Application for
Resource Consent

Section 88 of the Resource Management Act 1991

Te Kaunihera o Te Tairāwhiti
GISBORNE
DISTRICT COUNCIL

About this form

Please answer all the questions and provide the relevant details of your proposal. We recommend you talk your proposal through with Council planning staff before you fill in this form.

1. Activity type and location

This application is for:

☐ Change of consent notice (s.221) ☑ Land Use Consent ☑ Subdivision Consent ☑ Land Use (Regional)

☐ Other

Site(s) to which this application relates is described as:

Street/ Rapid No.: 556-560

Street/Road Name: Aberdeen Road, Gisborne

Property valuation No.:
(see rates invoice)

Legal Description: Lot 2 DP 1585; Part Lot 1 DP 1585; Lot 1 DP 1817

Fully describe the location:

OFFICE USE ONLY: Map Reference NZTM:

2. Applicant's details (all correspondence will be sent to the applicant unless agent's details are completed)

Name in full: NZHG Gisborne Limited - Mitch Jackson
Surname: First Name(s)

Postal address:

Phone:
Day Mobile:

Email: mitch.jackson@twproperty.co.nz

Email is Council's preferred method of contact.

Do you agree to receive your correspondence and consent by email? ☑ Yes ☐ No

Office use only

Application No:

Received GDC:		Received SO:		Received ADM:		EDRMS No:	
Deposit paid:		Date paid:		Category:		Officer:	

The applicant is the:

☑ Owner ☐ Occupier ☐ Prospective Purchaser ☐ The Crown ☐ Network Utility Operator

☐ Agent / Consultant (provide details over page)

3. Property owner's details (if different from applicant)

Name in full:

Surname: First Name(s)

Postal address:

Phone:

Day Mobile:

Email:

4. Agent/consultant's details (all correspondence will be sent to your agent)

Company: Stradegy Planning Ltd

Contact Person: Pip Beachen

Postal address:

Phone: Mobile: 0275726100

Day Mobile:

Email: pip@stradegy.co.nz

Email is Council's preferred method of contact.

Do you agree to receive your correspondence and consent by email? ☑ Yes ☐ No

5. Address for invoices

Send all invoices and annual charges to: ☑ Applicant ☑ Agent/Consultant ☐ Other

If other, name

Surname: First Name(s)

Postal address:

6. Detailed description of proposed activity

1. Land use consent to construct twelve dwellings as a Restricted Discretionary Activity pursuant to Rule 1.6.1 (17).
2. Land use consent as a Discretionary Activity pursuant to Rule 6.2.3(13) for point source water discharge.
3. Subdivision consent to create a twelve-lot fee simple subdivision as a Discretionary Activity pursuant to Rule 10.1.6 (9).
4. Land use consent as a Restricted Discretionary Activity pursuant to Regulation 10 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.

7. Additional resource consents required for this proposal

Are any other resource consent(s) required for your proposal, but are not being applied for under this application? ☑ Yes ☐ No

☐ Land Use Consent ☐ Subdivision Consent ☑ Discharge Permit

☐ Coastal permit ☐ Water Permit ☐ Land Disturbance

☐ Other (give details):

Please list any previous consents relevant to this current application:

8. Consultation

Have you consulted with iwi? ☑ Yes ☐ No

If yes, which iwi groups have you consulted with?

- Te Aitanga a Mahaki, and
- Rongowhakaata.

Who else have you consulted with?

Please attach any relevant correspondence.

9. Approval of potentially affected parties

Have you obtained written approval from all parties potentially affected by the proposal? ☐ Yes ☑ No

Please attach the completed approval forms with a copy of your plans also signed by the affected people.

Please Note: Council planning staff will determine whether any people or groups are potentially affected by your proposal. Please discuss with our planning staff prior to lodging your application.

10. Notification of the application

Are you requesting the application to be publicly notified? ☐ Yes ☑ No
Please discuss the implications of notification with our planning staff if necessary.

11. Assessment of Environmental Effects (AEE)

Further information about preparing an AEE is on our website.

Please note: An AEE generally requires a separate sheet/report. Please attach any additional information.

Please see attached.

12. Council contact

Have you discussed your proposal with any Council planning staff? ☑ Yes ☐ No

If yes, who have you spoken with:

Awhina White

(name of Council staff member)

13. Draft conditions

Do you wish to see the draft conditions prior to the release of the resource consent decision? ☑ Yes ☐ No

If yes, the Council may extend the processing timeframe pursuant to Section 37A of the Resource Management Act 1991 to give you time to consider and respond to Council.

14. Contributions

When granting consent to certain activities, Council may levy a monetary contribution. Development contributions are levies under the Local Government Act 2002 in accordance with the Council's Development Contribution Policy. Financial or reserve contributions are levies under the RMA and Council's Combined Regional Land and District Plan.

15. Deposit and signature

The required deposit must be paid before we process your application.

Please refer to the Fees and Charges Schedule as per the website.

☐ I enclose a deposit of $ ______ for processing this application.

☐ I have paid a deposit by electronic banking of $ ______ on ______ (date)

Council's bank account details: **Account No. 03 0638 0502288 00**

Particulars: RC DEPOSIT CODE: ______ (surname) PARTICULARS: ______ (road name)

Declaration

I understand that Council may invoice me for the actual and reasonable costs incurred in processing this application.

I NZHG (print your name),

Agree that:

☑ I am liable for all fees and charges relating to this application

☑ The deposit is to be paid at the time of lodging the application

☑ That payment is due within 30 days of the issue date of any additional charges

☑ The information provided in this application and the attachments are accurate.

Signature of Applicant: (or person authorised to sign on behalf of applicant)

Date: 23.11.23 KTaylor

Admin check ☐

16. Privacy information

The information you have provided on this form is required so that your application can be processed under the RMA and statistics can be collected by Council. The information will be stored on a public register held by Council. The details may also be made available to the public on Council's website. These details are collected to inform the general public and community groups about all consents which have been issued through Council. If you would like to request access to, or correct your details, please contact Council.

17. Checklist for completing your application

To ensure your application will be accepted by Council for processing, this checklist sets out the information required to be lodged with your application for a resource consent. This is a generic list of information required to be lodged with all resource consent applications. For some activities, specific information requirements are detailed in activity specific information requirement checklists.

If any of the required information is not supplied Council will not accept the application and will return the documentation and deposit fee.

Lodging

Two methods for consent applications to be lodged are:

1. Digital applications – to be emailed to rclodgement@gdc.govt.nz
   Please note if the combined file size of your documents exceeds 30MB you will need to contact Consent Coordinators on the above email address. Staff responding will send out a secure link to upload your files.
2. Physical applications, lodged in person over the front counter. These will need to be lodged with the Duty Planner at Council Offices. Two paper copies (including one unbound) of all the information is required.

Information required

Along with a completed application form, the following information is required:	Council use		
✔ Applicant to check	**Y**	**N**	**n/a**
☐ Proof of deposit fee payment.	☐	☐	☐
☐ Record(s) of Title less than three months old for the site to which this application relates. Please attach the title and any consent notices, covenants, easements attached to the title if relevant or affected by the proposed activity.	☐	☐	☐
☐ A detailed description of the proposed activity.	☐	☐	☐

☐ Locality plan or aerial photo. Indicate the location of the site in relation to the street and other landmarks. Show the location of the subject site and those of adjoining sites. ☐ ☐ ☐

A scaled site plan showing: ☐ ☐ ☐

☐ The boundaries; ☐ ☐ ☐

☐ The location of the proposed activity or building; ☐ ☐ ☐

☐ North point; ☐ ☐ ☐

☐ Title/reference number(s); ☐ ☐ ☐

☐ Date the plans were drawn and individual plan numbers; ☐ ☐ ☐

☐ Location of existing and proposed accessways and points of entry; ☐ ☐ ☐

☐ Topographic features; ☐ ☐ ☐

☐ Contours; ☐ ☐ ☐

☐ Location of any mapped natural or cultural heritage features; ☐ ☐ ☐

☐ Location of any mapped natural hazards; ☐ ☐ ☐

☐ Location of any rivers, streams, watercourses. ☐ ☐ ☐

☐ Also refer to the checklist specific to the consent type to see any additional features that need to be added to the site plan. ☐ ☐ ☐

☐ An assessment of the activity the relevant provisions of the Tairawhiti Resource Management Plan (TRMP) - A list of the rules from the TRMP that require resource approval and status of the proposed activity in the TRMP. ☐ ☐ ☐

☐ An assessment against any relevant National Environmental Standards. ☐ ☐ ☐

☐ An assessment against any relevant National Policy Statements (i.e NPS for highly productive land) ☐ ☐ ☐

☐ An assessment of effects on the environment (AEE) in accordance with Schedule 4 of the RMA at a level of detail that corresponds with the scale and significance of the effects that the proposed activity may have on the environment. In addition, this may require one or more technical specialist reports. The AEE must include a full description of the proposed activity, the effects that may be generated and how these will be managed. For more information refer the AEE guidance available for each consent activity type. ☐ ☐ ☐

☐ An assessment against the relevant matters in Part 2 of the RMA will be required. Part 2 matters may be included in your AEE or in a separate document. ☐ ☐ ☐

☐ An assessment against any relevant provisions (i.e. policies and objectives) of a statutory document (e.g. the Tairawhiti Resource Management Plan, Regional and/or National Policy Statement). The assessment may be included in your AEE or in a separate document.
Note: This is only required for discretionary and non-complying activities. ☐ ☐ ☐

☐ Include details (name, postal and site address) of any consultation undertaken (including iwi) and any responses from those consulted with. ☐ ☐ ☐

☐ Written approval from all affected persons which includes a completed Affected Party Approval form(s) and signed and dated copies of the site plan, elevations. ☐ ☐ ☐

☐ A completed checklist relevant to your application – Refer to the separate checklists relating to the consent you are applying for, i.e. the activity type. ☐ ☐ ☐

Pre-lodgement meeting

Have you had a pre-lodgement meeting with a Council Consents Planner? ☐ Yes ☐ No

Whom did you have the pre-lodgement meeting with? ☐

To ensure a smoother lodgement process and to increase the chance of the application being accepted (as any outstanding information would have been identified at the pre-lodgement meeting) we encourage you to arrange a pre-lodgement meeting with a planner prior to lodging your application.

Office use only

Signed by Acceptance Officer: ☐

Officer: ☐ Date: ☐

View Payment

Payment Details:

Payment Date: 24/11/2023
From Account: NZHG Gisborne - 00 – 03-0698-0184904-000
Other Party Name: GISBORNE DISTRICT CO
Particulars: RC DEPOSIT
Analysis Code: 556-560 ABER
Reference: 50225011
Amount: $1,800.00
Original Hash Value: 682929
Current Hash Value: 682929
Transaction Note:
Create Many Single Payments: No
Status: Processed

Payee Details:

Payee Name	Account Number	Particulars	Analysis Code	Reference	Amount
GISBORNE DISTRICT CO	03-0638-0502288-000	RC DEPOSIT	556-560 ABER	DEEN RD	$1,800.00
					Total: $1,800.00

Authorisation History:

Action	User Name	Date/Time
Create	Samantha Webby	24/11/2023 14:05
Approve	Tracey Roussety	24/11/2023 15:22
Approve	Sally Watts	24/11/2023 15:25

◁ Back

Note: Business Online Helpdesk 0800 337 522

STRADEGY

Urban, Environmental & Strategic Planning

Resource Consent Application for Land Use and Subdivision

556 and 560 Aberdeen Road, Gisborne

NZHG Gisborne Limited

23127 AP1
23 November 2023

APPLICATION DETAILS

Consent Authority: Gisborne District Council (GDC)

The Applicant: NZHG Gisborne Limited

Address for Service: Stradegy Planning Limited, PO Box 239, Napier 4140
Attn: Pip Beachen pip@stradegy.co.nz

Address for Invoice: Mitch Jackson
mitch.jackson@twproperty.co.nz

Site Details:

Street Address: ....556 – 560 Aberdeen Road, Gisborne

Street Address:	556 Aberdeen Road		560 Aberdeen Road
Legal Description:	Lot 2 DP 1585	Part Lot 1 DP 1585	Lot 1 DP 1817
Area:	703m²	956m²	1012m²

Area: 2,671m²
Zoning: ....General Residential Zone

Activity for which Consent is sought:

1. Land use consent to construct twelve dwellings as a Restricted Discretionary Activity pursuant to Rule 1.6.1 (17).
2. Land use consent as a Discretionary Activity pursuant to Rule 6.2.3(13) for point source water discharge.
3. Subdivision consent to create a twelve-lot fee simple subdivision as a Discretionary Activity pursuant to Rule 10.1.6 (9).
4. Land use consent as a Restricted Discretionary Activity pursuant to Regulation 10 of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.

Prepared by: PBeach

Reviewed and Approved for Release by:

Pip Beachen BSc MUrb Plan(Prof)
Senior Planner

Paul O'Shaughnessy BRP MSC
Senior Planner

TABLE OF CONTENTS

Appendices –

1. Record of Title
2. Development Plans
3. Subdivision Scheme Plan
4. Geotechnical Reports
5. Detailed Site Investigation
6. Servicing Report
7. District Plan Compliance Analysis
8. Design Process Overview

1. INTRODUCTION

The purpose of this application is to obtain resource consent approval on behalf of NZHG Gisborne Limited to construct twelve residential dwellings at 556 and 560 Aberdeen Road, Gisborne within the General Residential Zone of the Tairawhiti Resource Management Plan (TRMP). Additionally, a concurrent subdivision is proposed to obtain twelve separate records of title for each of the dwellings, a jointly owned access lot (JOAL) which will be subsequently amalgamated with eleven of the lots and nine titles around carparks which will additionally be amalgamated with their respective lots.

Residential activities can be undertaken as a permitted activity however due to infringements to performance standards set out in DD1 of the TRMP, the construction of the dwellings is to be assessed as a Restricted Discretionary Activity pursuant to rule 1.6.1(17). However, as the proposed lots to be subdivided are unable to meet minimum net site area requirements for subdivision, the proposal overall falls to be assessed as a Discretionary Activity pursuant to Rule 10.1.6 (9).

A Discretionary Activity is also required pursuant to Rule 6.2.3(13) for point source water discharge and resource consent is also required under Regulation 10 of the NES for Assessing and Managing Contaminants in Soil to Protect Human Health as a Restricted Discretionary Activity.

The proposed dwellings and lots have been designed and arranged in a manner that is considered to constitute an appropriate form of medium density residential development which is anticipated by the Plan and compatible with the pattern of development within the receiving environment.

The application seeks dual land use and subdivision approval, and it is proposed that the construction of the dwellings will begin prior to the issue of Section 224C certification and titles.

Specialist inputs have been prepared to inform the assessment of this application. These are detailed in **Table 1** and are included as appendices to this application.

Table 1: Expert Reports

Expert Report	Author	Purpose
Development Plans	Atkinson Hardwood Architecture	Provide plans showing the bulk, location and design of the development.
Subdivision Scheme Plan	Definition Surveying Limited	Inform the layout of the proposed subdivision.
Geotechnical Report	LDE Development & Engineering	Assessment of site suitability from a geotechnical perspective.
Detailed Site Investigation	EAM Consultants	To confirm any soil contamination under the NES-CS.

Servicing Report	Infir	To determine wastewater, water supply and stormwater servicing solutions and to develop the necessary earthworks plan.

The following report has been prepared in accordance with Schedule 4 of the Resource Management Act (**the RMA**) and meets the requirements of Form 9. The level of detail provided is commensurate to the scale and significance of the effects that the activity may have on the environment.

2. BACKGROUND AND SITE DESCRIPTION

The site is situated across three separate records of title at 556 – 560 Aberdeen Road in Gisborne. The lots are legally described as Part Lot 1 DP 1585, Lot 2 DP 1585 and Lot 1 DP 1817 and cover an area of 2,671m².

Cumulatively, the lots are irregularly shaped and have a total frontage toward Aberdeen Road of 51.72m. As shown in **Figure 2** below, the site is currently occupied by three dwellings and associated accessory buildings. All dwellings and buildings on the site are single storey in height. Vehicle access to both sites are located adjacent to each other centrally within the frontage.

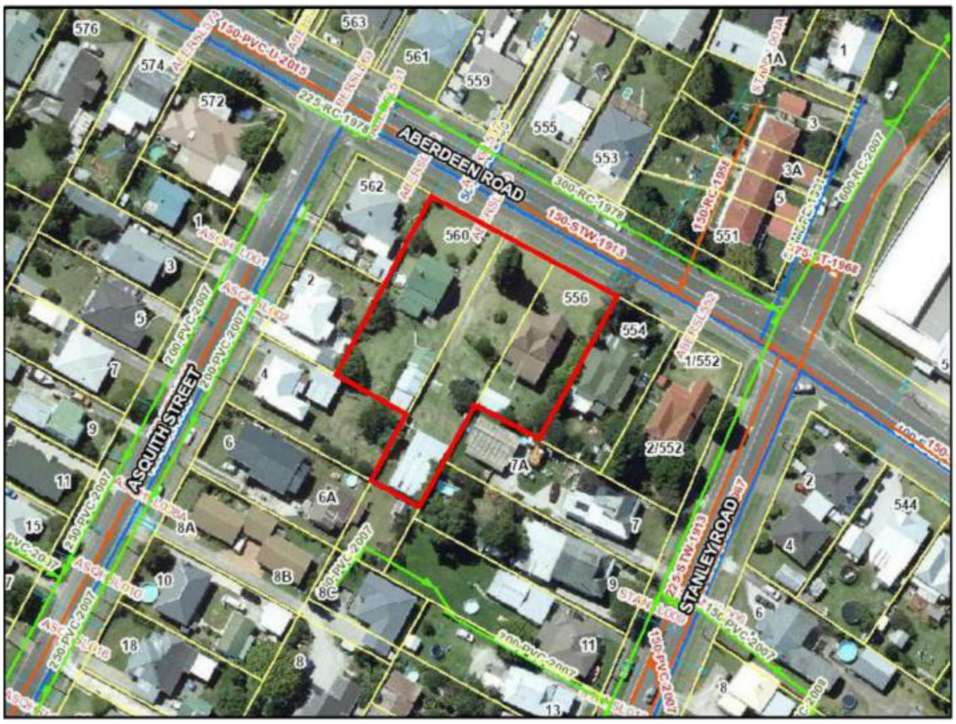
Figure 2: Locality Plan

As shown in **Figure 3** below, the site, and all sites surrounding it, are within the General Residential Zone of the District Plan.

Figure 3: District Plan Zoning

In terms of servicing, vehicle access to the site is currently achieved via two vehicle crossings located relatively centrally within the site. As demonstrated in **Figure 4** below, there are existing water and wastewater connections to the mains within Aberdeen Road. While there is a stormwater main within Aberdeen Road, there is currently no connection to the site. Aberdeen Road is identified as a collector road within the Tairāwhiti Resource Management Plan Roading Hierarchy.

Figure 4: Services within Aberdeen Road



As shown in the figures above, the surrounding locality is characterised by residential activities predominantly comprising detached dwellings on individual lots. In the wider area, a number of community resources are located within a 5 minute walking radius including Gisborne Girls' High School, Barry Park and Electrinet Sport Centre recreation facilities. Within 10 minute walking distance there are food outlet stores, an early child care centre, a church and Te Kura Kaupapa Māori o Horouta Wananga school.

Statutory Acknowledgment Areas

We understand that the subject site is located within the following Areas of Interest:

- Rongowhakaata (Rongowhakaata Claims Settlement Act 2012)
- Te Aitanga-a-Māhaki Area of Interest

Research into the Nga Whakaaetanga a Ture mo Te Tairawhiti (Statutory Acknowledgements of the Gisborne District June 2022) indicates that the site is not within a formal Statutory Acknowledgement Area.

Natural Hazards and Geotechnical Considerations

The site is known to be subject to moderate liquefaction risk. The site is not within a known Flood Hazard Area. Geotechnical assessments have been undertaken by LDE Consultants which are attached at **Appendix 4.** The assessments have the purpose of determining whether the site is suitable for subdivision and subsequent residential development as proposed. Its findings/recommendations are discussed further in Section 7 of this application in respect to the above hazards.

Legal Instruments

A copy of the relevant Records of Title are provided in **Appendix 1**. Here it is noted that there are no legal instruments or interests registered against the title that would compromise or restrict the exercise of the proposed activities.

Contaminated Soils

A Detailed Site Investigation prepared by EAM Environmental Consultants is attached at **Appendix 5**. The report outlines that soil sampling was undertaken in twelve different locations across the site with ten locations returning elevated levels of lead and one location returning elevated levels of arsenic above the NES residential land use standard. As such, the site is identified to be a piece of land subject to the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (**NESCS**).

3. DESCRIPTION OF PROPOSAL

The proposal entails the clearance of existing dwellings from the site and subsequent construction of twelve dwellings with a concurrent subdivision to provide an individual, fee-simple lot for each unit as well as a jointly owned access lot (JOAL). The development plans are included at **Appendix 2** with the proposed site layout reproduced in **Figure 5** below.

Figure 5: Proposed Multi-Unit Site Plan

Land Use

A number of specialist inputs providing detailed information in relation to the proposal are attached as appendices to this application. Specifically, the proposed development plans are attached at **Appendix 2.** In summary, the land use component of the application involves the following:

Dwellings, Site Layout and Access:

- The construction of twelve units across the site comprising:
    - Eight two storey, two bedroom dwellings constructed in duplex typology,
    - Two single storey, two bedroom duplex dwellings constructed in duplex typology,
    - One detached single storey, two bedroom dwelling, and
    - One detached single storey three bedroom dwelling.
- All dwellings will feature an open plan kitchen, dining and living room area.
- Materials selected for the dwellings includes a combination of Bevelback weatherboard and sheet cladding along with trapezoidal or corrugated roofing.
- Various earthy colour schemes are proposed across the site with further details of this shown on sheet 11 of the Plans.
- Roof styles are a combination of hip and gable end roofs with hipped roofs largely facing the exterior of the site to reduce dominance of buildings (with the exception of lots 5 and 6 which present as a gable end roof to the western boundary).
- Each dwelling is provided with an outdoor lawn area and service yard of varying sizes. The service yards provide space for a clothesline, small storage shed and space to store rubbish and recycling bins.
- Two vehicle accesses are proposed to the site as follows:
    - A proposed 3m wide single vehicle crossing in the northeastern corner of the site providing direct access to a parking pad provided for Lot 2.
    - A 5.5m wide JOAL providing vehicle access for Lots 1 and 3 – 12 which has a vehicle crossing width of 4.5m. A dedicated carpark is provided along the western extent of the JOAL for Lots 4 – 12. Lots 1 and 3 include carparking within their own lot. Sufficient manoeuvring space is provided within the JOAL for all vehicles to exit the site in a forward gear.
- Pedestrian access is provided directly off Aberdeen Road for Units 1, 2 and 9 – 12. A 1.2m wide footpath is proposed to be delineated along the western side of the JOAL to provide pedestrian access to and from the street.
- A copy of the site plan is demonstrated in **Figure 5** above with proposed perspectives from a north and south perspective in **Figures 6** and **7.**

Figure 6: Northern Perspective

Figure 7: Southern Perspective

Landscaping and Fencing:

- A fencing plan is included on Sheet 05 of the plans attached at **Appendix 2**. Here it is demonstrated that a combination of 1.25m and 1.85m high fencing is proposed throughout the site. Specifically, it is noted:

    - Fencing along the front boundary will comprise 1.55m high solid vertical timber paling with a 300mm high visually permeable portion above resulting in a total height of 1.85m. This will also extend along the JOAL adjacent to Lots 1 and 12,
    - Remaining fencing along the JOAL will be a combination of the above however reduced to 1.2m in some places, and
    - Exterior boundary fencing as well as intertenancy fencing is proposed as solid 1.85m vertical timber fencing.
- A high level of landscaping is proposed across the site which includes a combination of low landscaping beds, specimen trees, lawn and paved areas (as shown at Sheet 05).
- Landscaping beds are proposed along the JOAL, as well as within the individual site boundaries and include a combination of native and exotic species.
- Specimen trees are proposed throughout the development (largely around the perimeter and along the external extent of the JOAL) and comprise fruiting lemon, orange and feijoa trees as well as Puka, Pohutukawa and Kowhai varieties.

Earthworks and finished floor levels:

- Earthworks will be required to strip topsoil and unsuitable material from the building areas, excavations to install the soakage stormwater devices and form building platforms and the JOAL. Additionally, earthworks are required to shape the site such that stormwater runoff is controlled by draining lots to the proposed JOAL and to defined overland flow paths to avoid adverse effects on adjoining properties. The proposed volume of earthworks is in the order of:
    - 135m^3 of cut, and
    - 281m^3 of fill.
- Dwellings are proposed to have finished floor levels of:

Units 1 and 2	RL 7.10m
Unit 3	RL 7.10m
Unit 4	RL 6.75m
Units 5 and 6	RL 7.00m
Units 7 and 8	RL 7.15m
Units 9 and 10	RL 7.10m
Units 11 and 12	RL 7.10m

Servicing:

Details in relation to servicing are set out in the Servicing Report prepared by Infir attached at **Appendix 6**. Key points of the proposed design include:

- As a result of the topography of the site varying by approximately 1m, from north to south, the treatment of stormwater from the proposed development will be split as follows:
    - Run-off from roof areas is proposed to be attenuated by individual rainwater tanks on each of the lots before being discharged to Aberdeen Road via kerb connections. Lots 1, 2 and 7 – 12 have a proposed tank size of 1000L and Lots 3 – 6 will have a tank size of 2,000L. The combined discharge rate of 9.2L/s exceeds the capacity of a double kerb connection of 8L/s. As such, a double

    kerb connection and a single kerb connection to Aberdeen Road are proposed.
    - Discharge from all other paved surfaces will be directed to a Rainsmart system installed beneath the JOAL to attenuate and dispose of runoff from contributing areas via soakage to ground.
- The stormwater design aims to ensure that the runoff rates from any unattenuated areas, the discharge from the rainwater tanks and the overflow from the rainsmart system is no greater than that of the pre-development site during the 1 in 100-year event.
- The sumps within the access lane will be fitted with gross pollutant screens to capture debris larger than the aperture of the screens and it is additionally proposed to fit a Hynds first defence vortex prior to the rain smart system to treat stormwater further.
- In terms of wastewater, it is proposed to extend a DN150 connection into the development from the DN150 in Aberdeen Road. Individual DN100 connections will extend from each dwelling unit to connect to this common private wastewater pipe beneath the JOAL.
- Water will be supplied to the site via a DN50 connection from the DN100 water main located in the road reserve which will extend beneath the JOAL. A testable backflow prevention device and meter will be installed inside the boundary of the development. Individual connections to the common private water supply pipeline will be provided to each dwelling. A manifold will be installed within each dwelling lot.
- There is an existing fire hydrant located outside of the subject site and another within 40m of the site meeting compliance with the New Zealand Fire Fighting Code of Practice, no further hydrants are required to be proposed to service the development.
- A services trench is proposed beneath the JOAL to provide power and telecommunication connections to the rear dwellings. All household units will be provided with separate connections.

<u>Soil Remediation:</u>

As outlined previously, analysis of soils tested for heavy metal contaminants has determined that ten test locations have returned elevated levels of lead and one sample with elevated levels of arsenic. A Remedial Action Plan (RAP) has been prepared and is attached to the DSI in **Appendix 5**. Actions proposed to remediate the site are as follows:

- Undertake X-Ray Fluorescence (XRF) scanning across the entire site to assess any other areas of contamination which may be present and were not highlighted during sampling in the DSI.
- The XRF investigation will enable the depth and lateral extent of contamination to be established which will provide approximate volumes of soil requiring remediation.
- Options set out as potentially feasible to remediate the areas of contamination are:
    1. In Situ or Ex-situ mixing of impacted material with underlying clean soil or introduced clean soil.
    2. Excavation for disposal to landfill.
    3. A combination of 1 and 2.

The exact method for remediation will be established following the findings of the XRF scanning. We expect a condition of consent requiring remediation works to be undertaken in accordance with this RAP and that a Site Management Plan (SMP) is produced accordingly.

Subdivision

Concurrent to the land use consent, the applicant proposes to undertake a Fee Simple Subdivision to create 12 new residential titles each supporting a residential dwelling unit. A separate JOAL which will be subject to amalgamation with 11 of the residential lots (Lots 1 and 3 – 12) will provide legal access from the street.

Additionally, the individual carparks located within the JOAL will each be given their own separate record of title to be amalgamated with their corresponding lot. The carparks will be Lots 1004 – 1012.

The proposed subdivision scheme plan is attached to this application in **Appendix 3** and is reproduced below in **Figure 8**.

As shown below, the proposed sites can be described as follows:

Lot	Area	Lot	Area
Lot 1	156m^2	**Lot 7**	114m^2
Lot 2	157m^2	**Lot 8**	114m^2
Lot 3	343m^2	**Lot 9**	144m^2
Lot 4	280m^2	**Lot 10**	118m^2
Lot 5	217m^2	**Lot 11**	117m^2
Lot 6	176m^2	**Lot 12**	118m^2
Lot 100 (JOAL)	625m^2		

Easements

The subdivision scheme plan includes a Schedule of Easements and Easements in Gross. Easements are proposed to facilitate rights-of-way over the JOAL (Lot 100) for Lots 1 and 3 - 12. Rights are also conferred to facilitate three waters supply and the transmission of electricity and telecommunications, as well as party wall easements. An easement in gross is provided over lot 100 (the JOAL) in favour of Chorus New Zealand Limited for the right to convey telecommunications.

Amalgamation Conditions

The following amalgamation condition is proposed for the creation of the JOAL (Lot 100):

- *That Lot 100 (legal access) be held as to eleven (11) undivided one-eleventh shares by the owners of Lots 1 and 3 - 12 as tenants in common in the said shares and that individual records of title be issued in accordance therewith.*

Further amalgamation conditions are proposed for Lots 4 – 12 to amalgamate the corresponding carpark with the dwelling lot. These are shown on the scheme plan for each lot and read (as one example):

- *That Lot 12 hereon and lot 1012 heron be held in the same record of title.*

Figure 8: Proposed Subdivision Scheme Plan

Sequencing of Development

In terms of the sequencing of development, the applicant intends to undertake the consenting and development process as follows:

- Obtain resource consent,
- Obtain engineering approval to allow external service connections to public infrastructure,
- Obtain two separate building consents:
    1. Stage 1: Building Consent for the infrastructure and JOAL, and
    2. Stage 2: Building Consent for the vertical build.
- Undertake the construction of the development beginning with Stage 1 then following with Stage 2 of the building process.

Through following this process, an application for 223 and 224c can be lodged once the code compliance certificates have been approved for Stage 1. This generally provides for title and code compliance certificates for the buildings (Stage 2) being issued at the same time. As such, while the process of obtaining the new titles will be undertaken concurrently with the build, all dwellings will initially be constructed on the parent site as a whole. The following will therefore consider a 'pre-subdivision' (land use) and 'post-subdivision' (subdivision) scenario in terms of determining reasons for consent and activity status.

4. STATUTORY CONSIDERATIONS

Section 88 of the RMA allows any person to make a resource consent application, provided it is in the prescribed form and includes, in accordance with Schedule 4, an assessment of environmental effects in such detail as corresponds with the scale and significance of the effects that the activity may have on the environment.

Schedule 4 of the Act lists those matters that should and must be included in an assessment of environmental effects, as well those matters that should be considered. These matters are referenced throughout the body of this report confirming that the application meets all the requirements of Section 88.

In accordance with section 104(1), and when considering an application for a resource consent and any submissions received, the consent authority must, subject to Part 2 of the Act, have regard to:

a) Any actual and potential effects on the environment of allowing the activity; and
ab) any measure proposed or agreed to by the applicant for the purpose of ensuring positive effects on the environment to offset or compensate for any adverse effects on the environment that will or may result for allowing the activity; and
b) Any relevant provisions of:
    i) a national environmental standard:
    ii) other regulations:
    iii) a national policy statement:
    iv) a New Zealand coastal policy statement:
    v) a regional policy statement or proposed regional policy statement:
    vi) a plan or proposed plan; and
c) Any other matter the consent authority considers relevant and reasonably necessary to determine the application.

When considering an application for subdivision however, Section 106 must be satisfied first. Section 106 relates to circumstances where an application for subdivision may be refused and is considered in Section 7 of this report.

An assessment of the activities actual or potential effects in terms of section 104(1)(a) is undertaken in Section 8 of this report, the conclusions of which are considered in relation to notification in Section 9 prior to continuing with the more substantive considerations of section 104.

The relevant provisions of the TRMP in terms of section 104(1)(b) are considered in Section 10. Here we note that it is only the provisions of the TRMP that are relevant in terms of the various documents listed in s104(1)(b).

Part 2 of the Act contains sections 5, 6, 7 and 8. Section 5 outlines the purpose of the Act, which is to "*promote the sustainable management of natural and physical resources*", and the meaning of the "sustainable management". Sections 6 and 7 contain "matters of national importance" and "other matters", while Section 8 provides for the principles of the

Treaty of Waitangi. Part 2 of the Act is considered in Section 11 of this report where an overall assessment is arrived upon.

National Environmental Standards for Sources of Human Drinking Water 2007

In terms of National Environmental Standards, the NES for Sources of Human Drinking Water is relevant for discharge permits.

Given that the subject site is within an urban area, there are no known bores within close proximity to the subject site.

Due to the level of treatment proposed, it is considered the proposed discharge is unlikely to increase the concentration of any of the determinants at any registered drinking water abstraction points, nor is it likely to introduce, or increase, the concentration of any aesthetic determinants in the drinking water to levels exceeding the drinking water guideline values.

Therefore, the provisions of the NES need not apply as the effects of the proposed activity will not be significantly adverse (Regulations 11 and 12).

National Policy Statement for Freshwater Management 2020

The National Policy Statement for Freshwater Management (Freshwater NPS 2020) came into force on 3 September 2020, and was subsequently amended in February 2023. It generally relates to freshwater quantity and quality matters, but also contains a suite of further provisions relating to other matters such as tangata whenua involvement, integrated management, setting objectives/ outcomes/ actions and monitoring. These are generally high level and designed to inform plan development processes, with a limited number of provisions applicable to the consideration of resource consent applications of this nature and scale.

Regional Policy Statement

The RPS is contained within Part B of the TRMP. Section B6 Freshwater is considered relevant to this application.

5. PLANNING DOCUMENTS

The proposal is subject to the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NESCS) and the Tairawhiti Resource Management Plan (TRMP).

5.1 National Environmental Standard for Assessing and Managing Contaminants in Soil

The "National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (**NESCS**)" applies to the following activities where they are undertaken on land on which an activity or industry included on the "Hazardous Activities or Industries List" (**HAIL**) has been, is or is more likely than not to have been undertaken:

- The removal of underground fuel storage system and associated soil.
- Soil sampling.
- Soil disturbance.
- Subdivision of land.
- Change in land use.

Regulation 6(1) Methods, prescribes the only two methods that may be used for establishing whether or not an area is 'a piece of land' that is subject to the National Environmental Standard (**NES**):

6(2) By using the most up to date information about the area where the piece of land is located that the territorial authority holds on its dangerous goods files, property files or resource consent database or relevant registers or which it has available from the regional council.

6(3) By relying on the report of a Preliminary Site Investigation (**PSI**) stating that an activity on the HAIL is or is not/has or has not/been or is being undertaken on the piece of land or stating the likelihood of a HAIL being or been undertaken on the piece of land.

Owing to the nature and potential for contamination arising from historic building materials, EAM considered it necessary to undertake site testing to inform the potential for soil contamination. Testing undertaken, as reported on in the Detailed Site Investigation provided in **Appendix 5,** confirms elevated concentrations of lead and arsenic. The site is therefore considered a piece of land under the NESCS.

Soil disturbance and subdivision is provided for as a Permitted Activity under Regulations 8(3) and 8(4) respectively, where among other matters, a PSI has been undertaken and confirms that it is highly unlikely that there will be risk to human health. As this is unable to be stated, we move to Regulation 9.

Regulation 9 provides for soil disturbance and subdivision as a Controlled Activity, where among other matters, a DSI has been undertaken and confirms that the soil contamination exceeds the applicable standards in Regulation 7. As such standards are exceeded, we move to Regulation (10), which provides for soil disturbance and subdivision as a Restricted Discretionary Activity subject to compliance with the following:

(a) a detailed site investigation of the piece of land must exist:

(b) the report on the detailed site investigation must state that the soil contamination exceeds the applicable standard in regulation 7:

(c) the consent authority must have the report:

(d) conditions arising from the application of subclause (3), if there are any, must be complied with.

Given that a DSI is provided to Council, and the DSI confirms that the soil contamination exceeds the applicable standards, the proposal may remain to be assessed as a **Restricted Discretionary Activity** pursuant to Regulation 10 of the NESCS.

5.2 The Tairawhiti Resource Management Plan (TRMP)

The proposal involves the construction of twelve dwelling units and a concurrent fee simple subdivision to create twelve records of title to accommodate the proposed dwellings, along with a JOAL and individual titles for onsite carparking. The proposal is subject to the provisions of the TRMP and the reasons for resource consent are identified as follows.

The TRMP is a Unitary Plan, comprising both Regional Plan and District Plan matters. A detailed assessment of the proposal against the various provisions of the TRMP has been undertaken and is provided as **Appendix 7** to this application. This assessment has found that the activity complies with the Permitted Activity rules and associated general standards of the following Sections of the TRMP that are applicable to the proposal with Part C relating to 'Region Wide Provisions' (Parts 1-11):

- C1-Air Quality
- C3-Coastal Management
- C4-Cultural and Historic Heritage
- C5-Environmental Risks
- C7-Land Management
- C8-Natural Hazards
- C9-Natural Heritage
- C11-General Standards

The analysis does however determine that resource consent is required under the following rules for the following reasons:

Regional Activities

C6 – Freshwater

The discharge of stormwater from land, roofs, paved areas and roads, or diversion of the same to a public network is provided for as a Permitted Activity under Rule 6.2.3(2), however as development includes an impervious area of greater than 1000m², the proposal falls to be assessed as a **Discretionary Activity** pursuant to **Rule 6.2.3(13)**.

Residential Buildings and Land Use Activities

DD1 – Residential Zones

Residential Activities can be undertaken as a Permitted Activity pursuant to Rule 1.6.1(1) of the District Plan. Further, Construction of residential buildings can also be undertaken as a Permitted Activity (rule 1.6.1(2)) provided compliance is met with the permitted activity rules. A District Plan compliance analysis is attached to this application at **Appendix 7**, here it is demonstrated that the proposed dwellings cannot comply with the following:

- DD1.6.1(2) Minimum Site Area: The proposal does not meet the minimum net site area required of 400m² for detached dwellings and 320m² for duplex dwellings. It is proposed to establish sites of 280m² – 343m² for detached dwellings and 114m² – 217m² for duplex dwellings.

- DD.1.6.1(2) Yard Distances (a) Front Sites: The proposed 1.2m² storage sheds on Lots 2, 3 and 4 infringe the external 'other yard setback' of 2m being setback instead 1m, 1.37m and 1.74m respectively.

C2 – Built Environment, Infrastructure and Energy

The proposed development does not comply with C2.1.71(I7) for single site vehicle access as this requires a separation distance between crossings serving the same site of 15m where a separation distance of 14m is proposed.

Construction of dwellings which do not meet the above rules for permitted activities within Chapters DD1 and C2 fall to be assessed as a **Restricted Discretionary Activity** pursuant to **Rule 1.6.1 (17).**

Subdivision

C10 – Subdivision

The activity status for subdivision activities is outlined within Chapter C10 of the District Plan. Here it is outlined that any residential subdivision which meets the relevant standards set out in Rule C10.1.6 can be undertaken as a controlled activity (Rule 10.1.6(1)). The District Plan compliance analysis at **Appendix 7** demonstrates that the proposed subdivision cannot comply with the following:

- C10.1.6.1(A) General Standards: C10.1.6.1(A) requires subdivision activities to comply with Chapter C2 – Built Environment, Infrastructure and Energy and C9.2 Esplanade Reserves/Strips. The proposal does not meet the following criteria within Chapter C2:
  - *C2.1.7.1(I8) Multiple-site access and/or multiple unit access*: The proposal does not comply to (a), (b) and (e) as follows:
    - The JOAL is proposed to provide access to 11 dwellings which exceeds the maximum provided for by (a) of 10,
    - As above, while the JOAL is proposed to serve 11 dwellings, it is not propose to vest this as a public asset with GDC as required by (b),
    - The width of the accessway between Lots 1 and 12 is 5.5m. This meets the requirement for 10 dwellings however does not meet the requirement for 11 dwellings (being the width of a public road – 12m) in regard to (e).
- C10.1.6.1(B) Allotment Sizes and Dimensions: As above in relation to the land use, the proposal does not meet the minimum allotment sizes required by Figure C10.1 noting that a minimum lot size of 400m² is required within the General residential zone for detached dwellings and 320m² for duplex dwellings. As above, It is proposed to establish sites of 280m² – 343m² for detached dwellings and 114m² – 217m² for duplex dwellings.

Additional infringements arising as a result of the subdivision as it relates to the General Residential Zone include:

- DD1.6.1.1(B) Recession Planes: Due to their duplex layout, Lots 1, 2 and 5 – 12 will infringe the relative height in relation to boundary recession plane along the common party wall boundary. Additionally, the proposed dwellings will infringe the recession planes to the internal boundaries as follows:
    - Unit 1 as it relates to the western JOAL boundary by a maximum height of 0.55m for the length of the dwelling and the southern JOAL boundary by 0.31m,
    - Unit 2 as it relates to the southern boundary with Lot 3 by a maximum vertical height of 2.5m,
    - Unit 7 as it relates to the southern boundary with Lot 6 by a maximum vertical height of 3.25m for the length of the dwelling,
    - Unit 8 as it relates to the northern boundary by a maximum vertical height of 2.11m for the length of the dwelling,
    - Unit 9 as it relates to the southern boundary by a maximum vertical height of 0.736m,
    - Unit 10 as it related to the eastern boundary by a maximum vertical height of 2.17m for the length of the dwelling,
    - Unit 11 as it relates to the western boundary by a maximum vertical height of 1.59m, and
    - Unit 12 as it relates to the eastern JOAL boundary by a maximum vertical height of 1.86m for the length of the dwelling and the southern JOAL boundary by a maximum height of 1.7m.
- DD1.6.1(2) Site Coverage: Proposed Lots 6 – 11 exceed the maximum coverage of 35% with the following coverages proposed:
    - Lot 6: 38.2%
    - Lot 7: 36.2%
    - Lot 8: 36.2%
    - Lot 9: 39.4%
    - Lot 10: 52.4%
    - Lot 11: 52.4%
- DD1.6.1(2)(a) Yard Distances (Front sites): Being duplex dwellings, the proposed units on Lots 1, 2 and 9 – 12 will not meet the 2m setback required from 'other yards'. Additionally, the proposal can not comply as follows:
    - The unit on Lot 10 will infringe its eastern 2m side yard setback by 0.266m, and
    - The unit on Lot 11 will infringe its western 2m side yard setback by 0.356m.
- DD1.6.1(2)(b) Yard Distances (Rear sites): As a result of the subdivision, the units on Lots 5 – 6 and 7 – 8 will be wholly within the 3m setback along their common walls. Additionally, the following infringements will be generated in relation the 3m rear yard setback:
    - Unit 3 will infringe the 3m setback to the JOAL for a length of 4.3m,
    - Unit 5 will infringe the 3m setback to the JOAL by 0.27m – 1.42m across the frontage of the dwelling. Additionally, the 1.2m² storage shed will be within the 3m yard setback to Lot 6 being setback 1.8m from the boundary.
    - Unit 6 will infringe the 3m setback to the JOAL by a maximum of 1.42m and to the northern boundary with Lot 7 by a maximum of 1.77m. Additionally, the proposed 1.2m² storage shed is proposed to be setback 1.4m from the southern boundary.

- Unit 7 will infringe the 3m setback to the JOAL by 0.893m and the southern boundary by 1.66m.
- Unit 8 will infringe the 3m setback to the JOAL by 0.893m and the northern boundary by 1.66m. Additionally, the proposed 1.2m² storage shed is proposed to be setback only 1.3m from the southern boundary.

The subdivision therefore falls to be assessed as a **Discretionary Activity** pursuant to Rule 10.1.6 (9).

Overall Activity Status

Overall, the proposal is to be assessed under the TRMP as a **Discretionary Activity** being the most restrictive activity status.

5.3 Planning Context

The applicable planning context is established by the provisions of the Operative District Plan and National Policy Statement for Urban Development, with the provisions of the Proposed District Plan also having influence.

The Tairawhiti Resource Management Plan

As detailed in Section 5.1 above, the following policy context is relevant to the assessment of the application:

- *Part C – Region Wide Provisions*
    - C2 – Built Environment, Infrastructure and Energy
    - C6 – Freshwater
    - C10 – Subdivision
- *Part D – Area Based Provisions*
    - DD1 – Residential Zone

Each is summarised as follows.

<u>*C2 – Built Environment, Infrastructure and Energy*</u>

The subject application does not include any Network Utility Operations but does include the provision of works and services associated with servicing of the subdivision. To this end, the general controls related to infrastructure are applicable to the application. The six objectives for infrastructure are included within Section C2.1.3, and seek to:

- *Provide infrastructure that is designed, located, constructed, operated, and maintained in a manner that ensures a safe and healthy environment, achieves efficient use of energy and resources, and avoids, remedies, or mitigates adverse effects.*
- *Ensures that infrastructure associated with subdivision is provided in an integrated and co-ordinated manner.*
- *Enable and promote subdivision and development of infrastructure that allows implementation of good urban design practices, low impact design principles and reflects the environmental and social context of the location.*

The relevant policies related to funding and provision of infrastructure, the design and reticulation of infrastructure, and in particular works and services (being road reserve, landscaping, stormwater, water, and wastewater), are detailed in Sections C2.1.4.2, C2.1.4.3 and C2.1.4.5 respectively. A detailed assessment of the activity against these provisions is undertaken in Section 10 of this report below.

C6 – Freshwater

The policies relating to Point Source Discharges are set out within Section C6.2.2 of the TRMP. The most relevant to this application is considered to be Policy 3(a) being:

3. *Manage the adverse effects of stormwater discharges through:*
    a) *Promoting low impact design and other stormwater management practices, and requiring it where there is a need to:*
        i. *Improve the quality of stormwater discharges; or*
        ii. *Reduce volume and peak flows associated with additional runoff to manage risk to people and property from flooding and to maintain stream base flows; or*
        iii. *Protect Outstanding Waterbodies and wetlands;*
        iv. *Protect the values of sensitive receiving environments;*

C10 – Subdivision

The two objectives for subdivision are detailed in Part C10.1.3 and seek to:

- *Enable subdivision, provided that any consequent adverse environmental effects can be avoided remedied or mitigated.*
- *Subdivision that is consistent with high quality urban environment, in particular promoting a high level of amenity values and establishing a safe and healthy urban environment; and*
- *Encourage resource and energy efficiency.*
- *Avoid, remedy, or mitigate adverse effects on the environment.*

The associated policies detailed in C10.1.4 seek to ensure that a building platform can be established within each allotment, without causing or contributing to land instability; and that the proposed subdivision does not result in adverse effects with regard to network utility infrastructure. Further assessment of the application in terms of these considerations is provided in Section 7 and 8 of this report below.

DD1 – Residential Zone

The subject site is included within the General Residential Zone. Chapter DD1.1 details that:

> *The rules within the residential chapter endeavour to maximise the freedom of individuals to determine and provide for their physical and social needs whilst ensuring that the residential environment, which is potentially affected by each individual's decision s to meet his or her needs, is preserved, and enhanced for the benefit of present and future generations.*

The zone identifies 5 Objectives (Section DD1.3) of which the following three are considered relevant to the current application:

DD1.3.1-Residential Styles

To enable a diversity of residential styles to provide for the varied housing needs of the community.

DD1.3.2-Amenity Values

To maintain or enhance residential amenity; and

DD1.3.4-Location and Density

To enable the community to locate anywhere that does not compromise the capacity of the infrastructure systems to function, the amenity of the residential environment or the highly productive and fertile soils within the region.

National Policy Statement for Urban Development

The National Policy Statement for Urban Development (NPS-UD 2020) replaced the NPS-UDC 2016 and came into force on 20 August 2020, and is particularly reflected in Objective 4 of the NPS which states:

> New Zealand's urban environments, including their amenity values, develop and change over time in response to the diverse and changing needs of people, communities, and future generations.

The NPS-UDC 2016 required councils to improve planning processes to enable more development. The NPS-UD gives further direction in certain areas, such as where development capacity should be provided and how councils can be more responsive to development opportunities.

The NPS-UD is designed to improve the responsiveness and competitiveness of land and development markets. In particular, it requires local authorities to open up more development capacity, so more homes can be built in response to demand. This NPS is considered relevant to this application, insofar as it seeks to promote and encourage additional capacity for housing within existing urban environments.

It sets out different requirements for tier 1, 2 and 3 urban environments and local authorities, but in Section 1.5, '*strongly encourages*' tier 3 local authorities, such as Tairawhiti District Council, to '*do the things that tier 1 or 2 local authorities are obliged to do under Parts 2 and 3 of the NPS.*'

To this end, it is noted that there is a clear intention from the NPS that every local authority should give particular regard to the Objectives and Policies contained in Part 2 of the NPS when assessing an application for resource consent.

The Objectives include:

> *Objective 1: New Zealand has well-functioning urban environments that enable all people and communities to provide for their social, economic, and cultural wellbeing, and for their health and safety, now and into the future.*
>
> *Objective 2: Planning decisions improve housing affordability by supporting competitive land and development markets.*

> *Objective 3: Regional policy statements and district plans enable more people to live in, and more businesses and community services to be located in areas of an urban environment in which one or more of the following apply:*
>
> *(a) the area is in or near a centre zone or other area with many employment opportunities.*
> *(b) the area is well-serviced by existing or planned public transport.*
> *(c) there is high demand for housing or for business land in the area, relative to other areas within the urban environment.*
>
> *Objective 4: New Zealand's urban environments, including their amenity values, develop and change over time in response to the diverse and changing needs of people, communities, and future generations.*

The most relevant policies of the NPS-UD to this application are:

> *Policy 1: Planning decisions contribute to well-functioning urban environments, which are urban environments that, as a minimum:*
>
> *(a) have or enable a variety of homes that:*
> *(i) meet the needs, in terms of type, price, and location, of different households; and*
> *(ii) enable Māori to express their cultural traditions and norms; and National Policy Statement on Urban Development 2020 – updated May 2022 11*
> *(b) have or enable a variety of sites that are suitable for different business sectors in terms of location and site size; and*
> *(c) have good accessibility for all people between housing, jobs, community services, natural spaces, and open spaces, including by way of public or active transport.*
>
> *Policy 5: Regional policy statements and district plans applying to tier 2 and 3 urban environments enable heights and density of urban form commensurate with the greater of:*
>
> *a. the level of accessibility by existing or planned active or public transport to a range of commercial activities and community services; or*
> *b. relative demand for housing and business use in that location.*
>
> *Policy 6: When making planning decisions that affect urban environments, decision-makers have particular regard to the following matters:*
>
> *c. the planned urban built form anticipated by those RMA planning documents that have given effect to this National Policy Statement*
> *d. that the planned urban built form in those RMA planning documents may involve significant changes to an area, and those changes:*
> *i. may detract from amenity values appreciated by some people but improve amenity values appreciated by other people, communities, and future generations, including by providing increased and varied housing densities and types; and*
> *ii. are not, of themselves, an adverse effect.*
> *e. the benefits of urban development that are consistent with well-functioning urban environments (as described in Policy 1)*
> *f. any relevant contribution that will be made to meeting the requirements of this National Policy Statement to provide or realise development capacity.*

g. *the likely current and future effects of climate change.*

It is considered relevant that:

- Policy 5 contemplates District Plans applying to tier 3 urban environments allowing a change in density,
- Policy 6 recognises that changes in amenity values need not, of themselves, be considered an adverse effect - this is relevant in considering Policies 8 and 10 of Objectives 5.3.1(a) and (b).

As such, the consideration of this resource consent application for increased density need not be considered at odds with what is expected of practitioners, and an example of the type of step change encouraged by the NPS for how development initiatives can maximise opportunity.

Additional consideration of these provisions in relation to Section 104(1)(b)(vi) will occur in Section 10 of this report.

6. CONSULTATION

In accordance with Schedule 4 of the RMA, an application for resource consent should:

1. Identify the persons affected by the proposal,
2. The consultation undertaken,
3. Any response to the views of any person consulted.

To avoid doubt, while the applicant is not obliged to undertake consultation, nor is there any grounds for expecting the applicant to consult with any person, the applicant is obliged to report on who may be affected by the proposal. This is expanded upon in Section 9 of this report.

The development of the site has been introduced to the Council's Resource Consents Principal Planner (Awhina White) and Engineers (Barry Sanders and Phillip Dodds). Detail in relation to this consultation with Council has been attached at **Appendix 8**. In summary, feedback in relation to planning was largely oriented around confirming activity status with later feedback around the proposed density and how to address this in the application report.

In terms of servicing, correspondence between Joahn Ehlers of Infir and Barry Sanders confirmed appropriate stormwater design for the site including the level of detail and design required for a stormwater soakage solution. This has been addressed in the engineering report attached at **Appendix 6**.

Further, while there is no obligation under Schedule 4 of the RMA for consultation with Mana Whenua, the applicant has begun this consultation process with:

- Te Aitanga a Mahaki, and

- Rongowhakaata.

This consultation process is proposed to occur in parallel with the processing of the resource consent.

In terms of (2) and (3) however, the site is located within the General Residential Zone, the proposal is considered to constitute an anticipated and appropriate form of infill development with the effects of the activity considered to be less than minor. No other consultation was therefore considered necessary. This is expanded upon in Sections 8 and 9 of this report.

7. SECTION 106 ASSESSMENT

Section 106 relates to circumstances when the consent authority may refuse an application to subdivide and states:

> *(1) A consent authority may refuse to grant a subdivision consent, or may grant a subdivision consent subject to conditions, if it considers that:*
> - *(a) there is a significant risk from natural hazards; or*
> - *(b) [Repealed]*
> - *(c) sufficient provision has not been made for legal and physical access to each allotment to be created by the subdivision.*
>
> *(1A) For the purpose of subsection (1)(a), an assessment of the risk from natural hazards requires a combined assessment of:*
> - *(a) the likelihood of natural hazards occurring (whether individually or in combination); and*
> - *(b) the material damage to land in respect of which the consent is sought, other land, or structures that would result from natural hazards; and*
> - *(c) any likely subsequent use of the land in respect of which the consent is sought that would accelerate, worsen, or result in material damage of the kind referred to in paragraph (b).*
>
> *(2) Conditions under subsection (1) must be:*
> - *(a) for the purposes of avoiding, remedying, or mitigating the effects referred to in subsection (1); and*
> - *(b) of a type that could be imposed under Section 108.*

In terms of Section 106(1), and taking 106(1A) into account, detailed geotechnical investigations and assessments have been prepared by LDE Ltd (**Appendix 4**) with recommendations made with regard to foundation types and earthworks in response to the potential geotechnical hazards.

This expert report is relied on in coming to the view that while the potential for hazards does exist, the proposal is not considered to carry significant risk, or a degree of risk beyond that already anticipated under the District Plan.

Turning to Section 106(1)(c), legal and physical access to the sites can be provided via Aberdeen Road.

On this basis, it is not necessary to refuse the application on any of the grounds expressed in Section 106 of the RMA.

8. ASSESSMENT OF ENVIRONMENTAL EFFECTS

The TRMP provides for subdivision as a Controlled Activity where compliance with the general standards can be met, however based on the analysis above, the proposal is to be assessed overall as a Discretionary Activity.

Notwithstanding that Council's ability to assess the adverse effects of a Discretionary Activity is unrestricted, it is considered that the general standards specified for both subdivisions and land use activities, combined with the matters of control and assessment criteria pertaining to the different aspects of the proposal provide a useful framework to guide the assessment of the proposed development in terms of its effects.

In adopting these general standards, matters of control and assessment criteria to guide the assessment of environmental effects, the following section of this report is structured as follows:

- Section 8.1 – Land Use – Section DD1 (Rules for Residential zones)
- Section 8.2 – Subdivision
    - Section 8.2.1 – C10.1.6.1 – General Standards for all Subdivisions
    - Section 8.2.2 – C10.1.6(1) – Matters of Control for Subdivision
- Section 8.3 – Freshwater
- Section 8.4 – Construction Effects
- Section 8.5 – Summary

8.1 Land Use (Multi Unit Development)

Due to the sequencing of development, the proposal includes the construction of 12 dwellings on the site prior to the issue of Section 224 certification and issue of titles. This aspect has been assessed under the rules contained in DD1.6 (Rules for Residential zones). The activity does not achieve compliance with rules in relation to minimum site area and yard distances as it relates to the overall site and external boundaries. It is noted that infringements to recession planes and site coverage are generated following the subdivision of the site.

The matters of discretion are set out in DD1.6.1(17) and of relevance to the proposal are noted as:

d) Minimum site area,
e) Recession Planes;
f) Site coverage;
g) Yard distances;
h) Infrastructure, works and services.

There is no further guidance provided beyond the listed matters above. Thus this assessment will address each matter as follows:

Minimum Site Area

All proposed dwellings do not comply with either the required 320m² (duplex) or 400m² (detached units) minimum site area required.

The following comments are made:

- The proposed dwellings are fully compliant to external boundaries with regards to yard distances and height recession planes and comply with the building coverage control on a site wide basis. Further, all dwellings are provided with an outdoor living space which is either east, west or north of the dwellings and will achieve sunlight from the north and a separate, compliant service court of at least 15m² (across all sites) is provided. This careful design and high level of compliance across the site, ensures the outcomes of the residential zone sought by the minimum net site area rule are achieved.
- Further to the above, through the provision of compliant service spaces and high-quality outdoor living areas, the onsite amenity for each dwelling will not be compromised as a result of the reduced lot sizes.
- The utilisation of two storey, duplex dwellings additionally enables smaller lot sizes to be employed provided the amenity outcomes discussed above are met. Further, due to duplex dwellings being proposed, the actual density of built form is not dissimilar to six larger 3 – 4 bedroom dwellings with one minor dwelling located on the site which could otherwise occur as a permitted activity.
- In all two-story dwellings proposed, living areas for each dwelling are located on the ground floor with two bedrooms and a bathroom on the second story. Noting this, main outlook from living areas does not result in overlooking toward neighbours noting that a 1.85m privacy fence is proposed around the perimeter of the site, maintaining privacy to adjacent sites.
- It is noted that minimum net site areas prescribed by Council generally provide for the ability for compliant vehicle access, parking and manoeuvring on the site. As the proposal includes a communal parking access, parking and manoeuvring space for most dwellings, it removes the need for this area to be located within each individual site. Therefore, reducing the site area required per dwelling.
- The proposal has included a high level of landscaping (including specimen trees and lower growing ground cover plants) to ensure that the presence of buildings does not predominate the site. An emphasis of landscaping along the JOAL and site boundaries assists to reduce perceived dominance of the buildings as well as privacy screening. Notwithstanding this, the proposal complies with building

coverage on a site wide basis (31%), as such, the extent of buildings across the site is within that anticipated by the plan.

- In terms of a permitted/alternative development scenario, with the overall site area of 2,671m², the TRMP would allow for up to six sites of detached dwellings (at 400m² each) and eight sites of duplex dwellings (at 320m² each) as a compliant activity. However, it is noted that each of these lots could also contain a minor dwelling, therefore providing for 12 – 16 buildings across the site provided yard and site coverage controls are met. As such, the level of built form across the site will not be dissimilar (if not less) to a permitted activity of this scenario. It is noted however that the central access point, provides for greater openness and results in less built domination when viewed from adjacent sites than what could occur in a potential alternative development scenario.

Noting the above, through careful design of the site results in onsite amenity not being compromised as a result of minimum lot sizes not being met and any effects on the surrounding environment being mitigated or avoided and less than minor.

Recession Planes

The proposal is fully compliant with recession planes as it relates to the external boundaries and therefore any effects on the surrounding environment are within those anticipated by the plan.

In terms of the infringements arising as a result of the proposed subdivision:

- A number of the infringements arising are along the internal wall of the duplex dwellings which is an effect anticipated by Rule 1.6.1(2)(b) which allows for multiple dwellings to be connected to each other.
- Given that the infringements are internal to the site and compliance can be achieved with the external site boundaries, adverse shading, privacy and dominance effects on adjacent sites will be avoided.
- Due to the setbacks achieved from side boundaries and the open space afforded between the dwellings on Lots 1 and 12, streetscape amenity will not be compromised as a sense of spaciousness will be maintained. This is further promoted via the landscaping afforded within the front half of the site and along the JOAL boundaries.
- In terms of onsite amenity, adverse effects from the recession plane infringements are considered to be less than minor noting that internal and external living spaces will not be compromised as a result of the locations of the dwellings on the site.

Site Coverage

The proposal is fully compliant with site coverage requirements as it relates to the overall site area. However, infringements are generated as a result of the subdivision as it relates to Lots 6 – 11.

The following comments are made in relation to this matter:

- Given that the total building coverage across the site equates to 31%, the proposed infringements will be indiscernible to that of a compliant scheme when viewed from the surrounding locality as sufficient proportions of open space will be provided throughout the site.

- Despite the above, mitigation measures employed to reduce the dominance of buildings includes 1.85m perimeter fencing and varied fencing throughout the site, landscaping which includes various species (including specimen trees) and a combination of both single storey and two storey dwellings. Each of these aspects assists to reduce the overall perceived built dominance of the site.
- Further mitigation is afforded to adjacent sites via compliance with external yard, height and height in relation to boundary controls.
- The infringements to site coverage are essentially created through smaller lot sizes being utilised than what is anticipated by the District Plan. However, as has been established above, the lot sizes are considered to be adequate to provide for outcomes on the site which do not compromise residential amenity.

Yard Distances

As outlined previously, the proposed storage sheds located on Lots 2, 3 and 4 will not meet the required setbacks to the external boundary being setback 1m, 1.37m and 1.74m respectively. Noting that these are small, 1.2m² garden sheds which have a height of 2m so will largely be screened by permitter fencing, any adverse effects on adjacent sites because of these infringements will be avoided or mitigated and less than minor.

The following comments are made in relation to the yard infringements which arise as a result of the subdivision:

- It is noted that these are all internal to the site as such, any associated adverse effects generated are also internalised therefore avoiding privacy and shading impacts upon amenity on surrounding sites.
- As has been established above, while infringements are generated, the onsite amenity achieved will not be compromised.
- Through the compliance achieved with external boundaries by the dwellings and also the open space provided within the centre of the site afforded by the parking and manoeuvring areas, the development will retain a sense of spaciousness when viewed from the surrounding area.
- It is relevant to consider the baseline set by the Plan which allows for several conjoined dwellings with no internal separation through the provision of minimum net site areas for dwellings that can be attached on two sides in Rule 1.6.1(2)(b). Comparatively, the proposal offers mitigation to the bulk of buildings on the site through providing separation and a combination of both one and two storey dwellings.

Infrastructure, Works and Services

The proposal fails to meet the following standards as it relates to access:

- I7 Single-site vehicle access: Prior to subdivision, there will be two vehicle crossings serving one site which achieve a separation distance of only 14m, therefore not meeting the 15m required. Following the subdivision, this will become compliant.
- I8 Multiple-site access and/or multiple unit access: The proposal utilises a JOAL to provide access to 11 dwellings. As required by this standard, access to more than 10

dwellings requires to be served by a public road vested with Council. The proposal does not intend to vest this access.

The assessment criteria for Roading and Access is contained within Section C2.1.7.2(c) of the TRMP. Taking these into consideration, the following comments are made in relation to the proposed access:

- Adverse effects arising from an infringement to separation distance by 1m is considered to be negligible noting that the infringement will be resolved following the completion of the subdivision.
- In terms of the JOAL, while it is note intended to vest this to Council, the design and layout is considered suitable to provide for 11 vehicles. Particularly, a 5.5m wide entrance strip is provided off Aberdeen Road and space is provided within the JOAL for the manoeuvring of all vehicles to enter and exit the site in a forward gear. It's layout also reduces the level of potential conflict between vehicles and between vehicle users and pedestrians.
- It is further noted that, with the exception of Lot 3, all lots are provided with one car park and therefore vehicle access for one car (Lot 3 is provided with two). Given that the requirement for vesting the road refers to the number of dwellings and not the number of cars it services, it is valid to consider that it is not unusual for dwellings and/or residential lots to provide for the parking and access of at least two vehicles each. As such, taking this into consideration, it is considered that the proposed scenario actually provides for less volume of traffic compared to what is provided for by C2.1.7(I8).
- Given these design components and the well-functioning layout of the JOAL, the provision of access for one additional lot within the JOAL is considered to be indiscernible to a compliant scenario and any potential effects will be less than minor.

While the proposal complies with building coverage across the subject site, due to the additional density proposed, consideration is also given to the proposed stormwater solution. The proposal includes a combination of onsite attenuation, first defence treatment and soakage systems to treat and discharge wastewater generated by the development. As outlined in Section 6 above, pre-application correspondence with Barry Sanders ensured this was a supportable solution by Gisborne District Council.

The proposal includes the discharge of roof runoff to the road via individual attenuation tanks however due to the fall of the site all surface water runoff will be directed to a Rainsmart System soakage chamber (via a first defence treatment system) beneath the JOAL. Detailed calculations in relation to the pre- and post-development flows are included in the Servicing Report attached at **Appendix 6**. Here it is noted that the design aims to ensure that the sum of the runoff rates from unattenuated areas, the discharge from the rainwater tanks and overflow from the 'Rainsmart' system is no greater than for the pre-developed site during the 1 in 100-year event. Noting this, any potential effects generated in relation to stormwater from the additional density are considered to be mitigated to a level which is less than minor.

Overall, and considering the above assessments, the proposal is a conventional medium density residential infill development which is supported by the National Policy Statement-Urban Design 2020 and will result in adverse effects that will be less than minor. The proposal represents an appropriate density of development that can be suitably accessed and serviced and will not result in adverse impacts upon the amenity and character of the surrounding area.

8.2 Subdivision

8.2.1 C10.1.6.1 – General Standards for all Subdivisions

Section C10.1.6.1(a – f) details the general standards for all subdivisions. It is considered that compliance or otherwise of the proposed development against these general standards provides the baseline against which the effects of the proposed activity are able to be assessed – noting that such an application would otherwise be assessed as a Controlled Activity. Where the proposal is unable to comply with a particular standard, it is then necessary to consider the scale of effects that may subsequently arise. The assessment of the proposal against these matters follows.

A. Subdivisions shall comply with C2 – Built Environment, Infrastructure and Energy and C9.2 Esplanade Reserves and Strips

An assessment of the activity against the relevant provisions of C2 has been undertaken in the submitted TRMP Compliance Analysis (**Appendix 7**). The proposal does not meet standards in relation to access. This has been assessed in Section 8.1 above and will be expanded further in 8.2.2 below.

With reference to C9.2, the proposed subdivision is located within the Gisborne Urban Area and creates allotments of less than 4ha, however the site does not abut the coastal marine area, or a river specified in General Standard C9.2.6.1(D). As such, there is no requirement to provide an Esplanade Reserve nor Strip.

B. Allotment Sizes and Dimensions

Subdivisions shall comply with the rules for allotment sizes, shape factor and road frontage. For the (reticulated) General Residential Zone the minimum lot size is 400m² per unit where it is a standalone unit and 320m² for a duplex unit. There are no relevant shape factors or road frontage requirements specified in relation to the General Residential zone.

The proposal cannot comply with the minimum 400m² net area requirement, with respective net lot sizes of 343m² and 280m² for standalone units (Lots 3 and 4) and 114m² – 217m² for duplex units (Lots 1, 2 and 5 – 12). A detailed assessment in relation to the potential effects generated by the reduced lot sizes has been undertaken above and will be expanded upon further below however in summary it has been demonstrated that any potential effects will be less than minor.

C. Building Platforms

The proposed building platforms (and building typologies) have been identified in the Development Plans (**Appendix 2**). This proposed layout, combined with the geotechnical information, and ground conditions for the site furnished in the submitted Geotechnical Assessment (**Appendix 4**) will ensure that the proposed lots are provided with a stable building platform that are contoured to provide for controlled discharge of stormwater and will not be affected by any potentially unstable land.

D. Existing Buildings

The development will require all existing buildings to be removed from the site.

E. Boundary Adjustment

The proposal does not include any boundary adjustments.

F. Easements

The subject site is not subject to any easements that would affect the proposal.

The multiple easements associated with the proposed subdivision are contained within the subdivision scheme plan (**Appendix 3**).

Easements include rights of way, rights to convey three waters, party walls and power and telecommunications which are contained within the JOAL.

An easement in gross is proposed in favour of chorus New Zealand Limited.

8.2.2 C10.1.6(1) – Matters of Control for Subdivision

As detailed above, where a subdivision can comply with the General Standards detailed in Chapter C10, the application would be assessed as a Controlled Activity. The application is unable to comply with matters in relation to minimum lot sizes and access and requires assessment as a Discretionary Activity where discretion is unrestricted, however the following matters of control are considered appropriate to guide the assessment of effects as follows.

a) Suitability of building platforms

The Development Plans and geotechnical report (**Appendices 2 and 4**) detail the twelve proposed building platforms to be established on the proposed lots. As discussed in Section 7 and within this AEE, these platforms are considered to be suitable with regard to both land stability and the inclusion of engineer designed foundations, finished floor levels, and proposed land contouring which will reduce the potential for flooding and maintain overland flow paths.

b) ***Suitability of Infrastructure, Works, and Services***

The proposed infrastructure works and services to service the development are detailed in the Development Plans, associated Scheme Plan and Servicing Report (**Appendices 2, 3** and **6**) and are considered to be consistent with the scale and type of servicing that would otherwise be anticipated for medium density residential development within the General Residential Zone. An assessment in relation to access is provided in Section 8.1 above. Here it is determined that the proposed access arrangement is suitable for the development and any potential effects arising from not vesting the JOAL to Council will be less than minor.

Further details in relation to the point source discharge assessment are included in Section 8.4 below.

b) The extent to which the amenity values of the surrounding areas are affected.

The extent to which the proposed activity will have on the effects of the surrounding locality has been assessed in relation to the land use above where it was determined that the amenity values of the surrounding locality will be maintained.

While the proposed subdivision cannot meet the minimum site areas, the amenity of the surrounding area will not be compromised or otherwise affected for the following reasons:

- The proposal incorporates a high level of design in terms of lot and dwelling layout, landscaping, fencing, access and parking. Adverse effects associated with failing to meet the minimum lot size largely mitigated through the provision of communal, offsite parking spaces, utilisation of two-story dwellings, the provision of separate and adequate service and outdoor living spaces as well as landscaping proposed throughout the proposal.
- The external boundaries of the sites will be fenced with a combination of solid fencing and screen planting that will reduce visual impacts between the site and surrounding properties.
- The development complies with all external boundary controls (with the exception of the storage sheds). As such, any potential effects from infringements will be internal to the site and privacy, shading and bulk dominance effects toward neighbours are within a level which is anticipated by the plan.
- The layout and area of the proposed lots, although below the 400m² and 320m² minimum, is not incompatible with the surrounding area which provides for a variety of sites with varying lot size and density not dissimilar to the proposed development (particularly to the north).

c) Financial Contributions

It is anticipated that the development will be subject to assessment under the Development Contributions policy, noting that the developer will be installing and constructing all infrastructure related to access and three waters servicing as part of the subdivision development. All services will remain private. There are no special circumstances considered to apply that would warrant the calculation or application of financial contributions.

d) Any adverse effects of exotic flora and fauna on values identified in the overlays of Chapter C9 – Natural Heritage

The site is not located within any identified natural heritage overlay and thus this matter is not applicable. Notwithstanding this, the development will incorporate significant landscape elements and permeable area commensurate with this urban location.

Noting the above assessment, it is considered that any potential effects arising from the subdivision will be effectively managed and mitigated to a level which is less than minor.

8.3 NES for Assessing and Managing Contaminants in Soil to Protect Human Health

As outlined above, a DSI has been undertaken by EAM confirming that the soil contamination exceeds the applicable standards to the rear of the site. The associated soil disturbance associated with the proposal and the subsequent subdivision and land use therefore fall to be assessed as a Restricted Discretionary Activity pursuant to Regulation 10 of the NESCS.

Regulation 10(3) sets out the following matters to be considered:

a) the adequacy of the detailed site investigation, including—
  i. site sampling:
  ii. laboratory analysis:
  iii. risk assessment:
b) the suitability of the piece of land for the proposed activity, given the amount and kind of soil contamination:
c) the approach to the remediation or ongoing management of the piece of land, including—
  i. the remediation or management methods to address the risk posed by the contaminants to human health:
  ii. the timing of the remediation:
  iii. the standard of the remediation on completion:
  iv. the mitigation methods to address the risk posed by the contaminants to human health:
  v. the mitigation measures for the piece of land, including the frequency and location of monitoring of specified contaminants:
d) the adequacy of the site management plan or the site validation report or both, as applicable:
e) the transport, disposal, and tracking of soil and other materials taken away in the course of the activity:
f) the requirement for and conditions of a financial bond:
g) the timing and nature of the review of the conditions in the resource consent:
h) the duration of the resource consent.

In summary:

- A copy of the DSI prepared by EAM is attached at **Appendix 5**. The report contains an outline of the sampling undertaken together with the results of that sampling. It is considered that the author of the report is a Suitably Qualified and Experienced Person and that Clauses 10(3)(a)(i)-(iii) are appropriately satisfied.
- The EAM site investigation works identified an exceedance of lead and arsenic above the human health criteria (residential 10%) in ten of the twelve sample locations.
- As referenced in the DSI, it is recommended that further XRF imaging is undertaken across the site in order to identify any further soil contamination and delineate these areas more precisely.

- A Remedial Action Plan (RAP) has been prepared by EAM and is appended to their DSI as Appendix E. The RAP suitably addresses the matters set out in clauses 10(3)(c)(i)-(v). A condition can be imposed to require certification of a site management plan and site validation report by Council to ensure suitability in respect to (d) and (e).

It is considered that with appropriate conditions of consent pertaining to the implementation of this Remedial Action Plan, that any potential effects in terms of contaminated soils can be appropriately managed and avoided to a level which is less than minor.

8.4 Freshwater

Rule 6.2.3(2) outlines the following:

> *Contaminant reduction methods shall be designed and implemented to treat stormwater from the impervious area in accordance with TP 10, or by alternative methods that are demonstrated to achieve an equivalent level of contaminant removal as TP 10 devices. These methods include but are not limited to constructed wetlands, swales, vegetative filters or infiltration practices.*
>
> *Advisory Note: Demonstration of compliance with this Rule is required to be given to the Council. Compliance with this rule will be deemed to have occurred where the stormwater treatment is undertaken in accordance with Stormwater Management Devices: Design Guidelines Manual 2003. Technical Publication 10 (TP10) of the Auckland Council.*

The proposal includes a combined stormwater treatment system whereby runoff from roofs will be individually attenuated on each site before being discharged to the kerb. Runoff from all other areas will be directed to a rainsmart system beneath the JOAL where it will be discharged to ground via soakage. The runoff being directed into this system will first pass through a Hynds First Defence high capacity stormwater treatment system.

Runoff from roofs will not be treated as the roof material will be inert and the discharge will not comprise contaminants from a water quality perspective. Only discharge volume matters will be managed as described above.

Details in relation to the First Defence system are included at the end of the servicing report. In summary, the system is an enhanced vortex separator that combines an effective stormwater treatment chamber with an integral peak flow bypass to efficiently remove sediment, total suspended solids (TSS), trash and hydrocarbons from stormwater runoff without washing out previously captures pollutants. It is therefore considered an appropriate method of contaminant reduction resulting in compliance with TP 10.

The below ground rainsmart attenuation system is proposed to manage stormwater volume matters, reducing post development discharge rates to predevelopment runoff rates.

Overall, any potential downstream effects in respect to water quality and quantity matters are considered to be less than minor.

8.5 Construction Effects

The construction effects of the proposal are limited to the site's clearance, proposed earthworks, installation of services and the construction of the twelve new dwellings and associated access.

Construction activities are a function of reality when developing urban environments. Nuisance effects still need to be managed however, and in this regard:

- A Construction Management Plan addressing construction traffic, sediment control and hours of operation will be provided to Council prior to the commencement of any works on site. It is anticipated that the construction works will be limited to daytime/working hours, being 7.30am – 6.00pm Monday – Saturday
- All construction activity will be undertaken in accordance with the New Zealand Standard NZS 6803:1999 "Acoustics – Construction Noise".

In conjunction with the relative temporary duration of such effects, these initiatives will ensure that overall, effects with regard to construction can be managed to be less than minor.

8.6 Summary

Overall, in terms of the land use component, potential adverse effects of the proposed construction and use of twelve dwellings will be less than minor and will not compromise the existing amenity or character of the surrounding residential environment.

Further, as guided by the applicable criteria of the plan, the effects of the proposed subdivision are less than minor and will result in urban development that is generally consistent with the existing residential character of the surrounding area.

In terms of servicing and land suitability, expert reporting by Infir and LDE provides suitable solutions for three waters servicing and foundation design. Although not affected by an identified flood hazard, the application entails earthworks and provides minimum ground and floor levels and appropriate storm water management and any adverse effects in this respect will be less than minor.

9. NOTIFICATION

There is no presumption in the RMA itself as to whether or not an application will be notified, and a consent authority has discretion in determining whether or not notification is necessary. This assessment is primarily governed by Section 95A and Section 95B of the RMA.

Please note, the applicant wishes to be informed of any determination around notification prior to a formal decision being made.

9.1 Section 95A Assessment – Wider Environmental Effects

Section 95A of the RMA considers the need for public notification and sets out four steps in a specific order to be considered in determining whether to publicly notify.

In terms of Step (1), public notification has not been requested, Section 95C pertaining to notification in the event that further information is not provided under Section 92 is not applicable, and the application is not being made jointly with an application to exchange recreation reserve land under Section 15AA of the Reserves Act 1977.

In terms of Step (2), none of the circumstances precluding public notification are applicable as the application is for a Discretionary Activity and not a Controlled Activity or boundary activity.

Moving to Step 3, notification is not required by a rule in a Plan, and the adverse effects of the proposal on the wider environment (in terms of Section 95D) have been demonstrated in Section 8 of this report to be less than minor. In particular, the proposed development is generally in accordance with development anticipated and the outcomes sought by the TRMP. As such, effects with regard to character and amenity within the wider locale will be less than minor. Further, all infrastructure to service the site has been carefully considered and designed, such that the proposed development will not contribute too, nor exacerbate stormwater effects from the site under design events.

Finally, under step 4 it is not considered that any special circumstances apply to the application for the following reasons:

1. The subject site is located within the General Residential zone, therefore, to utilise this large tract of land for residential purposes is entirely consistent with the existing, surrounding land use character.
2. The subdivision has been designed to ensure residential density, which is provided for, and anticipated by the TRMP, and is generally consistent with the densities evident within the surrounding locale.
3. The proposed land contouring and stormwater design (including detention and attenuation) across the site ensures that all stormwater can be discharged effectively, without resulting in any additional flooding and/or natural hazard effects within the surrounding locale during design events.

Considering the above, public notification is not considered to be required under any of the pathways under Section 95A of the RMA.

9.2 Section 95B Assessment – Effects on the Local Environment and Particular Parties

While public notification is not necessary, any effects of the proposal on the local environment and upon particular parties must still be considered. This is addressed through Section 95B of the RMA, which has four steps similar to Section 95A.

In terms of Step (1), being outside the coastal marine area we understand there are no affected protected customary rights or customary marine title groups in terms of Subclause (2).

In terms of Subclause (3), and whether the proposed activity is on or adjacent to or may affect land that is the subject of a statutory acknowledgement made in accordance with an Act specified in Schedule 11, the site is located within an Area of interest but is not located within or adjacent to a Statutory Acknowledgment Area referred to in Schedule 11 in the context of S95B.

In terms of Step (2), none of the circumstances in subsection (6) apply that would preclude limited notification of the application and thus we progress to step 3.

Step 3 requires Council to determine in accordance with Section 95E whether there are any affected parties. Adjacent land (identified in **Figure 9**) is considered to include the following properties:

- 551, 553, 555, 557, 557A and 559 Aberdeen Road (north),
- 554 Aberdeen Road and 7, 7A and 9 Stanley Road (east),
- 6 and 6A Asquith Street (south), and
- 2 and 4 Asquith Street and 562 Aberdeen Road (west).

Figure 9: Adjacent Parties

It is considered that any adverse effect upon the above properties will be less than minor for the following reasons:

- The proposed dwellings are fully compliant with external boundary controls and yard infringements generated by the proposed garden storage sheds are considered to be negligible. It is noted that the proposed building coverage is compliant on a site wide basis as such when viewed from the surrounding locality the development will be indiscernible to that of a compliant scheme.
- Further to the above, the layout of the site has been carefully considered to manage external boundary effects in relation to this immediately adjoining land in line with outcomes of the TRMP. The design has employed a combination of both single and two storey dwellings to provide varied and reduced bulk across the site. Location of two-story dwellings at the north of the site and single storey dwellings to the rear (south) of the site reduces the level of shading experienced off the site on adjacent parties.
- A 1.85m perimeter fencing proposed around the boundary of the site will retain privacy from ground floor indoor and outdoor living areas. Careful placement of second story windows toward external boundaries mitigates overlooking from this higher level. The façades which face side boundaries of Units 2 and 9 include only a high level window in a bedroom and frosted bathroom windows so as to avoid overlooking neighbours. While a standard bedroom window is utlised on the second floor of Units 7 and 8 which have outlook toward the boundary, these dwellings are setback at least 7m which mitigates privacy effects towards neighbours and overlooking from bedroom windows will be less than if it was a living room.
- Specimen trees and assorted screen planting interspersed along the external boundaries and throughout the site provide added value in softening the interface of the development with adjoining sites, reducing perceived bulk of the dwellings and assisting in privacy screening.
- Notwithstanding the above, it is noted that changes in amenity values need not, of themselves, be considered an adverse effect.
- Proposed traffic engineering solutions have been designed to ensure that the activity can be provided with vehicle and pedestrian access in a manner which will ensure that any adverse impacts upon vehicle and pedestrian safety in the immediate area will be less than minor.
- Servicing solutions and in particular stormwater measures, will ensure that the development will not result in the exacerbation of any adverse stormwater effects upon adjacent land during design events.
- An earthworks and sediment plan is to be submitted prior to the Building Consent stage which will ensure that no sediment laden discharge will adversely affect the surrounding area during the construction phase of the development.

The following further comments are made in relation to the specific adjoining parties:

- The properties to the north (551, 553, 555, 557, 557A and 559 Aberdeen Road) are located on the opposite site of Aberdeen Road. Initial mitigation is provided by the 20m wide buffer afforded by the Hirini Street Road reserve. Furthermore, additional mitigation of visual impacts is provided in the form of screen fencing and landscape elements and all dwellings comply with the front yard setbacks required by the Plan therefore presenting as a compliant development to the street. Finally, when viewed from these properties the development will largely present as three, two storey dwellings which will offer significant screening of the remaining units on the rear lots. Overall, given the separation distance and limited interaction with the development, any adverse effects will be mitigated and less than minor.

- 554 Aberdeen Road lies adjacent to the subject site to the southeast, it is occupied by a single-story dwelling. As it relates to this site, Unit 2 being a two storey duplex dwelling will be setback 4m from the common boundary at the front of the site and Unit 3 (single storey detached unit), 3m from the boundary at the rear of the site. 1.85m perimeter fencing will maintain privacy from ground floor areas and outdoor living spaces and only high level bedroom, and frosted bathroom window face the site on the upper level of Unit 2. As such, potential privacy effects will be mitigated. Noting that Unit 2 will be setback 4m from the boundary, shading effects are mitigated and well within the level anticipated by the plan. Additionally, the 8.5m separation between the buildings reduces the perceived bulk of the development by maintaining a sense of spaciousness. As such, any adverse effects in terms of residential amenity on these persons will be avoided or mitigated and less than minor.

- The interface between 7, 7A and 9 Stanley Road (east), 6 and 6A Asquith Street (south) and 4 Asquith Street (west) with the development is largely restricted to the proposed single storey units on Lots 3, 4 and 5 (along with the manoeuvring area with respect to 7A Stanley Road). Due to the variation in the shape of the subject site, as well as this interface with single storey, compliant dwellings, any adverse effects on these persons are negligible.

- 2 Asquith Street is situated to the northwest of the subject site and is currently occupied by a single storey dwelling with a detached garage at the rear of the site against the common boundary. As it relates to this site, proposed Units 5 – 7 lie adjacent to the common boundary. It is noted that Units 5 and 6 are single storey and Unit 7 is the southern portion of a two-storey duplex. All dwellings are setback approximately 7m from the common boundary, resulting in full compliance with TRMP standards and residential amenity outcomes which are within the levels anticipated by the Plan. While each of the units have a west facing outdoor living area along this boundary, potential privacy effects are mitigated through the provision of a 1.85m privacy fence a long the boundary. As such, any adverse effects on these persons are considered to be avoided or mitigated and less than minor.

- 562 Aberdeen Road lies adjacent to the subject site to the northwest and has frontage to both Aberdeen Road and Asquith Street. While the proposal presents as two, two storey buildings to this site, compliance with yard setbacks, height and height in relation to boundary controls ensure that potential residential amenity effects are within the level anticipated by the Plan. Additionally, 1.85m perimeter fencing ensures privacy is maintained between the sites. The increased setback of Units 7 and 8 provide for a separation distance of approximately 7m to the boundary, reducing the perceived bulk dominance of the dwellings. Noting this, potential adverse effects are effectively mitigated and less than minor.

Overall, and particularly in relation to amenity values, the analysis undertaken in Section 8 and 9 confirms that the effects arising from the proposed density of development under this design package are not inconsistent with what is provided for under the District Plan when assessing density and weighing the scale of effects along property boundaries.

Given compliance with external yard controls and variations in dwelling typology proposed, it is not a proposal that gives rise to excessive bulk along boundaries which could otherwise occur on the site through the provision of consecutive terraced houses. The proposal does not result in unreasonable overlooking of boundaries, nor will adjoining properties access to sunlight be compromised.

On this basis, applying the tests in Section 95E, in addition noting that no special circumstances are considered to apply in terms of Step 4, the application may be processed on a non-notified basis without the need to obtain any affected persons consents.

As noted above, the applicant wishes to be informed of any determination around notification prior to a formal decision being made in order to address any concerns the processing officer may have which could lead to a potential limited notification determination.

10. RELEVANT OBJECTIVES AND POLICIES

In accordance with Section 104(1)(b) of the RMA, a consent authority must, subject to Part 2 of the RMA, have regard to the relevant provisions of any statutory plans and policy statements. This includes any relevant provisions of:

- National Environmental Standards (**NES**)
- Other regulations
- National Policy Statements
- The New Zealand Coastal Policy Statement (**NZCPS**)
- Regional Policy Statements or proposed Regional Policy Statements (**RPS**)
- A Plan or Proposed Plan.

Of these documents, the National Policy Statement on Urban Development Capacity as well as the TRMP are considered relevant. It is noted that the TRMP includes both the Regional Policy Statement, as well as the relevant District Objectives and Policies related to subdivision and the Residential Zone. Consideration of the application with reference to each of these matters follows.

10.1 National Policy Statement on Urban Development Capacity (Section 104(1)(b)(iii))

The National Policy Statement on Urban Development (NPS-UD) came into effect in 2020 (updated May 2022). Its preamble includes the following statement:

> *This national policy statement provides direction to decision-makers under the Resource Management Act 1991 (RMA) on planning for urban environments. It recognises the national significance of well-functioning urban environments, with particular focus on ensuring that local authorities, through their planning, both:*
>
> - *enable urban environments to grow and change in response to the changing needs of the communities, and future generations; and*
> - *provide enough space for their populations to happily live and work. This can be both through allowing development to go "up" by intensifying existing urban areas, and "out" by releasing land in greenfield areas.*

The NPS-UD (2020) includes the following in 'Part 2: Policies and Objectives':

> *Objective 1: New Zealand has well-functioning urban environments that enable all people and communities to provide for their social, economic, and cultural wellbeing, and for their health and safety, now and into the future.*
>
> *Objective 2: Planning decisions improve housing affordability by supporting competitive land and development markets.*
>
> *Objective 3: Regional policy statements and district plans enable more people to live in, and more businesses and community services to be located in, areas of an urban environment in which one or more of the following apply:*
>
> *(d) the area is in or near a centre zone or other area with many employment opportunities*
> *(e) the area is well-serviced by existing or planned public transport*
> *(f) there is high demand for housing or for business land in the area, relative to other areas within the urban environment*
>
> *Objective 4: New Zealand's urban environments, including their amenity values, develop and change over time in response to the diverse and changing needs of people, communities, and future generations.*

The most relevant policy of the NPSUD to this application is:

> *Policy 1: Planning decisions contribute to well-functioning urban environments, which are urban environments that, as a minimum:*
>
> *(a) have or enable a variety of homes that:*
> *(i) meet the needs, in terms of type, price, and location, of different households; and*
> *(ii) enable Māori to express their cultural traditions and norms; and National Policy Statement on Urban Development 2020 – updated May 2022 11*
> *(b) have or enable a variety of sites that are suitable for different business sectors in terms of location and site size; and*
> *(c) have good accessibility for all people between housing, jobs, community services, natural spaces, and open spaces, including by way of public or active transport;*

Although the NPS-UD (2020) objectives and policies provide high level direction, it is considered that the proposed subdivision and residential development is generally consistent with these objectives, particularly in regard to providing dwellings that incorporate and will achieve positive urban design outcomes for occupants and adjoining landowners. The sites are also well positioned to enable future occupants with access to retail and community facilities.

The proposed subdivision and residential development will provide benefit to the wellbeing of the future owners and residents of the proposed sites. The configuration of the dwellings, and the scale of the development has been balanced to achieve a best fit for the site, also having regard to the surrounds, and seeks to provide a balance between the provision of onsite amenity and density, thus resulting in a more efficient use of residential land.

Adopting a comprehensive design approach ensures the provision of onsite amenity and utility in an efficient and overall effective manner, resulting in a higher density residential outcome whilst still delivering a high amenity residential living environment and ensuring that adverse effects are avoided and mitigated, and also catering to provide housing at a scale, and value within Gisborne.

In this regard the proposal is considered to be consistent with the higher-level directions signalled in the NPS-UD (2020).

10.2 Regional Policy Statement

Part B of the TRMP provides the Regional Policy Statement for the Gisborne District. Relevant matters covered in the RPS include:

- Involvement of Tangata Whenua in Resource Management
- Transport and Infrastructure
- Environmental Risk including Natural Hazards

With reference to these matters, the following comments are made:

- The proposed design of the subdivision has sought to utilise low impact stormwater design mechanisms including devices to control both quality and quantity of water, recognising the environmental outcomes sought by Tangata Whenua in relation to freshwater.
- The proposal incorporates one JOAL and one additional vehicle crossing which provide access to the road in a safe and efficient manner. Pedestrian access is provided through the site to the road.
- The site is not affected by a known flood hazard, but mitigation is still provided in the form of minimum floor levels, land contouring and stormwater management.

10.3 Tairāwhiti Resource Management Plan

The relevant objectives and policies of the TRMP have been introduced in Section 5.1 of this report above. Further to this introduction of the policy context applicable to the assessment of the application, a more detailed assessment of the application against these relevant matters follows.

Rather than reproducing the entire provisions, of which there are many, the following references the specific Objective with a comment beneath and the relevant Policy with a comment alongside.

10.3.1 Infrastructure (C2.1.3)

With reference to the five relevant Objectives of C2.1.3, the following comments are made:

- The proposed infrastructure to be installed to service the proposed subdivision ensures that future dwellings on these lots are appropriately provided for, and will enhance the environmental, social, cultural, and economic wellbeing of future owners.
- The proposed infrastructure to be installed ensures that the subdivision will generate a safe and healthy environment and provide an efficient use of resources and suitably avoids adverse effects on the environment.
- We understand capacity exists within the local network to service the development with all on site services remaining in private ownership meaning there will be no unanticipated costs to the community because of the development.
- The proposal seeks to establish a subdivision that achieves a high degree of urban design outcomes – connectivity, low impact design, high architectural and landscaped aesthetic and largely reflects the existing residential character of the locale. The development has been architecturally designed, achieves a high level of compliance, and will provide occupants and surrounding land with a high degree of amenity.

The following considers the relevant Policies in C2.1.4.

C2.1.4.2 – Funding and Provision of Infrastructure

1\. The proposed infrastructure required to service the development is to remain in private ownership and will be undertaken at the developers cost, while it is noted that the establishment of each residential site will be subject to the calculation of development contributions in accordance with the Councils Policy.

4-7 There are no effects resulting from the proposed development that would require the payment of financial contributions to mitigate effects.

C2.1.4.3 – Design and Reticulation of Infrastructure

1. The design of infrastructure and the proposed construction of this infrastructure promotes an efficient use of physical resources, avoids adverse effects on the environment and actively responds to the environmental context of the development site.
2. It is considered both environmentally and financially feasible to provide infrastructure to the site at no cost to the ratepayer.

C2.1.4.5 - Works and Services

1. Access has been designed in a manner which will not compromise safety and efficiency of vehicle and pedestrian circulation in the surrounding area.
2. The proposed access points and associated vehicle traffic generation will not compromise the residential character and amenity of the local area.
3. We understand there is an adequate supply of water in terms of both volume and quality for each of the sites.
4. The proposal will promote the efficient use of water.
5. The proposed subdivision will be suitably serviced for firefighting with access available to suitable fire hydrants directly outside or nearby the site.
6. The disposal of wastewater from the site is to be conveyed by a rider main to the main located in Aberdeen Road. This ensures that there will be no risk to public health or safety.
7. The supply of both underground power and telecommunications is to be provided for within the JOAL for rear sites and direct connections to the front sites from Aberdeen Road.

10.3.2 Freshwater (Point Source Discharge C6.2.2)

With reference to the most relevant policy (Policy 3(a)) relating to Point Source Discharge, the proposal is considered to be consistent with this policy as follows:

i. Improve the quality of stormwater discharges.

The proposed first defence system will act to improve the quality of this discharge. The proposal is therefore directly in accordance with this policy.

ii. Reduce volume and peak flows associated with additional runoff to manage risk to people and property from flooding and to maintain stream base flows;

The water treatment device is coupled with an underground Rainsmart attenuation system which will assist to attenuate the additional volume of stormwater generated via the additional impervious area prior to discharge to ground soakage. The attached servicing report provides detailed calculations in relation to managing peak flows and reducing these to match predevelopment runoff rates in line with the outcomes sought in the Policy.

iv. Protect Outstanding Waterbodies and wetlands;

There are no known outstanding waterbodies or wetlands within the context of the subject site.

v. Protect the values of sensitive receiving environments;

As above, while the receiving environment may not be particularly sensitive, the proposed treatment and storage methods will mitigate any potential effects on downstream environments.

10.3.3 Subdivision (C10.1.3)

With reference to the two Objectives contained in Section C10.1.3, the following comments are made:

- The proposal seeks to enable subdivision that ensures adverse environmental effects are able to be adequately avoided, remedied, or mitigated.
- The proposed subdivision is considered to represent a high-quality urban environment, including a good degree of amenity both for residents and adjacent properties and a safe environment that provides emphasis on pedestrian access as well as vehicle access, and an efficient development of land and provision of infrastructure that does not result in adverse effects on the environment.

In respect to the relevant Policies in C10.1.4 the proposed building platforms have been identified for each site and are considered by LDE to be geotechnically appropriate for development subject to recommendations contained within that report.

10.3.4 Residential Zones (DD1.3)

With reference to the three relevant Objectives of DD1.3, the following comments are made:

- The proposed development will result in twelve new residential units consisting of eleven two-bedroom dwellings and one three bedroom dwelling, with the inclusion of accessible design for single storey units, which will meet varying community needs for housing.
- The proposed subdivision has been architecturally designed to maximise residential amenity values, through use of carefully considered lot design and layout.
- The location of the site within an existing urban neighbourhood is an efficient use of this land resource and while the proposed density is not fully compliant for the proposed housing typologies proposed on each lot, it is considered that mitigation has been provided in terms of site layout, building design, landscape elements, boundary fencing and by the characteristics of the immediate area which contains a range of housing typologies and lot sizes.

The following considers the relevant Policies in DD1.4:

<u>DD1.4.1 – Residential Styles Policy</u>

- The proposed subdivision and subsequent land use will provide twelve additional dwellings which have been designed and arranged in a manner which will not detract from the character and amenity of the surrounding area.
- The development presents as a high standard of amenity both as experienced from within the site, and from external viewpoints.
- The proposal is not considered to compromise the amenity experienced within adjacent sites.
- The site can be serviced in terms of three waters without affecting capacity in the surrounding area.

DD1.4.2 – Amenity Values Policy

- The proposed development provides for car-parking and compliant manoeuvring for all lots which have been designed in a manner which will not dominate the streetscape with no garages or carports proposed and the majority of parking located remote from the road frontage.
- The proposal includes a combination of both carefully placed and designed single storey and two storey dwellings throughout the site. The proposal is not considered to give rise to any privacy and/or amenity effects for adjacent properties which will be further reduced by screen fencing and landscape planting on all external boundaries.
- Traffic generation associated with the additional dwellings will easily assimilate into the local road network without creating any congestion issues or safety concerns for vehicles or pedestrians.

DD1.4.4 – Location and Densities Policy

- The proposed development is a new development that will have minimal effects on Councils infrastructural assets where capacity exists to accommodate the activity, and to this end, the development should be encouraged to occur on the site located within the General Residential zone.
- The density of development proposed, and the associated stormwater generated from roofed areas and associated hardstand areas will be commensurate with the mitigation proposed in terms of proposed detention, attenuation and discharge which will ensure pre-development discharge rates can be achieved during design events.

Taking the above into consideration, it can be determined that the proposed development is consistent with the direction and anticipated outcomes of the relevant objectives and policies of the Tairāwhiti Resource Management Plan.

11. PART 2 OF THE RESOURCE MANAGEMENT ACT 1991

The assessments contained in Sections 8 and 10 of this report are subject to the matters contained in Part 2 of the RMA, which contains Sections 5, 6, 7 and 8.

Section 5 sets out the purpose of the RMA, which is to promote the sustainable management of natural and physical resources and is supported by Sections 6, 7 and 8 of the RMA. Sections 6 and 7 contain the "matters of national importance" and "other matters" respectively and Section 8 provides for the principles of the Treaty of Waitangi. These sections are hierarchical and provide for a different level of consideration to be given to each.

The proposal is consistent with the purpose of the Act for the following reasons:

- The proposal represents an efficient use of significant land holding, providing for twelve household units to be developed on the site in a manner that is appropriately and efficiently serviced in terms of infrastructure.

- The proposed density of the subdivision is not totally anticipated by the TRMP however will not be incompatible in the context and nature of the surrounding built environment.
- The development has been designed to achieve a high level of compliance with the standards of the TRMP and the provision of good amenity outcomes for future occupants and surrounding landowners.

Sections 6(a), (b) and (c) are not applicable to an urban development of this nature. Likewise, access along rivers as provided for in Section 6(d) is not a relevant matter in this particular case. There are no heritage values in terms of Section 6(f), while the relationship of Māori and their culture and traditions with their ancestral lands, water, sites, waahi tapu and other taonga will not be threatened as a result of the activity. Lastly, it has been determined by expert inputs that it is reasonable to accommodate development on the site recognising and providing for Section 6(h) and the management of significant risks from natural hazards.

Section 7(b) relates to the efficient use and development of natural and physical resources. The proposal optimises infill potential while being in keeping with its surrounds and each lot can be suitably serviced.
Lastly, Sections 7(c) and 7(f) relate to the maintenance and enhancement of amenity values and the quality of the environment. These matters have been considered throughout the body of this report and it has been demonstrated that the activity is not inappropriate for the site and will not compromise reasonable amenity expectations. No other matters of Part 2 are specifically relevant.

In summary, the proposal can be considered consistent with the principles and purpose of the RMA and deserving of consent.

12. CONSENT DURATION

In relation to the point source discharge, Section 123 of the RMA allows a discharge permit to be granted for up to 35 years. Noting this, the proposal seeks a duration for a period of 35 years. A lapse date of 5 years is considered suitable.

13. CONCLUSION

The proposal is to undertake a joint land use and fee simple subdivision on the subject site at 556 and 560 Aberdeen Road in Gisborne involving earthworks, installation of access and infrastructure services, the construction of twelve new residential dwellings and the associated twelve lot subdivision. Overall, the proposal is to be assessed as a Discretionary Activity.

Figure 10: Development Perspective within the JOAL

In summary, the proposal will result in less than minor adverse effects on both the wider and immediate environments and no persons are considered to be affected by the proposal to a minor, or more than minor extent. Overall, it is considered that the application is consistent with the relevant Objectives and Policies of the TRMP, or any of the other statutory documents referred to in Section 104(1)(b).

Furthermore, having considered the proposal subject to Part 2 of the RMA, it is not expected to compromise the principles and purpose of the Act, and is subsequently considered to be deserving of consent pursuant to Section 104 and 104B and can be approved on a non-notified basis in accordance with Sections 95-59F.

Appendix 1

Record of Title

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

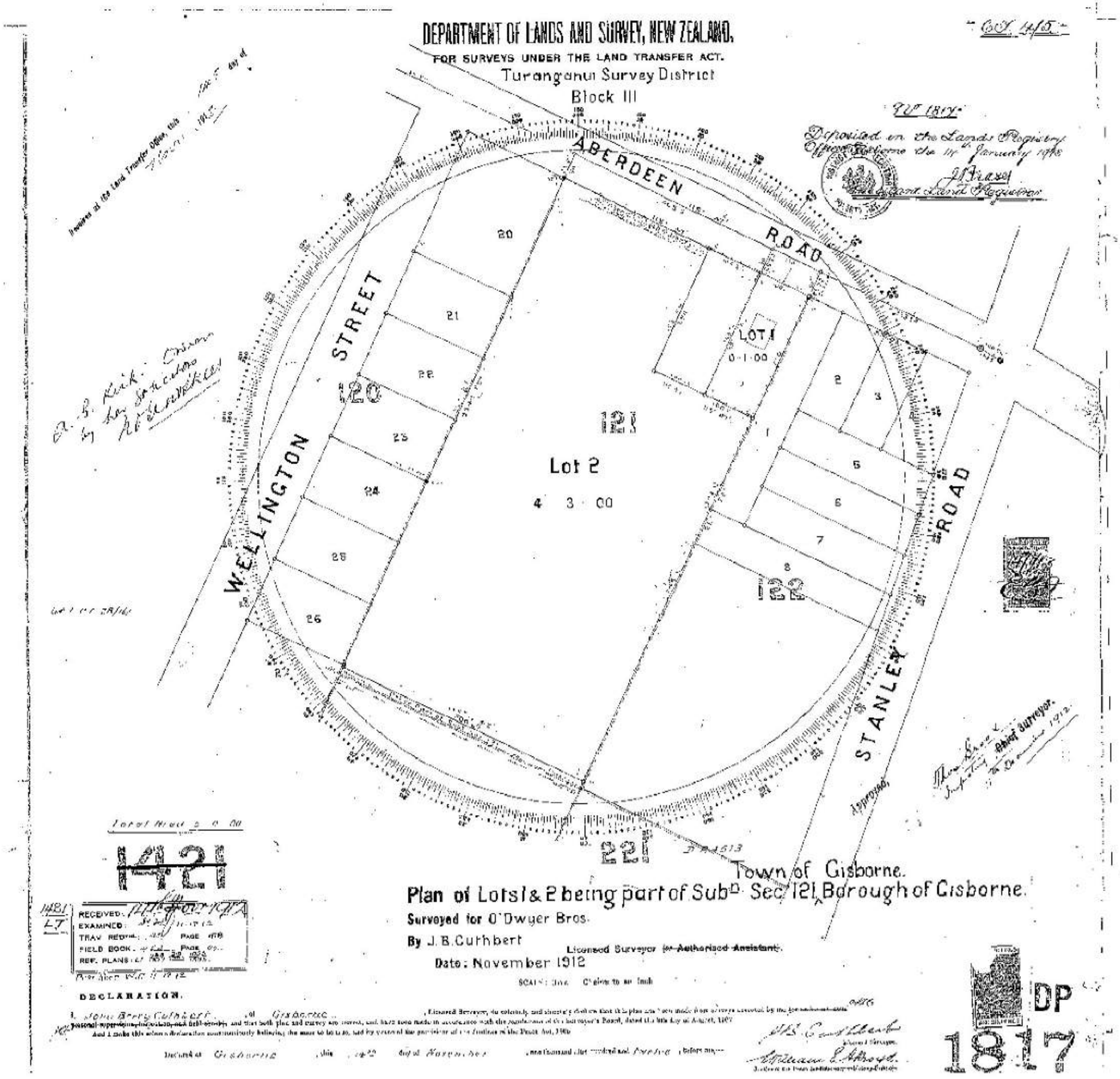
Identifier **GS2B/162**
Land Registration District **Gisborne**
Date Issued 29 April 1968

Prior References
GS50/244

Estate Fee Simple
Area 1012 square metres more or less
Legal Description Lot 1 Deposited Plan 1817
Registered Owners
Tracy Maree O'Connell

Interests

8273019.2 Mortgage to (now) The Gisborne SPCA Incorporated - 6.10.2009 at 12:11 pm



Town of Gisborne.
Plan of Lots 1 & 2 being part of Sub^D. Sec. 121, Borough of Gisborne.

Surveyed for O'Dwyer Bros.

By J. B. Cuthbert

Licensed Surveyor ~~or Authorised Assistant~~.

Date: November 1912

SCALE: One Chains to an Inch

DECLARATION.

I, John Berry Cuthbert, of Gisborne, Licensed Surveyor, do solemnly and sincerely declare that this plan has been made from surveys executed by ~~the~~ me ~~personal supervision, inspection, and field-checking~~, and that both plan and survey are correct, and have been made in accordance with the regulations of the Surveyor's Board, dated the 8th day of August, 1907.

And I make this solemn declaration conscientiously believing the same to be true, and by virtue of the provisions of the Justices of the Peace Act, 1908.

Declared at Gisborne, this 22 day of November, one thousand nine hundred and twelve, before me—

J B Cuthbert
Licensed Surveyor.

William L. Akroyd.

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier **GS2B/282**
Land Registration District **Gisborne**
Date Issued 23 May 1968

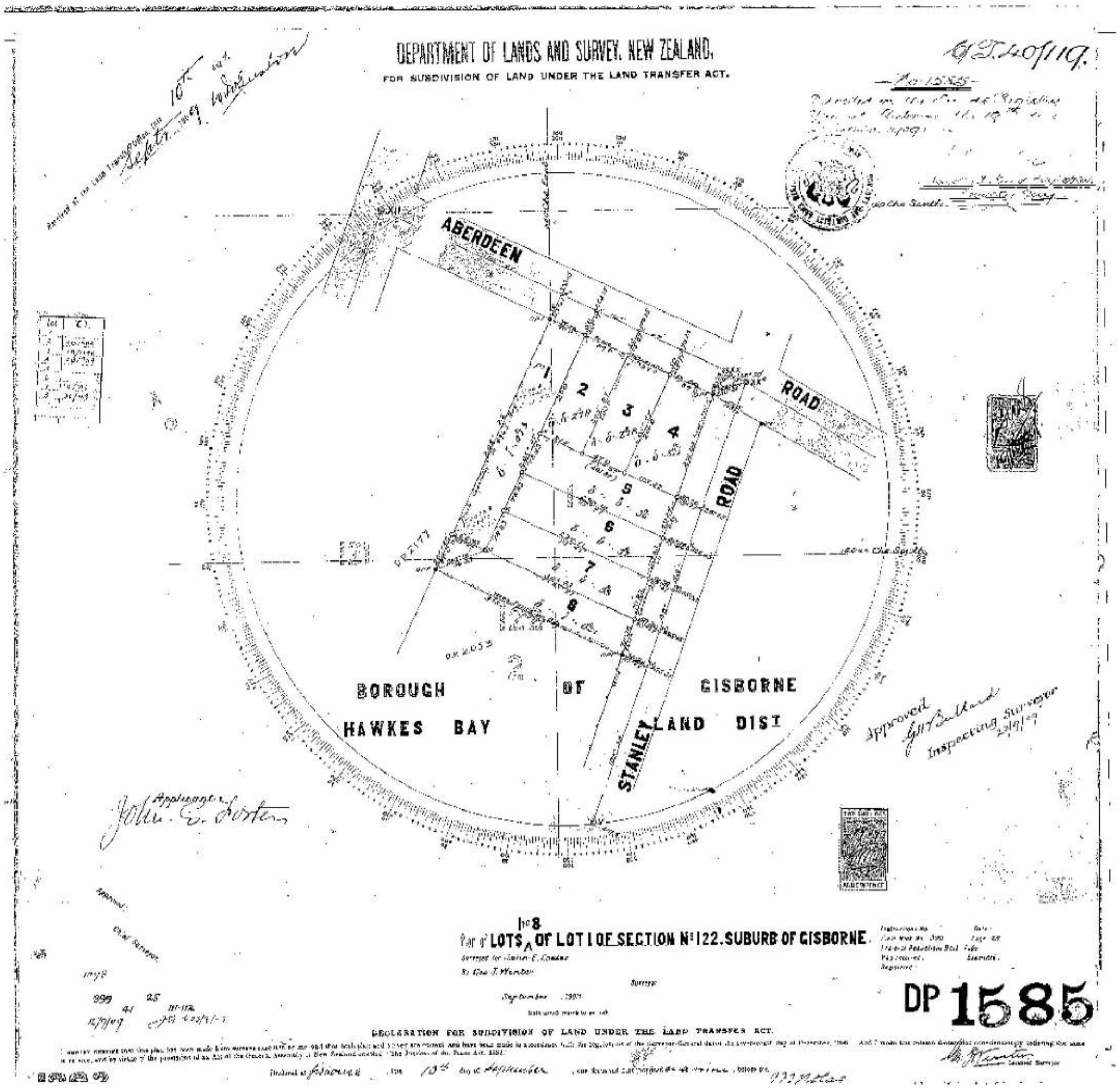
Prior References
GS46/73

Estate	Fee Simple
Area	703 square metres more or less
Legal Description	Lot 2 Deposited Plan 1585

Registered Owners
Terry O'Connell and Linda O'Connell

Interests

8273019.4 Mortgage to (now) The Gisborne SPCA Incorporated - 6.10.2009 at 12:11 pm



Part of LOTS 1 to 8 OF LOT 1 OF SECTION No 122. SUBURB OF GISBORNE.

September 1909

DP 1585

DECLARATION FOR SUBDIVISION OF LAND UNDER THE LAND TRANSFER ACT.

Declared at Gisborne this 13th day of September

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier **GS110/25**
Land Registration District **Gisborne**
Date Issued 09 June 1954

Prior References
GS46/72

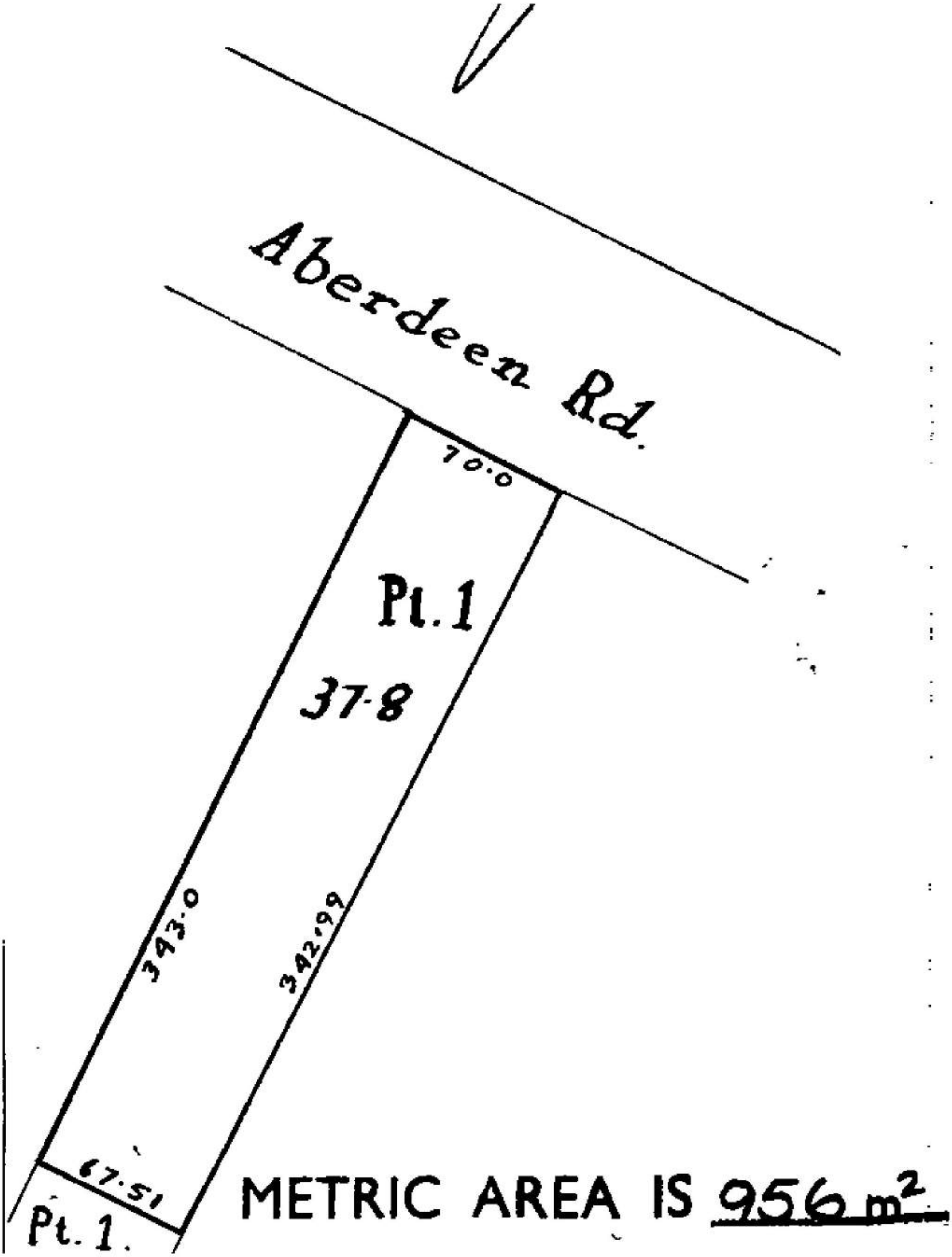
Estate	Fee Simple
Area	956 square metres more or less
Legal Description	Part Lot 1 Deposited Plan 1585

Registered Owners

Terry O'Connell and Linda O'Connell

Interests

8273019.4 Mortgage to (now) The Gisborne SPCA Incorporated - 6.10.2009 at 12:11 pm



METRIC AREA IS 956 m²

Appendix 2

Development Plans


ARTISTIC IMPRESSION ONLY

Sheet Index

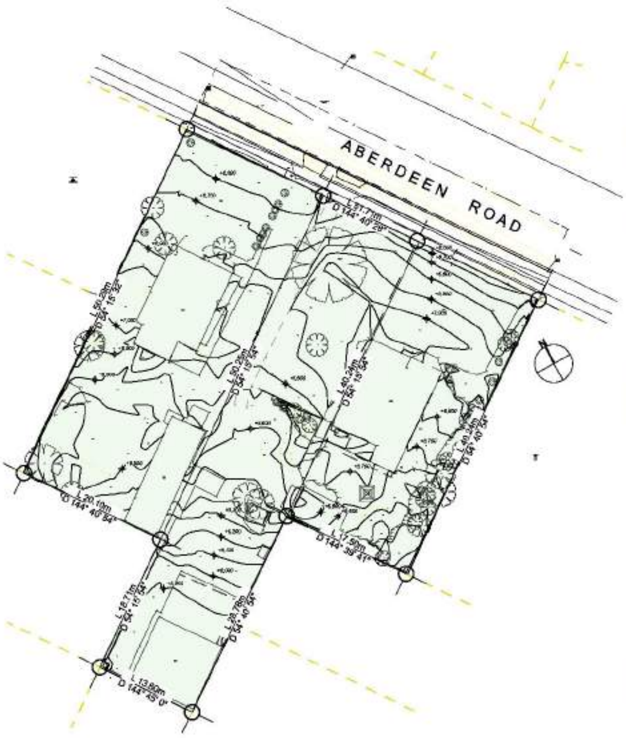
Layout ID	Layout Name	Status Code
01	Site Aerial and Existing Site Plan	15%
02	Neighbourhood Context	15%
03	Proposed Site Plan	15%
04	Unit Plan	15%
05	Landscaping and Fencing Plan	15%
06	Typology Floor Plans 01	15%
07	Typology Floor Plans 02	15%
08	Typology Floor Plans 03	15%
09	Site Elevations - External Boundaries	15%
10	Site Elevations - Inner Boundaries	15%
11	3D Persepctives & Colour Selections	15%
12	3D Perspectives	15%

Resource Consent

Issue Date: 22/11/2023
556 - 560 Aberdeen Road
Gisborne
New Zealand

NZHG Aberdeen Road

AHA
ATKINSON HARWOOD
ARCHITECTURE
e: sol@atkinsonharwood.co.nz
p: 027 465 9236



Existing Site Plan
Scale 1:500

Site Aerial

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Rev	Revision	Date

Site Aerial and Existing Site Plan

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556 - 560 Aberdeen Road
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Neighbourhood Context

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NZHG Aberdeen Road
556 - 560 Aberdeen Road
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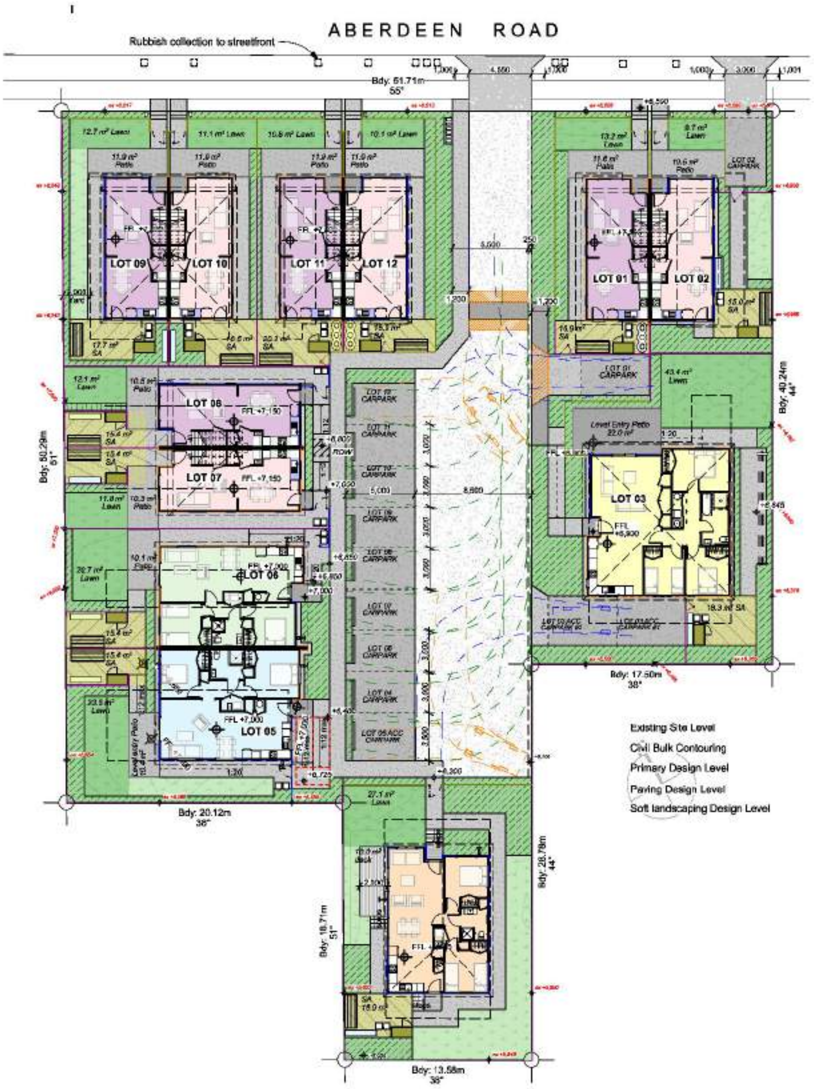

Fence Key	
2D Plan Preview	Description
—	1.25m Timber Paling Fence
—	1.85m Timber Paling Fence
—	1.85m Timber Paling Fence with visualy permeable upper section
⌐	Gate - 1.2m Aluminium
⌐	Gate: 1.8m Timber Paling on Metal frame

Site Features	
2D Plan Preview	Description
▤	28m Washing Line
▭	1000L APD Tank
○○○	BTS2000
■	Garden Master Shed 1.53 x 0.785
▫	Letter Box
▫	Rubbish Bins
═	Washing Line: Austral Retractaway 40

Site Works	
2D Plan Preview	Description
■	Concrete Paving (Broom Finish with 4% Oxide)
■	Concrete Paving (Broom Finish with 5% Oxide)
■	Concrete Paving (Broom Finish)
▨	Garden Bed with Mulch
□	New Vehicle Crossing
■	Private Carpark (Broom Finished with Sawcuts)
■	Service Court Concrete (Broom Finish)
□	Shared Driveway (Broom Finished with Sawcuts)
■	vehicle stop

Typologies	
2D Plan Preview	Description
🟪 🟥	I2 Two Storey Duplex
🟩 🟦	Z2 FE ACC/Standard Duplex
🟧	Z2 FE House
🟨	Z3+ SE Accessible

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Rev	Revision	Date

Proposed Site Plan

Resource Consent

NZHG Aberdeen Road
556 - 560 Aberdeen Road
Revision:
Scale at A3: 1:275, 1:1
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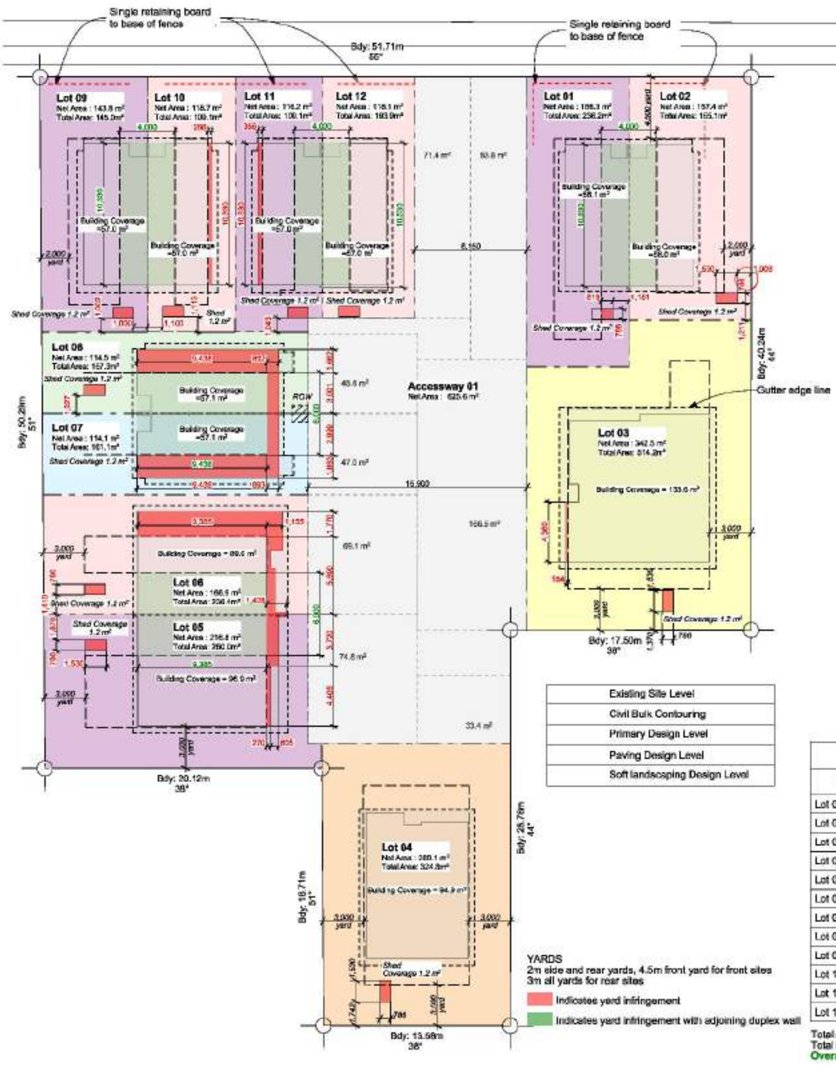

YARDS
2m side and rear yards, 4.5m front yard for front sites
3m all yards for rear sites

🟥 Indicates yard infringement

🟩 Indicates yard infringement with adjoining duplex wall

Lot Sizes and GDC Site Coverage					
Lot #	Net Area (m²)	Total Area (m²)	GDC Allowed Coverage (m²)	Proposed Building Coverage (m²)	Proposed Site Coverage (%)
Lot 01	156.3	236.2	82.7	57.2	22.3
Lot 02	157.4	155.1	54.3	57.2	34.0
Lot 03	342.5	514.2	180.0	134.3	26.1
Lot 04	280.1	324.8	113.7	96.1	29.6
Lot 05	216.8	280.0	98.0	71.1	25.4
Lot 06	166.9	236.4	82.7	90.2	38.2
Lot 07	114.1	161.1	56.4	58.3	36.2
Lot 08	114.5	157.3	56.7	59.6	36.2
Lot 09	143.8	145.0	50.1	57.2	39.4
Lot 10	118.7	109.1	38.2	57.2	52.4
Lot 11	116.2	109.1	38.2	57.2	52.4
Lot 12	118.1	193.9	67.7	57.2	29.5

Total site coverage: 852.8m²
Total site area: 2,671.0m²
Overall site coverage: 31.9%

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Rev	Revision	Date

Unit Plan

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556 - 560 Aberdeen Road
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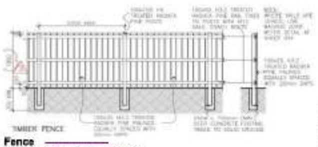
04

+6,500	Existing Site Level
+6,500	Civil Bulk Contouring
+6,500	Primary Design Level
+6,500	Paving Design Level
+6,500	Soft landscaping Design Level

Fence
1.2m Timber Palling Fence



Fence
1.85m Timber Palling Fence

Fence
1.85m Timber Fence with visually permeable upper section
- 1.55m Timber Palling Fence
- 300mm high Timber Battens to top

Site Planting							
2D Plan Preview	Element ID	Common Name	PB Size	Clearance / Spacing	Mature (H)	Mature (W)	Sun or Shade
St	Large Underplaning: Trecheleospermum Jasminoides	Star Jasmine	3	600	Climbing	5,000	Full sun / part shade
	Large Underplant: Arthropodium Cirratum	Rengarenga	3	600	1,000	1,000	Part shade / full shade
	Large Underplant: Astelia Nervosa	Mountain Astelia	3	600	1,000	1,000	Full sun / part shade
Ch	Large Underplant: Chionochloa Flavicans	Miniature Toe Toe	3	750	1,200	1,500	Full sun / part shade
He	Large Underplant: Hebe Topiara	Hebe	3	600	1,000	1,000	Full sun
	Large Underplant: Libertia Cranwelliae	Mikoikoi	3	750	400 - 900	400 - 900	Full sun / part shade / shade
	Large Underplant: Phormium Cookianum 'Emerald Green'	Dwarf Mountain Flax	3	750	800	800	Part shade / full shade
	Large Underplanting: Coprosma Repens 'Middlemore'	Mirror Plant	3	750	1500	1000	Part Shade
●	Small Underplant: Carex Dissita	Forest Sedge	3	500	500	500	Part shade / full shade
●	Small Underplant: Libertia Peregrinans	Tukauki	3	500	500	500	Full sun / part shade / full shade
●	Small Underplant: Phormium Tenax 'Sweet Mist'	Sweet Mist	3	400	400	400	Full sun / part shade
Fe	Specimen Tree: Acca Sellowiana	Feijoa	40	1,000	3,000	2,000	Full sun / part shade
Or	Specimen Tree: Citrus 'Harwoods Late'	Orange	40	750	2,000	2,000	Full sun / part shade
Me	Specimen Tree: Meryta sinclairii 'Puka'	Puka	95	1,500	4,000	2,000	Full sun / part shade (evergreen)
Po	Specimen Tree: Metrosideros excelsa 'Maori Princess'	Pohutukawa Māori Princess	95	1,500	4,000	3,000	Full sun
Ko	Specimen Tree: Sophora Fulvida 'West Coast Kōwhai'	West Coast Kōwhai	95	1,000	4,000	2,000	Full sun / part shade (deciduous)

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Rev	Remarks	Date

Landscaping and Fencing Plan

Resource Consent

NZHG Aberdeen Road
556 - 560 Aberdeen Road
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Date Issued: 22/11/2023

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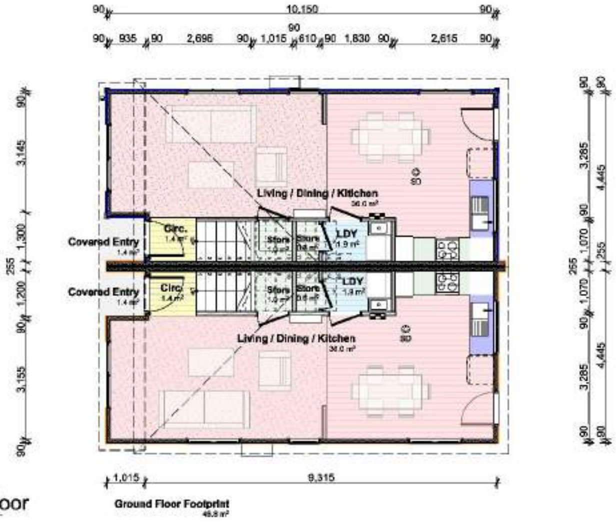
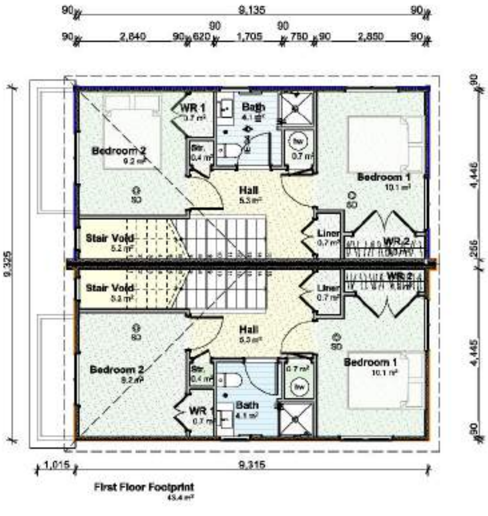
05



I2 Duplex Ground Floor



I2 Duplex First Floor

Areas		
	Space Name	Area (m²)
Footprint Per Unit		
	First Floor Footprint	43.4
	Ground Floor Footprint	46.8
		90.2 m²
Unit 1		
	Bath	4.1
	Bedroom 1	10.1
	Bedroom 2	9.2
	Circ.	1.4
	Covered Entry	1.4
	Hall	5.3
	HWC	0.7
	LDY	1.9
	Linen	0.7
	Living / Dining / Kitchen	36.0
	Stair Void	5.2
	Store	1.0
	Store	0.6
	Str.	0.4
	WR 1	0.7
	WR 2	1.3
		80.0 m²
Unit 2		
	Bath	4.1
	Bedroom 1	10.1
	Bedroom 2	9.2
	Circ.	1.4
	Covered Entry	1.4
	Hall	5.3
	HWC	0.7
	LDY	1.9
	Linen	0.7
	Living / Dining / Kitchen	36.0
	Stair Void	5.2
	Store	0.6
	Store	1.0
	Str.	0.4
	WR 1	0.7
	WR 2	1.3
		80.0 m²

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Rev	[illegible]	Date

Typology Floor Plans 01

Resource Consent

NZHG Aberdeen Road
556 - 560 Aberdeen Road
Revision:
Scale at A3: 1:100, 1:1
Date Issued: 22/11/2023

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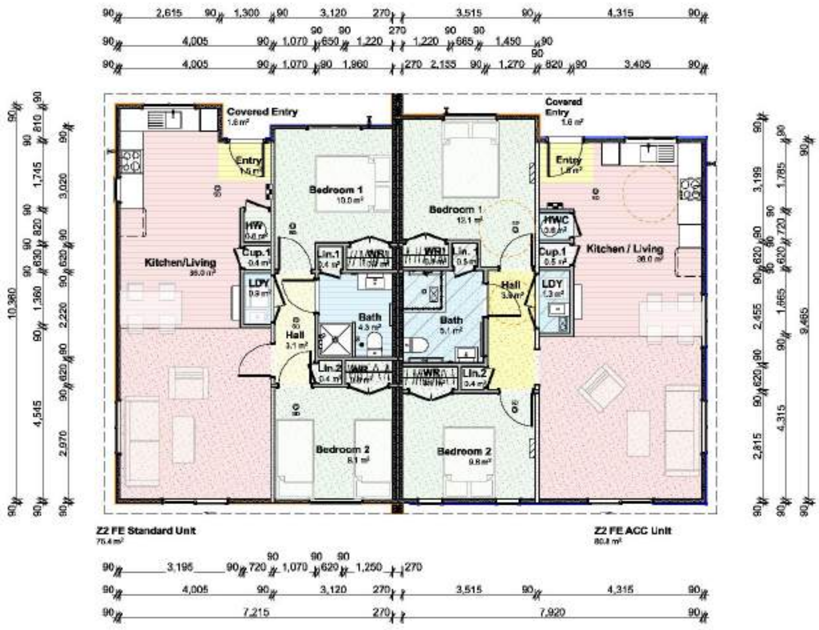

Areas (per Unit)		
Element ID	Space Name	Area (m²)
Z2 Standard Unit		
	Bath	4.3
	Bedroom 1	10.0
	Bedroom 2	9.1
	Covered Entry	1.6
	Cup.1	0.4
	Entry	1.5
	Hall	3.1
	HW	0.6
	Kitchen/Living	36.0
	LDY	0.9
	Lin.1	0.4
	Lin.2	0.4
	WR	0.7
	WR	0.8
Z2+ ACC Unit		
	Bath	5.1
	Bedroom 1	12.1
	Bedroom 2	9.8
	Covered Entry	1.6
	Cup.1	0.5
	Entry	1.5
	Hall	3.9
	HWC	0.6
	Kitchen / Living	36.0
	LDY	1.3
	Lin. 1	0.5
	Lin.2	0.4
	WR	0.9
	WR	0.8
		144.8 m²

Rev	Revision	Date

Typology Floor Plans 02

Resource Consent

NZHG Aberdeen Road
556 - 560 Aberdeen Road
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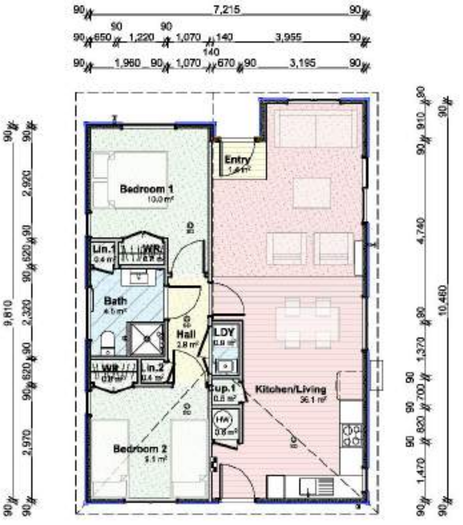
Proposed Floor Area = 107.1 m²

Z3+ ACC Side Entry House

Areas		
	Space Name	Area (m²)
Z3+ ACC		
	Bath	7.53
	Bedroom 1	12.45
	Bedroom 2	9.69
	Bedroom 3	9.08
	Covered Entry	1.40
	Hall	6.44
	LDY	1.78
	Linen	1.10
	Living / Dining / Kitchen	46.02
	Store	0.54
	Store	0.54
	WR1	1.09
	WR2	0.95
	WR3	0.74



Proposed Floor Area per unit = 75.3m²

Z2 Front Entry House

Scale 1:100

Areas		
	Space Name	Area (m²)
Z2 Front Entry		
	Bath	4.5
	Bedroom 1	10.0
	Bedroom 2	9.1
	Cup.1	0.5
	Entry	1.4
	Hall	2.9
	HW	0.6
	Kitchen/Living	36.1
	LDY	0.9
	Lin.1	0.4
	Lin.2	0.4
	WR	0.8
	WR	0.7

Rev	Remarks	Date

Typology Floor Plans 03

Resource Consent

NZHG Aberdeen Road
556 - 560 Aberdeen Road
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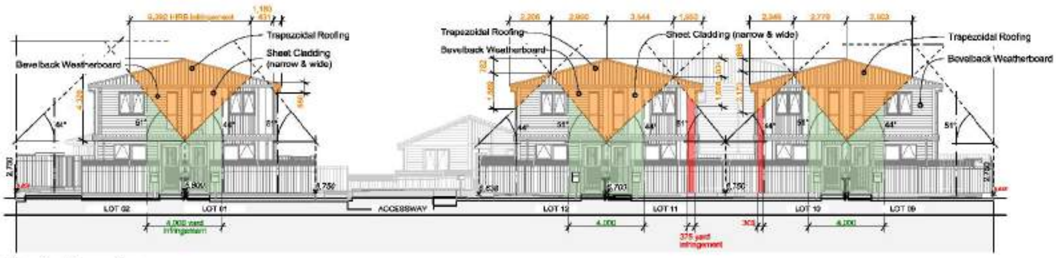
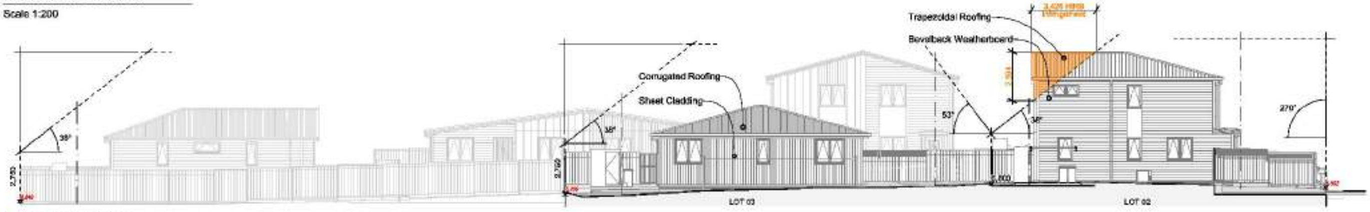


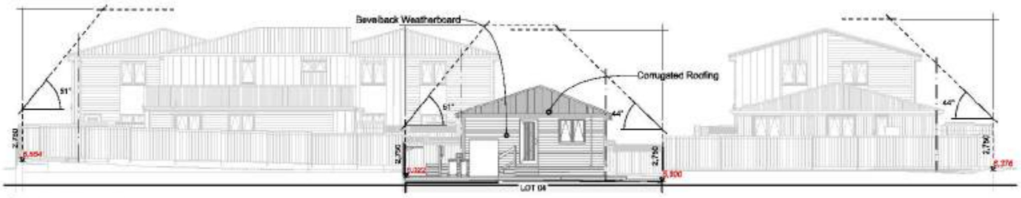
North Elevation

Scale 1:200



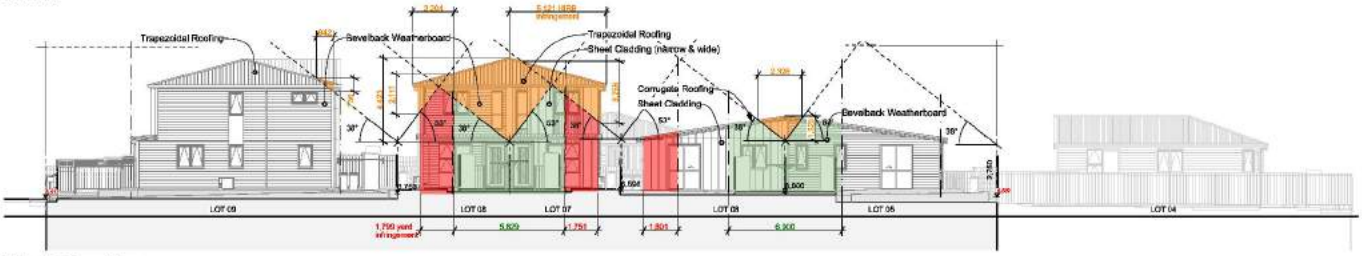
East Elevation

Scale 1:200



South Elevation

Scale 1:200



West Elevation

Scale 1:200

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Rev	Revision	Date

Site Elevations - External Boundaries

Resource Consent

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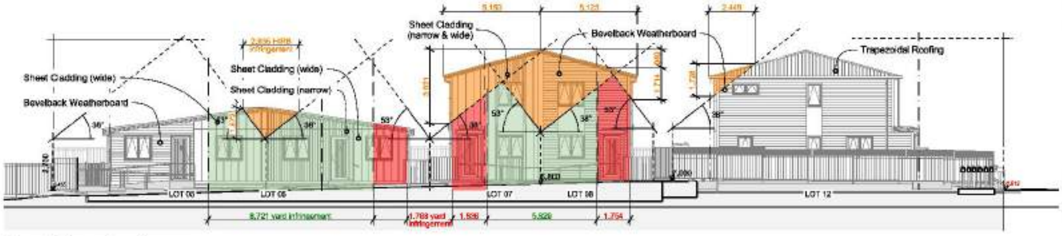
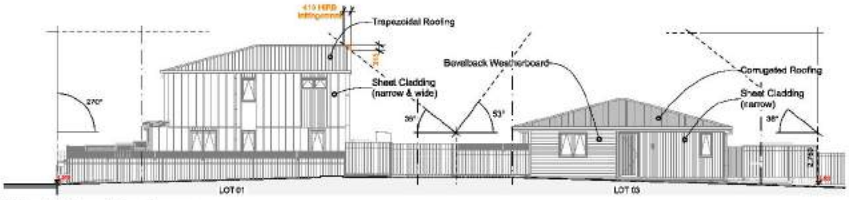
09



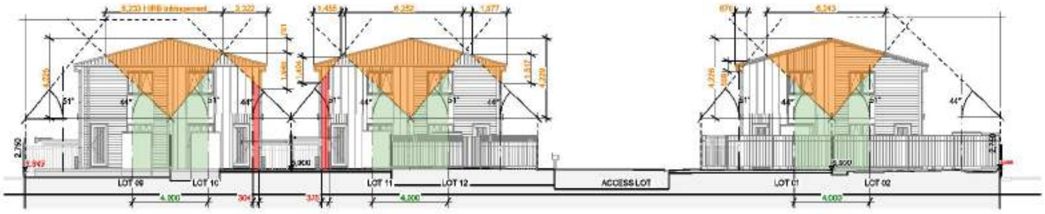
East Elevation Inner

Scale 1:200



West Elevation Inner

Scale 1:200



South Inner Elevation

Scale 1:200

PROPOSED COLOUR SCHEME

LOT 01 & 02 / 07 & 08

FlaxPod®

Exterior Joinery: Matt Flaxpod
Front Door: New Demin Blue

LOT 03

Gull Grey

Exterior Joinery: Matt Appliance White
Front Door: Matt Appliance White

LOT 04

Gull Grey

Exterior Joinery: Matt Appliance White
Front Door: Matt New Denim Blue

LOT 05 & 06

FlaxPod®

Exterior Joinery: Matt Flaxpod
Front Door: Matt New Denim Blue

LOT 09 & 10

FlaxPod®

Exterior Joinery: Matt Flaxpod
Front Door: Matt New Denim Blue

ATKINSON HARWOOD
ARCHITECTURE

Rev	Revision	Date

Site Elevations - Inner Boundaries

Resource Consent

NZHG Aberdeen Road
556 - 560 Aberdeen Road
Revision:
Scale at A3: 1:200
Date Issued: 22/11/2023

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p: 027 465 9236

10

North View

Driveway View

PROPOSED COLOUR SCHEME

LOT 01 & 02 / 07 & 08

Exterior Joinery: Matt Flaxpod
Front Door: New Demin Blue

LOT 03

Exterior Joinery: Matt Appliance White
Front Door: Matt Appliance White

LOT 04

Exterior Joinery: Matt Appliance White
Front Door: Matt New Denim Blue

LOT 05 & 06

Exterior Joinery: Matt Flaxpod
Front Door: Matt New Denim Blue

LOT 09 & 10

Exterior Joinery: Matt Flaxpod
Front Door: Matt New Denim Blue

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Rev	Revision	Date

3D Persepctives & Colour Selections

Resource Consent

NZHG Aberdeen Road
556 - 560 Aberdeen Road
Revision:
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Date Issued: 22/11/2023

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North View

South View

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Rev	Revision	Date

3D Perspectives

Resource Consent

NZHG Aberdeen Road
556 - 560 Aberdeen Road
Revision:
Scale at A3:
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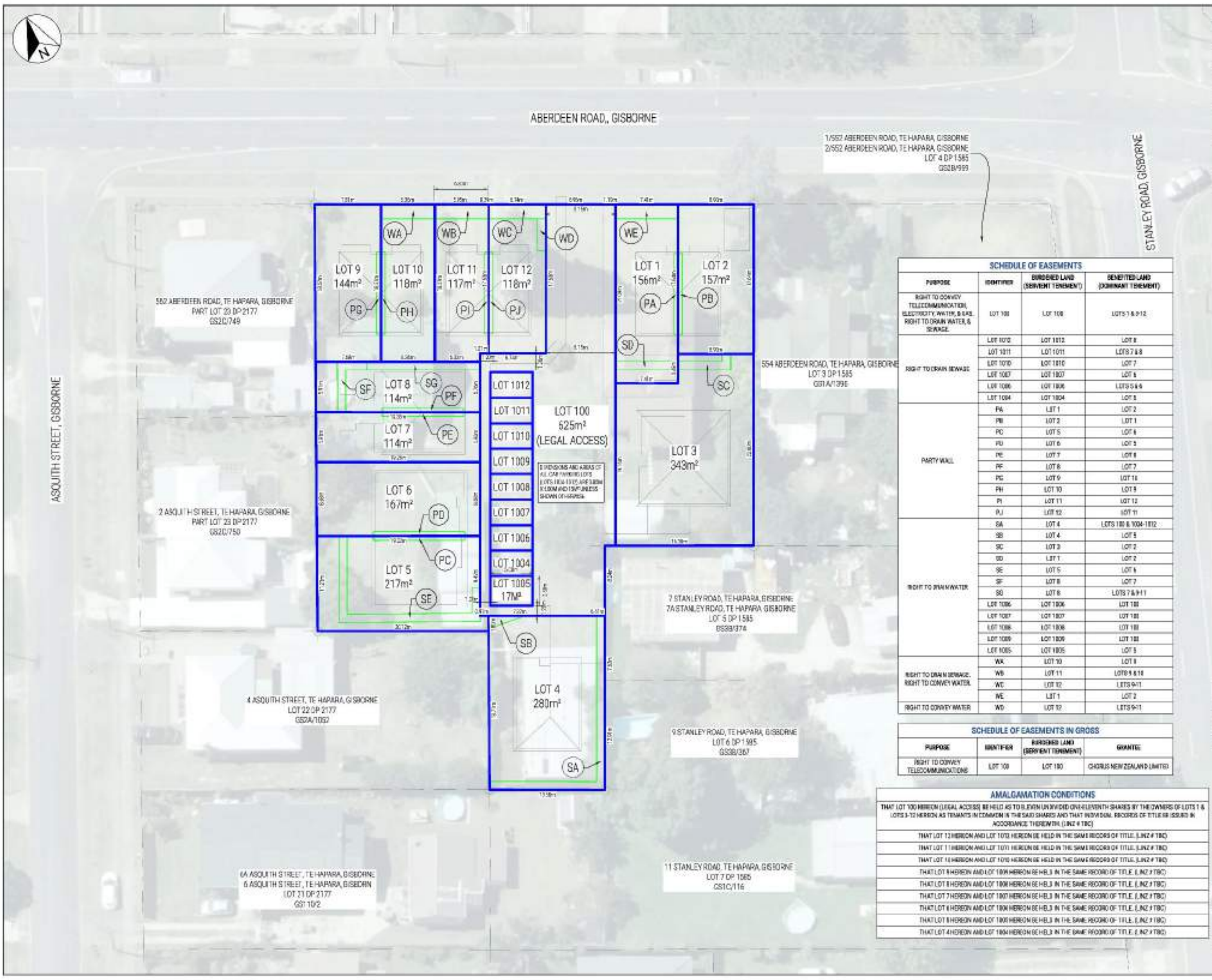
Appendix 3

Scheme Plan



SCHEDULE OF EASEMENTS

PURPOSE	IDENTIFIER	BURDENED LAND (SERVIENT TENEMENT)	BENEFITED LAND (DOMINANT TENEMENT)
RIGHT TO CONVEY TELECOMMUNICATION, ELECTRICITY, WATER, & GAS. RIGHT TO DRAIN WATER, & SEWAGE.	LOT 100	LOT 100	LOTS 1 & 3-12
RIGHT TO DRAIN SEWAGE	LOT 1012	LOT 1012	LOT 8
	LOT 1011	LOT 1011	LOTS 7 & 8
	LOT 1010	LOT 1010	LOT 7
	LOT 1007	LOT 1007	LOT 6
	LOT 1006	LOT 1006	LOTS 5 & 6
	LOT 1004	LOT 1004	LOT 5
PARTY WALL	PA	LOT 1	LOT 2
	PB	LOT 2	LOT 1
	PC	LOT 5	LOT 6
	PD	LOT 6	LOT 5
	PE	LOT 7	LOT 8
	PF	LOT 8	LOT 7
	PG	LOT 9	LOT 10
	PH	LOT 10	LOT 9
	PI	LOT 11	LOT 12
	PJ	LOT 12	LOT 11
RIGHT TO DRAIN WATER	SA	LOT 4	LOTS 100 & 1004-1012
	SB	LOT 4	LOT 5
	SC	LOT 3	LOT 2
	SD	LOT 1	LOT 2
	SE	LOT 5	LOT 6
	SF	LOT 8	LOT 7
	SG	LOT 8	LOTS 7 & 9-11
	LOT 1006	LOT 1006	LOT 100
	LOT 1007	LOT 1007	LOT 100
	LOT 1008	LOT 1008	LOT 100
	LOT 1009	LOT 1009	LOT 100
	LOT 1005	LOT 1005	LOT 5
RIGHT TO DRAIN SEWAGE. RIGHT TO CONVEY WATER.	WA	LOT 10	LOT 9
	WB	LOT 11	LOTS 9 & 10
	WC	LOT 12	LOTS 9-11
	WE	LOT 1	LOT 2
RIGHT TO CONVEY WATER	WD	LOT 12	LOTS 9-11

SCHEDULE OF EASEMENTS IN GROSS

PURPOSE	IDENTIFIER	BURDENED LAND (SERVIENT TENEMENT)	GRANTEE
RIGHT TO CONVEY TELECOMMUNICATIONS	LOT 100	LOT 100	CHORUS NEW ZEALAND LIMITED

AMALGAMATION CONDITIONS

THAT LOT 100 HEREON (LEGAL ACCESS) BE HELD AS TO ELEVEN UNDIVIDED ONE-ELEVENTH SHARES BY THE OWNERS OF LOTS 1 & LOTS 3-12 HEREON AS TENANTS IN COMMON IN THE SAID SHARES AND THAT INDIVIDUAL RECORDS OF TITLE BE ISSUED IN ACCORDANCE THEREWITH. (LINZ # TBC)

THAT LOT 12 HEREON AND LOT 1012 HEREON BE HELD IN THE SAME RECORD OF TITLE. (LINZ # TBC)

THAT LOT 11 HEREON AND LOT 1011 HEREON BE HELD IN THE SAME RECORD OF TITLE. (LINZ # TBC)

THAT LOT 10 HEREON AND LOT 1010 HEREON BE HELD IN THE SAME RECORD OF TITLE. (LINZ # TBC)

THAT LOT 9 HEREON AND LOT 1009 HEREON BE HELD IN THE SAME RECORD OF TITLE. (LINZ # TBC)

THAT LOT 8 HEREON AND LOT 1008 HEREON BE HELD IN THE SAME RECORD OF TITLE. (LINZ # TBC)

THAT LOT 7 HEREON AND LOT 1007 HEREON BE HELD IN THE SAME RECORD OF TITLE. (LINZ # TBC)

THAT LOT 6 HEREON AND LOT 1006 HEREON BE HELD IN THE SAME RECORD OF TITLE. (LINZ # TBC)

THAT LOT 5 HEREON AND LOT 1005 HEREON BE HELD IN THE SAME RECORD OF TITLE. (LINZ # TBC)

THAT LOT 4 HEREON AND LOT 1004 HEREON BE HELD IN THE SAME RECORD OF TITLE. (LINZ # TBC)

NOTES

1. THE COPYRIGHT AND INTELLECTUAL PROPERTY RIGHTS FOR THE INFORMATION SHOWN ON THIS PLAN REMAIN THE PROPERTY OF DEFINITION SURVEYING LTD.

SITE LOCATION

ADDRESS:	556 & 560 ABERDEEN ROAD, TE HAPARA, GISBORNE
APPELATION:	LOT 2 DP 1585, PART LOT 1 DP 1585, LOT 1 DP 1817
ZONE:	GENERAL RESIDENTIAL
RECORD OF TITLE:	GS2B/182, GS1 10/25, GS2B/182
REGISTERED OWNERS:	LINDA O'CONNELL, TERRY O'CONNELL, TRACY MAREE O'CONNELL

NOTES

THIS PLAN HAS BEEN PREPARED FOR RESOURCE CONSENT PURPOSES ONLY AND IS NOT INTENDED FOR ANY OTHER USE. ANY AREAS AND DIMENSIONS SHOWN ON THIS PLAN ARE INDICATIVE AND ARE SUBJECT TO FINAL SURVEY.

AERIAL IMAGERY HAS BEEN SOURCED FROM THE LINZ DATA SERVICE AND LICENSED BY THE DISTRICT/CITY COUNCIL FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.

REV	DESCRIPTION	BY	DATE
B	EASEMENTS AND CAR PARK LOTS ADDED	JD	19/11/2023
A	ISSUED FOR INFORMATION	JD	04/11/2023

STATUS: ISSUED FOR INFORMATION

DEFINITION SURVEYING LTD
BAY OF PLENTY | HAWKES BAY | CANTERBURY
WWW.DEFINITION.NZ

CLIENT:

GROUP OF COMPANIES

SURVEYOR: DEFINITION SURVEYING LTD
HAWKES BAY

SITE: LOT 2 DP 1585, PART LOT 1 DP 1585, LOT 1 DP 1817
556 & 560 ABERDEEN ROAD, TE HAPARA, GISBORNE

TITLE: SCHEME PLAN

SCALE @ A3	DATE	DRAWN	CHECKED
1:500	04/11/2023	KM	JD

PROJECT NO.	DRAWING NO.	REVISION
NZ30307.07	V200	B

Appendix 4

Geotechnical Reports

NZHG Gisborne Limited

GEOTECHNICAL ASSESSMENT REPORT FOR PROPOSED RESIDENTIAL DWELLING, LOT 1 AND 2

556-560 Aberdeen Road, Te Hapara, Gisborne

Project Reference: 24477
October 13, 2023

DOCUMENT CONTROL

Version	Date	Comments
01	13/10/2023	Issued for Resource Consent. Plan review required prior to submission for Building Consent.

Version	Issued For	Date	Prepared By	Reviewed & Authorised By
01	Issued for Design	13/10/2023	Sahil Sathwara *B.Tech (Civil), MEngNZ* Geotechnical Engineer	Dan Bond *CMEngNZ, PEngGeol.* Associate Engineering Geologist

CONTENTS

1 INTRODUCTION

Land Development & Engineering Ltd (LDE) was engaged by NZHG Gisborne Limited to undertake a geotechnical investigation of a site located at 556 & 560 Aberdeen Road, Gisborne (Figure 1).

The 2,700m^2 site is proposed to be subdivided into 12 Lots for residential development (Figure 1). This geotechnical report pertains to proposed Lot 1 and 2, 556 & 560 Aberdeen Road, Gisborne.

Figure 1: 556 & 560 Aberdeen Road (outlined in blue), with the proposed subdivision outlined in yellow, Lot 1 and 2 highlighted in white. Image source: Tairāwhiti Maps (Gisborne District Council, 2023) Accessed: September 2023

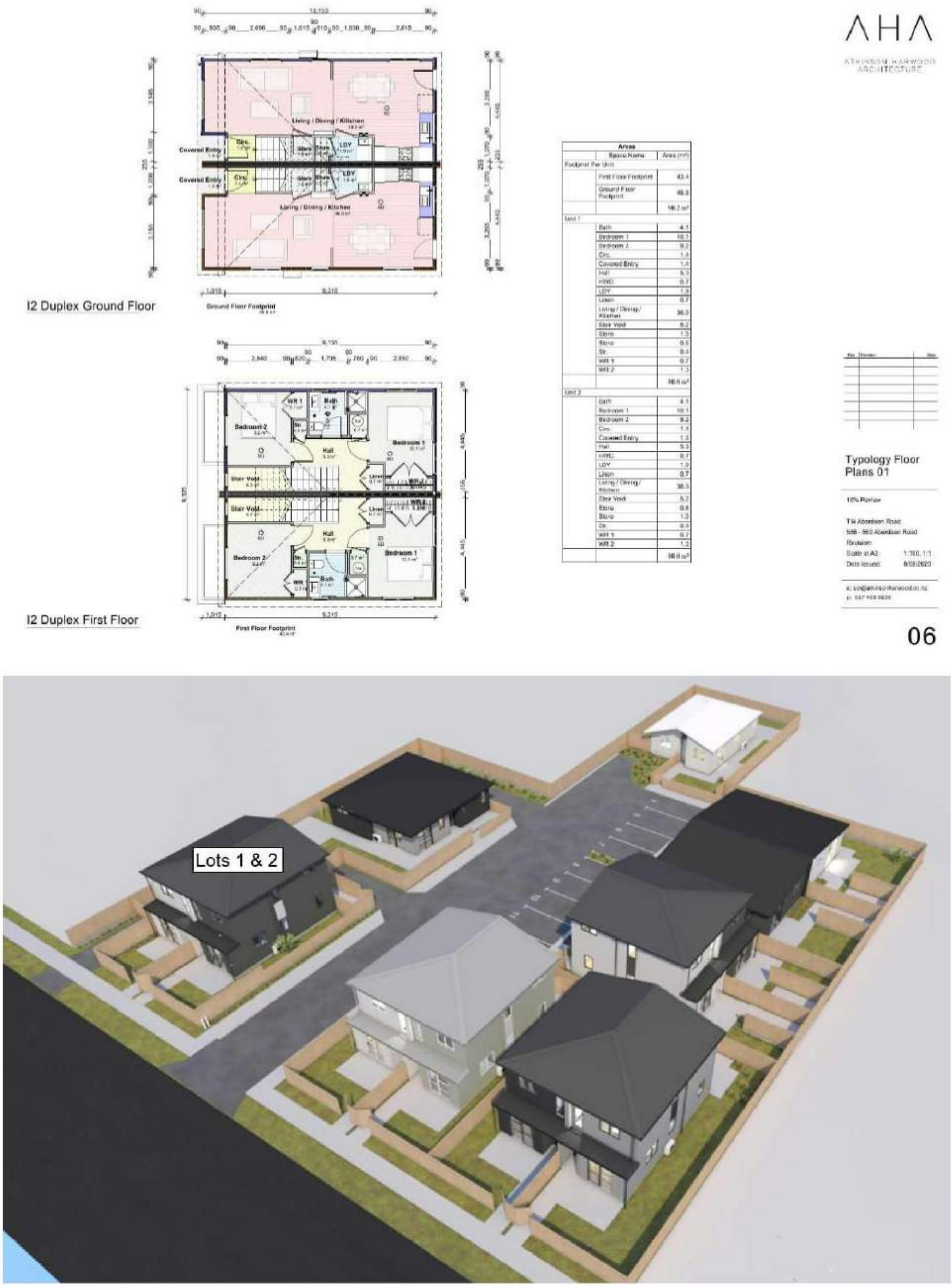
2 PROPOSED DEVELOPMENT

A 12-lot subdivision is proposed at 556 & 560 Aberdeen Road across the property with the legal description Lot 2 DP 1585, PT Lot 1 DP 1585, and Lot 1 DP 1817. The proposed development consists of 7 structures formed of four double-storey duplex buildings, one single-storey building and two standalone dwellings (Figure 1).

The proposed driveway is located centrally of the site to provide access between lots and Aberdeen Road. Proposed access and building platform locations are shown in Figure 1 and Appendix A.

A 93.6m^2 double storey building is proposed across Lot 1 and 2 (Figure 2), with timber framing in accordance with NZS3604 (2011), with weatherboard and sheet wall cladding, profiled metal roofing and a concrete floor or suspended timber floor.

The purpose of this investigation was to determine and assess the nature of the ground beneath the building site to inform our geotechnical recommendations for site development and design of the building's foundations. The investigation was completed to satisfy the requirements of Gisborne District Council (2022) for Resource and Building Consent.



Areas		
	Space Name	Area (m²)
Footprint Per Unit		
	First Floor Footprint	43.4
	Ground Floor Footprint	46.8
		90.2 m²
Unit 1		
	Bath	4.1
	Bedroom 1	10.1
	Bedroom 2	9.2
	Circ.	1.4
	Covered Entry	1.4
	Hall	5.3
	HWC	0.7
	LDY	1.9
	Linen	0.7
	Living / Dining / Kitchen	36.0
	Stair Void	5.2
	Store	1.0
	Store	0.8
	Str.	0.4
	WR 1	0.7
	WR 2	1.3
		98.0 m²
Unit 2		
	Bath	4.1
	Bedroom 1	10.1
	Bedroom 2	9.2
	Circ.	1.4
	Covered Entry	1.4
	Hall	5.3
	HWC	0.7
	LDY	1.9
	Linen	0.7
	Living / Dining / Kitchen	36.0
	Stair Void	5.2
	Store	0.8
	Store	1.0
	Str.	0.4
	WR 1	0.7
	WR 2	1.3
		98.0 m²

Figure 2: (From top to bottom): Floor plans for proposed duplex building across Lot 1 and 2, alongside the architect's drawing (Lot 1 and 2 are labelled). Image Source: Client supplied.

3 SITE STUDY

3.1 Site Description

The site is located within the established suburb of Te Hapara, Gisborne, approximately 2.0km northwest of the Gisborne CBD. The site is generally flat and is elevated between 6m and 7m (New Zealand Vertical Datum (NZVD) 2016). 556 (LOT 2 PT 1 DP 1585) & 560 (LOT 1 DP 1817) Aberdeen Road, occupy a combined area of approximately 2,700m^2.

3.2 Geomorphology and Geology

556 & 560 Aberdeen Road, occupy flat lying ground which, at one time, comprised the historic foreshore of Tūranganui-a-Kiwa (Poverty Bay). The 1:250,000 geological map of the region (Mazengarb & Speden, 2000) indicates the site is underlain by Holocene aged beach deposits which consist predominantly of sand. The Taruheru River is located approximately 120 m to the north; elevation falls relatively gently towards the river until the riverbank, which falls around 6m over some 25m laterally.

The GNS Active Fault Database does not identify any active fault traces or any fault buffer zones affecting the site. The nearest mapped active fault is the Repongaere Fault, located approximately 14 km to the north-west of the properties (GNS Science, 2020).

3.3 Geotechnical Risks

Our review of Gisborne District Council's (GDC) GIS viewer, Tairāwhiti Maps (Gisborne District Council, 2023), and GNS Science's Active Faults Database (GNS Science, 2020) revealed the following:

- 556 & 560 Aberdeen are mapped as being within an area of moderate liquefaction risk.
- The nearest active fault is the Repongaere Fault, located approximately 14 km to the north-west of the properties.
- The site is mapped as yellow tsunami evacuation zone.

In addition to the risk of liquefaction, the nearby riverbanks of the Taruheru River presents the possibility of lateral spreading in a liquefaction-inducing earthquake event.

Our review of the 2023 aerial photographs indicates that the properties were not severely impacted by flooding associated with Cyclone Gabrielle.

3.4 Historical Aerial Photographs

Historical aerial imagery was reviewed as part of this investigation using Retrolens and Google earth aerial

photography, which revealed the following: -

- Residential dwellings were constructed at both properties prior to 1942 (the earliest available aerial photograph with sufficient resolution).
- In the 1942 aerial photograph there appears to be some form of structure/s, a pile of material, or disturbance to the ground beneath the southwest corner of 556 Aberdeen Road. However, the resolution of the aerial photography is not sufficient to reliably determine what occupied the southwest corner of the property.
- A large shed was constructed in the southwest corner of 556 Aberdeen Road sometime between 1942 and 1966, along with smaller auxiliary structures at both properties.
- Several small structures or 'lean-tos' were constructed between 1966 and 1988 across both properties.
- A shed/garage was constructed in the south-east corner of 560 Aberdeen Road.
- Between 1988 and 2021 additions were carried out to the garage/shed in the south-east corner of 560, and the large shed in the southwest corner of 556. The water tank for 560 Aberdeen Road was removed, along with several of the smaller auxiliary structures across both properties.

Figure 3: Historical aerial imagery of the Aberdeen Road Subdivision (Source: (Retrolens.co.nz)), with the location of the individual lots marked in yellow. (a) Aerial imagery from 1942, (b)1966, (c) 1977, (d) 1988.

4 GEOTECHNICAL INVESTIGATION

4.1 Development wide Investigation Scope

Our investigation of the entire site included the following: -

- A walkover assessment of the site and immediate surrounding area to assess its geomorphology and identify any features which may influence our engineering recommendations, or the long-term performance of the ground.
- 15No. 50mm diameter, hand auger boreholes drilled to refusal or 2.5m target depth at the proposed building locations, with measurements of undrained shear strength taken every 0.2m, and associated DCP's to the 2.5m target depth.
- Complete liquefaction analysis of the Five CPTs which were undertaken across the site during the due diligence phase, three at 556 Aberdeen Road and two at 560 Aberdeen Road (Figure 4).

4.2 Lot 1 and Lot 2 Investigation Scope

The investigation of the site, completed on 12 September 2023 included the following work: -

- Two, 50mm diameter, hand-auger boreholes (HA01 and HA02), reached target depth 2.5m below ground level (bgl). Associated DCP tests were carried out at each test location to the 2.5m target depth within granular materials.
- Measurements of groundwater levels within invasive subsurface test holes, following hole completion.

The test locations are shown on the Geotechnical Investigation Plan (Figure 4), and as Appendix A. Logs with details of the relevant testing completed are presented as Appendices B and C.

Figure 4: Geotechnical Investigation Plan for proposed development, Lot 1 and 2 highlighted in white.

5 GROUND CONDITIONS

This section addresses the ground conditions encountered during our investigations.

5.1 Site Stratigraphy

5.1.1 Development Wide

Ground conditions are reasonably consistent across the site. Typically, the property is underlain by topsoil and/or fill to a depth between 0.3m and 0.8m below ground level (bgl), which overlies sand/ silt mixtures to a depth of 1.0m. Underlying this, medium dense to dense sand was encountered to around 6.5m to 7.0m. Deposits of firm clay were encountered from around 6.5m to 7.0m, with stiff silt/clay mixtures extending to depth from approximately 13m.

A copy of the test logs is provided as Appendix B.

5.1.2 Lot 1 and Lot 2 Site Specific Nuances

Topsoil was encountered in each hand auger borehole from the existing ground surface to depths up to 0.5m in hand auger testing.

Dynamic penetrometer testing in HA01 and HA02 typically ranged between 1 and 2 blows per 50mm penetration below the topsoil.

5.2 Groundwater

Groundwater was encountered at depths of between 1.50m and 2.88m across the site. A low-bound groundwater level of 1.65m bgl was adopted in our assessments. Given that testing was completed in the wettest year on record for Gisborne, the groundwater level adopted is considered significantly elevated from typical levels and no further allowance has been applied for seasonal variations.

6 NATURAL HAZARDS

6.1 Definition & Legislation

This section summarises our assessment of the natural hazards that might affect the site including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding, that might affect the property, as generally defined in Section 106 of the Resource Management Act., as well as the hazards as defined in Section 71(3) of the Building Act (2004), including erosion (including coastal erosion, bank erosion, and sheet erosion), falling debris (including soil, rock, snow and ice), subsidence, inundation (including flooding, overland flow, storm surge, tidal effects and ponding), and slippage.

6.2 Seismic Hazard

6.2.1 Surface Fault Rupture

The GNS NZ Geology Web-map and Active Faults Database (GNS Science, 2020) do not show any faults passing beneath the subject site. There also does not appear to be any surface expressions which would indicate the presence of an active fault beneath or within close proximity to the site. We therefore consider the surface fault rupture risk to be low.

6.2.2 Site Subsoil Class

Based on the published geological information for the region, discussed in Section 3.2, and obtained site-specific CPT data, we consider that a seismic site subsoil classification of D- "Deep or Soft Soil" is appropriate as defined by NZS 1170.5 (2004).

6.2.3 Seismic Actions

In accordance with the NZ Building Code and NZS 1170.5 (2004) the structure proposed is considered Importance Level 2 (IL2) with a design working life of 50 years, therefore:

- The Serviceability Limit State (SLS) design earthquake has an annual exceedance probability (AEP) of 1/25, and;
- The Ultimate Limit State (ULS) design earthquake has an AEP of 1/500.

An intermediate state event (ILS) has been considered in accordance with Gisborne District Council's (GDC's) requirements. This design case has an AEP of 1/100.

The modules of the Earthquake Geotechnical Engineering Practice series jointly published by Ministry of Business Innovation and Employment (MBIE) and the New Zealand Geotechnical Society (NZGS) (2021) provides guidance under Section 175 of the Building Act (2004), to assist with ensuring compliance with the Act. We have adopted the ground motions published within Module 1 (2021) for geotechnical design which are summarised in Table 1.

Table 1 - Summary of adopted seismic parameters.

Seismic Parameters	SLS	ILS	ULS
Horizontal Peak Ground Accelerations (PGA), g	0.12	0.28	0.65
Effective magnitude, Mw	6.3	6.8	7.5

6.3 Liquefaction and Cyclic Softening Assessments

6.3.1 Liquefaction

Liquefaction is the term used to describe the temporary, but substantial, loss of strength and stiffness which can occur in saturated, unconsolidated soils that are subjected to strong shaking. In addition to near-total strength loss, liquefaction may also result in the expulsion of sediment and water at the surface, ground, and structure settlement, and in lateral (spreading) displacement of the ground.

The liquefaction potential was assessed with site-specific CPT data using specialist geotechnical software (CLiq Ver.3.3.1.13) in general accordance with NZGS/ MBIE Module 3 Guidance (2021).

Liquefaction triggering was assessed using the method proposed by Boulanger and Idriss (2014).

Liquefaction-induced, free-field, vertical, volumetric strains were estimated using the method proposed by Zhang et al (2002)

A low-bound groundwater level of 1.65m bgl was adopted as discussed in Section 5.2.

6.3.2 Cyclic-Softening

Cyclic softening is a phenomenon that occurs when the strength and stiffness of a soil decreases due to repeated cyclic loading such as that resulting from strong seismic shaking. Relatively soft clay soils are commonly susceptible to this phenomenon, which can be accentuated where these soils are sensitive i.e., there is a significant difference between the soil's peak and residual shear strength.

Due to the presence of the clay rich estuarine soils at this site, we have undertaken a cyclic softening analysis for the ULS design case. The Gisborne 2007 earthquake was of comparable magnitude and PGA to the ILS design case. No liquefaction or induced settlements were identified within the proximity of the subject site because of this earthquake. Accordingly, cyclic softening has been assessed for the ULS design case only.

Our assessments assumed:

- An N_{kt} value of 14 for the clay-like soils, based on previous work undertaken proximally by LDE within the estuarine deposits.
- An estimate of the maximum, post-liquefaction, volumetric strain based on the work by Robertson and Cabal (Robertson & Cabal, 2014) which recommends a default value of 0.5% for clay-like soils.

6.3.3 Liquefaction and Cyclic Softening Results

The results of our analyses are summarised in Table 2; detailed outputs are included as Appendix D.

The Liquefaction Potential Index (LPI) and Liquefaction Severity Number (LSN) are indices used to assess the general performance level of liquefied deposits in accordance with the NZGS/MBIE Module 3 Guidance (2021).

Our analyses indicate that liquefaction-induced settlements are likely to be negligible (<5mm) in a design SLS seismic event.

Under the ILS design case, liquefaction-induced settlements are estimated to be between 20mm and 50mm. As discussed in Section 6.3.2, no liquefaction, or liquefaction-induced settlements were identified within the proximity of the subject site as a result of the Gisborne 2007 earthquake, which had almost identical ground motions. Accordingly, we consider it unlikely that liquefaction would be realised under ILS seismic shaking and conclude that the software is likely to be over-estimating liquefaction potential.

Table 2 - Summary of liquefaction analysis results.

Limit State / AEP	CPT ID	LPI	LSN	Estimated Seismic Volumetric Settlements (mm) [Limited to 10m] (3)			Effects of Liquefaction
				Liquefaction	Cyclic Softening	Total Seismic Settlement	
SLS 1/25 year	CPT-01	0	0	<5 [<5]	-	**<5 [<5]**	**L0**
	CPT-02	0	0	<5 [<5]	-	**<5 [<5]**	
	CPT-03	0	0	<5 [<5]	-	**<5 [<5]**	
	CPT-04	0	0	<5 [<5]	-	**<5 [<5]**	
	CPT-05	0	0	<5 [<5]	-	**<5 [<5]**	
ILS 1/100 year	CPT-01	2	8	~30 [~25]	-	**~30 [~25]**	**L2**
	CPT-02	4	12	~50 [~45]	-	**~50 [~45]**	
	CPT-03	2	5	~20 [~20]	-	**~20 [~20]**	
	CPT-04	4	12	~45 [~40]	-	**~45 [~40]**	
	CPT-05	3	10	~45 [~30]	-	**~45 [~30]**	
ULS 1/500 year	CPT-01	18	23	~75 [~70]	~45	**~120 [~70]**	**L3**
	CPT-02	18	23	~85 [~75]	~40	**~125 [~75]**	
	CPT-03	16	19	~70 [~65]	~40	**~110 [65]**	
	CPT-04	20	24	~85 [~80]	~40	**~125 [65]**	
	CPT-05	18	23	~85 [~65]	~40	**~125 [65]**	
Effects of liquefaction Key		**L0: Insignificant**	**L1: Mild**	**L2 Moderate**	**L3: High**	**L4 Severe**	**L5: Very Severe**

Notes:

- Liquefaction triggering Boulanger and Idriss (2014) methodology limited to upper 15m. Limited to 10m of soil profile shown in square brackets [ ].
- Settlements are free-field estimated settlements and do not include any building-induced settlements.
- Effects of Liquefaction based on NZGS Module 3 (New Zealand Geotechnical Society (NZGS) & Ministry of Business, Innovation and Employment (MBIE), 2021)

Under design ULS seismic shaking, settlements in the order of 110mm to 125mm are estimated. However, given the rationalisation to the Gisborne 2007 earthquake, discussed above, we consider that total, free-field, seismic settlements are likely to less than 100mm.

6.4 Lateral Spreading and Lateral Stretch

Lateral spreading typically occurs in sloping ground or level ground close to slopes or waterways and is most commonly caused by loss of strength due to earthquake-induced liquefaction. Typically, the degree of lateral movement diminishes as the distance from the waterway, or free face, increases.

Liquefaction-induced lateral displacements were estimated in CLiq software using the method proposed by Zhang et al (2004). utilising an Ic cut-off of 2.6, clean sand and overburden corrections, and inferred soil unit weights.

The methods available to predict lateral displacements from CPT data. Both these methods are based upon limited case studies and as such have inherent limitations for broader application. They are known to be highly inaccurate with predictions versus empirical data varying by a factor of two (NZGS Module 3 (2021)) or possibly more. Accordingly, lateral spreading potential was also assessed through numerical modelling, using Slide 2 (Version 9.027) by Rocscience Inc., to provide a more reliable estimate and allow sensitivity analyses to be undertaken.

Both methods, and associated results are discussed below.

6.4.1 CLiq Assessment

Our CLiq assessment adopted the 'Level ground with a free face' approach, because the alternative option (gently sloping ground) was found to estimate lateral displacements in excess of 600mm under the ILS design case.

Our assessment was based on the sites closest proximity to the Taruheru River (117m) and a free face height of 7m (elevation relief from the site to the river) and was completed for each CPT.

Table 3 presents the results of these analyses.

Table 3 - Summary of Lateral Spreading Displacements

<table>
<tr><th colspan="2">CPT ID</th><th>SLS
1/25 year
(mm)</th><th>ILS
1/100 year
(mm)</th><th>ULS
1/500 year
(mm)</th><th>Global Lateral Movement (ULS)</th></tr>
<tr><td colspan="2">CPT01</td><td><5</td><td>~105</td><td>~315</td><td>Major</td></tr>
<tr><td colspan="2">CPT02</td><td><5</td><td>~170</td><td>~390</td><td>Major</td></tr>
<tr><td colspan="2">CPT03</td><td><5</td><td>~100</td><td>~275</td><td>Minor to Moderate</td></tr>
<tr><td colspan="2">CPT04</td><td><5</td><td>~250</td><td>~460</td><td>Major</td></tr>
<tr><td colspan="2">CPT05</td><td><5</td><td>~180</td><td>~380</td><td>Major</td></tr>
<tr><td>Global lateral movement categories</td><td colspan="2">Minor to Moderate
0 to 300mm</td><td>Major
300 to 500mm</td><td colspan="2">Severe
>500mm</td></tr>
</table>

Notes:

- Free-face method adopted limits of lateral spreading to 2H. Chu et al (2006) have compared predicted values of lateral spread using the Zhang et al model with actual measurements of lateral displacement following the 1999 Chi Chi earthquake. They found that predicted values better matched observed values when liquefaction calculations in the CPT profile were limited to a depth of twice the free face height (2H).
- Global lateral movement categories based on MBIE Guidance for TC3 (Ministry of Business Innovation and Employment Hīkina Whakatutuki, 2015)

6.4.2 Numerical Modelling Assessment

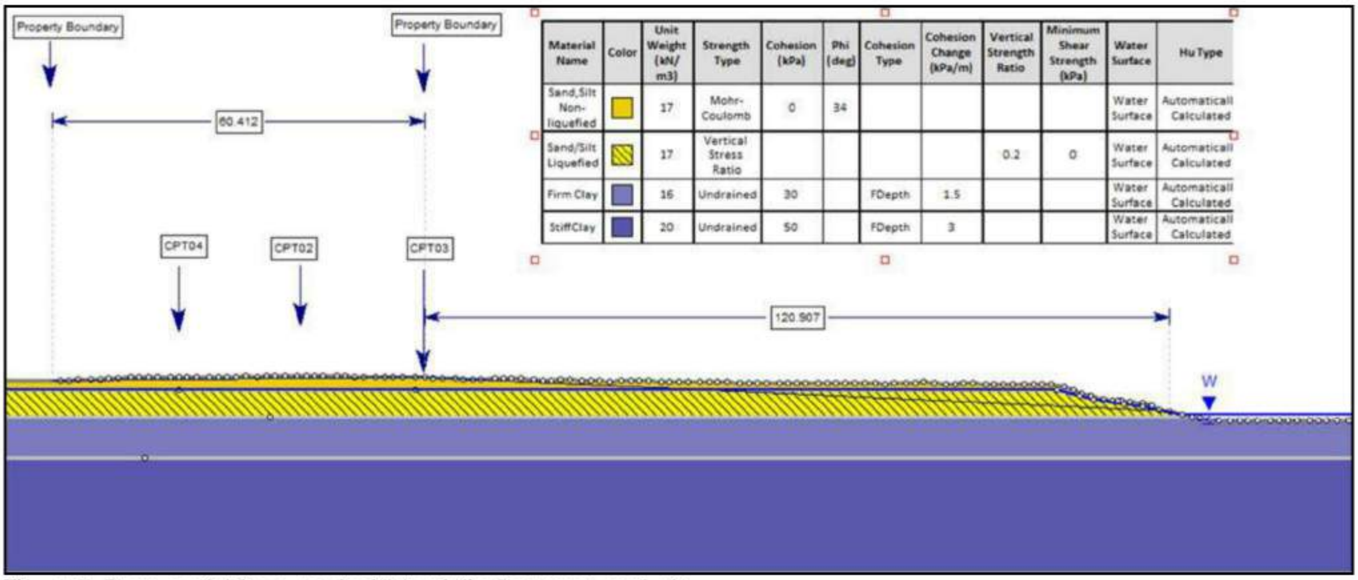
Numerical modelling was used to assess the potential for lateral displacements using Slide 2 as discussed above.

Our modelling assessed non-circular slip surfaces using the 'Cuckoo" search method and adopting the 'Vertical Strength Ratio' material strength model for the liquefied layer.

From past projects and general geological knowledge of this area, it is our experience that the Holocene beach sand transitions to clay-rich deposits towards the river, likely due to a combination of river migration and overbank deposition. In many areas along the Taruheru river a relic river terrace can be clearly identified, however this area had been developed prior to the earliest available historic aerial imagery and consequently the terrace boundary could not be identified.

Accordingly, we have adopted a conservative 'what if.' scenario in our modelling where the liquefied layer has been extended at consistent thickness and elevation to the river.

Figure 5 shows the base model, the surface profile of which was plotted from recent LiDAR data. Note the left side of the model has been manually extended to check the potential for more critical slip surfaces.



Material Name	Color	Unit Weight (kN/ m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Cohesion Type	Cohesion Change (kPa/m)	Vertical Strength Ratio	Minimum Shear Strength (kPa)	Water Surface	Hu Type
Sand,Silt Non-liquefied	🟨	17	Mohr-Coulomb	0	34					Water Surface	Automaticall Calculated
Sand/Silt Liquefied	▨	17	Vertical Stress Ratio					0.2	0	Water Surface	Automaticall Calculated
Firm Clay	🟪	16	Undrained	30		FDepth	1.5			Water Surface	Automaticall Calculated
StiffClay	🟦	20	Undrained	50		FDepth	3			Water Surface	Automaticall Calculated

Figure 5: Base model for numerical lateral displacement analysis

The liquefied shear strength to overburden stress (Tau/ Sigma) ratio was derived for the sand/ silt mixtures from statistical analysis of CPT data. The Tau/ Sigma Ratio was found to vary significantly, ranging from 0.08 to 0.98; a value of 0.2 was adopted to provide a moderately conservative estimate for the body of liquefied material. Figure 6 shows a plot of Tau/ Sigma ratio with depth for CPT04.

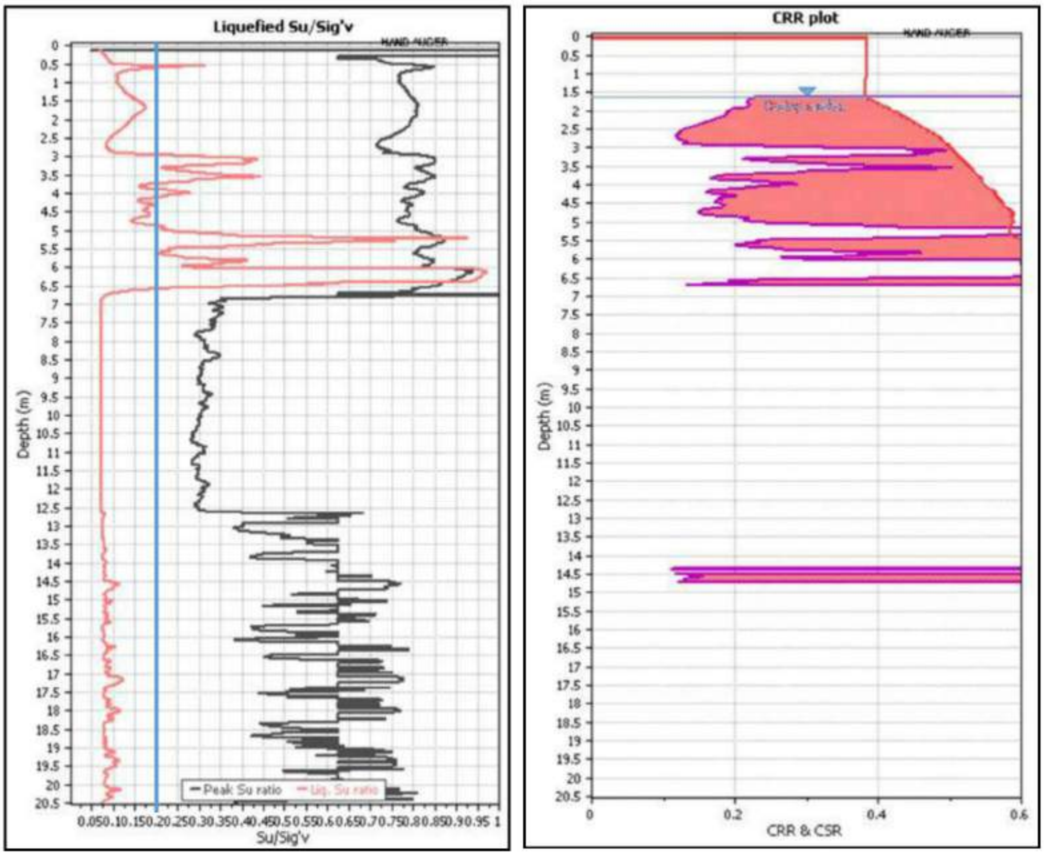


Figure 7: Tau/ Sigma ratio plot for CPT04 and plot showing depth of liquefiable material. Blue line shows value adopted in our modelling.

Two design cases were assessed:

1. Static Flow

   This design case models a post seismic liquefied case to assess the potential for flow failures to impact the subject property.
2. Seismic Yield

   This assessment determines the PGA required for the site to be affected by lateral displacements considering seismic action coincident with the fully liquefied condition. A magnitude of 0.1g was considered reasonable to represent an aftershock occurring within the short-term, liquefied timeframe.

6.4.2.1 Results

The results suggest that the property will not be affected in the static flow scenario with failures extending to a maximum of around 31m from the riverbank, some 85m from the subject property.

Under the seismic yield design case the subject property is estimated to be affected with a PGA of around 0.11g. Accordingly, lateral displacements are not anticipated in this scenario.

Full results are presented in Appendix E.

6.4.3 Conclusions

Numerical modelling indicates that lateral displacements of the magnitude estimated by CLiq are only achieved when full seismic PGAs are applied in the fully liquefied condition. Such a scenario is considered to be of very low probability, and highly conservative. We consider however that there is a reasonable probability of an aftershock occurring during this timeframe.

We conclude that the numerical modelling provides a more realistic estimate of ground performance, particularly given the apparent overestimation of liquefaction affects, discussed in Section 6.3.3. Accordingly, we consider that the subject site has low lateral spreading potential.

6.4.3.1 Lateral Stretch

Lateral stretch is a metric of the amount of differential extension that a portion of land may experience during an episode of lateral spreading. The lateral stretch across a foundation is a main factor in foundation damage due to liquefaction and lateral spreading as a result of a large earthquake.

Given the results of our numerical analyses, discussed above, lateral stretch is not anticipated at the subject site under the design cases assessed.

6.5 Liquefied Bearing

Liquefaction may lead to foundation bearing failure, by either 'punch through' failure or a reduction in bearing capacity when liquefaction occurs within the zone of influence of load bearing foundations.

A preferred foundation option has not been identified for the proposed structures at the time of writing and we have completed liquefied bearing assessments for both raft-type surface structures and piled foundations.

A unit weight of 17kN/m^3 was adopted for both the non-liquefied and liquefied soil layers. An angle of internal friction of 34 degree was adopted for the non-liquefied material.

The Tau/sigma ratio for these assessments was based on site-specific CPT data and taken as 0.075 for the liquefied material within the zone of influence of the foundations.

A low-bound groundwater level was taken as 1.65m, as discussed in Section 5.2.

A reduction factor of 0.75 was applied to the ultimate capacities calculated for the proposed, two-storey, duplex buildings, in accordance with MBIE Module 5 (2021) for moderately loaded structures.

6.5.1 Pile Foundation Assessment

Our assessment of pile foundations assumed:

- Ordinary piles embedded to a minimum depth of 0.5m at 0.3m diameter (including concrete cover), and

- Anchor piles embedded to a minimum depth of 0.9m at 0.4m diameter (including concrete cover), and
- 100kPa design load.

Both projected area and 'punch-through' failure mechanisms were assessed.

6.5.1.1 Results

The design load was found to be acceptable in both design cases. Note that our calculations are dependent on the assumptions listed within this Section. Should the pile diameter, pile embedment depth or design loads change, the liquefied bearing capacities will need to be reassessed.

6.5.2 Raft type Surface Structure Foundation Assessment

For the raft-type surface structures assessments were completed for the single-storey and two-storey buildings assuming:

- Foundation widths as presented in the 15% architectural drawings, and
- An embedment depth of 0.2m.

6.5.2.1 Results

Liquefied bearing capacities were calculated to be 19kPa for the proposed single-story buildings and 14kPa for the proposed two-storey duplex structures.

The values presented above are dependent on the assumptions listed. Should the foundation breadth, embedment depth or design loads change, the liquefied bearing capacities will need to be reassessed.

6.6 Equivalent MBIE Technical Category

Considering the rationalisation provided in Section 6.3.3, we consider that seismic ground performance at this site would be equivalent to a TC2 classification in accordance with Table 15.6 of the MBIE Guidance (2015).

6.7 Flood Hazard

The site is not located in a mapped flood hazard zone. GDC aerial imagery post cyclone Gabrielle does not indicate this site experienced significant impacts.

6.8 Tsunami

The Gisborne / East Cape coastline is classified as being at the highest risk in the country of being affected by tsunami. Modelling for the Gisborne region (GNS Science Te Pū Ao, 2016) indicates that the site is sufficiently elevated and is unlikely to be inundated in 1:100, 1:500, and 1:2500-year return period tsunami events, respectively. Civil defence tsunami inundation maps show that the site mapped as a yellow zone, which may be subject to tsunami

hazard in the case of a severe (ie M8.9) local earthquake on the Hikurangi subduction margin (Gisborne District Council Te Kaunihera o Te Tairāwhiti, 2019) .

6.9 Expansive Soils

Cohesive soils containing significant proportions of certain clay minerals can be subject to appreciable volume change caused by variations in soil moisture content, most notably between seasons or from the uptake of water through the root systems of trees and shrubs. This is referred to as soil reactivity or shrink-swell behaviour.

The surficial soils at this site are granular in nature and therefore not subject to expansivity.

6.10 Consolidation Settlement

The topsoil across the site is expected to be subject to consolidation with applied load and is not suitable to support structural loads.

The firm clay beneath the site may also be subject to consolidation settlement depending on the foundation option selected and the structural loads applied. The potential for consolidation settlement within this material should be assessed once the foundation type and structural loads have been determined.

6.11 Natural Hazards Summary

From our assessment of the natural hazards and ground deformation risks presented to the proposed development we consider that the proposed structures can be safely located on the site, provided that the recommendations given in Section 7 are adopted.

7 ENGINEERING RECOMMENDATIONS

7.1 Site Contouring and Topsoiling

The finished ground level should be graded so that water cannot pond against, beneath or around the buildings for the economic life of structure. To achieve this, it will be important that the building platform beneath the topsoil grades away from the site. Contouring should avoid the potential for concentration and discharge of surface water over point locations which could result in soil erosion or instability.

7.2 Access Road Construction

Access is proposed from Aberdeen Road. No major/ significant earthworks are anticipated to form access to the proposed dwellings.

7.3 Foundation Recommendations

7.3.1 Foundation Type

Based on the site investigation and analysis, we consider that foundations comprising pile foundations or raft-type surface structures are suitable for the site conditions providing the recommendations and limitations presented within this section are addressed in design.

7.3.2 Design Considerations

Based on the scope of work completed, the following aspects need to be considered in detailed design:

- Site Class - Class D - Deep or soft soil
- Liquefaction-induced vertical settlements - TC2 equivalent
- Relatively high groundwater level
- Liquefied bearing capacity
- Potential for consolidation settlement

7.3.3 Bearing Capacity and Founding Depth

Foundations must extend beneath any topsoil, uncontrolled fill, organic and/ or otherwise unsuitable material.

For the Lot 1/2 duplex structure we anticipate that a static geotechnical ultimate bearing capacity of 210kPa will be available from 0.5m depth. A reduction factor of 0.45 should be applied to this value to give the design bearing strength (q_{dbs}).

A short-term, post-seismic (static), liquefied bearing capacity, equivalent to the values presented in Section 6.5, should be assessed in structural design. Note that these liquefied bearing capacities are contingent on the assumptions listed within Section 6.5. Should these assumptions change in design, the liquefied bearing capacities will need to be reassessed. This may require some iterative design between the geotechnical and structural engineers.

7.4 Surface Water

Surface water from roof, impermeable surfaces, or any slopes should be collected and discharged away from the building to mitigate against flooding, erosion, soil expansivity, and/ or potential instability. The site will be connected to the reticulated network. Rainwater will be collected from the roof and all paved surfaces including parking areas and discharged into the GDC reticulated stormwater network.

7.4.1 Service Pipes

All service pipes, stormwater structures should be designed and constructed to ensure adequate capacity, strength, and water tightness to prevent leakage into the platform through blockage, running under pressure, or structural failure.

All service pipes installed within any fill should be flexible, or flexibly joined, so that they may deflect without breaking if the ground settles.

A record should be kept of the position, type, and size of all subsoil drains, and in particular of their outlets.

7.5 Trees and Shrubs

There are trees within the vicinity scattered across the property which might potentially cause damage through heaving as a result of root growth and/or settlement resulting from soil shrinkage from the moisture uptake of the roots. To reduce the chance of damage to the foundations, we recommend one of the following options:

- Any Trees/ plants that at their mature high will not be a minimum of that height away from the foundation should be removed including its major root structure.
- A root barrier should be designed and installed between the offending plant and the structure.
- Foundation should be taken to a depth no less than 1.0m where damage from the roots of a plant is unlikely.

If new trees, shrubs, or gardens are established near the structure, care should be taken to ensure:

- The vegetation does not interfere with any subfloor ventilation or services to the structure.
- Over-watering of the vegetation does not saturate the ground near the foundations.
- Trees or shrubs with the potential to develop significant root systems should be planted a minimum distance equal to the mature height of the plant away from the foundations.

8 SUSTAINABILITY

Considering sustainability as early as possible in a project's development, could lead to significant project opportunities and wider positive outcomes. Geotechnical opportunities for increased sustainability for this project include:

- Striping and stocking topsoil for reuse (dependant on presence/ levels of contaminants).
- Designing for cut and fill balance where possible.
- Reuse of site won materials, or using materials won from other sites including use of recycled crushed concrete aggregate for hard fill.
- Contributing site investigation data to the New Zealand Geotechnical Database (NZGD) to help reduce the site investigations needed in the future.

- Using local consultants and contractors to reduce transport related emissions.

9 CONCLUSIONS

Following development of the site in accordance with our recommendations, we consider that: -

a) The land in respect of which a consent is sought, or any structure on the land built in accordance with our recommendations, is unlikely to be subject to material damage by erosion, falling debris, subsidence, slippage, or inundation from any source; and

b) Any subsequent use that is likely to be made of the land is unlikely to accelerate, worsen, or result in material damage to the land, other land, or structure by erosion, falling debris, subsidence, slippage, or inundation from any source; and

c) Sufficient provision has been made for physical access to each allotment to be created by the subdivision.

10 PLAN REVIEW

Prior to an application for Building Consent, it is important we are given the opportunity to review the final development drawings to ensure the recommendations contained within this report have been followed and interpreted correctly. Following successful review of the development drawings, we are able to update this report to support an application for Building Consent.

11 VERIFICATION

Verification requirements will be provided once the form of the foundations has been determined.

12 LIMITATIONS

This report should be read and reproduced in its entirety including the limitations to understand the context of the opinions and recommendations given.

This report has been prepared exclusively for NZHG Gisborne Limited in accordance with the brief given to us or the agreed scope and they will be deemed the exclusive owner on full and final payment of the invoice. Information, opinions, and recommendations contained within this report can only be used for the purposes with which it was intended. LDE accepts no liability or responsibility whatsoever for any use or reliance on the report by any party other than the owner or parties working for or on behalf of the owner, such as local authorities, and for purposes beyond those for which it was intended.

This report was prepared in general accordance with current standards, codes and best practice at the time of this report. These may be subject to change.

Opinions given in this report are based on visual methods and subsurface investigations at discrete locations designed to the constraints of the project scope to provide the best assessment of the environment. It must be appreciated that the nature and continuity of the subsurface materials between these locations are inferred and that actual conditions could vary from that described herein. We should be contacted immediately if the conditions are found to differ from those described in this report.

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14 GLOSSARY

Compressible Soils:	Compressible soils are those that will undergo a reduction in volume under an imposed load, such as the weight of fill or a structure. This occurs firstly as a result of the expulsion of air and water from the soil void spaces (primary settlement) and secondly due to a restructuring of the soil skeleton to take the load (secondary settlement).
Cyclic Softening:	Cyclic-softening is a related condition to liquefaction can also affect clay soils when subjected to cyclic-loading. Clay soils may significantly soften and led to bearing capacity failure, in addition to post-earthquake consolidation settlements may occur as a result of the earthquake shaking.
Expansive Soils:	Cohesive soils containing significant proportions of certain clay minerals can be subject to appreciable volume change caused by variations in soil moisture content, most notably between seasons or from the uptake of water through the root systems of trees and shrubs. This is also often referred to as soil reactivity or shrink-swell behaviour.
Lateral Spread:	Lateral spread of liquefied soils is the lateral displacement of blocks of land moving laterally towards a free edge (for example a riverbank) or within sloping ground. More lateral movement tends to occur closest to the edge with less movement further back. Lateral spreading may result in large permanent ground displacements including cracks, fissures, vertical officesets and overall settlement of the ground.
Lateral Stretch:	Lateral stretch is the amount of differential extension that a portion of land may experience during an episode of lateral spreading. The lateral stretch across a foundation is a main factor in foundation damage due to liquefaction and lateral spreading because of a large earthquake.
LiDAR	Light Detection and Ranging (LiDAR) is a method of remote sensing topographical survey.
Limit States:	Seismic design criteria for performance-based design. SLS, SLS2 & ULS are prescribed in NZS1170.5 (Standards New Zealand Te Mana Tautikanga O Aotearoa, 2004) • **Serviceability Limit State (SLS):** Functional requirements for the serviceability limit state are assumed to be met if the structure or part can continue to be used as originally intended without the need for repair (SLS1) or can remain operational or continue to be occupied as appropriate (SLS2). SLS earthquakes are considered highly likely to occur during the lifetime of the structure. • **Ultimate Limit State (ULS):** Functional requirements for the ultimate limit state are assumed to be met if: a) People within, and adjacent to the structure are not endangered by the structure or part.

	b) Displacements of the structure are such that there is no contact between any parts of a structure for which contact is not intended, or between separate structures on the same site, if such contact would damage the structures or parts to the extent that persons would be endangered, or detrimentally alter the response of the structure(s) or parts, or reduce the strength of structural elements below the required strength. c) The structure does not deflect beyond a site boundary adjacent to which other structures can be built or collision between the structure and any adjacent existing structures cannot occur. d) There is no loss of structural integrity in either the structure or part. • **Intermediate Limit State (ILS):** ILS is an intermediate seismic event between SLS & ULS although is not a code requirement. The behaviour of soils and geotechnical systems under earthquake shaking may be highly non-linear and even exhibit a pronounced 'step change' in performance with increasing intensity of shaking. For such cases, only considering performance at the SLS and ULS levels of shaking would fail to identify potentially poor and unacceptable performance at intermediate return periods of shaking.
Liquefaction:	Liquefaction is the term used to describe the temporary, but substantial, loss of strength and stiffness which can occur in saturated, unconsolidated soils that are subjected to strong shaking. In addition to near-total strength loss, liquefaction may also result in the expulsion of sediment and water at the surface, ground and structure settlement, and in lateral (spreading) displacement of the ground.
LPI	Liquefaction potential index is a liquefaction damage index. LPI ranges between 0 and 100 and sites with an LPI of 5 indicate a high liquefaction risk and sites with LPI greater than 15 indicate very high risk (Iwasaki et al, 1982). Not to be used as a precise measure of liquefaction-induced ground damage but as an indicator of the general level of liquefaction severity.
LSN	Liquefaction Severity Number is a liquefaction damage index. LSN varies from 0 (representing no liquefaction vulnerability) to more than 100 (representing very high liquefaction vulnerability (van Ballegooy et al, 2013). LSN places greater importance (than LPI) on the thickness of the non-liquefied crust when the groundwater table is close to the ground surface. Not to be used as a precise measure of liquefaction-induced ground damage but as an indicator of the general level of liquefaction severity. LNS was developed based on the observations/ investigations from the Canterbury earthquake sequence
PGA:	Peak Ground Acceleration (PGA) is the maximum ground acceleration during an earthquake as a proportion of gravity.
Punch Through Failure:	Punch through failure occurs when a foundation punches through a crust of non-liquefiable material due to underlying liquefaction occurring and can lead to potential damage to foundations and/ or large settlements.

Technical Category: Following the 2010 -2011 Canterbury earthquake sequence the Ministry of Business Innovation and Employment (MBIE) assigned three technical categories (TC1, TC2, TC3) across the residential 'green zone' for foundation investigation and design guidance focusing on one and two storey timber-framed dwellings. These categories are broadly defined as below:

- **TC1:** Liquefaction damage is unlikely in future large earthquakes. Standard residential foundation assessment and construction is appropriate.
- **TC2:** Liquefaction damage is possible in future large earthquakes. Standard enhanced foundation repair and rebuild options in accordance with MBIE guidance are suitable to mitigate against this possibility.
- **TC3:** Liquefaction damage is possible in future large earthquakes. Individual engineering assessment is required to select the appropriate foundation repair or rebuild option.
- **TC2/ TC3 Hybrid:** A site that straddles liquefaction settlement limits of TC2 and TC3 where the SLS settlements are assessed as being less than 50 mm but the ULS settlements are assessed at greater than 100mm.

Whilst this guidance is intended for residential buildings in the Canterbury region, they have been widely adopted to convey liquefaction vulnerability across New Zealand.

The Modules: The New Zealand Geotechnical Society (NZGS) and MBIE jointly published a series of guidelines for Earthquake Geotechnical Engineering Practice. Revision 1 of the Modules was published in November 2021 and they provide guidance under section 175 of the Building Act 2004 to assist parties to comply with their obligations under the Building Act 2004. The following modules currently form the collection:

- **Module 1**: Overview of the guidelines
- **Module 2**: Geotechnical investigation for earthquake engineering
- **Module 3**: Identification, assessment, and mitigation of liquefaction hazards
- **Module 4**: Earthquake resistant foundation design
- **Module 5**: Ground improvement
- **Module 5A:** Specification of ground improvement for residential properties in the Canterbury region
- **Module 6**: Retaining walls

APPENDIX A

SITE PLAN

LEGEND

Project Data

🟨	Proposed Lots Boundary
🟥	Proposed Building Platform
—	Proposed Accessway
◒	Hand Auger + DCP
▽	CPT (Due Diligence)

0 6 12 18 24 m

SCALE A3: 1:350

NOTES

1. Aerial basemap and property boundaries sourced from LINZ Data Service (CC-BY 4.0).
2. Investigation locations shown approximately only.

CLIENT
NZHG Gisborne Limited

PROJECT
Geotechnical Investigation for proposed subdivision
556-560 Aberedeen Road, Te Hapara
Gisborne

DRAWING TITLE
Geotechnical Investigation Plan

LAND DEVELOPMENT & ENGINEERING

PROJECT REF	DRAWING REF	REVISION
24477	GIP	A
DATE	**PREPARED BY**	**CHECKED BY**
29/09/2023	SS	RH

FILE PATH
M:\FILES\LDE - Projects\77008-24477\Geo QGIS Zip Folder (ID 79084)\24477 QGIS Site Maps\24477 Aberdeen Rd.qgz

APPENDIX B

HAND AUGER TEST LOGS

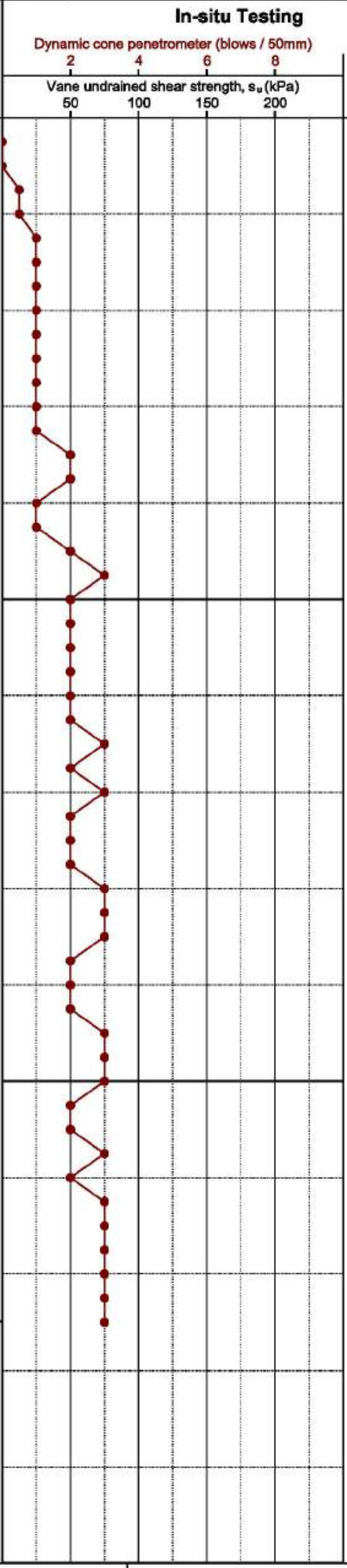
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA01**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709871mN, 2036134mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.5m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water
0.0–0.3	TS	SAND, with trace rootlets and silt; dark brown. Very loose; moist; sand, fine to medium.	Groundwater not encountered
0.3–2.5	Holocene Beach Deposits	SAND; brown. Loose; moist; sand, fine to medium. 1.80m: Light grey. 2.20m: Grey with orange mottles. 2.40m: Wet.	



Values	RL (m)
Vane ID: N/A peak / residual (sensitivity)	
	6.0 (0.5 m)
	5.5 (1.0 m)
	5.0 (1.5 m)
	4.5 (2.0 m)
	4.0 (2.5 m)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

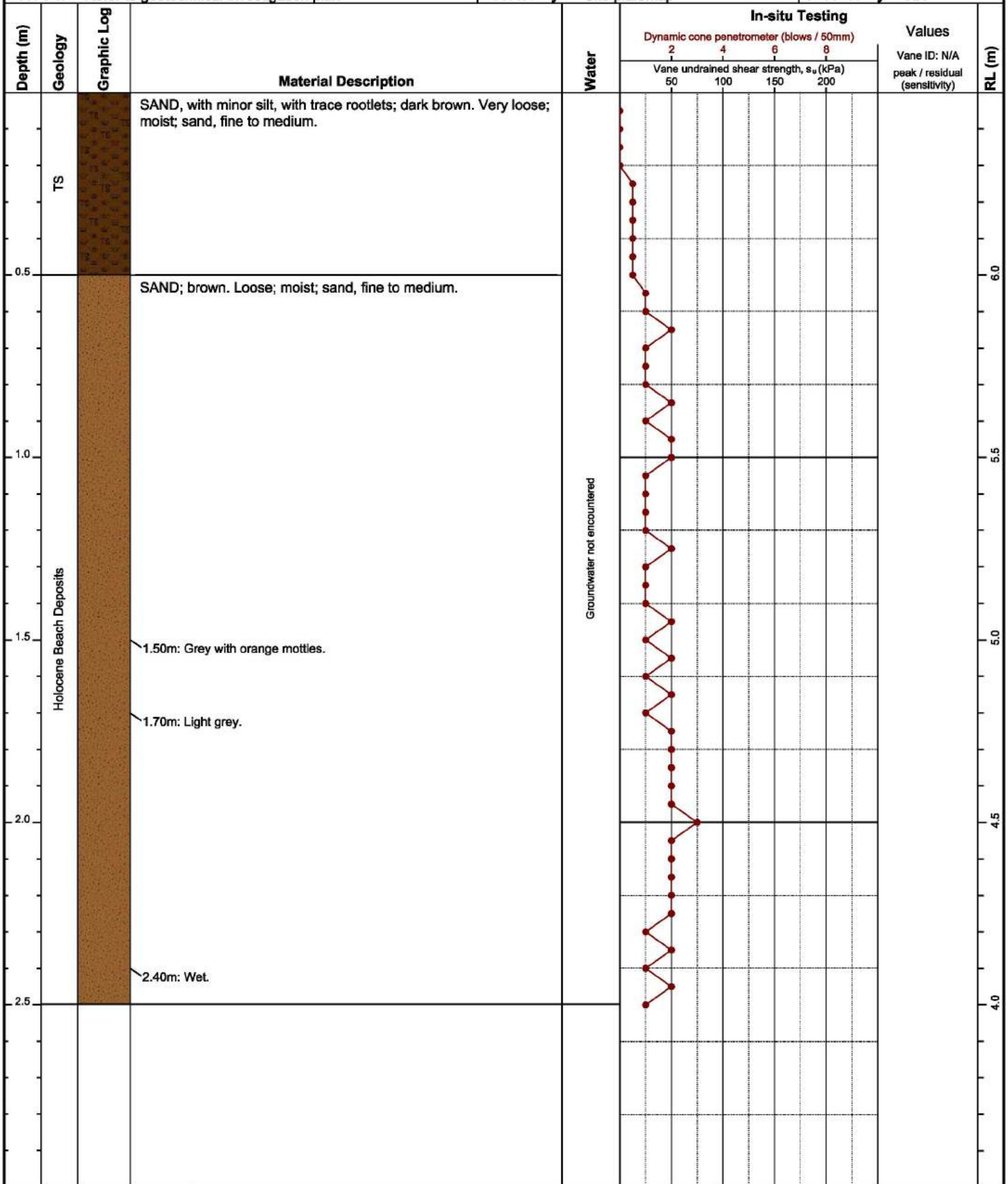
● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

Client:	NZHG	**Coordinates:**	5709864mN, 2036136mE	**Test ID:**	HA02
Project:	Geotechnical Investigation	**System:**	NZTM	**Project ID:**	24477
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.5m (NZVD2016)	**Sheet:**	1 of 1
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Test Date:**	12/09/2023
				Logged By:	SS
				Prepared By:	SS
				Checked By:	RH



SAND, with minor silt, with trace rootlets; dark brown. Very loose; moist; sand, fine to medium.

SAND; brown. Loose; moist; sand, fine to medium.

1.50m: Grey with orange mottles.

1.70m: Light grey.

2.40m: Wet.

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

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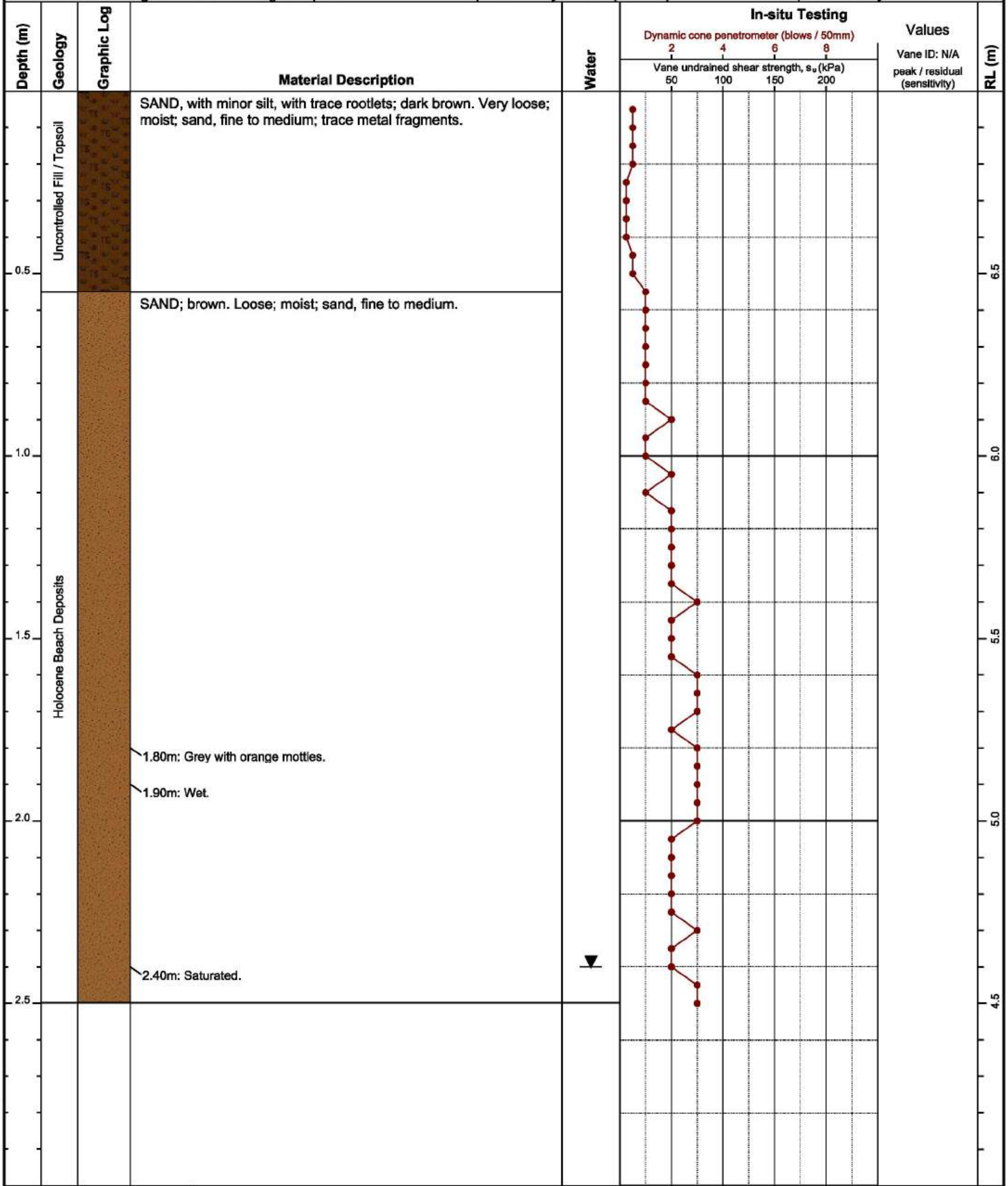
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA03**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709847mN, 2036129mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	7m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH



Material Description

SAND, with minor silt, with trace rootlets; dark brown. Very loose; moist; sand, fine to medium; trace metal fragments.

SAND; brown. Loose; moist; sand, fine to medium.

1.80m: Grey with orange mottles.

1.90m: Wet.

2.40m: Saturated.

Hole Depth: 2.50m

Termination: TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

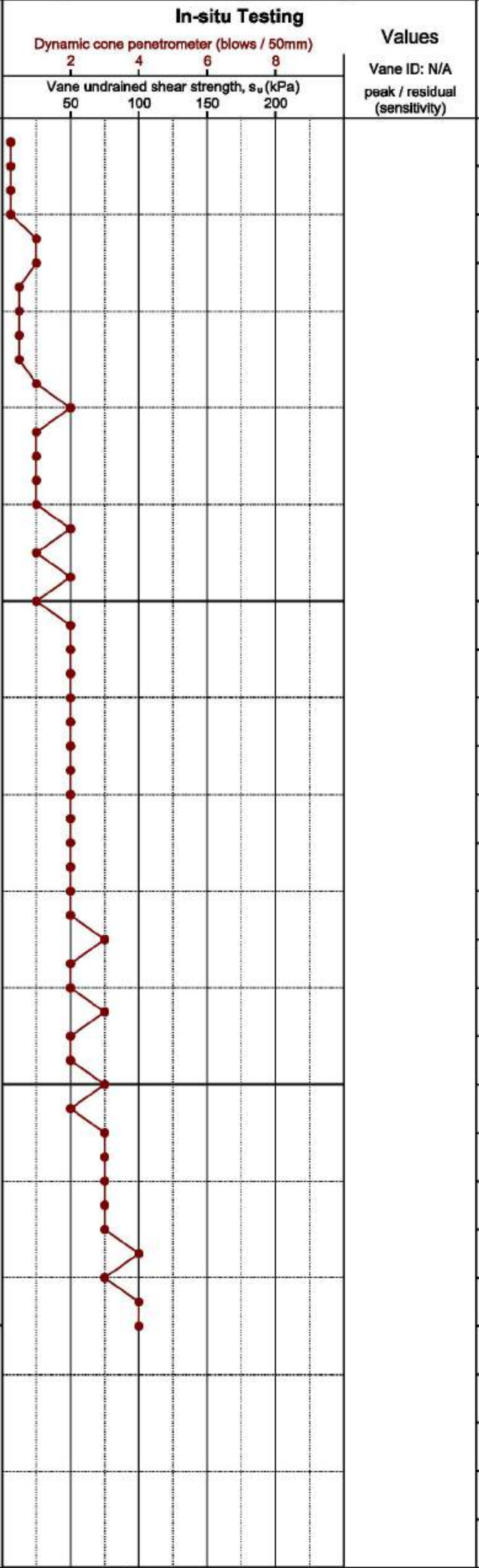
UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA04**		
Project ID:	24477		
Sheet:	1 of 1		
Client:	NZHG	**Coordinates:**	5709842mN, 2036126mE
Project:	Geotechnical Investigation	**System:**	NZTM
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	7m (NZVD2016)
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map
Test Date:	12/09/2023		
Logged By:	SS		
Prepared By:	SS		
Checked By:	RH		

Depth (m)	Geology	Graphic Log	Material Description	Water	RL (m)
	TS		SAND, with minor silt, with trace rootlets; dark brown. Loose; moist; sand, fine to medium.		
0.5 1.0 1.5 2.0 2.5	Holocene Beach Deposits		SAND; brown. Loose; moist; sand, fine to medium. 1.90m: Wet. 2.20m: Saturated.	▼	6.5 6.0 5.5 5.0 4.5



Hole Depth: 2.50m	**Termination:** TARGET DEPTH	
Remarks:		

- ● Vane peak
- ○ Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow

UTP = Unable to Penetrate

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

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Hand Auger Borehole Log

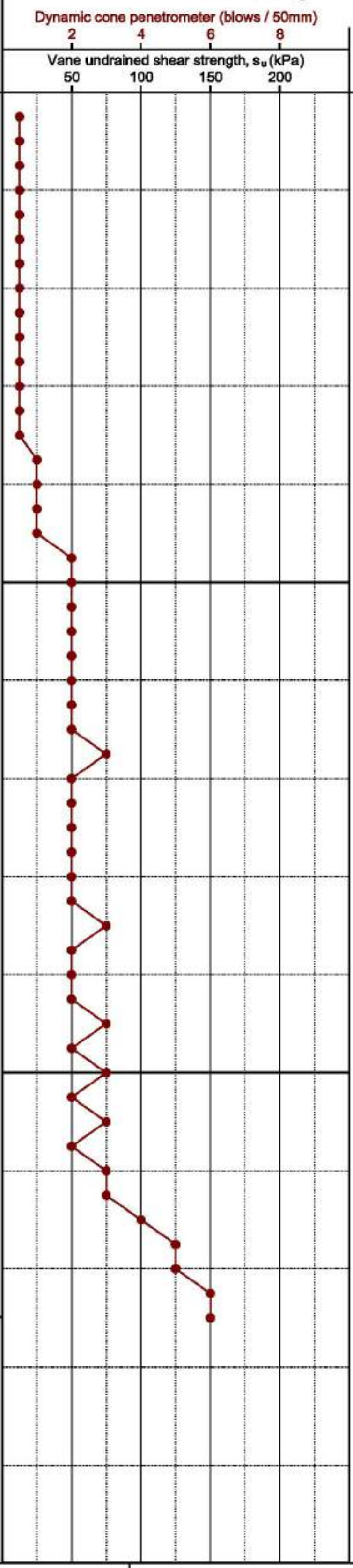
Method: 50mm Hand Auger

Test ID:	HA05
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709846mN, 2036121mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	7m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	RL (m)
0.0–0.5	Uncontrolled Fill / Topsoil	SAND, with minor silt, with trace rootlets and gravel; dark brown. Loose; moist; sand, fine to medium; gravel, fine to medium, subrounded to subangular.		
0.5–2.5	Holocene Beach Deposits	SAND; brown. Loose; moist; sand, fine to medium. 1.80m: Brownish grey. 1.90m: Wet. 2.40m: Saturated.	▼ (2.40m)	6.5 / 6.0 / 5.5 / 5.0 / 4.5

In-situ Testing



Values

Vane ID: N/A

peak / residual (sensitivity)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak
▼ Standing water level
○ Vane residual
◁ Groundwater inflow
◆ Vane UTP
▷ Groundwater outflow
UTP = Unable to Penetrate

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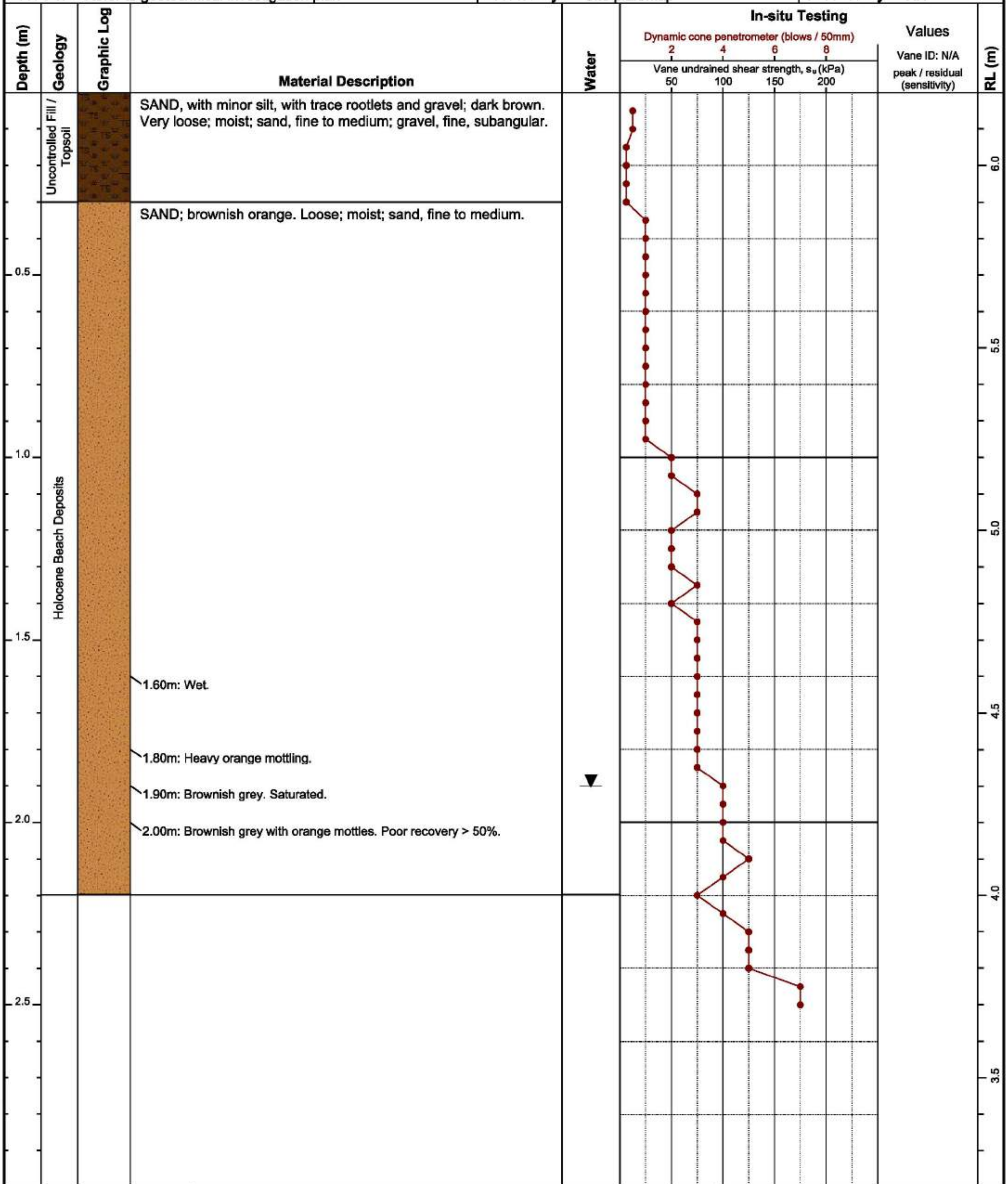
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA06**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709835mN, 2036107mE
Project:	Geotechnical Investigation	**System:**	NZTM
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.2m (NZVD2016)
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map

Test Date:	12/09/2023
Logged By:	SS
Prepared By:	SS
Checked By:	RH



SAND, with minor silt, with trace rootlets and gravel; dark brown. Very loose; moist; sand, fine to medium; gravel, fine, subangular.

SAND; brownish orange. Loose; moist; sand, fine to medium.

1.60m: Wet.

1.80m: Heavy orange mottling.

1.90m: Brownish grey. Saturated.

2.00m: Brownish grey with orange mottles. Poor recovery > 50%.

Hole Depth: 2.20m **Termination:** HOLE COLLAPSE

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

Hand Auger Borehole Log

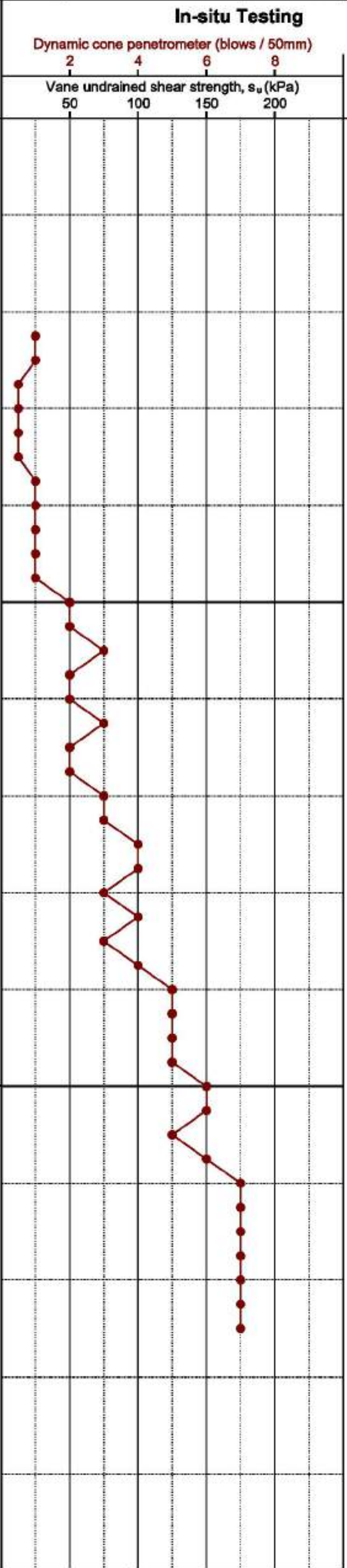
Method: 50mm Hand Auger

Test ID:	HA07				
Project ID:	24477				
Sheet:	1 of 1				
Client:	NZHG	**Coordinates:**	5709824mN, 2036090mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	RL (m)
0.0–0.80	Uncontrolled Fill / Topsoil	SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine to medium; trace charcoal. 0.40m: Sandy. Sand, fine to medium.		
0.80–2.0	Holocene Beach Deposits	SAND; light brown with orange mottles. Loose; moist; sand, fine to medium. 1.00m: Brownish grey with orange streaks. 1.20m: Wet. 1.50m: Saturated. 1.70m: Poor recovery > 30%.	▼ (1.5)	

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5

RL scale: 5.5, 5.0, 4.5, 4.0, 3.5



Values

Vane ID: N/A

peak / residual (sensitivity)

Hole Depth: 2.00m **Termination:** HOLE COLLAPSE

Remarks:

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

Hand Auger Borehole Log

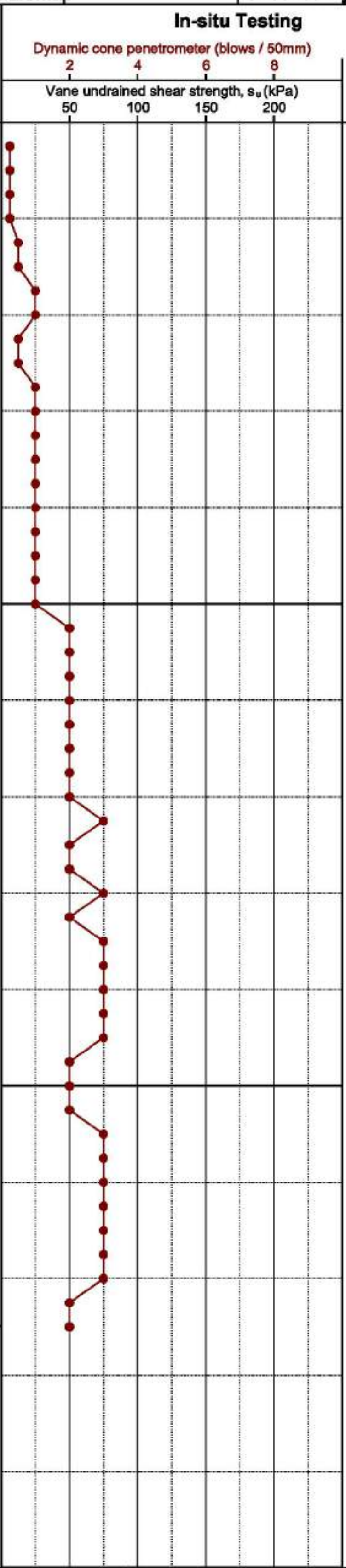
Method: 50mm Hand Auger

Test ID:	HA08
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709850mN, 2036087mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.5m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water
0.0	Topsoil	SAND, with minor silt, with trace rootlets; dark brown. Very loose; moist; sand, fine to medium.	
0.3	Holocene Beach Deposits	SAND; light brown. Loose; moist; sand, fine to medium.	
1.60		1.60m: Brownish grey.	
1.80		1.80m: Brownish grey orange streaks.	
2.00		2.00m: Dark brown. Wet.	
2.30		2.30m: Brownish grey.	
2.40		2.40m: Saturated.	▼
2.50			

In-situ Testing



Values

Vane ID: N/A

peak / residual (sensitivity)

Depth (m)	RL (m)
0.5	6.0
1.0	5.5
1.5	5.0
2.0	4.5
2.5	4.0

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak
○ Vane residual
◆ Vane UTP
▼ Standing water level
◁ Groundwater inflow
▷ Groundwater outflow
UTP = Unable to Penetrate

Hand Auger Borehole Log

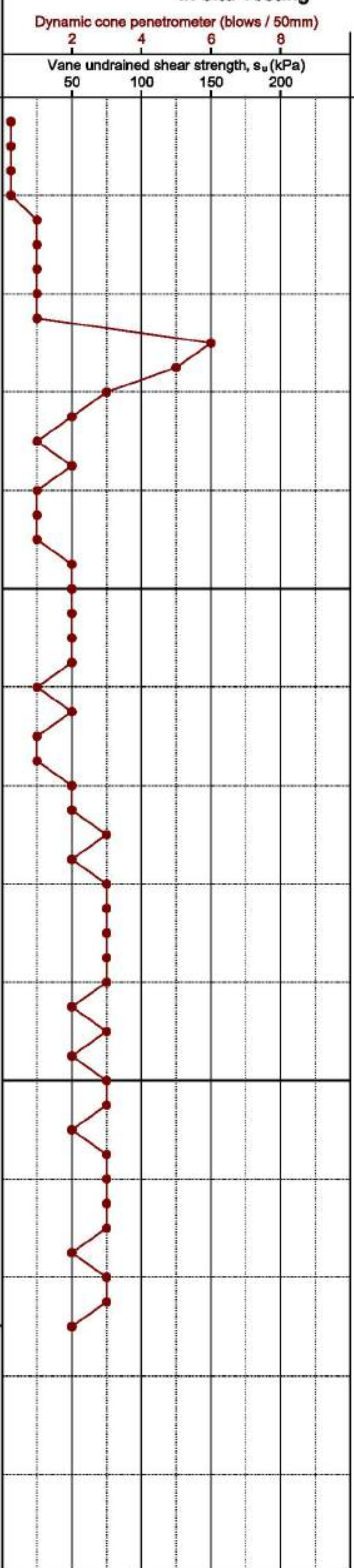
Method: 50mm Hand Auger

Test ID:	**HA09**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709853mN, 2036094mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.5m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	RL (m)
0.0 – 0.60	Topsoil	SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine. 0.20m: SAND, with minor silt. Sand, fine to medium; trace brick fragments.		
0.5				6.0
0.60 – 2.50	Holocene Beach Deposits	SAND; brownish orange. Loose; moist; sand, fine to medium. 1.50m: Brownish grey. 2.00m: Wet. 2.40m: Saturated.	▼ (2.40m)	
1.0				5.5
1.5				5.0
2.0				4.5
2.5				4.0

In-situ Testing



Values

Vane ID: N/A

peak / residual (sensitivity)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

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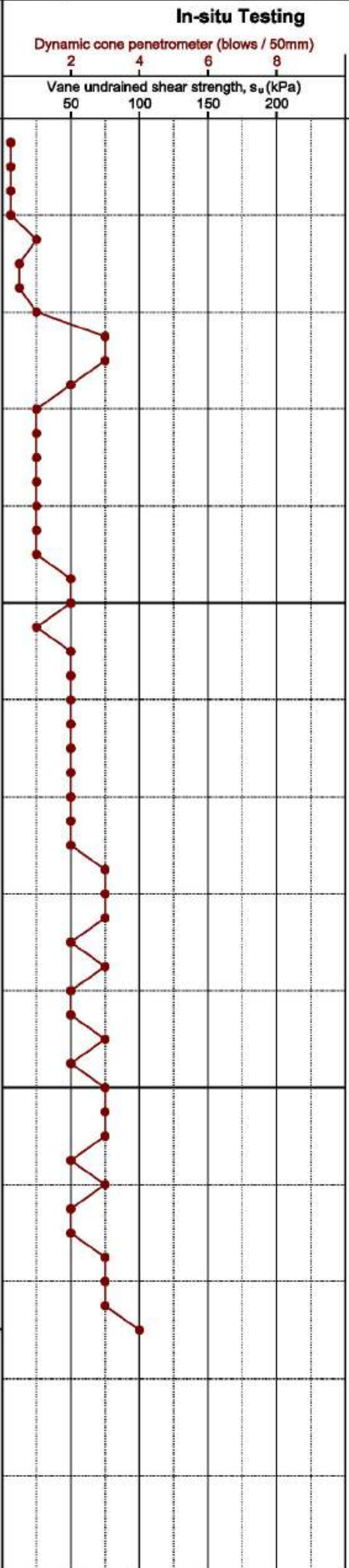
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA10**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709860mN, 2036093mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.5m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	RL (m)
0.0	Topsoil	SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine. 0.20m: SAND. Sand, fine to medium.		
0.5				6.0
0.70	Holocene Beach Deposits	SAND; brownish orange. Loose; moist; sand, fine to medium.		
1.0				5.5
1.5				5.0
1.70		1.70m: Brownish grey.		
2.0		2.00m: Wet.		4.5
2.40		2.40m: Dark brown. Saturated.	▼	
2.5				4.0



Values

Vane ID: N/A

peak / residual (sensitivity)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

● Vane peak ▼ Standing water level

○ Vane residual ◁ Groundwater inflow

◆ Vane UTP ▷ Groundwater outflow

UTP = Unable to Penetrate

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

Hand Auger Borehole Log

Method: 50mm Hand Auger

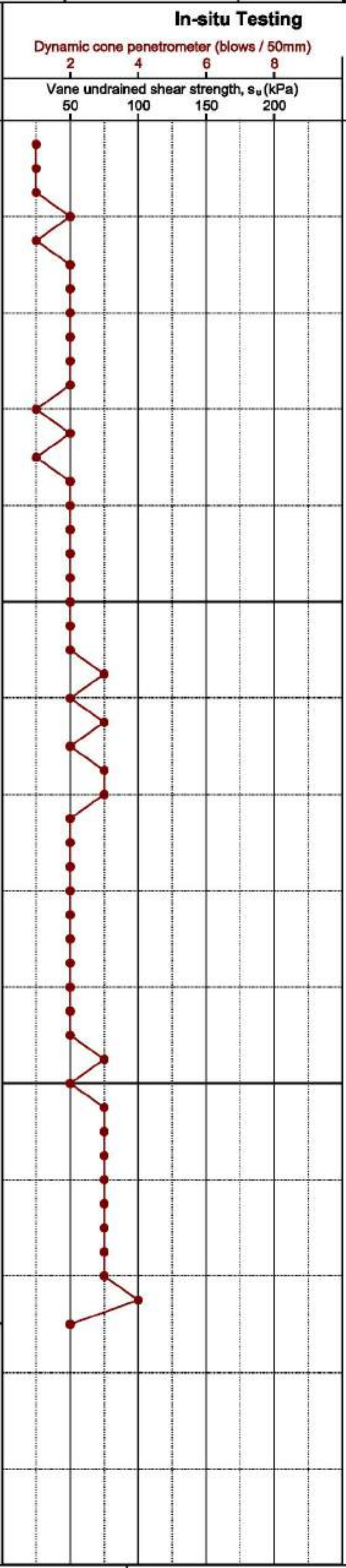
Test ID:	**HA11**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709865mN, 2036106mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	7m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	RL (m)
0.0 – 0.3	Uncontrolled Fill / Topsoil	SAND, with trace silt and gravel; dark brown. Loose; moist; sand, fine to medium; gravel, fine to medium, subrounded to subangular.	Groundwater not encountered	
0.3 – 2.5	Holocene Beach Deposits	SAND; brownish orange. Medium dense; moist; sand, fine to medium. 2.30m: Wet.		

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5 — RL scale: 6.5, 6.0, 5.5, 5.0, 4.5

In-situ Testing



Values

Vane ID: N/A

peak / residual (sensitivity)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

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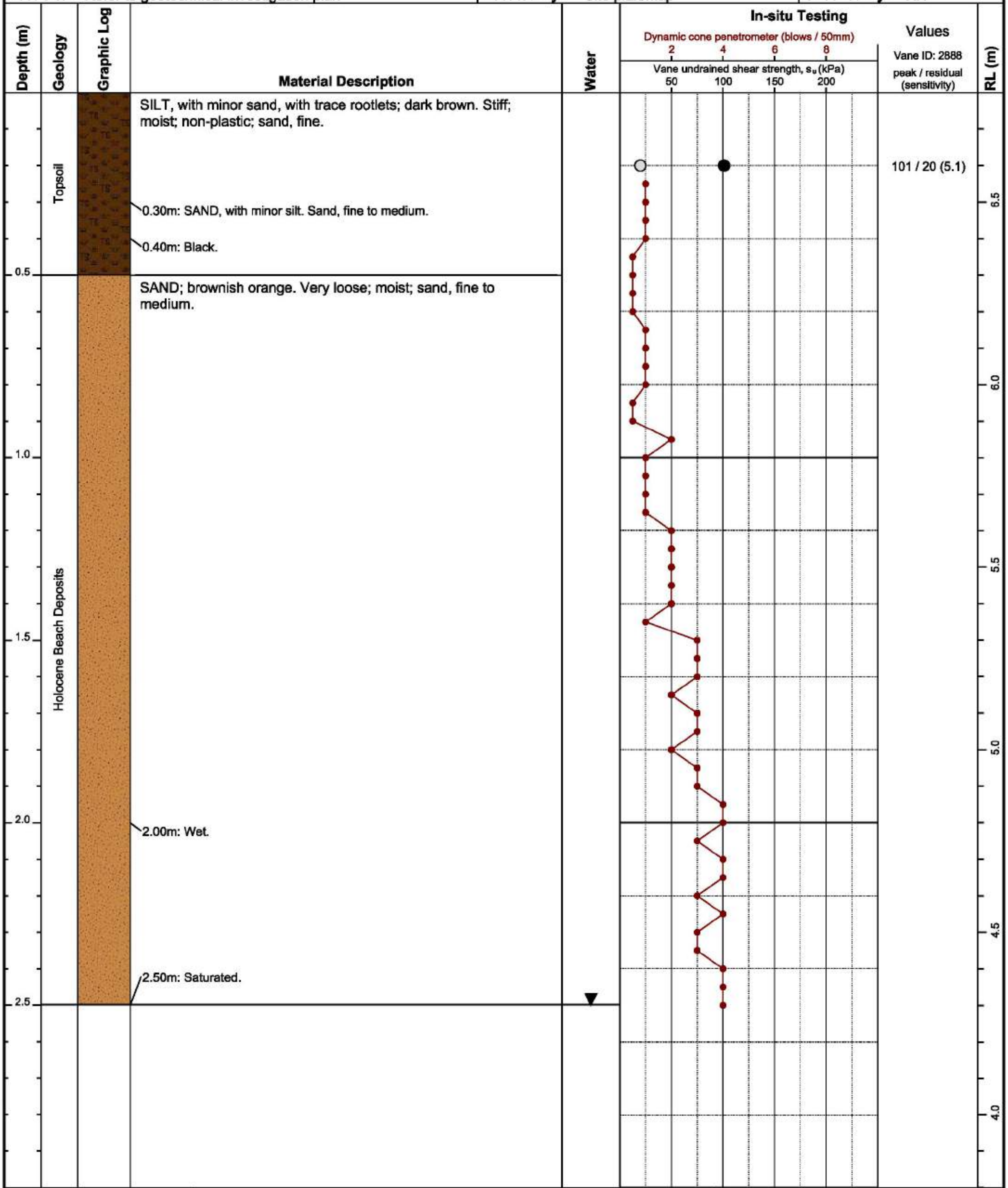
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	HA12
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709880mN, 2036108mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.8m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH



SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine.

0.30m: SAND, with minor silt. Sand, fine to medium.

0.40m: Black.

SAND; brownish orange. Very loose; moist; sand, fine to medium.

2.00m: Wet.

2.50m: Saturated.

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- ● Vane peak
- ○ Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow

UTP = Unable to Penetrate

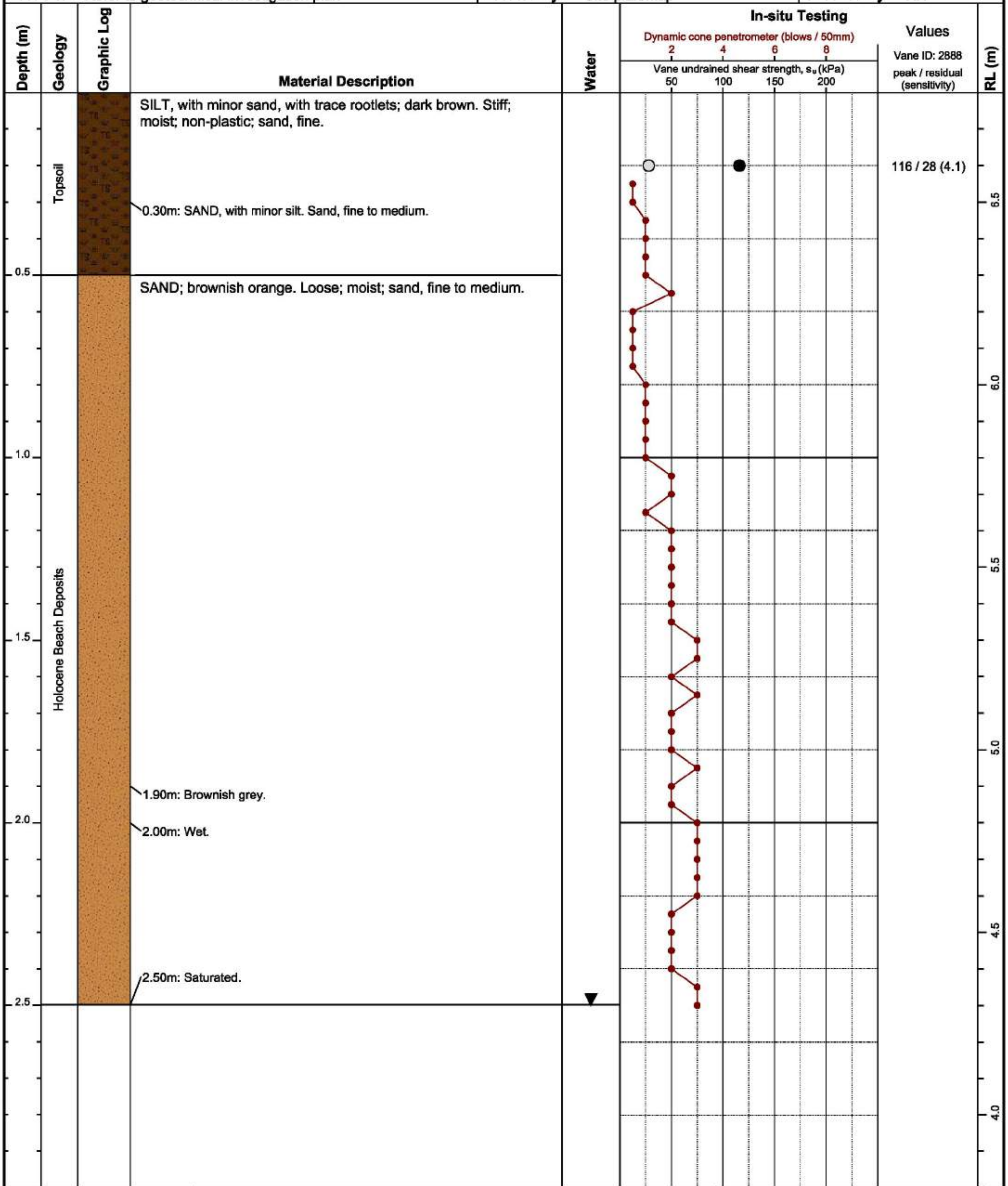
Generated with CORE-GS by Geroc - HAxTP Log v9 - 6/10/2023 11:09:32 am

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA13**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709882mN, 2036101mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.8m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH



SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine.

0.30m: SAND, with minor silt. Sand, fine to medium.

SAND; brownish orange. Loose; moist; sand, fine to medium.

1.90m: Brownish grey.

2.00m: Wet.

2.50m: Saturated.

116 / 28 (4.1)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

● Vane peak
○ Vane residual
◆ Vane UTP
▼ Standing water level
◁ Groundwater inflow
▷ Groundwater outflow
UTP = Unable to Penetrate

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

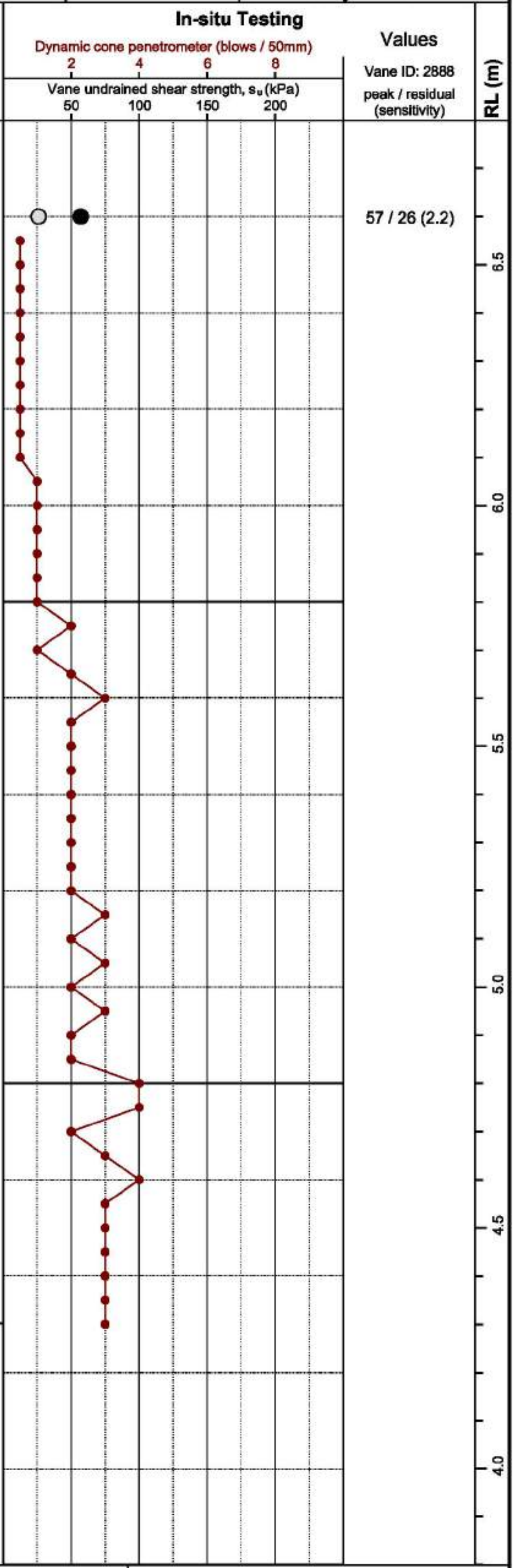
LAND DEVELOPMENT & ENGINEERING

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	HA14				
Project ID:	24477				
Sheet:	1 of 1				
Client:	NZHG	**Coordinates:**	5709887mN, 2036103mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.8m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water
0.0–0.3	Topsoil	SILT, with minor sand, with trace rootlets; dark brown. Firm; moist; non-plastic; sand, fine.	
0.3–2.5	Holocene Beach Deposits	SAND; brownish orange. Very loose; moist; sand, fine to medium. 1.60m: Brownish grey. 1.90m: Wet. 2.50m: Saturated.	▼ 2.5



Hole Depth: 2.50m	**Termination:** TARGET DEPTH	● Vane peak	▼ Standing water level
		○ Vane residual	◁ Groundwater inflow
		◆ Vane UTP	▷ Groundwater outflow

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

UTP = Unable to Penetrate

Hand Auger Borehole Log

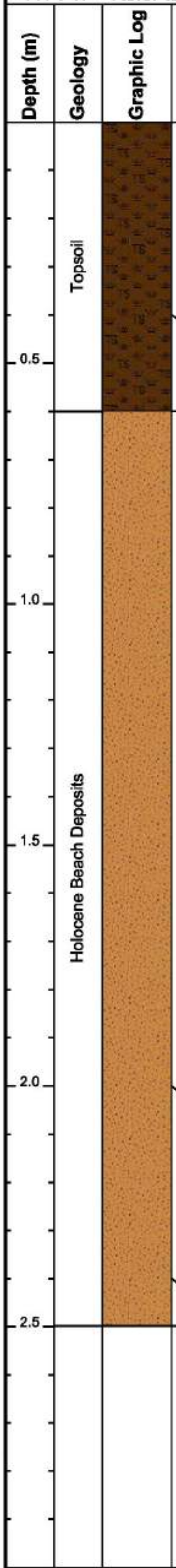
Method: 50mm Hand Auger

Test ID: HA15
Project ID: 24477
Sheet: 1 of 1

Client: NZHG
Project: Geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne
Test Site: Refer to geotechnical investigation plan

Coordinates: 5709885mN, 2036111mE
System: NZTM
Elevation: 6.8m (NZVD2016)
Located By: Site plan/map

Test Date: 12/09/2023
Logged By: SS
Prepared By: SS
Checked By: RH



Material Description

SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine.

0.40m: SAND, with minor silt. Sand, fine to medium.

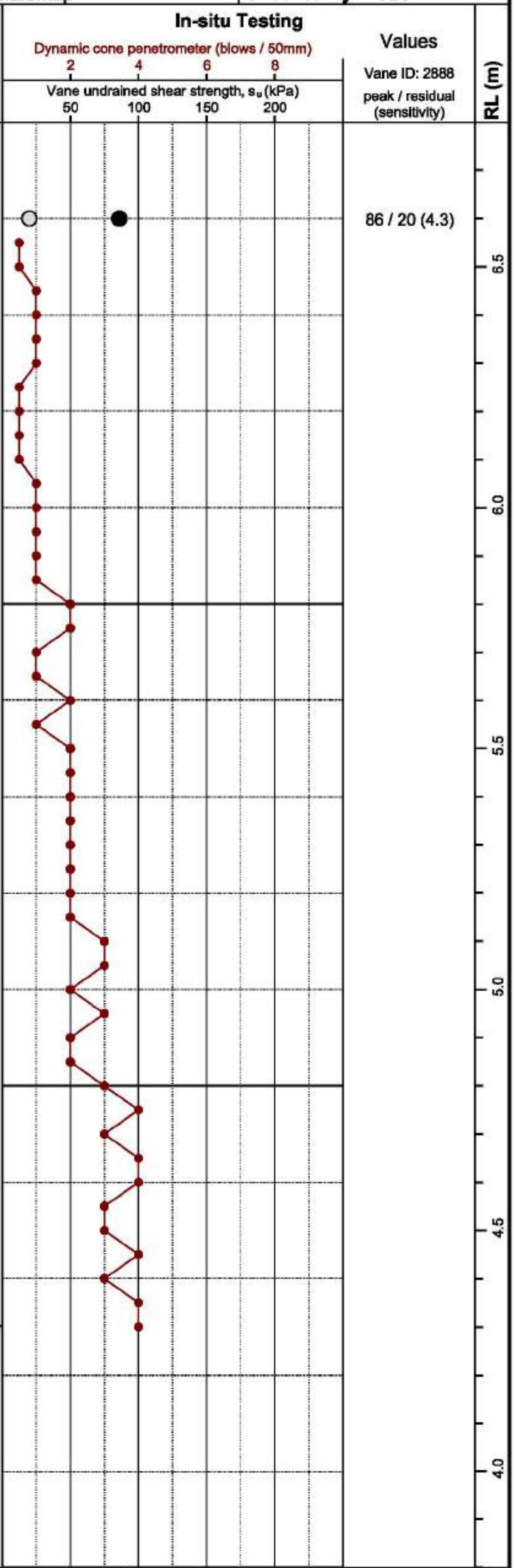
SAND; brownish orange. Very loose; moist; sand, fine to medium.

2.00m: Brownish grey. Wet.

2.40m: Saturated.

Water

▼



Hole Depth: 2.50m
Termination: TARGET DEPTH

Remarks:

● Vane peak
○ Vane residual
◆ Vane UTP
▼ Standing water level
◁ Groundwater inflow
▷ Groundwater outflow
UTP = Unable to Penetrate

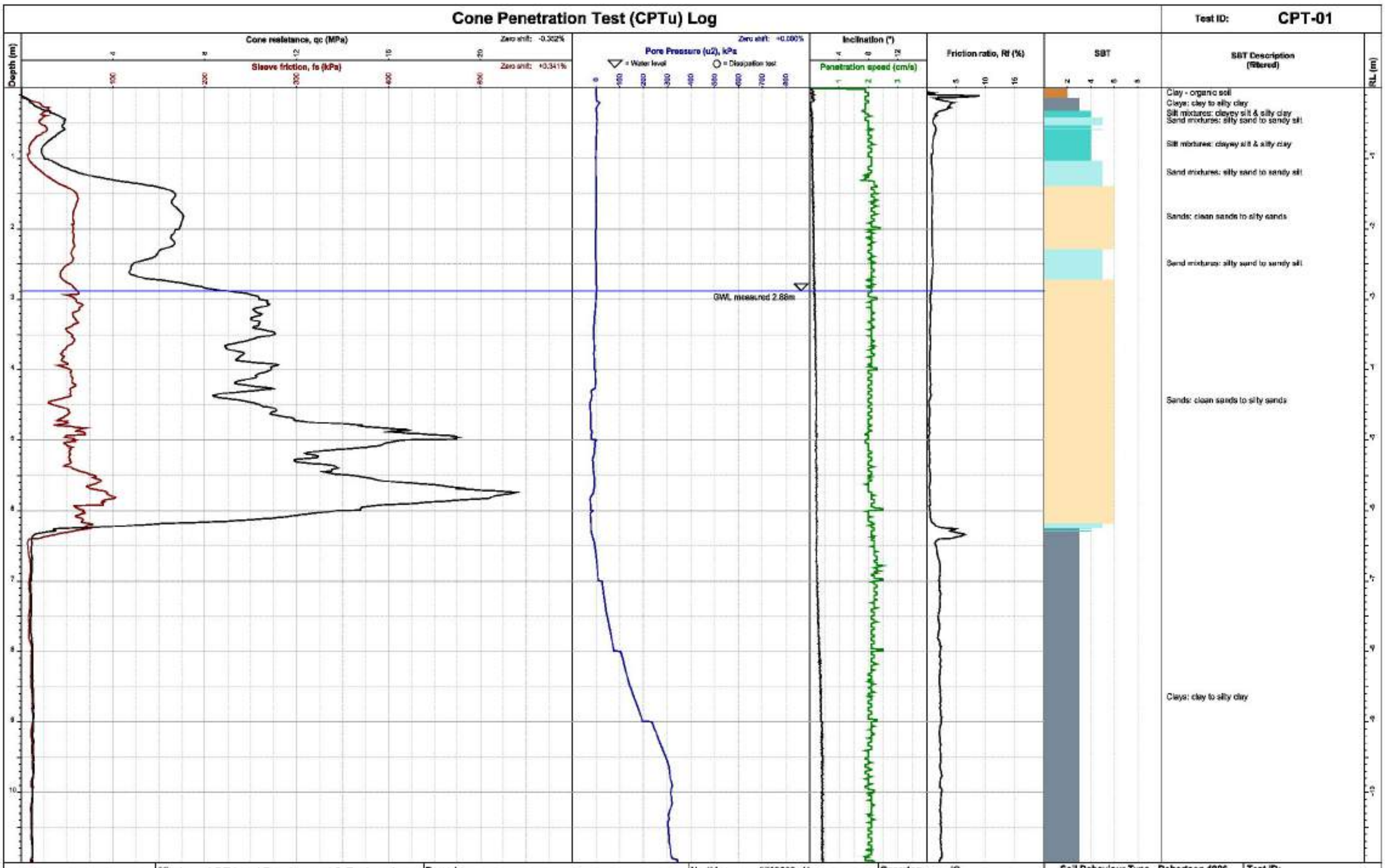
Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

APPENDIX C

CONE PENETRATION TEST LOGS

Cone Penetration Test (CPTu) Log

Test ID: CPT-01



Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:04 am

LDE LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.88m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709883mN
Easting:	2036106mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

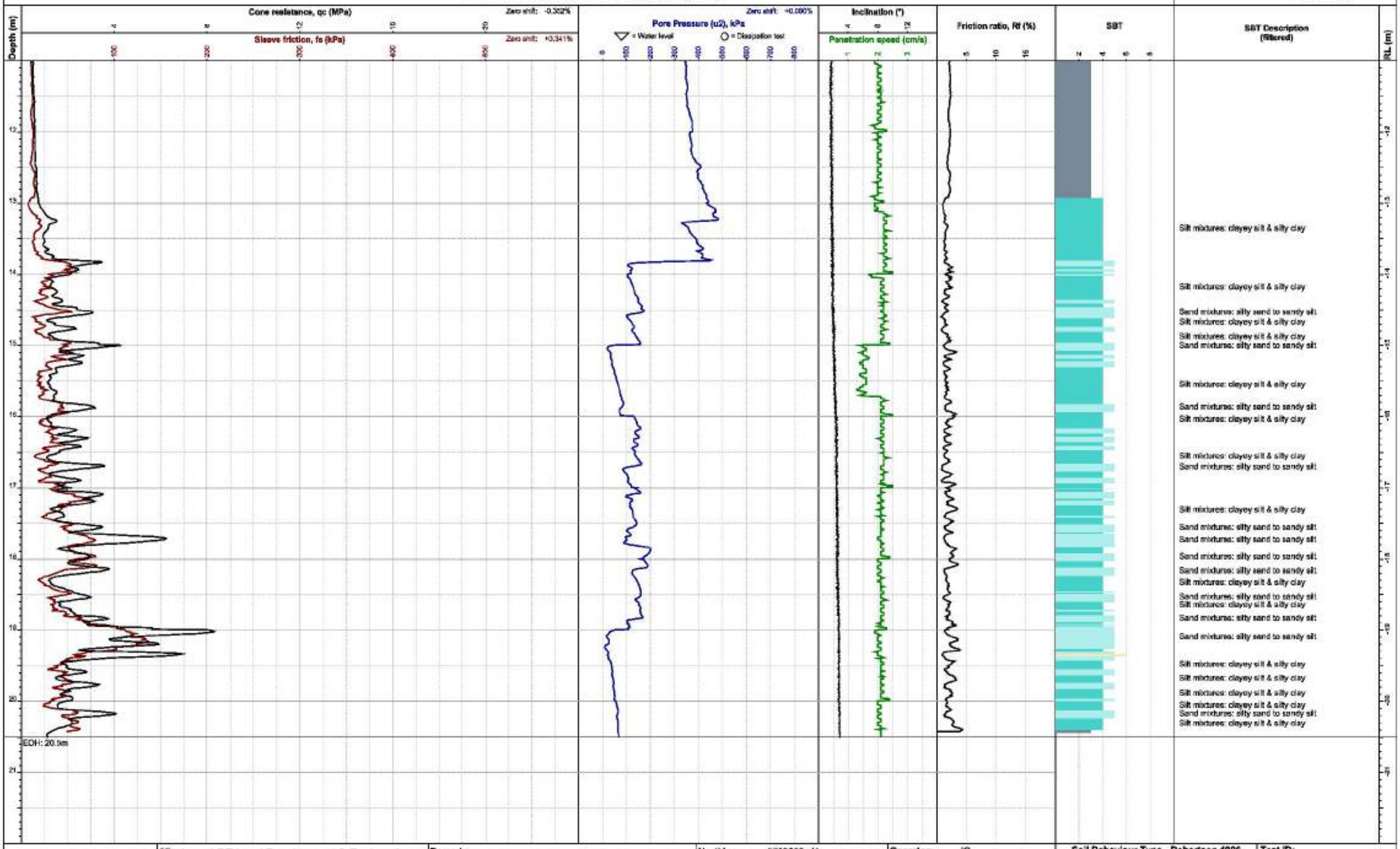
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-01

Project ID:	24477
Depth:	20.5m
Sheet:	1 of 2
Date:	30/05/2023

Cone Penetration Test (CPTu) Log

Test ID: CPT-01



Client: LDE Land Development & Engineering

Project: geotechnical Investigation

Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.88m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709883mN
Easting:	2036106mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

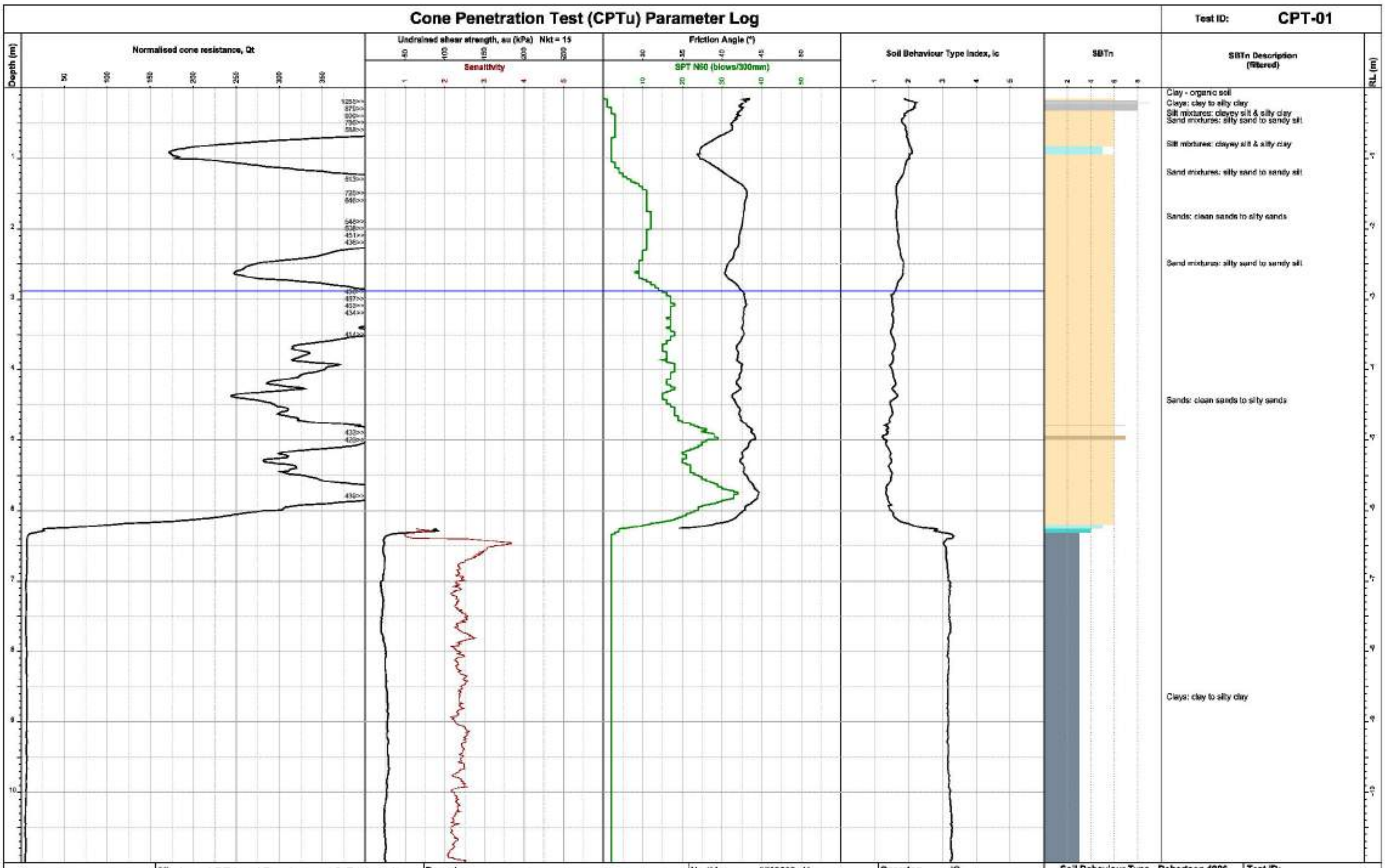
Test ID: CPT-01

Project ID:	24477
Depth:	20.5m
Sheet:	2 of 2
Date:	30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:04 am

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-01



Client:	LDE Land Development & Engineering	**Remarks:**	Ground water level located at 2.88m Test according to ISO 22476-1:12 (Class 2)
Project:	geotechnical Investigation	**Termination Reason:**	Target depth
Location:	556-560 Abeerdeen Rd, Gisborne		

Northing:	5709883mN	**Operator:**	JC
Easting:	2036106mE	**Rig:**	Pageni TG63-150
System:	NZTM	**Cone ID:**	Mks1042
Elevation:	Ground	**Type:**	Comp. piezo cone
Located By:	Phone GPS	**Cone Area:**	10 cm²
Location:	As per site plan	**Sleeve Area:**	150 cm²
		Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

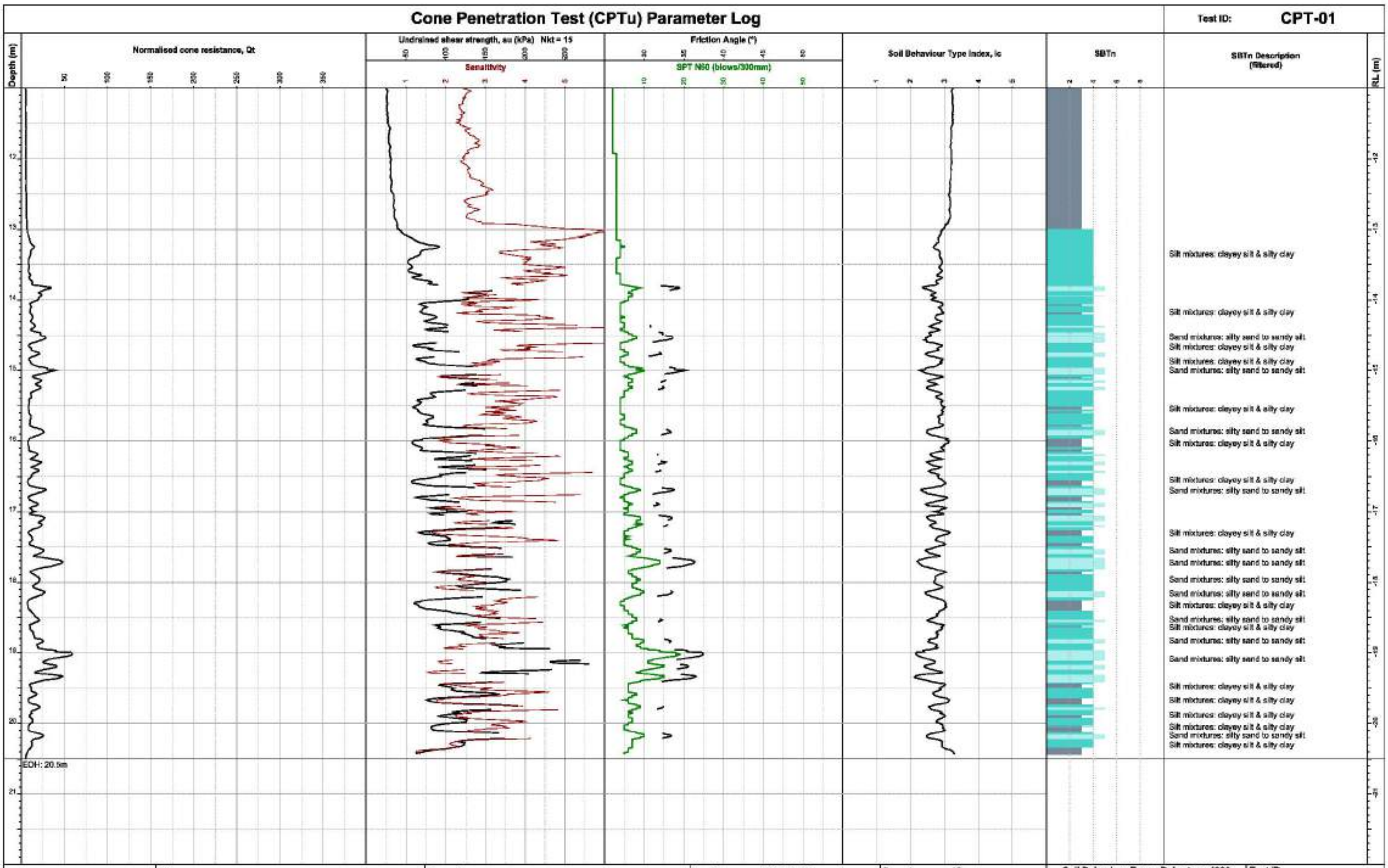
Test ID: CPT-01

Project ID:	24477
Depth:	20.5m
Sheet:	1 of 2
Date:	30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:04 am

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-01



Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Aberdeen Rd, Gisborne

Remarks:
Ground water level located at 2.88m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709883mN
Easting:	2036106mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

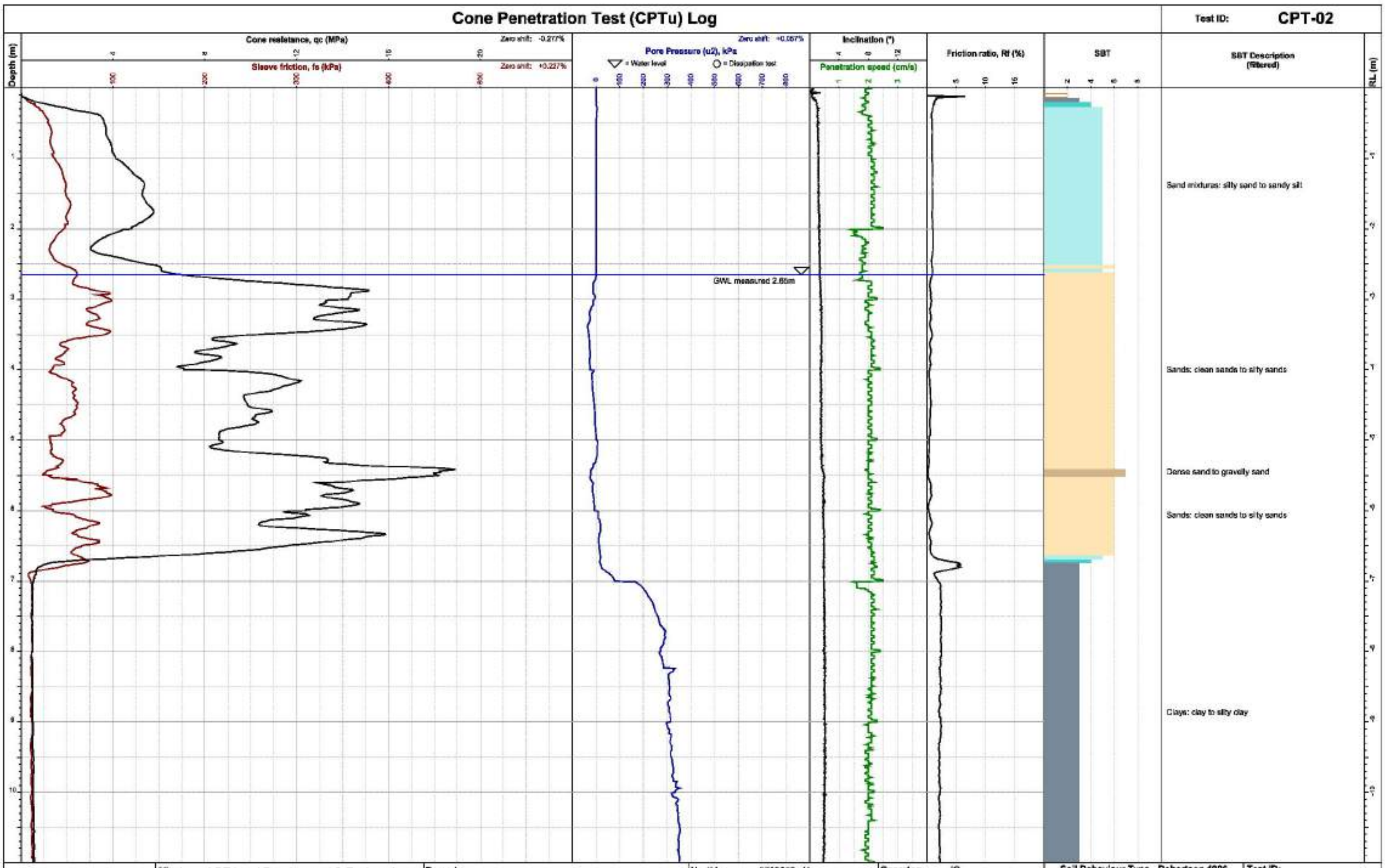
Test ID: CPT-01

Project ID:	24477
Depth:	20.5m
Sheet:	2 of 2
Date:	30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:38 am

Cone Penetration Test (CPTu) Log

Test ID: **CPT-02**



Client: LDE Land Development & Engineering

Project: geotechnical Investigation

Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.65m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709858mN
Easting:	2036112mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

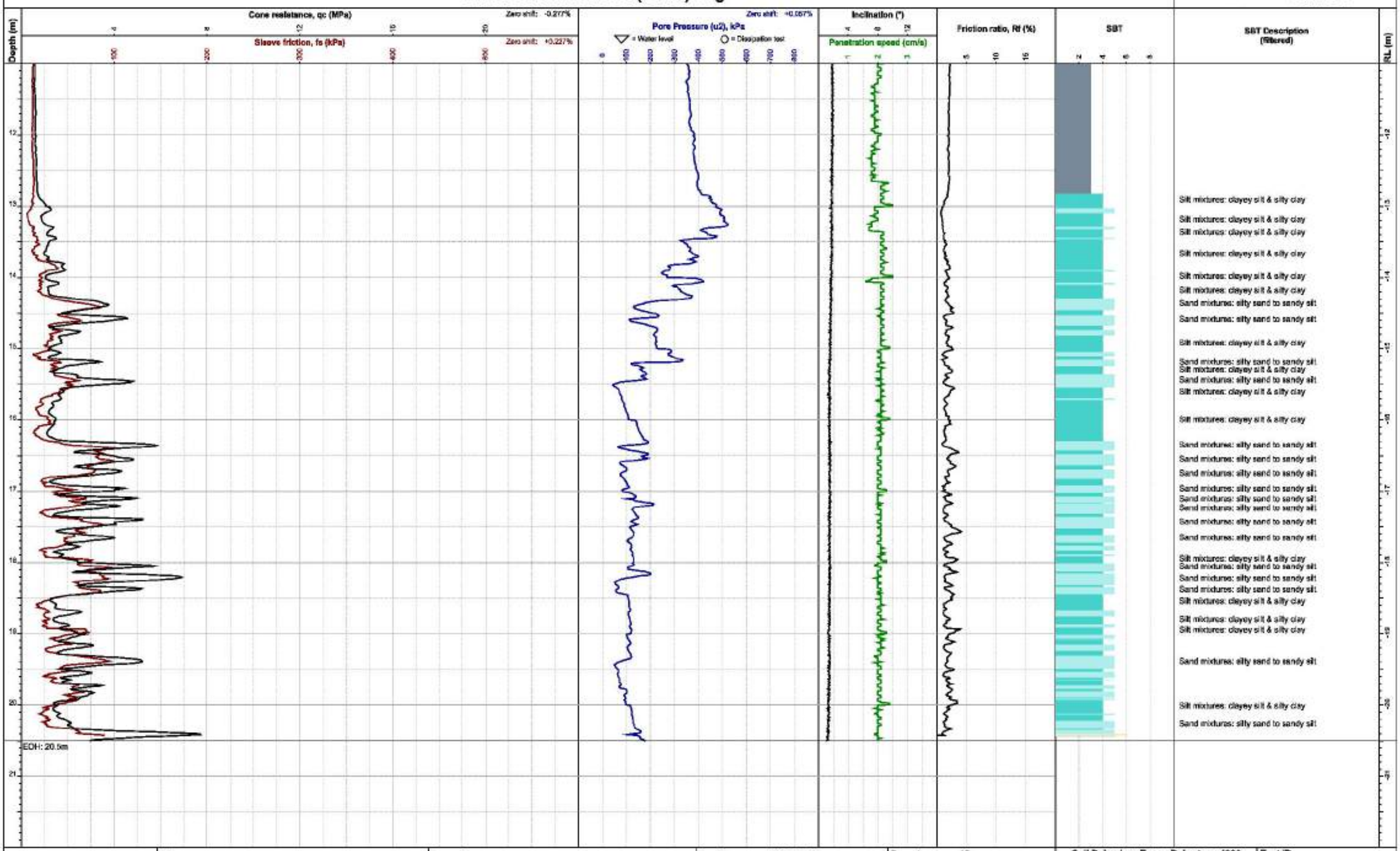
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: **CPT-02**

Project ID:	24477
Depth:	20.5m
Sheet:	1 of 2
Date:	30/05/2023

Cone Penetration Test (CPTu) Log

Test ID: CPT-02



LDE LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.65m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709868mN
Easting:	2036112mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

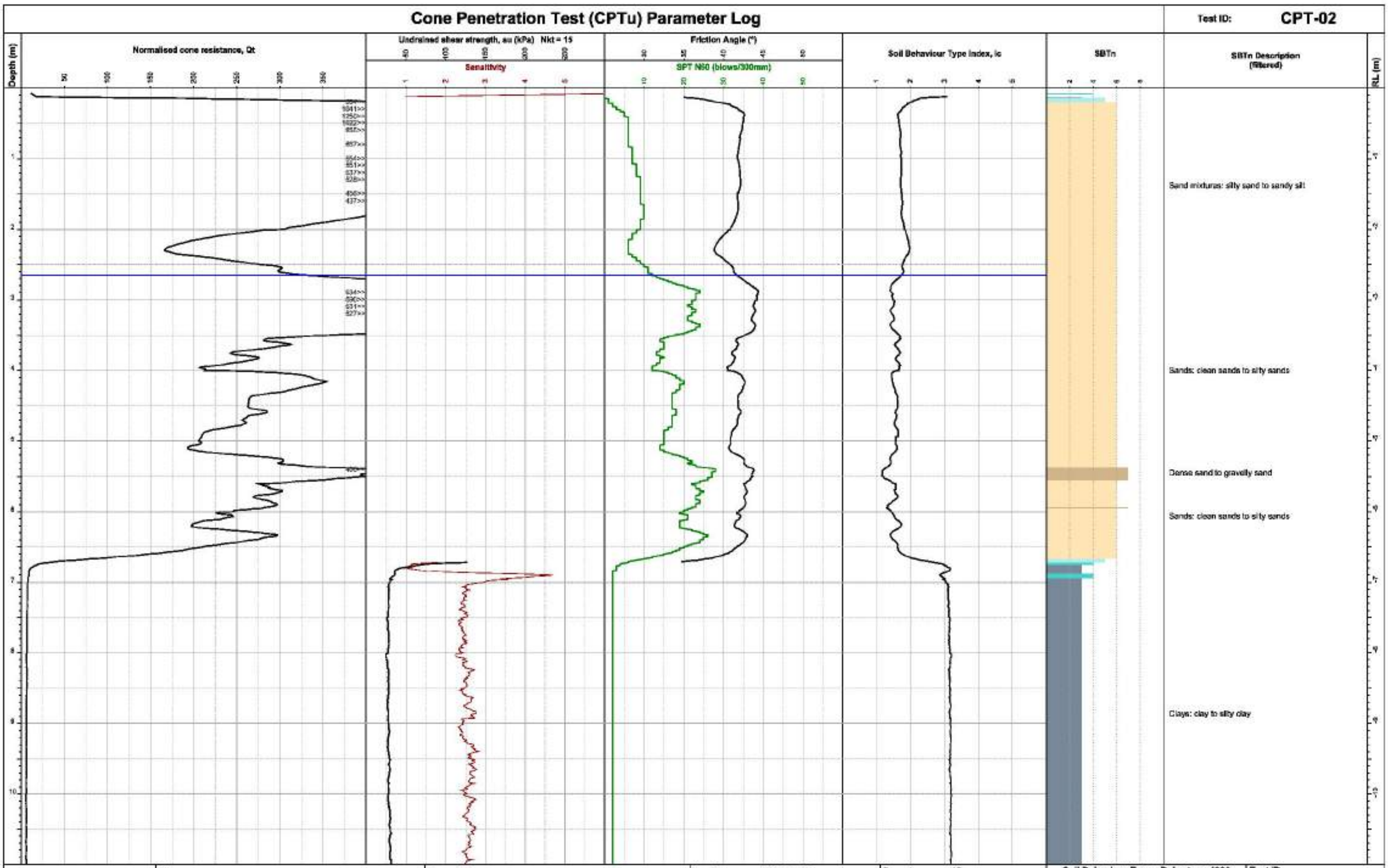
Test ID:
CPT-02

Project ID:	24477
Depth:	20.5m
Sheet:	2 of 2
Date:	30/05/2023

Generated with CORE GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:07 am

Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-02**



Client: LDE Land Development & Engineering

Project: geotechnical Investigation

Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.65m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709858mN
Easting:	2036112mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID:

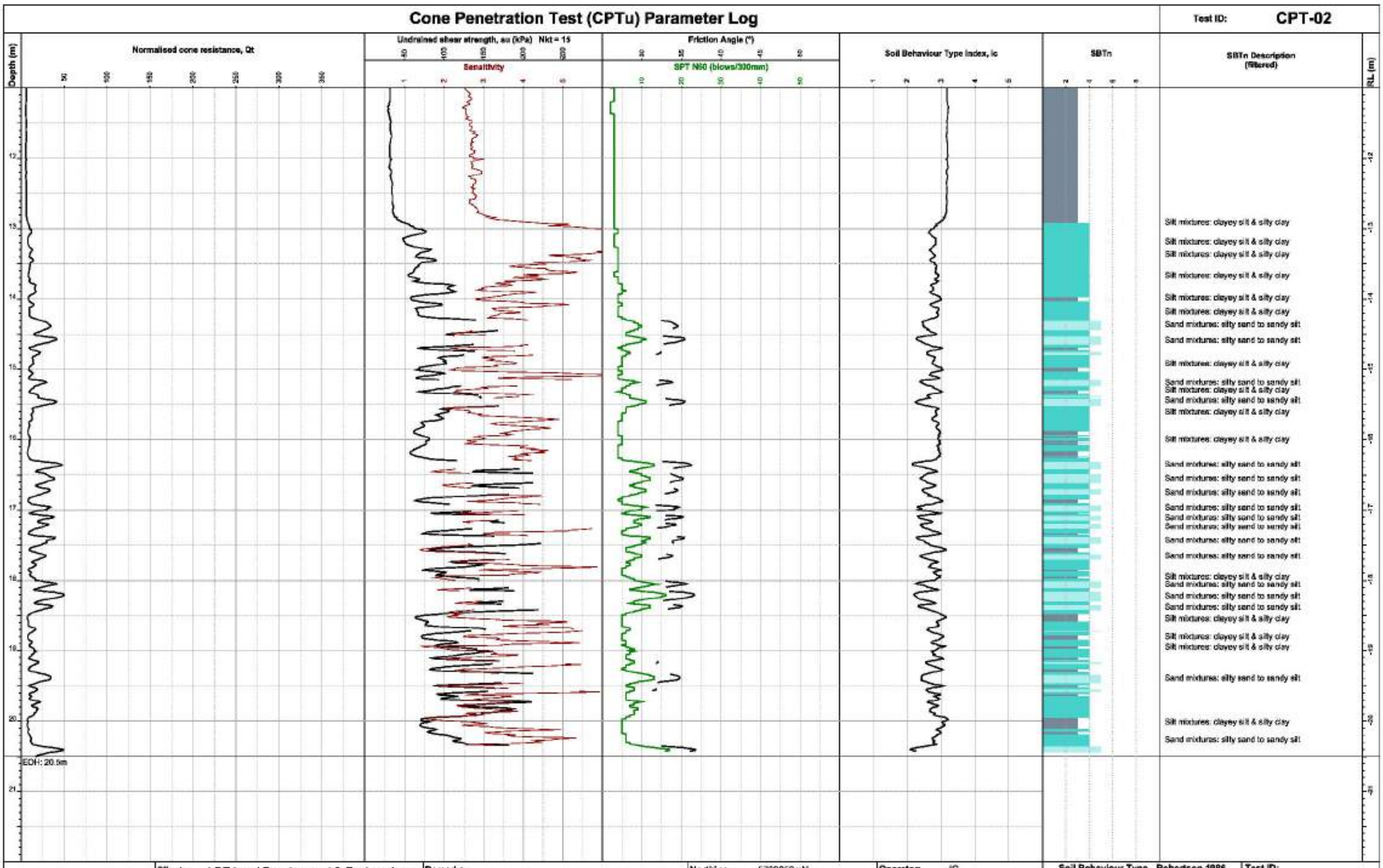
CPT-02

Project ID:	24477
Depth:	20.5m
Sheet:	1 of 2
Date:	30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:07 am

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-02



Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.65m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709858mN
Easting: 2036112mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

Soil Behaviour Type - Robertson 1986

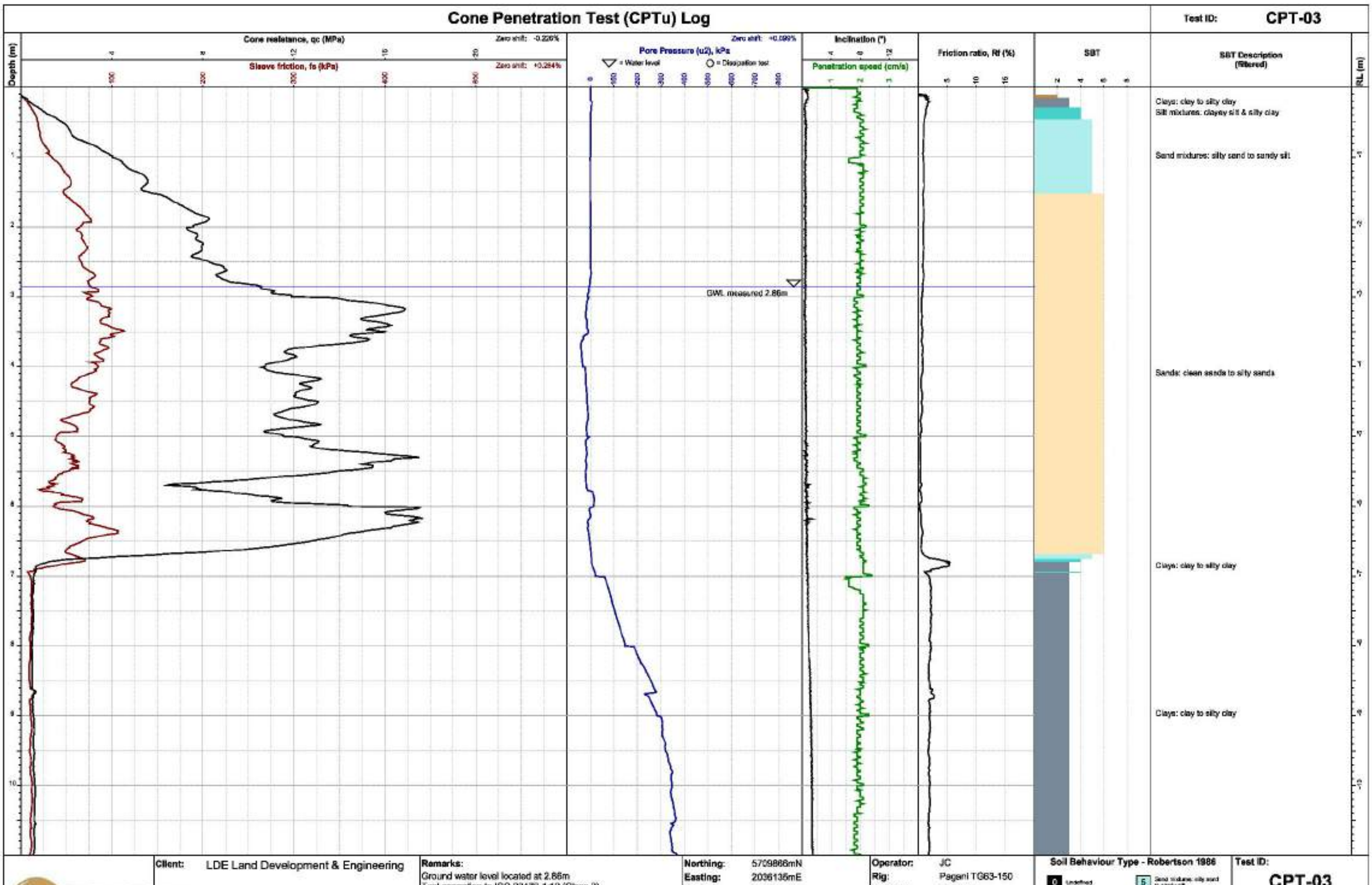
0 Undefined	5 Sand mixtures: silty sand to sandy silt
1 Sensitive fine-grained	6 Sands: clean sands to silty sands
2 Clay - organic soil	7 Dense sand to gravelly sand
3 Clays: clay to silty clay	8 Stiff sand to clayey sand
4 Silt mixtures: clayey silt & silty clay	9 Stiff fine-grained

Test ID: CPT-02
Project ID: 24477
Depth: 20.5m
Sheet: 2 of 2
Date: 30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:07 am

Cone Penetration Test (CPTu) Log

Test ID: CPT-03



Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.86m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709866mN
Easting: 2036135mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

Soil Behaviour Type - Robertson 1986

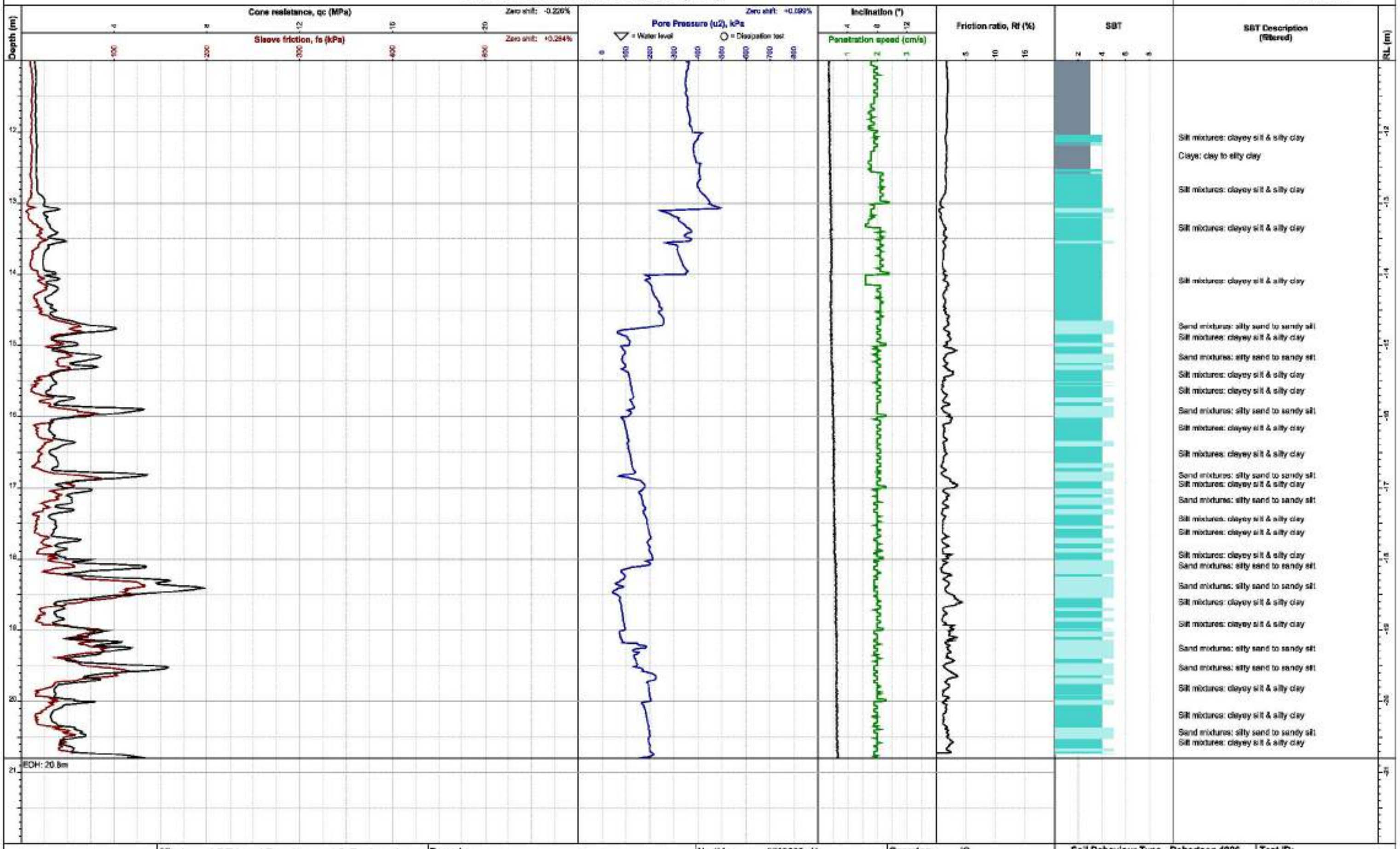
- 0 Undefined
- 1 Sensitive fine-grained
- 2 Clay - organic soil
- 3 Clays: clay to silty clay
- 4 Silt mixtures: clayey silt & silty clay
- 5 Sand mixtures: silty sand to sandy silt
- 6 Sands: clean sands to silty sands
- 7 Dense sand to gravelly sand
- 8 Stiff sand to clayey sand
- 9 Stiff fine-grained

Test ID: CPT-03
Project ID: 24477
Depth: 20.8m
Sheet: 1 of 2
Date: 30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:39 am

Cone Penetration Test (CPTu) Log

Test ID: **CPT-03**



LDE LAND DEVELOPMENT & ENGINEERING

Client:	LDE Land Development & Engineering
Project:	geotechnical Investigation
Location:	556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.86m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709868mN
Easting:	2036135mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

0	Undefined
1	Sensitive fine-grained
2	Clay - organic soil
3	Clays: clay to silty clay
4	Silt mixtures: clayey silt & silty clay
5	Sand mixtures: silty sand to sandy silt
6	Sands: clean sands to silty sands
7	Dense sand to gravelly sand
8	Stiff sand to clayey sand
9	Stiff fine-grained

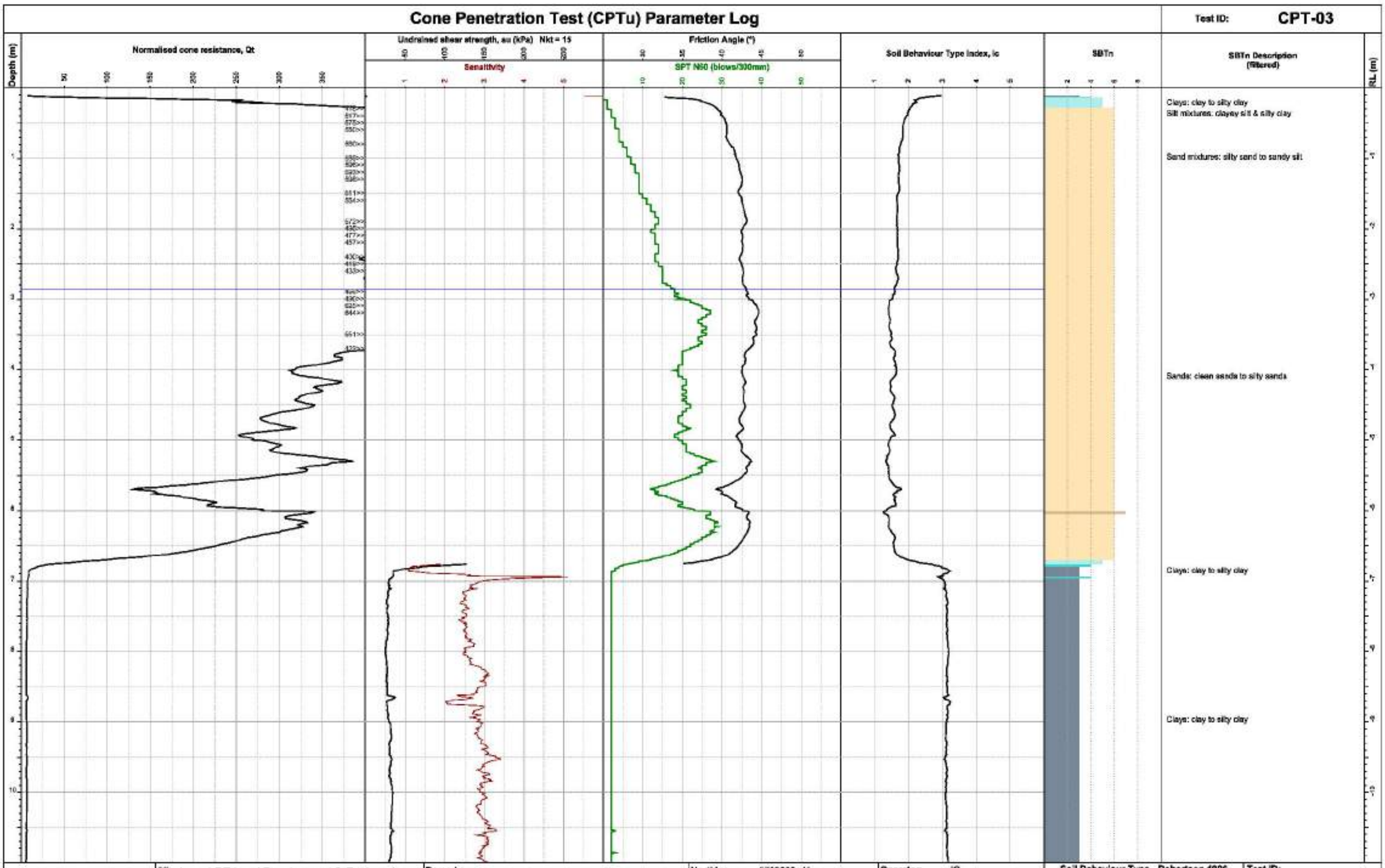
Test ID:

CPT-03

Project ID:	24477
Depth:	20.8m
Sheet:	2 of 2
Date:	30/05/2023

Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-03**



Client:	LDE Land Development & Engineering	**Remarks:** Ground water level located at 2.86m Test according to ISO 22476-1:12 (Class 2)	**Northing:**	5709866mN	**Operator:**	JC	**Test ID:** **CPT-03**
Project:	geotechnical Investigation		**Easting:**	2036135mE	**Rig:**	Pagani TG63-150	
			System:	NZTM	**Cone ID:**	Mks1042	
Location:	556-560 Abeerdeen Rd, Gisborne	**Termination Reason:** Target depth	**Elevation:**	Ground	**Type:**	Comp. piezo cone	**Project ID:** 24477
			Located By:	Phone GPS	**Cone Area:**	10 cm²	**Depth:** 20.8m
			Location:	As per site plan	**Sleeve Area:**	150 cm²	**Sheet:** 1 of 2
					Area Ratio:	0.8	**Date:** 30/05/2023

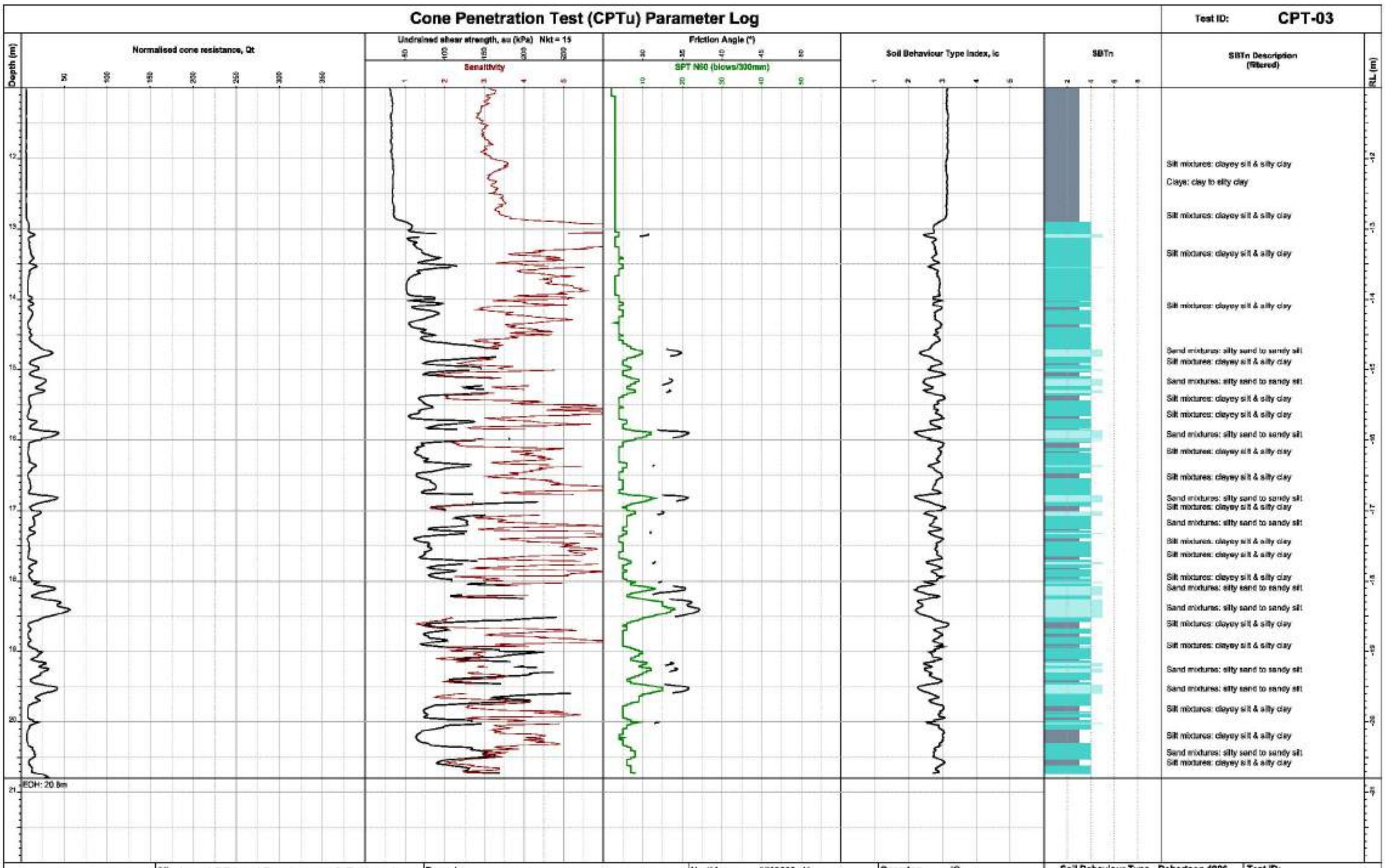
Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:10 am

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-03



LDE LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.86m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709866mN
Easting: 2036135mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

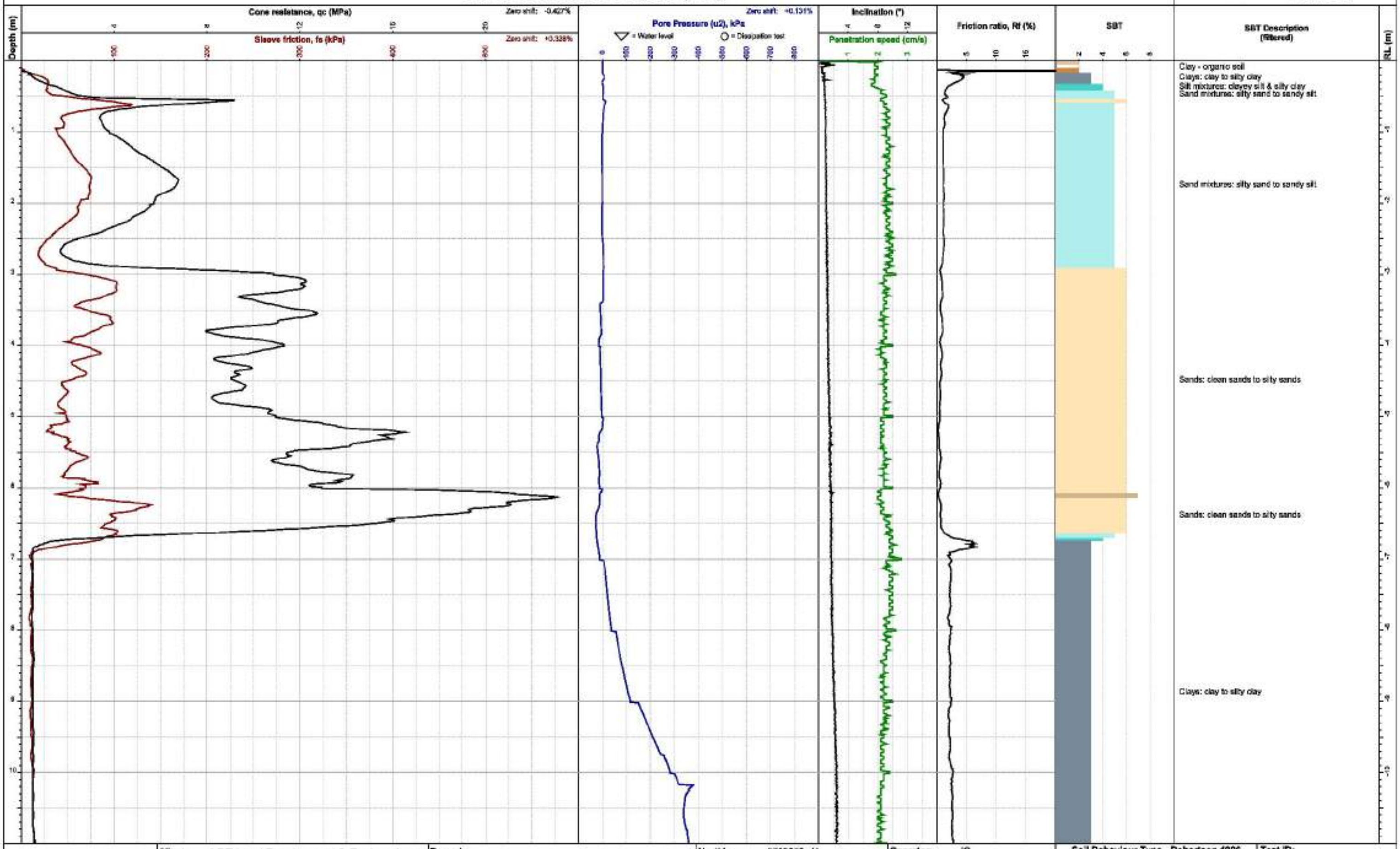
Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-03
Project ID: 24477
Depth: 20.8m
Sheet: 2 of 2
Date: 30/05/2023

Cone Penetration Test (CPTu) Log

Test ID: CPT-04



LDE LAND DEVELOPMENT & ENGINEERING

Client:	LDE Land Development & Engineering
Project:	geotechnical Investigation
Location:	556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.34m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709856mN
Easting:	2036093mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID:

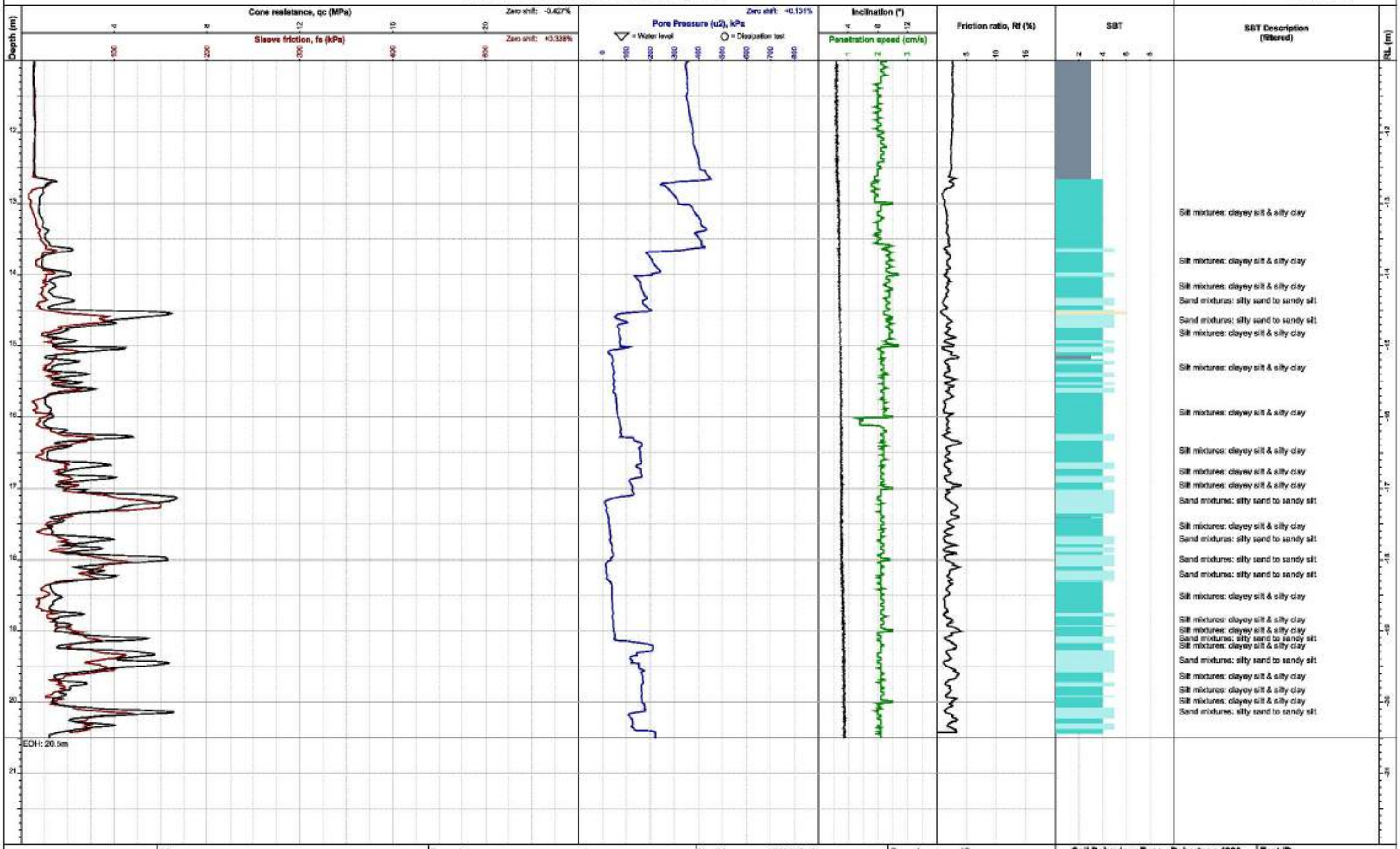
CPT-04

Project ID:	24477
Depth:	20.5m
Sheet:	1 of 2
Date:	30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:12 am

Cone Penetration Test (CPTu) Log

Test ID: **CPT-04**



Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:12 am

LDE LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.34m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709856mN
Easting: 2036093mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

Soil Behaviour Type - Robertson 1986

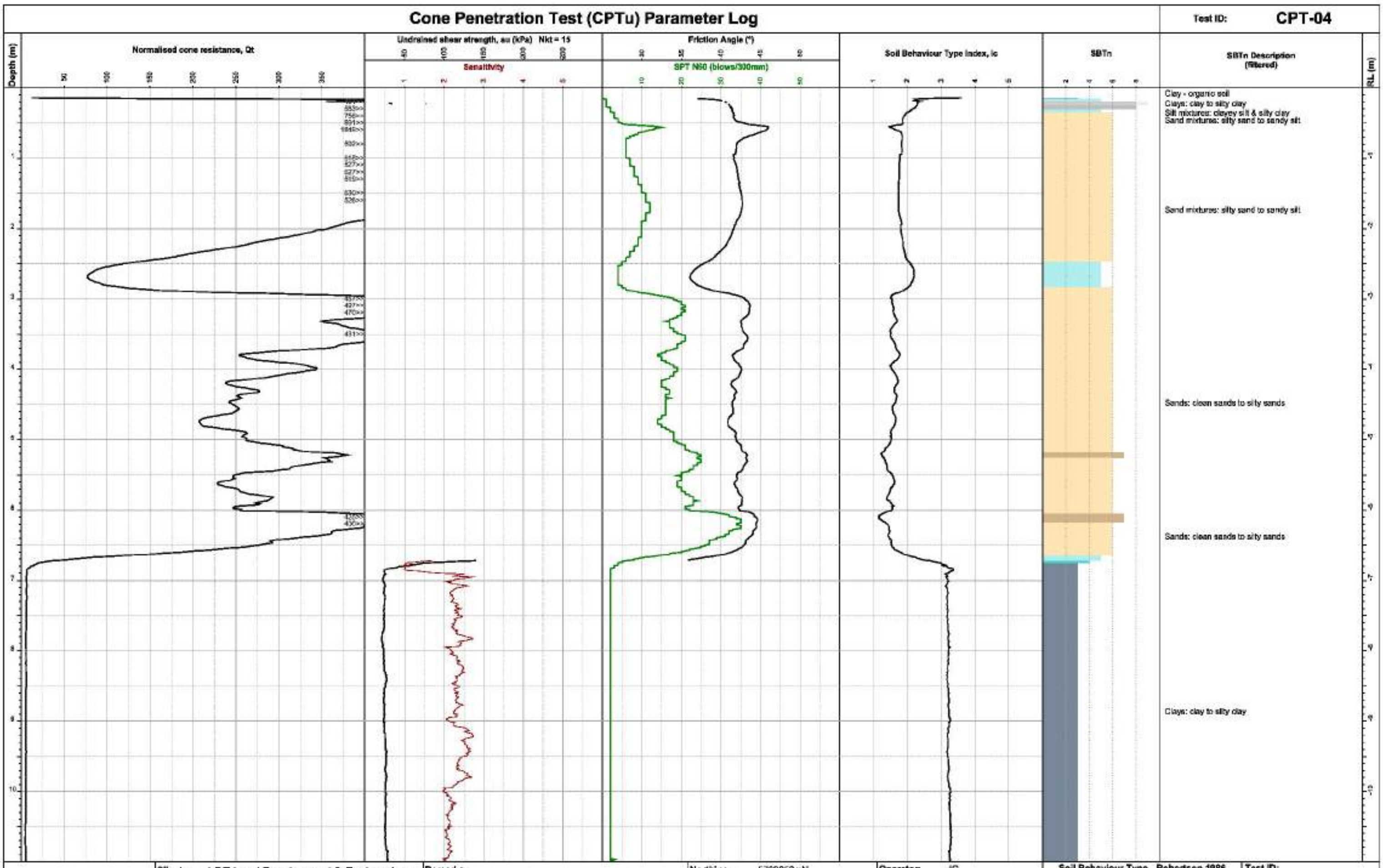
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: **CPT-04**

Project ID: 24477
Depth: 20.5m
Sheet: 2 of 2
Date: 30/05/2023

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-04



Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:12 am

LDE LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering

Project: geotechnical Investigation

Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.34m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709856mN
Easting: 2036093mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

Soil Behaviour Type - Robertson 1986

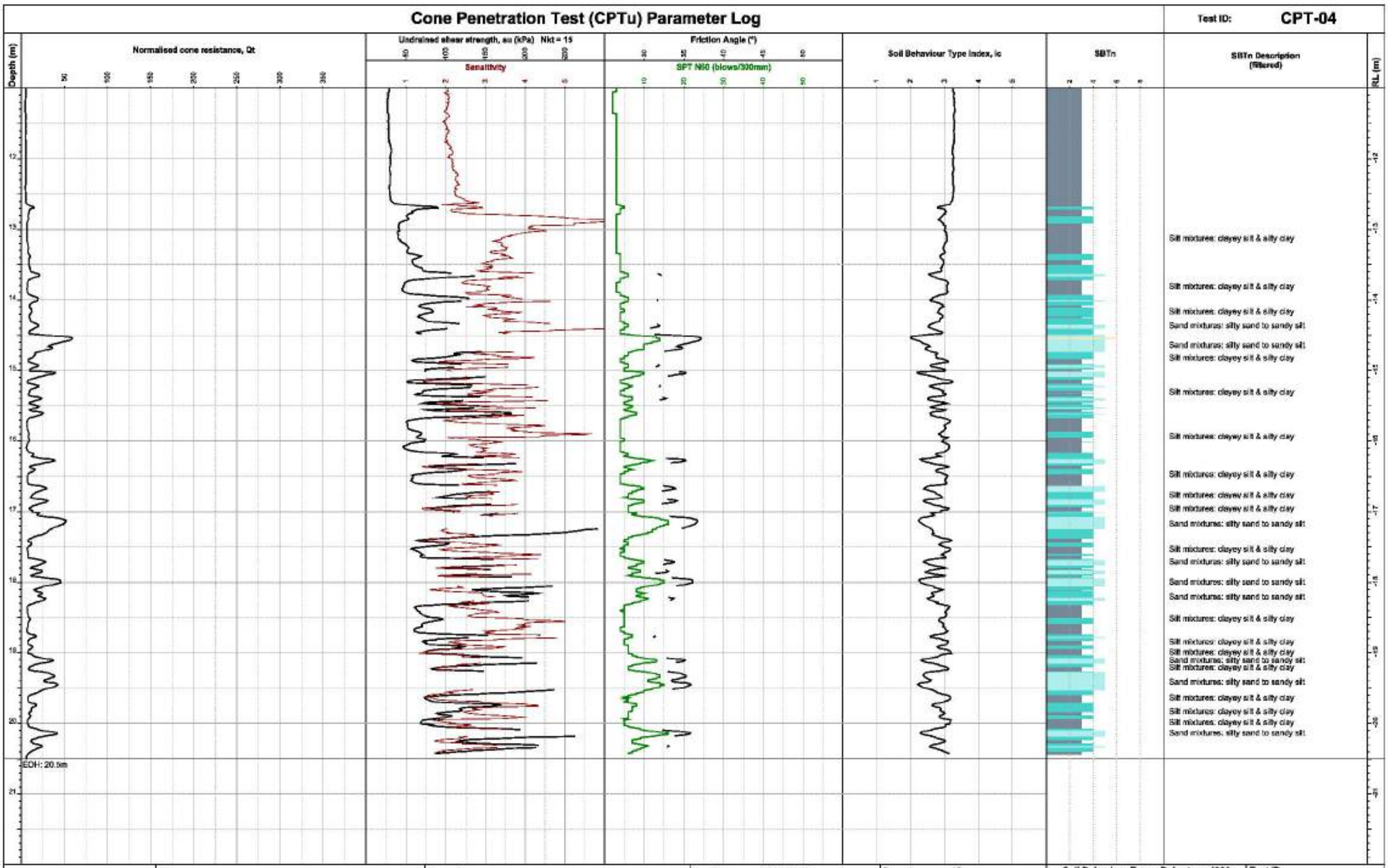
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-04

Project ID: 24477
Depth: 20.5m
Sheet: 1 of 2
Date: 30/05/2023

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-04



Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:13 am

LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.34m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709856mN
Easting: 2036093mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

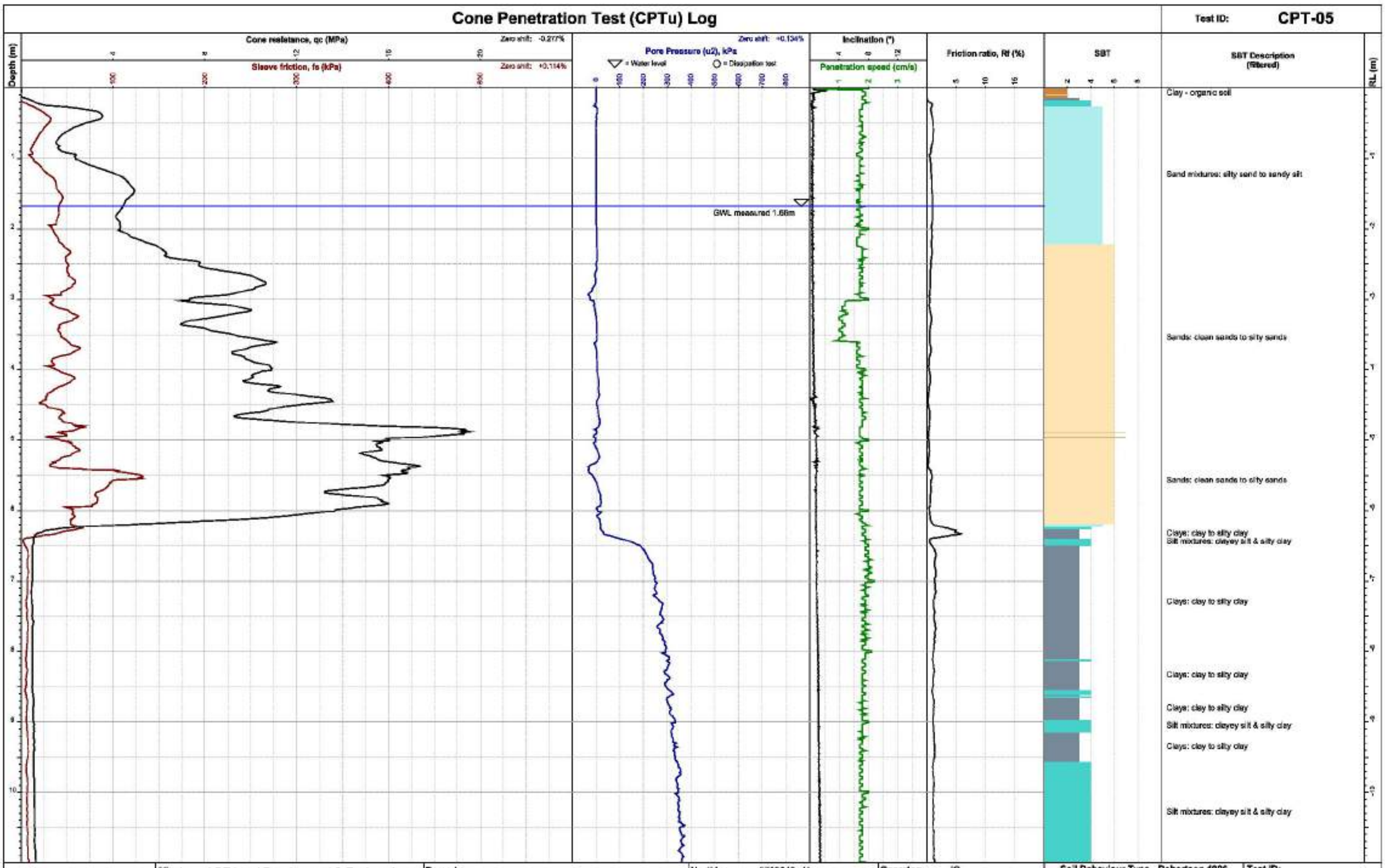
Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-04
Project ID: 24477
Depth: 20.5m
Sheet: 2 of 2
Date: 30/05/2023

Cone Penetration Test (CPTu) Log

Test ID: **CPT-05**



Client: LDE Land Development & Engineering

Project: geotechnical Investigation

Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 1.68m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709840mN
Easting: 2036107mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

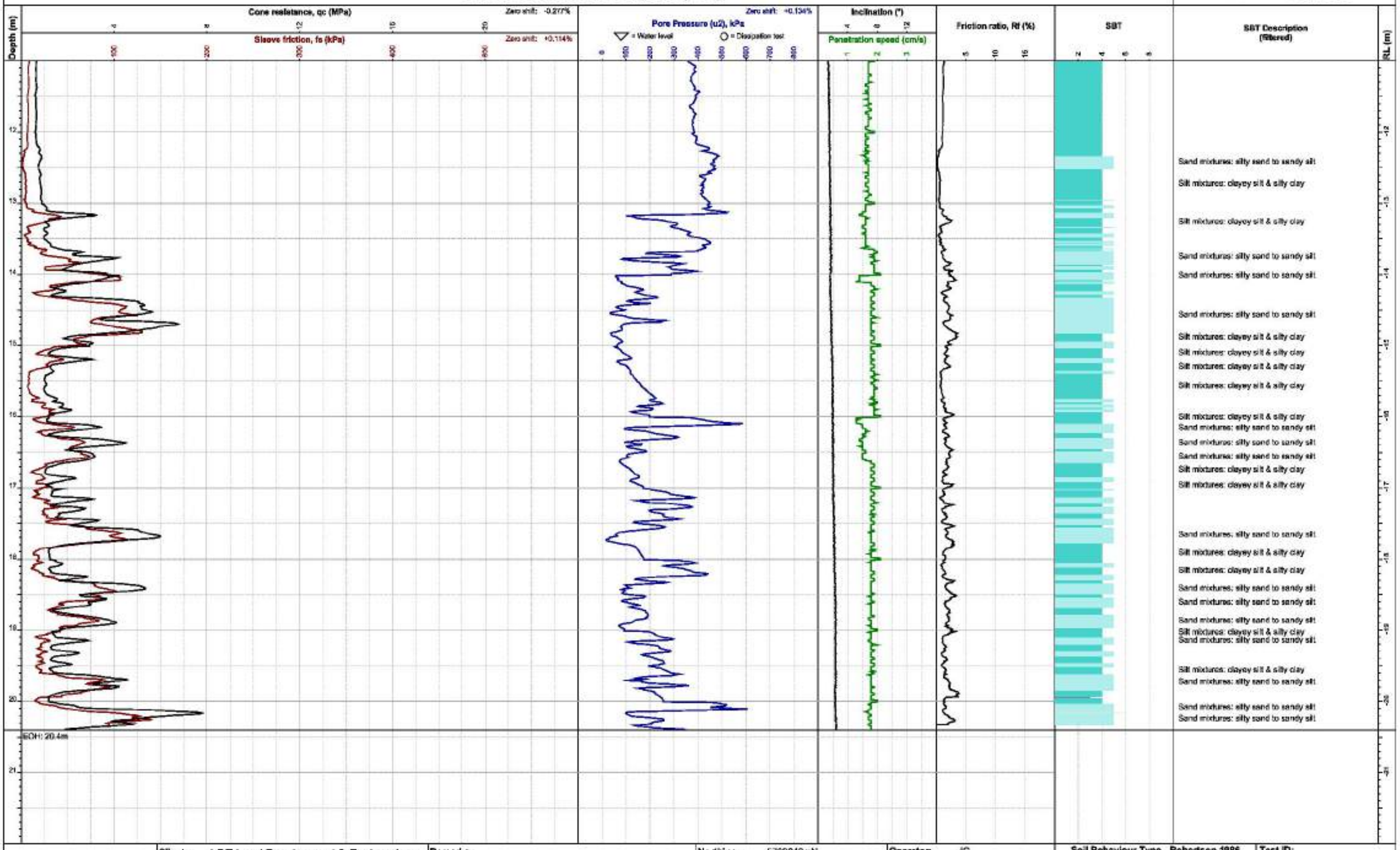
Test ID:
CPT-05

Project ID: 24477
Depth: 20.4m
Sheet: 1 of 2
Date: 30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:15 am

Cone Penetration Test (CPTu) Log

Test ID: CPT-05



LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 1.68m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709840mN
Easting: 2036107mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

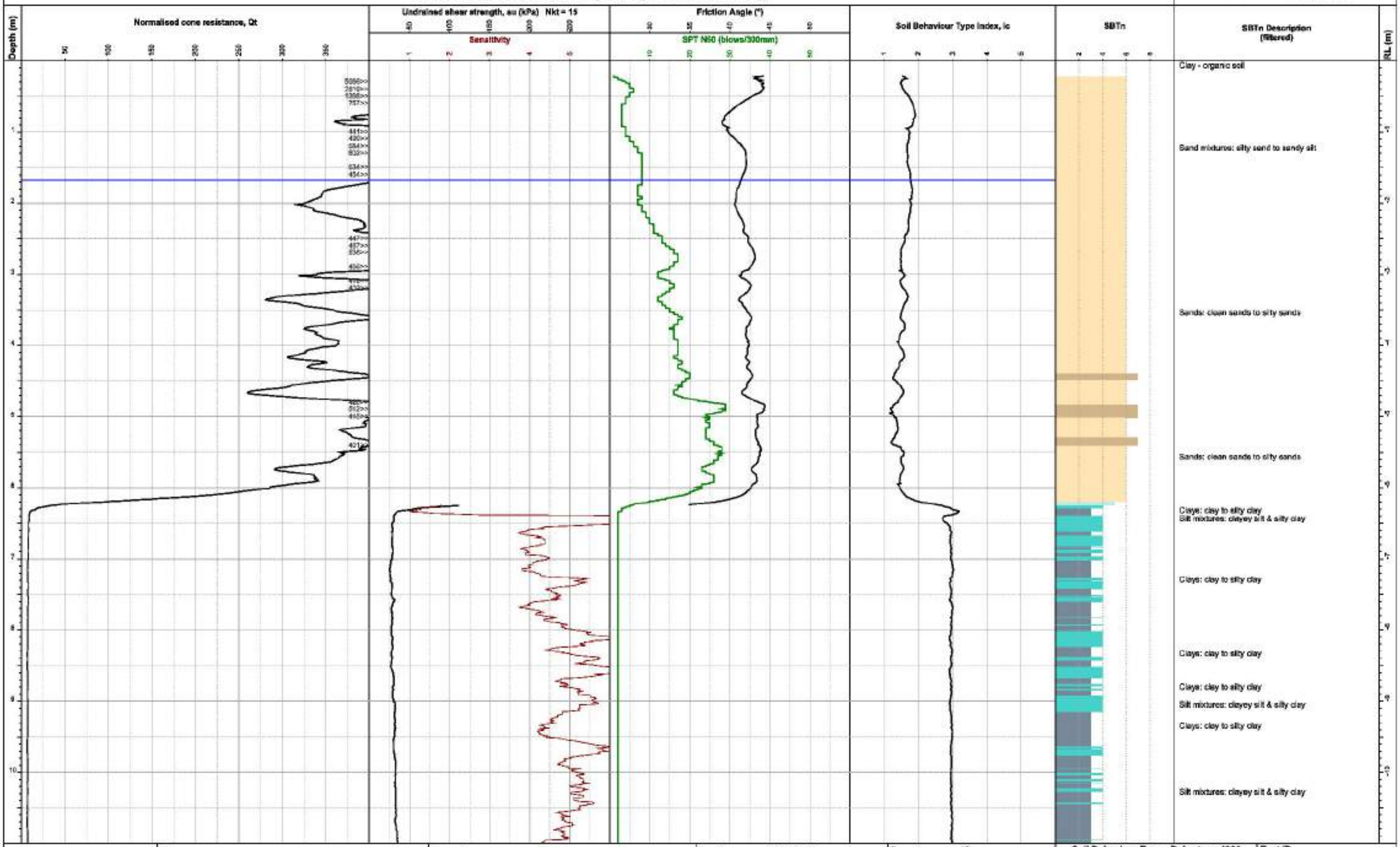
Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-05
Project ID: 24477
Depth: 20.4m
Sheet: 2 of 2
Date: 30/05/2023

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-05



Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:18 am

LDE LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering

Project: geotechnical Investigation

Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 1.68m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709840mN
Easting: 2036107mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

Soil Behaviour Type - Robertson 1986

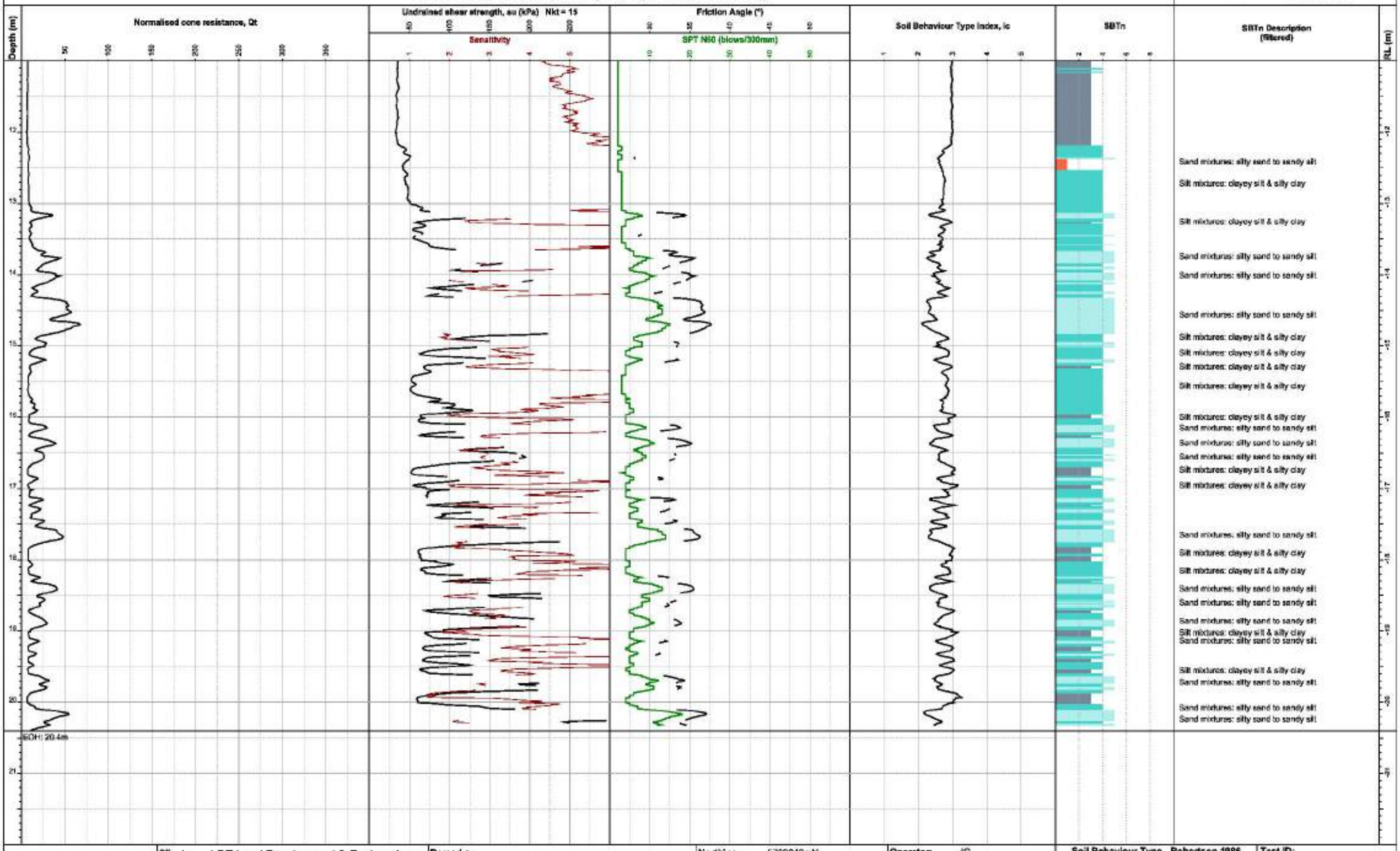
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-05

Project ID: 24477
Depth: 20.4m
Sheet: 1 of 2
Date: 30/05/2023

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-05



LDE LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 1.68m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709840mN
Easting:	2036107mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-05

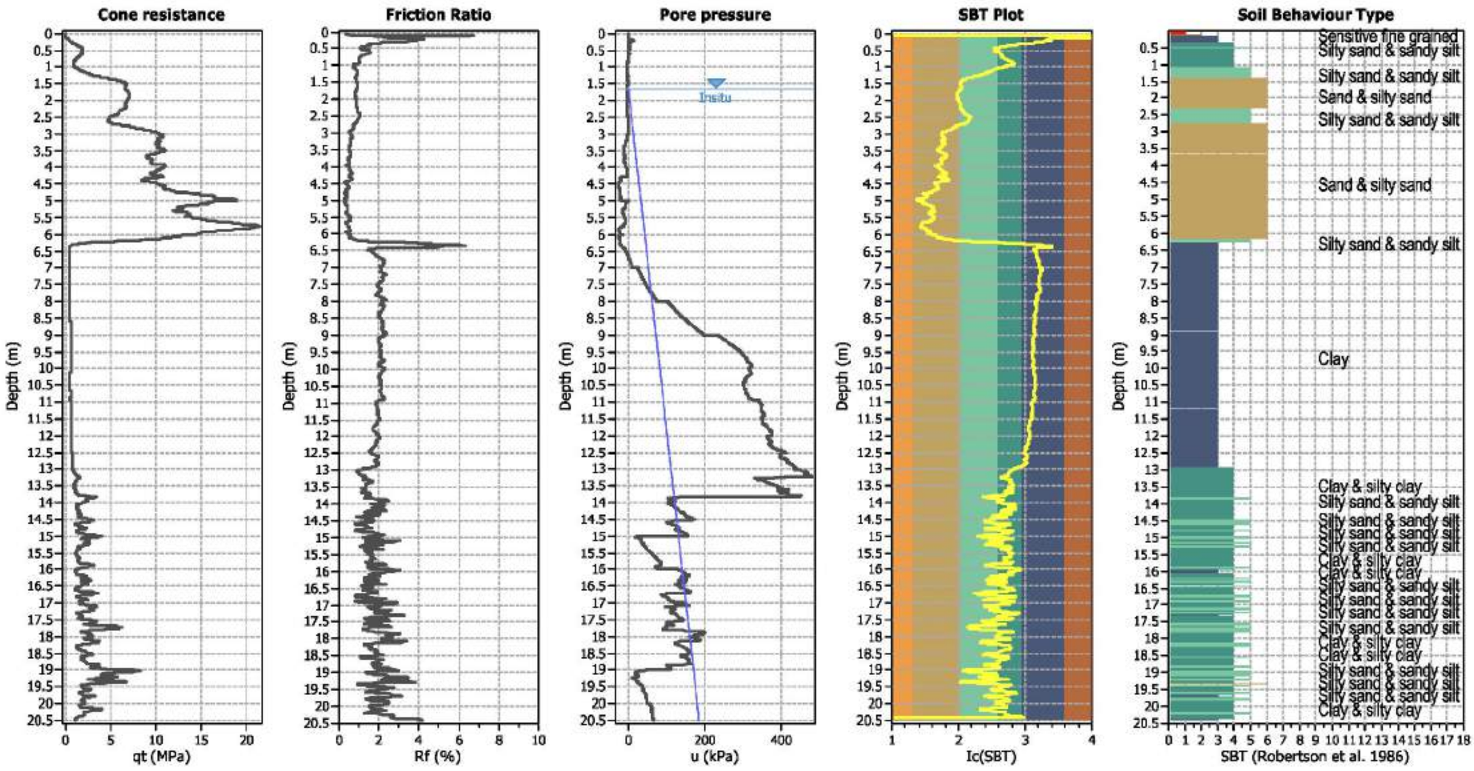
Project ID:	24477
Depth:	20.4m
Sheet:	2 of 2
Date:	30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:16 am

APPENDIX D

LIQUEFATION ANALYSIS RESULTS

CPT basic interpretation plots



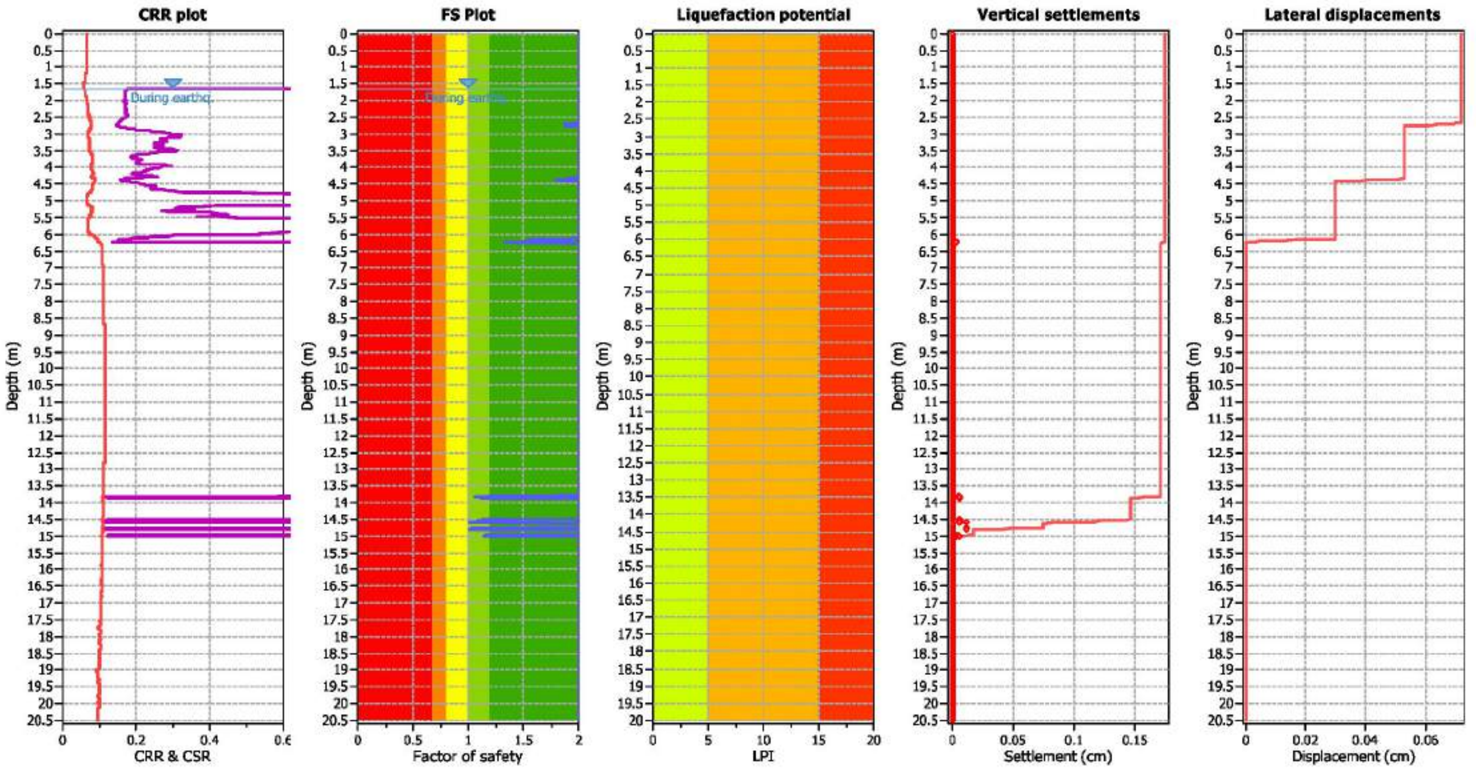
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

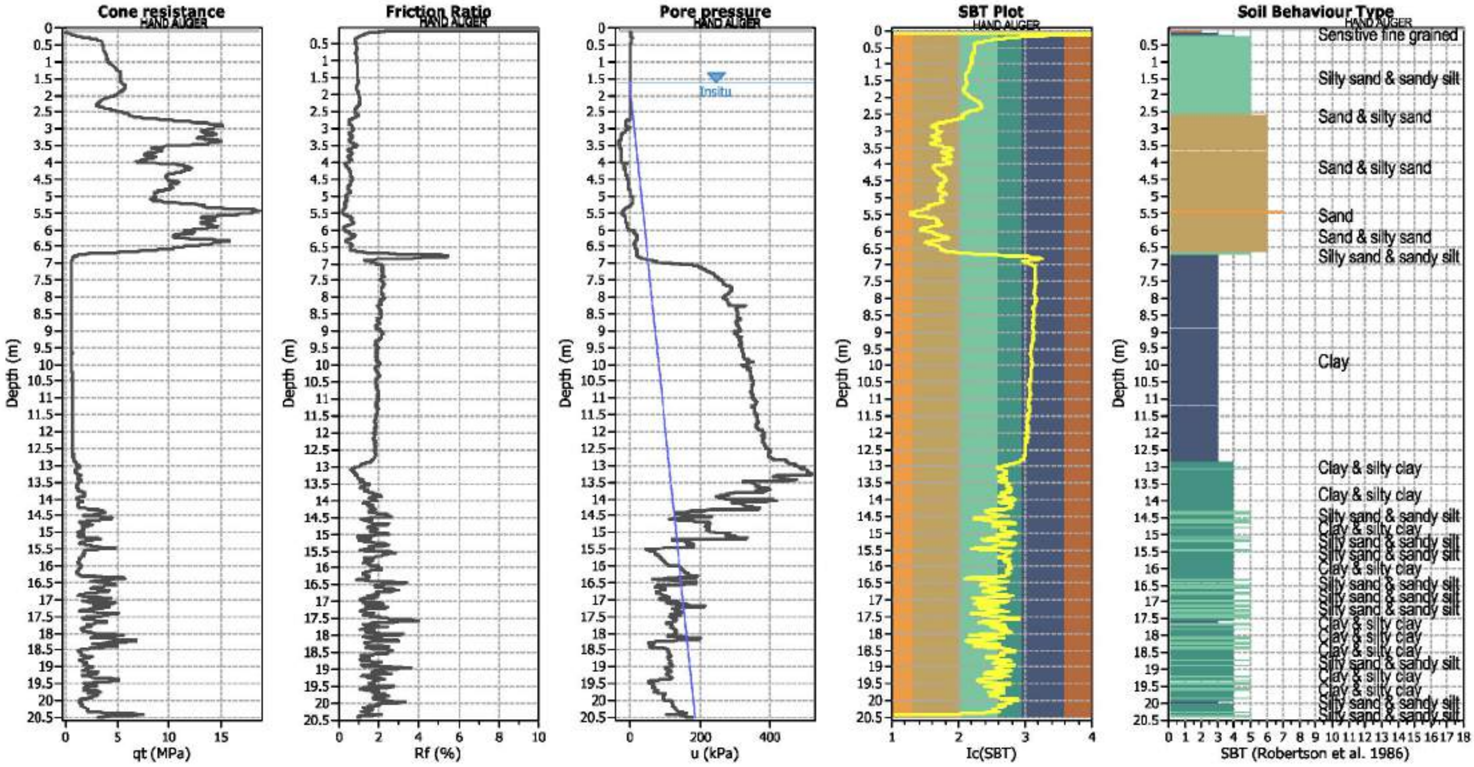
F.S. color scheme

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

LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟩 Low risk

CPT basic interpretation plots



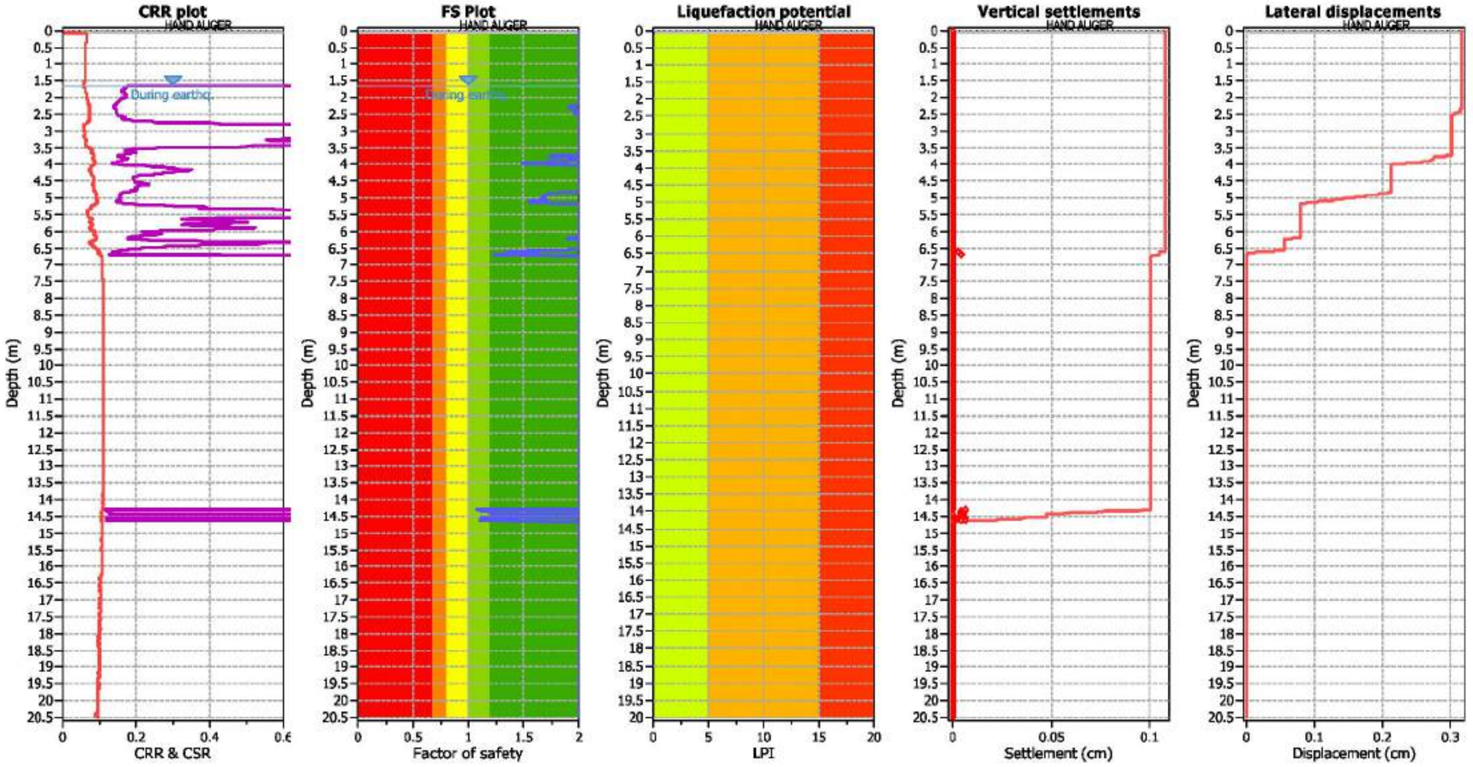
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

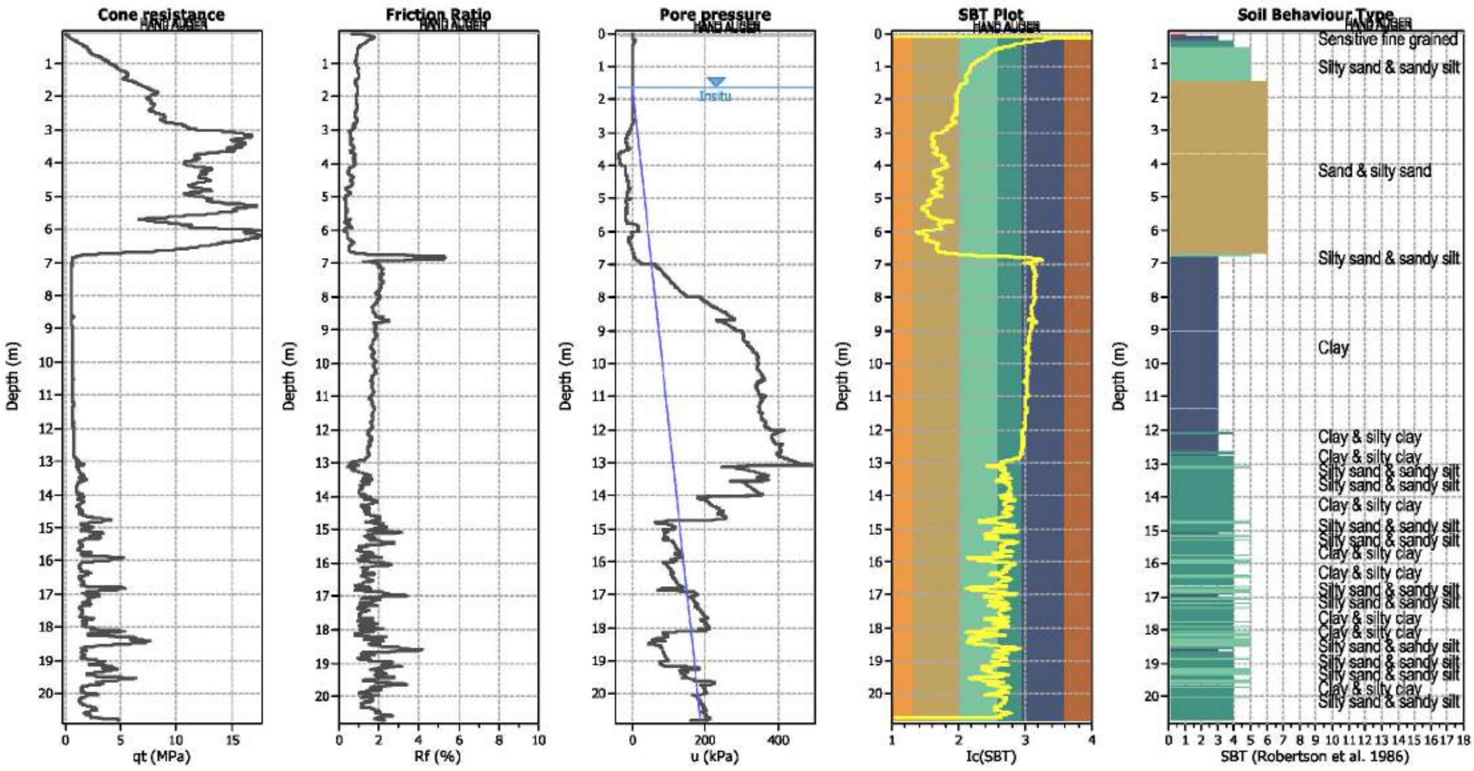
F.S. color scheme

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

LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

CPT basic interpretation plots



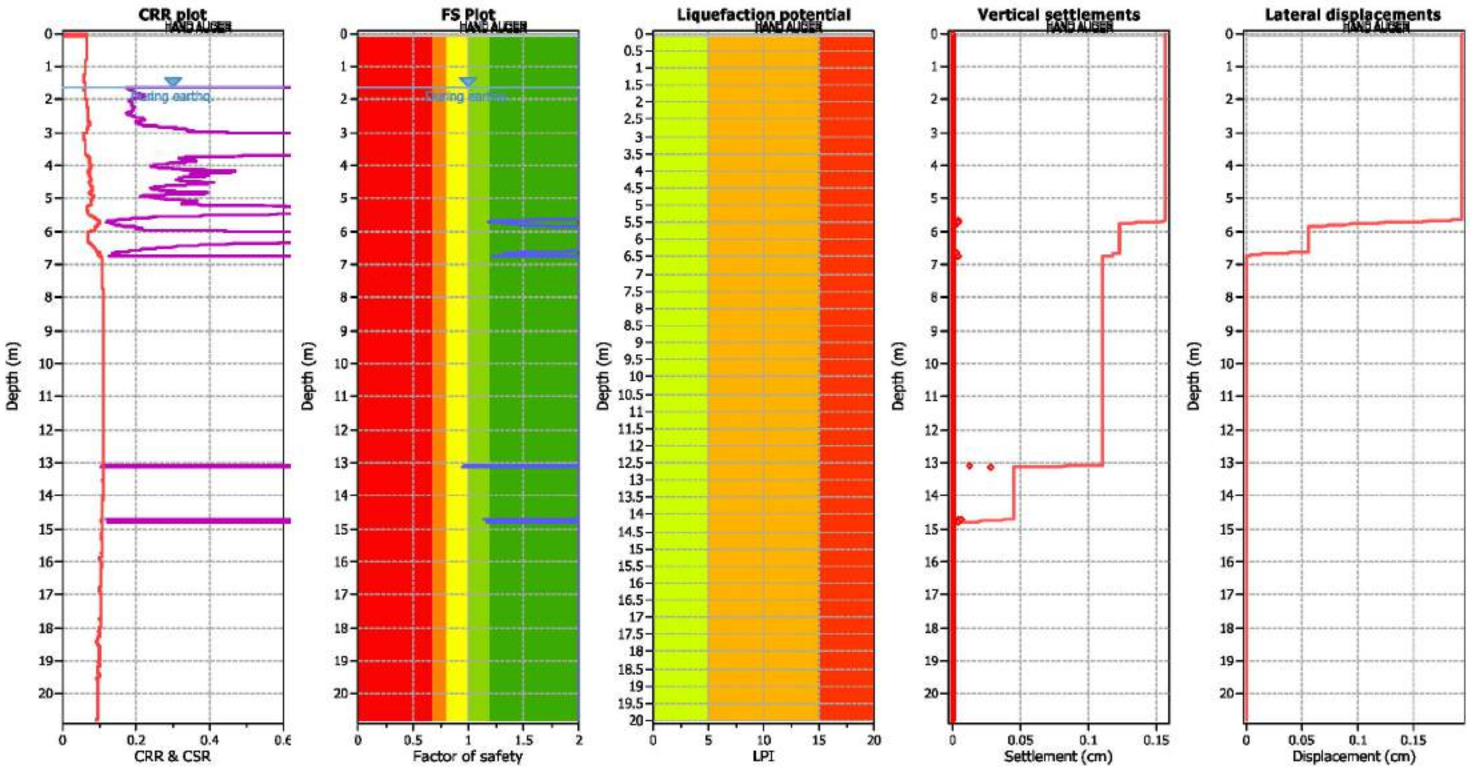
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.30
Peak ground acceleration: 0.12
Depth to water table (insitu): 1.65 m

Depth to GWT (erthq.): 1.65 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: Sands only
Limit depth applied: Yes
Limit depth: 15.00 m

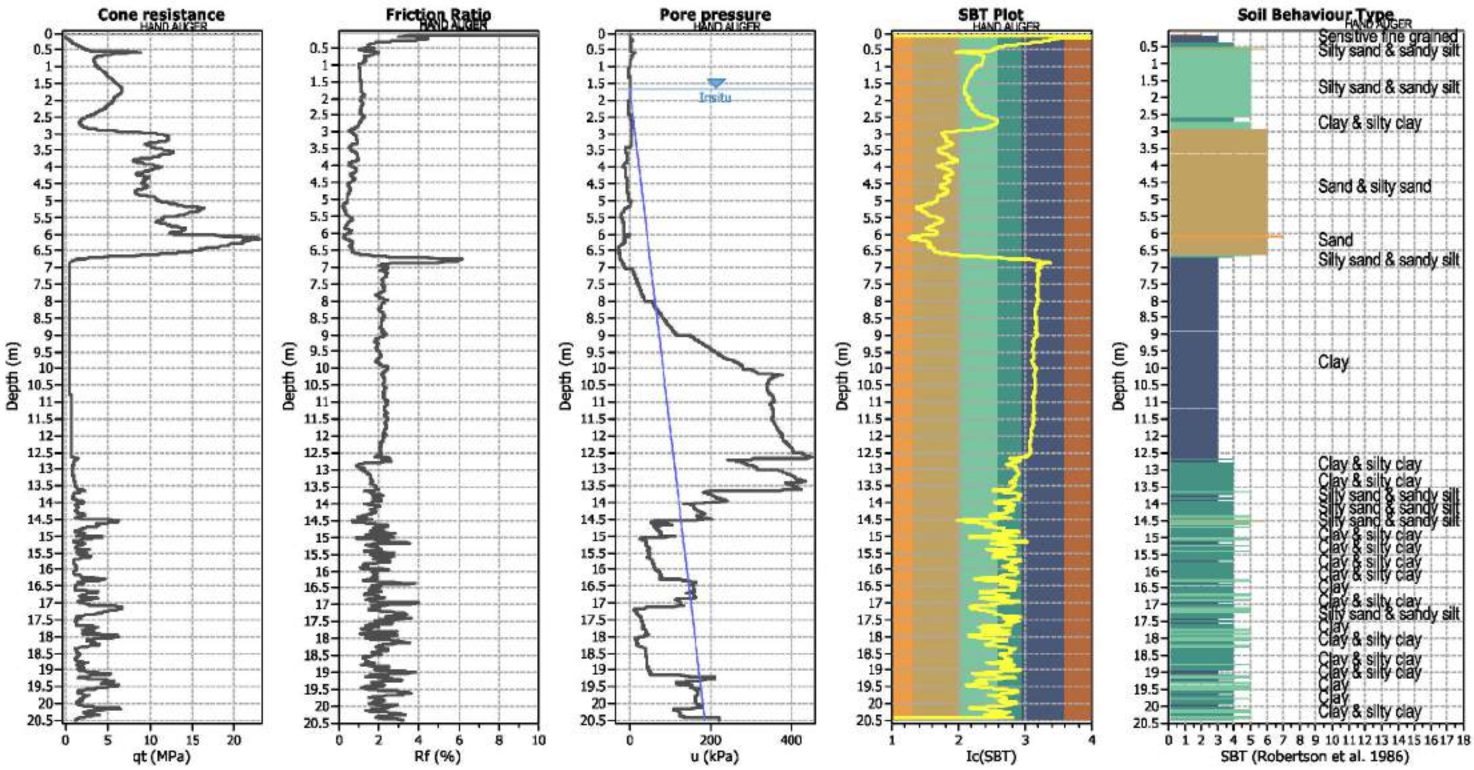
F.S. color scheme

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

LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

CPT basic interpretation plots



Input parameters and analysis data

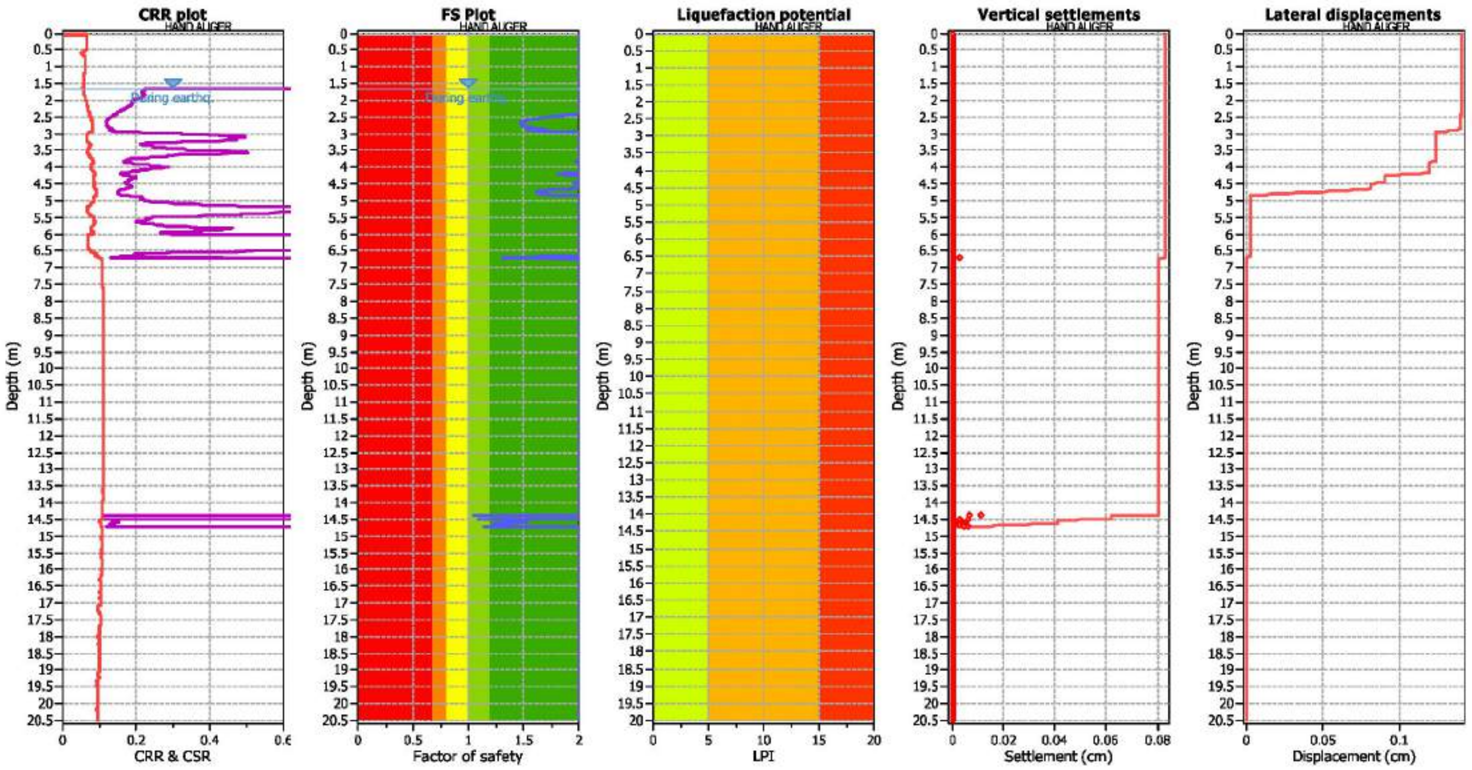
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

CPT name: SLS- CPT04

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

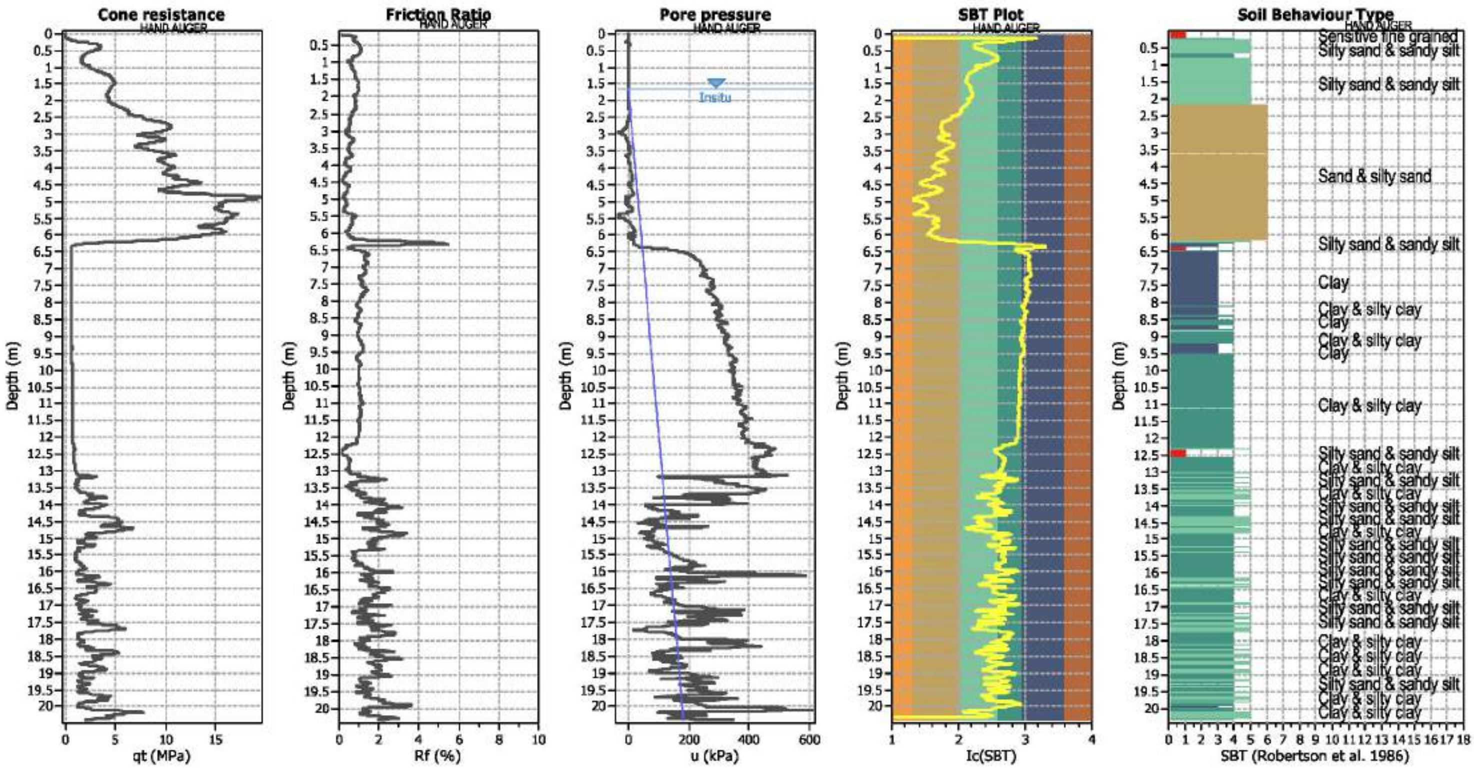
F.S. color scheme

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

LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

CPT basic interpretation plots



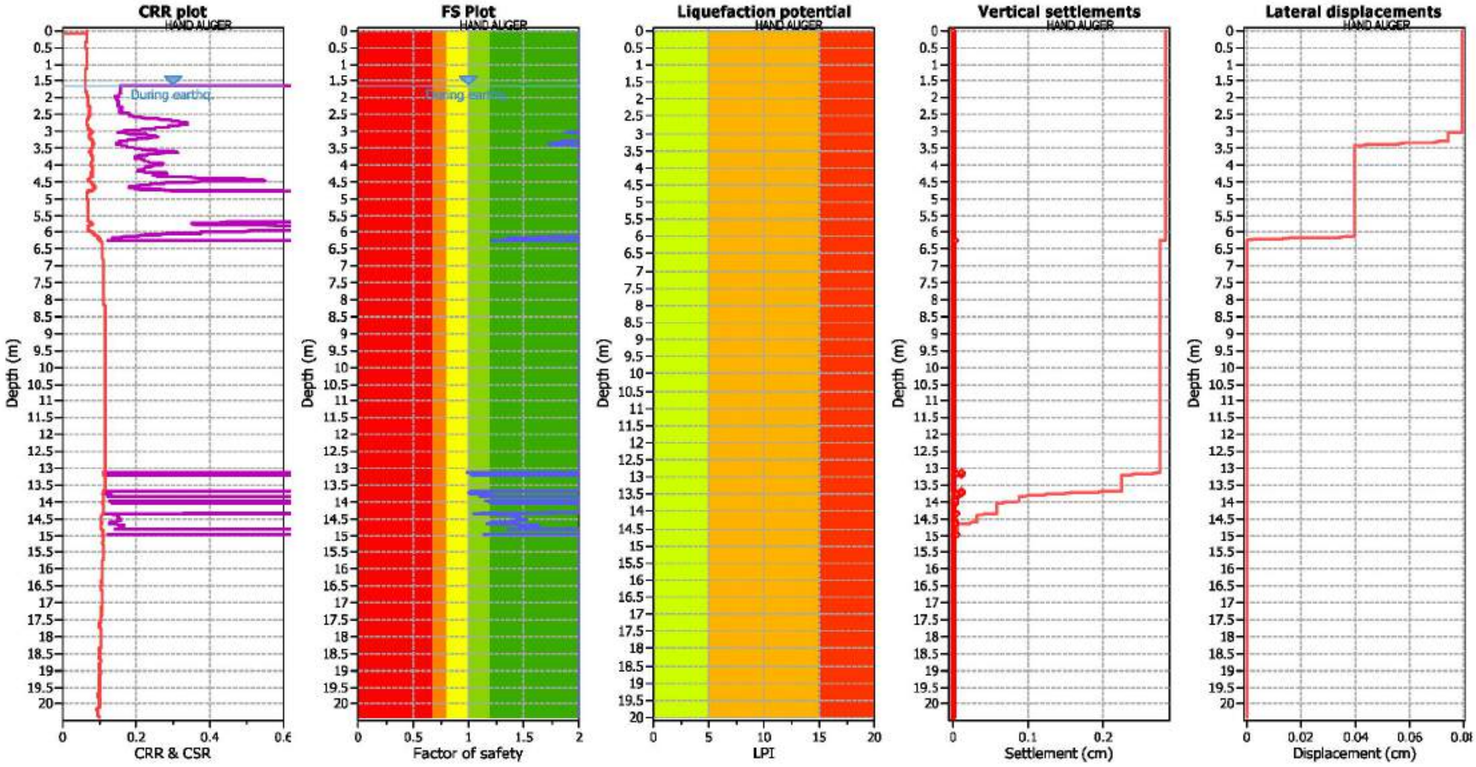
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

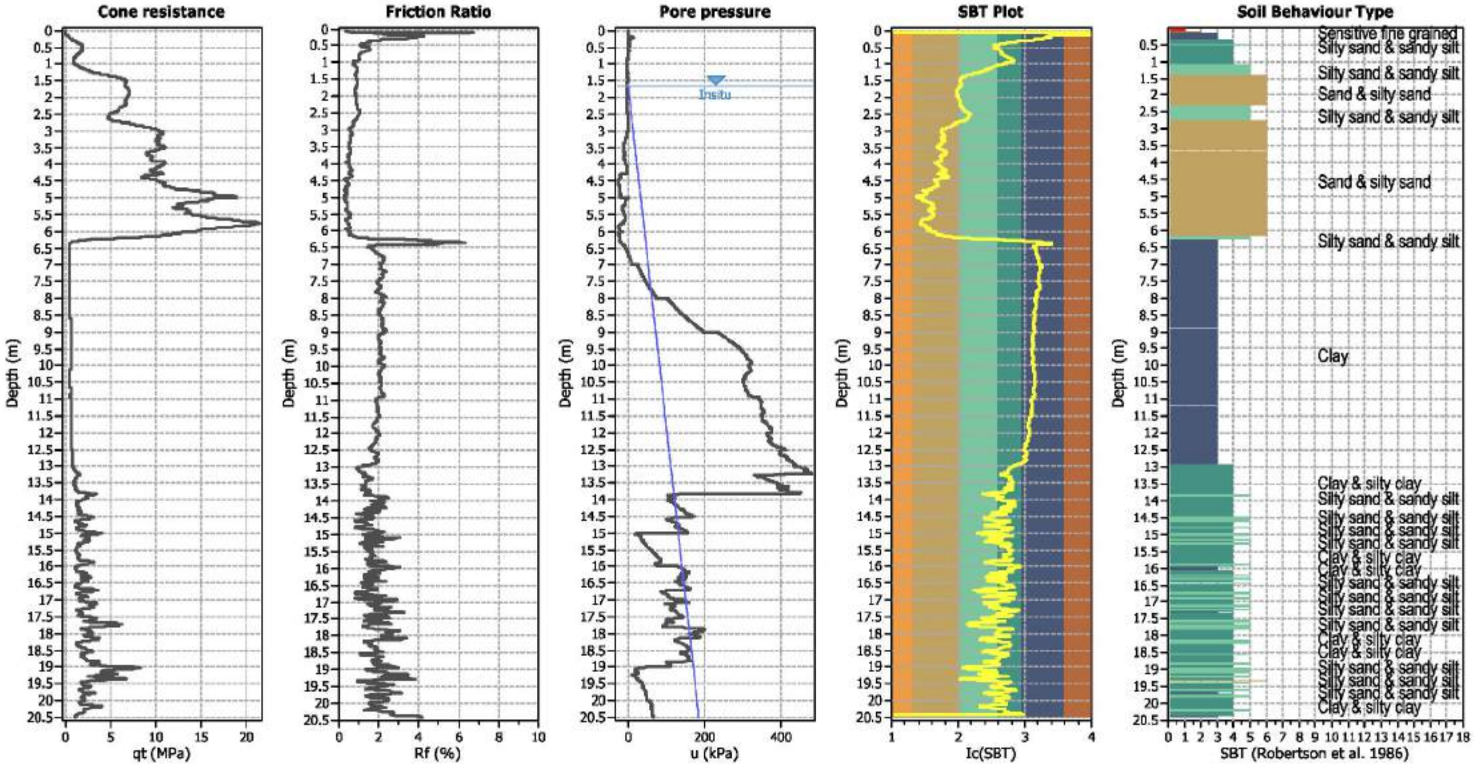
F.S. color scheme

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

LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

CPT basic interpretation plots



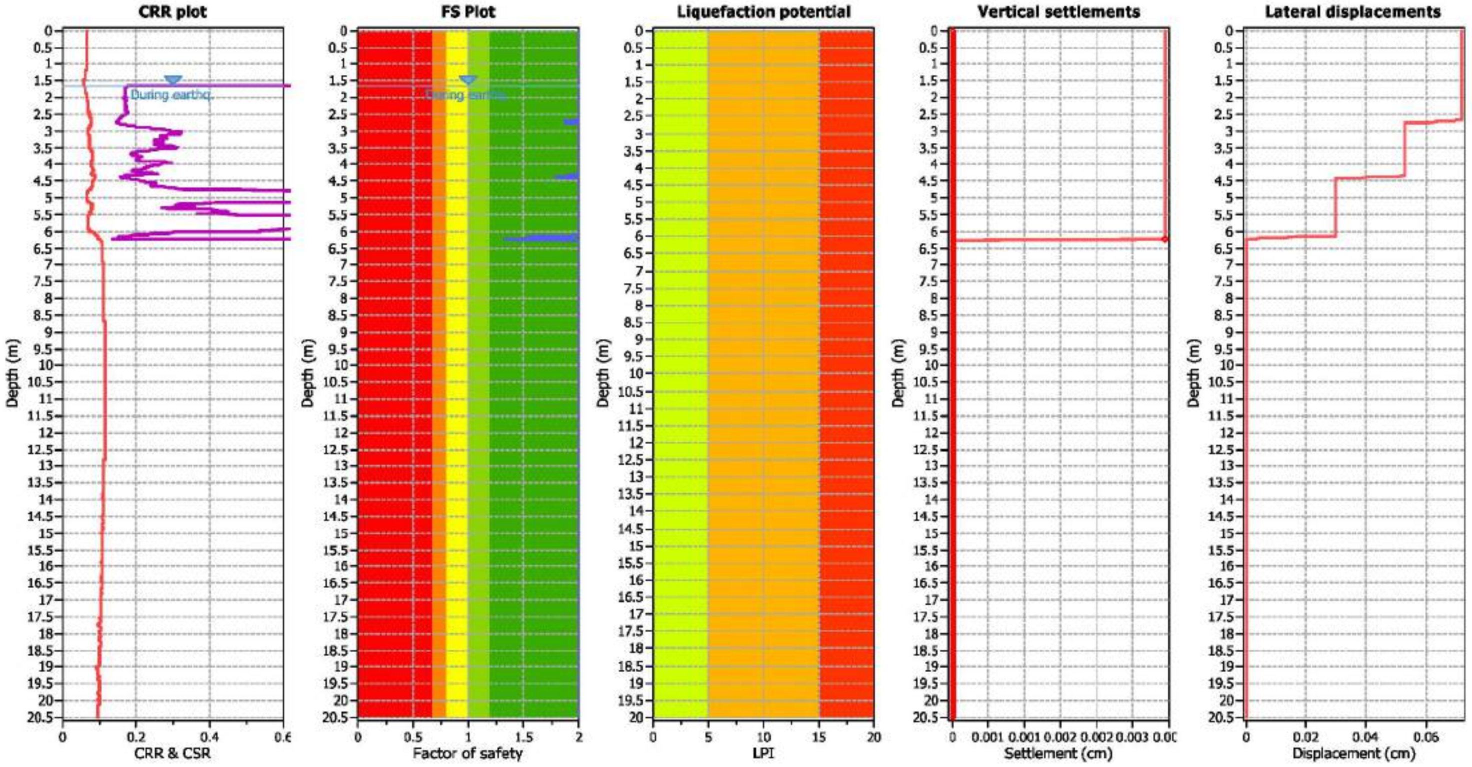
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.30
Peak ground acceleration: 0.12
Depth to water table (insitu): 1.65 m

Depth to GWT (erthq.): 1.65 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: Sands only
Limit depth applied: Yes
Limit depth: 10.00 m

F.S. color scheme

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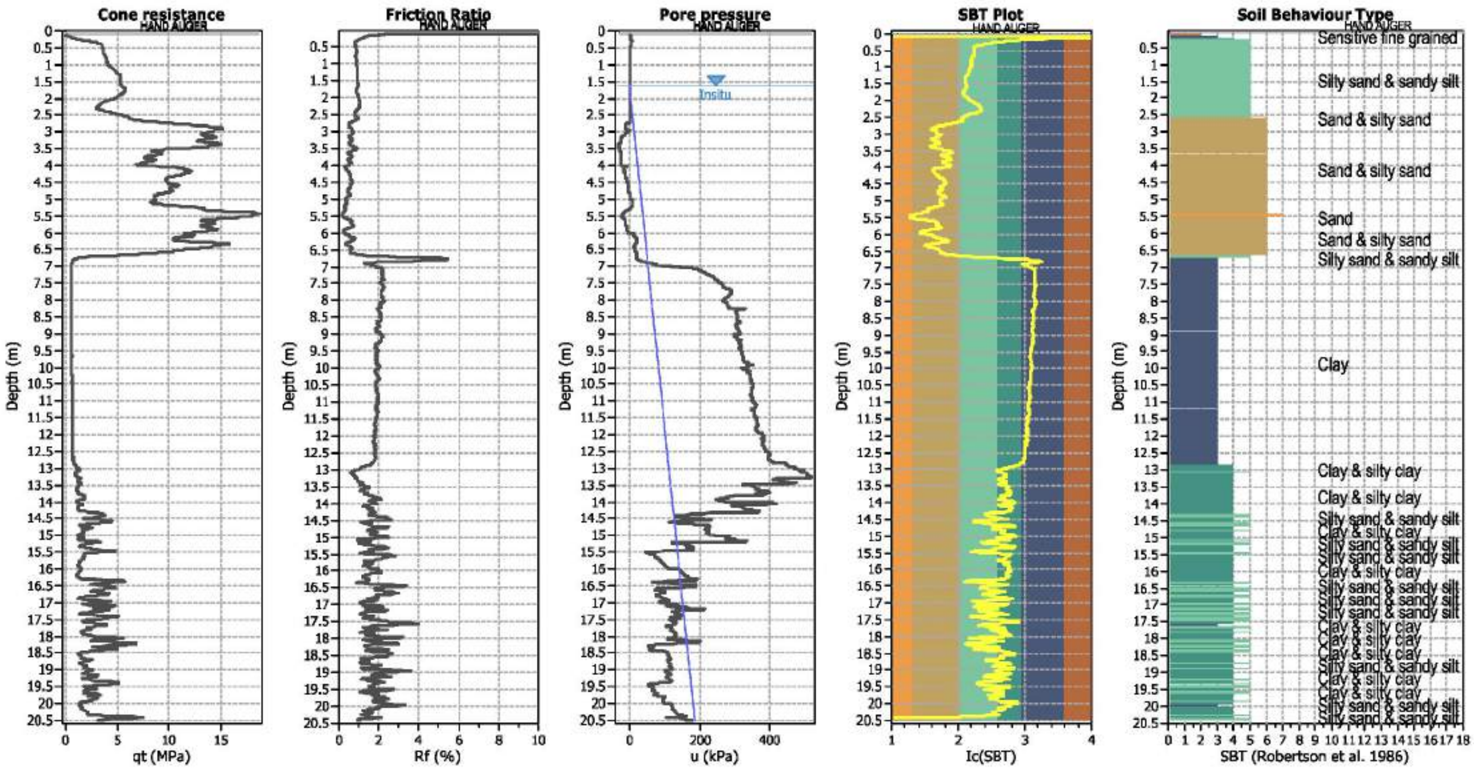
CPT basic interpretation plots



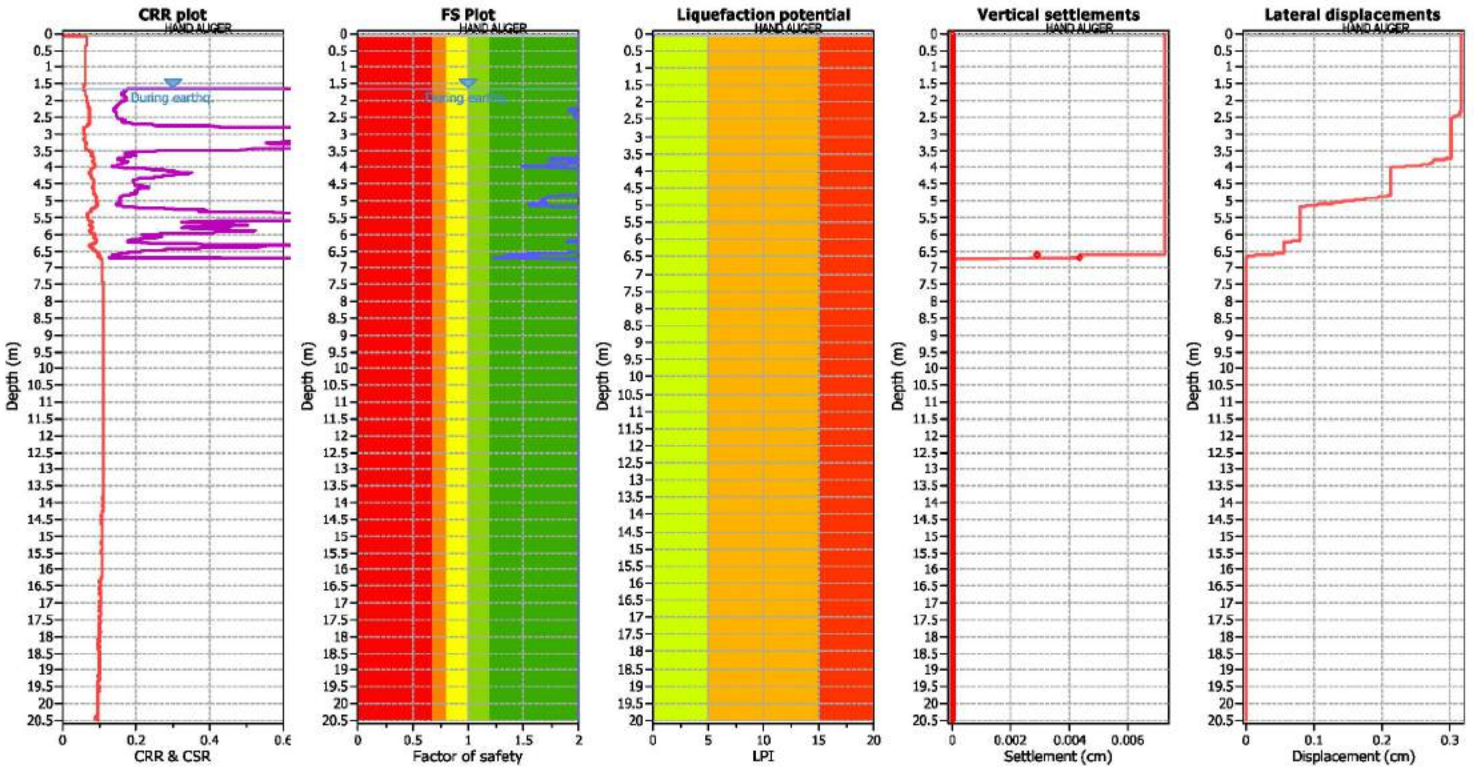
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

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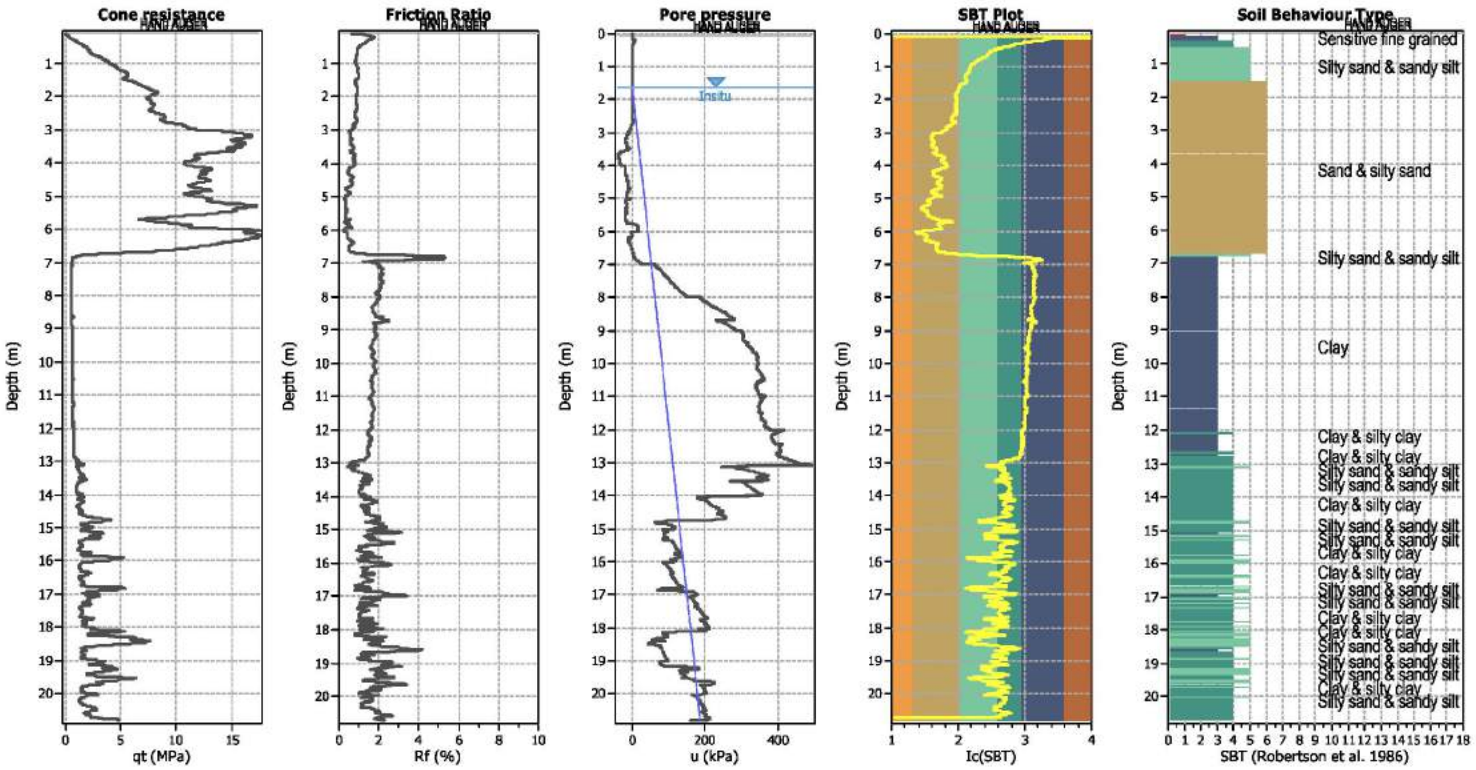
CPT basic interpretation plots



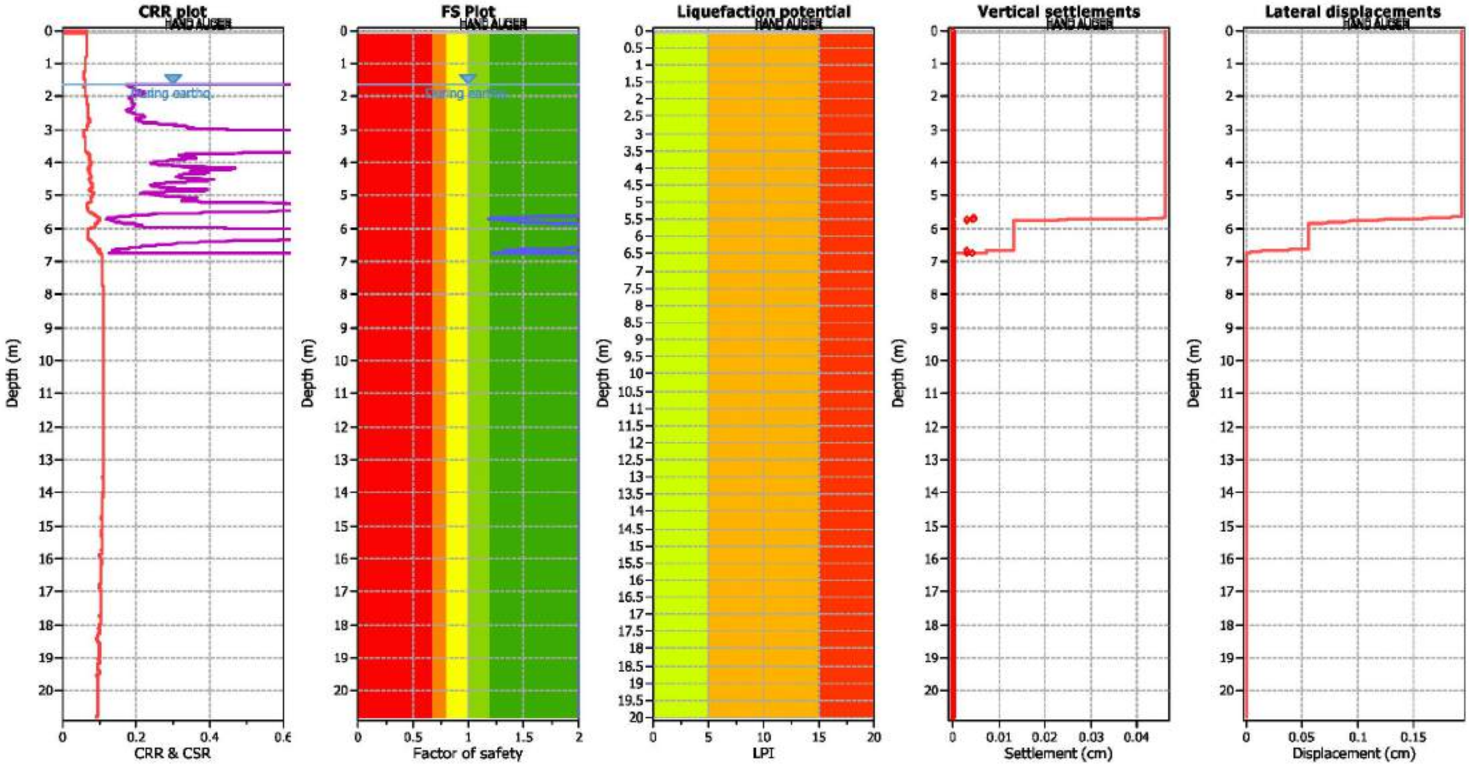
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
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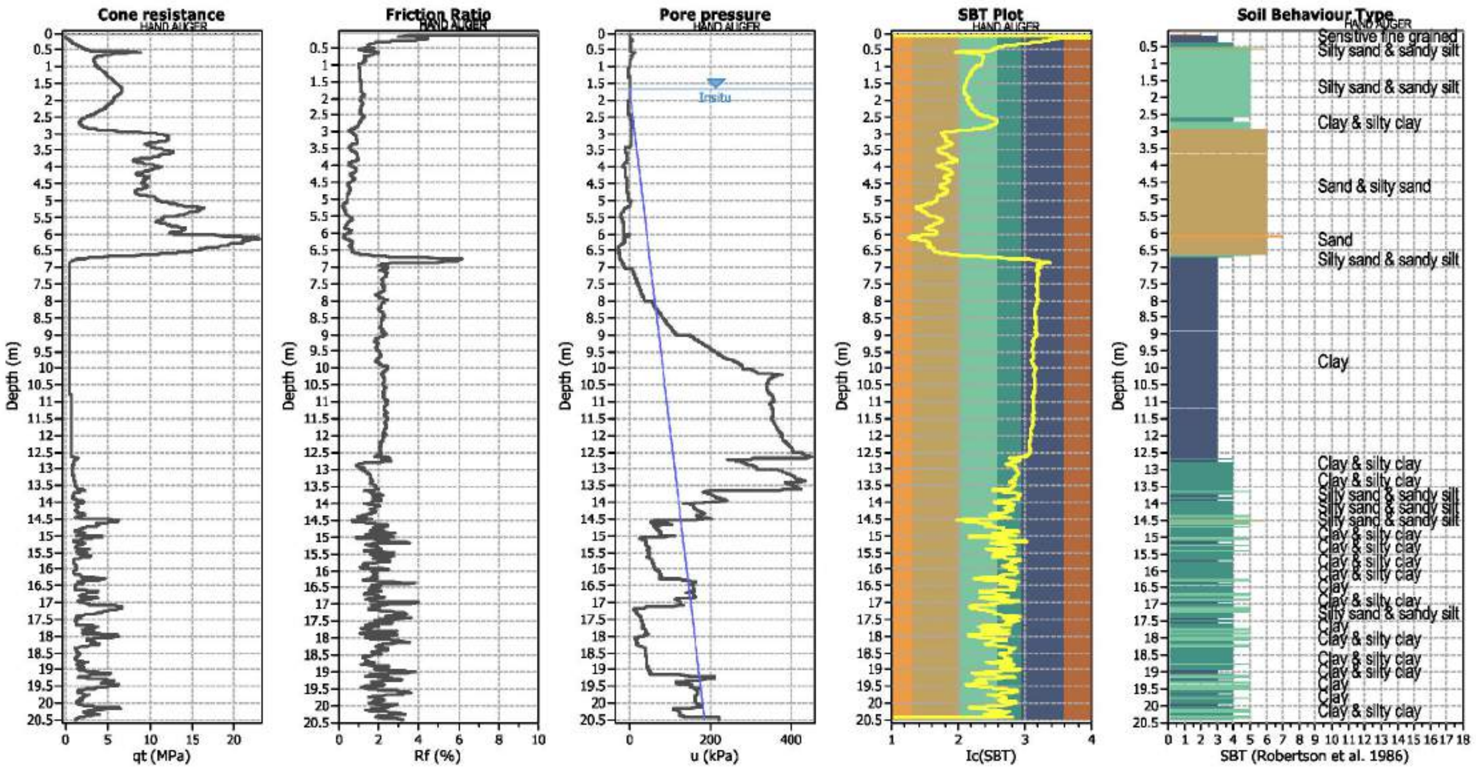
CPT basic interpretation plots



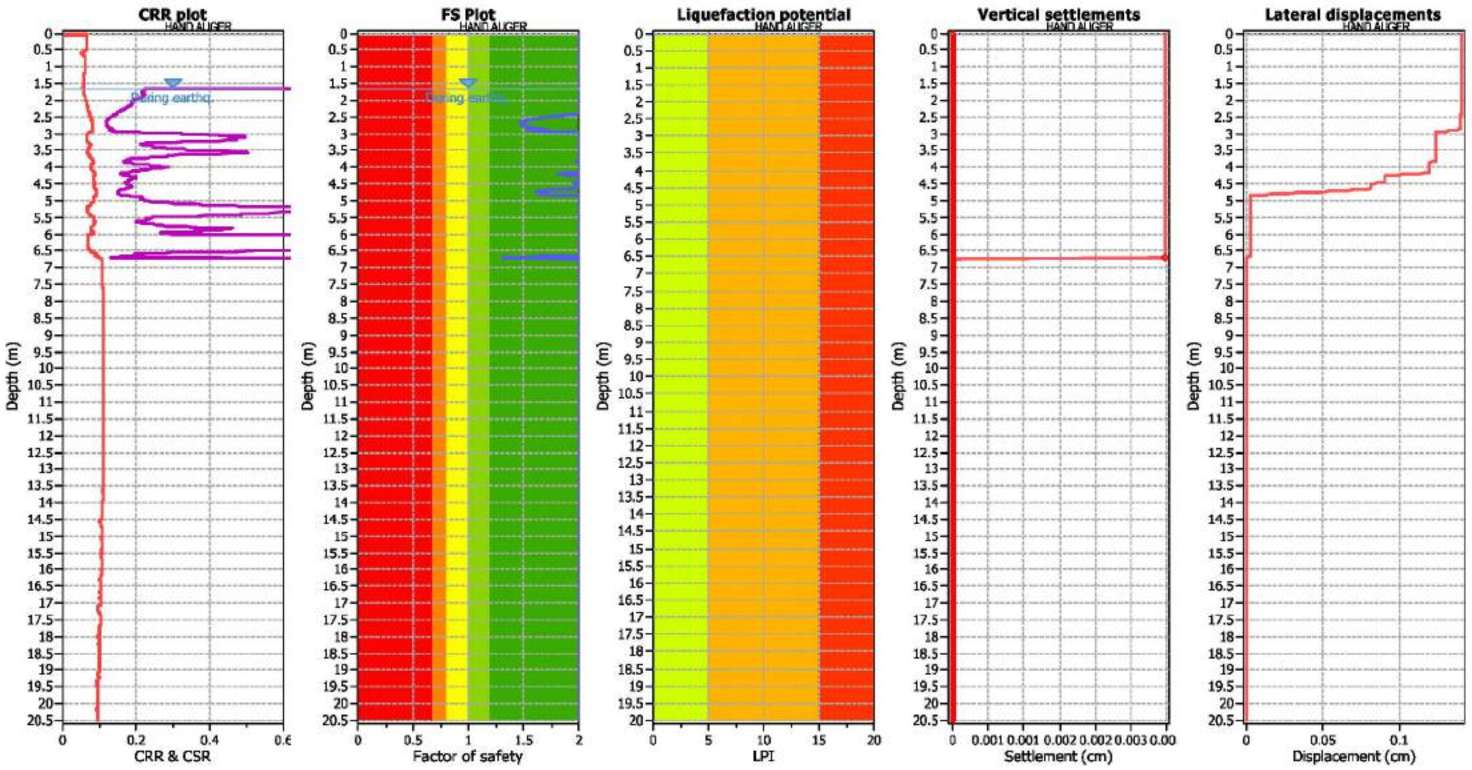
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
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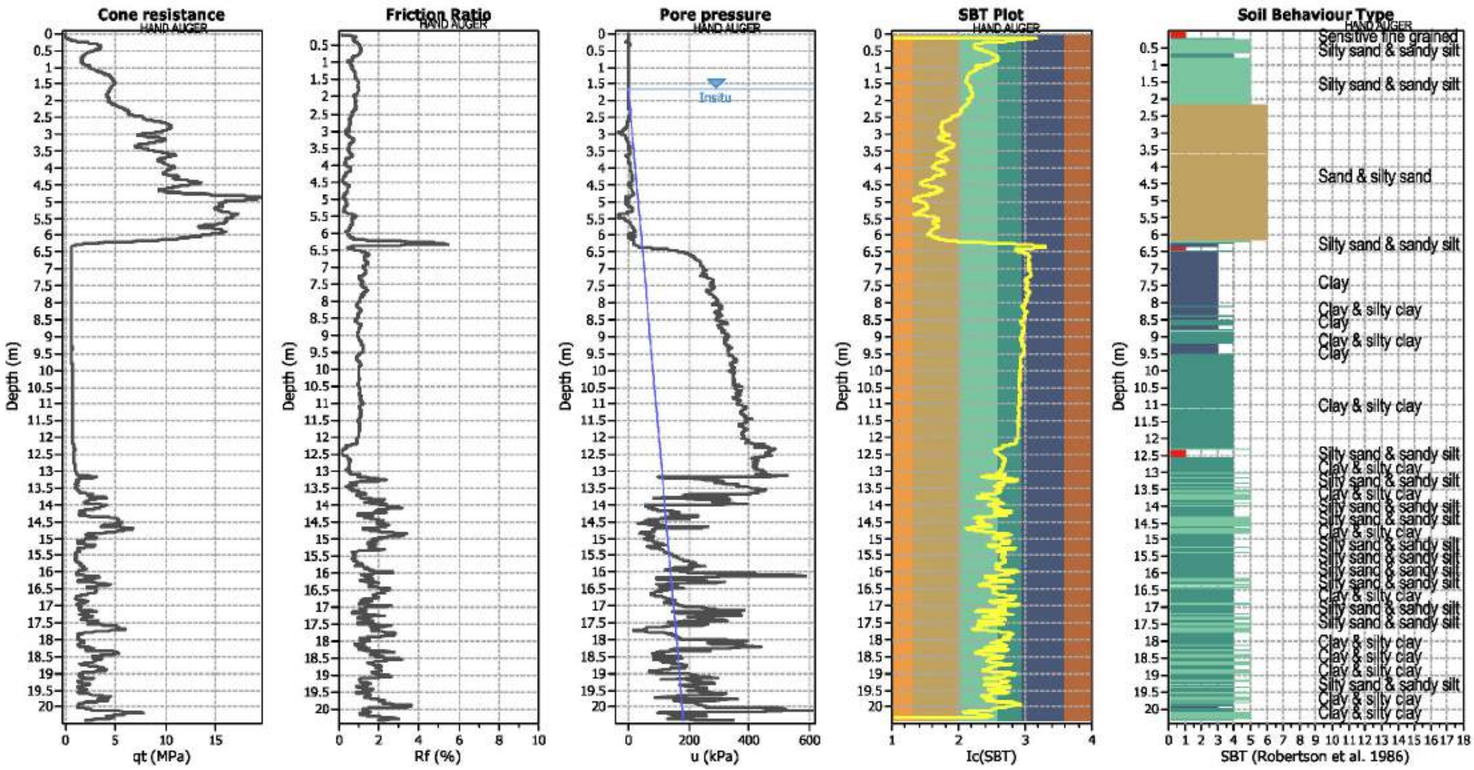
CPT basic interpretation plots



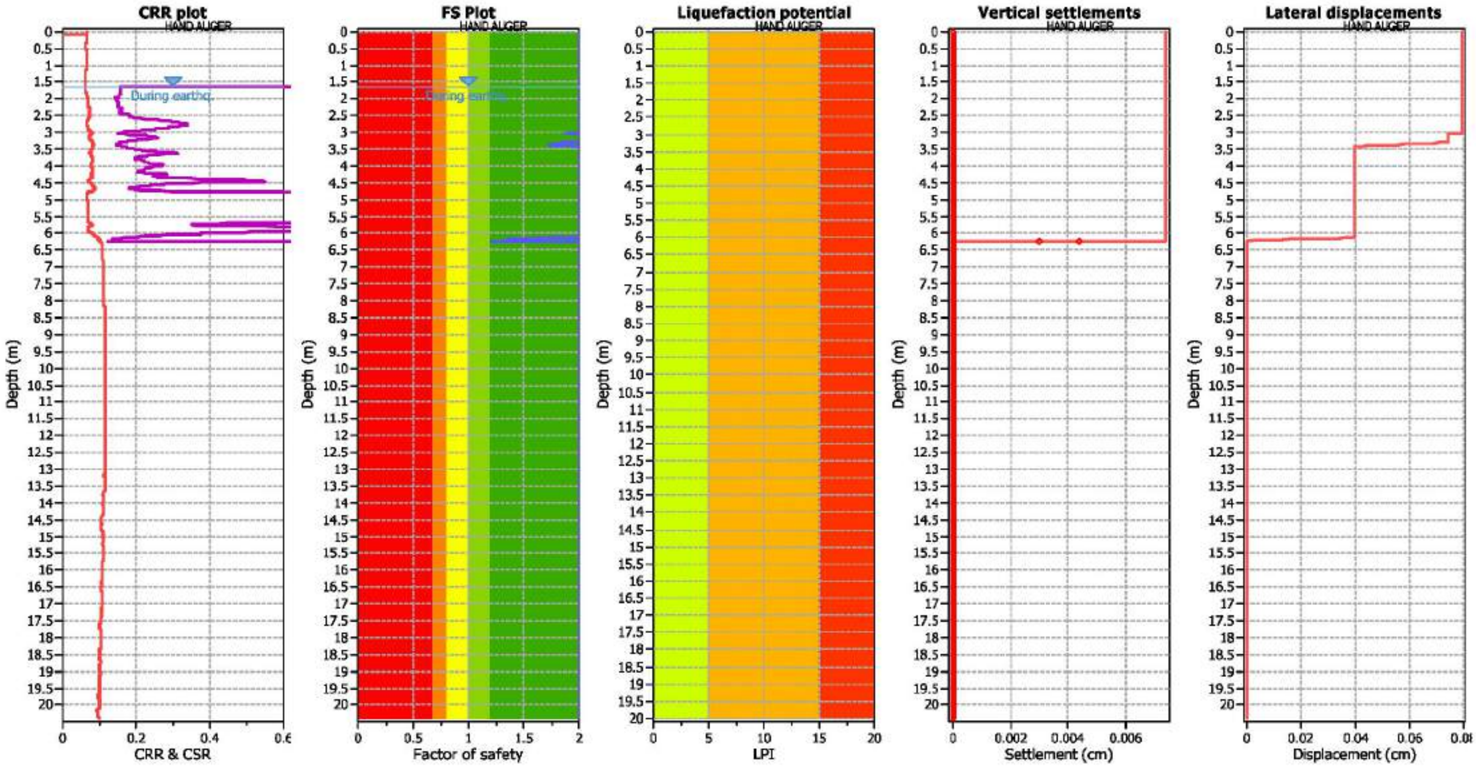
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
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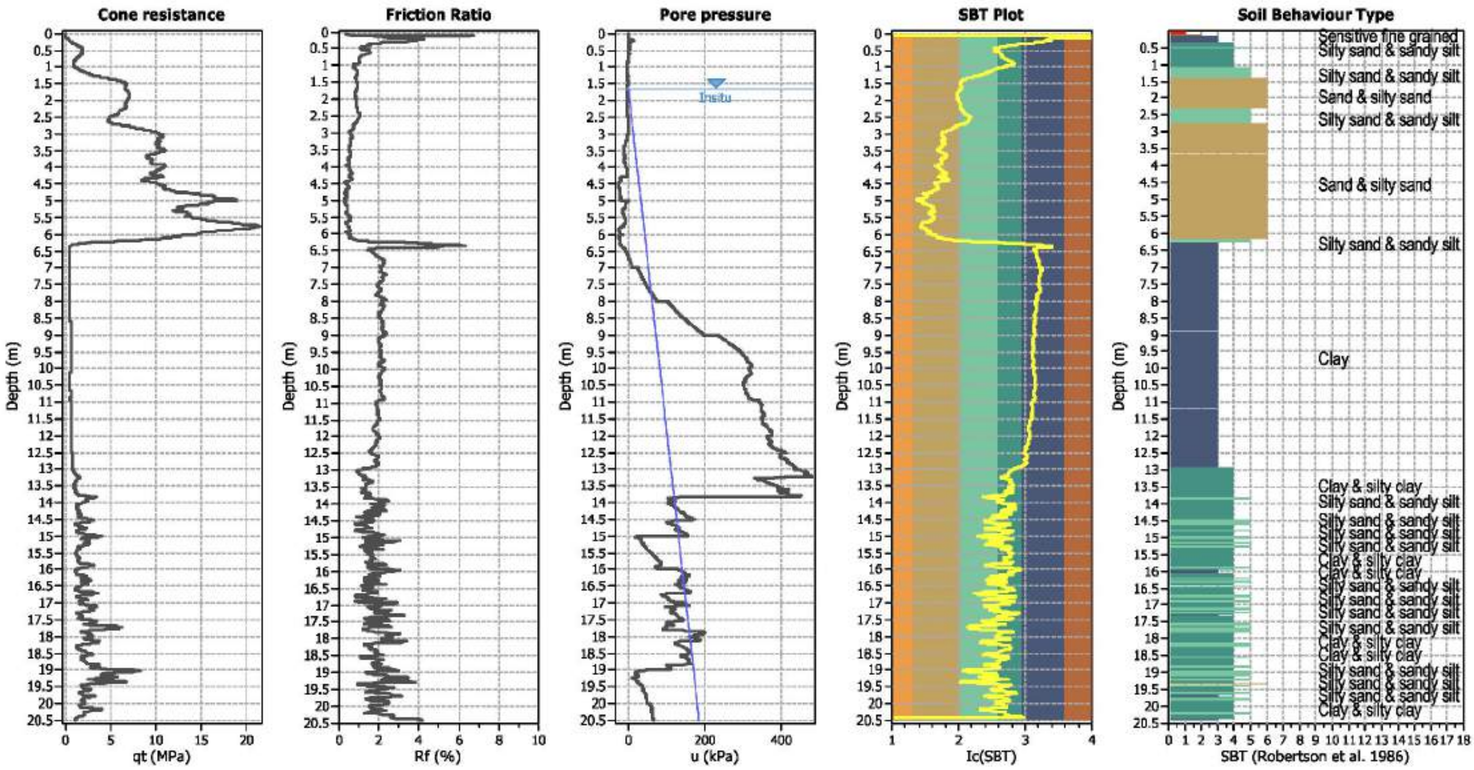
CPT basic interpretation plots



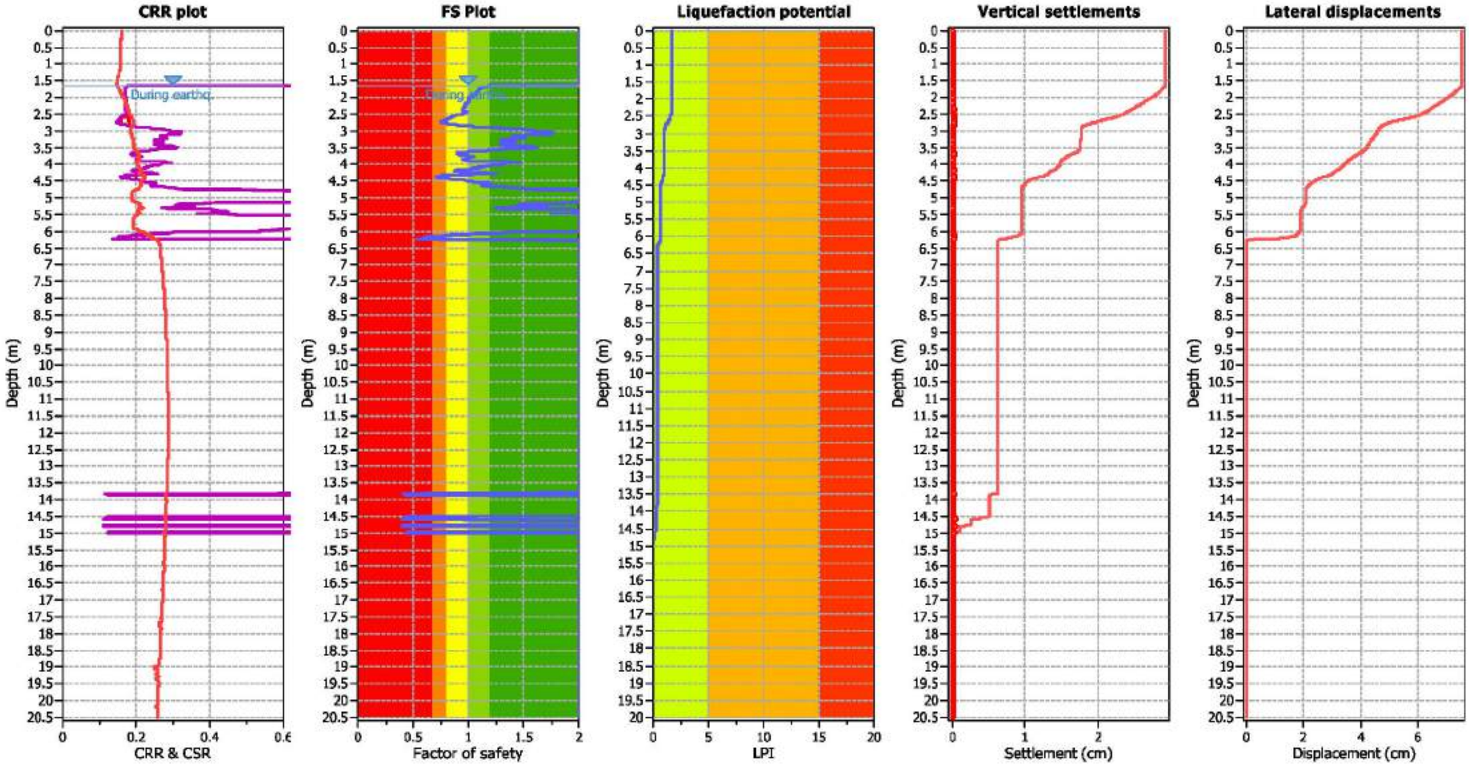
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

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LPI color scheme

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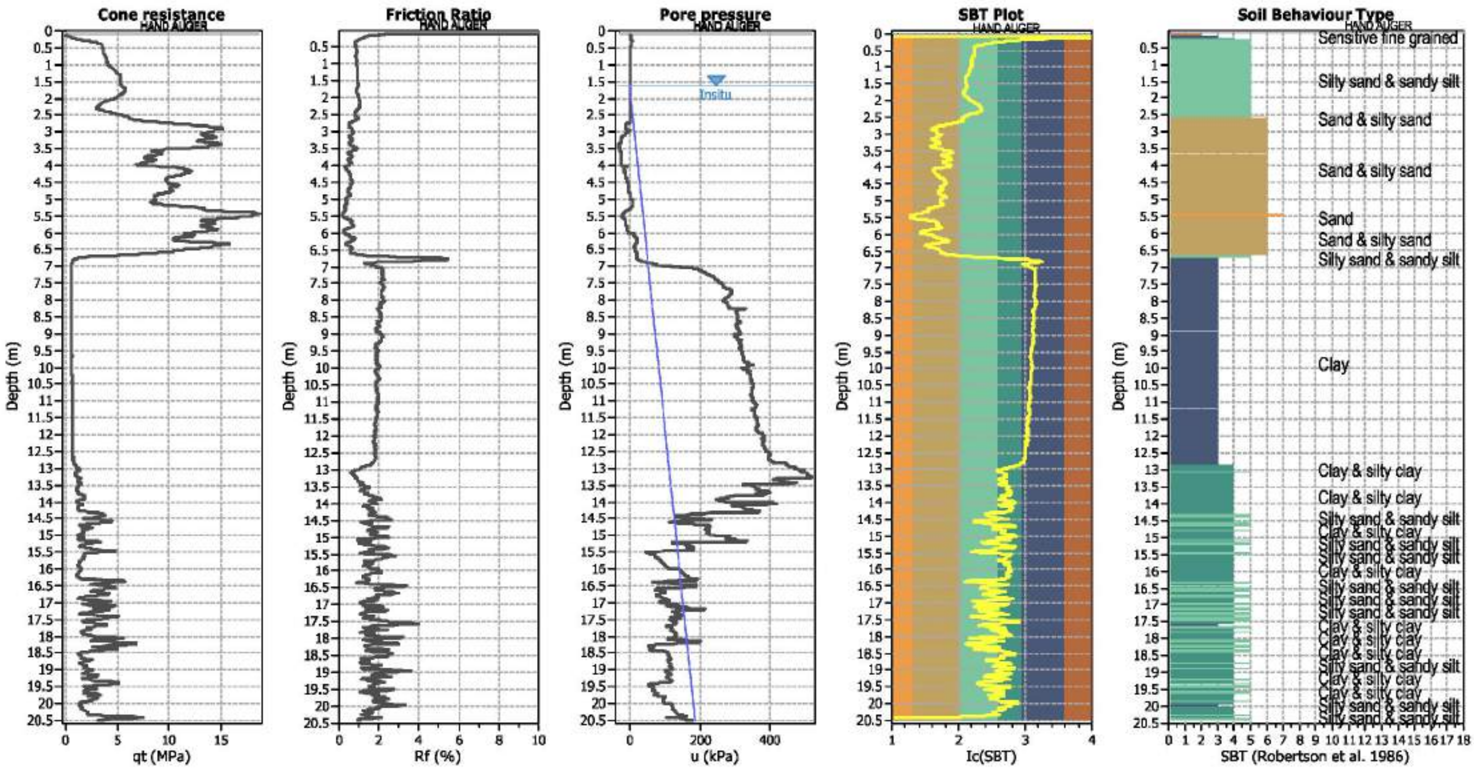
CPT basic interpretation plots



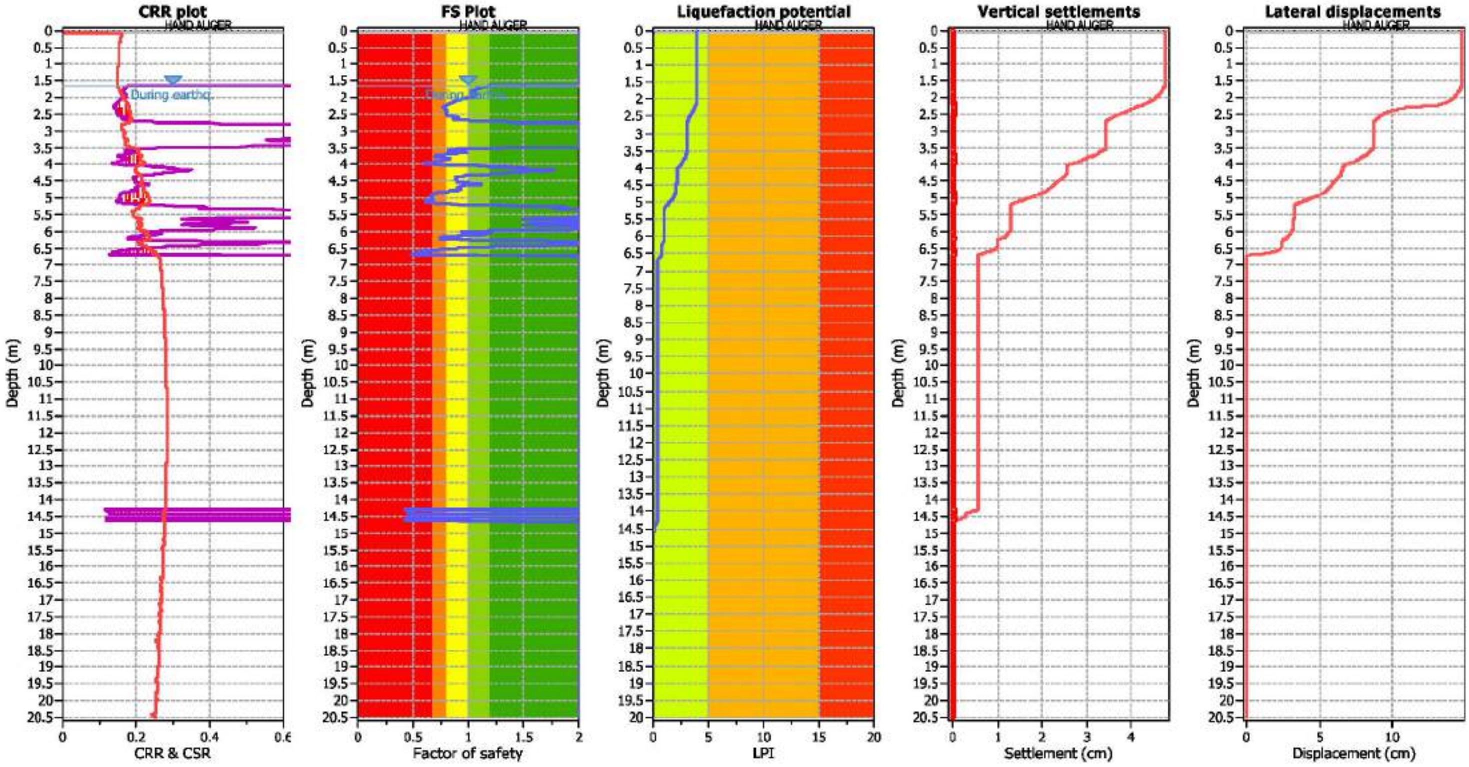
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

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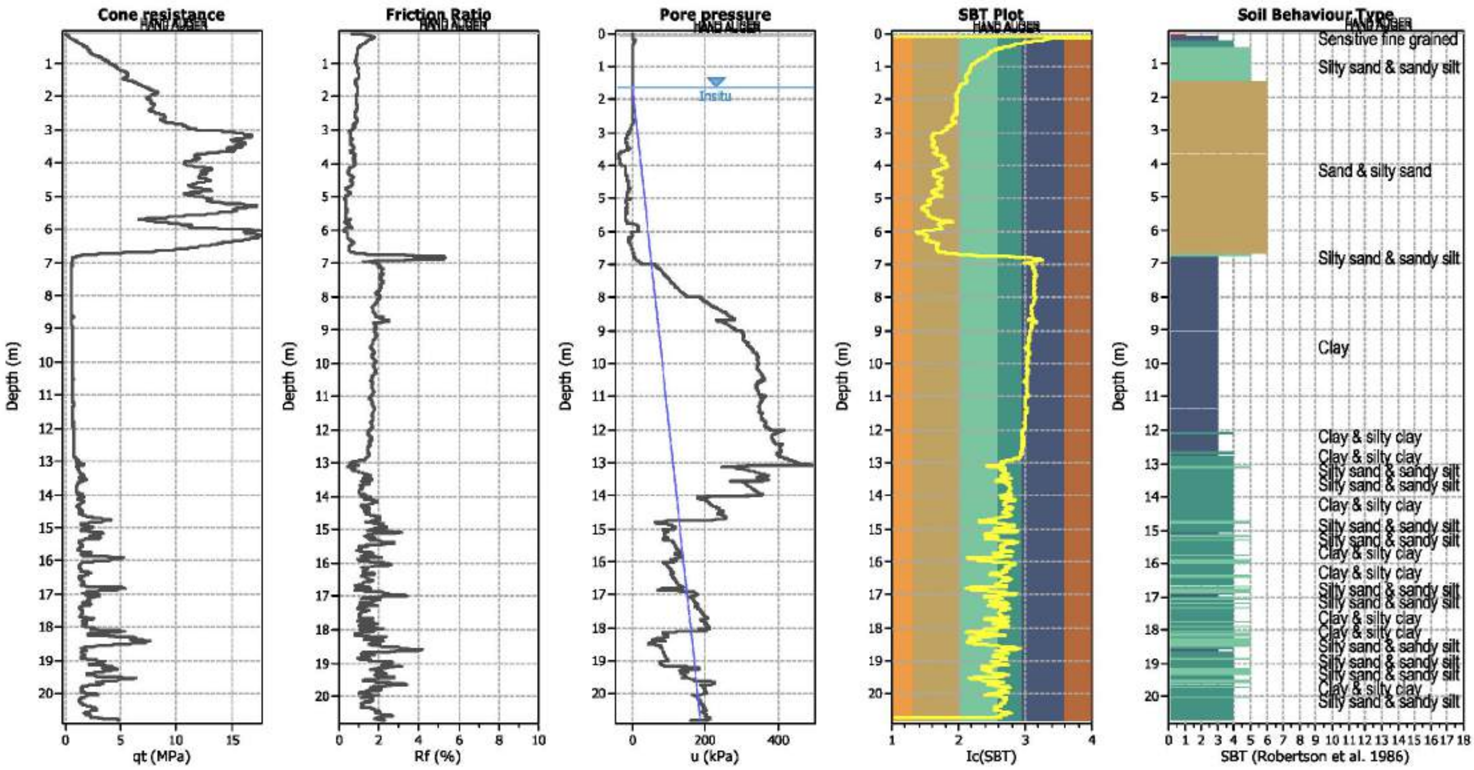
CPT basic interpretation plots



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: 6.80
Peak ground acceleration: 0.28
Depth to water table (insitu): 1.65 m

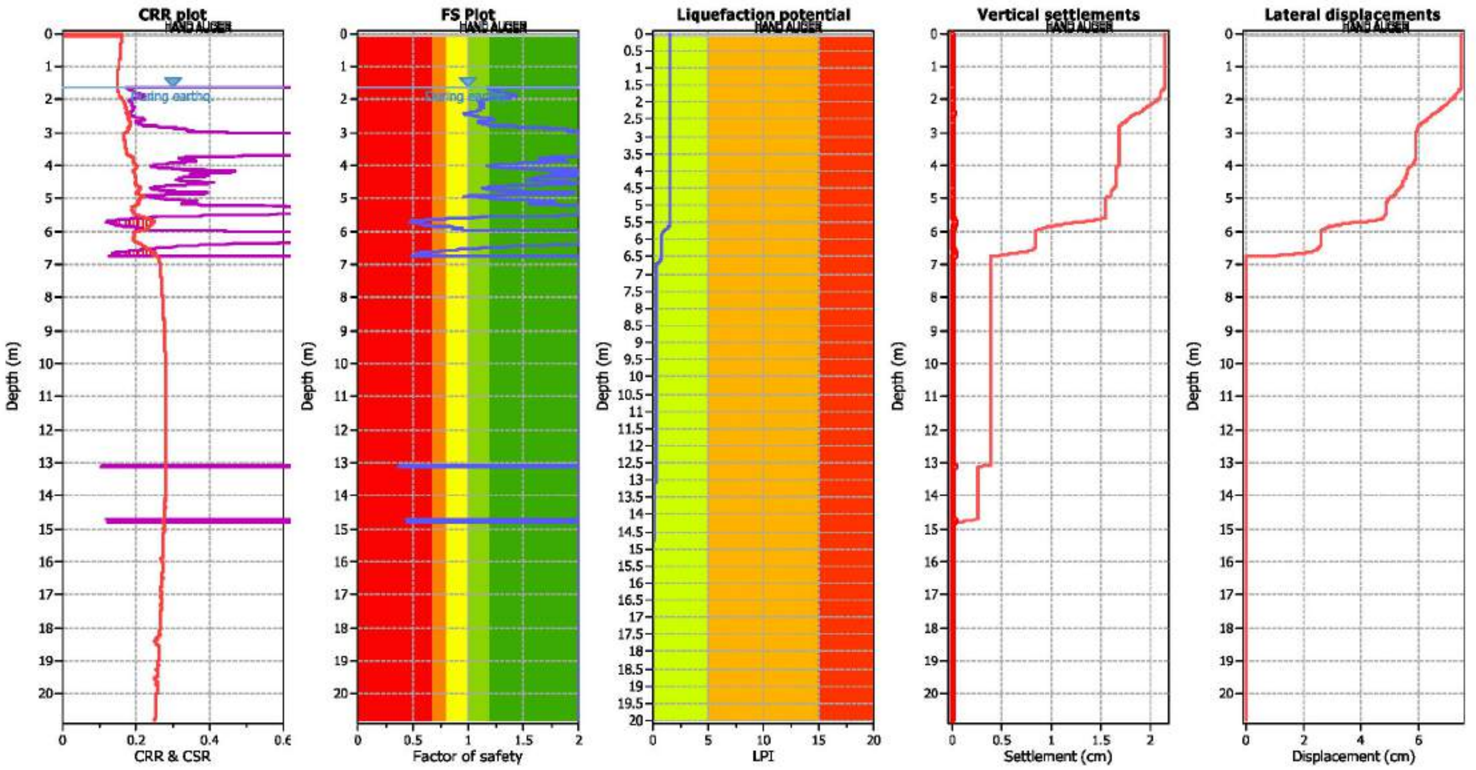
Depth to GWT (erthq.): 1.65 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
K_σ applied: Yes
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
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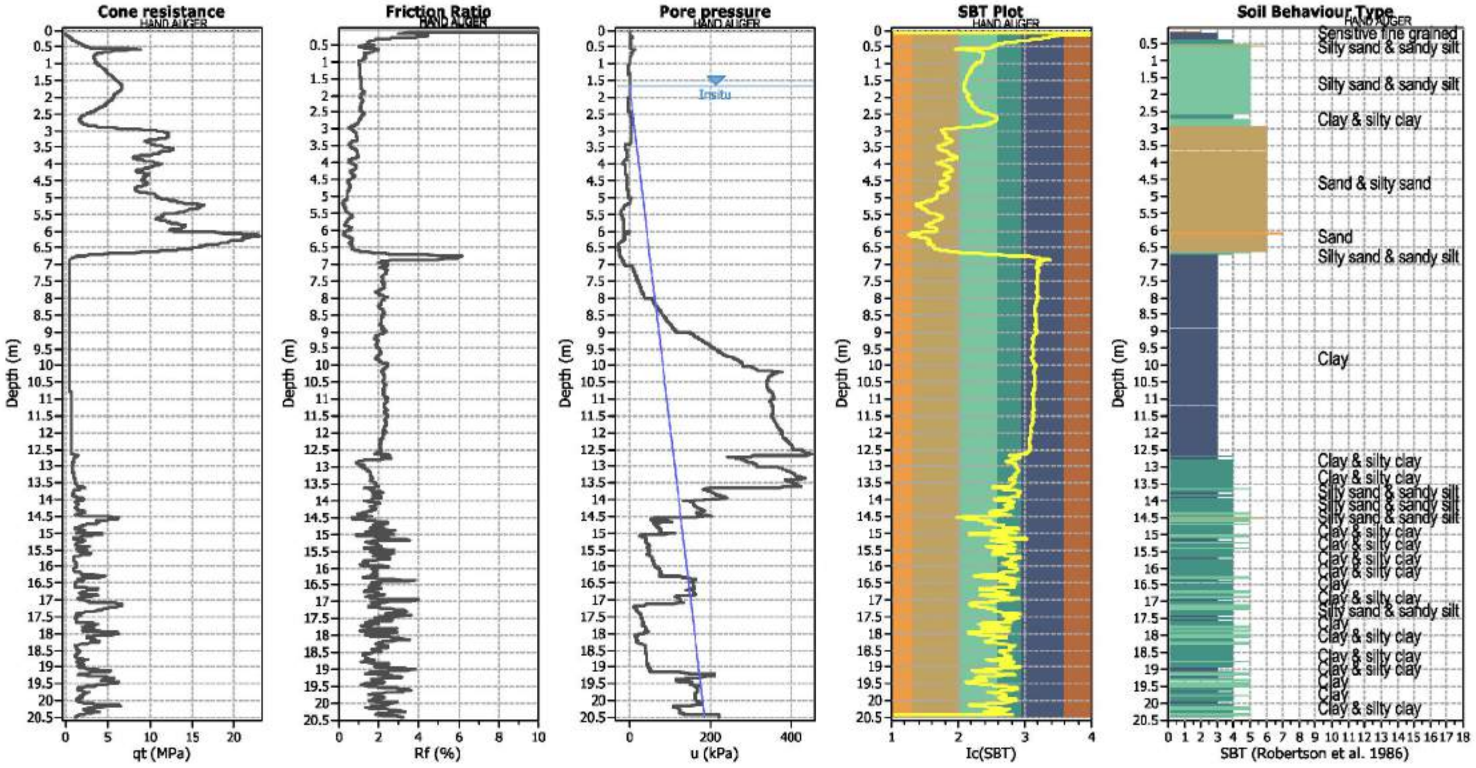

Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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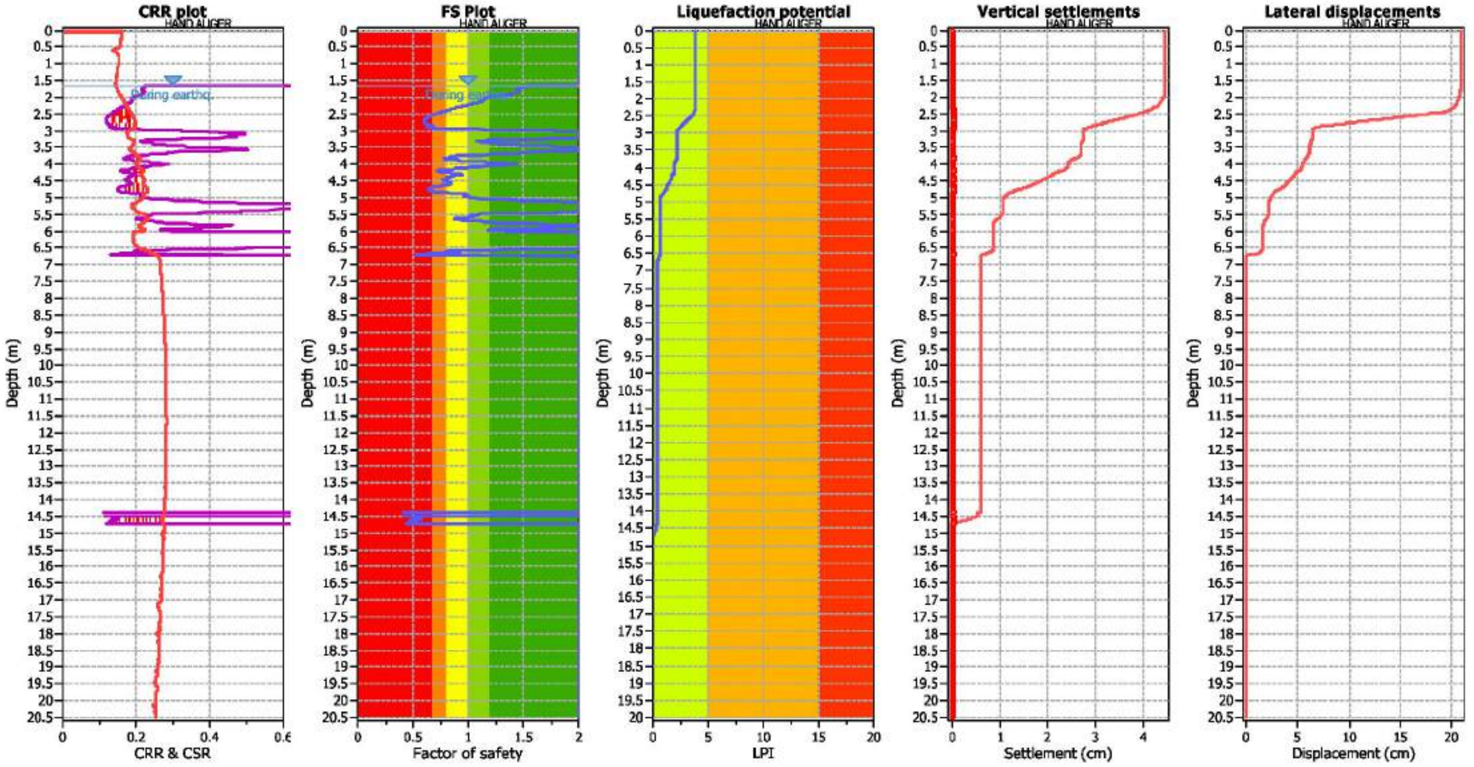
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	■ 8. Very stiff sand to
🟦 3. Clay to silty clay	🟨 6. Clean sand to silty sand	☐ 9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
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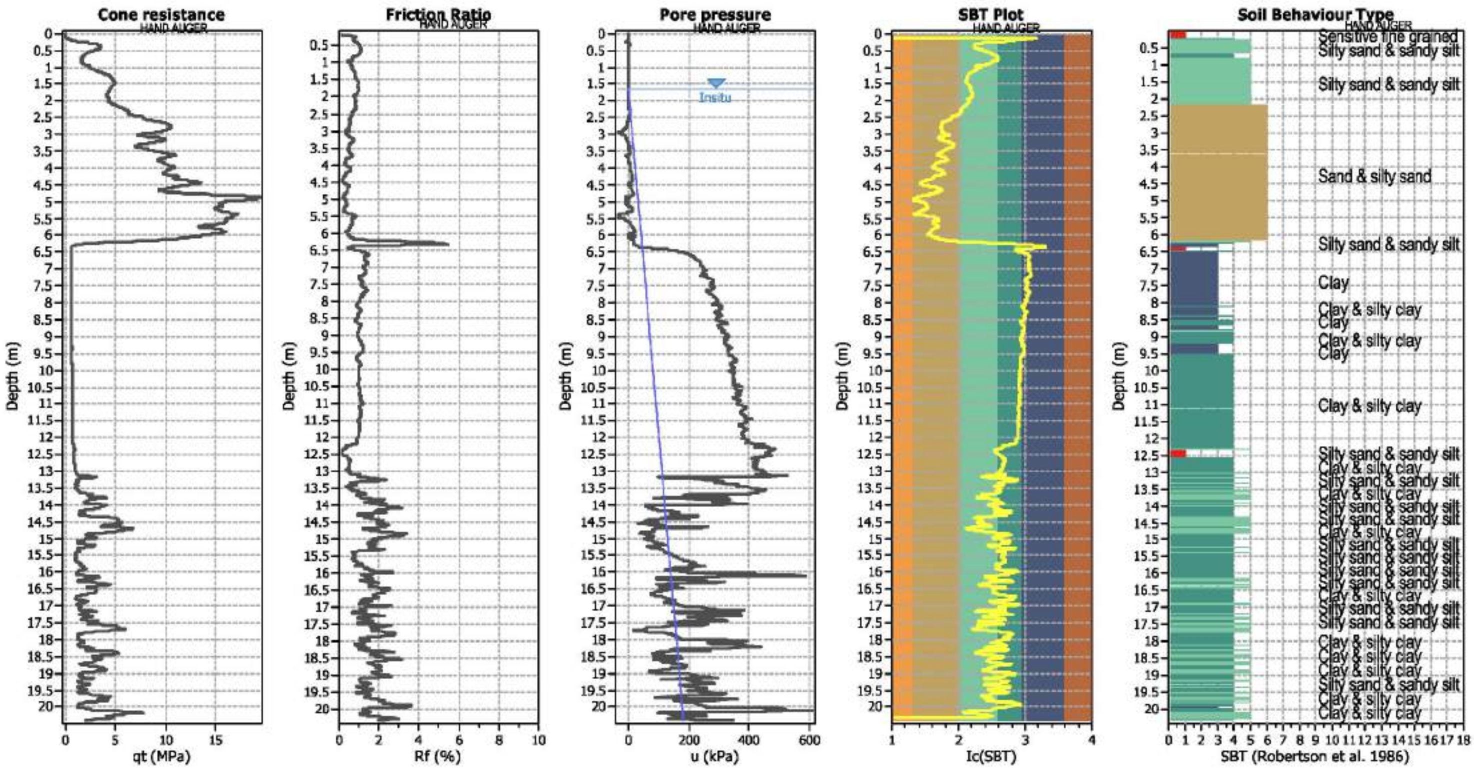
CPT basic interpretation plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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
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Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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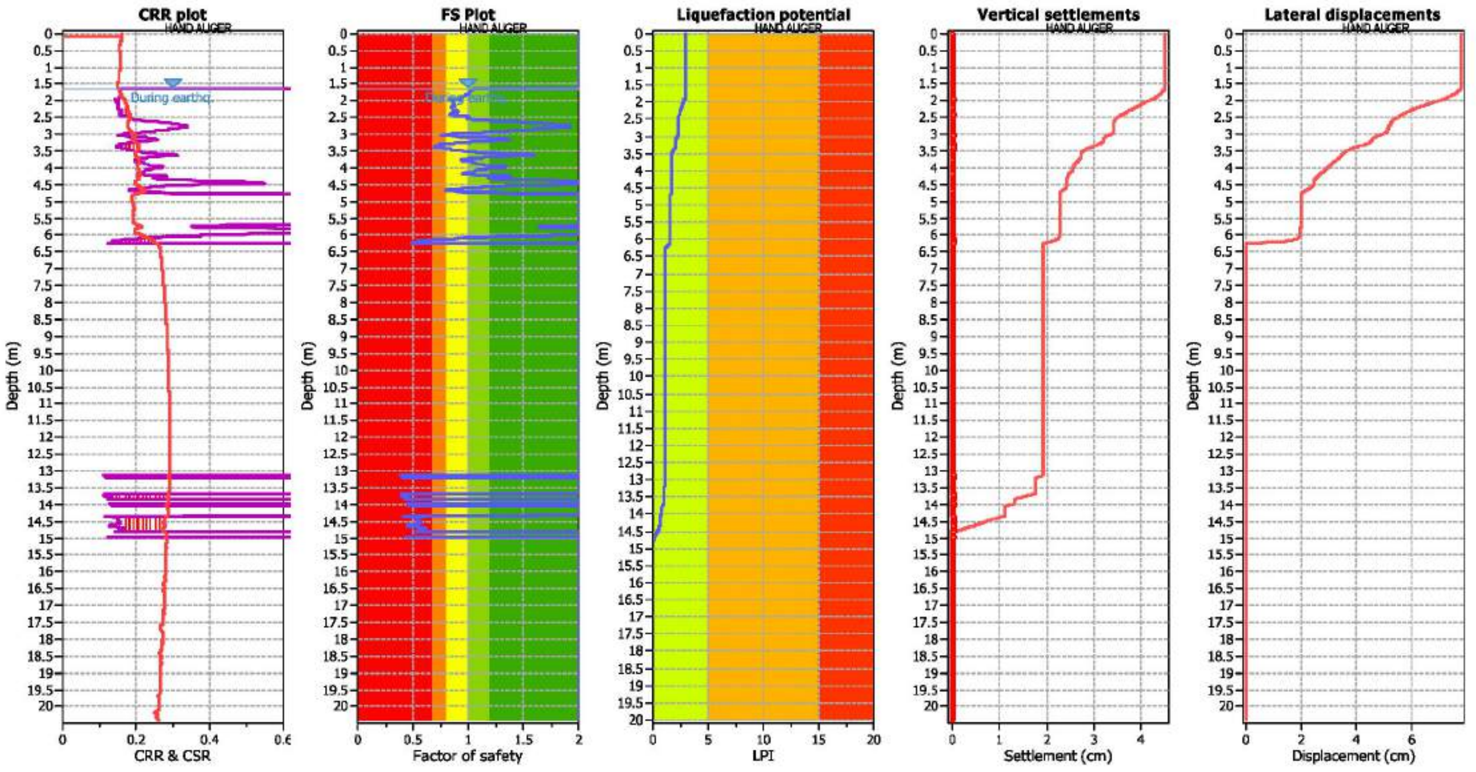
Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

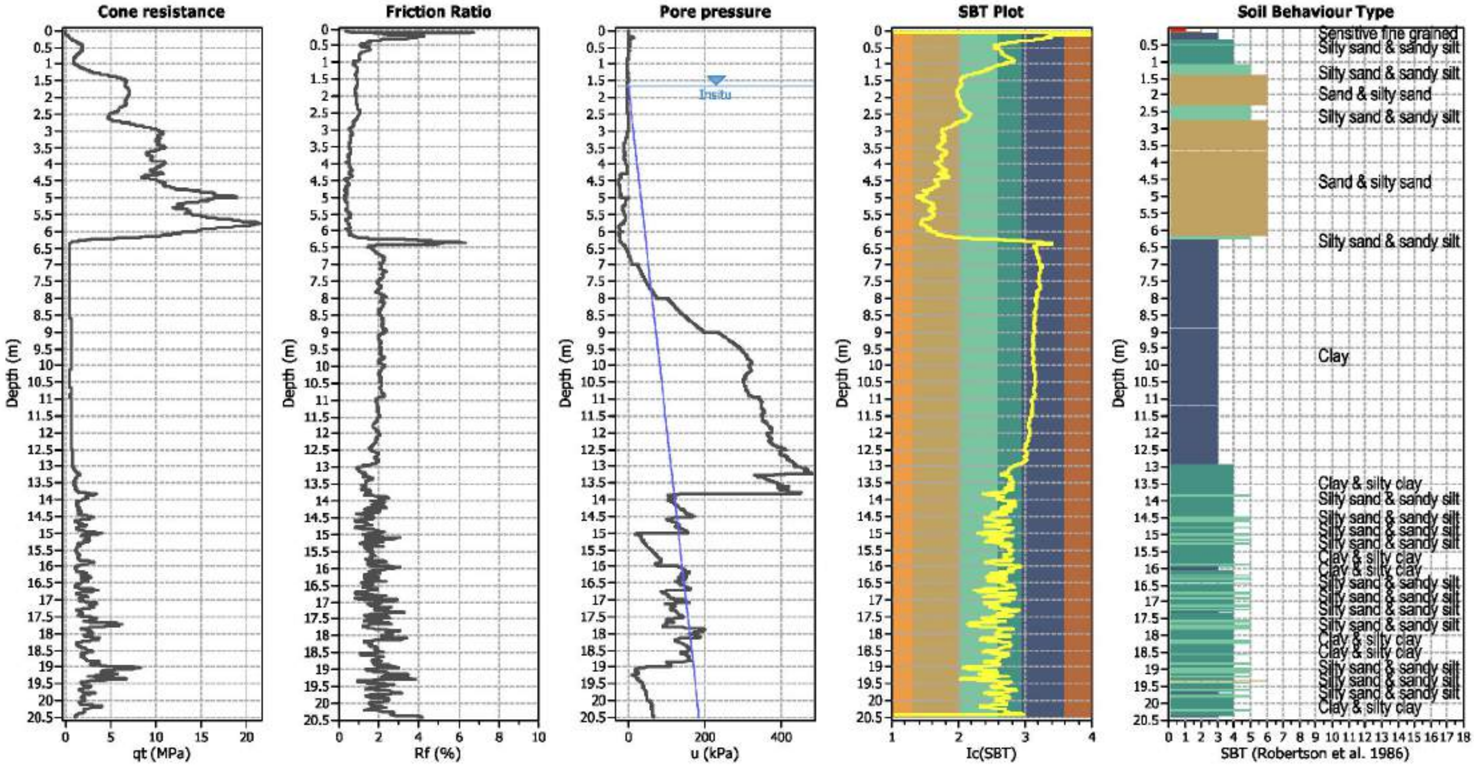
F.S. color scheme

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

LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

CPT basic interpretation plots



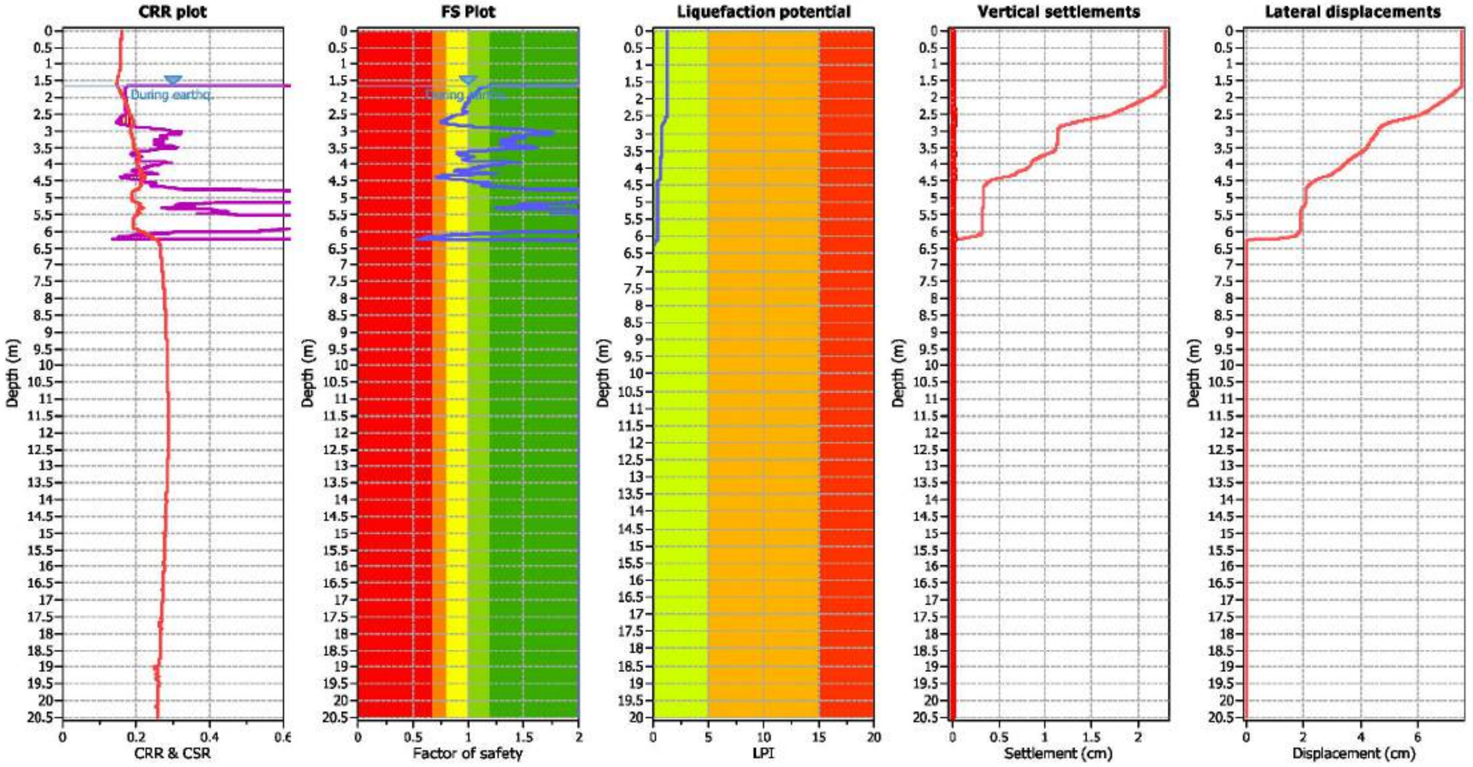
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.80
Peak ground acceleration: 0.28
Depth to water table (insitu): 1.65 m

Depth to GWT (erthq.): 1.65 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: Sands only
Limit depth applied: Yes
Limit depth: 10.00 m

F.S. color scheme

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LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
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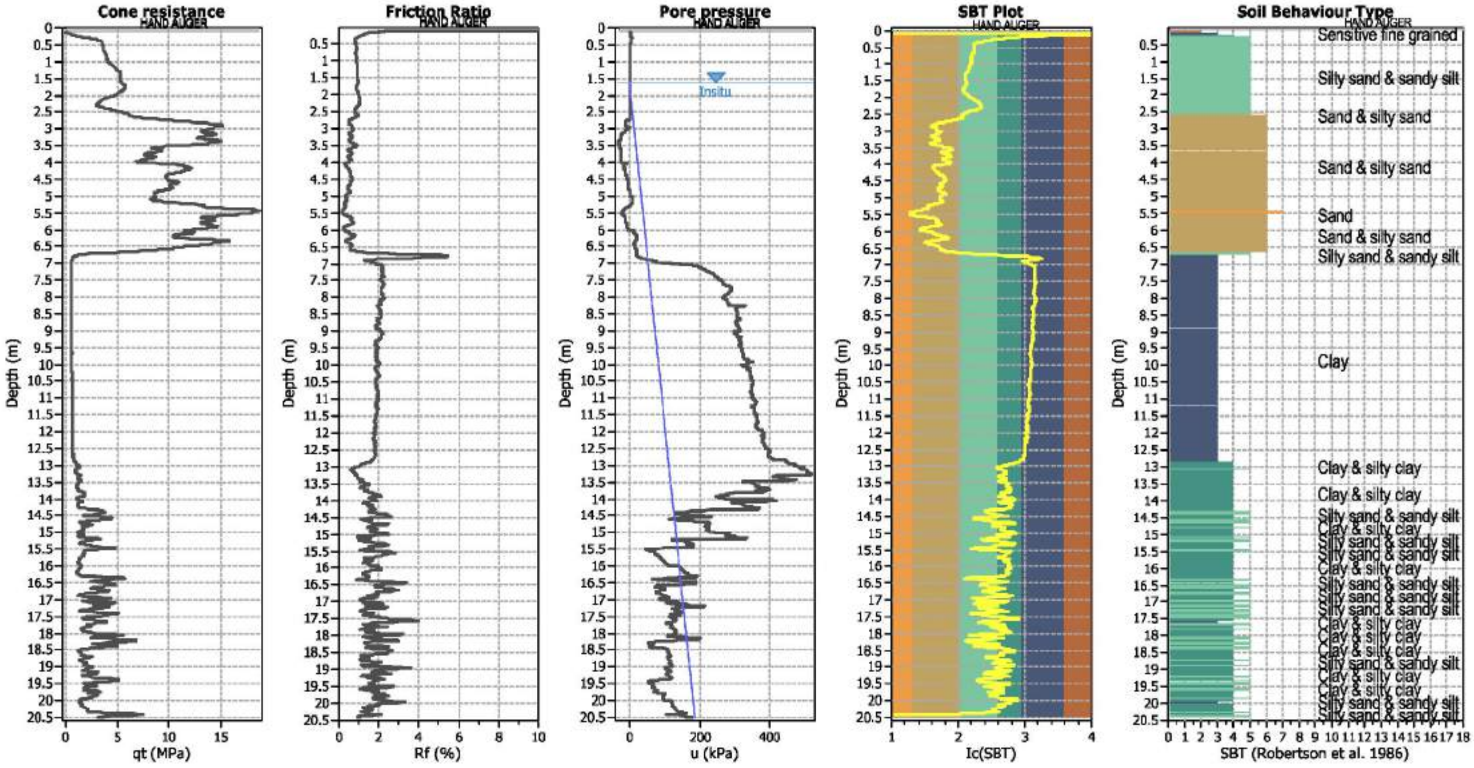
CPT basic interpretation plots



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: 6.80
Peak ground acceleration: 0.28
Depth to water table (insitu): 1.65 m

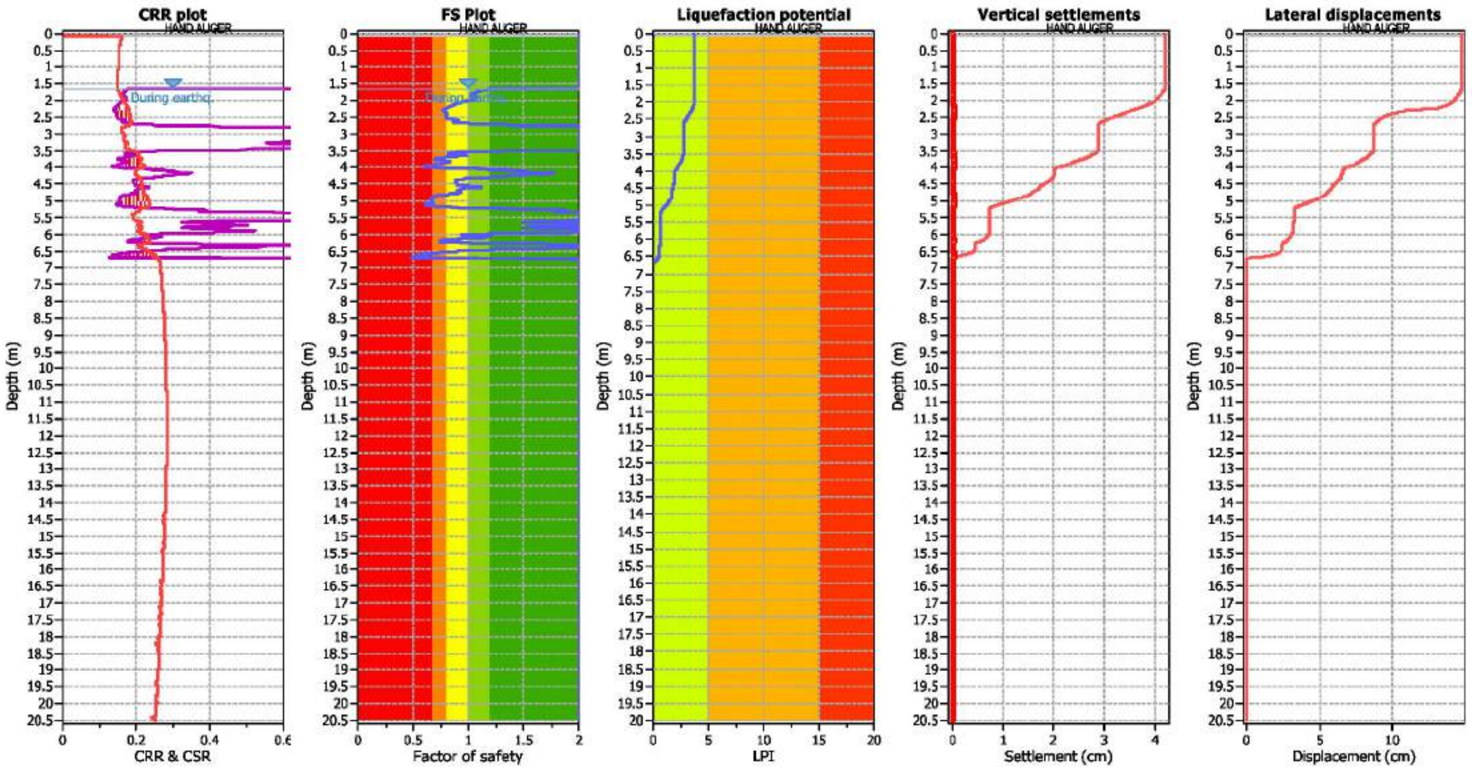
Depth to GWT (erthq.): 1.65 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
K_σ applied: Yes
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

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LPI color scheme

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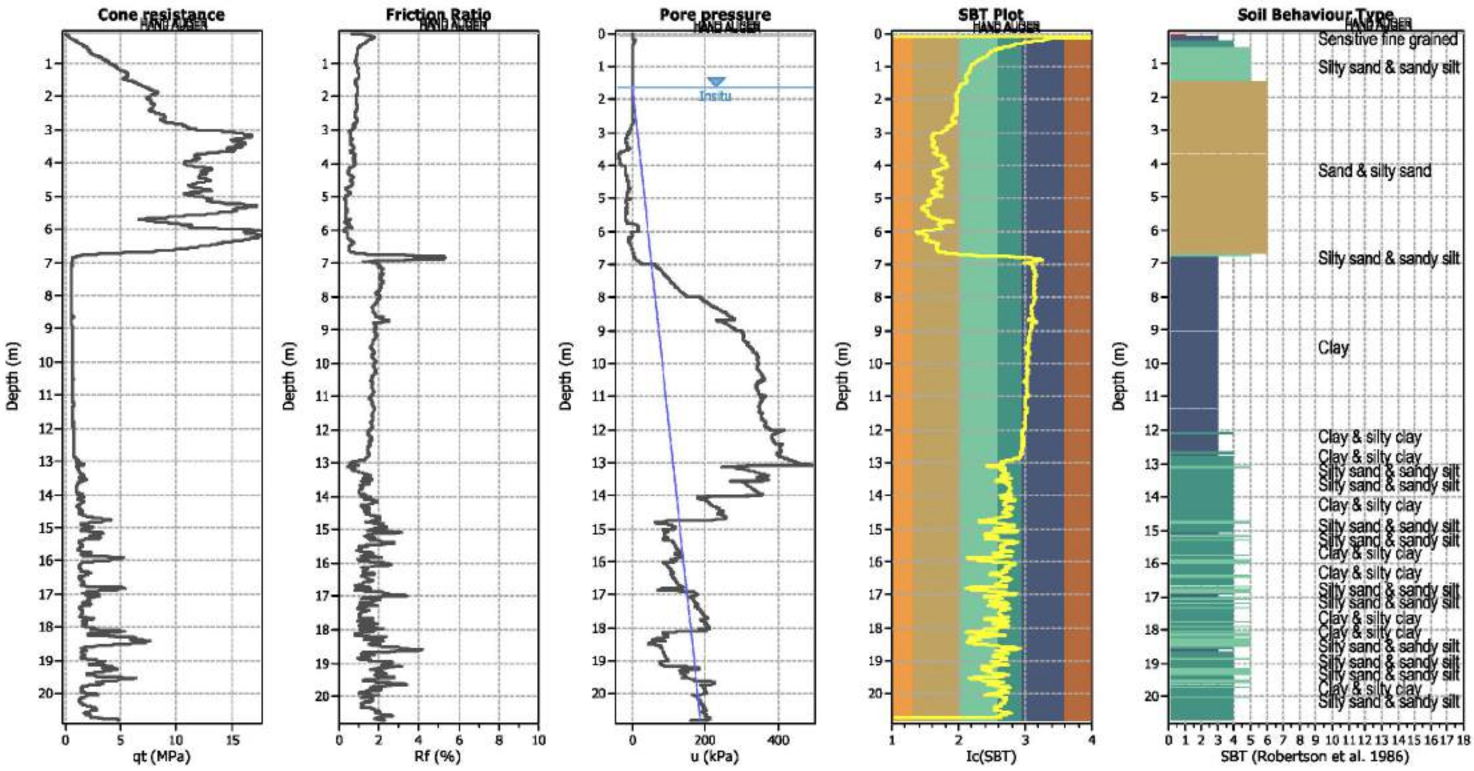
CPT basic interpretation plots



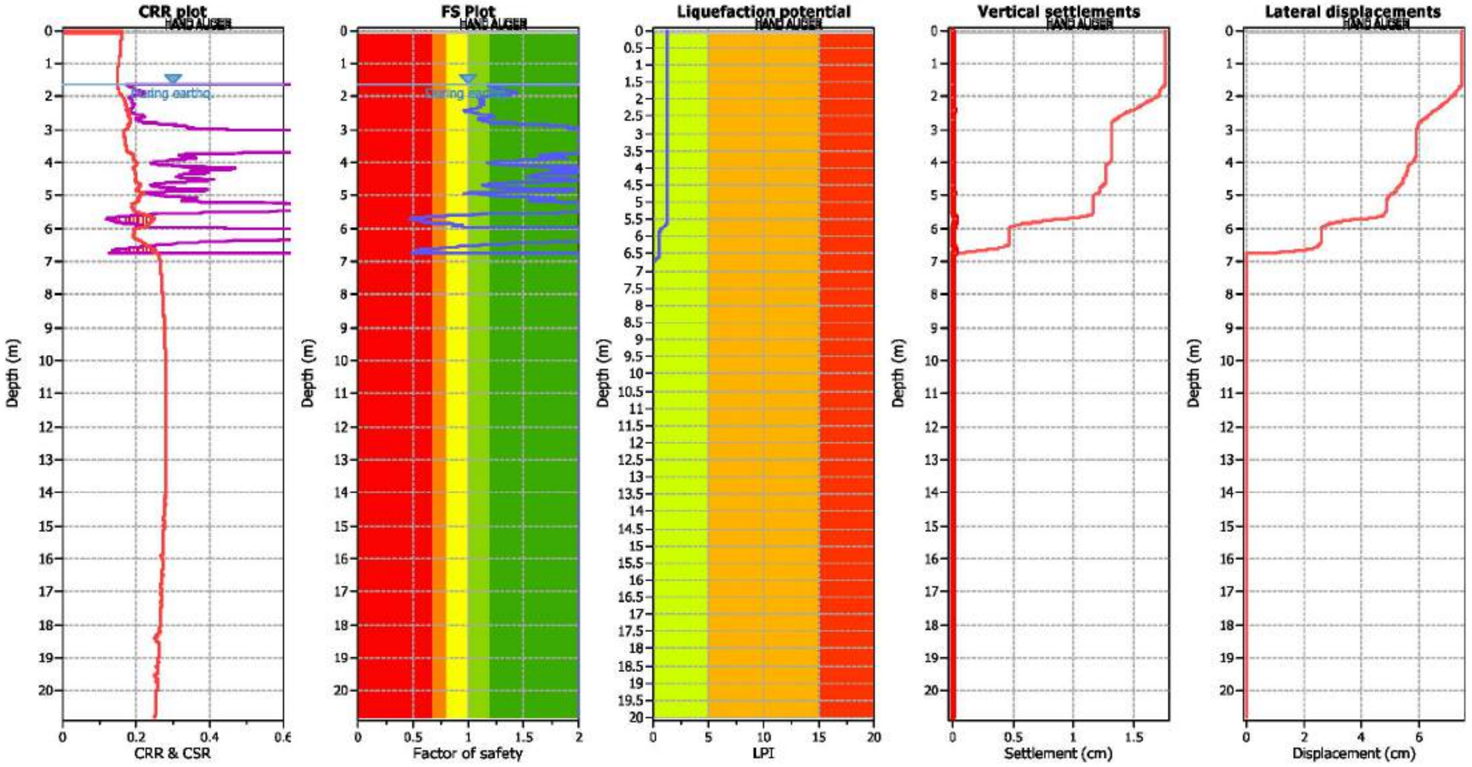
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.80
Peak ground acceleration: 0.28
Depth to water table (insitu): 1.65 m

Depth to GWT (erthq.): 1.65 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: Sands only
Limit depth applied: Yes
Limit depth: 10.00 m

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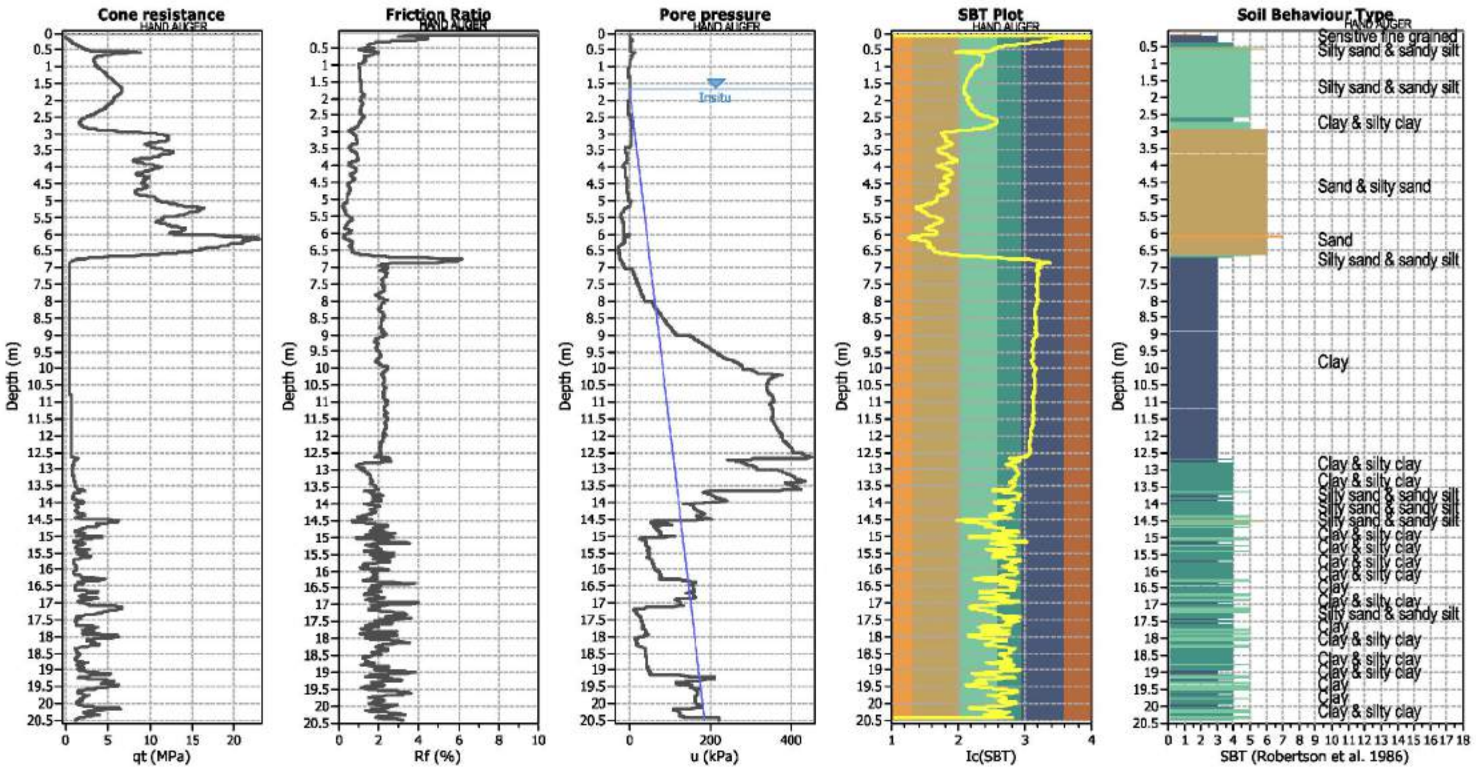
CPT basic interpretation plots



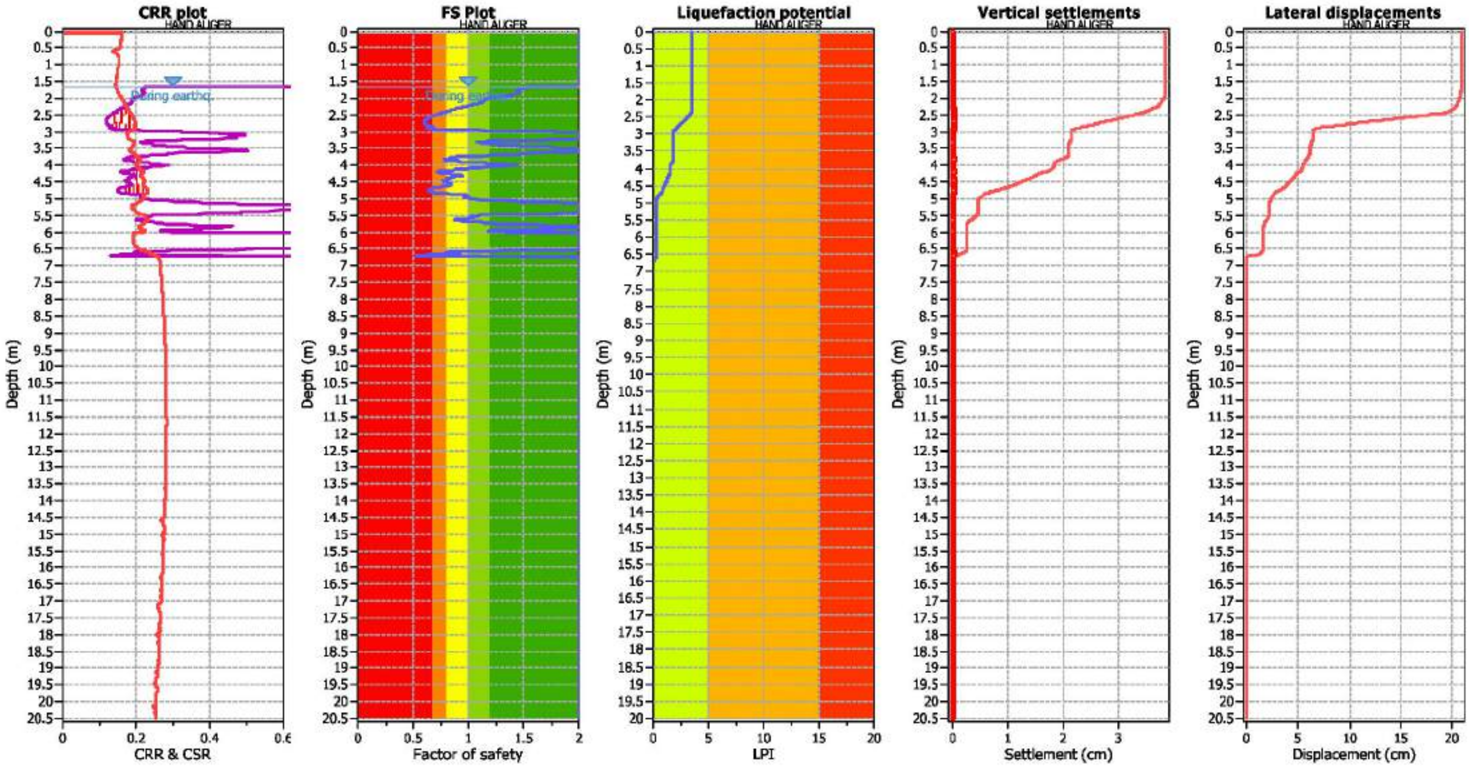
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

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LPI color scheme

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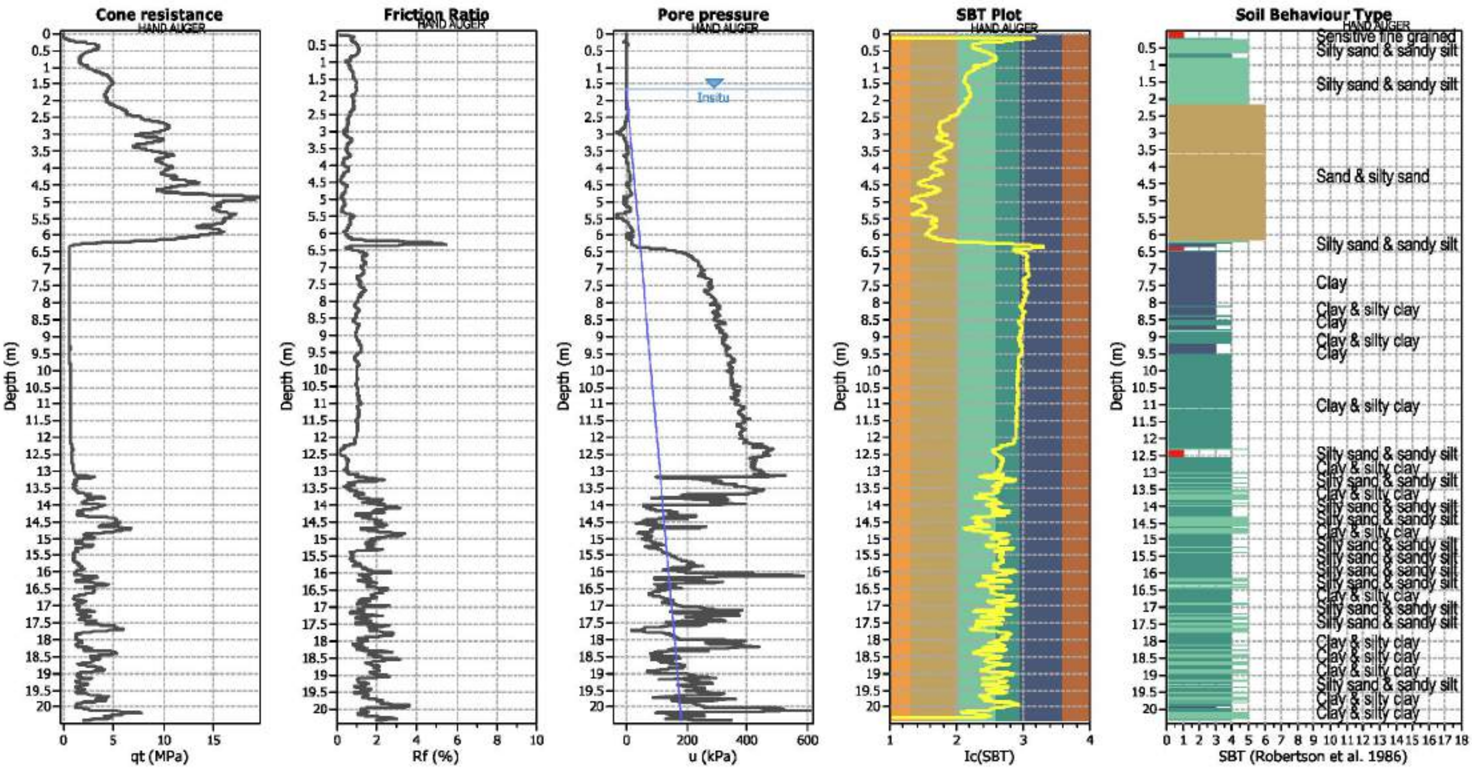
CPT basic interpretation plots



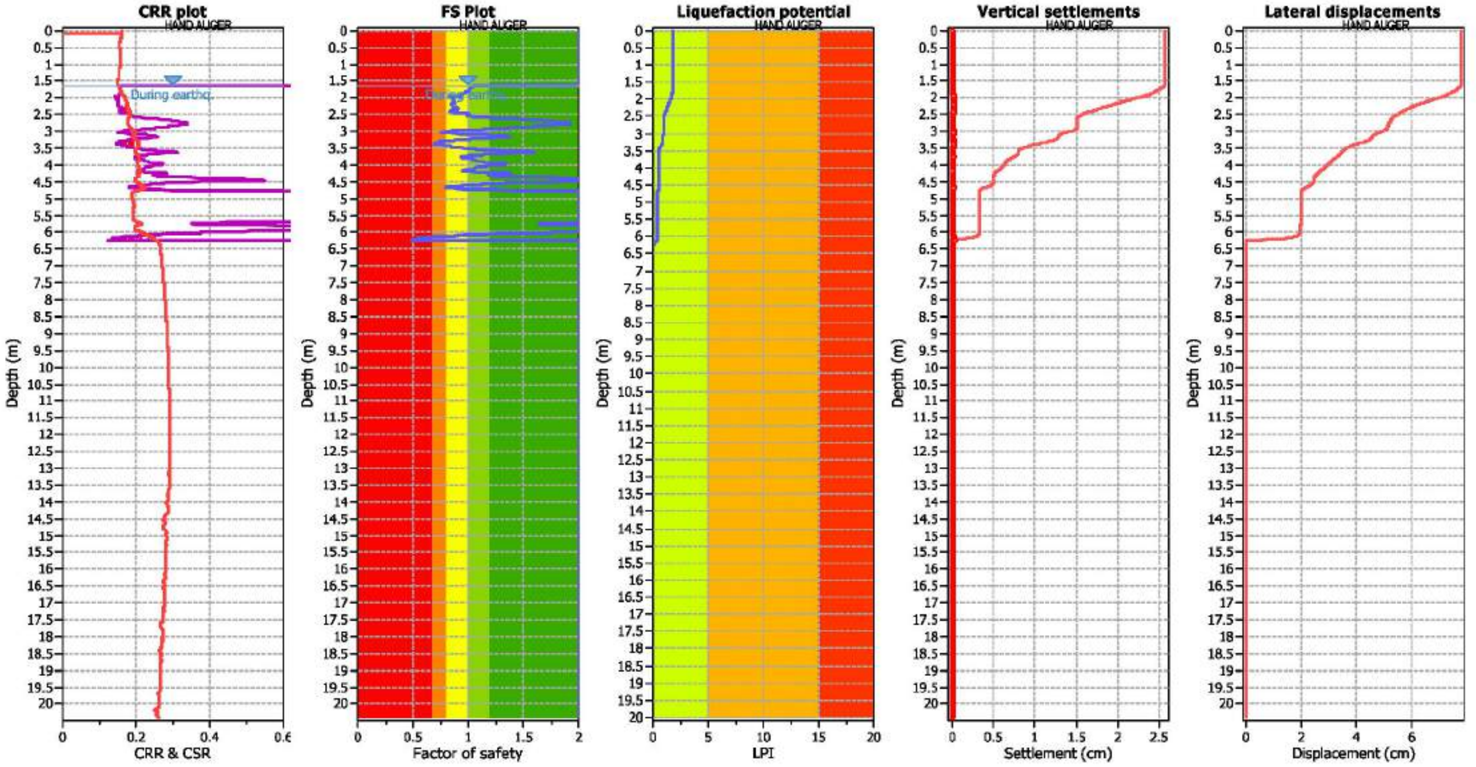
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

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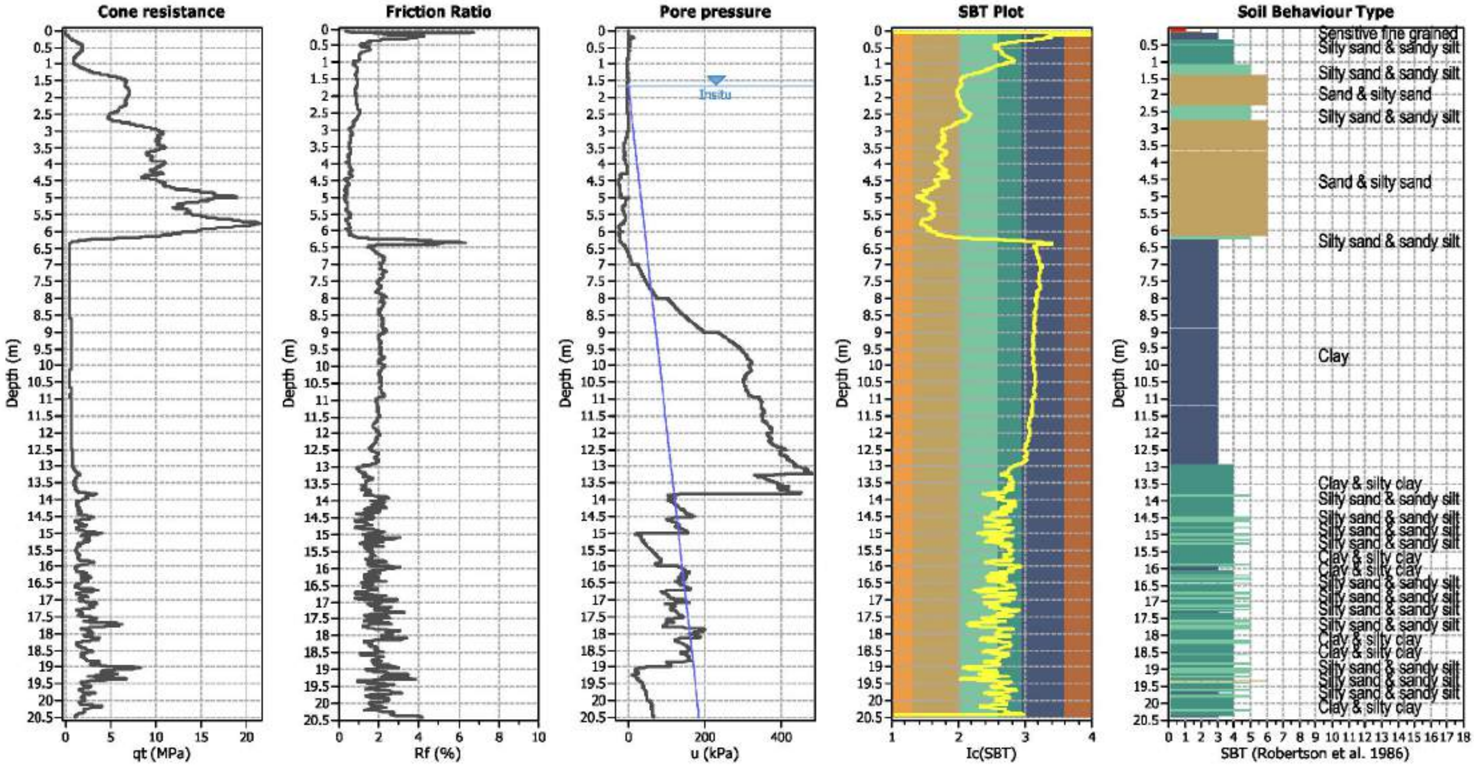
CPT basic interpretation plots



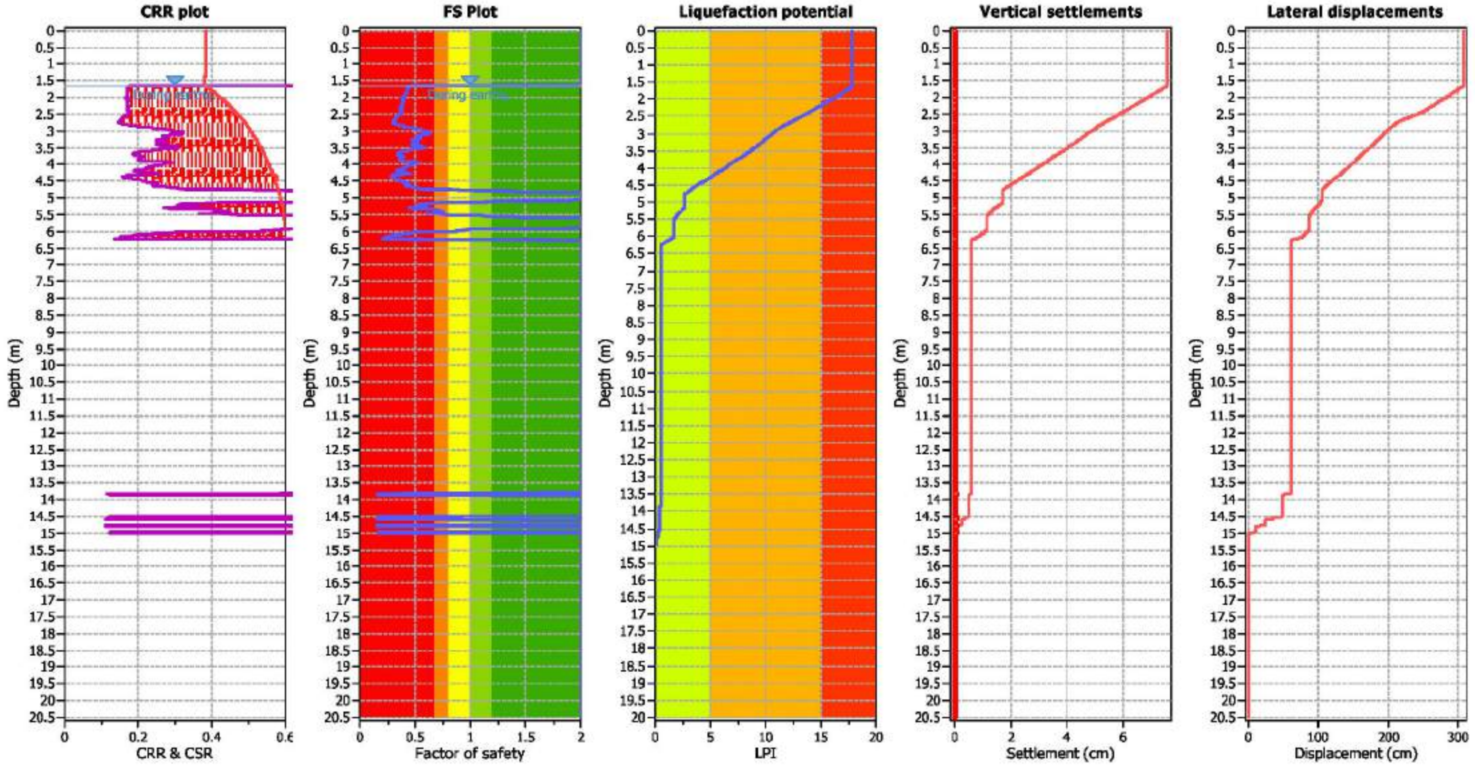
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

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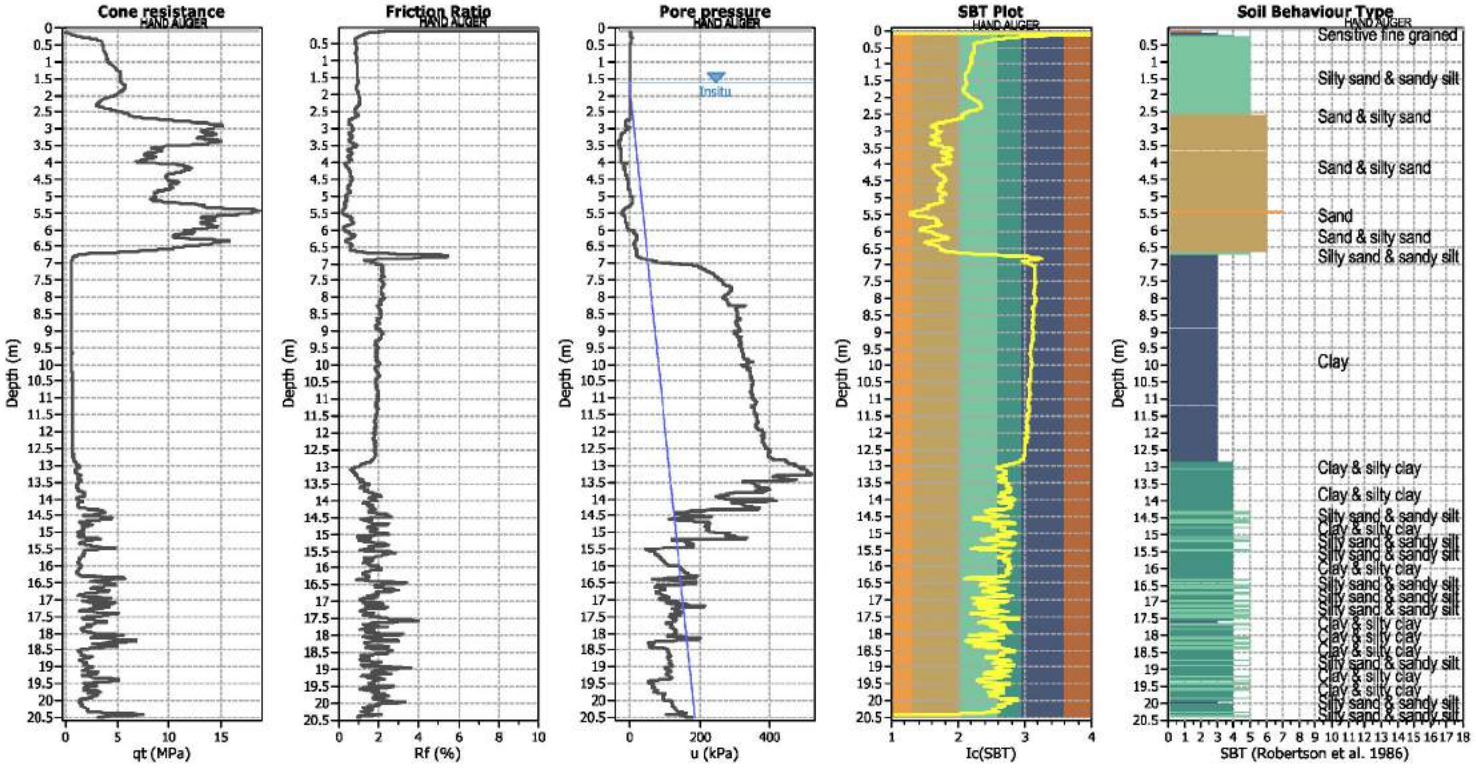
CPT basic interpretation plots



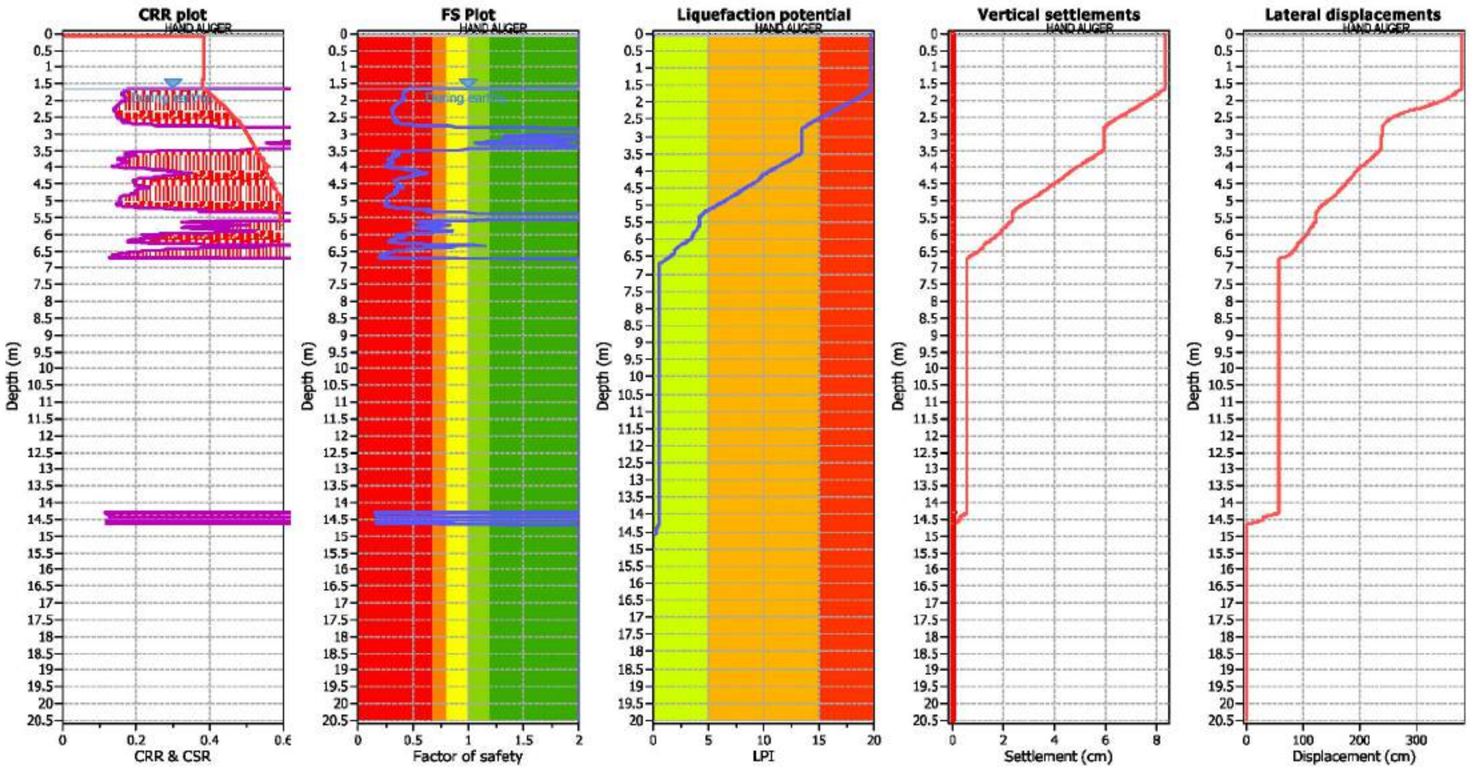
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.65
Depth to water table (insitu): 1.65 m

Depth to GWT (erthq.): 1.65 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: Sands only
Limit depth applied: Yes
Limit depth: 15.00 m

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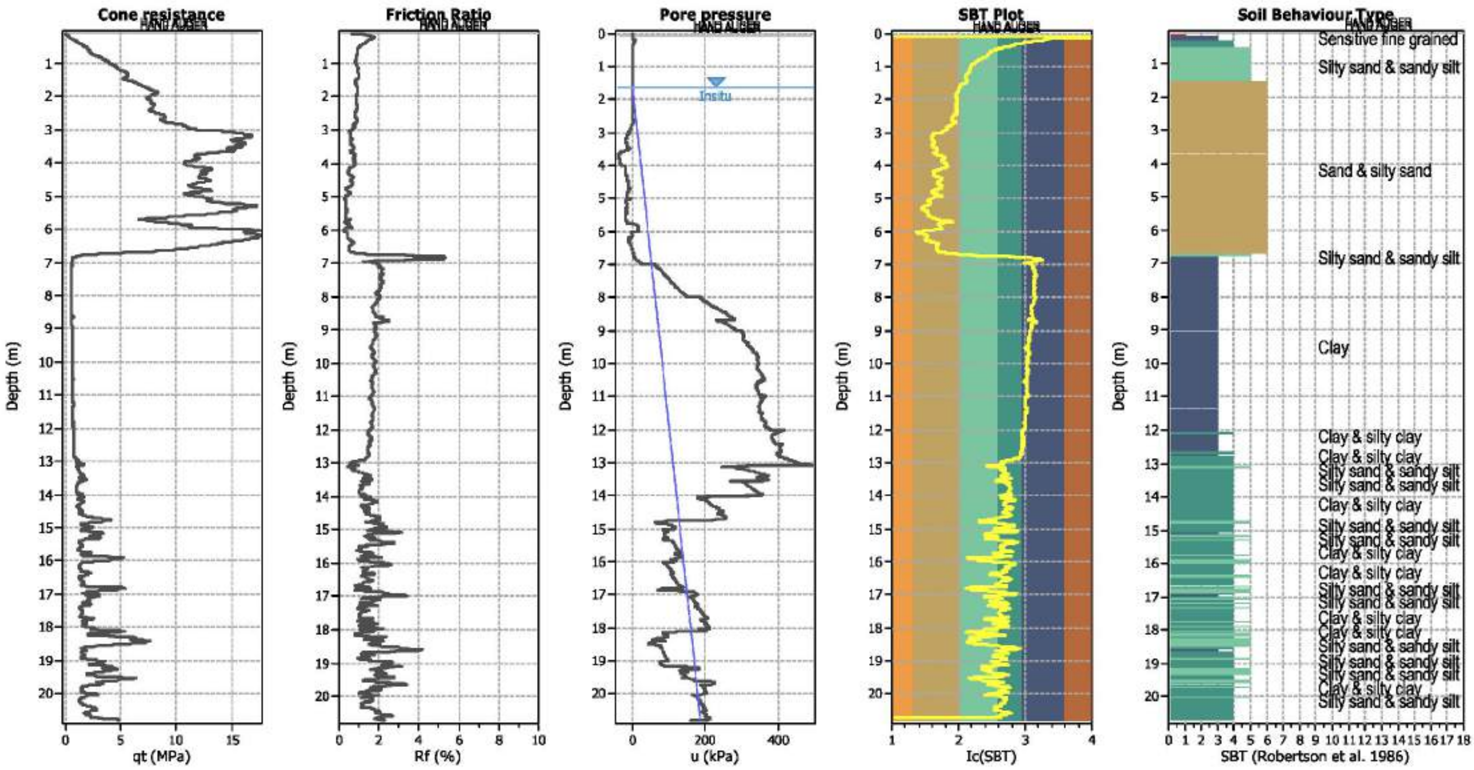
CPT basic interpretation plots



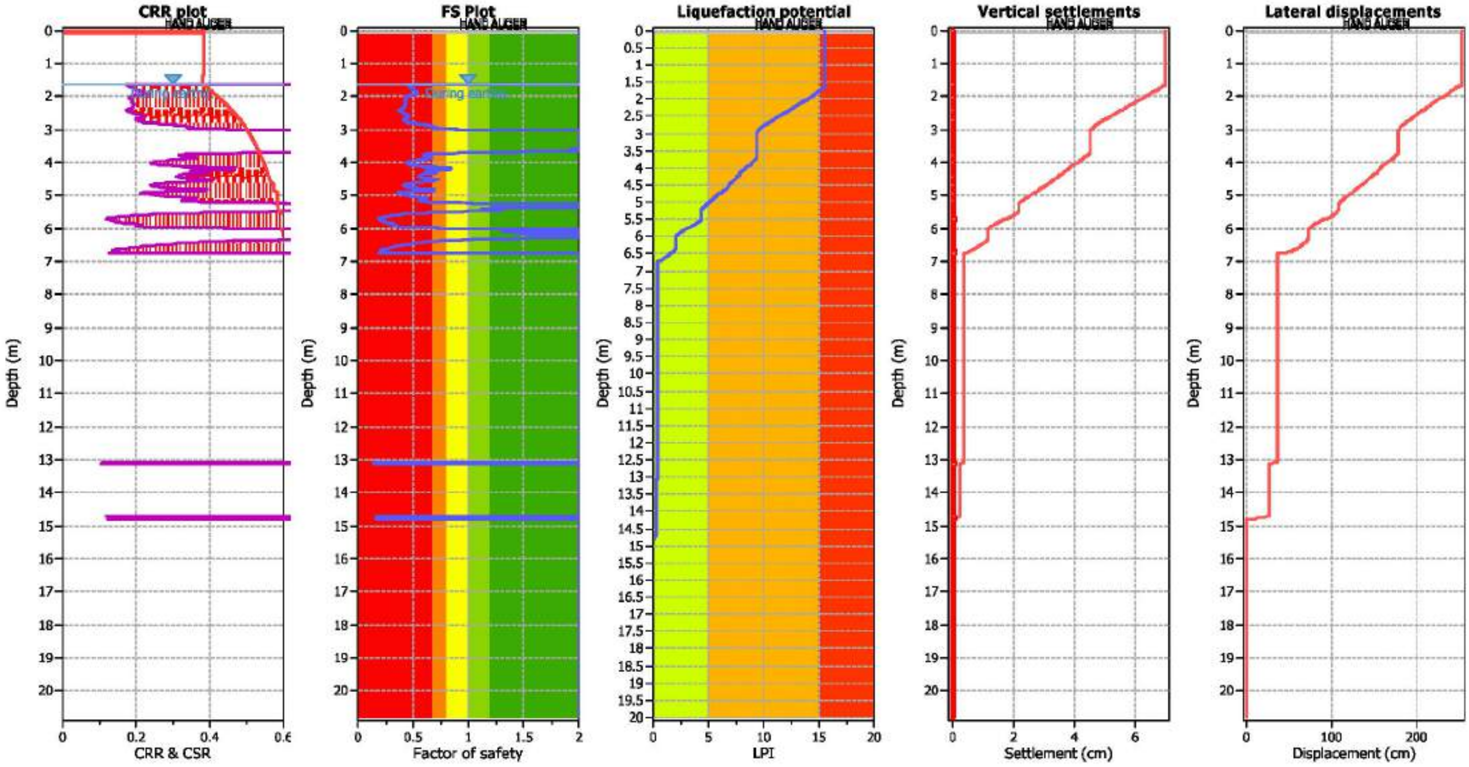
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

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LPI color scheme

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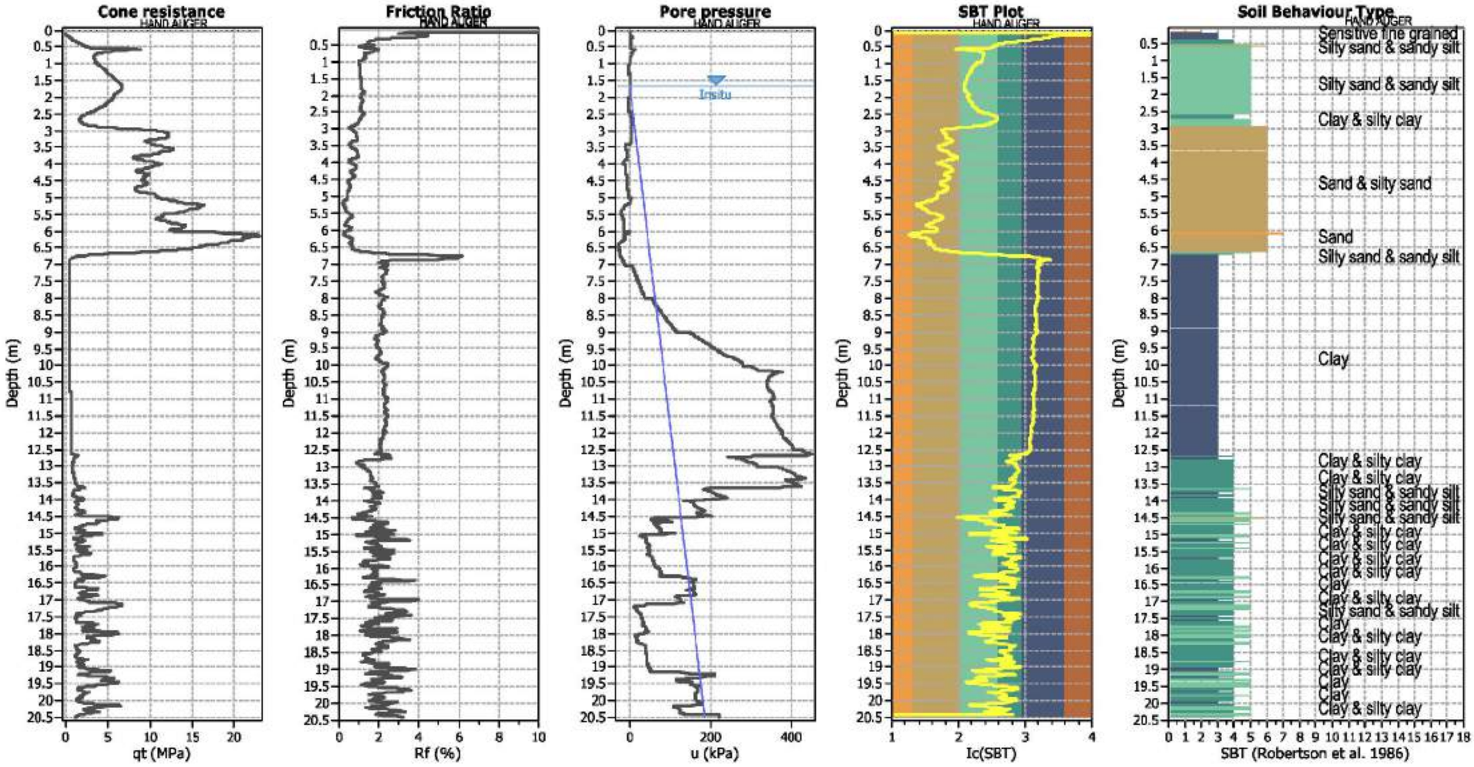
CPT basic interpretation plots



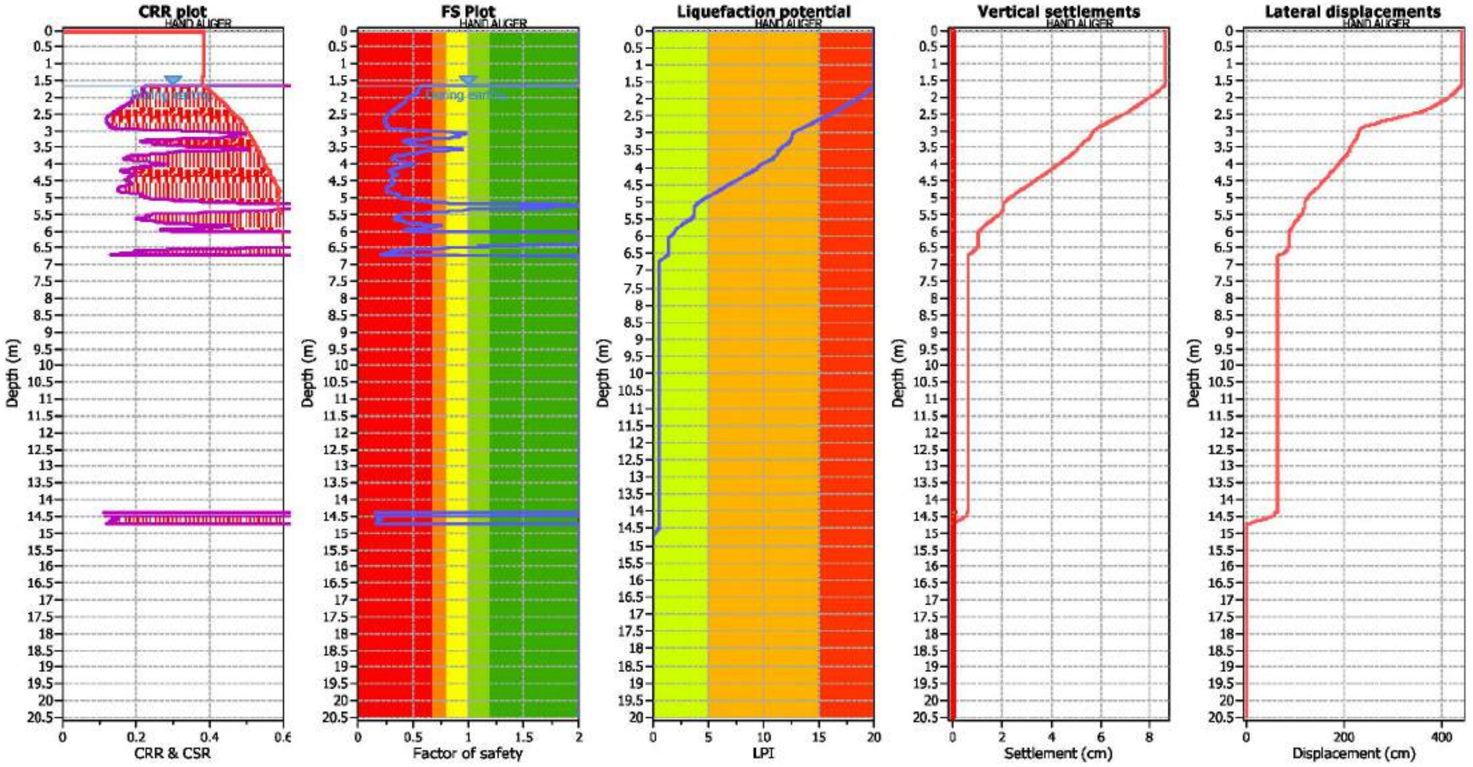
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
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Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

F.S. color scheme

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LPI color scheme

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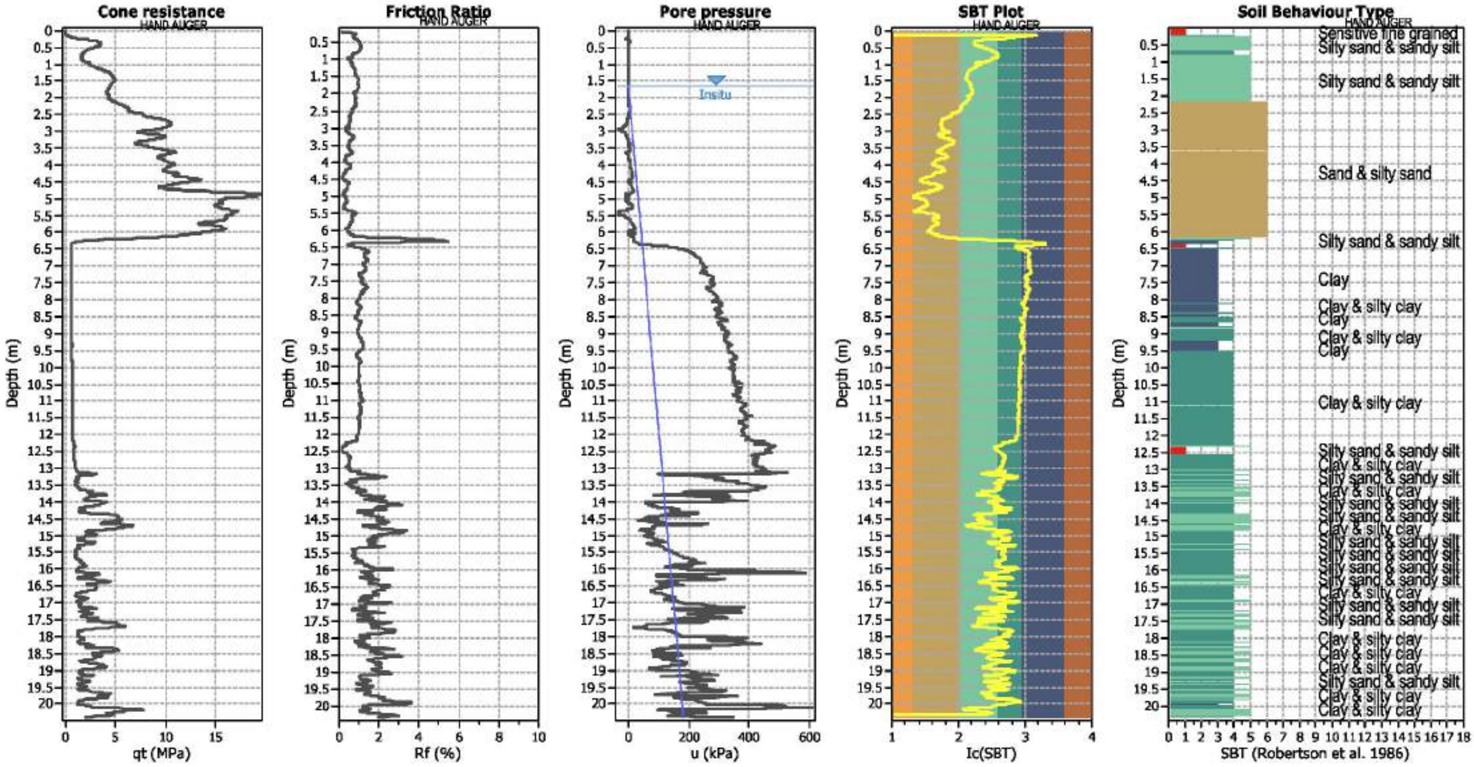
🟧	High risk
🟩	Low risk

CPT basic interpretation plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
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Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
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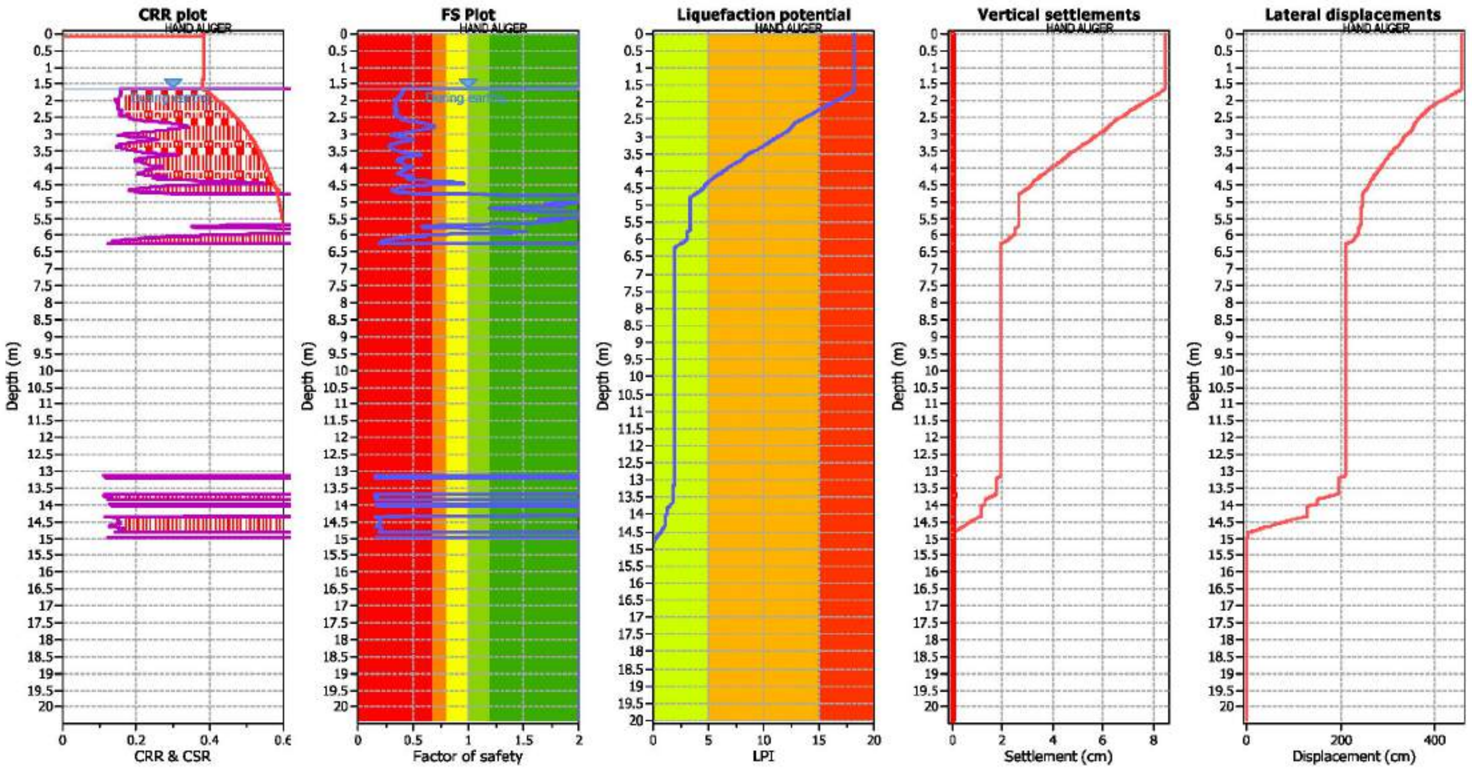
SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

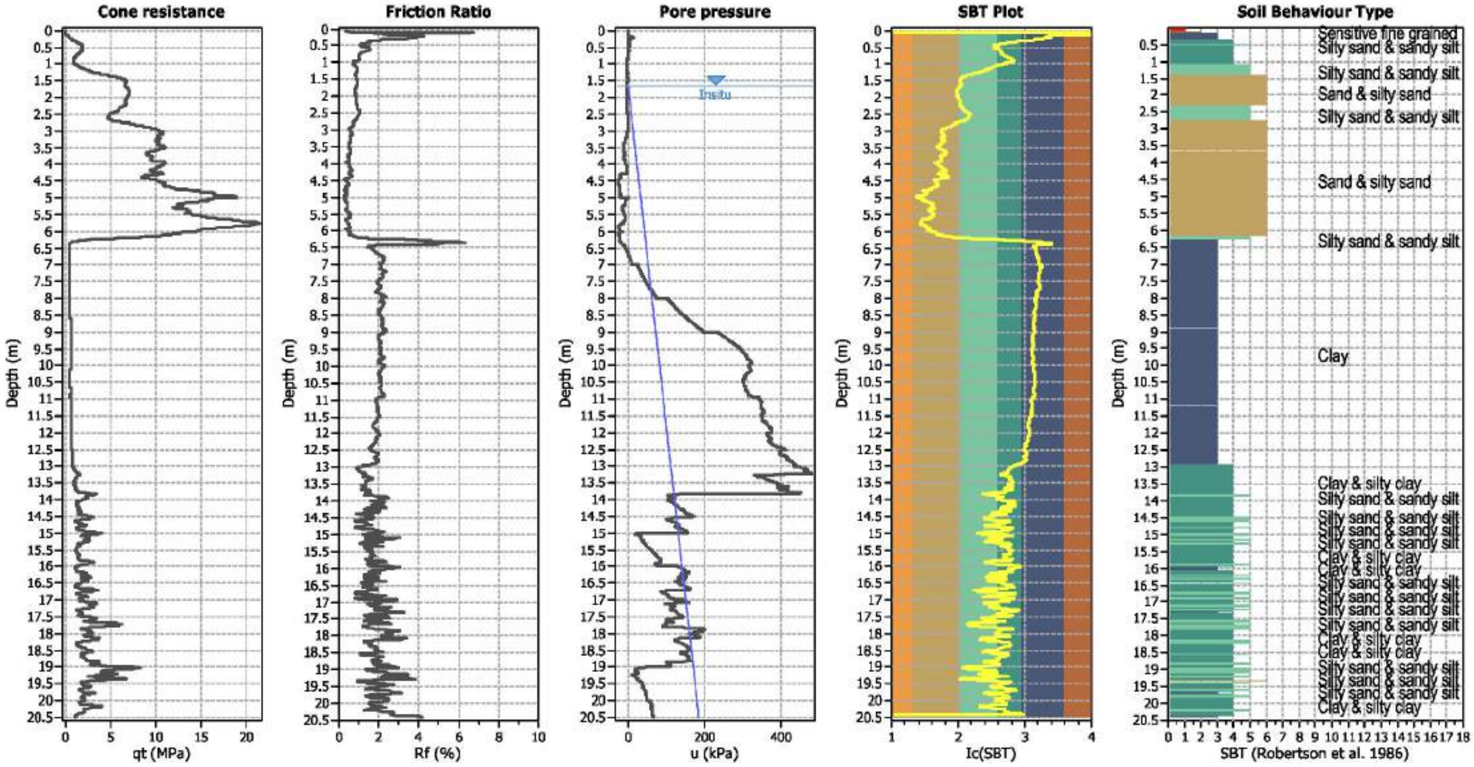
F.S. color scheme

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

LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

CPT basic interpretation plots



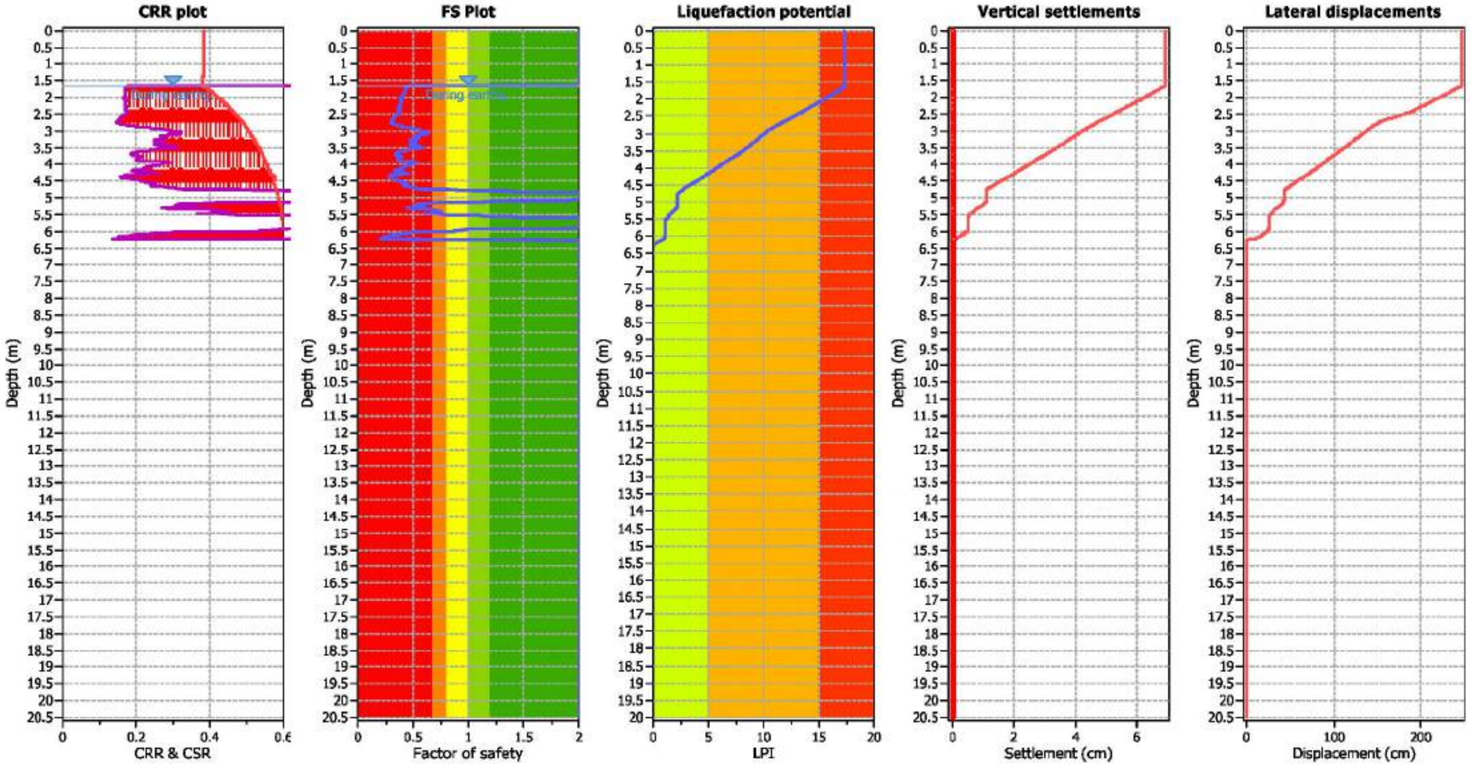
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.65
Depth to water table (insitu): 1.65 m

Depth to GWT (erthq.): 1.65 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: Sands only
Limit depth applied: Yes
Limit depth: 10.00 m

F.S. color scheme

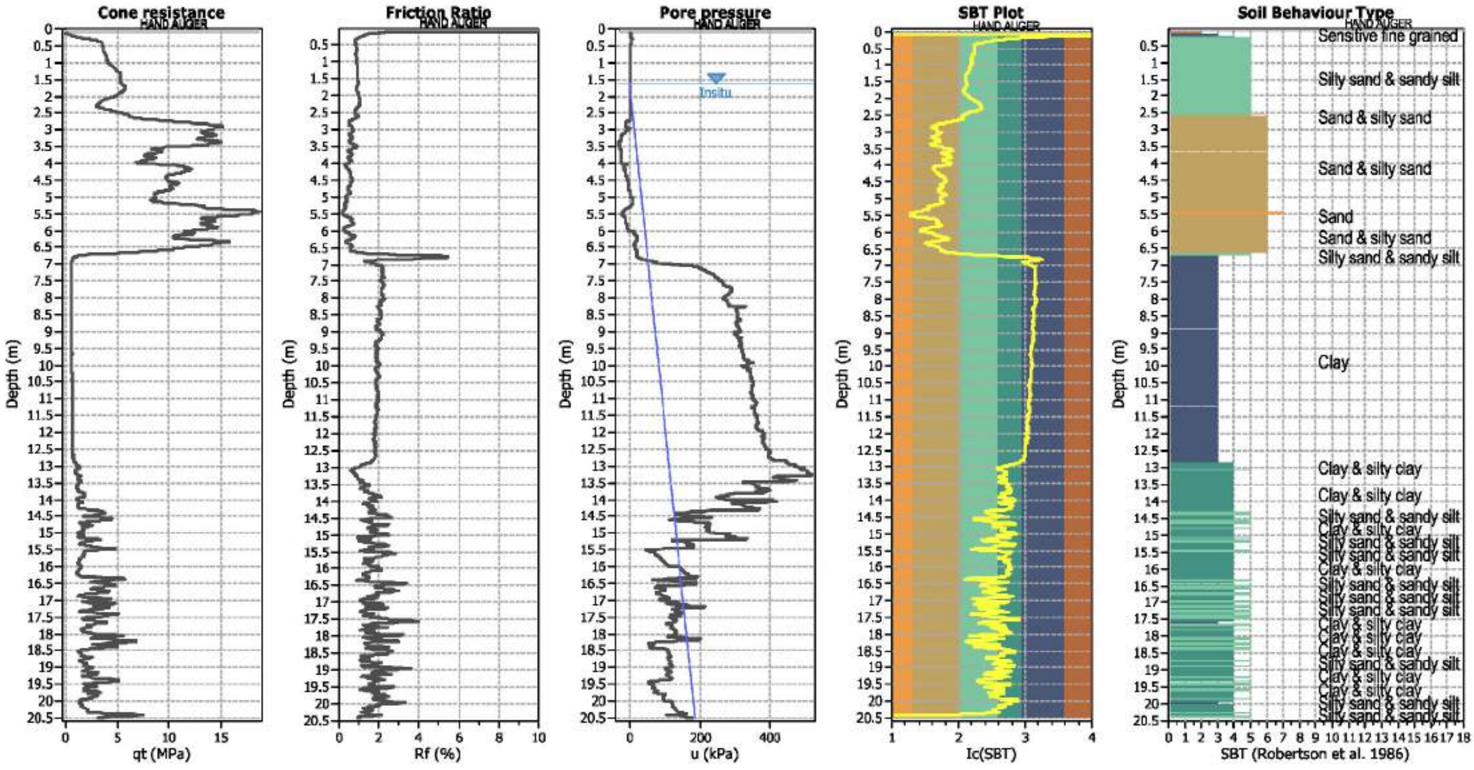
- 🟥 Almost certain it will liquefy
- 🟧 Very likely to liquefy
- 🟨 Liquefaction and no liq. are equally likely
- 🟩 Unlike to liquefy
- 🟩 Almost certain it will not liquefy

LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

CPT name: ULS- CPT02 (10m)

CPT basic interpretation plots



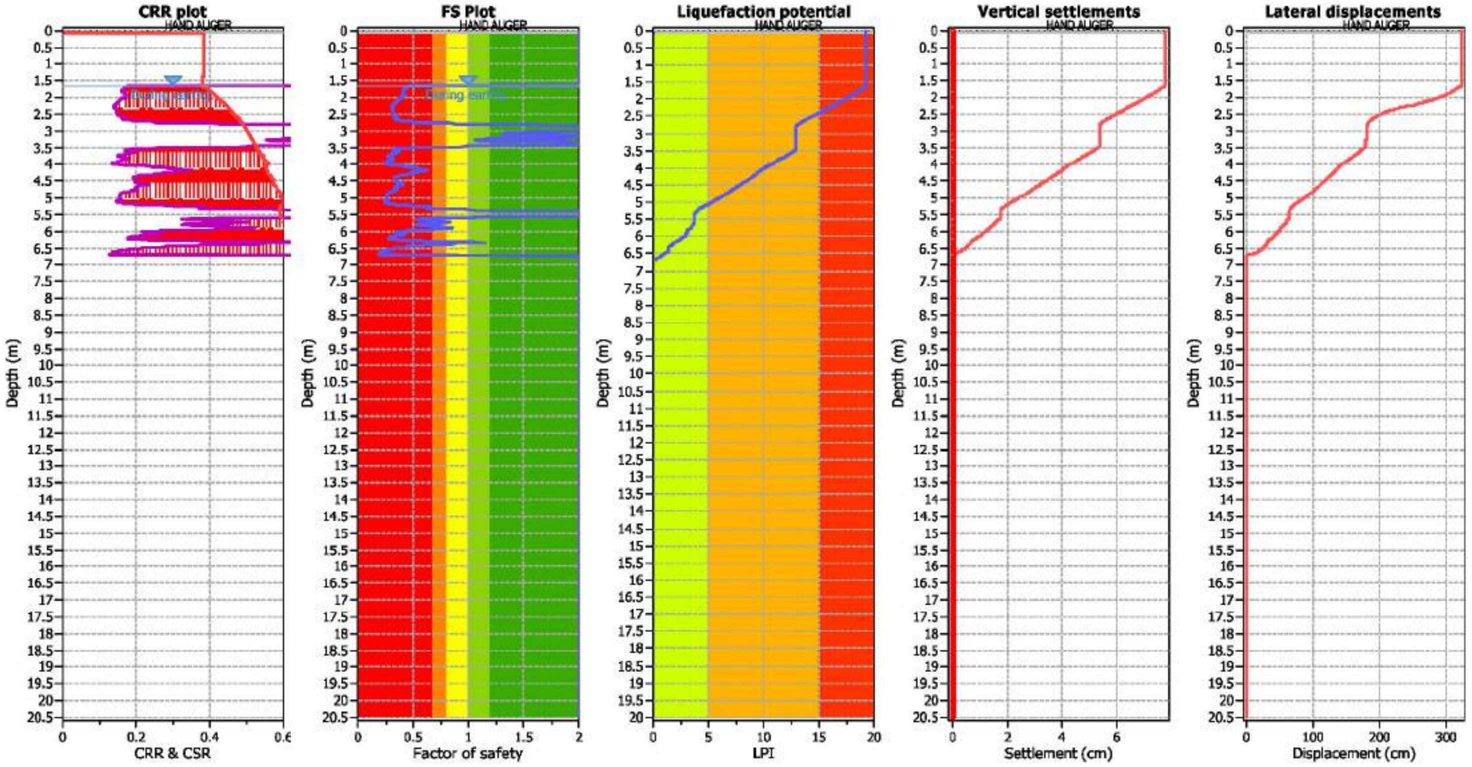
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

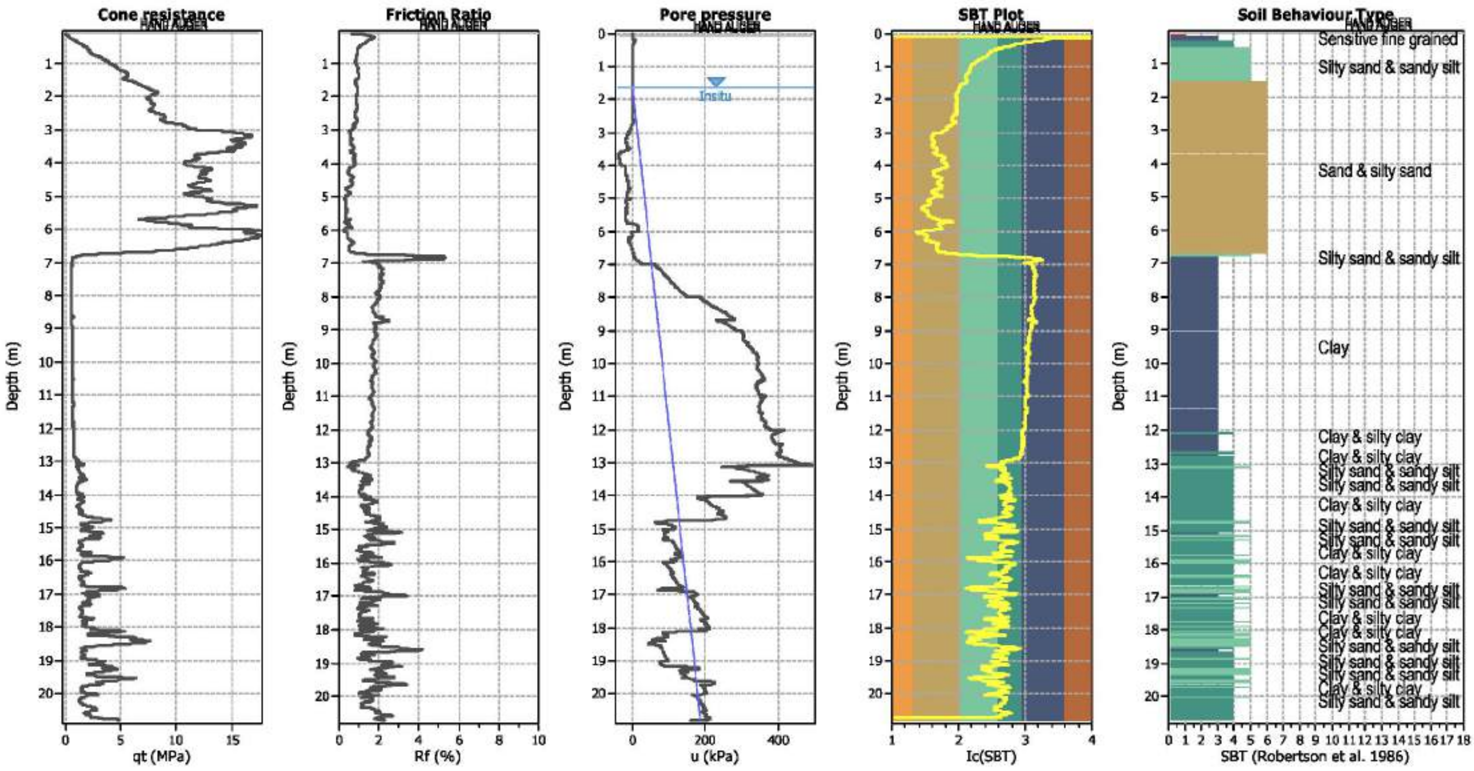
F.S. color scheme

🟥 Almost certain it will liquefy
🟧 Very likely to liquefy
🟨 Liquefaction and no liq. are equally likely
🟩 Unlike to liquefy
🟩 Almost certain it will not liquefy

LPI color scheme

🟥 Very high risk
🟧 High risk
🟩 Low risk

CPT basic interpretation plots



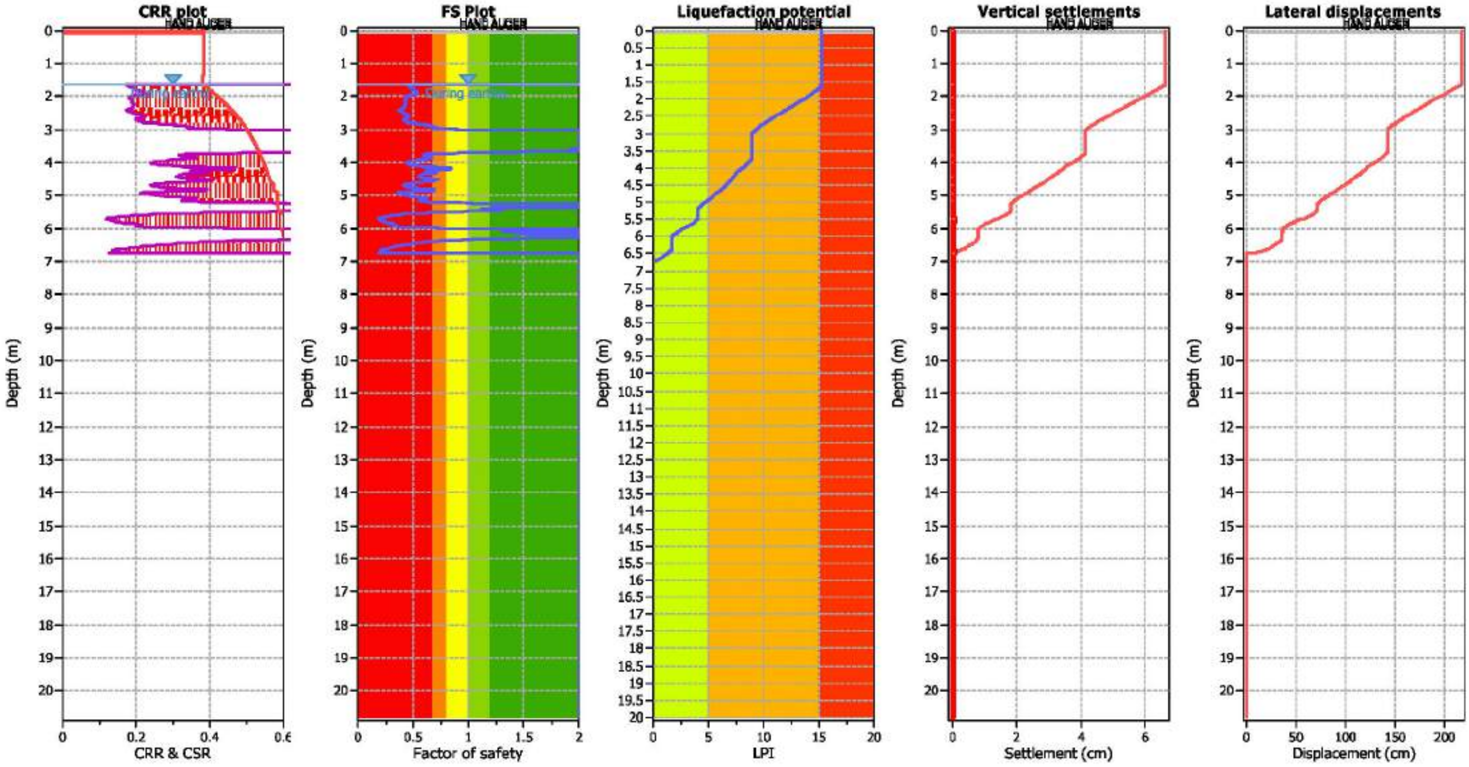
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

F.S. color scheme

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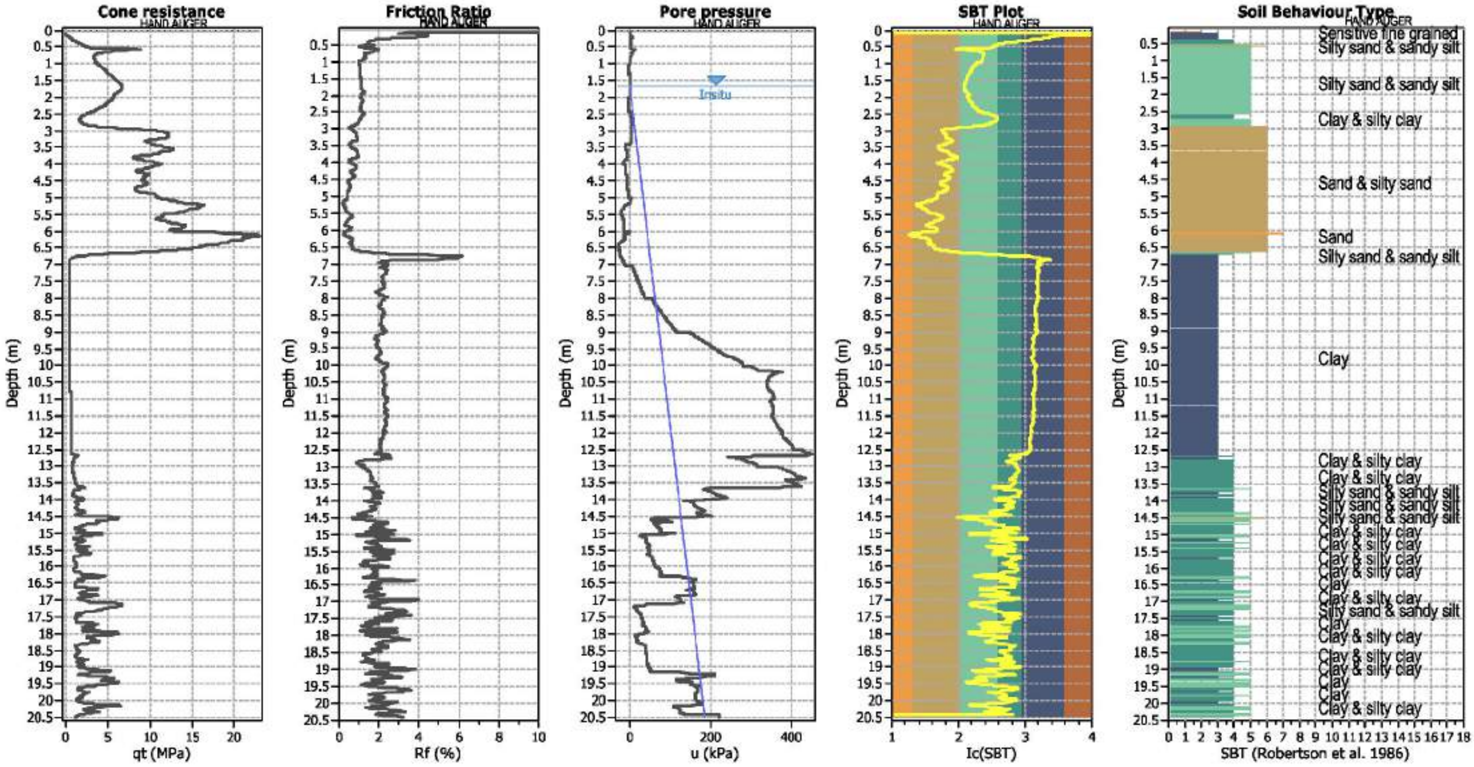
- 🟩 Almost certain it will not liquefy

LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

CPT basic interpretation plots



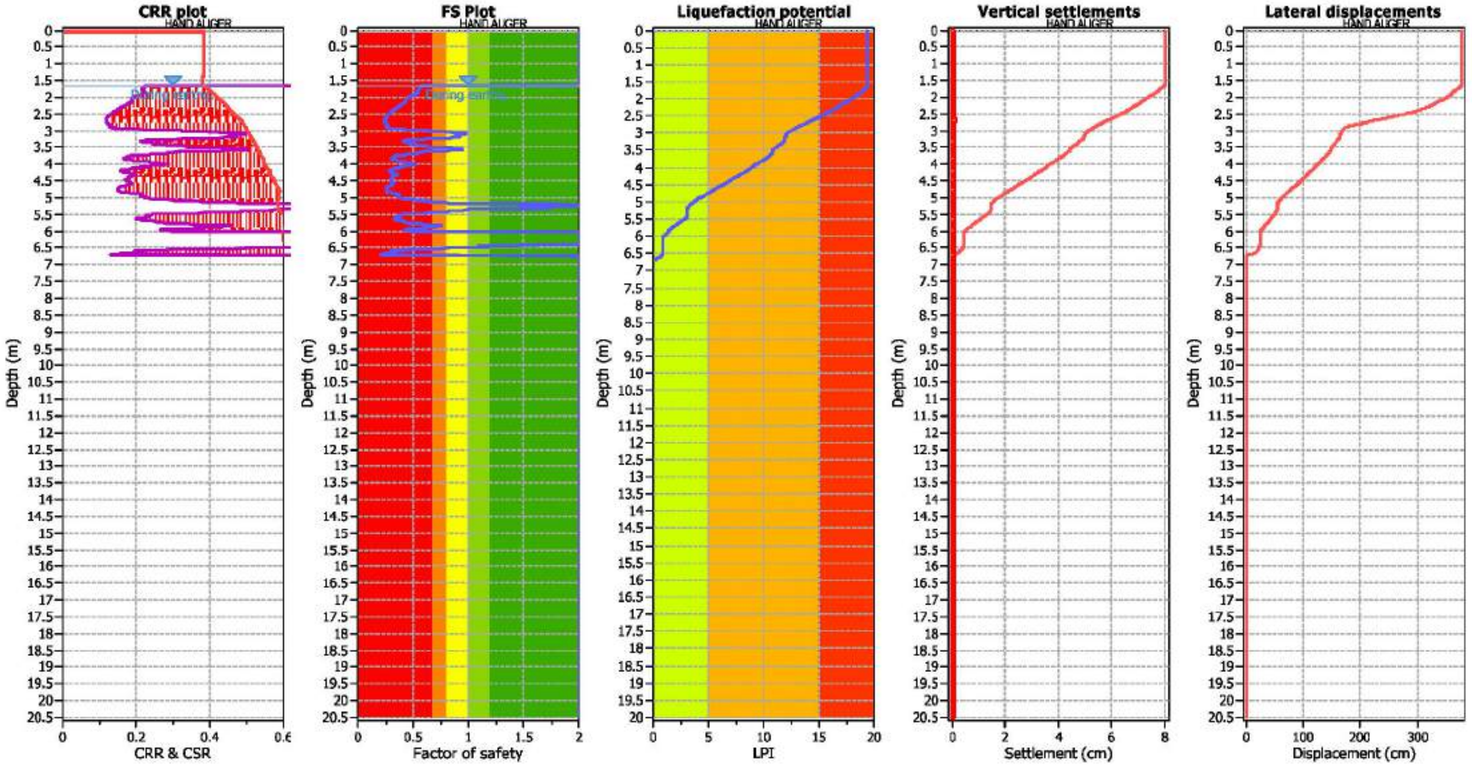
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

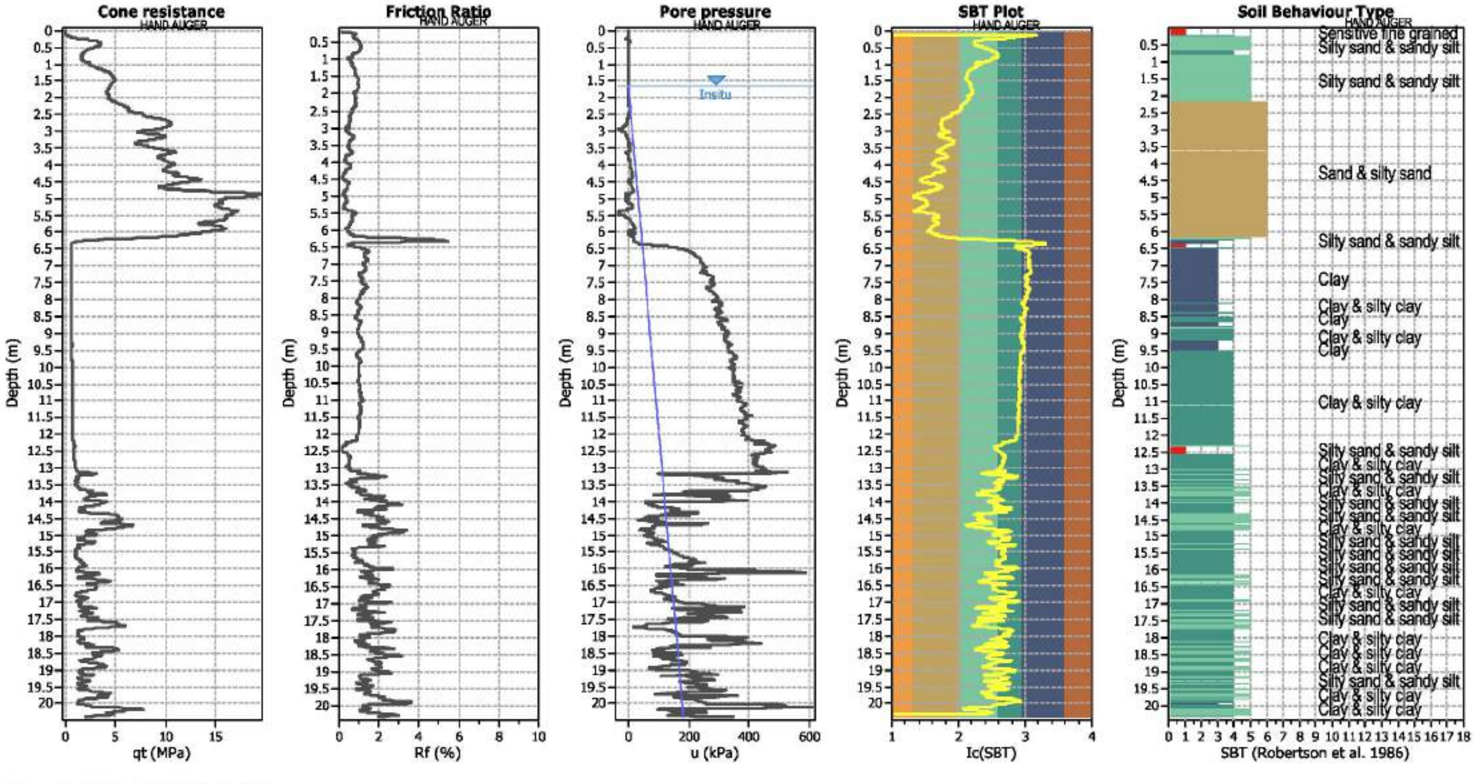
F.S. color scheme

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

LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟩 Low risk

CPT basic interpretation plots



Input parameters and analysis data

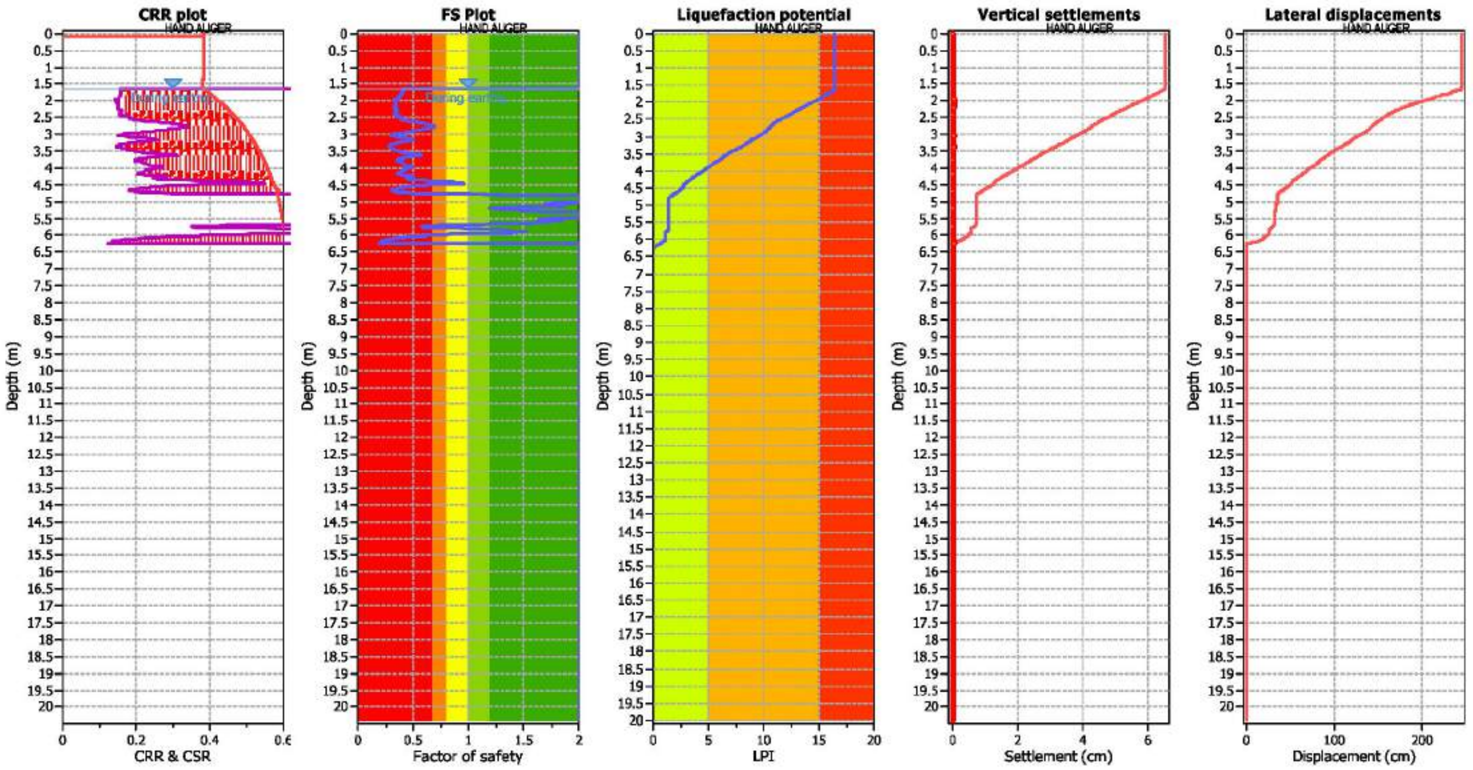
Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

CPT name: ULS- CPT05 (10m)

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

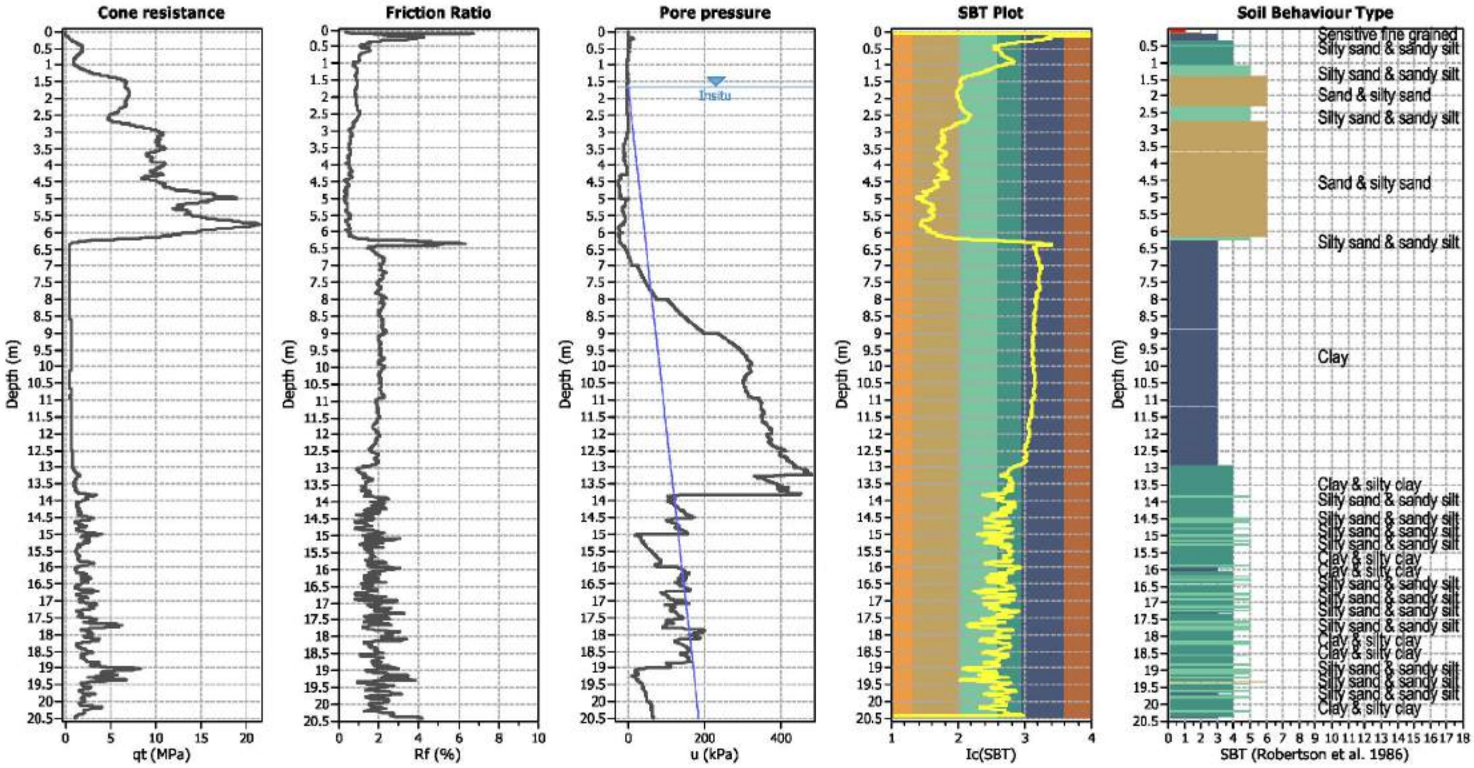
F.S. color scheme

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

LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

CPT basic interpretation plots



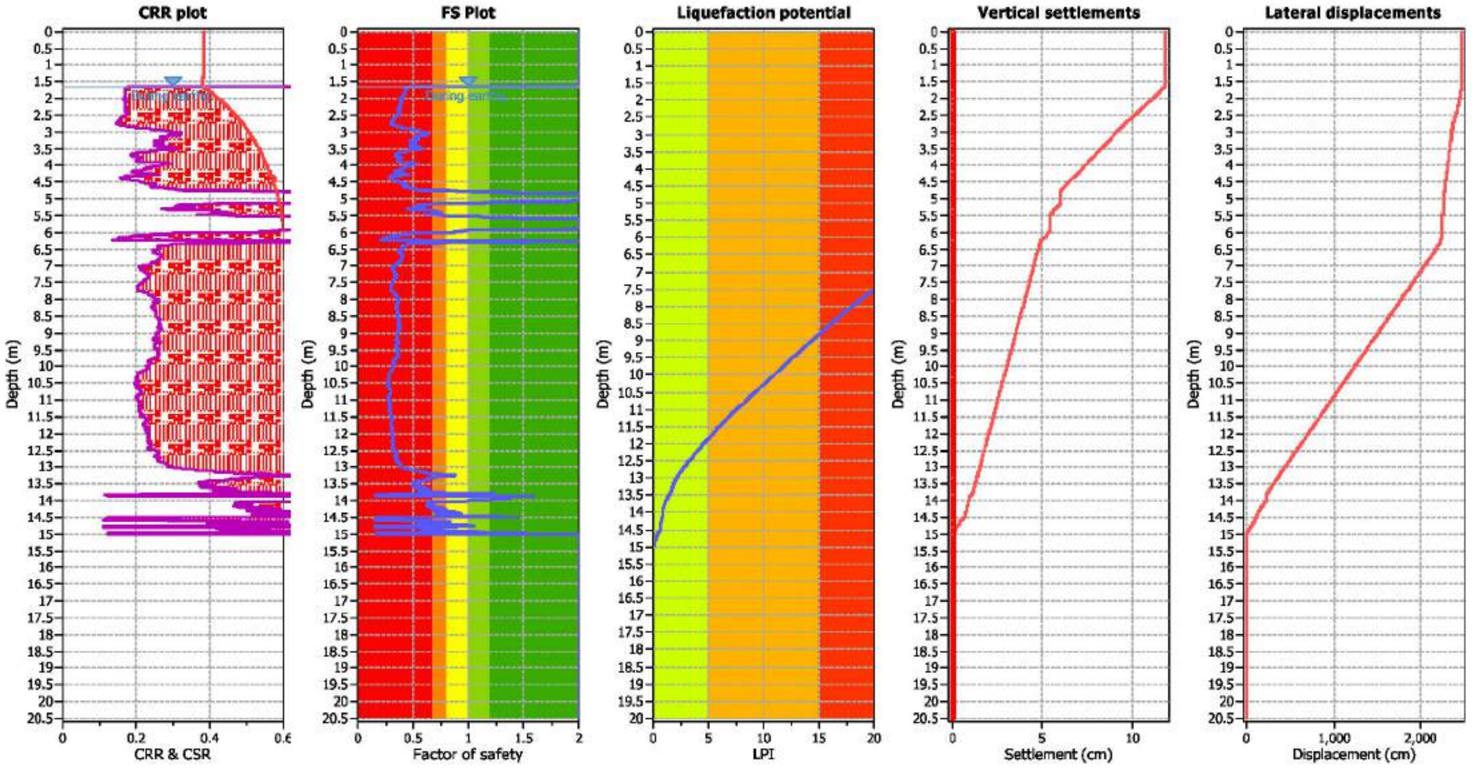
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.65
Depth to water table (insitu): 1.65 m

Depth to GWT (erthq.): 1.65 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: Yes
Limit depth: 15.00 m

F.S. color scheme

- 🟥 Almost certain it will liquefy
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- 🟨 Liquefaction and no liq. are equally likely
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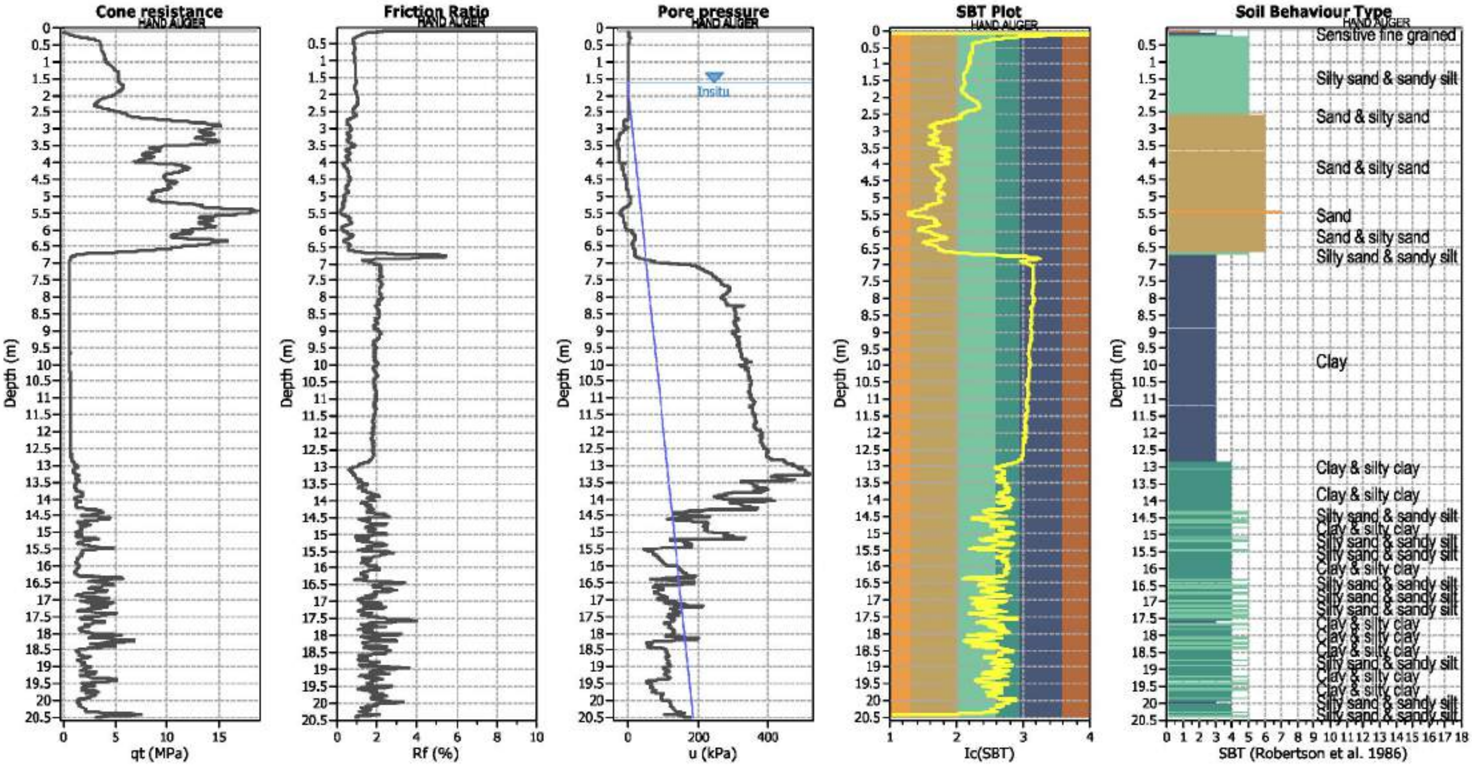
LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

CPT basic interpretation plots



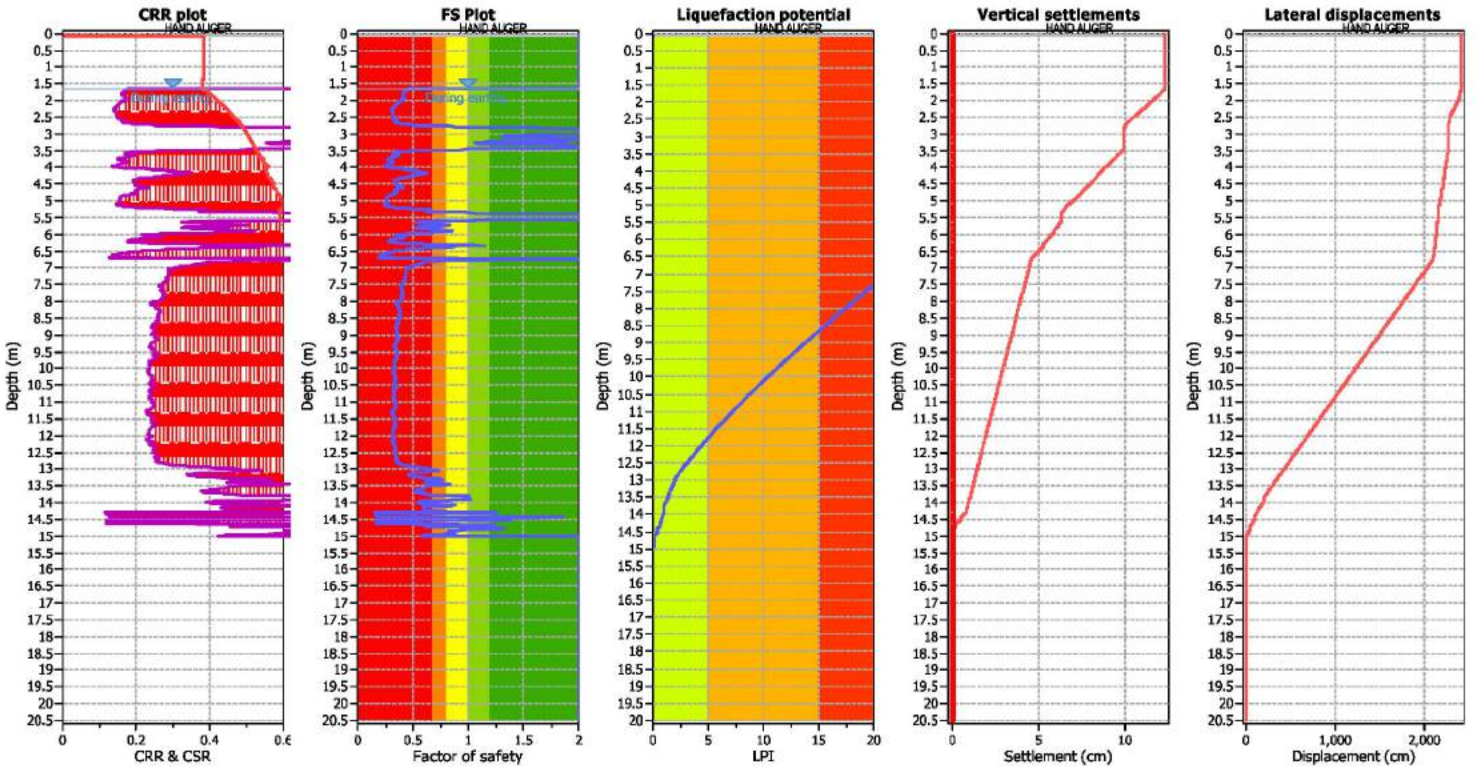
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

F.S. color scheme

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LPI color scheme

- 🟥 Very high risk
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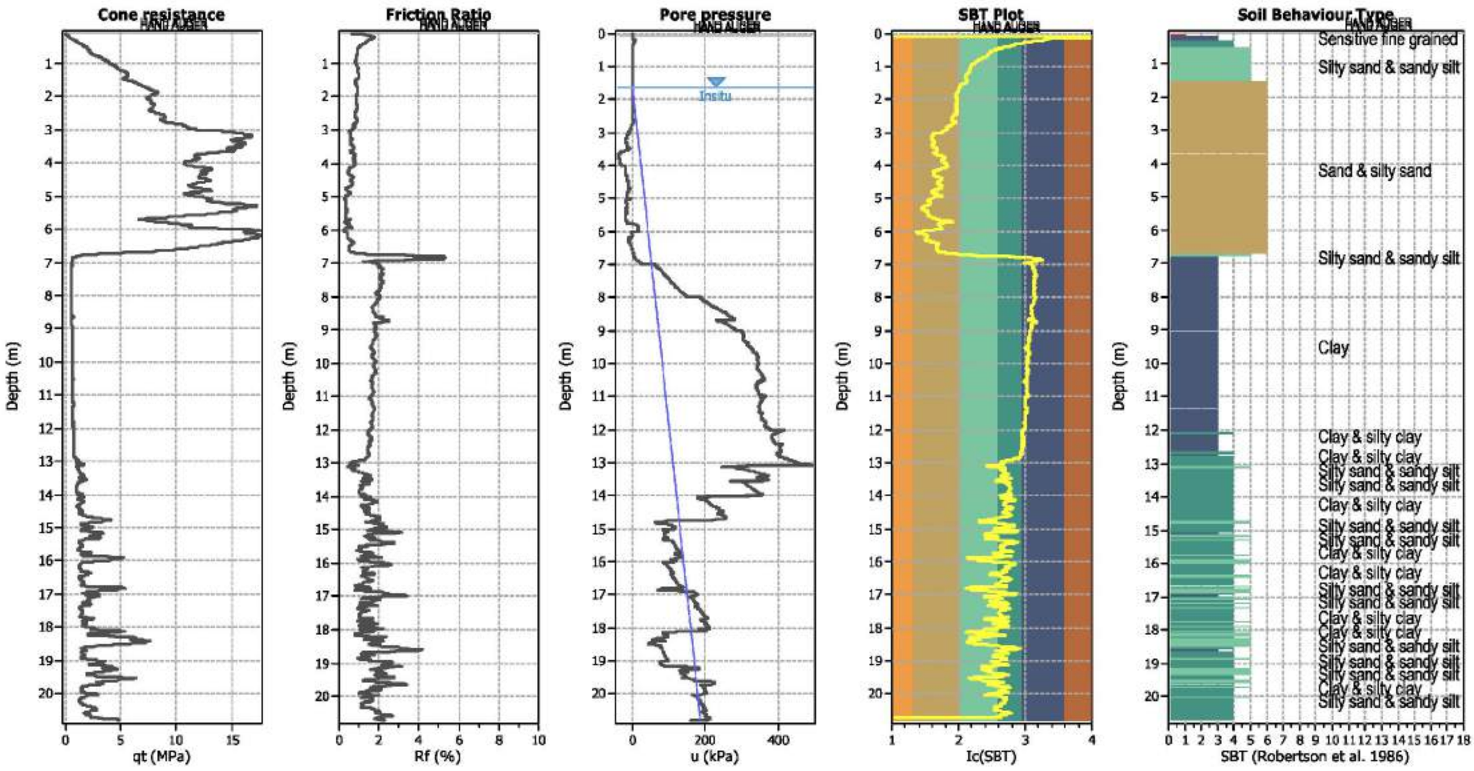
CPT basic interpretation plots



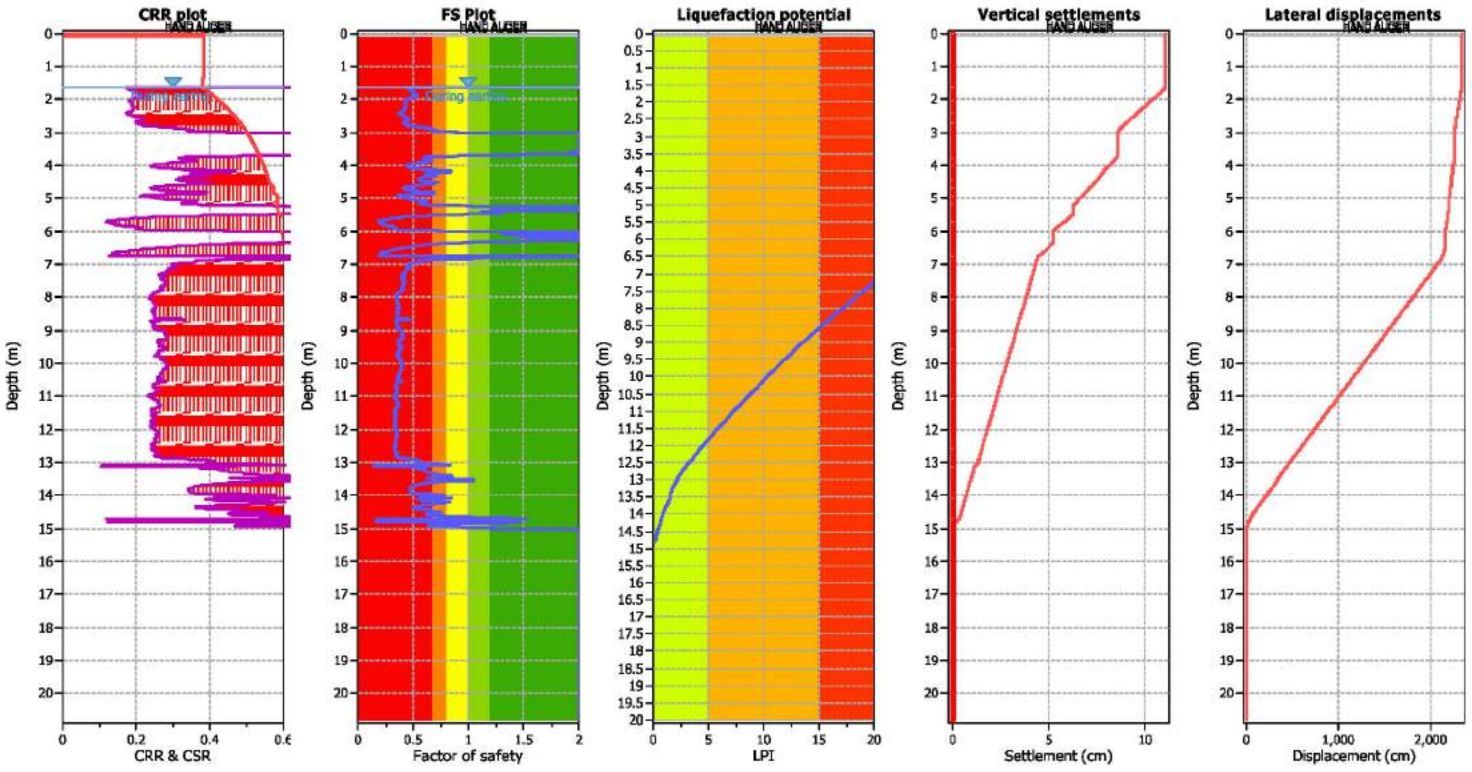
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

F.S. color scheme

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- 🟨 Liquefaction and no liq. are equally likely
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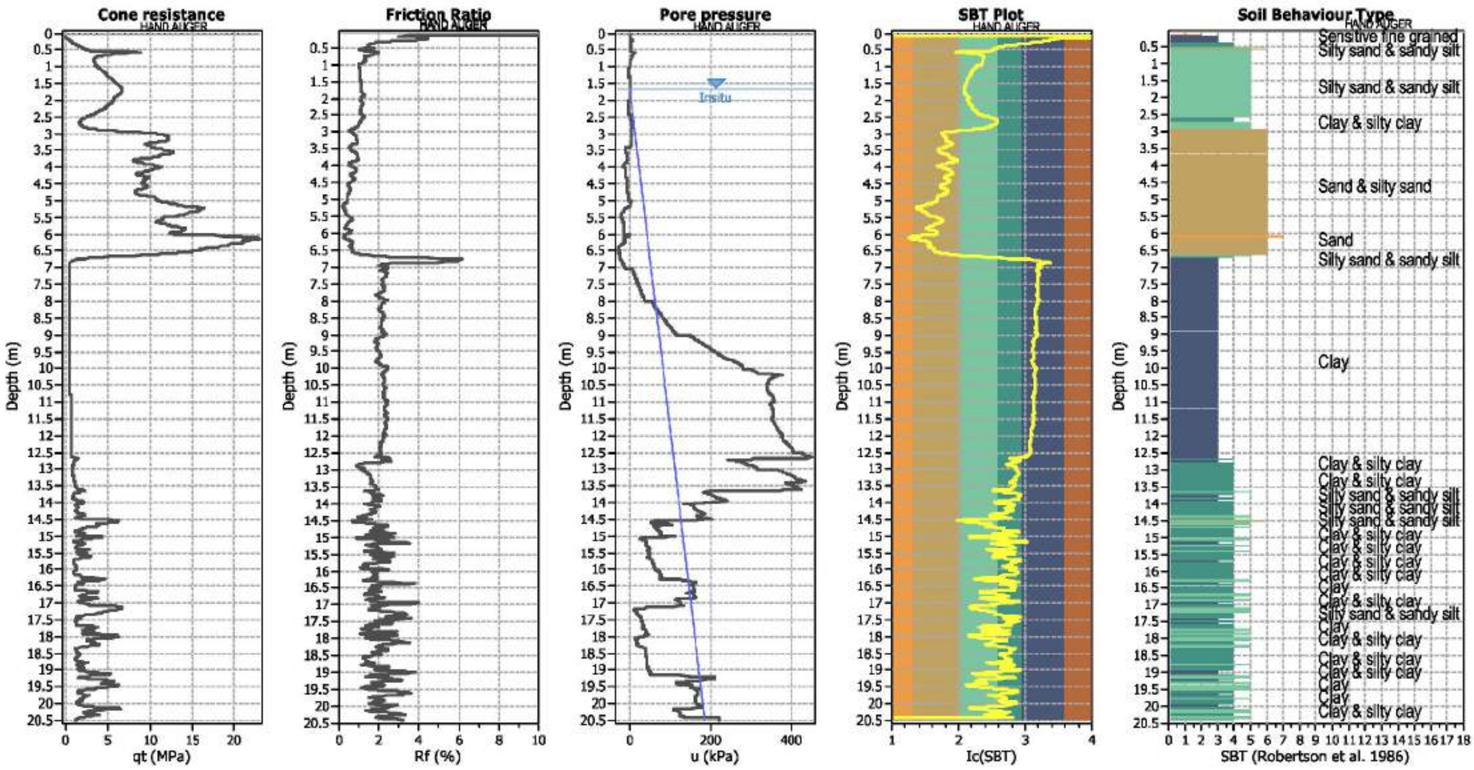
LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

CPT basic interpretation plots



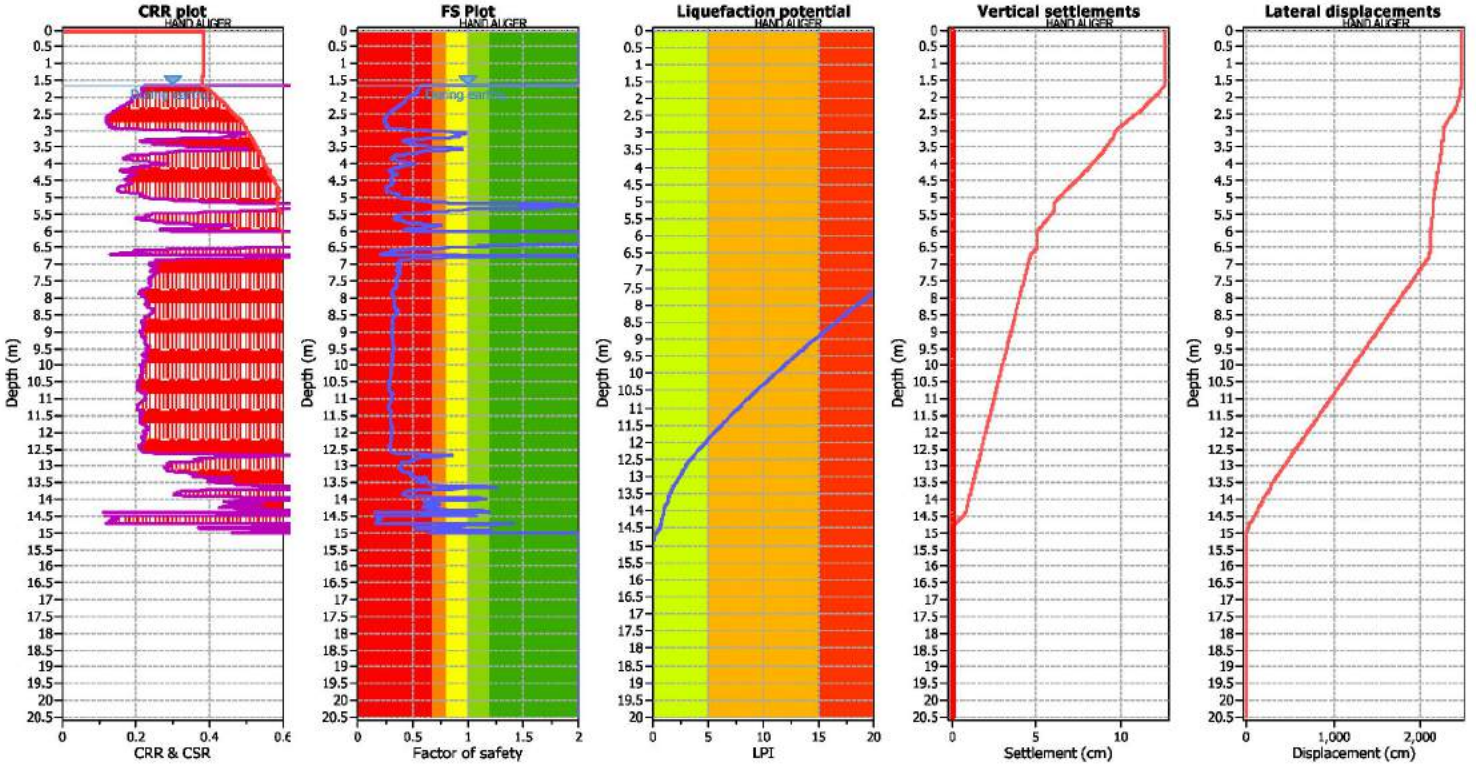
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.65
Depth to water table (insitu): 1.65 m

Depth to GWT (erthq.): 1.65 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: Yes
Limit depth: 15.00 m

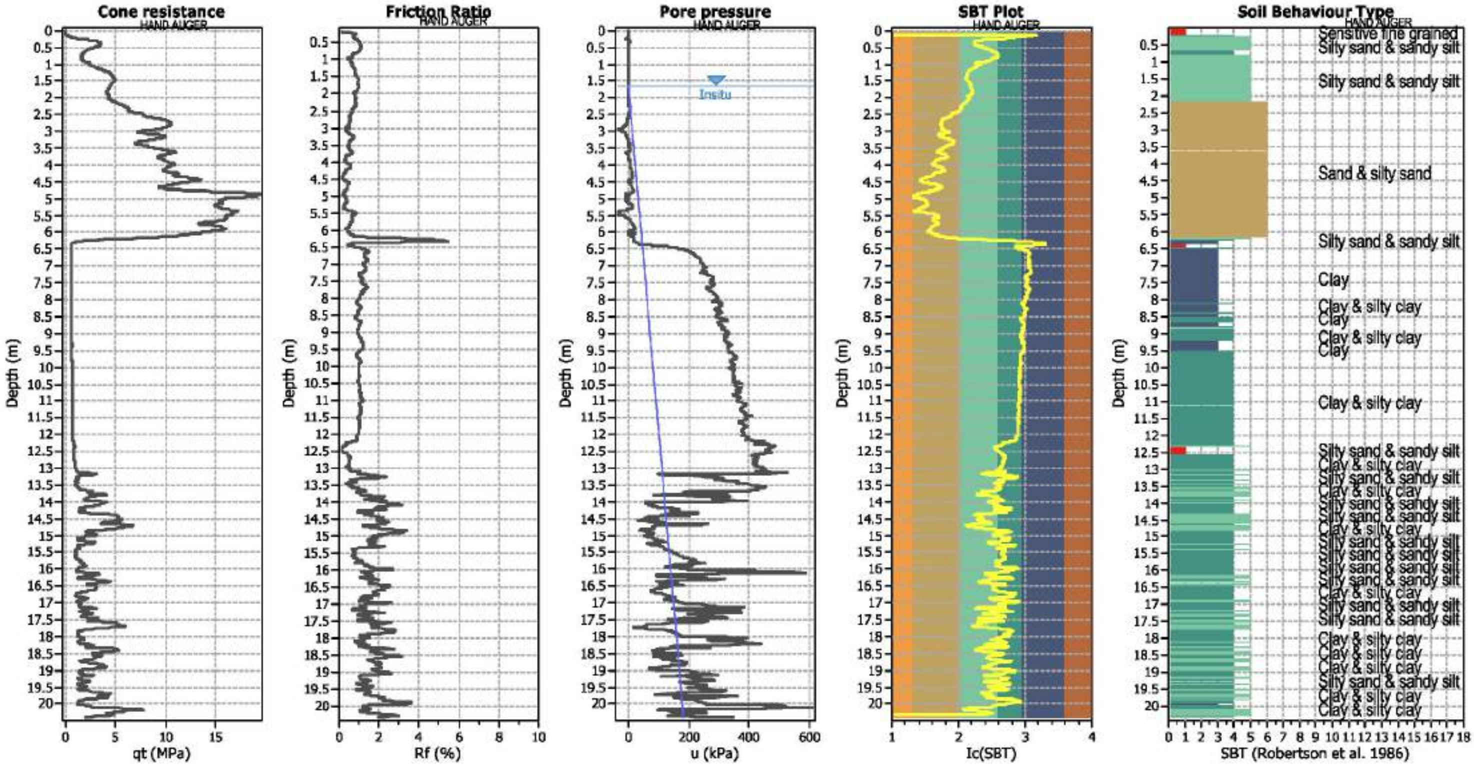
F.S. color scheme

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

LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

CPT basic interpretation plots



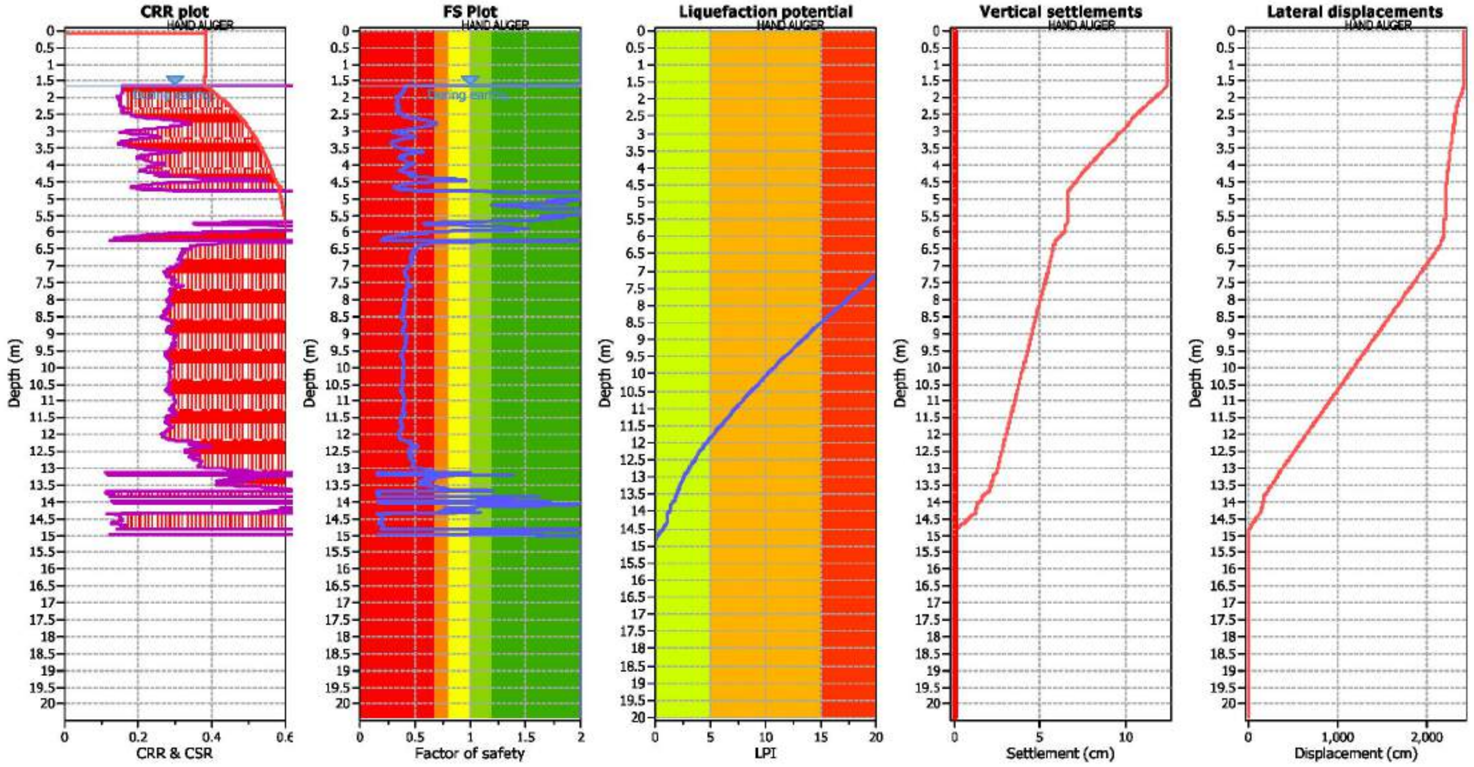
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sand & Clay
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

F.S. color scheme

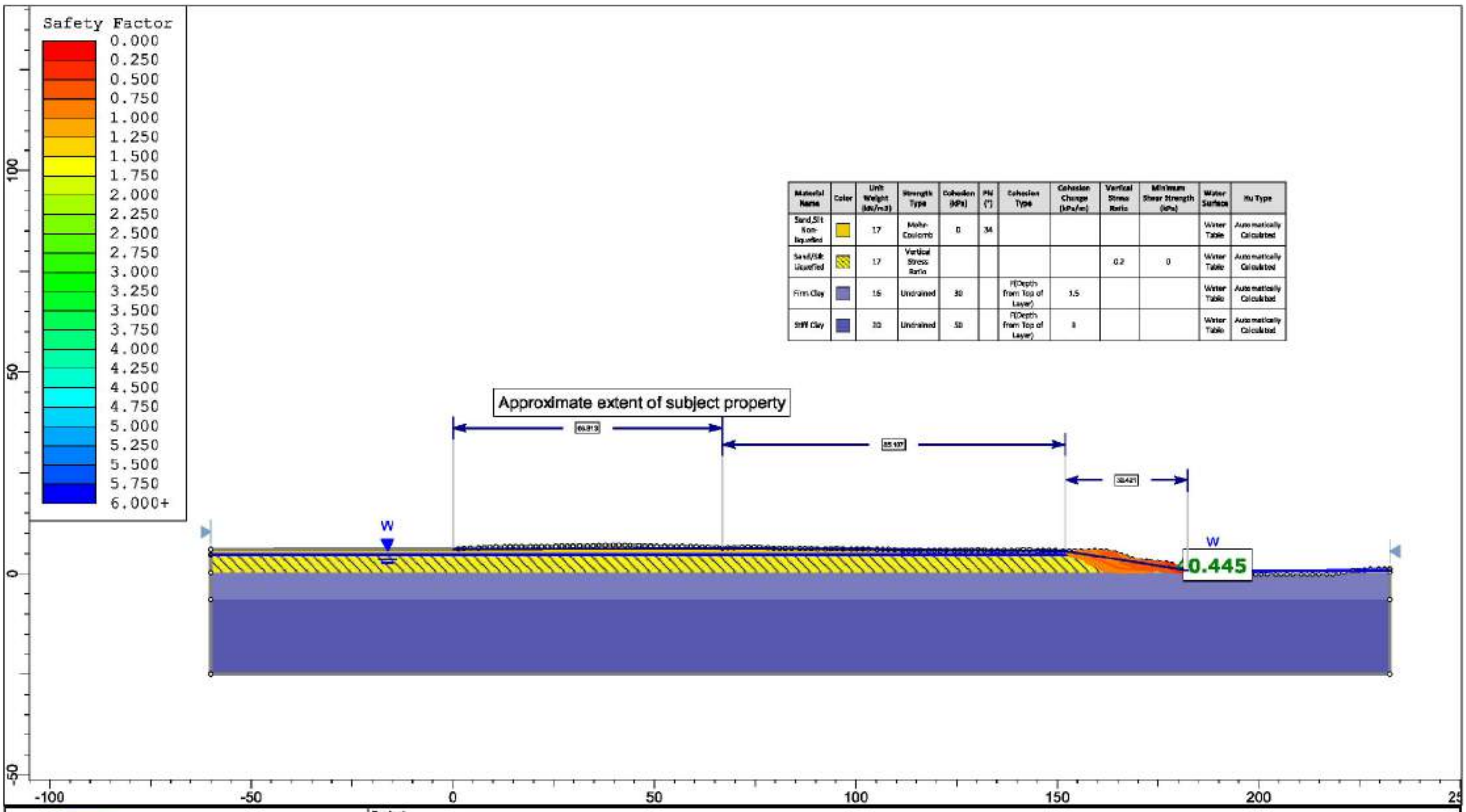
- 🟥 Almost certain it will liquefy
- 🟧 Very likely to liquefy
- 🟨 Liquefaction and no liq. are equally likely
- 🟩 Unlike to liquefy
- 🟩 Almost certain it will not liquefy

LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟨 Low risk

APPENDIX E

SLOPE STABILITY OUTPUTS

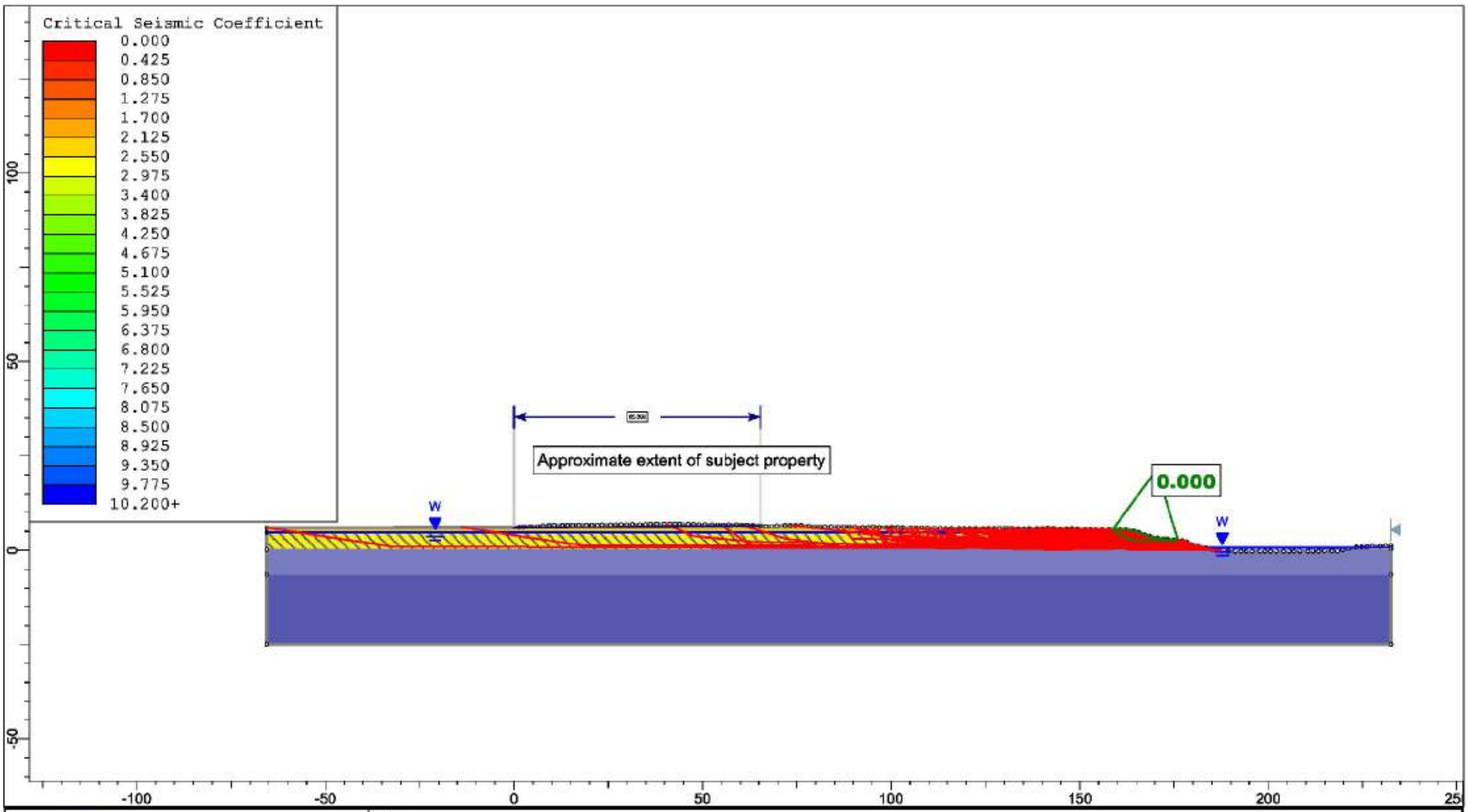


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Cohesion Change (kPa/m)	Vertical Stress Ratio	Minimum Shear Strength (kPa)	Water Surface	Hu Type
Sand,Silt Non-liquefied	🟨	17	Mohr-Coulomb	0	34					Water Table	Automatically Calculated
Sand/Silt Liquefied	▨	17	Vertical Stress Ratio					0.2	0	Water Table	Automatically Calculated
Firm Clay	🟪	16	Undrained	30		F(Depth from Top of Layer)	1.5			Water Table	Automatically Calculated
Stiff Clay	🟦	20	Undrained	50		F(Depth from Top of Layer)	8			Water Table	Automatically Calculated

LAND DEVELOPMENT & ENGINEERING

SLIDEINTERPRET 9.028

Project	Slide2 - An Interactive Slope Stability Program		
Group	Group 1	*Scenario*	T/S ratio 0.2 - Static Flow
Drawn By	SS	*Company*	LDE Ltd
Date	31/08/2023	*File Name*	Lateral Spreading Analysis.slmd



SLIDEINTERPRET 9.028

Project	Slide2 - An Interactive Slope Stability Program		
Group	Group 4	*Scenario*	T/S ratio 0.2 - Yield Seismic
Drawn By	SS	*Company*	LDE Ltd
Date	31/08/2023	*File Name*	Lateral Spreading Analysis.slmd

NZHG Gisborne Limited

GEOTECHNICAL ASSESSMENT REPORT FOR PROPOSED RESIDENTIAL DWELLING, LOT 3

556-560 Aberdeen Road, Te Hapara, Gisborne

Project Reference: 24477
October 12, 2023

DOCUMENT CONTROL

Version	Date	Comments
01	12/10/2023	Issued for Resource Consent. Plan review required prior to submission for Building Consent.

Version	Issued For	Date	Prepared By	Reviewed & Authorised By
01	Issued for Design	12/10/2023	Sathwara Sahil Sathwara *B.Tech (Civil), MEngNZ* Geotechnical Engineer	Daniel J.B Dan Bond *CMEngNZ, PEngGeol.* Associate Engineering Geologist

CONTENTS

1 INTRODUCTION

Land Development & Engineering Ltd (LDE) was engaged by NZHG Gisborne Limited to undertake a geotechnical investigation of a site located at 556 & 560 Aberdeen Road, Gisborne (Figure 1).

The 2,700m^2 site is proposed to be subdivided into 12 Lots for residential development (Figure 1). This geotechnical report pertains to proposed Lot 3, 556 & 560 Aberdeen Road, Gisborne.

Figure 1 556-560 Aberdeen Road (outlined in blue), with the proposed subdivision outlined in yellow, Lot 3 highlighted in white. Image source: Tairāwhiti Maps (Gisborne District Council, 2023) Accessed: September 2023

2 PROPOSED DEVELOPMENT

A 12-lot subdivision is proposed at 556 & 560 Aberdeen Road across the property with the legal description Lot 2 DP 1585, PT Lot 1 DP 1585, and Lot 1 DP 1817. The proposed development consists of 7 structures formed of four double-storey duplex buildings, one single-storey building and two standalone dwellings (Figure 1).

The proposed driveway is located centrally of the site to provide access between lots and Aberdeen Road. Proposed access and building platform locations are shown in and Appendix A.

A 107.1m^2 single storey standalone dwelling is proposed across Lot 3 (Figure 2), with timber framing in accordance with NZS3604 (2011), with weatherboard and sheet wall cladding, profiled metal roofing and a concrete floor or suspended timber floor.

The purpose of this investigation was to determine and assess the nature of the ground beneath the building site to inform our geotechnical recommendations for site development and design of the building's foundations. The investigation was completed to satisfy the requirements of Gisborne District Council (2022) for Resource and Building Consent.

Areas

	Space Name	Area (m²)
Z3+ ACC		
	Bath	7.53
	Bedroom 1	12.45
	Bedroom 2	9.69
	Bedroom 3	9.08
	Covered Entry	1.40
	Hall	6.44
	LDY	1.78
	Linen	1.10
	Living / Dining / Kitchen	46.02
	Store	0.54
	Store	0.54
	WR1	1.09
	WR2	0.95
	WR3	0.74

Figure 2: (From top to bottom): Floor plans for proposed duplex building across Lot 3, alongside the architect's drawing (Lot 3 is labelled). Image Source: Client supplied.

3 SITE STUDY

3.1 Site Description

The site is located within the established suburb of Te Hapara, Gisborne, approximately 2.0km northwest of the Gisborne CBD. The site is generally flat and is elevated between 6m and 7m (New Zealand Vertical Datum (NZVD) 2016). 556 (LOT 2 PT 1 DP 1585) & 560 (LOT 1 DP 1817) Aberdeen Road, occupy a combined area of approximately 2,700m^2.

3.2 Geomorphology and Geology

556 & 560 Aberdeen Road, occupy flat lying ground which, at one time, comprised the historic foreshore of Tūranganui-a-Kiwa (Poverty Bay). The 1:250,000 geological map of the region (Mazengarb & Speden, 2000) indicates the site is underlain by Holocene aged beach deposits which consist predominantly of sand. The Taruheru River is located approximately 120 m to the north; elevation falls relatively gently towards the river until the riverbank, which falls around 6m over some 25m laterally.

The GNS Active Fault Database does not identify any active fault traces or any fault buffer zones affecting the site. The nearest mapped active fault is the Repongaere Fault, located approximately 14 km to the north-west of the properties (GNS Science, 2020).

3.3 Geotechnical Risks

Our review of Gisborne District Council's (GDC) GIS viewer, Tairāwhiti Maps (Gisborne District Council, 2023), and GNS Science's Active Faults Database (GNS Science, 2020) revealed the following:

- 556 & 560 Aberdeen are mapped as being within an area of moderate liquefaction risk.
- The nearest active fault is the Repongaere Fault, located approximately 14 km to the north-west of the properties.
- The site is mapped as yellow tsunami evacuation zone.

In addition to the risk of liquefaction, the nearby riverbanks of the Taruheru River presents the possibility of lateral spreading in a liquefaction-inducing earthquake event.

Our review of the 2023 aerial photographs indicates that the properties were not severely impacted by flooding associated with Cyclone Gabrielle.

3.4 Historical Aerial Photographs

Historical aerial imagery was reviewed as part of this investigation using Retrolens and Google earth aerial

photography, which revealed the following: -

- Residential dwellings were constructed at both properties prior to 1942 (the earliest available aerial photograph with sufficient resolution).
- In the 1942 aerial photograph there appears to be some form of structure/s, a pile of material, or disturbance to the ground beneath the southwest corner of 556 Aberdeen Road. However, the resolution of the aerial photography is not sufficient to reliably determine what occupied the southwest corner of the property.
- A large shed was constructed in the southwest corner of 556 Aberdeen Road sometime between 1942 and 1966, along with smaller auxiliary structures at both properties.
- Several small structures or 'lean-tos' were constructed between 1966 and 1988 across both properties.
- A shed/garage was constructed in the south-east corner of 560 Aberdeen Road.
- Between 1988 and 2021 additions were carried out to the garage/shed in the south-east corner of 560, and the large shed in the southwest corner of 556. The water tank for 560 Aberdeen Road was removed, along with several of the smaller auxiliary structures across both properties.

Figure 3: Historical aerial imagery of the Aberdeen Road Subdivision (Source: (Retrolens.co.nz)), with the location of the individual lots marked in yellow. (a) Aerial imagery from 1942, (b)1966, (c) 1977, (d) 1988.

4 GEOTECHNICAL INVESTIGATION

4.1 Development wide Investigation Scope

Our investigation of the entire site included the following: -

- A walkover assessment of the site and immediate surrounding area to assess its geomorphology and identify any features which may influence our engineering recommendations, or the long-term performance of the ground.
- 15No. 50mm diameter, hand auger boreholes drilled to refusal or 2.5m target depth at the proposed building locations, with measurements of undrained shear strength taken every 0.2m, and associated DCP's to the 2.5m target depth.
- Complete liquefaction analysis of the Five CPTs which were undertaken across the site during the due diligence phase, three at 556 Aberdeen Road and two at 560 Aberdeen Road (Figure 4).

4.2 Lot 3 Investigation Scope

The investigation of the site, completed on 12 September 2023 included the following work: -

- Three, 50mm diameter, hand-auger boreholes (HA03, HA04 and HA05), reached target depth of 2.5m below ground level (bgl). Associated DCP tests were carried out at each test location to the 2.5m target depth within granular materials.
- Measurements of groundwater levels within invasive subsurface test holes, following hole completion.

The test locations are shown on the Geotechnical Investigation Plan (Figure 4), and as Appendix A. Logs with details of the relevant testing completed are presented as Appendices B and C.

Figure 4: Geotechnical Investigation Plan for proposed development, Lot 3 highlighted in white.

5 GROUND CONDITIONS

This section addresses the ground conditions encountered during our investigations.

5.1 Site Stratigraphy

5.1.1 Development Wide

Ground conditions are reasonably consistent across the site. Typically, the property is underlain by topsoil and/or fill to a depth between 0.3m and 0.8m below ground level (bgl), which overlies sand/ silt mixtures to a depth of 1.0m. Underlying this, medium dense to dense sand was encountered to around 6.5m to 7.0m.

Deposits of firm clay were encountered from around 6.5m to 7.0m, with stiff silt/clay mixtures extending to depth from approximately 13m.

A copy of the test logs is provided as Appendix B.

5.1.2 Lot 3 Site Specific Nuances

Topsoil/Fill was encountered in each hand auger borehole from the existing ground surface to the depths of 0.55m, 0.4m and 0.5m in HA03, HA04 and HA05 respectively.

Dynamic penetrometer testing in HA03, HA04 and HA05 typically ranged between 0.5 and 6 blows per 50mm penetration below the topsoil and 2.5m depth.

5.2 Groundwater

Groundwater was encountered at depths of between 1.50m and 2.88m across the site. A low-bound groundwater level of 1.65m bgl was adopted in our assessments. Given that testing was completed in the wettest year on record for Gisborne, the groundwater level adopted is considered significantly elevated from typical levels and no further allowance has been applied for seasonal variations.

6 NATURAL HAZARDS

6.1 Definition & Legislation

This section summarises our assessment of the natural hazards that might affect the site including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding, that might affect the property, as generally defined in Section 106 of the Resource Management Act., as well as the hazards as defined in Section 71(3) of the Building Act (2004), including erosion (including coastal erosion, bank erosion, and sheet erosion), falling debris (including soil, rock, snow and ice), subsidence, inundation (including flooding, overland flow, storm surge, tidal effects and ponding), and slippage.

6.2 Seismic Hazard

6.2.1 Surface Fault Rupture

The GNS NZ Geology Web-map and Active Faults Database (GNS Science, 2020) do not show any faults passing beneath the subject site. There also does not appear to be any surface expressions which would indicate the presence of an active fault beneath or within close proximity to the site. We therefore consider the surface fault rupture risk to be low.

6.2.2 Site Subsoil Class

Based on the published geological information for the region, discussed in Section 3.2, and obtained site-specific CPT data, we consider that a seismic site subsoil classification of D- "Deep or Soft Soil" is appropriate as defined by NZS 1170.5 (2004).

6.2.3 Seismic Actions

In accordance with the NZ Building Code and NZS 1170.5 (2004) the structure proposed is considered Importance Level 2 (IL2) with a design working life of 50 years, therefore:

- The Serviceability Limit State (SLS) design earthquake has an annual exceedance probability (AEP) of 1/25, and;
- The Ultimate Limit State (ULS) design earthquake has an AEP of 1/500.

An intermediate state event (ILS) has been considered in accordance with Gisborne District Council's (GDC's) requirements. This design case has an AEP of 1/100.

The modules of the Earthquake Geotechnical Engineering Practice series jointly published by Ministry of Business Innovation and Employment (MBIE) and the New Zealand Geotechnical Society (NZGS) (2021) provides guidance under Section 175 of the Building Act (2004), to assist with ensuring compliance with the Act. We have adopted the ground motions published within Module 1 (2021) for geotechnical design which are summarised in Table 1.

Table 1 - Summary of adopted seismic parameters.

Seismic Parameters	SLS	ILS	ULS
Horizontal Peak Ground Accelerations (PGA), g	0.12	0.28	0.65
Effective magnitude, Mw	6.3	6.8	7.5

6.3 Liquefaction and Cyclic Softening Assessments

6.3.1 Liquefaction

Liquefaction is the term used to describe the temporary, but substantial, loss of strength and stiffness which can occur in saturated, unconsolidated soils that are subjected to strong shaking. In addition to near-total strength loss, liquefaction may also result in the expulsion of sediment and water at the surface, ground, and structure settlement, and in lateral (spreading) displacement of the ground.

The liquefaction potential was assessed with site-specific CPT data using specialist geotechnical software (CLiq Ver.3.3.1.13) in general accordance with NZGS/ MBIE Module 3 Guidance (2021).

Liquefaction triggering was assessed using the method proposed by Boulanger and Idriss (2014).

Liquefaction-induced, free-field, vertical, volumetric strains were estimated using the method proposed by Zhang et al (2002)

A low-bound groundwater level of 1.65m bgl was adopted as discussed in Section 5.2.

6.3.2 Cyclic-Softening

Cyclic softening is a phenomenon that occurs when the strength and stiffness of a soil decreases due to repeated cyclic loading such as that resulting from strong seismic shaking. Relatively soft clay soils are commonly susceptible to this phenomenon, which can be accentuated where these soils are sensitive i.e., there is a significant difference between the soil's peak and residual shear strength.

Due to the presence of the clay rich estuarine soils at this site, we have undertaken a cyclic softening analysis for the ULS design case. The Gisborne 2007 earthquake was of comparable magnitude and PGA to the ILS design case. No liquefaction or induced settlements were identified within the proximity of the subject site because of this earthquake. Accordingly, cyclic softening has been assessed for the ULS design case only.

Our assessments assumed:

- An N_{kt} value of 14 for the clay-like soils, based on previous work undertaken proximally by LDE within the estuarine deposits.
- An estimate of the maximum, post-liquefaction, volumetric strain based on the work by Robertson and Cabal (Robertson & Cabal, 2014) which recommends a default value of 0.5% for clay-like soils.

6.3.3 Liquefaction and Cyclic Softening Results

The results of our analyses are summarised in Table 2; detailed outputs are included as Appendix D.

The Liquefaction Potential Index (LPI) and Liquefaction Severity Number (LSN) are indices used to assess the general performance level of liquefied deposits in accordance with the NZGS/MBIE Module 3 Guidance (2021).

Our analyses indicate that liquefaction-induced settlements are likely to be negligible (<5mm) in a design SLS seismic event.

Under the ILS design case, liquefaction-induced settlements are estimated to be between 20mm and 50mm. As discussed in Section 6.3.2, no liquefaction, or liquefaction-induced settlements were identified within the proximity of the subject site as a result of the Gisborne 2007 earthquake, which had almost identical ground motions. Accordingly, we consider it unlikely that liquefaction would be realised under ILS seismic shaking and conclude that the software is likely to be over-estimating liquefaction potential.

Table 2 - Summary of liquefaction analysis results.

Limit State / AEP	CPT ID	LPI	LSN	Estimated Seismic Volumetric Settlements (mm) [Limited to 10m] (3)			Effects of Liquefaction
				Liquefaction	Cyclic Softening	Total Seismic Settlement	
SLS 1/25 year	CPT-01	0	0	<5 [<5]	-	**<5 [<5]**	**L0**
	CPT-02	0	0	<5 [<5]	-	**<5 [<5]**	
	CPT-03	0	0	<5 [<5]	-	**<5 [<5]**	
	CPT-04	0	0	<5 [<5]	-	**<5 [<5]**	
	CPT-05	0	0	<5 [<5]	-	**<5 [<5]**	
ILS 1/100 year	CPT-01	2	8	~30 [~25]	-	**~30 [~25]**	**L2**
	CPT-02	4	12	~50 [~45]	-	**~50 [~45]**	
	CPT-03	2	5	~20 [~20]	-	**~20 [~20]**	
	CPT-04	4	12	~45 [~40]	-	**~45 [~40]**	
	CPT-05	3	10	~45 [~30]	-	**~45 [~30]**	
ULS 1/500 year	CPT-01	18	23	~75 [~70]	~45	**~120 [~70]**	**L3**
	CPT-02	18	23	~85 [~75]	~40	**~125 [~75]**	
	CPT-03	16	19	~70 [~65]	~40	**~110 [65]**	
	CPT-04	20	24	~85 [~80]	~40	**~125 [65]**	
	CPT-05	18	23	~85 [~65]	~40	**~125 [65]**	

Effects of liquefaction Key	**L0: Insignificant**	**L1: Mild**	**L2 Moderate**	**L3: High**	**L4 Severe**	**L5: Very Severe**

Notes:

- Liquefaction triggering Boulanger and Idriss (2014) methodology limited to upper 15m. Limited to 10m of soil profile shown in square brackets [ ].
- Settlements are free-field estimated settlements and do not include any building-induced settlements.
- Effects of Liquefaction based on NZGS Module 3 (New Zealand Geotechnical Society (NZGS) & Ministry of Business, Innovation and Employment (MBIE), 2021)

Under design ULS seismic shaking, settlements in the order of 110mm to 125mm are estimated. However, given the rationalisation to the Gisborne 2007 earthquake, discussed above, we consider that total, free-field, seismic settlements are likely to less than 100mm.

6.4 Lateral Spreading and Lateral Stretch

Lateral spreading typically occurs in sloping ground or level ground close to slopes or waterways and is most commonly caused by loss of strength due to earthquake-induced liquefaction. Typically, the degree of lateral movement diminishes as the distance from the waterway, or free face, increases.

Liquefaction-induced lateral displacements were estimated in CLiq software using the method proposed by Zhang et al (2004). utilising an Ic cut-off of 2.6, clean sand and overburden corrections, and inferred soil unit weights.

The methods available to predict lateral displacements from CPT data. Both these methods are based upon limited case studies and as such have inherent limitations for broader application. They are known to be highly inaccurate with predictions versus empirical data varying by a factor of two (NZGS Module 3 (2021)) or possibly more. Accordingly, lateral spreading potential was also assessed through numerical modelling, using Slide 2 (Version 9.027) by Rocscience Inc., to provide a more reliable estimate and allow sensitivity analyses to be undertaken.

Both methods, and associated results are discussed below.

6.4.1 CLiq Assessment

Our CLiq assessment adopted the 'Level ground with a free face' approach, because the alternative option (gently sloping ground) was found to estimate lateral displacements in excess of 600mm under the ILS design case.

Our assessment was based on the sites closest proximity to the Taruheru River (117m) and a free face height of 7m (elevation relief from the site to the river) and was completed for each CPT.

Table 3 presents the results of these analyses.

Table 3 - Summary of Lateral Spreading Displacements

CPT ID	SLS 1/25 year (mm)	ILS 1/100 year (mm)	ULS 1/500 year (mm)	Global Lateral Movement (ULS)
CPT01	<5	~105	~315	**Major**
CPT02	<5	~170	~390	**Major**
CPT03	<5	~100	~275	**Minor to Moderate**
CPT04	<5	~250	~460	**Major**
CPT05	<5	~180	~380	**Major**

Global lateral movement categories	**Minor to Moderate** **0 to 300mm**	**Major** **300 to 500mm**	**Severe** **>500mm**

Notes:

- Free-face method adopted limits of lateral spreading to 2H. Chu et al (2006) have compared predicted values of lateral spread using the Zhang et al model with actual measurements of lateral displacement following the 1999 Chi Chi earthquake. They found that predicted values better matched observed values when liquefaction calculations in the CPT profile were limited to a depth of twice the free face height (2H).
- Global lateral movement categories based on MBIE Guidance for TC3 (Ministry of Business Innovation and Employment Hīkina Whakatutuki, 2015)

6.4.2 Numerical Modelling Assessment

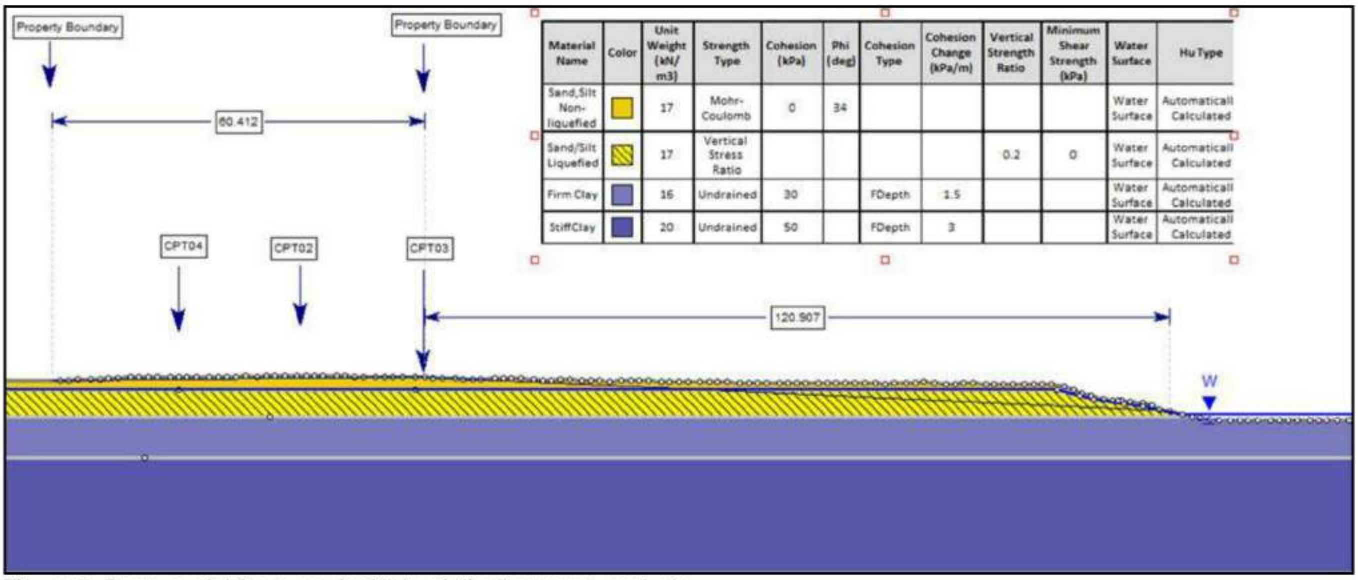
Numerical modelling was used to assess the potential for lateral displacements using Slide 2 as discussed above.

Our modelling assessed non-circular slip surfaces using the 'Cuckoo" search method and adopting the 'Vertical Strength Ratio' material strength model for the liquefied layer.

From past projects and general geological knowledge of this area, it is our experience that the Holocene beach sand transitions to clay-rich deposits towards the river, likely due to a combination of river migration and overbank deposition. In many areas along the Taruheru river a relic river terrace can be clearly identified, however this area had been developed prior to the earliest available historic aerial imagery and consequently the terrace boundary could not be identified.

Accordingly, we have adopted a conservative 'what if.' scenario in our modelling where the liquefied layer has been extended at consistent thickness and elevation to the river.

Figure 5 shows the base model, the surface profile of which was plotted from recent LiDAR data. Note the left side of the model has been manually extended to check the potential for more critical slip surfaces.



Material Name	Color	Unit Weight (kN/ m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Cohesion Type	Cohesion Change (kPa/m)	Vertical Strength Ratio	Minimum Shear Strength (kPa)	Water Surface	Hu Type
Sand,Silt Non-liquefied	🟨	17	Mohr-Coulomb	0	34					Water Surface	Automaticall Calculated
Sand/Silt Liquefied	▨	17	Vertical Stress Ratio					0.2	0	Water Surface	Automaticall Calculated
Firm Clay	🟪	16	Undrained	30		FDepth	1.5			Water Surface	Automaticall Calculated
StiffClay	🟦	20	Undrained	50		FDepth	3			Water Surface	Automaticall Calculated

Figure 5: Base model for numerical lateral displacement analysis

The liquefied shear strength to overburden stress (Tau/ Sigma) ratio was derived for the sand/ silt mixtures from statistical analysis of CPT data. The Tau/ Sigma Ratio was found to vary significantly, ranging from 0.08 to 0.98; a value of 0.2 was adopted to provide a moderately conservative estimate for the body of liquefied material. Figure 6 shows a plot of Tau/ Sigma ratio with depth for CPT04.

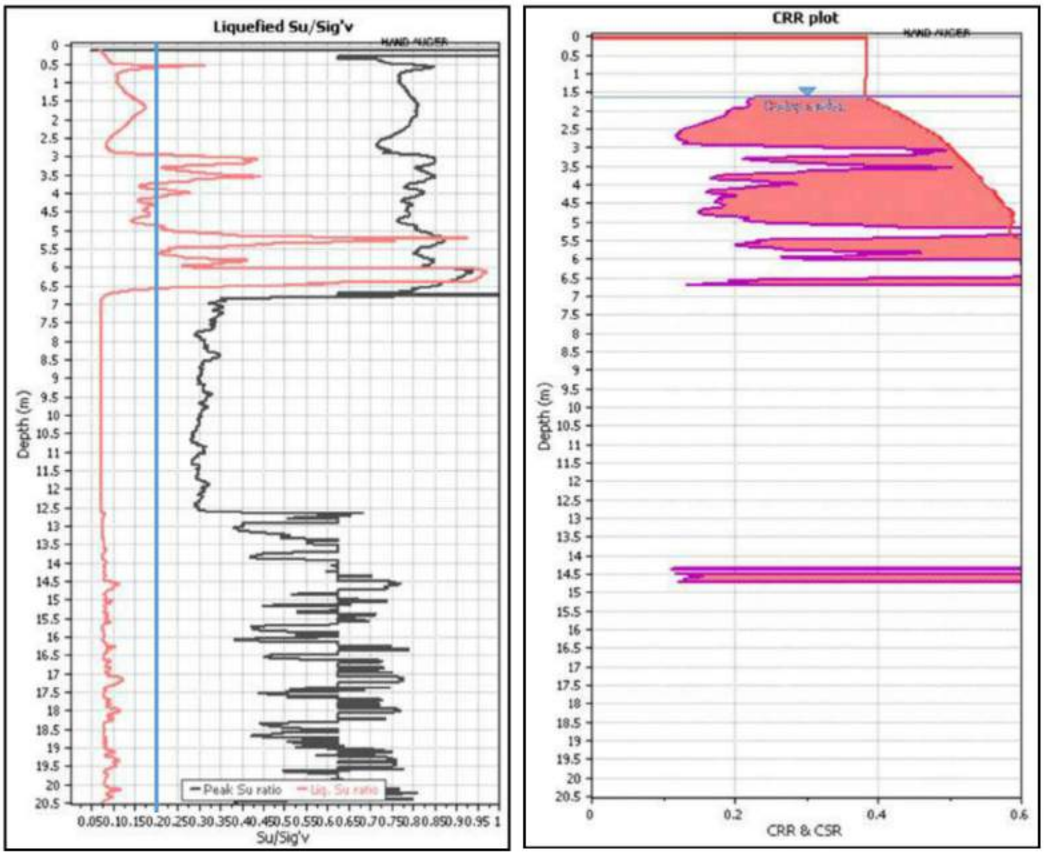


Figure 7: Tau/ Sigma ratio plot for CPT04 and plot showing depth of liquefiable material. Blue line shows value adopted in our modelling.

Two design cases were assessed:

1. Static Flow

   This design case models a post seismic liquefied case to assess the potential for flow failures to impact the subject property.
2. Seismic Yield

   This assessment determines the PGA required for the site to be affected by lateral displacements considering seismic action coincident with the fully liquefied condition. A magnitude of 0.1g was considered reasonable to represent an aftershock occurring within the short-term, liquefied timeframe.

6.4.2.1 Results

The results suggest that the property will not be affected in the static flow scenario with failures extending to a maximum of around 31m from the riverbank, some 85m from the subject property.

Under the seismic yield design case the subject property is estimated to be affected with a PGA of around 0.11g. Accordingly, lateral displacements are not anticipated in this scenario.

Full results are presented in Appendix E.

6.4.3 Conclusions

Numerical modelling indicates that lateral displacements of the magnitude estimated by CLiq are only achieved when full seismic PGAs are applied in the fully liquefied condition. Such a scenario is considered to be of very low probability, and highly conservative. We consider however that there is a reasonable probability of an aftershock occurring during this timeframe.

We conclude that the numerical modelling provides a more realistic estimate of ground performance, particularly given the apparent overestimation of liquefaction affects, discussed in Section 6.3.3. Accordingly, we consider that the subject site has low lateral spreading potential.

6.4.3.1 Lateral Stretch

Lateral stretch is a metric of the amount of differential extension that a portion of land may experience during an episode of lateral spreading. The lateral stretch across a foundation is a main factor in foundation damage due to liquefaction and lateral spreading as a result of a large earthquake.

Given the results of our numerical analyses, discussed above, lateral stretch is not anticipated at the subject site under the design cases assessed.

6.5 Liquefied Bearing

Liquefaction may lead to foundation bearing failure, by either 'punch through' failure or a reduction in bearing capacity when liquefaction occurs within the zone of influence of load bearing foundations.

A preferred foundation option has not been identified for the proposed structures at the time of writing and we have completed liquefied bearing assessments for both raft-type surface structures and piled foundations.

A unit weight of 17kN/m^3 was adopted for both the non-liquefied and liquefied soil layers. An angle of internal friction of 34 degree was adopted for the non-liquefied material.

The Tau/sigma ratio for these assessments was based on site-specific CPT data and taken as 0.075 for the liquefied material within the zone of influence of the foundations.

A low bound groundwater level was taken as 1.65m, as discussed in Section 5.2.

A reduction factor of 0.75 was applied to the ultimate capacities calculated for the proposed, two-storey, duplex buildings, in accordance with MBIE Module 5 (2021) for moderately loaded structures.

6.5.1 Pile Foundation Assessment

Our assessment of pile foundations assumed:

- Ordinary piles embedded to a minimum depth of 0.5m at 0.3m diameter (including concrete cover), and

- Anchor piles embedded to a minimum depth of 0.9m at 0.4m diameter (including concrete cover), and
- 100kPa design load.

Both projected area and 'punch-through' failure mechanisms were assessed.

6.5.1.1 Results

The design load was found to be acceptable in both design cases. Note that our calculations are dependent on the assumptions listed within this Section. Should the pile diameter, pile embedment depth or design loads change, the liquefied bearing capacities will need to be reassessed.

6.5.2 Raft type Surface Structure Foundation Assessment

For the raft-type surface structures assessments were completed for the single-storey and two-storey buildings assuming:

- Foundation widths as presented in the 15% architectural drawings, and
- An embedment depth of 0.2m.

6.5.2.1 Results

Liquefied bearing capacities were calculated to be 19kPa for the proposed single-story buildings and 14kPa for the proposed two-storey duplex structures.

The values presented above are dependent on the assumptions listed. Should the foundation breadth, embedment depth or design loads change, the liquefied bearing capacities will need to be reassessed.

6.6 Equivalent MBIE Technical Category

Considering the rationalisation provided in Section 6.3.3, we consider that seismic ground performance at this site would be equivalent to a TC2 classification in accordance with Table 15.6 of the MBIE Guidance (2015).

6.7 Flood Hazard

The site is not located in a mapped flood hazard zone. GDC aerial imagery post cyclone Gabrielle does not indicate this site experienced significant impacts.

6.8 Tsunami

The Gisborne / East Cape coastline is classified as being at the highest risk in the country of being affected by tsunami. Modelling for the Gisborne region (GNS Science Te Pū Ao, 2016) indicates that the site is sufficiently elevated and is unlikely to be inundated in 1:100, 1:500, and 1:2500-year return period tsunami events, respectively. Civil defence tsunami inundation maps show that the site mapped as a yellow zone, which may be subject to tsunami

hazard in the case of a severe (ie M8.9) local earthquake on the Hikurangi subduction margin (Gisborne District Council Te Kaunihera o Te Tairāwhiti, 2019) .

6.9 Expansive Soils

Cohesive soils containing significant proportions of certain clay minerals can be subject to appreciable volume change caused by variations in soil moisture content, most notably between seasons or from the uptake of water through the root systems of trees and shrubs. This is referred to as soil reactivity or shrink-swell behaviour.

The surficial soils at this site are granular in nature and therefore not subject to expansivity.

6.10 Consolidation Settlement

The topsoil across the site is expected to be subject to consolidation with applied load and is not suitable to support structural loads.

The firm clay beneath the site may also be subject to consolidation settlement depending on the foundation option selected and the structural loads applied. The potential for consolidation settlement within this material should be assessed once the foundation type and structural loads have been determined.

6.11 Natural Hazards Summary

From our assessment of the natural hazards and ground deformation risks presented to the proposed development we consider that the proposed structures can be safely located on the site, provided that the recommendations given in Section 7 are adopted.

7 ENGINEERING RECOMMENDATIONS

7.1 Site Contouring and Topsoiling

The finished ground level should be graded so that water cannot pond against, beneath or around the buildings for the economic life of structure. To achieve this, it will be important that the building platform beneath the topsoil grades away from the site. Contouring should avoid the potential for concentration and discharge of surface water over point locations which could result in soil erosion or instability.

7.2 Access Road Construction

Access is proposed from Aberdeen Road. No major/ significant earthworks are anticipated to form access to the proposed dwellings.

7.3 Foundation Recommendations

7.3.1 Foundation Type

Based on the site investigation and analysis, we consider that foundations comprising pile foundations or raft-type surface structures are suitable for the site conditions providing the recommendations and limitations presented within this section are addressed in design.

7.3.2 Design Considerations

Based on the scope of work completed, the following aspects need to be considered in detailed design:

- Site Class - Class D - Deep or soft soil
- Liquefaction-induced vertical settlements - TC2 equivalent
- Relatively high groundwater level
- Liquefied bearing capacity
- Potential for consolidation settlement

7.3.3 Bearing Capacity and Founding Depth

Foundations must extend beneath any topsoil, uncontrolled fill, organic and/ or otherwise unsuitable material.

For the Lot 3 building we anticipate that a static geotechnical ultimate bearing capacity (GUBC) of 210kPa will be available from 0.6m depth. Some localised deepening of foundations is anticipated in the vicinity of HA05. A reduction factor of 0.45 should be applied to the GUBC to give the design bearing strength (q_{dbs}).

A short-term, post-seismic (static), liquefied bearing capacity, equivalent to the values presented in Section 6.5, should be assessed in structural design. Note that these liquefied bearing capacities are contingent on the assumptions listed within Section 6.5. Should these assumptions change in design, the liquefied bearing capacities will need to be reassessed. This may require some iterative design between the geotechnical and structural engineers.

7.4 Surface Water

Surface water from roof, impermeable surfaces, or any slopes should be collected and discharged away from the building to mitigate against flooding, erosion, soil expansivity, and/ or potential instability. The site will be connected to the reticulated network. Rainwater will be collected from the roof and all paved surfaces including parking areas and discharged into the GDC reticulated stormwater network.

7.4.1 Service Pipes

All service pipes, stormwater structures should be designed and constructed to ensure adequate capacity, strength, and water tightness to prevent leakage into the platform through blockage, running under pressure, or structural failure.

All service pipes installed within any fill should be flexible, or flexibly joined, so that they may deflect without breaking if the ground settles.

A record should be kept of the position, type, and size of all subsoil drains, and in particular of their outlets.

7.5 Trees and Shrubs

There are trees within the vicinity scattered across the property which might potentially cause damage through heaving as a result of root growth and/or settlement resulting from soil shrinkage from the moisture uptake of the roots. To reduce the chance of damage to the foundations, we recommend one of the following options:

- Any Trees/ plants that at their mature high will not be a minimum of that height away from the foundation should be removed including its major root structure.
- A root barrier should be designed and installed between the offending plant and the structure.
- Foundation should be taken to a depth no less than 1.0m where damage from the roots of a plant is unlikely.

If new trees, shrubs, or gardens are established near the structure, care should be taken to ensure:

- The vegetation does not interfere with any subfloor ventilation or services to the structure.
- Over-watering of the vegetation does not saturate the ground near the foundations.
- Trees or shrubs with the potential to develop significant root systems should be planted a minimum distance equal to the mature height of the plant away from the foundations.

8 SUSTAINABILITY

Considering sustainability as early as possible in a project's development, could lead to significant project opportunities and wider positive outcomes. Geotechnical opportunities for increased sustainability for this project include:

- Striping and stocking topsoil for reuse (dependant on presence/ levels of contaminants).
- Designing for cut and fill balance where possible.
- Reuse of site won materials, or using materials won from other sites including use of recycled crushed concrete aggregate for hard fill.
- Contributing site investigation data to the New Zealand Geotechnical Database (NZGD) to help reduce the site investigations needed in the future.

- Using local consultants and contractors to reduce transport related emissions.

9 CONCLUSIONS

Following development of the site in accordance with our recommendations, we consider that: -

a) The land in respect of which a consent is sought, or any structure on the land built in accordance with our recommendations, is unlikely to be subject to material damage by erosion, falling debris, subsidence, slippage, or inundation from any source; and

b) Any subsequent use that is likely to be made of the land is unlikely to accelerate, worsen, or result in material damage to the land, other land, or structure by erosion, falling debris, subsidence, slippage, or inundation from any source; and

c) Sufficient provision has been made for physical access to each allotment to be created by the subdivision.

10 PLAN REVIEW

Prior to an application for Building Consent, it is important we are given the opportunity to review the final development drawings to ensure the recommendations contained within this report have been followed and interpreted correctly. Following successful review of the development drawings, we are able to update this report to support an application for Building Consent.

11 VERIFICATION

Verification requirements will be provided once the form of the foundations has been determined.

12 LIMITATIONS

This report should be read and reproduced in its entirety including the limitations to understand the context of the opinions and recommendations given.

This report has been prepared exclusively for NZHG Gisborne Limited in accordance with the brief given to us or the agreed scope and they will be deemed the exclusive owner on full and final payment of the invoice. Information, opinions, and recommendations contained within this report can only be used for the purposes with which it was intended. LDE accepts no liability or responsibility whatsoever for any use or reliance on the report by any party other than the owner or parties working for or on behalf of the owner, such as local authorities, and for purposes beyond those for which it was intended.

This report was prepared in general accordance with current standards, codes and best practice at the time of this report. These may be subject to change.

Opinions given in this report are based on visual methods and subsurface investigations at discrete locations designed to the constraints of the project scope to provide the best assessment of the environment. It must be appreciated that the nature and continuity of the subsurface materials between these locations are inferred and that actual conditions could vary from that described herein. We should be contacted immediately if the conditions are found to differ from those described in this report.

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14 GLOSSARY

Compressible Soils:	Compressible soils are those that will undergo a reduction in volume under an imposed load, such as the weight of fill or a structure. This occurs firstly as a result of the expulsion of air and water from the soil void spaces (primary settlement) and secondly due to a restructuring of the soil skeleton to take the load (secondary settlement).
Cyclic Softening:	Cyclic-softening is a related condition to liquefaction can also affect clay soils when subjected to cyclic-loading. Clay soils may significantly soften and led to bearing capacity failure, in addition to post-earthquake consolidation settlements may occur as a result of the earthquake shaking.
Expansive Soils:	Cohesive soils containing significant proportions of certain clay minerals can be subject to appreciable volume change caused by variations in soil moisture content, most notably between seasons or from the uptake of water through the root systems of trees and shrubs. This is also often referred to as soil reactivity or shrink-swell behaviour.
Lateral Spread:	Lateral spread of liquefied soils is the lateral displacement of blocks of land moving laterally towards a free edge (for example a riverbank) or within sloping ground. More lateral movement tends to occur closest to the edge with less movement further back. Lateral spreading may result in large permanent ground displacements including cracks, fissures, vertical officesets and overall settlement of the ground.
Lateral Stretch:	Lateral stretch is the amount of differential extension that a portion of land may experience during an episode of lateral spreading. The lateral stretch across a foundation is a main factor in foundation damage due to liquefaction and lateral spreading because of a large earthquake.
LiDAR	Light Detection and Ranging (LiDAR) is a method of remote sensing topographical survey.
Limit States:	Seismic design criteria for performance-based design. SLS, SLS2 & ULS are prescribed in NZS1170.5 (Standards New Zealand Te Mana Tautikanga O Aotearoa, 2004) • **Serviceability Limit State (SLS):** Functional requirements for the serviceability limit state are assumed to be met if the structure or part can continue to be used as originally intended without the need for repair (SLS1) or can remain operational or continue to be occupied as appropriate (SLS2). SLS earthquakes are considered highly likely to occur during the lifetime of the structure. • **Ultimate Limit State (ULS):** Functional requirements for the ultimate limit state are assumed to be met if: a) People within, and adjacent to the structure are not endangered by the structure or part.

  b) Displacements of the structure are such that there is no contact between any parts of a structure for which contact is not intended, or between separate structures on the same site, if such contact would damage the structures or parts to the extent that persons would be endangered, or detrimentally alter the response of the structure(s) or parts, or reduce the strength of structural elements below the required strength.
  c) The structure does not deflect beyond a site boundary adjacent to which other structures can be built or collision between the structure and any adjacent existing structures cannot occur.
  d) There is no loss of structural integrity in either the structure or part.

- **Intermediate Limit State (ILS):** ILS is an intermediate seismic event between SLS & ULS although is not a code requirement. The behaviour of soils and geotechnical systems under earthquake shaking may be highly non-linear and even exhibit a pronounced 'step change' in performance with increasing intensity of shaking. For such cases, only considering performance at the SLS and ULS levels of shaking would fail to identify potentially poor and unacceptable performance at intermediate return periods of shaking.

Liquefaction:	Liquefaction is the term used to describe the temporary, but substantial, loss of strength and stiffness which can occur in saturated, unconsolidated soils that are subjected to strong shaking. In addition to near-total strength loss, liquefaction may also result in the expulsion of sediment and water at the surface, ground and structure settlement, and in lateral (spreading) displacement of the ground.
LPI	Liquefaction potential index is a liquefaction damage index. LPI ranges between 0 and 100 and sites with an LPI of 5 indicate a high liquefaction risk and sites with LPI greater than 15 indicate very high risk (Iwasaki et al, 1982). Not to be used as a precise measure of liquefaction-induced ground damage but as an indicator of the general level of liquefaction severity.
LSN	Liquefaction Severity Number is a liquefaction damage index. LSN varies from 0 (representing no liquefaction vulnerability) to more than 100 (representing very high liquefaction vulnerability (van Ballegooy et al, 2013). LSN places greater importance (than LPI) on the thickness of the non-liquefied crust when the groundwater table is close to the ground surface. Not to be used as a precise measure of liquefaction-induced ground damage but as an indicator of the general level of liquefaction severity. LNS was developed based on the observations/ investigations from the Canterbury earthquake sequence
PGA:	Peak Ground Acceleration (PGA) is the maximum ground acceleration during an earthquake as a proportion of gravity.
Punch Through Failure:	Punch through failure occurs when a foundation punches through a crust of non-liquefiable material due to underlying liquefaction occurring and can lead to potential damage to foundations and/ or large settlements.

Technical Category:

Following the 2010 -2011 Canterbury earthquake sequence the Ministry of Business Innovation and Employment (MBIE) assigned three technical categories (TC1, TC2, TC3) across the residential 'green zone' for foundation investigation and design guidance focusing on one and two storey timber-framed dwellings. These categories are broadly defined as below:

- **TC1:** Liquefaction damage is unlikely in future large earthquakes. Standard residential foundation assessment and construction is appropriate.
- **TC2:** Liquefaction damage is possible in future large earthquakes. Standard enhanced foundation repair and rebuild options in accordance with MBIE guidance are suitable to mitigate against this possibility.
- **TC3:** Liquefaction damage is possible in future large earthquakes. Individual engineering assessment is required to select the appropriate foundation repair or rebuild option.
- **TC2/ TC3 Hybrid:** A site that straddles liquefaction settlement limits of TC2 and TC3 where the SLS settlements are assessed as being less than 50 mm but the ULS settlements are assessed at greater than 100mm.

Whilst this guidance is intended for residential buildings in the Canterbury region, they have been widely adopted to convey liquefaction vulnerability across New Zealand.

The Modules:

The New Zealand Geotechnical Society (NZGS) and MBIE jointly published a series of guidelines for Earthquake Geotechnical Engineering Practice. Revision 1 of the Modules was published in November 2021 and they provide guidance under section 175 of the Building Act 2004 to assist parties to comply with their obligations under the Building Act 2004. The following modules currently form the collection:

- **Module 1**: Overview of the guidelines
- **Module 2**: Geotechnical investigation for earthquake engineering
- **Module 3**: Identification, assessment, and mitigation of liquefaction hazards
- **Module 4**: Earthquake resistant foundation design
- **Module 5**: Ground improvement
- **Module 5A:** Specification of ground improvement for residential properties in the Canterbury region
- **Module 6**: Retaining walls

APPENDIX A

SITE PLAN

LEGEND

Project Data

- 🟨 Proposed Lots Boundary
- 🟥 Proposed Building Platform
- — Proposed Accessway
- ◐ Hand Auger + DCP
- ▽ CPT (Due Diligence)

0 6 12 18 24 m

SCALE A3: 1:350

NOTES
1. Aerial basemap and property boundaries sourced from LINZ Data Service (CC-BY 4.0).
2. Investigation locations shown approximately only.

CLIENT
NZHG Gisborne Limited

PROJECT
Geotechnical Investigation for proposed subdivision
556-560 Aberedeen Road, Te Hapara
Gisborne

DRAWING TITLE
Geotechnical Investigation Plan

PROJECT REF	DRAWING REF	REVISION
24477	GIP	A
DATE	PREPARED BY	CHECKED BY
29/09/2023	SS	RH

FILE PATH
M:\FILES\LDE - Projects\77008-24477\Geo QGIS Zip Folder (ID 79084)\24477 QGIS Site Maps\24477 Aberdeen Rd.qgz

APPENDIX B

HAND AUGER TEST LOGS

Hand Auger Borehole Log

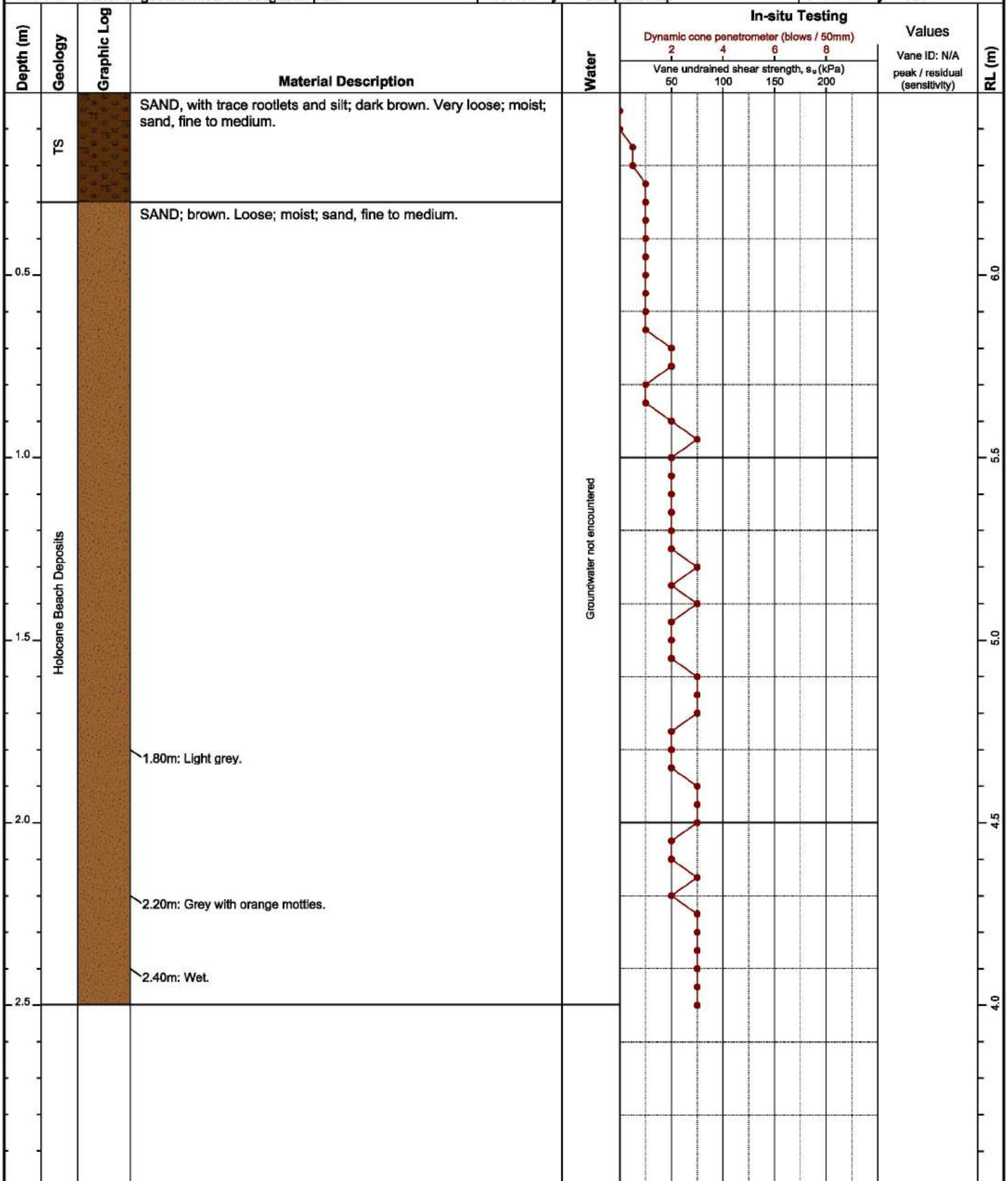
Method: 50mm Hand Auger

Test ID: HA01
Project ID: 24477
Sheet: 1 of 1

Client: NZHG
Project: Geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne
Test Site: Refer to geotechnical investigation plan

Coordinates: 5709871mN, 2036134mE
System: NZTM
Elevation: 6.5m (NZVD2016)
Located By: Site plan/map

Test Date: 12/09/2023
Logged By: SS
Prepared By: SS
Checked By: RH



SAND, with trace rootlets and silt; dark brown. Very loose; moist; sand, fine to medium.

SAND; brown. Loose; moist; sand, fine to medium.

1.80m: Light grey.

2.20m: Grey with orange mottles.

2.40m: Wet.

Hole Depth: 2.50m
Termination: TARGET DEPTH

Remarks:

● Vane peak
○ Vane residual
◆ Vane UTP
▼ Standing water level
◁ Groundwater inflow
▷ Groundwater outflow
UTP = Unable to Penetrate

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

Generated with CORE-GS by Geroc - HAxTP Log v9 - 6/10/2023 11:09:16 am

Hand Auger Borehole Log

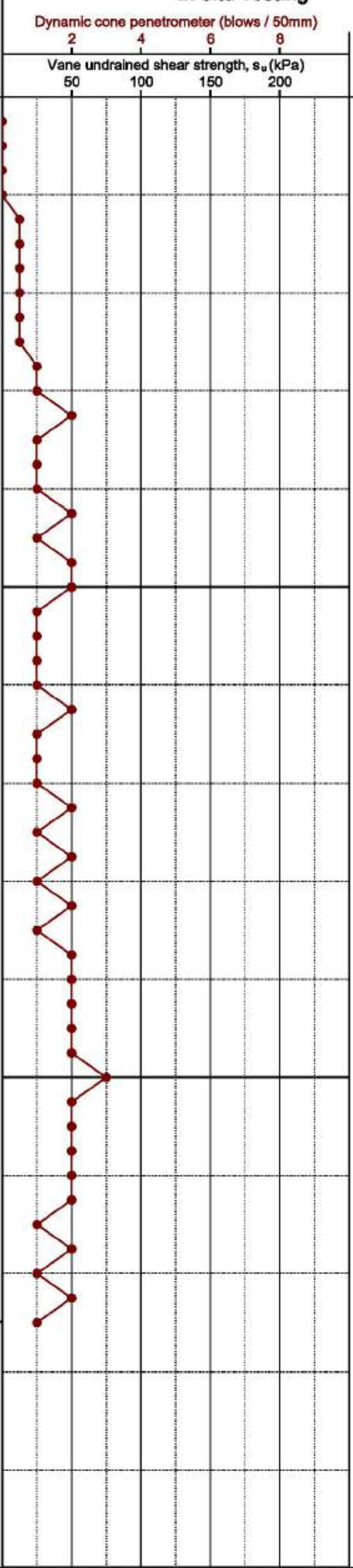
Method: 50mm Hand Auger

Test ID:	**HA02**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709864mN, 2036136mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.5m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Graphic Log	Material Description	Water	Values Vane ID: N/A peak / residual (sensitivity)	RL (m)
	TS		SAND, with minor silt, with trace rootlets; dark brown. Very loose; moist; sand, fine to medium.	Groundwater not encountered		
0.5	Holocene Beach Deposits		SAND; brown. Loose; moist; sand, fine to medium.			6.0
1.0						5.5
1.5			1.50m: Grey with orange mottles.			5.0
			1.70m: Light grey.			
2.0						4.5
			2.40m: Wet.			
2.5						4.0

In-situ Testing



Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

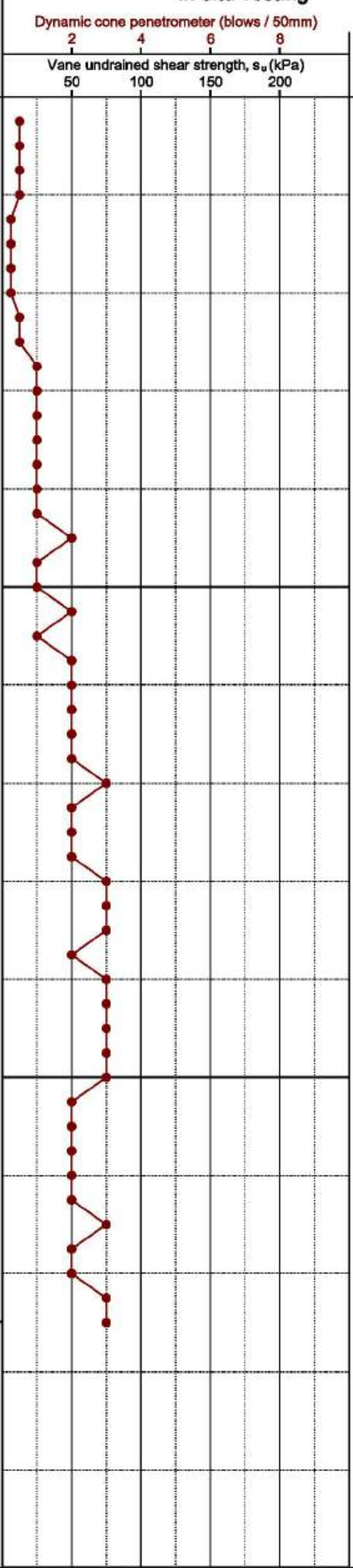
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	HA03				
Project ID:	24477				
Sheet:	1 of 1				
Client:	NZHG	**Coordinates:**	5709847mN, 2036129mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	7m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	RL (m)
0.0 – 0.55	Uncontrolled Fill / Topsoil	SAND, with minor silt, with trace rootlets; dark brown. Very loose; moist; sand, fine to medium; trace metal fragments.		
0.5				6.5
0.55 – 2.50	Holocene Beach Deposits	SAND; brown. Loose; moist; sand, fine to medium.		
1.0				6.0
1.5				5.5
1.80		1.80m: Grey with orange mottles.		
1.90		1.90m: Wet.		
2.0				5.0
2.40		2.40m: Saturated.	▼	
2.5				4.5

In-situ Testing



Values
Vane ID: N/A
peak / residual (sensitivity)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

LDE LAND DEVELOPMENT & ENGINEERING

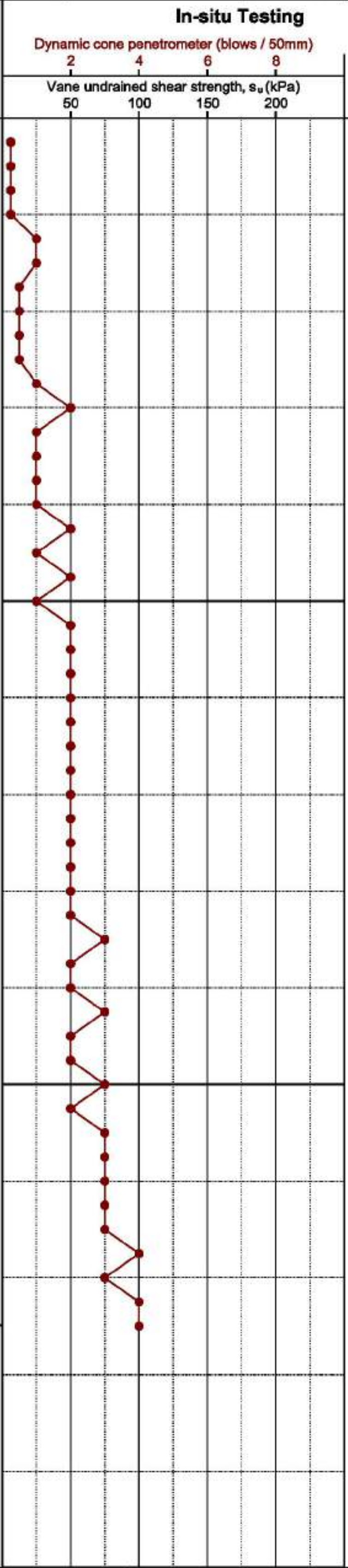
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	HA04		
Project ID:	24477		
Sheet:	1 of 1		
Client:	NZHG	**Coordinates:**	5709842mN, 2036126mE
Project:	Geotechnical Investigation	**System:**	NZTM
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	7m (NZVD2016)
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map
Test Date:	12/09/2023		
Logged By:	SS		
Prepared By:	SS		
Checked By:	RH		

Depth (m)	Geology	Graphic Log	Material Description	Water	RL (m)
	TS		SAND, with minor silt, with trace rootlets; dark brown. Loose; moist; sand, fine to medium.		
0.5	Holocene Beach Deposits		SAND; brown. Loose; moist; sand, fine to medium.		6.5
1.0					6.0
1.5					5.5
			1.90m: Wet.		
2.0					5.0
			2.20m: Saturated.	▼	
2.5					4.5

In-situ Testing



Values
Vane ID: N/A
peak / residual
(sensitivity)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

Hand Auger Borehole Log

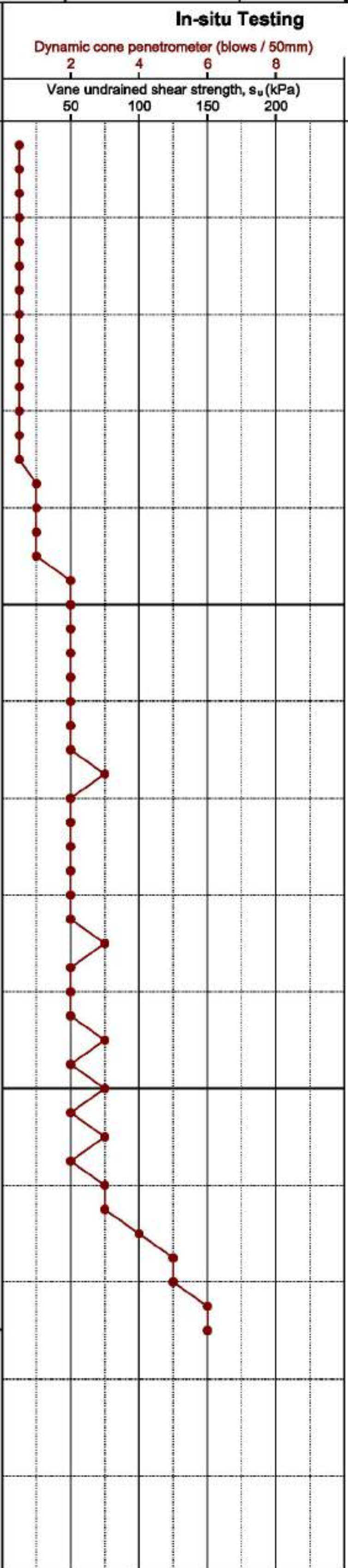
Method: 50mm Hand Auger

Test ID:	**HA05**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709846mN, 2036121mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	7m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	RL (m)
0.0–0.5	Uncontrolled Fill / Topsoil	SAND, with minor silt, with trace rootlets and gravel; dark brown. Loose; moist; sand, fine to medium; gravel, fine to medium, subrounded to subangular.		
0.5	Holocene Beach Deposits	SAND; brown. Loose; moist; sand, fine to medium.		6.5
1.0				6.0
1.5				5.5
		1.80m: Brownish grey.		
		1.90m: Wet.		
2.0				5.0
		2.40m: Saturated.	▼	
2.5				4.5

In-situ Testing



Values

Vane ID: N/A

peak / residual (sensitivity)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

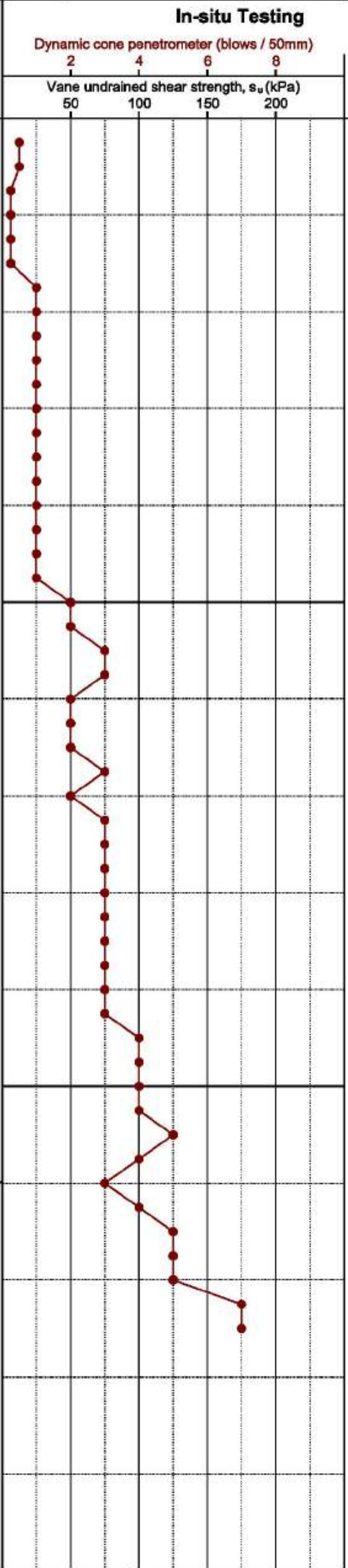
UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	HA06		
Project ID:	24477		
Sheet:	1 of 1		
Client:	NZHG	**Coordinates:**	5709835mN, 2036107mE
Project:	Geotechnical Investigation	**System:**	NZTM
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.2m (NZVD2016)
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map
Test Date:	12/09/2023		
Logged By:	SS		
Prepared By:	SS		
Checked By:	RH		

Depth (m)	Geology	Graphic Log	Material Description	Water	In-situ Testing	Values Vane ID: N/A peak / residual (sensitivity)	RL (m)
	Uncontrolled Fill / Topsoil		SAND, with minor silt, with trace rootlets and gravel; dark brown. Very loose; moist; sand, fine to medium; gravel, fine, subangular.				
	Holocene Beach Deposits		SAND; brownish orange. Loose; moist; sand, fine to medium. 1.60m: Wet. 1.80m: Heavy orange mottling. 1.90m: Brownish grey. Saturated. 2.00m: Brownish grey with orange mottles. Poor recovery > 50%.	▼			



Hole Depth: 2.20m **Termination:** HOLE COLLAPSE

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

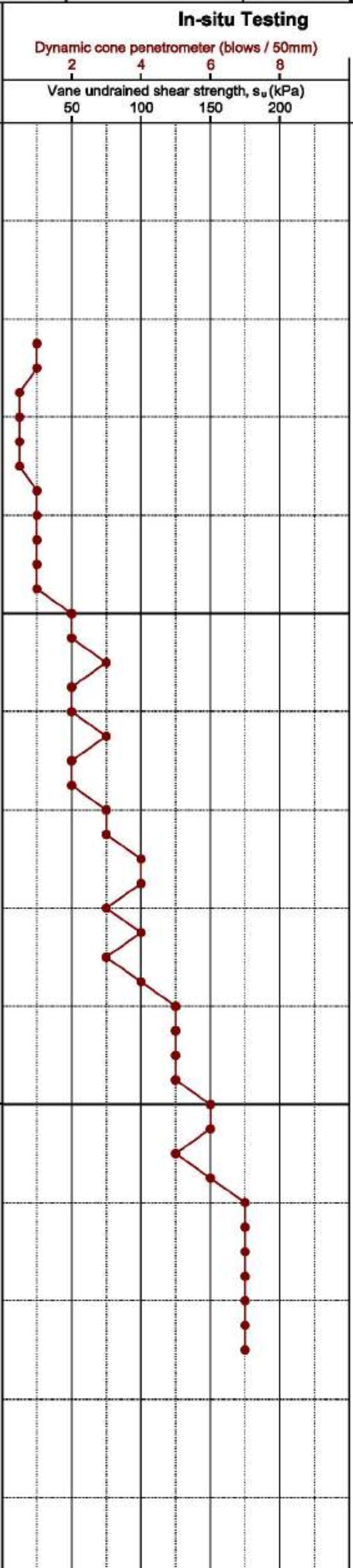
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID: HA07
Project ID: 24477
Sheet: 1 of 1

Client:	NZHG	**Coordinates:**	5709824mN, 2036090mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Graphic Log	Material Description	Water
	Uncontrolled Fill / Topsoil		SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine to medium; trace charcoal. 0.40m: Sandy. Sand, fine to medium.	
0.5				
1.0	Holocene Beach Deposits		SAND; light brown with orange mottles. Loose; moist; sand, fine to medium. 1.00m: Brownish grey with orange streaks. 1.20m: Wet. 1.50m: Saturated. 1.70m: Poor recovery > 30%.	
1.5				▼
2.0				
2.5				



Values
Vane ID: N/A
peak / residual (sensitivity)

RL (m): 5.5, 5.0, 4.5, 4.0, 3.5

Hole Depth: 2.00m **Termination:** HOLE COLLAPSE

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak
○ Vane residual
◆ Vane UTP
▼ Standing water level
◁ Groundwater inflow
▷ Groundwater outflow
UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

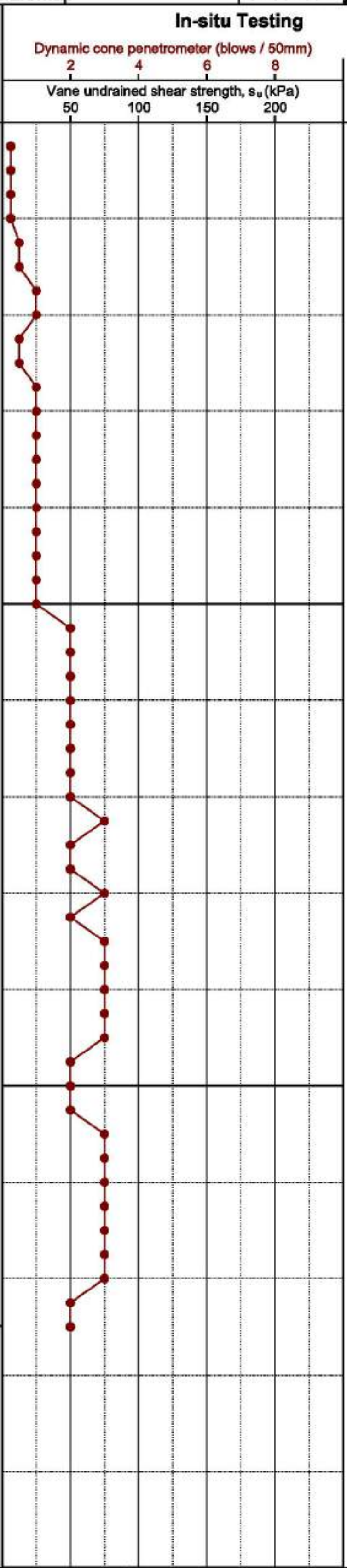
Test ID: HA08
Project ID: 24477
Sheet: 1 of 1

Client: NZHG
Project: Geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne
Test Site: Refer to geotechnical investigation plan

Coordinates: 5709850mN, 2036087mE
System: NZTM
Elevation: 6.5m (NZVD2016)
Located By: Site plan/map

Test Date: 12/09/2023
Logged By: SS
Prepared By: SS
Checked By: RH

Geology	Material Description	Water
Topsoil	SAND, with minor silt, with trace rootlets; dark brown. Very loose; moist; sand, fine to medium.	
Holocene Beach Deposits	SAND; light brown. Loose; moist; sand, fine to medium. 1.60m: Brownish grey. 1.80m: Brownish grey orange streaks. 2.00m: Dark brown. Wet. 2.30m: Brownish grey. 2.40m: Saturated.	▼



Values
Vane ID: N/A
peak / residual (sensitivity)

Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5
RL (m): 6.0, 5.5, 5.0, 4.5, 4.0

Hole Depth: 2.50m **Termination:** TARGET DEPTH
Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

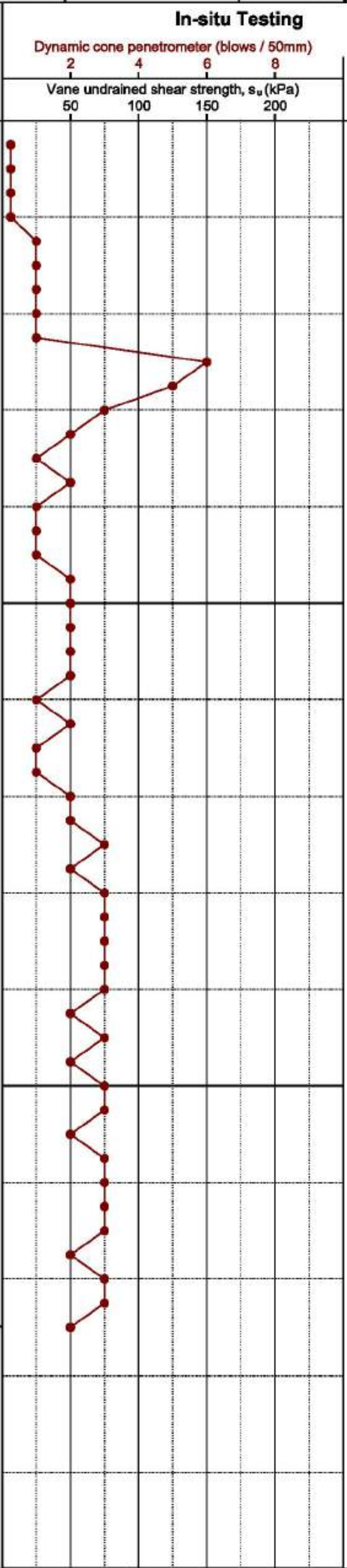
Method: 50mm Hand Auger

Test ID:	**HA09**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709853mN, 2036094mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.5m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	RL (m)
0.0 – 0.6	Topsoil	SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine. 0.20m: SAND, with minor silt. Sand, fine to medium; trace brick fragments.		
0.5				6.0
0.6 – 2.5	Holocene Beach Deposits	SAND; brownish orange. Loose; moist; sand, fine to medium. 1.50m: Brownish grey. 2.00m: Wet. 2.40m: Saturated.	▼ (2.4m)	
1.0				5.5
1.5				5.0
2.0				4.5
2.5				4.0

In-situ Testing



Values

Vane ID: N/A

peak / residual (sensitivity)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

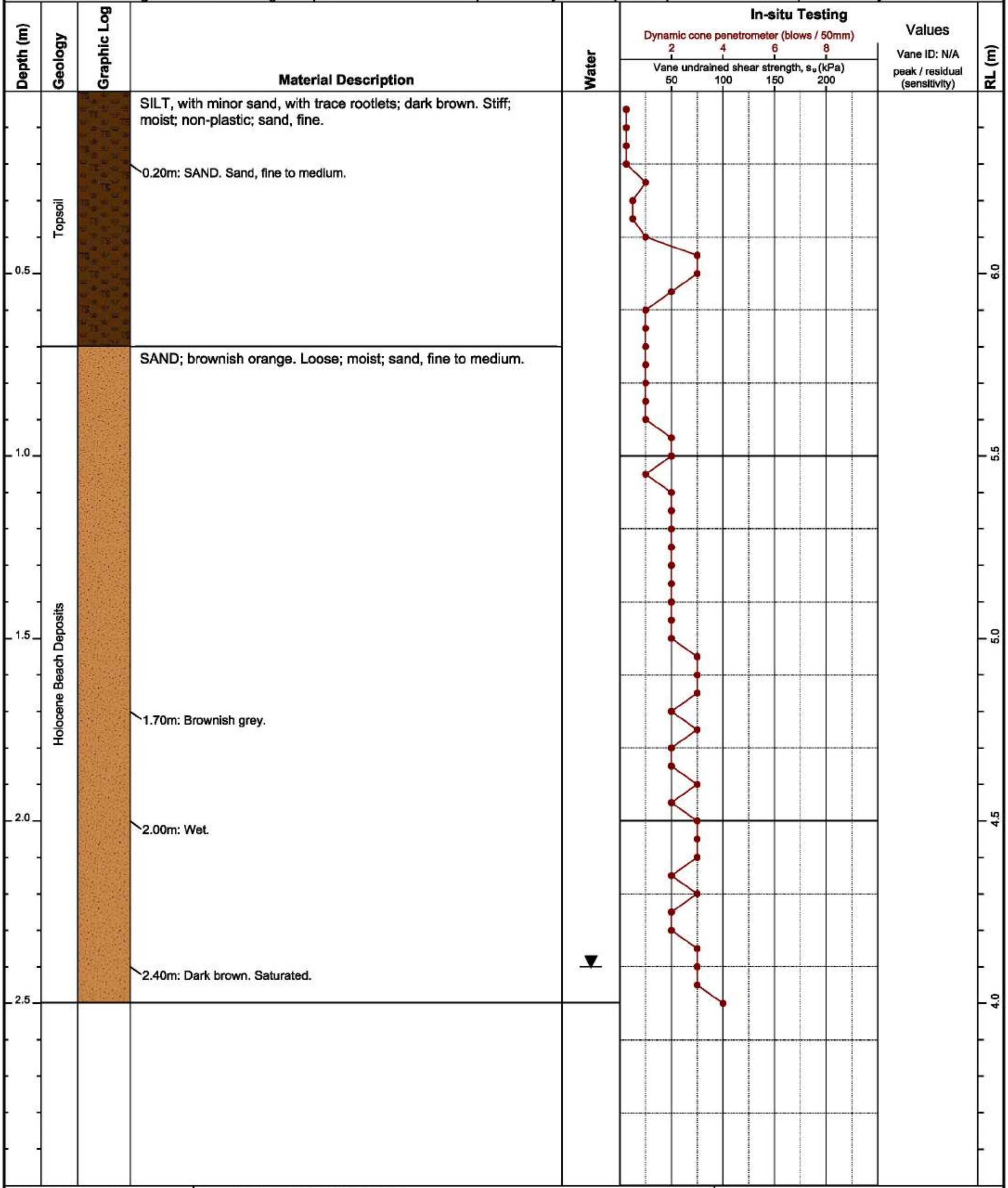
UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA10**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709860mN, 2036093mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.5m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH



SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine.

0.20m: SAND. Sand, fine to medium.

SAND; brownish orange. Loose; moist; sand, fine to medium.

1.70m: Brownish grey.

2.00m: Wet.

2.40m: Dark brown. Saturated.

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

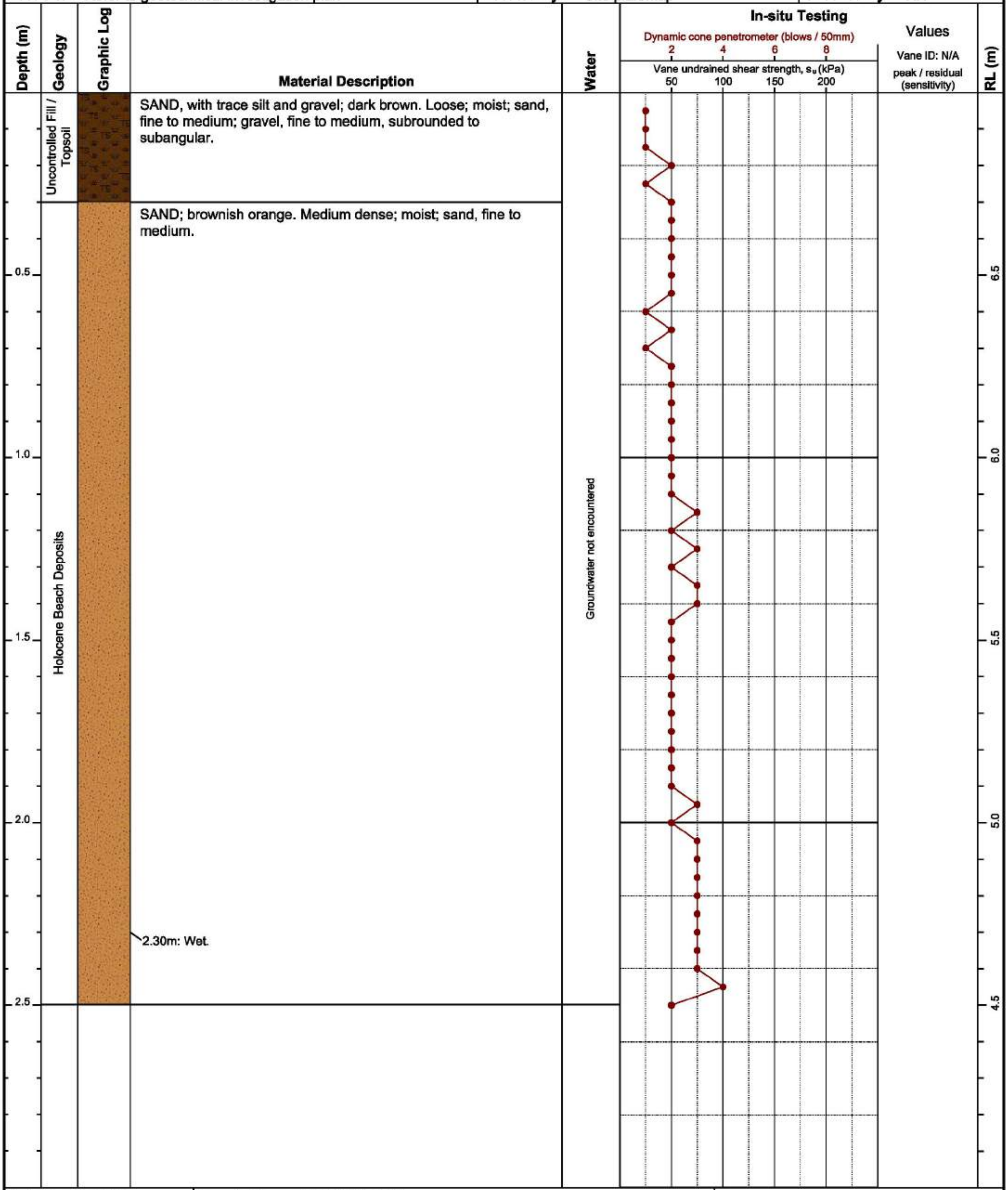
UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA11**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709865mN, 2036106mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	7m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH



Geology	Material Description	Water
Uncontrolled Fill / Topsoil	SAND, with trace silt and gravel; dark brown. Loose; moist; sand, fine to medium; gravel, fine to medium, subrounded to subangular.	
Holocene Beach Deposits	SAND; brownish orange. Medium dense; moist; sand, fine to medium. 2.30m: Wet.	Groundwater not encountered

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak
○ Vane residual
◆ Vane UTP
▼ Standing water level
◁ Groundwater inflow
▷ Groundwater outflow
UTP = Unable to Penetrate

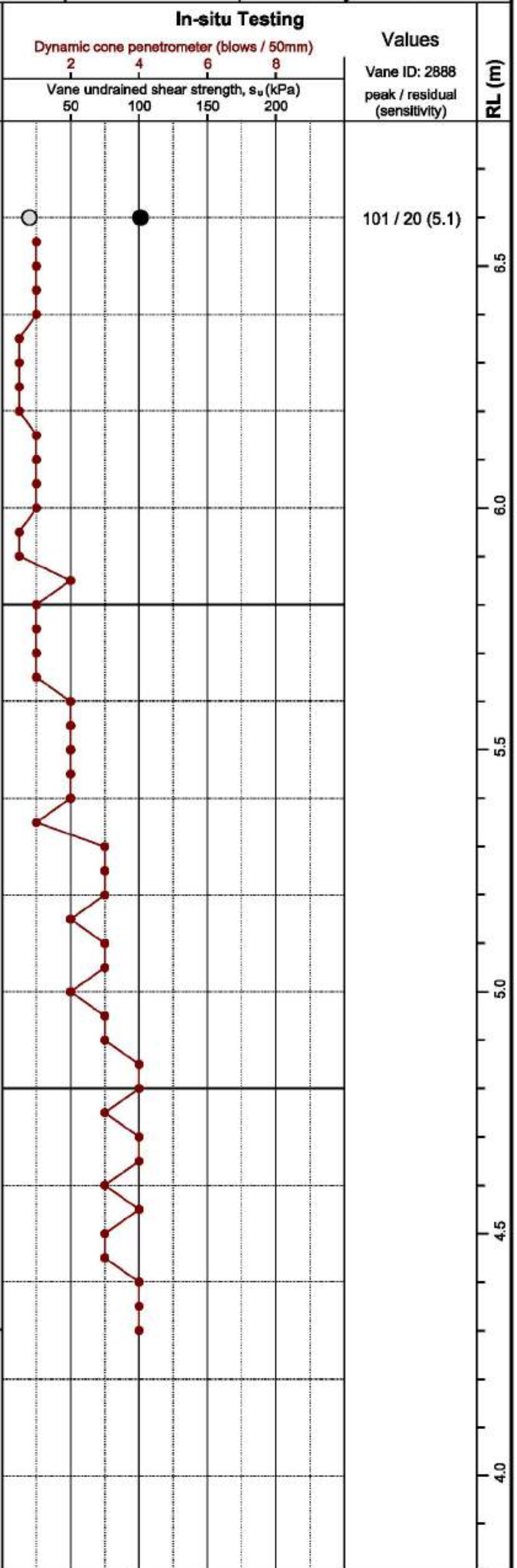
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA12**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709880mN, 2036108mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.8m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	Values (Vane ID: 2888, peak / residual (sensitivity))
0.0–0.5	Topsoil	SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine. 0.30m: SAND, with minor silt. Sand, fine to medium. 0.40m: Black.		101 / 20 (5.1)
0.5–2.5	Holocene Beach Deposits	SAND; brownish orange. Very loose; moist; sand, fine to medium. 2.00m: Wet. 2.50m: Saturated.	▼ 2.5	



Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

● Vane peak
○ Vane residual
◆ Vane UTP
▼ Standing water level
◁ Groundwater inflow
▷ Groundwater outflow
UTP = Unable to Penetrate

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

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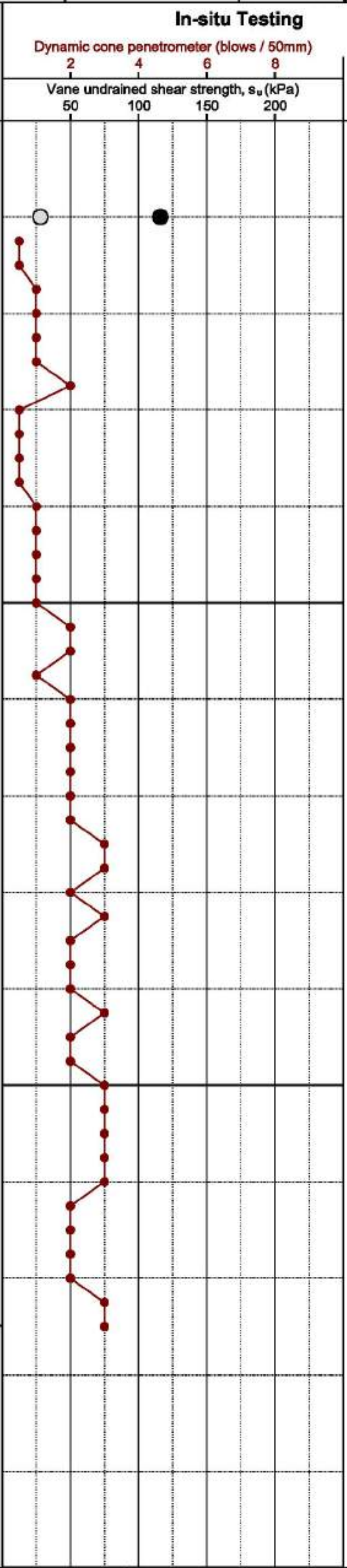
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	HA13
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709882mN, 2036101mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.8m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	Values (Vane ID: 2888, peak / residual (sensitivity))
0.0–0.5	Topsoil	SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine. 0.30m: SAND, with minor silt. Sand, fine to medium.		116 / 28 (4.1)
0.5–2.5	Holocene Beach Deposits	SAND; brownish orange. Loose; moist; sand, fine to medium. 1.90m: Brownish grey. 2.00m: Wet. 2.50m: Saturated.	▼ 2.5	



Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5

RL (m): 6.5, 6.0, 5.5, 5.0, 4.5, 4.0

Hole Depth: 2.50m	**Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

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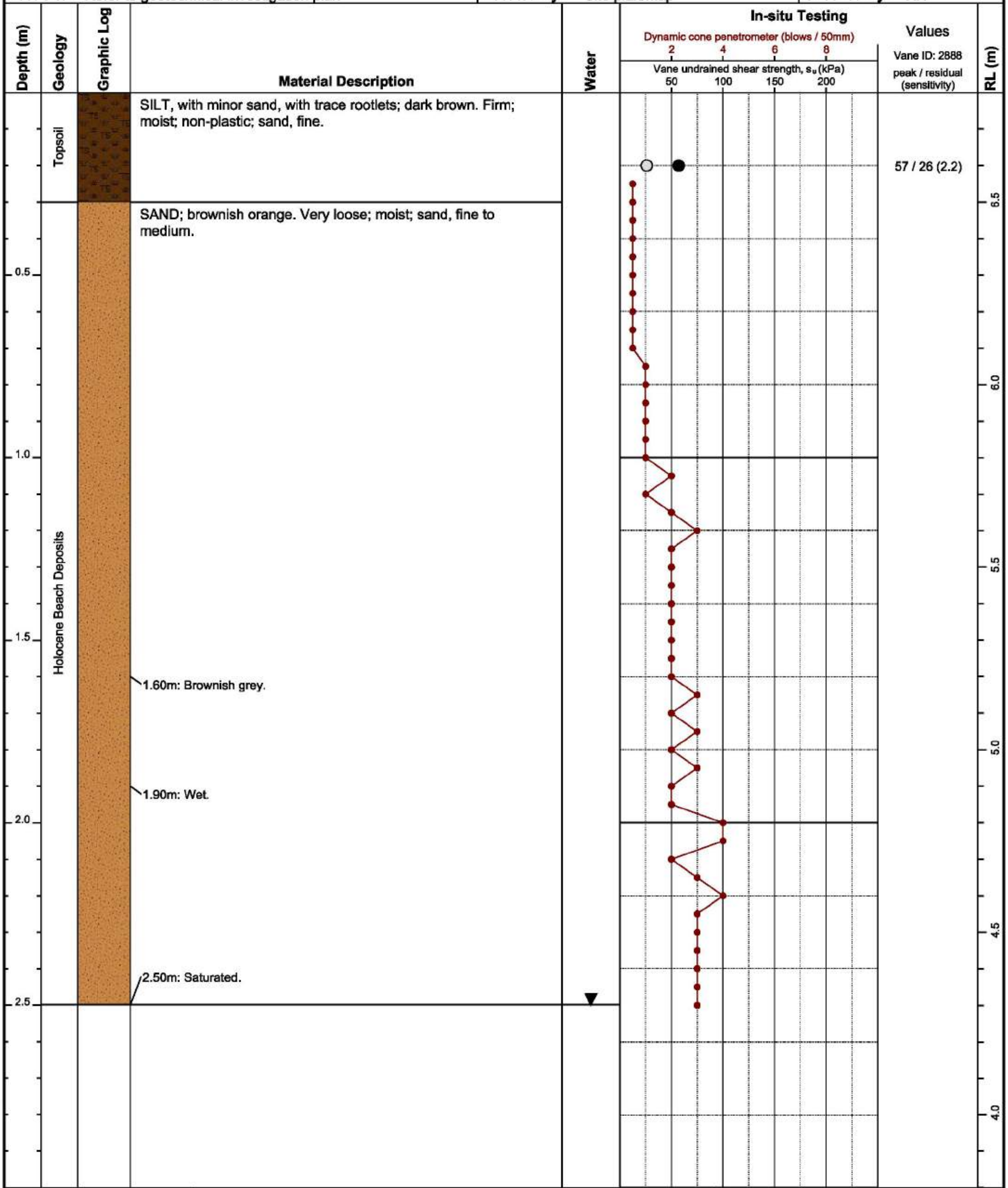
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA14**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709887mN, 2036103mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.8m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH



SILT, with minor sand, with trace rootlets; dark brown. Firm; moist; non-plastic; sand, fine.

57 / 26 (2.2)

SAND; brownish orange. Very loose; moist; sand, fine to medium.

1.60m: Brownish grey.

1.90m: Wet.

2.50m: Saturated.

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

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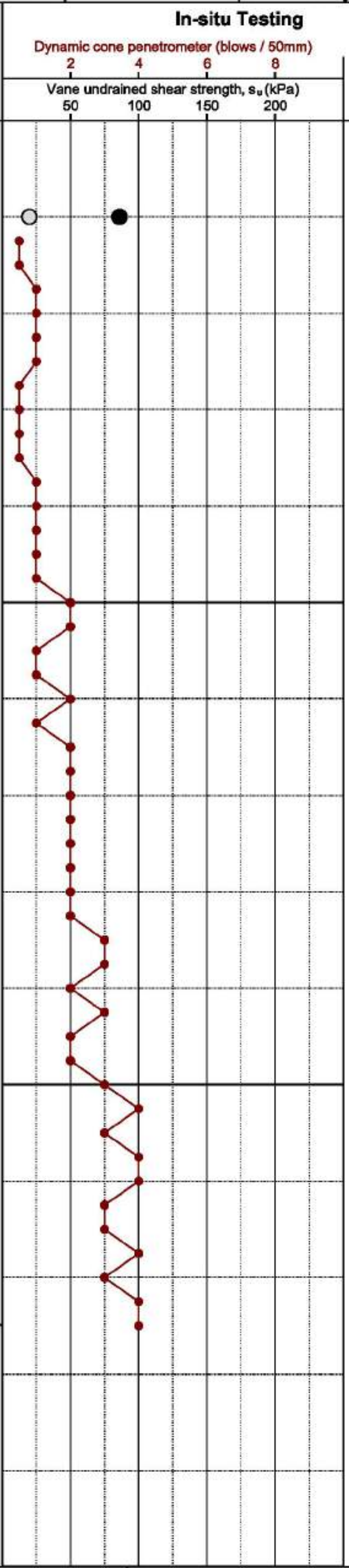
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA15**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709885mN, 2036111mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.8m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	Values (Vane ID: 2888 peak / residual (sensitivity))
0.0 – 0.60	Topsoil	SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine. 0.40m: SAND, with minor silt. Sand, fine to medium.		86 / 20 (4.3)
0.60 – 2.50	Holocene Beach Deposits	SAND; brownish orange. Very loose; moist; sand, fine to medium. 2.00m: Brownish grey. Wet. 2.40m: Saturated.	▼	



Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5

RL (m): 6.5, 6.0, 5.5, 5.0, 4.5, 4.0

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

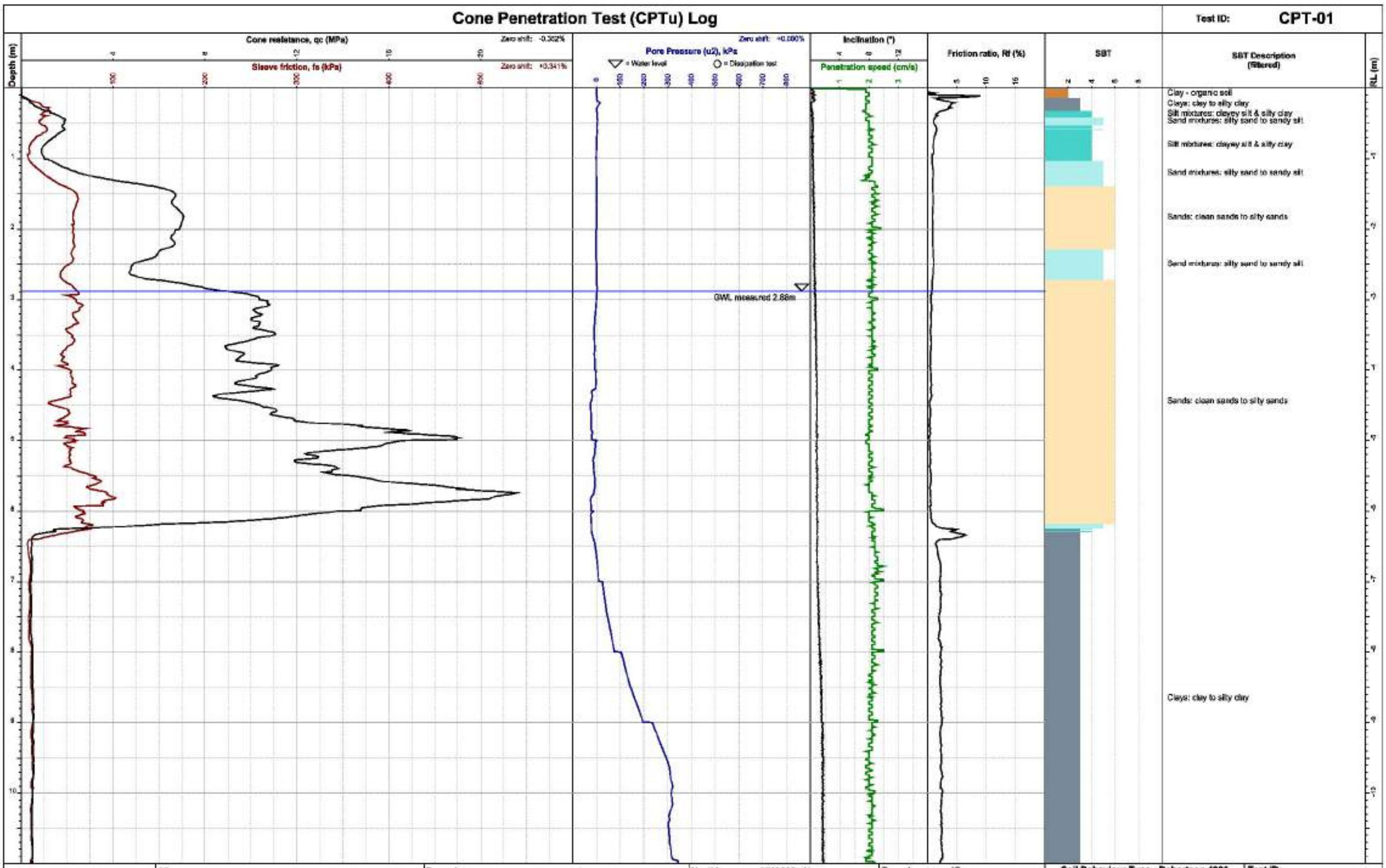
Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

APPENDIX C

CONE PENETRATION TEST LOGS

Cone Penetration Test (CPTu) Log

Test ID: CPT-01



Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:04 am

Client: LDE Land Development & Engineering

Project: geotechnical Investigation

Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.88m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709883mN
Easting: 2036106mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

Soil Behaviour Type - Robertson 1986

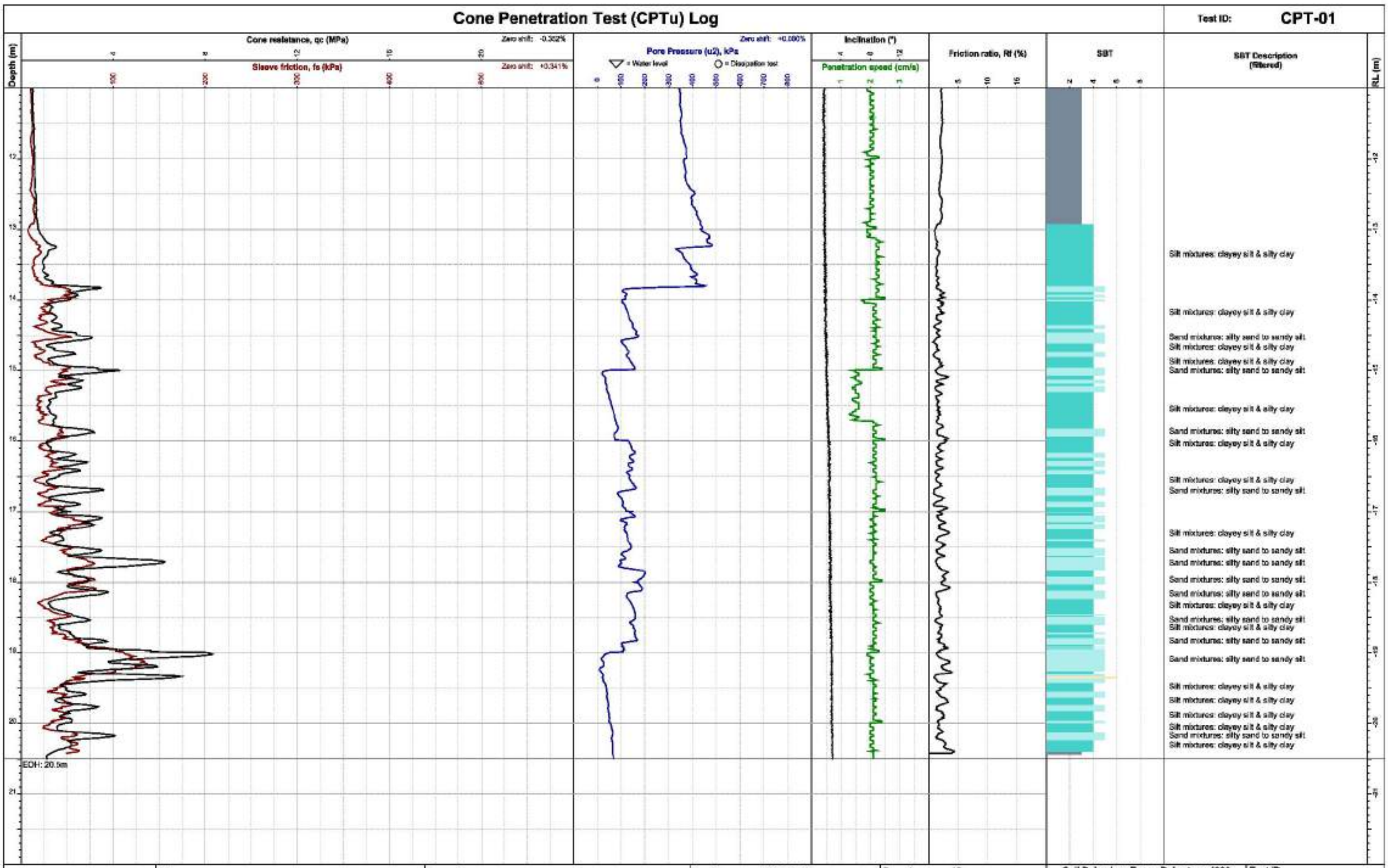
0 Undefined
1 Sensitive fine-grained
2 Clay - organic soil
3 Clays: clay to silty clay
4 Silt mixtures: clayey silt & silty clay
5 Sand mixtures: silty sand to sandy silt
6 Sands: clean sands to silty sands
7 Dense sand to gravelly sand
8 Stiff sand to clayey sand
9 Stiff fine-grained

Test ID: CPT-01

Project ID: 24477
Depth: 20.5m
Sheet: 1 of 2
Date: 30/05/2023

Cone Penetration Test (CPTu) Log

Test ID: **CPT-01**



Silt mixtures: clayey silt & silty clay

Silt mixtures: clayey silt & silty clay

Sand mixtures: silty sand to sandy silt
Silt mixtures: clayey silt & silty clay

Silt mixtures: clayey silt & silty clay
Sand mixtures: silty sand to sandy silt

Silt mixtures: clayey silt & silty clay

Sand mixtures: silty sand to sandy silt
Silt mixtures: clayey silt & silty clay

Silt mixtures: clayey silt & silty clay
Sand mixtures: silty sand to sandy silt

Silt mixtures: clayey silt & silty clay

Sand mixtures: silty sand to sandy silt
Sand mixtures: silty sand to sandy silt

Sand mixtures: silty sand to sandy silt

Sand mixtures: silty sand to sandy silt
Silt mixtures: clayey silt & silty clay

Sand mixtures: silty sand to sandy silt
Silt mixtures: clayey silt & silty clay

Sand mixtures: silty sand to sandy silt

Sand mixtures: silty sand to sandy silt

Silt mixtures: clayey silt & silty clay

Silt mixtures: clayey silt & silty clay

Silt mixtures: clayey silt & silty clay
Silt mixtures: clayey silt & silty clay
Sand mixtures: silty sand to sandy silt
Silt mixtures: clayey silt & silty clay

LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.88m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709883mN
Easting: 2036106mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

Soil Behaviour Type - Robertson 1986

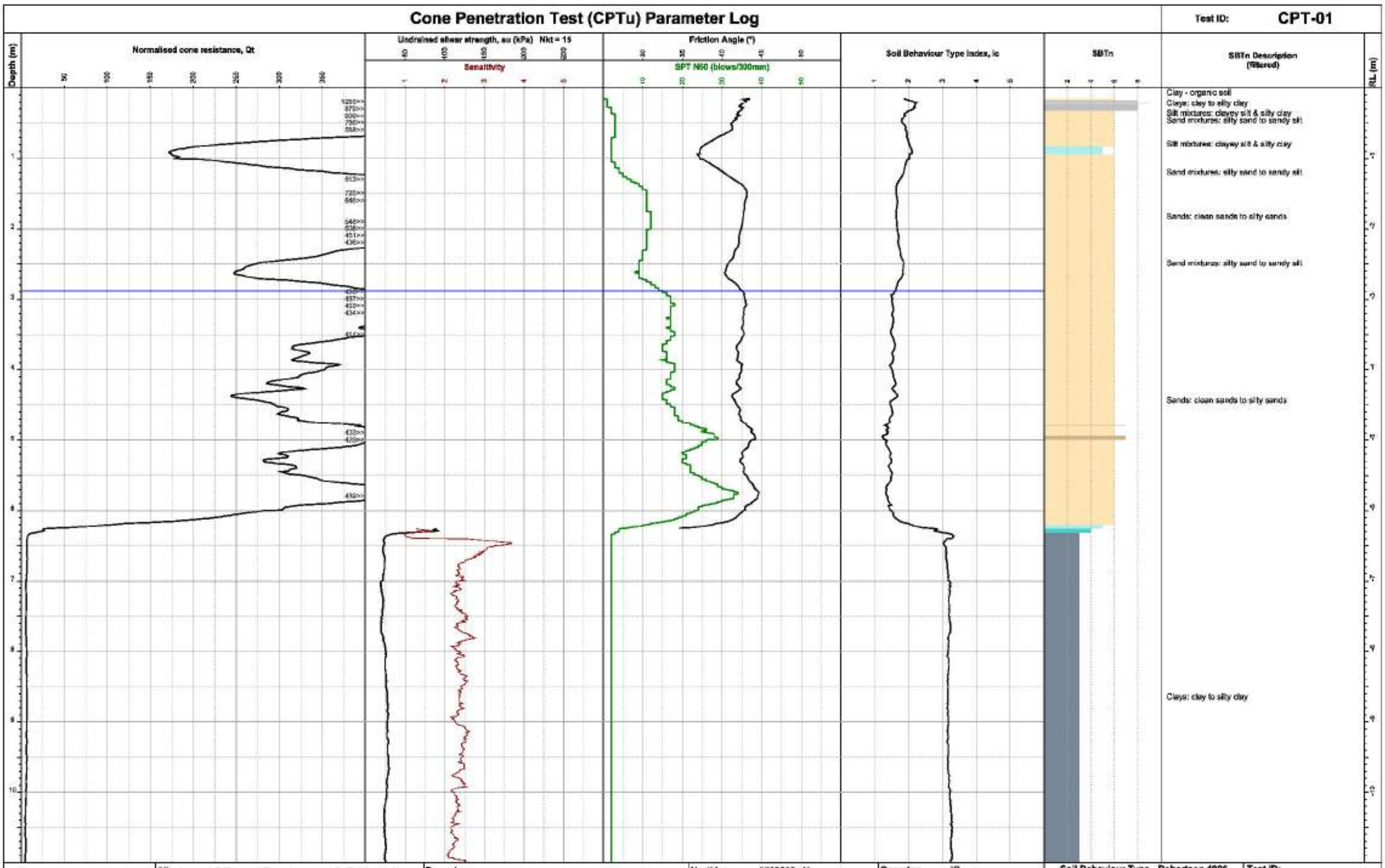
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: **CPT-01**
Project ID: 24477
Depth: 20.5m
Sheet: 2 of 2
Date: 30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:04 am

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-01



Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:04 am

LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.88m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709883mN
Easting:	2036106mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

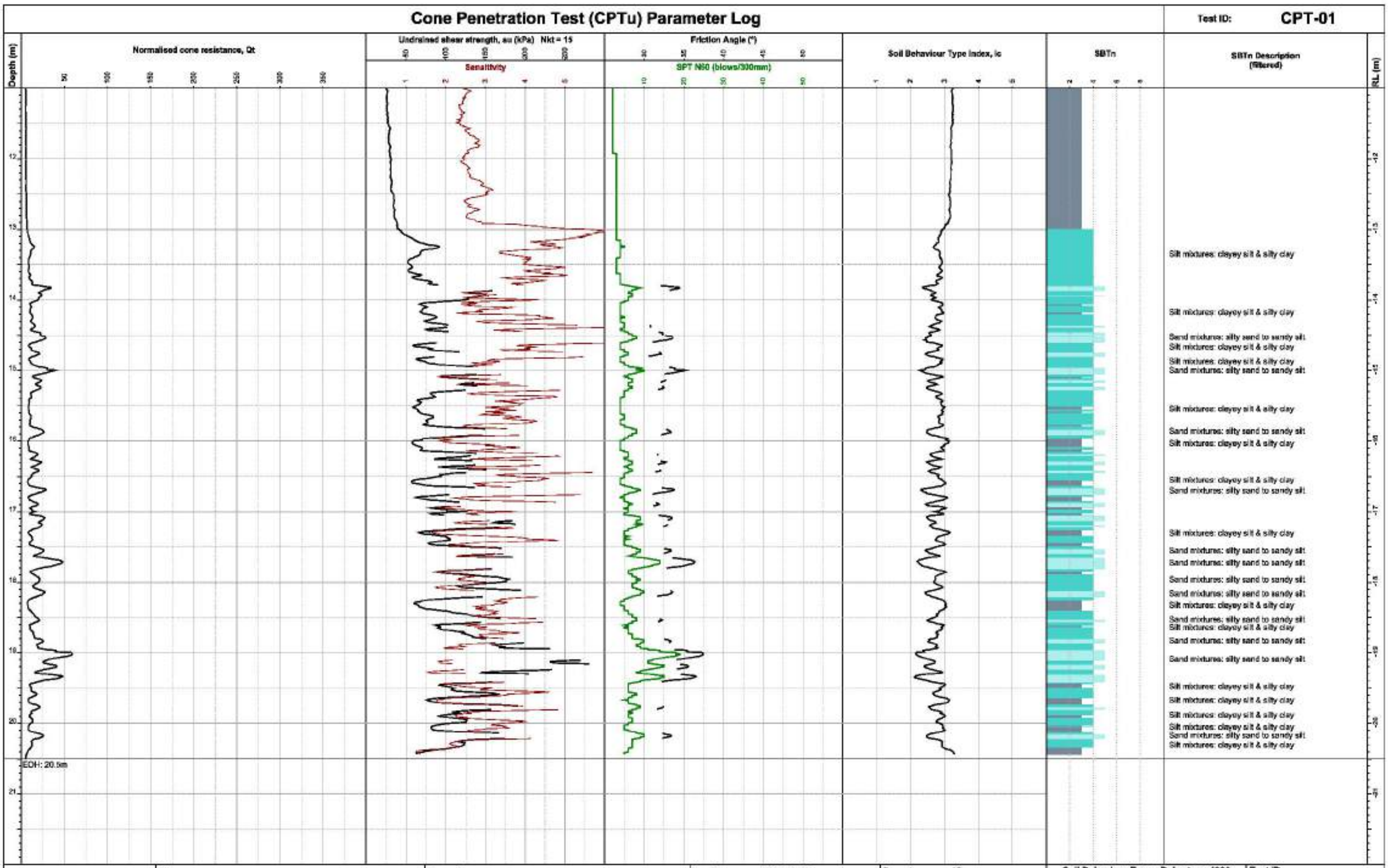
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID:
CPT-01

Project ID:	24477
Depth:	20.5m
Sheet:	1 of 2
Date:	30/05/2023

Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-01**



Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.88m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709883mN
Easting: 2036106mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

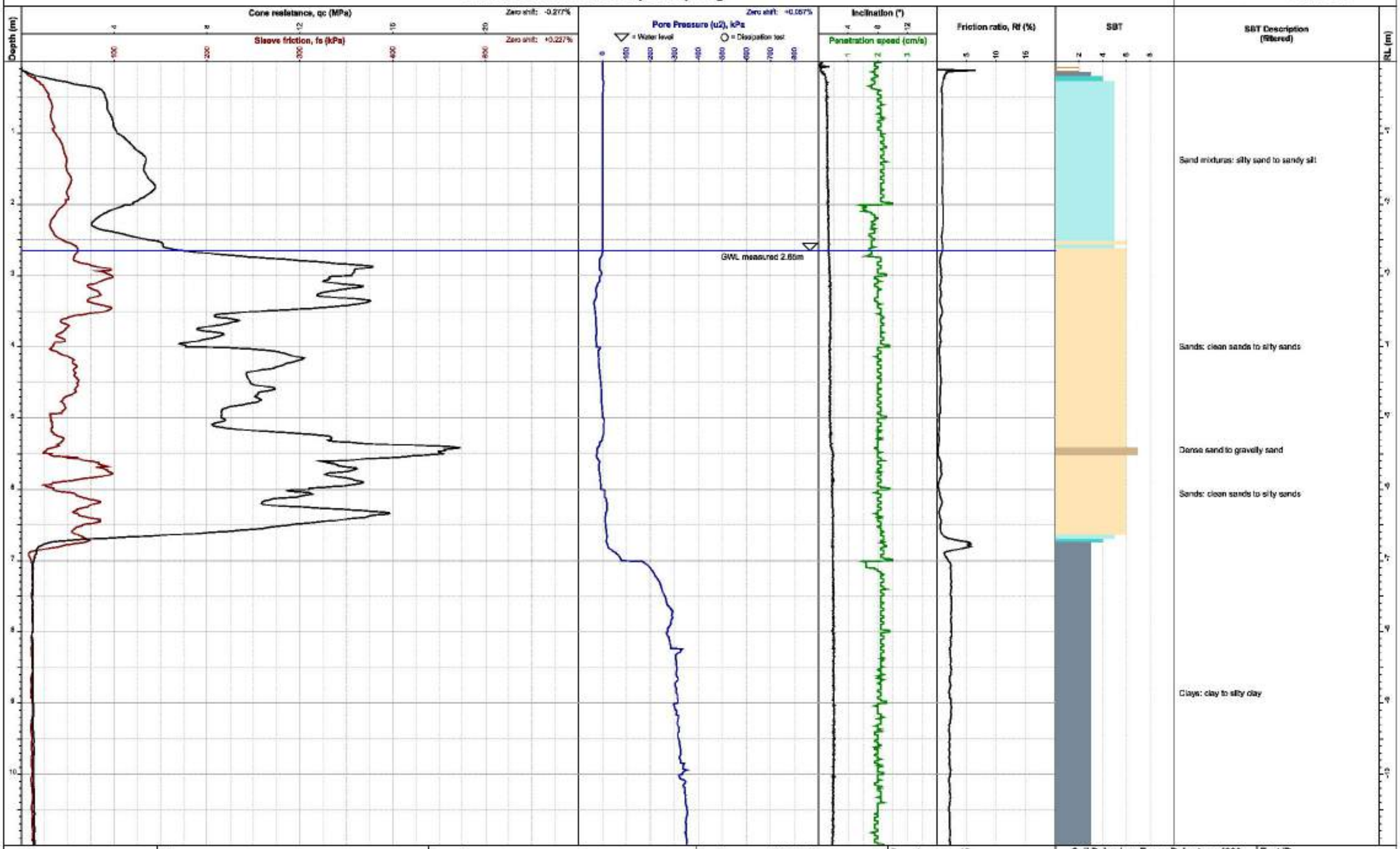
Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: **CPT-01**
Project ID: 24477
Depth: 20.5m
Sheet: 2 of 2
Date: 30/05/2023

Cone Penetration Test (CPTu) Log

Test ID: CPT-02



Client:	LDE Land Development & Engineering
Project:	geotechnical Investigation
Location:	556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.65m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709858mN
Easting:	2036112mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID:

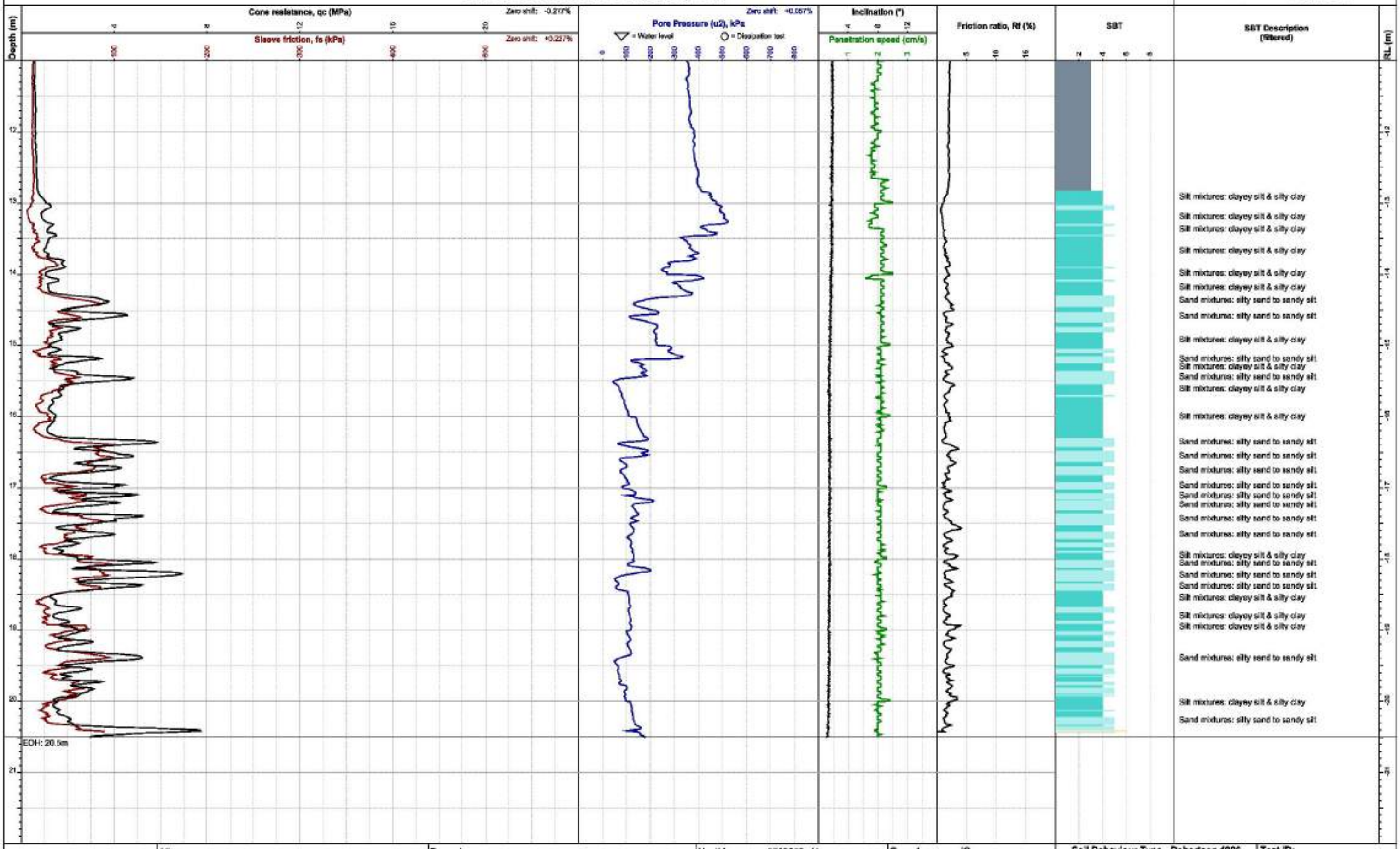
CPT-02

Project ID:	24477
Depth:	20.5m
Sheet:	1 of 2
Date:	30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:06 am

Cone Penetration Test (CPTu) Log

Test ID: CPT-02



Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:07 am

LDE LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.65m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709858mN
Easting:	2036112mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

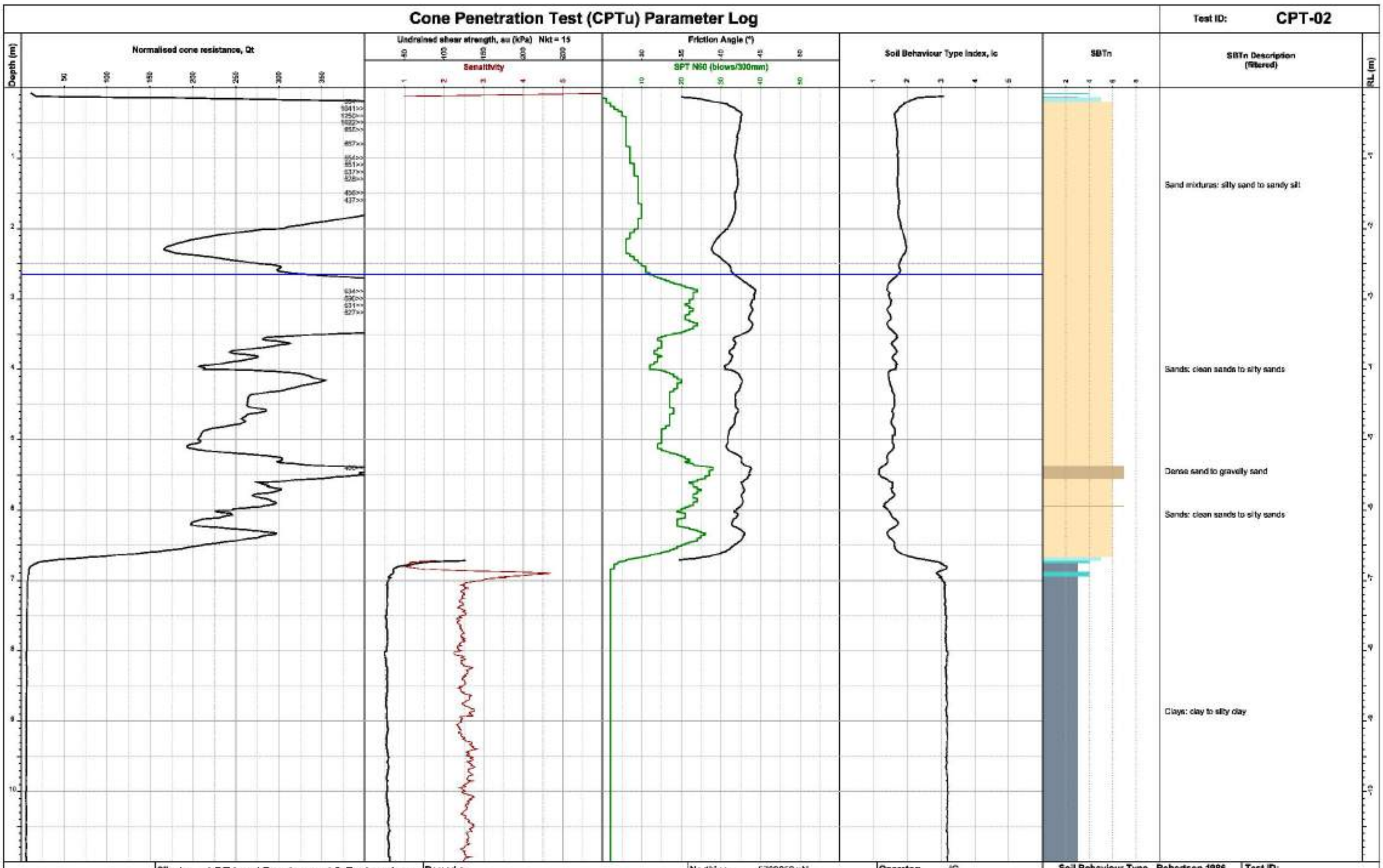
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID:
CPT-02

Project ID:	24477
Depth:	20.5m
Sheet:	2 of 2
Date:	30/05/2023

Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-02**



Generated with CORE GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:07 am

LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.65m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709858mN
Easting: 2036112mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

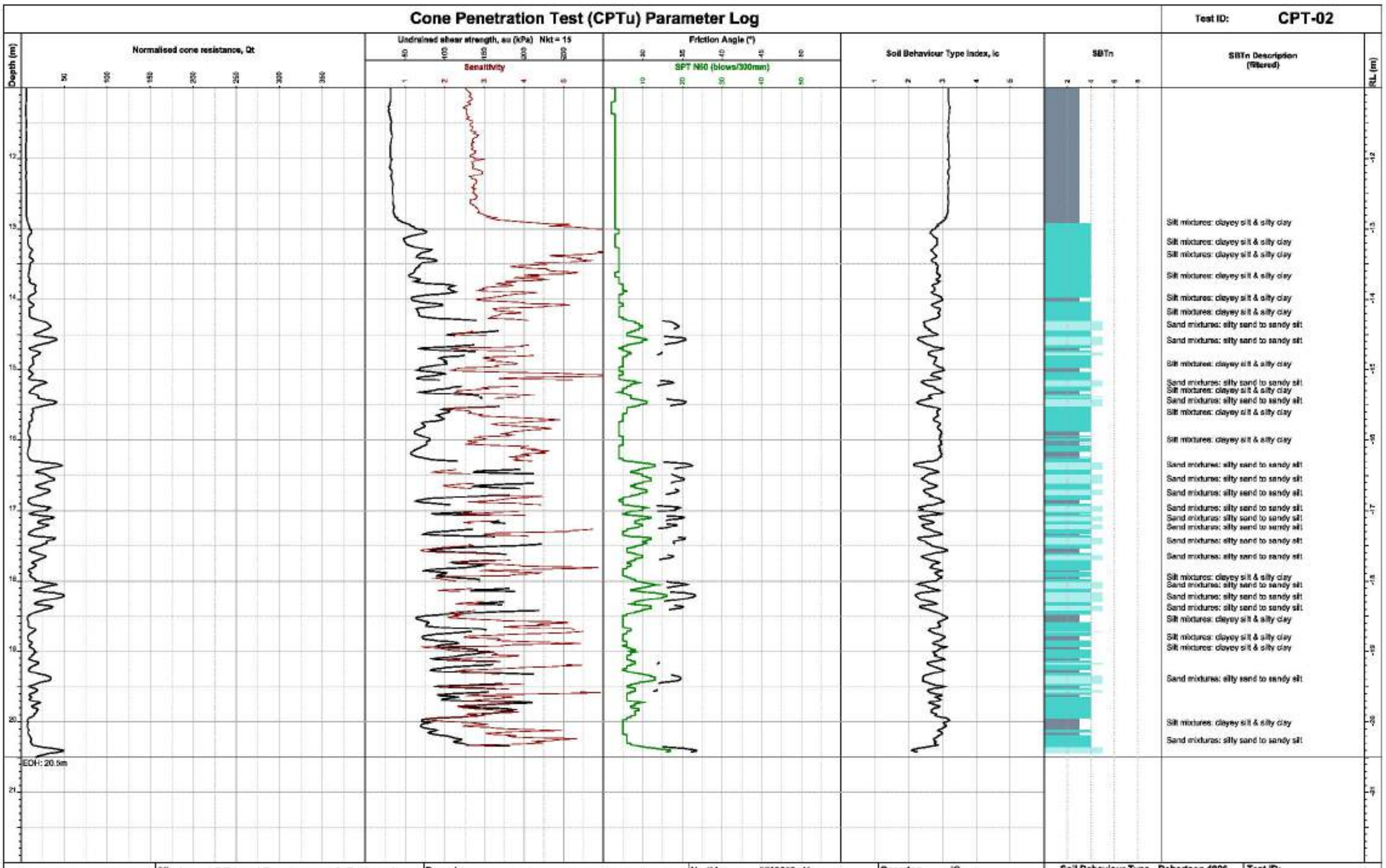
Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: **CPT-02**
Project ID: 24477
Depth: 20.5m
Sheet: 1 of 2
Date: 30/05/2023

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-02



Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.65m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709858mN
Easting:	2036112mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

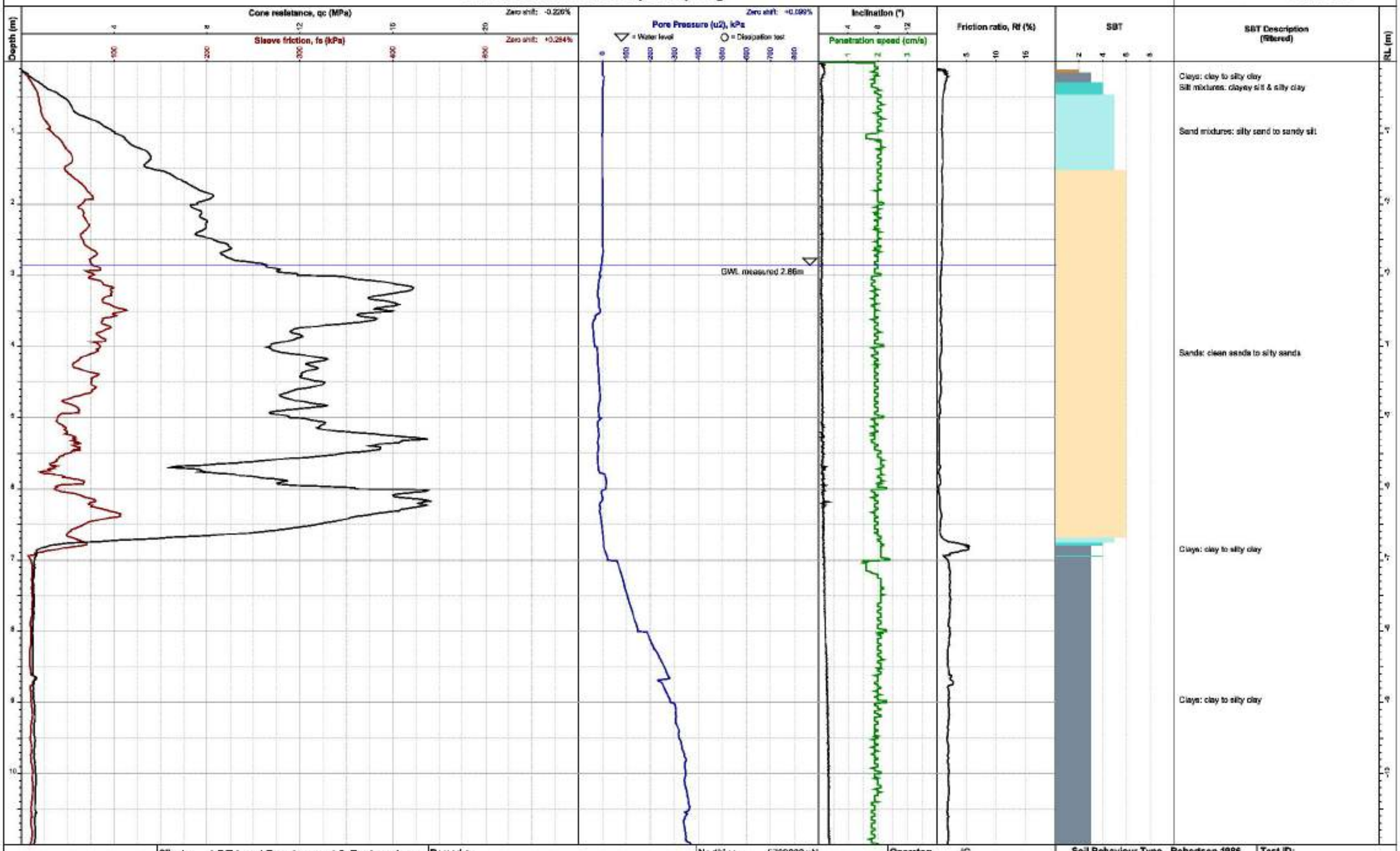
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-02

Project ID:	24477
Depth:	20.5m
Sheet:	2 of 2
Date:	30/05/2023

Cone Penetration Test (CPTu) Log

Test ID: CPT-03



Client:	LDE Land Development & Engineering
Project:	geotechnical Investigation
Location:	556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.86m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709866mN
Easting:	2036135mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

0	Undefined
1	Sensitive fine-grained
2	Clay - organic soil
3	Clays: clay to silty clay
4	Silt mixtures: clayey silt & silty clay
5	Sand mixtures: silty sand to sandy silt
6	Sands: clean sands to silty sands
7	Dense sand to gravelly sand
8	Stiff sand to clayey sand
9	Stiff fine-grained

Test ID: CPT-03

Project ID:	24477
Depth:	20.8m
Sheet:	1 of 2
Date:	30/05/2023

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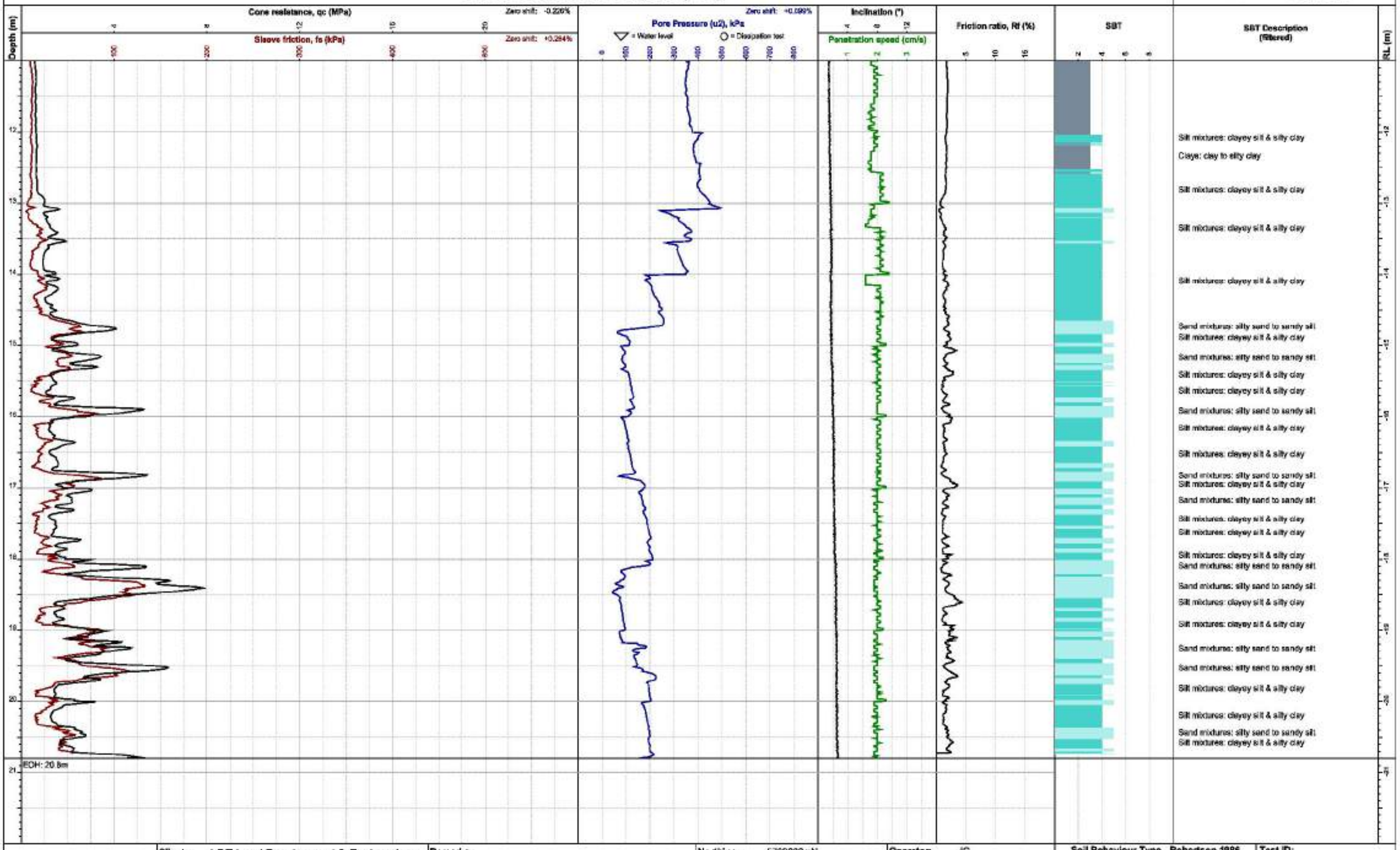
Cone Penetration Test (CPTu) Log

Test ID: CPT-03



Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:10 am

LDE LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering

Project: geotechnical Investigation

Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.86m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709866mN
Easting: 2036135mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

Soil Behaviour Type - Robertson 1986

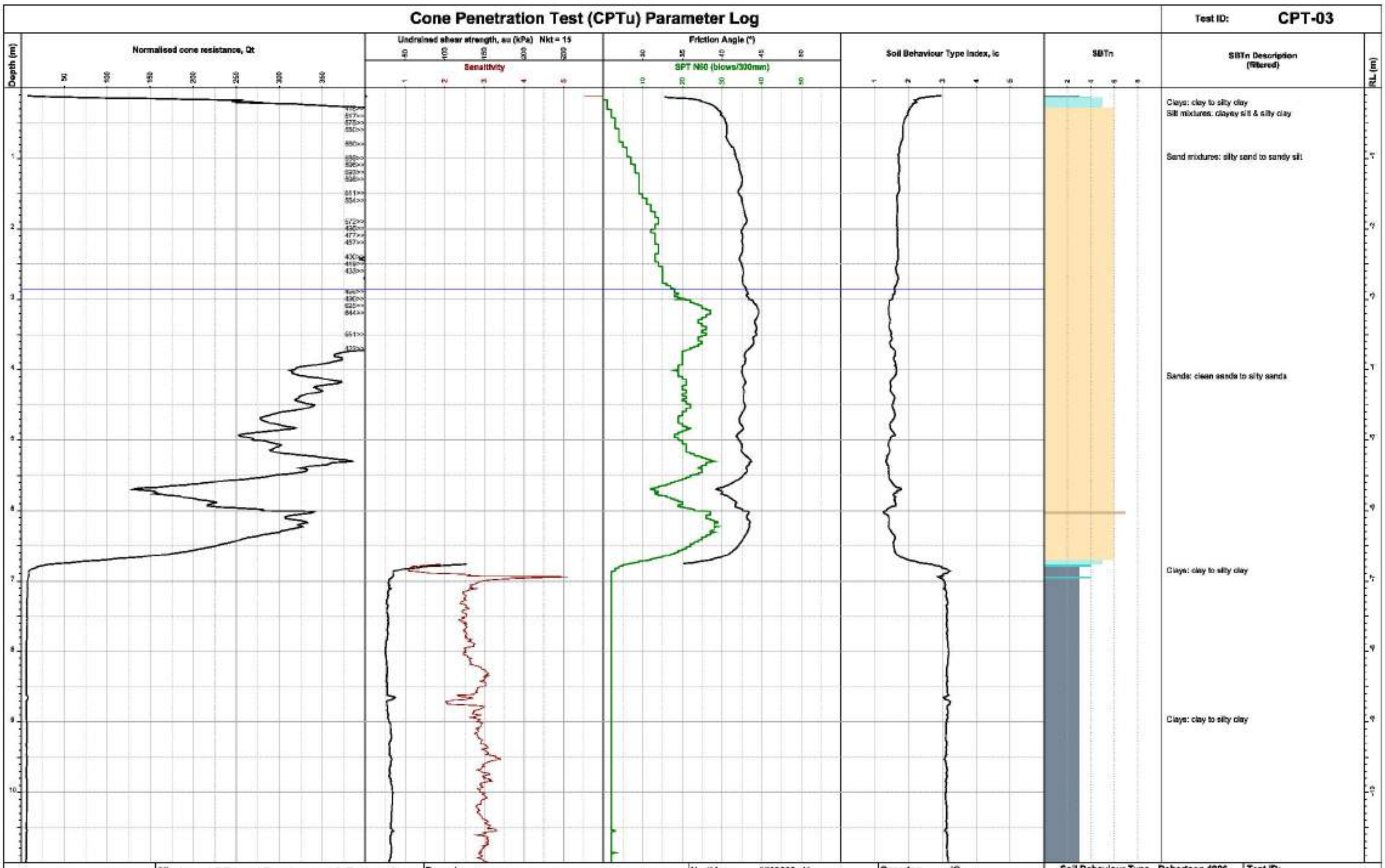
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-03

Project ID: 24477
Depth: 20.8m
Sheet: 2 of 2
Date: 30/05/2023

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-03



Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:10 am

LDE LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering

Project: geotechnical Investigation

Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.86m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709866mN
Easting: 2036135mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

Soil Behaviour Type - Robertson 1986

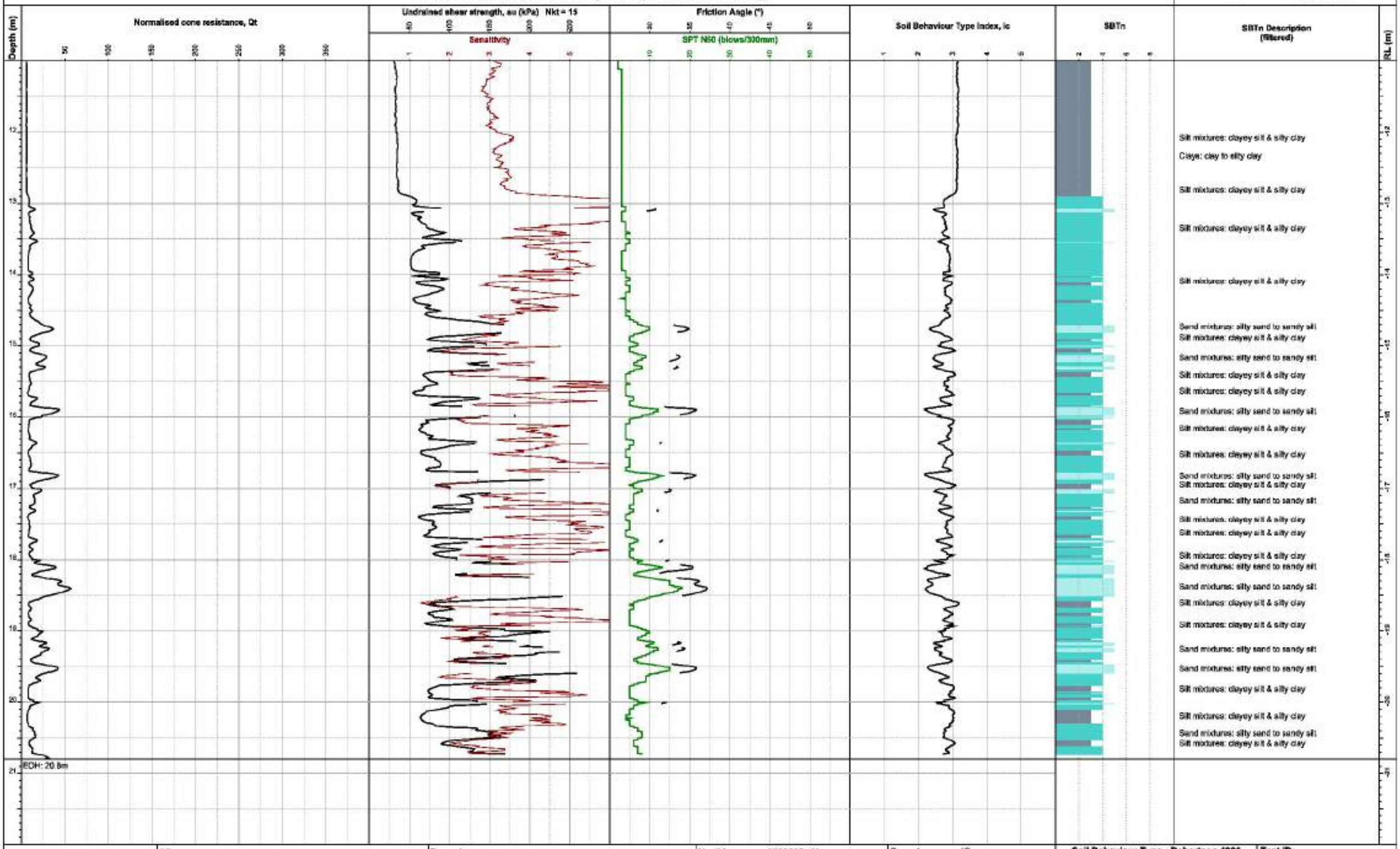
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-03

Project ID: 24477
Depth: 20.8m
Sheet: 1 of 2
Date: 30/05/2023

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-03



Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:10 am

Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.86m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709866mN
Easting: 2036135mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

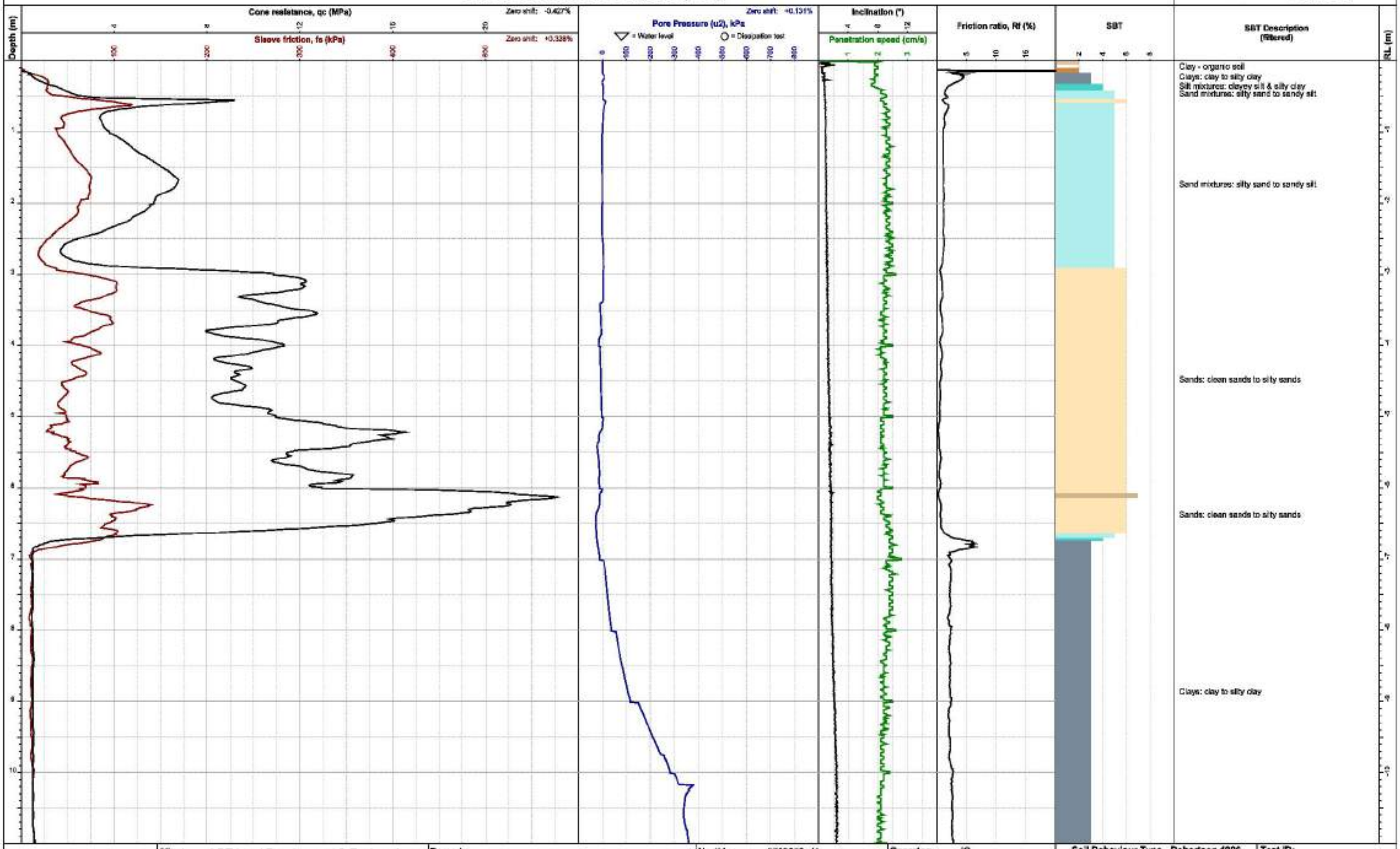
Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-03
Project ID: 24477
Depth: 20.8m
Sheet: 2 of 2
Date: 30/05/2023

Cone Penetration Test (CPTu) Log

Test ID: CPT-04



Client: LDE Land Development & Engineering

Project: geotechnical Investigation

Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.34m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709856mN
Easting: 2036093mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

Soil Behaviour Type - Robertson 1986

- 0 Undefined
- 1 Sensitive fine-grained
- 2 Clay - organic soil
- 3 Clays: clay to silty clay
- 4 Silt mixtures: clayey silt & silty clay
- 5 Sand mixtures: silty sand to sandy silt
- 6 Sands: clean sands to silty sands
- 7 Dense sand to gravelly sand
- 8 Stiff sand to clayey sand
- 9 Stiff fine-grained

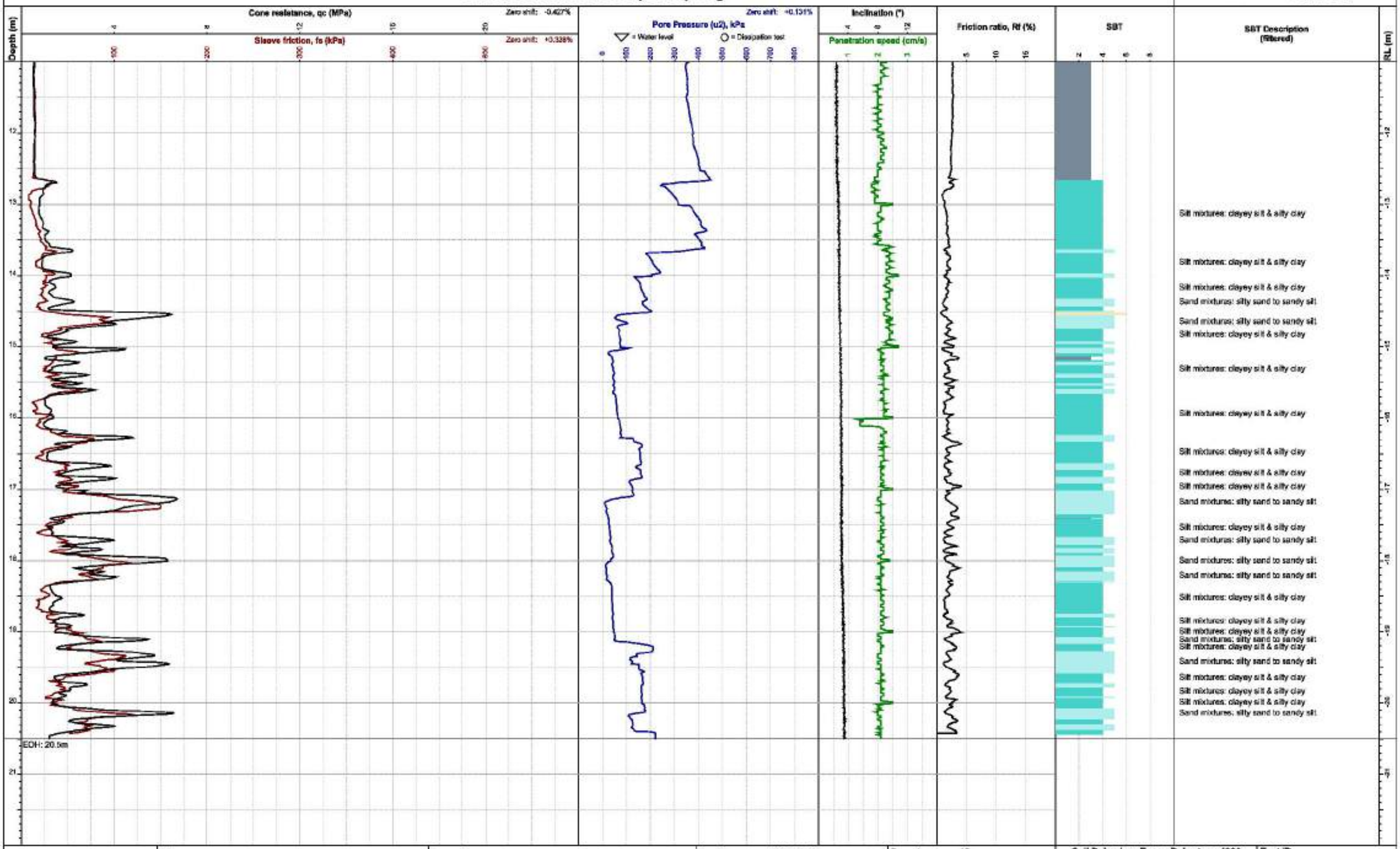
Test ID: CPT-04

Project ID: 24477
Depth: 20.5m
Sheet: 1 of 2
Date: 30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:12 am

Cone Penetration Test (CPTu) Log

Test ID: CPT-04



Client: LDE Land Development & Engineering

Project: geotechnical Investigation

Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.34m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709856mN
Easting:	2036093mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

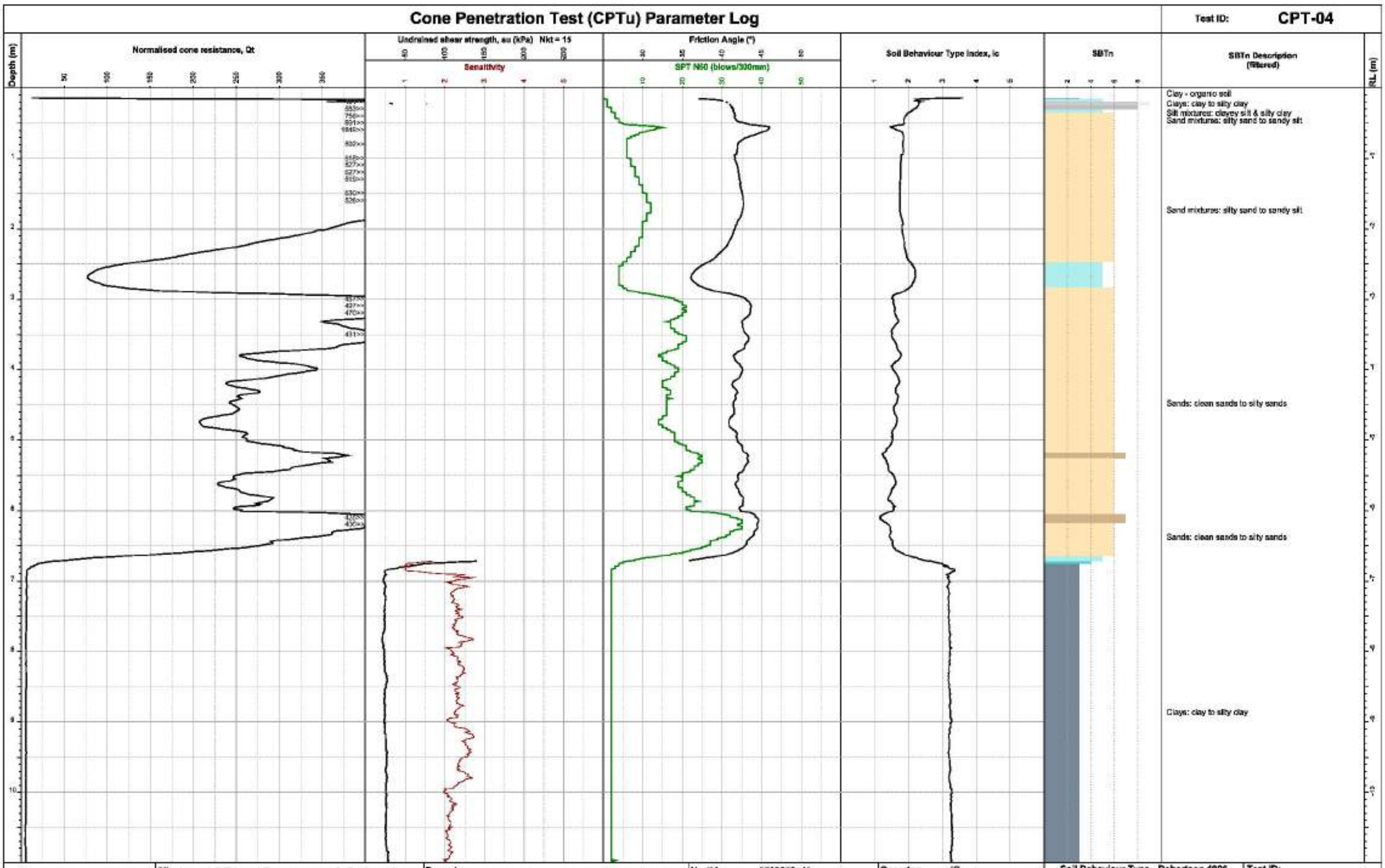
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-04

Project ID:	24477
Depth:	20.5m
Sheet:	2 of 2
Date:	30/05/2023

Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-04**



Client: LDE Land Development & Engineering

Project: geotechnical Investigation

Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.34m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709856mN
Easting: 2036093mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

Soil Behaviour Type - Robertson 1986

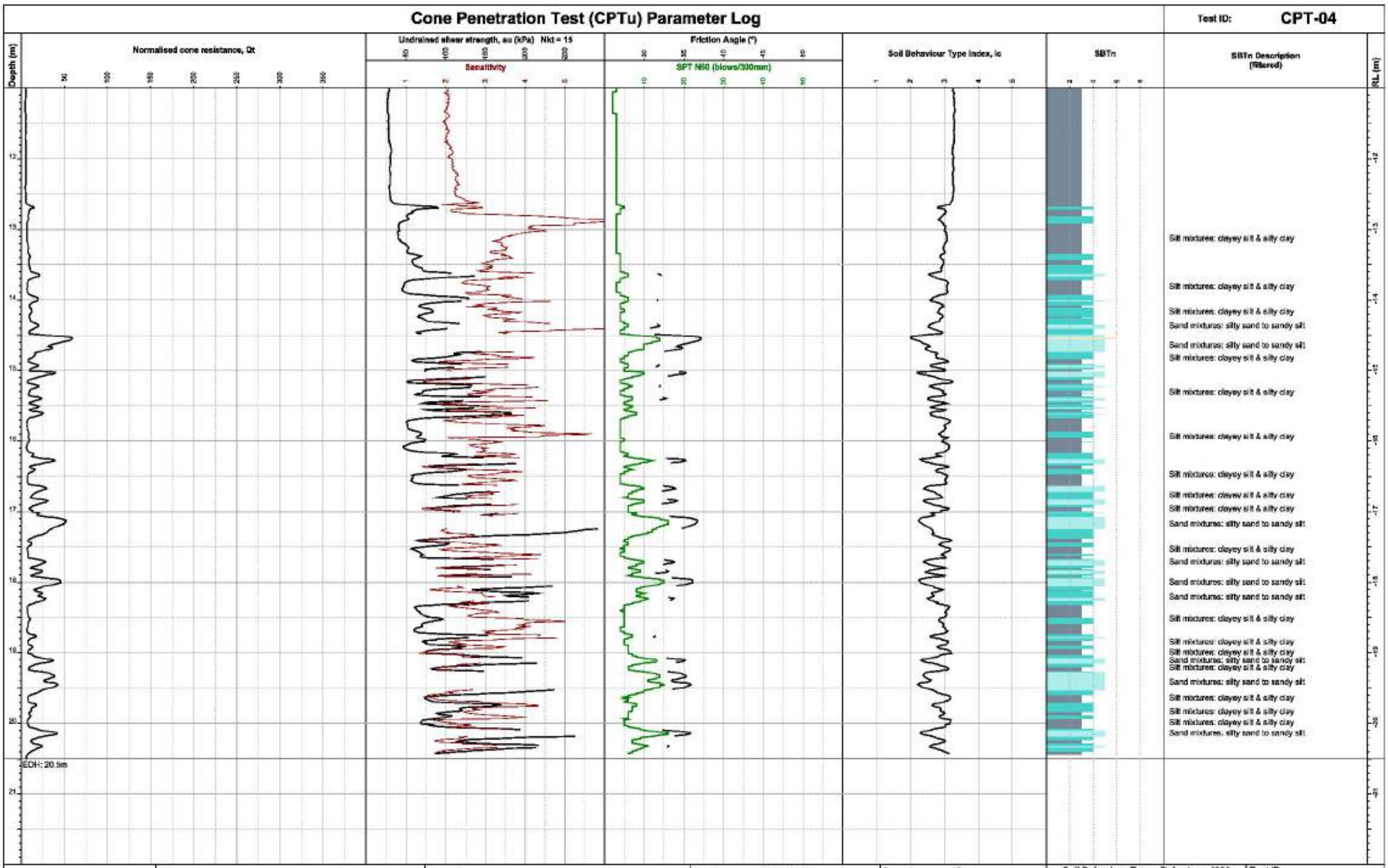
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID:
CPT-04
Project ID: 24477
Depth: 20.5m
Sheet: 1 of 2
Date: 30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:12 am

Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-04**



LDE LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 2.34m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709856mN
Easting: 2036093mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

Soil Behaviour Type - Robertson 1986

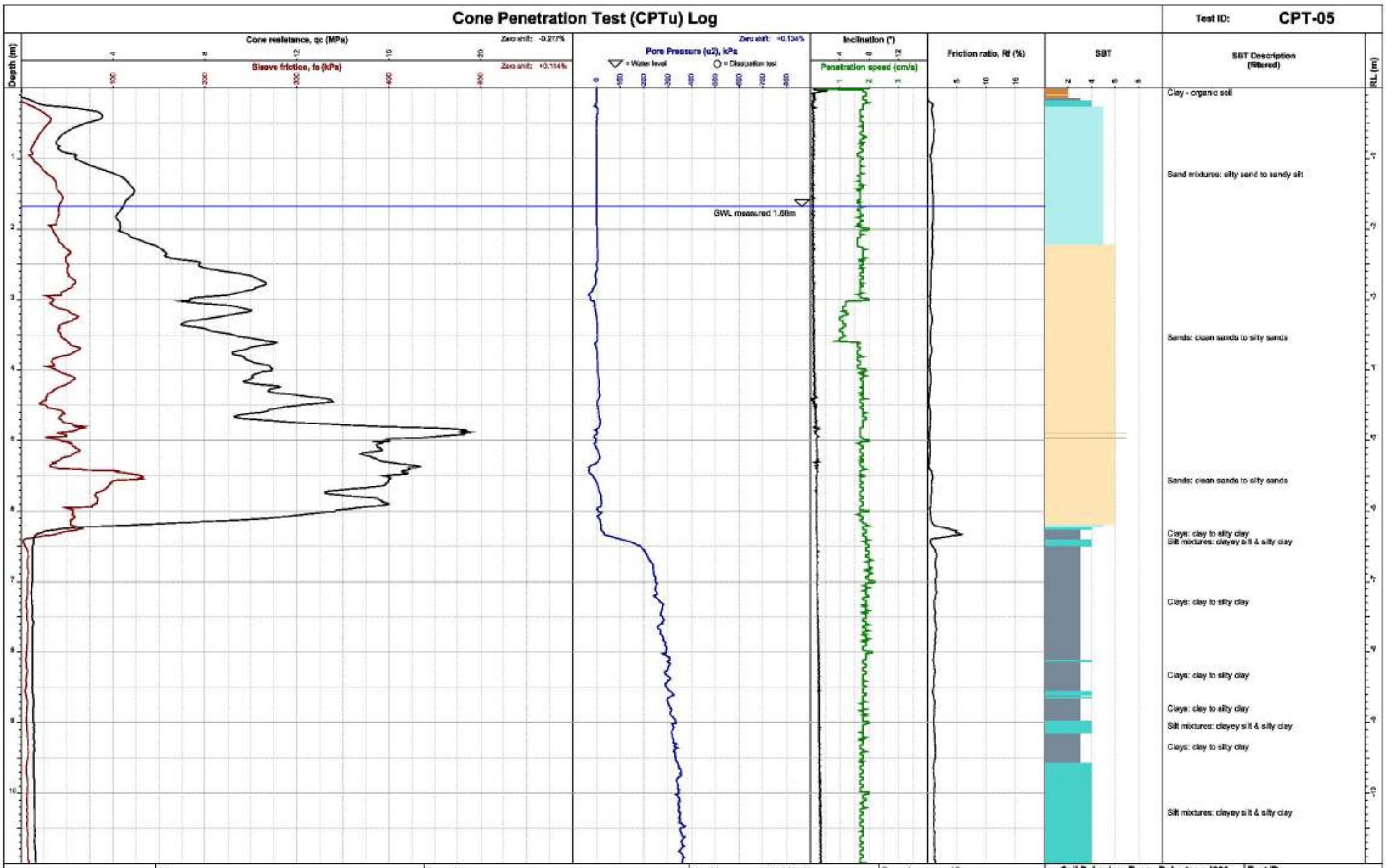
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: **CPT-04**
Project ID: 24477
Depth: 20.5m
Sheet: 2 of 2
Date: 30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:13 am

Cone Penetration Test (CPTu) Log

Test ID: CPT-05



Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:15 am

Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 1.68m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709840mN
Easting:	2036107mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

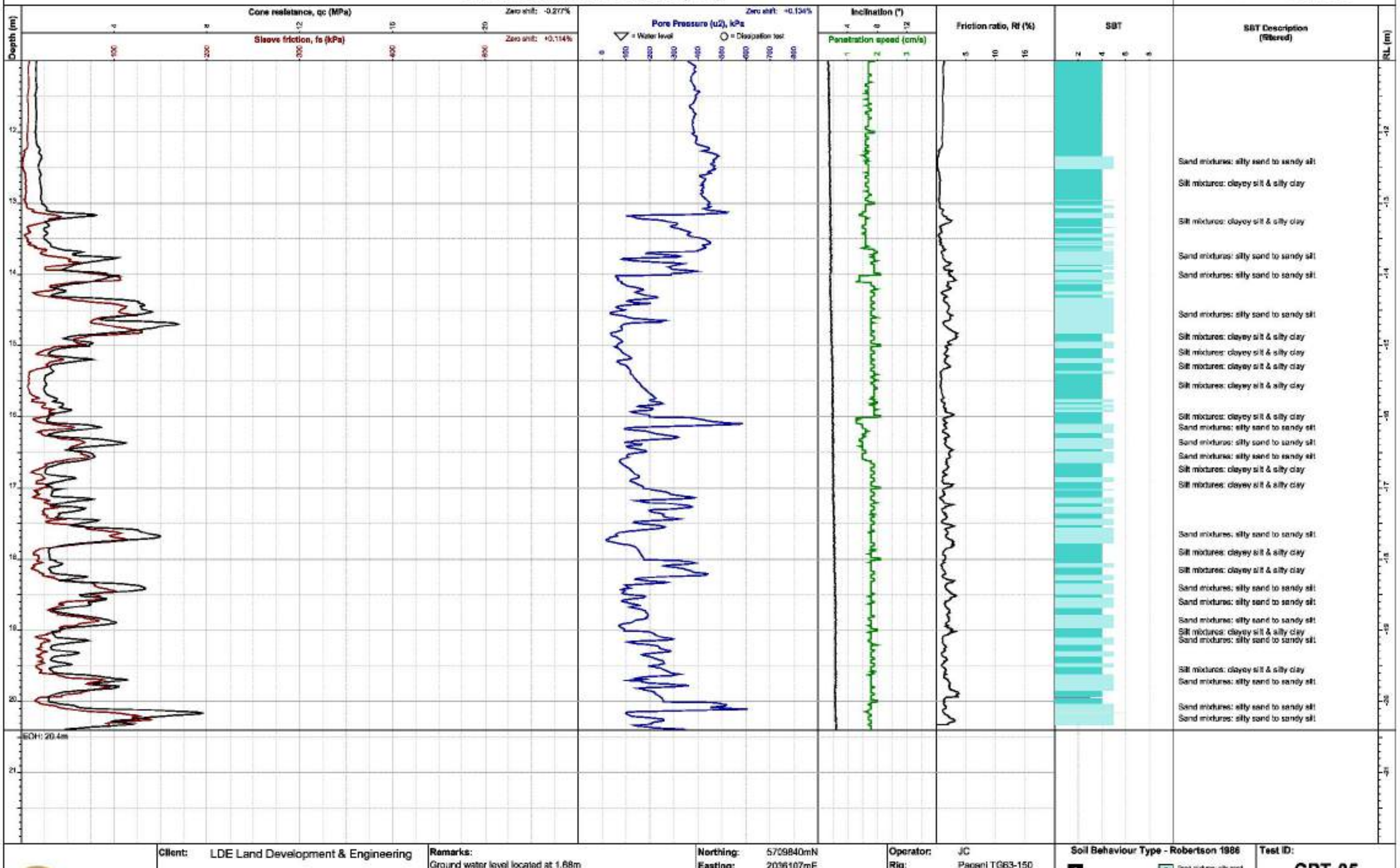
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID:
CPT-05

Project ID:	24477
Depth:	20.4m
Sheet:	1 of 2
Date:	30/05/2023

Cone Penetration Test (CPTu) Log

Test ID: CPT-05



Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 1.68m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709840mN
Easting:	2036107mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

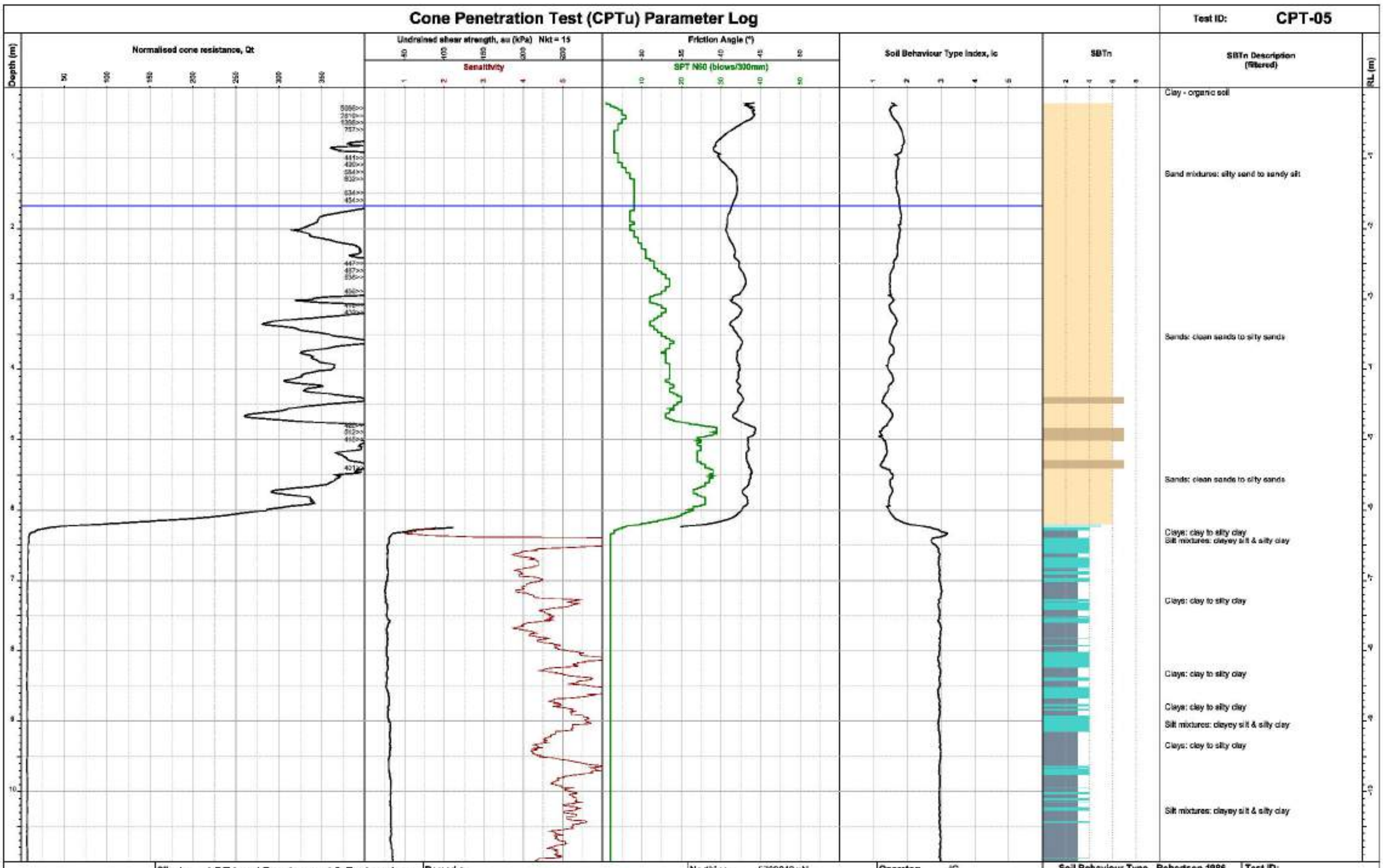
0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID: CPT-05

Project ID:	24477
Depth:	20.4m
Sheet:	2 of 2
Date:	30/05/2023

Cone Penetration Test (CPTu) Parameter Log

Test ID: CPT-05



LAND DEVELOPMENT & ENGINEERING

Client: LDE Land Development & Engineering

Project: geotechnical Investigation

Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 1.68m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing:	5709840mN
Easting:	2036107mE
System:	NZTM
Elevation:	Ground
Located By:	Phone GPS
Location:	As per site plan

Operator:	JC
Rig:	Pagani TG63-150
Cone ID:	Mks1042
Type:	Comp. piezo cone
Cone Area:	10 cm²
Sleeve Area:	150 cm²
Area Ratio:	0.8

Soil Behaviour Type - Robertson 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Test ID:

CPT-05

Project ID:	24477
Depth:	20.4m
Sheet:	1 of 2
Date:	30/05/2023

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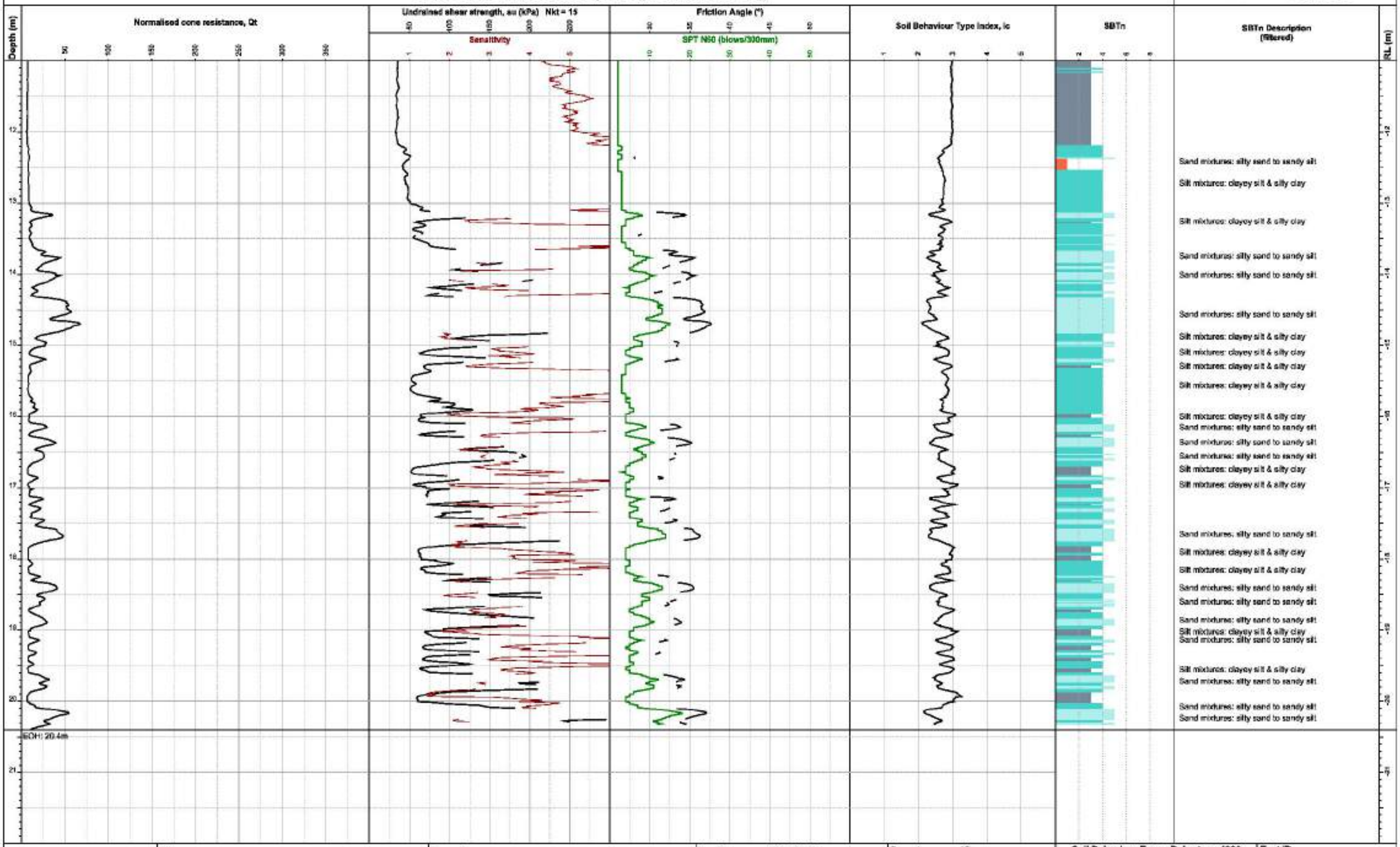
Cone Penetration Test (CPTu) Parameter Log

Test ID: **CPT-05**



Client: LDE Land Development & Engineering
Project: geotechnical Investigation
Location: 556-560 Abeerdeen Rd, Gisborne

Remarks:
Ground water level located at 1.68m
Test according to ISO 22476-1:12 (Class 2)

Termination Reason:
Target depth

Northing: 5709840mN
Easting: 2036107mE
System: NZTM
Elevation: Ground
Located By: Phone GPS
Location: As per site plan

Operator: JC
Rig: Pagani TG63-150
Cone ID: Mks1042
Type: Comp. piezo cone
Cone Area: 10 cm²
Sleeve Area: 150 cm²
Area Ratio: 0.8

Soil Behaviour Type - Robertson 1986

0 Undefined	5 Sand mixtures: silty sand to sandy silt
1 Sensitive fine-grained	6 Sands: clean sands to silty sands
2 Clay - organic soil	7 Dense sand to gravelly sand
3 Clays: clay to silty clay	8 Stiff sand to clayey sand
4 Silt mixtures: clayey silt & silty clay	9 Stiff fine-grained

Test ID: **CPT-05**

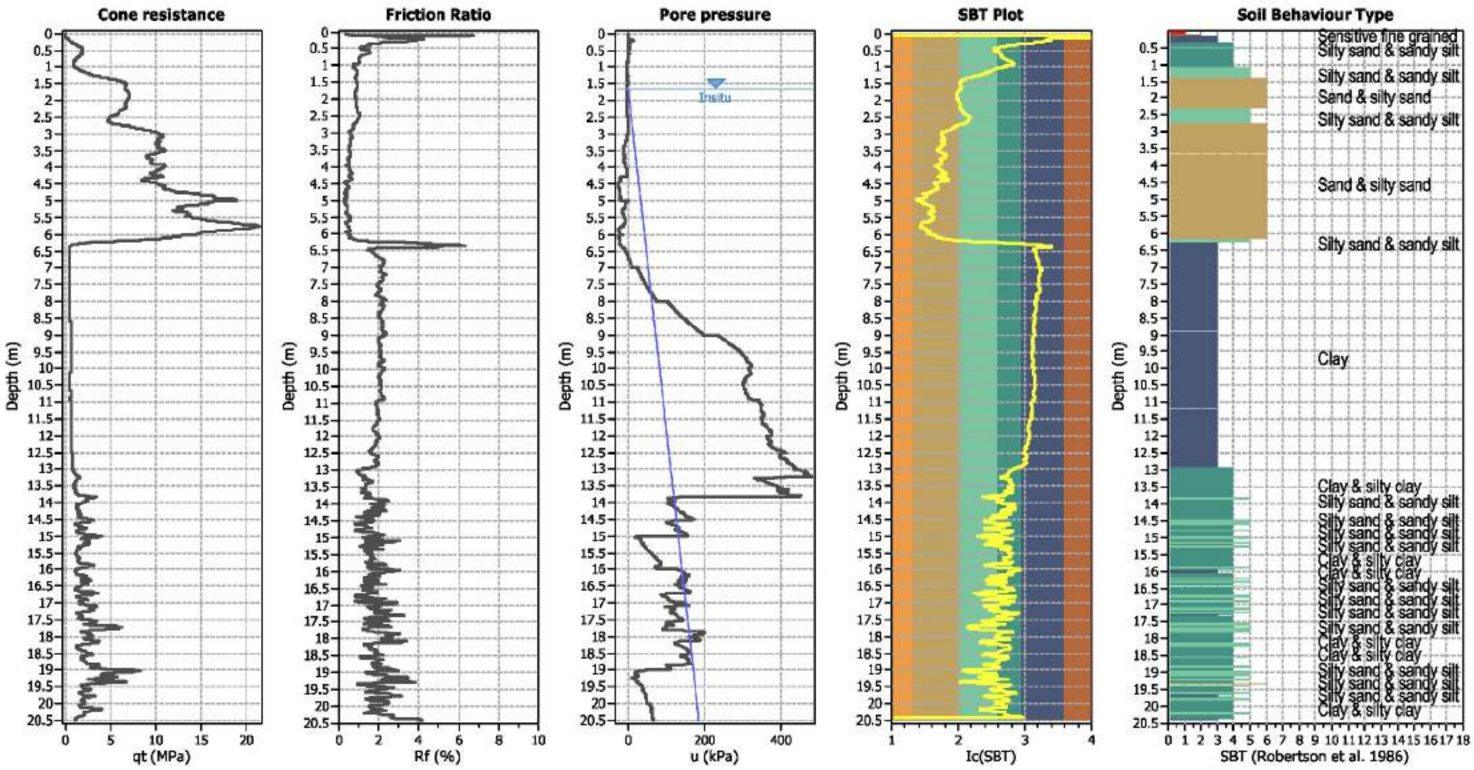
Project ID: 24477
Depth: 20.4m
Sheet: 2 of 2
Date: 30/05/2023

Generated with CORE-GS by Geroc - CPT Combined A3 v2 - 31/05/2023 9:14:16 am

APPENDIX D

LIQUEFATION ANALYSIS RESULTS

CPT basic interpretation plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

🟥 1. Sensitive fine grained	■ 4. Clayey silt to silty	🟧 7. Gravely sand to sand
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	■ 8. Very stiff sand to
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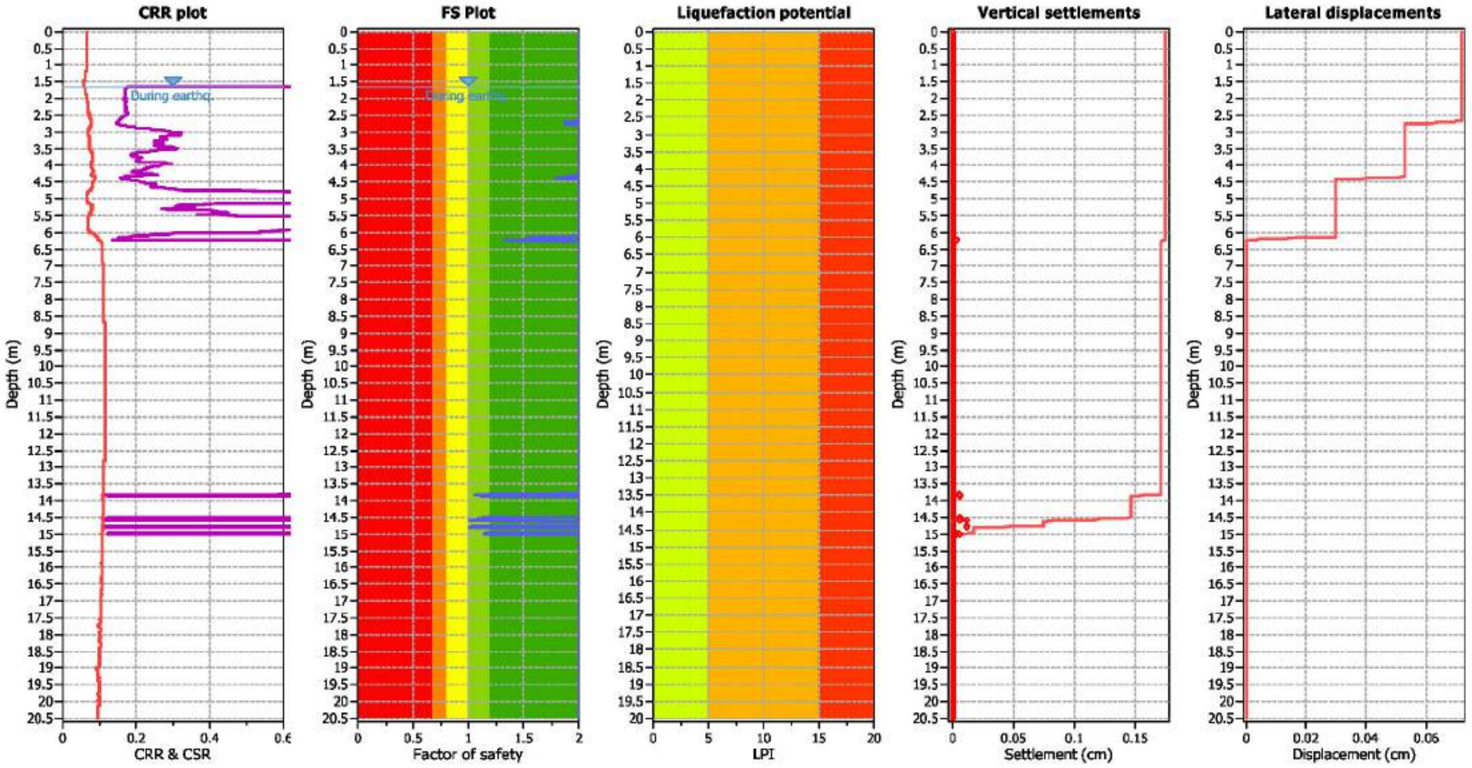
Liquefaction analysis overall plots



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F.S. color scheme

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LPI color scheme

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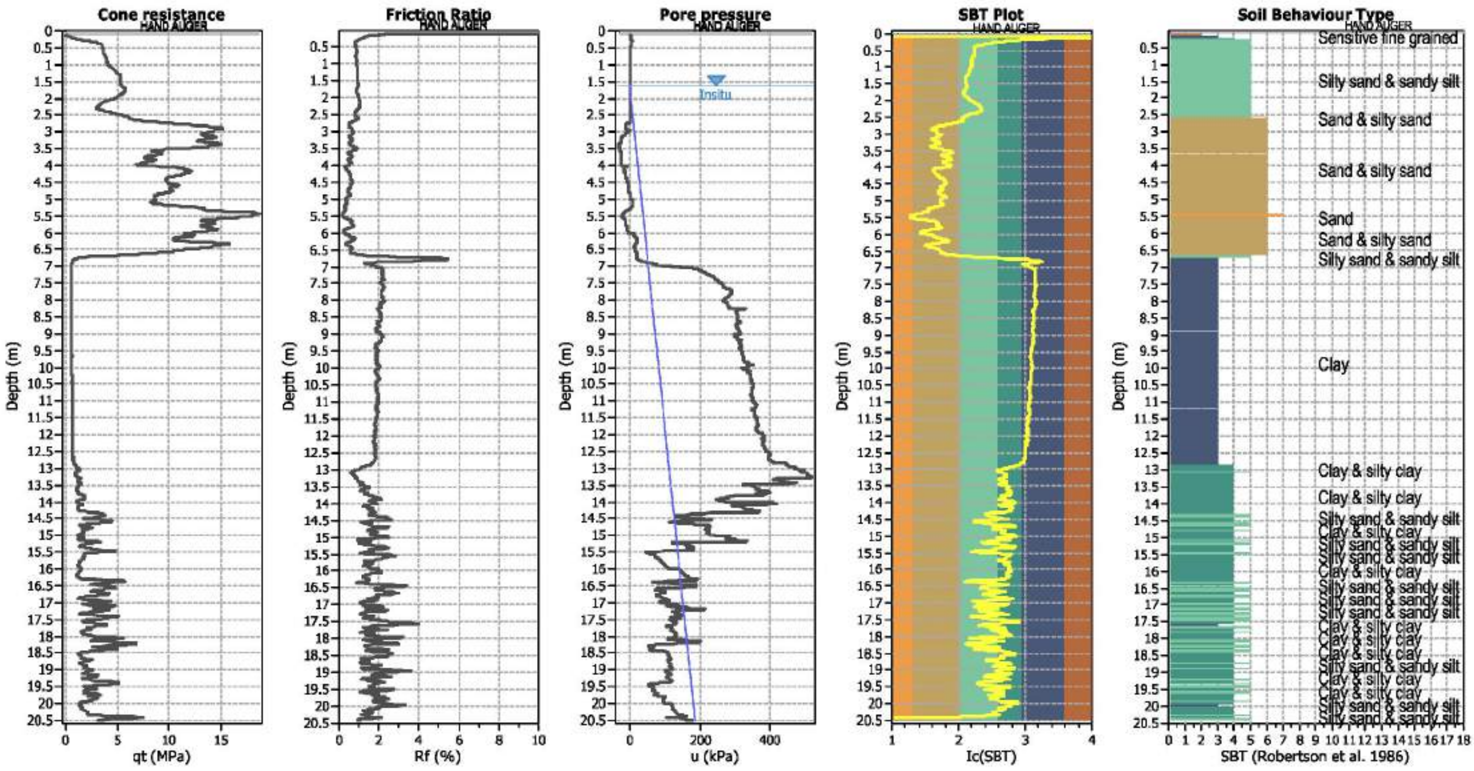

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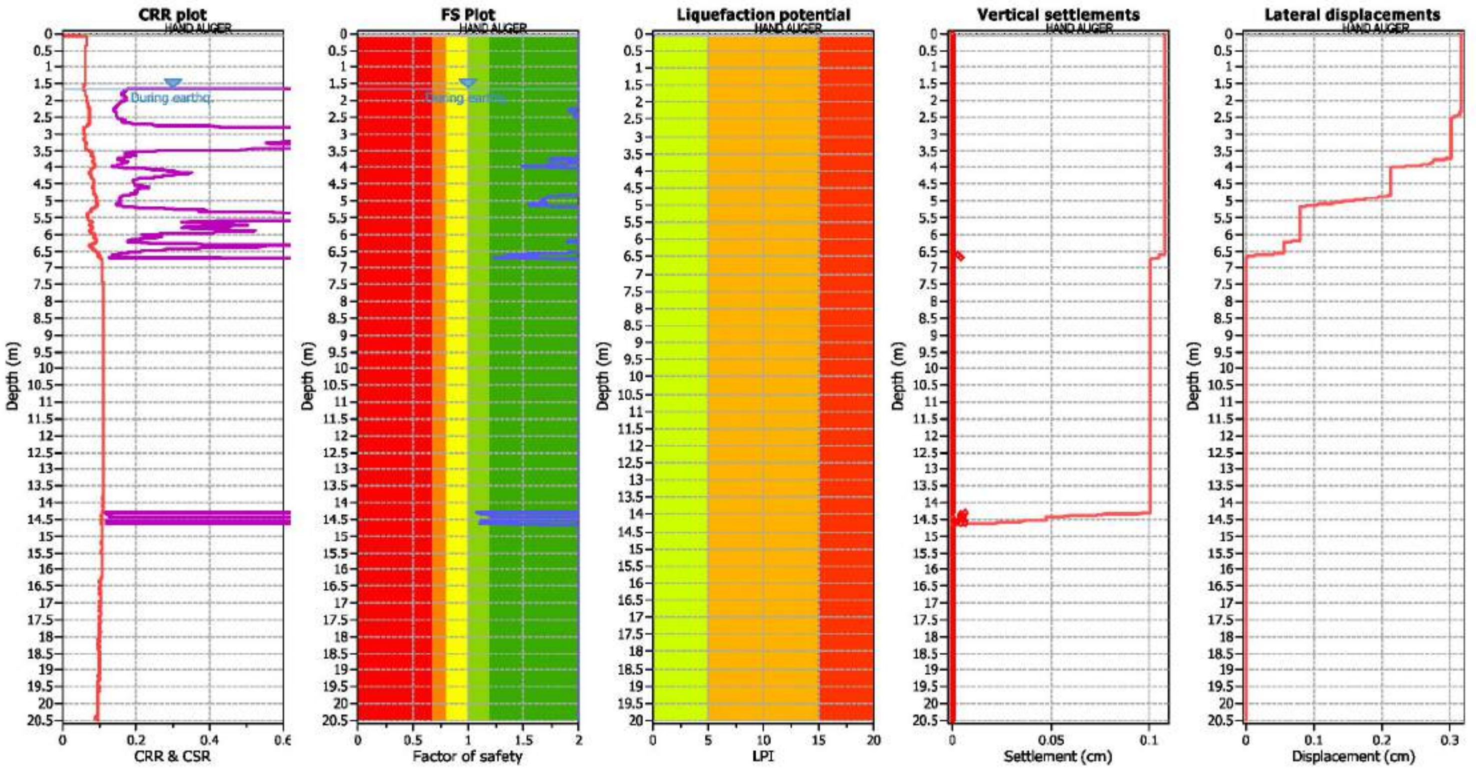

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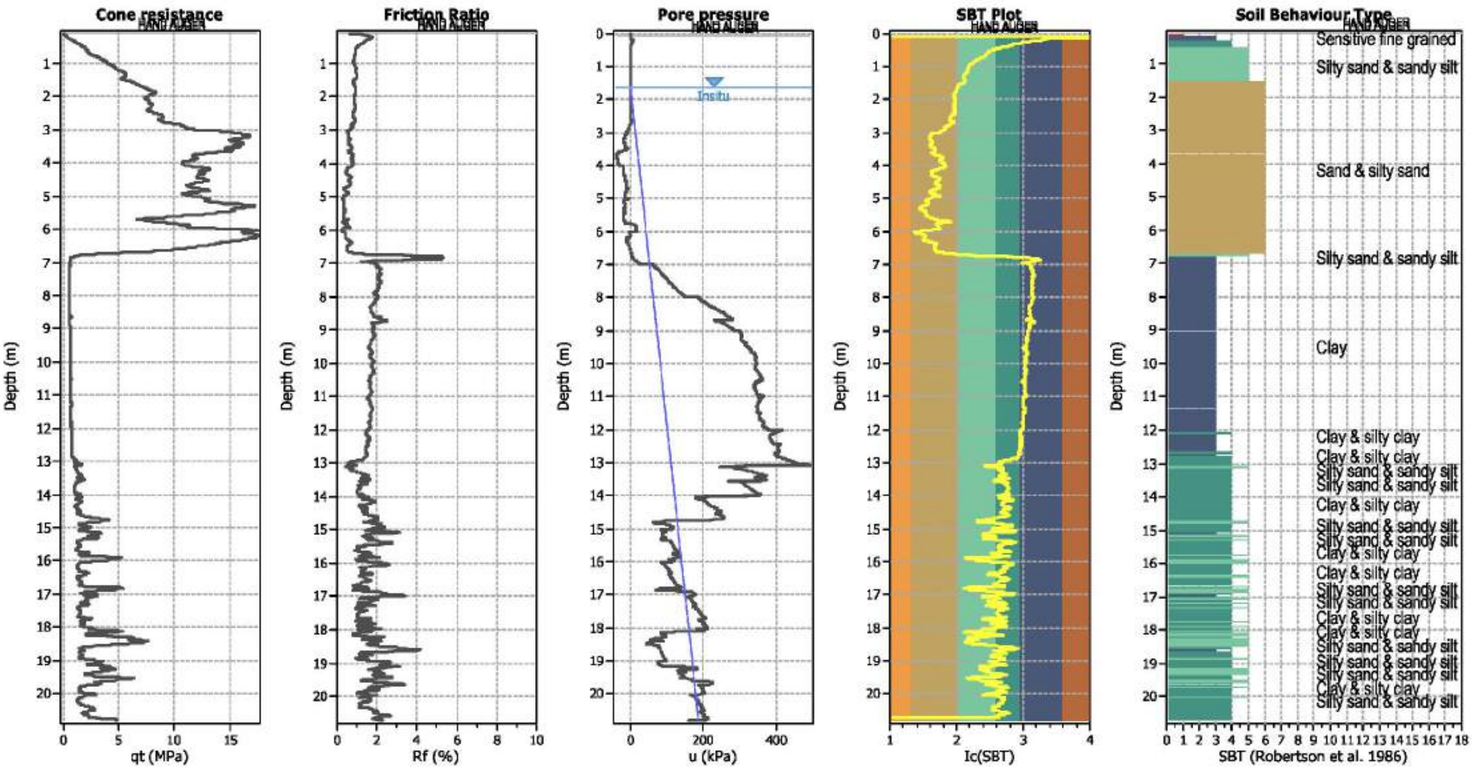

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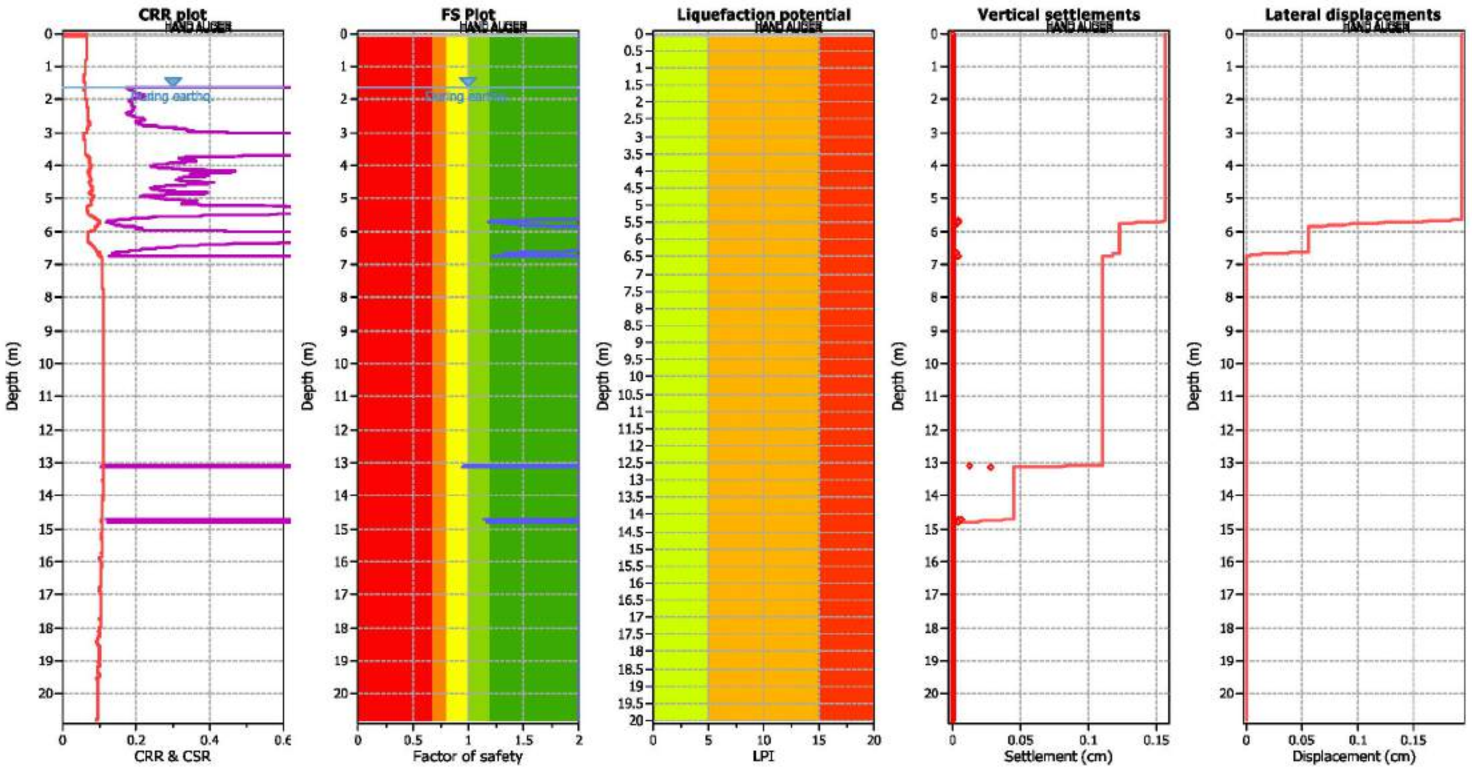

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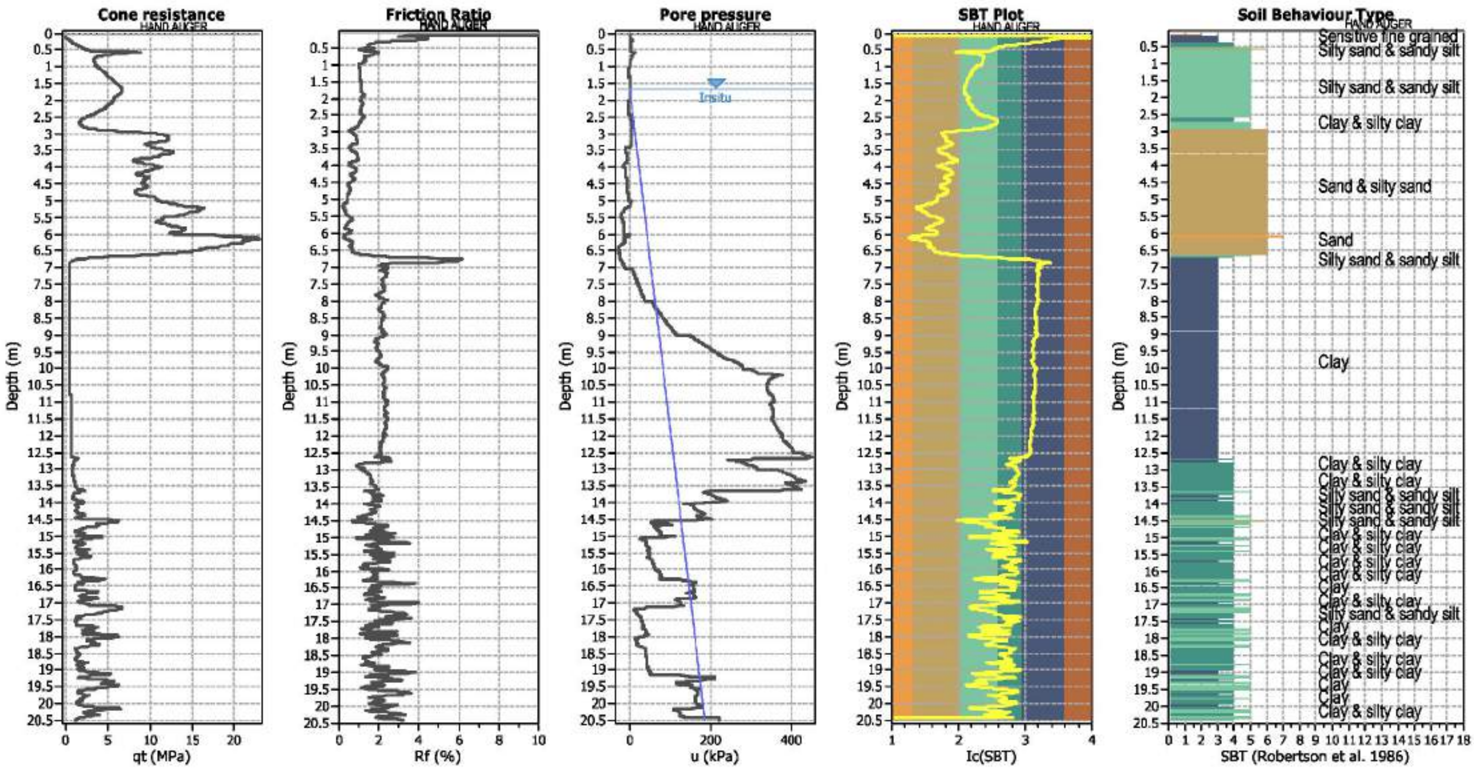

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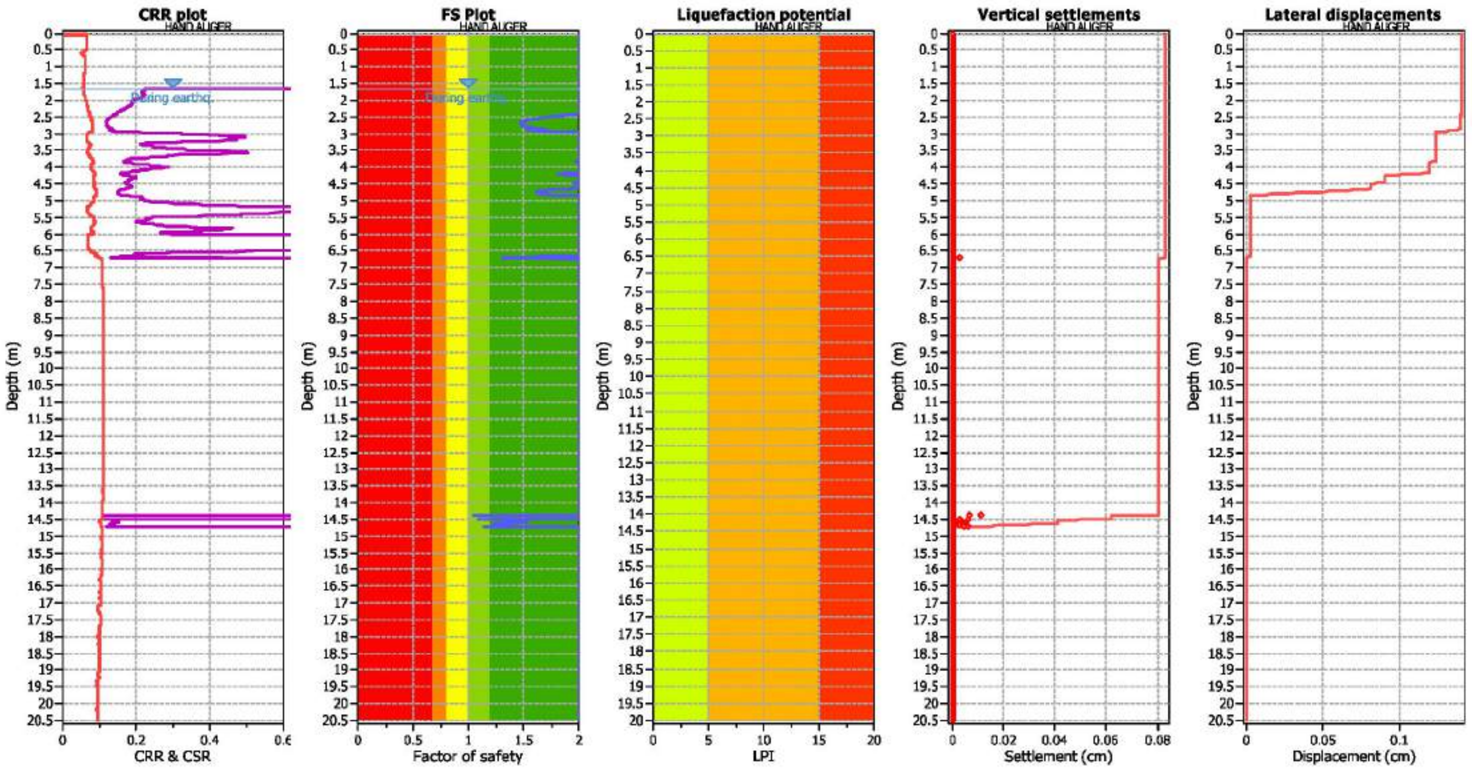

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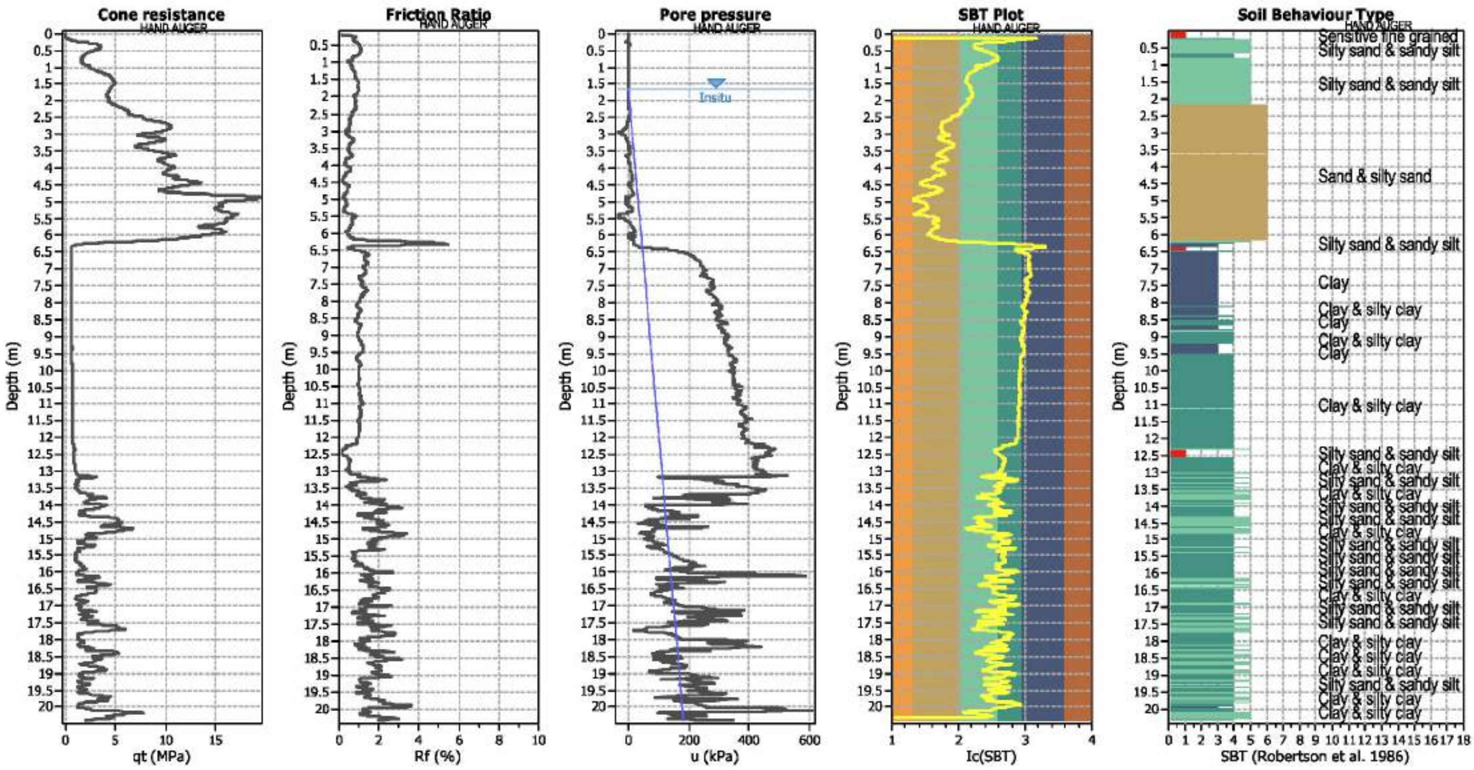

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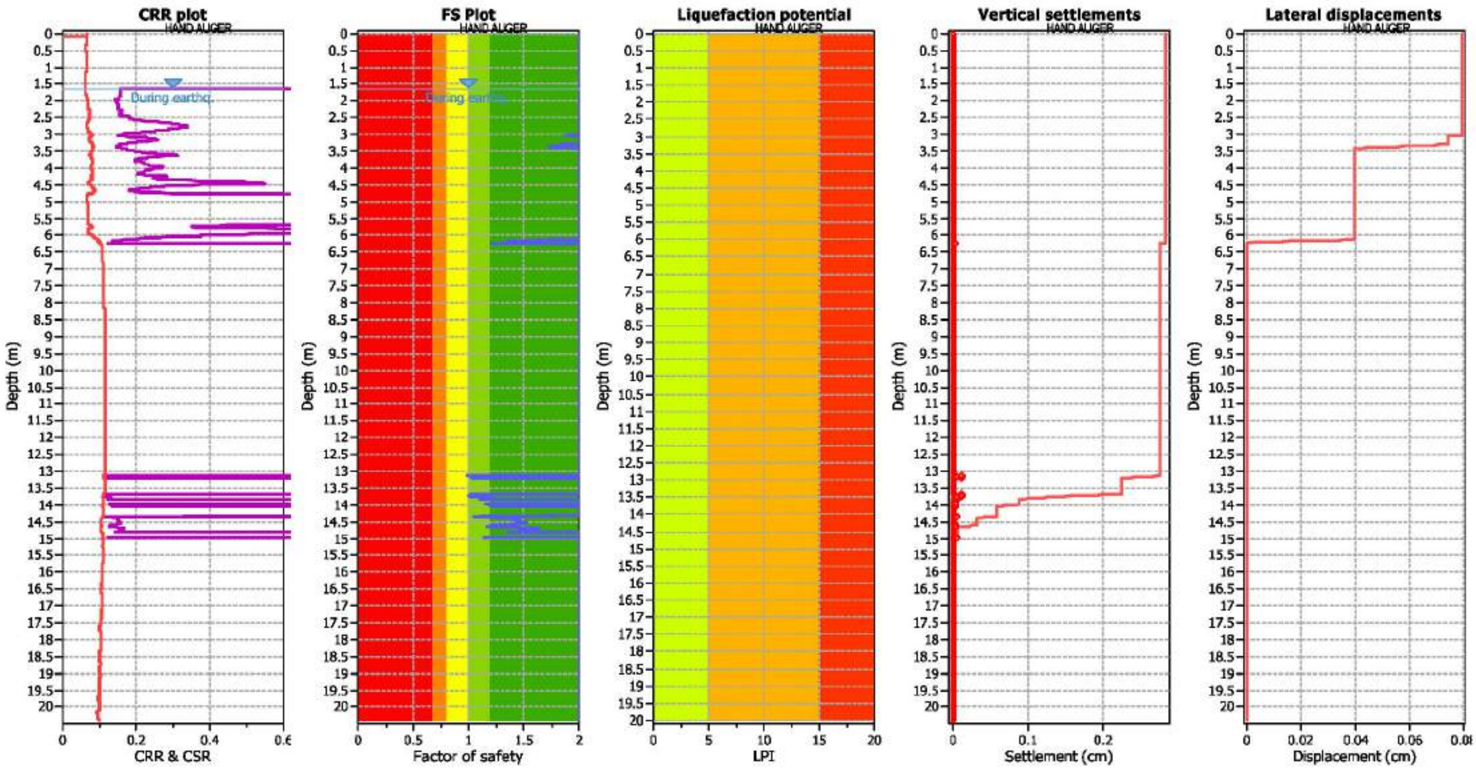

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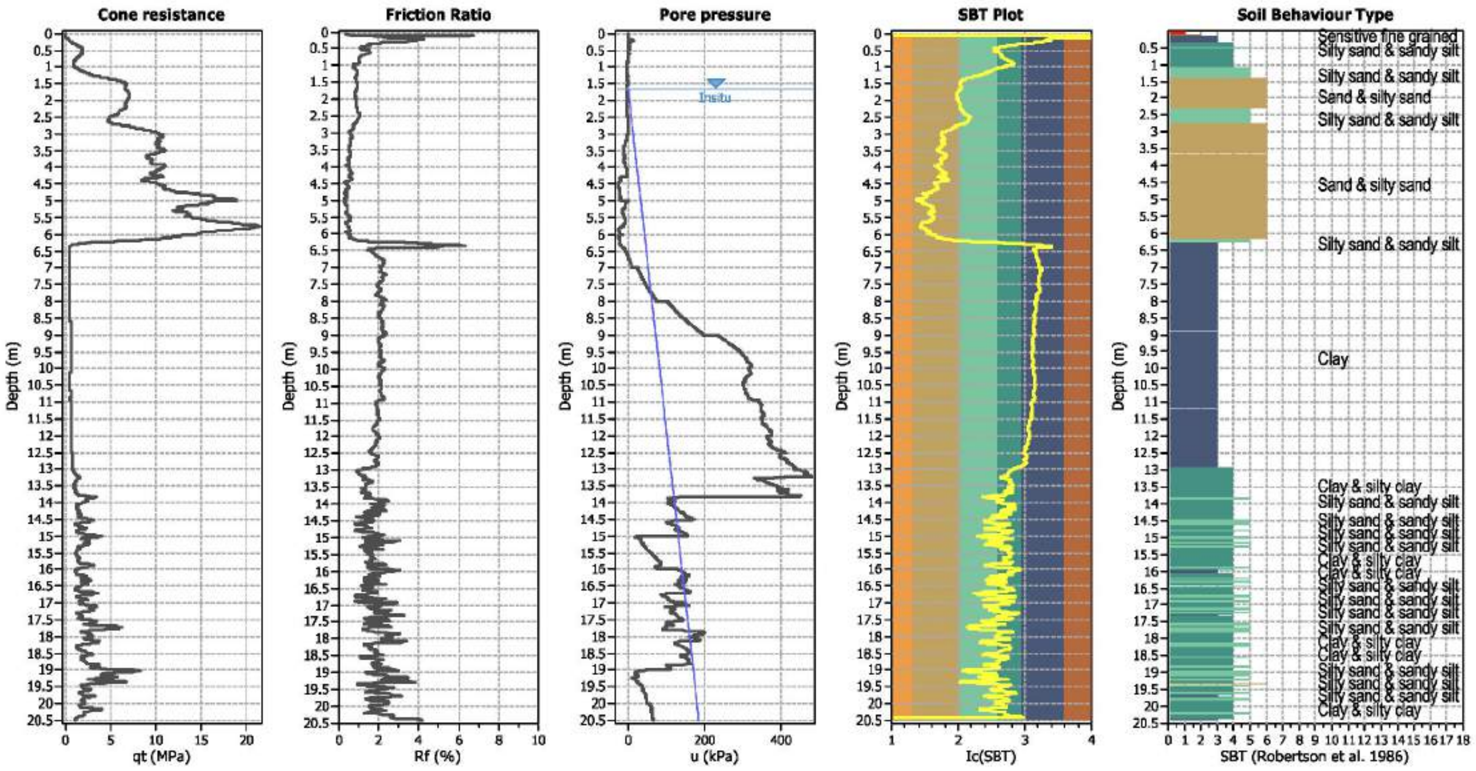

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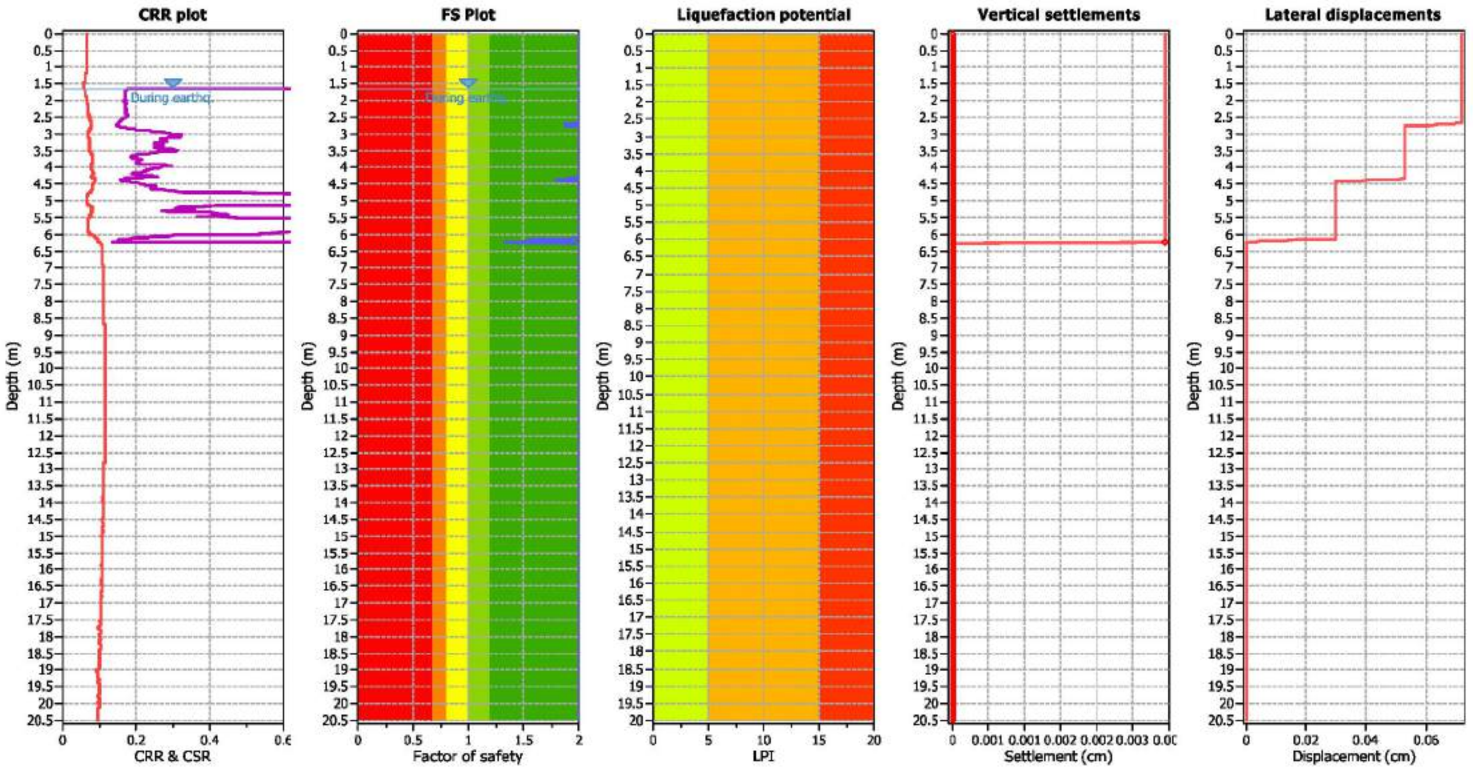

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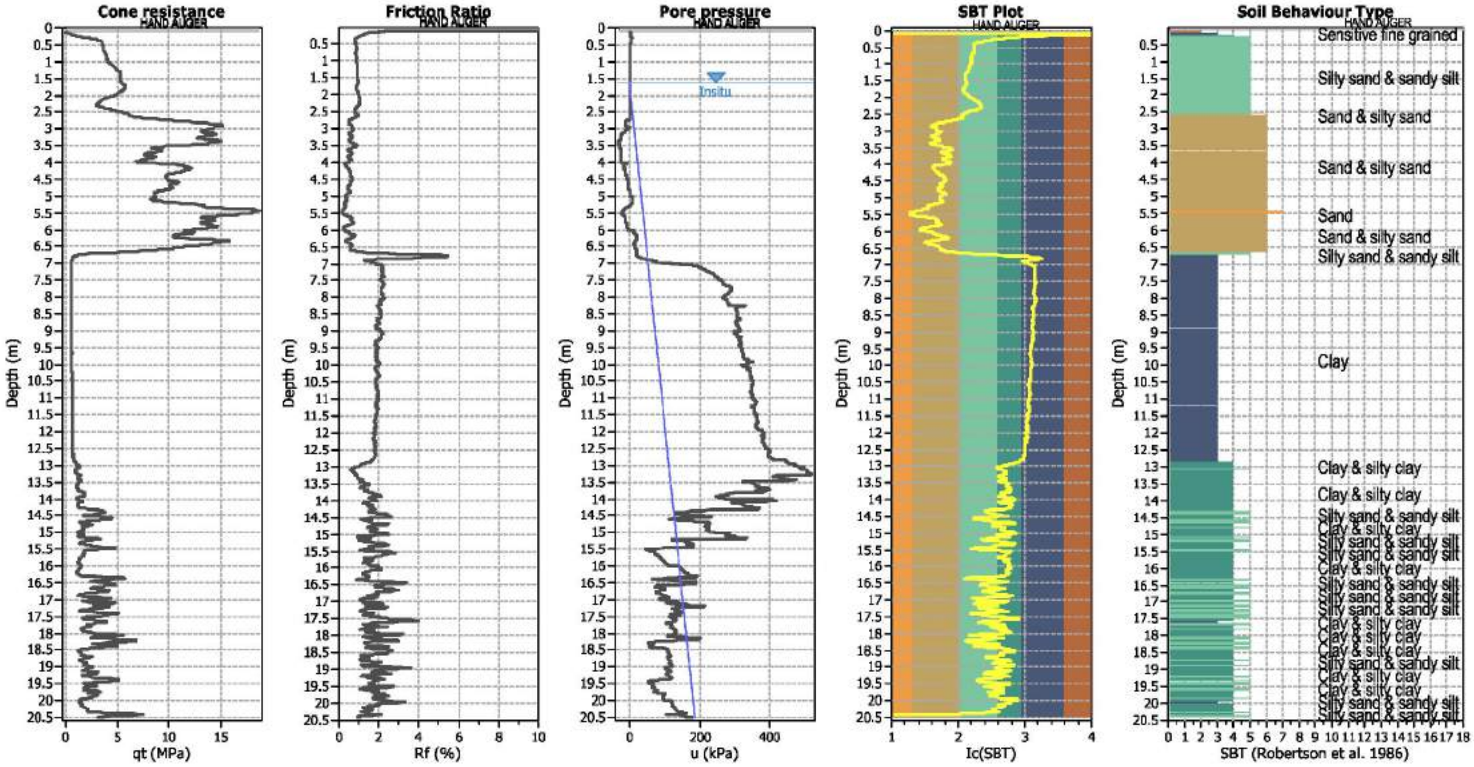

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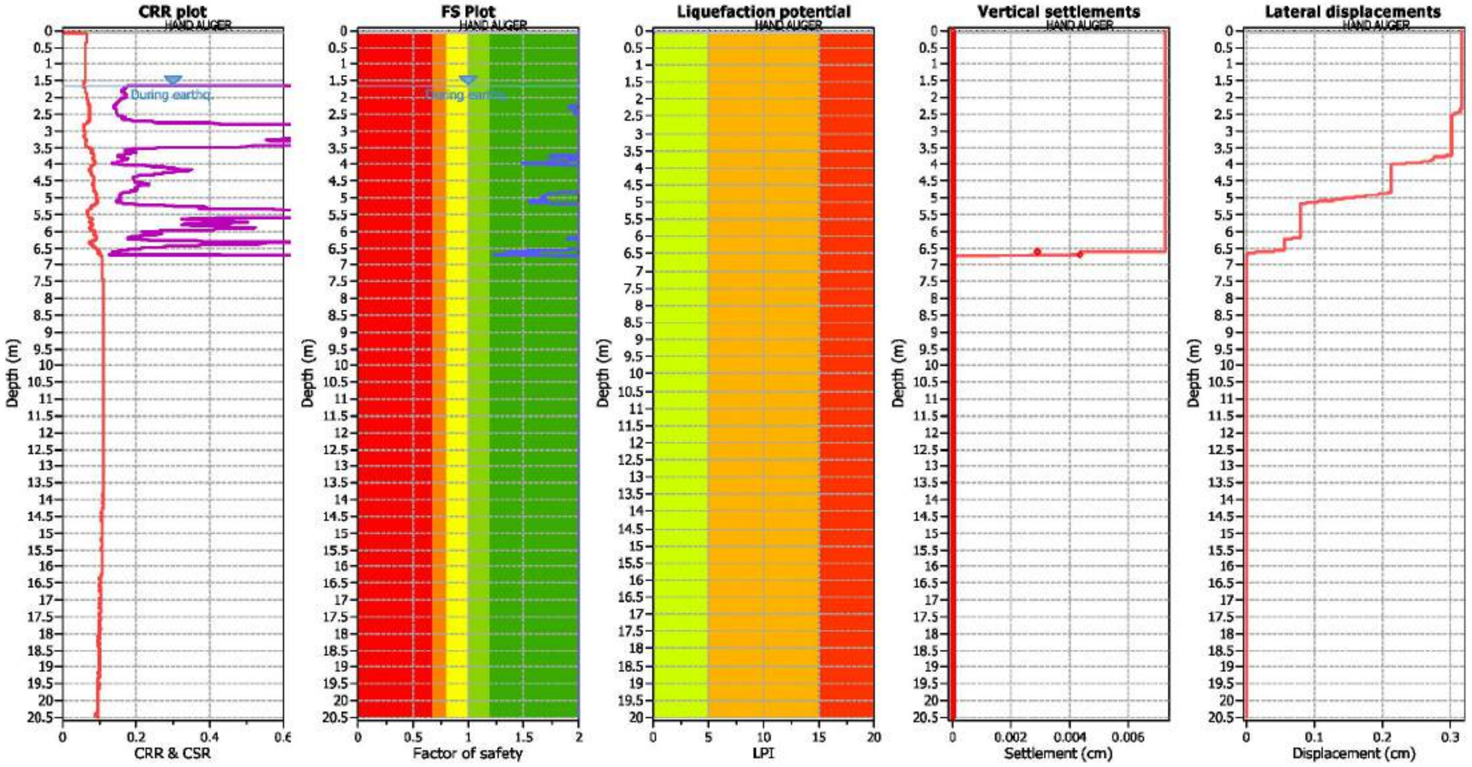

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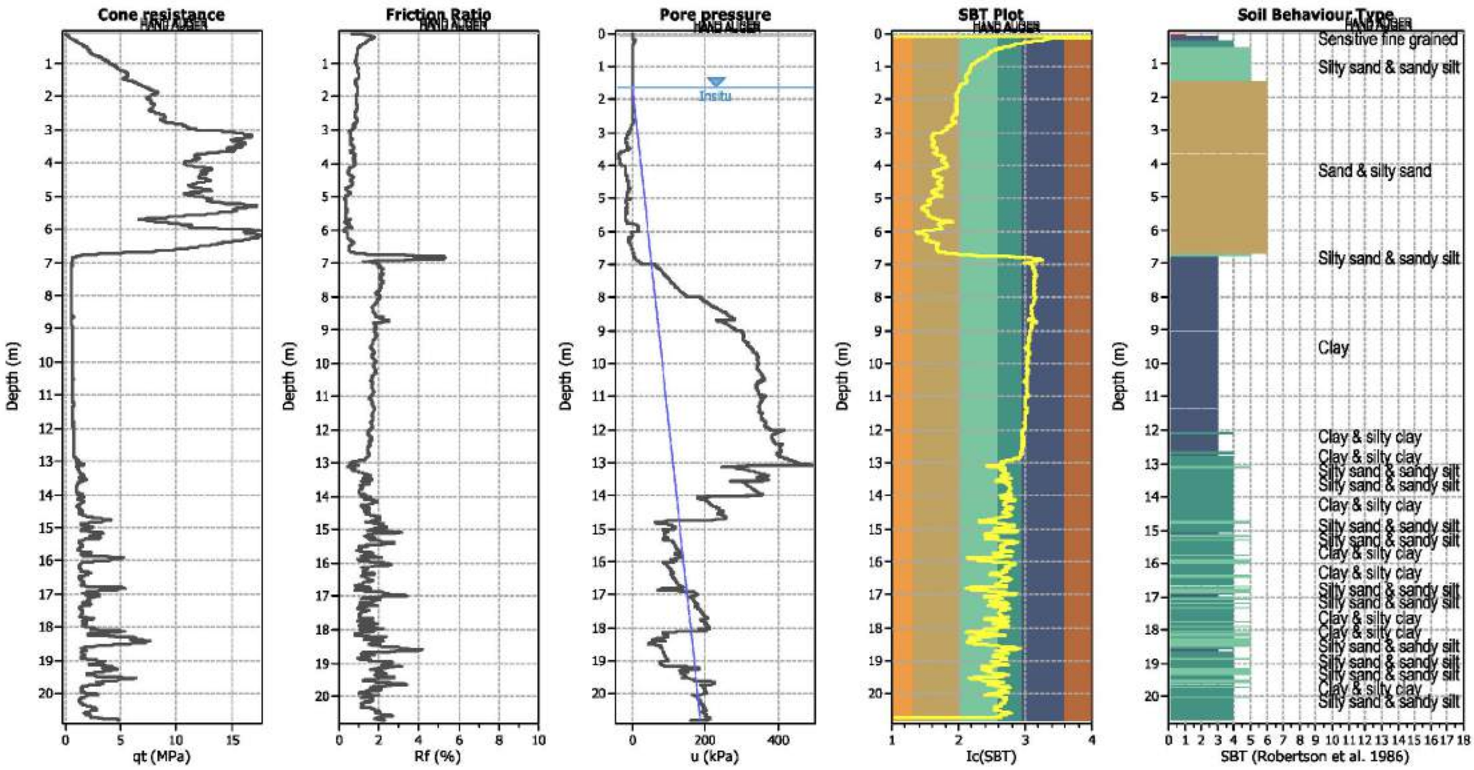

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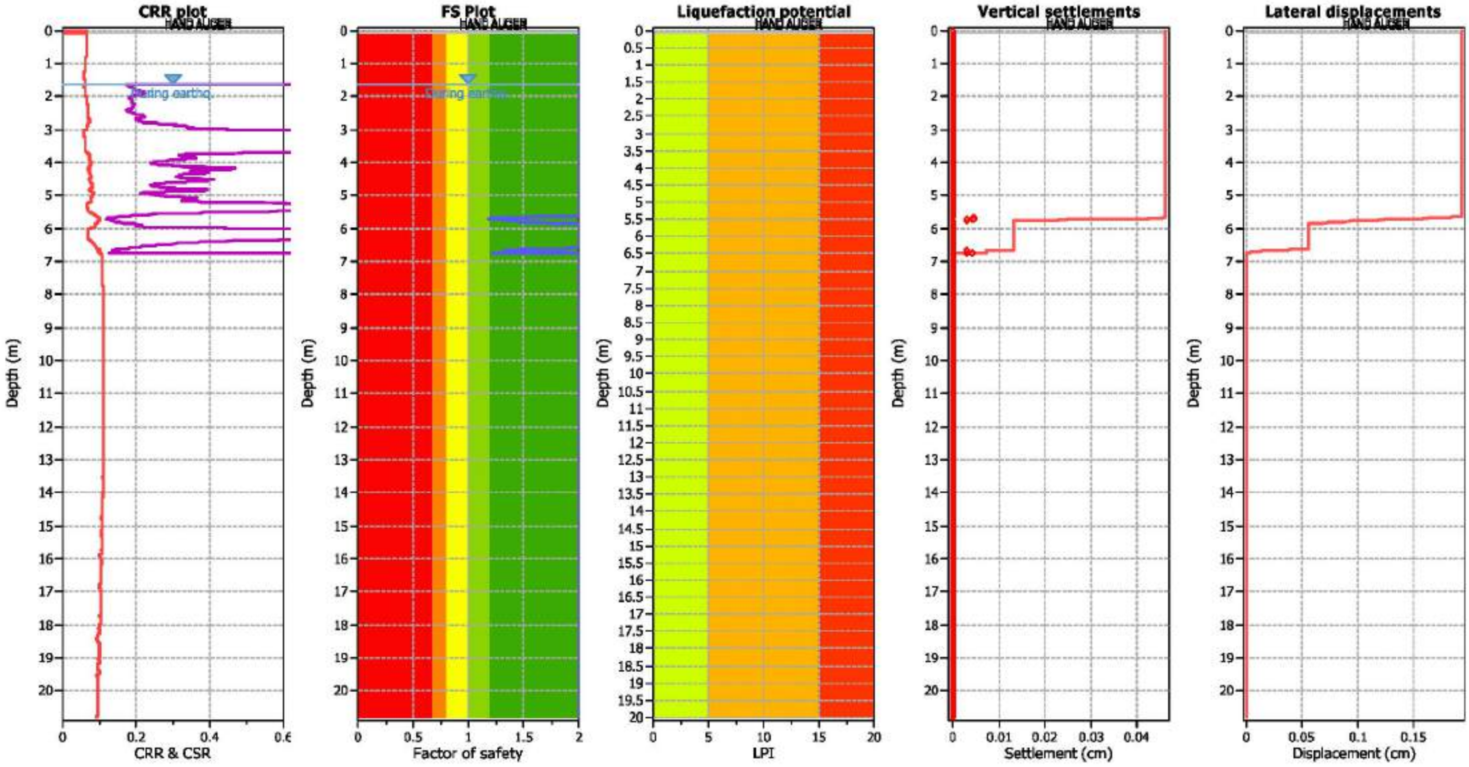

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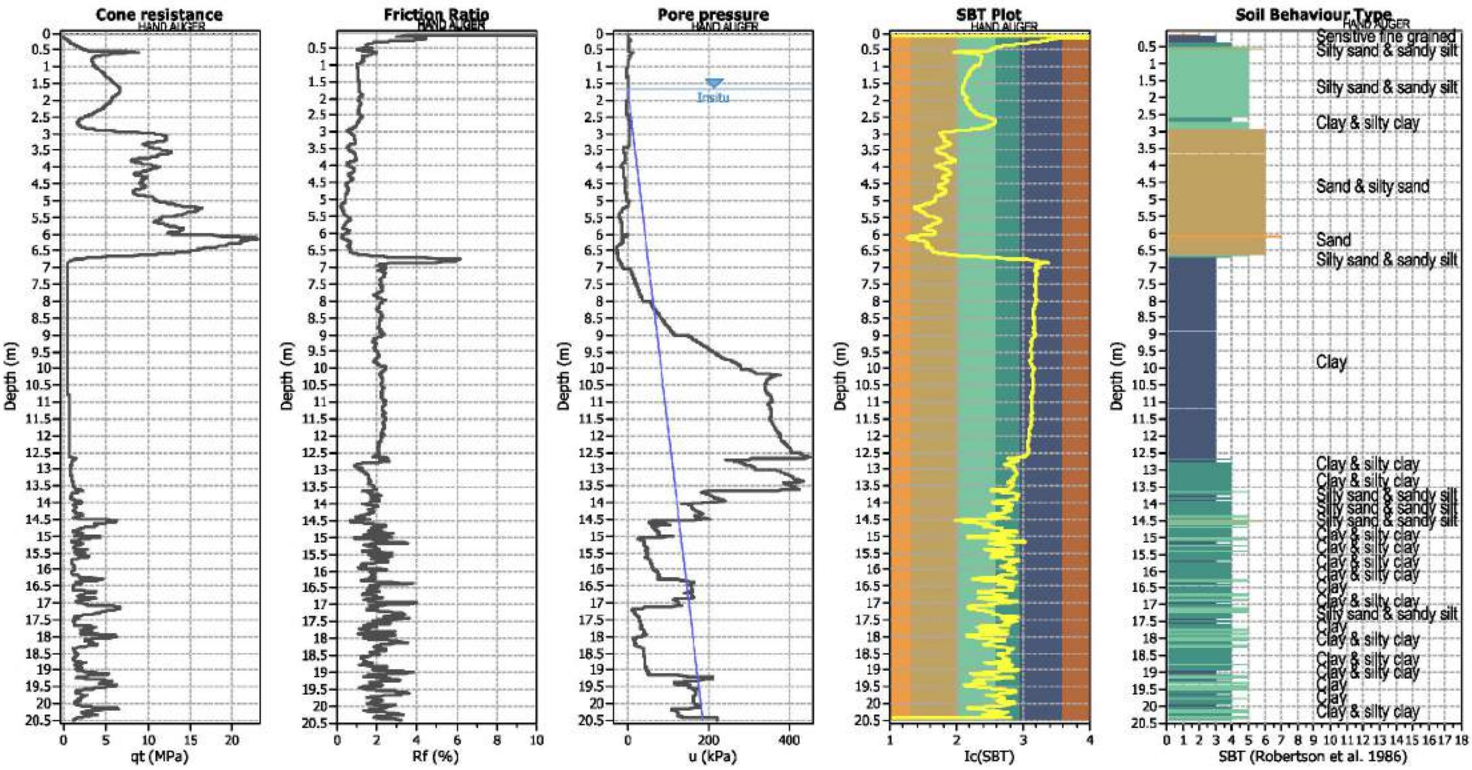

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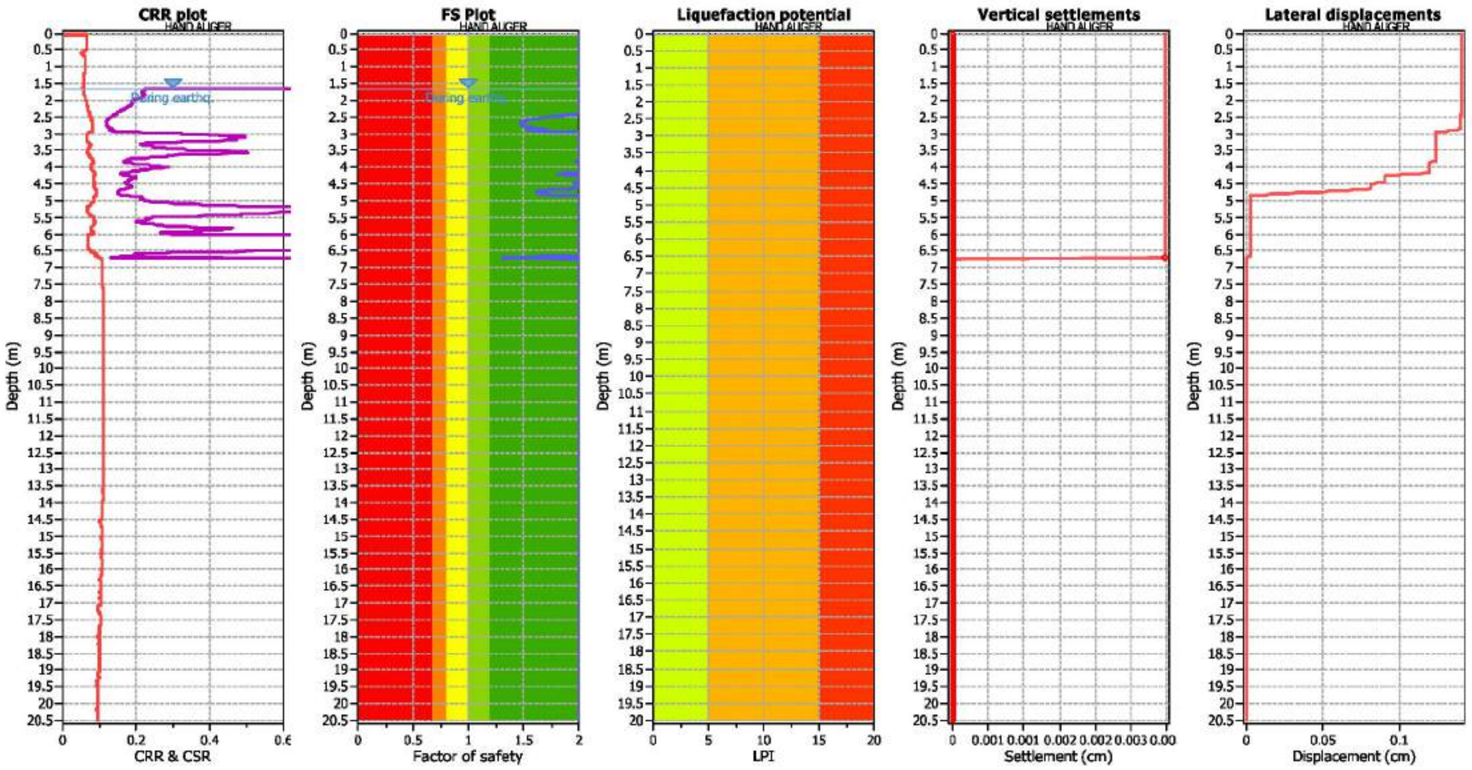

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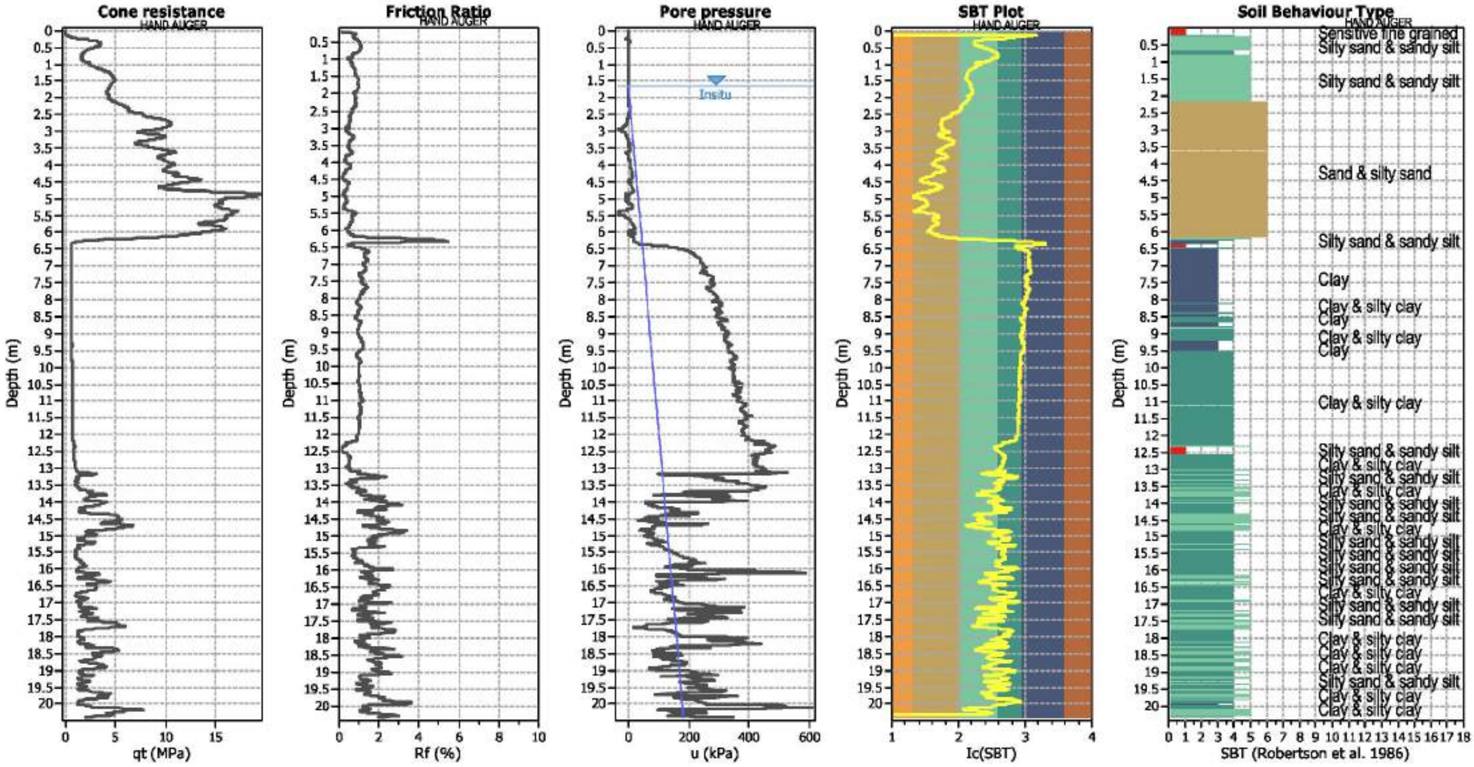


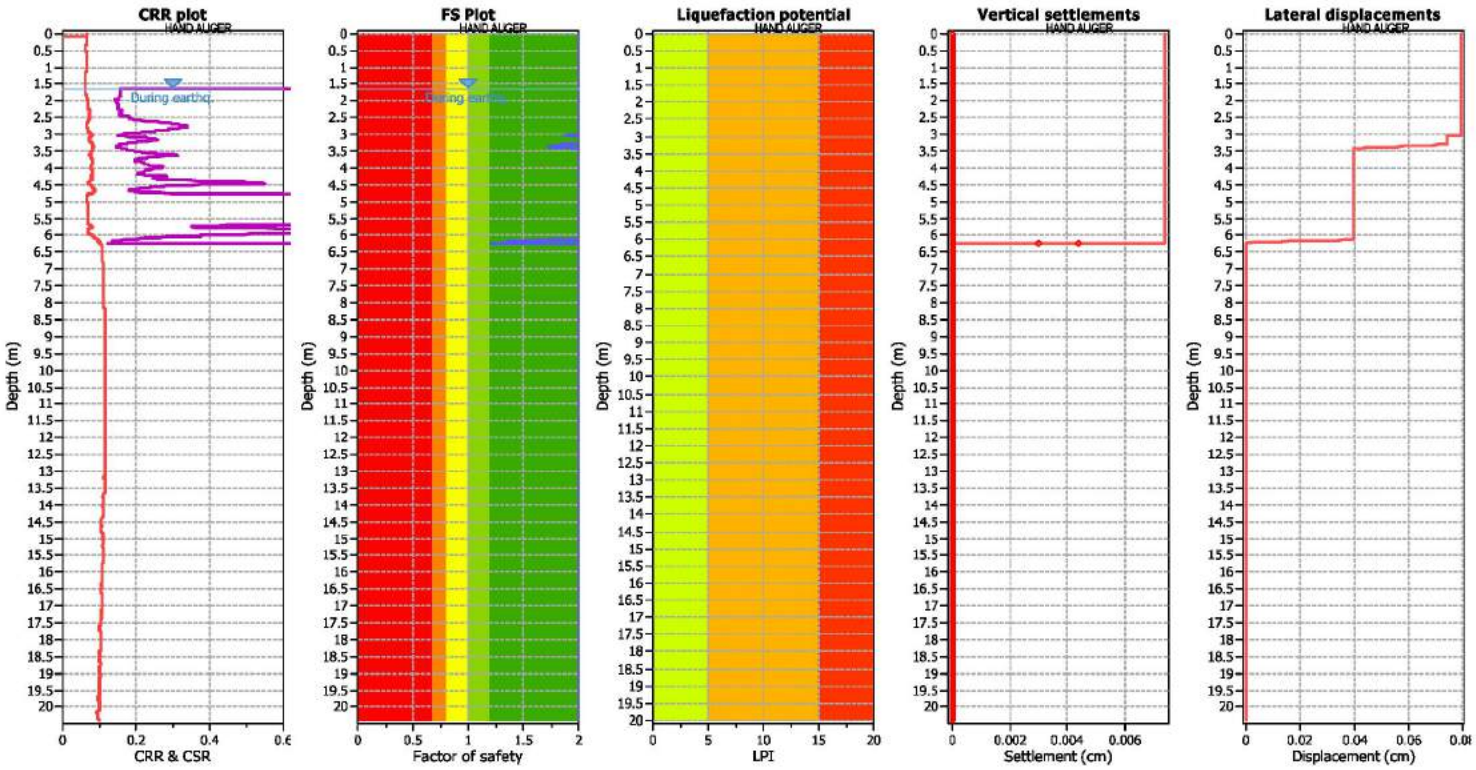
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.30	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.12	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

F.S. color scheme

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

LPI color scheme

- 🟥 Very high risk
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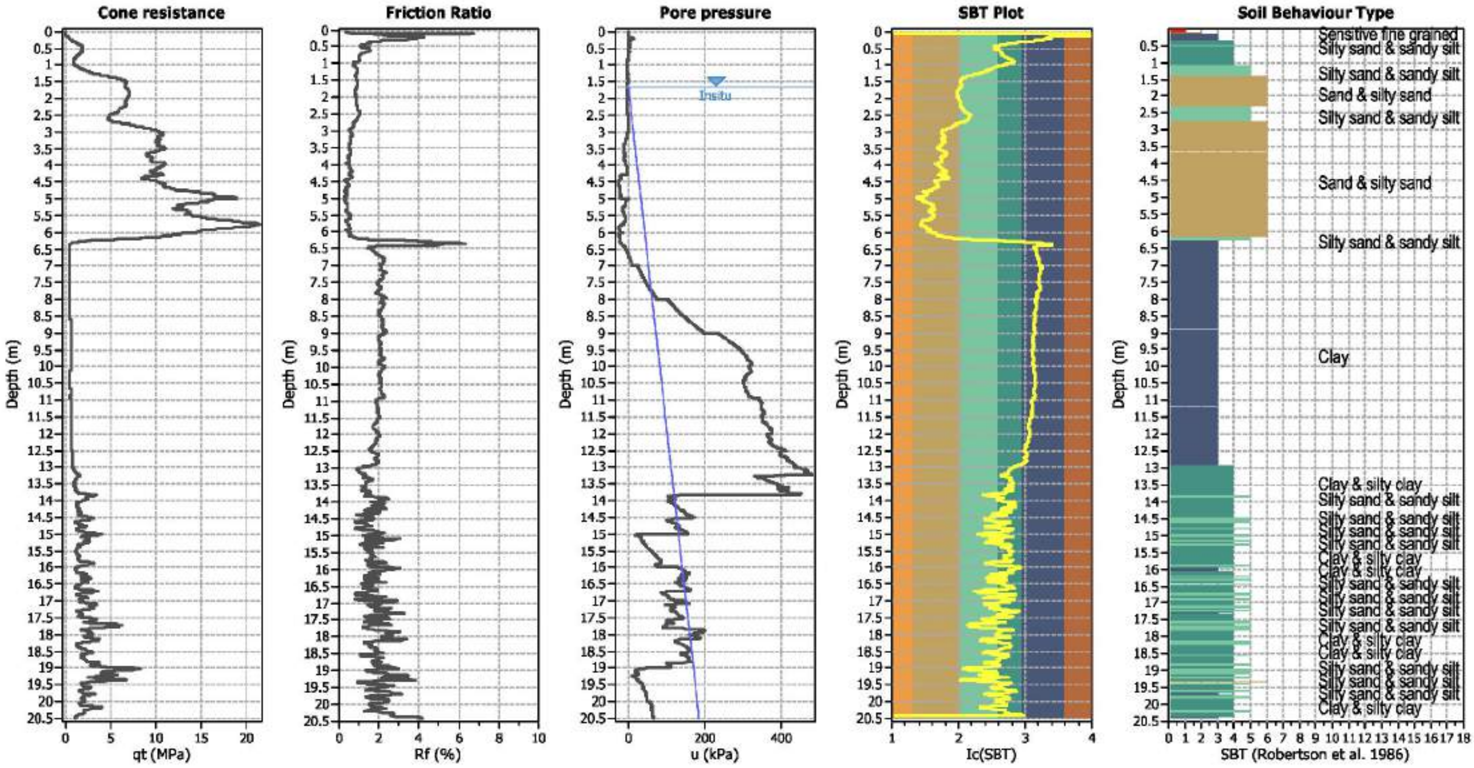
- 🟩 Low risk

CPT basic interpretation plots



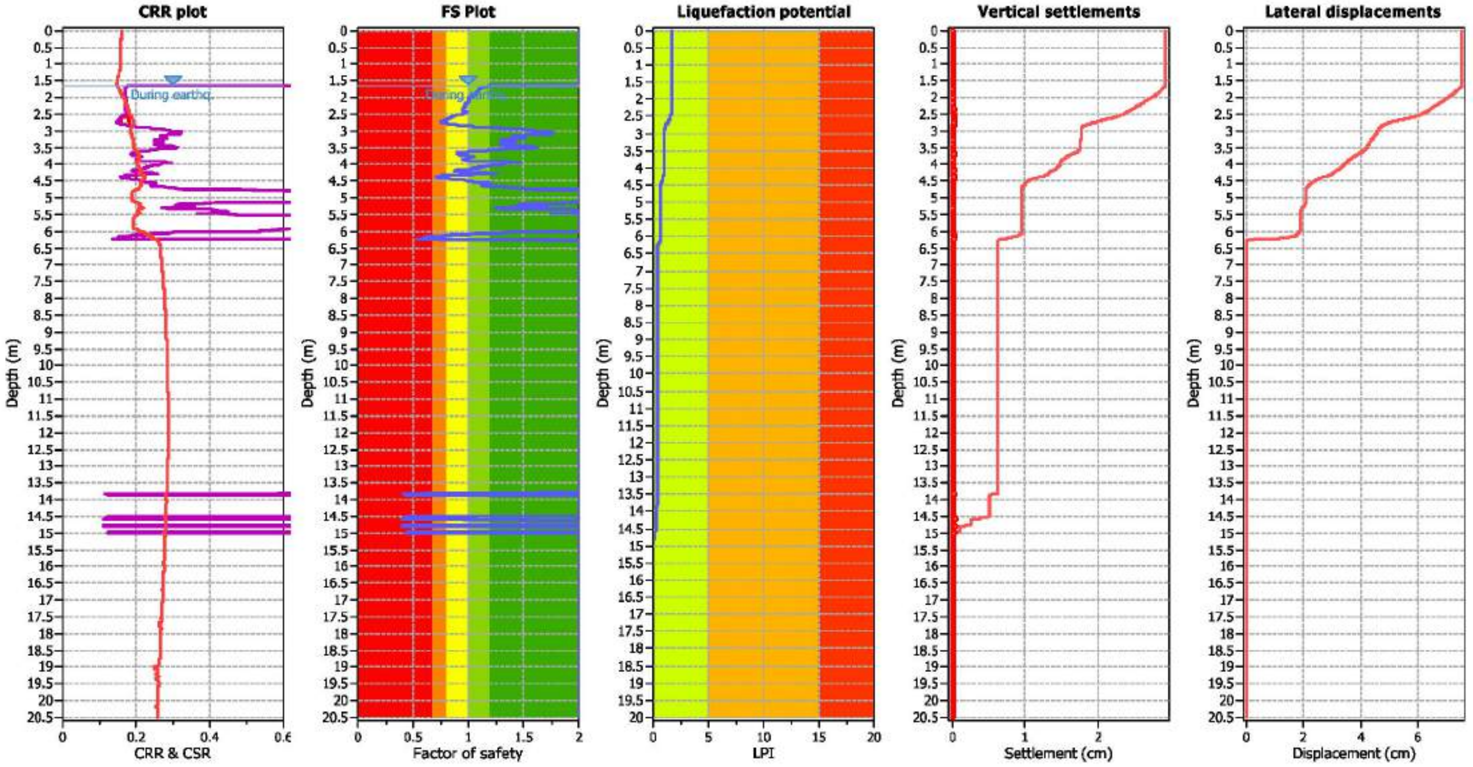
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

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LPI color scheme

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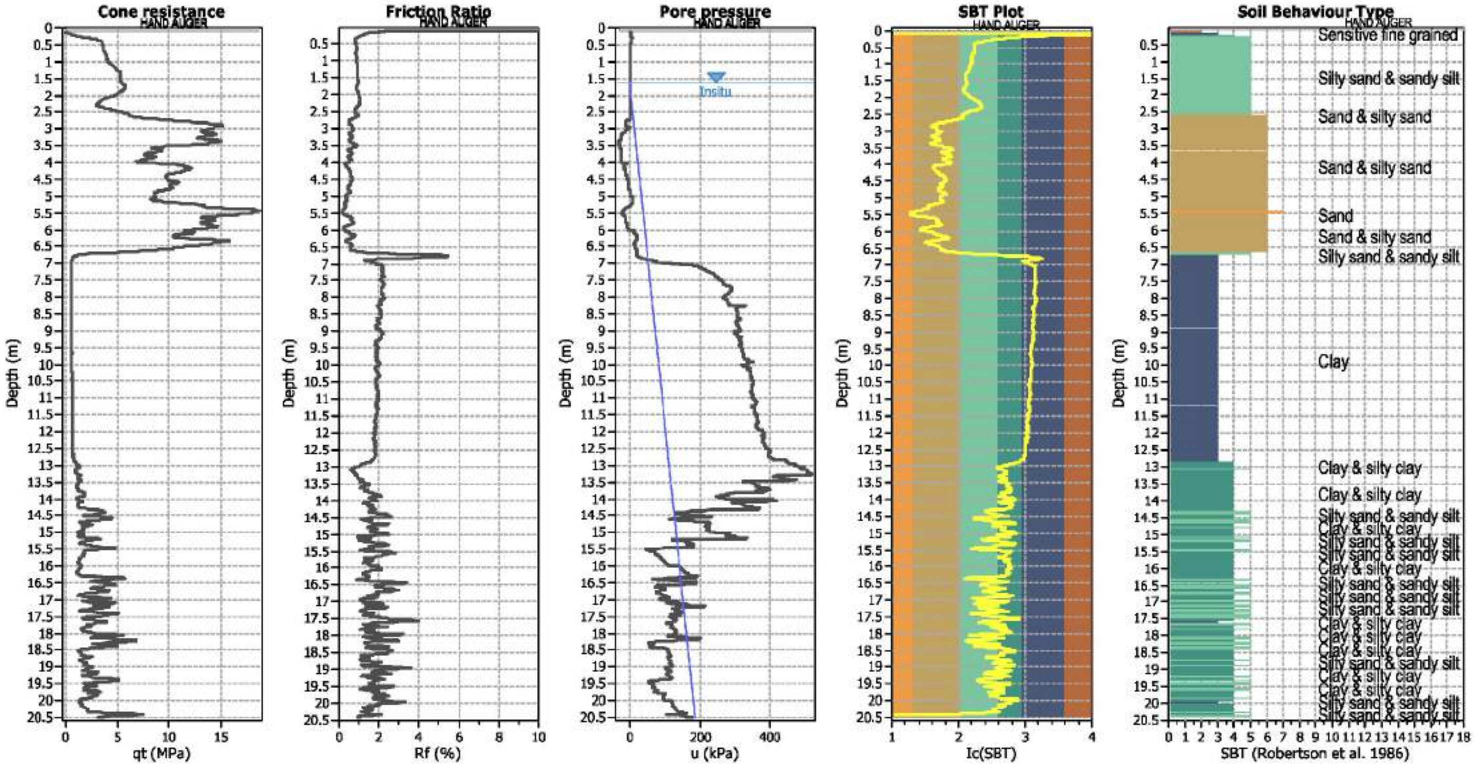
CPT basic interpretation plots



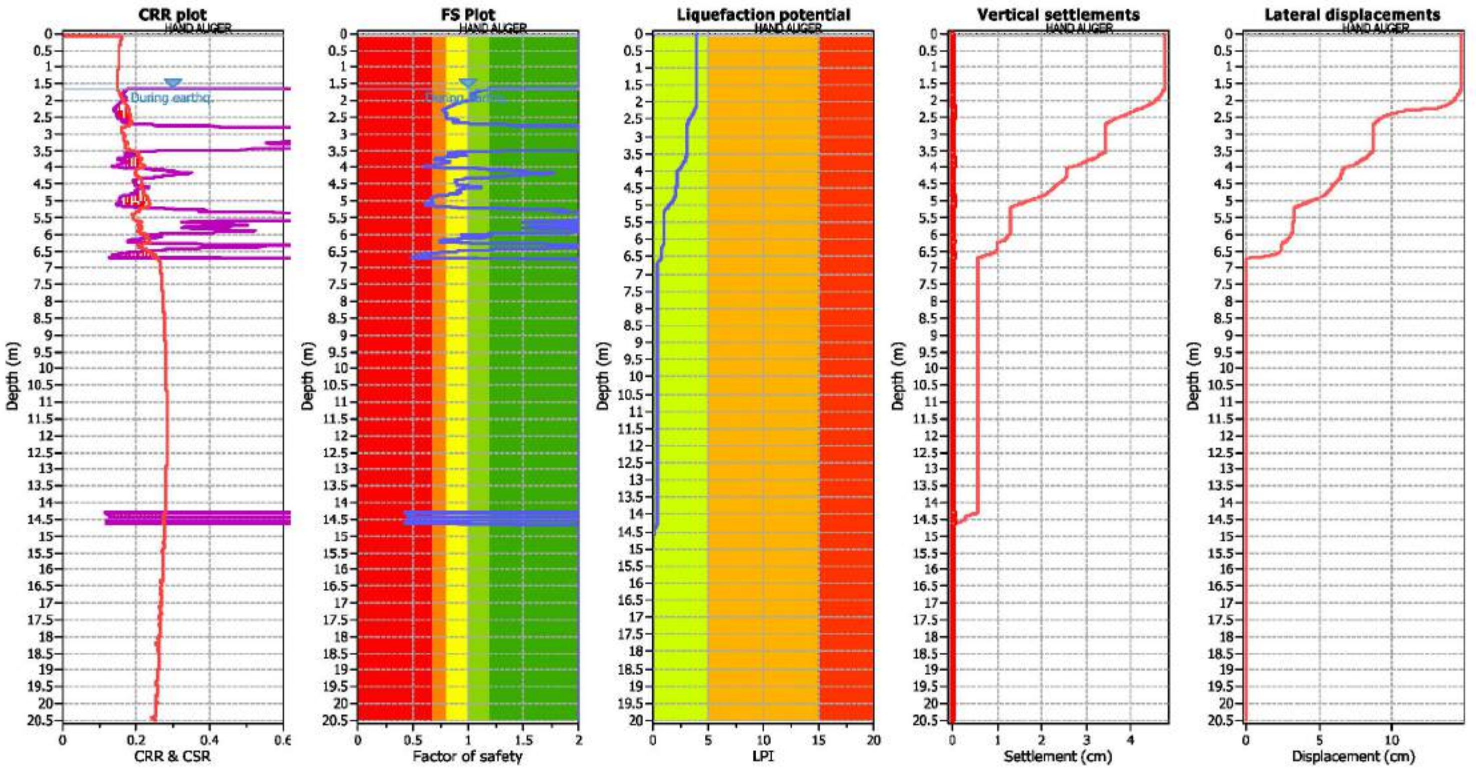
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 6.80
Peak ground acceleration: 0.28
Depth to water table (insitu): 1.65 m

Depth to GWT (erthq.): 1.65 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: Sands only
Limit depth applied: Yes
Limit depth: 15.00 m

F.S. color scheme

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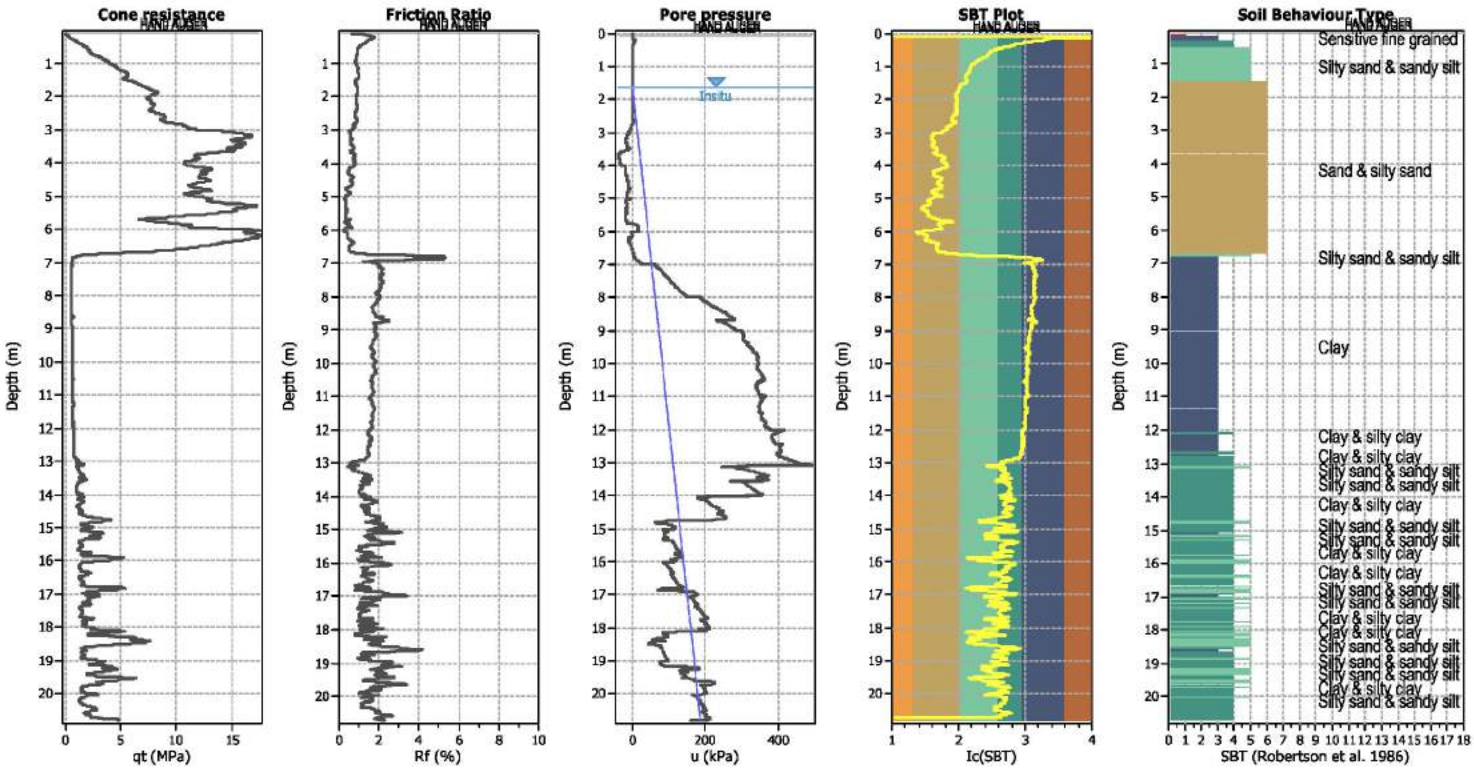
CPT basic interpretation plots



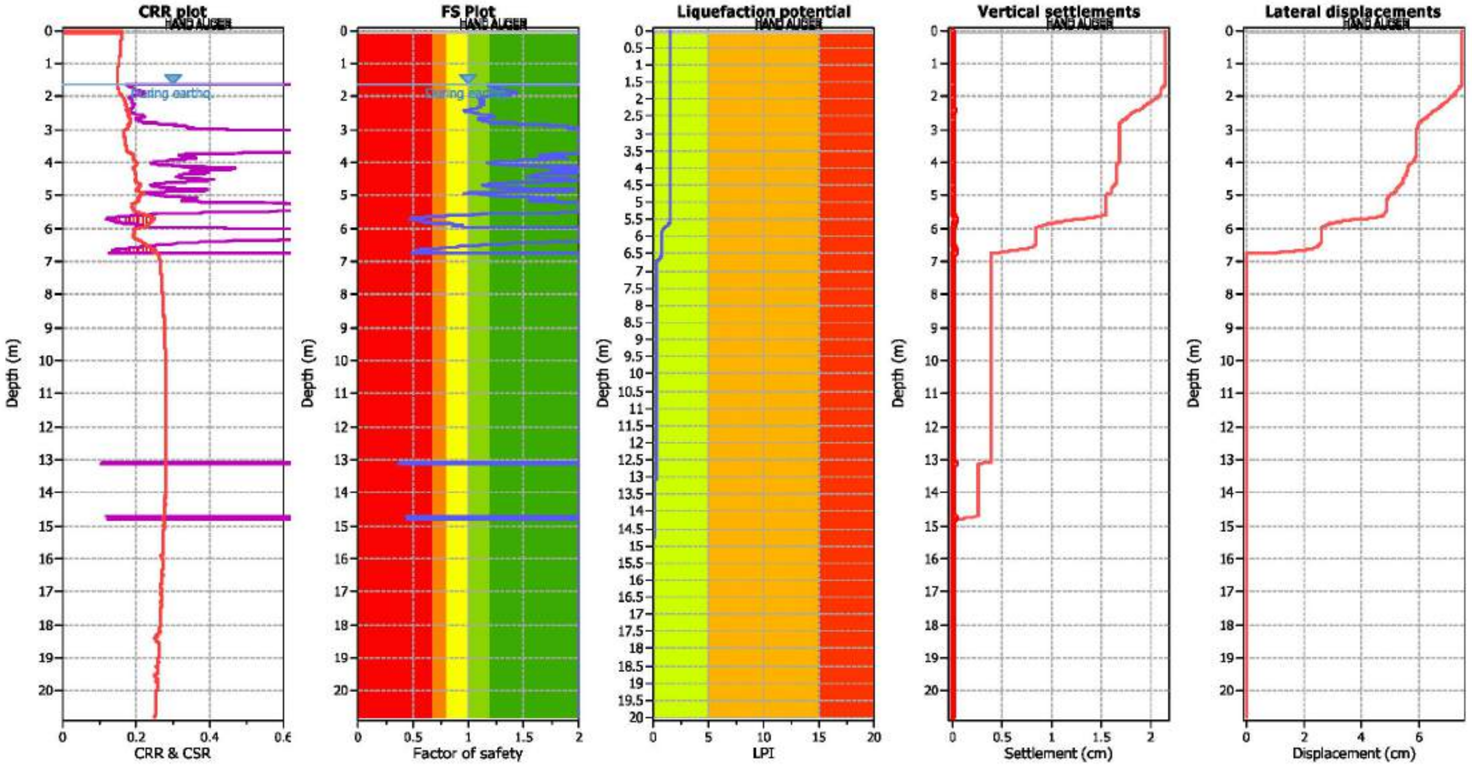
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

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LPI color scheme

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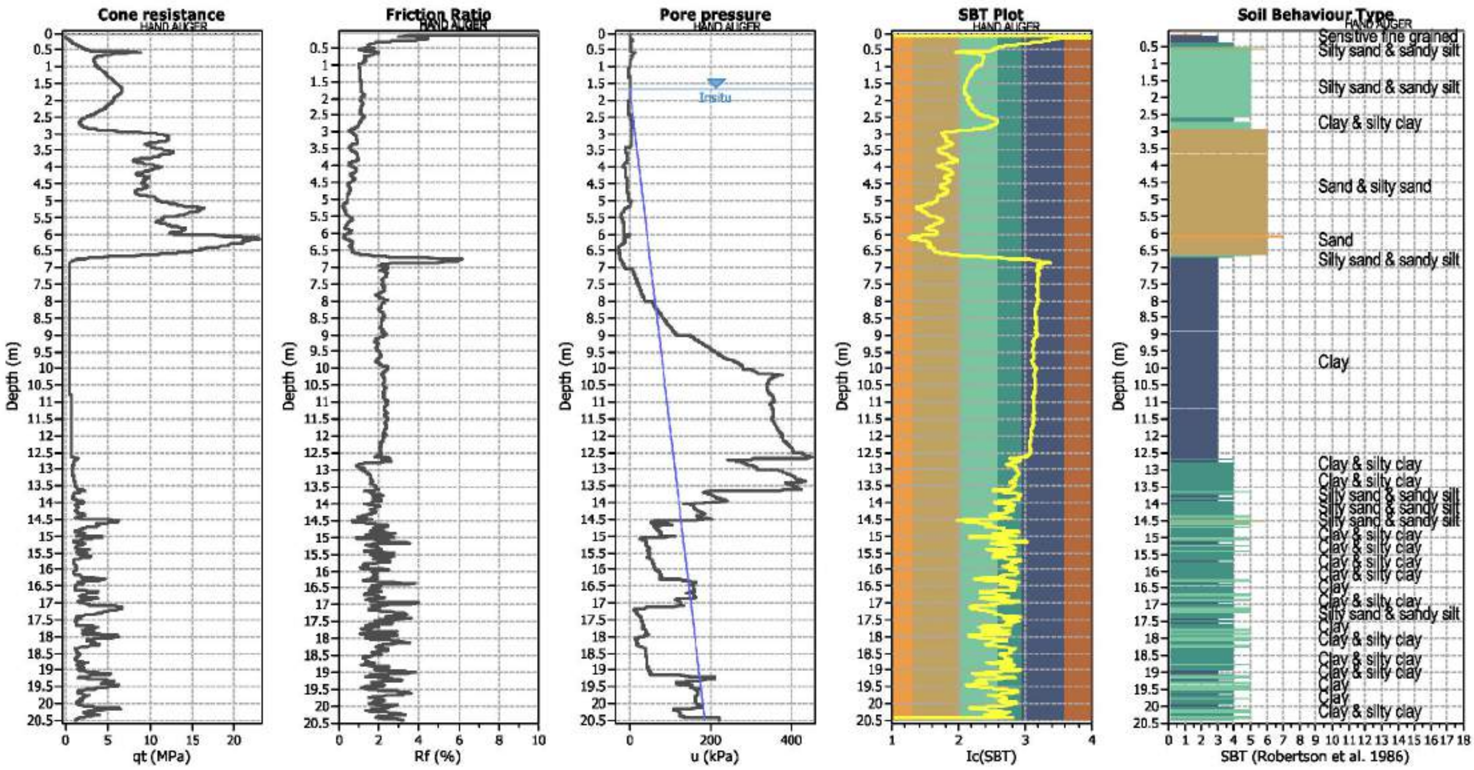
CPT basic interpretation plots



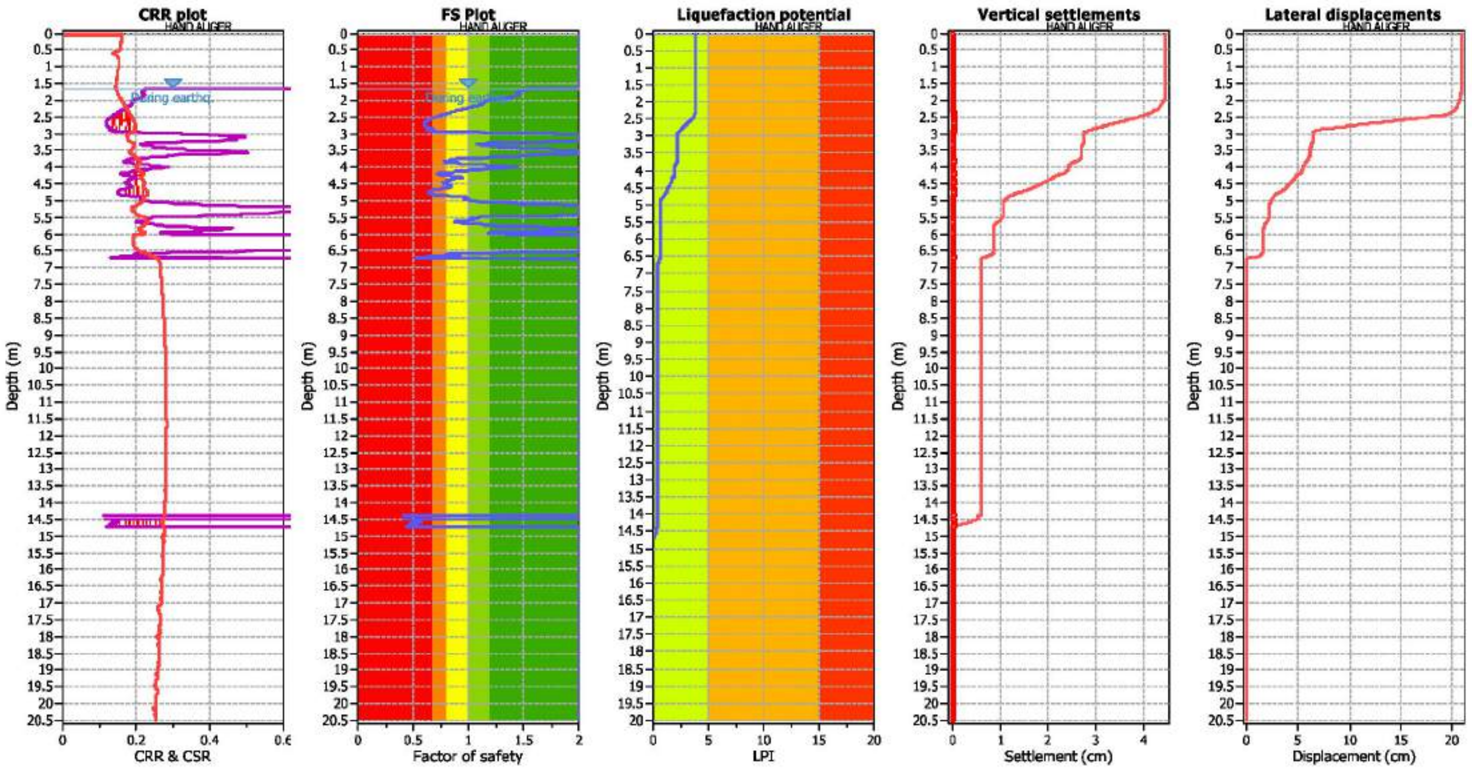
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

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LPI color scheme

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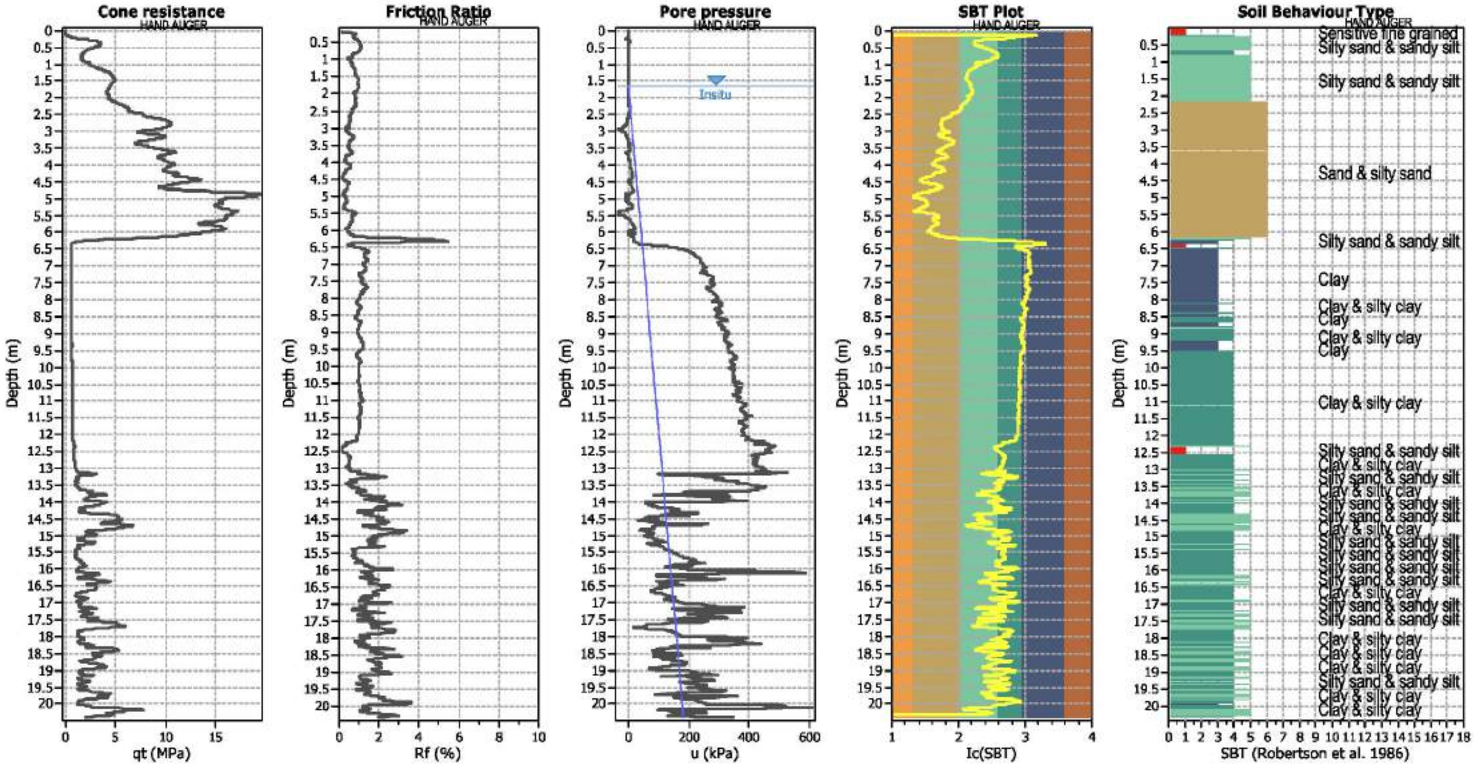
CPT basic interpretation plots



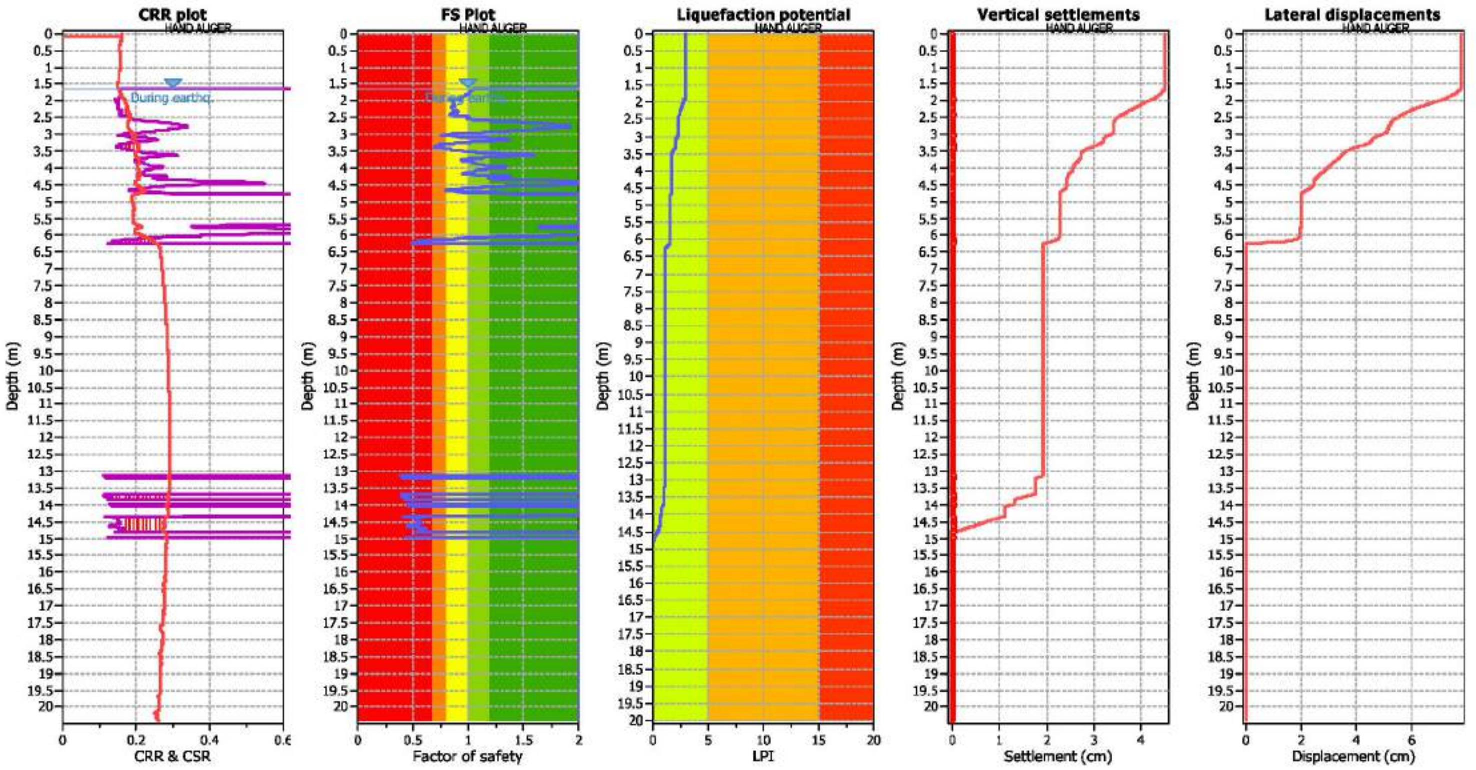
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

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LPI color scheme

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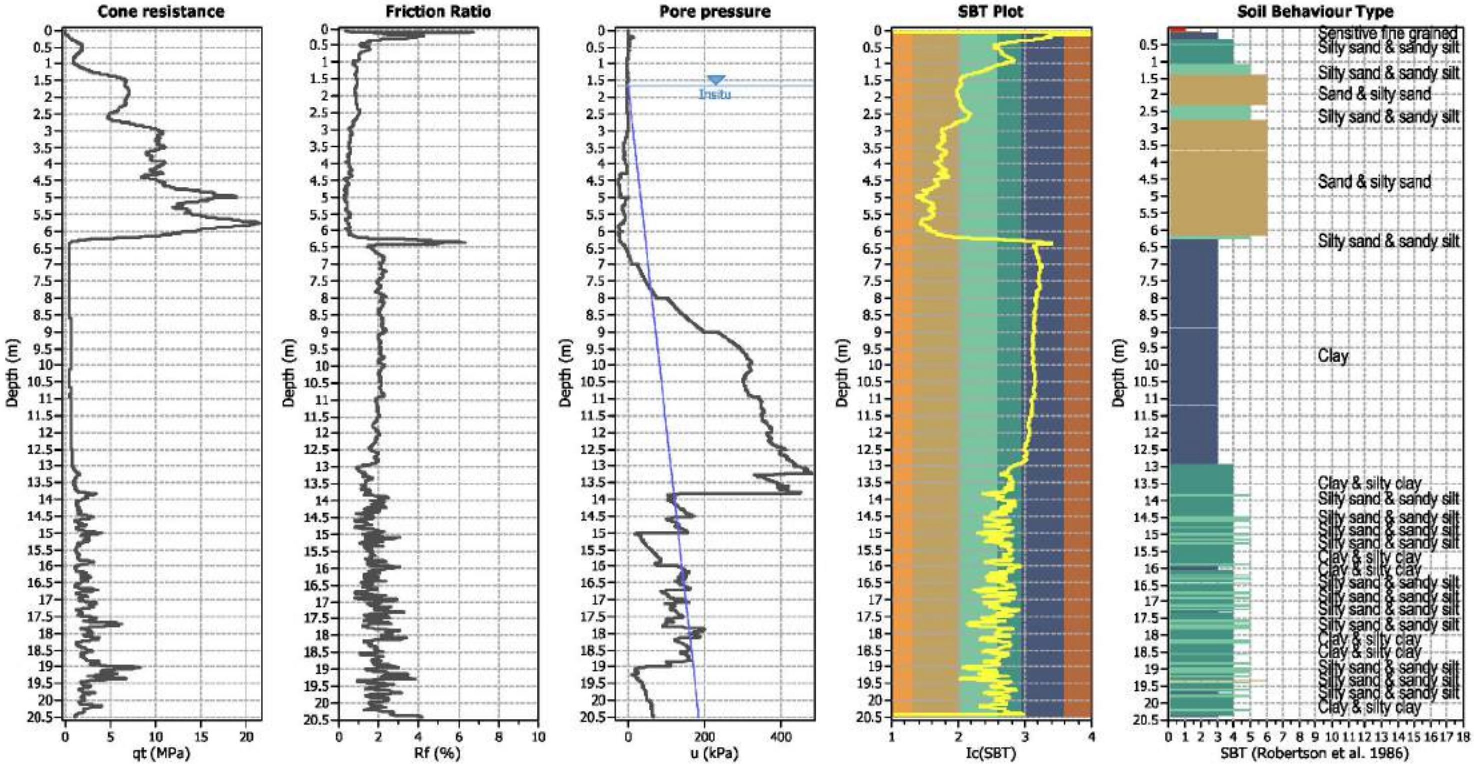
CPT basic interpretation plots



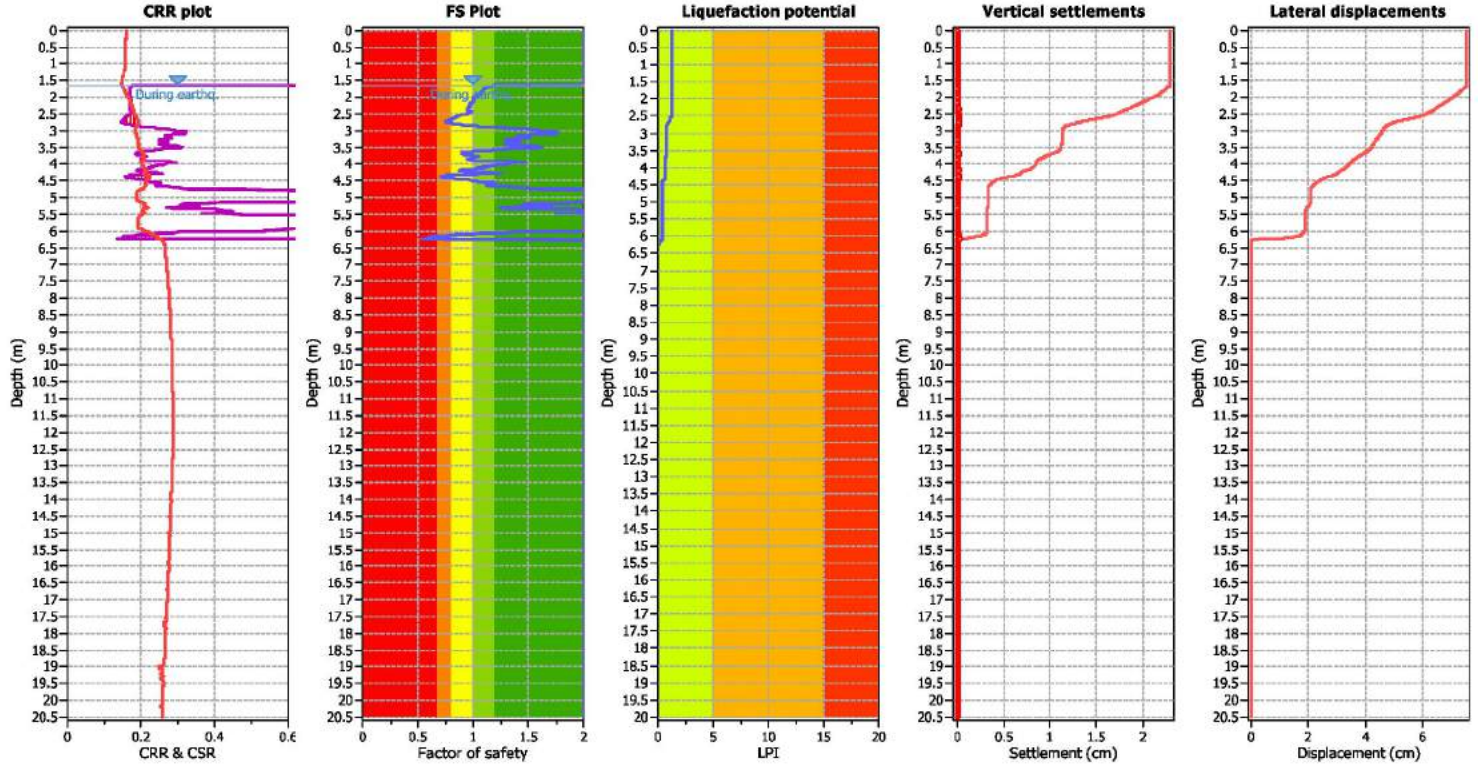
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
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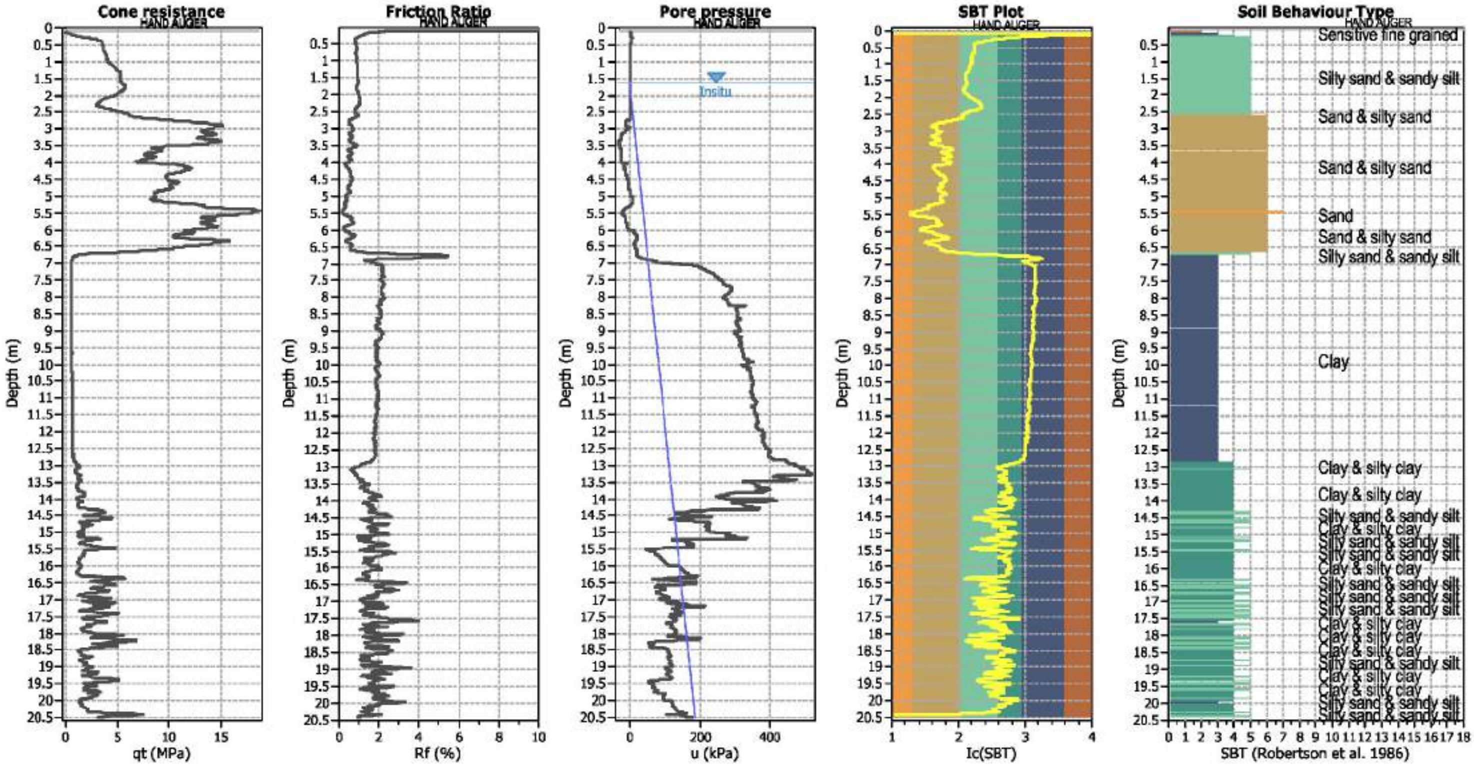
CPT basic interpretation plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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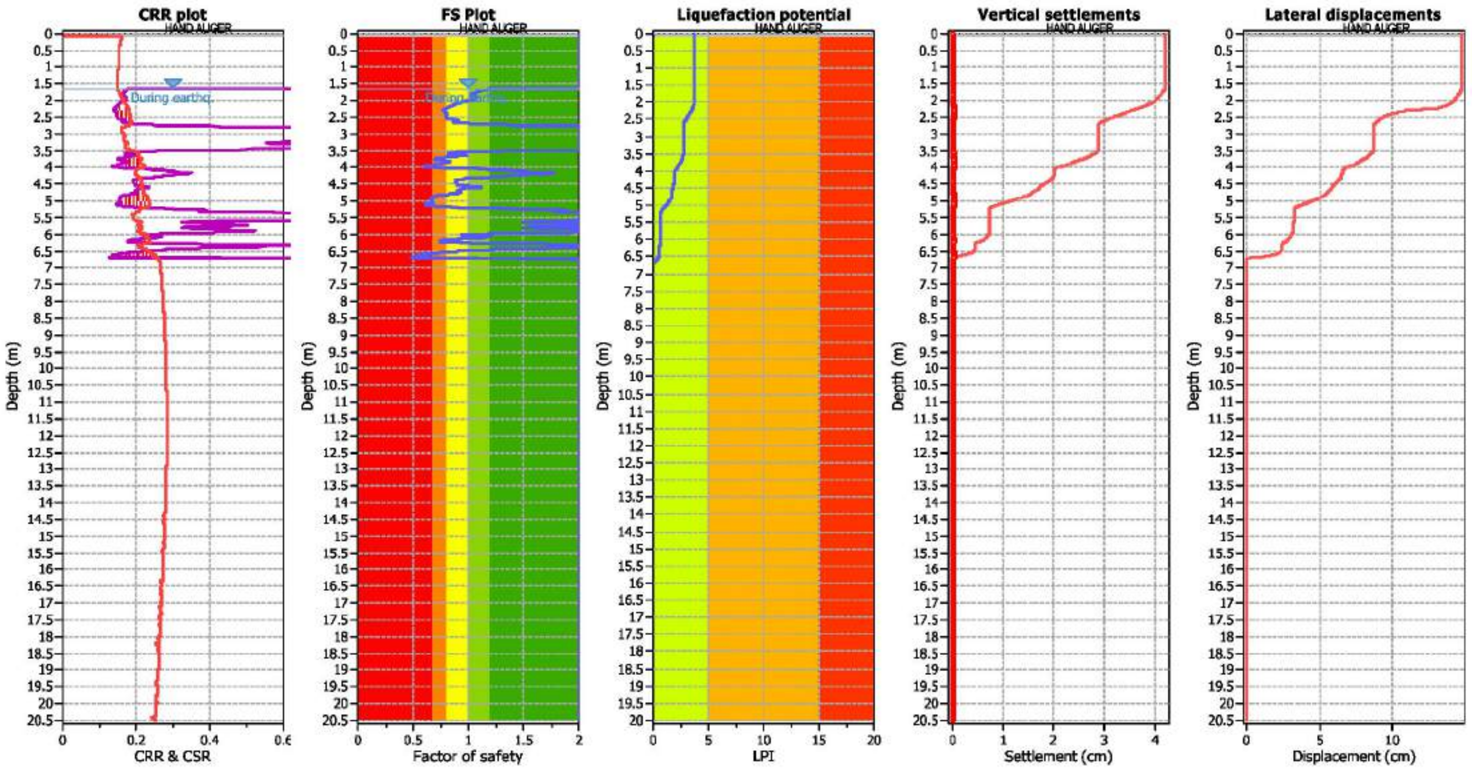
🟦 3. Clay to silty clay	🟨 6. Clean sand to silty sand	⬜ 9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

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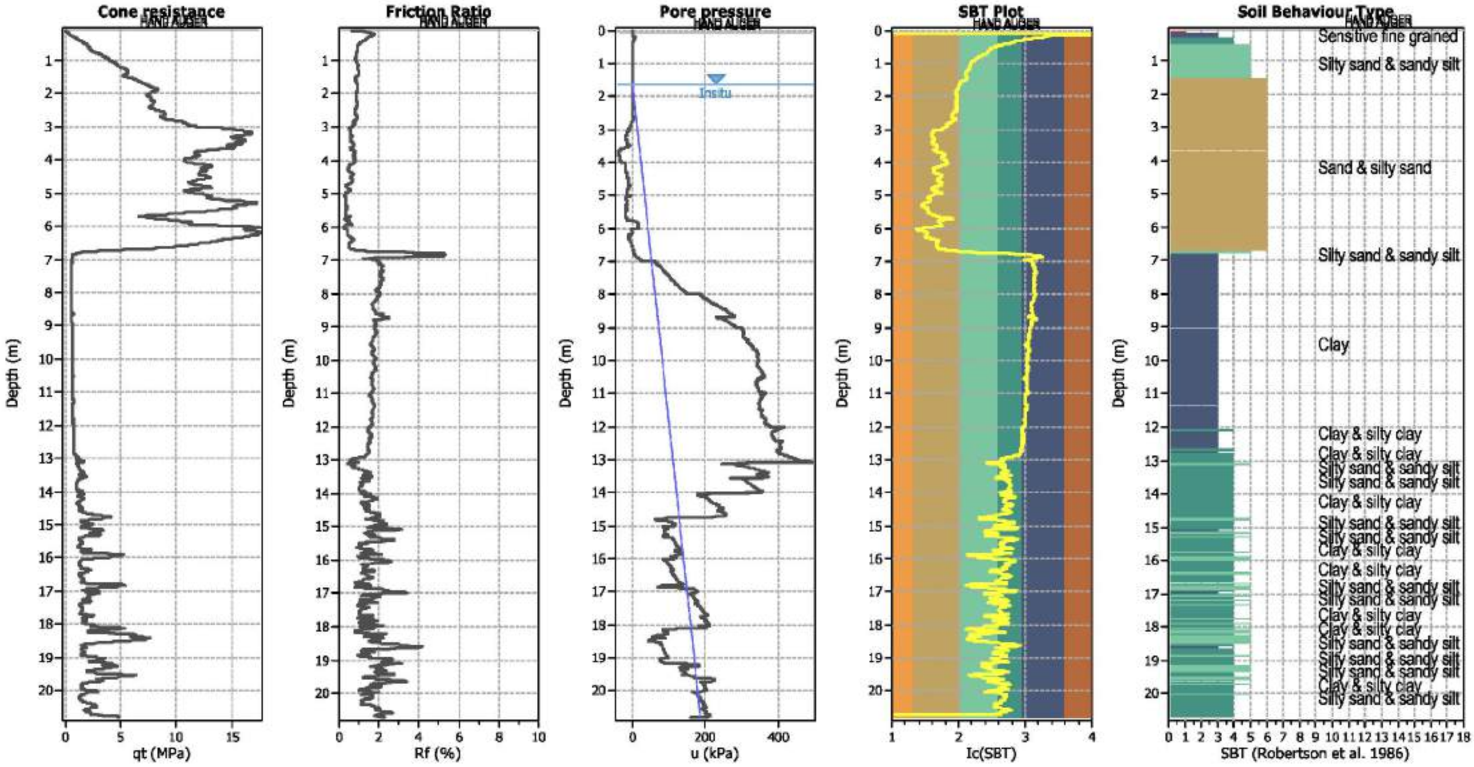
CPT basic interpretation plots



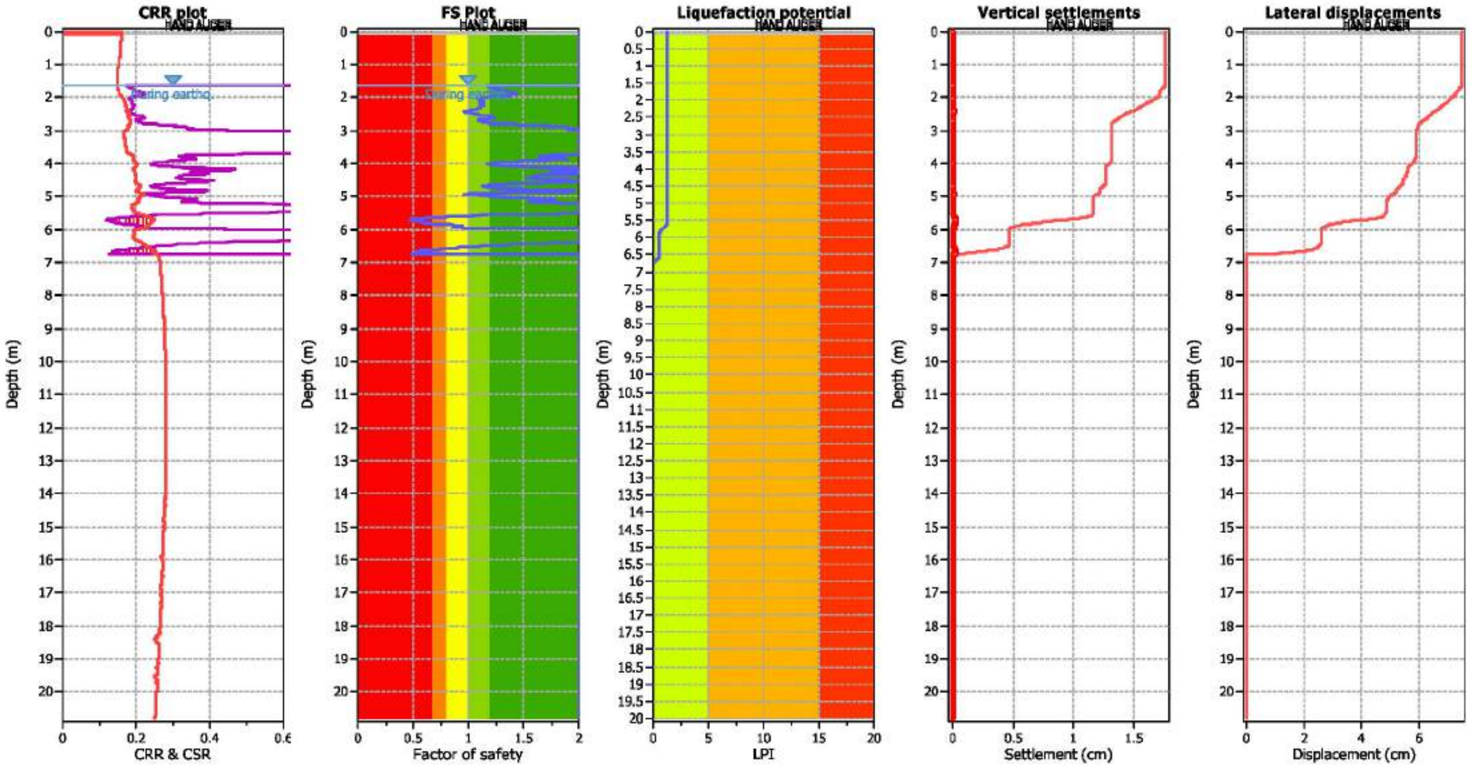
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
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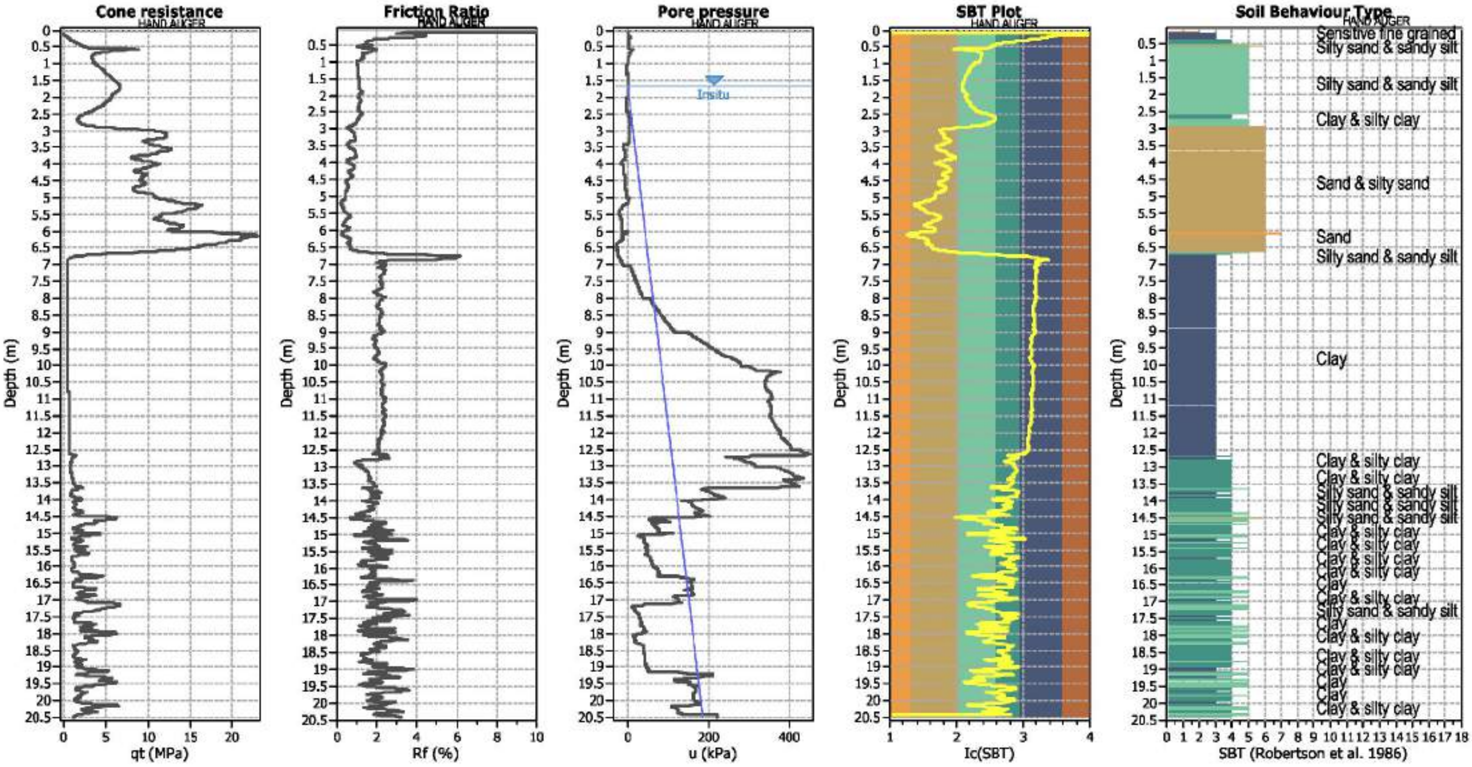
CPT basic interpretation plots



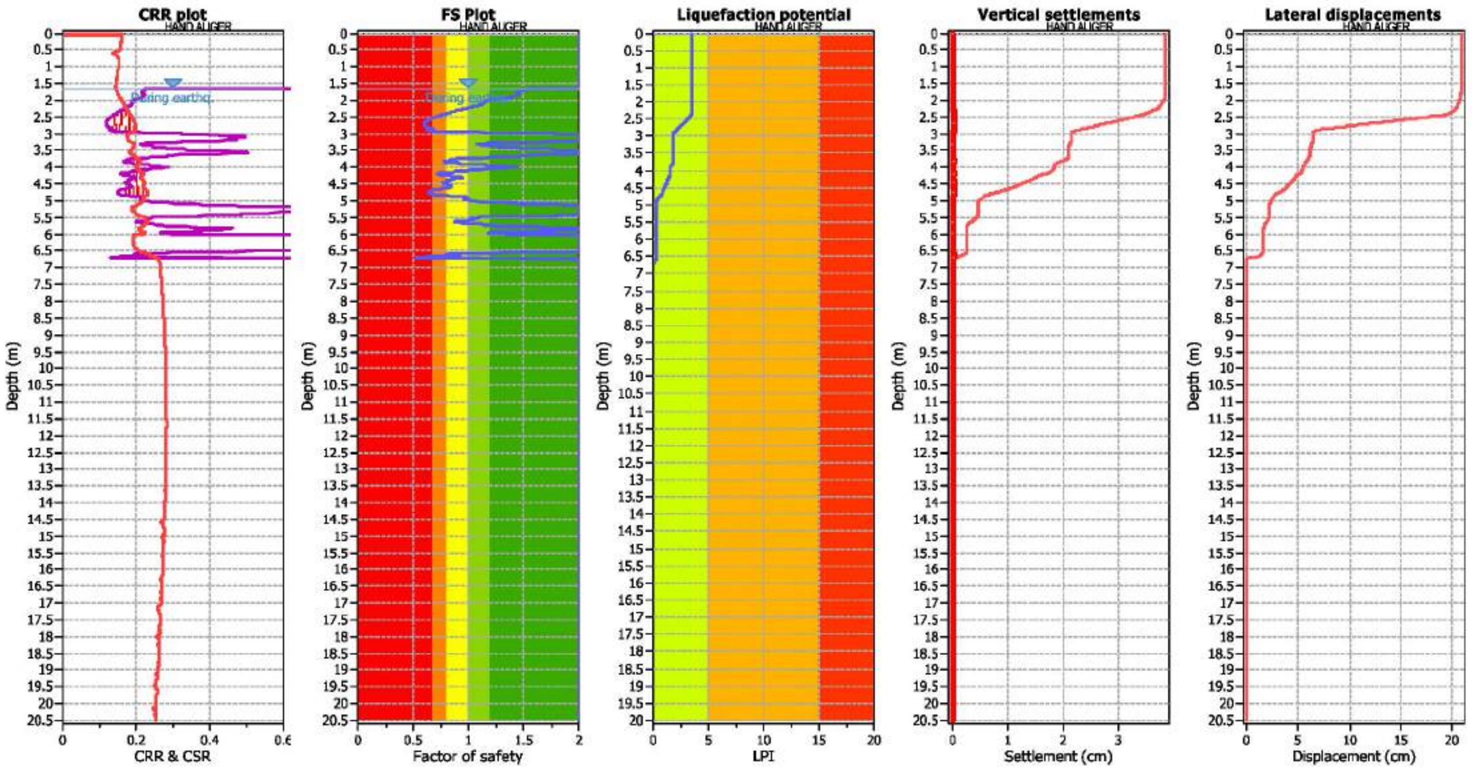
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

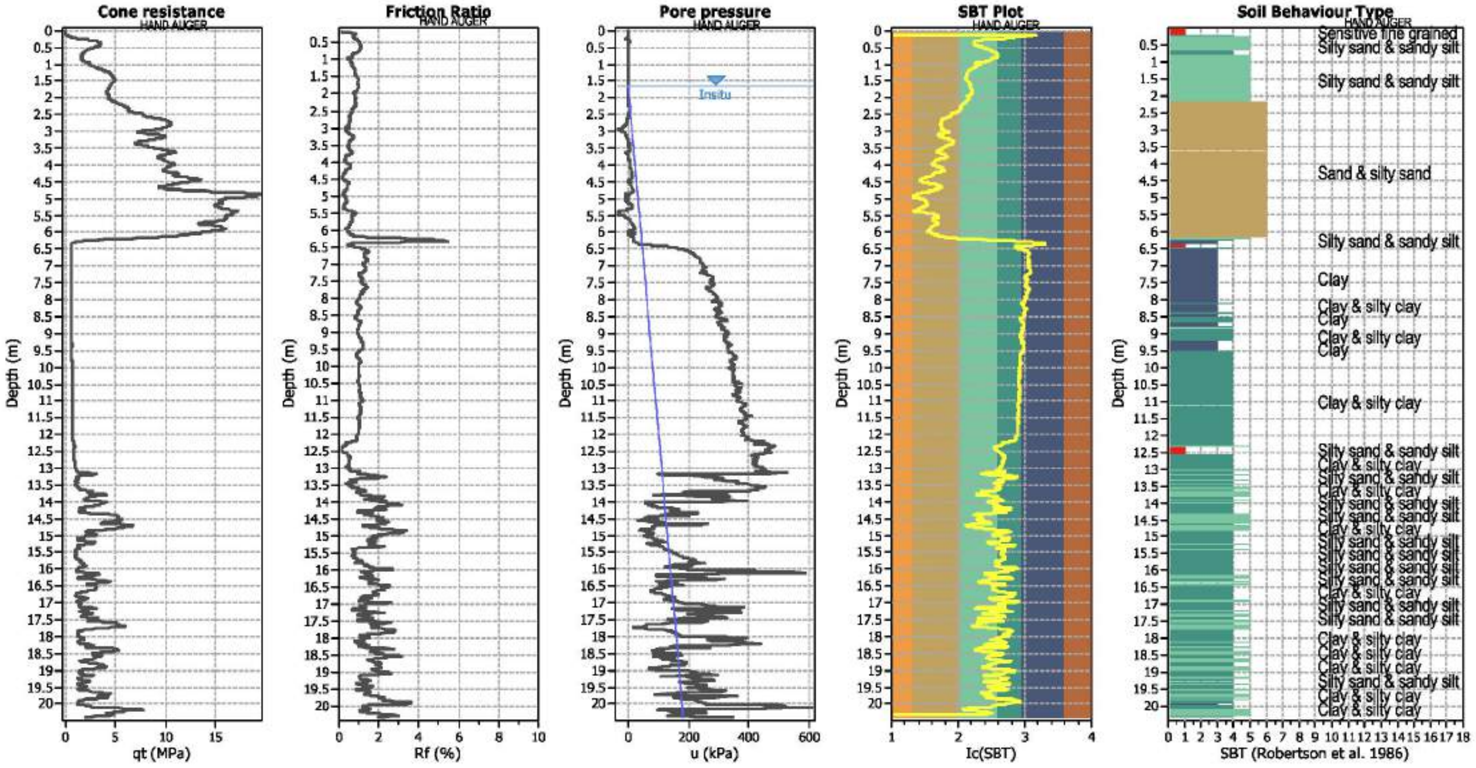
F.S. color scheme

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

LPI color scheme

- 🟥 Very high risk
- 🟧 High risk
- 🟩 Low risk

CPT basic interpretation plots



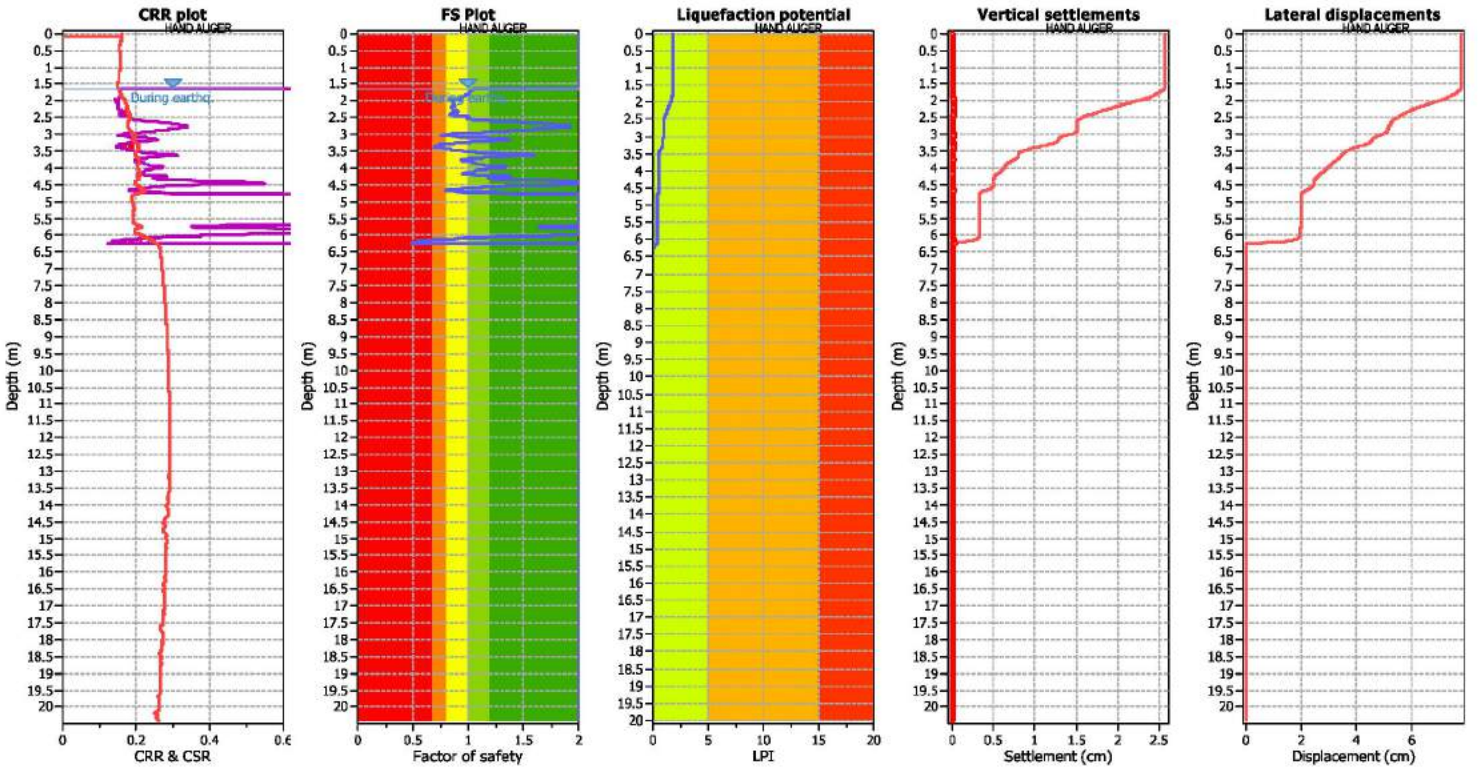
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 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:	6.80	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.28	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

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LPI color scheme

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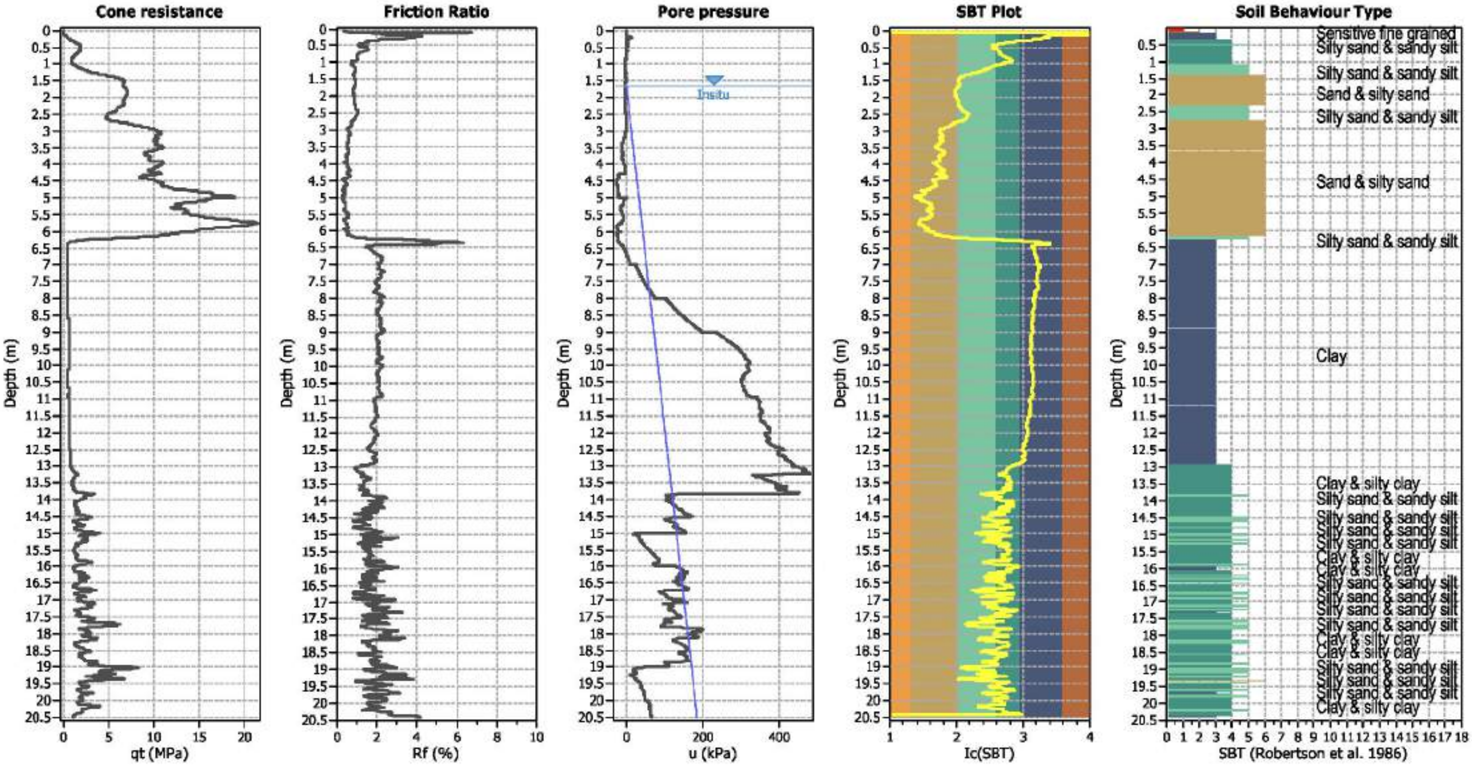
CPT basic interpretation plots



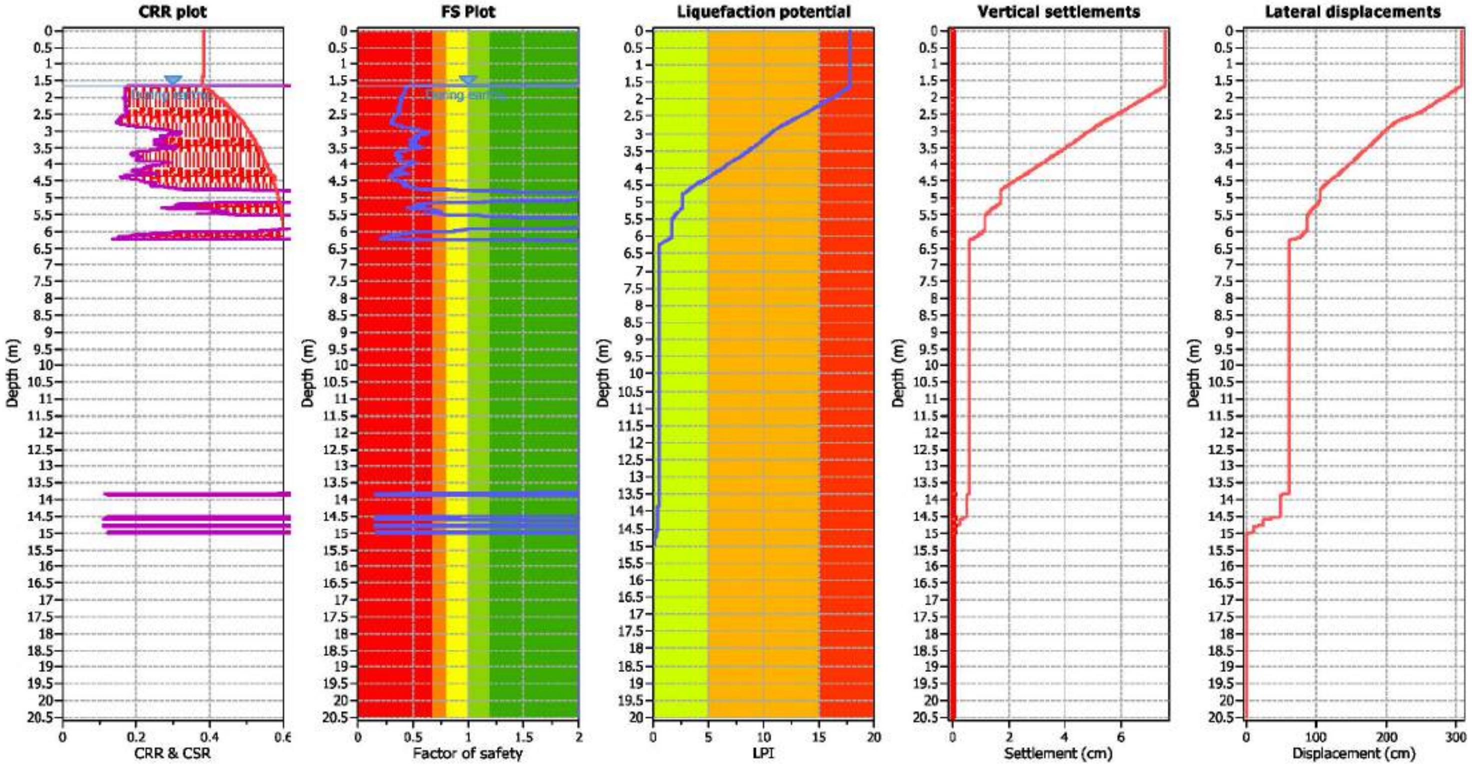
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

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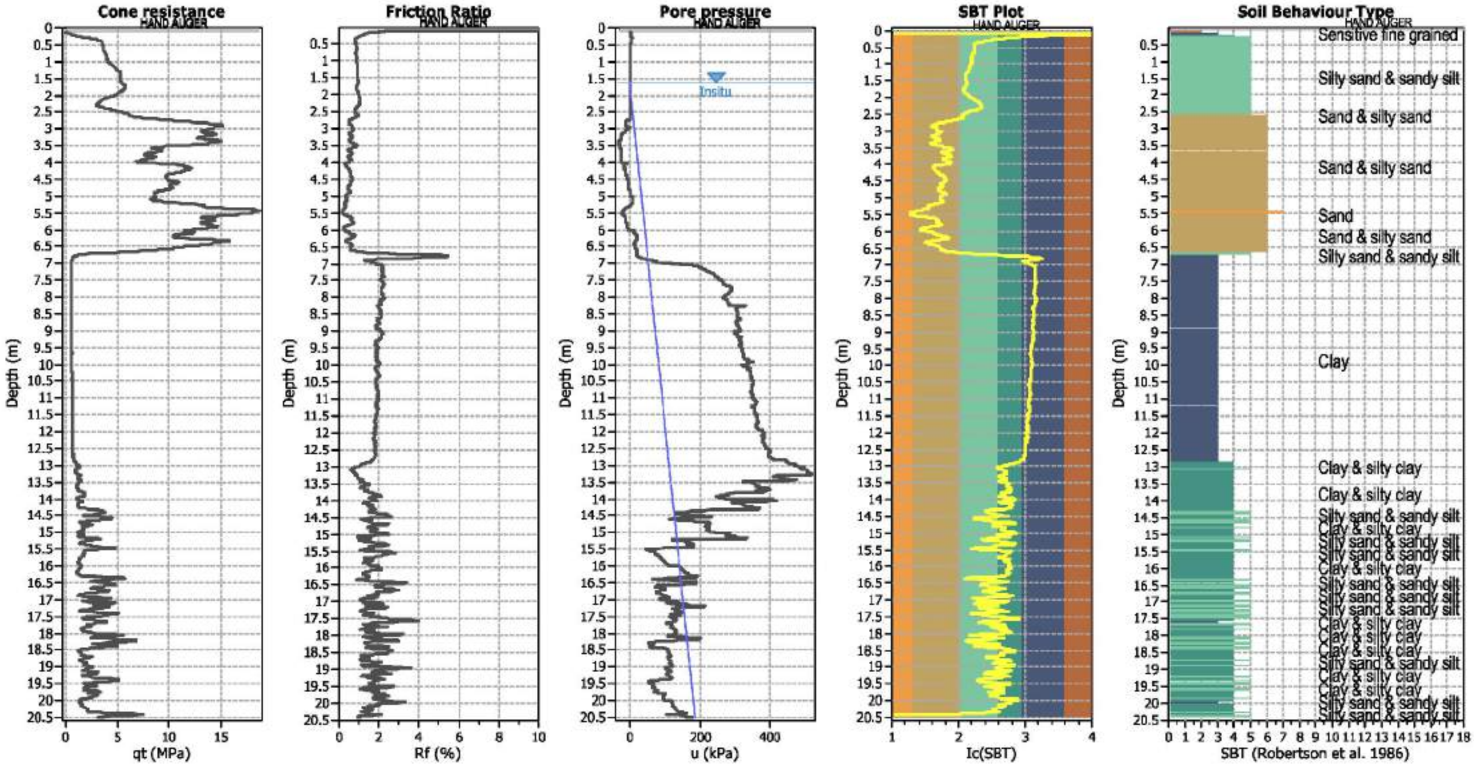
CPT basic interpretation plots



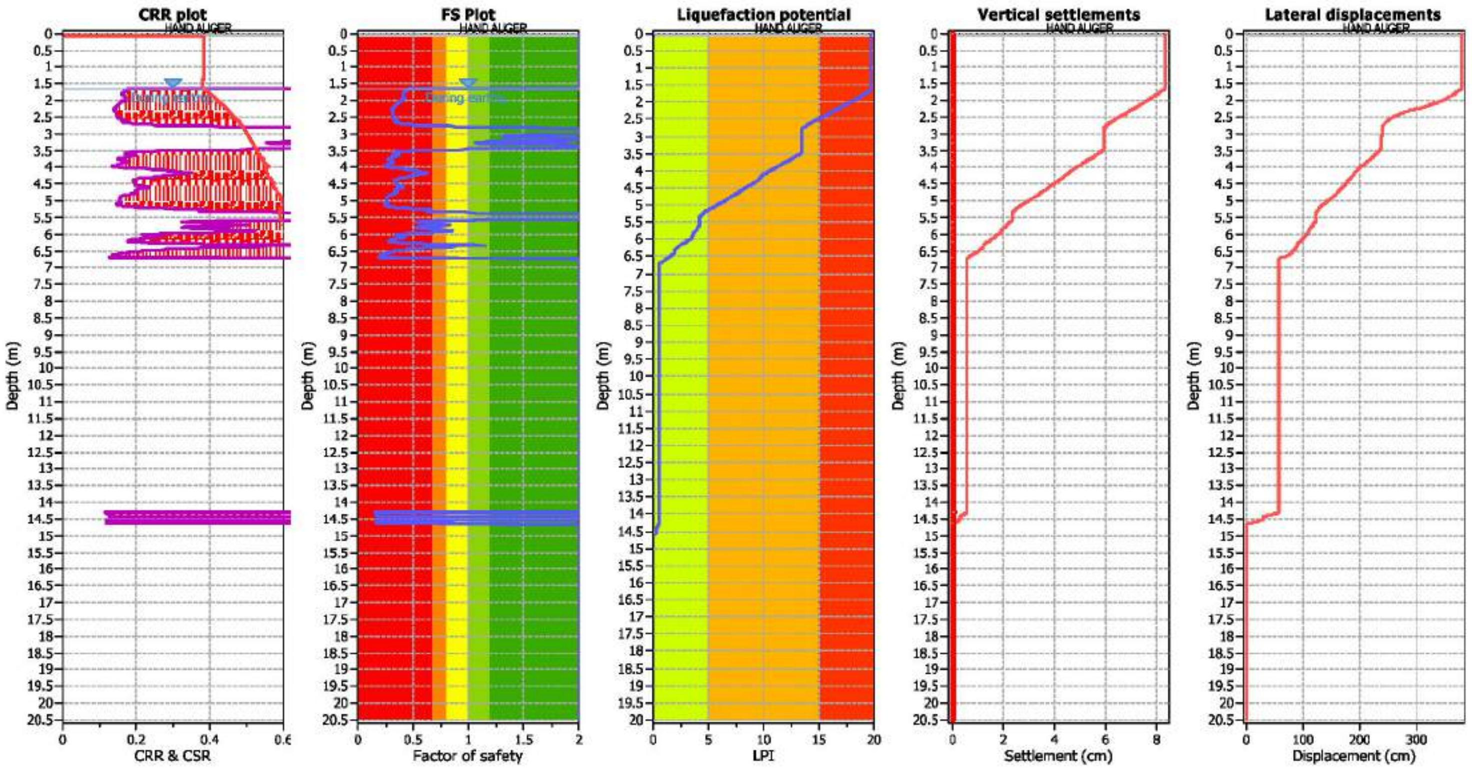
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.65
Depth to water table (insitu): 1.65 m

Depth to GWT (erthq.): 1.65 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: Sands only
Limit depth applied: Yes
Limit depth: 15.00 m

F.S. color scheme

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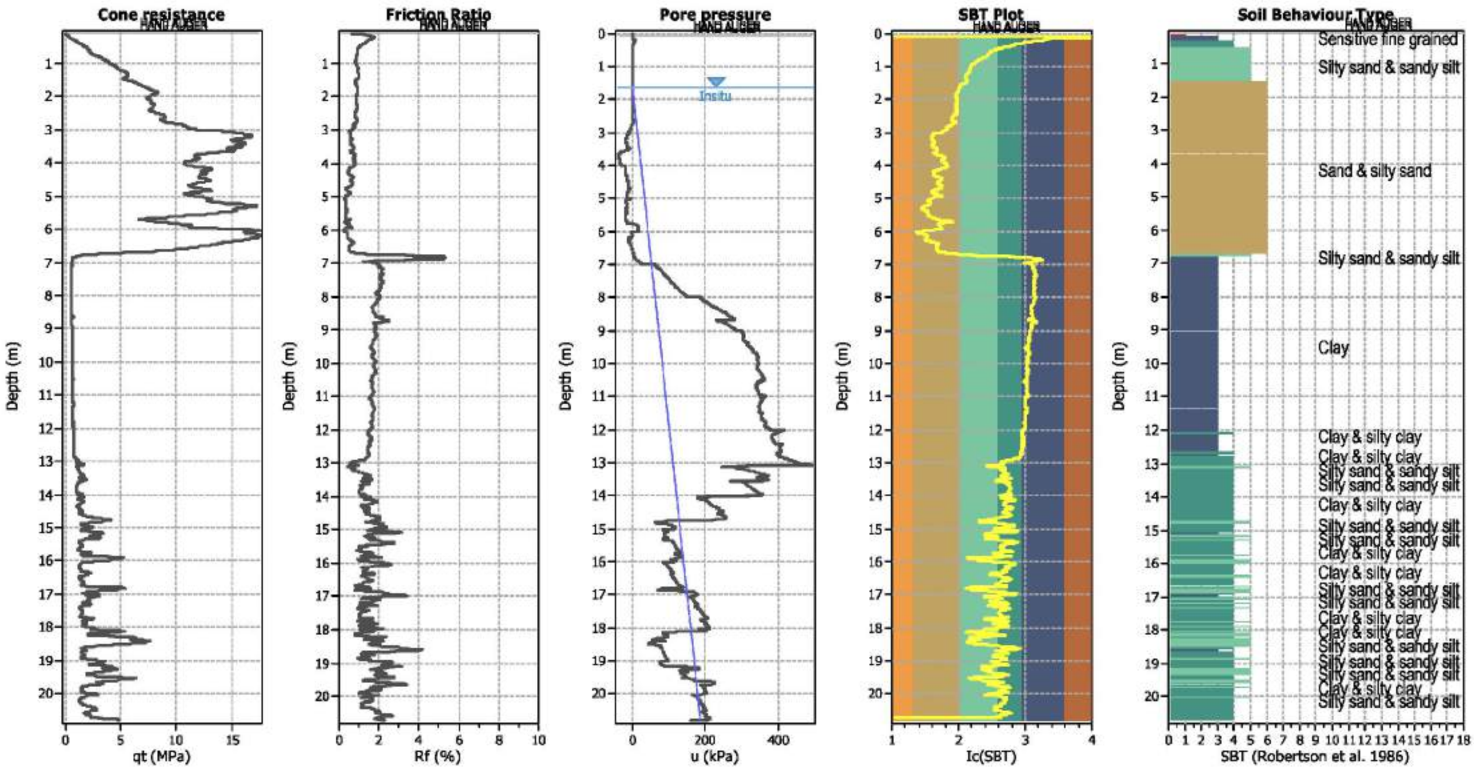
CPT basic interpretation plots



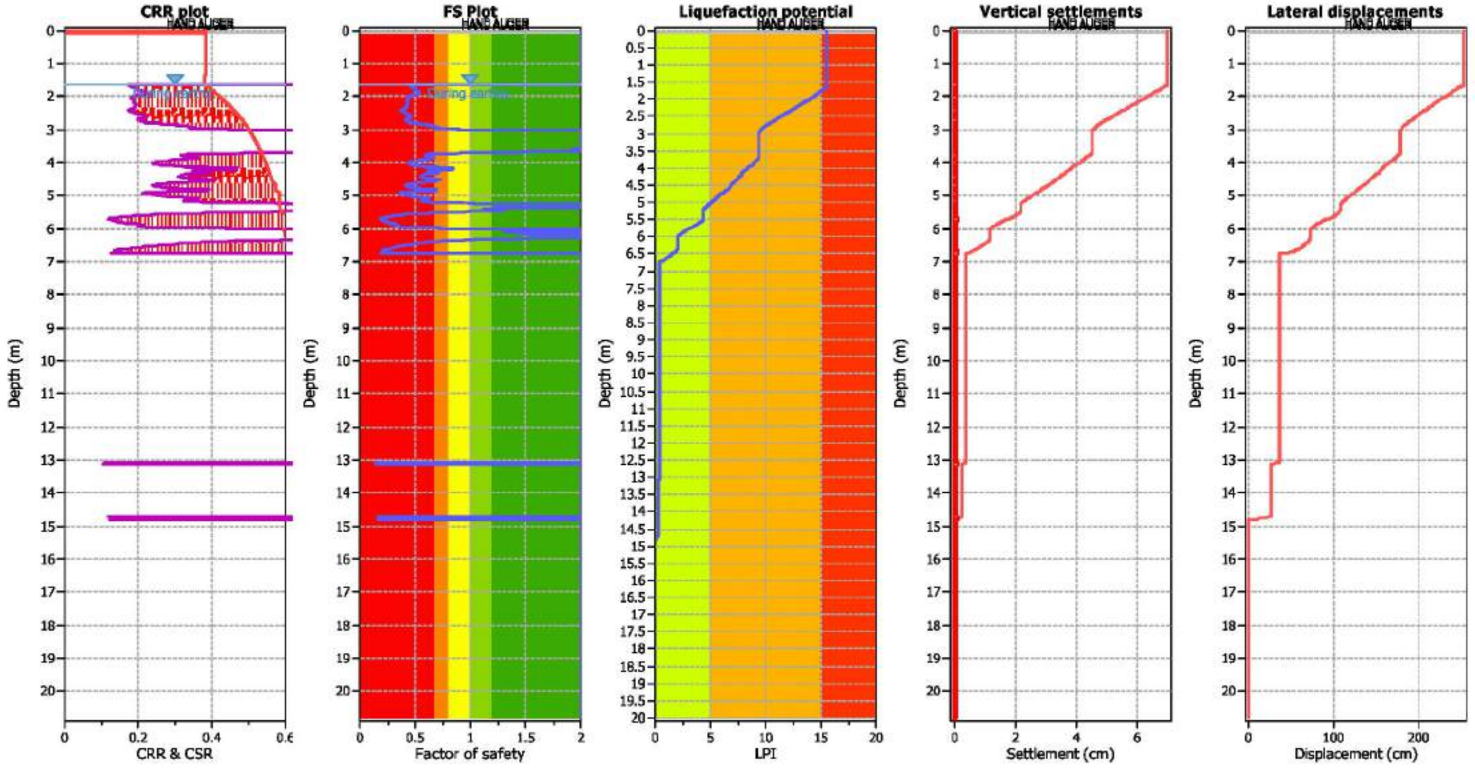
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

F.S. color scheme

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LPI color scheme

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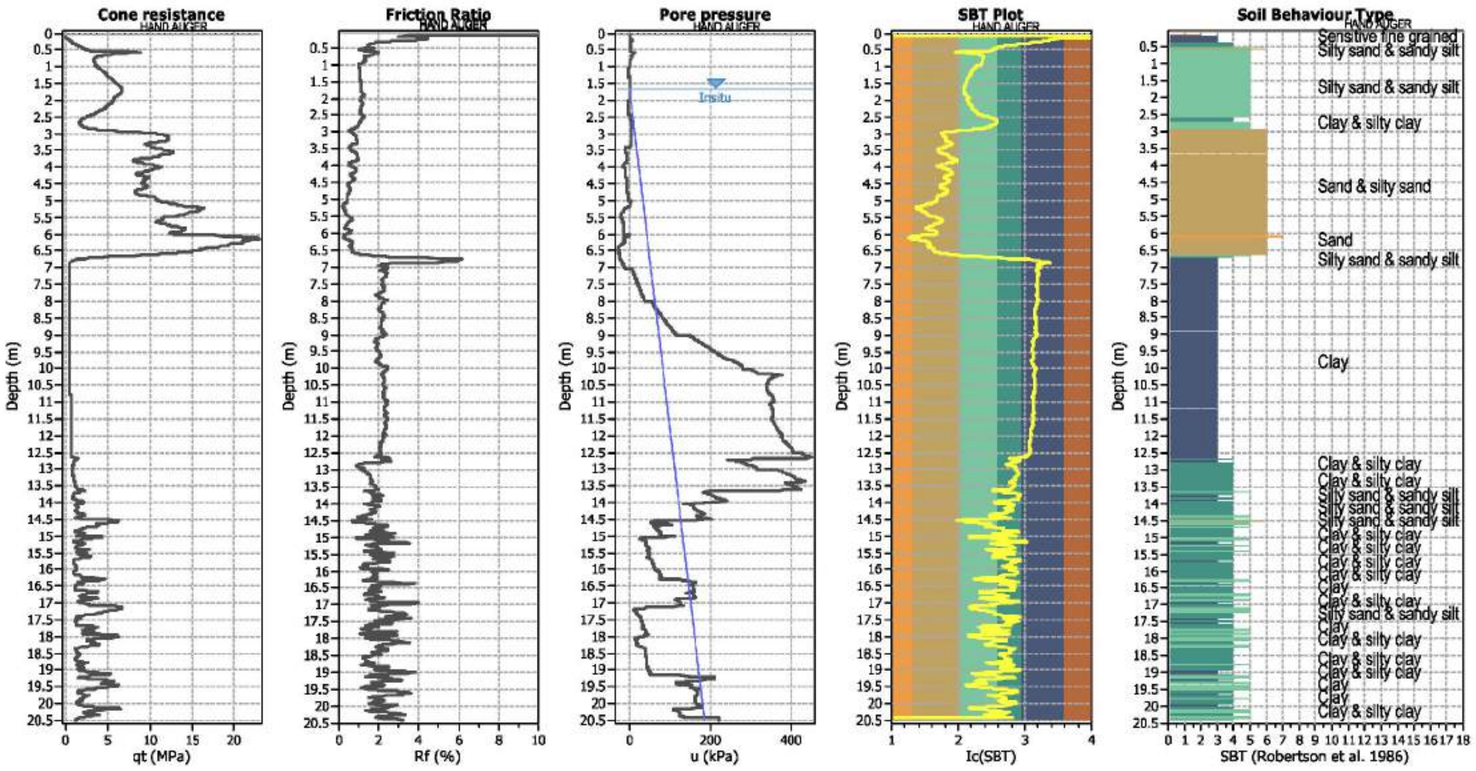
CPT basic interpretation plots



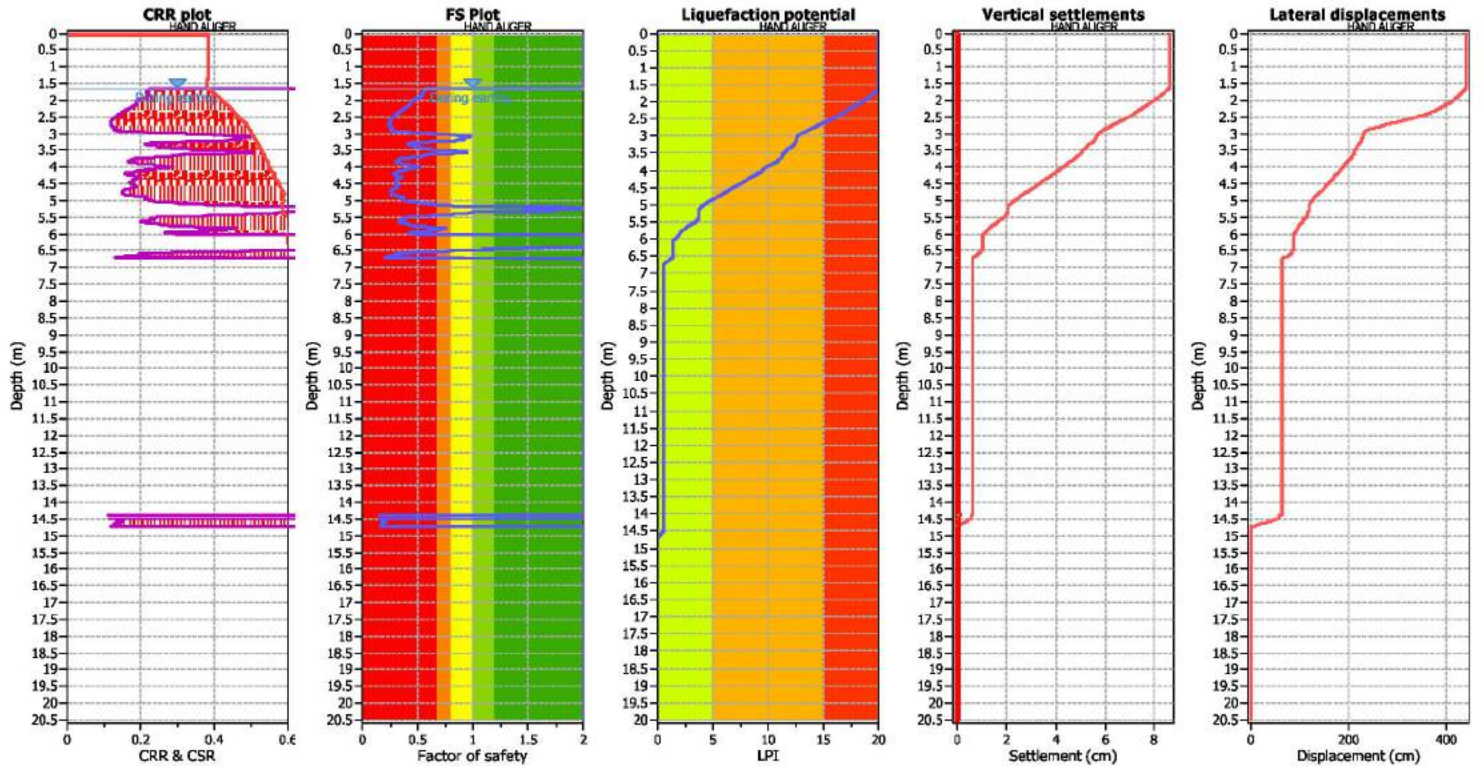
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

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LPI color scheme

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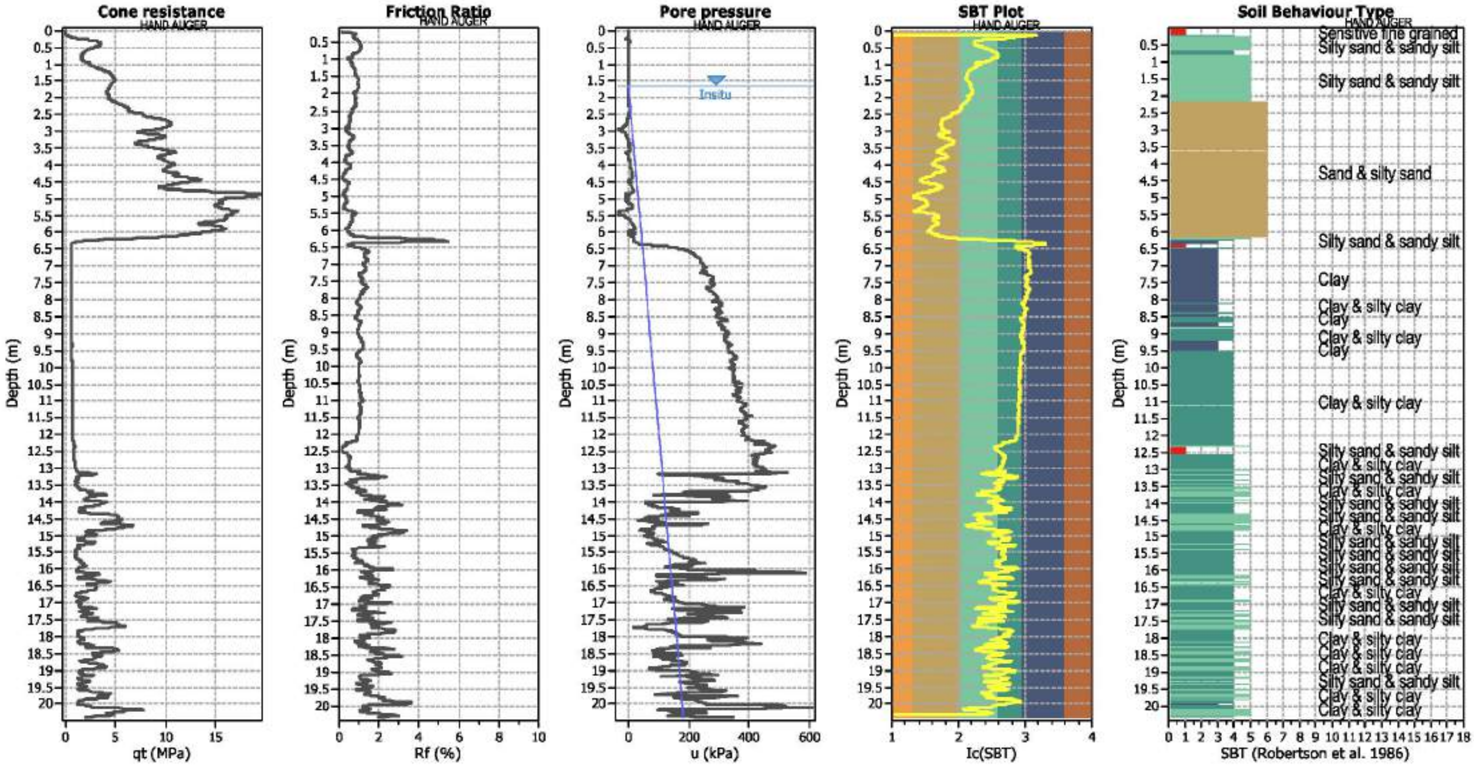
CPT basic interpretation plots



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: 7.50
Peak ground acceleration: 0.65
Depth to water table (insitu): 1.65 m

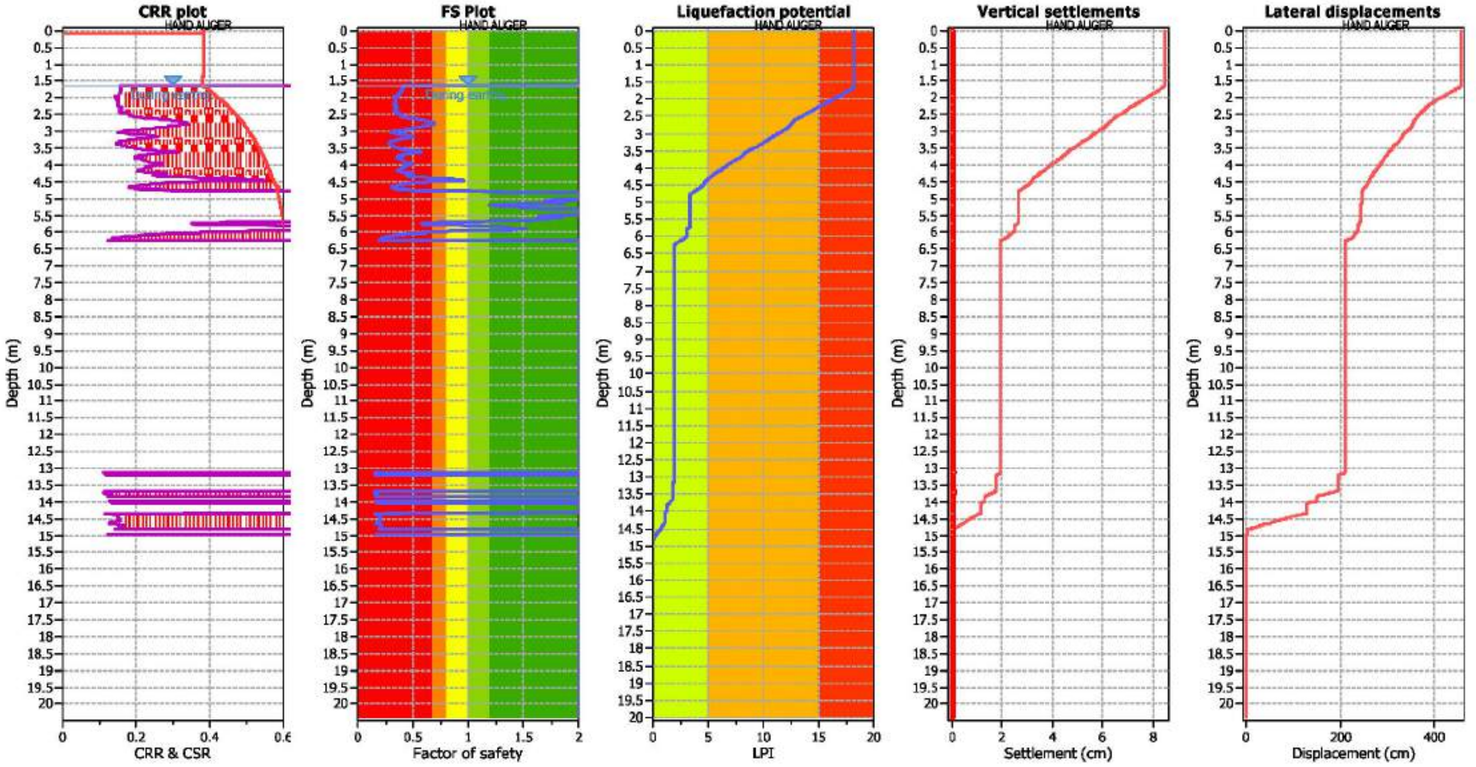
Depth to GWT (erthq.): 1.65 m
Average results interval: 3
Ic cut-off value: 2.60
Unit weight calculation: Based on SBT
Use fill: No
Fill height: N/A

Fill weight: N/A
Transition detect. applied: No
K_σ applied: Yes
Clay like behavior applied: Sands only
Limit depth applied: Yes
Limit depth: 15.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	15.00 m

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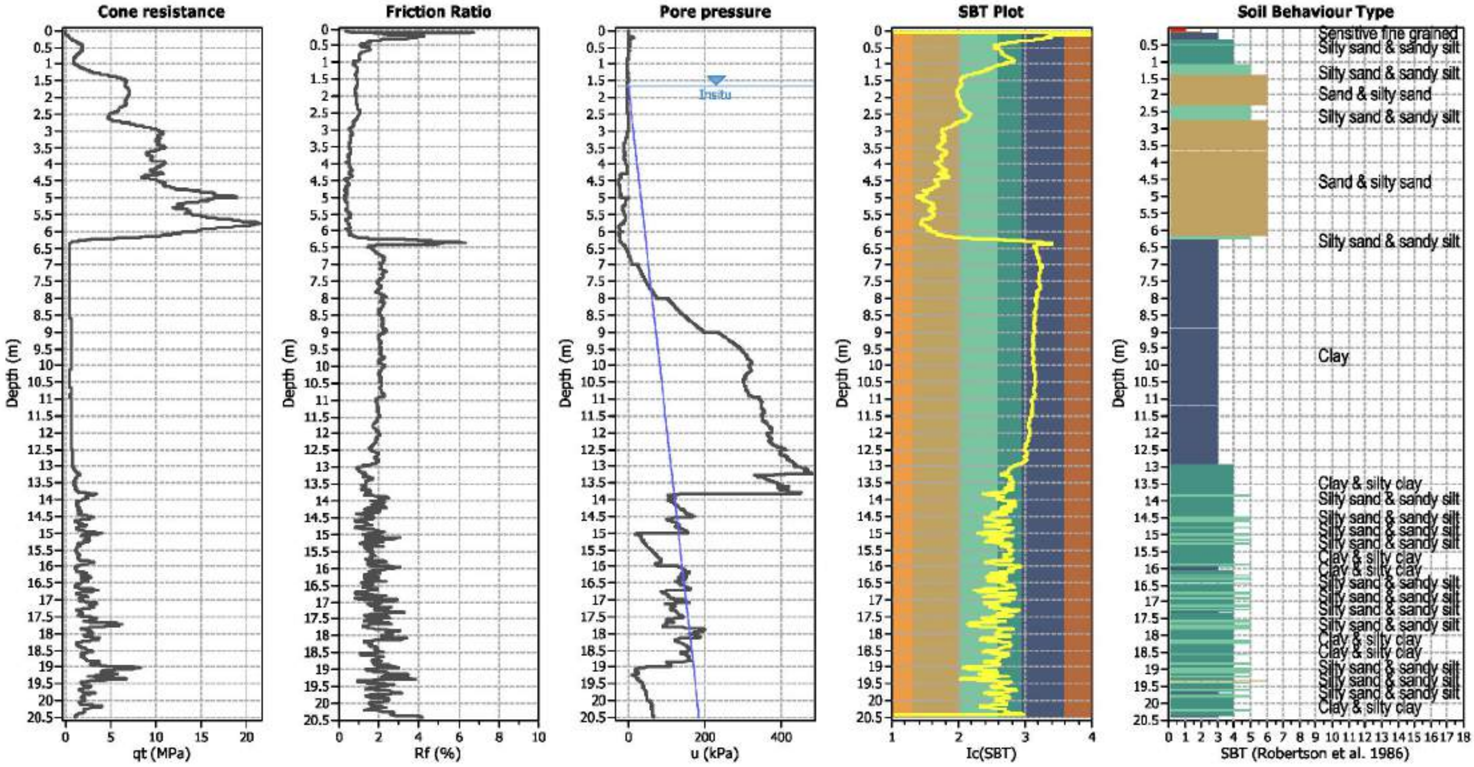
CPT basic interpretation plots



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: 7.50
Peak ground acceleration: 0.65
Depth to water table (insitu): 1.65 m

Depth to GWT (erthq.): 1.65 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: Sands only
Limit depth applied: Yes
Limit depth: 10.00 m

SBT legend

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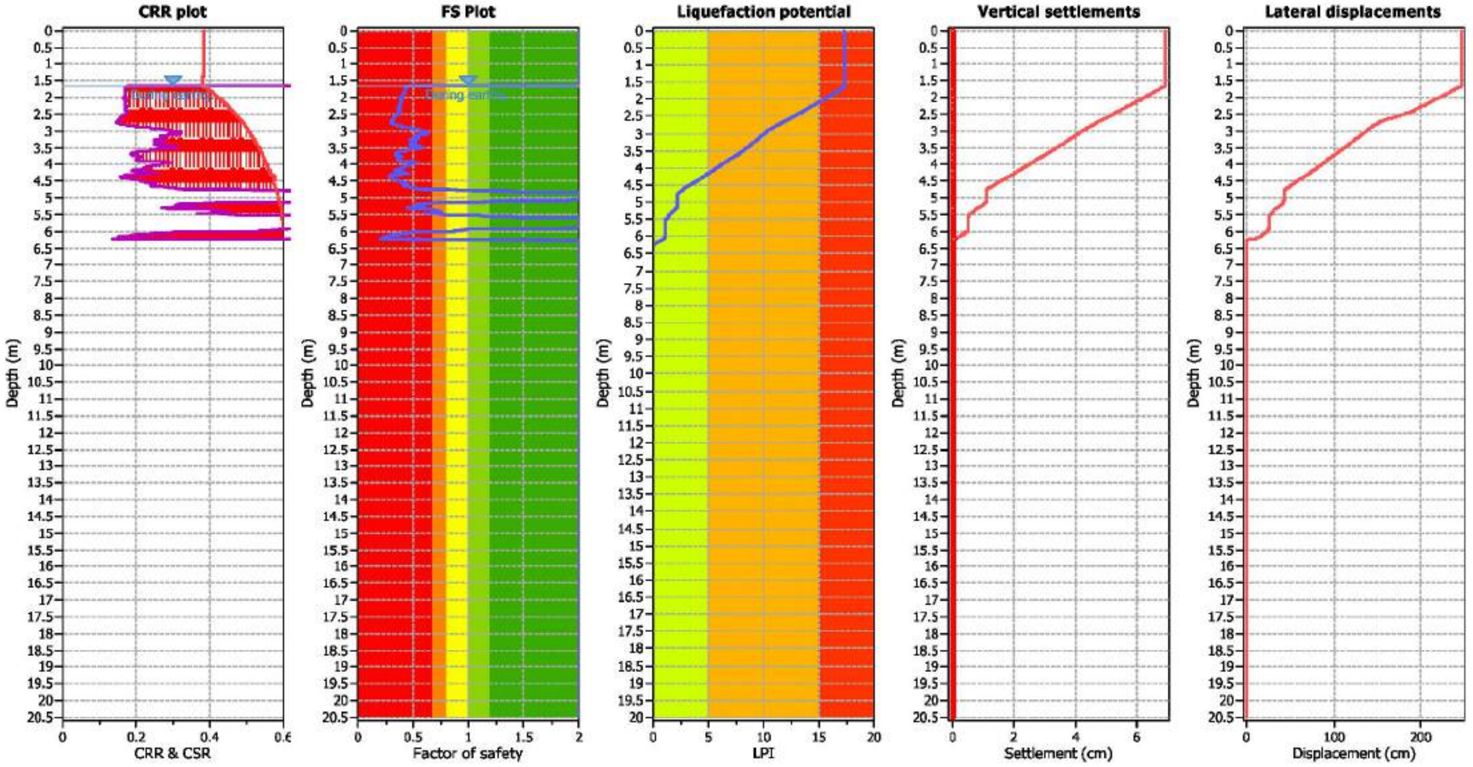
🟩 5. Silty sand to sandy silt
🟨 6. Clean sand to silty sand
🟧 7. Gravely sand to sand
⬛ 8. Very stiff sand to
⬜ 9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method: B&I (2014)
Fines correction method: B&I (2014)
Points to test: Based on Ic value
Earthquake magnitude M_w: 7.50
Peak ground acceleration: 0.65
Depth to water table (insitu): 1.65 m

Depth to GWT (erthq.): 1.65 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
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Clay like behavior applied: Sands only
Limit depth applied: Yes
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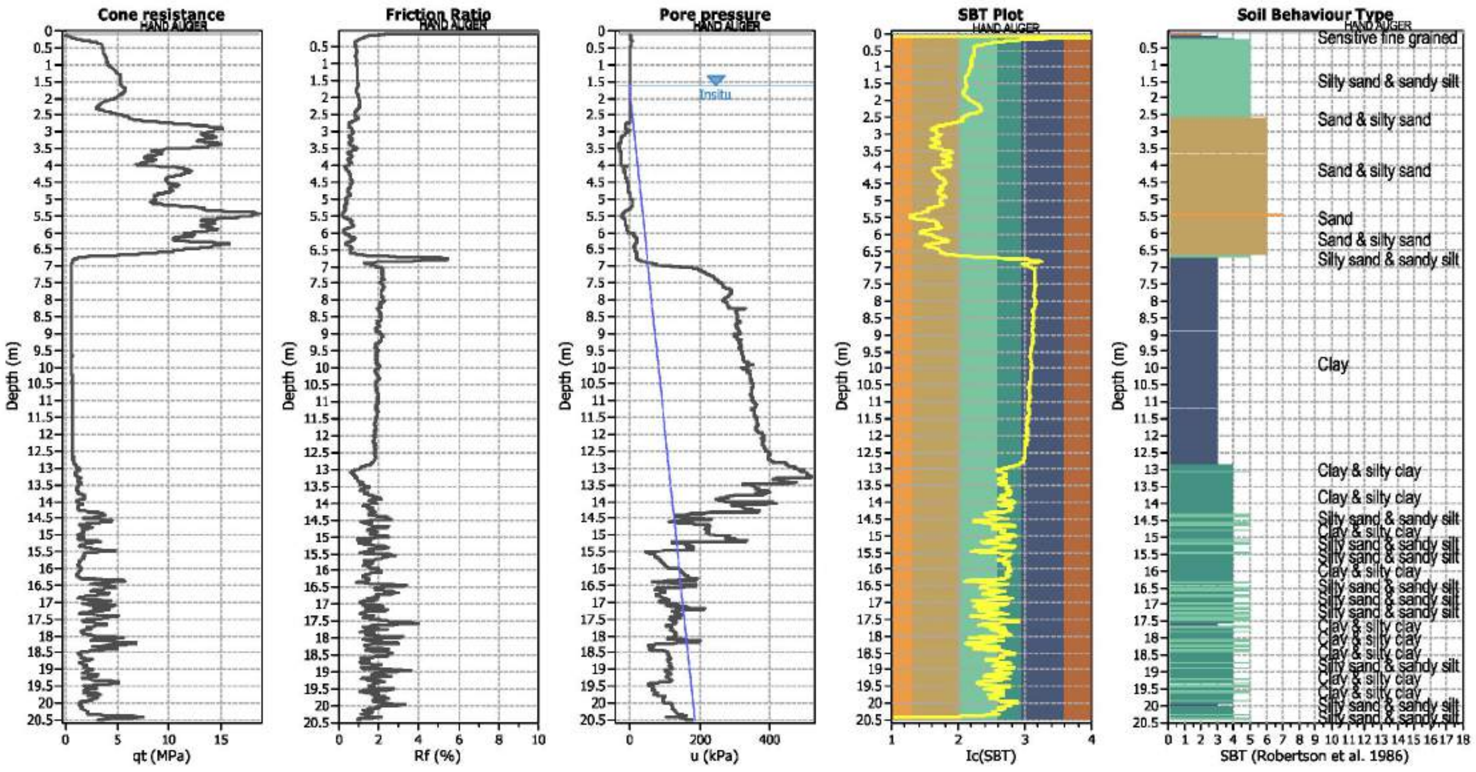
CPT basic interpretation plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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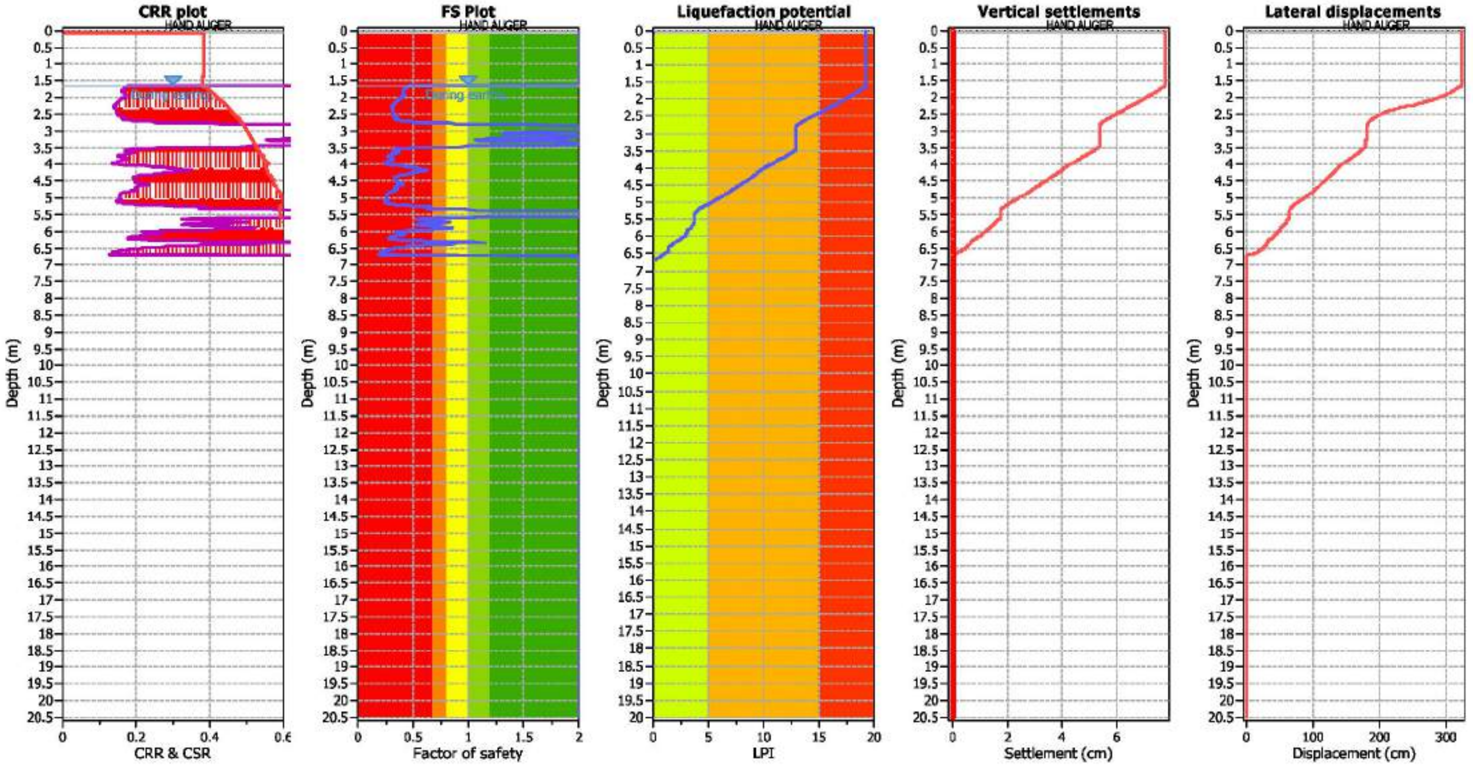
🟫 2. Organic material	🟩 5. Silty sand to sandy silt	⬜ 8. Very stiff sand to
🟦 3. Clay to silty clay	🟨 6. Clean sand to silty sand	⬜ 9. Very stiff fine grained

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

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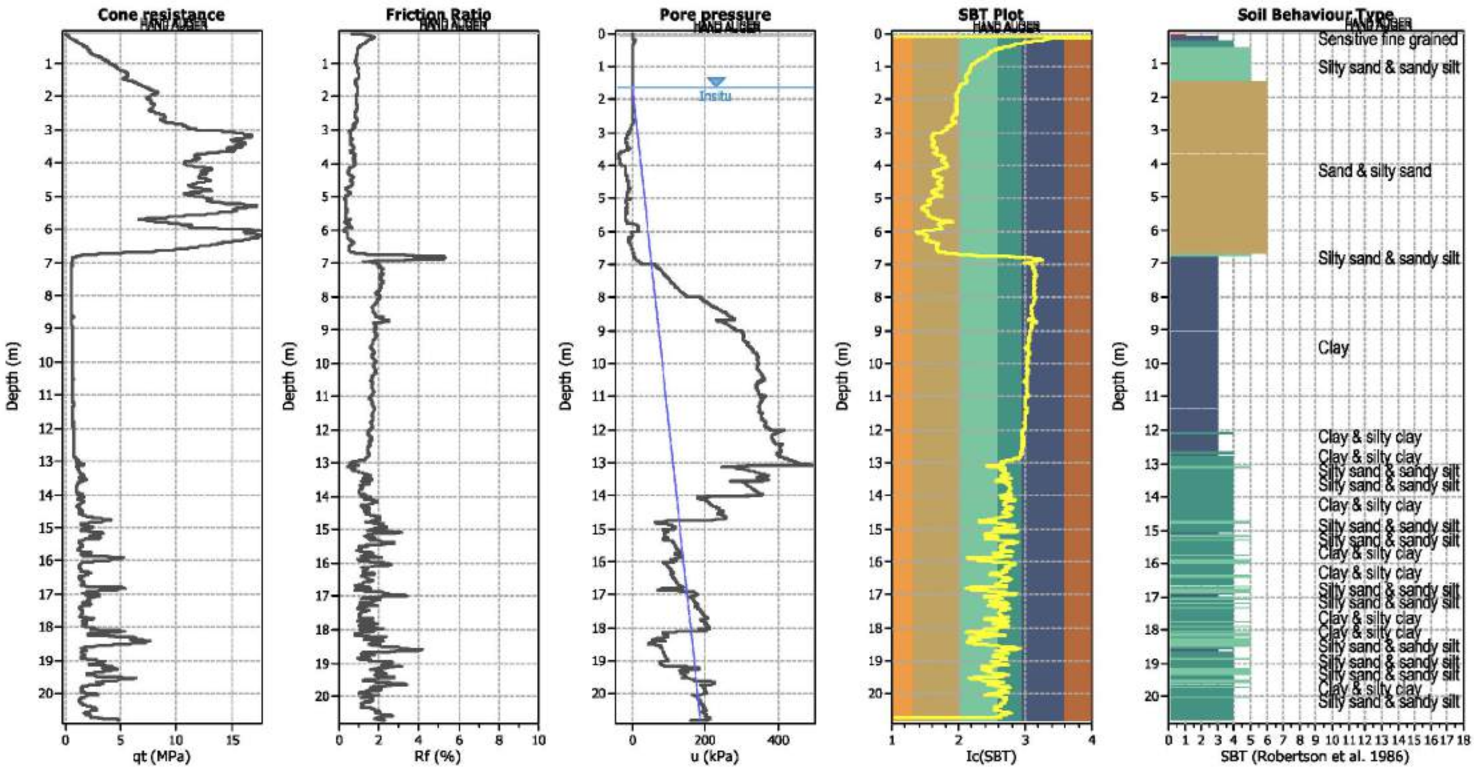
CPT basic interpretation plots



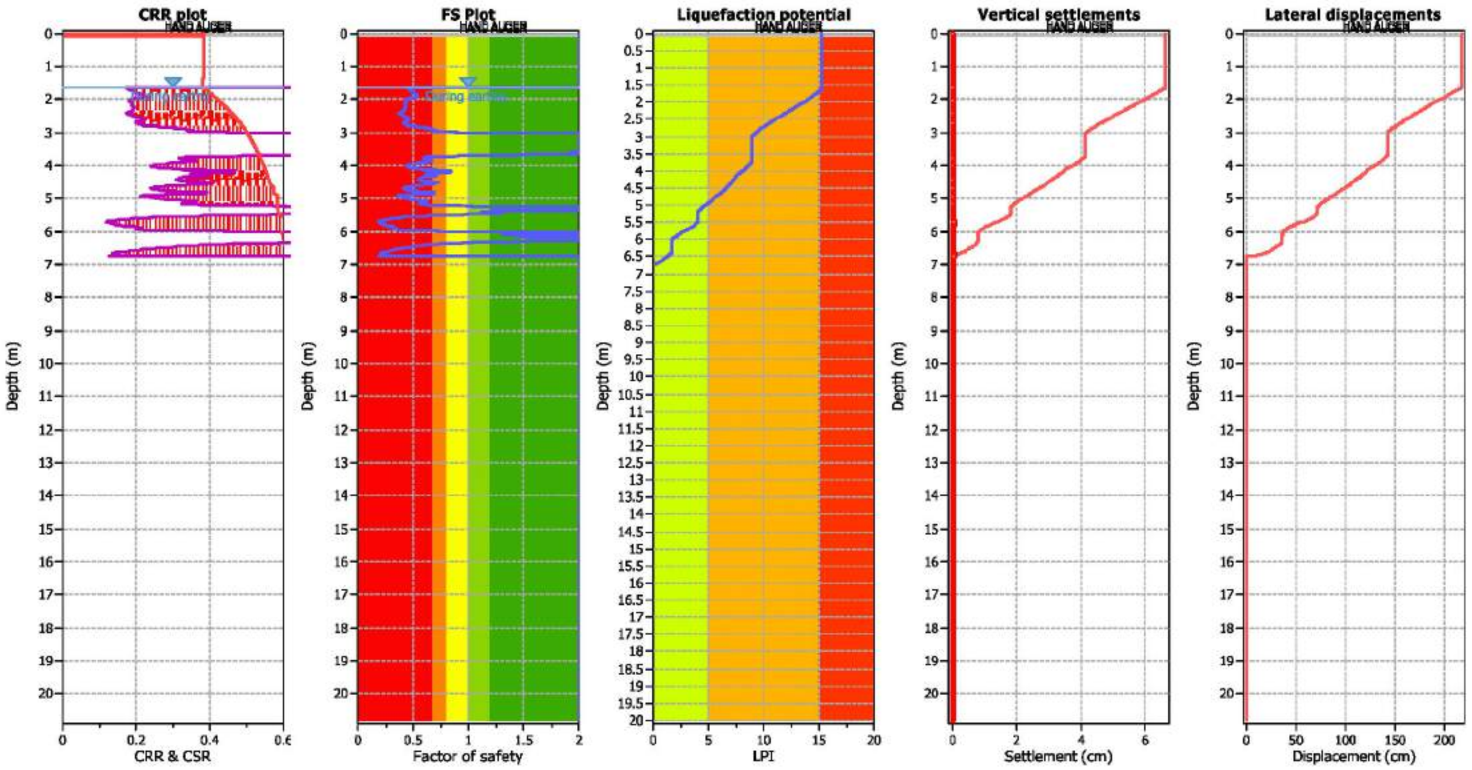
Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
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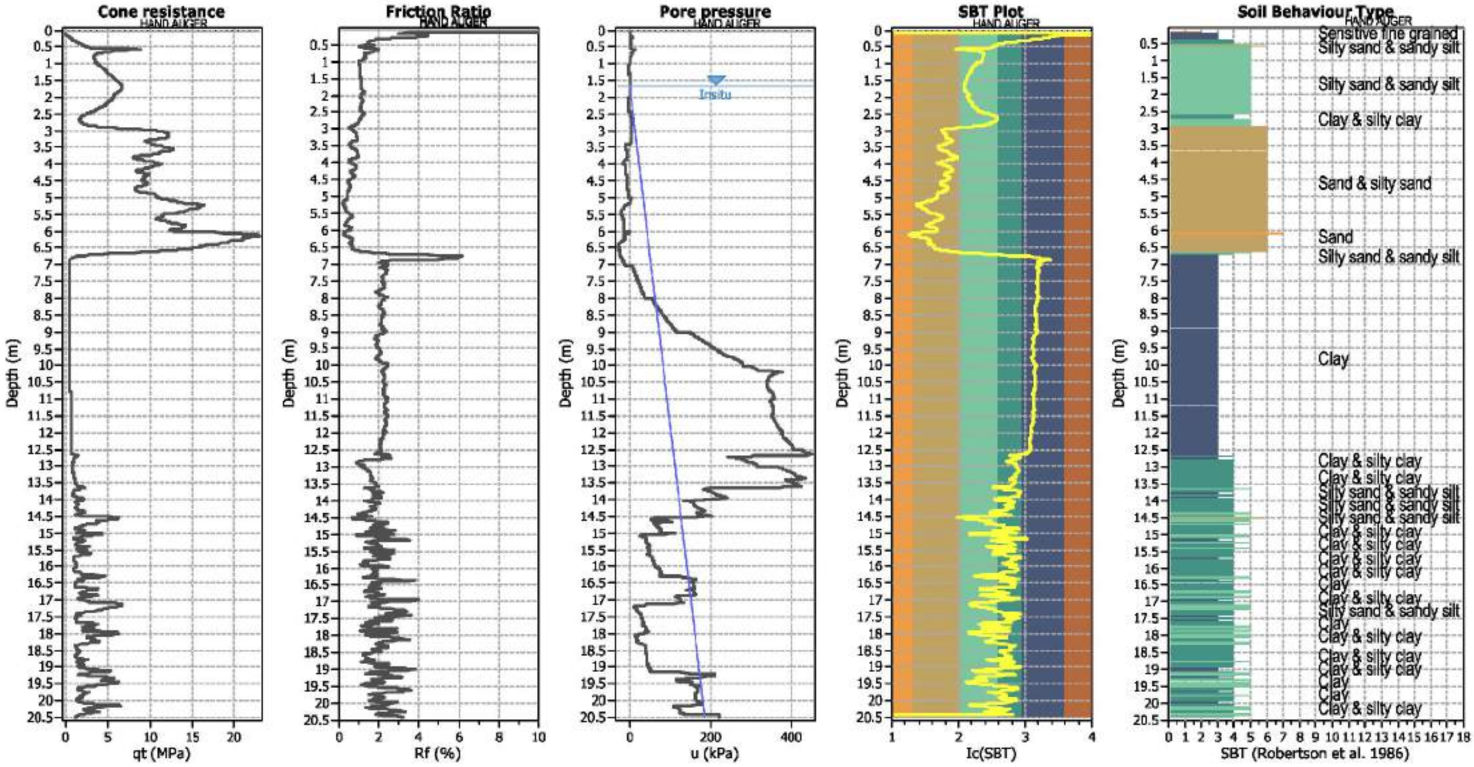
CPT basic interpretation plots



Input parameters and analysis data

Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
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Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
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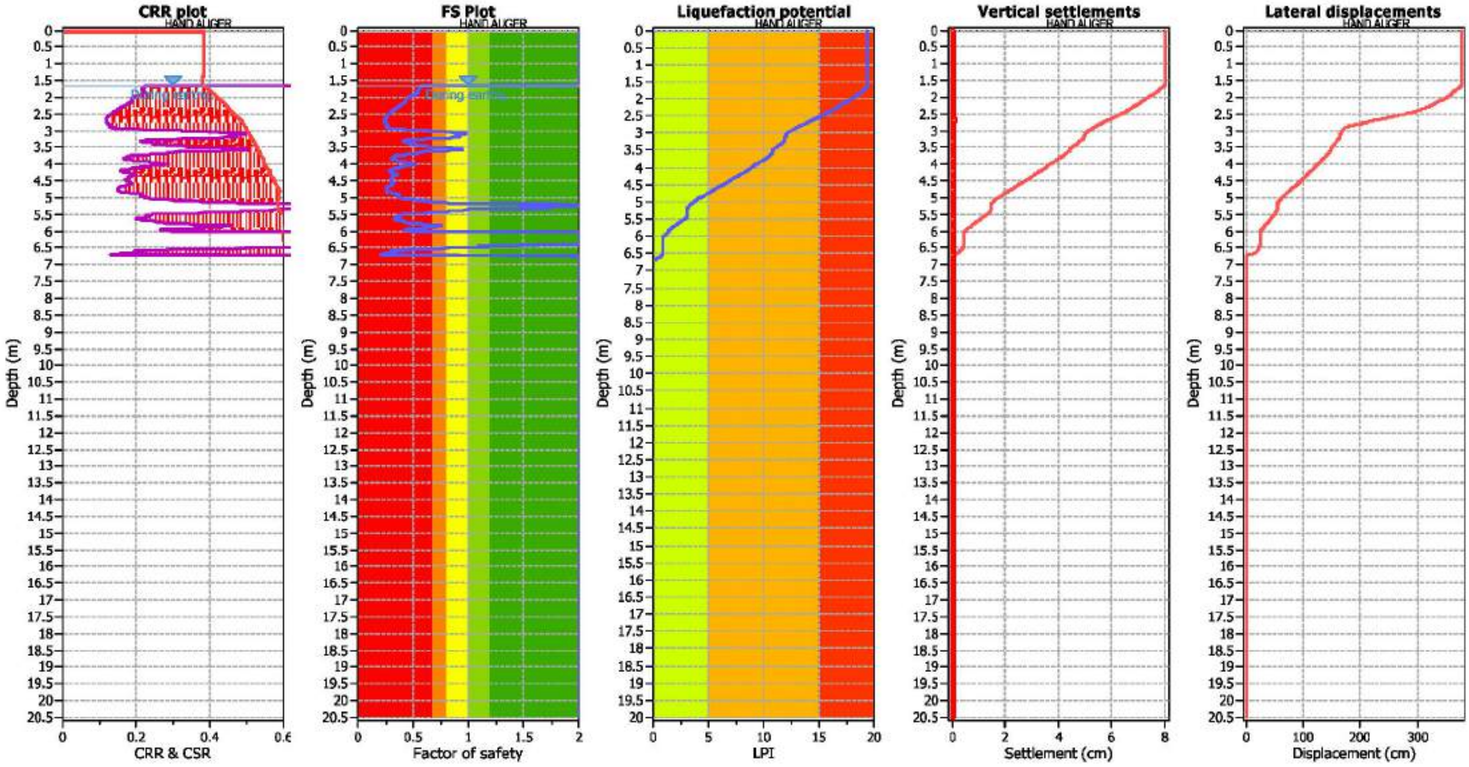
SBT legend

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

Liquefaction analysis overall plots



Input parameters and analysis data

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Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.50	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.65	Use fill:	No	Limit depth applied:	Yes
Depth to water table (insitu):	1.65 m	Fill height:	N/A	Limit depth:	10.00 m

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LPI color scheme

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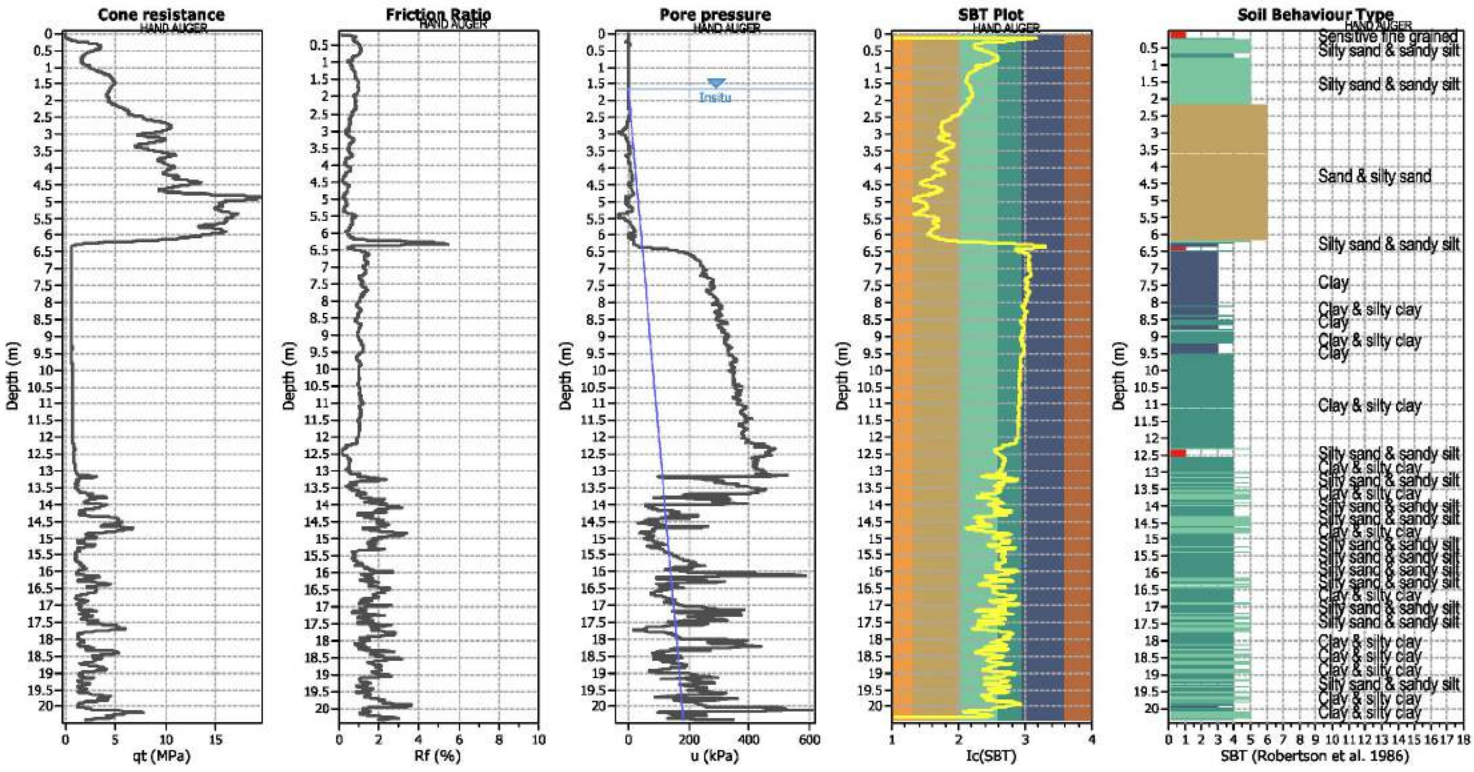
CPT basic interpretation plots



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SBT legend

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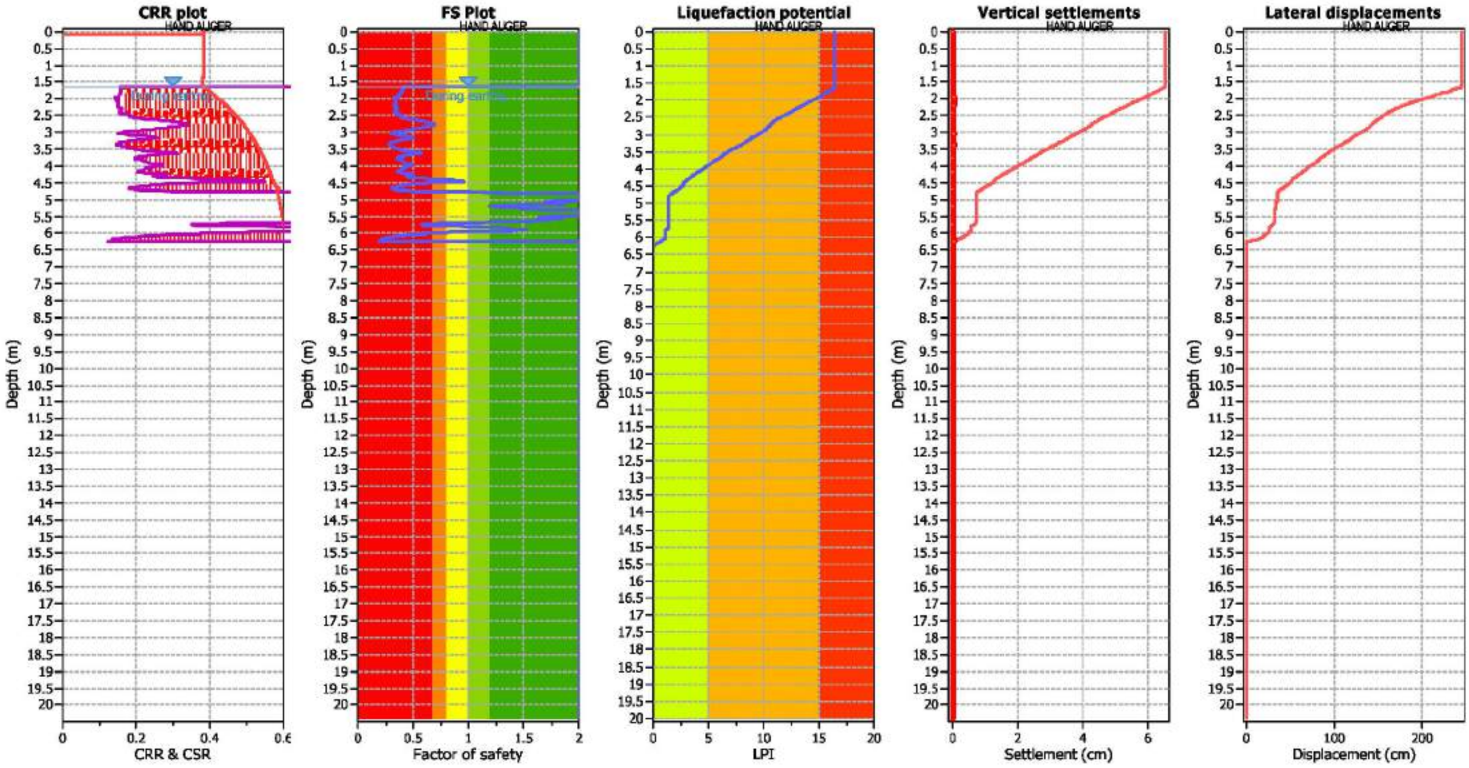
Liquefaction analysis overall plots



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Analysis method:	B&I (2014)	Depth to GWT (erthq.):	1.65 m	Fill weight:	N/A
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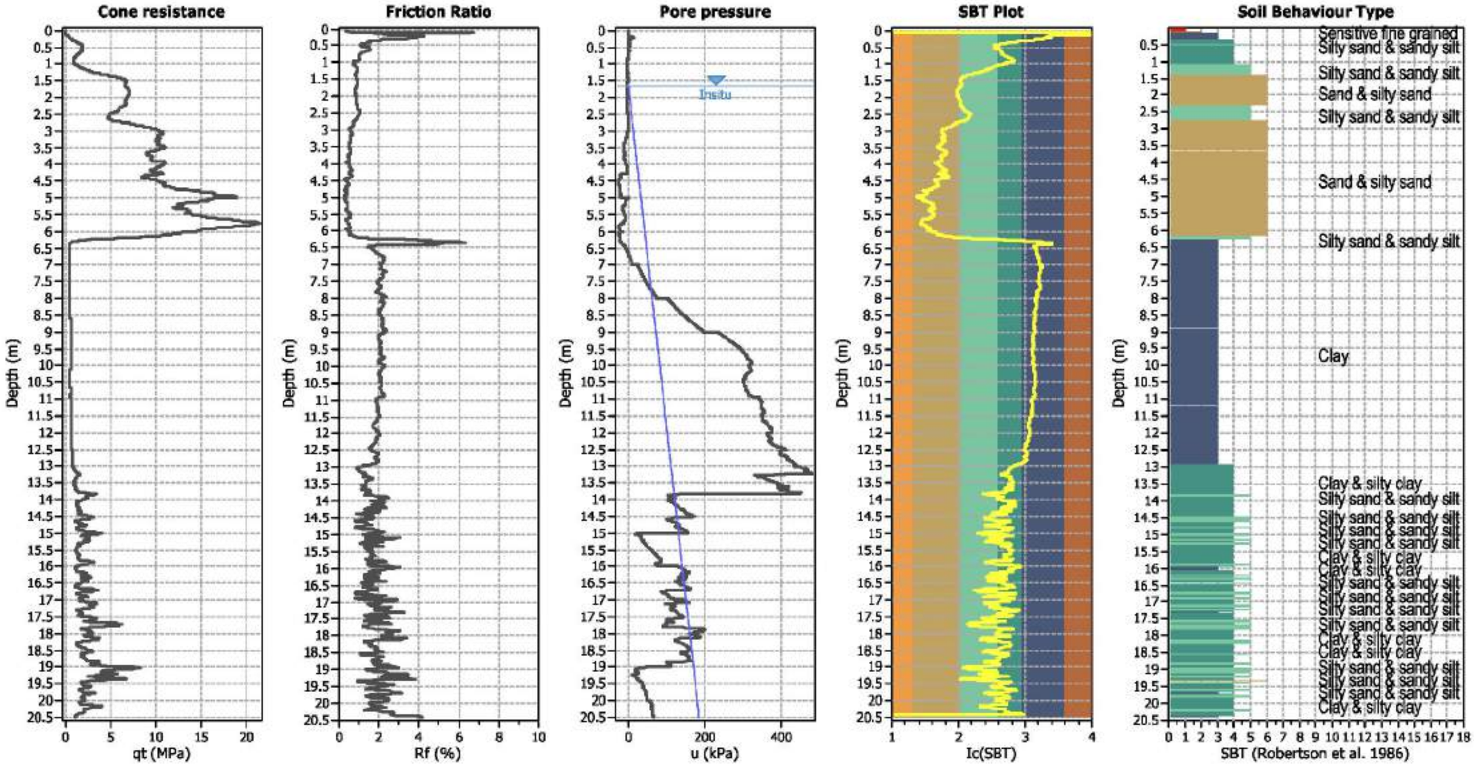

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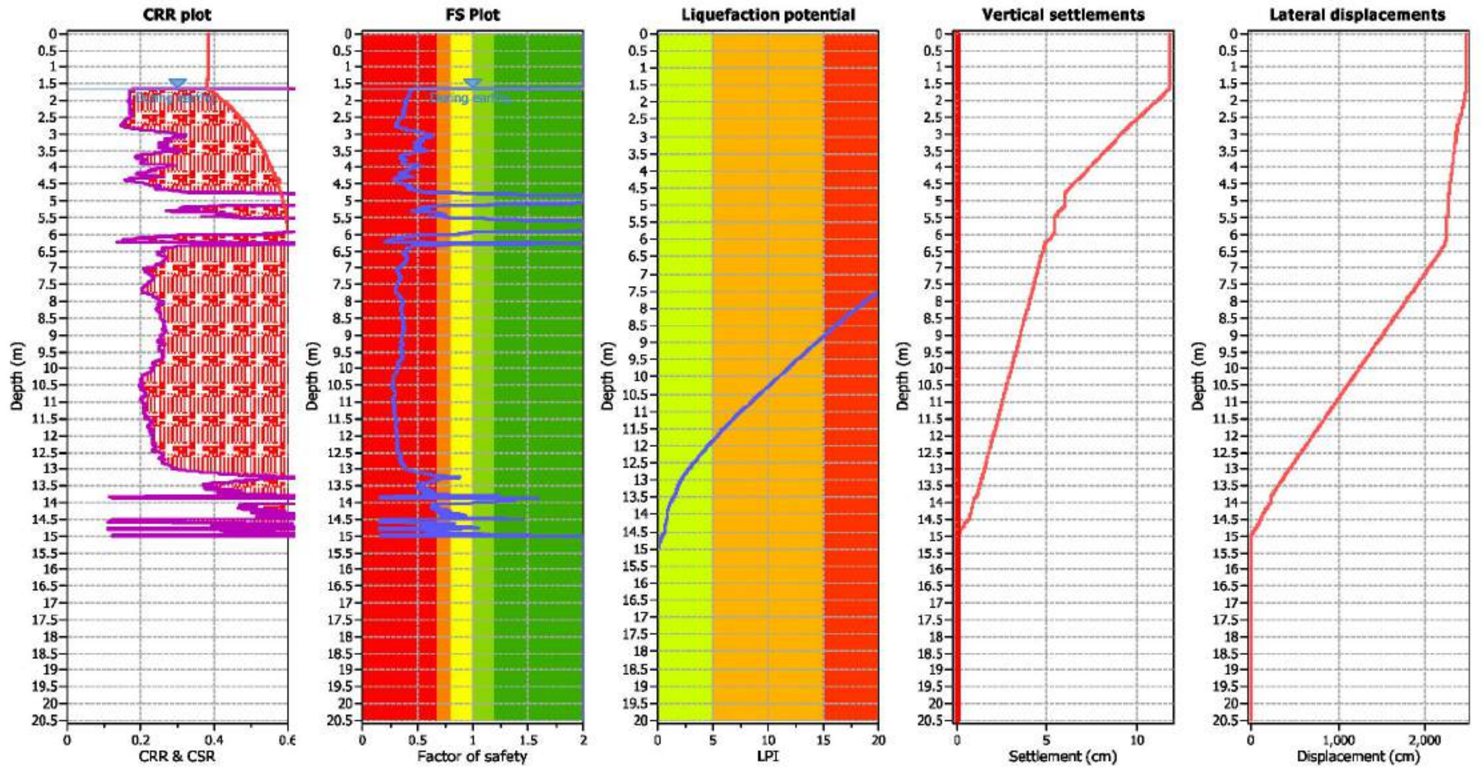
Liquefaction analysis overall plots



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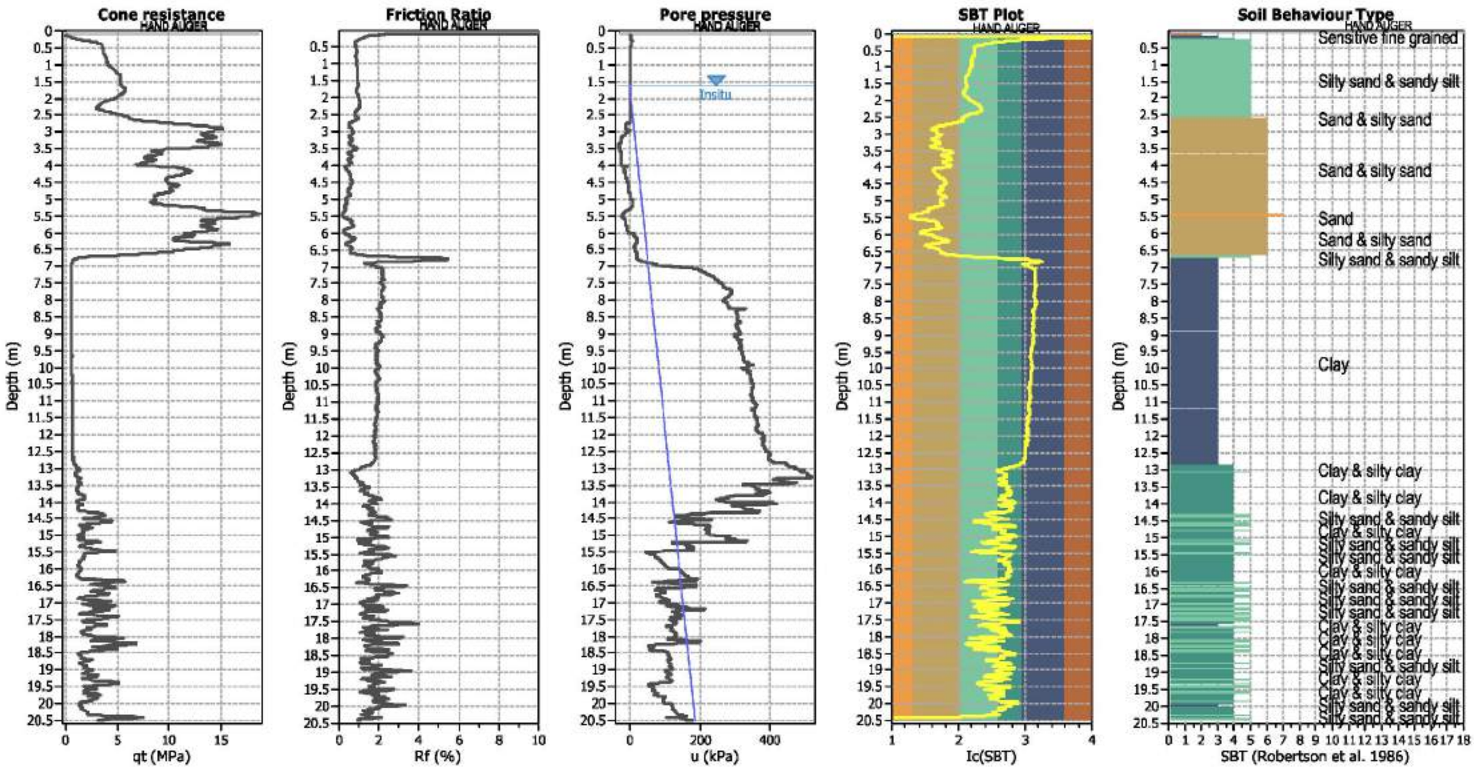

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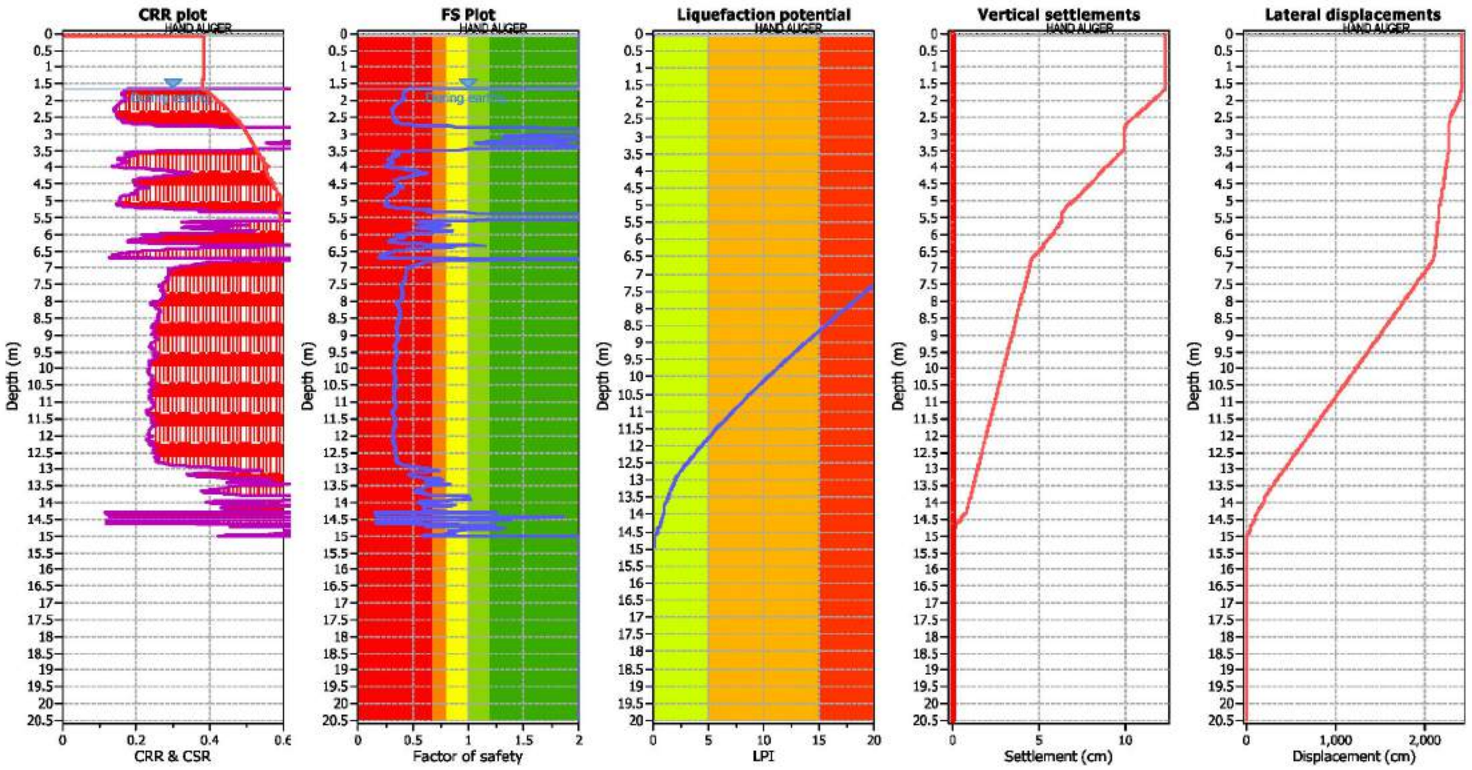
Liquefaction analysis overall plots



Input parameters and analysis data

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Fines correction method:	B&I (2014)	Average results interval:	3	Transition detect. applied:	No
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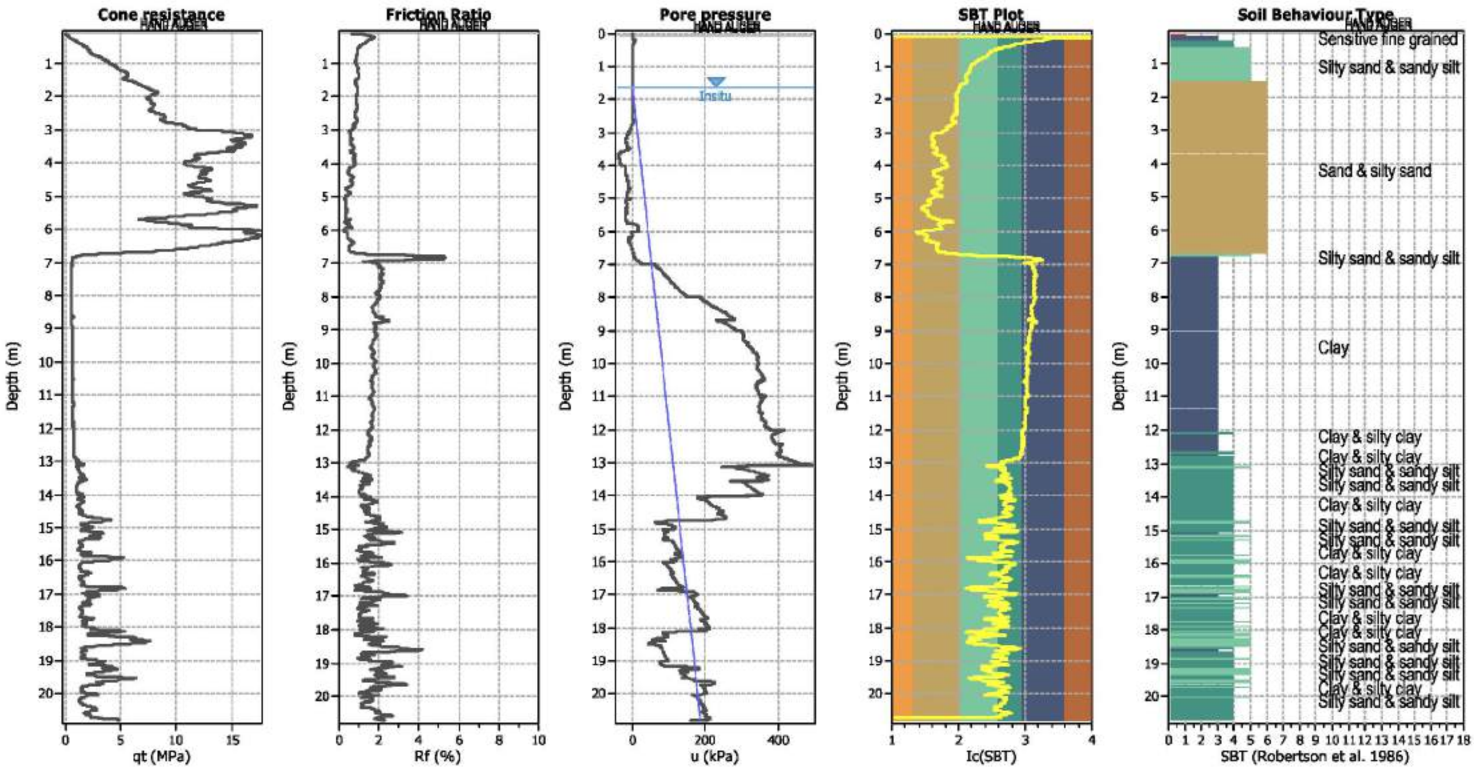

Input parameters and analysis data

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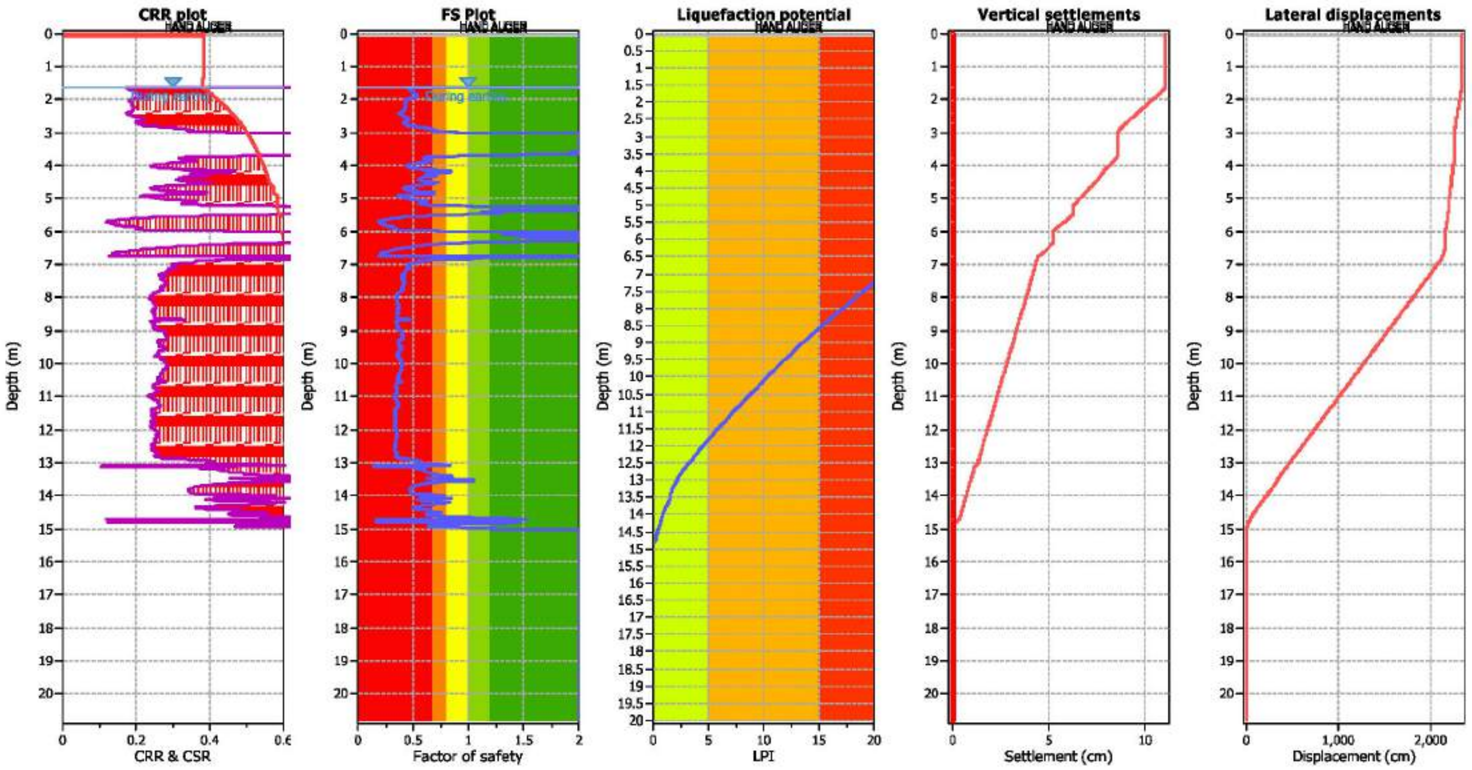

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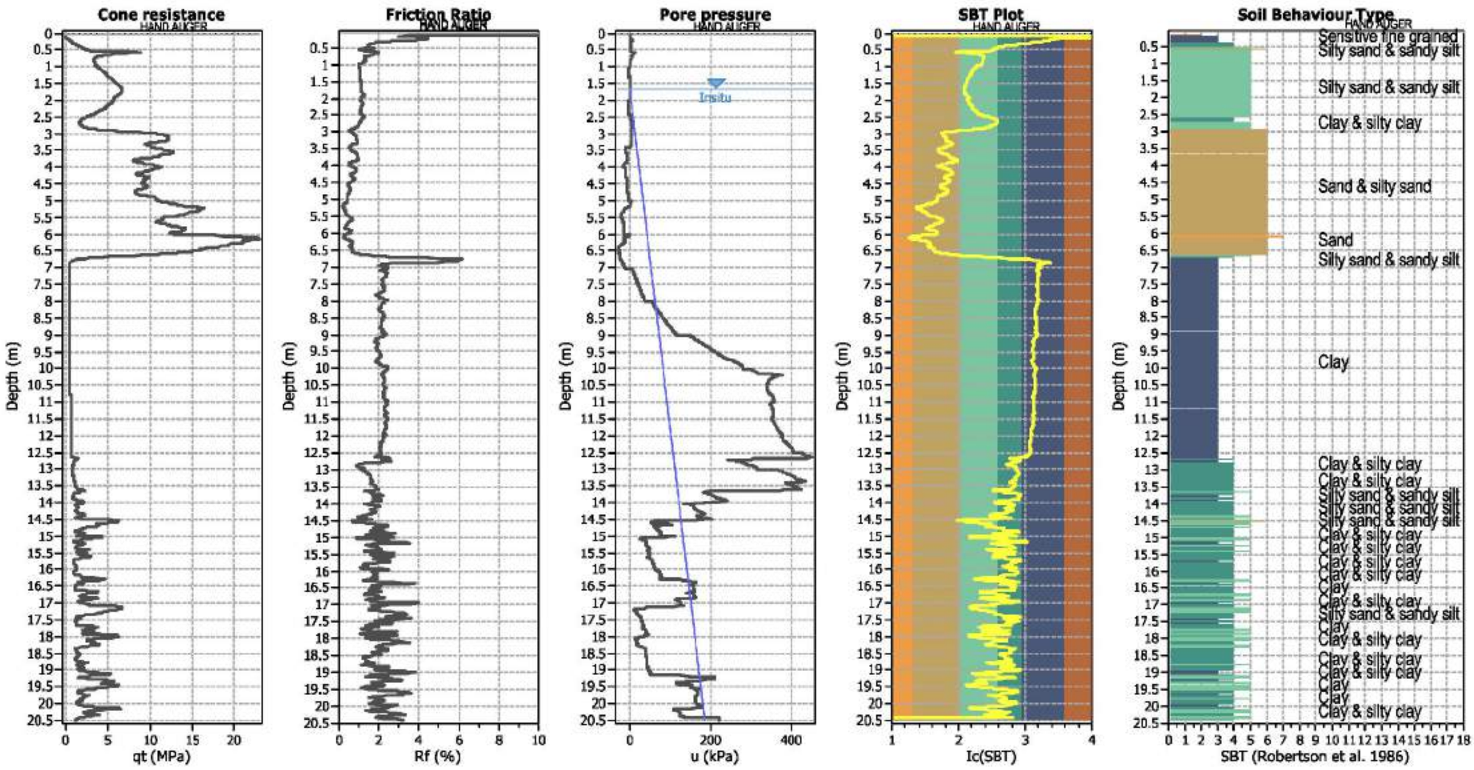

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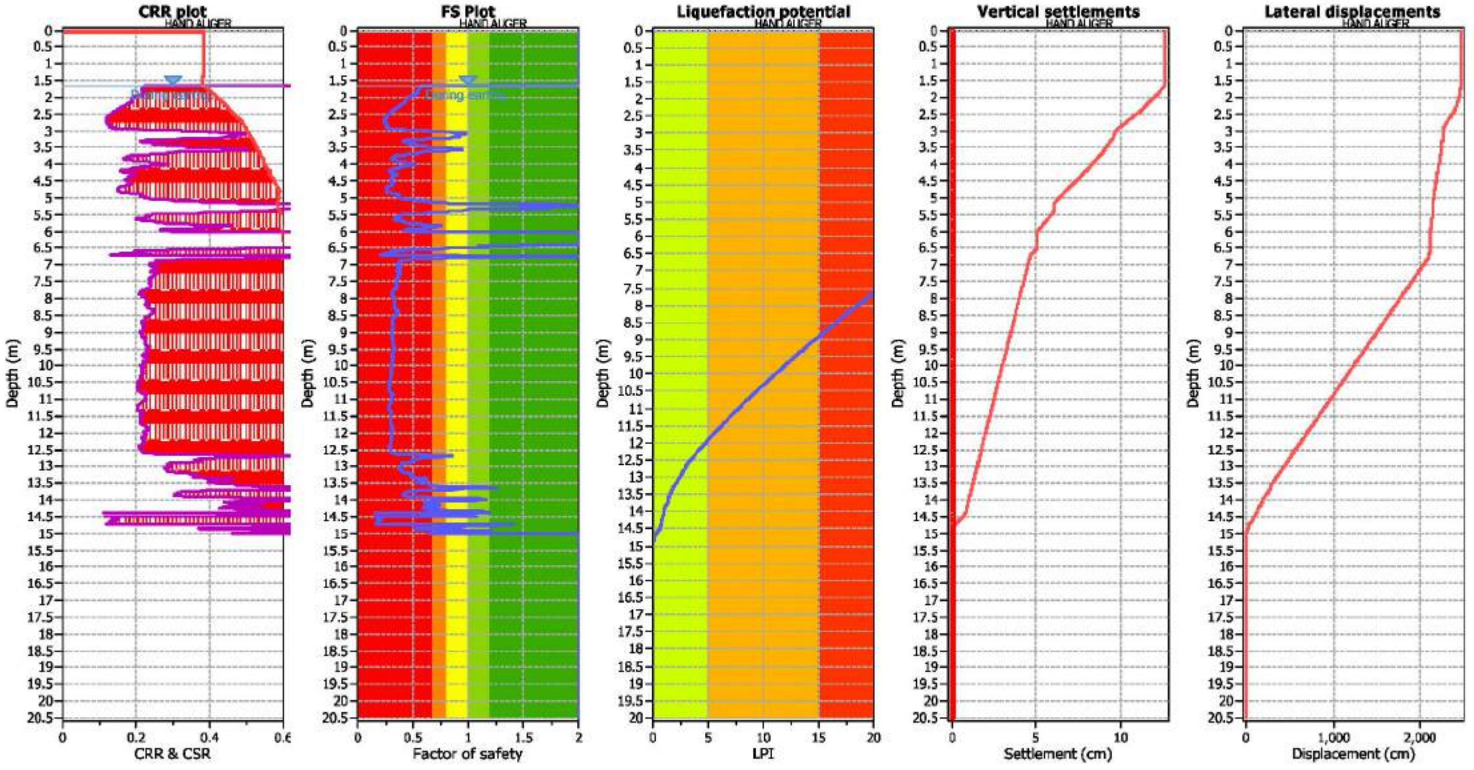

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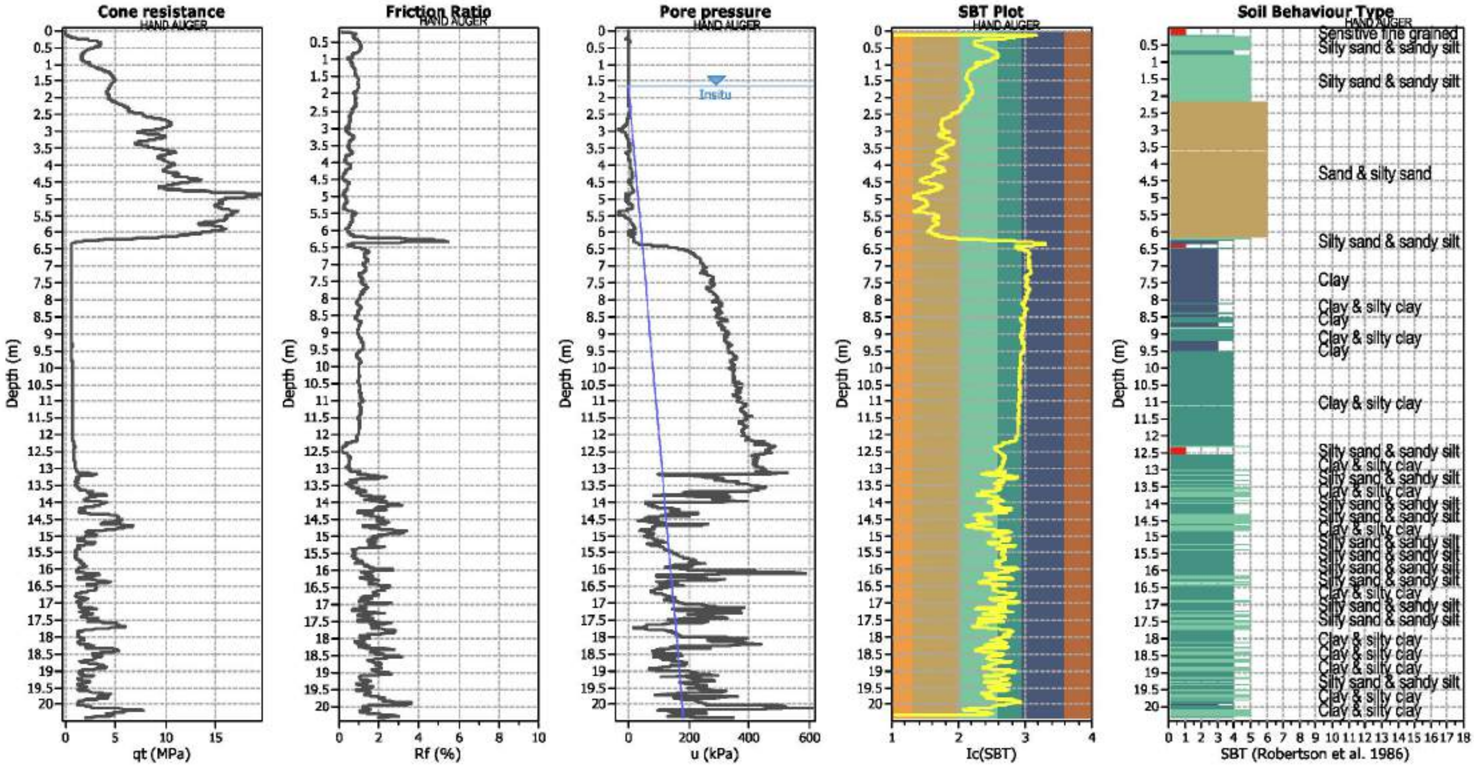

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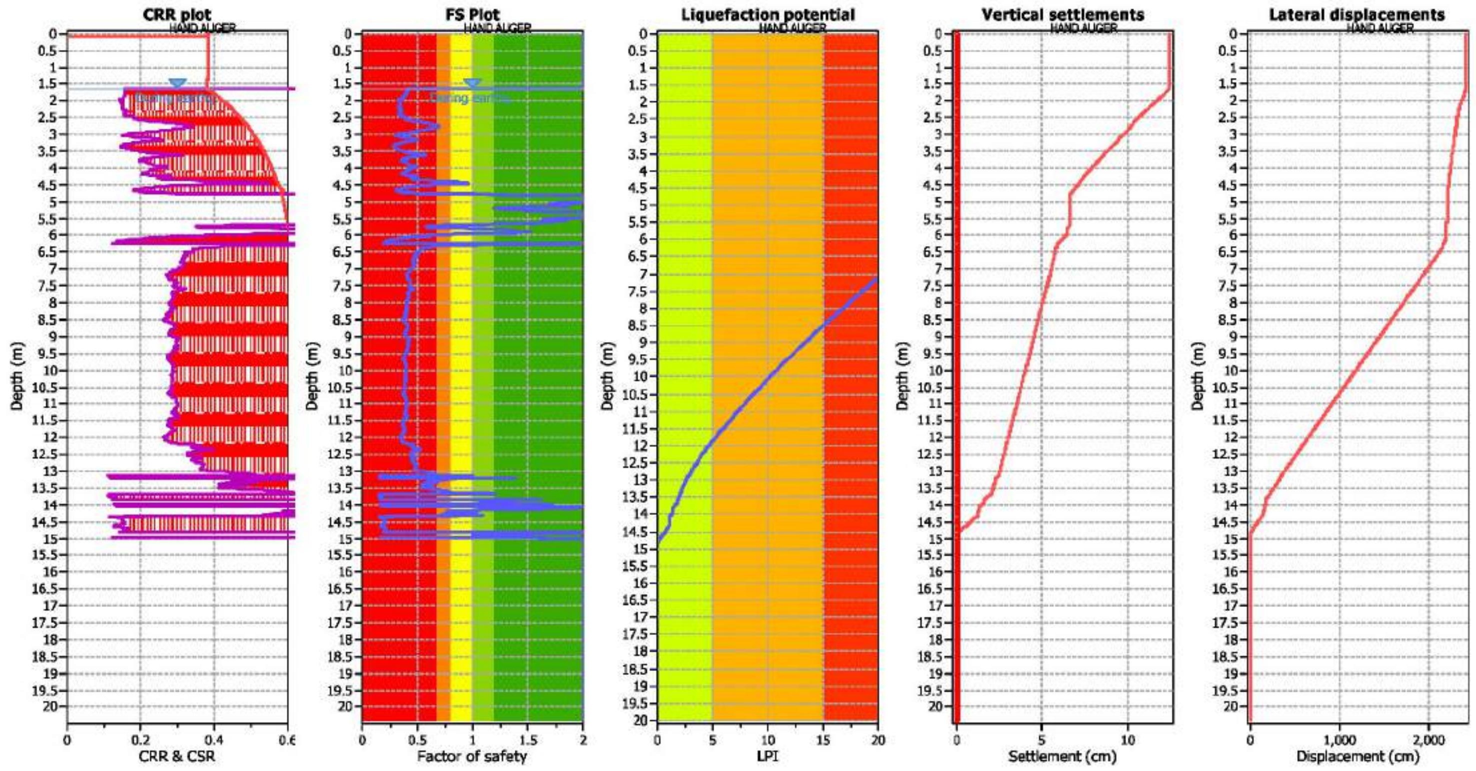

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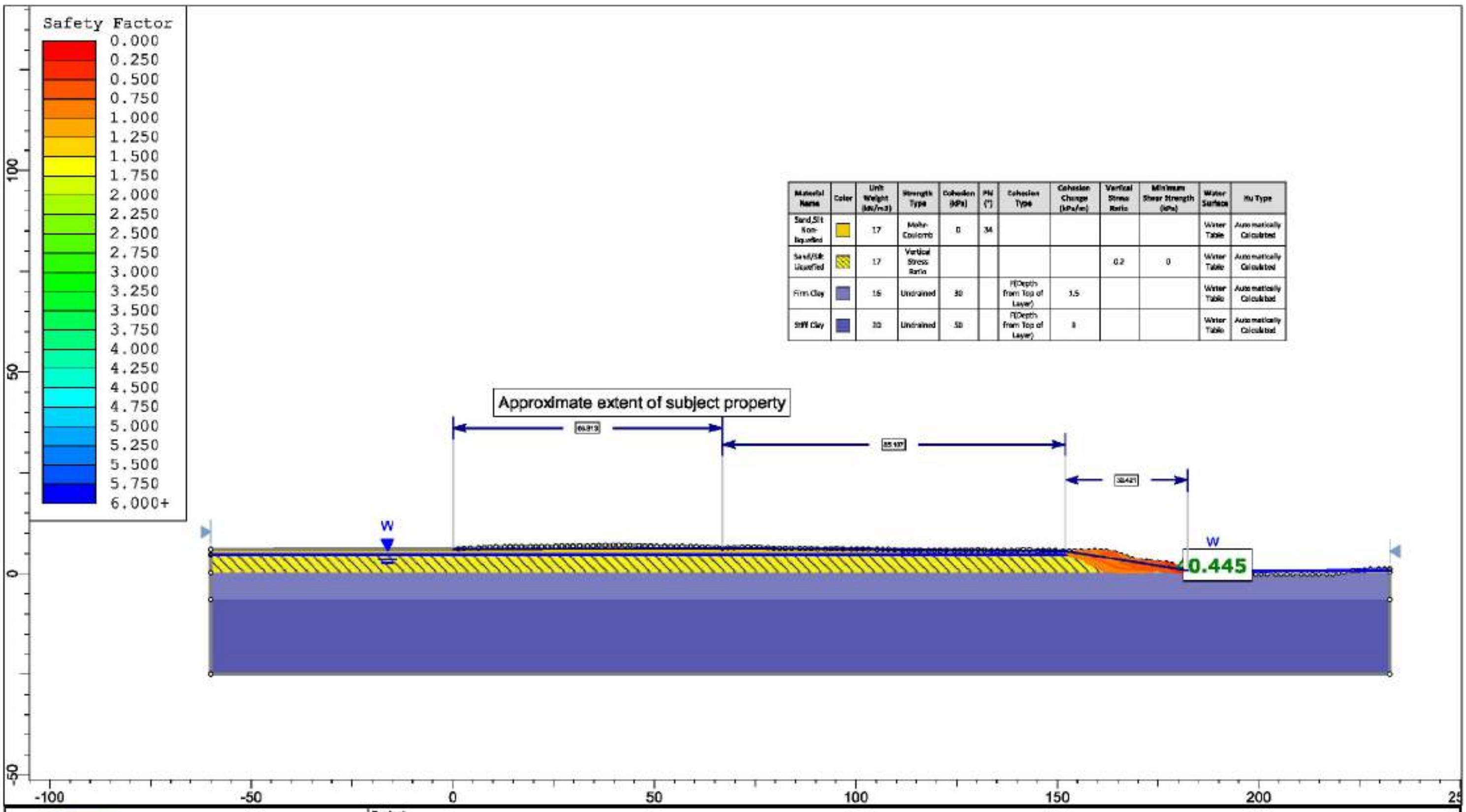
APPENDIX E

SLOPE STABILITY OUTPUTS

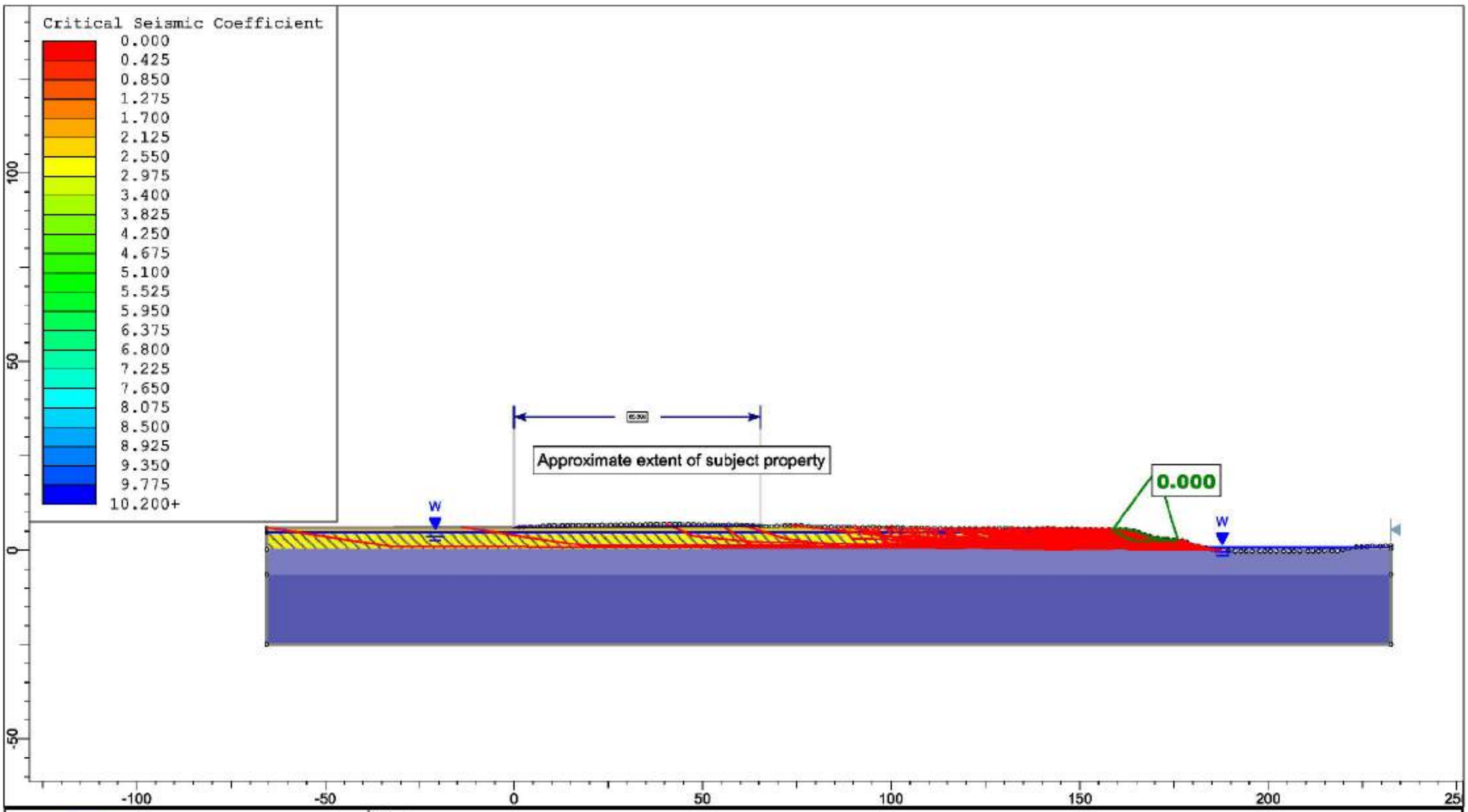


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)	Cohesion Type	Cohesion Change (kPa/m)	Vertical Stress Ratio	Minimum Shear Strength (kPa)	Water Surface	Hu Type
Sand,Silt Non-liquefied	🟨	17	Mohr-Coulomb	0	34					Water Table	Automatically Calculated
Sand/Silt Liquefied	▨	17	Vertical Stress Ratio					0.2	0	Water Table	Automatically Calculated
Firm Clay	🟪	16	Undrained	30		F(Depth from Top of Layer)	1.5			Water Table	Automatically Calculated
Stiff Clay	🟦	20	Undrained	50		F(Depth from Top of Layer)	8			Water Table	Automatically Calculated

LAND DEVELOPMENT & ENGINEERING

SLIDEINTERPRET 9.028

Project	Slide2 - An Interactive Slope Stability Program		
Group	Group 1	*Scenario*	T/S ratio 0.2 - Static Flow
Drawn By	SS	*Company*	LDE Ltd
Date	31/08/2023	*File Name*	Lateral Spreading Analysis.slmd



Project	Slide2 - An Interactive Slope Stability Program		
Group	Group 4	*Scenario*	T/S ratio 0.2 - Yield Seismic
Drawn By	SS	*Company*	LDE Ltd
Date	31/08/2023	*File Name*	Lateral Spreading Analysis.slmd

LAND DEVELOPMENT & ENGINEERING

SLIDEINTERPRET 9.028

NZHG Gisborne Limited

GEOTECHNICAL ASSESSMENT REPORT FOR PROPOSED RESIDENTIAL DWELLING, LOT 4

556-560 Aberdeen Road, Te Hapara, Gisborne

Project Reference: 24477
October 13, 2023

DOCUMENT CONTROL

Version	**Date**	**Comments**
01	13/10/2023	Issued for Resource Consent. Plan review required prior to submission for Building Consent.

Version	**Issued For**	**Date**	**Prepared By**	**Reviewed & Authorised By**
01	Issued for Design	13/10/2023	Sahil Sathwara *B.Tech (Civil), MEngNZ* Geotechnical Engineer	Dan Bond *CMEngNZ, PEngGeol.* Associate Engineering Geologist

CONTENTS

1 INTRODUCTION

Land Development & Engineering Ltd (LDE) was engaged by NZHG Gisborne Limited to undertake a geotechnical investigation of a site located at 556 & 560 Aberdeen Road, Gisborne (Figure 1).

The 2,700m^2 site is proposed to be subdivided into 12 Lots for residential development (Figure 1). This geotechnical report pertains to proposed Lot 4, 556 & 560 Aberdeen Road, Gisborne.

Figure 1 556-560 Aberdeen Road (outlined in blue), with the proposed subdivision outlined in yellow, Lot 4 highlighted in white. Image source: Tairāwhiti Maps (Gisborne District Council, 2023) Accessed: September 2023

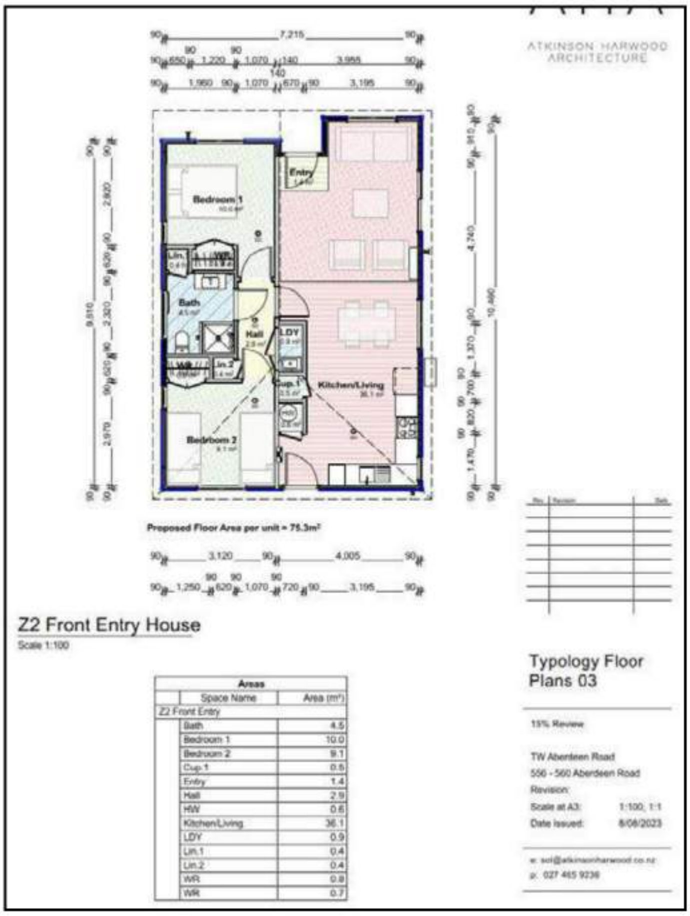
2 PROPOSED DEVELOPMENT

A 12-lot subdivision is proposed at 556 & 560 Aberdeen Road across the property with the legal description Lot 2 DP 1585, PT Lot 1 DP 1585, and Lot 1 DP 1817. The proposed development consists of 7 structures formed of four double-storey duplex buildings, one single-storey building and two standalone dwellings (Figure 1).

The proposed driveway is located centrally of the site to provide access between lots and Aberdeen Road. Proposed access and building platform locations are shown in Figure 1 and Appendix A.

A 75.3m^2 single storey standalone dwelling is proposed on Lot 4 (Figure 2), with timber framing in accordance with NZS3604 (2011), with weatherboard and sheet wall cladding, profiled metal roofing and a concrete floor or suspended timber floor.

The purpose of this investigation was to determine and assess the nature of the ground beneath the building site to inform our geotechnical recommendations for site development and design of the building's foundations. The investigation was completed to satisfy the requirements of Gisborne District Council (2022) for Resource and Building Consent.



Z2 Front Entry House
Scale 1:100

Areas		
	Space Name	Area (m²)
Z2 Front Entry		
	Bath	4.5
	Bedroom 1	10.0
	Bedroom 2	9.1
	Cup.1	0.5
	Entry	1.4
	Hall	2.9
	HW	0.6
	Kitchen/Living	36.1
	LDY	0.9
	Lin.1	0.4
	Lin.2	0.4
	WR	0.8
	WR	0.7

Typology Floor Plans 03

15% Review

TW Aberdeen Road
556 - 560 Aberdeen Road
Revision:
Scale at A3: 1:100, 1:1
Date issued: 8/08/2023

e: sol@atkinsonharwood.co.nz
p: 027 465 9236

Figure 2: (From top to bottom): Floor plans for proposed duplex building across Lot 4, alongside the architect's drawing (Lot 4 is labelled). Image Source: Client supplied.

3 SITE STUDY

3.1 Site Description

The site is located within the established suburb of Te Hapara, Gisborne, approximately 2.0km northwest of the Gisborne CBD. The site is generally flat and is elevated between 6m and 7m (New Zealand Vertical Datum (NZVD) 2016). 556 (LOT 2 PT 1 DP 1585) & 560 (LOT 1 DP 1817) Aberdeen Road, occupy a combined area of approximately 2,700m^2.

3.2 Geomorphology and Geology

556 & 560 Aberdeen Road, occupy flat lying ground which, at one time, comprised the historic foreshore of Tūranganui-a-Kiwa (Poverty Bay). The 1:250,000 geological map of the region (Mazengarb & Speden, 2000) indicates the site is underlain by Holocene aged beach deposits which consist predominantly of sand. The Taruheru River is located approximately 120 m to the north; elevation falls relatively gently towards the river until the riverbank, which falls around 6m over some 25m laterally.

The GNS Active Fault Database does not identify any active fault traces or any fault buffer zones affecting the site. The nearest mapped active fault is the Repongaere Fault, located approximately 14 km to the north-west of the properties (GNS Science, 2020).

3.3 Geotechnical Risks

Our review of Gisborne District Council's (GDC) GIS viewer, Tairāwhiti Maps (Gisborne District Council, 2023), and GNS Science's Active Faults Database (GNS Science, 2020) revealed the following:

- 556 & 560 Aberdeen are mapped as being within an area of moderate liquefaction risk.
- The nearest active fault is the Repongaere Fault, located approximately 14 km to the north-west of the properties.
- The site is mapped as yellow tsunami evacuation zone.

In addition to the risk of liquefaction, the nearby riverbanks of the Taruheru River presents the possibility of lateral spreading in a liquefaction-inducing earthquake event.

Our review of the 2023 aerial photographs indicates that the properties were not severely impacted by flooding associated with Cyclone Gabrielle.

3.4 Historical Aerial Photographs

Historical aerial imagery was reviewed as part of this investigation using Retrolens and Google earth aerial

photography, which revealed the following: -

- Residential dwellings were constructed at both properties prior to 1942 (the earliest available aerial photograph with sufficient resolution).
- In the 1942 aerial photograph there appears to be some form of structure/s, a pile of material, or disturbance to the ground beneath the southwest corner of 556 Aberdeen Road. However, the resolution of the aerial photography is not sufficient to reliably determine what occupied the southwest corner of the property.
- A large shed was constructed in the southwest corner of 556 Aberdeen Road sometime between 1942 and 1966, along with smaller auxiliary structures at both properties.
- Several small structures or 'lean-tos' were constructed between 1966 and 1988 across both properties.
- A shed/garage was constructed in the south-east corner of 560 Aberdeen Road.
- Between 1988 and 2021 additions were carried out to the garage/shed in the south-east corner of 560, and the large shed in the southwest corner of 556. The water tank for 560 Aberdeen Road was removed, along with several of the smaller auxiliary structures across both properties.

Figure 3: Historical aerial imagery of the Aberdeen Road Subdivision (Source: (Retrolens.co.nz)), with the location of the individual lots marked in yellow. (a) Aerial imagery from 1942, (b)1966, (c) 1977, (d) 1988.

4 GEOTECHNICAL INVESTIGATION

4.1 Development wide Investigation Scope

Our investigation of the entire site included the following: -

- A walkover assessment of the site and immediate surrounding area to assess its geomorphology and identify any features which may influence our engineering recommendations, or the long-term performance of the ground.
- 15No. 50mm diameter, hand auger boreholes drilled to refusal or 2.5m target depth at the proposed building locations, with measurements of undrained shear strength taken every 0.2m, and associated DCP's to the 2.5m target depth.
- Complete liquefaction analysis of the Five CPTs which were undertaken across the site during the due diligence phase, three at 556 Aberdeen Road and two at 560 Aberdeen Road (Figure 4).

4.2 Lot 4 Investigation Scope

The investigation of the site, completed on 12 September 2023 included the following work: -

- Two, 50mm diameter, hand-auger boreholes (HA06 and HA07), refused in a saturated sands at 2.2m and 2.0m below ground level (bgl). Associated DCP tests were carried out at each test location to the 2.5m target depth within granular materials.
- Measurements of groundwater levels within invasive subsurface test holes, following hole completion.

The test locations are shown on the Geotechnical Investigation Plan (Figure 4), and as Appendix A. Logs with details of the relevant testing completed are presented as Appendices B and C.

Figure 4: Geotechnical Investigation Plan for proposed development, Lot 4 highlighted in white.

5 GROUND CONDITIONS

This section addresses the ground conditions encountered during our investigations.

5.1 Site Stratigraphy

5.1.1 Development Wide

Ground conditions are reasonably consistent across the site. Typically, the property is underlain by topsoil and/or fill to a depth between 0.3m and 0.8m below ground level (bgl), which overlies sand/ silt mixtures to a depth of 1.0m. Underlying this, medium dense to dense sand was encountered to around 6.5m to 7.0m.
Deposits of firm clay were encountered from around 6.5m to 7.0m, with stiff silt/clay mixtures extending to depth from approximately 13m.

A copy of the test logs is provided as Appendix B.

5.1.2 Lot 4 Site Specific Nuances

Topsoil/Fill was encountered in each hand auger borehole from the existing ground surface to depths of 0.3m and 0.8m in HA06 and HA07 respectively.

The aerial imagery of 1942 depicts the existence of tree within the HA07 location, which appears to be removed between 1942-1966. The presence of deep unsuitable fill material in HA07 is expected to be associated with the removal of tree.

Dynamic penetrometer testing in HA06 and HA07 typically ranged between 1 and 7 blows per 50mm penetration below the topsoil.

5.2 Groundwater

Groundwater was encountered at depths of between 1.50m and 2.88m across the site. A low-bound groundwater level of 1.65m bgl was adopted in our assessments. Given that testing was completed in the wettest year on record for Gisborne, the groundwater level adopted is considered significantly elevated from typical levels and no further allowance has been applied for seasonal variations.

6 NATURAL HAZARDS

6.1 Definition & Legislation

This section summarises our assessment of the natural hazards that might affect the site including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding, that might affect the property, as generally defined in Section 106 of the Resource Management Act., as well as the hazards as defined in Section 71(3) of the Building Act (2004), including erosion (including coastal erosion, bank erosion, and sheet erosion), falling debris (including soil, rock, snow and ice), subsidence, inundation (including flooding, overland flow, storm surge, tidal effects and ponding), and slippage.

6.2 Seismic Hazard

6.2.1 Surface Fault Rupture

The GNS NZ Geology Web-map and Active Faults Database (GNS Science, 2020) do not show any faults passing beneath the subject site. There also does not appear to be any surface expressions which would indicate the presence of an active fault beneath or within close proximity to the site. We therefore consider the surface fault rupture risk to be low.

6.2.2 Site Subsoil Class

Based on the published geological information for the region, discussed in Section 3.2, and obtained site-specific CPT data, we consider that a seismic site subsoil classification of D- "Deep or Soft Soil" is appropriate as defined by NZS 1170.5 (2004).

6.2.3 Seismic Actions

In accordance with the NZ Building Code and NZS 1170.5 (2004) the structure proposed is considered Importance Level 2 (IL2) with a design working life of 50 years, therefore:

- The Serviceability Limit State (SLS) design earthquake has an annual exceedance probability (AEP) of 1/25, and;
- The Ultimate Limit State (ULS) design earthquake has an AEP of 1/500.

An intermediate state event (ILS) has been considered in accordance with Gisborne District Council's (GDC's) requirements. This design case has an AEP of 1/100.

The modules of the Earthquake Geotechnical Engineering Practice series jointly published by Ministry of Business Innovation and Employment (MBIE) and the New Zealand Geotechnical Society (NZGS) (2021) provides guidance under Section 175 of the Building Act (2004), to assist with ensuring compliance with the Act. We have adopted the ground motions published within Module 1 (2021) for geotechnical design which are summarised in Table 1.

Table 1 - Summary of adopted seismic parameters.

Seismic Parameters	SLS	ILS	ULS
Horizontal Peak Ground Accelerations (PGA), g	0.12	0.28	0.65
Effective magnitude, Mw	6.3	6.8	7.5

6.3 Liquefaction and Cyclic Softening Assessments

6.3.1 Liquefaction

Liquefaction is the term used to describe the temporary, but substantial, loss of strength and stiffness which can occur in saturated, unconsolidated soils that are subjected to strong shaking. In addition to near-total strength loss, liquefaction may also result in the expulsion of sediment and water at the surface, ground, and structure settlement, and in lateral (spreading) displacement of the ground.

The liquefaction potential was assessed with site-specific CPT data using specialist geotechnical software (CLiq Ver.3.3.1.13) in general accordance with NZGS/ MBIE Module 3 Guidance (2021).

Liquefaction triggering was assessed using the method proposed by Boulanger and Idriss (2014).

Liquefaction-induced, free-field, vertical, volumetric strains were estimated using the method proposed by Zhang et al (2002)

A low-bound groundwater level of 1.65m bgl was adopted as discussed in Section 5.2.

6.3.2 Cyclic-Softening

Cyclic softening is a phenomenon that occurs when the strength and stiffness of a soil decreases due to repeated cyclic loading such as that resulting from strong seismic shaking. Relatively soft clay soils are commonly susceptible to this phenomenon, which can be accentuated where these soils are sensitive i.e., there is a significant difference between the soil's peak and residual shear strength.

Due to the presence of the clay rich estuarine soils at this site, we have undertaken a cyclic softening analysis for the ULS design case. The Gisborne 2007 earthquake was of comparable magnitude and PGA to the ILS design case. No liquefaction or induced settlements were identified within the proximity of the subject site because of this earthquake. Accordingly, cyclic softening has been assessed for the ULS design case only.

Our assessments assumed:

- An N_{kt} value of 14 for the clay-like soils, based on previous work undertaken proximally by LDE within the estuarine deposits.
- An estimate of the maximum, post-liquefaction, volumetric strain based on the work by Robertson and Cabal (Robertson & Cabal, 2014) which recommends a default value of 0.5% for clay-like soils.

6.3.3 Liquefaction and Cyclic Softening Results

The results of our analyses are summarised in Table 2; detailed outputs are included as Appendix D.

The Liquefaction Potential Index (LPI) and Liquefaction Severity Number (LSN) are indices used to assess the general performance level of liquefied deposits in accordance with the NZGS/MBIE Module 3 Guidance (2021).

Our analyses indicate that liquefaction-induced settlements are likely to be negligible (<5mm) in a design SLS seismic event.

Under the ILS design case, liquefaction-induced settlements are estimated to be between 20mm and 50mm. As discussed in Section 6.3.2, no liquefaction, or liquefaction-induced settlements were identified within the proximity of the subject site as a result of the Gisborne 2007 earthquake, which had almost identical ground motions. Accordingly, we consider it unlikely that liquefaction would be realised under ILS seismic shaking and conclude that the software is likely to be over-estimating liquefaction potential.

Table 2 - Summary of liquefaction analysis results.

Limit State / AEP	CPT ID	LPI	LSN	Estimated Seismic Volumetric Settlements (mm) [Limited to 10m] (3)			Effects of Liquefaction
				Liquefaction	Cyclic Softening	Total Seismic Settlement	
SLS 1/25 year	CPT-01	0	0	<5 [<5]	-	**<5 [<5]**	**L0**
	CPT-02	0	0	<5 [<5]	-	**<5 [<5]**	
	CPT-03	0	0	<5 [<5]	-	**<5 [<5]**	
	CPT-04	0	0	<5 [<5]	-	**<5 [<5]**	
	CPT-05	0	0	<5 [<5]	-	**<5 [<5]**	
ILS 1/100 year	CPT-01	2	8	~30 [~25]	-	**~30 [~25]**	**L2**
	CPT-02	4	12	~50 [~45]	-	**~50 [~45]**	
	CPT-03	2	5	~20 [~20]	-	**~20 [~20]**	
	CPT-04	4	12	~45 [~40]	-	**~45 [~40]**	
	CPT-05	3	10	~45 [~30]	-	**~45 [~30]**	
ULS 1/500 year	CPT-01	18	23	~75 [~70]	~45	**~120 [~70]**	**L3**
	CPT-02	18	23	~85 [~75]	~40	**~125 [~75]**	
	CPT-03	16	19	~70 [~65]	~40	**~110 [65]**	
	CPT-04	20	24	~85 [~80]	~40	**~125 [65]**	
	CPT-05	18	23	~85 [~65]	~40	**~125 [65]**	
Effects of liquefaction Key		**L0: Insignificant**	**L1: Mild**	**L2 Moderate**	**L3: High**	**L4 Severe**	**L5: Very Severe**

Notes:

- Liquefaction triggering Boulanger and Idriss (2014) methodology limited to upper 15m. Limited to 10m of soil profile shown in square brackets [ ].
- Settlements are free-field estimated settlements and do not include any building-induced settlements.
- Effects of Liquefaction based on NZGS Module 3 (New Zealand Geotechnical Society (NZGS) & Ministry of Business, Innovation and Employment (MBIE), 2021)

Under design ULS seismic shaking, settlements in the order of 110mm to 125mm are estimated. However, given the rationalisation to the Gisborne 2007 earthquake, discussed above, we consider that total, free-field, seismic settlements are likely to less than 100mm.

6.4 Lateral Spreading and Lateral Stretch

Lateral spreading typically occurs in sloping ground or level ground close to slopes or waterways and is most commonly caused by loss of strength due to earthquake-induced liquefaction. Typically, the degree of lateral movement diminishes as the distance from the waterway, or free face, increases.

Liquefaction-induced lateral displacements were estimated in CLiq software using the method proposed by Zhang et al (2004). utilising an I_c cut-off of 2.6, clean sand and overburden corrections, and inferred soil unit weights.

The methods available to predict lateral displacements from CPT data. Both these methods are based upon limited case studies and as such have inherent limitations for broader application. They are known to be highly inaccurate with predictions versus empirical data varying by a factor of two (NZGS Module 3 (2021)) or possibly more. Accordingly, lateral spreading potential was also assessed through numerical modelling, using Slide 2 (Version 9.027) by Rocscience Inc., to provide a more reliable estimate and allow sensitivity analyses to be undertaken.

Both methods, and associated results are discussed below.

6.4.1 CLiq Assessment

Our CLiq assessment adopted the 'Level ground with a free face' approach because the alternative option (gently sloping ground) was found to estimate lateral displacements in excess of 600mm under the ILS design case.

Our assessment was based on the sites closest proximity to the Taruheru River (117m) and a free face height of 7m (elevation relief from the site to the river) and was completed for each CPT.

Table 3 presents the results of these analyses.

Table 3 - Summary of Lateral Spreading Displacements

CPT ID	SLS 1/25 year (mm)	ILS 1/100 year (mm)	ULS 1/500 year (mm)	Global Lateral Movement (ULS)
CPT01	<5	~105	~315	**Major**
CPT02	<5	~170	~390	**Major**
CPT03	<5	~100	~275	**Minor to Moderate**
CPT04	<5	~250	~460	**Major**
CPT05	<5	~180	~380	**Major**
Global lateral movement categories	**Minor to Moderate 0 to 300mm**	**Major 300 to 500mm**	**Severe >500mm**	

Notes:

- Free-face method adopted limits of lateral spreading to 2H. Chu et al (2006) have compared predicted values of lateral spread using the Zhang et al model with actual measurements of lateral displacement following the 1999 Chi Chi earthquake. They found that predicted values better matched observed values when liquefaction calculations in the CPT profile were limited to a depth of twice the free face height (2H).
- Global lateral movement categories based on MBIE Guidance for TC3 (Ministry of Business Innovation and Employment Hīkina Whakatutuki, 2015)

6.4.2 Numerical Modelling Assessment

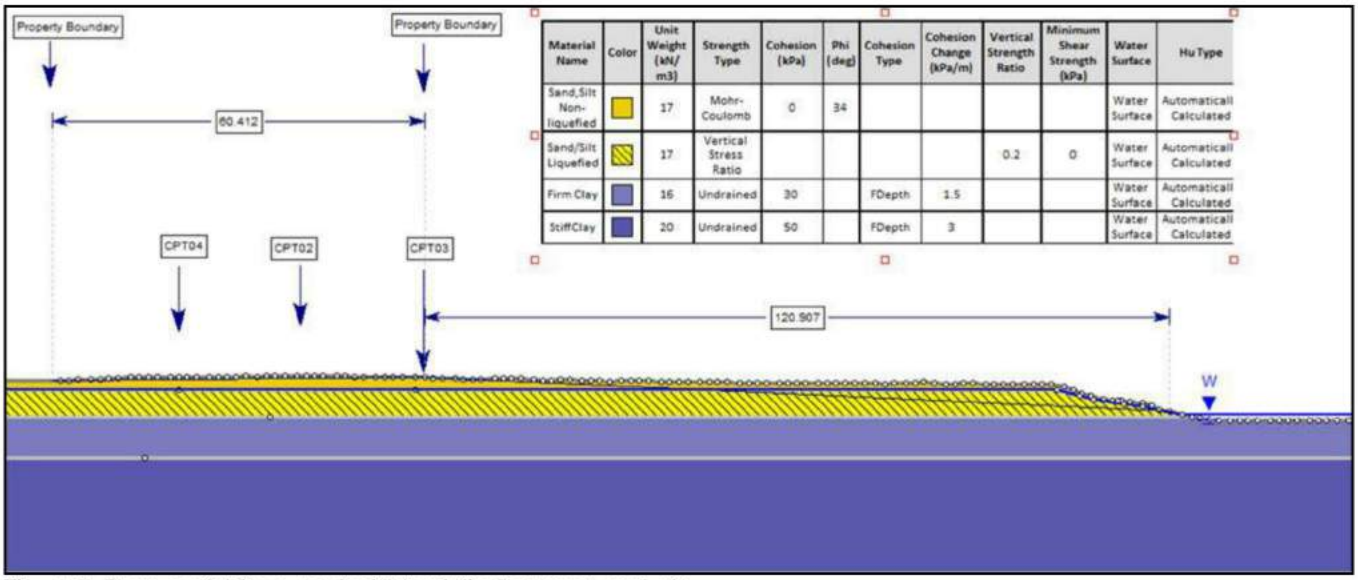
Numerical modelling was used to assess the potential for lateral displacements using Slide 2 as discussed above.

Our modelling assessed non-circular slip surfaces using the 'Cuckoo' search method and adopting the 'Vertical Strength Ratio' material strength model for the liquefied layer.

From past projects and general geological knowledge of this area, it is our experience that the Holocene beach sand transitions to clay-rich deposits towards the river, likely due to a combination of river migration and overbank deposition. In many areas along the Taruheru river a relic river terrace can be clearly identified, however this area had been developed prior to the earliest available historic aerial imagery and consequently the terrace boundary could not be identified.

Accordingly, we have adopted a conservative 'what if.' scenario in our modelling where the liquefied layer has been extended at consistent thickness and elevation to the river.

Figure 5 shows the base model, the surface profile of which was plotted from recent LiDAR data. Note the left side of the model has been manually extended to check the potential for more critical slip surfaces.



Material Name	Color	Unit Weight (kN/ m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Cohesion Type	Cohesion Change (kPa/m)	Vertical Strength Ratio	Minimum Shear Strength (kPa)	Water Surface	Hu Type
Sand,Silt Non-liquefied	🟨	17	Mohr-Coulomb	0	34					Water Surface	Automaticall Calculated
Sand/Silt Liquefied	▨	17	Vertical Stress Ratio					0.2	0	Water Surface	Automaticall Calculated
Firm Clay	🟪	16	Undrained	30		FDepth	1.5			Water Surface	Automaticall Calculated
StiffClay	🟦	20	Undrained	50		FDepth	3			Water Surface	Automaticall Calculated

Figure 5: Base model for numerical lateral displacement analysis

The liquefied shear strength to overburden stress (Tau/ Sigma) ratio was derived for the sand/ silt mixtures from statistical analysis of CPT data. The Tau/ Sigma Ratio was found to vary significantly, ranging from 0.08 to 0.98; a value of 0.2 was adopted to provide a moderately conservative estimate for the body of liquefied material. Figure 6 shows a plot of Tau/ Sigma ratio with depth for CPT04.

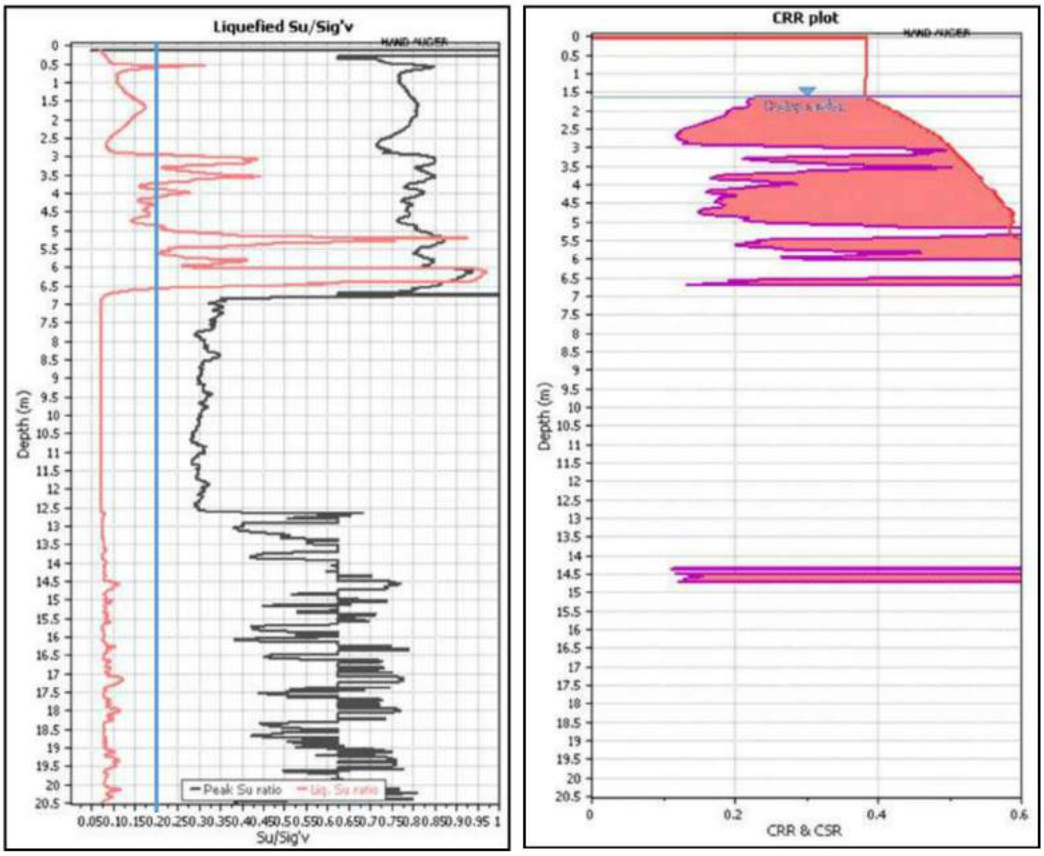


Figure 7: Tau/ Sigma ratio plot for CPT04 and plot showing depth of liquefiable material. Blue line shows value adopted in our modelling.

Two design cases were assessed:

1. Static Flow

   This design case models a post seismic liquefied case to assess the potential for flow failures to impact the subject property.
2. Seismic Yield

   This assessment determines the PGA required for the site to be affected by lateral displacements considering seismic action coincident with the fully liquefied condition. A magnitude of 0.1g was considered reasonable to represent an aftershock occurring within the short-term, liquefied timeframe.

6.4.2.1 Results

The results suggest that the property will not be affected in the static flow scenario with failures extending to a maximum of around 31m from the riverbank, some 85m from the subject property.

Under the seismic yield design case the subject property is estimated to be affected with a PGA of around 0.11g. Accordingly, lateral displacements are not anticipated in this scenario.

Full results are presented in Appendix E.

6.4.3 Conclusions

Numerical modelling indicates that lateral displacements of the magnitude estimated by CLiq are only achieved when full seismic PGAs are applied in the fully liquefied condition. Such a scenario is considered to be of very low probability, and highly conservative. We consider however that there is a reasonable probability of an aftershock occurring during this timeframe.

We conclude that the numerical modelling provides a more realistic estimate of ground performance, particularly given the apparent overestimation of liquefaction affects, discussed in Section 6.3.3. Accordingly, we consider that the subject site has low lateral spreading potential.

6.4.3.1 Lateral Stretch

Lateral stretch is a metric of the amount of differential extension that a portion of land may experience during an episode of lateral spreading. The lateral stretch across a foundation is a main factor in foundation damage due to liquefaction and lateral spreading as a result of a large earthquake.

Given the results of our numerical analyses, discussed above, lateral stretch is not anticipated at the subject site under the design cases assessed.

6.5 Liquefied Bearing

Liquefaction may lead to foundation bearing failure, by either 'punch through' failure or a reduction in bearing capacity when liquefaction occurs within the zone of influence of load bearing foundations.

A preferred foundation option has not been identified for the proposed structures at the time of writing and we have completed liquefied bearing assessments for both raft-type surface structures and piled foundations.

A unit weight of 17kN/m^3 was adopted for both the non-liquefied and liquefied soil layers. An angle of internal friction of 34 degree was adopted for the non-liquefied material.

The Tau/sigma ratio for these assessments was based on site-specific CPT data and taken as 0.075 for the liquefied material within the zone of influence of the foundations.

A low bound groundwater level was taken as 1.65m, as discussed in Section 5.2.

A reduction factor of 0.75 was applied to the ultimate capacities calculated for the proposed, two-storey, duplex buildings, in accordance with MBIE Module 5 (2021) for moderately loaded structures.

6.5.1 Pile Foundation Assessment

Our assessment of pile foundations assumed:

- Ordinary piles embedded to a minimum depth of 0.5m at 0.3m diameter (including concrete cover), and

- Anchor piles embedded to a minimum depth of 0.9m at 0.4m diameter (including concrete cover), and
- 100kPa design load.

Both projected area and 'punch-through' failure mechanisms were assessed.

6.5.1.1 Results

The design load was found to be acceptable in both design cases. Note that our calculations are dependent on the assumptions listed within this Section. Should the pile diameter, pile embedment depth or design loads change, the liquefied bearing capacities will need to be reassessed.

6.5.2 Raft type Surface Structure Foundation Assessment

For the raft-type surface structures assessments were completed for the single-storey and two-storey buildings assuming:

- Foundation widths as presented in the 15% architectural drawings, and
- An embedment depth of 0.2m.

6.5.2.1 Results

Liquefied bearing capacities were calculated to be 19kPa for the proposed single-story buildings and 14kPa for the proposed two-storey duplex structures.

The values presented above are dependent on the assumptions listed. Should the foundation breadth, embedment depth or design loads change, the liquefied bearing capacities will need to be reassessed.

6.6 Equivalent MBIE Technical Category

Considering the rationalisation provided in Section 6.3.3, we consider that seismic ground performance at this site would be equivalent to a TC2 classification in accordance with Table 15.6 of the MBIE Guidance (2015).

6.7 Flood Hazard

The site is not located in a mapped flood hazard zone. GDC aerial imagery post cyclone Gabrielle does not indicate this site experienced significant impacts.

6.8 Tsunami

The Gisborne / East Cape coastline is classified as being at the highest risk in the country of being affected by tsunami. Modelling for the Gisborne region (GNS Science Te Pū Ao, 2016) indicates that the site is sufficiently elevated and is unlikely to be inundated in 1:100, 1:500, and 1:2500-year return period tsunami events, respectively. Civil defence tsunami inundation maps show that the site mapped as a yellow zone, which may be subject to tsunami

hazard in the case of a severe (ie M8.9) local earthquake on the Hikurangi subduction margin (Gisborne District Council Te Kaunihera o Te Tairāwhiti, 2019) .

6.9 Expansive Soils

Cohesive soils containing significant proportions of certain clay minerals can be subject to appreciable volume change caused by variations in soil moisture content, most notably between seasons or from the uptake of water through the root systems of trees and shrubs. This is referred to as soil reactivity or shrink-swell behaviour.

The surficial soils at this site are granular in nature and therefore not subject to expansivity.

6.10 Consolidation Settlement

The topsoil across the site is expected to be subject to consolidation with applied load and is not suitable to support structural loads.

The firm clay beneath the site may also be subject to consolidation settlement depending on the foundation option selected and the structural loads applied. The potential for consolidation settlement within this material should be assessed once the foundation type and structural loads have been determined.

6.11 Natural Hazards Summary

From our assessment of the natural hazards and ground deformation risks presented to the proposed development we consider that the proposed structures can be safely located on the site, provided that the recommendations given in Section 7 are adopted.

7 ENGINEERING RECOMMENDATIONS

7.1 Site Contouring and Topsoiling

The finished ground level should be graded so that water cannot pond against, beneath or around the buildings for the economic life of structure. To achieve this, it will be important that the building platform beneath the topsoil grades away from the site. Contouring should avoid the potential for concentration and discharge of surface water over point locations which could result in soil erosion or instability.

7.2 Access Road Construction

Access is proposed from Aberdeen Road. No major/ significant earthworks are anticipated to form access to the proposed dwellings.

7.3 Foundation Recommendations

7.3.1 Foundation Type

Based on the site investigation and analysis, we consider that foundations comprising pile foundations or raft-type surface structures are suitable for the site conditions providing the recommendations and limitations presented within this section are addressed in design.

7.3.2 Design Considerations

Based on the scope of work completed, the following aspects need to be considered in detailed design:

- Site Class - Class D - Deep or soft soil
- Liquefaction-induced vertical settlements - TC2 equivalent
- Relatively high groundwater level
- Liquefied bearing capacity
- Potential for consolidation settlement

7.3.3 Bearing Capacity and Founding Depth

Foundations must extend beneath any topsoil, uncontrolled fill, organic and/ or otherwise unsuitable material.

For the Lot 4 building we anticipate that a static geotechnical ultimate bearing capacity of 210kPa will be available from 0.3m depth. Some localised deepening of foundations is anticipated in the vicinity of HA07. A reduction factor of 0.45 should be applied to the GUBC to give the design bearing strength (q_{dbs}).

A short-term, post-seismic (static), liquefied bearing capacity, equivalent to the values presented in Section 6.5, should be assessed in structural design. Note that these liquefied bearing capacities are contingent on the assumptions listed within Section 6.5. Should these assumptions change in design, the liquefied bearing capacities will need to be reassessed. This may require some iterative design between the geotechnical and structural engineers.

7.4 Surface Water

Surface water from roof, impermeable surfaces, or any slopes should be collected and discharged away from the building to mitigate against flooding, erosion, soil expansivity, and/ or potential instability. The site will be connected to the reticulated network. Rainwater will be collected from the roof and all paved surfaces including parking areas and discharged into the GDC reticulated stormwater network.

7.4.1 Service Pipes

All service pipes, stormwater structures should be designed and constructed to ensure adequate capacity, strength, and water tightness to prevent leakage into the platform through blockage, running under pressure, or structural failure.

All service pipes installed within any fill should be flexible, or flexibly joined, so that they may deflect without breaking if the ground settles.

A record should be kept of the position, type, and size of all subsoil drains, and in particular of their outlets.

7.5 Trees and Shrubs

There are trees within the vicinity scattered across the property which might potentially cause damage through heaving as a result of root growth and/or settlement resulting from soil shrinkage from the moisture uptake of the roots. To reduce the chance of damage to the foundations, we recommend one of the following options:

- Any Trees/ plants that at their mature high will not be a minimum of that height away from the foundation should be removed including its major root structure.
- A root barrier should be designed and installed between the offending plant and the structure.
- Foundation should be taken to a depth no less than 1.0m where damage from the roots of a plant is unlikely.

If new trees, shrubs, or gardens are established near the structure, care should be taken to ensure:

- The vegetation does not interfere with any subfloor ventilation or services to the structure.
- Over-watering of the vegetation does not saturate the ground near the foundations.
- Trees or shrubs with the potential to develop significant root systems should be planted a minimum distance equal to the mature height of the plant away from the foundations.

8 SUSTAINABILITY

Considering sustainability as early as possible in a project's development, could lead to significant project opportunities and wider positive outcomes. Geotechnical opportunities for increased sustainability for this project include:

- Striping and stocking topsoil for reuse (dependant on presence/ levels of contaminants).
- Designing for cut and fill balance where possible.
- Reuse of site won materials, or using materials won from other sites including use of recycled crushed concrete aggregate for hard fill.
- Contributing site investigation data to the New Zealand Geotechnical Database (NZGD) to help reduce the site investigations needed in the future.

- Using local consultants and contractors to reduce transport related emissions.

9 CONCLUSIONS

Following development of the site in accordance with our recommendations, we consider that: -

a) The land in respect of which a consent is sought, or any structure on the land built in accordance with our recommendations, is unlikely to be subject to material damage by erosion, falling debris, subsidence, slippage, or inundation from any source; and

b) Any subsequent use that is likely to be made of the land is unlikely to accelerate, worsen, or result in material damage to the land, other land, or structure by erosion, falling debris, subsidence, slippage, or inundation from any source; and

c) Sufficient provision has been made for physical access to each allotment to be created by the subdivision.

10 PLAN REVIEW

Prior to an application for Building Consent, it is important we are given the opportunity to review the final development drawings to ensure the recommendations contained within this report have been followed and interpreted correctly. Following successful review of the development drawings, we are able to update this report to support an application for Building Consent.

11 VERIFICATION

Verification requirements will be provided once the form of the foundations has been determined.

12 LIMITATIONS

This report should be read and reproduced in its entirety including the limitations to understand the context of the opinions and recommendations given.

This report has been prepared exclusively for NZHG Gisborne Limited in accordance with the brief given to us or the agreed scope and they will be deemed the exclusive owner on full and final payment of the invoice. Information, opinions, and recommendations contained within this report can only be used for the purposes with which it was intended. LDE accepts no liability or responsibility whatsoever for any use or reliance on the report by any party other than the owner or parties working for or on behalf of the owner, such as local authorities, and for purposes beyond those for which it was intended.

This report was prepared in general accordance with current standards, codes and best practice at the time of this report. These may be subject to change.

Opinions given in this report are based on visual methods and subsurface investigations at discrete locations designed to the constraints of the project scope to provide the best assessment of the environment. It must be appreciated that the nature and continuity of the subsurface materials between these locations are inferred and that actual conditions could vary from that described herein. We should be contacted immediately if the conditions are found to differ from those described in this report.

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14 GLOSSARY

Compressible Soils:	Compressible soils are those that will undergo a reduction in volume under an imposed load, such as the weight of fill or a structure. This occurs firstly as a result of the expulsion of air and water from the soil void spaces (primary settlement) and secondly due to a restructuring of the soil skeleton to take the load (secondary settlement).
Cyclic Softening:	Cyclic-softening is a related condition to liquefaction can also affect clay soils when subjected to cyclic-loading. Clay soils may significantly soften and led to bearing capacity failure, in addition to post-earthquake consolidation settlements may occur as a result of the earthquake shaking.
Expansive Soils:	Cohesive soils containing significant proportions of certain clay minerals can be subject to appreciable volume change caused by variations in soil moisture content, most notably between seasons or from the uptake of water through the root systems of trees and shrubs. This is also often referred to as soil reactivity or shrink-swell behaviour.
Lateral Spread:	Lateral spread of liquefied soils is the lateral displacement of blocks of land moving laterally towards a free edge (for example a riverbank) or within sloping ground. More lateral movement tends to occur closest to the edge with less movement further back. Lateral spreading may

result in large permanent ground displacements including cracks, fissures, vertical officesets and overall settlement of the ground.

Lateral Stretch: Lateral stretch is the amount of differential extension that a portion of land may experience during an episode of lateral spreading. The lateral stretch across a foundation is a main factor in foundation damage due to liquefaction and lateral spreading because of a large earthquake.

LiDAR Light Detection and Ranging (LiDAR) is a method of remote sensing topographical survey.

Limit States: Seismic design criteria for performance-based design. SLS, SLS2 & ULS are prescribed in NZS1170.5 (Standards New Zealand Te Mana Tautikanga O Aotearoa, 2004)

- **Serviceability Limit State (SLS):** Functional requirements for the serviceability limit state are assumed to be met if the structure or part can continue to be used as originally intended without the need for repair (SLS1) or can remain operational or continue to be occupied as appropriate (SLS2). SLS earthquakes are considered highly likely to occur during the lifetime of the structure.
- **Ultimate Limit State (ULS):** Functional requirements for the ultimate limit state are assumed to be met if:
    a) People within, and adjacent to the structure are not endangered by the structure or part.
    b) Displacements of the structure are such that there is no contact between any parts of a structure for which contact is not intended, or between separate structures on the same site, if such contact would damage the structures or parts to the extent that persons would be endangered, or detrimentally alter the response of the structure(s) or parts, or reduce the strength of structural elements below the required strength.
    c) The structure does not deflect beyond a site boundary adjacent to which other structures can be built or collision between the structure and any adjacent existing structures cannot occur.
    d) There is no loss of structural integrity in either the structure or part.
- **Intermediate Limit State (ILS):** ILS is an intermediate seismic event between SLS & ULS although is not a code requirement. The behaviour of soils and geotechnical systems under earthquake shaking may be highly non-linear and even exhibit a pronounced 'step change' in performance with increasing intensity of shaking. For such cases, only considering performance at the SLS and ULS levels of shaking would fail to identify potentially poor and unacceptable performance at intermediate return periods of shaking.

Liquefaction: Liquefaction is the term used to describe the temporary, but substantial, loss of strength and stiffness which can occur in saturated, unconsolidated soils that are subjected to strong shaking. In addition to near-total strength loss, liquefaction may also result in the expulsion of

	sediment and water at the surface, ground and structure settlement, and in lateral (spreading) displacement of the ground.
LPI	Liquefaction potential index is a liquefaction damage index. LPI ranges between 0 and 100 and sites with an LPI of 5 indicate a high liquefaction risk and sites with LPI greater than 15 indicate very high risk (Iwasaki et al, 1982). Not to be used as a precise measure of liquefaction-induced ground damage but as an indicator of the general level of liquefaction severity.
LSN	Liquefaction Severity Number is a liquefaction damage index. LSN varies from 0 (representing no liquefaction vulnerability) to more than 100 (representing very high liquefaction vulnerability (van Ballegooy et al, 2013). LSN places greater importance (than LPI) on the thickness of the non-liquefied crust when the groundwater table is close to the ground surface. Not to be used as a precise measure of liquefaction-induced ground damage but as an indicator of the general level of liquefaction severity. LNS was developed based on the observations/ investigations from the Canterbury earthquake sequence
PGA:	Peak Ground Acceleration (PGA) is the maximum ground acceleration during an earthquake as a proportion of gravity.
Punch Through Failure:	Punch through failure occurs when a foundation punches through a crust of non-liquefiable material due to underlying liquefaction occurring and can lead to potential damage to foundations and/ or large settlements.
Technical Category:	Following the 2010 -2011 Canterbury earthquake sequence the Ministry of Business Innovation and Employment (MBIE) assigned three technical categories (TC1, TC2, TC3) across the residential 'green zone' for foundation investigation and design guidance focusing on one and two storey timber-framed dwellings. These categories are broadly defined as below: • **TC1:** Liquefaction damage is unlikely in future large earthquakes. Standard residential foundation assessment and construction is appropriate. • **TC2:** Liquefaction damage is possible in future large earthquakes. Standard enhanced foundation repair and rebuild options in accordance with MBIE guidance are suitable to mitigate against this possibility. • **TC3:** Liquefaction damage is possible in future large earthquakes. Individual engineering assessment is required to select the appropriate foundation repair or rebuild option. • **TC2/ TC3 Hybrid**: A site that straddles liquefaction settlement limits of TC2 and TC3 where the SLS settlements are assessed as being less than 50mm, but the ULS settlements are assessed at greater than 100mm. Whilst this guidance is intended for residential buildings in the Canterbury region, they have been widely adopted to convey liquefaction vulnerability across New Zealand.
The Modules:	The New Zealand Geotechnical Society (NZGS) and MBIE jointly published a series of guidelines for Earthquake Geotechnical Engineering Practice. Revision 1 of the Modules was published in November 2021 and they provide guidance under section 175 of the Building Act

2004 to assist parties to comply with their obligations under the Building Act 2004. The following modules currently form the collection:

- **Module 1**: Overview of the guidelines
- **Module 2**: Geotechnical investigation for earthquake engineering
- **Module 3**: Identification, assessment, and mitigation of liquefaction hazards
- **Module 4**: Earthquake resistant foundation design
- **Module 5**: Ground improvement
- **Module 5A:** Specification of ground improvement for residential properties in the Canterbury region
- **Module 6**: Retaining walls

APPENDIX A

SITE PLAN

LEGEND

Project Data

🟨	Proposed Lots Boundary
🟥	Proposed Building Platform
—	Proposed Accessway
◐	Hand Auger + DCP
▽	CPT (Due Diligence)

0 6 12 18 24 m

SCALE A3: 1:350

NOTES

1. Aerial basemap and property boundaries sourced from LINZ Data Service (CC-BY 4.0).
2. Investigation locations shown approximately only.

CLIENT
NZHG Gisborne Limited

PROJECT
Geotechnical Investigation for proposed subdivision
556-560 Aberedeen Road, Te Hapara
Gisborne

DRAWING TITLE
Geotechnical Investigation Plan

LDE
LAND DEVELOPMENT & ENGINEERING

PROJECT REF	DRAWING REF	REVISION
24477	GIP	A
DATE	PREPARED BY	CHECKED BY
29/09/2023	SS	RH

FILE PATH
M:\FILES\LDE - Projects\77008-24477\Geo QGIS Zip Folder (ID 79064)\24477 QGIS Site Maps\24477 Aberdeen Rd.qgz

APPENDIX B

HAND AUGER TEST LOGS

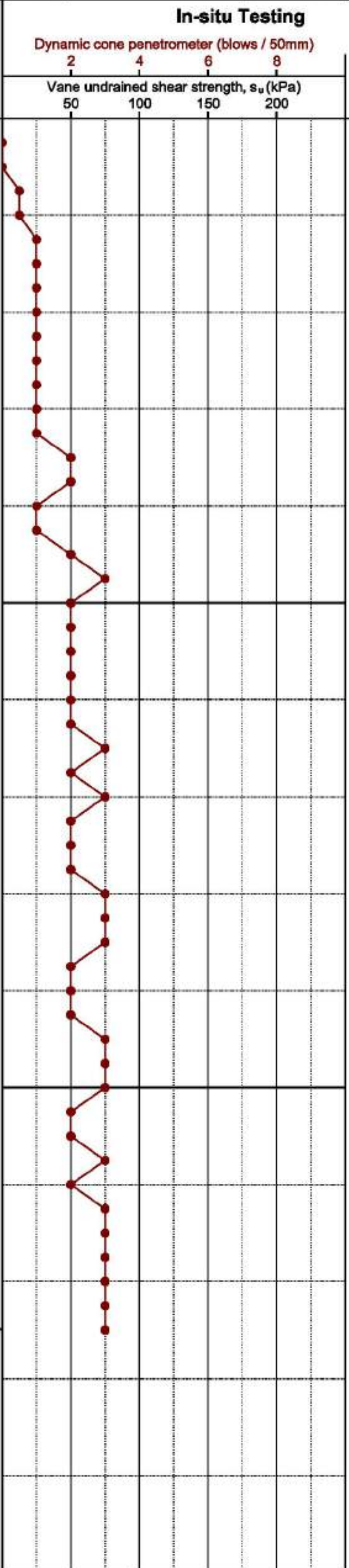
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA01**				
Project ID:	24477				
Sheet:	1 of 1				
Client:	NZHG	**Coordinates:**	5709871mN, 2036134mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.5m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Graphic Log	Material Description	Water
	TS		SAND, with trace rootlets and silt; dark brown. Very loose; moist; sand, fine to medium.	Groundwater not encountered
0.5 1.0 1.5 2.0 2.5	Holocene Beach Deposits		SAND; brown. Loose; moist; sand, fine to medium. 1.80m: Light grey. 2.20m: Grey with orange mottles. 2.40m: Wet.	

In-situ Testing



Values

Vane ID: N/A

peak / residual (sensitivity)

RL (m): 6.0, 5.5, 5.0, 4.5, 4.0

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

● Vane peak
○ Vane residual
◆ Vane UTP
▼ Standing water level
◁ Groundwater inflow
▷ Groundwater outflow
UTP = Unable to Penetrate

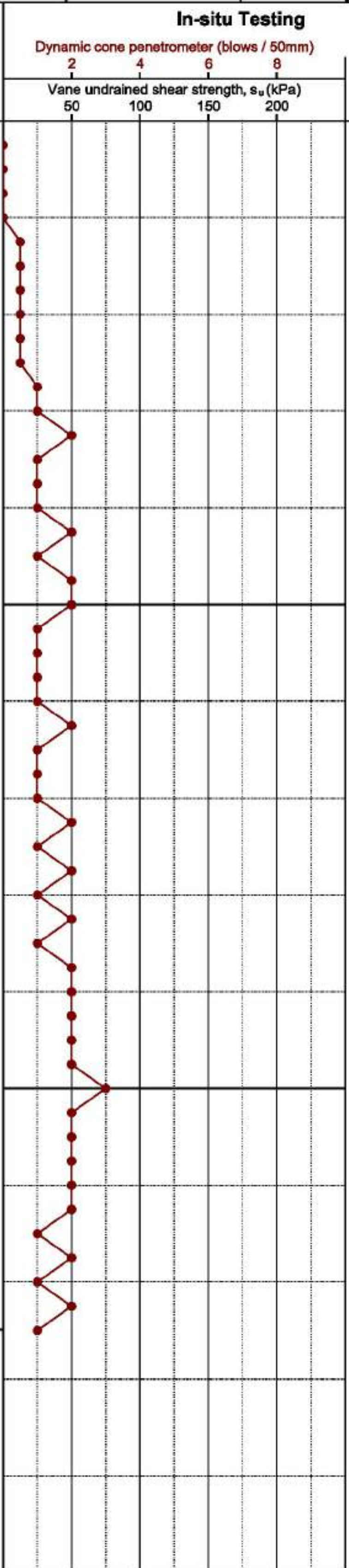
Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA02**				
Project ID:	24477				
Sheet:	1 of 1				
Client:	NZHG	**Coordinates:**	5709864mN, 2036136mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.5m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	RL (m)
0.0–0.5	TS	SAND, with minor silt, with trace rootlets; dark brown. Very loose; moist; sand, fine to medium.	Groundwater not encountered	
0.5	Holocene Beach Deposits	SAND; brown. Loose; moist; sand, fine to medium.		6.0
1.0				5.5
1.5		1.50m: Grey with orange mottles.		5.0
1.70		1.70m: Light grey.		
2.0				4.5
2.40		2.40m: Wet.		
2.5				4.0



Values

Vane ID: N/A

peak / residual (sensitivity)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

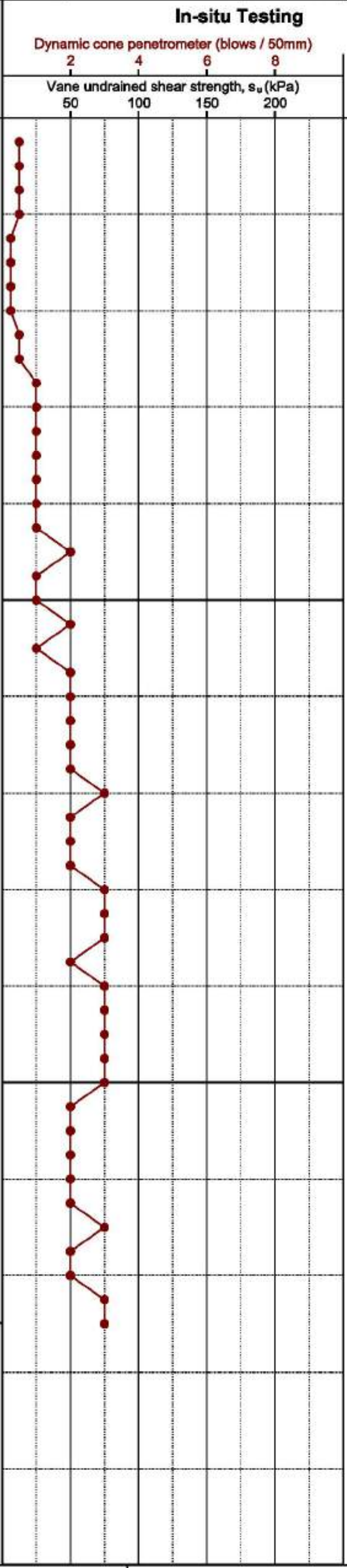
UTP = Unable to Penetrate

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	HA03				
Project ID:	24477				
Sheet:	1 of 1				
Client:	NZHG	**Coordinates:**	5709847mN, 2036129mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	7m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Graphic Log	Material Description	Water	RL (m)
0.5	Uncontrolled Fill / Topsoil		SAND, with minor silt, with trace rootlets; dark brown. Very loose; moist; sand, fine to medium; trace metal fragments.		6.5
1.0 1.5 2.0 2.5	Holocene Beach Deposits		SAND; brown. Loose; moist; sand, fine to medium. 1.80m: Grey with orange mottles. 1.90m: Wet. 2.40m: Saturated.	▼	6.0 5.5 5.0 4.5



Values
Vane ID: N/A
peak / residual (sensitivity)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak
○ Vane residual
◆ Vane UTP
▼ Standing water level
◁ Groundwater inflow
▷ Groundwater outflow
UTP = Unable to Penetrate

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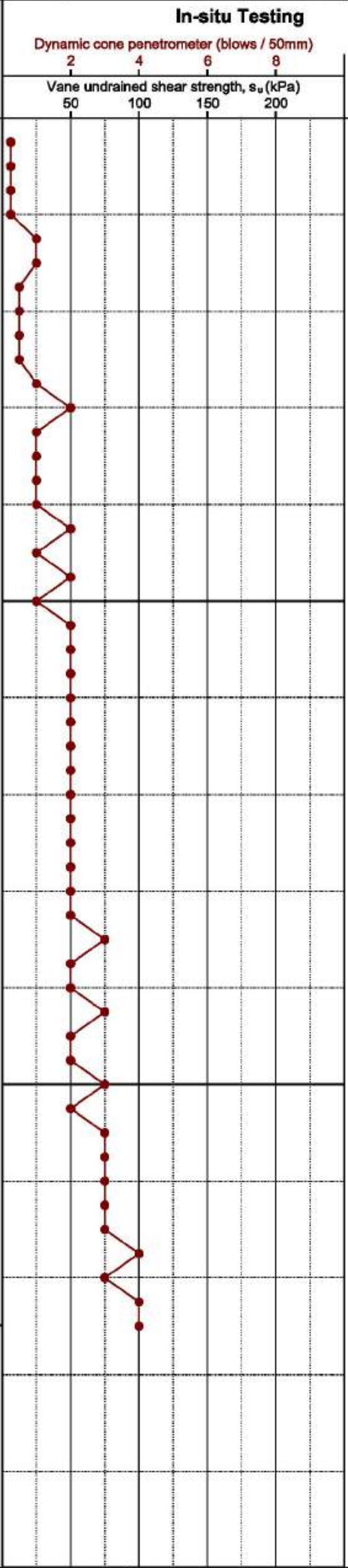
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA04**
Project ID:	24477
Sheet:	1 of 1

Client:	NZHG	**Coordinates:**	5709842mN, 2036126mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	7m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Graphic Log	Material Description	Water	RL (m)
0.0–0.4	TS		SAND, with minor silt, with trace rootlets; dark brown. Loose; moist; sand, fine to medium.		
0.4–2.5	Holocene Beach Deposits		SAND; brown. Loose; moist; sand, fine to medium. 1.90m: Wet. 2.20m: Saturated.	▼ (2.20)	
0.5					6.5
1.0					6.0
1.5					5.5
2.0					5.0
2.5					4.5



Values

Vane ID: N/A

peak / residual (sensitivity)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- ● Vane peak
- ○ Vane residual
- ◆ Vane UTP
- ▼ Standing water level
- ◁ Groundwater inflow
- ▷ Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

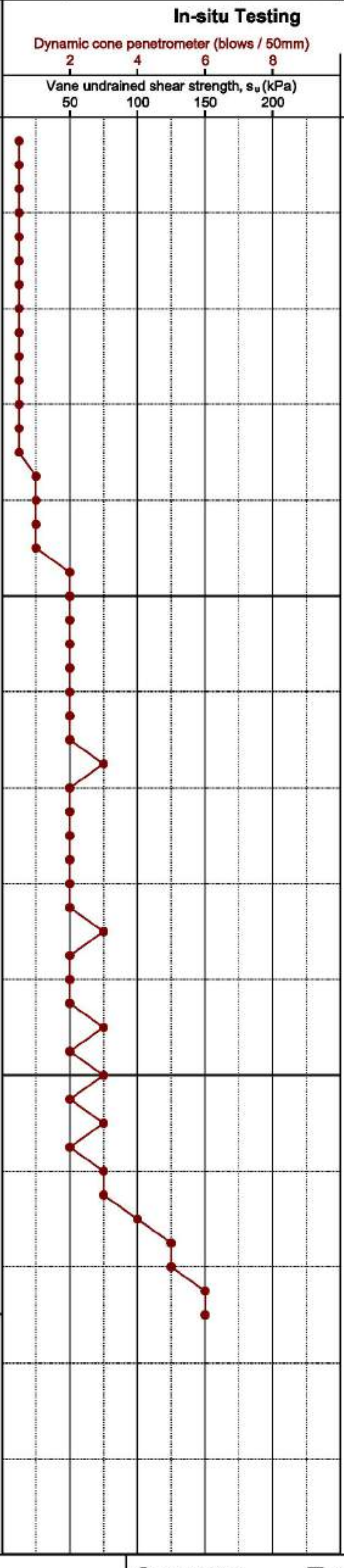
Method: 50mm Hand Auger

Test ID: HA05
Project ID: 24477
Sheet: 1 of 1

Client:	NZHG	**Coordinates:**	5709846mN, 2036121mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	7m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	RL (m)
0.0–0.5	Uncontrolled Fill / Topsoil	SAND, with minor silt, with trace rootlets and gravel; dark brown. Loose; moist; sand, fine to medium; gravel, fine to medium, subrounded to subangular.		7.0–6.5
0.5–2.5	Holocene Beach Deposits	SAND; brown. Loose; moist; sand, fine to medium. 1.80m: Brownish grey. 1.90m: Wet. 2.40m: Saturated.	▼ (2.40m)	6.5–4.5

In-situ Testing



Values

Vane ID: N/A

peak / residual (sensitivity)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	**HA06**
Project ID:	24477
Sheet:	1 of 1

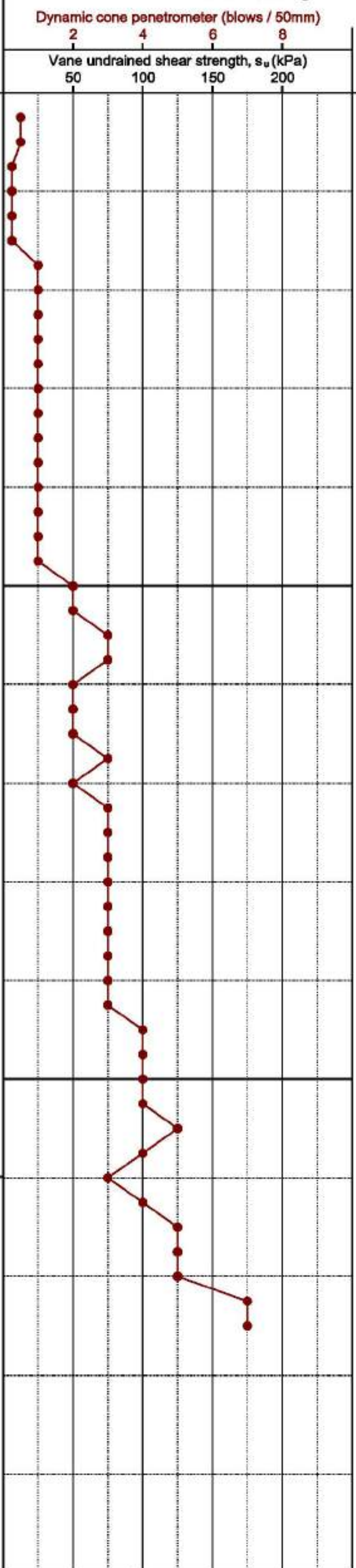
Client:	NZHG	**Coordinates:**	5709835mN, 2036107mE
Project:	Geotechnical Investigation	**System:**	NZTM
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.2m (NZVD2016)
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map

Test Date:	12/09/2023
Logged By:	SS
Prepared By:	SS
Checked By:	RH

Depth (m)	Geology	Material Description	Water
	Uncontrolled Fill / Topsoil	SAND, with minor silt, with trace rootlets and gravel; dark brown. Very loose; moist; sand, fine to medium; gravel, fine, subangular.	
0.5 1.0 1.5 2.0	Holocene Beach Deposits	SAND; brownish orange. Loose; moist; sand, fine to medium. 1.60m: Wet. 1.80m: Heavy orange mottling. 1.90m: Brownish grey. Saturated. 2.00m: Brownish grey with orange mottles. Poor recovery > 50%.	▼
2.5			

RL (m): 6.0, 5.5, 5.0, 4.5, 4.0, 3.5

In-situ Testing



Values

Vane ID: N/A

peak / residual (sensitivity)

Hole Depth: 2.20m	**Termination:** HOLE COLLAPSE

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Method: 50mm Hand Auger

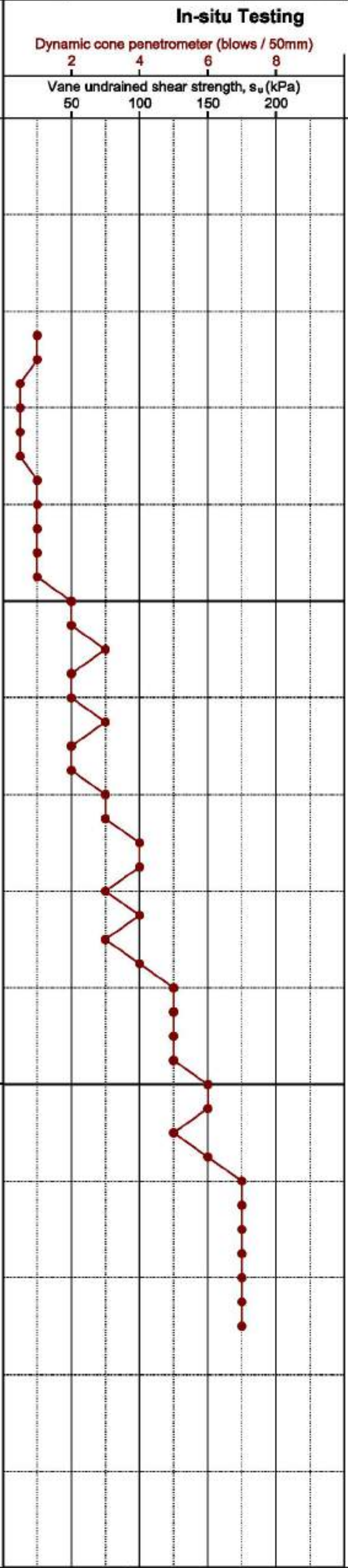
Test ID:	**HA07**				
Project ID:	24477				
Sheet:	1 of 1				
Client:	NZHG	**Coordinates:**	5709824mN, 2036090mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Graphic Log	Material Description	Water	RL (m)
0.0 – 0.80	Uncontrolled Fill / Topsoil		SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine to medium; trace charcoal. 0.40m: Sandy. Sand, fine to medium.		
0.80 – 2.00	Holocene Beach Deposits		SAND; light brown with orange mottles. Loose; moist; sand, fine to medium. 1.00m: Brownish grey with orange streaks. 1.20m: Wet. 1.50m: Saturated. 1.70m: Poor recovery > 30%.	▼ 1.50	

Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5

RL (m): 5.5, 5.0, 4.5, 4.0, 3.5

In-situ Testing



Values
Vane ID: N/A
peak / residual (sensitivity)

Hole Depth: 2.00m **Termination:** HOLE COLLAPSE

Remarks:

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

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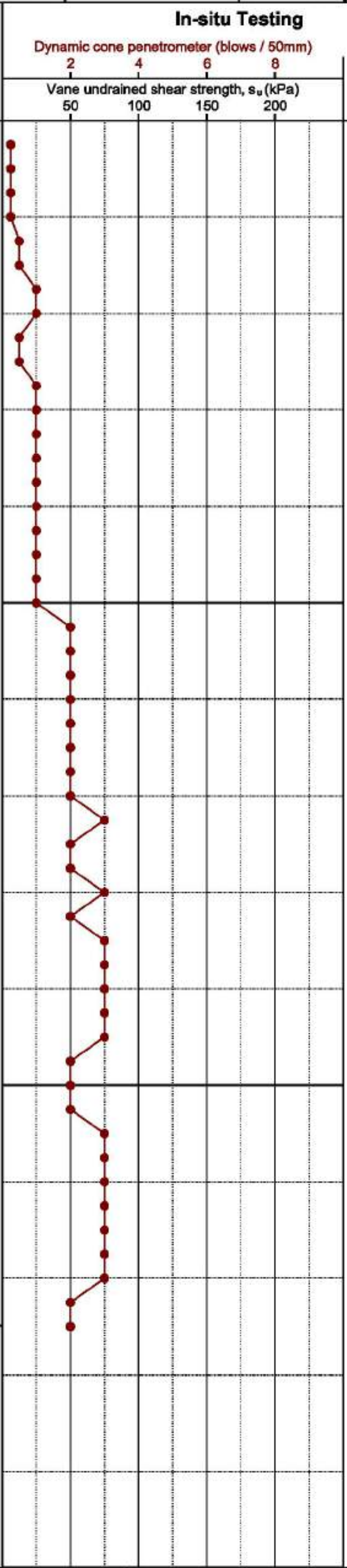
Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	HA08	**Project ID:**	24477
Sheet:	1 of 1		

Client:	NZHG	**Coordinates:**	5709850mN, 2036087mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.5m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	RL (m)
0.0–0.3	Topsoil	SAND, with minor silt, with trace rootlets; dark brown. Very loose; moist; sand, fine to medium.		
0.3–2.5	Holocene Beach Deposits	SAND; light brown. Loose; moist; sand, fine to medium. 1.60m: Brownish grey. 1.80m: Brownish grey orange streaks. 2.00m: Dark brown. Wet. 2.30m: Brownish grey. 2.40m: Saturated.	▼ (2.4)	



Hole Depth: 2.50m	**Termination:** TARGET DEPTH	● Vane peak	▼ Standing water level
Remarks:		○ Vane residual	◁ Groundwater inflow
		◆ Vane UTP	▷ Groundwater outflow
		UTP = Unable to Penetrate	

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

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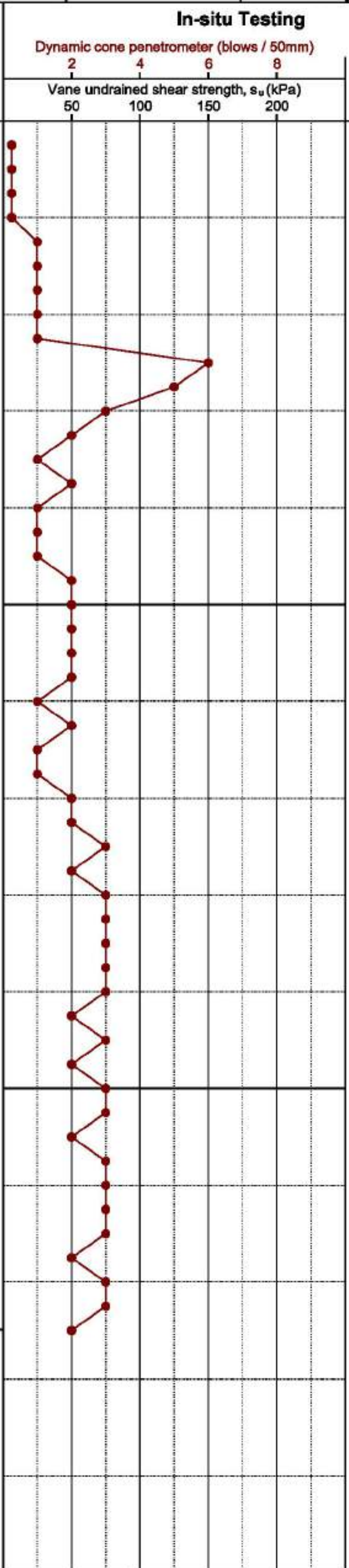
Hand Auger Borehole Log

Method: 50mm Hand Auger

Client:	NZHG	**Coordinates:**	5709853mN, 2036094mE	**Test ID:**	HA09
Project:	Geotechnical Investigation	**System:**	NZTM	**Project ID:**	24477
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.5m (NZVD2016)	**Sheet:**	1 of 1
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Test Date:**	12/09/2023
				Logged By:	SS
				Prepared By:	SS
				Checked By:	RH

Depth (m)	Geology	Material Description	Water	RL (m)
0.0–0.60	Topsoil	SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine. 0.20m: SAND, with minor silt. Sand, fine to medium; trace brick fragments.		
0.5				6.0
0.60–2.50	Holocene Beach Deposits	SAND; brownish orange. Loose; moist; sand, fine to medium. 1.50m: Brownish grey. 2.00m: Wet. 2.40m: Saturated.	▼ (2.40m)	
1.0				5.5
1.5				5.0
2.0				4.5
2.5				4.0

In-situ Testing



Values

Vane ID: N/A

peak / residual (sensitivity)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

Hand Auger Borehole Log

Method: 50mm Hand Auger

Test ID:	HA10
Project ID:	24477
Sheet:	1 of 1

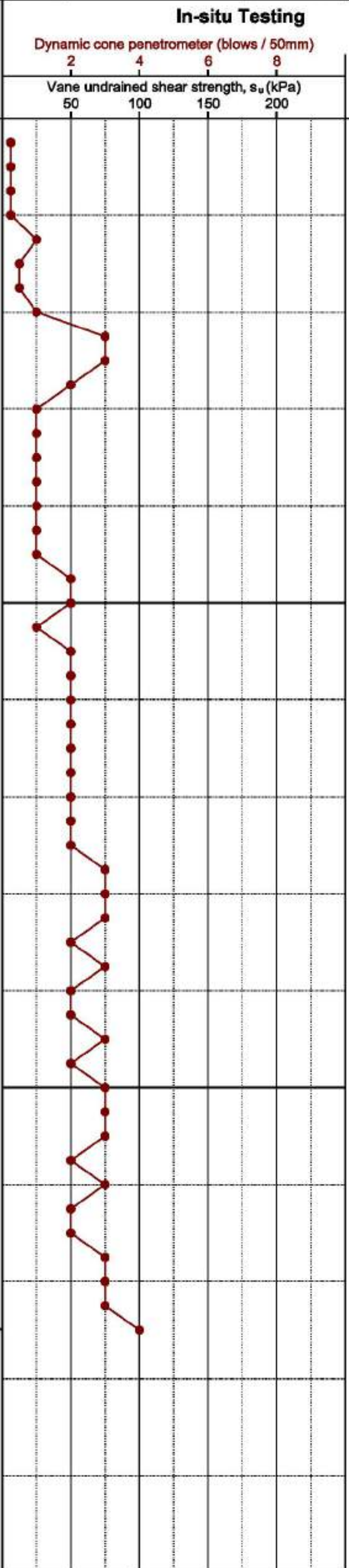
Client:	NZHG	**Coordinates:**	5709860mN, 2036093mE	**Test Date:**	12/09/2023
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	SS
Location:	556-560 Abeerdeen Rd, Gisborne	**Elevation:**	6.5m (NZVD2016)	**Prepared By:**	SS
Test Site:	Refer to geotechnical investigation plan	**Located By:**	Site plan/map	**Checked By:**	RH

Depth (m)	Geology	Material Description	Water	RL (m)
0.0 – 0.70	Topsoil	SILT, with minor sand, with trace rootlets; dark brown. Stiff; moist; non-plastic; sand, fine. 0.20m: SAND. Sand, fine to medium.		
0.70 – 2.50	Holocene Beach Deposits	SAND; brownish orange. Loose; moist; sand, fine to medium. 1.70m: Brownish grey. 2.00m: Wet. 2.40m: Dark brown. Saturated.	▼ (2.40m)	

Depth (m): 0.5, 1.0, 1.5, 2.0, 2.5

RL (m): 6.0, 5.5, 5.0, 4.5, 4.0

In-situ Testing



Values

Vane ID: N/A

peak / residual (sensitivity)

Hole Depth: 2.50m **Termination:** TARGET DEPTH

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak	▼ Standing water level
○ Vane residual	◁ Groundwater inflow
◆ Vane UTP	▷ Groundwater outflow

UTP = Unable to Penetrate