	4	6	6	5
700	5	5	6	6	4	7	5	5
750	7	6	9	7	5	7	5	6
800	7	6	10	8	6	6	6	6
850	7	6	refusal	8	6	7	6	7
900	7	6		9	7	7	7	9
950						11	7	9
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EDC

ADDRESS		P/N	
Waiotahi	11/8/22		Lots 82-91 Stage 5B

SCALA PENETROMETER TEST FIELD RECORD

	SC1 84	SC2 83	SC3	SC4	SC5	SC6	SC7	SC8
50	X	X						
100	X	X						
150	.5	.5						
200	.5	.5						
250	1	1						
300	1	1						
350	1	2						
400	2	3						
450	2	3						
500	2	3						
550	4	4						
600	5	5						
650	4	5						
700	6	6						
750	6	7						
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ENGINEERING DESIGN CONSULTANTS

SITE REPORT		HEALTH & SAFETY
EDC File No: 48749	Date: 2/9/22	Are you entering site alone? Yes/No (If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)
BC/EPA No:		Induction completed? Yes/No (If 'no' please give reason.....)
Time: 9:30	Weather: Fine	Signed in? Yes/No Signed out? Yes/No
Inspected by: JCB	Site Manager: Paul	Carry out 5 x 5 check? Yes/No (Please refer overleaf for instructions. Identify potential hazards and note below.)

Site Address: Waiotahi Drifts (sub-base) stage 5B

Findings

- The road area and all 4 Jcals in the stage has been tested, with with a Scala Penetrometer to confirm the sub-base bearing capacity.
- The results from the Scala Penetrometer indicate that 5 blows per 100 mm have been achieved from 300 mm bcgl.

Recommendation

There is no geological reason why construction of the road & Jcals can not continue.

JB
2/9/22

H & S Comments: See Over For Limitations and 5 x 5 Instructions

Moving machinery

Photos: ✓

EDC

ADDRESS		P/N	
Waiotahi drift	Stage 5 A sub base		2/9/22

SCALA PENETROMETER TEST FIELD RECORD

	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8
50	4	4	4	4	4	4		
100	4	4	4	4	4	4		
150	1	1	1	-9	-9	-9		
200	1	1	1	-5	-5	-5		
250	2	2	2	2	2	2		
300	3	2	3	3	2	2		
350	3	3	4	3	3	2		
400	3	4	5	3	4	3		
450	5	5	6	4	5	4		
500	6	6	7	5	6	5		
550	6	7	8	6	7	7		
600	7	8	—	7	8	7		
650	8	7		9	—	—		
700	9	9		—				
750	—	—						
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EDC

ADDRESS		P/N	
Wardhi	Tool 4 Stage 5B		

SCALA PENETROMETER TEST FIELD RECORD

Tool 5 Tool 6 Tool 7

	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8	
50	X	X	X	X	X	X	X	X	X
100	1	X	X	X	X	X	X	X	X
150	2	1	-5	-5	-5	1	1	-5	1
200	2	1	-5	-5	-5	1	1	-5	1
250	2	2	1	1	1	2	2	2	2
300	3	2	2	3	2	2	3	2	3
350	4	3	3	3	2	3	3	3	3
400	5	2	2	3	3	3	4	3	4
450	5	3	3	4	5	4	5	3	4
500	6	4	4	5	6	4	6	5	4
550	7	4	4	6	6	5	6	5	5
600	8	4	5	5	7	5	7	5	4
650	-	5	5	7	8	7	7	5	5
700		5	5	8	-	6	7	6	6
750		5	5	-		-	-	5	7
800		6	5					6	-
850		-	-					8	
900								-	
950									
1000									
1050									
1100									
1150									
1200									
1250									
1300									
1350									
1400									
1450									
1500									
1550									
1600									
1650									
1700									
1750									
1800									
1850									
1900									
1950									
2000									

EDC

ADDRESS		P/N	
Waiotahe	Jeal's		2/9/22

SCALA PENETROMETER TEST FIELD RECORD

Tool 3

	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8
50	X	X	X					
100	X	X	X					
150	1	1	1					
200	1	1	1					
250	2	2	1					
300	2	2	3					
350	3	2	3					
400	3	3	4					
450	4	4	4					
500	4	4	5					
550	5	6	5					
600	5	6	5					
650	6	6	6					
700	7	6	6					
750	=	=	8					
800			=					
850								
900								
950								
1000								
1050								
1100								
1150								
1200								
1250								
1300								
1350								
1400								
1450								
1500								
1550								
1600								
1650								
1700								
1750								
1800								
1850								
1900								
1950								
2000								

ENGINEERING DESIGN CONSULTANTS

SITE REPORT				HEALTH & SAFETY
EDC File No:	48749	Date:	12/09/22	Are you entering site alone? Yes/(No) (If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)
BC/EPA No:				Induction completed? (Yes)/No (If 'no' please give reason.....)
Time:	9:30am	Weather:	Fine rain	Signed in? (Yes)/No Signed out? Yes/(No)
Inspected by:	Bryn	Site Manager:	Maven	Carry out 5 x 5 check? (Yes)/No (Please refer overleaf for instructions. Identify potential hazards and note below.)

Site Address: Waiotahe Drifts

Findings

- Clegg hammer tests were carried out on the following right of ways J.O.A.L 5, 6, 7, 8, 22, 23.
- The clegg hammer results indicated that ~~20~~ 25 - 30 blows was generally acheived over all of the right of ways tested (J.O.A.L 5, 6, 7, 8, 22, 23).
- There is no geological reason why construction can't be continued. 12/09/22

BC

SCANNED

H & S Comments: See Over For Limitations and 5 x 5 Instructions

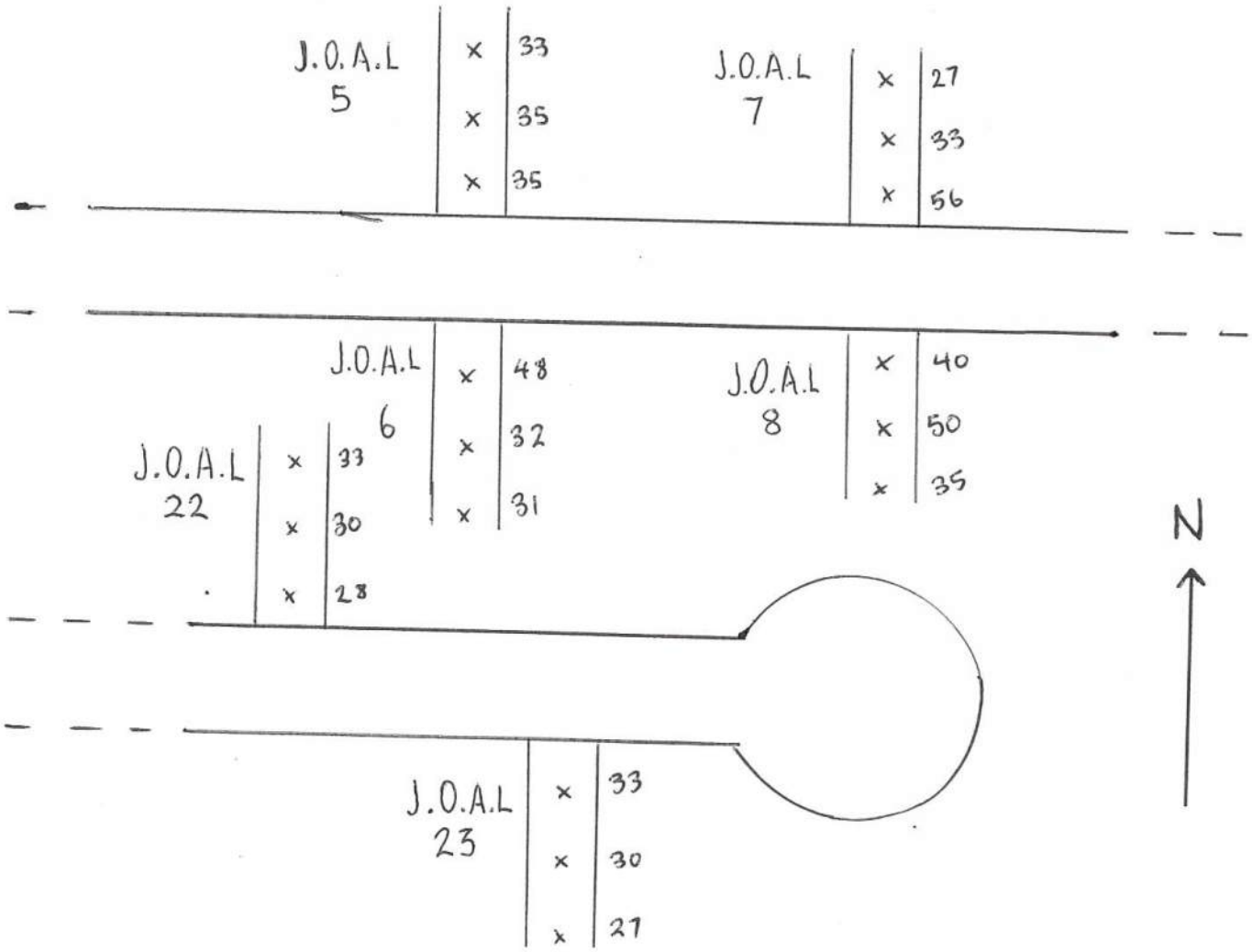
Hazards moving trucks, noise, dust, collapsing ground

Manage Correct PPE, Mask, hearing protection

Photos: ✓

ENGINEERING DESIGN CONSULTANTS

Job Name: Waiotahe Drifts		Page No:
Section: J.O.A.L 5, 6, 7, 8, 22 & 23		
Job No: 48749	Designed: Bryn	
Date: 12/09/22	Checked:	



Bryn Marshall
12/09/22

ENGINEERING DESIGN CONSULTANTS

SITE REPORT				HEALTH & SAFETY
EDC File No: 48749	Date: 16/09/22			Are you entering site alone? Yes (No) (If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)
BC/EPA No:				Induction completed? (Yes) No (If 'no' please give reason.....)
Time: 9am	Weather: Fine.			Signed in? (Yes) No Signed out? (Yes) No
Inspected by: Bryn	Site Manager: Maven			Carry out 5 x 5 check? (Yes) No (Please refer overleaf for instructions. Identify potential hazards and note below.)

Site Address:

Findings.

- Clegg hammer tests were carried out at Stage 5B and 6B on the Roads.
- The Clegg hammer results indicated a CIV reading of 30-35 was generally acheived In the areas tested, at stage 5B.
- The CIV readings from stage 6A were between 20-30 with a low reading of 15 CIV at a boney loose location.

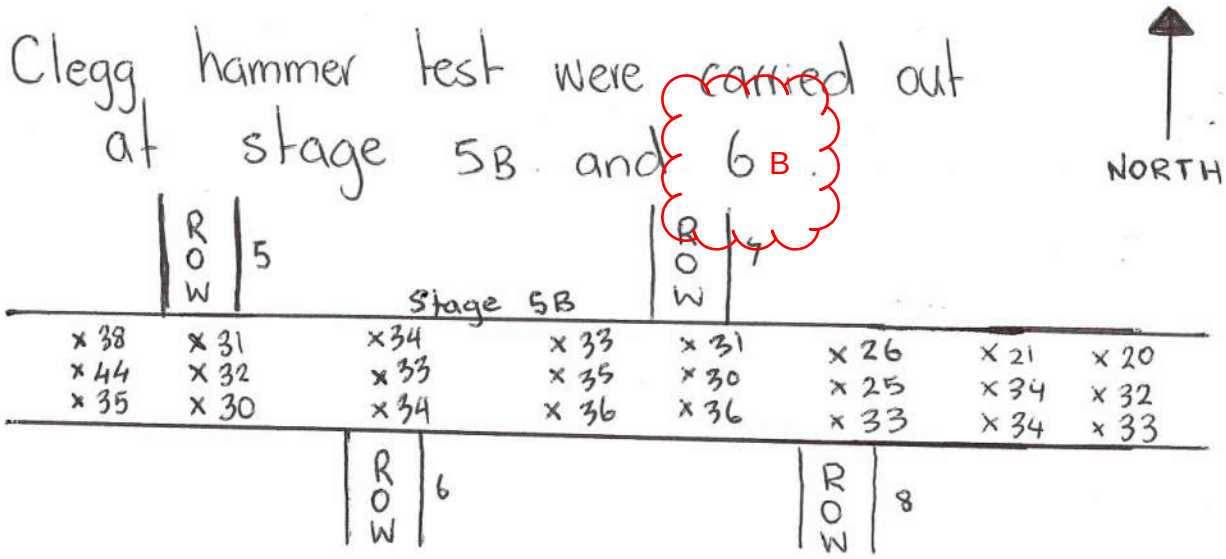
H & S Comments: See Over For Limitations and 5 x 5 Instructions

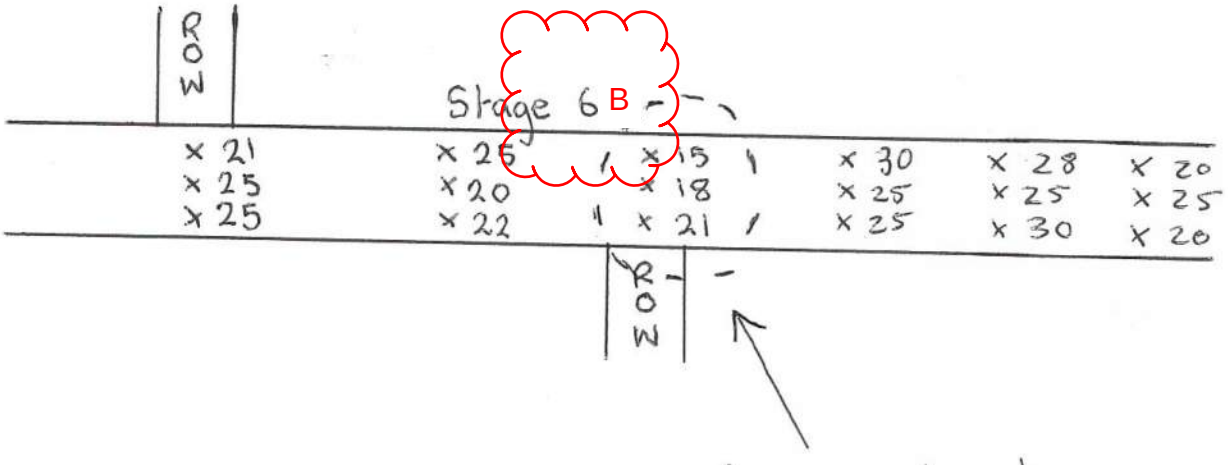
Dug out trenches watch where you walk
Moving trucks Hi Vis

Photos:

Stage 5B & 6A

- Clegg hammer test were ~~carried~~ out at stage 5B and 6B.





ENGINEERING DESIGN CONSULTANTS

SITE REPORT

EDC File No: 48749 Date: 14/4/2022

BC/EPA No:

Time: 15:15 Weather: fine

Inspected by: JGB Site Manager: Paul

Site Address: Waiotahi Drifts

HEALTH & SAFETY

Are you entering site alone? Yes/(No)
(If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)

Induction completed? Yes/(No)
(If 'no' please give reason.....)

Signed in? Yes/(No) Signed out? Yes/(No)

Carry out 5 x 5 check? (Yes)/No
(Please refer overleaf for instructions. Identify potential hazards and note below.)

Formation Inspection (Lot 106)

- The base of the lot consist of loose dune sand and all of the organic material was removed.
- The sand appears to be dry

Recommendation

- Backfilling of lot 106 can commence in layer of not more than 200mm and compacted.
- Due to the dry sand, we recommend that the sand should be watered down to control the moisture content as this will improve compaction results.

19/4/22

H & S Comments: See Over For Limitations and 5 x 5 Instructions

Photos:

ENGINEERING DESIGN CONSULTANTS

SITE REPORT		HEALTH & SAFETY
EDC File No: 48749	Date: 14/4/2022	Are you entering site alone? Yes/No (If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)
BC/EPA No:		Induction completed? Yes/No (If 'no' please give reason.....)
Time: 15:00	Weather: Fine	Signed in? Yes/No Signed out? Yes/No
Inspected by: JGB	Site Manager: Paul	Carry out 5 x 5 check? Yes/No (Please refer overleaf for instructions. Identify potential hazards and note below.)

Site Address: Waiotahi Drifts (Stage 5B)

Findings

- Several organic material was encountered ~~encountered~~ across all of the lots.
- A deep pocket of organic material was encountered in Lot 17. The organic was encounted at the base of a sand dune. The organic layer was approx 1.0m deep. Several other test pits were excavaded along stage 5B as several sand dunes are present in this stage. All of the test pits wee excavaded at the base of the dunes, these test pits were approx 2m x 2m. These test pits confirmed that across the entire stage, another 0.5m of organic material is still present, however, no deep pockets of organic materials were encountered.

- Three Scala Penetrometer tests were caried on top of the three highest dunes to determine the depth of the loose sand. The Scala results indicate that 5 blows per 100mm can be achieved at a depth of 1.4m beyLon top of the dunes.

- Recommendation

- A nother 0.5m of sand needs to be scrapped off along the entire stage to ensure that all the organics have been removed.

- As the soils were very dry at the time of the inspection, we recommend that the soil should be watered down to control the moisture content as this will improve the compaction once backfilling commences.

- Should more deep pockets of organic material ~~be~~ be encountered, then EDC should be notified to re-inspect the area.

JB
19/4/22

H & S Comments:

See Over For Limitations and 5 x 5 Instructions

Photos:

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EXPLORATORY HOLE LOG

ADDRESS: Waotahi Drift c	BOREHOLE / HA No:
	P/N:
DRILLED BY:	DEPTH OF WATER STRIKE:
	DATE: 14/4/22

DEPTH	STRATA DESCRIPTION	SHEAR VANES
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @
	Compaction results done ontop of dunes	/ @

SCALA START DEPTH.....

	X		2		X		1		4		1
0.1	X	1.1	3	2.1	X	3.1	1	4.1	X	5.1	2
	X		1		X		2		4		2
0.2	3	1.2	2	2.2	3	3.2	2	4.2	X	5.2	2
	3		2		3		2		5		2
0.3	3	1.3	3	2.3	3	3.3	2	4.3	5	5.3	2
	9		2		1		2		1		2
0.4	9	1.4	3	2.4	5	3.4	2	4.4	1	5.4	2
	1		2		5		2		1		2
0.5	1	1.5	2	2.5	1	3.5	3	4.5	1	5.5	3
	1		2		1		3		1		3
0.6	1	1.6	2	2.6	1	3.6	2	4.6	1	5.6	4
	1		3		1		3		2		3
0.7	1	1.7	3	2.7	1	3.7	3	4.7	1	5.7	4
	2		3		2		3		1		
0.8	1	1.8	2	2.8	1	3.8	4	4.8	1	5.8	
	1		3		2		3		2		
0.9	2	1.9	4	2.9	1	3.9	4	4.9	1	5.9	
	2				2				2		
1.0	2	2.0		3.0	1	4.0		5.0	1	6.0	

Lot 12 approx | Lot 16 approx | Lot 14 approx

ENGINEERING DESIGN CONSULTANTS

SITE REPORT		HEALTH & SAFETY
EDC File No:	Date: 4/5/22	Are you entering site alone? Yes/No (If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)
BC/EPA No:		Induction completed? Yes/No (If 'no' please give reason.....)
Time: 11:30	Weather: Fine	Signed in? Yes/No Signed out? Yes/No
Inspected by: JGB	Site Manager: Paul	Carry out 5 x 5 check? Yes/No (Please refer overleaf for instructions. Identify potential hazards and note below.)

Site Address: Waiotahe Drifts (Stage 5B formation)

Findings

- Across this stage most of the organic materials are removed, however, shells were identified at approximately Lots 14 & 15. A 10m² area was then left for an inspection by an archaeologist before removing the remaining organics.
- The base of the dug out consist of a loose fine dune sand.

Recommendation

- Once the archaeologist report is received, based on the results, the organic material must be scrapped off and photographs to be send to EDC.
- The strip that is used for access to stage 5A must also be stripped of all organics.

JB

4/5/2022

H & S Comments:

See Over For Limitations and 5 x 5 Instructions

Photos:

ENGINEERING DESIGN CONSULTANTS

SITE REPORT

EDC File No: 48749 Date: 8/6/2022

BC/EPA No:

Time: 10:00 Weather: Fine

Inspected by: JGB Site Manager: Paul

Site Address: Waiotahi Drifts (Stage 5B)

HEALTH & SAFETY

Are you entering site alone? Yes/No
(If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)

Induction completed? Yes/No
(If 'no' please give reason.....)

Signed in? Yes/No Signed out? Yes/No

Carry out 5 x 5 check? Yes/No
(Please refer overleaf for instructions. Identify potential hazards and note below.)

Findings

- Compaction tests were conducted on Lots 12 - 21 for stage 5B using a Scala Penetrometer.
- The results from the Scala Penetrometer indicated that the top 300mm - 400mm of sand is loose, however, from below 400mm, 5 blows per 100mm has been achieved. The top 300mm - 400mm loose sand is to be expected due to the nature of the sand.
- Recommendation

Lots 13, 14, 17, 18 and 20 are completed. However, Lots 12, 15, 16, 19 and 20 will require more compaction tests as these lots must be raised by another possible 2m.

8/6/2022

H & S Comments: See Over For Limitations and 5 x 5 Instructions

Photos: ✓

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EXPLORATORY HOLE LOG

ADDRESS: Waiotahi Drifts (Stage 5B	BOREHOLE / HA No:
	P/N:
DRILLED BY:	DEPTH OF WATER STRIKE:
	DATE: 8/6/22

DEPTH	STRATA DESCRIPTION	SHEAR VANES
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @

SCALA START DEPTH.....

	4		8		4		8		4		6
0.1	4	1.1	8	2.1	5	3.1	8	4.1	5	5.1	7
	5		8		5		6		5		6
0.2	5	1.2	9	2.2	1	3.2	5	4.2	1	5.2	7
	3		9		1		5		2		6
0.3	1	1.3	10	2.3	2	3.3	5	4.3	2	5.3	7
	2				1		5		3		6
0.4	2	1.4		2.4	2	3.4	5	4.4	3	5.4	7
	2				3		6		3		5
0.5	3	1.5		2.5	3	3.5	7	4.5	3	5.5	4
	3				5		7		4		6
0.6	3	1.6		2.6	5	3.6	6	4.6	4	5.6	7
	4				5		7		5		6
0.7	5	1.7		2.7	5	3.7	6	4.7	7	5.7	7
	5				5		7		7		6
0.8	6	1.8		2.8	5	3.8	6	4.8	7	5.8	7
	6				7		7		8		8
0.9	6	1.9		2.9	7	3.9	7	4.9	7	5.9	8
	7				7				6		
1.0	8	2.0		3.0	7	4.0		5.0	7	6.0	

Lot 20 | Lot 18 | Lot 17

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EXPLORATORY HOLE LOG

ADDRESS: Stage 5B		BOREHOLE / HA No:
		P/N:
DRILLED BY:	DEPTH OF WATER STRIKE:	DATE: 8/8/22

DEPTH	STRATA DESCRIPTION	SHEAR VANES
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @
		/ @

Lot 21

x	9
x	9
1	8
1	9
2	10
2	
2	
3	
3	
4	
3	
4	
6	
5	
6	
6	
7	
8	
8	
9	

Lot 19

x	9
x	9
1	8
1	9
2	10
2	
3	
4	
4	
4	
4	
4	
5	
6	
7	
7	
7	
8	
8	
8	

SCALA START DEPTH..... 14 13 12 15 16

	x		x		x		x		x		x			4
0.1	9	1.1	x	2.1	x	3.1	x	4.1	x	5.1	4			
	5		1		1		1		1					
0.2	1	1.2	1	2.2	1	3.2	1	4.2	2	5.2	4			
	1		2		2		1		1					
0.3	2	1.3	2	2.3	2	3.3	2	4.3	2	5.3	4			
	3		3		3		2		1					
0.4	3	1.4	4	2.4	3	3.4	3	4.4	2	5.4	6			
	4		6		4		4		4		7			
0.5	4	1.5	5	2.5	5	3.5	5	4.5	4	5.5	6			
	4		6		5		6		4		4			
0.6	5	1.6	7	2.6	5	3.6	6	4.6	5	5.6	5			
	5		7		6		7		4					
0.7	7	1.7	7	2.7	7	3.7	8	4.7	5	5.7				
	6		8		8		9		5					
0.8	8	1.8	9	2.8	8	3.8	9	4.8	5	5.8				
	9		8		9		8		4					
0.9	10	1.9	10	2.9	9	3.9	4	4.9	5	5.9				
									4					
1.0		2.0		3.0		4.0		5.0	5	6.0				

Lot 14 Lot 13 12

ENGINEERING DESIGN CONSULTANTS

SITE REPORT		HEALTH & SAFETY
EDC File No: 48749	Date: 27/6/22	Are you entering site alone? Yes/No (If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)
BC/EPA No:		Induction completed? Yes/No (If 'no' please give reason.....)
Time: 11:50	Weather: Fine	Signed in? Yes/No Signed out? Yes/No
Inspected by: JGB	Site Manager: Paul	Carry out 5 x 5 check? Yes/No (Please refer overleaf for instructions. Identify potential hazards and note below.)

Site Address: Waiotahi Drifts (Formation Inspection)

Findings

- Lots 82 - 93 and Lots 112 & 113 were investigated.
- All the organic material for the above mentioned lots were removed and the base of these lots consisted of fine to medium dune Sand.

Recommendation

These lots can now be backfilled in 200mm layer and compacted.

27/6/22

H & S Comments:

See Over For Limitations and 5 x 5 Instructions

Photos:

ENGINEERING DESIGN CONSULTANTS

SITE REPORT		HEALTH & SAFETY
EDC File No: 48764	Date: 2/9/22	Are you entering site alone? Yes/No (If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)
BC/EPA No:		Induction completed? Yes/No (If 'no' please give reason.....)
Time: 9:30	Weather: fine	Signed in? Yes/No Signed out? Yes/No
Inspected by: JB	Site Manager: Paul	Carry out 5 x 5 check? Yes/No (Please refer overleaf for instructions. Identify potential hazards and note below.)

Site Address: Waiotahe Drifts (sub-base) stage 6A

Findings

- Scala Penetrometer tests were carried out on the road area for Stage 6A.
- The Scala Penetrometer results indicated that the bearing capacity of the soils differs across the entire road area.

Recommendation

Due to the inconsistency of the soil, it is recommended that the top 1.0m needs to be excavated and recompacted in 200mm layers. Once completed, EDC will re-test the road to confirm the bearing capacity.

JB
2/9/22

H & S Comments:

See Over For Limitations and 5 x 5 Instructions

Photos:

EDC

ADDRESS		P/N	
Road, Stage 6A	Sub base		2/9/22

SCALA PENETROMETER TEST FIELD RECORD

	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8
50	X	X	X	X	X	X		
100	1	X	4	1	X	X		
150	2	-=	1	1	-=	1		
200	4	-5	1	1	-=	1		
250	4	1	1	1	1	1		
300	5	1	2	1	1	2		
350	4	1	1	2	1	1		
400	4	1	1	2	2	2		
450	5	1	2	3	2	2		
500	4	1	2	3	2	2		
550	4	2	3	3	3	3		
600	4	2	3	3	3	2		
650	4	3	3	4	3	2		
700	4	2	4	4	4	2		
750	4	2	4	4	3	1		
800	4	1	4	5	3	2		
850	3	1	4	5	3	1		
900	4	5	4	5	3	2		
950	—	5				—		
1000		3						
1050		3						
1100		3						
1150		3						
1200		3						
1250		0.3						
1300		1						
1350		1						
1400		1						
1450		1						
1500		1						
1550		1						
1600		2						
1650		4						
1700		3						
1750		3						
1800		3						
1850		3						
1900		3						
1950								
2000								

ENGINEERING DESIGN CONSULTANTS

SITE REPORT		HEALTH & SAFETY
EDC File No: 48749	Date: 5/9/22	Are you entering site alone? Yes/(No) (If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)
BC/EPA No:		Induction completed? (Yes)/No (If 'no' please give reason.....)
Time: 15:00	Weather: Rain	Signed in? Yes/(No) Signed out? Yes/(No)
Inspected by: JOB	Site Manager: Paul	Carry out 5 x 5 check? (Yes)/No (Please refer overleaf for instructions. Identify potential hazards and note below.)

Site Address: Waiotahi Drifts (Stage 6A)

~~Con~~ Finding

- Scala Penetrometer tests were carried out on the following Lots, 104 – 110, and Lots 114, 115, 118 and 119.
- The Scala Penetrometer results indicated that 5 blows per 100mm was generally achieved from 0.4 m bgl, however, Lot 115 only achieved 5 blows per 100mm from 0.6m bgl.
- Lots 111 – 113 were not completed at the time of the inspection

Recommendation

- The top 0.4m of fill on Lot 115 needs to be removed and recompacted.
- EDC must be notified once Lots 111 – 113 are completed so that they can be tested.
-

JB
6/9/22

H & S Comments: See Over For Limitations and 5 x 5 Instructions

Machinery observed, keep a distance from any moving machines

Photos:

ENGINEERING DESIGN CONSULTANTS

SITE REPORT

EDC File No: 48749 Date: 8/9/22

BC/EPA No:

Time: 10 am Weather: Sun

Inspected by: Bryn Site Manager: Maven

Site Address: Waiotahe drifts

HEALTH & SAFETY

Are you entering site alone? Yes (No)
(If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)

Induction completed? (Yes) No
(If 'no' please give reason.....)

Signed in? (Yes) No Signed out? (Yes) No

Carry out 5 x 5 check? (Yes) No
(Please refer overleaf for instructions. Identify potential hazards and note below.)

Finding

- Scalar Penetrometer tests were carried out on the following lots 112, 113 and Right of way 22 and 23.
- The scalar Penetrometer results indicated that 5 blows Per 100mm was acheived from 0.4m below ground level, however only lots 112, 113 and right of way 22 achieved.
- 5 blows per 100mm from 0.6mbgl

Recomendation

- There is no geotechical reason that the lots Can not Continue.

08/09/22

H & S Comments: See Over For Limitations and 5 x 5 Instructions

Hazards
Moving trucks, loud noise, dust, collapsing ground, Manage correct ppe, mask, Hearing protection gloves, boots

Photos:

EDC

ADDRESS: Waiotahe Drifts Sub | LOTS 109 - 113 | ~~D/NT~~ Date: 8/9/22 Bryn Marshall

SCALA PENETROMETER TEST FIELD RECORD

	SC1 109	SC2 110	SC3 111	SC4 112	SC5 113	SC6	SC7	SC8
50				X	X			
100				X	X			
150				1	1			
200				1	1			
250				2	2			
300				1	2			
350				2	3			
400				3	3			
450				4	3			
500				5	4			
550				6	4			
600				6	5			
650				7	6			
700				10	5			
750					10			
800								
850								
900								
950								
1000								
1050								
1100								
1150								
1200								
1250								
1300								
1350								
1400								
1450								
1500								
1550								
1600								
1650								
1700								
1750								
1800								
1850								
1900								
1950								
2000								

EDC

ADDRESS		Date	
Waiotahe Drifts Sub	J.O.A.L 22		8/9/22 Bryn Marshall

SCALA PENETROMETER TEST FIELD RECORD

	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8
50	x	x	x					
100	0.5	1	1					
150	0.5	1	2					
200	1	1	1					
250	1	2	2					
300	1	2	2					
350	1	2	2					
400	1	2	2					
450	2	2	3					
500	2	3	2					
550	2	2	4					
600	2	3	3					
650	3	3	4					
700	3	4	4					
750	3	4	5					
800	4	3	4					
850	3	4	4					
900	3	3	4					
950								
1000								
1050								
1100								
1150								
1200								
1250								
1300								
1350								
1400								
1450								
1500								
1550								
1600								
1650								
1700								
1750								
1800								
1850								
1900								
1950								
2000								

EDC

ADDRESS: Waiotahe Drifts Sub

J.O.A.L 23

P/N

Date: 8/9/22

Bryn Marshall

SCALA PENETROMETER TEST FIELD RECORD

	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8
50	X	X	X					
100	0.5	X	X					
150	0.5	0.5	0.5					
200	1	0.5	0.5					
250	1	1	1					
300	1	1	1					
350	1	1	1					
400	1	1	2					
450	1	1	2					
500	1	1	2					
550	1	1	2					
600	1	1	1					
650	1	1	2					
700	1	2	1					
750	2	2	2					
800	2	1	1					
850	1	2	2					
900	1	1	1					
950								
1000								
1050								
1100								
1150								
1200								
1250								
1300								
1350								
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1450								
1500								
1550								
1600								
1650								
1700								
1750								
1800								
1850								
1900								
1950								
2000								

ENGINEERING DESIGN CONSULTANTS

SITE REPORT				HEALTH & SAFETY
EDC File No:	48749	Date:	12/09/22	Are you entering site alone? Yes/(No) (If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)
BC/EPA No:				Induction completed? (Yes)/No (If 'no' please give reason.....)
Time:	9:30am	Weather:	Fine rain	Signed in? (Yes)/No Signed out? Yes/(No)
Inspected by:	Bryn	Site Manager:	Maven	Carry out 5 x 5 check? (Yes)/No (Please refer overleaf for instructions. Identify potential hazards and note below.)

Site Address: Waiotahe Drifts

Findings

- Clegg hammer tests were carried out on the following right of ways J.O.A.L 5, 6, 7, 8, 22, 23.
- The clegg hammer results indicated that ~~20~~ 25 - 30 blows was generally acheived over all of the right of ways tested (J.O.A.L 5, 6, 7, 8, 22, 23).
- There is no geological reason why construction can't be continued. 12/09/22

BC

SCANNED

H & S Comments: See Over For Limitations and 5 x 5 Instructions

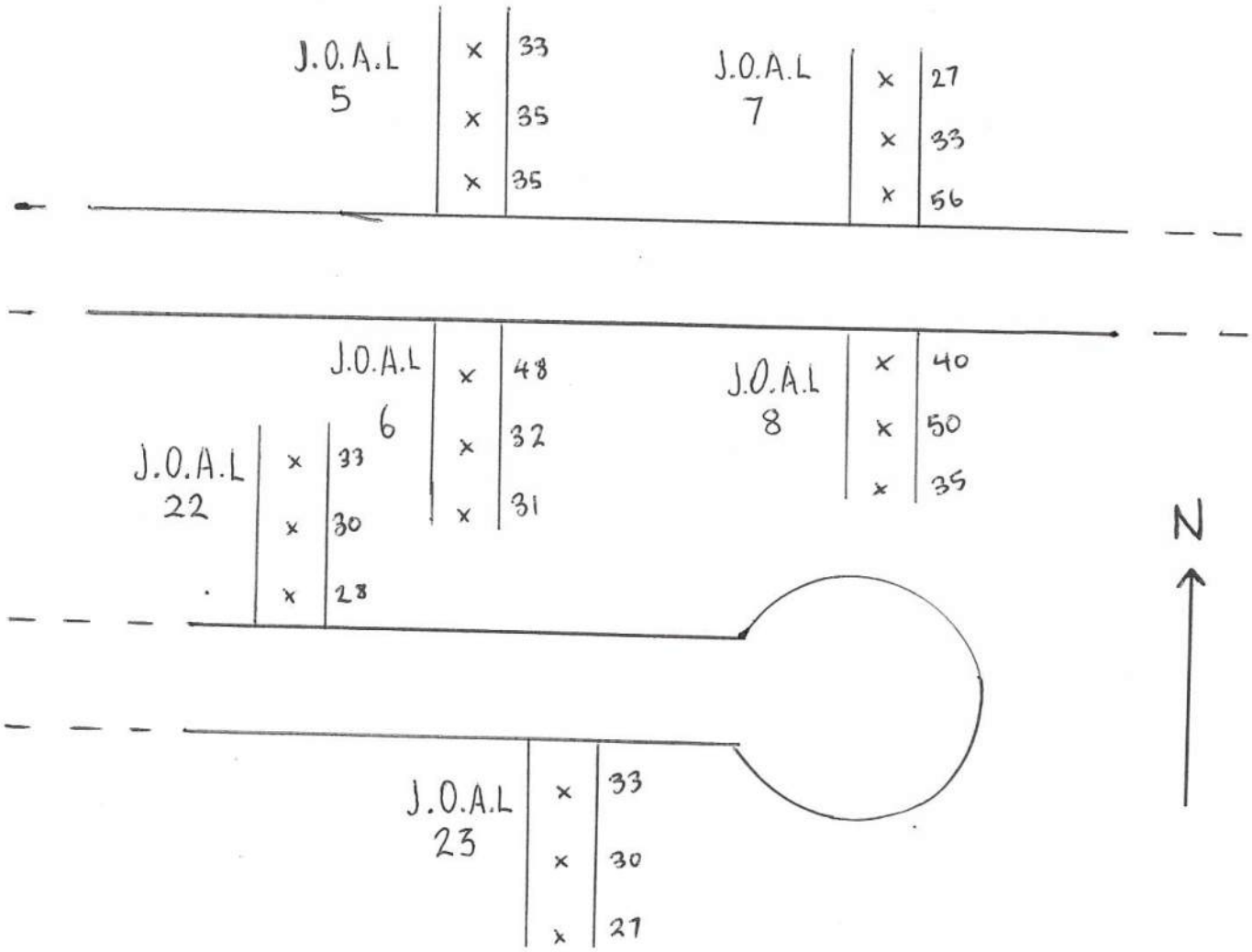
Hazards moving trucks, noise, dust, collapsing ground

Manage Correct PPE, Mask, hearing protection

Photos: ✓

ENGINEERING DESIGN CONSULTANTS

Job Name: Waiotahe Drifts		Page No:
Section: J.O.A.L 5, 6, 7, 8, 22 & 23		
Job No: 48749	Designed: Bryn	
Date: 12/09/22	Checked:	



Bryn Marshall
12/09/22

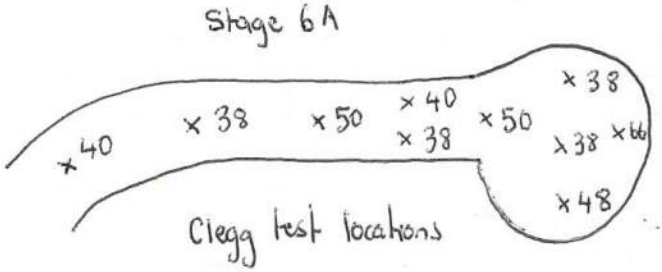
ENGINEERING DESIGN CONSULTANTS

SITE REPORT	HEALTH & SAFETY
EDC File No: 48749 Date: 16/09/22	Are you entering site alone? Yes/(No) (If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)
BC/EPA No:	Induction completed? (Yes)/No (If 'no' please give reason.....)
Time: 430 pm Weather: Fine	Signed in? (Yes)/No Signed out? (Yes)/No
Inspected by: Bryn Site Manager: Maven	Carry out 5 x 5 check? (Yes)/No (Please refer overleaf for instructions. Identify potential hazards and note below.)

Site Address: Waiotahi Drifts.

Findings

- Clegg hammer test were carried out on stage 6a.
- The results indicated a CIV reading of 38 and above was acheived on all test done on stage 6a.
- There is no geotechnical reason why construction can not continue.



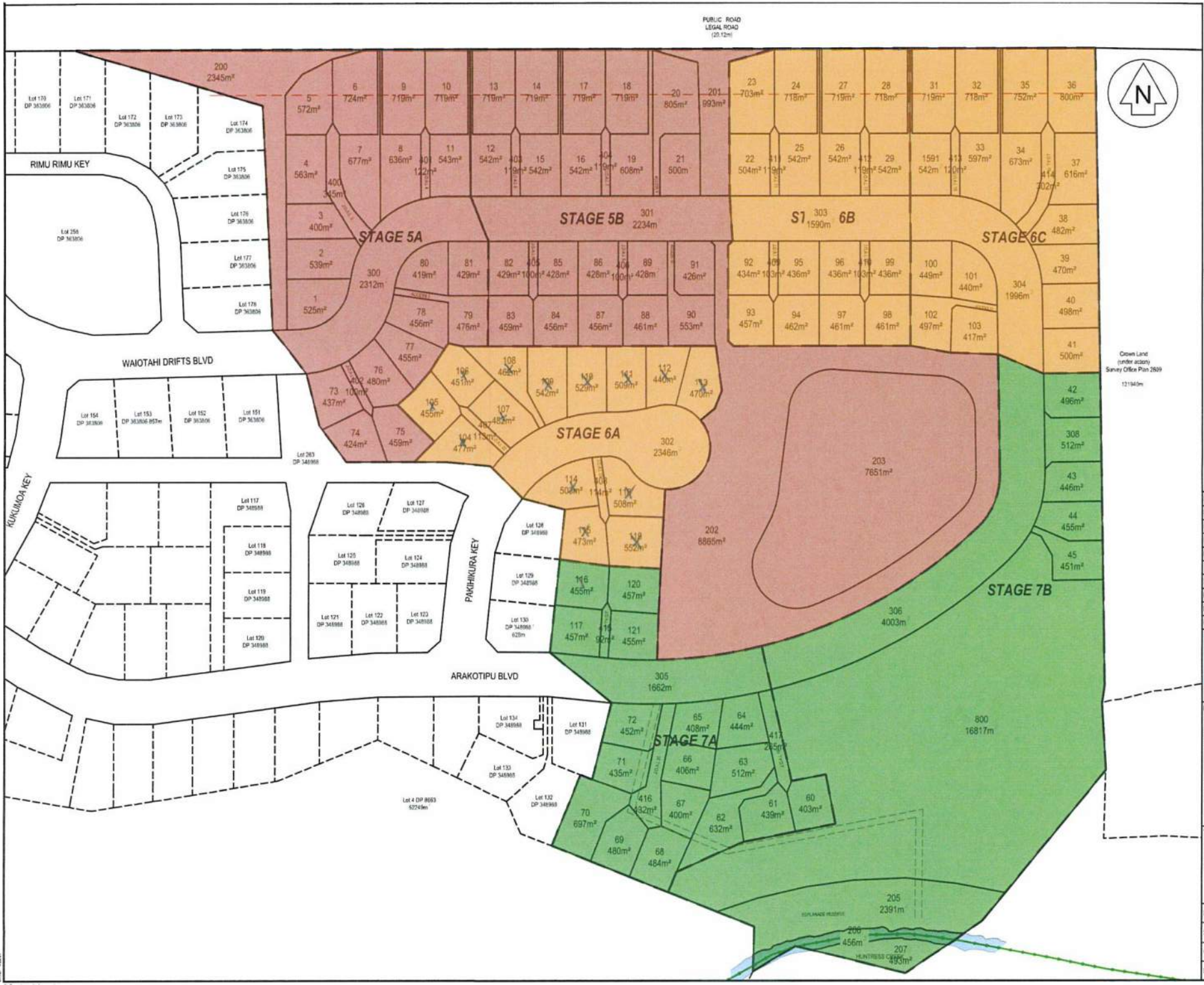
BP

16/09/22

H & S Comments: See Over For Limitations and 5 x 5 Instructions

Dug out trenches watch where you walk
Moving truck Hi Vis

Photos: ✓



Scala locations centre of lots on stage 6a 'x'

NOTES

1. All areas, easements and dimensions are subject to a full legal survey and approval by Land Information NZ.

Legend

- EX BDY
- PR BDY
- BUILDING LINE RESTRICTION

Ref	Revisions	By	Date
E	RC - Update Pack	GS	04/2021
D	RFI SEC 127	RK	03/2019
C	RC	CA	01/2019
B	S.127	CA	12/2018

	By	Date
Survey	-	-
Design	RK	07/18
Drawn	RM	12/2018
Checked	BV	07/18

Maven Associates
09 571 0050
info@maven.co.nz
www.maven.co.nz
12 -14 Walls Road, Pennse

Project

WAIOTAHE DUNES DEVELOPMENT WAIOTAHE FOR EQUINOX

Title

SCHEME PLAN OVERVIEW

Project no.	105006
Scale	Not To Scale
Cad file	105006-150 scheme
Drawing no.	C150 Rev E

EDC

ADDRESS	Waiotahe Drifts Stage 6a	P/N	Lots 104 - 111

SCALA PENETROMETER TEST FIELD RECORD

	SC1 104	SC2 105	SC3 106	SC4 107	SC5 108	SC6 109	SC7 110	SC8 111
50	1	2	2	1	1	1	1	1
100	2	2	2	1	1	1	1	1
150	1	2	1	1	1	1	1	1
200	3	2	1	1	1	1	1	2
250	5	4	2	2	2	2	2	2
300	5	4	3	3	3	2	3	3
350	5	5	4	4	4	3	5	5
400	5	4	5	5	5	4	5	4
450	5	4	5	4	4	5	5	5
500	6	5	5	5	5	5	4	5
550	5	5	5	6	4	5	5	5
600	5	6	5	5	5	5	4	6
650	5	5	5	5	6	5	5	5
700	6	5	6	5	5	6	5	5
750	6	5	5	6	5	5	6	5
800	5	5	5	6	6	5	6	5
850	5	5	6	5	5	6	5	5
900	6	6	5	5	5	5	5	6
950	6	5	5	6	5	6	5	6
1000	7	5	6	5	5	5	5	7
1050	9	5	6	9	5	7	6	7
1100	10	5	8	10	5	6	5	9
1150		6	10		6	7	5	10
1200		5			6	6	5	
1250		5			9	7	5	
1300		7			10	8	6	
1350		10				10	5	
1400							5	
1450							6	
1500							7	
1550							9	
1600							10	
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1750								
1800								
1850								
1900								
1950								
2000								

EDC

ADDRESS	Waiotahe Drifts Stage 6a	P/N	Lot 112 - 115 Lot 118 and 119

SCALA PENETROMETER TEST FIELD RECORD

	SC1 112	SC2 113	SC3 114	SC4 115	SC5 118	SC6 119	SC7	SC8
50	1	1	X	1	1	1		
100	1	1	1	2	1	1		
150	1	1	1	1	1	1		
200	2	2	1	2	1	1		
250	3	3	2	2	2	2		
300	4	2	3	2	3	3		
350	4	3	4	3	3	3		
400	5	3	4	4	4	3		
450	5	3	5	4	5	3		
500	5	4	6	5	4	3		
550	4	5	5	4	5	3		
600	5	5	5	5	5	3		
650	5	5	6	5	5	3		
700	4	6	5	6	4	3		
750	5	5	5	6	5	4		
800	5	5	6	5	5	5		
850	6	6	6	5	5	5		
900	6	5	6	6	5	6		
950	7	6	7	5	5	9		
1000	7	9	7	5	5	10		
1050	9	10	10	6	6			
1100	10			5	9			
1150				5	10			
1200				6				
1250				8				
1300				10				
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1850								
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2000								

ENGINEERING DESIGN CONSULTANTS

SITE REPORT		HEALTH & SAFETY
EDC File No: 48749	Date: 27/6/22	Are you entering site alone? Yes/No (If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)
BC/EPA No:		Induction completed? Yes/No (If 'no' please give reason.....)
Time: 11:50	Weather: Fine	Signed in? Yes/No Signed out? Yes/No
Inspected by: JGB	Site Manager: Paul	Carry out 5 x 5 check? Yes/No (Please refer overleaf for instructions. Identify potential hazards and note below.)

Site Address: Waiotahi Drifts (Formation Inspection)

Findings

- Lots 82 - 93 and Lots 112 & 113 were investigated.
- All the organic material for the above mentioned lots were removed and the base of these lots consisted of fine to medium dune Sand.

Recommendation

These lots can now be backfilled in 200mm layer and compacted.

27/6/22

H & S Comments:

See Over For Limitations and 5 x 5 Instructions

Photos:

ENGINEERING DESIGN CONSULTANTS

SITE REPORT		HEALTH & SAFETY
EDC File No: 48749	Date: 18/8/22	Are you entering site alone? Yes/No (If 'yes' call/text the office to advise when entering and leaving, ensure that you speak to someone or receive a response to your text.)
BC/EPA No:		Induction completed? Yes/No (If 'no' please give reason.....)
Time: 16:00	Weather: Rain	Signed in? Yes/No Signed out? Yes/No
Inspected by: JGB	Site Manager: Paul	Carry out 5 x 5 check? Yes/No (Please refer overleaf for instructions. Identify potential hazards and note below.)

Site Address: Waiotahi Drifts

Formation Inspection (Stage 6A)

All of the organic material across the stage has been removed, however some organics have been identified in Lots 110-111 and at Lots 118-119

Recommendation

Ensure that the organic material in Lots 110-111 & Lots 118-119 is removed before backfilling commences.

JB

19/8/22

H & S Comments: See Over For Limitations and 5 x 5 Instructions

No hazards were identified

Photos:

LIMITATIONS

UNDER THE CHARTERED ENGINEERS ACT (2002), PROFESSIONAL ENGINEERS CAN ONLY REVIEW WORK WITHIN THEIR AREAS OF EXPERTISE.

1. This observation is carried out for our client only and for the purpose stated.
   It should not be relied upon by any third party without our specific written agreement.

2. All weather-tightness and durability issues are excluded. Refer to Architect for all details specifically relating to B2 and E2 of the NZBC.

3. Engineering Design Consultants Ltd will be held blameless to all third parties.

4. All temporary works are the sole responsibility of the Builder / Contractor.

5. Report any discrepancies immediately to the Engineer.

6. Certification of registered building work is based on the understanding that this work is completed by licenced building practitioners holding a current practicing licence.

7. Engineering Design Consultants Ltd does not check set-out or levels. We recommend a licenced Professional Surveyor is engaged to provide this service.

8. By checking any work, Engineering Design Consultants Ltd does not verify that the work does not require a variation from Council. We recommend that this is confirmed in writing from Council Inspector/Engineer.

9. If in doubt, ASK the Engineer.

5 x 5 CHECK

1. STOP - engage brain before you act.
2. LOOK - identify any hazards.
3. ASSESS - what damage could those hazards cause.
4. MANAGE - implement controls, tell others.
5. SAFELY - complete the task.

ENGINEERING DESIGN CONSULTANTS LTD

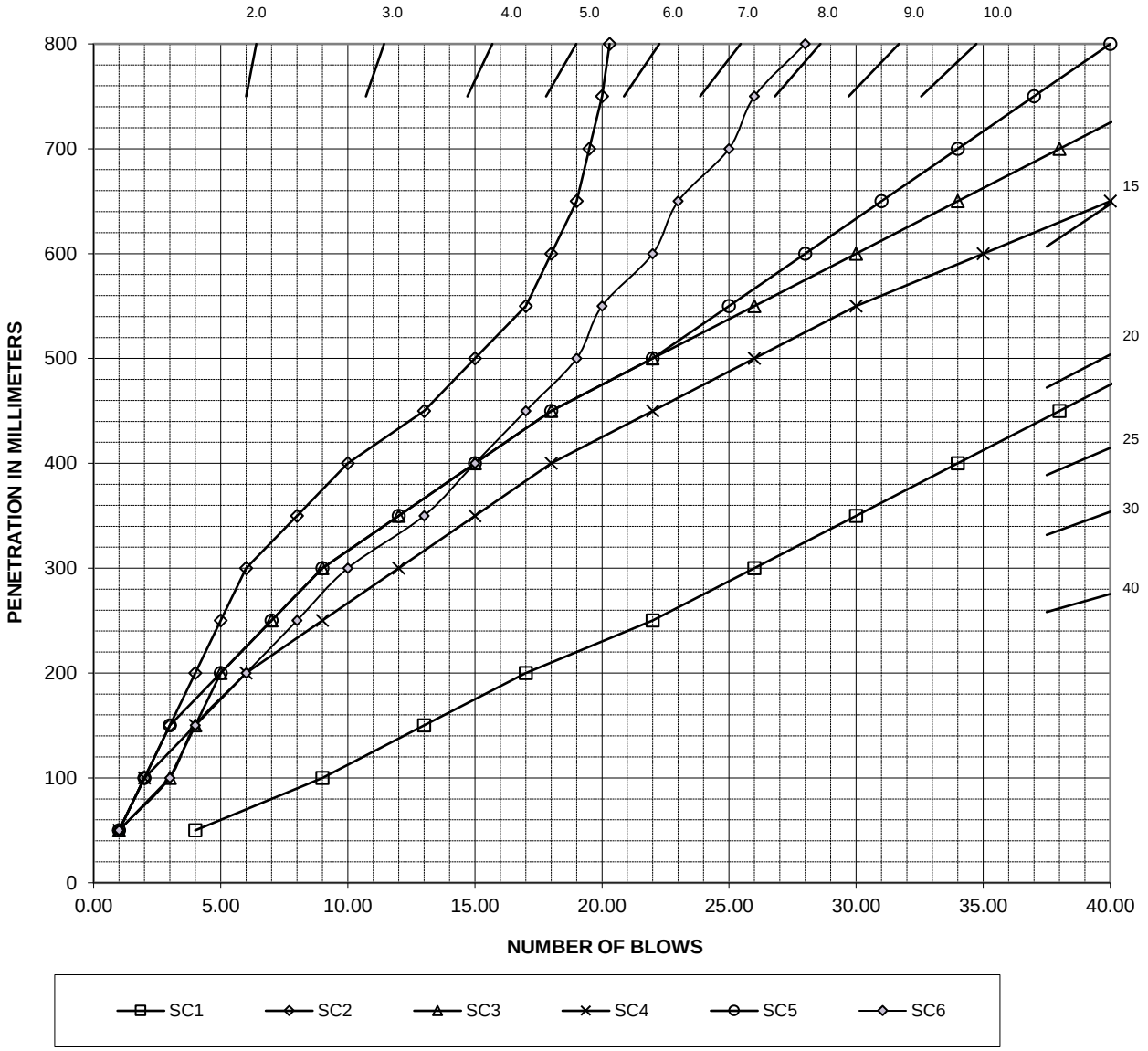
SCALA PENETROMETER TEST

Job No. 48749

Project Waiotahi Drifts Subdivision

Location Stage 6a Road Subgrade

CORRELATION OF SCALA PENETROMETER RESULTS WITH CBR



after Stockwell, M. J., 1977

Test No.	Estimated CBR
SC1	TBC
SC2	TBC
SC3	TBC
SC4	TBC
SC5	TBC
SC6	TBC

TESTED BY	JGB
DATE	01/09/22
CHECKED BY	DT
DATE	05/09/22

ENGINEERING DESIGN CONSULTANTS LTD

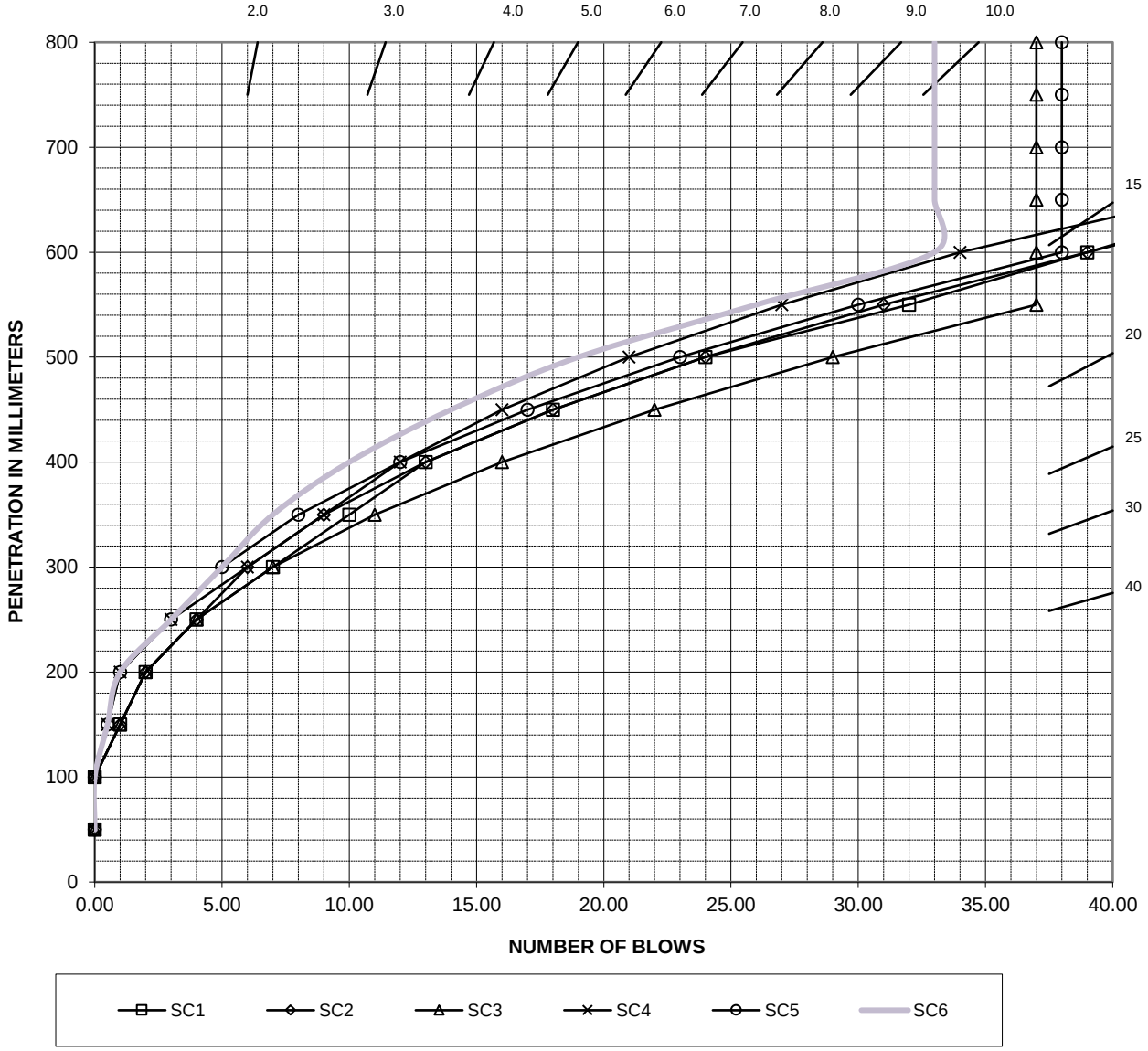
SCALA PENETROMETER TEST

Job No. 48749

Project Waiotahi Drifts Subdivision

Location Waiotahi Drifts

CORRELATION OF SCALA PENETROMETER RESULTS WITH CBR



after Stockwell, M. J., 1977

Test No.	Estimated CBR
SC1	10+
SC2	10+
SC3	10+
SC4	10+
SC5	10+
SC6	9.5

TESTED BY JGB

DATE 1/09/22

CHECKED BY

DATE

APPENDIX D

GEOLAB BENKELMAN BEAM RESULTS

Tauranga Laboratory

Geolab Limited

25/38 Ashley Place,
Papamoa NZ 3118

Phone:027 475 4011

Benkelman Beam Deflection

Report No: BB:TAUR22S-03003

Issue No: 2

This report replaces all previous issues of report no 'BB:TAUR22S-03003'.

Client:	Delta Contracting Limited 109 Gow Road PO Box 311 Opotiki
Principal:	Paul Blennerhassett
Project No.:	773-TAUR00101
Project Name:	Opotiki (EDC48749)
Lot No.:	**TRN:**

Approved Signatory: Eric Paton
(Director-Testing)
IANZ Accredited Laboratory Number:1352
Date of Issue: 22/09/2022

Site Details

Sample ID:	TAUR22S-03003	**Date Tested:**	20/09/2022
Source:		**Time Tested:**	10:00
Material:	GAP 65	**Tested By:**	Kim Vitali
Project Location:	Waiotahe Downs, Waiotahe Drifts Boulevard		
Test Location:	Waiotahe Drifts Boulevard CH 0 starts from the Asphalt		
Layer:	Subbase	**Offset From:**	Centreline

Benkelman Beam Deflection Test Results

Disp. (m)	Offset (m)	Lane	Deflection (mm)
10	2.4	LHS	0.96
30	0.4	LHS	0.74
50	2.4	LHS	1.12
70	0.4	LHS	0.86
90	2.4	LHS	0.96
110	0.4	LHS	1.24
100	0.4	RHS	1.16
80	2.4	RHS	1.26
60	0.4	RHS	0.64
40	2.4	RHS	1.06
20	0.4	RHS	0.68

Comments

ETAM22W00784

Tauranga Laboratory

Geolab Limited

25/38 Ashley Place,
Papamoa NZ 3118

Phone:027 475 4011

Benkelman Beam Deflection

Report No: BB:TAUR22S-03682
Issue No: 1

Client:	Delta Contracting Limited 109 Gow Road PO Box 311 Opotiki
Principal:	Paul Blennerhassett
Project No.:	773-TAUR00101
Project Name:	Opotiki (EDC48749)
Lot No.:	**TRN:**

Approved Signatory: Eric Paton
(Director-Testing)
IANZ Accredited Laboratory Number:1352
Date of Issue: 28/10/2022

Site Details

Sample ID:	TAUR22S-03682	**Date Tested:**	26/10/2022
Source:		**Time Tested:**	
Material:	M4	**Tested By:**	Kim Vitali
Project Location:	Waiotahe Downs, Waiotahe Drifts Boulevard		
Test Location:	Waiotahe Drifts Boulevard		
Layer:	Basecourse	**Offset From:**	Centreline

General Test Information

TNZ T/1

Axle Load (tonne): 8.20

Benkelman Beam Deflection Test Results

Disp. (m)	Offset (m)	Lane	Deflection (mm)
130	3	LHS	0.72
150	1	LHS	0.48
170	3	LHS	0.46
190	1	LHS	0.38
210	3	LHS	0.46
230	1	LHS	0.40
220	3	RHS	0.54
200	1	RHS	0.46
180	3	RHS	0.50
160	1	RHS	0.42
140	3	RHS	0.50

Comments

TAUR22W00933

Tauranga Laboratory

Geolab Limited

25/38 Ashley Place,
Papamoa NZ 3118

Phone:027 475 4011

Benkelman Beam Deflection

Report No: BB:TAUR22S-03004
Issue No: 1

Client:	Delta Contracting Limited 109 Gow Road PO Box 311 Opotiki
Principal:	Paul Blennerhassett
Project No.:	773-TAUR00101
Project Name:	Opotiki (EDC48749)
Lot No.:	**TRN:**

Approved Signatory: Eric Paton
(Director-Testing)
IANZ Accredited Laboratory Number:1352
Date of Issue: 22/09/2022

Site Details

Sample ID:	TAUR22S-03004	**Date Tested:**	20/09/2022
Source:		**Time Tested:**	11:05
Material:	GAP 65	**Tested By:**	Kim Vitali
Project Location:	Waiotahe Downs, Waiotahe Drifts Boulevard		
Test Location:	Bakahikura Key		
Layer:	Subbase	**Offset From:**	Centreline

Benkelman Beam Deflection Test Results

Disp. (m)	Offset (m)	Lane	Deflection (mm)
5	2.4	LHS	1.68
25	0.4	LHS	1.40
45	2.4	LHS	0.84
65	0.4	LHS	1.28
75	2	Culdesac	1.66
85	4	Culdesac	1.50
95	2	Culdesac	2.66
105	4	Culdesac	2.28
55	2.4	RHS	1.06
35	0.4	RHS	1.08
15	2.4	RHS	0.74

Comments

TAUR22W00784
The offsets for the Culdesac are from the kerbline

Tauranga Laboratory

Geolab Limited

25/38 Ashley Place,
Papamoa NZ 3118

Phone:027 475 4011

Benkelman Beam Deflection

Report No: BB:TAUR22S-03681

Issue No: 2

This report replaces all previous issues of report no 'BB:TAUR22S-03681'.

Client:	Delta Contracting Limited 109 Gow Road PO Box 311 Opotiki
Principal:	Paul Blennerhassett
Project No.:	773-TAUR00101
Project Name:	Opotiki (EDC48749)
Lot No.:	**TRN:**

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation.
{This document may not be altered or reproduced except in full. This report relates only to the positions tested.}

Approved Signatory: Eric Paton
(Director-Testing)
IANZ Accredited Laboratory Number:1352
Date of Issue: 22/11/2022

Site Details

Sample ID:	TAUR22S-03681	**Date Tested:**	26/10/2022
Source:		**Time Tested:**	15:00
Material:	M4	**Tested By:**	Kim Vitali
Project Location:	Waiotahe Downs, Waiotahe Drifts Boulevard		
Test Location:	Pakihikura Key		
Layer:	Basecourse	**Offset From:**	LHS Kerbline for Culdesac and Centreline

General Test Information

TNZ T/1

Axle Load (tonne): 8.20

Benkelman Beam Deflection Test Results

Disp. (m)	Offset (m)	Lane	Deflection (mm)
20	3	LHS	1.06
40	1	LHS	0.44
60	3	LHS	0.54
80	1	LHS	0.56
90	1.5	Culdesac	0.72
100	3.0	Culdesac	0.54
110	2.0	Culdesac	0.54
120	4.0	Culdesac	0.82
130	2.0	Culdesac	0.52
70	1	RHS	0.36
50	3	RHS	0.54
30	1	RHS	0.40

Comments

TAUR22W00933

APPENDIX E

IMPORTED HARDFILL GRADING CERTIFICATES

TNZ M/4 : 2006 AP40
TEST REPORT

Project :	**Production Testing**
Location :	**Motu River**
Client :	**Gaddum Construction Limited**
Contractor :	**N/a**
Sampled by :	**Guy Gaddum**
Date sampled :	**14/12/21**
Sampling method :	**N/a**
Sample description :	**AP40**
Sample condition :	**Moist**

Project No :	**2-89820.00**
Lab Ref No :	**RT3689**
Client Ref No :	

Particle Size Distribution

Sieve Size (mm)	Percentage Passing Sample	Limits
63.0	-	100 - 100
37.5	100	100 - 100
19.0	81	66 - 81
9.5	51	43 - 57
4.75	33	28 - 43
2.36	25	19 - 33
1.18	18	12 - 25
0.600	13	7 - 19
0.300	9	3 - 14
0.150	6	0 - 10
0.075	4	0 - 7

% passing the finest sieve is obtained by difference

Grading Shape Control

Fraction (mm)	% Within Fraction Sample	Limits
19.0 - 4.75	48	28 - 48
9.5 - 2.36	26	14 - 34
4.75 - 1.18	15	7 - 27
2.36 - 0.600	12	6 - 22
1.18 - 0.300	9	5 - 19
0.600 - 0.150	7	2 - 14

Crushing Resistance

% Fines @ Spec. Load	**Not Stated**	%
Specification	-	%
Crushing Resistance	-	kN
Nom Aggregate Size	-	mm
Specified Load	-	kN

Broken Faces Content of Aggregate

Fraction (mm)	Percentage by Weight Sample	Lower Limit
37.5 - 19.0	87	70
19.0 - 9.5	73	70
9.5 - 4.75	72	70

Plasticity Index

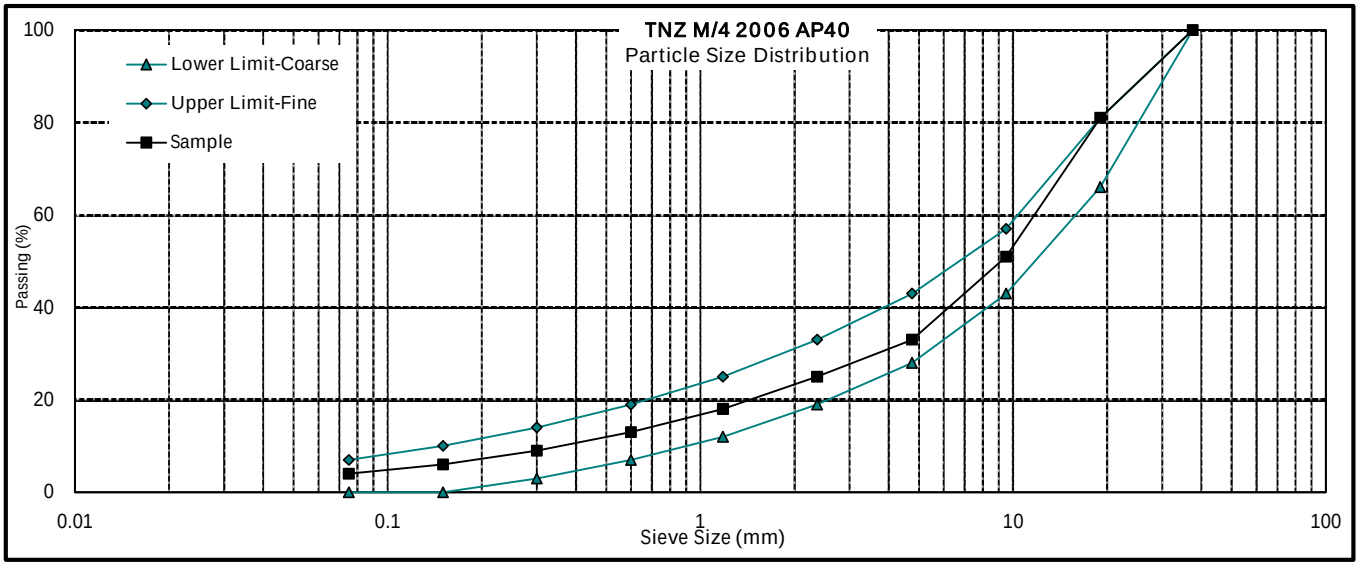
Sample PI	**Not Tested**
Specification	<= 5

Clay Index

Sample CI	**Not Tested**
Specification	<= 3

Sand Equivalent (Washed, Mechanical Shaking)

Sample SE	-
Specified	>= 40



Test Methods

Particle Size Distribution	NZS 4407 : 2015 : Test 3.8.1
Broken Faces Content of Aggregate	NZS 4407 : 2015 : Test 3.14

Date tested : 16/12/21

Date reported : 17/12/21

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.

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All information supplied by Client

IANZ Approved Signatory

Designation : *Laboratory Manager*

Date : 21/12/21

ACCREDITED IANZ TESTING LABORATORY

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

WSP
Rotorua (Vaughan Road)
Quality Management Systems Certified to ISO 9001

35 Vaughan Road
35 Vaughan Road, 3010, Rotorua, New Zealand

Telephone +64 7 343 1440
Website www.wsp.com/nz

GAP65
TEST REPORT

Project :	**Production Testing**
Location :	**Motu River**
Client :	**Gaddum Construction Limited**
Contractor :	**N/a**
Sampled by :	**Guy Gaddum**
Date sampled :	**7/12/21**
Sampling method :	**Not Stated**
Sample description :	**GAP 65**
Sample condition :	**Moist**
Source :	**Motu River**

Project No :	**2-89820.00**
Lab Ref No :	**RT3668**
Client Ref No :	**Motu River**

Particle Size Distribution

Sieve Size (mm)	Percentage Passing		
	Sample	Lower Limit - Coarse	Upper Limit - Fine
63.0	**100**	100	100
37.5	**86**	-	-
19.0	**60**	40	65
9.5	**45**	-	-
4.75	**32**	-	-
2.36	**21**	-	-
1.18	**13**	-	-
0.600	**8**	-	-
0.300	**5**	0	10
0.150	**4**	-	-
0.075	**3**	-	-

% passing the finest sieve is obtained by difference

Crushing Resistance

% Fines @ Spec. Load	**Not Tested**	%
Specification	-	%
Crushing Resistance	-	kN
Nom Aggregate Size	-	mm
Specified Load	-	kN

Broken Faces Content of Aggregate

Fraction (mm)	Percentage by Weight	
	Sample	Lower Limit
65.0 - 37.5	**99**	-
37.5 - 19.0	**85**	-
19.0 - 9.5	**89**	-
9.5 - 4.75	**98**	-

Plasticity Index

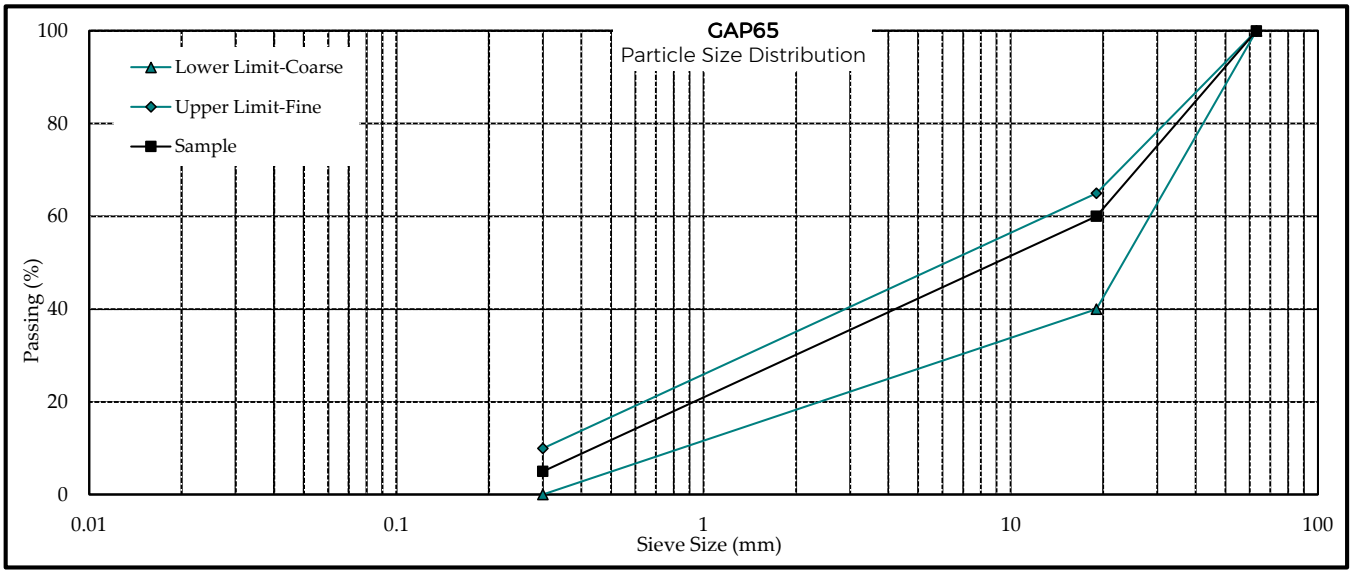
Sample CPL	**Not Tested**
Sample PI	-

Clay Index

Sample CI	**Not Tested**
Specification	-

Sand Equivalent (Washed, Mechanical Shaking)

Sample SE	**Not Tested**
Specified	>= 25



Test Methods

Plasticity Index	NZS 4407 : 2015 : Test 3.4	Crushing Resistance	NZS 4407 : 2015 : Test 3.10
Sand Equivalent	NZS 4407 : 2015 : Test 3.6	Broken Faces Content of Aggregate	NZS 4407 : 2015 : Test 3.14
Particle Size Distribution	NZS 4407 : 2015 : Test 3.8.1	Clay Index	NZS 4407 : 2015 : Test 3.5
		Testing specificatons from Waikato Local Authority RITS (2018)	

Date tested : 9/12/21
Date reported : 9/12/21

Sampling is not covered by IANZ Accreditation. Results apply only to sample tested.
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APPENDIX F

CONE PENETRATION TEST RESULTS & LIQUEFACTION ANALYSIS

Engineering Design Consultants Ltd.
www.edc.co.nz

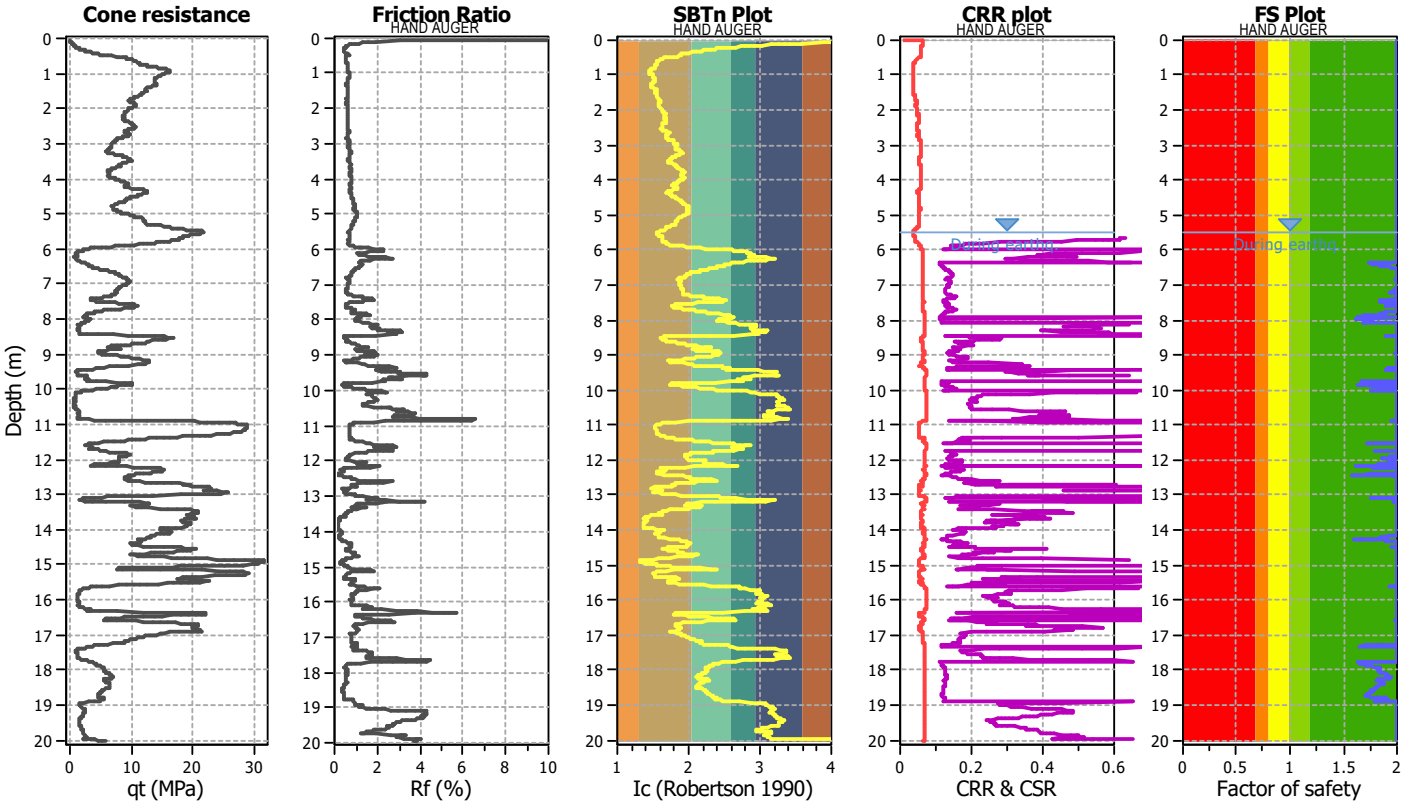
LIQUEFACTION ANALYSIS REPORT

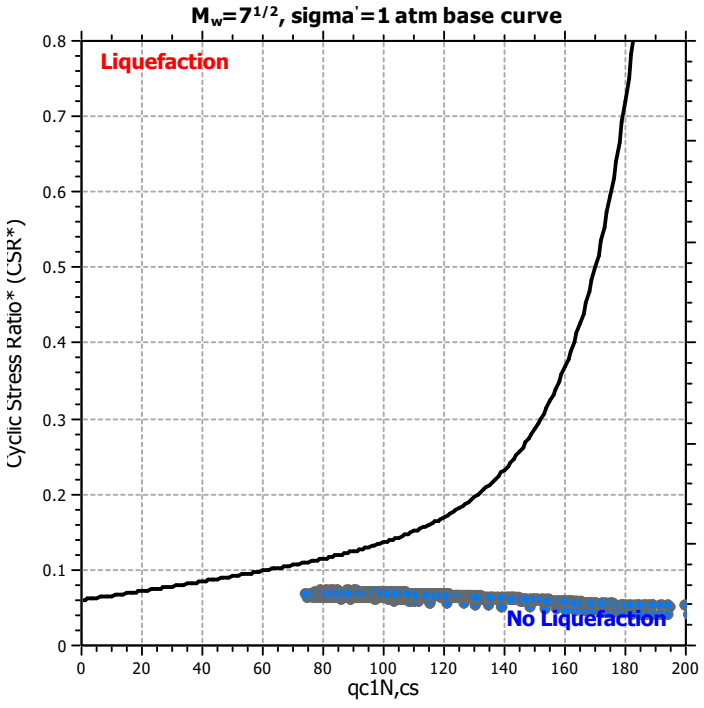
Project title : Liquefaction Analysis **Location : Waiotahe Drifts - Stage 5b & 6a**

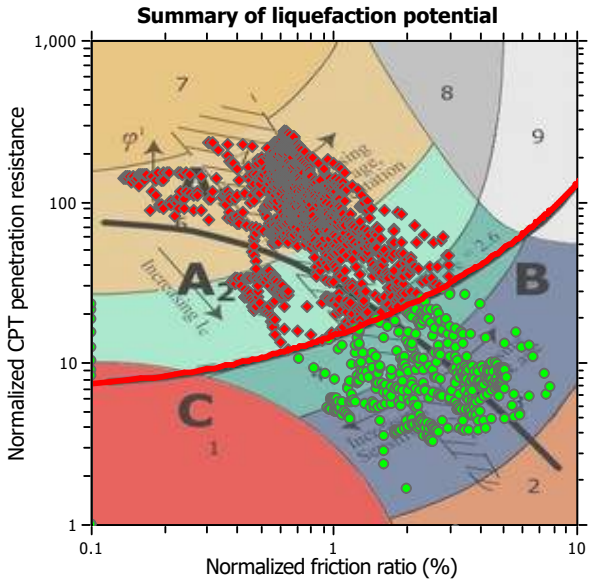
CPT file : CPT03

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.10	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.11	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

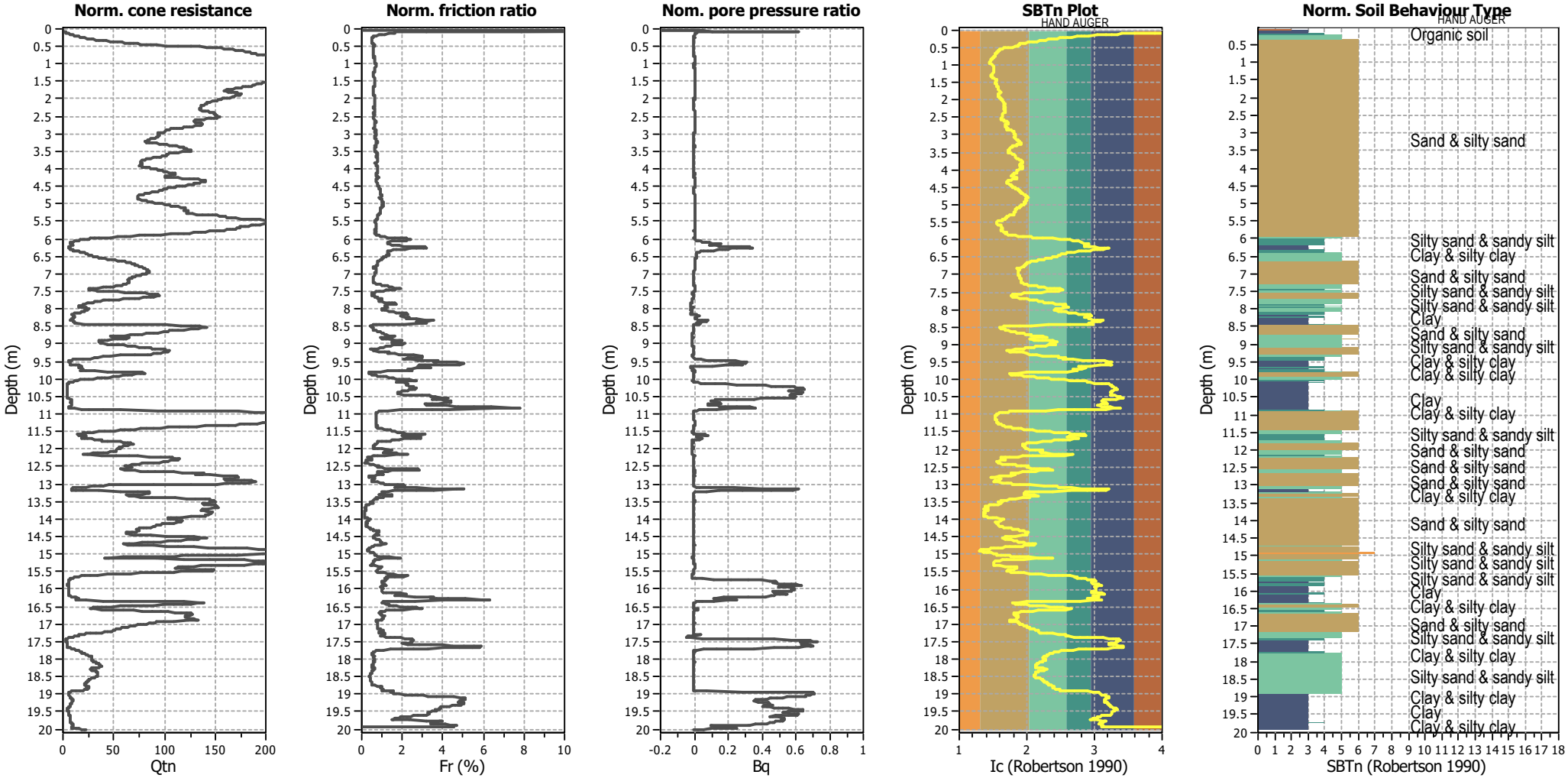






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



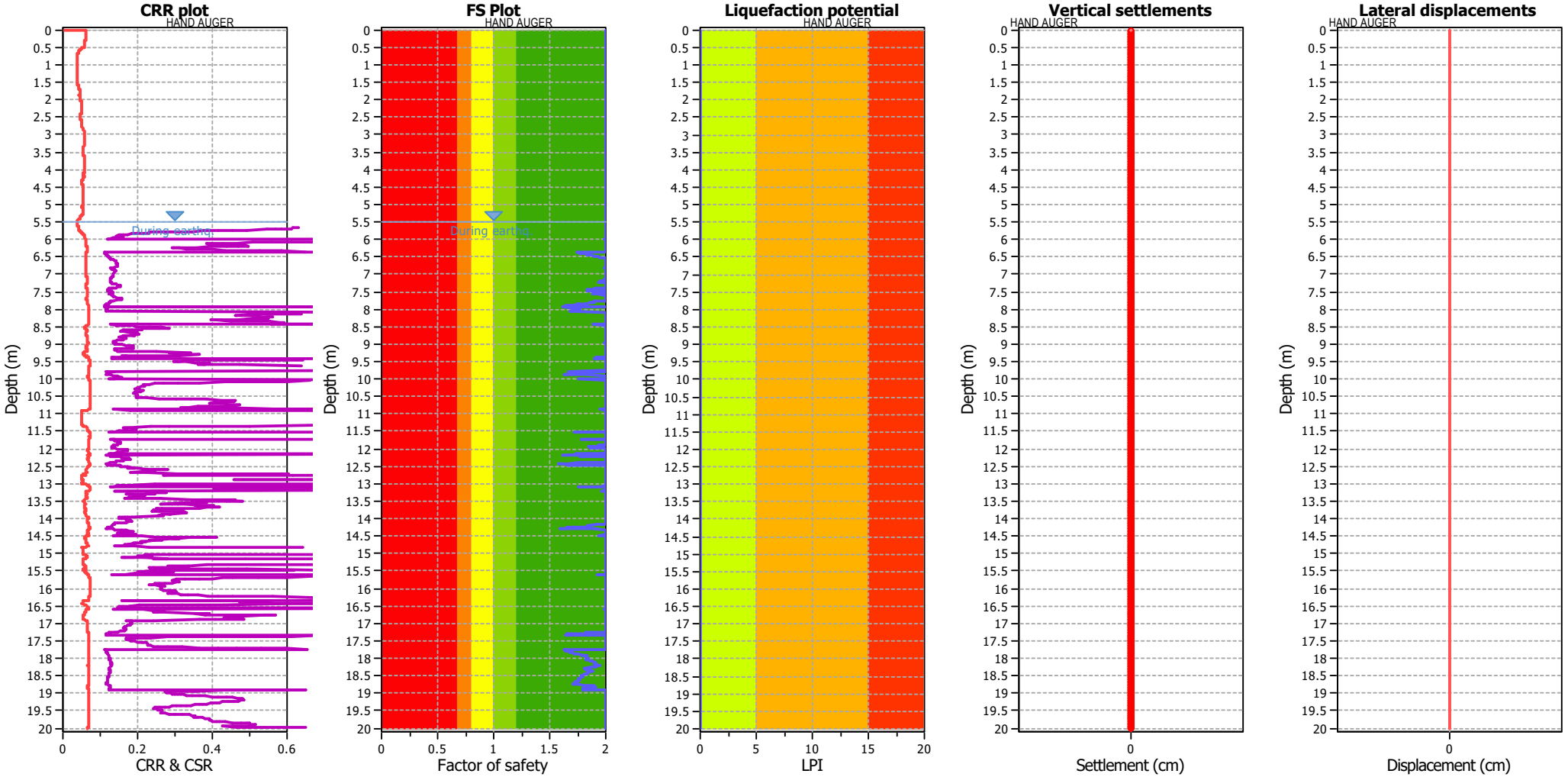
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.11	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.11	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	N/A

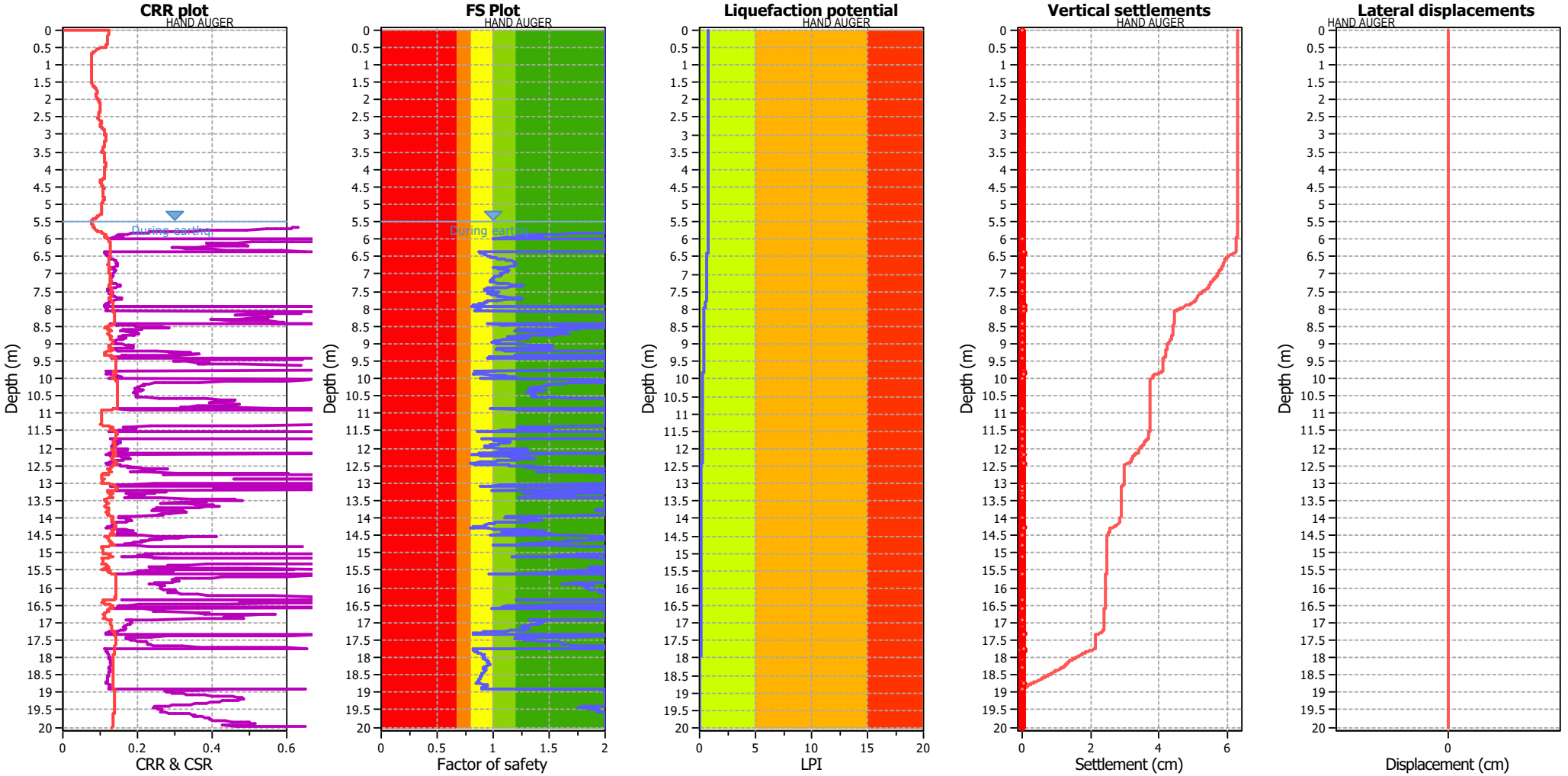
F.S. color scheme

- 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.):	5.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.22	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	N/A

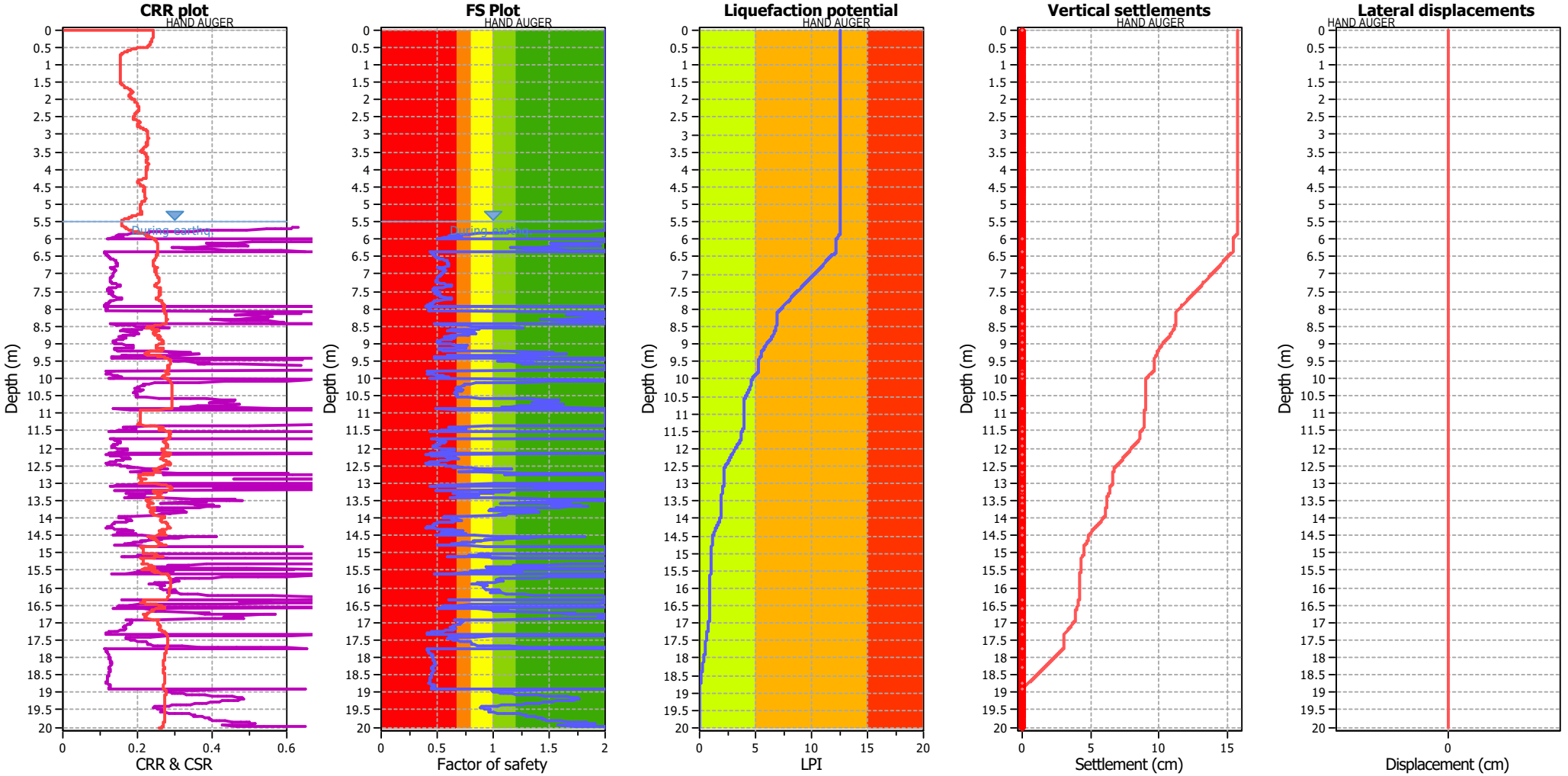
F.S. color scheme

- 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.):	5.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 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

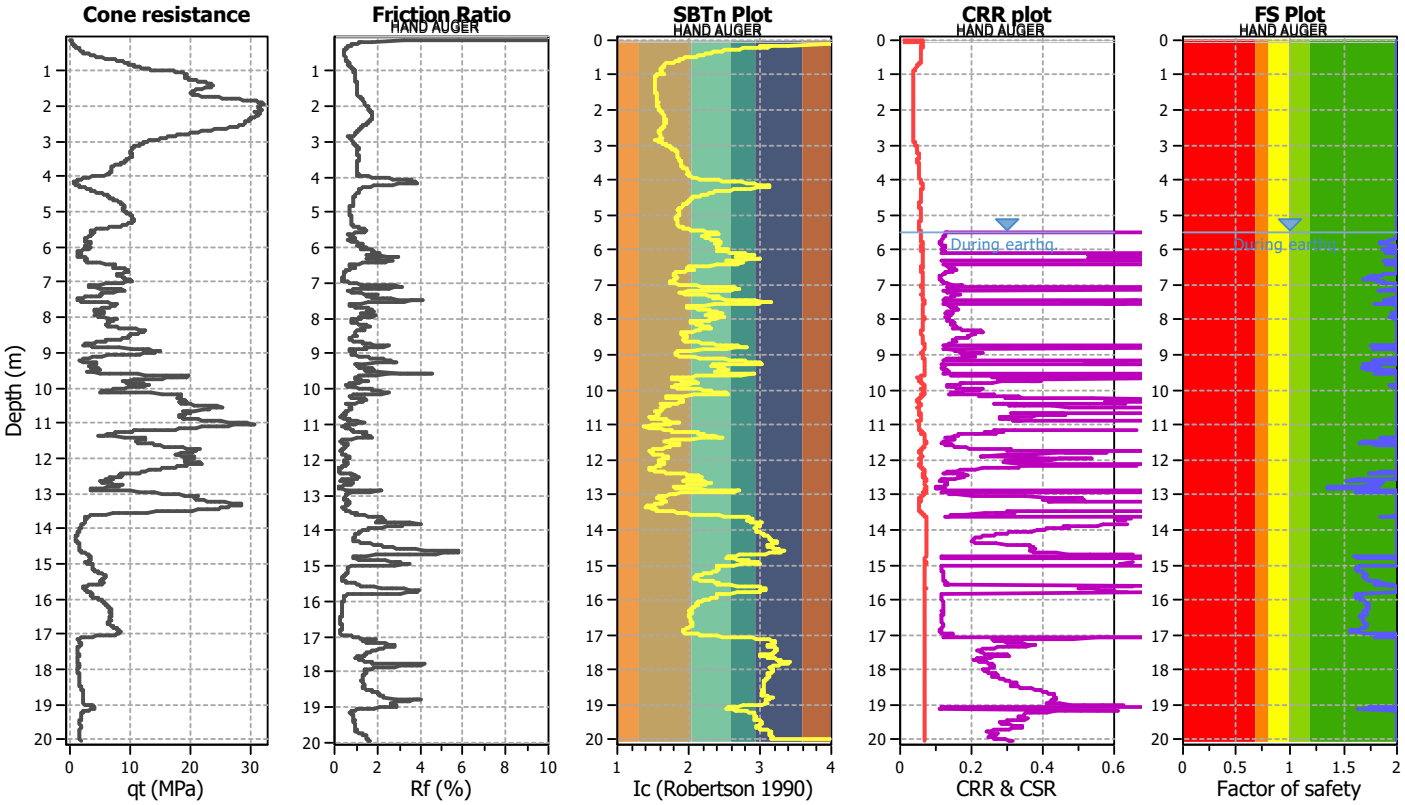
LIQUEFACTION ANALYSIS REPORT

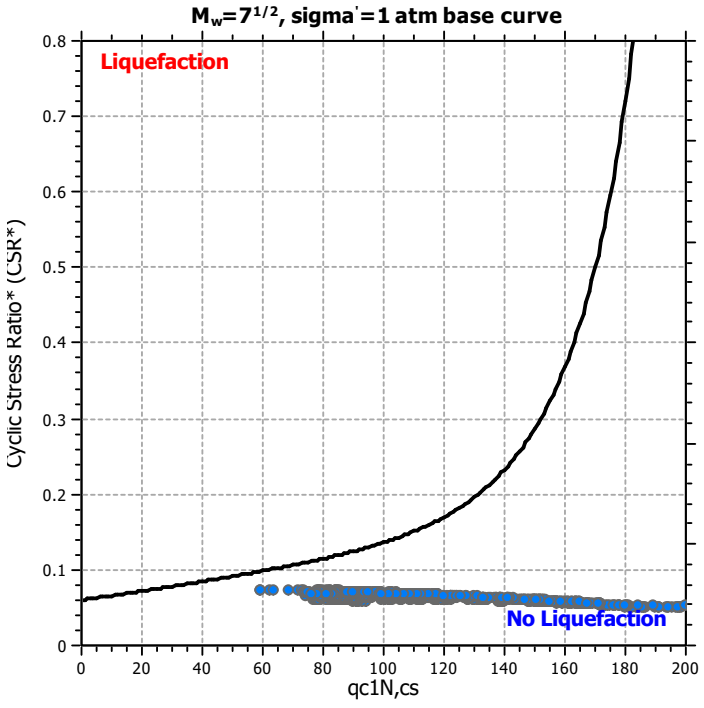
Project title : Liquefaction Analysis **Location : Waiotahe Drifts - Stage 5b & 6a**

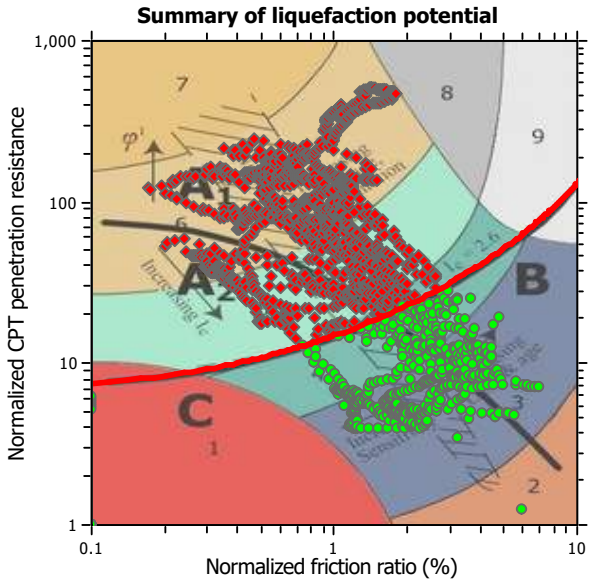
CPT file : CPT201

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.10	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.11	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

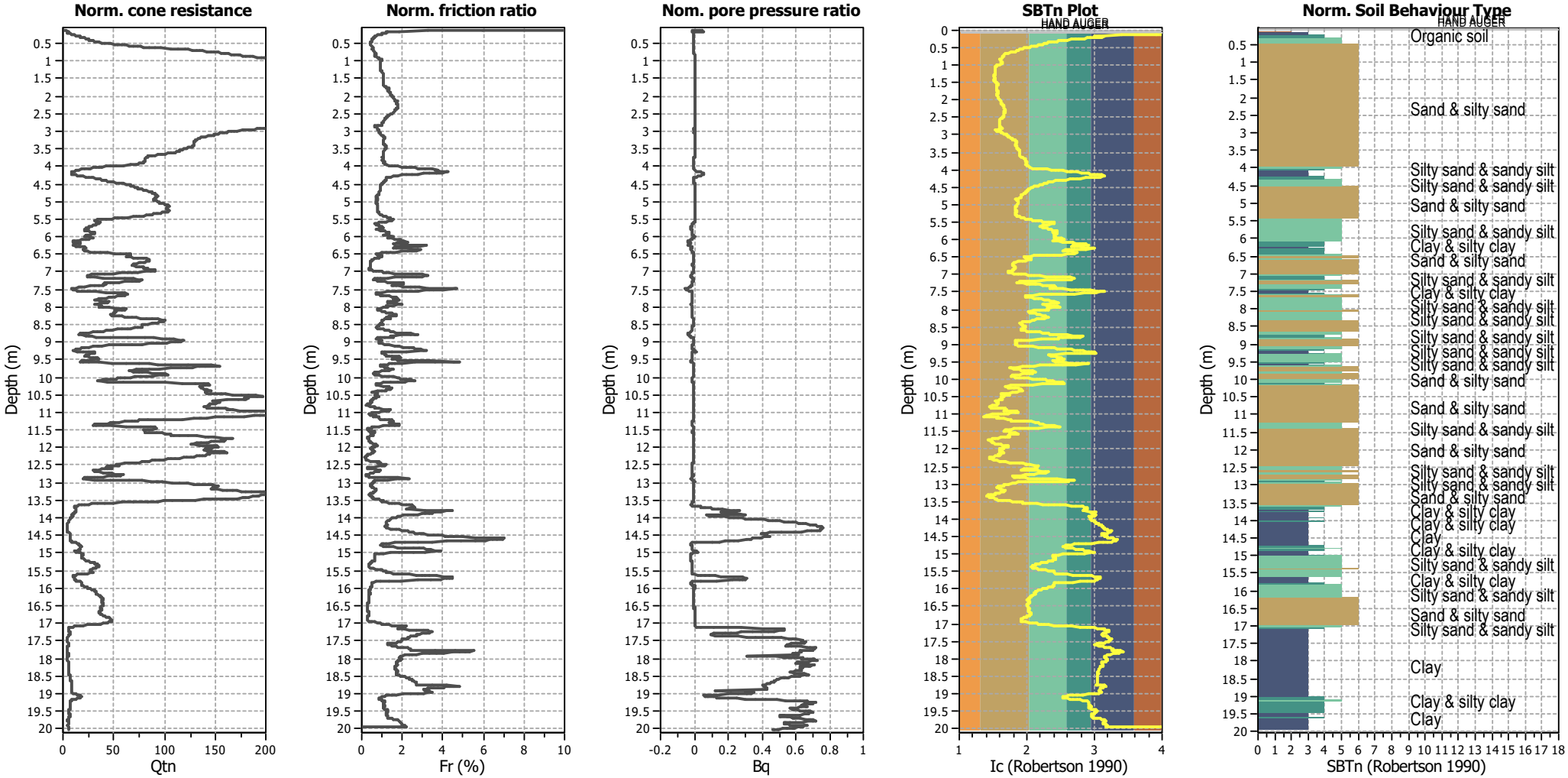






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



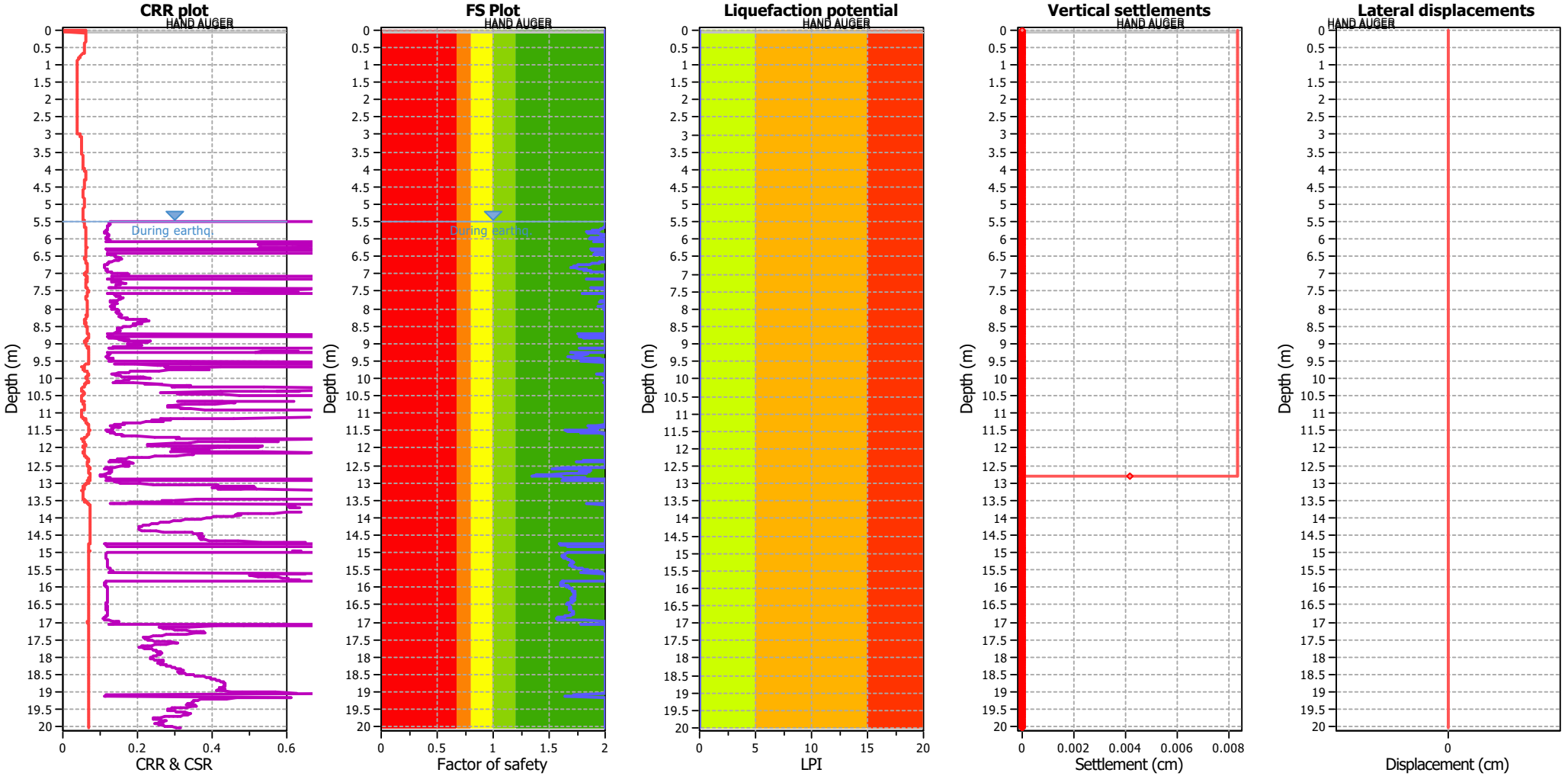
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.11	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.11	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	N/A

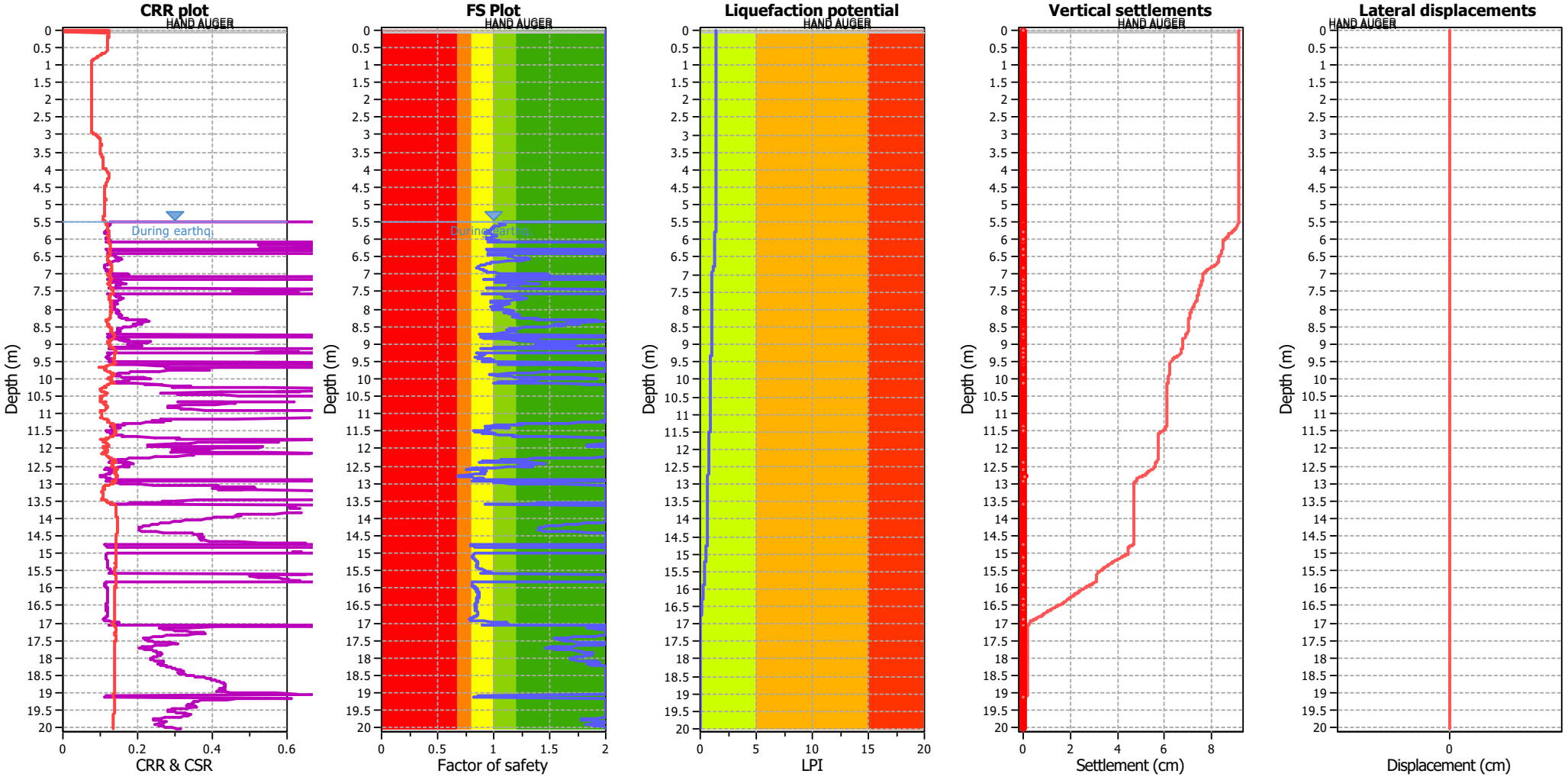
F.S. color scheme

- 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.):	5.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.22	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	N/A

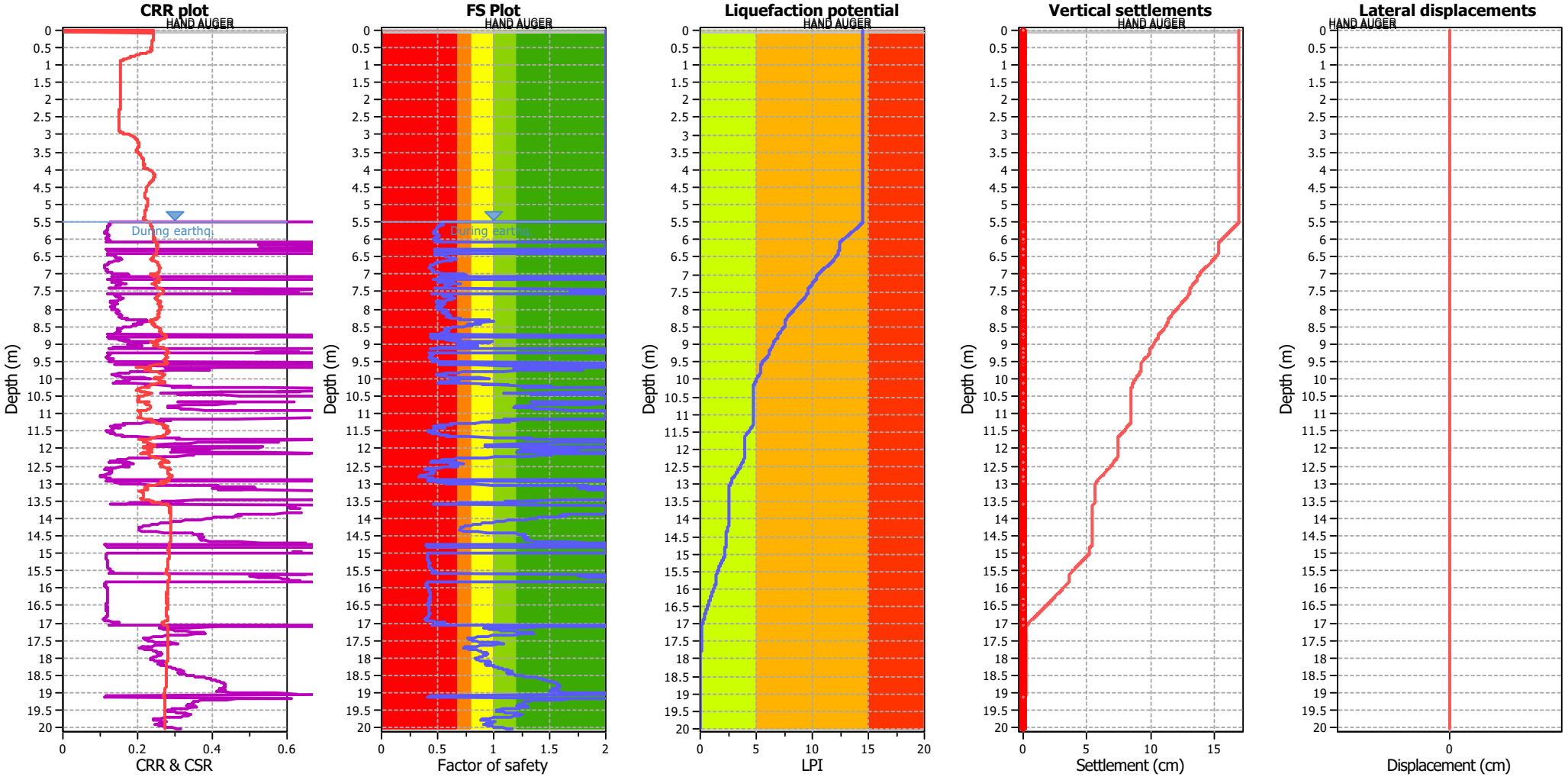
F.S. color scheme

- 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.):	5.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 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

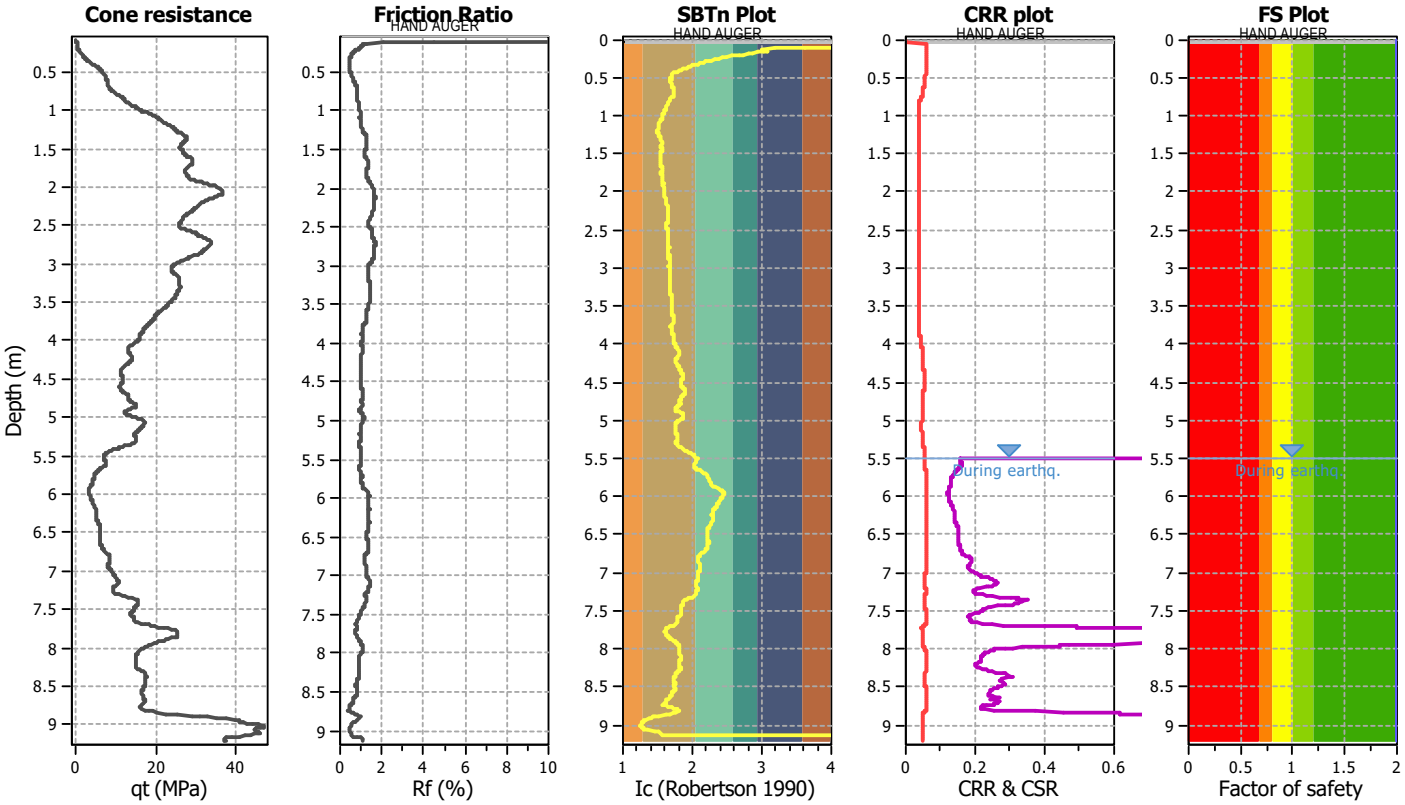
LIQUEFACTION ANALYSIS REPORT

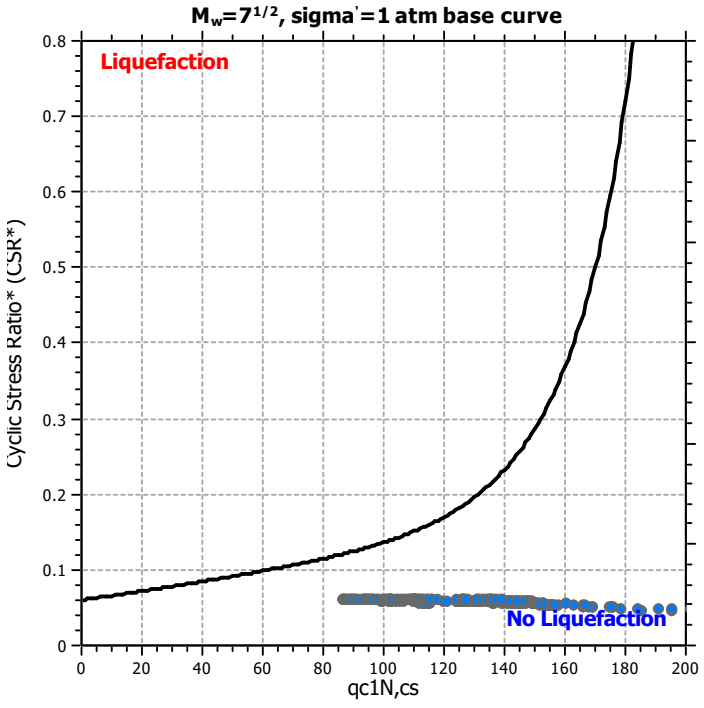
Project title : Liquefaction Analysis **Location : Waiotahe Drifts - Stage 5b & 6a**

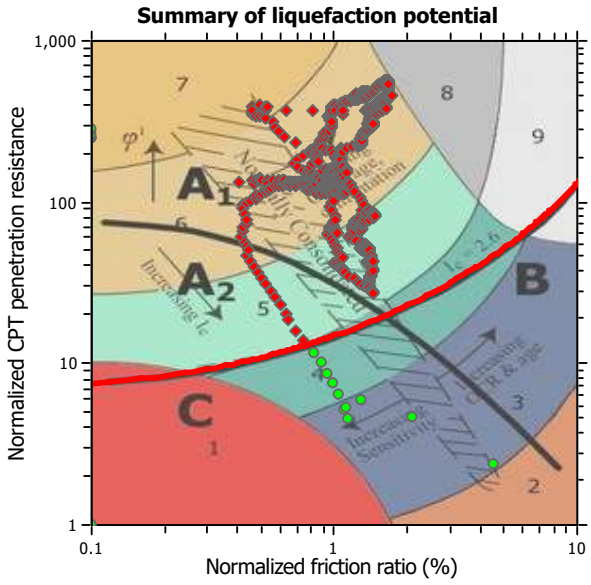
CPT file : CPT202

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	5.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.10	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.11	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

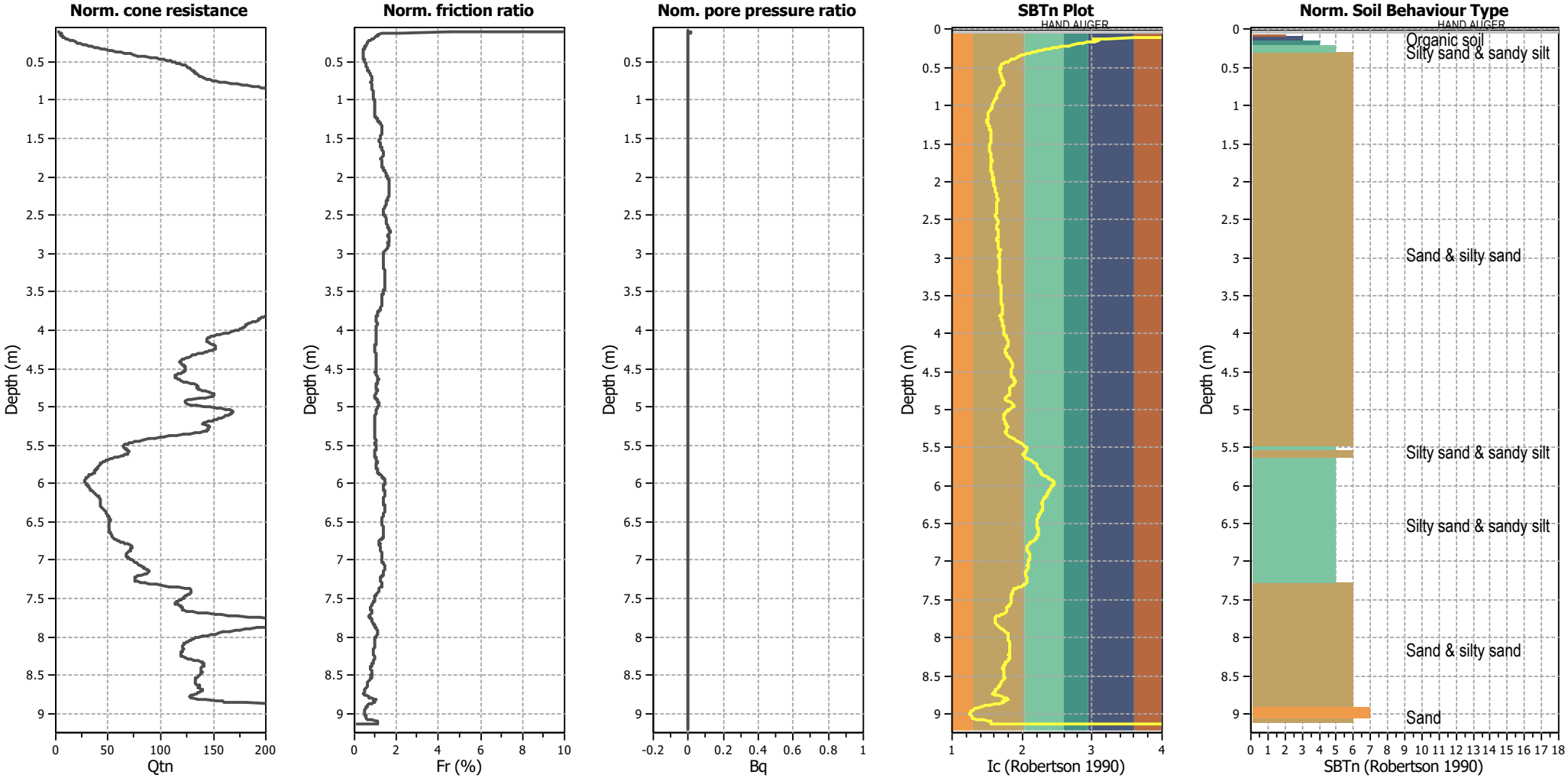






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



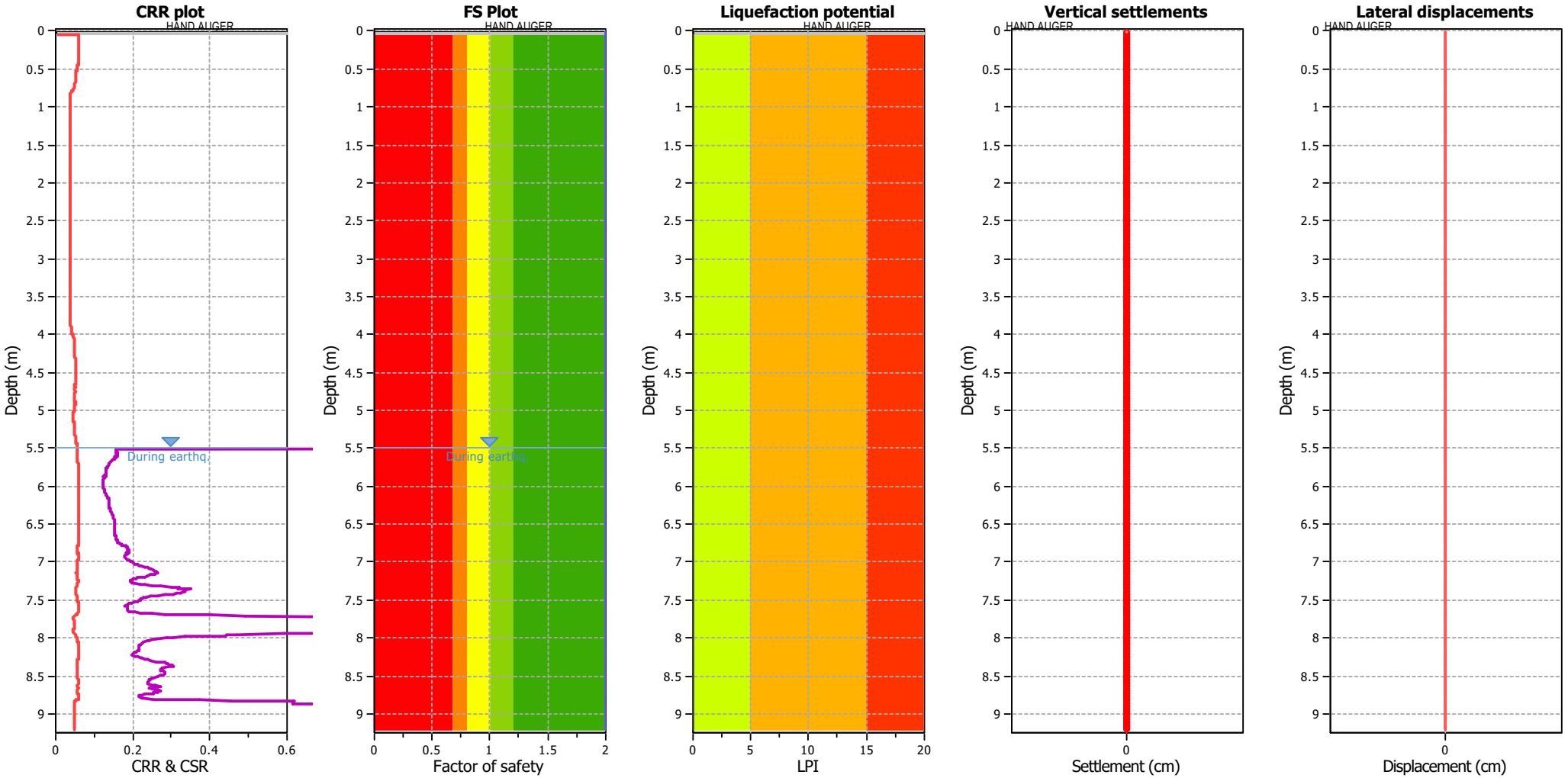
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.11	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.11	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 m	Fill height:	N/A	Limit depth:	N/A

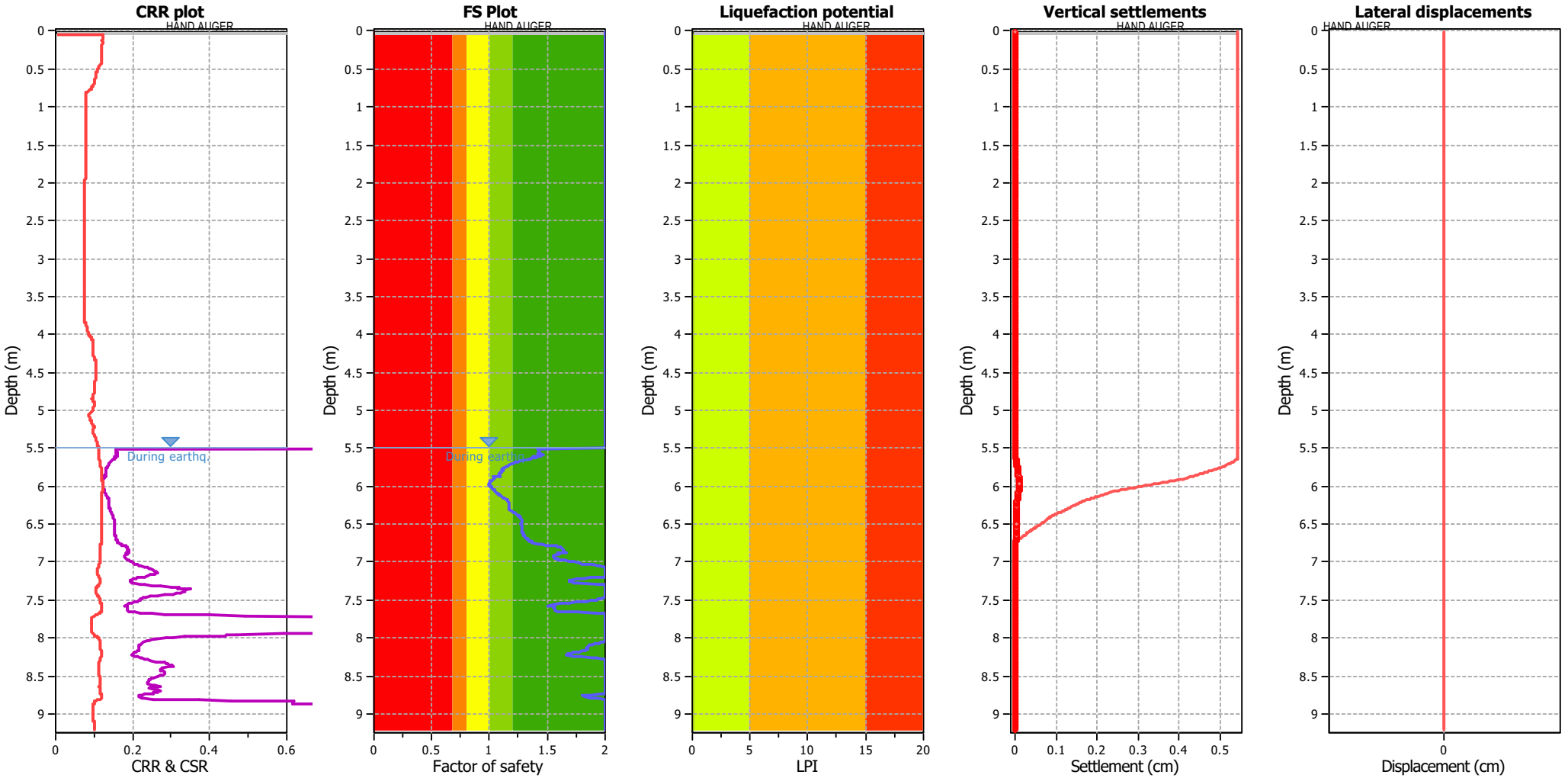
F.S. color scheme

- 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.):	5.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.22	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 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
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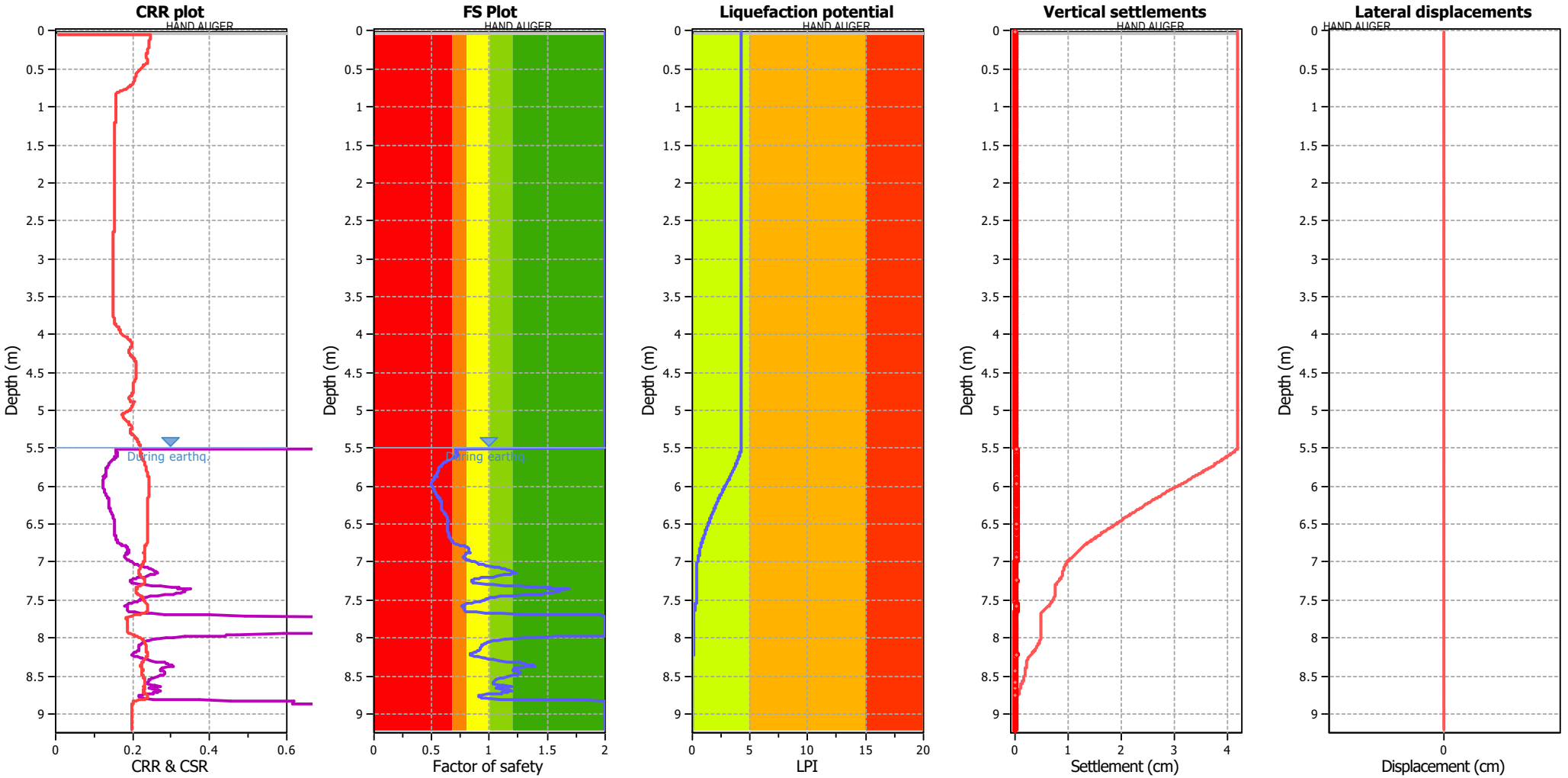
LPI color scheme

- 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.):	5.50 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.00 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

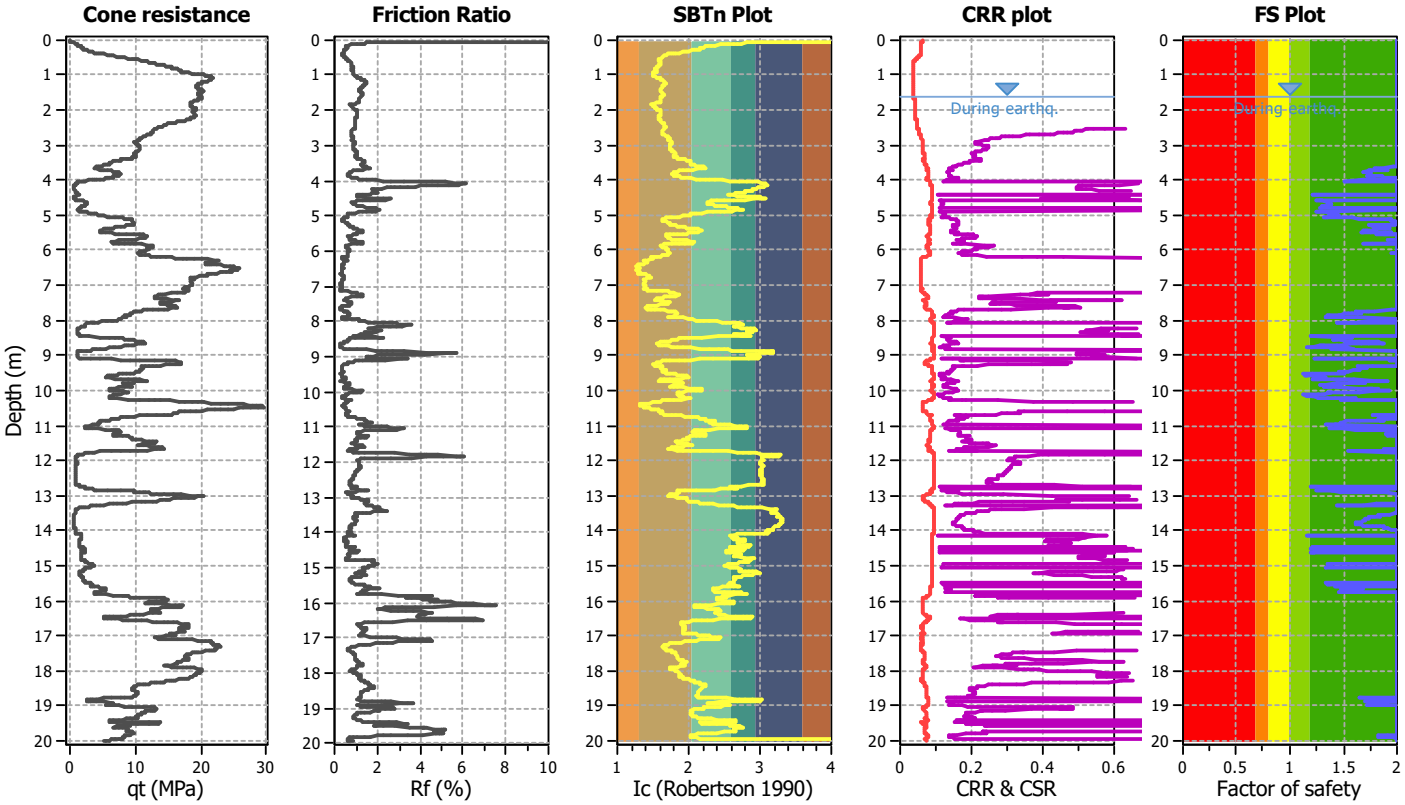
LIQUEFACTION ANALYSIS REPORT

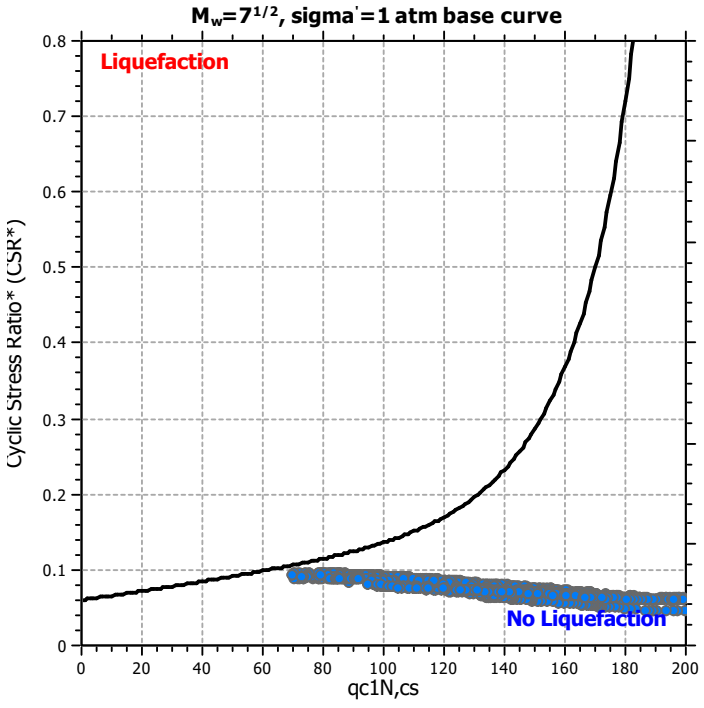
Project title : Liquefaction Analysis **Location : Waiotahe Drifts - Stage 5b & 6a**

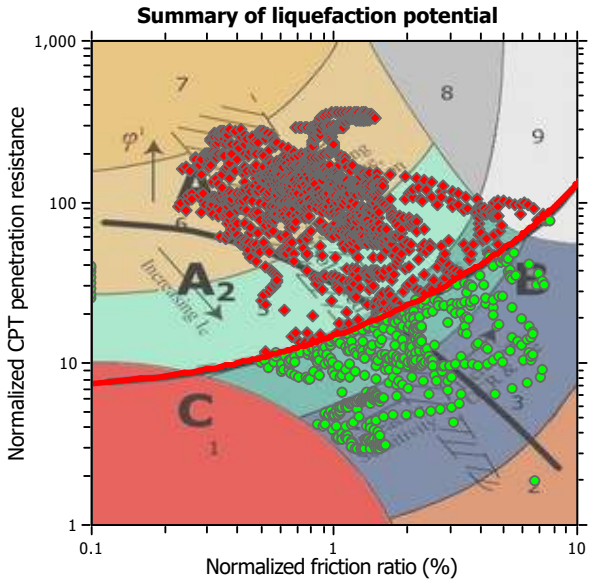
CPT file : CPT_301

Input parameters and analysis data

Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.10 m	Use fill:	No	Clay like behavior applied:	Sand & Clay
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.60 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	6.10	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.11	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

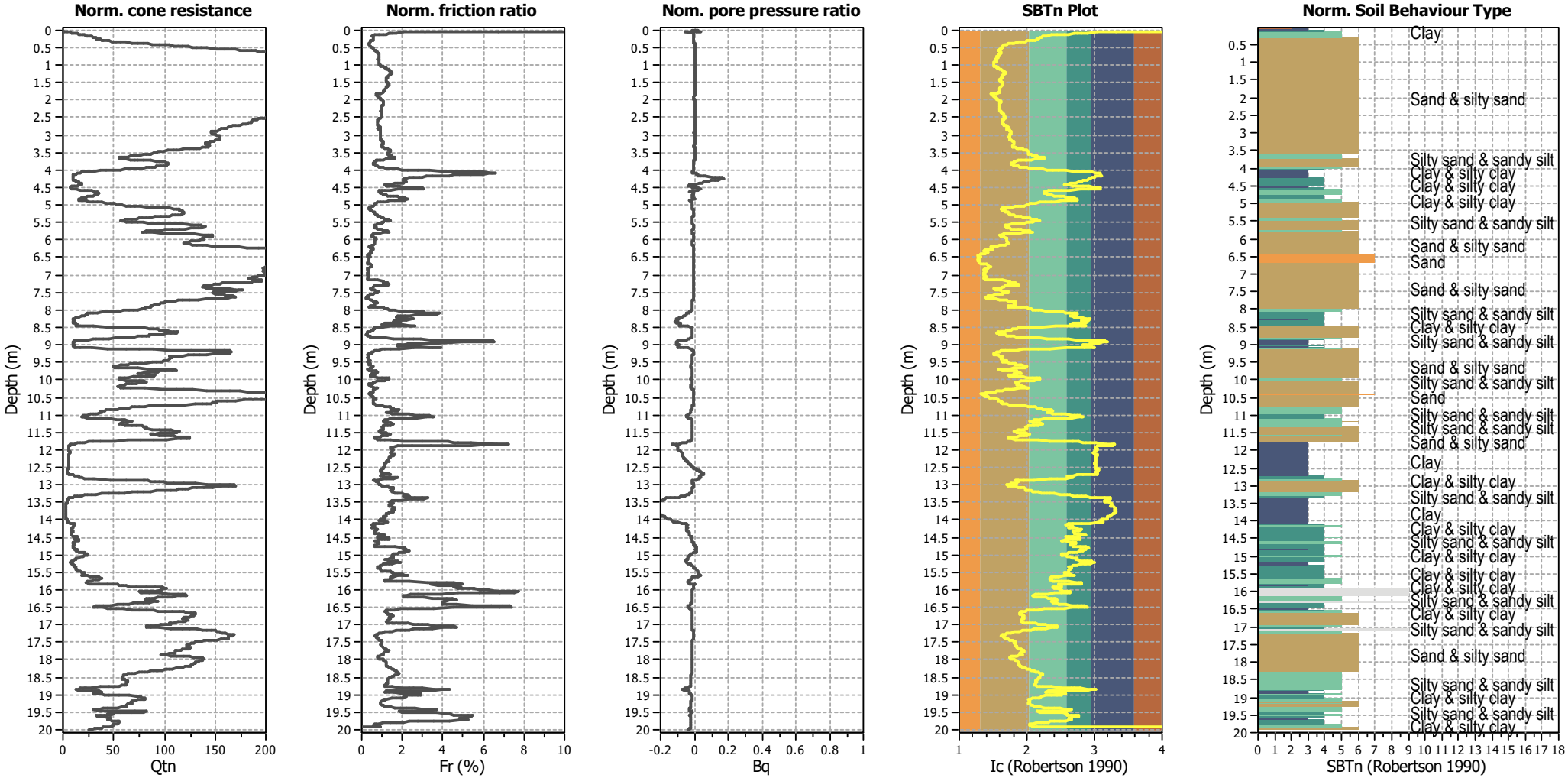






Zone A_1: Cyclic liquefaction likely depending on size and duration of cyclic loading
Zone A_2: Cyclic liquefaction and strength loss likely depending on loading and ground geometry
Zone B: Liquefaction and post-earthquake strength loss unlikely, check cyclic softening
Zone C: Cyclic liquefaction and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

CPT basic interpretation plots (normalized)



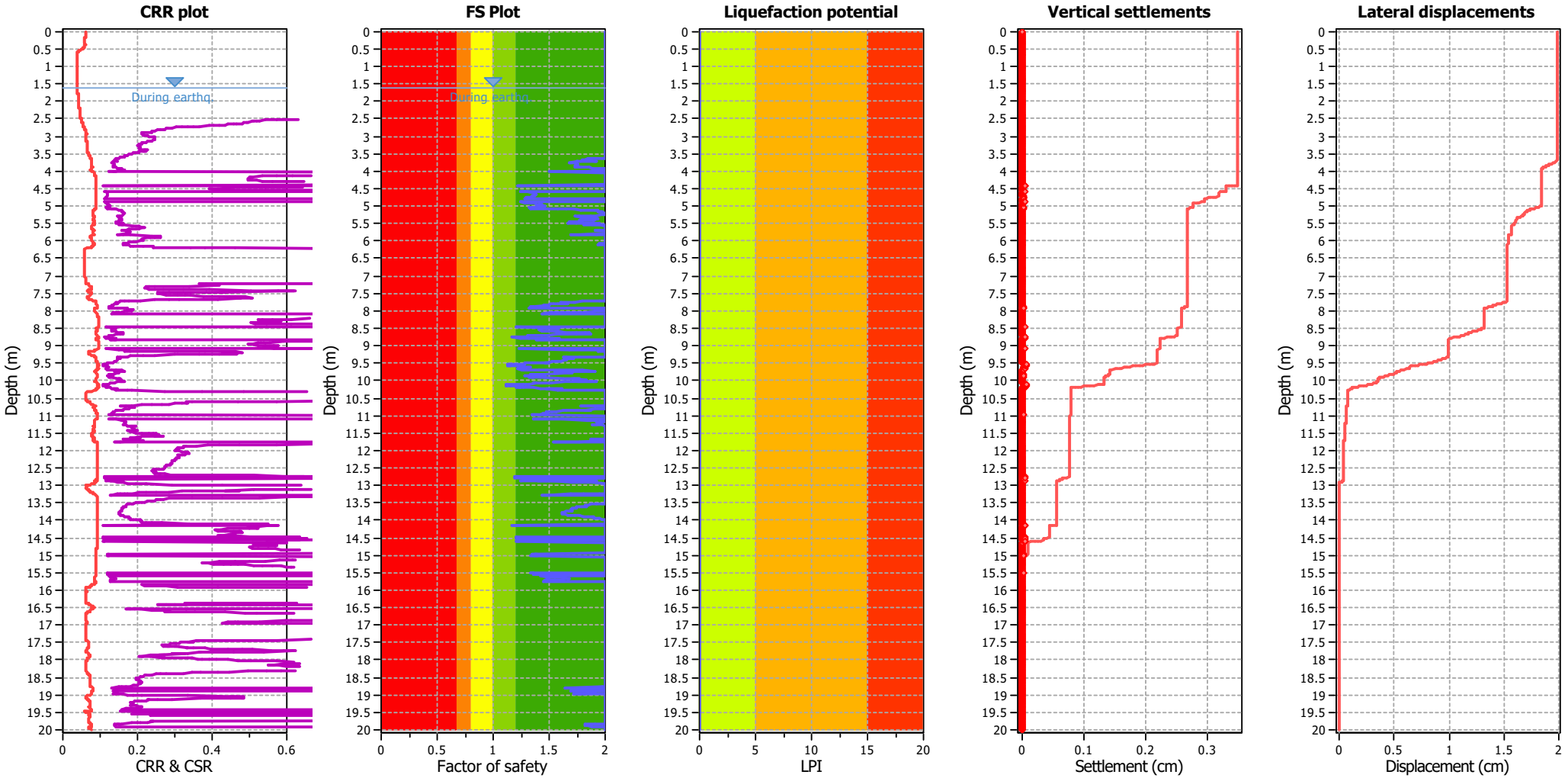
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.60 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.11	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.10 m	Fill height:	N/A	Limit depth:	N/A

SBTn legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.60 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.11	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.10 m	Fill height:	N/A	Limit depth:	N/A

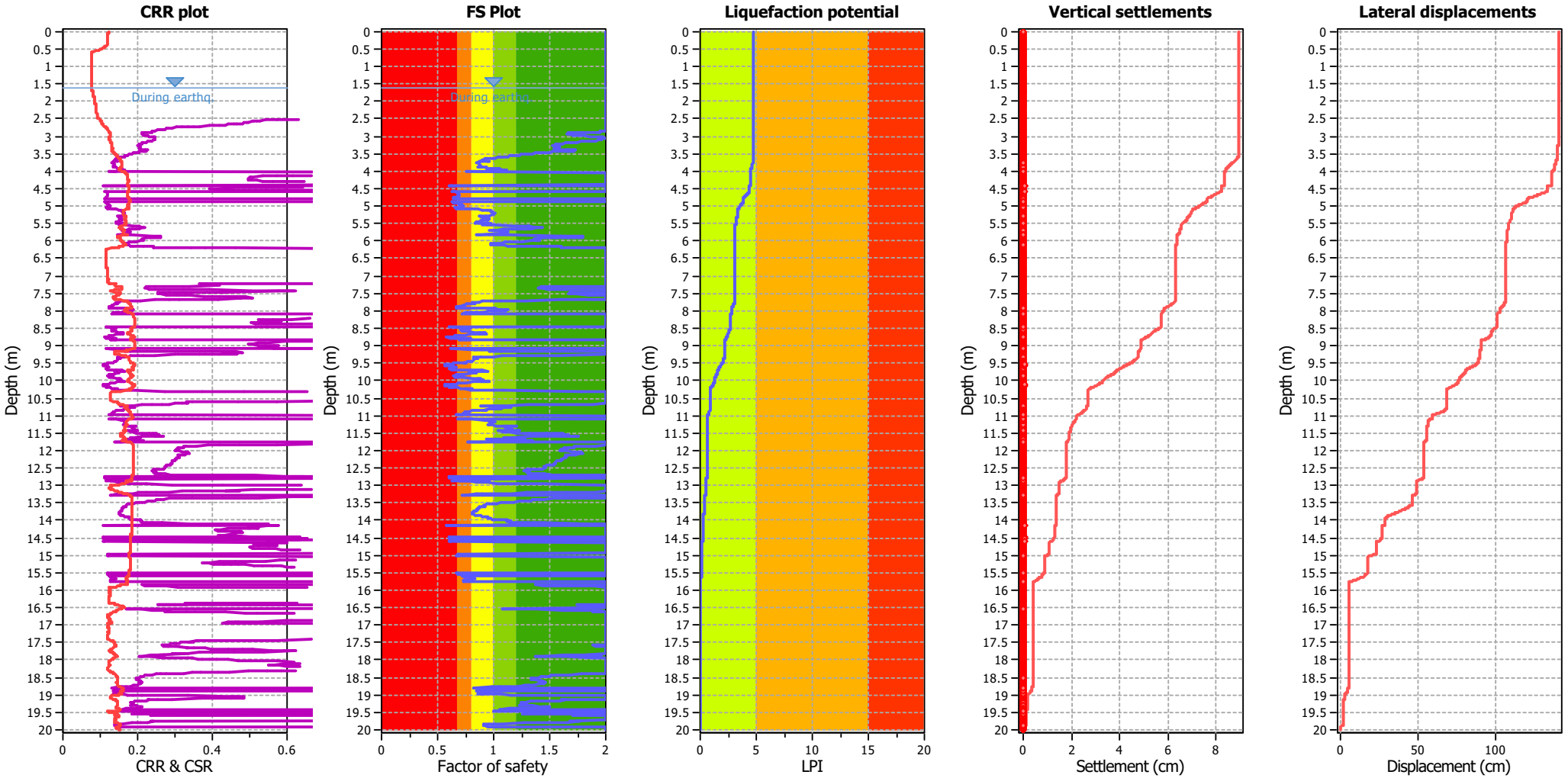
F.S. color scheme

- 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.):	1.60 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.22	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.10 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

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- Very likely to liquefy
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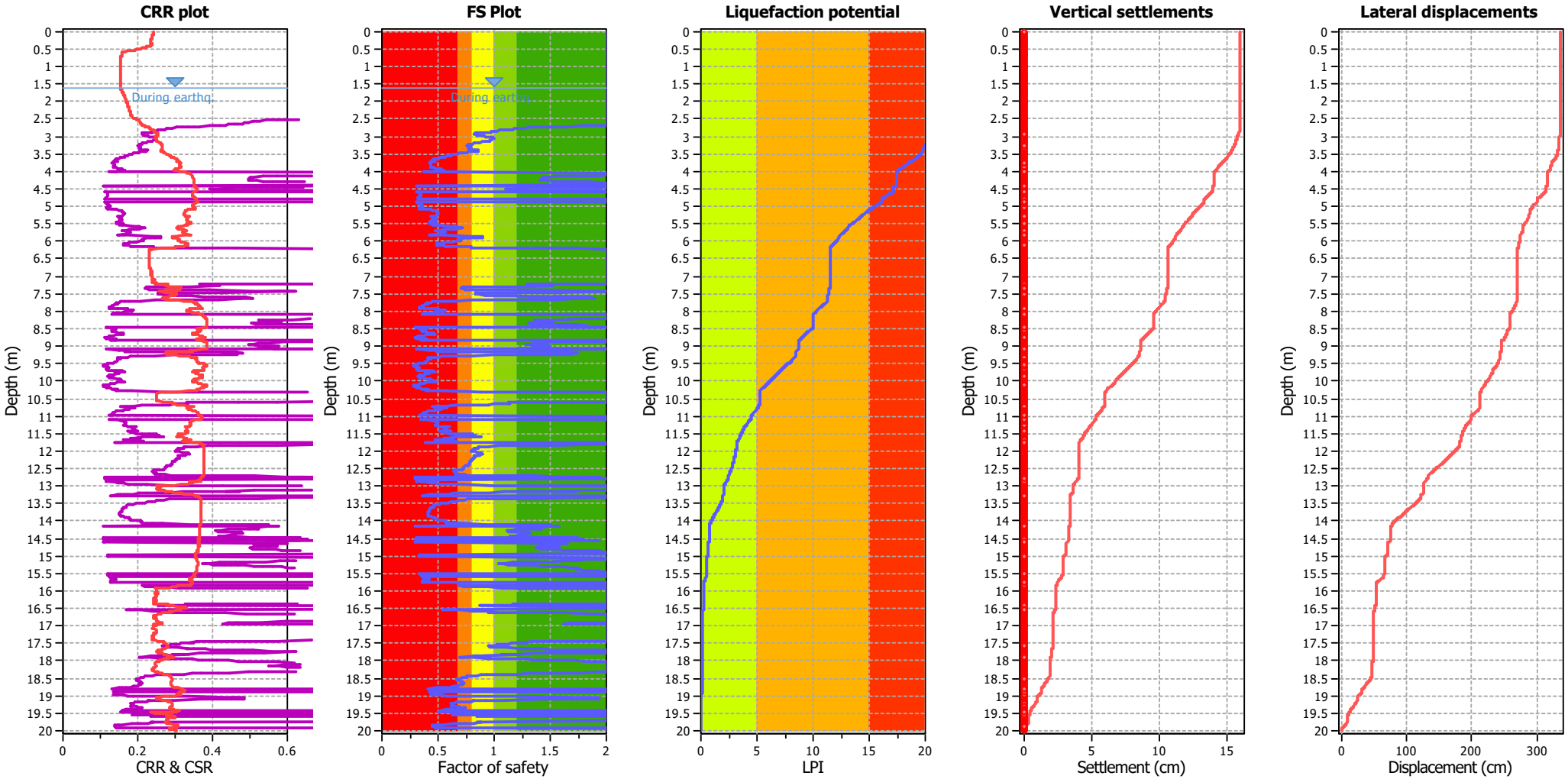
- Almost certain it will not liquefy

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.):	1.60 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.44	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.10 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- Almost certain it will liquefy
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LPI color scheme

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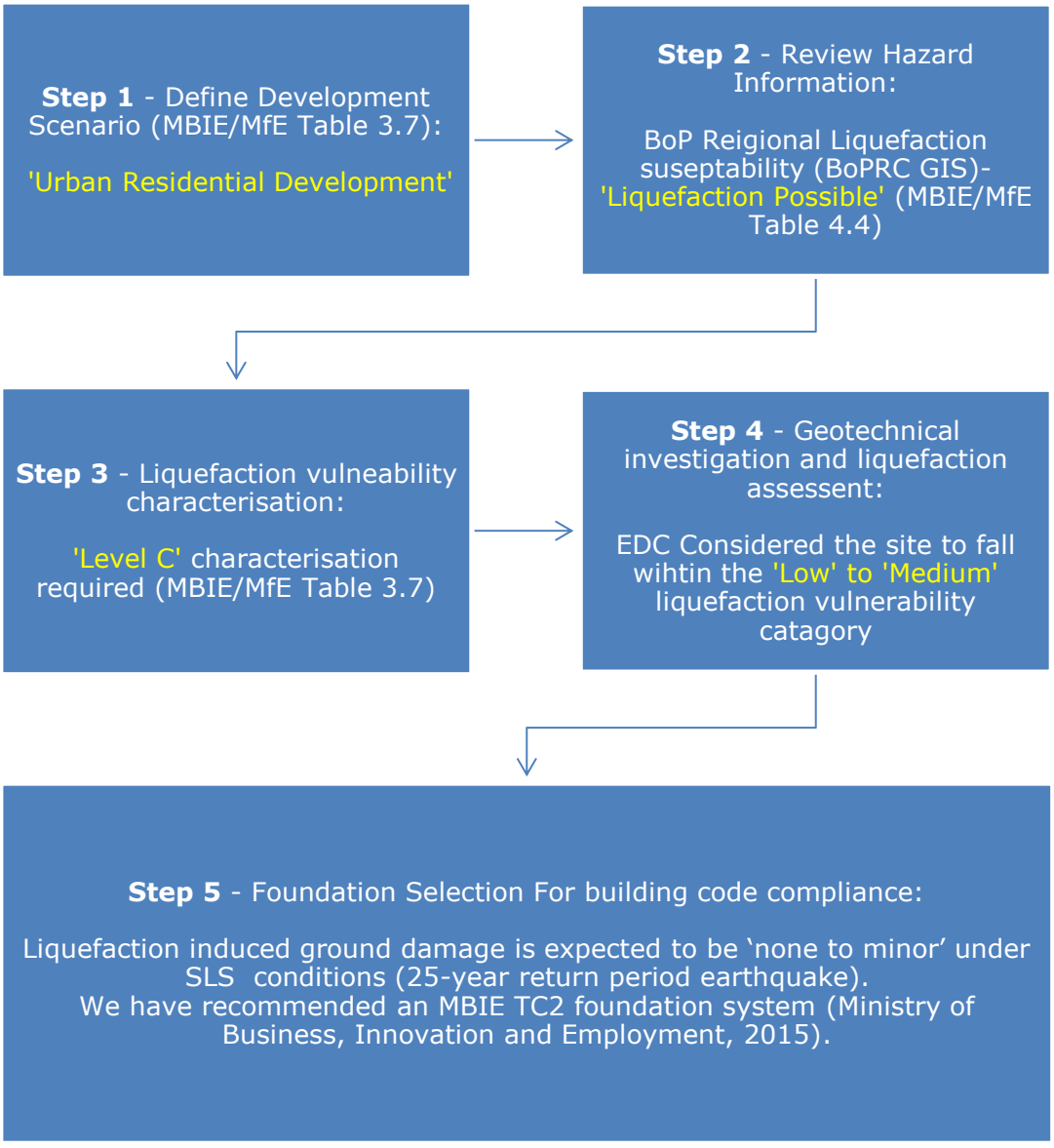
APPENDIX G

MBIE/MFE SITE SPECIFIC LIQUEFACTION ASSESSMENT FLOW CHART, ASSESSMENT MATRIX & DEFINITIONS



STEP 1 – Define development scenario (refer to Table 3.7 of MBIE/MfE Guidence (2017)

Increasing likelihood and severity of ground damage

Increasing new capital investment and total exposure to a single event

DEVELOPMENT SCENARIO[2]	LIQUEFACTION VULNERABILITY CATEGORY			
	LIQUEFACTION CATEGORY IS UNDETERMINED			
	LIQUEFACTION DAMAGE IS UNLIKELY		LIQUEFACTION DAMAGE IS POSSIBLE	
	Very Low	Low	Medium	High
Sparsely populated rural area (lot size more than 4 Ha) eg A new farm building	Level A	Level A	Level A	Level A
Rural-residential setting (lot size of 1 to 4 Ha) eg A 'lifestyle' property	Level A	Level B	Level B	Level B
Small-scale urban infill (original lot size less than 2500 m2) eg Demolish old house and replace with four townhouses	Level B	Level B	Level B	Level D
Commercial or industrial development[7] eg A warehouse building in an industrial park	Level B	Level B	Level C	Level D
Urban residential development (lot size less than 1 Ha; typically <1000 m2) eg Home in a new subdivision	Level B	Level C	Level C	Level D

Table 4.4: Performance criteria for determining the liquefaction vulnerability category

LIQUEFACTION CATEGORY IS UNDETERMINED

A liquefaction vulnerability category has not been assigned at this stage, either because a liquefaction assessment has not been undertaken for this area, or there is not enough information to determine the appropriate category with the required level of confidence.

LIQUEFACTION DAMAGE IS UNLIKELY		LIQUEFACTION DAMAGE IS POSSIBLE	
There is a probability of more than 85 percent that liquefaction-induced ground damage will be ***None to Minor*** for 500-year shaking. At this stage there is not enough information to distinguish between ***Very Low*** and ***Low***. More detailed assessment would be required to assign a more specific liquefaction category.		There is a probability of more than 15 percent that liquefaction-induced ground damage will be ***Minor to Moderate*** (or more) for 500-year shaking. At this stage there is not enough information to distinguish between ***Medium*** and ***High***. More detailed assessment would be required to assign a more specific liquefaction category.	
Very Low Liquefaction Vulnerability There is a probability of more than 99 percent that liquefaction-induced ground damage will be ***None to Minor*** for 500-year shaking.	**Low Liquefaction Vulnerability** There is a probability of more than 85 percent that liquefaction-induced ground damage will be ***None to Minor*** for 500-year shaking.	**Medium Liquefaction Vulnerability** There is a probability of more than 50 percent that liquefaction-induced ground damage will be: ***Minor to Moderate*** (or less) for 500-year shaking; and ***None to Minor*** for 100-year shaking.	**High Liquefaction Vulnerability** There is a probability of more than 50 percent that liquefaction-induced ground damage will be: ***Moderate to Severe*** for 500-year shaking; and/or ***Minor to Moderate*** (or more) for 100-year shaking.

Table 3.1: Levels of detail for liquefaction assessment studies, and the key defining features

LEVEL OF DETAIL	KEY FEATURES
Level A Basic desktop assessment	Considers only the most basic information about geology, groundwater and seismic hazard to assess the potential for liquefaction to occur. This can typically be completed as a simple 'desktop study', based on existing information (eg geological and topographic maps) and local knowledge. **Residual uncertainty:** The primary focus is identifying land where there is a ***High*** degree of certainty that ***Liquefaction Damage is Unlikely*** (so it can be 'taken off the table' without further assessment). For other areas, substantial uncertainty will likely remain regarding the level of risk.
Level B Calibrated desktop assessment	Includes high-level 'calibration' of geological/geomorphic maps. Qualitative (or possibly quantitative) assessment of a small number of subsurface investigations provides a better understanding of liquefaction susceptibility and triggering for the mapped deposits and underlying ground profile. For example, the calibration might indicate the ground performance within a broad area is likely to fall within a particular range. It may be possible to extrapolate the calibration results to other nearby areas of similar geology and geomorphology, however care should be taken not to over-extrapolate (particularly in highly variable ground such as alluvial deposits), and the associated uncertainties (and potential consequences) should be clearly communicated. Targeted collection of new information may be very useful in areas where existing information is sparse and reducing the uncertainty could have a significant impact on objectives and decision-making. **Residual uncertainty:** Because of the limited amount of subsurface ground information, significant uncertainty is likely to remain regarding the level of liquefaction-related risk, how it varies across each mapped area, and the delineation of boundaries between different areas.
Level C Detailed area-wide assessment	Includes quantitative assessment based on a moderate density of subsurface investigations, with other information (eg geomorphology and groundwater) also assessed in finer detail. May require significant investment in additional ground investigations and more complex engineering analysis. **Residual uncertainty:** The information analysed is sufficient to determine with a moderate degree of confidence the typical range of liquefaction-related risk within an area and delineation of boundaries between areas, but is insufficient to confidently determine the risk more precisely at a specific location.
Level D Site-specific assessment	Draws on a high density of subsurface investigations (eg on or very close to the site being assessed), and takes into account the specific details of the proposed site development (eg location, size and foundation type of building). **Residual uncertainty:** The information and analysis is sufficient to determine with a ***High*** degree of confidence the level of liquefaction-related risk at a specific location. However, the scientific understanding of liquefaction and seismic hazard is imperfect, so there remains a risk that actual land performance could differ from expectations even with a high level of site-specific detail in the assessment.

Increasing level of detail and decreasing degree of uncertainty

APPENDIX H

INDIVIDUAL LOT SUMMARY

Subdivision Geotechnical Summary Table

Waiotahe Drifts Subdivision - Stages 5b & 6a

EDC: 48749

1/10/2022

LOT	AREA	CUT		FILL		SLOPE TYPE	SPECIFIC CONSIDERATIONS				FOUNDATION REQUIREMENTS & COMMENTS AS APPLICABLE
		SOIL TYPE	MAX DEPTH	FILL TYPE	MAX DEPTH		Public Services	Retaining Walls	Expansive Soil	Building Set-Back	
12	542	Sand	2.0m	Sand	5.0m	Up to north	No	No	No	No	Recommended foundations include MBIE TC2 Enhanced Slab or shallow piles designed in accordance with building consent stage bearing capacity assessment.
13	719	Sand	2.0m	-	-	Up to north	No	No	No	No	
14	719	Sand	2.0m	-	-	Up to north	No	No	No	No	
15	542	Sand	2.0m	Sand	5.0m	Up to north	No	No	No	No	
16	542	Sand	2.0m	Sand	5.0m	Up to north	No	No	No	No	
17	719	Sand	2.0m	-	-	Up to north	No	No	No	No	
18	719	Sand	2.0m	-	-	Up to north	No	No	No	No	
19	608	Sand	2.0m	Sand	5.0m	Up to north	No	No	No	No	
20	805	Sand	2.0m	-	-	Up to north	No	No	No	No	
21	500	Sand	2.0m	Sand	5.0m	Up to north	No	No	No	No	
82	429	Sand	2.0m	Sand	4.0m	Level	No	No	No	No	
83	459	-	-	Sand	3.0m	Level	No	No	No	No	
84	456	-	-	Sand	3.0m	Level	No	No	No	No	
85	428	Sand	2.0m	Sand	4.0m	Level	No	No	No	No	
86	428	Sand	2.0m	Sand	4.0m	Level	No	No	No	No	
87	456	-	-	Sand	3.0m	Level	No	No	No	No	
88	461	-	-	Sand	3.0m	Level	No	No	No	No	
89	428	Sand	2.0m	Sand	4.0m	Level	No	No	No	No	
90	553	-	-	Sand	3.0m	Level	No	No	No	No	
91	426	Sand	2.0m	Sand	4.0m	Level	No	No	No	No	
104	477	Sand	1.0m	-	-	Level	No	No	No	No	
105	455	Sand	1.0m	-	-	Level	No	No	No	No	
106	451	Sand	1.0m	-	-	Level	No	No	No	No	
107	482	Sand	1.0m	-	-	Level	No	No	No	No	
108	462	Sand	1.0m	-	-	Level	No	No	No	No	
109	542	Sand	1.0m	-	-	Level	No	No	No	No	
110	529	Sand	1.0m	-	-	Level	No	No	No	No	
111	509	Sand	1.0m	-	-	Level	No	No	No	No	
112	440	Sand	1.0m	-	-	Level	No	No	No	No	
113	470	Sand	1.0m	-	-	Level	No	No	No	No	
114	503	Sand	1.0m	-	-	Level	No	No	No	No	
115	473	Sand	1.0m	-	-	Level	No	No	No	No	
118	508	Sand	1.0m	-	-	Level	No	No	No	No	
119	552	Sand	1.0m	-	-	Level	No	No	No	No	