Stage 6B,
Waiotahe Drifts Subdivision,
Opotiki

Geotechnical Completion Report

Prepared for Maven Associates Ltd.

Project 48749 - Rev.1 - 07/06/2023

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0	26/05/2023	DT	Final
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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, 5B & 6A has been completed and signed off, as documented in EDC's Waiotahe Drifts Subdivision, Stage 5a Geotechnical Completion Report (EDC File: 48749, dated 25/05/2022) and Stages 5B & 6A Geotechnical Completion Report (EDC File: 48749, dated 24/11/2022). This report relates to Stage 6B, referred to below as 'the site', the perimeter of which is marked in red in Figure 1.

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

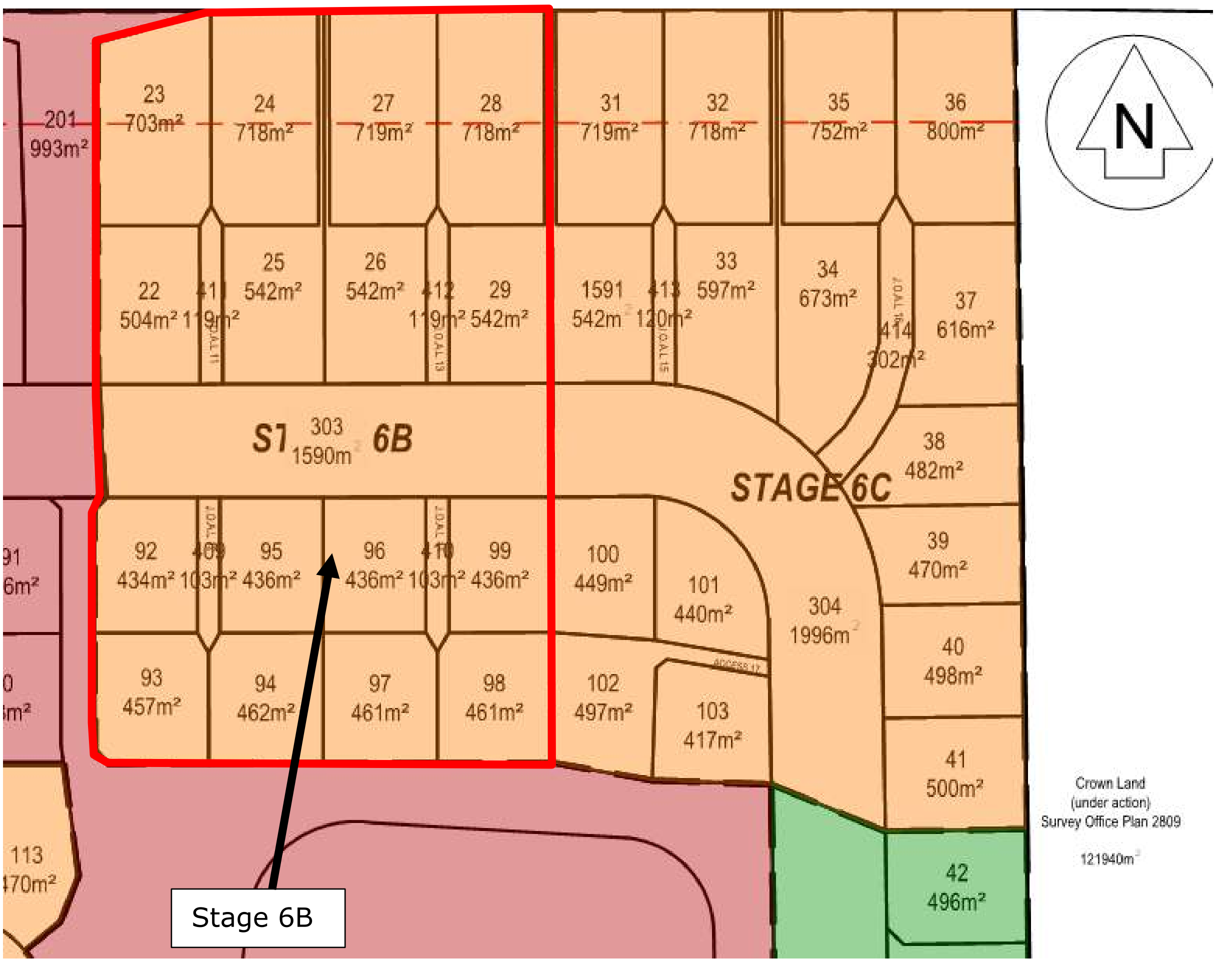


Figure 1: Subdivision plan for Stages 6B & 6C

To our understanding no geotechnical investigation or reporting has been undertaken in this area or the other subdivision stages to obtain 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 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'.

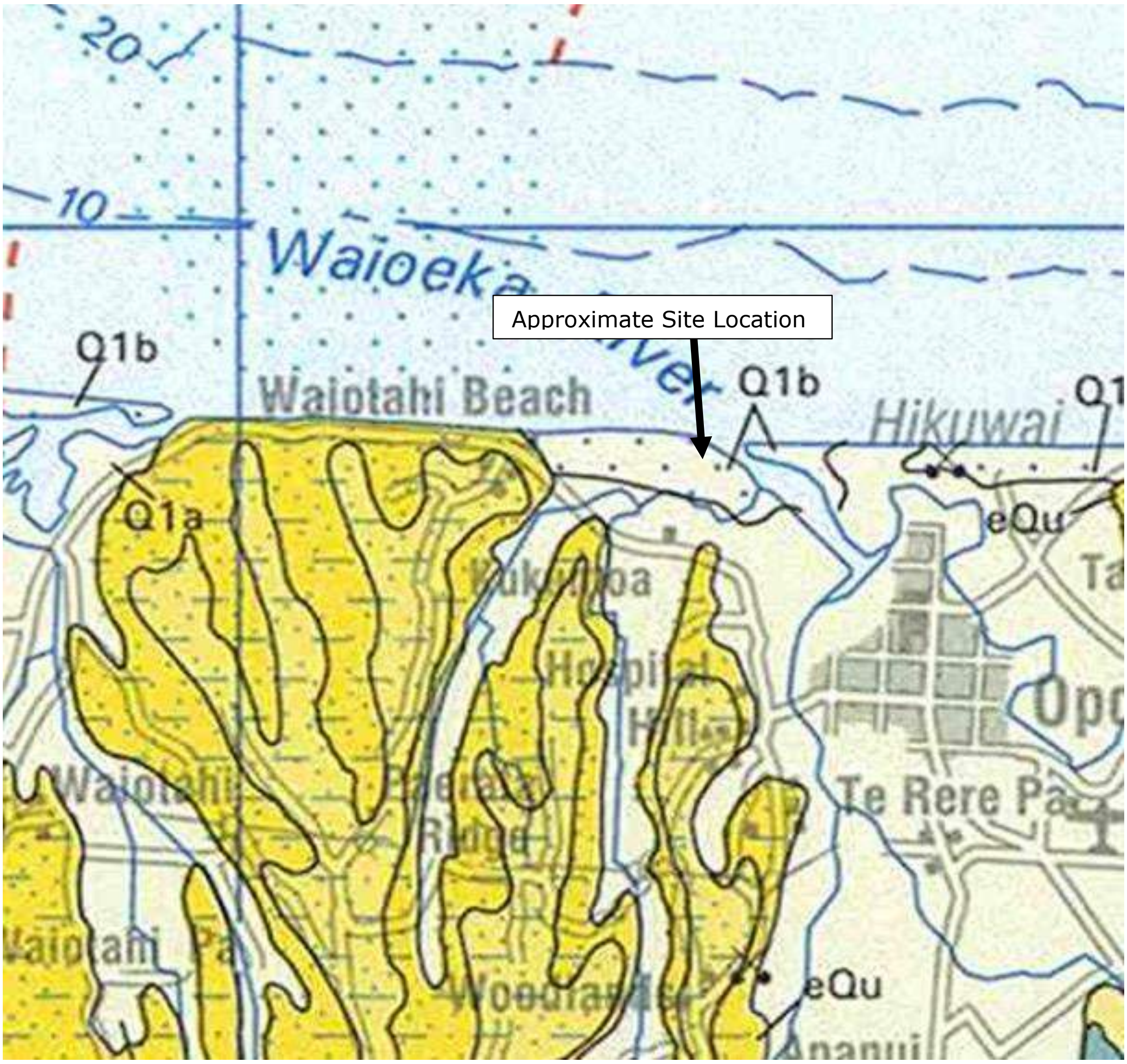


Figure 4: GNS Geology Map

2.0 DEVELOPMENT OVERVIEW

The development undertaken has resulted in the formation of 107 new lots. Stage 5b consists of 16 new residential lots.

Earthworks were undertaken to re-shape the land to allow the formation of suitable residential Lots 22 – 29 & 92 - 99. 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 has also been included in Appendix A.

At the time of preparing this GCR, all bulk earthworks for stage 6B have been completed.

2.1 Earthworks Specification

The 'Project Specification – Waiotahe Dunes' Document produced by Maven forms the basis of the Earthworks Specification and is contained in Appendix B. Several changes to the Project Specification have been approved by Maven to adapt to site conditions and due to specialist contractor availability. These changes are summarised 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 verification 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:
    - JOAL AP65 basecourse CIV minimum value of 25 and an average of >28.
    - Road Carriageway AP65 Subbase CIV minimum value of 35 and an average of >38.
3. Benkelman beam testing was undertaken on the finished AP40 road basecourse, with a maximum target deflection of 1.2mm.
4. River run gravel material has been substituted for sand fill where required. The river run material was visually inspected with any boulders/cobbles >100mm manually removed. Site won sand has been added as required to maintain suitable grading. River run has not been placed within 1.0m of the finished height.
5. A reduced compaction standard was agreed, at the discretion of Maven in the upper 0.7m of sand fill.

3.0 EARTHWORKS DETAILS

The bulk earthworks and civil works were undertaken by Delta Contracting from November 2022 to May 2023. The earthworks consisted of stripping the topsoil/organic soils 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. Due to a shortage of clean sand fill, quarried river run gravel hardfill has been used. Initial sand filling in the deeper fill areas (>3.5m) was compacted and inspected by EDC. Following this, the gravel hardfill (only in areas where total fill depths exceed 1.0m), was placed and compacted in 250mm thick layers, to a total thickness of up to 2.5m.

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 for Stage 6B included approximately 628m^3 of stripped topsoil which has been respread on the finished surface to facilitate grassed surfacing and future gardens. An estimated total fill volume of 21,978m^3 has been placed. The cut material was dune sand. This was reused as engineered fill or cut to waste if containing organics. No lime or cement stabilisation was used during filling. Over stages 6b & 6c approximately 27,500m^3 of river run was imported from Carters pit Otara River & Hughes pit Waioeka River.

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 smooth vibrating roller
- 1 x 5 tonne smooth 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 for sand fill and 250mm thick layers for gravel hardfill.

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 eleven site inspections during the subdivision earthworks for Stage 6B between 11/11/2022 to 12/05/2023. In addition to visual inspection, compaction testing was undertaken using Scala Penetrometer, Clegg Hammer and Cone Penetration Test. Our observations during the construction confirm an earth-fill generally complying with NZS:4431, and the fill is considered suitable for residential development subject to a site-specific bearing capacity assessment; in accordance with NZS:3604. A reduced compaction target has been accepted by Maven for Lots 23, 93, 95, 96, and 97 to maintain the earthworks program and as a result engineered foundation design will be required subject to site-specific bearing capacity assessment.

Below is a summary of all EDC's site visits during the construction supervision of Stage 6B.

Date	Lot/s Investigated	Formation Inspection	Compaction SC/CBR	Comment
11/11/2022	Stage 6B	Pass	-	All organics across site has been removed.
23/11/2022	22, 25, 26, 29 and 92- 99	-	Pass	Scala Penetrometer tests in sandfill below proposed hardfill.
24/11/2022	23, 24, 27 and 28	-	Pass	Compaction inspection pass.
28/11/2022	22, 25,26,29,92-98 and road	-	Pass	Approx 0.75m of gravel hardfill placed and compacted in 250mm layers. Residential Lots and roading sub-based passed with Clegg Hammer CIV averaging >20.
09/12/2023	25,26,29,92-98 and road	-	Pass following remediation of 'boney' areas	Lots 25, 26, 29: Approx 1.5m of fill placed (2/3 hardfill thickness). Average CBR reading of 22, several areas identified where the hardfill is "boney" and more fines must be placed over the "boney" areas to fill the voids. Lots 93, 94 & 97: Approx 1.5m of fill placed (final hardfill thickness). Average Clegg reading of 44. Southern end of these lots still requires hardfill.
06/03/2023	Lots 22,25,26 and 29	-	Pass following remediation of 'boney' areas	Hardfill is "boney" and more fines must be placed over the "boney" areas to fill the voids
	Road	-	Fail	Average CIV Clegg results of 26

20/03/2023	Lots 22,25,26 and 29	-	Fail	None of the CIV Clegg results were above 21
23/03/2023	Lots 22,25,26 and 29	-	Provisional Pass	Surface saturated by heavy rain post compaction. Clegg Hammer CIV's averaged 18. Retested by Delta Contracting on 24/03/2023 when surface dried and CIVs all >20.
05/04/2023	JOAL 11 & 13	-	Pass	Results approved by MAVEN.
14/04/2022	JOAL 12 & 14	-	Pass	Results approved by MAVEN.
	Road	-	Pass	Results approved by MAVEN.
12/05/2023	Final Compaction Inspection	-	Provisional Pass	Scala Penetrometer testing of Sand fill. Generally >5 blows/100mm from 0.3m (Pass). However, in Lots 23, 93, 95, 96, and 97 Scala values range from 2-4 blows per 100mm on to depths 500-700mm. These lots will require engineer designed foundation.

Table 1: Summary of EDC's site visits during Stage 6B

4.2 EDC Inspection Summary

In Lots 23, 93, 95, 96, and 97 Scala values range from 2-4 blows per 100mm to depths of 500-700mm. These lots will require engineer designed foundations. The remaining Lots (22, 24-29, 92, 94, 98 & 99) achieved the initial target compaction of >5 blows/100mm from 0.3m. The compaction methodology for the above-mentioned lots for Stage 6B are considered to meet amended Maven Fill Specification (see Section 2.1).

The new public road and JOAL's 11 - 14 subbase in Stage 6B was formed with sand fill. Civil engineering design required a minimum CBR of 7%. Testing conducted on the subgrade indicates this subgrade achieved this target CBR. Clegg Hammer testing in the JOAL's and roadway were provided to, and approved by Maven. The roading subgrade and base coarse for Stage 6B are considered to meet the Maven Fill Specification.

EDC's Site Inspection Notes are included 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 fill for the bulk earthworks consisted of ungraded 'River Run' gravel hardfill. The river run material was visually inspected with any boulders/cobbles >100mm manually removed. Site won sand has been added as required to maintain suitable grading. River run has not been placed within 1.0m of the finished ground level.

Imported certified 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 6B

November 2022

Figure 5: 1st Formation inspection for stage 6B

November 2022

Figure 6: View Lots 25 & 26 being filled with river run.

Figure 7: View of the river run across Stage 6b.

Figure 8: View of Lots 23. 24, 27 and 28

Figure 9: Contractors photo showing fines remediation of the boney material.

Figure 10: View of the road area for stage 6B

Figure 11: View of the road area for stage 6, later in March

Figure 12: View of Lots 95 & 96.

Figure 14: View of JOAL 12

Figure 13: View of JOAL 14

5.0 SITE CLASSIFICATION

5.1 Post Earthworks 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 within Stages 5b & 6c (adjacent to east and west o Stage 6b) to assess the liquefaction susceptibility.

Cone Penetration Testing (CPT), comprising 2 holes for Stage 5b (CPT's 201 & 202) and 2 holes for Stage 6C (CPT’s 401 & 402), were undertaken by Topdrill on 17/08/2022 & 18/05/2023 respectively. No CPT’s were undertaken on Stage 6b, but the soils indicated by the CPT’s on the adjacent stages 9as shown by the overlay plots in Figure 15 below), are considered similar enough to allow the assumption of continuity through Stage 6b. These holes are considered sufficient therefore, for the assessment of Stage 6B. CPT 201, CPT 401 & CPT 402 reached their target depth of 20.0m, while CPT 202 refused at 9.8m due to tip refusal.

Groundwater was dipped by the CPT contractor. Where there was hole collapse above the groundwater table, inferences on groundwater depth were made from the CPT porewater pressure data (see Table 2). However, it should be noted that ground water in this area will be tidally influenced.

CPT data overlays are shown on Figure 15. The approximate locations of the CPT's are indicated in Figures 16. Logs of the Normalised Soil Behaviour Type (SBT) for the CPT results are shown in Appendix F.

Test Ref.	Date	Location	CPT Depth (m)	Comment
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.
CPT401	18/05/2022	Lot 37	20m	CPT Hole collapsed (dry) at 4.8m
CPT402	18/05/2022	Lot 41	20m	Measured with dip meter at 2.9m

Table 2: Deep Intrusive Investigation Summary

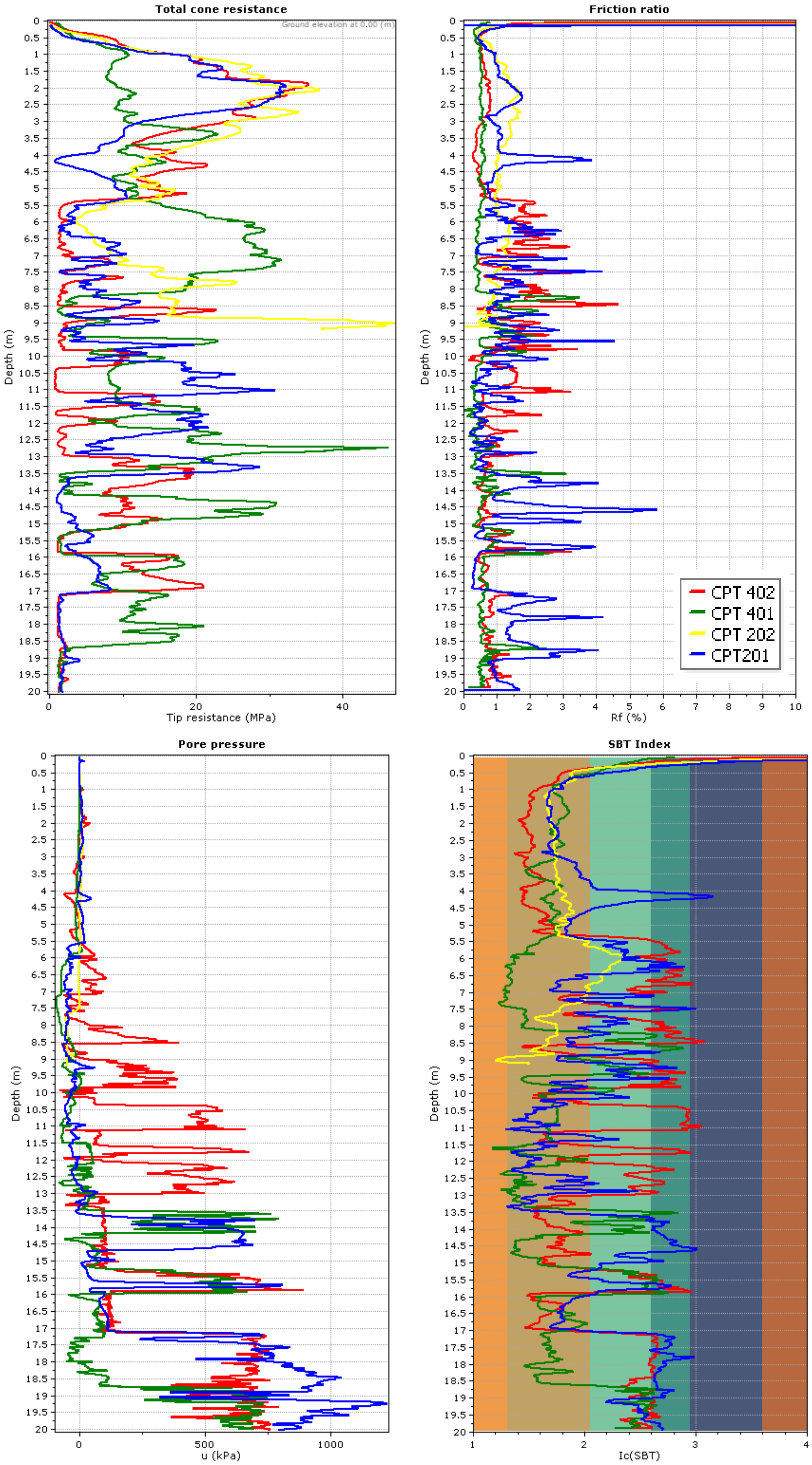


Figure 15: CPT Overlay

Post earthworks testing consisted of Scala Penetrometer (SC) testing in each individual lot. The approximate locations of the SC's are indicated in Figure 16.

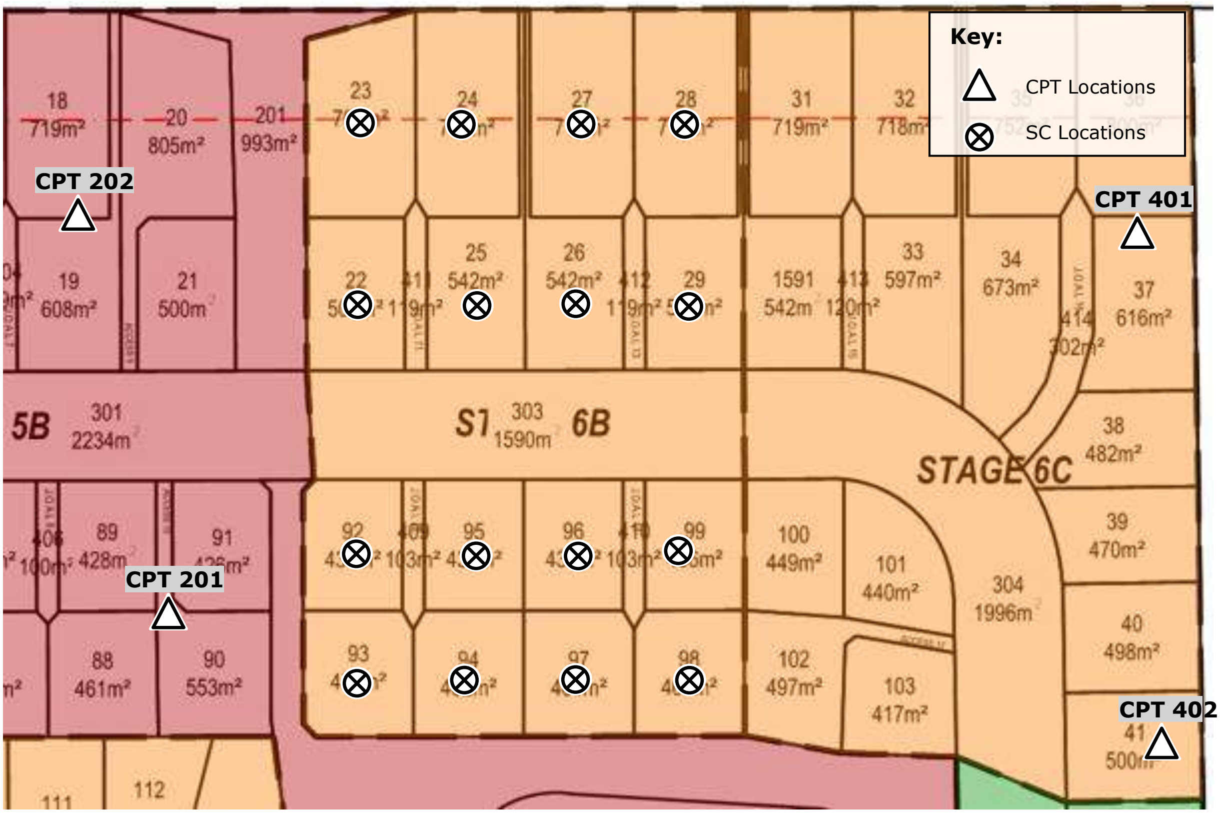


Figure 16: Final Intrusive Investigation Approximate Locations Stage 6b

As discussed in Section 4.1, Scala Penetrometer testing of Sand fill in Stage 6b, generally achieved the initial target compaction of >5 blows/100mm from 0.3m. However, in Lots 23, 93, 95, 96, and 97 Scala values range from 2-4 blows per 100mm on to depths of 500-700mm. These lots will require engineer designed foundation for a reduced bearing capacity.

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 3: 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 4: 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
CPT 201	20.0	0	0	15	59	75	163
CPT 202	9.8	0	0	2	2	32	33
CPT 401	20.0	0	0	14	84	45	179
CPT 402	20.0	2	3	33	86	49	146

Table 5: Summary of Estimated Liquefaction-Induced Settlement

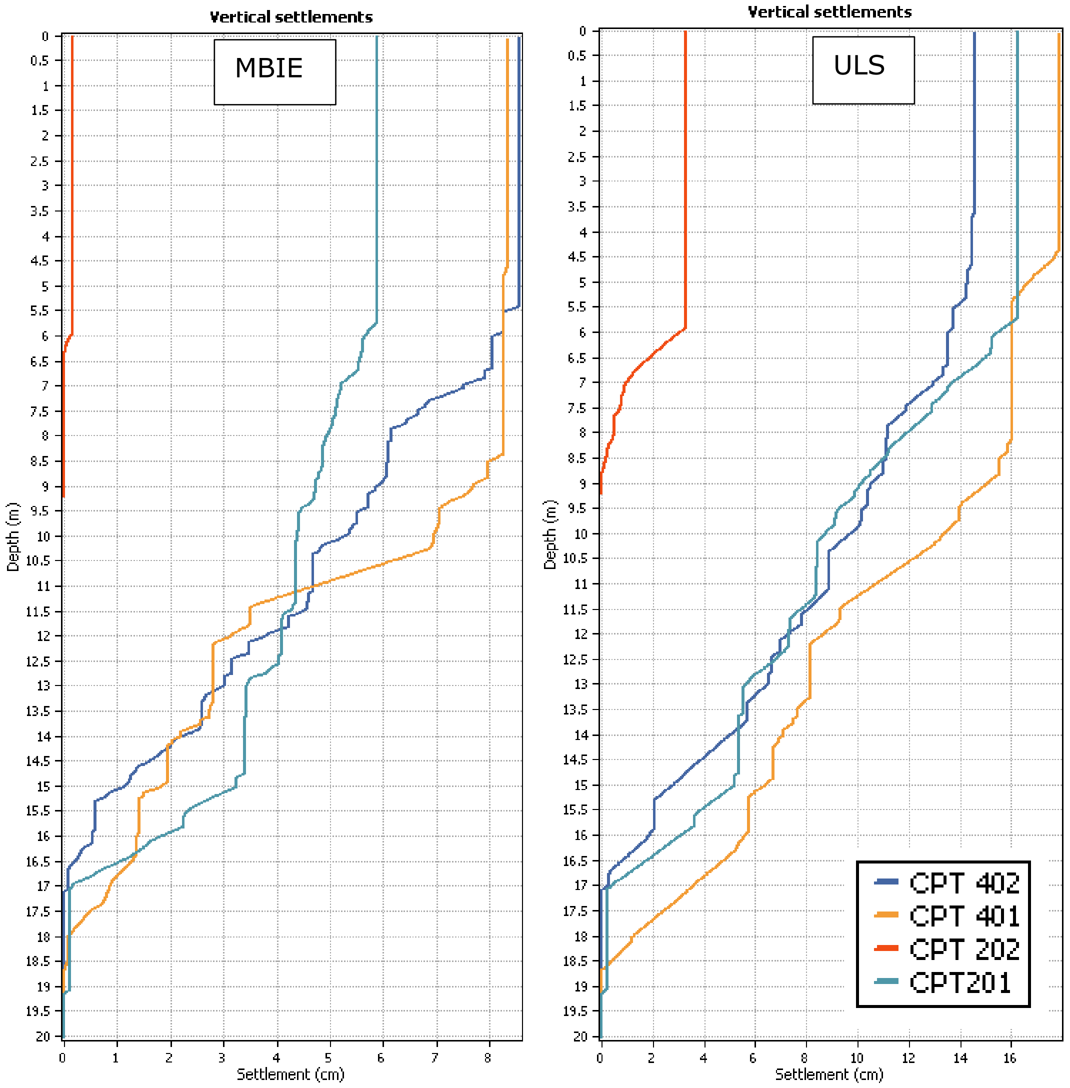


Figure 17: Estimated Total Vertical Settlement under MBIE 100yr and ULS Conditions

The on-site CPT analyses indicate:

- Under SLS conditions, negligible free-field ground settlement is estimated;
- Under MBIE conditions, free-field ground settlement up to 86mm is estimated;
- Under ULS conditions, free-field ground settlement up to 179mm is estimated.

The soils from the analysed ground water depth (that increases to the south i.e. away from the coast) 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
CPT 201	0	9	16
CPT 202	0	3	5
CPT 401	0	1	16
CPT 402	1	5	14

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 6: 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 7: 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 180mm 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.
- As such, the liquefaction vulnerability category for Stage 6b 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".

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

5.4 Static Settlement

During the works the contractor had concern regarding possible fill material volume 'loss' in Stage 6B. As such the contractor engaged the East Bay Surveyors to conduct settlement monitoring at three isolated locations of the Stage 6B & 6C filling works. It should be noted that no visible surface evidence of subsidence has been noted by EDC or the contractor.

5.4.1 Contractor Settlement Monitoring

Simplified settlement monitoring was started under the contractor's initiative with 2.0 - 3.5m of fill yet to be placed in Stage 6C and consisted of three steel plates located across the filled area with 4m rods extending vertically out of the fill. Fill was placed directly around the rod shaft during the continuing filling works. The steel base plate was initially surveyed and post filling works, the top of the rod was surveyed twice with a one-month interval. Surveying works were undertaken by East Bay Surveyors.

The following table shows the monitoring results:

	Location	Visit 1 (25/01/2023) Reading	Visit 2 (21/04/2023)		Visit 3 (25/05/2023)		
			Reading	Variation	Reading	Total Variation	Rolling Variation
Rod 1	344468.57mE 869907.90mN	RL 6.486	RL 6.248	-238mm	RL 6.245	-241mm	-3mm
Rod 2	344524.53mE 869911.20mN	RL 5.975	RL 5.747	-228mm	RL 5.739	-236mm	-8mm
Rod 3	344579.96mN 869884.04mE	RL 6.396	RL 6.327	-69mm	RL 6.327	-69mm	0mm

Table 8: Stage 6c static settlement monitoring summary

5.4.2 Subdivision Engineer As-Built Infrastructure Level Survey

A construction survey of the infrastructure by the contractor was supplied to Maven on 09/05/2023, it is understood that this construction survey was undertaken prior to adjacent filling works. These service lines were installed just below the ground level, prior to filling operations. As built surveys of the stormwater and wastewater services was supervised by Maven on 22/05/2023 as part of standard procedure. As a result of the contractors assertation that the loss of fill volume is a result of settlement, and the above monitoring, an additional infrastructure survey by a registered surveyor was commissioned by Maven on 31/05/2023.

Maven has undertaken a comparison of these surveys (attached in Appendix H), and concluded there is a maximum survey variation of 4mm, well within the tolerance of the survey equipment used. Accordingly, it is concluded that there has been negligible settlement due to the filling post installation of the services.

5.4.3 Retrospective Settlement Analysis

The raw data from the CPT's has been interpreted using CPeT-IT software to provide an indicative assessment of predicted settlement, retrospective of the Settlement Monitoring on-site. Ground settlement has been estimated using CPT 401 & 402, undertaken in Stage 6C, for assumed fill depths of 2.0-3.5m, and inferred average fill weights. The predicted settlements for these scenarios are shown below. It should be noted that these CPT's were undertaken post filling and therefore settlement predictions might have been higher had the CPT's been sunk prior to any filling works:

Fill depth (m)	Inferred Load (kPa)	Estimated Ground Settlement (mm)
2.0	40	35-75
3.5	70	52-110

Table 9: Indicative Static Settlement Calculation Results

The CPeT-IT settlement analysis reports from Appendix I.

Analysis of the duration of settlement has been undertake using Terzaghi's 1D Consolidation equations based on permeability values estimated from the CPT data. This analysis indicates that soils within the upper 17m of soil profile generally have a high average permeability, with thin isolated areas having relatively low permeability. As such the time of primary consolidation is short with 90% of total consolidation within this soil profile expected to occur within 1 day of the load being applied. Although, the CPT analysis indicates consolidation of a claylike layer below 17m will occur, given the stiffness of this soil the risk of on-going secondary consolidation is considered low.

5.4.4 Settlement Risk Assessment

The settlement monitoring undertaken by the contractor was not undertaken under supervision of Maven or EDC, and there is the potential for errors from several aspects of the methodology. For example, if the rod tilted by as little as 5 degrees during fill placement, the final reading would suggest an additional 15mm of settlement than actually occurred. Notwithstanding this, it is expected that some consolidation settlement of the underlying soils would have occurred as a result of the load applied by the subdivision filling works.

The vast majority of this settlement is expected to occur during or within a matter of days following the fill placement. In the deepest areas of filling, sand fill was placed and compacted prior to the placement of gravel fill or wastewater/stormwater infrastructure and it is inferred that the compaction process and load induced from this fill would have initiated shallow consolidation during placement. Based on Maven's Infrastructure level survey comparison, it appears that the additional fill placed above the wastewater /stormwater pipes has induced negligible additional settlement.

In summary based on the available information, although some consolidation is expected to have occurred during the filling works, the on-site infrastructure has not been affected, and with no visual evident of ground damage identified on-site there is no evidence to suggest that on-going consolidation is occurring.

5.5 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'.

6.0 CONCLUSIONS

The subdivision earthworks for Stage 6B of the Waiotahe Drifts Subdivision were undertaken by Delta Contracting from November 2022 to May 2023 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. Imported gravel hardfill was utilised to make up the volume for bulk earthworks.

The bulk filling was conducted in a controlled manner and compacted with a smooth vibrating roller in layers of generally 150 – 250mm thickness. EDC supervised the earthworks and undertook compaction testing using Scala Penetrometer, Clegg Hammer and Cone Penetration Test. 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 6b.

Consolidation settlement of the underlying soils is expected to have occurred as a result of the subdivision filling works. However, this settlement is expected to have occurred during or within a matter of days following the fill placement. Based on Maven's Infrastructure level survey comparison, it appears that the additional fill placed above the wastewater /stormwater pipes has induced negligible additional settlement. Based on the available information, the on-site infrastructure has not been affected and with no visual evident of ground damage identified on-site there is no evidence to suggest that on-going consolidation is occurring.

The soils at the site do not meet the NZS 3604 definition of 'Good Ground'.

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.

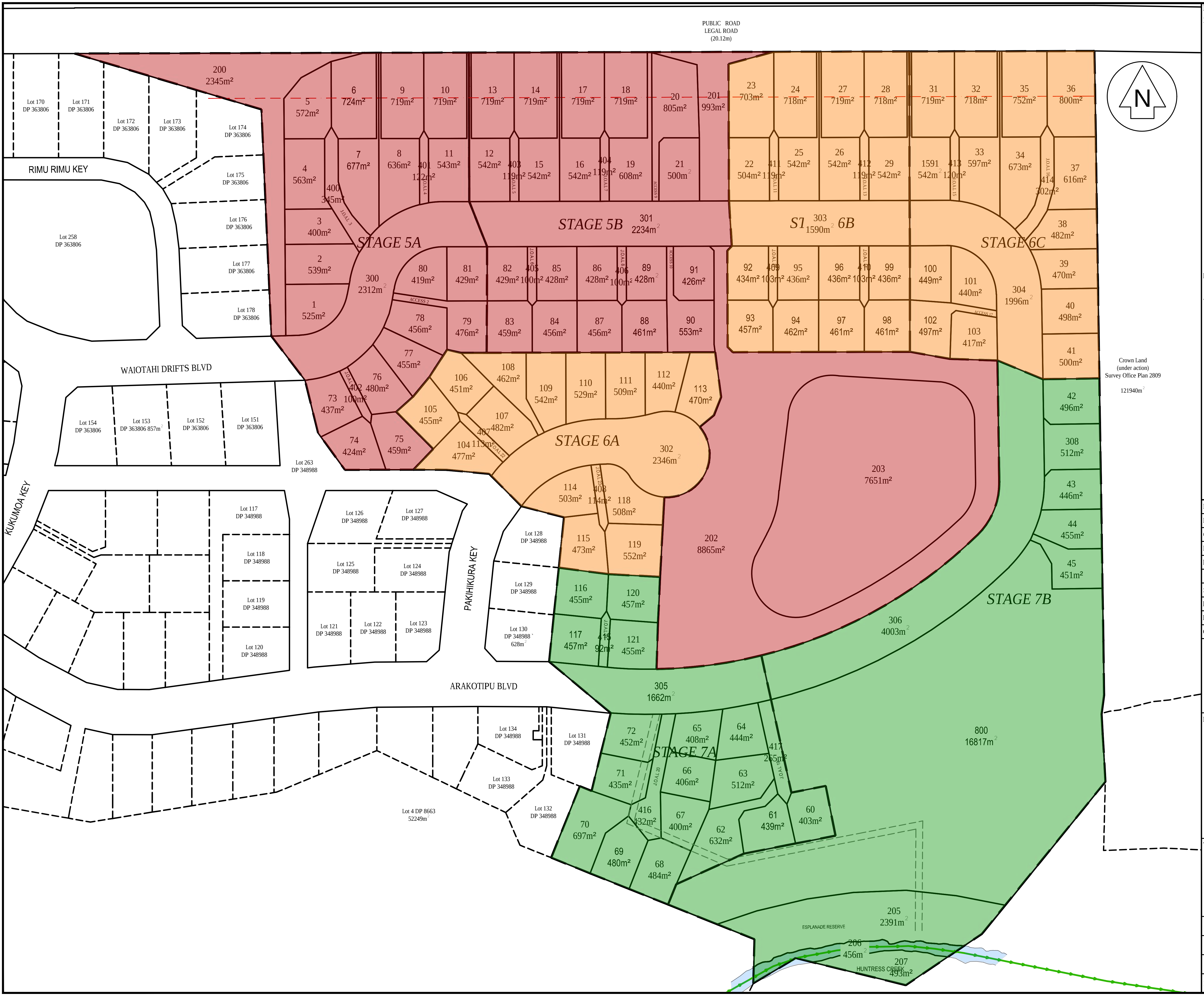
The subdivision earthworks are considered suitable for residential development subject to a site-specific bearing capacity assessment on each individual lot, in accordance with NZS3604, for Building Consent.

In Lots 23, 93, 95, 96, and 97 Scala Penetrometer values ranged from 2-4 blows per 100mm on to depths 500-700mm. As such these lots will require Specific Engineering Design for foundations and following the Building Consent stage site specific geotechnical bearing capacity assessment. An individual Lot Summary forms Appendix J, and EDC's Statement Of Professional Opinion As To Suitability Of Land For Building Development forms Appendix K.

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

APPENDIX A

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



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

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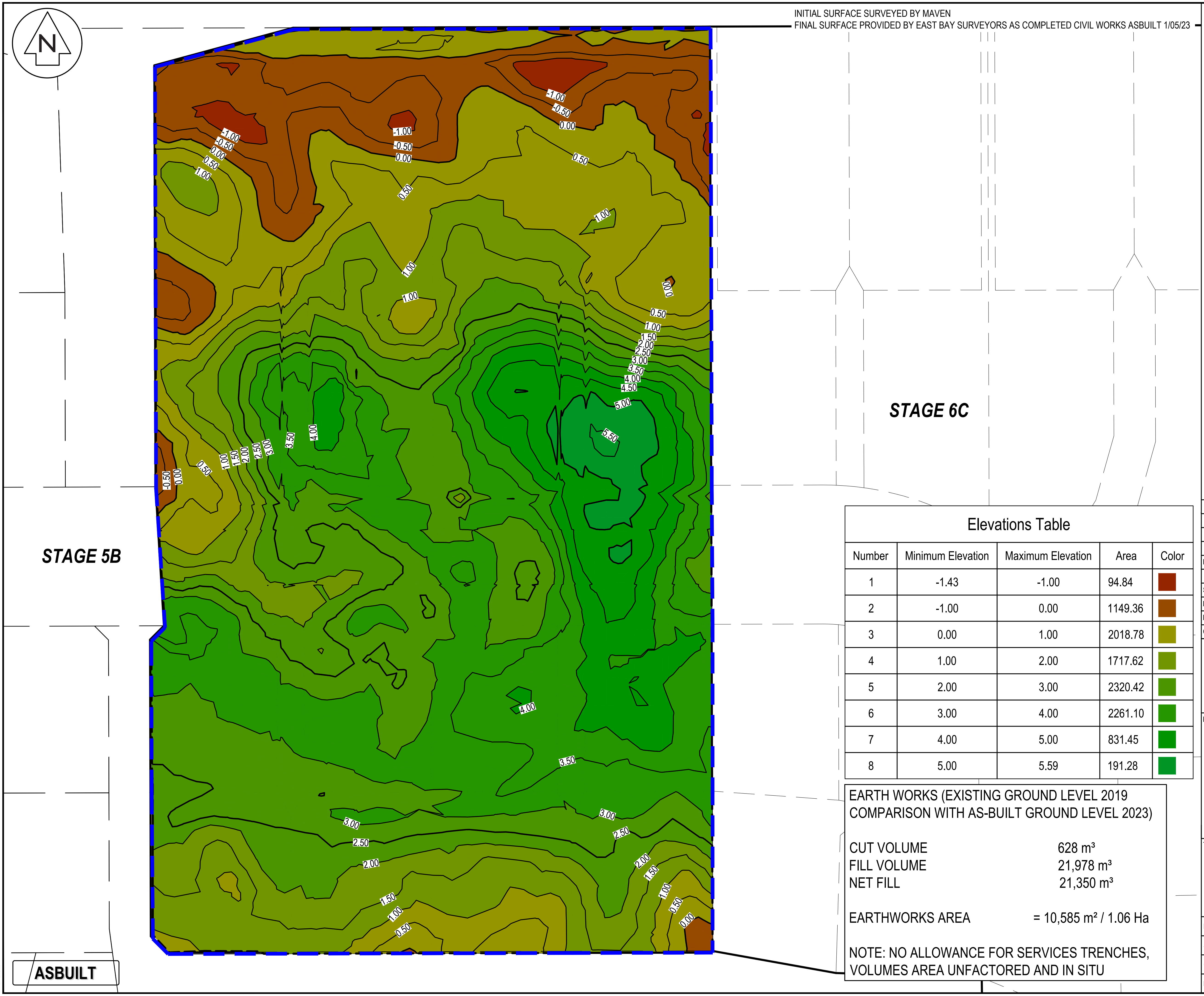
Project
WAIOTAHE DUNES
DEVELOPMENT
WAIOTAHE
FOR
EQUINOX

Title
SCHEME PLAN
OVERVIEW

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

DATE: 4/22/21

FILE: 105006-150 Scheme B.dwg



Notes

1. LEVELS ARE IN TERMS OF MOTURIKI DATUM 1953.
2. ORIGIN OF LEVELS = GA17/16 NO 2 (ABW6) PUBLISHED RL = 2.34, SOURCED FROM THE LINZ DIGITAL GEODETIC DATABASE
3. COORDINATES ARE IN TERMS NZGD2000, POVERTY BAY CIRCUIT
4. BOUNDARIES ARE SUBJECT TO FINAL SURVEY
5. SURVEY DATA COLLECTED BY GPS METHOD AND AS SUCH. ACCURACY +/- 0.02m POSITION +/- 0.03M LEVEL

Legend

▬▬▬	STAGE 6B BDY
— — —	PROP 6C BDY
— — —	EX ABUTTAL
▬ ▬ ▬	AS-BUILT EXTENT WORK

Elevations Table

Number	Minimum Elevation	Maximum Elevation	Area	Color
1	-1.43	-1.00	94.84	🟥
2	-1.00	0.00	1149.36	🟫
3	0.00	1.00	2018.78	🟨
4	1.00	2.00	1717.62	🟩
5	2.00	3.00	2320.42	🟩
6	3.00	4.00	2261.10	🟩
7	4.00	5.00	831.45	🟩
8	5.00	5.59	191.28	🟩

EARTH WORKS (EXISTING GROUND LEVEL 2019 COMPARISON WITH AS-BUILT GROUND LEVEL 2023)

CUT VOLUME	628 m³
FILL VOLUME	21,978 m³
NET FILL	21,350 m³

EARTHWORKS AREA = 10,585 m² / 1.06 Ha

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

Rev	Description	By	Date
A	AS-BUILT	AFC	05/2023

	By	Date
Survey		
Design	MAVEN	05/2023
Drawn	AFC	05/2023
Checked	OGS	05/2023

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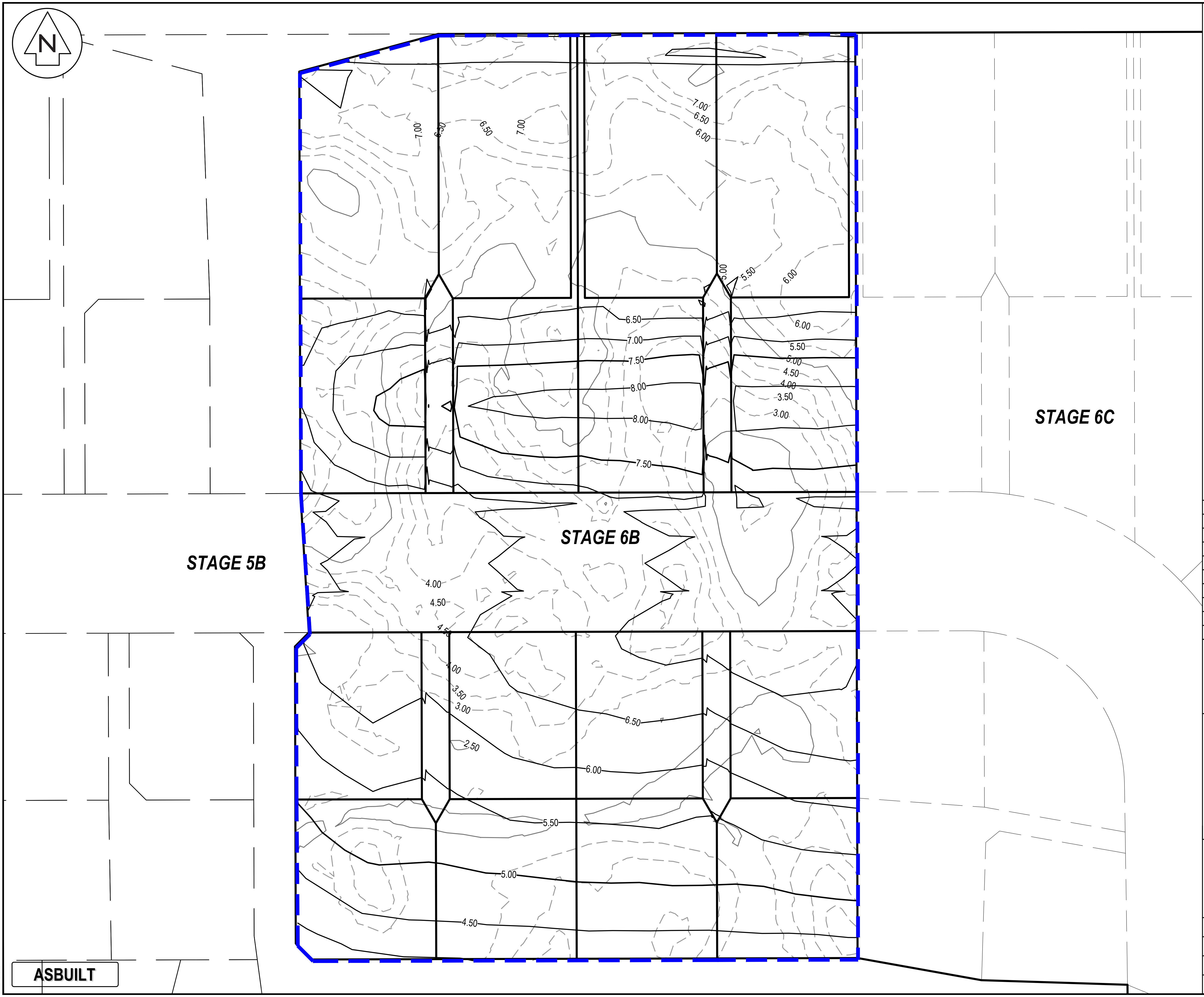
Project
WAIOTAHE DUNES DEVELOPMENT WAIOTAHE STAGE 6B FOR EQUINOX

Title
AS-BUILT CUT-FILL PLAN

Project no.	105006
Scale	1:500 @ A3
Cad file	105006 - FINISH LEVELS SURFACE AS-BUILT 6B.DWG
Drawing no.	C941
Rev	A

DATE: 5/23/23



ASBUILT

Notes
1. LEVELS ARE IN TERMS OF MOTURIKI DATUM 1953.
2. ORIGIN OF LEVELS = GA17/16 NO 2 (ABW6) PUBLISHED RL = 2.34, SOURCED FROM THE LINZ DIGITAL GEODETIC DATABASE
3. COORDINATES ARE IN TERMS NZGD2000, POVERTY BAY CIRCUIT
4. BOUNDARIES ARE SUBJECT TO FINAL SURVEY
5. SURVEY DATA COLLECTED BY GPS METHOD AND AS SUCH. ACCURACY +/- 0.02m POSITION +/- 0.03M LEVEL

Legend

▬▬▬	STAGE 6B BDY
— — —	PROP 6C BDY
— — —	EX ABUTTAL
———	EX MAJOR CONTOUR
———	EX MINOR CONTOUR
▬▬▬	PR MAJOR CONTOUR
———	PR MINOR CONTOUR
▬ ▬ ▬	AS-BUILT EXTENT WORK

Rev	Description	By	Date
A	AS-BUILT	AFC	05/2023

	By	Date
Survey		
Design	MAVEN	05/2023
Drawn	AFC	05/2023
Checked	OGS	05/2023

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Project
WAIOTAHE DUNES DEVELOPMENT WAIOTAHE STAGE 6B FOR EQUINOX

Title
AS-BUILT CONTOURS PLAN

Project no.	105006		
Scale	1:500 @ A3		
Cad file	105006 - FINISH LEVELS SURFACE AS-BUILT 6B.DWG		
Drawing no.	C942	Rev	A

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.

First and second coat chip seals

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

EDC
ENGINEERING DESIGN CONSULTANTS

SITE REPORT

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

BC/EPA No:

Time: 10am Weather: Rain

Inspected by: Bryn Marshall Site Manager: Paul

Site Address: Waiotahe drifts, stage 6B

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

- Generally all top soil and organics have been removed.
- Areas with some roots marked out are to be removed.
- No soft spots identified.
- No geotechnical reason construction can not continue.

11/11/22

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

No issue obsurved.

Photos: ✓

ENGINEERING DESIGN CONSULTANTS

SITE REPORT

EDC File No: 48749 Date: 23/11/22

BC/EPA No:

Time: 3pm Weather: Fine

Inspected by: Bryn Marshall Site Manager: Maven

Site Address: Waiotahi Drifts Subdivision

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

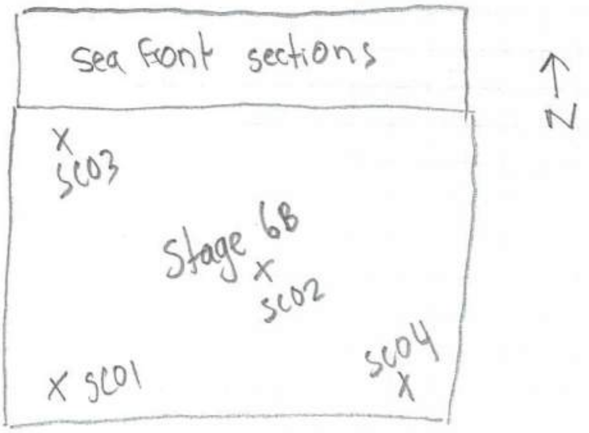
Carry out 5 x 5 check? [✓ Yes]/No
(Please refer overleaf for instructions. Identify potential hazards and note below.)

Compaction Inspection

Scala test at base of 6B below gravel Fill.

- Four Scala tests undertaken over the area of 6B.
- All four test show adequate compaction.
- No geotechnical reason works can not continue.

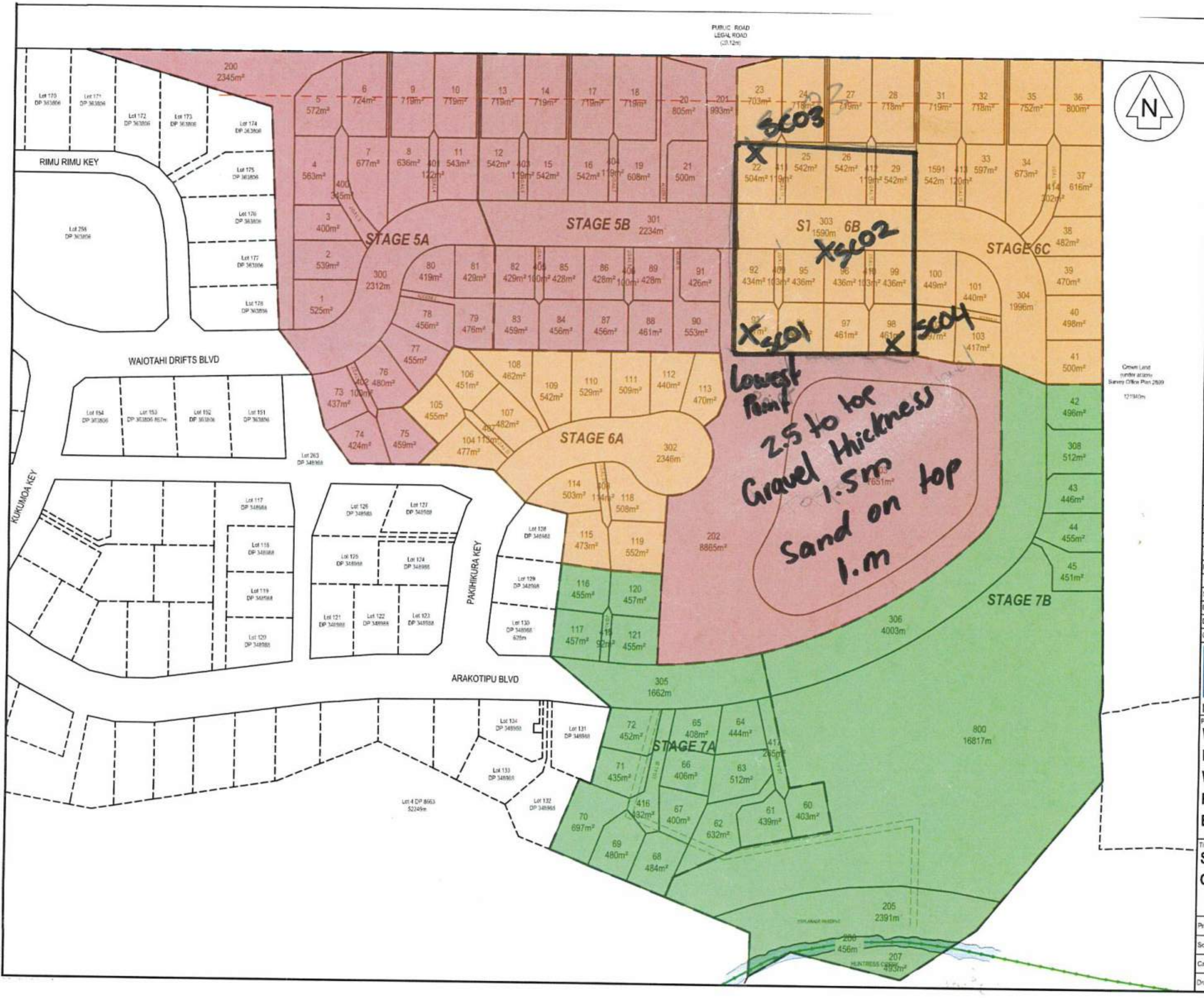
23/11/22



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

No Issues observed

Photos: ✓



SC03

SC02

SC01

SC04

Lowest Point

2.5 to top

Gravel thickness 1.5m

Sand on top 1.m

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 9050
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

EDC

ADDRESS	Waiotahi Drifts subdivision Stage 6B base	P/N	48749

SCALA PENETROMETER TEST FIELD RECORD

	SC1	SC2	SC3	SC4	SC5	SC6	SC7	SC8
50	X	1	X	X				
100	1	2	1	1				
150	2	3	1	1				
200	2	2	2	2				
250	2	3	3	2				
300	2	2	2	3				
350	2	3	2	3				
400	2	3	3	4				
450	2	3	3	3				
500	2	5	4	4				
550	2	4	5	3				
600	2	5	5	4				
650	2	4	7	3				
700	2	5	6	4				
750	2	5	5	4				
800	2	5	6	4				
850	2	5	5	4				
900	2	5	6	4				
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1850								
1900								
1950								
2000								

EDC
ENGINEERING DESIGN
CONSULTANTS

SITE REPORT

EDC File No: 48749 Date: 23/11/22

BC/EPA No:

Time: 3:30pm Weather: Fine

Inspected by: Bryn Marshall Site Manager: Maven

Site Address: Waiotahi Drifts subdivision stage 6B

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.)

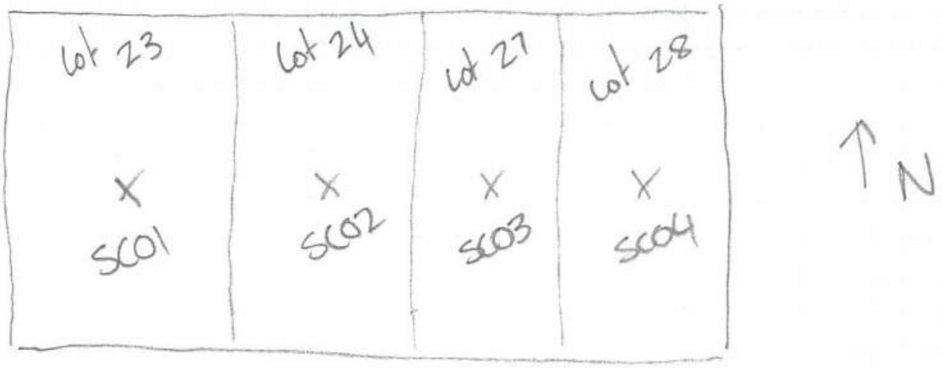
Induction completed? [✓ Yes]/No
(If 'no' please give reason...)

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.)

Compaction Inspection

Scala tests for units 23, 24, 27 and 28.



All Four Scala tests undertaken show adequate compaction.

No reason geotechnically why works can not continue.

23/11/22

H & S Comments: See Over For Limitations and 5 x 5 Instructions
No Issues observed

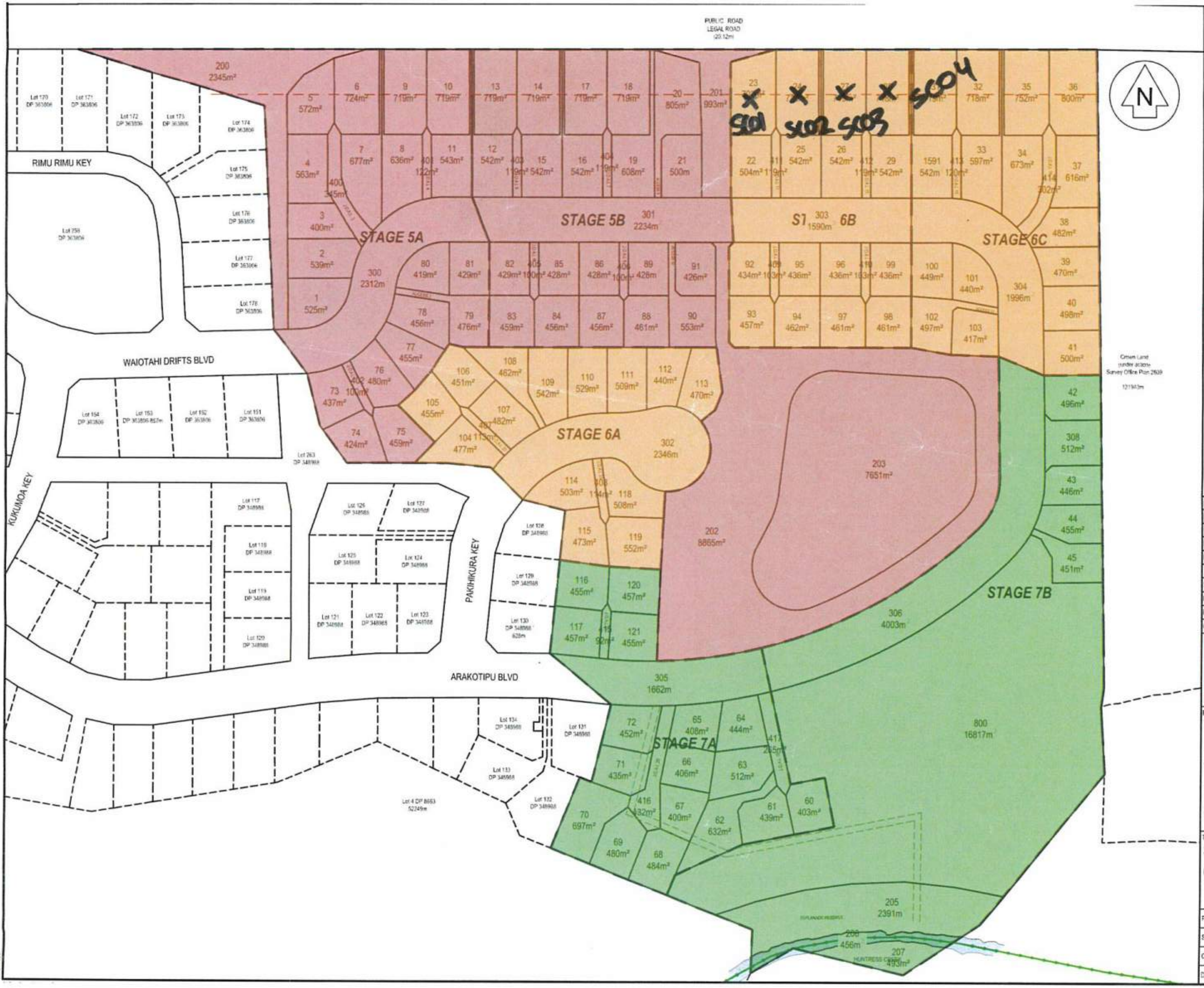
Photos: ✓

EDC

ADDRESS	Waiotahi Drifts Stage 6B units 23, 24, 27, 28	P/N	

SCALA PENETROMETER TEST FIELD RECORD

	SC1 lot 23	SC2 Lot 24	SC3 Lot 27	SC4 Lot 28	SC5	SC6	SC7	SC8
50	X	X	X	X				
100	1	1	1	1				
150	1	1	1	1				
200	2	2	2	2				
250	2	2	1	3				
300	3	3	2	3				
350	3	3	3	3				
400	4	4	4	4				
450	4	3	3	4				
500	4	4	4	5				
550	4	3	3	5				
600	4	4	4	4				
650	4	4	3	5				
700	4	4	4	4				
750	5	5	5	5				
800	4	4	4	5				
850	5	5	5	6				
900	5	4	4	5				
950	5	5	5	6				
1000	6	6	6	5				
1050	5	5	5	5				
1100	6	5	6	6				
1150	5	6	5	5				
1200	6	5	6	6				
1250	5	6	6	7				
1300	6	5	6	9				
1350	5	6	5	10				
1400	6	7	6					
1450	6	8	6					
1500	6	8	5					
1550	6	10	6					
1600	5		6					
1650	5		6					
1700	7		6					
1750	9		6					
1800	10		7					
1850			6					
1900			7					
1950								
2000								



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

Lots
23, 24
27, 28

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

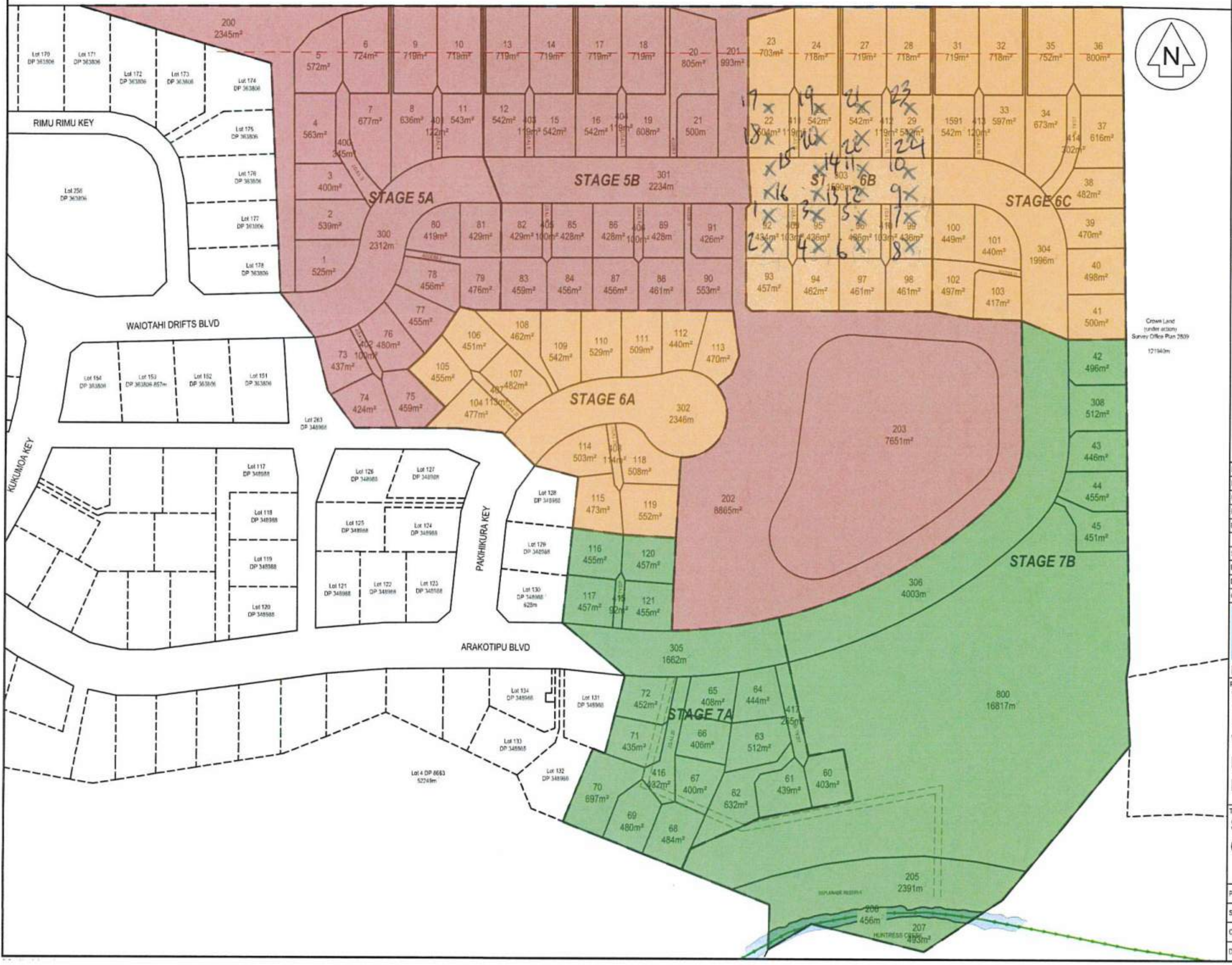
Maven Associates
09 571 0050
info@maven.co.nz
www.maven.co.nz
12-14 Walls Road, Penrose

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

Stage 6B - Hardfill Compaction inspection - 28/11/2023



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

Gleggs

1	24
2	24
3	20
4	20
5	18
6	20
7	30
8	25
9	22
10	24
11	24
12	18
13	22
14	20
15	18
16	20
17	20
18	25
19	30
20	30
21	24
22	26
23	18
24	24

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

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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

ENGINEERING DESIGN
CONSULTANTS

SITE REPORT		**HEALTH & SAFETY**
EDC File No: 48749	Date: 28/11/2022	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: 1pm	Weather: Fine	Signed in? [✓ Yes] No Signed out? Yes [✓ No]
Inspected by: Bryn Marshall	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 Subdivision stage 6B

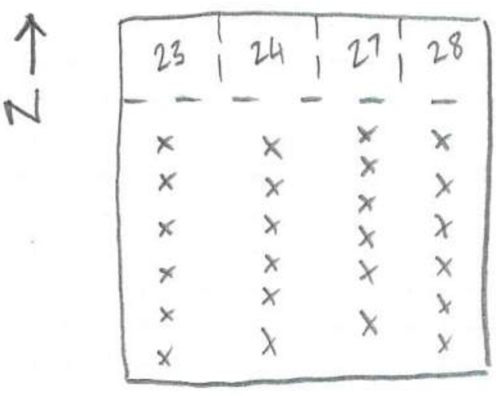
Compaction Inspection

Testing was conducted over stage 6B, not Including the front sections (lot 23, 24, 27 & 28).

Fill has been Compacted and consists of rounded river gravel.

All clegg tests done on compacted gravel fill showed adequate compaction over 6B.

There is no geotechnical reason works can not continue.



stage 6B

Clegg test locations 'x'

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

No Issues observed.

Photos: ✓

ENGINEERING DESIGN
CONSULTANTS

SITE REPORT

EDC File No: 48749   Date: 09/12/22

BC/EPA No:

Time: 10:30   Weather: Rain, Windy

Inspected by: Johon   Site Manager: Poul

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.)

Site Address: Waiotahe Drifts (Lots 25, 26, 29, 92 - 97) + Road

Findings (Stage 6B)

- Several Clegg hammer tests were carried out across these lots to determine the compaction of the hardfill layers
- The Clegg hammer results indicated an average reading of 22 per four blows. However, several areas where encountered where the hardfill is "boney" and loose under feet
- The southern areas of Lots 93, 94 & 97 had an average reading of 44 per four blows and is less boney.

- Recommendations

- Fine material needs to be placed over the boney areas and recompacted (photos must be sent to EDC once completed. Once completed, the Lots can be backfilled up to the required height.
- The southern end of lots 93, 94 & 97 require another ± 1.2m layer of hardfill. Once completed EDC, must be notified to test the compaction before backfilled gets placed.

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

Moving machinary

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.

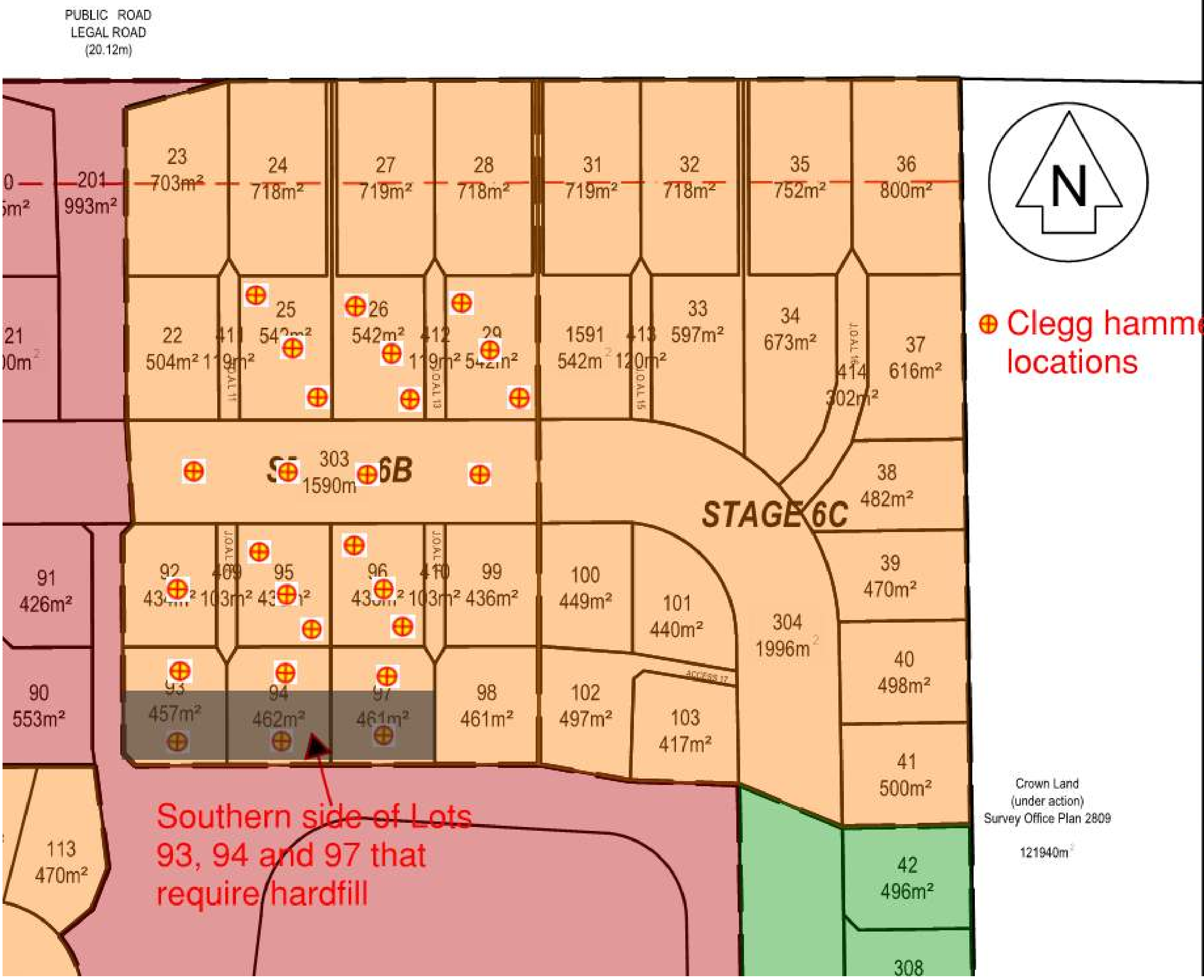
7. Engineering Design Consultants Ltd does not check set-out or levels. We recommend a licenced Professional Surveyor is engaged to provide this service.

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.



⊕ Clegg hammer test locations

Southern side of Lots 93, 94 and 97 that require hardfill

1. All areas, e
subject to a
Land Inform

ENGINEERING DESIGN
CONSULTANTS

SITE REPORT

EDC File No: 48749 Date: 20/03/23

BC/EPA No:

Time: 11:40 Weather: Sunny

Inspected by: Michael W Site Manager: Paul

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.)

Site Address: Vaiotahe Drifts

Clegg Hammer Results

Lot:	R	M	L
22	08	18	15
25	16	21	15
26	12	17	15
29	11	21	14
30	15	13	10
33	08	16	13
34	11	13	*
92	11	11	13
93	NA	NA	NA
94	08	09	11
95	09	16	19
96	13	14	16
97	13	NA	14
98	15	NA	19
99	11	11	15
100	15	13	15
101	12	12	13
102	18	10	09
103	11	19	09

34 Left See Scala results
See attached site plan

Compaction tests failed
further compaction and testing required

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

No Issues Observed

Photos: Yes

ENGINEERING DESIGN CONSULTANTS

SITE REPORT

EDC File No:

Date: 23/03/23

BC/EPA No:

Time: 08:41

Weather: Sunny

Inspected by: Michael W

Site Manager: Paul

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.)

Site Address: Waiotahe Drifts Stage 6b & 6c

Lot

Clegg hammer compaction testing

34 = 14, 15, Sand

33 = 17, 19, 16

30 = 20, 18, 15

29 = 15, 19, 17

26 = 20, 21, 19

25 = 15, 32, 15

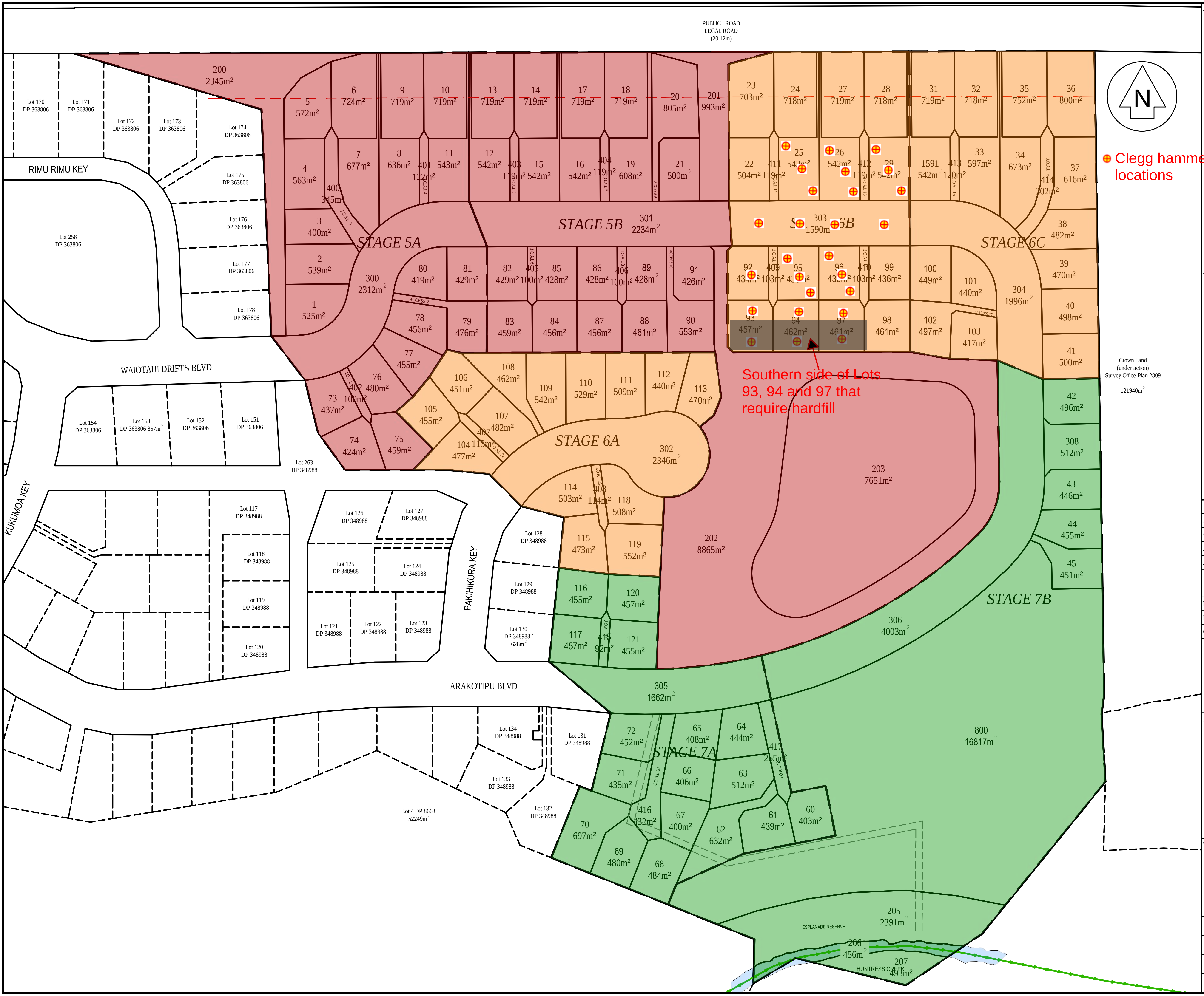
22 = 14, 18, 17.

H & S Comments:

See Over For Limitations and 5 x 5 Instructions

No issues observed

Photos: Yes



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: 4/22/21

FILE: 105006-150 Scheme B.dwg

SITE REPORT

EDC File No: 48749
Date: 14/04/23
BC/EPA No:
Time: 09:51
Weather: Overcast
Inspected by: Michael W
Site Manager: Paul

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.)

Site Address: Waiotahe Drifts

Compaction testing
Clegg Hammer

		1	2	3	4	5	6	7
RoW:	409	25	33	33				
	410	34	29	28				
Road Section:	303	41	40	55	37	34		
	304	44	34	34	41	50	47	

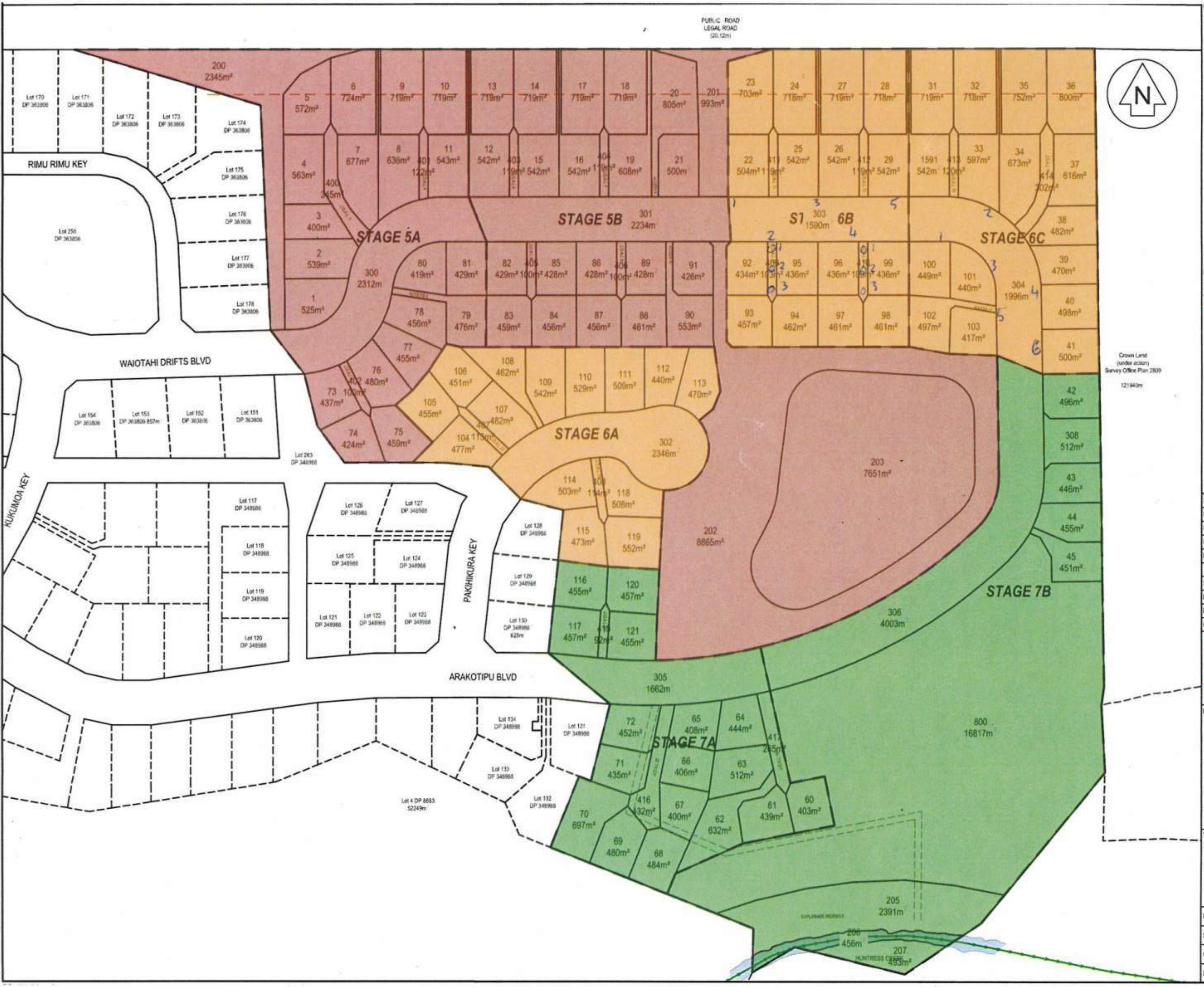
Hole locations
marked on
attached plans

Right of Way (RoW) Layer: AP65
Road layer: Sub grade

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

No Issues Observed

Photos: ✓



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

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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

Photo 1: JOAL 409

Photo 2: JOAL 410

Photo 3: Stage 6B Road, looking west

Photo 4: Stage 6C/6B road, looking west

Photo 5: Stage 6C road, looking south east

EDC

ADDRESS
Waiotahe Drifts

12/5/23

P/N

Stages 6B & 6C

SCALA PENETROMETER TEST FIELD RECORD

	SC1 28	SC2 34	SC3 33	SC4 30	SC5 29	SC6 26	SC7 25	SC8 ~~3~~22
50	.25	x	x	x	x	x	x	X
100	.25	x	x	.3	.3	1	x	.5
150	.25	.5	.33	.3	.3	1	.5	.5
200	.25	.5	.33	.3	.3	1	.5	1
250	.5	1	.37	1	1	1	.5	1
300	.5	1	1	1	1	3	.5	2
350	.5	1	1	2	3	2	2	1
400	.5	2	1	2	2	4	2	4
450	1	2	1	2	5	4	3	4
500	2	2	1	34	4	3	3	3
550	3	2	1	4	5	6	3	2
600	4	2	1	Bouncing	5		4	3
650	3	2	2		6	Bouncing		Bouncing
700	3	2	3				Bouncing	
750	34	4	2		Bouncing			
800	4	4	5					
850	4							
900	45		Bouncing					
950	3							
1000	4							
1050	3							
1100	3							
1150	5							
1200	5							
1250	5							
1300	4							
1350	45							
1400	5							
1450	5							
1500	54							
1550	84							
1600	75							
1650	75							
1700	87							
1750	67							
1800	8							
1850	98							
1900	7							
1950								
2000								

EDC

ADDRESS
Waiotchi
[illegible]

12/5/23

P/N
Stages 6B & 6C

SCALA PENETROMETER TEST FIELD RECORD

	SC1 100	SC2 99	SC3 96	SC4 95	SC5 23	SC6 24	SC7 27	SC8 28?
50	X	X	X	.5	X			
100	.5	.3	X	.5	.5	.5	X	
150	.5	.3	.3	.3	.5	.5	1	
200	.5	.3	.3	.3	1	1	.5	
250	.5	1	.3	.3	1	1	.5	
300	1	1	.5	1	1	2	1	
350	~~3~~ 2	2	.5	1	2	1	1	
400	1	1	1	2	2	2	2	
450	2	3	2	2	4	2	2	
500	3	3	2	2	4	4	3	
550	3	5	2	2	4	3	3	
600	2	5	3	2	5	5	5	
650	3	7	2	3	6	5	4	
700	4	bunch	1	2	6	4	6	
750	3		2	5	6	4	6	
800	4		1	bunch	bunch	4	5	
850	bunch		1			4	4	
900			bunch			4	5	
950						6	7	
1000						bunch	6	
1050							5	
1100							6	
1150							~~8~~ 6	
1200							7	
1250							8	
1300							9	
1350							bunch	
1400								
1450								
1500								
1550								
1600								
1650								
1700								
1750								
1800								
1850								
1900								
1950								
2000								

EDC

ADDRESS
Waiotahi Drifts

12/5/23

P/N

Stages 6B & 6C

SCALA PENETROMETER TEST FIELD RECORD

	SC1 92	SC2 93	SC3 94	SC4 97	SC5 98	SC6 102	SC7 103	SC8 101
50	X	X	X	X	X	.5	X .25	X
100	1.5	.3	.3	.25	X	.5	X .25	X
150	.5	.3	.3	.25	.5 1.25	.5	.25	.5
200	1	.3	.3	.25	.5 1.2	.5	.5	.5
250	1	1	1.5	.25	.5	.5	.5	.5
300	1	.5	.5	0.5	.1	.5	2	.5
350	3	.5	21	.5	1	1	2	2
400	3	1	12	1	1	2	3	1
450	4	2	3	21	1	2	3	2
500	3	1	3	12	1	3	4	3
550	3	2		2	1	4	4	3
600	3	3	BNC	2	3	2	4	4
650	3	2			3	5	3	4
700	3	3		BNC	3	3	4	4
750	4	6			3	4	3	3
800	3	bench			6	6	5	3
850	3				3	5	bench	bench
900	4				4	6		
950					7	6		
1000					3	bench		
1050					4			
1100					5			
1150					4			
1200					6			
1250					3			
1300					4			
1350					3			
1400								
1450					BNC			
1500								
1550								
1600								
1650								
1700								
1750								
1800								
1850								
1900								
1950								
2000								

APPENDIX D

GEOLAB BENKELMAN BEAM RESULTS

Tauranga Laboratory

Geolab Limited

25/38 Ashley Place,
Papamoa NZ 3118

Phone:027 475 4011

geolab

Benkelman Beam Deflection

Report No: BB:TAUR23S-01819
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:**

ACCREDITED IANZ TESTING LABORATORY

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.)

E. Paton

Approved Signatory: Eric Paton
(Director-Testing)
IANZ Accredited Laboratory Number:1352
Date of Issue: 18/04/2023

Site Details

Sample ID:	TAUR23S-01819	**Date Tested:**	17/04/2023
Source:	-	**Time Tested:**	10:55
Material:	GAP65	**Tested By:**	Kim Vitali
Project Location:	Waiotahe Downs		
Test Location:	Waiotahe Drifts Boulrvard		
Layer:	Subbase	**Offset From:**	Centre line

General Test Information

TNZ T/1

Axle Load (tonne): 8.20

Benkelman Beam Deflection Test Results

Disp. (m)	Offset (m)	Lane	Deflection (mm)
240	1	LHS Road	0.90
260	3	LHS Road	0.42
280	1	LHS Road	0.50
300	3	LHS Road	0.60
320	1	LHS Road	0.60
340	3	LHS Road	0.80
360	1	LHS Road	0.60
380	3	LHS Road	0.60
400	1	LHS Road	0.52
420	3	LHS Road	0.50
410	3	RHS Road	0.86
390	1	RHS Road	0.42
370	3	RHS Road	0.80
350	1	RHS Road	0.42
330	3	RHS Road	0.72
310	1	RHS Road	0.48
290	3	RHS Road	0.60
270	1	RHS Road	0.62
250	3	RHS Road	0.54

Comments

- TAUR23W00378

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	Percentage Passing 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	% Within Fraction 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	Percentage by Weight Lower Limit
37.5 - 19.0	87	70
19.0 - 9.5	73	70
9.5 - 4.75	72	70

Plasticity Index

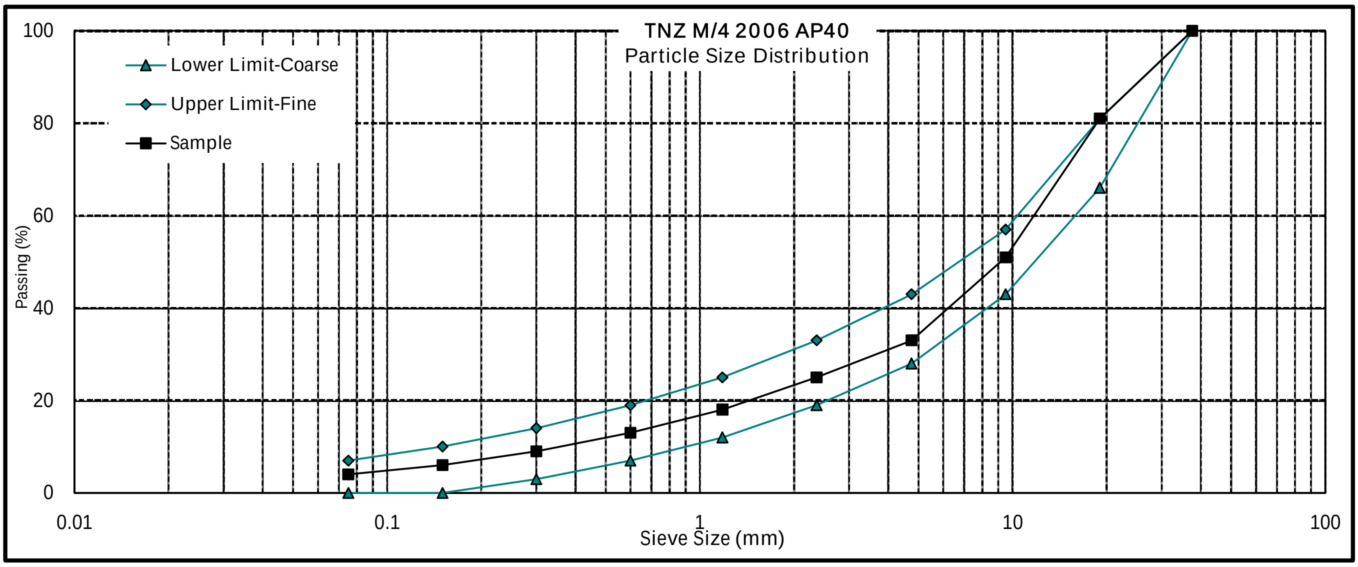
Sample PI	Not Tested
Specification	<= 5

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.

This report may only be reproduced in full

All information supplied by Client

IANZ Approved Signatory

Designation : *Laboratory Manager*

Date : 21/12/21

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

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

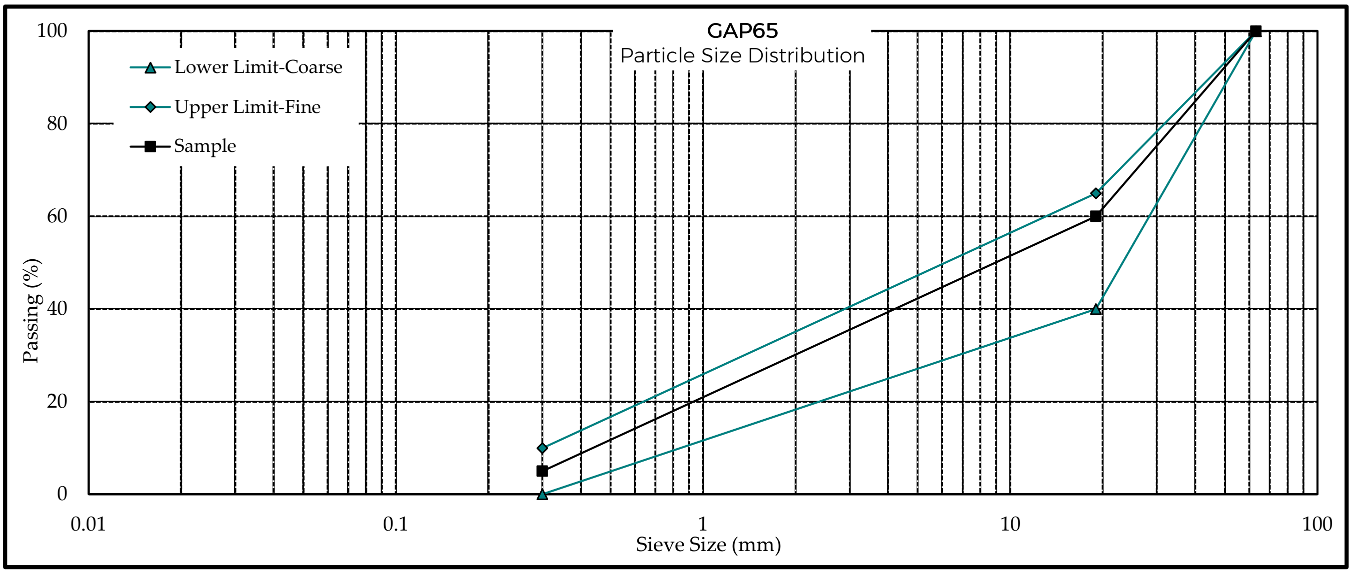
Sample CPL	**Not Tested**
Sample PI	-

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.

This report may only be reproduced in full

All information supplied by Client

IANZ Approved Signatory

Designation : *Laboratory Manager*

Date : 9/12/21

ACCREDITED IANZ TESTING LABORATORY

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

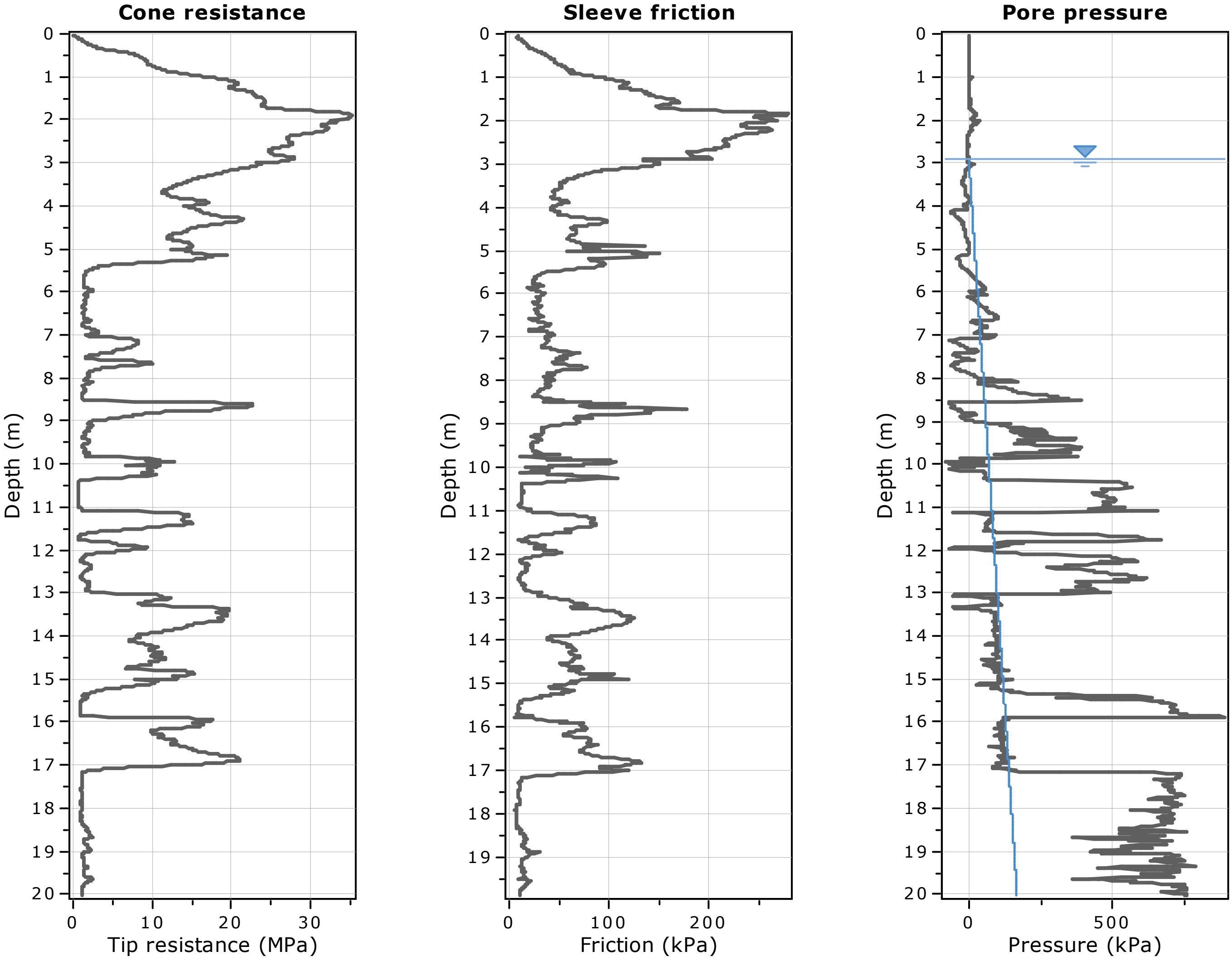
PF-LAB-043 (27/09/2021)

APPENDIX F

CONE PENETRATION TEST RESULTS & LIQUEFACTION ANALYSIS

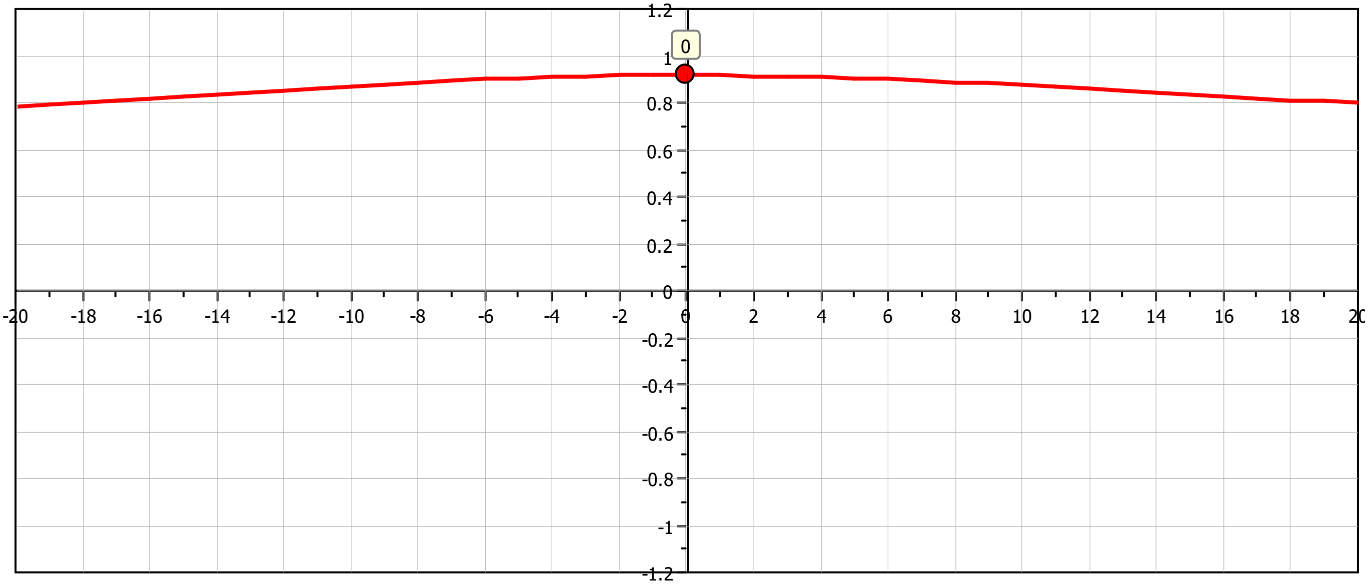
CPT: CPT 402
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**



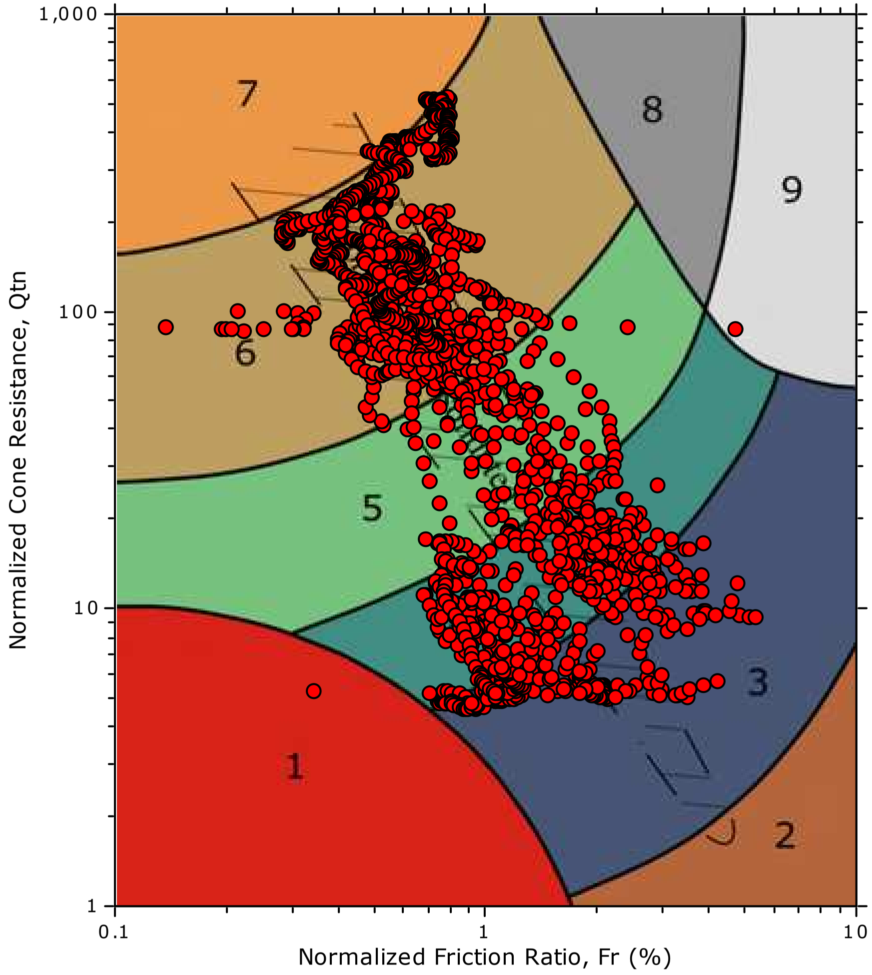
The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

Cross correlation between qc & fs

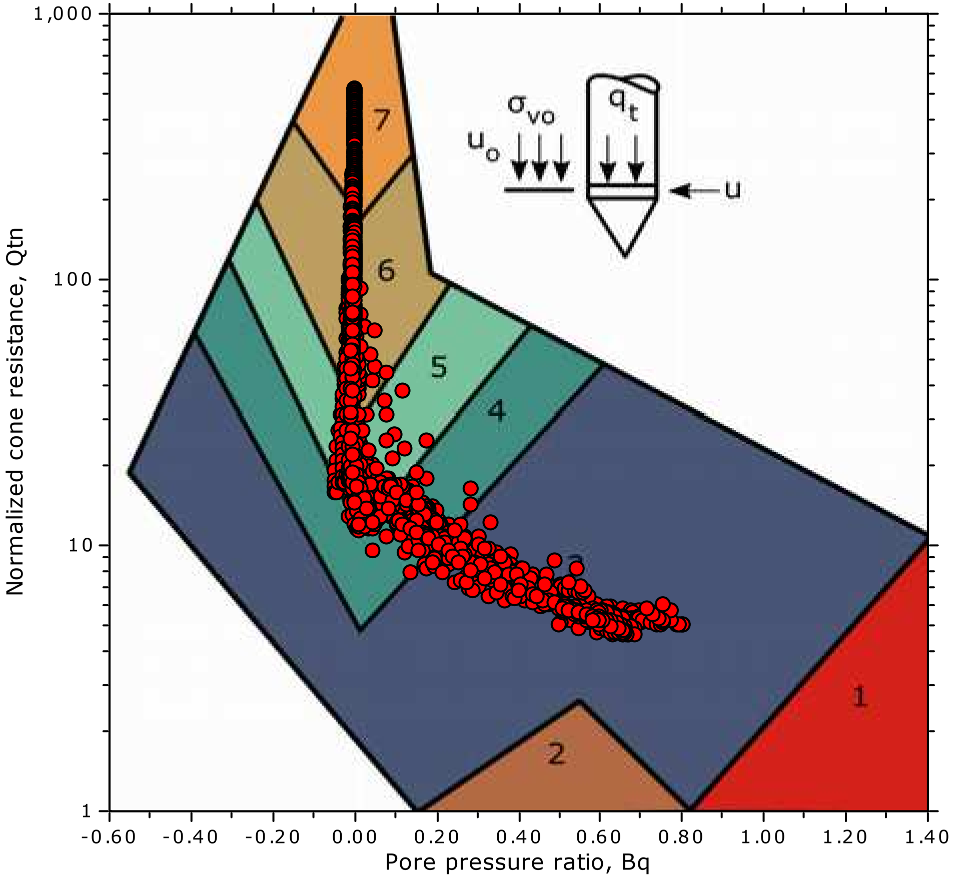


SBT - Bq plots (normalized)

SBTn plot



Normalized Bq plot



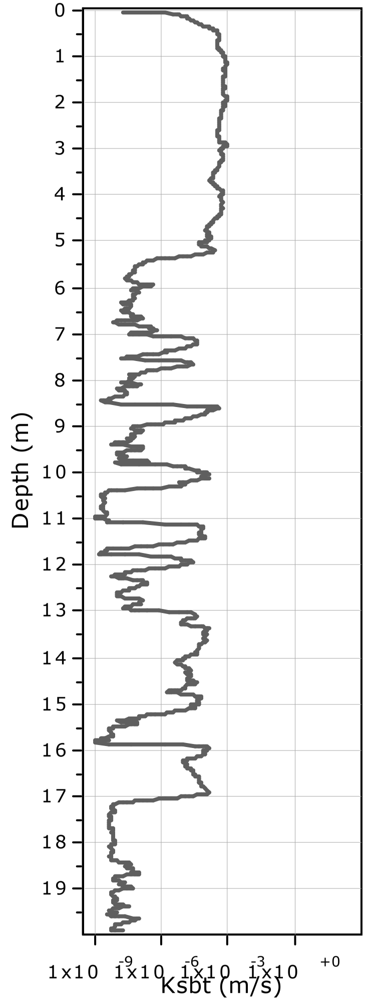
SBTn legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬜ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

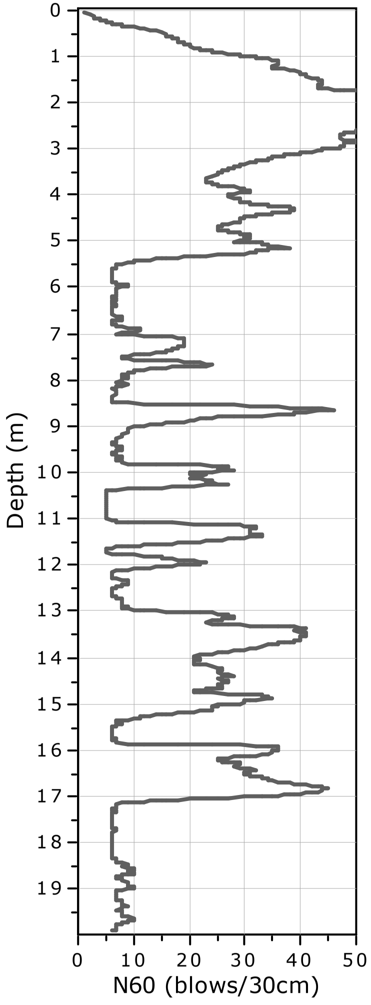
CPT: CPT 402
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

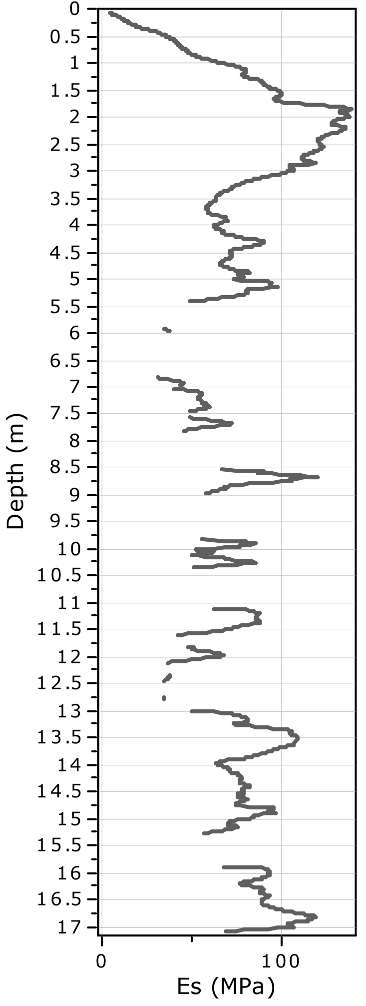
Permeability



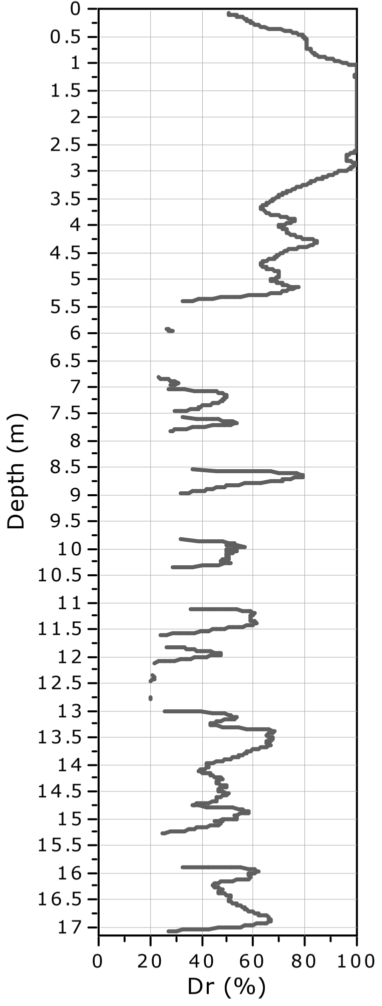
SPT N60



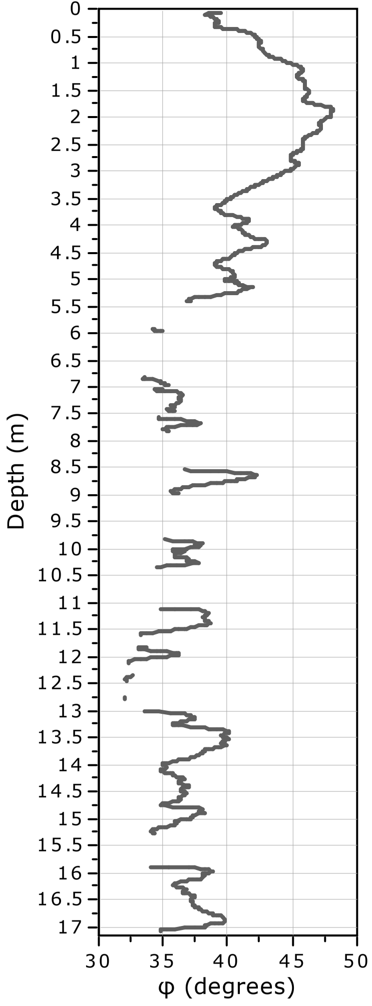
Young's modulus



Relative density



Friction angle



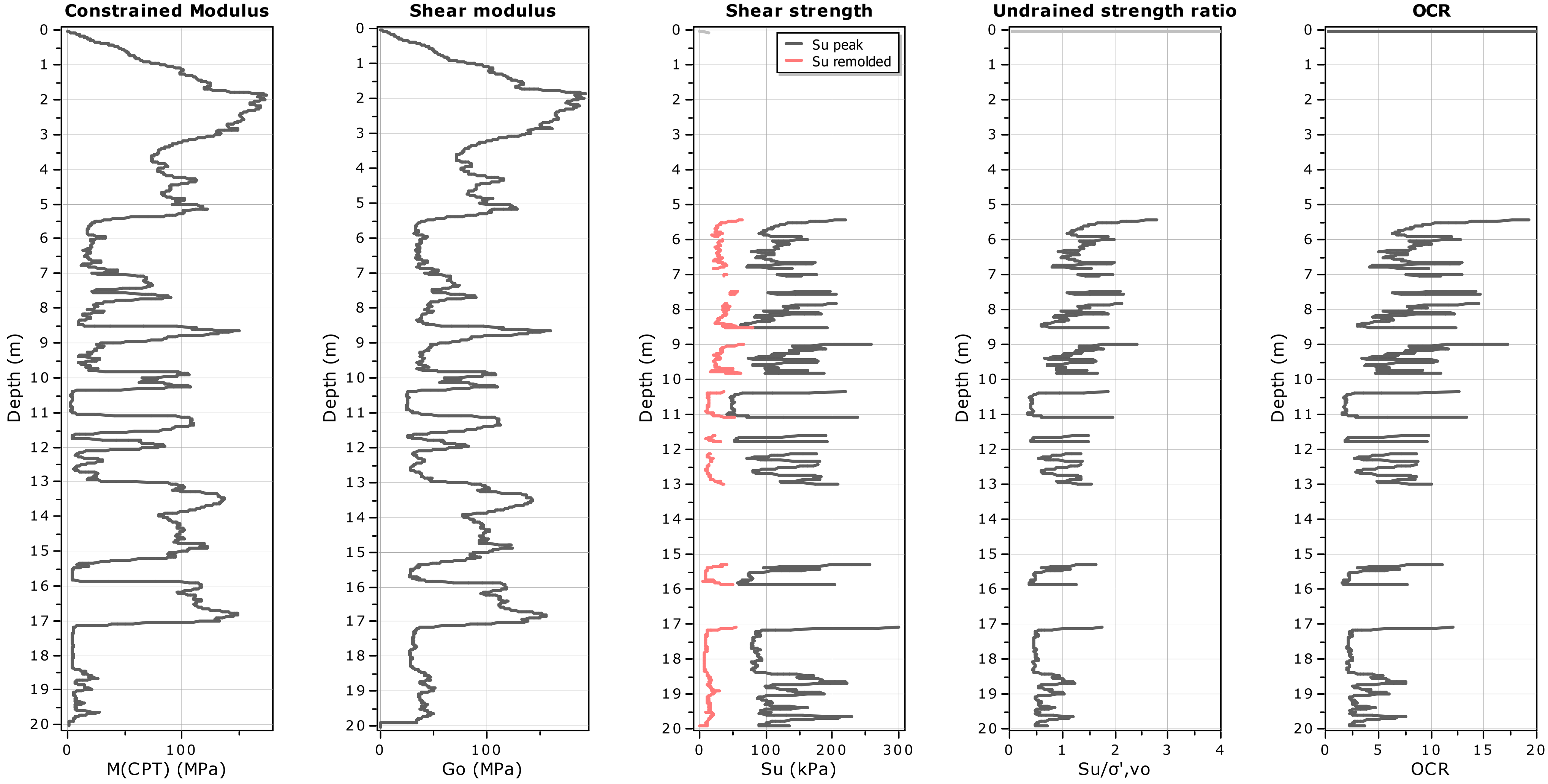
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CPT: CPT 402
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto

OCR factor for clays, N_{kt}: Auto
—●— Flat Dilatometer Test data

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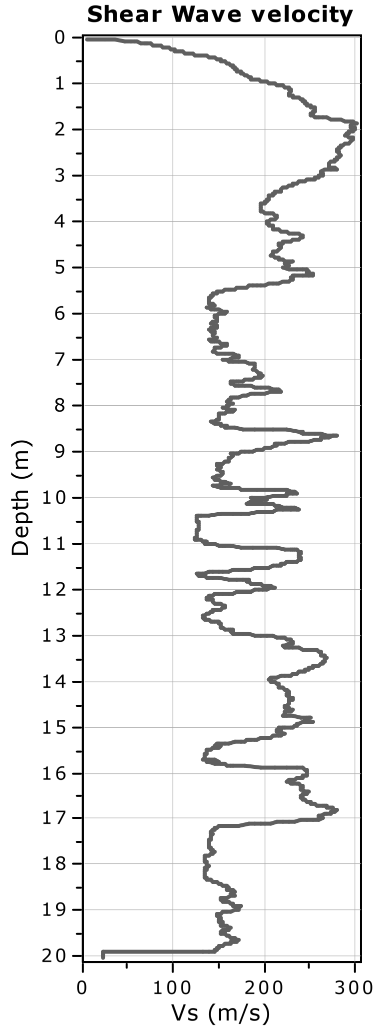
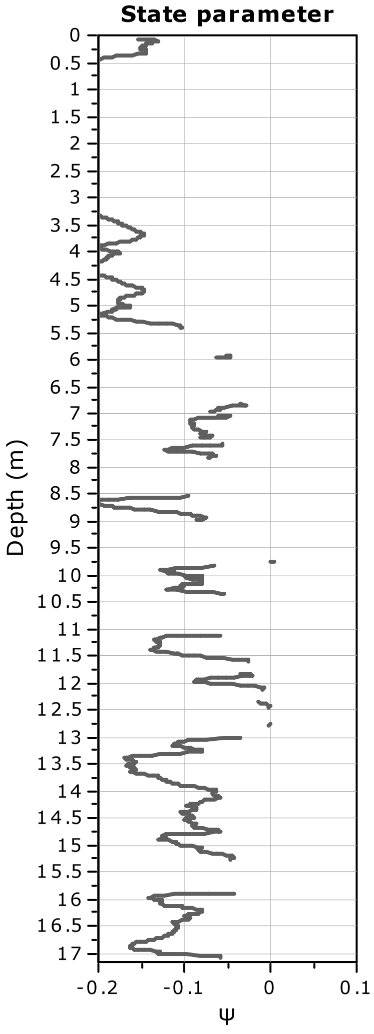
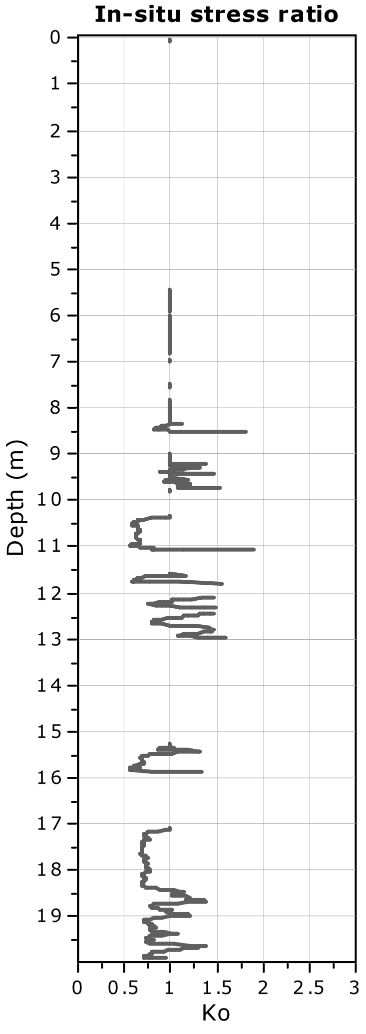
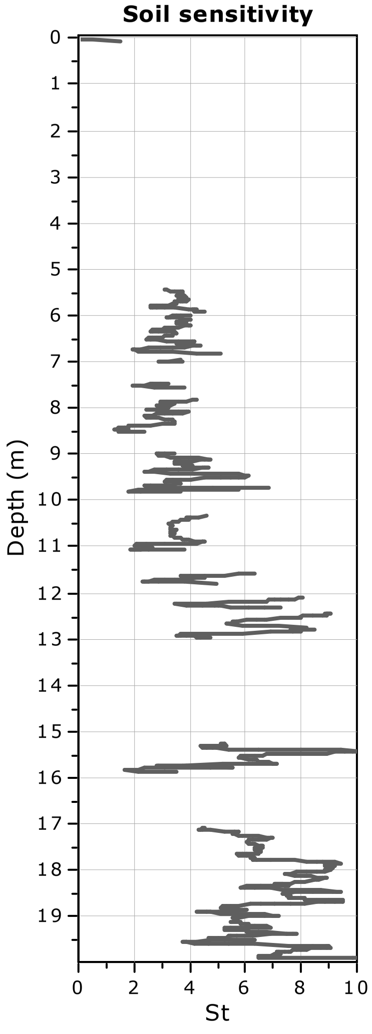
Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

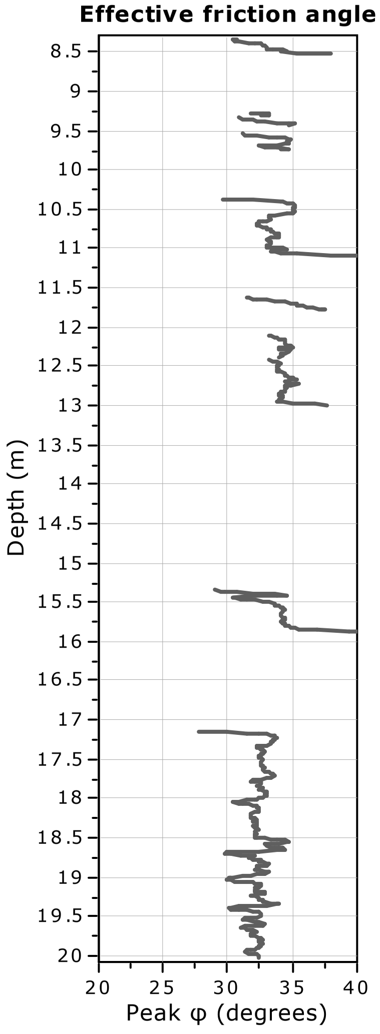
CPT: CPT 402
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:


Shear Wave velocity


State parameter


In-situ stress ratio


Soil sensitivity


Effective friction angle

Calculation parameters

Soil Sensitivity factor, N_S: 7.00

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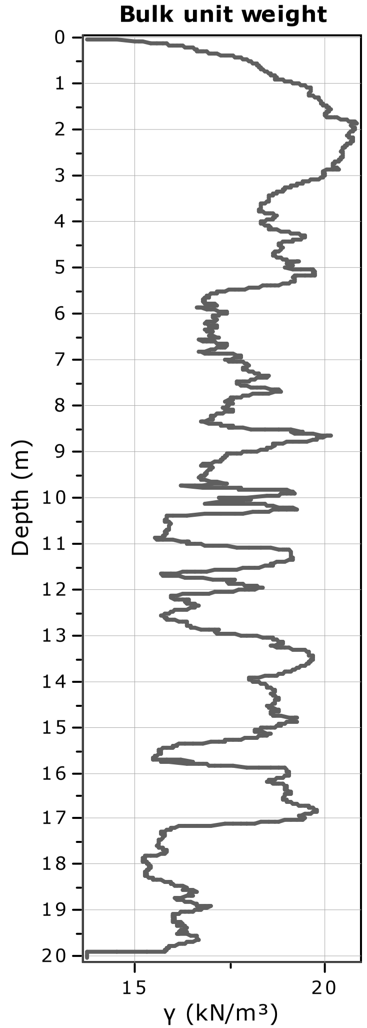
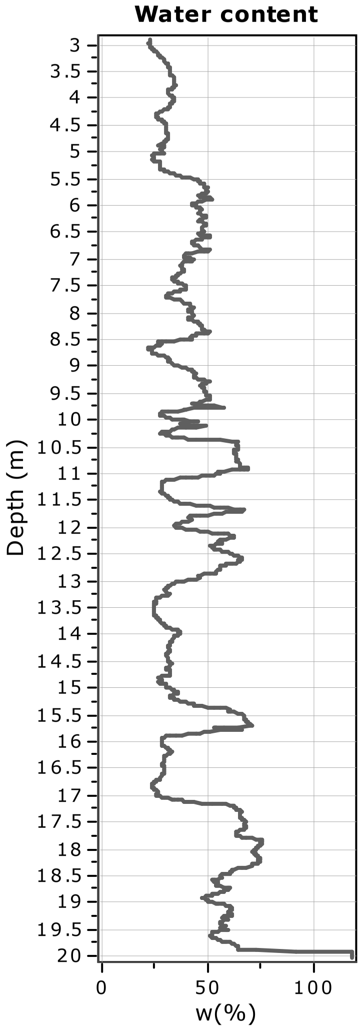
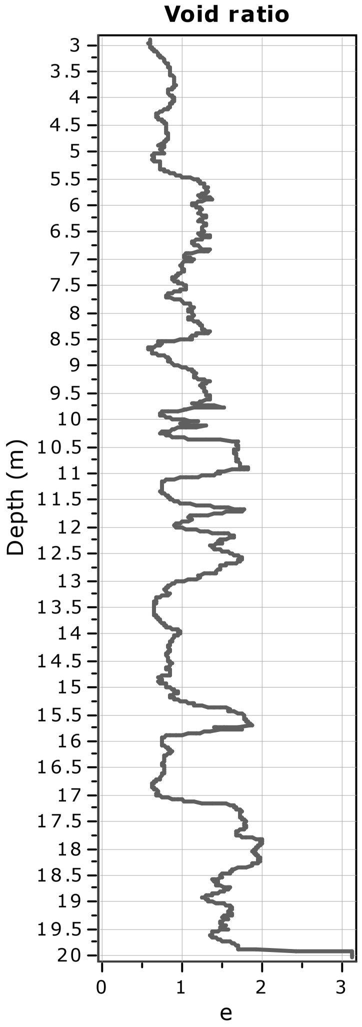
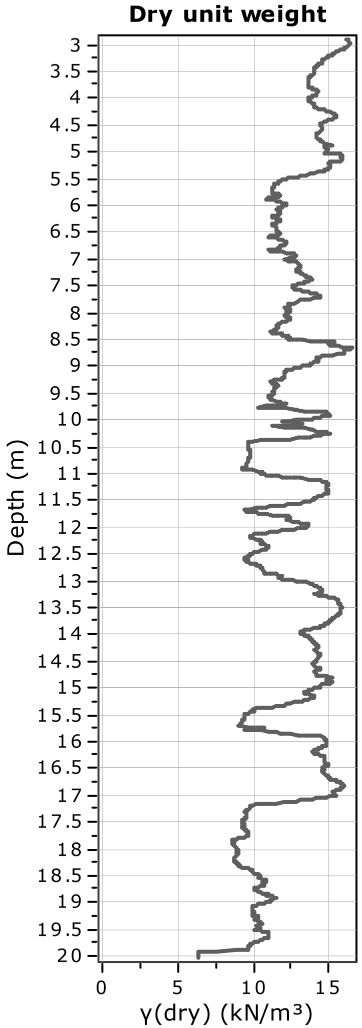
Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

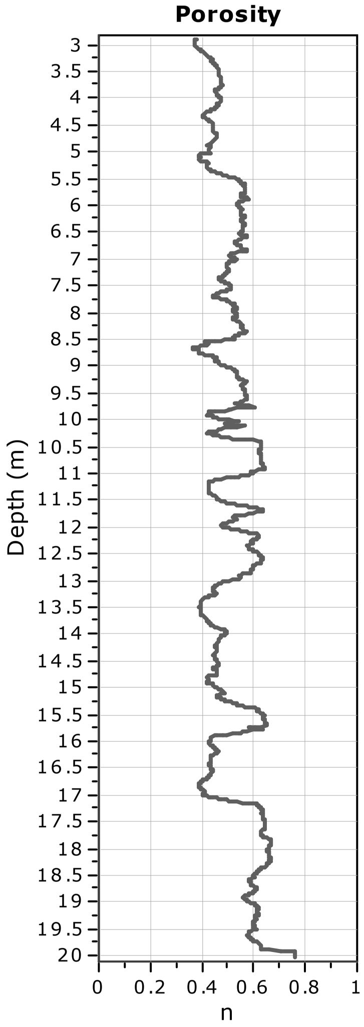
CPT: CPT 402
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:


Bulk unit weight


Water content


Void ratio


Dry unit weight


Porosity

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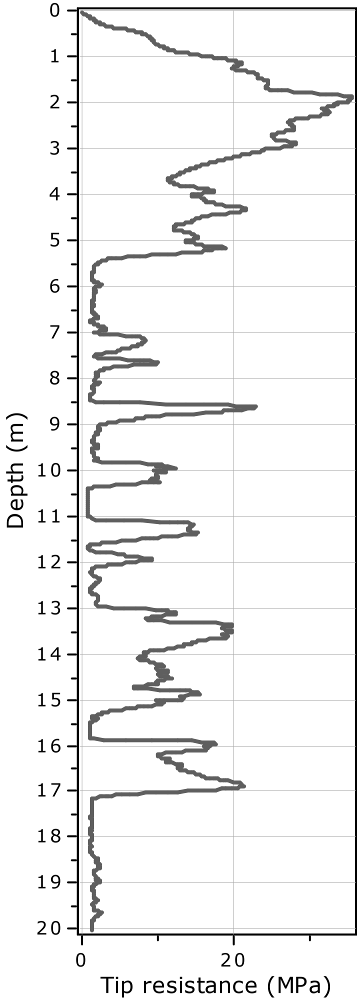
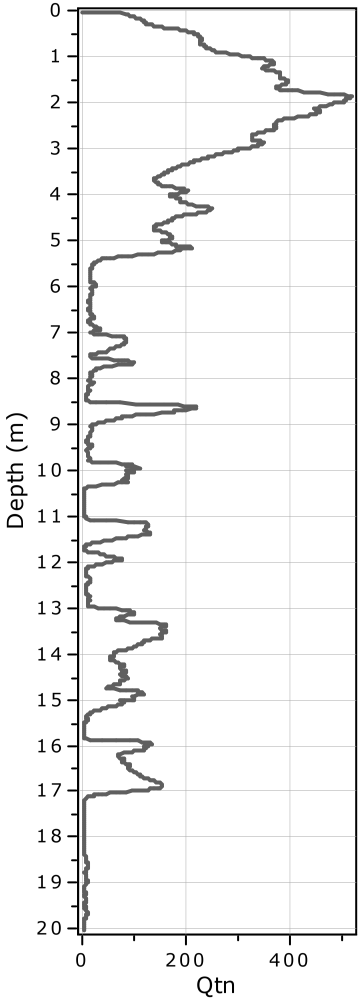
Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

CPT: CPT 402
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

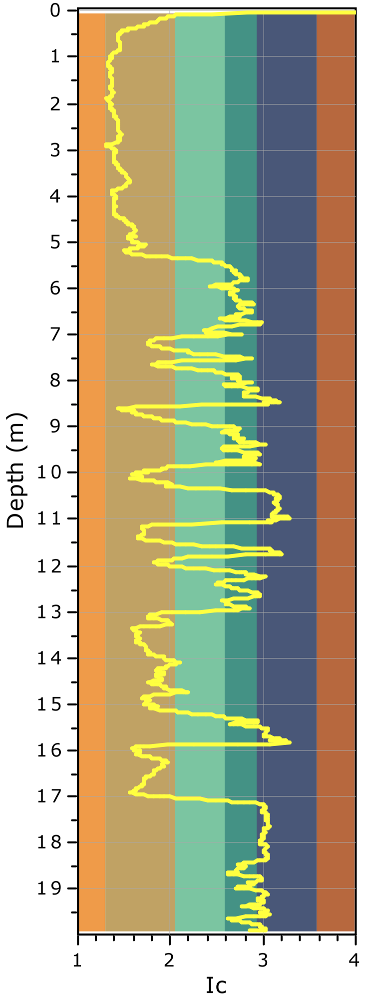
Cone resistance qt



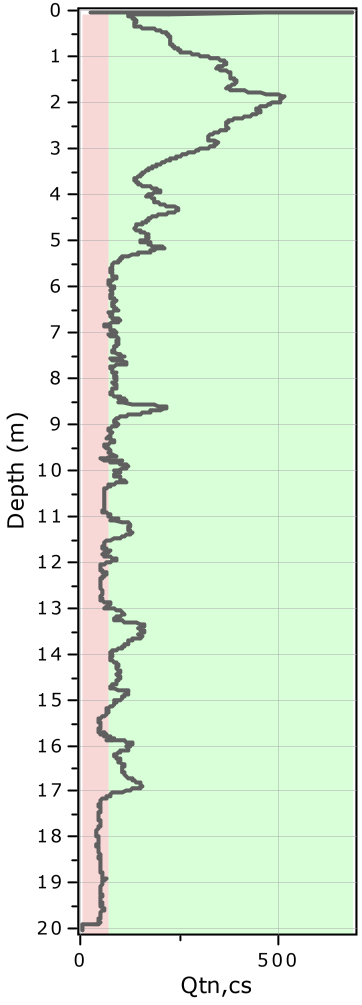
Norm. cone resistance



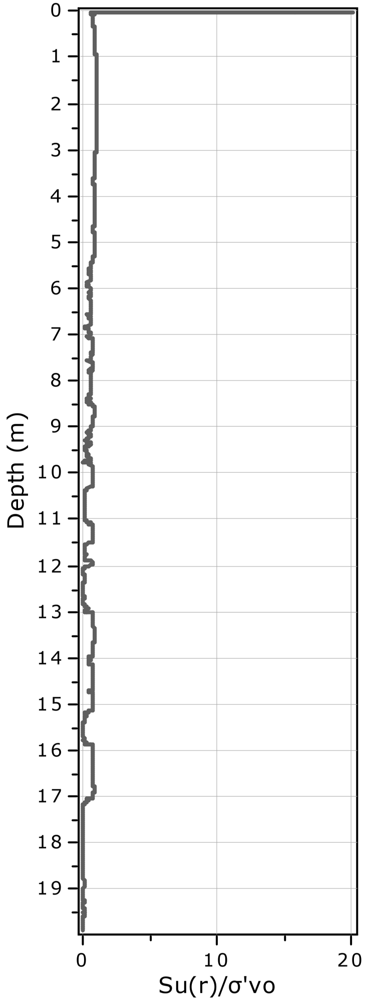
SBTn Index



Clean sand equivalent

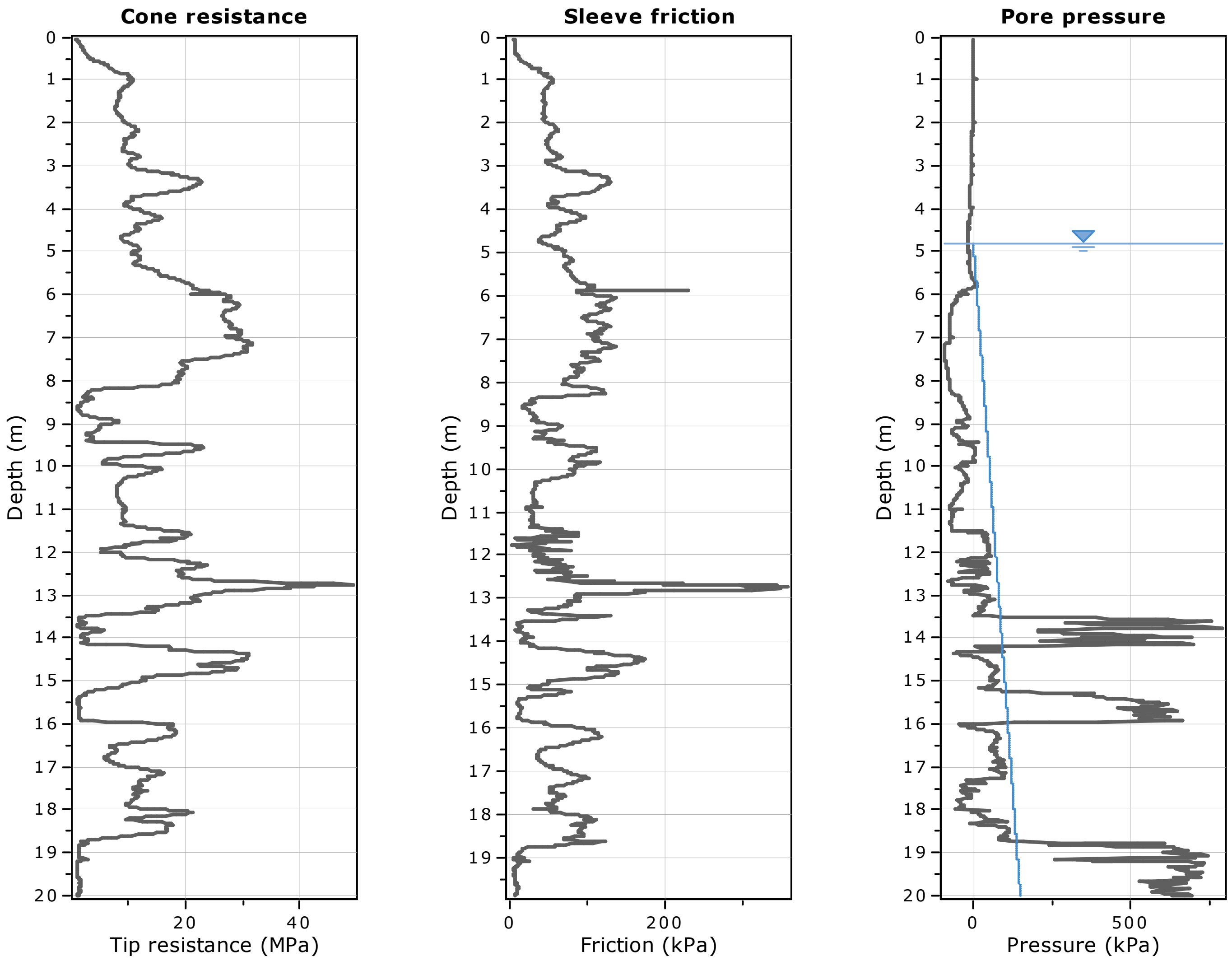


Residual strength ratio

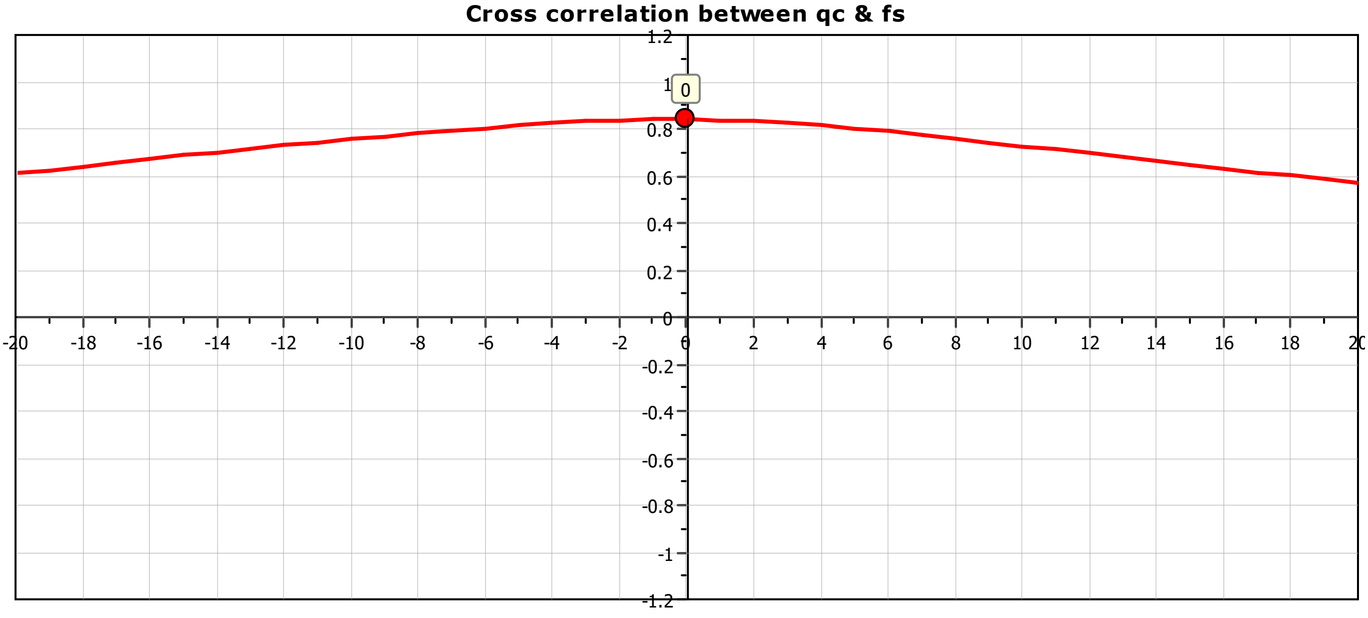


CPT: CPT 401
Total depth: 20.00 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

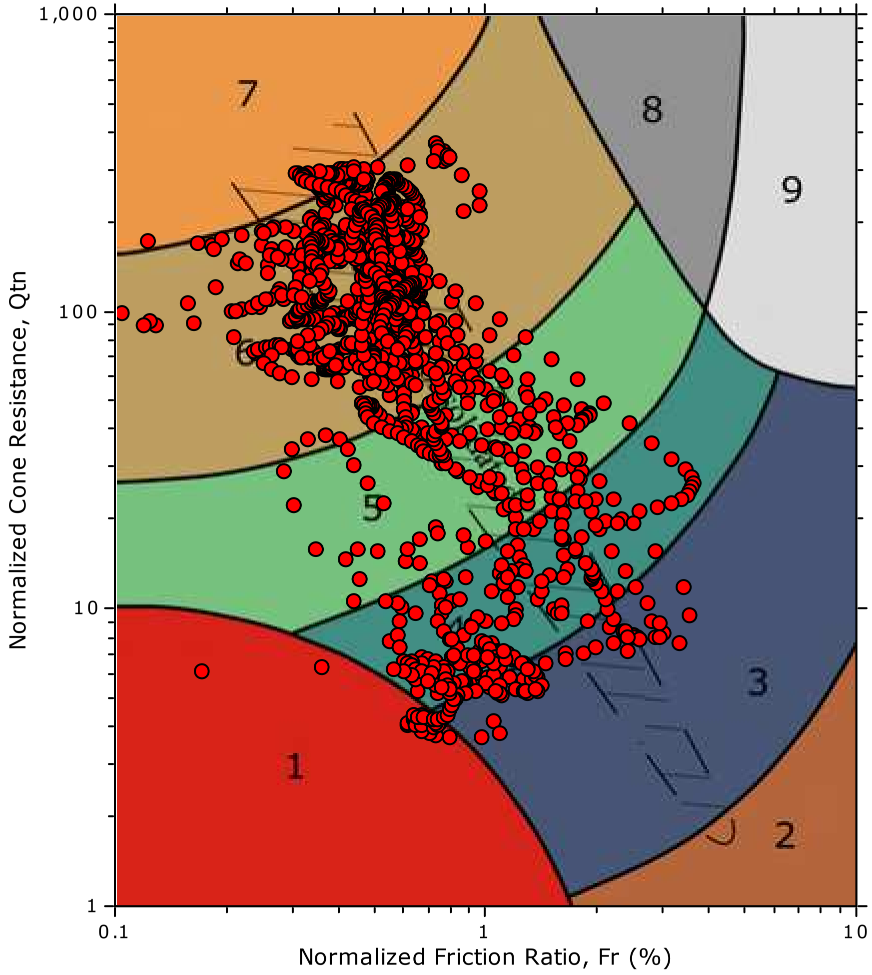


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

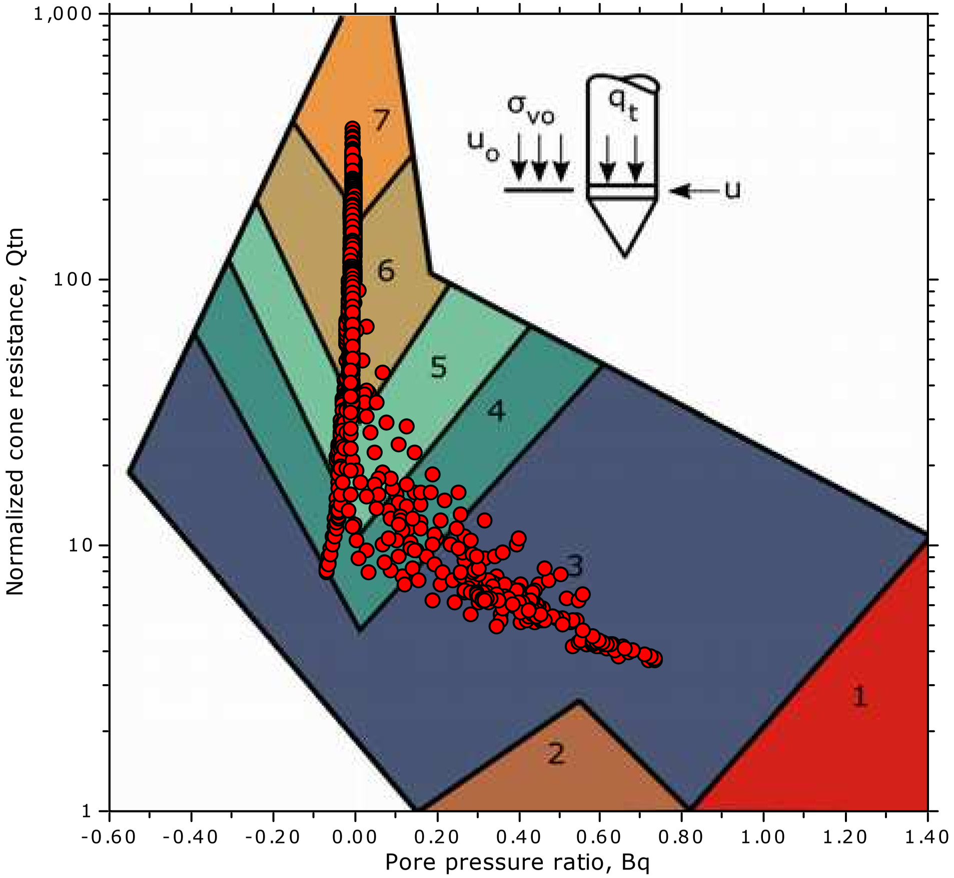


SBT - Bq plots (normalized)

SBTn plot



Normalized Bq plot



SBTn legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

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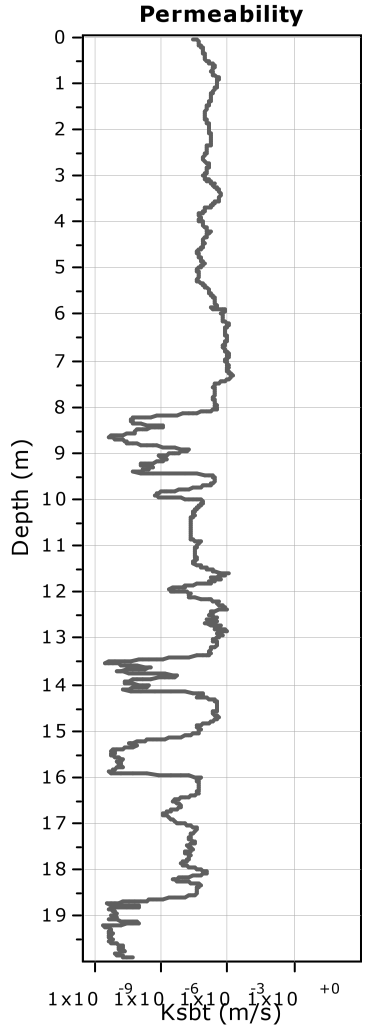
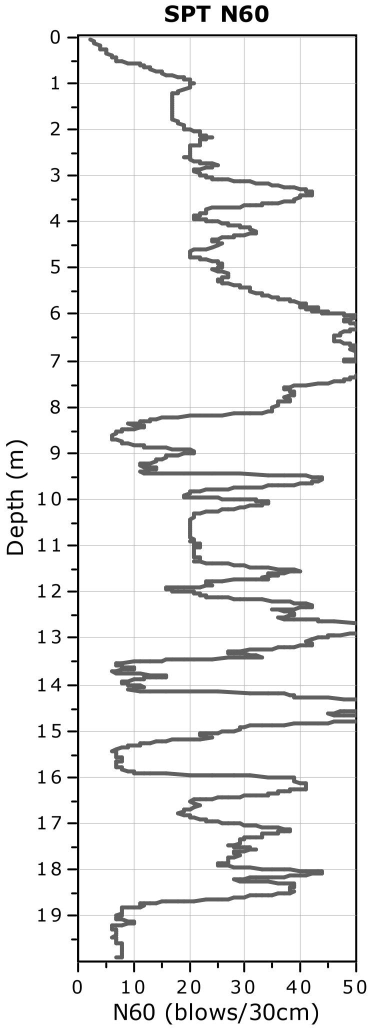
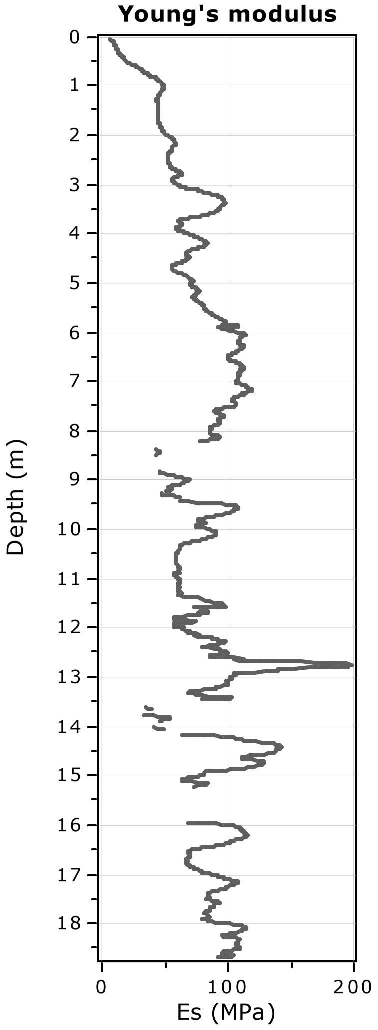
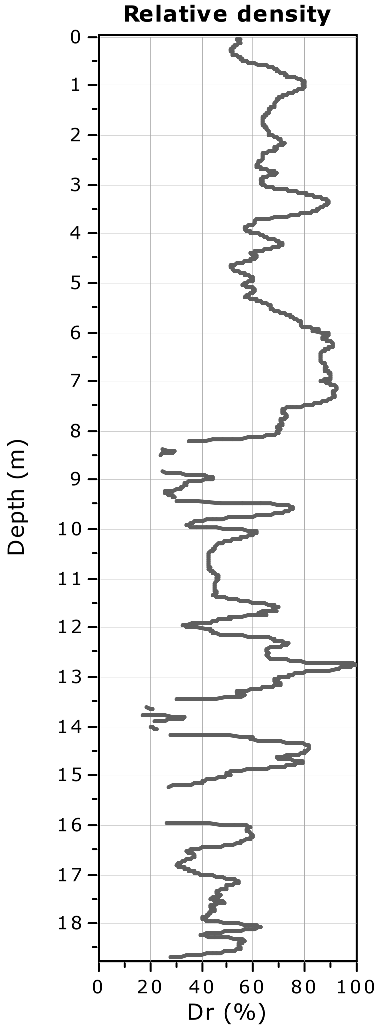
CPT: CPT 401
Total depth: 20.00 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

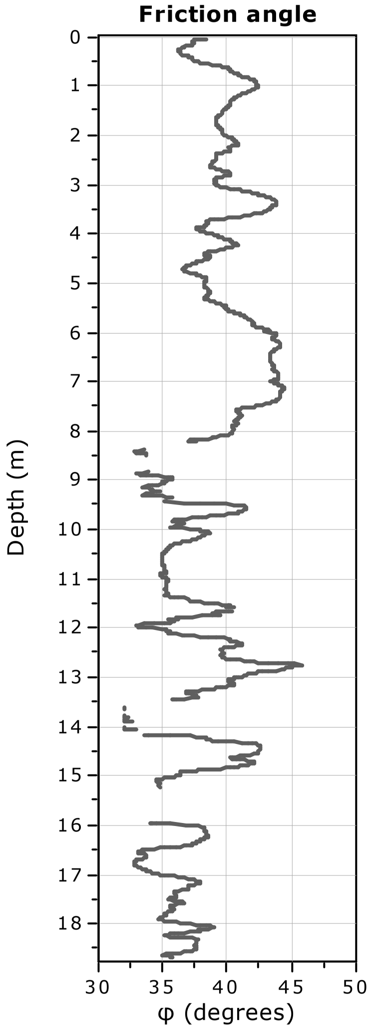
Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**











Calculation parameters

Permeability: Based on SBT_n

SPT N_{60}: Based on I_c and q_t

Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

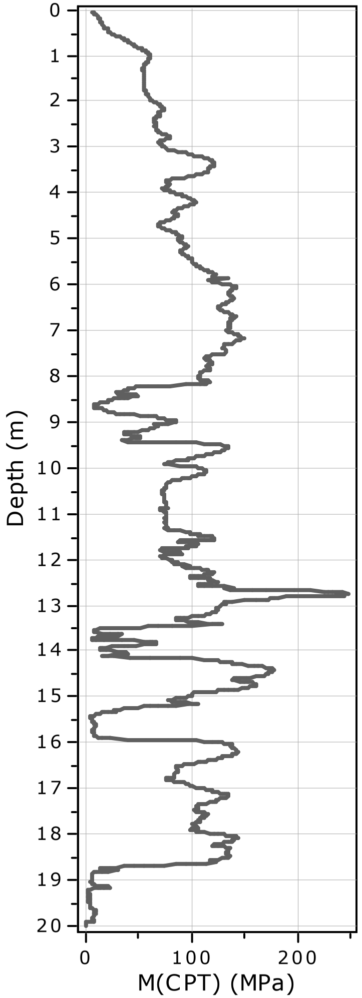
Relative density constant, C_{Dr}: 350.0

Phi: Based on Kulhawy & Mayne (1990)

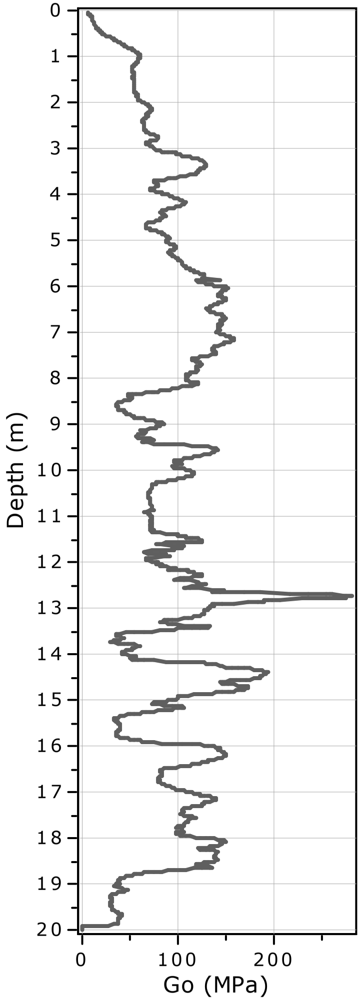
CPT: CPT 401
Total depth: 20.00 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

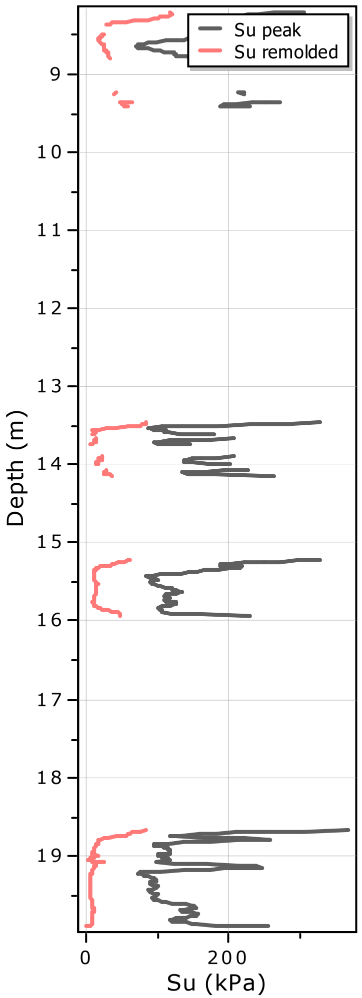
Constrained Modulus



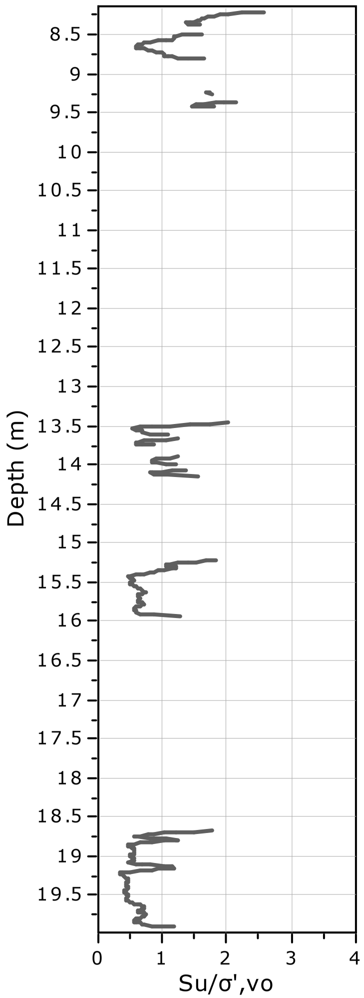
Shear modulus



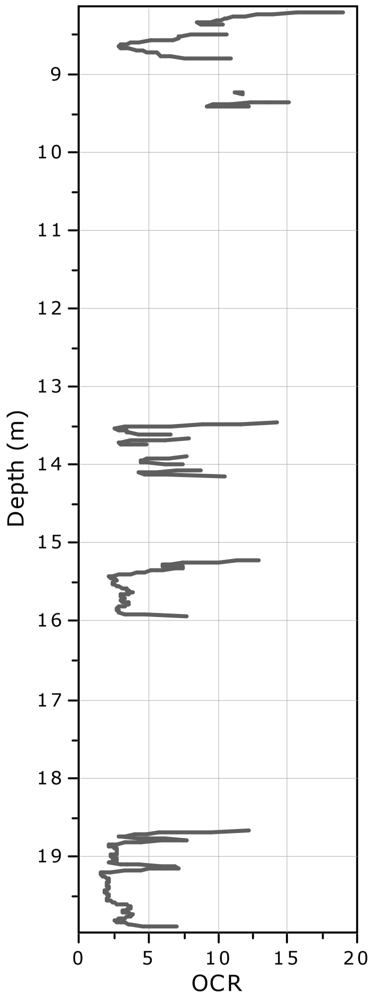
Shear strength



Undrained strength ratio



OCR



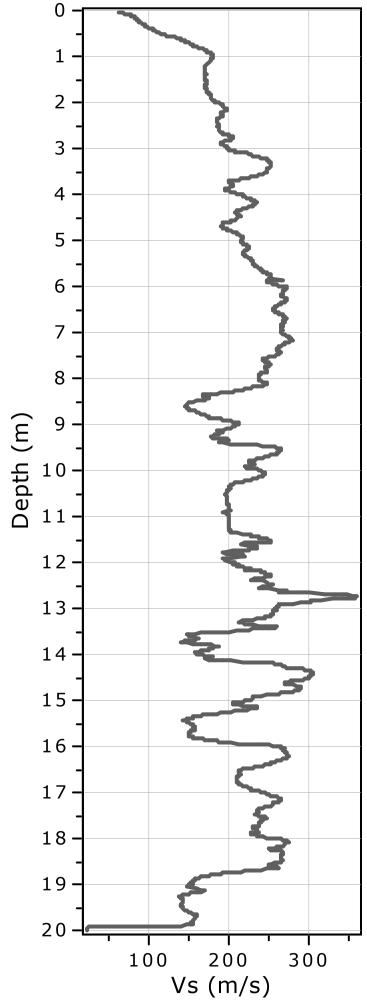
Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto

OCR factor for clays, N_{kt}: Auto
—●— Flat Dilatometer Test data

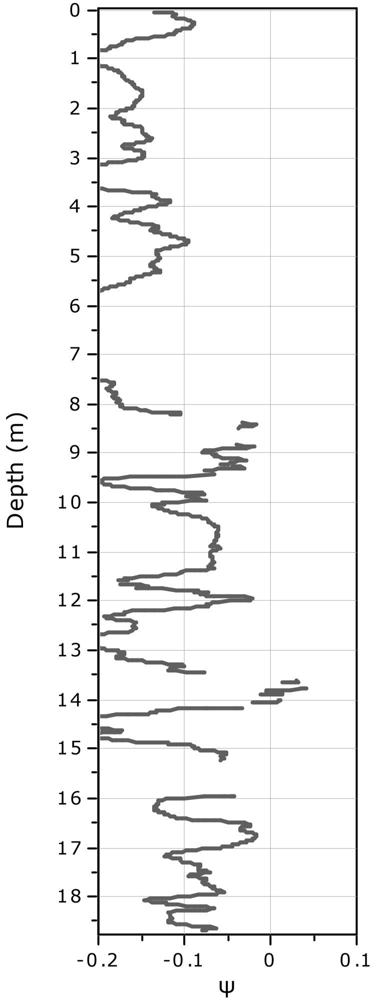
CPT: CPT 401
Total depth: 20.00 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

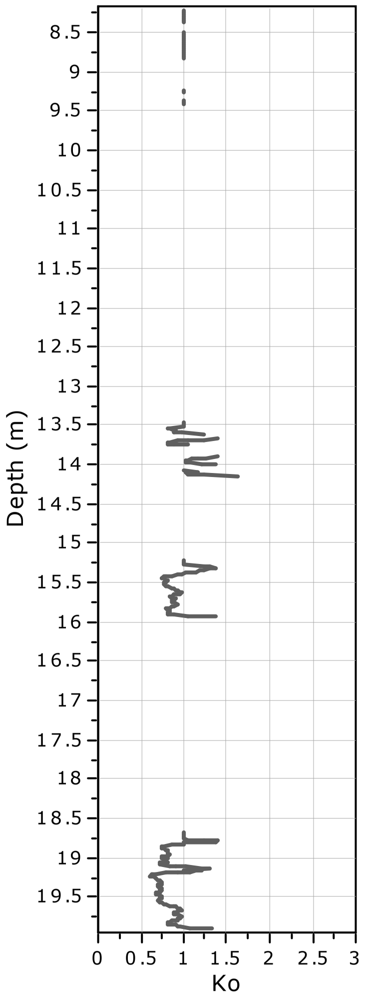
Shear Wave velocity



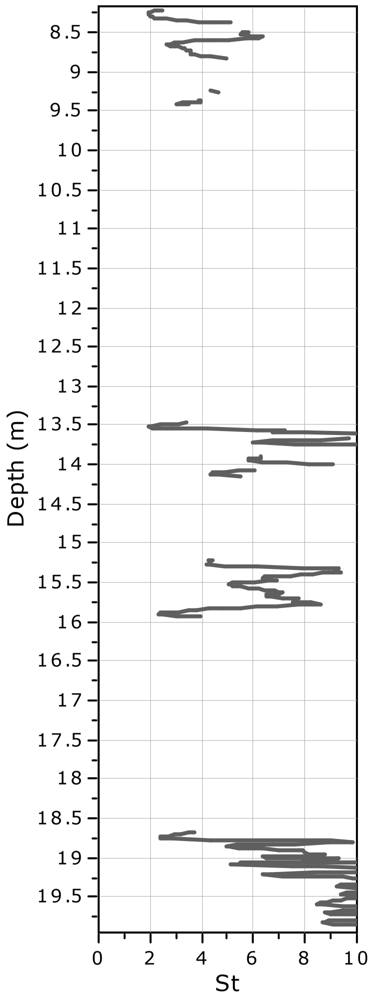
State parameter



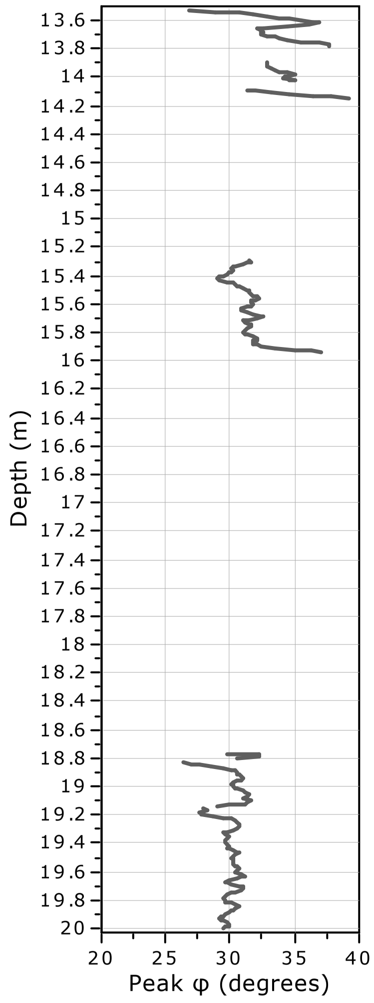
In-situ stress ratio



Soil sensitivity



Effective friction angle



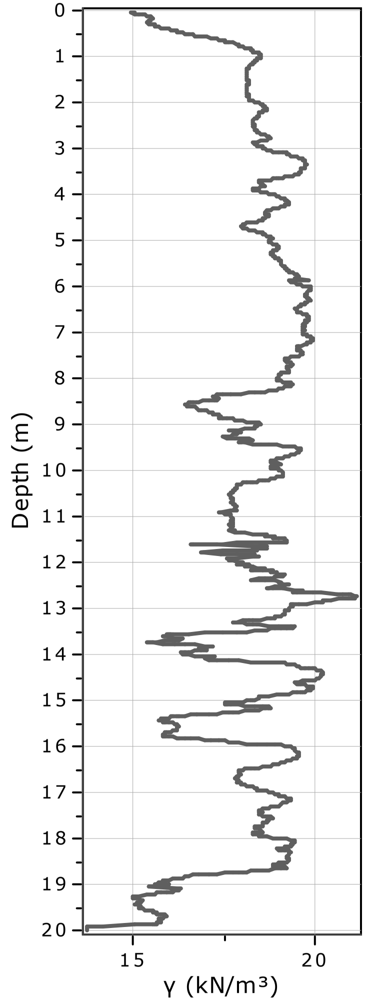
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

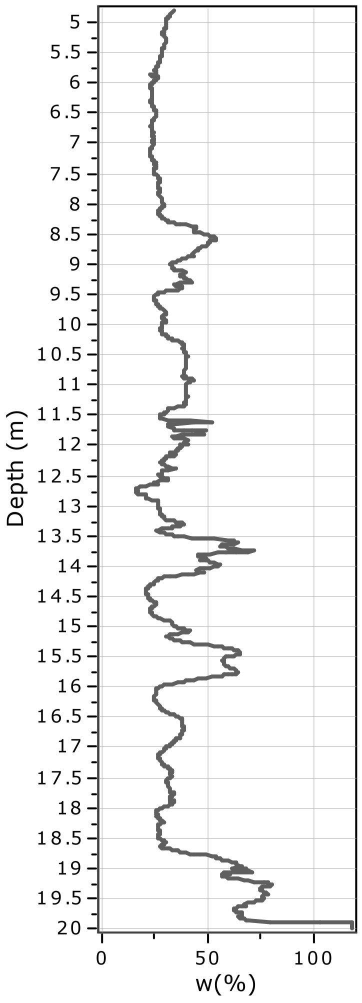
CPT: CPT 401
Total depth: 20.00 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

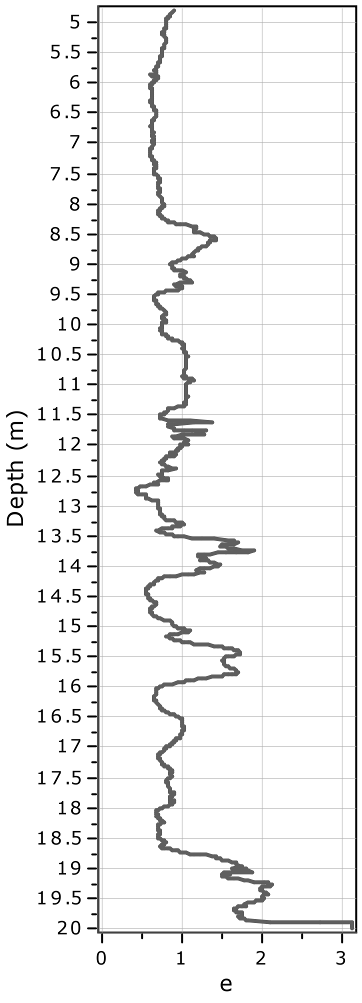
Bulk unit weight



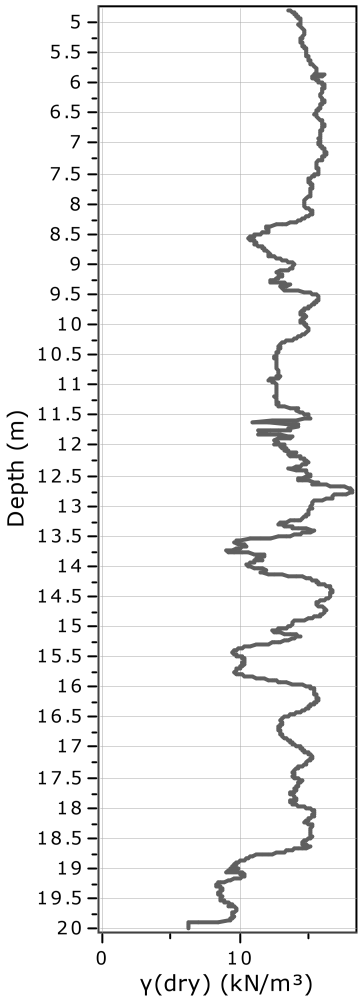
Water content



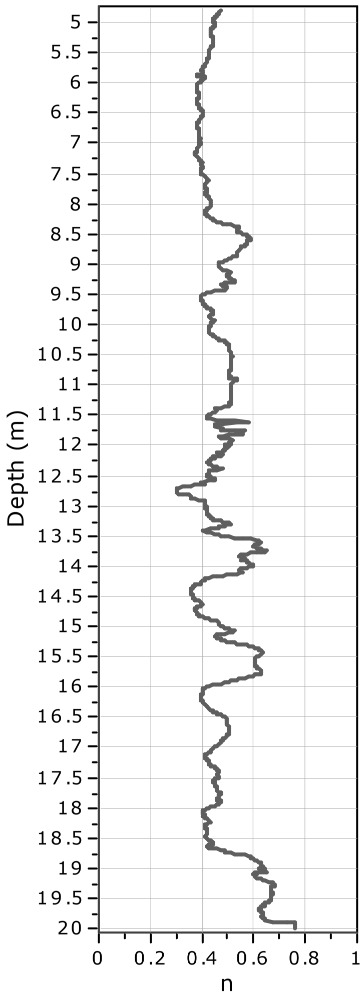
Void ratio



Dry unit weight

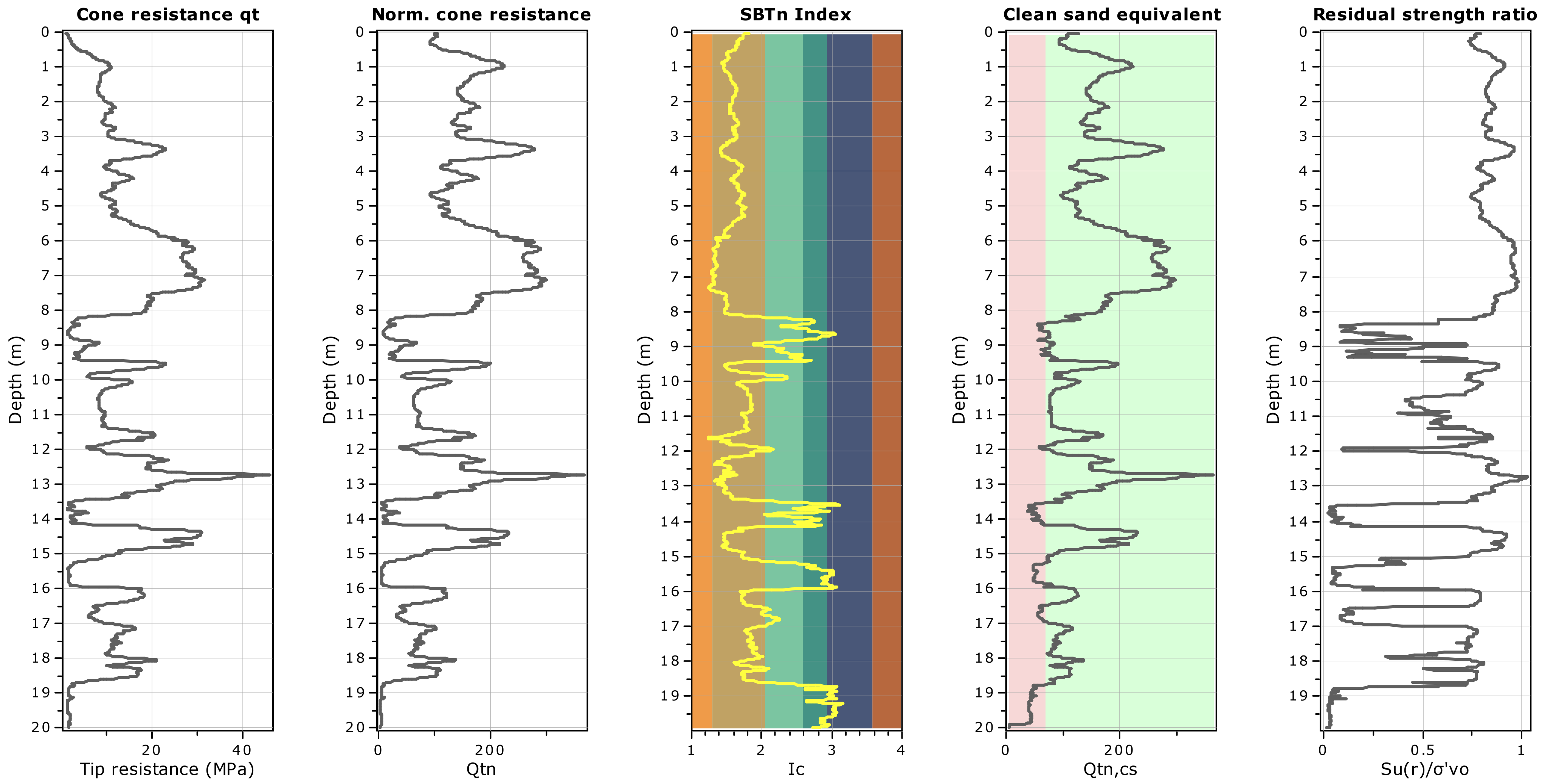


Porosity



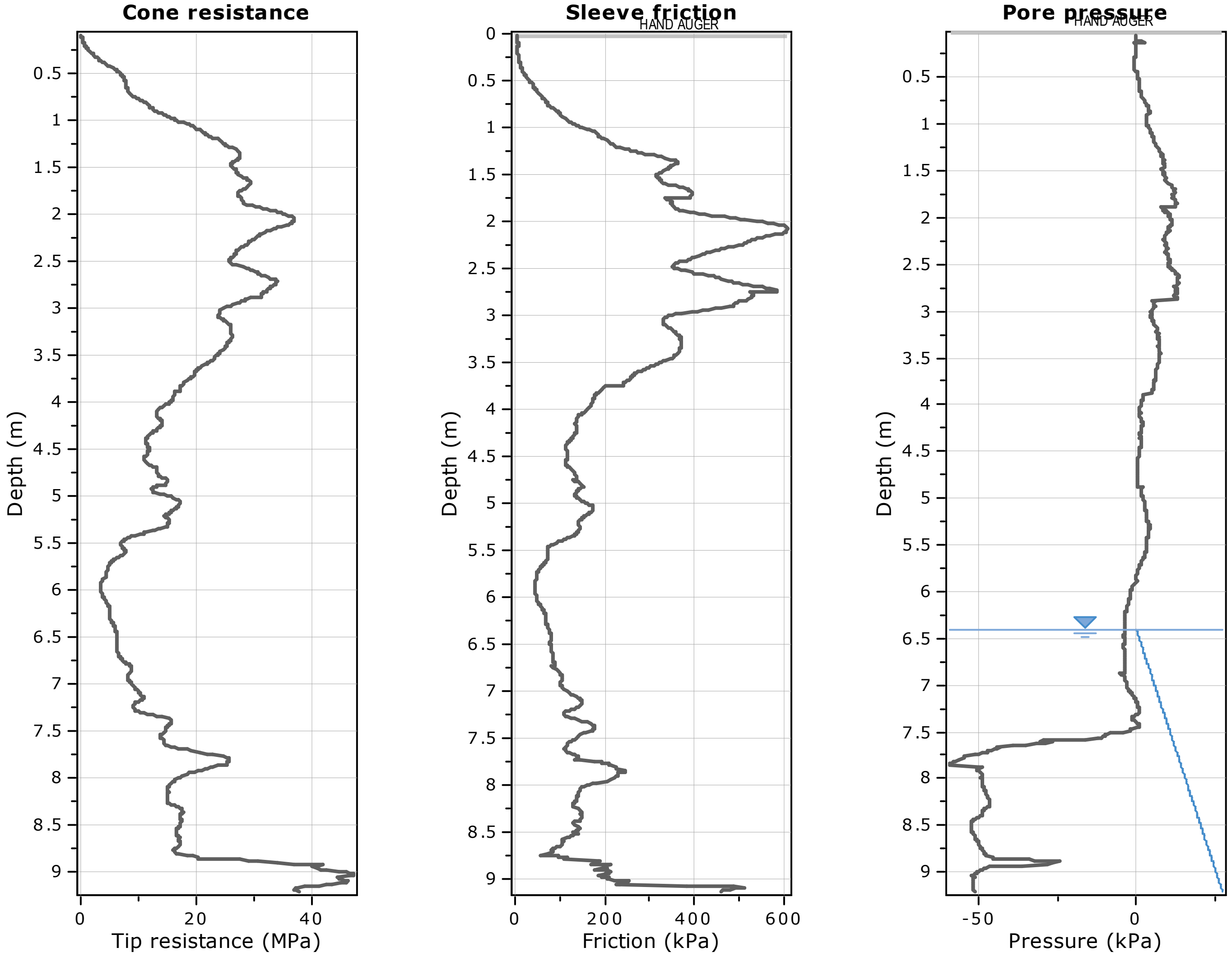
Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

CPT: CPT 401
Total depth: 20.00 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

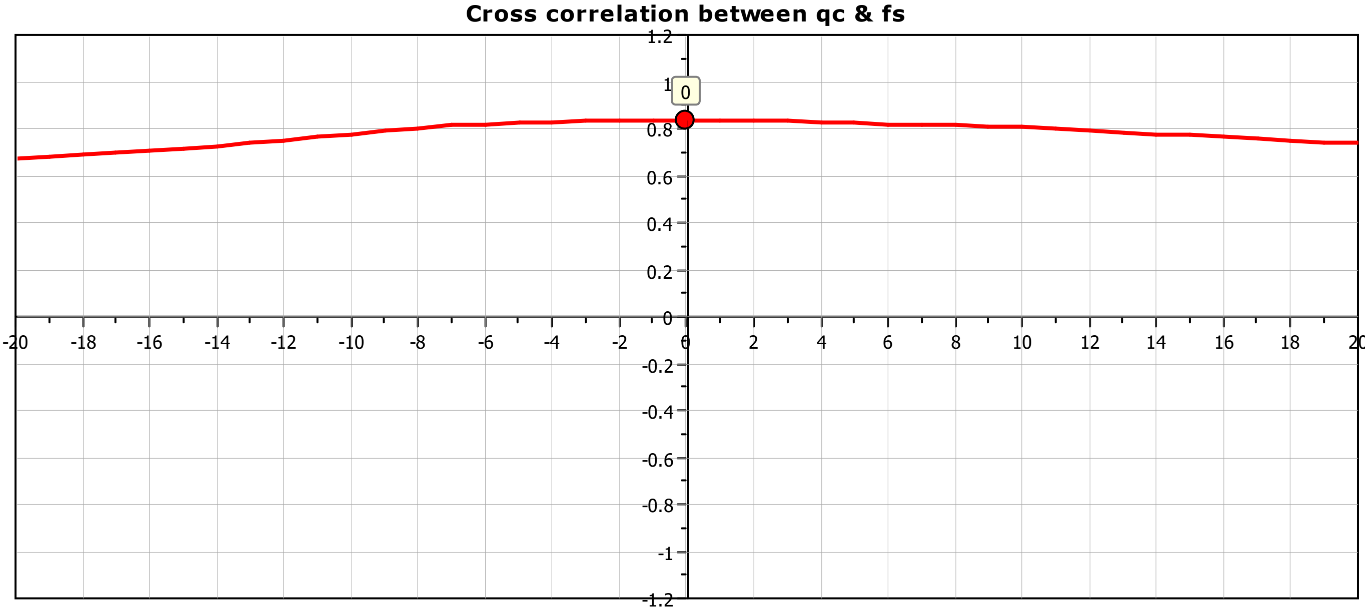


CPT: CPT 202
Total depth: 9.21 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

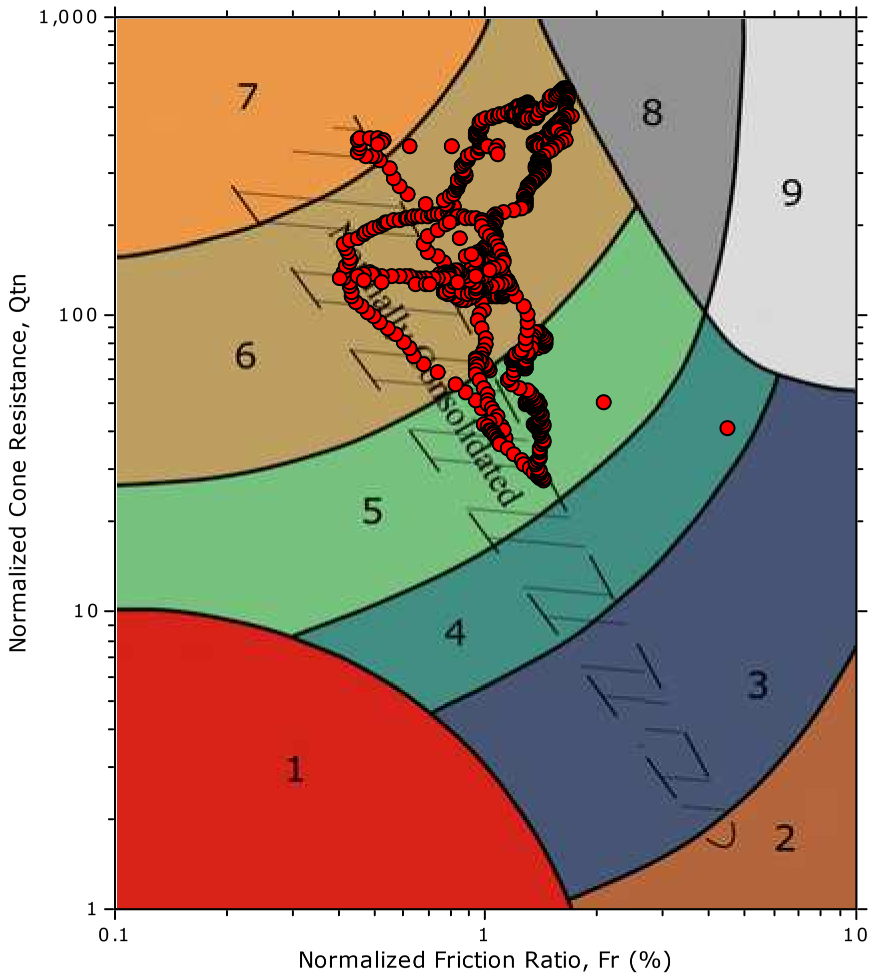


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

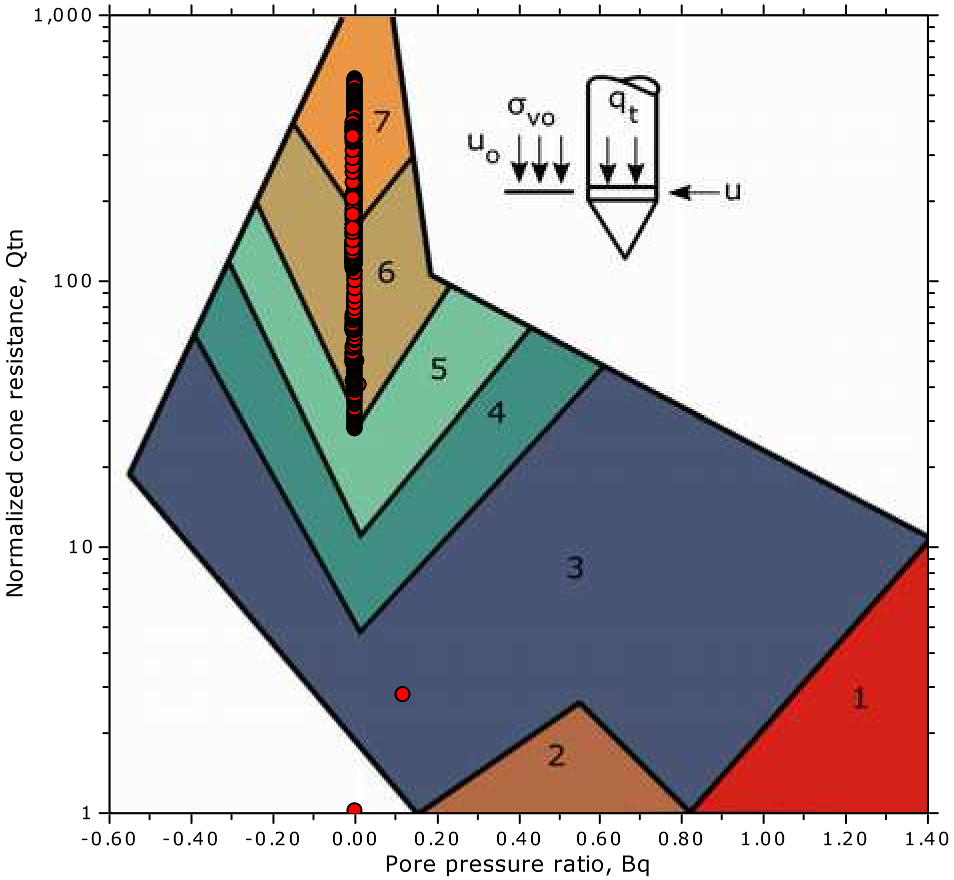


SBT - Bq plots (normalized)

SBTn plot



Normalized Bq plot

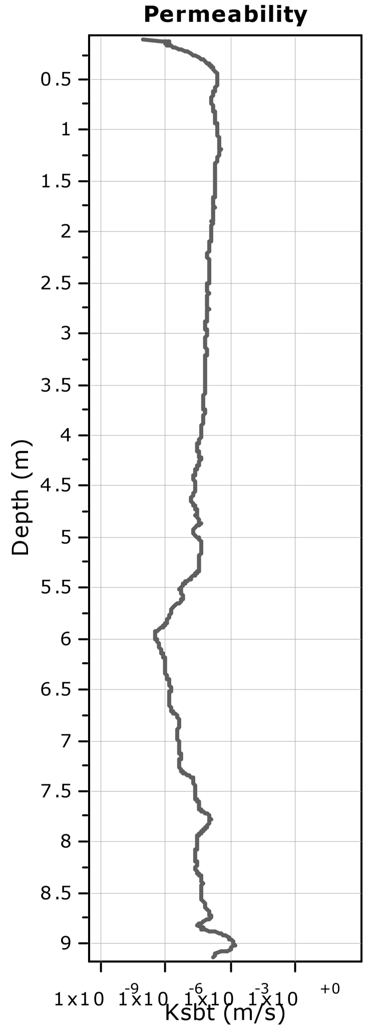


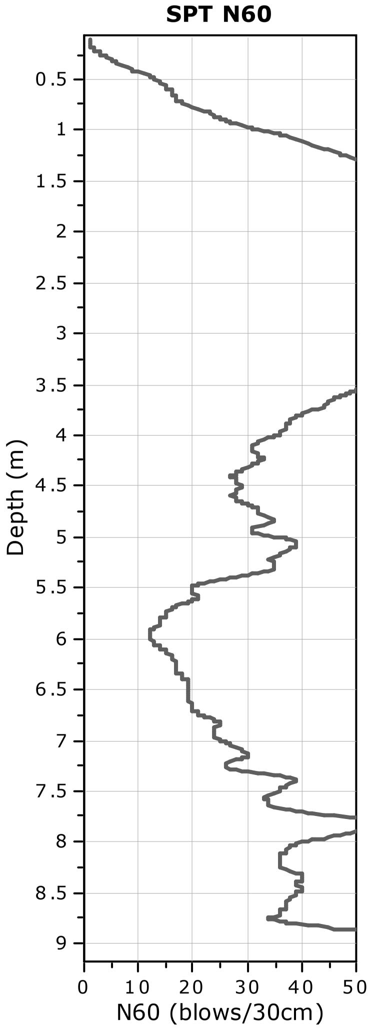
SBTn legend

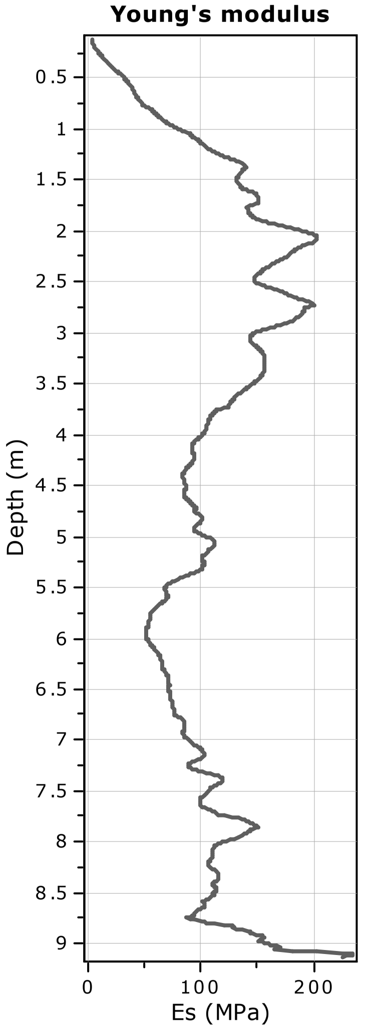
- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

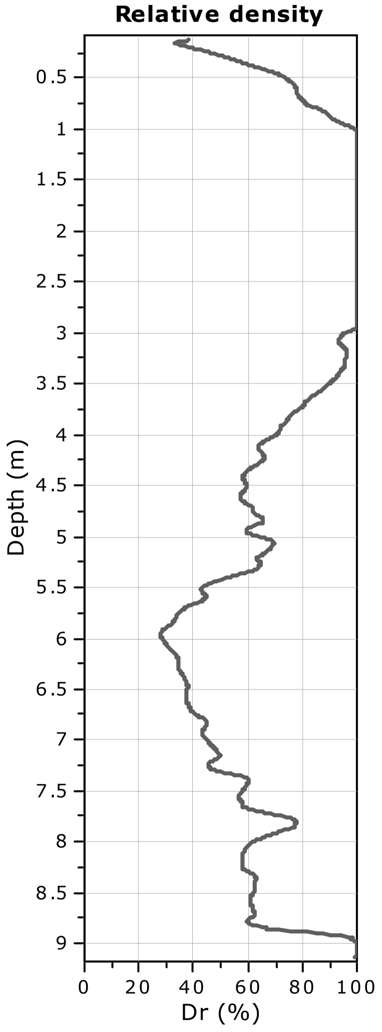
CPT: CPT 202
Total depth: 9.21 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

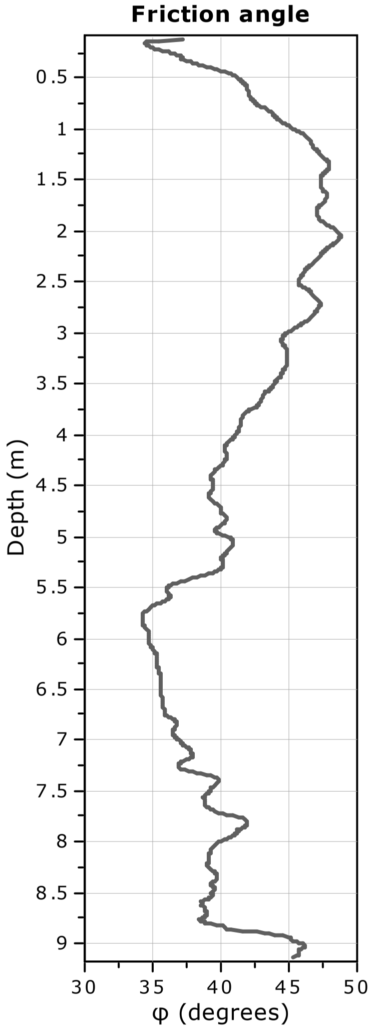
Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**


Permeability


SPT N60


Young's modulus


Relative density


Friction angle

Calculation parameters
Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

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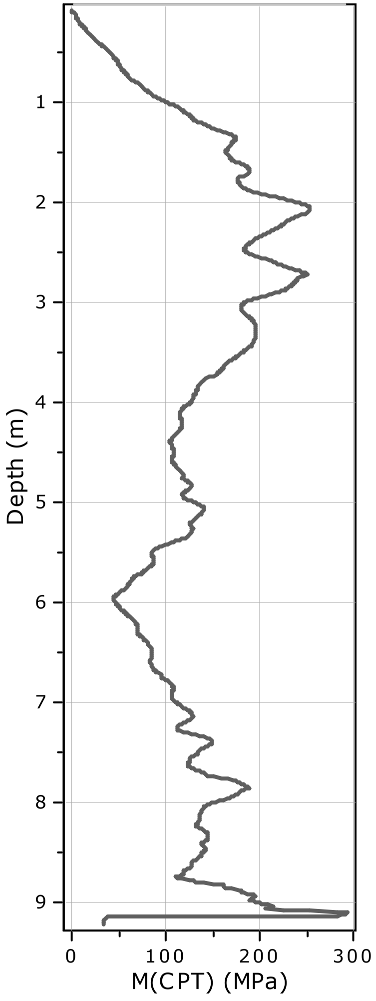
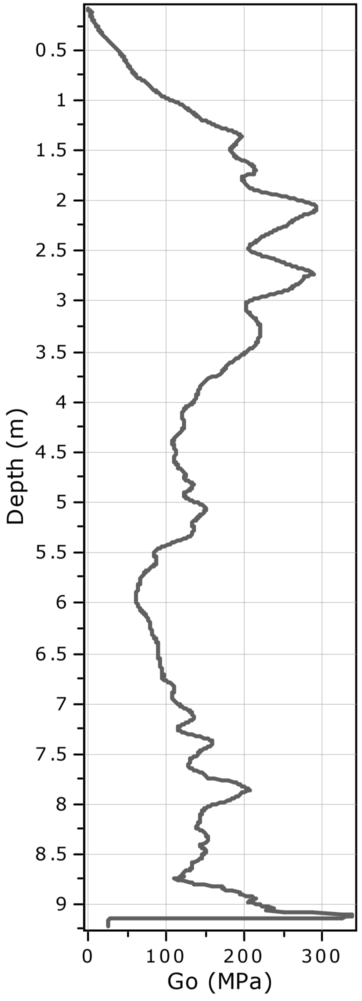
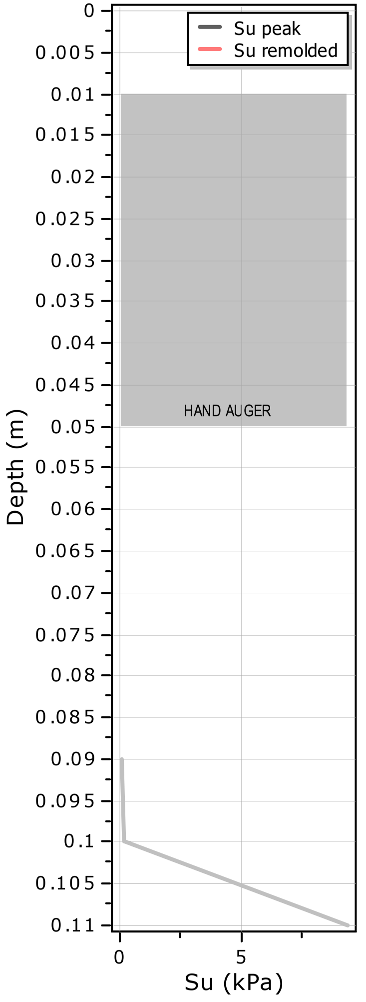
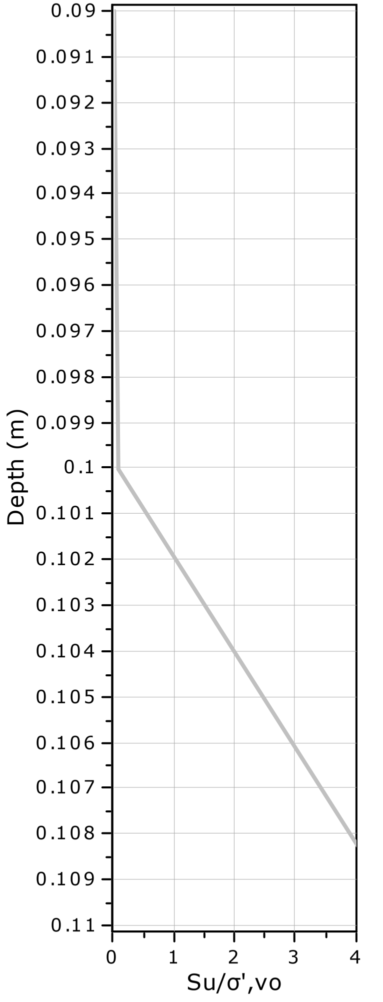
Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

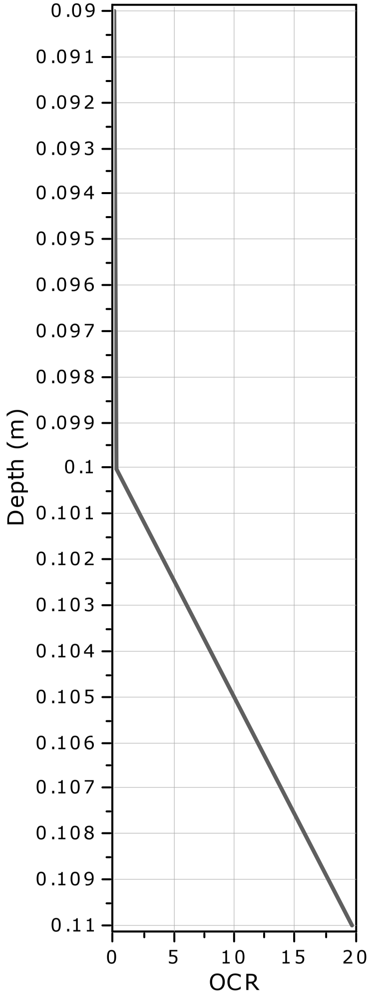
CPT: CPT 202
Total depth: 9.21 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:


Constrained Modulus


Shear modulus


Shear strength


Undrained strength rati


OCR

Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto

OCR factor for clays, N_{kt}: Auto
—●— Flat Dilatometer Test data

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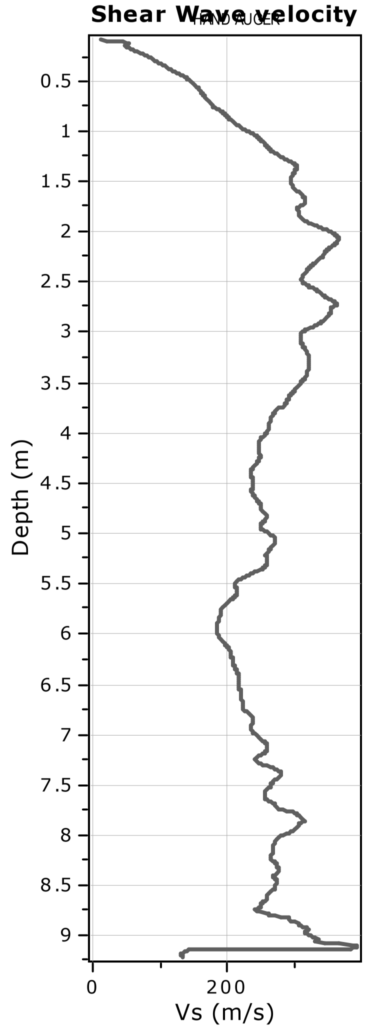
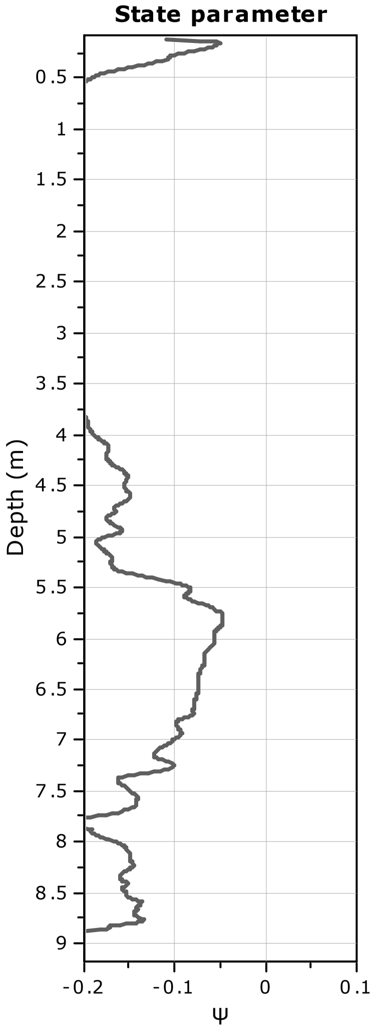
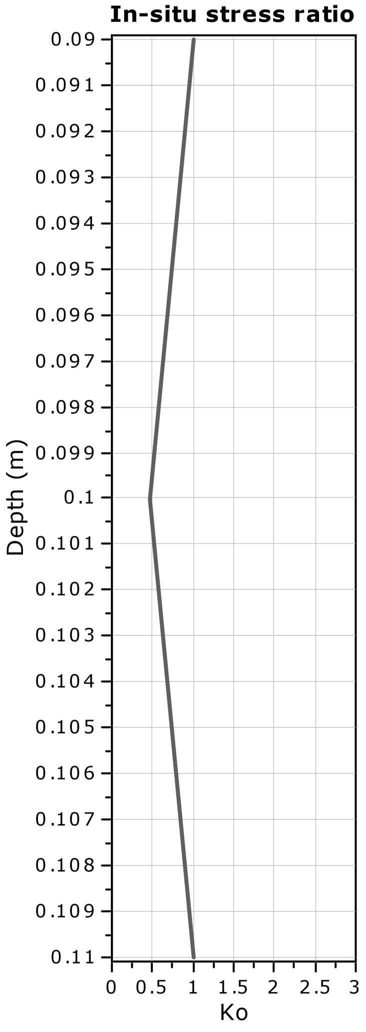
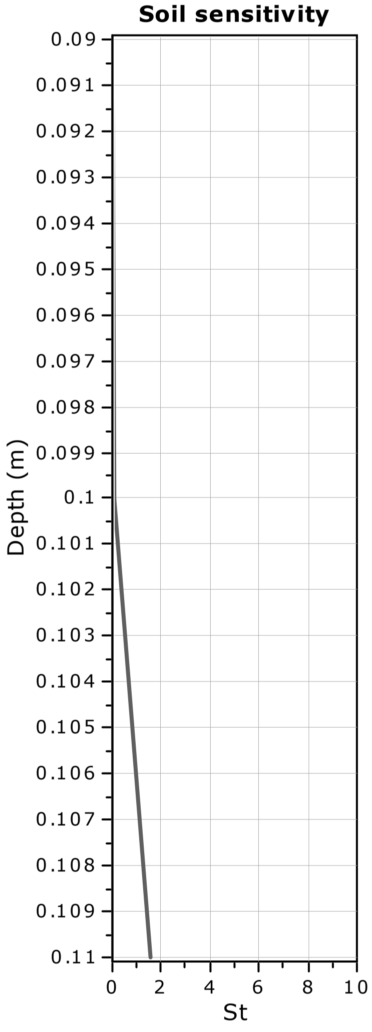
Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

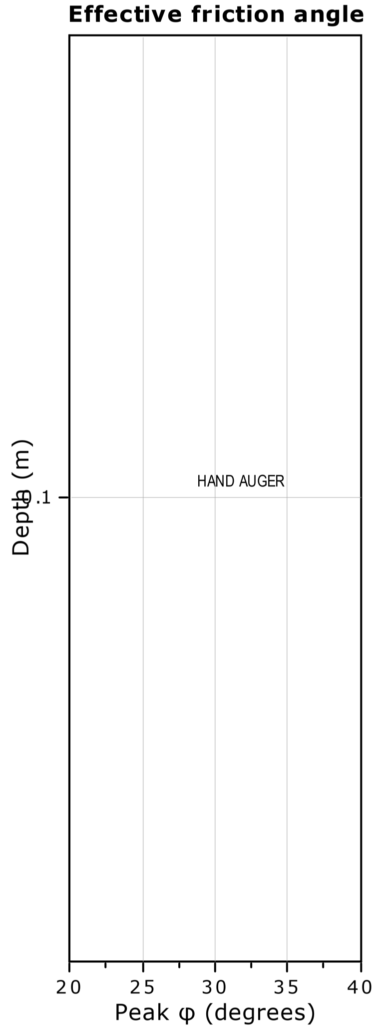
CPT: CPT 202
Total depth: 9.21 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:


Shear Wave velocity


State parameter


In-situ stress ratio


Soil sensitivity


Effective friction angle

Calculation parameters

Soil Sensitivity factor, N_S: 7.00

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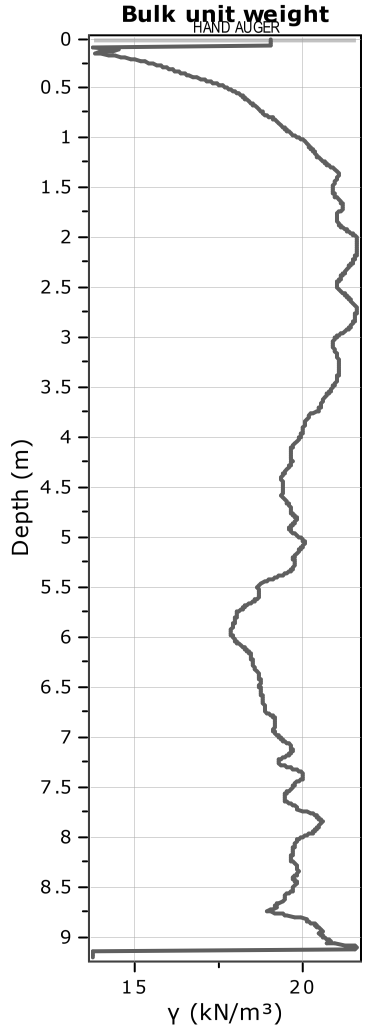
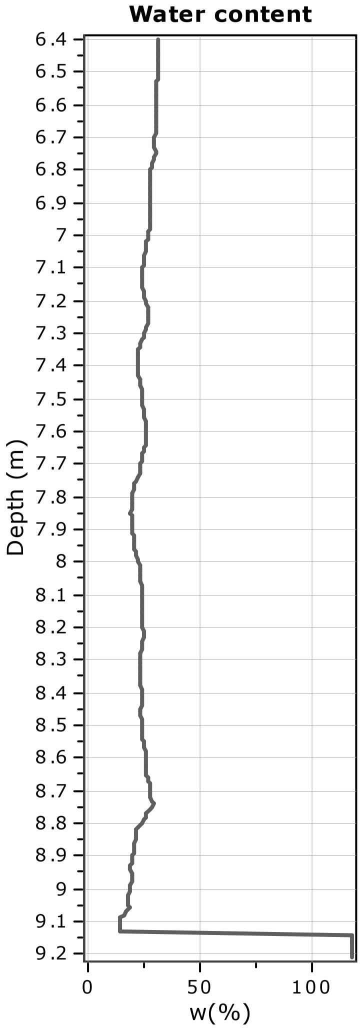
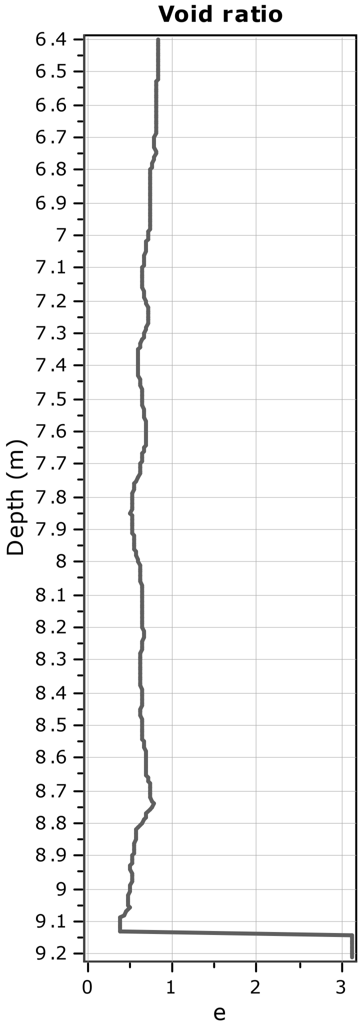
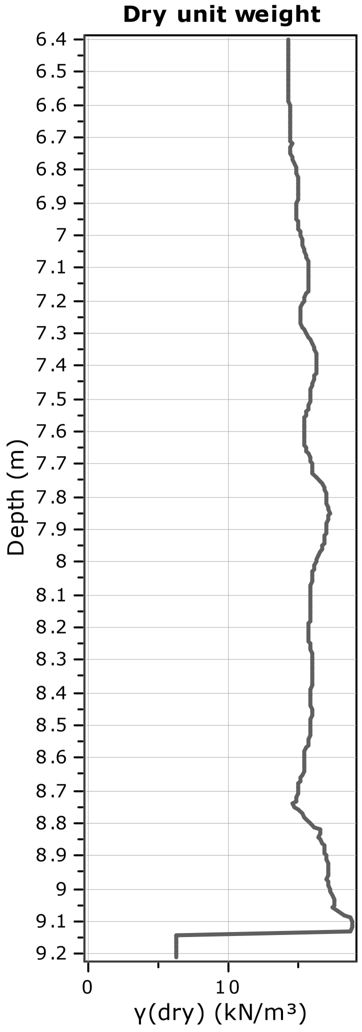
Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

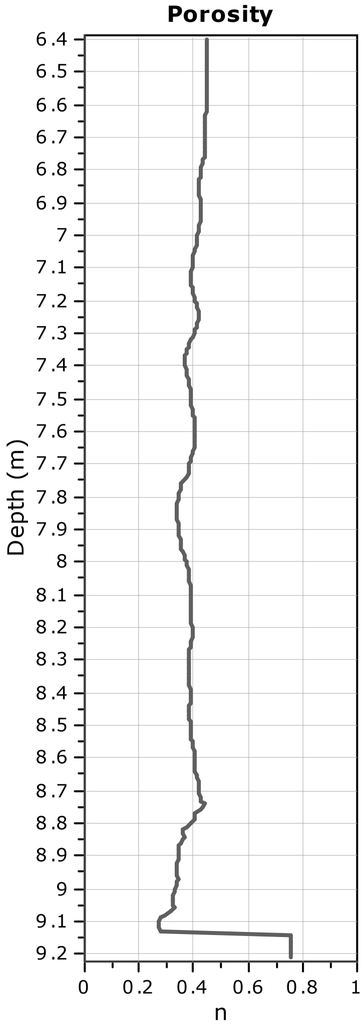
CPT: CPT 202
Total depth: 9.21 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:











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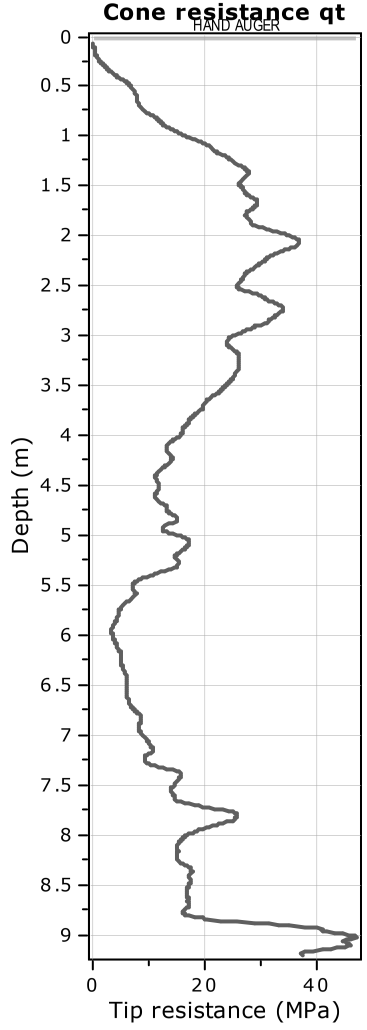
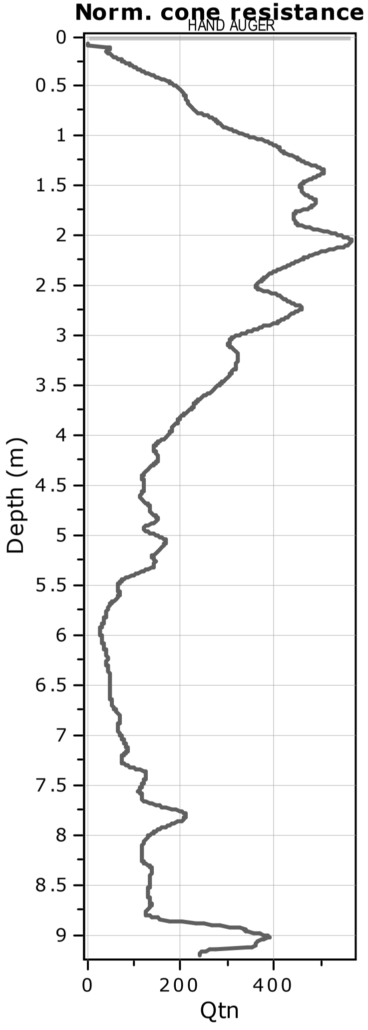
Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

CPT: CPT 202
Total depth: 9.21 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

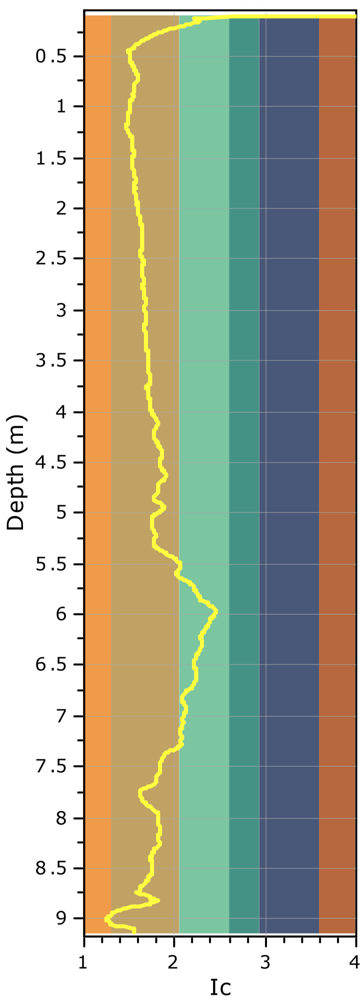
Cone resistance qt



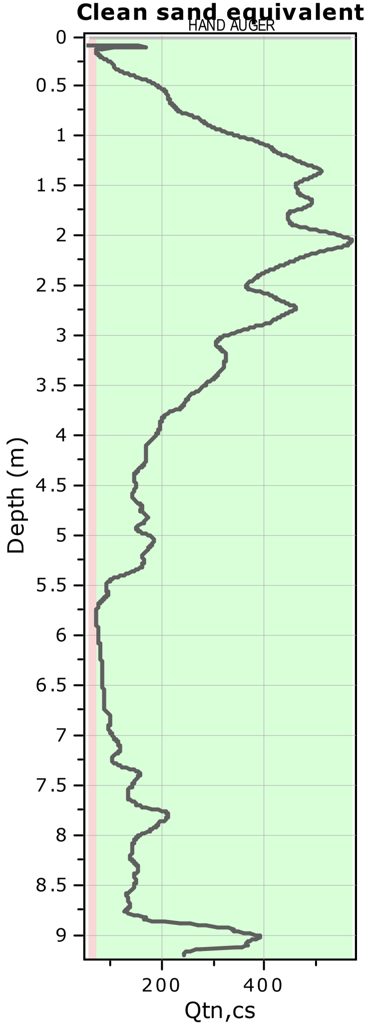
Norm. cone resistance



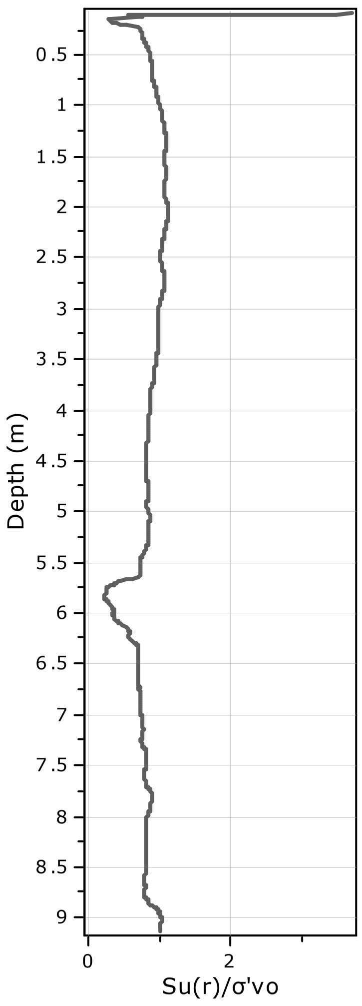
SBTn Index



Clean sand equivalent

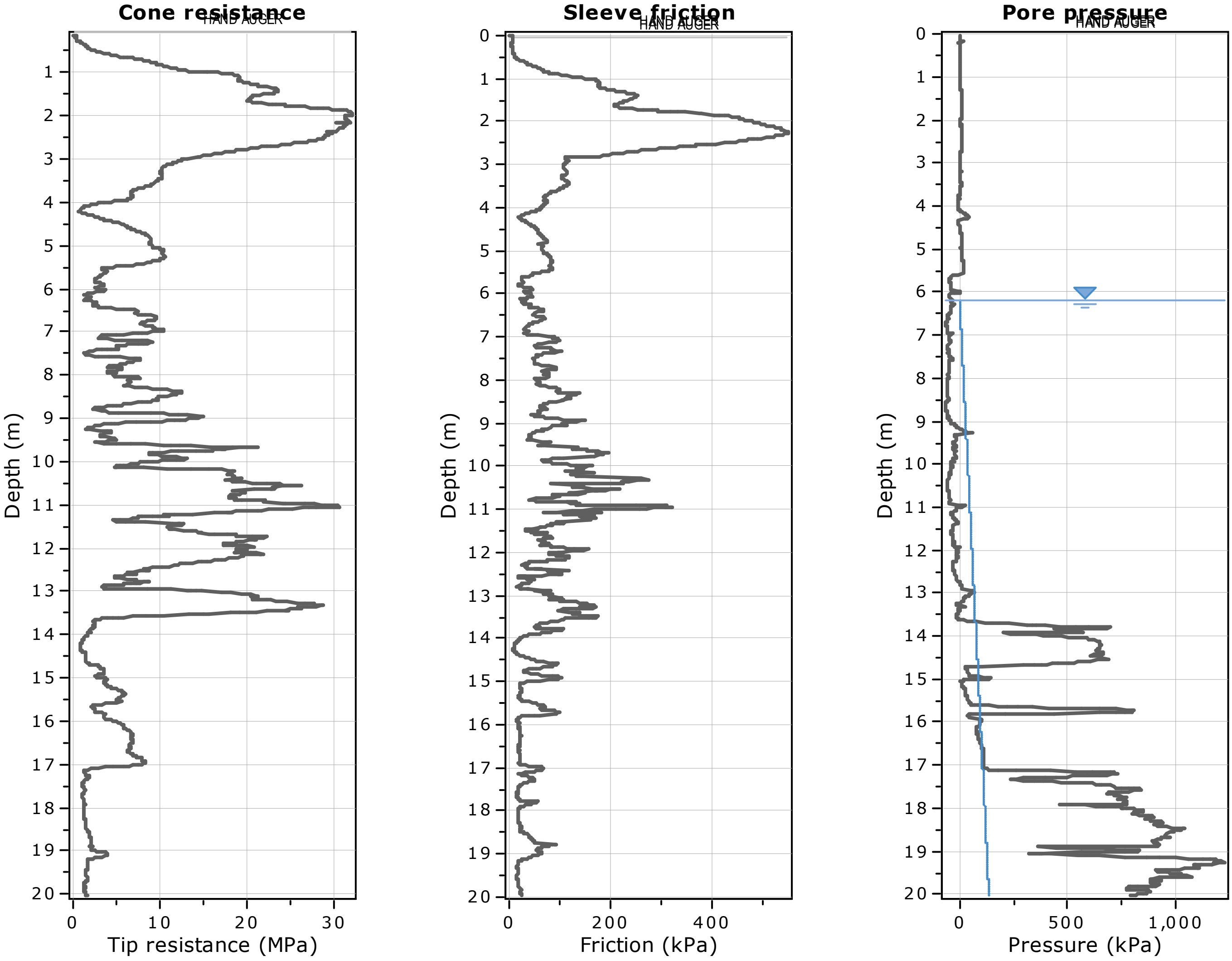


Residual strength ratio

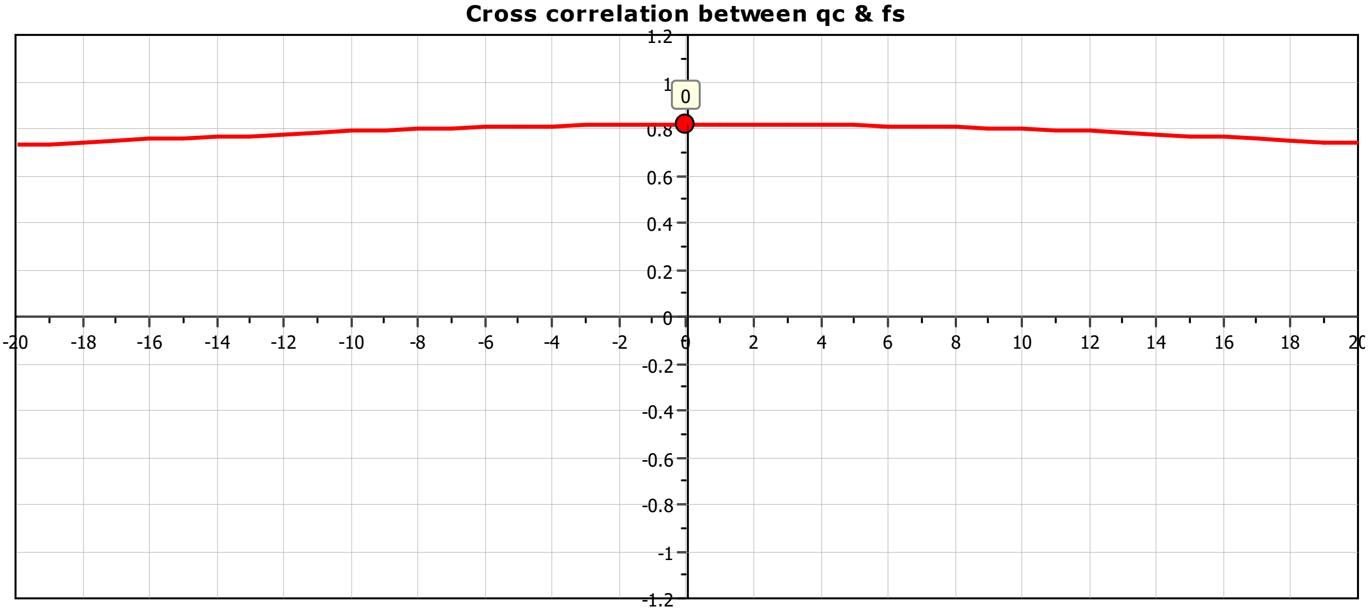


CPT: CPT201
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**



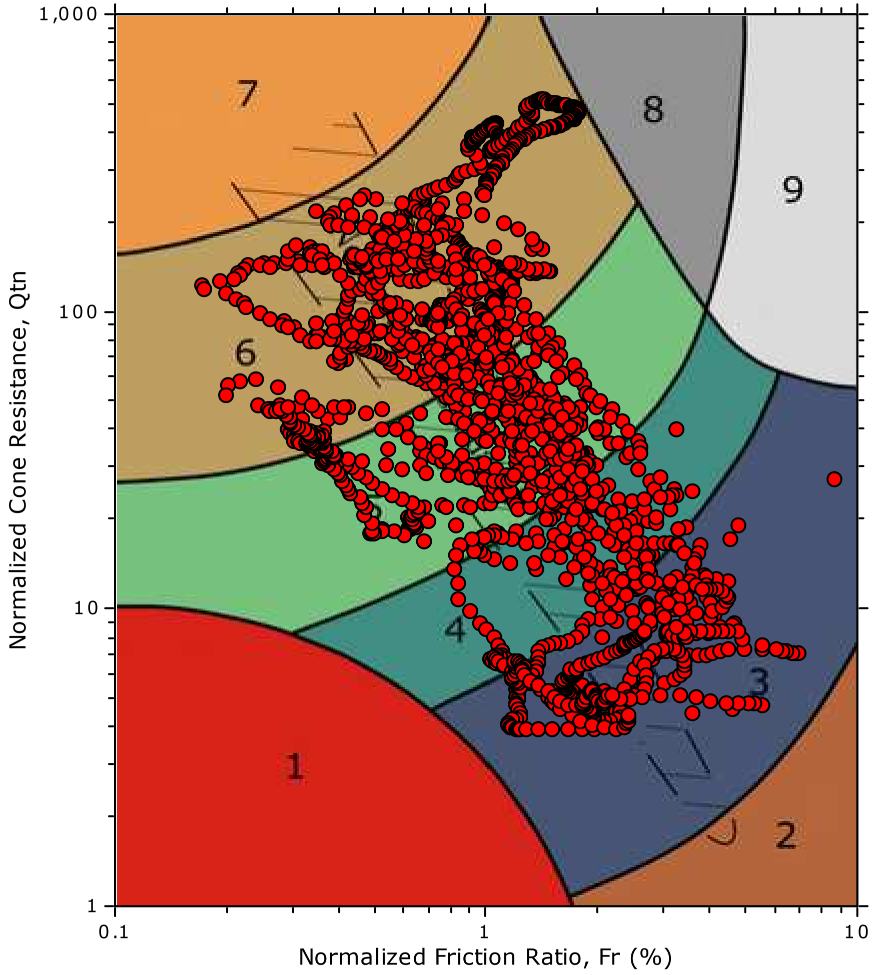
The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



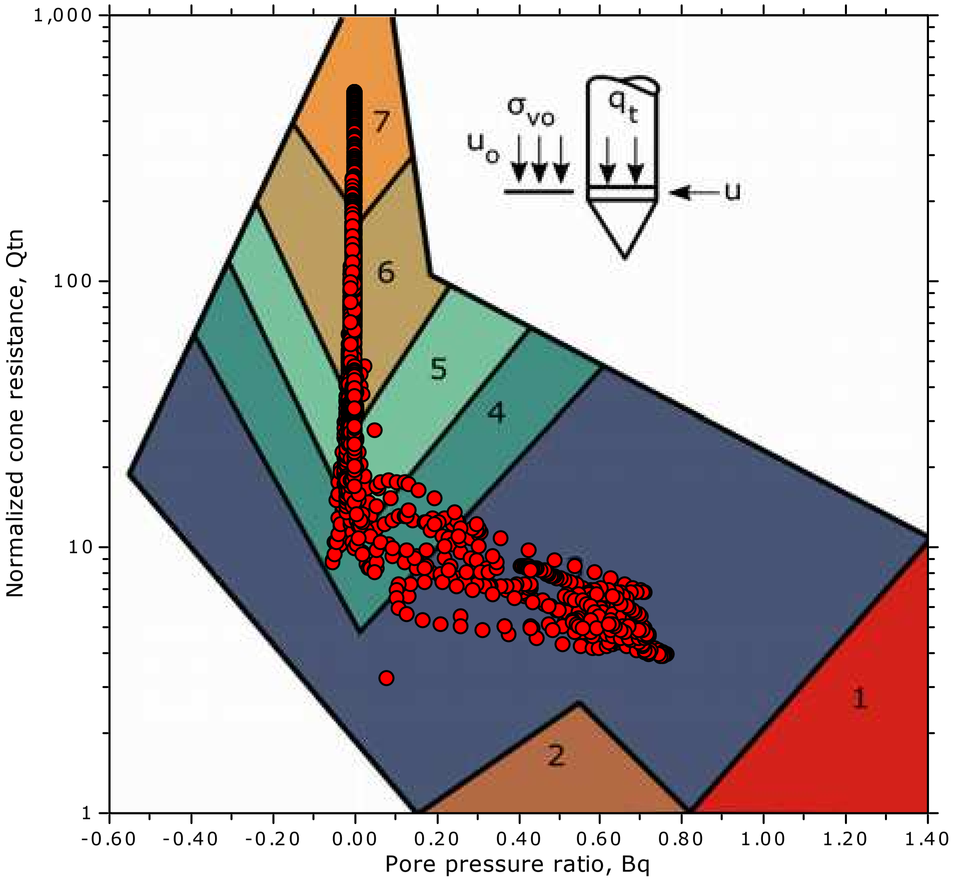
CPT: CPT201
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)

SBTn plot



Normalized Bq plot



SBTn legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravelly sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

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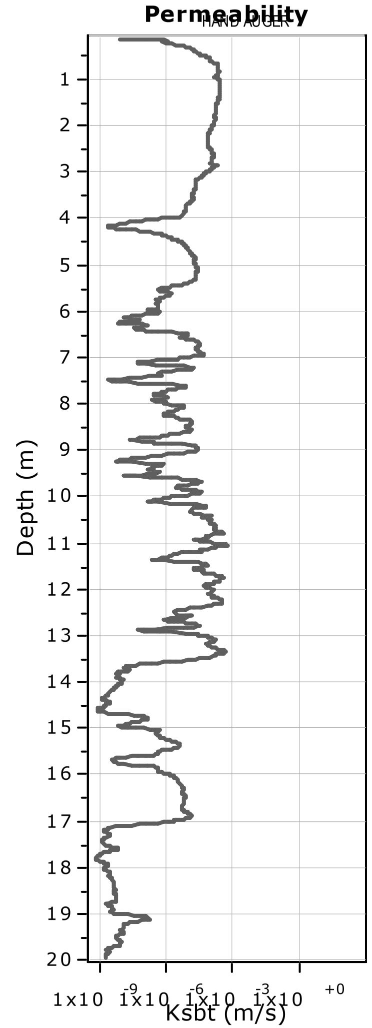
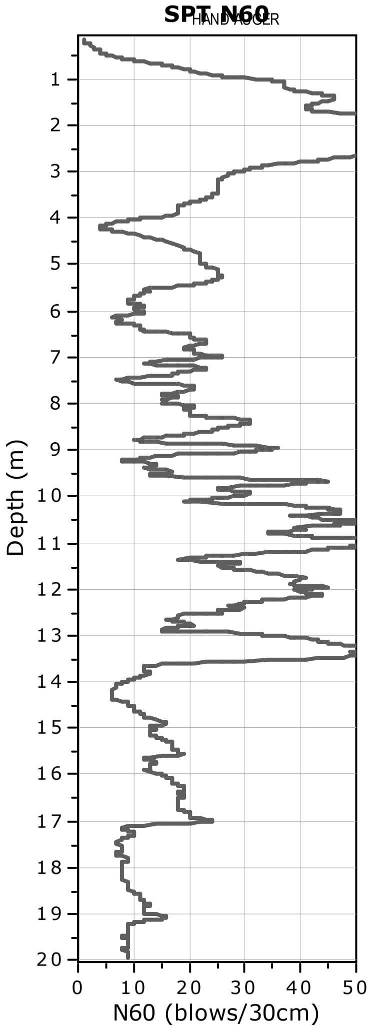
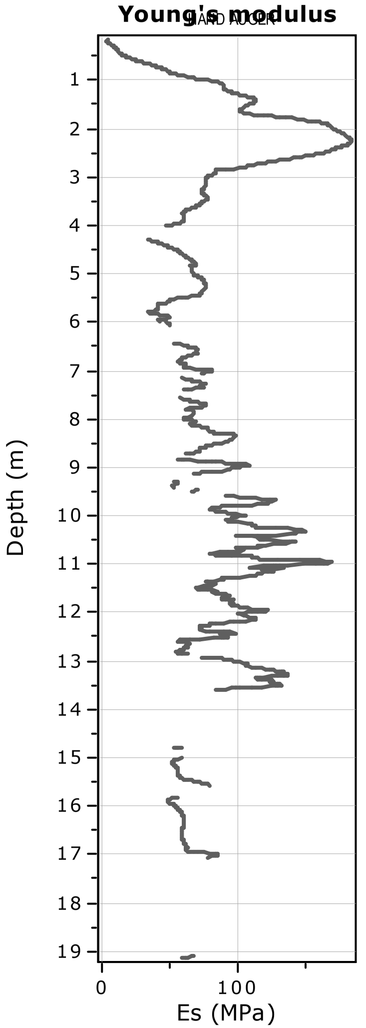
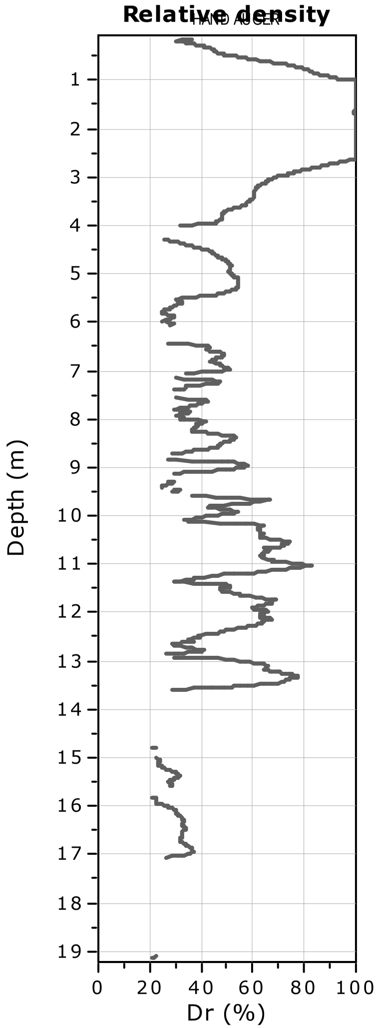
CPT: CPT201
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

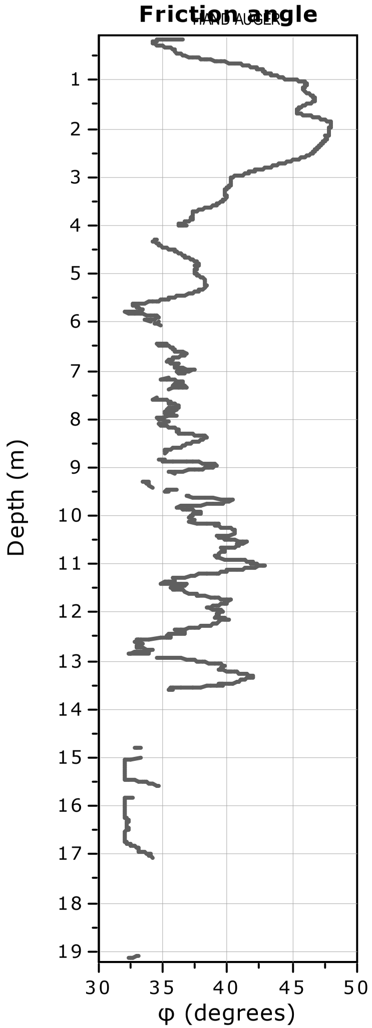
Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**


Permeability


SPT N60


Young's modulus


Relative density


Friction angle

Calculation parameters
Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)

Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

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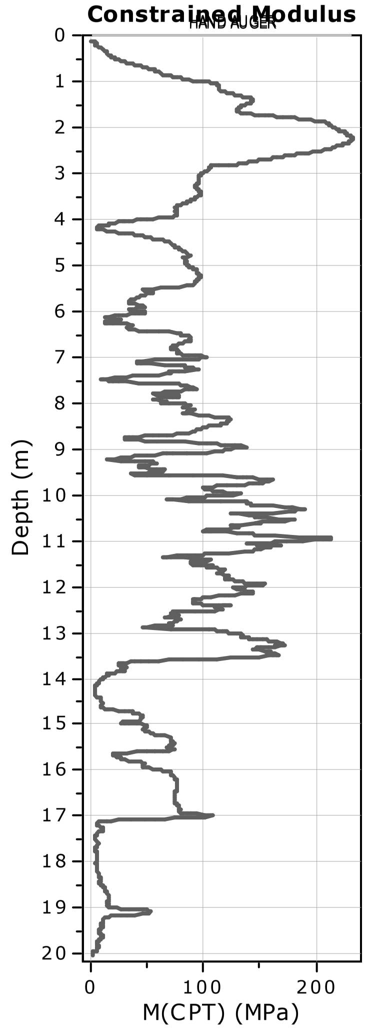
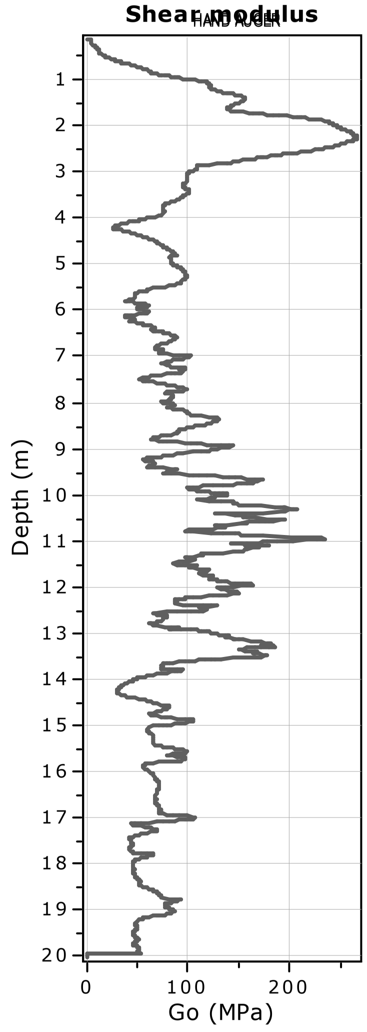
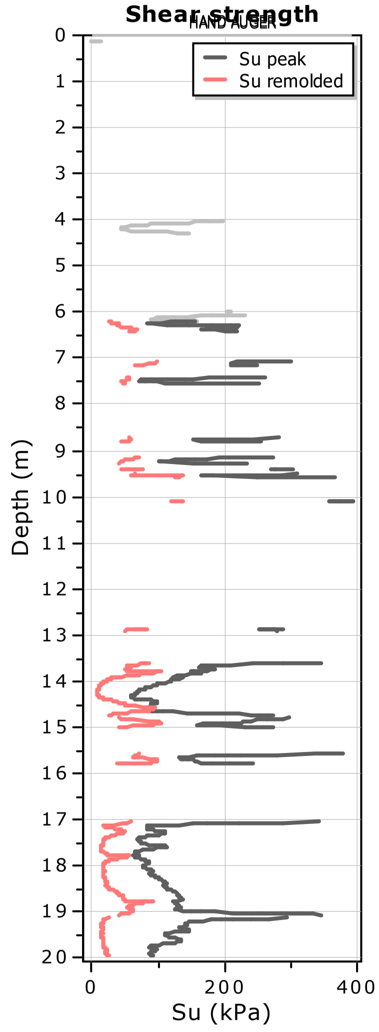
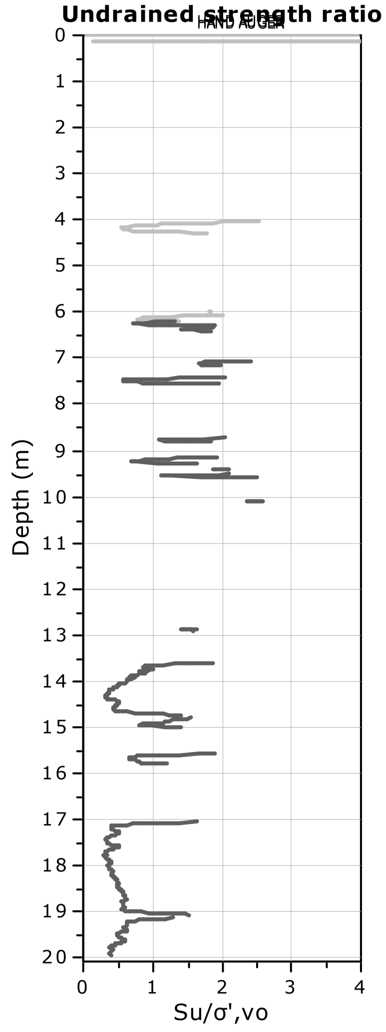
CPT: CPT201
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

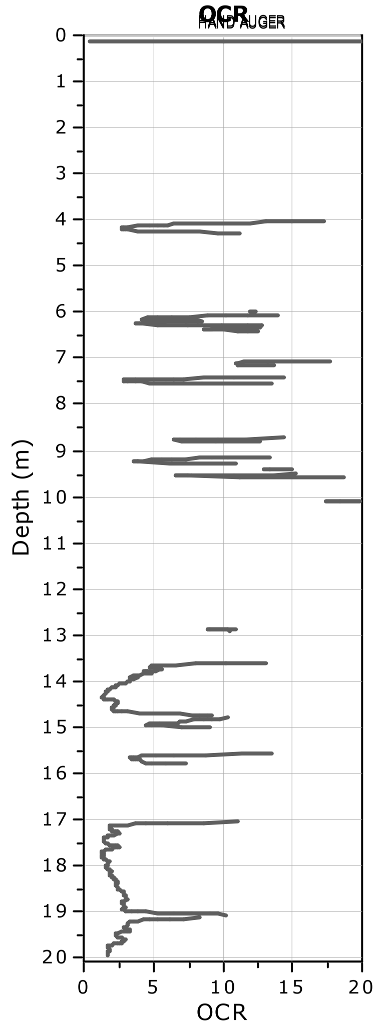
Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**











Calculation parameters

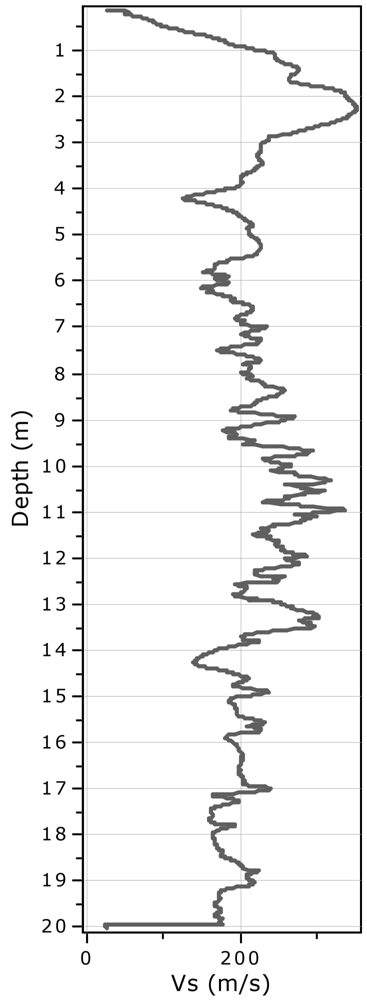
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto

OCR factor for clays, N_{kt}: Auto
—●— Flat Dilatometer Test data

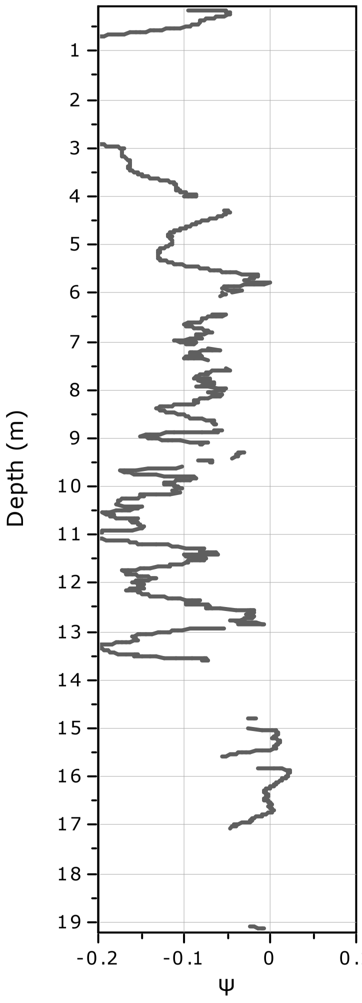
CPT: CPT201
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

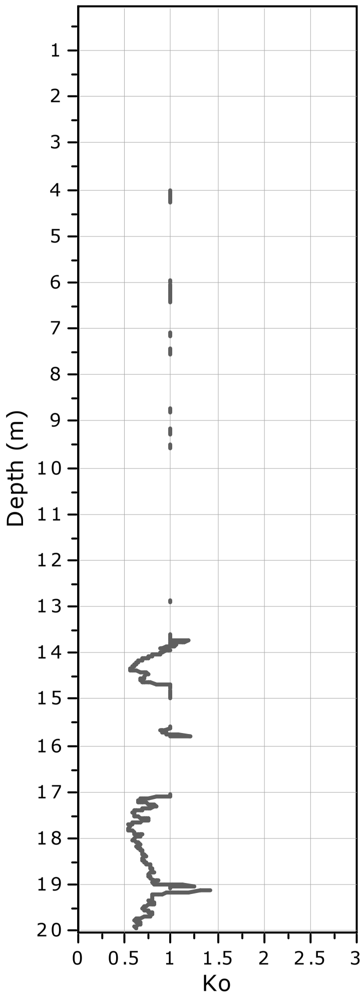
Shear Wave velocity



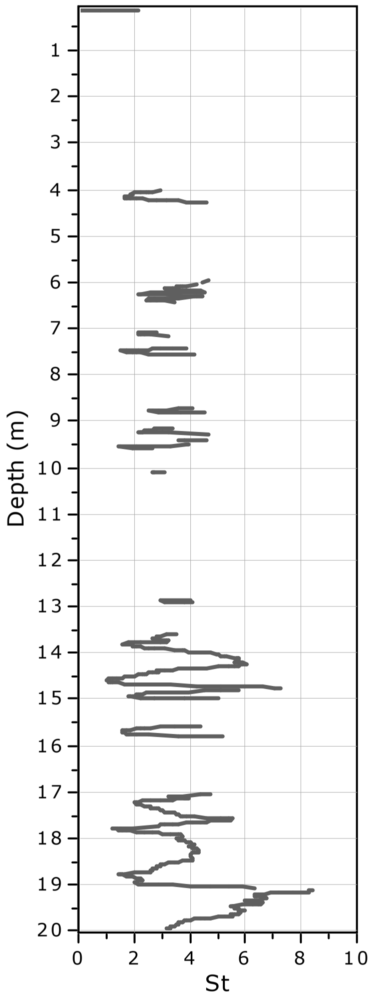
State parameter



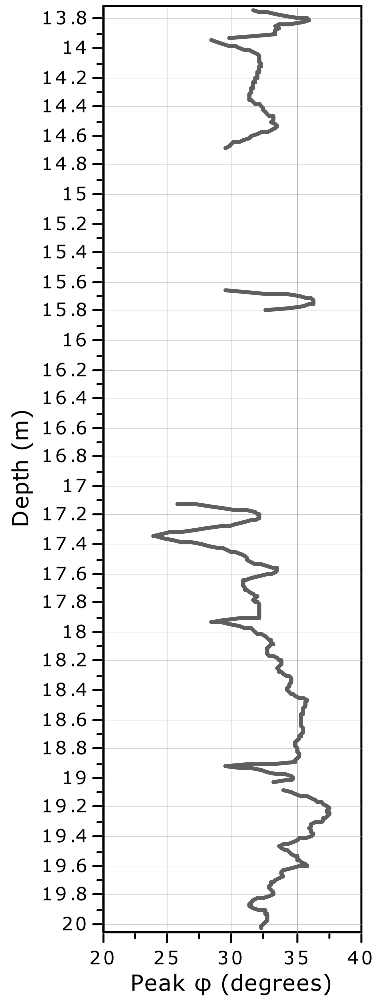
In-situ stress ratio



Soil sensitivity



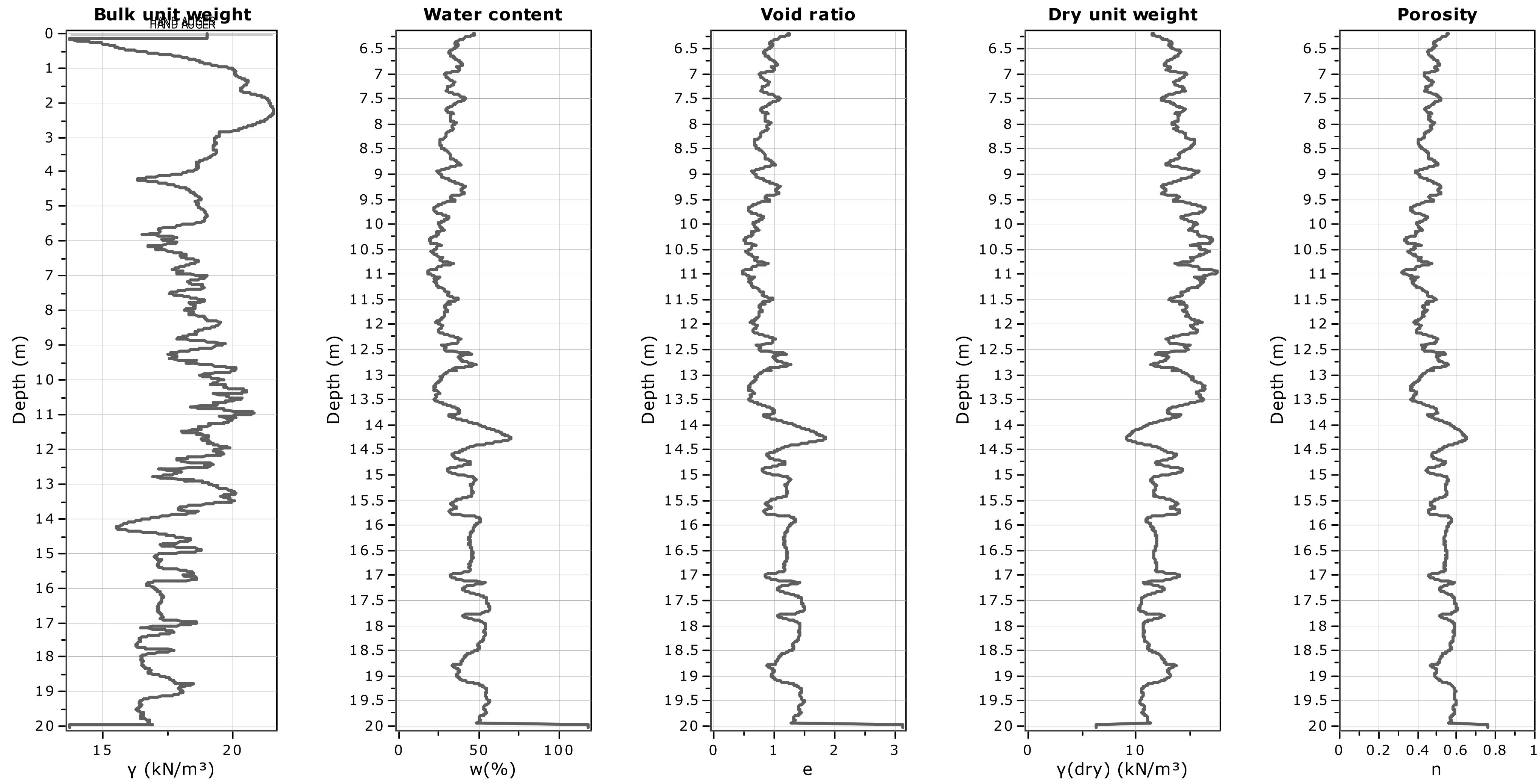
Effective friction angle



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CPT: CPT201
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



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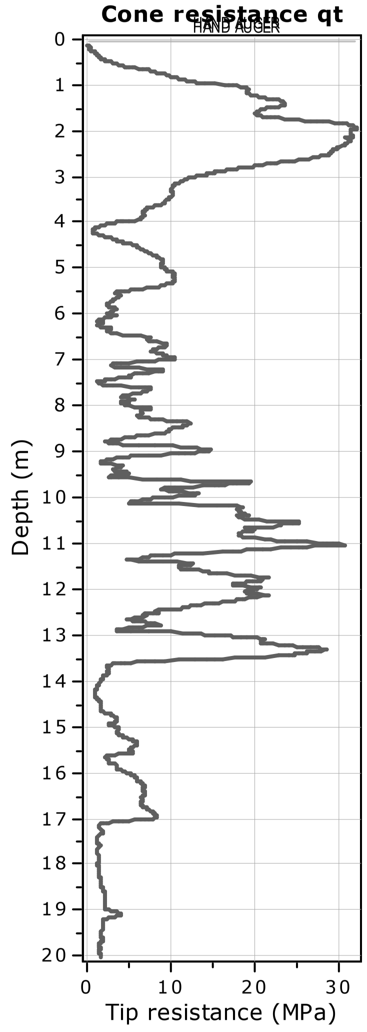
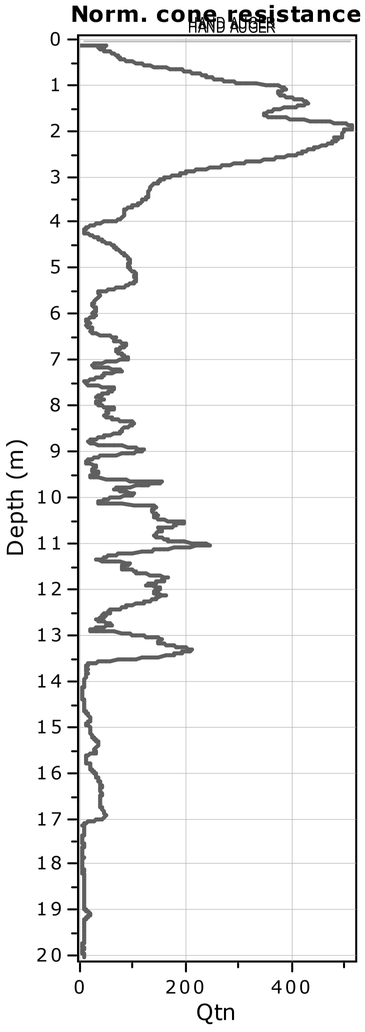
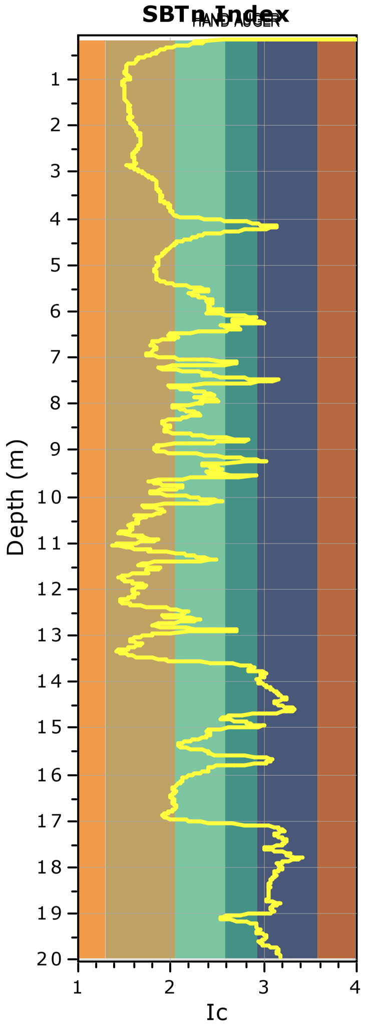
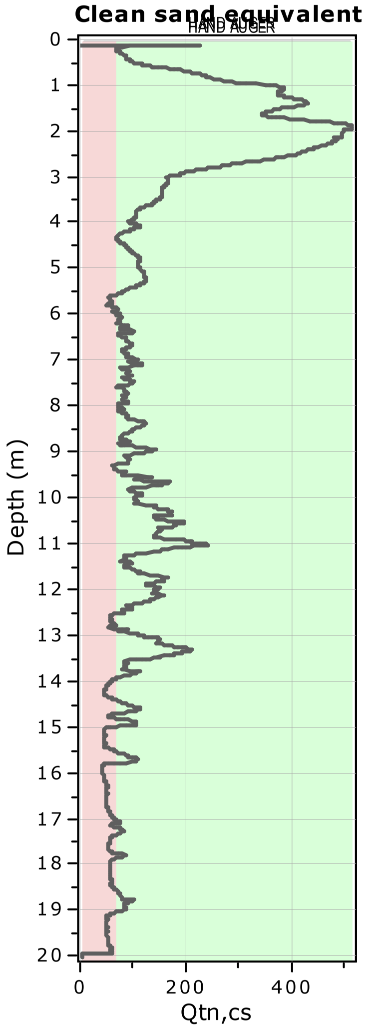
CPT: CPT201
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

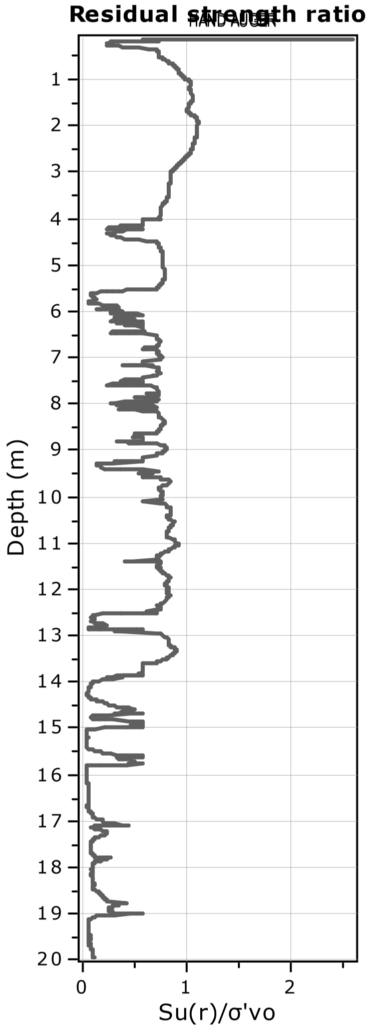
Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**


Cone resistance qt


Norm. cone resistance


SBTn Index


Clean sand equivalent


Residual strength ratio

Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

:: Unit Weight, g (kN/m³) ::

$$g = g_w \cdot \left(0.27 \cdot \log(R_f) + 0.36 \cdot \log(\frac{q_t}{p_a}) + 1.236 \right)$$

where g_w = water unit weight

:: Permeability, k (m/s) ::

$I_c < 3.27$ and $I_c > 1.00$ then $k = 10^{0.952-3.04 \cdot I_c}$

$I_c \leq 4.00$ and $I_c > 3.27$ then $k = 10^{-4.52-1.37 \cdot I_c}$

:: N$_{SPT}$ (blows per 30 cm) ::

$$N_{60} = \left(\frac{q_c}{P_a} \right) \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

:: Young's Modulus, Es (MPa) ::

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$$

(applicable only to $I_c < I_{c\_cutoff}$)

:: Relative Density, Dr (%) ::

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$$

(applicable only to SBT$_n$: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: State Parameter, ψ ::

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$$

:: Drained Friction Angle, φ (°) ::

$$\varphi = \varphi'_{cv} + 15.94 \cdot \log(Q_{tn,cs}) - 26.88$$

(applicable only to SBT$_n$: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: 1-D constrained modulus, M (MPa) ::

If $I_c > 2.20$
$\alpha = 14$ for $Q_{tn} > 14$
$\alpha = Q_{tn}$ for $Q_{tn} \leq 14$
$M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If $I_c \geq 2.20$

$$M_{CPT} = 0.03 \cdot (q_t - \sigma_v) \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Small strain shear Modulus, Go (MPa) ::

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Shear Wave Velocity, Vs (m/s) ::

$$V_s = \left(\frac{G_0}{\rho} \right)^{0.50}$$

:: Undrained peak shear strength, Su (kPa) ::

$N_{kt} = 10.50 + 7 \cdot \log(F_r)$ or user defined

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to SBT$_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Remolded undrained shear strength, Su(rem) (kPa) ::

$S_{u(rem)} = f_s$ (applicable only to SBT$_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Overconsolidation Ratio, OCR ::

$$k_{OCR} = \left[\frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 \cdot + 7 \cdot \log(F_r))} \right]^{1.25} \text{ or user defined}$$

$$OCR = k_{OCR} \cdot Q_{tn}$$

(applicable only to SBT$_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: In situ Stress Ratio, Ko ::

$$K_O = (1 - \sin\varphi') \cdot OCR^{\sin\varphi'}$$

(applicable only to SBT$_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Soil Sensitivity, S$_t$ ::

$$S_t = \frac{N_S}{F_r}$$

(applicable only to SBT$_n$: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Peak Friction Angle, φ' (°) ::

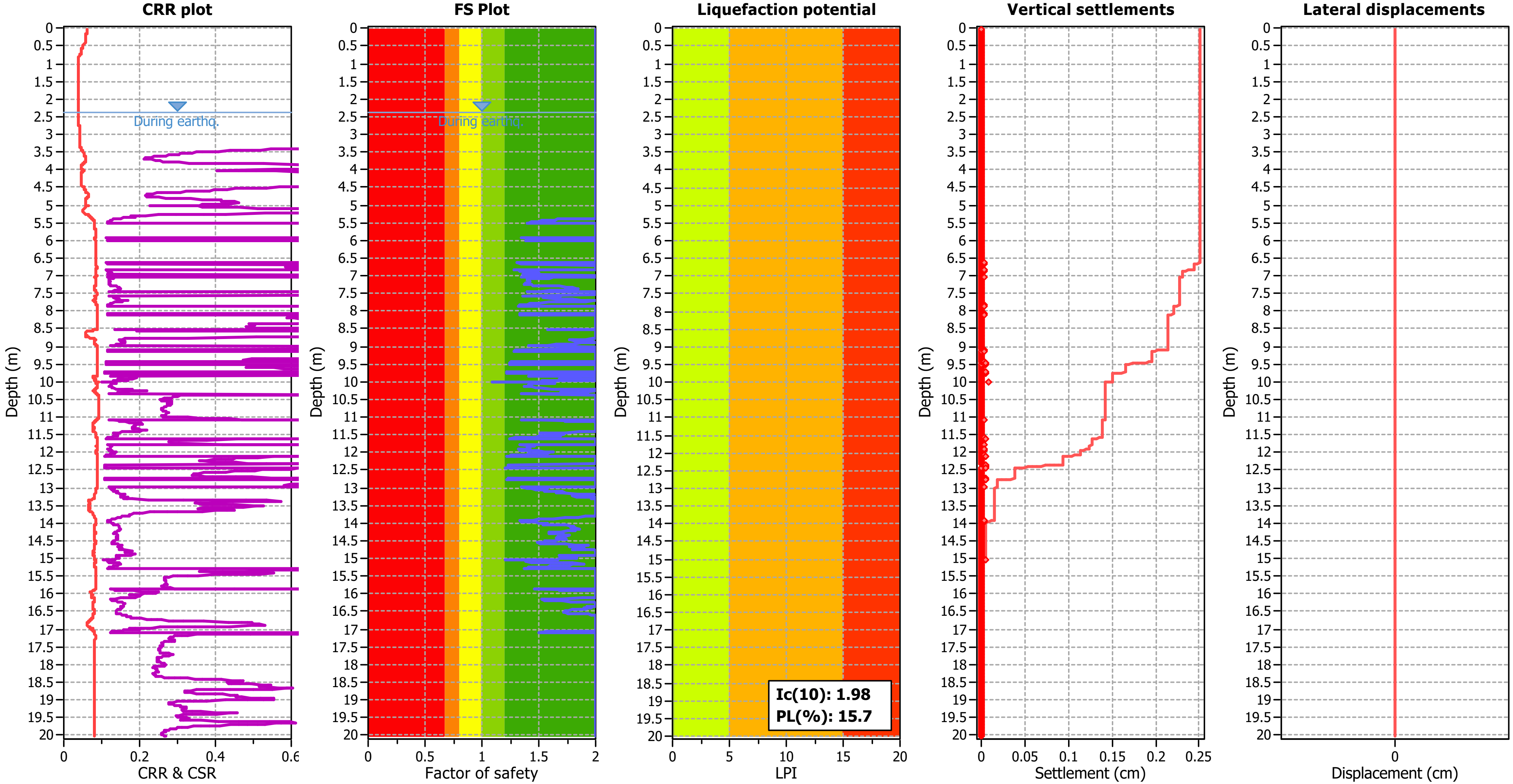
$$\varphi' = 29.5^\circ \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable for $0.10 < B_q < 1.00$)

References

- Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012
- Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)
- N Barounis, J Philpot, Estimation of in-situ water content, void ratio, dry unit weight and porosity using CPT for saturated sands, Proc. 20th NZGS Geotechnical Symposium

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.40 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	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):	2.90 m	Fill height:	N/A	Limit depth:	N/A

F.S. color scheme

- 🟥 Almost certain it will liquefy
- 🟧 Very likely to liquefy
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LPI color scheme

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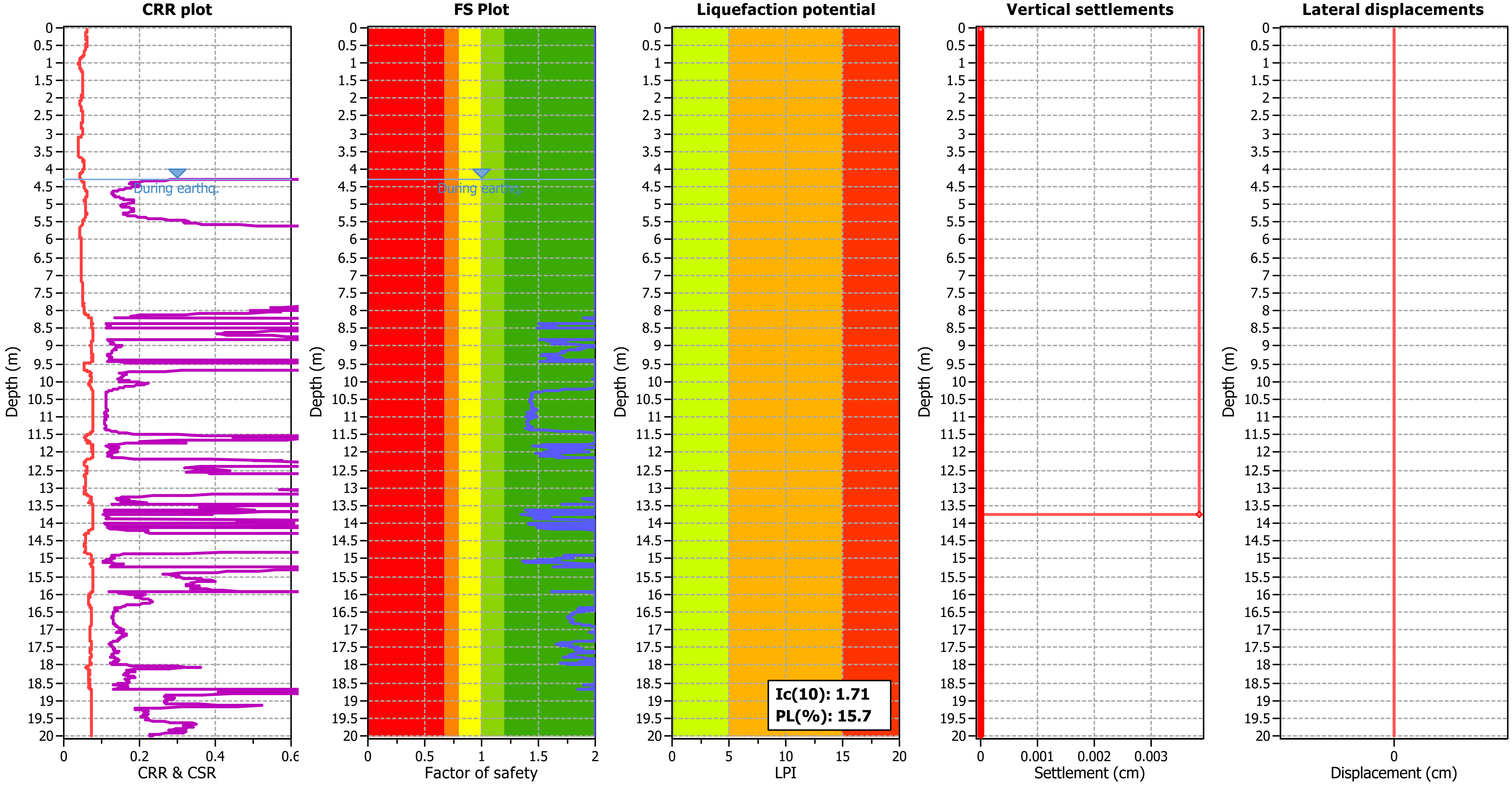
Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.30 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):	4.80 m	Fill height:	N/A	Limit depth:	N/A

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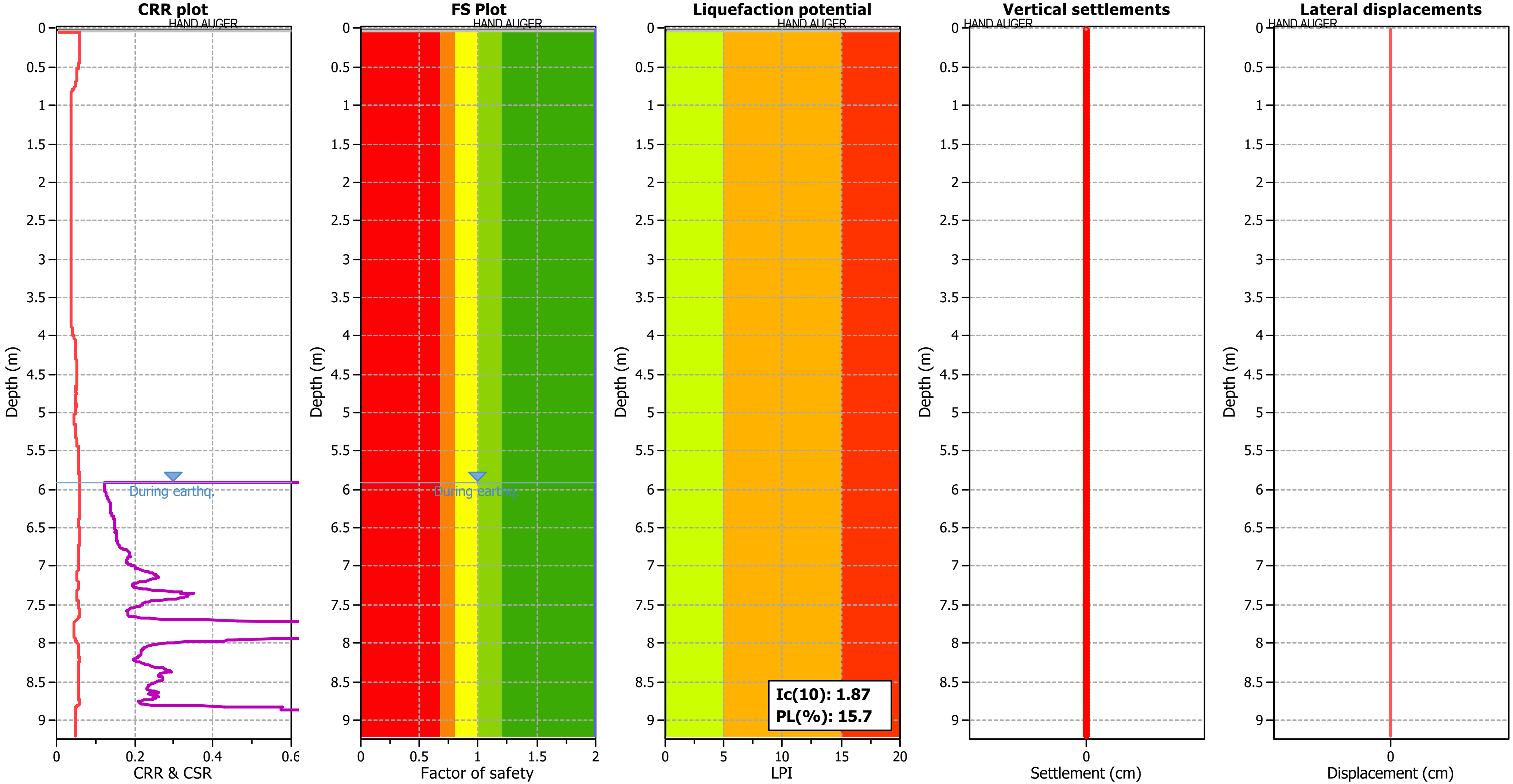

Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.90 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_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):	6.40 m	Fill height:	N/A	Limit depth:	N/A

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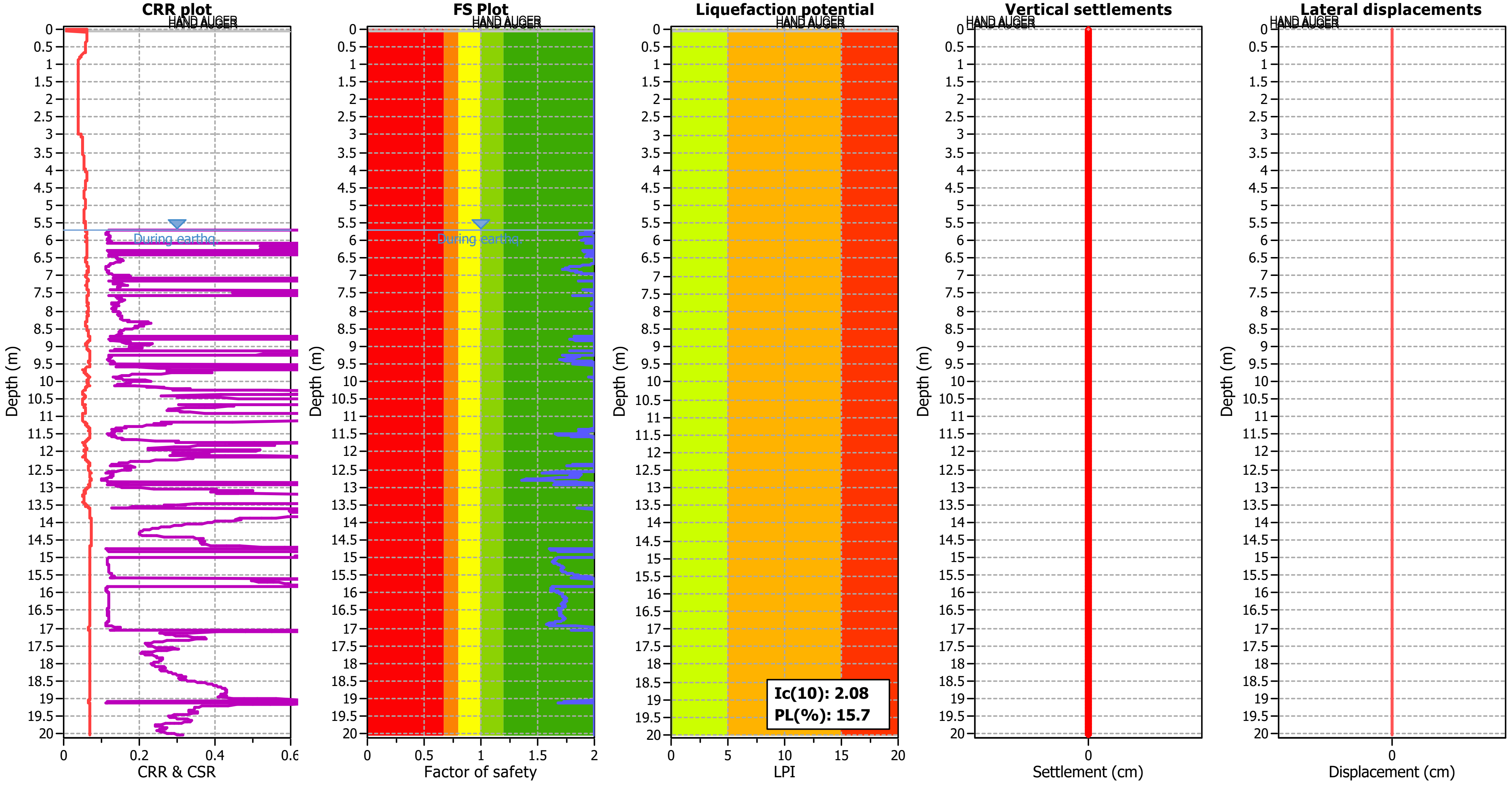

Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.10
Peak ground acceleration: 0.11
Depth to water table (insitu): 6.20 m

Depth to GWT (erthq.): 5.70 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

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

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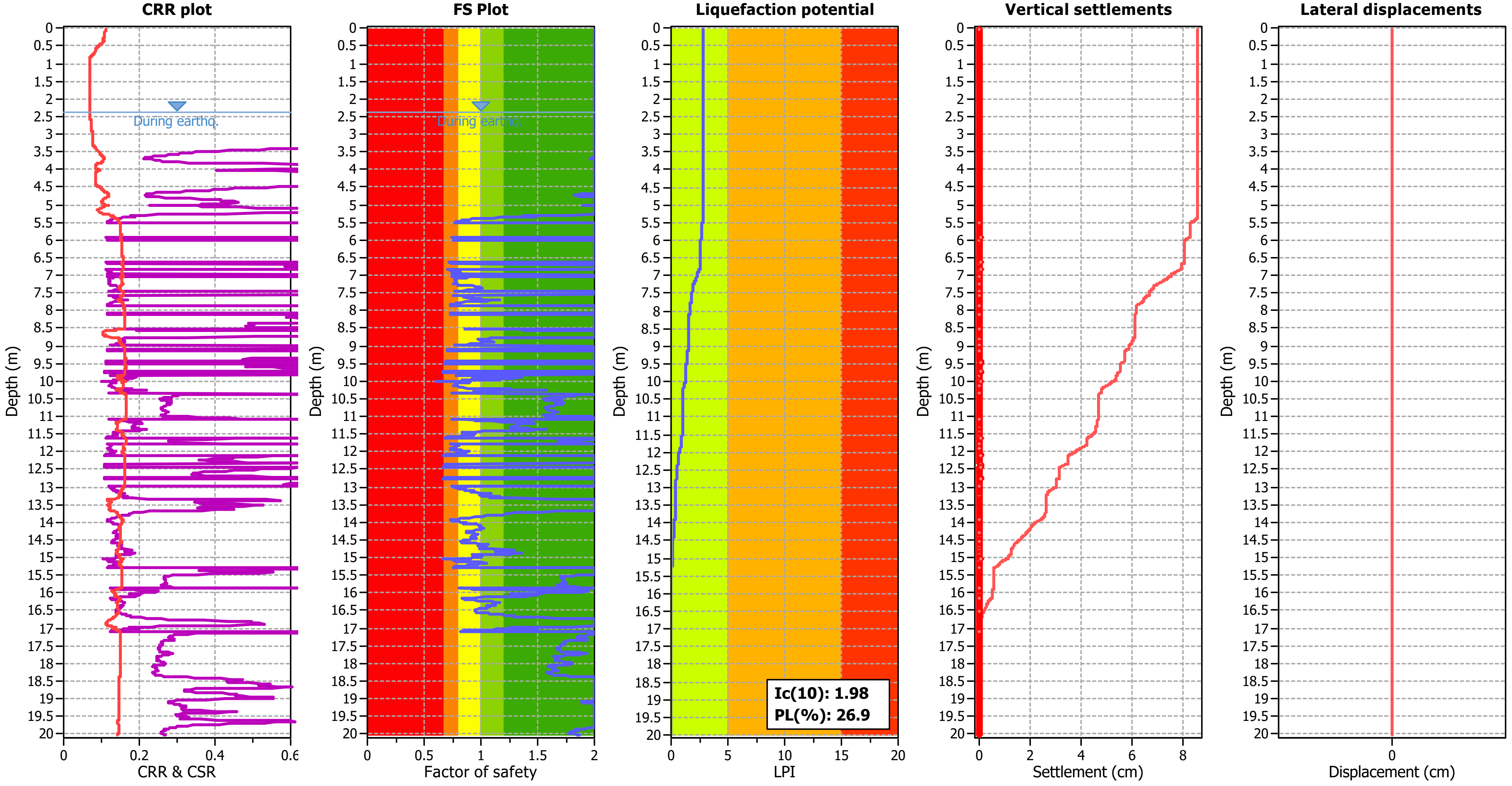

Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.40 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.20	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.90 m	Fill height:	N/A	Limit depth:	N/A

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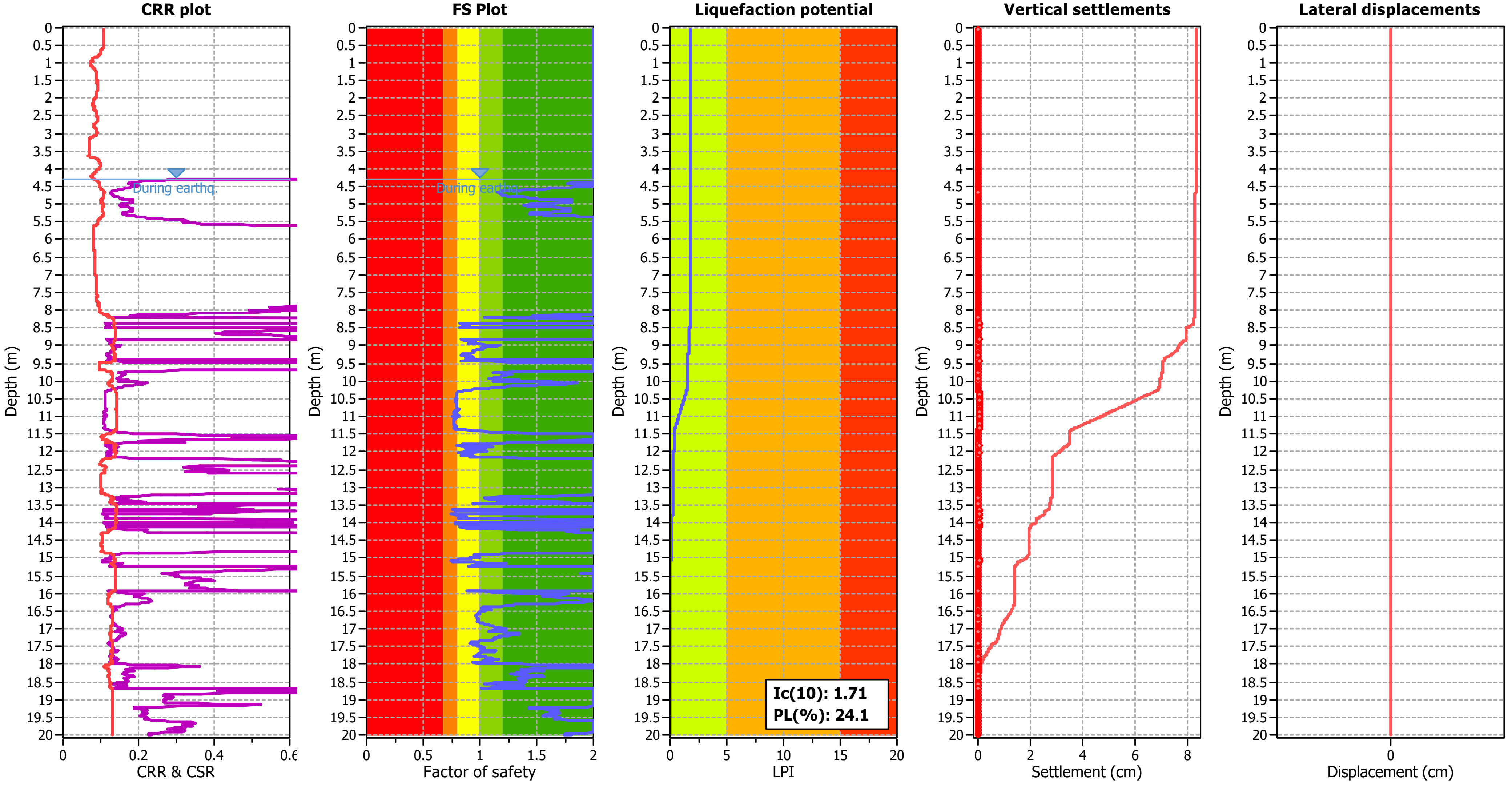

Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.30 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:	0.20	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.80 m	Fill height:	N/A	Limit depth:	N/A

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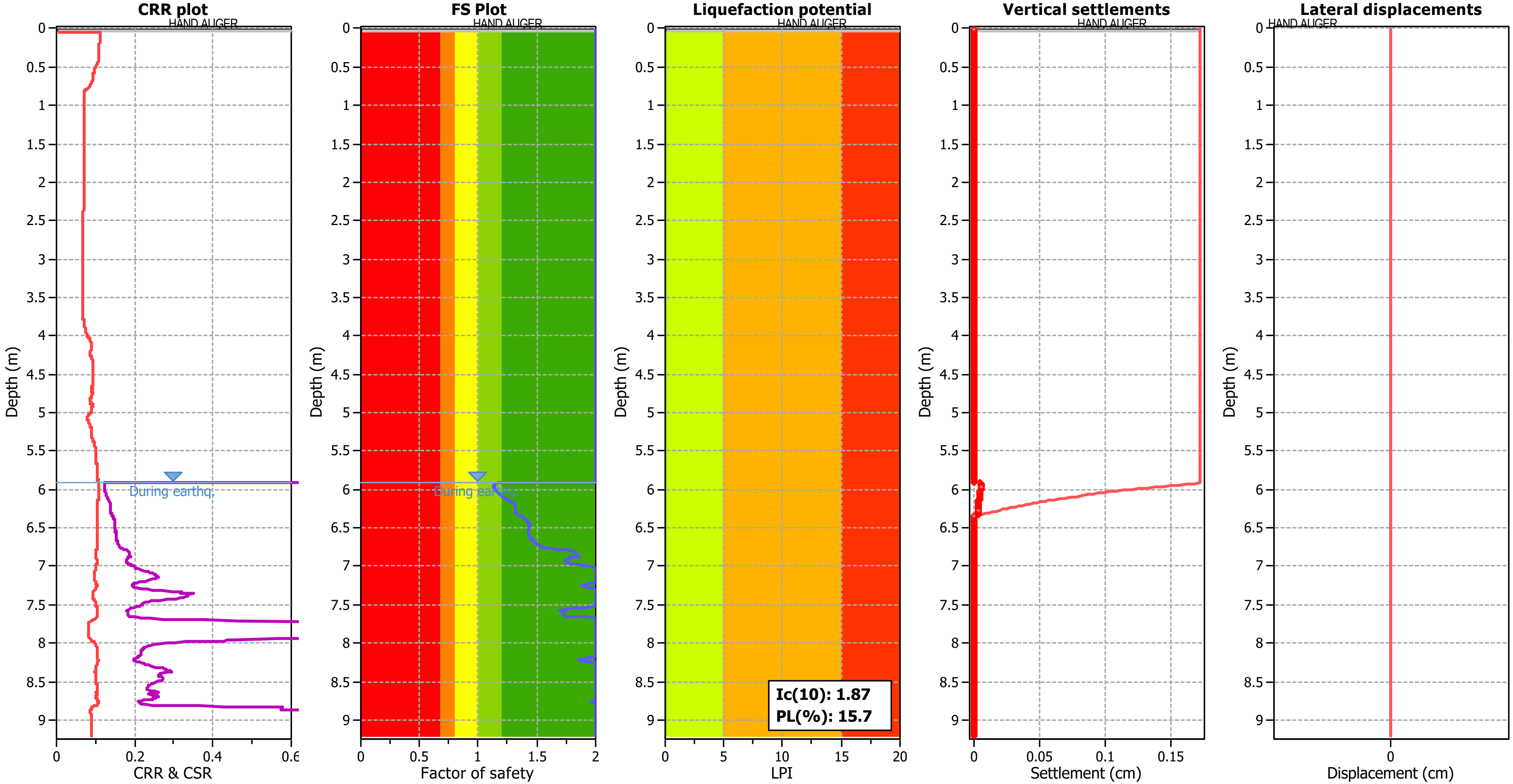

Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.90 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.20	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	6.40 m	Fill height:	N/A	Limit depth:	N/A

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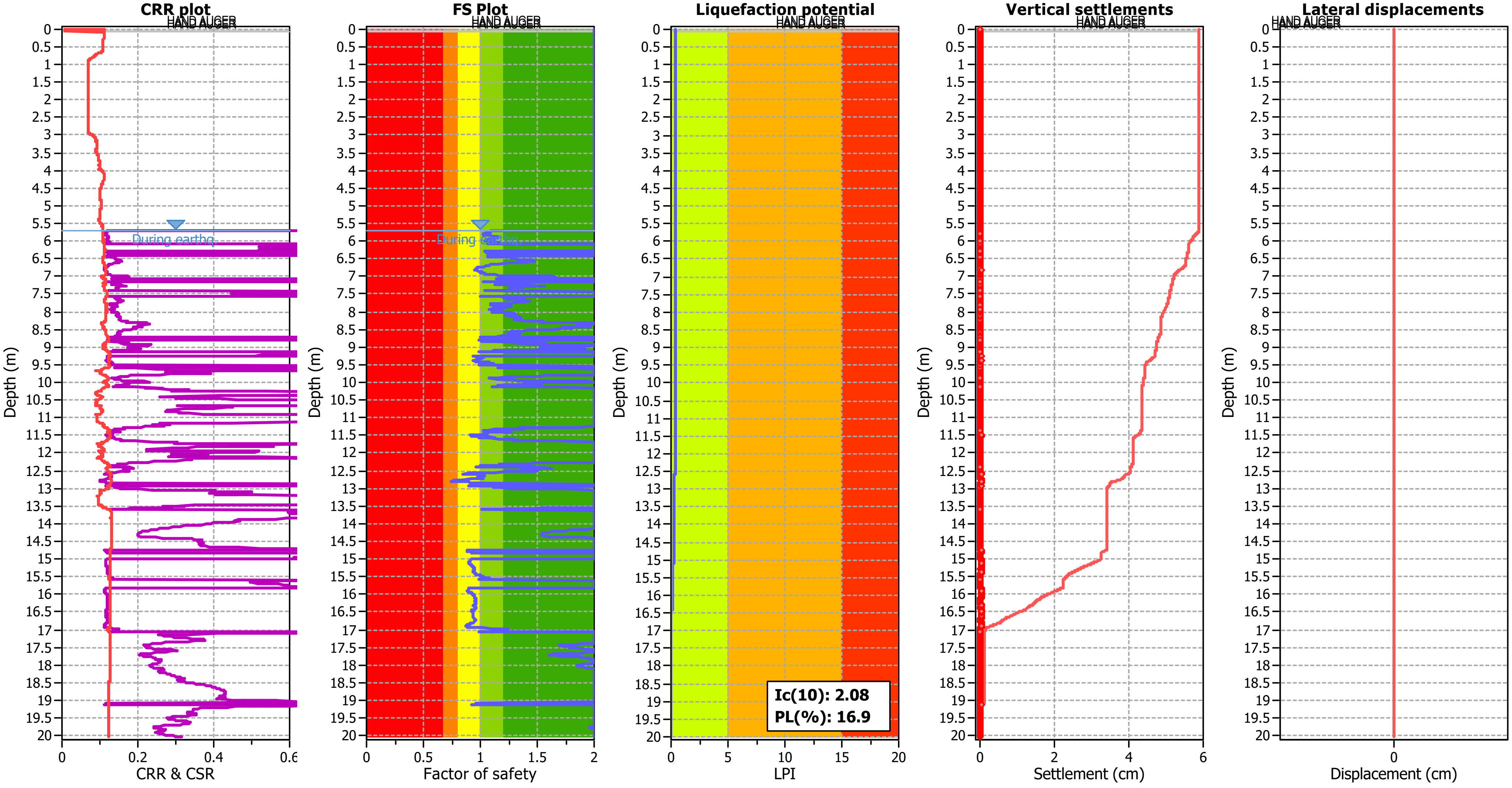

Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.10
Peak ground acceleration: 0.20
Depth to water table (insitu): 6.20 m

Depth to GWT (erthq.): 5.70 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

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

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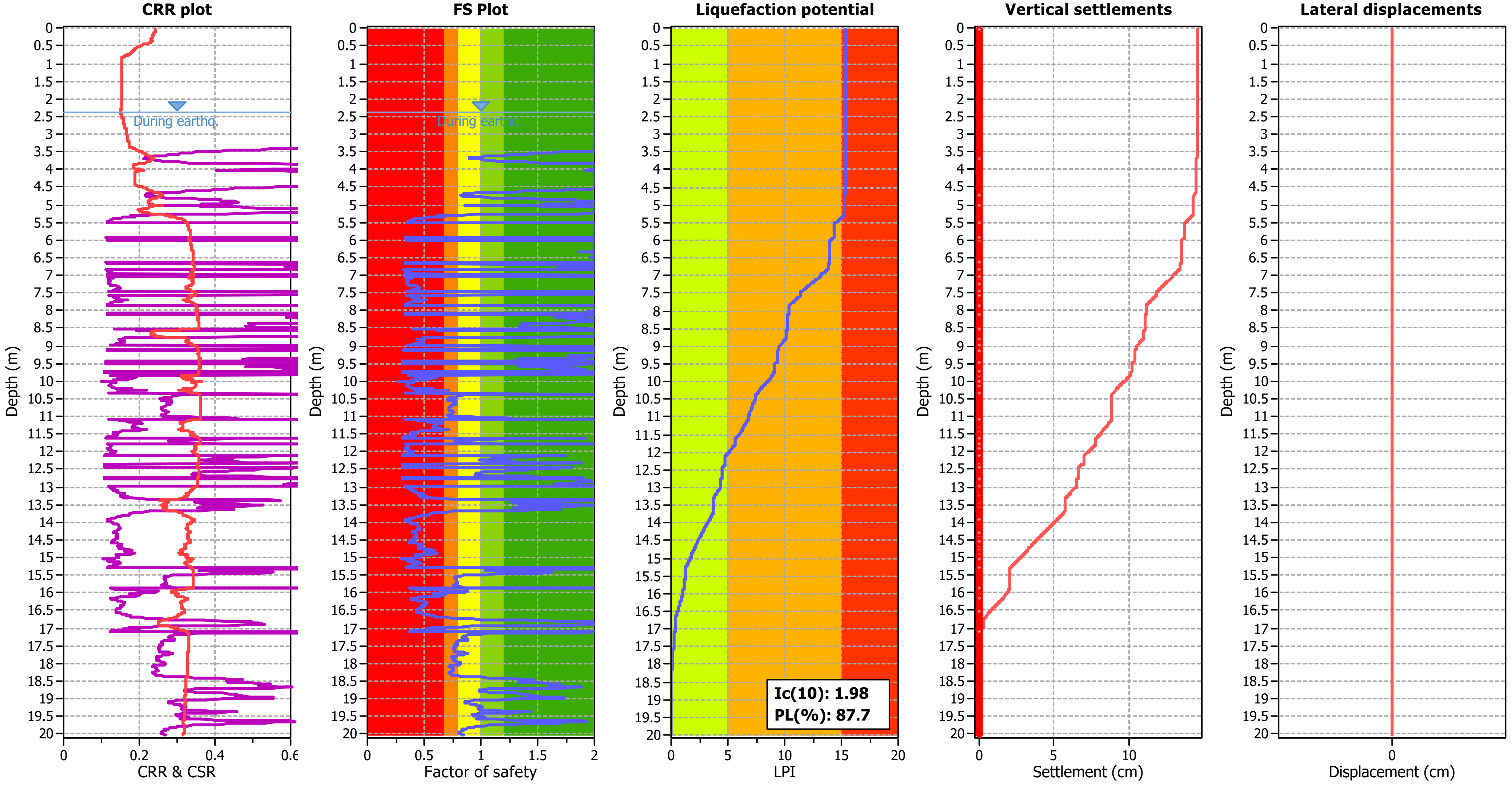

Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	2.40 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	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):	2.90 m	Fill height:	N/A	Limit depth:	N/A

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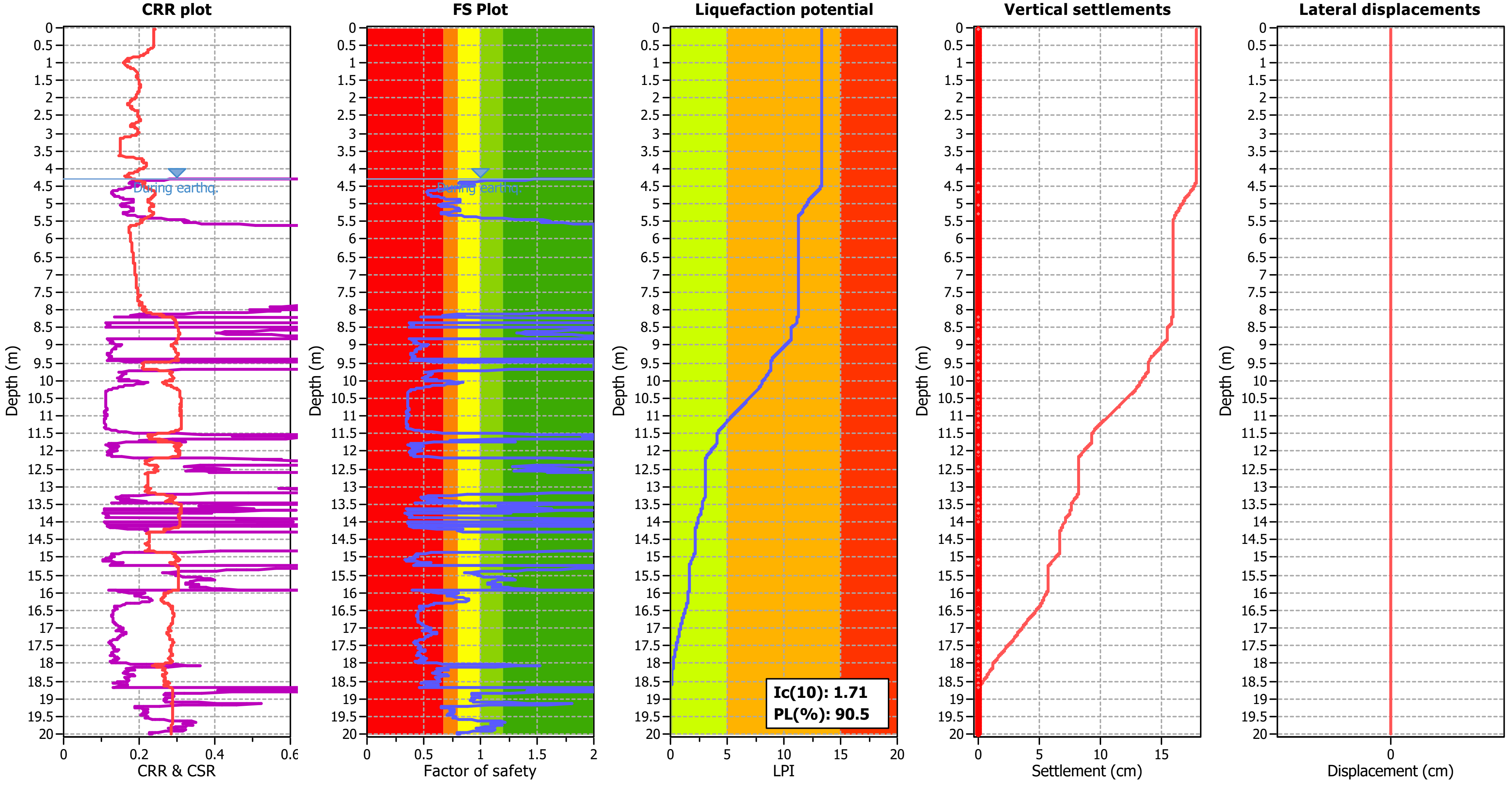

Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	4.30 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):	4.80 m	Fill height:	N/A	Limit depth:	N/A

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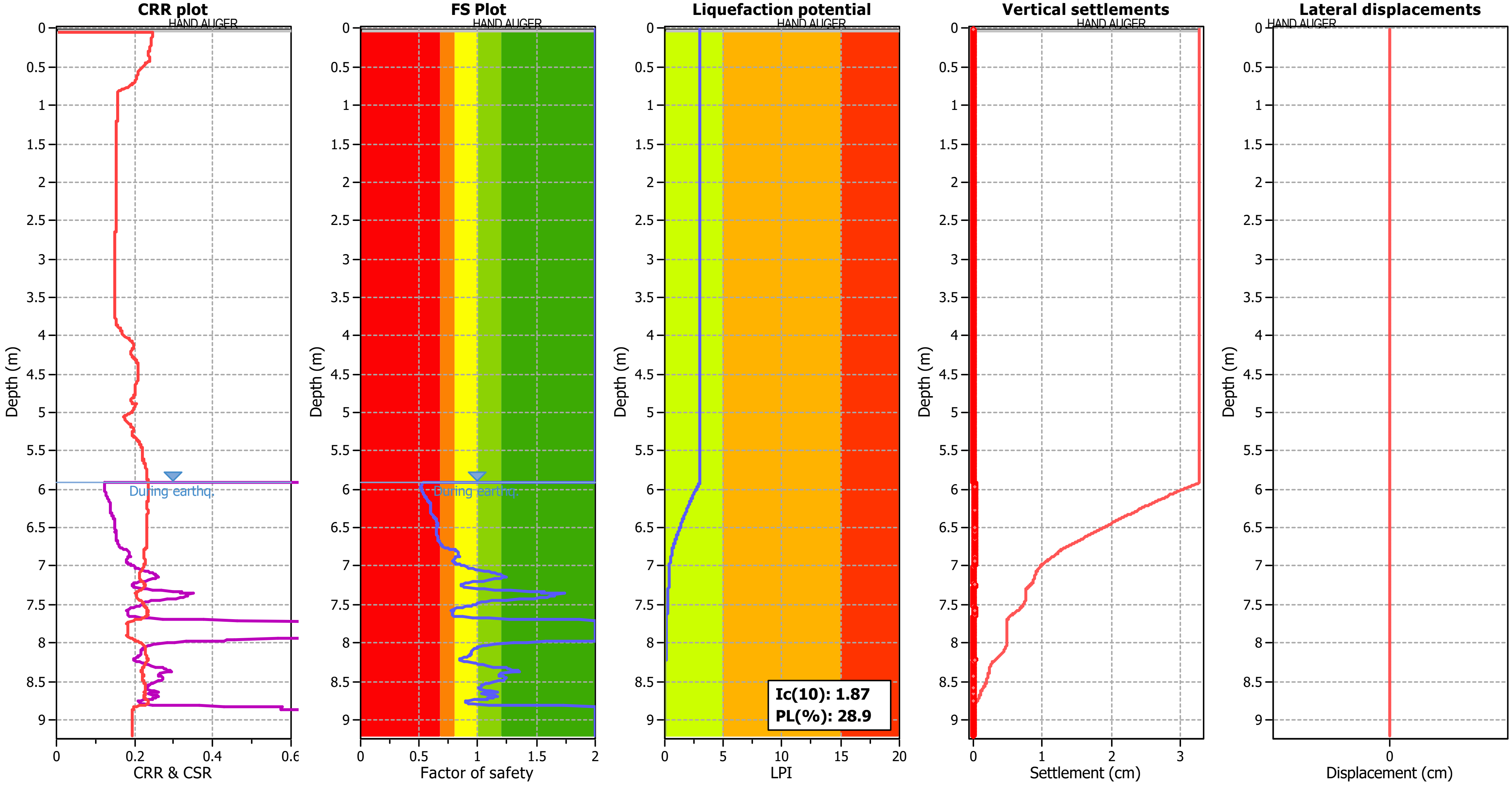

Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.10
Peak ground acceleration: 0.44
Depth to water table (insitu): 6.40 m

Depth to GWT (erthq.): 5.90 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

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

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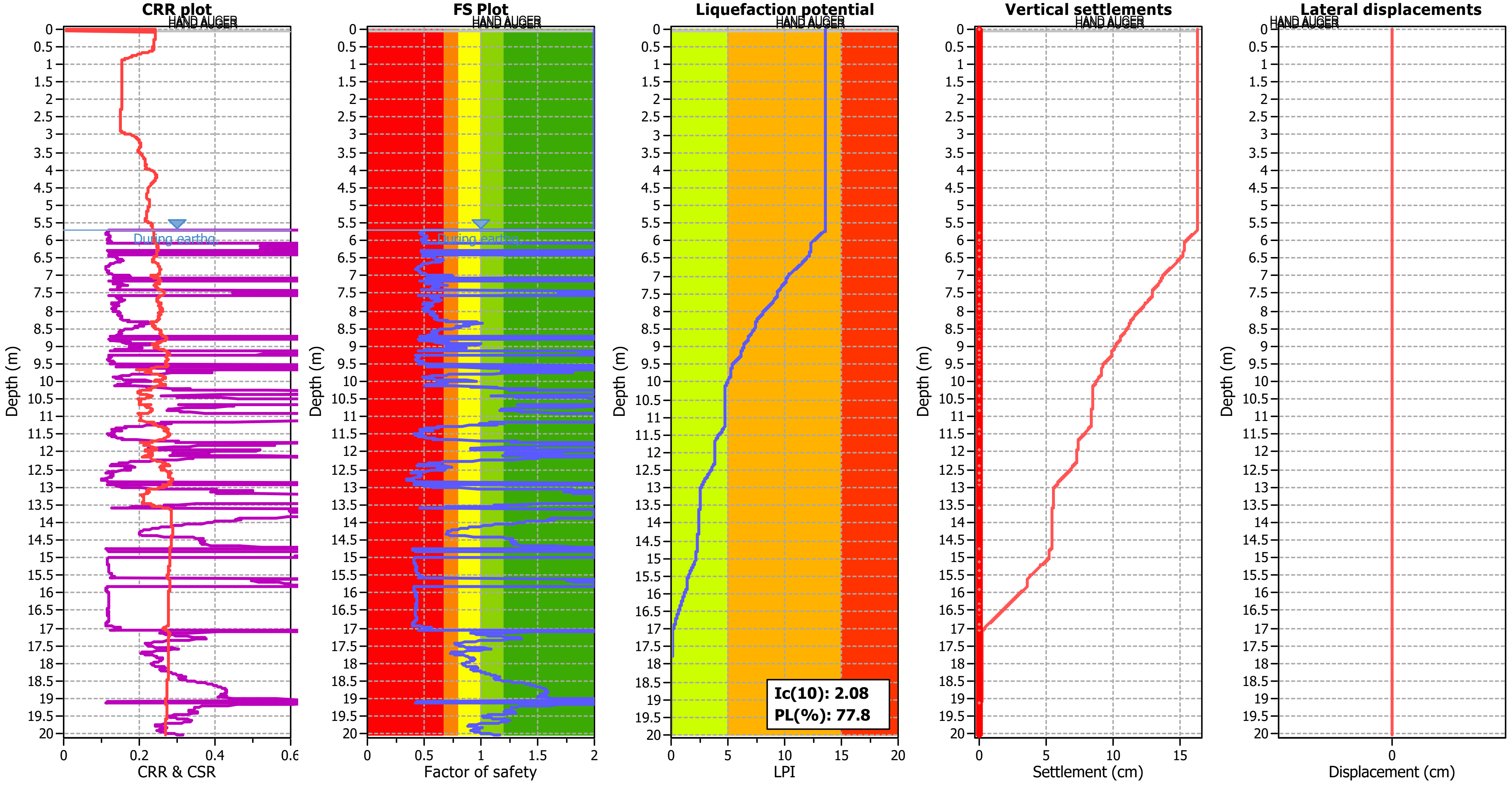
Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	5.70 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.10	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):	6.20 m	Fill height:	N/A	Limit depth:	N/A

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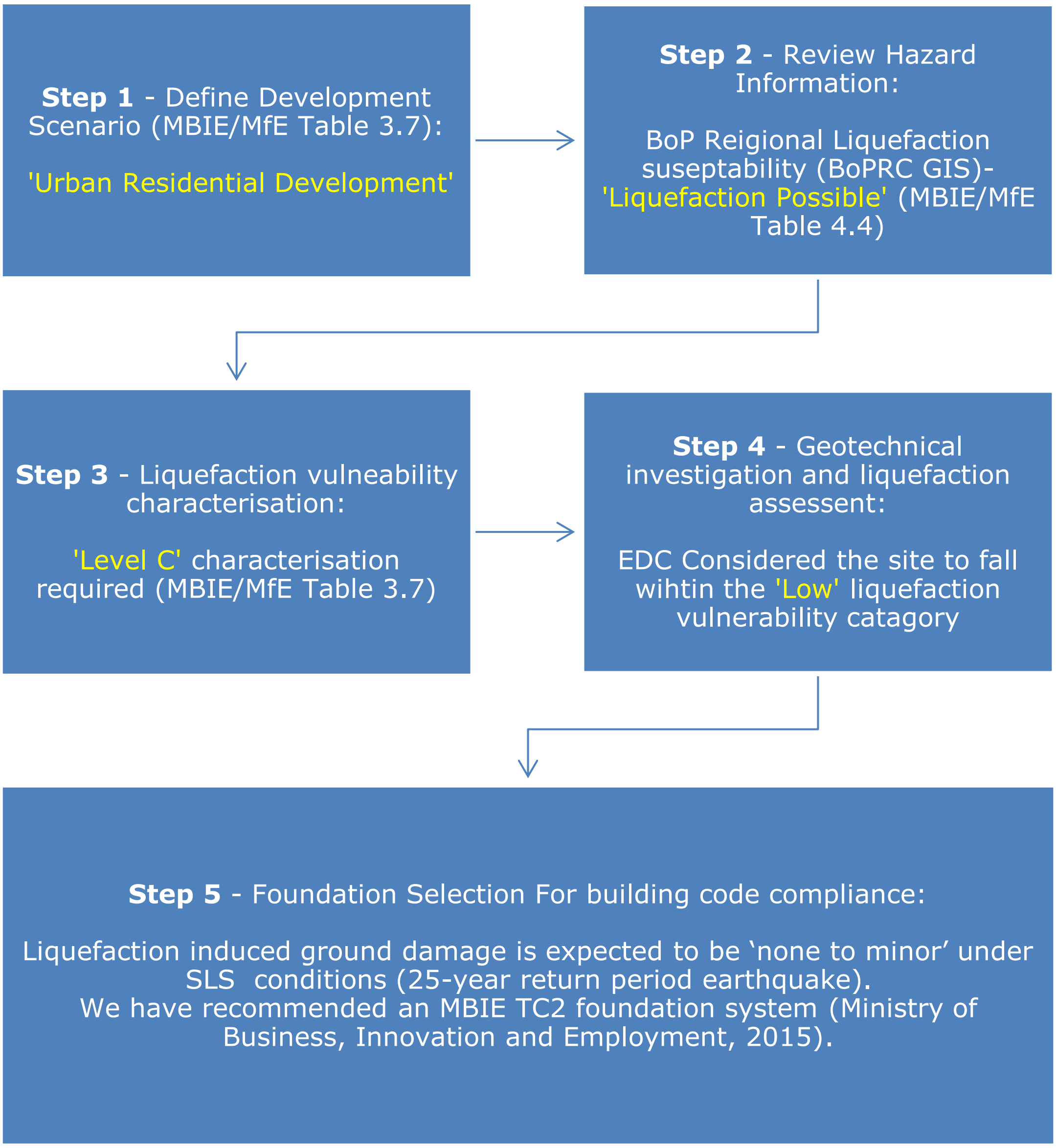
APPENDIX G

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



Step 1 - Define Development Scenario (MBIE/MfE Table 3.7):

'Urban Residential Development'

Step 2 - Review Hazard Information:

BoP Reigional Liquefaction suseptability (BoPRC GIS)- 'Liquefaction Possible' (MBIE/MfE Table 4.4)

Step 3 - Liquefaction vulneability characterisation:

'Level C' characterisation required (MBIE/MfE Table 3.7)

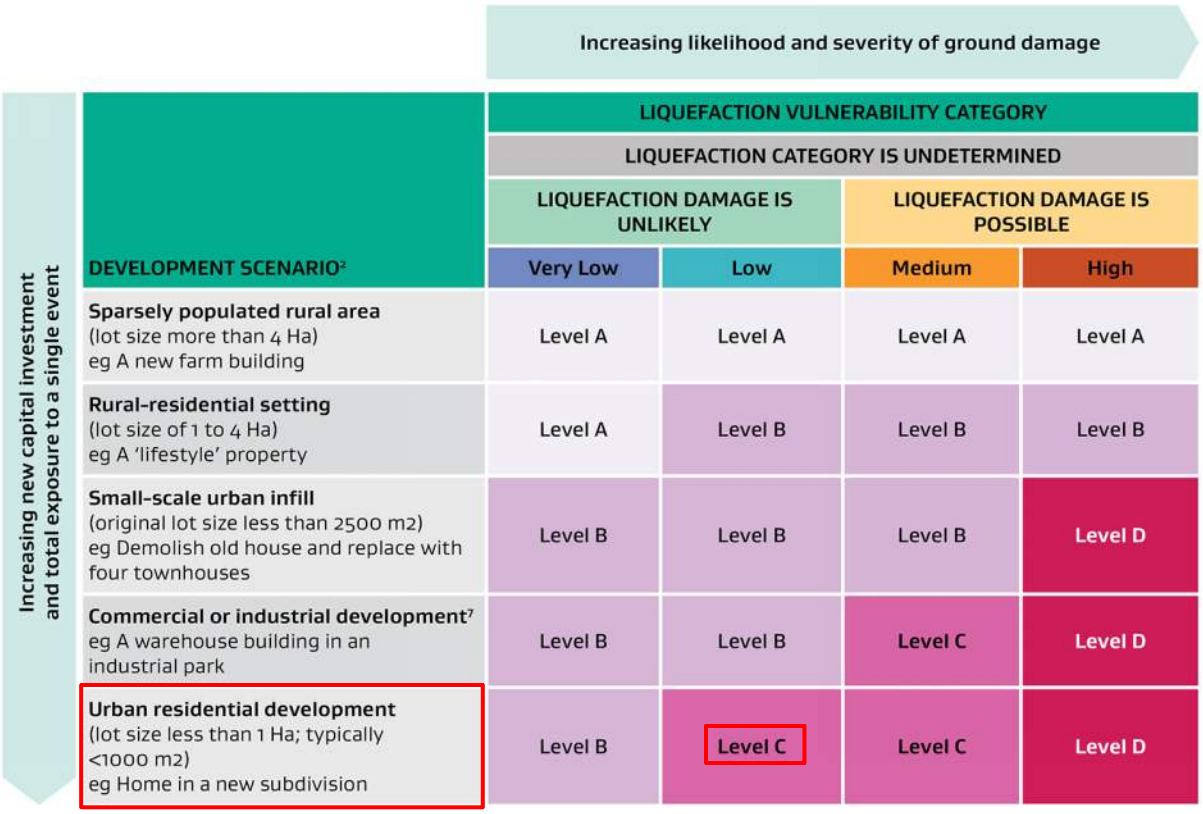
Step 4 - Geotechnical investigation and liquefaction assesent:

EDC Considered the site to fall wihtin the 'Low' liquefaction vulnerability catagory

Step 5 - Foundation Selection For building code compliance:

Liquefaction induced ground damage is expected to be 'none to minor' under SLS conditions (25-year return period earthquake).
We have recommended an MBIE TC2 foundation system (Ministry of Business, Innovation and Employment, 2015).

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

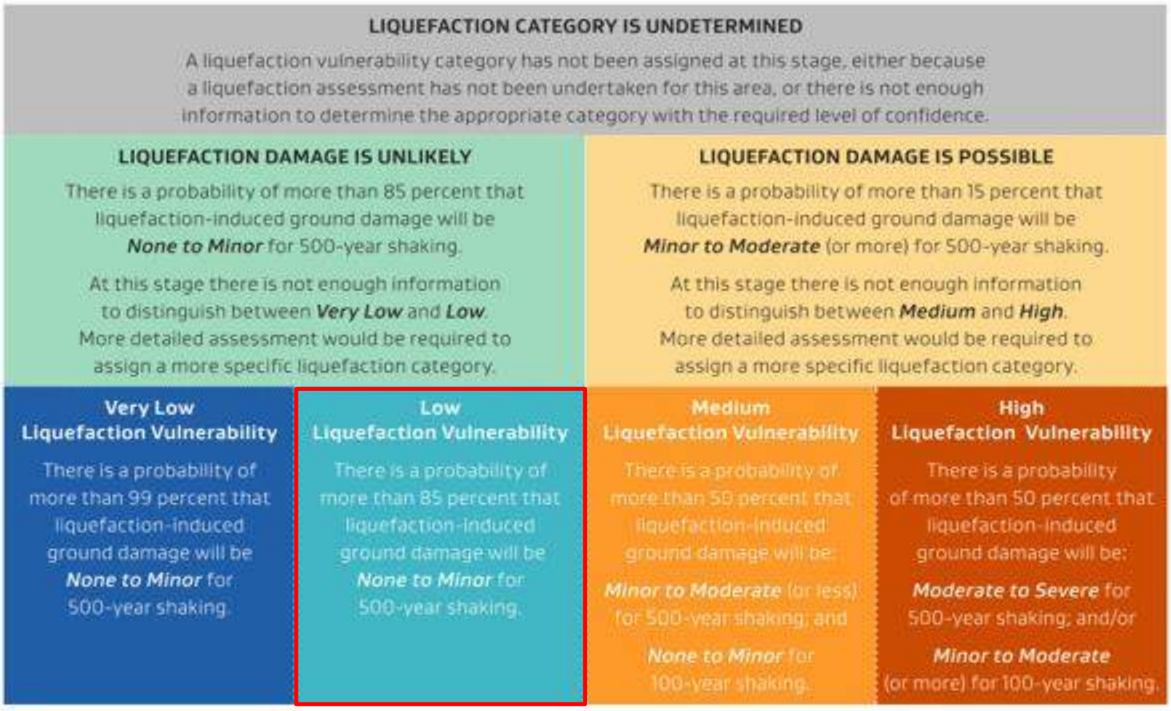


Increasing likelihood and severity of ground damage

Increasing new capital investment and total exposure to a single event

	LIQUEFACTION VULNERABILITY CATEGORY			
	LIQUEFACTION CATEGORY IS UNDETERMINED			
	LIQUEFACTION DAMAGE IS UNLIKELY		LIQUEFACTION DAMAGE IS POSSIBLE	
DEVELOPMENT SCENARIO[2]	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 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.		LIQUEFACTION DAMAGE IS POSSIBLE 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.

APPENDIX H

MAVEN COMPARISON OF AS-BUILT INFASTRUCTURE SURVEYS

Manhole	Contractors Asbuilt Invert pre-filling	Maven As Built 22.5.23	Maven ReChecks 31.5.23	Delta between measured values
SWMH 4-1	1.53	1.55		0.02
SWMH 4-11		3.87	3.86	-0.01
SWMH 4-10		3.38	3.36	-0.02
SWMH 1-2-1		2.54	2.54	0.00
SWMH 1-1-9		1.84	1.84	0.00
Wingwall	1.43	1.44		0.01

WWMH E7		3.01	3.03	0.02
WWMH E7-1	3.89	3.84	3.87	-0.02
WWMH E7-2	4.11	4.09		-0.02
WWMH E7-3	4.26	4.26		0.00
WWMH E7-4	4.57	4.58		0.01
WWMH E6		2.46	2.47	0.01
WWMH E6-1	3.12	3.16	3.15	0.03
WWMH E6-2				0.00
WWMH E6-3	3.58	3.6		0.02
WWMH E6-4	3.76	3.76		0.00
WWMH E8-1	4.46	4.42		-0.04
WWMH E8-2	4.7	4.71		0.01
WWMH E8-3	4.98	5		0.02

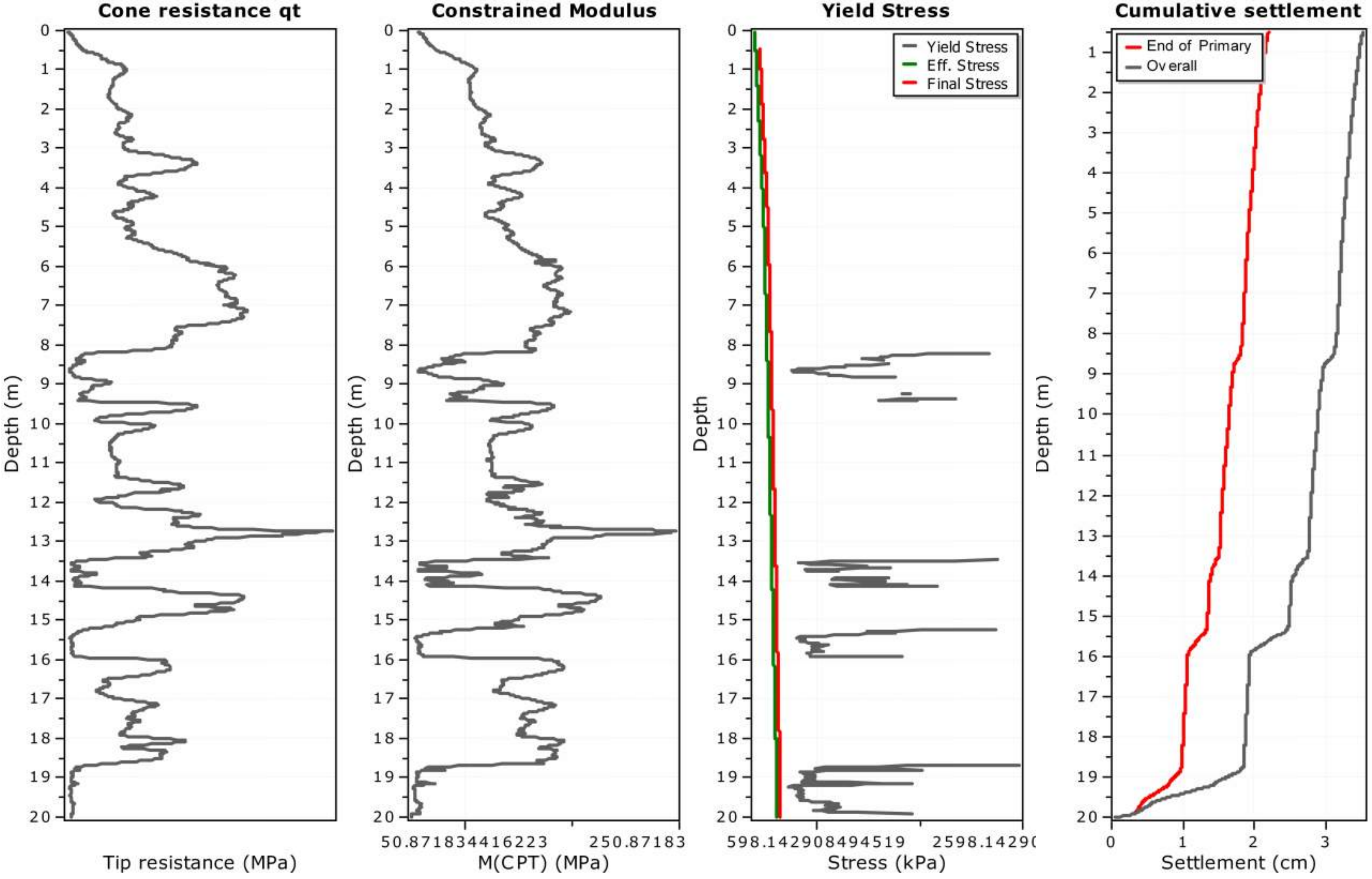
APPENDIX I

CPET-IT STATIC SETTLMENT ANLYSIS REPORTS

CPT: CPT 401
Total depth: 20.00 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 40.00 (kPa)
Embedment depth: 0.50 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

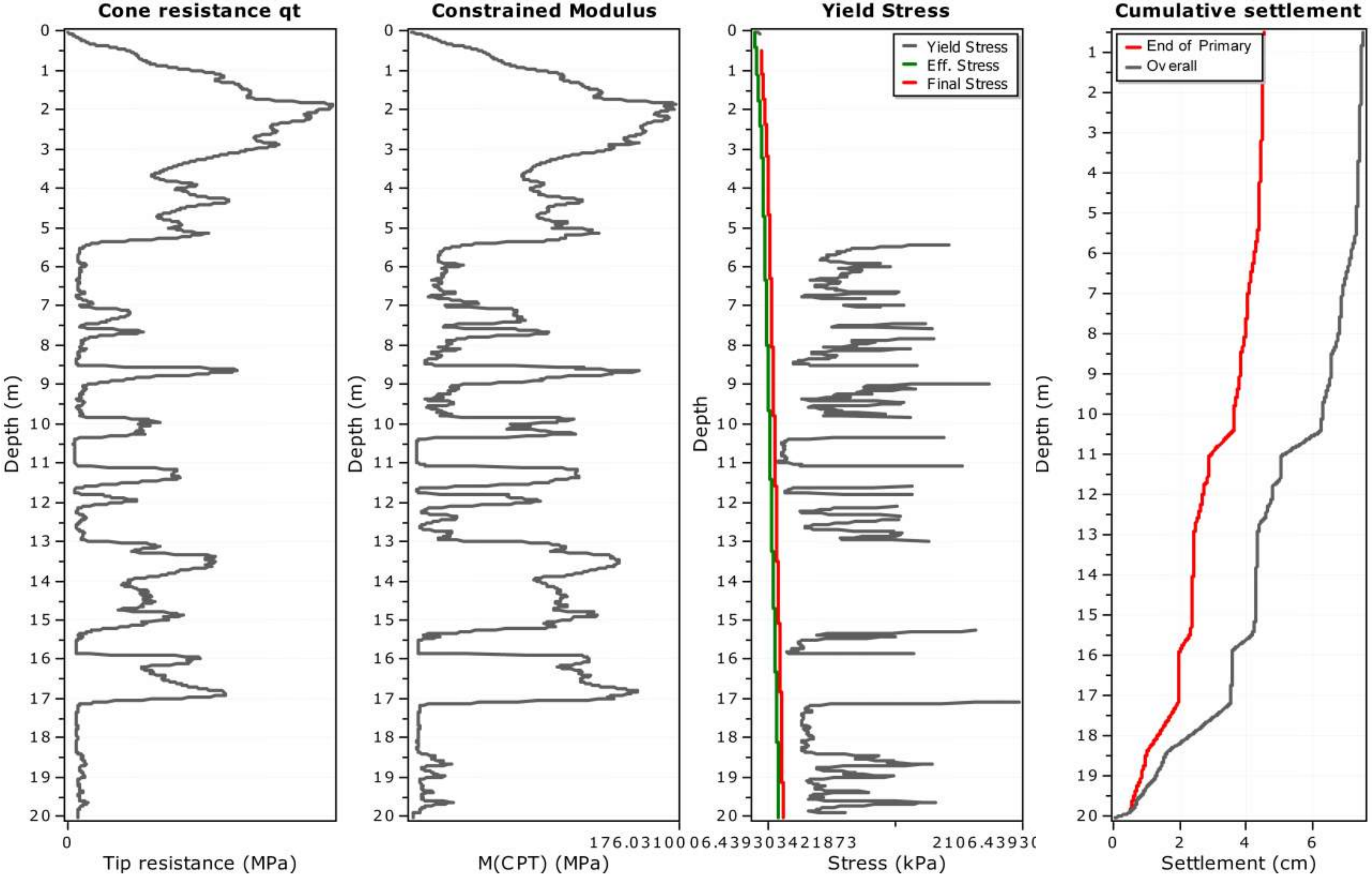
[illegible]

where t_p is the duration of primary consolidation

CPT: CPT 402
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 40.00 (kPa)
Embedment depth: 0.50 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

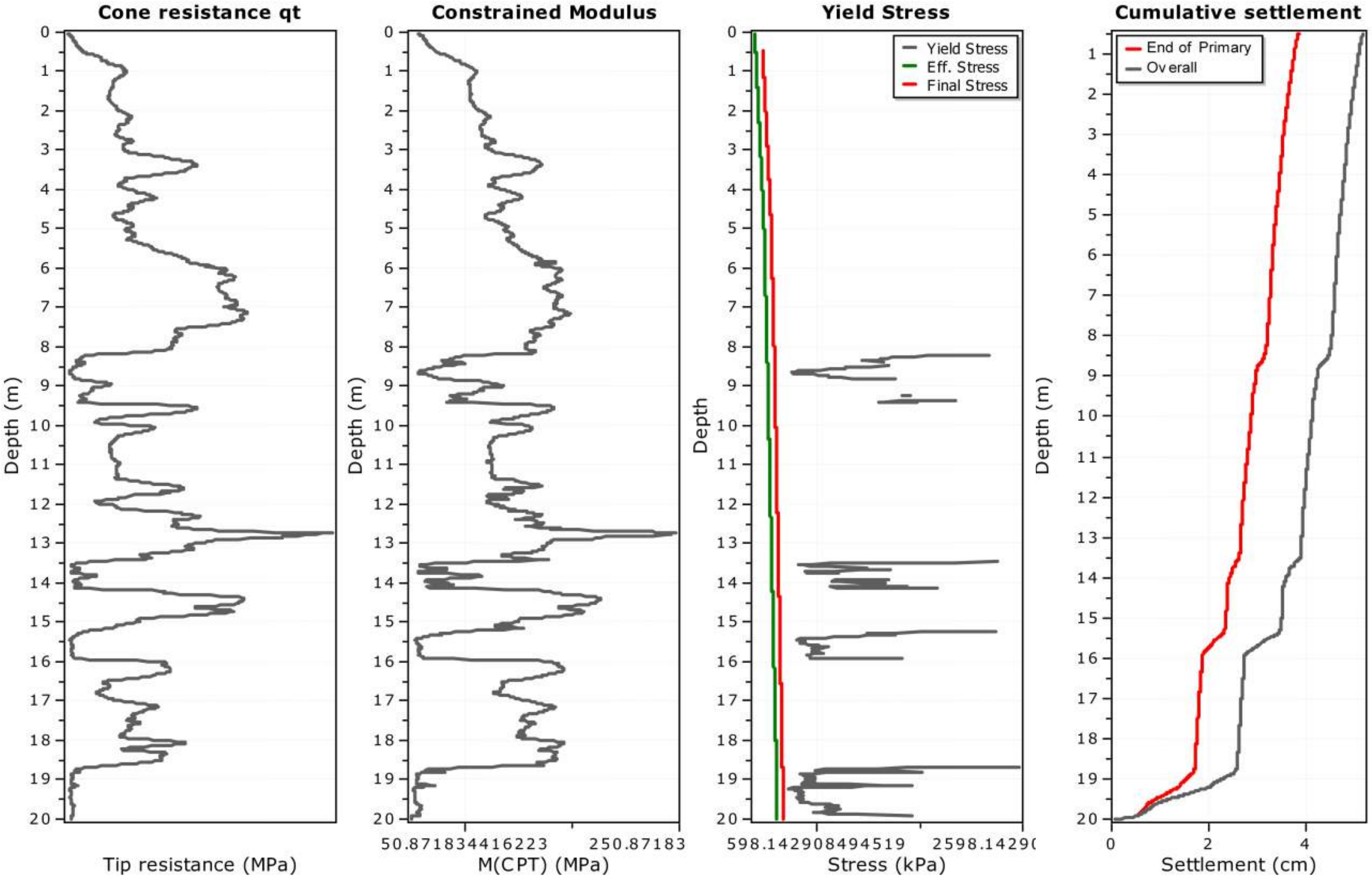
* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

where t_p is the duration of primary consolidation

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 70.00 (kPa)
Embedment depth: 0.50 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

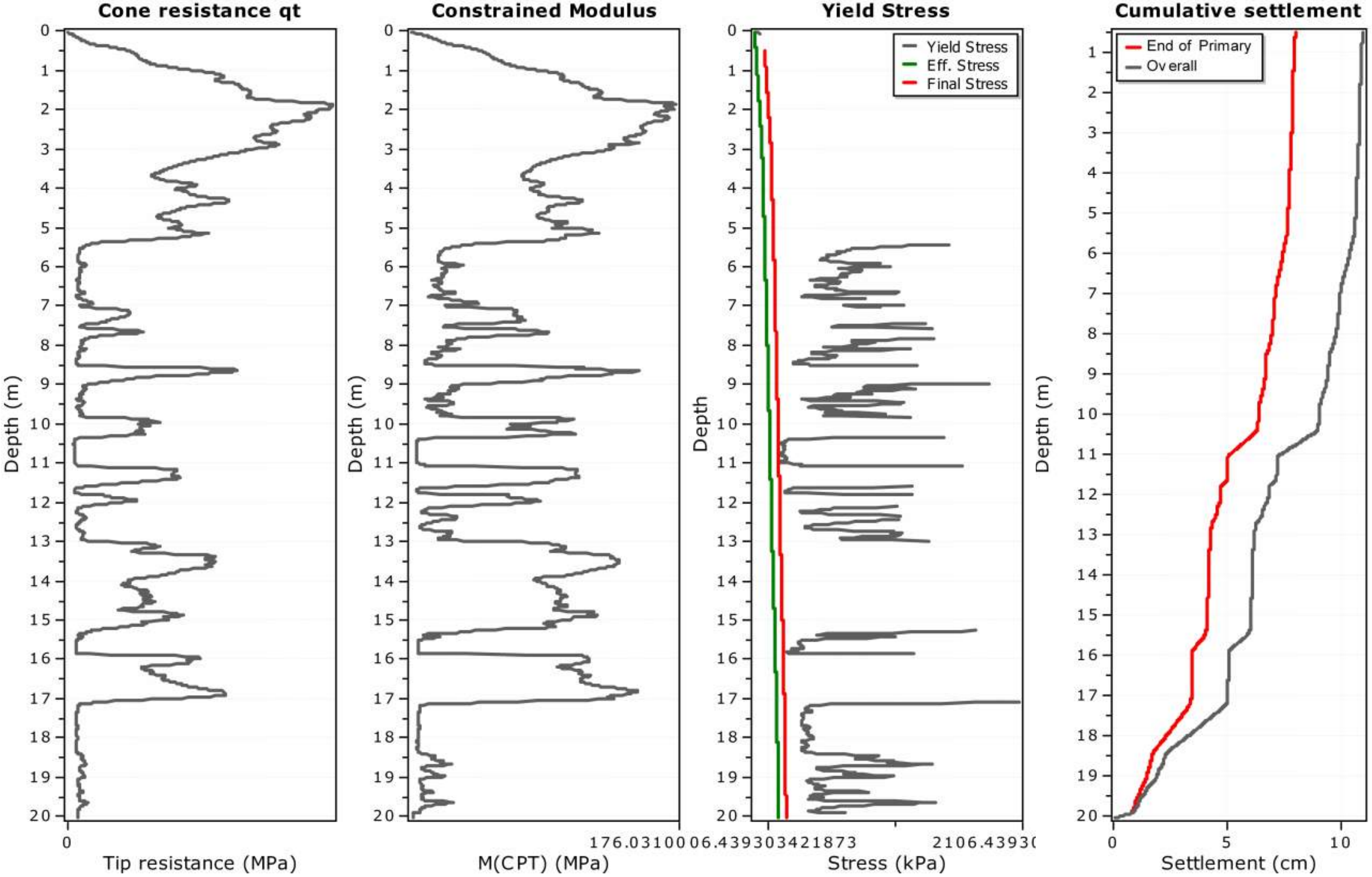
[illegible]

where t_p is the duration of primary consolidation

CPT: CPT 402
Total depth: 20.03 m, Date: 24/05/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Cone Penetration Testing**
Location: **Stage 6, Waiotahe Drifts Subdivision**

Settlements calculation according to theory of elasticity*



Calculation properties

Footing type: Rectangular
Footing width: 50.00 (m)
L/B: 1.0
Footing pressure: 70.00 (kPa)
Embedment depth: 0.50 (m)
Footing is rigid: No
Remove excavation load: No
Apply 20% rule: No
Calculate secondary settlements: Yes
Time period for primary consolidation: 6 months
Time period for second. settlements: 600 months

* Primary settlement calculation is performed according to the following formula:

$$S = \sum \frac{\Delta\sigma_v}{M_{CPT}} \Delta z$$

* Secondary (creep) settlement calculation is performed according to the following formula:

[illegible]

where t_p is the duration of primary consolidation

APPENDIX J

INDIVIDUAL LOT SUMMARY

Subdivision Geotechnical Summary Table

Waiotahe Drifts Subdivision - Stage 6b
EDC: 48749
26/05/2023

LOT	AREA	CUT		FILL		SLOPE TYPE	SPECIFIC CONSIDERATIONS				FOUNDATION REQUIREMENTS
		SOIL TYPE	MAX DEPTH	FILL TYPE	MAX DEPTH		Public Services	Retaining Walls	Expansive Soil	Building Set-Back	
22	504	Sand	0.5m	Sand & Gravel	3.5m	Central Ridge	No	No	No	No	Recommended foundations include MBIE TC2 Enhanced Slab or shallow piles designed in accordance with building consent stage bearing capacity assessment.
23	703	Sand	1.0m	Sand	1.0m	Level	No	No	No	No	Specific Engineer Designed Foundations are required for an anticipated reduced bearing capacity of 200kPa. Recommended foundations include MBIE TC2 Enhanced Slab or shallow piles designed in accordance with building consent stage bearing capacity assessment.
24	718	Sand	1.0m	Sand	1.0m	Level	No	No	No	No	Recommended foundations include MBIE TC2 Enhanced Slab or shallow piles designed in accordance with building consent stage bearing capacity assessment.
25	542	-	-	Sand & Gravel	4.0m	Central Ridge	No	No	No	No	
26	542	-	-	Sand & Gravel	5.0m	Central Ridge	No	No	No	No	
27	719	Sand	1.0m	Sand	1.0m	Level	No	No	No	No	
28	718	Sand	1.0m	Sand	1.0m	Level	No	No	No	No	
29	542	-	-	Sand & Gravel	5.5m	Central Ridge	No	No	No	No	
92	434	-	-	Sand & Gravel	3.0m	Down to south	No	No	No	No	
93	457	-	-	Sand & Gravel	3.0m	Down to south	No	No	No	No	Specific Engineer Designed Foundations are required for an anticipated reduced bearing capacity of 200kPa. Recommended foundations include MBIE TC2 Enhanced Slab or shallow piles designed in accordance with building consent stage bearing capacity assessment.
94	462	-	-	Sand & Gravel	3.0m	Down to south	No	No	No	No	Recommended foundations include MBIE TC2 Enhanced Slab or shallow piles designed in accordance with building consent stage bearing capacity assessment.
95	436	-	-	Sand & Gravel	3.0m	Down to south	No	No	No	No	Specific Engineer Designed Foundations are required for an anticipated reduced bearing capacity of 200kPa. Recommended foundations include MBIE TC2 Enhanced Slab or shallow piles designed in accordance with building consent stage bearing capacity assessment.
96	436	-	-	Sand & Gravel	4.0m	Down to south	No	No	No	No	
97	461	-	-	Sand & Gravel	3.0m	Down to south	No	No	No	No	
98	461	Sand	0.5m	Sand & Gravel	3.0m	Down to south	No	No	No	No	Recommended foundations include MBIE TC2 Enhanced Slab or shallow piles designed in accordance with building consent stage bearing capacity assessment.
99	436	-	-	Sand & Gravel	4.0m	Down to south	No	No	No	No	

APPENDIX K

STATEMENT OF PROFESSIONAL OPINION AS TO SUITABILITY OF LAND FOR BUILDING DEVELOPMENT

APPENDIX 1B

To: The Engineer
Opotiki District Council
P O Box 44
OPOTIKI 3092

STATEMENT OF PROFESSIONAL OPINION AS TO SUITABILITY OF LAND FOR BUILDING DEVELOPMENT

Subdivision:	Waiotahe Drifts Subdivision, Stage 6b
Owner/Developer:	Maven
Location:	Waiotahe Drifts, Opotiki

I, Gareth B Williams of Engineering Design Consultants Ltd.
(Full name) *(Name of Firm)*

202 The Strand, Whakatane
(Address of Firm)

hereby confirm that:

1. I am a Registered Engineer experienced in the field of soils engineering and was retained by the owner/developer as the Soils Engineer on the above subdivision.

2. The extent of my inspections during construction, and the results of all tests carried out are described in my report dated 07/06/2023 .

3. In my professional opinion, not to be construed as a guarantee, I certify that:

   *(a) That earthfills shown on the attached Plan No. C941 - A have been placed in compliance with the Code of Practice – Subdivision and Development of the Opotiki District Council.

   *(b) The completed works give due regard to land slope and foundation stability considerations.

   *(c) The filled ground is suitable for the erection thereon of residential buildings ~~not~~ requiring specific design in terms of NZ Building Act 1991 and NZ Building Regulations 1992, and related documents providing that:
   (i) Foundations require Specific Engineered Design, as outlined in our Geotechnical Completion Report (Rev. 1 Dated 07/06/2023)
   (ii)
   (iii)

   *(d) The original ground not affected by filling is suitable for the erection thereon of residential buildings ~~not~~ requiring specific design in terms of NZ Building Act 1991 and NZ Building Regulations 1992, and related documents, providing that::
   (i) Foundations require Specific Engineered Design, as outlined in
   (ii) our Geotechnical Completion Report (Rev. 1 Dated 07/06/2023)
   (iii)

4. This professional opinion is furnished to the Council and the owner/developer for their purposes alone, on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any dwelling.

Signed: Date: 07/06/2023

* *Delete items not applicable*