Te Kaunihera o Te Hiku o te Ika
Far North District Council

Office Use Only Application Number:

Application for resource consent or fast-track resource consent

(Or Associated Consent Pursuant to the Resource Management Act 1991 (RMA)) (If applying for a Resource Consent pursuant to Section 87AAC or 88 of the RMA, this form can be used to satisfy the requirements of Schedule 4). Prior to, and during, completion of this application form, please refer to Resource Consent Guidance Notes and Schedule of Fees and Charges — both available on the Council's web page.

1. Pre-Lodgement Meeting

Have you met with a council Resource Consent representative to discuss this application prior to lodgement? ☑ **Yes** ◯ **No**

2. Type of Consent being applied for

(more than one circle can be ticked):

☑ **Land Use**
◯ **Fast Track Land Use***
◯ **Subdivision**
◯ **Consent under National Environmental Standard** (e.g. Assessing and Managing Contaminants in Soil)
◯ **Other (please specify)** ______
◯ **Discharge**
◯ **Change of Consent Notice (s.221(3))**
◯ **Extension of time (s.125)**

*** The fast track is for simple land use consents and is restricted to consents with a controlled activity status.***

3. Would you like to opt out of the Fast Track Process?

◯ **Yes** ☑ **No**

4. Consultation

Have you consulted with Iwi/Hapū? ☑ **Yes** ◯ **No**

If yes, which groups have you consulted with?	Nga hapū o Mangamuka and Te Paatu (further detail in Section 8 of AEE)
Who else have you consulted with?	Department of Conservation and Northland Regional Council (further detail in Section 8 of AEE

For any questions or information regarding iwi/hapū consultation, please contact Te Hono at Far North District Council tehonosupport@fndc.govt.nz

5. Applicant Details

Name/s: New Zealand Transport Authority Waka Kotahi (NZTA)

Email:

Phone number:

Postal address:
(or alternative method of service under section 352 of the act)

[redacted]

6. Address for Correspondence

Name and address for service and correspondence (if using an Agent write their details here)

Name/s: Alex Erceg (Stellar Projects Limited)

Email:

Phone number:

Postal address:
(or alternative method of service under section 352 of the act)

[redacted]

** All correspondence will be sent by email in the first instance. Please advise us if you would prefer an alternative means of communication.*

7. Details of Property Owner/s and Occupier/s

Name and Address of the Owner/Occupiers of the land to which this application relates (where there are multiple owners or occupiers please list on a separate sheet if required)

Name/s: Department of Conservation and NZTA

Property Address/ Location: PO Box 10420, Wellington 6140 and Private Bag 106602, Auckland City, Auckland, 1143

Postcode

8. Application Site Details

Location and/or property street address of the proposed activity:

Name/s: Department of Conservation and NZTA

Site Address/ Location: Stahe Highway 1, Mangamuka Gorge, Mangamuka

Postcode

Legal Description: Refer Section 3.2 of AEE **Val Number:**

Certificate of title: None

Please remember to attach a copy of your Certificate of Title to the application, along with relevant consent notices and/or easements and encumbrances (search copy must be less than 6 months old)

Site visit requirements:

Is there a locked gate or security system restricting access by Council staff? ◯ **Yes** ✔ **No**

Is there a dog on the property? ◯ **Yes** ✔ **No**

Please provide details of any other entry restrictions that Council staff should be aware of, e.g. health and safety, caretaker's details. This is important to avoid a wasted trip and having to re-arrange a second visit.

Site is adjacent to State Highway 1 throuhg the Mangamuka Gorge with limited areas for parking.

9. Description of the Proposal:

Please enter a brief description of the proposal here. Please refer to Chapter 4 of the District Plan, and Guidance Notes, for further details of information requirements.

Earthworks and vegetation clearance and construction of a boardwalk. Refer Section 3 of the AEE for full detail.

If this is an application for a Change or Cancellation of Consent Notice conditions (s.221(3)), please quote relevant existing Resource Consents and Consent Notice identifiers and provide details of the change(s), with reasons for requesting them.

10. Would you like to request Public Notification?

◯ **Yes** ✔ **No**

11. Other Consent required/being applied for under different legislation

(more than one circle can be ticked):

◯ **Building Consent** Enter BC ref # here (if known)

✔ **Regional Council Consent (ref # if known)** Ref # here (if known)

✔ **National Environmental Standard consent** Consent here (if known)

✔ **Other (please specify)** Wildlife Permits and Concessions

12. National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health:

The site and proposal may be subject to the above NES. In order to determine whether regard needs to be had to the NES please answer the following:

Is the piece of land currently being used or has it historically ever been used for an activity or industry on the Hazardous Industries and Activities List (HAIL) ◯ **Yes** ✔ **No** ◯ **Don't know**

Is the proposed activity an activity covered by the NES? Please tick if any of the following apply to your proposal, as the NESCS may apply as a result. ◯ **Yes** ✔ **No** ◯ **Don't know**

◯ **Subdividing land**

◯ **Changing the use of a piece of land**

◯ **Disturbing, removing or sampling soil**

◯ **Removing or replacing a fuel storage system**

13. Assessment of Environmental Effects:

Every application for resource consent must be accompanied by an Assessment of Environmental Effects (AEE). This is a requirement of Schedule 4 of the Resource Management Act 1991 and an application can be rejected if an adequate AEE is not provided. The information in an AEE must be specified in sufficient detail to satisfy the purpose for which it is required. Your AEE may include additional information such as Written Approvals from adjoining property owners, or affected parties.

Your AEE is attached to this application ✔ **Yes**

13. Draft Conditions:

Do you wish to see the draft conditions prior to the release of the resource consent decision? ● **Yes** ◯ **No**

If yes, do you agree to extend the processing timeframe pursuant to Section 37 of the Resource Management Act by 5 working days? ✔ **Yes** ◯ **No**

14. Billing Details:

This identifies the person or entity that will be responsible for paying any invoices or receiving any refunds associated with processing this resource consent. Please also refer to Council's Fees and Charges Schedule.

Name/s: (please write in full) New Zealand Transport Authority Waka Kotahi

Email: [redacted]

Phone number:

Postal address:
(or alternative method of service under section 352 of the act)

Fees Information

An instalment fee for processing this application is payable at the time of lodgement and must accompany your application in order for it to be lodged. Please note that if the instalment fee is insufficient to cover the actual and reasonable costs of work undertaken to process the application you will be required to pay any additional costs. Invoiced amounts are payable by the 20th of the month following invoice date. You may also be required to make additional payments if your application requires notification.

Declaration concerning Payment of Fees

I/we understand that the Council may charge me/us for all costs actually and reasonably incurred in processing this application. Subject to my/our rights under Sections 357B and 358 of the RMA, to object to any costs, I/we undertake to pay all and future processing costs incurred by the Council. Without limiting the Far North District Council's legal rights if any steps (including the use of debt collection agencies) are necessary to recover unpaid processing costs I/we agree to pay all costs of recovering those processing costs. If this application is made on behalf of a trust (private or family), a society (incorporated or unincorporated) or a company in signing this application I/we are binding the trust, society or company to pay all the above costs and guaranteeing to pay all the above costs in my/our personal capacity.

Name: (please write in full) Kim Harris Cottle

Signature: (signature of bill payer) [redacted] **MANDATORY**

Date 9 June 2025

15. Important Information:

Note to applicant

You must include all information required by this form. The information must be specified in sufficient detail to satisfy the purpose for which it is required.

You may apply for 2 or more resource consents that are needed for the same activity on the same form.

You must pay the charge payable to the consent authority for the resource consent application under the Resource Management Act 1991.

Fast-track application

Under the fast-track resource consent process, notice of the decision must be given within 10 working days after the date the application was first lodged with the authority, unless the applicant opts out of that process at the time of lodgement.

A fast-track application may cease to be a fast-track application under section 87AAC(2) of the RMA.

Privacy Information:

Once this application is lodged with the Council it becomes public information. Please advise Council if there is sensitive information in the proposal. The information you have provided on this form is required so that your application for consent pursuant to the Resource Management Act 1991 can be processed under that Act. The information will be stored on a public register and held by the Far North District Council. The details of your application may also be made available to the public on the Council's website, www.fndc.govt.nz. These details are collected to inform the general public and community groups about all consents which have been issued through the Far North District Council.

15. Important information continued...

Declaration

The information I have supplied with this application is true and complete to the best of my knowledge.

Name: **(please write in full)**

Signature:

Date

A signature is not required if the application is made by electronic means

Checklist (please tick if information is provided)

- ◯ Payment (cheques payable to Far North District Council)
- ◯ A current Certificate of Title (Search Copy not more than 6 months old)
- ✔ Details of your consultation with Iwi and hapū
- ✔ Copies of any listed encumbrances, easements and/or consent notices relevant to the application
- ✔ Applicant / Agent / Property Owner / Bill Payer details provided
- ✔ Location of property and description of proposal
- ✔ Assessment of Environmental Effects
- ◯ Written Approvals / correspondence from consulted parties
- ✔ Reports from technical experts (if required)
- ✔ Copies of other relevant consents associated with this application
- ✔ Location and Site plans (land use) AND/OR
- ◯ Location and Scheme Plan (subdivision)
- ◯ Elevations / Floor plans
- ◯ Topographical / contour plans

Please refer to Chapter 4 of the District Plan for details of the information that must be provided with an application. Please also refer to the RC Checklist available on the Council's website. This contains more helpful hints as to what information needs to be shown on plans.

MANGAMUKA SLIP RESPONSE PROJECT 2022

Summary of Applications

New Zealand Transport Agency Waka Kotahi

10 JUNE 2025

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Copyright information

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QUALITY REVIEW AND APPROVAL RECORD

Item	Name	Date
Prepared by:	Alex Erceg Senior Planner, **Stellar Projects**	6 June 2025
Reviewed by:	Stuart Brooke Planning Manager, **Stellar Projects**	11 December 2024
Reviewed by:	Stephanie Kane Principal Planner, Environmental Planning (Auckland/Northland), **New Zealand Transport Agency Waka Kotahi**	17 January 2025
Approved for lodgement by:	Kim Cottle Principal Planner – **Poutiaki Taiao / Environmental Planning Team, New Zealand Transport Agency Waka Kotahi**	30 May 2025

ACRONYMS, TERMS AND ABBREVIATIONS

Acronym/Term	Description
ADP	Accidental Discovery Protocol
AEE	Assessment of Effects on the Environment
CFA	Continuous Flight Auger
COC	Certificate of Compliance
DOC	Department of Conservation
District Plan	Operative Far North District Plan 2009
ED	Ecological District
eDNA	Environmental DNA
FFR	Freshwater Fisheries Regulations 1983
FNDC	Te Kaunihera o Te Hiku o te Ika/Far North District Council
FNDP	Far North District Plan 2009
Gorge	Mangamuka Gorge
GRPA	Government Roading Powers Act 1989
HNZPT	Heritage New Zealand Pouhere Taonga
HNZPTA	Heritage New Zealand Pouhere Taonga Act 2014
LTMA	Land Transport Management Act 2003
National PMP	National Pest Management Plan
NESFW	Resource Management (National Environmental Standards for Freshwater) Regulations 2020
NESCS	Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011
NPSFM	National Policy Statement for Freshwater Management 2020
NPSHPL	National Policy Statement for Highly Productive Land 2022
NPSIB	National Policy Statement for Indigenous Biodiversity 2023
NRC	Northland Regional Council
NZTA	NZ Transport Agency Waka Kotahi
NOR	Notice of Requirement
ONL	Outstanding Natural Landscape
Outline Plan	Outline Plan of Work
OPW	Outline Plan of Work
PA	*Phytophthora agathidicida* or Kauri Dieback Disease
pFNDP	Proposed Far North District Plan 2024
Project	Mangamuka Slip Response Project 2022
pRPN	Proposed Regional Plan for Northland 2024
RMA	Resource Management Act 1991
RPS	Regional Policy Statement for Northland
SH1	State Highway 1
Slip Response	Mangamuka Slip Response Project 2022

EXECUTIVE SUMMARY

On 19 August 2022, Te Tai Tokerau/ Northland was hit with a Severe Weather Event, including strong wind gusts and significant rainfall, which caused widespread damage and flooding across the Region, and resulted in several landslides through the Mangamuka Gorge, making it impassable. This damage resulted in the complete closure of SH1 through the Gorge, severing a vital link for the Far North/ Te Hiku-o-te-Ika to the remainder of the country.

In total there are 24 critical slip sites across the entire Gorge, mostly comprising underslips. Remediation works were undertaken across all the slips, including replacement and upgrade of stormwater infrastructure such as culverts. Remote sites were also utilised for laydown and storage areas and cleanfill sites.

All remediation works were undertaken utilising either the existing road designation (identified in the District Plan as “SH”) and outline plan provisions or the s330 Emergency Works provisions under the RMA. For any works that were undertaken outside of the SH1 Designation, and any works that contravened a Regional Rule or Regulation in a National Environmental Standard (whether inside or outside of the Designation), consideration needed to be had, in accordance with s330 of the Resource Management Act 1991, to whether resource consent is required. All works that were undertaken within the Designation boundaries, whether or not they contravened a District Rule could be undertaken as per the conditions of the Designation.

Pursuant to s330A(2) of the Resource Management Act 1991, New Zealand Transport Agency Waka Kotahi is required to lodge applications for resource consent where the activity (but for s330) contravenes Sections 9, 12, 13, 14, or 15 ***and the adverse effects of the activity continue beyond the completion of the emergency works***. For emergency works activities where the adverse effects were temporary in nature and/or have been fully remediated and are no longer on-going, resource consent is not required nor sought.

The applications for resource consent will be lodged as five separate and distinct resource consent packages, with separate applications required to be submitted to the relevant territorial authorities.

This overarching document, being the “*Summary of Applications*” is designed to support the Assessment of Effects on the Environment reports that have been prepared in support of each of the separate resource consent packages. This report will accompany each resource consent package.

The purpose of this report is to provide the high-level and overarching information that is relevant across each individual resource consent package, avoiding duplication of the high-level information and common overarching project descriptions across each application.

The Emergency Works and Mangamuka Slip Response were officially completed on 23 May 2025.

1 INTRODUCTION

1.1 Report Purpose

New Zealand Transport Agency Waka Kotahi (NZTA) is lodging applications for resource consent under the provisions of the Resource Management Act 1991 (RMA). The applications for resource consent will be lodged as five separate and distinct resource consent packages (refer **Figure 1**), with separate applications submitted to the relevant territorial authorities, being Te Kaunihera o Te Hiku o te Ika/Far North District Council (FNDC) and Northland Regional Council (NRC), concurrently as part of each package. Whilst all being lodged individually, these application packages will be lodged in two tranches to align with the progressive completion of emergency works. Tranche 1 will involve resource consent packages 2 and 3, which address the remote sites. Tranche 2 will involve resource consent packages 1 and 4, being for the work sites within the Mangamuka Gorge, which will remain ongoing following the official re-opening of SH1.

The resource consents required for each package as shown on **Figure 1** are set out in **Table 1** in **Section 7.3.1** of this report.

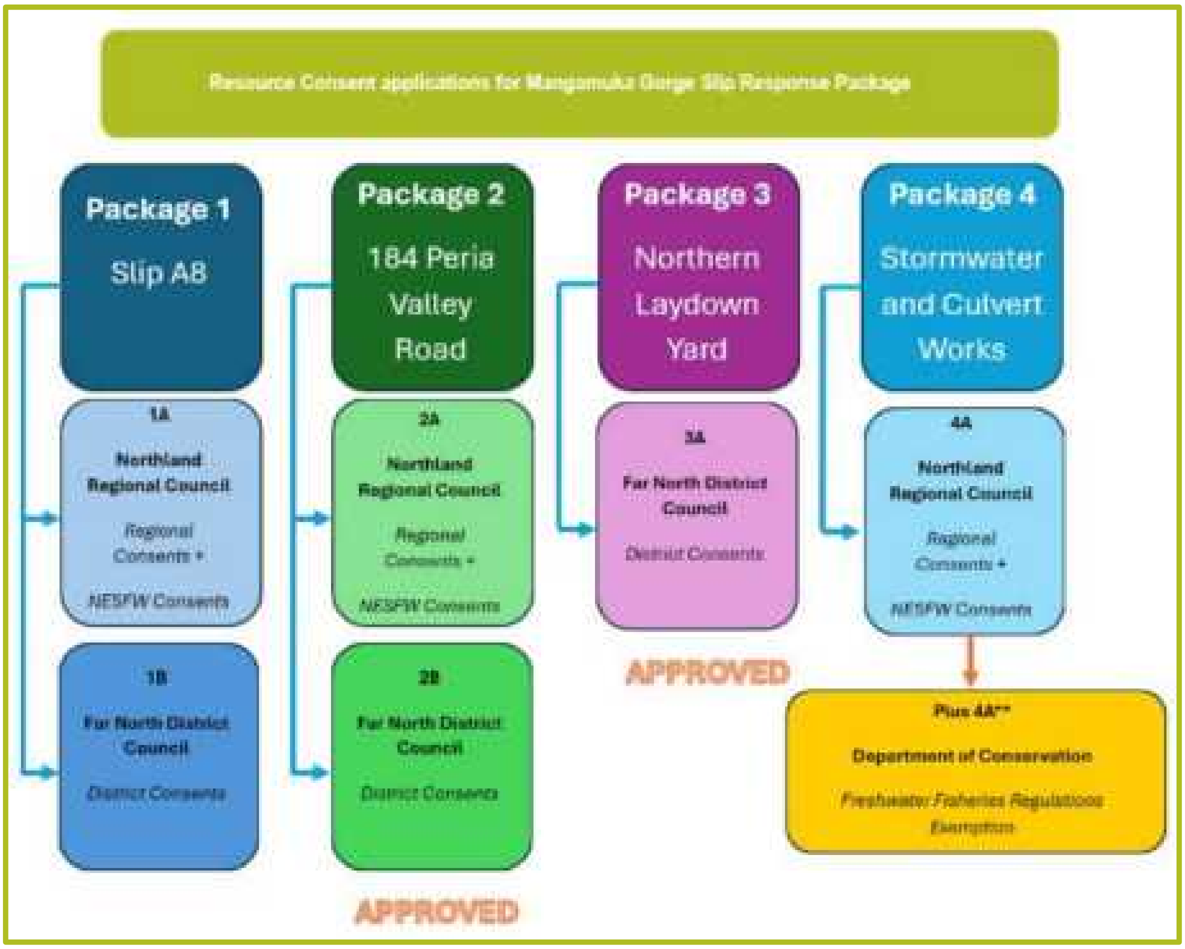

Figure 1: Mangamuka Slip Response Consenting Packages

This overarching document, being the "*Summary of Applications*" is designed to support the Assessment of Effects on the Environment (AEE) reports that have been prepared in support of each of the separate resource consent packages. This report will accompany each resource consent package, and whilst each resource consent package should be considered separately, based on their own merits, this report should be read in conjunction with each of those applications.

The purpose of this report is to provide the high-level and overarching information that is relevant across each individual resource consent package, avoiding duplication of the high-level information and common overarching project descriptions across each application.

Package 2 and Package 3 have received their approvals (refer **Section 9**).

The AEE for **Resource Consent Package 1B** (as described in **Figure 1** above) is appended to this report as **Addendum 1**.

1.2 New Zealand Transport Agency Waka Kotahi

NZTA is a Crown entity with its functions, powers and responsibilities set out in the Land Transport Management Act 2003 (LTMA) and the Government Roading Powers Act 1989 (GRPA). The primary objective of NZTA under Section 94 of the LTMA is to contribute to an effective, efficient, and safe land transport system in the public interest.

Its core functions can be summarised as:

- investing in land transport activities;
- managing the state highway network; and
- providing access to and regulation for land transport.

Section 96(1)(a) of the LTMA requires that NZTA exhibits a sense of social and environmental responsibility when undertaking its work. This statutory requirement is reflected in a raft of strategic and policy documents. One of the core position statements is that NZTA will responsibly manage the land transport system's interaction with people, places, and the environment.

The vision of NZTA is a "*land transport system connecting people, products and places for a thriving Aotearoa*", including "*keeping towns, cities and regions connected to each other for freight and tourism purposes*"[1].

With respect to this application, the works are located within and adjacent to State Highway 1 (SH1) through the Maungataniwha Range, more locally known as the Mangamuka Gorge (the Gorge), between Mangamuka and Kaitaia in Te Tai Tokerau/Northland. As per NZTA roles and responsibilities, they are responsible for the maintenance and operation of the SH1.

NZTA is a network utility operator pursuant to s166 of the RMA and is approved as a requiring authority under Section 167 of the RMA.

[1] https://www.nzta.govt.nz/about-us/about-nz-transport-agency-waka-kotahi/

2 SEVERE WEATHER EVENTS 2022

The Maungataniwha Ranges are a volcanic mountain range over which SH1 is constructed. During 2022, particularly in between June and August, the Maungataniwha Ranges and SH1 through the Gorge were subjected to significant rainfall, which resulted in the soils within the Ranges becoming completely saturated. On 19 August 2022, Te Tai Tokerau/ Northland was hit with a Severe Weather Event, including strong wind gusts and significant rainfall, which caused widespread damage and flooding across the Region, and resulted in a large number of landslides through the Gorge, making it impassable. For contractors to access and assess the Gorge a temporary track had to be cut through a large slip at the southern end of the Gorge.

Figure 2: A large slip at the southern end of the Gorge in the immediate aftermath of 19 August 2022 Weather Event (Source: NZTA Media Release - 24 August 2022)

These slips resulted in the complete closure of SH1 through the Gorge, cutting a vital link for the Far North/ Te Hiku-o-te-Ika to the remainder of the country, and adding additional travel time due to the available detour routes.

3 DESCRIPTION OF THE SITE

3.1 Maungataniwha Ranges

Approximately 15km south-east of Kaitaia, SH1 crosses the Maungataniwha Ranges, through the Mangamuka Gorge due to the name of the settlement and river on its southern side. SH1 is bordered on both sides by the Mangamuka Gorge Scenic Reserve, which is administered by Department of Conservation (DOC), with several private properties also adjacent towards the northern end of the Gorge.

Figure 3:Maungataniwha Range (Source: GoogleMaps - accessed 21 October 2024)

3.1.1 Landscape

The Maungataniwha Ranges including the SH1 corridor, are identified as an Outstanding Natural Landscape (ONL) in the operative Far North District Plan ("District Plan" or "FNDP").

As per the Northland Regional Landscape Assessment Worksheet 2014, the Maungataniwha Ranges are described as a "*bold belt of bush-clad, elevation land that runs across central upper Northland, spanning from the upper Hokianga to immediately inland of Whangaroa Harbour*".

The path of SH1 over the range via is "*some of the most spectacular on the main highway's route through Northland – and indeed over its entire corridor nationwide*". Furthermore, the "*combination of the adjacent Mangamuka River, the steep, imposing landform, substantial and diverse indigenous forest cover and the winding, intimate character of the highway itself are very distinctive and memorable*".

The landscape is defined as having "*very strong indigenous character*", and as containing large areas of substantial canopy that is "*of a scale that is not commonly found across large events*".

3.1.2 Ecology/Biodiversity

The Site is located in the Maungataniwha Ecological District (ED) and Northland Ecological Region[2]. The Maungataniwha ED encompasses approximately 101,900 ha and is centred within five other EDs: Whangaroa ED to the east, Puketi ED to the south, Hokianga ED to the southwest, Ahipara ED to the west, and Aupouri ED to the north.

The forests within the Maungataniwha Range contain northern rātā (*Metrosideros robusta*), rimu (*Dacrydium cupressinum*) with the occasional tōtara (*Podocarpus totara*), kahikatea, and kauri (*Agathis australis*) in the emergent layer, and tōwai (*Pterophylla sylvicola*) (at higher altitudes) and taraire (at lower altitudes), with numerous tawa (*B. tawa*), rewarewa (*Knightia excelsa*), and pūriri in the canopy[3]. Many of the large contiguous areas comprise mainly secondary forests and regenerating shrubland, with small pockets of mature forest. At higher altitudes and wetter sites, regenerating areas are dominated by tōwai, while mānuka and kānuka are dominant in drier, lower altitude sites. The regenerating areas provide habitat for North Island brown kiwi (kiwi-nui, *Apteryx mantelli*) and the endemic Northland green gecko (*Naultinus grayii*). No kiwi have been noted during the Project works. Regenerating shrublands on gumland also provide habitat for a variety of native ground orchids[4].

There are a number of streams running across the SH1 corridor, ranging from ephemeral streams through to intermittent and permanent streams. The streams are home to indigenous fish species, short-fin and long-fin eel/tuna, banded kōkopu and freshwater crayfish/ koura, all of which whose presence was identified though environmental DNA (eDNA)testing undertaken as part of the Project. It is noted that eDNA testing did not identify any short jaw kōkopu in the reaches of the streams in the vicinity of the SH, although they are accepted to be present in Te Tai Tokerau/Northland.

Long-tailed bats were confirmed/recorded on all acoustic recorders, at all monitoring sites. Based on the recent rediscovery of short-tailed bat populations in Ōmahuta and Puketī Forests and the contiguous forest landscape, it has been assumed that short-tailed bats are likely present and using habitat at the Site.

The Mangamuka Gorge is a known '*hot spot'* for kauri snails/pūpūrangi and the Gorge also provides habitat for other invertebrates such as caved and tusked wētā and various slugs and flatworms.

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[2] McEwen 1997 and Brook 1996
[3] Conning 2002
[4] Conning 2002

Figure 4: (Left to Right) Kauri Snail/Pūpūrangi crosses the road in Mangamuka Gorge; Tusked Wētā discovered during vegetation clearance (Source: NZ Environmental Management)

3.2 State Highway 1

SH1 is the longest road in Aotearoa New Zealand's roading network and runs from Cape Reinga/Te Rerenga Wairua at the top of the North Island/Te Ika-a-Māui to Bluff/Motopōhue at the bottom of the South Island/Te Waipounamu. In the North Island, it is referenced as SH1N.

NZTA, as the requiring authority, has an existing designation which encompasses the entirety of the State Highway network, including SH1 referenced on the Far North District planning maps as "*SH*".

SH1 within the Gorge follows an approximately 14km long route through the ranges, reaching a summit of 383m above sea level. The carriageway is contained within a road reserve of variable width, which is designated for state highway purposes under the Far North District Plan (referenced as SH).

The designation provides for "*NZTA, either itself or through its agents, to control, manage and improve the State Highway network including planning, design, research, construction and maintenance relating to all land within the designation. Such activities may also involve, but not necessarily be limited to, realigning the road, altering its physical configuration, culverts, bridges and associated protection works. The appropriate resource consents under the Act will be applied for where required*."

The designation has been given effect to and does not have an expiry date stated in the District Plan. It therefore remains operative in the District Plan. There are no conditions on the existing designation.

Under the Regional Policy Statement for Northland (RPS), SH1 is defined as "*regionally significant infrastructure*" as identified in Appendix 3. Consequently, SH1 is similarly "*specified infrastructure*" for the purposes of the National Policy Statement for Freshwater Management (NPSFM) and the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NESFW).

4 DESCRIPTION OF PROJECT / PROPOSED WORK

This section will provide a high-level overview of all the works. Specific works associated with the resource consent packages will be detailed in their respective applications for resource consent.

Due to the constrained nature of the main Gorge site, the project area includes a number of remote sites including

a) laydown areas for the storage of construction machinery and materials, and
b) fill sites for the disposal of spoil from works within the Gorge. These sites are described below.

4.1 Location

Significant remediation works were required through the entire length of the Gorge. As discussed previously, remote sites were also required (locations described in **Sections 4.2.6** and **4.2.6**)

In total there are 24 "*critical*" slip sites, being slips posing an imminent risk of complete evacuation of the road, across the entire Gorge (refer **Figure 5**), mostly comprising underslips and several "*minor*" slips. Remediation works were undertaken across all the slips, including replacement and upgrade of stormwater infrastructure such as culverts.

Figure 5: Critical Slip Sites - Mangamuka Gorge

4.2 Description of the project

4.2.1 Typical Slip Sites

The emergency works in relation to the remediation of the slip sites throughout the Gorge typically involved:

1. Initial slip clearance involving the removal of soil and vegetation on SH1 from overslips. All material was disposed offsite to an existing private fill site at 164 Makene Road
2. Initial slip mitigation works including:
    a. installation of new/ upgrade stormwater culverts to divert stormwater away from slip faces
    b. asphalt bunding on road surface to divert surface water to new culverts.
    c. sealing road cracks to reduce ground soakage.
3. Following the initial slip mitigation works, the majority of slips have been stabilised with the construction of a concrete pile wall on the outer edge of the road. This was a 2-stage process, whereby '*temporary'* shallow piles needed to be installed first to support a larger drilling rig which constructed the larger, permanent piles.
4. In-ground soil anchors to support the palisade wall.
5. Installation of bored subsoil drains in the land above the slip sites to reduce groundwater pore pressure levels above the slips. These were installed via direct drilling and seepage will drain to culverts.
6. Replacement of several culverts to increase capacity and replace damaged/broken culverts
7. Spoil from drilling was exported to offsite locations.

All critical slip sites had sediment and erosion controls which had been established and operated in accordance with the sediment and erosion control plan prepared by Southern Skies Limited (refer **Appendix A**), which are being audited regularly by Southern Skies.

The remediation works had been designed to minimise earthworks and vegetation alteration within areas of indigenous vegetation and fauna habitat adjoining the carriageway.

Figure 6: Example of Typical Slip Site (Slip A5 Near Completion of Remediation Works (Image Taken: 6 August 2024))

Figure 7: Example of Typical Slip Site (Slip A3 Near Completion of Remediation Works (Image Taken: 14 August 2024))

4.2.2 Slip A11

Slip A11 is a historic slip first reported in 1988 during Cyclone Bola and is known as a "*Whole Road Slip*". The slip was 50m wide and very deep-seated and extensive with a 20m depth failure surface under the downslope shoulder of the highway.

It was initially proposed to realign a 270m long section of road at Slip A11 for the purpose of retreating the road away from a significant slip feature and in the immediate vicinity of the site, replanting of native vegetation was proposed in the footprint of the section of road to be retired, comprising approximately 1,375m^2 in area.

However, with the bulk cut at Slip A11 completed in winter and a gully feature reforming along the above road slip face, there is not sufficient time available to "*clean up*" the gully feature and build the new road alignment in time to reopen the road safely by end of the year. Therefore, the road was remediated to rebuild the existing alignment.

In addition, the risk of the road subsiding and the under slip posing a critical threat has diminished significantly due to the removal of 30,000m^3 of material (60,000t of mass) off the slip prone feature.

NZTA have also installed a monitoring system to monitor any future movement where the road has been reinstated. The option to build the new alignment if required in the future is still retained.

The works further involved the unavoidable requirement to clear approximately 4,283m^2 of native vegetation, including a number of significant old growth trees.

Figure 8: Slip A11 (Images taken: August 2024)

4.2.3 Slip A8

The works to remediate Slip A8 involved the installation of CFA (continuous flight auger) (CFA) piles on both the northbound and southbound sides of the road. Bored drainage was then to be installed beneath the road.

An existing culvert (Culvert 78) was replaced effectively in the same location as it was, and then the culvert flume was extended to shift stormwater away from the active slip site and the road. Three culverts (Culverts 79, 80 and 80-1) were then blocked.

In order to install the required bored drainage, an access track has been constructed into the Reserve. To provide for ongoing maintenance and monitoring, a boardwalk is also required.

Monitoring bores are also to be installed to monitor the hydrology and groundwater levels associated with the lower and upper wetland.

During the works, measures were identified to remediate the on-going adverse effects of the activity, including the removal of extent of access track from within 10m of "natural inland wetlands", as well as extent of access track no required for on-going maintenance. Additionally, areas of the access tarck were identified to become waterlogged and therefore a boardwalk was constructed to reduce the environmental impact of this as well as to address health and safety during on-going operation and maintenance of the bored drainage.

4.2.4 Culvert and Stormwater Works

The severe weather events resulted in damage to a number of culverts and/or highlighted the inability of the culverts to cope with the volumes of stormwater generated in such events.

In addition to the culvert works undertaken at Slip A8 (as described in **Section 4.2.3**), the culvert and stormwater works as part of the Slip Response involved:

- The blocking of two culverts (Culverts 93 and 95) in intermittent or permanent streams.
- The replacement of three culverts (Culverts 52 and 92) in intermittent or permanent streams.
- The construction of five new culverts[5] (Culverts 88, 95-1, 51-1, 52-1 and 53-1) in intermittent or permanent streams.

No fish passage is to be provided within the above culverts, and in some cases, fish passage was blocked in the above culverts as a result of the works.

Further, the works under the recovery phase involved works relating to culverts on ephemeral streams. As "*ephemeral*" streams are not considered "*rivers*" under the relevant statutory documents, there are no relevant rules in relation to these works and therefore no consent requirements.

Fish passage structures were installed in several culverts based on a priority approach, which saw fish passage improved and/or restored to the four main permanent streams throughout the Gorge.

[5] Note: Some of these culverts were constructed in the initial and immediate response to the Severe Weather Events, whilst some have only just been constructed. For the purposes of consenting, they are not differentiated between as all are considered "*new*" culverts under the rules.

Figure 9: Fish Ladder installed as part of the Fish Passage Betterment across the Gorge (Image taken 5 December 2024)

Many of the culverts required the installation of longer flumes on the outfall of the culverts to direct stormwater further away from the active slip zones and the roadway in order to protect the asset during future weather events and reduce the risk of slipping.

4.2.5 Ancillary Works

In consultation with local hapū and kaitiaki, Pouwhenua (Pou) have been constructed and installed at both the Northern and Southern ends of the Gorge.

The Northern Pou (refer **Figure 10**) is carved from timber and is approximately 3.5m high with a 0.6m diameter.

The Southern Pou (refer **Figure 10**) is constructed out of steel is similarly approximately 3.5m high with a 0.6m diameter.

Figure 10: (Left) Northern Pouwhenua; (Right) Southern Pouwhenua

Landscaping has been completed at the Mangamuka Gorge Summit, including the construction of a "*rest area*" with seating and tables (refer **Figure 11**).

Figure 11: "Rest Area" constructed at the Mangamuka Gorge Summit

4.2.6 Works Outside the Gorge

Due to the narrow, steep and windy nature of the road within the Gorge, laydown sites were needed outside of the Gorge for the storage of construction materials and equipment.

Due to matters such as the distance between each end of the Gorge, there were separate laydown areas for the northern and southern project areas.

Liven the high ecological values and steep terrain within the Gorge, all spoil material from earthworks was exported from the Gorge to remote fill sites. Due to site constraints within the Gorge and in accordance with hapū feedback, all spoil from the southern section of the gorge was disposed of on the southern side of the gorge, and likewise all spoil from the northern section was disposed of on the northern side.

4.2.7 Laydown and Cleanfill Sites

4.2.7.1 Laydown Sites

The following laydown sites were established for the purpose of storage of materials, such as pipework and for the fabrication of mesh for the pile foundations:

- Southern Laydown Site at 4543 State Highway 1; and

- Northern Laydown Site at 6770 State Highway 1

Southern Laydown Site at 4543 State Highway 1

This laydown yard at 4543 SH1 was established in February 2023 over an already existing laydown yard to support the remediation works on the southern section of the Gorge. The yard is maintained in an aggregate surface and occupies approximately 4,000m^2 of flat, low-lying land in a corner of the site bounded by SH1 to the north and a driveway to the west. A vehicle entrance is located at the north-east corner of the site.

The southern edge of the laydown yard is demarcated with a grassed bund which is set back approximately 5m from a stream, and the eastern edge has a silt fence beyond which is a natural inland wetland. A "*no go*" zone was established (refer **Figure 12**) that ensured the works and utilisation of the Southern laydown site did not encroach within the natural inland wetland area, and the utilisation of the site was confined to the areas that were already established as a laydown area, prior to its use as one for the Slip Response.

The Site was purely used as a Laydown Yard; no fill activities were undertaken on the Site, and no cleanfill was deposited at the Site.

Figure 12: Excerpt from CLL Erosion & Sediment Control Plan, which also indicates "no go" zone in and around a natural inland wetland. *Note that fill was not disposed on the site despite the notations on the plan*. (Source: CLL Contractors)

Northern Laydown Site at 6770 State Highway 1

This laydown yard at 6770 SH1 was established in February 2023 to support the Phase 1 slip remediation works on the northern section of the Gorge. The laydown yard is maintained in an aggregate surface and occupies approximately 3,500m^2 of flat, low-lying land at the rear of an existing industrial yard operated by Brian Kitchen Contracting Ltd. It is understood that the only works undertaken to prepare the yard for this project was the laying of additional aggregate to stabilise the site for heavy equipment. FNDC considers this to be an impermeable surface. The side property boundaries are defined by privacy fencing and mixed vegetation, and the rear boundary with a tall shelter belt vegetation. There are no wetlands or watercourses located near the site; however, the site is located in a flood plain.

4.2.7.2 Cleanfill Sites

The following fill sites were established:

- Southern Fill Sites at:
  - 4321 State Highway 1 (which has three fill sites at that location); and
  - 164 Makene Road
- Northern Fill Sites at:
  - 184 Peria Valley Road; and
  - 6283 State Highway 1

A temporary transfer station was also established within the Gorge at the southern end, to aid in the works associated with Slip A11 and the significant volume of spoil to be shifted.

In total 11,718m^3 of spoil was transported to the northern fill sites and 39,000^3 was transported to the southern fill sites.

164 Makene Road Fill Site

This is a 190ha site located on the southern side of the Mangamuka Gorge. The landowner holds a resource consent from NRC (ref: LUC.044750.01.01) to carry out up to 150,000m^3 of fill earthworks over a 2ha area. The fill site has erosion and sediment controls in place, in accordance with the resource consent. This site was utilised for the disposal of spoil from the southern portion of the project until mid-2023, at which point access to the site along Makene Road became dangerous due to slips.

6283 State Highway 1 – Northern Fill Site

This 8.83ha site is located on the northern side of the Mangamuka Gorge. An approximately 4,000m^2 flat paddock area was used as a permanent fill site for spoil from the northern section of the project between February and July 2023.

A total of 4500-5000m^3 of fill was placed on this site, to a uniform depth of approximately 1 metre.

4321 State Highway 1

This 70ha rural landholding, to the south of the Gorge, is primarily utilised for pastoral farming. Three separate fill areas were established within paddocks on elevated, gently sloping terrain.

In total, 39,000m^3 of fill was deposited across the three fill sites at this location.

184 Peria Valley Road

This 85ha site is located on the northern side of the Mangamuka Gorge and landowner approval was obtained for the utilisation of this Site. Part of the site is dissected by Top Energy High Voltage Power Lines to the east. A 10m separation buffer was created between the fill activities and this infrastructure. The lower portion of the site contains an *induced* natural inland wetland caused by the construction of a farm track which has impounded natural drainage flows. This wetland has been drained and filled during the fill activities. The fill operation on this site has recently been completed.

Overall, 11,718m^3 of fill was deposited on this site.

Temporary Transfer Station

The site is at the southern entrance to the Gorge where the SH1 closure began, known under this project as the "*southern gate*". At this point, the road corridor widens to encompass an aggregate hardstand area of approximately 3,000m^2. It sits adjacent to a clearing within the scenic reserve and a stream. The site is within the road reserve and NZTA's existing designation. During the excavation works for Slip A11, the southern gate road closure was relocated further to the south, and the areas used as a transfer station for the stockpiling of material excavated from A11 by Moxies, where it was loaded into trucks and taken to the fill site at 4321 SH1.

5 EMERGENCY WORKS PURSUANT TO S330 OF THE RMA

Section 330 of the RMA provides for emergency works and power to undertake preventive or remedial action. It allows NZTA, as a network utility operator and requiring authority, to undertake certain activities (emergency work or measures) in emergency situations without the need to obtain a resource consent prior to the commencement of urgent works.

Emergency works can be undertaken by NZTA where, in their opinion, their assets are affected, or likely to be affected by:

- an adverse effect on the environment which requires immediate preventive or immediate remedial measures (s330(1)(d) and s330(1)(e)); or
- any sudden event causing or likely to cause loss of life, injury, or serious damage to property (s330(1)(f)).

Emergency works *'measures'* can include any physical work or action specifically directed at removing the cause of, or mitigating, any actual or likely adverse effect of the emergency. Of relevance to this project, the measures may include, but are not limited to:

- Earthworks
- Clearance of fill
- Stabilisation work
- Roading repairs

- Clearing and disposing of slip debris from a roadway

The immediate measures undertaken must only extend to what is necessary and sufficient for dealing with the emergency. The provisions do not extend to any actions that would go beyond either removing the cause of, or mitigating, any actual or likely adverse effect of the emergency.

5.1 Overview of s330 Provisions

Section 330 of the RMA provides for emergency works and power to take preventive or remedial action as set out below (with my emphasis added):

(1) Where—

(a) any public work for which any person has financial responsibility; or

(b) any natural and physical resource or area for which a local authority or consent authority has jurisdiction under this Act; or

(c) any project or work or network utility operation for which any network utility operator is approved as a requiring authority under section 167; or

(ca) any service or system that any lifeline utility operates or provides—

1. *is, in the opinion of the person, authority, network utility operator, or lifeline utility, affected by or likely to be affected by—*

(d) an adverse effect on the environment which requires immediate preventive measures; or

(e) an adverse effect on the environment which requires immediate remedial measures; or

(f) any sudden event causing or likely to cause loss of life, injury, or serious damage to property—

2. *the provisions of sections 9, 12, 13, 14, and 15 shall not apply to any activity undertaken by or on behalf of that person, authority, network utility operator, or lifeline utility to remove the cause of, or mitigate any actual or likely adverse effect of, the emergency*

As set out on **Section 1.2**, NZTA is a network utility operator approved as a requiring authority under s167 of the RMA.

It is important to note that subsection (1A) of s330 ensures that s330 applies irrespective of whether the adverse effect or sudden event was foreseeable.

Section 330 of the RMA requires that the opinion of NZTA (as the network utility operator approved as a requiring authority), formed in deciding whether or not to use the emergency powers, be one a reasonable person would form. This is an objective test, as to whether the situation is one in which any reasonable person or body would consider that it qualifies for emergency action.

In this case the severe weather event, being the "*sudden event*" caused serious damage to property, being SH1. Due to the ongoing slip movements, it was likely to cause further damage to property (SH1) and could have (in the absence of complete road closure) caused loss of life or injury. The slip movements, without remediation, did and could have resulted in further adverse effects on the environment, such as loss of indigenous flora and fauna and biodiversity, loss of habitat and sedimentation of waterways.

Therefore, it was determined that the provisions of s330 of the RMA applied, and NZTA could proceed with emergency remedial actions in accordance with those provisions. Therefore, sections 9, 12, 13, 14, and 15 of the RMA did not apply to any activity undertaken by or on behalf of NZTA as part of the Slip Response.

5.1.1 s330A Process

Section 330A of the RMA requires that:

1) *Where an activity is undertaken under section 330, the person (other than the occupier), authority, network utility operator, or lifeline utility who or which undertook the activity shall advise the appropriate consent authority, within 7 days, that the activity has been undertaken*
2) *Where such an activity, but for section 330, contravenes any of sections 9, 12, 13, 14, and 15 and the adverse effects of the activity continue, then the person (other than the occupier), authority, network utility operator, or lifeline utility who or which undertook the activity shall apply in writing to the appropriate consent authority for any necessary resource consents required in respect of the activity within 20 working days of the notification under subsection (1).*
3) *If the application is made within the time stated in subsection (2), the activity may continue until the application for a resource consent and any appeals have been finally determined.*

Section 330A(1) required NZTA to advise the appropriate consent authority, within 7 days, that the activity, being the emergency remediation works, had been undertaken. This notification was made to FNDC and NRC on 23 August 2022 (refer **Figure 13**).

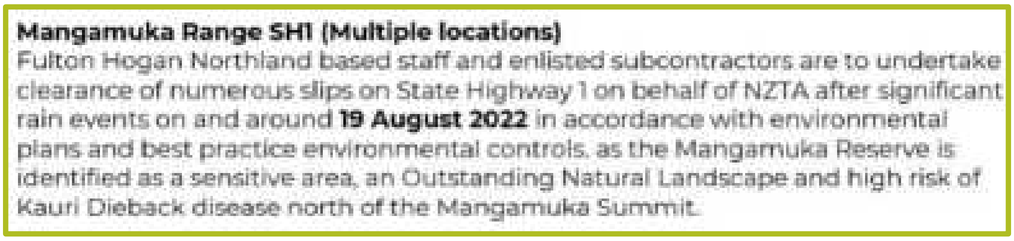

Mangamuka Range SH1 (Multiple locations)
Fulton Hogan Northland based staff and enlisted subcontractors are to undertake clearance of numerous slips on State Highway 1 on behalf of NZTA after significant rain events on and around **19 August 2022** in accordance with environmental plans and best practice environmental controls, as the Mangamuka Reserve is identified as a sensitive area, an Outstanding Natural Landscape and high risk of Kauri Dieback disease north of the Mangamuka Summit.

Figure 13: Snip of notification made to NTRC and FNDC notifying of NZTA intention to undertaken emergency works

Engagement and consultation has been ongoing with NRC and FNDC throughout the emergency response (further detailed in **Section 8**).

Under s330A(2) resource consents will be required for any activity, where the activity (but for s330) contravenes Sections 9, 12, 13, 14, or 15 ***and the adverse effects of the activity continue beyond the completion of the emergency works***.

If there are no ongoing adverse effects of the activities, the notification required by s330A(1) should also inform the Council that no resource consents are required.

As the notification required by s330A(1) is to be accompanied by notification as to whether resource consents are required (s330A(2)), it is considered the notification must be made after completion and not commencement in order to be able to fully comply with these provisions.

Notification must be made 7 [calendar] days from the completion of emergency works. This notification will be made to NRC and FNDC within the required timeframe following completion of the emergency works.

The road opened on 20 December 2024, however not all emergency works have been completed and are on-going. As such, these applications are being lodged well in advance of the statutory timeframe specified under the s330 provisions.

Where it has been determined that there are on-going effects at the completion of the emergency works, resource consent is required to be obtained for any activities that contravened Sections 9, 12, 13, 14, or 15 of the RMA. An application must be made to the appropriate consent authority for any necessary resource consents required within 20 working days of the notification under subsection s330A(1).

Where resource consents are required to be sought retrospectively is discussed further at **Section 7.3.1**.

5.1.2 Slip Response works covered by s330(1)

It is clear that the damage caused by August 2022 severe weather events to SH1 infrastructure within Mangamuka Gorge required immediate remedial measures to avoid the likely loss or life or injury, asnd further serious damage to property, as well as adverse environmental impacts. Therefore, NZTA were correct in proceeding with remedial measures under the s330(1) emergency works provisions.

The main issue for consideration was whether the full scope of the remediation works associated with the project could have reasonably been undertaken pursuant s330(1), and if not, what aspects of the project are not within these emergency provisions. I consider that two simple tests can be applied to determine this, as follows:

1. whether the works are required to safely re-open the Mangamuka Gorge section of SH1 to the public, and
2. whether these works are required to be carried out urgently to prevent further significant damage to critical infrastructure caused by further rainfall events.

Works within the Gorge

Using the criteria set out above, I consider that all works carried out as part of the Mangamuka Slip Response were required to safely re-open the Mangamuka Gorge section of SH1 to the public and were required to be carried out urgently to prevent further significant damage to critical infrastructure as a result of on-going slip movement, which could be exacerbated by future weather events. Further, it is considered had the remediation works not be undertaken in full, this would have posed a risk to life and safety of the users of SH1 and damage to property (being SH1).

The remediation works undertaken under the emergency works provisions are set out at **Section 4**.

Remote Sites

Due to the narrow, steep and windy nature of the road within the Gorge, laydown sites are needed outside of the Gorge for the storage of construction materials and equipment. Likewise, given the high ecological values and steep terrain within the Gorge, all spoil material from earthworks must be exported from the Gorge to remote fill sites.

These laydown and fill sites are an intrinsic component of the emergency slip response works and in my opinion are sufficiently interlinked and a basic requirement of the ability to undertake the remediation works. Therefore, these works also fall within the scope of s330 RMA emergency work provisions.

6 UTILISATION OF S330 OF THE RMA V DESIGNATION

As set out in the above section, it is considered that all works undertaken in the immediate aftermath and throughout the period up until now, are, and could have been undertaken pursuant to the emergency works provisions as set out in s330 of the RMA. However, as has been identified, SH1 through the Gorge is sited within an existing designation, whereby a majority of the slips and the work required to remediate those slips could be undertaken within the designation boundaries (the road reserve).

Consideration was given to whether the extent of the required remedial works thin the existing SH1 designation boundaries could fall within the scope of the existing designation, and the benefits of utilising the Designation (s176) / Outline Plan (s176A) process for the remedial works within the SH1 designation were weighed against the emergency provisions process under s330 of the Act. A decision was made that, with a few exceptions, the works could be undertaken within the boundaries of the road reserve/Designation and were within the scope of the Designation, therefore the Designation (s176) / Outline Plan process (s176A) for these works was to be used. As per s176 of the Act, s9(3) of the Act does not apply to any public works undertaken by a requiring authority within the designation, thus meaning no District Land Use Consents are required for works within the designation.

However, in spite of the above, it was determined due to the significant level of works and alteration required to remediate Slip A11, an Outline Plan of Works (OPW) was required to be submitted to FNDC pursuant to s176A of the RMA.

On 5 February 2024 an Outline Plan was confirmed (2240268-RMAOUT) (refer **Appendix B**) for the works at Slip A11.

For the remainder of the works within the designation, a request for a waiver of the requirement for an Outline Plan of works was submitted to FNDC, as it was considered the works were consistent with the purpose of the designation. The waiver request sought to retrospectively cover all work completed at the time and all future works associated with the Slip Response Project.

On 15 May 2024, FNDC granted the request to waive the requirement for an Outline Plan pursuant to s176A(2)(c) of the RMA (2240428-RMAOUW) (refer **Appendix C**).

In accordance with s330A(2) of the Act, retrospective resource consent requirements for any works remaining that were undertaken outside of the SH1 Designation, contravened a Regional Rule or Regulation in a National Environmental Standard (whether inside or outside of the Designation), and any works outside of the Designation that contravened a District rule (operative or proposed) needed to be determined based on whether the activities gave rise to any ongoing adverse effects.

7 STATUTORY CONSIDERATIONS

7.1 Overview

The location of work sites within and outside of the Gorge as well as the values and features in and around the Site mean that several different pieces of legislation are relevant to this Project. The relevant legislation includes higher order "*Acts*", and lower order legislation such as "*Order in Councils*" and "*Regulations*".

7.2 Relevant Legislation

The legislation that is relevant and has required consideration against for this Project are:

- Resource Management Act 1991 (RMA);
- Heritage New Zealand Pouhere Taonga Act 2014 (HNZPTA)
- Wildlife Act 1953
- Conservation Act 1987
- Reserves Act 1977
- Biosecurity Act 1993
- Fisheries Act 1983

7.3 Resource Management Act 1991 (RMA)

Under the RMA, the following statutory documents are considered to be relevant to this proposal.

- National Policy Statement for Freshwater Management 2020 (NPSFM)
- National Policy Statement for Indigenous Biodiversity 2023 (NPSIB)
- National Policy Statement for Highly Productive Land 2022 (NPSHPL)
- Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NESFW)
- National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health 2011 (NESCS)
- Regional Policy Statement for Northland 2016 (RPS)
    - Proposed Regional Plan for Northland February 2024 (pRPN)
    - Operative Far North District Plan 2009 (FNDP)
    - Proposed Far North District Plan (pFNDP)

As was discussed in **Sections 5** and **6**, District land use activities for works within the road designation have been addressed through Outline Plans and Outline Plan Waivers. Works not requiring retrospective resource consent pursuant to s330 will be notified to NRC and FNDC upon completion of the works as required.

7.3.1 Retrospective Resource Consents Required

The determination of whether the works will have ongoing adverse effects at the completion of each activity is crucial in assessing the need for seeking resource consent retrospectively pursuant to the s330 provisions (as outlined in **Section 5**). Technical experts have been consulted to provide their professional opinions on the matter.

Table 1 below outlines all the retrospective resource consents that are considered be required for the entirety of the Slip Response Project, due to the identification of the presence of on-going adverse effects at the completion of the respective activity. These have been split into separate "*consenting packages*". **Table 1** also identifies where these applications have been lodged and the outcome (where known) of this process.

The consent packages identified in **Table 1** below are for discrete work sites, and therefore applications are being lodged separately. The statutory documents that sit beneath the RMA will be considered as part of the respective application that is appended to this report.

Table 1: Retrospective Resource Consents Required

Site	Legislation	Activity	Rule/ Regulation	Activity Status	Consenting Authority	Application Submitted	Outcome (Granted (G) or Declined (D)
Slip A8	NESFW	Vegetation Clearance to construct an access track within 10m of a natural inland wetland	47(1)	Restricted Discretionary	NRC	N	TBD
		Earthworks to construct an access track within 10m of a natural inland wetland	47(2)	Restricted Discretionary		N	TBD
		Earthworks associated with the drilling of bored drainage within 10m of a natural inland wetland	47(2)	Restricted Discretionary		N	TBD
		Diversion and discharge of water within a natural inland wetland	47(3A)	Restricted Discretionary		N	TBD
		Diversion and discharge of water within a natural inland wetland	47(3A)	Restricted Discretionary		N	TBD
	pRPN	Land Drainage within 50m of a natural wetland	C.4.1.7	Discretionary		N	TBD
	FNDP	Excavation and/or Fill within an Outstanding Landscape for the construction of an access track	12.1.6.2	Discretionary	FNDC	N	TBD
		For a new building, where the purpose of the building is not directly for, or ancillary to	9.7.5.2	Restricted Discretionary		N	TBD

		the principal conservation activities of the site.					
	pFNDP	Vegetation clearance exceeding 100m^2 in a significant natural area	IB-R4	Discretionary		N	TBD
Various (Gorge)	NESFW	The placement and use of a culvert (Culverts 52, 92, 88, 95-1, 51-1, 52-1 and 53-1) in, on, over or under the bed of a river where fish passage is not provided	71	Discretionary	NRC	N	TBD
	pRPN	To block (remove) culverts 93 and 95	C.2.1.7	Discretionary		N	TBD
		To use, erect and place a culvert (Culverts 52, 92, 88, 95-1, 51-1, 52-1, 53-1) in, on, over or under the bed of a river	C.2.1.11	Discretionary		N	TBD
184 Peria Valley Road	NESFW	Vegetation clearance within, or within a 10m setback of a natural inland wetland for the purpose constructing or operating a cleanfill area	45B(1)	Discretionary	NRC	Y	**G**
		Earthworks within, or within a 10m setback of a natural inland wetland for the purpose constructing or operating a cleanfill area	45B(2)	Discretionary		Y	**G**
		Earthworks outside a 10m, but within a 100m setback of a natural inland wetland for the purpose constructing or operating a cleanfill area	45B(3)	Discretionary		Y	**G**

		Diversion of water within, or within a 100 m setback from, a natural inland wetland relating to the installation of sub-soil drainage to drain the wetland	45B(3)	Discretionary		Y	**G**
	FNDP	Fill exceeding 5000m^3 and exceeding 1.5m in height	12.3.6.2	Discretionary	FNDC	Y	**G**
Northern Laydown Yard	FNDP	For non-compliance with the stormwater management requirements due the deposition of aggregate surface resulting in impervious areas exceeding 20% of the site area.	8.6.5.4	Discretionary	FNDC	Y	**G**[6]

[6] FNDC approved this as a "*certificate of compliance*" as opposed to a resource consent

7.4 Heritage New Zealand Pouhere Taonga Act 2014 (HNZPTA)

Under the Heritage New Zealand Pouhere Taonga Act 2014 (HNZPTA) no person may modify or destroy an archaeological site unless an authority is granted by Heritage New Zealand Pouhere Taonga (HNZPT), whether or not the site is a recorded archaeological site.

The Mangamuka area has a rich history of pre-European settlement and, according to HNZPT Senior Archaeologist James Robinson[7], the area is likely to contain lots of archaeological sites (more so at either end of the gorge than within it) and wider heritage values.

There are no identified archaeological features within the works area in the Gorge and at the off-site spoil sites. Notwithstanding, NZTA engaged Geometria to prepare a comprehensive heritage values assessment, dated 25 October 2023 (refer **Appendix D**). The Geometria report confirmed that there are no known or likely heritage or archaeological features near the slip sites within the Gorge, or any of the remote sites. On this basis, both Geometria and HNZPT have confirmed that they are happy for all works to proceed operating under Accidental Discovery Protocols (ADP) with no archaeological authority in place. To date, no archaeological remains have been encountered.

7.5 Wildlife Act 1953

The Wildlife Act sets out protections of certain wildlife, particularly, and of most relevance, indigenous wildlife. Under this Act, a Wildlife Permit pursuant to s71 of the Wildlife Act is required for various activities associated with wildlife, including salvage, handling and destruction/killing of protecting wildlife. These permits are administered by DOC.

This project required significant areas of vegetation to be cleared, which could have required the salvage, handling and release/relocation of indigenous fauna such as Kauri Snails and Kiwi. Therefore, a Wildlife Permit (111521-FAU) was obtained on 18 March 2024 in relation to native invertebrates, lizards and birds, with a variation to that Permit obtained on 14 October 2024 (refer **Appendix E**). This permit allowed the ecology team to undertake fauna mitigation work associated with lizard, kauri snail and Northland tusked wētā salvage, kiwi relocation and egg uplift, and incidental mortality of all protected species identified in the Permit, associated with habitat clearance and earthworks. The Permit required various reporting to be undertaken, including a salvage report. These reports have been completed and provided as required.

Furthermore, a Certified Bat Expert, who holds their own Permit was engaged to advise and assist with works where bats may have been affected.

No further permits were required.

[7] As discussed during a meeting with NZTA and HNZPT representatives on 13 April 2023

Figure 14: Kiwi Detection Dogs were used to detect Kiwi present within work areas. No Kiwi were detected. (Kiwi Detection Dog Pearl at Slip A11) (Source: NZ Environmental Management)

7.6 Conservation Act 1987

As identified, the Gorge is largely surrounded on both sides by the Mangamuka Scenic Reserve. Being a conservation area, any works required within the Scenic Reserve (i.e. outside of the road designation) required a concession from DOC under s170 of the Conservation Act.

Works within the Scenic Reserve were required at three locations across the Gorge as follows:

- At Slip A3 for a right to drain water (stormwater pipe);
- At Slip A4 for a right to drain water (stormwater pipe); and
- At Slip A8 for a right to convey water (bored drainage), right to drain water (stormwater pipe) and a right of way (Access Track).

A concession for these works was obtained. Concession Number 113662-OTH was obtained from the Department of Conservation on 3 May 2024, and is valid for a period of 60 years (refer **Appendix F**).

On 17 December 2024, an application was lodged to vary the concession, as the works at A3 and A4 were found to be on private property and are therefore not required to be included in the concession. An addendum to that application to provide for the construction of the boardwalk and stairs at A8 was submitted on 11 March 2025. The variation applications are contained within **Appendix G** and **Appendix H** respectively. No decision on this application has been made at the time of preparing this report.

The concession includes a number of conditions and obligations, including:

- Vegetation must not be cut down or damaged nor can any natural feature or historic resource be damaged without prior consent.
- The stormwater pipes must be suitably disguised as to blend in with the surroundings.
- An annual maintenance programme must be approved by DOC.
- An on-going weed control programme to the satisfaction of DoC must be implemented.
- All activities were to be undertaken in accordance with the Accidental Discovery Protocol in relation to archaeological finds and historic sites.

In addition, the concession also requires that, in "*the event the monitoring of water levels by a piezometer at the swamp forest at the A8 slip site located above the road identifies that water levels have reduced, then the amount of water removed by the bored drains shall be reduced so that the original swamp forest water level is maintained*".

No further concessions were required.

7.7 Reserves Act 1977

The Mangamuka Scenic Reserve is protected through the Reserves Act. The Reserves Act sets out a number of protections including through the preservation of trees and bush, whereby trees and bush may not be cut or destroyed unless express consent in writing is obtained. It is considered the necessary approvals, being the Concession and Wildlife Permit provide the necessary consent for the works undertaken within the Scenic Reserve.

7.8 Biosecurity Act 1993

Of most relevance under the Biosecurity Act to this project is the Biosecurity (National PA Pest Management Plan) Order 2022.

7.8.1 Biosecurity (National PA Pest Management Plan) Order 2022.

A National Pest Management Plan (National PMP) relating to the control of the spread of *Phytophthora agathidicida* (PA), more commonly known as Kauri Dieback Disease, was introduced via and Order in Council made under the Biosecurity Act.

The site is located within an area of indigenous forest which contains a significant population of Kauri. The site is therefore located within a Kauri Protection Area, and the project must be undertaken in accordance with the National PMP, including the movement and disposal of any soil or vegetation matters.

A Kauri Survey was undertaken, and no Kauri Trees were identified within the work areas. A Kauri Dieback Procedure was prepared and was implemented (refer **Appendix I**).

The National PMP does not have any requirements for any type of approval that is to be obtained under any circumstance, but rather simply directs how activities must be undertaken in and around Kauri Trees. With respect to this project, these directions involve obligations to report any Kauri exhibiting any symptoms of

PA, restrictions on works within a Kauri Hygiene Zone and obligations around cleaning items before entering and existing Kauri Forest.

7.9 Fisheries Act 1983

Of most relevance to this project under the Fisheries Act, are the Freshwater Fisheries Regulations 1983.

7.9.1 Freshwater Fisheries Regulations 1983

The Freshwater Fisheries Regulations (FFR) set out a number of regulations relating to both indigenous and exotic (namely "*sport*") fish species, including, of most relevance, requirements for fish passage.

Part 6 of the FFR set out the regulations for fish passage and applies in any "*natural river, stream, or water*". Regulation 42 requires that "*no person shall construct any culvert or ford in any natural river, stream, or water in such a way that the passage of fish would be impeded, without the written approval of the Director-General incorporating such conditions as the Director-General thinks appropriate*".

As fish passage is being obstructed in several culverts as part of this project, an exemption will be required under the FFR and will be sought.

8 CONSULTATION AND ENGAGEMENT

Throughout the life of the project NZTA has engaged with several stakeholders through various means and channels, including:

- Quarterly hapū and iwi site visits
- Quarterly Kaitāia market activations/pop-ups
- Regular update features on local radio stations with the NZTA Waka Kotahi Project Director
- Online and in person presentations and updates with community and regional stakeholder groups
- Regular hapū and iwi hui updates through the designated project hapū representatives
- Monthly detailed newsletter updates
- Weekly social media and online content updates
- Media visits for broader regional and national level updates.

NZTA has undertaken continuous consultation and engagement throughout the life of the Project with the following stakeholders:

- Department of Conservation
- Te Kaunihera o Te Hiku o te Ika/Far North District Council Northland Regional Council
- Hapū and iwi groups

- Te Paatu
- Te Paatu ki Kauhanga
- Te Paatu ki Pamapuria (Te Paatu marae, Pamapuria)
- Nga Hapū o Mangamuka
- Ngāti Taranga (Mangataiore marae, Victoria Valley)
- Te Hiku Iwi Development Trust
- Ngāi Takoto
- Ngāi Takoto
- Ngāti Kahu
- Ngāti Kuru
- Te Aupōuri
- Te Rarawa

- NRC Regional Transport Committee
- Te Whatu Ora
- Civil Defence Emergency Management
- Emergency Services: Police, St Johns, Fire and Emergency New Zealand (FENZ)
- Landowners and adjacent landowners
- Kaitāia Business Association
- Community groups, Kaitāia Markets, Lions and Rotary clubs.

Key stakeholders of particular relevance to the statutory approvals process are DOC, FNDC, NRC and iwi/hapū groups. Consultation and engagement in this regard has consisted of regular meetings and informal pre-application type meetings. Key personnel within these organisations have also undertaken site visits. Hapū representatives and Kaitaiki are also on-site regularly and monitoring the works being undertaken.

8.1 Pre-Application Meetings

Pre application meetings have been had with Northland Regional Council on the following dates:

- 17 October 2025; and
- 12 December 2024

Pre application meetings have been had with Te Kaunihera o Te Hiku o te Ika/Far North District Council on the following dates:

- 22 October 2024

8.2 Iwi and Hapū

It is acknowledged that the Maungataniwha Ranges and the Mangamuka Gorge hold considerable cultural significance to iwi and hapū in the area. The Gorge is also home to a number of taonga species which hold significant cultural importance.

NZTA has continued to engage and consult with iwi and hapū groups since the beginning of the Project. A partnership has been developed with Nga hapū o Mangamuka and Te Paatu, who are an integral part of the Slip Response. Representatives of iwi and hapū have been ingrained in the Project and have formed part of the Project team. Kaitaiki from Nga hapū o Mangamuka and Te Paatu have been on-site at all times, monitoring and supervising works, including wildlife salvage and relocations. They have been on-site during site visits regarding the consenting requirements and attended bi-weekly meetings covering these matters.

When these applications are lodged, Nga hapū o Mangamuka and Te Paatu will receive copies of the application as they are lodged. They have been kept informed of the timings and the preparation of the resource consent applications as this has been undertaken.

9 APPROVAL OF RESOURCE CONSENTS

Resource consent applications have been lodged with both NRC and FNDC with respect of Resource Consent Packages 2 and 3.

Package 2 related to a cleanfill site adjacent to 184 Peria Valley Road. On 25 March 2025, FNDC granted resource consent 2250314-RMALUC, subject to conditions (refer **Appendix J**). On 31 March 2025, NRC granted, subject to conditions, resource consents AUT.046377.01.01, AUT.046377.02.01, AUT.046377.03.01 and AUT.046377.04.01 (refer **Appendix K**).

Package 3 related to the Northern Laydown Area at 6770 SH1, Kaitaia. Whilst an application for resource consent was lodged, FNDC determined that the approval required could be a certificate of compliance (COC) pursuant to s139A of the RMA. Therefore, on 26 March 2025, FNDC granted COC 2250315-RMACOC (refer **Appendix L**).

10 COMPLETION OF EMERGENCY WORKS

On 23 May 2025, the emergency works came to an end, as did the Mangamuka Slip Response 2022. Pursuant to s330 of the RMA, FNDC and NRC were sent notification of the conclusion of emergency works on 30 May 2025 (refer **Appendix M**). This notification outlined where resource consents were not required due to it being determined there were no on-going or residual adverse effects. This notification was also copied to the Department of Conservation.

APPENDIX A Erosion and Sediment Control Plan

Waka Kotahi

EROSION & SEDIMENT CONTROL PLAN

ESC# 001 – SH1 Mangamuka Emergency Repairs

Project Name:	SH1 Mangamuka Emergency Repairs
Project No:	
Principal:	Waka Kotahi
Prepared by:	Southern Skies Environmental
Date:	08 November 2024

Contents

1. Introduction

The Mangamuka Gorge on SH1 sustained severe damage during a storm event in August 2022. This section of SH1 is closed as part of the emergency repairs operations.

The proposed works involve a series of stabilisation works of five slip sites within the gorge. The stabilisation operations include the piling retaining wall structures and ground anchoring.

In order to achieve a high standard of environmental performance the following Erosion and Sediment Control Plan (ESCP) has been developed. The ESCP also includes spill management procedures.

2. Scope

The ESCP has been prepared to ensure that the works are undertaken in accordance with best practice to address the potential construction water effects associated with the works.

The overall ESCP will comprise several parts that deal with specific construction activities.

3. Reference Documents

- Auckland Council Guideline Document 2016/005 ‘Erosion and Sediment Control Guide for Land Disturbing Activities’ (GD05).

4. Site Description

The Mangamuka Gorge is located on SH1 approximately 5km north of Mangamuka and approximately 10km south of Kaitaia. The surrounding environment comprises of Mangamuka Scenic Reserve, steep vegetated native bush.

Access to the site is via SH1.

The works are within the road reserve of SH1 and the work will be undertaken while the section of SH1 is closed to public traffic.

The Mangamuka Gorge has sustained severe damage. The works area is unstable. Significant slips have occurred.

5. Description of Proposed Works

The area of the proposed works is five separate slip locations on SH1 within the Mangamuka Gorge. The emergency repair works will comprise the following activities:

- Installation of retaining concrete piles (1050mm diameter to varying depths) and associated capping beams;
- Installation of wire strand anchors
- Installation of new pipe drainage networks
- Relaying of roading surfaces

All works will occur with plant operations from SH1.

6. Erosion and Sediment Control

The erosion and sediment control (ESC) methodology has been designed in accordance with the best practice principles of GD05.

The layout and ESC measures and methodology are detailed in the ESC drawings attached in Appendix B. The works will commence in February 2023 and are expected to take approximately 12-18 months to complete.

Operations that involve the removal of material, such as the establishment of working benches and augured material, will be cut to waste (cut material to be removed from the works area to a designated disposal area).

Treatment tanks and silt fences will be installed at each site as practicable, as shown on the attached ESC drawings attached in Appendix B.

The general methodology at each site is as follows:

- Hot Mix Bund or similar (i.e. alternative concrete bund or timber dyna-bolted and sealed to road surface) will be installed along edge of seal to contain site runoff. The bunding will direct all work area water to a sump to then be piped to a series of treatment tanks for treatment. The treatment tanks will be located where practicable, as determined by the Site Engineer;
- Hot Mix Bunds or similar will also be installed to direct "clean" road water to water table drains to minimise the catchment of each works area. The water table drains will be protected from site runoff with Hot Mix Bunds or silt fences.
- On Site A9 "enabling" works will be undertaken to install water table drainage pipes to allow upper catchment water to be directed away from the slip area before the slip repairs works can commence.
- On most sites a bench will be excavated below the road to create a "level" area for the piling operations. The excavated material will be cut to waste (loaded onto trucks for removal away from the works area). All plant will operate from the road.
- On Site A12-13 a bench will not be cut due to the extensive slip below the road.
- A silt fence will then be installed on the bench as shown on the attached drawings. No silt fence will be installed on Site A12-13 due to the extensive slip below the road;
- Piling operations will commence with all plant operating from the road. All augured material to be cut to waste.
- Any pumping operations from the augured piles will be directed to the settlement tanks;
- During concrete pours, water will be collected from within the casings into ICB containers (or similar i.e. sucker truck). The water will be deemed contaminated and removed from site;
- During ground anchor operations, all wash material (drill fluids) will be collected by the drill rig and directed to settlement tanks.

6.1. Disposal Sites (Fill Sites)

Similarly to the works area, the ESC methodologies for each of the fill sites has been designed in accordance with the best practice principles of GD05.

The layout and ESC measures and methodologies for each of the disposal sites are detailed in the ESC drawings attached in Appendix B.

7. Spill Management

While best practice environmental systems will be implemented, to further reduce the possible consequence of spillage, refuelling points will be located well clear of the cleanwater road table drains. A trailer mounted diesel fuel tank will on occasions stay onsite overnight. The tank will be relocated a minimum 10m from any cleanwater table drain.

Spill kits will be provided onsite, located at the fuel tank onsite.

All site personnel will be trained to use spill kits (and spill booms) before commencing work, as part of the site induction. Preventative maintenance of plant (particularly hydraulic hoses) will also significantly reduce risk.

In the event of a spill, or another incident which results in an unauthorised discharge to ground, immediate action will be taken to contain the event. Spill response and recovery will be enacted in accordance with standard CLL environmental procedures, and the Client and the Northland Regional Council will be contacted. Once the situation has been controlled and rectified, an incident investigation will be completed, and a report prepared by the Project Manager.

Specific concrete management procedures will be separately developed as part of the Construction Work Method Statement.

Spill Response:

The following actions will be implemented.

In the event of a spillage:

1. Stop the flow at its source – shut valves, switch off engines or machinery, block leaks if it is safe to do so.
2. Contain the spillage – catch in container or with bunding and cover with absorbent material/ sand/ fines.
3. Stop from spreading by surrounding with the absorbent sock, or if being carried in water, by placing the sock ahead of the flow.
4. Notify the Project Manager who will contact NRC (as per process below).
5. In the event that any hazardous substance or contaminant enters a watercourse NRC should be notified directly via the 24-hour number – 0800 504 639.

Cleaning up after a spillage:

1. Commence cleaning up of spillage immediately to limit any soakage into the ground, or escape to surface water, if it is safe to do so.
2. Use absorbent material for initial clean up.
3. Excavate contaminated soils and place in a secure location. In water, use the absorbent sock to skim/ absorb the spillage from the water surface.
4. Ensure that all spillage material (including the contained spillage, any contaminated soils and any rags, socks, or other equipment used during the clean-up process) are stored in a secure location and transported off site for disposal at a registered landfill.

In the event of a hazardous substance spill, the CLL Manager will be notified immediately (within 2 hours). The Project Manager will inform NRC as soon as practicable, and as a minimum within 6 hours of becoming aware of the spill. The following information shall be provided to NRC:

- Date, time, location, and estimated volume of the spill.
- Cause of the spill.
- Type of contaminant spilled.
- Clean up procedures taken.
- Steps undertaken to control and remediate the effects of the spill on the receiving environment.
- Assessment of potential effects of the spill.

- Measures to be undertaken to prevent a recurrence.
- All incidents are to be reported on a standard incident report form within 48 hours of the incident occurring to identify corrective actions to help prevent a reoccurrence.
- All sites storing chemicals are to have a Spill Checklist located on site.

8. Monitoring and Maintenance

All erosion and sediment control measures will be maintained in accordance with GD05 throughout the works until the site is stabilised against erosion.

All erosion and sediment control measures and methodologies will be monitored during the works. Monitoring will be undertaken at least weekly, and before and immediately after rain events as well as during heavy rainfall events by the CLL. Any required maintenance or improvements to control measures will be undertaken immediately.

In addition, Meridian will undertake monthly audits on the erosion and sediment control of the site to ensure compliance with GD05.

Sediment deposits and bulges against the silt fences will be removed when sediment accumulation reaches 20% of the fabric height.

The settlement tanks will be cleaned out before accumulated sediment volume reaches 20% of the total volume.

9. Kauri Dieback

A Kauri Dieback procedure has been prepared for the project works. Refer to Appendix C.

10. Rainfall Response and Contingency Measures

Best management practices will be used to minimise sediment yields and monitor any potential effects. In addition to the visual inspections and weekly self-auditing refer above, if a severe weather event is forecast, (a severe weather event is defined as greater than a 5% AEP across the project works area) the following actions will be implemented.

Pre-Weather Event Procedure:

- Visually check controls on site prior to weather event to ensure, as far as practicable, that they will function as intended;
- Depending on site specific circumstances and practices used on site, consider limiting or ceasing earthwork activities to limit land disturbance;
- As far as practicable, stabilise disturbed areas; and
- Photograph critical ESC measures prior to the weather event to document pre-weather event condition.

During a severe weather event that results in the discharge of treated discharges from the sediment retention devices water quality inspections will be undertaken where practical at discharge locations where treated discharge could leave the site. The discharges will be checked to document water quality.

11. Contact Details

Name	Organisational Role	Contact Type	Responsibilities	Contact Number
Vaughan Robbins	*CLL Project Director*	*Working Hours 0800-1700*	*Reporting of spills onsite, site issues to NZTA*	*027 492 3576*
Tim Hunger	*CLL Project Manager*	*Working hours 08:00-17:00 After Hours, 17:00-08:00*	*Site ESC and Construction plan responsibility*	*0275719111*
Hendrik Postma	*Waka Kotahi Project Manager*	*Working Hours 0800-1700*	*Client Rep*	*0272287329*
Campbell Stewart	*ESC and Environmental Specialist*	*Working hours, 07:00-18:00*	*ESC and Environmental audits and advice*	*021837824*
Northland Regional Council	*Pollution Response*	*24/7*	*Regulator agency*	*0800 504 639 (environmental hotline)*

12. Summary

This ESCP addresses the proposed erosion and sediment control methodology associated with the land disturbing activities required to complete the emergency repair works on SH1 in the Mangamuka Gorge and incorporates the spill management methodology.

All land disturbance works will be carried out in general accordance best practice and GD05. The methodology proposed will ensure that any adverse effects of the construction works are temporary and minor.

Appendix A – Hazardous Register

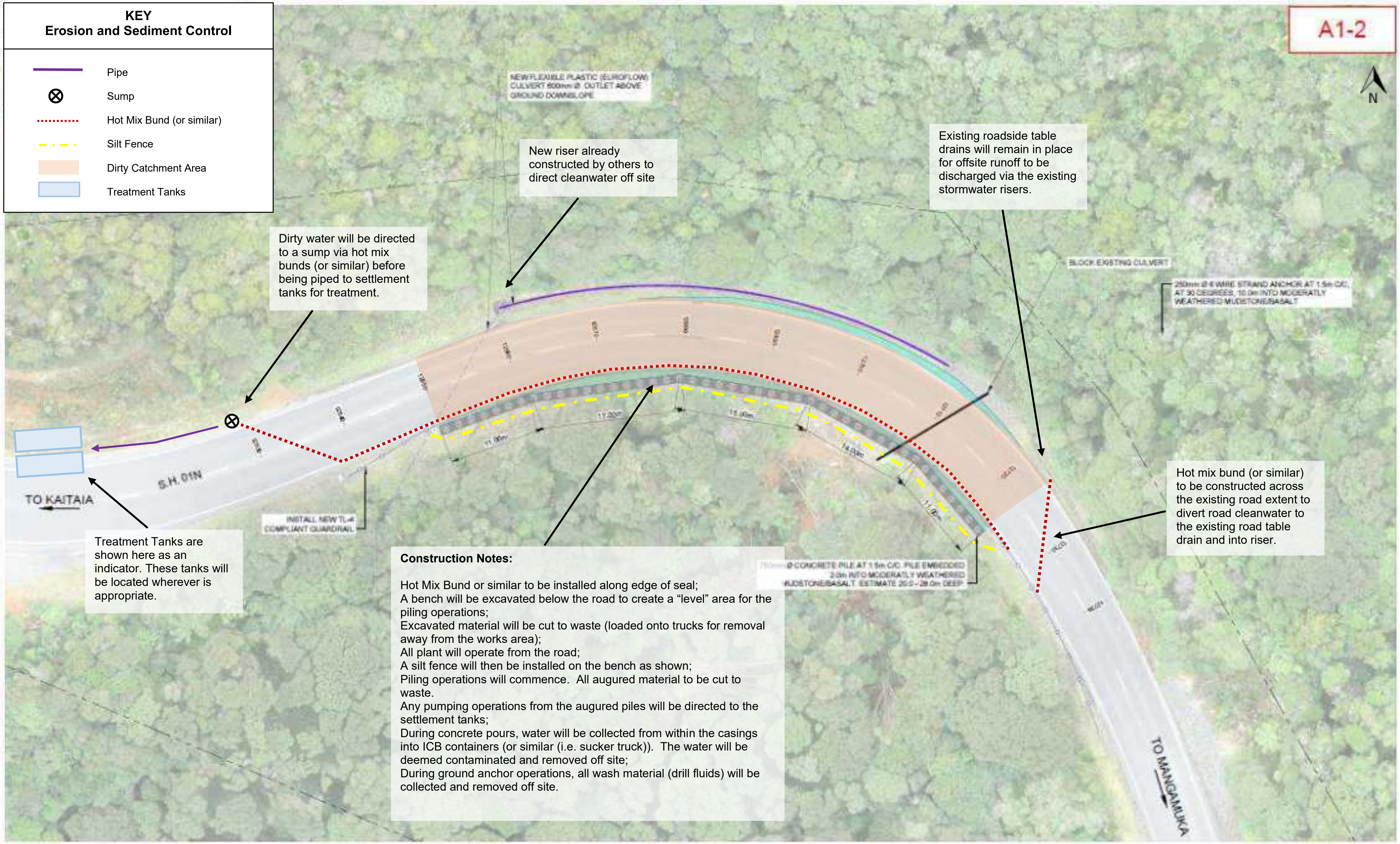
Hazardous Substance Register / Inventory

Name of Product	Total amount (Kg.L)	Solid, liquid or gas	Size of the container	Location	HSNO approval number and name of group standard UN class and packing group	HSNO classification (if available)	Special storage requirements

Appendix B – ESC Drawings

KEY
Erosion and Sediment Control

- Pipe
- Sump
- Hot Mix Bund (or similar)
- Silt Fence
- Dirty Catchment Area
- Treatment Tanks



New riser already constructed by others to direct cleanwater off site

Existing roadside table drains will remain in place for offsite runoff to be discharged via the existing stormwater risers.

Dirty water will be directed to a sump via hot mix bunds (or similar) before being piped to settlement tanks for treatment.

Hot mix bund (or similar) to be constructed across the existing road extent to divert road cleanwater to the existing road table drain and into riser.

Treatment Tanks are shown here as an indicator. These tanks will be located wherever is appropriate.

Construction Notes:

Hot Mix Bund or similar to be installed along edge of seal;
A bench will be excavated below the road to create a "level" area for the piling operations;
Excavated material will be cut to waste (loaded onto trucks for removal away from the works area);
All plant will operate from the road;
A silt fence will then be installed on the bench as shown;
Piling operations will commence. All augured material to be cut to waste.
Any pumping operations from the augured piles will be directed to the settlement tanks;
During concrete pours, water will be collected from within the casings into ICB containers (or similar (i.e. sucker truck)). The water will be deemed contaminated and removed off site;
During ground anchor operations, all wash material (drill fluids) will be collected and removed off site.

NOTES

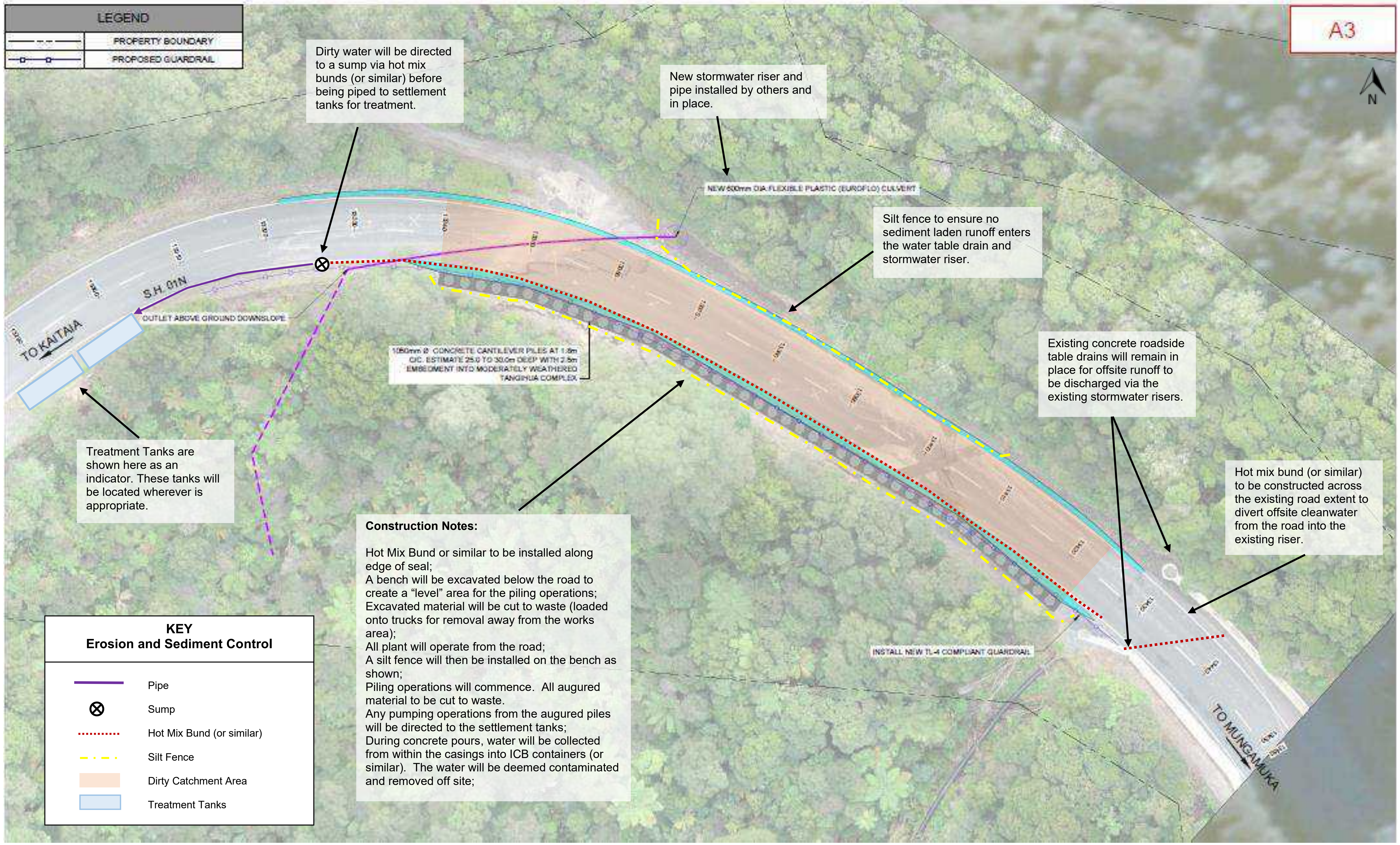
1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	31.01.23	Draft for review.	TH

CLL SERVICE & SOLUTIONS

Project	**MAUNGAMUKA GORGE**
Title	**Erosion and Sediment Control Plan – Stage A1 - 2**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-001-01	01



NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
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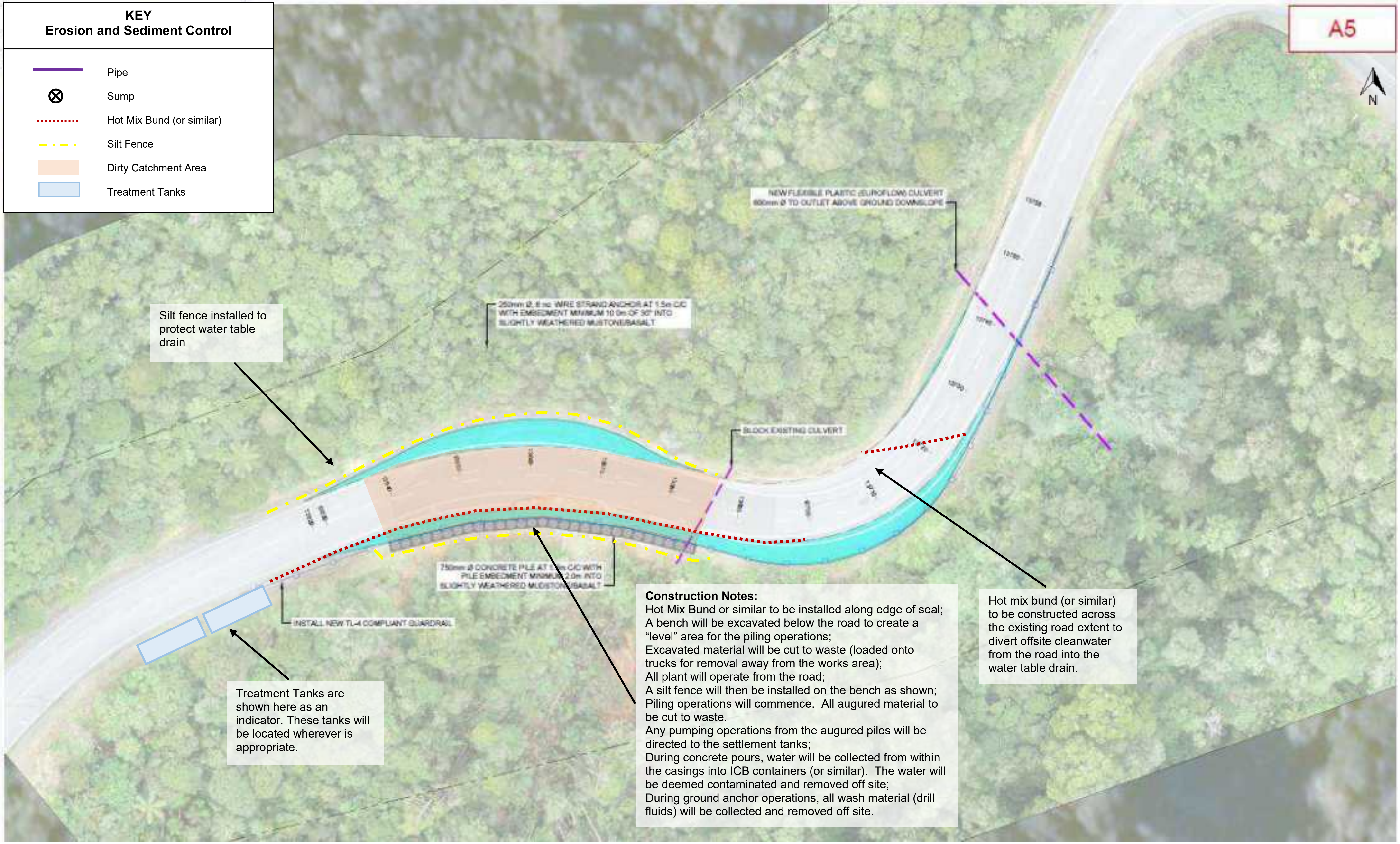
Project	**MAUNGAMUKA GORGE**
Title	**Erosion and Sediment Control Plan – Stage A3**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-001-01	01

KEY
Erosion and Sediment Control

	Pipe
⊗	Sump
	Hot Mix Bund (or similar)
	Silt Fence
	Dirty Catchment Area
	Treatment Tanks



Construction Notes:
Hot Mix Bund or similar to be installed along edge of seal;
A bench will be excavated below the road to create a "level" area for the piling operations;
Excavated material will be cut to waste (loaded onto trucks for removal away from the works area);
All plant will operate from the road;
A silt fence will then be installed on the bench as shown;
Piling operations will commence. All augured material to be cut to waste.
Any pumping operations from the augured piles will be directed to the settlement tanks;
During concrete pours, water will be collected from within the casings into ICB containers (or similar). The water will be deemed contaminated and removed off site;
During ground anchor operations, all wash material (drill fluids) will be collected and removed off site.

NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

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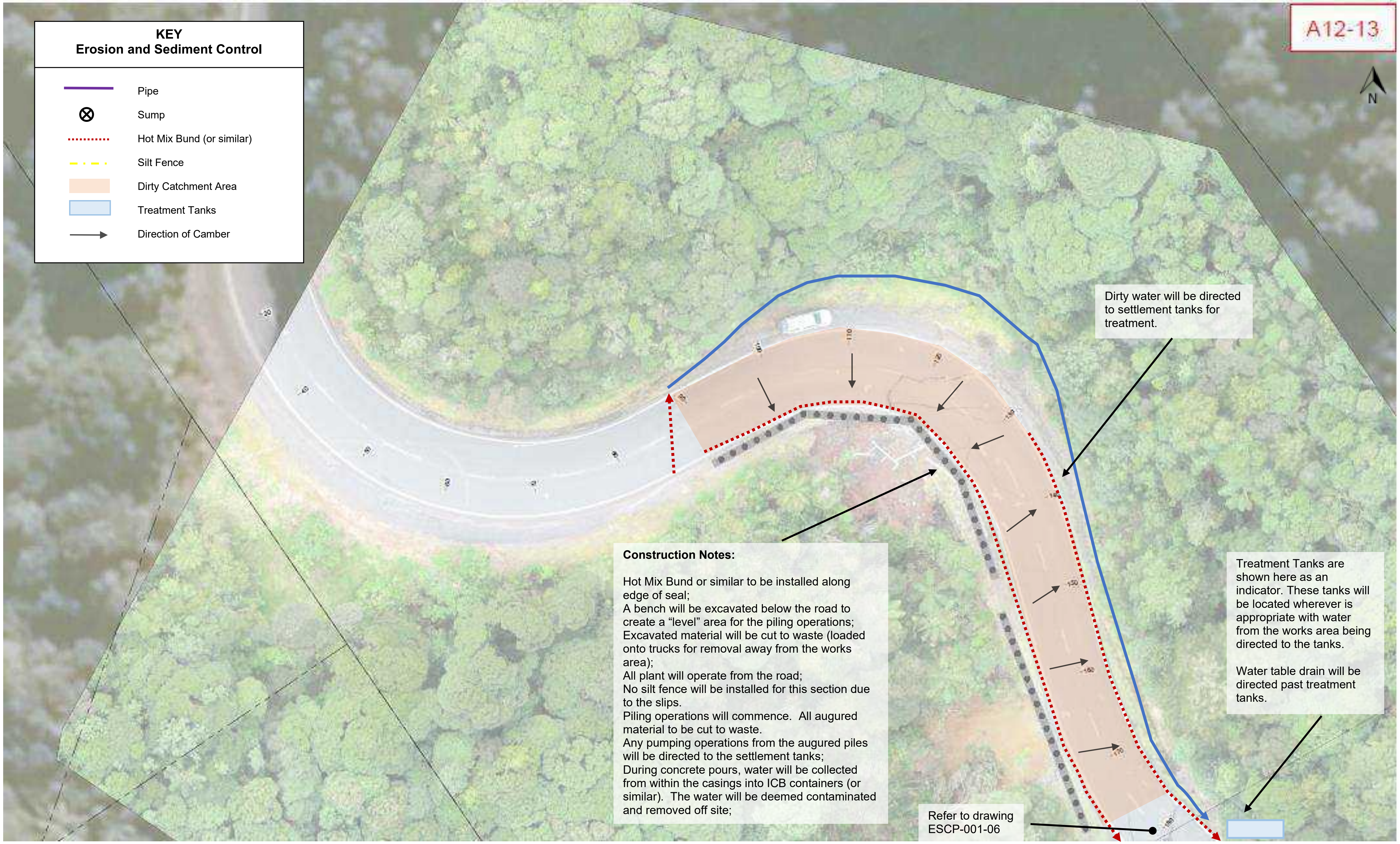
Project	MAUNGAMUKA GORGE
Title	**Erosion and Sediment Control Plan – Stage A5**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-001-03	03



NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

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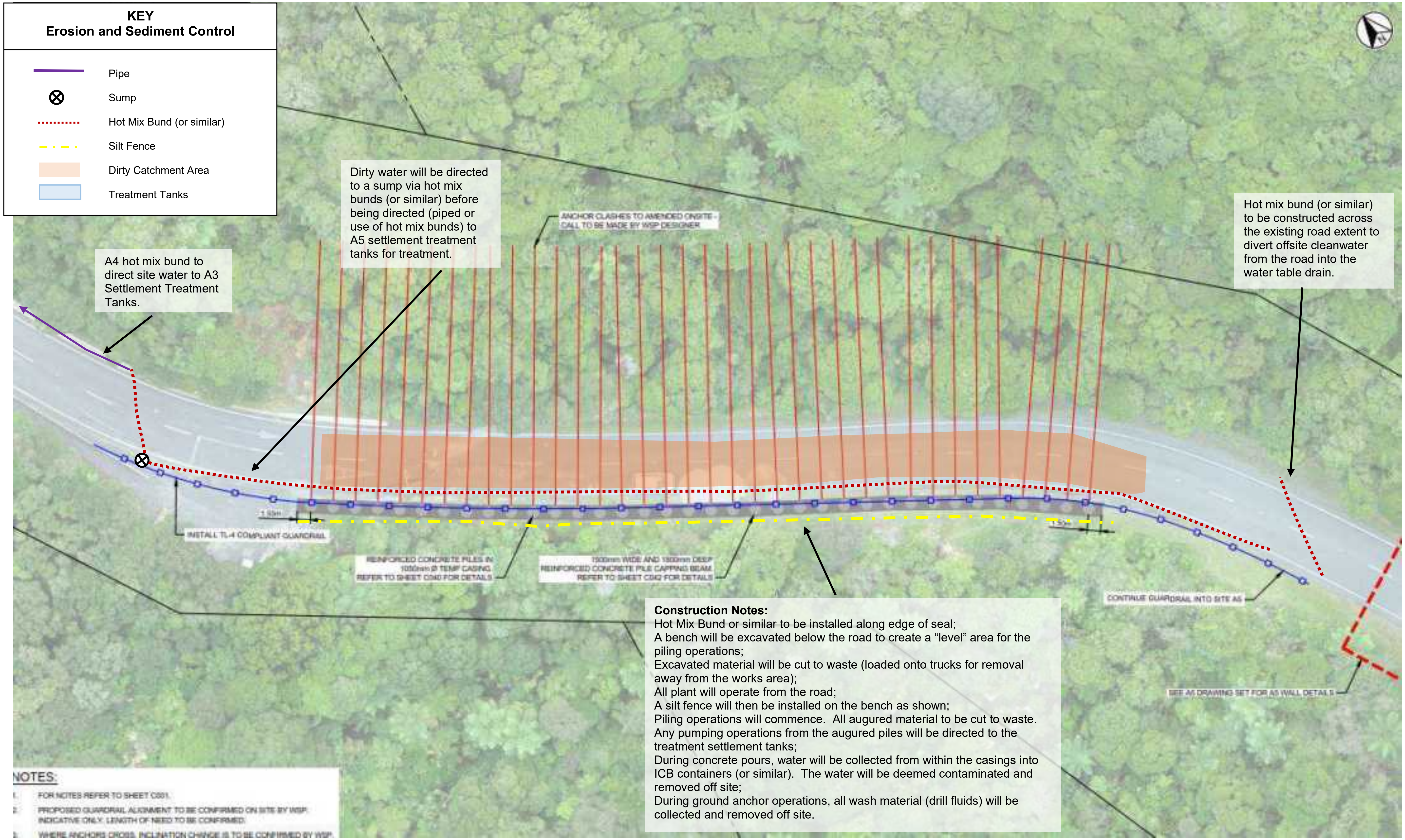
Project	MANGAMUKA GORGE
Title	Erosion and Sediment Control Plan – Stage A12-13 (Sheet 1 of 2)

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-001-05	05



NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

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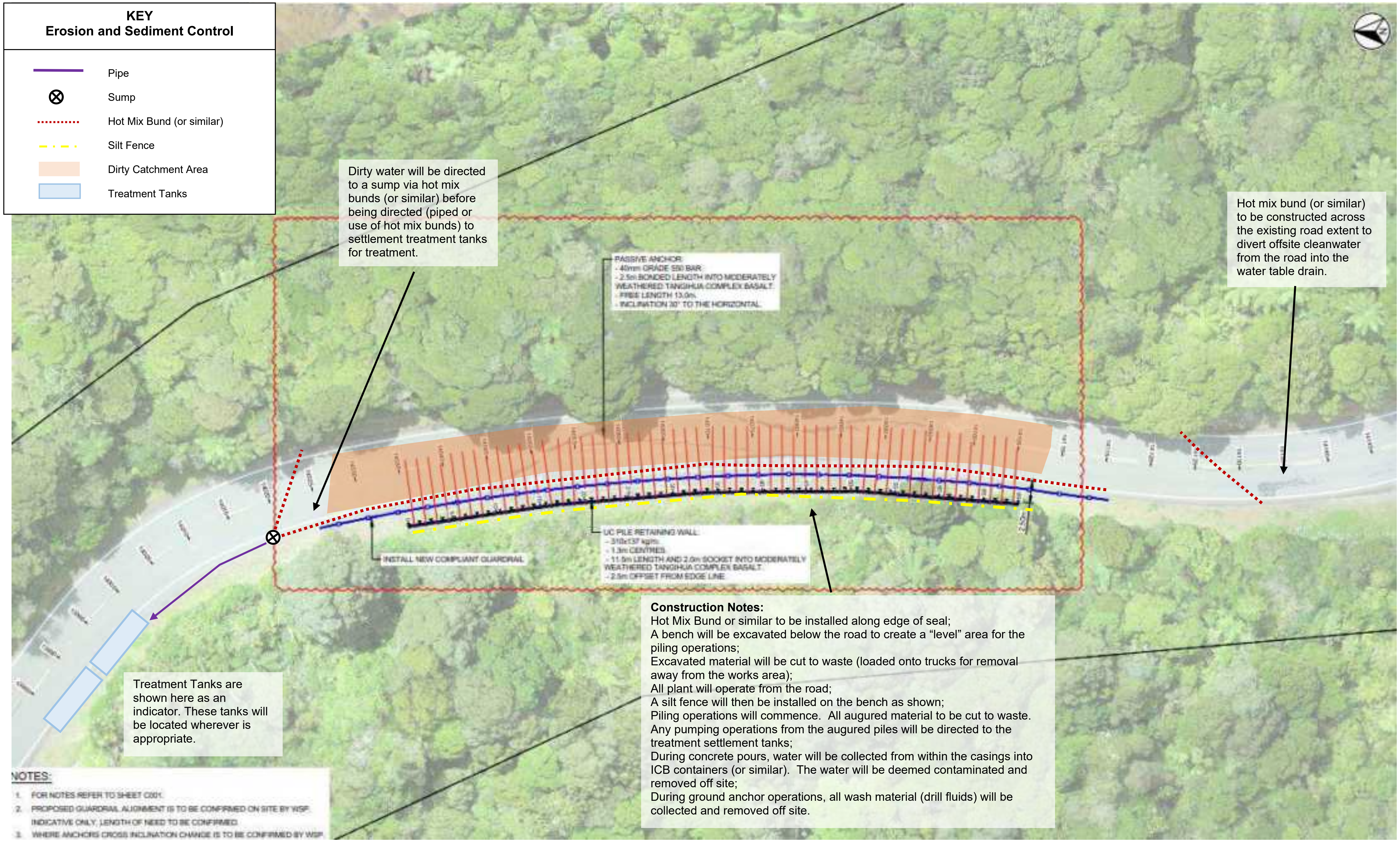
CLL SERVICE & SOLUTIONS

Project	**MAUNGAMUKA GORGE**
Title	**Erosion and Sediment Control Plan – Stage A4**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-001-09	09



NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

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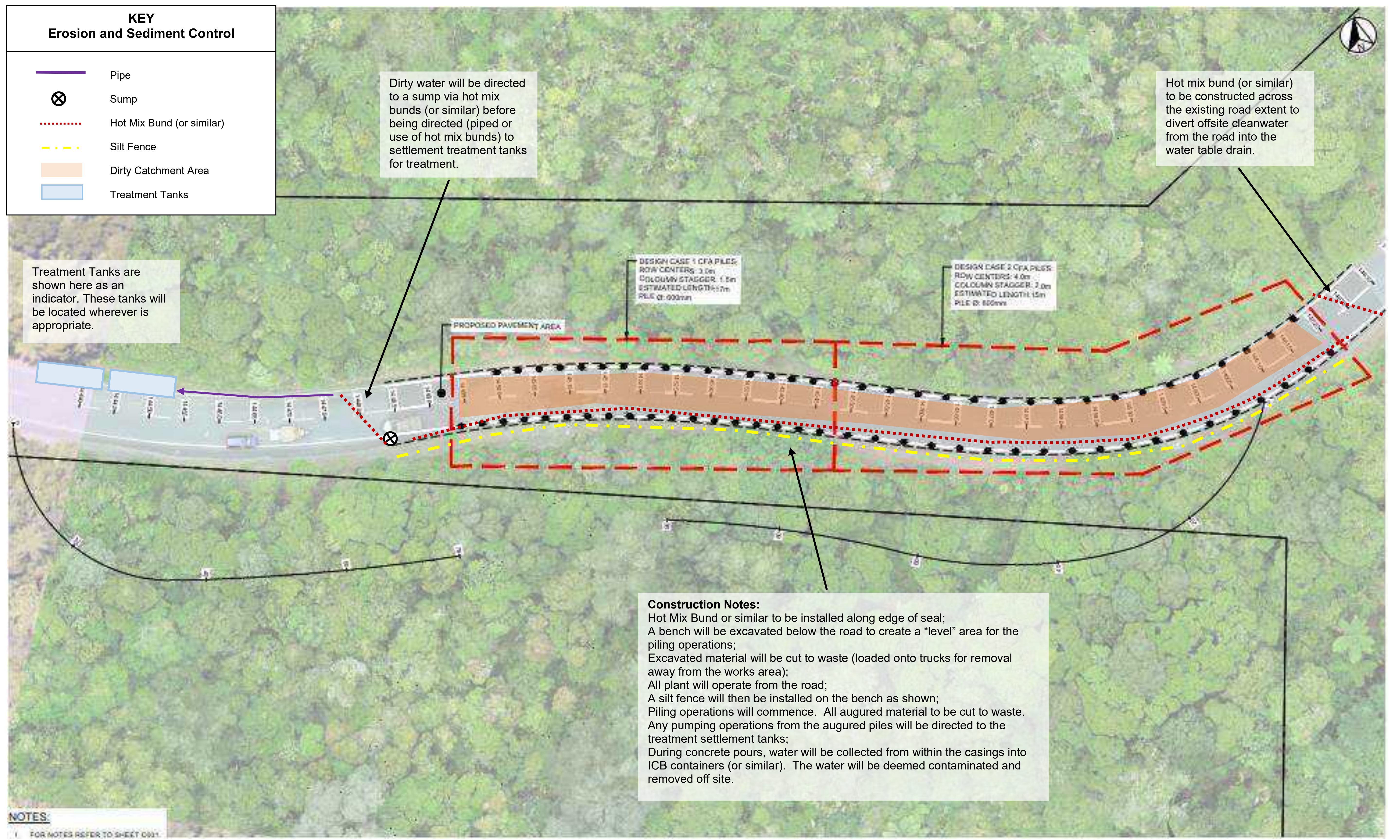
Project	MAUNGAMUKA GORGE
Title	Erosion and Sediment Control Plan – Stage A7

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-001-10	10



NOTES

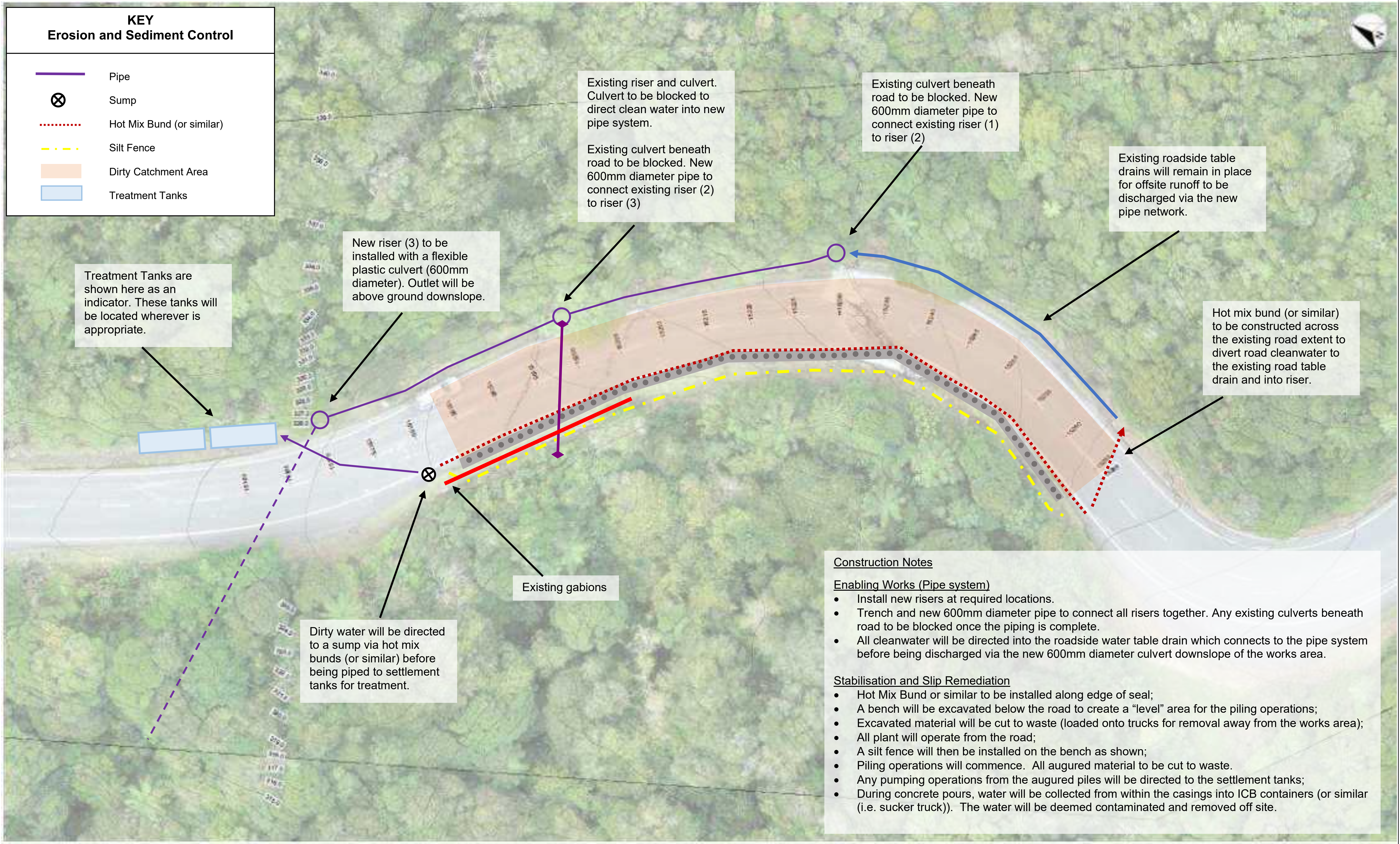
1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	08.11.24	Draft for review.	TH

CLL SERVICE & SOLUTIONS

Project	**MAUNGAMUKA GORGE**
Title	**Erosion and Sediment Control Plan – Stage A8**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-001-11	11



Construction Notes

Enabling Works (Pipe system)

- Install new risers at required locations.
- Trench and new 600mm diameter pipe to connect all risers together. Any existing culverts beneath road to be blocked once the piping is complete.
- All cleanwater will be directed into the roadside water table drain which connects to the pipe system before being discharged via the new 600mm diameter culvert downslope of the works area.

Stabilisation and Slip Remediation

- Hot Mix Bund or similar to be installed along edge of seal;
- A bench will be excavated below the road to create a "level" area for the piling operations;
- Excavated material will be cut to waste (loaded onto trucks for removal away from the works area);
- All plant will operate from the road;
- A silt fence will then be installed on the bench as shown;
- Piling operations will commence. All augured material to be cut to waste.
- Any pumping operations from the augured piles will be directed to the settlement tanks;
- During concrete pours, water will be collected from within the casings into ICB containers (or similar (i.e. sucker truck)). The water will be deemed contaminated and removed off site.

NOTES

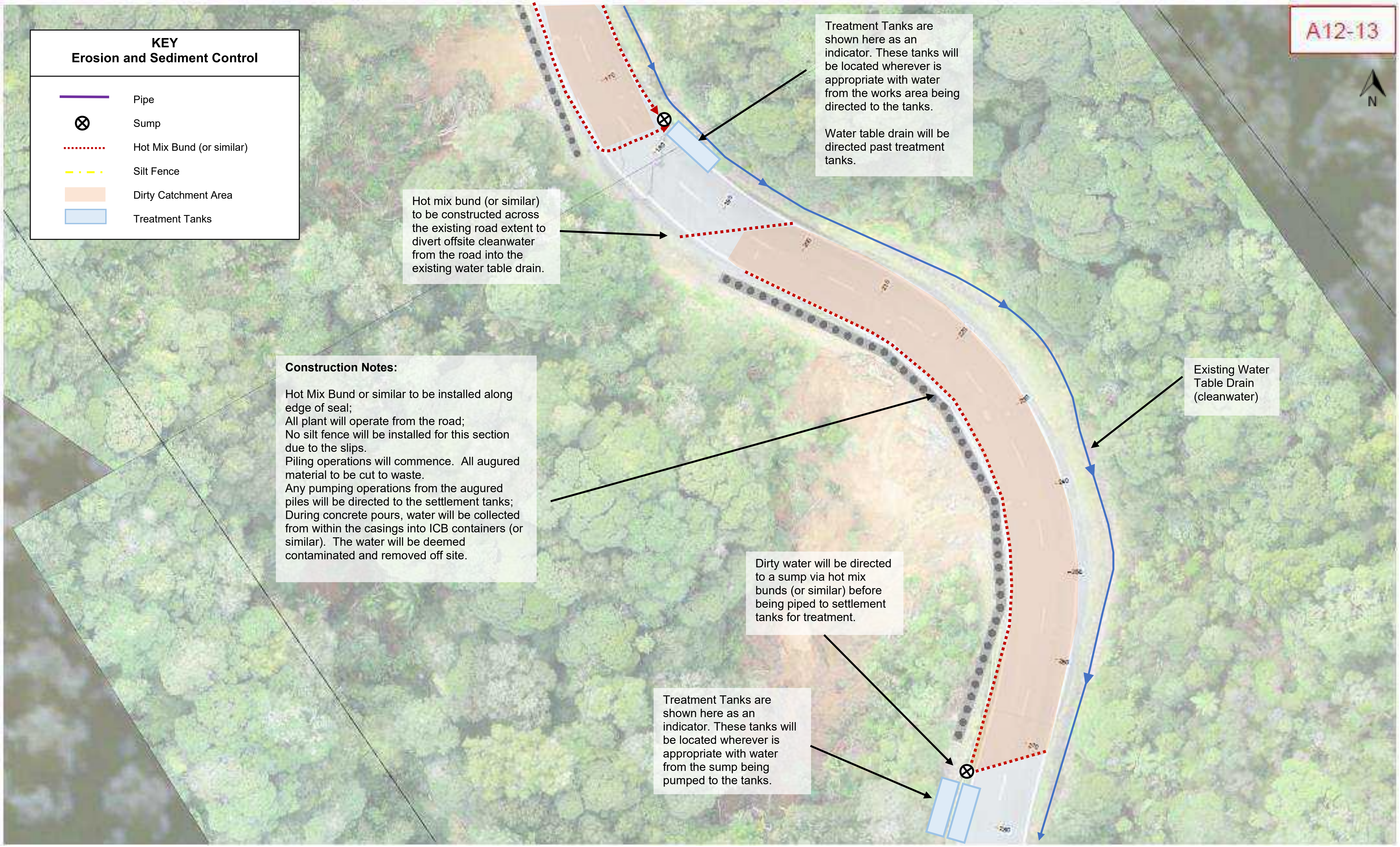
1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	31.01.23	Draft for review.	TH

CLL SERVICE & SOLUTIONS

Project	MAUNGAMUKA GORGE
Title	Erosion and Sediment Control Plan – Stage A9

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-001-04	04



NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	31.01.23	Draft for review.	TH

CLL SERVICE & SOLUTIONS

Project	MANGAMUKA GORGE
Title	Erosion and Sediment Control Plan – Stage A12-13 (Sheet 2 of 2)

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-001-06	06

KEY
Erosion and Sediment Control

- Pipe
- Sump
- Hot Mix Bund (or similar)
- Silt Fence
- Dirty Catchment Area
- Treatment Tanks

NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	19.06.23	Draft for review.	TH

CLL SERVICE & SOLUTIONS

Project	**MAUNGAMUKA GORGE**
Title	**Erosion and Sediment Control Plan – Stage A6**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-001-07	07

KEY
Erosion and Sediment Control

- Pipe
- Sump
- Hot Mix Bund (or similar)
- Silt Fence
- Dirty Catchment Area
- Treatment Tanks

Construction Notes:
Hot Mix Bund or similar to be installed along edge of seal;
A bench will be excavated below the road to create a “level” area for the piling operations;
Excavated material will be cut to waste (loaded onto trucks for removal away from the works area);
All plant will operate from the road;
A silt fence will then be installed on the bench as shown;
Piling operations will commence. All augured material to be cut to waste.
Any pumping operations from the augured piles will be directed to the treatment settlement tanks;
During concrete pours, water will be collected from within the casings into ICB containers (or similar). The water will be deemed contaminated and removed off site;
During ground anchor operations, all wash material (drill fluids) will be collected and removed off site.

NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	05.07.23	Draft for review.	TH

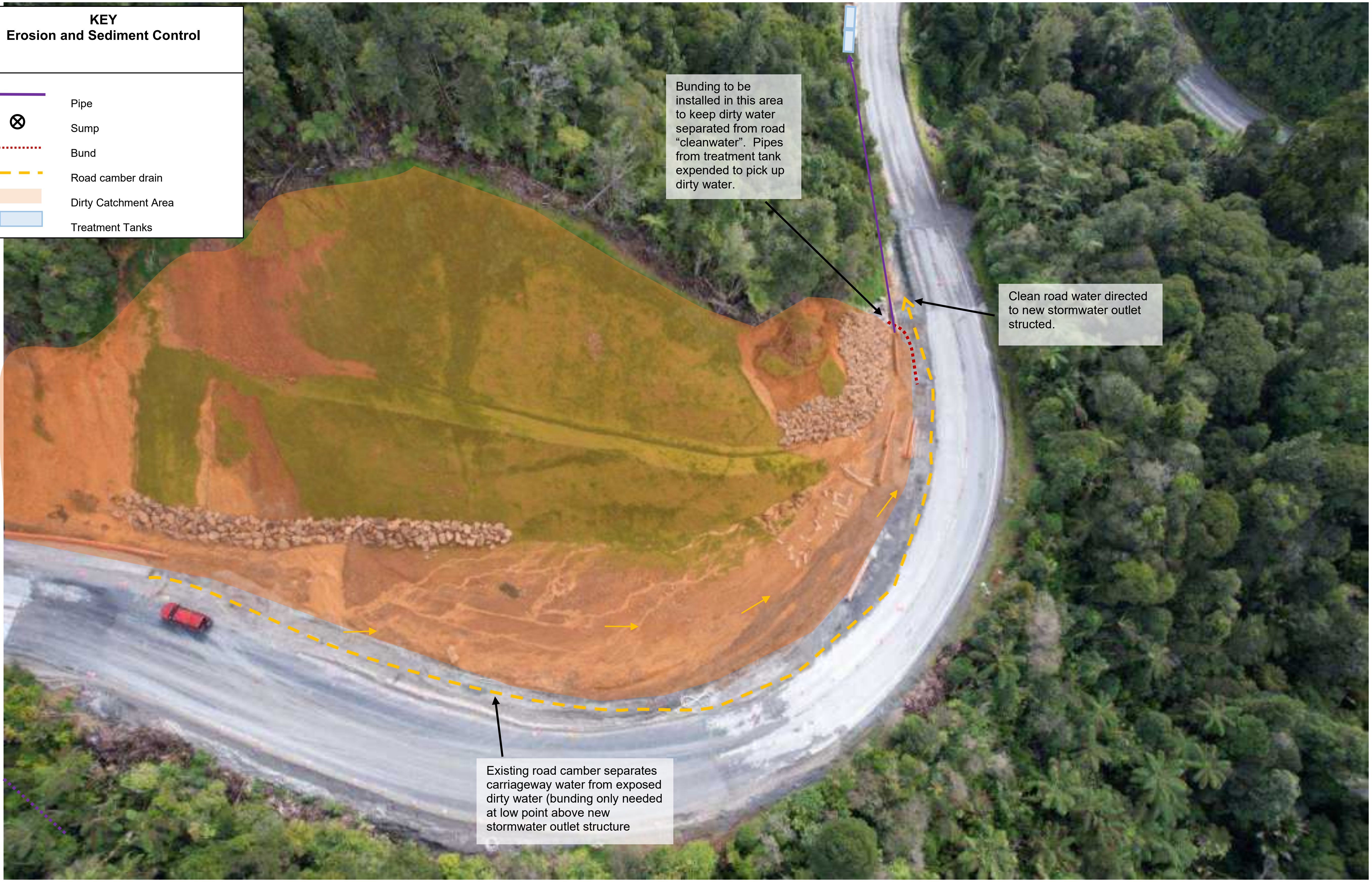
CLL SERVICE & SOLUTIONS

Project	**MAUNGAMUKA GORGE**
Title	**Erosion and Sediment Control Plan – Stage A26**

Drawn	Checked	Drawing No.	Sheet No.
CS	CTH	ESCP-001-08	08

KEY
Erosion and Sediment Control

	Pipe
⊗	Sump
	Bund
	Road camber drain
	Dirty Catchment Area
	Treatment Tanks



NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	25.01.24	Draft for review.	TH
B	05.04.24	Updates due to methodology change	TH
C	31.08.24	Updates due to partial completion works	TH

Project	MAUNGAMUKA GORGE
Title	Erosion and Sediment Control Plan – Stage A11
Drawn	CS
Checked	TH
Drawing No.	ESCP-001-09
Sheet No.	09

Silt fence should be constructed on the level contour along the edge of the flat area.

KEY
Erosion and Sediment Control

- Stabilised entranceway
- Access Track/Haul Road
- Perimeter Bund
- Silt Fence
- Stabilised Area
- Area to fill and level

NOTES

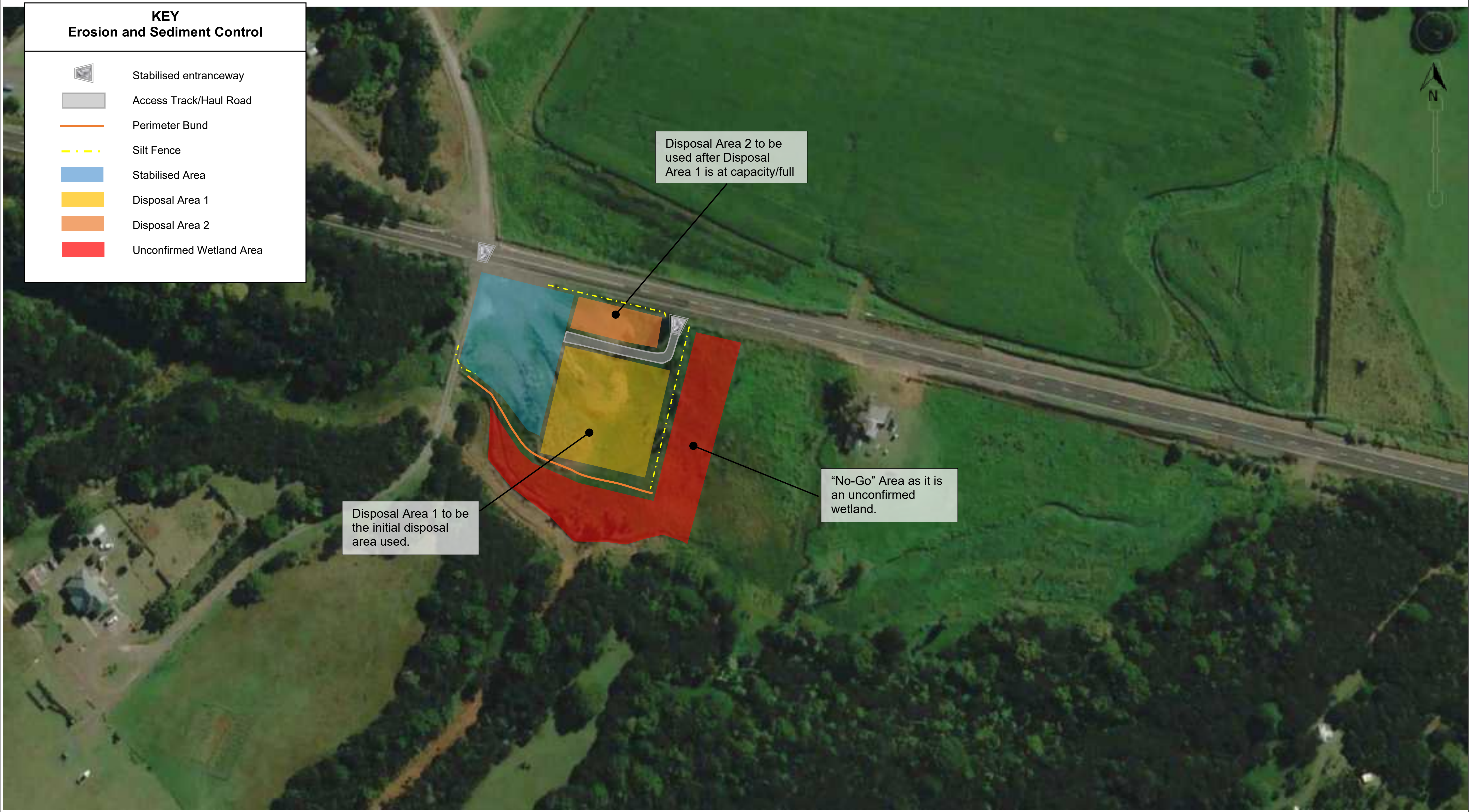
1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	03.04.23	Draft for review.	TH
B	12.04.23	Updates	TH
C	19.06.23	Slurry Pit additions	TH

CLL SERVICE & SOLUTIONS

Project	**MAUNGAMUKA GORGE**
Title	**Erosion and Sediment Control Plan – Disposal Site Makene Road**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-002-01	01



NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	31.01.23	Draft for review.	

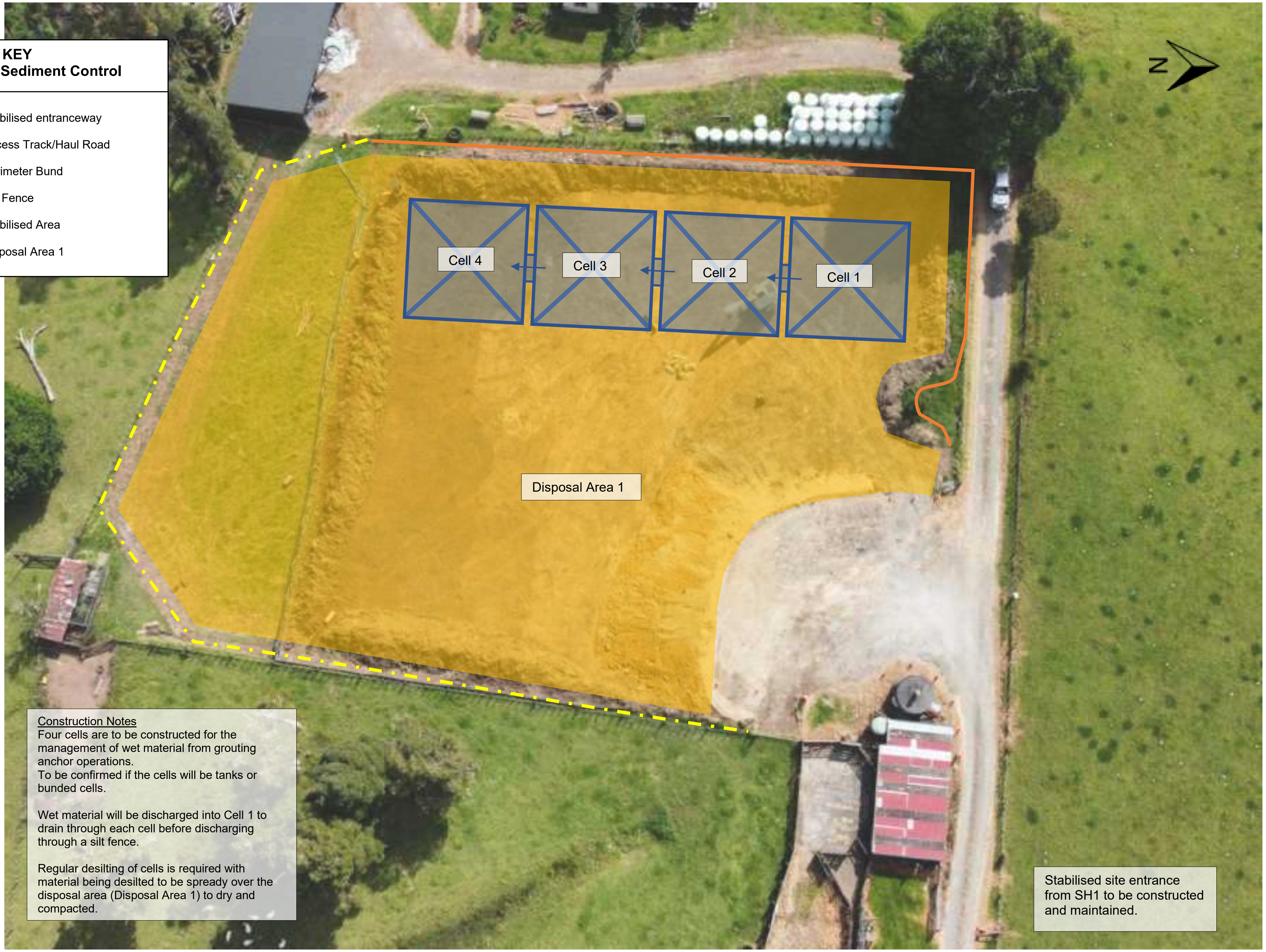
CLL SERVICE & SOLUTIONS

Project	MAUNGAMUKA GORGE
Title	Erosion and Sediment Control Plan – Disposal Site South

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-001-01	01

KEY
Erosion and Sediment Control

- Stabilised entranceway
- Access Track/Haul Road
- Perimeter Bund
- Silt Fence
- Stabilised Area
- Disposal Area 1



<u>Construction Notes</u>
Four cells are to be constructed for the management of wet material from grouting anchor operations.
To be confirmed if the cells will be tanks or bunded cells.

Wet material will be discharged into Cell 1 to drain through each cell before discharging through a silt fence.

Regular desilting of cells is required with material being desilted to be spready over the disposal area (Disposal Area 1) to dry and compacted.

Stabilised site entrance from SH1 to be constructed and maintained.

NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	03.03.23	Draft for review.	TH
B	03.04.23	Update of Disposal Area	TH
C	15.05.23	Cell Construction	TH

CLL SERVICE & SOLUTIONS

Project	**MAUNGAMUKA GORGE**
Title	**Erosion and Sediment Control Plan – Disposal Site North**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-001-01	01

NOTES

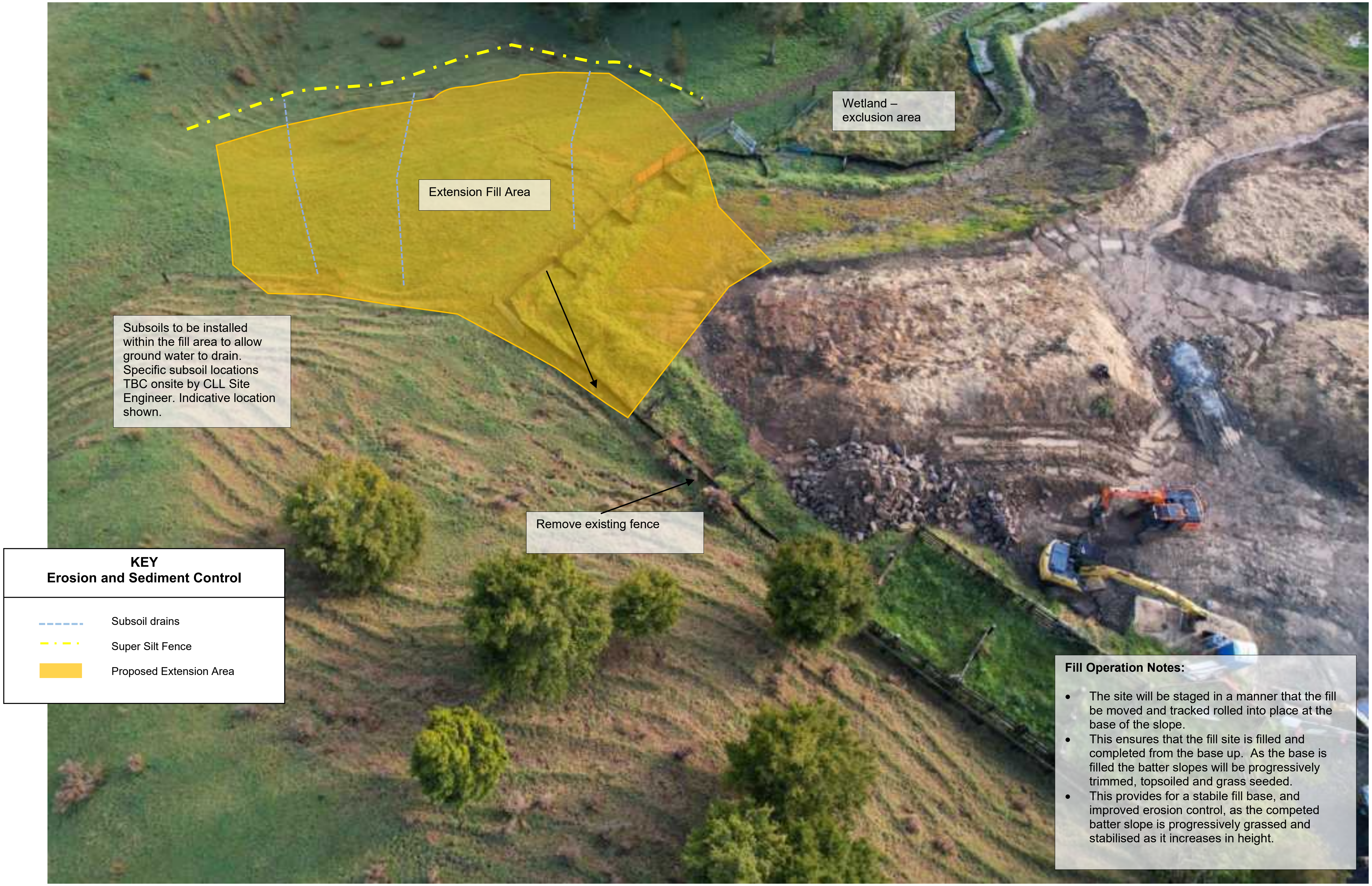
1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	16.05.23	Draft for review.	TH

CLL SERVICE & SOLUTIONS

Project	MAUNGAMUKA GORGE
Title	Erosion and Sediment Control Plan – Disposal Site Peria Valley Road

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-003-01	01



NOTES

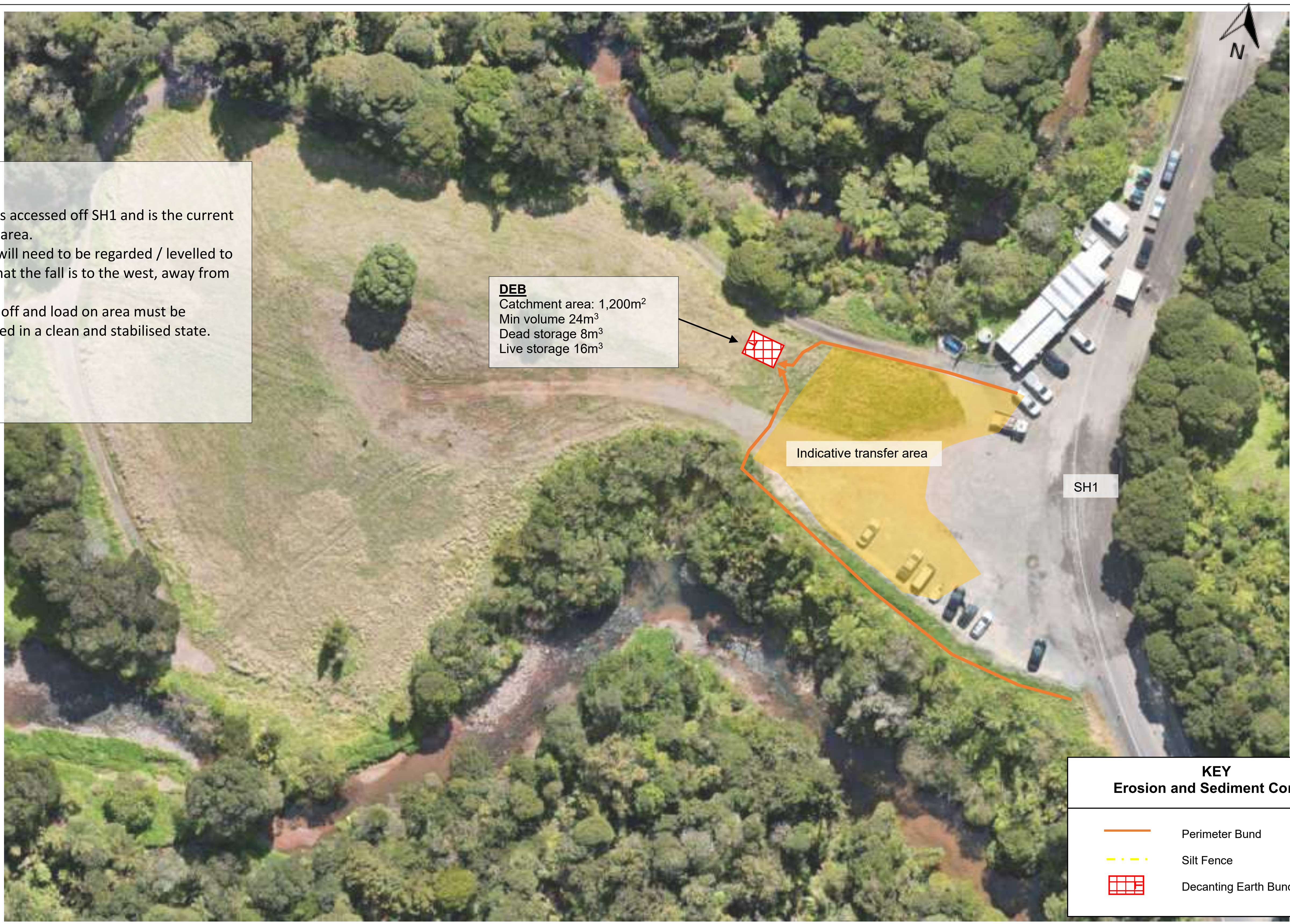
1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	31.08.24	Draft for review.	TH

CLL SERVICE & SOLUTIONS

Project	MAUNGAMUKA GORGE
Title	Erosion and Sediment Control Plan – Disposal Site Peria Valley Road - Extension

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-003-02	01



Operation Notes:

- The site is accessed off SH1 and is the current laydown area.
- The site will need to be regarded / levelled to ensure that the fall is to the west, away from SH1.
- The load off and load on area must be maintained in a clean and stabilised state.

KEY
Erosion and Sediment Control

- Perimeter Bund
- Silt Fence
- Decanting Earth Bund (DEB)

NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	19.04.24	Draft for review.	TH

CLL SERVICE & SOLUTIONS

Project	MANGAMUKA GORGE
Title	Erosion and Sediment Control Plan – Southern Gate Transfer Area – April 2024

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-001-01	01

Operation Notes:

Temporary Spoil Area has been designed to accommodate approximately 1,500m^3 of spoil material.

- Sediment Control will be via silt fences and silt socks
- A silt soc is to be installed across the entry point when rain is forecast or left over night.
- All spoil will be unloaded towards the back of the designated area first. The entry point into the spoil area will be maintained in a stabilised and clean state.
- Spoil will be grass seeded on a regular basis.

NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	20.08.24	Draft for review.	TH
B	30.08.24	Final	TH

CLL SERVICE & SOLUTIONS

Project	MANGAMUKA GORGE
Title	Erosion and Sediment Control Plan – SH1 6770 Kaitaia Temporary Spoil Site

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-TSS-001-01	01

Appendix C – Kauri Dieback Procedure

Project Name:	Mangamuka Gorge	Code:	
Procedure:	Appendix C: Kauri Dieback Procedure		

1 Application

This Plan forms a part of the Erosion and Sediment Control Plan (ESCP) for Mangamuka Gorge Road Rehabilitation works (the Project). The purpose of this Plan is to have the procedures in place to manage the risk of kauri dieback disease and to reduce the potential environmental impact the works may have on the spread of kauri dieback disease.

2 Scope of works

The construction activities of the Project include the following:

- Ground stability improvements (anchors);
- Retaining wall construction;
- Culvert works;
- Road reinstatement.

3 Potential Environmental Impacts of Activities.

Kauri (*Agathis australis*) are a cornerstone of the indigenous forests of the upper North Island and have had a large part to play not just in the landscape of Aotearoa but also in its culture and early history[1]. Kauri dieback is caused by a soil-borne pathogen. Minimising the movement of soil or plant material that is potentially contaminated with kauri dieback by people, animals, and limited natural spread (over small distances) is fundamental to the management of kauri dieback.

Kauri dieback spreads through the movement of contaminated soil and soil water and it is possible that it is also spread by streams and rivers particularly in times of flooding.

When working or conducting any activity within or around kauri or in native forests in Northland there is a risk of spreading kauri dieback. Kauri forests and stands can be less easily identifiable and have the potential to be in remnant forests across the region.

The key potential situations and the environmental impacts of these are:

Aspects	Impacts
Spread of kauri dieback disease around the local Native forests around the works area through the movement of soil via people, equipment/tools, heavy machinery, and vehicles.	Acute and chronic harm to local kauri by the spread of kauri dieback disease to healthy/uninfected kauri.

[1] Kauri Dieback Hygiene, Best Practice Guidelines; Northland Regional Council, March 2020

4 Key Responsibilities

Responsibilities.

The ***Project Director*** is responsible for:
- Ensuring controls to prevent kauri dieback spreading are in place; and
- Ensuring protocols and procedures to manage the risk of kauri dieback are in place.

The ***Project Manager is*** responsible for:
- Ensuring the implementation of this Plan;
- Communicating requirements to relevant site personnel; and
- Ensuring all personnel have received appropriate instruction and training in avoiding and following kauri dieback procedures.

The ***Site Engineer*** is responsible for:
- Ensuring adequate hygiene points and wash down stations are available for all soil disturbing activities where kauri may be present;
- Ensuring that all hygiene kits are in stock; and
- Ensuring all site personnel have received appropriate instruction and training in avoiding and following kauri dieback procedures.

All ***Site Personnel*** are responsible for:
- Following the requirements of this Procedure; and
- Reporting any concerns, incidents, or observations to the Earthworks Manager or Site/Contract Manager

5 Kauri Dieback Disease Prevention Procedures

5.1 Hygiene Procedures

- Ensure all gear (footwear, tools, equipment, and machinery) is clean before entering and after leaving if Kauri have been identified nearby the work site. It is recommended that all gear is cleaned at the beginning and end of each day if leaving the site. ‘Clean’ refers to completely soil-free. Soil and organic material cleaned from equipment (including vehicles and heavy machinery), where possible should be collected and disposed of appropriately at an approved landfill. Alternatively, the material can be left in situ at the source.
    - Wheeled or tracked machinery and vehicles pose a high risk and therefore must be cleaned thoroughly to remove all soil.
    - Where possible, machinery and vehicles should remain on sealed road for the duration of the project.
    - When moving from one area of Kauri to another (between work sites), all equipment should be cleaned prior to moving. A full wash-down of soil and debris should occur on site prior to movement as this contains any problems at the source.
    - Where the above recommendation cannot occur, vehicles and machinery may be taken off site and cleaned in a wash-down facility, but all loose soil and debris must be removed at the kauri site prior to moving and care should be taken to ensure that risk of spread during transport to that facility is minimised.
    - Operators are expected to carry out their own inspections and cleaning, however these may be checked by local Department of Conservation (DOC) or council staff.
- Vehicles and personnel should remain on roads and tracks where possible, particularly in wet conditions. If it is required that vehicles or personnel need to move onto/off tracks, portable

phytosanitary packs are required to be used to ensure that kauri dieback is not carried onto the track from surrounding kauri or between high-risk areas.

- Phytosanitary kits must be used when leaving an area showing symptoms of kauri dieback disease.
- Operations should be carried out under dry soil conditions where possible.
- Work sites should ideally be located downslope of kauri areas.
- When entering or exiting a stream system, you must use portable phytosanitary packs to ensure kauri dieback is not carried into the stream from surrounding kauri or between high-risk areas.
- Raw materials (soil/substrate/gravel) should not be sourced from kauri areas. Materials should be sourced from a 'clean' source not containing kauri.
- If any vegetation removal is required, methods that do not disturb the soil should be used.
    - If any diseased kauri and vegetation (including weeds and native vegetation in diseased zones) are trimmed or cleared they must be left in-situ, composted for use on site, or disposed of at an appropriate landfill site.
    - If any soil/plant material is to be removed from a "controlled area" this must be managed with biosecurity approval.

5.2 Additional General Considerations

- Avoid or restrict introduction of high-risk products (soil/substrate/gravel/vegetation) to the area. If any high-risk products are required, they must be from reputable/biosecurity accredited sources.
- Managing or limiting vehicle access where appropriate should be considered.
- Managers, visitors and users must be aware when undertaking high-risk activities in an infected area.
- Good hygiene practices by all users/visitors should be encouraged.
- If both infected/symptomatic and uninfected sites are identified within an area, hygiene measures must be taken to avoid soil transfer from infected to uninfected. Activity should be planned to move from uninfected to infected areas (not vice-versa where possible).

5.3 Phytosanitary information

Kauri dieback spores can be removed from footwear and equipment simply by scrubbing them with clean water to remove all soil then allowing gear to dry. However, while not essential, using Sterigene will increase the effectiveness of these hygiene measures. Sterigene should be used at a 2% mix.

It is recommended that Sterigene disinfectant is used on footwear, equipment, machinery and other items that have been in contact with soil. Sterigene is a broad-spectrum disinfectant which is non-toxic, non-corrosive, biodegradable and environmentally friendly compared to other products.

Alternatively, Virkon and Janola (Bleach) may be used, however its application is limited in a forest situation and any application should be in accordance with the product's label instructions and Material Safety Data Sheet. Options for mixes are outlined below:

- 70% Methylated Spirits, 30% water.
- 25% Bleach, 75% water.
- 2% Sterigene Mix

All gear should first be cleaned to remove soil. Sterigene should then be sprayed onto the clean surfaces (and left to dry). Sterigene will not kill kauri dieback spores that are embedded in soil hence it is important to remove soil before applying the disinfectant.

Water, soil, or slurry and Sterigene from cleaning dirty equipment needs to be disposed of carefully:

- Solution must be drained into waste water drains, not the stormwater system, or disposed of on a lawn or gravel pad.
- If necessary, expired Sterigene may be discarded on a lawn or gravel pad.

- Do not let Sterigene drain into septic systems.
- Sinks connected to waste waster systems are ideal for cleaning equipment off site.

Wearing reusable non disposable overshoe booties is an option for each kauri area. Sourcing an overshoe bootie that is durable and can be washed and reused regularly is recommended. These need to be cleaned at the hygiene point (disinfectant location at the edge of the works or forest area) like footwear. Disposable ones are not recommended.

5.4 Hygiene Kit Requirements

Outlined below are the items needed in hygiene kits around the site and at hygiene and wash down points:

- Stiff bristle scrubbing brush or broom;
- 500ml spray bottle with disinfectant (disinfectant mixes are outlined in Section 5.3);
- Boot bags;
- 1 litre pump sprayer with water.

For vehicle and heavy machinery wash down points the volumes of disinfectant and water will be larger than those listed above. These volumes will be dictated by the frequency of cleaning and the amount of equipment that needs to be cleaned on site. The same mixes of disinfectant will be used as listed in Section 5.3.

6 Wash-Down Sites

Wash down of vehicles and/or heavy machinery that was used within a kauri root zone should occur within that area where possible. If the vehicles/machinery have been operating outside a root zone, the wash-down should occur prior to exiting a kauri forest.

When selecting a suitable wash-down site, the following should be considered:

- Hard stand area and well drained surface (e.g., road near the edge, firm grass or gravel).
- At least 30m away from a water course or water body. This includes drains that discharge to water courses such as stormwater drains and culverts.
- An area within the root zone, if use of equipment and vehicles has occurred in this area.
- Is of gentle slope to drain wastewater away from:
  - The wash-down area and into a kauri root zone.
  - Water catchment.
  - Areas outside the kauri root zone.
  - Vehicles and heavy machinery being washed to prevent potential re-contamination.
- Enable cleaned objects to exit without being re-contaminated.
- Undertaking a risk assessment of the site to inform a health and safety risk management plan e.g., working around powerlines.

Where runoff cannot be managed to an acceptable standard (e.g., large quantity of wastewater and/or an extensive runoff) construction of a bund and sump may be required to safely dispose of the wastewater. DO not drive through wash down wastewater as this may re-contaminate the vehicle/machinery.

If wash down cannot occur in the forest, then the vehicles and/or heavy machinery should be taken to a suitable facility off site for decontamination. All loose soil and vegetation should be physically removed (preferably when dry) where possible before the vehicle or heavy machinery is transported offsite. This can be removed using a hard brush or broom or by using compressed air. Pay attention to the underside, between dual wheels, sump guards, mud flaps, hollow sections, foot wells, and bumper bars. The amount of water used should be minimised.

Footwear and equipment/tool hygiene points should be installed at the entrance and exit of a kauri forest site. If the same access point is used when moving from one area of kauri to another, a hygiene point should be set up between the two areas. Footwear should be cleaned following the procedures outlined in Section 5.3 and Section 5.4.

7 External Contacts

Kauri Dieback Helpline	0800 NZ KAURI
Kauri Dieback Team – Northland Regional Council	kauridieback@nrc.govt.nz

Project Team Contacts

Project Director: Vaughn Robbins	027 492 3576
Project Manager: Chris Tuxford	0272695275
ESC & Environmental: Campbell Stewart	021 837825
Site Engineer: Tim Hunger	0275719111

APPENDIX B - Outline Plan 2240268-RMAOUT

FAR NORTH DISTRICT COUNCIL

FAR NORTH OPERATIVE DISTRICT PLAN

IN THE MATTER OF
The Resource Management Act 1991

AND

IN THE MATTER OF
an application for Outline Plan Assessment under the aforesaid Act by

New Zealand Transport Agency

FILE NUMBER: **2240268-RMAOUT**

OUTLINE PLAN APPLICATION

The proposal is to to realign a 270m long section of road at Slip A11 that involves approximately 25514m3 of cut and 354m3 of fill earthworks and approximately 4282m3 of vegetation clearance.

The property in respect of which the application is made is situated State Highway 1, Mangamuka 0476.

The site is designated as under the Far North Operative District Plan (September 2009).

OUTLINE PLAN DETERMINATION

That pursuant to Section 176A of the Resource Management Act 1991, the Council has assessed the application by New Zealand Transport Agency to realign a 270m long section of road at Slip A11 that involves approximately 25514m3 of cut and 354m3 of fill earthworks and approximately 4282m3 of vegetation clearance located State Highway 1, Mangamuka 0476 and has determined that the proposal may proceed without change to that which is shown on the approved plans prepared by WSP, referenced WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND A11 NZTA EMERGENCY WORKS 2022, dated December 2023, and attached to this consent with the Council's "Approved Plan" stamp affixed to it and is subject to the following recommendations:

1. **It is recommended** that to ensure silt, sediment and dust control measures are maintained by an appropriately qualified and experienced person a site walk over shall be undertaken daily before leaving the site to identify any corrective maintenance required. A more thorough inspection shall be undertaken at the end of each week, before and after a major forecast storm event.

DECISION PREPARED BY: **Eden Nathan, Consents Planner**

CONSENT GRANTED UNDER DELEGATED AUTHORITY:

Tianxu (Brian) Huang
Team Leader – Resource Cosnents

DATE: 5 February 2024
2240268-RMAOUT

Far North District Council

Private Bag 752, Kaikohe
Kaikohe 0440, New Zealand
Freephone: 0800 920 029
Phone: (09) 401 5200
Fax: (09) 401 2137
Email: ask.us@fndc.govt.nz
Website: www.fndc.govt.nz

Te Kaunihera o Tai Tokerau Ki Te Raki

The top place where talent wants to live, work and invest

Application No: **2240268-RMAOUT**

5 February 2024

New Zealand Transport Agency
C/- Stellar Projects Ltd
PO Box 33915
Takapuna
Auckland 0740

Tēnā koe New Zealand Transport Agency,

Re: **2240268-RMAOUT - Outline Plan – OUTLINE PLAN ASSESSMENT**

I am pleased to inform you that your application for outline plan consideration has been accepted. The decision and any recommendations are enclosed for your information. The application was considered and determined under authority delegated to the Resource Consents Manager, District Services, of the Far North District Council, pursuant to Section 34 (4) of the Resource Management Act 1991.

It is important that you advise the territorial authority as soon as practicable of your acceptance or otherwise of any changes requested to the Outline Plan. If you have any questions or concerns about any aspect of this assessment or its suggested changes, please contact the planner who prepared the decision.

If you have any further queries regarding this matter, please contact the reporting planner on 09 401 5200 or 0800 920 029.

Ngā mihi,

EdenNathan

Eden Nathan
Consents Planner
Delivery and Operations

APPROVED PLAN

Planner: ENathan
RC: 2240268-RMAOUT
Date: 6/02/2024

WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

CIVIL
DETAILED DESIGN

Project No: 1-11241.13(A11)
Date: DECEMBER 2023

DRAWING INDEX		
SHEET No.	SHEET TITLE	REV. No.
GENERAL OVERVIEW		
C000(A11)	COVER SHEET	A
C001(A11)	NOTES AND INDEX	A
C002(A11)	PLAN - EXISTING CONTOURS	A
C003(A11)	PLAN- PROPOSED OPTION	A
C004(A11)	PLAN- PROFILE	A
C004(A11)	PLAN-CUT FILL DRAWING	A
C010-C016(A11)	CROSS SECTIONS	A
C050	PLAN-CUT FILL PLAN	A
C051	ALIGNMENT - SETTING OUT	A
C060	REPLANTING AREA	A
GEOTECHNICAL INVESTIGATIONS		
CIVIL WORKS - PLANS		
CIVIL WORKS - TYPICAL SECTIONS AND DETAILS		
LONG SECTIONS - PAVEMENT AND WALL		
CIVIL WORKS - CROSS SECTIONS		

NOTES.

1. PLANS TO BE READ IN CONJUNCTION WITH THE SPECIFICATIONS.
2. PROPERTY BOUNDARIES ARE APPROXIMATE ONLY (LINZ). NO BOUNDARY SURVEY HAS BEEN COMPLETED.
3. NO SERVICE IDENTIFICATION HAS BEEN UNDERTAKEN IN PREPARATION OF THESE PLANS. ANY SERVICES SHOWN ARE APPROXIMATE ONLY AND CLASHES MAY OCCUR.
4. IT IS THE CONTRACTOR'S RESPONSIBILITY TO MARK OUT THE LOCATION OF EXISTING SERVICES PRIOR TO COMMENCEMENT OF PHYSICAL WORK ON SITE.
5. ALL PLAN COORDINATES IN TERMS OF NZGD 2000 MOUNT EDEN CIRCUIT AND LEVEL DATUM IS NZVD 2016.
6. CONTAINS DATA SOURCED FROM LAND INFORMATION NEW ZEALAND(LINZ). LINZ GIVES NO WARRANTY IN RELATION TO THE DATA (INCLUDING ACCURACY, RELIABILITY, COMPLETENESS OR SUITABILITY) AND ACCEPTS NO LIABILITY (INCLUDING, WITHOUT LIMITATION, LIABILITY IN NEGLIGENCE) FOR ANY LOSS, DAMAGE OR COSTS RELATING TO ANY USE OF THE DATA. CROWN COPYRIGHT RESERVED.
7. PAVEMENT THICKNESS SHOWN IS INDICATIVE ONLY, NEEDS TO BE CONFIRMED AS PER DESIGN

APPROVED PLAN

Planner: ENathan
RC: 2240268-RMAOUT
Date: 6/02/2024

WORK IN PROGRESS
PRINTED 11/12/2023 3:38:45 pm

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR DETAILED DESIGN	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES: N/A
ORIGINAL SIZE: A1
DRAWN: K.DARSHAN
DESIGNED: M.LEGGETT
APPROVED: -
DRAWING VERIFIED: -
DESIGN VERIFIED: -
APPROVED DATE: -

FOR INFORMATION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

TITLE
NOTES AND INDEX

WSP PROJECT NO. (SUB-PROJECT): 1-11241.13(A11)
SHEET NO.: C001(A11)
REVISION: A

LEGEND	
— — —	PROPERTY BOUNDARY
———	ROAD RESERVE
⊠	HIGH VALUE TREES

APPROVED PLAN

Planner: ENathan
RC: 2240268-RMAOUT
Date: 6/02/2024

NOTES.

1. FOR GENERAL NOTES REFER TO SHEET C001

1:500 @ A1
1:1000 @ A3
0 5 10 15 20 25 30 35 40 45 50 m

WORK IN PROGRESS
PRINTED 11/12/2023 3:01:48 pm

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR DETAILED DESIGN		

WAKA KOTAHI NZ TRANSPORT AGENCY

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Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES		ORIGINAL SIZE
1:500 AT A1		A1
DRAWN	DESIGNED	APPROVED
K.DARSHAN	M.LEGGETT	APPROVER
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
VERIFIER	VERIFIER	YYYY-MM-DD

FOR INFORMATION

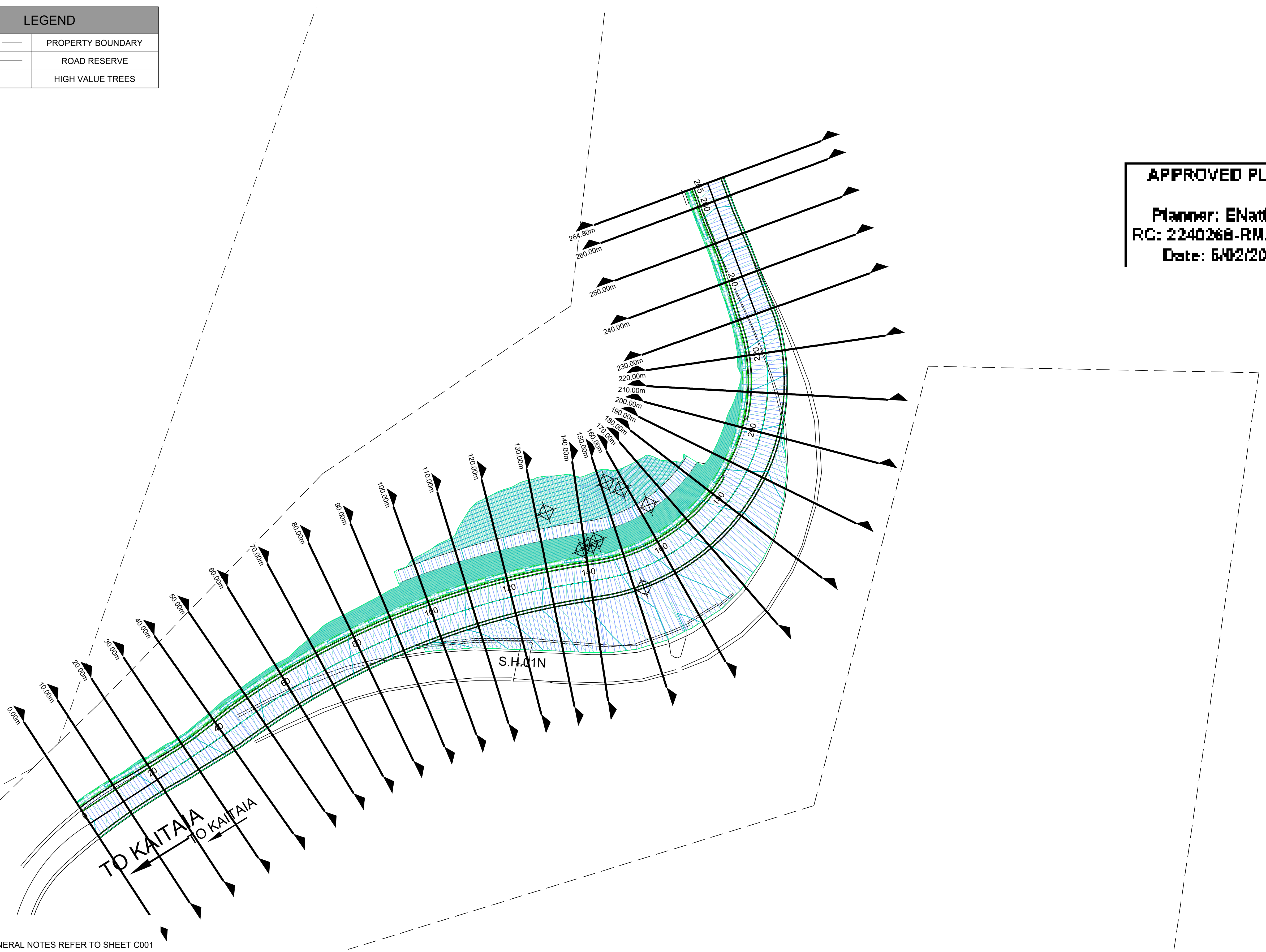
PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

TITLE
PLAN
EXISTING CONTOURS

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11241.13(A11)	C002(A11)	A

Original sheet size A1 (841x594) Plot Date 2023-12-11 at 3:01:48 pm \\corp.pbwan.net\ANZ\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A11\04_CADD\1-11241.13(A11)_C000-050 - REV 2.dwg C002

LEGEND	
— — —	PROPERTY BOUNDARY
———	ROAD RESERVE
⊠	HIGH VALUE TREES



APPROVED PLAN

Planner: ENathan
RC: 2240268-RMAOUT
Date: 6/02/2024

NOTES.

1. FOR GENERAL NOTES REFER TO SHEET C001

1:500 @ A1
1:1000 @ A3 0 5 10 15 20 25 30 35 40 45 50 m

WORK IN PROGRESS
PRINTED 11/12/2023 3:03:52 pm

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR INFORMATION AND DISCUSSION		

WAKA KOTAHI NZ TRANSPORT AGENCY

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Whangarei Office
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Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES: 1:500 AT A1
ORIGINAL SIZE: A1

DRAWN	DESIGNED	APPROVED
K.DARSHAN	M.LEGGETT	APPROVER
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
VERIFIER	VERIFIER	YYYY-MM-DD

FOR INFORMATION

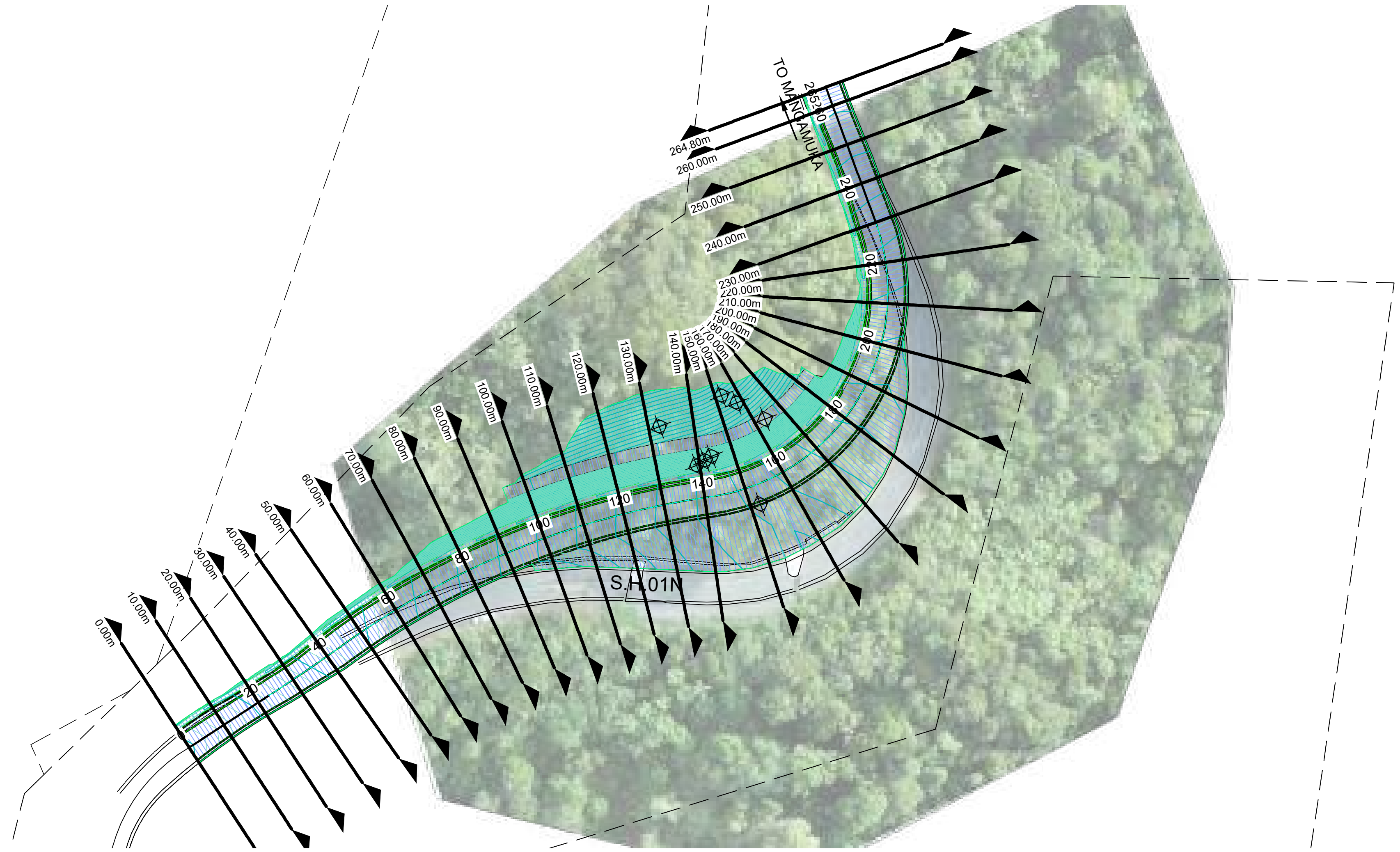
PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

TITLE
OVERALL PLAN
PROPOSED REALIGNMENT PLAN

WSP PROJECT NO. (SUB-PROJECT): 1-11241.13(A11)
SHEET NO.: C003(A11)
REVISION: A

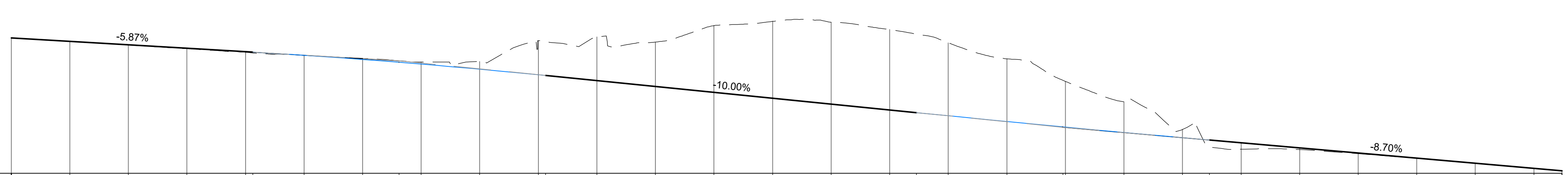
Original sheet size A1 (841x594) Plot Date 2023-12-11 at 3:03:52 pm \\corp.pbwan.net\ANZ\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A11\04_CADD\1-11241.13(A11)_C000-050 - REV 2.dwg C003

LEGEND	
— — —	PROPERTY BOUNDARY
———	ROAD RESERVE



APPROVED PLAN

Planner: ENathan
RC: 2240268-RMAOUT
Date: 6/02/2024



Datum R.L. 212.00

STATION	PROPOSED LEVEL	EXISTING LEVEL	CUT/FILL
0.00	235.07		0.00
10.00	234.49	234.49	0.00
20.00	233.90	233.87	0.03
30.00	233.31	233.25	0.06
40.00	232.73	232.63	0.09
41.23	232.65		0.13
50.00	232.11	232.11	0.00
60.00	231.40	231.59	-0.19
66.23	230.93		-0.26
70.00	230.62	230.98	-0.36
80.00	229.76	231.05	-1.30
90.00	228.81	234.63	-5.82
91.23	228.68		-5.91
100.00	227.81	235.25	-7.44
110.00	226.81	234.37	-7.56
120.00	225.81	237.18	-11.38
130.00	224.81	237.90	-13.09
140.00	223.81	237.76	-13.96
150.00	222.81	236.51	-13.70
154.59	222.35		-13.38
160.00	221.81	234.25	-12.44
170.00	220.84	231.51	-10.67
179.59	219.93	227.68	-7.93
180.00	219.89		-7.79
190.00	218.97	224.20	-5.23
200.00	218.08	219.49	-1.41
204.59	217.68		1.05
210.00	217.20	216.11	1.09
220.00	216.33	216.05	0.29
230.00	215.46	215.34	0.12
240.00	214.60	214.56	0.03
250.00	213.73	213.75	-0.02
260.00	212.86	212.86	0.00
264.80	212.44		0.00

VERTICAL GEOMETRY: -5.87% 41.30m | VC: 50.0m K: 12.12 | -10.00% 63.67m | VC: 50.0m K: 38.35 | -8.70% 60.45m

HORIZONTAL GEOMETRY: L=22.99m | L=22.20m R=492.00m | L=96.17m R=200.00m | L=89.15m R=50.00m | L=34.30m

Aln - Option 4
SCALE 1:250

NOTES.

1. FOR GENERAL NOTES REFER TO SHEET C001

1:750 @ A1
1:1500 @ A3 0 10 20 30 40 50 60 70 m

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REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR INFORMATION AND DISCUSSION		

WAKA KOTAHI NZ TRANSPORT AGENCY

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New Zealand

CIVIL

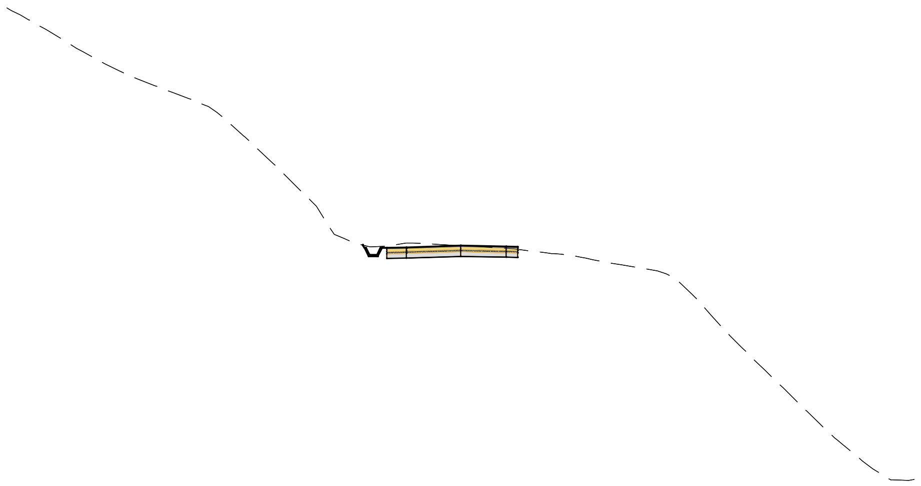
SCALES		ORIGINAL SIZE
1:750 AT A1		A1
DRAWN	DESIGNED	APPROVED
K.DARSHAN	M.LEGGETT	APPROVER
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
VERIFIER	VERIFIER	YYYY-MM-DD

FOR INFORMATION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

TITLE
OVERALL PLAN
PROPOSED REALIGNMENT PLAN

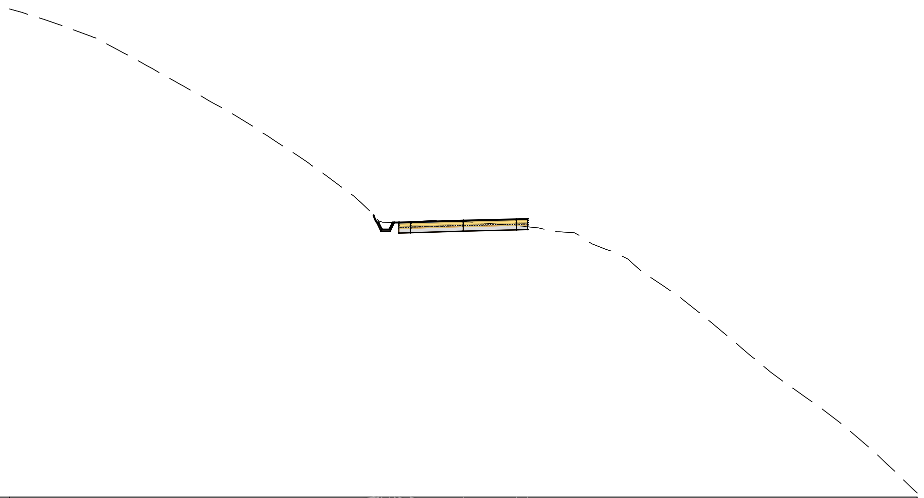
WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11241.13(A11)	C004(A11)	A



DATUM: 218.00m

DGN. LEVEL	234.52 234.54 234.34 233.89 233.89 234.34 234.34 234.38 234.49 234.43 234.42
OFFSETS	-6.47 -6.46 -6.25 -6.03 -5.53 -5.19 -4.89 -3.60 0.00 3.02 3.77
E.G. LEVEL	250.19 249.41 248.01 246.52 245.53 244.61 243.68 241.68 239.45 237.11 234.61 234.53 234.62 234.49 234.37 234.19 233.92 233.41 233.05 232.31 229.88 227.77 225.40 222.76 220.67 219.01 219.04
CUT / FILL	0.00 0.02 -0.13 -0.52 -0.53 -0.10 -0.13 -0.29 0.00 0.11 0.16

CHAINAGE: 10.00m



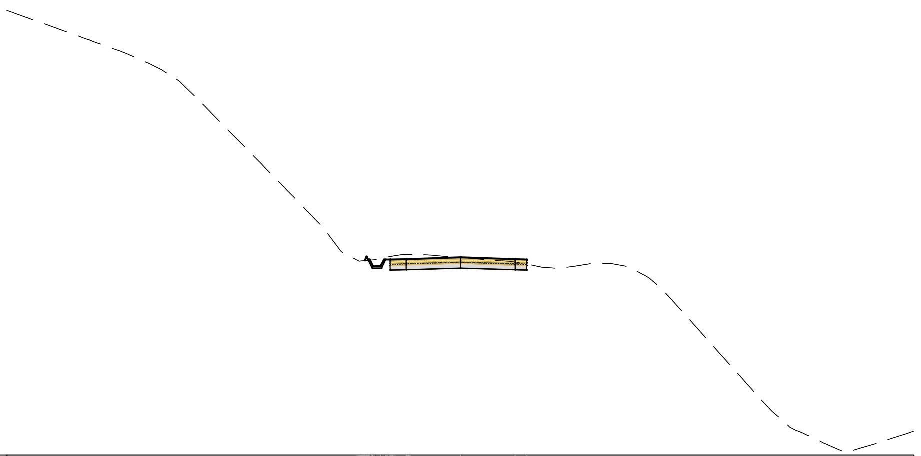
DATUM: 215.00m

DGN. LEVEL	233.65 233.39 233.19 232.74 232.74 233.19 233.19 233.21 233.31 233.41 233.43
OFFSETS	-5.92 -5.82 -5.61 -5.39 -4.89 -4.55 -4.25 -3.50 0.00 3.50 4.25
E.G. LEVEL	247.33 246.63 245.89 244.86 243.37 242.16 240.92 239.51 237.97 236.34 234.53 233.20 233.32 233.25 233.08 232.82 232.52 231.42 229.99 228.18 226.26 224.28 222.60 220.77 218.87 216.71 215.27
CUT / FILL	0.00 -0.16 -0.12 -0.49 -0.47 -0.02 -0.02 -0.04 0.06 0.43 0.53

CHAINAGE: 30.00m

APPROVED PLAN

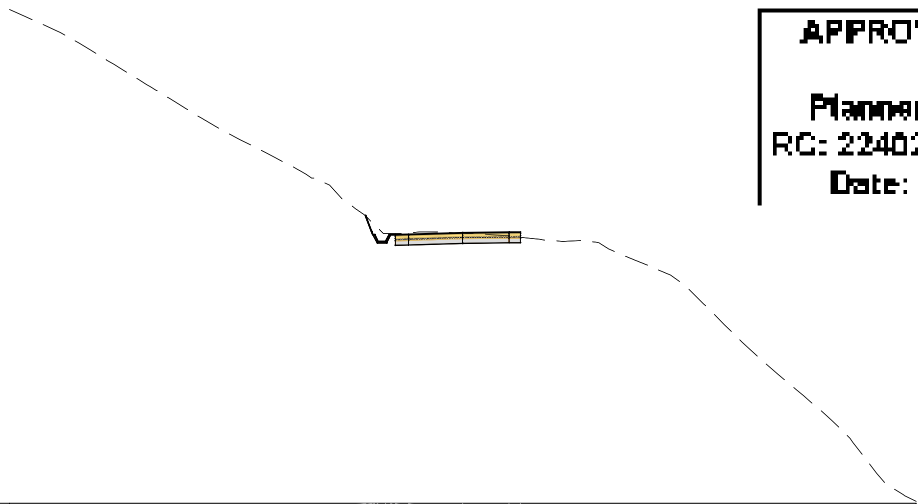
Planner: ENathan
RC: 2240268-RMAOUT
Date: 6/02/2024



DATUM: 222.00m

DGN. LEVEL	234.87 235.14 234.94 234.49 234.49 234.94 234.94 234.97 235.07 234.97 234.94
OFFSETS	-6.32 -6.22 -6.01 -5.78 -5.28 -4.95 -4.65 -3.60 0.00 3.63 4.38
E.G. LEVEL	251.42 250.72 249.87 249.02 247.90 246.41 244.36 241.94 239.38 237.06 234.84 235.20 235.24 235.07 234.85 234.47 234.45 234.68 233.84 231.51 228.85 226.20 223.85 222.83 222.49 223.23 223.60
CUT / FILL	0.00 0.25 0.04 -0.43 -0.52 -0.14 -0.20 -0.30 0.00 0.20 0.31

CHAINAGE: 0.00m



DATUM: 216.00m

DGN. LEVEL	235.03 233.97 233.77 233.32 233.32 233.77 233.77 233.79 233.90 233.93 233.94
OFFSETS	-6.43 -6.04 -5.83 -5.61 -5.11 -4.77 -4.47 -3.60 0.00 3.05 3.80
E.G. LEVEL	248.67 248.22 247.06 245.74 244.29 242.56 241.30 240.05 238.84 237.51 235.86 233.85 233.96 233.87 233.71 233.46 233.39 232.60 231.63 230.19 227.82 225.55 223.74 221.47 218.73 216.60 216.12
CUT / FILL	0.00 -0.64 -0.64 -0.87 -0.53 -0.08 -0.07 -0.09 0.03 0.23 0.33

CHAINAGE: 20.00m

NOTES.

1. FOR GENERAL NOTES REFER TO SHEET C001

1:200 @ A1 / 1:400 @ A3 — 0 2 4 6 8 10 12 14 16 18 20 m

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PRINTED 11/12/2023 2:15:24 pm

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR DISCUSSION		

WAKA KOTAHI NZ TRANSPORT AGENCY

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Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES		ORIGINAL SIZE
1:200 AT A1		A1
DRAWN	DESIGNED	APPROVED
K.DARSHAN	M.LEGGETT	APPROVER
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
VERIFIER	VERIFIER	YYYY-MM-DD

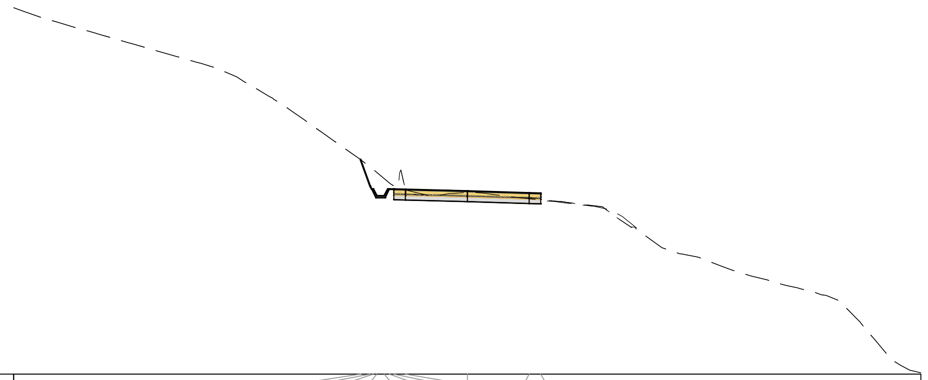
FOR INFORMATION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

TITLE
CROSSSECTION
A11 MANGAMUKHA

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11241.13(A11)	C010(A11)	A

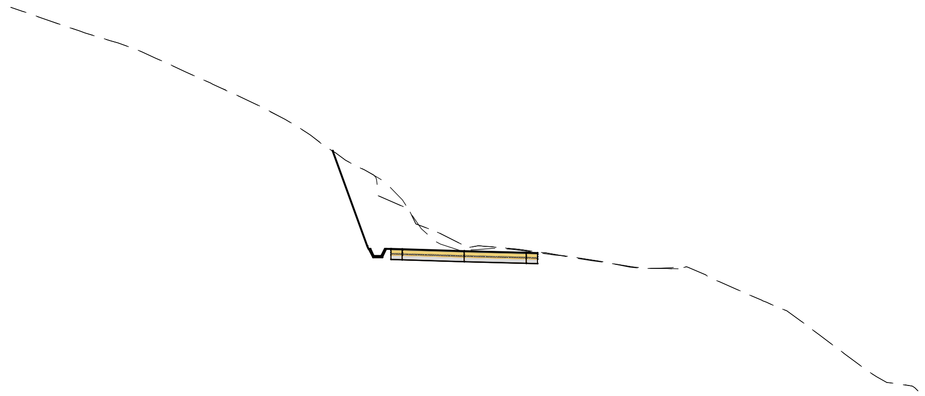
Original sheet size A1 (841x594) Plot Date 2023-12-11 at 2:15:24 pm \\corp.pbwan.net\ANZ\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A11\04_CADD\1-11241.13(A11)_C000-050 - REV 2.dwg C010



DATUM: 220.00m

DGN. LEVEL	234.20, 232.44, 232.24, 231.79, 231.79, 232.24, 232.24, 232.22, 232.11, 231.99, 231.97
OFFSETS	-7.06, -6.42, -6.21, -5.99, -5.49, -5.15, -4.85, -4.10, 0.00, 4.10, 4.85
E.G. LEVEL	244.25, 243.59, 242.90, 242.23, 241.56, 240.82, 240.03, 238.96, 237.50, 235.83, 234.16, 233.52, 232.09, 232.11, 231.83, 231.47, 231.08, 229.71, 228.01, 227.45, 226.50, 225.87, 225.27, 223.79, 220.93, 220.10
CUT / FILL	0.00, -1.26, -1.29, -1.57, -1.14, -0.40, -0.18, 0.01, 0.00, 0.31, 0.39

CHAINAGE: 50.00m



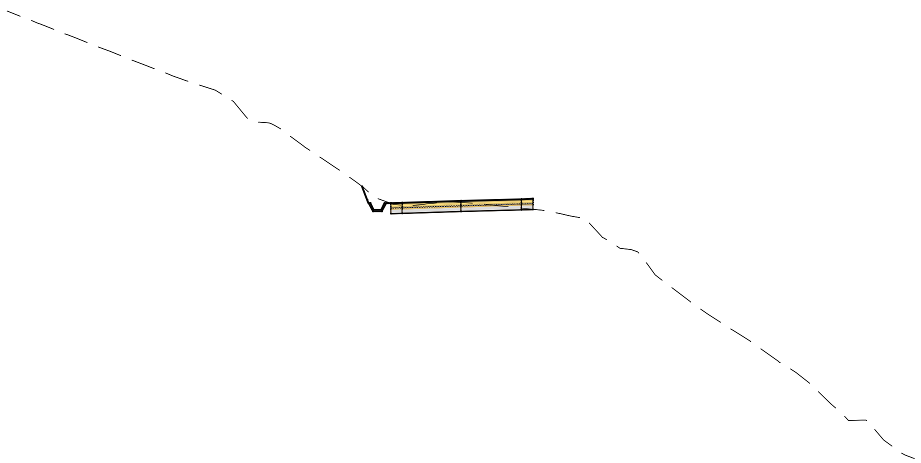
DATUM: 221.00m

DGN. LEVEL	237.24, 230.96, 230.76, 230.31, 230.31, 230.76, 230.76, 230.74, 230.62, 230.51, 230.49
OFFSETS	-8.71, -6.42, -6.21, -5.99, -5.49, -5.15, -4.85, -4.10, 0.00, 4.10, 4.85
E.G. LEVEL	246.73, 246.01, 245.04, 244.38, 243.24, 242.22, 240.96, 239.86, 238.28, 236.62, 234.29, 232.42, 230.99, 230.81, 230.58, 230.22, 229.87, 229.46, 229.58, 228.60, 227.38, 226.01, 224.22, 222.31, 221.70, 221.40
CUT / FILL	0.00, -4.94, -5.03, -5.35, -3.89, -3.29, -3.16, -2.86, -0.37, -0.16, -0.09

CHAINAGE: 70.00m

APPROVED PLAN

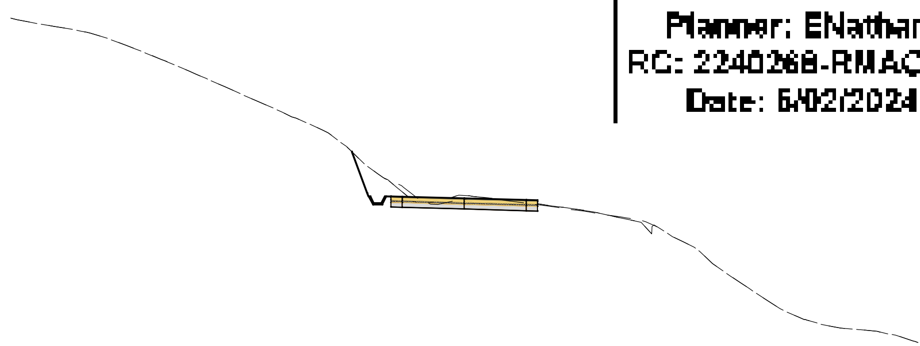
Planner: ENathan
RC: 2240268-RMAOUT
Date: 6/02/2024



DATUM: 215.00m

DGN. LEVEL	233.69, 232.79, 232.59, 232.14, 232.14, 232.59, 232.59, 232.61, 232.73, 232.85, 232.87
OFFSETS	-6.53, -6.20, -5.99, -5.77, -5.27, -4.93, -4.63, -3.88, 0.00, 4.01, 4.76
E.G. LEVEL	245.28, 245.28, 244.32, 243.52, 242.61, 241.70, 240.70, 240.01, 237.98, 237.23, 235.57, 233.98, 232.50, 232.54, 232.63, 232.40, 232.18, 231.77, 230.41, 229.37, 226.94, 225.24, 223.75, 222.22, 220.69, 218.21, 216.92, 215.68
CUT / FILL	0.00, -0.61, -0.61, -0.85, -0.66, -0.10, 0.02, 0.16, 0.09, 0.59, 0.69

CHAINAGE: 40.00m



DATUM: 221.00m

DGN. LEVEL	234.50, 231.74, 231.54, 231.09, 231.09, 231.54, 231.54, 231.52, 231.40, 231.29, 231.27
OFFSETS	-7.43, -6.42, -6.21, -5.99, -5.49, -5.15, -4.85, -4.10, 0.00, 4.10, 4.85
E.G. LEVEL	243.35, 243.00, 242.55, 241.95, 241.04, 239.84, 238.81, 237.91, 236.71, 235.74, 233.66, 232.09, 231.12, 231.59, 231.35, 231.10, 230.80, 230.29, 229.82, 228.88, 227.10, 225.44, 224.11, 223.17, 222.73, 222.43, 221.86
CUT / FILL	0.00, -1.81, -1.85, -2.14, -1.78, -1.13, -0.91, -0.31, -0.19, 0.13, 0.22

CHAINAGE: 60.00m

NOTES.

1. FOR GENERAL NOTES REFER TO SHEET C001

1:200 @ A1 / 1:400 @ A3 — 0 2 4 6 8 10 12 14 16 18 20 m

WORK IN PROGRESS
PRINTED 11/12/2023 2:16:16 pm

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR DISCUSSION		

WAKA KOTAHI NZ TRANSPORT AGENCY

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Whangarei 0148
New Zealand

CIVIL

SCALES		ORIGINAL SIZE
1:200 AT A1		A1
DRAWN	DESIGNED	APPROVED
K.DARSHAN	M.LEGGETT	APPROVER
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
VERIFIER	VERIFIER	YYYY-MM-DD

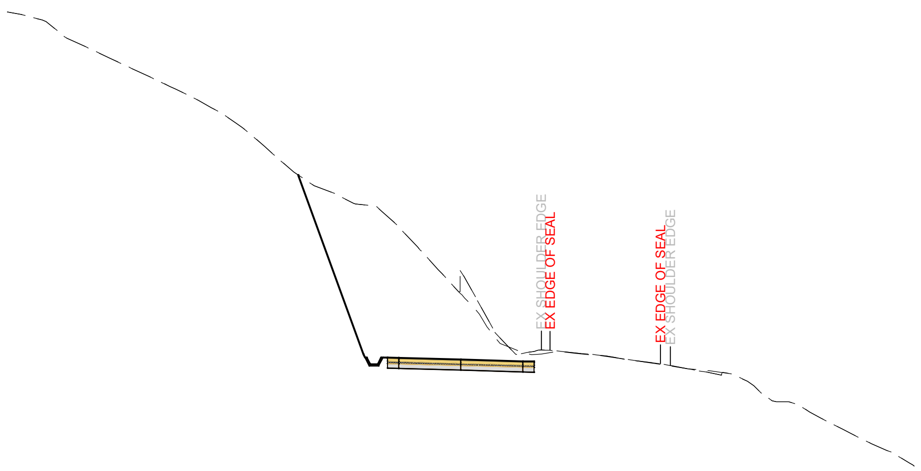
FOR INFORMATION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

TITLE
CROSSSECTION
A11 MANGAMUKHA

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11241.13(A11)	C011(A11)	A

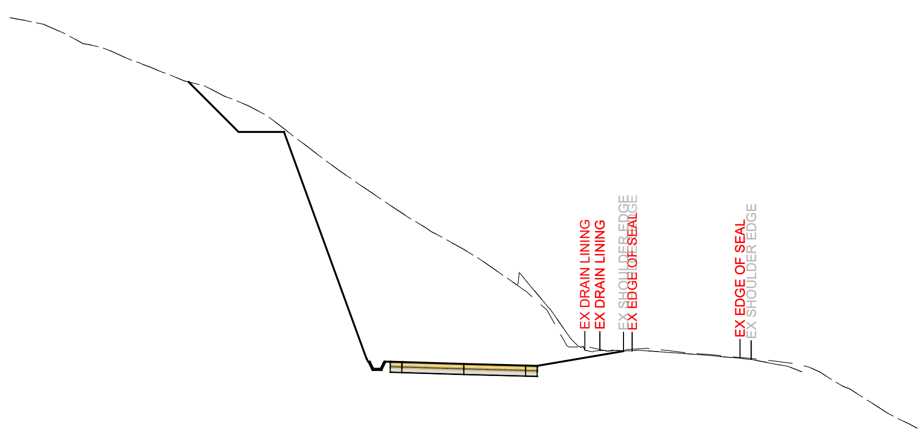
Original sheet size A1 (841x594) Plot Date 2023-12-11 at 2:16:16 pm \\corp.pbwan.net\ANZ\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A11\04_CADD\1-11241.13(A11)_C000-050 - REV 2.dwg C011



DATUM: 221.00m

DGN. LEVEL	241.01 229.14 228.94 228.49 228.49 228.94 228.94 228.92 228.81 228.69 228.67
OFFSETS	-10.74 -6.42 -6.21 -5.99 -5.49 -5.15 -4.85 -4.10 0.00 4.10 4.85
E.G. LEVEL	251.80 251.55 250.17 249.14 248.08 246.70 245.14 243.59 241.22 239.79 238.62 236.05 234.64 230.58 229.28 229.32 229.12 228.76 228.45 228.07 227.88 226.59 225.81 224.62 223.45 221.95 221.77
CUT / FILL	0.00 -9.90 -10.08 -10.50 -10.36 -9.61 -9.34 -8.65 -5.83 -0.52 -0.67

CHAINAGE: 90.00m



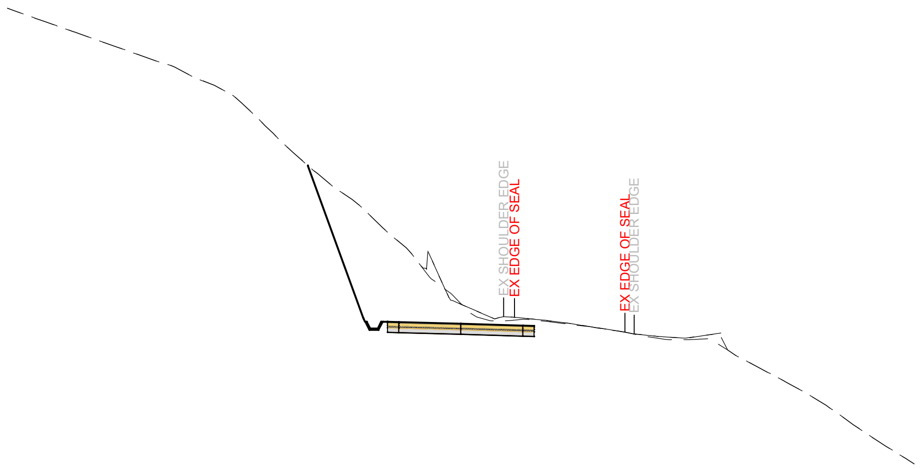
DATUM: 222.00m

DGN. LEVEL	245.46 242.14 242.14 227.14 226.94 226.49 226.49 226.94 226.94 226.92 226.81 226.69 226.67 227.65
OFFSETS	-18.20 -14.88 -11.88 -6.42 -6.21 -5.99 -5.49 -5.15 -4.85 -4.10 0.00 4.10 4.85 10.57
E.G. LEVEL	249.71 249.56 248.63 247.48 246.44 245.53 244.49 243.00 241.29 239.31 237.49 235.55 234.37 232.80 230.34 227.96 227.68 227.61 227.35 227.13 226.67 226.26 224.46 223.19 222.56
CUT / FILL	0.00 -2.00 -0.21 -11.21 -11.27 -11.57 -11.23 -10.55 -10.35 -9.87 -7.57 -5.65 -4.78 -0.03

CHAINAGE: 110.00m

APPROVED PLAN

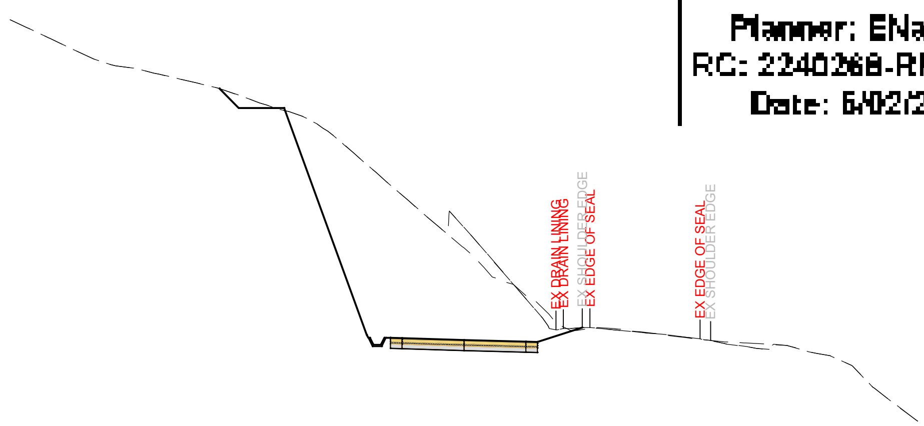
Planner: ENathan
RC: 2240268-RMAOUT
Date: 6/02/2024



DATUM: 220.00m

DGN. LEVEL	240.23 230.09 229.89 229.44 229.44 229.89 229.89 229.87 229.76 229.64 229.62
OFFSETS	-10.11 -6.42 -6.21 -5.99 -5.49 -5.15 -4.85 -4.10 0.00 4.10 4.85
E.G. LEVEL	250.63 249.76 249.00 247.90 247.16 246.02 244.37 242.32 239.68 237.61 235.56 234.56 231.06 230.08 230.04 229.78 229.27 228.94 229.01 227.27 226.01 224.35 222.53 221.05 220.49
CUT / FILL	0.00 -7.24 -7.24 -7.48 -6.99 -6.21 -5.94 -5.32 -1.30 -0.49 -0.44

CHAINAGE: 80.00m



DATUM: 222.00m

DGN. LEVEL	244.43 243.14 243.14 228.14 227.94 227.49 227.49 227.94 227.94 227.92 227.81 227.69 227.67 228.64
OFFSETS	-16.17 -14.88 -11.88 -6.42 -6.21 -5.99 -5.49 -5.15 -4.85 -4.10 0.00 4.10 4.85 7.83
E.G. LEVEL	248.99 247.73 246.38 245.74 245.06 244.33 243.33 242.63 241.40 239.50 237.66 235.85 235.26 229.26 228.64 228.44 228.17 227.88 227.38 227.51 227.02 226.14 223.62 222.44
CUT / FILL	0.00 -0.85 0.16 -11.27 -11.29 -11.54 -11.11 -10.36 -10.10 -9.47 -7.45 -2.84 -1.99 0.00

CHAINAGE: 100.00m

NOTES.

1. FOR GENERAL NOTES REFER TO SHEET C001

1:200 @ A1 1:400 @ A3 0 2 4 6 8 10 12 14 16 18 20 m

WORK IN PROGRESS
PRINTED 11/12/2023 2:16:44 pm

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR DISCUSSION		

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES 1:200 AT A1		ORIGINAL SIZE A1
DRAWN K.DARSHAN	DESIGNED M.LEGGETT	APPROVED APPROVER
DRAWING VERIFIED VERIFIER	DESIGN VERIFIED VERIFIER	APPROVED DATE YYYY-MM-DD

FOR INFORMATION

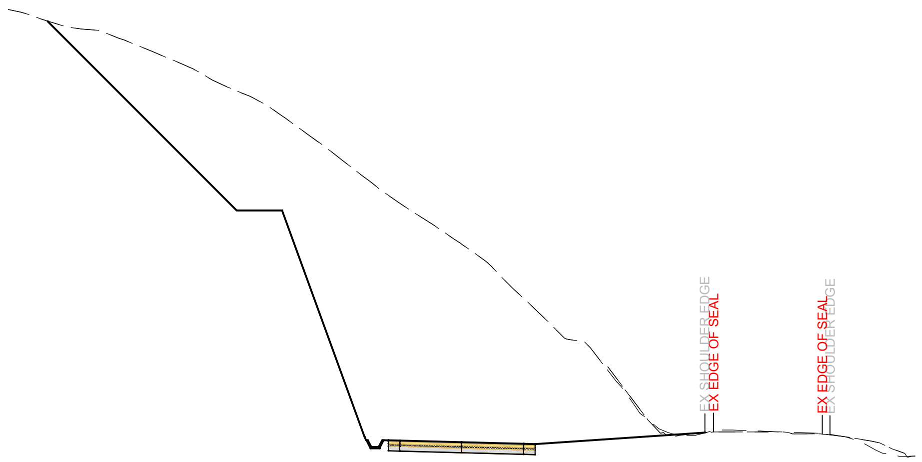
PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

TITLE
CROSSSECTION
A11 MANGAMUKHA

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11241.13(A11)	C012(A11)	A

Original sheet size A1 (841x594) Plot Date 2023-12-11 at 2:16:44 pm \\corp.pbwan.net\ANZ\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A11\04_CADD\1-11241.13(A11)_C000-050 - REV 2.dwg C012

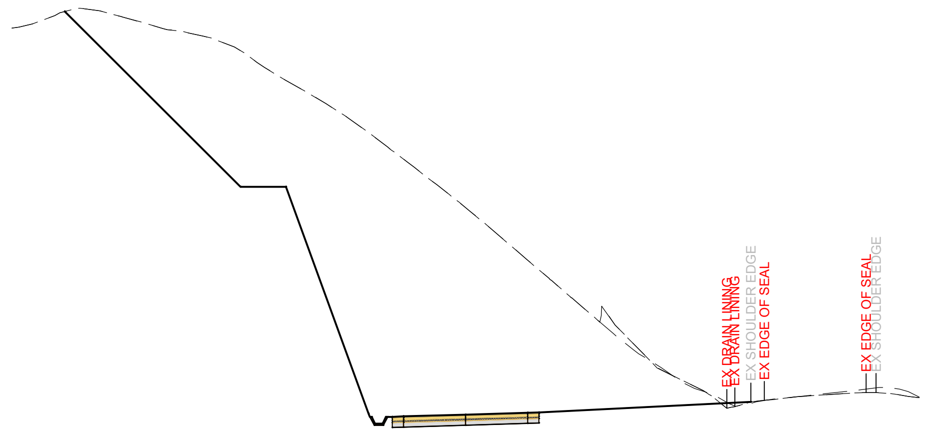
300 mm
200
100
50
0 10 mm



DATUM: 223.00m

DGN. LEVEL	252.65, 240.14, 240.14, 225.14, 224.94, 224.49, 224.49, 224.94, 224.94, 224.92, 224.81, 224.70, 224.68, 225.44
OFFSETS	-27.39, -14.88, -11.88, -6.42, -6.21, -5.99, -5.49, -5.15, -4.85, -4.10, 0.00, 4.10, 4.85, 16.09
E.G. LEVEL	253.42, 252.67, 252.13, 251.40, 250.54, 249.48, 248.20, 247.04, 245.28, 243.45, 241.37, 239.87, 237.90, 235.67, 233.37, 231.44, 226.26, 225.27, 225.47, 225.49, 225.41, 225.34, 225.09, 224.38, 223.88
CUT / FILL	0.00, -7.89, -6.25, -17.18, -17.21, -17.49, -17.11, -16.40, -16.19, -15.69, -13.09, -9.62, -8.93, 0.00

CHAINAGE: 130.00m



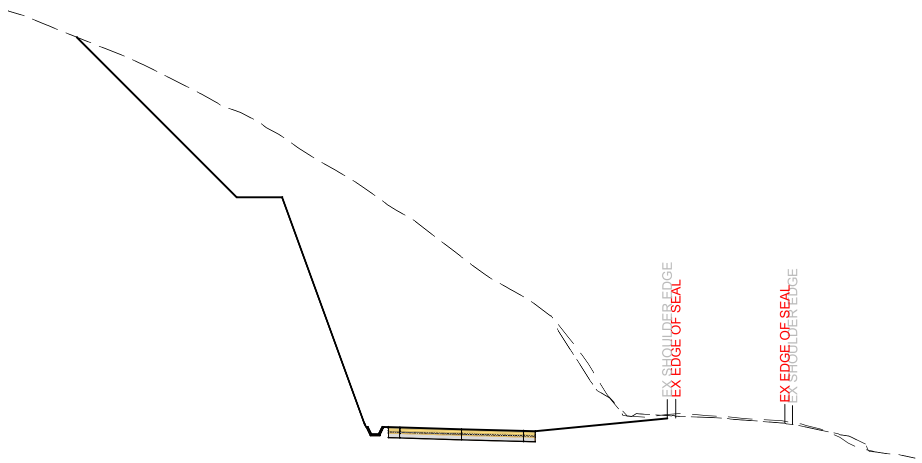
DATUM: 221.00m

DGN. LEVEL	249.47, 237.86, 237.86, 222.86, 222.66, 222.21, 222.21, 222.66, 222.66, 222.68, 222.81, 222.93, 222.95, 223.65
OFFSETS	-26.49, -14.88, -11.88, -6.42, -6.21, -5.99, -5.49, -5.15, -4.85, -4.10, 0.00, 4.10, 4.85, 18.87
E.G. LEVEL	248.36, 248.81, 249.67, 249.11, 248.27, 247.70, 246.74, 245.17, 243.83, 242.49, 240.29, 238.43, 236.50, 234.36, 232.35, 230.54, 228.74, 225.90, 224.38, 223.33, 223.80, 224.05, 224.23, 224.22, 223.92
CUT / FILL	0.00, -9.02, -7.06, -18.61, -18.65, -18.93, -18.54, -17.84, -17.61, -17.01, -13.69, -10.09, -9.43, 0.00

CHAINAGE: 150.00m

APPROVED PLAN

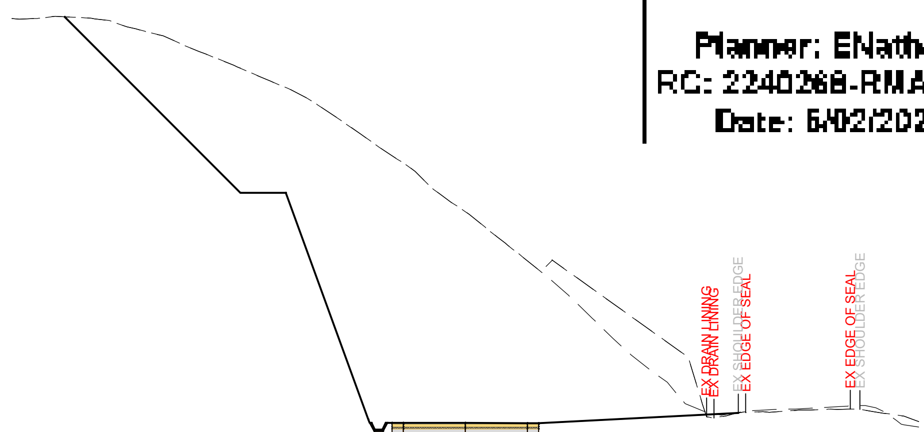
Planner: ENathan
RC: 2240268-RMAOUT
Date: 6/02/2024



DATUM: 223.00m

DGN. LEVEL	251.74, 241.14, 241.14, 226.14, 225.94, 225.49, 225.49, 225.94, 225.94, 225.92, 225.81, 225.69, 225.67, 226.53
OFFSETS	-25.48, -14.88, -11.88, -6.42, -6.21, -5.99, -5.49, -5.15, -4.85, -4.10, 0.00, 4.10, 4.85, 13.59
E.G. LEVEL	253.48, 253.48, 252.51, 251.50, 250.47, 249.06, 247.97, 246.71, 245.30, 243.62, 242.13, 240.66, 239.06, 237.19, 235.12, 233.33, 229.03, 226.93, 226.70, 226.58, 226.20, 225.50, 224.33, 224.09, 223.89
CUT / FILL	0.00, -5.70, -4.02, -15.60, -15.65, -15.94, -15.59, -14.89, -14.68, -14.24, -11.38, -8.86, -8.40, -0.18

CHAINAGE: 120.00m



DATUM: 223.00m

DGN. LEVEL	250.63, 239.02, 239.02, 224.02, 223.82, 223.37, 223.37, 223.82, 223.82, 223.82, 223.81, 223.80, 223.80, 224.47
OFFSETS	-26.50, -14.88, -11.88, -6.42, -6.21, -5.99, -5.49, -5.15, -4.85, -4.10, 0.00, 4.10, 4.85, 18.04
E.G. LEVEL	250.52, 250.55, 250.62, 250.39, 249.58, 248.69, 247.88, 246.87, 245.85, 244.49, 242.86, 241.07, 239.25, 237.77, 236.09, 233.80, 228.34, 224.16, 224.52, 224.58, 224.71, 224.71, 224.26, 223.89
CUT / FILL	0.00, -8.23, -6.95, -18.52, -18.57, -18.86, -18.52, -17.85, -17.65, -17.17, -13.96, -10.72, -10.13, 0.00

CHAINAGE: 140.00m

NOTES.

1. FOR GENERAL NOTES REFER TO SHEET C001

1:200 @ A1
1:400 @ A3
0 2 4 6 8 10 12 14 16 18 20 m

WORK IN PROGRESS
PRINTED 11/12/2023 2:17:09 pm

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR DISCUSSION		

WAKA KOTAHI
NZ TRANSPORT AGENCY

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Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES 1:200 AT A1		ORIGINAL SIZE A1
DRAWN K.DARSHAN	DESIGNED M.LEGGETT	APPROVED APPROVER
DRAWING VERIFIED VERIFIER	DESIGN VERIFIED VERIFIER	APPROVED DATE YYYY-MM-DD

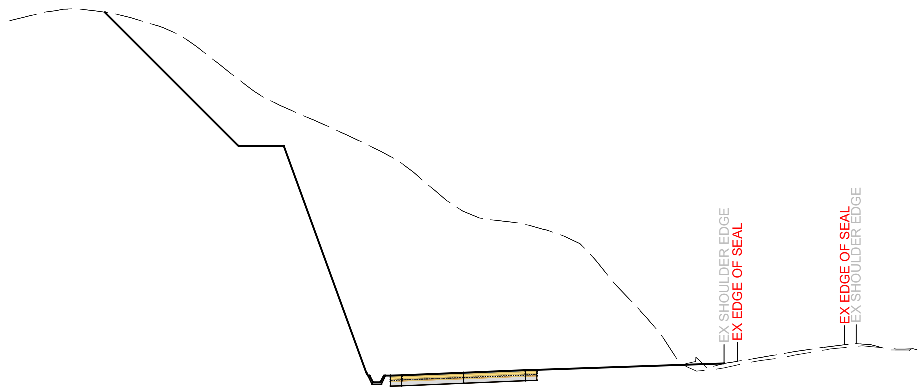
FOR INFORMATION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

TITLE
CROSSSECTION
A11 MANGAMUKHA

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11241.13(A11)	C013(A11)	A

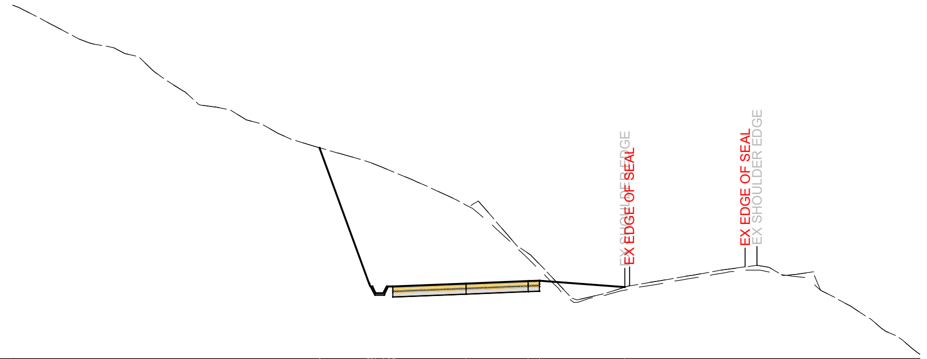
Original sheet size A1 (841x594) Plot Date 2023-12-11 at 2:17:09 pm \\corp.pbwan.net\ANZ\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A11\04_CADD\1-11241.13(A11)_C000-050 - REV 2.dwg C013



DATUM: 219.00m

DGN. LEVEL	244.68, 235.84, 235.84, 220.84, 220.64, 220.19, 220.19, 220.64, 220.64, 220.67, 220.84, 221.00, 221.03, 221.44
OFFSETS	-23.71, -14.88, -11.88, -6.42, -6.21, -5.99, -5.49, -5.15, -4.85, -4.10, 0.00, 4.10, 4.85, 17.24
E.G. LEVEL	244.11, 244.19, 244.70, 244.88, 244.60, 243.99, 243.20, 241.74, 240.14, 238.81, 237.87, 236.97, 236.02, 234.83, 233.15, 231.50, 230.90, 230.58, 229.89, 228.23, 225.68, 223.15, 221.58, 221.58, 222.18, 222.68, 222.36, 222.36
CUT / FILL	0.00, -4.40, -2.56, -15.10, -15.20, -15.53, -15.29, -14.66, -14.50, -14.02, -10.66, -9.64, -9.42, 0.00

CHAINAGE: 170.00m



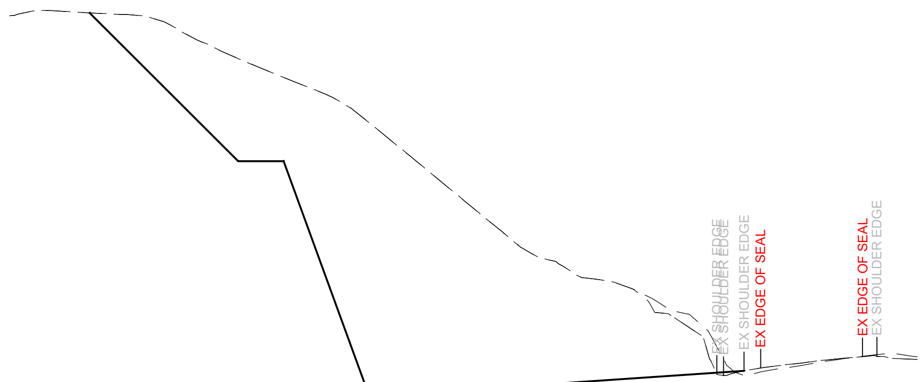
DATUM: 214.00m

DGN. LEVEL	227.95, 218.98, 218.78, 218.33, 218.33, 218.78, 218.78, 218.97, 219.14, 219.17, 218.73
OFFSETS	-9.69, -6.42, -6.21, -5.99, -5.49, -5.15, -4.85, 0.00, 4.10, 4.85, 10.49
E.G. LEVEL	237.39, 236.73, 235.67, 234.79, 234.18, 232.96, 231.64, 230.65, 229.81, 228.94, 228.17, 227.57, 226.97, 226.11, 225.22, 224.20, 221.49, 217.99, 218.31, 218.91, 219.27, 219.85, 220.13, 219.50, 219.74, 217.46, 216.03, 214.71, 214.30
CUT / FILL	0.00, -8.03, -8.15, -8.51, -8.31, -7.72, -7.60, -5.23, -1.85, -1.09, 0.00

CHAINAGE: 190.00m

APPROVED PLAN

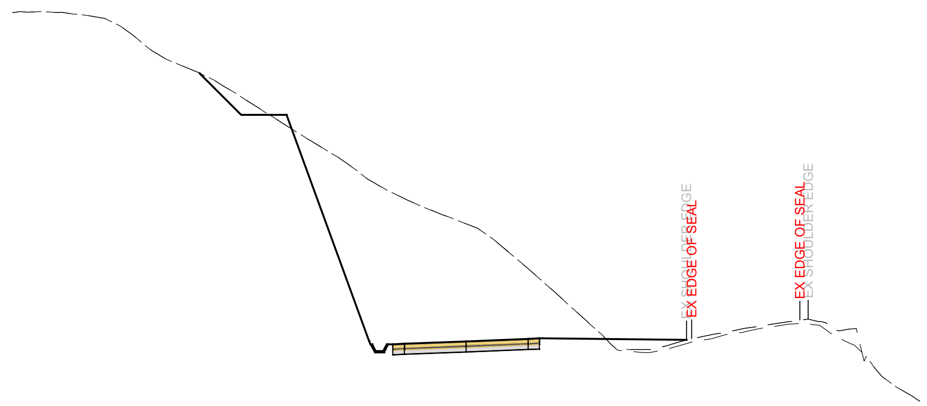
Planner: ENathan
RC: 2240268-RMAOUT
Date: 6/02/2024



DATUM: 220.00m

DGN. LEVEL	246.65, 236.82, 236.82, 221.82, 221.62, 221.17, 221.17, 221.62, 221.62, 221.65, 221.81, 221.98, 222.01, 222.95
OFFSETS	-24.71, -14.88, -11.88, -6.42, -6.21, -5.99, -5.49, -5.15, -4.85, -4.10, 0.00, 4.10, 4.85, 18.55
E.G. LEVEL	246.44, 246.56, 246.79, 246.63, 246.54, 246.06, 244.72, 243.59, 242.55, 241.55, 240.17, 238.28, 236.18, 234.25, 232.59, 230.76, 229.83, 229.00, 228.36, 226.73, 225.20, 222.95, 223.33, 223.64, 223.87, 223.70, 223.69
CUT / FILL	0.00, -6.80, -5.55, -17.71, -17.74, -18.01, -17.60, -16.87, -16.62, -15.97, -12.43, -8.97, -8.52, 0.00

CHAINAGE: 160.00m



DATUM: 215.00m

DGN. LEVEL	237.65, 234.90, 234.90, 219.90, 219.70, 219.25, 219.25, 219.70, 219.70, 219.73, 219.89, 220.06, 220.09, 219.99
OFFSETS	-17.63, -14.88, -11.88, -6.42, -6.21, -5.99, -5.49, -5.15, -4.85, -4.10, 0.00, 4.10, 4.85, 14.57
E.G. LEVEL	241.67, 241.69, 241.67, 241.45, 240.78, 239.17, 238.13, 237.21, 235.91, 234.63, 233.33, 232.11, 230.59, 229.49, 228.58, 227.68, 225.80, 224.04, 222.18, 220.32, 219.37, 219.99, 220.45, 220.93, 221.30, 220.71, 218.57, 216.92, 215.93
CUT / FILL	0.00, -1.18, 0.72, -10.68, -10.76, -11.08, -10.79, -10.16, -10.02, -9.62, -7.79, -4.64, -3.97, 0.00

CHAINAGE: 180.00m

NOTES.

1. FOR GENERAL NOTES REFER TO SHEET C001

1:200 @ A1
1:400 @ A3 0 2 4 6 8 10 12 14 16 18 20 m

WORK IN PROGRESS
PRINTED 11/12/2023 2:17:35 pm

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR DISCUSSION		

WAKA KOTAHI NZ TRANSPORT AGENCY

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Whangarei 0148
New Zealand

CIVIL

SCALES 1:200 AT A1		ORIGINAL SIZE A1
DRAWN K.DARSHAN	DESIGNED M.LEGGETT	APPROVED APPROVER
DRAWING VERIFIED VERIFIER	DESIGN VERIFIED VERIFIER	APPROVED DATE YYYY-MM-DD

FOR INFORMATION

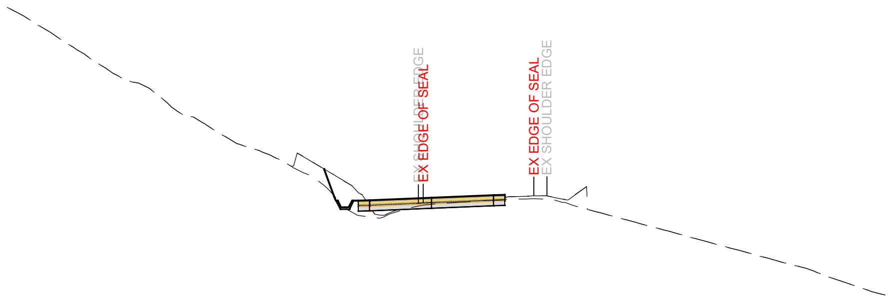
PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

TITLE
CROSSSECTION
A11 MANGAMUKHA

WSP PROJECT NO. (SUB-PROJECT) 1-11241.13(A11)
SHEET NO. C014(A11)
REVISION A

Original sheet size A1 (841x594) Plot Date 2023-12-11 at 2:17:35 pm \\corp.pbwan.net\ANZ\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A11\04_CADD\1-11241.13(A11)_C000-050 - REV 2.dwg C014

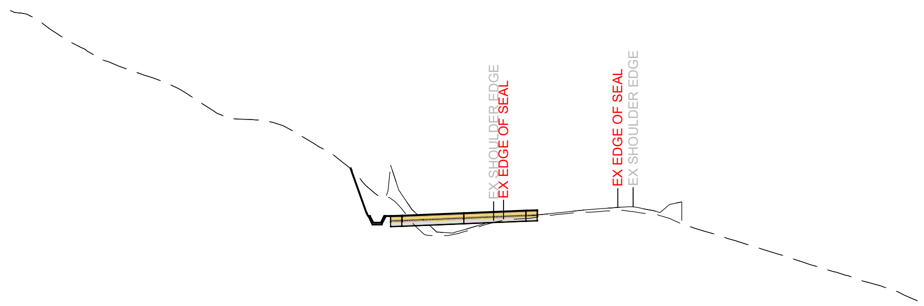
LEGEND	
— — —	EXISTING GROUND
———	DESIGN SURFACE



DATUM: 209.00m

DGN. LEVEL	218.25 216.34 216.14 215.69 215.69 216.14 216.14 216.17 216.33 216.50 216.53
OFFSETS	-7.12 -6.42 -6.21 -5.99 -5.49 -5.15 -4.85 -4.10 0.00 4.10 4.85
E.G. LEVEL	229.90 229.57 228.57 227.27 225.88 224.47 223.55 221.69 220.37 219.35 219.31 216.66 215.37 216.05 216.26 216.39 216.47 217.08 214.98 214.43 213.85 213.21 212.61 212.01 211.38 210.65 209.97 209.89
CUT / FILL	0.00 -1.49 -1.56 -1.88 -1.58 -0.87 -0.54 0.39 0.29 0.16 0.15

CHAINAGE: 220.00m



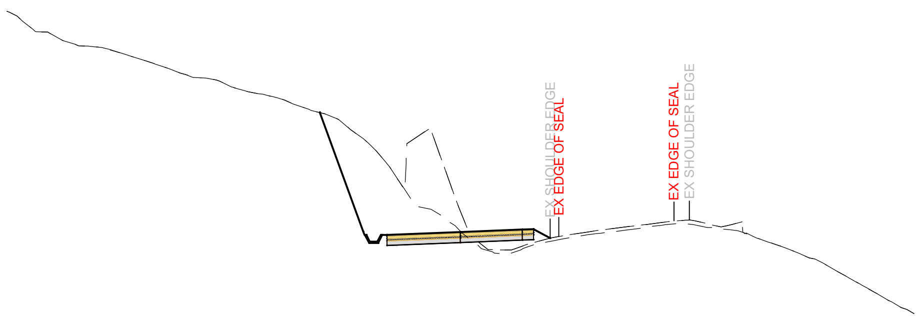
DATUM: 211.00m

DGN. LEVEL	220.16 217.21 217.01 216.56 216.56 217.01 217.01 217.04 217.20 217.37 217.40
OFFSETS	-7.50 -6.42 -6.21 -5.99 -5.49 -5.15 -4.85 -4.10 0.00 4.10 4.85
E.G. LEVEL	230.61 230.44 229.18 227.94 226.89 226.18 225.22 223.84 223.42 223.04 221.82 220.39 218.32 217.44 216.11 216.78 217.05 217.30 217.54 217.49 217.94 215.76 215.05 214.38 213.68 213.05 212.39 211.52 211.41
CUT / FILL	0.00 -1.78 -1.80 -2.05 -1.69 -1.30 -3.36 -1.39 1.09 0.37 0.32

CHAINAGE: 210.00m

APPROVED PLAN

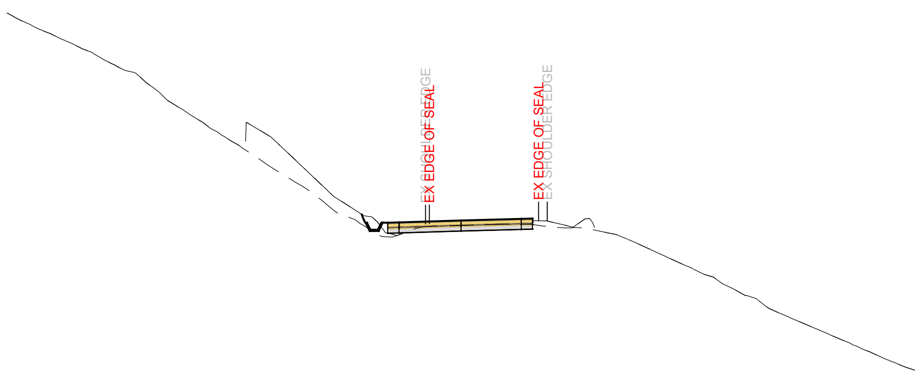
Planner: ENathan
RC: 2240268-RMAQUT
Date: 6/02/2024



DATUM: 212.00m

DGN. LEVEL	225.98 218.08 217.88 217.43 217.43 217.88 217.88 218.08 218.24 218.27 217.68
OFFSETS	-9.30 -6.42 -6.21 -5.99 -5.49 -5.15 -4.85 0.00 4.10 4.85 5.95
E.G. LEVEL	232.67 231.52 230.74 230.33 229.84 229.19 228.49 228.13 227.36 226.94 226.19 225.49 223.42 223.92 219.46 216.88 217.68 218.04 218.48 218.81 218.52 217.97 217.22 216.36 215.17 214.02 212.95 212.67
CUT / FILL	0.00 -6.19 -6.19 -6.43 -5.93 -5.07 -4.72 -1.39 1.11 0.89 0.00

CHAINAGE: 200.00m



DATUM: 205.00m

DGN. LEVEL	215.86 215.52 215.32 214.87 214.87 215.32 215.32 215.34 215.46 215.58 215.60
OFFSETS	-6.55 -6.42 -6.21 -5.99 -5.49 -5.15 -4.85 -4.10 0.00 3.99 4.73
E.G. LEVEL	229.19 228.80 227.83 226.85 225.71 224.61 222.97 221.57 221.98 219.19 215.80 214.47 215.26 215.34 215.45 215.45 215.04 214.68 213.92 212.94 211.98 210.89 209.76 208.79 207.88 206.95 206.05 205.56
CUT / FILL	0.00 -0.27 -0.44 -0.85 -0.46 0.45 0.68 0.81 0.12 0.13 0.14

CHAINAGE: 230.00m

300 mm
200
100
50
10 mm
0

NOTES.

1. FOR GENERAL NOTES REFER TO SHEET C001

1:200 @ A1
1:400 @ A3
0 2 4 6 8 10 12 14 16 18 20 m

WORK IN PROGRESS
PRINTED 11/12/2023 2:20:44 pm

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR DISCUSSION		

WAKA KOTAHI NZ TRANSPORT AGENCY

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Whangarei 0148
New Zealand

CIVIL

SCALES		ORIGINAL SIZE
1:200 AT A1		A1
DRAWN	DESIGNED	APPROVED
K.DARSHAN	M.LEGGETT	APPROVER
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
VERIFIER	VERIFIER	YYYY-MM-DD

FOR INFORMATION

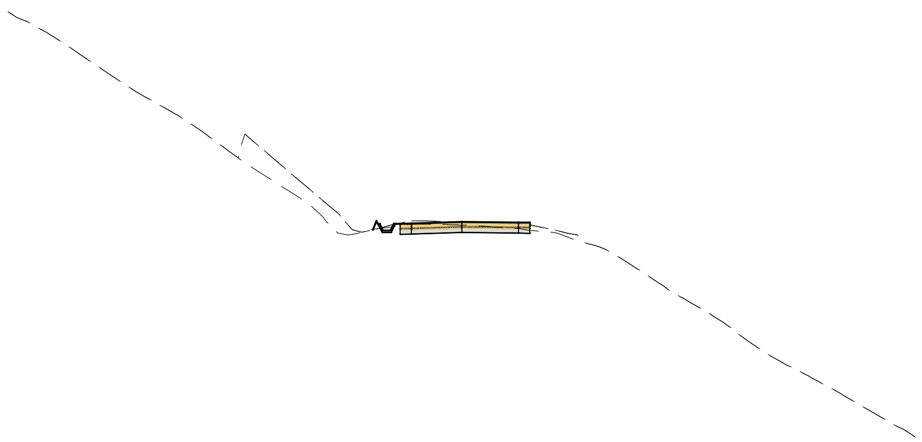
PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

TITLE
CROSSSECTION
A11 MANGAMUKHA

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11241.13(A11)	C015(A11)	A

Original sheet size A1 (841x594) Plot Date 2023-12-11 at 2:20:44 pm \\corp.pbwan.net\ANZ\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A11\04_CADD\1-11241.13(A11)_C000-050 - REV 2.dwg C015

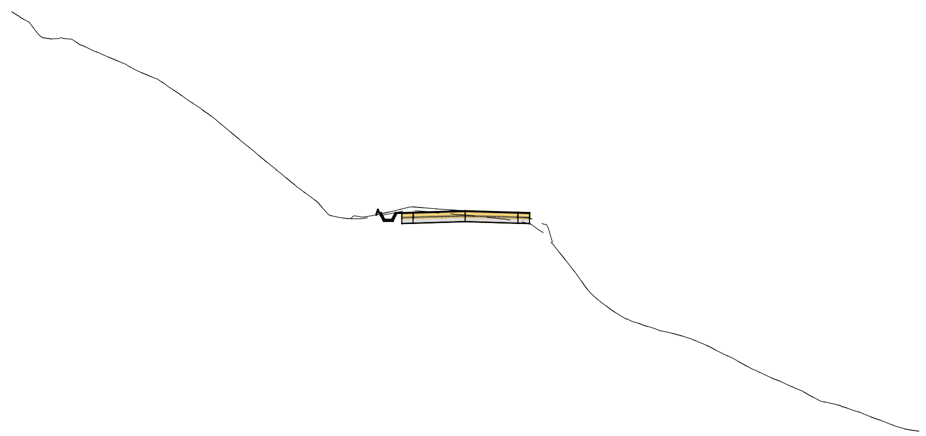
LEGEND	
— — —	EXISTING GROUND
———	DESIGN SURFACE



DATUM: 199.00m

DGN. LEVEL	213.20 213.80 213.60 213.15 213.15 213.60 213.60 213.63 213.73 213.69 213.68
OFFSETS	-5.87 -5.65 -5.44 -5.22 -4.72 -4.38 -4.08 -3.33 0.00 3.75 4.51
E.G. LEVEL	227.63 227.23 226.08 224.76 223.33 222.00 220.80 219.36 219.52 213.05 213.56 213.79 213.75 213.63 213.18 212.28 211.34 209.93 208.64 207.31 205.56 204.27 203.16 201.99 200.76 199.54 199.53
CUT / FILL	0.00 0.56 0.30 -0.22 -0.36 0.01 -0.05 -0.16 -0.02 0.10 0.15

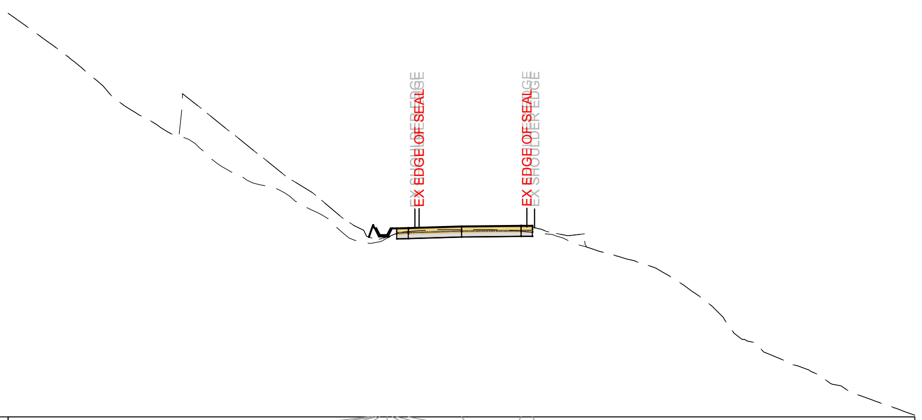
CHAINAGE: 250.00m



DATUM: 197.00m

DGN. LEVEL	212.18 212.51 212.31 211.86 211.86 212.31 212.31 212.33 212.44 212.33 212.31
OFFSETS	-5.90 -5.78 -5.56 -5.34 -4.84 -4.50 -4.20 -3.45 0.00 3.50 4.25
E.G. LEVEL	225.61 225.34 223.82 223.37 222.45 221.45 220.19 218.71 216.97 215.21 213.53 212.00 212.13 212.70 212.44 212.08 210.18 207.41 205.63 204.77 204.17 203.31 202.20 201.23 200.22 199.51 198.73 198.00 197.87
CUT / FILL	0.00 0.30 0.06 -0.44 -0.55 -0.18 -0.26 -0.36 0.00 0.26 0.33

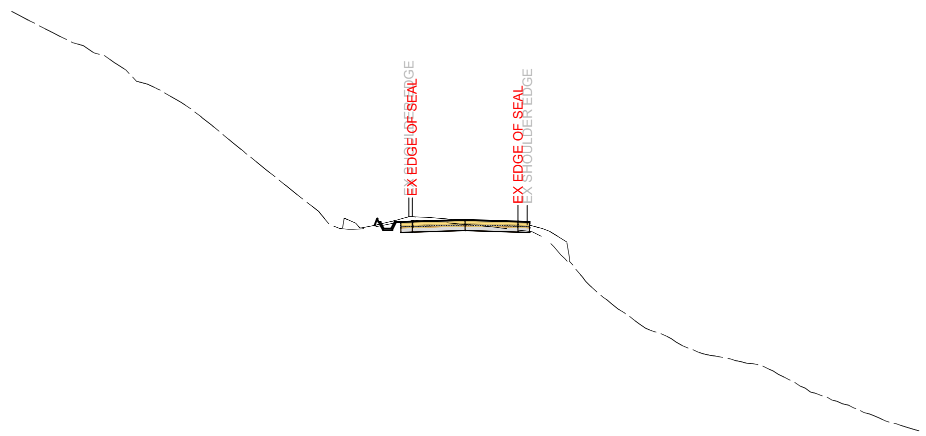
CHAINAGE: 264.80m



DATUM: 202.00m

DGN. LEVEL	213.88 214.67 214.47 214.02 214.02 214.47 214.47 214.49 214.60 214.63 214.64
OFFSETS	-6.14 -5.85 -5.64 -5.41 -4.91 -4.58 -4.28 -3.53 0.00 3.94 4.69
E.G. LEVEL	228.69 228.24 226.72 225.06 223.09 221.77 223.38 216.84 214.63 213.94 214.52 214.56 214.59 214.51 213.97 212.96 212.31 211.30 209.86 207.54 206.15 205.14 204.04 203.14 202.34 202.10
CUT / FILL	0.00 0.86 0.70 0.26 0.12 0.45 0.32 0.08 0.03 0.08 0.12

CHAINAGE: 240.00m



DATUM: 198.00m

DGN. LEVEL	212.50 212.93 212.73 212.28 212.28 212.73 212.73 212.75 212.86 212.75 212.73
OFFSETS	-5.98 -5.83 -5.62 -5.39 -4.89 -4.55 -4.25 -3.50 0.00 3.50 4.25
E.G. LEVEL	226.62 225.64 224.55 223.70 221.99 221.09 219.61 217.95 216.13 214.53 212.50 212.36 212.85 213.01 212.86 212.63 212.27 209.86 207.57 205.97 205.00 204.00 203.55 203.02 201.90 200.97 200.13 199.38 198.93
CUT / FILL	0.00 0.40 0.15 -0.35 -0.47 -0.11 -0.19 -0.30 0.00 0.18 0.22

CHAINAGE: 260.00m

0 10 mm 50 100 200 300 mm

APPROVED PLAN
Planner: ENathan
RC: 2240268-RMAOUT
Date: 6/02/2024

NOTES.

1. FOR GENERAL NOTES REFER TO SHEET C001

1:200 @ A1
1:400 @ A3 0 2 4 6 8 10 12 14 16 18 20 m

WORK IN PROGRESS
PRINTED 11/12/2023 2:23:32 pm

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR DISCUSSION		

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES 1:200 AT A1 | ORIGINAL SIZE A1
DRAWN K.DARSHAN | DESIGNED M.LEGGETT | APPROVED APPROVER
DRAWING VERIFIED VERIFIER | DESIGN VERIFIED VERIFIER | APPROVED DATE YYYY-MM-DD

FOR INFORMATION

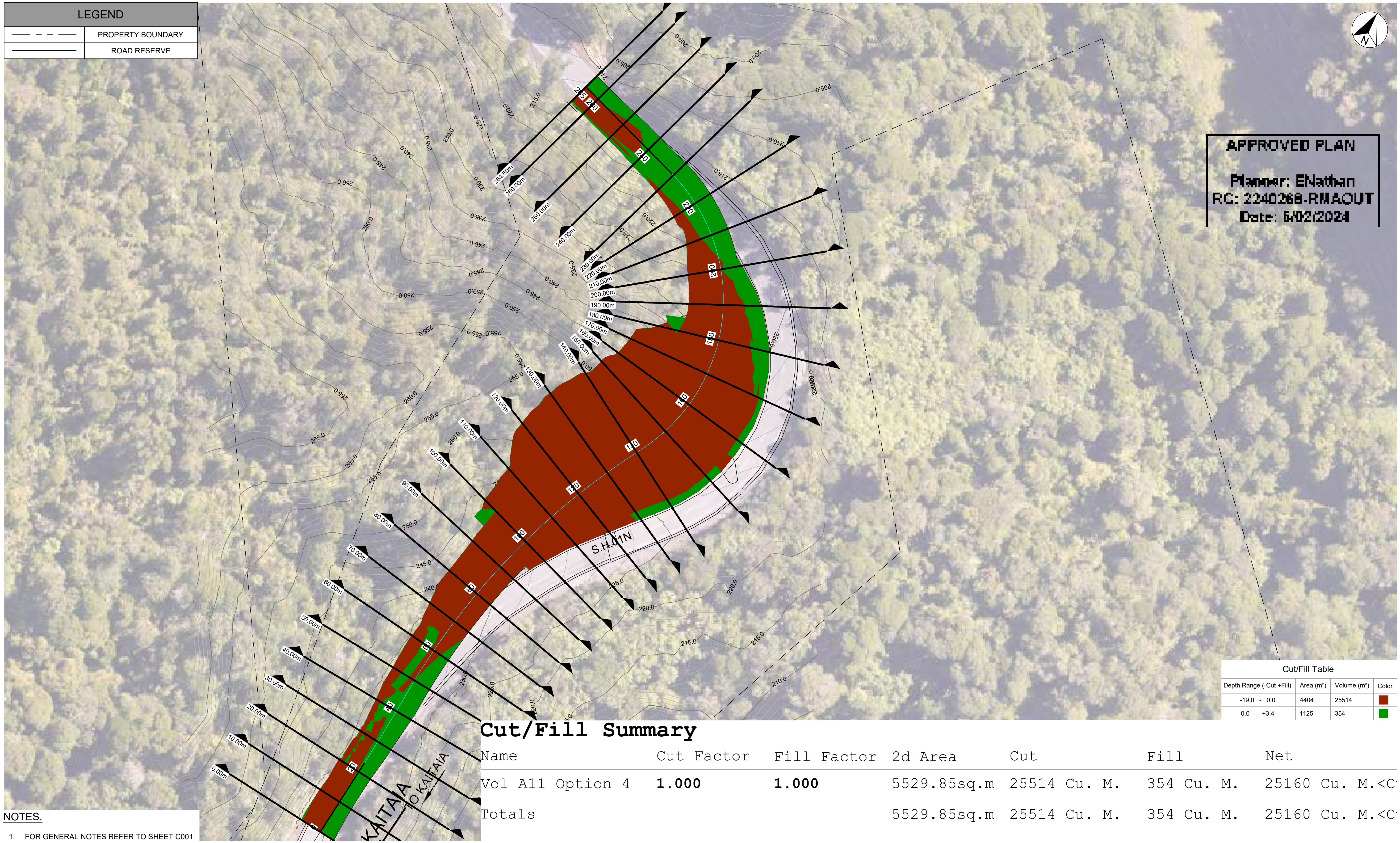
PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

TITLE
CROSSSECTION
A11 MANGAMUKHA

WSP PROJECT NO. (SUB-PROJECT) 1-11241.13(A11) | SHEET NO. C016(A11) | REVISION A

LEGEND

— — —	PROPERTY BOUNDARY
———	ROAD RESERVE



APPROVED PLAN

Planner: ENathan
RC: 2240268-RMAOUT
Date: 6/02/2024

Cut/Fill Table

Depth Range (-Cut +Fill)	Area (m²)	Volume (m³)	Color
-19.0 - 0.0	4404	25514	
0.0 - +3.4	1125	354	

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
Vol A11 Option 4	1.000	1.000	5529.85sq.m	25514 Cu. M.	354 Cu. M.	25160 Cu. M.<C
Totals			5529.85sq.m	25514 Cu. M.	354 Cu. M.	25160 Cu. M.<C

NOTES.

1. FOR GENERAL NOTES REFER TO SHEET C001

1:500 @ A1
1:1000 @ A3 0 5 10 15 20 25 30 35 40 45 50 m

WORK IN PROGRESS

PRINTED 11/12/2023 3:00:54 pm

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR INFORMATION AND DISCUSSION		

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Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES: 1:500 AT A1
ORIGINAL SIZE: A1

DRAWN	DESIGNED	APPROVED
K.DARSHAN	M.LEGGETT	APPROVER

DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
VERIFIER	VERIFIER	YYYY-MM-DD

FOR INFORMATION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

TITLE
CUT FILL PLAN
A11

WSP PROJECT NO. (SUB-PROJECT): 1-11241.13(A11)
SHEET NO.: C050(A11)
REVISION: A

Original sheet size A1 (841x594) Plot Date 2023-12-11 at 3:00:54 pm \\corp.pbwan.net\ANZ\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A11\04_CADD\1-11241.13(A11)_C000-050 - REV 2.dwg C050

LEGEND	
————————	PROPERTY BOUNDARY

APPROVED PLAN

Planner: ENathan
RC: 2240268-RMAOUT
Date: 6/02/2024

A11- SETTING OUT				
Number	Radius	Length	Line/Chord Direction	A Value
L1		22.99	32° 35' 40.58"	
C1	492.00	22.20	31° 18' 07.80"	
C2	200.00	96.17	43° 47' 05.14"	
C3	50.00	89.15	6° 28' 45.12"	
L2		34.30	315° 23' 54.98"	

WORK IN PROGRESS

PRINTED 11/12/2023 3:27:05 pm

NOTES.

1. FOR GENERAL NOTES REFER TO SHEET C001

1:500 @ A1 / 1:1000 @ A3 — 0 5 10 15 20 25 30 35 40 45 50 m

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR INFORMATION AND DISCUSSION		

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New Zealand

CIVIL

SCALES: 1:500 AT A1
ORIGINAL SIZE: A1
DRAWN: K.DARSHAN
DESIGNED: M.LEGGETT
APPROVED: APPROVER
DRAWING VERIFIED: VERIFIER
DESIGN VERIFIED: VERIFIER
APPROVED DATE: YYYY-MM-DD

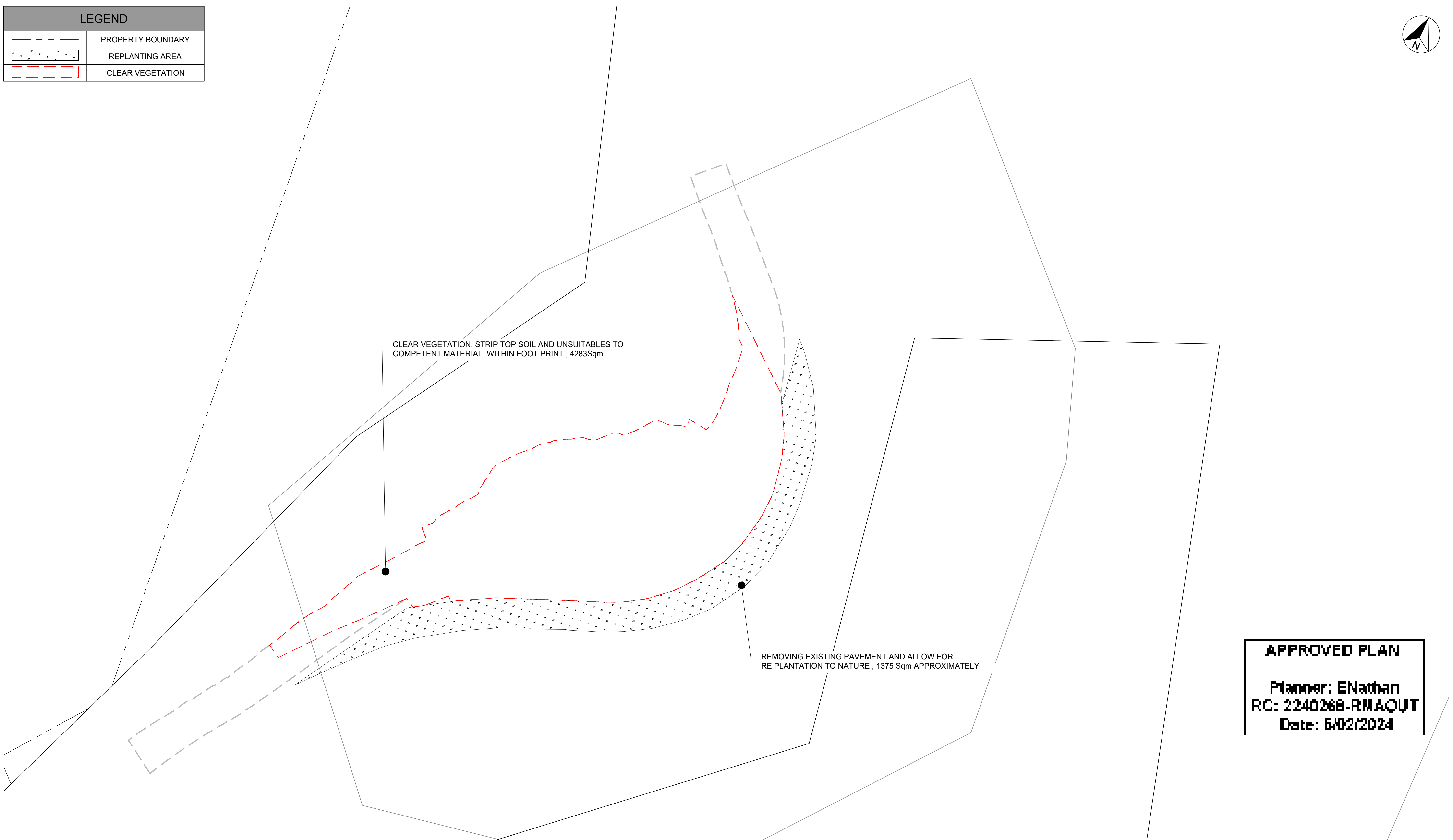
FOR INFORMATION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

TITLE
ALIGNMENT SETTING OUT
A11

WSP PROJECT NO. (SUB-PROJECT): 1-11241.13(A11)
SHEET NO.: C051(A11)
REVISION: A

Original sheet size A1 (841x594) Plot Date 2023-12-11 at 3:27:05 pm \\corp.pbwan.net\ANZ\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A11\04_CADD\02_Model\1-11240.00 NZTA A11 Mangamukha- opt 4- Aln Setting out.dwg C051



NOTES.

1. FOR GENERAL NOTES REFER TO SHEET C001

1:500 @ A1 / 1:1000 @ A3 — 0 5 10 15 20 25 30 35 40 45 50 m

WORK IN PROGRESS

PRINTED 11/12/2023 3:53:50 pm

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR INFORMATION AND DISCUSSION		

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Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES		ORIGINAL SIZE
1:500 AT A1		A1
DRAWN	DESIGNED	APPROVED
K.DARSHAN	M.LEGGETT	APPROVER
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
VERIFIER	VERIFIER	YYYY-MM-DD

FOR INFORMATION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.748 - 2.835, MANGAMUKA, NORTHLAND
A11 NZTA EMERGENCY WORKS 2022

TITLE
REPLANTING AREA
A11

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11241.13(A11)	C060(A11)	A

Original sheet size A1 (841x594) Plot Date 2023-12-11 at 3:53:50 pm \\corp.pbwan.net\ANZ\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A11\04_CADD\01_XREF\A11 - replanting area r 1.dwg C060

APPENDIX C -Outline Plan 2240428 – RMAOUW

Far North District Council

Private Bag 752, Memorial Ave
Kaikohe 0440, New Zealand
Freephone: 0800 920 029
Phone: (09) 401 5200
Fax: (09) 401 2137
Email: ask.us@fndc.govt.nz
Website: www.fndc.govt.nz

Te Kaunihera o Tai Tokerau Ki Te Raki

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15 May 2024

Waka Kotahi - NZ Transport Agency
PRIVATE BAG 106602
29 Customs Street West
Auckland Central
Auckland 1143

Tēnā koe New Zealand Transport Agency – Waka Kotahi,

Re: 2240428-RMAOUW - Outline Plan Waiver for Transit New Zealand (now known as NZTA) – Designation SH.

I am pleased to advise that your application to waive the requirement to submit an outline plan waiver is duly granted pursuant to s.176A (2)(c) of the Resource Management Act 1991.

The property in respect of which the application is made is situated along State Highway 1, Mangamuka 0476.

The site is designated as:

Desig #	Site Notation/Purpose	Requiring Authority	Site Location	Area	Map	Underlying Zone
SH (As shown on Planning Maps)	All of NZTA's State Highway network, including State Highways 1F, 1N, 10, 11 & 12	Transit New Zealand (now known as NZTA)			ALL	Refer definition of Road (Ch3)

The outline plan waiver is to undertake remediation and repair works on roading slips A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A12, A13, A26, and A27 along a section of State Highway 1 within the Mangamuka Gorge. The proposal is as detailed in the information submitted with the application for 2240428-RMAOUW and which is shown on the plans prepared by WSP, project titled WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY S.H. 01N R.S. 119 R.P. 13.613 - 13.722, MANGAMUKA, NORTHLAND A5 NZTA EMERGENCY WORKS 2022, Project Number: 1-11241.13, and referenced and dated as listed below:

Title	Sheet No.	Date
Plan Pavement Extents	C021(A1-A2) – Rev. 2	12-07-2023
Plan Pavement Reconstruction	C021 – Rev. 2	12-07-2023
Plan Pavement Reconstruction	C021(A4) – Rev. 1	02-11-2023
Plan Pavement Extents	C021(A5) – Rev. 2	12-07-2023
Plan Pavement Extents	C021(A6) – Rev. 1	19-10-2023
Plan Pavement Extents	C021(A7) – Rev. 2	15-01-2024
Plan Existing Contours	C002(A8) – Rev. 1	27-11-2023
Plan - Pavement Extents Sheet 1 of 2	C021(A9) – Rev. 2	12-07-2023
Plan Pavement Extents	C021(A10) – Rev. A	No Date
Plan - Pavement Extents Sheet 1 of 2	C022(A12-A13)	12-07-2023

Plan - Pavement Extents Sheet 2 of 2	C023(A12-A13) – Rev. 3	12-12-2023
Plan Pavement Extents	C021(A26) – Rev. 1	29-09-2023
Plan Design Overview	C020(A27) – Rev. 1	06-10-2023

In exercising Council's delegated authority, consideration has been given to the purpose of the Transit New Zealand (now known as NZTA) designation, and the intent and scale of the proposed works. It is concluded that the works are within the purpose of the Designation.

If you have any queries regarding this information, please do not hesitate to contact the undersigned.

Ngā mihi,

Tianxu (Brian) Huang
Team Leader – Resource Consents

Date: 15 May 2024

LEGEND	
	ROAD RESERVE
	PROPERTY BOUNDARY
	PROPOSED ROAD MARKINGS
	PROPOSED EDGE OF SEAL
	PROPOSED GUARDRAIL

NOTES:

1. FOR NOTES REFER TO SHEET C001.

1:200 @ A1
1:400 @ A3
0 2 4 6 8 10 12 14 16 18 20 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION	CJP	06-03-2023
2	ISSUED FOR CONSTRUCTION	SHG	12-07-2023

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
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Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES		ORIGINAL SIZE
1:200 AT A1		A1
DRAWN	DESIGNED	APPROVED
D. MOORE	M. LEGGET	C. PARKER
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
K. MEIN	S. GRIEVE	06-03-2023

FOR CONSTRUCTION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 119 R.P. 12.597 - 12.750, MANGAMUKA, NORTHLAND
A1/2 NZTA EMERGENCY WORKS AUGUST 2022

TITLE
PLAN
PAVEMENT EXTENTS

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11241.13	C021(A1-A2)	2

Original sheet size A1 (841x594) Plot Date 2023-07-13 at 9:15:54 am U:\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A1\(C)Civil\+AutoCAD\1-11241.13_C020-039.dwg C021

LEGEND	
	ROAD RESERVE
	PROPERTY BOUNDARY
	PROPOSED ROAD MARKINGS
	PROPOSED EDGE OF SEAL
	PROPOSED GUARDRAIL

NOTES:

1. FOR NOTES REFER TO SHEET C001.

1:200 @ A1
1:400 @ A3 0 2 4 6 8 10 12 14 16 18 20 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION	CJP	06-03-2023
2	ISSUED FOR CONSTRUCITON	SHG	12-07-2023

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
+64 9 430 1700
Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES
1:200 AT A1
ORIGINAL SIZE A1

DRAWN	DESIGNED	APPROVED
D. MOORE	M. LEGGET	C. PARKER
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
K. MEIN	S. GRIEVE	06-03-2023

FOR CONSTRUCTION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 119 R.P. 13.317 - 13.422.0, MANGAMUKA, NORTHLAND
A3 NZTA EMERGENCY WORKS AUGUST 2022

TITLE
PLAN
PAVEMENT RECONSTRUCTION

WSP PROJECT NO. (SUB-PROJECT) 1-11241.13
SHEET NO. C021
REVISION 2

Original sheet size A1 (841x594) Plot Date 2023-07-13 at 11:35:13 am U:\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A3\(C)Civil\+AutoCAD\1-11241.13_C020-039.dwg C021

LEGEND

	ROAD RESERVE
	PROPERTY BOUNDARY
	PROPOSED ROAD MARKINGS
	PROPOSED EDGE OF SEAL
	PROPOSED GUARDRAIL

NOTES:

1. FOR NOTES REFER TO SHEET C001.

1:200 @ A1 / 1:400 @ A3 — 0 2 4 6 8 10 12 14 16 18 20 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION	S.H.G.	02-11-2023

WAKA KOTAHI NZ TRANSPORT AGENCY

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Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES: 1:200 AT A1 — ORIGINAL SIZE: A1

DRAWN	DESIGNED	APPROVED
D. MOORE	M. LEGGETT	S. GRIEVE
DRAWING VERIFIED	**DESIGN VERIFIED**	**APPROVED DATE**
V. GILES	S. GRIEVE	02-11-2023

FOR CONSTRUCTION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 119 R.P. 13.500 - 13.590, MANGAMUKA, NORTHLAND
A4 NZTA EMERGENCY WORKS AUGUST 2022

TITLE
PLAN
PAVEMENT RECONSTRUCTION

WSP PROJECT NO. (SUB-PROJECT): 1-11241.13 — SHEET NO.: C021(A4) — REVISION: 1

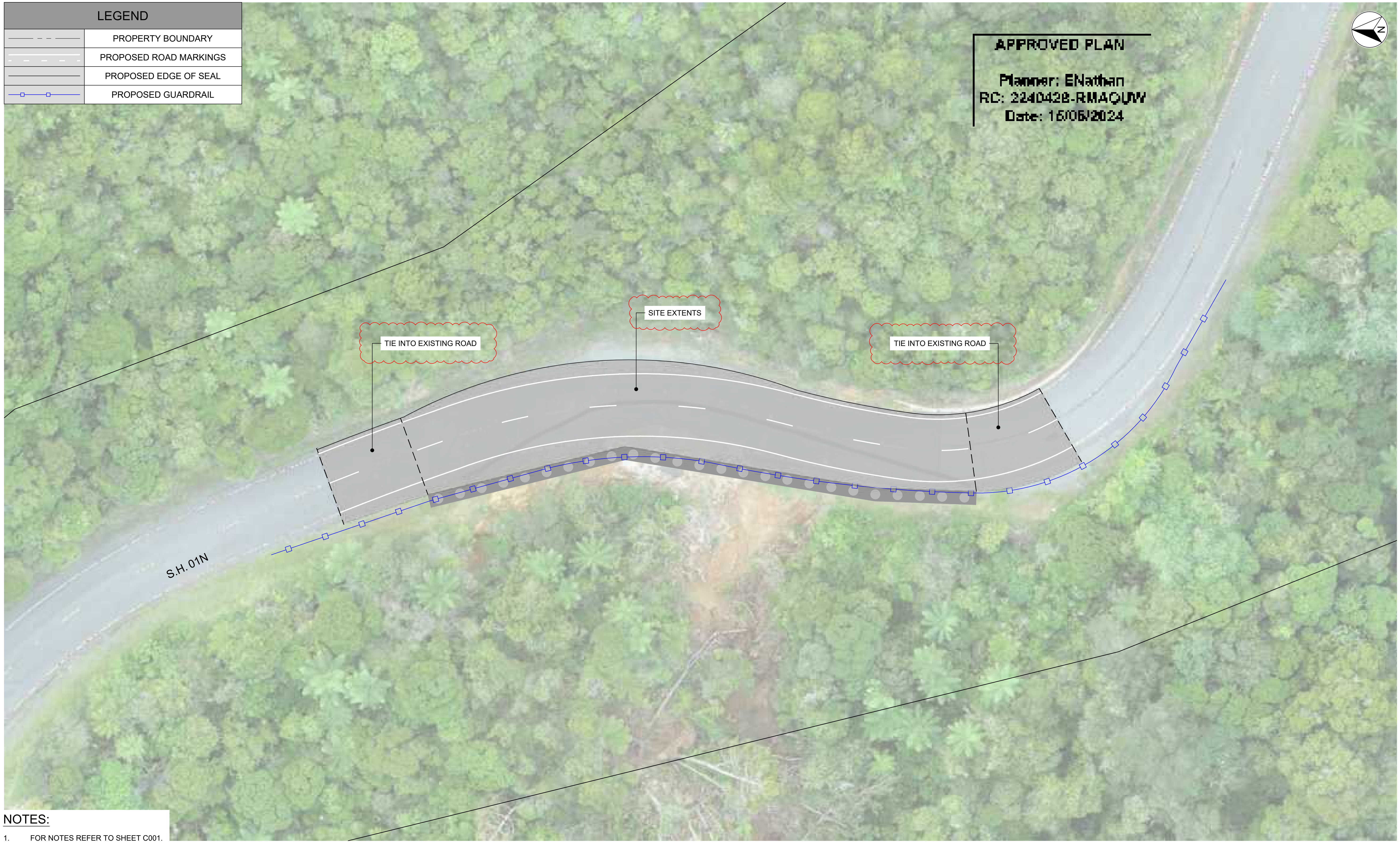
Original sheet size A1 (841x594) Plot Date 2023-11-02 at 2:34:47 pm \\corp.pbwan.net\ANZ\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A4\04_CADD\1-11241.13(A4)_C020-039.dwg C021

LEGEND

	PROPERTY BOUNDARY
	PROPOSED ROAD MARKINGS
	PROPOSED EDGE OF SEAL
	PROPOSED GUARDRAIL

APPROVED PLAN

Planner: ENathan
RC: 2240428-RMAQUW
Date: 16/06/2024



NOTES:

1. FOR NOTES REFER TO SHEET C001.

1:200 @ A1 / 1:400 @ A3 — 0 2 4 6 8 10 12 14 16 18 20 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED AS FOR CONSTRUCTION	CJP	06-03-2023
2	ISSUED FOR CONSTRUCTION	SHG	12-07-2023

WAKA KOTAHI NZ TRANSPORT AGENCY

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Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES		ORIGINAL SIZE
1:200 AT A1		A1
DRAWN	DESIGNED	APPROVED
D. MOORE	M. LEGGETT	C. PARKER
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
K. MEIN	S. GRIEVE	06-03-2023

FOR CONSTRUCTION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 119 R.P. 13.613 - 13.722, MANGAMUKA, NORTHLAND
A5 NZTA EMERGENCY WORKS 2022

TITLE
PLAN
PAVEMENT EXTENTS

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11241.13	C021(A5)	2

Original sheet size A1 (841x594) Plot Date 2023-07-13 at 11:21:31 am U:\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A5\(C)Civil\+AutoCAD\1-11241.13_C020-039.dwg C021

NOTES:

1. FOR NOTES REFER TO SHEET C001.

1:200 @ A1
1:400 @ A3 0 2 4 6 8 10 12 14 16 18 20 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED AS FOR CONSTRUCTION	S.H.G.	19-10-2023

WAKA KOTAHI NZ TRANSPORT AGENCY

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Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES 1:200 AT A1 — ORIGINAL SIZE A1

DRAWN	DESIGNED	APPROVED
D. MOORE	D. CLAASSEN	S. GRIEVE
DRAWING VERIFIED	**DESIGN VERIFIED**	**APPROVED DATE**
V. GILES	S. GRIEVE	19-10-2023

FOR CONSTRUCTION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 119 R.P. 13.750 - 13.860, MANGAMUKA, NORTHLAND
A6 NZTA EMERGENCY WORKS 2022

TITLE
PLAN
PAVEMENT EXTENTS

WSP PROJECT NO. (SUB-PROJECT) 1-11241.13 — SHEET NO. C021(A6) — REVISION 1

Original sheet size A1 (841x594) Plot Date 2023-10-19 at 4:12:35 pm U:\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A6\04_CADD\1-11241.13(A6)_C020-039.dwg C021

LEGEND	
	ROAD BOUNDARY
	PROPERTY BOUNDARY
	PROPOSED GUARDRAIL
	ROAD MARKINGS
	ROAD EDGE OF SEAL

APPROVED PLAN

Planner: ENathan
RC: 2240428-RMAQUW
Date: 16/05/2024

NOTES:

1. FOR NOTES REFER TO SHEET C001.

1:200 @ A1 1:400 @ A3 0 2 4 6 8 10 12 14 16 18 20 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED AS FOR CONSTRUCTION	S.H.G.	17-11-2023
2	ISSUED FOR CONSTRUCTION - WALL ALIGNMENT CHANGE	S.H.G.	15-01-2024

WAKA KOTAHI NZ TRANSPORT AGENCY

wsp
Whangarei Office
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Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES		ORIGINAL SIZE
1:200 AT A1		A1
DRAWN	DESIGNED	APPROVED
D. MOORE	D. CLAASSEN	S. GRIEVE
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
J. MOOLMAN	S. GRIEVE	17-11-2023

FOR CONSTRUCTION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 119 R.P. 14.030 - 14.110, MANGAMUKA, NORTHLAND
A7 NZTA EMERGENCY WORKS 2022

TITLE
PLAN
PAVEMENT EXTENTS

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11241.13	C021(A7)	2

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LEGEND	
	ROAD BOUNDARY
	PROPERTY BOUNDARY
	EXISTING MAJOR CONTOUR (5.0m)
	EXISTING MINOR CONTOUR (1.0m)

APPROVED PLAN

Planner: ENathan
RC: 2240428-RMAQUW
Date: 16/06/2024

NOTES.

1. FOR NOTES REFER TO SHEET C001.

1:250 @ A1
1:500 @ A3
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REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION	S.H.G.	27-11-2023

WAKA KOTAHI NZ TRANSPORT AGENCY

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CIVIL

SCALES: 1:250 AT A1
ORIGINAL SIZE: A1

DRAWN	DESIGNED	APPROVED
D. MOORE	M. LEGGET	S. GRIEVE
DRAWING VERIFIED	**DESIGN VERIFIED**	**APPROVED DATE**
V. GILES	S. GRIEVE	27-11-2023

FOR CONSTRUCTION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 119 R.P. 14.480 - 14.630, MANGAMUKA, NORTHLAND
A8 NZTA EMERGENCY WORKS 2022

TITLE
PLAN
EXISTING CONTOURS

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APPROVED PLAN

Planner: ENathan
RC: 2240428-RMAQUW
Date: 16/06/2024

NOTES:

1. FOR NOTES REFER TO SHEET C001.

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0 10 mm 50 100 200 300 mm

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION	CJP	06-03-2023
2	ISSUED FOR CONSTRUCTION	SHG	12-07-2023

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SCALES: 1:200 AT A1
ORIGINAL SIZE: A1

DRAWN	DESIGNED	APPROVED
D. MOORE	D. CLAASSEN	C. PARKER
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
K. MEIN	S. GRIEVE	06-03-2023

FOR CONSTRUCTION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 119 R.P. 15.135 - 15.323, MANGAMUKA, NORTHLAND
A9 NZTA EMERGENCY WORKS 2022

TITLE
PLAN - PAVEMENT EXTENTS
SHEET 1 OF 2

WSP PROJECT NO. (SUB-PROJECT): 1-11241.13
SHEET NO.: C021(A9)
REVISION: 2

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	PROPERTY BOUNDARY
	PROPOSED GUARDRAIL
	ROAD MARKINGS
	ROAD EDGE OF SEAL

NOTES.

1. FOR GENERAL NOTES REFER TO SHEET C001.

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WORK IN PROGRESS

PRINTED 1/03/2024 12:07:14 pm

REVISION	AMENDMENT	APPROVED	DATE
A	ISSUED FOR DRAFT	-	-

WAKA KOTAHI NZ TRANSPORT AGENCY

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Private Bag 9017
Whangarei 0148
New Zealand

CIVIL

SCALES		ORIGINAL SIZE
1:250 AT A1		A1
DRAWN	DESIGNED	APPROVED
T. TAUNGA	M. LEGGETT	-
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
-	-	-

DRAFT

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 2.213 - 2.385, MANGAMUKA, NORTHLAND
A10 NZTA EMERGENCY WORKS 2022

TITLE
PLAN
PAVEMENT EXTENTS

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11241.13(A10)	C021(A10)	A

NOTES:

1. FOR NOTES REFER TO SHEET C001.

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REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION	CJP	06-03-2023
2	ISSUED FOR CONSTRUCTION	SHG	12-07-2023

WAKA KOTAHI NZ TRANSPORT AGENCY

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Whangarei 0148
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CIVIL

SCALES: 1:200 AT A1
ORIGINAL SIZE: A1

DRAWN	DESIGNED	APPROVED
D. MOORE	D. CLAASSEN	C. PARKER
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
K. MEIN	S. GRIEVE	06-03-2023

FOR CONSTRUCTION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 4.360 - 4.625, MANGAMUKA, NORTHLAND
A12/13 NZTA EMERGENCY WORKS 2022

TITLE
PLAN - PAVEMENT EXTENTS
SHEET 1 OF 2

WSP PROJECT NO. (SUB-PROJECT): 1-11241.13
SHEET NO.: C022(A12-A13)
REVISION: 2

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NOTES:

1. FOR NOTES REFER TO SHEET C001.

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REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION	CJP	06-03-2023
2	ISSUED FOR CONSTRUCTION	SHG	12-07-2023
3	ISSUED FOR CONSTRUCTION - NEW WALL ALIGNMENT	SHG	12-12-2023

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CIVIL

SCALES: 1:200 AT A1		ORIGINAL SIZE: A1
DRAWN: D. MOORE	DESIGNED: D. CLAASSEN	APPROVED: C. PARKER
DRAWING VERIFIED: K. MEIN	DESIGN VERIFIED: S. GRIEVE	APPROVED DATE: 06-03-2023

FOR CONSTRUCTION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 134 R.P. 4.360 - 4.625, MANGAMUKA, NORTHLAND
A12/13 NZTA EMERGENCY WORKS 2022

TITLE
PLAN - PAVEMENT EXTENTS
SHEET 2 OF 2

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
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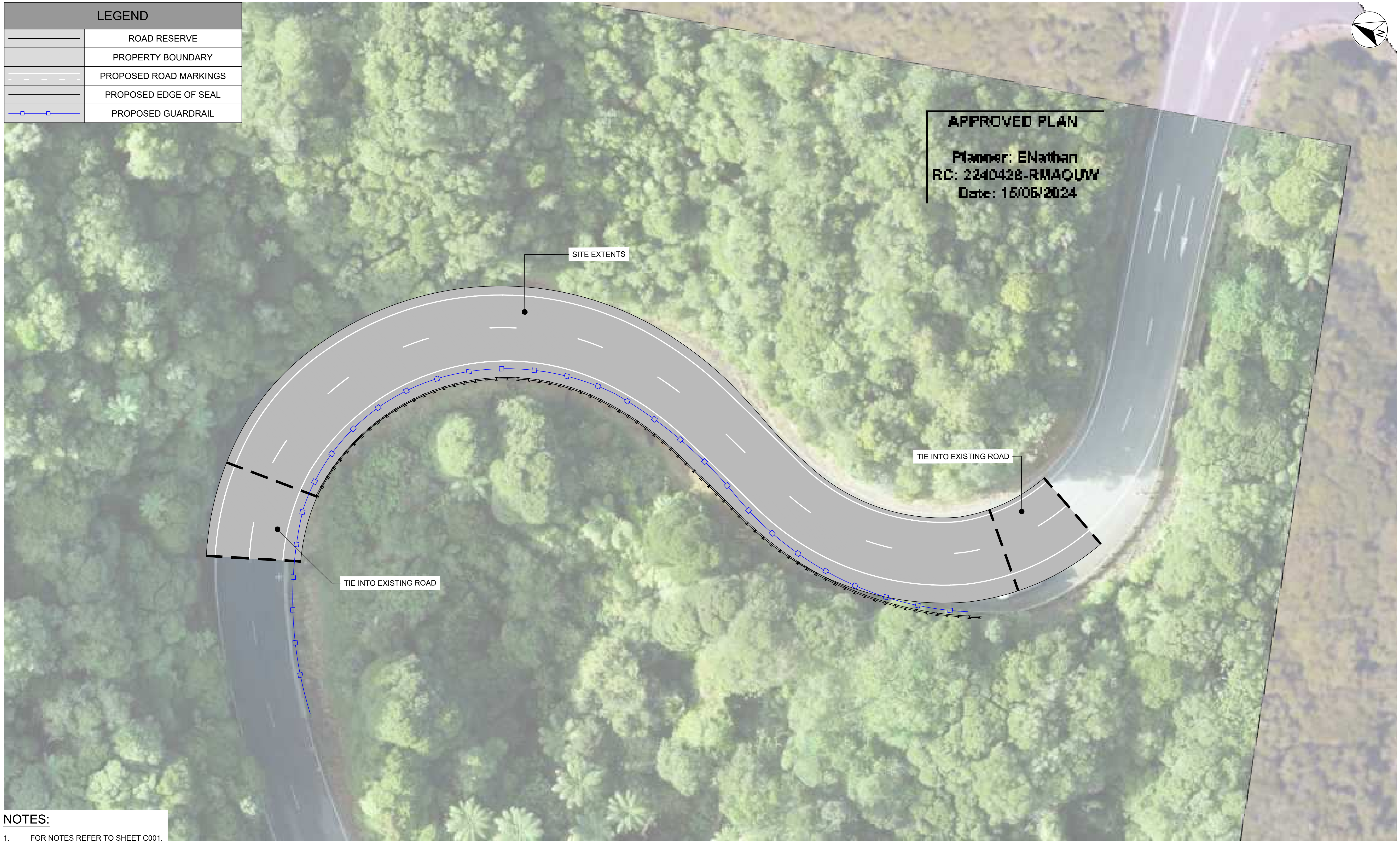

LEGEND

	ROAD RESERVE
	PROPERTY BOUNDARY
	PROPOSED ROAD MARKINGS
	PROPOSED EDGE OF SEAL
	PROPOSED GUARDRAIL

NOTES:

1. FOR NOTES REFER TO SHEET C001.

1:200 @ A1
1:400 @ A3 0 2 4 6 8 10 12 14 16 18 20 m

REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION	S.H.G.	29-09-2023

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New Zealand

CIVIL

SCALES 1:200 AT A1 — ORIGINAL SIZE A1

DRAWN	DESIGNED	APPROVED
D. MOORE	D. CLAASSEN	S. GRIEVE
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
V. GILES	S. GRIEVE	29-09-2023

FOR CONSTRUCTION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 119 R.P. 15.780 - 15.795, MANGAMUKA, NORTHLAND
NZTA EMERGENCY WORKS 2022

TITLE
PLAN
PAVEMENT EXTENTS

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NOTES:

1. REFER TO SHEET C001 FOR NOTES

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REVISION	AMENDMENT	APPROVED	DATE
1	ISSUED FOR CONSTRUCTION	SHG	06-10-2023

WAKA KOTAHI NZ TRANSPORT AGENCY

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Whangarei 0148
New Zealand

CIVIL

SCALES		ORIGINAL SIZE
1:100 AT A1		A1
DRAWN	DESIGNED	APPROVED
S. JENKINS	D. CLAASSEN	S. GRIEVE
DRAWING VERIFIED	DESIGN VERIFIED	APPROVED DATE
K. MEIN	S. GRIEVE	06-10-2023

FOR CONSTRUCTION

PROJECT
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S 134 R.P 4.470 - 4530, MANGAMUKA, NORTHLAND
A27 NZTA EMERGENCY WORKS 2022

TITLE
PLAN
DESIGN OVERVIEW

WSP PROJECT NO. (SUB-PROJECT)	SHEET NO.	REVISION
1-11241.13	C020(A27)	1

Original sheet size A1 (841x594) Plot Date 2023-10-06 at 2:15:43 pm U:\ProjectsNZ\11\1-11240.00 NZTA Northland Resilience and Emergency\Home\41 EW\August 2022 Storm\200 Technical\210 Drawings\04 CADD (A1-A13 MANGAMUKA)\A27\04_CADD\1-11241.13_C020-029.dwg C020

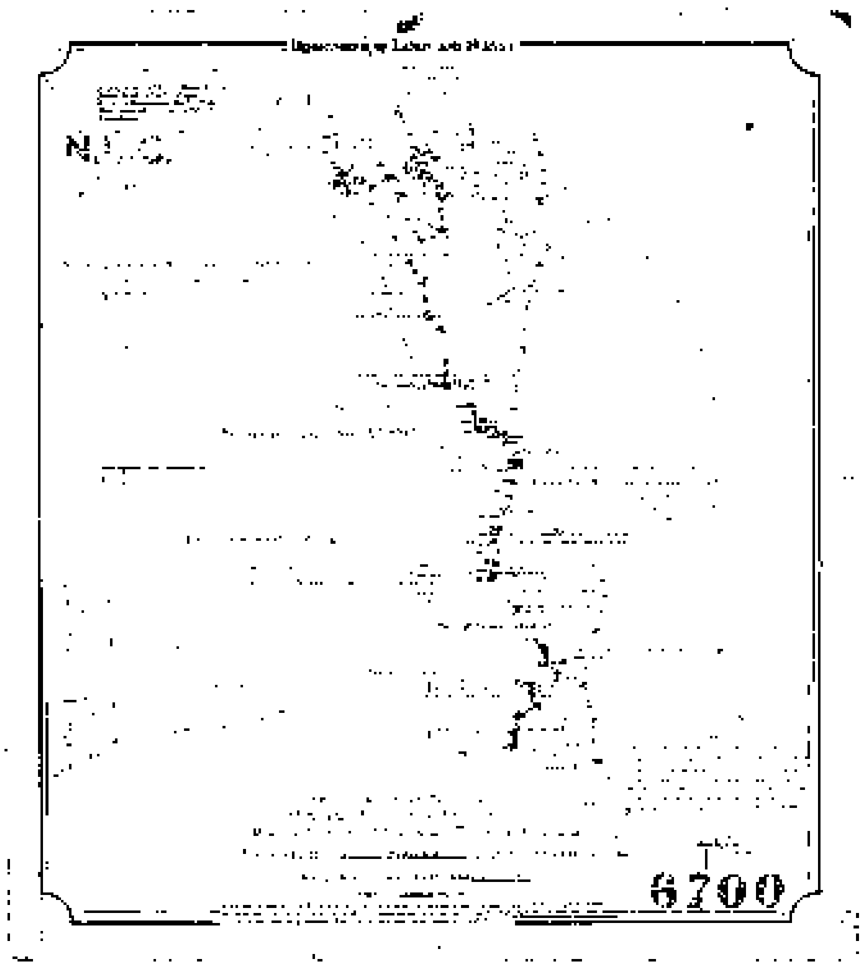
APPENDIX D Heritage Values Assessment

Archaeological and Historic Heritage Assessment

State Highway 1 Slip Repairs

Mangamuka-Victoria Valley

25 October 2023



Prepared for:

Waka Kotahi

Prepared by:

Geometria Limited

PO Box 1972
Whangarei 0140

0.1 Executive Summary

This report provides an assessment of archaeological and heritage values along the State Highway 1 corridor from Mangamuka to Victoria Valley in order to assist with undertaking slip repairs through the Mangamuka gorge and over the Mangamuka range. It extends outside the area of slips in order to encompass areas which may be required as spoil dump sites and for other purposes associated the slip repairs, and any future works. There are no existing such assessments for the area and due to a prior lack of development, few recorded archaeological sites. A review of historic plans and other sources has identified more than 400 heritage features in the area and many of these may have an extant physical component and potentially meet the statutory definition of an archaeological site under the Heritage New Zealand Pouhere Taonga Act. Numerous names and historic topographic and vegetation descriptions have also been identified.

No archaeological sites are likely to be affected by the slip repairs themselves and these may occur under an Accidental Discovery Protocol. However several areas where spoil dump sites have been, or are in use are in areas of potential archaeological, historical and cultural significance and require assessment. New spoil dump sites and other works outside the slip areas will also need to be assessed early in the planning stages in order to avoid harm. Additional assessments will be added as appendices.

0.2 Quality Information

Document: Archaeological and Historic Heritage Assessment. State Highway Slip Repairs. Mangamuka-Victoria Valley

Ref: 2023-101

Date: 25 October 2023

Prepared by: Jonathan Carpenter

0.3 Revision History

Revision	Revision Date	Details	Authorized Name
Client draft v0.1	10 June 2023		J. Carpenter
Client Final v1.0	18 August 2023		J. Carpenter
Client Final v2.0	25 October 0223		J. Carpenter

File ref.:
D:\Documents\2023\2023_101_SH1_Mangamuka\Reports\Working\20230228_SH_1_Mangamuka_Desktop_Assesment.docx

Contents

Figures

Tables

Glossary

Classic	The later period of New Zealand settlement
Fire scoop	Fireplace used for various reasons (cooking, warming, etc.)
Hangi	An earth oven for cooking food
Midden	The remains of food refuse usually consisting of shells, and bone, but can also contain artefacts
Pa	A site fortified with earthworks and palisade defences
Pit	Rectangular excavated pit used to store crops by Maori
Radiocarbon	Method of absolute dating using known rates of decay of a carbon isotope
Terrace	A platform cut into the hill slope used for habitation
Wahi tapu	Sites of spiritual significance to Maori

1.0 Introduction

Geometria Ltd was commissioned by Waka Kotahi to undertake an archaeological assessment of slip repair work on State Highway 1 through the Mangamuka gorge, between Mangamuka and Victoria Valley in the Far North. The work was requested by K. O'Reilly, Waka Kotahi Principal Project Manager, Infrastructure Delivery (Northland and Auckland). No particular Zone of Influence has been indicated and so this assessment takes a geographically broad approach, extending from the Mangamuka Bridge in the south east to the State Highway 1/Takahue Road intersection in the north west in order to account for existing and potential spoil dump sites at some distance from the slips/works themselves.

Under the Heritage New Zealand Pouhere Taonga Act 2014 all archaeological sites are protected from any modification, damage or destruction except by the authority of the Heritage New Zealand Pouhere Taonga.

This assessment uses archaeological techniques to assess archaeological values and does not seek to locate or identify wahi tapu or other places of cultural or spiritual significance to Maori. Such assessments may only be made by Tangata Whenua, who may be approached independently of this report for advice.

Likewise, such an assessment by Tangata Whenua does not constitute an archaeological assessment and permission to undertake ground disturbing activity on and around archaeological sites and features may only be provided by Heritage New Zealand Pouhere Taonga, and may only be monitored or investigated by a qualified archaeologist approved through the archaeological authority process.

1.1 The Resource Management Act 1991.

Archaeological sites and other historic heritage may also be considered under the Resource Management Act 1991 (RMA). The RMA establishes (under Part 2) in the Act's purpose (Section 5) the matters of national importance (Section 6), and other matters (Section 7) and all decisions by a Council are subject to these provisions. Sections 6e and 6f identify historic heritage (which includes archaeological sites) and Maori heritage as matters of national importance.

Councils have a responsibility to recognise and provide for the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, wahi tapu, and other taonga (Section 6e). Councils also have the statutory responsibility to recognise and provide for the protection of historic heritage from inappropriate subdivision, use and development within the context of sustainable management (Section 6f). Responsibilities for managing adverse effects on heritage arise as part of policy and plan preparation and the resource consent processes.

1.2 The Heritage New Zealand Pouhere Taonga Act 2014

Under the Heritage New Zealand Pouhere[2] Taonga Act 2014 (HNZPTA; previously the Historic Places Act 1993) all archaeological sites are protected from any modification, damage or destruction except by the authority of the Historic Places Trust. Section 6 of the HNZPTA defines an archaeological site as:

> *" any place in New Zealand, including any building or structure (or part of a building or structure), that—*
>
> > *(i) was associated with human activity that occurred before 1900 or is the site of the wreck of any vessel where the wreck occurred before 1900; and*

(ii) provides or may provide, through investigation by archaeological methods, evidence relating to the history of New Zealand; and

(b) includes a site for which a declaration is made under section 43(1)"

To be protected under the HNZPTA an archaeological site must have physical remains that pre-date 1900 and that can be investigated by scientific archaeological techniques. Sites from 1900 or post-1900 can be declared archaeological under section 43(1) of the Act.

If a development is likely to impact on an archaeological site, an authority to modify or destroy this site can be sought from the local Heritage New Zealand Pouhere Taonga office under section 44 of the Act. Where damage or destruction of archaeological sites is to occur Heritage New Zealand usually requires mitigation. Penalties for modifying a site without an authority include fines of up to $300,000 for destruction of a site.

Most archaeological evidence consists of sub-surface remains which are often not visible or obvious and indications of an archaeological site are often very subtle and hard to distinguish on the ground surface. Sub-surface excavations on a suspected archaeological site can only take place with an authority issued under Section 56 of the HNZPTA issued by the Heritage New Zealand.

2.0 Location

The project area is the State Highway 1 corridor between Mangamuka and Victoria Valley, and several adjacent spoil dump sites (Figure 1). The slips are located between the Taupapa Stream outfall to the Mangamuka River on the southeast side of the gorge, to the Raetea Valley DOC campground on the northwest side.

Current and closed spoil dump sites are located at Mangamuka State Highway 1 at Church Road, Makene Road, Victoria Valley Road, Mangatoetoe Road, and the north side of SH1 midway between Victoria Valley and Kitchen Road. New spoil dumps are being established at Peria Valley Road and the Mangamuka Valley as of August 2023.

2.1 Topography, Geology, Climate and Vegetation

The project area lies within the Maungataniwha ecological district, with Maungataniwha itself approximately one kilometre east of the highway with the summit at an elevation of 744m above sea level. The Maungataniwha range, extending northeast towards Whangaroa and Manganui, and southwest towards the Hokianga and Whangape either side of the high point comprises heavily forest, steep and dissected hill country 300-400m high. There are marine-cut ancient beach terraces up to 160m above sea level, and deep alluvial deposits on the floors of the larger valley systems.

Across the range, the underlying geology comprises basalt and dolerite with some breccia, weathering to soft brown clay up to 30m thick. Through the gorge, the weathering geology has produced Awapuku clay loam, with an area of Manganui clay in the Raetea Valley. On the steep country above, the rock has weathered to Te Kie stoney clay loam and red loam steepland soils. The Te Kie suite soils are semi-volcanic brown granular loams and clays, derived from Tangihua volcanic deposits mixed with sedimentary rock. While they can be highly fertile on the flat land, on the steep country they are prone to severe shallow or deep-seated slipping as the Te Kie soils are described as skeletal, comprising 35% or more rock fragments, and slip scars are difficult to revegetate.

On the valley floors, alluvium comprises varying amounts of mud, sand and gravels forming riverbed, flood plain and terrace deposits of unconsolidated and un-weathered to slightly weathered to clay deposits up to 2m thick. Marine terraces underlie the slightly higher rolling country 30-150m above sea level west of the highway in the central part of the Mangamuka valley. To the west and east/north east of the Mangamuka valley towards Mangataipa and Fern Flat respectively, and north of the Victoria Valley towards Peria are blue-grey thin to medium bedded mudstones interbedded with fine sandstones, weathering to soft silty clay up to 10m deep.

The valley floors have weathered to Mangakahia clay loam and silt loam with the rolling hill country either side Kohumaru clay, beyond which the patchwork of soil types becomes more complex. The flood plain soils are relatively fertile and free-draining, with periodic flooding adding nutrients and depositing coarse sediment in the upper valleys and near the stream banks (silt loams) and finer material in the lower valleys and further away from the banks (clay loams). These are highly productive arable and pastoral soils. The clay soils are foundon the higher terraces, are no longer being replenished by flood-borne sediment and are far more variable in terms of fertility and drainage.

The area has a mild, wet climate with the predominant winds from the south west, and annual rainfall ranging from 140mm on the low country to 2150mm across the ranges. The annual mean temperature is 15.9 with seasonal averages ranging from 12 degrees in June to 20 degrees in February.

The vegetation in the area was originally dominated by broadleaf podocarp-kauri forest, with intensive logging from European arrival of podocarps and to a lesser extent puriri and kauri (there appears to have been less kauri here than in many parts of Taitokerau). The larger river valleys contained extensive wetlands and kahikatea-dominated swamp forests. By the time of European arrival much of the low land areas had been cleared of primary forest by Maori, leaving a patchwork of primary forest in cooler, wetter gullies, and bracken fernlands and manuka-kanuka dominated shrublands, with areas of intensive Maori horticulture on the fertile and well-watered valley floors.

In summary, the soils and climate in the project area have produced a highly productive horticultural and pastoral landscape on the valley floors on either side of the Maungataniwha Range, with very steep, high and slip-prone country in between.

Figure 1: Slips on State Highway 1, Mangamuka

3.0 Proposed Works

Slip repairs in the project area take a more or less common form across the project area. Slips are to be retained with drilled concrete piles with a concrete pile cap beam. The cap beam is anchored back into the hillside with wire strand anchors.

Arrays of bored subsurface drains will take water from the upslope side of the slips to central manholes and then dispose of it via the existing stormwater system. Concrete channels and minor road widening will also be undertaken. Plans for works at slip A3 near the Raetea campground are provided below as an example of the typical treatment (Figure 2- Figure 5), along with typical cross sections for concrete piles and drains (Figure 6-Figure 7), and similar plans for all the slips have been provided and considered, along with associated/enabling works.

The locations of a number of closed, open and potential future spoil dump sites in the wider Victoria Valley and Mangamuka Valley area have also been provided for assessment, with separate site-based assessments contained in the Appendices of this report.

4.0 Methodology

The methods used to assess the presence and state of archaeological remains in the project area included both a desktop review and preliminary field assessment.

The initial desktop assessment involved an investigation of written records relating to the history of the project area and surrounds. These included regional historical and archaeological publications and unpublished reports, and New Zealand Archaeological Association Site Record Files (NZAA SRF) downloaded via the ArchSite website. Deeds indexes and other resources held by Archives New Zealand and land plans held at Land Information New Zealand were consulted, along with other historic maps and plans, historic and modern aerial and terrestrial imagery, and primary historic sources (Google Earth/Retrolens/Whangarei Public Library/Auckland Public Library/Alexander Turnbull Library/University of Auckland/Victoria University of Wellington/Paperspast/Appendices to the Journal of the House of Representatives). The Far North District Plan and Heritage New Zealand List were also consulted.

Subsequently, site visits were undertaken to view the slip repairs, and assess closed, operational and proposed soil dump sites and other areas of interest.

Figure 2: Slip A3.

Figure 3: Slip A3, plan of concrete cap and pile retaining and new channelling.

Figure 4: Slip A3, plan of pavement reconstruction.

Figure 5: Slip A3, plan of bored drains.

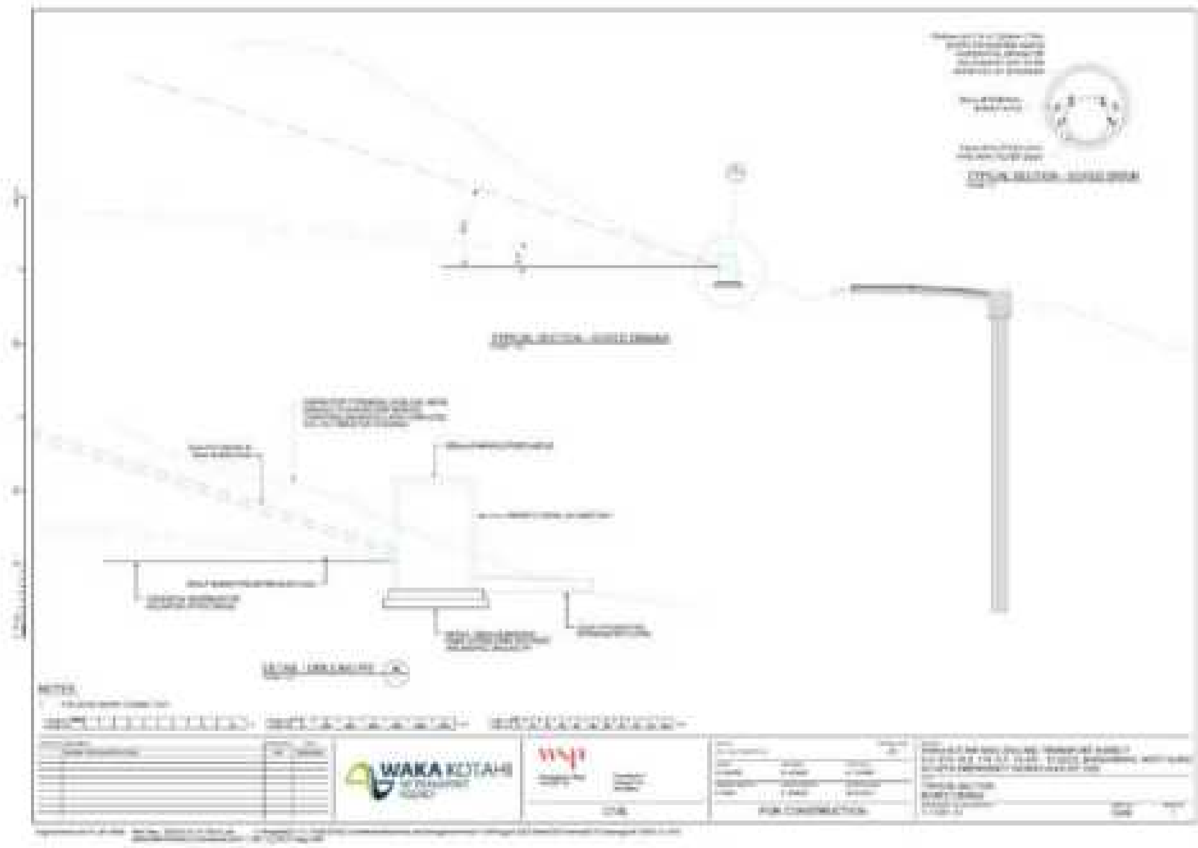


Figure 6: Typical cross section, bored drains.

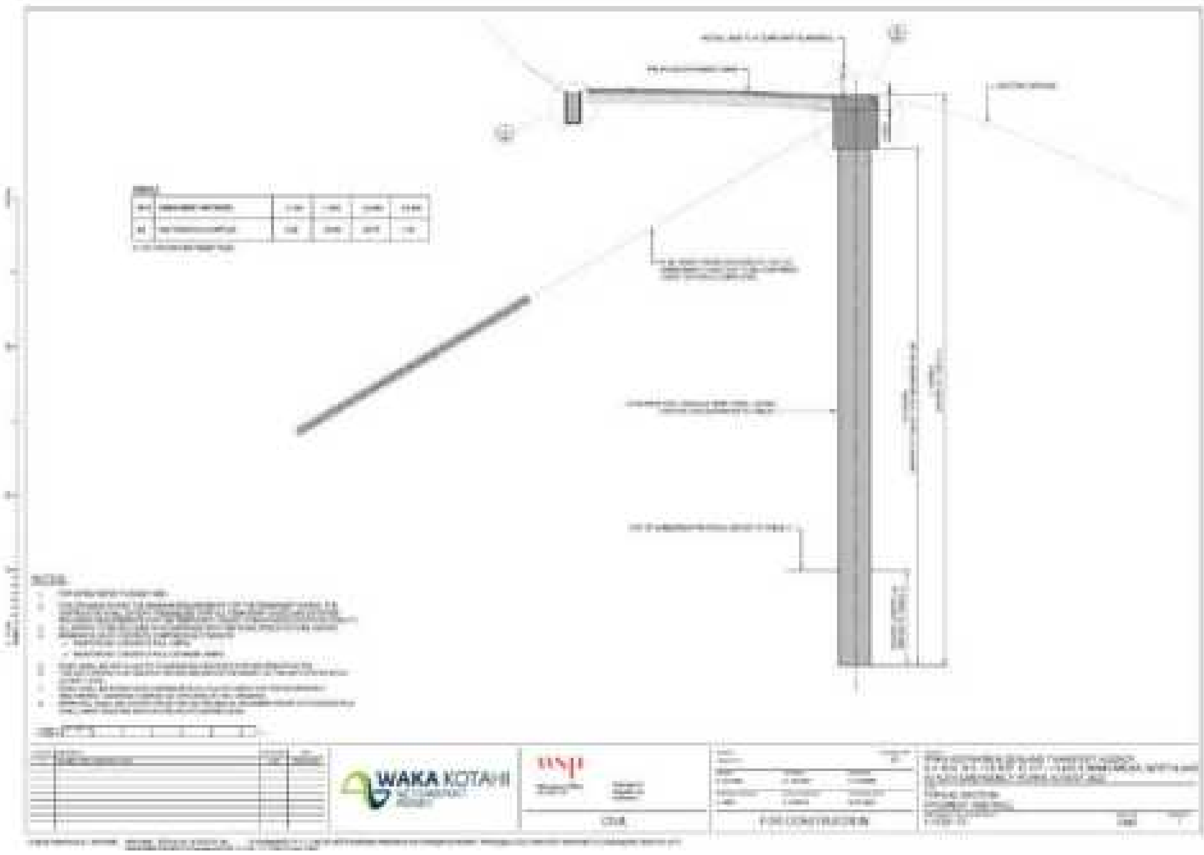


Figure 7: Typical cross section, concrete cap and pile retaining, channelling and pavement.

5.0 Background

5.1 Archaeological sites in the Project Area

There are no recorded archaeological sites in the project area through the Mangamuka gorge and over the range, but a number of sites are recorded in the central Mangamuka valley to the southeast of the gorge, and to the north west at Victoria Valley. A review of reports held by Heritage New Zealand and the New Zealand Archaeological Association suggests no archaeological surveys have been undertaken in the vicinity (Note: archaeological assessments which did not result in an archaeological Authority being sought may not be included in these repositories), and the sites have largely been recorded in an ad hoc fashion.

The nearest known prior formal archaeological assessments are to the west at Takahue (Gibb 2017, 2019), and in the Oruru valley/Peria to the north (Hensley 2003; Johnson, L., 1986, 1996, 2016. Large numbers of Maori archaeological sites including pa, pit and terrace complex, midden and horticultural sites are present in the Oruru Valley including more than 40 pa sites (Robinson pers. comm.), but most have yet to be formally recorded. A large number of similar sites are also present in the Takahue Valley, with a smaller cluster north of the Victoria River between Takahue Road and Te Rore Road, but far more are likely to be present given the importance of the valley to Maori for horticultural activities.

The nearest sites to the project area are 1-3km east of the mouth of the Mangamuka gorge, around the modern settlement of Mangamuka. O05/209 is taro, recorded by P. Matthews in 1985 as part of his survey of extant wild and cultivated taro in Northland (Matthews 1985). He records the variety at RR, actively grown by Mrs Harris on the north side of the highway, between the road and river. RR is an acronym for red petioles, rounded blades, and the varietal is one of the likely pre-European introductions of taro, and the most common type found in the survey, at 75%. This variety is the most important food crop, the most well-dispersed, and found in a range of contexts including in the wild, associated with archaeological sites, and being cultivated at the time of survey, as opposed to e.g. later taro introductions as pig feed in the historic period (Matthews 1985: 268-269).

O05/208 is also taro, recorded by P. Matthews. This taro was of the GR variety in a derelict garden, and was gardened by Violet Harris's mother on the flats below the Harris house, on the south side of the highway. GR is green petioles and rounded blades, made up 13% of Matthews samples, and was most common north of Auckland in non-derelict, non-cultivated gardens. O05/211 is another Matthews Taro site, of the RR variety and growing wild in an old apple orchard near the Abraham Road bridge. O05/210 is another Matthews Taro site, of the RR variety and growing wild in a 20m long clump in the valley below the road, 400m east of the Abraham-Iwitaua Road intersection.

The next nearest site is well to the south, where burials are recorded on the Mangamuka-Broadwood Road, between Mangataipa and Tutekehua. To the east, a number of timber industry sites are recorded in the Omahuta Forest. But the overall impression is one of few sites and/or little site recording having occurred in the area.

At Victoria Valley, three pa sites and four pit/terrace complexes are recorded approximately four kilometres west of where the State Highway leaves the Mangamuka ranges at Mangataiore and passes over the river flats. All the sites were recorded by R. Pollock in 1982 and haven't been re-visited by an archaeologist since that time. R. Pollock appears to have been employed by the Forest Service in this period, undertaking archaeological surveys in State Forests. There is no record of a report associated with this episode of site recording in the Heritage New Zealand digital catalogue or the New Zealand Archaeological Association Northland Site Record File report library. The Pollock sites may have been recorded as part of an ad-hoc survey of a proposed afforestation project or similar at the request of the local Forest Service office. The sites comprise five small to medium sized pit and terrace complexes on the spurs running south towards the river (O04/567, 568, 596, 571, 572) from the main Panther Hill and subsidiary ridges; one large pa site named Pahoro (O04/570), immediately adjacent to the river on the west bank; and a small pa on Panther Hill itself, O04/573 (Carpenter 2019).

As the highway travels west the sites increase in density with large numbers of pa, pits and terraces recorded either side of the highway and the Victoria and Takahue Rivers, and the upper Awanui.

The lack of recorded archaeological sites in the Mangamuka-Victoria Valley area is likely due to a number of factors. A lack of large scale subdivision and development activity in the area since the 2004 RMA amendments has meant that archaeological and historic heritage assessment have not been undertaken in the area, and the lack of previously recorded sites/ad-hoc recording e.g. of prominent sites visible from public areas has meant that what small scale subdivision and development has occurred has not triggered heritage assessments as there are no sites which might act as red flags in the course of consenting.

The lack of sites is belied by the descriptions of the dense 19th century Maori occupation of the valleys by observers, as discussed in Section 5.3 below, and a pre-European contact traditional history stretching back to the time of Kupe.

5.2 Other Heritage Sites and Features

There several scheduled Historic Heritage Items or Areas, or Sites or Areas of Significance to Maori in the project area and its immediate vicinity, in the Far North District Plan. At Mangamuka, the Ratana Church is scheduled Historic Site, Building or Object #178 and is 200m from the highway. There are also several scheduled Sites of Cultural Significance to Maori including MS08-34 the Kupe memorial, and MS08-29 a wahi tapu, both of which are immediately adjacent to the highway.

In the Mangamuka Gorge immediately adjacent to the highway is MS08-27 the Tapapa wahi tapu. This reserve is adjacent to the meeting place of the Tapapa and Patuturi Rivers. Tapapa refers to a story about a man hiding by lying face down on a rock by the river here. Near here is the place known as Hoanga, after the meeting of two friends (the rivers) Te hono o te awa o Patuturi kia Tapapa (Mangamuka School Centenary Committee, 1983: 45-46).

At Mangataiore on the northwest side of the range there are Scheduled three wahi tapu, MS05-60 Taunoke, MS05-59 Mangataiore, and MS05-28 Kotipu Marae. The latter two are immediately adjacent to the highway, the first is 300 from the road.

There is a scheduled Notable Tree in the Far North District Plan, Tree #4 a puriri at the Victoria Valley school site. There is one Listed Historic Places, Historic Areas or Wahi Tapu or Wahi Tapu Areas on the Heritage New Zealand Pouhere Taonga List in the vicinity. The Ratana Church at Mangamuka is Listed Historic Place #3884.

Figure 8: Archaeological sites in the vicinity of the project area, Takahue to Mangamuka (ArchSite; project area in blue, 1 of 6).

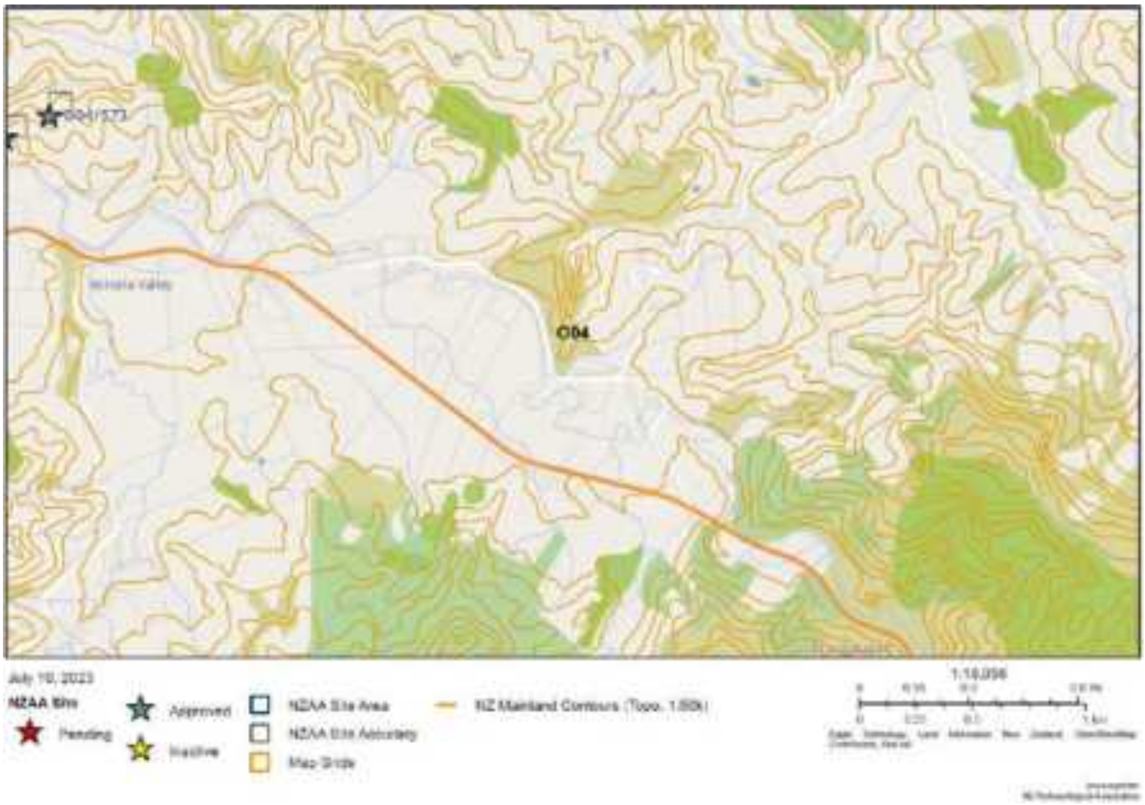


Figure 9: Archaeological sites in the vicinity of the project area, Takahue to Mangamuka (ArchSite; project area in blue, 2 of 6).

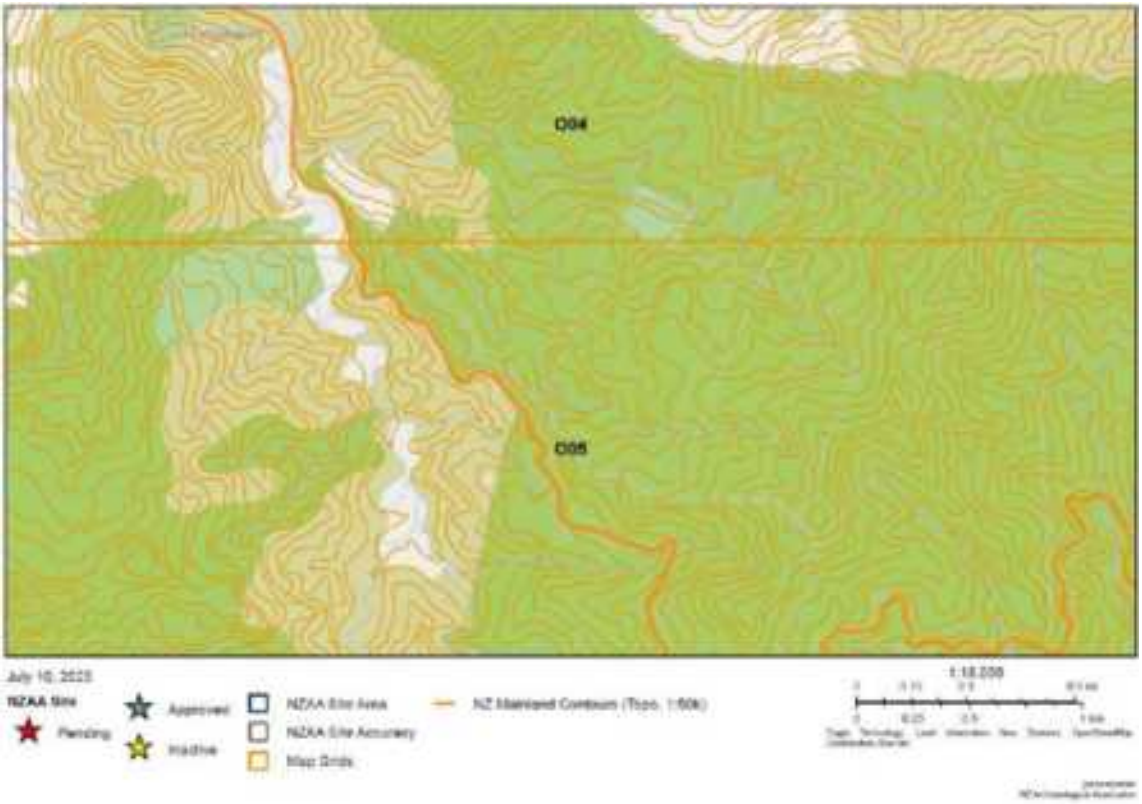


Figure 10: Archaeological sites in the vicinity of the project area, Takahue to Mangamuka (ArchSite; project area in blue, 3 of 6).

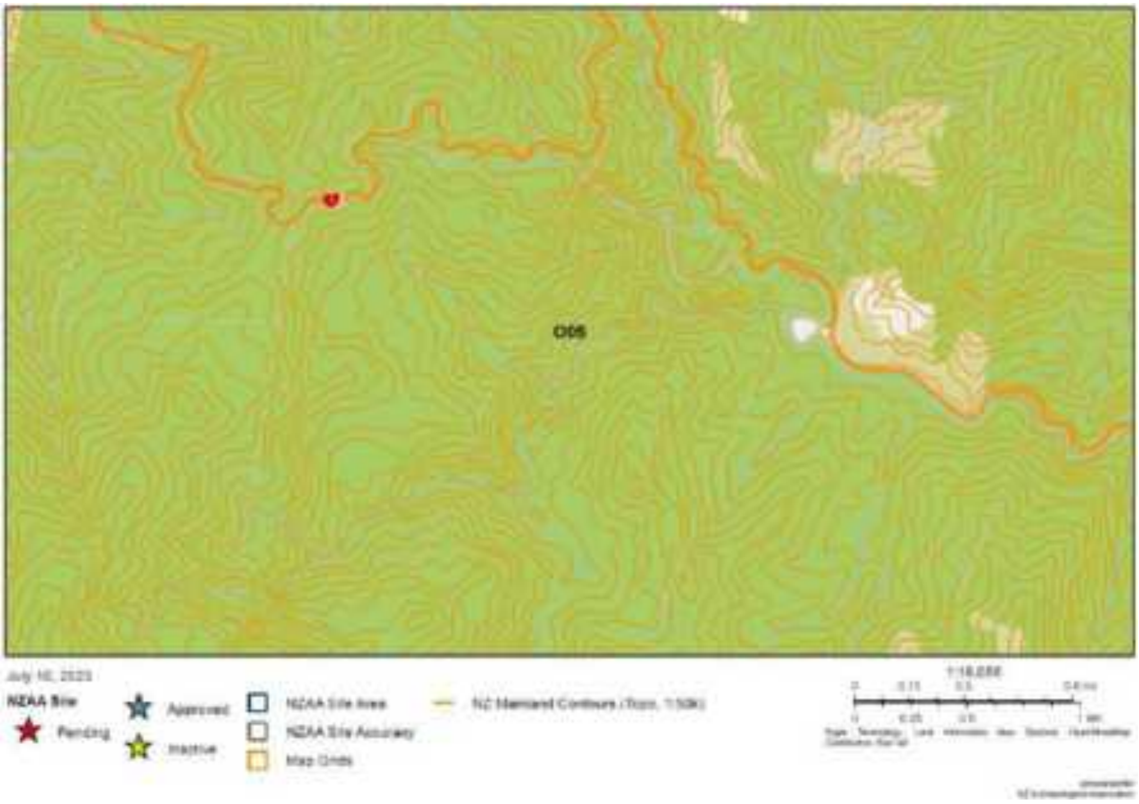


Figure 11: Archaeological sites in the vicinity of the project area, Takahue to Mangamuka (ArchSite; project area in blue, 4 of 6).

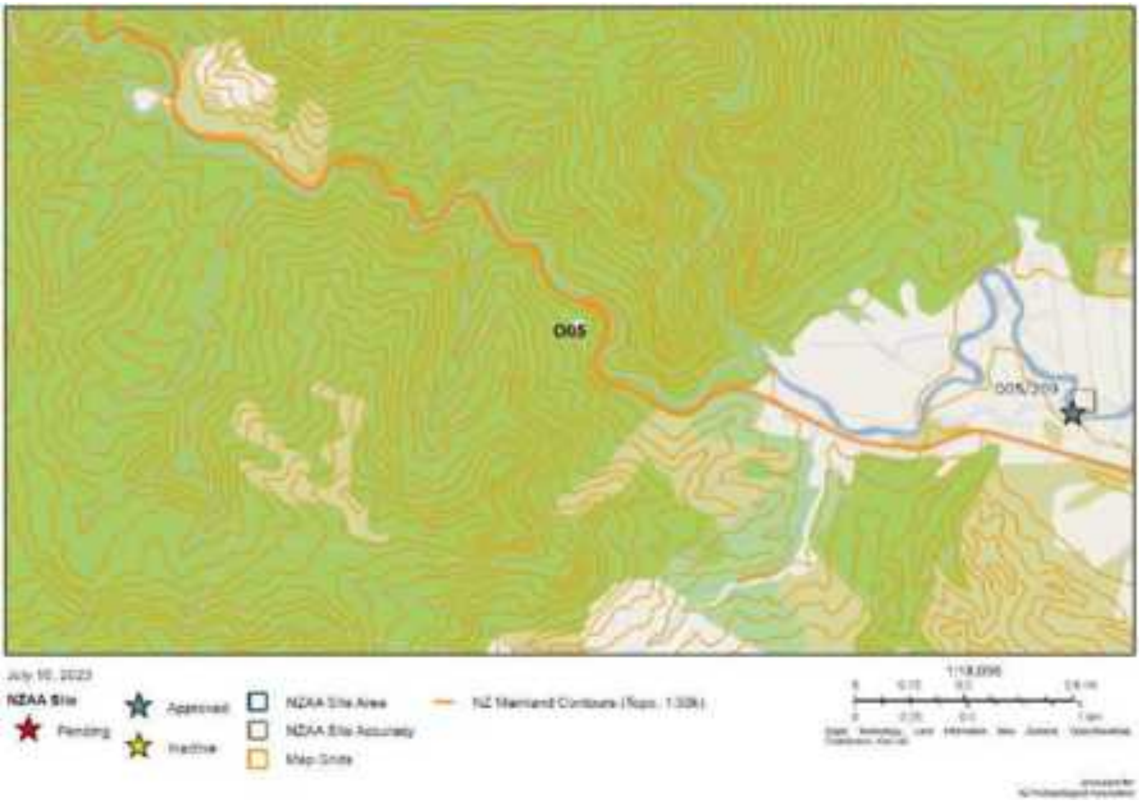


Figure 12: Archaeological sites in the vicinity of the project area, Takahue to Mangamuka (ArchSite; project area in blue, 5 of 6).

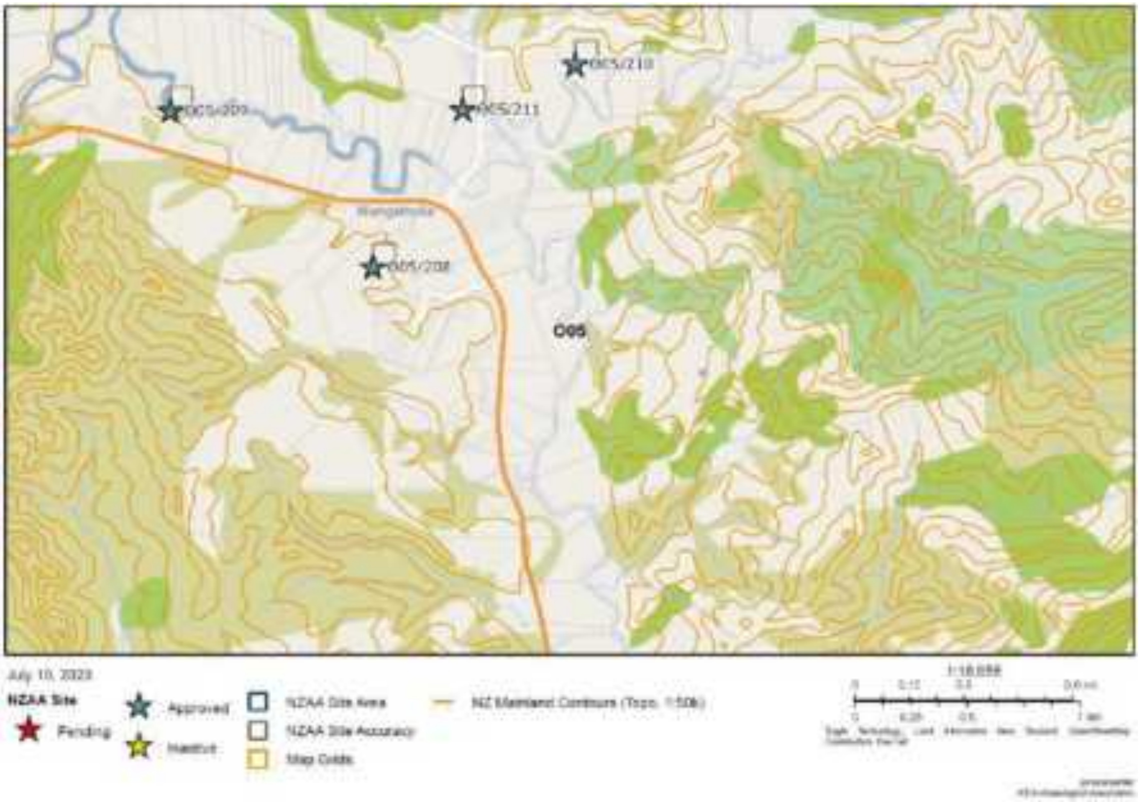


Figure 13: Archaeological sites in the vicinity of the project area, Takahue to Mangamuka (ArchSite; project area in blue, 6 of 6).

Figure 14: Map sheet key.

Figure 15: Map sheet 1 – archaeological sites.

Figure 16: Map sheet 2 – archaeological sites.

Figure 17: Map sheet 3 – archaeological sites.

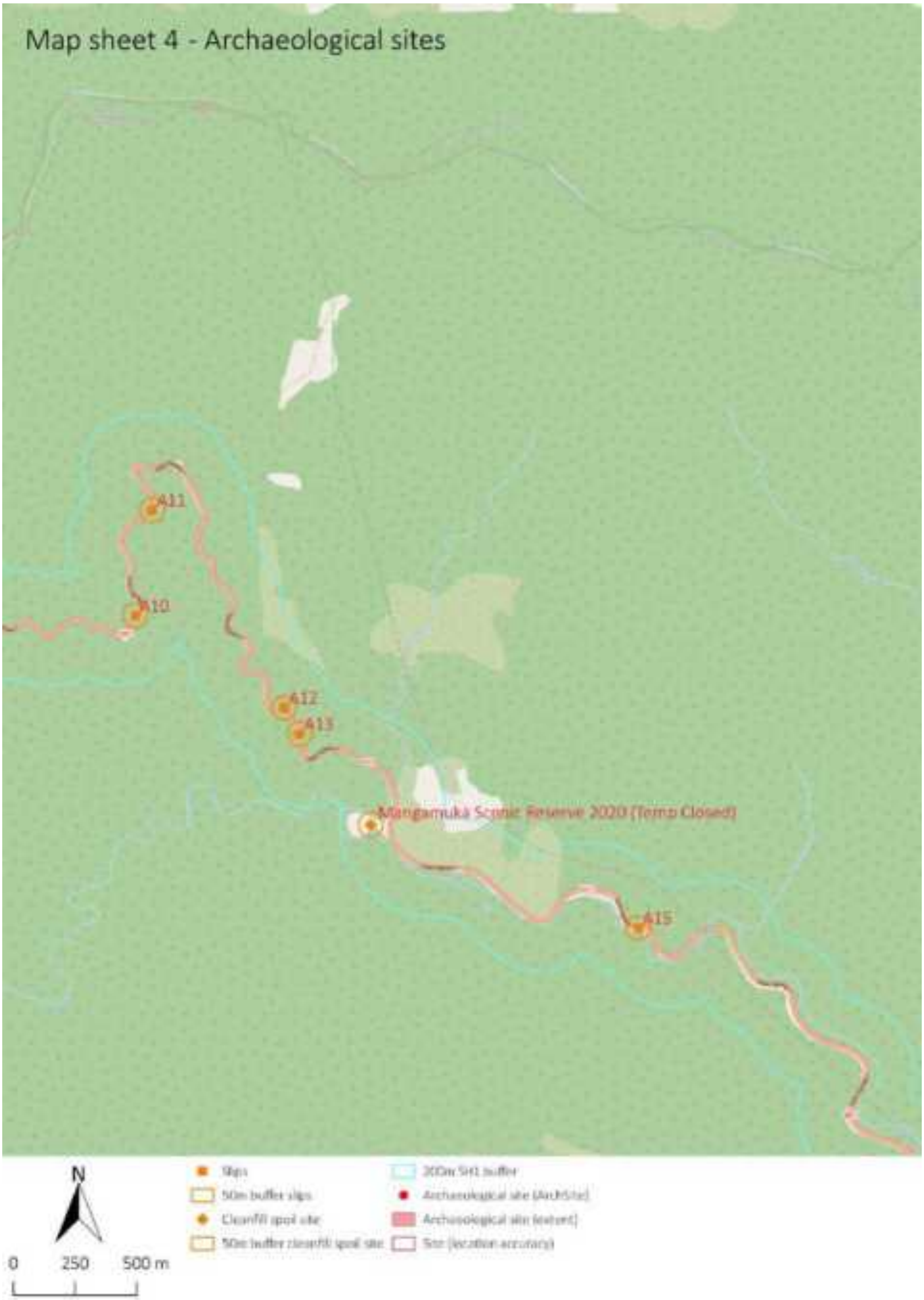


Figure 18: Map sheet 4 – archaeological sites.

Figure 19: Map sheet 5 – archaeological sites.

Figure 20: Map sheet 6 – archaeological sites.

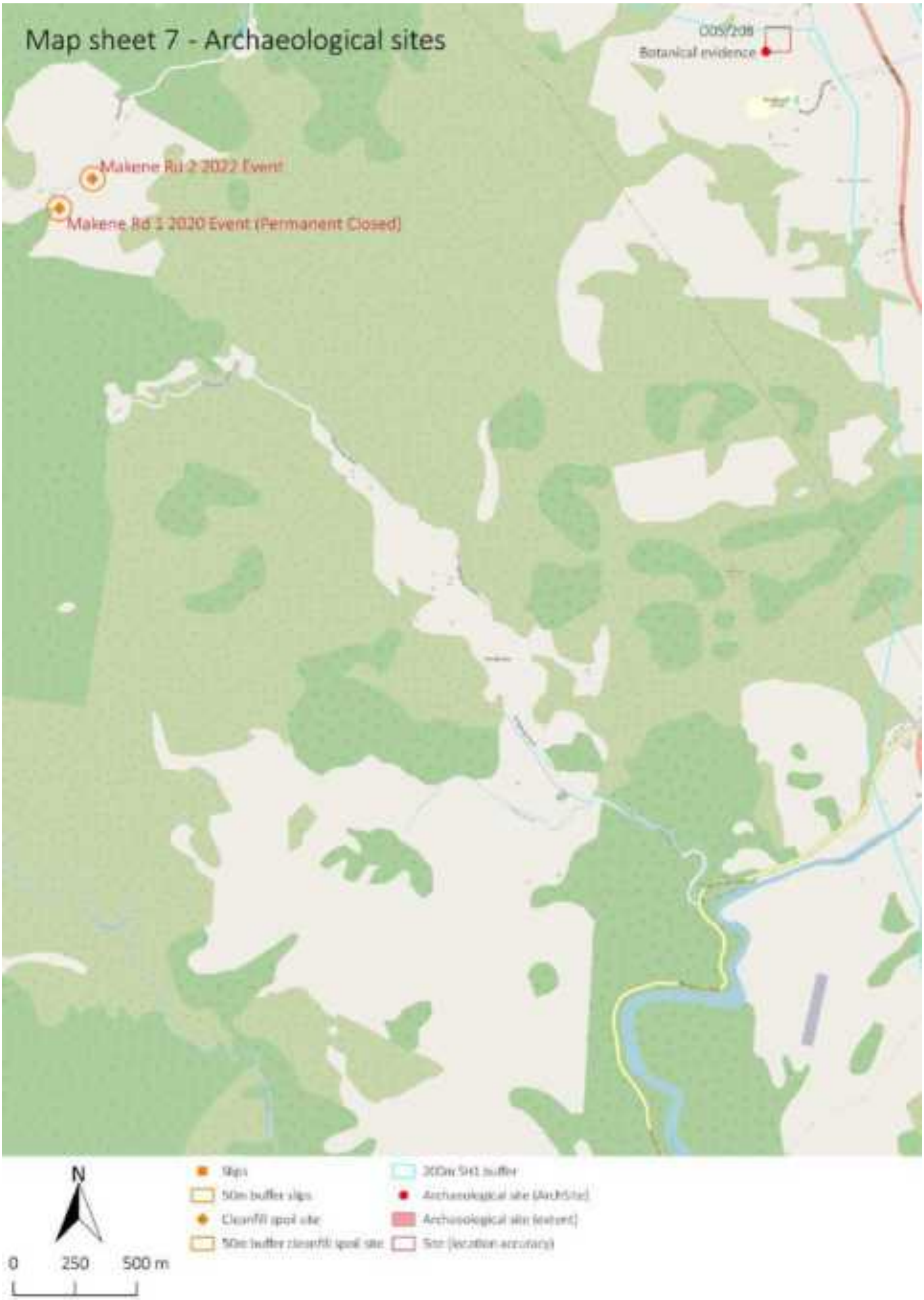


Figure 21: Map sheet 7 – archaeological sites.

Figure 22: Map sheet 8 – archaeological sites.

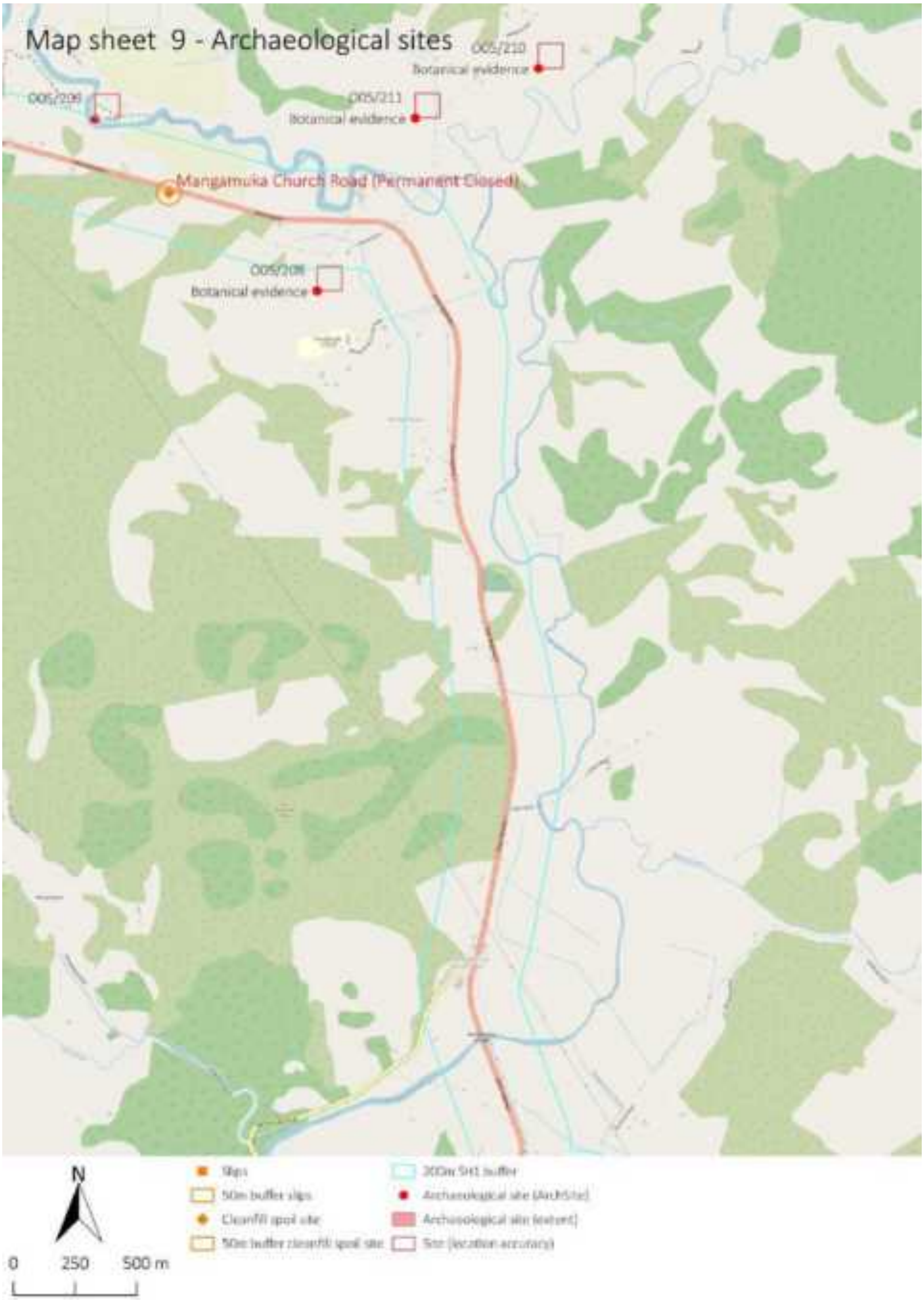


Figure 23: Map sheet 9 – archaeological sites.

5.3 Historic Background

Maori Traditional History

The Mangamuka valley is named for the muka flax, which once grew abundantly along the river banks there. The navigator Kupe visited the area, naming it Hokianga-nui-a-Kupe. His grandson Nukutawhiti, and Nukutawhiti's brother in law Ruanui returned to Hokianga and settled there with those who remained when Kupe returned to Hawaiiki. A number of subsequent waka arrived in the area, along with movements of people through the Hokianga from elsewhere in the motu. Most consequential for Te Rarawa was the arrival of the Tīnana waka captained by Tūmoana, at Tauroa west of Ahipara. His descendants included Houpure the ancestor of Te Rarawa, and his brother Houmeaiti who would settle at Hokianga. They would come into conflict with Ngāti Miru and Ngāti Awa to the north, ultimately dividing the area amongst themselves.

By the 18th century, Te Rarawa would hold the land from Ahipara up to Hukatere and over to Kaitaia through to Takahue, Maungataniwha and Mangamuka to the Hokianga and the west coast and the smaller harbours between Hokianga and Ahipara. To the north were Ngati Kuri and Te Aupouri, Ngai Takoto to the northeast and Ngati Kahu and Ngati Kahi ki Whangaroa to the east, and Ngati Pou to the southeast and Nga Puhi beyond.

At the end of the 18th century and into the early 19th century, the iwi and hapu of Hokianga, Muriwhenua, Whangaroa, Ipiripi and were in regular conflict with the interrelated tribes of Ngati Whatua, Te Roroa and Te Uri O Hau. Hongi Hika was shot and wounded at Mangamuka during a skirmish with Ngati-Pou and Te Roroa elements on the south bank of the Operehu River in early 1827, at a battle known as Hunuhunua, after driving Ngati-Pou from Whangaroa. Many dead from the battle lay on the other side of the Tapapa River for a time.

European accounts of Mangamuka in the mid-19th century

European accounts from the 1830s and 1840s, made by explorers and missionaries give the impression of a thriving Maori community of multiple undefended kainga on the Mangamuka River flats, with large and abundant plantations of traditional and introduced cultigens, separated by pockets of remnant forest on the lowlands. The occasional threat of violence still necessitated the establishment from time to time of ad hoc defences, but there are no descriptions of major pa being occupied or defended by this time. A large number of Europeans, mostly involved in the kauri spar trade lived along the river banks on the lower reaches, while the kainga were on the productive river flats of the Mangamuka valley. There were two major named kainga at the time, Mangataipa where the river turned to the east to enter the mouth of the Mangamuka valley and became shallow and winding, and Rotopipiwai just north of the modern Mangamuka bridge. Other smaller kainga were located further up the valley.

Transport was via the main river up to where it became shallow and winding, and thereafter by a mix of shallow-bottomed waka towai or river canoes and forest tracks. At the north end of the valley, foot tracks provided access over the Maungataniwha-Mangamuka ranges to the Oruru Valley, and the Victoria Valley and CMS Mission in Kaitaia. The area was well-travelled by both European and Maori in the earlier decades, with Missionaries from the Wesleyan Mission at Mangungu on the Hokianga preaching in Mangamuka every fortnight. Working with the tides and an early start allowed a visit from Mangungu to Mangamuka to be accomplished in a day, but Maori families travelling to Sunday service at Mangunu would often make the trip a three-day affair.

A map of the Hokianga, published by the British Parliament's Select Committee on the Present State of the Islands of New Zealand (British Parliamentary Papers 1838: 234) shows three chapels established on the upper Mangamuka River by the Wesleyan Mission, according to the accompanying key at Mangataipa, Rotopipiwai and Hunuahunua.

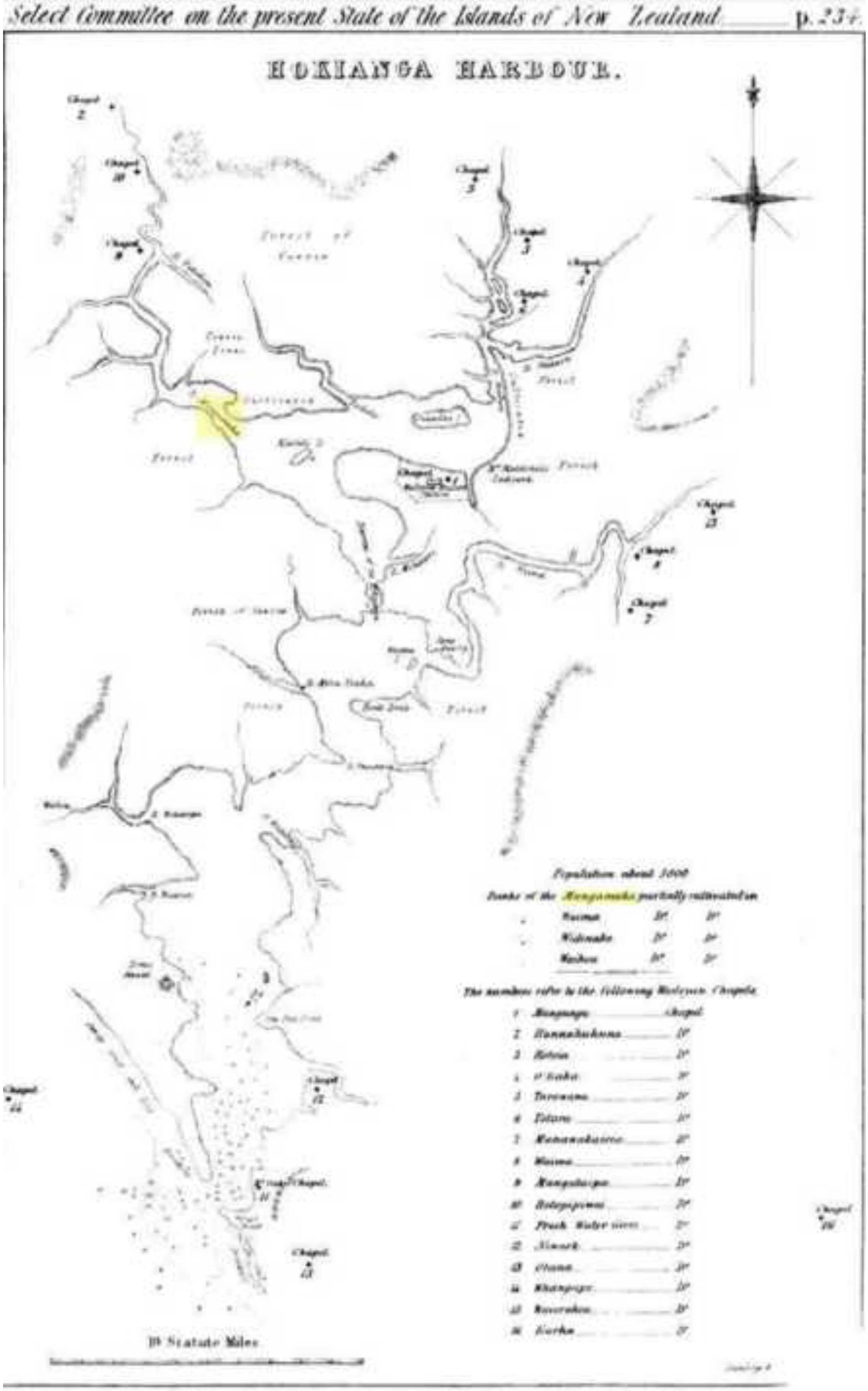

Select Committee on the present State of the Islands of New Zealand p. 234
HOKIANGA HARBOUR.
Population about 3000
Banks of the Mangamuka partially cultivated on
The numbers refer to the following Wesleyan Chapels
10 Statute Miles

Figure 24: Map of Hokianga, with chapels at Mangataipa, Rotopopiwai and Hunuhunua on the Mangamuka River.

In February 1834, a European settler named Oakes visited Mangamuka with William White (Wakefield 1937: 260-261), the Wesleyan Missioner at Mangungu from 1830 to 1836. He talks about "the village of Mangamuka", possibly Rotopipiwai being three miles walk above the navigable part of the river and the valley itself containing the finest cultivation he had seen in New Zealand, in patches cleared from the "thickest forest imaginable". At the time, White was erecting one of the three chapels noted above, and his congregation had prayer books and bibles in Maori to learn and sing from and most could read and write well. Unfortunately couched in the unaffectedly racist language of the day, Oakes noted the Maori of Mangamuka were the most industrious and hospitable tribe he had met, which he put down to White's fine character.

Writing in March 1834, Edward Markham reported 11 sawyers, and 20 Europeans overall, living on the Mangamuka River. He reports that Maori settlement grew denser the further he travelled up the river and by that time were all professing Christians. The sawyer's houses are described as being of weatherboard and lined (presumably as opposed to whare of nikau or similar), some of them very nice, and with their saw pits roofed.

Near the head of the river, as far as boats could go, he stayed in kainga, and the next day travelled seven miles to go to a tangi, all the way travelling through cultivations and crossing a stream multiple times. Cultivations included maize, potatoes, kumara and taro but it appeared that the land had only been recently cleared, as large freshly burned stumps were present throughout the cultivated areas. Peaches were also in abundance, with peach trees around the kainga which was in a large, flat valley with the shallow gravel-bottomed stream winding through it. Potatoes were stored in 60lb kete on whata, raised platforms 20-30 feet high. He saw one whata 80 feet high, situated in a tree with all the branches removed but it is not clear if this was in Mangamuka or somewhere else.

The Rev. James Buller, serving at the Mangungu mission station had cause to travel to Mangamuka in 1837, after two Maori missionaries were murdered and the event risked spiralling into a wider utu-driven confrontation. Four young Christian chiefs had gone to a small village several miles from Rotopipiwai to evangelise at the settlement of a Chief, Kaitoke, who was an adherent of Papahurihia/Te Atua Wera, a notable Maori prophet of the period. Having been told by Kaitoke that any attempt to proselytize again would be met with violence, the four young men Wiremu Patene, Matiu, Rihimona, and Hohepa Otane were fired upon as they approached Kaitoke's holding; Matiu lived long enough to wish that no further violence would be done in his name, and Rihimona, shot in the gut, survived for several days. Patene stayed with the casualties while Otane raised the alarm.

Buller, Turner and Whitely went up the river by boat as far as Mangataipa, then took a canoe onwards to Rotopipiwai. Hone Wetere had retrieved Matiu and Rihimona and they were in a whare on the other side of a potato field from where the Missionary party landed. They arrived in the dark, and were eating a meal of potatoes at 11pm when a party of Ihutai, related to the deceased, arrived at the kainga. The Missionaries counselled the aggrieved party to send for the British Resident Busby who could arrange a conference between the parties.

The next morning, the Missionary party arose at 5am and travelled some way up "…this beautiful valley, rich in crops of maize, potatoes, kumaras, etc., and the little huts nestled snugly under the spreading branches of the peach trees, or the karaka groves". At 10am, a ruckus ensued as the great Hokianga chiefs (Tamati Waka) Nene, Mohi (Tawhai) and Taonui (Makoare) arrived and a mock battle was fought. Argument ensued as to what steps to take, Rihimona was commended to God by Turner, and as relative peace returned, pigs and potatoes were put in the ovens. But at that point, some of the younger men stole away up the forest track in the direction of Kaitoke's kainga.

A general rush ensued as the party of approximately 500 warriors, followed by the Missionaries, charged down on Kaitoke's kainga, where a new entrenchment had been quickly thrown up. The defenders fired first, killing another Christian chief, Himeona, and wounding another. Then, everyone began firing. In the ensuing rush, ten were killed, the rest captured including Kaitoke who was wounded; he was removed to Otararau where he was tended to by the Missionaries. For some time, the whole area was unsettled, war canoes travelled the water ways, new pa were built and no one was sure whether the violence would turn into a full scale conflict, and settlers were raided

In 1839 the Rev John Bumby visited Mangamuka. The first leg of the trip involved a hard row of four hours from Mangunun to the end of the navigable portion, followed by a walk through beautiful plantations of potatoes and kumara to the Christian kainga of Rotopipiwai. Leaving the kainga the next day he reports having to cross the same river 20 times, while it was in flood, and climb immense mountains and that the day's journey was disagreeable. In the afternoon they arrived at the next kainga and stayed in a six foot long whare four feet high, with a central fire. He notes the richness of the valley, but also a number of abandoned kainga and ruined pa nearby, noting that the population must have once been more numerous. He goes on to note that about noon his party arrived at the chapel, a commodious and substantial Maori building, in the midst of the valley. While he makes no mention of the events to years previous, it seems likely the abandoned kainga were the result of the unsettled period after the events on 1837.

William Wade, writing in 1842 recorded travelling up the Mangamuka with Mrs Woon. They left at 9am in a large boat and he noted the thickly wooded banks and cottages of European settlers, mostly sawyers, living on the river banks. They visited one of the settlers, and then came to a 'retired' pa, Mangataipa on the bend of the river. At that point, the stream became narrow and more winding, through a forest growing down to the waters edge. Higher up the stream became impassable for European boats, but local shallow draughted waka tiwai could manage to travel further around the fallen trees and shallow stream bottom. Eventually they landed on the west bank and after a short walk through the forest arrived at Rotopipiwai, described as being 15 miles up the river and "delightfully situated in a fertile valley". There was no pa, the village consisting of scattered whare surrounded by fences, with a large Maori chapel. Wade records that Mr Woon had said that there were different villages further up the valley, some considerably further up than Rotopipiwai, and that villagers often travelled down on Saturdays for Sunday services at Mangununu, then back up on Monday.

By the late 1860s, the Mangamuka River and Valley had fallen on hard times. A combination of the remove of the capital to Auckland in 1840, the Northern War of 1845-1846, and the winding down of the Hokianga spar trade saw the European sawyers depart. As that part of the Hokianga emptied of Europeans, so did the market for the cash crop horticulture in the Mangamuka valley by the Maori inhabitants, many of whom appear to have moved elsewhere.

Mangamuka in the Late 19th Century

The Rev. James Buller returned to the Hokianga where he had once worked at the Mission at Mangunu. At six in the morning he travelled up the Mangamuka with the tide. By 1869 the sawyers houses on the river were gone, only marked by a wilding plot of grass or European trees. A few Maori were still living at Mangataipa where they were squaring logs. They left their boat there where the stream became shallow and borrowed some horses to proceed up the valley. They went to Rotopipiwai where the old chapel was in ruins but a number of cows grazed behind a post and rail fence. The old Christian chief Te Otane still dwelt at the foot of Maungataniwha. Buller was back at Mangungu by five in the afternoon.

The death of chief Te Otene Pura/Otane would go on to be reported in the 1874 Report from Officers in the Native Districts (AJHR 1874, Session 1 G-02: 2). Von Sturmer reported that the old chief, who had fought for the Crown in the Northern War against Kawiti and Heke had received a government pension in return for his services, and died at about 90 years old.

Wiremu Patene, Otene's old friend had died a dozen years earlier. The Maori Messenger/Te Karere Maori reported his death in its edition of 16 December 1862. Te Otene said of his friend that he was esteemed by both Ngapuhi and Te Rarawa because he was good and would do no evil. He had taken in ill in 1860 but had managed to return to the north in June 1862 and attend the Mangonui Rununga in July. He had visited his relatives in Oruru and then returned to Mangamuka where he passed several months later.

Reports to the House of Representatives in the 1870s concerning the Maori population, education matters, as well as general reports by government officers provide snapshots of life in the area. In the 1872 Papers Relating to Native Schools (AJHR 1872, Session 1 F-05: 14), Maori in Mangamuka were asking the government for a native school for the valley but were going to wait to see how the new school at Waitapu near the Hokianga Heads progressed before they made a final decision.

In the 1874 census of Maori population, Hokianga Resident Magistrate Von Sturmer reported that 235 Maori were living at Mangamuka and identifying as Te Ihutai, 126 males and 109 females. There were 165 people identifying as Te Urekopura, 102 males and 63 females, and three Ngati Toa (AJHR 1874, Session 1 G-07). These numbers would make the Mangamuka area the most highly populated Maori community in the Hokianga, with Waima coming second.

In 1878 Von Sturmer reported 140 Maori living at Mangamuka, 79 males and 61 females. He also recorded that they identified as Te Urimahoe. He noted that while 30 people had returned to the locality from the east coast that year, all over the Hokianga a large number of young Maori families had left to work in the kauri industry at Whangaroa and Kaipara because of the money they could make. He also reported two epidemics, measles and whooping cough, had greatly affected the local Maori population and caused numerous deaths in infants and "delicate youth". Overall there had been an 8% drop in the Maori population in the Hokianga since 1874 (AJHR 1874, Session 1 G-07: 12).

The 1879 Report from Officers (AJHR 1879, Session 1 G-01A: 2, 12-17) noted that at Mangamuka, Maori were successfully growing tobacco in large patches and that their crop was supplanting imported tobacco. The 1882 Education: Native Schools report (AJHR 1883, Session 1 E-02: 3) stated that a new school had been opened at Mangamuka in March and that "…it will certainly be a good one. The master did good work at Rakau Para for many years under disadvantageous circumstances; with a neat and comfortable schoolhouse and residence, and a large and regular attendance, he will probably do even better."

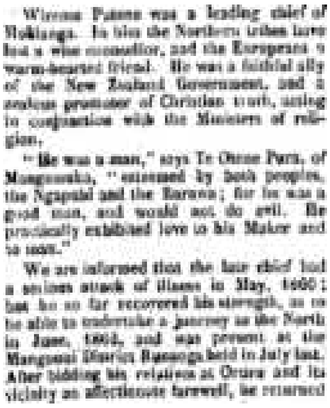
The Master was J. Harrison, the Sewing Mistress was his wife, and in the course of the first year 60 children enrolled with 45 still attending at the end of the year. Of the 45 children at the end of the year, 23 were boys and 22 were girls, 33 were Maori, five European and the balance of mixed race. The school cost £602 to build, with staff salaries totalling £161 and expenses of £20.

The 1884 Education reports notes 38 children in attendance during the inspection and the roll consisted largely of experienced students from Rakau Para and new students from Mangamuka, with few students of middle years. Overall the performance was satisfactory (AJHR 1884, Session 1 E-02: 5). The Officers report of the same year noted that grape growing had taken off in the valley since some German winemakers had arrived, and one Maori resident had sold a ton of grapes for two pennies a pound.

In 1892 three notable men lived in Mangamuka, Tamiora, the former Member of the House of Representatives Hori Karaka, and the Wesleyan Missionary Pirpipi Rakena who had served in the South

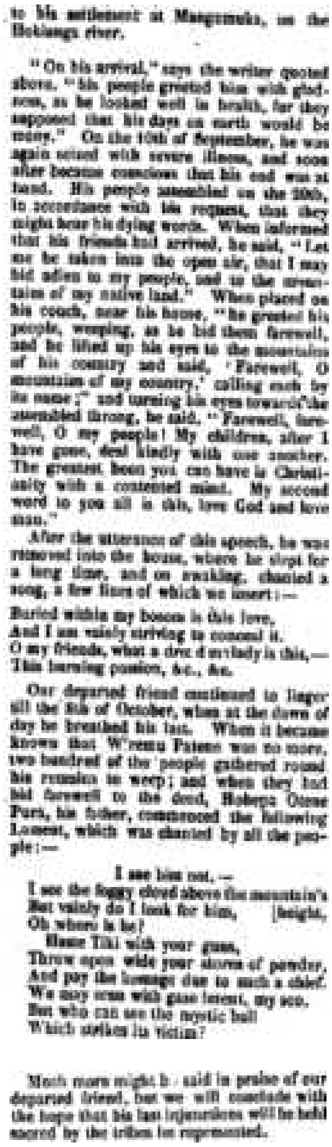
Island. They were living in a settlement known as Otene, below Maungataniwha (New Zealand Herlad, 12 March 1892).

In the 1893, the chiefs of Mangamuka gathered together and promoted a temperance policy in opposition to the formal granting of a liquor licence to the Mangamuka Hotel. Karaka Tawiti, Mitikakau Otene, To Tawio Pou, To Rakena Pou, Moka Kaio, Tipeno Apatari, Puhi Otene, Karena Kiwa, Hone Pororua, Pakia Tika, Eru Mate, and Makoro Kere joined to promote a policy of fining anyone caught walking tipsily on the road, or caught drinking or smelling of liquor £1 for the offence. The ban on alcohol sale and consumption was to last a year and a petition signed by 62 locals was sent to Parliament in aid of obtaining support, and Pirpipi Rakena stated that all the local Maori were supportive, and bemoaned their European friends in the Hokianga supporting the sale of alcohol (New Zealand Herald and Daily Southern Cross, 29 August 1893).


Wiremu Patene was a leading chief of Hokianga. In him the Northern tribes have lost a wise counsellor, and the Europeans a warm-hearted friend. He was a faithful ally of the New Zealand Government, and a zealous promoter of Christian truth, acting in conjunction with the Ministers of religion.

"He was a man," says Te Otene Pura, of Mangamuka, "esteemed by both peoples, the Ngapuhi and the Rarawa; for he was a good man, and would not do evil. He practically exhibited love to his Maker and to man."

We are informed that the late chief had a serious attack of illness in May, 1860; but he so far recovered his strength, as to be able to undertake a journey to the North in June, [illegible], and was present at the Mangonui District Runanga held in July last. After bidding his relatives at Oruru and its vicinity an affectionate farewell, he returned



to his settlement at Mangamuka, on the Hokianga river.

"On his arrival," says the writer quoted above, "his people greeted him with gladness, as he looked well in health, for they supposed that his days on earth would be many." On the 10th of September, he was again seized with severe illness, and soon after became conscious that his end was at hand. His people assembled on the 20th, in accordance with his request, that they might hear his dying words. When informed that his friends had arrived, he said, "Let me be taken into the open air, that I may bid adieu to my people, and to the mountains of my native land." When placed on his couch, near his house, "he greeted his people, weeping, as he bid them farewell, and he lifted up his eyes to the mountains of his country and said, 'Farewell, O mountains of my country,' calling each by its name;" and turning his eyes towards the assembled throng, he said, "Farewell, farewell, O my people! My children, after I have gone, deal kindly with one another. The greatest boon you can have is Christianity with a contented mind. My second word to you all is this, love God and love man."

After the utterance of this speech, he was removed into the house, where he slept for a long time, and on awaking, chanted a song, a few lines of which we insert:—

Buried within my bosom is this love,
And I am vainly striving to conceal it.
O my friends, what a dire malady is this,—
This burning passion, &c., &c.

Our departed friend continued to linger till the 8th of October, when at the dawn of day he breathed his last. When it became known that Wiremu Patene was no more, two hundred of the people gathered round his remains to weep; and when they had bid farewell to the dead, Hohepa Otene Pura, his father, commenced the following Lament, which was chanted by all the people:—

I see him not,—
I see the foggy cloud above the mountain's [height,
But vainly do I look for him,
Oh where is he?
Hone Tiki with your guns,
Throw open wide your stores of powder,
And pay the homage due to such a chief.
We may roar with guns intent, my son,
But who can see the mystic ball
Which strikes its victim?

Much more might be said in praise of our departed friend, but we will conclude with the hope that his last injunctions will be held sacred by the tribes he represented.

Figure 25: Obituary of Wiremu Patene.

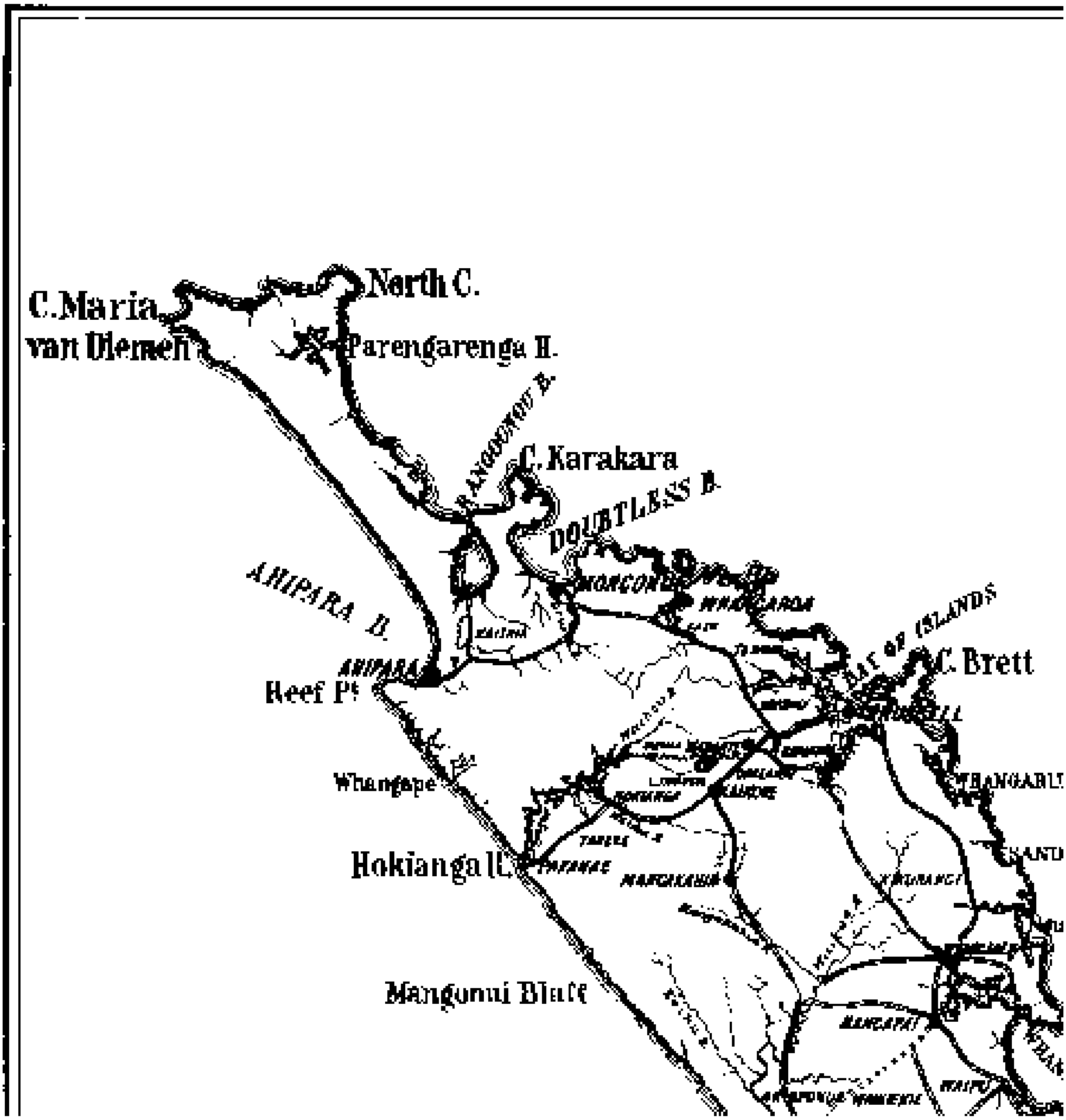


Figure 26: Detail from sketch map of roads and rail in the North Island form the Public Works Department (Appendix to the Journal of House of Representatives, 1875 Session 1 Appendix E-03).

Takahue and Victoria Valley

There are few European accounts describing Takaue/Victoria Valley in the early to mid-19th century. Ernst Dieffenbach provides a broad description of the area formed as he travelled through in 1840, moving down the Awanui River (which he called the Awaroa) and describing the broad valley land south and east of Kaitaia and the steep range of Maungataniwha. Above Kaitaia, the river was only passable by canoe and Maori brought down food from their plantations to Kaitaia which by then was the principal settlement (thanks to the CMS Mission being located there). The plantations in the valley are described as “extensive, and kept in good order” and Dieffenbach describes seeing several acres of wheat reaped and ploughed, and the exchange of decayed maize (i.e. pirau corn) and potatoes, for bread. Several Maori encountered by Dieffenbach owned cattle and horses. He noted that the Maori at Kaitaia had moved over from the Hokianga about 25 years previous, taking the area from Te Aupouri and Ngati Kuri, and noting the number of pa on the hills, suggested the former population was very numerous.

He notes that "for a very small payment", local Maori have cut a bridle road 32 miles long from the CMS Mission at Kaitaia, to the Mission at Waimate. Fifty Maori cut the road in six weeks and were paid in blankets, and Dieffenbach includes a waiata sung by those about the poor working conditions.

> "Ka ngaro te purapura,
>
> Te pata kai:
>
> Etiki ka mate: ko Taewa ka mate:
>
> Ko te Paki ka mate:
>
> Ko te Matiu ka mate:
>
> Ka ka po nei te manawa:
>
> Ka tahuri au ki te reinga:
>
> He poro kaki ka mate.
>
> The tobacco is gone: we have no food cooked in a pot: Etiki is hungry: Taewa is sick: Te Matiu is sick: Te Paki is hungry: all our good cheer is exhausted: we turn back towards the Reinga: we are sick for some food."

Dieffenbach records the bridle track ascending nearly to the summit of Maungataniwha, then proceeds in a different direction. From the top of Maungatanwha, the bridle track turns westwards and drops steeply into the Mangamuka valley. He says the upper part of the valley is flat and fertile alluvial land five or six miles broad and eight miles long, with the river flowing 20 miles to the Hokianga. The valley was then bounded by wooden hills and the river ran over a bed of whinstone pebbles and appears to flood frequently. He notes the hills on the lower river are covered with kauri trees but the best of them near the waters edge had already been felled.

Through the 1850s, the Crown and settler interests became increasingly enamoured with the Victoria Valley and its agricultural potential, and references to the area start to increase in various publications. Henry Tacey Kemp recorded that Panakareao would not sell the land, figuring it would be needed by Maori once all the surplus land they saw no need for had been sold to Europeans.

Kemp described the Victoria Valley in 1858, in the course of Crown attempts to purchase it from Panakareao. He noted that Maori referred to the area as Takahue, situated on the northern side of the "Rua Taniwah range". He described the valley as well-watered and covered in excellent timber, with rich alluvial soil, and suggested it was about 20,000 acres in size. He noted a large proportion of the valley had been under cultivation but at the present there were only a few scattered plantations. Panakareao was described as the principal owner and when Kemp asked to visit, told him it had never been offered for sale and would probably need to be retained by Moari. Kemp suggested he then inferred a large price would be asked if the Crown persisted with its purchase.

Surveyor Charles Heaphy noted that "The Victoria Valley contains some fine land well wooded: it is at present in the possession of the natives, but they evince a disposition to sell, if such sale shall secure to them the immediate residence of Europeans, or the location of a settlement in their vicinity (Heaphy 1860: 76).

"The immigrants from Prince Edward's Island are also about to locate themselves at Mongonui. There is already a large extent of land in that neighbourhood at the disposal of the Government. The Natives--- who anxiously desire to have settlers near them--have promised to sell the celebrated "Victoria Valley;" and thus, if a good harbour, good land, capital, labour, and a ready market, can make a settlement prosperous, the future of Mongonui is secure." (Ridgeway and Sons, 1860: 42).

Crown Purchases and Native Reserves

As noted above, local Maori, and in particular Te Patu hapu of Te Rarawa rangatire Nopera Panakareao were loathe to sell the Takahue/Victoria Valley lands to Europeans. The Muriwhenua Report (Waitangi Tribunal 1997: 199-200, 303-306) provides a detailed description of attempts to purchase the valley while Panakareao was still alive, and which did not succeed until after his death in 1856. Even then, it required the disinterment of his remains which he had placed in the centre of the valley to tapu the area.

The current highway runs through or adjacent to several Crown purchases and Native Reserves at the eastern end of the Victoria Valley.

South of the Victoria River and eastwards to the centre of the range were the Maungataniwha Blocks. Maungataniwha West No. 2 was sold in 1863 for £560, with two Native Reserves carved out; the 79 acre Ta Keke and 381 acre Mangataiore Reserve. Takeke was on-sold in 1877 for £70, and 191 acres of Mangataiore was subsequently sold. The Maungataniwha Block No. 1 extended northwards from the centre of the range, to Peria (ANZ Record No. R12153644).

The original Deed for Maungataniwha No. 2 West is provided in Appendix C but the text and signatories are as follows (Turton 1877: 18-19):

> "This Deed written on this 14th day of January in the Year of our Lord 1863 is a full and final sale of conveyance and surrender by us the Chiefs and People of the Tribe "Te Rarawa" whose names are hereunto subscribed And Witnesseth that on behalf of ourselves our relatives and descendants we have by signing this Deed under the shining sun of this day parted with and for ever transferred unto Victoria Queen of England Her Heirs the Kings and Queens who may succeed Her and Her and Their Assigns for ever in consideration of the Sum of Five hundred and sixty pounds two shillings Pounds to us paid by Henry Tacy Kemp on behalf of the Queen Victoria (and we hereby acknowledge the receipt of the said monies) all that piece of our Land situated at Mangonui and named Maungataniwha—(West) the boundaries whereof are set forth at the foot of this Deed and a, plan of which Land is annexed thereto with its trees minerals waters rivers lakes streams and all appertaining to the said Land or beneath the surface of the said Land and all our right title claim and interest whatsoever thereon To Hold to Queen Victoria Her Heirs and Assigns as a lasting possession absolutely for ever and ever. And in testimony of our consent to all the conditions of this Deed we have hereunto subscribed our names and marks. And in testimony of the consent of the Queen of England on her part to all the conditions of this Deed the name of Henry T. Kemp, District Commissioner is hereunto subscribed. These are the boundaries of the Land commencing at a Hill named Puketoetoe, along the survey lines to Te Huinga, thence along the survey lines to a point known as Tapuketukituki, thence along, the survey lines to a point called Opou on the Kaitaia Stream, thence along the survey lines, returning towards the Kaitaia River, thence along the Kaitaia River to the Native Reserve known as Mangataeore, thence along the survey line of the Native Reserve to a Peg on the Kaitaia river, named Kowhatupotaka-taka, thence along the survey line to the starting point at Puketoetoe.

Receipt for £560. 2. 0. Received this 14th day of January in the Year of Our Lord One thousand eight hundred and the Sum of Five hundred and sixty 2s. Pounds sterling being the consideration money expressed in the above-written Deed to be paid by Henry T. Kemp on behalf of Her Majesty the Queen to us.

(Signed) Wiremu Pikahu.

Na Wharerau x.

Rei: Kiriwi.

Ko Te Huhu.

Rapata Take.

Na Te Kepa Taiaroa.

Rutene te Wa.

Na Wiremu Kingi.

Witnesses—

Henry Grover, R. M. Clerk, Mangonui.

Henry S. F. Richardson, Surveyor

W. B. White, Residt. Magte."

H. T. Kemp.

The survey of Ta Keke is on plan ML 109, and the block is located immediate east of the Takahue Road intersection. Archives New Zealand contains a certificate of title issued in 1865 with the owners named as Tohuora Parahiku, Wharerau Te Rata, Ngapipi Mumu, Hore Ngakoti, Hemi Pau, Pita Tohia, Rupene Hopewai, Rapiana Tohe, Rata Te Ahi and Nopera Kirione (ANZ Record No. 1029).

The title investigation for Ta Keke is contain in Native Land Court Northern Minute Book 1: 7, with the hearing held on 30 December 1865 immediately after the investigation into the Wai Mamaku Block discussed below. Tohuora Parahiku stated that the 79 acre block of that name surveyed by Campbell, reserved out of the Maungataniwha Block, and named those who claimed the land as in the preceding paragraph. His claim was supported by Wharerau te Kanohi and title was issued in January 1866.

The Manga Tai Ore reserve is shown on ML 389, also from 1866, and extends either side of the highway from Victoria Valley Road to Kitchen Road. Archives New Zealand has a Certificate of Title issued in 1867 to Hemi Te Pau, Maihi Te Huhu, Karipa Ehakai, Nopera Kiriona, Ngatawa Pana Kareau, Hakitara Paea, Nopera Puru, Watene Pipi, Henare Waha and Tipene Te Taha (ANZ Record No. 1043).

Maori Land Court Northern Minute Book 2: 33 contains the record of the title investigation, attended by Hemi Te Pau, Nopera Kiriona and Kapira Ehakai on 15 March 1867. Hemi Te Pau states the block is reserved out of the Maungataniwha Block for their own use based on the ancestor Te Ure (or Ku?) Paraoa; the Maori Land Court database refers to Te Ku Paraoa while the survey plan has an annotation Te Ure Praoa (sic) within a clearing on the block. Nopera Kiriona agreed with Hemi Te Pau's statement, noting that there was no person to interfere with the claim and they did not wish it to be sold. Kapira

Ehakai also agreed, noting he lived on the land and cultivated it. Surveyor Samuel Campbel also attested the claimants were living and cultivating on the block.

In the early to mid-1890s, Huirama Ngatawa of Mangonui made several claims to a share of Mangataiore. In 1896 he wrote to the government asking under whose authority the share of the deceased Ngatawa P. Kareau had been assigned to someone else and was still inquiring into the Ngatawa Pana Kareau succession in 1915 (ANZ Record No. 1891, 183 and 850; 1895/1207; 1915/2285).

In 1915, Wairama Maihi who was the son of Maihi Te Huhu wrote to the Native Affairs Parliamentary Select Committee, asking that his father's share of Mangataeore (sic) be transferred to him, his brother and his sister as the current successors (Hariata Pene and Paurini Wahanui) were not children of Maihi Te Huhu (ANZ Record No. 1915/2568). On investigation, it became apparent that Pene and Wahanui who were cousins of Maihi had been added as successors by Wairama Maihi himself in 1896, upon the death of his father.

The claim and definition of relatives interests went through the Maori Land Court in 1915 (Northern Minute Book N0.37: 72, 74, 88-91, 110-111).

The land was obviously much contested as in 1916, Herepete Karipa and seven others wrote asking that the land be re-vested as disputes had arisen about individual holdings ANZ Record No. 1916/4001).

The Kaiaka Block was the last Crown purchase before the Native Land Court was established in 1865. It comprised 7367 acres of broken country north of the Maungataniwha Block and Victoria River, purchased for £1114 or 3s an acre, the second highest per acre rate of all Crown purchases. In February 1865 Civil Commissioner W. B. White wrote to District Commissioner Kemp stating that despite it being superior land that local Maori had long declined to sell he had argued the price down from 5s per acre to 3s per acre for 8000 acres, and that the Kaiaka Block had been surveyed but not mapped (White to Kemp, 24 February 1865 in Turton 1883: 17).

The original Kaiaka Block deed is contained in Appendix C but the text and signatories are as follows (Turton 1877: 26-27):

> "This Deed written on this thirtieth day of May in the year of Our Lord 1865 is a full and final sale conveyance and surrender by us the Chiefs and People of the Tribe Te Patu (Rarawa) whose names are hereunto subscribed And Witnesseth that on behalf of ourselves our relatives and descendants we have by signing this Deed under the shining sun of this day parted with and for ever transferred unto Victoria Queen of England Her Heirs the Kings and Queens who may succeed Her and Her and Their Assigns for ever in consideration of the Sum of one thousand one hundred and fourteen 1/- Pounds to us paid by W. B. White Esqre. Civil Commissioner on behalf of the Queen Victoria (and we hereby acknowledge the receipt of the said monies) all that piece of our Land situated at Mongonui and named Kaiaka the boundaries whereof are set forth at the foot of this Deed and a plan of which Land is annexed thereto with its trees minerals waters rivers lakes streams and all appertaining to the said Land or beneath the surface of the said Land and all our right title claim and interest whatsoever thereon To Hold to Queen Victoria Her Heirs and Assigns as a lasting possession absolutely for ever and ever. And in testimony of our consent to all the conditions of this Deed we have hereunto subscribed our names and marks. And in testimony of the consent of the Queen of England on her part to all the conditions of this Deed the name of William Bertram White Civil Commissioner is hereunto subscribed. These are the boundaries of the Land commencing at the North from Boundaries. Taumerekauri, Mangatete to the Toatoa block to Tutaihika. On the East by a surveyed line, Native Reserve, in the Maungataniwha West

No. 1 block, to Waiotira Creek, along the Creek to Hokotuku, to Te Puihi, along the surveyed line to Mahititawa to Te Kati to Tetaporoahi, Opake, on to Te Pahi. On the South by Maungataniwha West No. 2 to Kotengenioru, then by the Victoria river to Parakokopu. On the West from Parakokopu by land belonging to Natives by a surveyed line to Tearawhati on to the Puihi Creek, along the Creek to the Kaiherehere to the Kaiherehere Creek, up to the Taumerekauri.

Witnesses to the payment and signatures—

Reihana Kiriuri.
Karaka Waruora.
Timoti Papata.
Hone te Karu.
Puru.
Rupene Hopewai.
Ko Wi te Hau.
Neho Wetekia.
Pane te Pae.
Tipene Taha.
Rakena.

Received this thirtieth day of May in the Year of Our Lord One thousand eight hundred and sixty five the Sum of one thousand one hundred and fourteen 1/- Pounds sterling being the full consideration money expressed in the above-written Deed to be paid by W. B. White Civil Commissioner on behalf of Her Majesty the Queen to us.

Witnesses—

Rutene.
Hare Reweti.
Karaka.
Reihana Matiu.
Rapuhana Tohe.
Tohuora.
te Wiremu Pi Ka Hu."

The 154 acre Waimamaku Reserve was carved out of the block next to the Victoria River, along with three others. The Muriwhenua Report (Waitangi Tribunal 1997: 236) states that none of the reserves were identified in the Kaiaka Deed or Plan and the reserves must have been arranged after the sale.

The survey of the Wai Mamaku reserve is contained on land plan ML 106 from 1866 showing the reserve approximately on kilometre east of the State Highway 1/Takahue Road intersection. Maori Land Court Northern Minute Book 1: 7 contains the record of investigation into the Waimamaku title in December 1865. Wharerau Te Kanoho states that the block shown in the survey undertaken by Campbell was to be reserved from the sale of the Kaiaka Block for himself and Hehi Wharerau. Hehi Wharerau confirmed the others' statement. This was confirmed by Karaka Karau and there was no opposition to the claim, so title was granted to the two claimants in January 1866

Archives New Zealand contains a certificate of title for "Waimamaku at Victoria", issued to Wharerau Te Kanoho and Hehi Wharerau in 1865-1866 (ANZ Record No. 1030). The Muriwhenua Report notes the land was sold in 1941, and Archives New Zealand has an alienation file wherein the land was purchased by James Maurice Panther (ANZ Record No. 33910C).

In 1868, a report was made by W. B. White, the Resident Magistrate in Mangonui, in Reports on the Social and Political State of the Natives in Various Districts at the Time of the Arrival of Sir G. F. Bowen (AJHR 1868 Session 01-A04: 36). He noted that on his first arrival, twenty years ago, on visiting Ahipara, he was struck by the size of the Rarawa population their large villages and pa, and the extent of the cultivations and quantities of produce being sent to Mangonui to supply the whalers then visiting the port, besides wheat, corn, onions, exported to Auckland, and even Sydney. By 1868 he described the area as a wasteland, the population dwindled to a few hundred. A census taken in 1858 gives the population of this district as 2,362. No census had been taken since, but he noted that year earlier, a dispute about some land assembled two-thirds of the male adult population in Victoria Valley, about 300 fighting men; he had heard from CMS Missioner Mr. Puckey, of Kaitaia, that fifty years earlier, Nopera Panakareao's father could lead over 2,000 fighting men.

By 1872, work had started on a road to connect the Victoria Valley with Mangonui, according to the 1872 Public Works Statement (AJHR Session 1 B-02A 1872: 5). In his 1875 report, Resident Magistrate White reported that the local Maori were enthusiastic regarding the establishment of a school at Victoria Valley, as had occurred at Ahipara. They had also engaged with building the bush track to Victoria Valley funded by the Auckland Provincial Government through the Ahipara and Mangonui Road Boards and constructing roads and culverts, but both Maori and European residents were disappointed that no work had been undertaken by the Public Works Board (AJHR Session 1 F-03 1872: 5).

The first European settlers into the valley included the Panthers, Switzers and Kitchen families, taking up lands under the Homestead Act and arriving via Mangonui in the 1870s.

A school was proposed for Mangataeore in 1873, shortly after the school at Kaitaia was proposed. The Mangataeore School would be the fifth in line, after Kaitaia, Peria, Kohumaru near Mangonui, and Parapara near Taipa, and ahead of schools at Taupo Bay, Herekino and Motukaka (Native Schools, AJHR Session 1, G-04, 1873: 7). At about that time, there were 57 Maori living at Mangataeore, identifying as Ngatiterangi hapu of Patu. There were 32 males and 25 females, 27 under fifteen (Approximate Census of the Maori Population. AJHR Session I, G-07, 1874: 1). George Kelly, writing in the absence of Resident Magistrate White of Mangonui noted that a typhoid and measles epidemic had hit the Maori population hard in late 1874 and early 1875, leaving to a decrease in population. There were 38 Maori at Mangataeore that year, 20 males and 18 females, and 20 were under fifteen (Census of Maori Population, 1878. AJHR Session I, G-02, 1878: 1, 11). Note in this report, they are referred to as being affiliated with Ngatitaranga.

The school was opened in Victoria Valley in 1880, under Master James Patton at a salary of £110 per annum. £53 was spent on the school building and furnishings that year (AJHR Session I, E-01 1881 Appendix: 9) and £219 in 1879 for the establishment (AJHR 1880).

<u>The Mangamuka-Victoria Valley Road</u>

In the 1870s there were still no roads between Okaihau and Kaitaia. In the 1875 Public Works Statement reported to the House of Representatives, three miles of clearing, three quarters of a mile of side cutting, and a number of bridges and culverts had been undertaken between Okaihau and the Waihou River (AJHR 1875 Session 1, E-03: 53).

The Crown Lands Department report of 1880 (AJHR 1880 Session I C-0 1880: 6) states that 30 miles of bridle track had been surveyed from the north side of the Hokianga opposite Herds Point (Rawene) to Victoria Valley, with seven or eight miles completed at either end. The form of the bridle tracks under construction are described as a carefully-graded line which could easily be widened to dray road width and serve as a main road as time and money permitted, with the bush felled for at least half a chain and generally one chain wide. The road, via Paponga, Broadwood and Takahue was surveyed from 1878-

1880 and completed for horse traffic in 1880, was 28 miles in length and maintained a 1 in 10 grade despite a climb of 1160 feet to get over the saddle north of Broadwood. It cost £4,938, including some of the survey and was the first road to connect the Hokianga with the Far North (AJHR Session I, C-04 1881: 31).

In 1882, the Surveys of New Zealand Report for 1881-1882 (AJHR Session I, C-03 1882: 19) reported that J. Garsed had explored about 17 miles of the proposed route of the Great North Road between Okaihau and Kaitaia, crossing the Maungataniwha range at about 1,100 feet. The report noted that Garsed had obtained a grade of 1 in 21, suggesting that crossing the range would come at considerable cost due to the steepness of the required cuttings and because it would be made through forest. Work was due to start in the spring of the following year.

In 1883 the first tenders were let for the Okaihau to Victoria Valley Road were let. The European communities had been advocating for a road outlet since the late 1870s, but political inertia and delays in negotiating access over the substantial amount of Maori land involved meant that progress was relatively slow. In September of that year, a line through the gorge and over the range was surveyed by J. Garsed, and a specification for the road including bridges, embankments, and culverts was prepared.

A Joshua Garsed served as Forest Ranger for the Puhipuhi Forest in the mid-late 1880s, and was the nephew of Surveyor General S. Percy Smith, and may be the J. Garsed in question. He served in the militia in southern Taranaki and had connections with Whanganui. Regardless, as well as surveying the road and preparing the specification, Garsed was involved in its construction in 1884-1885, supervised by E. Fairburn.

The work was not without problems, even in the early stages. H. W. Bishop, the Resident Magistrate for Mangonui reported in May 1884 in Reports from Officers in the Native Districts that at the Victoria Valley end, Garsed was turned off the land and prevented from cutting his line through the Mangataeore Block by the owners. Despite being fined £10 and costs, the opponents continued to frustrate the survey as they did not want the road through their land (AJHR 1884 Session 2, G-01).

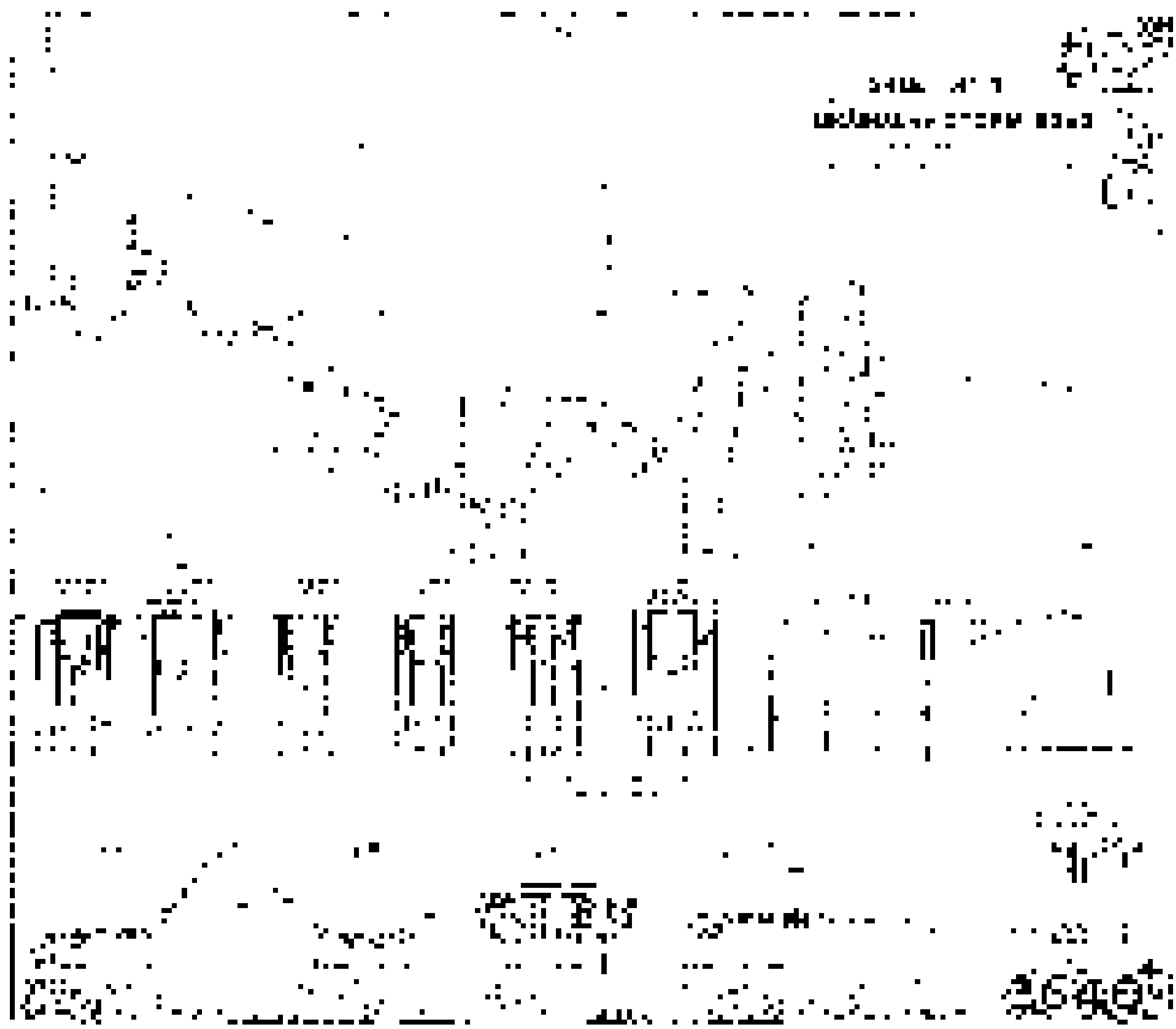


Figure 27: SO 3640/4 Okaihau-Victoria Valley Road. J. Garsed, 1883. This plan shows exemplary elevations road formation and structures which do not appear to have been built before 1900.

In 1884 the New Zealand Herald reported that access to Victoria Valley was available from three directions, including from Mangamuka Bridge where the surveyor had laid his line over the range to Victoria Valley and works on the road were progressing, although the road only extended seven miles north of Okaihau at that point (New Zealand Herald, 12 January 1884).

The Appendix to the Journal of the House of Representatives report on Surveys of New Zealand (AJHR 1886 Session 1, C-01A: 22) and specifically reporting on the progress of roads being opened up to access Crown Lands reported on progress on the Okaihau-Victoria Valley Road, noting that the 1885 report conveyed that 17 ¾ miles of road had been constructed north of Okaihau, with 10 miles of cart road and 7 ¾ miles of bridle track beyond that. Another 4 ½ miles was added in the most recent year, taking the road as far as Mangamuka, where a bridge was being constructed over the river by a contractor. There is no reporting on the road prior to this date.

The 1886 Surveys of New Zealand report (AJHR 1887 Session 2, C-02: 14) reported that the Mangamuka Bridge had been built and another half a mile of bridle track completed. From that point the road ran through Maori land and local Maori were under contract to build one and a half miles of bridle track. The works would soon reach the junction with the Oruru Road which was being built by the Mangonui

County, and while only 7200 acres of Crown Land would be opened by the government road, a huge additional acreage of Crown and private land would be indirectly served by the new road. The work was being project managed by E. Fairburn with direct supervision by G. G. Menzies. The bridge is likely to have been the one approximately 400m west/downstream of the Mangamuka bridge, which is shown on an 1894 survey plan discussed in the next section. The Oruru Road appears to run along the line of what is now Iwitaua Road and Abraham Road, running northwards from the later to Te Karoa Road on the north side of the Maungataniwha Range. This alignment is also shown on two other plans from 1894 where it is described as a cut road to Oruru.

The 1887 Surveys of New Zealand report (AJHR 1888 Session 2, C-01A: 15) noted that the bridge previously reported on over the Mangamuka River had a 130 foot span and that in the preceding season, 230 chains (almost three miles) had been constructed, comprising 27 chains of cart road and 203 of bridle track. The junction with the Oruru bridle track had also been met that year. The 1889 report (AJHR 1889 Session 1, C-01A: 18) noted little progress, as local Maori had been tied up with land disputes and sittings of the Native Land Court. One of the two contracts let the year before had been completed, and 34 chains of bridle track and 24 foot of bridging had been undertaken, with the road now extending past the Oruru road junction. The costs had not increased as inspection of the finished work had been done at the same time as the inspection of the Oruru_Fern-Flat road. To the south, eleven miles of Bridle Road between Mangamuka and Waihou Bridge had been maintained and repaired.

The 1890 report (AJHR 1890 Session 1, C-05: 21) notes that in the year prior, work on the south side of the range had stopped in favour of the north side, as improving that end would have the greatest immediate positive impact for the European settlers. Accordingly, a six foot wide road formation 14 chains long and 20 foot of bridging was undertaken, along with four miles of grading and pegging by Mr Grut. Repairs had also been undertaken on the already formed piece of road, largely as a result of fires. Mr Menzies continued to have charge on the south side.

By 1891, an additional 17 chains of bridle road had been formed, largely on the northern side of the range, with an additional two miles and 20 chains of bridle road improved and six miles maintained. One hundred and eighty chains or two and a quarter miles of forest had been cleared (AJHR 1891 Session 2, C-01: 19).

Reporting changed at this time, with roading now reported in the Department of Lands and Survey's annual report to the House, with somewhat less specificity. The 1894 report (AJHR 1894 Session 1, C-01: 36) noted that three miles of bridle track had been opened on the Victoria Valley side, and eight miles on the Mungamuka side. The eight miles of bridle track between Mangamuka and the Waihou River had been put in good order and further work would be undertaken shortly to extend the bridle track northwards, the survey of the intervening land being in hand.

In 1893 a correspondent to the Northern Advocate (7 October 1893), noting the possibilities of settlement for Rangiahua noted that the road northwards was still only a bridle track "…which wise people shun as much as possible. If a good metal road were formed right through the Victoria valley it would give a wonderful impetus to settlement and would open up thousands of acres of land, a large extent of which is covered in valuable timber." He goes on to note that the land in the Mangamuka Valley is as good as anywhere in the colony but it "might as well be at Timbuctoo" as far as access went.

The 1896 Department of Lands and Survey annual report (AJHR 1896 Session 1, C-01: 47, 49) noted that to get from Ohaeawai to Awanui there were "two routes available, one via Kaeo-Iwitaua and Mangonui, the other vid Okaihau-Rangiahau and Victoria Valley. Neither of these roads are constructed, though the first is available for horse-traffic throughout; the other being only formed to Mangamuka. From here, however, connection is made with the Mangonui-Awanui Road by a branch line via Fern Flat. Should it be determined to construct any of these roads so as to be available for wheel-traffic, it will be necessary to make several deviations to obtain better grades".

The 1896 report later notes that "This road traverses a portion of three counties, and is of a total length of about forty miles. It is one of the routes referred to in my report on the Warkworth-Awanui Road, and, in my opinion, ought to be the one selected as the Great North Road. It is made available for wheel-traffic between Okaihau and Rangiahua, from Rangiahua to Mangamuka, about eight miles; at the Victoria Valley end about three miles are constructed a bridle-track, and nine miles are yet to be constructed. During the year about 29 chains of road have been constructed and metalled, and the bridges repaired as far as possible with the money available. If this line is to be properly formed, several deviations will be required, which will considerably shorten the road. The exceedingly dry summer and extensive bush fires have destroyed and injured several bridges and culverts, so that a considerable sum is now required to do general repairs during the coming year".

In 1897, the Annual report (AJHR 1897 Session 2, C-01: 47), the road is still only a bridle track from Rangiahua to Mangamuka and has yet to be formed through to Takahue. Traffic still has to travel via the northern deviation via Fern Flat. The Surveyor General still supported the road being opened as it was the most direct route northwards but little more than repairs and maintenance has occurred on the existing formation in the previous year. The 1898 report suggested little progress being made, and that "from Mangamuka northwards the line was laid out but never constructed, except about two miles at the northern end, which was done to give access to settlers and to the Takahue Block" (AJHR 1898 Session 1, C-01: 44). In 1898 the situation had not progressed north of Mangamuka as the land was still in Maori ownership, although parts of the Rangiahoua to Mangamuka section had been widened and improved. On the north side there was two miles of cart road to provide access between Victoria Valley and Takahue (AJHR 1899 Session 1, C-01: 47. The 1900 report (AJHR 1900 Session 1, C-01) provides no information on the road between Mangamuka and Victoria Valley.

The 1901 Annual report states the road had been formed three miles towards Victoria Valley from Mangamuka at that time but that very little had been done recently due to a lack of funds and the existing road was in very poor repair. Nine miles of road required forming and grading before the Victoria Valley and Takahue Block could be reached (AJHR 1901 Session 1, C-01: 67). After 1901, the annual reporting of progress on the road in the AJHR appears to have ceased, although the Public Works Department published its annual accounts which sometimes included money spent on the road through the first two decades of the new century.

On 4 May 1908, the Northern Advocate reported that work on the "through road" between mangamuka and Victoria Valley had been suspended due to a lack of funds. The report bemoaned the delay in completing the road as once finished it would open up thousands of acres for settlement including valuable timber country. The land was currently owned by Maori but the correspondent hoped the Native Land Court would find some way of "dealing with it".

In 1910, the Maunganui Country A. and P. Association met in Kaitaia and among other business passed a resolution asking the government to build the Victoria Valley-Mangamuka Road in order to open up direct communication with the Bay of Islands (Northern Advocate, 9 May 1910). In July 1910, local settlers in Kaitaia asked Maunganui County Councillor Masters to ask via Member of Parliament Vernon Reed what steps had been taken to open up the road (Northland Age, 25 July 1910).

On 3 December 1910, the Northland Age reported that settler's wishes were finally granted with £500 voted by the government for construction of the road. The correspondent stated it was astonishing that it had taken so long to secure a road through some of the richest land in the Dominion and which would save 40 miles on a trip between Kaitaia and the Bay of Islands.

In 1911, Vernon Smith and the Royal Commission of Inquiry into North Auckland Railroads visited the area, taking two days to travel from Kohukohu to Kaitaia via Mangamuka and returning via Broadwood. Over the Mangamuka road the party experienced great difficulty with MP Stalworthy thrown from his horse into a boghole, and Mr Reed's horse falling through a bridge (Northland Age, 22 April 1911). It is not clear whether they travelled by the northern deviation through Fern Flat and Peria, or via the road still under construction.

In 1915, local communities were still arguing about which route between Mangamuka and Kaitaia should be improved. A correspondent to the Northern Advocate argued (Northern Advocate, 15 March 1915) that the communities should put aside local jealousies and join together in one voice and lobby central government for a "thoroughly serviceable road" to link the Maungonui and Hokianga Counties and provide access to the railhead, and suitable for motorised traffic and other vehicles. While the easiest route would be via Oruru and Fern Flat to Mangamuka, the route from Victoria Valley to Mangamuka would be more central.

In the Public Works Statement of 1917 (AJHR 1917, Session D-01 :) bush had been felled for a distance of 34 chains, the road widened 86 chains, and 12 chains of dray road formed, 11 of which were in rock), and 230 chains of road repaired.

In April 1919, MP Vernon Reed attended a meeting of the Hokianga Council to present a proposal whereby central government and the two local councils would each contribute to the cost of metalling the road from Victoria Valley to Mangamuka and Rangiahoua, estimated to cost £18,000; the government would contribute £3000 per annum for three years to undertake the work.

Improvements to the roads had been delayed by disagreement over priorities between Mangonui and Hokianga County, and central Government. An attempt to fund improvements to the road over the Takahue saddle so it could act as a temporary mail route to the railhead at Rangiahoua was turned down by the counties in fear that they would lose the opportunity to improve the Mangamuka and Fern Flat Routes. Later in the year, Reed was successful in bringing the counties on board.at which he was informed the Council would sign up to his proposal to immediately metal the road from Rangiahoua through to Mangamuka and Victoria Valley, with Hokianga and Mangonui County contributing 25% each and central government 50% of the cost (Northland Age,)

In 1920, 270 chains were widened and 15 chains of new formation completed, and filling, metalling, culverting and removal of slips was carried out (AJHR 1920, Session 1, D-01: 27). The 1923 Statement reports 16 miles 32 chains first class formation, 9 miles 10 chains second-class surfacing, together with 3,809 lineal feet culverts completed on the Victoria Valley-Mangamuka Road (AJHR 1923 Session 1-2, D-01: 42). In 1924 six miles of dray road were completed and three miles metalled (AJHR 1924 Session 1, D-01: 42). By 1926 78 chains of road has been widened, 103 chains. metalled, and 280 chains blinded (AJHR 1926 Session 1, D-01: 47).

The 1928 Statement reports that for the first time a fully metalled road route was opened between Kaitaia and the railhead at Okaihau through Mangamuka. Six and half miles of deviation were completed, the base course of limestone was laid and rolled, and one mile of metal laid (AJHR 1928 Session 1, D-01: 142. This would appear to be the conclusion of a 45 year project to transform the road from a walking track to bridle track to dray road to metalled road suitable for motor vehicles.

There is one published account of a fatality of a road worker. Henry Clay was killed in 1921 while working on the road (Northland Age, 11 October 1921) but many accounts of car accidents, fatal and non-fatal in the 1920s and 1930s. There are no particulars of Mr Clay's death, and no inquest was subsequently reported on. There is a Coroner's inquest file from 1921 for Henry Clay, presumably the same man, in the Archives New Zealand Wellington repository (ANZ R23724037).

Throughout the period from 1890-1910, funds were being spent on the Mangamuka-Oruru Road via Te Korua and it appears that maintaining this link between the east coast and Hokianga was the priority by far, as it was far quicker than going the long way around via Broadwood and Kohukohu, or Kaeo and Okaihau. During the war years, the issue of roading was side-stepped as the alignment of the railway north of the Waihou was debated.

The road remained a bridle track through the gorge and there is no indication that the structures on the 1883 plan had been constructed by that time.

5.4 Review of Historic Maps and Plans

Ninety historic survey plans were examined in order to identify potential archaeological, historic and cultural heritage features, from Mangataipa/Mangamuka Bridge north to the Takahue Road intersection of State Highway 1, a stretch of approximately twenty kilometres of road. These plans were produced between 1862 and 1931. Thirty-two plan sheets illustrated the positions of features of archaeological, historic and/or cultural interest in the project area, and were georeferenced into GIS software. The features digitised into points, lines and polygons so their location assessed against State Highway 1 and areas of work.

Review of the plans identified more than 450 features in the vicinity of State Highway 1 including "Native Reserves", wahi tapu and cemeteries, domestic, commercial and public or community buildings, sheds and other outbuildings, cultivations, orchards and individual fruit trees, tracks, bridges, culverts, names of places, owners and occupants, and descriptions of topography, vegetation and soils, some of which (such as clearings, areas in fern or light manuka/kanuka 'scrub bush' regenerating forest, or areas described as having good soil may be indicative of past human occupation or horticulture).

Key plans which indicate the locations of pre-1900 features which may have a physical/archaeological component or are otherwise potentially significant are discussed below in chronological order and illustrated in Figure 27-Figure 35. The plans are provided in Appendix C and tables of digitized features are provided in Appendix D.

<u>SO 802</u>

SO 802 (1862) is the plan of the Maunga Taniwha (Maungataniwha) West No. 1 and No. 2 Blocks undertaken by S. Campbell in 1862. The plan is in very poor condition and due to illegibility and skew the scanned copy is poorly registered. Nevertheless it shows the names of the original European settlers who took blocks on the difficult country north and south of the highway on the western side of the range and into the Victoria Valley.

<u>ML 12805 and SO 867</u>

ML 12805 (1862) is the plan of the 11,000 acre Maungataniwha West No. 2 Block, surveyed by Campbell and Richardson. Along with descriptions of topography and forest cover, it also shows the western end of the old bridle track from Victoria Valley to Mangamuka and Oruru. The line of the bridle track runs westwards towards Kaitaia, on or adjacent to the line of the current highway until the vicinity of the Takahue Road intersection, where it takes a more southerly route.

Half a kilometre west of the Kitchen Road intersection with the highway, the survey plan also shows a "Native Reserve" south of the Victoria River and cut by the highway, along with the annotation "Te Ure o Paraoa", with the land further west being described as "Very good soil, Level Land".

SO 867 (1862) is the plan of the almost 13,000 acre Maungataniwha No. 1 Block, also surveyed by Campbell and Richardson. It shows the bridle track splitting to Mangamuka, Oruru and Waimate at the summit of Maungataniwha, and also shows the separate track from Victoria Valley to Oruru via Peria. It shows 6000 acres belonging to Wiremu and Reihana, and almost 7000 acres belonging to Wiremu alone.

ML 106

ML 106 (1866) is the survey of the 154 acre Wai Mamaku (Waimamaku) Block, between the Maungataniwha No. 2 and Kaiake Blocks and immediately east of the SH1/Takahue Road intserction. It straddles the Victoria River and the Highway and historic Missionary bridle track run along the southern boundary. Most of the land either side of the river is cleared, and there is a wetland south of the road/bridle track.

ML 109

ML 109 (1865?) is the plan of the Ta Keke (Takeke) Native Reserve, surveyed by Campbell and located immediately west of Wai Mamaku around what is now the Takahue Road intersection. It shows both the original surveyed road line following the bridle track, and the 1972 road taking for the current alignment of the highway and intersection.

Three enclosures are shown, two on the south side of the Victoria River and one on the northwest side. The central, southern enclosure appears to have a structure within it, adjacent to the bridle track alignment. These features are 180-200m from the highway, with the highway either following the bridle track or diverting up to 300m from the original alignment.

ML 389

ML 389 (1866) is S. Campbell's survey of the 581 acre Manga Tae Ore Block (Mangataiore) at the eastern end of Victoria Valley, on the south side of the river south east of the State Highway 1/Victoria Valley Road intersection.

The plan shows one apparent enclosure annotated "Cultivation" between the current highway and the river, and four other apparent enclosures, one with what appears to be a structure. The cultivation in 160m from the highway. The highway also cuts through a clearing immediately north west of the lower Kahikatea Stream annotated "Te Ure Praoa (sic)"; this is the ancestor Te Ure Paraoa through whom claim to the land was made at the 1866 title investigation.

The Oruru and Victoria Valley Road is shown. Two apparent later annotations show additional road lines, including one by Wheeler in 1888 along with the plan reference (SO) 5029.

SO 798

SO 798 (1867) is the plan of roads taken through the Kaiaka Block, surveyed by Campbell in 1867. The Kaiaka Block is the land north of the Victoria Valley River, excluding the Ta Keke and Wai Mamaku reserves.

This survey formally surveyed the line of the CMS missionary bridle track south of the river, and where it crosses over the river and along the southern side of W. F. Thompson's land as it turns northeast towards Mangonui, ultimately following the line of what is now Peria Valley Road.

SO 1031

SO 1031 (1876) shows homestead selections in the Kaiaka Block, north of the Victoria River. C. White's 100 acre Section 65 and W. F. Thompson's 200 acre Section 66 immediately north of the river are shown, with the land immediately adjacent to the river cleared, and the Victoria Valley road on the southern side of the water. The road is what is now the highway, and Victoria Valley Road from the highway intersection east and over the river, being the-then road to Mangonui. The line of what is now Panther Road is surveyed, including the intersection with highway; that area is cleared but further north and over most of the Panther's Section 67 is forest, with a small central clearing.

SO 1426

SO 1476 (1870s) is the topographical plan of the Takahue District. It shows the lines of existing and proposed tracks from Victoria Valley to Ahipara and Takahue, and from Takahue to Whangape and Hokianga. Along with the tracks, groupings of small black squares suggest kainga or Maori villages in the different valleys.

SO 1969

SO 1969 (1879) is the plan of the Victoria Valley school site, surveyed out of W. F. Thomson's land by Sidney Weetman. The school site is an acre square on the north side of what is now Victoria Valley Road but then was the road between Ahipara and Mangonui. The school site is now the site of the Victoria Valley Hall, and is adjacent to closed 2020 spoil site.

ML 3608/A

ML 3608/A (1880) is a sketch map of the Mangamuka and Operehu Blocks. At the southern end it shows a tapu area in a bend of the Mangataipa Stream, and the 118 acre property of Webster and Campbell on the eastern side of the Mangamuka River, along with their house. On the western side of the river in the centre of the valley it shows Kauhoehoe, site of the old school. The edge of the bushline is shown around the Mangamuka and Operehu valleys.

ML 3007/4

ML 3007 (1880?) is the centreline survey of the section of the Okaihau-Victoria Valley road, from to the confluence of the Mangamuka River and Operehu Stream to the Waihou River. It is undated but has an annotation from 1880 and shows the location of the Mangamuka School established in 1879-1880. It shows the-then road survey through the valley on the eastern side of the river, with fenced enclosures on both sides of the river at/south of the Operehu outfall, each with multiple structures inside. A suggested bridge location is shown on the Operehu. The enclosures and whare on the western side of the river are likely to be in the vicinity of SH1.

SO 3228

SO 3228 (1891) is the survey of what is now Peria Valley Road, planned to replace the old bridle track to Mangonui and undertaken by Campbell and O'Neill. At the lower end by the school and Victoria Valley Road, the new alignment runs south of the old track while to the north east it runs north of the bridle track.

SO 3640

SO 3640 (1883) is the survey of the new road through Mangamuka Gorge and over the Mangamuka Range to Victoria Valley. Along with sections of older track, the plan (over four sheets) specifies the formation of the road in terms of cuttings, embankments, bridges and culverts, along with dimensioned elevations of the formation and structures. Approximately 200 of the recorded features are from this series of plans. However further research into the records of road building published by the Public Works Department in the Appendix to the Journal of the House of Representatives suggest that little or no work was undertaken over the difficult ground through the gorge and over the range until after 1900.

The plan shows more than 150 timber boxed culverts 18 inches to three feet wide, along with 13 bridges ten to thirty eight feet long, and chainage for side cutting, breast cutting, embankments and flat formations with and without drains.

SO 5029

SO 5029 (1888) is Wheeler's 1888 road survey through the Manga Tae Ore Block, taken by proclamation in 1889, and as later annotated on ML 369 (1866). The line of this road is on or immediately adjacent to the existing highway. From the Victoria Valley Road intersection, the survey has a specification for 57 chains of flat formation, six chains of light side cutting, 2 chains of filling and fascining and a further 10 chains of flat formation.

SO 6314

SO 6314 (1891) is the plan of the north end of the Okaihau to Victoria Valley Road, surveyed by Wheeler in 1891. It shows multiple road alignments, including the north end of Garsed's road which was proposed for closing, Campbell's abandoned road which was surveyed 30 years prior as part of the earlier bridle track via the summit of Maungataniwha (both on the south side of the Victoria River), and Wheeler's new line of the road on the north side of the Victoria River. A fourth line of road runs between the other three, and south of the river but there is no annotation to say which iteration of the road it belongs to, but it appears to extend towards the Raetea Valley from a road shown on the Manga Tai Ore Block survey of 1866 (ML 389). All these old road alignments have sections within 100m of SH1.

The plan also shows three houses on the south side of the Victoria River, from north west to south east associated with settlers Switzer, George Kitchen, and Tracy. The Tracy house is 50m from the highway, the Switzer house is 75m from the highway. North of the river the Victoria Valley School Reserve and building is shown.

ML 3608/B and C

ML 3608/B (1894) is the plan of surveyed by W. G. G. Spencer. The survey shows the Mangamuka East or Operehu Block. It shows the northern part of the cut road to Oruru, running north from Mangamuka. A later annotation shows this road was closed on plan SO 29231 (1925). It also shows the extent of clearings around the confluence of the Operehu and Mangamuka River.

ML 3608/C (1894) is the plan of the subdivision of the Mangamuka East Block, also surveyed by Spencer. Notably it shows cultivations on the north side of the Mangamuka River, west of the confluence of the Operehu Stream. The alluvial flats east of the confluence are in fern and scrub. The plan also shows the southern part of the cut road to Oruru, starting just west of the confluence.

SO 7084/3 and SO 7084/4

The SO 7084 (1894) plans show the resurvey of the Victoria Valley – Okaihau Road undertaken by Spencer in 1894, with plans /3 and /4 showing the sections through the Mangamuka Valley and Gorge respectively.

SO 7084/3 shows "Native Cultivations" between the highway and river at the north western end of the valley, from the mouth of the gorge to approximately 700m south of the confluence with the Operehu Stream. The church is present 125m west of the highway, and Spencer's road runs past the church and skirts the edge of the flats and the high ground to the west.

In the centre of the valley, Spencer's road runs to the east of the old school house and an adjacent burial ground; the highway runs closer to these features, at a distance of less than 40m. At the southern end of the valley, Spencer's road and bridge is 400m downstream of the modern crossing, afterwhich the road turns east again for 400m and rejoins the modern highway alignment.

SO 7084/4 generally followed the line of Garsed's road survey, ending at the first switchbacks north of the Tapapa Stream confluence.

ML 6700

ML 6700 (1898) is a plan of the Mangamuka West Block being all the land west of the Mangamuka River to the summit of the range, and north to the main west to east ridge north of the highway. The southern western boundary runs from Kumetewhiwhia west to Mangataipa. The block was surveyed for Te Rata Herewaka and Moko Herewaka, Maraea Pororua and others and was 12,600 acres

It has an annotation "Native cultivations" between the highway and the river at the western end of the valley. It also shows the new Kauhoehoe school site gazetted in 1895 just west of the highway but subsequent annotations suggest this was mislocated, and the actual school site is the current one to the north west. It also shows the original partitions of the block on the western side of the river, but while the acreages can be read, the owners names are largely illegible.

SO 12895

SO 12895 (1904) is the plan of Section 1 and 2 Block XII Takahue Survey District. It was surveyed in 1904 by Percy Ward for J. W. Groves and G. Kitchen and covers land from the highway southwest over the lower Raetea Valley and into the high ground above.

The plan shows the 1300 acre Section 1 and 200 acre Section 2, with access to the rear Section 2 via a road line through George Kitchen's Section 145 and 147. Two road alignments south of where the highway crosses the river near the mouth of the Raetea Valley form the northern boundary of Section 1, with the road immediately west of the current highway described as a graded line to Mangamuka. It also shows a new clearing in the valley. Presumably Groves was surveying access through to his section and breaking it in.

SO 12998

SO 12998 (1904) was surveyed for D. Kitchen, being Section 3 Block XII Takahue Survey District, east of Section 2 noted above and immediately south of the highway. One of the creeks forming the headwaters of the Victoria River runs south to north through the valley, before turning north west into the Raetea Valley proper. A road line is surveyed from the highway south, along the eastern side of the creek and the ground beside the creek is described as good land.

ML 6700

ML 6700 (1907) provides a snapshot of the settlement of the Mangamuka Valley at the start of the 20th century. Whare, from Mangamuka Bridge north to the Operehu. Outbuildings, whare nui, church, school, store and post office buildings are shown, along with wahi tapu, orchards and cultivations. The owners' and other names are shown and the map appears to have been produced with the help of multiple local informants. At this time, most of the river flats appear to have been cultivated in corn, kumera and pumpkins with peach and pear trees scattered throughout.

Many of the features shown will have been built prior to 1900 and depending on subsequent development in the immediate vicinity, will have archaeological features remaining, and most are within

100m of the highway. The river flats on both sides of the Mangamuka River from Mangamuka Bridge to the mouth of the gorge are highly archaeologically sensitive.

ML 9105/1 and ML 9105/4

ML 9105/1-4 (1913) are Percy Ward's surveys of the Mangamuka West Block for the Crown. ML 9105/1 shows the road alignment through the Mangamuka gorge to the road summit. It describes the road at the time as a formed bridle track, with an older line of track over some high ground to the north of the Tapapa confluence with the Mangamuka. This track is within 100m of the highway.

ML 9105/4 shows the road alignment from a kilometre east of the Tapapa confluence, to the centre of the valley. In the centre of the valley, 110m west of the highway alignment is the Puketapu or Kauhau (or Kauwhau) wahi tapu or cemetery. On the eastern side of the highway to the north is an enclosure, with two structures within, 180m from the road. Two school buildings are also shown, along with the post office and whare nui near the river at Iwitaua Road.

SO 18581

SO 18581 (1915) is assistant surveyor F. R. Burnley's plan of sections including Forest Reserve sections in Maungataniwha Block 1 and 2, and the Okaihau-Victoria Valley Road. It covers both sides of the highway alignment from the mouth of the Raeatea Valley to the summit of the road. Section 1, previously owned by Groves according to SO 12895 is now owned by H. J. Clapper, while Section 3 to the east is owned by J. Clark. The land either side of the highway summit is Forest Reserve. The area is described as good river flats with volcanic soil.

ML 9999

ML 9999 (1915) was surveyed by H. C. Cooper and is the plan of several sections in the Mangamuka West block, both north and south of the Mangamuka River at the western end of the valley near the mouth of the gorge. On the north side of the river are enclosures with houses, cultivations, and orchard belonging to Puhipi Tiwene, and enclosures, houses and cultivations belonging to Hemi te Hara and Stannaway.

South of the highway, the line of Makene Road has been surveyed but only the lower part around the intersection with State Highway 1 has been cleared; the area of the Makene Road spoil sites are still in primary forest. To the west, the boundaries of the Mangamuka West 3E Block has been cleared but the centre is still in forest, while further west part of the Mangamuka No.3 DD No. 5 has a fern-covered spur surrounded by forest.

6.0 Preliminary Findings

6.1 Archaeological and Historic Heritage Features at the Slip and Spoil Sites

There are no recorded archaeological sites in the project area. There is one scheduled Site of Cultural Significance to Maori in the project area, the Tapapa wahi tapu. This area is currently being used as a site office for the slip repair project and has been used for spoil dumping in the past. No additional ground disturbance or dumping should occur in this area without further assessment, and the effects of the existing dumpsite should be assessed, and the cultural values of the area identified. Another currentl active spoil dumpsite lies within an area that was cleared in 1866 and associated with the ancestor Te Ure Paraoa.

The highway through the Mangamuka gorge and over the range where the slips and slip repairs are being undertaken was not formed until after 1900, based on newspaper accounts and the records of the Journal of the House of Representatives. This is despite the line through the most difficult country surveyed and specifications for bridges, culverts, cutting, embankments and a standard formation being prepared in 1883, and the approaches through the Mangamuka and Victoria Valleys being formed by.

The delay in building the road appears to be a result of the difficult terrain, problems with securing the route across Maori land, a lack of funds possibly relating to the Depression of the early 1890s (the worst until the GFC of 2008/2009), and the presence of a usable but longer and easier northern route via Fern Flat and Peria.

Historic research has suggested that every extant slip on the Mangamuka section of State Highway 1 may be within 50m of a structure specified on the 1883 Victoria Valley Road plan, but probably not built, if at all, until after 1900. It is not clear if these structures were actually built, and their locations in relation to the slips is imprecise owing to the poor scanning/plan quality and subsequent difficulty in georeferencing the plans.

Given the ongoing maintenance and improvement of the road since it was finally completed in 1928, the ongoing slips on the alignment, and the expected uselife of timber structures (many made of totara) in that environment, it is unlikely that any of the potential post-1900 structures have survived.

The works being undertaken to repair the slips and stabilise the highway are occurring in areas which have been highly modified by the existing highway formation, which can be expected to have largely destroyed prior iterations of the road, apart from where major deviations have occurred. The treatments being undertaken are also of a form and are in locations that are unlikely to uncover archaeological features. That is to say works on the upslope side of the highway comprise pavement, curbing, channelling and drainage at a level already cut down substantially for the current road formation, with subsurface drains into the hillside. Downslope works for retaining, guardrails etc are over active slips and areas of fill, with auguring for piles providing limited opportunities to view/identify features which may be buried below the current road level.

Nevertheless it is possible that these post-1900 archaeological or historic heritage features, which do not have statutory protection under the Heritage New Zealand Pouhere Taonga Act 2014, may be encountered and require consideration and management based on Waka Kotahi internal policy and general advice provided regarding historic heritage managed by Government departments and other agencies. A table of features in the vicinity of the Project area is provided below (Table 1).

6.2 Archaeological and Other Historic Heritage within 200m of State Highway 1

Outside the specific area of works on the slips and associated locations, there are a large number of potential archaeological sites within 200m of the State Highway corridor between Victoria Valley and Mangamuka. The highway passes through or is immediately adjacent to three Native Reserves, carved out of the Kaiaka and Maungataniwha West No. 2 Block Crown purchases in the mid-1860s. The Ta Keke, Wai Mamaku and Manga Tai Ore blocks were those areas that were of particular significance and or use and which needed to be retained by the vendors in the Victoria Valley. Plans of the three Reserves show clearings, areas under cultivation, whare, and claimants, owners and occupiers of the land in the mid to late 19th century prior to European settlers arriving in the area. They also show the lines of the original tracks between Maori settlements and plantations at Takahue, Ahipara, Kaitaia, Oruru and Mangamuka through the valley and over the Maungataniwha Range, and wetlands and watercourses prior to changes wrought by farmer’s drains and raised roadbeds.

Later plans from the 1880s-1900s show the lines of European Roads pushed through both Mangamuka and Victoria valleys, including Garsed’s original line, and later lines surveyed by Campbell, Spencer and Wheeler.

Where the highway, roads and other 20th century developments have not occurred, it can be expected that archaeological features will remain from these occupations and activities – houses and whare will leave postholes, hearths, ovens and fire places, midden and rubbish pits, old roads and track may still be present as overgrown cuttings, embankments and raised formations, with culverts and piles for bridges over streams. Where deep ploughing has not occurred, features related to Maori horticultural activities across the river flats may still be present.

From the mouth of the Raetea Valley westwards to Kaitaia, and from the mouth of Mangamuka Gorge running east and then south to Mangamuka Bridge, the margins of State Highway 1 should be considered archaeologically sensitive. No work should occur outside the existing formation without an archaeological assessment and any future spoil dump sites or other off-line requirements will require an archaeological assessment.

Table 1: Slips, Spoil Sites, Other Activities, Features, Treatments and Risk in the State Highway 1 Corridor.

Slip/Spoil Site	Feature within 50m and 50-100m	Source	Treatment	Risk
A1	Graded line to Mangamuka 18" timber boxed culvert Side cutting	SO 12895 (1904) SO 3640 (1883)	Concrete pile and cap; concrete channel; guardrail. Manhole and bored drains	Low
A2	Graded line to Mangamuka 18" timber boxed culvert Side cutting	SO 12895 (1904) SO 3640 (1883)	Concrete pile and cap; concrete channel; guardrail. Manhole and bored drains	Low
A3	18" timber boxed culvert Earlier historic track 50-100m west Side cutting	SO 3640 (1883) SO 12998 (1904)	Concrete pile and cap; concrete channel; guardrail. Manhole and bored drains	Low
A4	18" timber boxed culvert Side cutting	SO 3640 (1883)		Low
A5	18" timber boxed culvert Side cutting	SO 3640 (1883)	Concrete pile and cap; guardrail. Manhole and bored drains	Low
A6	18" timber boxed culvert x3 Side cutting	SO 3640 (1883)		Low
A7	18" timber boxed culvert Side cutting	SO 3640 (1883)		Low
A8	18" timber boxed culvert	SO 3640 (1883)		Low
A9	3' timber boxed culvert Historic track 50-100m north Side cutting	SO 3640 (1883) SO 3640 (1883)	Concrete pile and cap; concrete channel; guardrail. Manhole and bored drains	Medium
A10	18" timber boxed culvert Side cutting	SO 3640 (1883)		Low
A11	15' timber bridge 2' timber boxed culvert 18" timber boxed culvert Side cutting	SO 3640 (1883) SO 3640 (1883) SO 3640 (1883)		Medium
A12	2'6" x 20' totara timber boxed culvert 2' x 25' totara timber	SO 3640 (1883) SO 3640 (1883) SO 3640 (1883)	Concrete pile and cap; concrete channel; guardrail. Manhole and bored drains	Medium

	boxed culvert 2" timber boxed culvert Side cutting *Earlier track 50-100m, upslope	ML 9105 (1913)		
A13	Side cutting *Earlier track 50-100m north	ML 9105 (1913)	Concrete pile and cap; concrete channel; guardrail. Manhole and bored drains	
A14	Side cutting	SO 3640 (1883)	--	
A15	16' bridge Side cutting	SO 3640 (1883)	Overslip cleaned up	Medium
Mangamuka Scenic Reserve	Tapapa Wahi Tapu Flat formation Flat formation with ditch Side cutting	FNDC DP SO 3640 (1883) SO 3640 (1883) SO 3640 (1883)		Medium
Mangamuka Church Road	--	--	--	
Makene Road 1	--	--	--	Low
Makene Road 2	--	--	--	Low
Mangatoetoe Road	--	--	--	Low
Victoria Valley Road	1879 School site	SO 6314 (1891) SO 6314 (1891)		Medium
SH 1	1867 Clearing, "Te Ure o Praoa" (sic)	ML 389 (1867)		Medium

Figure 28: Map Sheet 1 – Heritage Features.

Figure 29: Map Sheet 2 – Heritage Features.

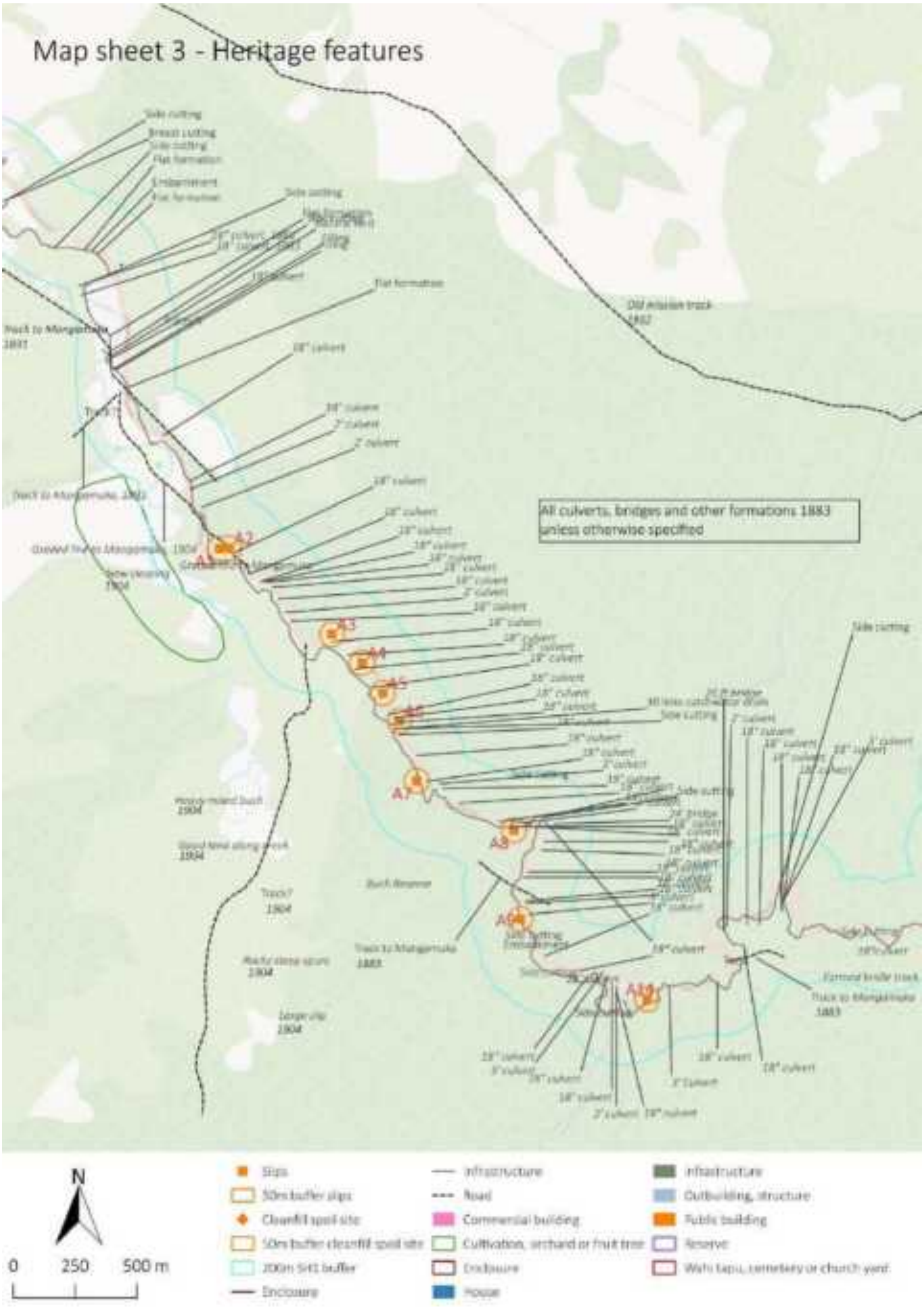


Figure 30: Map Sheet 3 – Heritage Features.

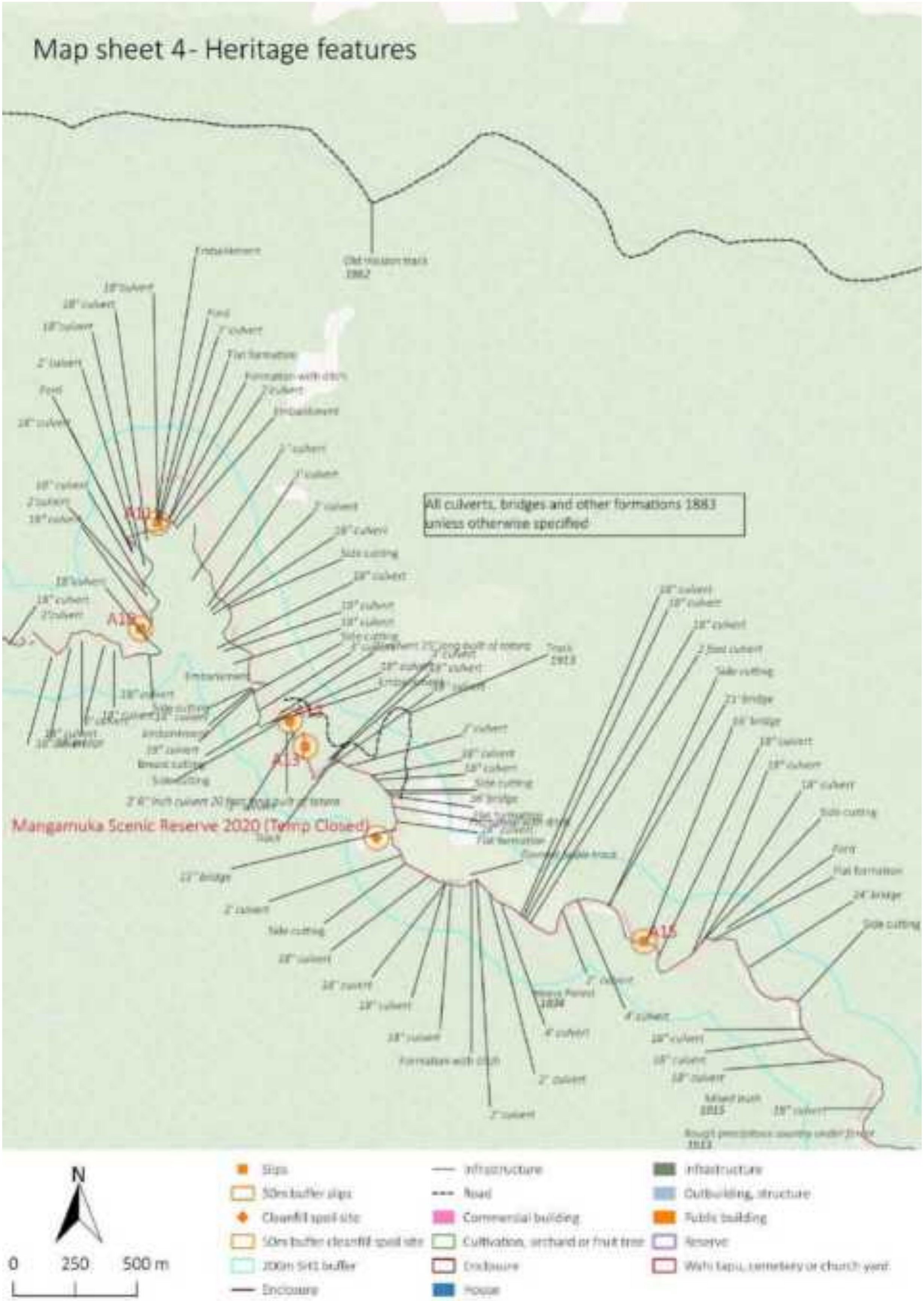


Figure 31: Map Sheet 4 – Heritage Features.

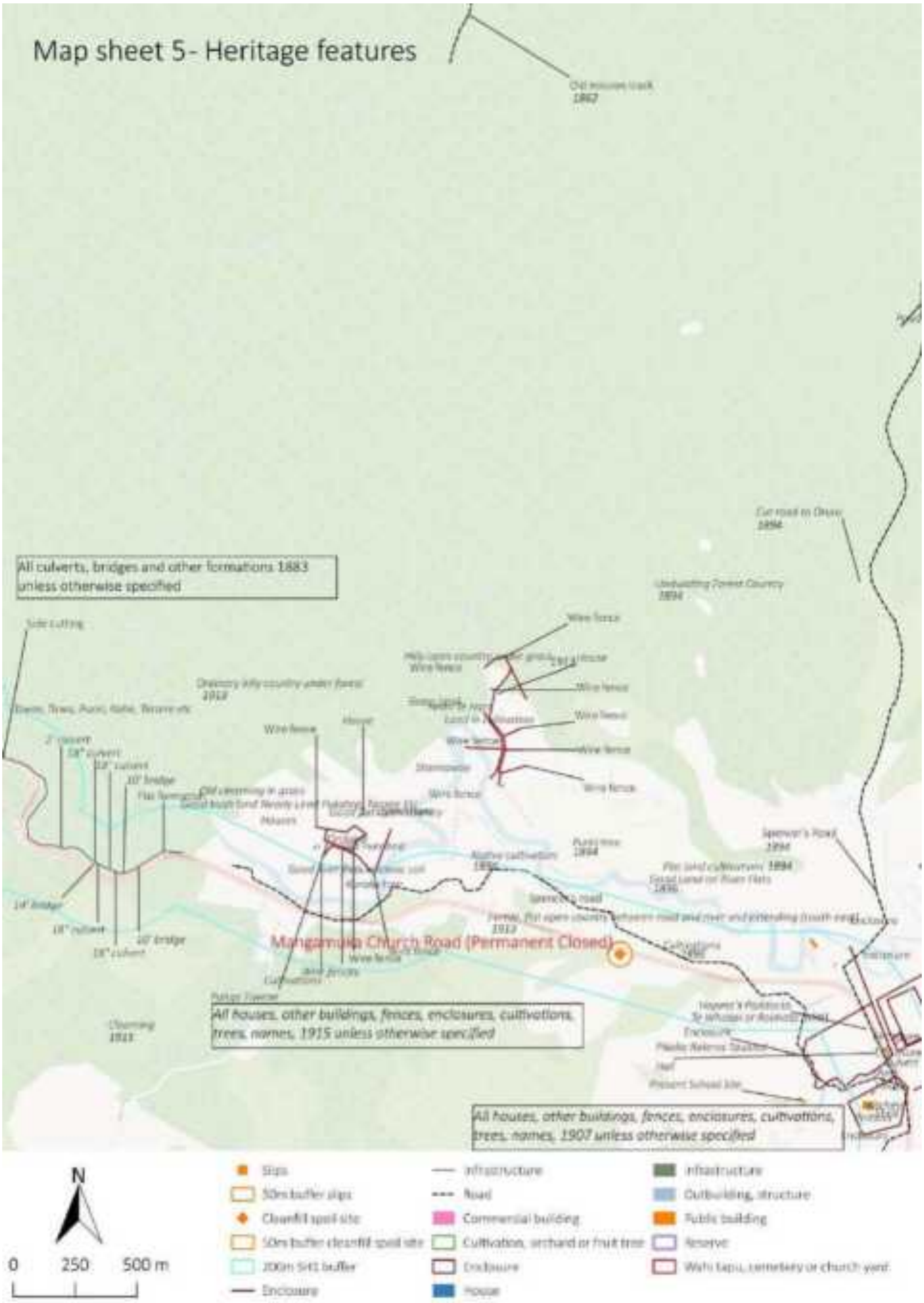


Figure 32: Map Sheet 5 – Heritage Features.

Figure 33: Map Sheet 6 – Heritage Features.

Figure 34: Map Sheet 7 – Heritage Features.

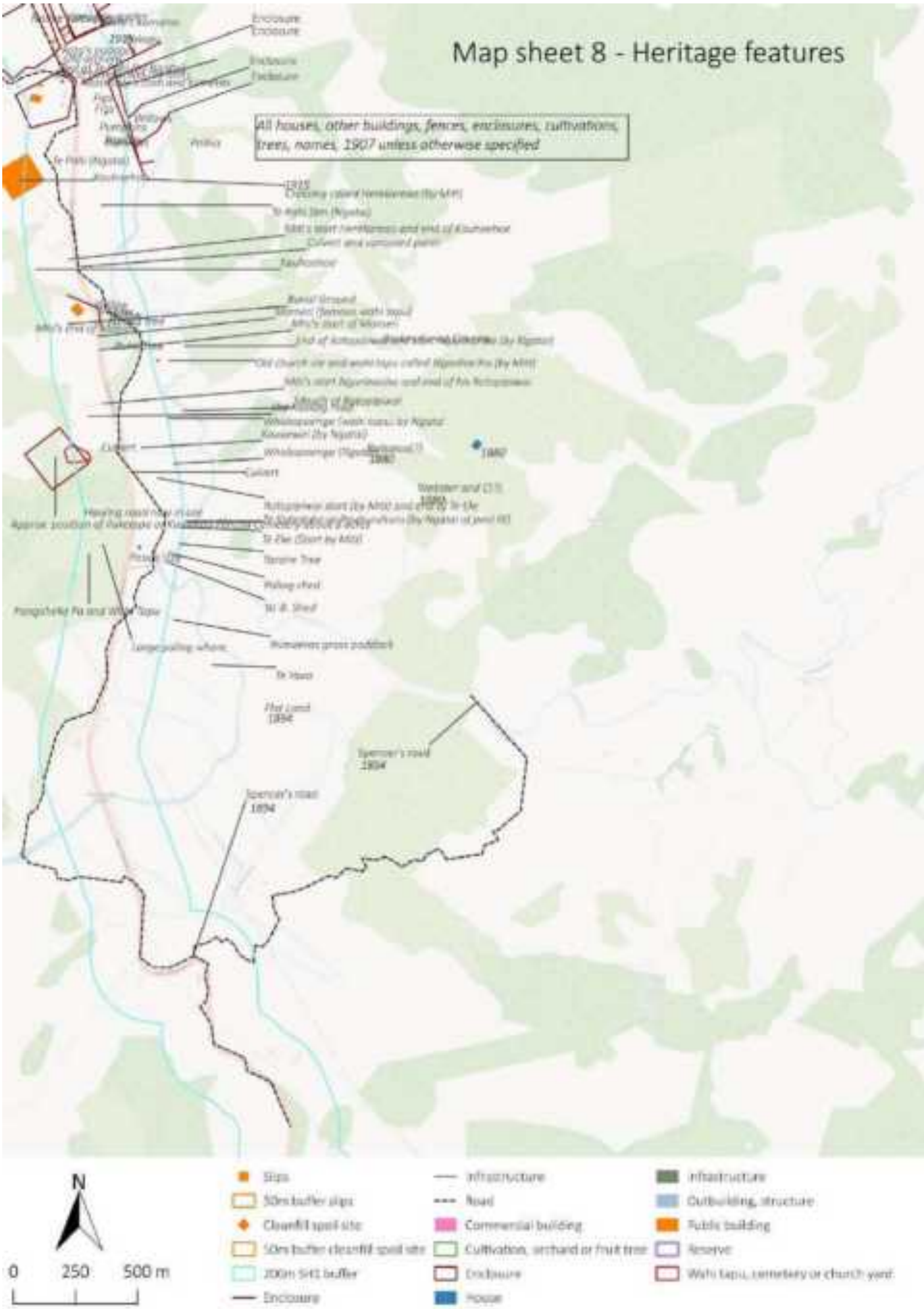


Figure 35: Map Sheet 8 – Heritage Features.

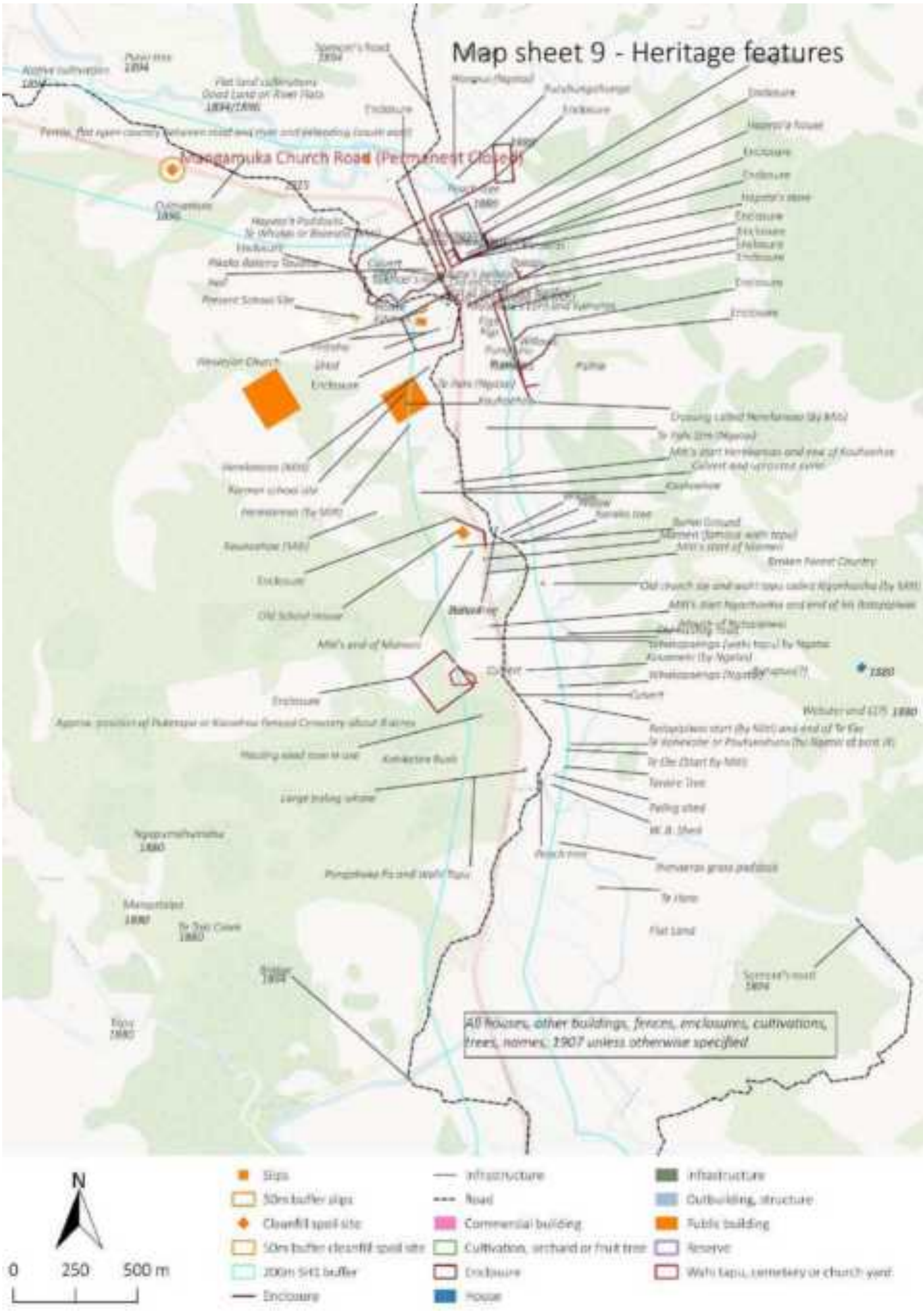


Figure 36: Map Sheet 9 – Heritage Features.

Table 2: Historic features within 200m of State Highway 1, Takahue Road Intersection to Mangamuka Bridge (Polygons).

Date	Source	Feature	Description/Comment
1861?	ML109	Enclosure	Enclosure?
1861?	ML109	Enclosure	Enclosure?
1865?	ML 109	Reserve	Ta Keke
1866	ML 389	Reserve	Manga Tai Ore
1866	ML 389	Cultivation, orchard or fruit tree	Cultivation
1866	ML 389	House	House?
	ML 389	Cultivation, orchard or fruit tree	Clearing, annotated “Te Ure o Praoa”
1866	ML 106	Reserve	Wai Mamaku
1880?	ML 3007	Enclosure	Enclosure and two structures (poor registration)
1891	SO 6314	House	House
1891	SO 6314	House	House
1894	SO 7084-3	Public building	Old School House
1894	SO 7084-3	Public building	Church
1907	ML 6700	House	House
1907	ML 6700	Commercial building	Hapeta's store
1907	ML 6700	Public building	Hall
1907	ML 6700	Outbuilding, structure	Shed
1907	ML 6700	Public building	Church
1907	ML 6700	House	House
1907	ML 6700	Outbuilding, structure	Kitchen
1907	ML 6700	Outbuilding, structure	Shed
1907	ML 6700	House	Whare
1907	ML 6700	Outbuilding, structure	Shed
1907	ML 6700	Outbuilding, structure	Shed
1907	ML 6700	Public building	Former School SIte Kauhoehoe
1913	ML 9105-2	Public building	Post office
1913	ML 9105-2	Public building	Hui house
1913	ML 9105-2	House	Whare
1913	ML 9105-2	House	Whare

Table 3: Historic features within 200m of State Highway 1, Takahue Road Intersection to Mangamuka Bridge (Lines).

Date	Source	Feature type	Description/Comment
1861?	ML106	Road	Oruru and Victoria Road
1862	ML 12805	Road	Old Mission track
1862	SO12805	Road	Old Mission track
1865	ML109	Road	Road taking 1972
1866	ML389	Road	Oruru and Victoria Road
1866	ML389	Road	Road survey
1866	ML389	Road	Road survey
1866	ML389	Road	Road survey
1870s			Flat formation
1870s	SO 1426	Road	Road to Awanui
188	SO 3640	Infrastructure	Embankment
1880	ML 3608-S	Topography and vegetation	Bushline
1880	ML 3608-A	Topography and vegetation	Bushline
1883	SO 3640	Road	Track
1883	SO3640	Road	Track to Mungamuka
1883	SO 3640	Infrastructure	Natural ford

1883	SO3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Filling
1883	SO 3640	Infrastructure	30 links catchwater drain
1883	SO 3640	Infrastructure	Flat formation
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Flat formation
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Formation with ditch
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Flat formation
1883	SO 3640	Infrastructure	Formation with ditch
1883	SO 3640	Infrastructure	Flat formation
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Embankment
1883	SO 3640	Infrastructure	Breast cutting
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Embankment
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Formation with ditch
1883	SO 3640	Infrastructure	Flat formation
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Embankment
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Embankment
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Flat formation
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Flat formation
1883	SO 3640	Infrastructure	
1883	SO 3640	Infrastructure	Filling
1883	SO 3640	Infrastructure	Side cutting
1883?	ML 106	Road	Kaitaia-Oruru Road
1891	SO 6314	Road	Track?
1891	SO 6314	Road	Road
1891	SO 6314	Road	Road
1891	SO 6341	Road	
1894	SO 7084/3	Road	Spencer's road
1894	SO 7084	Road	Spencer's road
1894	SO 7084	Road	Spencer's road
1894	SO 7084/3	Road	Spencer's Road
1894	SO 7084	Road	Spencer's road
1904	SO 12998	Road	Track?
1904	SO 12895	Topography and vegetation	New clearing
1904	SO 12895	Road	Graded line to Mangamuka
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure

1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1913	ML 9105-1	Road	Track
1913	ML 9105-2	Wahi tapu or cemetery	Wahi tapu
1913	ML 9105-2	Enclosure	Enclosure
1913	ML 9105-2	Topography and vegetation	Bushline
1913	ML 9105-2	Topography and vegetation	Bushline
1913	ML 9105-2	Topography and vegetation	Bushline
1915	ML 9999	Enclosure	Wire fence
1915	ML 9999	Topography and vegetation	Bushline
1915	ML 9999	Topography and vegetation	Bushline
1915	ML 9999	Topography and vegetation	Bushline
1915	ML 9999	Topography and vegetation	Bushline

Table 4: Historic features within 200m of State Highway 1, Takahue Road Intersection to Mangamuka Bridge (Points).

Date	Source	Feature type	Description/Comment
1862	ML 12805	Name	Native Reserve
1862	ML 12805	Name	Te Ure Paraoa
1862	ML 12805	Topography and vegetation	Native Reserve
1862	ML 12805	Topography and vegetation	Very rich alluvial soil, level Land
1883	SO 3640	Infrastructure	16 ft bridge
1883	SO 3640	Infrastructure	24 ft bridge
1883	SO 3640	Infrastructure	14 ft bridge
1883	SO 3640	Infrastructure	10 ft bridge
1883	SO 3640	Infrastructure	Ford
1883	SO 3640-3	Infrastructure	26 ft bridge
1883	SO 3640	Infrastructure	17 f bridge
1883	SO 3640-3	Infrastructure	Ford
1883	SO 3640-3	Infrastructure	36 ft bridge
1883	SO 3640-3	Infrastructure	15 ' bridge
1883	SO 3640-3	Infrastructure	Ford
1883	SO 3640-3	Infrastructure	21 ft bridge
1883	SO 3640	Infrastructure	3 ' Culvert
1883	SO 3640	Infrastructure	18 ' culvert
1883	SO 3640	Infrastructure	18 ' culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	3 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	3 ' culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	18 " culvert

1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	38 ' bridge
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	Embankment
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	3 ' culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	18 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Road	Track to Mangamuka
1883	SO 3640	Infrastructure	3 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	2 ' culvert 25 ' long built of totara
1883	SO 3640	Infrastructure	2 ' 6 " culvert 20 ' long built of totara
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	3 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	18 " cuvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	4 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert

1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	4 ' culvert
1883	SO 3640	Infrastructure	18 ' culvert
1883	SO 3640	Infrastructure	18 ' culvert
1883	SO 3640	Infrastructure	18 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	10 ' bridge
1883	SO3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	2' culvert
1883	SO 3640	Infrastructure	2' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	2' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	3' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	3' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	24' bridge
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert

1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	3' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	3' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	2' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO3640	Infrastructure	Embankment
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	3 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	3 ' culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	18 " culvert
1883	SO 3640	Infrastructure	2 ' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1891	SO 6314	Name	Campbell's abandoned Road surveyed about 30 years ago
1891	SO 6314	Name	Garsed's Road which it is proposed to close
1894	SO 3640	Wahi tapu or cemetery	Burial Ground
1894	SO7084-3	Public building	Old School House
1894	SO7084-3	Cultivation, orchard, fruit tree	Native cultivations
1896	ML 6700	Cultivation, orchard, fruit tree	Cultivations
1904	SO 12895	Road	Graded line to Mangamuka
1907	ML 6700-1	Name	Maunganui
1907	ML 6700-1	Name	Hapeta's Paddocks
1907	ML 6700-1	Name	Te Whakai or Roimata (Miti)
1907	ML 6700-1	Name	Hapeta'a house
1907	ML 6700-1	Name	Hapeta's store
1907	ML 6700-1	Name	Rata's paddock
1907	ML 6700-1	Cultivation, orchard, fruit tree	Old orchard
1907	ML 6700-1	Infrastructure	Culvert
1907	ML 6700-1	Name	Piritaha
1907	ML 6700-1	Outbuilding, structure	Kitchen
1907	ML 6700-1	Outbuilding, structure	Shed
1907	ML 6700-1	House	House
1907	ML 6700-1	Outbuilding, structure	Shed
1907	ML 6700-1	Name	End of Herekareao (by Miti)
1907	ML 6700-1	Topography and vegetation	Poplars
1907	ML 6700-1	Name	Miti's start Herekareao and end of

			Kauhoehoe
1907	ML 6700-1	Infrastructure	Culvert and uprooted puriri
1907	ML 6700-1	Topography and vegetation	Willow
1907	ML 6700-1	Topography and vegetation	Willow
1907	ML 6700-1	Topography and vegetation	Willow
1907	ML 6700-1	Cultivation, orchard, fruit tree	Karaka tree
1907	ML 6700-1	Name	Miti's end of Mameri
1907	ML 6700-1	Name	Mameri (famous wahi tapu)
1907	ML 6700-1	Topography and vegetation	Puriri Tree
1907	ML 6700-1	Name	Miti's start of Mameri
1907	ML 6700-1	Name	Miti's start Ngarihariha and end of his Rotopipiwai
1907	ML 6700-1	Road	Old hauling road
1907	ML 6700-1	Infrastructure	Culvert
1907	ML 6700-1	Name	Whakapaenga (Ngatai)
1907	ML 6700-1	Infrastructure	Culvert
1907	ML 6700-1	Name	Rotopipiwai start (by Miti) and end of Te Eke
1907	ML 6700-1	Road	Hauling road now in use
1907	ML 6700-1	House	Large paling whare
1907	ML 6700-1	Name	Pongaheka Pa and Wahi Tapu
1907	ML 6700-1	Outbuilding, structure	Paling shed
1907	ML 6700-1	Cultivation, orchard, fruit tree	Peach tree
1907	ML 6700-1	Outbuilding, structure	W. B. Shed
1907	ML 6700-1	Topography and vegetation	Taraire Tree
1907	ML 6700-1	Name	Kauaewiri (by Ngatai)
1907	ML 6700-1	Name	Te Eke (Start by Miti)
1907	ML 6700-1	Name	Kauhoehoe
1907	ML 6700-1	Name	Te Pahi Stm (Ngatai)
1907	ML 6700-1	Name	Herekareao (by Miti)
1907	ML 6700-1	Name	Herekareao (Miti)
1907	ML 6700-1	Public building	Hall
1907	ML 6700-1	Name	Te Pahi (Ngatai)
1913	ML 9105	Road	Formed bridle track
1913	ML 9105-1	Road	Track
1913	ML 9105-1	Road	Formed bridle track
1913	ML 9105-2	Topography and vegetation	Fertile, flat open country between road and river and extending [south east]
1915	ML 9999	Topography and vegetation	Good river flats volcanic soil
1915	ML 9999	Cultivation, orchard, fruit tree	Karaka tree

7.0 Recommendations

An archaeological Authority is not required for the slip remediation and associated works in the Mangamuka gorge and over the range. The features recorded in the project area do not appear to have been constructed before 1900, and if they were are unlikely to have survived subsequent road building activity and slip, and/or the works being undertaken provide limited opportunity to identify or recognise such features. Nevertheless, an accidental discovery protocol should be in place and any potential features uncovered should be investigated.

An assessment of the Mangamuka Scenic Reserve should be undertaken, given the area is a scheduled site of significance to Maori and the area has already been affected by use as a spoil dump site and as a site office for the slip remediation. If additional ground disturbing activity is required in this area, it should be assessed.

An assessment of the spoil dump site at State Highway 1 Victoria Valley should be undertaken, given the area was a surveyed clearing associated with the descendants or Ure of Praoa (sic; probably Paraoa) however the area has already been affected by use as a spoil dump site and farm buildings/yards. If additional ground disturbing activity is required in this area, it should be assessed.

An extensive archaeological landscape is present to the northwest and southeast of the project area, within Mangamuka and Victoria Valleys/Takahue. Both valley systems were highly productive horticultural landscapes utilised by Maori, and recognised by European settlers. Extensive accounts of dense occupation and horticulture are available for Mangamuka in the 19th century and this likely extended into the pre-European contact period despite the few archaeological sites recorded in the area. In contrast, many sites have previously been recorded in the Victoria Valley area (at the western end near the confluence of the Victora and Takahue River valleys) but there are fewer detailed 19th century descriptions, although its value to Maori and the recognition of the importance in maintaining ownership over it in the face of land sales is discussed in detail in the Muriwhenua Waitangi Tribunal report.

No work, including site establishment, spoil dump site establishment, disestablishment or other ground disturbance should occur in the vicinity of State Highway 1 between the SH1/Omahuta Road intersection and the Mangamuka Scenic Reserve or from the Raetea campground northwards to Kaitaia without an archaeological assessment. These assessments should be circulated to stakeholders and appended to this report as they are produced.

Work may occur on or within the existing formation without assessment through the gorge and over the range.

8.0 Summary

Geometria Ltd was commissioned by Waka Kotahi to provide an assessment of archaeological and historic heritage values for State Highway 1 from Mangamuka to Victoria Valley due to the need to undertake slip repairs on the highway through the Mangamuka gorge and over the range to the Raetea Valley.

The Mangamuka and Victoria Valleys were centres of pre- and post-European contact Maori settlement. European explorers describe a dense Maori occupation in the mid-19th century. A network of foot tracks and the navigable parts of the rivers connected kainga or undefended settlements and adjacent extensive plantations of traditional and more recently introduced crops and fruit trees with each other, traversing tracts of primary forest. European sawyers huts were present on the lower banks of the Mangamuka River. The Mangamuka gorge and Mangamuka/Maungataniwha range was an important route between the Hokianga, Oruru and Victora/Takahue Valleys, but the earlier track networks were located away from the current alignment through the rough and broken country.

Improvements and realignments of existing tracks through the area was lobbied for by European settlers in the 1870s and 1880s seeking another outlet for their produce, but was hampered by terrain and the necessity of securing access over a substantial area of Maori land. A major centreline survey and specification for the road with numerous bridges, cuttings, embankments and several hundred culverts was undertaken in 1883 but it appears that none of this work was undertaken prior to 1900, with the main route deviating from the current alignment at the north western end of the Mangamuka Valley to the north through Fern Flat until the early 20th century.

By 1900 the settlement pattern in the Mangamuka and Victoria valley had changed to one of dispersed individual homesteads and adjacent paddocks, cultivations and orchards, but the old communal plantations and kainga had probably been abandoned in favour of a more individualised living arrangements several decades earlier.

There is abundant evidence of potential archaeological sites in the Mangamuka and Victoria Valleys, with house sites, public and commercial buildings, cultivations, orchards and paddocks indicated, along with wahi tapu, burial grounds, and the sites of earlier settlements, defended and undefended. However within the project area where the slips are being resolved there are unlikely to be any archaeological effects and an archaeological Authority is not required for the current works. Ad-hoc work such as opening new spoil dump sites may have archaeological or other historic or cultural heritage effects if undertaken without assessment, so these should be carefully considered prior to establishment.

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ML 3608/4

ML 6700/1

ML 6700/2

ML 9105/1

ML 9105/2

ML 9105/3

ML 9105/4

ML 9999

ML 12805/1

ML 12805/2

ML 12805/3

ML 12805/4

ML 12805

ML 13095

ML 15326

SO 798/1

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SO 798/4

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SO 7084/2

SO 7084/3

SO 7084/4

SO 8481

SO 12894

SO 12895

SO 12998

SO 16386

SO 18581

SO 18581

SO 19837

SO 23291

SO 24399

Appendix A – Maori Land Court Minutes

Table 5: Mangamuka Block Records.

Minute Details	Kaikorero	Whakapapa	Tupuna	Iwi/Hapu	Note
Mangamuka West Plan ML 3608 Northern MB No. 19: 137-150 10 April 1897 Title investigation Rawene	Henare, Hapeta Pou, Tawhio Te Waru, Piraki Apatari, Tipene Mete, Rihari Kiroa, Hipirini Rore, Kare Hohaia Pero, Mange Hare, Rihi Otene, Mitikakau	Pou, Tawhio Mete, Rihari Rore, Kare Hohaia Pero, Mange Hare, Rihi	Raroa Roha Rihi Papanui Mawi Kanohi Kaiwhare Kahuti Tupoto	Te Kohatutaka Te Uri-o-Te Aho Te Uri-o-Rorokai Te Waiwhakahihi Te Patu Te Rarawa	Papatupu claim Arranging case
Mangamuka West Northern MB No. 19: 151- 13 April 1897 Title investigation Rawene	Pou, Tawhio Apatari, Tipene Otene, Mitikakau	Pou, Tawhio Apatari, Tipene Otene, Mitikakau	Paihia Moewaka Whata Tama Tamahaere	Ngati Rangitinia Te Patu Te Rarawa	
Mangamuka West Northern MB No. 20: 1-72, 74-112, 116-145, 151, 161 23 April 1897 Title investigation	Otene, Mitikakau Hahakai, Karipa Kiroa, Hipirini	Hahakai, Karipa Kiroa, Hipirini Pero, Mange	Tamahotu Tama Kaiwhare	Te Uri-o-Te Aho Te Rarawa Te Patu / Te Rarawa	Kauri forests, p.90 Decision, pp.139-145 Index to witnesses,

Rawene	Rore, Kare Hohaia Pero, Mange Hare, Rihi Mato, Taniora Pororua, Tahere	Hare, Rihi Mato, Taniora Kiwa, Karena	Kahuti Papanui Te Hoe Moewaka Tariaho Rapehuamutu	Te Kohatutaka Ngai Tupoto Te Uri-o-Rorokai Ngati Kaiwhare Ngati Te Rauwawe = Te Kohatutaka	pp.191-195
Mangamuka West Northern MB No. 20: 176-195 31 May 1897 Title investigation Rawene	Whiu, Ropata Otene, Mitikakau Hare, Nui Kerenene, Hori Mato, Taniora Tauranga, Kurupae	Kerenene, Hori	Te Waha Parangia		Arranging lists Lists of trustees, pp.187-189 Index to witnesses, pp.191-195
Mangamuka West Northern MB No. 22: 33-34, 188-190 27 July 1897 Injunction	Hapeta, Henare				Re timber cutting

Rawene					
Mangamuka West Northern MB No. 29: 168-189, 199-210, 265-269, 273-274 11 May 1900 Title Investigation, appeal Rawene	Hape, Hone Henare, Hapeta Te Waru, Paraki Kiroa, Hipirini Wepiha, Hone Henare, Hapeta				Decision, pp. 265-269 List of owners, pp. 273-274
Mangamuka West Northern MB No. 35: 82, 85, 90-101, 104-112, 122 8 January 1904 Partition Rawene	Kiwa, Karena Otene, Mitikakau Mete, Rihari			Te Uri-o-Te Aho Te Patu	Decision, pp.111-112
Mangamuka West Northern MB No.					

Table 6: Mangataeore (Mangataiore, Manga Tai Ore) Block Records

Minute Details	Kaikorero	Whakapapa	Tupuna	Iwi/Hapu	Note
Mangataeore Northern Minute Book 1: 33 15 March 1867 Title Investigation Ahipara	Te Pau, Hemi Kiriona, Nopera Ehakai, Karipa		Te Ure Paraoa		381 acres
Mangataeore Northern Minute Book 37: 72, 74, 88-91, 110-11 4 April 1905 Definition of Relatives Interests Mangonui	Maihi, Wairama				

Table 7: Ta Keke (Takeke) Block Records

Minute Details	Kaikorero	Whakapapa	Tupuna	Iwi/Hapu	Note
Northern Minute Book 1: 7 30 December 1865 Title Investigation Ahipara	Parihiku, Tohuora Te Kanohi, Wharerau				79 acres

Table 8: Wai Mamaku (Waimamaku) Block Records

Minute Details	Kaikorero	Whakapapa	Tupuna	Iwi/Hapu	Note

Northern Minute Book 1: 7 30 December 1865 Title Investigation Ahipara	Te Kanohi, Wharerau Wharerau, Hehi Karaka, Kawau				154 acres

Appendix B – European Descriptions of Mangamuka and Takahue/Victoria Valley

Wakefied., E. G., 1837. The British Colonisation of New Zealand. The New Zealand Association, London.

Wakefield quotes a letter from an English settler, Oakes, to The Colonist newspaper referring to a trip up the Mangamuka he took in February 1834 (260-261):

> "On one of my excursions I met Mr White the Wesleyan missionary. I had two or three days previously the pleasure of making his acquaintance; he invited me to accompany him up the Mangamuka river another branch of the Hokianga. He proceeded fifteen miles up the river (Mangamuka) which is as far as it is navigable from about half way the river narrows gradually to about a hundred feet in width. Here the beautiful pines and other evergreens on each side meet at a considerable height in the centre and form a complete shelter from the heat of the sun. The village of Mangamuka is about three miles above the navigable part of the river which we walked. This valley exhibits by far the finest cultivation I have seen. It is cleared in patches from the thickest forest imaginable which extends for miles on both sides. Here Mr White is erecting a chapel some few of the natives have been baptized and a great proportion of them are much inclined to Christianity. After tea a very respectable congregation assembled with prayer books and bibles and hymns were sung; I believe a translation of Watts; in fact, all their books were in the New Zealand language but printed in the English character. Most of the natives present could read and write well.
>
> The service was concluded by a short exhortation; some of the chiefs remained in cheerful conversation versation with Mr White till it was time to retire to rest. It would be absurd, were I from the little experience and information I have been able to acquire, to say that the missionaries have generally benefited the savage inhabitants of this country, for benighted and savage they will continue until they can be dissuaded from their barbarous propensity for war; but I have no hesitation in declaring as my opinion, that, were all the missionaries like Mr White, who is beloved and respected by natives and Europeans, there could be no doubt of the successful result of their labours; and I must say, to the infinite credit of this benevolent man and zealous Christian that the natives of Mangamuka are far more industrious, cleanly, and obliging, than any other tribe I have seen:- and many of them influenced by his persuasion, have become excellent sawyers. The cultivation of their land, in particular, affords an example worthy of imitation to the more experienced farmer of a civilized country. Mr White's colleague is likewise a very deserving and respectable young man; I am sorry I forget his name. They are both married, and their amiable wives are indefatigable in their exertions to instruct the native females in religious duties and useful knowledge I am so satisfied".

Markham, E. 1863. New Zealand or Recollections of It. Part 1.

In 1834 Markham arrived in New Zealand and settled in Kohukohu (Coko) In March he travelled to Mangamuka:

> "The beginning of this Month I went up the Mouna Mouca [Mangamuka], or Black flax River Twenty five miles above the Coko, to a Native Village (Kangar Mourie). There are Eleven different Sawyers settled up this River; some bought land, In fact most of it; about 20 Europeans living up there. I went up with Poynton, took 2 pieces of Pork, 2 or 3 Kits of Potatoes, a bottle of Rum. Poynton understands their Customs and is a pretty good Linguist, ** The River is beautiful. Fine Woods on both sides, here and there the Mud banks covered with Mangroves. Shot some King fishers and a Duck or two. As you get higher up the River the Native Settlements become thicker. They are all Missionaries as they call the Christians *** and the Sawyers Houses mostly Weather boarded and lined.

Some of them very nice and their Saw pits Sheded over, and Thatched and convenient for Water carriage. As the Coudie Forests is on the tops of the Hills all the way up and down the River. There is something so beautiful in the Rivers in this Country. A Stillness, fine sky over head! no Noise! now and then a Fish will leap or King fisher dart down and a beautiful little Bird called a

Colly Mocko [Marginal note]

"Colly Mocko" **** who flutters about a Flower more like a Butter fly with all his feathers spread so that he looks large, but is not the size of a Wall-nut.

Pea Walker [Marginal note]

There is an other small bird called a Pea Walker [piwakawaka]. The Natives call Russel at Showracky, Pea Walker as he is a very diminutive Fellow.

We at length arrived as near the head of the River as Boats can go, for fallen Timber. At a native settlement, The Chief and Priest for he is Tabbooed, gave me a small hut to sleep in and cut fresh Palm leaves, and a clean Mat for me to sleep on, but in the first instance, I laid down in the front place of his Hut, a sort of Audience Chamber on clean Mat. Venus awoke me by killing a Rat close to me; about Sunset we had Pork and Potatoes and a Glass of Grog and lay down after to Talk by the light of the Fire. The Chief asked a number of questions. I was called a Rangatara tara, or great Chief ***** come to see other Countries, and he asked me if I had a Waheinee [wahine]! No. Would I like one? Certainly. Then take my daughter. Which I did in New Zealand fashion. I took her out of his Womens Hut, She screaming till I put her into the Hut drest out for me.

* Our first quarrell was about my boys. E. M.

** Poynton was sent to NSW for white Boyism. E. M. The Whiteboys were members of a secret Irish agrarian association and were so called because they wore white shirts over their other clothes to distinguish each other during night raids.

***I have seen 10 or 12 cannoes full of Natives go down this River, to the Wesleyan Mission on the Saturday afternoon ready for the Sunday. E. M.

**** 'Colly Mocko' suggests korimako, the bell bird, but the description points rather to the fantail {piwakawaka) which Markham goes on to mention.

***** A mistranslation; the only complimentary meanings of tara that fit the context are 'quick', 'active', or 'distant'.

The Row ceased and no further opposition was offered. Next morning we all went about 7 miles inland to a large Settlement To see a New Zealand Wake. I crossed a Stream a dozen times, mostly on a Mans back called a (Pekow [pikau] is to carry Upanga [hapainga], lift me up). * I shot some small birds by the way. We had to go through Cultivation mostly all the way.

Tarraw or Yam [Marginal note]

Indian Corn, potatoes and Cumeras [kumara] or Sweet potatoes, Tarraw [taro] a kind of Yam. The Tarras comes I believe from the Southsea Islands. It grows about three feet from the Ground but it is not good. I was very fond of the Cumeras, and Venus got so knowing, that she used to go and Overhaul all their Canoes for them, as they keep them cold, boiled. The land was rich on all sides and plentiful Crops of Maize or Indian Corn. Numbers of Immense Trees sticking up here and there half Burnt and blackened, in the midst of the Corn and showing that it could not have been in cultivation many years, having been all Forest. At last we came to the Village and were received by the Dogs in advance, but we

Peaches [Marginal note]

found some two or three hundred people sitting about in groups. I had Peaches given me in quantities, and have no doubt that some day the Natives will have all sorts of Fruits and Vegetables. On arriving I was requested to fire my two Purra [tupara] as the Natives call a double barreled Gun, in honour of the (Mattie Noue) [mate nui] dead. She was a young lady, who had been living with a Man named Cockrane [Cochrane] a Sawyer. She was to be buried the next day, and we saw her laid out on a Mat with her Cacahow over her as if she was asleep, with her Hair drest out with Feathers. You often see a red Box in which the Bodies are put, till

Tabboo or Tappoo [Marginal note]

the flesh is rotted off. Then the Priest scrapes the bones, or some people are Tabbooed for the purpose. When people are Tabbooed they are fed by Children, and they must not touch food with their own hands. There were people crying and very like an Irish howl going on, and plenty of Potatoes scraped. The place was a dead Flat in a Valley of high Wooded Hills on either side. I then took a walk round the settlement. A fine running stream over a gravelly bed winding through the Valley. Near the

* Though the meaning of this sentence is fairly clear, punctuation and syntax are even more defective than usual: pikau means to carry on the back; hapainga is the passive form of hapai, lift up, raise.

Huts were plenty of Peach trees with Peaches on them. I saw the Potatoes on (Wutters) [whata] for the first time; there are two sorts, one is four upright Posts, 20 or 30 feet high and floored over like a hurdle so far apart that they can get their hands Through, and the Potatoes are in Kits * or Baskets said to average 60 lb weight. They are drawn up and stowed and then Thatched over for some Months till They are wanted. The Rats attack them so that they have hit upon an ingenious plan of putting bark all round the upright Posts and trees, and the Rats get up into a kind of Extinguisher all round the Tree or Wutter but the Rats can not mount. Air being given from below they keep well. I have seen a Wutter or Plat form 80 feet above ground in an immense Tree all the Branches cut off and a Platform well secured, and the Potatoes on it and thatched over. They have no Frosts of any consequence to hurt them during their Winter, but I know to my cost, it is very Cold and I enjoyed a fire very much during the cold weather. The Natives wanted Venus as she was very much admired at this settlement. I was very much afraid of losing her. We returned the seven miles but found the Tide, ti Puddie [taipari] or Ebb Tide, ** had made so that the Boat would not float, so we staid that night. So we Cooked our Pork and Potatoes, drank my Grog and took a Stroll. I was delighted in seeing Miss Awattie *** [Watea?] having a Swim, previous to her taking up her abode in my Hut this night. No noise this evening; like a good girl she was awaiting her Lord; in the morning we had Potatoes done the Native way. I had to pay for my Nights amusement and asking Poynton how it

* Markham may be using the Maori kete, 'basket made of flax', the English 'kit', meaning knapsack or valise, or a combination of both; the similarity between the two words and their respective referents has added to the New Zealand idiom a distinctive term of which this may be an early example.

** The Maori phrase literally means flowing tide.

*** The 'A' which Markham prefixes to this and other personal names is probably the vocative 'E', corresponding to the English 'O'.

was to be managed, he advised me to give my Shirt so I took my Shirt off and gave it to the Priest her Father. A Box of Lucifers to light the pipe of her Lady Mother. A Pocket handkerchief to the young lady herself. And wishing the Aimable Family Good day returned down the River to the Coco, with a beautiful breeze. There was a laugh at my Expence at the Coco, about the Shirts and my Boys told the others and they were very Facetious on the Subject and every body knew what I had been about up and down the River.

Wade, W., 1842. A Journey in the Northern Island of New Zealand.

"Mr. Woon, having made arrangements for taking Mrs. Woon up the Mangamuka river, I was glad to avail myself of his friendly invitation to accompany them. At nine o'clock, A.M., we left the settlement in a large boat belonging to Capt. M'Donnell. The banks of the Mangamuka are thickly wooded. Here and there were seen the homely cottages of white settlers; those who were then living on the banks of the river being for the most part sawyers. The Hokianga is a noble river, running through a thickly timbered district, and supplying the spars which are so much in request for masts, &c; but the bar at the entrance of the harbour has always been a serious deduction from its other advantages…

After calling on one of the Mangamuka settlers, we came to Mangataipa, a retired pa, situated on a bend of the river. Beyond this, the stream becomes narrow and more winding, and as it takes its course through a forest of lofty evergreens, which grow close to the water's edge, and frequently overhang the river, the eye is refreshed by varying and lovely scenery. Higher up, the river is impassable for boats, the trees which have fallen into, and across it forming a serious obstruction. The natives, however, with their shallow canoes, easily manage to glide over or under. We landed on the western bank of the river, and, after a short and pleasant walk through the wood, arrived at Rotopipiwai, a native settlement fifteen miles or more up the river, and delightfully situated in a fertile valley. There was no pa, but only a few scattered houses, with low fences, and a large native built chapel. We could see the lofty peak of Maungataniwa in the distance.

Maungataniwa is one of the loftiest mountains in this part of New Zealand. It rises towering amid a wilderness of hills, clad to their very summits with the perpetual green of a dense forest. The road which has been cut through this forest runs within about a quarter of an hour's climb of the pointed top of Maungataniwa. Travelling once in that road, a splendid scene, near the great mountain's top, unexpectedly opened before us. Through an agreeable break in the seemingly interminable wood, we looked down upon what appeared to be an immense unruffled lake, its clear mirrored surface reflecting many a floating cloud of varied hue, while here and there a wooded island rose to add its interest to the scene. We looked up; not a cloud was visible. In truth, we had been gazing upon a brilliant mass of sunny clouds beneath us, and our imagined islands were neither more nor less than hill tops peeping through.

Mr. Woon informed me that many natives from the different villages on the Mangamuka, --some from a considerable distance higher up than Rotopipiwai, --were in the habit of assembling at Mangungu on Sundays; bringing their wives and families in canoes on the Saturday, and returning on the Monday. From other branches of the Hokianga, natives also attended in a similar manner.

We returned part of the way down the Mangamuka in a small canoe, in which we had to pass both over and under the fallen trees. To glide under one large tree, which had fallen completely across the river, we were compelled to lie perfectly flat in the canoe. It was about eight o'clock, P.M., when we got back to Mangungu"

Dieffenbach, E., 1843. Travels In New Zealand.

"[The Awaroa (Awanui) River] arrives at Kaitaia. A mission-station and native settlement is situated about eight miles from the western coast, on a hilly eminence, an offset of the chain of hills which run from near this point through the interior. Between this chain and the range of western coast hills which I have above mentioned, flows the Awaroa, having its source near that of the Mango-muka--a branch of the Hokianga river, from which it is separated by the Maunga Taniwa, a remarkable pyramidical peak which towers above the chain of hills, being nearly 1500 feet high.

Throughout its course the valley of the Awaroa is capable of being made very productive, as the soil is extremely fertile: from Kaitaia it narrows to the breadth of one mile. Several miles below Kaitaia the river is joined by another, coming from the eastern hills in the neighbourhood of Mangonui in Lauriston Bay, and at the point of junction scarcely inferior in size to the Awaroa. Above Kaitaia the Awaroa is only passable by canoes, in which the natives carry down food from their plantations to their principal settlement at Kaitaia. They prefer the upper part of the valley for cultivation, as indeed they usually do; and their fields are very extensive, and kept in good order. From Kaitaia to the western coast the land is equally good. In some places there is excellent grass, rather an unusual thing in New Zealand. A wooden bridge over the river has been built by the natives, under the guidance of the missionaries; and if we cross it, and pass to Waro on the western coast, several valleys are seen stretching from the western hills into the plain, in most of which natives reside. To the northward of Waro low ridges run parallel to the sea-coast, small creeks flowing between them, and the light soil there is eagerly sought after for the cultivation of kumeras. At one of these creeks, the Wai-mimi, there is an extensive bed of lignite. About two miles to the northward of Kaitaia is a small fresh-water lake, containing large eels and two kinds of small fishes; crawfish is also found there.

The natives form the tribe of the Rarewa, and their whole number is about 8000, including all those who inhabit the valley of the Awaroa. Of all the natives who are under the influence of the missionaries, this tribe is the most advanced in the arts of civilization. This must be ascribed partly to the endeavours of the missionaries and partly to the comparative isolation of the natives, resulting from their having been powerful enough to resist the aggressions of E'Ongi from the Bay of Islands, and of the neighbouring tribes. The traveller does not meet here with that begging and grasping behaviour which renders the natives on the coast so importunate; on the contrary, they are a quiet hard-working people, and they have, for a very small payment, cut a road thirty-two miles long through the primitive forest, between Kaitaia and Waimate, in the neighbourhood of the Bay of Islands; they have also cut roads in the neighbourhood of their own village. During my stay I saw them reap wheat and plough several acres of land, and the missionaries encourage them to exchange their former unwholesome food of decayed maize and potatoes for bread. Several of the natives have one or two head of cattle and horses; and I have every reason to believe that here at least the missionaries will encourage their acquiring them, in order to dispose of the increase of their own stock.

The village has quite an English appearance; a large church, with a steeple of kauri boards, has been constructed almost entirely by the natives; gardens, with roses, are before the houses, and at the foot of the hill wheat alternates with vines, with hops, which thrive extremely well, and with various fruit-trees and vegetables: there are also several patches planted with tobacco.

The natives lived originally at the Hokianga, but about twenty-five years ago they took Kaitaia from the Haupouri and Nga-te-kuri, who must have been very numerous, judging from the remains of their pas on the neighbouring hills. A great portion of these tribes were slaughtered, and the rest either were made slaves or mixed with the conquerors. About eight years ago the missionaries established a station here, the wars between the native tribes having come to a termination, and they found it comparatively easy to obtain an influence over them.

The hills which stretch from Kaitaia, through the interior of the country, are wooded, and only a few miles from Kaitaia they are covered with kauri-forest. Near the entrance to Rangaunu Bay are very fine groves of this valuable tree, mixed with tanekaha, rata, towai, and other excellent timber-trees. An arm of the sea, which is joined here by a fresh-water creek, the Mangake, and which flows through a considerable extent of forest, affords facilities for floating the timber down, or for establishing saw-mills.

The alluvial land, as already observed, is for the most part fit for immediate cultivation: the herds of cattle and horses belonging to the missionaries are in excellent condition, and show that there is a sufficiency of pasturage.

In the neighbourhood of the mission-station there is found a white, hard, and very closely-grained sandstone, which would prove an excellent building-stone.

The hills near the western coast, on the left bank of the Awaroa, consist of basaltic masses, of rounded forms and of moderate height. They are covered with a mixed forest; no kauri is found there; and all the land to the westward of the Awaroa must be considered as excellent, notwithstanding its hilly character. The hills on the right bank, which extend through the interior of the island, are composed of a soft argillaceous slate, reposing upon a base of hard volcanic rock, phonolithe, or clinkstone. Where the claystone and the phonolithe are in contact, a transition from the hard condition of the latter to the soft state of the former is observable to the eye of the geologist, and displays an instructive phenomenon. Very near Kaitaia, about 150 feet above the level of the valley, a slaty marl crops out in perpendicular slabs in the depressions of the hills, and is an excellent material for improving the soil of certain kinds of fields, and is, in fact, extensively used in agriculture.

A bridle-road leads from Kaitaia for thirty-four miles through the forest: it was cut by fifty natives for as many blankets, and was completed in six weeks. They were, however, glad when they had finished their task, as they had suffered much from want during the time, as is shown by the following song, which was sung by them on the occasion: --

Ka ngaro te purapura,

Te pata kai:

Etiki ka mate: ko Taewa ka mate:

Ko te Paki ka mate:

Ko te Matiu ka mate:

Ka ka po nei te manawa:

Ka tahuri au ki te reinga:

He poro kaki ka mate.

The tobacco is gone: we have no food cooked in a pot: Etiki is hungry: Taewa is sick: Te Matiu is sick: Te Paki is hungry: all our good cheer is exhausted: we turn back towards the Reinga: we are sick for some food.

The days of such cheap work are now gone by in New Zealand. At a distance of seventeen miles and a half on this road is situated Maunga Taniwa.

The whole valley of the Awaroa cannot contain less than 120,000 acres of arable land. In respect to the quality of the soil, the facility of cultivation, as well as of water communication, the abundance of excellent wood and of other building materials, the district is one of the most favoured in New Zealand. A great portion of the land has been purchased by a few private individuals; but if the intentions of Government, of not allowing more than 2500 acres to any one individual, is strictly carried into effect, a great part of these purchases will come back to the natives, and, without injuring the interests of the latter, government will have no difficulty in acquiring a fine agricultural district. Kaitaia itself, which is eight miles from the western coast, and six from Southee's station, is a desirable place for a provincial town, as it is in the centre of the district, and in a healthy situation; it stands on an eminence commanding a view of the whole district, and is especially adapted to serve as a central point and market-place for the surrounding native population.

...

We now return to the western coast. If we travel from Kaitaia towards the source of the Awaroa, we see its valley separated from the coast by undulating hills of basaltic structure, and covered with forest. Where the basaltic rock is found, the soil is generally good; and I have no doubt that in the course of time these hills will all be cultivated, and thus increase the area which I have assigned to the district of Kaitaia. I do not include in this the hills in the middle of the island, to which Maunga Taniwa belongs: they are too steep ever to be anything but forest-land. The coast from Waro to Wangape, or False Hokianga, fifteen miles to the northward of Hokianga, is bold and rocky. Wangape has never been surveyed. Its entrance is about 200 yards wide; it then expands into a fine basin, surrounded by low wooded hills, and appears to afford no shelter for shipping. The natives have extensive plantations, and belong to the tribe which lives at Hokianga.

Passing from Kaitaia to Hokianga, the bridle-road ascends nearly to the summit of Maunga Taniwa, and then proceeds in a different direction. We leave it here by turning to the westward, and, descending rapidly, soon arrive in a valley, through which a mountain-stream flows, which in its upper part has formed alluvial land about five or six miles broad and eight miles long. This river is the Mangumuka; its length, from Maunga Taniwa to the point where it joins the estuary called the Hokianga, is about twenty miles. At the upper part of the valley there is flat and fertile alluvial land, bounded on all sides by wooded hills; the river, running in a bed of whinstone pebbles, at some places deepens, at others shoals, and its banks bear signs of frequent floods. Lower down its depth becomes more equal, and for about ten miles from its embouchure into the Hokianga harbour it admits vessels of moderate burden. This lower part is bounded on both sides by steep hills covered with kauri-trees, but the best of them have been cut down near the water's edge."

Barrett, A. 1852. The Life of the Rev. John Hewgill Bumby.

In a letter from Brumby to the mission at Mangunu, December 20th, 1839:

REVEREND AND DEAR SIRS,--Having for some time contemplated a visit to Horuru to see the infant church there, and baptize some natives, who, on account of old age and numerous infirmities, were said to be unable to come to Mangungu, a distance of about sixty miles, when the business of the District-Meeting was over, I induced Mr. Whiteley to accompany me, in connexion with Mr. Ironside and Mr. Creed. An opportunity of sending to England offering, I forward a brief account of our expedition, particularly with the view of bringing Wangaroa, our first Missionary settlement in New-Zealand, before the attention of the Committee, as a place which I would very much like to have again enrolled in our list of Stations.

The first evening, after pulling hard for four hours, we arrived at the top of the Mangamuka river, where we left the boat hauled up on the bank, and walked through some beautiful plantations of potatoes and kumeras to Rotopipinai, an interesting settlement of Christian natives, with whom we held service, and spent the night. A hut was given up to us; but it was so small and disagreeable, that I made choice of the outside as my sleeping-place. The following morning, many of the Rotopipinai people accompanied us, so that we formed a numerous and respectable party. Soon after the commencement of the journey, the bottles of heaven were opened, and the rain came down in the most drenching torrents, which, together with the immense mountains we had to climb, and a deep river which had to be crossed about twenty times, rendered travelling rather laborious and disagreeable work. In the afternoon we arrived at the first native settlement, where, with some difficulty, we procured a house, about six feet square and four feet high, in the middle of which we kindled a fire; by which, having wrapped ourselves in blankets, we dried our wet clothes, and boiled the tea-kettle. Having taken food, we were refreshed, and forgot our toil and weariness in travelling up the valley: while we were delighted with the richness of the soil, and the loveliness of the scenery, sorrow filled our hearts in observing several ruined fortifications and desolated villages, from which it was evident, that the population was once much more numerous than at present. About noon we arrived at the chapel, a commodious and substantial native building, which stands in the midst of the valley, as the house of God and the gate of heaven.

Drury, Captain B., 1852 – Survey of the Western Portion of the Northern Province of New Zealand., HMS Pandora, 31 December 1852. Published in the Australian and New Zealand Gazette. 30 July 1853: 871-

There is no other stream of any consequence until we pass the and come to the Mongamuka a river of some considerable importance and down this river most of the timber is conveyed It is navigable three miles at low water for vessels drawing under twelve feet and channel is more than a cable broad Above this the channels are some distance small and intricate It improves again above and as water becomes fresh the timber ponds

> are seen off the north banks Five miles from the mouth at the end of the mangroves the hills de scend steep to the water's edge the channels are narrow and the come down with great force The tide has now little influence mile and a half we come to the village of Mongatipa on the south opposite this village the clay cliff is perpendicular 30 feet high is with the windings of the river two miles above this on the bank is a small compact settlement of Wesleyan missionary natives Above this no boat can proceed but the rapid stream winds through valley admirably cultivated for four miles There is a track and it is the main communication over the shoulder of the Maungataniwa Mountain to Kaitaia and Monganui There are or rather have been two English stations on the river The one belonging to Mr Cockrane a timber merchant now in the Waima the other to a Mr Murray who has built a wooden bridge that must have cost much labour connecting his establishment on an island with the main for driving his cattle to pasture The deserted site of Mr Cockrane's establishment three miles from the mouth is now overrun with peaches and figs growing in great luxuriance amongst the flax and fern There is a creek near this the Moturata up which I am told there is excellent limestone and the specimen we procured was almost equal to marble.

Kemp, H. T., 1856.

> The valley of the Victoria, better known to the natives as Takahue, is situated on the northern side of the Rua Taniwah range, and about midway between the Oruru Valley and the western coast, the two valleys being separated by a bush of from seven to eight miles in length; which I traversed and through which a road might be easily opened up, thereby connecting the two districts and thus forming a nearly direct line of communication with the Harbour of Mangonui, the principal port of safety in that part of the island. The Victoria Valley is nearly triangular in shape, is well watered, and skirted with excellent timber, the soil of a rich alluvial deposit, and, at a rough estimate, may be said to contain about twenty thousand (20,000) acres. A large portion of it has been under cultivation by the Natives, and there exist at present some few scattered plantations of no very large extent. Noble Panakareao, the chief of the Rarawa tribe, is the principal owner of the valley, and upon my expressing a desire to visit, he informed me that it had never been offered for sale, that it was more than probable it would be required for the use of the Natives, whenever the surrounding districts shall have been purchased by the Government. At the same time he led me to infer that a large price would be asked if the Crown should propose to buy.
>
> I regret that, owing to the very sudden and serious illness of Noble, further enquiries have been postponed; but judging from what I have heard in other influential quarters, I think a sum of £3,000 (Three thousand pounds) if the money were on the spot, and a few reserves, comprising in all about two thousand (2,000) acres, would effect the purchase. Of its importance taken in conjunction with the settlements of Oruru and Mangonui, there seems to be no doubt; and that a large portion of it would be taken up at once by settlers, if the Native title were extinguished. It is decidedly the finest district in that part of the Province, and presents great facilities for settling.

Buller, J., 1878. Forty years in New Zealand. Part 1.

In 1869 James Buller travelled to one of his old homes, the Hokianga.

> “We dined with Mr. Von Sturmer, collector of customs, etc, and at night were accommodated at the Kohukohu, by Mr. J. Webster. When I was last here, this place was

occupied by the late Mr. Russell. His half-caste daughters were well educated; and their husbands carried on a flourishing trade in timber and gum.

In order to catch the flowing tide next morning, we had an early breakfast, and at six a.m. were on our way up the romantic tributary, the Mangamuka. Here every object seemed to have a tongue that spoke to me. I thought of Turner, Woon, Whiteley, and others, who are no more. There used to be, on the sharp jutting points of the river, European dwellings. Not a vestige of those remained;--a wild grassplot, or a few trees, marked the spots. It was a solitude! Saw no one till we came to Mangataipa, where we found some natives, squaring logs. The stream is shallow here; we left our boat, and horses were brought for us, to proceed up the valley. Broken bridles did good service, and strings of Korari, or flax, supplied the lack of stirrups. Thus we went to Rotopipiwai. The old chapel was a ruin; a goodly number of cows and calves met the eye; a long line of Puriri, four-railed fence, indicated an improved method of cultivation, and this was confirmed by an ample supply of warm cow's milk to our dinner. At the foot of the Maunga-taniwha range, we found Te Otane, now old and feeble, a solitary remnant of a large class of Christian chiefs of thirty years ago.

Returning from Mangamuka, we landed at Mangungu at five P.M.”

Appendix C – Historic Plans

Figure 37: Maungataniwha West No. 2 Deed (1863; ANZ R12153645).

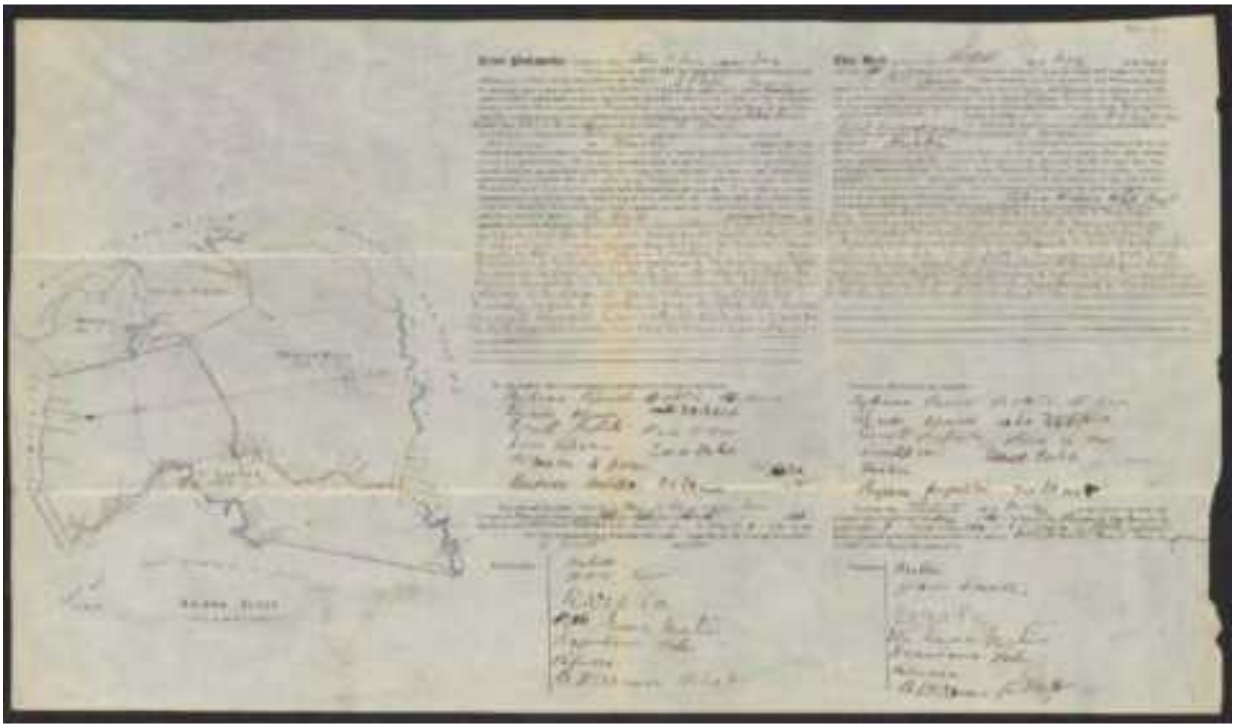


Figure 38: Kaiaka Block Deed (1865; ANZ R12153615).

Figure 39: SO 802 (1862, part).

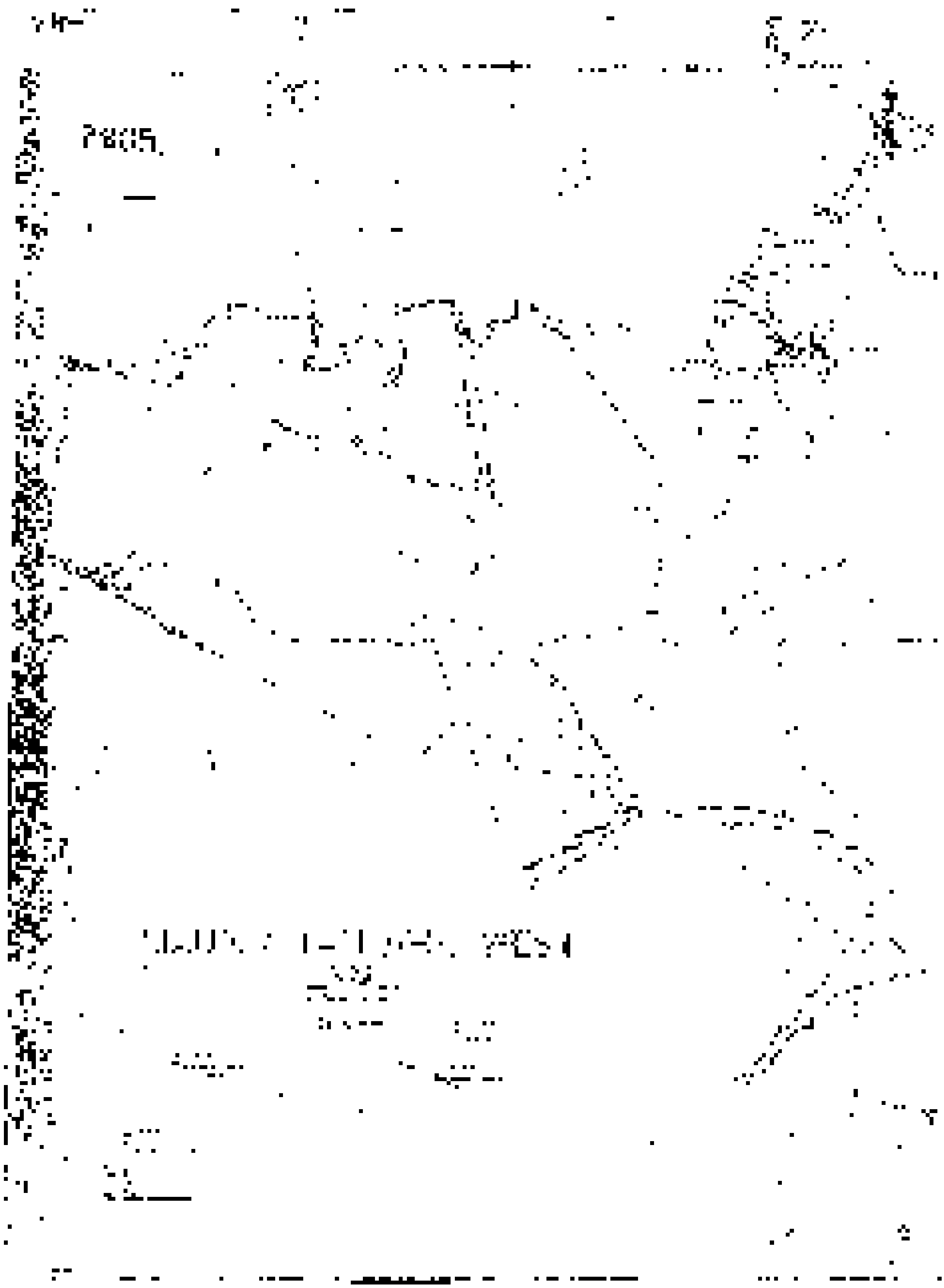


Figure 40: ML 12805 (1862, part).

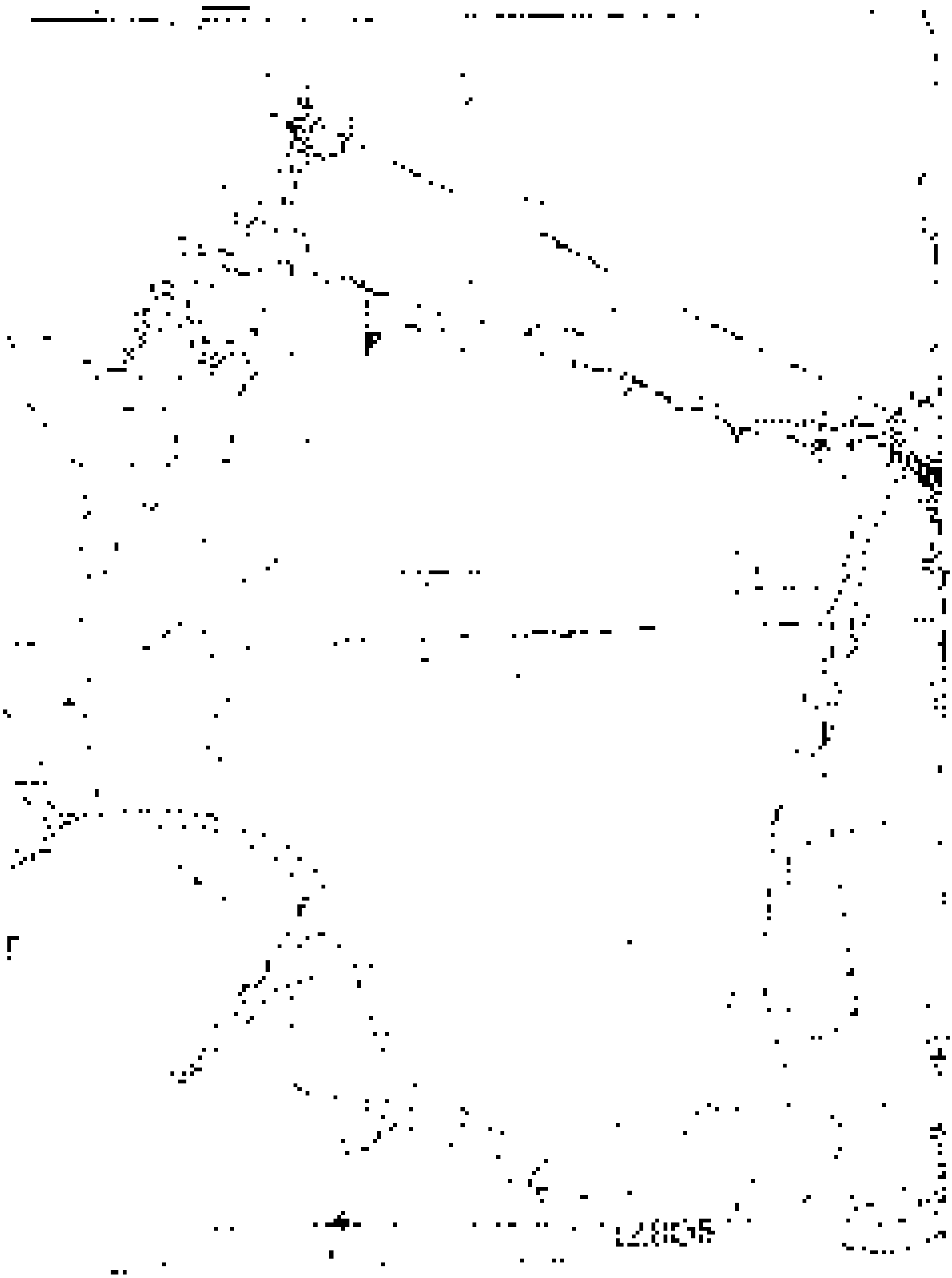


Figure 41: ML 12805 (1862, part).

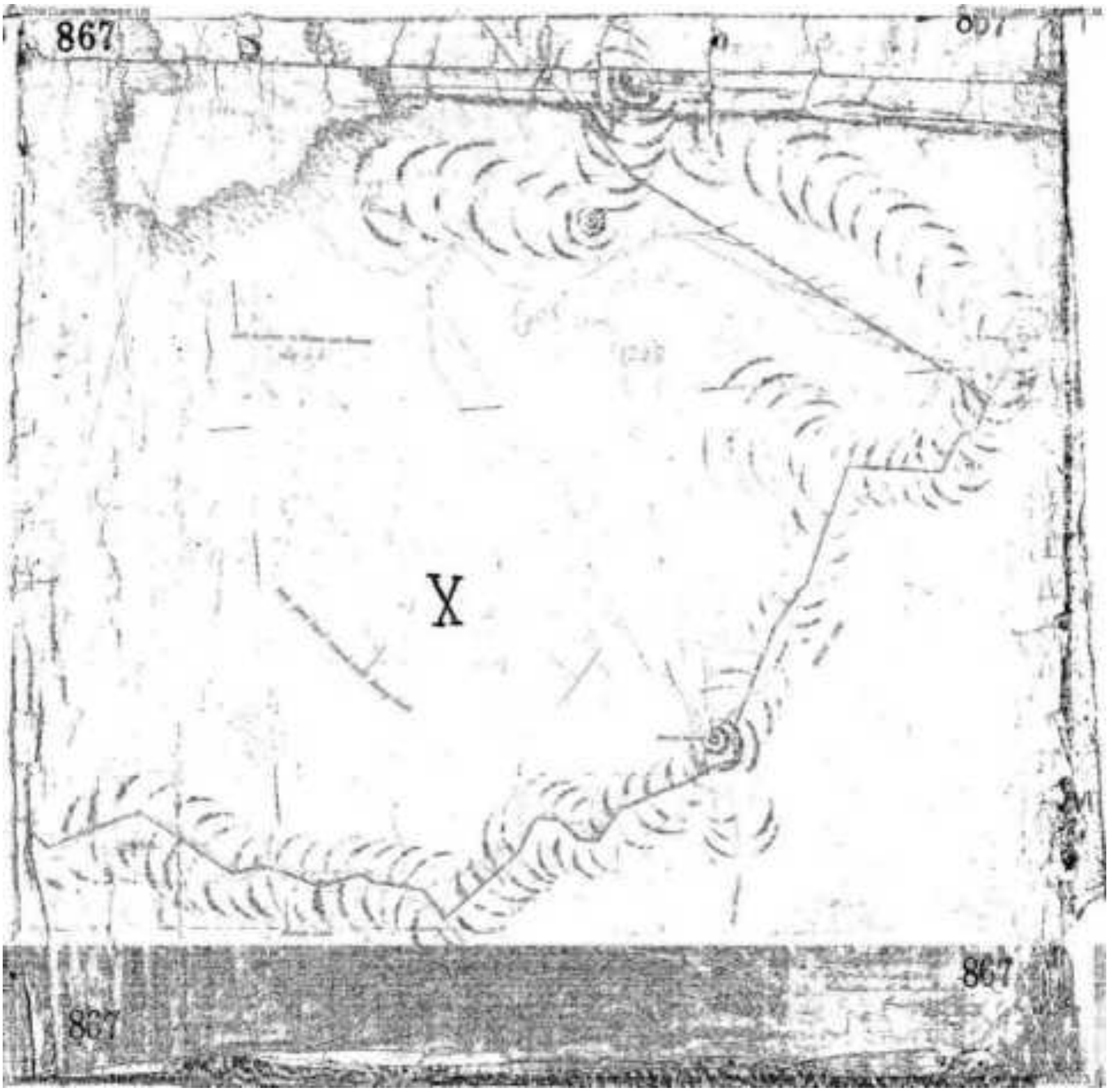


Figure 42: SO 867 (1862).

Figure 43: ML 105 (1865?).

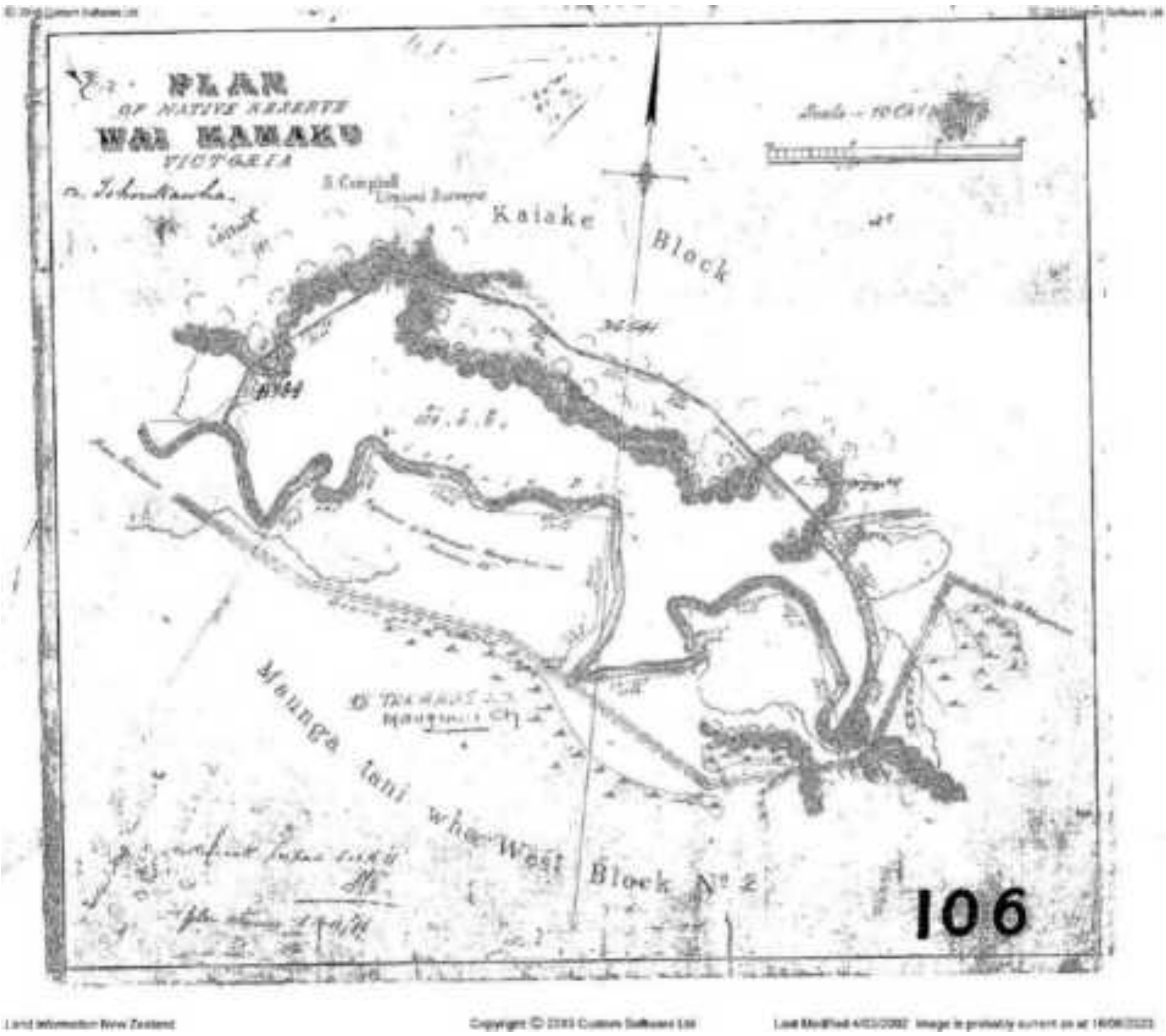


Figure 44: ML 106 (1866).

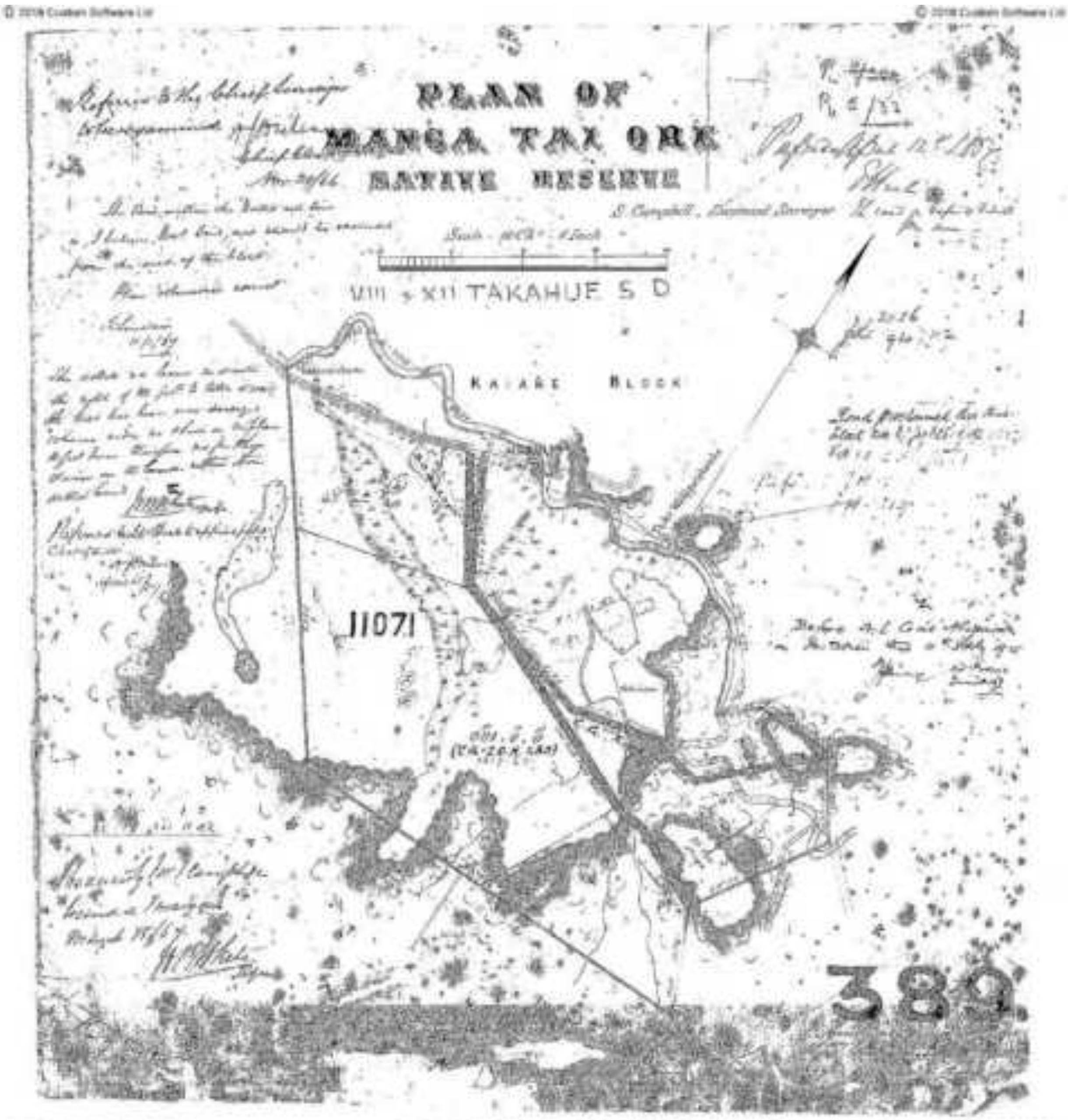


Figure 45: ML 389 (1866).

Figure 46: SO 798 (1867, part).

Figure 47: SO 1031 (1876).

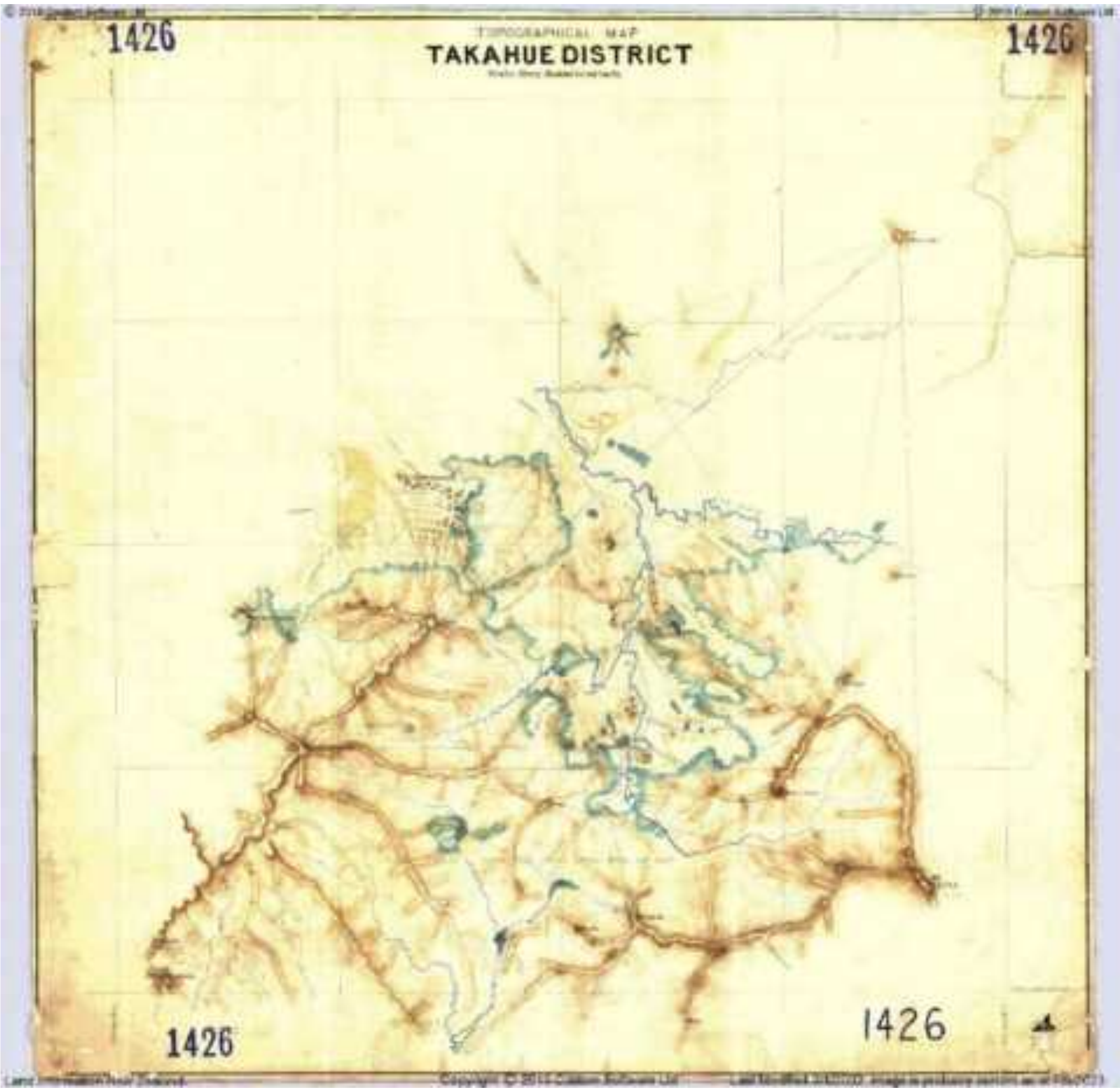


Figure 48: SO 1426 (1870s?).

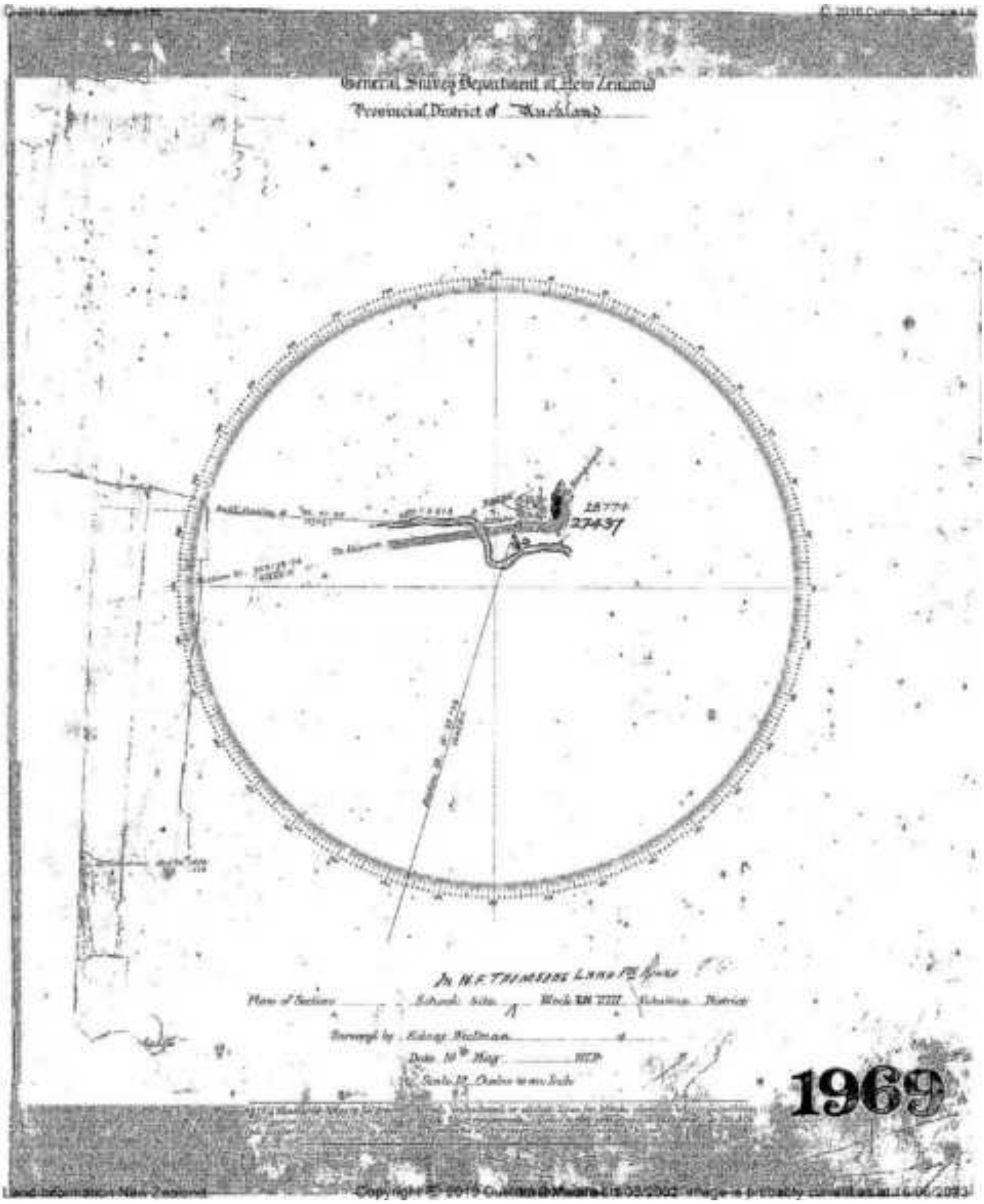


Figure 49: SO 1969 (1879).

Figure 50: ML 3608 A (1880?).

Figure 51: ML 3007/4 (1880?).

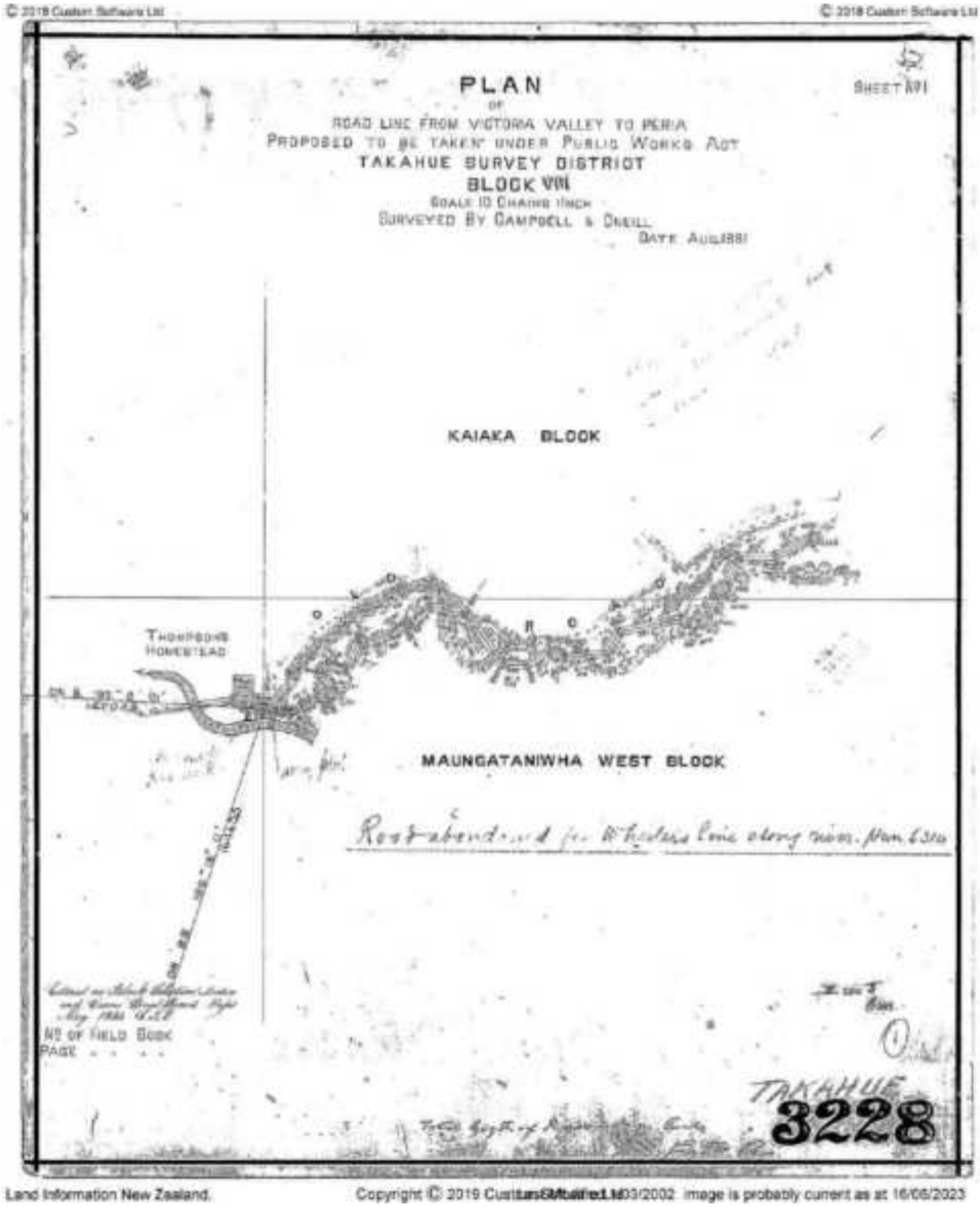


Figure 52: SO 3228 (1881).

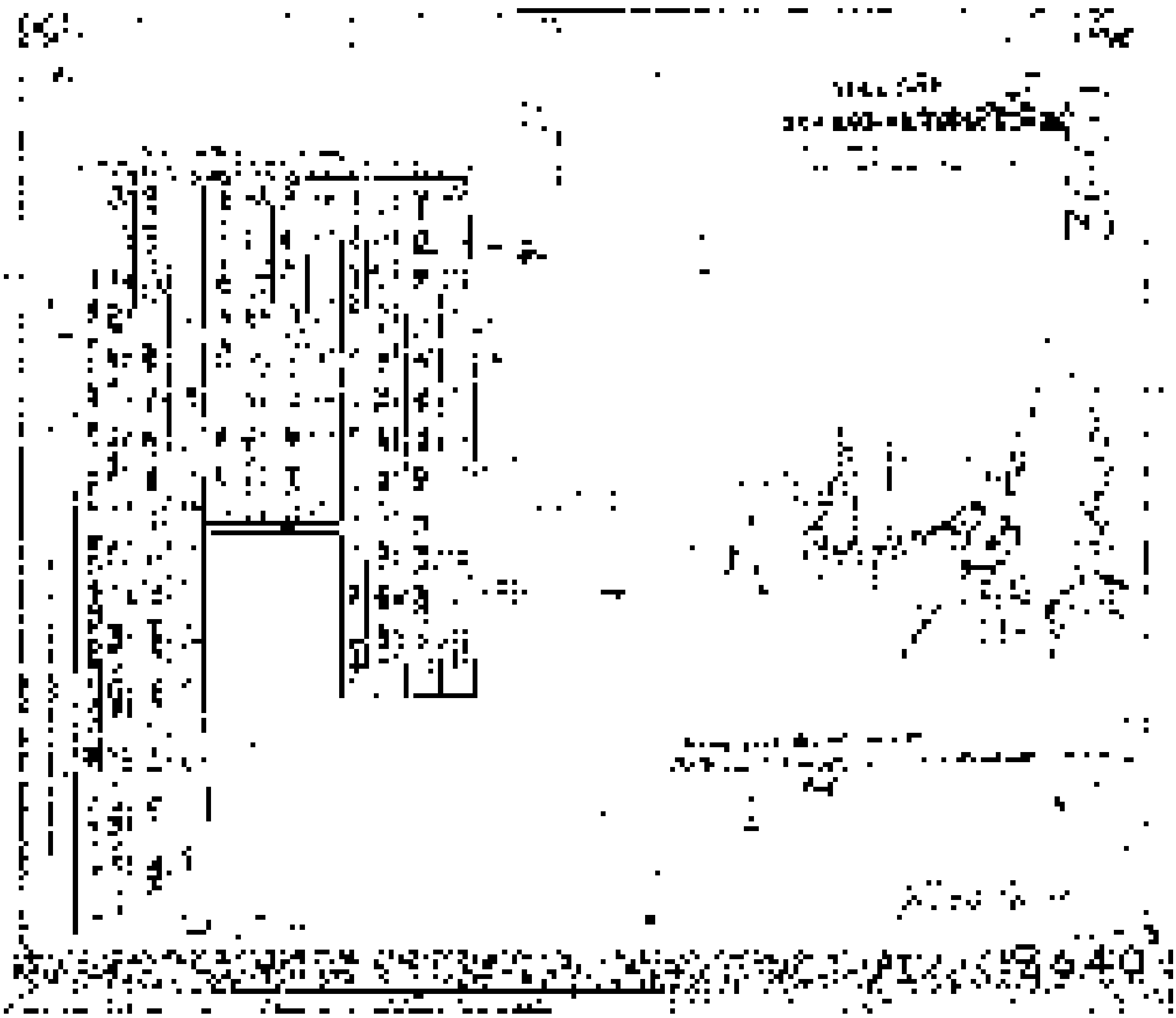


Figure 53: SO 3640/1 (1883).

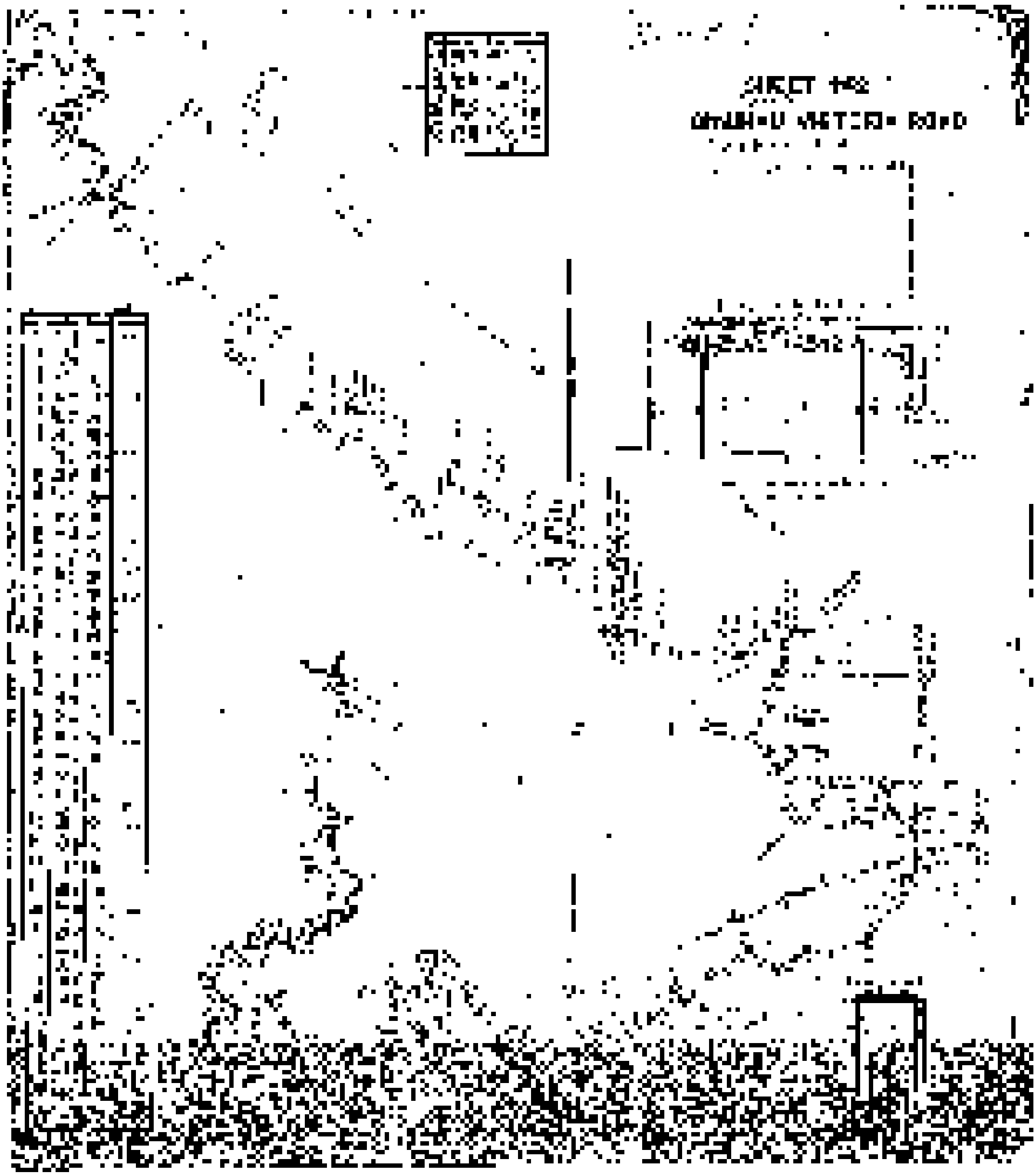


Figure 54: SO 3640/2 (1883).

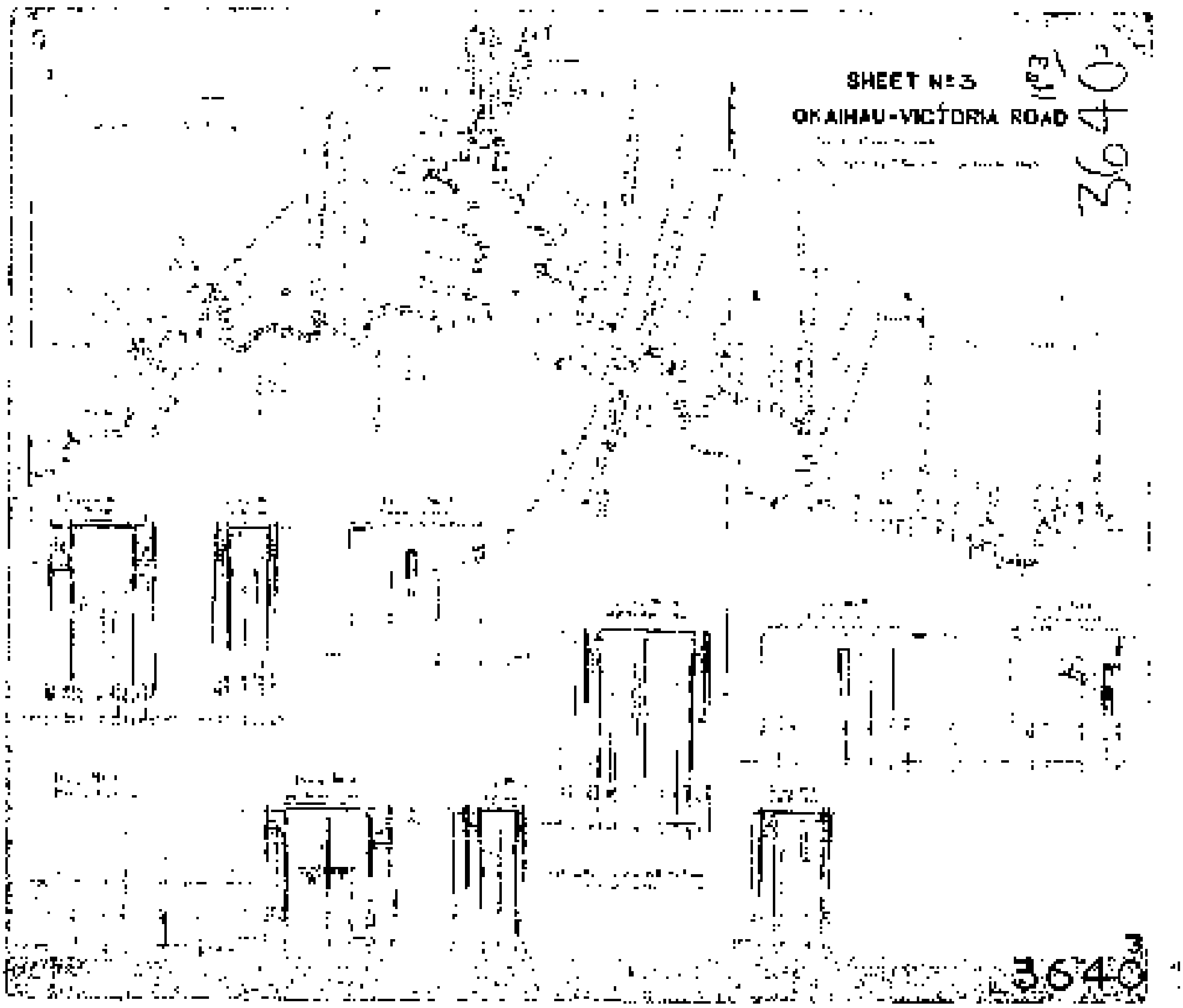


Figure 55: ML 3640/3 (1883).

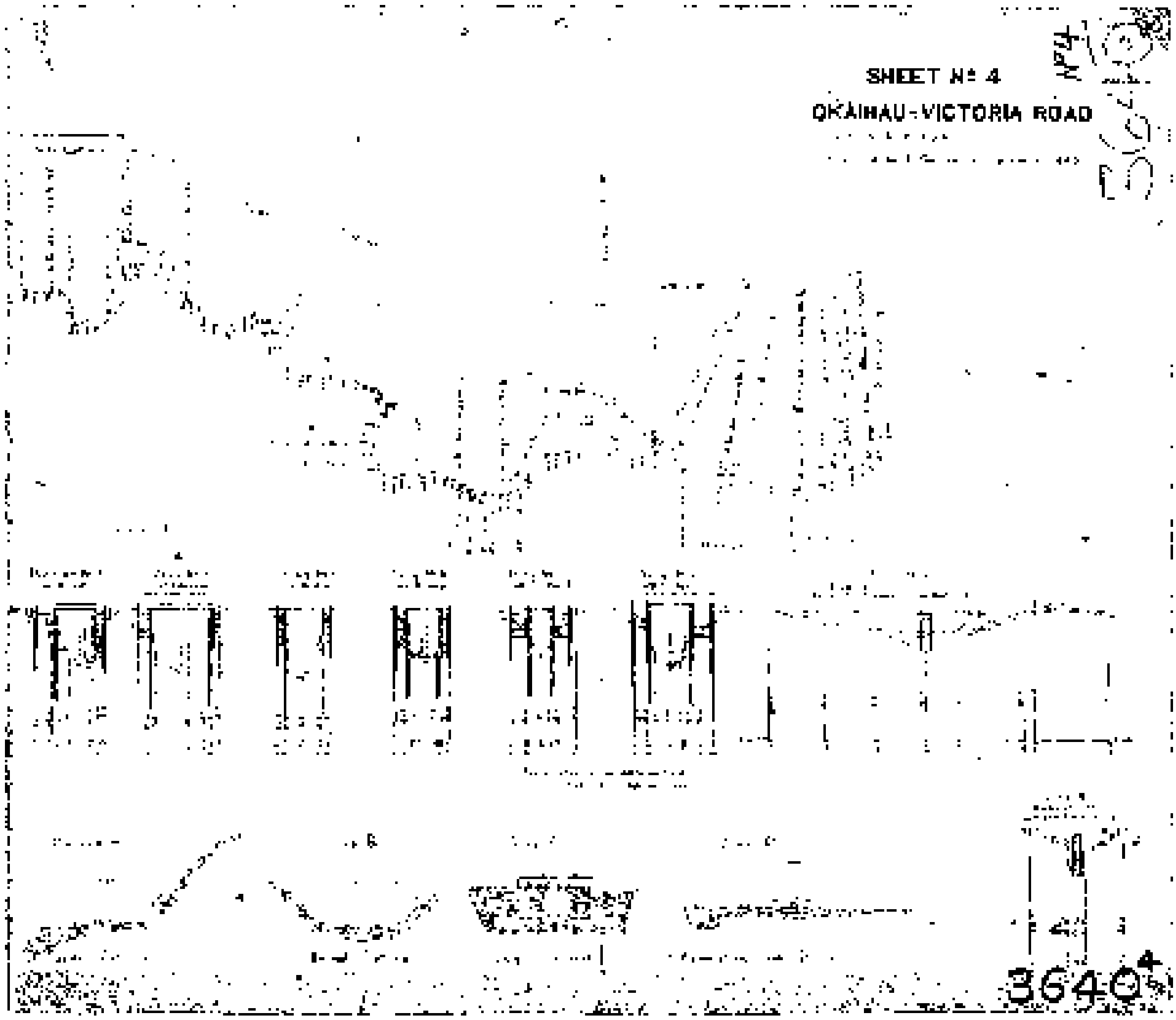


Figure 56: SO 3640/4 (1883).

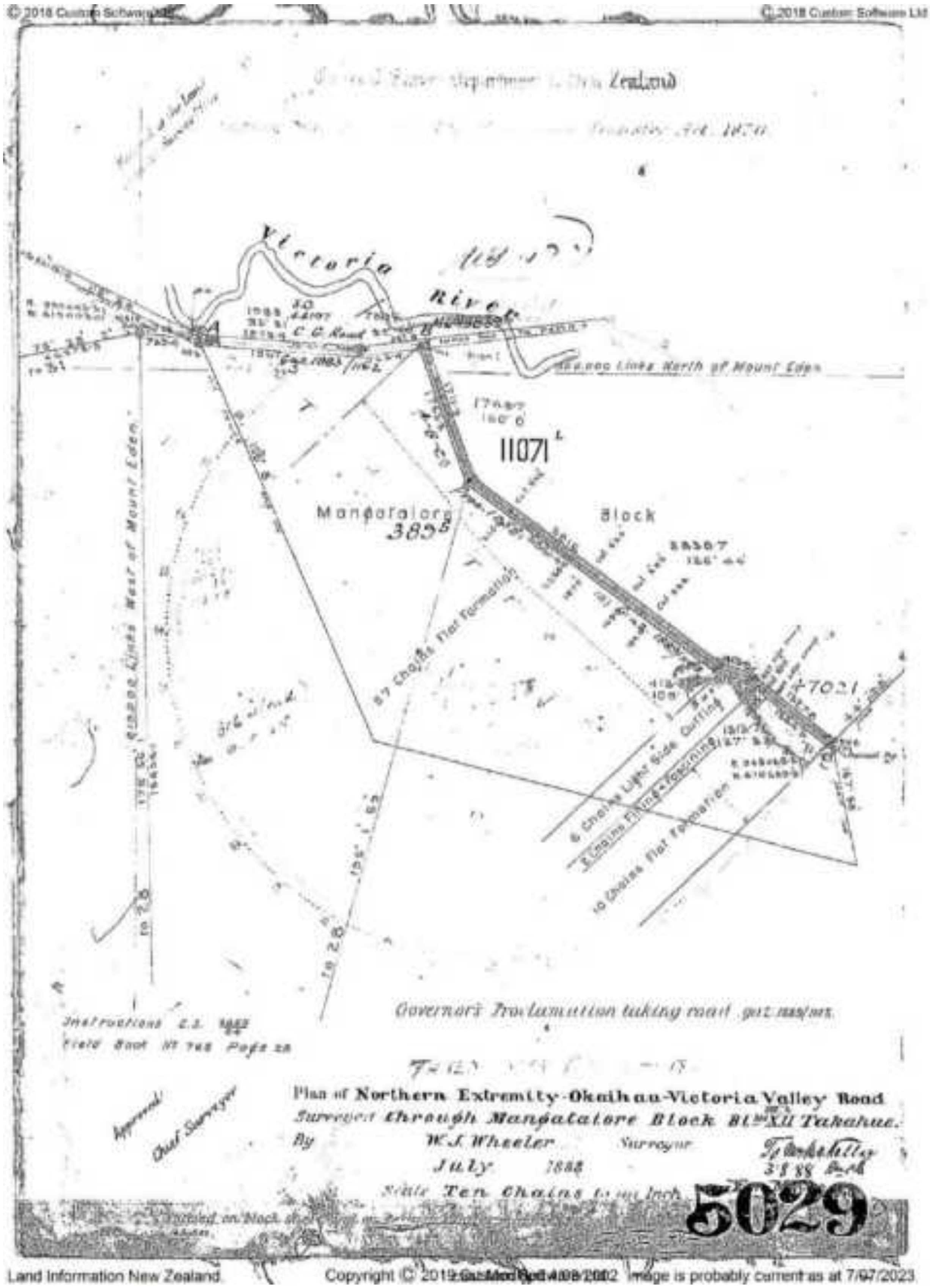


Figure 57: SO 5029 (1888).

Figure 58: SO 6314 (1891).

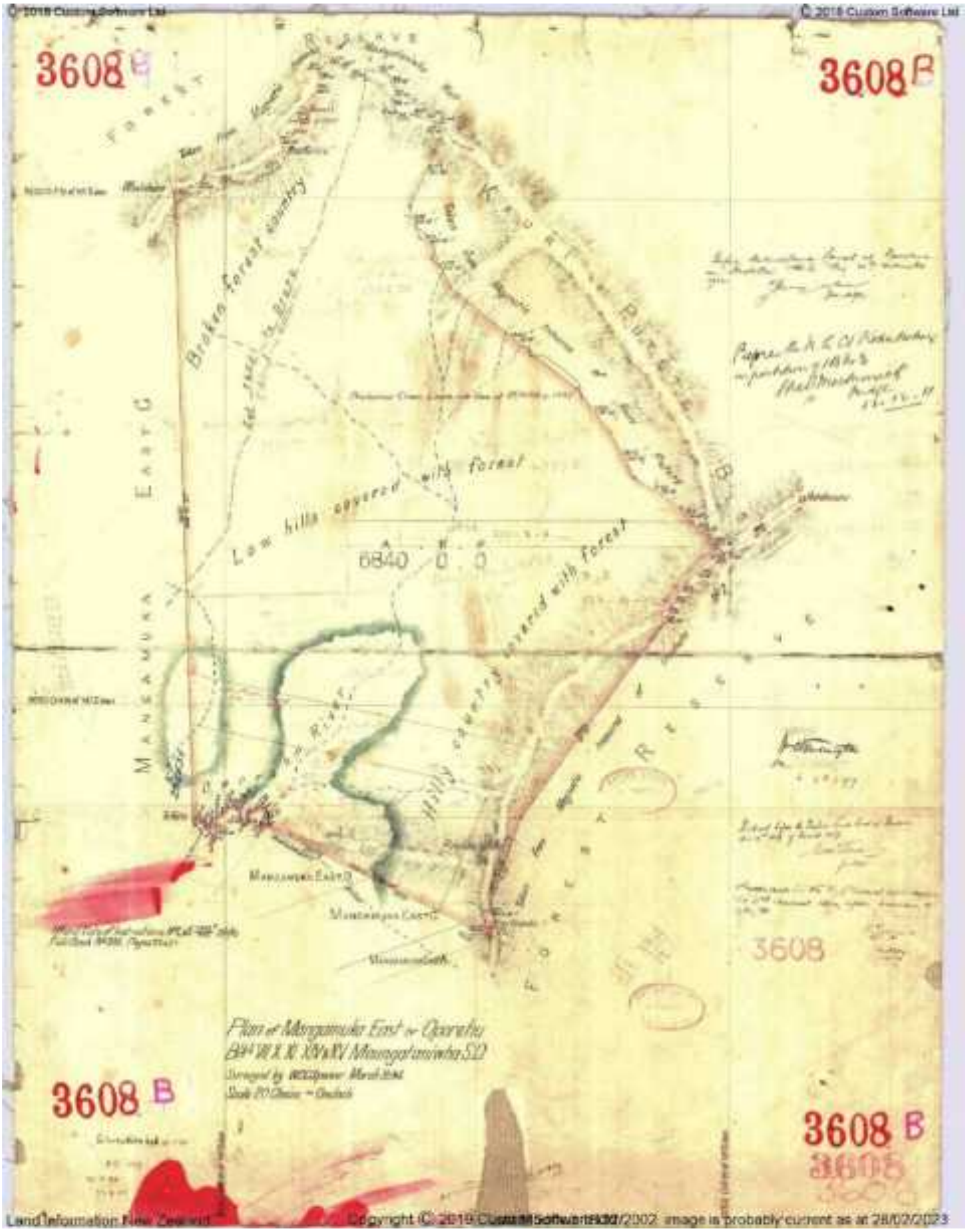


Figure 59: ML 3608 B (1894).

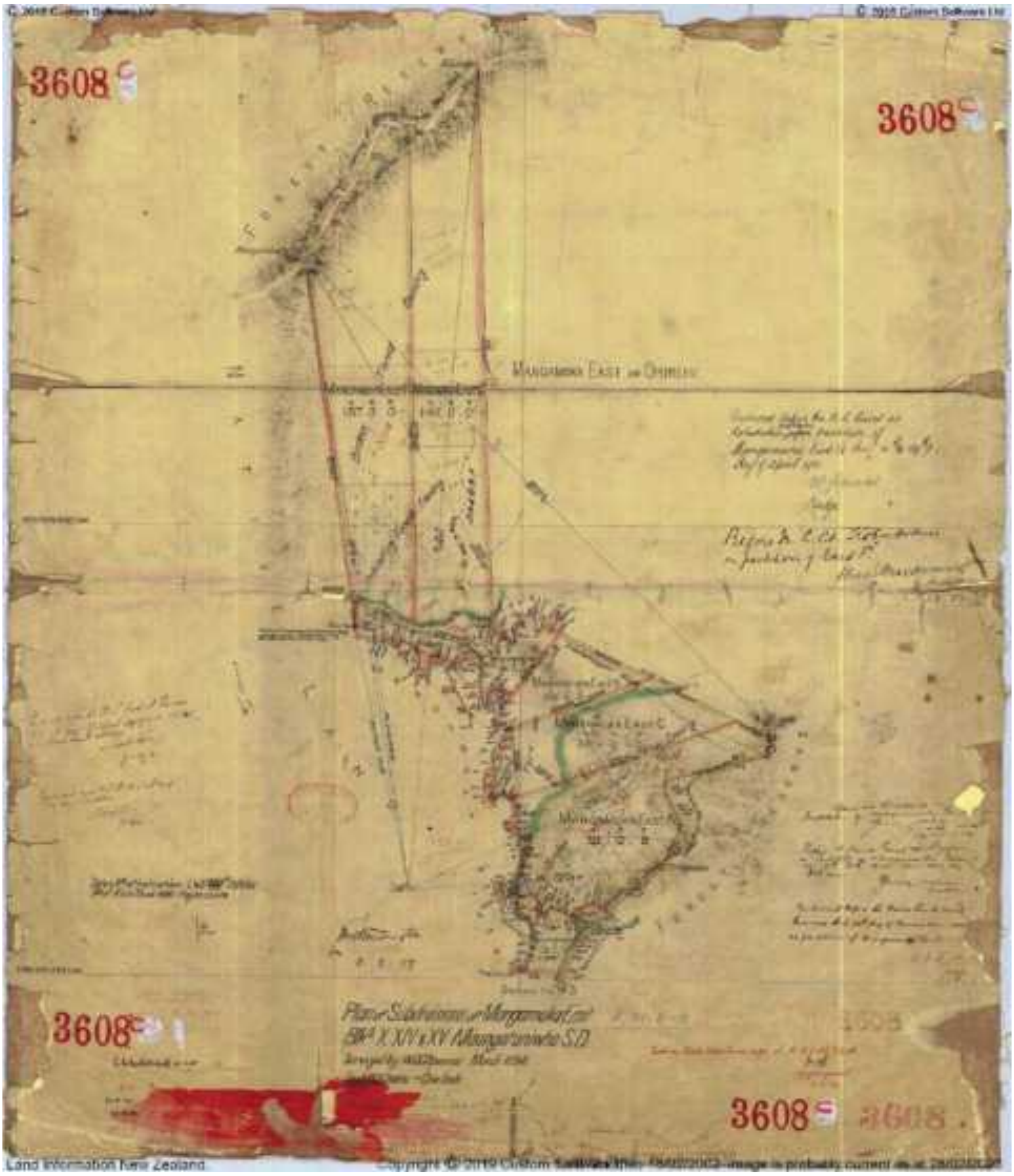


Figure 60: ML 3608 C (1894).

Figure 61: SO 7084/3 (1894).

Figure 62: SO 7084/4 (1894).

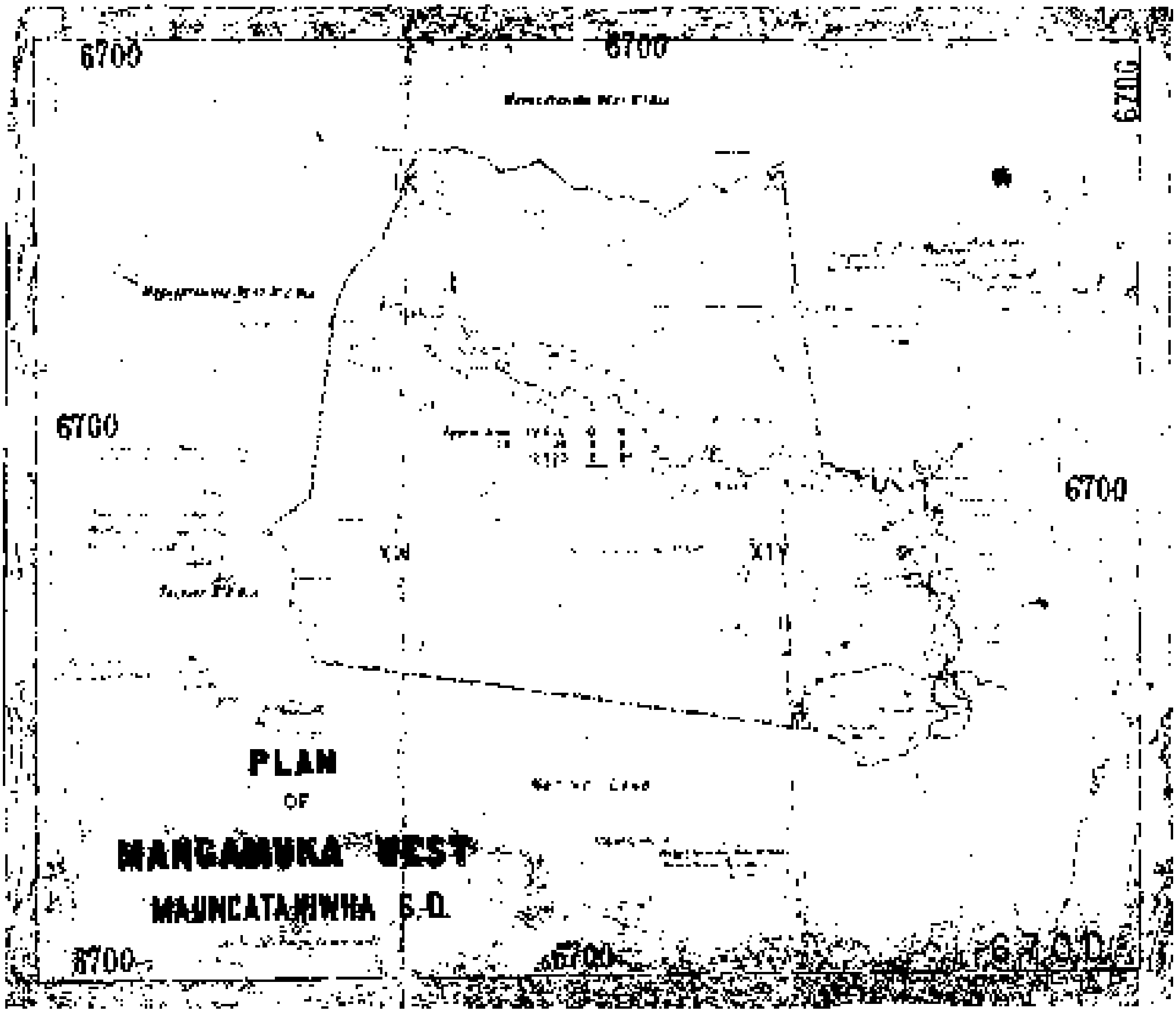


Figure 63: ML 6700 (1898).

Figure 64: SO 12895 (1904).

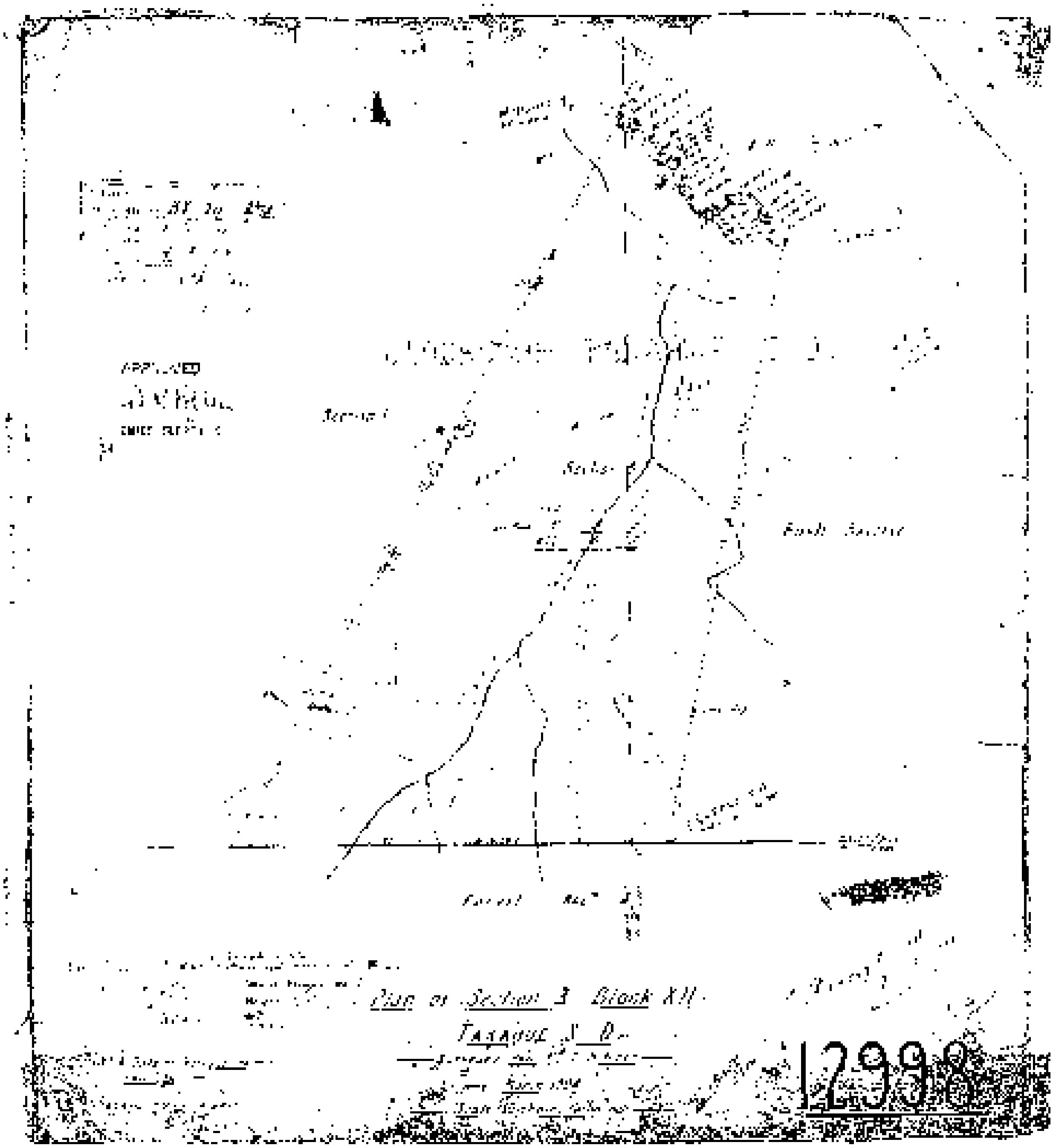


Figure 65: SO 12998 (1904).

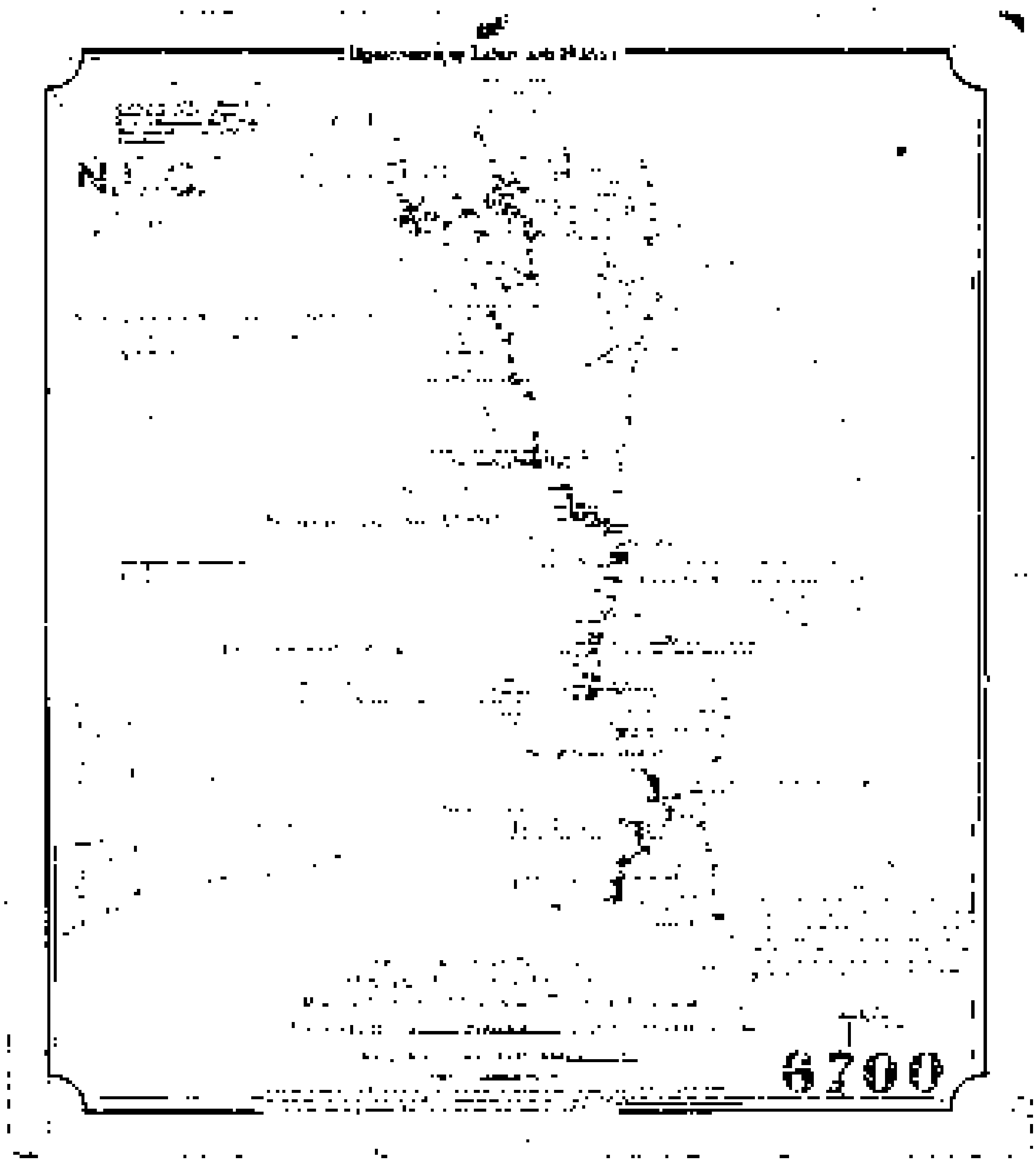


Figure 66: SO 6700 (1907).

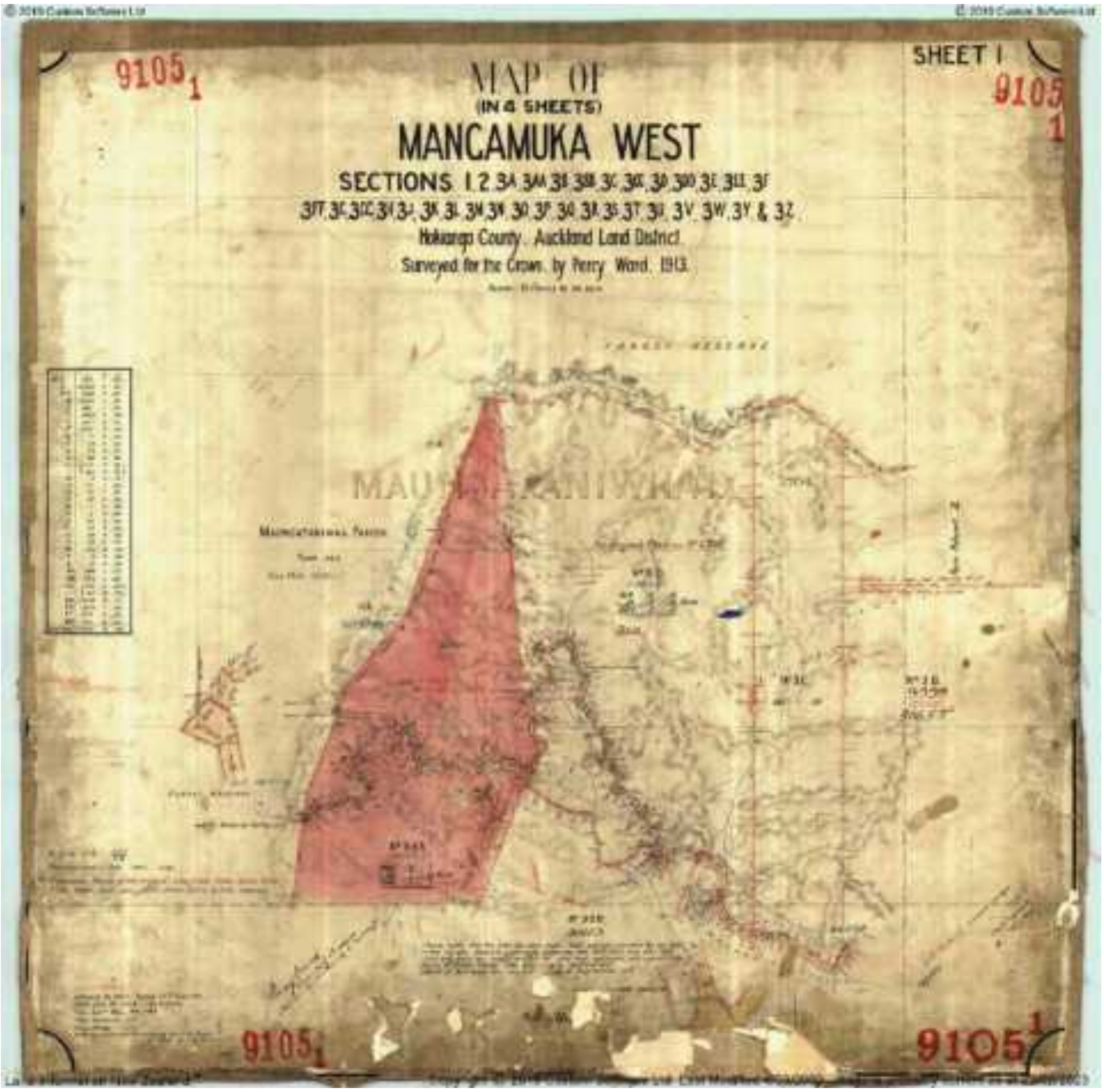


Figure 67: ML 9105-1 (1913).

Figure 68: ML 9105-4 (1913).

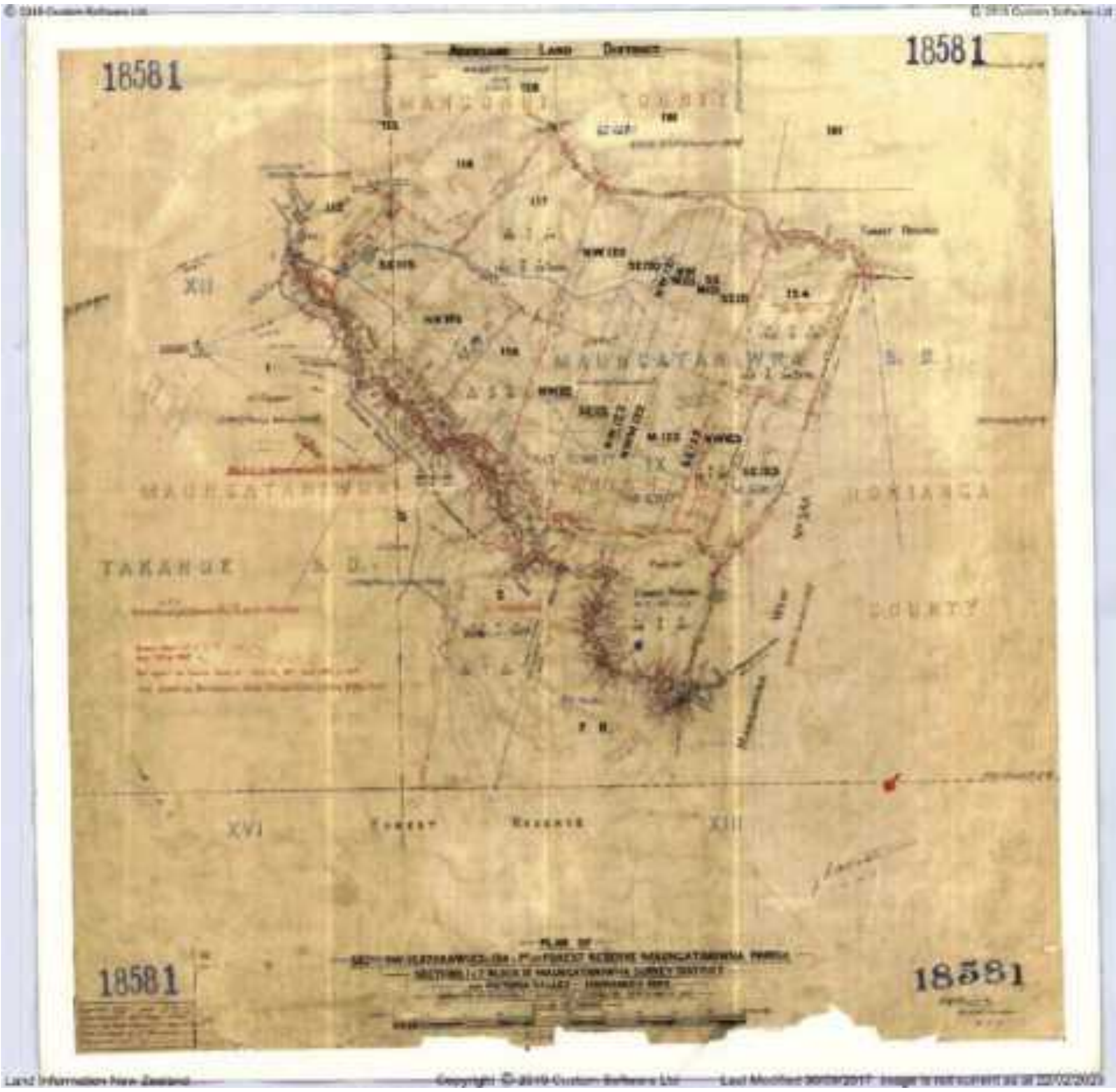


Figure 69: SO 18581 (1915).

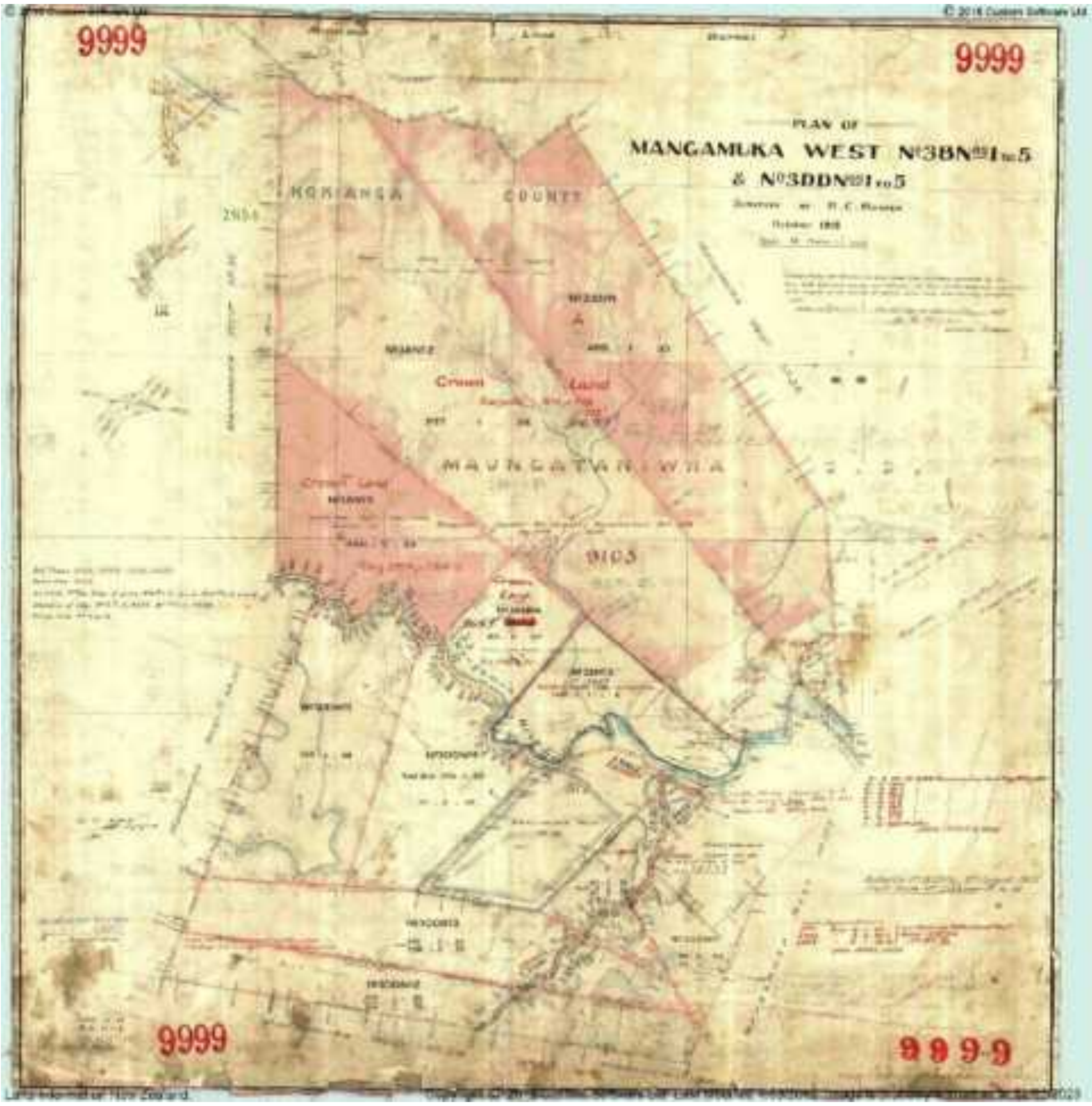


Figure 70: ML 9999 (1913).

Appendix D – Features Recorded from Historic Plans

Table 9: Polygon features.

Date	Source	Feature Type	Description/Detail
1866	ML 106	Native Reserve	Wai Mamaku
1866	ML 109	Native Reserve	Ta Keke
1865?	ML 109	Enclosure	Enclosure?
1865?	ML 109	Enclosure	Enclosure?
1865?	ML 109	Enclosure	Enclosure
1865?	ML 109	House	House
1866	ML 389	Native Reserve	Manga Tai Ore
1866	ML 389	Cultivation, orchard or fruit tree	Cultivation
1866	ML 389	Enclosure	Enclosure?
1866	ML 389	House	House?
1866	ML 389	House	House?
1866	ML 389	Enclosure	Enclosure?
1866	ML 389	Enclosure	Enclosure?
1870s	SO 1426	Houses	Kainga?
1870s	SO 1426	Houses	Kainga?
1870s	SO 1426	Houses	Kainga?
1870s	SO 1426	Houses	Kainga?
1870s	SO 1426	Houses	Kainga?
1870s	SO 1426	Houses	Kainga?
1870s	SO 1426	Houses	Kainga?
1870s	SO 1426	Houses	Kainga?
1870s	SO 1426	Houses	Kaing
1870s	SO 1426	Houses	Kainga
1879	SO 1969	Public building	School site
1880	ML 3608-A	Name	Kauhoehoue
1880	ML 3608-A	House	House
1880?	ML 3007	Enclosure	Enclosure and three structures (poor registration)
1880?	ML 3007	Enclosure	Enclosure and two structures (poor registration)
1891	SO 6314	House	House
1891	SO 6314	House	House
1891	SO 6314	House	House
1891	SO 6314	House	House
1894	SO 7084-3	Public building	Old School House
1894	SO 7084-3	Infrastructure	Bridge
1894	SO 7084-3	Public building	Church
1907	ML 6700	House	House
1907	ML 6700	Commercial building	Hapeta's store
1907	ML 6700	Public building	Hall
1907	ML 6700	Outbuilding, structure	Shed
1907	ML 6700	Outbuilding, structure	Shed
1907	ML 6700	House	House
1907	ML 6700	Public building	Church
1907	ML 6700	House	House
1907	ML 6700	Outbuilding, structure	Kitchen
1907	ML 6700	Outbuilding, structure	Shed
1907	ML 6700	House	Whare
1907	ML 6700	Outbuilding, structure	Shed

Date	Source	Feature Type	Description/Detail
1907	ML 6700	Outbuilding, structure	Shed
1907	ML 6700-1	Public building	Church
1907	ML 6700	Public building	Former School SIte Kauhoehoe
1913	ML 9105-2	Public building	Post office
1913	ML 9105-2	Public building	Hui house
1913	ML 9105-2	Public building	School
1913	ML 9105-2	Public building	School
1913	ML 9105-2	House	Whare
1913	ML 9105-2	House	Whare
1913	ML 9105-2	House	Whare
1913	ML 8864	House	House
1915	ML 9999	House	House
1915	ML 9999	House	House
1915	ML 9999	House	House
1915	ML 9999	House	House
1915	ML 9999	House	House

Table 10: Line features.

Date	Source	Feature Type	Description/Comment
1861?	ML 106	Road	Oruru and Victoria Road
1862	ML 12805	Road	Old Mission track
1862	SO12805	Road	Old Mission track
1862	SO 867	Road	Old mission track
1862	SO867	Road	Old Mission Track
1862	SO867	Road	Old Mission track
1862	SO862	Road	Old mission track
1862	SO867	Road	Track from Victoria
1865	ML109	Road	Road taking 1972
1866	ML389	Road	Oruru and Victoria Road
1866	ML389	Road	Road survey
1866	ML389	Road	Road survey
1866	ML389	Road	Road survey
1866	ML389	Road	Road survey
			Flat formation
1870s	SO 1426	Road	Road to Awanui
1870s	SO 1426	Road	Road to Takahue
1870s	SO 1426	Road	Road to Taheke
1870s	SO 1426	Road	Road to Takahue
1870s	SO 1426	Road	Road to Takahue
1870s	SO 1426	Road	Road to Whangape
1870s	SO 1426	Road	Road to Hokiang
1870s	SO 1426	Road	Road to Ahipara
1870s	SO 1426	Road	Road to Ahipara
1870s	SO 1426	Road	Proposed road to Ahipara
1870s	SO 1426	Road	Road to Takahue
1870s	SO 1429	Road	Road to Ahipara
1870s	SO 1426	Road	Road to Takahue
188	SO 3640	Infrastructure	Embankment
1880	ML 3608-S	Topography and vegetation	Bushline

1880	ML 3608-A	Topography and vegetation	Bushline
Date	**Source**	**Feature Type**	**Description/Detail**
1883	SO 3640	Road	Track
1883	SO3640	Road	Track to Mungamuka
1883	SO 3640	Infrastructure	Natural ford
1883	SO3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Filling
1883	SO 3640	Infrastructure	30 links catchwater drain
1883	SO 3640	Infrastructure	Flat formation
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Flat formation
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Formation with ditch
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Flat formation
1883	SO 3640	Infrastructure	Formation with ditch
1883	SO 3640	Infrastructure	Flat formation
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Embankment
1883	SO 3640	Infrastructure	Breast cutting
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Embankment
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Formation with ditch
1883	SO 3640	Infrastructure	Flat formation
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Embankment
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Embankment
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Flat formation
1883	SO 3640	Infrastructure	Side cutting
1883	SO 3640	Infrastructure	Flat formation
1883	SO 3640	Infrastructure	
1883	SO 3640	Infrastructure	Filling
1883	SO 3640	Infrastructure	Side cutting
1883?	ML 106	Road	Kaitaia-Oruru Road
1891	SO 6314	Enclosure	Enclosure
1891	SO 6314	Road	Track?
1891	SO 6314	Road	Road
1891	SO 6314	Road	Road
1891	SO 6341	Road	
1894	ML 3608-B	Road	Road
1894	ML 3608-B	Topography and vegetation	Bushline
1894	ML 3608-B	Topography and vegetation	Bushline
1894	ML 3608-C	Road	Road
1894	ML 3608-C	Topography and vegetation	Bushline

1894	ML 3608-C	Topography and vegetation	Bushline
Date	**Source**	**Feature type**	**Description/Comment**
1894	SO 7084/3	Road	Spencer's road
1894	SO 7084	Road	Spencer's road
1894	SO 7084	Road	Spencer's road
1894	SO 7084/3	Road	Spencer's Road
1894	SO 7084	Road	Spencer's road
1904	SO 12998	Road	Track?
1904	SO 12895	Topography and vegetation	New clearing
1904	SO 12895	Road	Graded line to Mangamuka
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1907	ML 6700-1	Enclosure	Enclosure
1913	ML 9105-1	Road	Track
1913	ML 9105-2	Wahi tapu or cemetery	Wahi tapu
1913	ML 9105-2	Enclosure	Enclosure
1913	ML 9105-2	Topography and vegetation	Bushline
1913	ML 9105-2	Topography and vegetation	Bushline
1913	ML 9105-2	Topography and vegetation	Bushline
1913	ML 9105-2	Topography and vegetation	Bushline
1915	ML 9999	Enclosure	Wire fence
1915	ML 9999	Enclosure	Wire fence
1915	ML 9999	Enclosure	Wire fence
1915	ML 9999	Enclosure	Wire fence
1915	ML 9999	Enclosure	Wire fence
1915	ML 9999	Enclosure	Wire fence
1915	ML 9999	Enclosure	Wire fence
1915	ML 9999	Enclosure	Wire fence
1915	ML 9999	Enclosure	Wire fence
1915	ML 9999	Enclosure	Wire fence
1915	ML 9999	Enclosure	Wire fence
1915	ML 9999	Topography and vegetation	Bushline
1915	ML 9999	Topography and vegetation	Bushline
1915	ML 9999	Topography and vegetation	Bushline
1915	ML 9999	Topography and vegetation	Bushline
1915	ML 9999	Topography and vegetation	Bushline
1915	ML 9999	Topography and vegetation	Bushline
1915	ML 9999	Topography and vegetation	Bushline
1915	ML 9999	Topography and vegetation	Bushline
1915	ML 9999	Topography and vegetation	Bushline
1915	ML 9999	Topography and vegetation	Bushline

1915	ML 9999	Topography and vegetation	Bushline
1915	ML 9999	Topography and vegetation	Bushline
1915	ML9999	Topography and vegetation	Bushline

Table 11: Point features.

Date	Source	Feature	Description/Comment
1862	SO 867	Name	Land belonging to Wiremu and Reihana
1862	SO 867	Topography and vegetation	Very good land covered with heavy bush
1862	ML 12805	Name	Native Reserve
1862	ML 12805	Name	Te Ure Paraoa
1862	ML 12805	Topography and vegetation	Very good soil Level land
1862	ML 12805	Topography and vegetation	Native Reserve
1862	ML 12805	Topography and vegetation	Very rich alluvial soil, level Land
1866	SO798	Topography and vegetation	Broken Land Covered With Forest
1867	SO 3640	Name	Panther and Family 150 acres
1867	SO798	Name	W. F. Thompson 200 acres
1867	SO 798	Name	C. H. and C. White
1867	SO798	Name	Panther and Johnson
1867	SO798	Topography and vegetation	Tea Tree Scrub
1867	SO798	Topography and vegetation	Undulating land of good quality
1876	SO1031	Name	Government Reserve
1880	ML 3608-A	Wahi tapu or cemetery	Tapu
1880	ML 3608-A	Name	Rutupua(?)
1880	ML 3608-A	Name	Webster and C(?)
1880	ML 3608-A	Name	Ngapumahumahu
1880	ML 3608	Name	Mangataipa
1880	ML 3608	Name	Te Toki Creek
1880	ML 3608	Name	Ko Te Awa o te Mangataipa
1883	SO 3640	Infrastructure	16 ft bridge
1883	SO 3640	Infrastructure	24 ft bridge
1883	SO 3640	Infrastructure	14 ft bridge
1883	SO 3640	Infrastructure	10 ft bridge
1883	SO 3640	Infrastructure	Ford
1883	SO 3640-3	Infrastructure	26 ft bridge
1883	SO 3640	Infrastructure	17 f bridge
1883	SO 3640-3	Infrastructure	Ford
1883	SO 3640-3	Infrastructure	36 ft bridge
1883	SO 3640-3	Infrastructure	15 foot bridge
1883	SO 3640-3	Infrastructure	Ford
1883	SO 3640-3	Infrastructure	21 ft bridge
1883	SO 3640	Infrastructure	3 foot Culvert
1883	SO 3640	Infrastructure	18 Foot culvert
1883	SO 3640	Infrastructure	18 foot culvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	3 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	3 foot culvert

1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
Date	Source	Feature type	Description/Comment
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	38 foot bridge
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	Embankment
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	3 Foot culvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	18 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Road	Track to Mangamuka
1883	SO 3640	Infrastructure	3 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	2 foot culvert 25 foot long built of totara
1883	SO 3640	Infrastructure	2 foot 6 inch culvert 20 foot long built of totara
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	3 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	2 foot culvert

1883	SO 3640	Infrastructure	18 inch cuvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	4 foot culvert
Date	**Source**	**Feature type**	**Description/Comment**
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	4 foot culvert
1883	SO 3640	Infrastructure	18 foot culvert
1883	SO 3640	Infrastructure	18 foot culvert
1883	SO 3640	Infrastructure	18 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	10 foot bridge
1883	SO3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	2' culvert
1883	SO 3640	Infrastructure	2' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	2' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	3' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	3' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert

1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	24' bridge
1883	SO 3640	Infrastructure	18" culvert
Date	Source	Feature type	Description/Comment
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	3' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	3' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	2' culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO3640	Infrastructure	Embankment
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	3 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	3 foot culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	18 inch culvert
1883	SO 3640	Infrastructure	2 foot culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1883	SO 3640	Infrastructure	18" culvert
1891	SO 6314	Public building	Public School
1891	SO 6314	Name	To Mangamuka
1891	SO 6314	Name	Tracey's
1891	SO 6314	Name	Crown Land
1891	SO 6314	Name	Geo Kitchen's
1891	SO 6314	Name	Switzer's
1891	SO 6314	Name	Campbell's abandoned Road surveyed about 30 years ago
1891	SO 6314	Name	Garsea's Road which it is proposed to close
1894	SO 6909	Topography and vegetation	Bush Very Broken fair soil
1894	SO 7842	Topography and vegetation	Heavy Forest
1894	ML 3608-C	Cultivation, orchard, fruit tree	Flat land cultivations
1894	ML 3608-C	Cultivation, orchard, fruit tree	Undulating Foreset Country
1894	ML 3608-C	Road	Cut road to Oruru

1894	ML 3608-C	Topography and vegetation	Broken Forest Country
1894	ML 3608-C	Topography and vegetation	Flat Land
1894	ML 3608-B	Topography and vegetation	Low hills covered with forest
1894	ML 3608-B	Topography and vegetation	Forest Reserve
Date	**Source**	**Feature type**	**Description/Comment**
1894	ML 3608-B	Topography and vegetation	Hilly country covered with forest
1894	ML 3608-B	Road	Cut road to Oruru
1894	ML 3608-B	Topography and vegetation	Broken forest country
1894	ML 3608-B	Name	Te Keru
1894	ML 3608-C	Topography and vegetation	Puriri tree
1894	SO 3640	Wahi tapu or cemetery	Burial Ground
1894	SO7084-3	Public building	Old School House
1894	SO7084-3	Infrastructure	Bridge
1894	SO7084-3	Cultivation, orchard, fruit tree	Native cultivations
1894	SO7084	Cultivation, orchard, fruit tree	Native cultivation
1896	ML 6700	Cultivation, orchard, fruit tree	Cultivations
1898	ML 6700	Name	Taipari and Rihari Mate
1898	ML 6700	Name	Hapeta
1904	SO 12998	Topography and vegetation	Heavy mixed bush
1904	SO 12998	Topography and vegetation	Good land along creek
1904	SO 12998	Topography and vegetation	Large slip
1904	SO 12998	Topography and vegetation	Bush Reserve
1904	SO 12998	Topography and vegetation	Rocky steep spurs
1904	SO 12895	Name	Kitchen, owner
1904	SO 12895	Road	Graded line to Mangamuka
1904	SO 12895	Topography and vegetation	New clearing
1907	ML 6700-1	Name	Haranui (Ngatai)
1907	ML 6700-1	Name	Puruhungahunga
1907	ML 6700-1	Cultivation, orchard, fruit tree	Peach tree
1907	ML 6700-1	Name	Maunganui
1907	ML 6700-1	Name	Hapeta's Paddocks
1907	ML 6700-1	Name	Te Whakai or Roimata (Miti)
1907	ML 6700-1	Name	Pikaka Rakena Tauanui
1907	ML 6700-1	Name	Hapeta'a house
1907	ML 6700-1	Name	Hapeta's store
1907	ML 6700-1	Cultivation, orchard, fruit tree	Vines figs apples
1907	ML 6700-1	Name	Rata's kumaras
1907	ML 6700-1	Name	Pokapu
1907	ML 6700-1	Name	Rata's paddock
1907	ML 6700-1	Cultivation, orchard, fruit tree	Old orchard
1907	ML 6700-1	Infrastructure	Culvert
1907	ML 6700-1	Name	Piritaha
1907	ML 6700-1	Outbuilding, structure	Kitchen
1907	ML 6700-1	Outbuilding, structure	Shed
1907	ML 6700-1	House	House
1907	ML 6700-1	Public building	Wesleyan Church
1907	ML 6700-1	Outbuilding, structure	Shed
1907	ML 6700-1	Name	End of Te Pahi (by Ngatai)
1907	ML 6700-1	Name	End of Herekareao (by Miti)
1907	ML 6700-1	Name	Matehare's corn and kumeras
1907	ML 6700-1	Topography and vegetation	Poplars
1907	ML 6700-1	Cultivation, orchard, fruit tree	Figs
1907	ML 6700-1	Cultivation, orchard, fruit tree	Figs

1907	ML 6700-1	Topography and vegetation	Willows
1907	ML 6700-1	Cultivation, orchard, fruit tree	Pumpkins
1907	ML 6700-1	Cultivation, orchard, fruit tree	Kumeras
1907	ML 6700-1	Name	Paihia
Date	Source	Feature type	Description/Comment
1907	ML 6700-1	Name	Crossing called Herekareao (by Miti)
1907	ML 6700-1	Public building	Former school site
1907	ML 6700-1	Name	Kauhoehoe
1907	ML 6700-1	Name	Miti's start Herekareao and end of Kauhoehoe
1907	ML 6700-1	Infrastructure	Culvert and uprooted puriri
1907	ML 6700-1	Topography and vegetation	Willow
1907	ML 6700-1	Topography and vegetation	Willow
1907	ML 6700-1	Topography and vegetation	Willow
1907	ML 6700-1	Cultivation, orchard, fruit tree	Karaka tree
1907	ML 6700-1	Name	Miti's end of Mameri
1907	ML 6700-1	Name	Mameri (famous wahi tapu)
1907	ML 6700-1	Topography and vegetation	Puriri Tree
1907	ML 6700-1	Name	Miti's start of Mameri
1907	ML 6700-1	Name	End of Rotopipiwai and start Ngarihariha (by Ngatai)
1907	ML 6700-1	Wahi tapu or cemetery	Old church ste and wahi tapu called Ngarihariha (by Miti)
1907	ML 6700-1	Name	Miti's start Ngarihariha and end of his Rotopipiwai
1907	ML 6700-1	Name	Mouth of Rotopipiwai
1907	ML 6700-1	Name	Whakapaenga (wahi tapu) by Ngatai
1907	ML 6700-1	Road	Old hauling road
1907	ML 6700-1	Infrastructure	Culvert
1907	ML 6700-1	Name	Whakapaenga (Ngatai)
1907	ML 6700-1	Infrastructure	Culvert
1907	ML 6700-1	Name	Rotopipiwai start (by Miti) and end of Te Eke
1907	ML 6700-1	Road	Hauling road now in use
1907	ML 6700-1	Topography and vegetation	Kahikatea Bush
1907	ML 6700-1	House	Large paling whare
1907	ML 6700-1	Name	Pongaheka Pa and Wahi Tapu
1907	ML 6700-1	Outbuilding, structure	Paling shed
1907	ML 6700-1	Cultivation, orchard, fruit tree	Peach tree
1907	ML 6700-1	Outbuilding, structure	W. B. Shed
1907	ML 6700-1	Topography and vegetation	Taraire Tree
1907	ML 6700-1	Name	Kauaewiri (by Ngatai)
1907	ML 6700-1	Name	Ihimaeras grass paddock
1907	ML 6700-1	Name	Te Horo
1907	ML 6700-1	Name	Te Eke (Start by Miti)
1907	ML 6700-1	Name	Te Kohekohe or Pouhuruhuru (by Ngatai at post IX)
1907	ML 6700-1	Name	Approx. position of Puketapu or Kauwhau Fenced Cemetery about 8 acres
1907	ML 6700-1	Name	Kauhoehoe (Miti)
1907	ML 6700-1	Name	Kauhoehoe
1907	ML 6700-1	Name	Te Pahi Stm (Ngatai)

1907	ML 6700-1	Name	Herekareao (by Miti)
1907	ML 6700-1	Name	Herekareao (Miti)
1907	ML 6700-1	Public building	Present School Site
1907	ML 6700-1	Outbuilding, structure	Paling shed
1907	ML 6700-1	Public building	Hall
Date	Source	Feature type	Description/Comment
1907	ML 6700-1	Name	Te Pahi (Ngatai)
1913	ML 9105	Road	Formed bridle track
1913	ML 9105-1	Road	Track
1913	ML 9105-1	Road	Formed bridle track
1913	ML 9105-2	Topography and vegetation	Fertile, flat open country between road and river and extending [south east]
1913	ML 9105-2	Topography and vegetation	Good flat open country
1913	ML 9105-2	Topography and vegetation	Ordinary hilly country under forest
1913	ML 9105-2	Topography and vegetation	Hilly open country under grass
1913	ML 9105-2	Topography and vegetation	Rough precipitous country under forest
1913	ML 9105-2	Topography and vegetation	Ordinary hilly country with patches of forest
1913	ML 9999	Name	Hemi Te Hara
1913	ML 8864	Topography and vegetation	Good Land on River Flats
1913	ML 8864	Topography and vegetation	Old Kauri Workings Rough hills
1913	ML 8864	Topography and vegetation	Good land Partly cultivated
1913	ML 8864	Topography and vegetation	Good grazing
1913	ML 8864	Topography and vegetation	Partly Cultivated
1915	M 9999	Cultivation, orchard, fruit tree	Land in cultivation
1915	ML 9999	Name	Stannaway
1915	ML 9999	Cultivation, orchard, fruit tree	Cultivations
1915	ML 9999	House	House
1915	ML 9999	Cultivation, orchard, fruit tree	Orchard
1915	ML 9999	Cultivation, orchard, fruit tree	Cultivations
1915	ML 9999	Topography and vegetation	Good river flats volcanic soil
1915	ML 9999	Cultivation, orchard, fruit tree	Karaka tree
1915	ML 9999	House	Houses
1915	ML 9999	Name	Puhipi Tiwene
1915	ML 9999	Topography and vegetation	Old clearning in grass
1915	ML 9999	Topography and vegetation	Good bush land Nearly Level Pukatea, Taraire Etc
1915	ML 9999	Topography and vegetation	Towai, Tawa, Puriri, Kohe, Taraire etc
1915	ML 9999	Topography and vegetation	Mixed bush
1915	ML 9999	Topography and vegetation	Fern spur
1915	ML 9999	Topography and vegetation	2 chains wide Fell and Burnt
1915	ML 9999	Topography and vegetation	Clearning
1915	ML 9999	Topography and vegetation	High Bush Country
1915	ML 9999	Topography and vegetation	Poor fern spurs
1915	ML 9999	Topography and vegetation	Old river bed
1915	ML 9999	Enclosure	Wire fences
1915	ML 9999	Topography and vegetation	Grass land
1915	ML 9999	House	House

Appendix E – Southern Spoil Dump Site

E1.0 Proposal

Waka Kotahi proposes establishing three dump sites on the Mangamuka West 3G G Block, 4321 State Highway 1, Mangamuka including establishment of sediment control around the sites, topsoil stripping and improvements to the existing access track, and other tracks and fences. The area is located west of State Highway 1, with the road crossing to access the sites 1800m north of the SH1/Mangamuka Road intersection.

The proposal has been provided in the form of the planning checklist document prepared by Stellar Projects Ltd provided by S. Brooke in late July 2023, Mangamuka 2022 Slip Response. Southern Fill Site. 4321 State Highway 1, and construction notes for spoil dump site 1, the closest of the three dump sites to the highway, provided by CLL Ltd.

E2.0 Desktop Review

No archaeological sites are recorded in the vicinity.

The nearest recorded potential archaeological or heritage feature is the site of the original Mangamuka School property and buildings, established in 1879. This site is located on a five-acre parcel, Pt Kauhoehoe block west of SH1, immediately south of the road crossing and track to the dump site. The block is illustrated on survey plan ML 5097 (1881) just after the school was established, and later on plans SO 7084 (1894) and ML 9105 (1913). ML 9105 also shows dump site 3 was under forest in the early 20th century while dump sites 1 and 2 had been cleared by that time. The current alignment of State Highway 1 was taken through the eastern side of the Pt Kauhoehoe block in 1959 as shown on (ML 5097) and subsequent road development may have modified or destroyed the old school site. The partition of the Kauhoehoe Block was investigated in 1886 and recorded in Judge Puckey's Minute Book 8: 20 of the Native Land Court but this has not been reviewed to-date.

The next nearest site is the Mameri urupa, 250m south of the subject site road crossing the eastern side of SH1, on the Mangamuka West 3 M Block.

There is no indication of potential archaeological features in the historic or modern aerial imagery. Aerial image SN 356-C-4 (1944) shows the area under fern land or scrubby forest with established forest in the stream gullies, but a number of narrow tracks provide access to the higher ground/interior west of the river flats including along the line of the current track. The area must have been abandoned and left to revegetate at some point after the ML 9105 survey in 1913.

Aerial image SN 1417-F-4 (1961) shows dump site 1 and 2 under scrubby forest, but dump site 3 and the level ground to the southwest was in pasture by that time. Aerial image SN 3025-5025-1 (1968) shows all three dump sites in pasture by that time as do subsequent images SN 5006-D-13 (1977) and image SN 5932-I-19 (1981) shows all three dump sites in pasture.

E3.0 Site Visit

The proposed dump sites were visited in the company of T. Otene over the course of an hour on 14 August 2023. The dump sites appear to be located over ancient marine terraces as noted in Section 2.1.

T. Otene related that his cousins owned the property, and he had helped clear vegetation off the area of the dump sites as a young man. He also noted he had hunted extensively in the surrounding areas and had not seen or been told of any wahi tapu or potential archaeological or heritage features in the vicinity.

No archaeological sites or features were observed on the ground surface.

E4.0 Findings and Recommendations

There are no archaeological or historic sites or features on the proposed dump sites. The rolling to level high ground appears to have been cleared by the early 20th century but had revegetated by the time of World War II. It is likely that the area was grazed in the late 19th century but the extensive cultivations recorded on the flats of the Mangamuka valley floor do not seem to have extended to the higher ground nearby and other use or occupation of the area seems unlikely although the area is north facing and relatively well-drained and sheltered.

There is a small chance of encountering isolated archaeological features such as hearths, ovens or anthropogenic or made garden soils (i.e. imported river gravels, sand, charcoal etc added to natural soils to improve growing properties) related to land clearance and horticultural activities but these are unlikely to be identified prior to large-scale topsoil stripping and does not meet the threshold of requiring an archaeological Authority on a precautionary basis and may be adequately managed under an accidental discovery protocol.

1) An archaeological Authority is not required for the establishment of the spoil dump sites on the Mangamuka West 3G Block.

2) An accidental discovery protocol should be in place during site establishment, track/road improvements and topsoil stripping for sediment control features and the dump sites themselves.

3) T. Otene should monitor the establishment and topsoil stripping for the dump sites.

4) If archaeological remains or buried cultural deposits are encountered during works, such as layers of shell midden, oven stones, black, charcoal-rich or stained soils, artefacts etc., work should cease in the immediate vicinity and Heritage New Zealand and Geometria Ltd should be contacted for advice on how to proceed according to the site instruction protocols.

Appendix F – Peria Valley Road Spoil Dump Site

E1.0 Proposal

Waka Kotahi proposes establishing a dump site at 184 Peria Valley Road, including improvements to the road crossing establishment of sediment control around the site, topsoil stripping and changes to drainage, fencing and farm tracks.

The dump site is located on Lot 1 DP 35169.

The proposal has been provided in the form of the planning checklist document prepared by Stellar Projects Ltd provided by S. Brooke in late July 2023, Mangamuka 2022 Slip Response. Northern Fill Site. 184 Peria Valley Road.

E2.0 Desktop Review

No archaeological sites are recorded in the vicinity.

The nearest recorded potential archaeological or heritage feature is the line of the old road from Victoria Valley to Peria, which was surveyed in 1881 when the new road to be taken was surveyed. This is shown on SO 3288 (1881) Plan of Road Line from Victoria Valley Road to Peria Proposed To Be Taken Under the Public Works Act, with the track as a dashed line along the northern side of the dump site, with the new road survey to the south more or less on its current alignment. In the area of the dump site, the old road is shown as cleared while the high ground above with the new road is still forested.

In 1894 when Sections 17, 18 and 19 Parish of Maungataniwha south of Peria Valley Road were survyed (SO 6883, 1894), the old road was formally surveyed and described as “Old Ridge Road to Victoria Valley” and the end of the formation of the current alignment is shown, 300m to the northeast of the dumpsite near the intersection with Mangatoetoe Road.

There is no indication of potential archaeological features in the historic or modern aerial imagery, aside from the old track/road.

E3.0 Site Visit

The proposed dump site was visited on 12 September 2023 and J. Tahere of Tahere Contractors Ltd was on-site at the time.

The existing upper winter works were walked over, with particular attention paid to swales and spoil, afterwhich the lower, summer dump site was inspected, along with the spurs above.

No archaeological sites or features were observed.

E4.0 Findings and Recommendations

There are no archaeological or historic sites or features on the proposed dump site. The steep to rolling country along Peria Valley Road appears to have been cleared by the late 19th century with the current road following more or less the original Maori track between Victoria Valley and Peria with minor deviations to traverse the steeper country . Pre-1900 use and occupation of the area seems unlikely, apart from transiting the area via the different iterations of the track and road, until after 1894 when the modern sections were surveyed out of the Maungataniwha Block and opened for settlement.

There is little to know chance of archaeological or other heritage sites or features being affected.

1) An archaeological Authority is not required for the establishment of the spoil dump site on Lot 1 DP 35169.

2) An accidental discovery protocol should be in place during site establishment, track/road improvements and topsoil stripping for sediment control features and the dump site itself.

3) If archaeological remains or buried cultural deposits are encountered during works, such as layers of shell midden, oven stones, black, charcoal-rich or stained soils, artefacts etc., work should cease in the immediate vicinity and Heritage New Zealand and Geometria Ltd should be contacted for advice on how to proceed according to the site instruction protocols.

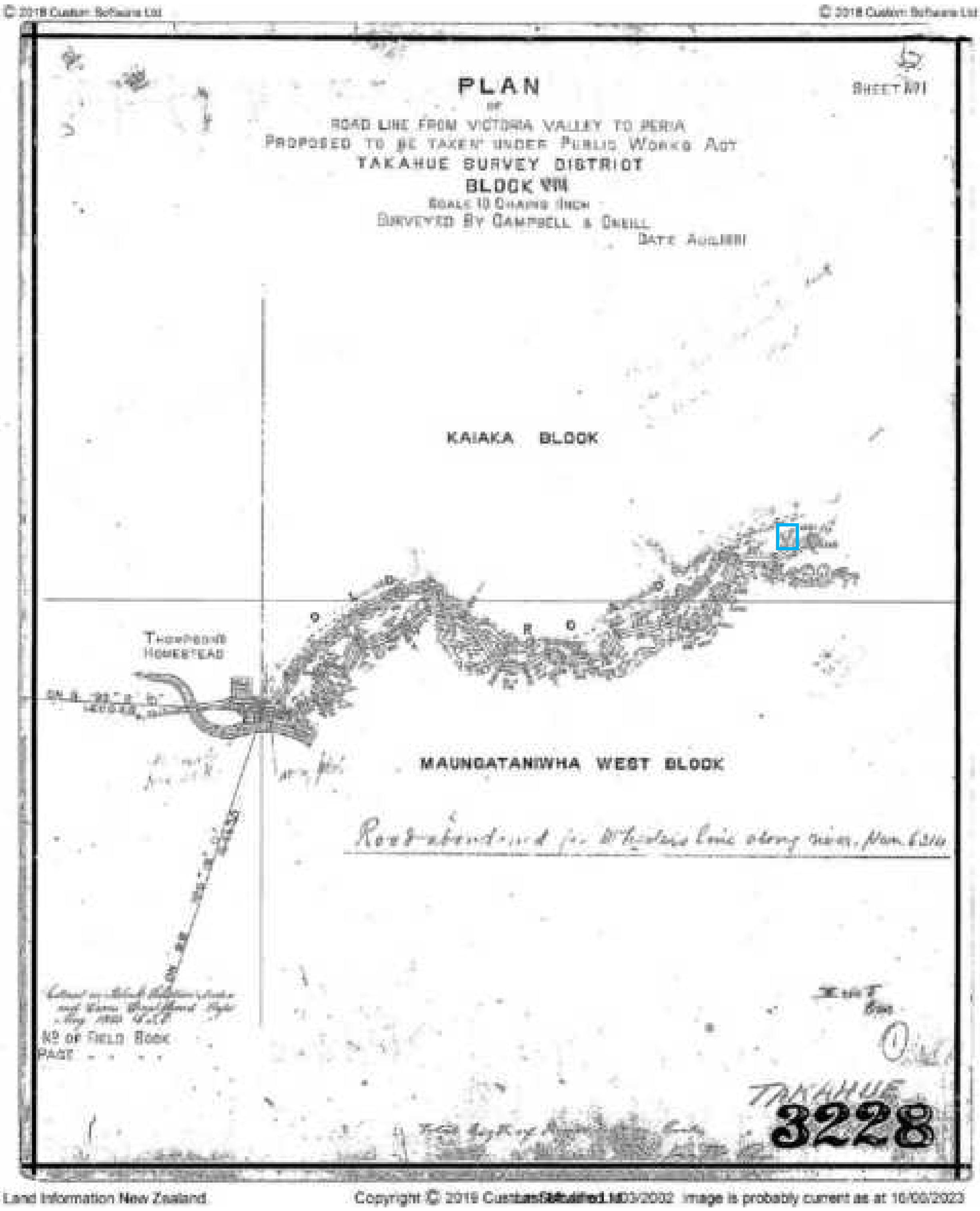


Figure 71: SO 3288-1 (1881) with approximate location of spoil dump site in blue.

Figure 72: SO 6933 (1894) with approximate location of spoil dump site in blue.

Figure 73: Peria Valley Road spoil dump site, looking west.

Figure 74: Looking north.

Figure 75: Looking northeast along farm track/old road alignment.

Appendix G – Pamapuria Spoil Dump Site

G1.0 Proposal

Waka Kotahi proposes establishing a dump site at 7189 State Highway 1 Pamapuria, including improvements to the road crossing establishment of sediment control around the site, topsoil stripping and changes to drainage and fencing. Some retaining would also probably be required.

The proposal has been provided in the form of the planning checklist document prepared by Stellar Projects Ltd provided by S. Brooke in September 2023, MANGAMUKA 2022 SLIP RESPONSE Possible Northern Fill Site 7189 State Highway 1, Kaitaia, dated 31 May 2023.

The dump proposed site is located on the western side of the 2ha Te Konoti Block A6B Block, with the level eastern side of the block containing the urupa and church. The western side of the block is in rank grass, and is separated from the church and urupa by a post and wire fence. It is bisected by a gully rising west to east towards the dividing fence. A road crossing and gate to the highway on the northern side of the bare block provides access to a narrow strip of level land adjacent to the highway, which then drops away into the gully. On the south side of the gully the ground rises steeply to meet a spur which rises west to east to the level ground.

The proposal calls for placing spoil on the upper slope of the north side of the gully to raise the ground level and provide room for the expansion of the urupa. The gully has a moderate slope and the earthworks would likely require specific geotechnical design to ensure land stability is achieved. There has been no geotechnical investigation or civil design of the proposed activity.

G2.0 Desktop Review

Archaeological site O04/210 site is recorded on the south side of the property. It was originally recorded by Forest Service superintendent and avocational archaeologist R. Lawn who recorded the site as a ridge pā with 'levels' (terraces) under grass on the low ridge south of the church. The site was re-recorded by A. Leahy in 1979 who noted that most of the site had been destroyed by the urupa with the rest in poor pasture. She recorded a dozen ill-defined terraces on the ridge, with a possible in-filled ditch behind the urupa, east of the terraces (Figure 76). The site was viewed from the western side of the river by E. Callaghan in 2014, when she was asked to relocate the site by an adjacent landowner as it was mislocated on their property at the time, according to the ArchSite database.

The urupa and churchyard is also a scheduled Site of Cultural Significance to Māori in the Far North District Plan, MS05-78 Tarakaka Cemetery Reserve & waahi tapu. A five acre cemetery was partitioned out of the Te Konoti Block in 1894 (Te Konoti A2), according to Maori Land Court records and a historic narrative prepared by T. Latimer.

The current church is the third on the site, the second church being visible in the 1950 aerial imagery to the south west of the current building, and aligned parallel to the highway, rather than perpedicular like the current building. This building was replaced by the new church in 1956 and this area is now in graves; the old church was to be used as the local hall.

Both modern and historic aerial imagery (Figure 77 - Figure 80) show the remains of what appears to be a defensive earthwork with multiple flanking angles suggestive of gun-fighting adaptation on the northern face, most obvious in the 1950 aerial. A western return of the ditch back towards the river is most visible in the 1973 aerial.

It seems probable that there was a gunfighting pa established on the edge of the escarpment above the river, with the defensive ditch on the western and northern side enclosing approximately 900m^2, and the southern and eastern side protected by the steep slope down to the river. It is not clear whether the terraces on the western spur are part of the same occupation, or pre- or post-date the pā.

A review of approximately 20 historic survey plans for the area did not reveal any additional information about the pā or other occupation in the vicinity of the spoil dump site and urupa/churchyard. ML 677 (1867) is the original survey of the Te Konoti Block produced in the course of the original title investigation. The name "Hikutara" is shown on ML 677 (1867; Figure 81) approximately 300m to the southeast of the project area. Other cultivation areas, whare, names and descriptions of physical features are shown in the wider area on other plans from this period through to 1917. Survey plan ML 2347 (1871; Figure 82) Orakiroa shows the next nearest historic feature, a cultivation on the south side of the river, approximately 200m south of the pā.

ML 677/A (~1884?; Figure 83) probably dates to the first partition of Te Konoti, with subsequent subdivisions marked up on the plan, along with the various dates it was produced at the Native Land Court. It shows the survey of the five acre Te Konoti A2, the original appellation of the urupa which was partitioned out of Te Konoti A in 1894.

Features recorded in the vicinity are illustrated on Figure 84 - Figure 85.

G3.0 Site Visit

The proposed spoil dump site (Figure 86) was visited for an hour on 9 September 2023, in the company of T. Latimer, R. Gabel, and G. Latimer. The possible infilled defensive ditch in the urupa was visible as a slightly darker line of vegetation and shallow swale running across the rear of the urupa under closely mowed grass, but was not visible beneath the rank grass on the western side of the internal fence (Figure 87).

A number of possible terraces were observed on the southern descending spur to the west of the fence. There were larger transverse terraces on the spur which were 10-15 x 10 x 0.3m in size, and smaller lateral terraces around the head of the gully which are more likely to be erosional features. However they were all relatively indistinct and while they looked like they started as erosion features, have probably been modified by occupation and/or gardening (Figure 88).

A track has been benched along the western side of the fence line north to south, but no archaeological features, layering or artefacts were visible in the batter where it was visible.

G4.0 Preliminary Findings and Recommendations

There is an archaeological site present in the project area, O04/210 and it is likely to have been a pā at some point. Some of the features recorded in Leahy's 1979 are present in the area of the proposed spoil dump site on the northwest side of the parcel, but the bulk of the site is on the southern half of Te Konoti A6B.

There is a moderate likelihood of modifying archaeological features if the northern part of the property is used as a spoil dump site. Archaeological features are likely to be relatively shallow, would be modified by topsoil stripping and other otherwise minor works like sediment control and retaining. The features may or may not be associated with the occupation suggested by the pā site and terraces. Likely features include postholes, ovens and hearths, food refuse, and given the presence of the wahi tapu, formal burials may be present.

A formal archaeological significance assessment is likely to find the site as being of high archaeological significance, based on the site type and association with the urupa.

Heritage New Zealand Pouhere Taonga has a long-standing policy of not granting Authorities or allowing development on pā or wahi tapu, with limited exceptions for e.g. walking tracks, signage and toher visitor amenities over pā in public ownership, stabilisation of sites, and management activities associated with the ongoing and use of such places.

However, if the establishment of the spoil dump site provides additional room for the future expansion of the urupa and if this can be accomplished in lieu of extending burials into the pā and the pā can be protected from further modification, this may be a net gain for protecting archaeological and historic heritage values.

In summary:

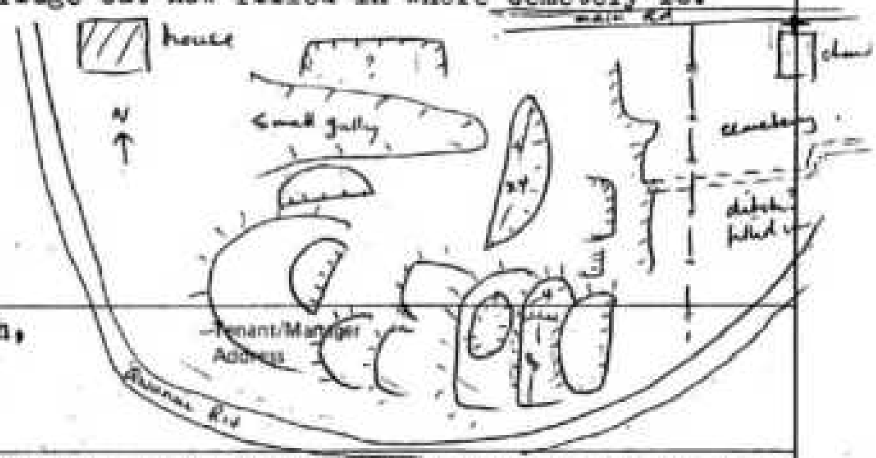
1) An archaeological Authority is required for the establishment of the spoil dump site on the Te Konoti A6B block.

2) Any earthworks including enabling works and topsoil stripping should be monitored by an archaeologist.

3) Any features encountered would need to be investigated.

4) Given the ongoing use of the urupa, and long-term plans for extending westwards into the as yet undeveloped part of the property, the development of the northern part as a spoil dump site could be used as an opportunity to confirm or otherwise the presence of a pā by test excavation of the possible infilled defensive ditch while excavators are on site for the spoil site, followed by permanent protection of the pā and reserving it from future burials.

5) If archaeological remains or buried cultural deposits are encountered in the project area in the meantime, such as layers of shell midden, oven stones, black, charcoal-rich or stained soils, artefacts etc., work should cease in the immediate vicinity and Heritage New Zealand and Geometria Ltd should be contacted for advice on how to proceed according to the site instruction protocols.


Ill-defined stepped terraces beside Awanui River. Possible ditch ~~across ditch~~ across ridge but now filled in where cemetery is.

Owner Address: Anglican Church, Rangitihi, Kaitaia.

Tenant/Manager Address

Nature of information (hearsay, brief or extended visit, etc.) Walked over & paced part of site

Figure 76: Sketch map of site by Leahy (1979).

Figure 77: Detail from aerial image SN 350 1365/16 (1950) showing clearest image of possible defensive ditch with gun-fighting flanking angles at rear of urupa (in blue).

Figure 78: Detail from SN 1417 B/12 (1961) showing possible defensive ditch with gun-fighting features at rear of urupa.

Figure 79: Detail from aerial image SN 3675 C/3 (1973) with defensive ditch and possible terraces.

Figure 80: Detail from 2016 aerial showing possible terraces, and defensive ditch (Google Earth).

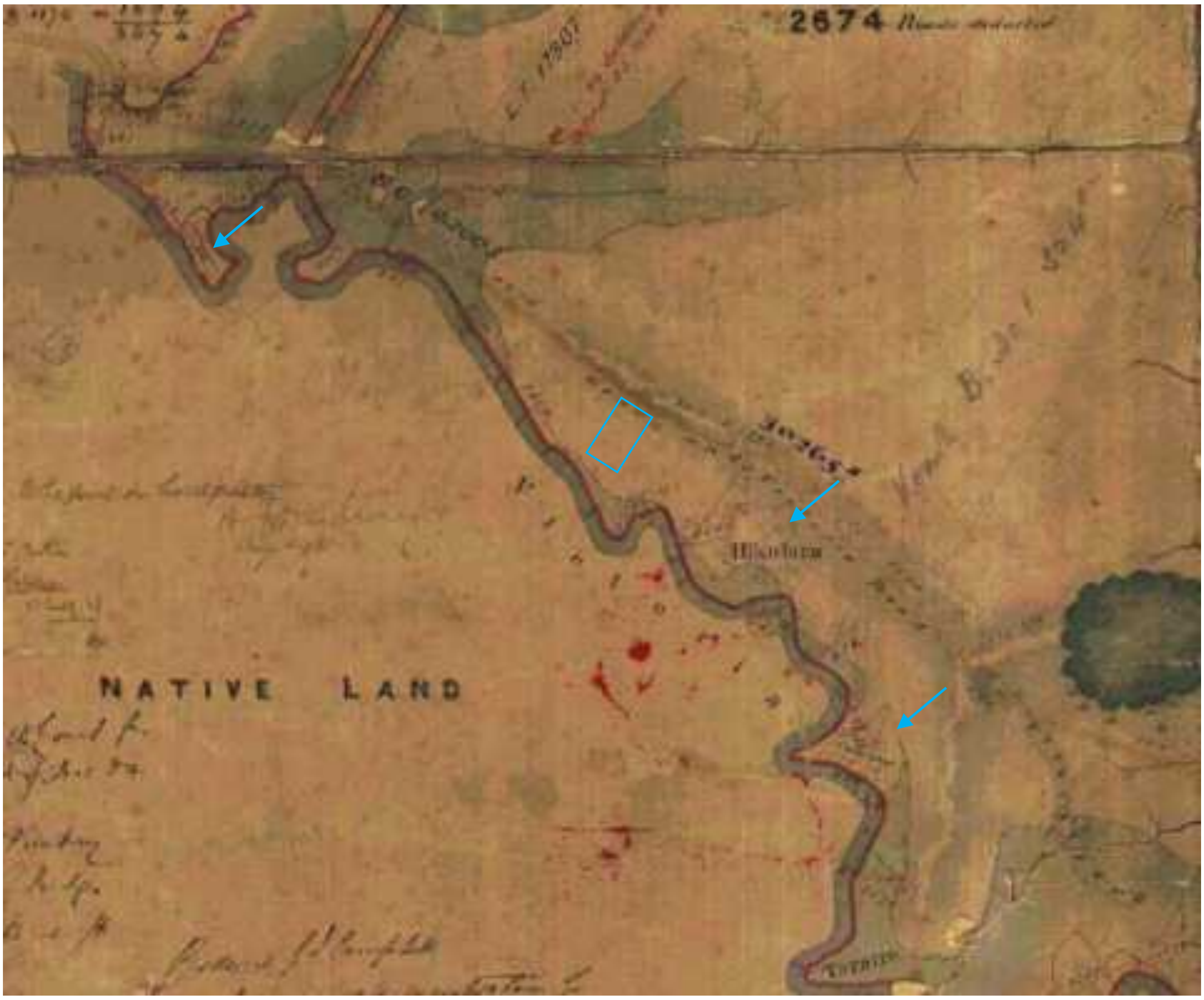


Figure 81: Detail from ML 677 (1867) Plan of the Te Konoti Block, showing "Hikutara" southwest of project area, and neighbouring cultivations.

Figure 82: ML 2347 (1871) Orakiroa, with cultivation on the eastern side of the block adjacent to the river, south of the project area.

Figure 83: ML 677/A (~1884) with partition of the five acre Te Konoti A2 block for the urupa.

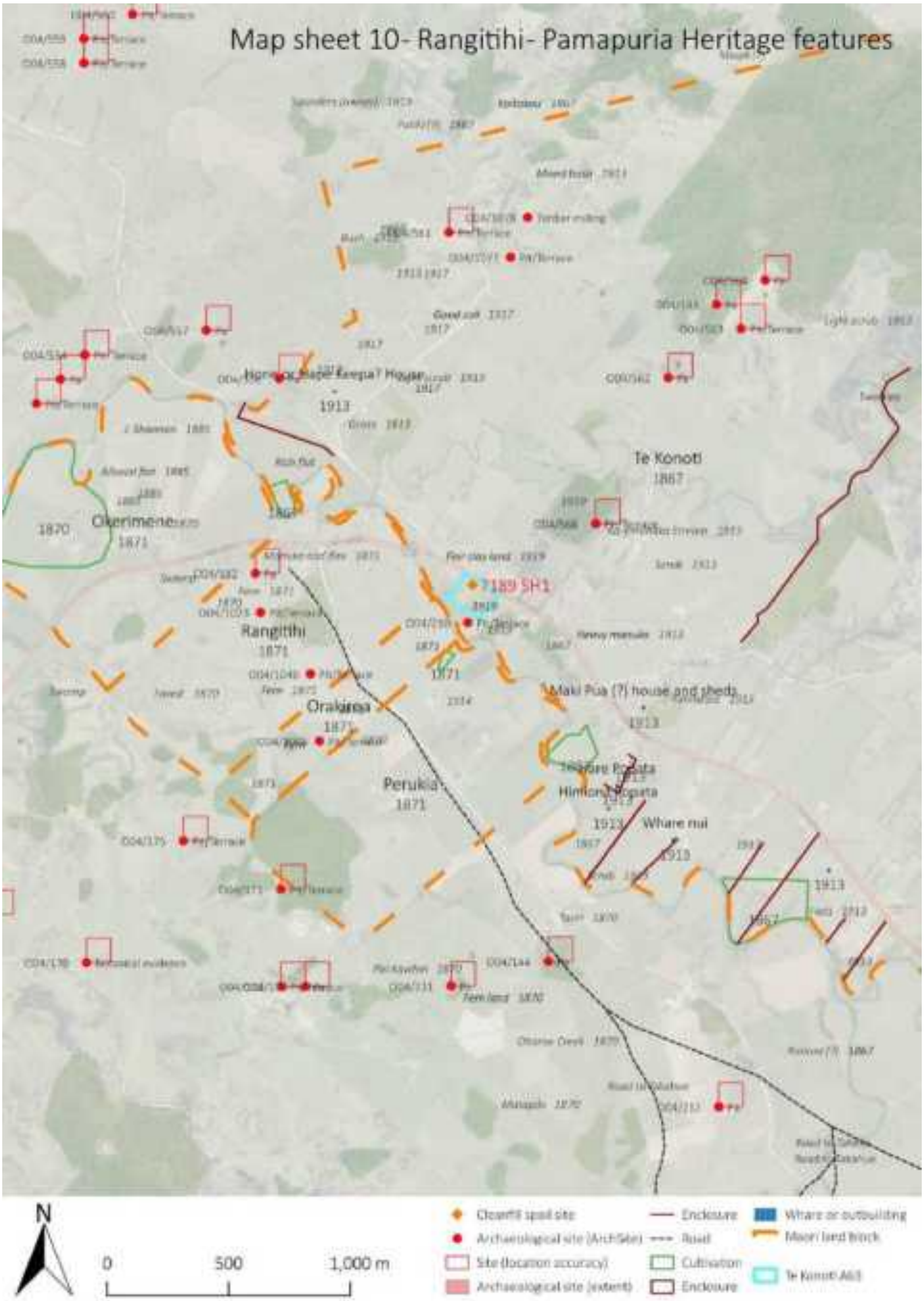


Figure 84: Archaeological and historic heritage features at Rangitihi-Pamapuria.

Figure 85: Archaeological and historic heritage features at Te Konoti A6B.

Figure 86: Looking north towards proposed spoil dump site.

Figure 87: Looking south over rear of urupa with possible infilled ditch.

Figure 88: Possible terraces down western ridgeline.

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

Site Record Form

NZAA SITE NUMBER: O04/210

SITE TYPE: Pit/Terrace

SITE NAME(s):

DATE RECORDED:

SITE COORDINATES (NZTM) Easting: 1630225 **Northing:** 6113419 **Source:** On Screen

IMPERIAL SITE NUMBER: N10/13 **METRIC SITE NUMBER:** O04/210

Finding aids to the location of the site

South of main road. West of Anglican Church and cemetery.

Brief description

Terraced ridge, and possible in-filled ditch.

Recorded features

Terrace

Other sites associated with this site

SITE RECORD HISTORY	NZAA SITE NUMBER: O04/210

Site description

Updated 31/10/2014 (Field visit), submitted by elisabethcallaghan , visited 21/10/2014 by Callaghan, Elisabeth
Grid reference (E1630225 / N6113419)

The site is located on the northern side of the Victoria/Awanui River in the Victoria Valley. Refer to the original site record form sketch diagram of the site. Site viewed from across the river on an adjacent property to the west on the western side of the river. The site visit was as a result of a request by the owners agent to confirm location of site O04/210. The site was incorrectly located on ArchSite database.

Condition of the site

Statement of condition

Updated: 01/09/2015, Visited: 21/10/2014 - Poor - Visible features are incomplete, unclear and/or the majority have been damaged in some way

Current land use:

Threats:

SITE RECORD INVENTORY	NZAA SITE NUMBER: O04/210

Supporting documentation held in ArchSite

SITE RECORD FORM

1. [illegible] Just below [illegible] on edge of [illegible] River where it crosses SH1.

2. [illegible]

3. [illegible]

4. [illegible]
Address

Address

5. Method and equipment used

6. Aerial photographs consulted: No

7. [illegible]
Address

Date

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD FORM (NZMS1)

NZMS 1 map number: N10
NZMS 1 map name: Kaitaia
NZMS 1 map edition: 2nd 1977

NZAA NZMS 1 SITE NUMBER: N10/13
DATE VISITED: 12/3/79
SITE TYPE: terraced ridge (P)
SITE NAME: MAORI
OTHER

Grid Reference: Easting 0 8 1 6 0 0 Northing 8 6 8 1 0 0

1. Aids to relocation of site (attach a sketch map)

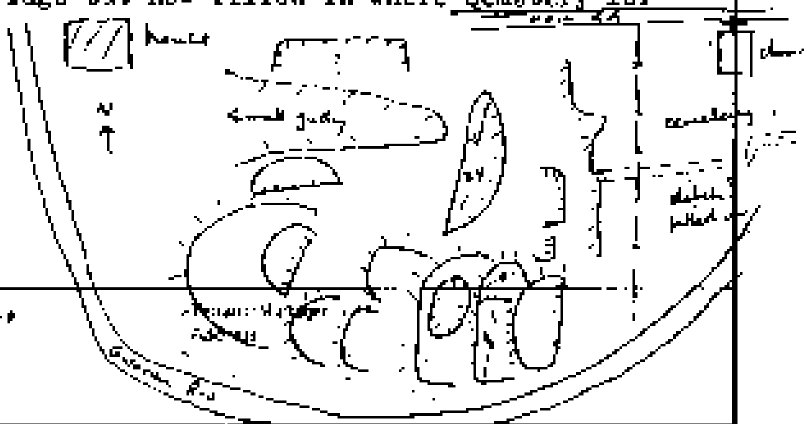
East of Awanui River bridge at Rangitihi & south of main road. West of Anglican church & cemetery.

2. State of site and possible future damage

Part of site totally destroyed by cemetery, rest in poor pasture. May have once been a pa with ditch now filled in.

3. Description of site (Supply full details, history, local environment, references, sketches, etc. If extra sheets are attached, include a summary here)

Ill-defined stepped terraces beside Awanui River. Possible ditch ~~across ditch~~ across ridge but now filled in where cemetery is.



4. Owner: Anglican Church,
Address: Rangitihi,
Kaitaia.

Tenant/Manager
Address

5. Nature of information (hearsay, brief or extended visit, etc.) Walked over & paced part of site

Photographs (reference numbers, and where they are held)

Aerial photographs (reference numbers, and clarity of site) 2589/5-6 shows badly

6. Reported by: L. Leahy,
Address: Auckland.

Previously recorded.

Filekeeper: p.p. S.M.C.
Date: 11/12/79

7. Key words

ridge terraces on river bend.

8. New Zealand Register of Archaeological Sites for office use
NZAA NZMS1 Site Record

A	P	Type of site
A	W	Local environment today
A	E	Land classification

6	6	Present condition and future danger of destruction
A	A	Security code
D	R	Local theory

Appendix G – Pamapuria Spoil Dump Site

G1.0 Proposal

Waka Kotahi proposes establishing a dump site at 7189 State Highway 1 Pamapuria, including improvements to the road crossing establishment of sediment control around the site, topsoil stripping and changes to drainage and fencing. Some retaining would also probably be required.

The proposal has been provided in the form of the planning checklist document prepared by Stellar Projects Ltd provided by S. Brooke in September 2023, MANGAMUKA 2022 SLIP RESPONSE Possible Northern Fill Site 7189 State Highway 1, Kaitaia, dated 31 May 2023.

The dump proposed site is located on the western side of the 2ha Te Konoti Block A6B Block, with the level eastern side of the block containing the urupa and church. The western side of the block is in rank grass, and is separated from the church and urupa by a post and wire fence. It is bisected by a gully rising west to east towards the dividing fence. A road crossing and gate to the highway on the northern side of the bare block provides access to a narrow strip of level land adjacent to the highway, which then drops away into the gully. On the south side of the gully the ground rises steeply to meet a spur which rises west to east to the level ground.

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The urupa and churchyard is also a scheduled Site of Cultural Significance to Māori in the Far North District Plan, MS05-78 Tarakaka Cemetery Reserve & waahi tapu. A five acre cemetery was partitioned out of the Te Konoti Block in 1894 (Te Konoti A2), according to Maori Land Court records and a historic narrative prepared by T. Latimer.

The current church is the third on the site, the second church being visible in the 1950 aerial imagery to the south west of the current building, and aligned parallel to the highway, rather than perpedicular like the current building. This building was replaced by the new church in 1956 and this area is now in graves; the old church was to be used as the local hall.

Both modern and historic aerial imagery (Figure 77 - Figure 80) show the remains of what appears to be a defensive earthwork with multiple flanking angles suggestive of gun-fighting adaptation on the northern face, most obvious in the 1950 aerial. A western return of the ditch back towards the river is most visible in the 1973 aerial.

It seems probable that there was a gunfighting pa established on the edge of the escarpment above the river, with the defensive ditch on the western and northern side enclosing approximately 900m^2, and the southern and eastern side protected by the steep slope down to the river. It is not clear whether the terraces on the western spur are part of the same occupation, or pre- or post-date the pā.

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Features recorded in the vicinity are illustrated on Figure 84 - Figure 85.

G3.0 Site Visit

The proposed spoil dump site (Figure 86) was visited for an hour on 9 September 2023, in the company of T. Latimer, R. Gabel, and G. Latimer. The possible infilled defensive ditch in the urupa was visible as a slightly darker line of vegetation and shallow swale running across the rear of the urupa under closely mowed grass, but was not visible beneath the rank grass on the western side of the internal fence (Figure 87).

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A track has been benched along the western side of the fence line north to south, but no archaeological features, layering or artefacts were visible in the batter where it was visible.

G4.0 Preliminary Findings and Recommendations

There is an archaeological site present in the project area, O04/210 and it is likely to have been a pā at some point. Some of the features recorded in Leahy's 1979 are present in the area of the proposed spoil dump site on the northwest side of the parcel, but the bulk of the site is on the southern half of Te Konoti A6B.

There is a moderate likelihood of modifying archaeological features if the northern part of the property is used as a spoil dump site. Archaeological features are likely to be relatively shallow, would be modified by topsoil stripping and other otherwise minor works like sediment control and retaining. The features may or may not be associated with the occupation suggested by the pā site and terraces. Likely features include postholes, ovens and hearths, food refuse, and given the presence of the wahi tapu, formal burials may be present.

A formal archaeological significance assessment is likely to find the site as being of high archaeological significance, based on the site type and association with the urupa.

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However, if the establishment of the spoil dump site provides additional room for the future expansion of the urupa and if this can be accomplished in lieu of extending burials into the pā and the pā can be protected from further modification, this may be a net gain for protecting archaeological and historic heritage values.

In summary:

1) An archaeological Authority is required for the establishment of the spoil dump site on the Te Konoti A6B block.

2) Any earthworks including enabling works and topsoil stripping should be monitored by an archaeologist.

3) Any features encountered would need to be investigated.

4) Given the ongoing use of the urupa, and long-term plans for extending westwards into the as yet undeveloped part of the property, the development of the northern part as a spoil dump site could be used as an opportunity to confirm or otherwise the presence of a pā by test excavation of the possible infilled defensive ditch while excavators are on site for the spoil site, followed by permanent protection of the pā and reserving it from future burials.

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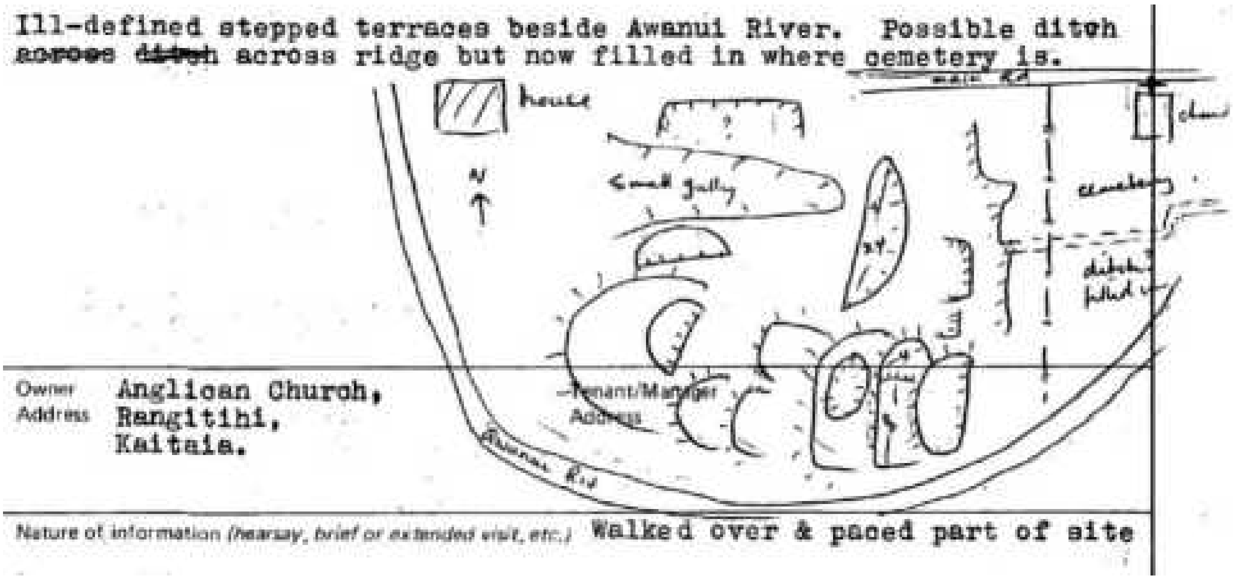

Ill-defined stepped terraces beside Awanui River. Possible ditch ~~across ditch~~ across ridge but now filled in where cemetery is.

Owner Address: Anglican Church, Rangitihi, Kaitaia.

~~Tenant/Manager~~ Address

Nature of information (hearsay, brief or extended visit, etc.) Walked over & paced part of site

Figure 76: Sketch map of site by Leahy (1979).

Figure 77: Detail from aerial image SN 350 1365/16 (1950) showing clearest image of possible defensive ditch with gun-fighting flanking angles at rear of urupa (in blue).

Figure 78: Detail from SN 1417 B/12 (1961) showing possible defensive ditch with gun-fighting features at rear of urupa.

Figure 79: Detail from aerial image SN 3675 C/3 (1973) with defensive ditch and possible terraces.

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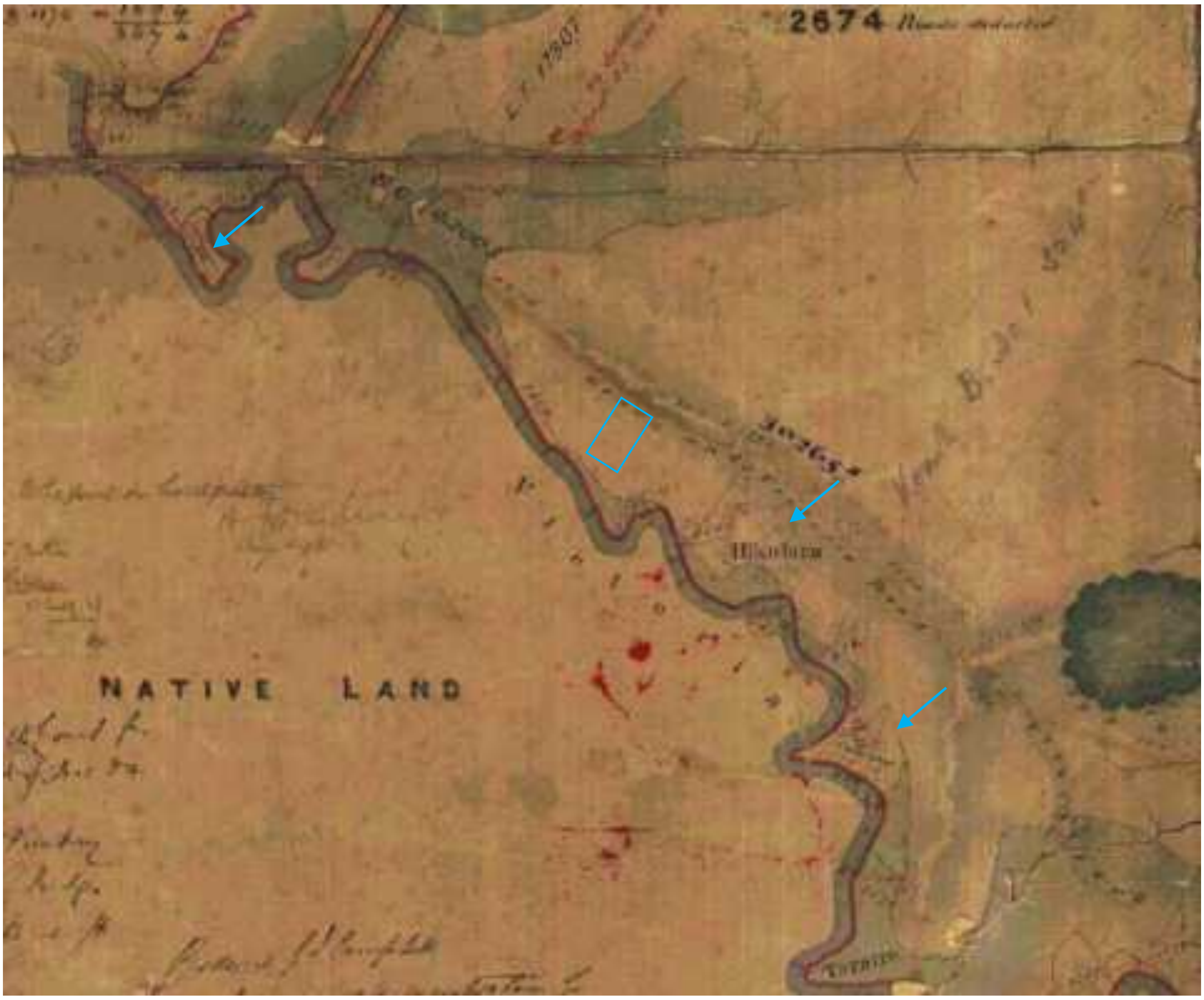


Figure 81: Detail from ML 677 (1867) Plan of the Te Konoti Block, showing "Hikutara" southwest of project area, and neighbouring cultivations.

Figure 82: ML 2347 (1871) Orakiroa, with cultivation on the eastern side of the block adjacent to the river, south of the project area.

Figure 83: ML 677/A (~1884) with partition of the five acre Te Konoti A2 block for the urupa.

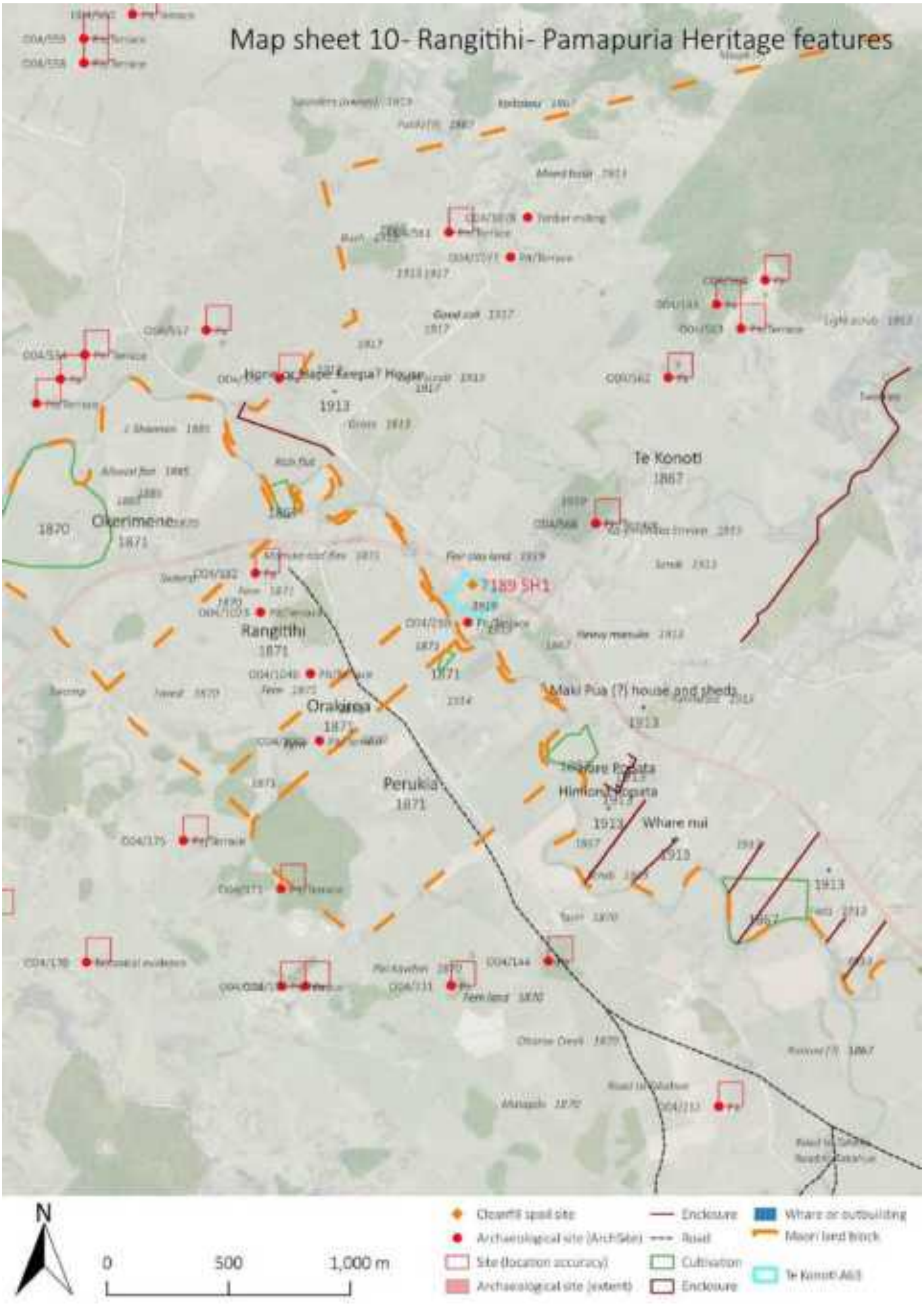


Figure 84: Archaeological and historic heritage features at Rangitihi-Pamapuria.

Figure 85: Archaeological and historic heritage features at Te Konoti A6B.

Figure 86: Looking north towards proposed spoil dump site.

Figure 87: Looking south over rear of urupa with possible infilled ditch.

Figure 88: Possible terraces down western ridgeline.

ARCHSITE archaeological site recording scheme

Site Record Form

NZAA SITE NUMBER: O04/210

SITE TYPE: Pit/Terrace

SITE NAME(s):

DATE RECORDED:

SITE COORDINATES (NZTM) Easting: 1630225 **Northing:** 6113419 **Source:** On Screen

IMPERIAL SITE NUMBER: N10/13 **METRIC SITE NUMBER:** O04/210

Finding aids to the location of the site

South of main road. West of Anglican Church and cemetery.

Brief description

Terraced ridge, and possible in-filled ditch.

Recorded features

Terrace

Other sites associated with this site

SITE RECORD HISTORY	NZAA SITE NUMBER: O04/210

Site description

Updated 31/10/2014 (Field visit), submitted by elisabethcallaghan , visited 21/10/2014 by Callaghan, Elisabeth
Grid reference (E1630225 / N6113419)

The site is located on the northern side of the Victoria/Awanui River in the Victoria Valley. Refer to the original site record form sketch diagram of the site. Site viewed from across the river on an adjacent property to the west on the western side of the river. The site visit was as a result of a request by the owners agent to confirm location of site O04/210. The site was incorrectly located on ArchSite database.

Condition of the site

Statement of condition

Updated: 01/09/2015, Visited: 21/10/2014 - Poor - Visible features are incomplete, unclear and/or the majority have been damaged in some way

Current land use:

Threats:

SITE RECORD INVENTORY	NZAA SITE NUMBER: O04/210

Supporting documentation held in ArchSite

[illegible]

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD FORM

Map number [illegible]
Map name [illegible]
Map edition [illegible]
Grid Reference [illegible]

Site type [illegible]

1\. [illegible] just below [illegible] on edge of [illegible] River where it crosses SH1.

2\. [illegible] possibility of damage or destruction

3\. [illegible]

[illegible]

4\. Owner
Address

Tenant/Manager
Address

5\. Method and equipment used

[illegible]
Date recorded [illegible]

6\. Aerial photographs consulted: No

7\. [illegible]
Address

Date

Filekeeper [illegible]

Date [illegible]

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD FORM (NZMS1)

NZMS 1 map number: N10
NZMS 1 map name: Kaitaia
NZMS 1 map edition: 2nd 1977

NZAA NZMS 1 SITE NUMBER: N10/I3
DATE VISITED: I2/3/79
SITE TYPE: terraced ridge (P?)
SITE NAME: MAORI
OTHER

Grid Reference — Easting: 0 8 3 6 0 0 — Northing: 8 6 8 3 0 0

1. Aids to relocation of site (attach a sketch map)

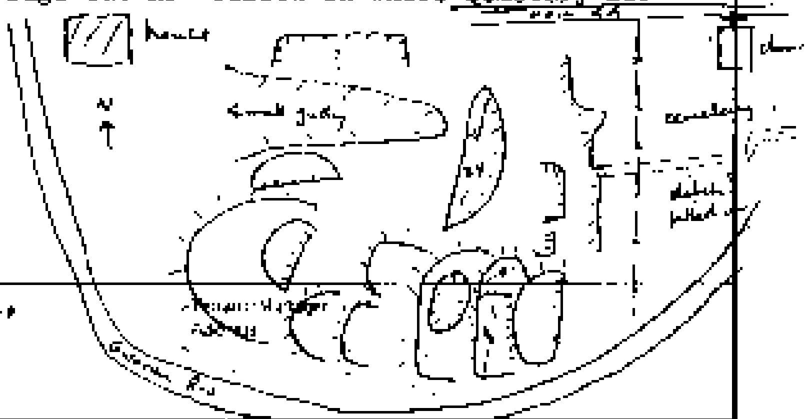
East of Awanui River bridge at Rangitihi & south of main road. West of Anglican church & cemetery.

2. State of site and possible future damage

Part of site totally destroyed by cemetery, rest in poor pasture. May have once been a pa with ditch now filled in.

3. Description of site (Supply full details, history, local environment, references, sketches, etc. If extra sheets are attached, include a summary here)

Ill-defined stepped terraces beside Awanui River. Possible ditch ~~across ditch~~ across ridge but now filled in where cemetery is.



4. Owner: Anglican Church,
Address: Rangitihi,
Kaitaia.

Tenant/Manager
Address

5. Nature of information (hearsay, brief or extended visit, etc.) Walked over & paced part of site

Photographs (reference numbers, and where they are held)

Aerial photographs (reference numbers, and clarity of site) 2589/5-6 shows badly

6. Reported by: A. Leahy,
Address: Auckland.

Previously recorded.

Filekeeper: P.P. S.M.S.
Date: 11/12/79

7. Key words

ridge terraces on river bend.

8. New Zealand Register of Archaeological Sites (for office use)
NZMS 1 Site Record Code

A P	Type of site	G 6	Present condition and future danger of destruction
A W	Local environment today	A A	Security code
A E	Land classification	D R	Local body

APPENDIX E Wildlife Permit 111521-FAU

Consent in respect of protected wildlife

Consent Number: 111521-FAU

Pursuant to section 71 of the Wildlife Act 1953:

New Zealand Transport Agency / Waka Kotahi

Is authorised to exercise its powers under the Government Roading Powers Act 1989 in respect of protected wildlife as specified in this consent, and subject to the conditions specified in this consent.

BACKGROUND:

The Minister of Conservation and the Minister of Transport's delegated authorities are empowered to issue consents in respect of any protected wildlife under the Wildlife Act 1953.

The New Zealand Transport Agency (NZTA) needs to do emergency works under the 'Mangamuka 2022 Slip Response Project' (the Project) along State Highway 1 through the Maungataniwha Range south of Kaitaia. NZTA is empowered by section 61(4) of the Government Roading Powers Act 1989 to construct and maintain State highways.

In the course of construction, NZTA is expected to incidentally kill and disturb (including by taking steps to minimise harm to wildlife) protected wildlife. To do so requires the prior consent of the Minister of Conservation and the Minister of Transport delegated authority, under section 71 of the Wildlife Act.

This consent authorises NZTA (hereinafter, the Consent Holder) to undertake activities under the Government Powers Roading Act 1989 in respect of wildlife as specified in this consent, and subject to the conditions specified in this consent and its schedules.

SIGNED by the Minister of Conservation's Delegated Authority Senior Manager Regulatory Delivery	**SIGNED by the Minister of Transport's Delegated Authority Transport Secretary**
Stacey Wrenn	Bronwyn Turley

SCHEDULE 1

1.	**Consented activity in respect of Wildlife (including the species, any approved quantities and collection methods)** (Subject to Schedule 2, clause 2, Schedule 3)	1. The activities consented to are: i. To catch or otherwise obtain alive, possess, and liberate protected wildlife identified in Schedule 4 for the purpose of species management. ii. To take or otherwise obtain the eggs of Northland brown kiwi *Apteryx mantelli* as listed in Schedule 5. iii. To kill protected wildlife identified in Schedule 4. 2. Quantity: i. As required. 3. Methodology: i. All activities must be carried out in a way that protects wildlife to the greatest extent possible and in accordance with the relevant species management plans found in Schedule 6 attached to this consent and in addition to any further conditions as required by this consent.
2.	**The Land** (Schedule 2, clause 2)	i. As shown on the maps in Schedule 7 being approximately 0.5 hectares of vegetation removal
3.	**Personnel authorised to undertake activities** (Schedule 2, clause 3)	i. Qualified experts with expertise relevant to the protected wildlife species concerned. ii. Others under the direct supervision of the qualified experts
4.	**Term** (Schedule 2, clause 4)	Commencing on and including 29 February 2024 and ending on and including 28 February 2028.
5.	**Consent Holder's address for notices** (Schedule 2, clause 7)	The Consent Holder's address in New Zealand Level 5 AON Centre 29 Customs Street West Auckland
6.	**Department of Conservation address for notices**	Address for all correspondence is: Permissions Team Department of Conservation Level 4 73 Rostrevor Street Hamilton, 3204 Email: permissionshamilton@doc.govt.nz

SCHEDULE 2

STANDARD TERMS AND CONDITIONS OF THE CONSENT

1. Interpretation

1.1. The Consent Holder is responsible for the acts and omissions of its employees, contractors or agents. The Consent Holder is liable under this Consent for any breach of the terms of the Consent by its employees, contractors, or agents as if the breach had been committed by the Consent Holder.

1.2. Where obligations bind more than one person, those obligations bind those persons jointly and separately.

2. Activities being Consented to

2.1. The Consent Holder is only allowed to carry out the activities specified in Schedule 1, clause 1, on the Land described in Schedule 1, clause 2.

2.2. Any arrangements necessary for access over private land or leased land are the responsibility of the Consent Holder. This consent does not warrant that such access can be obtained.

2.3. The Consent Holder must comply with any reasonable request from the Minister of Conservation, delegate of the Minister of Conservation or Department of Conservation Ranger, for access to any wildlife.

2.4. The Consent Holder must immediately notify the Department of Conservation Kaitaia District Office Operations Manager (kaitaia@doc.govt.nz) of any taxa found which are new to science. In addition, the Consent Holder must lodge holotype specimens and a voucher specimen of any new taxa with a recognised national collection.

3. Authorised Personnel

3.1. Only the Consent Holder, through the Authorised Personnel described in Schedule 1, clause 3(i)-(ii), must carry out the activities unless otherwise agreed in writing by the Department of Conservation Kaitaia District Office Operations Manager.

4. Term of the Consent

4.1. This Consent commences and ends on the dates set out in Schedule 1, clause 4.

5. Compliance with statutory instruments, notices and directions

5.1. The Consent Holder will comply with all notices, directions and requisitions and any competent authority relating to the conduct of the Activities.

6. Terminating or varying the Consent by the Minister of Transport and Minister of Conservation

6.1. This Consent may be terminated at any time in whole or in any part of the Activities if the Consent Holder breaches any of the conditions of this Consent.

6.2. Pursuant to section 48 of the Legislation Act 2019 and section 71 of the Conservation Act, the Minister of Transport and Minister of Conservation or their delegates may:

6.2.1. review, amend, delete, add to or otherwise vary the conditions or any other part of this Consent; or

6.2.2. terminate this Consent;

where they consider there has been a material change to the circumstances under which the Consent was granted (including, for example, because the effects of the Project on wildlife are more extensive or severe than foreseen) and the variation or revocation is appropriate considering the purposes of the Wildlife Act and the Government Roading Powers Act.

6.3. Before varying or revoking the Consent through Schedule 2, clause 6.2, the Minister of Transport and Minister of Conservation or their delegates will:

6.3.1. serve notice of their intention to do so on the Consent Holder stating the reasons for that proposed action and any information relied on in forming that intention;

6.3.2. invite the Consent Holder to submit on the proposed action within 20 working days; and

6.3.3. consider any submission from the Consent Holder provided within 20 working days.

7. Address for notices

7.1. If the Consent Holder's details specified in Schedule 1, clause 5 change then the Consent Holder must notify the Department of Conservation within five working days of such change.

8. Payment of costs

8.1. The Authority Holder must pay the standard Department of Conservation charge-out rates for any staff time and mileage required to monitor compliance with this Consent and to investigate any alleged breaches of the terms and conditions of it.

8.2. The Department of Conservation may at any time furnish the Consent Holder with an invoice for costs identified in Schedule 2, clause 8.1 of this Consent. The Consent Holder will pay the invoice within 20 working days of receipt of that invoice.

9. Varying the Consent by request of the Authority Holder

9.1. The Authority Holder may apply to have this Consent varied by lodging an application with the Department of Conservation.

10. Special Conditions

10.1. Special conditions are specified in Schedule 3. In the event of inconsistency or conflict, the Special Conditions will prevail over this Schedule 2.

SCHEDULE 3

SPECIAL CONDITIONS

1. General

1.1. The Consent Holder must address the effects that the Activities will have on wildlife in accordance with the associated effects management measures set out in the species management plans, dated February 2024 (SMPs) under Schedule 6. As such, the Consent Holder will not undertake the Activities under Schedule 1, clause 1 until it is certain that it will implement the full suite of effects management measures specified in the SMPs.

1.2. The provisions of the SMPs form a part of this Consent. For the avoidance of doubt where the provisions of the SMPs conflict with the terms and conditions of this Consent, the Consent prevails.

1.3. The Consent Holder must undertake the Activities including the methodologies, in accordance with the SMPs.

1.4. When woody vegetation is felled, and where it is safe and practical to do so, every effort must be made to move the vegetation a minimal distance outside the project footprint to a location of similar woody habitat and then left to degrade naturally.

1.5. Prior to mulching felled, woody vegetation, the Consent Holder must make every effort identify, catch, and remove protected wildlife that is within or upon the vegetation.

1.6. The Consent Holder must immediately notify the Department of Conservation Kaitaia District Office Operations Manager if it encounters wildlife that are not covered by this Consent and seek to obtain further Consent under the Act, as required. The Consent Holder must bear all costs associated with or connected to obtaining such further Consent.

1.7. North Island kiwi eggs must only be removed using Department of Conservation approved standard techniques (see https://www.doc.govt.nz/globalassets/documents/science-and-technical/sap262entire.pdf for the best practice model).

2. Ownership of Protected Wildlife

2.1. All wildlife remains the property of the Crown. This includes any dead wildlife, live wildlife, any parts thereof, any eggs or progeny of the wildlife, genetic material, and any replicated genetic material.

2.2. The Consent Holder may possess protected wildlife in accordance with the terms and conditions of this Consent.

2.3. Unless expressly authorised by the New Plymouth district office operations manager in writing, the Consent Holder must not donate, sell, or otherwise transfer to any third party any wildlife subject to this Consent.

3. Death of Protected Wildlife Associated with Activities Covered by the Consent

3.1. If any Threatened, At Risk or Data Deficient species (see NZ Threat Classification System and Lists: http://www.doc.govt.nz/about-us/science-publications/conservation-publications/nz-threat-classification-system/) should die, the Consent Holder must:

3.1.1. inform the Kaitaia District Officer Operations Manager within 48 hours of the death; and

3.1.2. chill the body if it can be delivered within 72 hours of the death, or freeze the body if delivery will take longer than 72 hours; and

3.1.3. notwithstanding clause 5.3, send the body to Massey University Wildlife Post-mortem Service for necropsy along with details of the animal's history; and

3.1.4. pay for all costs incurred in investigating the death of any Threatened, At Risk or Data Deficient species; and

3.1.5. if required by the Kaitaia District Office Operations Manager, cease the Activities for a period determined by that person.

4. Injured Protected Wildlife and Euthanasia

4.1. If any protected wildlife are injured in the course of undertaking activities associated with the Project, the Consent Holder must contact a suitably qualified person to get advice on management of the protected wildlife, including how to best address the injury.

4.2. The Consent Holder will take all reasonable steps to rehabilitate protected wildlife in consultation with the Department of Conservation's Kaitaia Operations Manager.

4.3. The Consent Holder must notify the Department of Conservation's Kaitaia Operations Manager within 48 hours of euthanizing protected wildlife. The notification will include details of the species of wildlife euthanized and personnel involved in the euthanizing of the wildlife**.**

5. Salvage, Relocation and Handling

5.1. Protected wildlife capture, handling and relocation must be undertaken at a suitable time of year when wildlife are active, as advised by the personnel in Schedule 1, clause 3(i).

5.2. The Consent Holder must ensure that the relevant suitably qualified experts are at the on-site induction prior to works commencing.

6. Capture and handling methods for all species

6.1. Capture and handling methods (including North Island brown kiwi egg removal) must follow those described in the inventory and monitoring toolbox http://www.doc.govt.nz/our-work/biodiversity-inventory-and-monitoring.

7. Lizard Capture and Survey

7.1. The Consent Holder must sterilise any instruments that come in contact with the lizards and/or are used to collect or measure lizards between each location. A separate holding bag such as those described in clause 12.2 must be used for each animal. All equipment must be thoroughly cleaned and dried between sites.

7.2. The Consent Holder must ensure lizards are held temporarily in a suitable container (such as a breathable cloth bag) and placed out of direct sunlight to minimise the risk of overheating, stress and death as advised and supervised by a qualified herpetologist approved by the Department of Conservation's Kaitaia Operations Manager.

7.3. The Consent Holder must be supervised by a qualified expert (i.e., a herpetologist) as per Schedule 1., clause 3(i).

7.4. Lizard capture, handling and relocation should be undertaken at a suitable time of year when lizards are active, as advised by a suitably experienced herpetologist.

7.5. Capture and handling of lizards must involve only techniques that avoid or minimise the risk of infection or injury to the animal.

7.6. The Consent Holder must ensure all live capture traps are covered to protect lizards from exposure and minimise stress. Damp leaf litter or other similar natural materials must be provided to reduce desiccation risk and the bottom of the pit-fall trap must be perforated to allow drainage of water.

8. Bat Conditions

8.1. Any injured bats found must be taken to a suitable veterinarian confirmed by the Department of Conservation's Kaitaia Operations Manager for triage or further care. If the veterinarian determines that the bat is in a healthy condition, a qualified expert (i.e., a chiropterologist) appointed by the Consent Holder as per Schedule 1., clause 3(i), is authorised to immediately liberate the bats provided that the bat(s) are:

8.1.1. only liberated in an area where works are not occurring; and

8.1.2. are liberated into an appropriate habitat as determined by the qualified expert at least one hour after dusk and before midnight; and

8.1.3. are liberated in appropriate environmental conditions: Little to no rain with temperatures above 12 degrees Celsius.

8.2. In the event any bat is killed or injured by enabling construction works, or if any vegetation is removed and on inspection bats are found in it during or post-felling, then the following shall take place:

8.2.1. works must cease immediately on sighting the bat(s); and

8.2.2. the Consent Holder must report the death or injury within 48 hours to the Department of Conservation's Kaitaia Operations Manager ; and

8.2.3. a review of the development methodology in question must then be undertaken in conjunction with the Department of Conservation's Kaitaia Operations Manager and an agreed process to minimise the further killing or injury to wildlife implemented, prior to works recommencing.

8.3. The Consent Holder shall ensure that all tree felling is in accordance with the Bat Roost Protocols and the Applicant's Bat Management Plan.

8.4. The Consent Holder must ensure that all supervisors, managers, or others in a leadership capacity working under this Consent carry a copy of this Consent and the Bat Roost Protocols at all times and must ensure the Consent terms and conditions are complied with.

9. Reporting

9.1. A full report of all bat monitoring data must be provided to the Department of Conservation at the conclusion of the tree felling and at any reasonable time upon request by the Department of Conservation during the felling operations. All reports shall be forwarded to: kaitaia@doc.govt.nz and titled "Attention: community ranger"; and to permissionsupdates@doc.govt.nz citing Consent number 111521-FAU, by 30 June each year for the duration of this Consent.

9.2. A salvaging report must be submitted to kaitaia@doc.govt.nz and titled "Attention: community ranger" and to permissionsupdates@doc.govt.nz citing permission number 111521-FAU, by 30 June each year for the duration of this Consent, summarising outcomes in accordance with the Species Specific Management Plan. Each report must include:

9.2.1. the species and number of any animals caught and released;

9.2.2. the GPS location (and/or a detailed map) of the collection point(s) and release point(s);

9.2.3. copies of approved Assessment of Environment Effects (lizards); Lizard Management Plans or similar; and

9.2.4. results of all surveys and monitoring.

Completed Amphibian and Reptile Distribution System (ARDS) cards for all herpetofauna sightings and captures (http://www.doc.govt.nz/conservation/native-animals/reptiles-and-frogs/species-information/herpetofauna-data-collection/ards-card/) must be sent to Herpetofauna, Department of Conservation, National Office, PO Box 10420 Wellington 6143 or herpetofauna@doc.govt.nz.

10. Kiwi conditions

10.1 All activities must be carried out as per the latest Kiwi Best Practice Manual (https://www.doc.govt.nz/globalassets/documents/science-and-technical/sap262entire.pdf) and in accordance with related provisions of the Avifauna Management Plan.

10.2 A kiwi shall only be captured using the assistance of a contracted certified kiwi dog handler.

10.3 Vegetation removal of the two largest areas (slips A8 and A11) shall occur prior to June, to avoid kiwi nests.

10.4 Where vegetation removal is proposed, roadside vegetation shall initially be cut down to a height of approximately 1 metre to scare kiwi away and then removed completely on the same day. Larger vegetation removal shall involve hand cutting to scare kiwi away. Any vegetation slash that is to be removed by machinery shall be done on the same day as vegetation clearance to avoid kiwi sheltering in it.

11. Kauri snails and other invertebrates

11.1 Either:

a) no kauri snail or other invertebrates transfers are made,

OR

b) Kauri snails or other invertebrates are placed downslope of each discovery below a slip or within ten metres adjacent.

SCHEDULE 4

	[redacted]	[redacted]
[redacted]	Kauri snail	*Paryphanta busbyi busbyi*
[redacted]	copper skink	*Oligosoma aeneum*
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	Pacific gecko	*Dactylocnemis pacificus*
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

SCHEDULE 5

	Common name	**Scientific name**
1	Northland brown kiwi	*Apteryx mantelli*

SCHEDULE 6 – Species Management Plans

Refer to the attached species management plans in the 111521-FAU bundle of documents.

SCHEDULE 7

Refer to the attached maps in the 111521-FAU bundle of documents.

Variation to a Wildlife Act Consent under the Wildlife Act 1953

Authorisation Number: 111521-FAU

THIS DEED OF VARIATION OF A CONSENT is made this 14th day of October 2024

PARTIES:

The Minister of Conservation and the Minister of Transport (the Grantor)

AND

New Zealand Transport Agency (the Consent Holder)

BACKGROUND

A. By an authorisation dated the 18th day of March 2024 the Minister of Conservation and the Minister of Transport granted Consent under Section 71 of the Wildlife Act 1953 to the Consent Holder upon the terms and conditions expressed and implied in the Consent.

B. The Grantor hereby varies that Consent.

NOW BY THIS DEED the Grantor consents to the following:

1. Variation

In exercise of the Grantor's powers under the Wildlife Act the Grantor varies the Consent as follows:

(i) Clause 1.1 of Schedule 3 is deleted and replaced with:

The Consent Holder must address the effects that the Activities will have on wildlife in accordance with the associated effects management measures set out in the species management plans(SMPs), <u>including the updated Avifauna Management Plan dated April 2024 under Schedule 6.</u>
As such, the Consent Holder will not undertake the Activities under Schedule 1, clause 1 until it is certain that it will implement the full suite of effects management measures specified in the SMPs.

(ii) Clause 2.3 of Schedule 3 is deleted and replaced with:

Unless expressly authorised by the Kaitaia district office operations manager in writing, the Consent Holder must not donate, sell, or otherwise transfer to any third party any wildlife subject to this Consent.

(iii) Clause 10.4 of Schedule 3 is deleted and replaced with:

“Where vegetation removal is proposed, roadside vegetation shall initially be cut down to a height of approximately 1 metre to scare kiwi away and then removed completely on the same day, unless the following measures are applied, and kiwi were not detected:

a) A kiwi dog sweep through is conducted on a day of vegetation removal; and

b) Kiwi call recordings are conducted and analysed for kiwi activity the night prior to vegetation removal.

Larger vegetation removal shall involve hand cutting to scare kiwi away. Any vegetation slash that is to be removed by machinery shall be done on the same day as vegetation clearance to avoid kiwi sheltering in it."

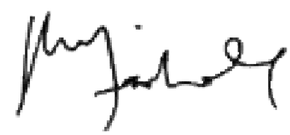
2. Confirmation of other Consent Covenants

Except to the extent to which they are amended by this Variation the provisions expressed and implied in the Consent continue to apply.

The Consent Holder must keep a copy of this Deed of Variation together with the original Consent at all times and present it when requested by a member of the Department of Conservation.

3. Costs

The Consent Holder must pay the costs of and incidental to the preparation and completion of this Variation.

SIGNED by the Minister of Conservation's Delegated Authority Director of Regulatory Services	**SIGNED by the Minister of Transport's Delegated Authority Deputy Chief Executive Policy Group**
	
Phillippa Fox	**Ruth Fairhall**

APPENDIX F DOC Concession 113662-OTH

Permission: 113662-OTH

6 May 2024

New Zealand Transport Agency, *Waka Kotahi*
Private Bag 6995
Wellington 6141

For the attention of, Kim Cottle and Hendrik Postma
Kim.Cottle@nzta.govt.nz

Hendrik.Postma@nzta.govt.nz

stuart.b@stellarprojects.co.nz

Tēnā koe Kim Cottle and Hendrik Postma

CONCESSION APPLICATION APPROVAL

Easement for stormwater infrastructure - Mangamuka Gorge Scenic Reserve near SH1

I am pleased to advise you that your application for a concession has been approved and we are now able to offer you a concession document outlining the terms and conditions of this approval. Please find attached a copy of this for your consideration.

This document contains all the terms and conditions of your concession to operate on public conservation land and represents the formal agreement between the Department and New Zealand Transport Agency.

Please read it carefully before signing so that you clearly understand your obligations. It is advised that you seek legal advice.

The conditions listed in your concession are related only to the role and responsibilities of the Minister of Conservation and/or the Director-General of Conservation. It does not cover the role or responsibilities of local or regional councils, other government agencies e.g., Ministry of Transport, Civil Aviation Authority or Police. You may need to contact other agencies to ensure you have all other required legal documentation in place.

Acceptance of Offer

You can accept the terms and conditions of the concession document by signing a copy of the document. Please make sure that your signature is formally witnessed.

The document has already been signed by the Minister of Conservation's representative. Once you have signed the document, please return it to Michelle Pearce at mpearce@doc.govt.nz by 6th June 2024. If we do not receive a signed copy of the document by this date, your concession document may be cancelled.

Reconsideration of Decision

You have the right to request that this decision is reconsidered, at your cost, under section 17ZJ of the Conservation Act. If, for any reason, you wish to apply for reconsideration please inform me by 6th June 2024. I am happy to outline the reconsideration process for you if this is something that you wish to know more about. If this is the case, please contact me.

Insurance

Your concession requires you to have current insurance to the prescribed limits. While you are not required to provide evidence of this at this time, please be aware that it may be requested at any time during the term of your concession.

Payment of Processing Fees

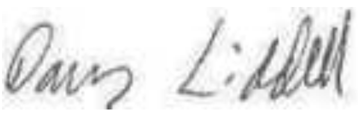
The final cost of processing your concession was $2,065.00 + GST. I have arranged for an invoice to be sent to you for this amount.

Public Works Act

Given an easement does not restrict public access to the site of structures and maintenance areas and there are low conservation values in the area, the New Zealand Transport Agency *Waka Kotahi* could apply under the Public Works Act to acquire this area.

If you have any queries regarding this letter or the enclosed/attached concession document, please do not hesitate to contact me by email dliddell@doc.govt.nz .

Nāku noa, nā



Darcy Liddell
Permissions Advisor
Hamilton Office
Department of Conservation | Te Papa Atawhai
www.doc.govt.nz

Department of Conservation
Te Papa Atawhai

Concession Document (Easement)

Concession Number: 113662-OTH

THIS CONCESSION is made this 3rd day of May 2024

PARTIES:

Minister of Conservation (the Grantor)

New Zealand Transport Agency, *Waka Kotahi* (the Concessionaire)

BACKGROUND

A. The Department of Conservation ("Department") Te Papa Atawhai is responsible for managing and promoting conservation of the natural and historic heritage of New Zealand on behalf of, and for the benefit of, present and future New Zealanders.

B. The Department is under the control of the Grantor.

C. The carrying out of these functions may result in the Grantor granting concessions to carry out activities on public conservation land.

D. The Grantor administers the public conservation land described in Schedule 1 as the Easement Land.

E. The Conservation legislation applying to the Easement Land authorises the Grantor to grant a concession over the Easement Land.

F. The Concessionaire wishes to carry out the Concession Activity on the Easement Land subject to the terms and conditions of this Concession.

G. The Concessionaire acknowledges that the Easement Land may be the subject of Treaty of Waitangi claims.

H. The Parties wish to record the terms and conditions of this Concession.

OPERATIVE PARTS

I. In exercise of the Grantor's powers under the Conservation legislation the Grantor **GRANTS** to the Concessionaire an **EASEMENT** to carry out the Concession Activity on the Easement Land subject to the terms and conditions contained in this Concession, including its Schedules.

SIGNED on behalf of the Minister of Conservation by Sue Reed-Thomas, Director Operations for the Northland Region acting under delegated authority in the presence of: Permissions Advisor Witness Signature A copy of the Instrument of Delegation may be inspected at the Director-General's office at 18-22 Manners Street, Wellington.	SIGNED on behalf of the New Zealand Transport Agency by Wayne Loader, Principal Property Acquisition Manager - Regional Lead. in the presence of: Don Harrington Witness Signature [INSERT DIGITAL SIGNATURE]

SCHEDULE 1

1.	**Easement Land** (burdened land - the land where the easement activity occurs) (Schedule 4)	Three separate locations within Mangamuka Gorge Scenic Reserve, being: (1) Slip A3: 35°10'34.09"S,173°26'33.93"E (2) Slip A4: 35°10'37.41"S, 173°26'39.73"E (3) Slip A8: 35°10'58.30"S, 173°27'1.37"E. As marked on the attached plans in Schedule 4 being: Physical Description/Common Name: Mangamuka Gorge Scenic Reserve Land Status: Scenic Reserve
2.	**Land** (benefited land - the land that benefits from the easement) (If none then select "in gross") (Schedule 4)	Is the easement in gross? Yes
3.	**Concession Activity** (clause 2)	(a) a right to convey water: 15 bored drains at slip A8 (b) a right to drain water: 3 stormwater pipes at each of slips A3, A4 and A8 (c) a right of way: Access track at slip A8 For the purpose of reducing the risk of slip failure adjoining State Highway 1 near Kaitaia
4.	**Term** (clause 3)	60 years commencing on 1 May 2024
5.	**Final Expiry Date** (clause 3)	30 April 2084
6.	**Concession Fee** (clause 4)	**Concession Activity Fee:** $5,330.00 per annum plus GST **Concession Management Fee:** $250.00 per annum plus GST **Environmental Monitoring Fee:** Standard Department charge-out rates for staff time and mileage required to monitor the effects of the Concession Activity and compliance with concession conditions
7.	**Concession Fee Payment Date** (clause 4)	1 May Annually

8.	**Penalty Interest Rate** (clause 4)	Double the current Official Cash Rate (OCR). See Reserve Bank of New Zealand website
9.	**Concession Fee Review Date(s)** (clause 5)	1 May 2027, 1 May 2030, 1 May 2033 then three (3) yearly on the anniversary (and for the duration) of this Concession.
10.	**Insurance** (To be obtained by Concessionaire) (clause 11)	Types and amounts: Public Liability Insurance for general indemnity for an amount no less than $1,000,000.00; and Third party vehicle liability for an amount no less than $500,000.00.
11.	**Addresses for Notices** (clause 20)	The Grantor's address is: Physical Address: Department of Conservation 265 Princes Street Dunedin 9016 Postal Address: Department of Conservation Att: National Transaction Centre PO Box 5244 Dunedin 9054 Phone: (03) 477 0677 Email: transactioncentre@doc.govt.nz
		The Concessionaire's address in New Zealand is: Level 5 AON Centre 29 Customs Street West Auckland Email: consents@nzta.govt.nz
12.	**Special Conditions** (clause 25)	See Schedule 3
13.	**Processing Fee** (clause 4)	$2,065.00 plus GST

Note: The clause references are to the Grantor's Standard Terms and Conditions set out in Schedule 2.

SCHEDULE 2

STANDARD TERMS AND CONDITIONS

1. Interpretation

1.1 The Concessionaire is responsible for the acts and omissions of its employees, contractors, agents, clients and invitees (excluding other members of the public accessing the Easement Land). The Concessionaire is liable under this Concession for any breach of the terms of the Concession by its employees, contractors, agents, clients and invitees (excluding other members of the public accessing the Easement Land), as if the breach had been committed by the Concessionaire.

1.2 Where this Concession requires the Grantor to exercise a discretion or give any approval or provides for any other actions by the Grantor, then the Grantor must act reasonably and within a reasonable time. When a consent is required under this Concession such consent must not be unreasonably withheld.

2. What is being authorised?

2.1 The Concessionaire is only allowed to use the Easement Land for the Concession Activity.

2.2 The Concessionaire must not commence the Concession Activity until the Concessionaire has signed the Concession Document and returned one copy of this Document to the Grantor, as if it were a notice to be given under this Concession.

3. How long is the Concession for - the Term?

3.1 This Concession commences on the date specified in Item 4 of Schedule 1 and ends on the Final Expiry Date specified in Item 5 of Schedule 1.

4. What are the fees and when are they to be paid?

4.1 The Concessionaire must pay the Processing Fee (Item 13 of Schedule 1) to the Grantor in the manner directed by the Grantor. Except where the Grantor's written consent has been given, the Concessionaire cannot commence the Concession Activity until the Processing Fee has been paid.

4.2 The Concessionaire must pay to the Grantor in the manner directed by the Grantor the Concession Fee plus GST on the Concession Fee Payment Date specified in Items 6, and 7 of Schedule 1.

4.3 If the Concessionaire fails to make payment within 14 days of the Concession Fee Payment Date then the Concessionaire is to pay interest on the unpaid Concession Fee from the Concession Fee Payment Date until the date of payment at the Penalty Interest Rate specified in Item 8 of Schedule 1.

5. When can the fee be reviewed?

5.1 The Grantor is to review the Concession Fee on the Concession Fee Review Date in Item 9 of Schedule 1 in the following manner:

(a) The Grantor must commence the review not earlier than 3 months before a Concession Fee Review Date and no later than 9 months following the Concession Fee Review Date by giving notice to the Concessionaire.

(b) Subject to clause 5.1(e) the notice must specify the Concession Fee which the Grantor considers to be the market value for the Concession Activity as at the Concession Fee Review Date having regard to the matters specified in section 17Y(2) of the Conservation Act 1987.

(c) If, within 28 days of receipt of the Grantor's notice, the Concessionaire gives notice to the Grantor that the Concessionaire disputes the proposed new Concession Fee the new Concession Fee is to be determined in accordance with clause 5.2**.**

(d) If the Concessionaire does not give notice to the Grantor under clause 5.1(c) the Concessionaire is to be deemed to have accepted the Concession Fee specified in the Grantor's notice.

(e) Notwithstanding clause 5.1(b) the new Concession Fee so determined or accepted must not be less than the Concession Fee payable during the year preceding the particular Concession Fee Review Date and is to be the Concession Fee payable by the Concessionaire from the Concession Fee Review Date.

(f) Until determination of the new Concession Fee, the Concession Fee payable by the Concessionaire from the Concession Fee Review Date is to be the Concession Fee specified in the Grantor's notice. On determination of the new Concession Fee in accordance with clause 5.2 an adjustment is to be made and paid, either by the Grantor or by the Concessionaire, whichever is applicable.

5.2 Immediately the Concessionaire gives notice to the Grantor under clause 5.1(c) the parties are to endeavor to agree on a new Concession Fee. If the parties are unable to reach agreement within 28 days the new Concession Fee is to be determined either:

(a) By one party giving notice to the other requiring the new Concession Fee to be determined in accordance with the Disputes clause (clause 19) or, if the parties agree,

(b) by registered valuers acting as experts and not as arbitrators as follows:

(i) Each party must appoint a valuer and give notice of the appointment to the other party within 14 days of the parties agreeing to determine the new Concession Fee by this means.

(ii) If the party receiving a notice does not appoint a valuer within the 14 day period the valuer appointed by the other party is to determine the new Concession Fee and that valuer's determination is to be binding on both parties.

(iii) Before commencing their determination the respective valuers must appoint an umpire who need not be a registered valuer.

(iv) The valuers are to determine the new Concession Fee which they consider to be the market value for the Concession Activity as at the Concession Fee Review Date having regard to the matters specified in section 17Y(2) of the Conservation Act 1987 but in no case is the new Concession Fee to be less than the Concession Fee payable during the year preceding the particular Concession Fee Review Date. If the valuers fail to agree, the Concession Fee is to be determined by the umpire.

(v) In determining the Concession Fee the valuers or umpire are to disregard the annual cost to the Concessionaire to maintain or provide access to the Easement Land.

(vi) Each party is to be given the opportunity to make written or oral representations or submissions to the valuers or the umpire subject to such reasonable time and other limits as the valuers or the umpire may prescribe.

(vii) The valuers or the umpire must have regard to any such representations but are not bound by them.

(c) The valuers or umpire must give written notice to the parties once they have determined the new Concession Fee. The notice is to be binding on the parties and is to provide how the costs of the determination are to be borne.

(d) If a Concession Fee Review Date is postponed because of a moratorium imposed by law the Concession Fee Review is to take place at the date the moratorium is lifted or so soon afterwards as is practicable and the following applies:

(i) the Concession Fee Review is to establish the market value for the Concession Activity as at that date instead of the date fixed under clause 5.1 having regard to the matters specified in section 17Y(2) of the Conservation Act 1987 but in no case is the new Concession Fee to be less than the Concession Fee payable during the year preceding the particular Concession Fee Review Date; and

(ii) each subsequent Concession Fee Review is to take place in accordance with the procedure fixed in clause 5.1.

6. Are there any other charges?

6.1 The Concessionaire must pay all levies rates and other charges, including utility charges payable in respect of the Easement Land or for the services provided to the Easement Land which relate to the Concessionaire's use of the Easement Land or the carrying on of the Concession Activity.

6.2 The Grantor is not liable for any cost incurred in re-establishing the supply of any utilities in the event of any of them becoming unavailable for any reason.

6.3 Where the Grantor has paid such levies, rates or other charges the Concessionaire must on receipt of an invoice from the Grantor pay such sum to the Grantor within 14 days of receiving the invoice. If payment is not made within the 14 days then the Concessionaire is to pay interest on the unpaid sum from the date payment was due until the date of payment at the Penalty Interest Rate specified in Item 8 of Schedule 1.

7. When can the Concession be assigned?

7.1 The Concessionaire must not transfer, sublease, assign, mortgage or otherwise dispose of the Concessionaire's interest under this Concession or any part of it (which includes the Concessionaire entering into a contract or any other arrangement whatsoever whereby the Concession Activity would be carried out by a person (called the Assignee) other than the Concessionaire) without the prior written consent of the Grantor.

7.2 The Grantor may in the Grantor's discretion under clause 7.1:

(a) decline any application for consent; or

(b) grant consent subject to such conditions as the Grantor thinks fit.

7.3 Sections 17S to 17ZC of the Conservation Act 1987 apply to applications for consent under this clause unless the Grantor, in the Grantor's discretion, decides otherwise.

7.4 If the Grantor gives consent under this clause then the Concessionaire remains liable to observe and perform the terms and conditions of this Concession throughout the Term and is to procure from the Assignee a covenant to be bound by the terms and conditions of this Concession.

7.5 The Concessionaire must pay the costs reasonably incurred by the Grantor incidental to any application for consent, whether or not such consent is granted.

7.6 If the Concessionaire is not a publicly listed company any change in the shareholding of the Concessionaire altering the effective control of the Concessionaire is to be deemed to be an assignment and requires the consent of the Grantor.

8. What are the obligations to protect the environment?

8.1 The Concessionaire must not, without the prior consent of the Grantor:

(a) cut down or damage any vegetation; or

(b) damage any natural feature or historic resource on the Easement Land; or

(c) light any fire on the Easement Land.

8.2 The Concessionaire must, at its cost:

(a) keep the easement facility (as defined in Schedule 5) now or hereafter upon the Easement Land, in good order, condition and repair; and

(b) must keep the Easement Land in a clean and tidy condition.

8.3 The Concessionaire must not store hazardous materials on the Easement Land nor store other materials on the Easement Land where they may obstruct the public or create a nuisance.

9. When can structures be erected?

9.1 The Concessionaire must not erect, nor place any structures on, under or over the Easement Land without the prior consent of the Grantor.

10. What if the Concessionaire wishes to surrender the Concession?

10.1 If the Concessionaire wishes to surrender this Concession during the currency of the Term, then the Grantor may accept that surrender on such conditions as the Grantor considers appropriate.

11. What are the liabilities and who insures?

11.1 The Concessionaire agrees to use the Easement Land at the Concessionaire's own risk and releases to the full extent permitted by law the Grantor (and the

Grantor's employees, agents and contractors) from all claims and demands of any kind and from all liability which may arise in respect of any accident, damage or injury occurring to any person or property in or about the Easement Land.

11.2 The Concessionaire must indemnify the Grantor against all claims, actions, losses and expenses of any nature which the Grantor may suffer or incur or for which the Grantor may become liable arising from the Concessionaire's performance of the Concession Activity.

11.3 This indemnity is to continue after the expiry or termination of this Concession in respect of any acts or omissions occurring or arising before its expiry or termination.

11.4 The Concessionaire has no responsibility or liability for costs, loss, or damage of whatsoever nature arising from any act or omission or lack of performance or any negligent or fraudulent act or omission by the Grantor, or any contractor or supplier to the Grantor, or any employee or agent of the Grantor.

11.5 Despite anything else in clause 11 the Concessionaire is not liable for any indirect or consequential damage or loss howsoever caused.

11.6 The Grantor is not liable and does not accept any responsibility for damage to or interference with the Easement Land, the Concession Activity, or to any structures, equipment or facilities on the Easement Land or any other indirect or consequential damage or loss due to any natural disaster, vandalism, sabotage, fire, or exposure to the elements except where, subject to clause 11.7, such damage or interference is caused by any wilful act or omission of the Grantor, the Grantor's employees, agents or contractors.

11.7 Where the Grantor is found to be liable in accordance with clause 11.6, the total extent of the Grantor's liability is limited to $1,000,000 in respect of the Concessionaire's structures, equipment and facilities.

11.8 Despite anything else in clause 11 the Grantor is not liable for any indirect or consequential damage or loss howsoever caused.

11.9 Without prejudice to or in any way limiting its liability under this clause 11 the Concessionaire at the Concessionaire's expense must take out and keep current policies for insurance and for the amounts not less than the sums specified in Item 10 of Schedule 1 with a substantial and reputable insurer.

11.10 After every three year period of the Term the Grantor may, on giving 10 working day's notice to the Concessionaire, alter the amounts of insurance required under clause 11.9. On receiving such notice the Concessionaire must within 10 working days take out and keep current policies for insurance and for the amounts not less than the sums specified in that notice.

11.11 The Concessionaire must provide to the Grantor within 5 working days of the Grantor so requesting:

(a) details of any insurance policies required to be obtained under this Concession, including any renewal policies if such renewal occurs during the Term; and/or;

(b) a copy of the current certificate of such policies.

12. What about Health and Safety?

12.1 The Concessionaire must exercise the rights granted by this Concession in a safe and reliable manner and must comply with the Health and Safety at Work Act 2015 and its regulations and all other provisions or requirements of any competent authority relating to the exercise of this Concession. The Concessionaire must comply with any safety directions of the Grantor.

13. What are the compliance obligations of the Concessionaire?

13.1 The Concessionaire must comply where relevant:

(a) with the provisions of any conservation management strategy or conservation management plan under the Conservation Act 1987 or Part IIA of the Reserves Act 1977, or any general policy statement made under the Conservation Act 1987, Reserves Act 1977, National Parks Act 1980, or Wildlife Act 1953, or management plan under section 45 of the National Parks Act 1980, whichever is appropriate to the Easement Land, together with any amendment or review of any policy, strategy or plan whether approved before, on, or after the date on which this Concession takes effect; and

(b) with the Conservation Act 1987, the Reserves Act 1977, the National Parks Act 1980, Wildlife Act 1953, Climate Change Response Act 2002 and any other statute, ordinance, regulation, bylaw, or other enactment (collectively the “Legislation”) affecting or relating to the Easement Land or affecting or relating to the Concession Activity, including any regulations made under the Conservation Act 1987 and Wildlife Act 1953 or bylaws made under the Reserves Act 1977 or the National Parks Act 1980; and

(c) with all notices and requisitions of any competent authority affecting or relating to the Easement Land or affecting or relating to the conduct of the Concession Activity; and

(d) with all Department signs and notices placed on or affecting the Easement Land

13.2 The Concessionaire must comply with this Concession.

13.3 A breach or contravention by the Concessionaire of a relevant conservation management strategy, conservation management plan, management plan or any statement of general policy referred to in clause 13.1(a) is deemed to be a breach of this Concession.

13.4 A breach or contravention by the Concessionaire of any Legislation affecting or relating to the Easement Land or affecting or relating to the Concession Activity is deemed to be a breach of this Concession.

14. When can the Concession be terminated?

14.1 If the Concessionaire breaches any of the conditions of this Concession the Grantor may terminate this Concession at any time in respect of the whole or any part of the Easement Land. Before so terminating the Grantor must give the Concessionaire either:

(a) one calendar month's notice in writing; or

(b) such other time period which in the sole opinion of the Grantor appears reasonable and necessary;

of the Grantor's intention so to terminate this Concession. If this Concession is terminated then the Grantor, at the Grantor's sole discretion, may adjust the Concession Fee payable or refund any Concession Fee paid in advance.

14.2 The Grantor may choose to remedy at any time any default by the Concessionaire under this Concession. Where that occurs, the Concessionaire must pay forthwith on demand all reasonable costs incurred by the Grantor in remedying such default. Before electing to so remedy in accordance with this clause the Grantor must, if practicable, first give the Concessionaire notice of the default and a reasonable opportunity to remedy the default.

15. What happens on termination or expiry of the Concession?

15.1 On expiry or termination of this Concession, either as to all or part of the Easement Land, the Concessionaire is not entitled to compensation for any structures or other improvements placed or carried out by the Concessionaire on the Easement Land.

15.2 The Concessionaire may, with the Grantor's written consent, remove any specified structures and other improvements on the Easement Land. Removal under this clause must occur within the time specified by the Grantor and the Concessionaire is to make good any damage and leave the Easement Land and other public conservation land affected by the removal in a clean and tidy condition.

15.3 The Concessionaire must, if the Grantor gives written notice, remove any specified structures and other improvements on the Easement Land. Removal under this clause must occur within the time specified by the Grantor and the Concessionaire is to make good any damage and leave the Easement Land and other public conservation land affected by the removal in a clean and tidy condition and replant the Easement Land with indigenous vegetation of a similar abundance and diversity as at the commencement of the Term. If before the expiry of the Term the Concessionaire makes an application for a further concession in respect of the same Concession Activity on the Easement Land then the Grantor cannot require such removal and reinstatement until such time as that concession application has been determined. If a new concession is granted then removal and reinstatement cannot be required until the expiry or termination of the new concession.

16. When is the Grantor's consent required?

16.1 Where the Grantor's consent or approval is expressly required under this Concession then the Concessionaire must seek that approval or consent for each separate time it is required even though the Grantor may have given approval or consent for a like purpose on a prior occasion. Any such consent or approval may be made on such conditions as the Grantor considers appropriate.

17. Are there limitations on public access and closure?

17.1 The Concessionaire acknowledges that the Easement Land is open to the public for access and that the Grantor may close public access during periods of high fire hazard or for reasons of public safety or emergency.

18. What about other concessions?

18.1 Nothing expressed or implied in this Concession is to be construed as preventing the Grantor from granting other concessions, whether similar or not, to other persons provided that the Grantor must not grant another concession that would derogate in any material way from the Concessionaire's ability to carry out the Concession Activity.

19. How will disputes be resolved?

19.1 If a dispute arises between the parties in connection with this Concession the parties must, without prejudice to any other rights or entitlements they may have, attempt to resolve the dispute by agreement using informal dispute resolution techniques such as negotiation, mediation, independent expert appraisal or any other alternative dispute resolution technique. The rules governing any such technique adopted are to be agreed between the parties.

19.2 If the dispute cannot be resolved by agreement within 14 days of written notice by one party to the other (or such further period as the parties may agree to in writing) either party may refer the dispute to the Disputes Tribunal, where relevant, or to arbitration, which arbitration is to be carried out in accordance with the provisions of the Arbitration Act 1996.

19.3 If the parties do not agree on an arbitrator within 10 working days of a party giving written notice of the requirement to appoint an arbitrator the President of the New Zealand Law Society is to appoint the arbitrator. In either case the arbitrator must not be a person who has participated in an informal dispute resolution procedure in respect of the dispute.

19.4 The arbitrator must include in the arbitration award reasons for the determination.

19.5 Despite the existence of a dispute, each party must continue to perform its obligations under this Concession.

20. How are notices sent and when are they received?

20.1 Any notice to be given under this Concession is to be in writing and made by personal delivery, by pre-paid post or email to the receiving party at the address, or email address specified in Item 11 of Schedule 1. Any such notice is to be deemed to have been received:

(a) in the case of personal delivery, on the date of delivery;

(b) in the case of post, on the 3rd working day after posting;

(c) in the case of email,

(i) if sent between the hours of 9am and 5pm on a working day, at the time of transmission; or

(ii) if subclause (i) does not apply, at 9am on the working day most immediately after the time of sending.

Provided that an email is not deemed received unless (if receipt is disputed) the party giving notice produces a printed copy of the email which evidences that the email was sent to the email address of the party given notice.

20.2 If either party's details specified in Item 11 of Schedule 1 change then the party whose details change must within 5 working days of such change provide the other party with the changed details.

21. What about the payment of costs?

21.1 The Concessionaire must pay the Grantor’s legal costs and expenses of and incidental to preparing and signing this Concession or any extension or variation of it.

21.2 The Concessionaire must pay in full immediately and on demand all costs and fees (including solicitor’s costs and fees of debt collecting agencies engaged by the Grantor) arising out of and associated with steps taken by the Grantor to enforce or attempt to enforce the Grantor’s rights and powers under this Concession including the right to recover outstanding money owed to the Grantor.

22. What about the powers implied by statute?

22.1 The rights and powers implied in the relevant easements by Schedule 5 to the Land Transfer Regulations 2018 (as set out in Schedule 5 of this Concession) apply to this Concession **EXCEPT** to the extent set out in Schedule 3 of this Concession.

22.2 The rights and powers implied by Schedule 5 to the Property Law Act 2007 do not apply to this Concession.

23. What about Co-Siting?

23.1 In this clause "Co-Site" means the use of the Concessionaire's structures or facilities on the Easement Land by a third party for an activity; and "Co-Sitee" and "Co-Siting" have corresponding meanings.

23.2 The Concessionaire must not allow Co-Siting on the Easement Land without the prior written consent of the Grantor.

23.3 The Grantor’s consent must not be unreasonably withheld but is at the Grantor’s sole discretion and subject to such reasonable terms and conditions as the Grantor thinks fit including a requirement that the Co-Sitee be liable for direct payment to the Grantor of a concession fee and any environmental premium assessed in respect of the Co-Sitee’s activity on the Easement Land.

23.4 In addition, the Grantor must withhold consent if:

(a) the Co-Siting would result in a substantial change to the Concession Activity on the Easement Land; or

(b) the Grantor considers the change to be detrimental to the environment of the Easement Land.

23.5 Subject to clause 23.4 the Concessionaire must, if required by the Grantor, allow Co-Siting on the Easement Land.

23.6 Where the Concessionaire maintains that Co-Siting by a third party on the Easement Land would:

(a) detrimentally interfere physically or technically with the use by the Concessionaire of the Easement Land; or

(b) materially prejudice any resource consents obtained by the Concessionaire or cause more onerous conditions to be imposed on it by the relevant authority; or

(c) obstruct or impair the Concessionaire's ability effectively to operate from the Easement Land; or

(d) interfere with or prevent future forecast works of the Concessionaire,

the Grantor, must, as a pre-condition to consideration of an application to grant a concession to a third party, require that third party to obtain, at its own cost, a report prepared by an independent consultant acceptable to the Grantor confirming or rejecting the presence of the matters specified in this clause 23.6. The Grantor must not grant a concession to a third party where the report confirms that the proposed concession would give rise to one or more of the matters specified in this clause 23.6.

23.7 If the independent consultant report rejects the Concessionaire's concerns, the Concessionaire may dispute this in accordance with the procedure set out in clause 19 of this Schedule 2.

23.8 Where the Concessionaire is required under clause 23.5 to allow Co-Siting on the Easement Land, the Concessionaire is, subject to clause 23.10 entitled to enter into commercial agreements with third parties for them to conduct an activity on the Easement Land and to receive a reasonable fee from them for any agreed activity they intend to carry out on the Easement Land. If a dispute arises between the Concessionaire and a third party such dispute must be determined by the Grantor having regard to, but not limited to, the following matters:

(a) any written comments or submissions of the Concessionaire and third party;

(b) market value for the concession activity proposed by the third party having regard to the matters specified in Section 17Y(2) of the Conservation Act 1987;

(c) any other matters the Grantor considers relevant.

23.9 If the Concessionaire does not accept the Grantor's determination, the Concessionaire may dispute this in accordance with the procedure set out in clause 19 of this Schedule 2.

23.10 For the avoidance of doubt, a Co-Sitee permitted on the Easement Land must enter into a separate concession with the Grantor in terms of which the Co-Sitee may be required to pay to the Grantor a concession fee and environmental premium assessed in respect of the Co-Sitee's activity on the Easement Land This separate concession must not contain provisions that conflict with the Concessionaire's rights and obligations in relation to the Easement Land.

23.11 The Grantor must not authorise the third party to commence work on the Easement Land until all relevant resource consents are issued, an agreement is executed between the Concessionaire and third party, and any conditions imposed by the Concessionaire have been met.

24. Jointly and severally liable

24.1 In the event that this Concession is held by multiple Concessionaire's, they will be jointly and severally liable.

25. Are there any Special Conditions?

25.1 Special conditions are specified in Schedule 3. If there is a conflict between this Schedule 2 and the Special Conditions in Schedule 3, the Special Conditions shall prevail.

26. The Law

26.1 This Concession is to be governed by and interpreted in accordance with the laws of New Zealand.

SCHEDULE 3

SPECIAL CONDITIONS

1. The rights and powers implied in easements under Schedule 5 of the Land Transfer Regulations 2018, apply as is relevant to the class of easement provided for in this Concession. Schedule 5 of the Regulations (excluding clauses 13 and 14) is set out in Schedule 5 of this Concession and the clauses are varied as follows:
   (a) Clause 1 is amended by adding the words "in Schedule 4" after the words "on a plan" in paragraph (a) of the interpretation of "**easement area**"
   (b) Clause 1 is amended by deleting the words "grantee and" from the interpretation of "**grantee** and **grantor**"
   (c) Schedule 5 is amended by adding a new clause 1A: "Any reference to "grantee" in this Schedule is to be read as "Concessionaire" and includes the Concessionaire's agents, employees, contractors, tenants, licensees and invitees."
   (d) Clause 11(2) is deleted and clause 11(4) is amended by deleting the reference to (2).
   (e) Clauses 13 and 14 are deleted.

2. If the Concessionaire wishes the easement to be registered, the Concessionaire must at its own expense:
   (a) prepare an easement instrument in accordance with the Land Transfer Act 2017 and the rights and powers provided in the easement as set out in this Concession; and
   (b) arrange for any necessary survey; and
   (c) register the easement.

3. The Grantor, if satisfied the easement instrument implements this Concession, must sign the easement instrument to enable registration.

Climate change considerations

4. The Concessionaire acknowledges that the Grantor and the Department of Conservation are reviewing their obligations under the Climate Change Response Act 2002 and developing responses to address greenhouse gas emissions from activities conducted on public conservation land and waters. The reviews are likely to result in policies which seek to measure, manage and reduce greenhouse gas emissions from Concession Activities. The Grantor wishes to signal to the Concessionaire that new concession conditions related to both climate change mitigation and adaptation may be imposed during the life of this Concession to address greenhouse gas emissions associated with the Concession Activity.

5. If the Grantor requests data relating to greenhouse gas emissions associated with the Concession Activity, the Concessionaire must provide any relevant data that is reasonably available to it within 6 months of the Grantor's request.

6. The Grantor may review and amend the conditions of this Concession to reflect climate change-related legislation and government or Departmental policy and those conditions ("Revised Conditions") may, amongst other things, require the Concessionaire to measure, manage and reduce the greenhouse gas emissions of the Concession Activity.

7. Before amending the conditions of this Concession in accordance with clause 4, the Grantor will provide the Concessionaire the draft Revised Conditions. The

Concessionaire may provide written comments on those draft Revised Conditions within 60 days. The Grantor must take into account any comments received from the Concessionaire on the Revised Conditions before finalising the Revised Conditions.

8. The Revised Conditions will apply to the Concession Activity 4 months after the Grantor has notified the Concessionaire of the Revised Conditions in accordance with clause 5 or any later date specified in the Revised Conditions.

Construction conditions (pipeline)

9. The pipeline intake must be suitably disguised so as to blend in with the surroundings.

10. That, prior to the right of way construction, the Concessionaire must:
    (a) Mark the centre line of the right of way easement with tape on the ground, for the approval of the Grantor; and the Concessionaire must use best endeavours to conform to that approved route. Any deviation or variance from the approved route requires the prior written consent from the Grantor.

    (b) Provide to the Grantor, a work plan detailing the contractors to be used, commencement dates, timelines, construction methods and standards and amend the work plan if required by the Grantor.

    (c) Prepare an annual maintenance programme for the approval of the Grantor.

    (d) The Concessionaire must implement an on-going weed control programme to the satisfaction of the Grantor, to keep the Easement Land free from all introduced weeds, resulting from the Concessionaire's use of the Easement Land.

Construction conditions (general)

11. Any vegetation removal and soil disturbance necessary to install and undertake the activity must be kept to a minimum.

12. The surface of the ground must be reinstated in a tidy manner following the installation of the easement facility.

13. No alterations to the easement facility requiring earth disturbance must be undertaken without prior consent in writing of the Grantor.

14. The Concessionaire must ensure that all machinery, tools and equipment used in undertaking the Concession Activity is steamed cleaned and weed free prior to being taken onto the Easement Land.

15. The Concessionaire must ensure that all gravel and other materials used in undertaking the Concession Activity are from a weed free source.

Accidental Discovery Protocol

16. The Concessionaire must take all reasonable care to avoid any archaeological values on the Land which includes (but is not limited to) historic sites and protected New Zealand objects on the Easement Land. In the event that archaeological sites or other features with heritage values are found during any approved earth disturbance work on the Easement Land:
    (a) Work must cease immediately until further notice and advice must be sought from the Grantor;

(b) If it is an archaeological site as defined by the Heritage New Zealand Pouhere Taonga Act 2014 then Heritage New Zealand must be contacted and its advice sought;
(c) If it is an archaeological site relating to Māori activity then local iwi must be contacted and their advice sought;
(d) If it is an artefact as defined by the Protected Objects Act 1975 then the Ministry for Culture and Heritage must be notified within 28 days;
(e) If it is human remains the New Zealand Police should also be notified;
(f) In the event of cessation of approved work because of discovery of potential historical artefact or archaeological site the Concessionaire must not recommence work until permitted to do so by the Grantor.

17. The Concessionaire must take reasonable and proper care not to damage any property of the Grantor and must promptly repair any such damage.

18. If the Concessionaire opens up the surface of the Easement Land the Concessionaire must immediately upon completion of any works restore the surface of the Easement Land as nearly as possible to its former condition to the satisfaction of the Grantor.

19. Nothing contained or implied in this Concession requires the Grantor or the Concessionaire to supply services on or under the Easement Land or entitles the Concessionaire to interfere with the services of any other user of the Easement Land.

Myrtle Rust Protocols

20. The Concessionaire must know the plants that are affected by myrtle rust and what the rust symptoms look like. This serious fungal disease only affects plants in the Myrtle (Myrtaceae) Family which includes pohutukawa, manuka, kanuka, and ramarama. See https://www.mpi.govt.nz/protection-and-response/responding/alerts/myrtle-rust/.

21. If the Concessionaire encounters suspected symptoms of myrtle rust, the Concessionaire must not touch it and must take the following steps:
(a) Call the MPI Exotic Pest and Disease Hotline immediately on 0800 80 99 66;
(b) Take clear photos, including the whole plant, the whole affected leaf, and a close-up of the spores/affected areas of the plant;
(c) Don’t touch or try to collect samples as this may increase the spread of the disease;
(d) If accidental contact with the affected plant or rust occurs, bag clothing and wash clothes, bags and shoes as soon as possible.

Kauri Dieback

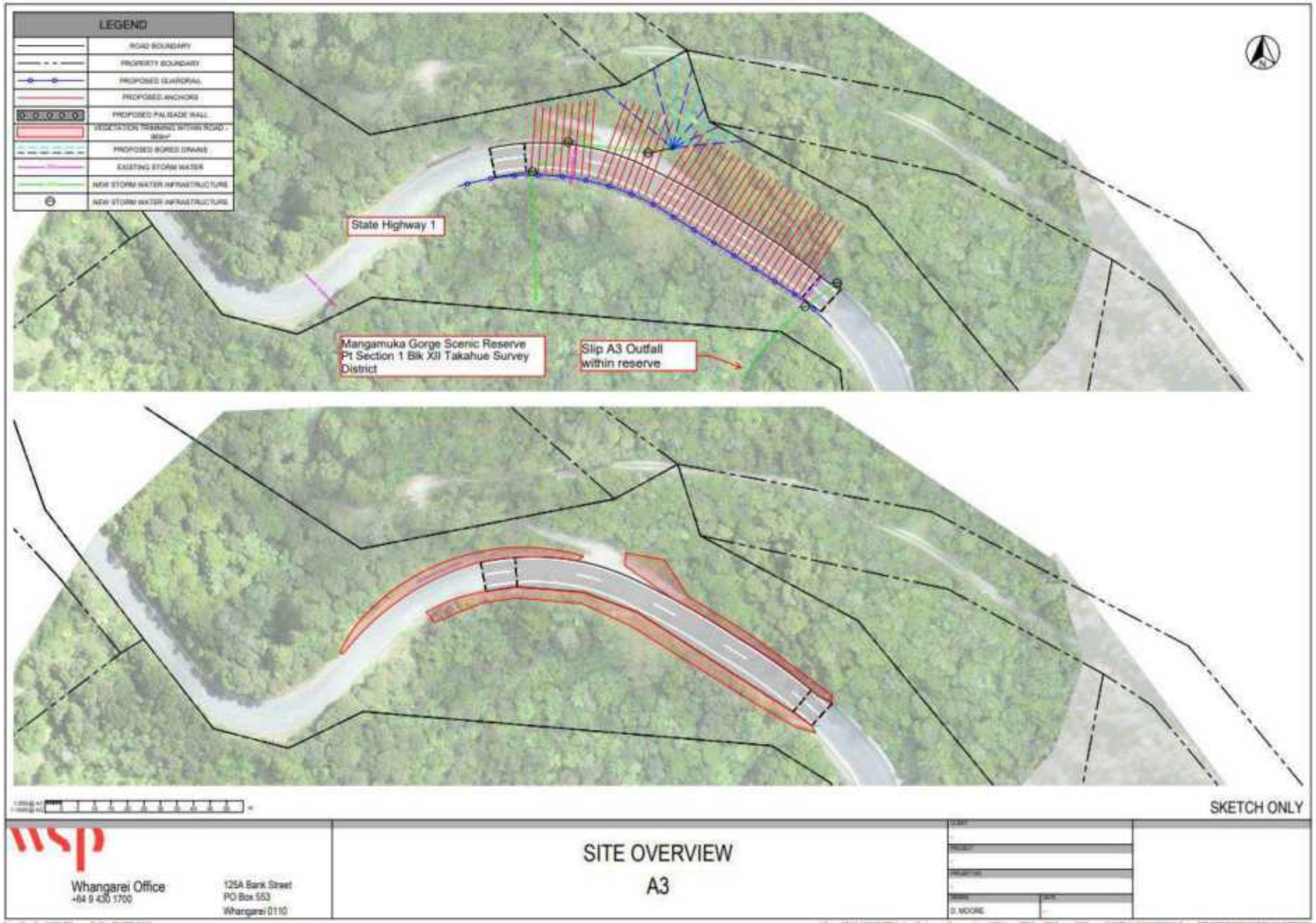
22. The Concessionaire must comply with all guidelines and notices issued by the Kauri Dieback Programme (lead by Ministry of Primary Industry) to prevent and avoid the spread of the pest organism Phytophthora taxon Agathis (PTA) Kauri Dieback Disease as specified by the website http://www.kauridieback.co.nz/. The Concessionaire must comply with the general guidelines and for specific concession activities the relevant guidelines as specified on http://www.kauridieback.co.nz/publications. The Concessionaire must update itself on these websites on a regular basis.

23. The Concessionaire must ensure that all vehicles and equipment are thoroughly cleaned of all visible soil and that footwear once cleaned is sprayed with SteriGENE (formally known as Trigene) solution before entering and when moving between areas where there are kauri. This is to reduce the potential for spread of PTA. Contact details for suppliers of SteriGENE may be obtained through the Department of Conservation.

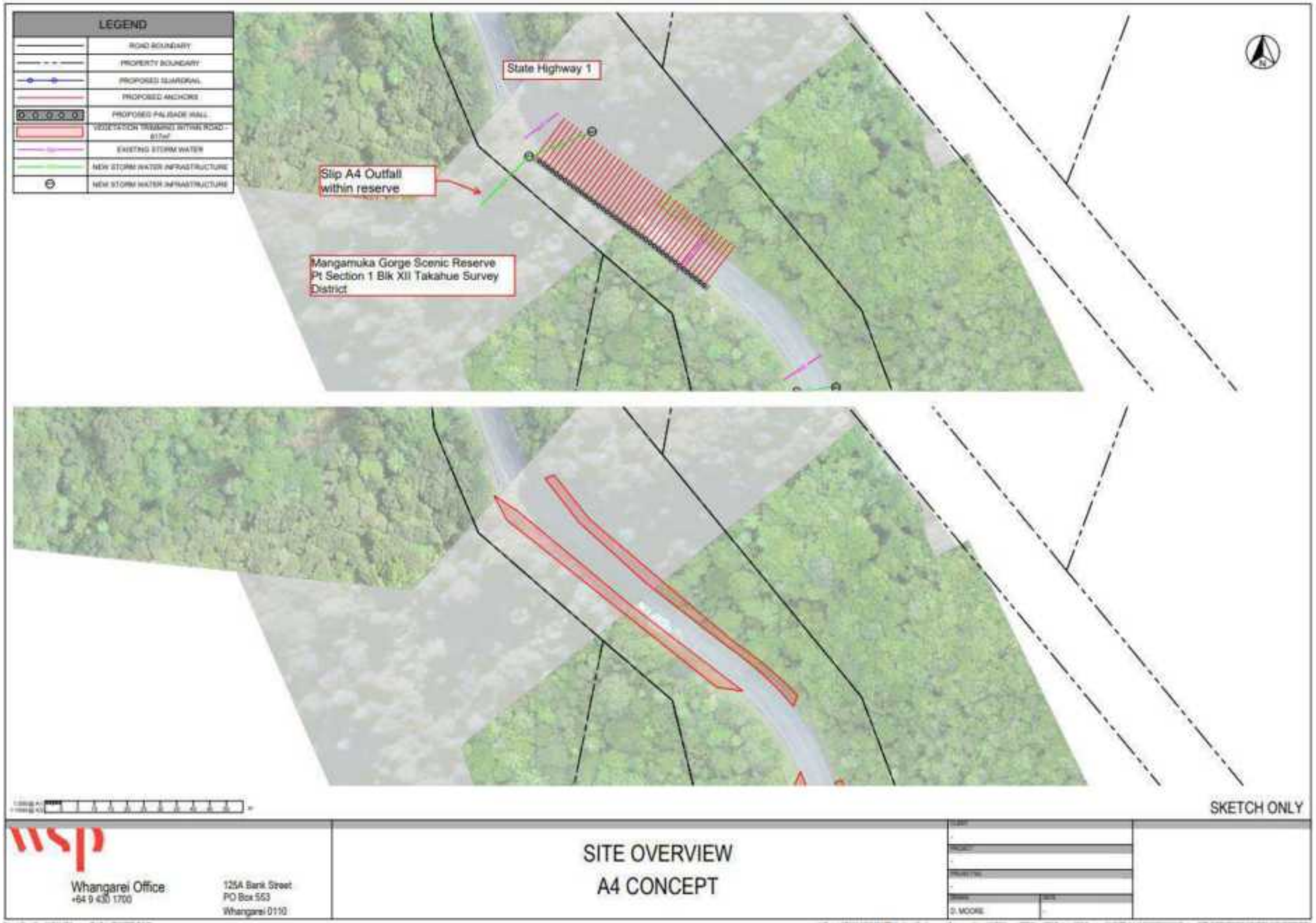
Swamp Forest Monitoring

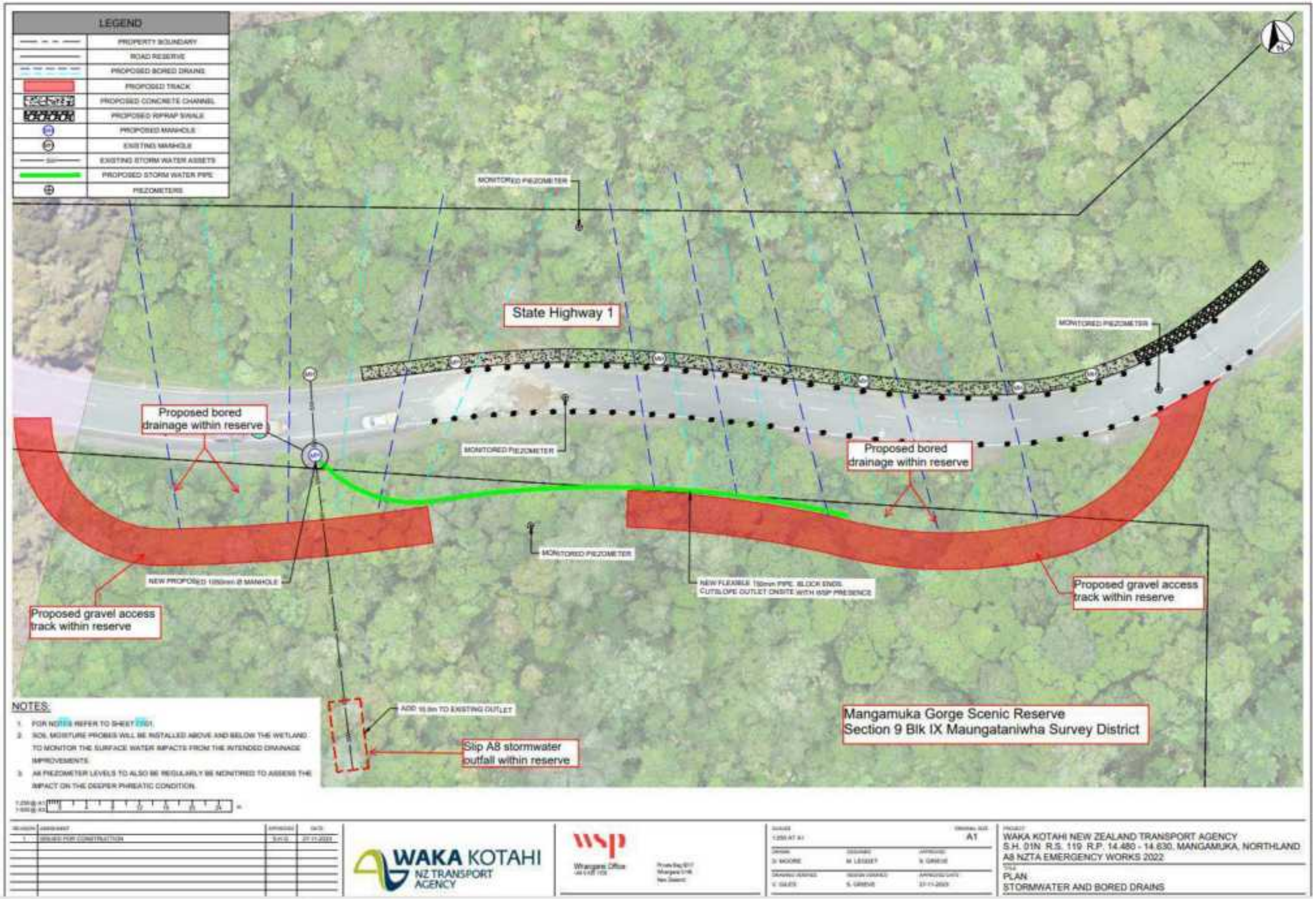
24. In the event the monitoring of water levels by a piezometer at the swamp forest at the A8 slip site located above the road (shown on sheet C021 of the application) identifies that water levels have reduced, then the amount of water removed by the bored drains shall be reduced so that the original swamp forest water level is maintained.

SCHEDULE 4



LEGEND
ROAD BOUNDARY
PROPERTY BOUNDARY
PROPOSED GUARDRAIL
PROPOSED ANCHORS
PROPOSED PALISADE WALL
PROPOSED BORED DRAINS
EXISTING STORM WATER
NEW STORM WATER INFRASTRUCTURE
NEW STORM WATER INFRASTRUCTURE
State Highway 1
Mangamuka Gorge Scenic Reserve
Pt Section 1 Blk XII Takahue Survey
District
Slip A3 Outfall
within reserve
SKETCH ONLY
Whangarei Office
+64 9 430 1700
125A Bank Street
PO Box 553
Whangarei 0110
SITE OVERVIEW
A3
D. MOORE


LEGEND
State Highway 1
Slip A4 Outfall within reserve
Mangamuka Gorge Scenic Reserve Pt Section 1 Blk XII Takahue Survey District
SKETCH ONLY
Whangarei Office
125A Bank Street
PO Box 553
Whangarei 0110
SITE OVERVIEW
A4 CONCEPT
D. MOORE


LEGEND
PROPERTY BOUNDARY
ROAD RESERVE
PROPOSED BORED DRAINS
PROPOSED TRACK
PROPOSED CONCRETE CHANNEL
PROPOSED RIPRAP SWALE
PROPOSED MANHOLE
EXISTING MANHOLE
EXISTING STORM WATER ASSETS
PROPOSED STORM WATER PIPE
PIEZOMETERS
MONITORED PIEZOMETER
State Highway 1
Proposed bored drainage within reserve
Proposed bored drainage within reserve
MONITORED PIEZOMETER
MONITORED PIEZOMETER
MONITORED PIEZOMETER
NEW PROPOSED 1050mm Ø MANHOLE
NEW FLEXIBLE 150mm PIPE. BLOCK ENDS. CUTSLOPE OUTLET ONSITE WITH WSP PRESENCE
Proposed gravel access track within reserve
Proposed gravel access track within reserve
ADD 15.0m TO EXISTING OUTLET
Slip A8 stormwater outfall within reserve
Mangamuka Gorge Scenic Reserve
Section 9 Blk IX Maungataniwha Survey District
NOTES:
1. FOR NOTES REFER TO SHEET C001.
2. SOIL MOISTURE PROBES WILL BE INSTALLED ABOVE AND BELOW THE WETLAND TO MONITOR THE SURFACE WATER IMPACTS FROM THE INTENDED DRAINAGE IMPROVEMENTS.
3. A8 PIEZOMETER LEVELS TO ALSO BE REGULARLY BE MONITRED TO ASSESS THE IMPACT ON THE DEEPER PHREATIC CONDITION.
1 ISSUED FOR CONSTRUCTION
WAKA KOTAHI
NZ TRANSPORT AGENCY
wsp
A1
WAKA KOTAHI NEW ZEALAND TRANSPORT AGENCY
S.H. 01N R.S. 119 R.P. 14.480 - 14.830, MANGAMUKA, NORTHLAND
A8 NZTA EMERGENCY WORKS 2022
PLAN
STORMWATER AND BORED DRAINS

SCHEDULE 5

RIGHTS AND POWERS IMPLIED IN EASEMENTS

LAND TRANSFER REGULATIONS 2018

The following are the rights and powers implied in easements as set out in Schedule 5 of the Land Transfer Regulations 2018. The Regulation Schedule applies to all classes of easement and so it is only the specific provisions which relate to the class of easement dealt with in this Concession which apply, along with those that apply to all forms of easement. This Schedule does not include clauses 13 and 14 of Schedule 5 of the Regulations as they are deleted and replaced by the specific default and dispute provisions of the Concession. Refer to Schedule 3 of the Concession for changes to these implied rights and powers.

1 Interpretation

In this schedule, unless the context otherwise requires,—

benefited land, in relation to an easement that benefits land, means the land that takes the benefit of the easement and that is described by reference to the register in the relevant easement instrument, transfer instrument, or deposit document

burdened land, in relation to an easement,—

(a) means the land over which the easement in registered and that is described by reference to the register in the relevant easement instrument, transfer instrument, or deposit document; and

(b) includes the easement area

easement area, in relation to an easement, means an area that—

(a) is shown on a plan in Schedule 4; and

(b) is referred to in the relevant easement instrument, transfer instrument, or deposit document as the area to which the easement applies

easement facility,—

(a) for a right to convey water, means pipes, pumps, pump sheds, storage tanks, water purifying equipment, other equipment suitable for that purpose (whether above or under the ground), and anything in replacement or substitution:

(b) for a right to convey electricity or a right to convey telecommunications, means wires, cables (containing wire or other media conducting materials), ducts, surface boxes, towers, poles, transformers, switching gear, other equipment suitable for that purpose (whether above or under the ground), and anything in replacement or substitution:

(c) for a right of way, means the surface of the land described as the easement area, including any driveway:

(d) for a right to drain water, means pipes, conduits, open drains, pumps, tanks (with or without headwalls), manholes, valves, surface boxes, other equipment suitable for that purpose (whether above or under the ground), and anything in replacement or substitution:

(e) for a right to drain sewage, means pipes, conduits, pumps, tanks (with or without headwalls), manholes, valves, surface boxes, other equipment suitable for that purpose (whether above or under the ground), and anything in replacement or substitution:

(f) for a right to convey gas, means pipes, conduits, valves, other equipment suitable for that purpose (whether above or under the ground), and anything in replacement or substitution

grantor—

(a) has the meanings given by section 107 of the Act; and

(b) in clauses 3 to 9 and 12(1), include those persons' agents, employees, contractors, tenants, licensees, and invitees

repair and maintenance, in relation to an easement facility, includes the replacement of the easement facility

telecommunication means the conveyance by electromagnetic means from one device to another of any encrypted or non-encrypted sign, signal, impulse, writing, image, sound, instruction, information, or intelligence of any nature, whether for the information of any person using the device or not.

1A Any reference to "grantee" in this schedule 5 is to be read as "Concessionaire" and includes the Concessionaire's agents, employees, contractors, tenants, licensees and invitees.

2 Classes of easements

For the purposes of regulation 21, easements are classified by reference to the following rights:

(a) a right to convey water:
(b) a right to drain water:
(c) a right to drain sewage:
(d) a right of way:
(e) a right to convey electricity:
(f) a right to convey telecommunications:
(g) a right to convey gas.

Rights and powers implied in easements granting certain rights

3 Right to convey water

(1) A right to convey water includes the right for the grantee, in common with the grantor and other persons to whom the grantor may grant similar rights, at all times, to take and convey water in free and unimpeded flow from the source of supply or point of entry through the easement facility and over the easement area and (for an easement that benefits land) to the benefited land.

(2) The right to take and convey water in free and unimpeded flow is limited to the extent required by any period of necessary cleansing, renewal, modification, or repair of the easement facility.

(3) The easement facility for the relevant easement is the easement facility laid or to be laid along the easement area in accordance with clause 10(1).

(4) The grantor must not do and must not allow to be done anything on the burdened land that may cause the purity or flow of water in the water supply system to be polluted or diminished.

4 Right to drain water

(1) A right to drain water includes the right for the grantee, in common with the grantor and other persons to whom the grantor may grant similar rights, at all times, to convey water (whether sourced from rain, springs, soakage, or seepage) in any quantity—

(a) from the benefited land through the easement facility and over the easement area; or

(b) for an easement in gross, through the easement facility and over the easement area.

(2) The right to drain water is limited to the extent required by any period of necessary cleansing, renewal, modification, or repair of the easement facility.

(3) The easement facility for the relevant easement is the easement facility laid or to be laid along the easement area in accordance with clause 10(1).

5 Right to drain sewage

(1) A right to drain sewage includes the right for the grantee, in common with the grantor and other persons to whom the grantor may grant similar rights, at all times, to drain, discharge, and convey sewage and other waste material and waste fluids in any quantity—

(a) from the benefited land through the easement facility and over the easement area; or

(b) for an easement in gross, through the easement facility and over the easement area.

(2) The right to drain, discharge, and convey sewage and other waste material and waste fluids is limited to the extent required by any period of necessary cleansing, renewal, modification, or repair of the easement facility.

(3) The easement facility for the relevant easement is the easement facility laid or to be laid along the easement area in accordance with clause 10(1).

6 Rights of way

(1) A right of way includes the right for the grantee, in common with the grantor and other persons to whom the grantor may grant similar rights, at all times, to go over and along the easement facility.

(2) The right to go over and along the easement facility includes the right to go over and along the easement facility with or without any kind of—

(a) vehicle, machinery, or implement.

(3) A right of way includes the right to have the easement facility kept clear at all times of obstructions (whether caused by parked vehicles, deposits of materials, or unreasonable impediment) to the use and enjoyment of the easement facility.

(4) The right to go over and along the easement facility, and to have the easement facility kept clear, is limited to the extent by any period of necessary repair or maintenance of the easement facility.

(5) The easement facility for the relevant easement is the surface of the land described as the easement area, including any easement facility laid or to be laid along the easement area in accordance with clause 10(1).

7 Right to convey electricity

(1) A right to convey electricity includes the right for the grantee, in common with the grantor and other persons to whom the grantor may grant similar rights, at all times, to lead and convey electricity and electrical impulses without interruption or impediment from the point of entry through the easement facility and over the easement area and (for an easement that benefits land) to the benefited land.

(2) The right to convey electricity without interruption or impediment is limited to the extent required by any period of necessary renewal or repair of the easement facility.

(3) The easement facility for the relevant easement is the easement facility laid or to be laid along the easement area in accordance with clause 10(1).

8 Right to convey telecommunications

(1) A right to convey telecommunications includes the right for the grantee, in common with the grantor and other persons to whom the grantor may grant similar rights, at all times, to lead and convey telecommunications without interruption or impediment through the easement facility and over the easement area and (for an easement that benefits land) to and from the benefited land.

(2) The right to convey telecommunications without interruption or impediment is limited to the extent required by any period of necessary renewal or repair of the easement facility.

(3) The easement facility for the relevant easement is the easement facility laid or to be laid along the easement area in accordance with clause 10(1).

9 Right to convey gas

(1) A right to convey gas includes the right for the grantee, in common with the grantor and other persons to whom the grantor may grant similar rights, at all times, to lead and convey gas without interruption or impediment from the point of entry through the easement facility and over the easement area and (for an easement that benefits land) to the benefited land.

(2) The right to lead and convey gas without interruption or impediment is limited to the extent required by any period of necessary renewal or repair of the easement facility.

(3) The easement facility for the relevant easement is the easement facility laid or to be laid along the easement area in accordance with clause 10(1).

Rights and powers implied in all classes of easement

10 General rights

(1) All the easements referred to in this schedule include—

(a) the right to use any easement facility already situated in the easement area for the purpose of the easement granted; and

(b) if no suitable easement facility exists in the easement area, the right to lay, install, and construct in the easement area (including the right to excavate land for the purpose of that construction) an easement facility that the grantee reasonably requires and for which the grantor has given prior consent; and

(c) the right to repair and maintain the easement facility.

(2) The grantor must not unreasonably withhold consent under subclause (1)(b).

(3) The grantor must not do and must not allow to be done on the burdened land anything that may interfere with or restrict the rights of any other party or interfere with the efficient operation of the easement facility.

(4) The grantee must not do and must not allow to be done on the benefited land (if any) or the burdened land anything that may interfere with or restrict the rights of any other party or interfere with the efficient operation of the easement facility.

(5) To avoid doubt, all the easements referred to in this schedule (other than for a right to convey electricity) include the right to convey electricity necessary to operate a pump or other equipment that is part of the easement facility.

11 Repair, maintenance, and costs

(1) If the 1 or more grantees have exclusive use of the easement facility, each grantee is responsible for arranging the repair and maintenance of the easement facility, and for the associated costs, so as to keep the facility in good order and to prevent it from becoming a danger or nuisance.

(2) Deleted.

(3) If the easement is in gross, the grantee bears the cost of all work done outside the burdened land.

(4) The parties responsible for maintenance under subclause (1), , or (5) (as the case may be) must meet any associated requirements of the relevant local authority.

(5) Any repair or maintenance of the easement facility that is attributable solely to an act or omission by the grantor or the grantee must be promptly carried out by that grantor or grantee at their sole cost.

(6) However, if the repair and maintenance of the easement facility is only partly attributable to an act or omission by the grantor or grantee,—

(a) that party must pay the portion of the costs of the repair and maintenance that is attributable to that act or omission; and

(b) the balance of those costs is payable in accordance with subclause (2).

(7) The costs of any electricity used for the conveyance of water must be apportioned between users of the water in proportion to their usage of the water.

12 Rights of entry

(1) The grantee may, for the purpose of exercising any right or power, or performing any related duty, implied in an easement by these regulations,—

(a) enter upon the burdened land by a reasonable route and with all necessary tools, vehicles, and equipment; and

(b) remain on the burdened land for a reasonable time for the sole purpose of completing the necessary work; and

(c) leave any vehicles or equipment on the burdened land for a reasonable time if work is proceeding.

(2) However, the grantee must first give reasonable notice to the grantor.

(3) The grantee must ensure that as little damage or disturbance as possible is caused to the burdened land or to the grantor.

(4) The grantee must ensure that all work is performed properly.

(5) The grantee must ensure that all work is completed promptly.

(6) The grantee must immediately make good any damage done to the burdened land by restoring the surface of the land as nearly as possible to its former condition.

(7) The grantee must compensate the grantor for all damage caused by the work to any crop (whether ready for harvest or not) or to any buildings, erections, or fences on the burdened land.

13 Default

Deleted.

14 Disputes

Deleted.

APPENDIX G DOC Variation Application December 2024

Application for an Easement on Public Conservation Land

Is this the right application for me?

Use this application form if you seek an easement concession across public conservation land, either to benefit other land or in gross (e.g. right of way), for the following purpose:

- a right to convey water.
- a right to drain water.
- a right to drain sewage.
- a right of way.
- a right to convey electricity.
- a right to convey telecommunications.
- a right to convey gas.

Use this form for new applications and variations to an existing easement concession across land administered by the Department of Conservation (DOC).

How do I complete this application form?

- Complete all sections of this form.
- DOC encourages electronic applications (e.g. a typed Word document), rather than handwritten applications. Electronic applications are easier to read and less likely to be returned to you for clarification.
- If you need extra space, attach or include extra documents and label them according to the relevant section. Record the document details in section **L Attachments**.
- It is recommended that you read the standard and optional terms and conditions in the concession (easement) template[1] to inform your application.

Personal information will be managed by DOC confidentially. For further information check DOC's privacy and security statements.

If I need some help, where do I get more information?

- Check DOC's Access/Easement[2] webpage.
- Arrange a pre-application meeting (either face to face or over the phone) by contacting the local DOC office[3] closest to where your activity is taking place. You can use DOC maps[4] to identify which District Office you should contact. Or arrange a meeting with any of our offices that process concessions[5] – choose the one closest to where the activity is proposed.
- It is recommended that you seek legal advice for guidance when completing this form.

[1] https://www.doc.govt.nz/globalassets/documents/about-doc/concessions-and-permits/concessions/concession-contract-easement.pdf
[2] https://www.doc.govt.nz/get-involved/apply-for-permits/business-or-activity/access-easements/
[3] https://www.doc.govt.nz/footer-links/contact-us/office-by-name/
[4] http://maps.doc.govt.nz/mapviewer/index.html?viewer=docmaps
[5] https://www.doc.govt.nz/get-involved/apply-for-permits/contacts

Published 29 October 2019

Have you considered DOC's statutory planning documents?

Your easement concession must not be inconsistent with DOC's relevant statutory planning documents[6] as they set out how DOC and our Treaty partners manage public conservation land. Statutory planning documents can have a direct impact on your application.

Book a pre-application meeting with DOC staff if you require assistance navigating DOC's statutory planning documents.

Have you considered the environmental effects of your easement concession?

It is your responsibility, as the applicant for the concession (easement), to **provide a detailed description** of the:

- Activity.
- The potential effects.
- Ways that you can remedy, mitigate or avoid any potential adverse effects.

A list of potential effects is supplied in this application form, under section **K Effects Assessment** for you to consider and attach to this application. The size and scale or your environmental effects assessment should be in proportion with the size and sale of the activity and its potential effects. You will need to describe the existing environment, the potential effects and describe your methods to avoid, remedy or mitigate these effects. For further information check DOC's Environmental Impact Assessment[7] and DOC's guide to preparing your environmental impact assessment[8]. We also recommend that you read the standard conditions in the concession (easement) template[9] about protecting the environment to inform your application. In many cases an Assessment of Environmental Effect (AEE) prepared for a resource consent under the Resource Management Act 1991 may be sufficient.

Book a pre-application meeting with DOC staff if you require assistance in scoping the environmental effects you will need to consider in your application.

How do I submit my application?

Email your completed application, recommended location forms, and any other attachments to:

permissions@doc.govt.nz

What happens next?

Once received, your application will be assessed by DOC. If your application is complete, DOC will begin processing.

If your application is incomplete it will be returned to you for more information.

Why does DOC ask for this information?

The questions in this application form are designed to cover the requirements set out in conservation legislation. Your answers allow us to assess:

- The effects of your activity and your proposed methods to avoid, remedy or mitigate any adverse effects of the activity.
- Your qualifications, resources, skills and experience to adequately conduct the activity on public conservation land.

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6 https://www.doc.govt.nz/about-us/our-policies-and-plans/statutory-plans/

7 https://www.doc.govt.nz/get-involved/apply-for-permits/managing-your-concession/environmental-impact-assessment/

8 https://www.doc.govt.nz/globalassets/documents/about-doc/concessions-and-permits/concessions/guide-to-environmental-impact-assessments.pdf

9 https://www.doc.govt.nz/globalassets/documents/about-doc/concessions-and-permits/concessions/concession-contract-easement.pdf

- Your creditworthiness is a factor in determining whether DOC should extend credit to you and set up a DOC customer accounts receivable credit account for cost recovery. To make this assessment DOC will supply your information to a credit checking agency.

Note: Information collected by DOC will be supplied to a debt collection agency in the event of non-payment of payable fees.

Treaty Partner consultation

DOC has a statutory responsibility to give effect to the principles of the Treaty of Waitangi. One component of this may be DOC consulting with Treaty Partners about your application. This consultation will feed into DOC's decision-making process. More information can be found on the DOC website on our iwi/hapū/whānau consultation[10] page.

Contact your local DOC office[11] if you require further information about consultation.

What fees will I pay?

You may be required to pay a **processing fee** for this application regardless of whether your application is granted or not. You may request an estimate of the processing fees for your application. If you request an estimate, DOC may require you to pay the reasonable costs of the estimate prior to it being prepared. DOC will not process your application until the estimate has been provided to you. In addition, if you are granted an easement concession over public conservation land you may also be required to pay a **bond, insurance, monitoring fees and ongoing concession easement activity[12] and management fees**. Minor easement concession fees are listed on the Access/Easement[13] page on the DOC website.

DOC will invoice your processing fees after your application has been considered. If your application is large or complex, DOC may undertake billing at intervals periodically during processing until a decision is made. If you withdraw your application DOC will invoice you for the costs incurred up to the point of your withdrawal.

Your application will set up a credit account with DOC. See the checklist at the end of the form for the terms and conditions you need to accept for a DOC credit account.

Will my application be publicly notified?

- Your application for an easement concession may be publicly notified if having regard to the effects of the activity it is considered appropriate to do so.[14]

What does DOC require if my application is approved?

If your application is approved DOC may require:

- **Insurance** to indemnify the Minister of Conservation against any claims or liabilities arising from your actions. The level of insurance cover will depend on the activity.
- A **bond** may be required to be in place before undertaking your activity.[15]

Note: The Minister can vary the easement concession if the information on which the easement concession was granted contained material inaccuracies. DOC may also recover any costs incurred.

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[10] https://www.doc.govt.nz/get-involved/apply-for-permits/iwi-consultation/
[11] https://www.doc.govt.nz/footer-links/contact-us/office-by-name/
[12] https://www.doc.govt.nz/get-involved/apply-for-permits/managing-your-concession/ongoing-concession-fees/
[13] https://www.doc.govt.nz/get-involved/apply-for-permits/business-or-activity/access-easements/
[14] http://www.legislation.govt.nz/act/public/1987/0065/latest/DLM7475509.html
[15] http://www.legislation.govt.nz/act/public/1987/0065/latest/DLM104654.html

Registration

If you wish to register the easement concession on the Record of Title (formerly known as a Certificate of Title) you need to:

- Discuss with DOC your intention to register your application.
- Record your intent to register in section **M Registration on a Record of Title**.
- Gain DOC's permission to register your application.
- Engage your own legal advice to complete your registration.
- Check the conditions in the concession (easement) template.
- Provide detailed plans to DOC (GIS shapefiles (.shp) are recommended).

Note: The applicant will be responsible for registering the easement concession and all the costs of registration.

A. Applicant details

Legal status of applicant (tick)	☐ **Individual** (Go to ❶)	
	☐ **Registered company** (Go to ❷)	☐ **Trust** (Go to ❷)
	☐ **Incorporated society** (Go to ❷)	☑ **Other** (Go to ❷)

❶	**Applicant name (individual)**			
	Phone		**Mobile phone**	
	Email			
	Physical address		**Postcode**	
	Postal address (if different from above)		**Postcode**	

❷	**Applicant name (full name of registered company, trust, incorporated society or other)**	NZ Transport Agency (Waka Kotahi)		
	Trading name (if different from applicant name)			
	NZBN (To apply go to: https://www.nzbn.govt.nz)		**Company, trust or incorporated society registration number**	
	Registered office of company or incorporated society (if applicable)			
	Company phone	09 954 4750	**Company website**	www.nzta.govt.nz
	Contact person and role	Kim Cottle, Principal Planner		
	Phone		**Mobile phone**	021 769 905
	Email	consents@nzta.govt.nz		
	Postal address	Private Bag 106602, Auckland City	**Postcode**	1143
	Street address (if different from postal address)	Level 5, AON Centre 29 Customs Street West, Auckland	**Postcode**	

Published 29 October 2019

B. Variation of an existing easement concession.

Is this application *varying* an existing easement concession?

No	☐
Yes	☑
Easement concession number you wish to vary	113662

C. Pre-application meeting

Have you had a pre-application meeting or spoken to someone in DOC in relation to this application?

No	☑
Yes	☐

If yes, state when and who you met/spoke with.

Discussions have been held with Darcy Liddell. Please refer to the Addendum to the Application Form, attached to the application cover letter.

D. Location and nature of the proposed easement concession

Name (physical description/common name) and land status of public conservation land on which the concession (easement) will cover.

Easement concessions are required for stormwater infrastructure in one location within Mangamuka Gorge Scenic Reserve: Slip A8: 35°10'58.30"S, 173°27'1.37"E. Removing the other 2 locations

Will your easement concession benefit other land?

No	☐
Yes	☑

If yes, provide the Lot, Deposited Plan (DP) and record of title of the other land that the easement concession will benefit.

State Highway 1 road corridor. There is no record of title for this land. The subject land for A8 is vested in the Crown, surveyed on SO 46561 as Sec 9 Block IX Maungataniwha Survey District, and set apart as a reserve for scenic purposes subject to the Reserves Act 1977

Provide the following documents (as attachments) and record the document details in the section L Attachments of this form:

- **Detailed site plan -** with proposed easement, for example:
  - For a road: the length, width, area and position where the easement will be situated.
  - For a pipe: length, width, diameter of the pipe, area and position where the easement will be situated.
  - For telecommunications: mast dimensions and type, including height, site footprint (m^2) and position where the easement facility will be situated.
- **Map** of the site
- **Aerial photo** of the site
- **Drawings of the proposal (**DOC's recommendation is for a GIS shapefiles (.shp) especially if you are going to register the easement on the title of the land)
- **GPS coordinates** (if available) and **provisional survey plan** (if available).

Record the document details in the section L Attachments of this form.

E. Description of activity

Select (by ticking the box) all the easement concession types you are applying for:

A right to convey water:	☑ discharge stormwater from SH1 to scenic reserve
A right to drain water:	☑ bored drainage Slip A8 only
A right to drain sewage:	☐
A right of way:	☑ access to maintain bored drainage Slip A8 only
A right to convey electricity:	☐
A right to convey telecommunications:	☐
A right to convey gas:	☐

Describe in detail the reasons for your proposed easement concession, including why an easement is required (as opposed to a lease, license or permit). Location details can be completed in section D.

Please refer to the Addendum to the Application Form, attached to the application cover letter which states the need to vary the concession

F. Permanent or temporary structures or facilities

As part of your easement, do you wish to build, extend or add to any permanent or temporary structures or facilities on public conservation land (e.g. pipes, pumps, pump sheds, storage tanks, towers, poles, fences, storage facilities)?

No	☐
Yes	☑

If yes, answer the following four questions.

❶ Provide full details about the structure or facility (e.g. dimensions, materials, location, purpose) and methods of construction (e.g. number of people and vehicles involved).

Please refer to the Addendum to the Application Form, attached to the application cover letter.

❷ Will you or do you own the structure?

- If yes, will you have co-sitees located on the structure?
- If yes, provide details of any co-sitees.
- If no, provide details of who owns the structure.

Yes, NZTA will own the structures.

❸ Could your structure or facility, or addition/extension to an existing structure or facility, be reasonably located outside public conservation land?

- If yes, provide details of other sites/areas that have been considered.
- If no, provide reasons why existing structures or facilities outside of public conservation land are not suitable.

The structure provides a vital stormwater drainage function to ensure the ongoing safe and efficient operations of SH 1. To maximise its function it is important that it is located further away from the road and needs to run into the scenic reserve to divert stormwater away from existing slip and to lower the groundwater levels at A8.

❹ Could any potential adverse effects of your structure or facility (or addition/extension to an existing structure or facility) be significantly less (and/or different) in another conservation area or another part of the conservation area you are applying for? Give details/reasons.

The stormwater pipesat A8 is above ground structures which have required minimal disturbance to native vegetation. The pipe at A8 has been modified to return baseflows to a nearby wetland.
A site visit was held on 20/12/23 at Slip A8 with DOC advisor Andrew Townshend, local hapu representatives and our project ecologists to discuss a preferred route for the two proposed access tracks (required to install bored drainage) to avoid large/significant vegetation.

❺ Could you use an existing structure or facility? Could you use the existing structure or facility without any additions?

- If yes, provide details of any existing structures or facilities that you have considered using, or how your activity might be undertaken without making an addition to the existing structure or facility.
- If no, provide reasons why any existing structure or facility could not be used without any additions.

No

G. Technical Specifications (for telecommunications easements only)

If you are applying for telecommunications sites, you must provide full details about the following information:

Radio frequencies	
Transmitter power output	
Polarisation of the signal	
Type of antennae	
Likely portion of a 24-hour period that transmission will occur	
Likely heaviest period of use during a 24-hour period	
Describe how the site(s) will be accessed (e.g. by foot along x track, by x road, or by a helicopter landing at x)	

H. Are you applying for any other DOC permissions?

Are you applying for other DOC permissions in addition to this easement?

No	☑
Yes e.g. Permanent and temporary structures (that are not part of your easement)	☐

If yes, state the other permits you are applying for?

I. Duration (term of easement)

In accordance with section 17Z(3)(a)(c) of the Conservation Act 1987, an easement may be granted for a term not exceeding 30 years, except:

(a) In exceptional circumstances, the Minister may grant a term not exceeding 60 years

(b) Where the easement provides a right of way access to a property to which there is no other practical access, the term may be for such longer period as the Minister considers appropriate

(c) Where the easement is for a public work (as defined in the Public Works Act 1981), the term may be for the reasonably foreseeable duration of that public work.

Detail the length of the term sought (i.e. **must be** number of years or months) and why *(Note: in perpetuity/forever or similar meaning is not a term under the Act and not able to be granted)*:

60 years and zero months

If you are seeking over 30 years, explain why:

The easement is for a permanent public work to which there is no other practical location or access.

J. Consultation undertaken

DOC has a statutory obligation to give effect to the principles of the Treaty of Waitangi. This often requires consultation with our Treaty Partner (iwi/hapū/whānau of local Maori) on your application. If you have already consulted with our Treaty Partner, or with other interested stakeholders (including other parties already located at your proposed location), DOC would like to know about it.

We recommend you discuss consultation with a DOC staff member before starting your application.

Have you carried out any consultation?

No	☐
Yes	☑

If yes, supply details of each Treaty Partner or interested stakeholders consulted with.

Copy and paste the table below and complete for each Treaty Partner or other interested stakeholders. If you received a written response to consultation attach a copy and record all attachments in section 'L Attachments', including:

- Additional pages with the required information
- Written responses to your consultation with Treaty Partners or other interested stakeholders.

Whānau/hapū/iwi or other interested party consulted with:	Two hapū are engaged in all aspects of this programme: Te Paatu (manawhenua on the northern side of Mangamuka Gorge Scenic Reserve), and Ngā Hapū ō Mangamuka (manawhenua on the southern side).
Name of individual you consulted with:	Key hapu representatives are Tomo Otene and Tina Latimer
Date of consultation:	
Form of consultation (e.g. email, meeting):	
Outcome of consultation:	Hapū are employed by this programme as contractors and cultural monitors. Representatives are present at all times to supervise and support the project ecology and planning team. Fortnightly environmental meetings are held via Teams and hapū representatives are at these. Further, fortnightly hapū meetings are also held via Teams to ensure they are always informed of where the project is at. No documents have been attached as proof of this as DoC has also been involved in these meetings and are already well informed of hapū's involvement in this project. Hapu representatives also attended the site walkover at Slip A8 on 20.12.23. NB: Iwi involvement is not required for the variation of the concession

Other interested stakeholders consulted with e.g. Conservation Boards or community groups:	no other stakeholders have been consulted in relation to this application.
Name of individual you consulted with:	
Date of consultation:	
Form of consultation (e.g. email, meeting):	
Outcome of consultation:	

K. Consistency with DOC statutory plans

List the DOC's statutory planning documents[16] relevant to your application.

Please refer to the Addendum to the Application Form, attached to the application cover letter.

Are you aware of any potential inconsistency of your easement concession with DOC's statutory planning documents?

No	☑
Yes	☐

[16] https://www.doc.govt.nz/about-us/our-policies-and-plans/statutory-plans/

If you have answered yes, explain why it is inconsistent with the statutory planning documents

L. Effects assessment

Identify actual or possible effects of the easement concession applied for. Describe the actions you propose to take to avoid, remedy or mitigate any adverse effects. For further information check DOC's Environmental Impact Assessment[17] and DOC's guide to preparing your environmental impact assessment[18].

If you have identified effects or mitigation measures for adverse effects not included in the table below or you have a full Environmental Impact Assessment attach this information to your application. Record this additional information in the table below and in section K as an attachment.

Have you attached a full Environmental Impact Assessment?

Yes	☐
No	☑

If you have answered **no** provide a **description of environmental effects** of your easement concession in the table below including details of the:

- Existing environment
- Potential effects
- Proposed methods to avoid, remedy or mitigate the adverse effect/s.

Description of environmental effects	
No effects as the easement uses an existing structure or facility (including a road or track) and there will be no modification or disturbance due to increased use.	☐

[17] https://www.doc.govt.nz/get-involved/apply-for-permits/managing-your-concession/environmental-impact-assessment/
[18] https://www.doc.govt.nz/globalassets/documents/about-doc/concessions-and-permits/concessions/guide-to-environmental-impact-assessments.pdf

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Effects	Description
Effects on the **landscape** e.g. ability of landscape to accommodate changes.	Please refer to the original Addendum to the Application Form, attached to the original application cover letter where an expanded version of this table was included.
Effects on the **visual** composition of the landscape	
Effects on **cultural values** of Tangata Whenua or members of the public	
Effects on **historic sites or objects** including Wahi Tapu e.g, disturbance of the ground.	
Effects on **existing infrastructure** such as roads, tracks, huts, carparks, huts etc.	
Effects on **existing vegetation** e.g. disturbance or removal of vegetation.	
Effects of **earthworks** e.g. removal of topsoil and where removed earthworks will be stored. Note: All earthworks storage on public conservation land needs to be authorised.	
Effects on **wildlife or wildlife habitat**	
Effects on **aquatic habitat** (waterways, swamps, freshwater animals and vegetation)**.**	
Effects **on other users** (tangata whenua, recreational users and concessionaires) of the Land.	
Effects of the easement **increase threats** (pests, weeds, pathogens and fire) to public conservation land.	
Effects of **increased rubbish, toilet waste or debris left on public conservation land** during construction and regular use of the easement.	
Cumulative effects that could be caused by the easement.	
Positive effects of the easement.	

M. Attachments

Attachments should *only* be used if there is:

- A specific question requiring a map or further information
- Not enough space on the form to finish your answer
- You have additional information that supports your answer
- You wish to make an additional request of DOC regarding the application.

Label each document clearly and complete the table below.

Section of the application form the attachment relates to	Document title	Document format (e.g. Word, PDF, Excel, jpg etc.)	Description of attachment
Correct example ✓ *D*	*Easement site plan*	*.shp (shapefile)*	*Detailed site plan of the easement*
Correct example ✓ *J*	*Effects Assessment*	*Word*	*Effects assessment on: Landscape, cultural values, existing vegetation, wildlife, earthworks, other users and positive effects.*
Incorrect example ✗ *Table*	*Doc1*	*Word*	*Table*
F	Cover letter and addendum	PDF	Addendum requesting variation to existing easement application is attached to cover letter.

N. Registration on a Record of Title

Are you going to register your easement concession (if granted) on the Record of Title (formerly known as the Certificate of Title)?

No	☐
Yes	☑

If yes, you will be responsible for registering the easement concession, including all costs.

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O. Checklist

Application checklist	Tick
I have completed all sections of this form relevant to my application and understand that the form will be returned to me if it is incomplete.	☑
I certify that the information provided in this application form and any attached additional forms is, to the best of my knowledge, true and correct.	☑
I have supplied maps to accompany my shapefiles (.shp) and/or NZTM GPS locations listed in section E Locations.	☑
I have detailed, in Section 'K Effects assessment', the easements environmental effects or I have supplied a full Environmental Impact Assessment and attached to section 'L Attachments'.	☑
I have indicated in section 'M Do you intend to register the easement concession' that I do or do not want the easement registered.	☑
I understand if I want the easement registered on the Record of Title I will be paying all the costs of the registration including surveying and independent legal advice.	☑
I have appropriately labelled all attachments and completed section 'L. Attachments' to match.	☑

P. Terms and conditions for a credit account with the Department of Conservation

Have you held an account with the Department of Conservation before?	Tick
No	☐
Yes	☑
If "yes", under what name:	NZ Transport Agency

In ticking this checklist and placing your name below you are acknowledging that you have read and agreed to these terms and conditions for an account with the Department of Conservation

Terms and conditions	**Tick**
I/We agree that the Department of Conservation can provide my/our details to the Department's Credit Checking Agency to enable it to conduct a full credit check.	☑
I/We agree that any change which affects the trading address, legal entity, structure of management or control of the applicant's company (as detailed in this application) will be notified in writing to the Department of Conservation within 7 days of that change becoming effective.	☑
I/We agree to notify the Department of Conservation of any disputed charges within 14 days of the date of the invoice.	☑
I/We agree to fully pay the Department of Conservation for any invoice received on or before the due date.	☑
I/We agree to pay all costs incurred (including interest, legal costs and debt recovery fees) to recover any money owing on this account.	☑
I/We agree that the credit account provided by the Department of Conservation may be withdrawn by the Department of Conservation, if any terms and conditions (as above) of the credit account are not met.	☑
I/We agree that the Department of Conservation can provide my details to the Department's Debt Collection Agency in the event of non-payment of payable fees.	☑

Applicant Name/s (of authorised person/s)	Kim Cottle	**Date**	11 December 2024

For Departmental use			
Credit check completed			
Comments:			
Signed		**Name**	
Approved (Tier 4 manager or above)		**Name**	

Published 29 October 2019

WAKA KOTAHI
NZ TRANSPORT AGENCY

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11/12/2024

Department of Conservation
Operations & Regulatory Services

Via email: permissions@doc.govt.nz

Application to vary Easement Concession Number 113662: Mangamuka 2022 Slip Response Project (Public Conservation Land)

Dear Sir/Madam

Please find enclosed an application by Waka Kotahi to vary easement concession number 113662 in the Mangamuka Gorge Scenic Reserve for stormwater infrastructure associated with the Mangamuka 2022 Slip Response Project.

The Department of Conservation (DOC) and NZ Transport Agency (NZTA agreed to commence the concession on 1 May 2024 in three separate locations within Mangamuka Gorge Scenic Reserve; locations, A3, A4 and A8 shown on the plan below.

The subject land for A8 is vested in the Crown, surveyed on SO 46561 as Sec 9 Block IX Maungataniwha Survey District, and set apart as a reserve for scenic purposes subject to the Reserves Act 1977. The subject land for A3 and A4 is private land, held in Record of Title NA70C/847, owned by Bruce Alexander Shine. The concession with DOC is, therefore, not the appropriate agreement for the infrastructure located at A3 and A4 with DOC not being the owner of the land.

A concession should remain for the infrastructure located at A8, however, pursuant to section 17ZC subpart 3(c) of the Conservation Act 1987, a variation of the existing concession is necessary to exclude locations A3 and A4. NZTA will be removing the flumes from private land at locations A3 and A4.

Additionally, NZTA would like DOC to consider varying the concession to not only include location A8, but also for the annual fee (reduced only for location A8), establishment/processing fees and ongoing management fees, to be waived pursuant to section 17X of the Conservation Act 1987, with various grounds for waiving the fee outlined in the addendum attached further below.

The current 60-year term would continue free of any fees with all other appropriate management conditions remaining on the concession agreement, but varied to only apply for location A8.

Supporting information enclosed with this application includes:

- Application form to vary the concession.
- Addendum to the application form (attached below)

We look forward to hearing from you soon.

Yours Sincerely

Kim Cottle
Principal Planner
Poutiaki Taiao / Environmental Planning
Email: kim.cottle@nzta.govt.nz
Phone: 09 954 4750
Mobile: 021 769 905

Addendum to the Application Form: Additional Information Outlining Grounds to Waive Fees Pursuant to

Recent discussions between DOC and NZTA

During recent conversations with DOC, it was suggested waiving the fee was possible, pending DOC's commercial team (Regulatory Services) agreeing to the case being put forward. DOC had mentioned the fee could not be waived on the sole basis the concessionaire is another crown agency, but this case is not being made solely on this basis, and instead, for the many reasons outlined further below. NZTA have engaged with The Property Group (TPG) to provide advice on this case.

The urgency of this variation

DOC has provided info on the application process to vary the easement concession, which happens to be the same process taken for the initial application. Therefore, they estimate a basic concession variation may be subject to the same timeframe of 4-6 months. However, the Mangamuka 2022 Slip Response Project is coming up to completion end of March 2025, therefore, it is crucial that a resolution is sought on this variation application before completion.

Making the case for DOC to waive the fee (following a revision to only include location A8)

During conversations with DOC regulatory services representatives, it had been expressed that NZTA need to put together a case for the reasons to waive the annual concession fee. Given there is multiple grounds to waive the fee, rather than just on the sole basis of NZTA being another Crown agency, these grounds for a fee waiver ought to be considered by the Minister of Conservation or delegated authority due to their relation to the conditions provided in section 17X of the Conservation Act 1987.

For clarification purposes, section 17X of the Conservation Act 1987 states the following:

> *In granting any concession, the Minister may impose such conditions as he or she considers appropriate for the activity, structure, or facility, including (but not limited to) conditions relating to or providing for:*
>
> *(f) the waiver or reduction of any rent, compensation, or bond where—*
>
> > *(i) the concessionaire makes any contribution to the management of the lands or the public interest in those lands; or*
> >
> > *(ii) there is any other non-commercial public benefit from the activity; or*
> >
> > *(iii) any circumstances of the concession justify such waiver or reduction; or*
> >
> > *(iv) the costs of setting and collecting the rent exceed any rent which may be collected:*

The numerous reasons (grounds) for waiving the fee and how some of them relate to these conditions, have been summarised below:

Consideration	Potential grounds for waiving the fee
Cost saving for the taxpayer	This concession agreement could be considered not appropriate for a Crown-to-Crown agreement. It appears a document typical of an arrangement between DOC and a private entity has been used. In the spirit of providing effective and efficient govt services across all of

Pursuant to s17X subpart (f)(iv) of the Conservation Act	government, DOC, NZTA and Treasury may see a variation of the concession as an opportunity to reduce costs to the taxpayer. Pursuant to s17X subpart (f)(iv), although it is difficult to quantify the costs involved in setting (every 3 years) and collecting the fee (rent), because the concessionaire is another crown entity, consideration should be made to assume the total costs for Crown as a whole (both entities) to set, collect and process the fee (rent) on both sides, may offset or exceed the need for the fee in the first instance. By either; 1. assuming the current annual fee of $5,330 (excl. GST) is reduced by a third (removing 2 of the 3 locations) coming to an annual fee of approx. $1,776.67 (excl. GST), or, 2. referring to the information provided by DOC on how a fee is established which assumes an annual fee of $400 (excl. GST) is set for a non-commercial easement for the right to discharge/convey water, We can assume the costs of setting and collecting the rent/fee exceed any rent which may be collected.
Emergency works benefiting the surrounding reserve land Pursuant to s17X subpart (f)(i) and (ii) of the Conservation Act	NZTA's work in repairing the road infrastructure in the Mangamuka Scenic Reserve had been classified as 'Emergency Works' following significant weather events causing slips in 2022. The upgrade of this key infrastructure could be viewed as benefiting the scenic reserve by increasing the resilience of the infrastructure against future climate events that would otherwise jeopardise the roading infrastructure, causing further slips, and affecting the surrounding reserve land. The purpose of the infrastructure on the land could be viewed as activities that reduce environmental impact on the reserve land (see s17X subpart (f)(i)), whilst maintaining key roading infrastructure (see s17X subpart (f)(ii).
NZTA's recent activities to support conservation in the Mangamuka Scenic Reserve Pursuant to s17X subpart (f)(i)	NZTA has recently supported DOC's efforts to install fish passages in the scenic reserve (potentially in other areas also) including installation of culverts, providing passage for fish to travel/migrate to spawning areas upstream. Pursuant to s17X subpart (f)(i), consideration to waive the fee should be made due to these efforts, and potential future efforts on other conservation activities by NZTA, represents the collaborative approach between the agencies to achieve conservation outcomes.
National Land Transport Programme (NLTP) Funding Assistance Rates (FAR) Pursuant to s17X subpart (f)(i)	Also, for the purposes of s17X subpart (f)(i), NZTA provides funding contributions, in percentage terms, known as a FARs, to DOC to maintain roads and roading boundaries/reserves in the Mangamukas. The 2021-24 NLTP included FARs, for NZTA to provide DOC funding to maintain roading vested in DOC, agreed at 51%. This too, represents the collaborative approach between the agencies, and may provide further grounds to convince DOC to waive the fee.
To accommodate both parties needs to reduce effort in	DOC's concession easements on reserve land are often not recorded in a conventional manner, by registration on the title. Instead, they're administered within DOC's own internal register, via concessions, governed by the Conservation Act 1987. Surveying and the registration of

administering a concession Pursuant to s17X subpart (f)(iii)	easement instruments are often not required if the concession easement is of a typical nature of 30 (sometimes 60) years in tenure and not of a technical nature. Therefore, reiterating earlier comments, the administration of a reduced concession for location A8 only would be less intensive and costly compared to acquiring the land. It won't require survey, valuation and legalisation. And on the other hand, with DOC having expressed their preference to not administer low complexity concessions long term, an appealing middle ground that would accommodate both parties needs to reduce effort could be to waive the fee. This would then mean less administration to process fees and fee reviews on a 3 yearly basis for a smaller concession

APPENDIX H March 2025 Addendum to DOC Variation Application

11/03/2025

Department of Conservation
Operations & Regulatory Services
Via email: permissions@doc.govt.nz
CC: dliddell@doc.govt.nz and mhardy-birch@doc.govt.nz

Application to vary Easement Concession Number 113662-OTH: Mangamuka 2022 Slip Response Project (Public Conservation Land)

Tēnā koe

On 11 December 2024, the New Zealand Transport Agency Waka Kotahi (NZTA) lodged an application with the Department of Conservation (DOC) to vary an easement (113662-OTH). Easement 113662-OTH was approved on 3 May 2024.

It has been identified that a further variation may be required and following a meeting with Darcy Liddell and Meirene Hardy-Birch from DOC for the erection of structures, namely a timber boardwalk. It was considered the most efficient approach was to incorporate it with the already applied for variation.

We note, that NZTA are seeking this approval retrospectively. Due to the emergency nature of the project, it was imperative that these works proceeded in order to complete the remediation works associated with Slip A8.

Easement 113662-OTH

As per clause 3, the concession currently provides an easement which provides for, amongst other things, for a right of way for an access track at Slip A8. The purpose of the access track was to allow NZTA to install bored drainage to reduce poor pressure, mitigating the risk of further slips and damage to, or loss of State Highway 1. At the time the concession was sought, the "*access track*" was proposed to be a gravel track

Clause 9.1 of Schedule 1 requires that the "*Concessionaire must not erect, nor place any structures on, under or over the Easement Land without the prior consent of the Grantor*".

Whilst the above condition suggests that a structure could be erected without a variation to the concession, provided consent was obtained, we note a variation application is already being considered by DOC, therefore seek to also vary the concession to allow for a boardwalk structure.

Attachment 1 provides photographs of the access track and bored drainage outlets constructed in line with the concession.

Boardwalk Structure

As per the concession, NZTA constructed a gravel access track at Slip A8. It was identified however that an area of the access track was waterlogged, creating unsafe and wet and muddy conditions for workers, and would remain so for workers undertaking on-going maintenance of the bored drainage.

Therefore, a raised timber boardwalk, with handrails was constructed (refer **Attachment 2** for Site Plan). The boardwalk is 240m -1065m off the ground, with the height at the top of the handrail being 1.050m from boardwalk walkway. The boardwalk is 28.45m long by 1.570m wide (refer **Figure 1**).

Figure 1: Timber Boardwalk (Image taken 4 March 2024)

In addition, timber stairs are to be erected at each entrance to the access track (refer **Figure 2**). Most of the stairs (as evident on the Site Plan at **Attachment 2**) will be located outside of the DOC reserve and within the road corridor and the NZTA held designation for State Highway

1, however a small portion may extend into the DOC reserve. Therefore, for completeness and as a conservative approach, it is requested the stairs, where they may cross into the DOC reserve are included in the concession.

Figure 2: Stairs at North End of Access Track (Image taken 4 March 2025)

Public Access

It is not intended that the boardwalk (or stairs) be used for public access. Whilst this cannot be avoided completely, NZTA is undertaking measures to mitigate this occurring.

The stairs will be hidden from public view as much as is possible and reasonably practicable, with large boulders placed along the roadside to prevent vehicles in particular from being able to access the boardwalk.

Figure 3: (Left) North Stairs as Visible from Roadway (Right) South Stairs as Visible from Roadway (Images taken: 10 March 2025)

The roadway at the site (Slip A8) does not provide sufficient room for a vehicle to safely stop (such as a long visible approach or wide berm or layby area) reducing the likelihood that a member of the public would come across the stairs and access to the boardwalk. If a member of the public, whilst driving past happened to notice the stairs, they would need to drive a few hundred metres further down the road, and walk back along the road, where there is limited availability to do so. Generally speaking, it is not considered likely, due to the number of obstacles, a member of the public would access the stairs and/or boardwalk.

Figure 4: Streetview at Slip A8 showing no room to safely stop a vehicle (Source: GoogleMaps Streetview - accessed 26 February 2025)

Health and Safety

As identified above, it is not considered likely a member of the public would access the stairs/boardwalk, and boulders will have been installed to prevent vehicle access. In the unlikely event a member of the public does access the structures, handrails have been installed, and the structures are built in compliance with building standards. A building consent is not required under the Building Act 2004. Anti-slip matting has been applied to the boardwalk to prevent slips and falls, particularly during wet weather.

The structures will be checked annually when the annual maintenance of the bored drainage at Slip A8 is undertaken. Any necessary repairs will be made when identified.

Consequently, it is not considered Health and Safety risks have been mitigated as much as reasonably practicable.

Assessment of Effects on the Environment

The concession approved the construction of a gravel access track. It is not considered that the boardwalk or stairs gives rise to any greater level of effect than that of the already approved track. The boardwalk and stairs have been constructed entirely within the footprint of the approved gravel track and did not require any further vegetation clearance nor more than minimal additional earthworks. The structures provide for on-going maintenance of the bored drainage and culverts at Slip A8 to be undertaken in a manner which reduces the damage caused by machinery and personnel undertaking the maintenance, due to the wet and muddy nature of the ground.

Table 1: Assessment of Effects

Effects	Description
Effects on the **landscape** e.g. ability of landscape to accommodate changes.	There will be minimal landscape effects as the structures are small in scale, well removed from any walking tracks and not visible in wider landscape context. Views of structures will be limited to fleeting views from vehicles on SH1 or by off-track reserve users.
Effects on the **visual** composition of the landscape	See above
Effects on **cultural values** of Tangata Whenua or members of the public	Relevant cultural values relate to the protection of native fauna, significant vegetation, and wider ecological values which are discussed below. Ongoing consultation with our hapū partners is being carried out
Effects on **historic sites or objects** including Wahi Tapu e.g, disturbance of the ground.	The proposed locations are not located near any known historic sites or Wahi Tapu sites. A comprehensive heritage values assessment of Mangamuka Gorge was carried out and can be shared
Effects on **existing infrastructure** such as roads, tracks, huts, carparks, huts etc.	The proposed structures are not located near any existing DOC infrastructure.
Effects on **existing vegetation** e.g. disturbance or removal of vegetation.	Vegetation had already been cleared in accordance with the approved concession and no additional vegetation clearance was required.
Effects of **earthworks** e.g. removal of topsoil and where removed earthworks will be stored. Note: All earthworks storage on public conservation land needs to be authorised.	Minimal earthworks above what was required for the approved access track were undertaken by way of installing the boardwalk piles into the ground.

Effects on **wildlife or wildlife habitat**	Construction works were carried out in accordance with various s71 Wildlife Act permits to appropriately manage effects on wildlife. The permanent structures are small in size and won't significantly reduce habitat areas or obstruct wildlife movement, with the boardwalk being raised, allowing wildlife to move freely beneath it, as well as being able to move along and over it.
Effects on **aquatic habitat** (waterways, swamps, freshwater animals and vegetation)**.**	The structures are not within, or within a 10m setback of the wetland.
Effects **on other users** (tangata whenua, recreational users and concessionaires) of the Land.	There are no other users who would be affected by the proposal.
Effects of the easement **increase threats** (pests, weeds, pathogens and fire) to public conservation land.	It is not considered the structures increase threats to public conservation land.
Effects of **increased rubbish, toilet waste or debris left on public conservation land** during construction and regular use of the easement.	The entrances to the structures be disguised from SH1 to reduce potential use by the general public, and associated rubbish and waste.
Cumulative effects that could be caused by the easement.	It is not considered the structures give rise to adverse cumulative effects. They are generally not visible to the public, nor result in additional effects above the access track already authorised by the concession.
Positive effects of the easement.	The structures will significantly reduce the risk of future slips in these locations, thereby improving the resilience of SH1 and providing for the social, cultural and economic needs of local communities and the wider region, by providing for the on-going maintenance of the bored drainage which reduces poor pressure and culverts which divert water away from the roadway. It allows this to be done in a manner which reduces the damage caused by machinery and personnel undertaking the maintenance,

Consistency with DOC Statutory Plans

Northland Conservation Management Strategy 2014-2024 (CMS)

Under the Northland CMS, the portion of Mangamuka Gorge Scenic Reserve subject to this application is located within the Ahipara-Herekino-Raetea-Warawara Place. Under the various CMS Maps, the area is identified as:

- not being within an Ecosystem Priority, Icon or Gateway Destination area
- within a Front Country Visitor Management Zone
- within an Aircraft Access Green Zone

The Northland CMS does not have any specific policies for the Mangamuka area, however the proposal will be undertaken in a manner that is consistent with broader CMS policy objectives, as was set out in the application for the concession. It is not considered the erection of the structures alters the conclusions made in that application.

Kim Cottle

Principal Planner– Poutiaki Taiao / Environmental Planning

System Design, Transport Services

Phone: (09) 954-4750

Email: consents@nzta.govt.nz

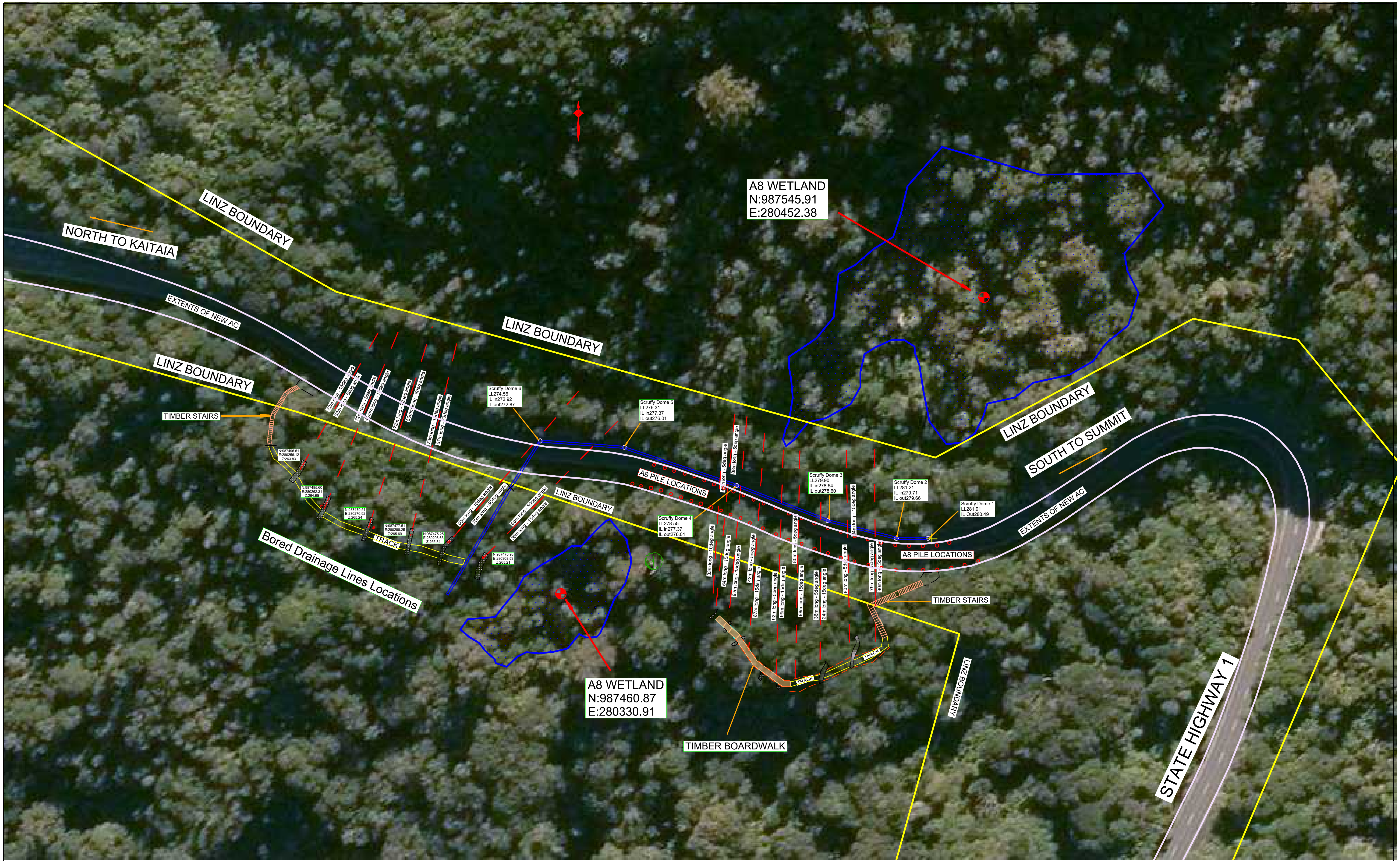
Attachments

Attachment 1: Photographs of Access Track (4 March 2025)

Attachment 2: Site Plan

Attachment 1: Photographs of Access Track (4 March 2025)

Attachment 2: Site Plan



REVISION HISTORY:			
#	DATE	DESCRIPTION	APPROVED
1	11/12/2024	Add in Slot Drains Area 2	AR
2	18/02/2025	Add in Boardwalk Survey	AR
3	06/03/2025	Completed Walkway Stairs	AR
4			

NOTES:

- Levels are in terms of MT EDEN 2000
- Horizontal data is in NZVD2016
- All underground and above services may not be surveyed or shown on this plan.
- Please consult Service Providers before carrying out any excavation or construction.
- Taiao Surveyors accepts no responsibility for services omitted by this survey.
- Contours are at N/A intervals.

Prepared By:

	BY	DATE
SURVEY	DC	18/02/2025
DRAWN	AR	20/02/2025
CHECKED	TH	20/02/2025
REVIEWED		

TAIAO SURVEYORS
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Client: WAKA KOTAHI

Agent: CLL

TITLE: Mangamuka Project - A8 Existing Wetlands & Slot Drains Location Plan
State Highway 1, Mangamuka Gorge

JOB:

SHEET 7

SCALE: 1:1000 @ A3

PROJECT FILE: Data old

REVISION

APPENDIX I Kauri Dieback Procedure

	PROCEDURE		
Project Name:	Mangamuka Gorge	Code:	
Procedure:	Appendix C: Kauri Dieback Procedure		

1 Application

This Plan forms a part of the Erosion and Sediment Control Plan (ESCP) for Mangamuka Gorge Road Rehabilitation works (the Project). The purpose of this Plan is to have the procedures in place to manage the risk of kauri dieback disease and to reduce the potential environmental impact the works may have on the spread of kauri dieback disease.

2 Scope of works

The construction activities of the Project include the following:

- Ground stability improvements (anchors);
- Retaining wall construction;
- Culvert works;
- Road reinstatement.

3 Potential Environmental Impacts of Activities.

Kauri (*Agathis australis*) are a cornerstone of the indigenous forests of the upper North Island and have had a large part to play not just in the landscape of Aotearoa but also in its culture and early history[1]. Kauri dieback is caused by a soil-borne pathogen. Minimising the movement of soil or plant material that is potentially contaminated with kauri dieback by people, animals, and limited natural spread (over small distances) is fundamental to the management of kauri dieback.

Kauri dieback spreads through the movement of contaminated soil and soil water and it is possible that it is also spread by streams and rivers particularly in times of flooding.

When working or conducting any activity within or around kauri or in native forests in Northland there is a risk of spreading kauri dieback. Kauri forests and stands can be less easily identifiable and have the potential to be in remnant forests across the region.

The key potential situations and the environmental impacts of these are:

Aspects	Impacts
Spread of kauri dieback disease around the local Native forests around the works area through the movement of soil via people, equipment/tools, heavy machinery, and vehicles.	Acute and chronic harm to local kauri by the spread of kauri dieback disease to healthy/uninfected kauri.

[1] Kauri Dieback Hygiene, Best Practice Guidelines; Northland Regional Council, March 2020

4 Key Responsibilities

Responsibilities.

The ***Project Director*** is responsible for:
- Ensuring controls to prevent kauri dieback spreading are in place; and
- Ensuring protocols and procedures to manage the risk of kauri dieback are in place.

The ***Project Manager is*** responsible for:
- Ensuring the implementation of this Plan;
- Communicating requirements to relevant site personnel; and
- Ensuring all personnel have received appropriate instruction and training in avoiding and following kauri dieback procedures.

The ***Site Engineer*** is responsible for:
- Ensuring adequate hygiene points and wash down stations are available for all soil disturbing activities where kauri may be present;
- Ensuring that all hygiene kits are in stock; and
- Ensuring all site personnel have received appropriate instruction and training in avoiding and following kauri dieback procedures.

All ***Site Personnel*** are responsible for:
- Following the requirements of this Procedure; and
- Reporting any concerns, incidents, or observations to the Earthworks Manager or Site/Contract Manager

5 Kauri Dieback Disease Prevention Procedures

5.1 Hygiene Procedures

- Ensure all gear (footwear, tools, equipment, and machinery) is clean before entering and after leaving if Kauri have been identified nearby the work site. It is recommended that all gear is cleaned at the beginning and end of each day if leaving the site. 'Clean' refers to completely soil-free. Soil and organic material cleaned from equipment (including vehicles and heavy machinery), where possible should be collected and disposed of appropriately at an approved landfill. Alternatively, the material can be left in situ at the source.
    - Wheeled or tracked machinery and vehicles pose a high risk and therefore must be cleaned thoroughly to remove all soil.
    - Where possible, machinery and vehicles should remain on sealed road for the duration of the project.
    - When moving from one area of Kauri to another (between work sites), all equipment should be cleaned prior to moving. A full wash-down of soil and debris should occur on site prior to movement as this contains any problems at the source.
    - Where the above recommendation cannot occur, vehicles and machinery may be taken off site and cleaned in a wash-down facility, but all loose soil and debris must be removed at the kauri site prior to moving and care should be taken to ensure that risk of spread during transport to that facility is minimised.
    - Operators are expected to carry out their own inspections and cleaning, however these may be checked by local Department of Conservation (DOC) or council staff.
- Vehicles and personnel should remain on roads and tracks where possible, particularly in wet conditions. If it is required that vehicles or personnel need to move onto/off tracks, portable

phytosanitary packs are required to be used to ensure that kauri dieback is not carried onto the track from surrounding kauri or between high-risk areas.
- Phytosanitary kits must be used when leaving an area showing symptoms of kauri dieback disease.
- Operations should be carried out under dry soil conditions where possible.
- Work sites should ideally be located downslope of kauri areas.
- When entering or exiting a stream system, you must use portable phytosanitary packs to ensure kauri dieback is not carried into the stream from surrounding kauri or between high-risk areas.
- Raw materials (soil/substrate/gravel) should not be sourced from kauri areas. Materials should be sourced from a 'clean' source not containing kauri.
- If any vegetation removal is required, methods that do not disturb the soil should be used.
  - If any diseased kauri and vegetation (including weeds and native vegetation in diseased zones) are trimmed or cleared they must be left in-situ, composted for use on site, or disposed of at an appropriate landfill site.
  - If any soil/plant material is to be removed from a "controlled area" this must be managed with biosecurity approval.

5.2 Additional General Considerations

- Avoid or restrict introduction of high-risk products (soil/substrate/gravel/vegetation) to the area. If any high-risk products are required, they must be from reputable/biosecurity accredited sources.
- Managing or limiting vehicle access where appropriate should be considered.
- Managers, visitors and users must be aware when undertaking high-risk activities in an infected area.
- Good hygiene practices by all users/visitors should be encouraged.
- If both infected/symptomatic and uninfected sites are identified within an area, hygiene measures must be taken to avoid soil transfer from infected to uninfected. Activity should be planned to move from uninfected to infected areas (not vice-versa where possible).

5.3 Phytosanitary information

Kauri dieback spores can be removed from footwear and equipment simply by scrubbing them with clean water to remove all soil then allowing gear to dry. However, while not essential, using Sterigene will increase the effectiveness of these hygiene measures. Sterigene should be used at a 2% mix.

It is recommended that Sterigene disinfectant is used on footwear, equipment, machinery and other items that have been in contact with soil. Sterigene is a broad-spectrum disinfectant which is non-toxic, non-corrosive, biodegradable and environmentally friendly compared to other products.

Alternatively, Virkon and Janola (Bleach) may be used, however its application is limited in a forest situation and any application should be in accordance with the product's label instructions and Material Safety Data Sheet. Options for mixes are outlined below:

- 70% Methylated Spirits, 30% water.
- 25% Bleach, 75% water.
- 2% Sterigene Mix

All gear should first be cleaned to remove soil. Sterigene should then be sprayed onto the clean surfaces (and left to dry). Sterigene will not kill kauri dieback spores that are embedded in soil hence it is important to remove soil before applying the disinfectant.

Water, soil, or slurry and Sterigene from cleaning dirty equipment needs to be disposed of carefully:

- Solution must be drained into waste water drains, not the stormwater system, or disposed of on a lawn or gravel pad.
- If necessary, expired Sterigene may be discarded on a lawn or gravel pad.

- Do not let Sterigene drain into septic systems.
- Sinks connected to waste waster systems are ideal for cleaning equipment off site.

Wearing reusable non disposable overshoe booties is an option for each kauri area. Sourcing an overshoe bootie that is durable and can be washed and reused regularly is recommended. These need to be cleaned at the hygiene point (disinfectant location at the edge of the works or forest area) like footwear. Disposable ones are not recommended.

5.4 Hygiene Kit Requirements

Outlined below are the items needed in hygiene kits around the site and at hygiene and wash down points:

- Stiff bristle scrubbing brush or broom;
- 500ml spray bottle with disinfectant (disinfectant mixes are outlined in Section 5.3);
- Boot bags;
- 1 litre pump sprayer with water.

For vehicle and heavy machinery wash down points the volumes of disinfectant and water will be larger than those listed above. These volumes will be dictated by the frequency of cleaning and the amount of equipment that needs to be cleaned on site. The same mixes of disinfectant will be used as listed in Section 5.3.

6 Wash-Down Sites

Wash down of vehicles and/or heavy machinery that was used within a kauri root zone should occur within that area where possible. If the vehicles/machinery have been operating outside a root zone, the wash-down should occur prior to exiting a kauri forest.

When selecting a suitable wash-down site, the following should be considered:

- Hard stand area and well drained surface (e.g., road near the edge, firm grass or gravel).
- At least 30m away from a water course or water body. This includes drains that discharge to water courses such as stormwater drains and culverts.
- An area within the root zone, if use of equipment and vehicles has occurred in this area.
- Is of gentle slope to drain wastewater away from:
  - The wash-down area and into a kauri root zone.
  - Water catchment.
  - Areas outside the kauri root zone.
  - Vehicles and heavy machinery being washed to prevent potential re-contamination.
- Enable cleaned objects to exit without being re-contaminated.
- Undertaking a risk assessment of the site to inform a health and safety risk management plan e.g., working around powerlines.

Where runoff cannot be managed to an acceptable standard (e.g., large quantity of wastewater and/or an extensive runoff) construction of a bund and sump may be required to safely dispose of the wastewater. DO not drive through wash down wastewater as this may re-contaminate the vehicle/machinery.

If wash down cannot occur in the forest, then the vehicles and/or heavy machinery should be taken to a suitable facility off site for decontamination. All loose soil and vegetation should be physically removed (preferably when dry) where possible before the vehicle or heavy machinery is transported offsite. This can be removed using a hard brush or broom or by using compressed air. Pay attention to the underside, between dual wheels, sump guards, mud flaps, hollow sections, foot wells, and bumper bars. The amount of water used should be minimised.

Footwear and equipment/tool hygiene points should be installed at the entrance and exit of a kauri forest site. If the same access point is used when moving from one area of kauri to another, a hygiene point should be set up between the two areas. Footwear should be cleaned following the procedures outlined in Section 5.3 and Section 5.4.

7 External Contacts

Kauri Dieback Helpline	0800 NZ KAURI
Kauri Dieback Team – Northland Regional Council	kauridieback@nrc.govt.nz

Project Team Contacts

Project Director: Vaughn Robbins	027 492 3576
Project Manager: Chris Tuxford	0272695275
ESC & Environmental: Campbell Stewart	021 837825
Site Engineer: Tim Hunger	0275719111

APPENDIX J Southern Fill Site Approved District Resource Consents

DECISION ON LAND USE CONSENT APPLICATION

UNDER THE RESOURCE MANAGEMENT ACT 1991

Decision

Pursuant to section 34(1) and sections 104, 104B, and Part 2 of the Resource Management Act 1991 (the Act), the Far North District Council **grants** land use resource consent for a Controlled / Restricted Discretionary / Discretionary / Non-Complying activity, subject to the conditions listed below to:

Applicant:	New Zealand Transport Agency
Council Reference:	2250314-RMALUC
Property Address:	69 Victoria Valley Road, Victoria Valley 0481
Legal Description:	LOT 1 DP 35169 (NA1558/22)

The activities to which this decision relates are listed below:

Retrospective Resource Consent for Emergency Works Undertaken under Section 330 of the RMA for the Establishment and Operation of a Clean fill Site in the Rural Production Zone, breaching Operative District Plan Rules 12.3.6.2 (Earthworks) and 12.7.6.1.3 (Preservation of Indigenous Wetlands), and Proposed District Plan Rule IB-R4 (Indigenous Vegetation Clearance Outside a Significant Natural Area), as a Discretionary Activity.

Conditions

Pursuant to sections 108 of the Act, this consent is granted subject to the following conditions:

1. The activity is carried out in general accordance with the approved plans:

   -Cleanfill cross sections and running totals of clean fill deposition. Prepared by Taiao Surveyors, dated November 2024 (Drawing #212702);
   -Erosion and Sediment Control Plan – Disposal Site Peria Valley Road, Drawing ESCP-003-01 and ESCP-003-02, prepared by CLL.
   -Wetland Assessment of the Proposed Soil Disposal Site at 184 Peria Valley Road, prepared by NZ Environmental Management Ltd, dated 21 November 2024.

   and attached to this consent with the Council’s “Approved Stamp” affixed to them.

2. Pursuant to section 128(1)(a) of the Resource Management Act 1991, the Far North District Council may, by serving notice on the consent holder, initiate a review of the conditions of this consent no earlier than six months after the date of issue, for any of the following purposes:

a. To address any additional adverse effects on the environment arising from the activity, including those identified through consents or requirements issued by the Northland Regional Council; or
b. To assess whether additional or amended conditions are necessary where the Regional Council consent process has triggered further rule breaches or regulatory requirements; or
c. To require the adoption of the best practicable option to avoid, remedy, or mitigate any such effects.

Advice Notes

Lapsing of Consent

1. *Pursuant to section 125 of the Act, this resource consent will lapse 5 years after the date of commencement of consent unless, before the consent lapses;*
   a) *The consent is given effect to; or*
   b) *An application is made to the Council to extend the period of consent, and the council decides to grant an extension after taking into account the statutory considerations, set out in section 125(1)(b) of the Act.*

Right of Objection

2. *If you are dissatisfied with the decision or any part of it, you have the right (pursuant to section 357A of the Act) to object to the decision. The objection must be in writing, stating reasons for the objection and must be received by Council within 15 working days of the receipt of this decision.*

Archaeological Sites

3. *Archaeological sites are protected pursuant to the Heritage New Zealand Pouhere Taonga Act 2014. It is an offence, pursuant to the Act, to modify, damage or destroy an archaeological site without an archaeological authority issued pursuant to that Act. Should any site be inadvertently uncovered, the procedure is that work should cease, with the Trust and local iwi consulted immediately. The New Zealand Police should also be consulted if the discovery includes koiwi (human remains). A copy of Heritage New Zealand's Archaeological Discovery Protocol (ADP) is attached for your information. This should be made available to all person(s) working on site.*

Reasons for the Decision

1. By way of an earlier report that is contained within the electronic file of this consent, it was determined that pursuant to sections 95A and 95B of the Act the proposed activity will not have, and is not likely to have, adverse effects on the environment that are more than minor, there are also no affected persons and no special circumstances exist. Therefore, under delegated authority, it was determined that the application be processed without notification.

2. The application is for a Discretionary activity resource consent as such under section 104 the Council can consider all relevant matters. In particular the matters listed in section 12.3.6.2 and 12.7.6.1.3 of the Operative District Plan are of particular relevance.

3. In regard to section 104(1)(a) of the Act the actual and potential effects of the proposal will be acceptable as:

   a. The earthworks have already been undertaken and involved the deposition of approximately 11,718m^3 of clean fill material within a indigenous wetland identified by the applicant. The activity was undertaken as emergency works under section 330 of the RMA in response to the Mangamuka Gorge slip event.
   b. The affected area does not meet the criteria for a Significant Natural Area under the District Plan. The ecological assessment concludes that the effects on the wider ecological context are less than minor.
   c. The project avoided a nearby kahikatea-rimu treeland wetland area which contained "at-risk" lichen species.
   d. The applicant explored alternative areas avoiding other areas of higher ecological significance. The subject site was selected as the best option. This demonstrated a commitment to minimising ecological impacts where possible,
   e. Erosion and sediment controls in accordance with GD05 standards were implemented during the duration of the earthworks.

   The proposal will also result in positive effects, including

   f. The cleanfill site enabled critical emergency response works for the remediation of State Highway 1 (SH1) through the Mangamuka Gorge, a regionally significant transport corridor. This supported the safe reopening of a lifeline route, restoring connectivity and resilience for the Te Hiku and wider Northland communities.
   g. The site's close proximity to the Gorge minimised the distance that trucks and heavy machinery needed to travel, reducing vehicle emissions and avoiding additional environmental impacts from haulage.
   h. Following the fill operation, the site was recontoured and returned to pasture. The deposited soil matched the existing Land Use Capability (LUC) and enhanced conditions for rural primary production such as pastoral grazing.

3. In regard to section 104(1)(b) of the Act the following statutory documents are considered to be relevant to the application:

   a. National Environmental Standards for Freshwater 2020 (NES-F)

   The NES-F is relevant to this application due to the modification and filling of a natural inland wetland, which meets the definition under Regulation 3. The activity potentially breaches:

   Regulation 38 – drainage of a natural wetland; and

   Regulation 54 – earthworks within or within 100 metres of a natural wetland.

   These provisions require regional consent where such activities are not permitted or excluded under specific conditions. While the NES-F is administered by Northland Regional Council and not enforced directly by the Far North District Council, the applicant is concurrently applying for the necessary consents from the Northland Regional Council. These regulatory breaches are not determinative for this land use consent, but they have been considered as part of the effects assessment under section 104(1)(a) of the RMA. Given the potential for additional conditions or constraints to arise from the regional consent process, a section 128 condition has been included to allow for review of this consent should any material changes or further rule breaches be confirmed through the NRC process.

b. National Policy Statement for Indigenous Biodiversity (NPS-IB)

The National Policy Statement for Indigenous Biodiversity (NPS-IB), which came into effect in 2023, sets out objectives and policies to protect, maintain, and restore indigenous biodiversity. While the NPS-IB primarily directs regional and district plan development, it is a relevant consideration under section 104(1)(b) of the Resource Management Act 1991.

In this case, the affected wetland area does not meet the criteria for a Significant Natural Area (SNA) and was assessed as being of low ecological value due to historical degradation and grazing. The higher-value kahikatea-rimu treeland wetland area, assessed as moderate ecological value, was avoided by revising the spoil footprint, consistent with the avoidance and minimisation steps in the effects management hierarchy.

Residual adverse effects on indigenous biodiversity have been assessed as Low to Very Low, and mitigation measures (such as retaining sediment controls and limiting encroachment near retained vegetation) are in place. The applicant's approach generally aligns with the intent of the NPS-IB to maintain and manage indigenous biodiversity values, particularly through avoidance of the more sensitive wetland features.

Therefore, the proposal is considered to be broadly consistent with the objectives and policies of the NPS-IB, especially considering its retrospective nature, the low biodiversity value of the affected area, and the retention of moderate-value wetland vegetation.

c. Operative Far North District Plan 2009

The site is zoned Rural Production under the Operative Far North District Plan. The key objectives and policies relevant to this proposal are contained within the Rural Environment (Chapter 8.6) and Natural and Physical Resources (Chapter 12). These provisions aim to enable productive rural activities while safeguarding ecological, landscape, and soil values. The following objectives were considered relevant to assess the proposal:

Chapter 8: Rural Production Zone:
Objectives: 8.6.3.1 | 8.6.3.2 | 8.6.3.3 | 8.6.3.4 | 8.6.3.5 | 8.6.3.6 | 8.6.3.7 | 8.6.3.8 |.
Policies: 8.6.3.9 | 8.6.4.1 | 8.6.4.2 | 8.6.4.3 | 8.6.4.4 | 8.6.4.5 | 8.6.4.6 | 8.6.4.7 | 8.6.4.8 | 8.6.4.9 |.

The Rural Production Zone seeks to enable a wide range of land use activities that support rural productivity, while ensuring that the character, amenity, and environmental values of rural areas are maintained.

The proposal is considered to be consistent with the relevant objectives and policies of this chapter. It supports the efficient use of rural land by facilitating the continued productive use of the site post-earthworks. The cleanfill operation did not result in fragmentation or loss of productive land, as the imported material was compatible with the existing land use capability and the site has been rehabilitated for future pastoral use.

The open rural character has been maintained, with earthworks integrated into the landform and the site being grassed following completion. The activity supported the repair of regionally significant infrastructure (State Highway 1), aligning with the broader purpose of rural connectivity and economic resilience.

Ecological values were considered, with the more sensitive kahikatea-rimu treeland wetland specifically excluded from the fill footprint. The proposal did not give rise to significant amenity, landscape, or natural character effects, due to the localised and temporary nature of the works and the limited visibility of the site. Cultural values were recognised through ongoing engagement with mana whenua and the presence of kaitiaki during the works.

Chapter 12 Natural and Physical Resources
Objectives: 12.1.3.3 | 12.1.3.4 |.
Policies: 12.1.4.5 | 12.1.4.6 | 12.1.4.8 | 12.1.4.10 |

This chapter seeks to ensure that natural resources are sustainably managed, and that activities such as earthworks avoid or mitigate adverse effects on indigenous biodiversity, ecosystems, and land stability.

The proposal aligns well with these outcomes. While the activity involved the filling of a inland indigenous wetland, it was assessed as having low ecological value. In contrast, the more ecologically significant area of wetland vegetation in the wider environment was retained and protected, demonstrating that the activity appropriately recognised and avoided adverse effects on key ecological features.

Erosion and sediment control measures were implemented in accordance with best practice guidelines and will remain in place until full revegetation is achieved, ensuring protection of downstream receiving environments. The land has been stabilised and returned to pasture use, maintaining its contribution to the rural land resource.

d. Proposed Far North District Plan 2022

Part 2 – District-Wide Matters. Natural environment values-Ecosystems and indigenous biodiversity

Objectives: IB-O1 | IB-O2 | IB-O3
Policies: IB-P1 | IB-P3 | IB-P4 | IB-P6 | IB-P8 | IB-P10 |.

The proposal aligns with Objective IB-O1, which seeks to maintain indigenous biodiversity and recognise its contribution to the district’s environmental well-being. While a putative indigenous wetland was affected, the site was assessed as having low ecological value and was not within a Significant Natural Area (SNA). Higher-value vegetation was avoided and protected, and sediment controls remain in place to prevent off-site impacts.

Objective IB-O2 requires activities to be managed to protect indigenous biodiversity from inappropriate use and development. The activity was temporary, responsive, and appropriately managed to minimise ecological impacts. Restoration and stabilisation have occurred, ensuring that long-term ecological integrity is not compromised.

Objective IB-O3 emphasises a precautionary approach to managing activities that may adversely affect indigenous biodiversity. The applicant engaged ecological experts and incorporated recommendations into the site design to avoid sensitive areas. The retrospective assessment further confirmed that the effects on biodiversity were low and appropriately mitigated.

Policy IB-P1 supports the identification and protection of indigenous biodiversity. In this case, ecological values were assessed pre- and post-activity. The proposal avoided more significant areas, such as the kahikatea-rimu treeland wetland, and conditions have been applied to protect these features.

Policy IB-P3 requires consideration of the values and functions of wetlands and associated habitats. While the filled wetland met the definition of an indigenous wetland, its degraded state and low ecological function were confirmed by ecological experts. The proposal responded by limiting disturbance and implementing sediment controls.

Policy IB-P4 directs the use of the effects management hierarchy. This was achieved by:

Avoiding the higher-value wetland area;

Minimising effects through targeted fill placement and controls;

Mitigating potential downstream impacts through erosion and sediment management.

Policy IB-P6 requires that adverse effects on indigenous biodiversity be managed to ensure no net loss. The ecological effects were assessed as Low to Very Low, and mitigation measures, including post-fill revegetation and protection of adjacent areas, support consistency with this policy.

Policy IB-P8 recognises the role of Tangata Whenua as kaitiaki. The proposal included engagement with mana whenua during the extend of the emergency works.

Policy IB-P10 is particularly important, as it enables activities that support critical infrastructure, including State Highway 1, provided adverse effects are appropriately managed. In this case, the cleanfill site was essential to the emergency repair works required to reopen the Mangamuka Gorge, which had been closed due to severe weather damage. The subject site was selected based on its proximity to the slip, reduced haulage distance, and limited ecological and land use conflicts. Among all evaluated options, it was the most suitable and least environmentally impactful location.

Weighting of the Operative and Proposed District Plans

For this resource consent application the relevant provisions of both an operative and any proposed plan must be considered. Weighting is relevant if different outcomes arise from assessments of objectives and policies under both the operative and proposed plans.

As the outcomes sought are the same under the operative and the proposed plan frameworks, no weighting is necessary.

4. In regard to section 104(1)(c) of the Act there are no other matters relevant and reasonably necessary to determine the application

5. Based on the assessment above the activity will be consistent with Part 2 of the Act. The activity will avoid, remedy or mitigate any potential adverse effects on the environment while providing for the sustainable management of natural and physical resources and is therefore in keeping with the Purpose and Principles of the Act. There are no matters under section 6 that are relevant to the application. The proposal is an efficient use and development of the site that will maintain existing amenity values without compromising the quality of the environment. The activity is not considered to raise any issues in regard to Te Tiriti o Waitangi.

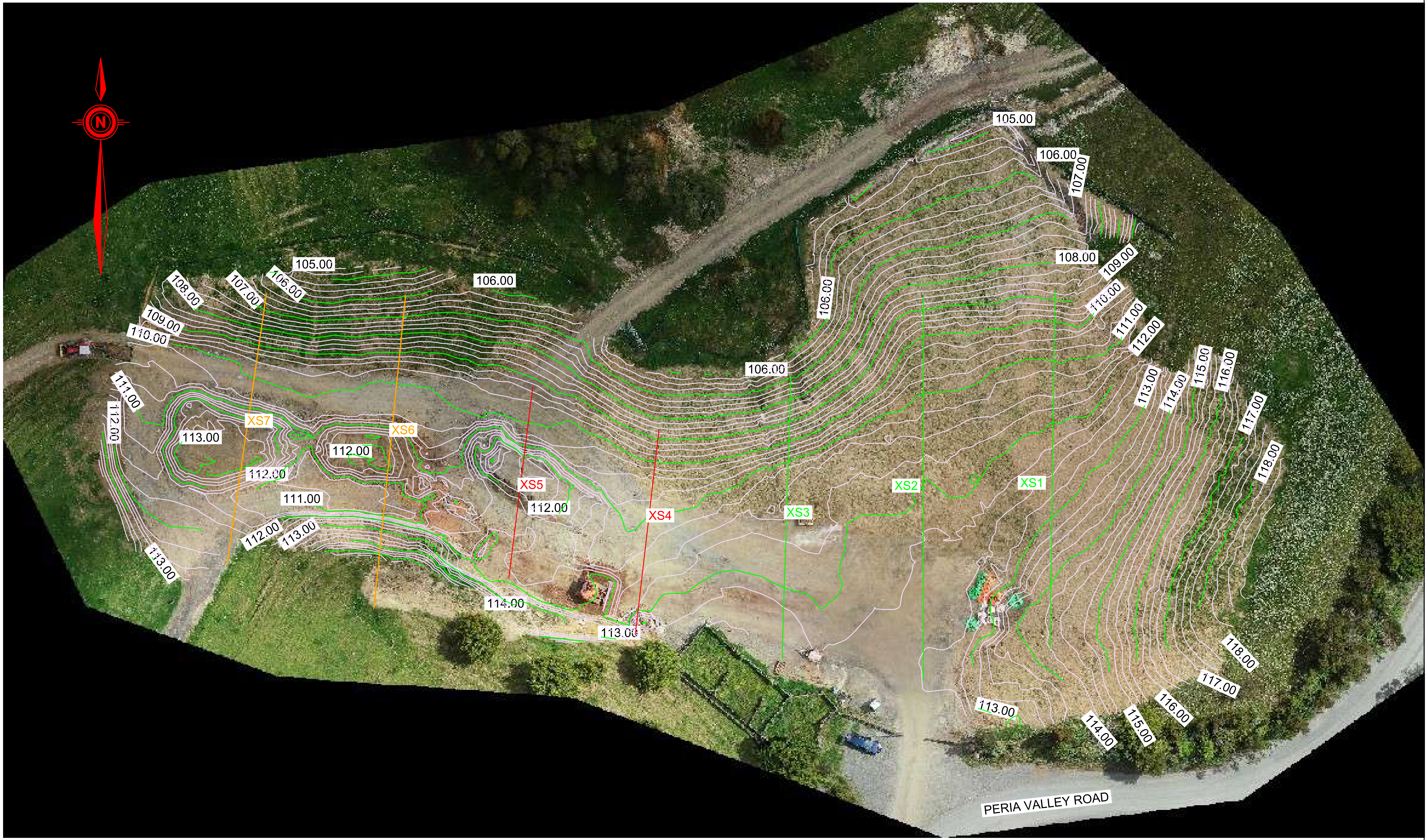
6. Overall, for the reasons above it is appropriate for consent to be granted subject to the imposed conditions.

Approval

This resource consent has been prepared by Diego Solarte, Resource Planner. I have reviewed this and the associated information (including the application and electronic file material) and for the reasons and subject to the conditions above, and under delegated authority, grant this resource consent.

Name: Nick Williamson **Date:** 25/03/2025

Resource Consents Team Leader



REVISION HISTORY:

#	DATE	DESCRIPTION	APPROVED
1			
2			
3			
4			

NOTES:

- Levels are in terms of NZVD2016
- Horizontal data is in MT EDEN2000
- All underground and above services may not be surveyed or shown on this plan.
- Please consult Service Providers before carrying out any excavation or construction.
- Taiao Surveyors accepts no responsibility for services omitted by this survey.
- Contours are at intervals.

Prepared By:

	BY	DATE
SURVEY	Various	28/11/2024
DRAWN	AR	05/11/2024
CHECKED	LS	06/11/2024
REVIEWED		

TAIAO SURVEYORS
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Email: taiaosurveyors@gmail.com

Client: WAKA KOTAHI

Agent: CLL

APPROVED PLAN

Planner: DGarcia
RC: 2250314-RMALUC
Date: 26/03/2025

TITLE:
Mangamuka Project - Cross Sections Location Plan for
Dumpsite at Peria Valley Rd, Victoria Valley

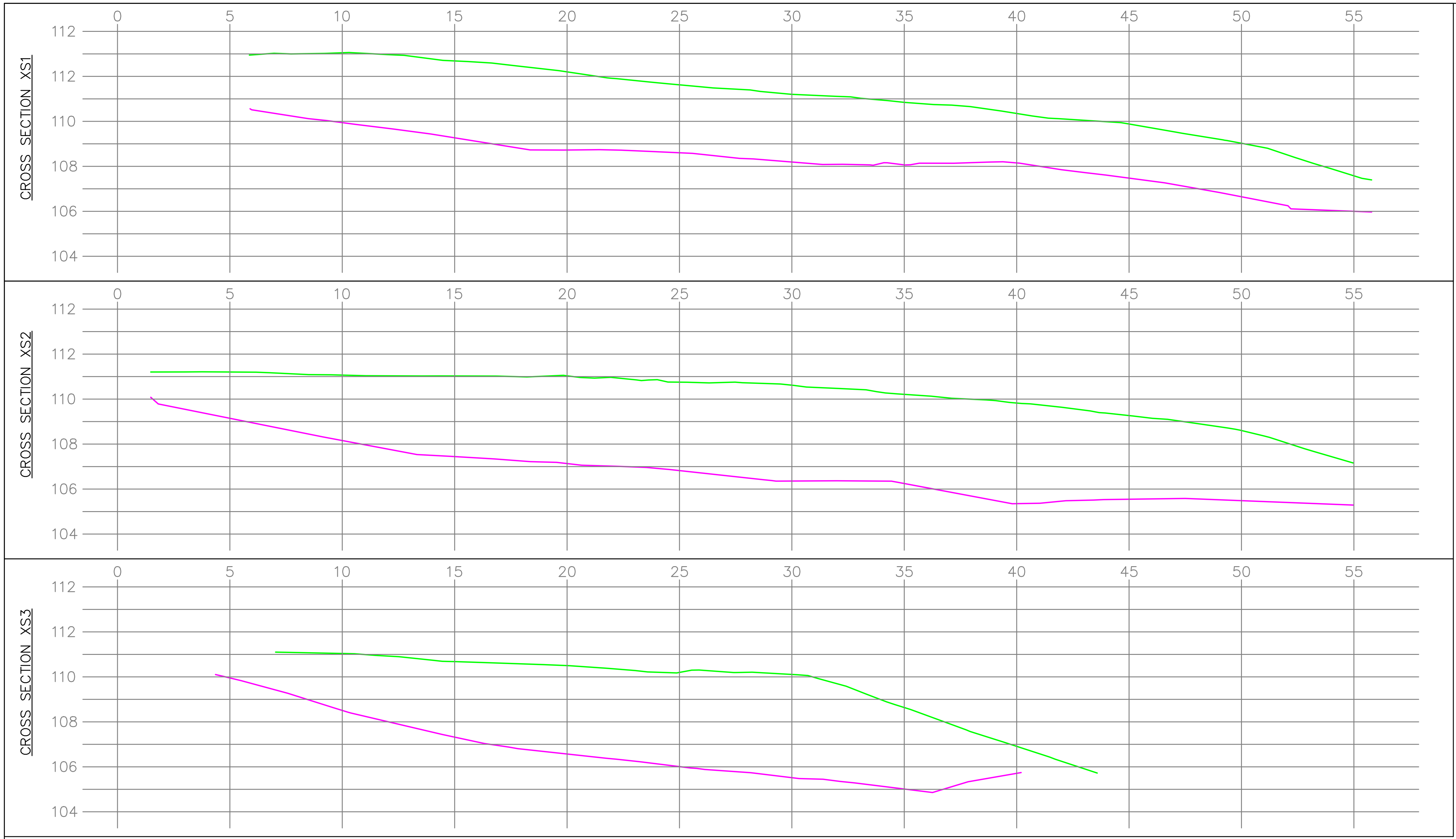
JOB:

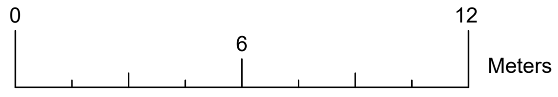
SHEET: 2

SCALE: 1:500 @ A3

PROJECT FILE: Data old

REVISION





LEGEND
- 28/11/2024 SURFACE
- 28/11/2024 SURFACE
- 28/11/2024 SURFACE
- 01/10/2024 SURFACE
- 05/06/2024 SURFACE

APPROVED PLAN

Planner: DGarcia
RC: 2250314-RMALUC
Date: 26/03/2026

REVISION HISTORY:

#	DATE	DESCRIPTION	APPROVED
1	-	-	-
2	-	-	-
3	-	-	-
4	-	-	-

NOTES:

- Levels are in terms of LINZ/DOSLI datum (One Tree Point 1964 Datum).
- Horizontal data is in MT. EDEN coordinate projection NZGD2000.
- All underground and above services may not be surveyed or shown on this plan.
- Please consult Service Providers before carrying out any excavation or construction.
- Taiao Surveyors Ltd. accepts no responsibility for services omitted by this survey.
- Contours are at 0.25m intervals.

Prepared By:

	BY	DATE
SURVEY	A RAMEKA	28/11/2024
DRAWN	L SANFT	04/12/2024
CHECKED	A RAMEKA	04/12/2024
REVIEWED	A RAMEKA	04/12/2024

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-
-

Agent:
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KUMEU 0810

TITLE:
NZ STATE HIGHWAY NO. 1
MAUNGAMUKA SLIP REPAIRS AND ROAD IMPROVEMENTS
PERIA VALLEY ROAD FILL SITE CROSS SECTIONS
PRE-CON SURFACES VS FINAL FILL SURFACE 28/11/2024

JOB: #212702
SHEET 1 of 2
SCALE: 1:200 @ A3
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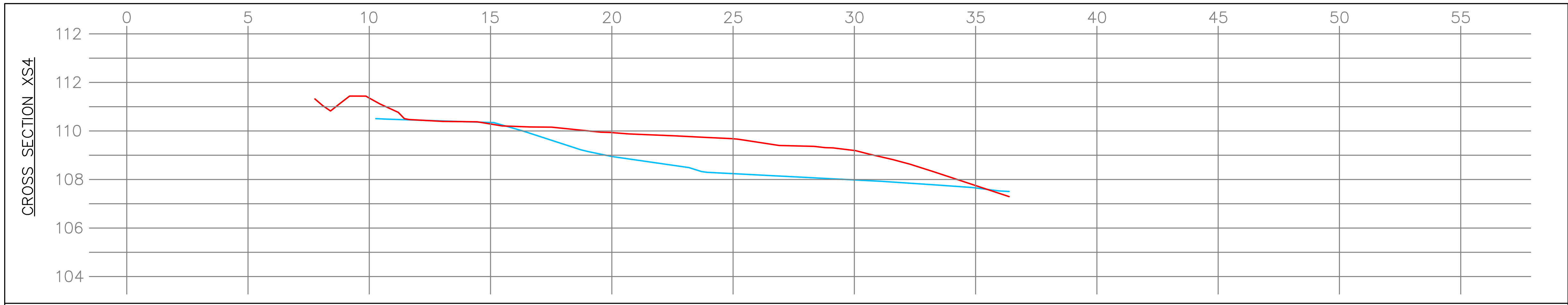
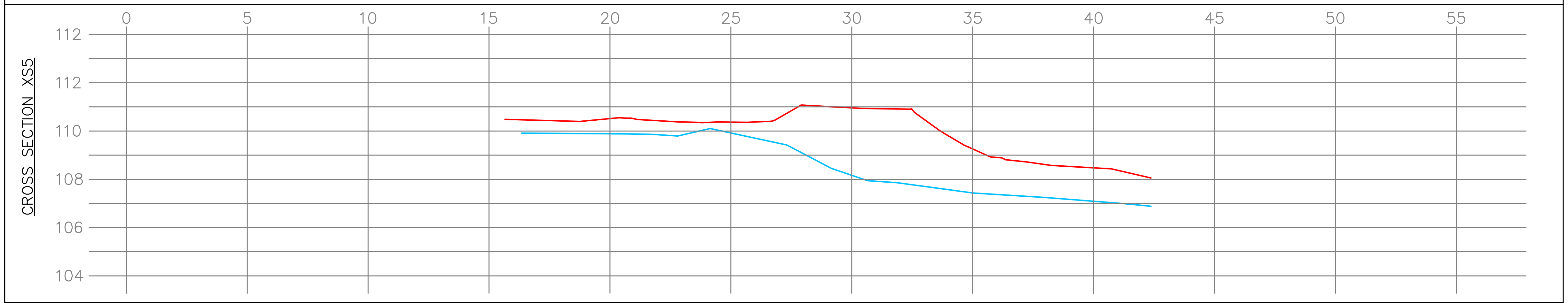
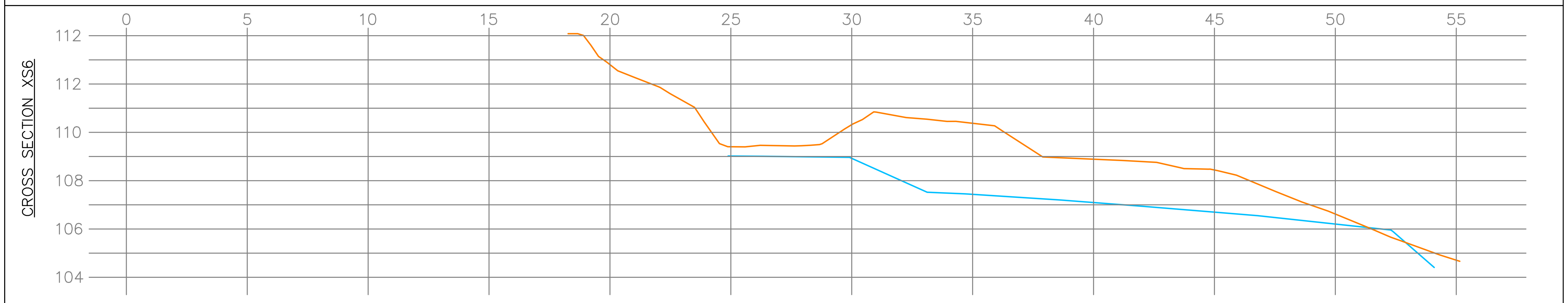
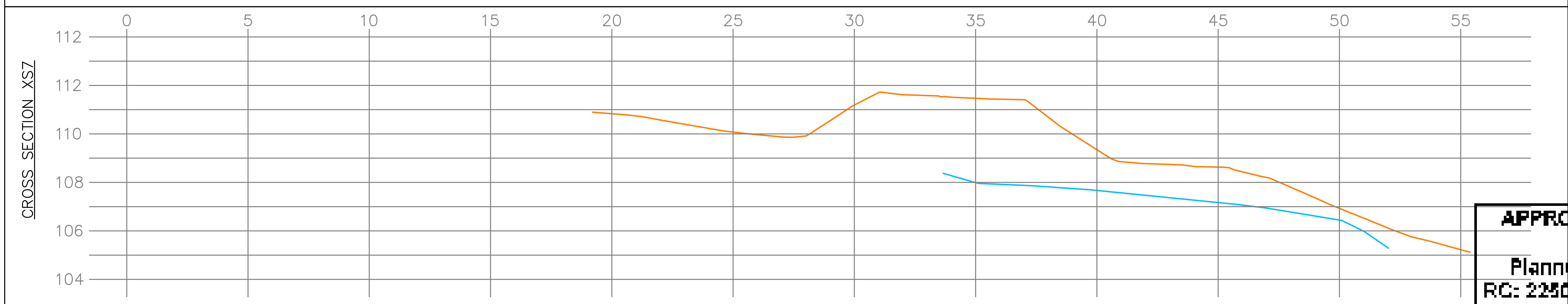
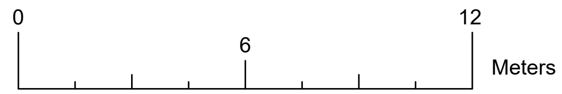
REVISION 0











LEGEND
28/11/2024 SURFACE
28/11/2024 SURFACE
28/11/2024 SURFACE
01/10/2024 SURFACE
05/06/2024 SURFACE

APPROVED PLAN
Planner: DGarcia
RC: 2250314-RMALUC
Date: 25/03/2025

REVISION HISTORY:

#	DATE	DESCRIPTION	APPROVED
1	-	-	-
2	-	-	-
3	-	-	-
4	-	-	-

NOTES:
- Levels are in terms of LINZ/DOSLI datum (One Tree Point 1964 Datum).
- Horizontal data is in MT. EDEN coordinate projection NZGD2000.
- All underground and above services may not be surveyed or shown on this plan.
- Please consult Service Providers before carrying out any excavation or construction.
- Taiao Surveyors Ltd. accepts no responsibility for services omitted by this survey.
- Contours are at 0.25m intervals.

Prepared By:

	BY	DATE
SURVEY	A RAMEKA	28/11/2024
DRAWN	L SANFT	04/12/2024
CHECKED	A RAMEKA	04/12/2024
REVIEWED	A RAMEKA	04/12/2024

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TITLE: NZ STATE HIGHWAY NO. 1
MAUNGAMUKA SLIP REPAIRS AND ROAD IMPROVEMENTS
PERIA VALLEY ROAD FILL SITE CROSS SECTIONS
PRE-CON SURFACES VS FINAL FILL SURFACE 28/11/2024

JOB: #212702
SHEET 2 of 2
SCALE: 1:200 @ A3
CAD FILE: 241204 PERIA VALLEY ROAD
REVISION 0

Peria Valley												
Month	Dec-23	Jan-24	Feb-24	Mar-24	Apr-24	May-24	Jun-24	Jul-24	Aug-24	Sep-24	Oct-24	Nov-24
Volume m3		250	100	75	47	1300	428	2240	1130	820	2900	1300
Running Total m3	5328	5578	5678	5753	5800	7100	7528	9768	10898	11718	14618	15918

APPROVED PLAN

Planner: DGarcia
RC: 2250314-RMALUC
Date: 26/03/2026

APPROVED PLAN
Planner: DGarcia
RC: 2250314-RMALUC
Date: 26/03/2026

NOTES

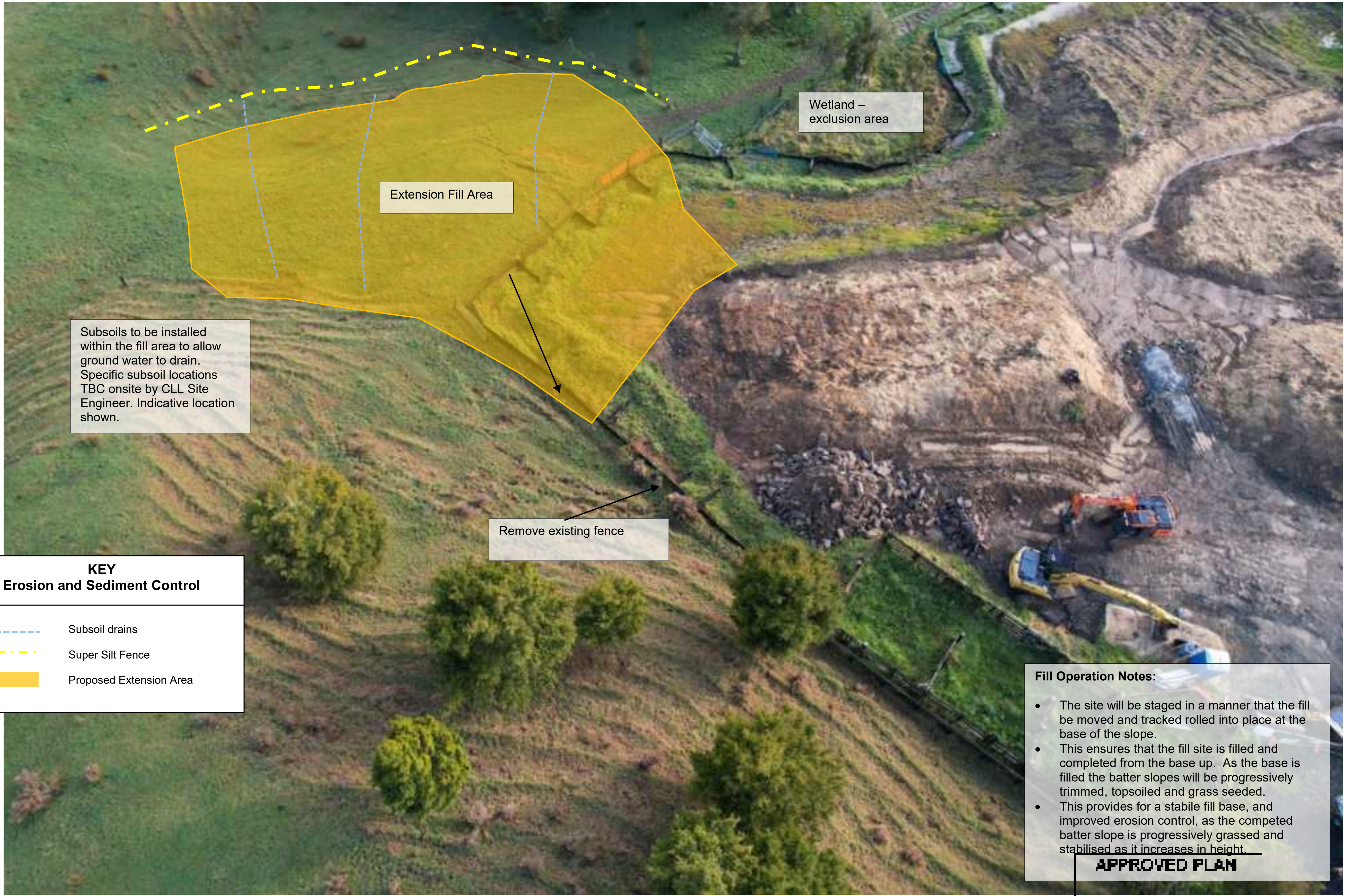
1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	16.05.23	Draft for review.	TH

CLL SERVICE & SOLUTIONS

Project	MAUNGAMUKA GORGE
Title	**Erosion and Sediment Control Plan – Disposal Site Peria Valley Road**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-003-01	01



KEY
Erosion and Sediment Control

Symbol	Description
Blue dashed line	Subsoil drains
Yellow dash-dot line	Super Silt Fence
Yellow fill	Proposed Extension Area

Fill Operation Notes:

- The site will be staged in a manner that the fill be moved and tracked rolled into place at the base of the slope.
- This ensures that the fill site is filled and completed from the base up. As the base is filled the batter slopes will be progressively trimmed, topsoiled and grass seeded.
- This provides for a stabile fill base, and improved erosion control, as the competed batter slope is progressively grassed and stabilised as it increases in height.

APPROVED PLAN
Planner: DGarcia
RC: 2250314-RMALUC
Date: 26/03/2026

NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	31.08.24	Draft for review.	TH

CLL SERVICE & SOLUTIONS

Project	**MAUNGAMUKA GORGE**
Title	**Erosion and Sediment Control Plan – Disposal Site Peria Valley Road - Extension**

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-003-02	01

Prepared for
WAKA KOTAHI NZ TRANSPORT AGENCY

WETLAND ASSESSMENT

OF THE PROPOSED SOIL DISPOSAL SITE AT 184 PERIA VALLEY ROAD

FINAL REPORT 2024

APPROVED PLAN

Planner: DGarcia
RC: 2250314-RMALUC
Date: 26/03/2026

NZ Environmental
Management

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SECTIONS

APPENDICES

APPROVED PLAN

Planner: DGarcia
RC: 2250314-RMALUC
Date: 26/03/2026

DOCUMENT CONTROL

NZEM Quality System:

Document Reference	p:/ Projects/North Island/2024 Mangamuka
Report Revision	3
Report Status	Final
Prepared by	Joana Unteregger, Tim Martin
Reviewed by	Tim Martin
Approved by	Grace Henty
Date created	21 November 2024
Date Issued	21 November 2024

PERSONNEL

Joana Unteregger – Ecologist

Joana Unteregger is a plant ecologist, with a background in environmental science and biosecurity. She holds a BSc (in environmental science, ecology and biodiversity, 2018), and a MSc (Research) degree from the University of Waikato (Environmental Science, 2021). Her thesis investigated the flowering phenology of mānuka in Aotearoa, New Zealand. Joana conducts a variety of ecological and wetland assessments, and prepares Planting, Weed, and Pest Management Plans.

Tim Martin – Principal Ecologist

Tim Martin is an ecologist with over 20 years experience in terrestrial and aquatic habitat and biodiversity surveys, environmental impact assessment (including large scale infrastructure projects), sustainable land use, and biodiversity management. Tim has worked on roading projects throughout North Island, including Waikato Expressway, Puhoi to Warkworth, Otaki to North Levin, Mount Messenger, and the Manawatu Gorge Bypass. He has a PhD in Environmental Science from the University of Auckland (2007). For his thesis he researched forest dynamics and disturbance in the mountains of central and southern North Island. Tim has extensive experience in New Zealand and the Asia-Pacific Region, including Indonesia, Solomon Islands, Vanuatu, Fiji, Samoa, and Cook Islands. Northland is home for Tim and he is recognized for his excellent local knowledge of Northland ecosystems, flora, and fauna. He has worked on many projects across Te Tai Tokerau, including wetland delineation, mapping, and ranking, mapping kauri forests for the entire region, and identification of gumland ecosystems.

1. INTRODUCTION

1.1 BACKGROUND

Waka Kotahi NZ Transport Agency is conducting emergency works in the Mangamuka Gorge, State Highway 1, repairing more than 25 slips. As part of the slip repairs of Nationally and Regionally Significant Infrastructure, soil is being removed from the affected slip areas into soil disposal sites. However, due to kauri dieback (caused by the pathogen *Phytophthora agathidicida*) the movement of soil from within and around potentially infected kauri forest creates a significant risk of infecting other forests and kauri populations. To avoid and mitigate the risk of moving the pathogen throughout the region, NZ Transport Agency propose to keep the soil disposal sites within the catchment that the soil originated from.

In addition to the above risks, topography of the land must be suitable for soil disposal to ensure that soil does not move and negatively impact other areas. Due to these constraints, NZ Environmental Management Limited (**'NZEM'**) was retained by Stellar Projects on behalf of NZ Transport Agency to conduct an ecological assessment, with specific regard to any wetlands, of the area proposed for soil disposal/fill (**'the Site'**) at 184 Peria Valley Road, Northland (legally described as Lot 1 DP 35169) (Figure 1-1).

Figure 1-1 shows the extent of the winter and summer works areas, highlighting the erosion and sediment controls which will be implemented for the life of the disposal site.

The Site will continue to be utilised as a grazing area post the completion of works.

Figure 1-1: Map and scheme plan of the existing and proposed soil disposal site at 184 Peria Valley Road, Northland.

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2. METHODS

2.1 FIELD SURVEYS

Field surveys were undertaken on the 31 May 2023 by Joana Unteregger and Ashlee Deeming, and on 28 August 2023 by Tim Martin. The proposed soil disposal site was walked, all species seen were recorded and identified, and vegetation and habitats were described and mapped. Representative photographs were taken of habitats at the site. The vegetation and any putative wetlands were assessed against the relevant tests and definitions of the National Policy Statement for Freshwater Management 2020 (**'NPS-FM'**), National Environment Standards for Freshwater 2020 (**'NES-FW'**), and the Ministry for the Environment Pasture Exclusion Assessment Methodology (2022). The putative wetlands were also assessed against the 'Indigenous Wetland' definition in the Far North District Plan (**'FNDP'**) (Appendix **I**).

2.2 ASSESSMENT

The EIANZ Ecological Impact Assessment (**'EcIA'**) Guidelines (Roper-Lindsay et al., 2018) were used as a guide to assess value to species and habitats, determine ecological effects of the proposal, assess the magnitude of the effect of the proposal, and to determine the overall level of ecological effects, after any mitigation actions have been completed. Summaries of the EcIA criteria are listed in the Appendix **II**.

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3. ECOLOGICAL CONTEXT

3.1 ECOLOGICAL DISTRICT

The Site is located in the Maungataniwha Ecological District (**'ED'**) and Northland Ecological Region (McEwen 1987, Brook 1996). The Maungataniwha ED encompasses approximately 101,900 ha and is bordered by five other EDs: Whangaroa ED to the east, Puketi ED to the south, Hokianga ED to the southwest, Ahipara ED to the west, and Aupouri ED to the north.

Conning (2000) mapped and described areas of indigenous natural vegetation within the Maungataniwha ED, and also provided an analysis of the main vegetation types, threatened species, and other taxa of scientific interest present in the district, as part of the Protected Natural Areas Programme (**'PNAP'**) in 1994 and 1995. Maungataniwha ED is distinctive for the high number of small, fragmented remnants of natural forests and shrubland, and is characterised by the extensive linkages between areas of indigenous vegetation. The natural areas identified comprise approximately one-third of the ED, of which 66% are forest, 31% shrubland, 2.5% estuarine and less than 1% are wetland (Conning, 2002).

The Site does not contain any Recommended Areas for Protection (**'RAPs'**). The closest RAPs are approximately 1 km away (Victoria Valley Road: PNA O04/063 in the west, and Tracey/Edwards Roads: PNA O04/114 to the east). The nearest areas of indigenous vegetation to the Site are stands of secondary kahikatea (*Dacrycarpus dacrydioides*) forest in gullies immediately to the north of the proposed spoil disposal area. These forest stands have severely limited and degraded understoreys due to stock grazing.

3.2 ECOLOGICAL SETTING

The Site comprises a small, shallow basin surrounded by gently rolling to steeply rolling hills dominated by pasture grasses. To the south of the spoil site is Peria Valley Road, and to the north is a farm track. The existing and proposed spoil site comprises exotic grassland on hillslope, and a wetland in a hillslope seepage. The farm track along the northern edge of the proposed spoil site may be locally increasing soil moisture along the lower edge of the hillslope seepage wetland.

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4. VEGETATION AND HABITATS

4.1 VEGETATION TYPES

4.1.1 Exotic Grassland on Hillslope

Rapid visual assessment confirmed that most of the spoil disposal area is exotic grassland on hillslopes. This grassland is dominated by kikuyu (*Cenchrus clandestinus*), paspalum (*Paspalum urvillei*), parsley dropwort (*Oenanthe pimpellinoides*), and buttercup (*Ranunculus repens*) with occasional gorse (*Ulex europaeus*) (Plate 4-1).

Plate 4-1: Overview of the Site, showing exotic grassland on hillslope (foreground) and hillslope seepage (right of centre).

4.1.2 Wīwī-Spike Sedge Rushland on Hillslope Seepage (1,365 m^2)

The lower hillslope within the spoil disposal site is a hillslope seepage wetland (Plate 4-2). This area meets the definition of a wetland provided in the Resource Management Act 1991, as it comprises "permanently or intermittently wet areas… that support a natural ecosystem of plants and animals that are adapted to wet conditions". This wetland type occurs on sloping ground where the groundwater levels are close to or at the ground surface, resulting in permanently wet soils (Wildland Consultants, 2012). The hydrophytic vegetation in this seepage (Figure 4-1) meets the tests and definitions of a natural inland wetland in the NPS-FM and NES-FW. Whilst the lower edge of the wetland may have higher water levels due to the construction of an adjacent farm race, the wetland is on a sloping surface, and most of the wetland lies at a higher elevation than this race and is not there due to this artificial impoundment. Additionally, the water source does not exclude this wetland as a natural inland wetland as the site has a permanently high water table that interacts with the ground surface (vs. the alternative of only being subject to temporary rain-derived water pooling). The wetland is dominated by two indigenous species, wīwī (*Juncus edgariae* – facultative wetland species) and spike sedge (*Eleocharis acuta* – obligate wetland species) (Plate 4-2). Mercer grass (*Paspalum distichum*), and soft rush (*Juncus effusus* var. *effusus*) are also present, and exotic grasses increase in abundance towards the drier top edge of the wetland.

Plate 4-2: Hillslope seepage wetland within the spoil disposal area. The vegetation is dominated by wīwī (*Juncus edgariae*), and spike sedge (*Eleocharis acuta*) is common.

Due to the abundance of wīwī and spike sedge, the cover of indigenous species is greater than 50%, and most of the wetland meets the definition of an indigenous wetland in the Far North District Plan (Appendix I).

Smaller areas along the top edge of the wetland are likely to have been more dominated by grasses, including exotic species, prior to spoil deposition. These areas are likely to have not met the definition of indigenous wetland under the Far North District Plan.

4.1.3 Kahikatea-rimu Treeland in Hillslope Seepage (35 m^2)

Near the northwest edge of the hillslope seepage wetland is a small area of kahikatea-rimu treeland. This treeland comprises seven kahikatea and two rimu (*Dacrydium cupressinum*) (Summer Fill Area, Figure 1-1). Many of these trees exhibited late-stage symptoms of disease and/or overall stunted growth and ill-health (Plate 4-3). Whilst small, this treeland meets the definition of an indigenous wetland in the Far North District Plan (Appendix I).

Plate 4-3: Kahikatea-rimu treeland on the northwest edge of the hillslope seepage wetland.

Figure 4-1: Map of vegetation and habitats at the proposed soil disposal site at 184 Peria Valley Road, Northland.

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4.1.4 Wetland areas of the wider catchment area

A desktop map was produced of wetland areas in the wider catchment area, using Google Earth imagery.

Figure 4 1: Desktop map of wetland habitats in the catchment of the spoil site. The wetland within the spoil site is shown in blue. Additional wetland areas are likely present but concealed from view by tree canopy.

4.2 FLORA

The Site is known to support one ‘At Risk’ species. The kahikatea in the kahikatea-rimu treeland is habitat for an epiphytic lichen, *Teloschistes flavicans*, which has a conservation status of ‘At Risk-Declining’ (Plate 4-4) (de Lange et al., 2018). The lower trunks of the trees supported at least 10 plants (Plate 4-5), and additional plants may be present in the upper canopy. A second survey was undertaken on 14 September 2023 to determine the size of the local *Teloschistes* population on trees on the same property. The survey found a further c. 90 individuals, spread across 16 other kahikatea within 250 m of the spoil disposal site. This is a conservative estimate of the size of the wider population, as the lichen favours canopy habitats and only trees on the edges of forest remnants could be observed.

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Plate 4-4: T. flavicans (gold-coloured lichen) on kahikatea tree in hillslope seepage wetland within proposed spoil site.

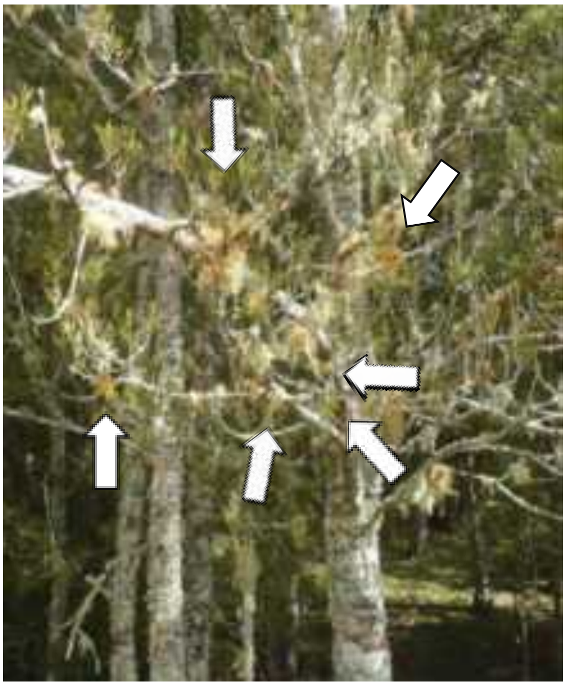

Plate 4-5: T. flavicans (gold-coloured lichen) on kahikatea trees in forest immediately

4.3 FAUNA

During the site visits, three bird species were observed, the introduced skylark (*Alauda arvensis*) and myna (*Acridotheres tristis*), and the native kāhu (swamp harrier, *Circus approximans*, Not Threatened) (Robertson et al., 2021). Lizards, and in particular indigenous skinks, are not likely to be present in the footprint of the proposed spoil site.

Aside from the small size of the wetland and its degradation by grazing, the wetland lacks the habitat components typically associated with Threatened or At Risk bird species that can utilise smaller wetlands within pasture areas. The wetland lacks pools of open water, the key feeding habitat for matuku-hūrepo (Australasian bittern, Threatened – Nationally Critical), the wetland lacks dense stands of taller reeds such as raupo, the typical habitat of pūweto (spotless crake, At Risk – Declining), and the wetland lacks a shrub tier, which is an important structural component of habitats where mātātā (North Island fernbird, At Risk -Declining) are usually found. The long history of grazing, and the low structural and compositional diversity of the wetland, mean that the only common wetland birds such as pukeko and putangitangi (paradise shelduck) are likely to utilise the habitat provided by the wetland.

Long-tailed bats (Threatened – Nationally Critical) could be present in the catchment. Long-tailed bats can forage over farmland, including pasture, streams and wetland areas, and are known to roost in larger, older trees with cavities or flaking bark.

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5. ASSESSMENT OF ECOLOGICAL VALUES, SIGNIFICANCE, AND EFFECTS

5.1 ECOLOGICAL VALUES

5.1.1 Hillslope Seepage Wetland

The hillslope seepage wetland has been severely degraded by historic vegetation clearance, followed by a long history of grazing. This wetland, prior to human modification, was most likely swamp forest, dominated by kahikatea, with pukatea (*Laurelia novae-zelandiae*) and maire tawake (swamp maire; *Syzygium maire*) also potentially present as canopy trees. Currently, most of the wetland has a cover of wetland rushes and grasses. Two indigenous species, wīwī and spike sedge, remain dominant as these can persist in grazed habitats. The wetland retains a small stand of kahikatea and rimu, that likely regenerated at a time when the site reverted to scrub, before clearance reinstated grassland and rushland over most of the proposed spoil site. These trees are habitat for *Teloschistes flavicans*, a lichen species with a conservation status of 'At Risk-Declining'. The wīwī-spike sedge rushland in hillslope seepage is of Low ecological value. The kahikatea-rimu treeland in the hillslope seepage is of Moderate ecological value.

5.1.2 Exotic Grassland on Hillslope

The grassland on the hillslope is almost solely comprised of exotic plant species. The grassland would provide some habitat value for highly mobile indigenous birds, such as pūkeko and kāhu, that favour modified open habitats. Exotic grassland is the most common habitat type in the local landscape and has Negligible ecological value.

5.2 ASSESSMENT OF SIGNIFICANCE

The two wetland vegetation types were assessed for significance (Table 5-1). using the criteria in Appendix 5 of the Regional Policy Statement for Northland (2016). Significance is met if the indigenous vegetation meets one or more of the four criteria. Some of the criteria provide sub criteria and the site is significant if any of the sub criteria are met (e.g. Representativeness 1 a or b) whereas the criteria for Rarity Distinctiveness includes four sub criteria all of which must be met (a, b, c, and d). Neither of the two wetland vegetation types were assessed as Significant.

Table 5-1. Assessment of significance for wetland habitats at the project site.

	Wīwī-spike sedge rushland in hillslope seepage wetland	Criteria met (yes/no)	Kahikatea-rimu treeland in hillslope seepage wetland	Criteria met (yes/no)
1. Representativeness (a) Indigenous vegetation and typical of what existed c. 1840, or representative of fauna expected for the habitat type, or (b) Large example or a good example of its type	1 (a) Degraded vegetation induced by grazing. (b) not a large or good example	No	1 (a) Degraded vegetation induced by grazing. (b) not a large or good example	No
2. Rarity/distinctiveness (a) Acutely or Chronically Threatened land environments or trigger Appendix 5 Criteria or exceed 0.05 ha (for seepage wetlands) (b) Supports rare, threatened or uncommon species	2 (a) Yes - a seepage wetland larger than 0.05 ha (b) No rare, threatened or uncommon species recorded (c) No Northland	No. Meets 2 (a) and (d) but not (b) and (c). Does not meet all components for Criteria 2.	2 (a) Yes - a seepage wetland larger than 0.05 ha (b) Yes – an At Risk lichen species is present (c) No Northland endemics or species at limits	No. Meets 2 (a), (b) and (d) but not (c). Does not meet all components for Criteria 2.

	Wīwī-spike sedge rushland in hillslope seepage wetland	**Criteria met (yes/no)**	**Kahikatea-rimu treeland in hillslope seepage wetland**	**Criteria met (yes/no)**
(c) Contains vegetation or taxa endemic to Northland or at distributional limits (d) Vegetation or taxa of restricted occurrence or originally rare ecosystem, or naturally rare or recognised by NZ Marine Protected Areas Policy	endemics or species at limits (d) Yes, seepages are a naturally rare ecosystem type		(d) Yes, seepages are a naturally rare ecosystem type	
3. Diversity and pattern (a) Vegetation or habitat with high diversity (b) Composition reflects diverse features or ecological gradients or (c) Ecological sequences	3 (a) low diversity due to grazing impacts, (b) limited compositional changes, (c) no ecological sequences	No	3 (a) low diversity due to grazing impacts, (b) limited compositional changes, (c) no ecological sequences	No
4. Ecological Context (a) Important linkage or network, important buffering, or (b) Important role for protecting the function of other sites, or (c) Important habitat for a critical life history stage for indigenous fauna.	4 (a) limited linkage value due to degraded habitats, small size, and catchment position (upper edge). (b) Limited role in protection of other sites due to small size and degraded nature. (c) not important habitat for a critical life stage	No	4 (a) limited linkage value due to degraded habitats, small size, and catchment position (upper edge). (b) Limited role in protection of other sites due to small size and degraded nature. (c) not important habitat for a critical life stage	No
Area is significant?	No		No	

5.3 ASSESSMENT OF ECOLOGICAL EFFECTS

Following completion of a preliminary ecological assessment, the footprint of the proposed spoil site was revised to avoid the small stand of kahikatea and rimu in the hillslope seepage wetland, that was assessed as of Moderate ecological value. This revision, whilst small, avoids any significant impact on an indigenous lichen species that is “At Risk-Declining".

The revised footprint of the proposed spoil site will fill the gully head, resulting in the loss of most of this hillslope seepage wetland, and a larger area of surrounding exotic grassland. Without avoidance and or mitigation, the potential adverse effects of revised spoil disposal at this site include:

- Loss of wetland habitats
- Sedimentation of downstream aquatic habitats.

This assessment of level of effects has been undertaken at the scale of the wetland system affected by the proposal, which extends through several gully heads to the north of the spoil site, before converging at a farm pond approximately 250 metres to the northwest.

Whilst degraded by vegetation clearance and grazing, loss of an upper reach of this wetland will still result in localised habitat loss for common wetland species (e.g. pukeko; *Porphyrio melanotus*, Not Threatened), and the lost opportunity to restore this portion of the wetland to higher value wetland habitats. Higher value wetland habitats occur nearby (e.g. kahikatea forest on seepages, raupo reedland), and these provide a greater extent of higher quality habitat for the wetland species present in this catchment. The unmitigated level of effect on wetland habitat and wetland species within the wider catchment is assessed as Low for the wīwī-spike sedge rushland.

Without best practice sediment control practices, disposal of spoil of this site could increase sedimentation of aquatic and wetland habitats downstream of the Site. If the Site was subject to a catastrophic failure of the spoil site, this sedimentation could be at a scale that leads to the loss of downstream wetland habitat (through rapid infilling).

Using EcIA guidelines, and without any avoidance and or mitigation measures, the level of effect will or has been Very Low to Moderate, depending on the habitat or species impacted (Roper-Lindsay et al., 2018). The potential adverse impacts of the project are summarised in Table 5-1.

Table 5-2: Habitat type and species, ecological value, magnitude of loss, and level of effect (unmitigated) for habitats and species at the spoil site.

Habitat type/species	Ecological Value	Magnitude of Effect	Level of Unmitigated Effect
Wīwī-spike sedge rushland in hillslope seepage wetland	Low	Moderate	Low
Kahikatea-rimu treeland in hillslope seepage wetland	Moderate	Low (due to revision of spoil site to exclude this area)	Low
Aquatic habitats and kahikatea wetlands downstream of spoil site	Moderate	Moderate	Moderate
Exotic grassland	Negligible	Low (under assumption that grassland is reestablished on the completed spoil site)	Very Low
Teloschistes flavicans	Moderate	Low (as this species is present on kahikatea to the south)	Low

5.4 OPPORTUNITIES TO MANAGE ECOLOGICAL EFFECTS

To address the ecological effects of the spoil disposal area at 184 Peria Valley Road the following actions should be implemented:

- Sediment be controlled during the preparation and use of the soil disposal site by implementing the GD05 guidelines.
  - A silt fence should be erected to protect the small stand of kahikatea and rimu trees within the wetland, and the forest remnant and wetlands immediately to the north.
  - After, and where appropriate during, the life of the soil disposal site, the bare soil should be grassed to stabilise the soil, preventing erosion.
- The small stand of kahikatea-rimu in the wetland has been excluded from the final soil spoil disposal area. The spoil disposal area should come no closer than 3 metres from the trunks of the closest trees.
- For Low adverse effects that cannot be avoided, the EcIA guidelines (5.1.84) note that design and construction should minimise adverse effects; however, revision of the design to avoid the wetland area was not feasible.

- With the mitigation described in Table 5-2 below, the adverse ecological effects on habitats of the catchment will be Low or Very Low.
- The EcIA guidance (p. 85) equates a very low level of effect with "not more than minor".

Table 5-1: Habitat type, level of effect (unmitigated) for the catchment, proposed mitigation, and level of residual effects.

Habitat type	Level of Unmitigated Effect	Mitigation	Residual Level of Effect
Wīwī-spike sedge rushland in hillslope seepage wetland	Low	Almost all of this wetland lost. No mitigation possible.	Low
Kahikatea-rimu treeland in hillslope seepage wetland	Low	Retain trees	Very Low
Aquatic habitats	Moderate	Best practice sediment control	Low
Exotic grassland	Very low	N/A	Very Low
Teloschistes flavicans	Low (as trees retained)	Excluded from spoil site.	Very Low

APPROVED PLAN

Planner: DGarcia
RC: 2250314-RMALUC
Date: 26/03/2026

6. CONCLUSIONS

To avoid potentially spreading kauri dieback contaminated soil throughout the region, Waka Kotahi NZ Transport Agency constructed a soil disposal site within the catchment to accommodate the works and soil removal required for the Mangamuka Gorge slip repairs on State Highway 1 (Emergency work on Nationally Significant Infrastructure).

The Site at 184 Peria Valley Road contains areas of hydrophytic vegetation which meet the tests and definitions of a natural inland wetland in the NPS-FM and NES-FW. The wetland vegetation is a hillslope seepage and meets the definition of an Indigenous Wetland in the Far North District Plan but does not meet the criteria for Significant Indigenous Wetland.

Final design of the spoil site has excluded the small area of kahikatea-rimu treeland on the northwest edge of the spoil site. By revision of the footprint of the spoil site, indigenous wetland vegetation of Moderate ecological value will be avoided, and the effects of habitat removal on an At Risk-Declining lichen species will also be avoided. Under this scenario, the residual adverse effects of the proposed spoil site were assessed as Low or Very Low for terrestrial habitats, Very Low for an At Risk lichen species, and for Low or Very Low wetland vegetation. Whilst it is recognised that the project will result in the loss of a hillslope seepage wetland, the ecological value of this area, considering its local context, is Low, and the residual effects of its loss are also Low.

APPROVED PLAN

Planner: DGarcia
RC: 2250314-RMALUC
Date: 26/03/2025

7. REFERENCES

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APPENDIX

Appendix I: Far North District Plan: Definition of an Indigenous Wetland

An indigenous wetland is any naturally occurring wetland of 50m^2 or more (with a minimum width of 5m) which is permanently or seasonally wet (in that the water table is at or near the ground surface during high water table conditions) and which is dominated by indigenous wetland plant species including all or some of the following:

a) raupo;
b) flax;
c) sedge associations;
d) kahikatea;
e) cabbage tree;
f) manuka/kanuka on peatlands;
g) mangrove and saltmarsh;
h) kuta

For the purposes of this Plan, indigenous wetlands that have been created for conservation purposes, as a requirement of a resource consent, are included within the definition of "indigenous wetlands". The definition excludes wetlands created and subsequently maintained principally for or in connection with:

a) effluent treatment and disposal systems; or
b) stormwater management; or
c) water storage; or
d) other artificial wetlands, water courses or open drains.

The definition also excludes:

a) trees with a pasture understorey; or
b) exotic rush/pasture communities;
c) or land which has been modified to the extent that it is no longer ecologically viable

Appendix II: Assessment of Effects Methodology (Roper-Lindsay et al., 2018)

The Ecological Impact Assessment (EcIA) guidelines consider the factors set out in Table 1 when assigning value to species.

Once the overall level of ecological effects is determined the requirement and types of mitigation can be considered.

Table 1: Assigning value to species according to the EcIA guidelines.

Determining Factors	Value Ascribed
Nationally threatened species found within the project's zone of influence, either permanently or seasonally	**Very high**
Species listed as threatened or at risk (declining) found within the project's zone of influence, either permanently or seasonally	**High**
Species listed as any other category of "at risk" found in the project's zone of influence either permanently or seasonally	**Moderate**
Locally uncommon (within the ecological district) or distinctive species present	**Moderate**
Nationally and locally common indigenous species present	**Low**
Exotic species, including pest species present, having recreational value	**Negligible**

APPROVED PLAN

Planner: DGarcia
RC: 2250314-RMALUC
Date: 26/03/2026

Table 2: Descriptors for the magnitude of ecological effects according to EcIA guidelines.

Magnitude	Description
Very high	Total loss of, or very major alteration to, key elements or features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; and/or Loss of a very high proportion of the known population or range of the element/feature
High	Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; and/or Loss of a high proportion of the known population or range of the element/feature
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; and/or Loss of a moderate proportion of the known population or range of the element or feature
Low	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes will be similar to pre-development circumstances or patterns; and/or Having a minor effect on the known population or range of the element/feature
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; and/or Having negligible effect on the known population or range of the element/feature

Table 3: EcIA criteria for describing the overall level of ecological effects.

Ecological value / Magnitude	Very high	High	Moderate	Low	Negligible
Very High	Very high	Very high	High	Moderate	Low
High	Very high	Very high	Moderate	Low	Very low
Moderate	High	High	Moderate	Low	Very low
Low	Moderate	Low	Low	Very low	Very low
Negligible	Low	Very low	Very low	Very low	Very low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain

APPROVED PLAN

Planner: DGarcia
RC: 2250314-RMALUC
Date: 26/03/2026

APPENDIX K Southern Fill Site Approved Regional Resource Consents

Northland REGIONAL COUNCIL
Te Kaunihera ā rohe o Te Taitokerau

Application Number: APP.046377.01.01

Application Type: Non-notified New

Applicant Name: New Zealand Transport Agency - Waka Kotahi

Note: *In this decision document, "application", "activity" and "consent" refer to all activities that are part of the consent application.*

REASONS FOR THE DECISION

This consent is granted pursuant to Section 104B of the Resource Management Act 1991 (the Act). In reaching this decision, the council has considered the matters outlined in Part 2 and Section 104 of the Act. It has been determined that:

(1) The adverse effects of the proposed activity on the environment will be no more than minor.

(2) The proposed activity is consistent with the relevant statutory planning documents and regulations.

(3) The granting of this resource consent achieves the purposes of the Act.

Summary of Activity

Background

In August 2022, Northland was impacted by a severe weather event resulting in a large number of landslides through the Mangamuka Gorge on State Highway 1 making it impassable. As the relevant authority, the New Zealand Transport Agency (NZTA) Waka Kotahi (the Applicant) established the *'Mangamuka Slip Response Project 2022'* to progress the remedial works required to reopen the road. Spoil from the northern side of the Gorge was initially disposed of at an established clean fill site located at 6283 SH1, however, that fill site had reached capacity by mid-2023. A suitable site to accommodate further spoil material was required and Lot 1 DP 35169 (184 Peria Valley Road, Kaitaia, Northland) was chosen as the most practicable site for the operation of a clean fill site.

Description of Activities

This application is for resource consent to regularise following activities at Lot 1 DP 35169 under the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NES-FW) for the operation of a clean fill area. Resource consent is required for the following activities:

- Vegetation clearance within and within 10m setback from a natural inland wetland;
- Earthworks within, or within a 10m setback of a natural inland wetland;
- Earthworks set back 10m but within 100m of a natural inland wetland; and
- Diversion of water within, or within a 100m setback from, a natural inland wetland for the installation of subsurface drainage to drain a wetland.

Resource consent for the above listed activities is sought retrospectively in accordance with Section 330A(2) of the Resource Management Act (1991) for emergency works.

No clean fill material has been disposed of at the site since 24 December 2024. Since lodging the application, the Applicant has completed the final levelling of the site to the satisfaction of the landowner and removed the erosion and sediment controls.

Description of Completed Works

Access to the clean fill site was immediately off Peria Valley Road. The Applicant formed a stabilised site entrance. Prior to the commencement of any filling, erosion and sediment controls were designed and installed at the application site. This included subsoil drainage along the northern extent of the staged clean fill / disposal areas to enable groundwater to drain from the soils. Clean fill disposal cross section plans were prepared and are attached as Appendix E of the application documents submitted to the council.

A total of 16,000 cubic metres (m^3) of clean fill has been disposed over the application site in three stages. **Stage 1** (Southern Extent) comprised of clean fill material placed over a maximum area of 2,650m^2 during the summer of 2023 / 2024. **Stage 2** (Northern Extent) comprised of clean fill material placed over an area of 1,900m^2 during the winter months of 2024. **Stage 3** (Western Extension) comprised of clean fill material placed over an expanded area to the southwestern portion of the application site during August through to December 2024. All clean fill material was layered no greater than 200mm in depth at any one time and track rolled for compaction. The deepest extent of fill material was 4.5 m above natural ground level (abl).

The operation of the clean fill site resulted in the removal of vegetation, earthworks and diversion / drainage of water within, and within 10m of a natural inland wetland. The activities completed to date have resulted in a loss of 1,365 square meters (m^2) of natural inland wetland extent classified as 'wīwī-spike sedge rushland'. The wetland was not considered a 'significant wetland' as it did not meet all of the significance criteria under the relevant planning provisions and criteria. A portion of wetland classified as 'kahikatea-rimu treeland' habitat to the northwest of the fill site comprising of 35m^2 in area has been retained due to its moderate ecological value. Erosion and sedimentation controls were designed in accordance with Auckland Council Guideline Document 2016/005 (GD05), installed and maintained around the extent of this habitat and the extent of the clean fill operation during works at the site.

Figure 1 Wetland habitats present at the application site as identified by NZEM, 2024. Image adapted from NZEM EIA Report (p. 4-7, 2024).

Application Site

The Applicant provided a description of the site under Section 3.3 of the Assessment of Effects on the Environment (AEE) Report (Stellar Projects, 2025). The clean fill site sits within the road fronting paddock of an operational farm, in a rural production area with site access immediately off Peria Valley Road. The application site is not subject to any overlays or restrictions under the regional council planning maps.

Regional Plan Rule(s) Affected

Under Section 330A(2) of the RMA, an activity that contravenes any of sections 9, 12, 13, 14 and 15 *and* the adverse effects of the activity continue, then the person, authority, network utility operator, or lifeline utility who or which undertook the activity shall apply in writing to the appropriate consent authority for any necessary resource consents required in respect of the activity.

In this case, there are no applicable rules for earthworks and vegetation clearance within a natural inland wetland under the Proposed Regional Plan for Northland (PRP) therefore the activities are classified as discretionary activities in accordance with Section 87B(1)(a) of the Act.

National Environmental Standard Regulation(s) Affected

The following listed activities require resource consent under the Resource management (National Environmental Regulations for Freshwater) Regulations 2020 (NES-FW):

Vegetation clearance within, or within a 10m setback of a natural inland wetland is a discretionary activity in accordance with Regulation 45B(1) of the NES-FW.

Earthworks within, or within a 10m setback of a natural inland wetland is a discretionary activity in accordance with Regulation 45B(2) of the NES-FW.

Earthworks outside a 10m, but within a 100m setback of a natural inland wetland is a discretionary activity in accordance with Regulation 45B(3) of the NES-FW.

Diversion of water within, or within a 100m setback from a natural inland wetland is a discretionary activity in accordance with Regulation 45B(1) of the NES-FW.

Overall, the activity status is Discretionary. No further consents are required.

Actual and Potential Effects (Section 104(1)(a) of the Act)

The adverse effects on the environment of this activity have been determined to be no more than minor for the following reasons:

Erosion and Sediment Control

An erosion and sediment control plan (ESCP) was submitted to the council with the application documentation. The ESCP was prepared and designed by a suitably qualified professional and has taken into consideration the requirements set out under the *Auckland Council Guideline Document 2016/005 (GD05)* and updated as required. The Applicant confirmed that all erosion and sediment controls were installed prior to the commencement of any filling at the application site. Evidence of the installation of the relevant erosion and sediment controls has been provided to the council, and the application noted that weekly inspections of erosion and sediment controls were undertaken and sediment deposits and bulges against the silt fences removed when sediment accumulation reached 20% of the fabric height.

The ESCP included in design, the installation of subsoil drainage to drain and divert water from the natural inland wetland areas within the disposal / fill site prior to the commencement of any works. The installation of silt fencing along the perimeter of the clean fill site minimised and managed any sedimentation entering adjacent natural wetland habitats or waterbodies resulting from the land disturbance activities. The formation of a stabilised entrance off Peria Valley Road reduced the amount of soil tracked onto the road. All temporary erosion and sediment controls have since been removed from the site following the completion of works in December 2024.

Ecological/Habitat Effects

The Applicant engaged NZ Environmental Management Ltd (NZEM) to prepare an Ecological Impact Assessment (EIA) Report (2024) for the application site prior to the commencement of any activities. The Report defined the identified fill site as wīwī-spike sedge rushland on hillslope seepage comprising of a total area of 1,365 m^2 in area. The habitat met the definition of a wetland provided in the RMA, and the presence of hydrophytic vegetation in the seepage areas met the tests and definitions of a natural inland wetland in the National Policy Statement for Freshwater Management 2020 ('NPS-FM') and NES-FW (section 4.1.2, NZEM, 2024). There was reported to be an abundance of wīwī and spike sedge, with the cover of indigenous species being greater than 50% in some areas of the habitat, thereby meeting the definition of an indigenous wetland under the Far North District Plan (p. 4-5, NZEM, 2024). The activities at the site resulted in a total loss of 1,365m^2 of wīwī-spike sedge rushland habitat. A desktop analysis completed by NZEM confirmed 12 other similar wetland habitats present within the property and able to be retained during the works (p. 4-8, NZEM, 2024). The ecological value of the natural inland wetland habitat was reported to be low due to the highly modified nature of the land, current and historic intensive livestock grazing practices. As a result, the wetland lacked key habitat components such as pools of open water, dense stands of taller reeds, shrub tier and a lack of compositional and structural diversity (p.4-9, NZEM, 2024). Given the lack of these distinctive components, the EIA Report concluded the wetland was unlikely to support Threatened or At-Risk bird species and deemed to be of low ecological value.

The permanent diversion of groundwater was associated with the removal and drainage of the wetland habitat. Any loss of hydrological function is negligible in this regard, as the wetland habitat has been removed to facilitate the establishment and safe operation of the clean fill site.

The report identified a $35m^2$ habitat extent of natural inland wetland classified as *kahikatea-rimu treeland* to the northwest of the site, and adjacent to the wīwī-spike sedge rushland habitat. While the *kahikatea-rimu treeland* did not meet the criteria for a 'significant' natural inland wetland when assessed against the relevant tests and definitions of the planning documents, the kahikatea present provided habitat for at least ten native plant species in addition to an epiphytic lichen identified as golden-hair lichen (*Teloschistes flavicans*) with a conservation status of 'At Risk-Declining'. Given these components of the wetland, the kahikatea-rimu treeland was assessed as having moderate ecological value. The recommendations outlined in the EIA Report included the retention and preservation of the *kahikatea-rimu treeland* habitat extent through the installation of erosion and sedimentation controls around the perimeter of the wetland. All fill operation activities occurred to the south of the treeland habitat and adjacent to the road frontage of the property.

As such, the Applicant has demonstrated that the potential loss of this wetland has been avoided, and any actual or potential adverse effects generated by the land disturbance activities has been suitably mitigated and managed.

Assessment of Alternatives

In considering this application, the council has taken into consideration the relevant principals outlined in Section 6 of the Act. If it is likely that the activity will result in any significant adverse effects on the environment, clause 6(1)(a) of the Fourth Schedule requires a description of the possible alternative locations or methods for undertaking the activity. The Applicant has provided an assessment of alternatives under Section 6 of the AEE Report submitted to the council and forming part of the resource consent (Stellar Projects, 2025). Prior to selecting the subject site for the clean fill operation, the Applicant demonstrated that consideration was given to the following site requirements: proximity to the Mangamuka Gorge remediation works; environmental effects and planning restrictions; cultural considerations including the spread of Kauri Dieback Disease; cost; efficiency; safe site access; minimum site size requirements; topography; and landowner agreement (Section 6, Stellar Projects, 2025). The clean fill site had to be located outside of the Gorge due to natural constraints and cultural considerations. It was required to be in the immediate vicinity of the Gorge in order to provide shorter transportation journeys of the spoils (reducing traffic and emissions impacts) and was required to be in the same general area and catchment due to cultural considerations and to mitigate the risk of spreading Kauri Dieback Disease. In addition, the Applicant had to engage in landowner agreement. The council is satisfied that the Applicant has demonstrated consideration of practicable alternative site locations, and as such, there were no alternative locations to under the activity.

Cultural Effects

The application has been circulated to tāngata whenua who have registered with council as having an interest in resource consent applications within the area of the activity. No response has been received by the council from tāngata whenua.

The application documents detailed that a partnership has been developed between the Applicant, Nga hapū o Mangamuka and Te Paatu (Ngāti Kahu iwi), with ongoing consultation and engagement with the hapū throughout the duration of the *'Mangamuka Slip Response Project 2022'.* The local hapū have been integrated within the project team and Kaitiaki have been on-site during works, monitoring and supervising works, including wildlife salvage and relocations. Nga hapū o Mangamuka and Te Paatu have been kept informed of the timings and preparation of resource consent applications and received copies of the application from the Applicant as they have been lodged.

Due to cultural considerations and project requirements, the establishment and operation of a new cleanfill site had to be north of the Mangamuka Gorge and therefore any site south of the Gorge was already not considered to be a practicable alternative. Specifically, cultural considerations required the Applicant to consider sites within the same catchment area to mitigate the risk of spreading Kauri Dieback Disease.

There are no mapped places or areas of significance to tāngata whenua or identified wāhi tapu associated with the consent location or its immediate vicinity. The application will not have adverse effects on indigenous biodiversity or on the ability for tāngata whenua to carry out cultural and traditional activities. The application is outside of the coastal marine area or any permanent or intermittently flowing freshwater rivers so any actual or potential adverse effects on tāiapure, mataitai or Māori non-commercial fishery is avoided.

Relevant Statutory Provisions (Section 104(1)(b) of the Act)

The council has determined that the granting of this resource consent is consistent with the objective and policies contained in Sections D.1, D.2, D.4 and F of the PRP.

The objectives and policies of the PRP now have considerable weight. Council therefore considers that it does not need to undertake an additional assessment of the respective objectives and policies in the Regional Water and Soil Plan for Northland.

There are no iwi/hapū environmental management plans relevant to the location of this activity.

Te Rarawa has a Settlement Act that covers the location of this activity. The activity is not within, or adjacent to, any statutory acknowledgement areas listed under Schedule 5 of the of Settlement Claims Act, including and the Awaroa River, Takahue River, Awanui River and Wairoa Stream. The granting of this consent will have no adverse effect on a statutory acknowledgement area.

Duration of the Consent

No duration of consent was requested by the Applicant as the activities have been completed in full under S330A of the Act. In this instance, a period of one month is considered appropriate.

In determining duration, regard has also been had to Policy D.2.14 of the PRP.

Name and Signature of Authorised Person:

Paul Maxwell
Coastal and Works Consents Manager

31 March 2025

FILE: 46377
01 to 04
New

Resource Consent

Document Date: 31.03.2025

Pursuant to the Resource Management Act 1991, the Northland Regional Council (hereinafter called "the council") does hereby grant a Resource Consent to:

NEW ZEALAND TRANSPORT AGENCY - WAKA KOTAHI

To undertake the following activities associated with the establishment of a clean fill site on Lot 1 DP 35169 (184 Peria Valley Road, Kaitaia), at or about location co-ordinates 1638896E 6111109N:

Note: All location co-ordinates in this document refer to Geodetic Datum 2000, New Zealand Transverse Mercator Projection.

AUT.046377.01.01	**Vegetation clearance within and within 10 metres of a natural inland wetland.**
AUT.046377.02.01	**Earthworks within and within 10 metres of a natural inland wetland.**
AUT.046377.03.01	**Earthworks outside a 10 metre, but within a 100 metre setback of a natural inland wetland.**
AUT.046377.04.01	**Diversion of water within and within a 100 metre setback from a natural inland wetland.**

Subject to the following conditions:

1 The exercise of these consents must be undertaken in general accordance with the **attached** Taiao Surveyors drawings referenced as Northland Regional Council Plan Numbers **5509/1** to **5509/3**. However, if there are any differences or apparent conflict between these drawings and any conditions of these consents, then the conditions of consent must prevail.

2 Slash, soil, debris and detritus associated with the exercise of these consents must not be placed in a position where it may be washed into any water body.

3 All bare areas of land and fill must be either sealed or covered with aggregate, or topsoiled and established with a suitable grass/legume mixture to achieve an 80% groundcover within one month of the completion of earthworks. Temporary mulching or other suitable groundcover material must be applied to achieve total groundcover of any areas that are topsoiled and unable to achieve the above requirements.

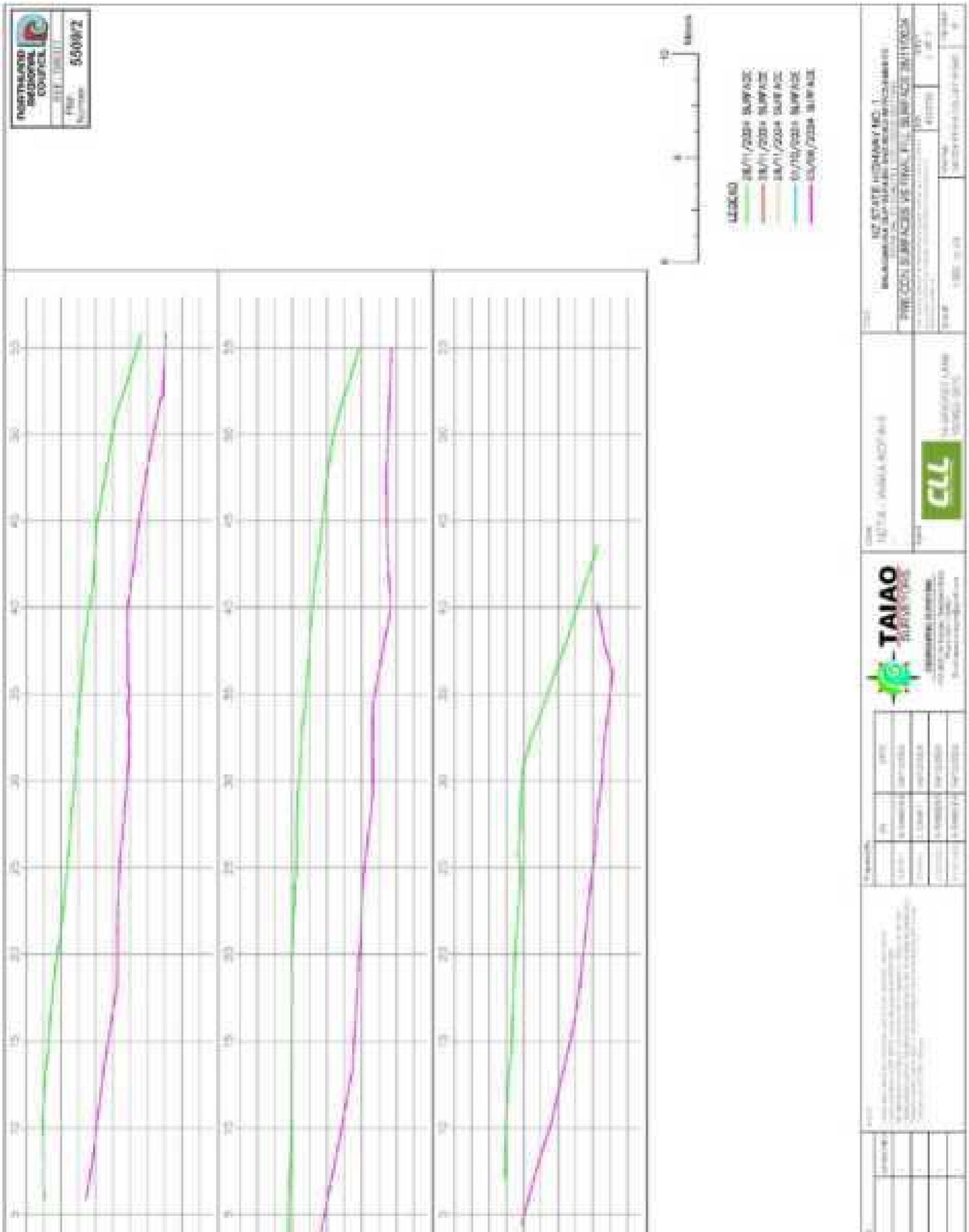
EXPIRY DATE: 30 APRIL 2025

These consents are granted this Thirty First day of March 2025 under delegated authority from the council by:

Paul Maxwell
Coastal and Works Consents Manager

Northland REGIONAL COUNCIL
Te Kaunihera ā rohe o Te Taitokerau


5508/1
PERIA VALLEY ROAD
CLL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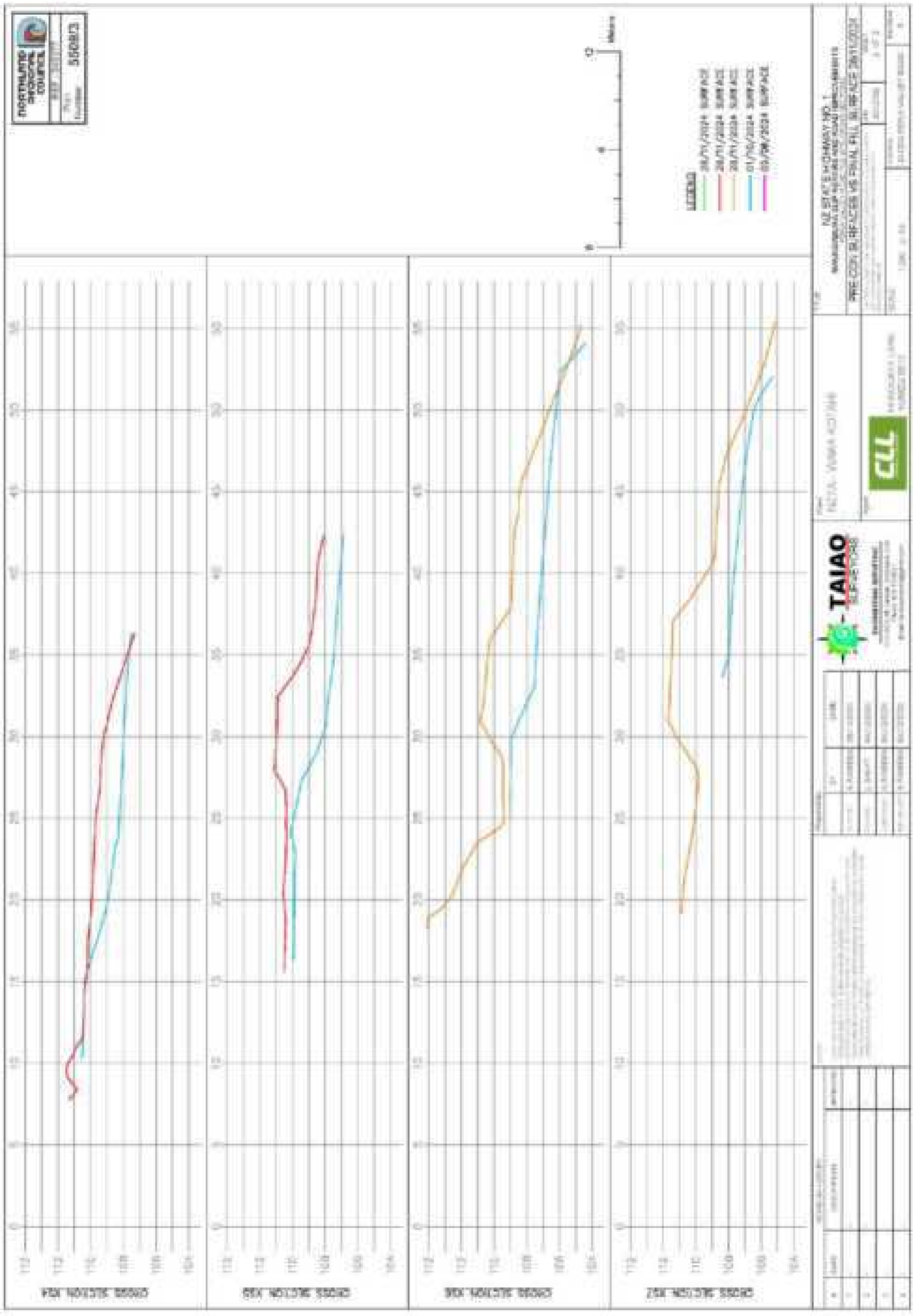

APPENDIX L Northern Laydown Approved District Certificate of Compliance

Te Kaunihera o Te Hiku o te Ika
Far North District Council

HE ARA TĀMATA
CREATING GREAT PLACES
Supporting our people

Private Bag 752, Kaikohe 0440, New Zealand
0800 920 029
fndc.govt.nz

CERTIFICATE OF COMPLIANCE

UNDER SECTION 139A OF THE RESOURCE MANAGEMENT ACT 1991

Council Reference:	2250315-RMACOC
Applicant:	New Zealand Transport Agency
Property Address:	6770 State Highway 1, Kaitaia 0481
Legal Description:	LOT 1 DP 153400 BLK VII TAKAHUE SD - SUBJ TO ROW
Description of Application:	Certificate of Compliance for the Establishment and Operation of a Cleanfill Site (Northern Laydown Area) Associated with the Mangamuka Gorge Repair Works.

Acting under delegated authority, I certify that the use of the site at 6770 State Highway 1, Kaitaia (Lot 1 DP 153400, Block VII Takahue Survey District) as a clean fill and laydown area to support emergency infrastructure works in the Mangamuka Gorge, including:

- Stockpiling of fill and aggregate on metalled yard areas;
- Use of machinery and vehicle access via the existing entrance to State Highway 1;
- Temporary placement and storage of materials and equipment associated with infrastructure repair;
- Resurfacing of the rear yard area with aggregate;

was:

- Compliant with Rule 8.6.5.4 (Impermeable Surfaces) of the Operative Far North District Plan by virtue of existing use rights;
- Compliant with Rule 12.3.6.1.1 (Earthworks) of the Operative Far North District Plan; and
- Not in breach of any rules with immediate legal effect in the Proposed Far North District Plan;

and therefore, could be lawfully undertaken without a resource consent under both the Operative Far North District Plan and the Proposed Far North District Plan, as at the date the application was received, 20 March 2025.

Name: Nick Williamson
Resource Consents Team Leader

Date: 26 March 2025

Private Bag 752, Kaikohe 0440, New Zealand
ask.us@fndc.govt.nz
0800 920 029
fndc.govt.nz

Notes

1. This Certificate is issued in relation to the following plans and information:

   Engineering Letter titled “Mangamuka Gorge Project – Northern Laydown Area”. Prepared by: Michael Fox, WSP (Whangārei Office). Dated: 10 December 2024

   Land Requirement Plan – 6770 State Highway 1, Kaitaia. Prepared by: Hoskin Civil. Dated: 22 February 2023

2. The information provided by the applicant in support of the request for this Certificate has been relied upon. Any error or omissions within that supporting information identified after the issue of this Certificate may render this Certificate null and void.

APPROVED PLAN

Planner: DGarcia
RC: 2250318-RMACOC
Date: 26/03/2026

LAND REQUIREMENT PLAN
6770 STATE HIGHWAY 1, KAITAIA

SUBJECT PROPERTY

LAND REQUIRED

ADDRESS:
6770 STATE HIGHWAY 1
KAITAIA

OWNERSHIP:

LEGAL DESCRIPTION:
PARCEL ID: 4701761
LOT 1 DP 153400

CLIENT:
WAKA KOTAHI
NZ TRANSPORT AGENCY

DATE:	SCALE:	
22 FEBRUARY 2023	NTS	
DRAWN: L WILLIAMS	CHECKED: J OLSEN	APPROVED:
SHEET No: 1 OF 1	DWG No:	

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THE INFORMATION DISPLAYED HERE IS INDICATIVE ONLY.
MEASUREMENTS ARE APPROXIMATE AND SUBJECT TO SURVEY.

APPROVED PLAN

Planner: DGarcia
RC: 2250316-RMACOC
Date: 26/03/2026

10 December 2024

Hendrik Postma
NZTA / Waka Kotahi
Private Bag 106602
Auckland City
Auckland 1143

Mangamuka Gorge Project- Northern Laydown Area

1-11241.13

Dear Hendrik,

As requested, we have conducted a brief review of the engineering information available concerning the permeability of the Northern Laydown Area (comprising the rear portion of 6670 State Highway 1, Kaitaia).

This is summarised as follows:

1. The natural ground has been surfaced with loosely placed granular material;
2. The granular material used is open graded (i.e. minimal or no fine material);
3. Site observations through the project (February 2022 to present) confirm that this aggregate is free-draining, with no surface runoff observed to neighbouring properties.

The effects of this work on stormwater flow and flooding are considered in the following paragraphs.

Stormwater flow

The area is a vehicle manoeuvring area, which is defined as impermeable in the District Plan.

The Northland 0.4m Rural Aerial Photos 2014-2016 (LINZ) available on the Far North Maps website, show that the area was already an aggregate covered vehicle manoeuvring area before our works. Thus, we have made no change to the impermeability of the surface.

As the before and after surfaces are both impermeable, there is consequently no change to the volume of runoff.

The direction in which the stormwater will flow depends on the slope of the new top surface. We visited the site on 6 December 2024 to observe the topography and to check the fall direction of the ground surface. The fall directions observed are consistent with those before the works as plotted on the above aerial photos. Thus, there is no change to the direction of flow as a result of these works.

Therefore, there is no change to the direction or flow volume due to these works.

WSP
Whangarei
Mansfield Terrace Service Lane
125A Bank Street
PO Box 553
Whangarei 0140, New Zealand
+64 9 430 1700
wsp.com/nz

Flooding

Northland Regional Council have completed flood mapping of this area. A review of these maps shows that the 50-year flood does not flood the site. There is some flooding of the site in the 100-year flood. Copies of these flood maps are attached to this letter.

The flooding that occurs in the 100-year flood is backwater flooding- i.e. the area flooded on this site forms part of the flood plain but is not part of the main flood channel. Raising the ground level at the site will therefore not constrict water flow during flooding but will result in a small loss of storage. An area of 655 m^2 is flooded. If an average depth of 200 mm of aggregate has been placed over this area and we conservatively assume that the flood depth in this area is at least the full depth of the new aggregate, there will be a loss of 131 m^3 of water storage on the floodplain in the 100-year event. This is negligible in the context of the catchment.

Therefore, the works will have negligible effect on flooding in the area.

Please contact me should you require any further information on the above.

Kind regards

Michael Fox B.E.(Hons), CPEng
Civil Engineer

APPENDIX M Completion of Emergency Works Notifcation

NZ TRANSPORT AGENCY
WAKA KOTAHI

Address

30/05/2025

Paul Maxwell
Northland Regional Council
Via email:
paulm@nrc.govt.nz

Tēnā koe Paul

RE: Mangamuka Slip Response Project 2022 - Completion of Emergency Works

On 23 August 2022, WSP provided Northland Regional Council with a "*Notification of Emergency Works*" with resect of State Highway 1 (SH1) through the Mangamuka Gorge (the Gorge) pursuant to s330A of the Resource Management Act 1991 (RMA).

This represented the beginning of the Mangamuka Slip Response Project 2022 (the Slip Response), which has been on-going since that date. All works completed have been undertaken pursuant to s330 of the RMA, and its emergency works provisions. The emergency response included works through the length of the Gorge. Due to the sensitive nature of the surrounding Reserve and cultural and physical constraints, this also involved remote sites utilised as fill sites and laydown areas.

All emergency works and the Slip Response were completed on **23 May 2025**.

In accordance with s330A(1) of the RMA, the New Zealand Transport Authority Waka Kotahi gives Northland Regional Council notice that the emergency works are now complete.

Section 330A(2) of the RMA requires "[w}*here such an activity, but for section 330, contravenes any of sections 9, 12, 13, 14, and 15 and the adverse effects of the activity continue, then the person (other than the occupier), authority, network utility operator, or lifeline utility who or which undertook the activity shall apply in writing to the appropriate consent authority for any necessary resource consents required in respect of the activity."*

As per this requirement all activities have been assessed against the relevant provisions of all relevant National Environmental Standards and proposed and operative District and Regional Plans. This has determined whether any resource consents are required.

A "*summary of activities*" has also been prepared which provides an overview of works completed, as well as all the approvals obtained. It further outlines where resource consents are required and where resource consents are not required. The "*summary of activities*" is appended for information purposes as **Attachment A**. The "*summary of activities*" provides a detailed overview of the works, and the relevant sites associated with the works and should be read in conjunction with this letter.

Resource consents and approvals have already been granted by Far North District Council/ Te Kaunihera o Te Hiku o te Ika and Northland Regional Council respectively, for activities where there are on-going residual effects. These relate to works associated with:

- A laydown area at 6770 SH1, Kaitaia; and
- A fill site located adjacent to 184 Peria Valley Road, Kaitaia.

Further resource consents are required for activities associated with:

- Remediation of SH1 at Slip A8.
- Stormwater and Culvert Upgrades throughout the Gorge, SH1.

These resource consents will be lodged imminently and well within the 20 working-day timeframe specified in s330A(2) of the RMA.

Works associated with the following activities are not considered to have on-going or residual adverse effects:

- Southern Laydown Site at 4543 SH1, Mangamuka
- Temporary Earthworks Transfer Facility located at the southern end of the Mangamuka Gorge on SH1
- Southern Fill Site at 4321 SH1, Mangamuka
- Drilling of bore holes and installation of monitoring bores, piezometers and inclinometers.

The "*Southern Laydown Site*" was an established site maintained with an aggregate surface. It was used for temporary storage of equipment and machinery. Upon cessation of its use, there were no on-going residual adverse effects, such as those related to its use, being namely noise and traffic. Consequently, <u>resource consent(s) is/are not required</u>.

A planning assessment for the "*Temporary Earthworks Transfer Facility*" is appended as **Attachment B**. This planning assessment details all the "*triggers*" for resource consent and outlines the reasons why there are no on-going residual adverse effects, and therefore the reasons why <u>resource consent(s) is/are not required</u>.

A planning assessment for the "*Southern Fill Site*" is appended as **Attachment C**. This planning assessment details all the "*triggers*" for resource consent and outlines the reasons why there are no on-going residual adverse effects, and therefore the reasons why <u>resource consent(s) is/are not required.</u>

No planning assessment was undertaken for the drilling of bore holes and installation of monitoring bores, piezometers and inclinometers. Due to the drilling of bore holes and installation of monitoring bores, piezometers and inclinometers being done under the emergency works provisions, Northland Regional Council was not notified 10 days prior to the construction of any bore hole or bore as required by Rule C.8.5.1 Resource consent would therefore be "*triggered*", in "*normal circumstances*" under Rule C.8.5.3 of the proposed Regional Plan for Northland. However, the drilling of bore holes and installation of monitoring bores, piezometers and inclinometers has been undertaken in accordance with New Zealand standards. Where the bores have not been decommissioned, they are maintained in accordance with New Zealand Standards and have been capped appropriately. Bore Logs for all bores are attached as **Attachment D**. It is considered there are no on-going adverse effects from these activities and therefore, pursuant to s330A of the RMA, <u>resource consent is not required.</u>

If you have any questions, please feel free to contact me.

Nāku noa, nā

Kim Cottle

Principal Planner – Poutiaki Taiao / Environmental Planning Team
New Zealand Transport Agency Waka Kotahi

CC: Meirene Hardy-Birch (DOC), Darcy Liddell (DOC), Carol Nicholson (DOC)

Attachments:

A – Summary of Activities

B – Temporary Earthworks Transfer Facility Planning Assessment

C- Southern Fill Site Planning Assessment

D – Bore Logs

NZ TRANSPORT AGENCY
WAKA KOTAHI

Address

30/05/2025

Nick Williamson
Far North District Council/ Te Kaunihera o Te Hiku o te Ika
Via email:
nick.williamson@fndc.govt.nz

Tēnā koe Nick

RE: Mangamuka Slip Response Project 2022 - Completion of Emergency Works

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This represented the beginning of the Mangamuka Slip Response Project 2022 (the Slip Response), which has been on-going since that date. All works completed have been undertaken pursuant to s330 of the RMA, and its emergency works provisions. The emergency response included works through the length of the Gorge. Due to the sensitive nature of the surrounding Reserve and cultural and physical constraints, this also involved remote sites utilised as fill sites and laydown areas.

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As per this requirement all activities have been assessed against the relevant provisions of all relevant National Environmental Standards and proposed and operative District and Regional Plans. This has determined whether any resource consents are required.

A "*summary of activities*" has also been prepared which provides an overview of works completed, as well as all the approvals obtained. It further outlines where resource consents are required and where resource consents are not required. The "*summary of activities*" is appended for information purposes as **Attachment A**. The "*summary of activities*" provides a detailed overview of the works, and the relevant sites associated with the works and should be read in conjunction with this letter.

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If you have any questions, please feel free to contact me.

Nāku noa, nā

Kim Cottle

Principal Planner – Poutiaki Taiao / Environmental Planning Team
New Zealand Transport Agency Waka Kotahi

CC: Meirene Hardy-Birch (DOC), Darcy Liddell (DOC), Carol Nicholson (DOC)

Attachments:

A – Summary of Activities

B – Temporary Earthworks Transfer Facility Planning Assessment

C- Southern Fill Site Planning Assessment

D – Bore Logs

Attachment A – Summary of Activities

THIS ATTACHMENT IS NOT PROVIDED HERE AS IT IS A REPEAT OF THE "SUMMARY OF APPLICATIONS" DOCUMENT

Attachment B – Temporary Earthworks Transfer Facility Planning Assessment

MANGAMUKA 2022 SLIP RESPONSE

Temporary Earthwork Transfer Facility

State Highway 1, Mangamuka Gorge

PLANNING CHECKLIST:

Far North District Council Bylaws

Northland Proposed Regional Plan

National Environmental Standards

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Stellar Projects Ltd is a multi-disciplinary
consultancy excelling in project delivery.

1. DOCUMENT QUALITY CONTROL RECORD

To	Kim Cottle, Principal Planner, NZTA Waka Kotahi
Copy	Hendrik Postma, Senior Project Manager, NZTA Waka Kotahi Benji Potvin, Senior Project Manager, Stellar Projects
Document Status	Client Issue V1
Date	22 April 2024
Prepared By	Alex Erceg, Senior Planner, Stellar Projects
Authorised for Issue	Stuart Brooke, Planning Manager, Stellar Projects
File/Ref	J004190 – Mangamuka 2022 Slip Response
Front cover image:	Proposed Laydown Area (Image taken: 4 April 2024)

2. RELEVANT SITE DETAILS

Site Address	State Highway 1, Mangamuka Gorge (southern end)
Site Area	0.45 ha (approx.)
Legal Description	Road
Relevant Title Instruments	N/A
Owner/s	NZTA
Relevant Plans & Regulations & Policy Statements	Proposed Regional Plan for Northland – February 2024 (Operative in Part) Far North District Council Bylaws National Environmental Standards: • Freshwater 2020 (updated January 2023); Assessing and • Managing Contaminants in Soil to Protect Human Health (2011)

3. CONSENTING SUMMARY TABLE

CLL on behalf of NZTA Waka Kotahi is carrying out the fill activity at 4321 State Highway 1 under the emergency works provisions of s330 of the Resource Management Act 1991 (as further explained in **Section 7** below). Within this context, the purpose of carrying out this Regional Plan rule checklist is to:

a) achieve compliance with permitted standards where possible; and

b) identify potential requirements for retrospective consents under s330A RMA where rule infringements will result in ongoing adverse effects following the completion of emergency works.

An assessment has been undertaken against the relevant statutory documents.

Planning Regulation	**Consent Triggered (Y/N)**	**Comments**
Operative Far North District Plan	No	NZTA Waka Kotahi holds a designation for SH1 and an Outline Plan of Works for road realignment of Slip A11. All works will be undertaken within the road designation and are considered to be part of the works encompassed by the OPW, as such no District Consents are required.
Proposed Far North District Plan	No	
Far North District Council – Control of Earthworks Bylaw	No	Bylaw Exemption will be required if depth of earthworks exceeds 1.5m.
Proposed Regional Plan for Northland	No	The proposal can meet the permitted activity criteria.
National Environmental Standard: Freshwater	No	The activity broadly fits under Regulation 45 for the construction of Specified Infrastructure. No natural wetland has been identified within 100m of the facility. Nevertheless, should a natural wetland be present within 100m the proposal would not result, or likely result in the complete or partial drainage of a wetland. As such, the proposal does not "trigger" the need for a resource consent under this regulation. The proposed temporary stockpiling of spoil is not considered to meet the definition of "cleanfill area".

Planning Regulation	Consent Triggered (Y/N)	Comments
National Environmental Standard: Contamination	No	The site is not known to have any soil contamination.

4. BACKGROUND TO THE PROPOSAL

The section of State Highway 1 through the Maungataniwha Range, commonly referred to as the Mangamuka Gorge ("Gorge"), has been closed since August 2022 due to severe weather events which have caused a large number of land slips along the 14km section of road between the Gorge. Emergency remediation of critical slips within the gorge is currently being carried out and is expected to be completed by December 2024.

Works required to remediate slip A11 require a large amount of earthworks. In order to allow the project to keep moving, the earthworks have to be undertaken prior to winter, and as such, to allow fill to be removed from slip A11 in a timely and efficient manner, a temporary Fill Laydown and Transfer Facility is proposed to be established ay the southern end of the Gorge, to then be transported to a fill site at 4321 State Highway 1 (**SH1**).

NZTA Waka Kotahi holds a designation for SH1 and an Outline Plan of Works (**OPW**) for road realignment of Slip A11 (2240268-RMAOUT) approved on 5 February 2024. All works will be undertaken within the road designation and are considered to be part of the works encompassed by the OPW, as such no District Consents are required.

5. SITE DESCRIPTION

The site is at the southern entrance to the Gorge where the SH1 closure begins, known under this project as the "southern gate". At this point, the road corridor widens to encompass a circa 3000m^2 aggregate hardstand area which is currently used as a carpark and site office. It sits adjacent to a clearing within the scenic reserve and a stream. The site is within the road reserve and NZTA's existing designation.

Figure 1: Location of proposed Fill Laydown and Transfer Facility (orange star)

6. PROPOSAL

The proposal seeks to establish a temporary earthworks transfer facility, whereby material excavated from Slip A11 can be stockpiled and then transferred to the fill site at 4321 State Highway 1.

The transfer facility will be wholly contained within the road reserve and NZTA Waka Kotahi existing designation.

This planning assessment has been undertaken prior to the preparation of a detailed erosion and sediment control plan (ESCP). The only available documentation to assess the proposal is a high level concept layout plan (refer **Figure 2**). The concept layout shows that an earth bund will be installed around the permitter of the facility, and stormwater diverted to a DEB (decanting earth bund), with an outflow, located at the road reserve boundary, into the scenic reserve above the stream.

Figure 2: *Proposed Layout of Facility*

Figure 3: *Aerial Image indicating road reserve boundaries*

7. DO S330 RMA EMERGENCY WORKS PROVISIONS APPLY?

Section 330 allows Waka Kotahi, as a network utility operator and requiring authority, to undertake certain activities (emergency work or measures) in emergency situations without the need to obtain a resource consent under the RMA.

Emergency works can be undertaken by Waka Kotahi where, in their opinion, their assets are affected, or likely to be affected by:

- an adverse effect on the environment which requires immediate preventive or immediate remedial measures s330(1)(d) and s330(1)(e); or
- any sudden event causing or likely to cause loss of life, injury, or serious damage to property s330(1)(f).

On 23 August 2022 WSP on behalf of Waka Kotahi sent notification to Northland Regional Council, Far North District Council, and Department of Conservation that emergency works were commencing pursuant to s330 Resource Management Act to undertake initial slip clearance and carry out subsequent slip remedial works. Although the project will span more than 2 years in total, the project remains under the emergency works provisions.

Under s330A(2) resource consents will be required for any activity, where the activity (but for s330) contravenes Sections 9, 12, 13, 14, and 15 <u>and the adverse effects of the activity continue beyond the completion of the emergency works</u>. If there are no adverse effects of the activities which are ongoing, the s330A(1) correspondence should inform the Council that no resource consents are required.

The retrospective consent provision in s330A is unlikely to be relevant as the permitted activity criteria for relevant rules under the Regional Plan can be met. No District Rules are triggered as the works are within NZTA's existing designation and can be undertaken under the provisions of the designation.

8. PLANNING CONTEXT TABLE

FNDP Zone (Operative):	Conservation (adoption of adjacent zone)
FNDP Zone (Proposed):	Conservation (adoption of adjacent zone)
FNDP Resource area	N/A
FNDP Overlays	Outstanding Landscape There is a site of cultural significance to Māori (red outline) adjacent to proposed transfer station area (blue outline). 
Soil classification:	LUC 6
Northland brown kiwi & mudfish distribution:	N/A
Significant indigenous vegetation & significant habitats of indigenous fauna:	No indigenous vegetation within road reserve area.
Surface Water Protection zone:	N/A
NRC Natural Hazards:	River Flood Hazard zone (10, 50 & 1—year) surrounding proposed transfer station (orange star). 

Designations:	Works wholly within NZTA designation for SH1
Statutory Acknowledgement Area:	Proposed site not within a Statutory Acknowledgement Area.
HAIL:	The site is not showing as a recognized HAIL site on Northland Regional Councils Selected Land-use Register.
Heritage & Archeology:	No heritage or archaeological sites are showing on, or in proximity to, the site on the New Zealand Archaeological Association online maps or FNDC GIS maps. An archaeological assessment has confirmed no heritage values within the works area.
Regional Plan notations and requirements:	• Hill Country and Lowland Areas: Hill Country Area • River Water Quantity Management Units: Coastal River • Groundwater Management Units: Groundwater Zone
Other relevant planning documents:	N/A
Reserves and protected areas and relevant management plans / strategies:	N/A

APPENDIX 1 - PROPOSED REGIONAL PLAN FOR NORTHLAND (APPEALS VERSION 7 JUNE 2023)

Relevant Definitions		**Notes**
Earthworks	The mechanical disturbance of earth by excavation, cutting and filling, blading, ripping, contouring, quarrying or placing or replacing earth or cleanfill material and includes associated revegetation, but does not include: 1. construction, repair, alteration or maintenance of bores, or 2. the maintenance of walking and other recreational tracks and farm tracks, or 3. the placement of roading aggregates during road and track works, or 4. directional drilling, boring or thrusting up to 250mm diameter, or 5. digging post holes, or 6. planting trees, or 7. land preparation, or 8. vegetation clearance	Stockpiling operations fall within this definition
Erosion control plan	Means a plan developed by a suitably qualified professional which specifically identifies areas of gully, landslide, and earthflow erosion and measures to mitigate sediment yield from these areas and meets the requirements of H.2 Erosion Control Plans. For the purposes of preparing Erosion Control Plans, "suitably qualified professional" means a person who: 1. has at least five years' experience in the management of pastoral, horticultural or arable farm systems, and 2. has completed advanced training or has tertiary qualifications in soil conservation, soil science or sediment management, or 3. is a Northland Regional Council Land Management Advisor.	Proposed sediment control plan meets this definition
Erosion Prone Land	Land defined as Land Use Capability (LUC) units 6e17, 6e19, 7e1 - 7e10, 8e1 - 8e3, and 8s1. The LUC units are generally depicted in the New Zealand Land Resource Inventory (NZLRI) and are also shown in I Maps | Ngā mahere matawhenua.	No land whereby the stockpiling activity will occur is on land identified as erosion prone.

Proposed Regional Plan for Northland (PRP)					
Relevant Chapter	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
EARTHWORKS					
Permitted Activity Rules					
C.8.3.1 Earthworks outside the bed of a river, lake, wetland and the coastal marine area, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water:					
C.8.3.1.1 The area and volume of earthworks at a particular location or associated with a project complies with the thresholds in table 15 (above)	☐	☒	☐	Permitted	**Comment:** **Aerial imagery suggests the stream is over 10m from the proposed transfer station laydown area.** **The area is not identified as "erosion prone land".** **The area, whilst surrounded by flood susceptible land, is not identified as being within a flood hazard.** **At any one time, there will not be more than 5000m² of exposed earth.** ***Note: The associated diversion and discharge of stormwater is included under this rule.***
Controlled Activity Rules (Operative)					

Table 15: Permitted activity earthworks thresholds

Location	Earthworks thresholds
Within 10m of a natural wetland, the bed of a continually or intermittently flowing river or lake	200 square metres of exposed earth at any time, and 50 cubic metres of moved or placed earth in any 12-month period.
Within 10m of an inanga spawning site	200 square metres of exposed earth at any time, and 50 cubic metres of moved or placed earth in any 12-month period.
Catchment of an outstanding lake	2500 square metres of exposed earth at any time.
Erosion-prone land	2500 square metres of exposed earth at any time.
High-risk flood hazard area	50 cubic metres of moved or placed earth in any 12-month period.
Coastal riparian and foredune management area	Excluding for coastal dune restoration, 200 square metres of exposed earth at any time.
Flood hazard area	100 cubic metres of moved or placed earth in any 12-month period.
Other areas	5000 square metres of exposed earth at any time.

Proposed Regional Plan for Northland (PRP)					
Relevant Chapter	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
C.8.3.2 Earthworks outside the bed of a river or lake, wetland and the coastal marine area that exceed 5,000m^2 of exposed earth at any time at a particular location or associated with a project area, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water	☒	☐	☐	Controlled	
C.8.3.3 Earthworks in a flood hazard area that involve more than 50 cubic metres, but not more than 1,000m^3, of earth being moved or placed in any 12-month period, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water.	☒	☐	☐		**Comment:** **No earthworks are proposed within a flood hazard area.**
Discretionary Activity Rules (Operative)					
C.8.3.4 - Earthworks – discretionary activity Earthworks outside the bed of a river or lake, a wetland, or the coastal marine area, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water, that are not a permitted or controlled activity under another rule in section C.8.3 of this Plan.	☒	☐	☐		
C.8.4 Vegetation clearance in riparian areas and foredune management area					
C.8.4.1 Coastal dune restoration within the coastal riparian and foredune management area – permitted activity	☒	☐	☐		N/A
C.8.4.2 Vegetation clearance in riparian areas – permitted activity Vegetation clearance within 10 metres of a natural wetland or within 10 metres of the bed of a continually or intermittently flowing river or lake, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water, are permitted activities, provided: 1) the area of cleared vegetation does not exceed 200 square metres in any 12-month period, and 2) vegetation is felled away from rivers, lakes, and natural wetlands, except where it is unsafe or impractical to do so, and 3) vegetation, slash, disturbed soil or debris is not deposited in a position where it could mobilise because of heavy rain or flood flows and: a) be deposited on other property, or b) divert or dam water, or c) cause bed or bank erosion, or d) damage receiving environments, downstream infrastructure, or property, and 4) any discharge of sediment originating from the cleared area does not give rise to any of the following effects in the receiving waters beyond a 20 metre radius of the point of discharge: a) any conspicuous change in colour or visual clarity, or b) the rendering of fresh water unsuitable for consumption by farm animals, or c) the rendering of surface water taken from a mapped priority drinking water abstraction point (refer I Maps | Ngā mahere matawhenua) unsuitable for human consumption after existing treatment.	☒	☐	☐		**Comment: no vegetation clearance within 10m of a stream or natural wetland**

Proposed Regional Plan for Northland (PRP)					
Relevant Chapter	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
C.2 Activities in the beds of lakes and rivers and in wetlands					
C.2.2 Activities affecting wetlands					
C.2.2.1 Natural wetland maintenance and enhancement – permitted activity	☒	☐	☐		N/A – no maintenance and enhancement of any wetlands is proposed.
C.2.2.2 Structures in wetlands – permitted activity	☒	☐	☐		N/A – no structures are proposed in a wetland
C.2.2.3 Constructed wetland alteration – permitted activity	☒	☐	☐		N/A – the alteration of a constructed wetland is proposed.
C.2.2.4 Activities in natural and constructed wetlands – discretionary activity 1) damage, destruction, disturbance, or removal of a plant in a wetland or deliberate introduction of a plant in a wetland for wetland maintenance or wetland enhancement, or 2) use, erection, reconstruction, placement, alteration, extension, removal, or demolition of any structure in a wetland, or 3) disturbance of the bed of a constructed wetland and construction or installation of a structure in a constructed wetland, that is not the subject of any other rule in this Plan are discretionary activities, provided the activities are not undertaken in a significant wetland.	☒	☐	☐		**Comment: No works have occurred or are proposed within a natural wetland.**

APPENDIX 2 NATIONAL ENVIRONMENTAL STANDARDS AND NATIONAL POLICY STATEMENTS

NES – Freshwater

Regulation 3: Interpretation - Relevant Definitions		**Comments**
cleanfill area	means an area used exclusively for the disposal of cleanfill material.	The activity does not meet the definition of cleanfill area, particularly as the proposal is for a temporary laydown and transfer facility, whereby spoil is temporarily stockpiled.
cleanfill material	means virgin excavated natural materials including clay, gravel, sand, soil and rock that are free of: (a) combustible, putrescible, degradable or leachable components; (b) hazardous substances and materials; (c) products and materials derived from hazardous waste treatment, stabilisation or disposal practices; (d) medical and veterinary wastes, asbestos, and radioactive substances; (e) contaminated soil and other contaminated materials; and (f) liquid wastes.	Spoil meets the definition of cleanfill material.
Specified Infrastructure	means any of the following: (a) infrastructure that delivers a service operated by a lifeline utility (as defined in the Civil Defence Emergency Management Act 2002) (b) regionally significant infrastructure identified as such in a regional policy statement or regional plan (c) any water storage infrastructure (d) any public flood control, flood protection, or drainage works carried out: (i) by or on behalf of a local authority, including works carried out for the purposes set out in section 133 of the Soil Conservation and Rivers Control Act 1941; or (ii) for the purpose of drainage by drainage districts under the Land Drainage Act 1908 (e) defence facilities operated by the New Zealand Defence Force to meet its obligations under the Defence Act 1990 (f) ski area infrastructure	NZTA Waka Kotahi is a lifeline utility under the Civil Defence Emergency Management Act. A state highway is therefore specified infrastructure.

Part 3 Standards for other activities that relate to freshwater

Subpart 1 – Natural Inland Wetlands

Activity	**Not applicable**	**Complies**	**Does not Comply**	**Comment**
Regulation 45 Construction of Specified Infrastructure	☒	☐	☐	**Regulations apply to activities associated with the construction of specified infrastructure within, or within 100m of a natural inland wetland. There are no identified natural inland wetlands within 100m. For completeness, if there was a natural inland wetland within 100m, it is not expected the temporary stockpile**

				would result, nor likely result in the complete or partial drainage of a natural inland wetland. **No resource consents triggered.**
Regulation 45B Landfill and Cleanfill areas	☒	☐	☐	**The temporary stockpiling of cleanfill material does not meet the definition of cleanfill area.**

NES – Contaminants in Soil				
If works of the following activities are taking place, then the NES may apply to the development:				
Activity	***Not Applicable***	***Complies***	***Consent Required***	***Comment***
Removing or replacing fuel storage system	☒	☐	☐	
Sampling soil	☒	☐	☐	
Disturbing soil	☐	☒	☐	The site is not showing as a HAIL site on Northland Regional Council Selected Land use maps and is not known to have any contaminated soil within the works area.
Subdividing or changing use	☒	☐	☐	

Attachment C – Southern Fill Site Planning Assessment

STELLAR | PROJECT DELIVERY SPECIALISTS

MANGAMUKA 2022 SLIP RESPONSE

Southern Fill Site (Stage 1 Fill Area)

4321 State Highway 1, Mangamuka

PLANNING CHECKLIST:

Far North Operative District Plan

Far North Proposed District Plan

Far North District Council Bylaws

Northland Proposed Regional Plan

National Environmental Standards

National Policy Statements

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1. DOCUMENT QUALITY CONTROL RECORD

To	Kim Cottle, Principal Planner, Waka Kotahi
Copy	Hendrik Postma, Senior Project Manager, Waka Kotahi
Document Status	Version 4: Client issue
Date	3 October 2024
Prepared By	Stuart Brooke, Planning Manager, Stellar Projects Updated V4: Alex Erceg, Senior Planner, Stellar Projects
Authorised for Issue	Stuart Brooke, Planning Manager, Stellar Projects
File/Ref	J004190 – Mangamuka 2022 Slip Response
Front cover image:	Drone survey showing construction of the Stage 1 fill site

2. RELEVANT SITE DETAILS

Site Address	4321 State Highway 1
Site Area	70.7162 hectares
Legal Description	Mangamuka West 3GG Block contained in NA21A/428 Mangamuka West 3CC Block contained in NA316/204
Relevant Title Instruments	Appurtenant right of way created by Court Order 12593 (over Part Mangamuka West No.3 O Block contained in Title 498573) Appurtenant hereto is a right of way created by Maori Land Court Order 10859753.1 (over Part Kauhoehoe Block contained in Title 307725)
Owner/s	Wharepapa Landholdings Limited
Relevant Plans & Regulations & Policy Statements	Operative Far North District Plan – 2009 Proposed Far North District Plan – 23 May 2023 (Rules with immediate legal effect) Proposed Northland Regional Plan – February 2024 National Environmental Standards: Freshwater 2020 (updated January 2023); Assessing and Managing Contaminants in Soil to Protect Human Health (2011) National Policy Statement for Highly Productive Land

3. CONSENTING SUMMARY TABLE

CLL on behalf of Waka Kotahi is carrying out the fill activity at 4321 State Highway 1 under the emergency works provisions of s330 of the Resource Management Act 1991 (as further explained in Section 6 below). Within this context, the purpose of carrying out this District and Regional Plan rule checklist is to:

a) achieve compliance with permitted standards where possible; and

b) identify potential requirements for retrospective consents under s330A RMA where rule infringements will result in ongoing adverse effects following the completion of emergency works.

We have determined that the Stage 1 fill site is a permitted activity under the relevant plans, being the Far North Operative District Plan, the Northland Proposed Regional Plan – Appeals Version, based on the following assumptions:

- The activity will comply with the relevant noise standards.
- Spoil material will be limited to non-contaminated soils, rocks, gravel, sand, clay and other natural materials that meet the following standards:
    - Waste Acceptance Criteria: Class 5 Clean Fill[1]
    - Clean Fill in Far North District Plan Rule 12.3.6.1.4.

Planning Regulation	**Consent Triggered (Y/N)?**	**Consents Required/Comments**	**Will retrospective consent be required (explained further in Section 7)**
Operative Far North District Plan	Yes	Consents will be triggered for infringements of: • **Rule 8.6.5.1.5** - Transportation – **Restricted Discretionary** • **Rule 15.1.6A** – Maximum One-way Traffic Movements – **Restricted Discretionary**	No retrospective resource consents required as no on-going adverse effects.
Proposed Far North District Plan	No	No works within a Significant Natural Area. There are no other relevant rules with immediate legal effect.	N/A

[1] Technical Guidelines for Disposal to Land - Revision 3, WasteMINZ, October 2022

Far North District Council – Control of Earthworks Bylaw	Possibly	Bylaw Exemption will be required if depth of earthworks exceeds 1.5m.	It is understood maximum height will not exceed 1.5m, however exemption will be required if it does.
Proposed Regional Plan for Northland	No	Earthworks will not exceed than 5,000m^2. No works within (or within minimum setback of) a natural wetland, stream or riparian yard.	N/A
National Environmental Standard: Freshwater	No	No works within 10m of a natural wetland. Water diversion and discharge from earthworks will not have a hydrological connection with wetlands within 100m of activity	N/A
National Environmental Standard: Contamination	No	The site is not known to have any soil contamination.	N/A
National Policy Statement: Highly Productive Land	No	Not applicable as activity associated with maintenance of specified infrastructure	N/A

4. BACKGROUND TO THE PROPOSAL

The section of State Highway 1 through the Maungataniwha Range, commonly referred to as the Mangamuka Gorge ("Gorge"), has been closed since August 2022 due to severe weather events which have caused a large number of land slips along the 14km section of road between the Gorge. Emergency remediation of critical slips within the gorge is currently being carried out and is expected to be completed by December 2024.

Due to the high ecological values and steep terrain within the Gorge, all spoil material from earthworks within the gorge needs to be exported to remote fill sites. The Gorge

The Gorge contains two separate river catchments. The northern side of the gorge summit forms the headwaters of the Victoria River, and the southern side of the gorge summit forms the headwaters of the Mangamuka River. To minimise the risk of spreading *Phytophthora agathidicida* (kauri disease), all spoil material must be retained in the catchment where it was excavated. Thus all spoil from the slip sites on the south side of the summit must be disposed to locations south of the Gorge and vice versa.

A suitable site to accommodate spoil from the southern section of the gorge project has been identified at 4321 State Highway 1 ("the site"), which is a 70ha rural landholding that is primarily utilised for pastoral farming. This will involve all spoil from slip sites south of the gorge summit until the completion of the project, most notably the current Slip A12/13 works and the proposed works at Slip A11 which requires significant excavation to accommodate a road realignment. All spoil material will meet the

The fill operation is proposed to take place in three separate locations across the site (refer to **Figure 2** below) in a staged approach. Stage 1, which is the subject of this assessment, comprises a fill area in the south-eastern corner of the site, which is labelled '*Dumpsite 1'* in Figure 2. A separate planning assessment has been completed for the area in Figure 2 identified as "*Dumpsite 3*". "*Dumpsite 2*" was not utilised.

This planning assessment finalises two previous versions of this assessment already provided to NZTA Waka Kotahi.

Further stages of the fill operation, including the placement of additional spoil within Dumpsite 1 beyond 5,000m3, will require a separate assessment and are not addressed in this report.

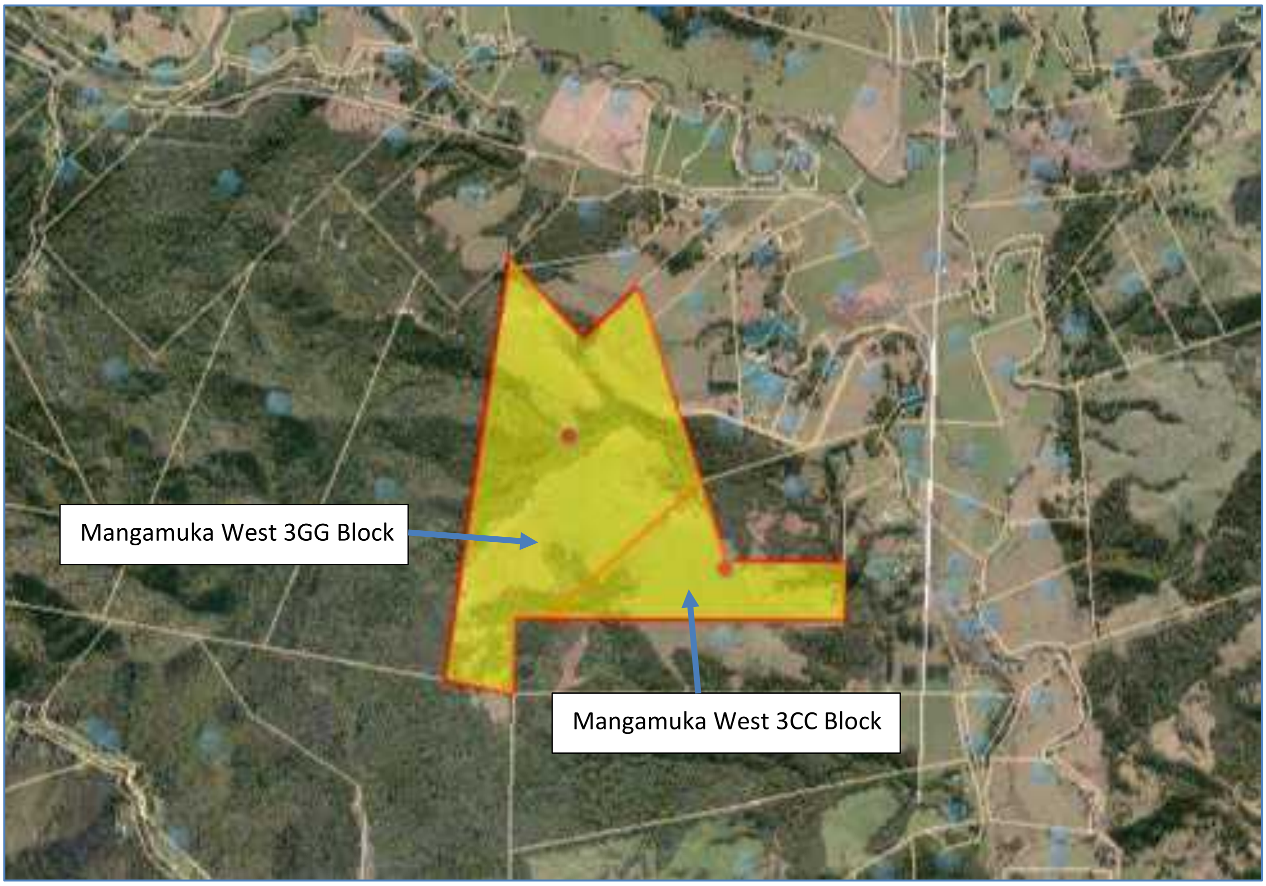

Figure 1: 4321 State Highway 1 site locality aerial photograph

Figure 2: Most recent available aerial photograph of the site (google maps) showing approximate location of the proposed fill site ("Dump site 1") and additional fill areas for future works (Dumpsites 2 & 3 – not part of this assessment).

5. SITE DESCRIPTION & PROPOSAL

As noted above, the site comprises 70ha of land in two titles (refer Figure 1) which is predominantly used for pastoral farming. The site has an elevated aspect above the low-lying plains to the north and east that are associated with Mangamuka River.

Access to the site from SH1 is via a 10m wide right of way easement (ROW) over two adjacent properties: a 4.97ha property legally described as Part Mangamuka West No.3 O Block, and 1.68ha property legally described as Part Kauhoehoe Block (refer Figure 2). As per Clause 2, Schedule 5 of the Property Law Act 2007, the owners and occupiers (including CLL as a lessee) of the benefitted land (i.e. 4321 SH1) has the right to establish a driveway and make necessary repairs[2]. The vehicle crossing to SH1 has a wide splay and good sight lines in both directions (refer Figure 4).

The accessway within the ROW is a one-way gravel driveway of variable width, which has recently been resurfaced and widened by up to approximately 2m in places to prepare for the fill operation (this can be seen in Figure 9). A short section of the driveway that passes over an old culvert crossing has been upgraded to concrete to avoid the weight of trucks damaging the culvert (refer Figure 5). The driveway meets the relevant minimum standards for a private accessway in the Rural Production zone, being 1:5 Maximum gradient and 3.0m minimum width.

[2] Email advice from Michael Hibbert of The Property Group, 24 November 2023

Figure 3: Aerial photograph of the two adjoining properties where ROW access is provided to the site.

Figure 4: Photograph of site entrance from State Highway 1.

Figure 5: Photograph of culvert crossing being upgraded to concrete finish

The Stage 1 fill site is located on gently sloping pastoral land in the south-eastern corner of the site, with a setback of at least 15m from a gully below which contains native bush. and is setback at least 15m from the gully vegetation. An ecological assessment of the site has confirmed no natural wetlands are located within or near the proposed fill area, including the gully below. The sediment control plan notes that there are two wetland areas located 45m and 63m away from the fill site. These are located to the south / southwest on the far side of a ridgeline, and not linked hydrologically to the fill site. As detailed in Section below, the Stage 1 fill area is not subject to any restrictive planning overlays or notations.

The fill area will contain a disposal area of 4,990m^2 and is designed to accommodate 5,000m^3 fill. It is divided into two separate catchments by a ridgeline feature. A detailed sediment and erosion control plan has been designed by CLL and Southern Skies and contains a range of sediment control measures, including a perimeter earth bund leading to a decanting earth bund for the eastern catchment, and a silt fence for the western catchment (refer to **Figure 6**). Slurry pit cells have been installed on the western edge of the fill site to accommodate sediment-laden material from the sediment control bins being used throughout the Gorge slip sites, which are pumped into hydro-excavator trucks and discharged into the slurry pits. These sediment control measures comply with the relevant standards in the Proposed Regional Plan.

Ancillary works associated with Stage 1 fill area include an approximately 1,000m^2 aggregate area above the fill site to provide for truck manoeuvring (visible in Figure 7) and a site office.

Total one-way vehicle movements will not exceed 60 per day for the Stage 1 fill operation. This is based on a typical intensity of:

- 10 return truck movements per day for removal of spoil at Slips A12/13
- 5 pump trucks discharging sediment laden water into slurry pits
- A small number of vehicle movements associated with site workers (typically 5 workers on-site, and max of 10).

This equates to a maximum of between 50 and 60 1-way vehicle movements per day.

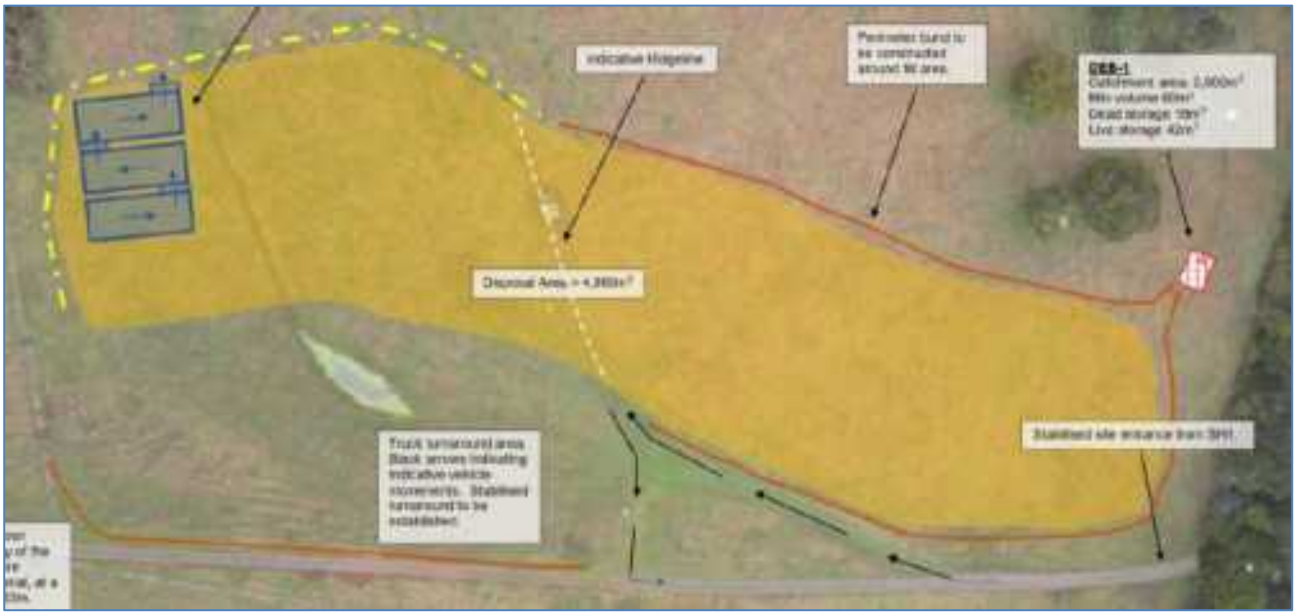

Figure 6: Extent of Stage 1 fill site and sediment control measures.

Figure 7: Aerial drone survey showing the construction of the Stage 1 fill site

Figure 8: Photograph of Stage 1 fill area looking north-west.

Figure 9: Photograph of upgraded driveway, looking west

6. DO S330 RMA EMERGENCY WORKS PROVISIONS APPLY?

In this case this is not applicable as the activities have been determined to be permitted activities.

7. PLANNING CONTEXT TABLE

FNDP Zone (Operative):	Rural Production
FNDP Zone (Proposed):	Rural Production
FNDP Resource area	N/A
FNDP Notations	Top Energy High Voltage Power Lines – the fill sites are sufficiently removed from these lines. 
Soil classification:	The property contains LUC 2 however the fill locations 1- 3 are LUC 4 – Arable. As such NPS-HPL does not apply to this site.
Northland brown kiwi & mudfish distribution:	N/A
Significant indigenous vegetation & significant habitats of indigenous fauna:	The property contains a PNAP area (in purple) being the Mangamuka-Mangataipa Mosaic however the proposed fill locations 1- 3 (white circles) are outside this area 
Surface Water Protection zone:	N/A

NRC Natural Hazards:	River Flood Hazard zone (10, 50 & 1—year) on site but outside proposed fill locations 1- 3 (white circles)  Land hazard: Flood susceptible site - Undulating Terraces on site (shown in green below), appears to be on the boundary of proposed fill site 1 (shown in red)  Tsunami Evacuation zone
Designations:	N/A
Statutory Acknowledgement Area:	Treaty Settlement Area of Interest: Te Rarawa
HAIL:	The site is not showing as a recognized HAIL site on Northland Regional Councils Selected Landuse Register.
Heritage & Archeology:	No heritage or archaeological sites are showing on, or in proximity to, the site on the New Zealand Archaeological Association online maps or FNDC GIS maps. An archaeological assessment has confirmed no heritage values within the works area.
Regional Plan notations and requirements:	• Hill Country and Lowland Areas: Hill Country Area

	• River Water Quantity Management Units: Coastal River • Groundwater Management Units: Groundwater Zone
Other relevant planning documents:	N/A
Reserves and protected areas and relevant management plans / strategies:	N/A

APPENDIX 1: PLANNING CHECKLIST: OPERATIVE FAR NORTH DISTRICT PLAN 2009

Relevant FNDC Definitions		**Comments**
Impermeable surface	In relation to any site means any building or surface on or over the land which creates a barrier to water penetration into the ground. This definition includes but is not restricted to: (a) decks (including decks less than 1m in height above the ground) excluding open slatted decks where there are gaps between the boards; (b) pools, but does not include pools designed to operate as a detention pond; (c) any surfaced area used for parking, manoeuvring, access or loading of motor vehicles, including areas covered with aggregate; (d) areas that are paved with concrete, asphalt, open jointed slabs, bricks, gobi or materials with similar properties to those listed; (e) roof coverage area on plan; But excludes: i. Water storage tanks occupying up to a maximum cumulative area of 20m2 ; and ii. Paths and paving less than 1m wide, provided they are separated from other Impermeable Surfaces by a minimum of 1m. For the purpose of calculating impermeable surfaces, account shall not be taken of any additional areas that are overlapped by another form of impermeable surfaces. In the case of jointly owned access lots that contain impermeable surfaces within their boundaries, the total area of these impermeable surfaces are to be divided equally and considered as parts of the various sites served by the access lot for the purpose of determining compliance with the relevant stormwater management rules.	Aggregate accessways, parking and manoeuvring areas will be considered impervious.

CHAPTER 8: ZONE RULES – Rural Production Zone					
Activity or standard checked *Note: irrelevant rules have not been included below*	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement**
Standards					
8.6.5.1.3 Stormwater Management	☐	☒	☐	Permitted	8.6.5.1.3 allows a maximum proportion of the gross site area covered by building and other impermeable surfaces shall be 15%. The aggregate vehicle accessway and truck turning area falls within the definition of impermeable surfaces. **Comment: Will comply – impervious surfaces will be less than 1% of the site area.**
8.6.5.1.5 Transportation	☐	☐	☒	Restricted Discretionary	Refers to chapter 15 Rule 8.6.5.3 – Any activity that does not comply with 8.6.5.1.5 Transportation is a restricted discretionary activity. **Comment: Will not comply with the maximum one-way traffic movement requirements.**
8.6.5.1.7 Noise	☐	☒	☐	Permitted	8.6.5.1.6 Noise 8.6.5.1.6(a) – N/A

CHAPTER 8: ZONE RULES – Rural Production Zone

Activity or standard checked *Note: irrelevant rules have not been included below*	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement**
					8.6.5.6(b) - Construction noise shall meet the limits recommended in, and shall be measured and assessed in accordance with, NZS 6803P:1984 "The Measurement and Assessment of Noise from Construction, Maintenance and Demolition Work". **Comment – It is assumed that the proposed earthworks could be designed to comply with this standard given the large separation distance to neighbouring properties (At least 200m to the nearest dwelling). Note: if the works cannot comply with the construction noise standards for rural production zone, then consent would be required as a restricted discretionary activity under Rule 8.6.5.3**
8.6.5.1.11 Scale of Activities	☐	☒	☐	Permitted	For activities ancillary to farming or plantation forestry activities, 8 persons per site or 2 person per 1 hectare of net site area, whichever is the greater. For all other activities, 4 persons per site or 1 person per 1 hectare of net site area, whichever is the greater. **Comment: As the site is 70ha, this allows for up to 70 people on the site. The activity will have between 5 – 10 site workers onsite therefore comfortably complying with this rule.**

CHAPTER 12: Natural and physical resources

Standard Checked	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
Natural Resources					
Outstanding Landscapes and Features					
12.1.6.1.1 Protection of outstanding landscape features	☒	☐	☐		The site does not contain an outstanding natural feature or outstanding natural landscape area.
12.1.6.1.2 Indigenous vegetation clearance in outstanding landscapes	☒	☐	☐		
12.1.6.1.3 Tree planting in outstanding landscapes	☒	☐	☐		
12.1.6.1.4 Excavation and/or filling within an outstanding landscape	☒	☐	☐		
12.1.6.1.5 Buildings within outstanding landscapes	☒	☐	☐		
12.1.6.1.6 Utility services in outstanding landscapes	☒	☐	☐		
12.1.6.3.1 Development Bonus	☒	☐	☐		
12.1.6.3.3 Development on an outstanding natural feature	☒	☐	☐		
Indigenous Flora and Fauna					
12.2.6.1.1 Indigenous vegetation clearance permitted throughout the district	☒	☐	☐		Under Rule 12.2.6.1.2 The clearance of indigenous vegetation in the rural production zone which is more than 10 years old is a permitted activity where:

CHAPTER 12: Natural and physical resources					
Standard Checked	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
					(a) It is not in a remnant forest, not within 20m of a lake, indigenous wetland or continually flowing river, and the clearance does not exceed 2Ha per site. *(refer to FNDP for full text version of the rule)* **Comment: No clearance of indigenous vegetation will be required**
12.2.6.1.2 Indigenous vegetation clearance in rural production	☒	☐	☐		
Soils and Minerals					
12.3.6.1.1 Excavation and/or filling, excluding mining and quarrying	☐	☒	☐	Permitted	Excavation and/or filling, excluding mining and quarrying, on any site in the Rural Production Zone or Kauri Cliffs Zone is permitted, provided that: (a) it does not exceed 5,000m3 in any 12-month period per site; and (b) it does not involve a continuous cut or filled face exceeding an average of 1.5m in height over the length of the face i.e. the maximum permitted average cut and fill height may be 3m. **Comment: The Stage 1 fill area will not exceed 5,000m3**
12.3.6.1.4 Nature of filling material in all zones	☐	☒	☐	Permitted	Filling in any zone shall meet the following standards: (a) the fill material shall not contain putrescible, pollutant, inflammable or hazardous components; and (b) the fill shall not consist of material other than soil, rock, stone, aggregate, gravel, sand, silt, or demolition material; and (c) the fill material shall not comprise more than 5% vegetation (by volume) of any load. **Comment: Assumed fill will comply with these standards.**
12.3.6.2 Discretionary activities	☒	☐	☐		An activity is a discretionary activity if: (a) it does not comply with one or more of the standards for permitted or restricted discretionary activities as set out under Rules 12.3.6.1 and 12.3.6.2 above; or (b) The excavation and/or filling is for the purposes of mining or quarrying, other than a quarry covered by definition of 'normal rural practices', and a Development Plan is part of the application as provided for in Rule 12.3.6.3.1 below; but (c) it complies with the relevant standards for permitted, controlled, restricted discretionary and discretionary activities in the zone in which it is located, set out in Part 2 of the Plan - Environment Provisions; and (d) it complies with the other relevant standards for permitted, controlled, restricted discretionary or discretionary activities set out in Part 3 of the Plan - District Wide Provisions.
Natural Hazards					
12.4.6.1.1 Coastal Hazard 2 Areas	☒	☐	☐		The site is not identified as a coastal hazard zone. No buildings are proposed.
12.4.6.1.2 Fire Risk to residential units	☒	☐	☐		
12.4.6.2.1 new buildings & additions to existing buildings in coastal hazard 2 areas	☒	☐	☐		
12.4.6.3.1 Coastal hazard 1 areas	☒	☐	☐		

CHAPTER 12: Natural and physical resources					
Standard Checked	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
Heritage					
12.5.6.1.1 Notable trees	☒	☐	☐		No heritage features are identified on the site
12.5.6.1.2 Altercations to/and maintenance of historic sites, buildings and objects	☒	☐	☐		
12.5.6.1.3 Registered Archaeological Sites	☒	☐	☐		
12.5.6.2.1 Heritage resources – permanent protection	☒	☐	☐		
12.5.6.2.2 Activities which could affect sites of cultural significance to Maori	☒	☐	☐		
12.5.6.3.1 Development bonus	☒	☐	☐		
Lakes, Rivers, Wetlands and the Coastline					
12.7.6.1.1 Setback from Lakes, rivers and coastal marine area	☒	☐	☐		There are no lakes or rivers (minimum 3m average width) near the Stage 1 fill site.
12.7.6.1.2 Setback from smaller lakes, rivers and wetlands	☐	☒	☐	Permitted	This rule requires to the following setbacks of buildings and impervious surfaces: - 10 x the average width of the river where it passes through or past the site; - 30m from any wetland that is 1ha or more in area **Comment:** **No buildings are proposed, and the only new impervious areas are the widened haulage road and truck turnaround area above the fill site. This rule does not apply to river crossings or activities relating to the construction or maintenance of river crossings – therefore the driveway widening is exempt.** **The truck turnaround area is located approximately 150m away from the gully area and will easily comply with the minimum setback required from any small stream within the gully. There are no wetlands >1ha on the site.**
12.7.6.1.3 Preservation of indigenous wetlands	☐	☒	☐	Permitted	Any land use activity within an indigenous wetland of 200m^2 or more that does not change the natural range of water levels or the natural ecosystem or flora and fauna it supports is a permitted activity. **Comment: there are no indigenous wetland of 200m2 or more near the Dumpsite 1. There is a wetland area on the northern side of the accessway, near the site entrance, that is >200m2 and may meet the definition of "indigenous wetland". The minor driveway upgrade works are very unlikely to change the natural range of water levels within this wetland.**
12.7.6.1.6 Noise	☒	☐	☐		N/A – This rule is relevant to noise on lakes and streams

CHAPTER 15: Transportation					
Activity or standard checked	**Not Applicable**	**Complies**	**Consent Required**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
Rural Production zone					

CHAPTER 12: Natural and physical resources					
Standard Checked	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
15.1.6A Maximum Daily one-way traffic movements	☐	☐	☐	Restricted Discretionary	Permitted: Rural Production maximum daily one-way movements: 30 one-way movements if via a State Highway Restricted Discretionary: 31- 200 one-way movements. Discretionary: More than 200 one-way movements. *Note: construction traffic is exempt but has to be associated with establishment of an activity.* **Comment:** **It is anticipated one-way traffic movements would exceed 30 one-way movements per day. As the traffic does not relate to the establishment of an activity, it is not exempt from this rule.**
15.1.6B.1.1 Car parking spaces	☒	☐	☐		This rule relates to a change in activity or additional buildings on the site.
15.1.6C.1.1 Standards for private access	☐	☒	☐	Permitted	**Comment** **The accessway complies with the relevant minimum standards for a private accessway in the Rural Production zone are:** ➢ **1:5 Maximum gradient** ➢ **3.0m minimum width** **As SH1 is a limited access road, it is recommended that consultation with the WK Environmental Planning team is undertaken to check if any measures are required (e.g. traffic management plan) to ensure adequate safety for the crossing.**

APPENDIX 2: PLANNING CHECKLIST: BYLAWS FOR FAR NORTH DISTRICT COUNCIL

	Not Applicable	**Complies**	**Does not comply**	**Rule(s) infringed and the extent of the infringement.**
Control of Earthworks Bylaw 2019 Where a Resource Consent for earthworks and/or filling is not required under the Far North District Plan, then no person shall carry out or cause to be carried out, any excavation, cellar construction or filling until the Council's approval has been obtained and a permit has been issued for earthworks: (a) that is within 3 metres of any boundary or water body in all zones, except Minerals zone; …	☐	☐	☐	**Comment: the average depth of fill will be 1m across the site, however it is not known whether there will be any areas of fill greater than 1.5m in any location at this stage. If this occurs, a Bylaw exemption will be required from FNDC.**

	Not Applicable	Complies	Does not comply	Rule(s) infringed and the extent of the infringement.
(c) that is in a Rural Production zone, and beyond 3 metres of any boundary or water body, and **that exceeds 1.5 metres in depth**; (d) in any area of natural or physical resource specified in Part 3 of the Far North District Plan				
Control of On-site Wastewater Disposal Systems Bylaw 2010	☐	☒	☐	
Speed Limit Bylaw 2019	☐	☒	☐	

APPENDIX 3: PLANNING CHECKLIST: FAR NORTH DISTRICT PLAN (PROPOSED) 2023

Relevant Definitions		**Comments**
Significant Natural Area	means an area: identified in Schedule 4 of the District Plan as an area of significant indigenous vegetation or significant habitat of indigenous fauna; or assessed by a suitably qualified and experienced ecologist as meeting one of the criteria for ecological significance in Appendix 5 of the Regional Policy Statement for Northland 2016 or within any more recently gazetted National Policy Statement on indigenous biodiversity.	A site walkover by the project ecologist confirmed that the Stage 1 fill area does not contain any vegetation or habitat that meets the SNA definition.

Far North District Plan (Proposed)					
Rules with immediate Legal effect	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
Permitted					
EW-R13 Earthworks and sediment The earthworks comply with standard EW-S5 Erosion and sediment control and EW S3 Accidental discovery protocols EW-S5 – Erosion and sediment controls: i. must for their duration be controlled in accordance with the Erosion and Sediment Control Guidelines for Land Disturbing Activities in the Auckland Region 2016 (Auckland Council Guideline Document GD2016/005); ii. shall be implemented to prevent silt or sediment from entering water bodies, coastal marine area, any stormwater system, overland flow paths, or roads. EW-S3 -Accidental discovery protocol	☐	☒	☐	Permitted	**Comment: Erosion and sediment controls have been implemented in accordance with this standard and Accidental discovery protocols will be implemented for the duration of works.**

Far North District Plan (Proposed)					
Rules with immediate Legal effect	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
IB-R4 - Indigenous vegetation clearance and any associated land disturbance outside a Significant Natural Area All zones Where: PER-1 1. A report has been obtained from a suitably qualified and experienced ecologist confirming that the indigenous vegetation does not meet the criteria for a Significant Natural Area and it is submitted to Council 14 days in advance of the clearance being undertaken; and 2. It does not exceed the following amounts per site over a 5-year period: i. Rural Production zone, Horticulture zone, Māori Purpose zone and Treaty Settlement Land Overlay – 5,000m2 if not in a remnant forest, otherwise 500m2 in a remnant forest; ii. All other zones – 500m2. PER-2 A report has not been obtained from a suitably qualified and experienced ecologist confirming that the indigenous vegetation does not meet the criteria for a Significant Natural Area and a report has not been submitted to Council 14 days in advance of the clearance being undertaken; and It does not exceed 100m2 per site in any calendar year.	☒	☐	☐		**Comment: No indigenous vegetation clearance is proposed.**

APPENDIX 4 - PROPOSED REGIONAL PLAN FOR NORTHLAND

Relevant Definitions		**Notes**
Earthworks	The mechanical disturbance of earth by excavation, cutting and filling, blading, ripping, contouring, quarrying or placing or replacing earth or cleanfill material and includes associated revegetation, but does not include: 1. construction, repair, alteration or maintenance of bores, or 2. the maintenance of walking and other recreational tracks and farm tracks, or 3. the placement of roading aggregates during road and track works, or 4. directional drilling, boring or thrusting up to 250mm diameter, or 5. digging post holes, or 6. planting trees, or 7. land preparation, or 8. vegetation clearance	Fill operations fall within this definition
Erosion control plan	Means a plan developed by a suitably qualified professional which specifically identifies areas of gully, landslide, and earthflow erosion and measures to mitigate sediment yield from these areas and meets the requirements of H.2 Erosion Control Plans. For the purposes of preparing Erosion Control Plans, "suitably qualified professional" means a person who: 1. has at least five years' experience in the management of pastoral, horticultural or arable farm systems, and 2. has completed advanced training or has tertiary qualifications in soil conservation, soil science or sediment management, or	Proposed sediment control plan meets this definition

	3. is a Northland Regional Council Land Management Advisor.	
Erosion Prone Land	Land defined as Land Use Capability (LUC) units 6e17, 6e19, 7e1 - 7e10, 8e1 - 8e3, and 8s1. The LUC units are generally depicted in the New Zealand Land Resource Inventory (NZLRI) and are also shown in I Maps | Ngā mahere matawhenua.	The fill site does not meet this definition
Induced wetlands	Wetlands that have formed naturally where wetlands did not previously exist, as a result of human activities, such as construction of roads and railways bunds. Does not include a constructed wetland nor any type of wet, damp or boggy ground that might incidentally occur as a result of land compaction, nor any ditch, drain, silt-trap, pit, bund, stockwater dam, or treatment pond associated with agricultural, pastoral or horticultural activities. Notes: 1. Induced wetlands are a type of natural wetland. 2. The relationship between the various types of wetlands is shown in H.6 Wetland definitions relationships	There are no known induced wetlands within the Stage 1 Fill Site
Natural wetland	Any wetland including an induced wetland and a reverted wetland, regardless of whether it is dominated by indigenous vegetation, but does not include: 1. a constructed wetland, or 2. wet pasture, damp gully heads, or 3. areas where water temporarily ponds after rain, or 4. pasture containing patches of rushes, or 5. artificial water storage facilities; detention dams; reservoirs for firefighting, irrigation, domestic or community water supply; engineered soil conservation structures including sediment traps; and roadside drainage channels. Notes: 1. The Regional Council's wetland mapping indicates the extents of known wetlands – these can be found on the Regional Council's website. 2. The relationship between the various types of wetlands is shown in Appendix H.6 Wetland definitions relationships	There are no natural wetlands near Stage 1 Fill Site, although there is a suspected natural wetland on the north side of the driveway, near SH1
Significant wetland	A natural wetland that meets the significance criteria in the Regional Policy Statement, Appendix 5 –"Areas of significant indigenous vegetation and significant habitats of indigenous fauna in terrestrial, freshwater and marine environments". This includes natural wetlands comprising indigenous vegetation exceeding any of the following area thresholds: 1. saltmarsh greater than 0.5 hectare in area, or 2. lake margins and riverbeds with shallow water less than two metres deep and greater than 0.5 hectare in area, or 3. swamp greater than 0.4 hectare in area, or 4. bog greater than 0.2 hectare in area, or 5. wet heathland (including gumland and ironstone heathland) greater than 0.2 hectare in area, or 6. marsh, fen, ephemeral wetland or seepage greater than 0.05 hectares in area. Notes: 1. If there is any doubt over wetland extent use: Clarkson, B. R., 2013. A vegetation tool for wetland delineation in New Zealand. Prepared by Landcare Research for Meridian Energy Limited. 2. The Regional Council's wetland mapping indicates the extents of known wetlands – these can be found on the Regional Council's website. The purpose of this mapping is to help locate and identify different wetland types. The maps do not form part of this Plan. 3. The relationship between the various types of wetlands is shown in Appendix H.6 Wetland definitions relationships.	There are no known significant wetlands near Stage 1 Fill Site

Proposed Regional Plan for Northland (PRP)

Relevant Chapter	Not Applicable	Complies	Does not comply	Activity Status	Rule(s) infringed and the extent of the infringement.
EARTHWORKS					
Permitted Activity Rules					
C.8.3.1 Earthworks outside the bed of a river, lake, wetland and the coastal marine area, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water:					

Table 15: Permitted activity earthworks thresholds

Location	Earthworks thresholds
Within 10m of a natural wetland, the bed of a continually or intermittently flowing river or lake	200 square metres of exposed earth at any time, and 50 cubic metres of moved or placed earth in any 12-month period.
Within 10m of an inanga spawning site	200 square metres of exposed earth at any time, and 50 cubic metres of moved or placed earth in any 12-month period.
Catchment of an outstanding lake	2500 square metres of exposed earth at any time.
Erosion-prone land	2500 square metres of exposed earth at any time.
High-risk flood hazard area	50 cubic metres of moved or placed earth in any 12-month period.
Coastal riparian and foredune management area	Excluding for coastal dune restoration, 200 square metres of exposed earth at any time.
Flood hazard area	100 cubic metres of moved or placed earth in any 12-month period.
Other areas	5000 square metres of exposed earth at any time.

Relevant Chapter	Not Applicable	Complies	Does not comply	Activity Status	Rule(s) infringed and the extent of the infringement.
C.8.3.1.1 The area and volume of earthworks at a particular location or associated with a project complies with the thresholds in table 15 below	☐	☒	☐	Permitted	**Comment:** **The Stage 1 fill area is not subject to any of the restricted areas listed in Table 15, therefore the maximum permitted volume is 5,000m^2.** **Parts of the driveway are within a flood hazard area and river. Earthworks associated with upgrading the culvert crossing were less than 200m2 area and 50m3 cut/fill. No other earthworks were undertaken as part of the driveway upgrade.**
Controlled Activity Rules (Operative)					
C.8.3.2 Earthworks outside the bed of a river or lake, wetland and the coastal marine area that exceed 5,000m^2 of exposed earth at any time at a particular location or associated with a project area, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water	☒	☐	☐	n/a	**Comment:** **Earthworks will not exceed 5,000m2 for Stage 1 Fill Site**
C.8.3.3	☒	☐	☐		**Comment:**

Proposed Regional Plan for Northland (PRP)					
Relevant Chapter	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
Earthworks in a flood hazard area that involve more than 50 cubic metres, but not more than 1,000m^3, of earth being moved or placed in any 12-month period, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water.					**Earthworks will not exceed 50m3 within a flood hazard area**
Discretionary Activity Rules (Operative)					
C.8.3.4 - Earthworks – discretionary activity Earthworks outside the bed of a river or lake, a wetland, or the coastal marine area, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water, that are not a permitted or controlled activity under another rule in section C.8.3 of this Plan.	☒	☐	☐		
C.8.4 Vegetation clearance in riparian areas and foredune management area					
C.8.4.1 Coastal dune restoration within the coastal riparian and foredune management area – permitted activity	☒	☐	☐		N/A
C.8.4.2 Vegetation clearance in riparian areas – permitted activity Vegetation clearance within 10 metres of a natural wetland or within 10 metres of the bed of a continually or intermittently flowing river or lake, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water, are permitted activities, provided: 1) the area of cleared vegetation does not exceed 200 square metres in any 12-month period, and 2) vegetation is felled away from rivers, lakes, and natural wetlands, except where it is unsafe or impractical to do so, and 3) vegetation, slash, disturbed soil or debris is not deposited in a position where it could mobilise because of heavy rain or flood flows and: a) be deposited on other property, or b) divert or dam water, or c) cause bed or bank erosion, or d) damage receiving environments, downstream infrastructure, or property, and 4) any discharge of sediment originating from the cleared area does not give rise to any of the following effects in the receiving waters beyond a 20 metre radius of the point of discharge: a) any conspicuous change in colour or visual clarity, or b) the rendering of fresh water unsuitable for consumption by farm animals, or c) the rendering of surface water taken from a mapped priority drinking water abstraction point (refer I Maps | Ngā mahere matawhenua) unsuitable for human consumption after existing treatment.	☒	☐	☐	Permitted	**Comment: no vegetation clearance within 10m of a stream or natural wetland**

APPENDIX 5 NATIONAL ENVIRONMENTAL STANDARDS AND NATIONAL POLICY STATEMENTS

NES – Freshwater	
Regulation 3: Interpretation - Relevant Definitions	
cleanfill area	means an area used exclusively for the disposal of cleanfill material.
cleanfill material	means virgin excavated natural materials including clay, gravel, sand, soil and rock that are free of: (a) combustible, putrescible, degradable or leachable components; (b) hazardous substances and materials; (c) products and materials derived from hazardous waste treatment, stabilisation or disposal practices; (d) medical and veterinary wastes, asbestos, and radioactive substances; (e) contaminated soil and other contaminated materials; and (f) liquid wastes.
Natural Inland Wetland	natural inland wetland means a wetland (as defined in the Act) that is not: (a) in the coastal marine area; or (b) a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or (c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or (d) a geothermal wetland; or (e) a wetland that: (i) is within an area of pasture used for grazing; and (ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless (iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply
Specified infrastructure	Specified infrastructure means any of the following: (a) infrastructure that delivers a service operated by a lifeline utility (as defined in the Civil Defence Emergency Management Act 2002) (b) regionally significant infrastructure identified as such in a regional policy statement or regional plan (c) any water storage infrastructure (d) any public flood control, flood protection, or drainage works carried out: (i) by or on behalf of a local authority, including works carried out for the purposes set out in section 133 of the Soil Conservation and Rivers Control Act 1941; or (ii) for the purpose of drainage by drainage districts under the Land Drainage Act 1908 (e) defence facilities operated by the New Zealand Defence Force to meet its obligations under the Defence Act 1990 National Policy Statement for Freshwater Management 2020 (f) ski area infrastructure
vegetation clearance	vegetation clearance— (a) means the disturbance, damage, destruction, or removal of vegetation by any means (for example, by cutting, crushing, application of chemicals, or burning); and (b) includes activities that result in the disturbance, damage, destruction, or removal of vegetation (for example, over-planting, applying the seed of exotic pasture species, mob-stocking, or draining away water); but (c) does not include— (i) the removal of sphagnum moss for the purpose of a harvest in accordance with regulation 48 or 49; or

	(ii) the crushing of other vegetation for the purpose of maintaining the dominance of sphagnum moss, if the crushing is carried out during a harvest of sphagnum moss or to rehabilitate the moss after it is harvested; or (iii) an activity described in paragraph (a) or (b) that is for the maintenance or construction of fencing for the purpose of excluding stock or marking property boundaries; or (iv) an activity described in paragraph (a) or (b) that is for the maintenance of shelter belts; or (v) grazing

Part 3 Standards for other activities that relate to freshwater

Subpart 1 – Natural Inland Wetlands

Reg 45B: Landfills and Cleanfill Areas				
Activity	**Not applicable**	**Complies**	**Does not Comply**	**Comment**
45B(1) Vegetation clearance within, or within a 10 m setback from, a natural inland wetland is a discretionary activity if it is for the purpose of constructing or operating a landfill or a cleanfill area.	☒	☐	☐	**no vegetation clearance will occur within, or within 10m of a natural inland wetland.**
45B(2) Earthworks or land disturbance within, or within a 10 m setback from, a natural inland wetland is a discretionary activity if it is for the purpose of constructing or operating a landfill or a cleanfill area.	☒	☐	☐	**no earthworks will occur within, or within 10m of a natural inland wetland for the purpose of constructing a landfill**
45B(3) Earthworks or land disturbance outside a 10 m, but within a 100 m, setback from a natural inland wetland is a discretionary activity if it— (a) is for the purpose of constructing or operating a landfill or a cleanfill area; and (b) results, or is likely to result, in the complete or partial drainage of all or part of the wetland.	☒	☐	☐	**As noted on the sediment control plan, there are two wetlands within 100m of the fill area. These wetlands are not located within the same water catchment as the fill area, and will therefore not be partially or completely drained by the earthworks.**
45B(4) The taking, use, damming, or diversion of water within, or within a 100 m setback from, a natural inland wetland is a discretionary activity if— (a) the activity is for the purpose of constructing or operating a landfill or a cleanfill area; and (b) there is a hydrological connection between the taking, use, damming, or diversion and the wetland; and (c) the taking, use, damming, or diversion will change, or is likely to change, the water level range or hydrological function of the wetland.	☒	☐	☐	**The sediment controls for the fill site will involve the diversion of water. However, as per comments above there is no hydrological connection between the fill site and the two wetlands which are within 100m of the activity.**
45B(5) The discharge of water into water within, or within a 100 m setback from, a natural inland wetland is a discretionary activity if— (a) the discharge is for the purpose of constructing or operating a landfill or a cleanfill area; and (b) there is a hydrological connection between the discharge and the wetland; and (c) the discharge will enter the wetland; and (d) the discharge will change, or is likely to change, the water level range or hydrological function of the wetland.	☒	☐	☐	**The sediment controls for the fill site will involve the concentrated discharge of water below the DEB and slurry pits. There are no wetlands within 100m of the discharge points which have a hydrological connection with the discharge.**
45B(6) A resource consent for a discretionary activity under this regulation must not be granted unless the consent authority has first—				Not applicable

(a) satisfied itself that the landfill or cleanfill area— (i) will provide significant national or regional benefits; or (ii) is required to support the quarrying activities regulated under regulation 45A; or (iii) is required to support urban development regulated under regulation 45C; or (iv) is required to support the extraction of minerals regulated under regulation 45D; and (b) satisfied itself that— (i) there is no practicable alternative location for the landfill or cleanfill area in the region; or (ii) every other practicable alternative location in the region would have equal or greater adverse effects on a natural inland wetland; and (c) applied the effects management hierarchy.				

NES – Contaminants in Soil

If works of the following activities are taking place, then the NES may apply to the development:

Activity	***Not Applicable***	***Complies***	***Consent Required***	***Comment***
Removing or replacing fuel storage system	☒	☐	☐	
Sampling soil	☒	☐	☐	
Disturbing soil	☐	☒	☐	The site is not showing as a HAIL site on Northland Regional Council Selected Landuse maps, and is not known to have any contaminated soil within the works area.
Subdividing or changing use	☒	☐	☐	

National Policy Statement for Highly Productive Land

Part 3: Implementation – Landuse requirements

Section	***Not applicable***	***Complies***	***Does not Comply***	***Comment***
	☒	☐	☐	The site has LUC Class 1 & 2 soils however the NPS:HPL policy framework is not applicable as the activity is associated with the maintenance of specified infrastructure (being the repair of State Highway 1).

STELLAR PROJECT DELIVERY SPECIALISTS

MANGAMUKA 2022 SLIP RESPONSE

Southern Fill Site (Fill Sites 2 and 3)

4321 State Highway 1, Mangamuka

PLANNING CHECKLIST:

Far North Operative District Plan

Far North Proposed District Plan

Far North District Council Bylaws

Northland Proposed Regional Plan

National Environmental Standards

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1. DOCUMENT QUALITY CONTROL RECORD

To	Kim Cottle, Principal Planner, NZTA Waka Kotahi
Copy	Hendrik Postma, Senior Project Manager, NZTA Waka Kotahi Benji Potvin, Senior Project Manager, Stellar Projects
Document Status	Client Issue V4
Date	3 October 2024
Prepared By	Alex Erceg, Senior Planner, Stellar Projects
Authorised for Issue	Stuart Brooke, Planning Manager, Stellar Projects
File/Ref	J004190 – Mangamuka 2022 Slip Response
Front cover image:	Proposed Fill site area (Image taken: 4 April 2024)

2. RELEVANT SITE DETAILS

Site Address	4321 State Highway 1
Site Area	70.7162 hectares
Legal Description	Mangamuka West 3GG Block contained in NA21A/428[1] Mangamuka West 3CC Block contained in NA316/204
Relevant Title Instruments	Appurtenant right of way created by Court Order 12593 (over Part Mangamuka West No.3 O Block contained in Title 498573) Appurtenant hereto is a right of way created by Maori Land Court Order 10859753.1 (over Part Kauhoehoe Block contained in Title 307725)
Owner/s	Wharepapa Landholdings Limited
Relevant Plans & Regulations & Policy Statements	Operative Far North District Plan – 2009 Proposed Far North District Plan – 23 May 2023 (Rules with immediate legal effect) Proposed Regional Plan for Northland – February 2024 (Operative in Part) National Environmental Standards: • Freshwater 2020 (updated January 2023); Assessing and • Managing Contaminants in Soil to Protect Human Health (2011)

[1] Fill sites to be located entirely within this legal description, however an access track will need to be formed across both parcels.

3. CONSENTING SUMMARY TABLE

CLL on behalf of Waka Kotahi is carrying out the fill activity at 4321 State Highway 1 under the emergency works provisions of s330 of the Resource Management Act 1991 (as further explained in **Section 7** below). Within this context, the purpose of carrying out this District and Regional Plan rule checklist is to:

a) achieve compliance with permitted standards where possible; and

b) identify potential requirements for retrospective consents under s330A RMA where rule infringements will result in ongoing adverse effects following the completion of emergency works.

An assessment has been undertaken against the relevant statutory documents, based on the following assumptions:

- The activity will comply with the relevant noise standards;
- The extension to the access track will not be placed within 30m of a stream or wetland;
- Spoil material will be limited to non-contaminated soils, rocks, gravel, sand, clay and other natural materials that meet the following standards:
  - Waste Acceptance Criteria: Class 5 Clean Fill[2]
  - Clean Fill in Far North District Plan Rule 12.3.6.1.4.

It has been determined that consents are required as follows:

Planning Regulation	Consent Triggered (Y/N)	Consents Required/Comments	Will retrospective consent be required (explained further in Section 7)
Operative Far North District Plan	Yes	Consents will be triggered for infringements of: • **Rule 8.6.5.1.5** - Transportation – **Restricted Discretionary** • **Rule 12.3.6.2** – Excavation and/or filling – **Restricted Discretionary** • **Rule 15.1.6A** – Maximum One-way Traffic Movements – **Restricted Discretionary**	No retrospective resource consents required as no on-going adverse effects.

[2] Technical Guidelines for Disposal to Land - Revision 3, WasteMINZ, October 2022

Planning Regulation	Consent Triggered (Y/N)	Consents Required/Comments	Will retrospective consent be required (explained further in Section 7)
Proposed Far North District Plan	No	No works within a Significant Natural Area. There are no other relevant rules with immediate legal effect.	N/A
Far North District Council – Control of Earthworks Bylaw	No	Maximum depth will not exceed 1.5m	N/A
Proposed Regional Plan for Northland	Yes	Consents will be required for: • **Rule C.8.3.2** – Earthworks - **Controlled**	No retrospective resource consents required as no on-going adverse effects.
National Environmental Standard: Freshwater	No	WSP has confirmed little change in hydrological pathways to the wetland as a result of the activity, therefore it is not considered resource consents are triggered (refer **Section 7** and **Appendices 6** and **7**)	No retrospective resource consents required as no on-going adverse effects.
National Environmental Standard: Contamination	No	The site is not known to have any soil contamination.	N/A

4. BACKGROUND TO THE PROPOSAL

The section of State Highway 1 through the Maungataniwha Range, commonly referred to as the Mangamuka Gorge ("**Gorge**"), has been closed since August 2022 due to severe weather events which have caused a large number of land slips along the 14km section of road between the Gorge. Emergency remediation of critical slips within the gorge is currently being carried out and is expected to be completed by December 2024.

Due to the high ecological values and steep terrain within the Gorge, all spoil material from earthworks within the gorge needs to be exported to remote fill sites.

The Gorge contains two separate river catchments. The northern side of the gorge summit forms the headwaters of the Victoria River, and the southern side of the gorge summit forms the headwaters of the Mangamuka River. To minimise the risk of spreading *Phytophthora agathidicida* (kauri dieback disease), all spoil material must be retained in the catchment where it was excavated. Thus, all spoil from the slip sites on the south side of the summit must be disposed to locations south of the Gorge and vice versa.

A fill site has been established and is operational for the southern section of the gorge project and is located at 4321 State Highway 1 ("**the site**"), which is a 70ha rural landholding, made up of two legal descriptions, that is primarily utilised for pastoral farming. The already operational fill area (**Fill Site 1**) has a disposal area of 4,990m^2 and is designed to accommodate 5,000m^3 fill. It is divided into two separate catchments by a ridgeline feature. Ancillary works associated with Fill Site 1 include an approximately 1,000m^2 aggregate area above the fill site to provide for truck manoeuvring and a site office. This area was established and has been operational since August 2023.

In order to undertake the earthworks required for the remediation of slip A11 prior to winter to ensure the project timeline can be achieved approximately 26000m^3 of spoil needs to be removed from the gorge. The Stage 1 fill site does not have sufficient capacity to receive that level of spoil and as such a new fill site at 4321 State Highway 1 needs to be established.

Figure 1: *4321 State Highway 1 site locality aerial photograph*

5. SITE DESCRIPTION

As noted above, the site comprises 70ha of land in two titles (refer **Figure 1**) which is predominantly used for pastoral farming. The proposed fill site is to be wholly located on the Mangamuka West 3GG block, with a stabilised access track to be constructed, which will extend across both titles.

The site has an elevated aspect above the low-lying plains to the north and east that are associated with Mangamuka River. There is a large natural inland wetland identified on the Mangamuka West 3GG block, and this allotment is bordered by indigenous vegetation/bush.

Access to the site from SH1 is via a 10m wide right of way easement (ROW) over two adjacent properties: a 4.97ha property legally described as Part Mangamuka West No.3

O Block, and 1.68ha property legally described as Part Kauhoehoe Block (refer **Figure 2).**

Figure 2: *Aerial photograph of the two adjoining properties where ROW access is provided to the site.*

Fill Site 3 is located on undulating pastoral land, sloping downwards from a ridgeline towards the property boundary and indigenous bush. An ecological assessment of the site has confirmed the presence of a natural wetlands located within proposed fill area.

6. PROPOSAL

The proposal, as detailed in the Erosion and Sediment Control Plan (ESCP) prepared by CLL (refer **Appendix 1**) seeks to establish to two separate fill site areas adjacent to each other in the northeastern portion of the site (refer **Figure 3**). The northern most fill area (**Fill Site 3**) will be established first, with the other area being established as required due to the capacity of the other fill site (**Fill Site 2**).

A stabilised access track will need to be constructed from the existing ROW and truck manoeuvring area already constructed during the establishment of the Stage 1 fill site, approximately 1km in length.

The fill area will contain a disposal area of 12,600m^2 (Fill Site 3) and 6,300 m$^{2\,(}$Fill Site 2) resulting in a combined disposal area of 18,900 m^2, and is designed to accommodate 30,000m^3 fill combined total. The fill sites are divided into two separate catchments by a ridgeline feature.

Figure 3: *Proposed fill site layout (Snip for Erosion and Sediment Control Plan)*

Figure 4: *View from within wetland area up to top of hill. Vehicles parked in approximate location of where access track will be constructed.*

A natural inland wetland has been identified on the ESCP (W3) (refer **Figure 3**) between and below the fill areas. A 10m setback has been identified, and no fill or earthworks are to be undertaken within that setback. A perimeter bund will be established around the fill catchment areas (and outside the 10m wetland setback).

The ESCP contains a range of sediment control measures. These sediment control measures comply with the relevant standards in the Proposed Regional Plan.

A sediment retention pond (SRP) will be established outflows from the fill catchment areas to treat stormwater prior to discharge. A stormwater discharge point located at the lowest point in each fill area, discharging towards the lower parts of the wetland area via the SRP.

The fill areas and associated discharge points will reduce the catchment area to parts of the wetland, thus potentially altering the hydrological function of the wetland. WSP are undertaking a hydrological assessment to investigate the potential effects on the wetland and any recommended mitigation measures, such as recontouring following the completion of the fill activity. This was not available at the time of preparing this assessment.

Ancillary works associated with the establishment and operation of Fill Sites 2 and 3 include the establishment of a stabilised access track from the existing fill site of approximately 1km in length.

Material from the excavation at Slip A11 will be temporarily stockpiled at the southern road closure at the gorge, contained wholly within the road reserve. A separate assessment for the temporary stockpiling activity has been undertaken. The material will then be trucked to the southern fill site. A Traffic Management Plan is being prepared by the contractor for the Slip A11 excavation works, but this was not available at the time of preparing this assessment.

Total one-way vehicle movements will occur as follows:

- 1 truck per 15 min between 0700 – 1730 except for 2 x 30-min breaks at 1000 and 1400
- 4 x return truck movements per hour x 9.5 hours = 38 return movements/day

This equates to 76 one-way vehicle movements per day, which exceeds the permitted threshold of 30 one-way vehicle movements per day.

7. DO S330 RMA EMERGENCY WORKS PROVISIONS APPLY?

Section 330 allows Waka Kotahi, as a network utility operator and requiring authority, to undertake certain activities (emergency work or measures) in emergency situations without the need to obtain a resource consent under the RMA.

Emergency works can be undertaken by Waka Kotahi where, in their opinion, their assets are affected, or likely to be affected by:

- an adverse effect on the environment which requires immediate preventive or immediate remedial measures s330(1)(d) and s330(1)(e); or

- any sudden event causing or likely to cause loss of life, injury, or serious damage to property s330(1)(f).

On 23 August 2022 WSP on behalf of Waka Kotahi sent notification to Northland Regional Council, Far North District Council, and Department of Conservation that emergency works were commencing pursuant to s330 Resource Management Act to undertake initial slip clearance and carry out subsequent slip remedial works. Although the project will span more than 2 years in total, the project remains under the emergency works provisions due to the urgent need to re-open the road as soon as possible.

The operation of remote fill sites is a fundamental requirement for the emergency works being undertaken within the Mangamuka Gorge to remediate critical slip sites that are at imminent risk of catastrophic evacuation. Therefore, we consider that this earthworks activity is subject to the s330 RMA for the duration that it is used to support the emergency works being carried out in the gorge.

Under s330A(2) resource consents will be required for any activity, where the activity (but for s330) contravenes Sections 9, 12, 13, 14, and 15 <u>and the adverse effects of the activity continue beyond the completion of the emergency works</u>. If there are no adverse effects of the activities which are ongoing, the s330A(1) correspondence should inform the Council that no resource consents are required.

The retrospective consent provision in s330A is relevant to the proposed Fill Operation as earthworks and traffic volumes exceed permitted activity thresholds.

With respect to vehicle movements, provided this is managed appropriately and in accordance with a Traffic Management Plan, there will be no on-going adverse effects associated with vehicle movements beyond the completion of the fill activity, and as such no retrospective consent will be required.

With regards to earthworks, whether there will be on-going effects will relate to effects on the natural wetland, including effects on the hydrological function of that wetland.

WSP has prepared a memorandum (refer **Appendix 7**) that concludes:

"*Looking at the … comparison in the drainage network there has been little change in the hydrological pathways feeding the wetland.*

This together with the assumptions made in the statement prior to earthworks regarding the hydrogeological impact to the wetland over a surface water influence, the earthworks to date at the site is assessed to have had a minimal impact to the ecology surrounding the dump site".

Based on these conclusions, it is identified the overland flow paths are the same or similar to that that existed prior to the fill site activities and therefore it is not anticipated that the fill would divert water from the wetland and therefore the hydrological function and water level range will not be altered. It is also not anticipated that the would be any residual effects following the completion of the fill site activities.

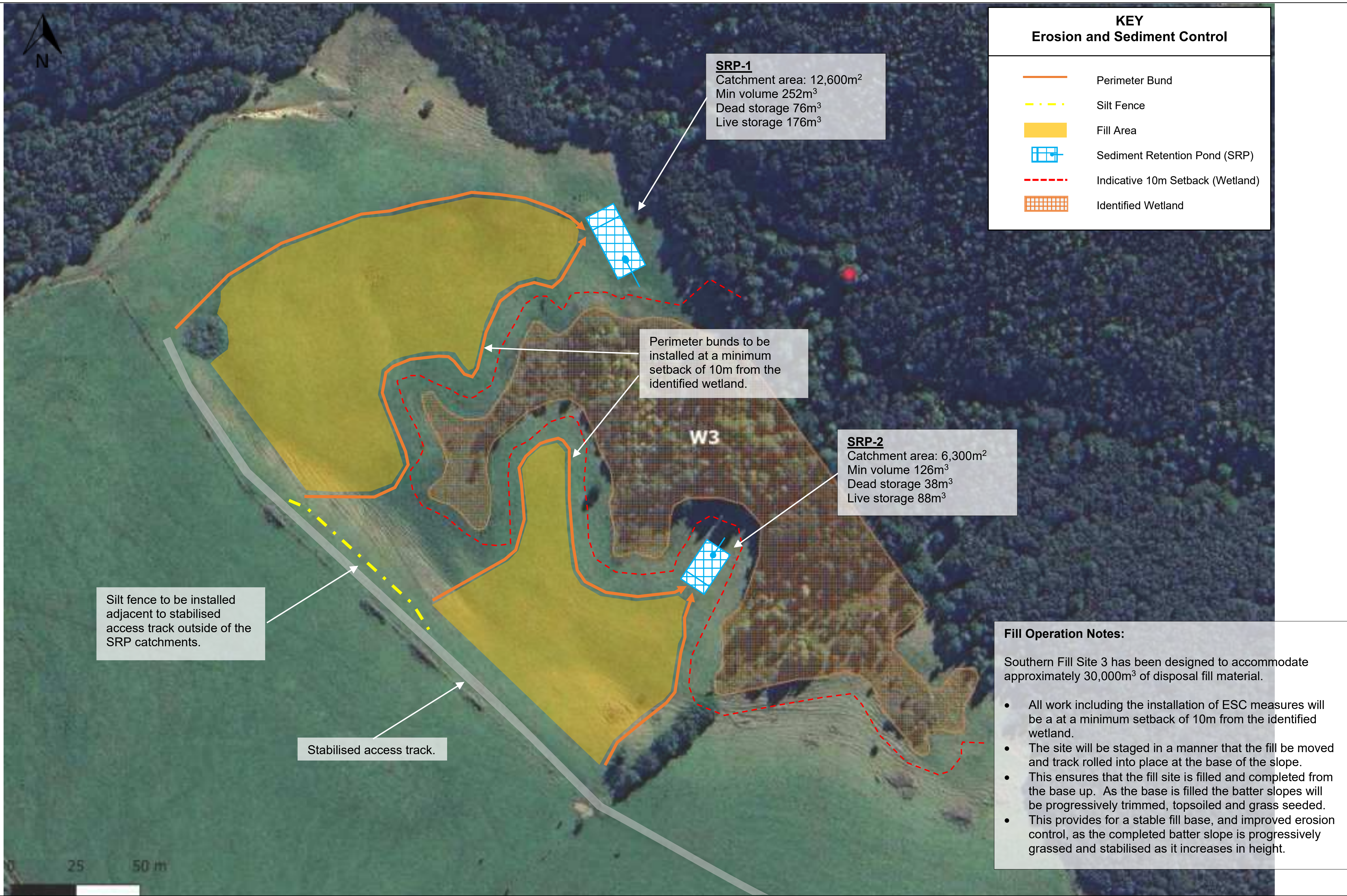
8. PLANNING CONTEXT TABLE

FNDP Zone (Operative):	Rural Production
FNDP Zone (Proposed):	Rural Production
FNDP Resource area	N/A
FNDP Notations	Top Energy High Voltage Power Lines – the fill sites are sufficiently removed from these lines. 
Soil classification:	The property contains LUC 2 however the fill locations 1- 3 are LUC 4 – Arable. As such NPS-HPL does not apply to this site.
Northland brown kiwi & mudfish distribution:	N/A
Significant indigenous vegetation & significant habitats of indigenous fauna:	The property contains a Protected Natural Areas Programme (**PNAP**) area (in purple) being the Mangamuka-Mangataipa Mosaic however the proposed fill locations (white circle) are outside this area. The area of native vegetation below the proposed fill sites is not identified as a PNAP

	
Surface Water Protection zone:	N/A
NRC Natural Hazards:	River Flood Hazard zone (10, 50 & 1—year) on site but outside proposed fill locations 1- 3 (white circles) 
Designations:	N/A
Statutory Acknowledgement Area:	Treaty Settlement Area of Interest: Te Rarawa
HAIL:	The site is not showing as a recognized HAIL site on Northland Regional Councils Selected Landuse Register.
Heritage & Archeology:	No heritage or archaeological sites are showing on, or in proximity to, the site on the New Zealand Archaeological Association online maps or FNDC GIS maps. An archaeological assessment has confirmed no heritage values within the works area.

Regional Plan notations and requirements:	• Hill Country and Lowland Areas: Hill Country Area • River Water Quantity Management Units: Coastal River • Groundwater Management Units: Groundwater Zone
Other relevant planning documents:	N/A
Reserves and protected areas and relevant management plans / strategies:	N/A

APPENDIX 1: EROSION AND SEDIMENT CONTROL PLAN



NOTES

1. All erosion and sediment controls will be installed and maintained in accordance with Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities'* (GD05).
2. Earthworks are to be programmed to ensure rapid stabilisation.
3. All erosion and sediment control measures will be inspected on a daily basis by the site foreman.
4. Site monitoring will be undertaken before and immediately after rain as well as during heavy rainfall events. Any required maintenance or improvements to control measures will be undertaken immediately.

REV	DATE	REVISION DETAILS	APPROVED
A	05.04.24	Draft for review.	TH

CLL SERVICE & SOLUTIONS

Project	MANGAMUKA GORGE
Title	Erosion and Sediment Control Plan – Southern Fill Site 3 – April 2024

Drawn	Checked	Drawing No.	Sheet No.
MD	CS	ESCP-SFS-003-01	01

Appendix A – Erosion and Sediment Control Details

Perimeter Bund Sizing Summary

The perimeter bunds will provide perimeter control. The perimeter bunds will ensure that no water can discharge off site without flowing to either the SRP or silt fence.

As referred to in GD05, the standard height for a diversion bund (Figure 2) for catchment areas less than 5ha is 550mm (including 300mm of freeboard) and the standard width at the base of the bund is 2m. This will be complied with on site.

All bunds onsite will have a minimum height of 550mm.

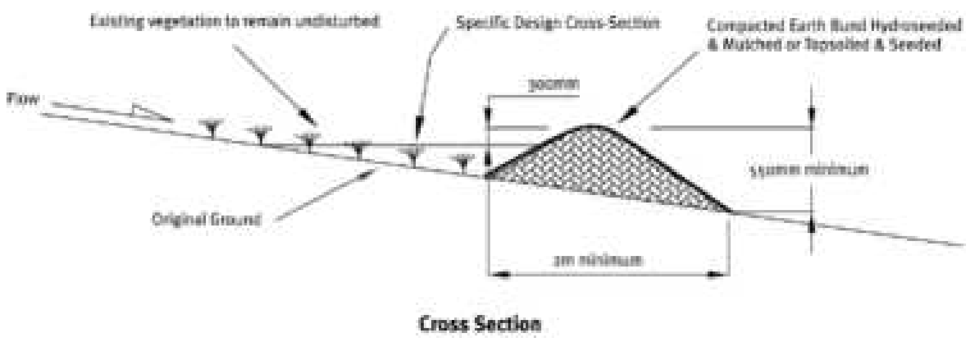


Figure 2: Cross section of a perimeter diversion bund.

Sediment Retention Pond Design Details

SRP-1

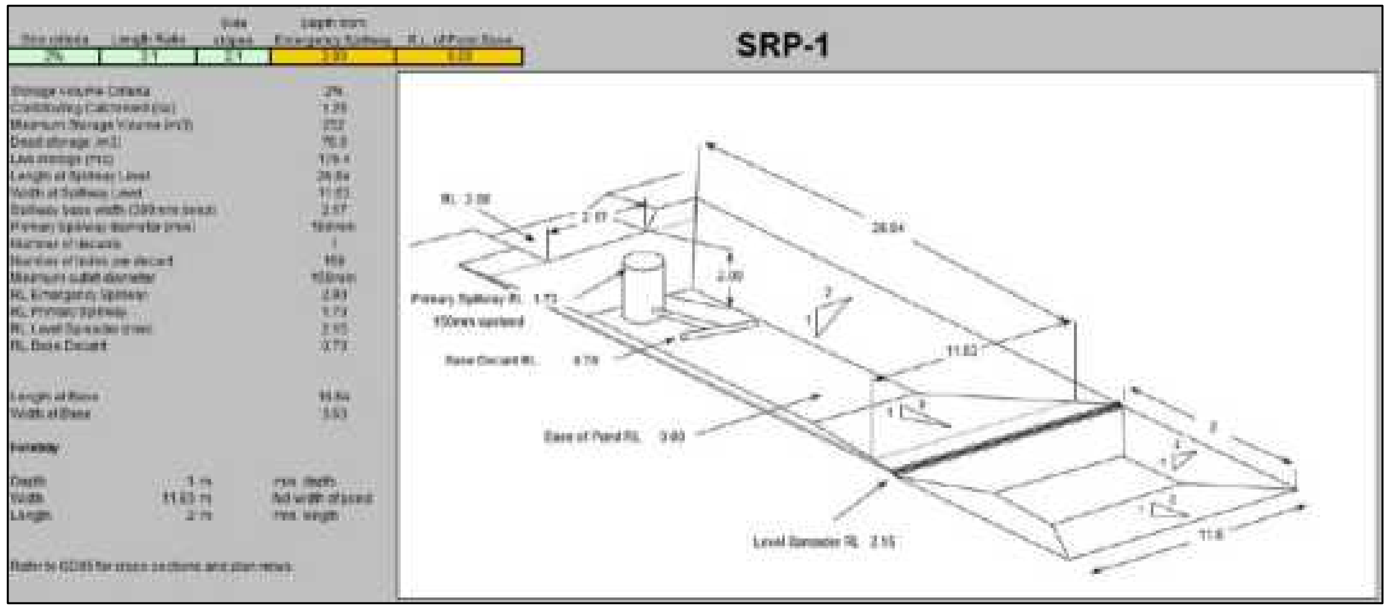


Figure 3: SRP-1 design details.

Note: volume is calculated to the top of the primary spillway but dimensions shown are from emergency spillway height.

SRP-2

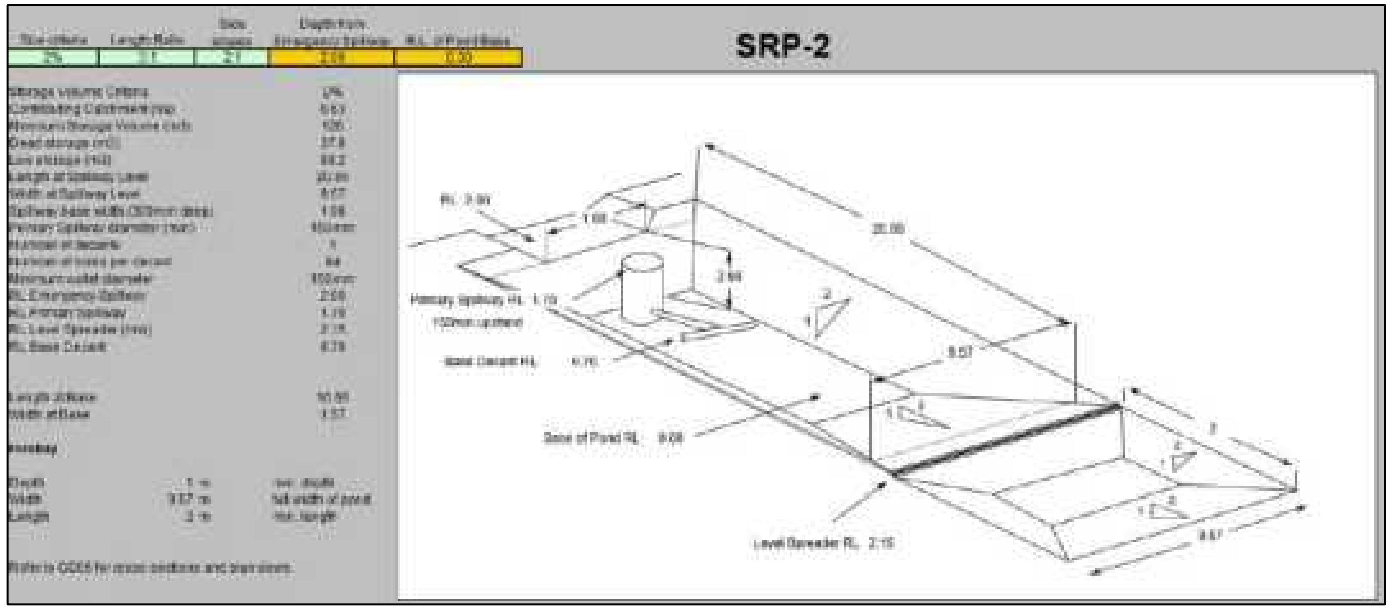


Figure 4: SRP-2 design details.

Note: volume is calculated to the top of the primary spillway but dimensions shown are from emergency spillway height.

Appendix B – ESC Drawing

Title	Drawing No.	Sheet No.	Revision	Date
MANGAMUKA GORGE Erosion and Sediment Control Plan – Southern Fill Site 3 – April 2024	ESCP-SFS3-001-01	1	A	05.04.24

1 SOUTHERN DISPOSAL SITE 3 - ESCP - CONSTRUCTION NOTES

1.1 Scope

This Erosion and Sediment Control Plan (ESCP) covers the earthworks and disposal activities associated with the Southern Disposal Site 3 in Mangamuka. The site will be established to place fill from the State Highway 1 – Mangamuka Gorge Road reconstruction project. The fill site is proposed to take approximately 30,000 cubic metres over a total area of 2ha.

The erosion and sediment control (ESC) and construction methodologies related to the disposal works are detailed below.

The earthworks activities undertaken as part of this ESCP include:

- General earthworks and service / drainage installations.
- Site stabilisation.

The proposed ESC measures have been designed in accordance with the principles of the *Auckland Council Guideline Document 2016/005 'Erosion and Sediment Control Guide for Land Disturbing Activities' (GD05).* This ESCP is supported by the following reference drawing provided in Appendix B:

- ESCP-SFS3-001-01

The works are programmed to commence in April 2024 and will be undertaken in a staged manner, with works expected to be completed over approximately a 9-month period.

1.2 Construction Methodology

- Prior to the commencement of any earthworks, the Construction Manager will inspect the site to confirm the suitability of the proposed controls and methodologies.
- Construction of ESC measures will commence including the construction of two Sediment Retention Ponds (SRP-1 and SRP-2), perimeter bunds and installation of the silt fences.
- The SRP's have been sized in accordance with GD05.
- The perimeter bunds have been designed to contain the 5% Annual Exceedance Probability (AEP) rain event. Supporting calculations can be found in Appendix A.
- The site is accessed off SH1. The initial section of farm access track has already been upgraded as it is associated with Disposal Site 1 which is already established. From Site 1 to Site 3 an existing farm access track will be upgraded, sheeted with aggregate and a site turnaround formed. The access track and turnaround will be maintained in a stabilised state.

Fill Placement and Staging

All fill is unloaded at the tip head and turn around area. The material is then pushed into the fill site. The site will be staged in a manner such that the fill be moved, and track rolled into place at the base of the slope.

The material will be layered in no greater than 200mm layers, and track rolled for compaction. Any non-structural loads will be stockpiled and used for final landscaping.

The layering and compacting will be in accordance with the NZTA document TNZ F/1:1997, section 10.4.

10.4 Layer Thickness

10.4.1 The maximum thickness of each layer of fill before compaction shall be in accordance with Tables 1 and 2 unless field trials show, to the satisfaction of the Engineer, that the specified compaction is obtained with thicker layers.

Table 1: Bulk Fill

Nominal Maximum Particle Size	Maximum Layer Thickness
Up to 100 mm	200 mm
100 mm to 200 mm	1.5 times the 85 percentile size
Over 200 mm	Refer contract documents where applicable

In addition to the above standard, the Far North District Council (FNDC) Max Depth of fill/cut: *it does not involve a continuous cut or filled face exceeding an average of 1.5m in height over the length of the face i.e. the maximum permitted average cut and fill height may be 3m.*

The Project Engineer will be responsible for ensuring that the material is compacted in layers specified in the table above and FNDC rule. The material will be track rolled until it appears to plateau out i.e., no more noticeable settling is occurring when continuing to track roll.

This fill methodology ensures that the fill site is filled and completed from the base up. As the base is filled the batter slopes will be progressively trimmed, topsoiled and grass seeded.

This provides for a stable fill base, and improved erosion control, as the compacted batter slope is progressively grassed and stabilised as it increases in height.

1.3 Operation and Maintenance

- The ESC measures will be inspected and signed off by the Project Engineer or the Construction Manager prior to commencement of earthworks.
- The monitoring and maintenance requirements for the ESC measures will be in accordance with GD05 procedures and schedules including extreme weather events, remedial actions and responses.
- The ESC monitoring and maintenance requirements will include, but are not limited to:
  - All ESC structures will be inspected on a weekly basis and within 24 hours of each rainstorm event that is likely to impair the function of performance of the controls.
  - Any required maintenance or improvements to control measures will be undertaken immediately;
  - The silt fences will be cleaned of sediment before accumulated sediment volume reaches 20% of the total volume of the structure;
  - All erosion and sediment control measures will be maintained in accordance with GD05; and
  - Weather forecasts will be monitored on a daily basis.
- A record will be maintained of the date and time of inspections undertaken, any maintenance requirements identified, and any maintenance undertaken.
- All ESC measures are to be monitored and maintained throughout the works until the site is stabilised.

1.4 Dust Management

- The emphasis of the site's dust management strategy will be one of prevention. The topsoil perimeter bunds will be stabilised immediately. Any temporary stockpiling of topsoil will be seeded.
- Vehicle movements on site will be governed by speed restrictions (10km) which will, among other things, assist in preventing dust generation.

- The topsoil will be stripped to form perimeter bunds and will be progressively stabilised (seeded and mulched) to assist in dust management. Any additional topsoil will be stockpiled in an area approved by the Engineer.

1.5 Rainfall Response and Contingency Measures

- Best management practices will be used to minimise sediment yields and monitor any potential effects. In addition to the visual inspections and weekly self-auditing refer above, if a severe weather event is forecast, (a severe weather event is defined as greater than a 5% AEP across the project works area) the following actions will be implemented.
- Pre-Weather Event Procedure:
    - Visually check controls on site prior to weather event to ensure, as far as practicable, that they will function as intended;
    - Depending on site specific circumstances and practices used on site, consider limiting or ceasing earthwork activities to limit land disturbance;
    - As far as practicable, stabilise disturbed areas; and
    - Photograph critical ESC measures prior to the weather event to document pre-weather event condition.
- During the severe weather event that results in the discharge of treated discharges from the sediment retention devices water quality inspections will be undertaken where practical at discharge locations where treated discharge could leave the site. The discharges will be checked to document water quality.

1.6 Site Management and Responsibilities

- Details of site responsibilities, specifically who are responsible for erosion and sediment controls, monitoring and stabilisation processes during the works are as follows:

Position	Name	Ph Number
Construction Manager	Tim Hunger	027 571 9111
ESC Advisor	Campbell Stewart	021 837 824

1.7 Spill Management and Contingency

- Spill kits will be located at the sign in station and in all site engineers and supervisor's vehicles. Fire extinguishers will be located in all site vehicles.
- All refuelling will be undertaken on the flat turnaround area which is a minimum of 130m away from a water course.
- If there is a chemical spill onsite, it shall be immediately contained using earth bunds, or silt socks to prevent it from discharging off site. The spilt chemical shall be recovered if possible and placed in polyethylene containers. If the spilt chemical cannot be recovered, it shall be mixed with a volume of soil to allow the spilt chemical to be collected along with the soil. The material will then be collected and removed off site to an authorised facility.
- If there is a spill of chemical into ponded water, discharge from the pond off site shall be prevented.
- If there is a spill of chemical off site:
    1) Northland Regional Council shall be advised immediately.
    2) The volume of the spill shall be recorded.
    3) If possible, the spilt chemical shall be pumped into a bund or excavation until all the spilt chemical has been removed from the flow path.

1.8 Accidental Discovery

In the event of Māori archaeological sites (e.g., shell midden, hangi or ovens, garden soils, pit depressions, occupation evidence, burials, taonga) or koiwi (human remains) being uncovered, activities in the vicinity of the discovery shall cease and FH will notify the Consent Holder. The consent holder shall then notify iwi and Heritage New Zealand Puhere Taonga Central Regional Office and shall not recommence works in the area of the discovery until the relevant approvals to damage, destroy or modify such sites have been obtained.

1.9 Ecological Constraints

A wetland has been identified in the vicinity of the disposal area (refer to figure 1). A minimum 10m setback will be observed for the establishment of the perimeter controls (perimeter bunds). All works, plant and operations are to stay clear of the wetlands.

Figure 1: Identified Wetland 3

APPENDIX 2: PLANNING CHECKLIST: OPERATIVE FAR NORTH DISTRICT PLAN 2009

Relevant FNDC Definitions		**Comments**
Impermeable surface	In relation to any site means any building or surface on or over the land which creates a barrier to water penetration into the ground. This definition includes but is not restricted to: (a) decks (including decks less than 1m in height above the ground) excluding open slatted decks where there are gaps between the boards; (b) pools, but does not include pools designed to operate as a detention pond; (c) any surfaced area used for parking, manoeuvring, access or loading of motor vehicles, including areas covered with aggregate; (d) areas that are paved with concrete, asphalt, open jointed slabs, bricks, gobi or materials with similar properties to those listed; (e) roof coverage area on plan; But excludes: i. Water storage tanks occupying up to a maximum cumulative area of 20m2 ; and ii. Paths and paving less than 1m wide, provided they are separated from other Impermeable Surfaces by a minimum of 1m. For the purpose of calculating impermeable surfaces, account shall not be taken of any additional areas that are overlapped by another form of impermeable surfaces. In the case of jointly owned access lots that contain impermeable surfaces within their boundaries, the total area of these impermeable surfaces are to be divided equally and considered as parts of the various sites served by the access lot for the purpose of determining compliance with the relevant stormwater management rules.	Aggregate accessways, parking and manoeuvring areas will be considered impervious.
Indigenous Wetland	An indigenous wetland is any naturally occurring wetland of 50m2 or more (with a minimum width of 5m) which is permanently or seasonally wet (in that the water table is at or near the ground surface during high water table conditions) and which is dominated by indigenous wetland plant species including all or some of the following: (a) raupo; (b) flax; (c) sedge associations; (d) kahikatea; (e) cabbage tree; (f) manuka/kanuka on peatlands; (g) mangrove and saltmarsh; (h) kuta.	
Utility Services	Utility Services include: (f) the construction and operation of a road network or railway line	

CHAPTER 8: ZONE RULES – Rural Production Zone					
Activity or standard checked *Note: irrelevant rules have not been included below*	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement**
Standards					
8.6.5.1.3 Stormwater Management	☐	☒	☐	Permitted	8.6.5.1.3 allows a maximum proportion of the gross site area covered by building and other impermeable surfaces shall be 15%. The aggregate vehicle accessway and truck turning area falls within the definition of impermeable surfaces. **Comment** **Impermeable surfaces will not exceed 15% of the gross site area, including with the addition of the extension to the access track.**
8.6.5.1.5 Transportation	☐	☐	☒	Restricted Discretionary	Refers to chapter 15 Rule 8.6.5.3 – Any activity that does not comply with 8.6.5.1.5 Transportation is a restricted discretionary activity. **Comment: Will not comply with the maximum one-way traffic movement requirements.**
8.6.5.1.7 Noise	☐	☒	☐	Permitted	8.6.5.1.6 Noise 8.6.5.1.6(a) – N/A 8.6.5.6(b) - Construction noise shall meet the limits recommended in, and shall be measured and assessed in accordance with, NZS 6803P:1984 "The Measurement and Assessment of Noise from Construction, Maintenance and Demolition Work". **Comment** **It is assumed that the proposed earthworks could be designed to comply with this standard given the large separation distance to neighbouring properties (At least 250m to the nearest dwelling).** **Note: if the works cannot comply with the construction noise standards for rural production zone, then consent would be required as a restricted discretionary activity under Rule 8.6.5.3**
8.6.5.1.11 Scale of Activities	☐	☒	☐	Permitted	For activities ancillary to farming or plantation forestry activities, 8 persons per site or 2 persons per 1 hectare of net site area, whichever is the greater. For all other activities, 4 persons per site or 1 person per 1 hectare of net site area, whichever is the greater. **Comment** **As the site is 70ha, this allows for up to 70 people on the site. It is expected the activity will easily comply with this rule.**

CHAPTER 12: Natural and physical resources					
Standard Checked	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
Natural Resources					
Outstanding Landscapes and Features					
12.1.6.1.1 Protection of outstanding landscape features	☒	☐	☐		The site does not contain an outstanding natural feature or outstanding natural landscape area.
12.1.6.1.2 Indigenous vegetation clearance in outstanding landscapes	☐	☐	☐		
12.1.6.1.3 Tree planting in outstanding landscapes	☒	☐	☐		
12.1.6.1.4 Excavation and/or filling within an outstanding landscape	☒	☐	☐		
12.1.6.1.5 Buildings within outstanding landscapes	☒	☐	☐		
12.1.6.1.6 Utility services in outstanding landscapes	☒	☐	☐		
12.1.6.3.1 Development Bonus	☒	☐	☐		
12.1.6.3.3 Development on an outstanding natural feature	☒	☐	☐		
Indigenous Flora and Fauna					
12.2.6.1.1 Indigenous vegetation clearance permitted throughout the district	☒	☐	☐		Under Rule 12.2.6.1.2 The clearance of indigenous vegetation in the rural production zone which is more than 10 years old is a permitted activity where: (a) It is not in a remnant forest, not within 20m of a lake, indigenous wetland or continually flowing river, and the clearance does not exceed 2Ha per site. *(refer to FNDP for full text version of the rule)* **Comment:** **All indigenous vegetation is located within the area identified as natural wetland. No clearance of indigenous vegetation will be required.**
12.2.6.1.2 Indigenous vegetation clearance in rural production	☒	☐	☐		
Soils and Minerals					
12.3.6.1.1 Excavation and/or filling, excluding mining and quarrying	☐	☐	☒	Restricted Discretionary	Excavation and/or filling, excluding mining and quarrying, on any site in the Rural Production Zone or Kauri Cliffs Zone is permitted, provided that:

CHAPTER 12: Natural and physical resources					
Standard Checked	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
					(a) it does not exceed 5,000m3 in any 12-month period per site; and (b) it does not involve a continuous cut or filled face exceeding an average of 1.5m in height over the length of the face i.e. the maximum permitted average cut and fill height may be 3m. **Comment:** **"Southern Fill Site 3"** • **will have capacity for 30,000m^3 of fill; and** • **the depth of fill will not exceed 1.5m.** **Does not comply with permitted activity rules. Restricted Discretionary resource consent required.**
12.3.6.1.4 Nature of filling material in all zones	☐	☒	☐	Permitted	Filling in any zone shall meet the following standards: (a) the fill material shall not contain putrescible, pollutant, inflammable or hazardous components; and (b) the fill shall not consist of material other than soil, rock, stone, aggregate, gravel, sand, silt, or demolition material; and (c) the fill material shall not comprise more than 5% vegetation (by volume) of any load. **Comment: Assumed fill will comply with these standards.**
12.3.6.2 Restricted Discretionary activities	☐	☒	☐	Restricted Discretionary	An activity is a restricted discretionary activity if: It does not comply with Rule 12.3.6.1.1 but complies with 12.3.6.1.4 and all relevant standards for permitted, controlled, and restricted discretionary activities under Parts 2 and 3 of the District Plan. **Comment:** **Earthworks do not comply with Rule 12.3.6.2, but it is assumed it will comply with 12.3.6.1.4.**

CHAPTER 12: Natural and physical resources					
Standard Checked	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
12.3.6.3 Discretionary activities	☒	☐	☐		An activity is a discretionary activity if: (a) it does not comply with one or more of the standards for permitted or restricted discretionary activities as set out under Rules 12.3.6.1 and 12.3.6.2 above; or (b) The excavation and/or filling is for the purposes of mining or quarrying, other than a quarry covered by definition of 'normal rural practices', and a Development Plan is part of the application as provided for in Rule 12.3.6.3.1 below; but (c) it complies with the relevant standards for permitted, controlled, restricted discretionary and discretionary activities in the zone in which it is located, set out in Part 2 of the Plan - Environment Provisions; and (d) it complies with the other relevant standards for permitted, controlled, restricted discretionary or discretionary activities set out in Part 3 of the Plan - District Wide Provisions.
Natural Hazards					
12.4.6.1.1 Coastal Hazard 2 Areas	☒	☐	☐		The site is not identified as a coastal hazard zone. No buildings are proposed.
12.4.6.1.2 Fire Risk to residential units	☒	☐	☐		
12.4.6.2.1 new buildings & additions to existing buildings in coastal hazard 2 areas	☒	☐	☐		
12.4.6.3.1 Coastal hazard 1 areas	☒	☐	☐		
Heritage					
12.5.6.1.1 Notable trees	☒	☐	☐		No heritage features are identified on the site
12.5.6.1.2 Altercations to/and maintenance of historic sites, buildings and objects	☒	☐	☐		
12.5.6.1.3 Registered Archaeological Sites	☒	☐	☐		
12.5.6.2.1 Heritage resources – permanent protection	☒	☐	☐		
12.5.6.2.2 Activities which could affect sites of cultural significance to Maori	☒	☐	☐		
12.5.6.3.1 Development bonus	☒	☐	☐		
Lakes, Rivers, Wetlands and the Coastline					
12.7.6.1.1 Setback from Lakes, rivers and coastal marine area	☒	☐	☐		There are no lakes or rivers (minimum 3m average width) near the Stage 1 fill site.
12.7.6.1.2 Setback from smaller lakes, rivers and wetlands	☐	☒	☐	Permitted	This rule requires to the following setbacks of buildings and impervious surfaces:

CHAPTER 12: Natural and physical resources

Standard Checked	Not Applicable	Complies	Does not comply	Activity Status	Rule(s) infringed and the extent of the infringement.
					- 10 x the average width of the river where it passes through or past the site; - 30m from any wetland that is 1ha or more in area **Comment:** **No buildings are proposed.** **It is assumed the access track required will not be within 30m from any lake, river or wetland. Nonetheless, as the activities are associated with the maintenance of SH1, being an existing linear network utility, the setbacks do not apply.**
12.7.6.1.3 Preservation of indigenous wetlands	☐	☒	☐	Permitted	Any land use activity **within** an indigenous wetland of 200m² or more that does not change the natural range of water levels or the natural ecosystem or flora and fauna it supports is a permitted activity. **Comment:** **There is no land use within a natural indigenous wetland.**
12.7.6.1.6 Noise	☒	☐	☐		N/A – This rule is relevant to noise on lakes and streams

CHAPTER 15: Transportation

Standard Checked	Not Applicable	Complies	Does not comply	Activity Status	Rule(s) infringed and the extent of the infringement.
Rural Production zone					
15.1.6A Maximum Daily one-way traffic movements	☐	☐	☒	Restricted Discretionary	Permitted: Rural Production maximum daily one-way movements: 30 one-way movements if via a State Highway Restricted Discretionary: 31- 200 one-way movements.

CHAPTER 15: Transportation					
Standard Checked	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
Rural Production zone					
					Discretionary: More than 200 one-way movements. *Note: construction traffic is exempt but has to be associated with establishment of an activity.* **Comment:** **One way traffic will be approximately 76 per day, well below the threshold of 200 for a Restricted Discretionary Activity. As the traffic does not relate to the establishment of an activity, it is not exempt from this rule.**
15.1.6B.1.1 Car parking spaces	☒	☐	☐		This rule relates to a change in activity or additional buildings on the site.
15.1.6C.1.1 Standards for private access	☐	☒	☐	Permitted	**Comment** **The accessway complies with the relevant minimum standards for a private accessway in the Rural Production zone are:** ➢ **1:5 Maximum gradient** ➢ **3.0m minimum width** **As SH1 is a limited access road, it is recommended that consultation with the WK Environmental Planning team is undertaken to check if any measures are required (e.g. traffic management plan) to ensure adequate safety for the crossing.**

APPENDIX 3: PLANNING CHECKLIST: BYLAWS FOR FAR NORTH DISTRICT COUNCIL

	Not Applicable	Complies	Does not comply	Rule(s) infringed and the extent of the infringement.
Control of Earthworks Bylaw 2019 Where a Resource Consent for earthworks and/or filling is not required under the Far North District Plan, then no person shall carry out or cause to be carried out, any excavation, cellar construction or filling until the Council's approval has been obtained and a permit has been issued for earthworks: (a) that is within 3 metres of any boundary or water body in all zones, except Minerals zone; … (c) that is in a Rural Production zone, and beyond 3 metres of any boundary or water body, and **that exceeds 1.5 metres in depth**; (d) in any area of natural or physical resource specified in Part 3 of the Far North District Plan	☐	☐	☐	**Comment: The depth of fill will not exceed 1.5m**
Control of On-site Wastewater Disposal Systems Bylaw 2010	☐	☒	☐	
Speed Limit Bylaw 2019	☐	☒	☐	

APPENDIX 4: PLANNING CHECKLIST: FAR NORTH DISTRICT PLAN (PROPOSED) 2023

Relevant Definitions		**Comments**
Significant Natural Area	means an area: identified in Schedule 4 of the District Plan as an area of significant indigenous vegetation or significant habitat of indigenous fauna; or assessed by a suitably qualified and experienced ecologist as meeting one of the criteria for ecological significance in Appendix 5 of the Regional Policy Statement for Northland 2016 or within any more recently gazetted National Policy Statement on indigenous biodiversity.	No vegetation clearance is proposed and there will be no earthworks within 10m of any indigenous vegetation.

Far North District Plan (Proposed)					
Rules with immediate Legal effect	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
Permitted					
EW-R13 Earthworks and sediment The earthworks comply with standard EW-S5 Erosion and sediment control and EW S3 Accidental discovery protocols EW-S5 – Erosion and sediment controls: i. must for their duration be controlled in accordance with the Erosion and Sediment Control Guidelines for Land Disturbing Activities in the Auckland Region 2016 (Auckland Council Guideline Document GD2016/005); ii. shall be implemented to prevent silt or sediment from entering water bodies, coastal marine area, any stormwater system, overland flow paths, or roads. EW-S3 -Accidental discovery protocol	☐	☒	☐	Permitted	**Comment: Erosion and sediment controls have been implemented in accordance with this standard and Accidental discovery protocols will be implemented for the duration of works.**
IB-R4 - Indigenous vegetation clearance and any associated land disturbance outside a Significant Natural Area All zones Where: PER-1 1. A report has been obtained from a suitably qualified and experienced ecologist confirming that the indigenous vegetation does not meet the criteria for a Significant Natural Area and it is submitted to Council 14 days in advance of the clearance being undertaken; and 2. It does not exceed the following amounts per site over a 5-year period: i. Rural Production zone, Horticulture zone, Māori Purpose zone and Treaty Settlement Land Overlay – 5,000m2 if not in a remnant forest, otherwise 500m2 in a remnant forest; ii. All other zones – 500m2.	☒	☐	☐		**Comment: No indigenous vegetation clearance is proposed.**

Far North District Plan (Proposed)					
Rules with immediate Legal effect	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
PER-2 A report has not been obtained from a suitably qualified and experienced ecologist confirming that the indigenous vegetation does not meet the criteria for a Significant Natural Area and a report has not been submitted to Council 14 days in advance of the clearance being undertaken; and It does not exceed 100m2 per site in any calendar year.					

APPENDIX 5 - PROPOSED REGIONAL PLAN FOR NORTHLAND (APPEALS VERSION 7 JUNE 2023)

Relevant Definitions		**Notes**
Earthworks	The mechanical disturbance of earth by excavation, cutting and filling, blading, ripping, contouring, quarrying or placing or replacing earth or cleanfill material and includes associated revegetation, but does not include: 1. construction, repair, alteration or maintenance of bores, or 2. the maintenance of walking and other recreational tracks and farm tracks, or 3. the placement of roading aggregates during road and track works, or 4. directional drilling, boring or thrusting up to 250mm diameter, or 5. digging post holes, or 6. planting trees, or 7. land preparation, or 8. vegetation clearance	Fill operations fall within this definition
Erosion control plan	Means a plan developed by a suitably qualified professional which specifically identifies areas of gully, landslide, and earthflow erosion and measures to mitigate sediment yield from these areas and meets the requirements of H.2 Erosion Control Plans. For the purposes of preparing Erosion Control Plans, "suitably qualified professional" means a person who: 1. has at least five years' experience in the management of pastoral, horticultural or arable farm systems, and 2. has completed advanced training or has tertiary qualifications in soil conservation, soil science or sediment management, or 3. is a Northland Regional Council Land Management Advisor.	Proposed sediment control plan meets this definition
Erosion Prone Land	Land defined as Land Use Capability (LUC) units 6e17, 6e19, 7e1 - 7e10, 8e1 - 8e3, and 8s1. The LUC units are generally depicted in the New Zealand Land Resource Inventory (NZLRI) and are also shown in I Maps | Ngā mahere matawhenua.	The fill site does not meet this definition
Induced wetlands	Wetlands that have formed naturally where wetlands did not previously exist, as a result of human activities, such as construction of roads and railways bunds. Does not include a constructed wetland nor any type of wet, damp or boggy ground that might incidentally occur as a result of land compaction, nor any ditch, drain, silt-trap, pit, bund, stockwater dam, or treatment pond associated with agricultural, pastoral or horticultural activities. Notes: 1. Induced wetlands are a type of natural wetland. 2. The relationship between the various types of wetlands is shown in H.6 Wetland definitions relationships	There are no known induced wetlands
Natural wetland	Any wetland including an induced wetland and a reverted wetland, regardless of whether it is dominated by indigenous vegetation, but does not include: 1. a constructed wetland, or 2. wet pasture, damp gully heads, or 3. areas where water temporarily ponds after rain, or 4. pasture containing patches of rushes, or 5. artificial water storage facilities; detention dams; reservoirs for firefighting, irrigation, domestic or community water supply; engineered soil conservation structures including sediment traps; and roadside drainage channels. Notes: 1. The Regional Council's wetland mapping indicates the extents of known wetlands – these can be found on the Regional Council's website. 2. The relationship between the various types of wetlands is shown in Appendix H.6 Wetland definitions relationships	The wetland near the proposed fill sites meets this definition.
Significant wetland	A natural wetland that meets the significance criteria in the Regional Policy Statement, Appendix 5 –"Areas of significant indigenous vegetation and significant habitats of indigenous fauna in terrestrial, freshwater and marine environments". This includes natural wetlands comprising indigenous vegetation exceeding any of the following area thresholds: 1. saltmarsh greater than 0.5 hectare in area, or	There are no works proposed within any wetland. Rules relating to Significant Wetlands only relate to works within significant

	2. lake margins and riverbeds with shallow water less than two metres deep and greater than 0.5 hectare in area, or 3. swamp greater than 0.4 hectare in area, or 4. bog greater than 0.2 hectare in area, or 5. wet heathland (including gumland and ironstone heathland) greater than 0.2 hectare in area, or 6. marsh, fen, ephemeral wetland or seepage greater than 0.05 hectares in area. Notes: 1. If there is any doubt over wetland extent use: Clarkson, B. R., 2013. A vegetation tool for wetland delineation in New Zealand. Prepared by Landcare Research for Meridian Energy Limited. 2. The Regional Council's wetland mapping indicates the extents of known wetlands – these can be found on the Regional Council's website. The purpose of this mapping is to help locate and identify different wetland types. The maps do not form part of this Plan. 3. The relationship between the various types of wetlands is shown in Appendix H.6 Wetland definitions relationships.	wetlands, and as such are not applicable.

Proposed Regional Plan for Northland (PRP)

Relevant Chapter	Not Applicable	Complies	Does not comply	Activity Status	Rule(s) infringed and the extent of the infringement.
EARTHWORKS					
Permitted Activity Rules					
C.8.3.1 Earthworks outside the bed of a river, lake, wetland and the coastal marine area, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water:					

Table 15: Permitted activity earthworks thresholds

Location	Earthworks thresholds
Within 10m of a natural wetland, the bed of a continually or intermittently flowing river or lake	200 square metres of exposed earth at any time, and 50 cubic metres of moved or placed earth in any 12-month period.
Within 10m of an inanga spawning site	200 square metres of exposed earth at any time, and 50 cubic metres of moved or placed earth in any 12-month period.
Catchment of an outstanding lake	2500 square metres of exposed earth at any time.
Erosion-prone land	2500 square metres of exposed earth at any time.
High-risk flood hazard area	50 cubic metres of moved or placed earth in any 12-month period.
Coastal riparian and foredune management area	Excluding for coastal dune restoration, 200 square metres of exposed earth at any time.
Flood hazard area	100 cubic metres of moved or placed earth in any 12-month period.
Other areas	5000 square metres of exposed earth at any time.

C.8.3.1.1 The area and volume of earthworks at a particular location or associated with a project complies with the thresholds in table 15 (above)	☐	☐	☒	Permitted	**Comment:**

Proposed Regional Plan for Northland (PRP)					
Relevant Chapter	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
					The fill site will have a 10m buffer around the wetland, however, will exceed to the threshold of 5000m² for "other areas".
Controlled Activity Rules (Operative)					
C.8.3.2 Earthworks outside the bed of a river or lake, wetland and the coastal marine area that exceed 5,000m² of exposed earth at any time at a particular location or associated with a project area, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water	☐	☒	☐	Controlled	**Comment:** **Earthworks exceed 5000m² and is outside the 10m buffer of the natural wetland.** ***Note: The associated stormwater diversion from the natural wetland will be included in this rule.***
C.8.3.3 Earthworks in a flood hazard area that involve more than 50 cubic metres, but not more than 1,000m³, of earth being moved or placed in any 12-month period, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water.	☒	☐	☐		**Comment:** **No earthworks are proposed within a flood hazard area.**
Discretionary Activity Rules (Operative)					
C.8.3.4 - Earthworks – discretionary activity Earthworks outside the bed of a river or lake, a wetland, or the coastal marine area, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water, that are not a permitted or controlled activity under another rule in section C.8.3 of this Plan.	☒	☐	☐		
C.8.4 Vegetation clearance in riparian areas and foredune management area					
C.8.4.1 Coastal dune restoration within the coastal riparian and foredune management area – permitted activity	☒	☐	☐		N/A
C.8.4.2 Vegetation clearance in riparian areas – permitted activity Vegetation clearance within 10 metres of a natural wetland or within 10 metres of the bed of a continually or intermittently flowing river or lake, and any associated damming and diversion of stormwater and discharge of stormwater onto or into land where it may enter water, are permitted activities, provided: 1) the area of cleared vegetation does not exceed 200 square metres in any 12-month period, and 2) vegetation is felled away from rivers, lakes, and natural wetlands, except where it is unsafe or impractical to do so, and 3) vegetation, slash, disturbed soil or debris is not deposited in a position where it could mobilise because of heavy rain or flood flows and: a) be deposited on other property, or b) divert or dam water, or c) cause bed or bank erosion, or d) damage receiving environments, downstream infrastructure, or property, and 4) any discharge of sediment originating from the cleared area does not give rise to any of the following effects in the receiving waters beyond a 20 metre radius of the point of discharge: a) any conspicuous change in colour or visual clarity, or	☒	☐	☐		**Comment: no vegetation clearance within 10m of a stream or natural wetland**

Proposed Regional Plan for Northland (PRP)					
Relevant Chapter	**Not Applicable**	**Complies**	**Does not comply**	**Activity Status**	**Rule(s) infringed and the extent of the infringement.**
b) the rendering of fresh water unsuitable for consumption by farm animals, or c) the rendering of surface water taken from a mapped priority drinking water abstraction point (refer I Maps | Ngā mahere matawhenua) unsuitable for human consumption after existing treatment.					
C.2 Activities in the beds of lakes and rivers and in wetlands					
C.2.2 Activities affecting wetlands					
C.2.2.1 Natural wetland maintenance and enhancement – permitted activity	☒	☐	☐		N/A – no maintenance and enhancement of any wetlands is proposed.
C.2.2.2 Structures in wetlands – permitted activity	☒	☐	☐		N/A – no structures are proposed in a wetland
C.2.2.3 Constructed wetland alteration – permitted activity	☒	☐	☐		N/A – the alteration of a constructed wetland is proposed.
C.2.2.4 Activities in natural and constructed wetlands – discretionary activity 1) damage, destruction, disturbance, or removal of a plant in a wetland or deliberate introduction of a plant in a wetland for wetland maintenance or wetland enhancement, or 2) use, erection, reconstruction, placement, alteration, extension, removal, or demolition of any structure in a wetland, or 3) disturbance of the bed of a constructed wetland and construction or installation of a structure in a constructed wetland, that is not the subject of any other rule in this Plan are discretionary activities, provided the activities are not undertaken in a significant wetland.	☒	☐	☐		**Comment: No works have occurred or are proposed within a natural wetland.**

APPENDIX 6: NATIONAL ENVIRONMENTAL STANDARDS

NES – Freshwater	
Regulation 3: Interpretation - Relevant Definitions	
cleanfill area	means an area used exclusively for the disposal of cleanfill material.
cleanfill material	means virgin excavated natural materials including clay, gravel, sand, soil and rock that are free of: (a) combustible, putrescible, degradable or leachable components; (b) hazardous substances and materials; (c) products and materials derived from hazardous waste treatment, stabilisation or disposal practices; (d) medical and veterinary wastes, asbestos, and radioactive substances; (e) contaminated soil and other contaminated materials; and (f) liquid wastes.
Natural Inland Wetland	natural inland wetland means a wetland (as defined in the Act) that is not: (a) in the coastal marine area; or (b) a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or (c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or (d) a geothermal wetland; or (e) a wetland that: (i) is within an area of pasture used for grazing; and (ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless (iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply
Specified infrastructure	Specified infrastructure means any of the following: (a) infrastructure that delivers a service operated by a lifeline utility (as defined in the Civil Defence Emergency Management Act 2002) (b) regionally significant infrastructure identified as such in a regional policy statement or regional plan (c) any water storage infrastructure (d) any public flood control, flood protection, or drainage works carried out: (i) by or on behalf of a local authority, including works carried out for the purposes set out in section 133 of the Soil Conservation and Rivers Control Act 1941; or (ii) for the purpose of drainage by drainage districts under the Land Drainage Act 1908 (e) defence facilities operated by the New Zealand Defence Force to meet its obligations under the Defence Act 1990 National Policy Statement for Freshwater Management 2020 (f) ski area infrastructure
vegetation clearance	vegetation clearance— (a) means the disturbance, damage, destruction, or removal of vegetation by any means (for example, by cutting, crushing, application of chemicals, or burning); and (b) includes activities that result in the disturbance, damage, destruction, or removal of vegetation (for example, over-planting, applying the seed of exotic pasture species, mob-stocking, or draining away water); but (c) does not include— (i) the removal of sphagnum moss for the purpose of a harvest in accordance with regulation 48 or 49; or

	(ii) the crushing of other vegetation for the purpose of maintaining the dominance of sphagnum moss, if the crushing is carried out during a harvest of sphagnum moss or to rehabilitate the moss after it is harvested; or (iii) an activity described in paragraph (a) or (b) that is for the maintenance or construction of fencing for the purpose of excluding stock or marking property boundaries; or (iv) an activity described in paragraph (a) or (b) that is for the maintenance of shelter belts; or (v) grazing

Part 3 Standards for other activities that relate to freshwater

Subpart 1 – Natural Inland Wetlands

Reg 45B: Landfills and Cleanfill Areas

Activity	Not applicable	Complies	Does not Comply	Comment
45B(1) Vegetation clearance within, or within a 10 m setback from, a natural inland wetland is a discretionary activity if it is for the purpose of constructing or operating a landfill or a cleanfill area.	☒	☐	☐	**No vegetation clearance will occur within, or within 10m of a natural inland wetland.**
45B(2) Earthworks or land disturbance within, or within a 10 m setback from, a natural inland wetland is a discretionary activity if it is for the purpose of constructing or operating a landfill or a cleanfill area.	☒	☐	☐	**No earthworks will occur within, or within 10m of a natural inland wetland for the purpose of constructing a landfill**
45B(3) Earthworks or land disturbance outside a 10 m, but within a 100 m, setback from a natural inland wetland is a discretionary activity if it— (a) is for the purpose of constructing or operating a landfill or a cleanfill area; and (b) results, or is likely to result, in the complete or partial drainage of all or part of the wetland.	☒	☐	☐	**The fill site will be located outside 10m but within 100m of a natural wetland.** **WSP has confirmed site has been recontoured to ensure overland flow paths into wetland are the same or similar to that that existed prior to activities. It is not anticipated that the activity has, or will likely result in the complete or partial drainage of all or part of the wetland**
45B(4) The taking, use, damming, or diversion of water within, or within a 100 m setback from, a natural inland wetland is a discretionary activity if— (a) the activity is for the purpose of constructing or operating a landfill or a cleanfill area; and (b) there is a hydrological connection between the taking, use, damming, or diversion and the wetland; and (c) the taking, use, damming, or diversion will change, or is likely to change, the water level range or hydrological function of the wetland.	☒	☐	☐	**WSP has confirmed site has been recontoured to ensure overland flow paths into wetland are the same or like that that existed prior to activities. It is not anticipated that the activity has or will likely result in a change in water level or hydrological function of the wetland.**
45B(5) The discharge of water into water within, or within a 100 m setback from, a natural inland wetland is a discretionary activity if— (a) the discharge is for the purpose of constructing or operating a landfill or a cleanfill area; and (b) there is a hydrological connection between the discharge and the wetland; and (c) the discharge will enter the wetland; and (d) the discharge will change, or is likely to change, the water level range or hydrological function of the wetland.	☒	☐	☐	**The sediment controls for the fill site will involve the concentrated discharge of water below the sediment retention ponds, which is within 100m of a natural wetland and are for the purpose of operating the fill area and there will be a hydrological connection, however this is in line with the overland flow paths as they existed and therefore is not anticipated to alter the hydrological function or water level range.**

				TBC
45B(6) A resource consent for a discretionary activity under this regulation must not be granted unless the consent authority has first— (a) satisfied itself that the landfill or cleanfill area— (i) will provide significant national or regional benefits; or (ii) is required to support the quarrying activities regulated under regulation 45A; or (iii) is required to support urban development regulated under regulation 45C; or (iv) is required to support the extraction of minerals regulated under regulation 45D; and (b) satisfied itself that— (i) there is no practicable alternative location for the landfill or cleanfill area in the region; or (ii) every other practicable alternative location in the region would have equal or greater adverse effects on a natural inland wetland; and (c) applied the effects management hierarchy.				**Comment** **If retrospective consent is required, we will need to demonstrate that the 'no practicable alternative' test has been met.**

NES – Contaminants in Soil

If works of the following activities are taking place, then the NES may apply to the development:

Activity	***Not Applicable***	***Complies***	***Consent Required***	***Comment***
Removing or replacing fuel storage system	☒	☐	☐	
Sampling soil	☒	☐	☐	
Disturbing soil	☐	☒	☐	The site is not showing as a HAIL site on Northland Regional Council Selected Landuse maps and is not known to have any contaminated soil within the works area.
Subdividing or changing use	☒	☐	☐	

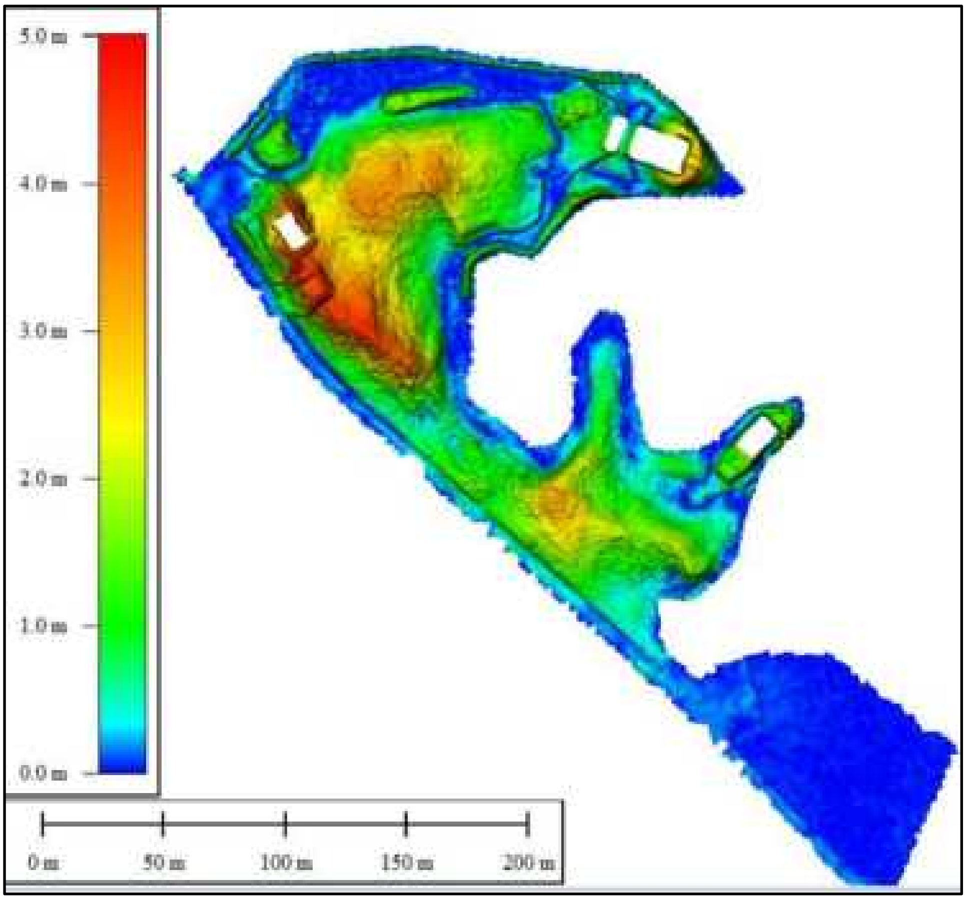
APPENDIX 7: WSP MEMORANDUM

Memorandum

To	Waka Kotahi, Stellar
Copy	Shaun Grieve (WSP)
From	Matt Leggett
Office	Auckland
Date	6 September 2024
File/Ref	1-11241.13
Subject	Mangamuka 4321 Dump site Topographical Comparison

This memo presents a high-level assessment of the topographical impact of the dumping works in relation to the earthworks operations carried out to date.

Below is a visual representation of the filling works as a differential between the original ground surface (Northland LiDAR 1m DEM 2018-2020) and existing ground level following a recent drone survey carried out by WSP on Monday 2nd September.



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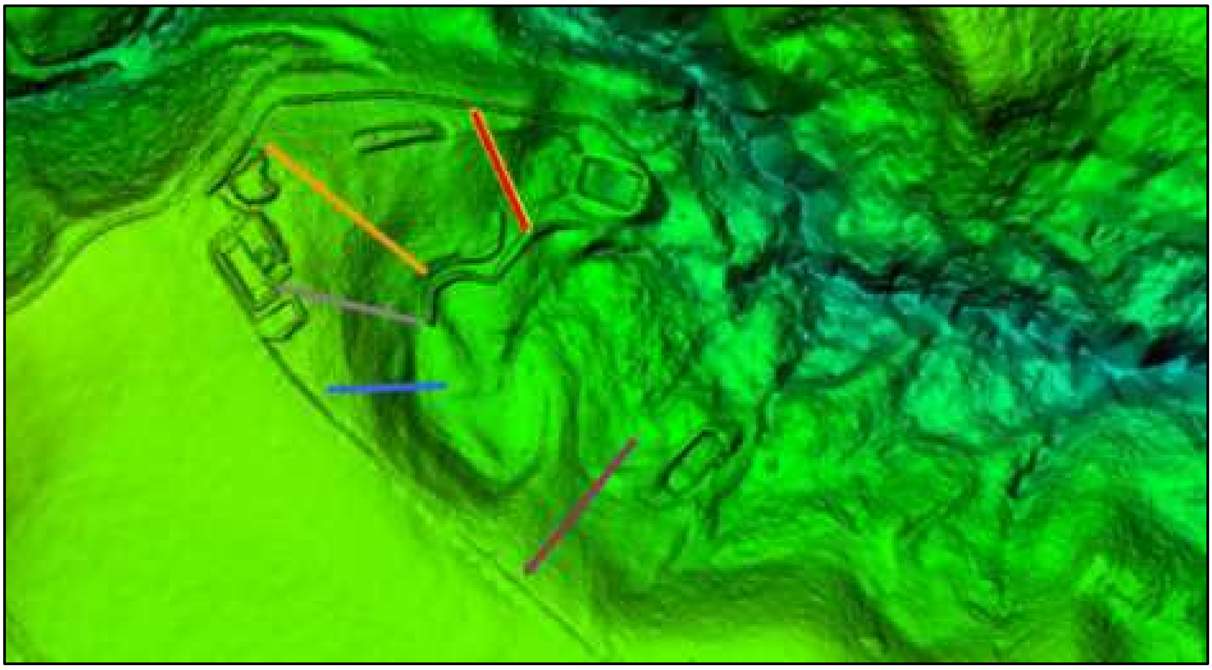
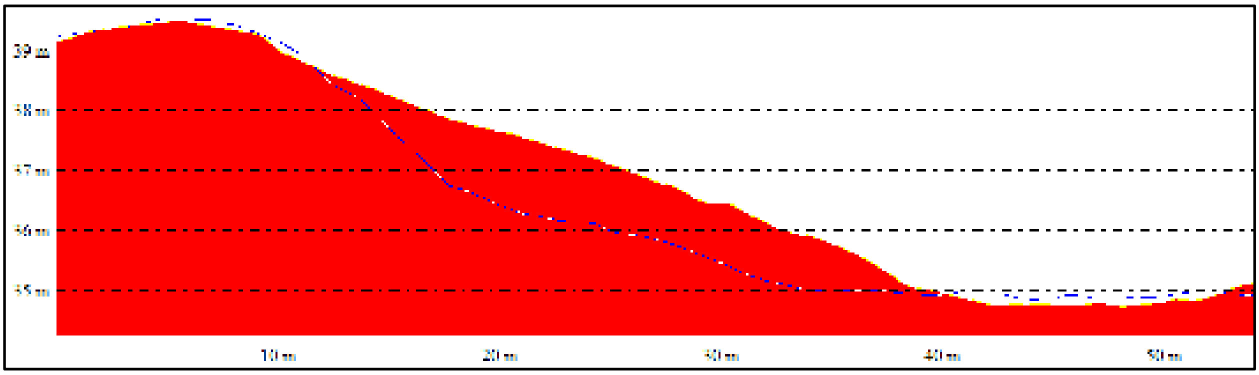
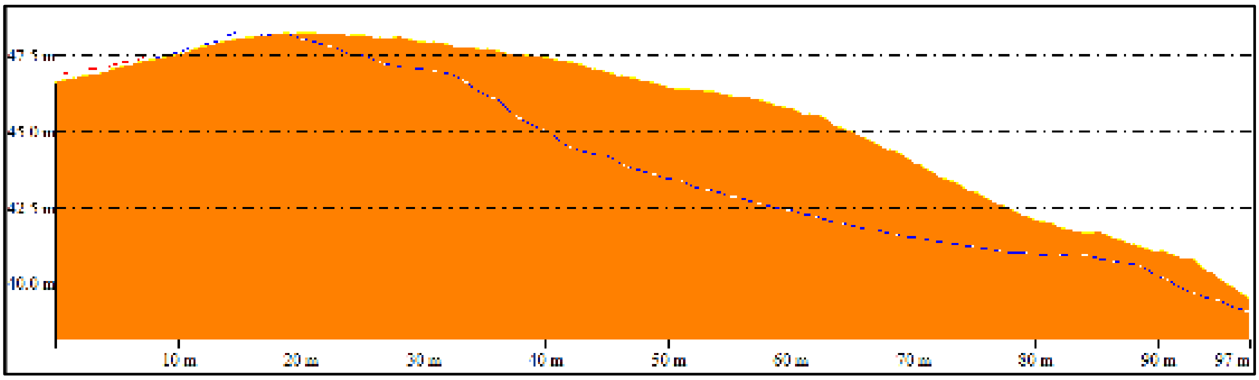
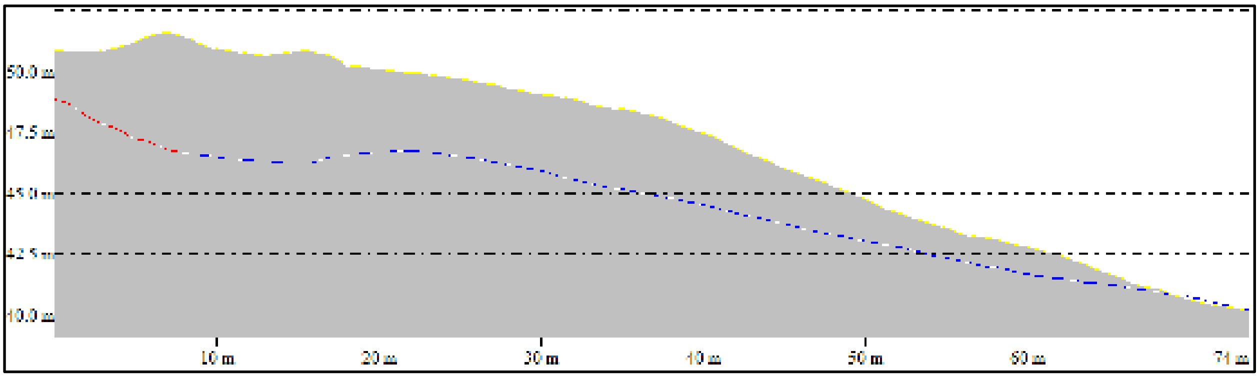
Fill works at site have resulting in up to around 4.5m of elevation gain centred around the western extent of the dumpsite. This location is centred within a bowl-shaped feature likely formed following historical slope movements towards the water source downslope. Outside of this area, the majority of the dumpsite has been raised by 0.5m-2.5m.

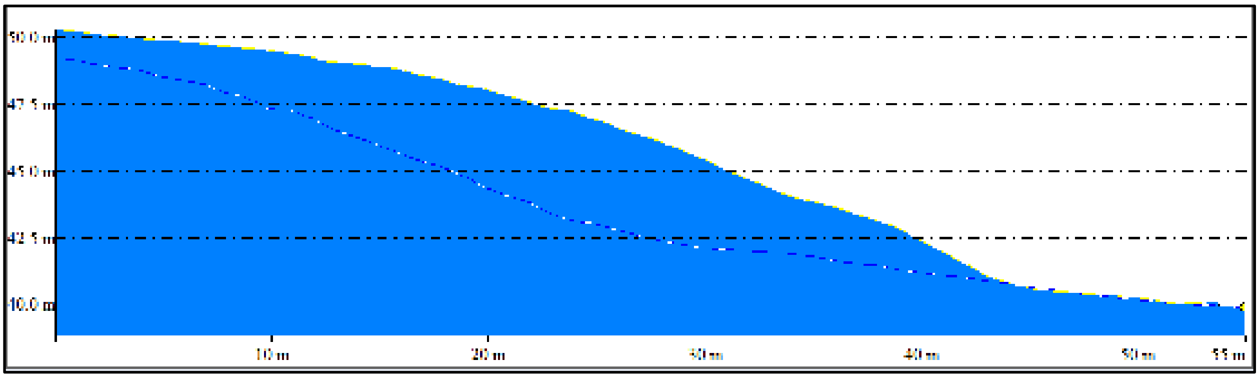
Below is a series of cross sections across the site to further illustrate the change in elevation. The dashed line presented on the cross sections represents the original ground surface.

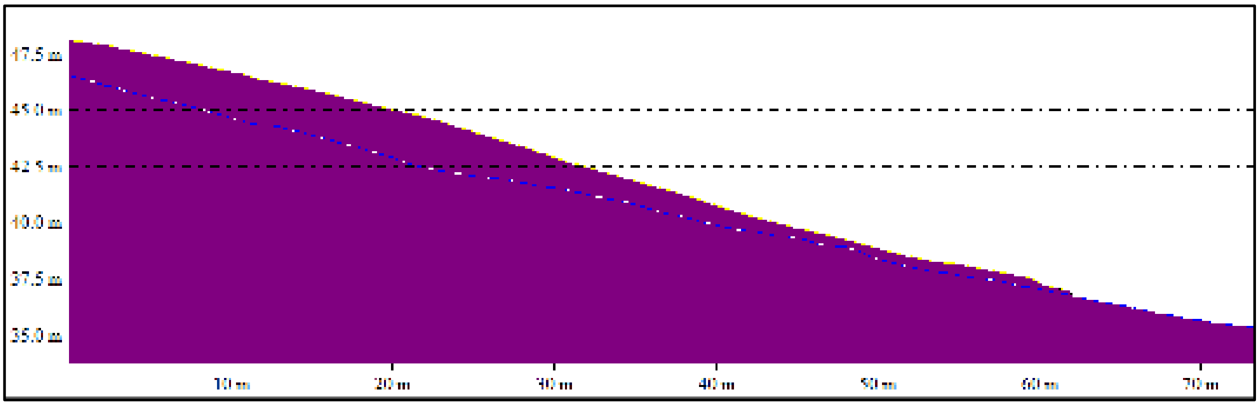






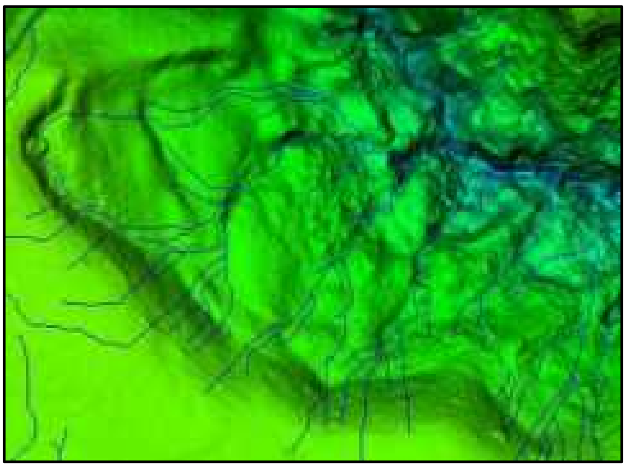


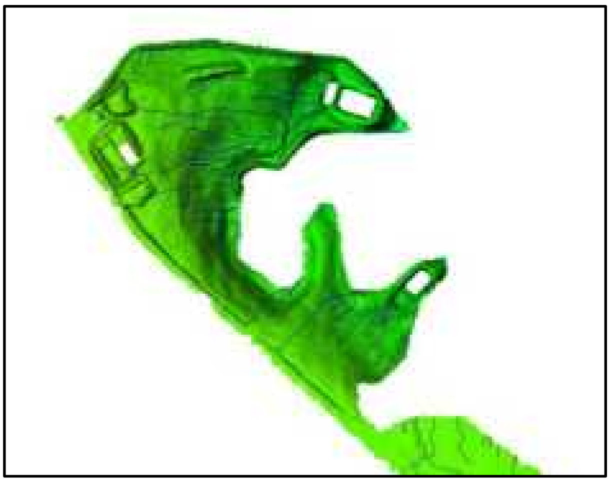




Within these 5 critical cross sections, the overall grade of slope has been kept relatively consistent with the original ground surface.

Below is a comparison of the inferred drainage.





Looking at the above comparison in the drainage network there has been little change in the hydrological pathways feeding the wetland.

This together with the assumptions made in the statement prior to earthworks regarding the hydrogeological impact to the wetland over a surface water influence, the earthworks to date at the site is assessed to have had a minimal impact to the ecology surrounding the dump site.

For long term considerations an ecologist should be consulted regarding monitoring wetland performance over time,.

Attachment D – Bore Logs

From:	McMullen, Kathleen
To:	Alex Erceg
Cc:	Benji Potvin; Hendrik Postma
Subject:	FW: Mangamuka Info Requirements - Follow Up
Date:	Friday, 8 November 2024 3:26:36 pm
Attachments:	image001.png

Hi Team,

See below from Ryan

Cheers,
Kat

From: Ryan Tidswell <Ryan@drillforce.co.nz>
Sent: Friday, 8 November 2024 10:51 am
To: McMullen, Kathleen <kathleen.mcmullen@wsp.com>
Subject: RE: Mangamuka Info Requirements - Follow Up

Hi Kat

I can confirm that the drilling and installations are carried out to comply with NZ Environmental Standard for Drilling of Soil and Rock (NZS 4411:20001).

In terms of maintenance, I assume these are handed over to NZTA? The "maintenance" will mostly be around ensuring that water does not enter from the surface. Installations are completed with either 0.5-1.0m above ground(standpipe), or flush tobies that have a gasket in the lid to prevent groundwater getting in to the tops.

If the piezometer is on a regular monitoring calendar, it will be worth dipping to the bottom to check for silt accumulation. If they have telemetry, suggest every year or so; if there is no silt accumulation, it could be dropped. We sometimes get invited to develop piezometers that have been sitting for extended periods of time.

Regards

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copies.

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Project Number: 1-11240.00

NZTA Northland Resilience and Emergency Works- August 2022-10174/22A9

24 November 2022

CONFIDENTIAL

Interpretive Geotechnical Investigation Report

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Date: 22/11/2022
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Prepared by
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Reviewed by
Matt Leggett

Approved for release by
Shaun Grieve

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Revision	Date	Author	Reviewed by	Approved by	Status
00	22/11/2022	Ellie Eastaugh	Matt Leggett	Shaun Grieve	Final

Revision Details

Revision	Details

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for New Zealand Transport Agency ('**Client**') in relation to Mangamuka Gorge Slips Emergency Works ('**Purpose**'). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

1 Introduction

Two storm events in July and August have caused widespread flooding and associated landsliding across much of Northland. Following the August rain event WSP were engaged by Waka Kotahi to form part of the emergency response and undertake an urgent geotechnical investigation along a section of State Highway (SH) 1 through Mangamuka Gorge. A total of 12 underslips have been identified requiring significant geotechnical analysis and associated permanent remedial measures.

This report covers the investigation and assessment at site 10174/22A9 (henceforth referred to as A9) and provides a recommended remedial solution to prevent further damage to the existing highway.

Site A9 is located at RP15.139 along SH1, approximately 21km southeast Kaitaia. The landslide is an under slip likely caused by a material saturation resulting from the recent storm events. The site location is shown below in Figure 1-1 together with the other slip sites.

Figure 1-1: 10174/22A9 Site location Plan

2 Regional Geology

The 1:250 000 scale QMAP seamless digital data (GNS, 2013) indicates the site area to be underlain by the Undifferentiated Tangihua Complex in Northland Allochthon comprising basalt pillow lava, with subvolcanic intrusives of basalt, dolerite and gabbro; locally incorporating siliceous mudstone. (Figure 2-1). The Tangihua Complex has been emplaced onto New Zealand through convergent plate tectonics and sea floor sliding. As a result, the material has been historically sheared with the rock underlying the site expected to be highly fractured and degraded through original emplacement processes and further modified by weathering.

Figure 2-1: Regional geology

3 Site Investigation

Between 2nd and 3rd September 2022, a geotechnical investigation was undertaken to identify sub-surface ground conditions and to help inform the options for remedial measures required at site A9 The works comprised the following:

- A single rotary cored borehole (BH) was completed to a depth of 19.5m, with standard penetration tests (SPTs) at 1.5m intervals.
- Installation of BH inclinometer upon completion of BH22A9-1.
- 3no. Cone penetration tests (CPT01-CPT03) refused at 7.34m, 8.32m and 15.35m respectively.
- The intrusive drilling works was undertaken by Drillforce Limited including the boreholes, CPT's as well as the installation of inclinometer tubing for monitoring ground movement and piezometers for groundwater, all under the supervision of WSP site staff.

- All the boreholes were logged in accordance with the NZGS *Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes*, December 2005 and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg. 365, Table 1. Borehole and CPT locations displayed on Figure 3-1 below with logs displayed in Appendix A.

- Tiltmeters were installed on the ground surface by WSP Research staff to obtain Realtime monitoring of surface movements.

- Monitoring of the inclinometer was undertaken by GeoCivil Ltd under direction of WSP staff.

Figure 3-1: Exploratory hole location plan

3.1 Observations

The slip was inspected on 23rd September 2022 by WSP. The inspection identified the following:

- Slip A9 is an ongoing slumping requiring levelling with the imminent risk of complete evacuation of the road.

- The cracking was first observed in October 2021 and has continued to move incrementally since with heavy rainfall events. The total length of affected road is 60m. The grade of slope below is approximately 1v:2.5h.

- The headscarp extends across the entirety of the road with slumping also visible within the upslope. There has been up to 1m of vertical and up to 500mm horizontal with the greatest amount of movement at the southern scarp adjacent to CPT04.

- Along the affected section, the highway is flanked to the north by a small cut slope into the steep natural slopes that extend above. The upslope has a grade of 1v:2h and is 8m in height.

- The base of the cut slope incorporates a drainage channel feeding into a culvert. Of note this position of the highway crosses the head of a gully feature where the slip has occurred.

- There are many felled trees downslope suggesting the slip continues for a significant distance downslope.
- Additional tension cracking has started to form further towards the centreline and the slip is likely to continue to regress.
- Surface seepage was not noted during the site investigation.

4 Geomorphological Mapping

A terrain evaluation is presented below in Figure 4-1. Geomorphological mapping undertaken from both Lidar and aerial photography as well as site observations.

The site area is comprised of steeping dipping slopes of approximately 30° - 40° and includes historic slip features manifesting as large gullies extending from the slope above to the river below. It has been observed that the gullies coincide with the extend of the main failure surface on site, with additional smaller scarps visible further down slope. Site A9 is located within a larger dormant scarp which extends further up slope.

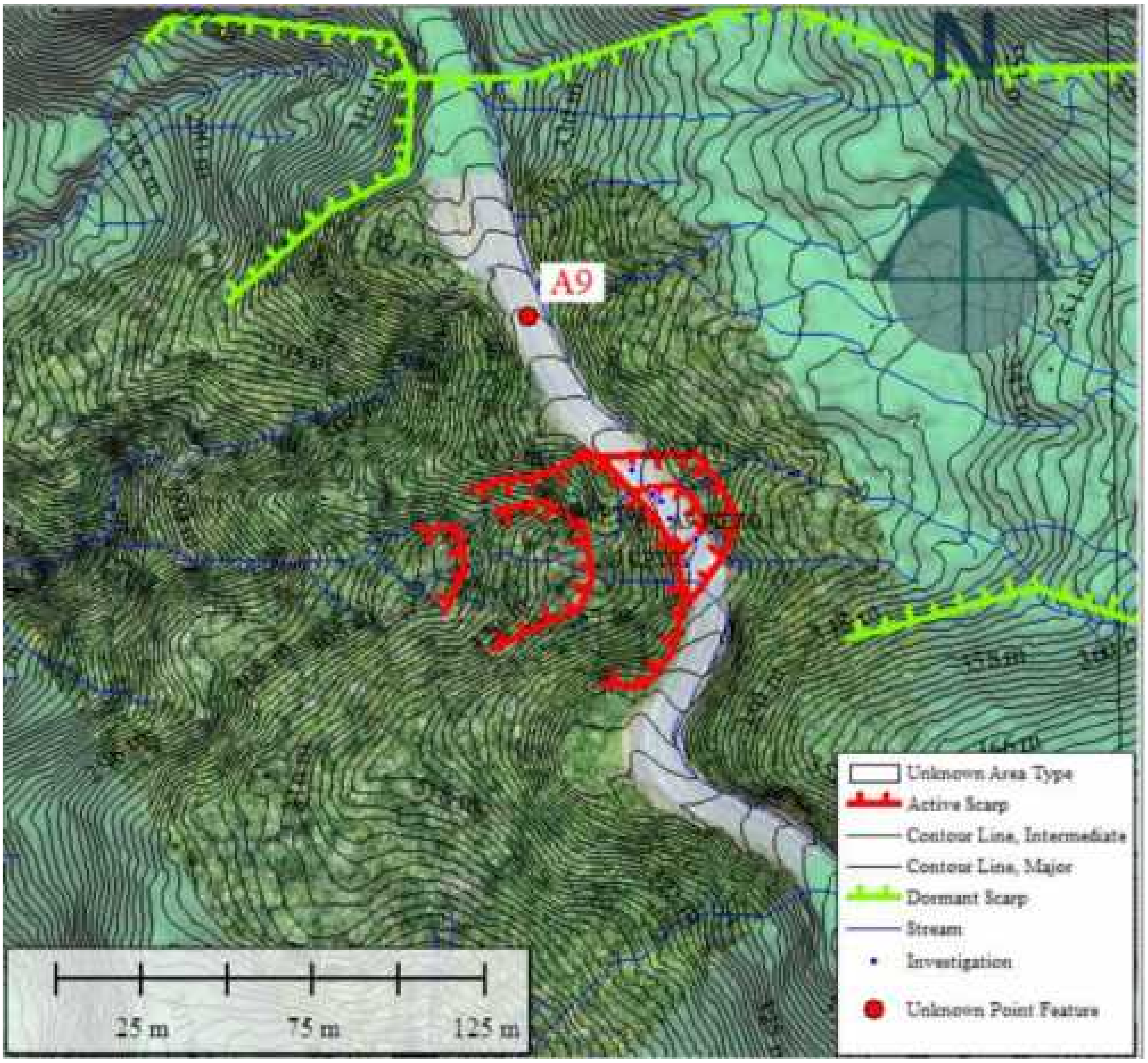


Figure 4-1: Geomorphological map

5 Ground Model

Table 5-1 below summarises the ground model for site A9. A conceptual geological cross section is presented within Appendix B.

Table 5-1: A9 Ground Model

Lithology	Top (m bgl)	Base (m bgl)	Total thickness (m)	SPT N Value	GSI
Fill	0	0.8	0.8	0*	
Colluvium	0.8* 1.2*	2.15*6.00*	1.35	0*	
Completely Weathered Tangihua Complex BASALT/MUDSTONE/CATACLASTIC ROCK (V-VI)	2.15*6.00*	9.80*14.00*	7.65	0-50+	
Highly degraded Tangihua Complex MUDSTONE/BASALT	9.80*14.00*	11.75*14.00*	1.95	50+	0-10
Moderately Degraded Tangihua Complex MUDSTONE/BASALT	11.75*14.00*	13.00*15.5*	1.25	50+	20-30
Slightly Weathered Tangihua Complex	13.00*	14.00*			
MODERATELY Degraded Tangihua Complex MUDSTONE/CATACLSTIC ROCK (III)	14.00*	16.55*	6.5	50+	20-30
Tangihua Complex MUDSTONE/CATACLSTIC ROCK (II)	16.55*	19.50*			

* Inferred from CPT results. CPTs

** Where base proven.

Fill was encountered from surface within BH09-01 and inferred to be present within all three CPT's. The material is described as Asphalt, fine to coarse gravel, basalt with minor fines, dense to very dense.

Colluvium was encountered at 0.80mBGL within BH09-01 and inferred to be present within all CPTs. The material is predominantly described as clayey SILT with trace sand and organics, subangular to subrounded gravels of basalt. Colluvium thickness varies from 2.15m (BH09-01) to 6.0m (CPT03).

Completely Weathered Tangihua Complex material was encountered at 2.15mBGL to 9.8mbgl within BH01 and inferred to be present within CPT02, described as silty CLAY with some sand and trace gravel, firm. Material thickness varies from 2.15mbgl (BH0T03 1) to 6.00mbgl (CPT03).

CPT inferred boundaries between the Colluvium and Completely weathered bedrock are difficult to infer given the similarities in material properties. It's reasonable to expect the thicknesses of these materials to vary across the site.

Highly Degraded Cataclastic Tangihua Complex IV was encountered withing BH09 and inferred to be present within all CPTs. This material is described as extremely weak sheared MUDSTONE from 9.8mbgl 11.75mbgl and inferred to be present within all CPTs, described predominantly as dark reddish-brown Mudstone sheared with dark brown Basalt, gravelly with some zeolite and fines.

Moderately Degraded Cataclastic Tangihua Complex III was encountered at 11.75mBGL within BH01 with a thickness of 7.75mbgl. Material described as very weak MUDSTONE sheared with moderately weathered BASALT with zeolite alternation. Proportions of sedimentary/igneous material vary throughout this unit.

Slightly weathered Tangihua Complex II Rock was encountered from 14.90mbgl down to the machine borehole termination depth of 16.50mbgl within BH01 described as Slightly weathered, bluish grey, highly fractured BASALT; Very strong; extremely closely to closely spaced, gently to steeply inclined, planar smooth (50%) and undulating smooth to rough (50%) defects; iron staining on defect surface; zeolite veining.

Groundwater was encountered at 5.6m depth during drilling within the Completely Weathered Tangihua Complex.

5.1 Instrumentation Summary

Tilt sensors data and rainfall sensors data is presented within Appendix C, collected from 14th September 2022. Tilt sensor positions shown below on Figure 5-1.

No significant tilt sensor movements have been identified to date at site A9 with peaks and troughs typically displaying cyclic changes in temperature affecting both the ground and monitoring equipment. MA Tilt 1,2 and 3 all displayed X, Y, Z movements up to 0.30° between 17th September and 20th September 2022.

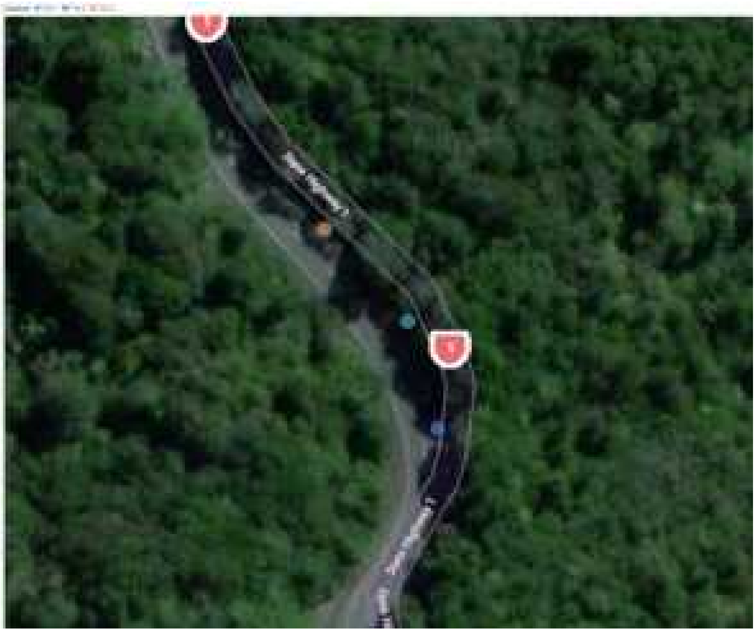


Figure 5-1: Tilt sensor positioning site A9

At completion of the borehole (BH01), inclinometer casing was installed to 18.5m depth for subsequent monitoring. Inclinometer monitoring is ongoing, commencing on 13th September 2022. Results are presented within Appendix C.

Visible movement is apparent at 9.5m depth. 7mm of movement occurred in a 2-week period between the second and third monitoring visit. Material at this depth within BHA9-01 is described as silty fine SAND with a 150mm zone of core loss from 8.85m to 9.00m depth. Below this bedrock is encountered at 9.80m depth.

6 Recommendations

A deep-seated landslide has occurred at site A9 caused by progressive saturation of the ground. Visible movement is apparent with the inclinometer at 9.5m depth.

The geomorphological assessment shows the slip extends a significant distance downslope with historical features observed.

There is an imminent risk of complete evacuation of road given the proximity of the headscarp and underlying ground conditions. Bedrock has been weathered/degraded to soil to 9.80m depth with SPT results between 0-7.

It is recommended that a tied back concrete pile wall is constructed, keyed into the more competent rock from about 10m depth, below the failure surface. This solution would have an estimated construction costs ranging from $1.5m-$2.5m and would be a permanent fix with very little maintenance costs.

Further information provided within October 2022 Storm Response Options Update- Memo no.2 including discounted solutions.

7 Limitation

This report has been prepared for the benefit of NZTA only and is based on limited investigation and visual inspection only. Given the complex geological setting changes in ground condition could occur across the site that differ from those summarised within this report.

Appendix A

Borehole Logs
CPT Report

Borehole No. BHA9-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280495 E 987052 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	328.8 m
Location:	Slip22A9 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000
Depth:	19.5 m	*Inclination:*	Vertical

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION
	ASPHALT
Fill	Fine to coarse GRAVEL; bluish grey mottled grey. Very dense; subangular, well graded, BASALT [Gap 40 Subgrade].
Colluvium	Sandy fine to medium GRAVEL; brown mottled dark grey. Dense, wet; gravel, subangular, poorly sorted, slightly weathered, strong basalt; sand, fine.
Colluvium	Clayey SILT, some sand, trace gravel; light brown trace greenish grey. Firm, wet, highly plastic; sand, fine; gravel, fine to medium, subangular to subrounded, highly weathered, very weak basalt. 1.00m - Light greenish grey mottled green and brown, soft.
Colluvium	1.75 - 1.95m - Core loss; No sample recovery.
Colluvium	Clayey SILT, some sand, trace gravel; light brown mottled greenish grey. Firm, wet, highly plastic; sand, fine; gravel, fine to medium, subangular to subrounded, highly weathered, very weak basalt.
Tangihua Complex	Silty CLAY, trace gravel; reddish brown. Firm, wet, highly plastic; gravel, fine, extremely weak mudstone [Completely weathered]. 2.50m - Very soft, saturated.
Tangihua Complex	2.75 - 3.00m - Core loss; No sample recovery.
Tangihua Complex	Silty CLAY, minor sand; light yellowish brown mottled light brown. Soft, wet, highly plastic; sand, fine [Completely weathered].
Tangihua Complex	3.23 - 3.45m - Core loss; No sample recovery.
Tangihua Complex	Clayey SILT, trace sand; light yellowish brown. Soft, wet, highly plastic; sand, fine [Completely weathered].
Tangihua Complex	Clayey SILT, trace sand and gravel; light brown mottled dark reddish brown. Firm, wet, highly plastic; sand fine, gravel, fine, suangular to subrounded, basalt and mudstone [Completely weathered].
Tangihua Complex	Clayey SILT, minor sand; light brown trace dark brown. Firm, moist, highly plastic; sand, fine [Completely weathered].
Tangihua Complex	Clayey SILT, minor sand, trace gravel; light brown trace dark brown. Firm, moist, highly plastic; sand, fine, gravel, fine, subrounded, completely weathered, extremely weak basalt [Completely weathered].
Tangihua Complex	Silty CLAY, minor sand, trace gravel; brown mottled dark reddish brown. Firm, moist, highly plastic; sand, fine; gravel, fine to medium, subangular to subrounded, completely weathered, extremely weak mudstone [Completely weathered].
Tangihua Complex	8.85 - 9.00m - Core loss; No sample recovery.
Tangihua Complex	Silty fine SAND; light brown trace dark brown. Fim, loose; sand, poorly sorted [Completely weathered].

R.L. (m): 328, 326, 324, 322, 320. DEPTH (m): 1, 2, 3, 4, 5, 6, 7, 8, 9.

SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE
0	0// 0/0/0/0
0	0// 0/0/0/0
4	1// 0/1/1/2
7	1// 1/2/2/2
4	1// 0/2/1/1
5	1// 1/1/1/2

ROCK WEATHERING: CW

EW HW EC

DEFECT DIP degrees 0 90

SAMPLE TYPE	TCR (%)
HQ	100
SPT	56
HQ	76
SPT	51
HQ	100
SPT	100
HQ	100
SPT	100
HQ	100
SPT	100
HQ	86
SPT	100
HQ	95

DRILLING METHOD: HQ Size, Triple Tube, Wireline Rotary Coring

BASE OF HOLE & WATER LEVEL: SWL 5.60m 2/09

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	2/09/2022	*Finished:*	3/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Borehole No. BHA9-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280495 E 987052 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	19.5 m
Project No.:	1-11244.00	*R.L.:*	328.8 m	*Inclination:*	Vertical
Location:	Slip22A9 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

GEOLOGY: Tangihua Complex

MAIN DESCRIPTION / DETAIL DESCRIPTION	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING
Highly degraded, dark reddish brown MUDSTONE (70%) sheared with dark brown BASALT (30%). Extremely weak.	EW	HW	EC
[Silty CLAY, minor gravel; hard, moist, highly plastic; gravel, fine, highly weathered, very weak mudstone].*(continued)*			
10.45 - 10.50m - Core loss; No sample recovery.			
Highly degraded, dark reddish brown MUDSTONE (70%) sheared with dark brown BASALT (30%). Extremely weak; extremely closely to very closely space, sub-horizontal, plannar smooth defects;	VW	HW	EC
[Silty CLAY, minor gravel; hard, moist, highly plastic; gravel, fine to medium, highly weathered, very weak mudstone].			
11.45 - 10.75m - Core loss; No sample recovery.			
Moderately degraded, dark reddish brown MUDSTONE (70%) sheared with dark brown BASALT (30%). Very weak; extremely closely spaced, sub-horizontal, undulating rough defects.	VW	MW	EC
Moderately weathered, dark reddish brown MUDSTONE (90%) sheared with dark brown BASALT (10%). Very weak; extremely closely spaced, sub-horizontal, planar rough defects.			
Slightly weathered, dark reddish brown MUDSTONE (85%) sheared with dark brown BASALT (15%). Moderately strong; extremely closely to closely spaced, sub-horizontal to gentle inclined, planar rough defects.	MS	SW	VC
Moderately weathered, brown, BASALT. Very weak; very closely to closely spaced, sub-horizontal inclined, planner roguh defects; relic remnant sealed jointing.	VW	MW	VC
Moderately degraded, dark reddish brown MUDSTONE (80%) sheared with dark brown BASALT (20%). Weak; extremely closely spaced, sub-horizontal, undulating rough defects.	W	MW	EC
15.02 - 15.12m - Core loss; No sample recovery.			
Moderately degraded, dark reddish brown MUDSTONE (80%) sheared with dark brown BASALT (20%). Weak; extremely closely spaced, sub-horizontal, undulating rough defects.			
Slightly weathered, Dark reddish brown MUDSTONE (90%) sheared with dark brown BASALT (10%). Strong; extremely closely to closely spaced, sub-horizontal to very steeply inclined, undulating rough defects.	S	SW	EC
END OF BOREHOLE AT 19.5m - Target Criteria Achieved			

R.L. (m): 318, 316, 314, 312, 310
DEPTH (m): 11, 12, 13, 14, 15, 16, 17, 18, 19

TESTS

SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE
50+	50
50+	50 for initial 130mm
50+	49 for initial 95mm
50+	16 for initial 20mm

DEFECTS / NOTES / OTHER TESTS: 15.00m - Solid cone testing - bouncing.

CORE

SAMPLE TYPE	TCR (%)	RQD (%)
HQ	95	
SPT	100	
HQ	78	22
SPT	100	
HQ	100	18
SC	0	
HQ	100	35
SC	0	
HQ	93	0
HQ	100	32
HQ	100	24

DRILLING METHOD: HQ Size, Triple Tube, Wireline Rotary Coring

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	2/09/2022	*Finished:*	3/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.
Scale 1:50 @ A4

Borehole No. BHA9-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280495 E 987052 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	19.5 m
Project No.:	1-11244.00	*R.L.:*	328.8 m	*Inclination:*	Vertical
Location:	Slip22A9 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BHA9-1.1
BOX01: 0.00 - 3.45m.

Photo BHA9-1.2
BOX02: 3.45 - 6.00m.

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	2/09/2022	*Finished:*	3/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Borehole No. BHA9-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280495 E 987052 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	19.5 m
Project No.:	1-11244.00	*R.L.:*	328.8 m	*Inclination:*	Vertical
Location:	Slip22A9 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BHA9-1.3
BOX03: 6.00 - 9.00m.

Photo BHA9-1.4
BOX04: 9.00 - 12.13m.

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 22/11/22

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	2/09/2022	*Finished:*	3/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Borehole No. BHA9-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280495 E 987052 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	19.5 m
Project No.:	1-11244.00	*R.L.:*	328.8 m	*Inclination:*	Vertical
Location:	Slip22A9 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BHA9-1.5
BOX05: 12.13 - 14.80m.

Photo BHA9-1.6
BOX06: 14.80 - 17.70m.

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	2/09/2022	*Finished:*	3/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Borehole No. BHA9-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280495 E 987052 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	19.5 m
Project No.:	1-11244.00	*R.L.:*	328.8 m	*Inclination:*	Vertical
Location:	Slip22A9 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

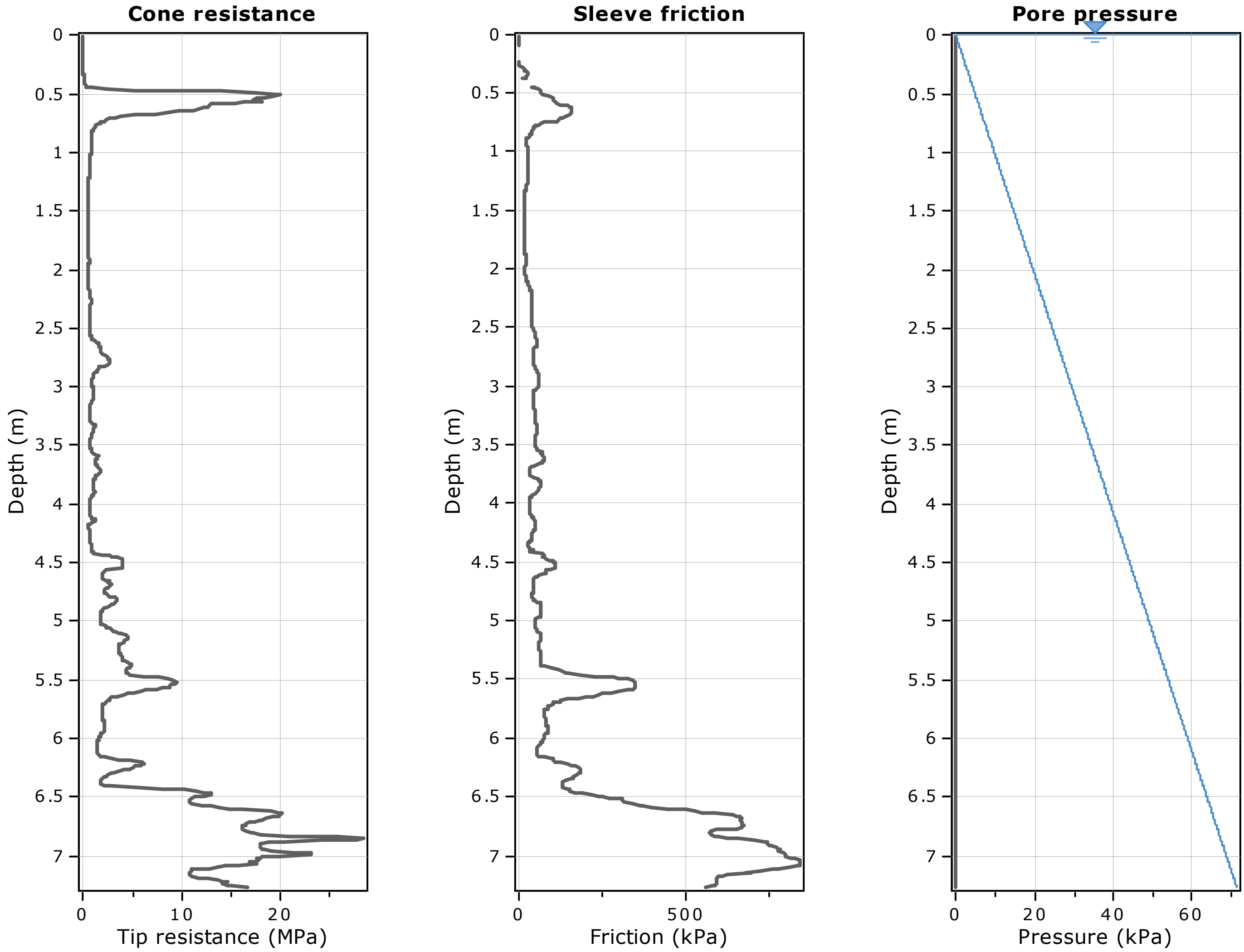
PHOTOGRAPHS

Photo BHA9-1.7
BOX07: 17.70 - 19.50m.

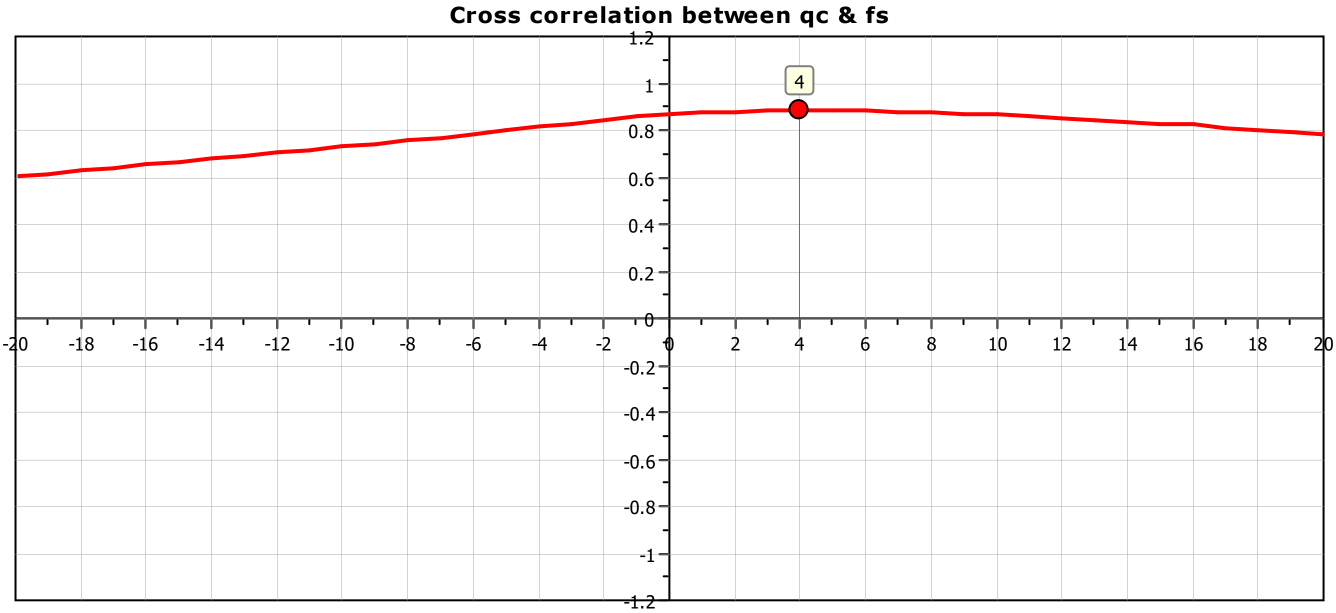
BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 22/11/22

Notes:		*Started:*	2/09/2022	*Finished:*	3/09/2022
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.		*Drilling Co.:*	DFNZ	*Drilling Rig:*	Canter Rig
		Logged by:	HQ	*Checked by:*	ML

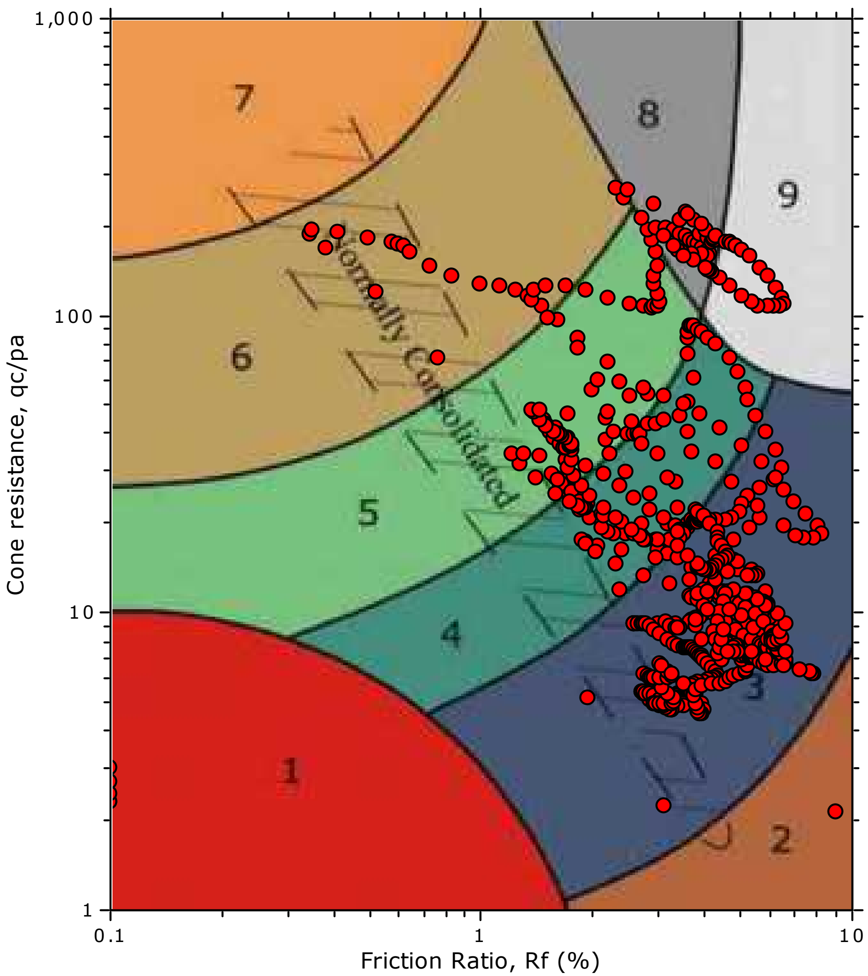
Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.
Scale 1:50 @ A4

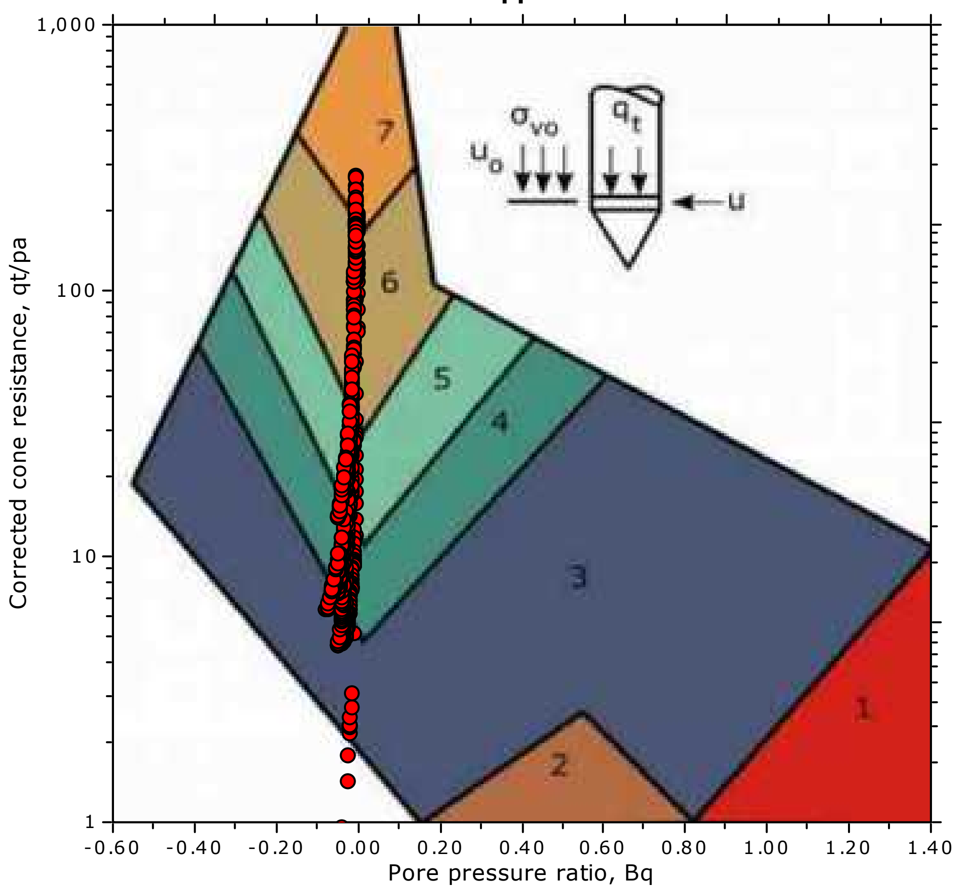


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

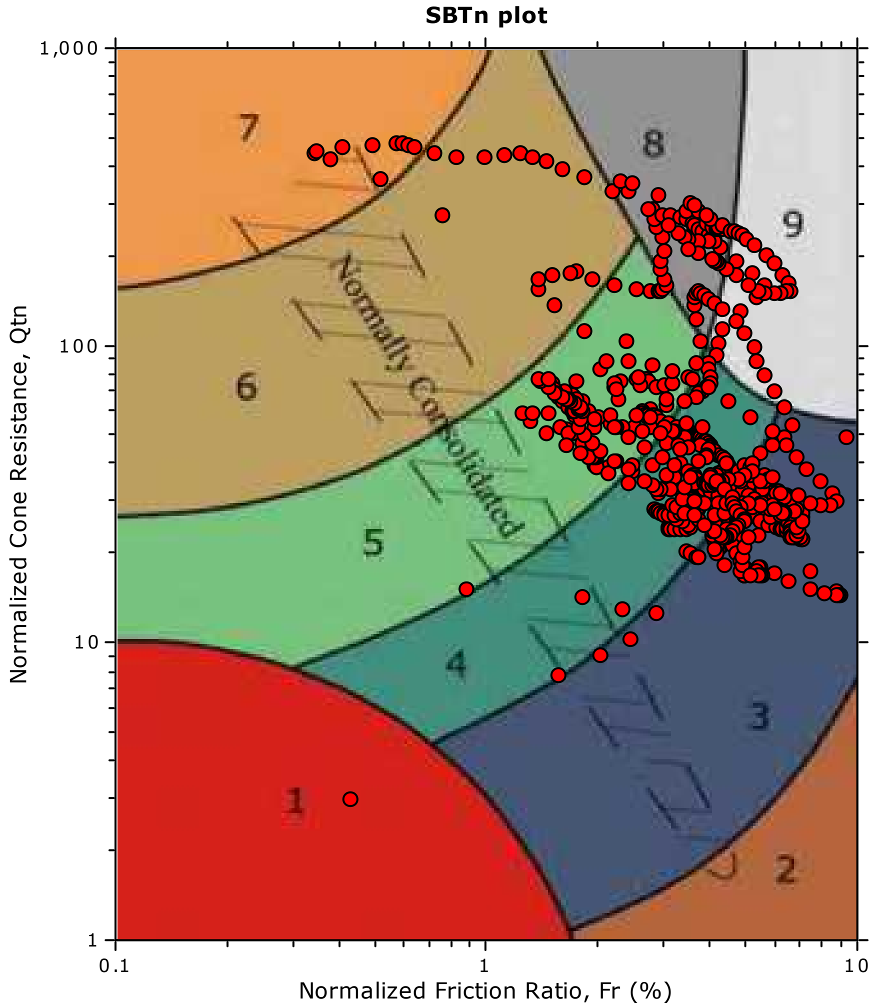


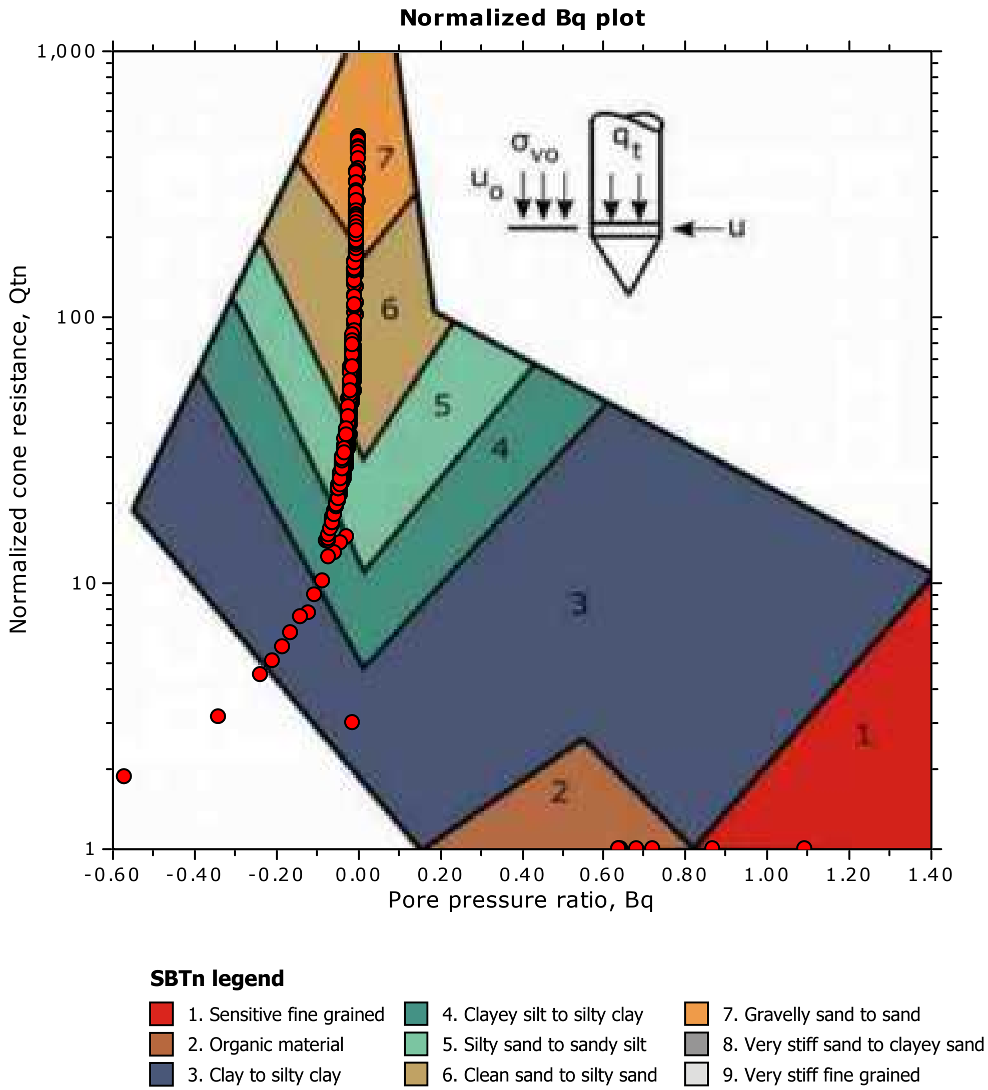


SBT legend

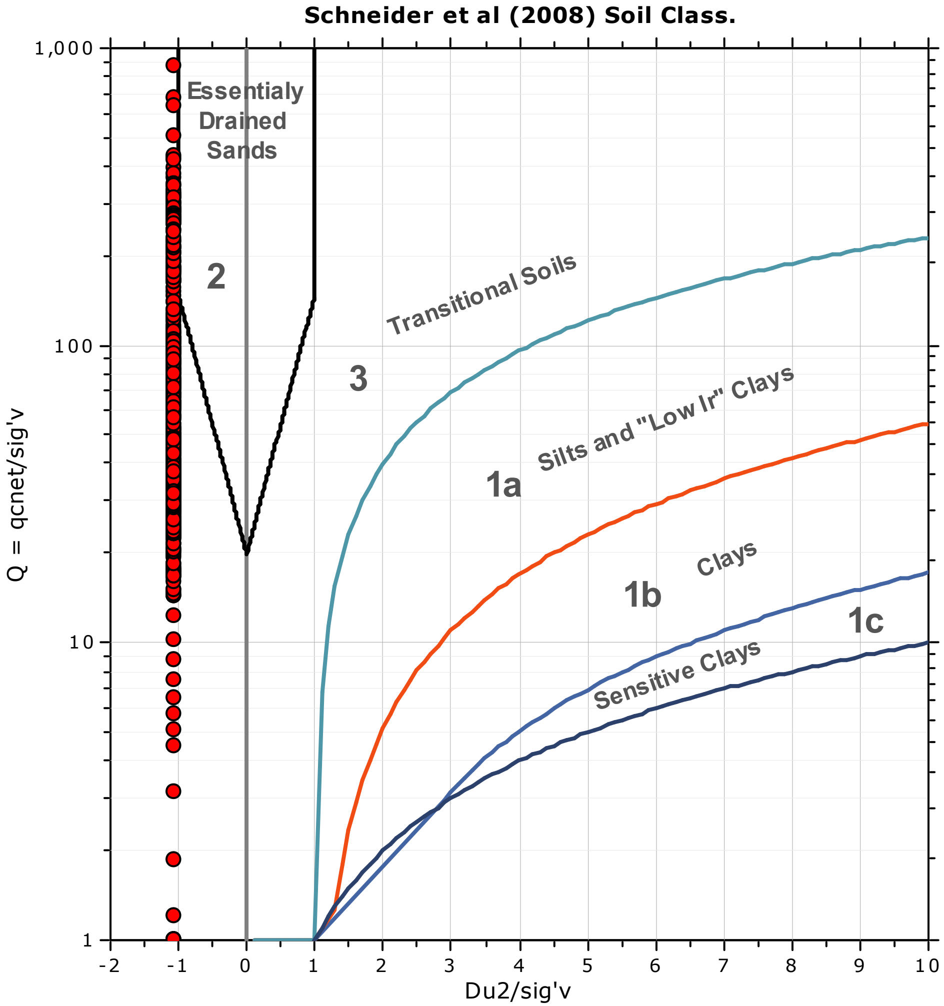
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

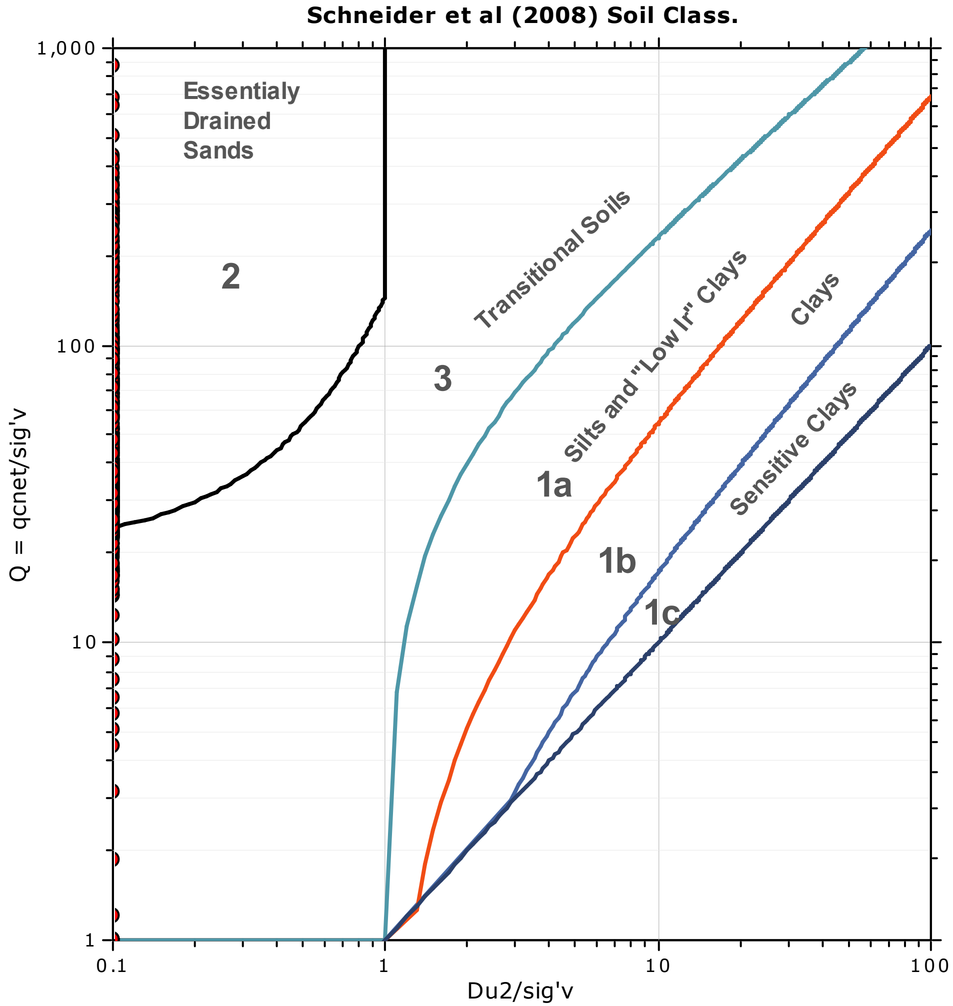
SBT - Bq plots (normalized)

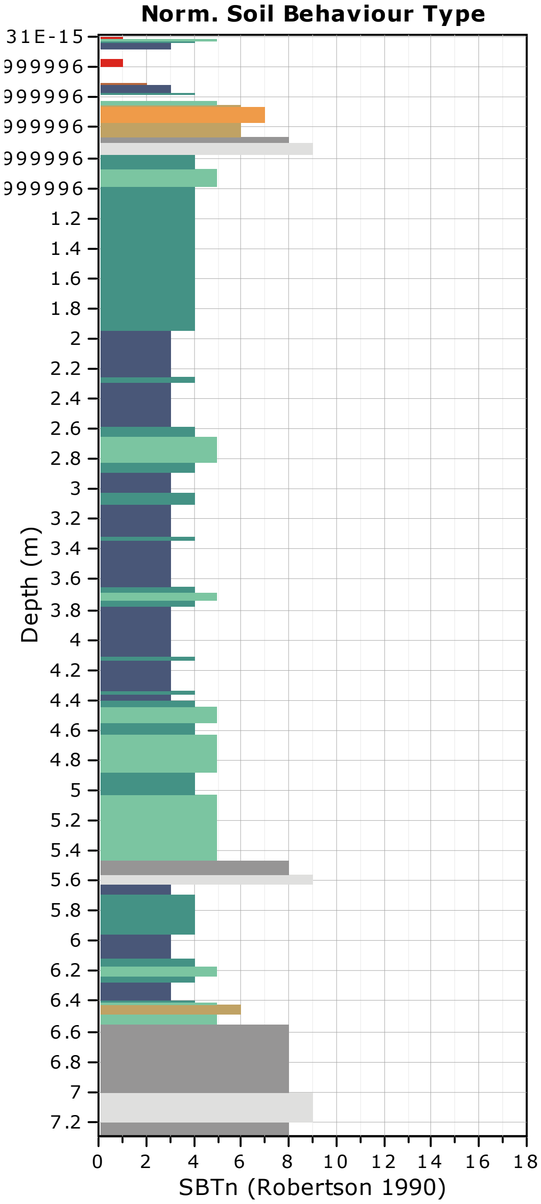


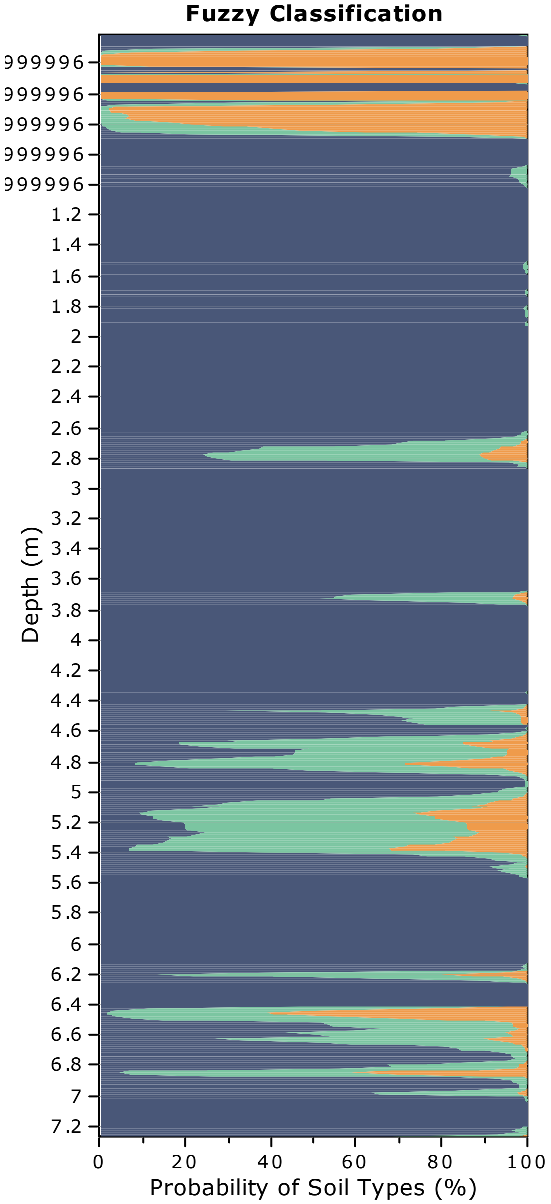


Bq plots (Schneider)





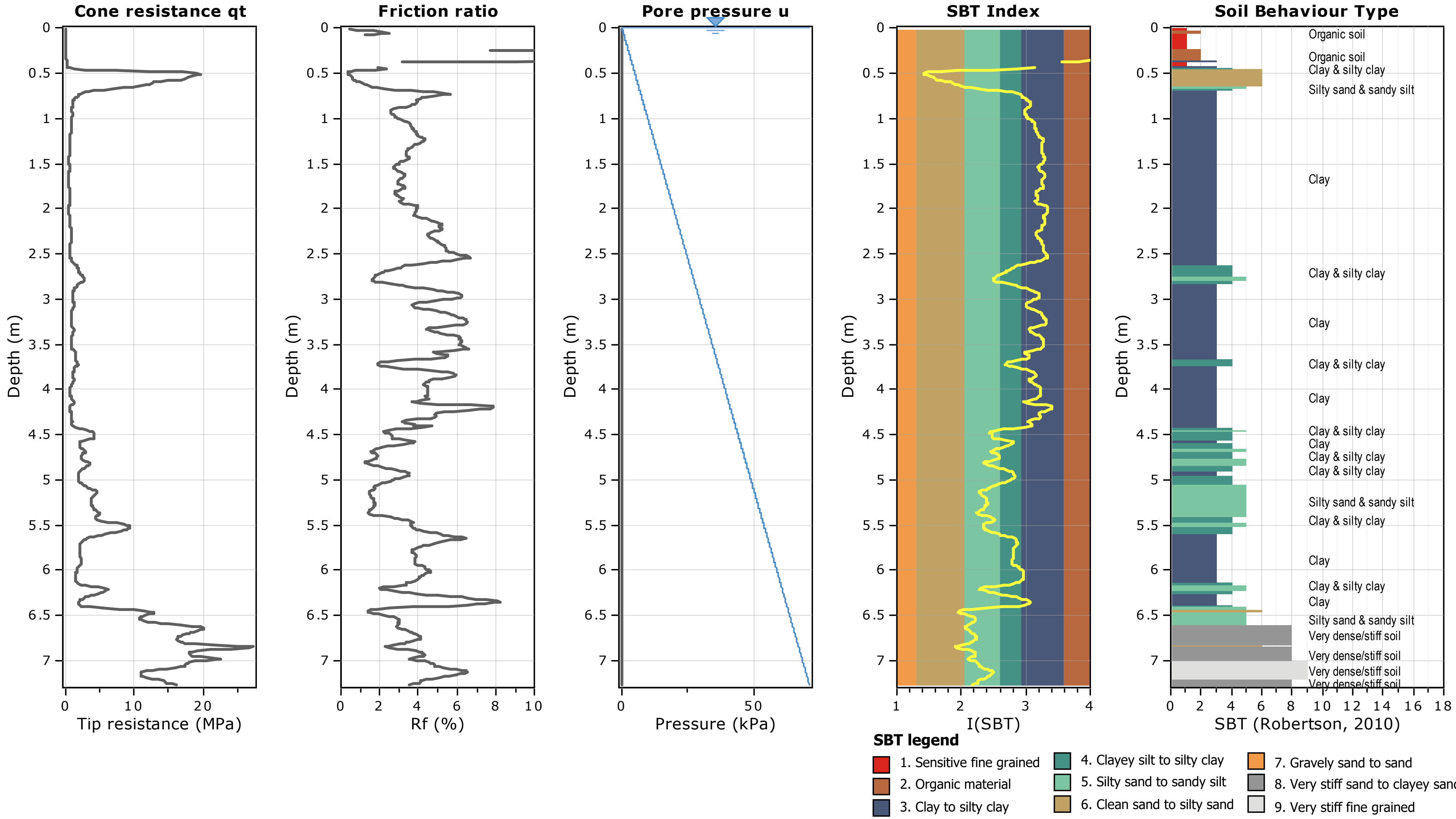

Norm. Soil Behaviour Type
Depth (m)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
Probability of Soil Types (%)

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A9-CPT01
Total depth: 7.27 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

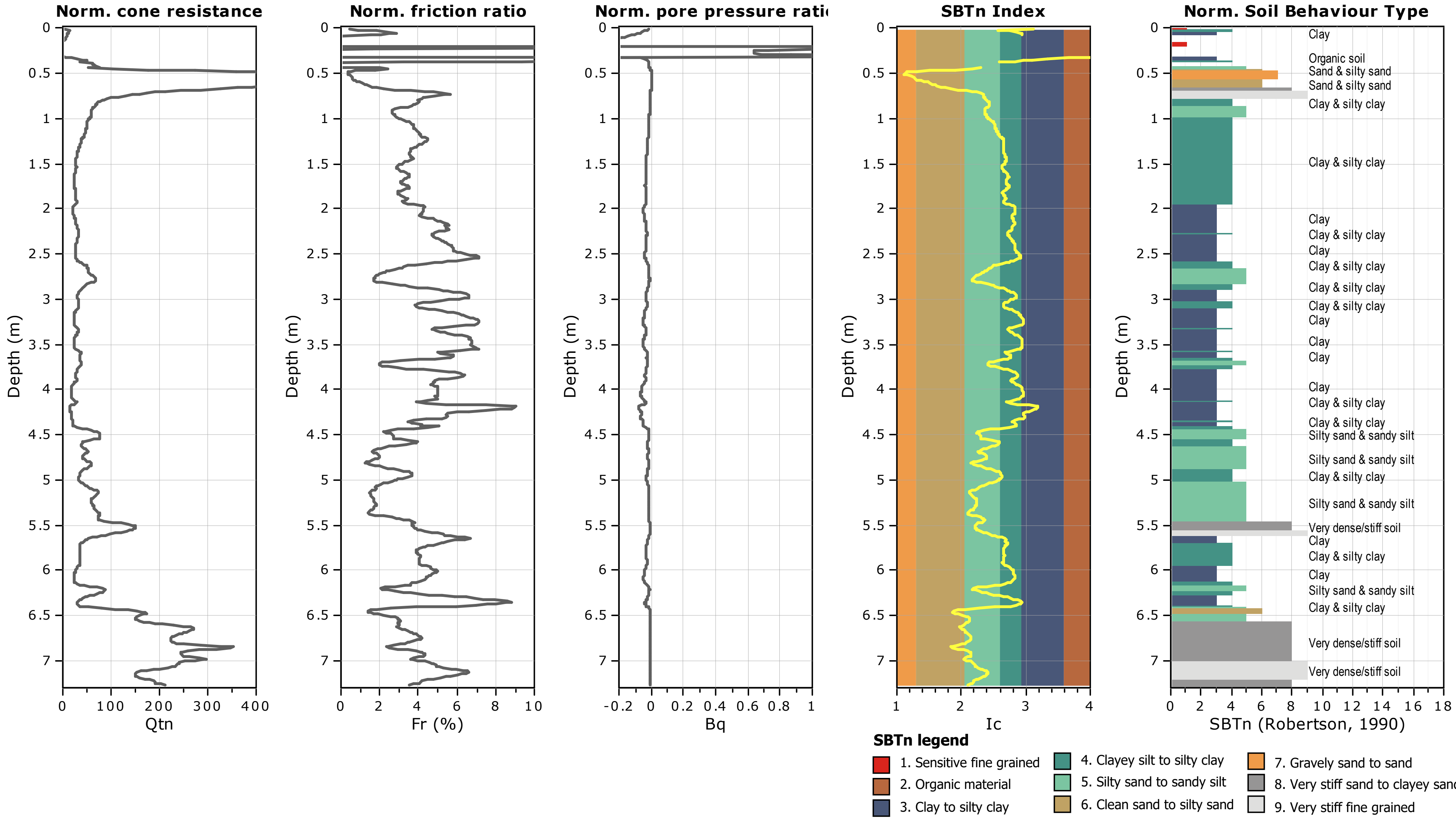
Project:
Location:



GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A9-CPT01
Total depth: 7.27 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

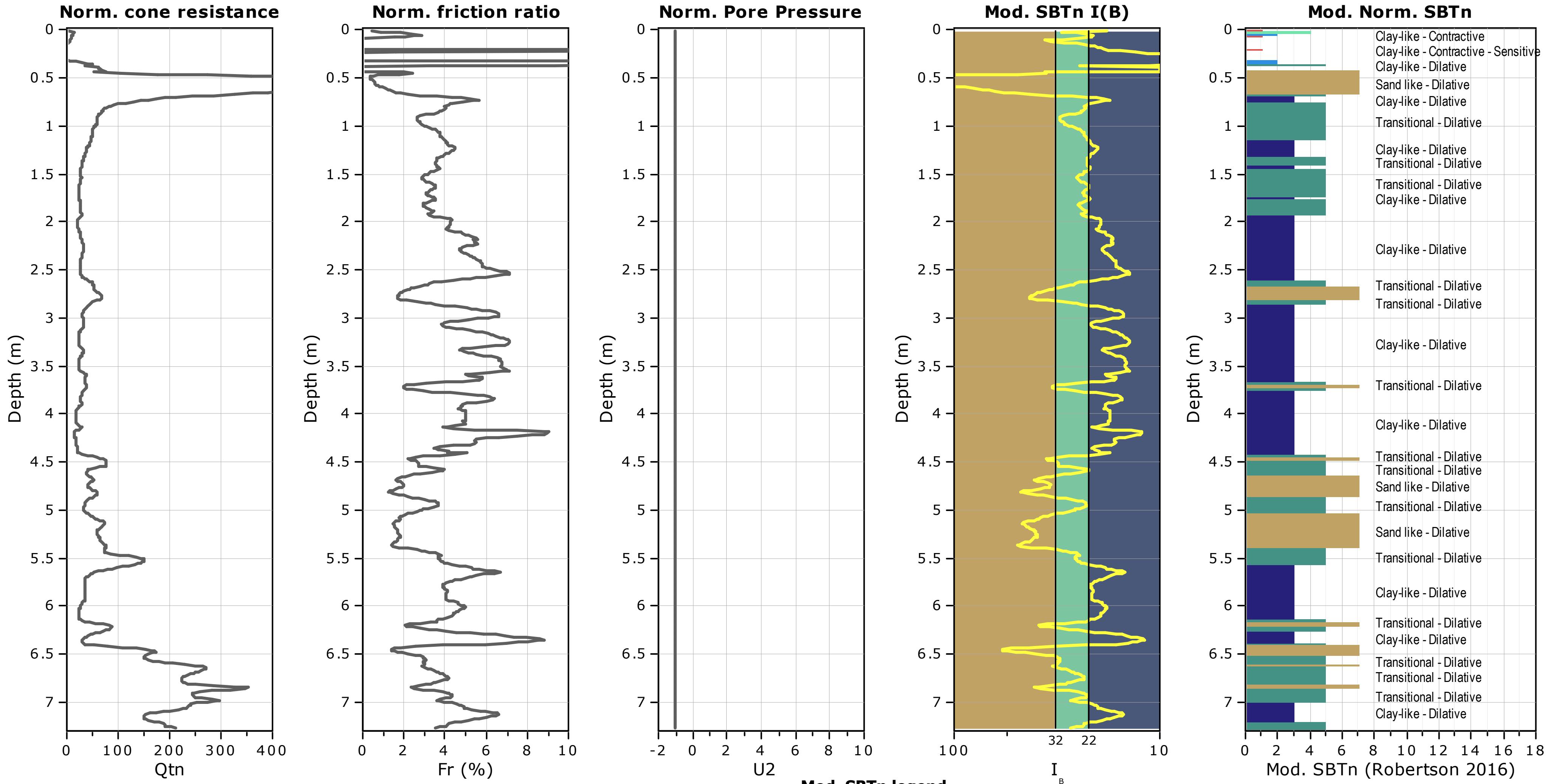
Project:
Location:



GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A9-CPT01
Total depth: 7.27 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

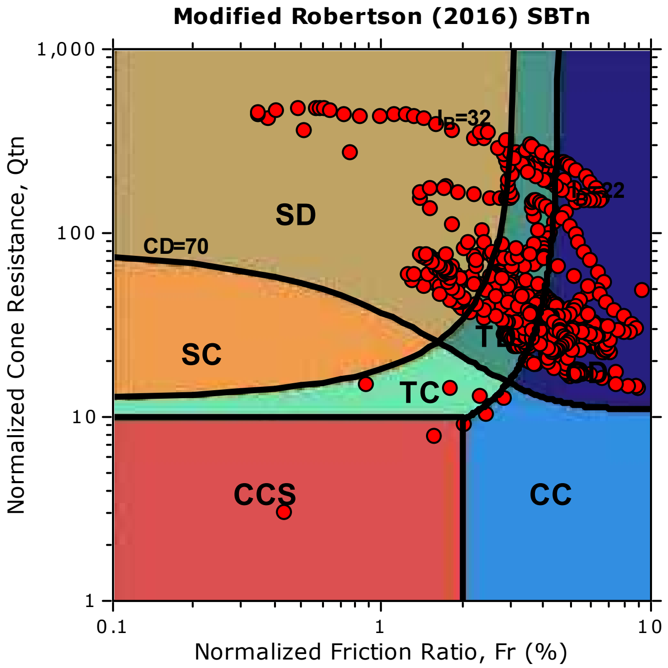
Project:
Location:

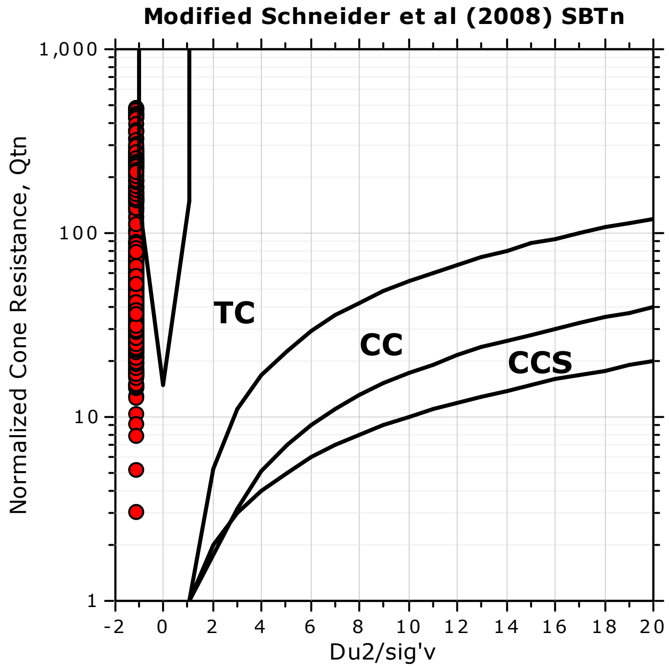


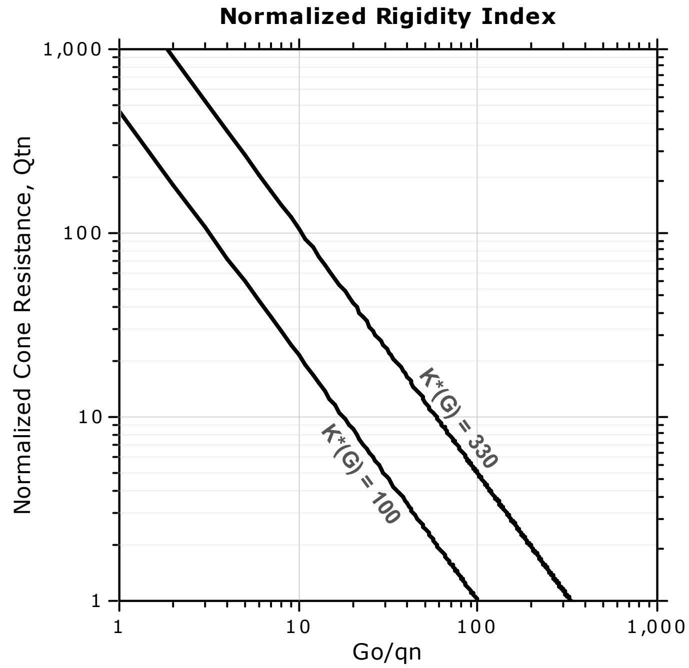
Mod. SBTn legend

1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

Updated SBTn plots







CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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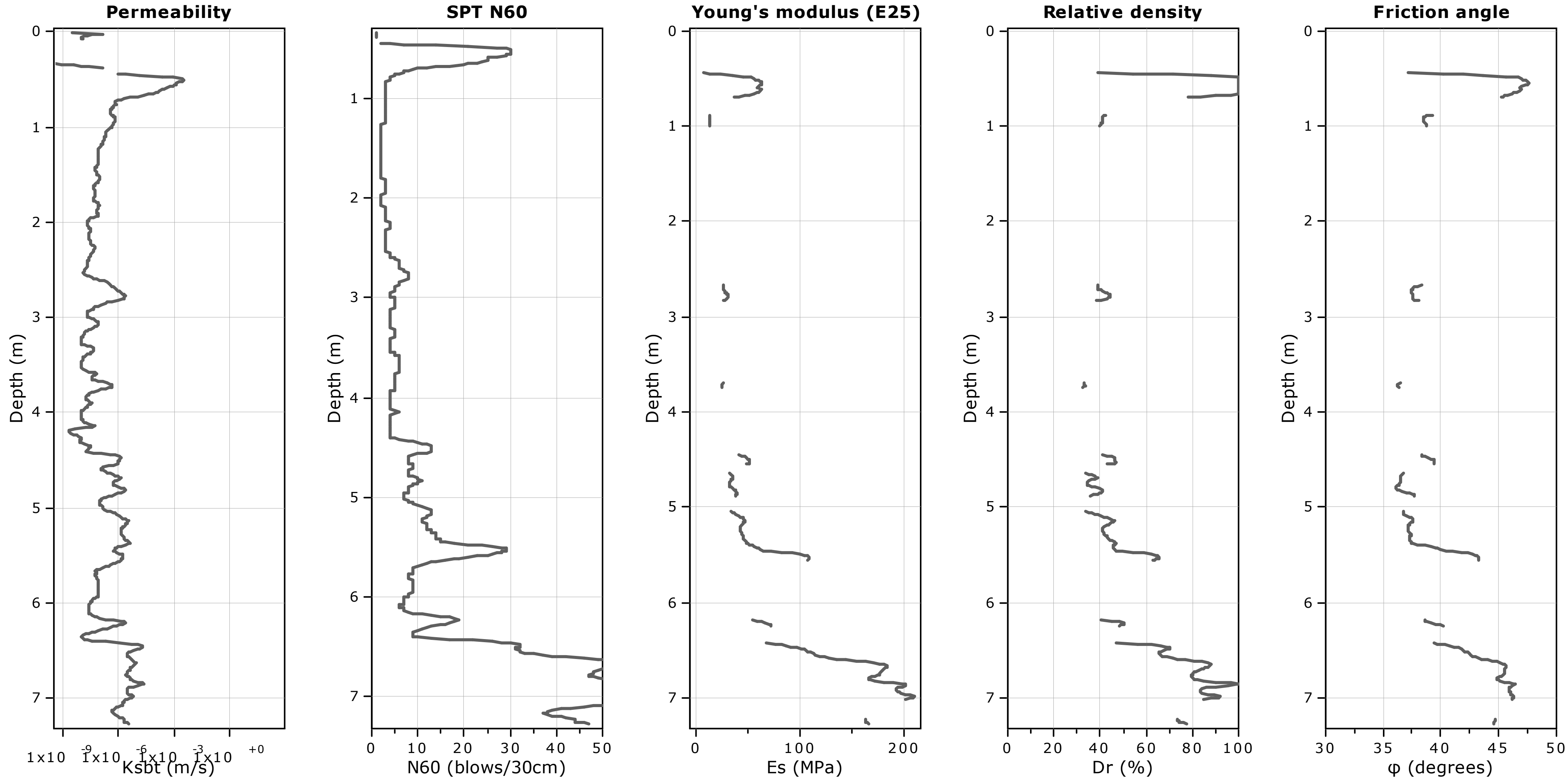
CPT: A9-CPT01
Total depth: 7.27 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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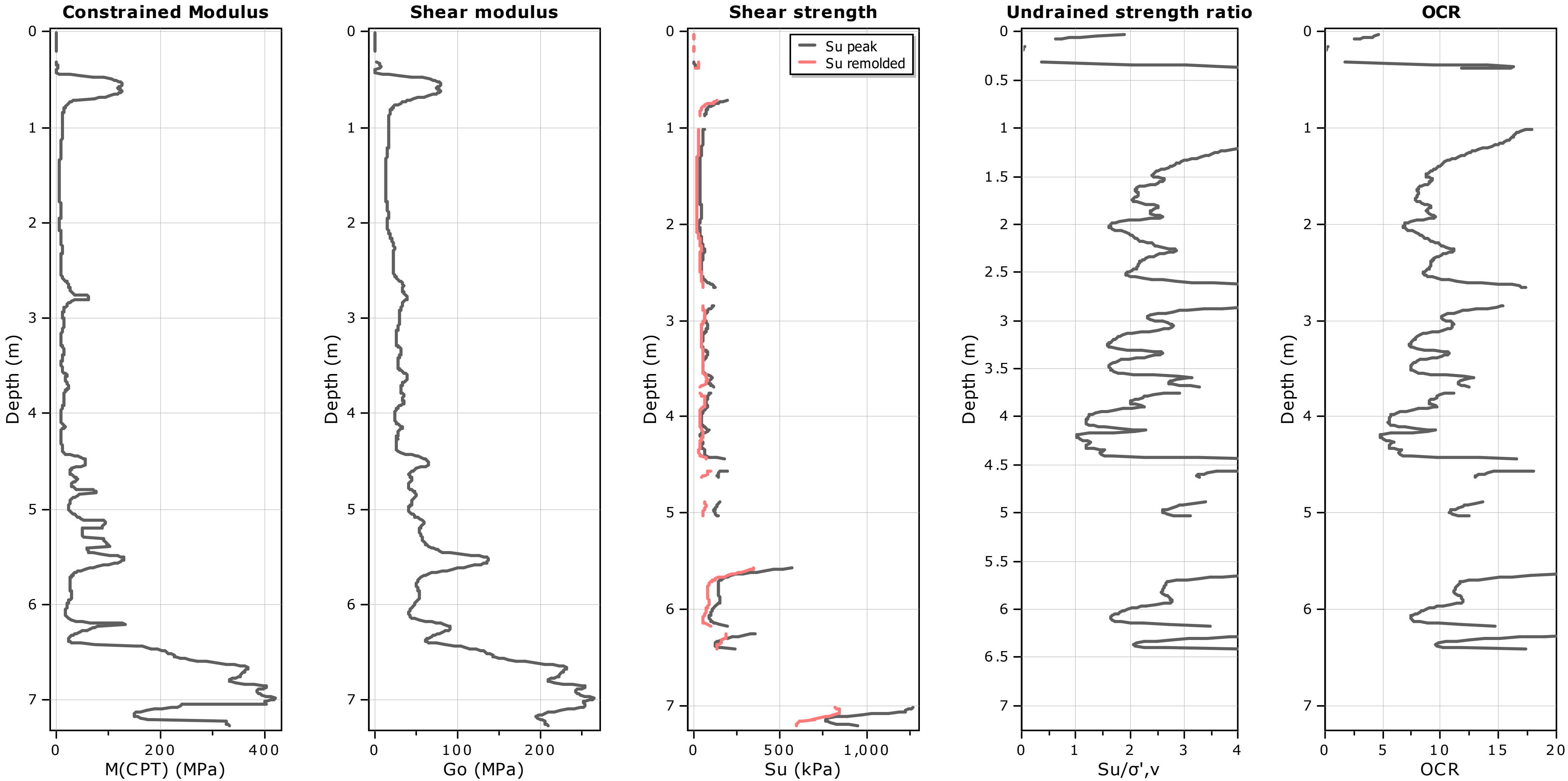
CPT: A9-CPT01
Total depth: 7.27 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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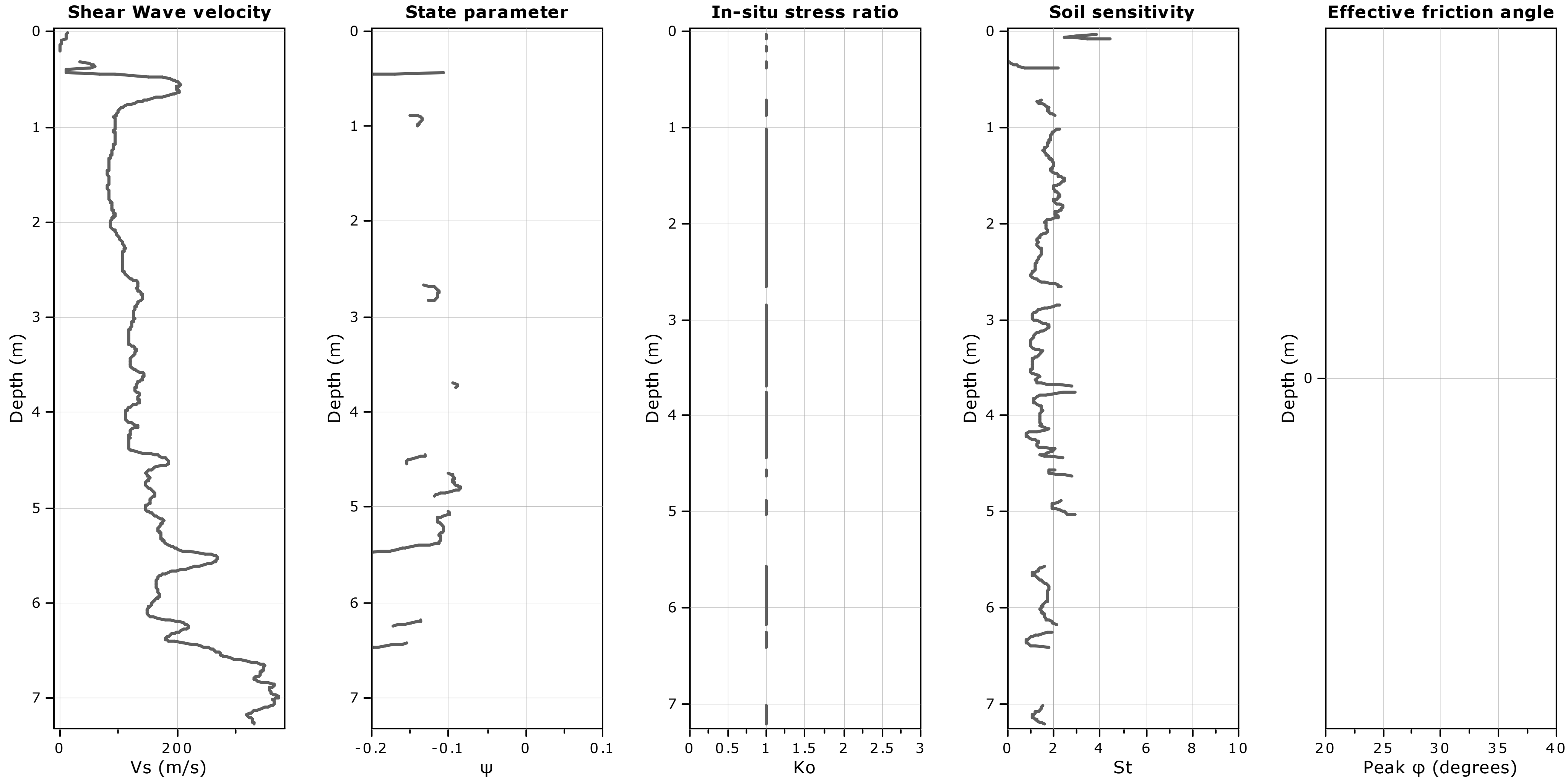
CPT: A9-CPT01
Total depth: 7.27 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

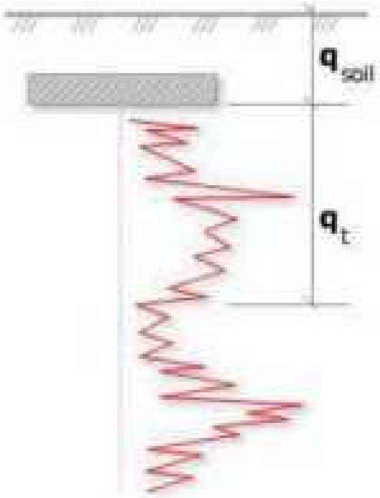
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

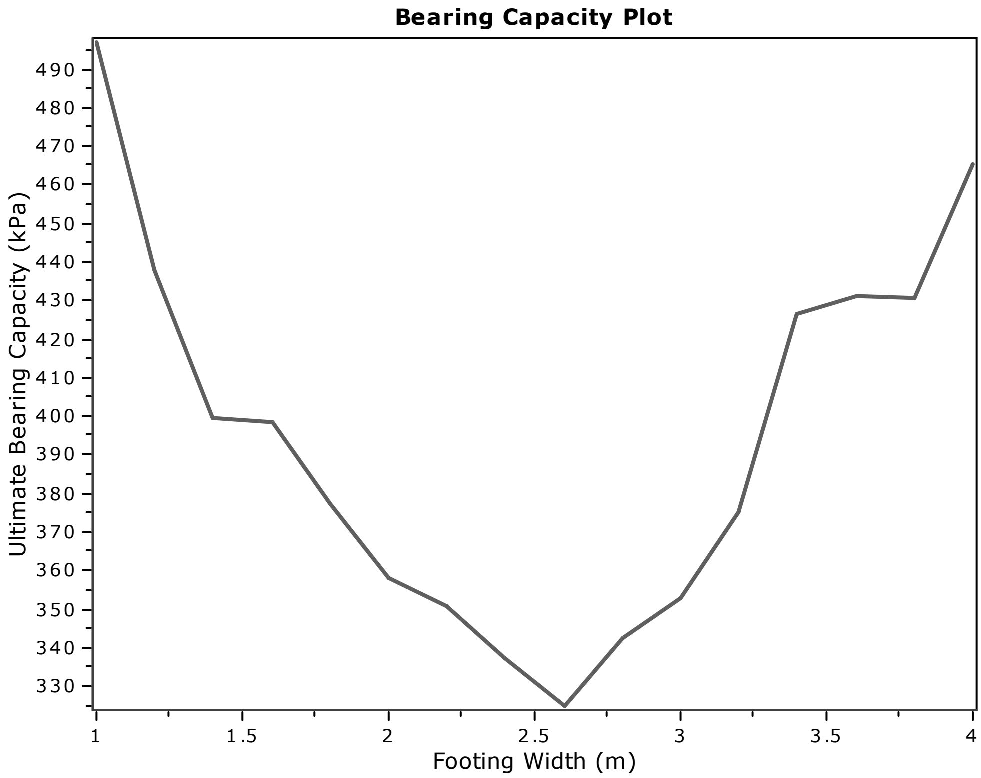
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

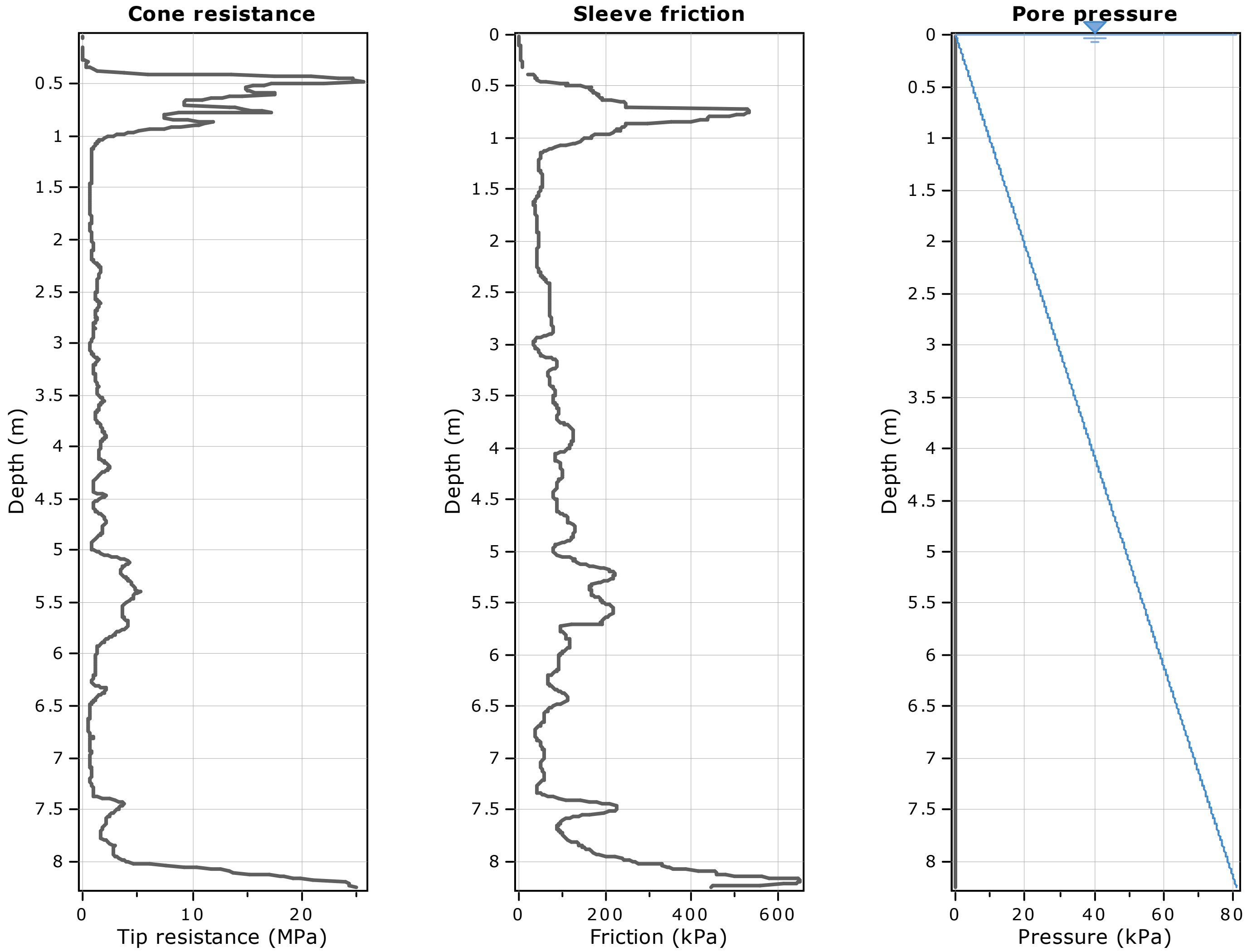
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

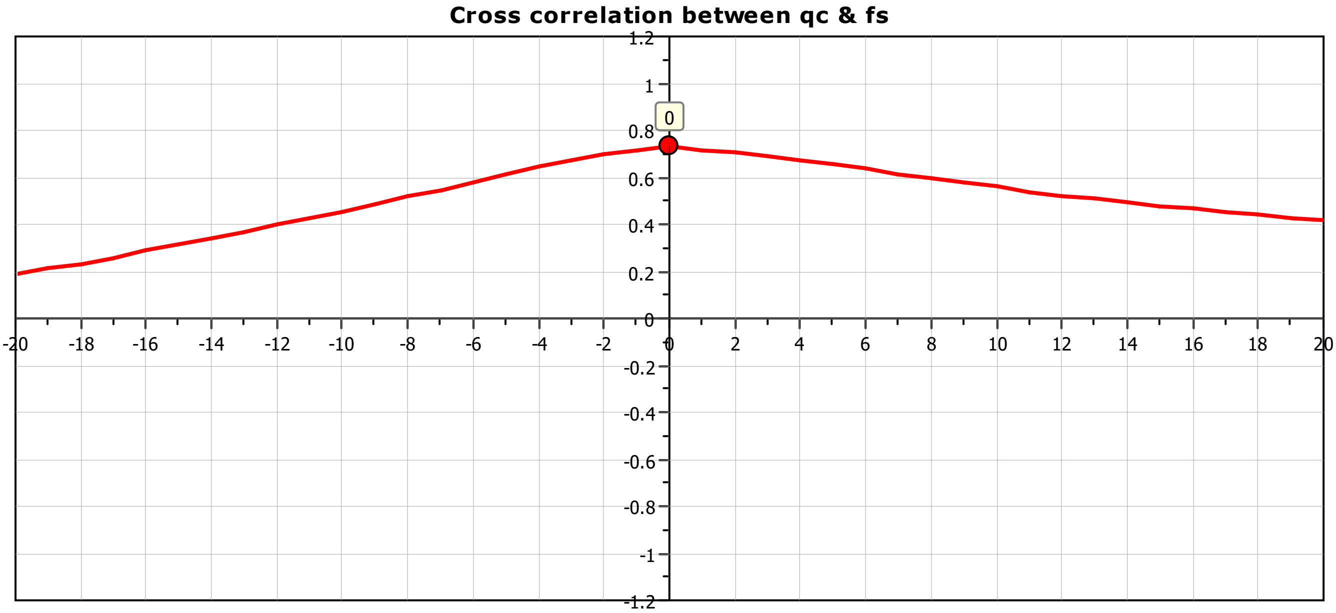


:: Tabular results ::

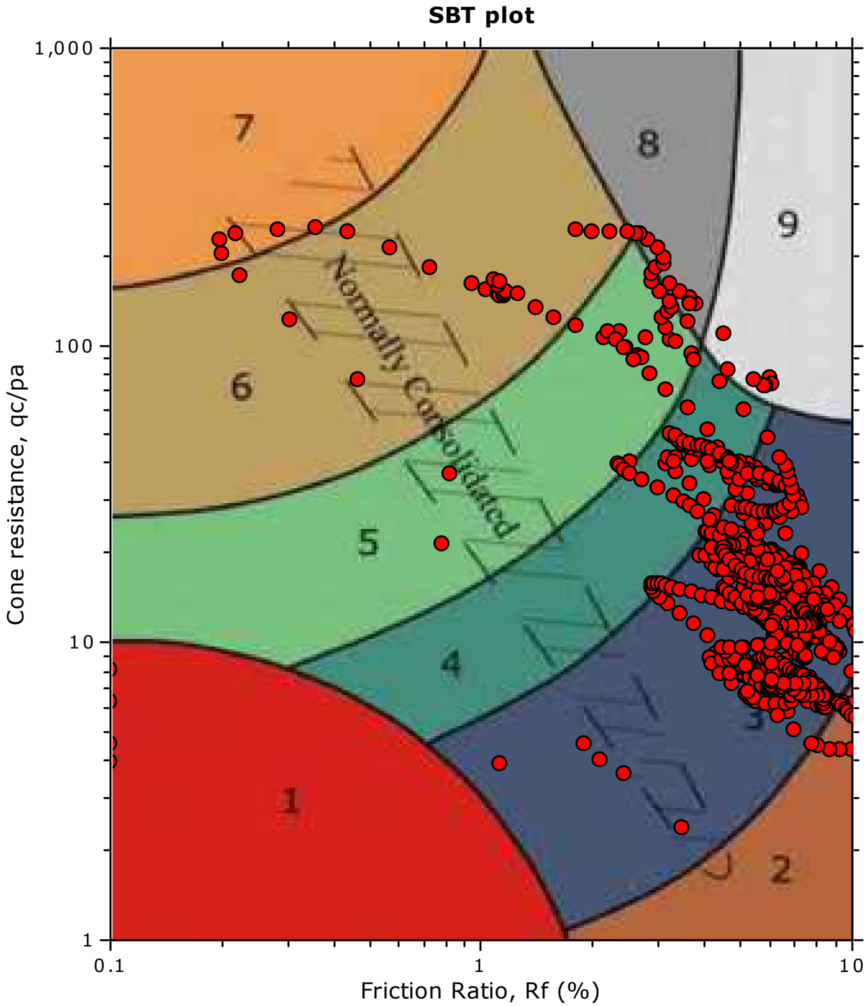
No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	2.44	0.20	9.50	497.05
2	1.20	0.50	2.30	2.14	0.20	9.50	437.96
3	1.40	0.50	2.60	1.95	0.20	9.50	399.34
4	1.60	0.50	2.90	1.94	0.20	9.50	398.32
5	1.80	0.50	3.20	1.84	0.20	9.50	377.06
6	2.00	0.50	3.50	1.74	0.20	9.50	358.10
7	2.20	0.50	3.80	1.71	0.20	9.50	350.63
8	2.40	0.50	4.10	1.64	0.20	9.50	337.17
9	2.60	0.50	4.40	1.58	0.20	9.50	324.91
10	2.80	0.50	4.70	1.67	0.20	9.50	342.78
11	3.00	0.50	5.00	1.72	0.20	9.50	352.91
12	3.20	0.50	5.30	1.83	0.20	9.50	375.33
13	3.40	0.50	5.60	2.09	0.20	9.50	426.51
14	3.60	0.50	5.90	2.11	0.20	9.50	431.17
15	3.80	0.50	6.20	2.11	0.20	9.50	430.64
16	4.00	0.50	6.50	2.28	0.20	9.50	465.52

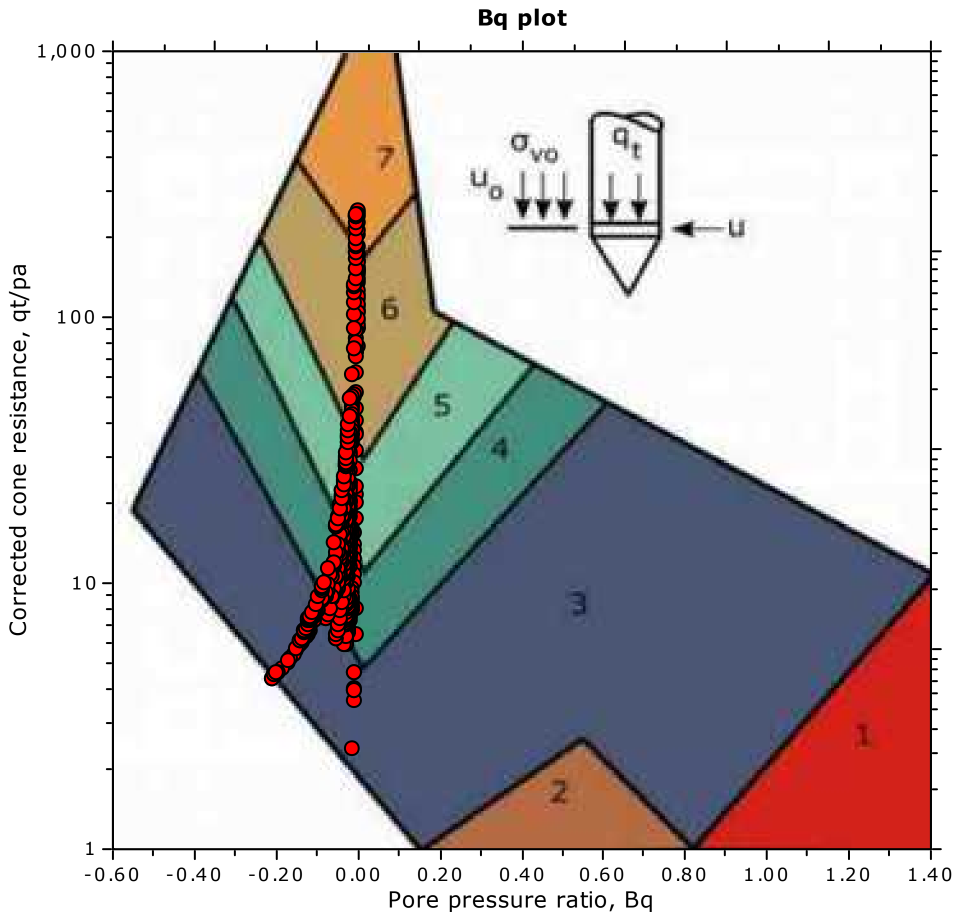


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

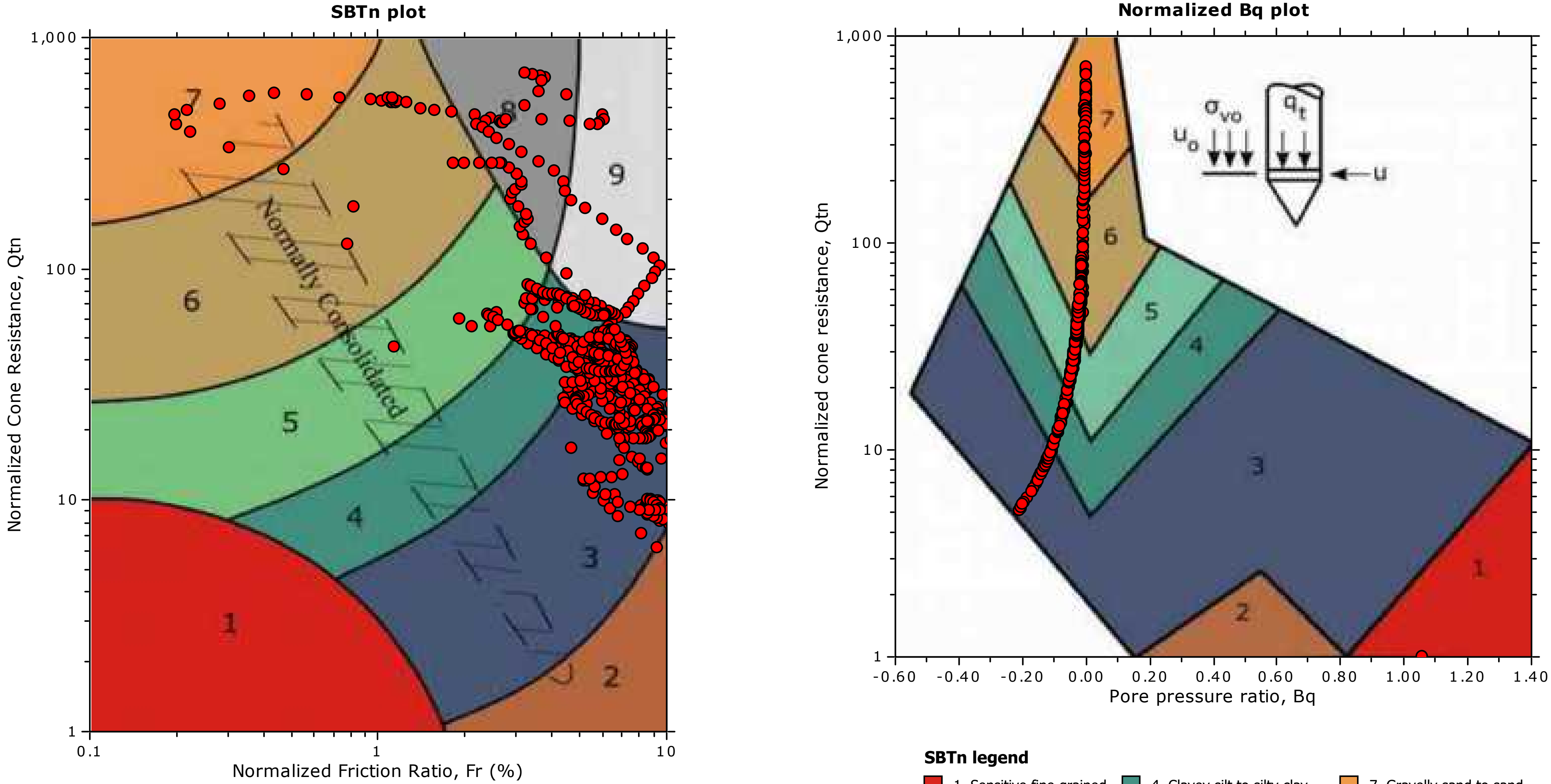




SBT legend

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

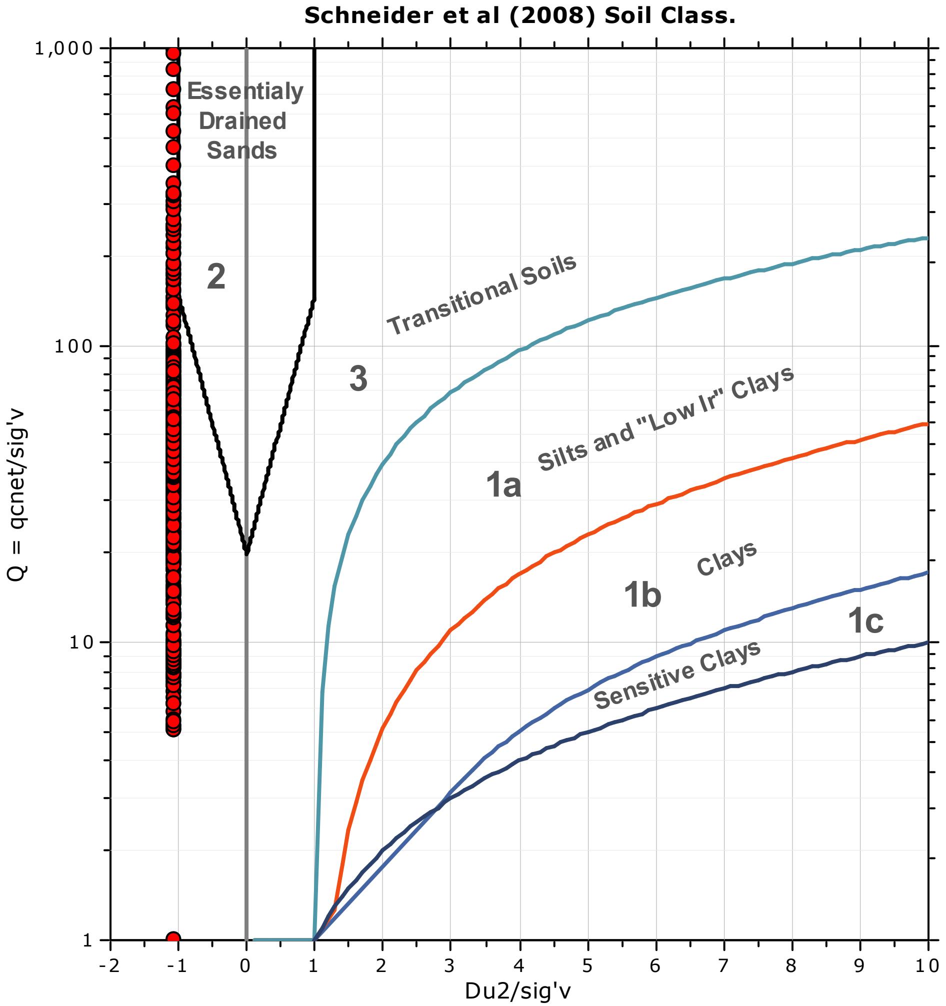
SBT - Bq plots (normalized)

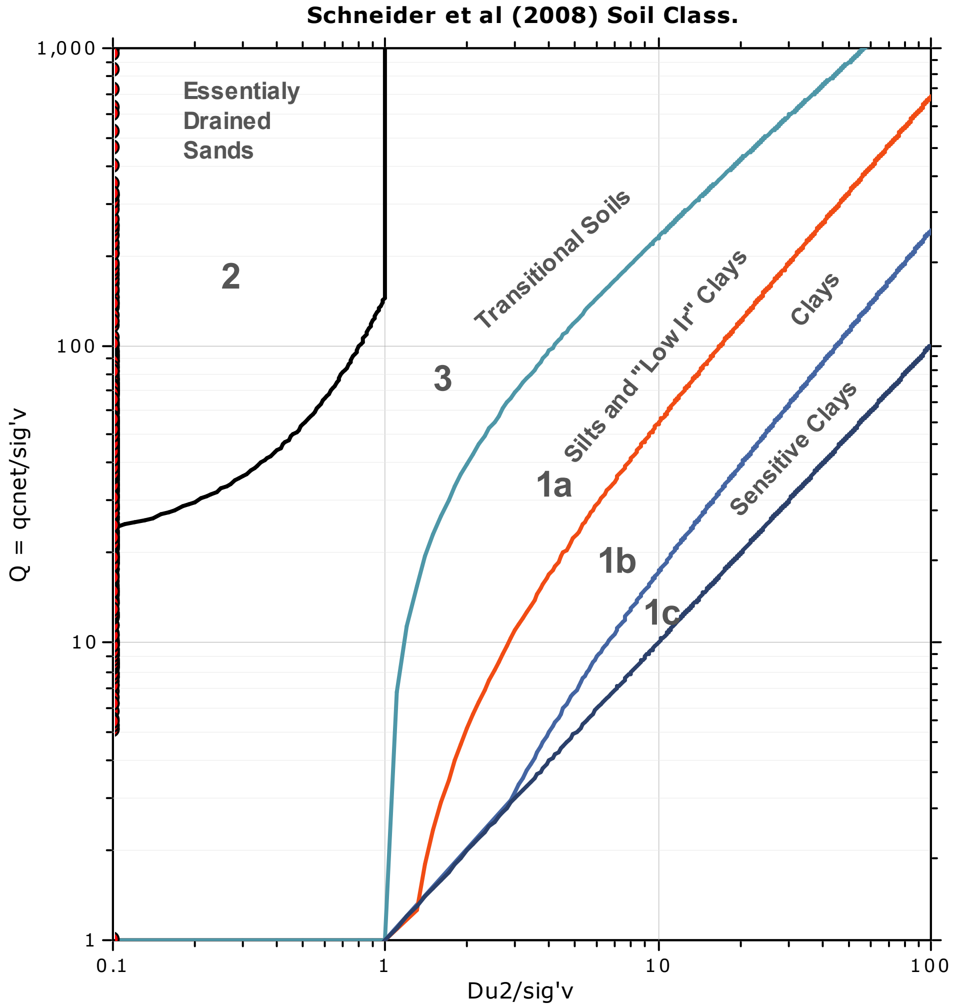


SBTn legend

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

Bq plots (Schneider)





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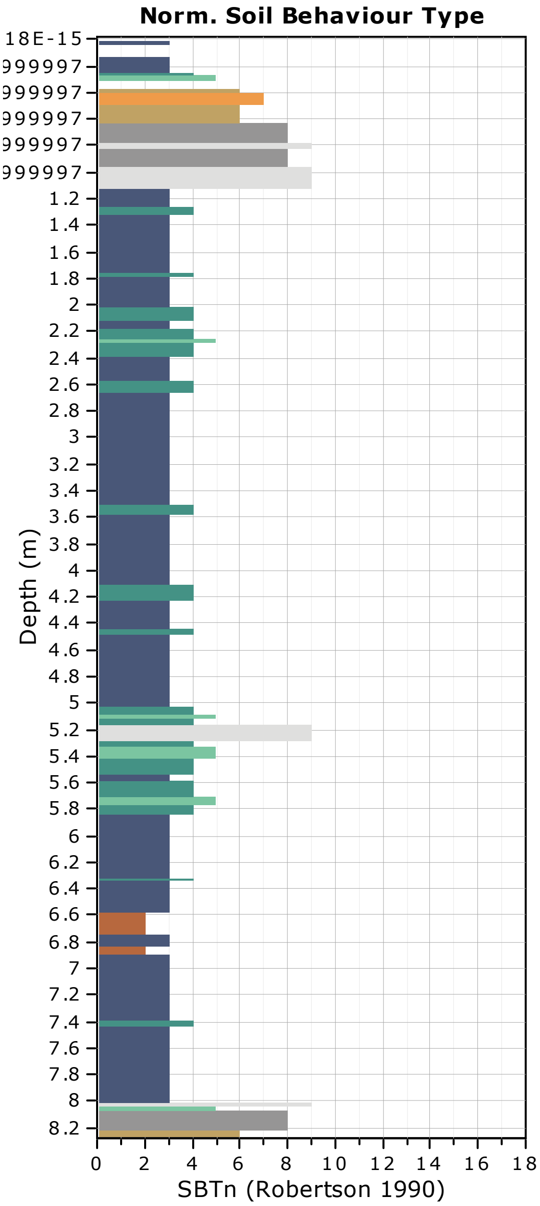
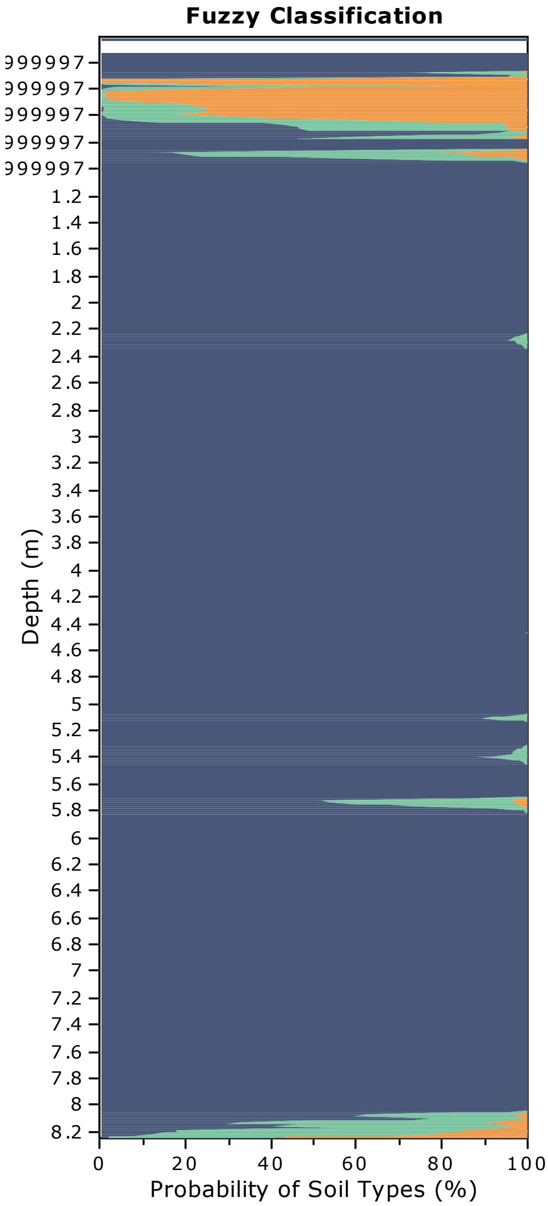
CPT: A9-CPT02
Total depth: 8.25 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:





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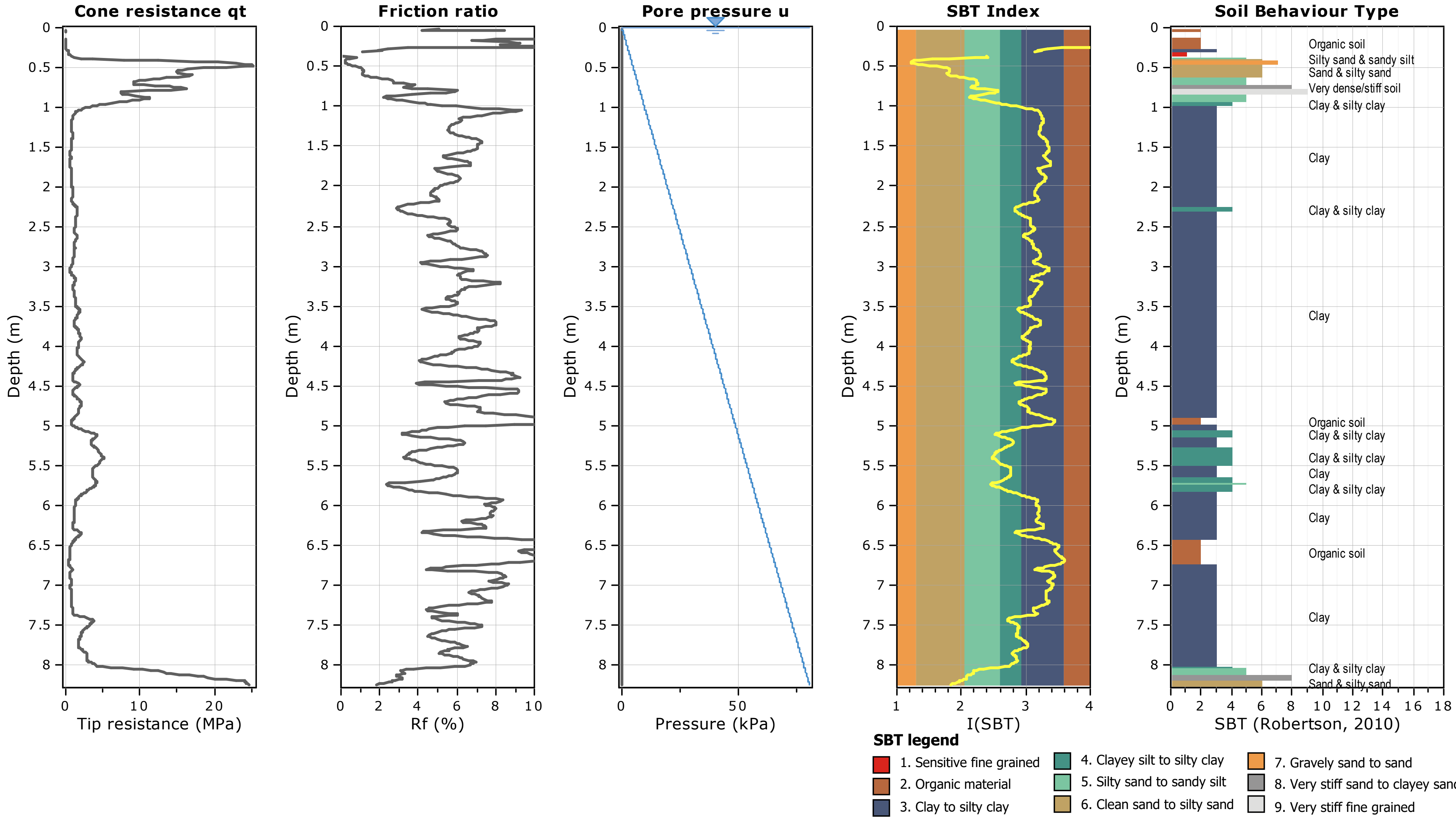
CPT: A9-CPT02
Total depth: 8.25 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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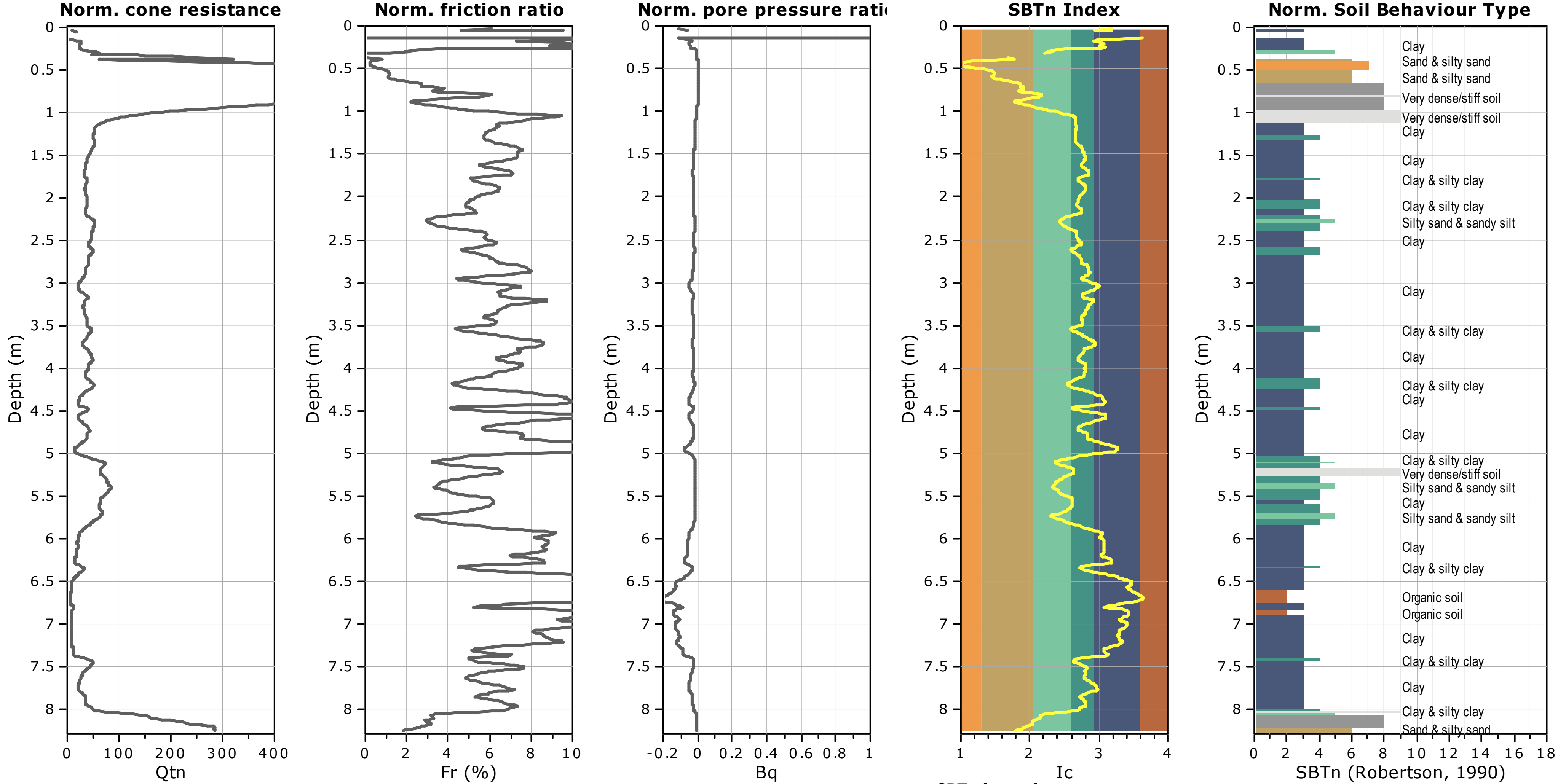
CPT: A9-CPT02
Total depth: 8.25 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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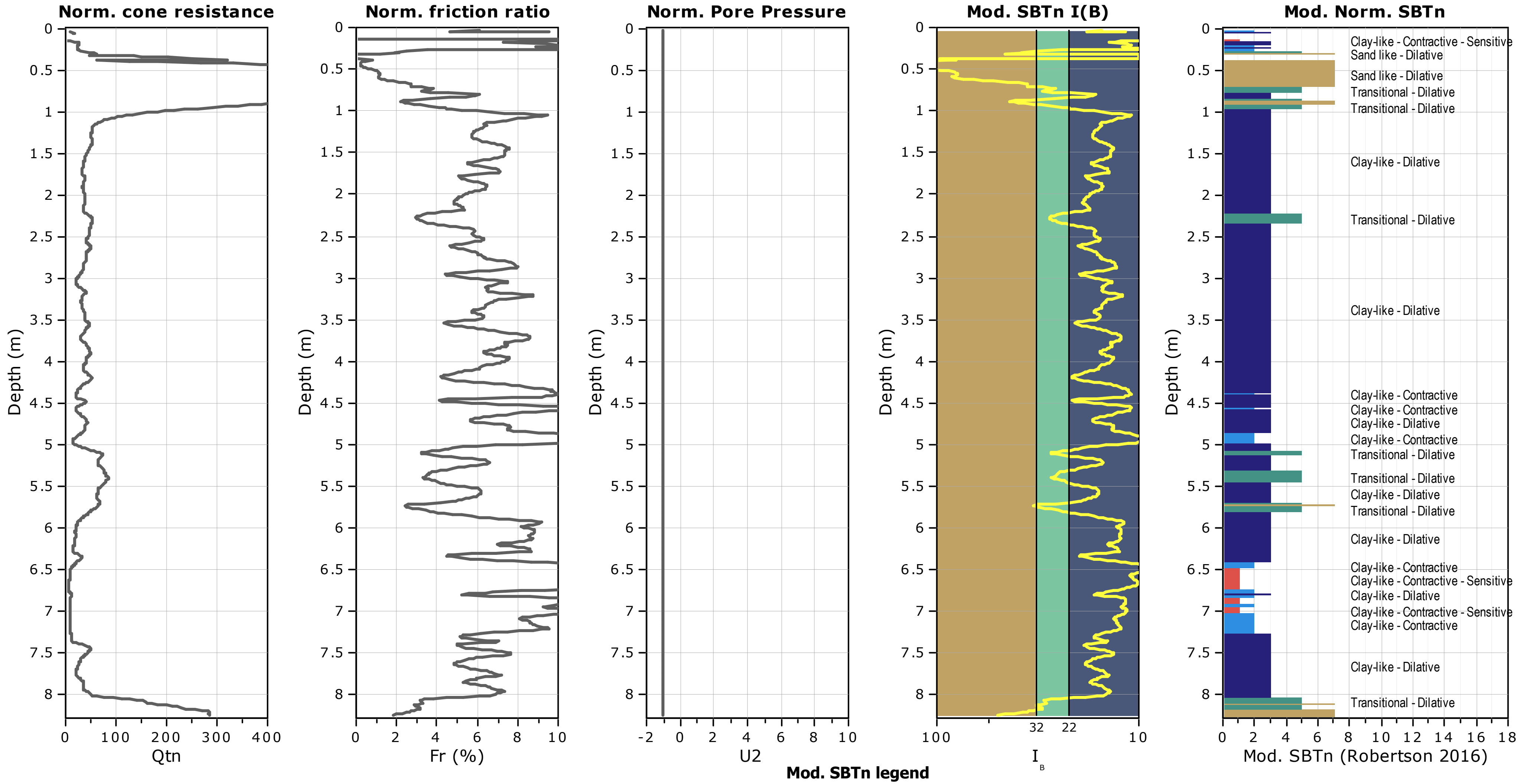
CPT: A9-CPT02
Total depth: 8.25 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

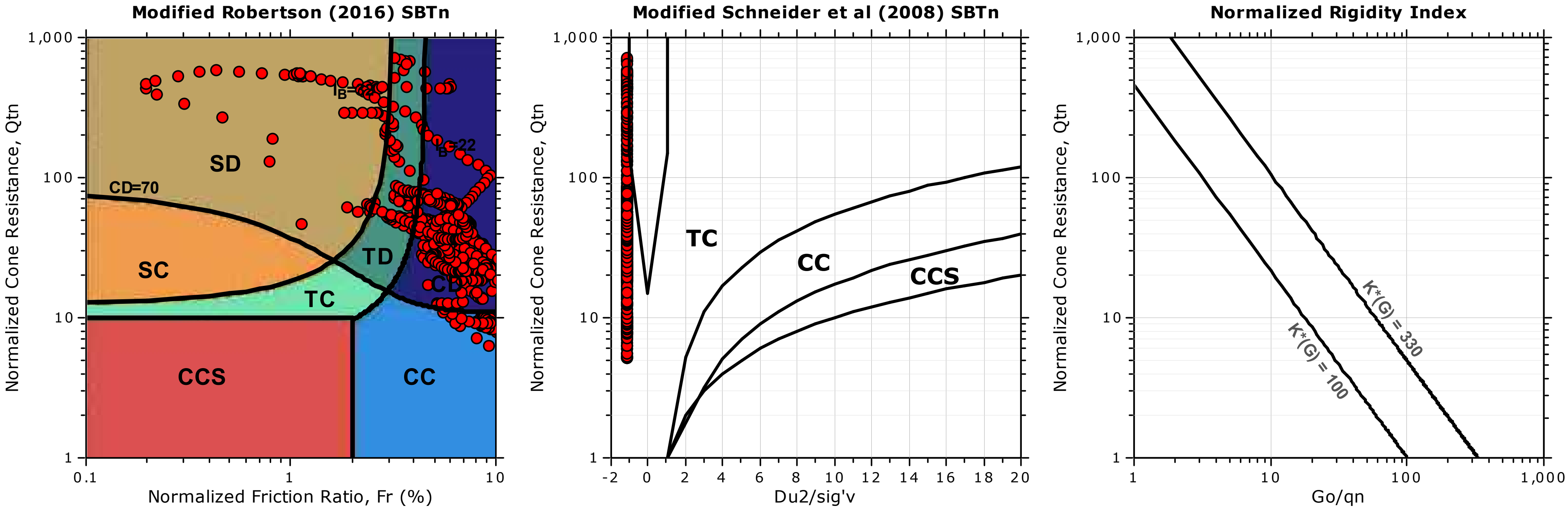
Project:
Location:



Mod. SBTn legend

1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

Updated SBTn plots

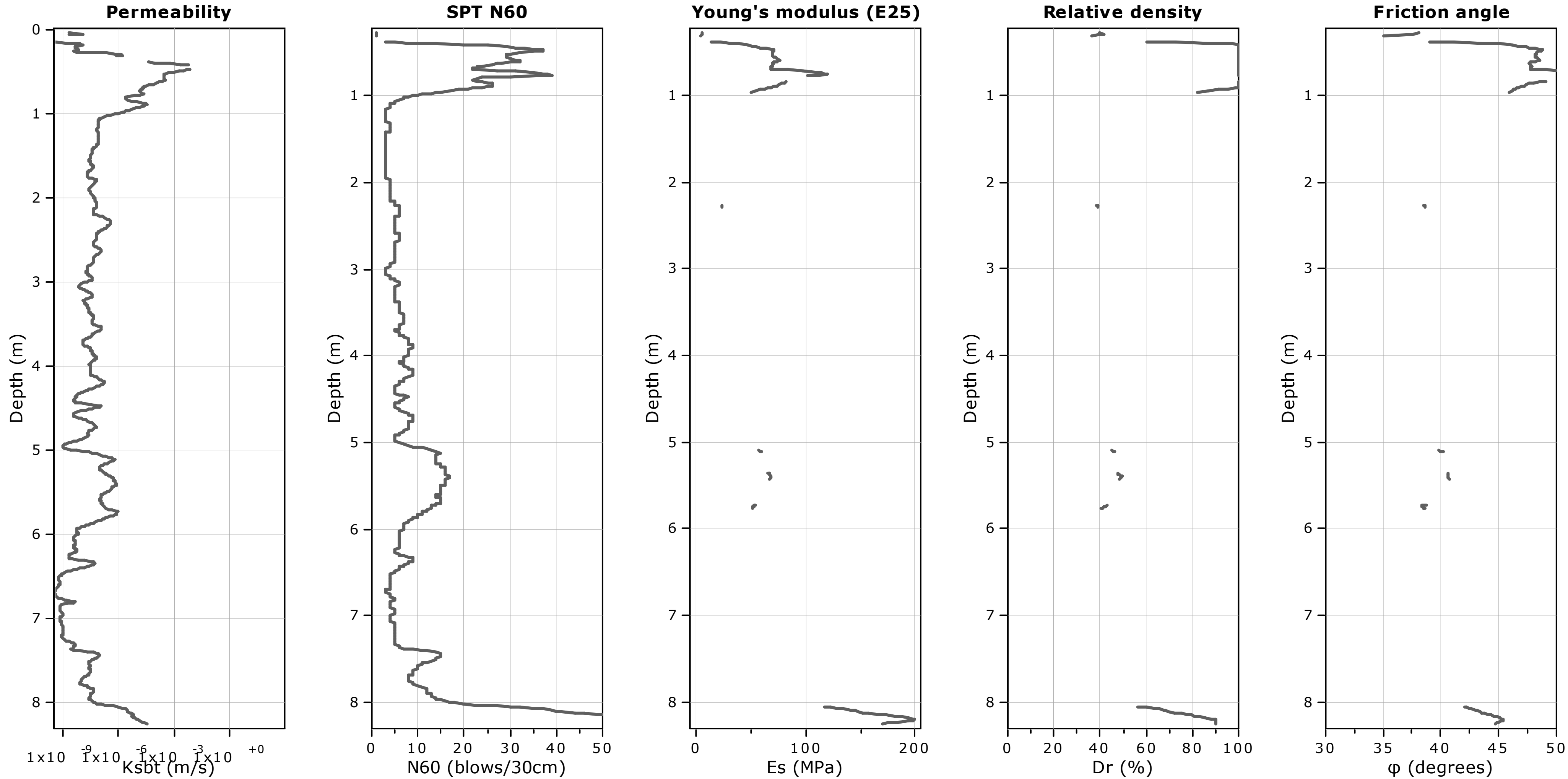


CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CPT: A9-CPT02
Total depth: 8.25 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

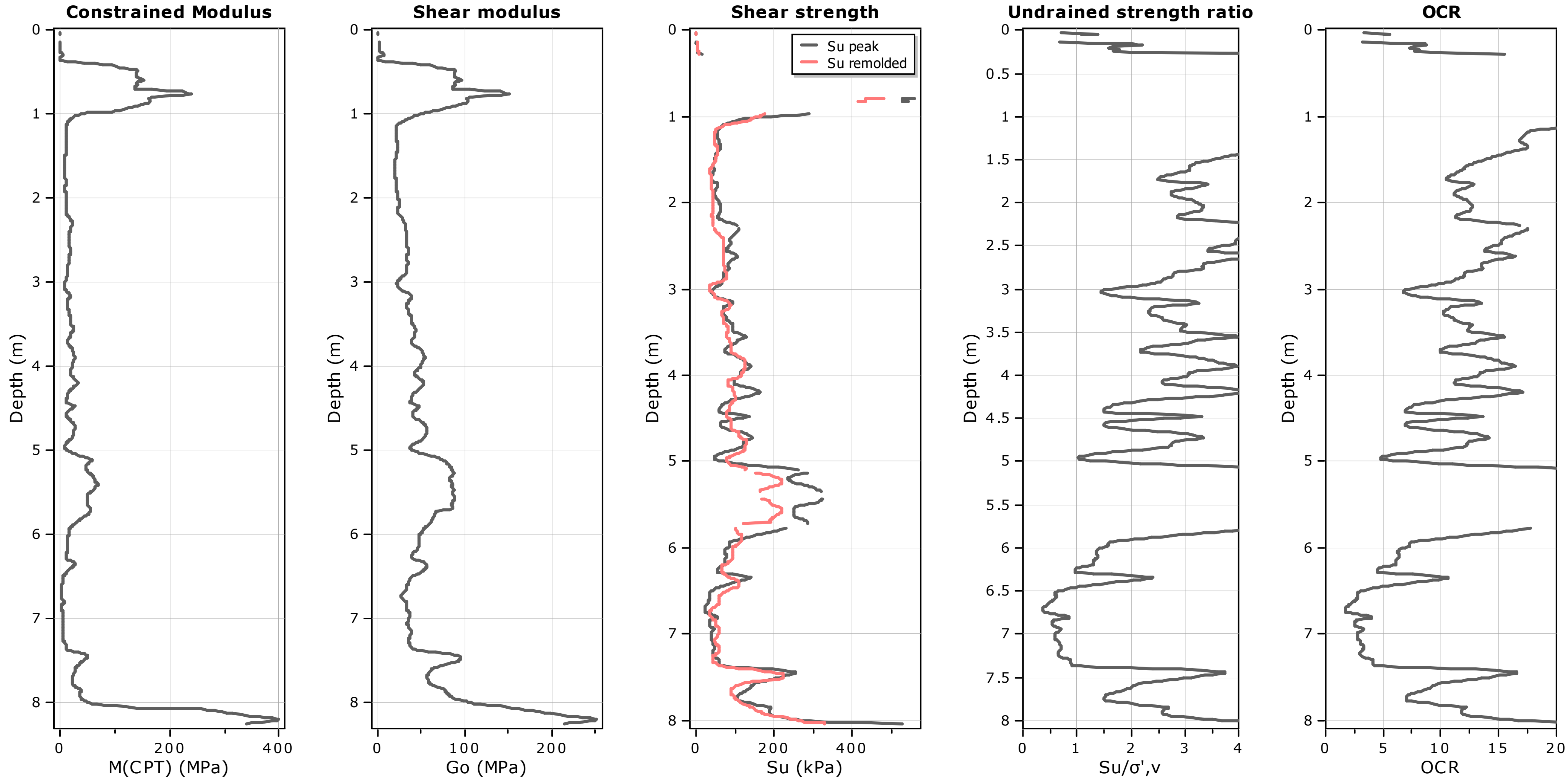
Project:
Location:



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

CPT: A9-CPT02
Total depth: 8.25 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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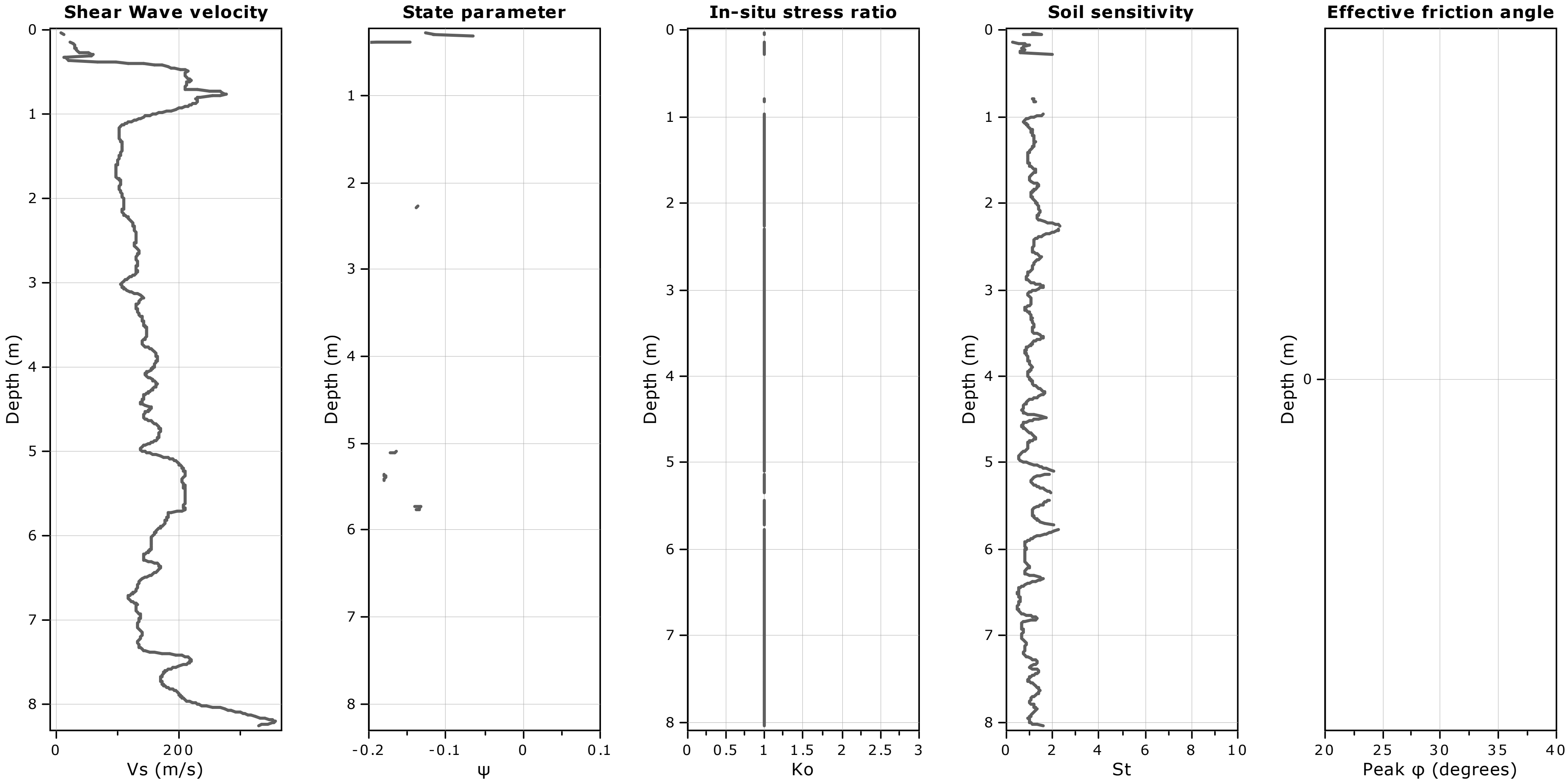
CPT: A9-CPT02
Total depth: 8.25 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

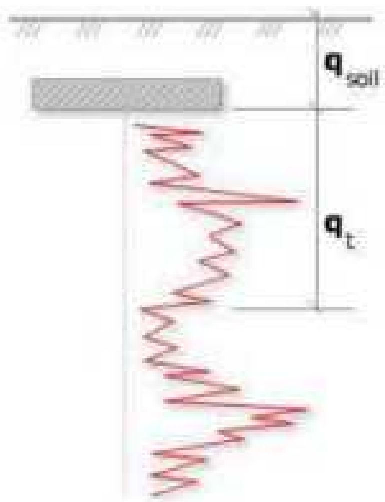
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

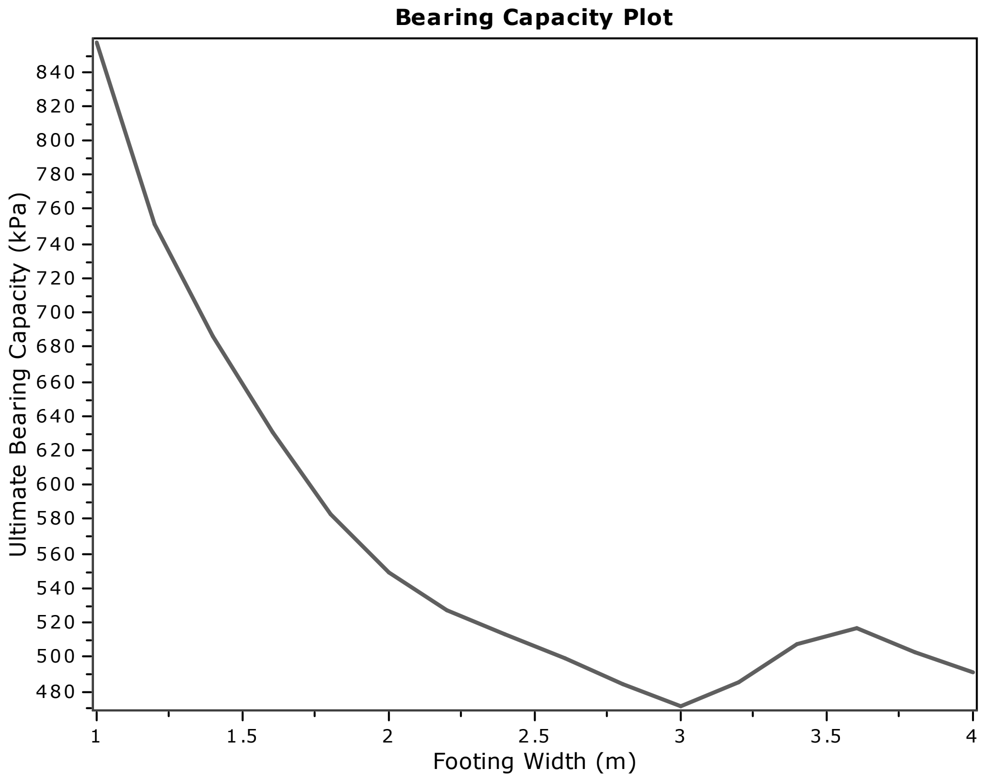
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

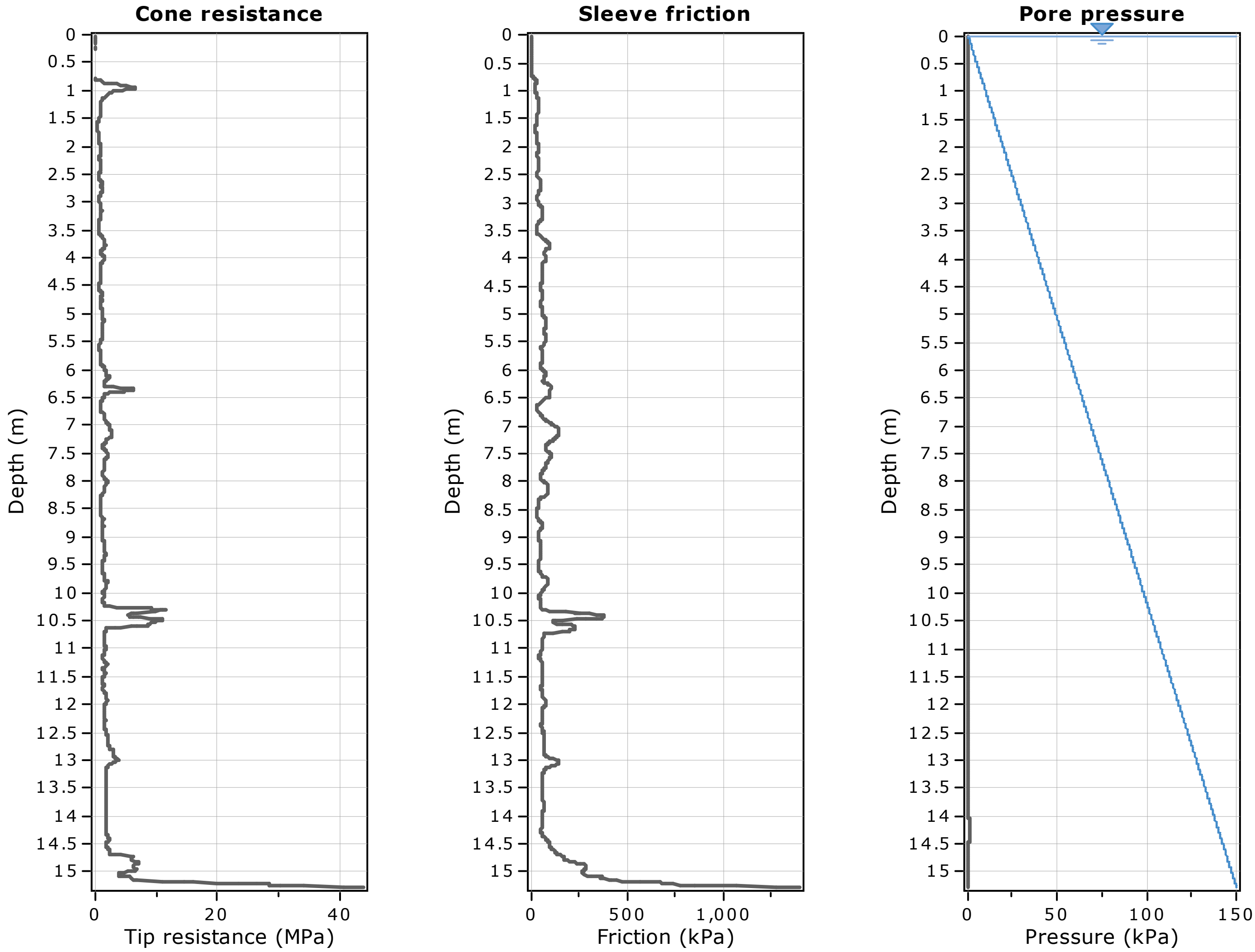
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

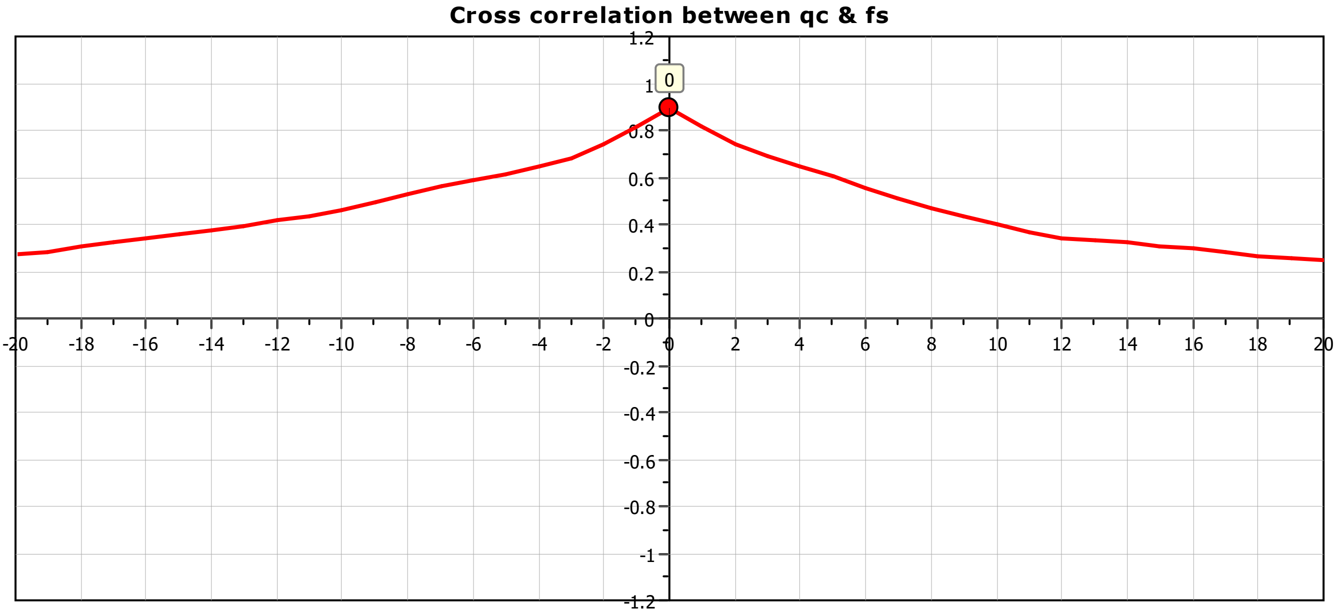


:: Tabular results ::

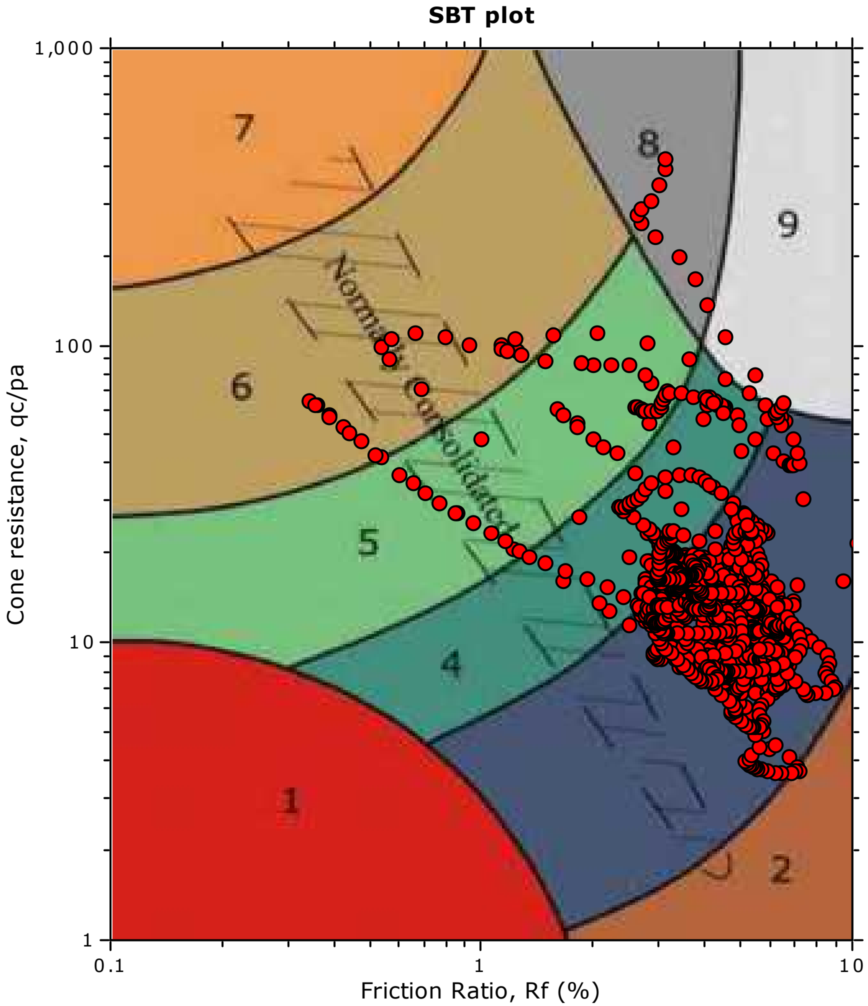
No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	4.24	0.20	9.50	856.98
2	1.20	0.50	2.30	3.71	0.20	9.50	751.84
3	1.40	0.50	2.60	3.38	0.20	9.50	686.06
4	1.60	0.50	2.90	3.11	0.20	9.50	630.53
5	1.80	0.50	3.20	2.86	0.20	9.50	582.45
6	2.00	0.50	3.50	2.70	0.20	9.50	549.62
7	2.20	0.50	3.80	2.59	0.20	9.50	527.22
8	2.40	0.50	4.10	2.52	0.20	9.50	512.80
9	2.60	0.50	4.40	2.45	0.20	9.50	499.05
10	2.80	0.50	4.70	2.37	0.20	9.50	483.89
11	3.00	0.50	5.00	2.31	0.20	9.50	471.30
12	3.20	0.50	5.30	2.38	0.20	9.50	484.97
13	3.40	0.50	5.60	2.49	0.20	9.50	507.73
14	3.60	0.50	5.90	2.53	0.20	9.50	516.37
15	3.80	0.50	6.20	2.47	0.20	9.50	502.74
16	4.00	0.50	6.50	2.41	0.20	9.50	490.76

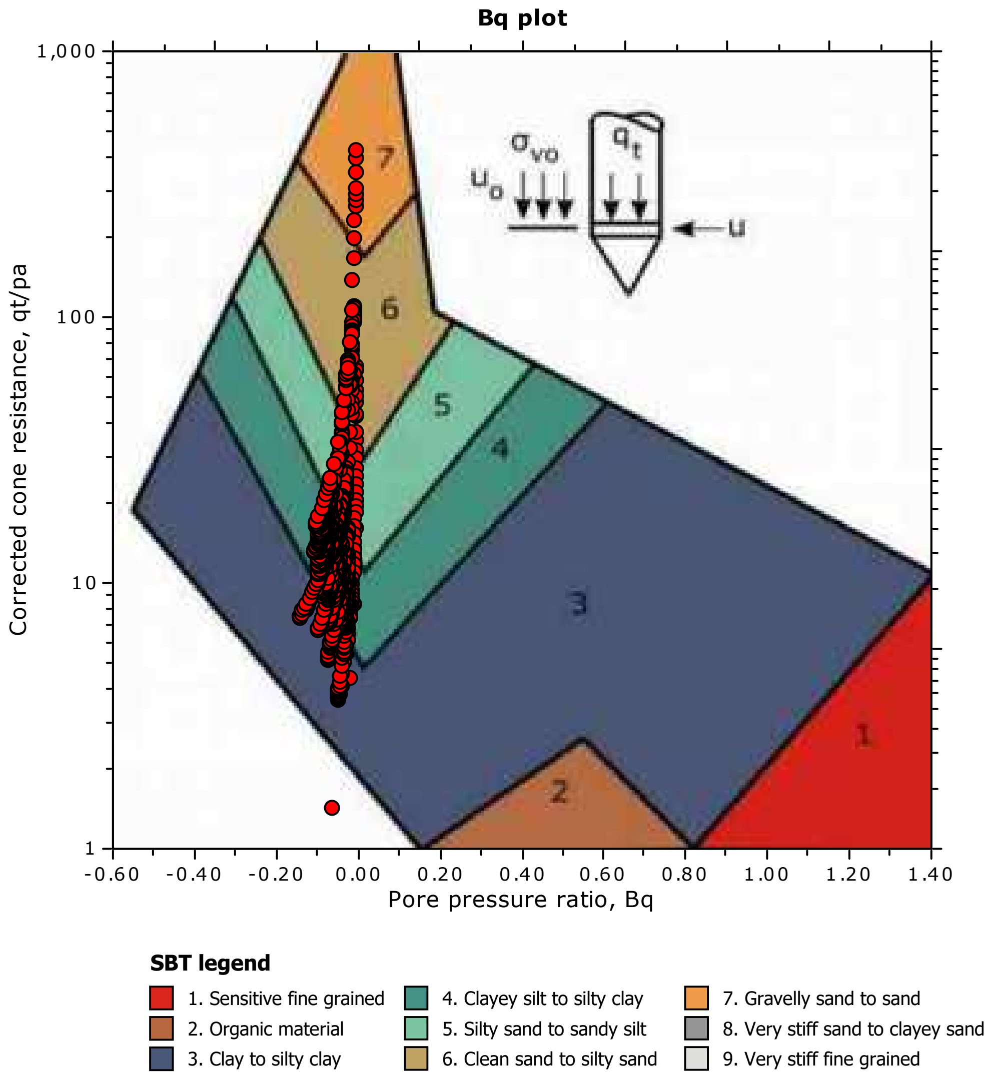


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots


SBT plot
Cone resistance, qc/pa
Friction Ratio, Rf (%)
1,000
100
10
1
0.1
1
10
7
8
9
6
5
4
1
2
Normally Consolidated


Bq plot
Corrected cone resistance, qt/pa
Pore pressure ratio, Bq
1,000
100
10
1
-0.60
-0.40
-0.20
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
7
6
5
4
3
2
1
u
SBT legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

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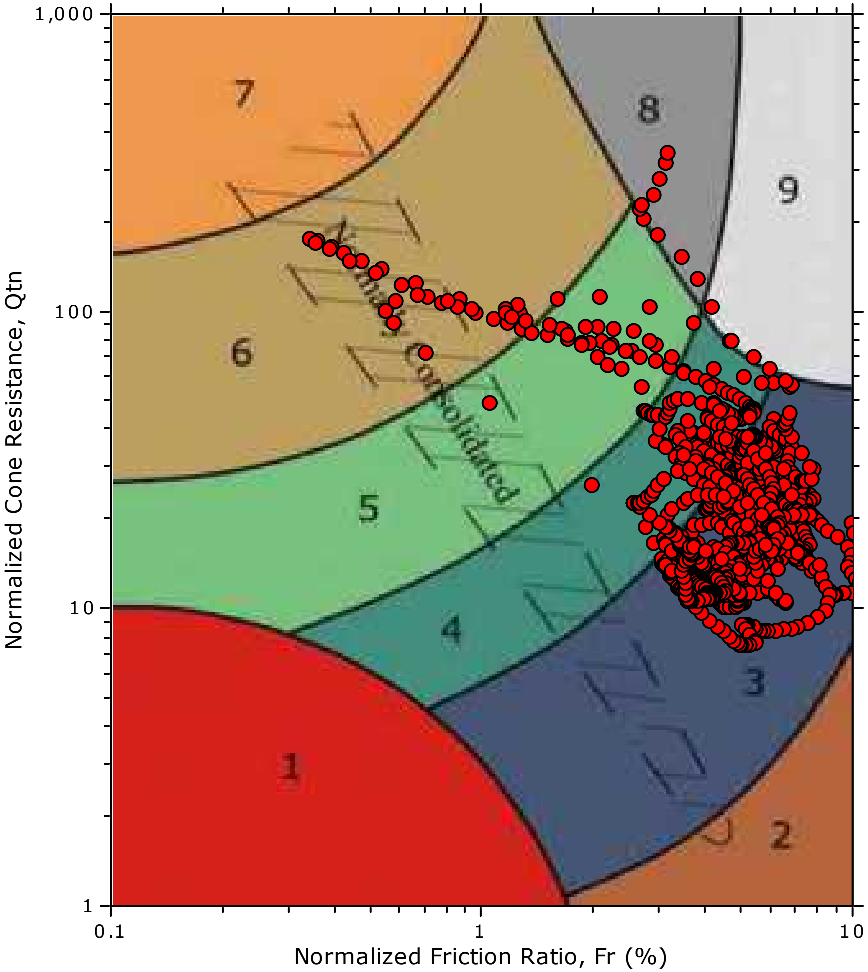
CPT: A9-CPT03
Total depth: 15.28 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

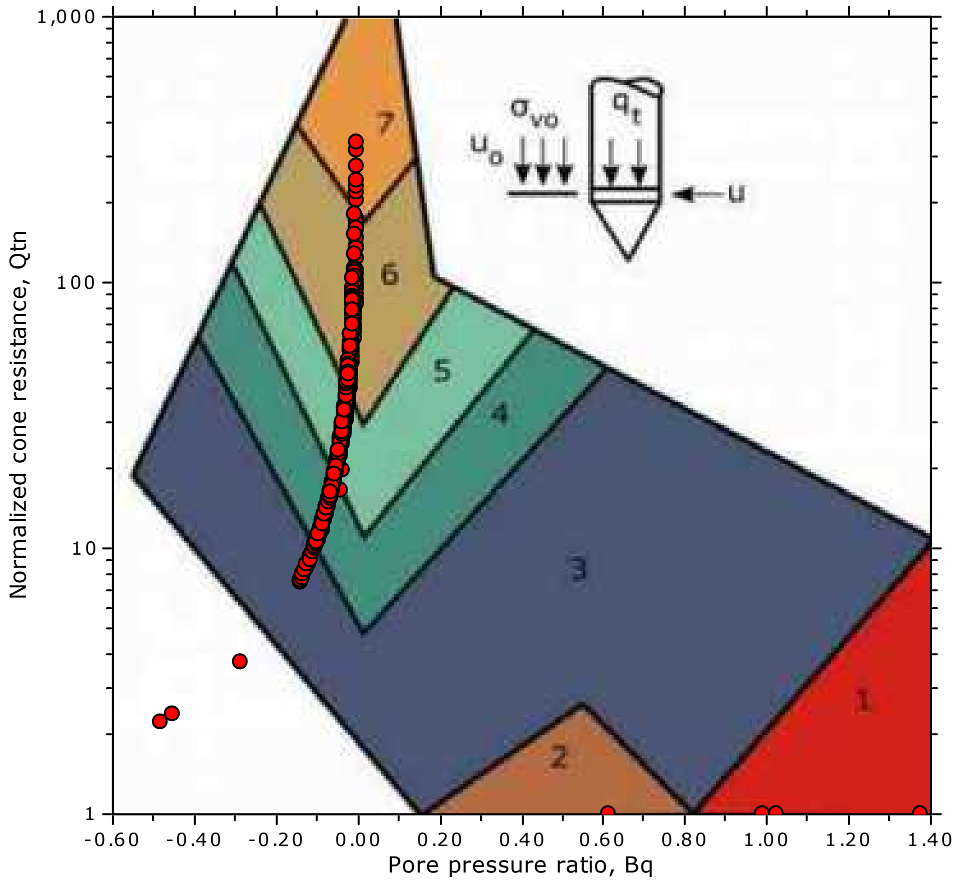
Project:
Location:

SBT - Bq plots (normalized)

SBTn plot



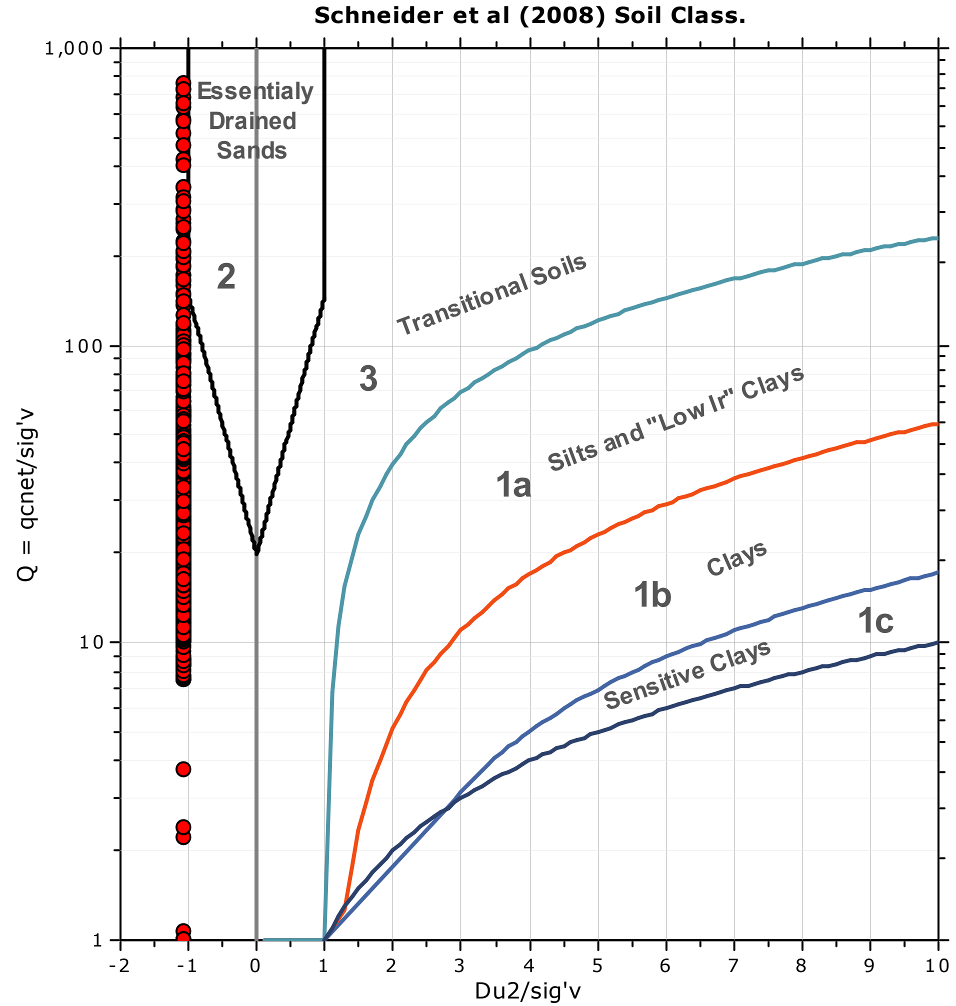
Normalized Bq plot

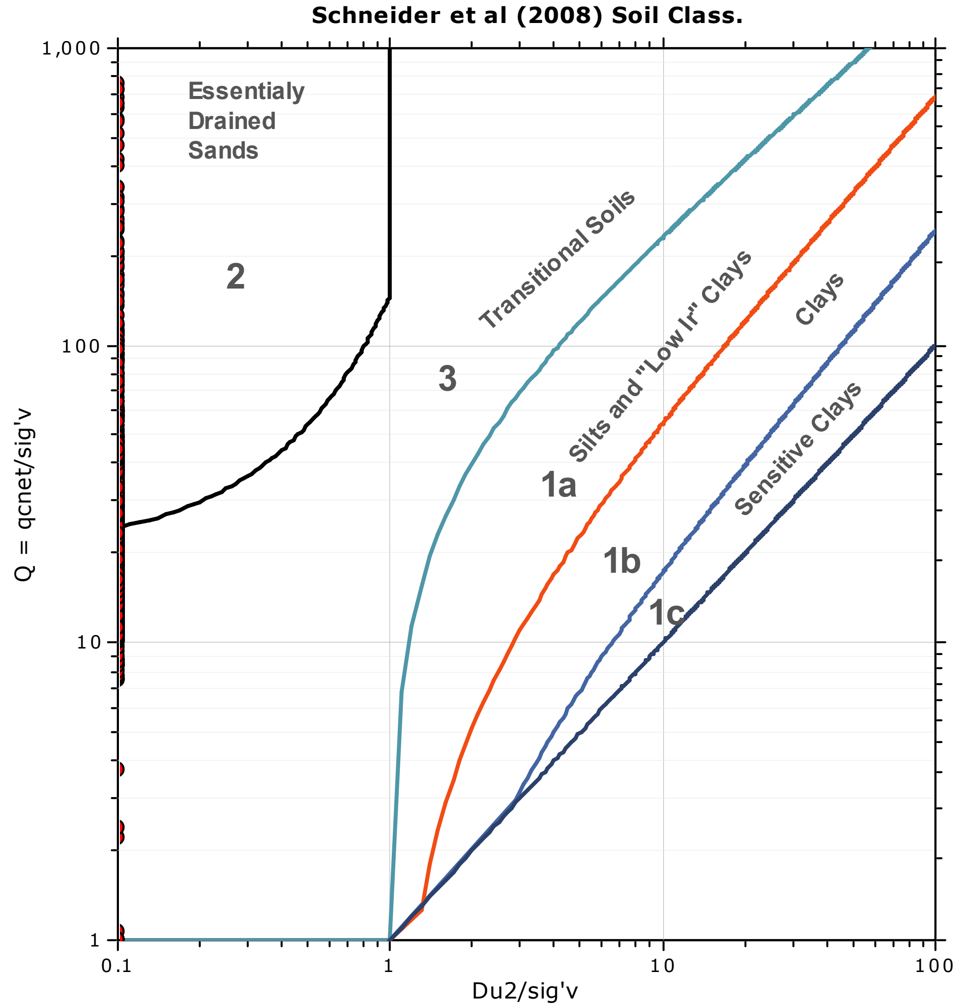


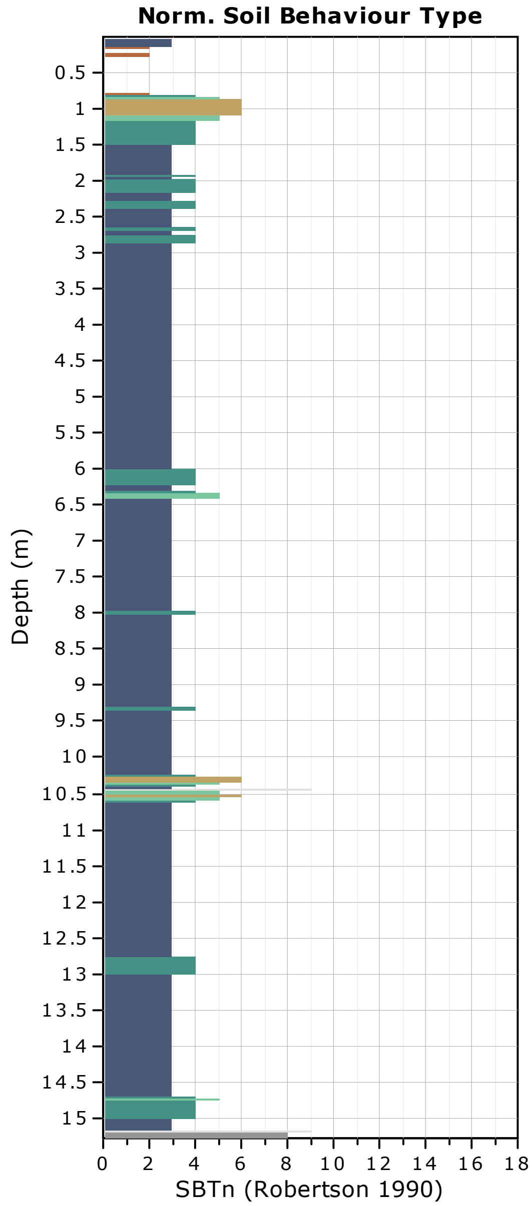
SBTn legend

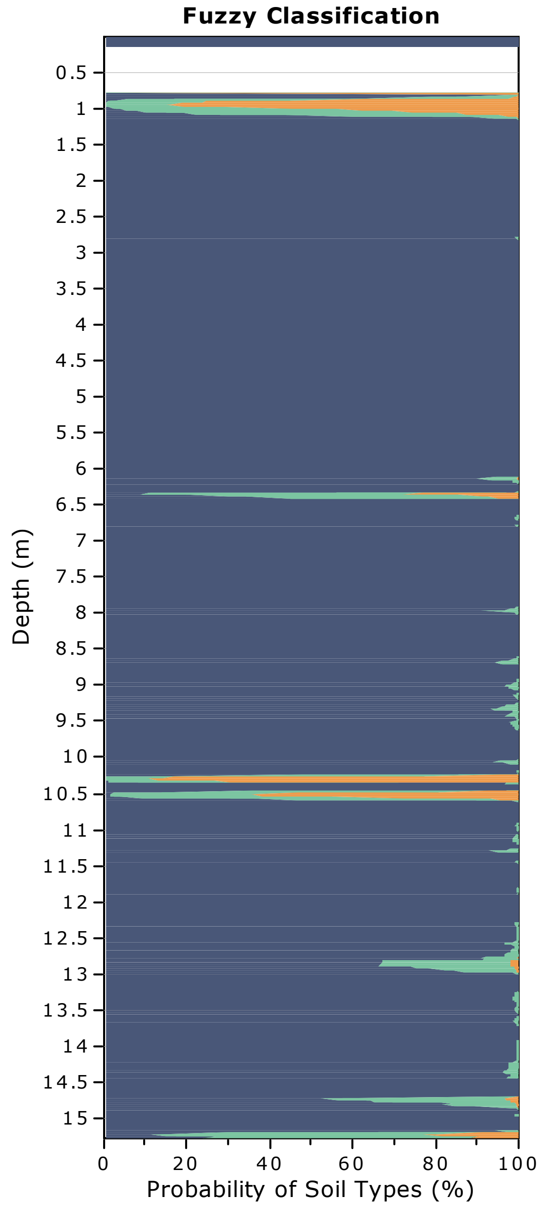
- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty clay
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravelly sand to sand
- 8. Very stiff sand to clayey sand
- 9. Very stiff fine grained

Bq plots (Schneider)






Norm. Soil Behaviour Type
Depth (m)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
11.5
12
12.5
13
13.5
14
14.5
15
0 2 4 6 8 10 12 14 16 18
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
11.5
12
12.5
13
13.5
14
14.5
15
0 20 40 60 80 100
Probability of Soil Types (%)

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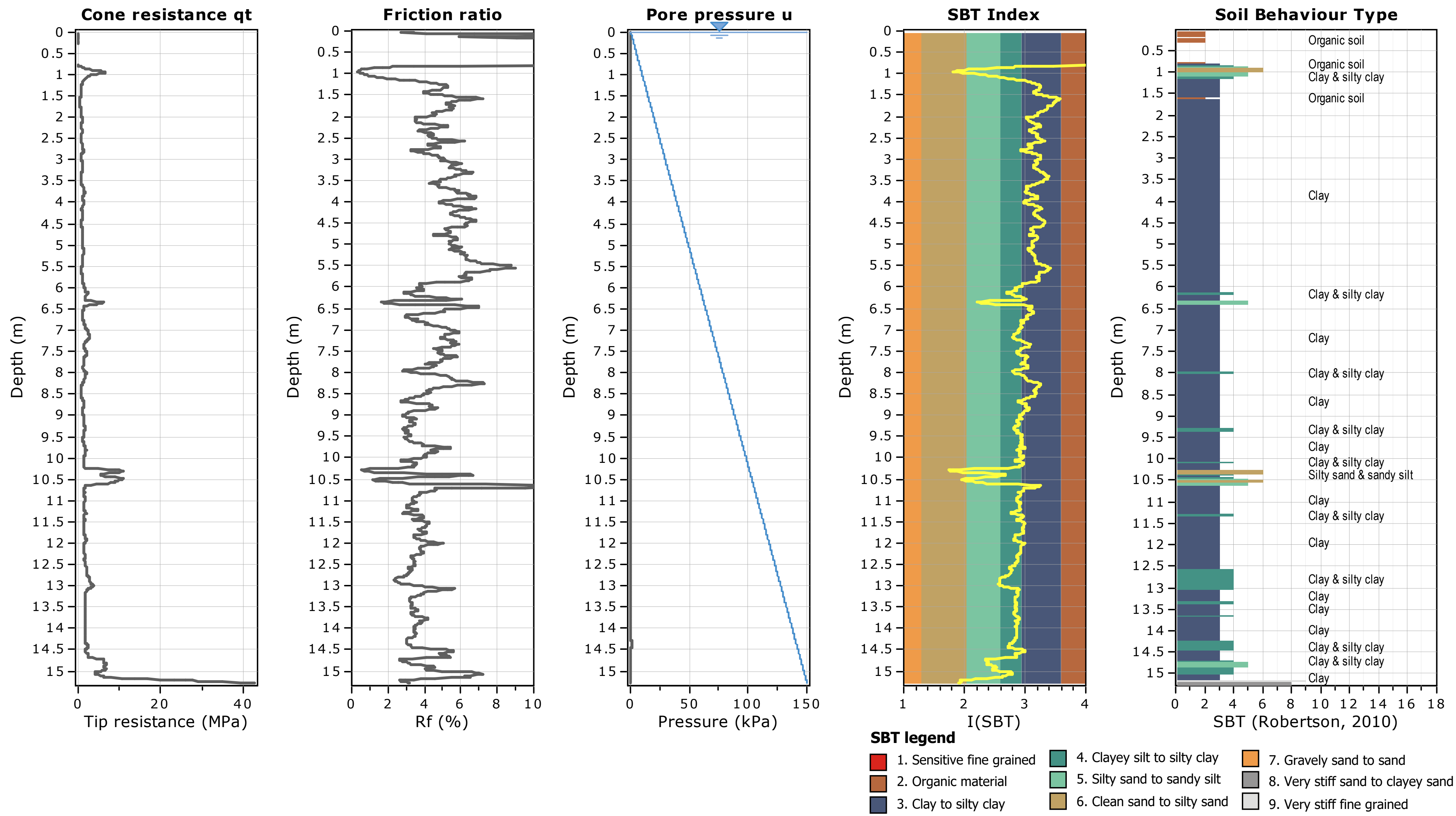
CPT: A9-CPT03
Total depth: 15.28 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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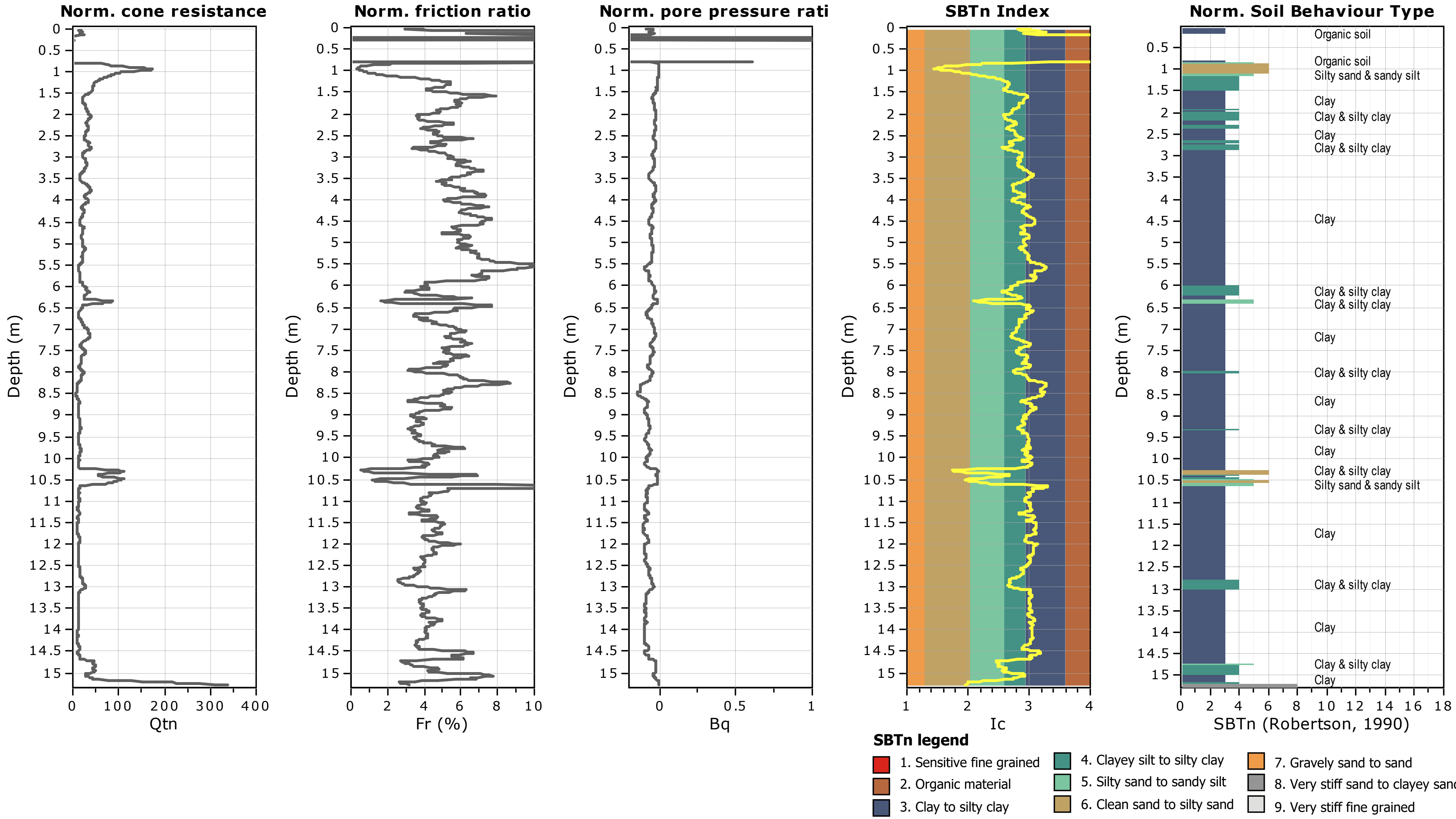
CPT: A9-CPT03
Total depth: 15.28 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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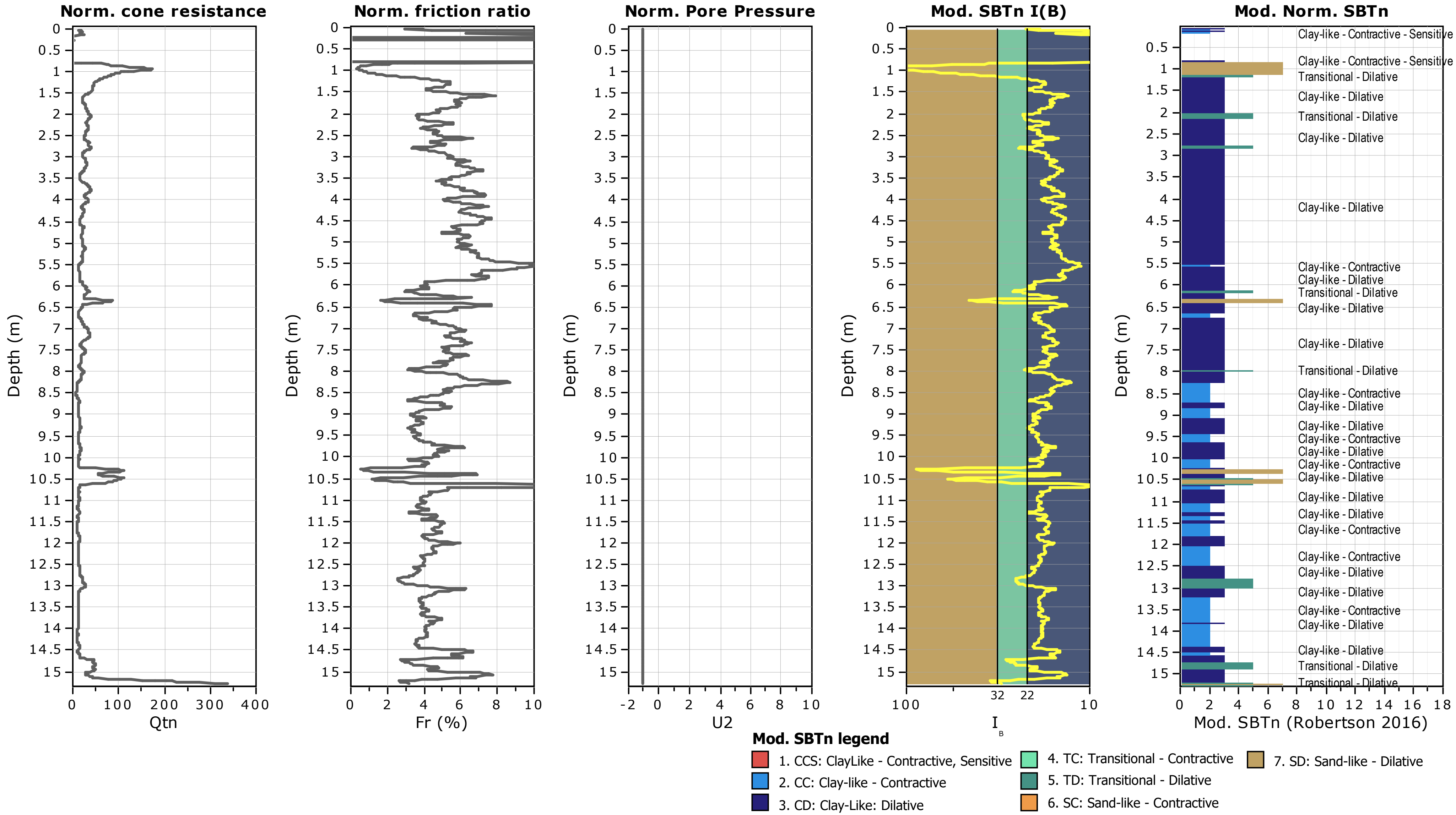
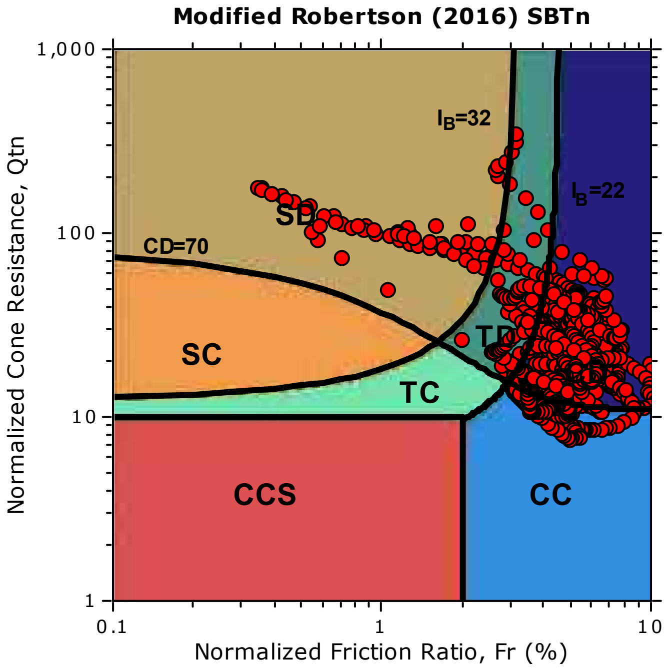
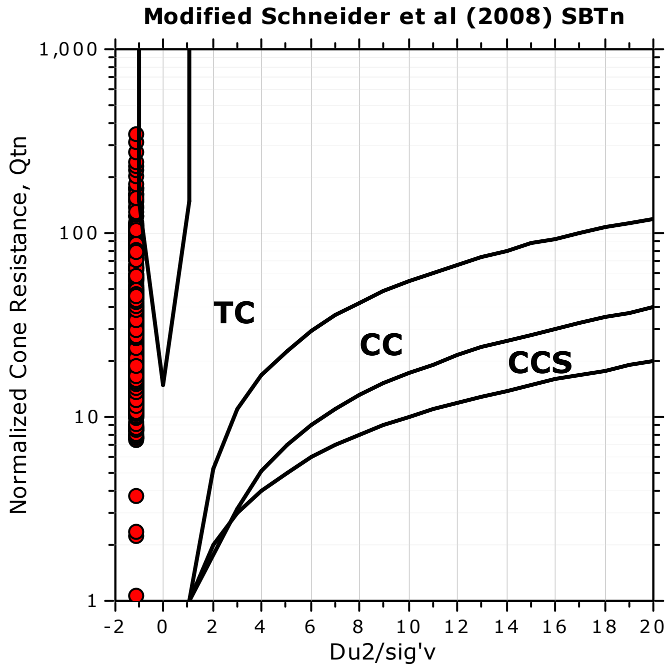
CPT: A9-CPT03
Total depth: 15.28 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

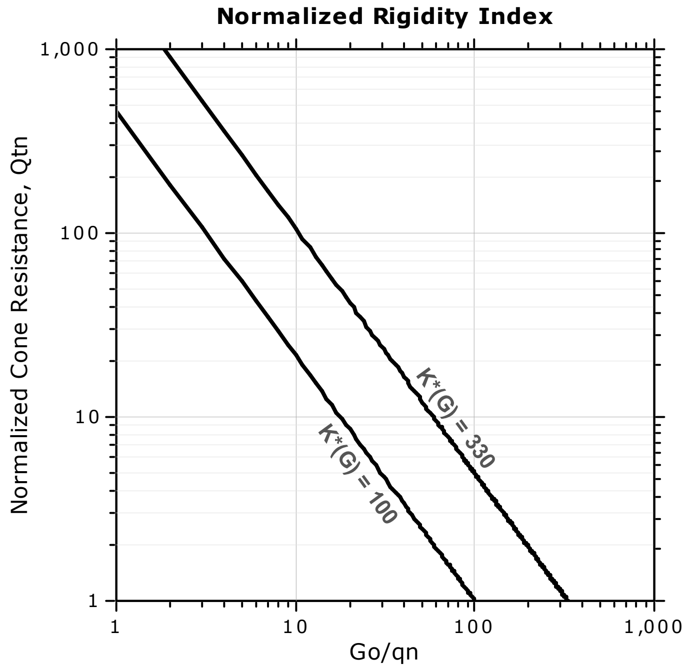
Project:
Location:



Updated SBTn plots







CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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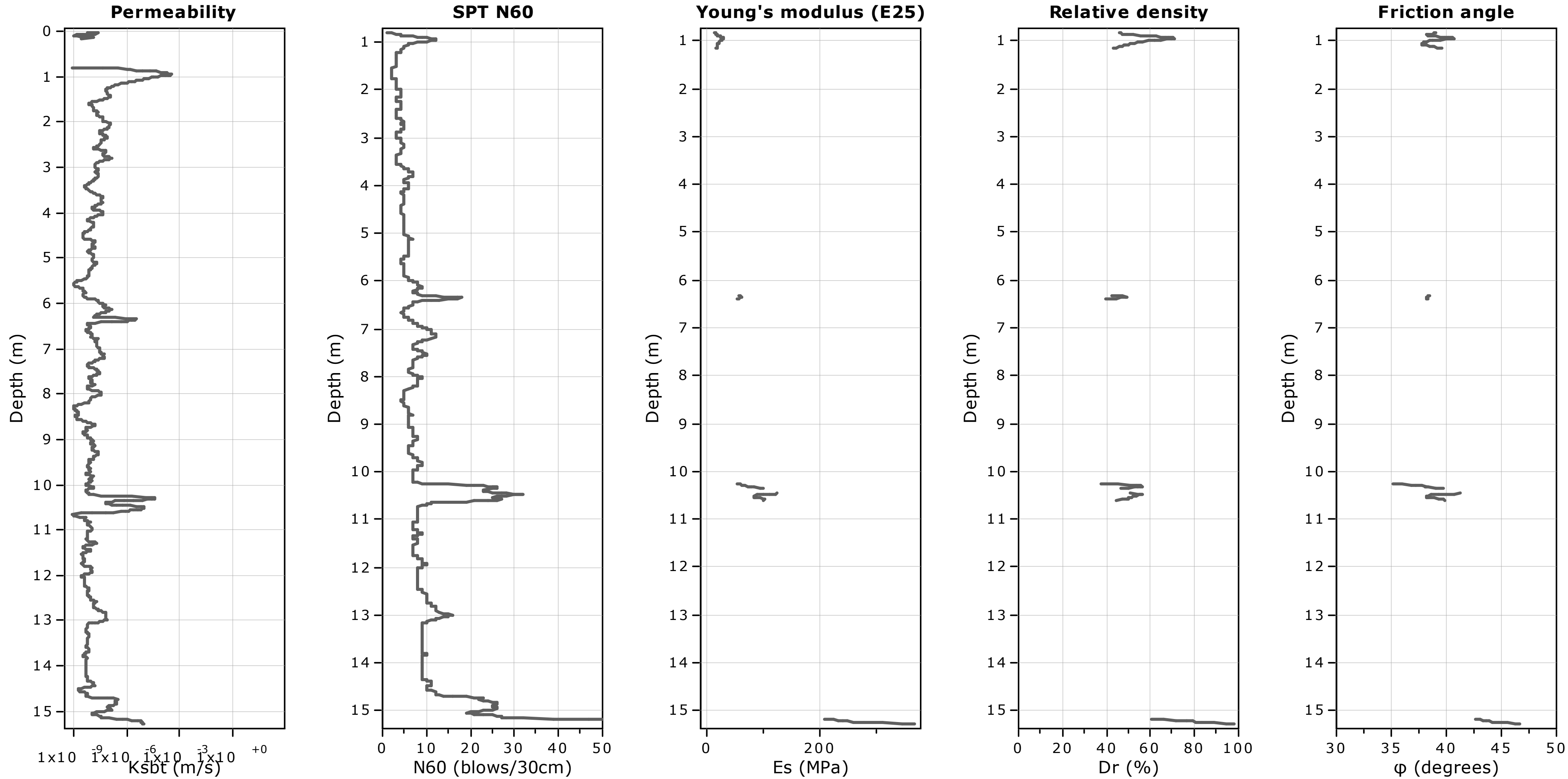
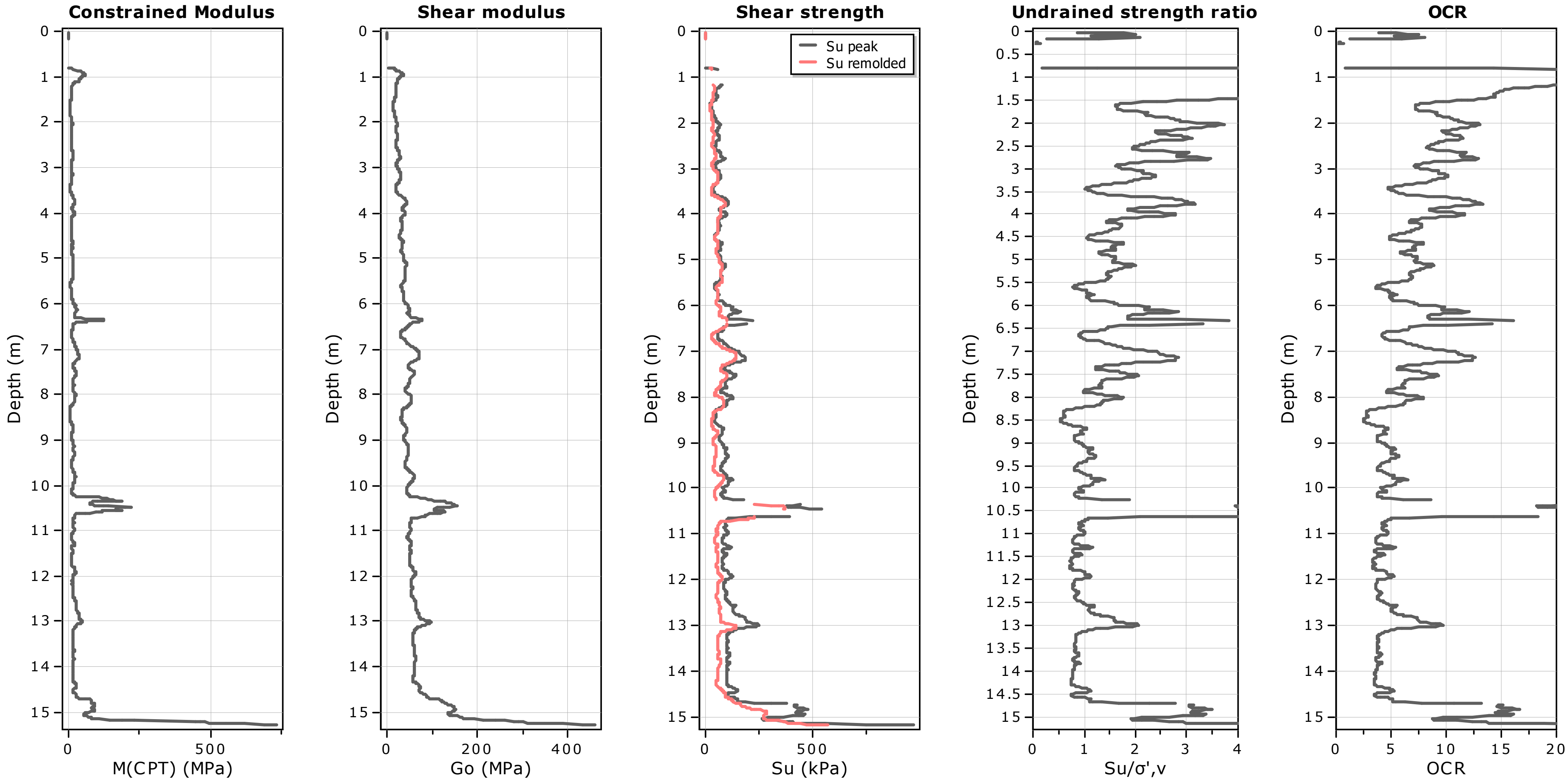
CPT: A9-CPT03
Total depth: 15.28 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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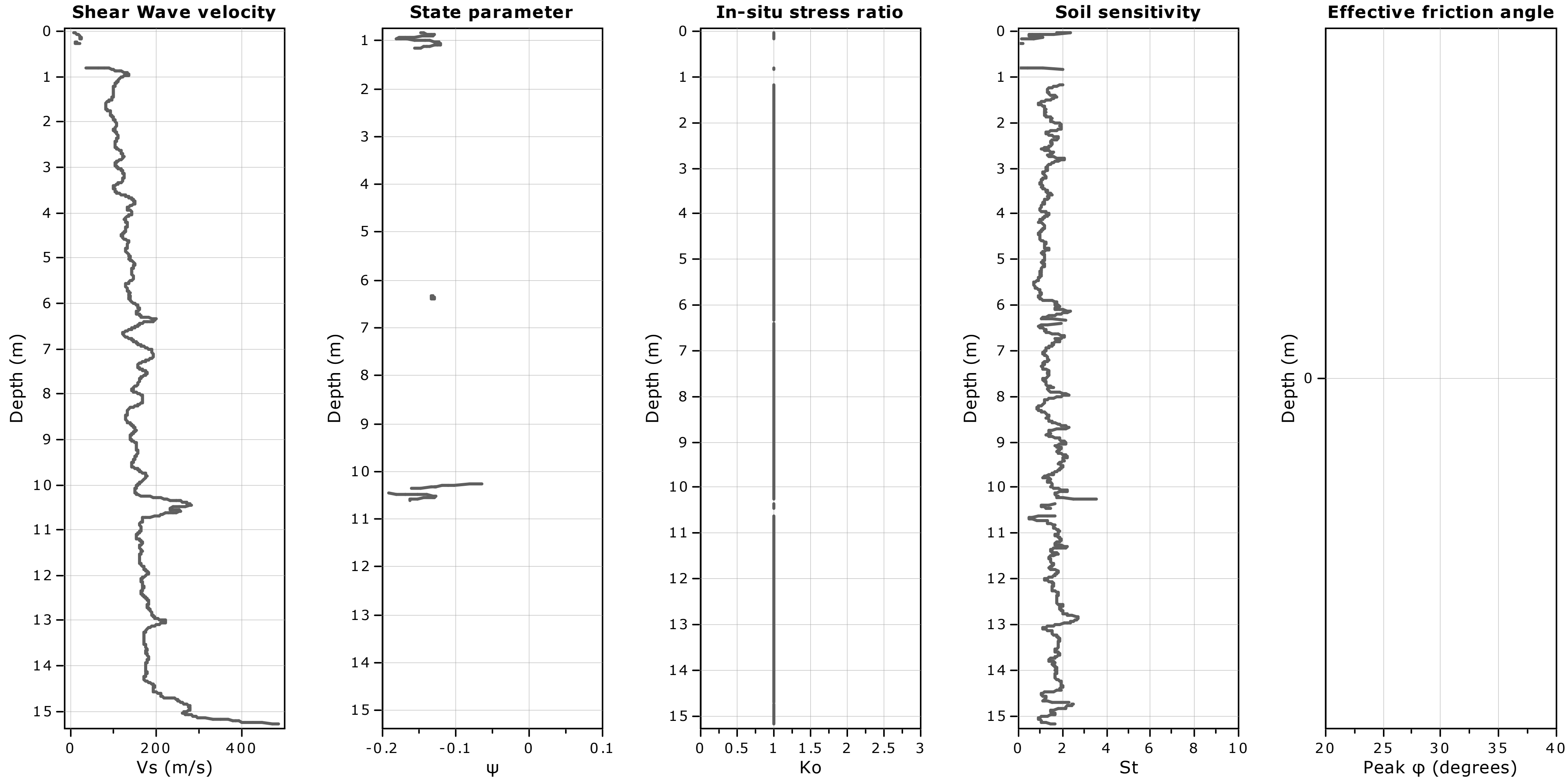
CPT: A9-CPT03
Total depth: 15.28 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

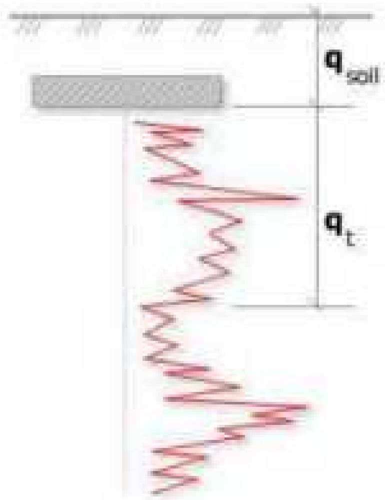
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

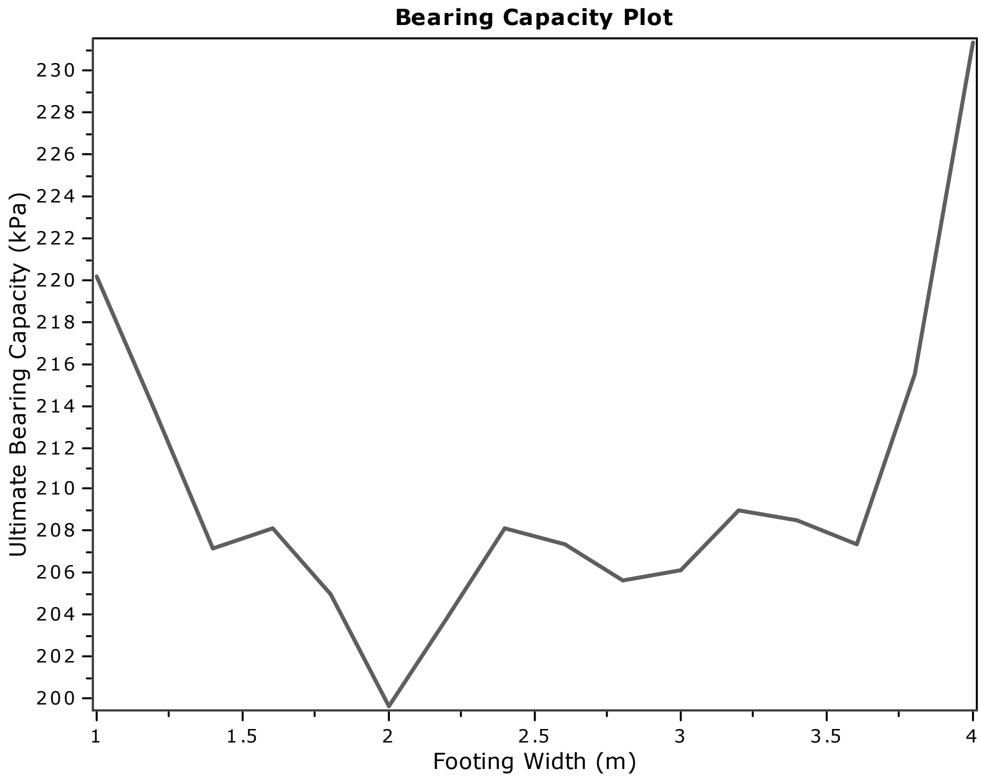
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.05	0.20	9.50	220.14
2	1.20	0.50	2.30	1.02	0.20	9.50	213.74
3	1.40	0.50	2.60	0.99	0.20	9.50	207.15
4	1.60	0.50	2.90	0.99	0.20	9.50	208.08
5	1.80	0.50	3.20	0.98	0.20	9.50	204.99
6	2.00	0.50	3.50	0.95	0.20	9.50	199.61
7	2.20	0.50	3.80	0.97	0.20	9.50	203.79
8	2.40	0.50	4.10	0.99	0.20	9.50	208.08
9	2.60	0.50	4.40	0.99	0.20	9.50	207.35
10	2.80	0.50	4.70	0.98	0.20	9.50	205.60
11	3.00	0.50	5.00	0.98	0.20	9.50	206.12
12	3.20	0.50	5.30	1.00	0.20	9.50	208.99
13	3.40	0.50	5.60	1.00	0.20	9.50	208.56
14	3.60	0.50	5.90	0.99	0.20	9.50	207.37
15	3.80	0.50	6.20	1.03	0.20	9.50	215.48
16	4.00	0.50	6.50	1.11	0.20	9.50	231.38

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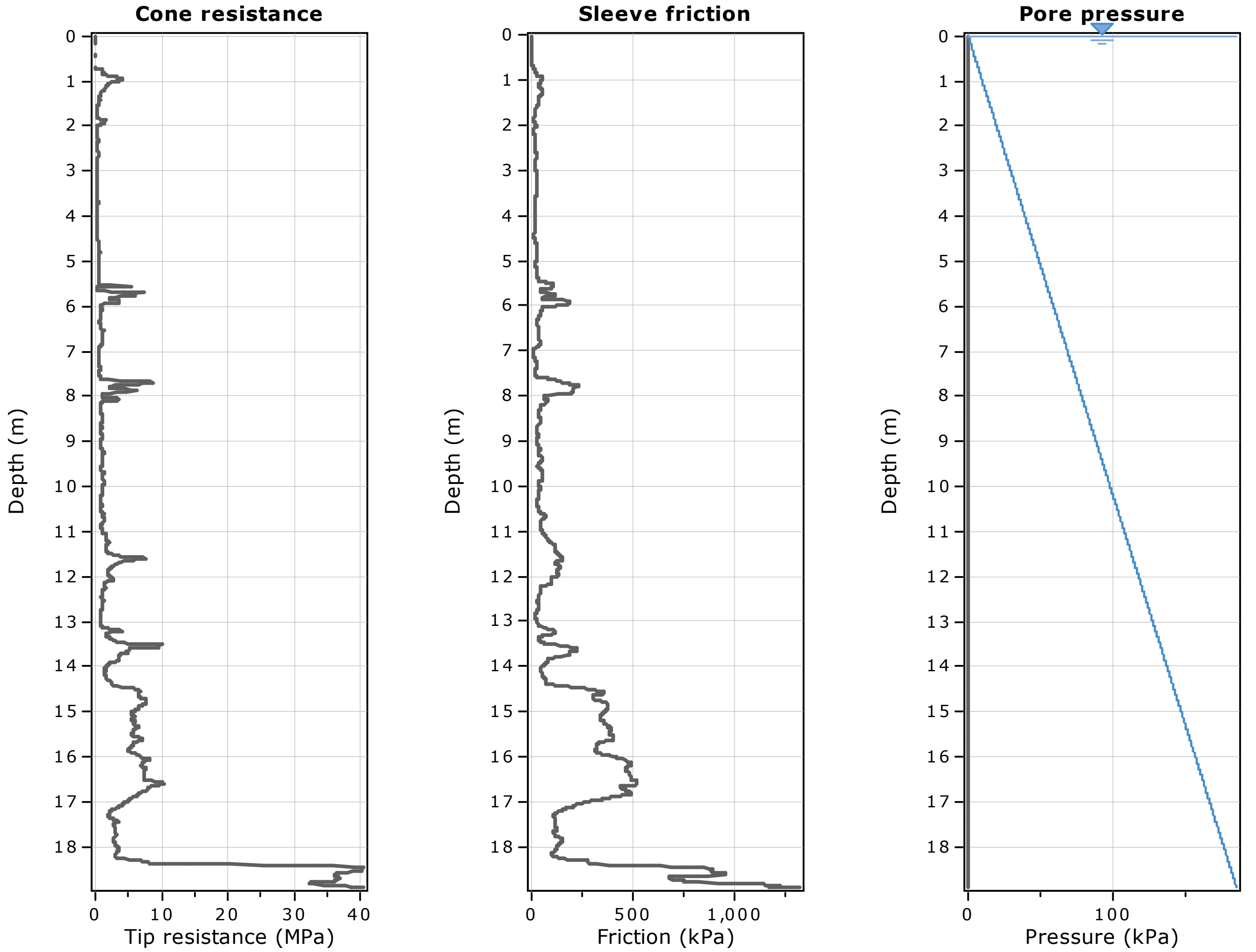
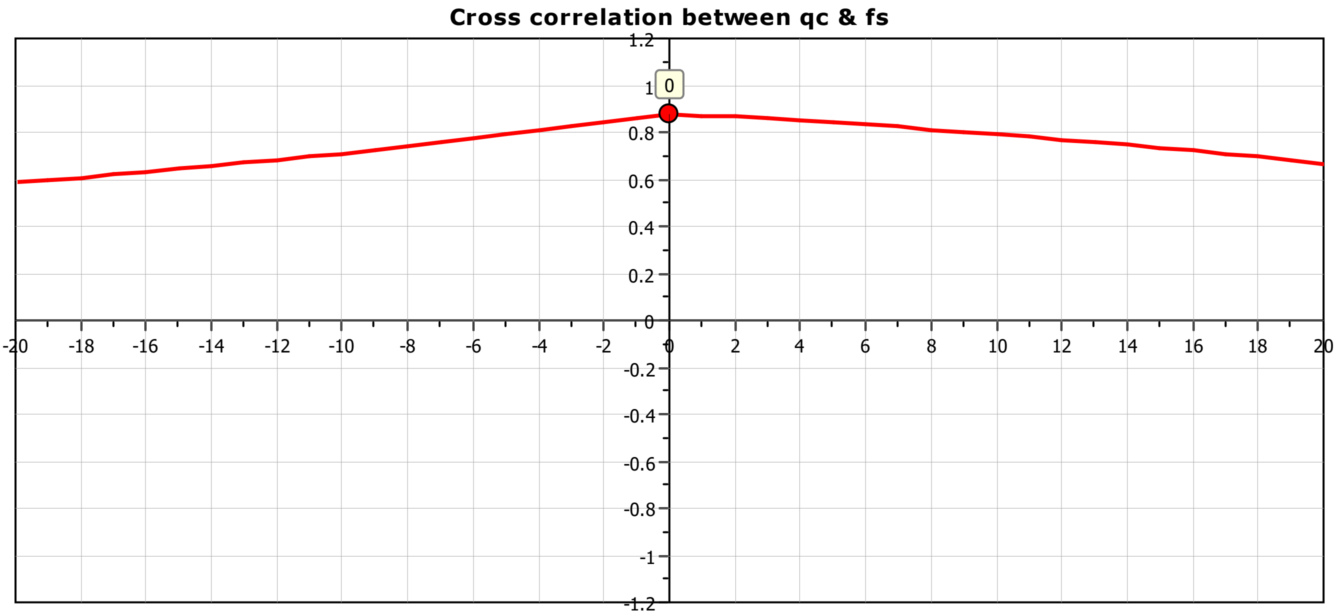
CPT: A9-CPT04
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

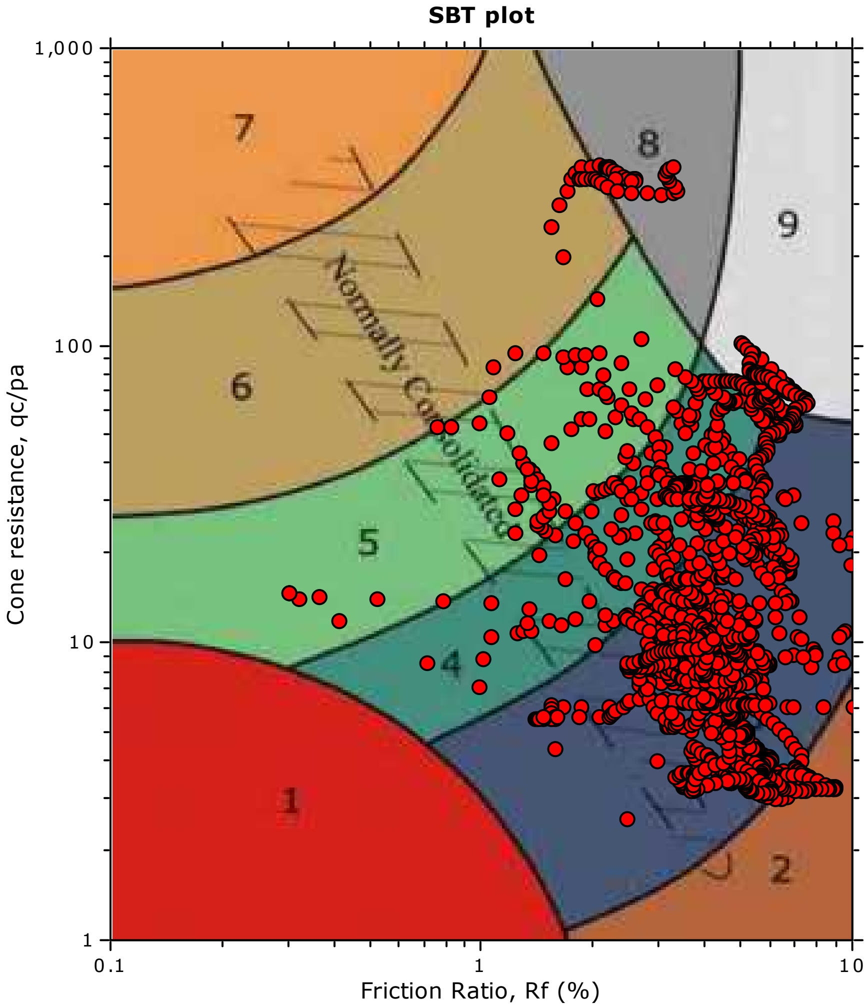
Project:
Location:

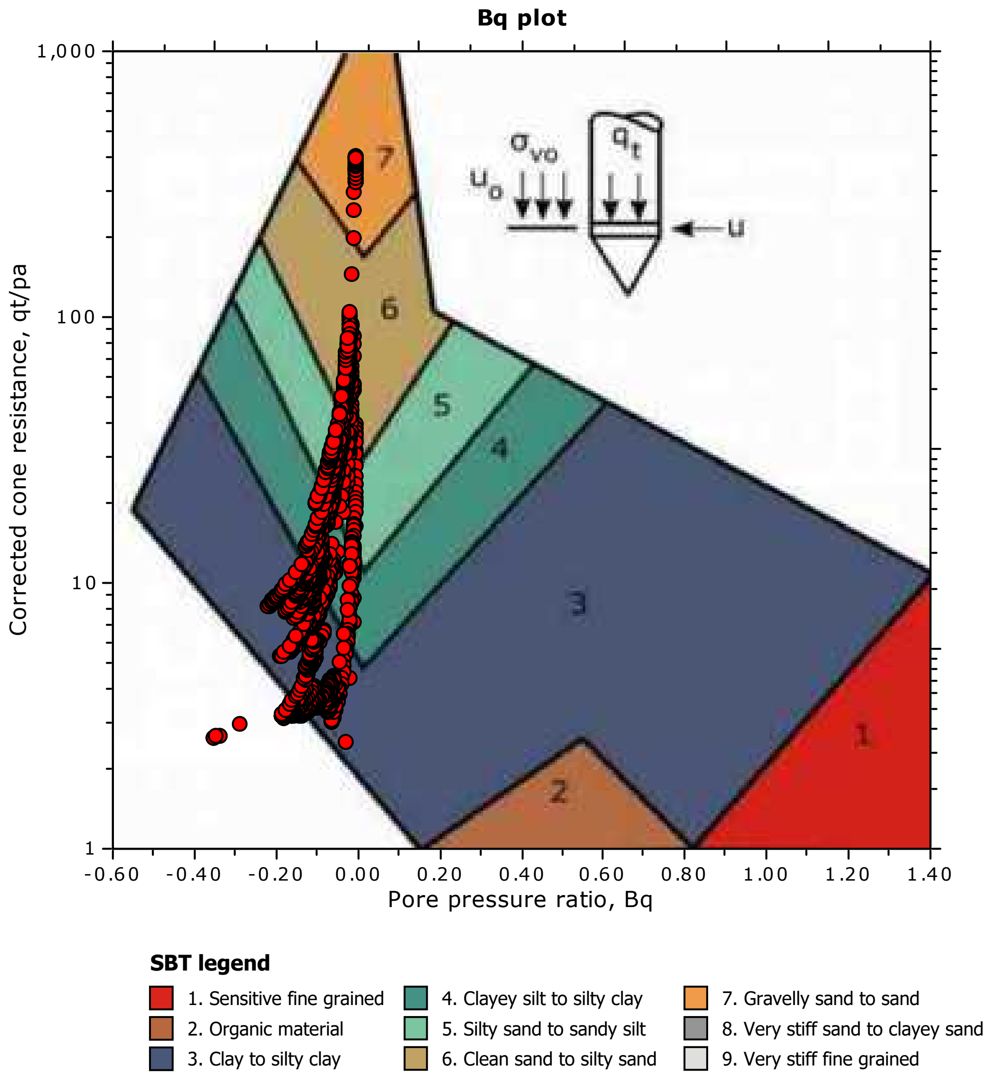


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

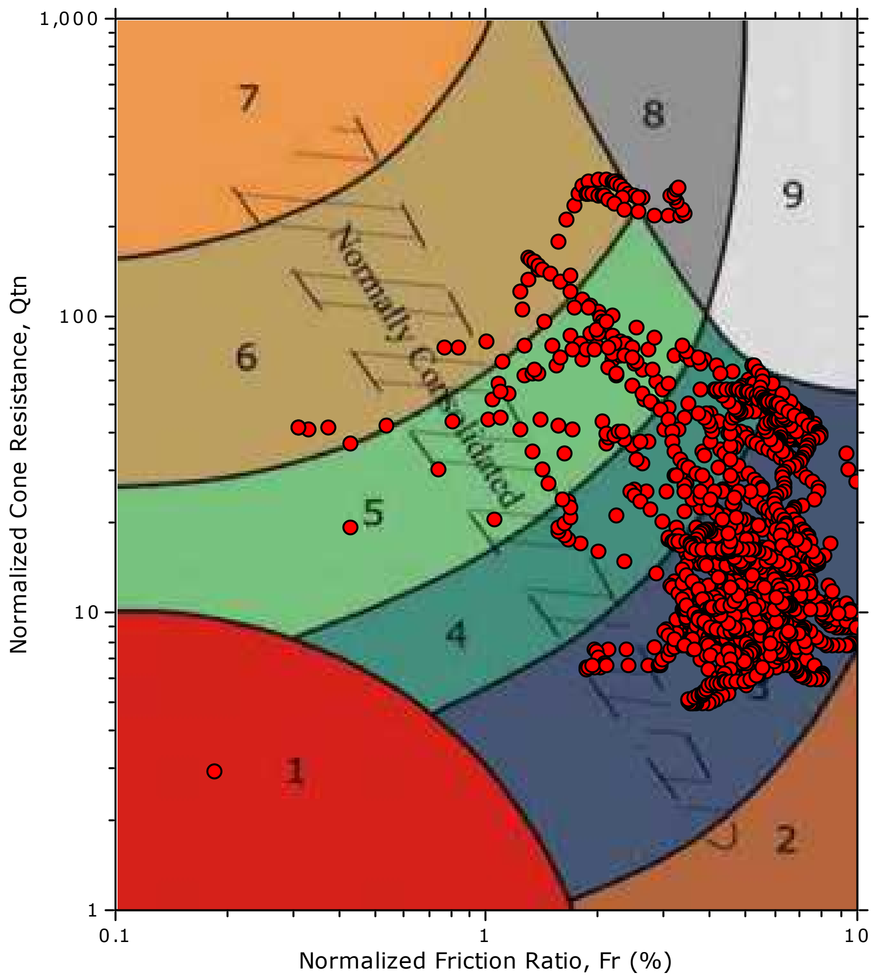


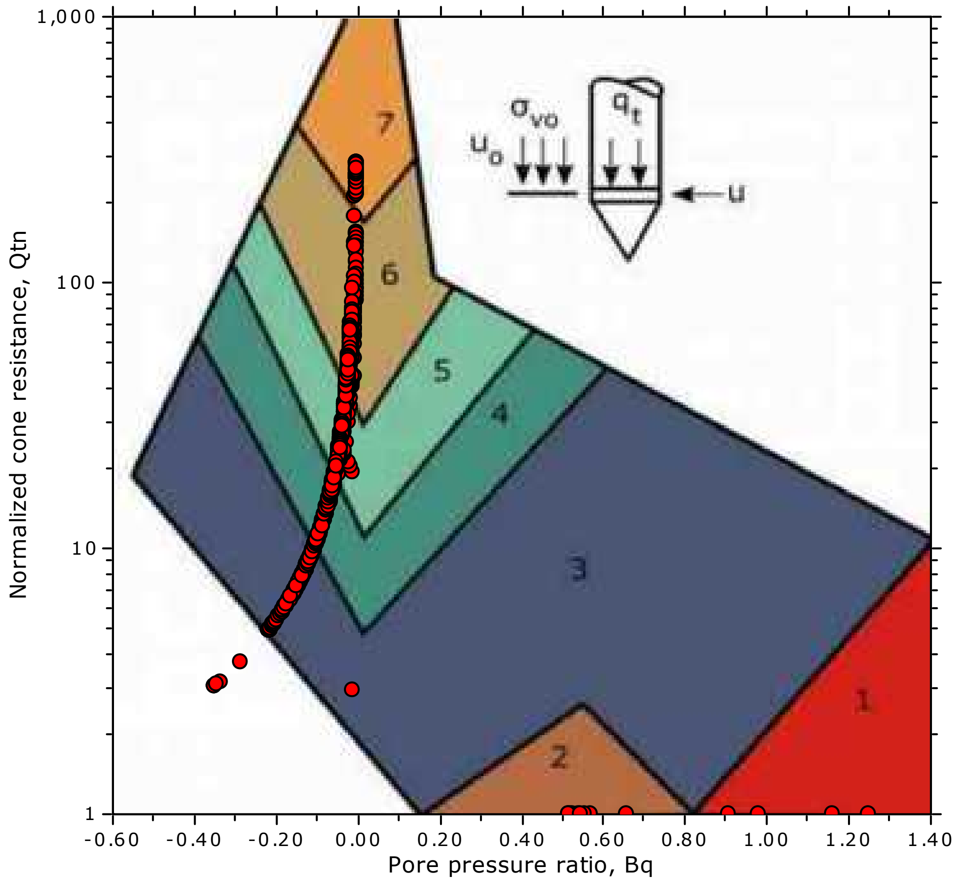
SBT - Bq plots


SBT plot
Cone resistance, qc/pa
Friction Ratio, Rf (%)
1,000
100
10
1
0.1
1
10
7
8
9
6
5
4
1
2
Normally Consolidated


Bq plot
Corrected cone resistance, qt/pa
Pore pressure ratio, Bq
1,000
100
10
1
-0.60
-0.40
-0.20
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
7
6
5
4
3
2
1
SBT legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

SBT - Bq plots (normalized)

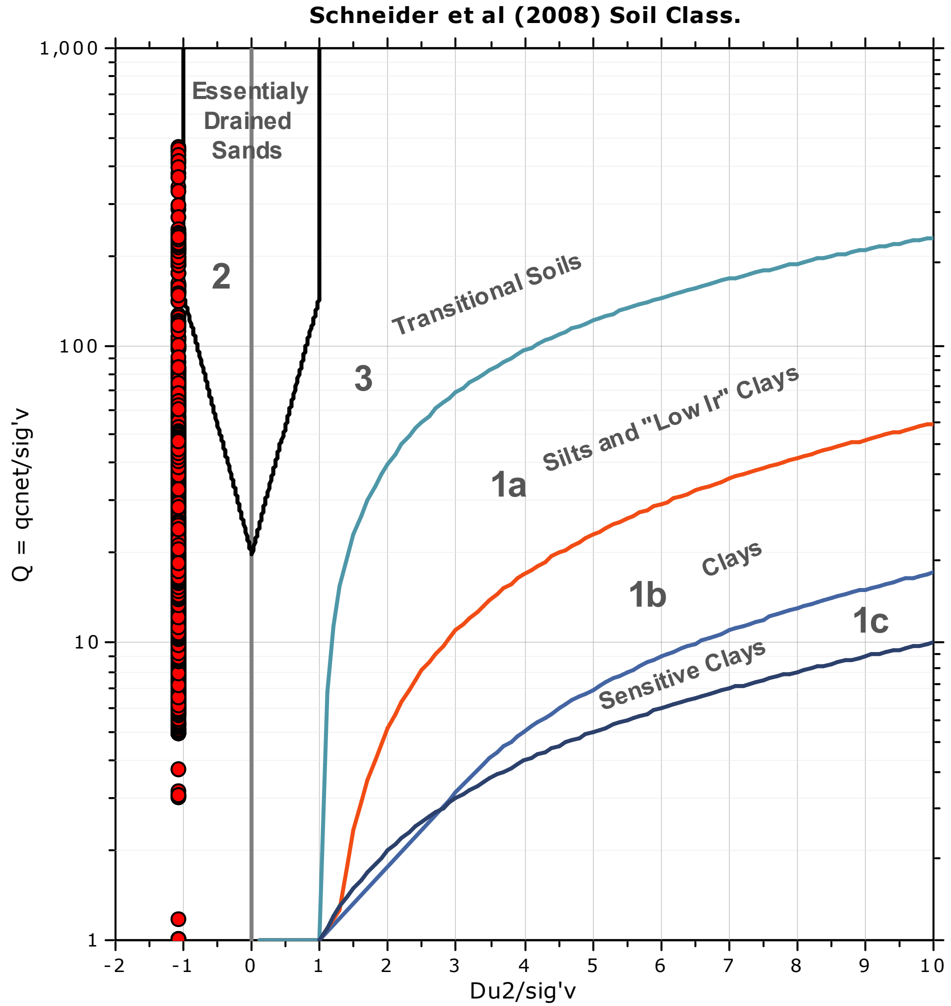


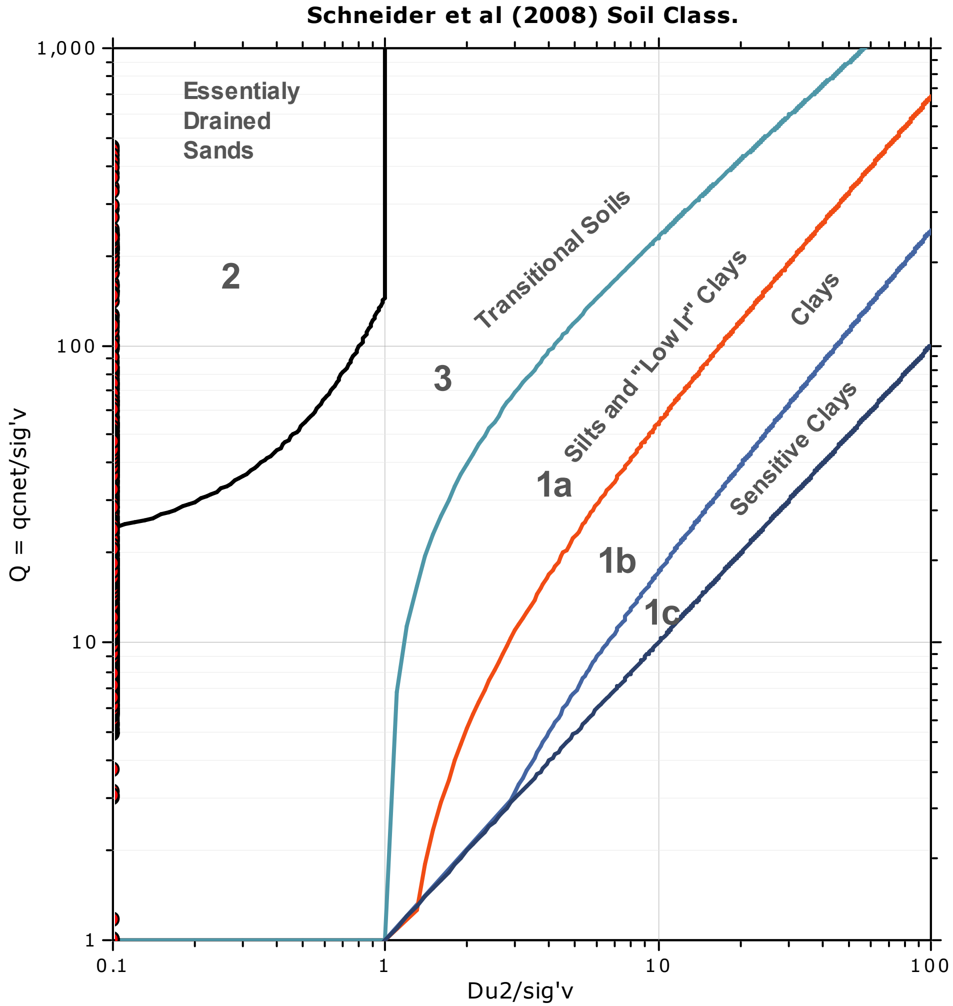


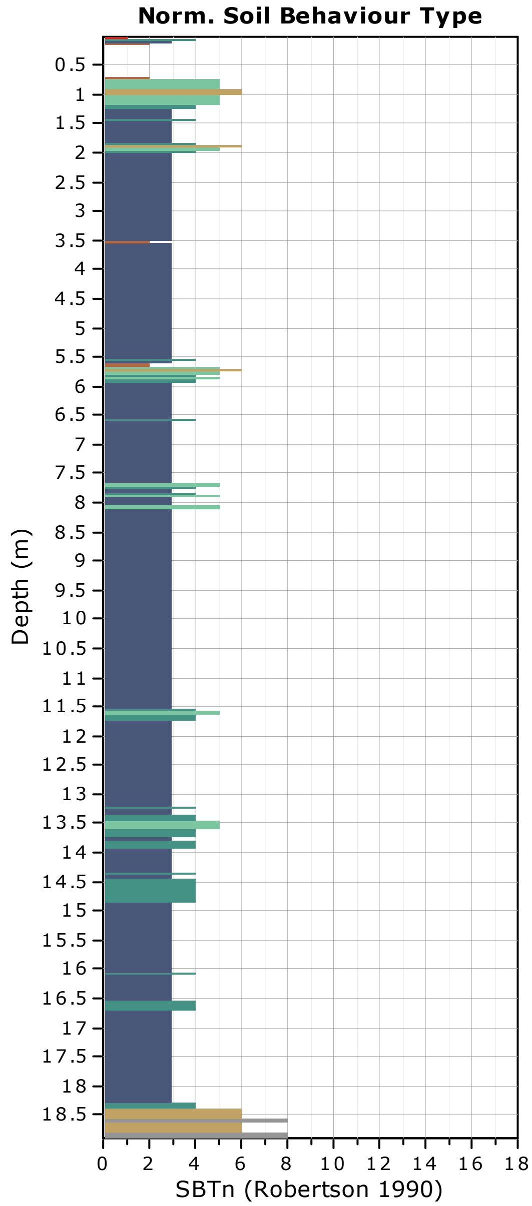
SBTn legend

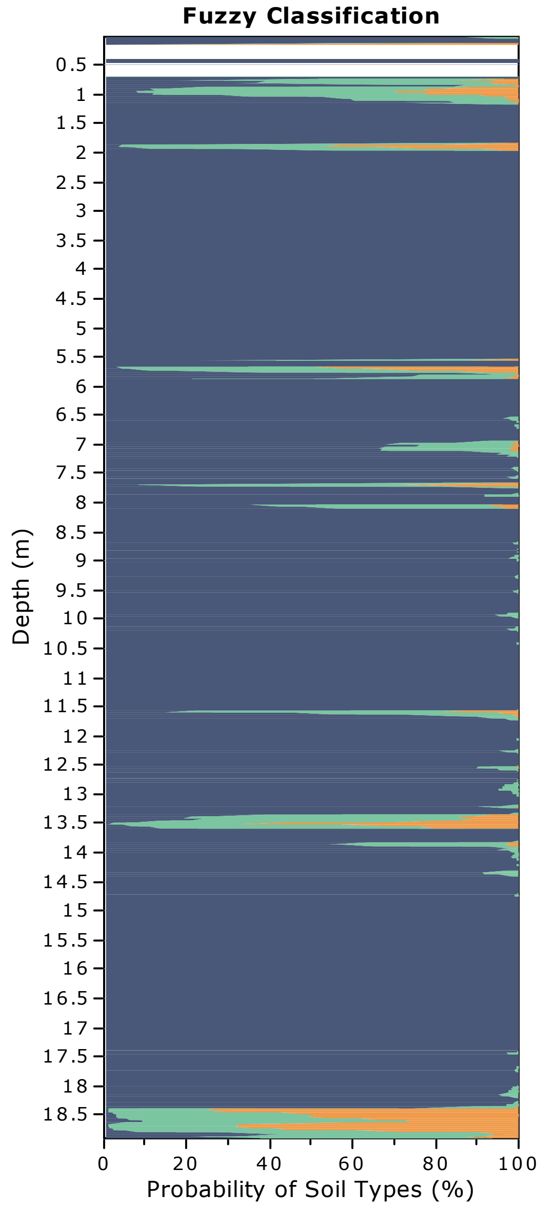
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

Bq plots (Schneider)






Norm. Soil Behaviour Type
Depth (m)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
11.5
12
12.5
13
13.5
14
14.5
15
15.5
16
16.5
17
17.5
18
18.5
0 2 4 6 8 10 12 14 16 18
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
11.5
12
12.5
13
13.5
14
14.5
15
15.5
16
16.5
17
17.5
18
18.5
0 20 40 60 80 100
Probability of Soil Types (%)

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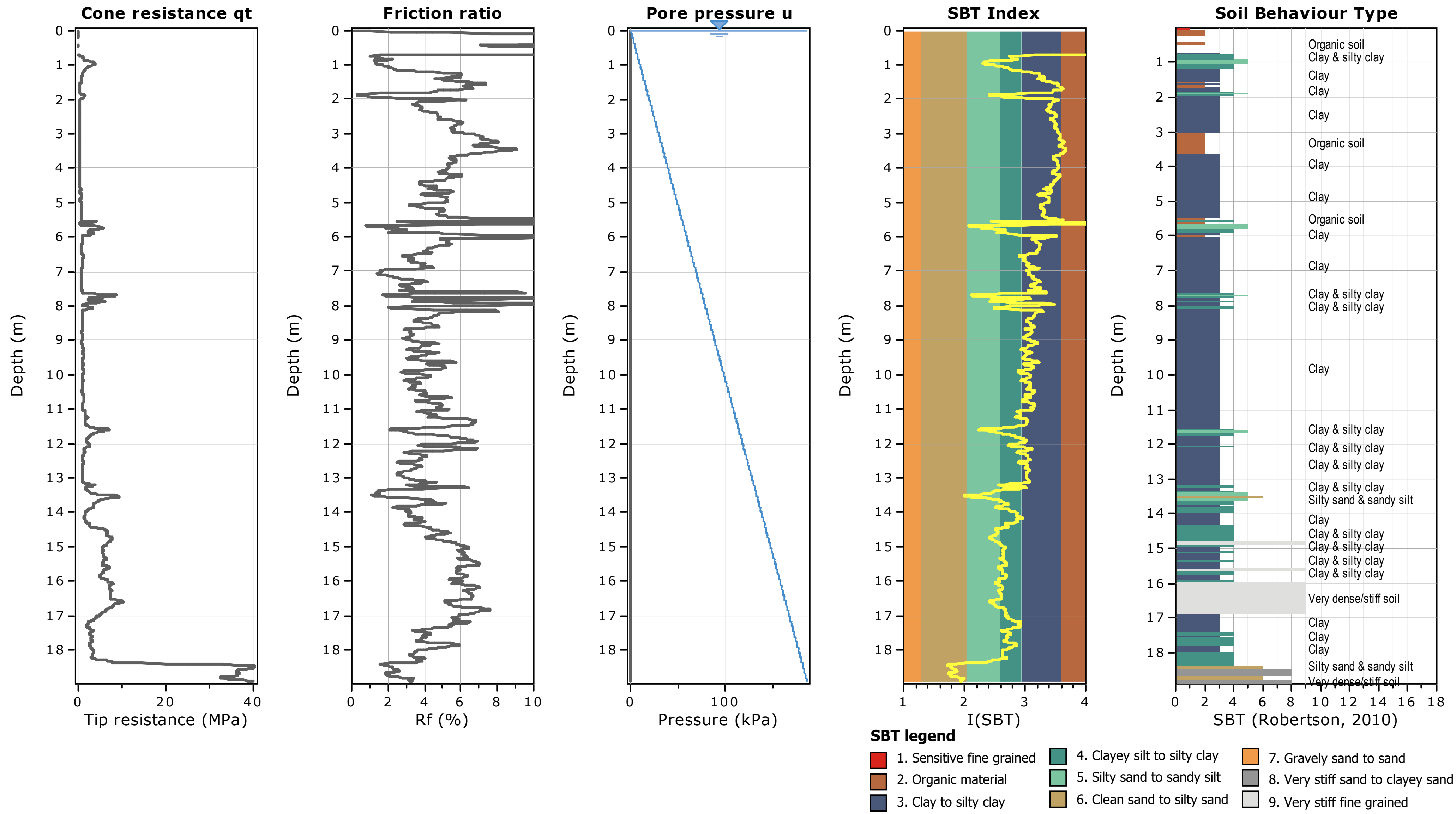
CPT: A9-CPT04
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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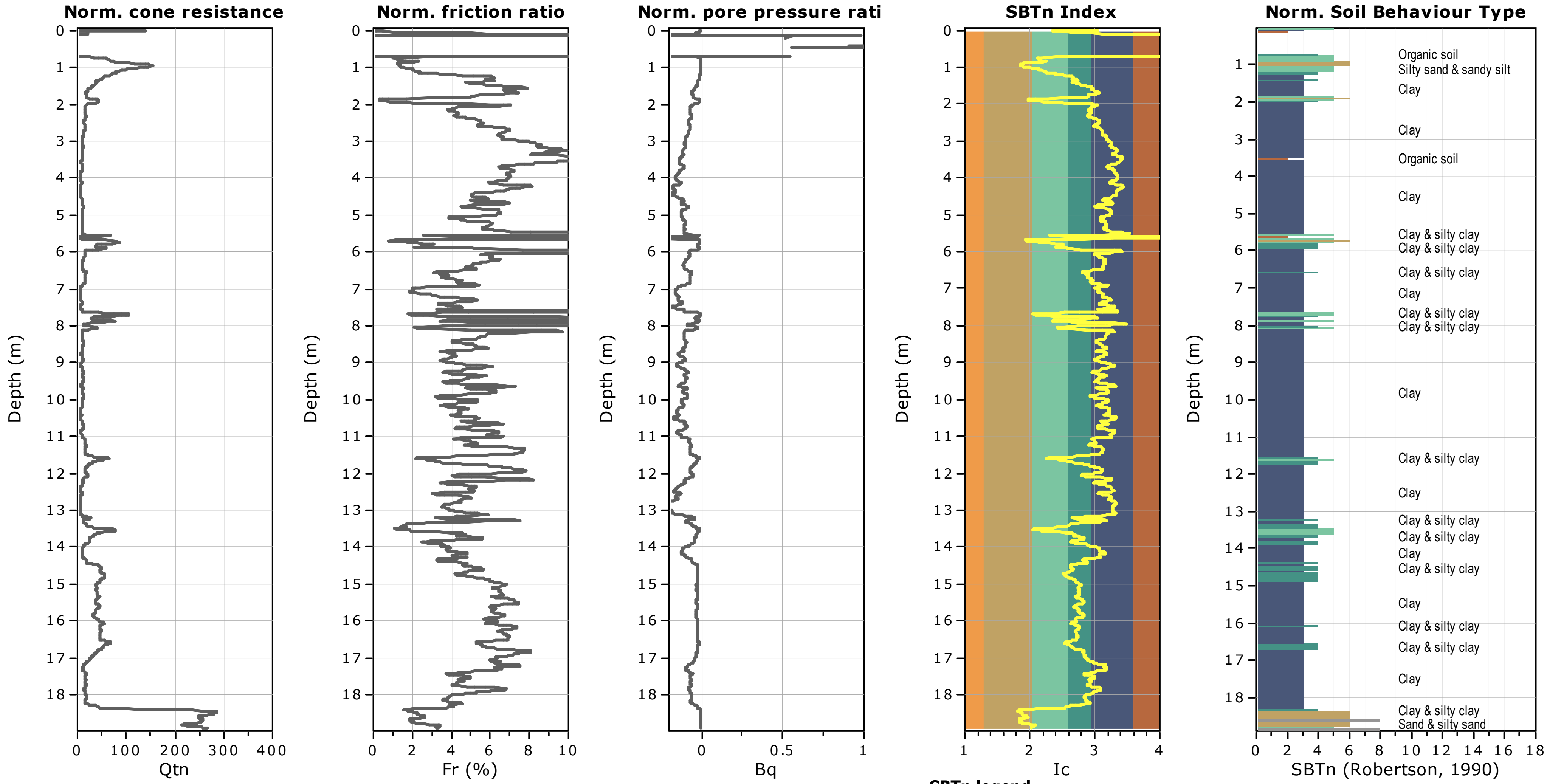
CPT: A9-CPT04
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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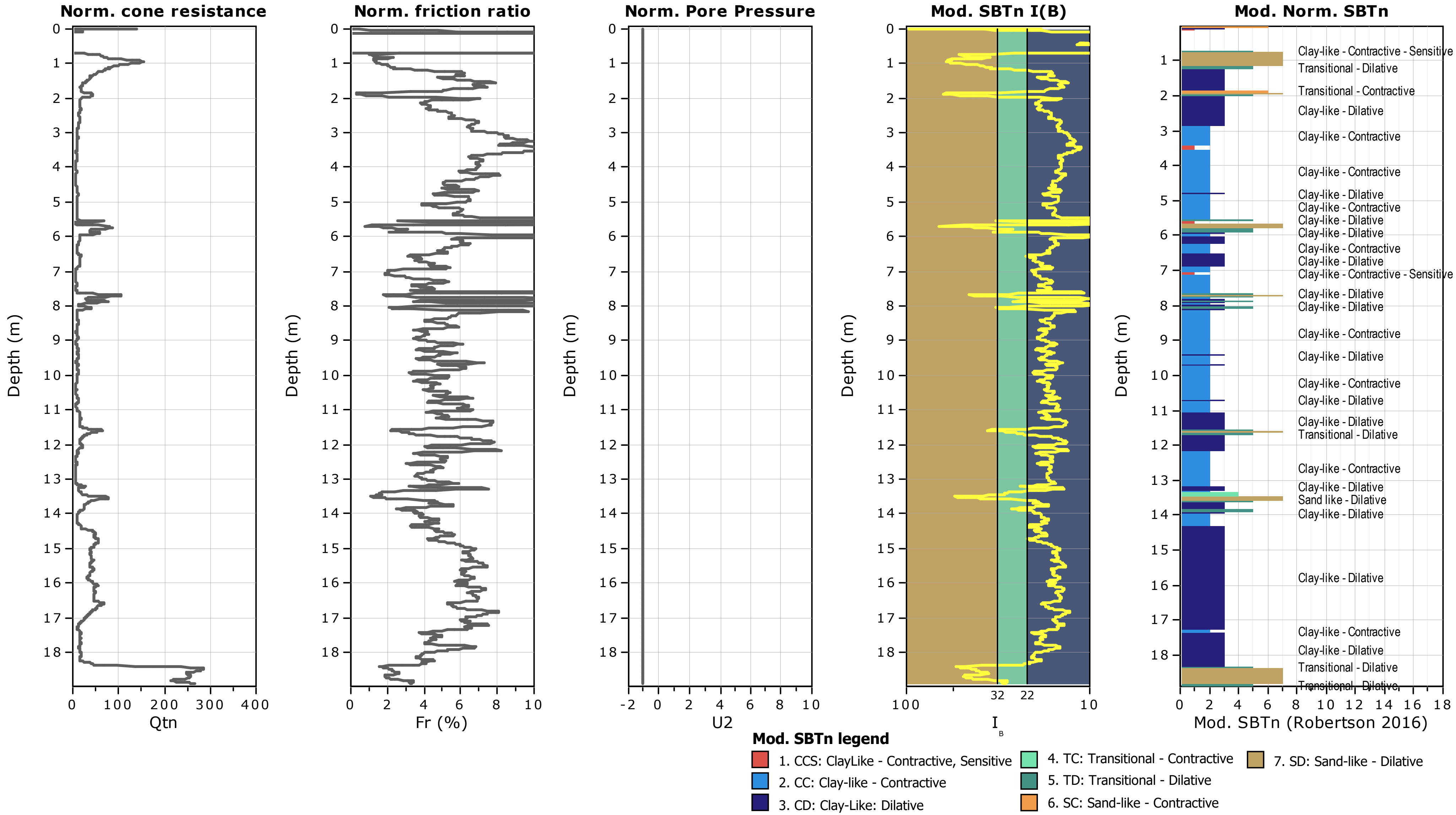
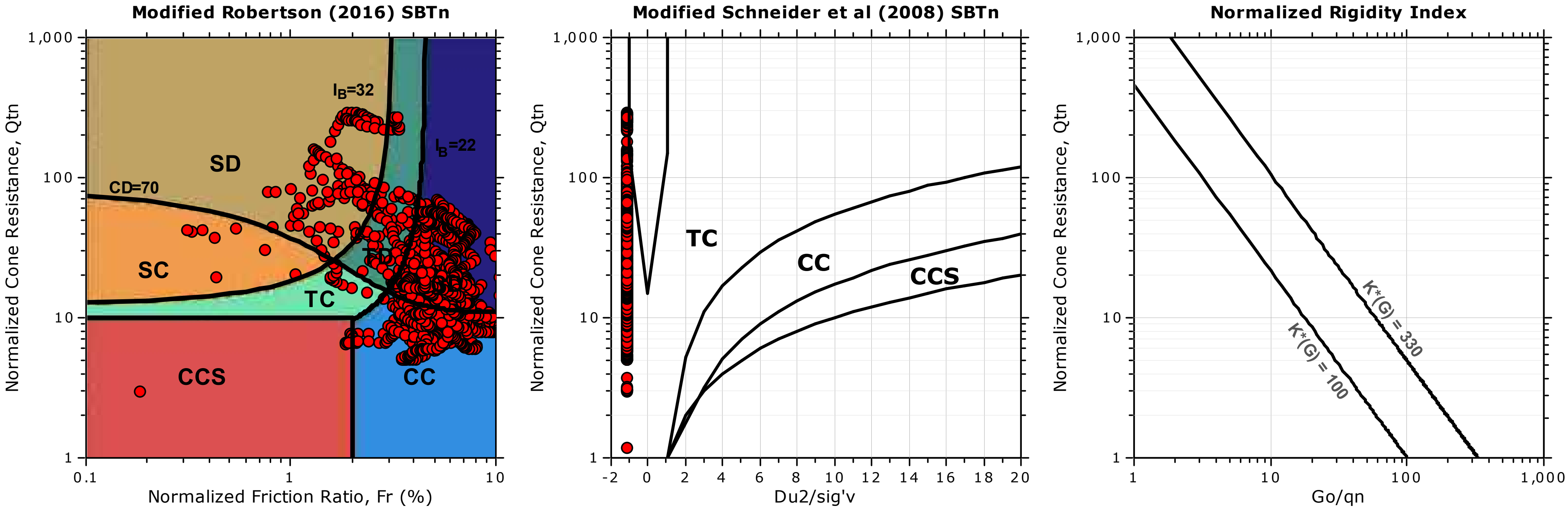
CPT: A9-CPT04
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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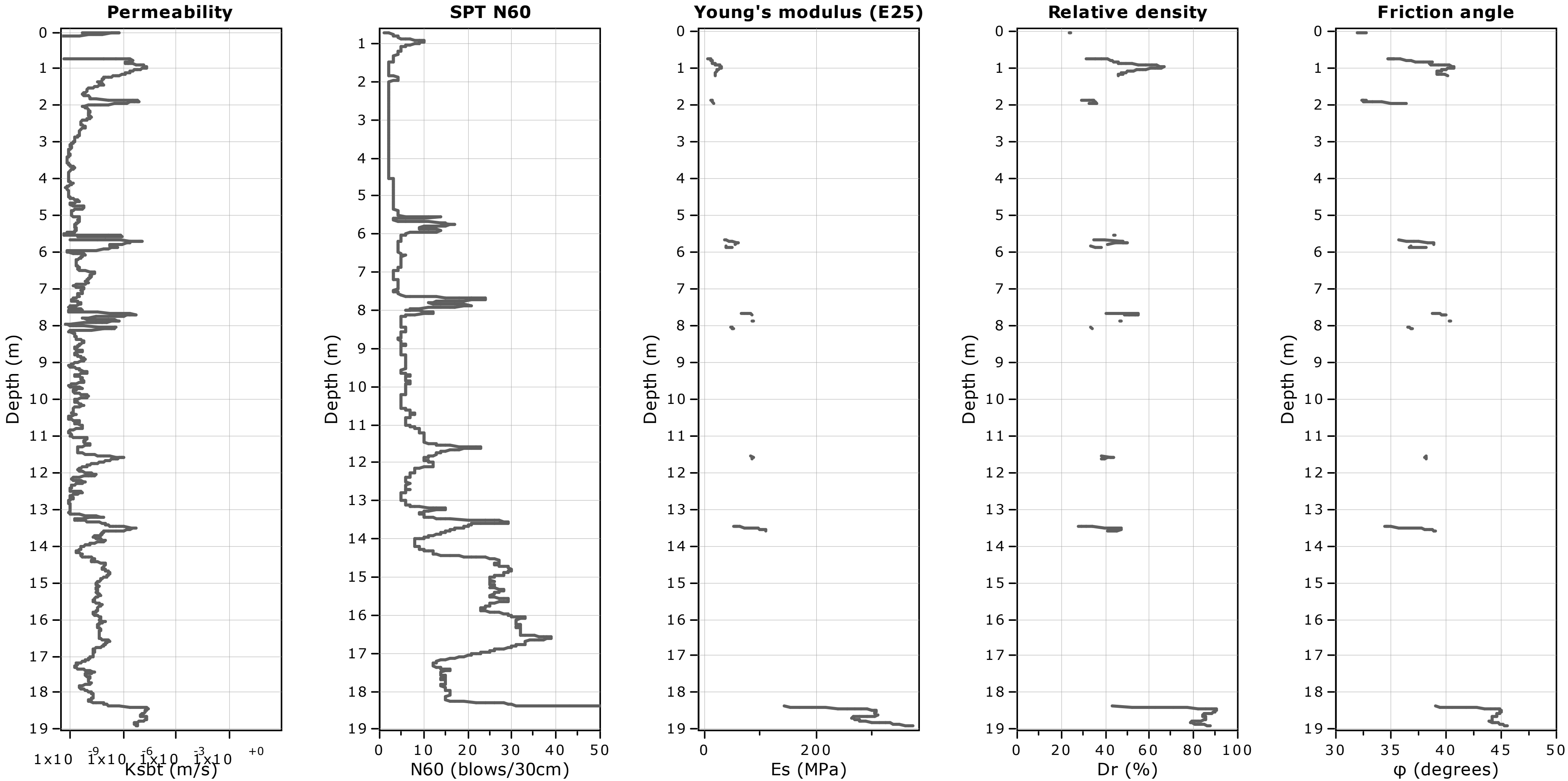
CPT: A9-CPT04
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

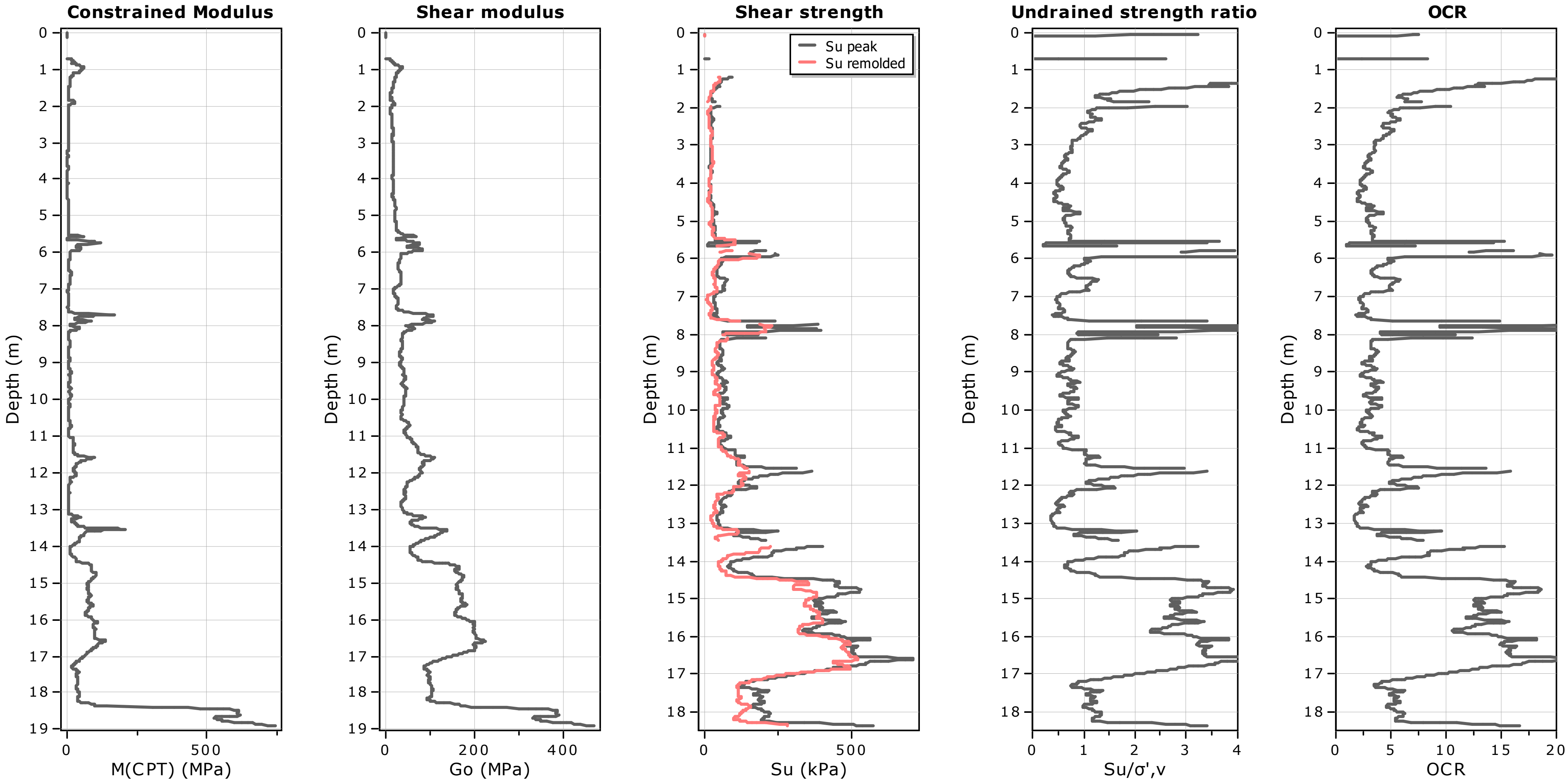
Project:
Location:



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

CPT: A9-CPT04
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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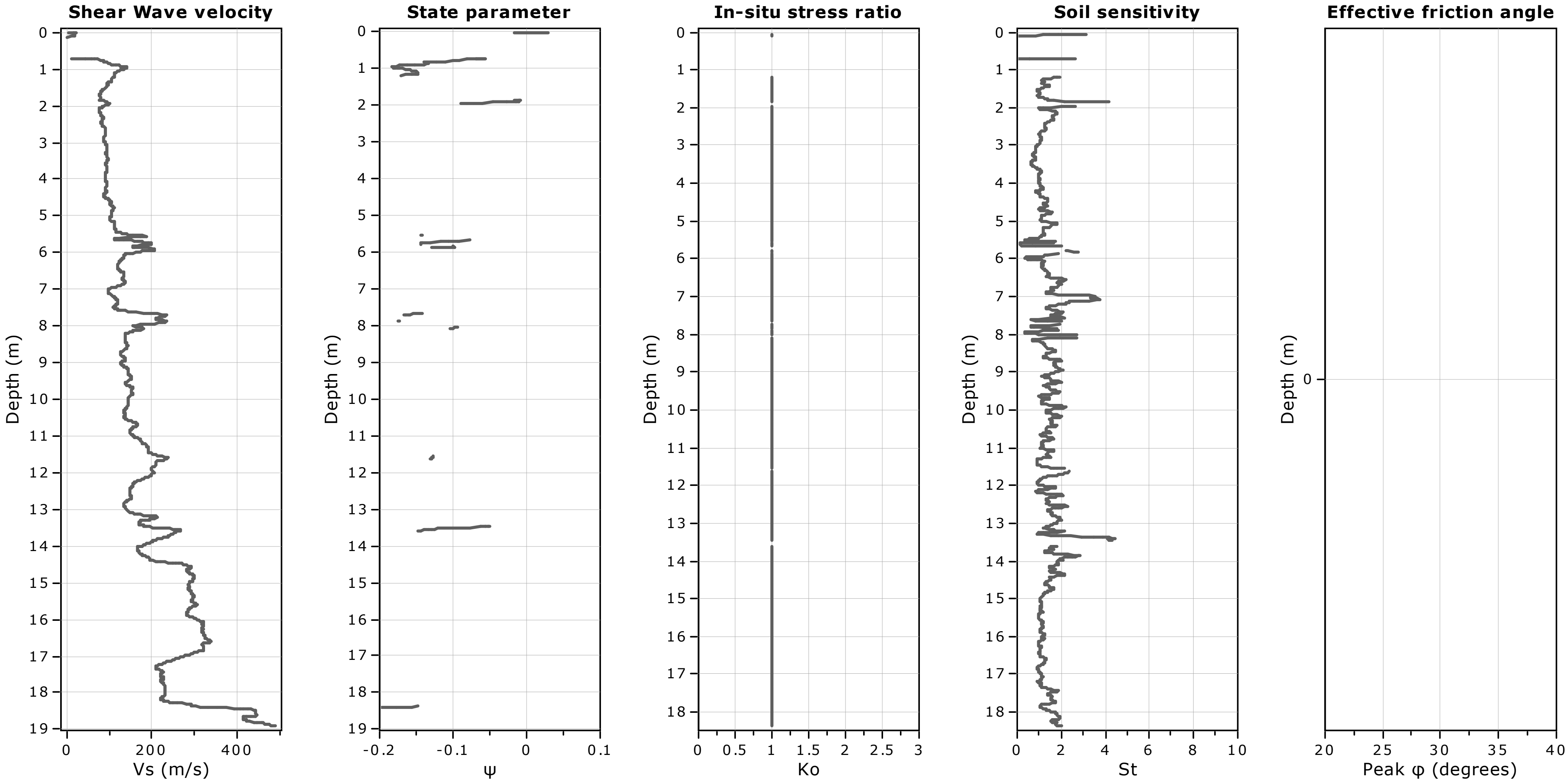
CPT: A9-CPT04
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

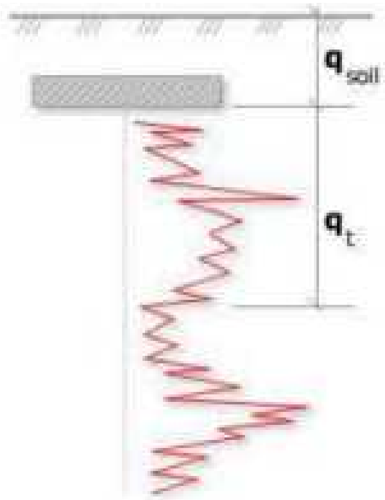
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

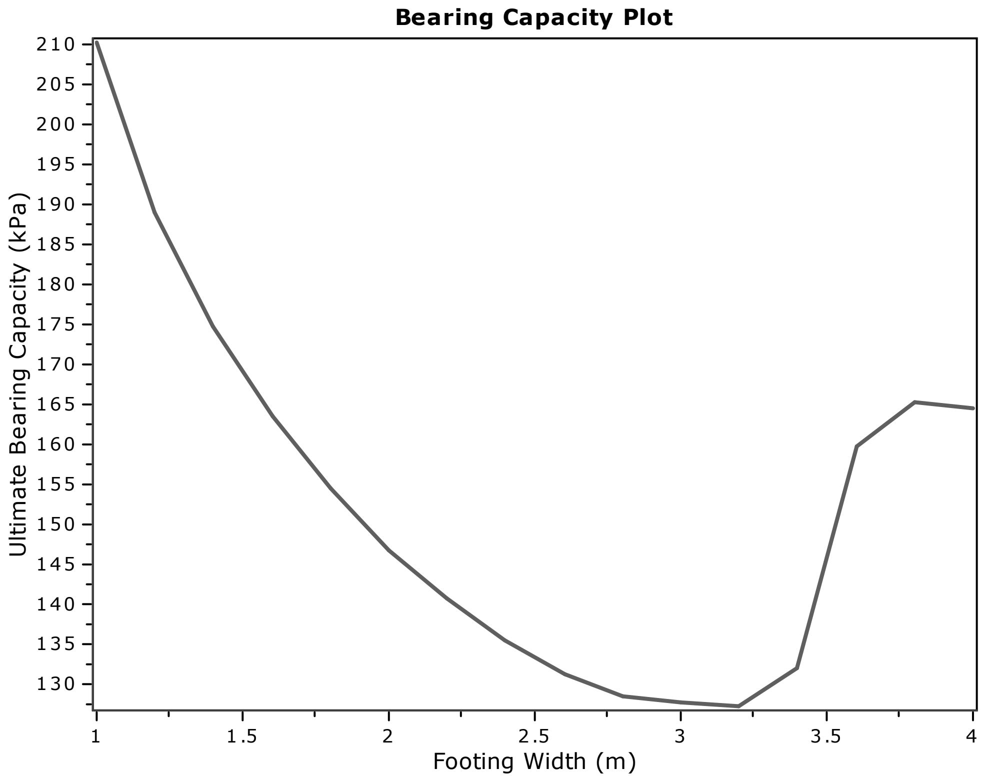
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.00	0.20	9.50	210.37
2	1.20	0.50	2.30	0.90	0.20	9.50	189.09
3	1.40	0.50	2.60	0.83	0.20	9.50	174.85
4	1.60	0.50	2.90	0.77	0.20	9.50	163.64
5	1.80	0.50	3.20	0.72	0.20	9.50	154.47
6	2.00	0.50	3.50	0.69	0.20	9.50	146.75
7	2.20	0.50	3.80	0.66	0.20	9.50	140.87
8	2.40	0.50	4.10	0.63	0.20	9.50	135.55
9	2.60	0.50	4.40	0.61	0.20	9.50	131.20
10	2.80	0.50	4.70	0.59	0.20	9.50	128.49
11	3.00	0.50	5.00	0.59	0.20	9.50	127.65
12	3.20	0.50	5.30	0.59	0.20	9.50	127.27
13	3.40	0.50	5.60	0.61	0.20	9.50	131.96
14	3.60	0.50	5.90	0.75	0.20	9.50	159.91
15	3.80	0.50	6.20	0.78	0.20	9.50	165.23
16	4.00	0.50	6.50	0.78	0.20	9.50	164.66

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

:: N_{SPT} (blows per 30 cm) ::

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

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

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

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

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

:: Relative Density, Dr (%) ::

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

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

:: State Parameter, ψ ::

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

:: Drained Friction Angle, φ (°) ::

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

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

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

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

If $I_c \geq 2.20$

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

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

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

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

:: Soil Sensitivity, S_t ::

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

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

:: Peak Friction Angle, φ' (°) ::

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

(applicable for $0.10 < B_q < 1.00$)

References

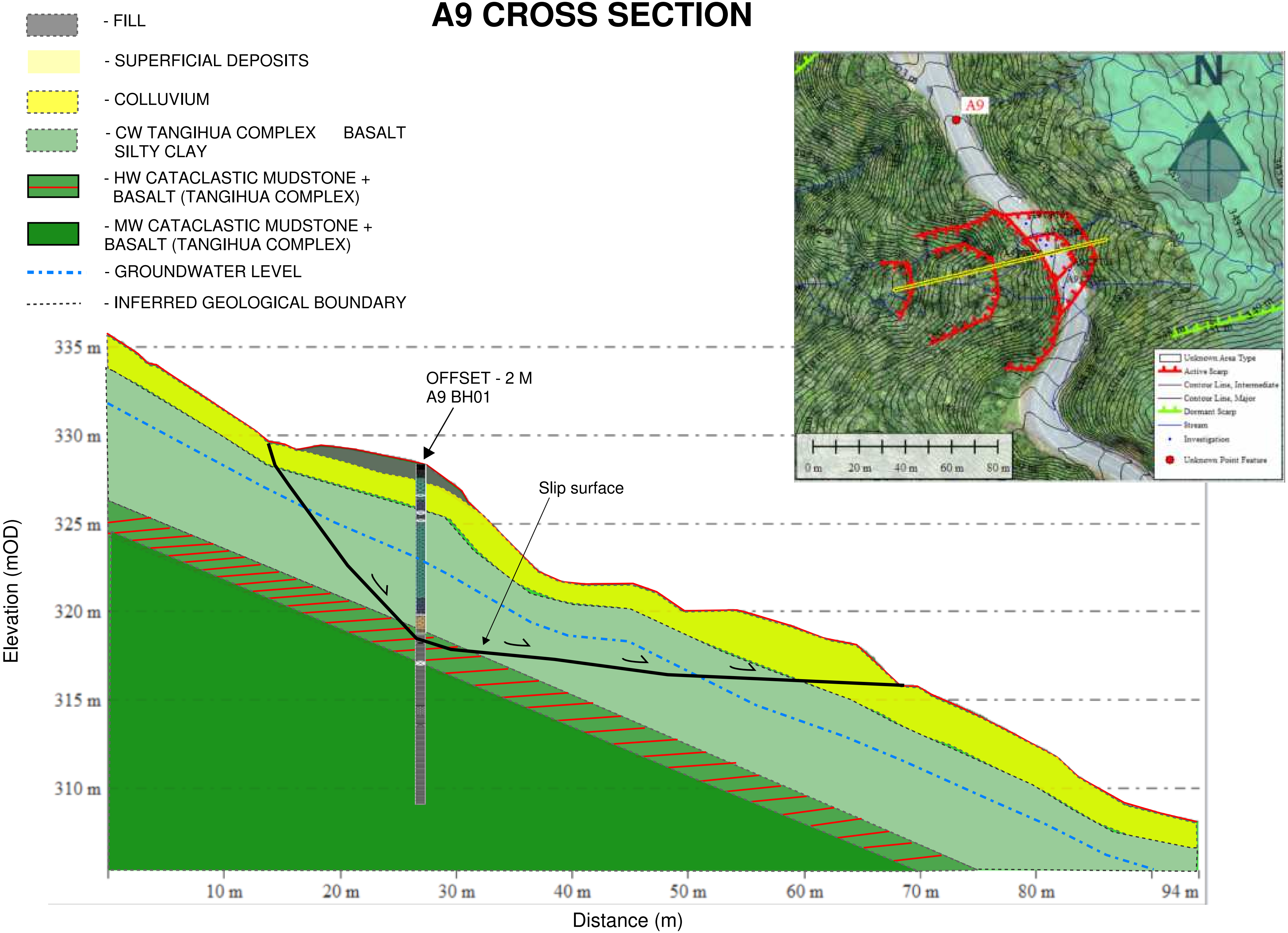
• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

Appendix B

Conceptual Geological Cross Section

A9 CROSS SECTION



Appendix C

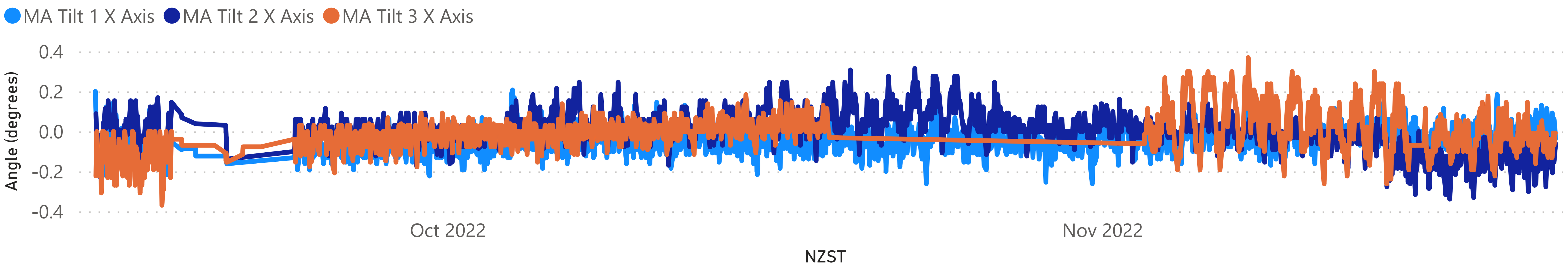
Tilt Sensor and Rainfall Data

Inclinometer Data

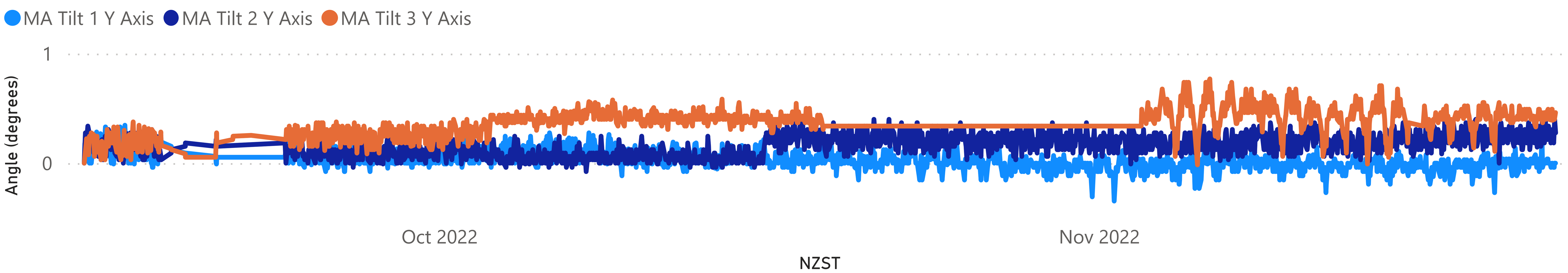
Mangamuka Gorge - Site A9 (T1 - T3)

9/14/2022 | 11/22/2022

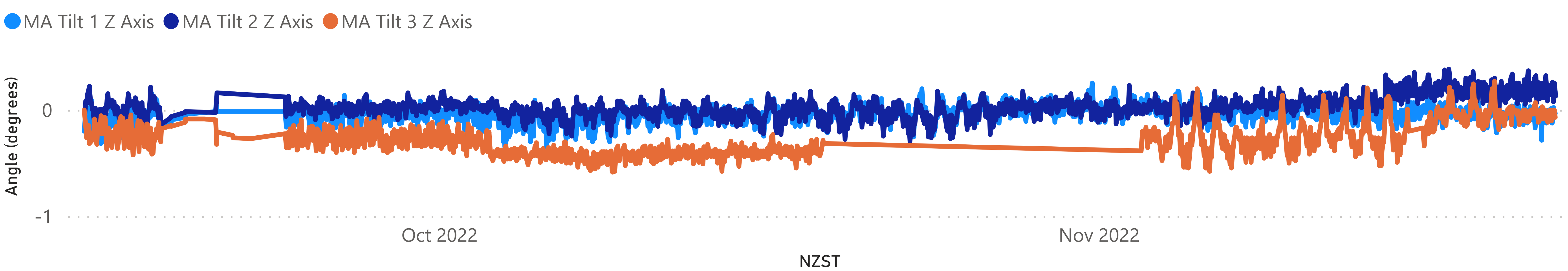
MA Tilt 1 X Axis, MA Tilt 2 X Axis and MA Tilt 3 X Axis by NZST



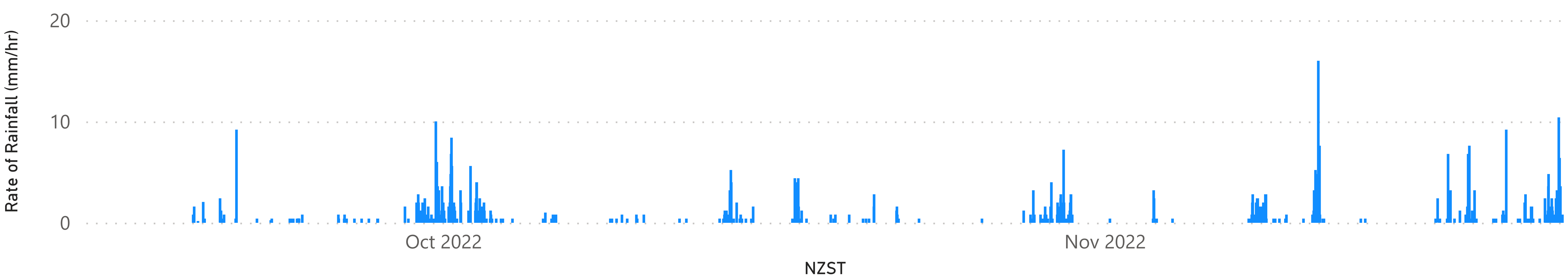
MA Tilt 1 Y Axis, MA Tilt 2 Y Axis and MA Tilt 3 Y Axis by NZST



MA Tilt 1 Z Axis, MA Tilt 2 Z Axis and MA Tilt 3 Z Axis by NZST



Rate of Rainfall (mm/hr) by NZST

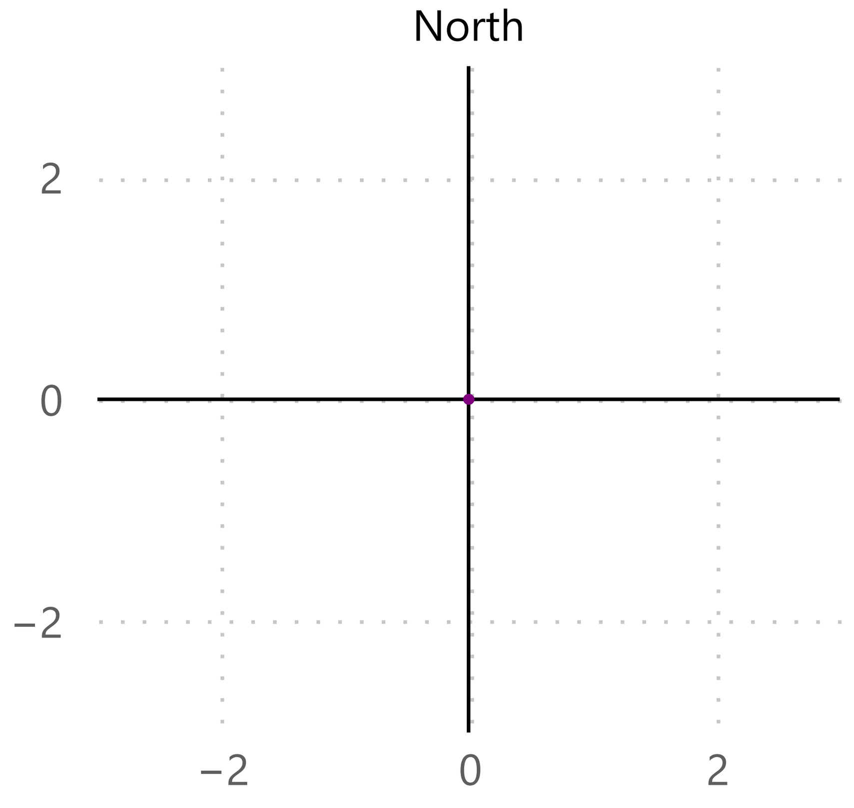


TARP

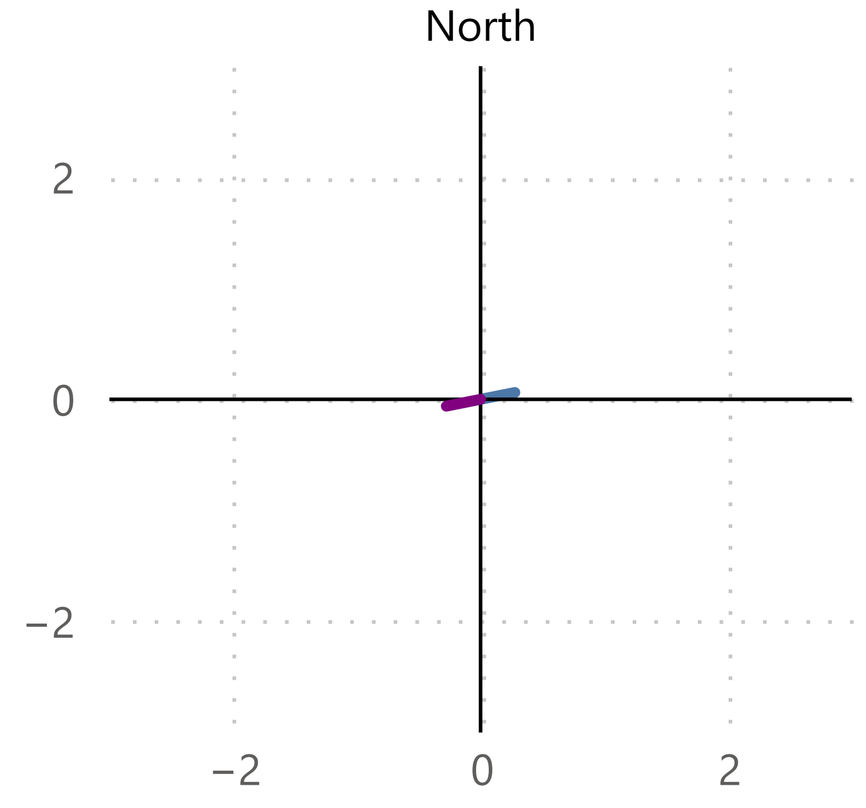
Site	Level
A09	

Device

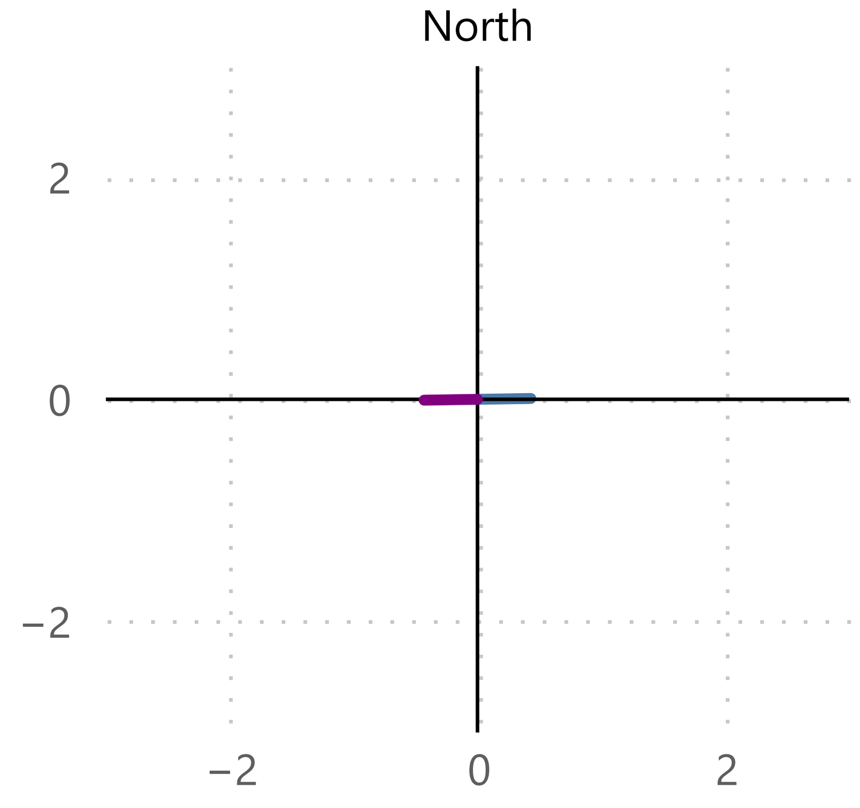
Tilt 1
North



Tilt 2
North



Tilt 3
North

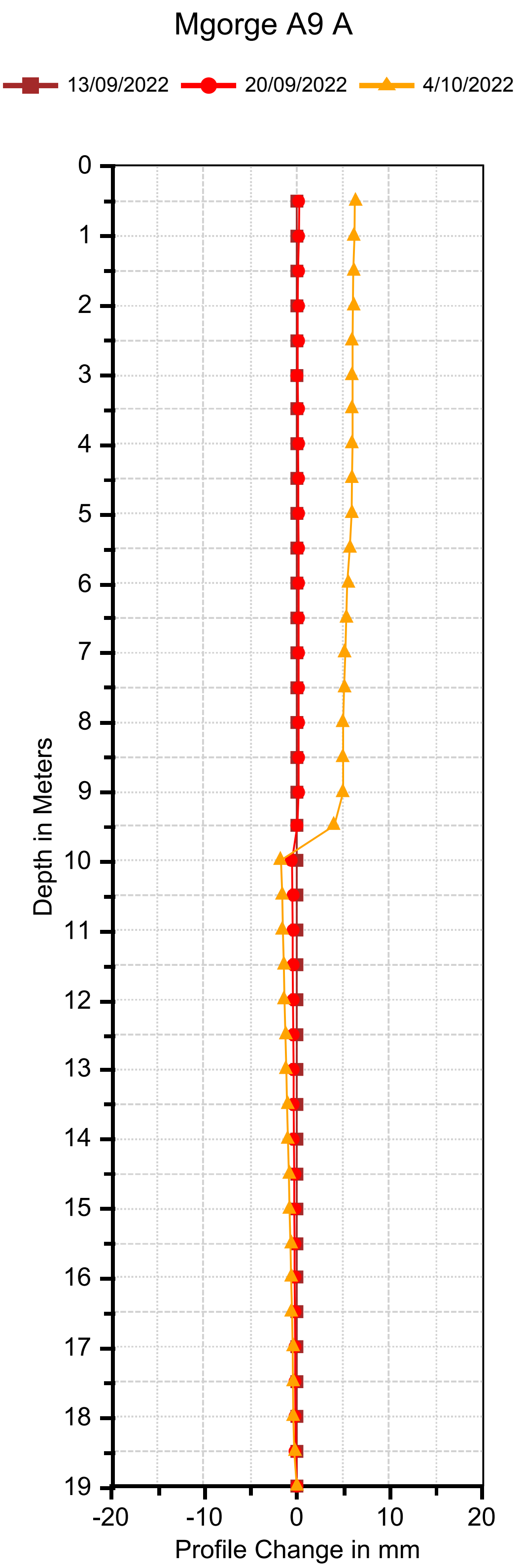


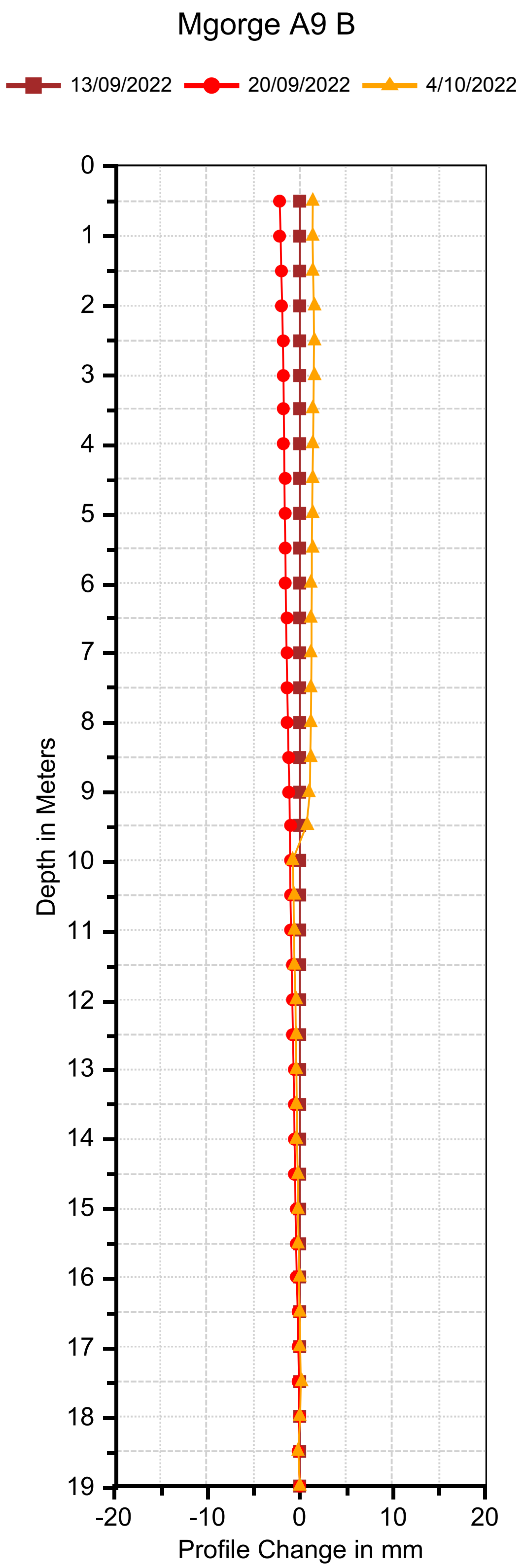
LEGEND

Actual Tilt Direction

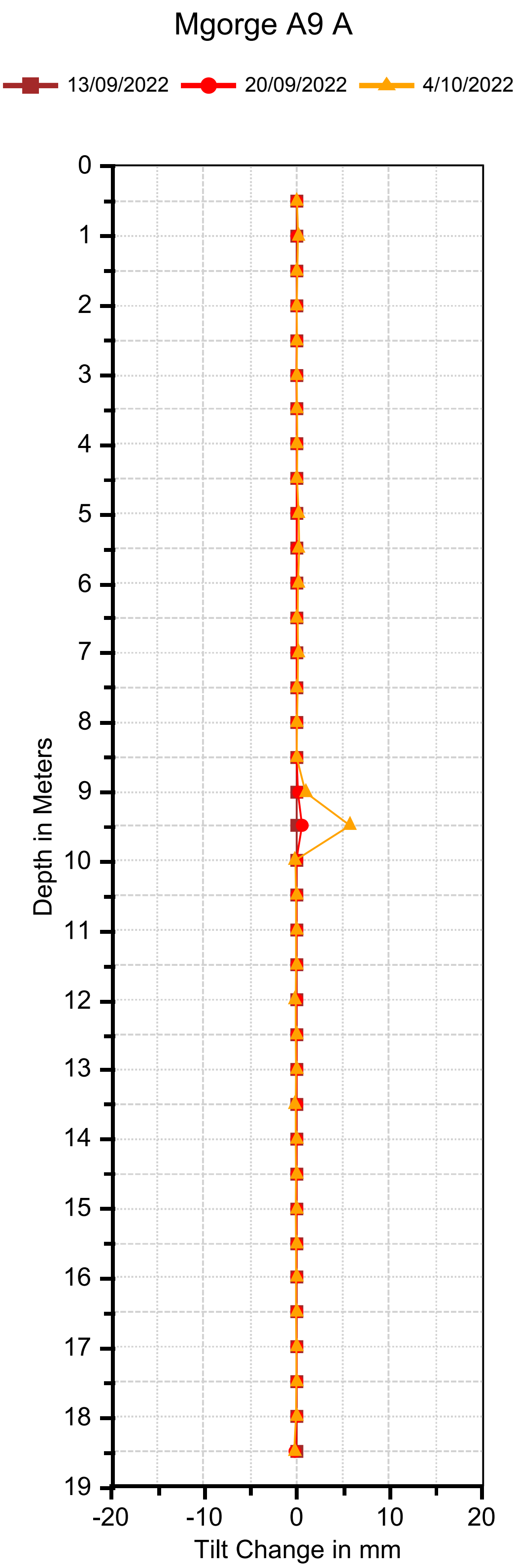
Estimated Land Direction

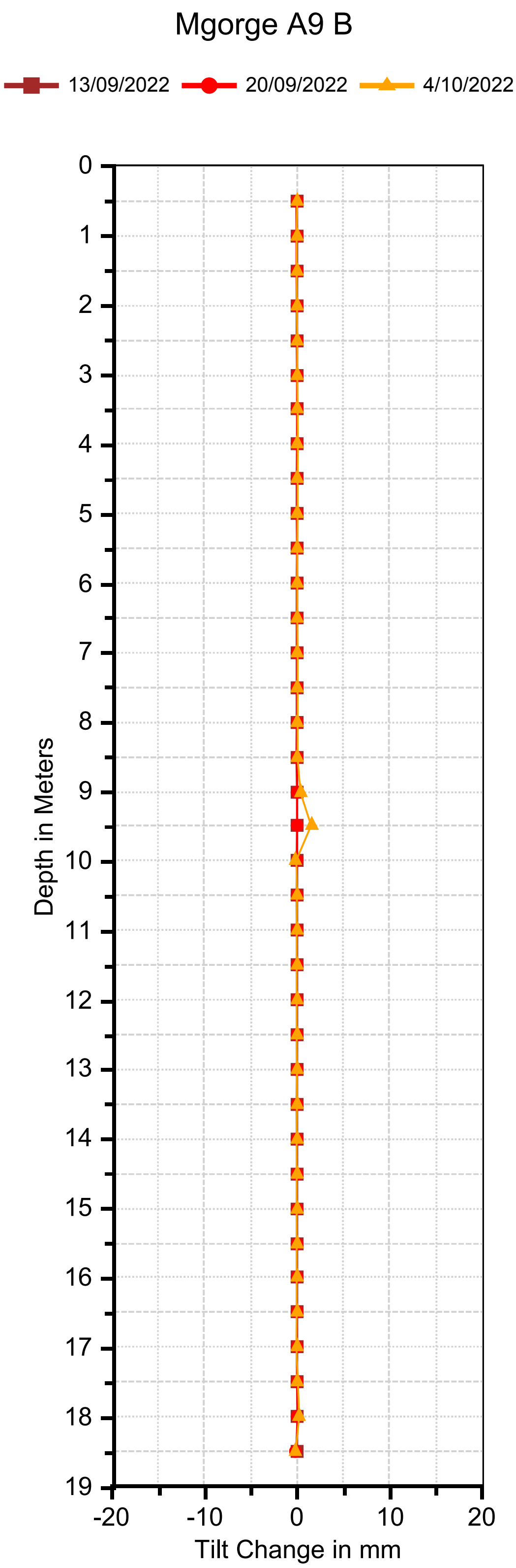
Whangarei Lab
166 Bank Street
Whangarei
Ph 09 438 4417





Whangarei Lab
166 Bank Street
Whangarei
Ph 09 438 4417





wsp.com/nz

Project Number: 1-11240.00

NZTA Northland Resilience and Emergency Works- August 2022- 10176/22A8

25 November 2022

CONFIDENTIAL

Interpretive Geotechnical Investigation Report

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Reviewed by
Matt Leggett

Approved for release by
Shaun Grieve

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00	15/11/2022	Ellie Eastaugh	Matt Leggett	Shaun Grieve	Final

Revision Details

Revision	Details

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for New Zealand Transport Agency ('**Client**') in relation to Mangamuka Gorge Slips Emergency Works ('**Purpose**'). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

1 Introduction

Two storm events in July and August have caused widespread flooding and associated landsliding across much of Northland. Following the August rain event WSP were engaged by Waka Kotahi to form part of the emergency response and undertake an urgent geotechnical investigation along a section of State Highway (SH) 1 through Mangamuka Gorge. A total of 12 underslips have been identified requiring significant geotechnical analysis and associated permanent remedial measures.

This report covers the investigation and assessment at 10176/22A8 (henceforth referred to as A8) and provides a recommended solution. Site A8 is located at RP14.580 along SH1, approximately 2km north of Mangamuka Summit and 21km southeast Kaitaia. The feature is an historical underslip with movement activated as a result of the recent storm events with heavy rainfall.

The site location is shown below in Figure 1-1 together with the other slip sites.

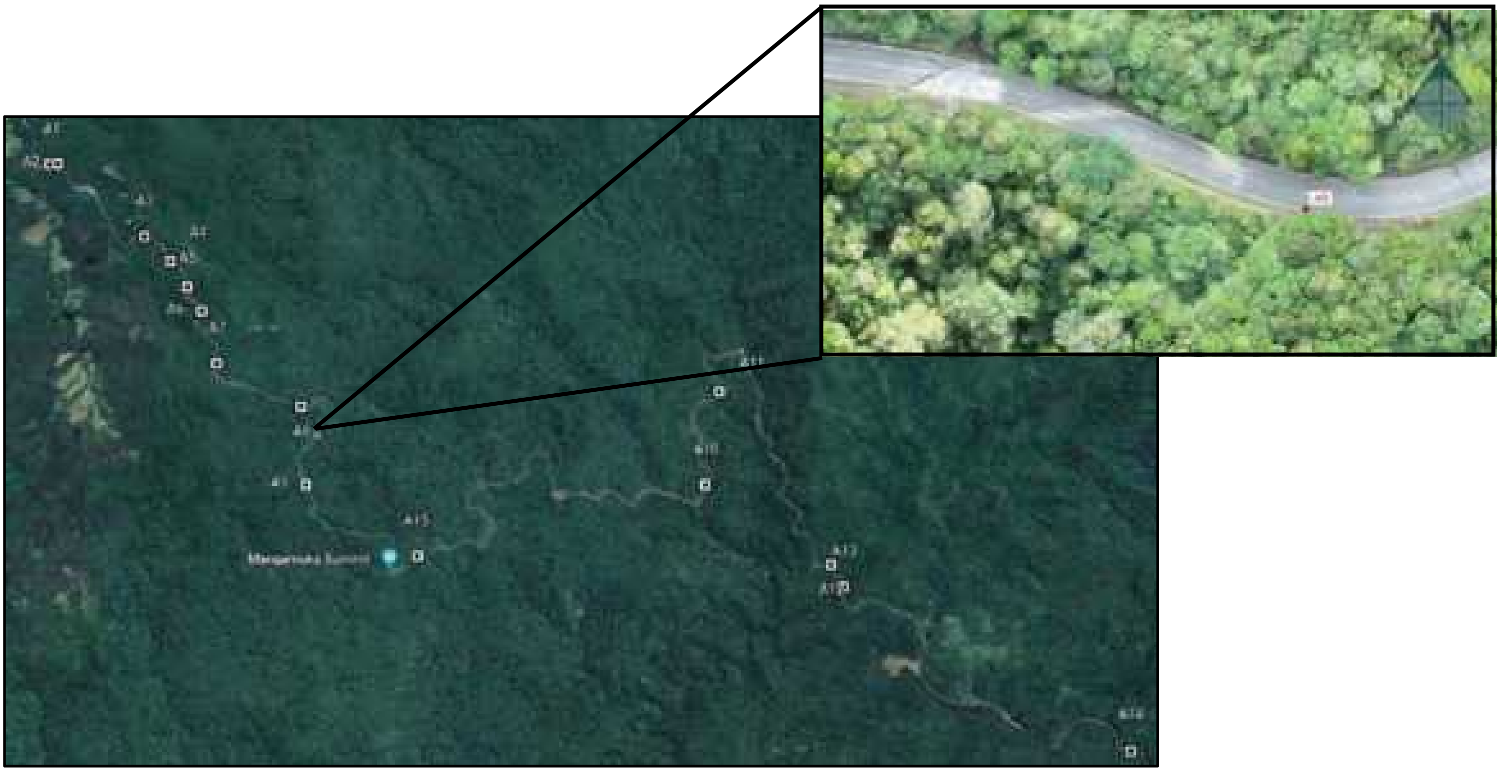


Figure 1-1: 10176/22A8 Site location Plan

2 Regional Geology

The 1:250 000 scale QMAP seamless digital data (GNS, 2013) indicates the site area to be underlain by the Undifferentiated Tangihua Complex in Northland Allochthon comprising basalt pillow lava, with subvolcanic intrusives of basalt, dolerite, and gabbro; locally incorporating siliceous mudstone. (Figure 2-1).

The Tangihua Complex has been emplaced onto New Zealand through convergent plate tectonics and sea floor sliding. As a result, the material has been historically sheared with the rock underlying the site expected to be highly fractured and degraded through original emplacement processes and further modified by weathering.

Figure 2-1: Regional geology

3 Site Investigation

Between 25th August and 19th October, a geotechnical investigation was undertaken to identify sub-surface ground conditions and to help inform the options for remedial measures required at site A8. The works comprised the following:

- 2no. Rotary cored boreholes (BH) were completed to a maximum depth of 30.0mbgl with standard penetration tests (SPTs) at 1.5m intervals.
- Installation of inclinometer within A8-BH01 upon completion.
- Installation of dual piezometer within A8-BH02 to a depth of 25.5m. The screen zone for piezo 01 is between 1.0mbgl and 6.5mbgl and the screen zone for piezo 02 is between 8.0mbgl and 25.5m bgl.
- 4no. Cone penetration tests (CPTs) to a maximum depth of 19.79mbgl.

- The intrusive drilling works was undertaken by Drillforce Limited including the boreholes, CPT's aa well as the installation of inclinometer tubing for monitoring ground movement and piezometers for groundwater, all under the supervision of WSP site staff.
- All the boreholes were logged in accordance with the NZGS *Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes*, December 2005 and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg. 365, Table 1. Borehole and CPT locations displayed on Figure 3-1 below with logs displayed in Appendix A.
- Tiltmeters were installed on the ground surface by WSP Research staff to obtain Realtime monitoring of surface movements.
- Monitoring of the piezometers and inclinometers was undertaken by GeoCivil Ltd under direction of WSP staff.

Figure 3-1: Exploratory hole location plan

3.1 Observations

The slip was inspected on 23rd September 2022 by WSP. The inspection identified the following:

- The total length of affected road is 100m, with the road constructed on top of two historical landslides which extend both up and downslope.
- The grade of slope is approximately 1v:2h. The easternmost slip is inferred to extend 40m upslope with the westernmost slip extending 10m upslope.
- At the time of inspection, the headscarp has encroached within both the southbound and northbound lane. There has been up to 100mm of vertical settlement with 200mm of horizontal movement downslope. Heaving of the pavement has occurred at the eastern most headscarp as a result of the broader hillside moving from west to east as well as north to south.

- Additional tension cracking has started to form further towards the centreline and the slip is likely to continue to slump and require frequency maintenance/levelling.
- The upslope has a grade of 1.v:2h and is comprised of historical slip material and completely weathered bedrock.
- Surface seepage was not noted during the site investigation.

4 Geomorphological Mapping

A terrain evaluation is presented below in Figure 4-1. Geomorphological mapping undertaken from both Lidar and aerial photography as well as site observations.

Figure 4-1: Geomorphological map

The site area at A8 situated in the mountainous terrain of Mangamuka, comprises of two long headscarps daylighting within the north and southbound lanes. The features are likely to extend further than is currently visible and form part of a larger feature. A drainage channel is located at the southernmost part of the headscarp and forms a gulley downslope to Victoria River below. It has been observed that the gullies coincide with the extend of the main failure surfaces on site, with additional smaller scarps visible further down slope. The two slips at Site A8 is located within two larger dormant scarps which extend further up slope.

5 Ground Model

Table 5-1 below summarises the ground model for site A8. A conceptual geological cross section and long section is presented within Appendix B.

Table 5-1: A8 Ground Model

Lithology	Top (m bgl)	Base (m bgl)	Total thickness (m)	SPT N Value	GSI
Fill	0.0	0.70 1.15	0.70 - 1.15	6-10	-
Colluvium	0.7 1.15	5.00 6.50	3.85 – 5.80	3-36	-
Completely Weathered Tangihua Complex BASALT CATACLASTIC ROCK (V-VI)	5.00 6.50	15.60 12.10	5.60-10.60	13-50+	-
Highly Weathered Tangihua Complex BASALT	12.10 15.60	17.80 27.00	5.70 11.40	13-50+	0-10
Moderately Weathered Tangihua Complex BASALT	17.80 27.00	22.50 29.00	4.70 2.00	50+	20-30
Slightly Weathered Tangihua Complex	22.50 29.00	Not proven	-	50+	50-60

Fill was encountered from surface within BH08-01 and BH08-02 inferred to be present within all four CPT's. The material in BH08-01 is described as GAP40; fine to coarse angular gravel, basalt with minor fines and sand, dense to very dense. The material within BH08-02 is described as Coarse GRAVEL, minor silt, trace clay; light grey. Dense, moist, sub-rounded basalt.

Colluvium was encountered within both BH08-01 and BH08-02 and inferred to be present within all CPT's. The material is described as organic silty CLAY, trace gravel; brownish dark grey. Soft, moist, moderately plastic; gravel, medium to coarse, subangular basalt. Deposit likely reworked Alluvium. Material thickness varies from 3.85m (BH08-01) to 5.80m (BH08-02).

Completely weathered Tangihua Complex material was encountered at 6.50mbgl to 12.10mbgl within BH08-02 and at 5.00mbgl to 15.60mbgl within BHA8-01, described as completely weathered BASALT; light brown-orange mottled white. weathered to gravelly SAND with some silt. Weakly cemented, medium dense. Material also inferred to be present within all CPT's. Material thickness varies from 5.60m (BH08-02) to 10.60m (BH08-01). CPT inferred boundaries between the Colluvium and Completely weathered bedrock are difficult to infer given the similarities in material properties. It's reasonable to expect the thicknesses of these materials to vary across the site.

Highly weathered Tangihua Complex BASALT was encountered within BH08-01 between 15.60mbgl and 27.00mbgl with a layer of varied weathering between 16.95mbgl and 18.50mbgl. Highly weathered rock was also encountered within BH08-02 between 12.10mbgl and 17.80mbgl, below which is a 200mm thick layer of completely weathered material. Highly weathered material described as light brown mottled orange BASALT. Extremely weak; closely spaced, sub-horizontal inclined, undulating smooth to rough defects; relic incipient joints. Localised area of weak material was noted at 24m within BHA8-01, with an N value of 19, this may represent deep seated movement.

Moderately Weathered Tangihua Complex BASALT material was encountered within BH08-01 between 27.00mbgl and 29.00mbgl with a layer of "fresher rock" between 25.10m to 25.50m and

27.75m to 28.5m depth. BH08-02 from 18.00mbgl to 22.50mbgl . This material is described as Moderately weathered to highly weathered light orange-brown BASALT; weak, sheared, gravel is subangular basalt. Zeolite present throughout. weathered to gravelly SAND with some silt. CPT03 refusal at 19.79mbgl respectively, inferred to be within the moderately weathered complex rock.

Slightly weathered Tangihua Complex Rock surface was encountered within BH08-02 at 22.50mbgl and 29.00m depth within BH08-01. Described as slightly weathered light blue grey DOLERITE; very strong, relict shearing with zeolite. Depth to base of strata not proven.

CPT inferred ground conditions shown on long section presented within Appendix B.

Groundwater reading at BHA8-01 on the 28th August 2022 was 2.30mbgl at start of drilling. After overnight infiltration, the groundwater reading was 11.6mbgl at start of shift. After overnight infiltration Groundwater reading at BHA8-02 on the 14th October 2022 was 12.3mbgl.

Two groundwater readings were carried out on 28th and 18th November. Results are summarised below in Table 5-2.

Table 5-2: Groundwater Monitoring Results

BH	Date	Piezo 01 depth to GW (mbgl)	Lithology	Piezo 02 depth to GW (mbgl)	Lithology
BHA8-2	28/10/2022	5.80	Colluvium	11.59	CW to HW Tangihua Complex
	18/11/2022	5.98		11.12	

5.1 Instrumentation Summary

Tilt sensors data and rainfall sensors data is presented within Appendix C, collected from 14th September 2022. Tilt sensor positions shown below on Figure 5-1.

Figure 5-1: Tilt sensor position A8

Mangamuka gorge experienced 16mm of rain at 11pm on the 29th October 2022, resulting in the following movements at MA tilt sensor:

- -1.49° MA Tilt 4 Y axis
- -071° MA Tilt 4 Axis

Mangamuka gorge experienced the following movements on the 22nd and 23rd of October at MA tilt sensor, which has been perpetuated by previous rainfall events and that leading up to it; 6.40mm/ph on 22nd of November at 7:30am.

- 0.75° MA Tilt 4 Z Axis
- -0.50° MA Tilt 4 X Axis

No further significant movement was identified to date, with trends generally displaying cyclic changes in temperature.

At completion of the borehole (BH01), inclinometer casing was installed to 29.5m depth for subsequent monitoring. Inclinometer monitoring was carried out over an initial period of three weeks between 13th September 2022 and 4th October 2022 (monitoring ongoing). Results are presented within Appendix C. A profile and B profile graphs display movement originating at 8m.

Material at failure depth within BHA8-01 is described as Colluvium consisting of Sandy SILT, trace clay; greyish dark brown with white specks. Soft to firm, moist, dilatant; sand, fine.

During the investigation, reactivation of the western slip occurred at some point between 20th September 2022 and 4th October 2022 with 17mm (A direction) and 11mm (B direction) of movement during this time. This likely coinciding with the period of prolonged rainfall between 29th September and 2nd October which saw 60mm of rain.

A further 10mm (A direction) of movement was recorded between 4th October 2022 and 27th October 2022. likely coinciding with the period of prolonged rainfall on the 14th and 17th October 2022.

Movements displayed in Appendix C consisted with the historical creep movements with the B direction movement evidenced as surface by the pavement heaving observed on the road.

6 Conclusions and Recommendations

6.1 Conclusions

The road has been constructed on top of two historical deep-seated landslides extending upslope, with site A8 movements caused by progressive saturation of the ground. Visible movement is apparent with the inclinometer at 8m depth.

Evacuation of the road at site A8 is unlikely given the historical movements and observed failure mechanics on site.

6.2 Recommendations

Based on the available geotechnical information it is recommended to top up, compact and reinstate the slump as well as improve the drainage in the area. The cost for these works is relatively low, ranging from $250k to $500k. The site is likely to continue to slump/creep following extended periods of heavy rainfall, as seen previously and during the ongoing monitoring, and will require frequent maintenance moving forward.

Further information provided within October 2022 Storm Response Options Update- Memo no.2 including discounted solutions.

7 Limitation

This report has been prepared for the benefit of NZTA only and is based on limited investigation and visual inspection only. Given the complex geological setting changes in ground condition could occur across the site that differ from those summarised within this report.

Appendix A

Borehole Logs
CPT Report

Borehole No. BH22A8-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280352 E 987494 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	30 m
Project No.:	1-11244.00	*R.L.:*	276.946 m	*Inclination:*	-90°
Location:	Slip 22A8 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016	*Azimuth:*	0°

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m)	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK WEATHERING	SAMPLE TYPE	TCR (%)	DRILLING METHOD	BASE OF HOLE & WATER LEVEL
FILL	ASPHALT									
	Coarse GRAVEL, minor silt, trace clay; light grey. Dense, moist.									
	Clayey SILT, trace gravel; orange dark brown. Recovered as very stiff, moist, plastic; gravel, fine, subrounded basalt.	276	1				HQ	105		
COLLUVIUM	SILT, minor clay, trace gravel; pinkish light brown. Very stiff, moist, moderately plastic; gravel, fine, angular basalt.		2	10	2// 1/3/3/3		SPT	100		
	Boulder of slightly weathered, bluish light grey, BASALT; extremely strong.						HQ	119		
	Clayey SILT, trace clay, trace gravel; orange dark brown. Soft to firm, moist, moderately plastic; gravel, fine, angular basalt.	274	3							
	Silty CLAY, trace gravel; brownish dark grey. Soft, moist, moderately plastic; gravel, medium to coarse, subangular basalt.		4	2	1// 0/1/0/1		SPT	67		SWL 2.30m 24/08
							HQ	102		
	Silty CLAY; orange dark brown. Firm to stiff, moist, plastic to highly plastic.	272	5	3	1// 0/1/1/1		SPT	67		
TANGIHUA COMPLEX	Silty medium to coarse SAND, trace clay; greyish dark brown with zeolite. Loose, moist, dilatant.						HQ	105	Rotary cored	
	Sandy SILT, trace clay; greyish dark brown with white specks. Soft to firm, moist, dilatant; sand, fine.		6							
	Silty medium to coarse SAND, trace clay; greyish dark brown with white specks. Loose, moist, dilatant.	270	7	2	0// 1/0/1/0		SPT	96		
							HQ	105		
	Sandy SILT, trace clay; greyish dark brown with white specks. Soft to firm, moist, dilatant; sand, fine.		8	4	0// 0/1/1/2		SPT	84		
	Boulder of slightly to moderately weathered, bluish dark grey BASALT; extremely strong.						HQ	91		
	Silty medium to coarse SAND, trace clay; greyish dark brown with white specks. Loose, moist, dilatant. 8.60-8.65m - iron oxide staining.	268	9							
	Completely weathered BASALT; Sheared, gravel is subangular basalt. Zeolite present throughout. weathered to gravelly SAND with some silt.			7	0// 1/1/1/4	CW	SPT	67		
	BASALT COBBLE; bluish dark grey. Loose, dry.									
	Completely weathered BASALT; Sheared. Recovered as Sandy SILT, trace clay; dark brown. Very soft, wet, dilatant; sand, medium,						HQ	95		

Notes:

Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	23/08/2022	*Finished:*	25/08/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig #99
Logged by:	EE	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A8-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280352 E 987494 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	276.946 m
Location:	Slip 22A8 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016

Depth: 30 m
Inclination: -90°
Azimuth: 0°

Geology: TANGIHUA COMPLEX

MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m)	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	SAMPLE TYPE	TCR (%)	RQD (%)
subrounded. Coarse BASALT GRAVEL; dark grey. Loose, wet.*(continued)*							HQ	95	
Completely weathered BASALT; light brown orange mottled white. Sheared, gravel is subangular basalt. Zeolite present throughout. weathered to gravelly SAND with some silt. Weakly cemented, medium dense.	266	11	11	2// 2/3/3/3		CW	SPT	89	
							HQ	105	
12.00-12.70m - Completely weathered BASALT becoming loose.		12	5	1// 1/1/1/2			SPT	78	
Boulder of slightly weathered, bluish grey DIORITE; extremely strong.					ES	SW			
Completely weathered BASALT; light brown orange mottled white. Sheared, gravel is subangular basalt. Zeolite present throughout. weathered to gravelly SAND with some silt. Weakly cemented, loose.	264	13				CW	HQ	102	
		14	9	5// 2/2/2/3			SPT	69	
							HQ	101	
15.00-17.00m - BASALT becoming medium dense	262	15	16	5// 4/3/4/5			SPT	100	
Highly weathered BASALT; light brown orange mottled white. Sheared, gravel is subangular basalt. Zeolite present throughout. weathered to gravelly SAND with some silt. Weakly cemented, loose. 15.70-16.21m - bands of white zeolites.		16			EW	HW	HQ	90	
			38	8// 7/6/8/17			SPT	89	
Slightly weathered, dark grey, fractured BASALT; extremely strong with random fractures	260	17			ES	SW	HQ	52	0
17.5m - 18.0m: CORELOSS (0.5m)									
Completely weathered BASALT; light brown orange mottled white. Extremely weak, sheared, gravel is subangular basalt. Zeolite present throughout. weathered to gravelly SAND with some silt.		18	17	6// 5/4/4/4		CW	SPT	80	
Highly weathered BASALT; light brown orange mottled white. Extremely weak, sheared, gravel is subangular basalt. Zeolite present throughout. weathered to gravelly SAND with some silt.	258	19			EW	HW	HQ	100	
Highly weathered light brown DOLERITE; very weak, zeolite veining.			26	3// 4/5/7/10	VW	HW	SPT	100	

Drilling method: Rotary cored

Defect dip: degrees 0 – 90

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	23/08/2022	*Finished:*	25/08/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig #99
Logged by:	EE	*Checked by:*	ML

Borehole No. BH22A8-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280352 E 987494 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	30 m
Project No.:	1-11244.00	*R.L.:*	276.946 m	*Inclination:*	-90°
Location:	Slip 22A8 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016	*Azimuth:*	0°

Geology: TANGIHUA COMPLEX

Main Description / Detail Description	R.L. (m)	Depth (m)	SPT 'N' Value	SPT Blow Counts or Shear Value	Rock Strength	Rock Weathering	Defects / Notes / Other Tests	Sample Type	TCR (%)	RQD (%)
Highly weathered light brown DOLERITE; very weak, zeolite veining.*(continued)*	256	21	50+	17// 13/13/14/15 for 75mm	VW	HW		HQ / HQ / SPT	100 / 100 / 100	
		22						HQ	95	
	254	23	50+	30// 25/23/21 for 20mm	VW	HW		SPT / HQ	100 / 100	
		24	19	6// 4/4/5/6				SPT	100	
	252	25			W	HW		HQ	95	23
Slightly weathered light blue grey BASALT; strong, zeolite veining, limonite on fracture surface.					S	SW	25.20m - J, 70°, RO, ST, iron 25.25m - J, 85°, ST 25.48m - J, 20°, RO, ST, iron			
Highly weathered light grey DOLERITE; strong, zeolite veining.		26	50+	15// 11/15/16/5 for 25mm	W	HW		SPT / HQ / SPT	88 / 100 / 100	0 / 0
Moderately weathered light brown DOLERITE; strong, zeolite veining.	250	27	50+	31// 25/25 for 45mm	S	MW		SPT	89	0
Slightly weathered light brown DOLERITE; strong, zeolite veining.		28			S	SW	27.85m - J, 70°, RO, ST, N, iron 28.05m - J, 35°, RO, ST, iron 28.19m - J, 60°, SM, UN, N, iron 28.25m - J, 45°, RO, ST, N, iron 28.30m - J, 30°, RO, ST, VN, zeolite	HQ	95	47
Moderately weathered grey mottled brown DOLERITE, strong, zeolite veining.	248	29	50+	16 for initial 20mm	S	MW	SPT:Bouncing. 28.60m - J, 85°, RO, ST, MW, zeolite iron			46
Slightly weathered light brown DOLERITE; strong, zeolite veining.					S	SW	29.25m - J, 80°, RO, ST, MN, zeolite iron 29.41m - J, 55°, SM, UN, MN, zeolite iron	HQ	100	

Drilling method: Rotary cored

END OF BOREHOLE AT 30m - Target Criteria Achieved

Notes: Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	23/08/2022	*Finished:*	25/08/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig #99
Logged by:	EE	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A8-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280352 E 987494 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	30 m
Project No.:	1-11244.00	*R.L.:*	276.946 m	*Inclination:*	-90°
Location:	Slip 22A8 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016	*Azimuth:*	0°

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m)	DEPTH (m)	GRAPHIC LOG	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING	DEFECT DIP degrees 0 90	DEFECTS / NOTES / OTHER TESTS	CORE: SAMPLE TYPE	CORE: TCR (%)	CORE: RQD (%)	DRILLING: DRILLING METHOD	DRILLING: CASING	BASE OF HOLE & WATER LEVEL	INSTALLATION DETAILS
											29.56m - CZ 29.60m - J, 30°, RO, UN, W, iron 29.80m - J, 30°, RO, UN, W, iron							
		246	31															
			32															
		244	33															
			34															
		242	35															
			36															
		240	37															
			38															
		238	39															

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	23/08/2022	*Finished:*	25/08/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig #99
Logged by:	EE	*Checked by:*	ML

Borehole No. BH22A8-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280352 E 987494 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	30 m
Project No.:	1-11244.00	*R.L.:*	276.946 m	*Inclination:*	-90°
Location:	Slip 22A8 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016	*Azimuth:*	0°

PHOTOGRAPHS

Photo BH22A8-1.1
BOX01: 0.00m - 2.70m

Photo BH22A8-1.2
BOX02: 2.70m - 5.90m

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 25/11/22

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	23/08/2022	*Finished:*	25/08/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig #99
Logged by:	EE	*Checked by:*	ML

Borehole No. BH22A8-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280352 E 987494 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	30 m
Project No.:	1-11244.00	*R.L.:*	276.946 m	*Inclination:*	-90°
Location:	Slip 22A8 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016	*Azimuth:*	0°

PHOTOGRAPHS

Photo BH22A8-1.3
BOX03: 5.90m - 8.90m

Photo BH22A8-1.4
BOX04: 8.90m - 12.0m

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 25/11/22

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	23/08/2022	*Finished:*	25/08/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig #99
Logged by:	EE	*Checked by:*	ML

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280352 E 987494 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	30 m
Project No.:	1-11244.00	*R.L.:*	276.946 m	*Inclination:*	-90°
Location:	Slip 22A8 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016	*Azimuth:*	0°

PHOTOGRAPHS

Photo BH22A8-1.5
BOX05: 12.0m - 15.0m

Photo BH22A8-1.6
BOX06: 15.0m - 18.45m

Notes:		*Started:*	23/08/2022	*Finished:*	25/08/2022
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.		*Drilling Co.:*	DFNZ	*Drilling Rig:*	Canter Rig #99
		Logged by:	EE	*Checked by:*	ML

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280352 E 987494 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	30 m
Project No.:	1-11244.00	*R.L.:*	276.946 m	*Inclination:*	-90°
Location:	Slip 22A8 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016	*Azimuth:*	0°

PHOTOGRAPHS

Photo BH22A8-1.7
BOX07: 18.45m - 21.6m

Photo BH22A8-1.8
BOX08: 21.62m - 25.2m

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	23/08/2022	*Finished:*	25/08/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig #99
Logged by:	EE	*Checked by:*	ML

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280352 E 987494 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	30 m
Project No.:	1-11244.00	*R.L.:*	276.946 m	*Inclination:*	-90°
Location:	Slip 22A8 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016	*Azimuth:*	0°

PHOTOGRAPHS

Photo BH22A8-1.9
BOX09: 25.52m - 27.6m

Photo BH22A8-1.10
BOX10: 27.9m - 30.0m

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 25/11/22

Started:	23/08/2022	*Finished:*	25/08/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig #99
Logged by:	EE	*Checked by:*	ML

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Borehole No. BH22A8-2

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280438 E 987470 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	25.5 m
Project No.:	1-11244.00	*R.L.:*	282 m	*Inclination:*	Vertical
Location:	Slip22A8 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m)	DEPTH (m)	ROCK WEATHERING
FILL	Sandy coarse GRAVEL with minor fines; Light brown grey, compacted. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse basalt.			
COLLUVIUM	Silty CLAY with trace black organics and gravels of subrounded greywacke weathered Basalt; Light orange brown mottled black and grey. Firm, moist, high plasticity.		1	
COLLUVIUM	1.95 - 2.20 m CORE LOSS	280	2	
COLLUVIUM	Silty CLAY with trace medium sand; Light orange, soft, moist, plastic. Silty CLAY with trace medium sand; Grey mottled black and white. Soft, moist, plastic.		3	
COLLUVIUM	Sandy SILT with trace black organics and angular cobble gravels of highly weathered basalt; Very soft, moist, non-plastic. Silty CLAY with trace black organics and white zeolite; light grey mottled black and white. Clasts of highly weathered basalt cobbles, soft to firm, moist, plastic. (Reworked Alluvium). 4.15-4.19m - PEAT. Black organic ring.	278	4	
COLLUVIUM			5	
COLLUVIUM	Clayey SAND; light grey, purple, blue light green. Highly weathered section in cataclastic unit. Orange limonite (iron). 5.95-6.00m - Black organics and trace chloride bluish colour. 6.00-6.45m - Lisengang rings	276	6	
TANGIHUA COMPLEX	Completely weathered light orange brown mottled yellow grey BASALT; sheared, gravel is subangular basalt. Weathered to gravelly SAND with some silt, zeolite. Completely weathered light orange brown BASALT; sheared, gravel is subangular basalt. Zeolite present throughout. Weathered to gravelly SAND with some silt, zeolite.		7	CW
TANGIHUA COMPLEX	7.50 - 7.75 m CORE LOSS			CW
TANGIHUA COMPLEX	Completely weathered light orange brown BASALT; sheared, gravel is subangular basalt. Zeolite present throughout. Weathered to gravelly SAND with some silt.	274	8	CW
TANGIHUA COMPLEX		272	9	CW

TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	CORE: SAMPLE TYPE	CORE: TCR (%)
		HQ	100
6	2// 2/2/1/2	SPT	100
		HQ	77
3	0// 0/1/1/1	SPT	100
		HQ	100
3	0// 0/1/1/1	SPT	100
		HQ	100
36	1// 4/6/9/17	SPT	100
		HQ	100
12	3// 2/3/3/4	SPT	89
		HQ	100
13	3// 2/3/3/5	SPT	100
		HQ	100

Other column headings: GRAPHIC LOG; ROCK STRENGTH; ROCK DEFECT SPACING; DEFECT DIP degrees 0 90; DEFECTS / NOTES / OTHER TESTS; RQD (%); DRILLING: DRILLING METHOD, CASING, BASE OF HOLE & WATER LEVEL; INSTALLATION DETAILS

DRILLING METHOD: HQ Size, Triple Tube, Wireline Rotary Coring

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 25/11/22

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	7/10/2022	*Finished:*	15/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig #99
Logged by:	EE	*Checked by:*	ML

Borehole No. BH22A8-2

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280438 E 987470 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	282 m
Location:	Slip22A8 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000
		Depth:	25.5 m
		Inclination:	Vertical

GEOLOGY: TANGIHUA COMPLEX

MAIN DESCRIPTION / DETAIL DESCRIPTION	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING
Completely weathered light orange brown BASALT; sheared, gravel is subangular basalt. Zeolite present throughout. Weathered to gravelly SAND with some silt.*(continued)*	26	5// 5/6/7/8		CW
12.00 - 12.10 m CORE LOSS				
Highly weathered light orange brown BASALT; sheared, gravel is subangular basalt. Zeolite present throughout. Weathered to gravelly SAND with some silt.	18	3// 3/4/5/6	VW	HW
Highly weathered light orange brown BASALT; sheared, gravel is subangular basalt. Zeolite present throughout. Weathered to gravelly SAND with some silt.	40	7// 8/9/11/12		
	47	9// 7/11/14/15		
15.44 - 15.75 m CORE LOSS (due to fallen gravel in the borehole causing washout)				
Highly weathered light orange brown mottled light yellow grey BASALT; sheared. Weathered to clayey SILT with some basalt clasts. Zeolite.				
15.95 - 16.50 m CORE LOSS (due to fallen gravel in the borehole causing wash out)				
Highly weathered light brown mottled white BASALT; sheared, gravel is subangular basalt. Zeolite present throughout. weathered to gravelly SAND with some silt.	50+	15// 12/15/20/3 for 20mm		
Completely weathered light brown mottled white BASALT; , sheared, Zeolite present throughout. weathered to gravelly SAND with some silt.				CW
Moderately weathered to highly weathered light orange brown BASALT; weak, sheared Zeolite present throughout.	47	13// 11/13/11/12	W	HW / MW
	50+	16// 15/16/20 for 75mm		

R.L. (m): 270 (12 m), 268 (14 m), 266 (16 m), 264 (18 m), 262 (20 m). DEPTH (m): 11, 12, 13, 14, 15, 16, 17, 18, 19.

SAMPLE TYPE	TCR (%)
HQ	100
SPT	100
HQ	100
SPT	78
HQ	100
SPT	100
HQ	100
SPT	83
HQ	15
SPT	83
HQ	100
SPT	89
HQ	100
SPT	80

DRILLING METHOD: HQ Size, Triple Tube, Wireline Rotary Coring

BASE OF HOLE & WATER LEVEL: SWL 2.30m 13/10

Column headings: GEOLOGY; MAIN DESCRIPTION / DETAIL DESCRIPTION; R.L. (m); DEPTH (m); GRAPHIC LOG; TESTS: SPT 'N' VALUE, SPT BLOW COUNTS OR SHEAR VALUE; ROCK STRENGTH; ROCK WEATHERING; ROCK DEFECT SPACING; DEFECT DIP degrees 0 90; DEFECTS / NOTES / OTHER TESTS; CORE: SAMPLE TYPE, TCR (%), RQD (%); DRILLING: DRILLING METHOD, CASING, BASE OF HOLE & WATER LEVEL; INSTALLATION DETAILS

Notes:

Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	7/10/2022	*Finished:*	15/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig #99
Logged by:	EE	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A8-2

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280438 E 987470 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	282 m
Location:	Slip22A8 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000

Depth: 25.5 m
Inclination: Vertical

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m)	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD	BASE OF HOLE & WATER LEVEL
TANGIHUA COMPLEX	Moderately weathered to highly weathered light orange brown BASALT; weak, sheared Zeolite present throughout.*(continued)*									HQ	100		HQ Size, Triple Tube, Wireline Rotary Coring	SWL 12.30m 14/10
	Moderately weathered to highly weathered light to dark orange brown mottled white BASALT; weak, sheared, gravel is subangular basalt. Zeolite present throughout.	261	21	50+	35// 25/25 for 50mm	W	HW	MW		HQ	100			
										SPT	100			
		260	22							HQ	100			
	Slightly weathered light blue grey DOLERITE; very strong, relict shearing with zeolite.	259	23			VS	SW	MW	SPT:Bouncing - stopped SPT test. 22.65m - J, 35°, SL, ST, N, iron 22.85m - J, 30°, SL, ST, N, iron 22.97m - J, 87°, SL, UN, MN, iron 23.08m - J, 50°, RO, ST, VN, iron 23.45m - J, 55°, RO, ST, N, iron 23.55m - DD 23.65m - J, 48°, RO, ST, VN, iron 24.00m - DD 24.20m - DD 24.35m - J, 32°, RO, ST, N, iron 24.43m - J, 15°, RO, ST, N, iron 24.50m - J, 10°, RO, ST, N, iron 24.60m - J, 60°, RO, ST, W 24.80m - J, 1°, RO, ST, VN, carbonate coated 24.90m - J, 50°, RO, ST, VW, iron 24.97m - J, 53°, RO, ST, N, iron 25.27m - J, 8°, RO, UN, VN, iron 25.30m - J, 15°, SL, ST, VN, iron 25.38m - J, 33°, RO, ST, VN, iron 25.43m - J, 20°, RO, ST	HQ	89	71		
		258	24											
		257	25							HQ	100	41		
	END OF BOREHOLE AT 25.5m - Target Criteria Achieved	256	26											
		255	27											
		254	28											
		253	29											
		252												

Defect dip (degrees 0–90) plotted: J35, J30, J87, J50, J55, J48, J32, J15, J10, J60, J1, J50, J53, J8, J15, J20, J33

GRAPHIC LOG | TESTS | DEFECT DIP | CORE | DRILLING | CASING | INSTALLATION DETAILS

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 25/11/22

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	7/10/2022	*Finished:*	15/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig #99
Logged by:	EE	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A8-2

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280438 E 987470 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	25.5 m
Project No.:	1-11244.00	*R.L.:*	282 m	*Inclination:*	Vertical
Location:	Slip22A8 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A8-2.1
BOX 01 - 0.00 - 4.15m

Photo BH22A8-2.2
BOX 02 - 4.15 - 7.35m

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	7/10/2022	*Finished:*	15/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig #99
Logged by:	EE	*Checked by:*	ML

Project: Waka Kotahi Northland Emergency Resilience
Client: Waka Kotahi
Project No.: 1-11244.00
Location: Slip22A8
Mangamuka Range

Coordinates: 280438 E 987470 N
Ref. Grid: NZTM
R.L.: 282 m
Datum: NZ Geodetic Datum 2000
Depth: 25.5 m
Inclination: Vertical

PHOTOGRAPHS

Photo BH22A8-2.3
BOX 03 - 7.35 - 10.75m

Photo BH22A8-2.4
BOX 04 - 10.75 - 13.95m

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started: 7/10/2022
Drilling Co.: DFNZ
Logged by: EE
Finished: 15/10/2022
Drilling Rig: Canter Rig #99
Checked by: ML

Borehole No. BH22A8-2

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280438 E 987470 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	25.5 m
Project No.:	1-11244.00	*R.L.:*	282 m	*Inclination:*	Vertical
Location:	Slip22A8 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A8-2.5
BOX 05 -13.15 - 17.7m

Photo BH22A8-2.6
BOX 06 - 17.7 - 20.5m

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	7/10/2022	*Finished:*	15/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig #99
Logged by:	EE	*Checked by:*	ML

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280438 E 987470 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	25.5 m
Project No.:	1-11244.00	*R.L.:*	282 m	*Inclination:*	Vertical
Location:	Slip22A8 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A8-2.7
BOX 07 - 20.5 - 23.15m

Photo BH22A8-2.8
BOX 08 - 23.15 - 25.5m

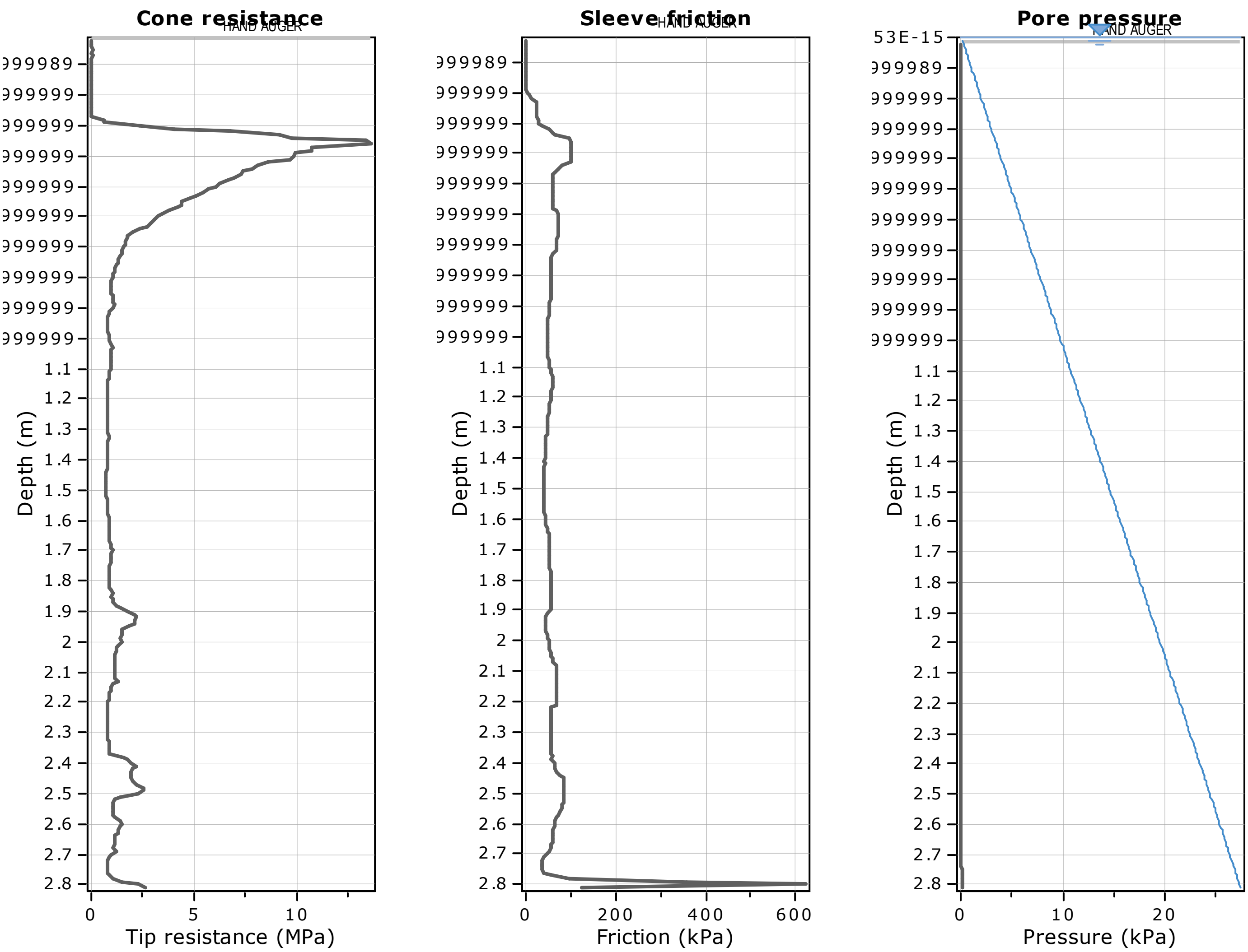
Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	7/10/2022	*Finished:*	15/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig #99
Logged by:	EE	*Checked by:*	ML

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

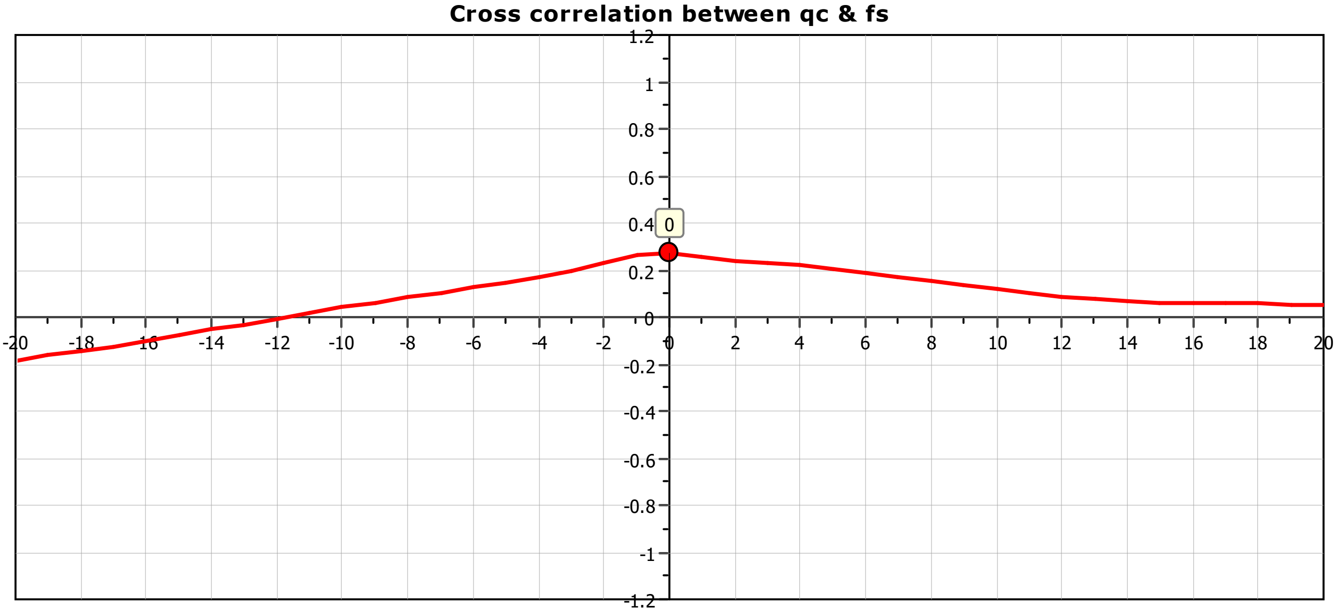
CPT: A8-CPT01
Total depth: 2.81 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

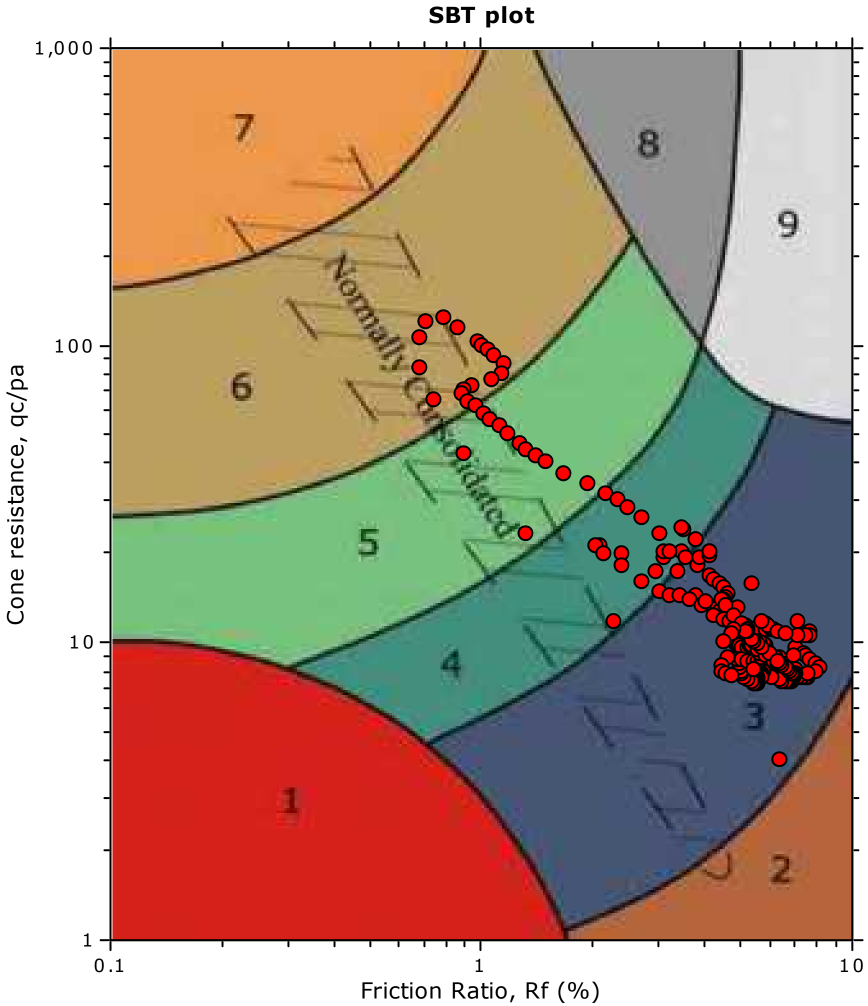


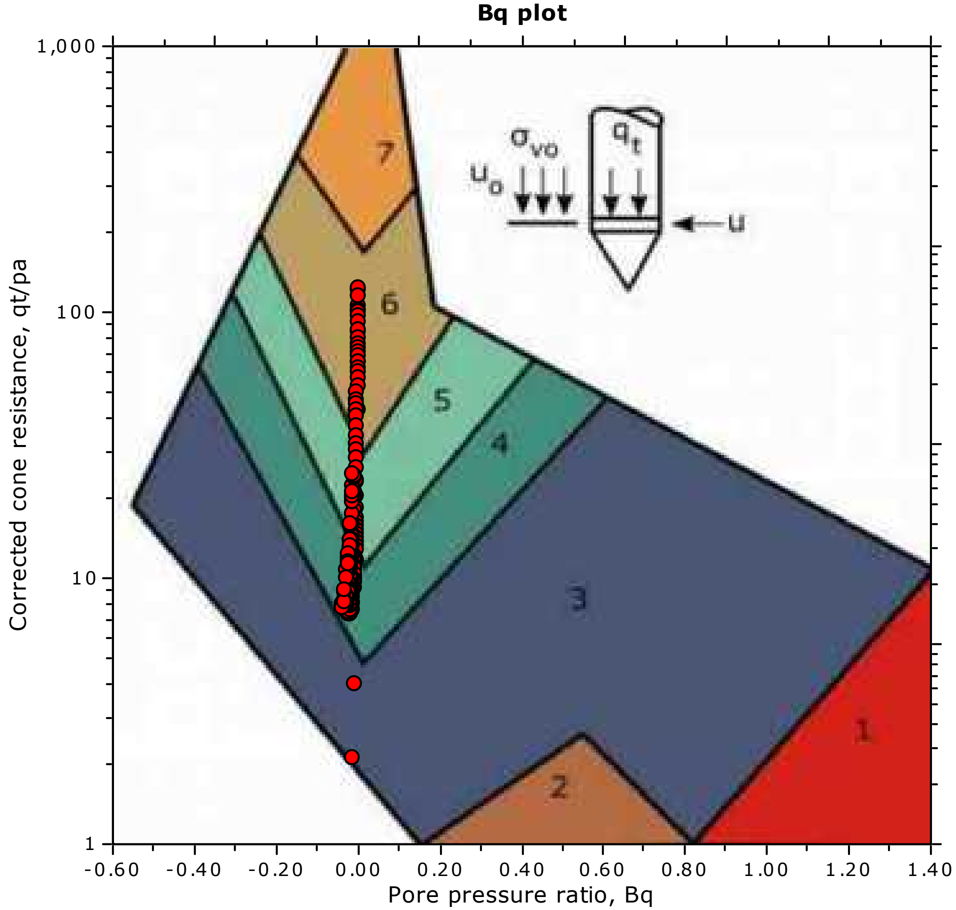
The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

Cross correlation between qc & fs



SBT - Bq plots

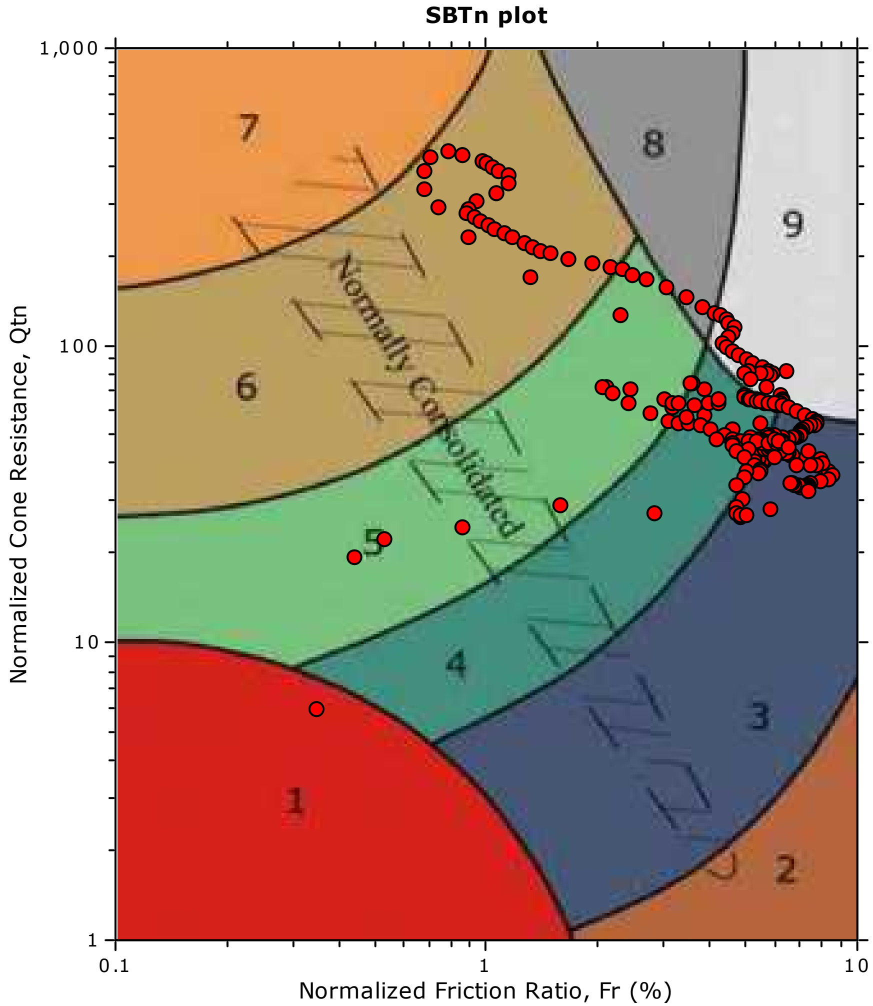


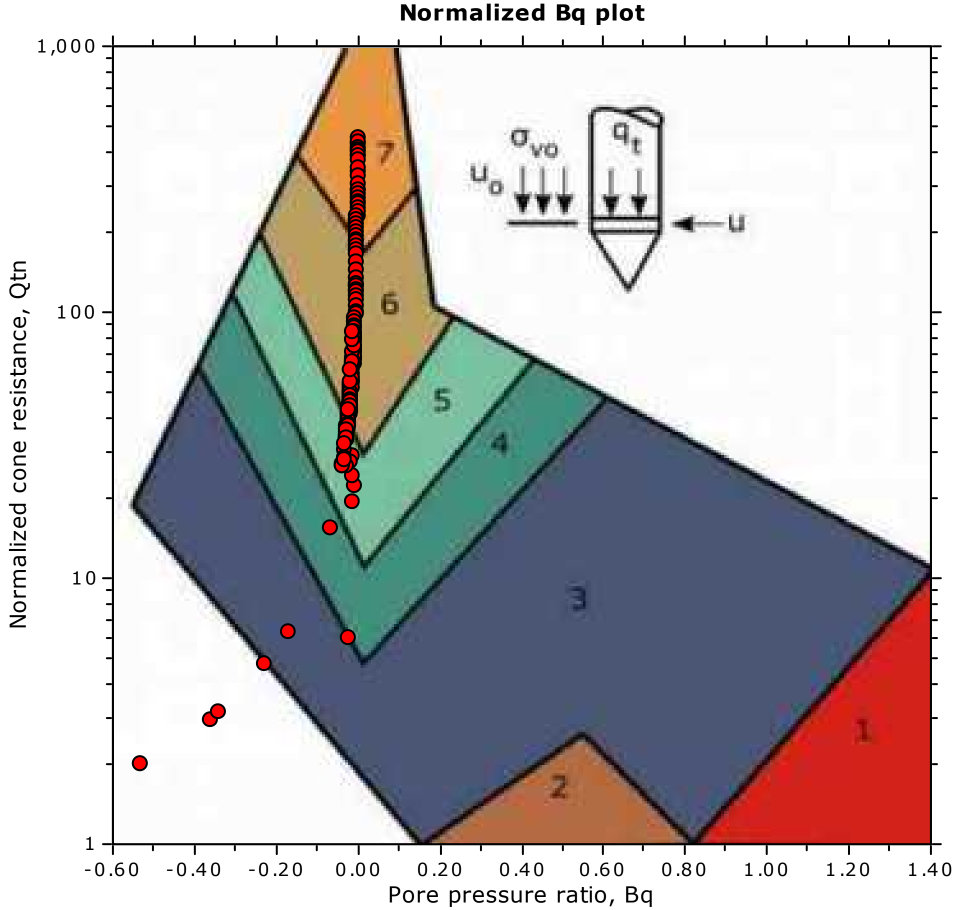


SBT legend

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

SBT - Bq plots (normalized)





SBTn legend

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

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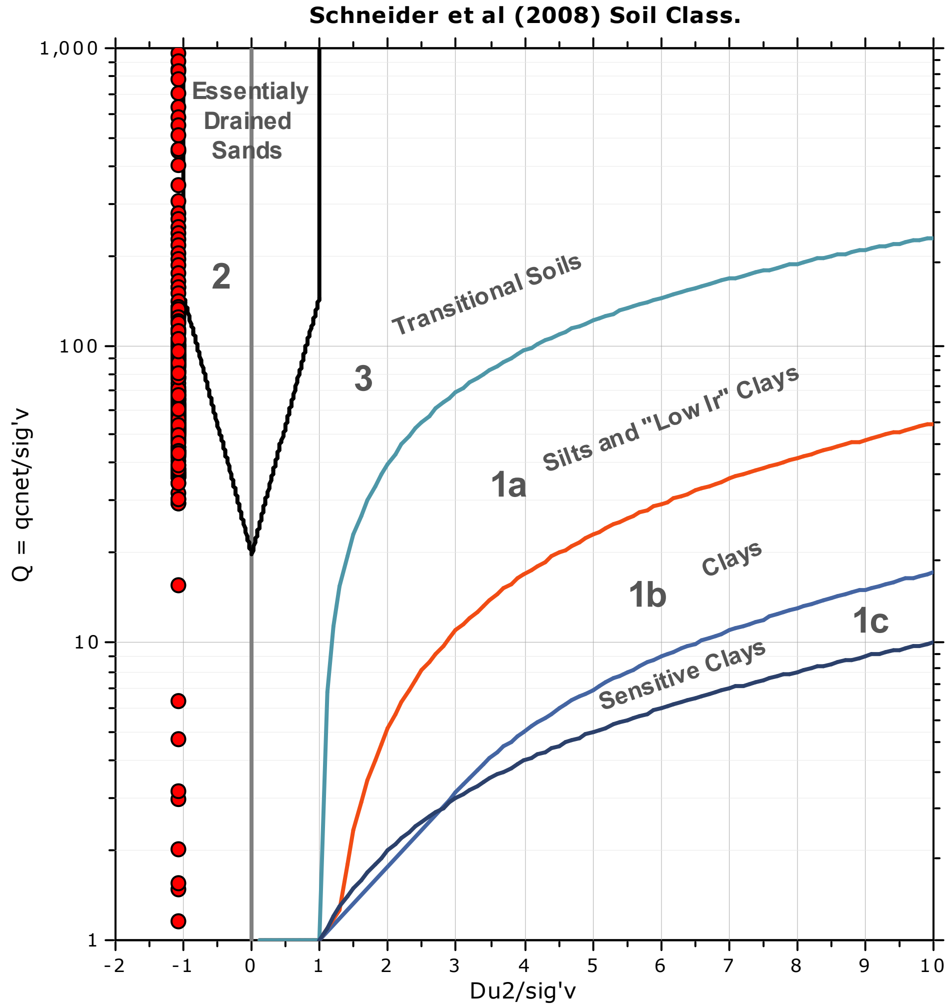
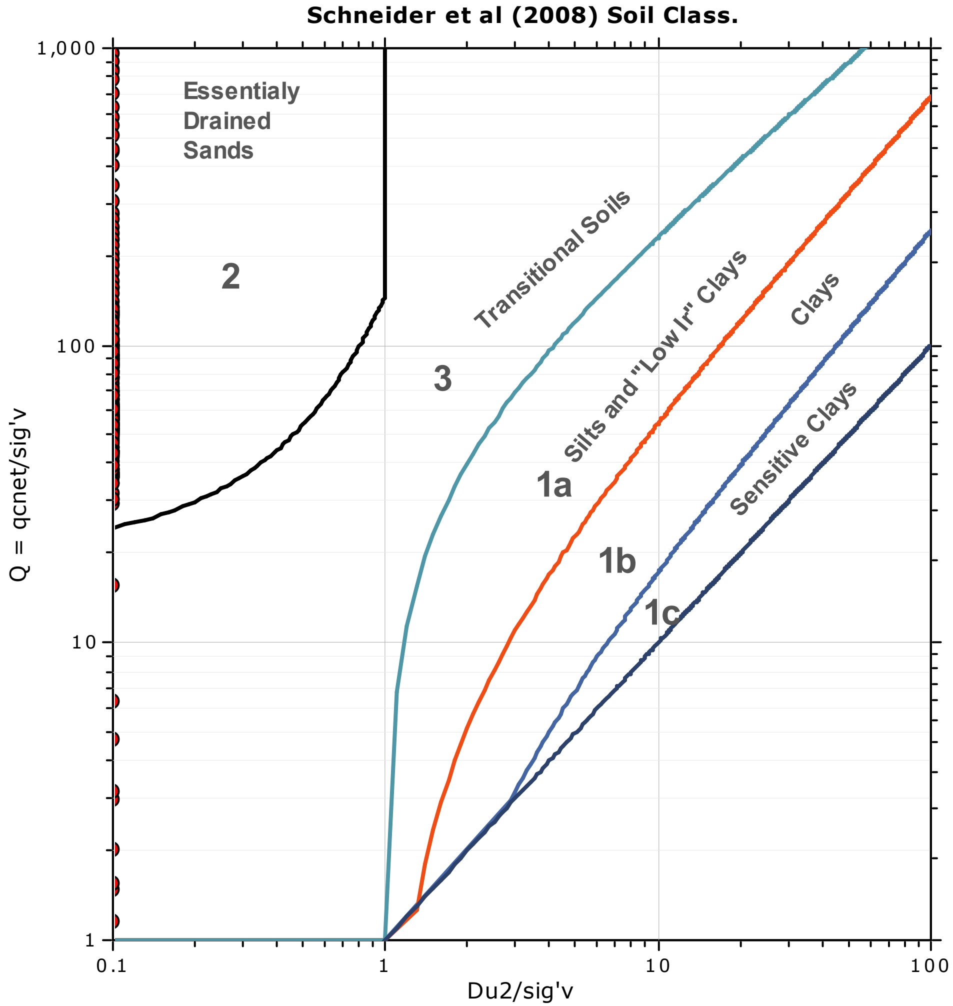
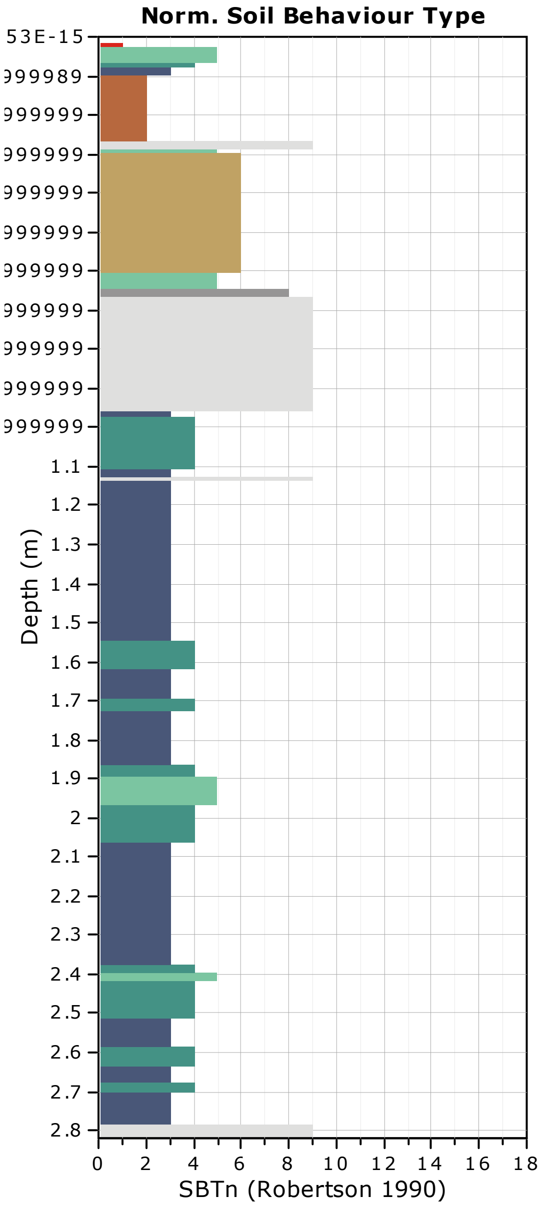
CPT: A8-CPT01
Total depth: 2.81 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

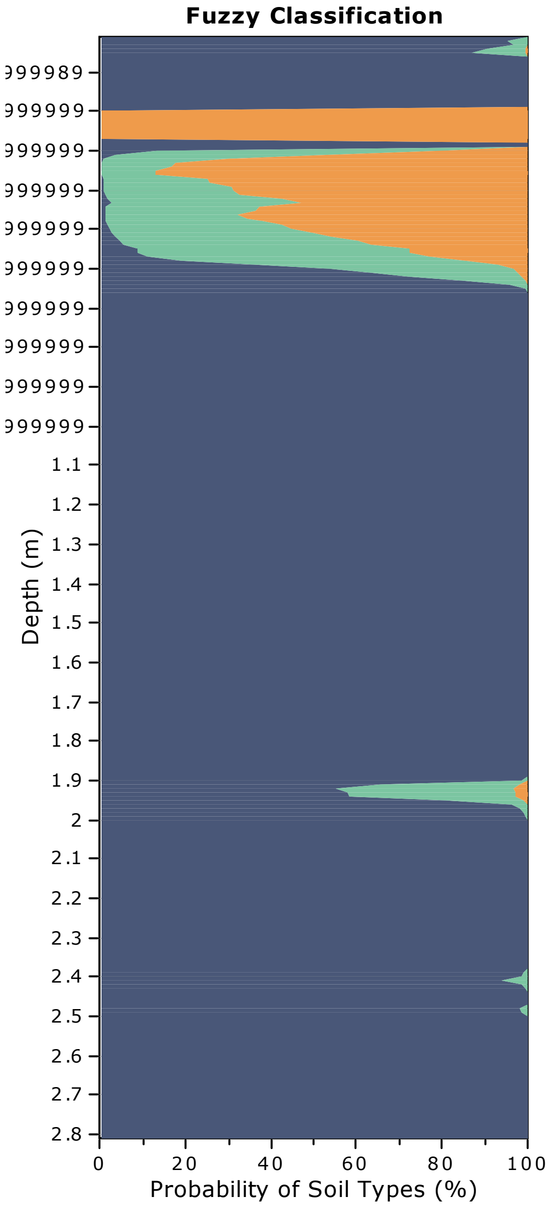
Project:
Location:

Bq plots (Schneider)






Norm. Soil Behaviour Type
Depth (m)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
Probability of Soil Types (%)

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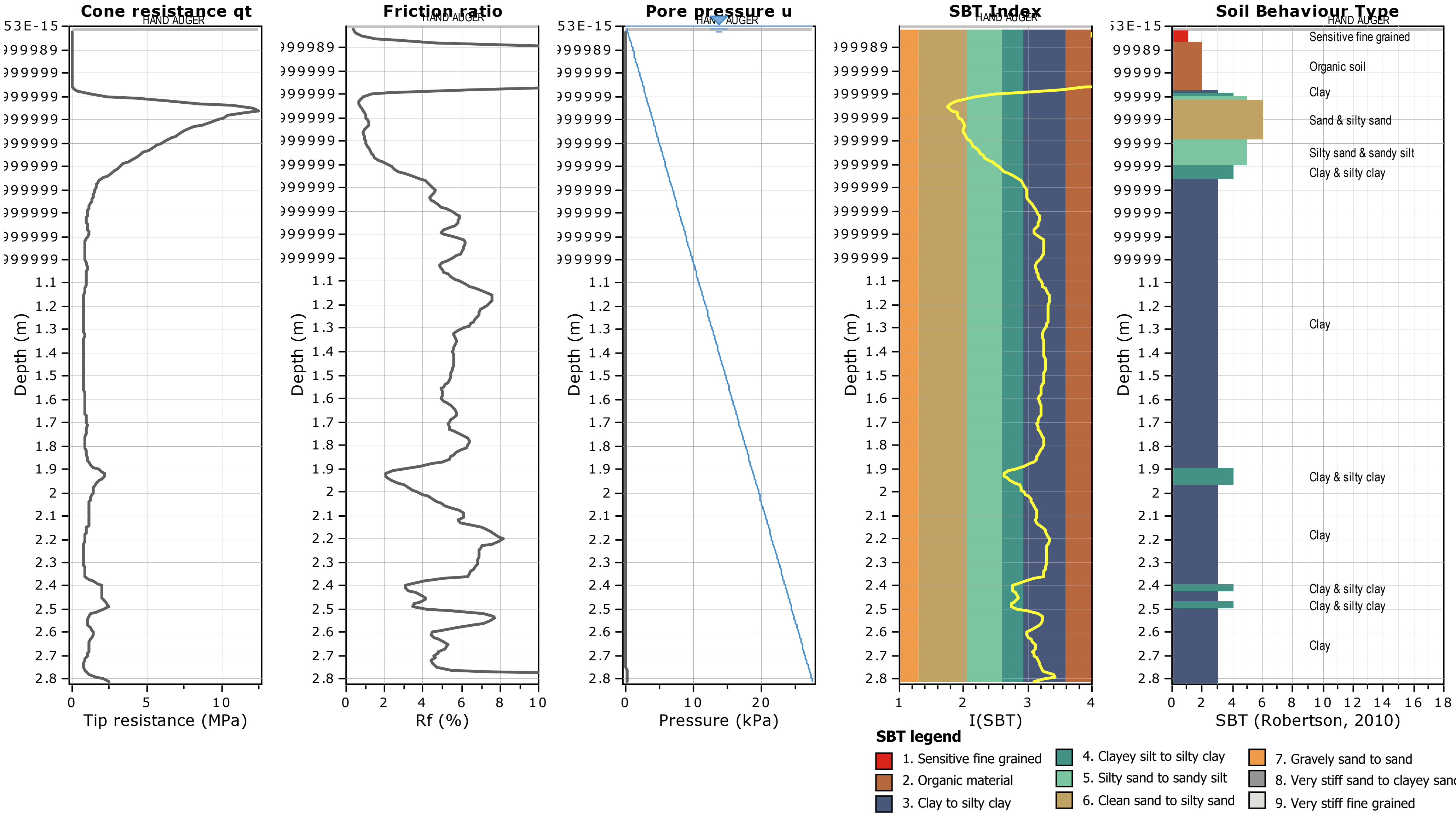
CPT: A8-CPT01
Total depth: 2.81 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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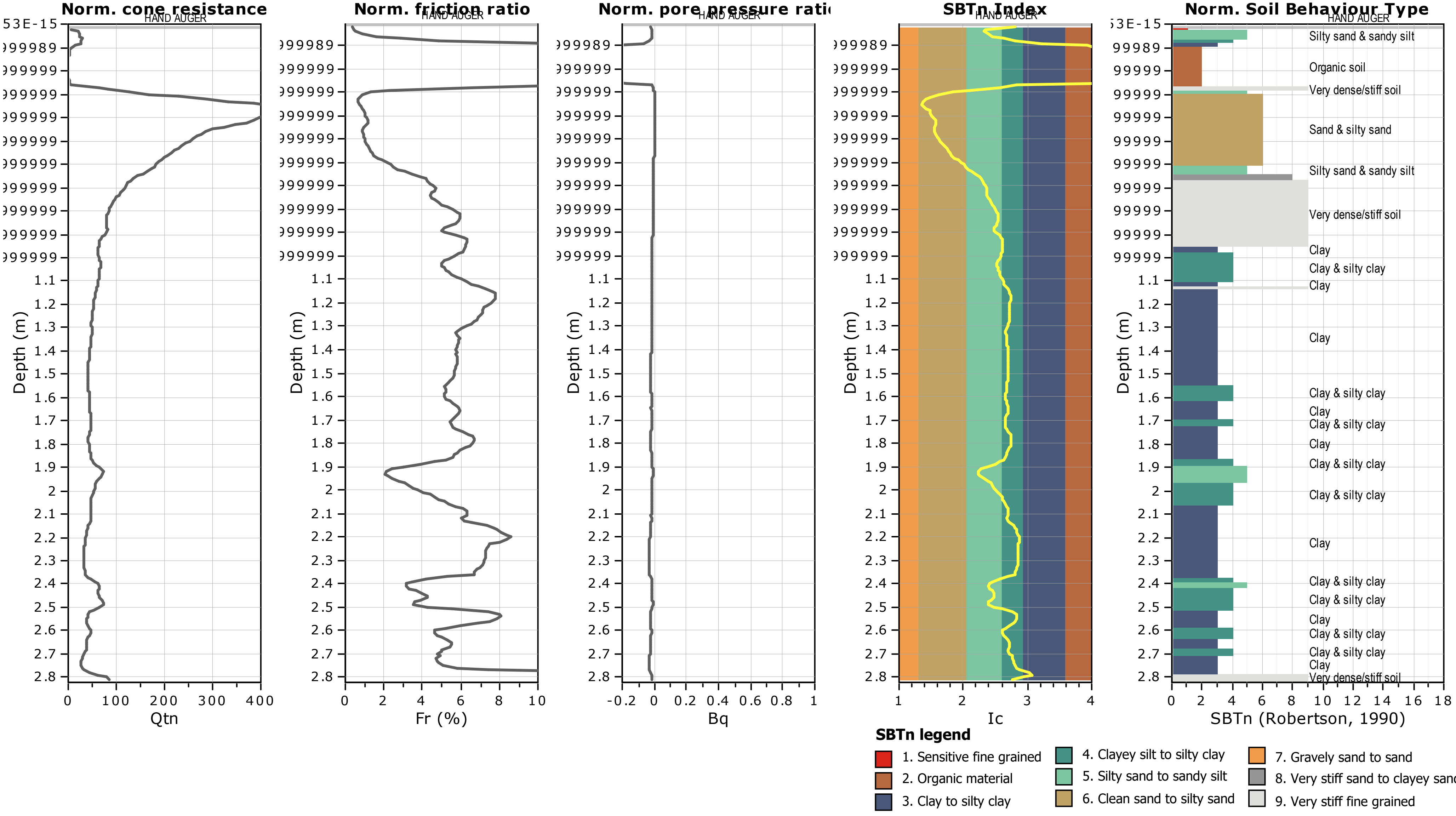
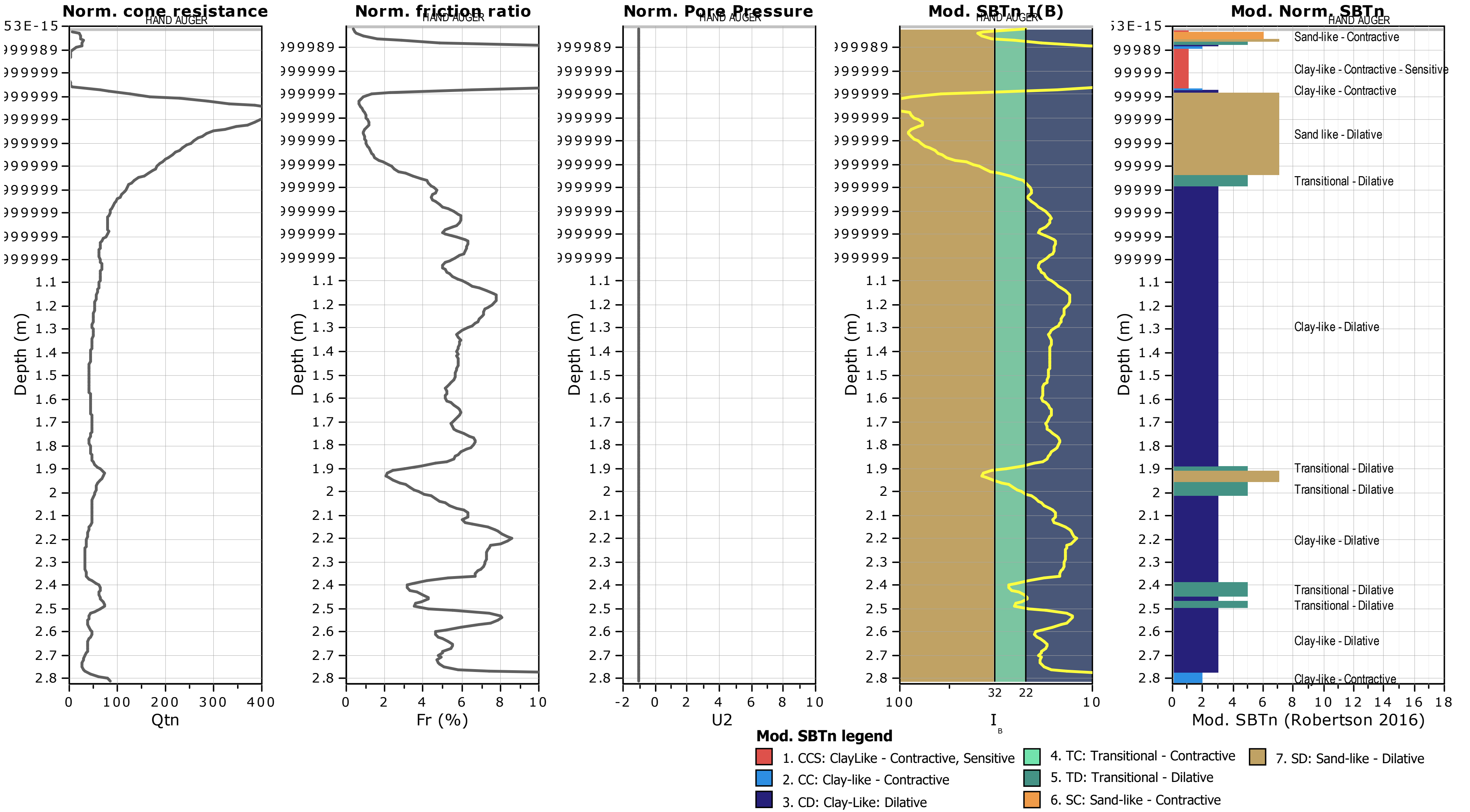
CPT: A8-CPT01
Total depth: 2.81 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

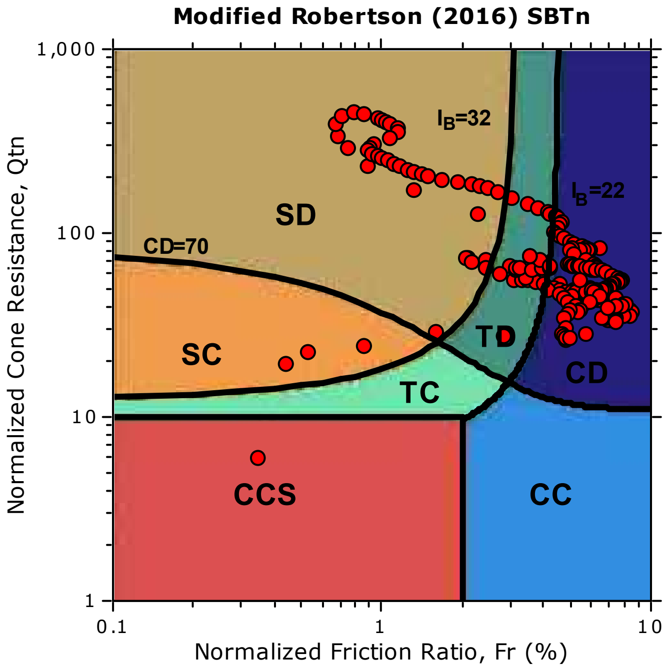


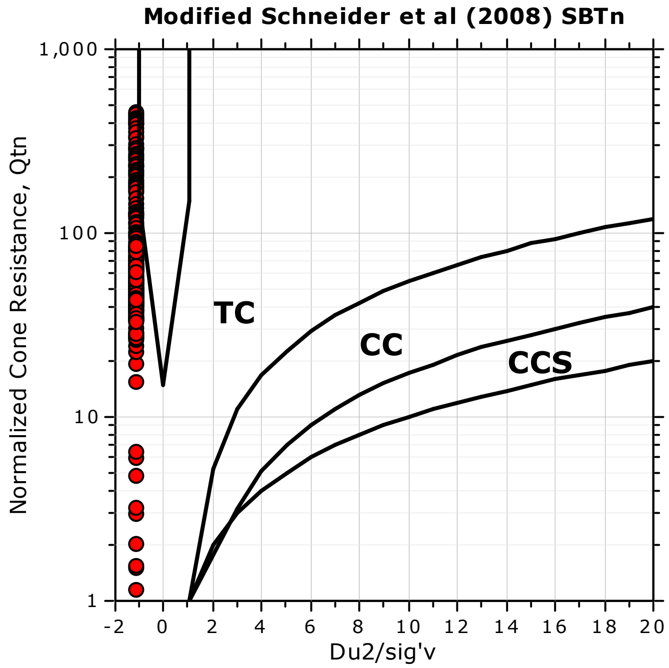
CPT: A8-CPT01
Total depth: 2.81 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

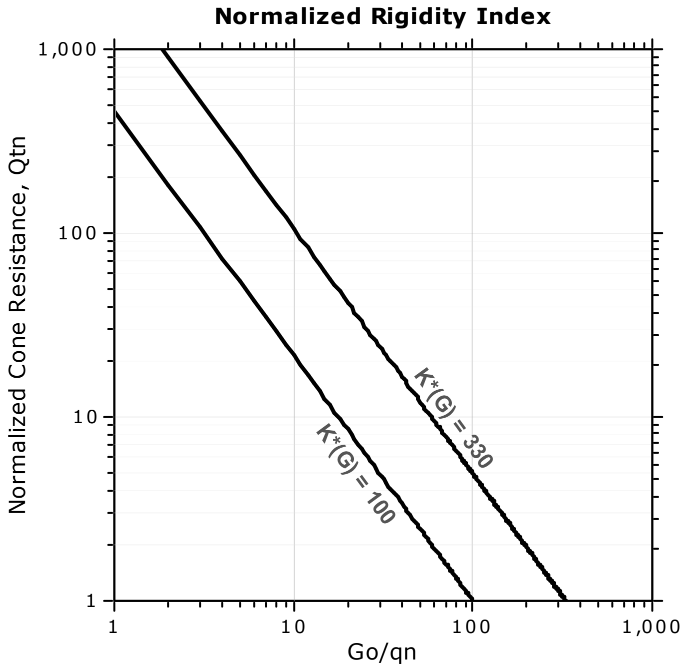
Project:
Location:



Updated SBTn plots







CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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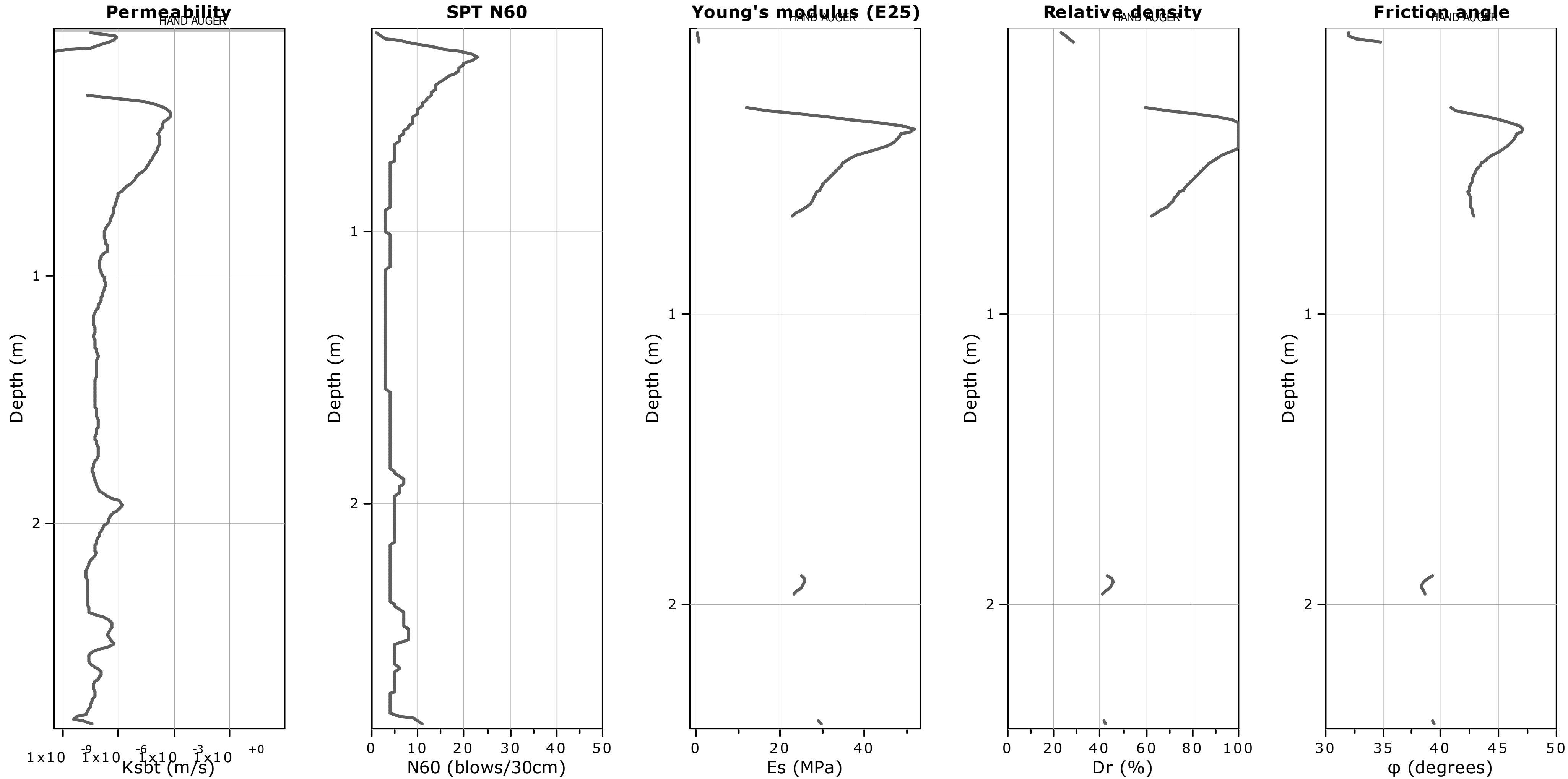
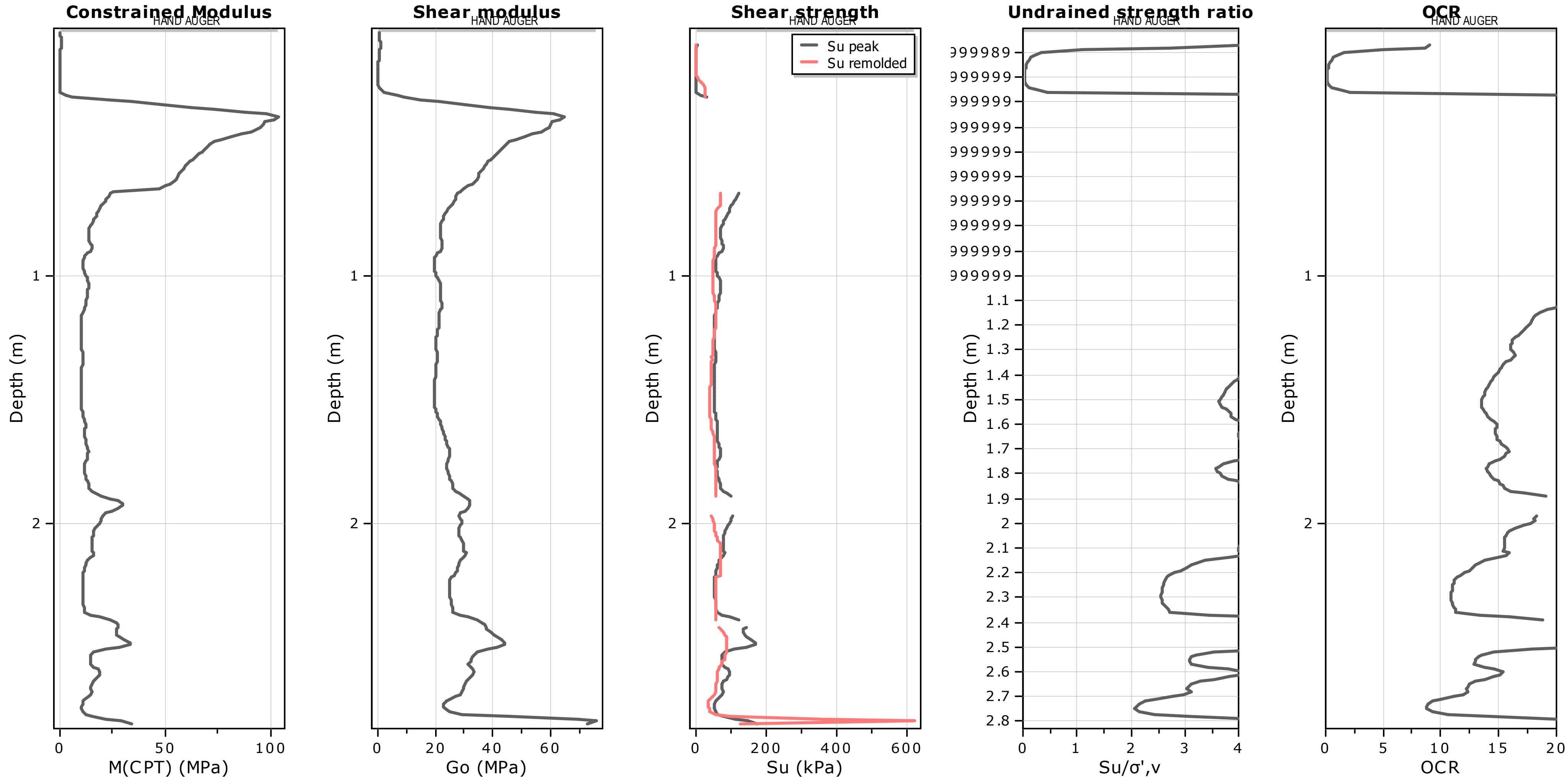
CPT: A8-CPT01
Total depth: 2.81 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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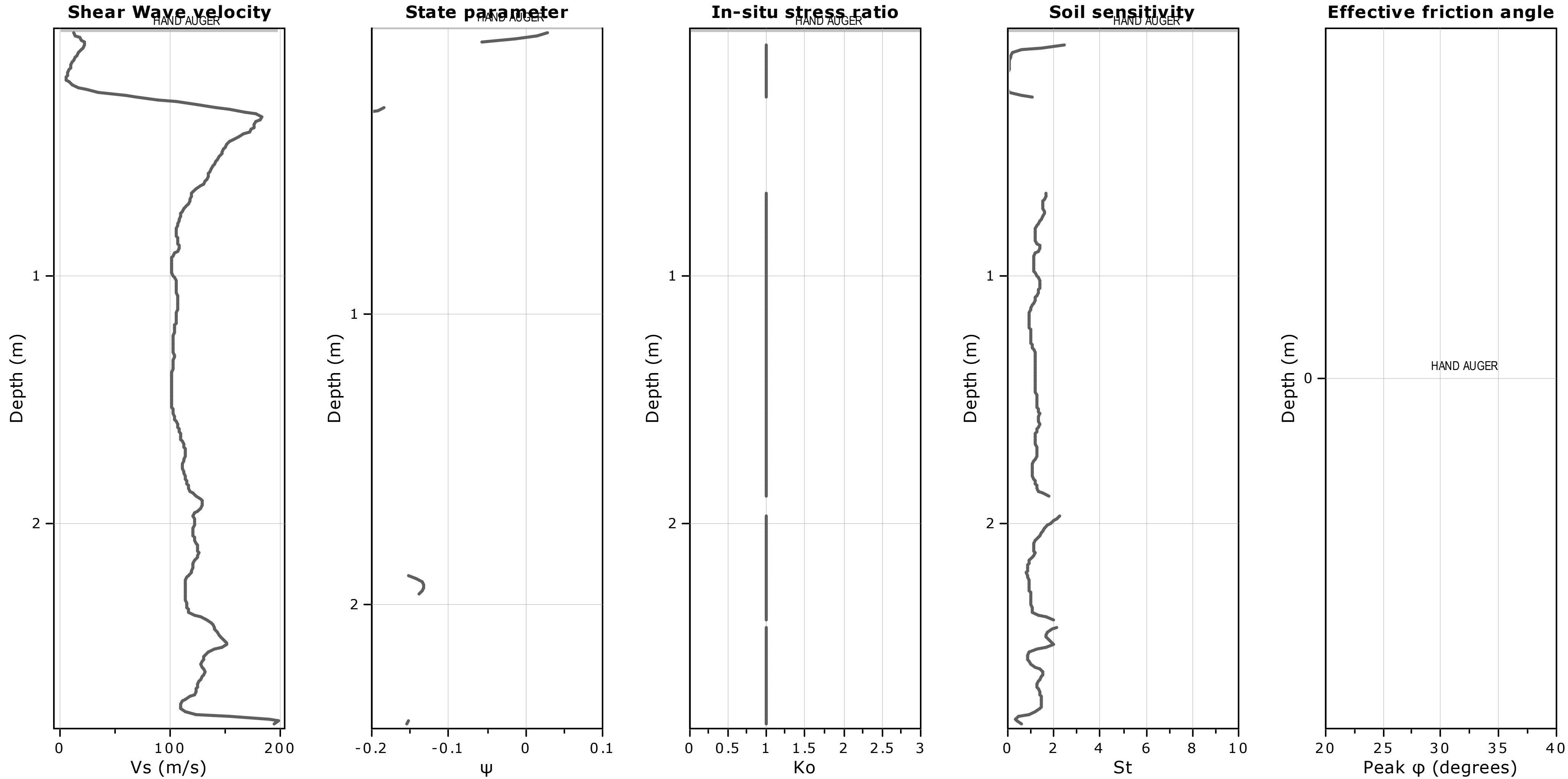
CPT: A8-CPT01
Total depth: 2.81 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

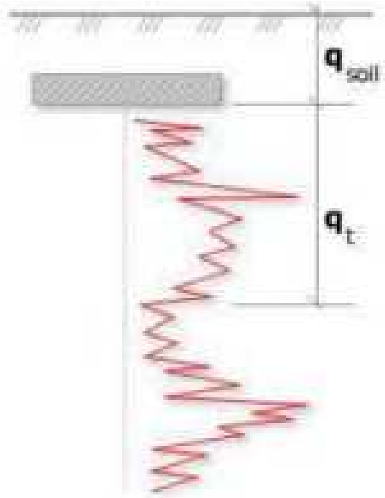
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

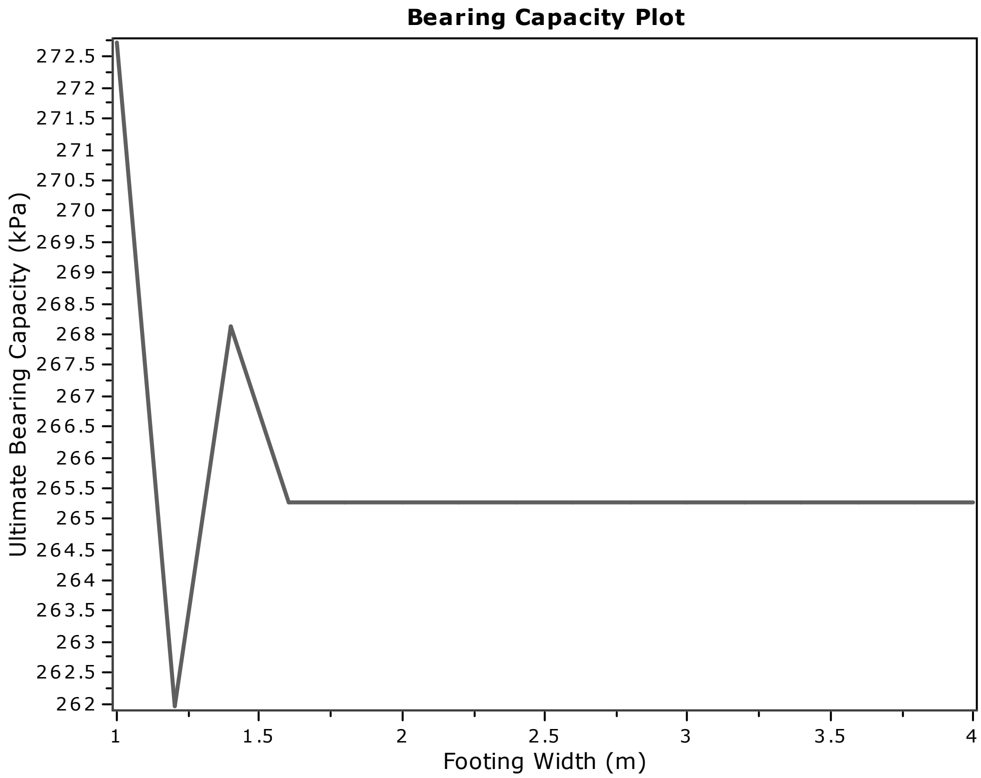
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

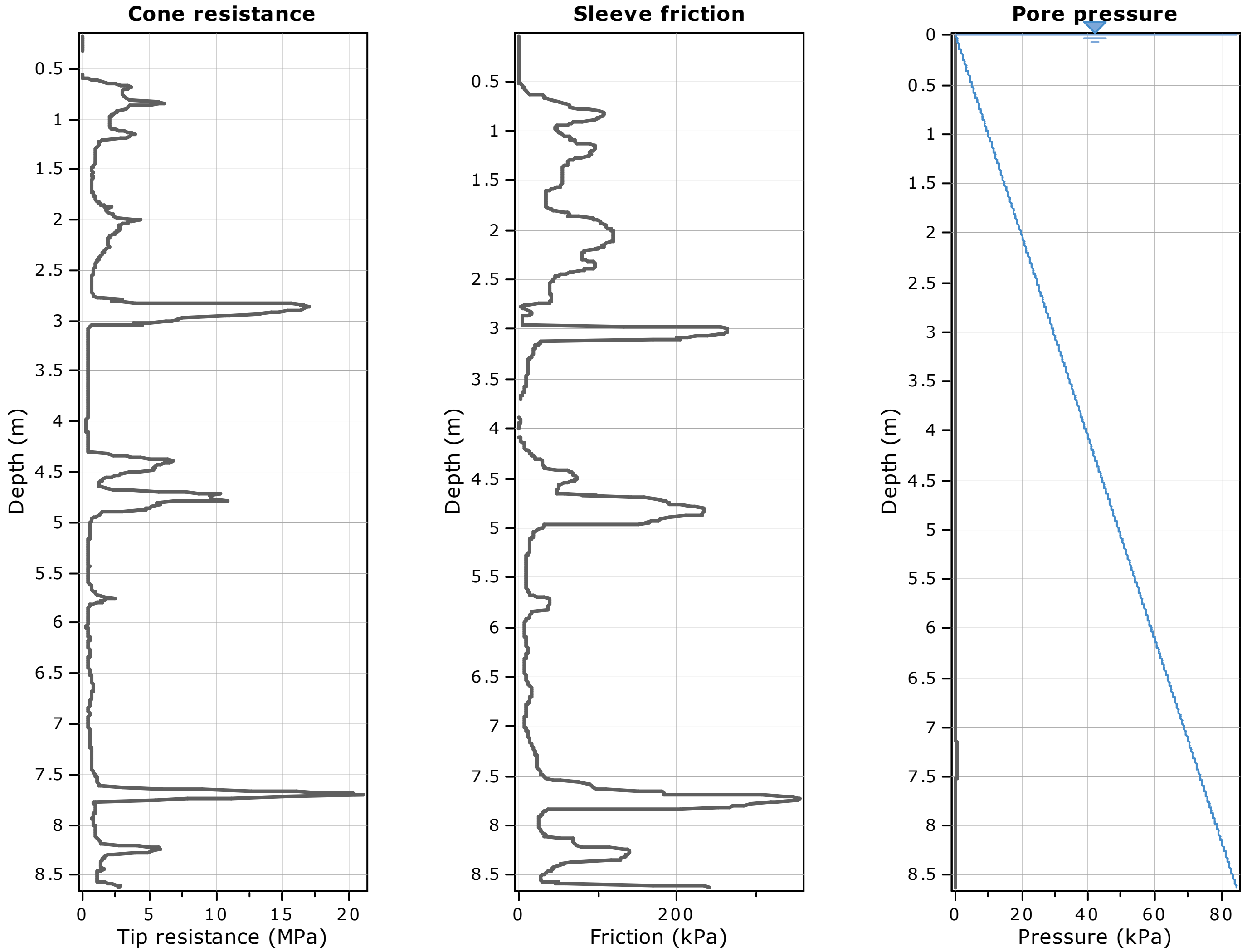
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

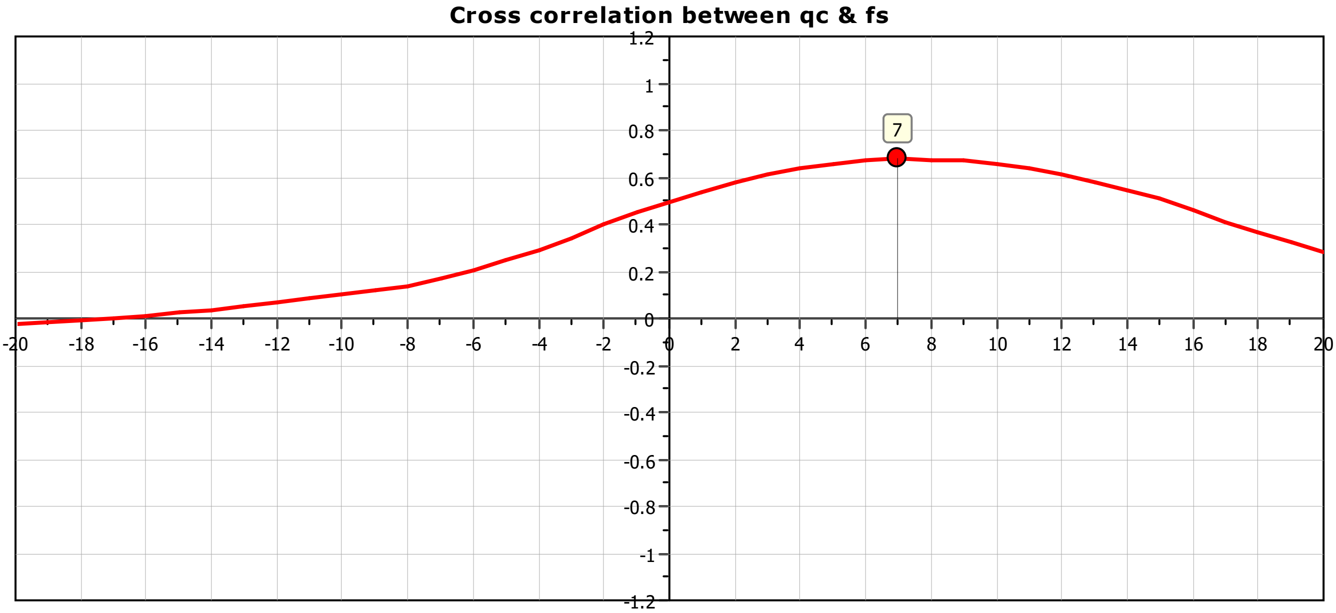


:: Tabular results ::

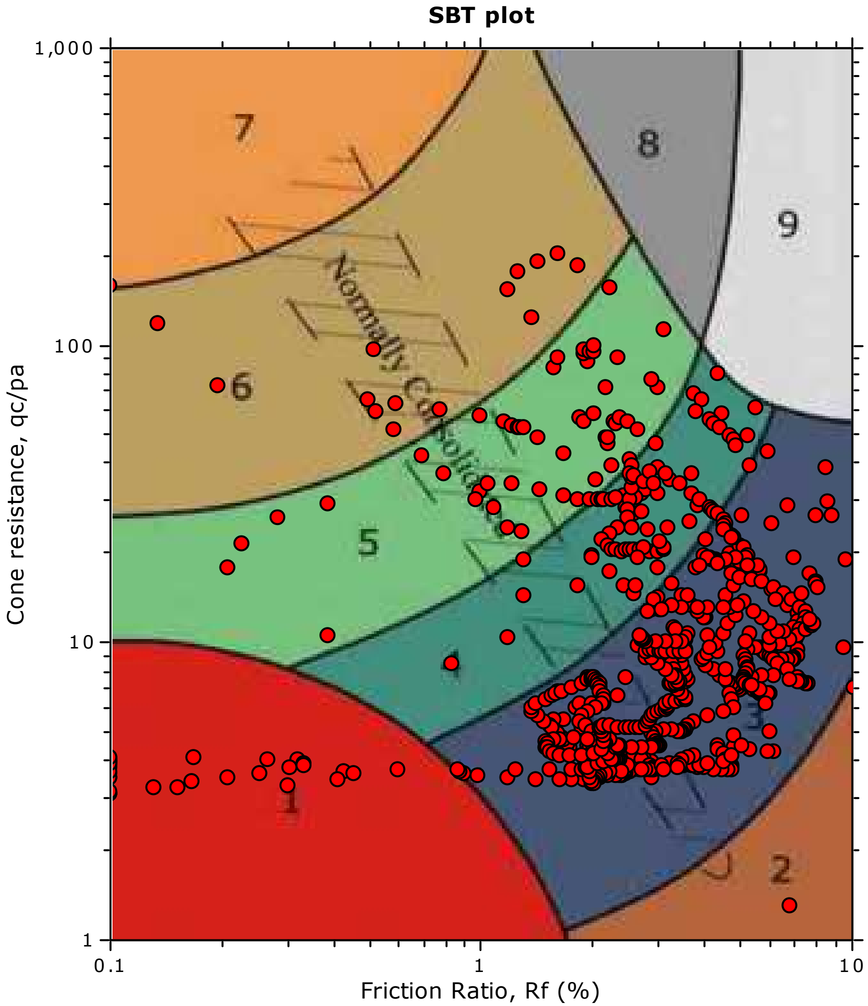
No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.32	0.20	9.50	272.74
2	1.20	0.50	2.30	1.26	0.20	9.50	261.96
3	1.40	0.50	2.60	1.29	0.20	9.50	268.11
4	1.60	0.50	2.90	1.28	0.20	9.50	265.27
5	1.80	0.50	3.20	1.28	0.20	9.50	265.27
6	2.00	0.50	3.50	1.28	0.20	9.50	265.27
7	2.20	0.50	3.80	1.28	0.20	9.50	265.27
8	2.40	0.50	4.10	1.28	0.20	9.50	265.27
9	2.60	0.50	4.40	1.28	0.20	9.50	265.27
10	2.80	0.50	4.70	1.28	0.20	9.50	265.27
11	3.00	0.50	5.00	1.28	0.20	9.50	265.27
12	3.20	0.50	5.30	1.28	0.20	9.50	265.27
13	3.40	0.50	5.60	1.28	0.20	9.50	265.27
14	3.60	0.50	5.90	1.28	0.20	9.50	265.27
15	3.80	0.50	6.20	1.28	0.20	9.50	265.27
16	4.00	0.50	6.50	1.28	0.20	9.50	265.27

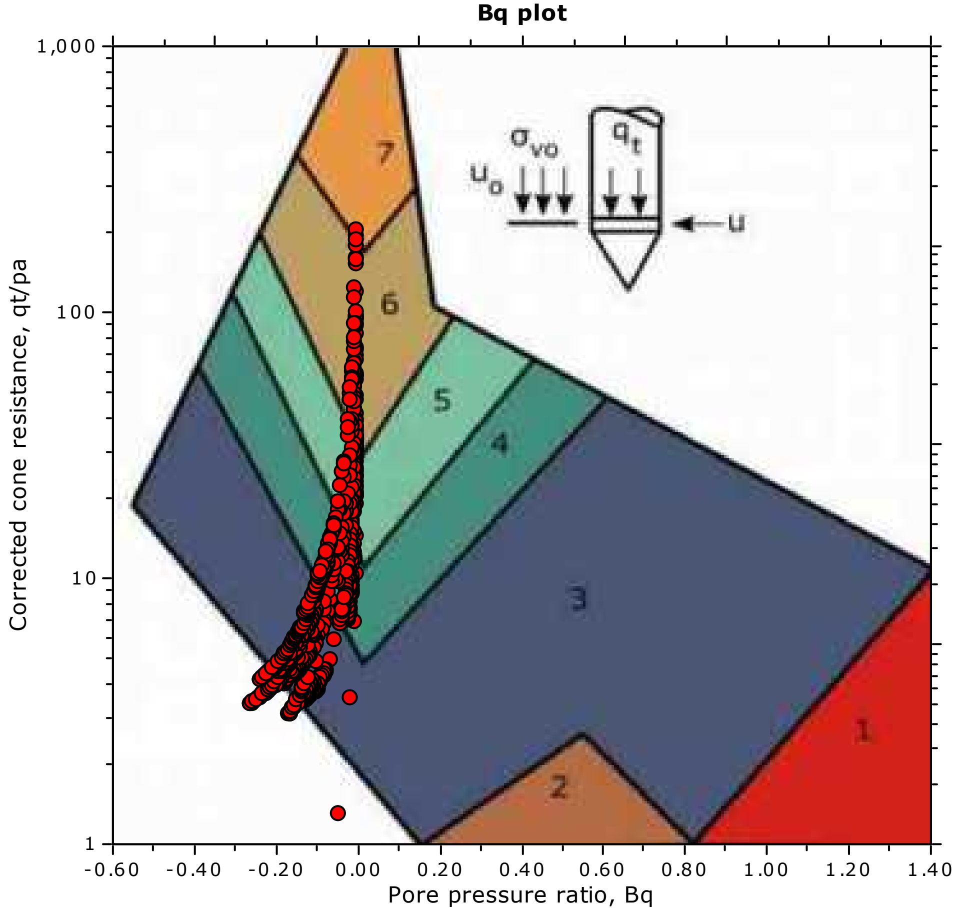


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots





SBT legend

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

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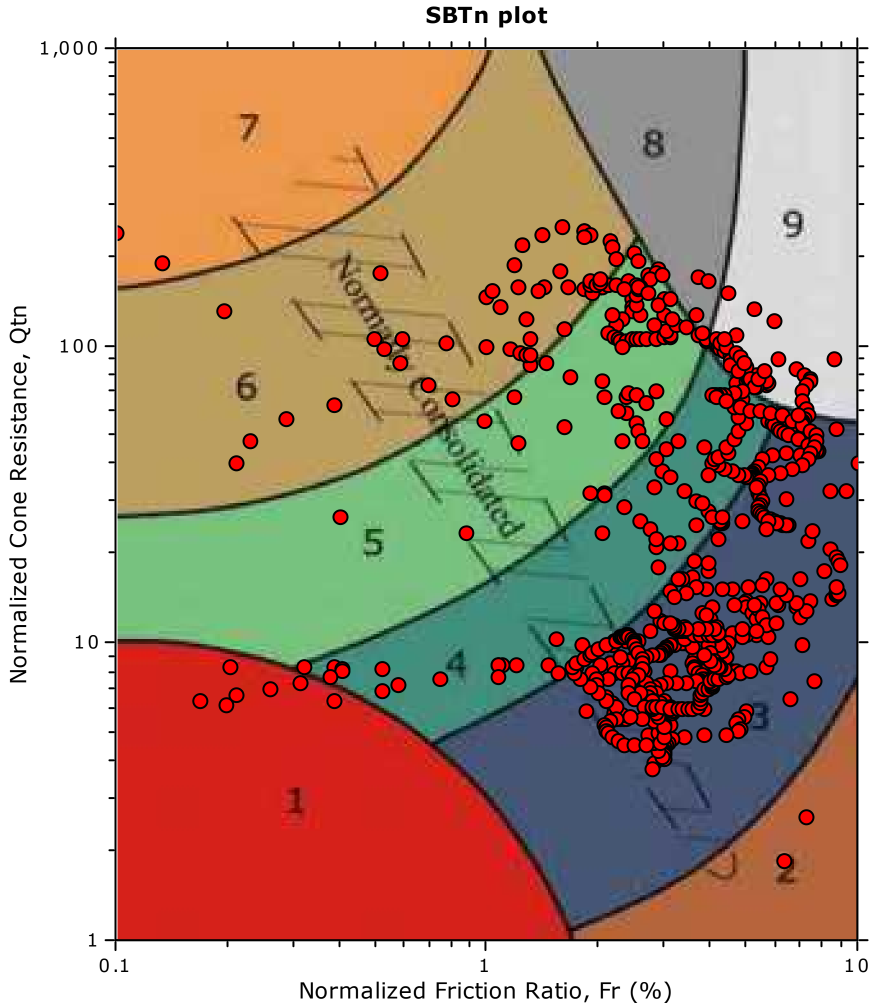
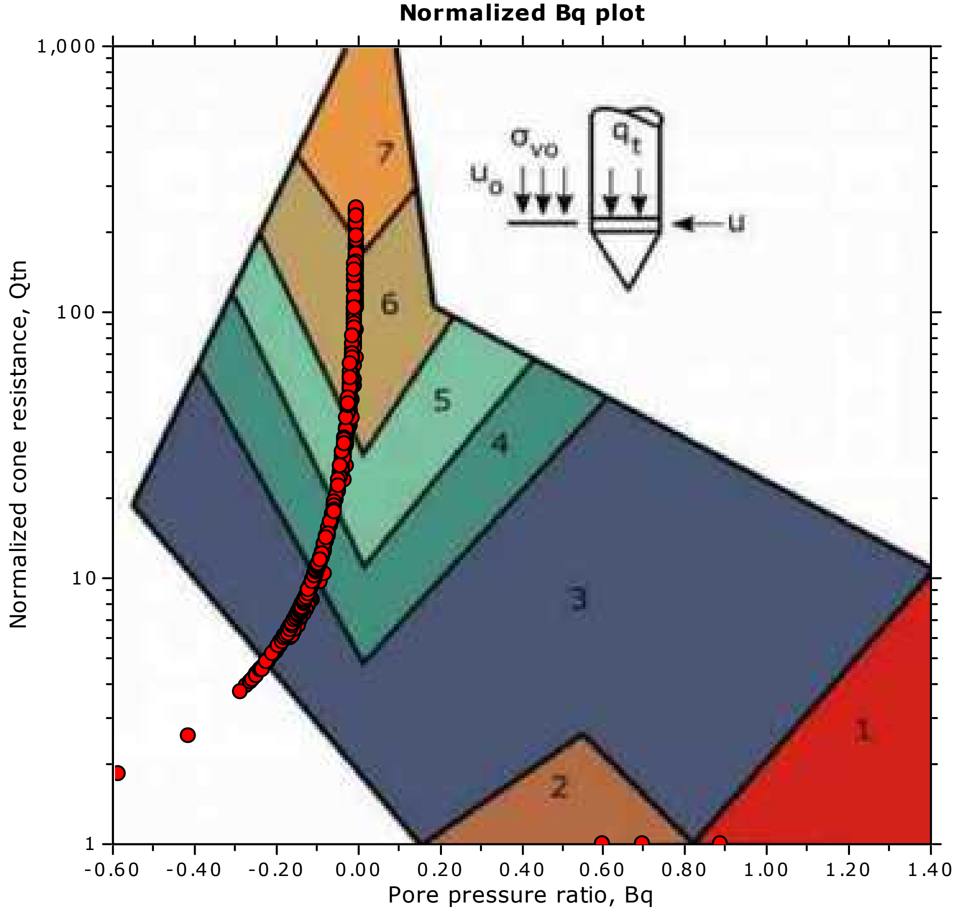
CPT: A8-CPT01A
Total depth: 8.62 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

SBT - Bq plots (normalized)

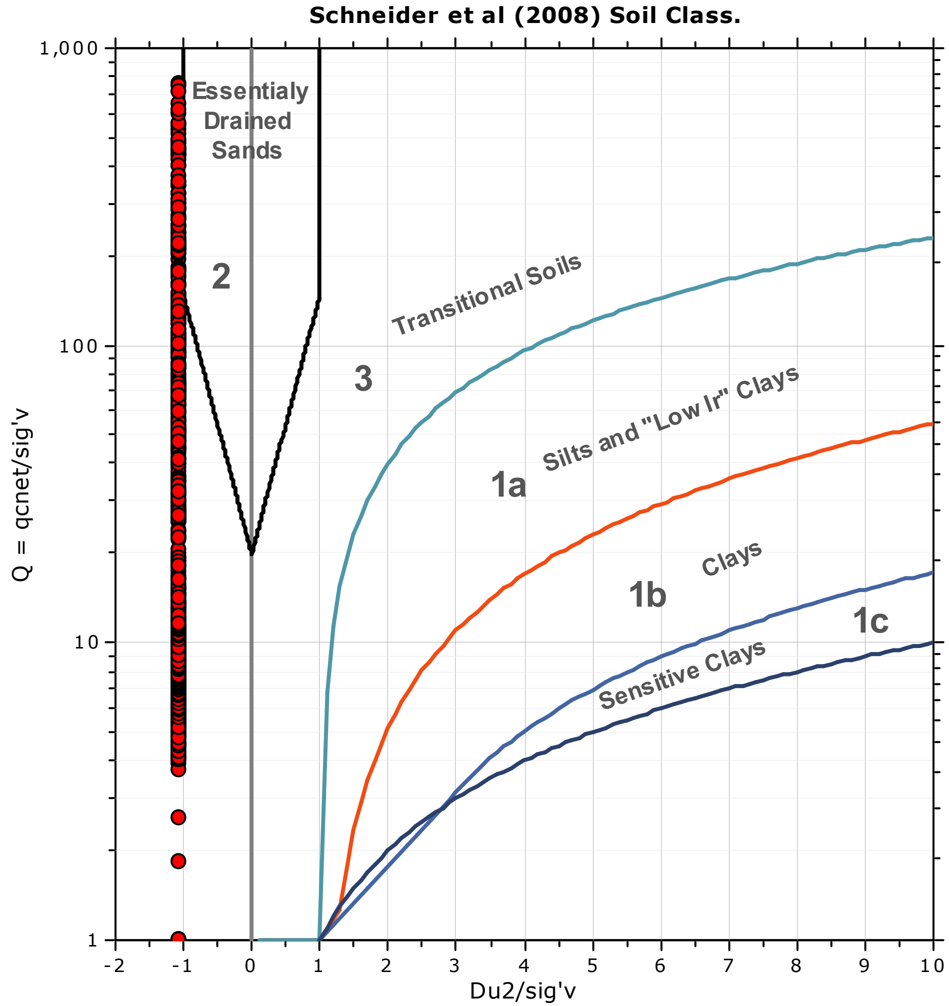


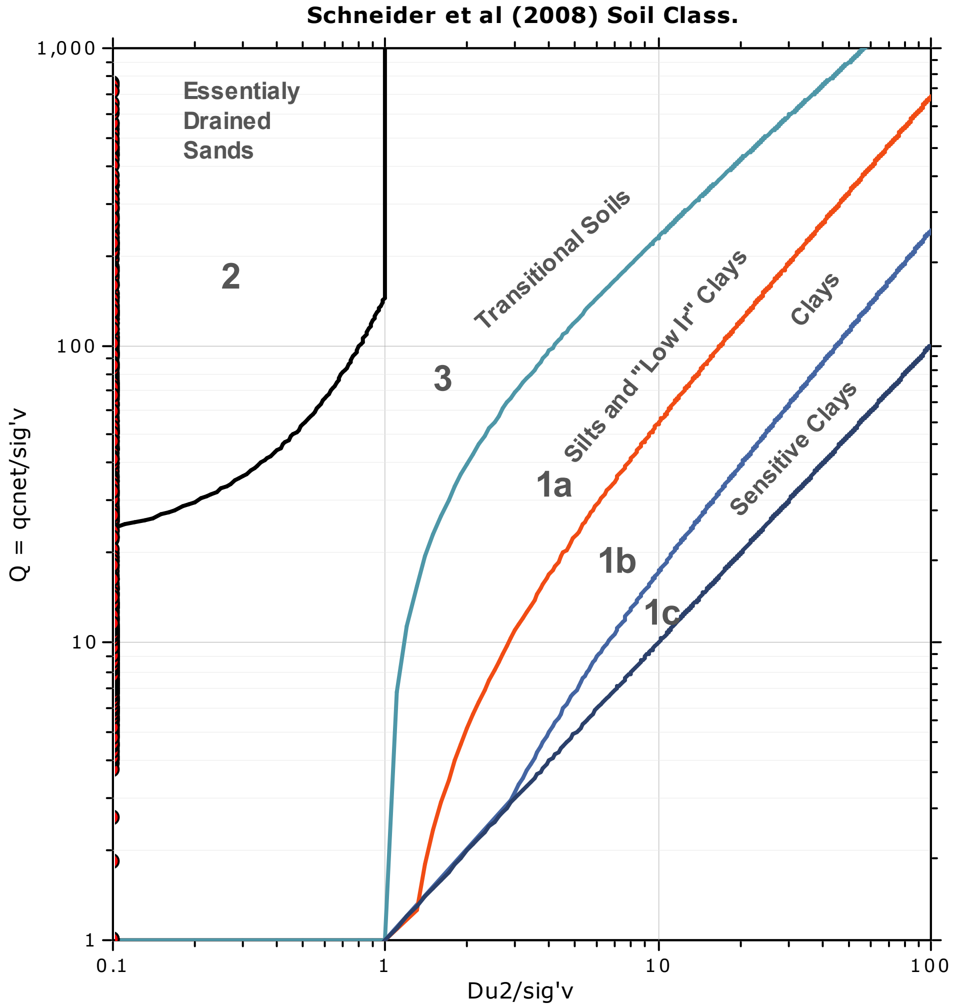


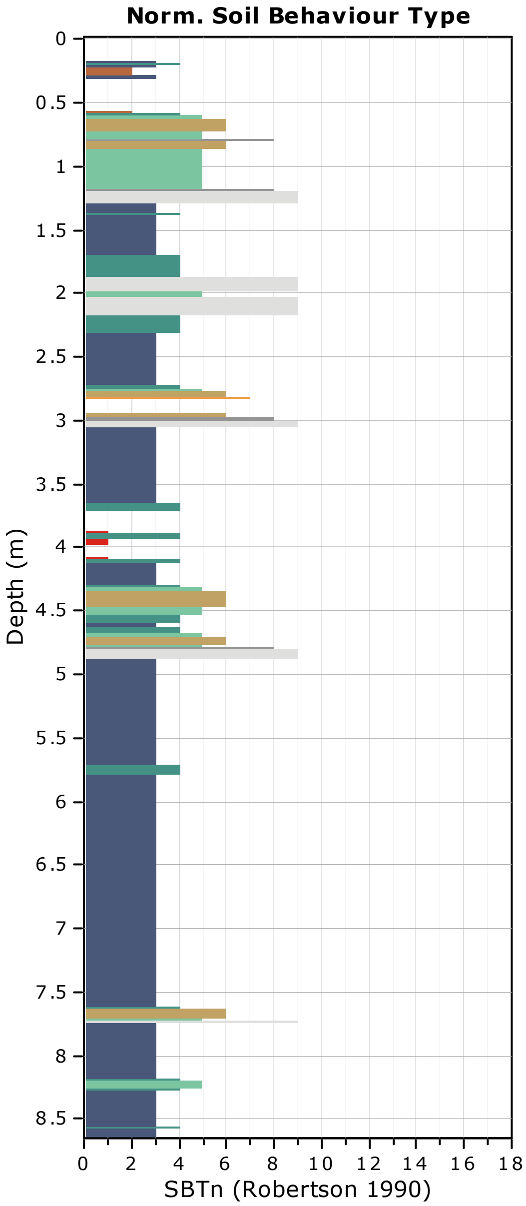
SBTn legend

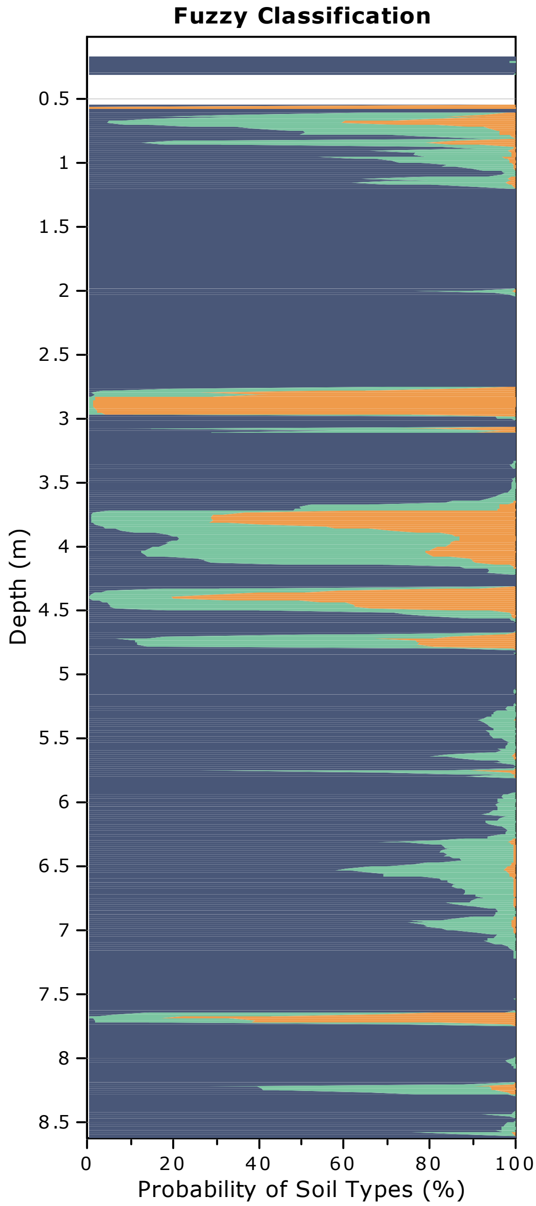
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

Bq plots (Schneider)






Norm. Soil Behaviour Type
Depth (m)
SBTn (Robertson 1990)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
0 2 4 6 8 10 12 14 16 18


Fuzzy Classification
Depth (m)
Probability of Soil Types (%)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
0 20 40 60 80 100

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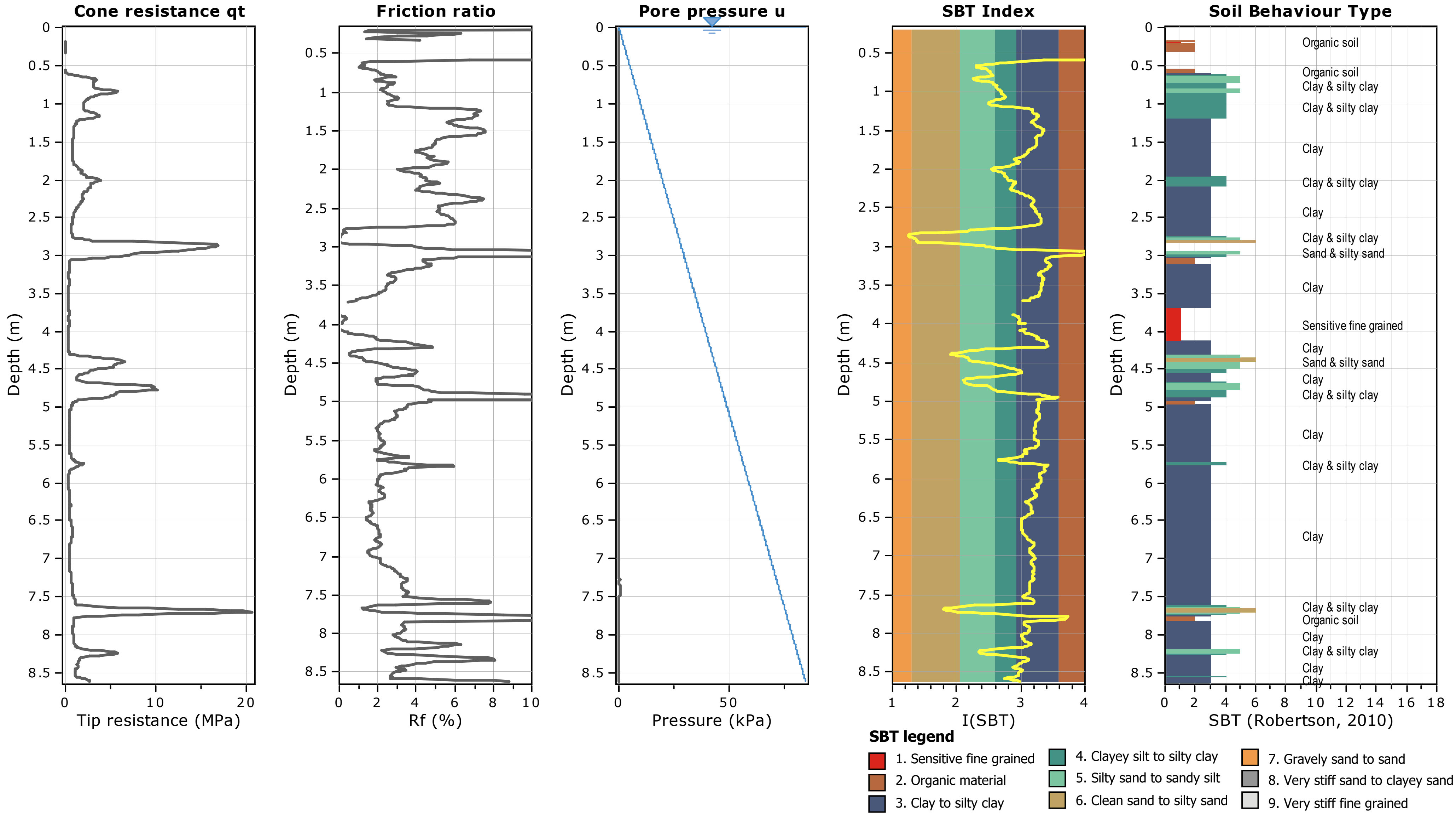
CPT: A8-CPT01A
Total depth: 8.62 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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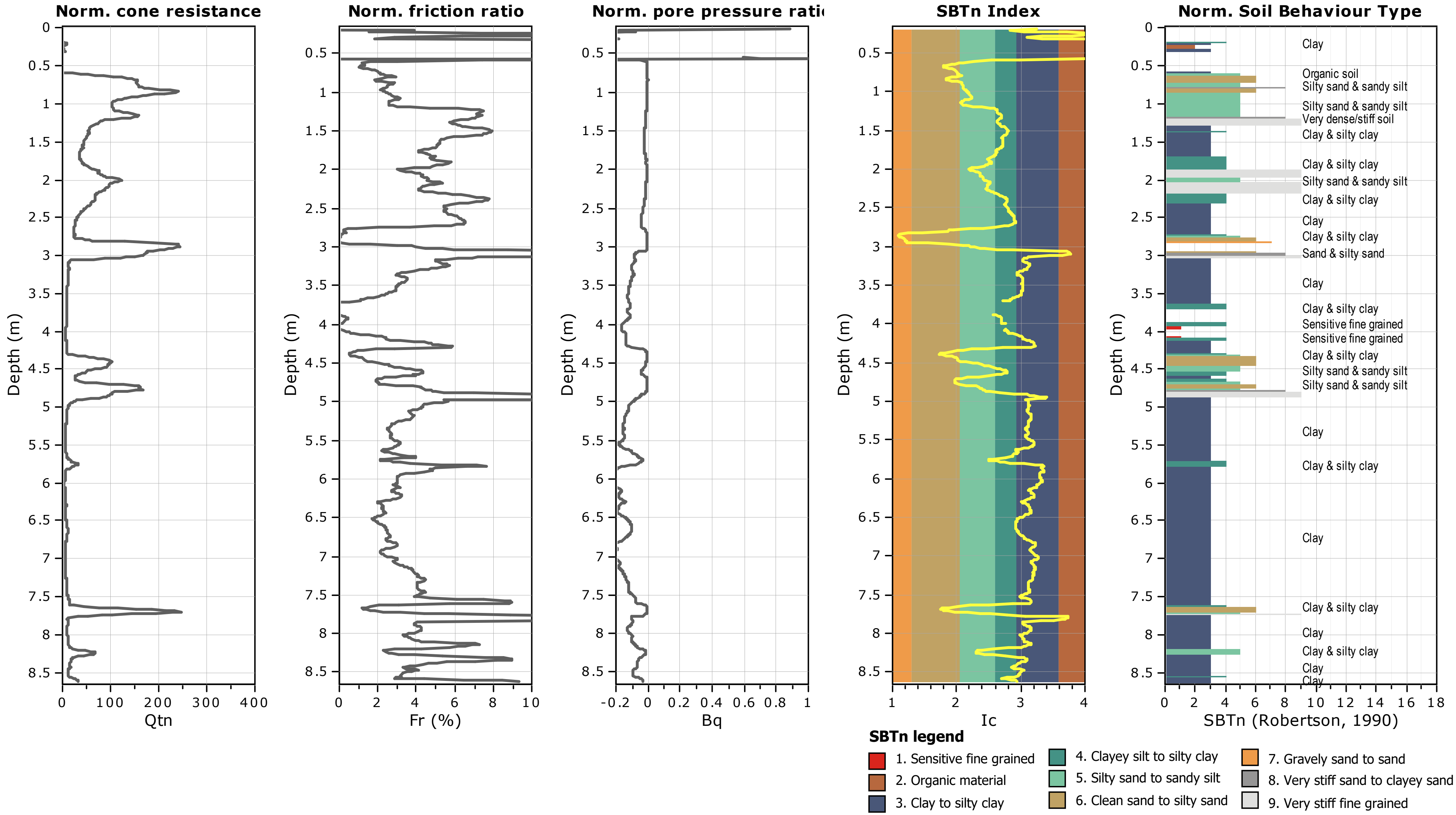
CPT: A8-CPT01A
Total depth: 8.62 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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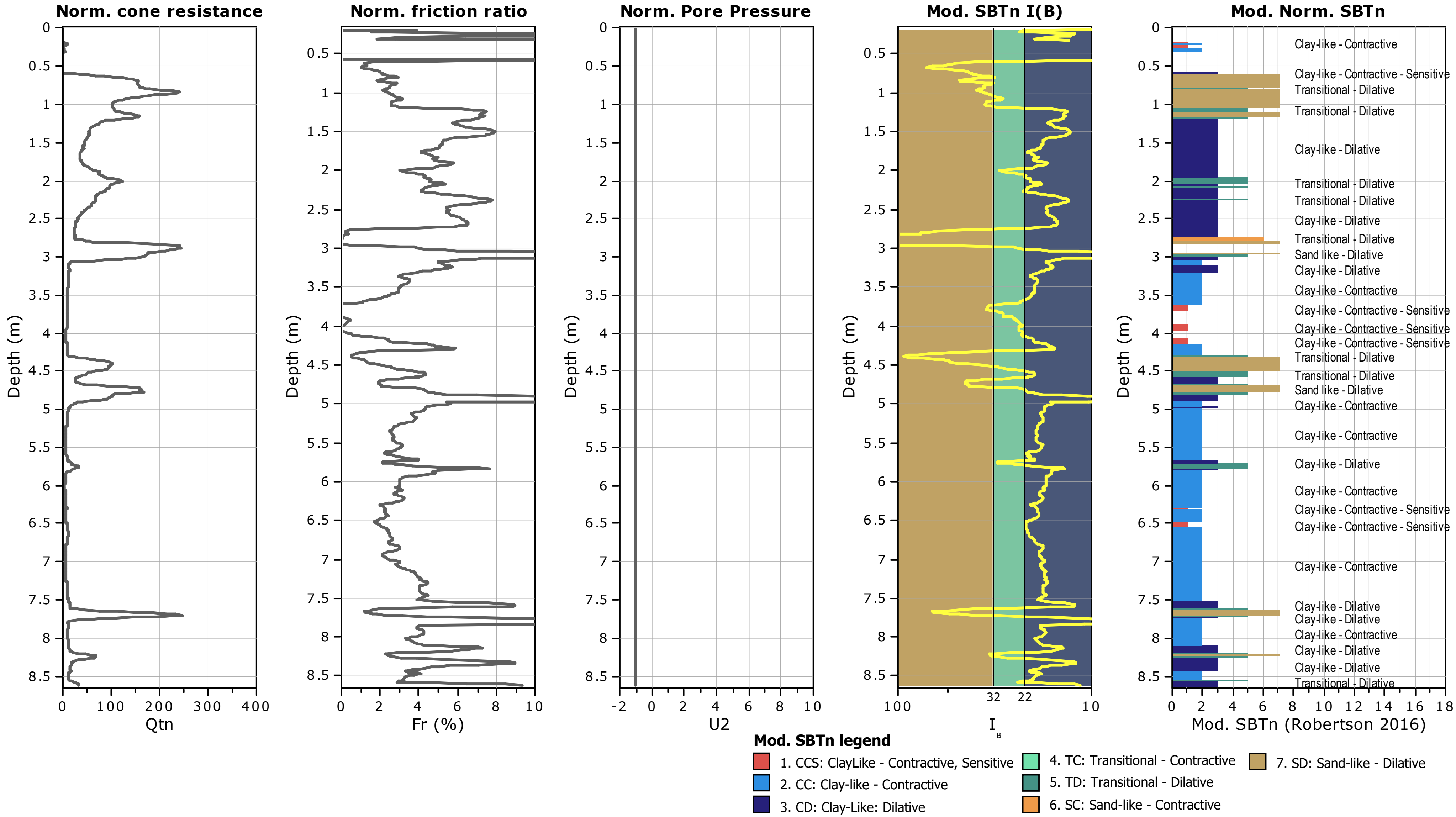
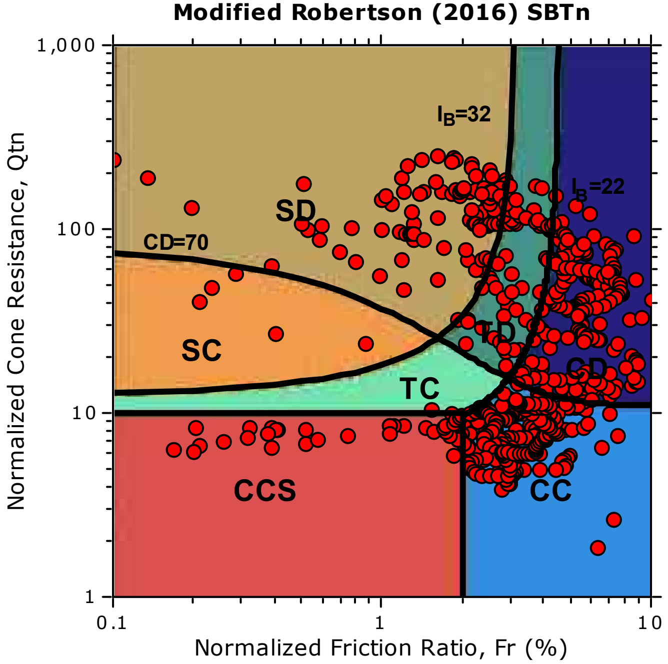
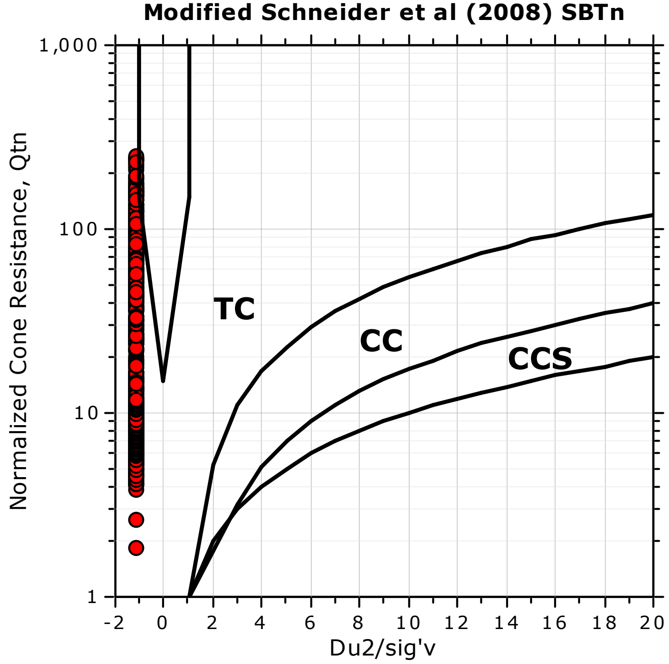
CPT: A8-CPT01A
Total depth: 8.62 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

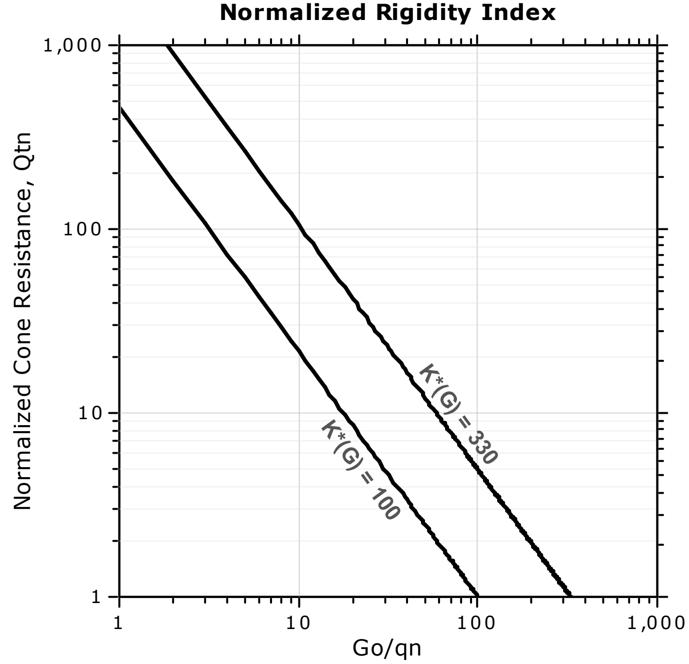
Project:
Location:



Updated SBTn plots





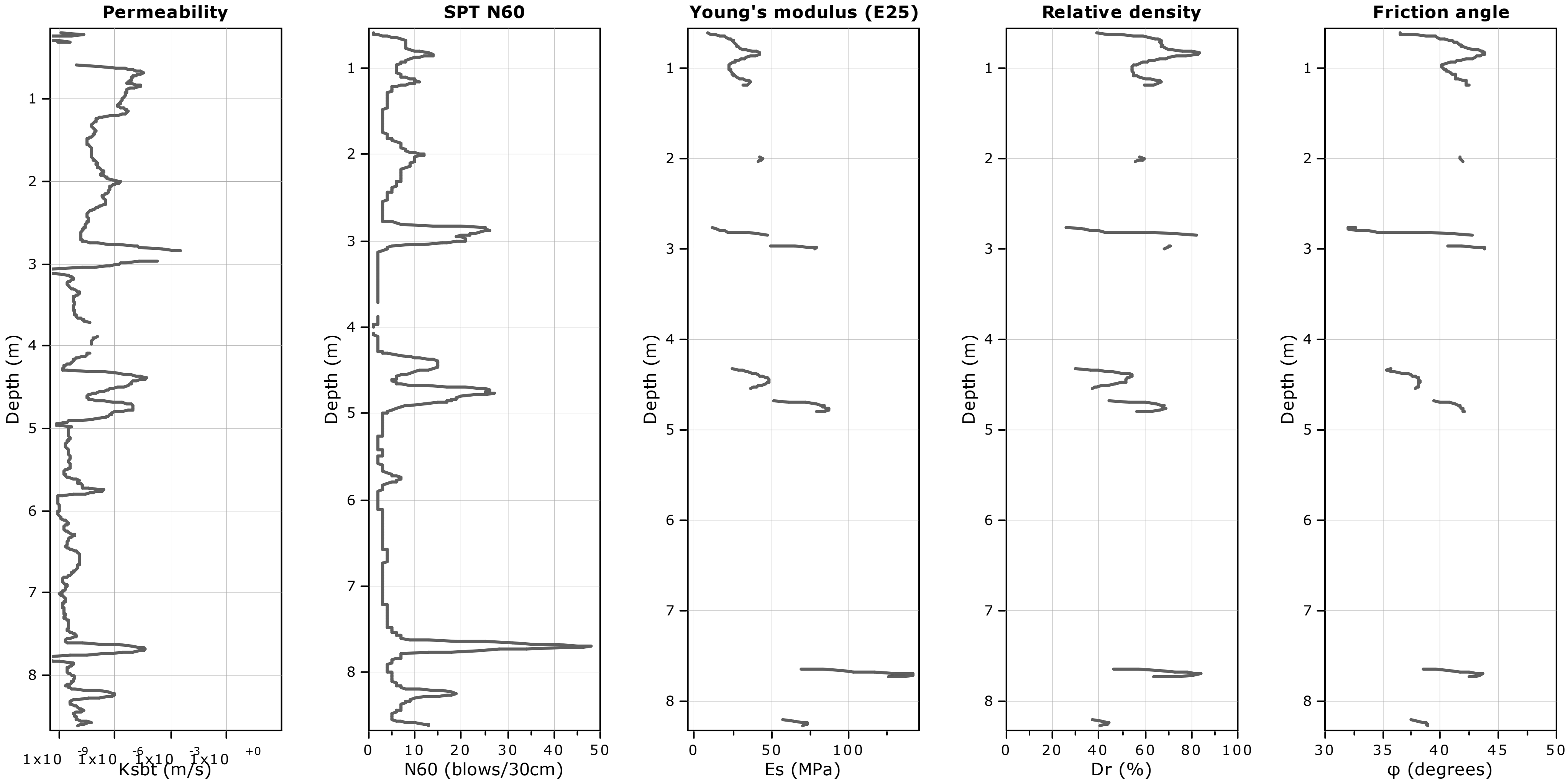


CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CPT: A8-CPT01A
Total depth: 8.62 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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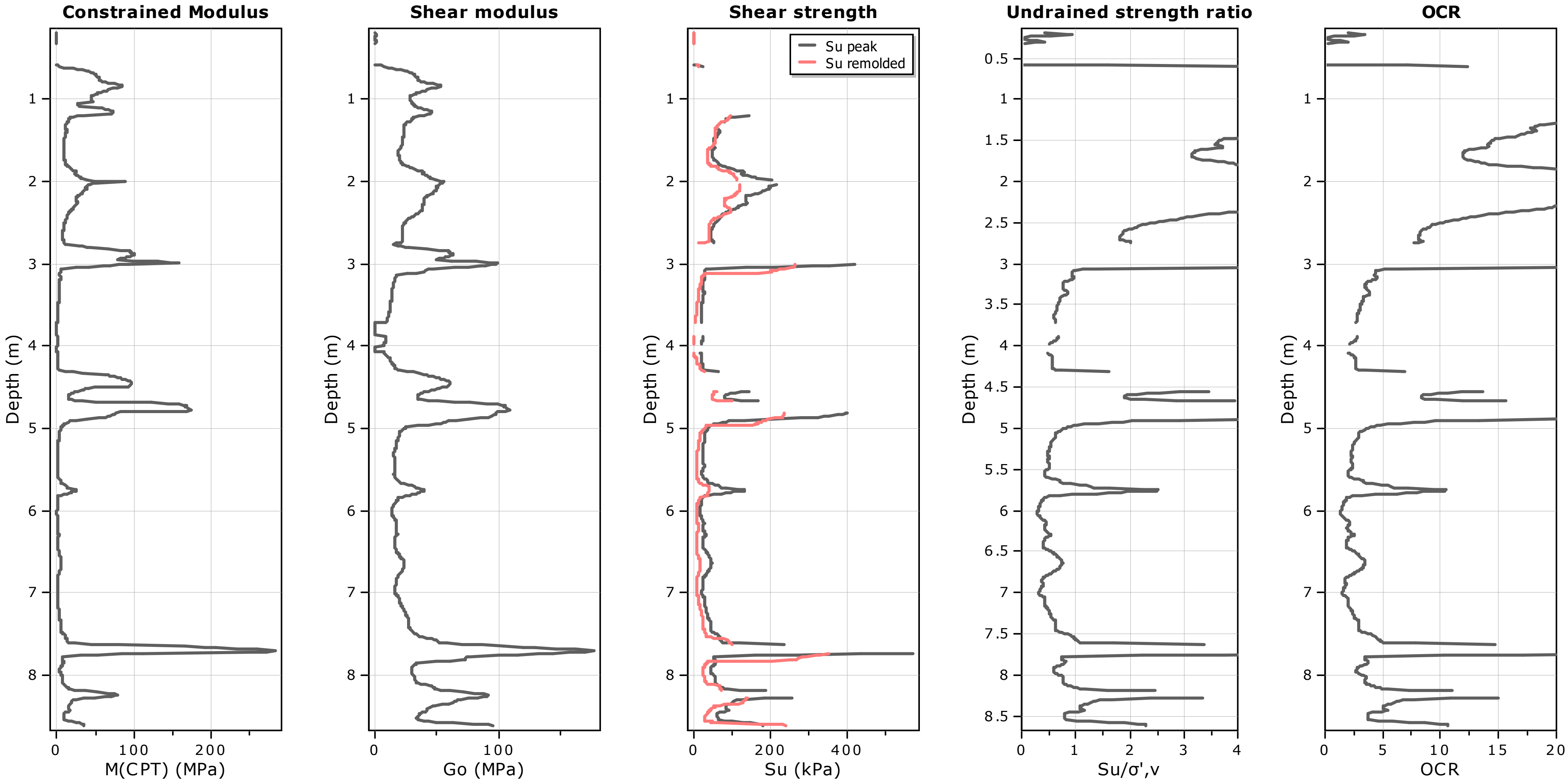
CPT: A8-CPT01A
Total depth: 8.62 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

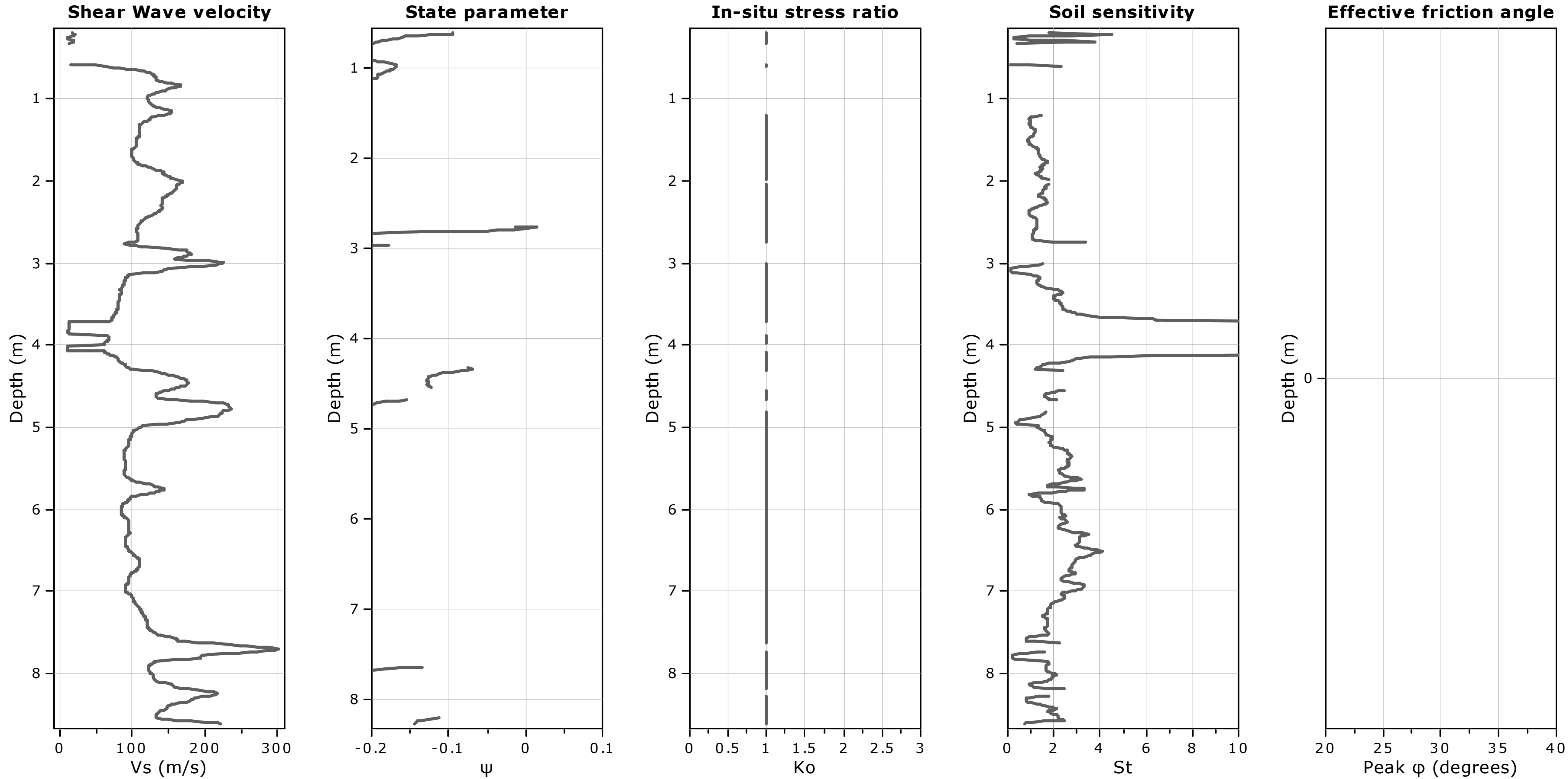
Project:
Location:



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

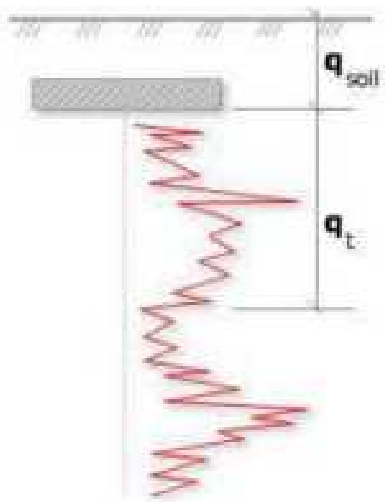
OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

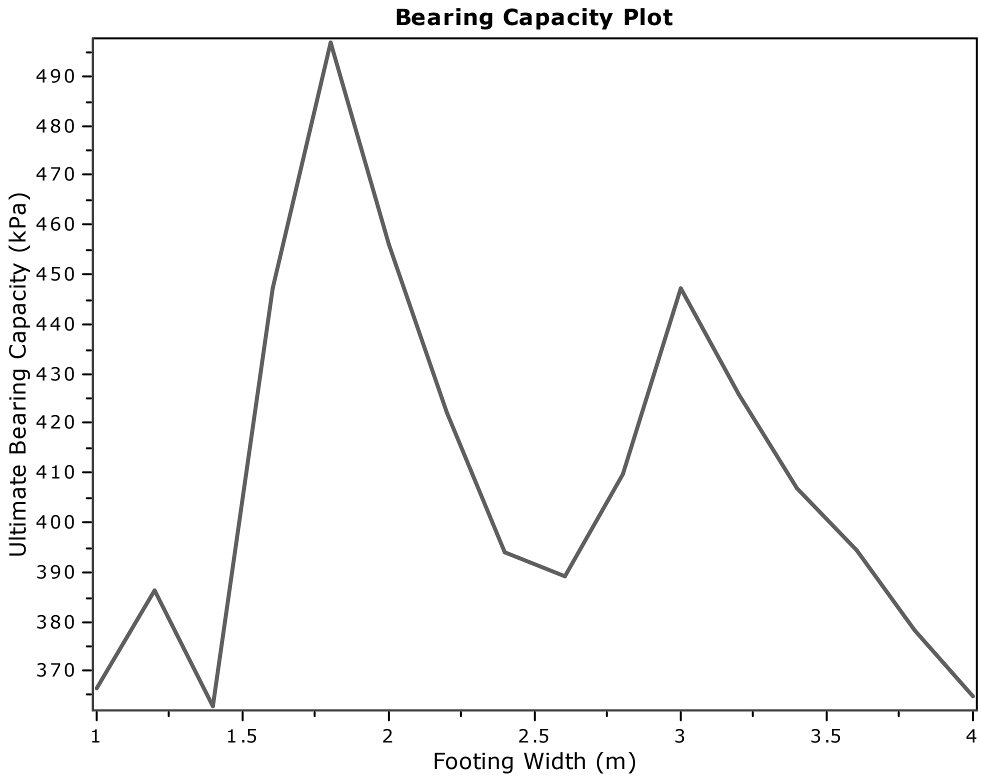
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

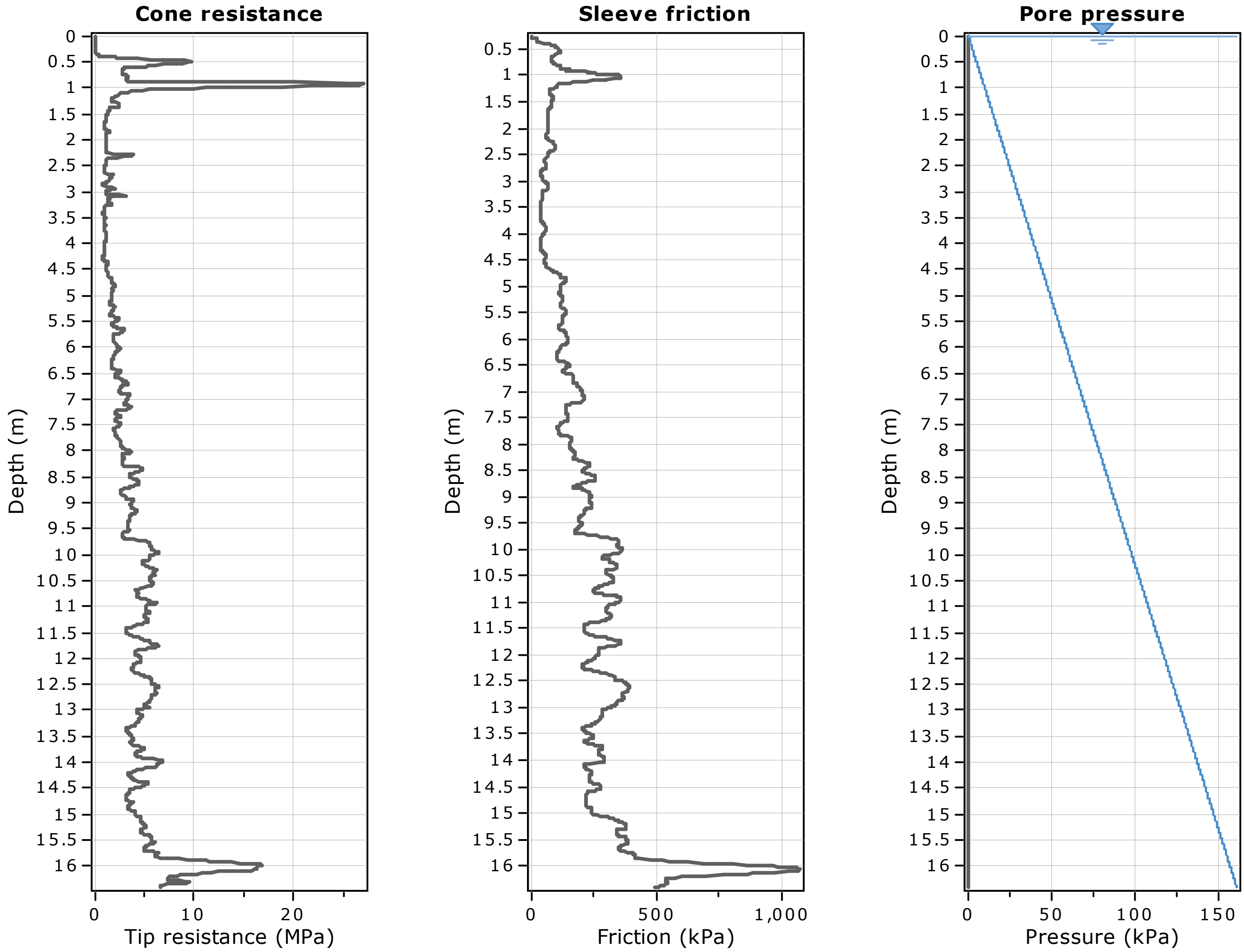
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

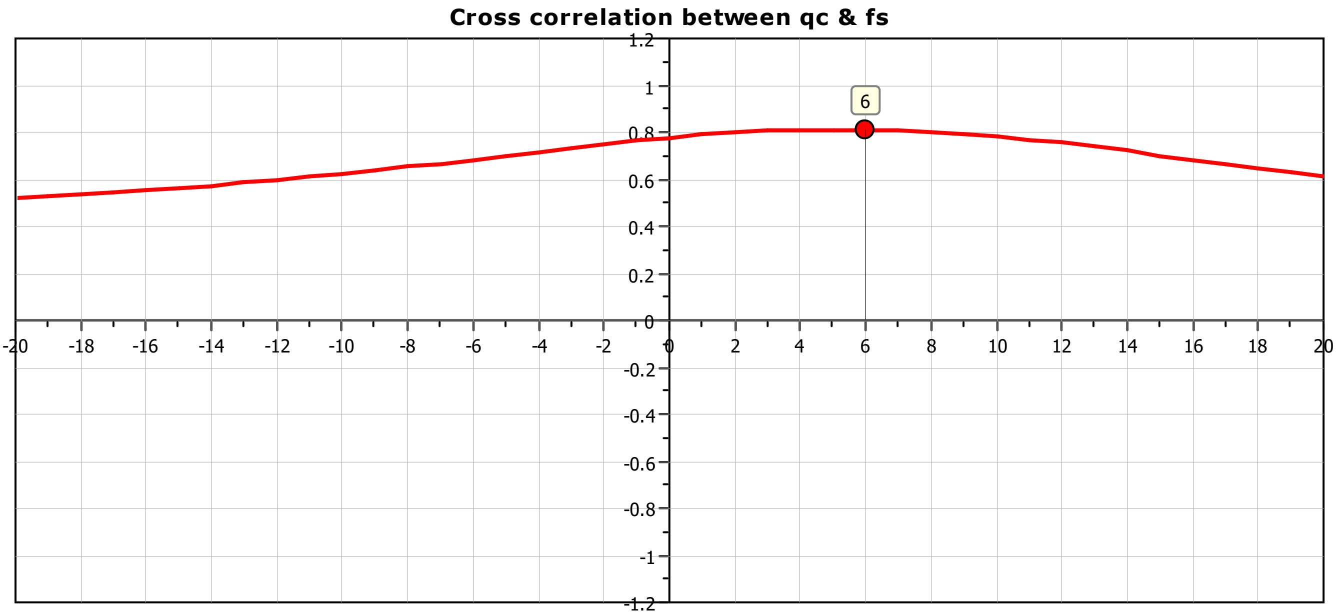


:: Tabular results ::

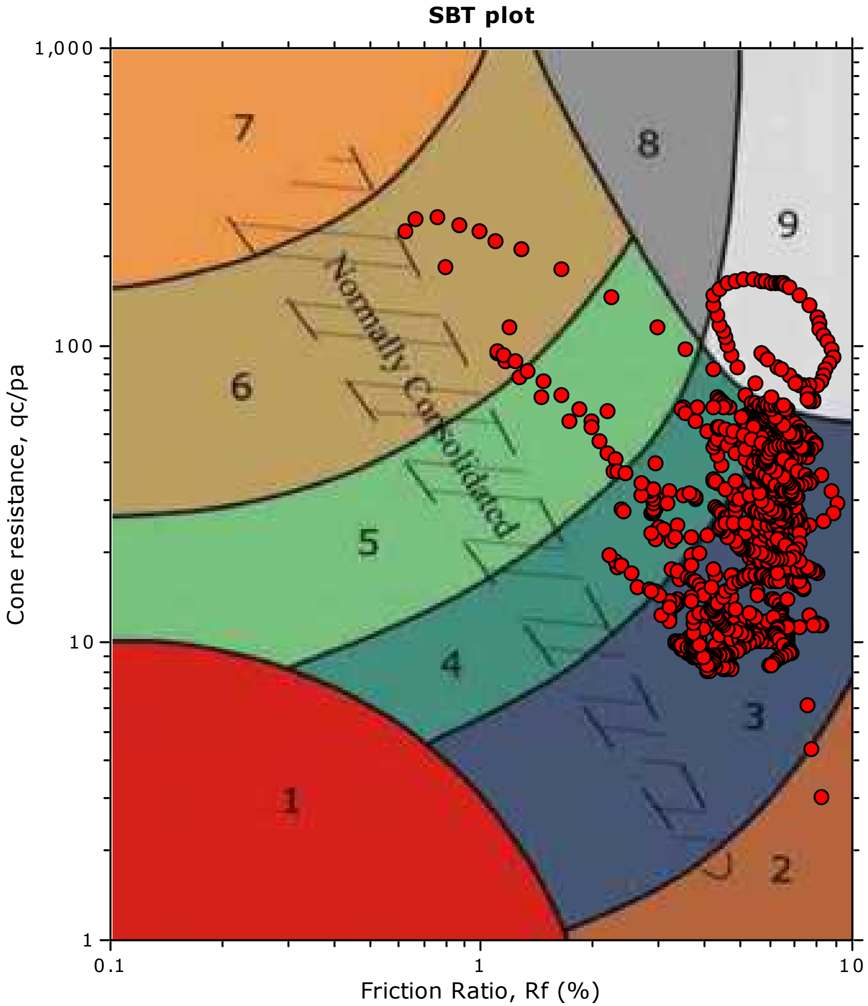
No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.79	0.20	9.50	366.60
2	1.20	0.50	2.30	1.88	0.20	9.50	386.31
3	1.40	0.50	2.60	1.77	0.20	9.50	362.91
4	1.60	0.50	2.90	2.19	0.20	9.50	447.35
5	1.80	0.50	3.20	2.44	0.20	9.50	496.76
6	2.00	0.50	3.50	2.23	0.20	9.50	455.99
7	2.20	0.50	3.80	2.06	0.20	9.50	422.28
8	2.40	0.50	4.10	1.92	0.20	9.50	393.90
9	2.60	0.50	4.40	1.90	0.20	9.50	389.17
10	2.80	0.50	4.70	2.00	0.20	9.50	409.62
11	3.00	0.50	5.00	2.19	0.20	9.50	447.22
12	3.20	0.50	5.30	2.08	0.20	9.50	425.97
13	3.40	0.50	5.60	1.99	0.20	9.50	406.69
14	3.60	0.50	5.90	1.92	0.20	9.50	394.39
15	3.80	0.50	6.20	1.84	0.20	9.50	378.31
16	4.00	0.50	6.50	1.78	0.20	9.50	364.73

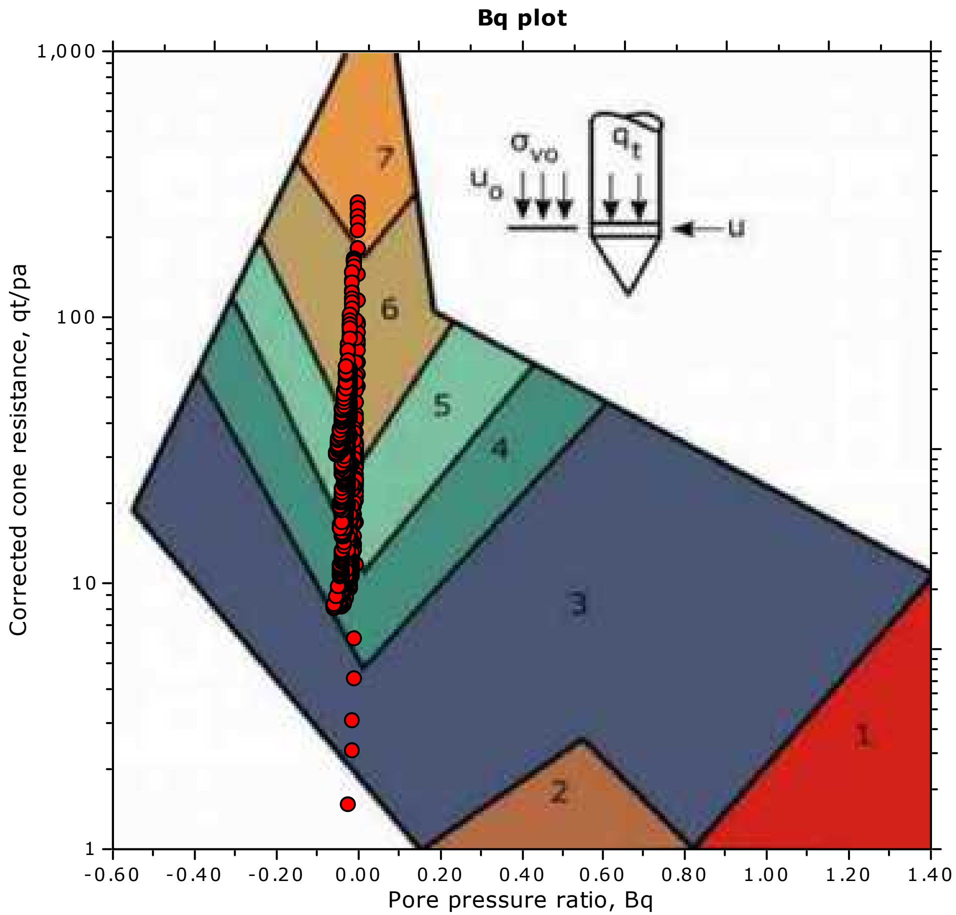


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

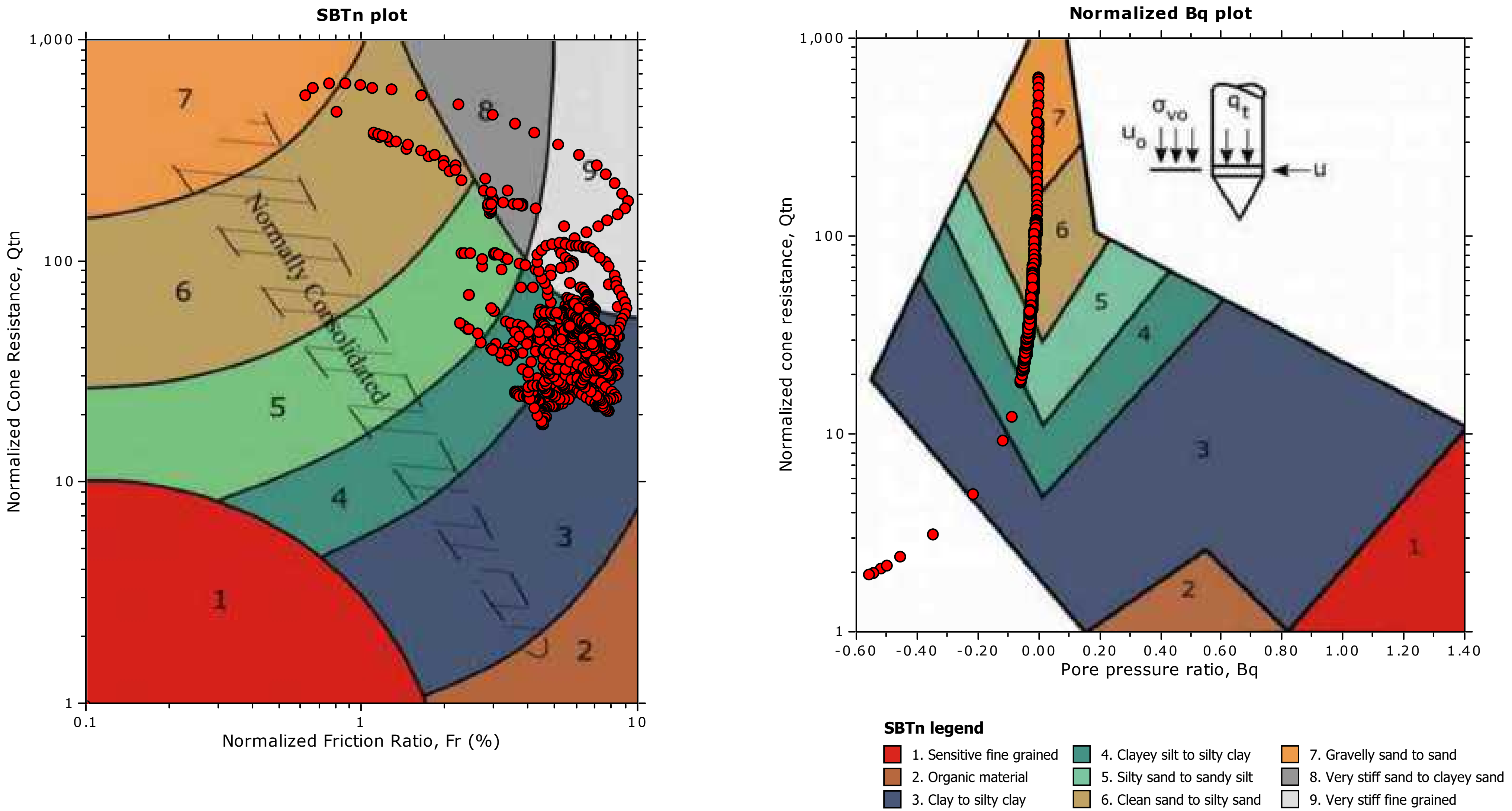




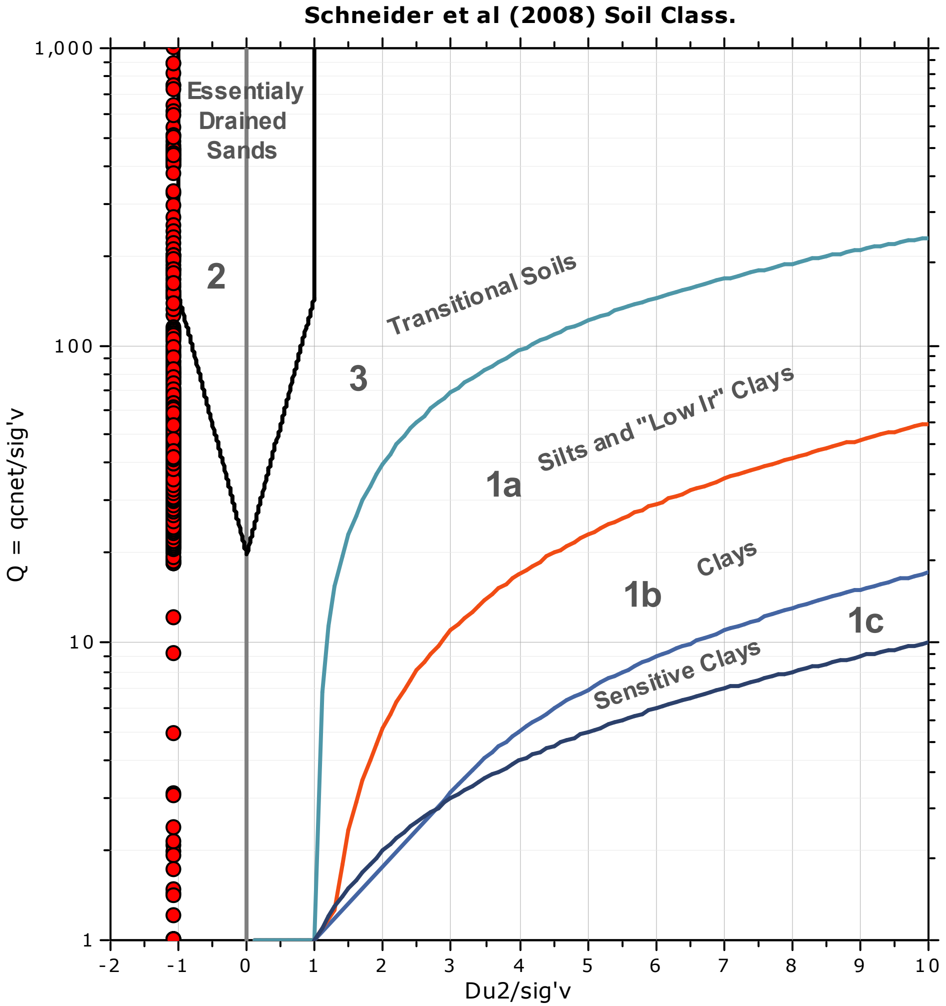
SBT legend

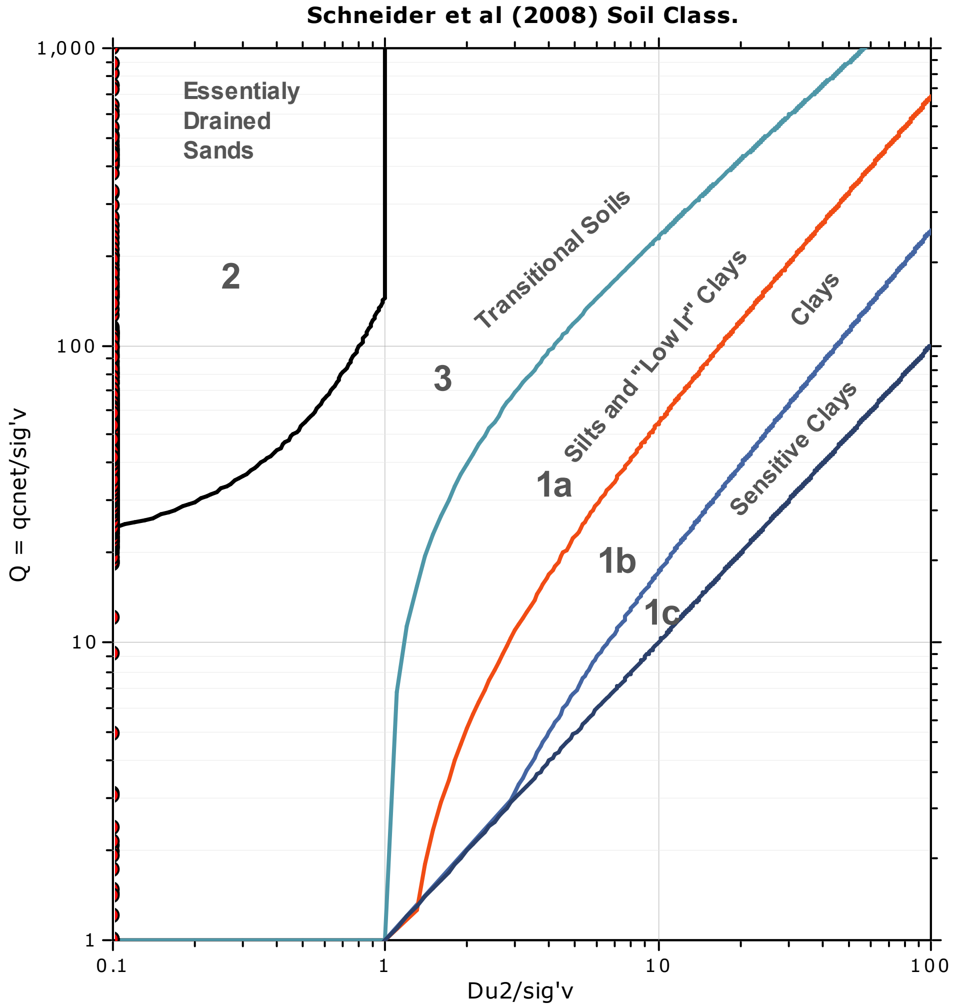
- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty clay
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravelly sand to sand
- 8. Very stiff sand to clayey sand
- 9. Very stiff fine grained

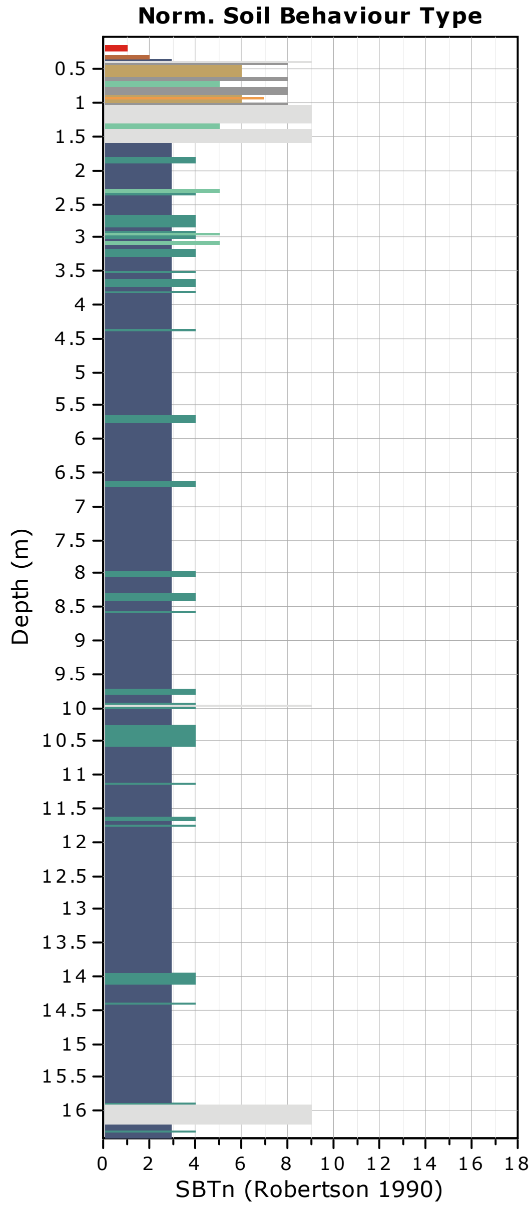
SBT - Bq plots (normalized)

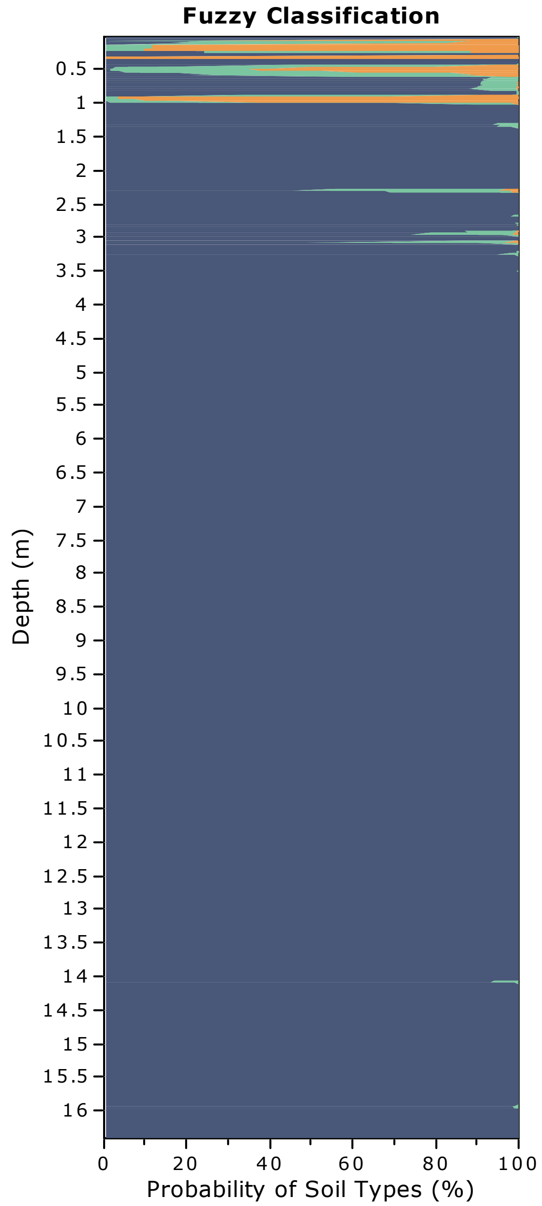


Bq plots (Schneider)






Norm. Soil Behaviour Type
Depth (m)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
Probability of Soil Types (%)

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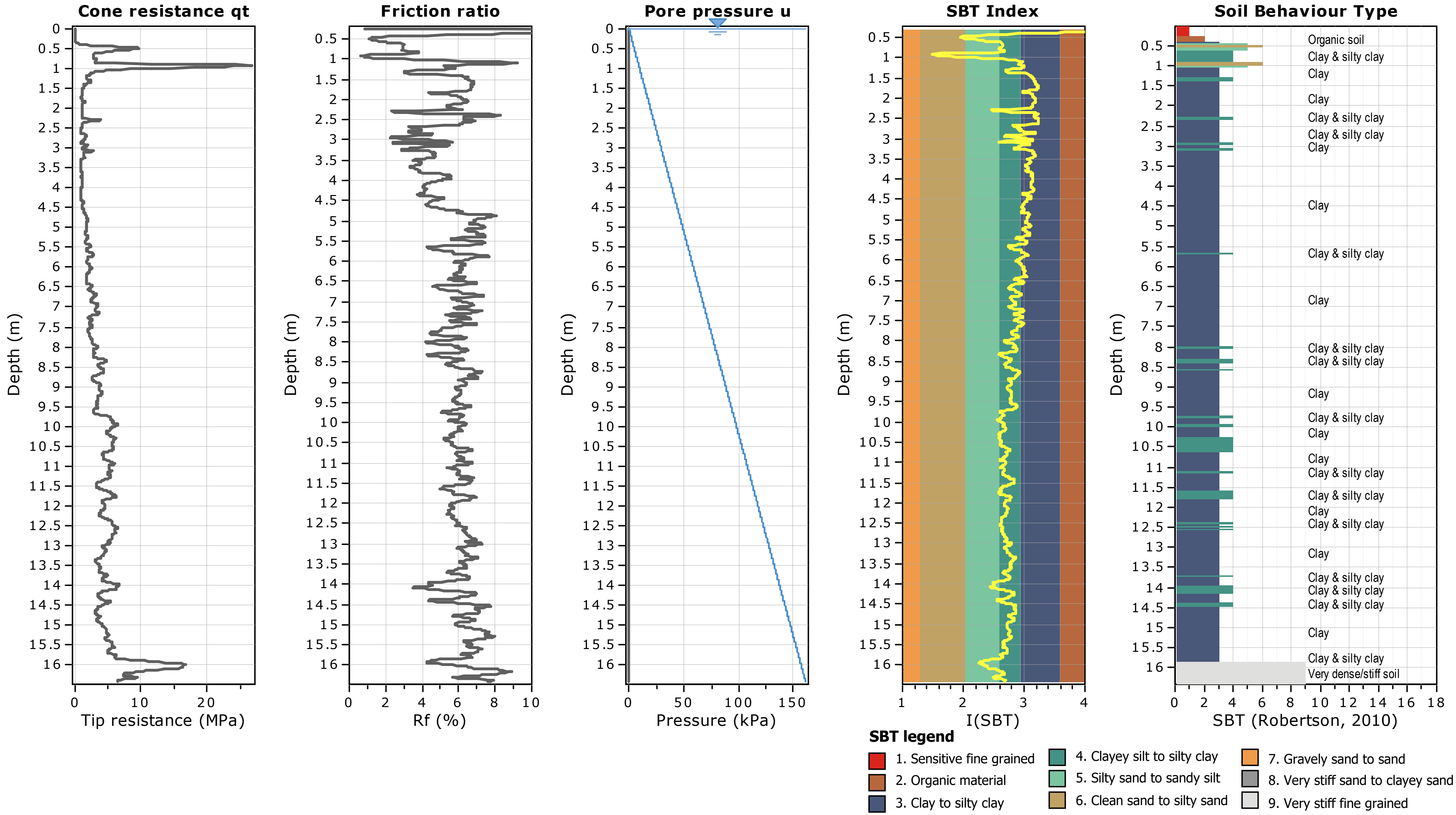
CPT: A8-CPT02
Total depth: 16.41 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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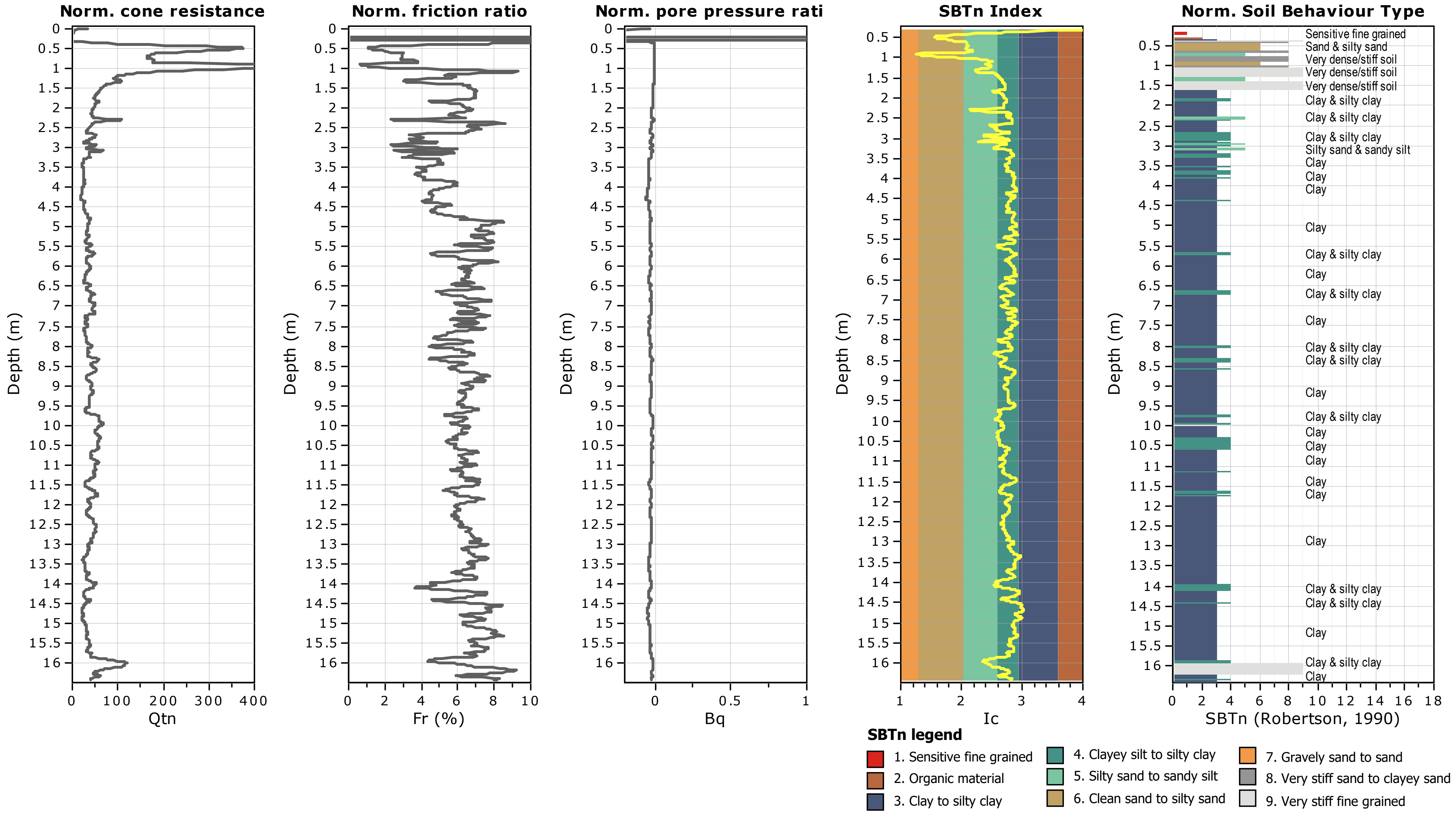
CPT: A8-CPT02
Total depth: 16.41 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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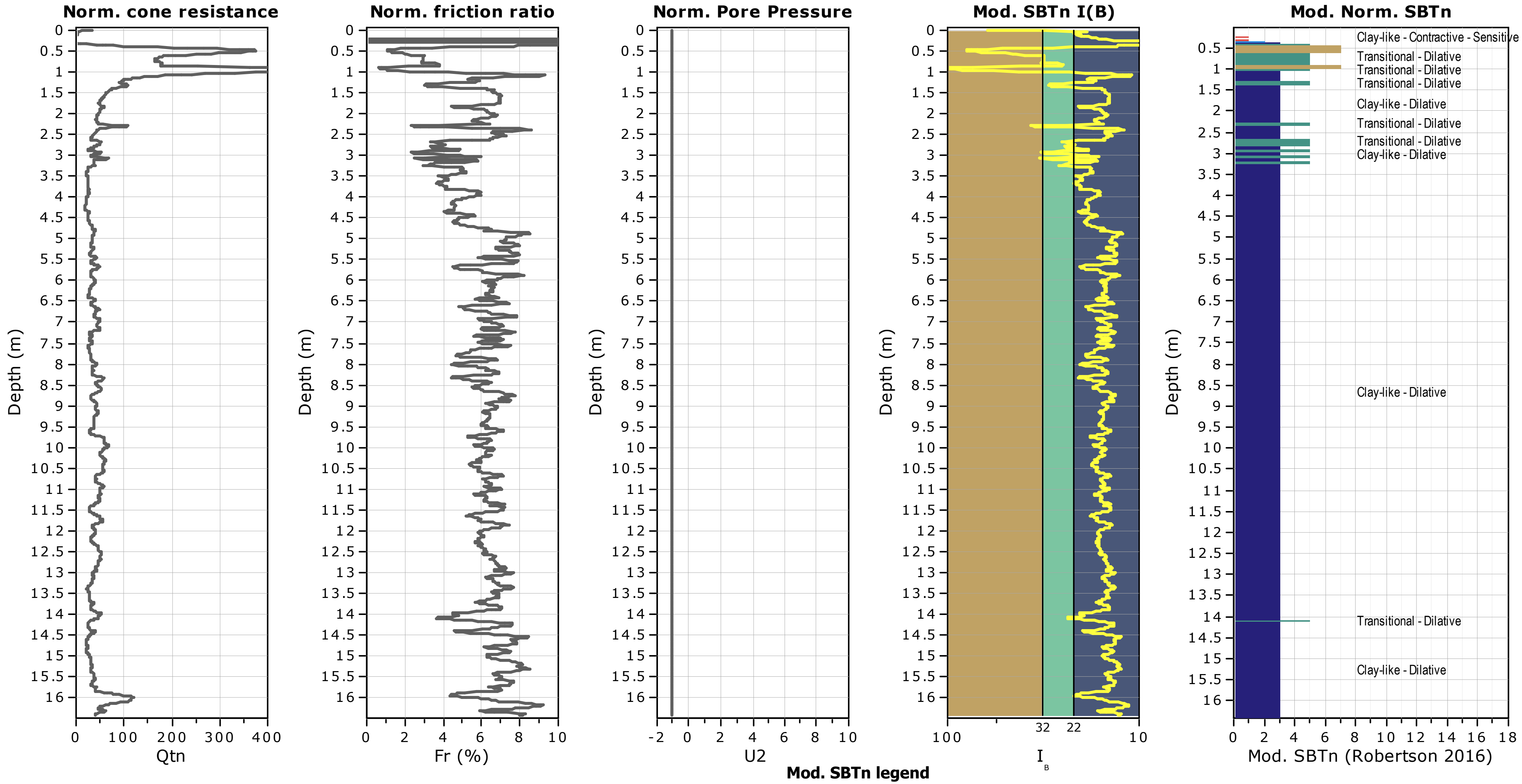
http://www.geologismiki.gr

CPT: A8-CPT02
Total depth: 16.41 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

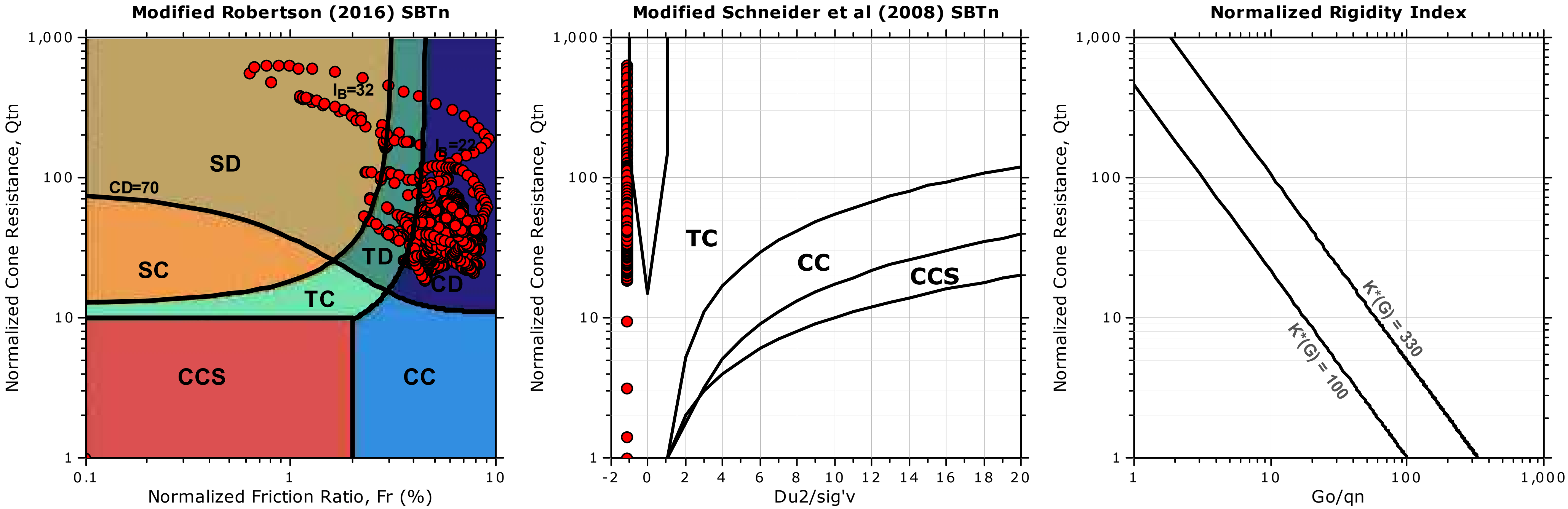
Project:
Location:



Mod. SBTn legend

1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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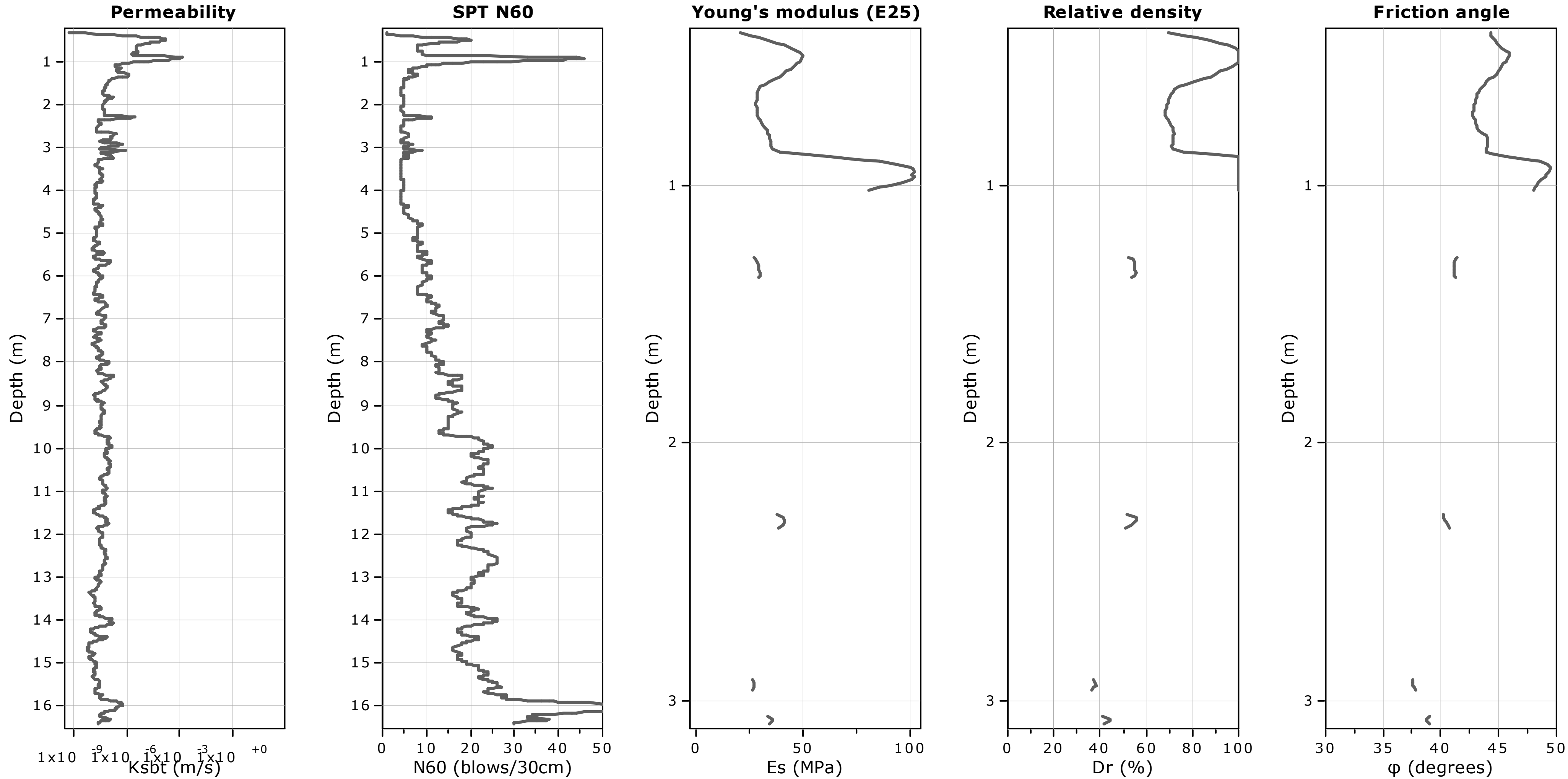
CPT: A8-CPT02
Total depth: 16.41 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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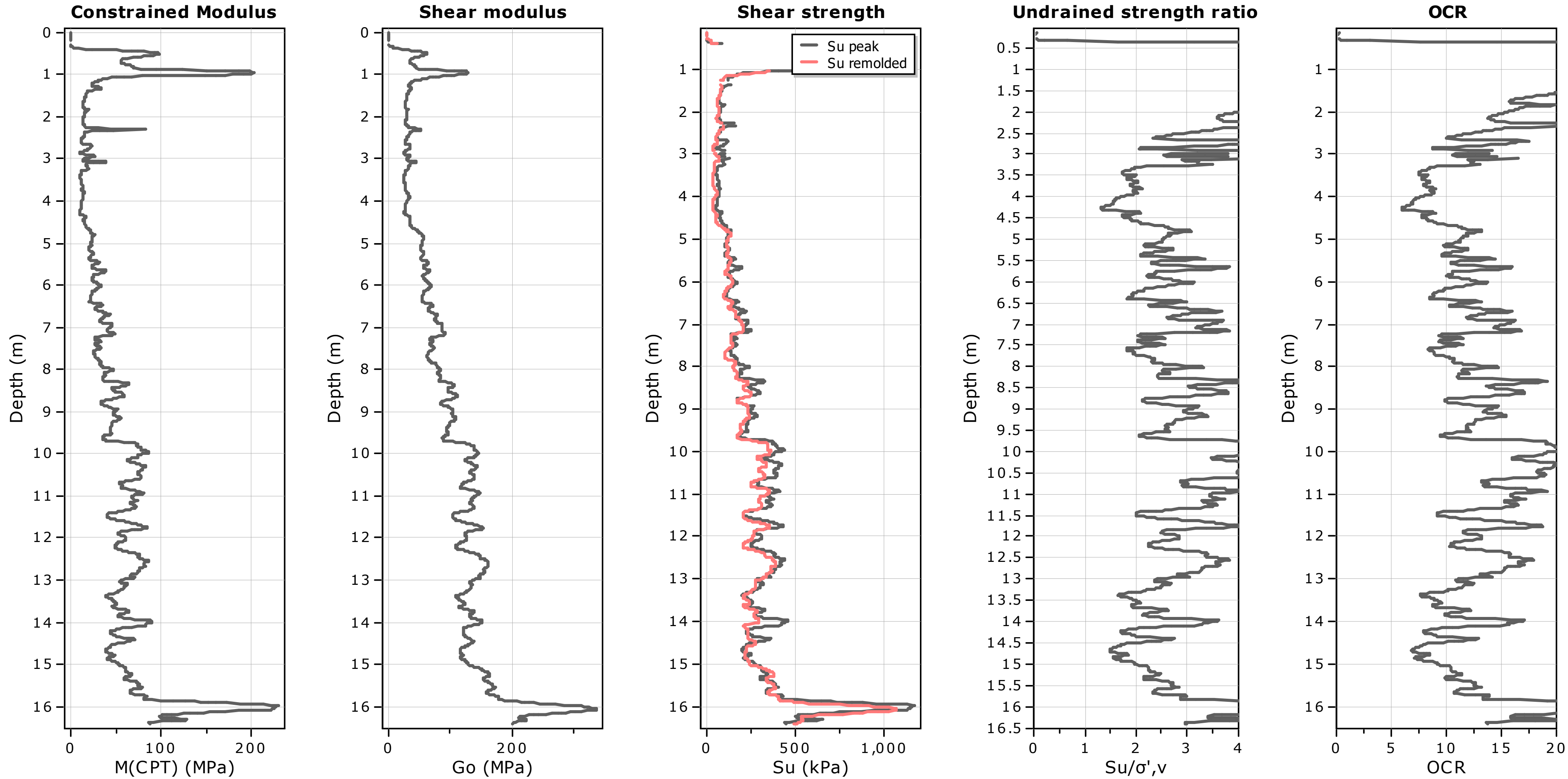
CPT: A8-CPT02
Total depth: 16.41 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

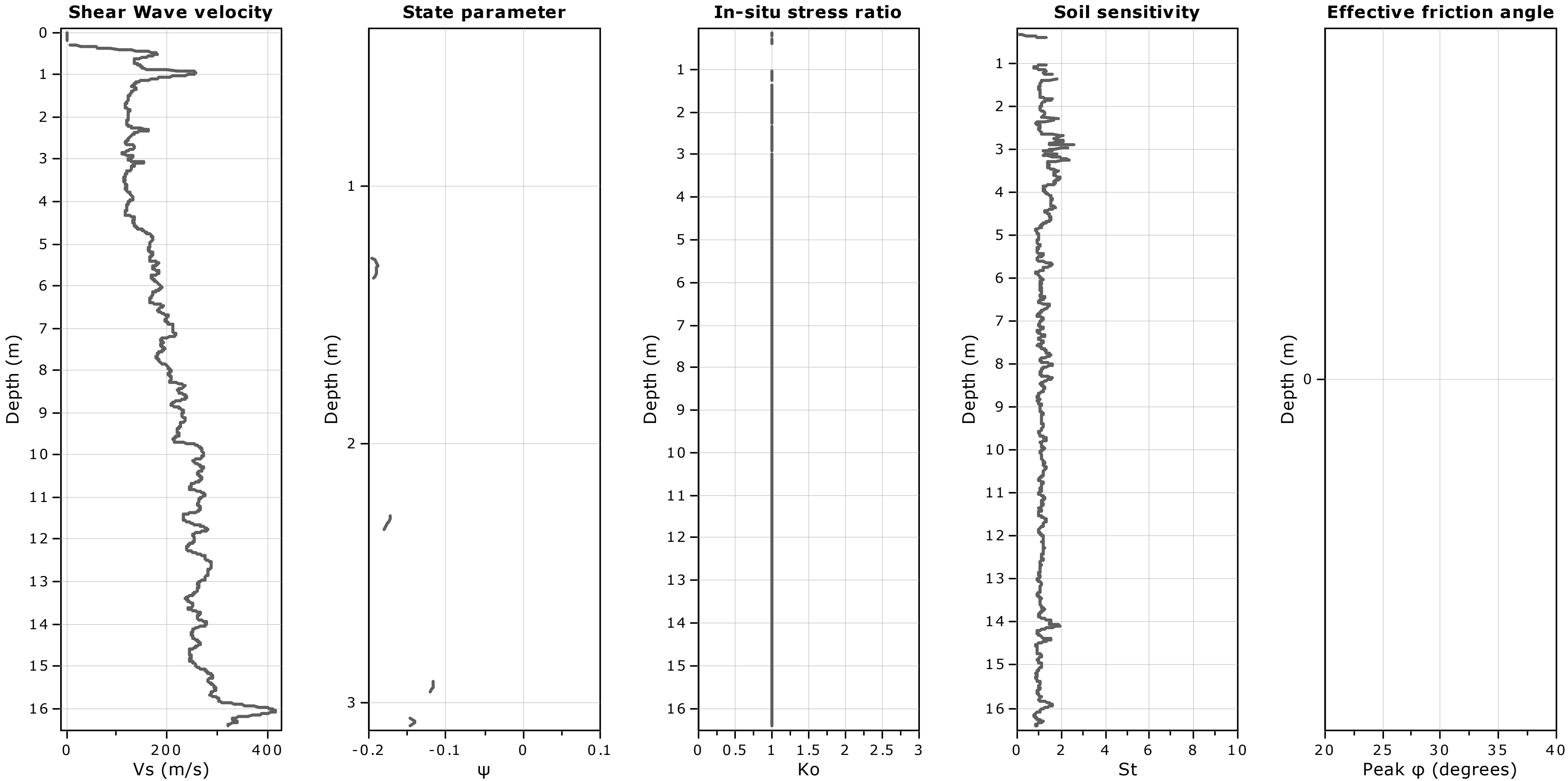
Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14
OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

CPT: A8-CPT02
Total depth: 16.41 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

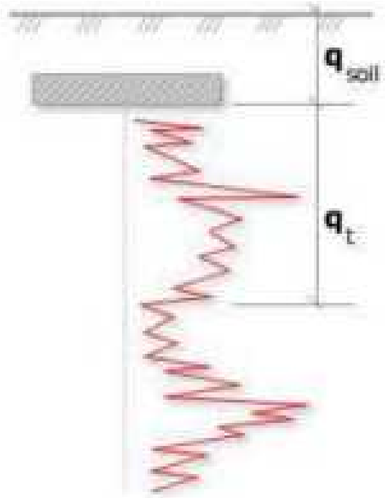
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

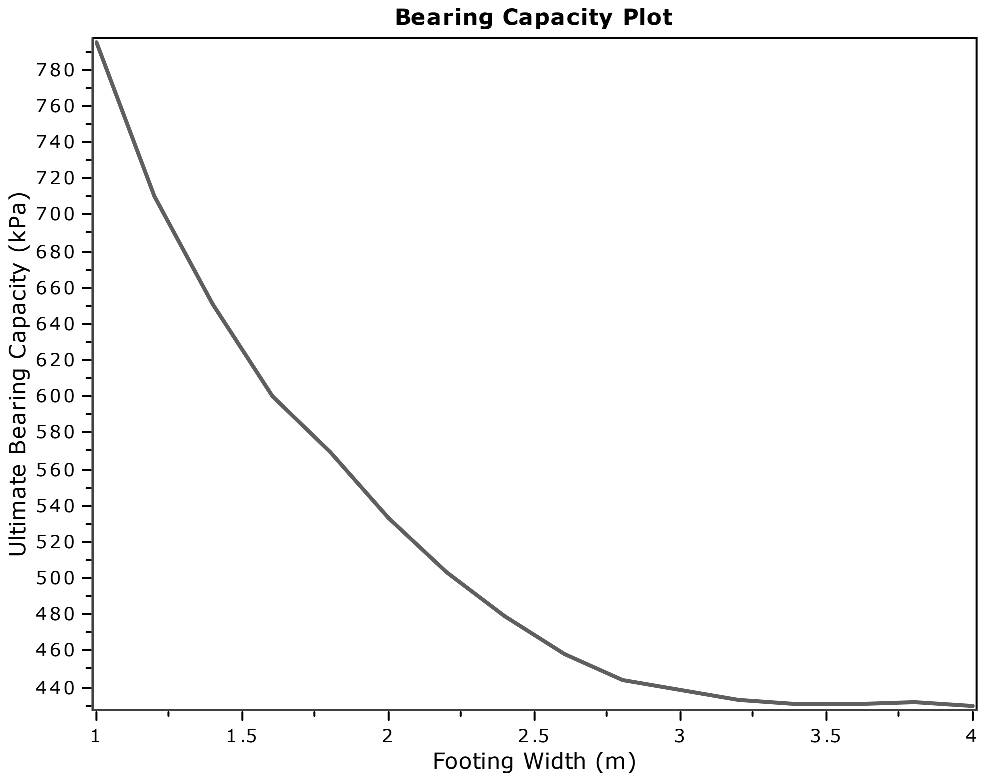
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

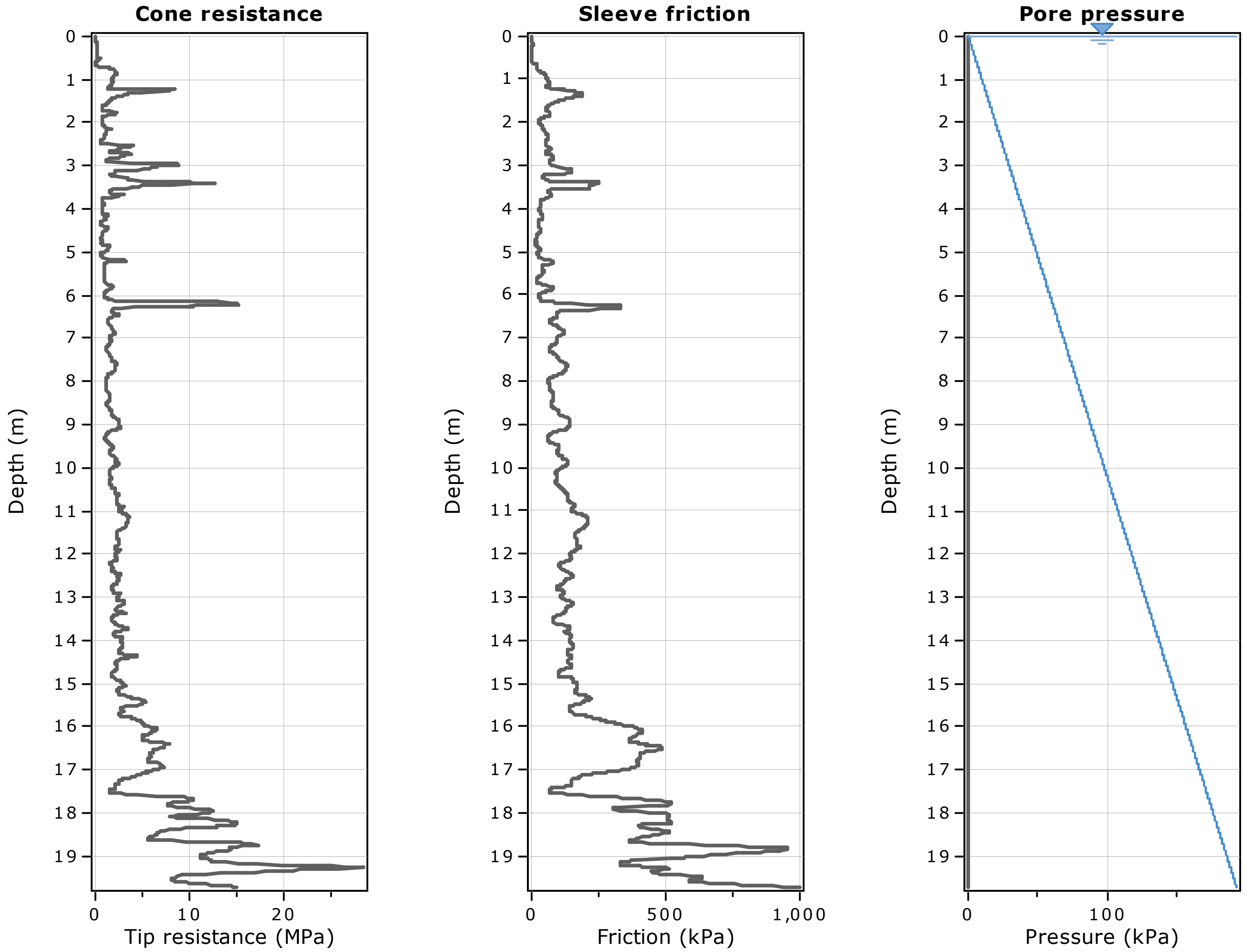


:: Tabular results ::

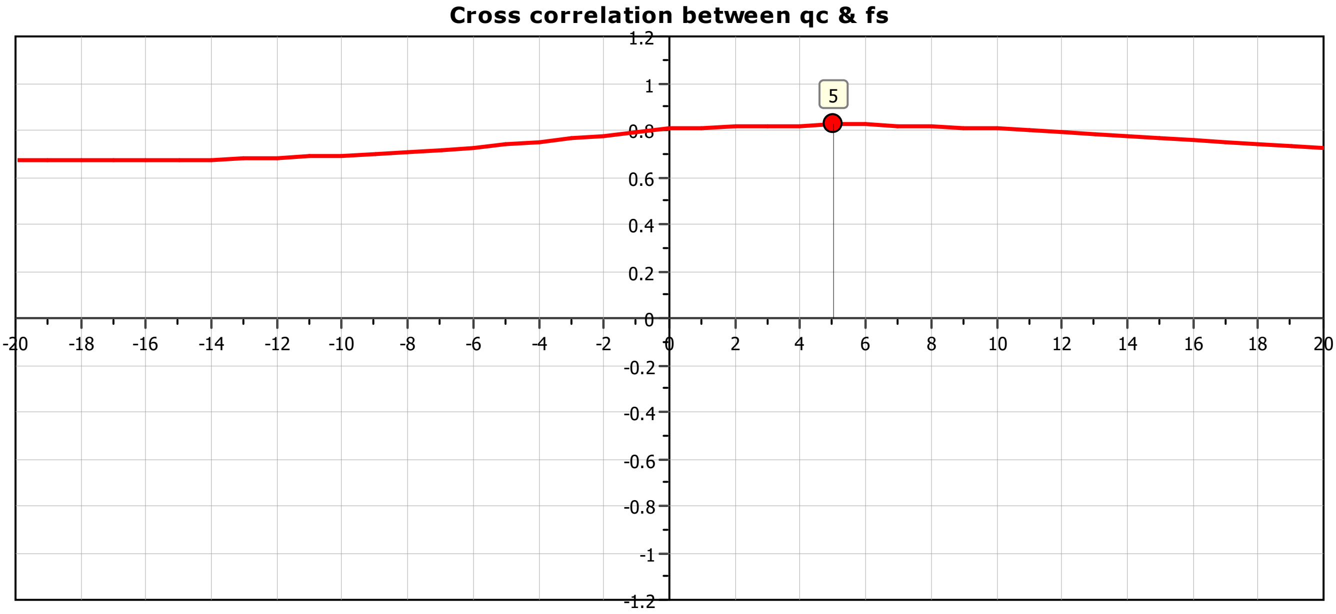
No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	3.93	0.20	9.50	795.24
2	1.20	0.50	2.30	3.50	0.20	9.50	710.42
3	1.40	0.50	2.60	3.21	0.20	9.50	651.24
4	1.60	0.50	2.90	2.95	0.20	9.50	600.33
5	1.80	0.50	3.20	2.80	0.20	9.50	569.57
6	2.00	0.50	3.50	2.62	0.20	9.50	533.68
7	2.20	0.50	3.80	2.47	0.20	9.50	503.83
8	2.40	0.50	4.10	2.35	0.20	9.50	479.39
9	2.60	0.50	4.40	2.24	0.20	9.50	457.89
10	2.80	0.50	4.70	2.17	0.20	9.50	444.00
11	3.00	0.50	5.00	2.15	0.20	9.50	438.74
12	3.20	0.50	5.30	2.12	0.20	9.50	433.25
13	3.40	0.50	5.60	2.10	0.20	9.50	430.36
14	3.60	0.50	5.90	2.11	0.20	9.50	431.17
15	3.80	0.50	6.20	2.11	0.20	9.50	431.65
16	4.00	0.50	6.50	2.10	0.20	9.50	429.66

CPT: A8-CPT03
Total depth: 19.72 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

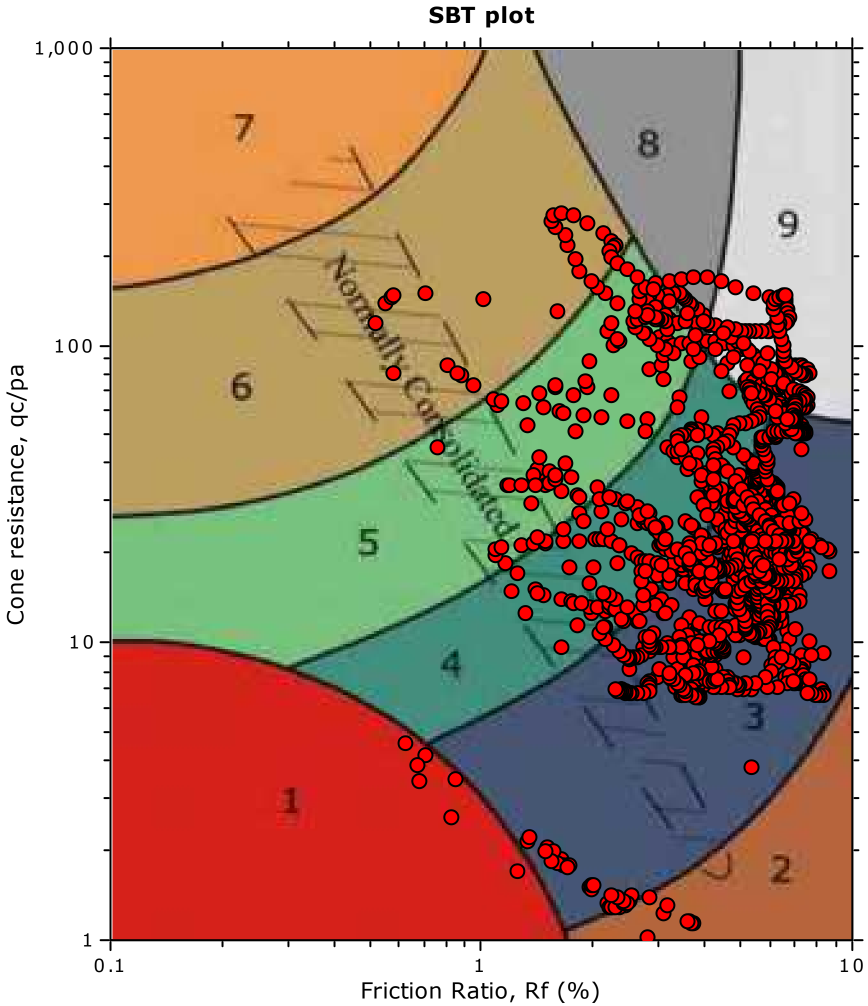
Project:
Location:

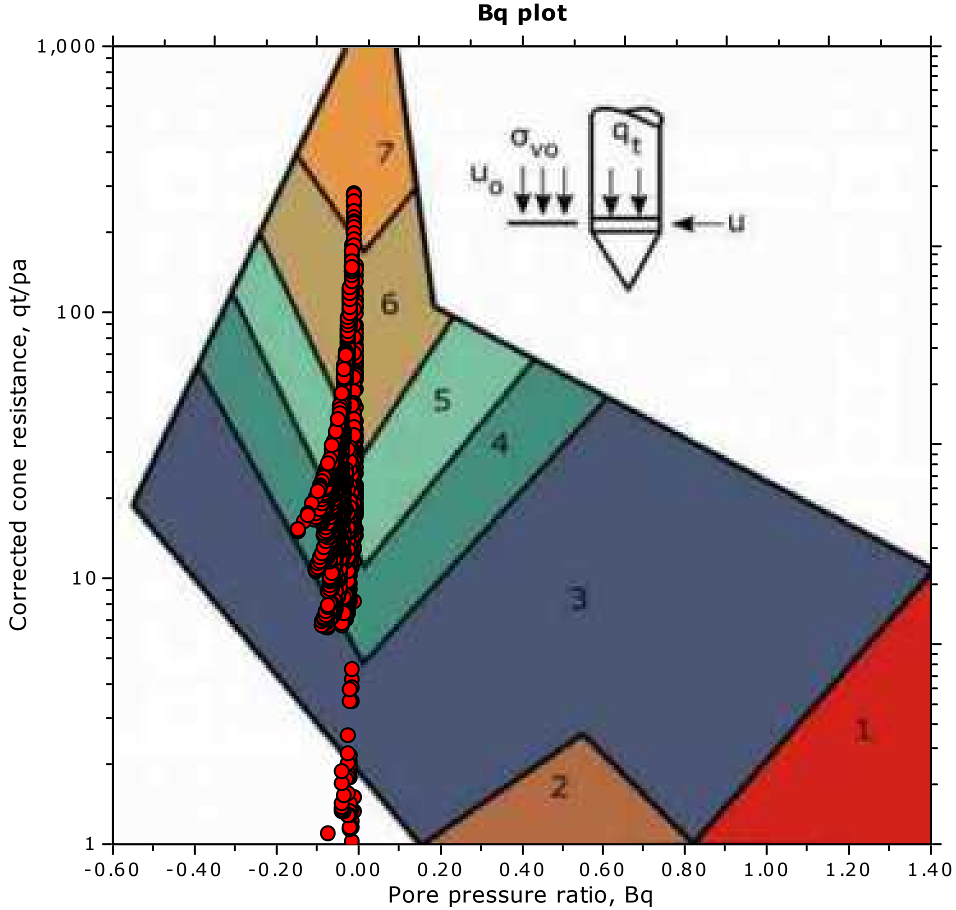


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots





SBT legend

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

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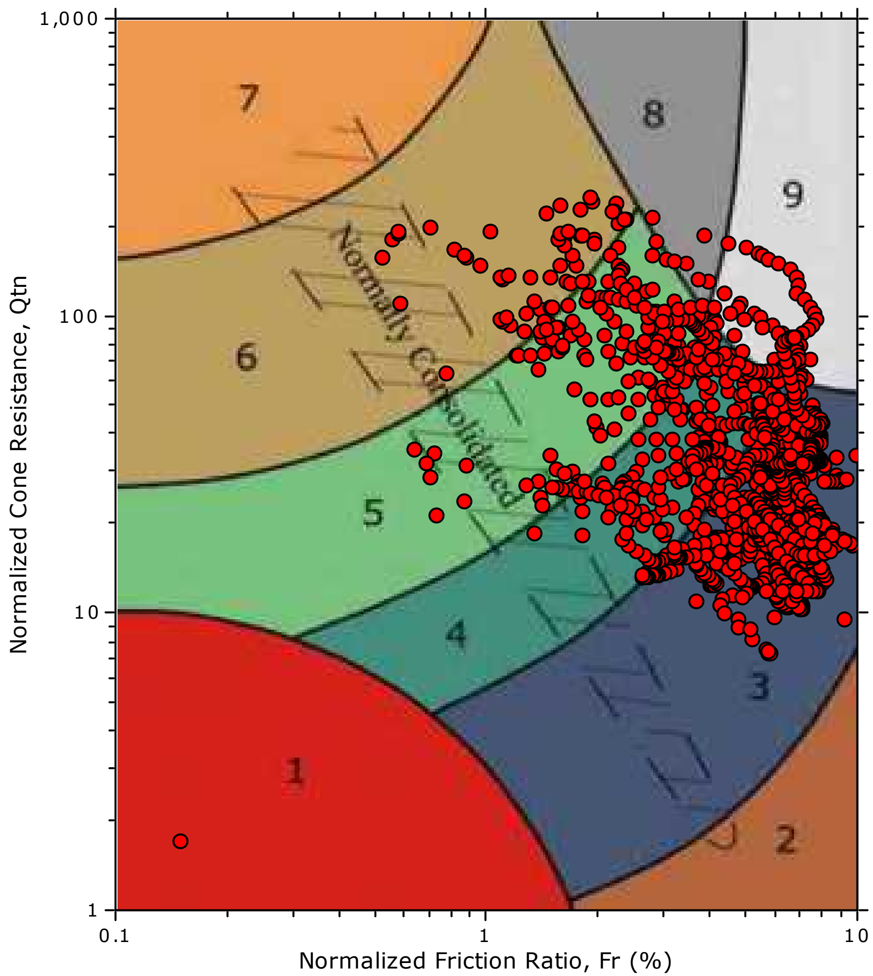
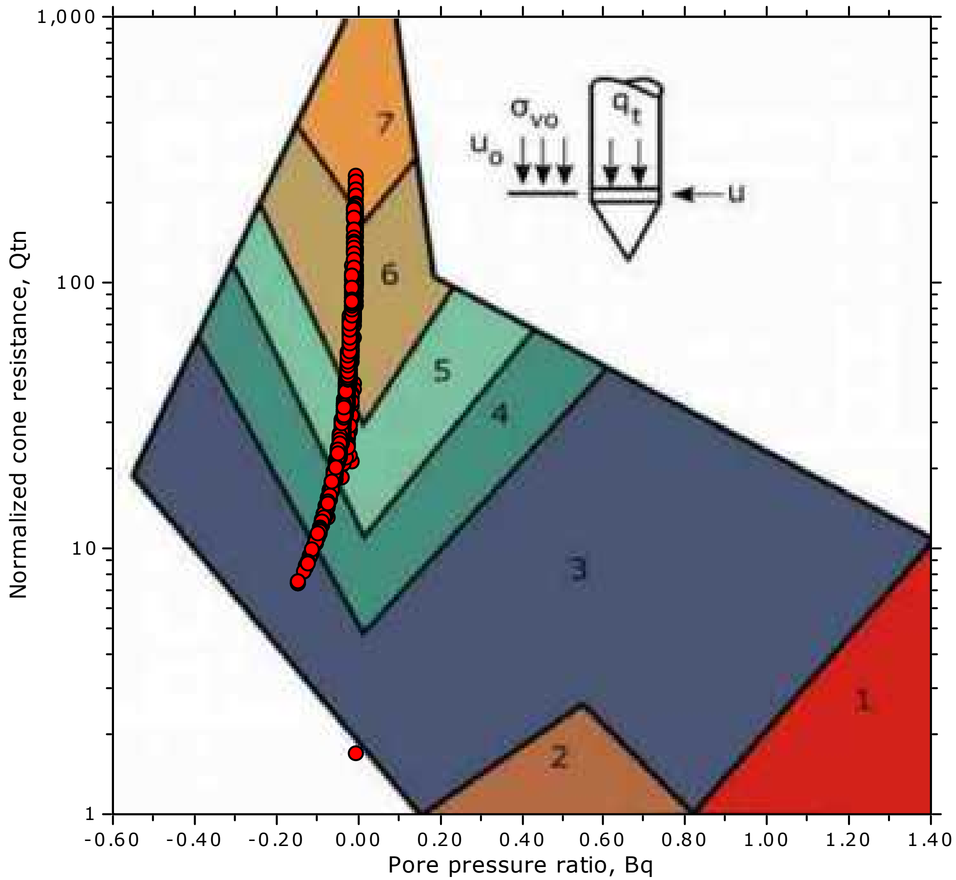
CPT: A8-CPT03
Total depth: 19.72 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

SBT - Bq plots (normalized)

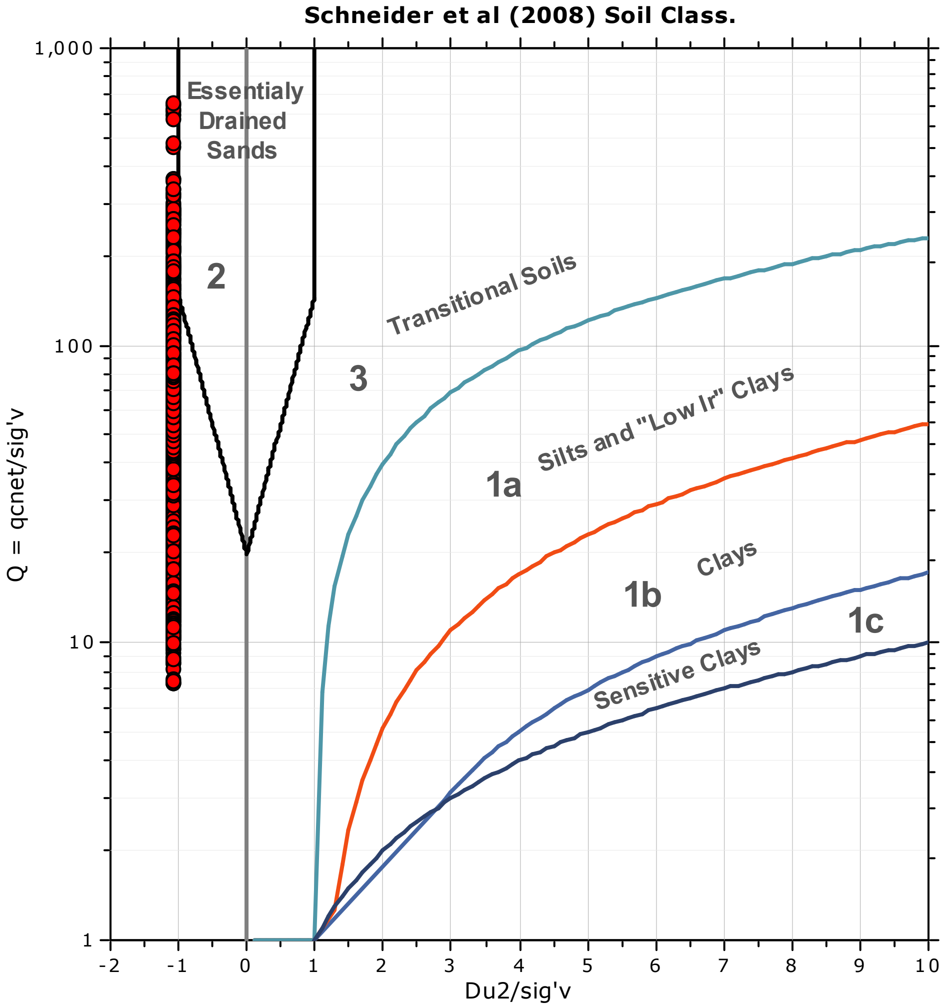


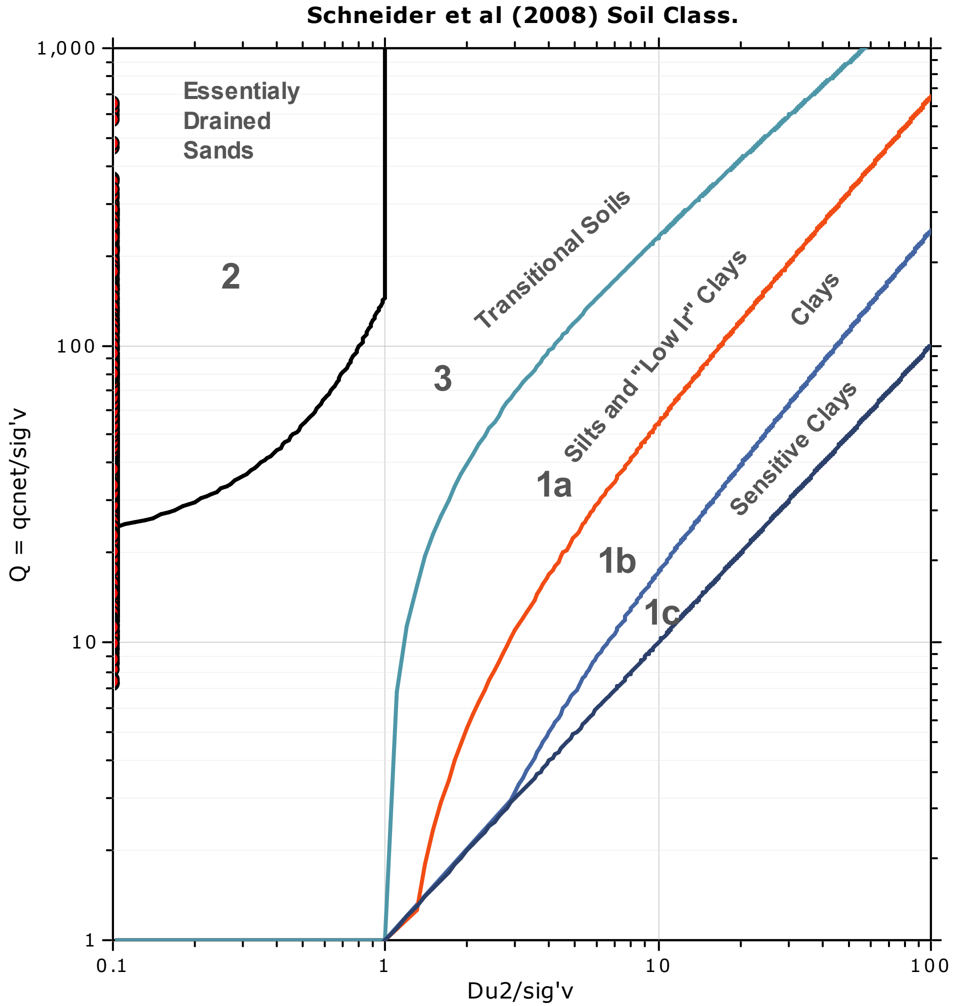


SBTn legend

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

Bq plots (Schneider)





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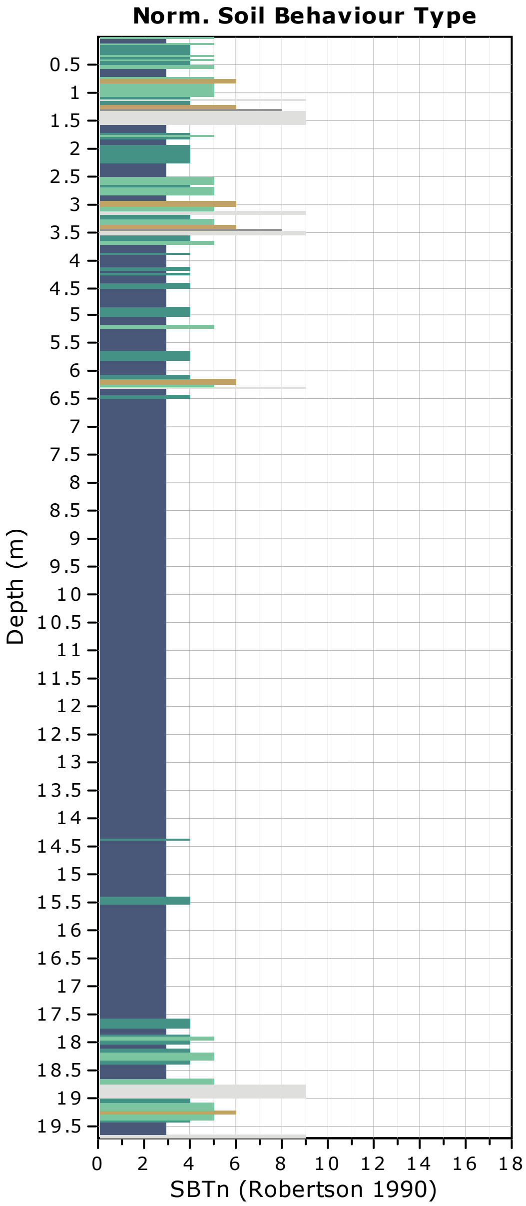
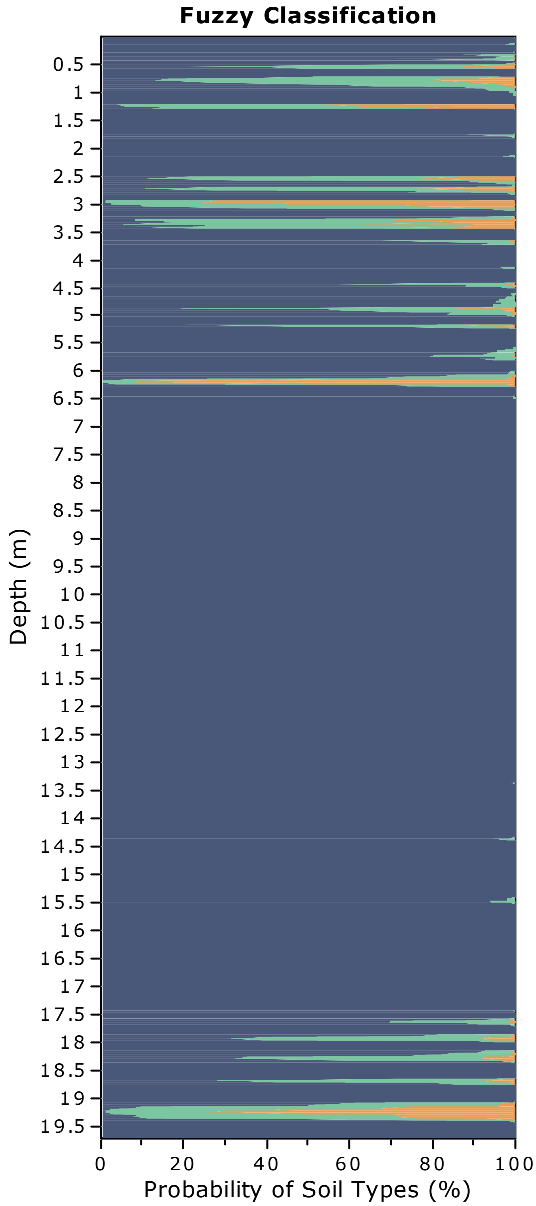
CPT: A8-CPT03
Total depth: 19.72 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:





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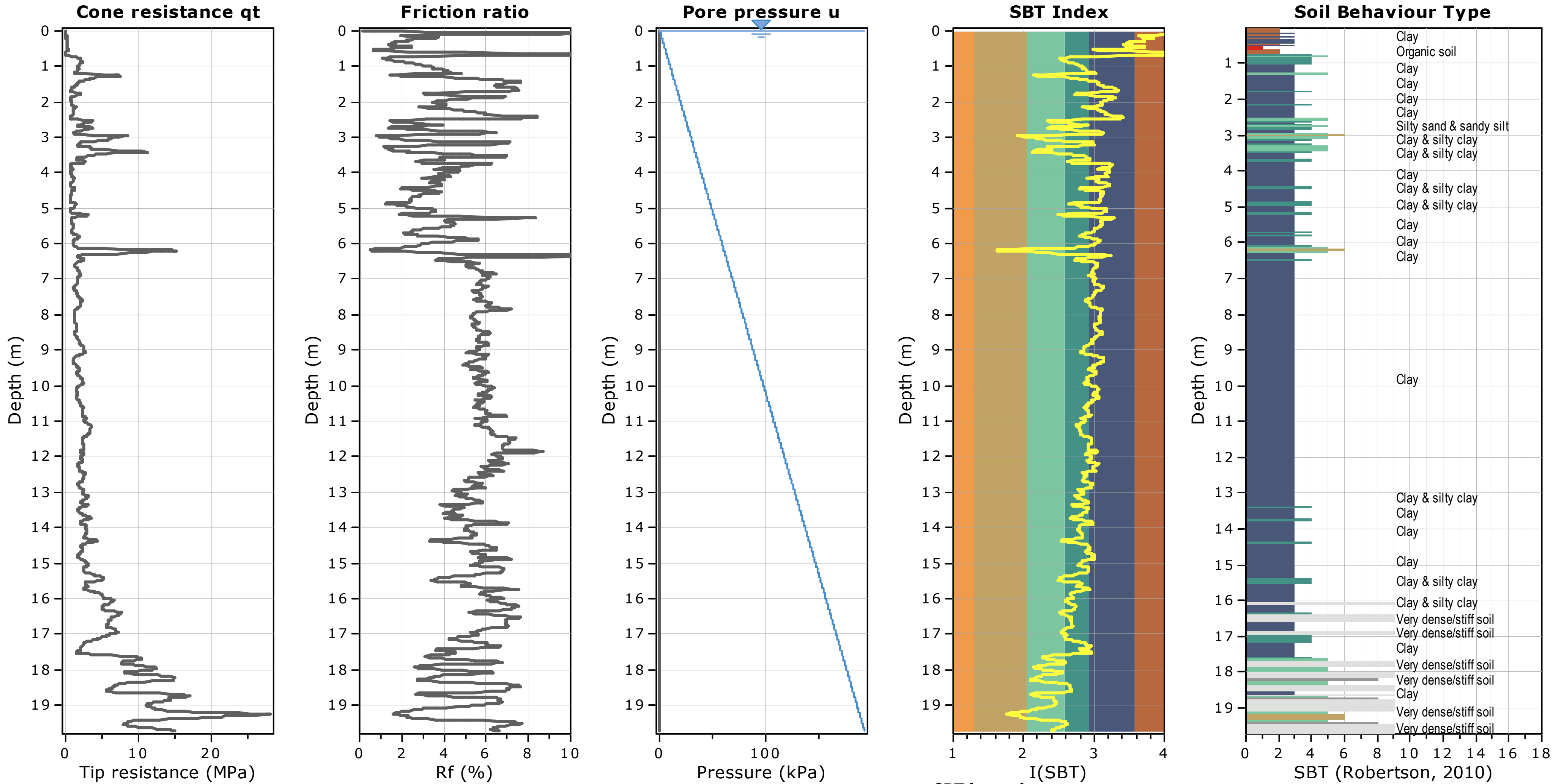
CPT: A8-CPT03
Total depth: 19.72 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBT legend

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

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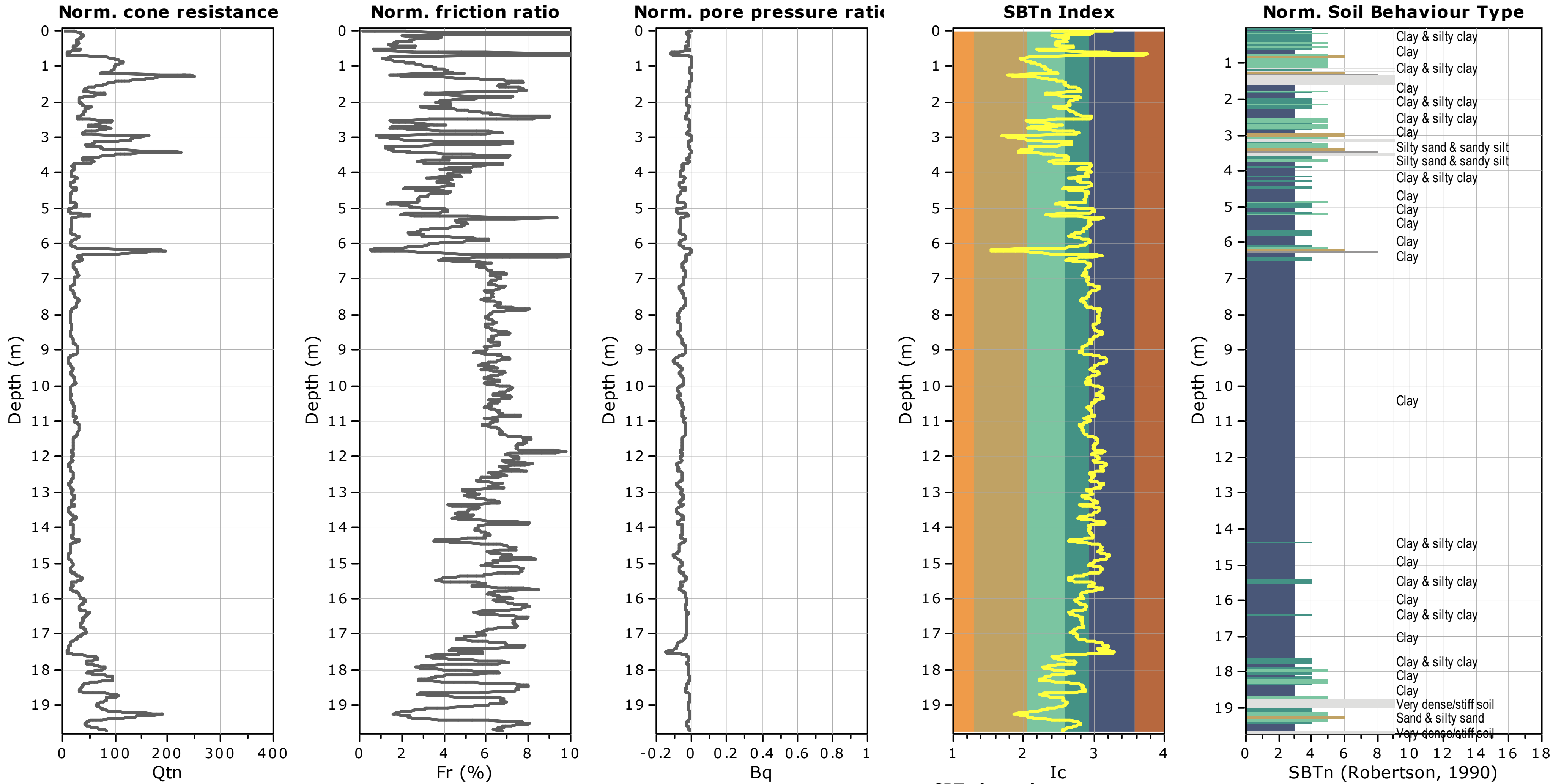
CPT: A8-CPT03
Total depth: 19.72 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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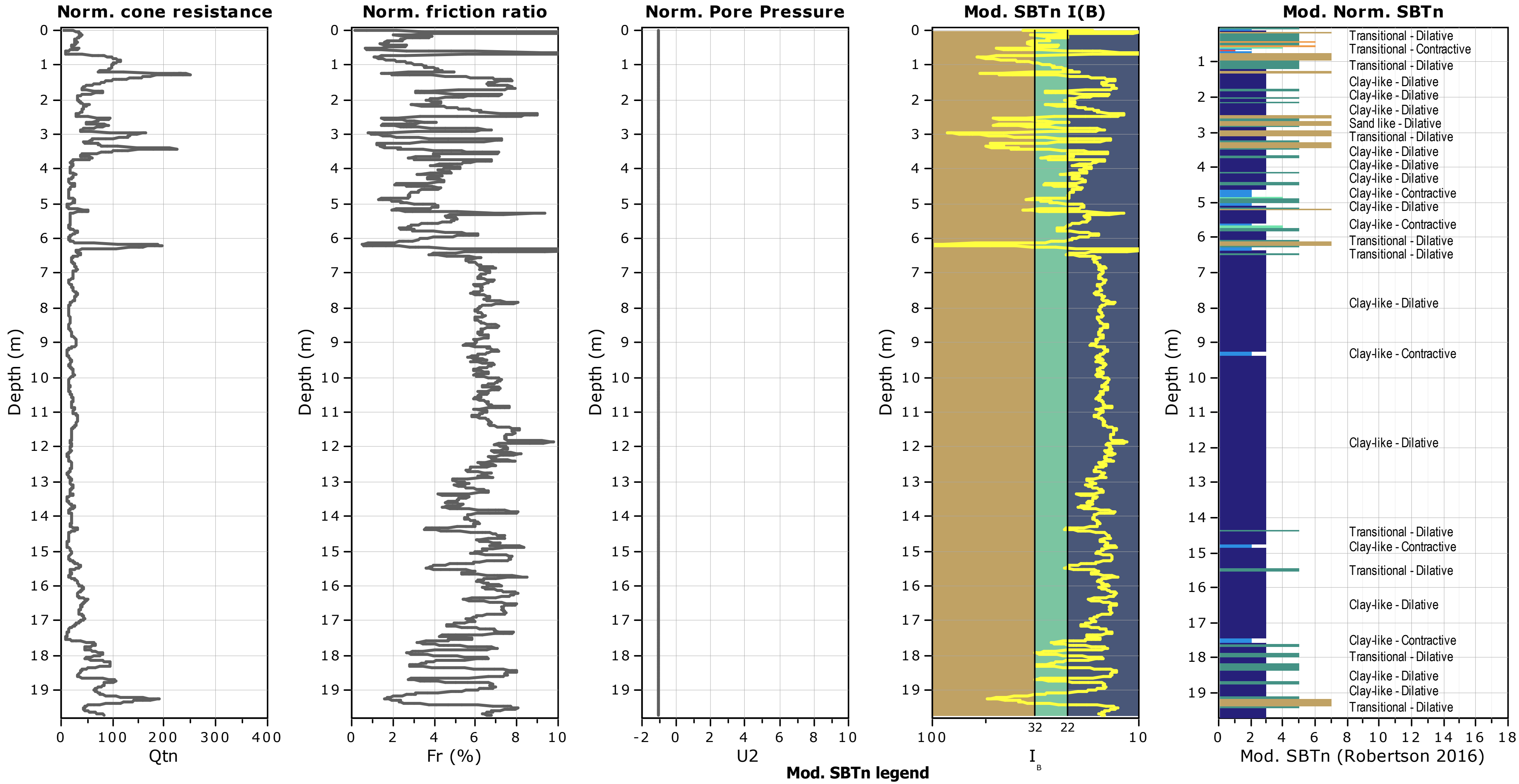
CPT: A8-CPT03
Total depth: 19.72 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

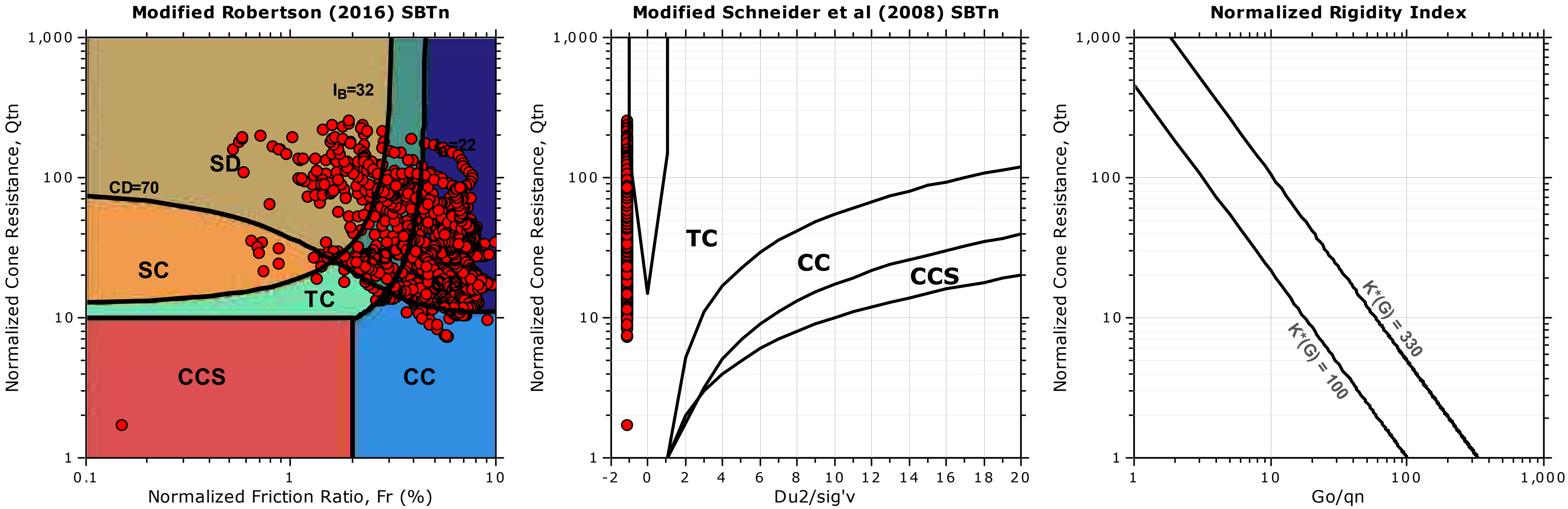
Project:
Location:



Mod. SBTn legend

- 1. CCS: ClayLike - Contractive, Sensitive
- 2. CC: Clay-like - Contractive
- 3. CD: Clay-Like: Dilative
- 4. TC: Transitional - Contractive
- 5. TD: Transitional - Dilative
- 6. SC: Sand-like - Contractive
- 7. SD: Sand-like - Dilative

Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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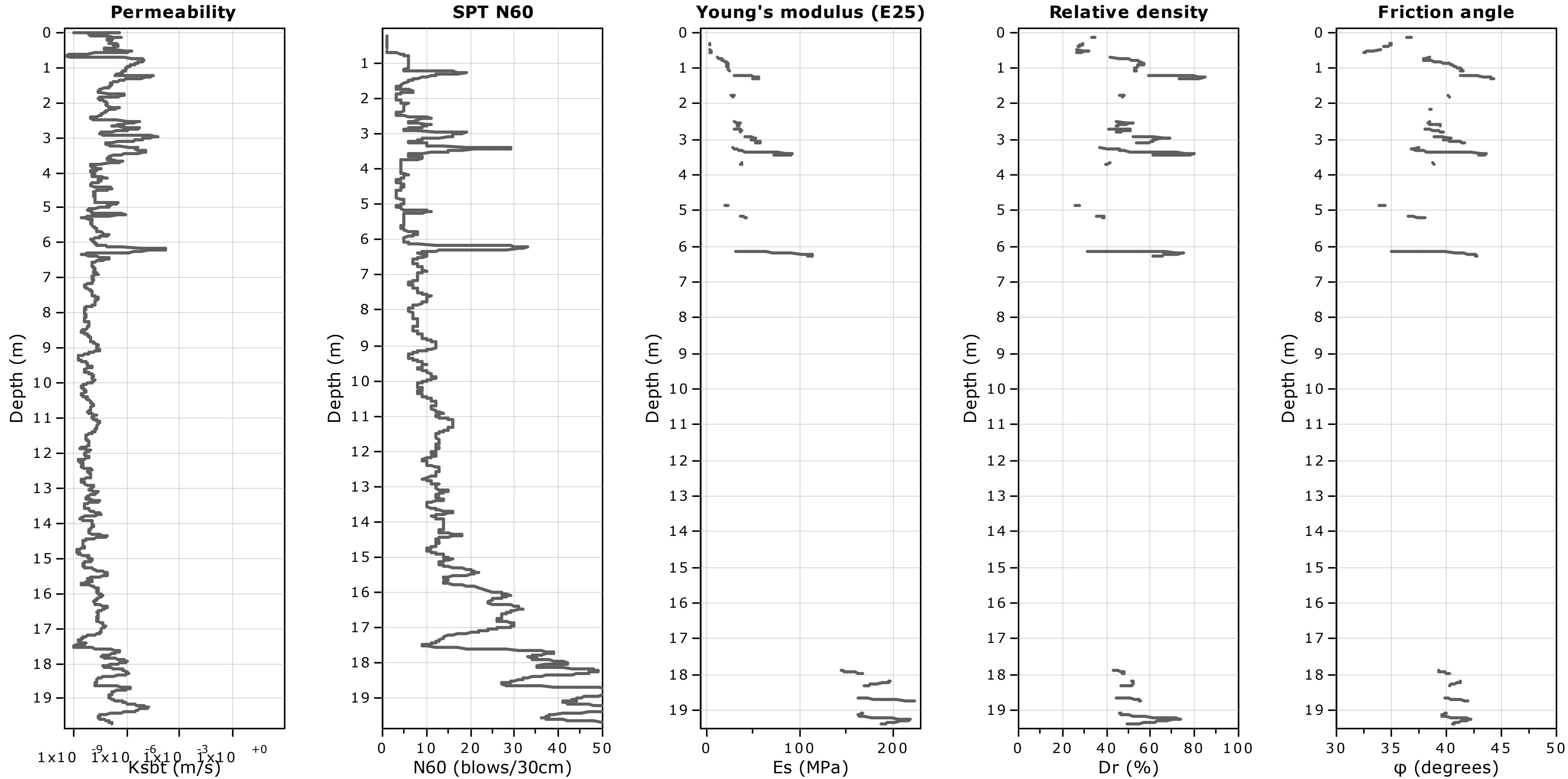
CPT: A8-CPT03
Total depth: 19.72 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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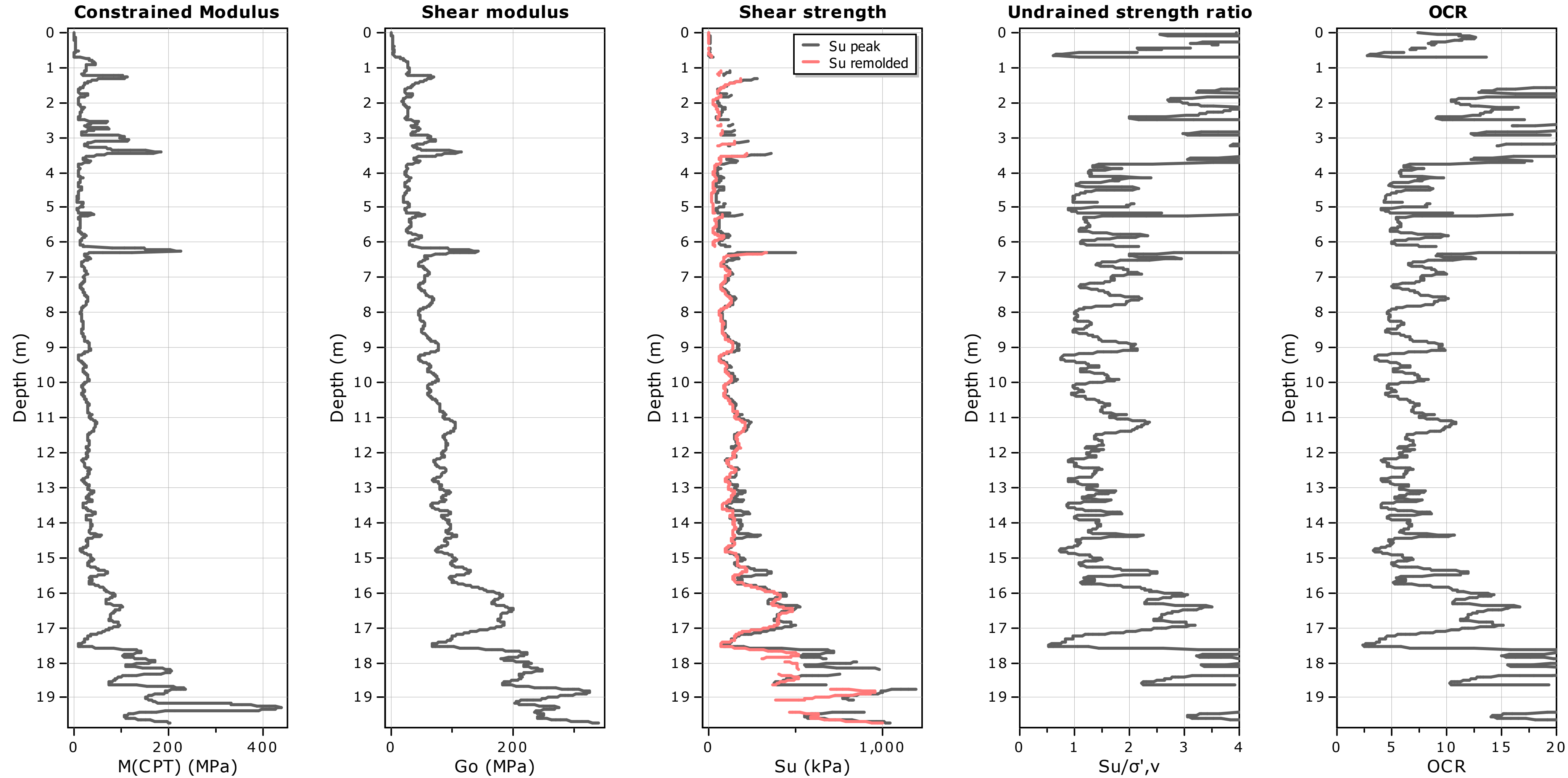
CPT: A8-CPT03
Total depth: 19.72 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14
OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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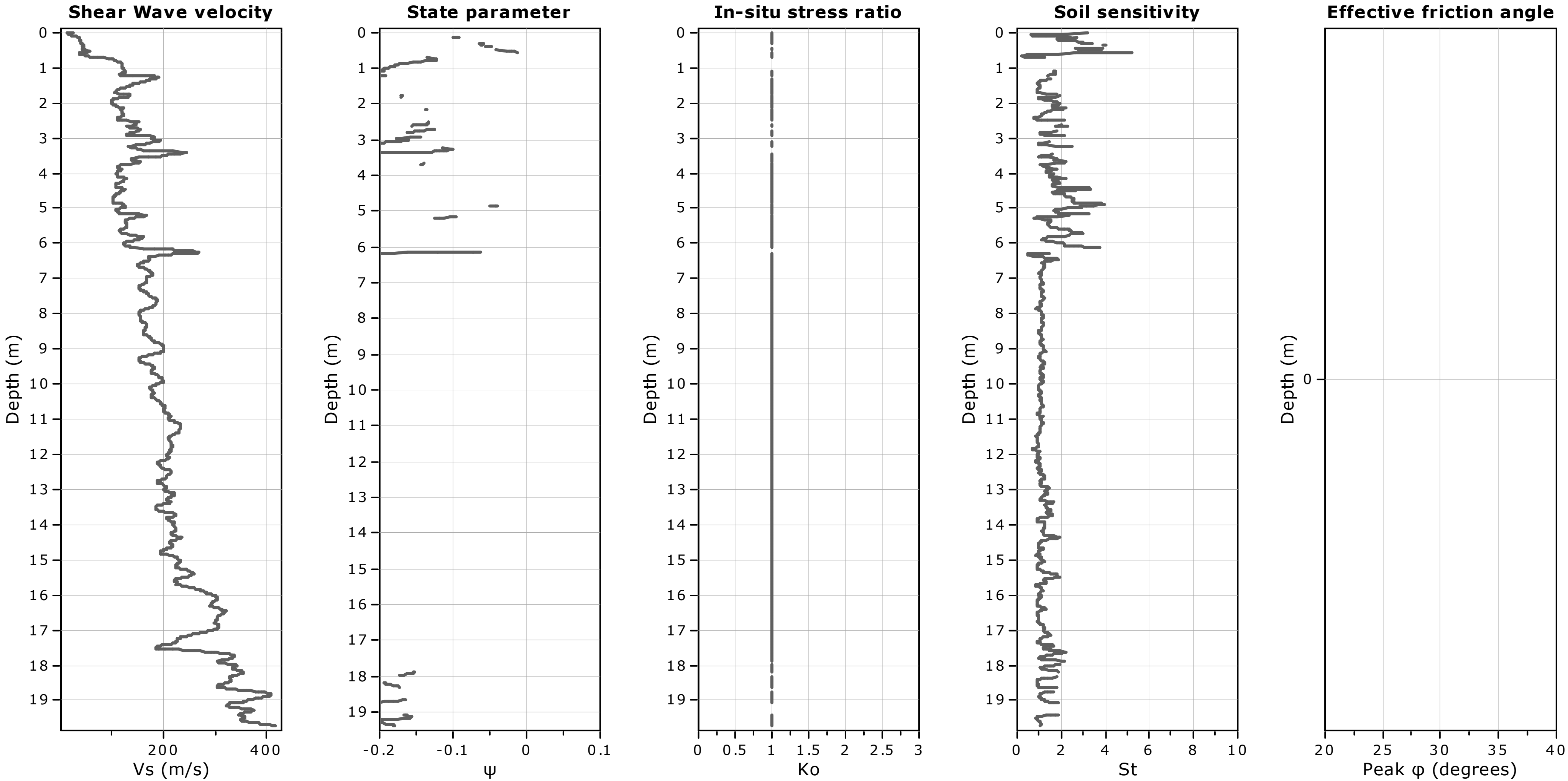
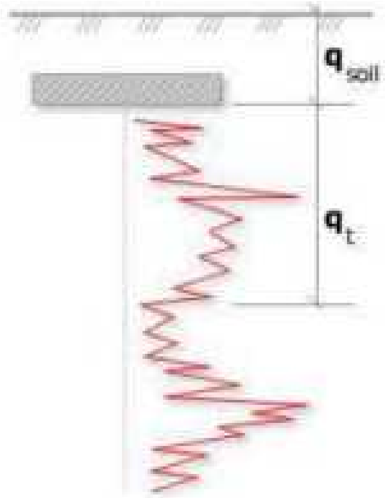
CPT: A8-CPT03
Total depth: 19.72 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters

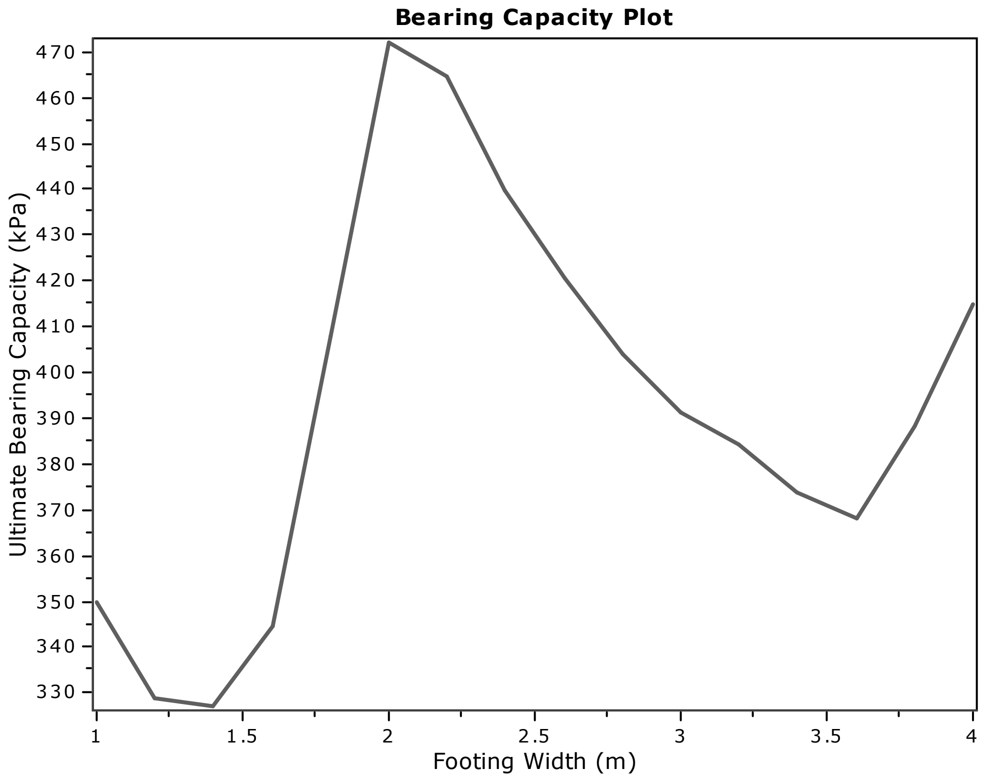
Soil Sensitivity factor, N_S: 7.00
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

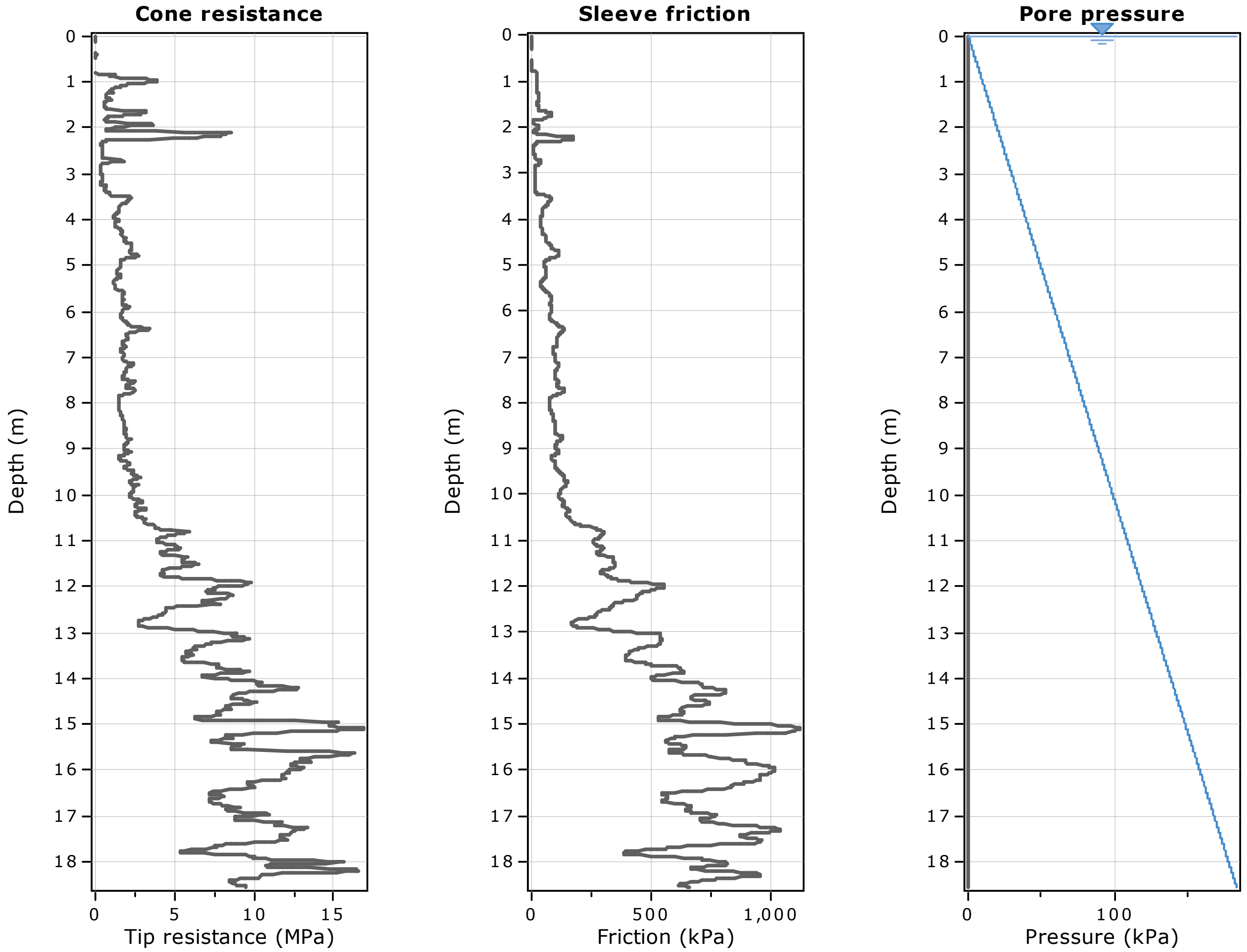


:: Tabular results ::

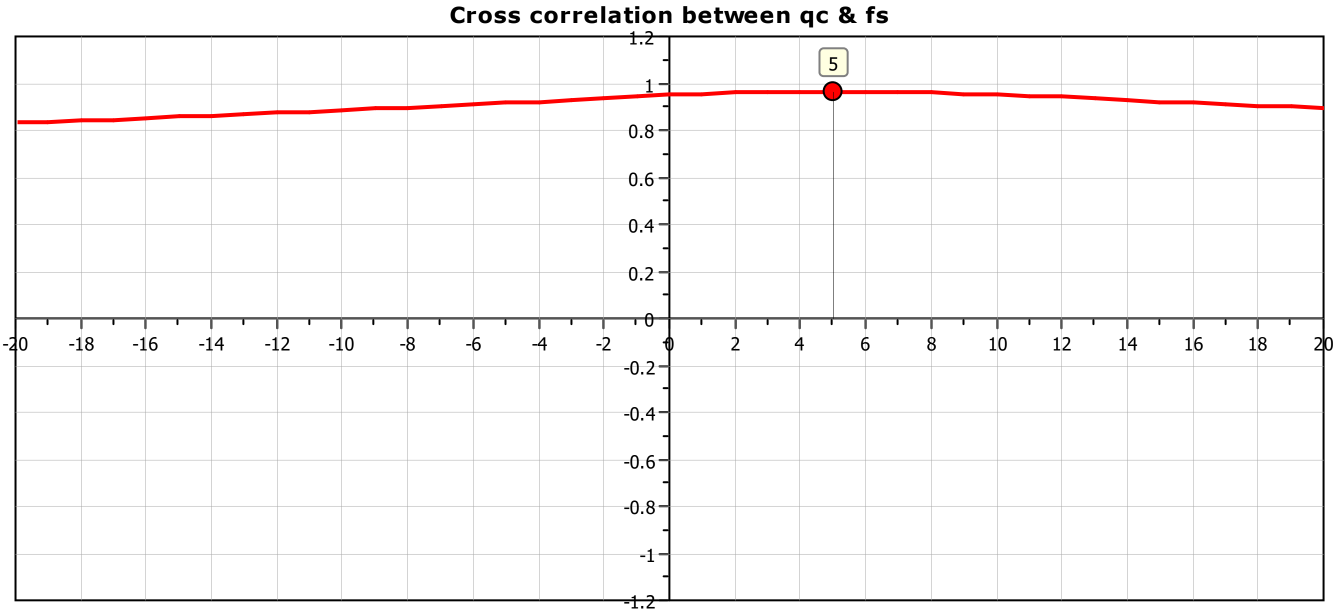
No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.70	0.20	9.50	349.73
2	1.20	0.50	2.30	1.60	0.20	9.50	328.98
3	1.40	0.50	2.60	1.59	0.20	9.50	327.07
4	1.60	0.50	2.90	1.68	0.20	9.50	344.50
5	1.80	0.50	3.20	1.99	0.20	9.50	407.79
6	2.00	0.50	3.50	2.31	0.20	9.50	472.10
7	2.20	0.50	3.80	2.27	0.20	9.50	464.48
8	2.40	0.50	4.10	2.15	0.20	9.50	439.71
9	2.60	0.50	4.40	2.05	0.20	9.50	420.40
10	2.80	0.50	4.70	1.97	0.20	9.50	404.12
11	3.00	0.50	5.00	1.91	0.20	9.50	391.42
12	3.20	0.50	5.30	1.87	0.20	9.50	384.43
13	3.40	0.50	5.60	1.82	0.20	9.50	373.72
14	3.60	0.50	5.90	1.79	0.20	9.50	368.08
15	3.80	0.50	6.20	1.89	0.20	9.50	388.22
16	4.00	0.50	6.50	2.03	0.20	9.50	414.92

CPT: A8-CPT04
Total depth: 18.55 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

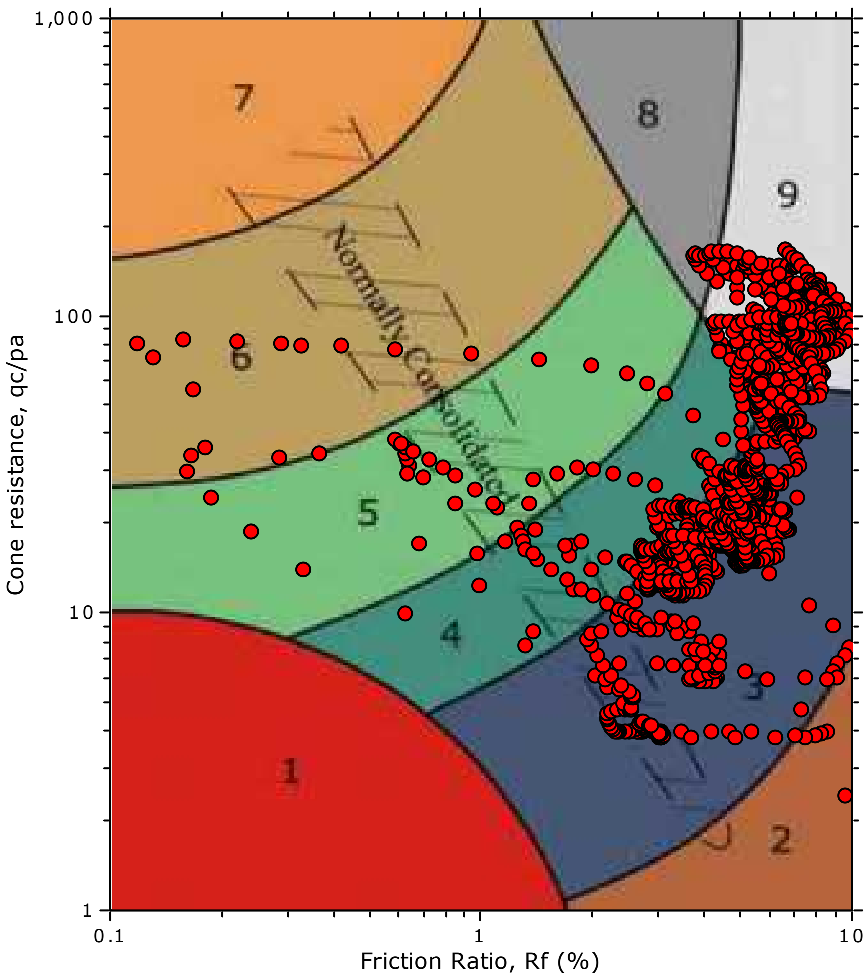
Project:
Location:

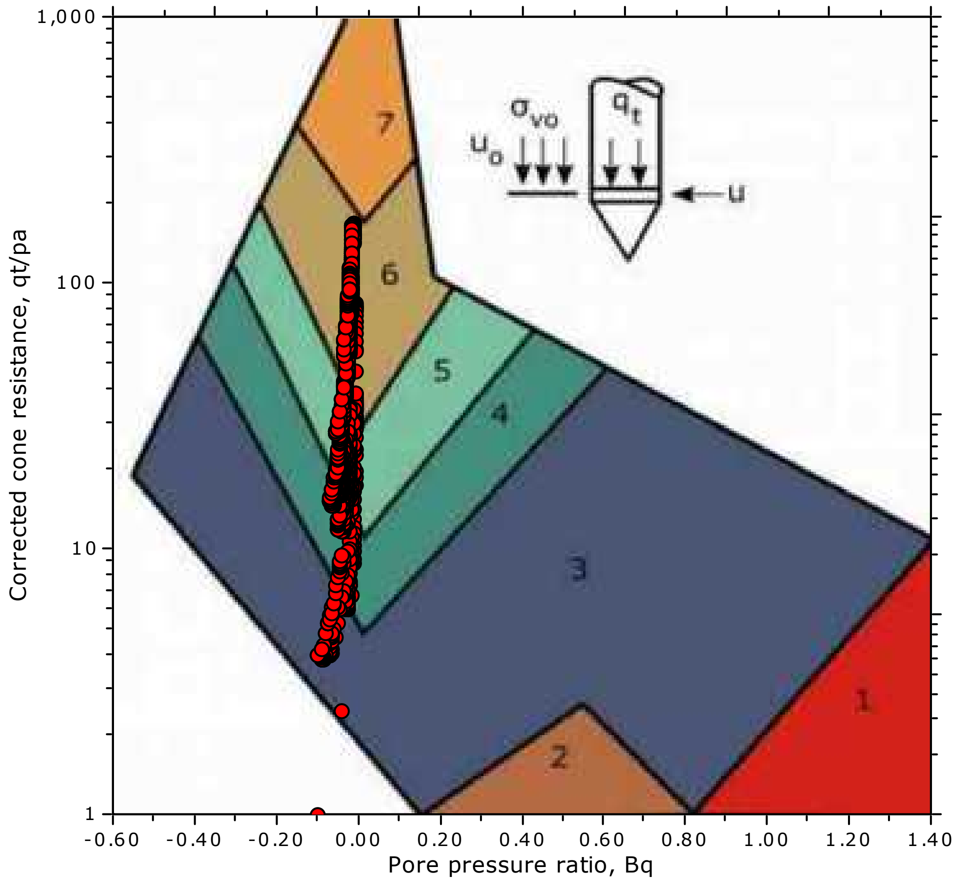


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

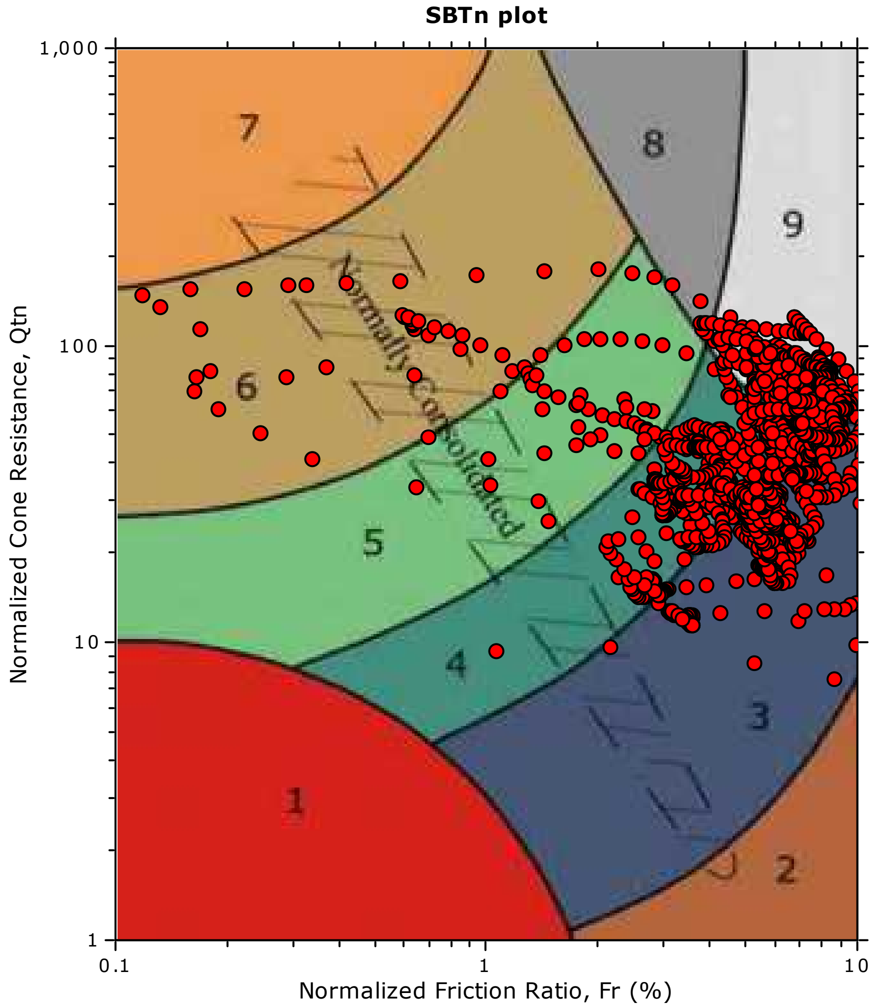


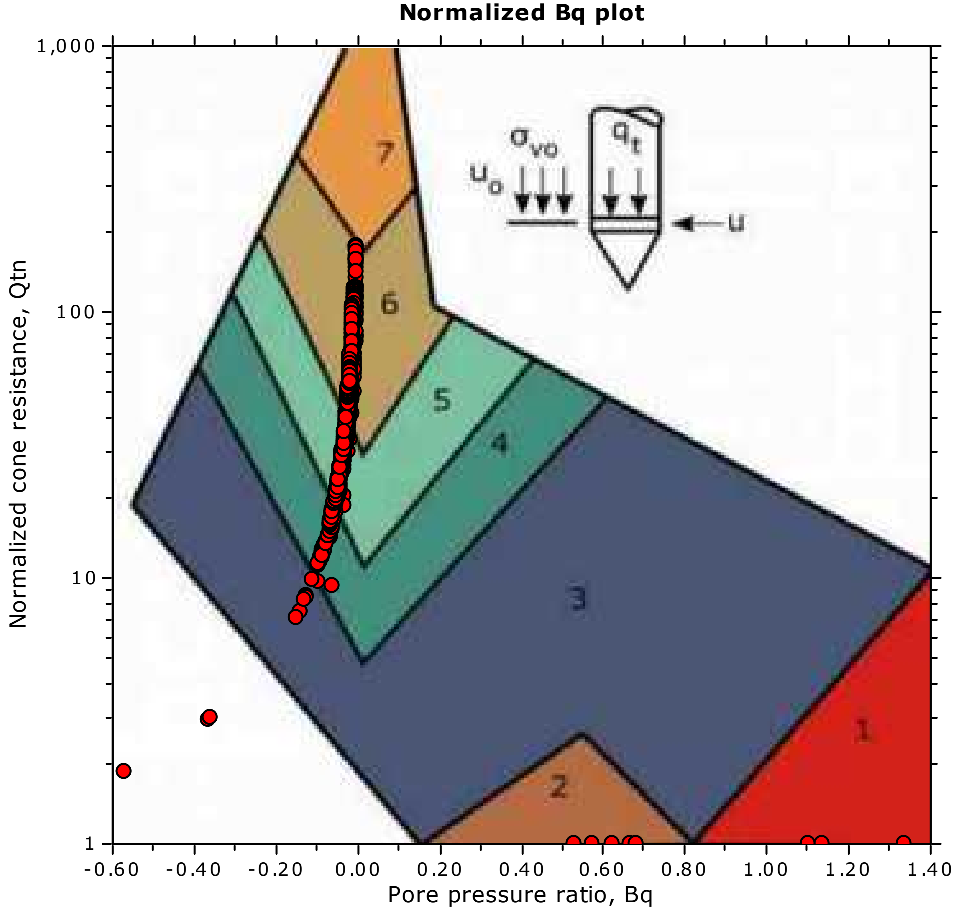


SBT legend

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

SBT - Bq plots (normalized)

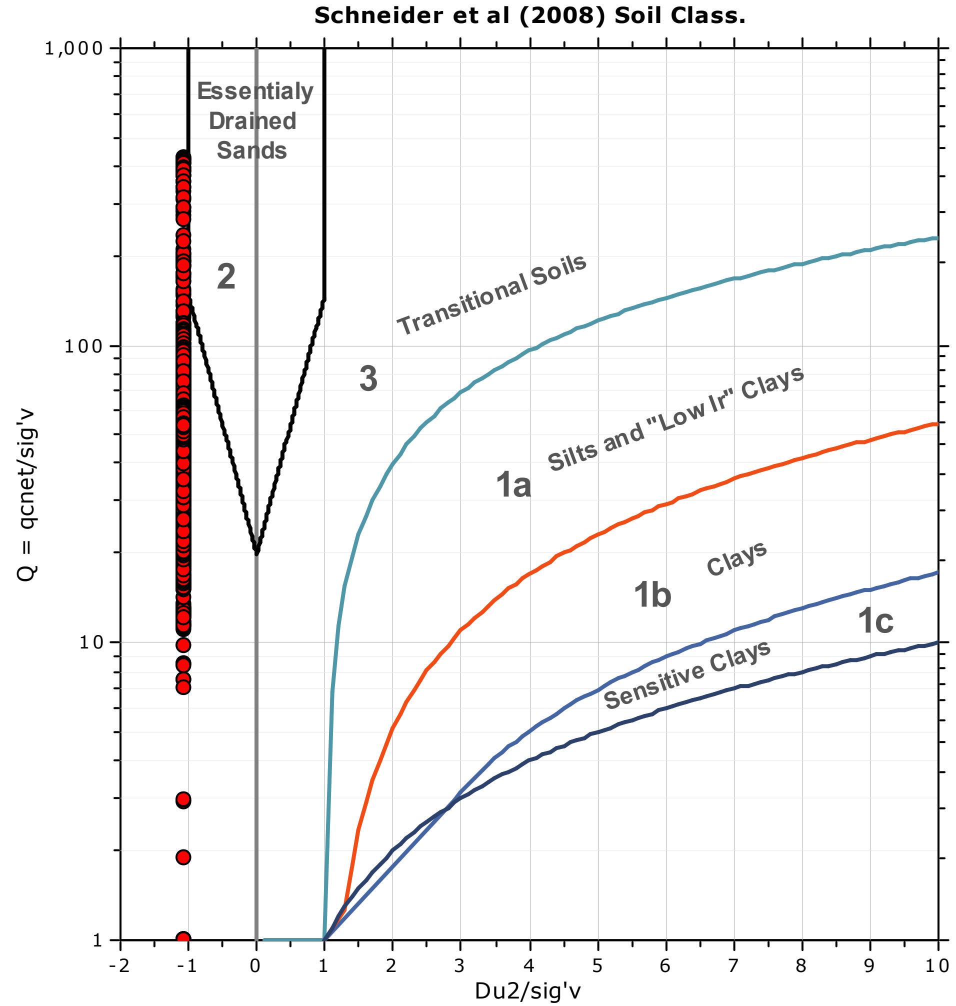


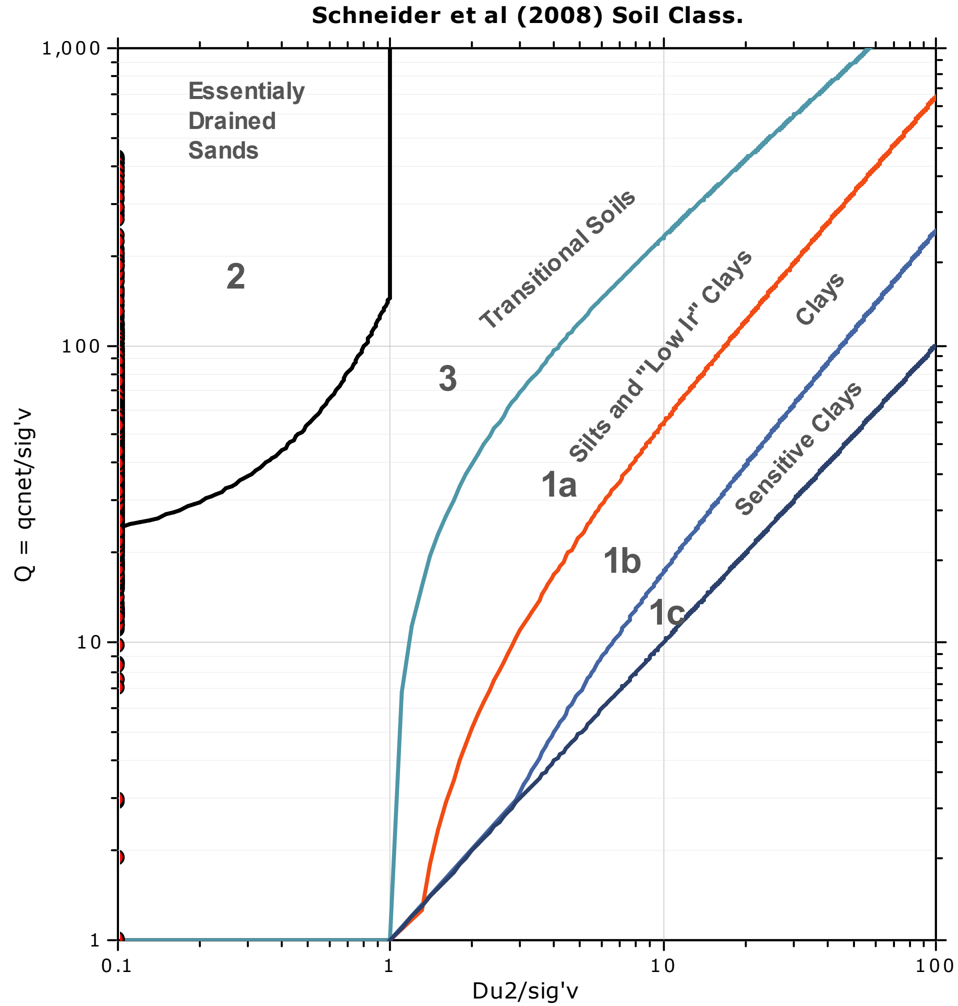


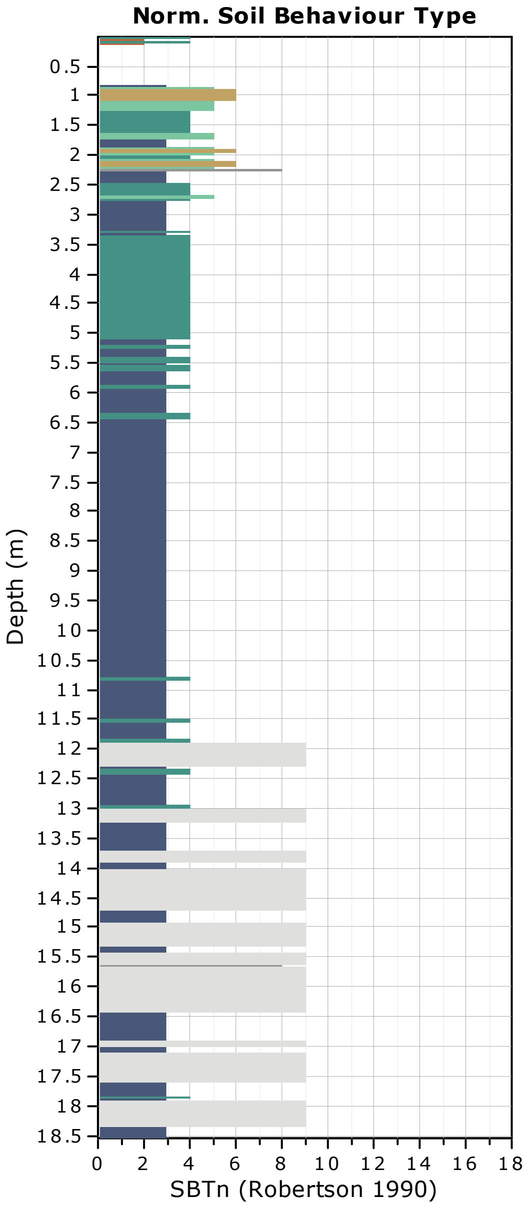
SBTn legend

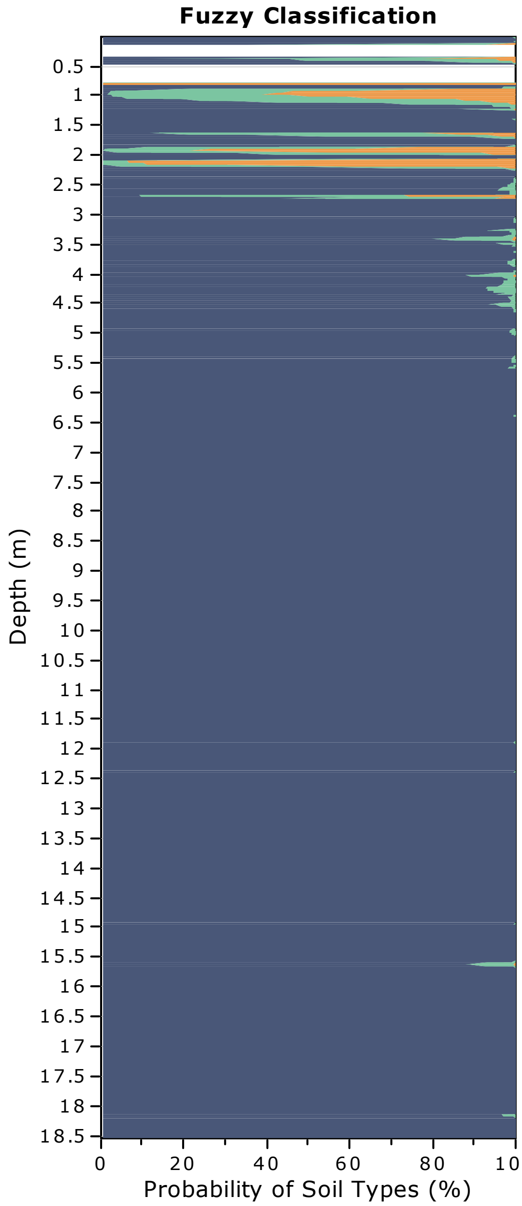
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

Bq plots (Schneider)





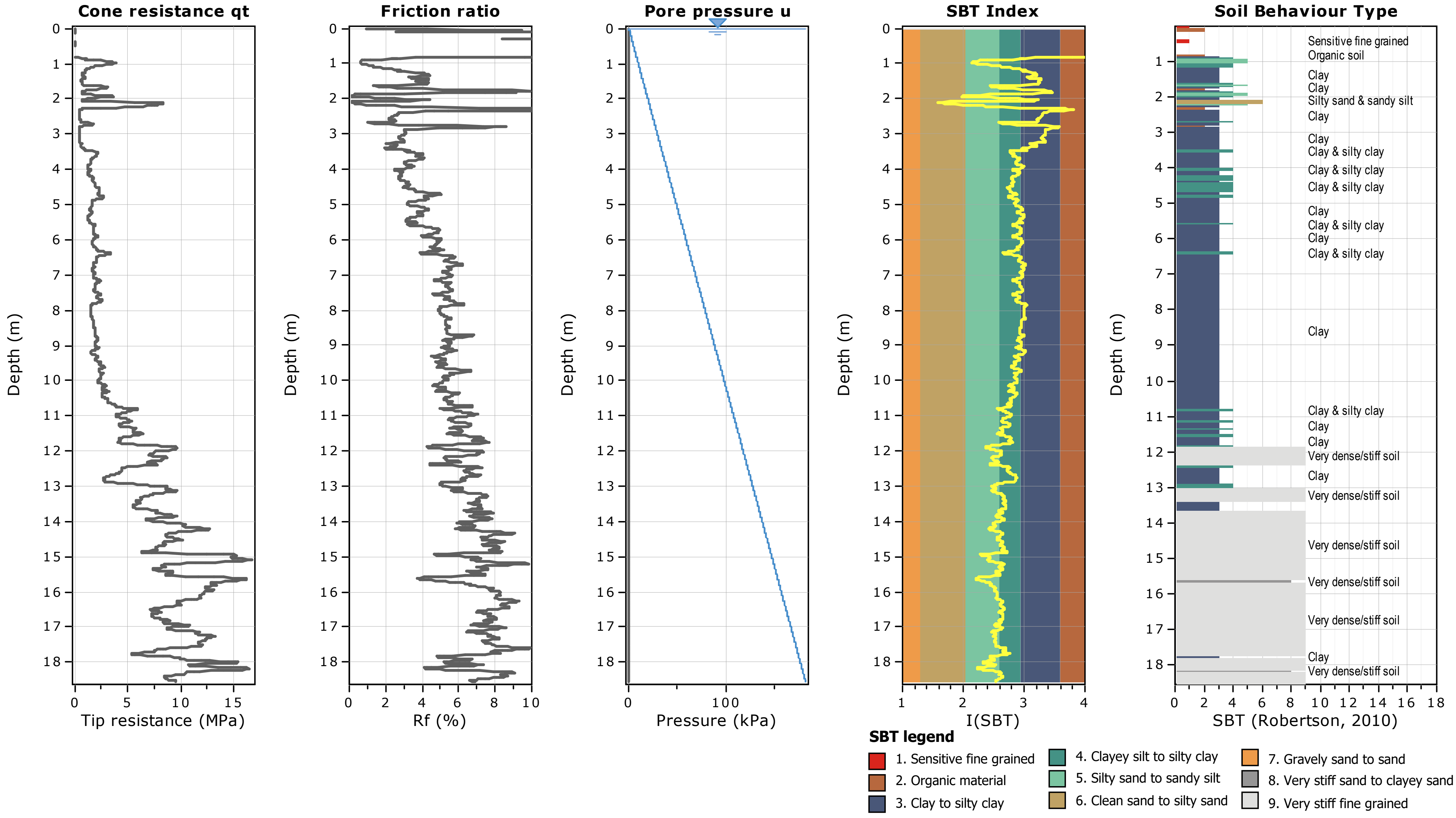

Norm. Soil Behaviour Type
Depth (m)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
11.5
12
12.5
13
13.5
14
14.5
15
15.5
16
16.5
17
17.5
18
18.5
0 2 4 6 8 10 12 14 16 18
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
0 20 40 60 80 100
Probability of Soil Types (%)

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A8-CPT04
Total depth: 18.55 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

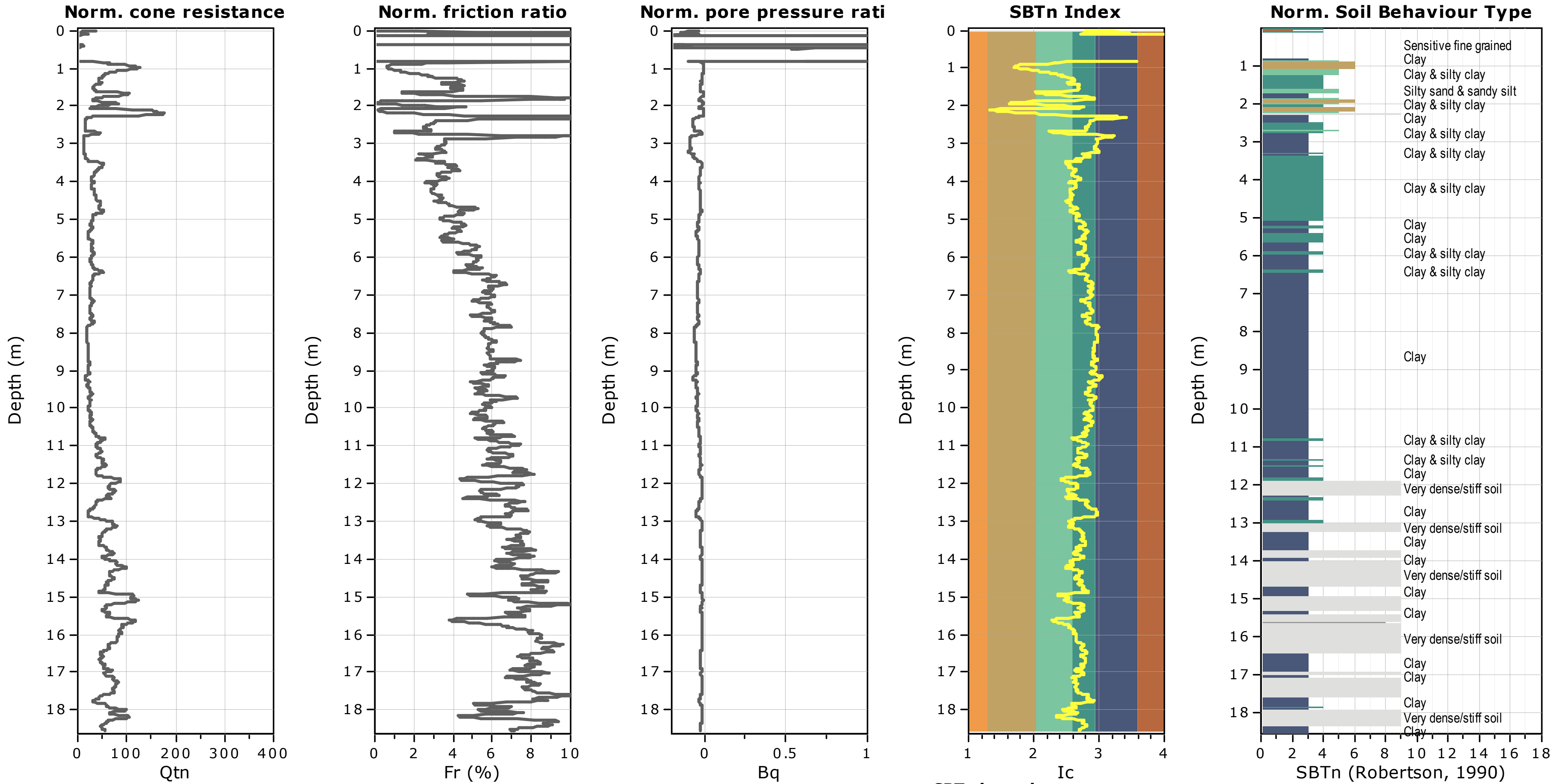
Project:
Location:



GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A8-CPT04
Total depth: 18.55 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

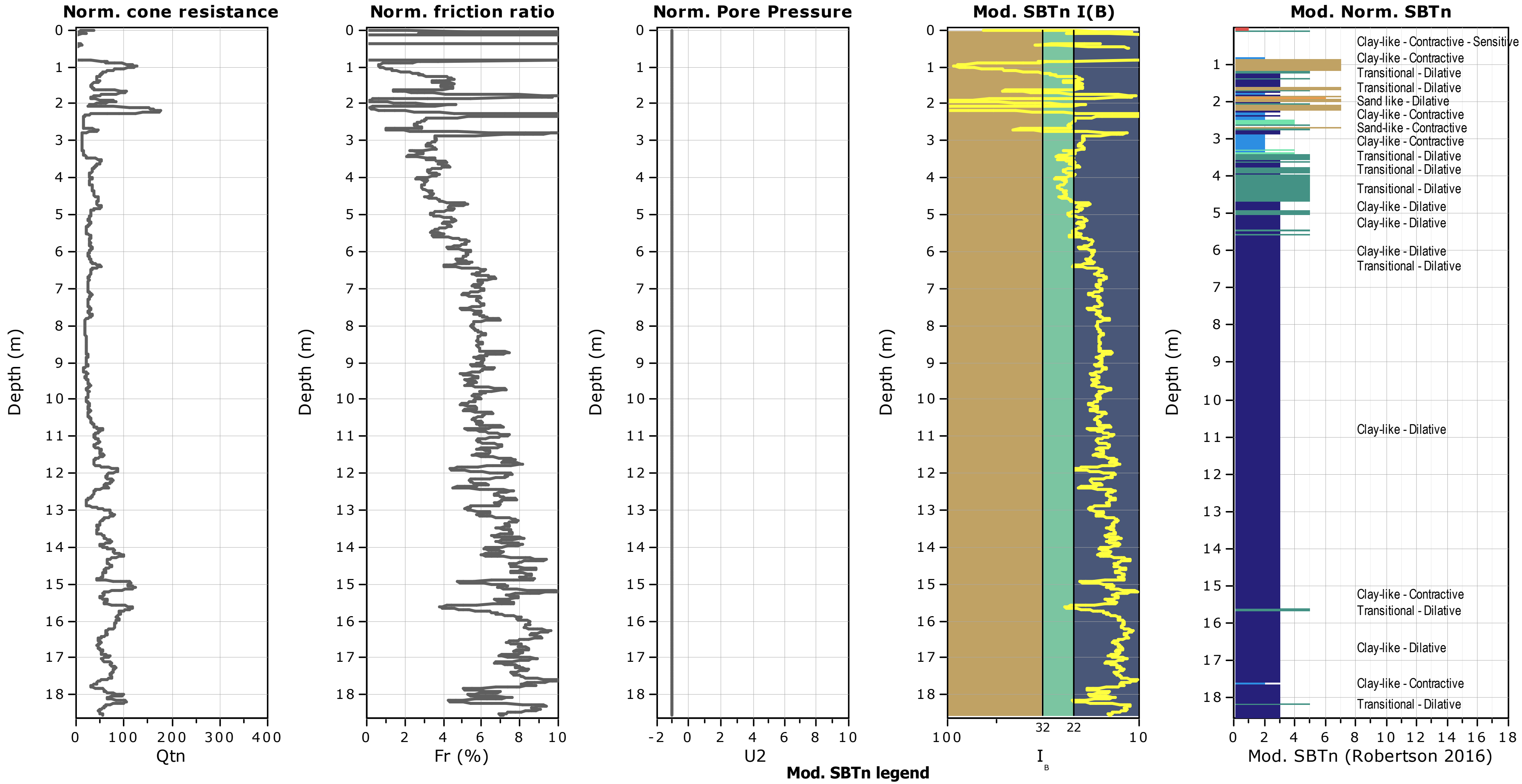


SBTn legend

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

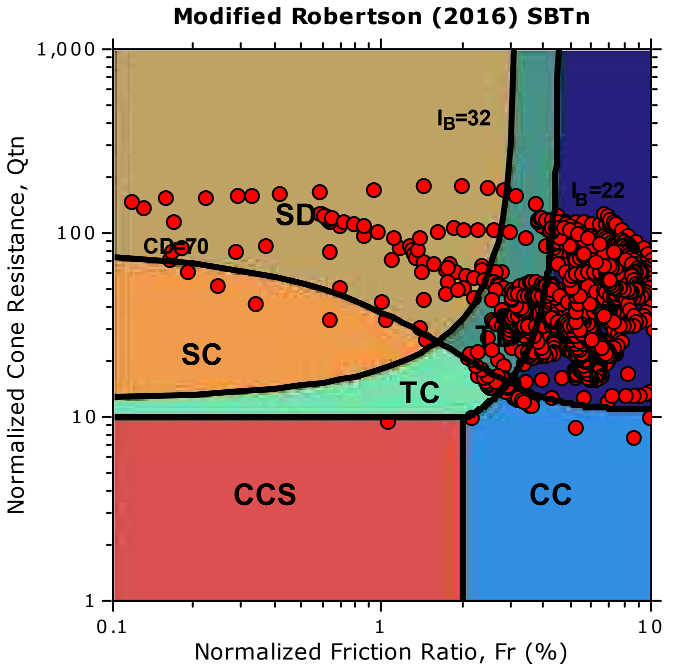
CPT: A8-CPT04
Total depth: 18.55 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

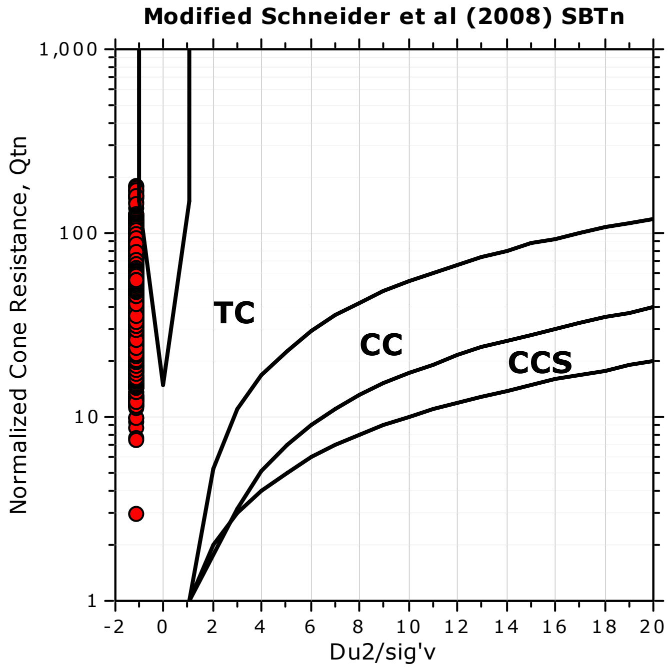
Project:
Location:

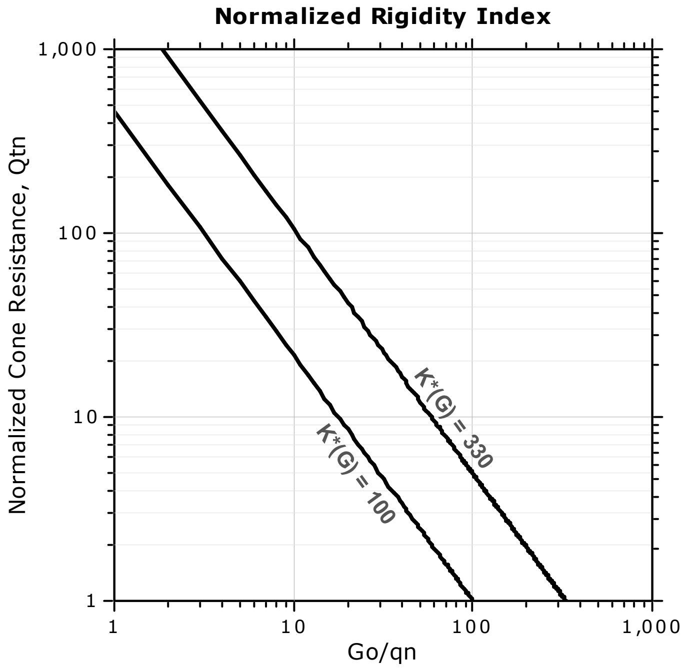


Mod. SBTn legend
1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

Updated SBTn plots







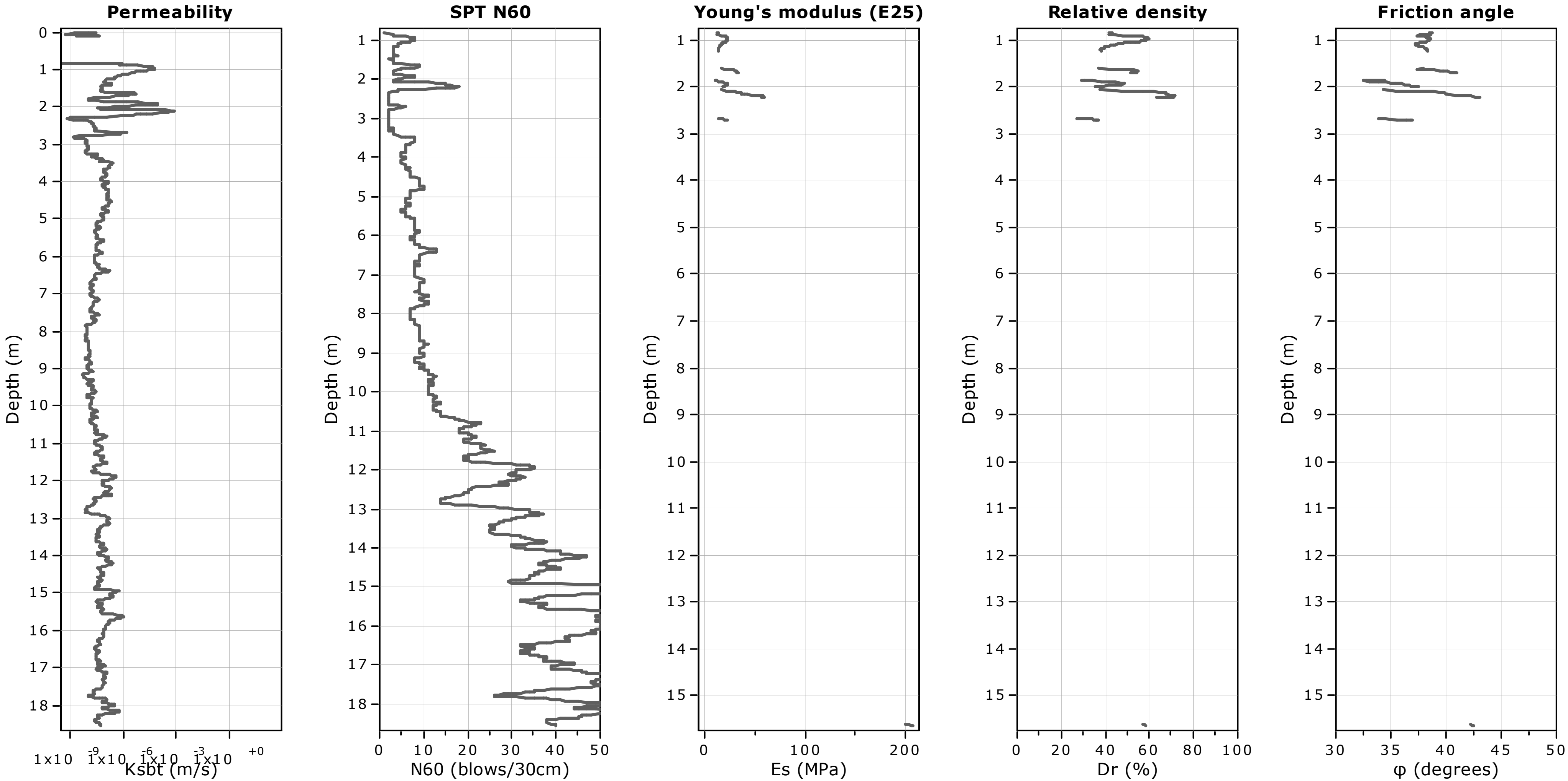
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A8-CPT04
Total depth: 18.55 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

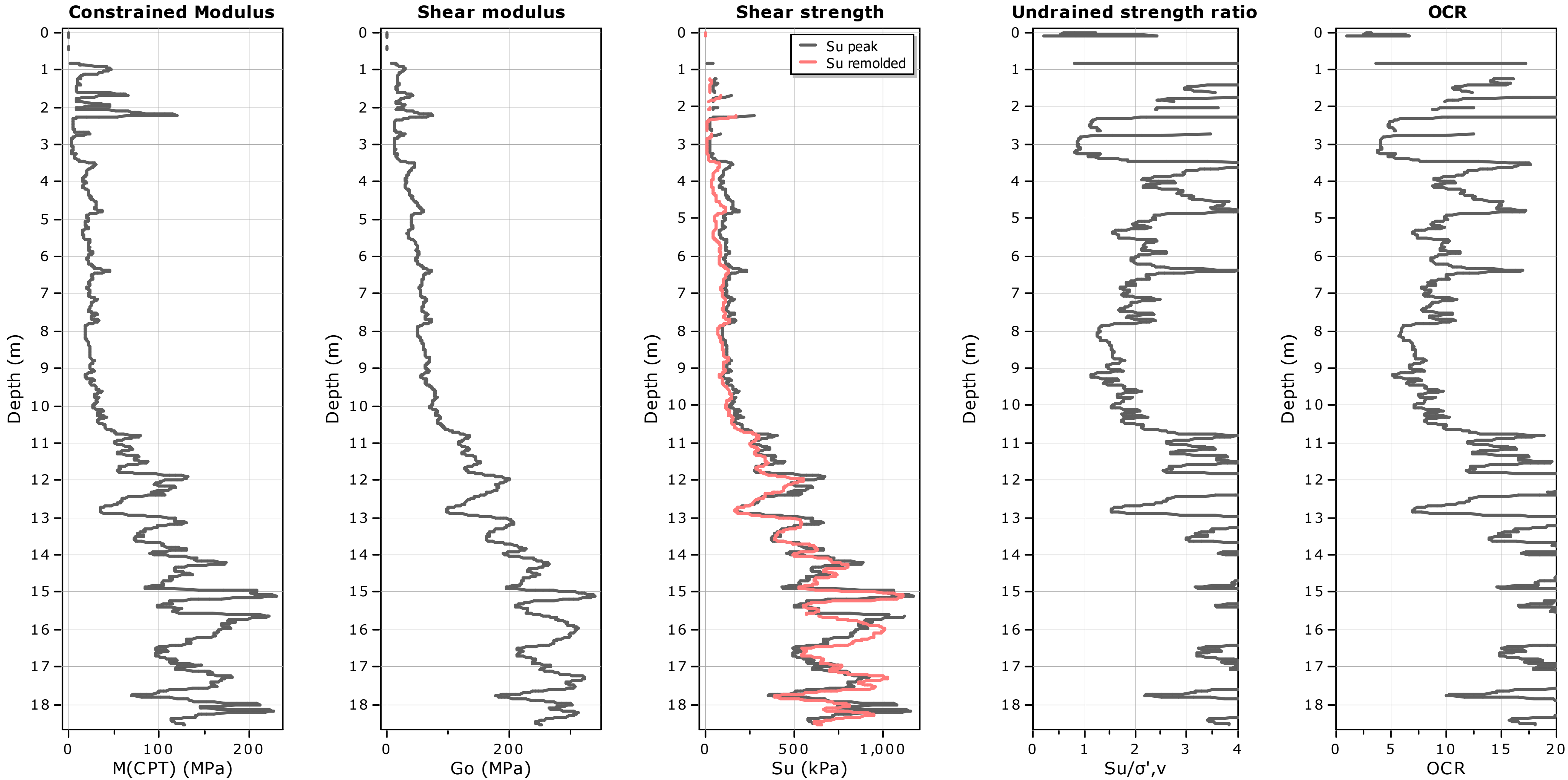
Project:
Location:



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

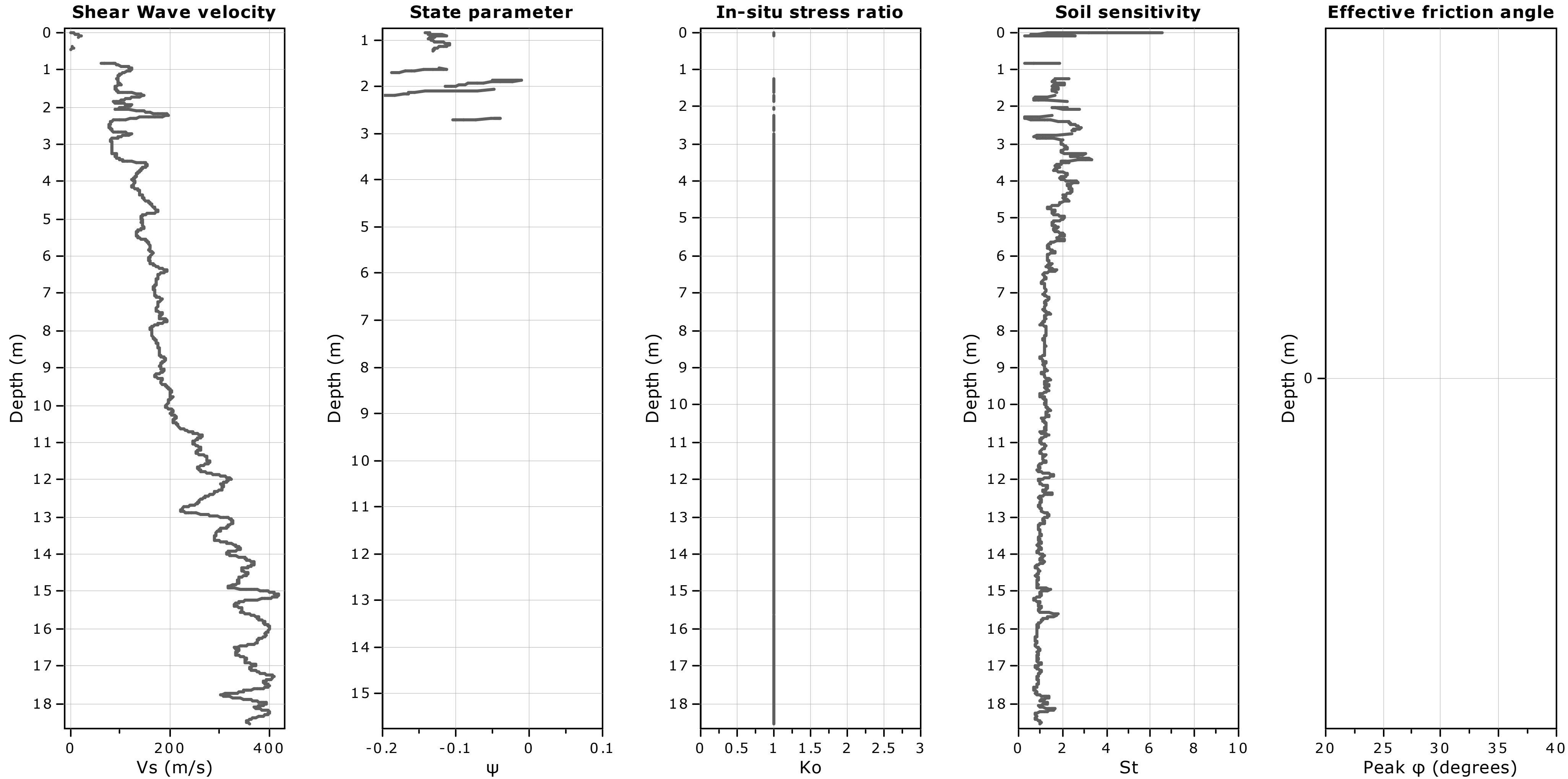
CPT: A8-CPT04
Total depth: 18.55 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

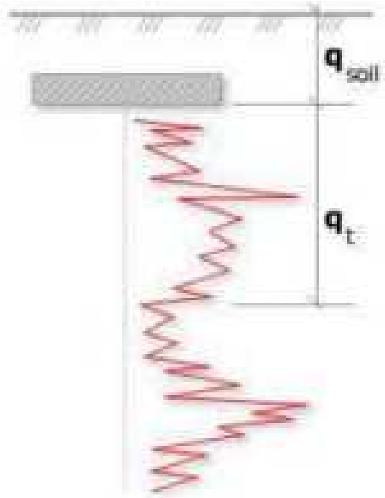
OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

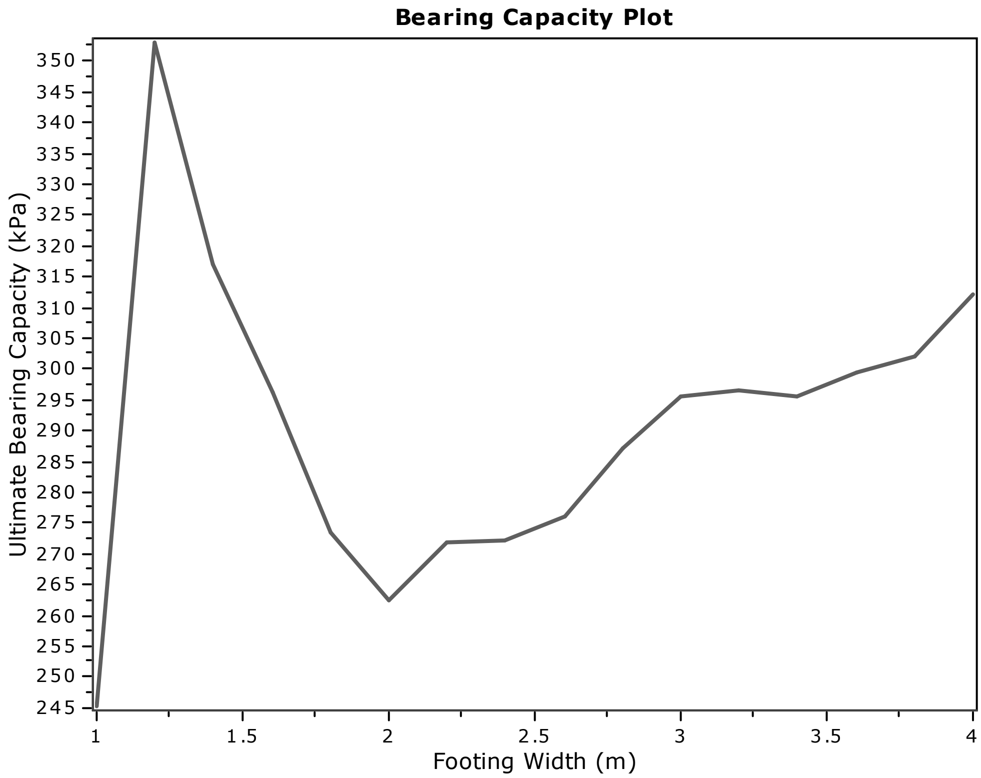
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.18	0.20	9.50	245.27
2	1.20	0.50	2.30	1.72	0.20	9.50	353.03
3	1.40	0.50	2.60	1.54	0.20	9.50	317.15
4	1.60	0.50	2.90	1.43	0.20	9.50	296.18
5	1.80	0.50	3.20	1.32	0.20	9.50	273.40
6	2.00	0.50	3.50	1.26	0.20	9.50	262.46
7	2.20	0.50	3.80	1.31	0.20	9.50	271.96
8	2.40	0.50	4.10	1.31	0.20	9.50	272.19
9	2.60	0.50	4.40	1.33	0.20	9.50	275.97
10	2.80	0.50	4.70	1.39	0.20	9.50	287.30
11	3.00	0.50	5.00	1.43	0.20	9.50	295.70
12	3.20	0.50	5.30	1.43	0.20	9.50	296.47
13	3.40	0.50	5.60	1.43	0.20	9.50	295.68
14	3.60	0.50	5.90	1.45	0.20	9.50	299.32
15	3.80	0.50	6.20	1.46	0.20	9.50	302.18
16	4.00	0.50	6.50	1.51	0.20	9.50	311.97

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

:: N_{SPT} (blows per 30 cm) ::

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

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

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

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

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

:: Relative Density, Dr (%) ::

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

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

:: State Parameter, ψ ::

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

:: Drained Friction Angle, φ (°) ::

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

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

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

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

If $I_c \geq 2.20$

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

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

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

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

:: Soil Sensitivity, S_t ::

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

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

:: Peak Friction Angle, φ' (°) ::

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

(applicable for $0.10 < B_q < 1.00$)

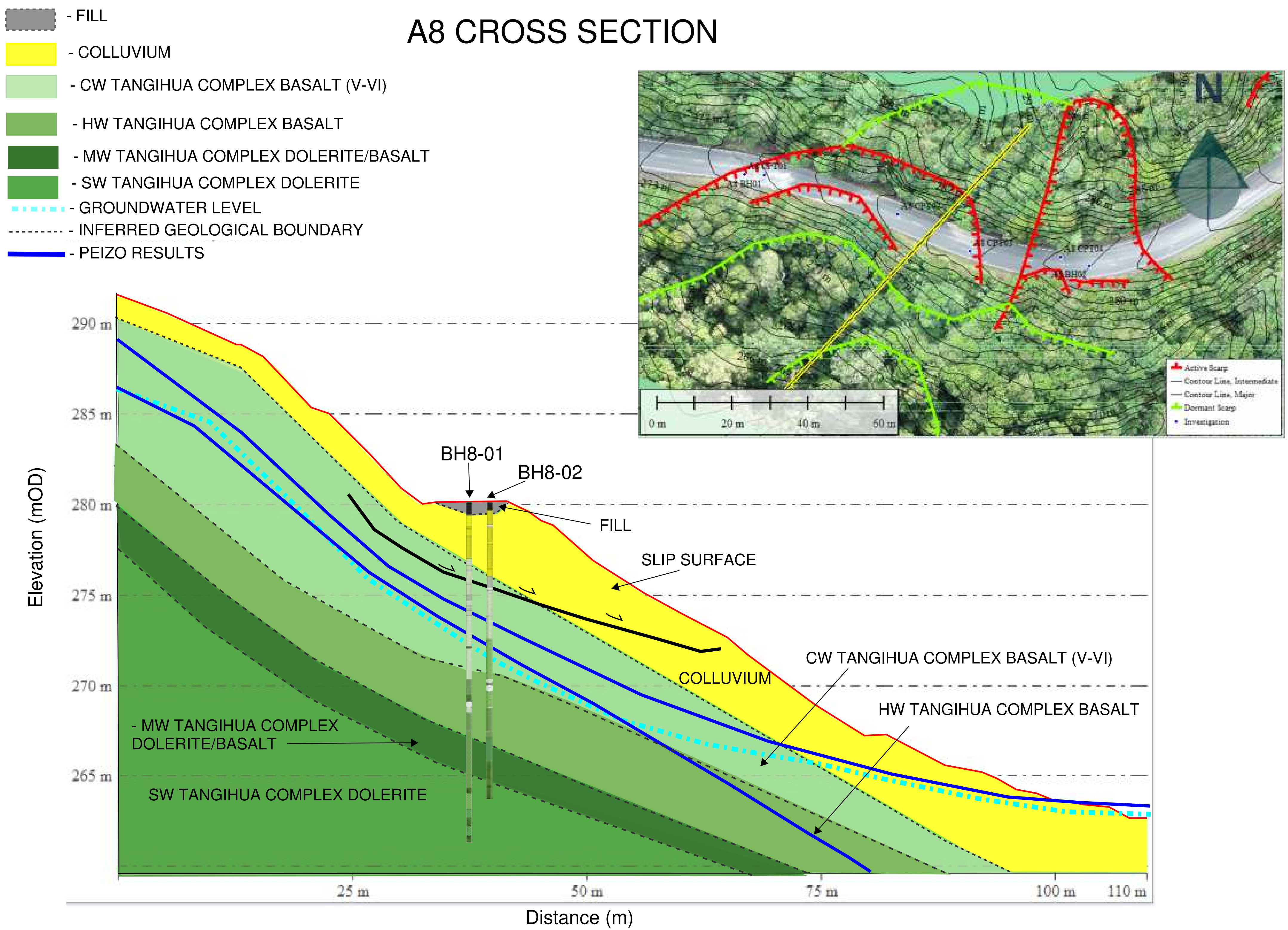
References

• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

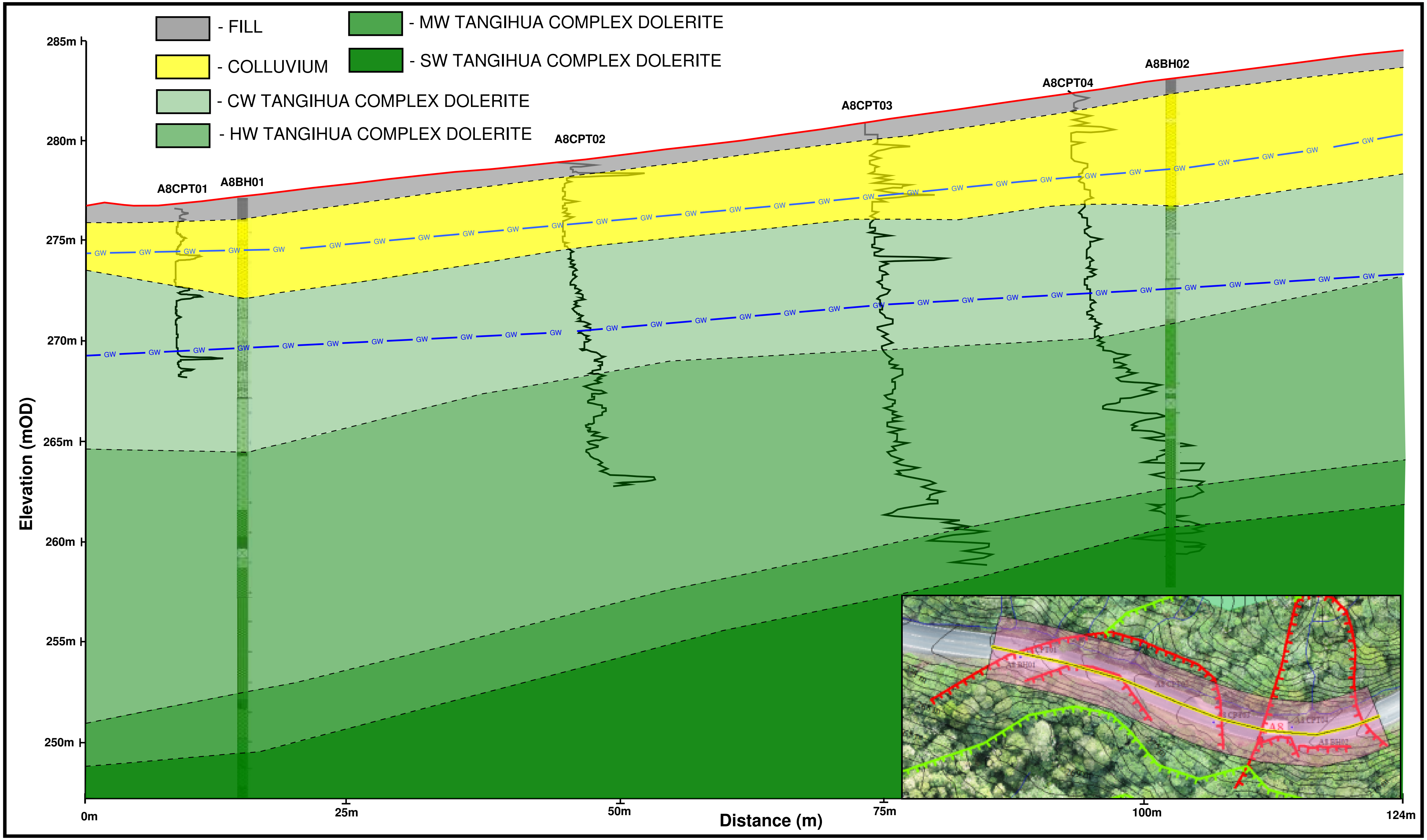
• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

Appendix B

Conceptual Geological Cross Section
Conceptual Geological Long Section



A8 CROSS SECTION
- FILL
- COLLUVIUM
- CW TANGIHUA COMPLEX BASALT (V-VI)
- HW TANGIHUA COMPLEX BASALT
- MW TANGIHUA COMPLEX DOLERITE/BASALT
- SW TANGIHUA COMPLEX DOLERITE
- GROUNDWATER LEVEL
- INFERRED GEOLOGICAL BOUNDARY
- PEIZO RESULTS
N
Active Scarp
Contour Line, Intermediate
Contour Line, Major
Dormant Scarp
Investigation
0 m
20 m
40 m
60 m
BH8-01
BH8-02
FILL
SLIP SURFACE
COLLUVIUM
CW TANGIHUA COMPLEX BASALT (V-VI)
HW TANGIHUA COMPLEX BASALT
- MW TANGIHUA COMPLEX DOLERITE/BASALT
SW TANGIHUA COMPLEX DOLERITE
Elevation (mOD)
290 m
285 m
280 m
275 m
270 m
265 m
25 m
50 m
75 m
100 m
110 m
Distance (m)



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100 Beaumont Street
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New Zealand

Project: NZTA Northland Resilience and Emergency Works- Mangamuka SH1		Job number: 1-11240.00
Description: 22A8- Long Section		Revision: 001
Drawn by: ML	Checked by:	Date: 25/11/2022

Appendix C

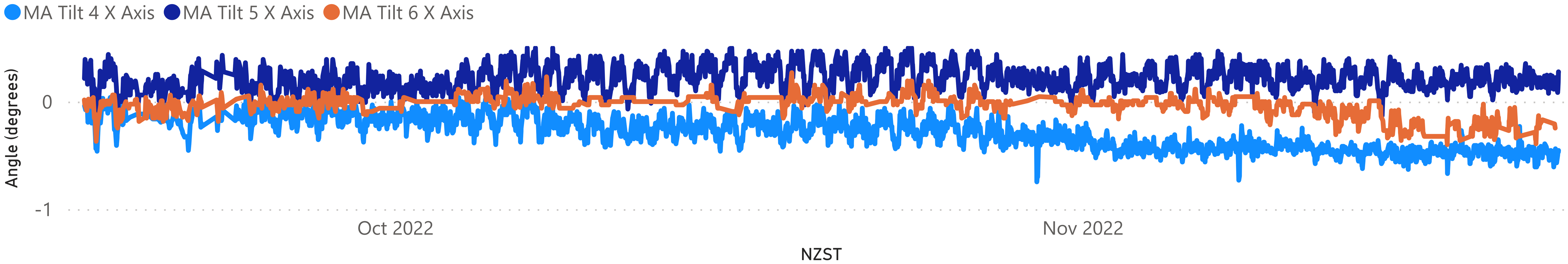
Tilt Sensor and Rainfall Data

Inclinometer Data

Mangamuka Gorge - Site A8 (T4 - T6)

9/17/2022 11/22/2022

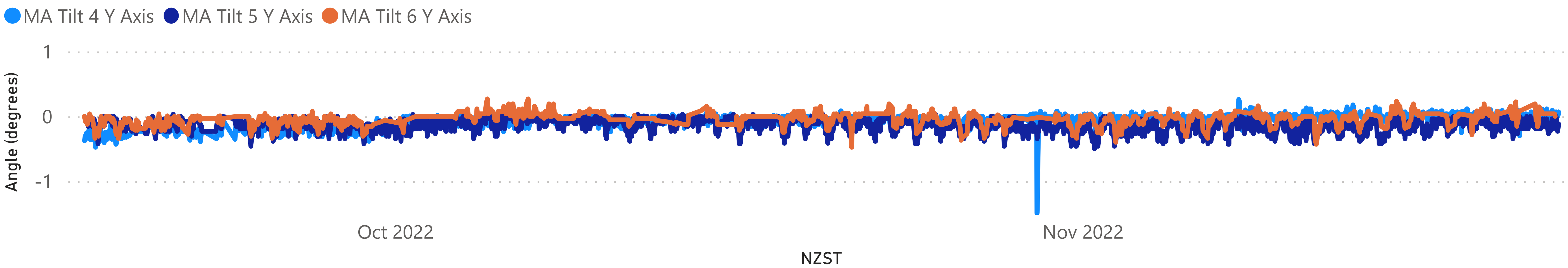
MA Tilt 4 X Axis, MA Tilt 5 X Axis and MA Tilt 6 X Axis by NZST



TARP

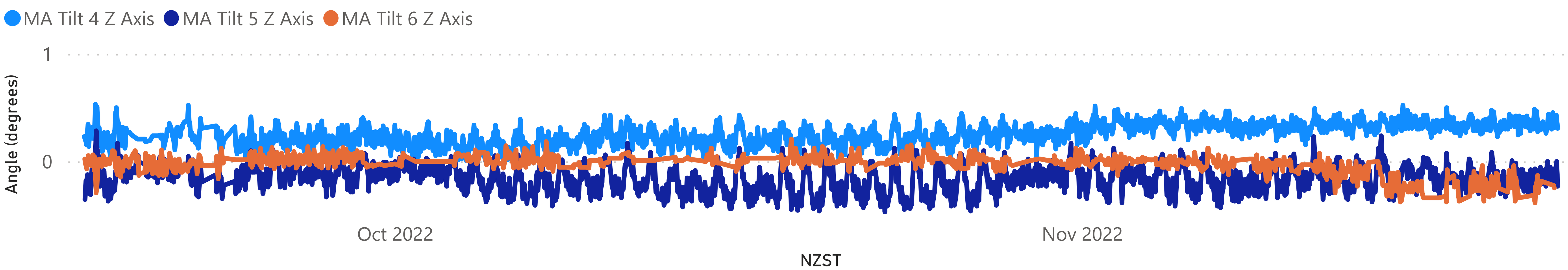
Site	Level
A08	

MA Tilt 4 Y Axis, MA Tilt 5 Y Axis and MA Tilt 6 Y Axis by NZST

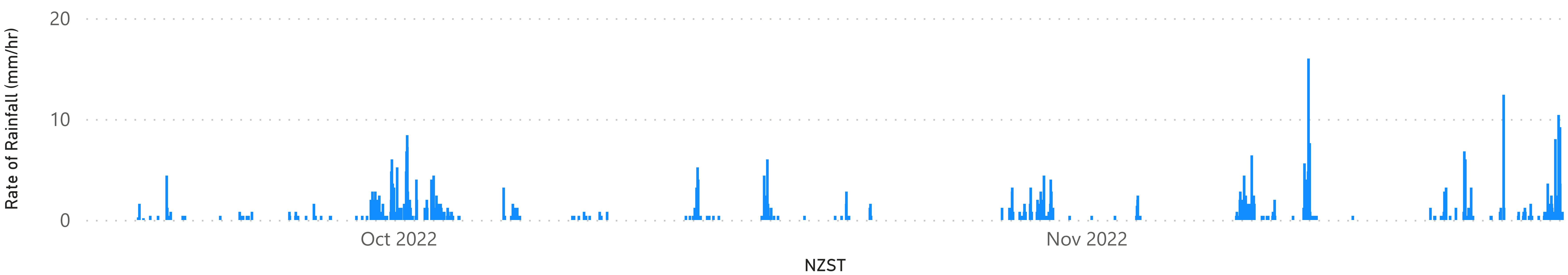


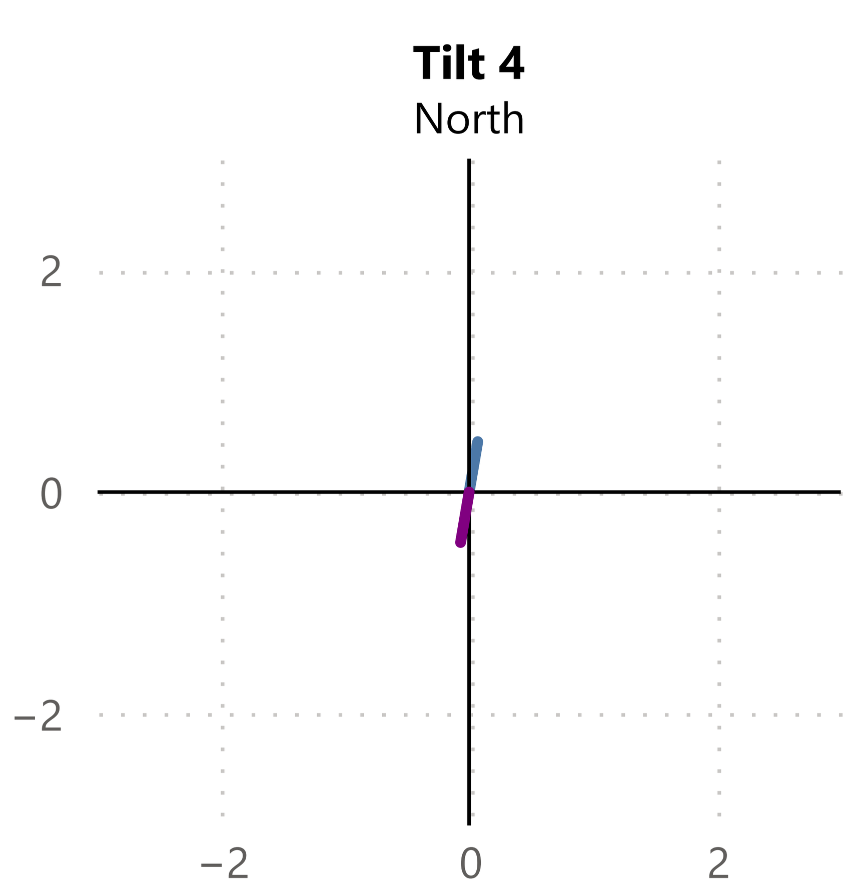
Device Tilt 4 Tilt 5 Tilt 6

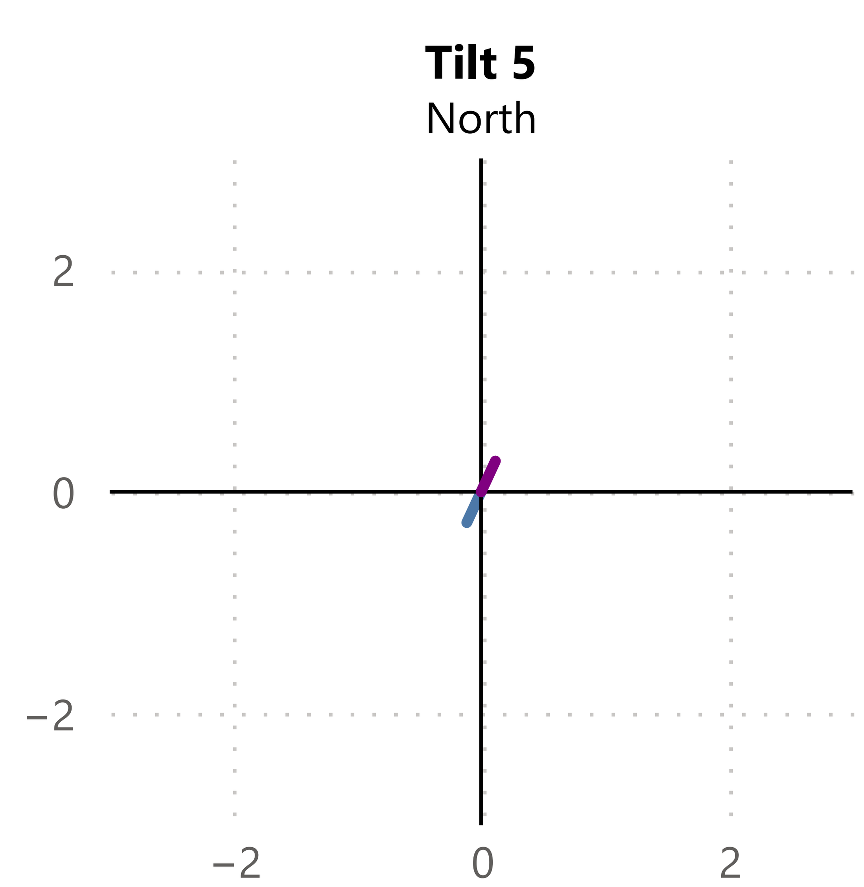
MA Tilt 4 Z Axis, MA Tilt 5 Z Axis and MA Tilt 6 Z Axis by NZST

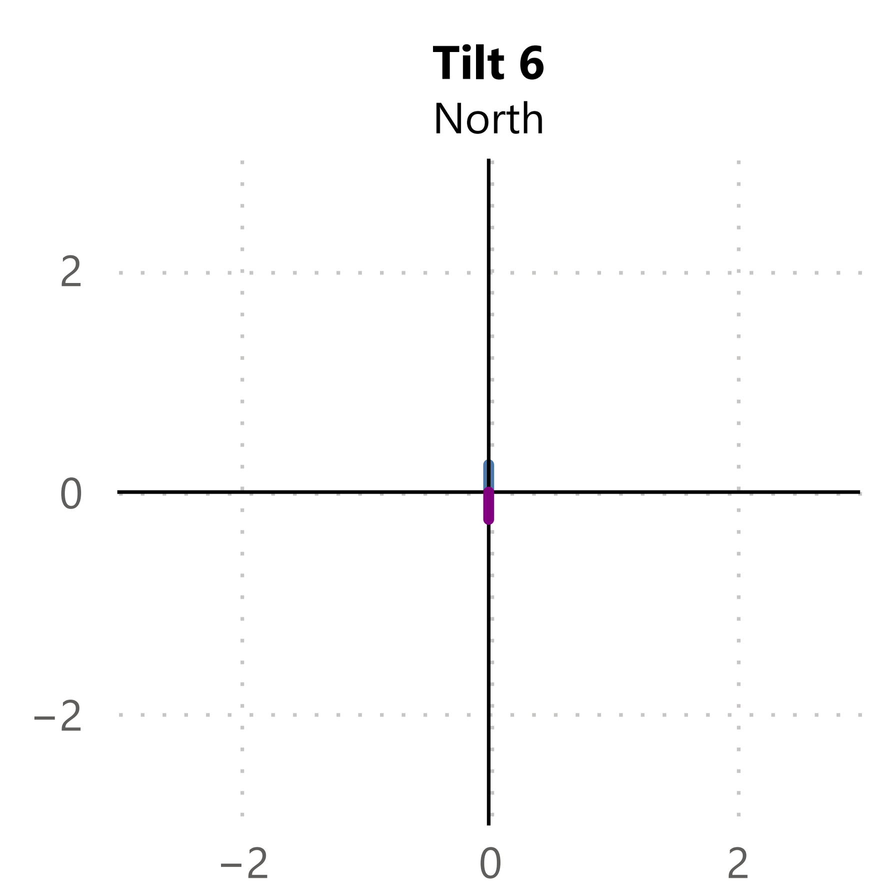


Rate of Rainfall (mm/hr) by NZST





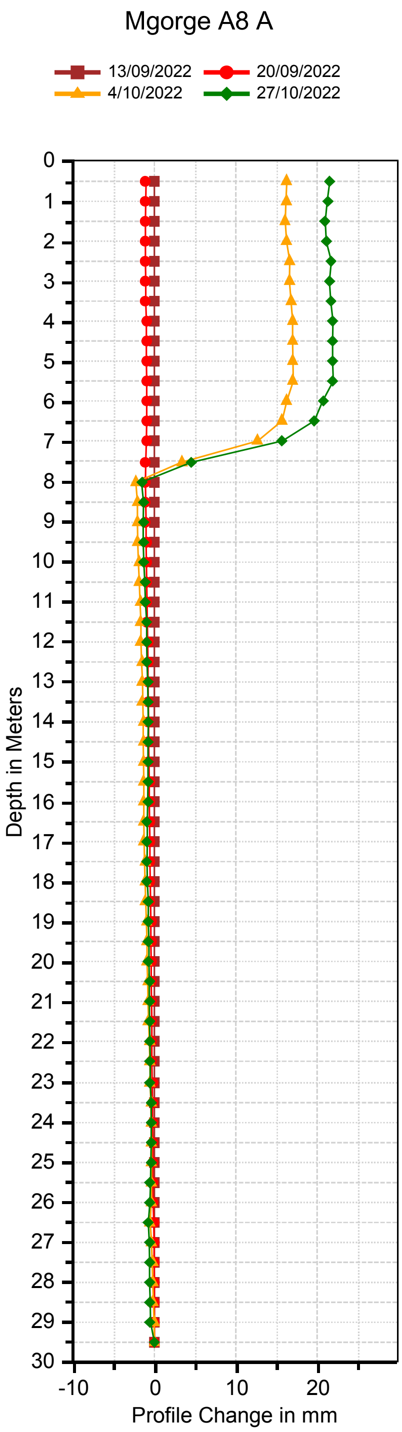


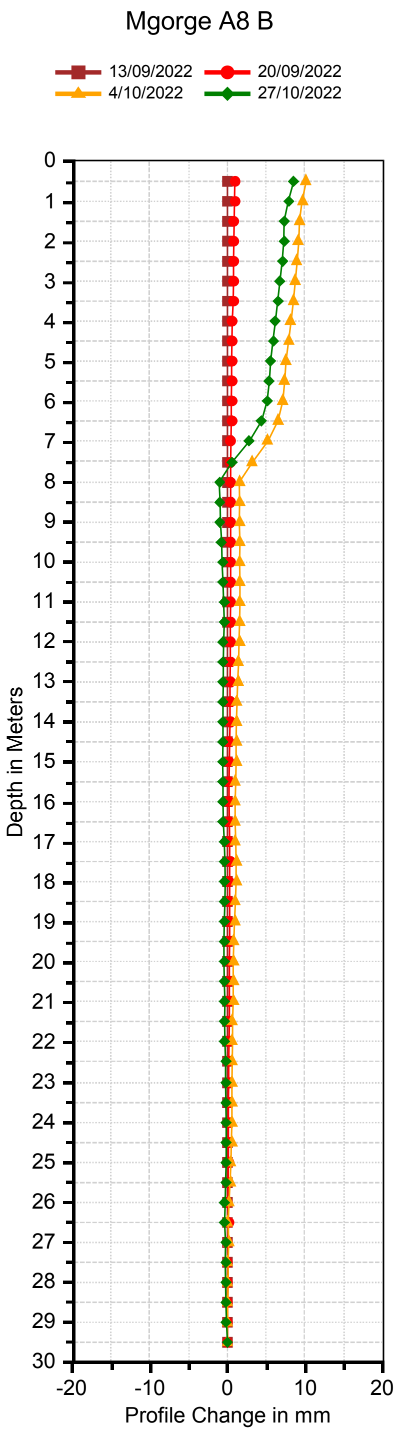


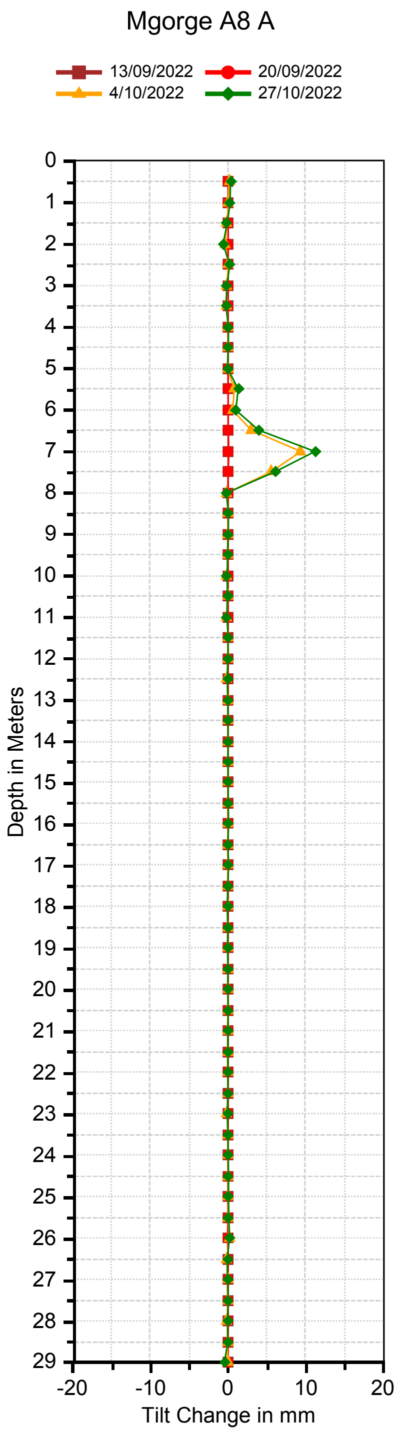
LEGEND

Actual Tilt Direction

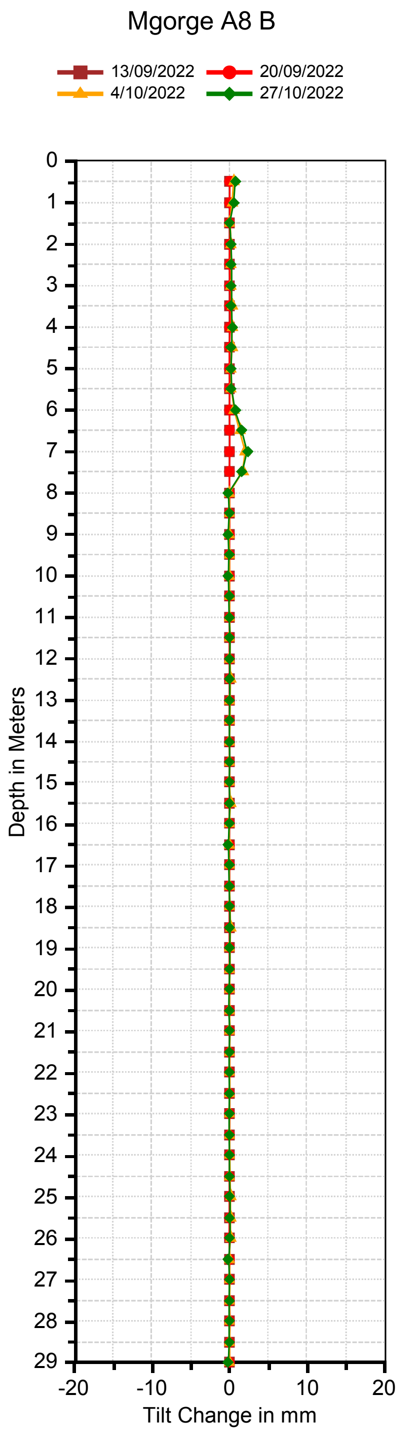
Estimated Land Direction


Mgorge A8 A
13/09/2022
20/09/2022
4/10/2022
27/10/2022
Depth in Meters
Profile Change in mm


Mgorge A8 B
13/09/2022
20/09/2022
4/10/2022
27/10/2022
Depth in Meters
Profile Change in mm



Mgorge A8 A
13/09/2022
20/09/2022
4/10/2022
27/10/2022
Depth in Meters
Tilt Change in mm



Mgorge A8 B
13/09/2022
20/09/2022
4/10/2022
27/10/2022
Depth in Meters
Tilt Change in mm

wsp.com/nz

Project Number: 1-11240.00

NZTA Northland Resilience and Emergency Works- August 2022- 10037/22A7

24 November 2022

CONFIDENTIAL

Interpretive Geotechnical Investigation Report

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Reviewed by
Matt Leggett

Approved for release by
Shaun Grieve

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Revision Details

Revision	Details

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for New Zealand Transport Agency ('**Client**') in relation to Mangamuka Gorge Slips Emergency Works ('**Purpose**'). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

1 Introduction

Two storm events in July and August have caused widespread flooding and associated landsliding across much of Northland. Following the August rain event WSP were engaged by Waka Kotahi to form part of the emergency response and undertake an urgent geotechnical investigation along a section of State Highway (SH) 1 through Mangamuka Gorge. A total of 12 underslips have been identified requiring significant geotechnical analysis and associated permanent remedial measures.

This report summarises the results of the ground investigation and provides a recommended remedial solution to prevent further damage to the existing highway.

This report covers the investigation and assessment at site 10037/22A7 (henceforth referred to as A7) and is located 3.3km into the gorge, immediately southbound of site 10177/A6 at the northern end of the study area.

Site A7 is located at RP14100 along SH1, approximately 20km southeast Kaitaia. The landslide is an underslip likely caused by a material saturation resulting from the recent storm events. The site location is shown below in together with the other slip sites.

The cracking was first observed in July (refer to July 2022 Storm Event Initial Advice – Memo no.1)

Figure 1-1: 10037/22A7 Site location Plan

2 Regional Geology

The 1:250 000 scale QMAP seamless digital data (GNS, 2013) indicates the site area to be underlain by the Undifferentiated Tangihua Complex in Northland Allochthon comprising basalt pillow lava, with subvolcanic intrusives of basalt, dolerite, and gabbro; locally incorporating siliceous mudstone. (Figure 2-1). The Tangihua Complex has been emplaced onto New Zealand through convergent plate tectonics. As a result, the material has been historically sheared with the rock underlying the site expected to be highly fractured/degraded.

Figure 2-1: Regional geology

3 Site Investigation

Between 3rd August and 1st September 2022, a targeted geotechnical investigation was undertaken to inform the remedial measures required at site A7. The works comprised the following:

- A single rotary cored borehole (BH) was completed to a depth of 16.5m with standard penetration tests (SPTs) at 1.5m intervals.
- Installation of BH inclinometer upon completion.
- 3no. Cone penetration tests (CPTs) taken to a maximum depth of 6.25m.
- The intrusive drilling works was undertaken by Drillforce Limited including the boreholes, CPT's as well as the installation of inclinometer tubing for monitoring ground movement and piezometers for groundwater, all under the supervision of WSP site staff.
- All the boreholes were logged in accordance with the NZGS *Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes*, December 2005 and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg. 365, Table 1. Borehole and CPT locations displayed on Figure 3-1 below with logs displayed in Appendix A.
- Tiltmeters were installed on the ground surface by WSP Research staff to obtain Realtime monitoring of surface movements.
- Piezometer wash bore to be completed at a later date.

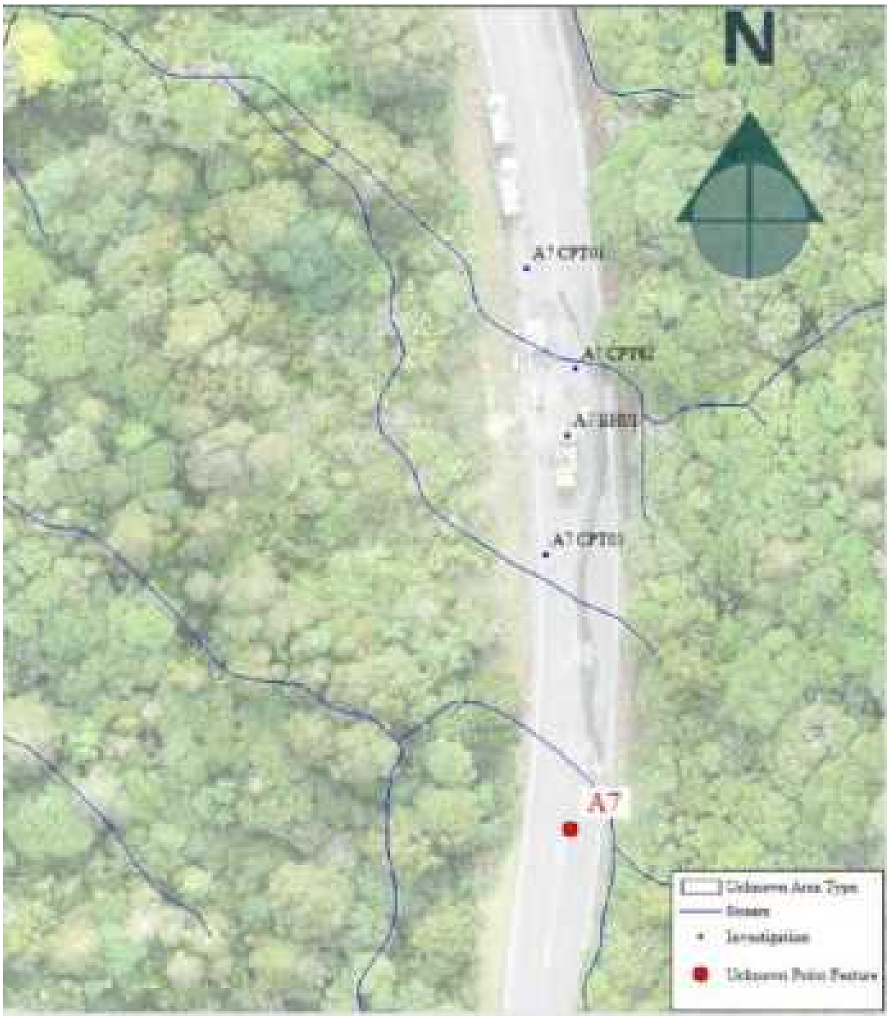


Figure 3-1: Exploratory hole location plan

3.1 Observations

Movement at the site was first observed in July (refer to July 2022 Storm Event Initial Advice – Memo no.1) with features developing in the months since.

The slip was inspected on 23rd September 2022 by WSP. The inspection identified the following:

- The total length of affected road is 60m with the height of slip estimated to be 12m. The grade of slope is approximately 1v:2h.
- At the time of inspection, the headscarp has encroached within both the southbound and northbound lane. There has been up to 380mm of vertical settlement with 500mm of horizontal movement downslope.
- Additional tension cracking has started to form further towards the centreline and the slip is likely to continue to slump and require frequency maintenance/levelling.
- The upslope has a grade of 1v:1h and is comprised of completely weathered bedrock.
- Surface seepage was not noted during the site investigation.

4 Geomorphological Mapping

A terrain evaluation is presented below in Figure 4-1. Geomorphological mapping undertaken from both Lidar and aerial photography as well as site observations.

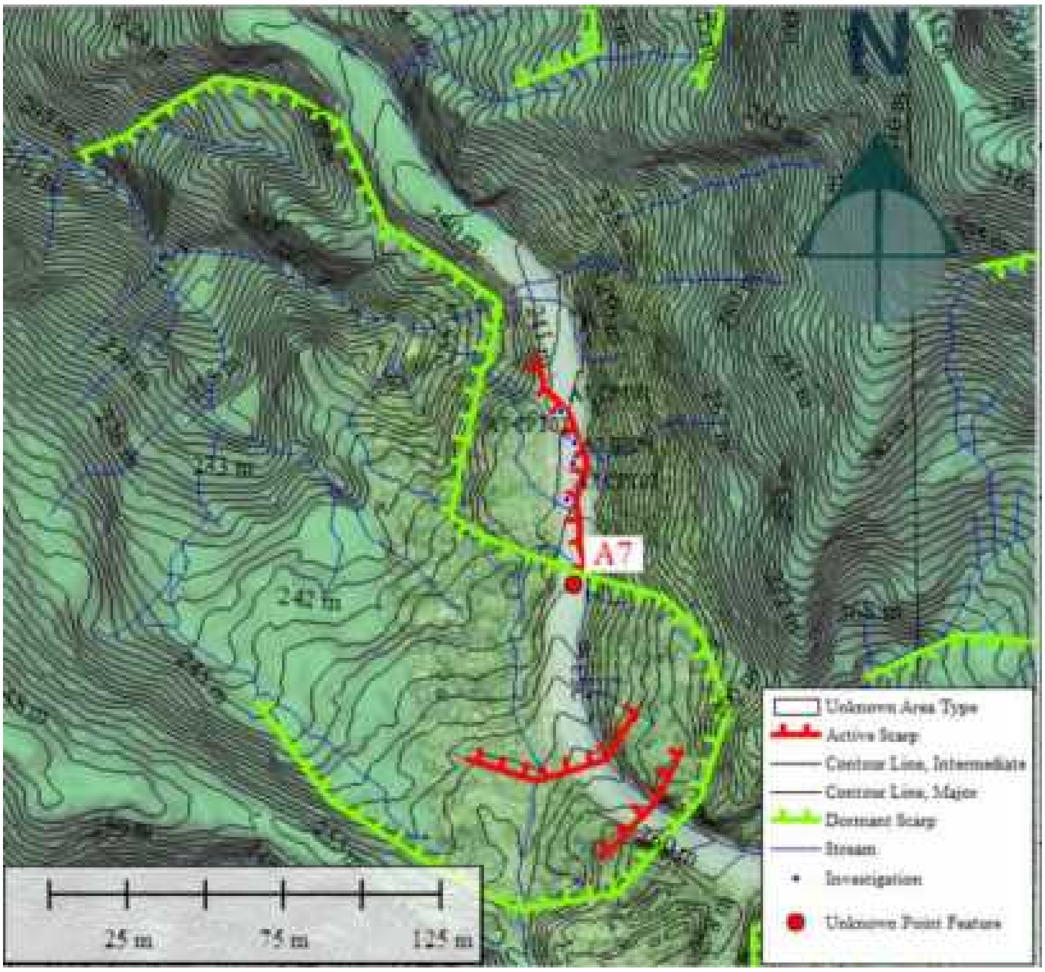


Figure 4-1: Geomorphological map

The site area at A7 situated in the mountainous terrain of Mangamuka, comprises one long headscarp daylighting within the north and southbound lanes. The feature is likely to extend further than is currently visible and form part of a larger feature. A drainage channel is located at the southernmost part of the headscarp and forms a gulley downslope to Victoria River below.

5 Ground Model

Table 1 below summarises the ground model for site A7. A conceptual geological cross section is presented within Appendix B.

Table 1 – Ground Model

Lithology	Top (m bgl)	Base (m bgl)	Total thickness (m)	SPT N Value	GSI
Fill	0*	0.75*	0.75*		-
Completely Weathered Tangihua Complex BASALT/MUDSTONE/CATACLASTIC ROCK (V-VI)	0.75*	3.41*	2.66*	4, 50+	-

Highly Weathered Tangihua Complex BASALT	10.00*	10.65*	0.65*	50+	0-10
Moderately Weathered Tangihua Complex BASALT	3.41*	14.90*	8.99*	50+	20-30
MODERATELY Degraded Tangihua Complex MUDSTONE/CATACLSTIC ROCK (III)	10.95*	11.20*	0.25*	50+	20-30
Slightly Weathered Tangihua Complex	14.90*	-	Not Proven	50+	50-60

* Inferred from CPT results. CPTs

** Where base proven.

Fill was encountered from surface within BH07-01 and inferred to be present within all three CPT's. The material is described as GAP40; fine to coarse angular gravel, basalt with minor fines, dense to very dense.

Completely weathered Tangihua Complex material was encountered at 0.75mbgl to 3.41mbgl within BH01 and inferred to be present within CPT02, described as Clayey SILT, some gravel; light brown mottled brown. stiff, moist, highly plastic; gravel, fine to medium, angular, completely weathered BASALT. Material thickness varies from 1.91mbgl (BH07-01) to 4.00mbgl (CPT03). CPT inferred boundaries between the Colluvium and Completely weathered bedrock are difficult to infer given the similarities in material properties. It's reasonable to expect the thicknesses of these materials to vary across the site.

Moderately Weathered Tangihua Complex BASALT material was encountered at 3.41mbgl to 10.00mbgl and 10.95mbgl to 14.90mbgl. Within BH07-01 this unit is described as Moderately weathered, light brown mottled dark brown, BASALT. Weak; very closely to closely spaced, steeply inclined, planar smooth (90%) and undulating smooth (10%) defects; iron staining on the defect surfaces; zeolite veining; relic incipient joints. The unit is inferred to be present within all CPTs, Material thickness where proven is 8.99m (BH01). CPT 01, 02 & 03 refusal at 6.25mbgl, 4.68mbgl and 4.68mbgl respectively, inferred to be within the moderately weathered complex II rock.

Highly weathered Tangihua Complex BASALT was encountered between 10.00mbgl to 10.65mbgl. This material is described as highly weathered, light brown mottled orange BASALT. Extremely weak; closely spaced, sub-horizontal inclined, undulating smooth to rough defects; relic incipient joints.

Moderately degraded material Was encountered withing BH07-01 from 10.95bgl to 11.20mbgl. This material is described as Moderately degraded, dark reddish brown, MUDSTONE (85%) sheared with dark brown BASALT (15%). Strong; very closely spaced, sub-horizontal to moderately inclined, undulating smooth to rough defects.

Slightly weathered Tangihua Complex II Rock was encountered from 14.90mbgl down to the machine borehole termination depth of 16.50mbgl within BH07-01. Described as slightly weathered, bluish grey, highly fractured BASALT; very strong; extremely closely to closely spaced, gently to steeply inclined, planar smooth (50%) and undulating smooth to rough (50%) defects; iron staining on defect surface; zeolite veining.

Groundwater reading on the 31st August 2022 1.30mbgl at start of drilling. After overnight infiltration, the groundwater reading was 11.6mbgl at start of shift.

5.1 Instrumentation Summary

Tilt sensors data and rainfall sensors data is presented within Appendix C, collected from 14th September 2022. Tilt sensor positions shown below on Figure 5-1.

Figure 5-1: Tilt sensor position A7

No significant tilt sensor movements have been identified to date at site A7 with peaks and troughs typically displaying cyclic changes in temperature.

At completion of the borehole (BH01), inclinometer casing was installed to 16.5m depth for subsequent monitoring. Inclinometer monitoring was carried out over an initial period of three weeks between 13th September 2022 and 4th October 2022 (monitoring ongoing). Results are presented within Appendix C. A profile and B profile graphs display some minor movement originating at 13m and 14.5m. However, this is likely due to drift of the instrument as no spikes are picked up on the tilt change graph.

6 Recommendations

Based on the available geotechnical information it is recommended to top up, compact and reinstate the slump as well as improve the drainage in the area. The cost for these works is relatively low, ranging from $250k to $500k. The site is likely to continue to slump/creep following extended periods of heavy rainfall, as seen previously, requiring frequent improvements and maintenance.

The inclinometer results are inconclusive with no clear failure surface identified. Therefore, given the nature of failure and observed monitoring results the slip is not believed to require a permanent solution.

Further information provided within October 2022 Storm Response Options Update- Memo no.2 including discounted solutions.

7 Limitation

This report has been prepared for the benefit of NZTA only and is based on limited investigation and visual inspection only. Given the complex geological setting changes in ground condition could occur across the site that differ from those summarised within this report.

Appendix A

Borehole Logs
CPT Report

Borehole No. BH22A7-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280024 E 987701 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	16.5 m
Project No.:	1-11244.00	*R.L.:*	246.612 m	*Inclination:*	Vertical
Location:	Slip 22A7 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING
	ASPHALT			
Fill	Fine to coarse GRAVEL; dark grey mottled bluish grey. Very dense; angular, well graded, slightly weathered BASALT [Gap 40 SUBGRADE].			
Tangihua Complex	Silty CLAY, some sand; light brown. Firm, moist, highly plastic; sand, fine to coarse, well graded [Completely weathered]		CW	
	1.29 - 1.50m - Core Loss; No sample recovered.			
	Silty CLAY, some sand; light brown. Firm, moist, highly plastic; sand, fine to coarse, well graded [Completely weathered]		CW	
	Clayey SILT, some gravel; light brown mottled brown. stiff, mosit, highly plastic; gravel, fine to medium, angular, completely weathered basalt [Completely weathered]. 2.90-3.15m - Very stiff.		CW	
	Clayey fine to coarse SAND; light brown speckled with white. Medium Dense, moist; sand, well graded [Completely weathered].		CW	
	Moderately weathered, light brown mottled dark brown, BASALT. Very weak; very closely to moderately wide spaced, gently to very steeply inclined, planar rough defects; iron staining on the defect surfaces; zeolite veining.	VW	MW	C
	Moderately weathered, light brown mottled dark brown, BASALT. Weak; very closely to closely spaced, steeply inclined, planar smooth (90%) and undulating smooth (10%) defects; iron staining on the defect surfaces; zeolite veining; relic incipient joints.	W	MW	C
	Moderately weathered, light brown mottled dark brown,BASALT. Moderately strong; very closely to closely spaced, steeply to very steeply inclined, planar smooth (90%) and undulating smooth (10%) defects; iron staining on the defect surfaces; zeolite veining.	MS	MW	C
	9.80 - 10.00m - Core Loss; No sample recovered.			

R.L. (m): 246, 244, 242, 240, 238

DEPTH (m): 1, 2, 3, 4, 5, 6, 7, 8, 9

TESTS

SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE
4	0// 1/1/1/1
50+	2// 11/19/20 for 40mm
50+	40 for initial 125mm
50+	50
50+	50 for initial 75mm
50+	23 for initial 45mm

DEFECT DIP (degrees 0–90): J35, J50, J60, J50, J50, J80, J80, J30, J70, J10, J25, J50, J10, J40, J20, J20, J20, J40, J45, J85, J45, J40, J10, J26, J20, J10, J30, J18, J51

DEFECTS / OTHER TESTS

3.55m - J, 35°, RO, PL
4.00m - J, 50°, RO, PL
4.05m - J, 60°, RO, PL
4.45m - J, 50°, SM, PL
4.50m - J, 50°, SM, PL
5.20m - J, 80°, SM, PL
5.70m - J, 80°, SM, PL
6.35m - J, 30°, SM, UN
6.38m - J, 70°, SM, UN
6.75m - J, 10°, SM, PL
6.87m - J, 25°, SM, PL
6.95m - J, 50°, SM, PL
7.05m - J, 40°, SM, UN
7.10m - J, 10°, SM, PL
7.20m - J, 20°, SM, PL
7.37m - J, 20°, SM, PL
7.80m - J, 40°, SM, PL
7.82m - J, 20°, SM, UN
8.20m - J, 45°, SM, UN
8.35m - J, 85°, SM, UN
8.70m - J, 45°, SM, PL
8.85m - J, 40°, SM, UN
8.95m - J, 10°, RO, PL
9.28m - J, 26°, SM, UN
9.39m - J, 20°, SM, UN
9.50m - J, 10°, RO, UN
9.53m - J, 30°, SM, PL
9.65m - J, 18°, SM, UN
9.72m - J, 51°, SM, PL

CORE

SAMPLE TYPE	TCR (%)	RQD (%)
HQ	100	
HQ	72	
SPT	100	
HQ	100	
SPT	100	
HQ	64	64
SPT	100	
HQ	51	51
SPT	100	
HQ	100	73
SPT	100	
HQ	100	42
SC	0	
HQ	91	39

DRILLING

DRILLING METHOD: HQ Size, Triple Tube, Wireline Rotary Coring

BASE OF HOLE & WATER LEVEL: SWL 1.30m 31/08

INSTALLATION DETAILS

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	30/08/2022	*Finished:*	1/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Borehole No. BH22A7-1

Project: Waka Kotahi Northland Emergency Resilience	*Coordinates:* 280024 E 987701 N		
Client: Waka Kotahi	*Ref. Grid:* NZTM	*Depth:* 16.5 m	
Project No.: 1-11244.00	*R.L.:* 246.612 m	*Inclination:* Vertical	
Location: Slip 22A7 Mangamuka Range	*Datum:* NZ Geodetic Datum 2000		

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m)	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD	BASE OF HOLE & WATER LEVEL
Tangihua Complex	Highly weathered, light brown mottled brownish orange, BASALT. Extremely weak; Iron staining on the defect surfaces; relic incipient joints. Weathered to Silty fine to coarse SAND, some gravel; very stiff, moist; sand, well sorted; gravel, fine to medium, completely to highly weathered basalt.	236				EW	HW	C		HQ	91	39	HQ Size, Triple Tube, Wireline Rotary Coring	
				50+	50					SC	0			
	Moderately weathered, light brown mottled brownish orange, BASALT. Moderately strong; closely spaced, sub-horizontal inclined, undulating smooth to rough defects; Iron staining on the defect surfaces; relic incipient joints.		11			MS	MW	C	10.75m - J, 10°, SM, UN	HQ	100	48		
	Moderately degraded, dark reddish brown, MUDSTONE (85%) sheared with dark brown BASALT (15%). Strong; very closely spaced, sub-horizontal to moderately inclined, undulating smooth to rough defects					MS	MW	C	11.15m - J, 45°, SM, UN 11.20m - CZ					SWL 11.60m 1/09
	Moderately weathered, light brown mottled brownish orange, BASALT. Weak; extremely closely to closely spaced, sub-horizontal to moderately inclined, undulating smooth to rough defects; Iron staining on the defect surfaces; zeolite veining; relic incipient joints.		12	50+	50 for initial 125mm	W	MW	C		SC	0			
	Moderately weathered, brown mottled dark grey and dark brown, BASALT. Moderately strong; extremely closely to closely spaced, sub-horizontal to moderately inclined, undulating slickensided to rough defect; iron staining on defect surfaces, zeolite veining, relic incipient joints.	234	13			MS	MW	C	12.29m - J, 10°, SL, UN 12.31m - J, 10°, SM, UN 12.46m - CZ 12.48m - J, 10°, SM, UN 12.62m - CZ 12.72m - J, 16°, SM, UN 12.74m - J, 15°, SM, UN 12.87m - J, 36°, SM, UN 13.20m - J, 20°, RO, UN 13.35m - J, 70°, SL, UN 13.40m - J, 20°, SM, UN 13.45m - J, 20°, RO, UN 13.60m - CZ 13.80m - J, 30°, SL, UN 14.20m - CZ	HQ	100	0		
				50+	19 for initial 75mm					SC	0			
		232	14							HQ	100	21		
	Slightly weathered, bluish grey, highly fractured BASALT; Very strong; extremely closely to closely spaced, gently to steeply inclined, planar smooth (50%) and undulating smooth to rough (50%) defects; iron staining on defect surface; zeolite veining.		15 16			S	SW	C	15.03m - J, 18°, RO, UN 15.12m - CZ 15.27m - J, 30°, SM, PL 15.29m - J, 36°, SM, PL 15.32m - J, 45°, RO, UN 15.53m - J, 40°, SM, PL 15.63m - J, 46°, SM, PL 15.66m - J, 30°, SM, PL 15.70m - J, 60°, RO, UN 15.84m - J, 65°, RO, UN 16.32m - J, 18°, SM, PL	HQ	100	39		
	END OF BOREHOLE AT 16.5m - Target Criteria Achieved	230 228	17 18 19											

Defect dip (degrees 0–90) plot labels: J10, J45, J10, J10, J10, J16, J36, J20, J20, J20, J70, J30, J18, J30, J36, J45, J40, J30, J46, J60, J65, J18

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	30/08/2022	*Finished:*	1/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280024 E 987701 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	16.5 m
Project No.:	1-11244.00	*R.L.:*	246.612 m	*Inclination:*	Vertical
Location:	Slip 22A7 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A7-1.1
BOX01: 0.00 - 3.25m.

Photo BH22A7-1.2
BOX02: 3.25 - 6.00m.

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	30/08/2022	*Finished:*	1/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280024 E 987701 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	16.5 m
Project No.:	1-11244.00	*R.L.:*	246.612 m	*Inclination:*	Vertical
Location:	Slip 22A7 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A7-1.3
BOX03: 6.00 - 8.60m.

Photo BH22A7-1.4
BOX04: 8.60 - 11.50m.

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 22/11/22

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	30/08/2022	*Finished:*	1/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Borehole No. BH22A7-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	280024 E 987701 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	16.5 m
Project No.:	1-11244.00	*R.L.:*	246.612 m	*Inclination:*	Vertical
Location:	Slip 22A7 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A7-1.5
BOX05: 11.50 - 14.38m.

Photo BH22A7-1.6
BOX06: 14.38 - 16.50m.

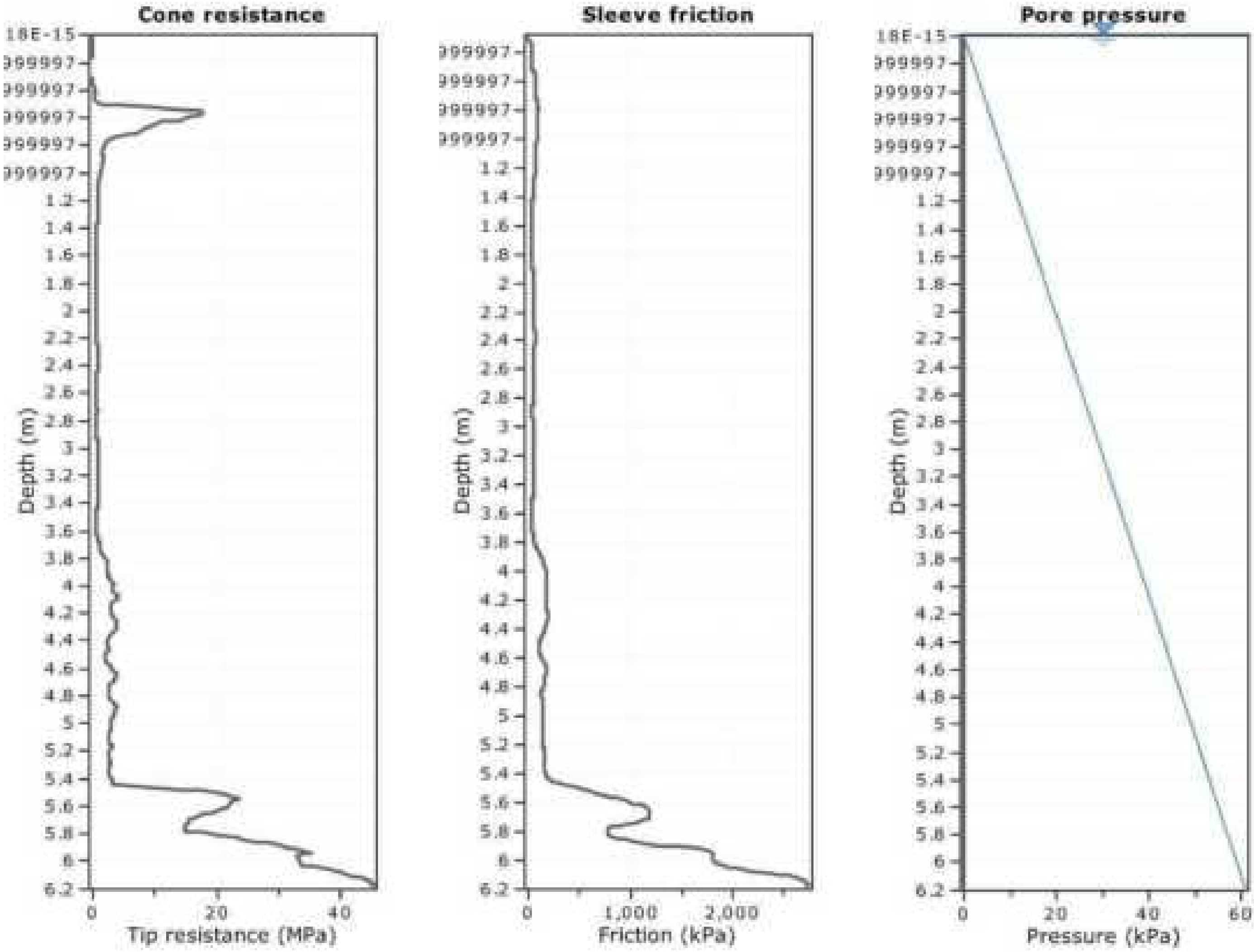
Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	30/08/2022	*Finished:*	1/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

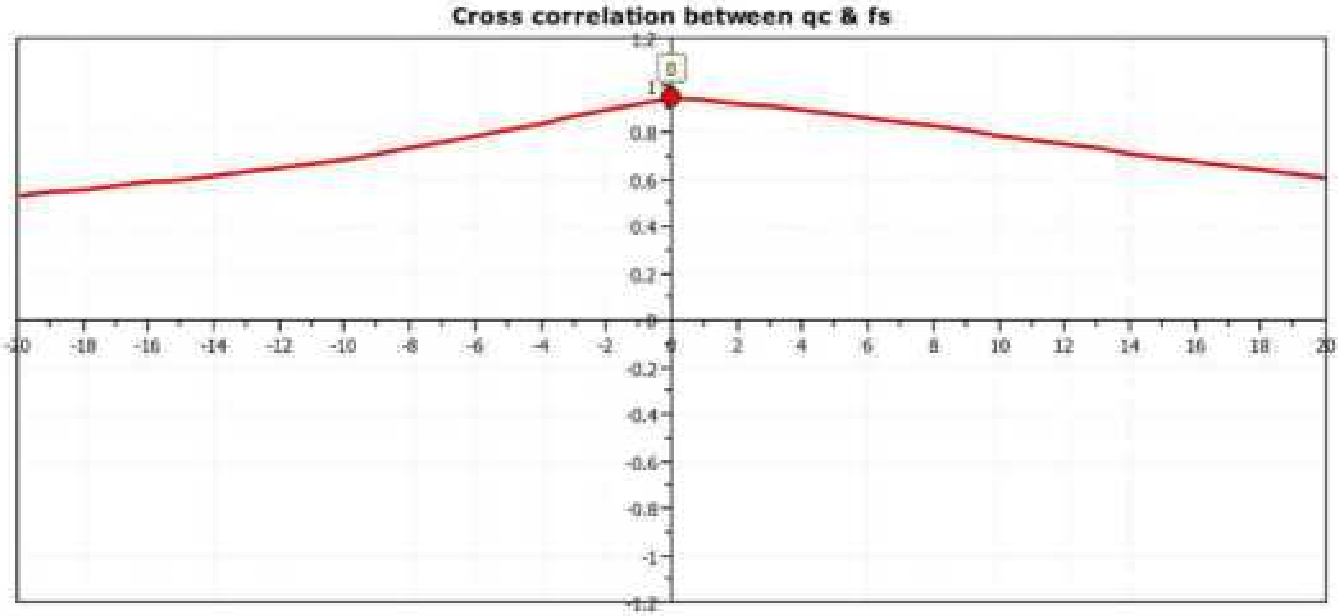
GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A7-01
Total depth: 6.18 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

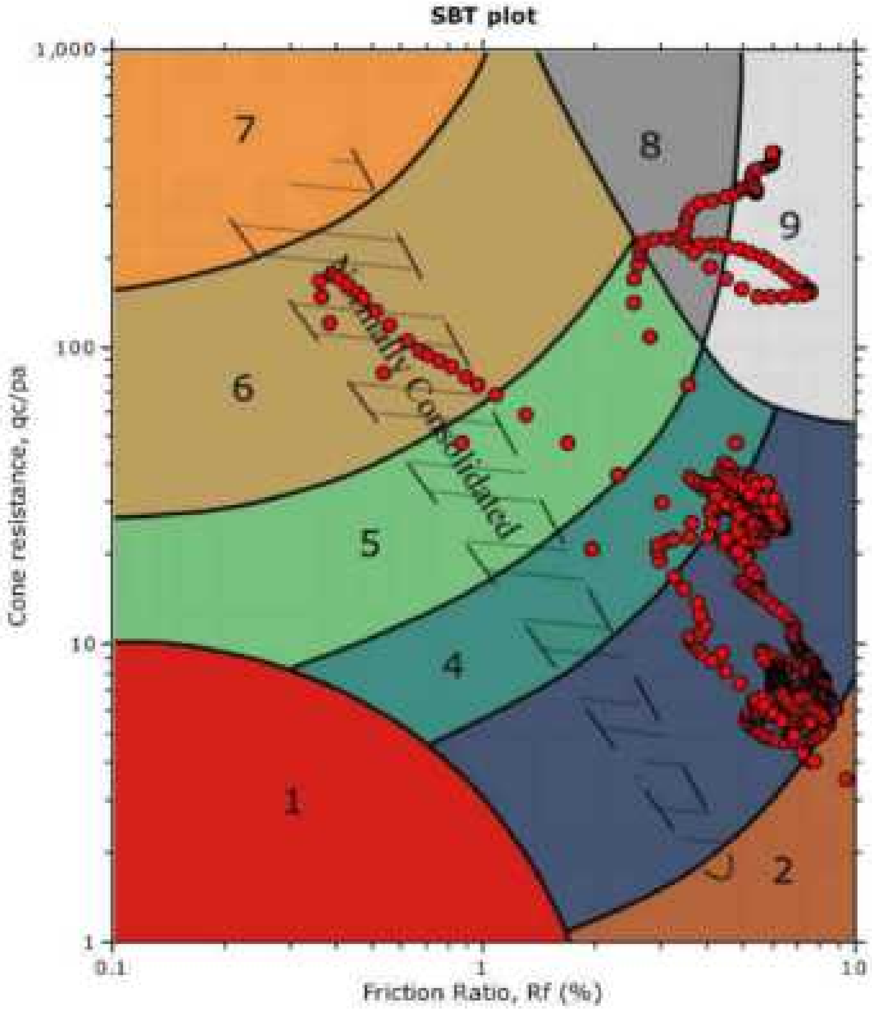
Project:
Location:

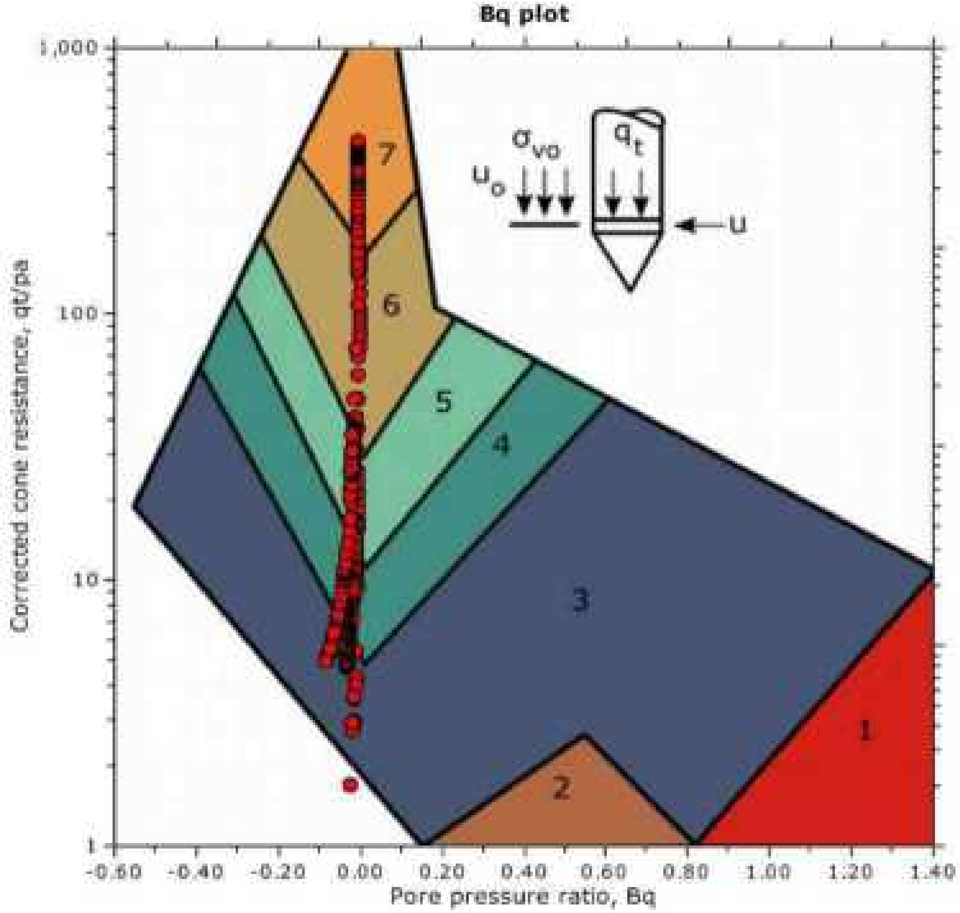


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

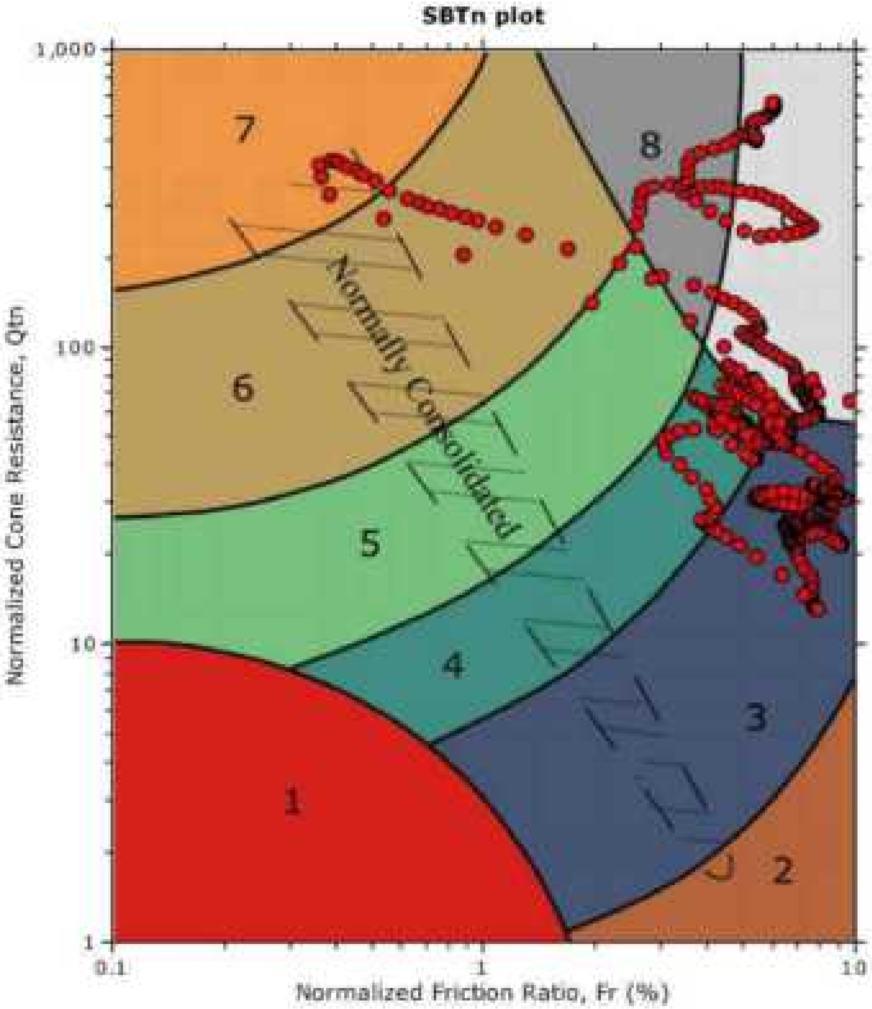


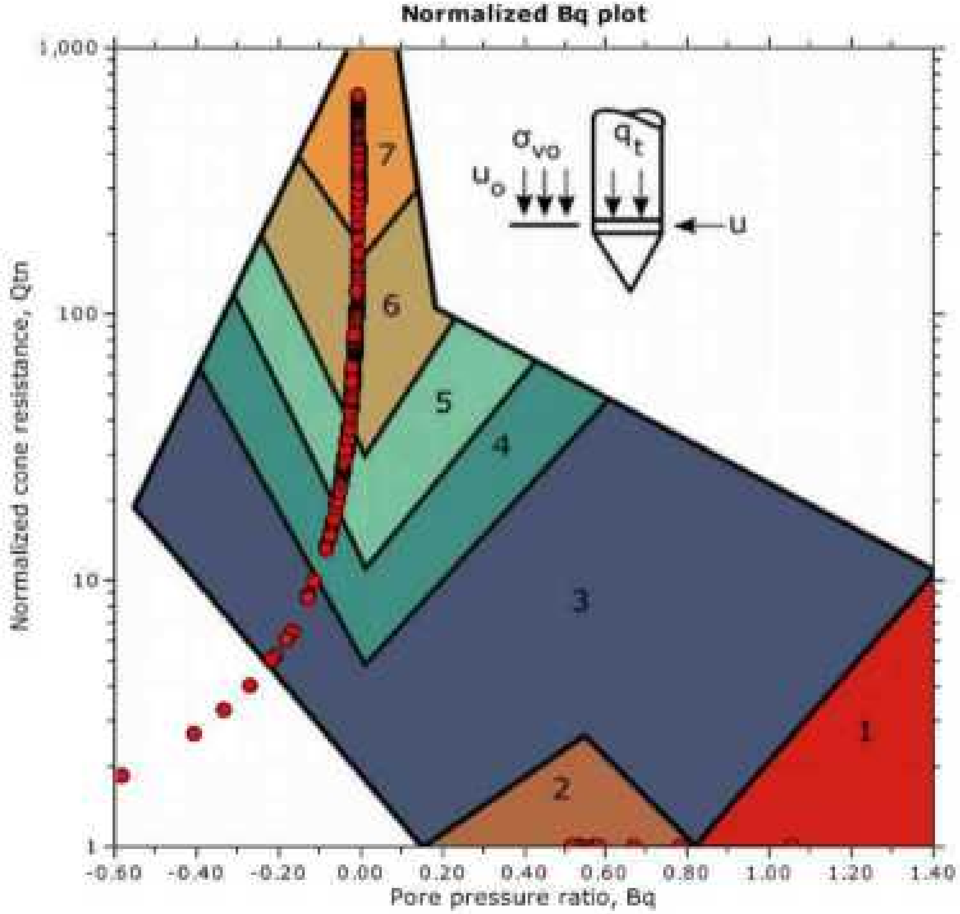


SBT legend

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

SBT - Bq plots (normalized)

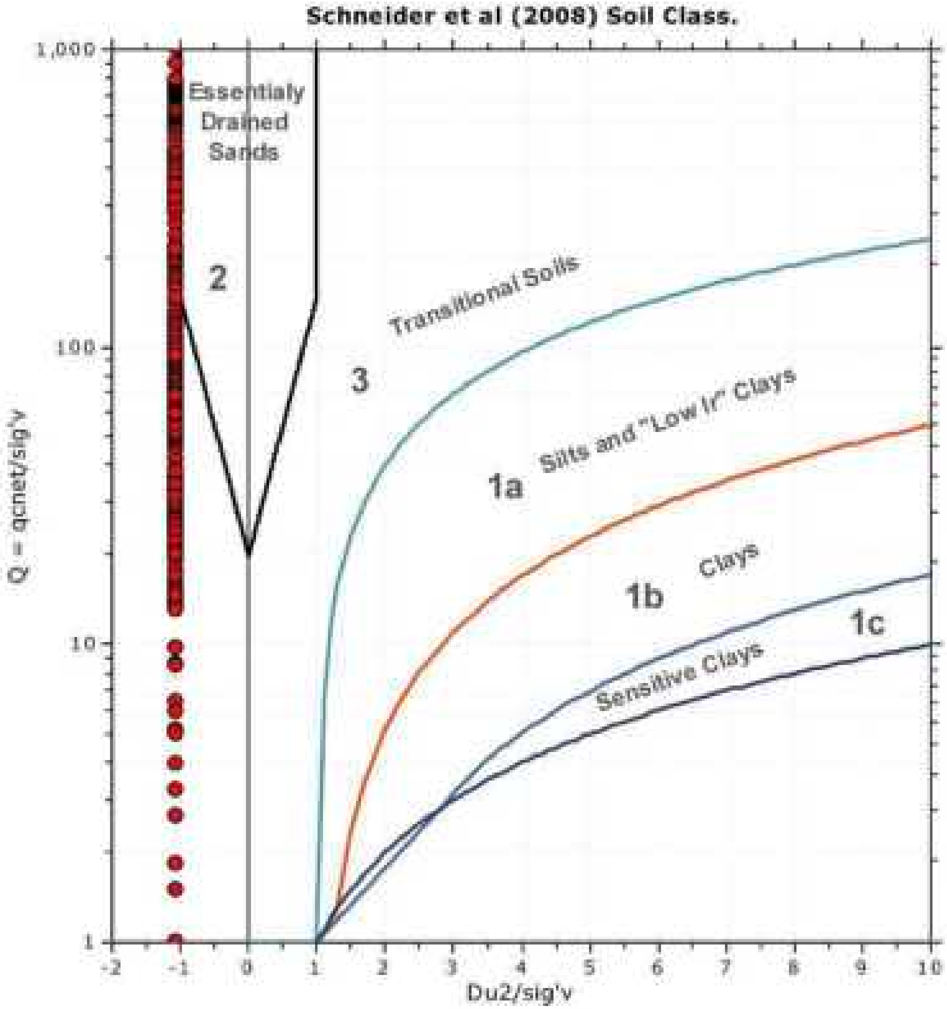


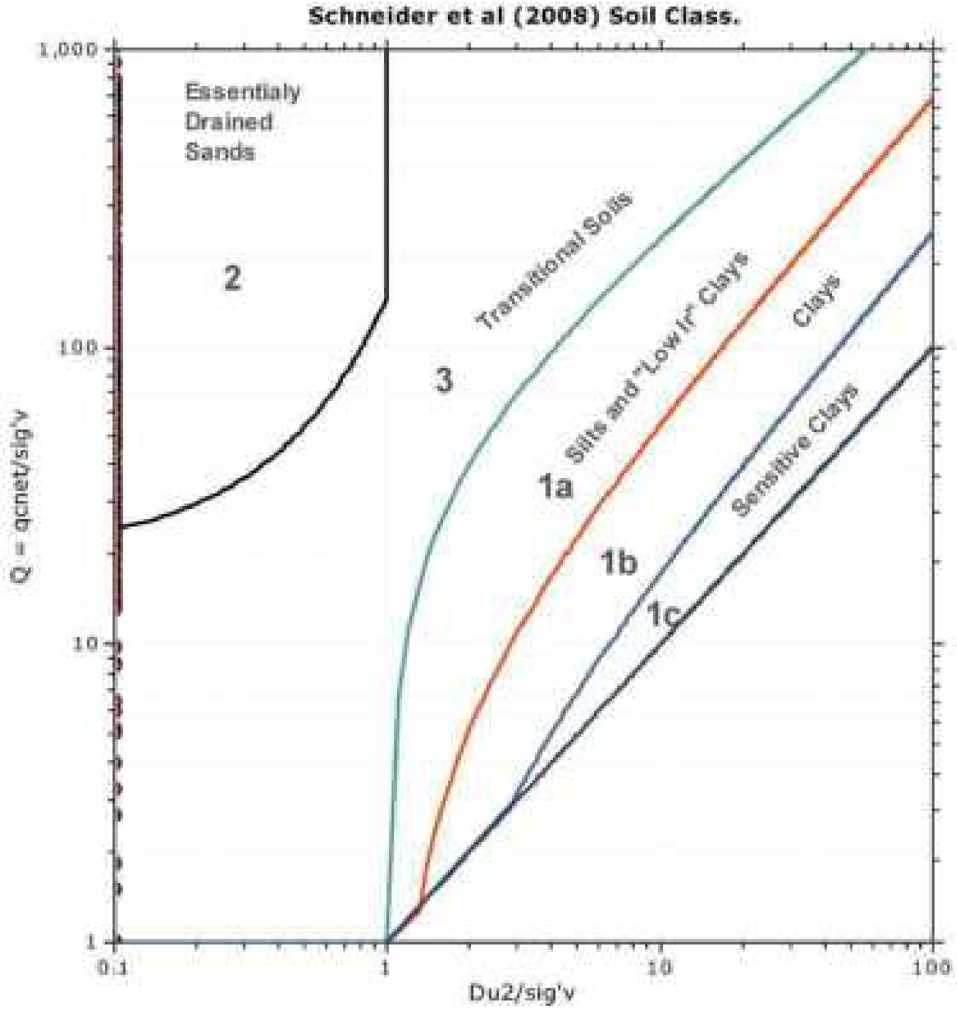


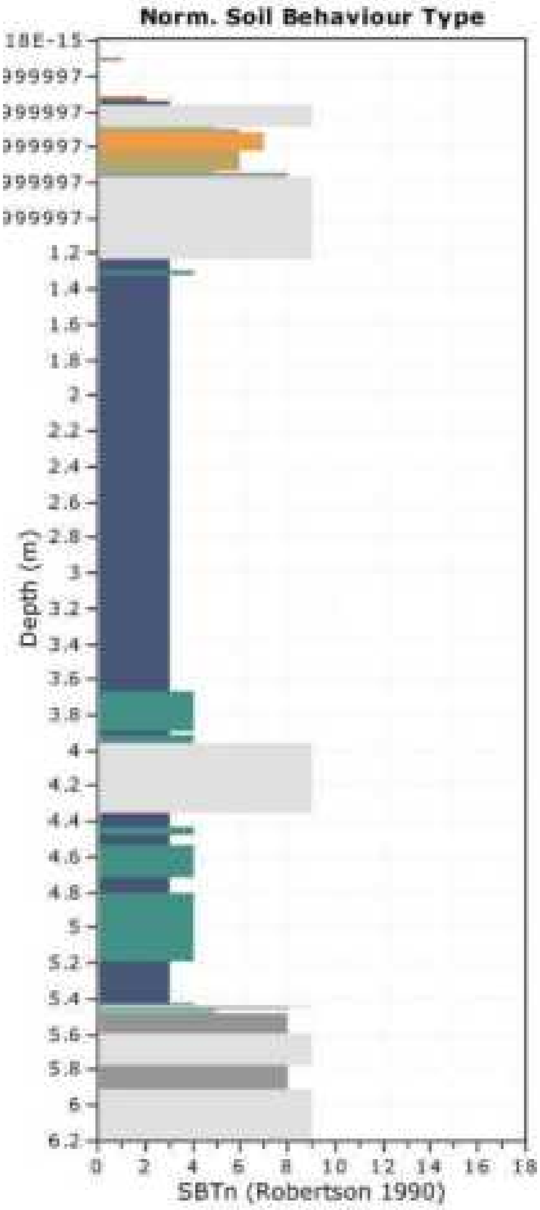
SBTn legend

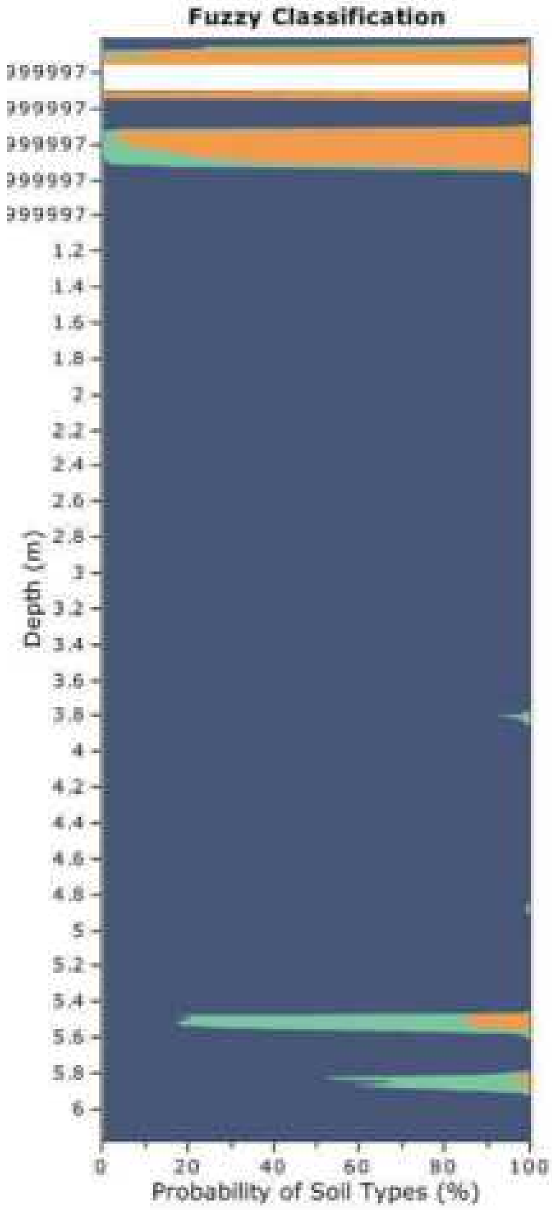
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

Bq plots (Schneider)





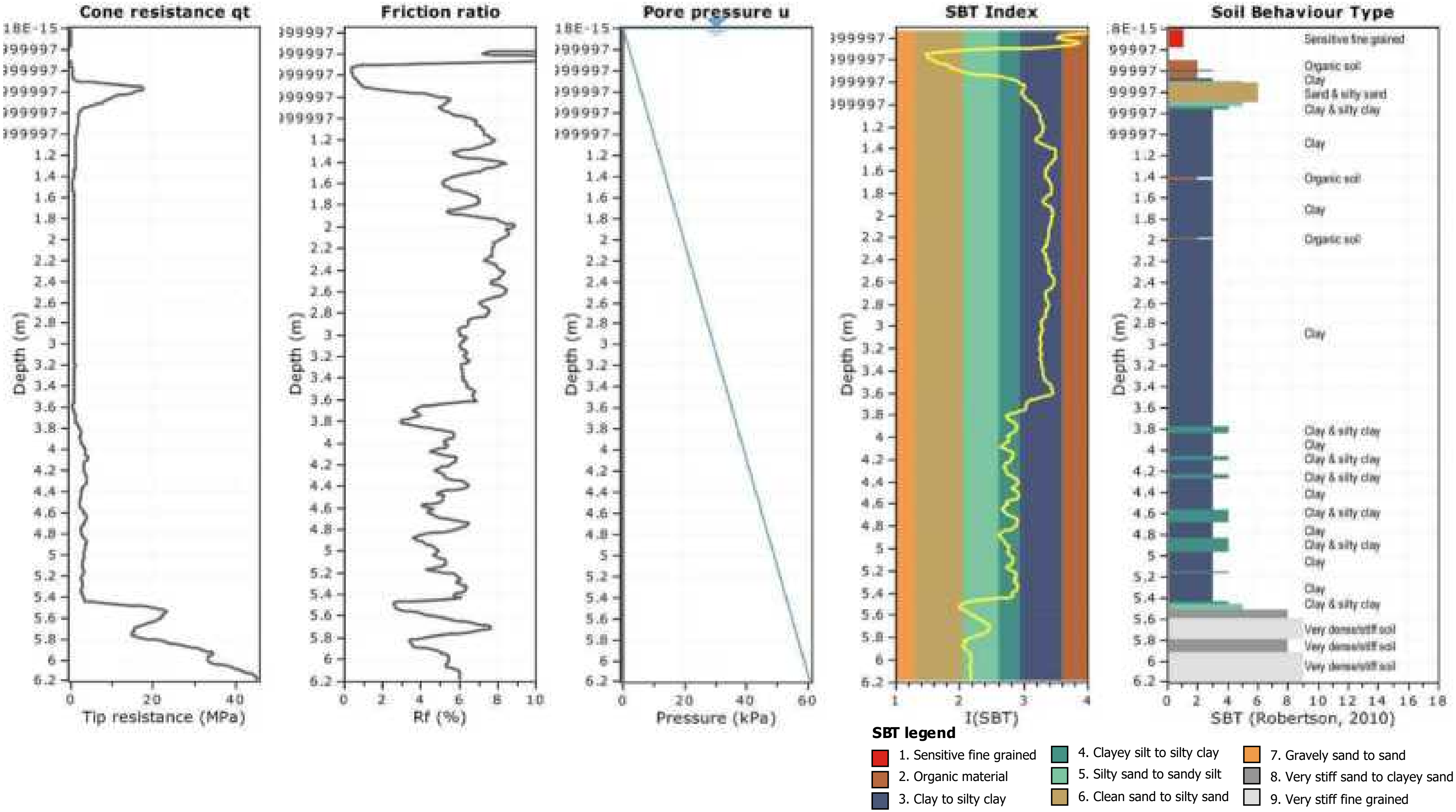

Norm. Soil Behaviour Type
Depth (m)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
Probability of Soil Types (%)

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A7-01
Total depth: 6.18 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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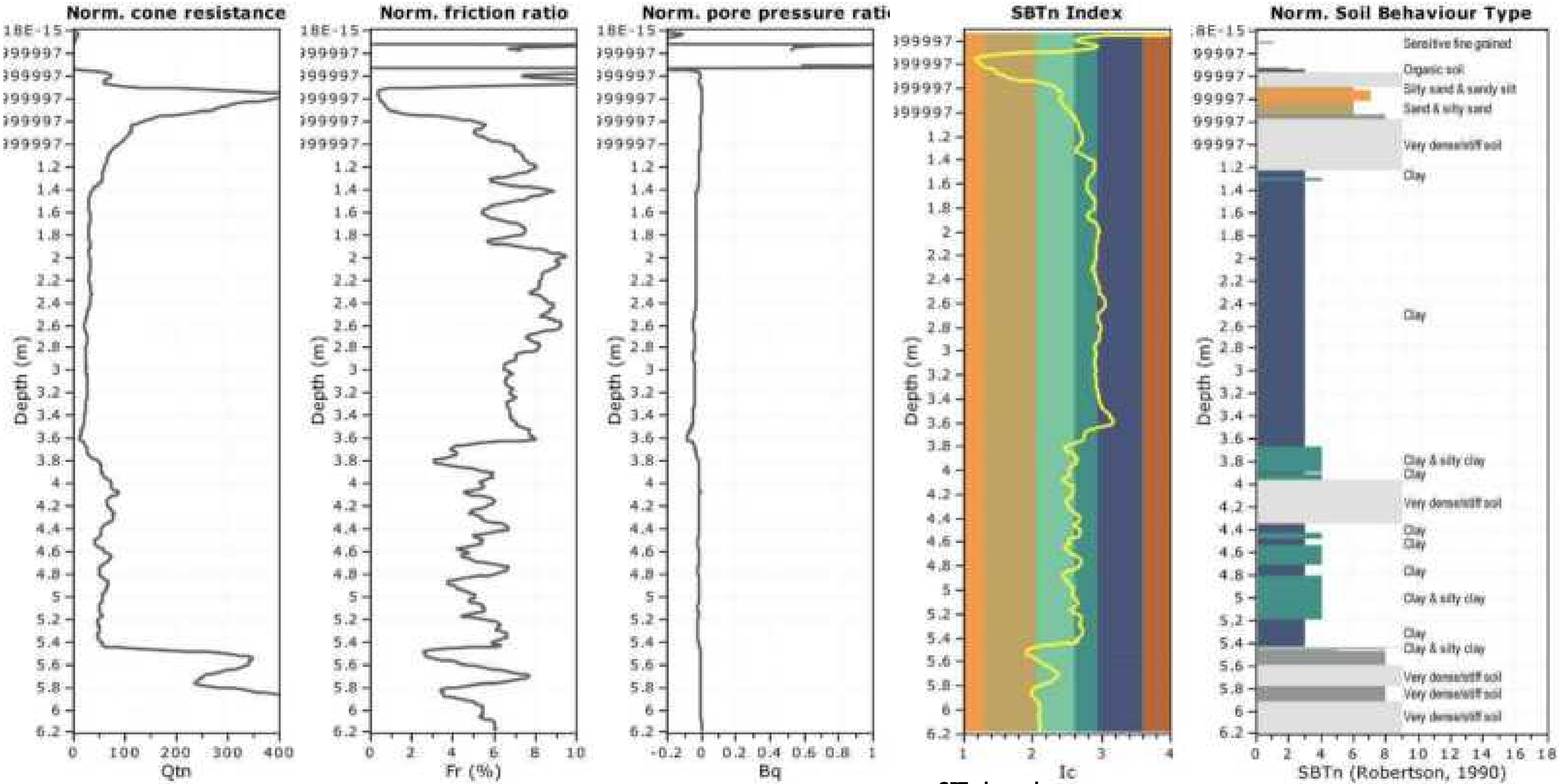
CPT: A7-01
Total depth: 6.18 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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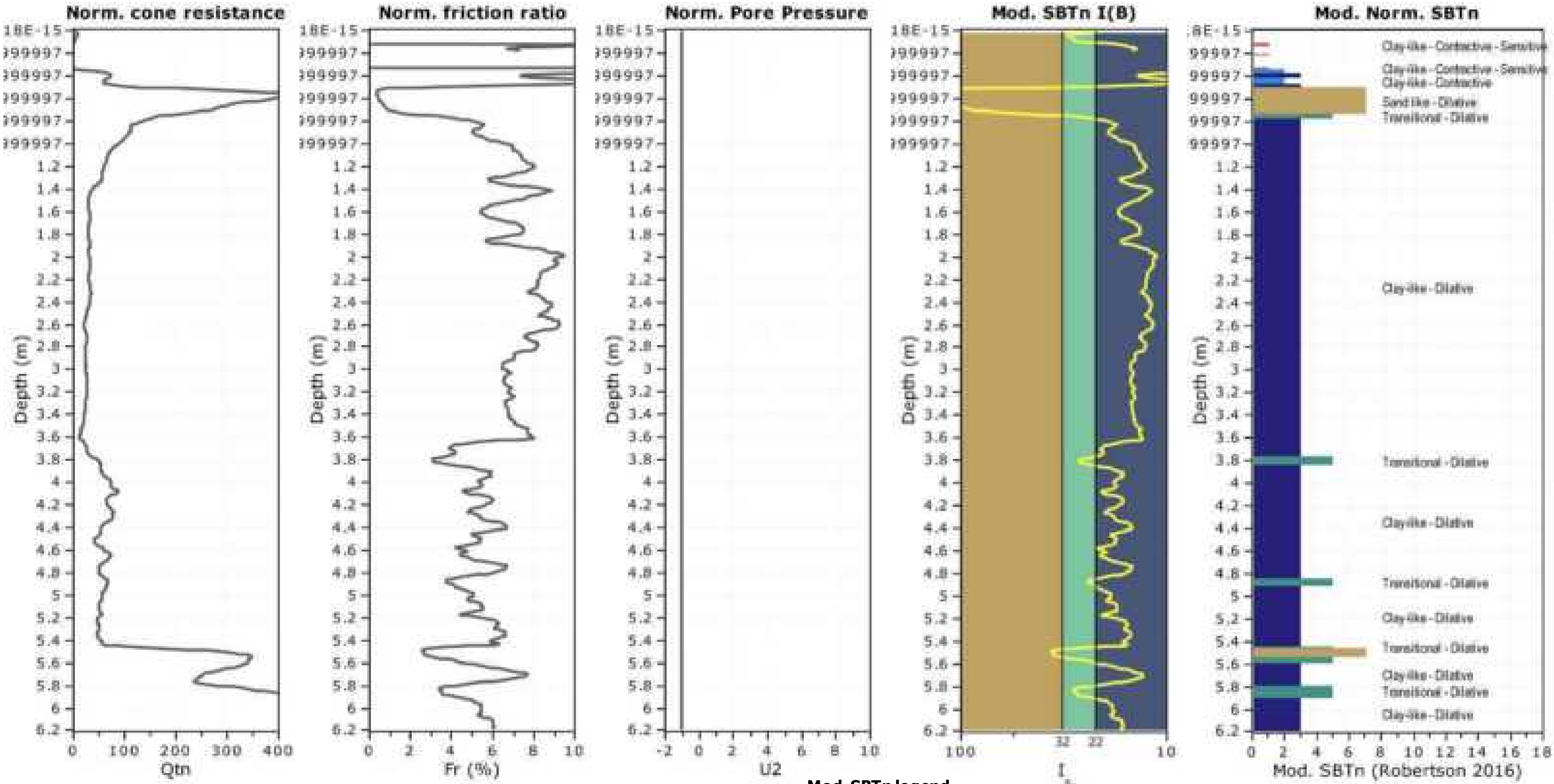
CPT: A7-01
Total depth: 6.18 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

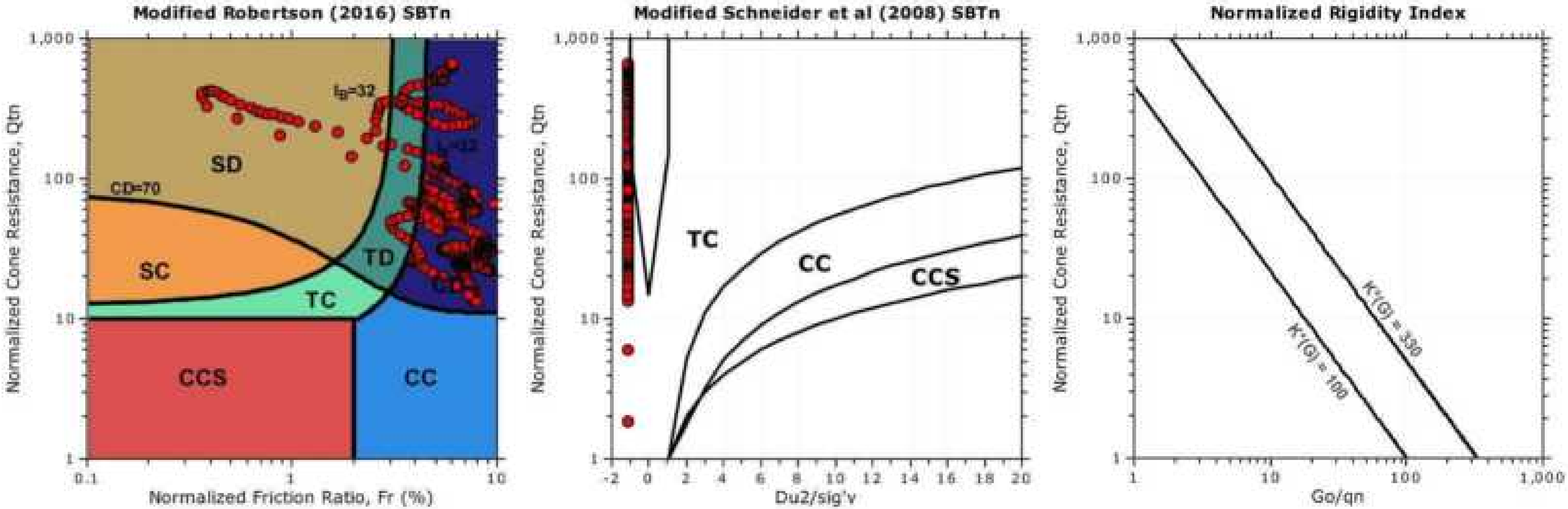
Project:
Location:



Mod. SBTn legend

1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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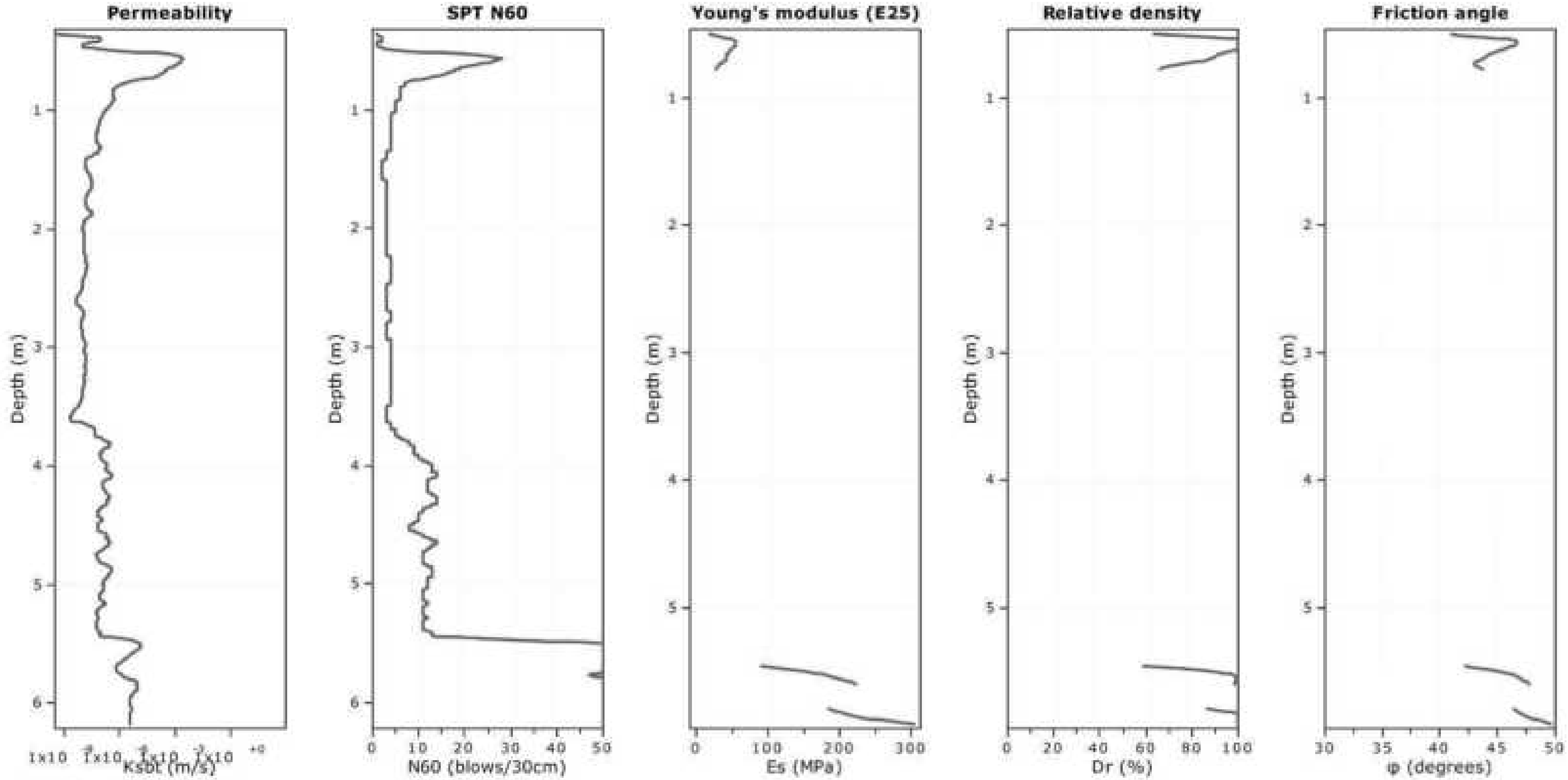
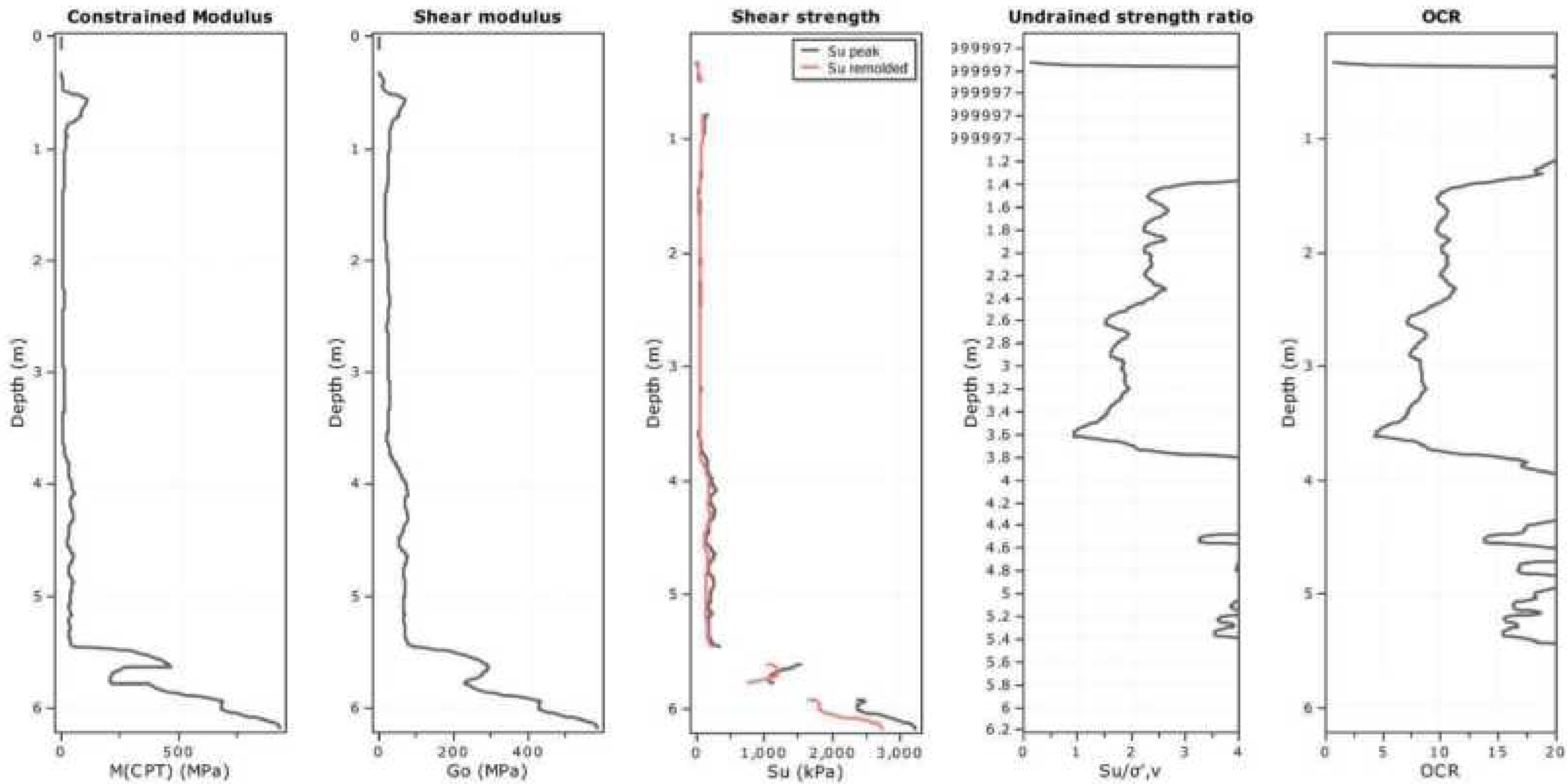
CPT: A7-01
Total depth: 6.18 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



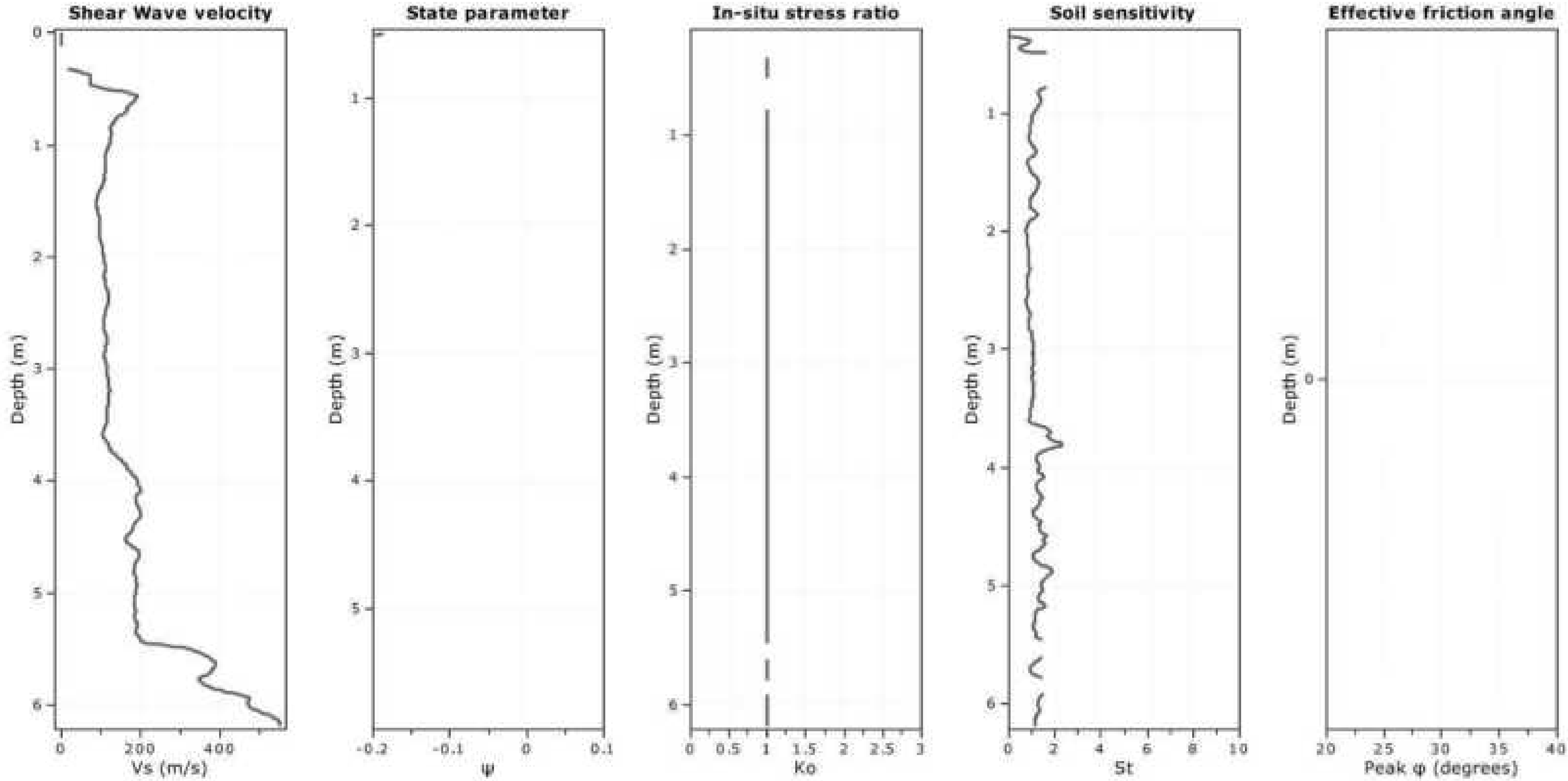
Calculation parameters
Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data



Calculation parameters

Constrained modulus: Based on variable alpha using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable alpha using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

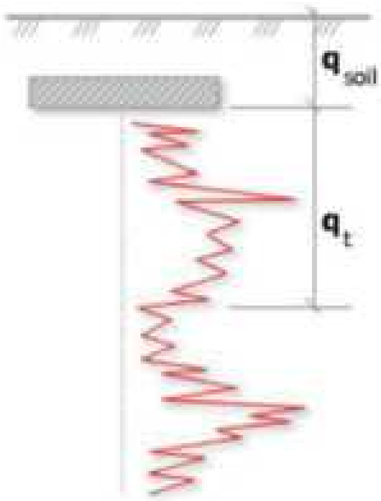
OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

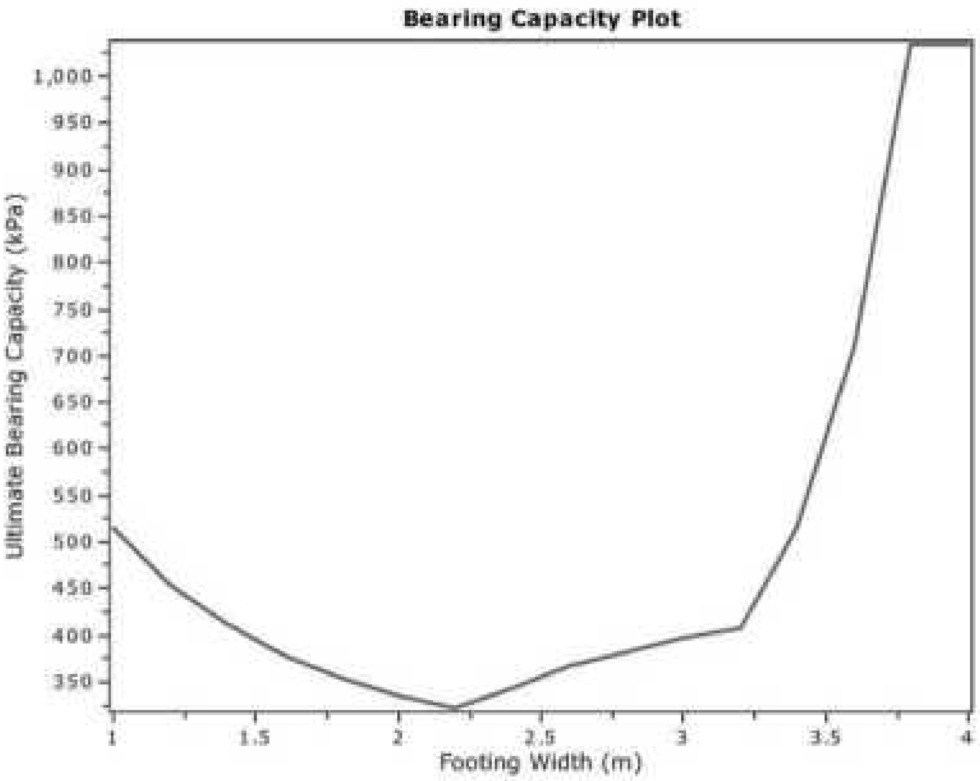
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \, ¼ q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



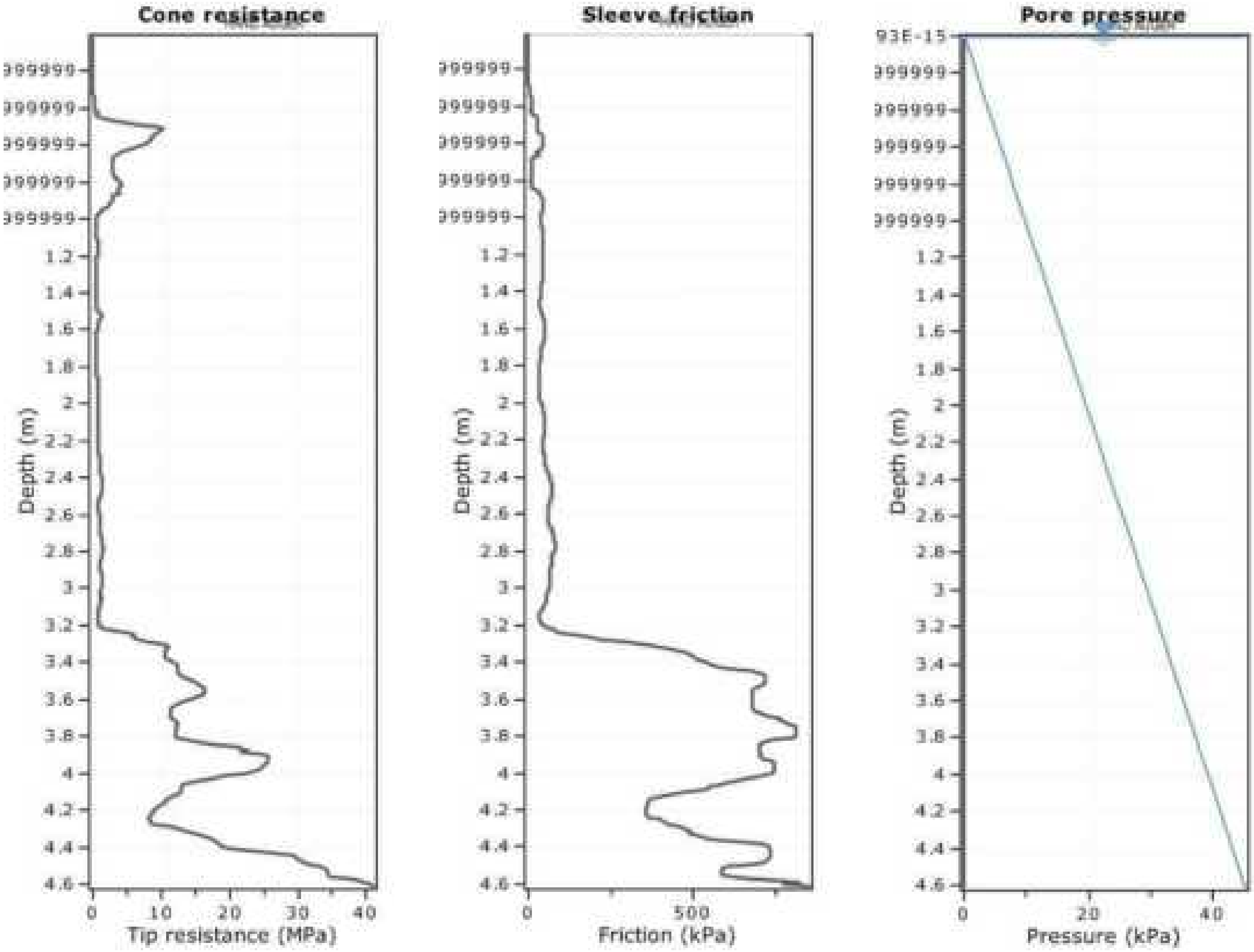
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	2.53	0.20	9.50	514.62
2	1.20	0.50	2.30	2.22	0.20	9.50	453.91
3	1.40	0.50	2.60	2.01	0.20	9.50	412.14
4	1.60	0.50	2.90	1.84	0.20	9.50	377.40
5	1.80	0.50	3.20	1.72	0.20	9.50	354.09
6	2.00	0.50	3.50	1.63	0.20	9.50	335.07
7	2.20	0.50	3.80	1.56	0.20	9.50	322.36
8	2.40	0.50	4.10	1.68	0.20	9.50	344.65
9	2.60	0.50	4.40	1.79	0.20	9.50	368.04
10	2.80	0.50	4.70	1.86	0.20	9.50	381.53
11	3.00	0.50	5.00	1.94	0.20	9.50	396.95
12	3.20	0.50	5.30	1.99	0.20	9.50	407.10
13	3.40	0.50	5.60	2.53	0.20	9.50	515.02
14	3.60	0.50	5.90	3.50	0.20	9.50	709.84
15	3.80	0.50	6.20	5.12	0.20	9.50	1034.09
16	4.00	0.50	6.50	5.12	0.20	9.50	1034.09

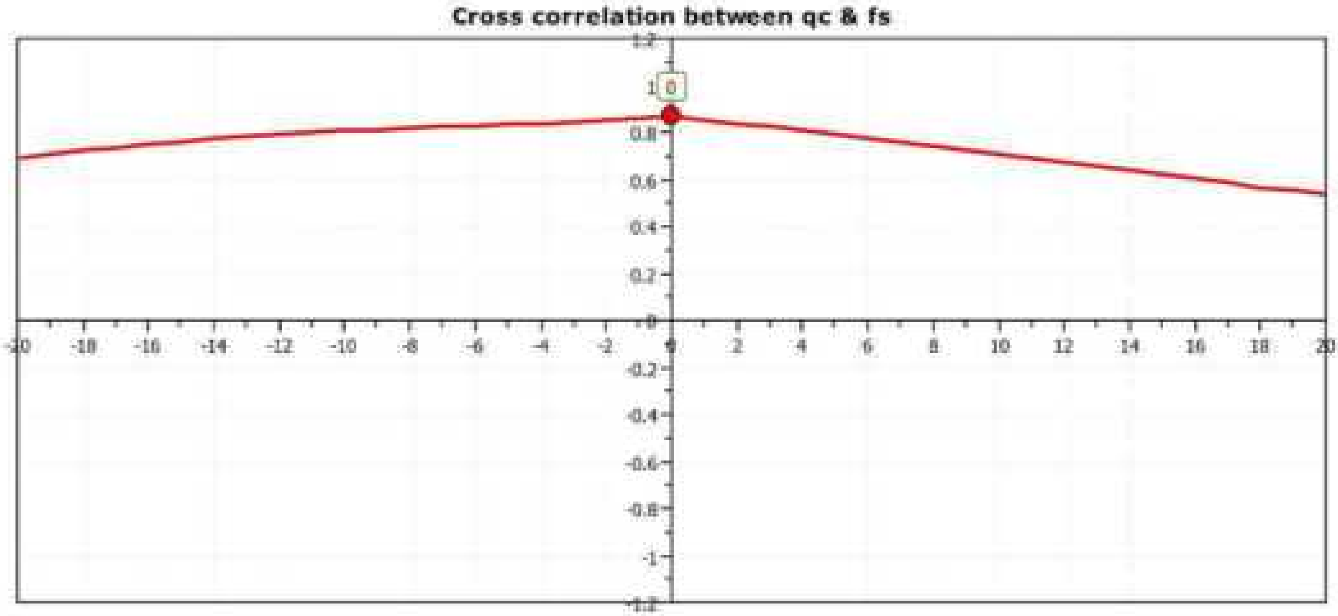
CPT: A7-02

Total depth: 4.61 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

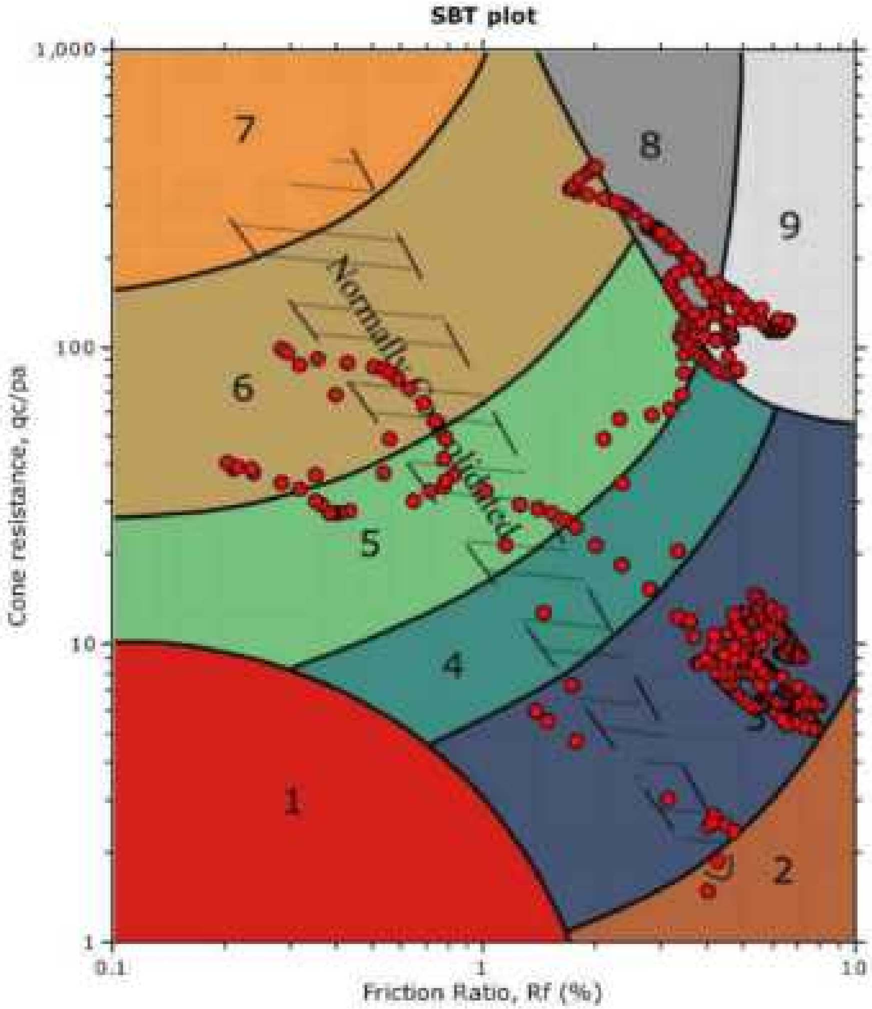
Project:
Location:

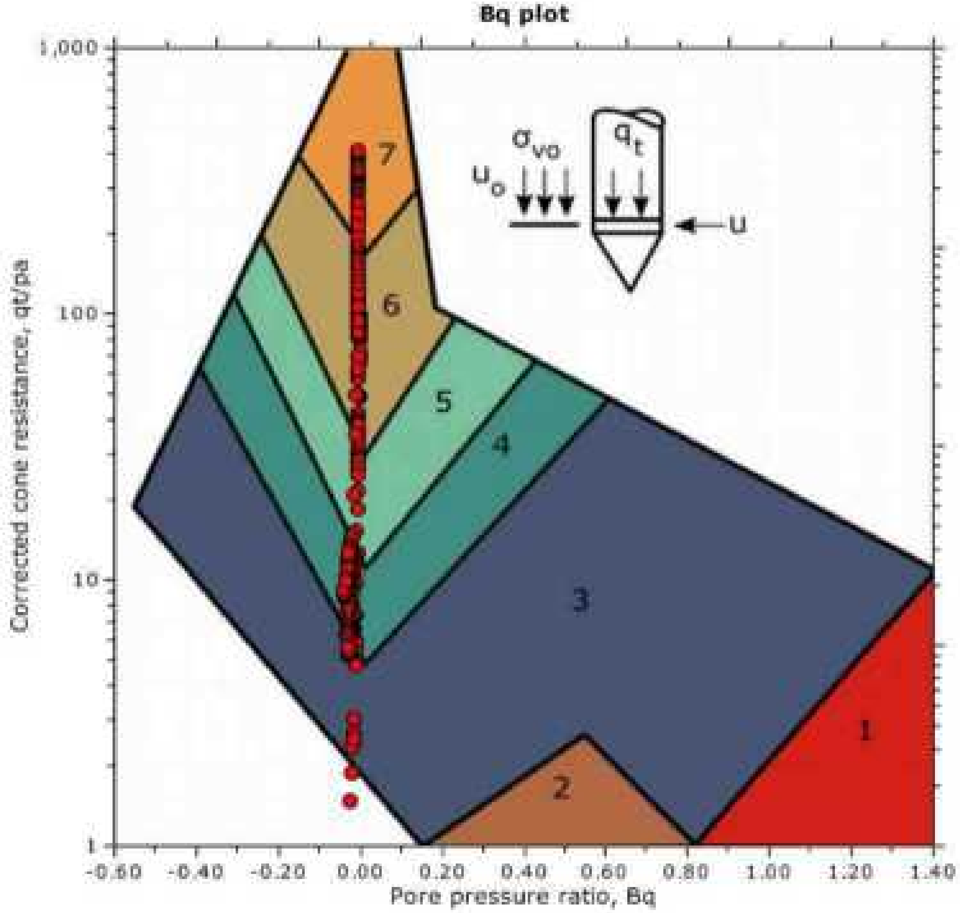


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

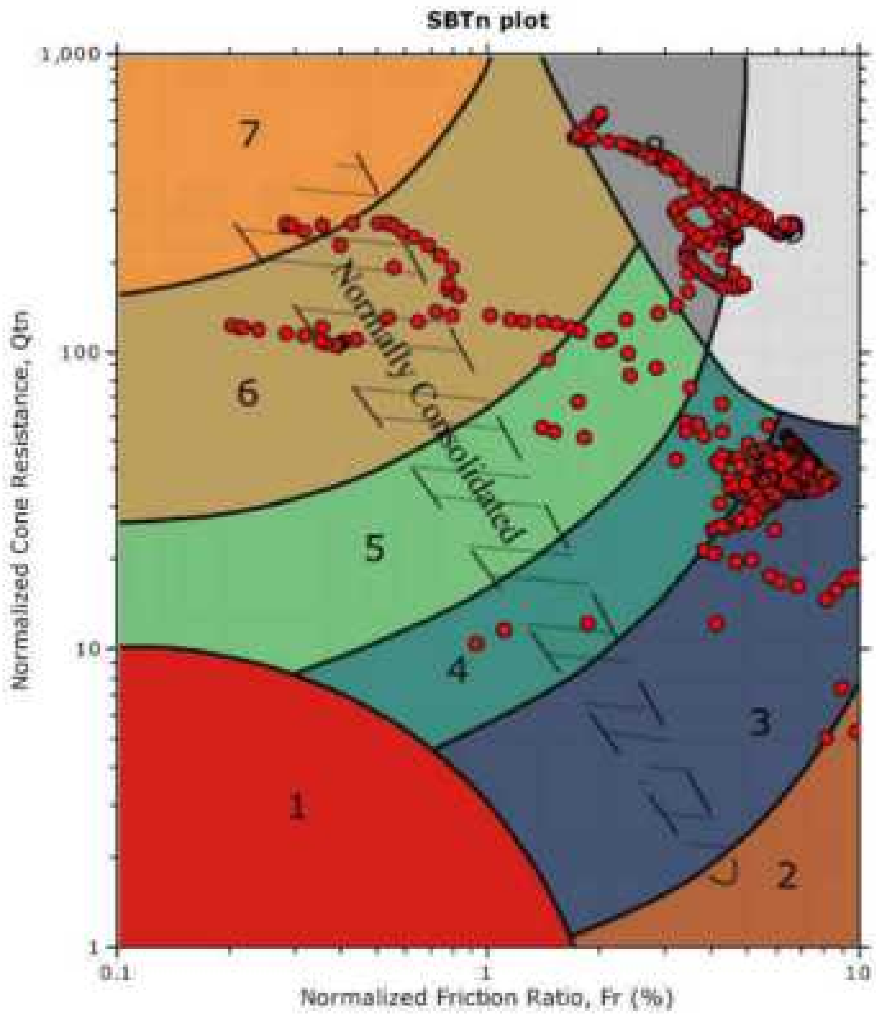


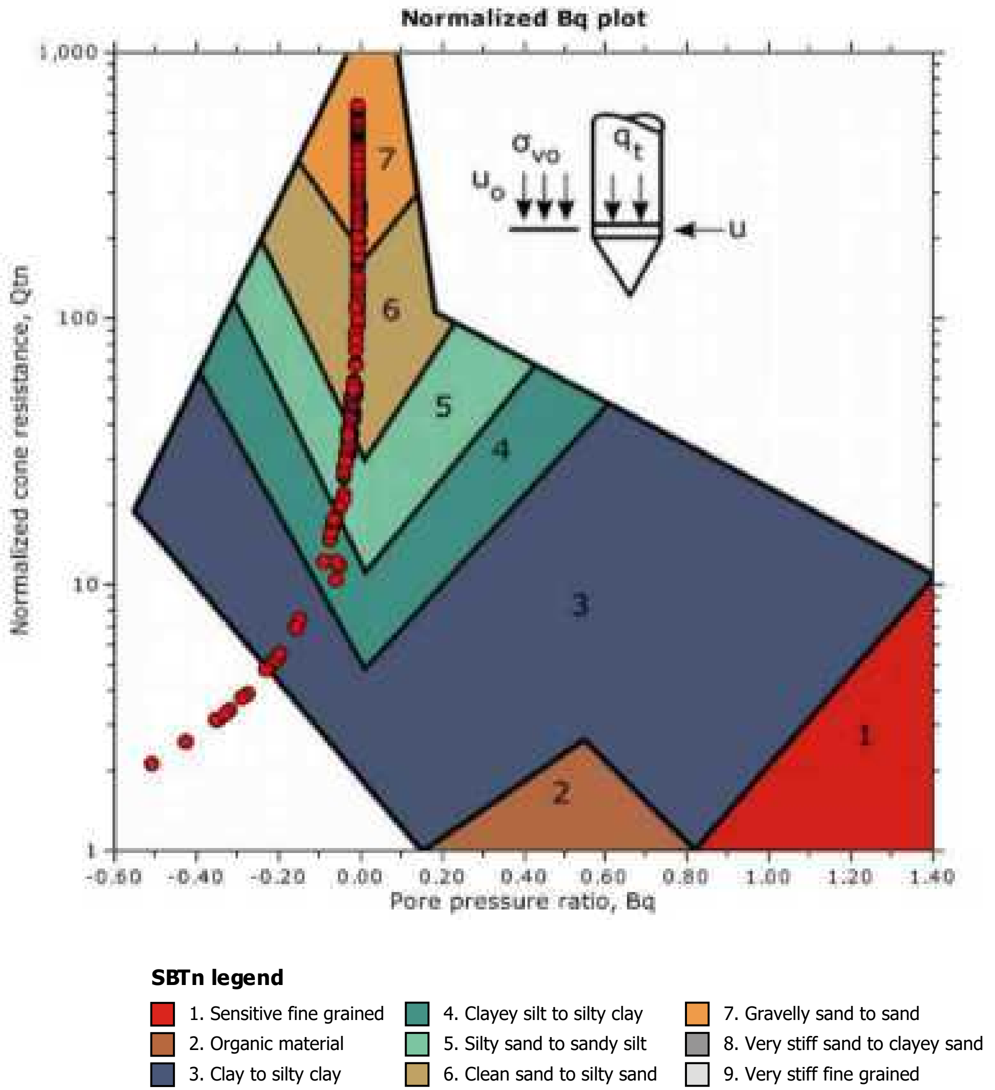


SBT legend

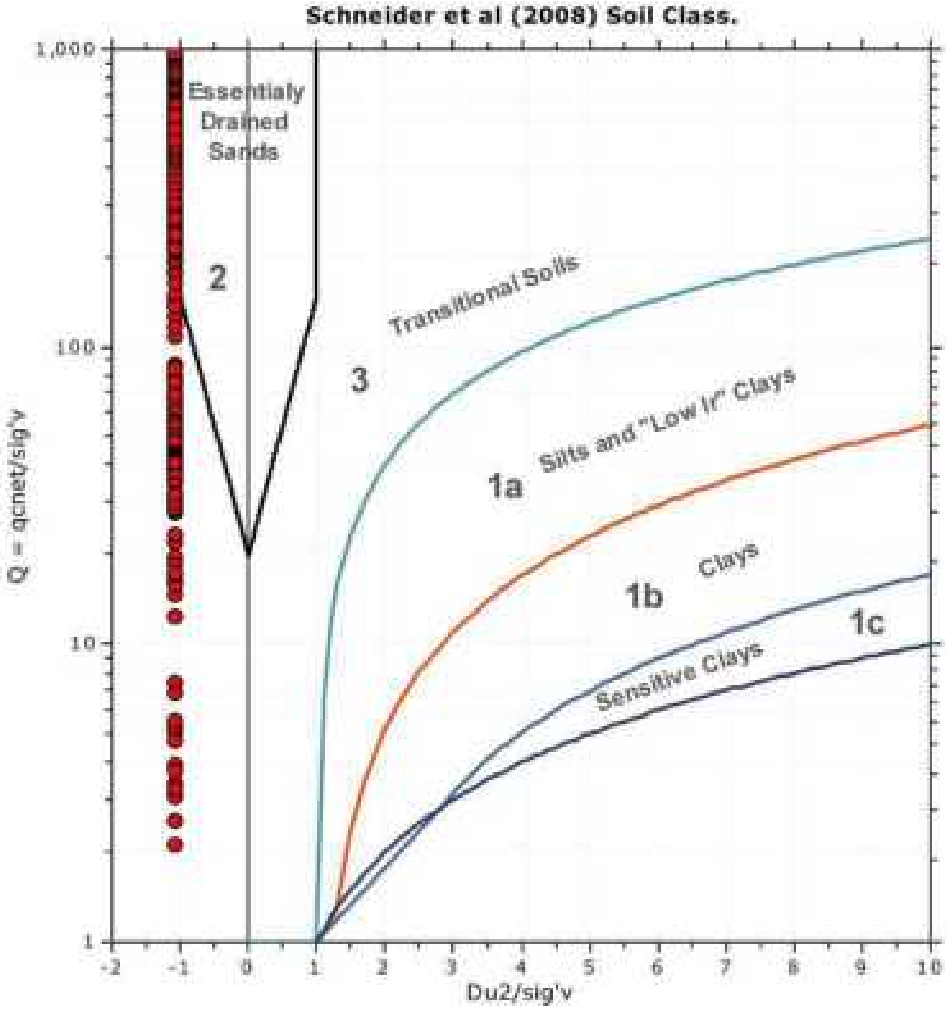
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

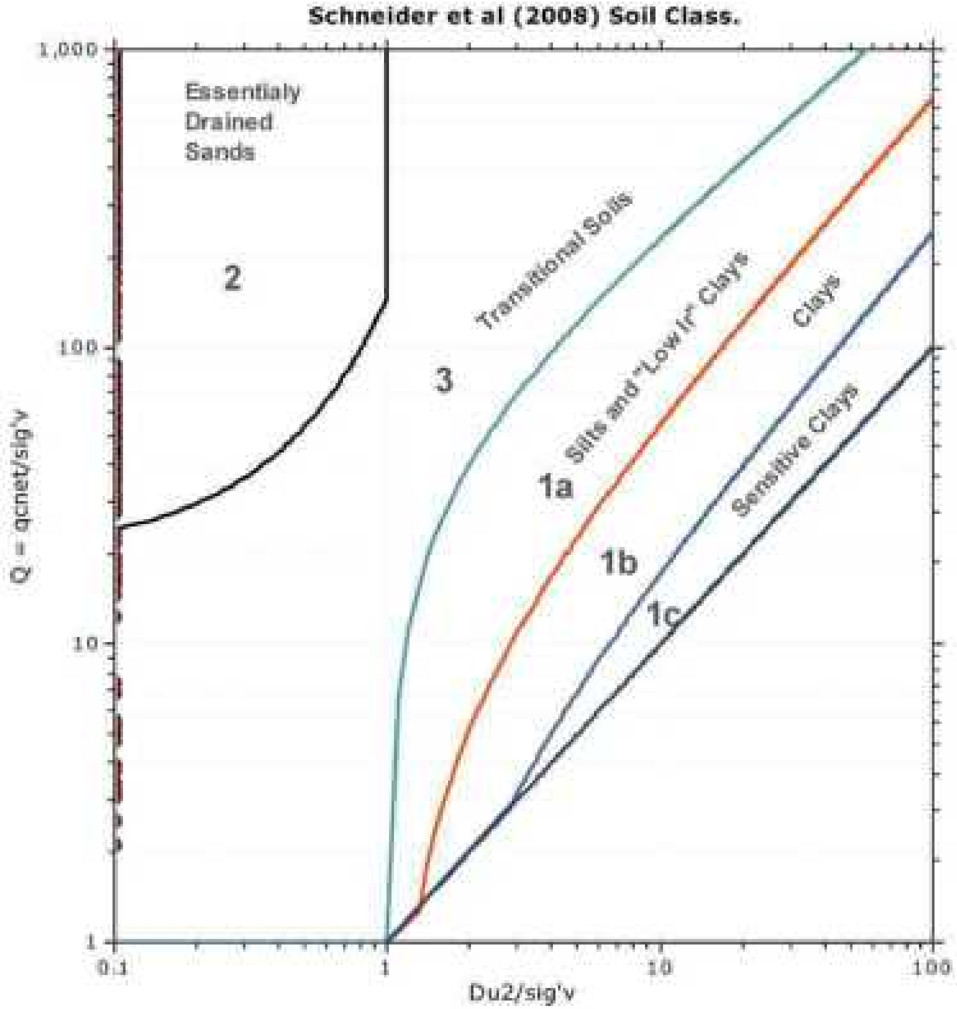
SBT - Bq plots (normalized)

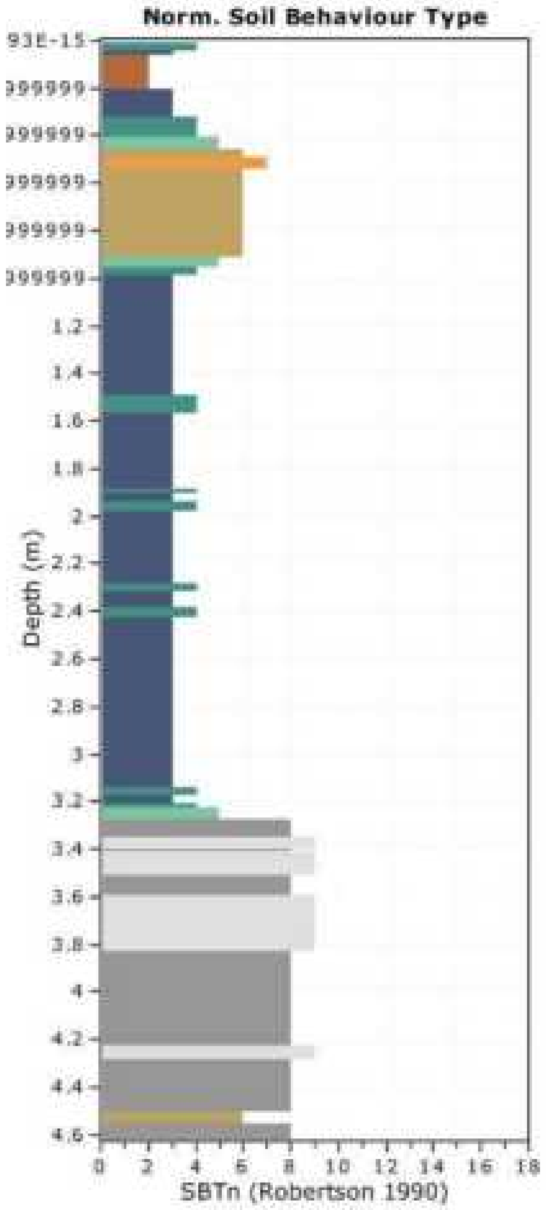


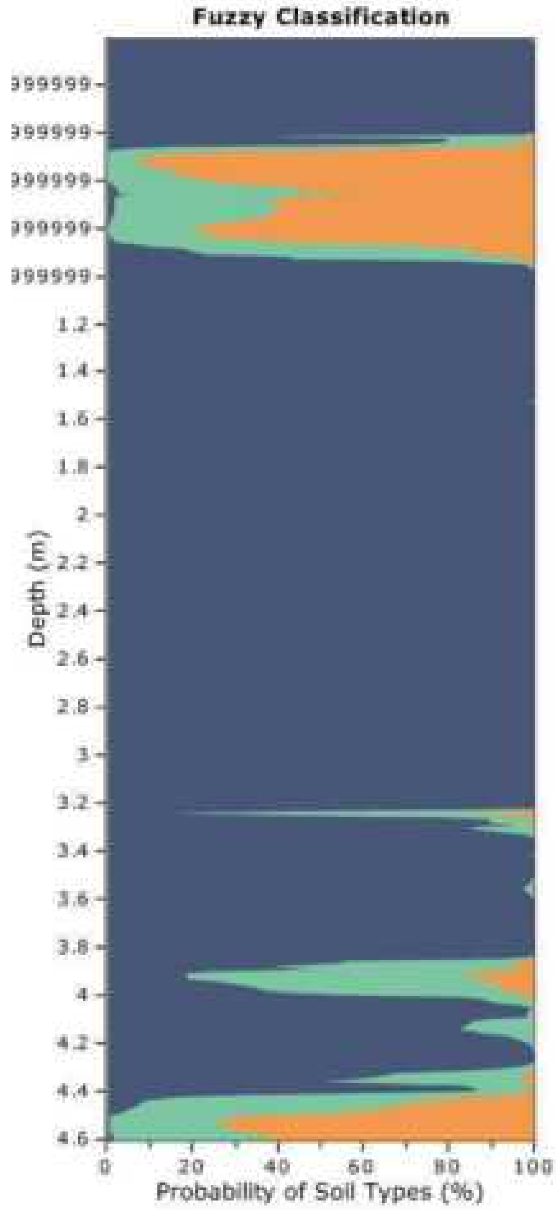


Bq plots (Schneider)






Norm. Soil Behaviour Type
Depth (m)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
Probability of Soil Types (%)

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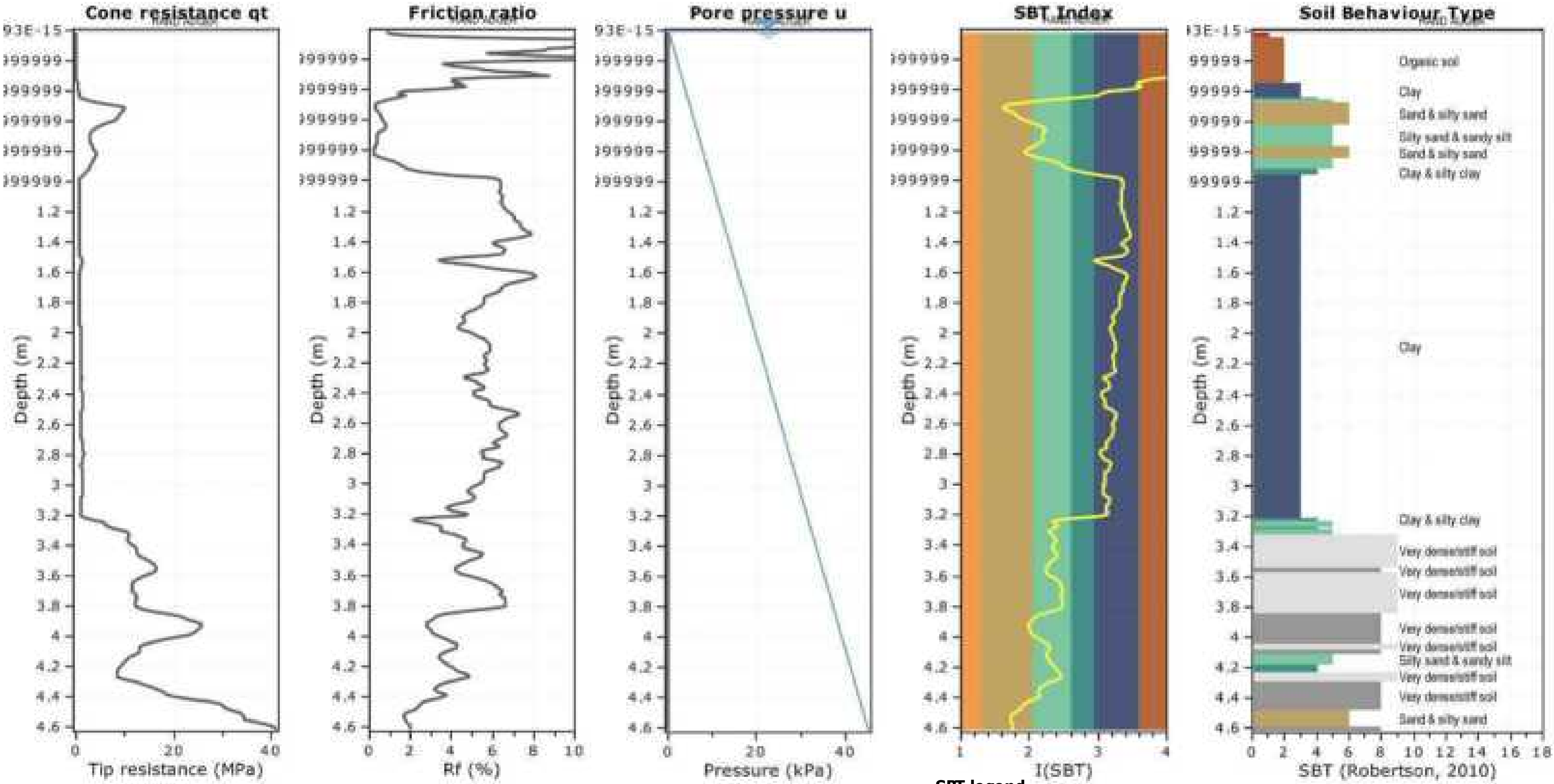
CPT: A7-02
Total depth: 4.61 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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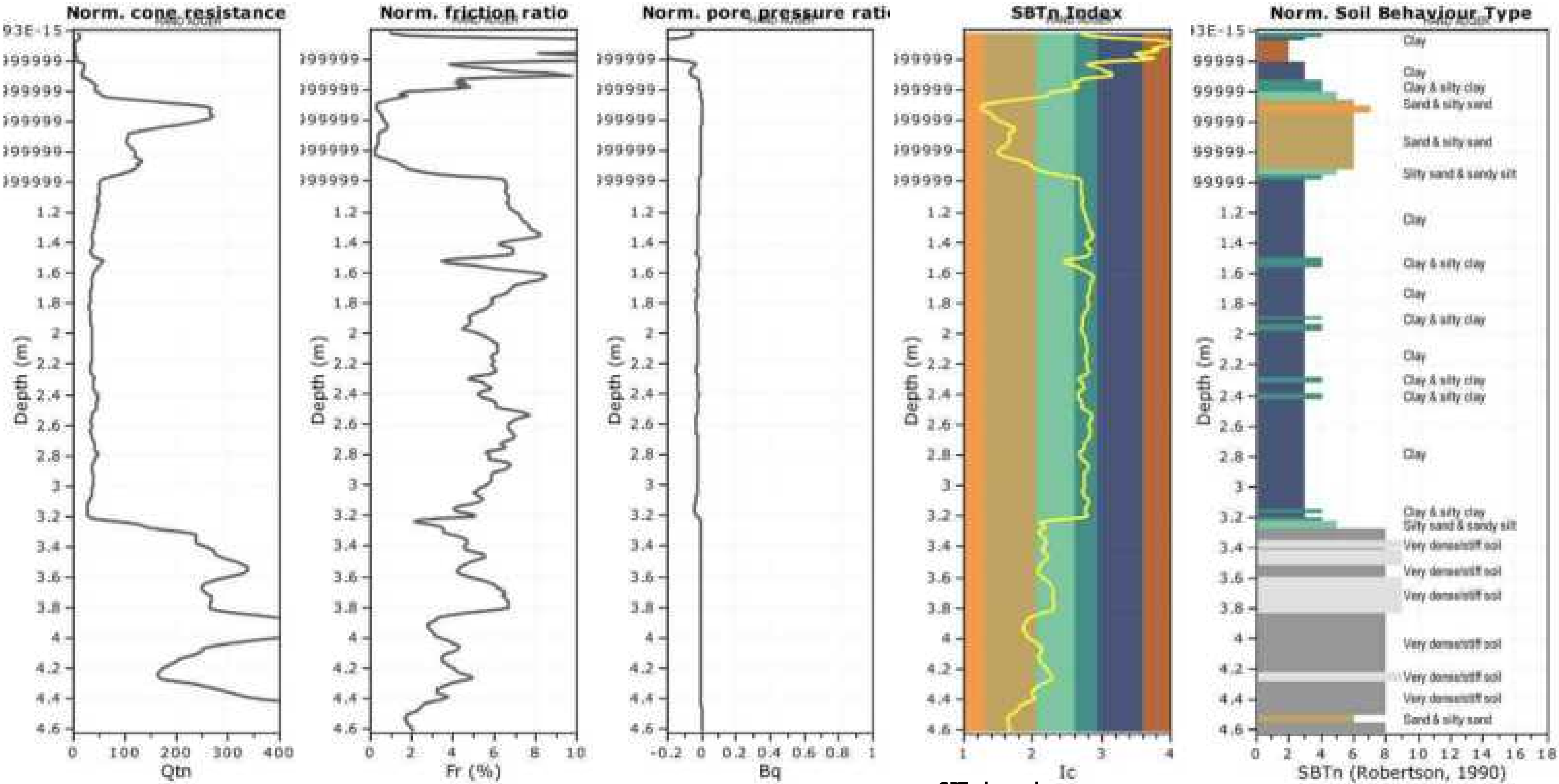
CPT: A7-02
Total depth: 4.61 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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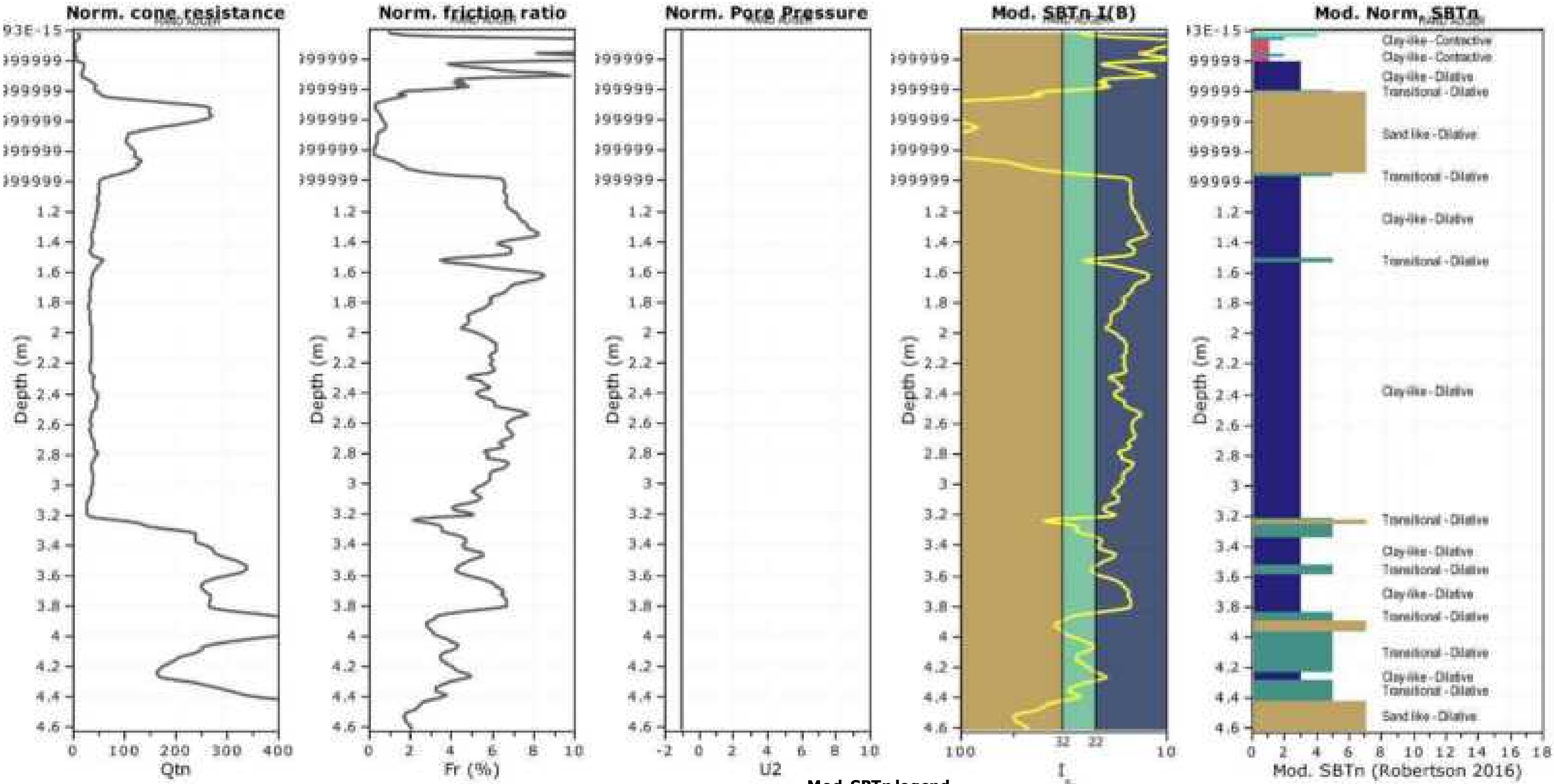
CPT: A7-02
Total depth: 4.61 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

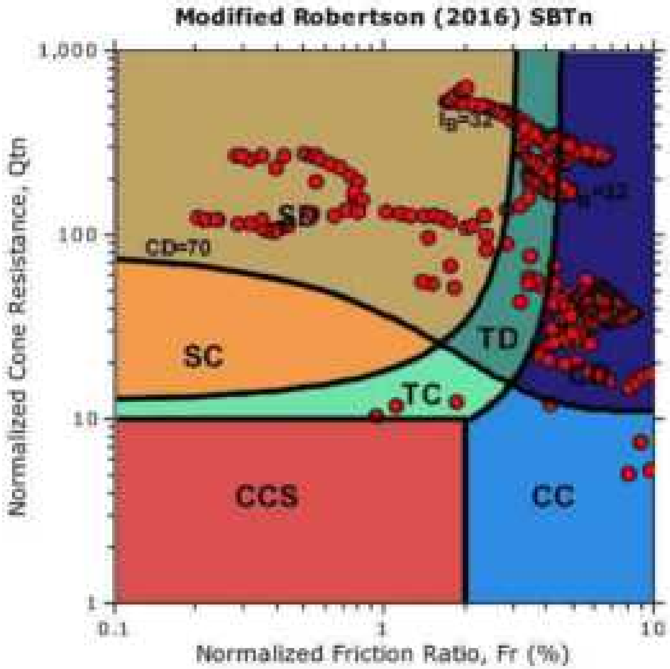
Project:
Location:

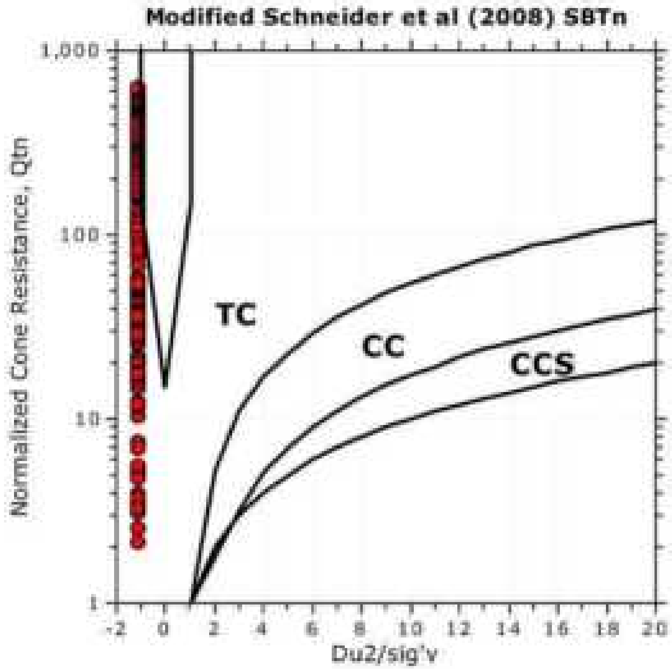


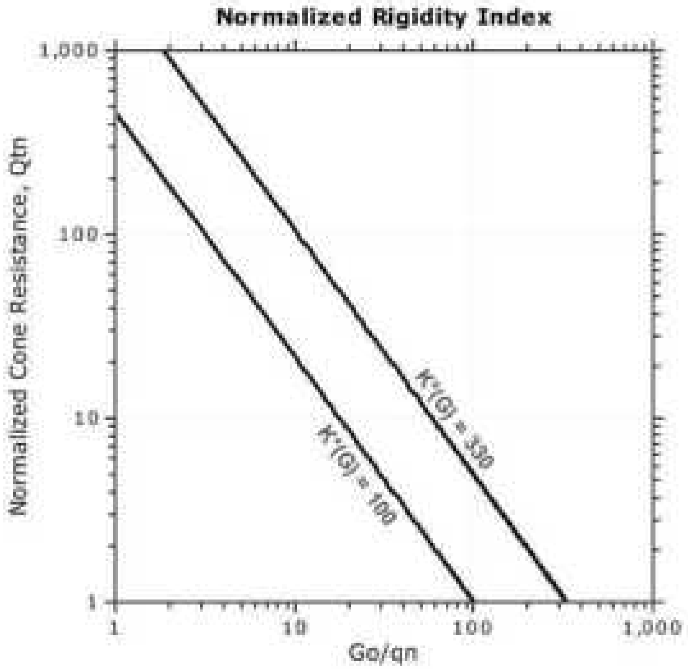
Mod. SBTn legend

1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

Updated SBTn plots

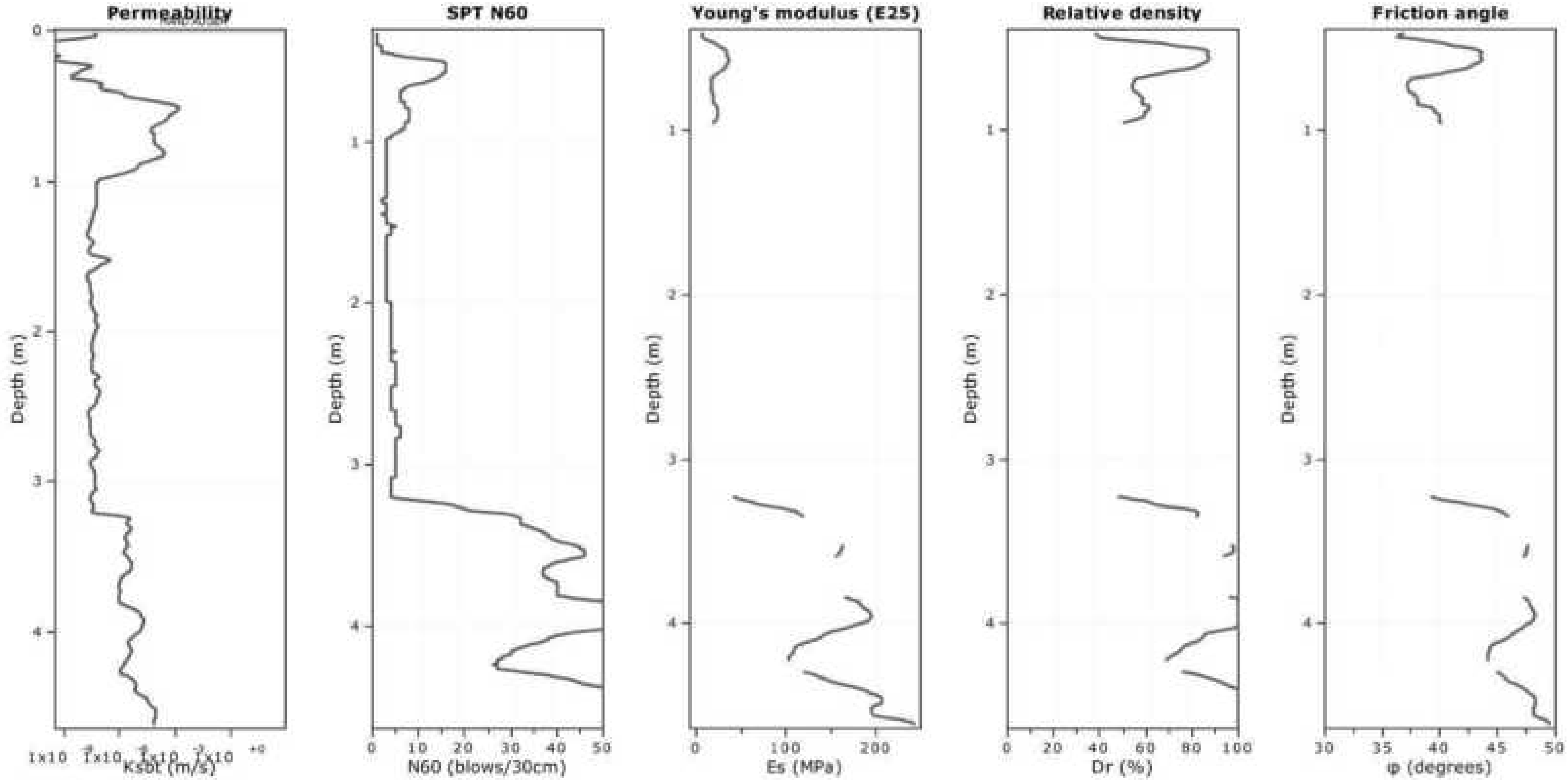






CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)



Calculation parameters

Permeability: Based on SBT_n

SPT N_{60}: Based on I_c and q_t

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

Relative density constant, C_{Dr}: 350.0

Phi: Based on Kulhawy & Mayne (1990)

User defined estimation data

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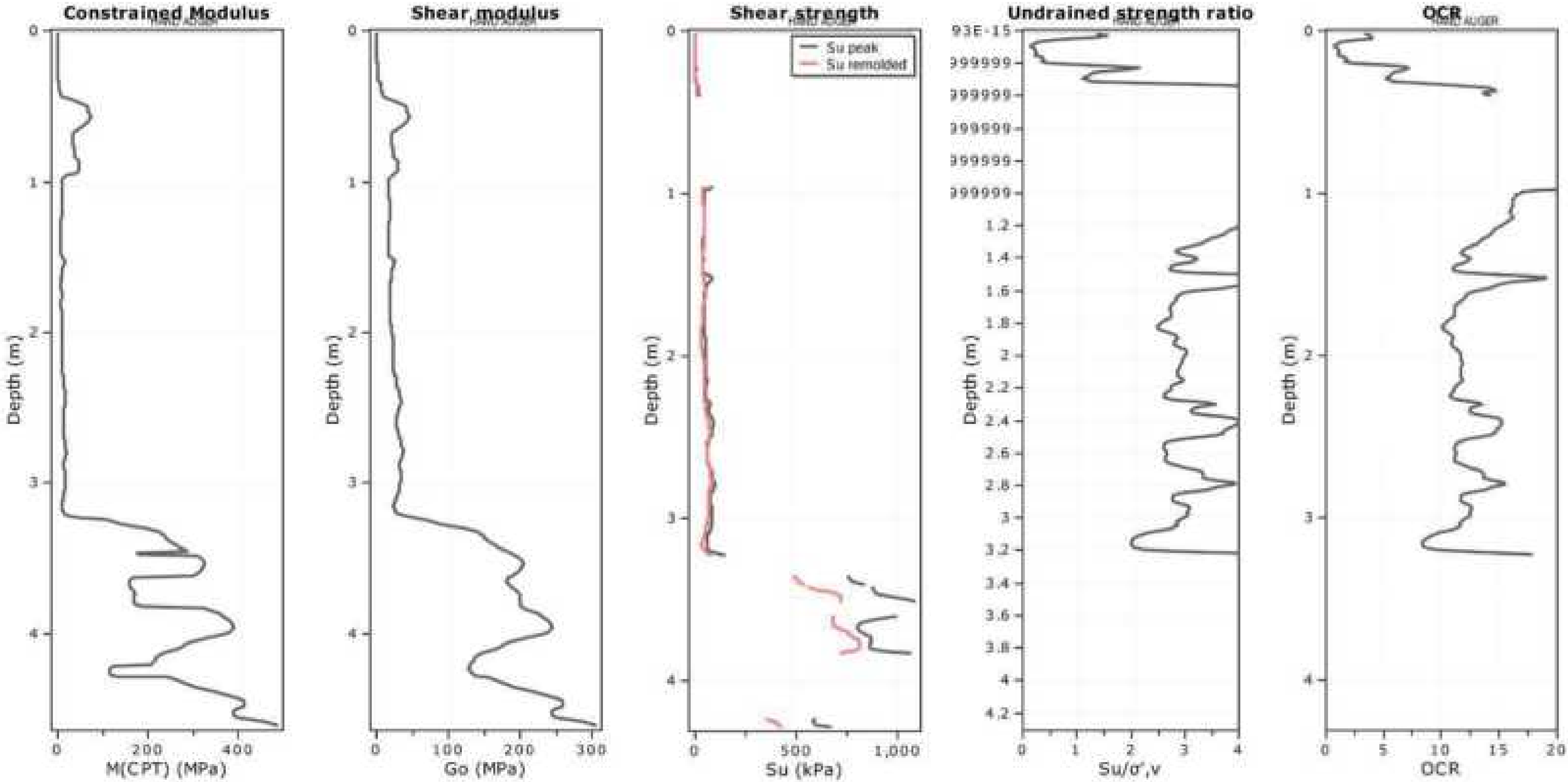
CPT: A7-02
Total depth: 4.61 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable alpha using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable alpha using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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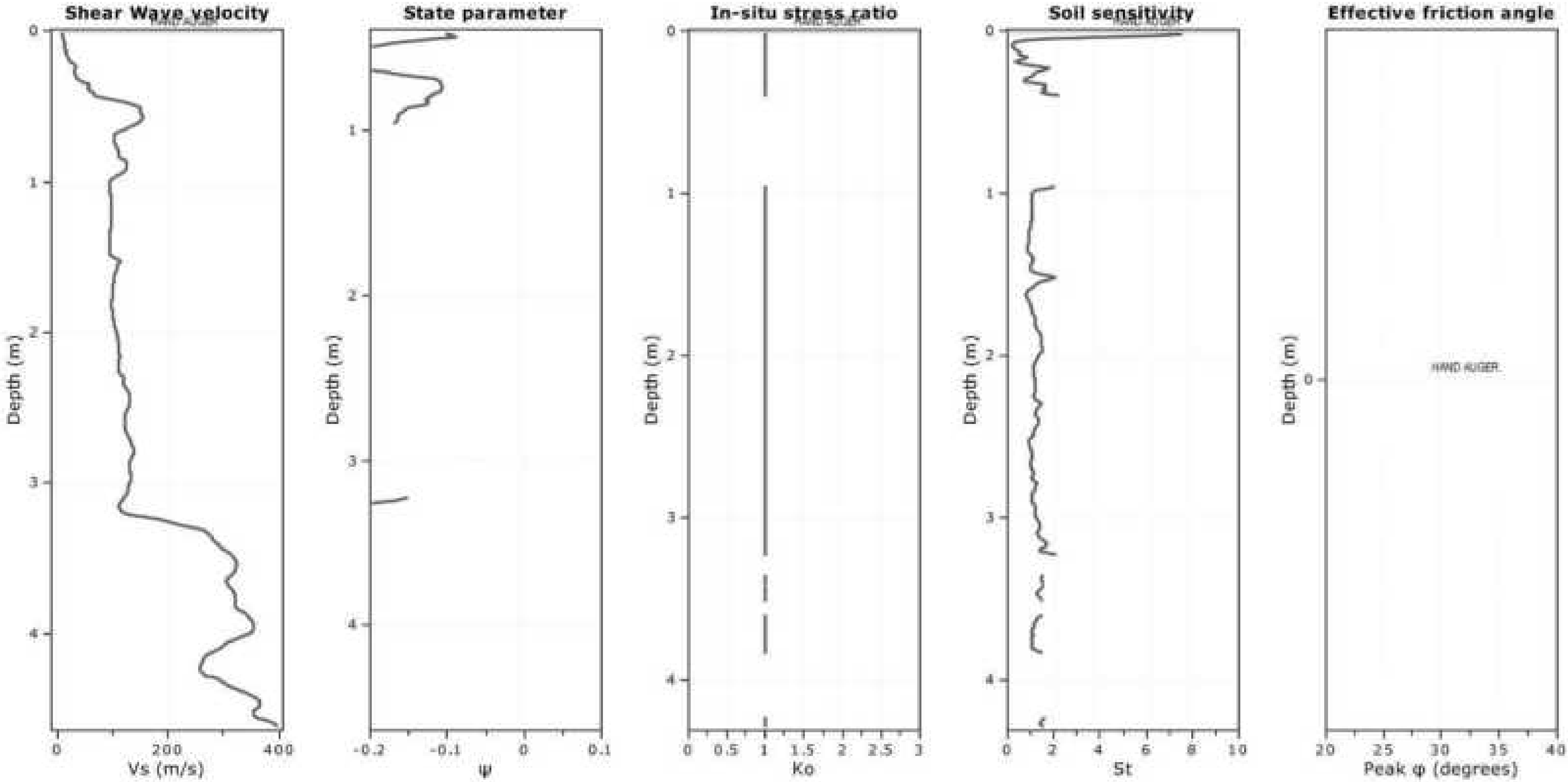
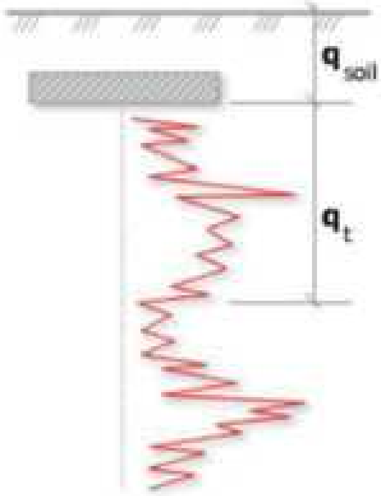
CPT: A7-02
Total depth: 4.61 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters

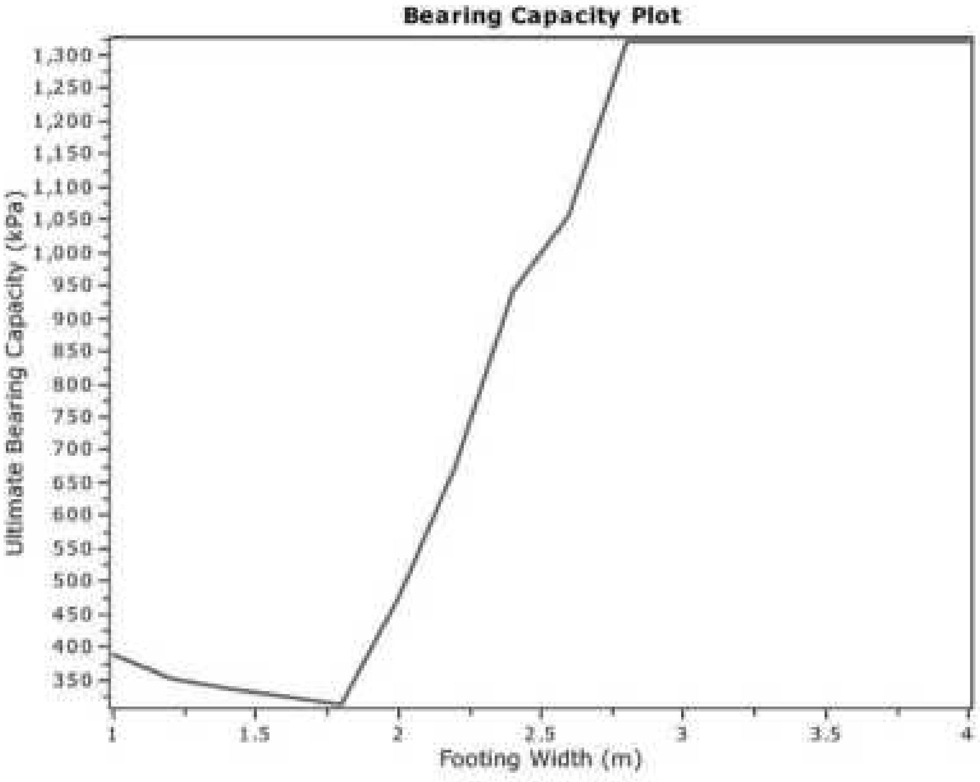
Soil Sensitivity factor, N_S: 7.00
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \, ¼ q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.90	0.20	9.50	388.72
2	1.20	0.50	2.30	1.72	0.20	9.50	353.88
3	1.40	0.50	2.60	1.63	0.20	9.50	336.44
4	1.60	0.50	2.90	1.57	0.20	9.50	324.00
5	1.80	0.50	3.20	1.52	0.20	9.50	312.93
6	2.00	0.50	3.50	2.34	0.20	9.50	477.46
7	2.20	0.50	3.80	3.32	0.20	9.50	674.32
8	2.40	0.50	4.10	4.66	0.20	9.50	941.23
9	2.60	0.50	4.40	5.23	0.20	9.50	1055.72
10	2.80	0.50	4.70	6.56	0.20	9.50	1320.53
11	3.00	0.50	5.00	6.56	0.20	9.50	1320.53
12	3.20	0.50	5.30	6.56	0.20	9.50	1320.53
13	3.40	0.50	5.60	6.56	0.20	9.50	1320.53
14	3.60	0.50	5.90	6.56	0.20	9.50	1320.53
15	3.80	0.50	6.20	6.56	0.20	9.50	1320.53
16	4.00	0.50	6.50	6.56	0.20	9.50	1320.53

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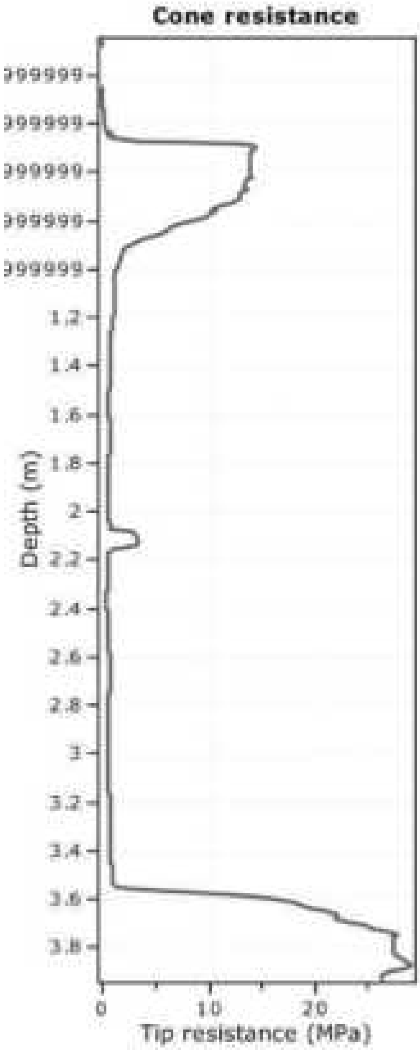
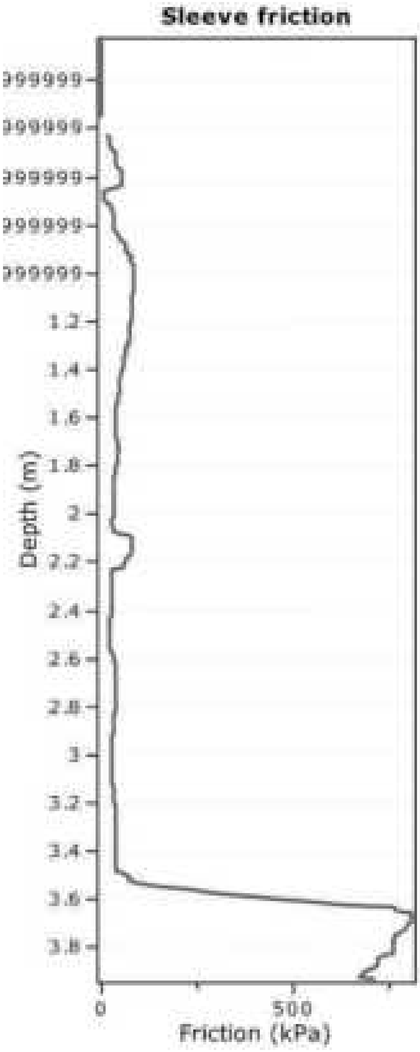
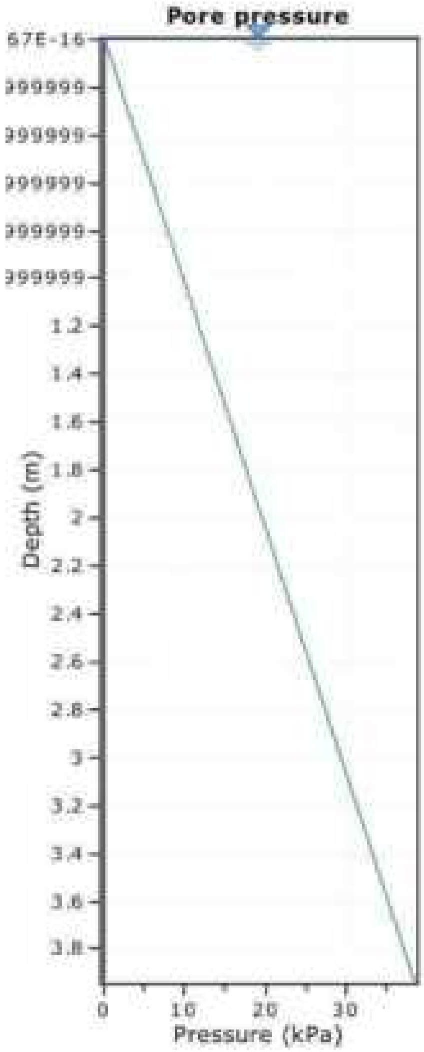
CPT: A7-03
Total depth: 3.93 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

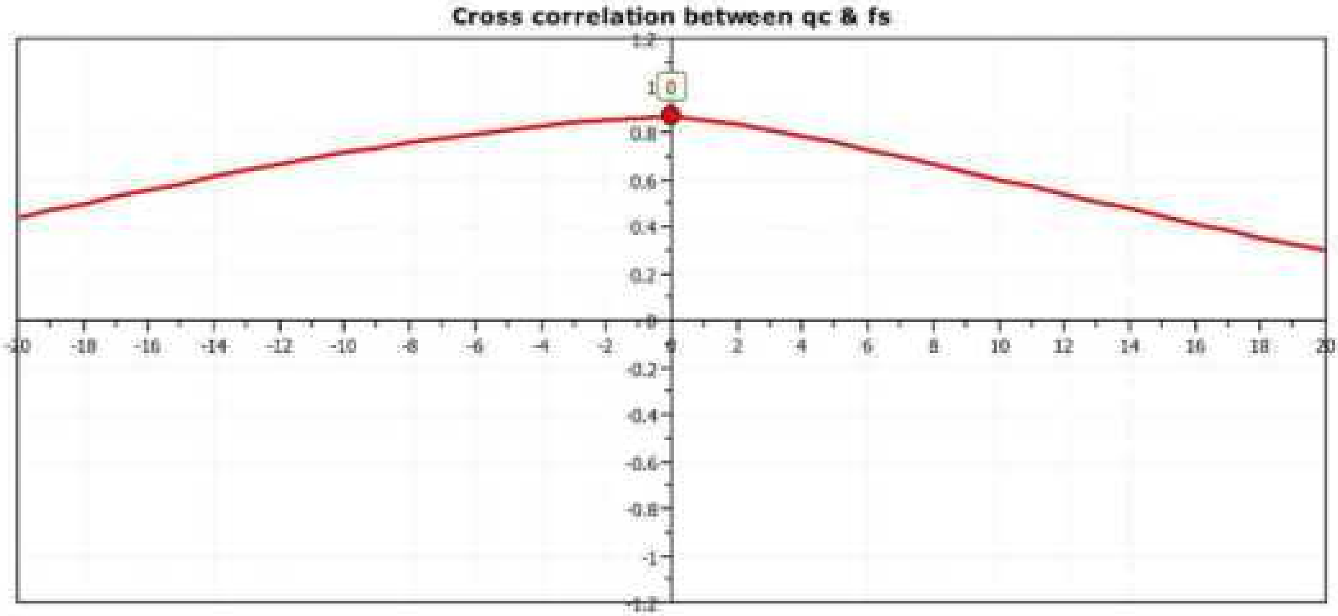
Project:
Location:



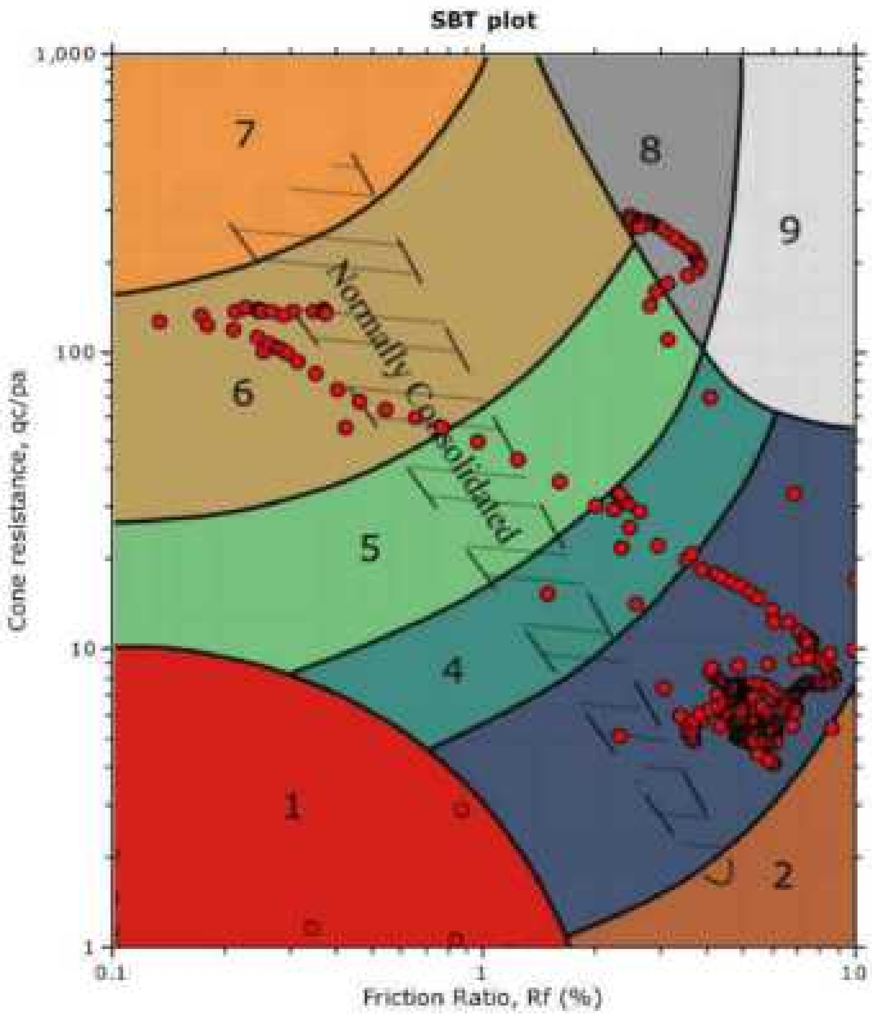


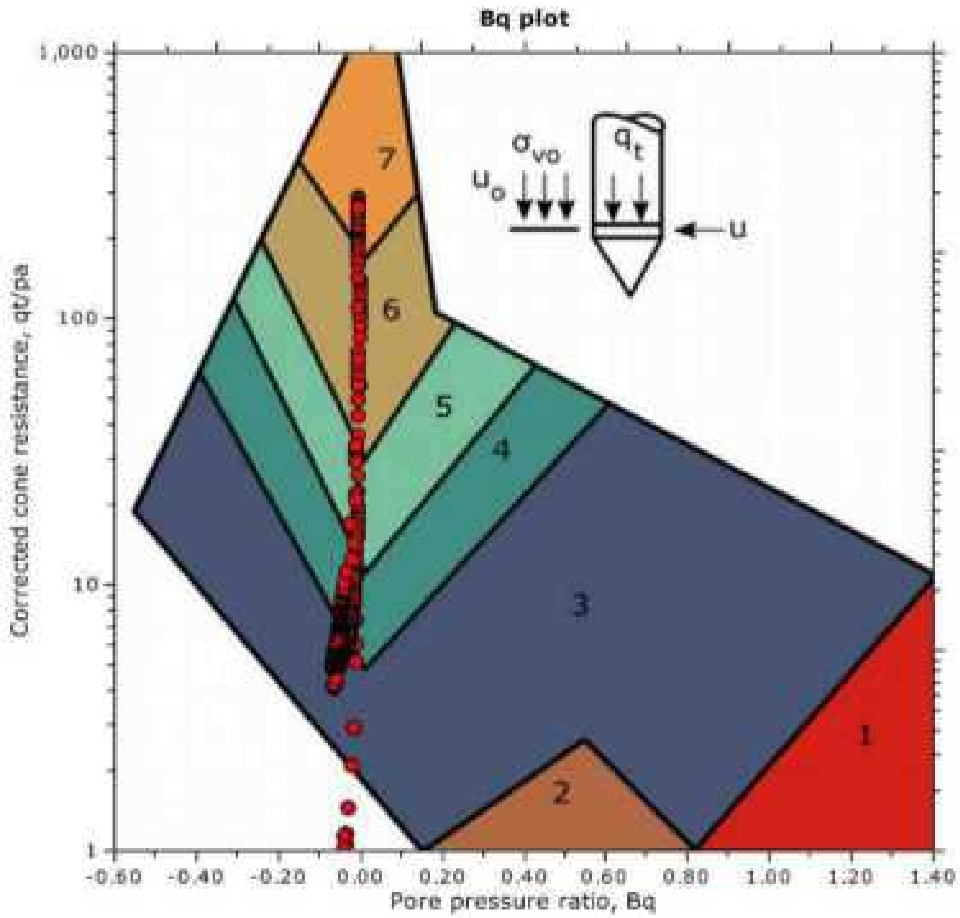


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

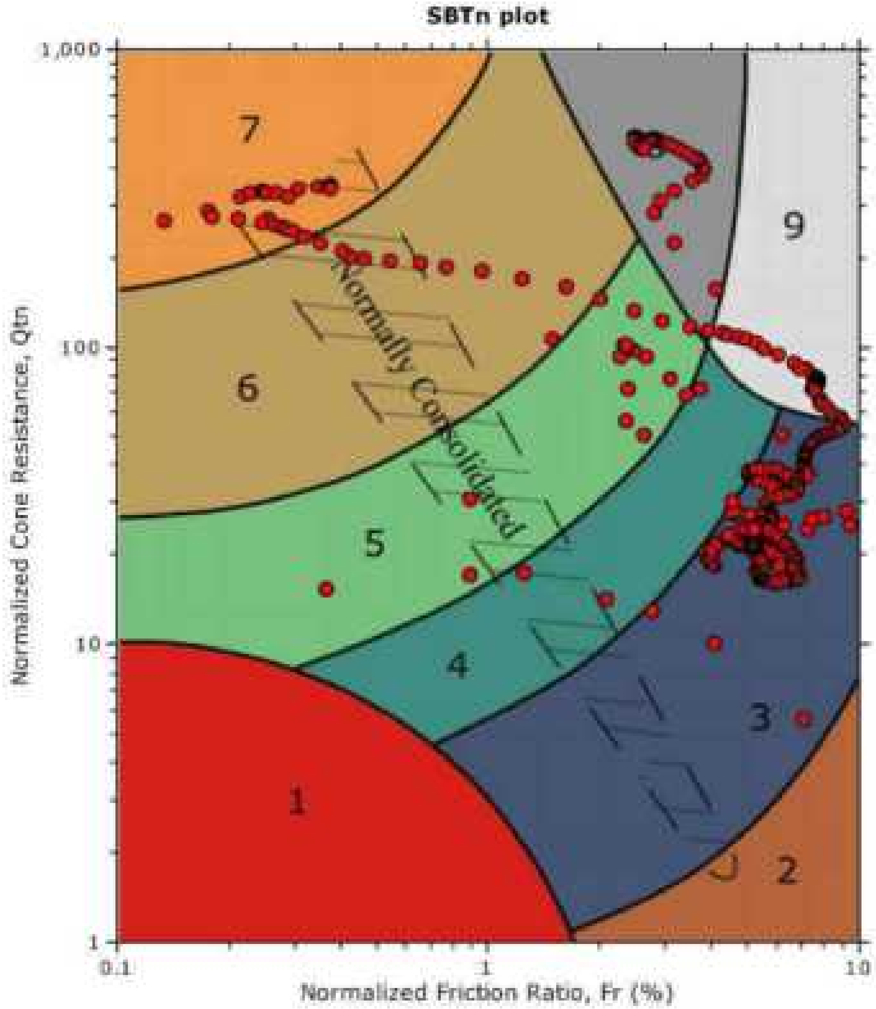


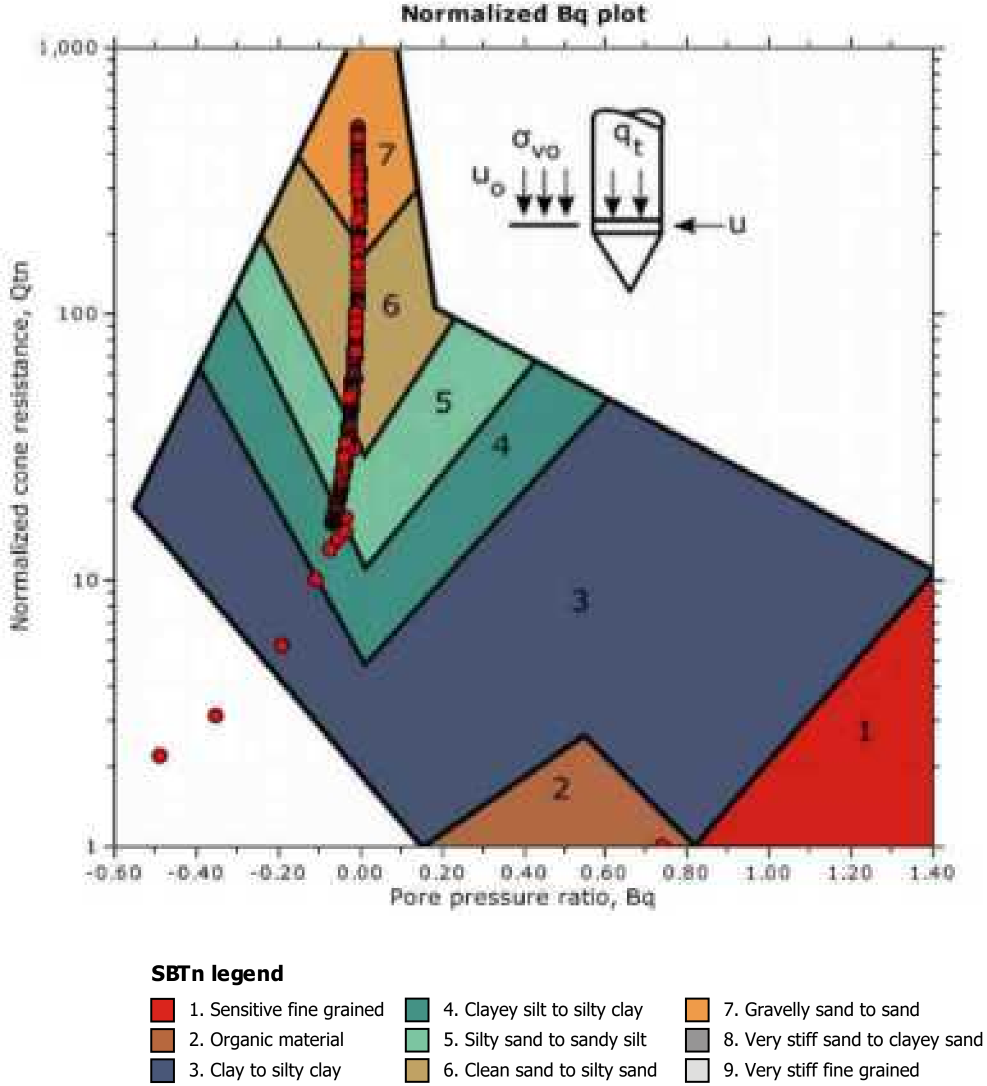


SBT legend

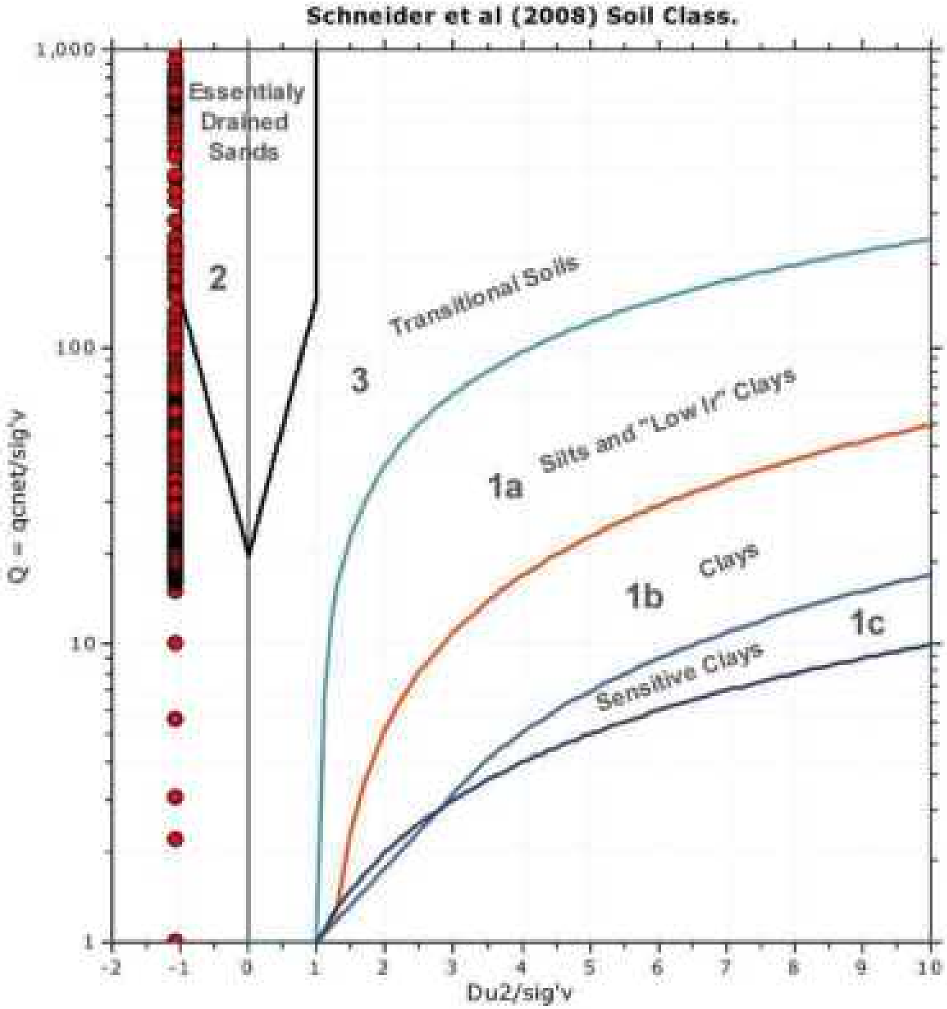
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

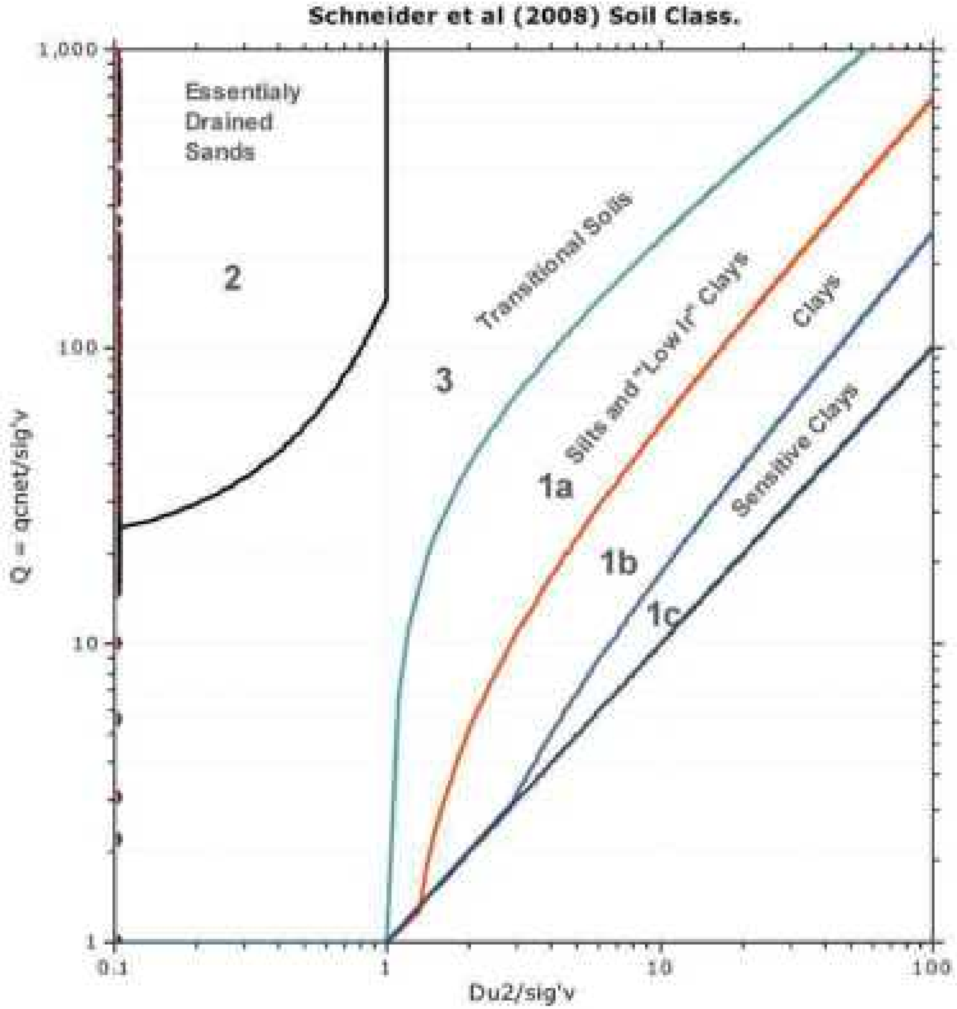
SBT - Bq plots (normalized)

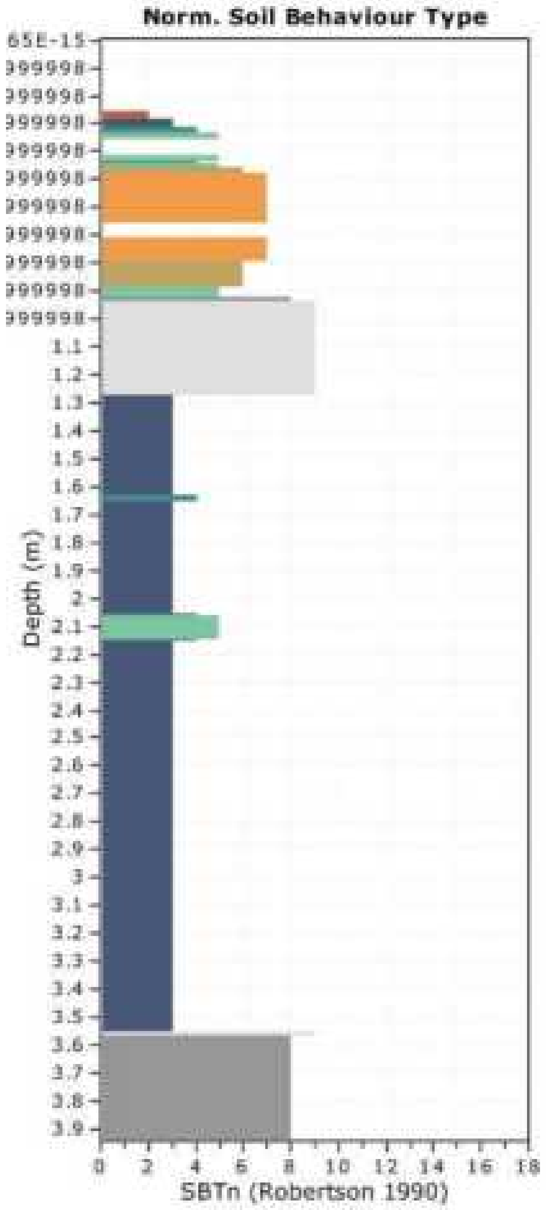


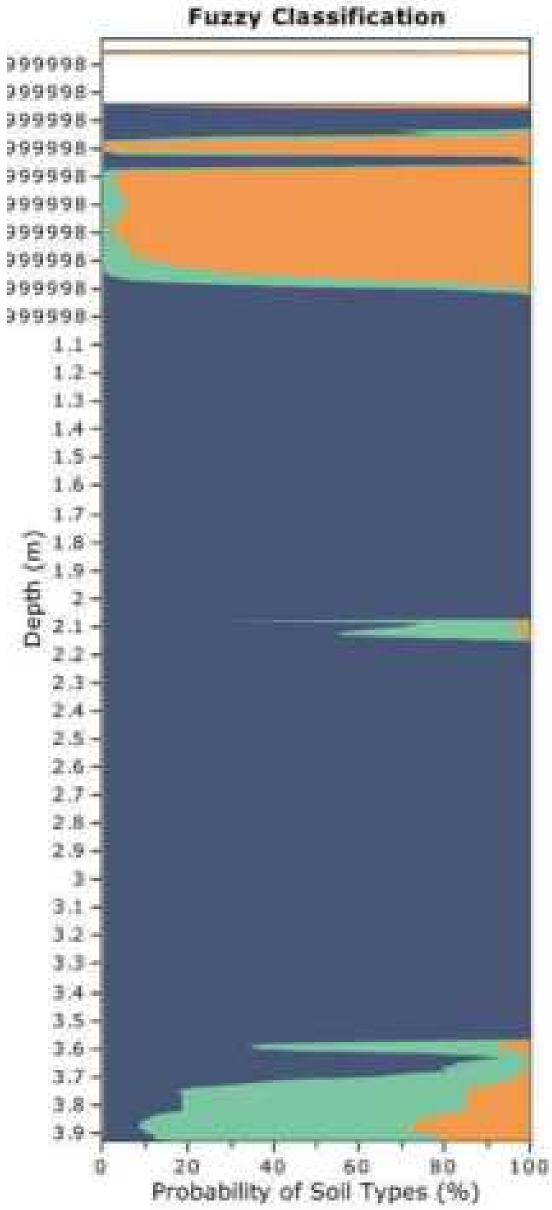


Bq plots (Schneider)





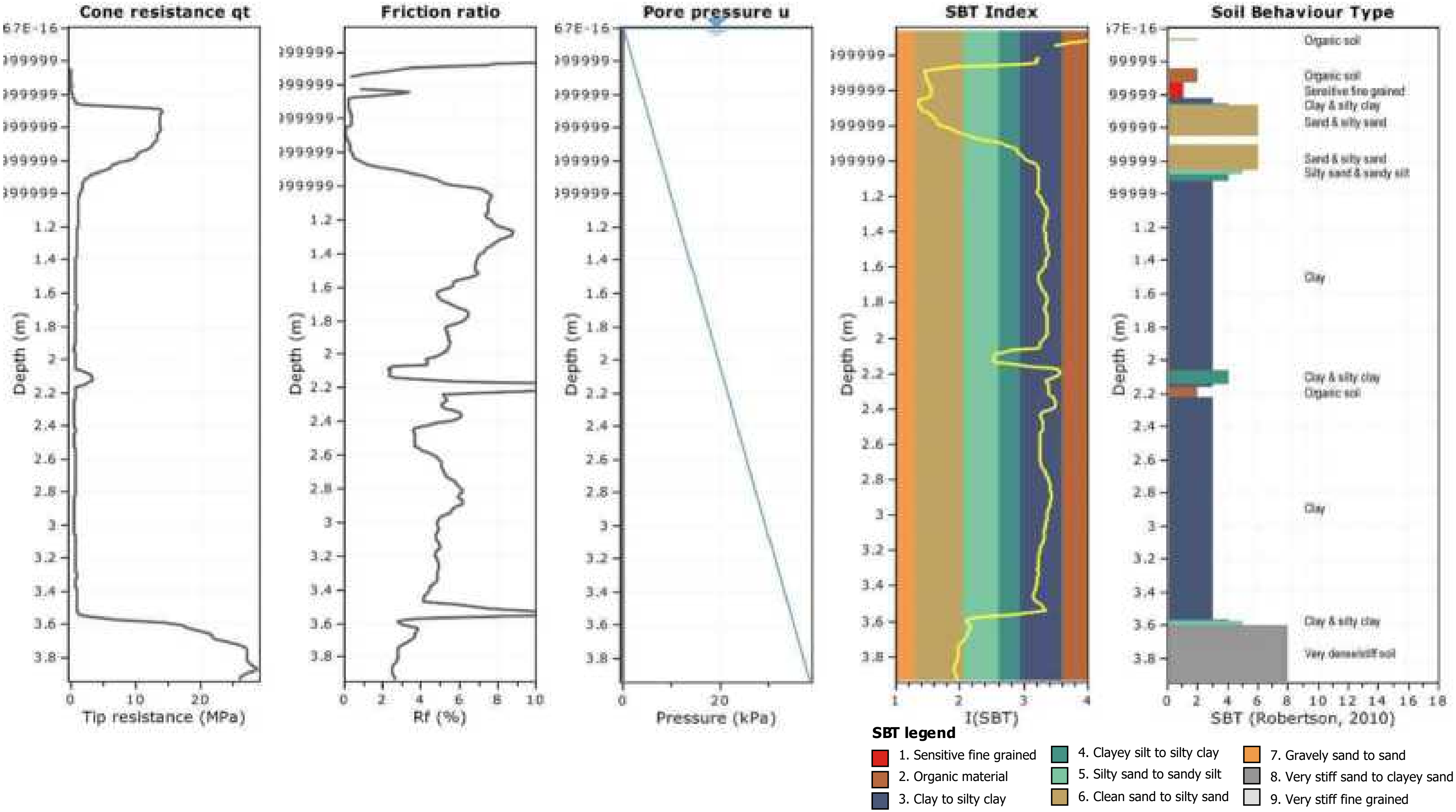

Norm. Soil Behaviour Type
Depth (m)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
Probability of Soil Types (%)

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A7-03
Total depth: 3.93 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

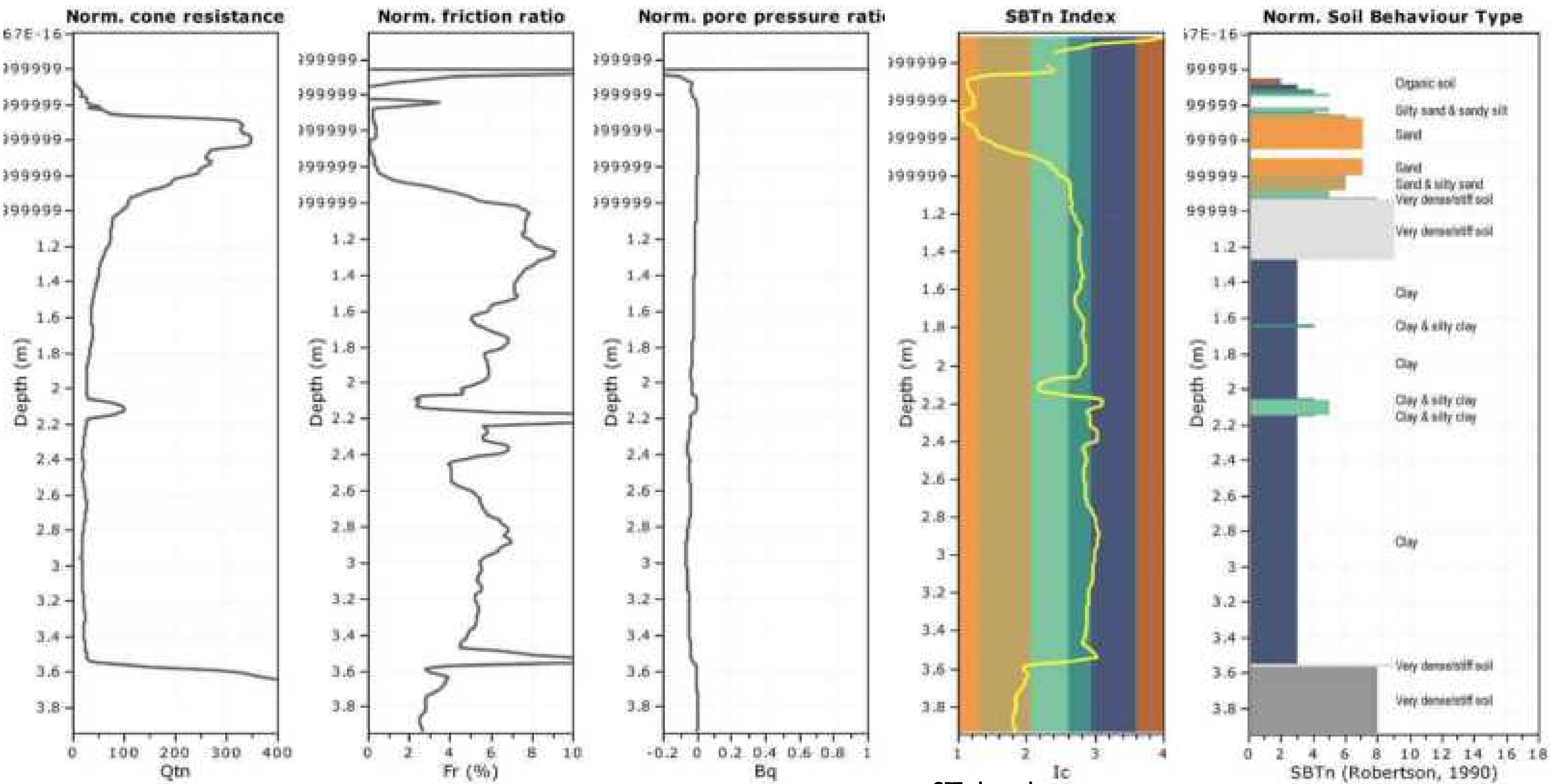
Project:
Location:



GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A7-03
Total depth: 3.93 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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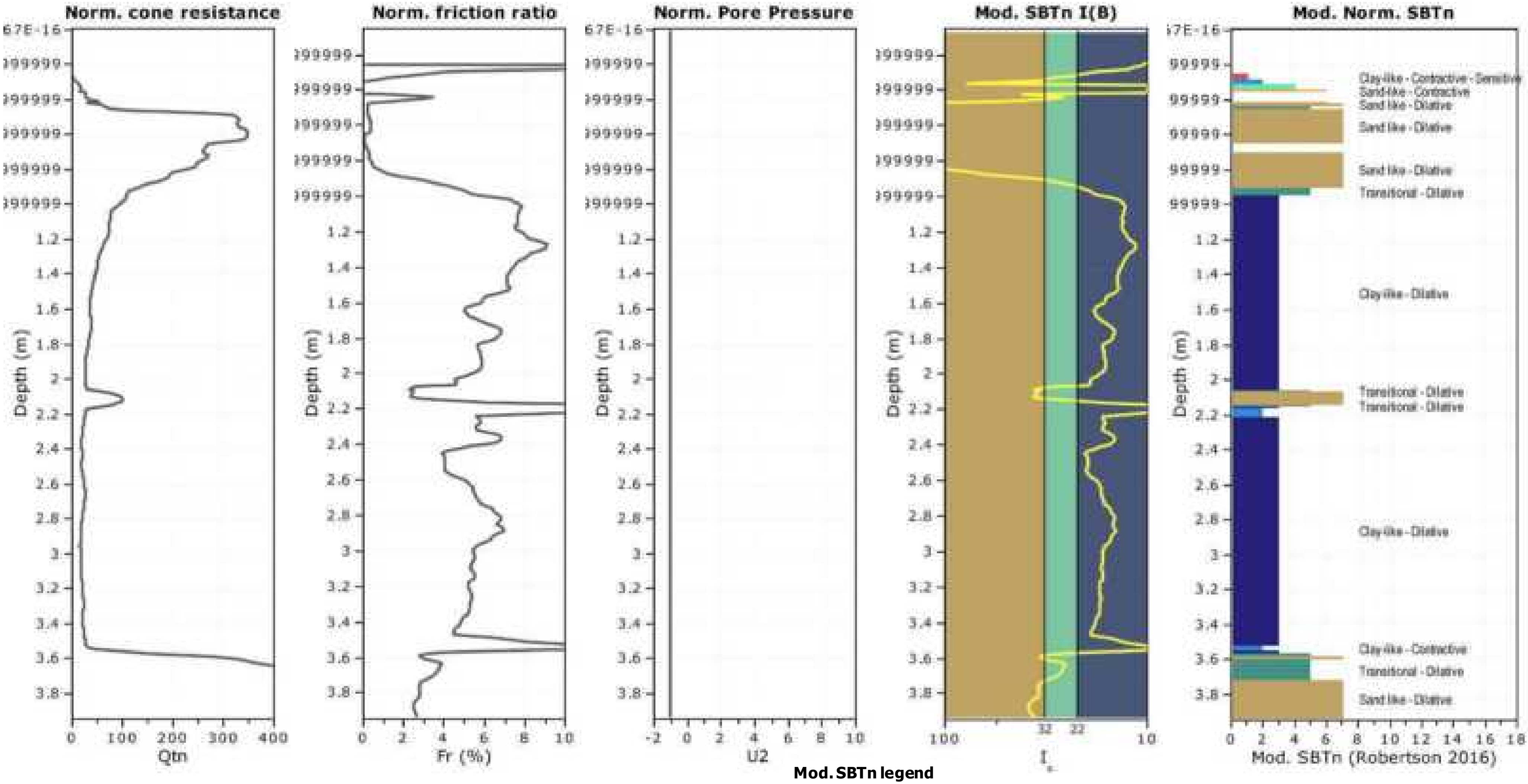
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

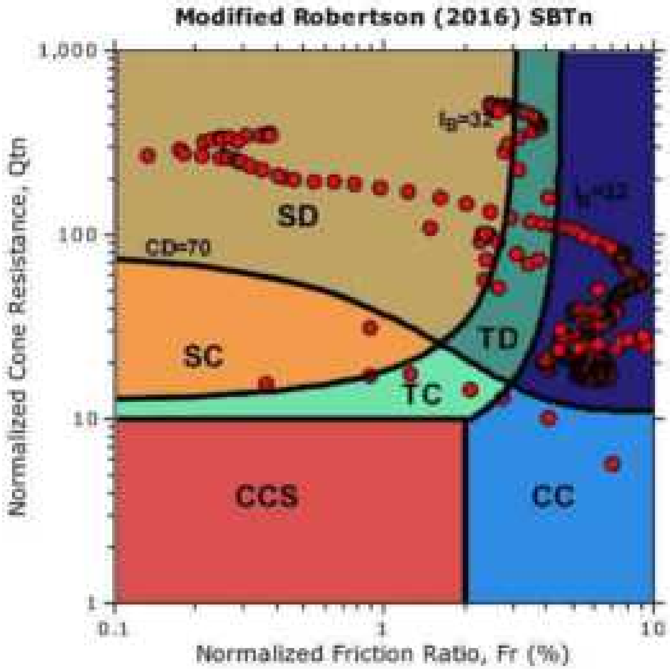
CPT: A7-03
Total depth: 3.93 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

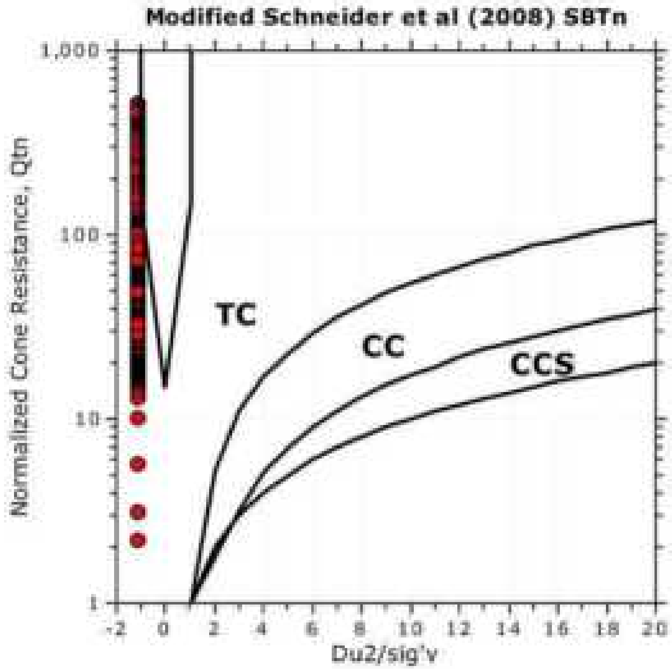
Project:
Location:

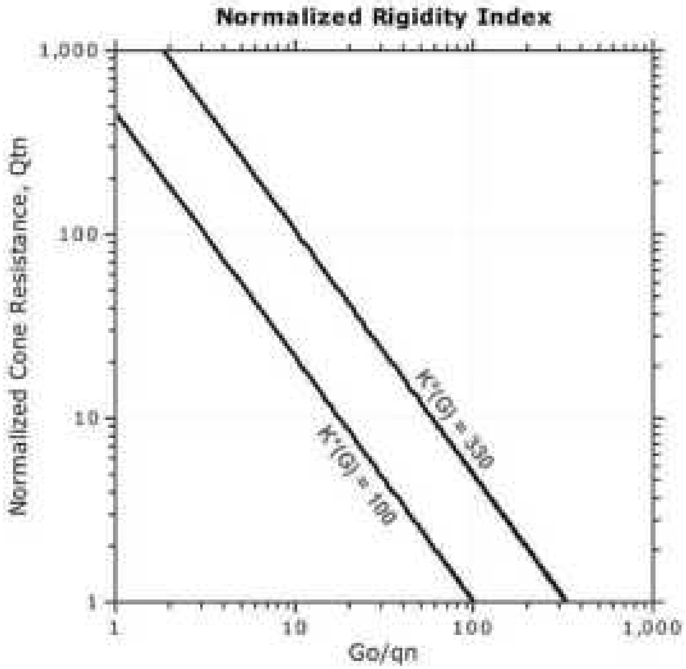


Mod. SBTn legend
1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

Updated SBTn plots







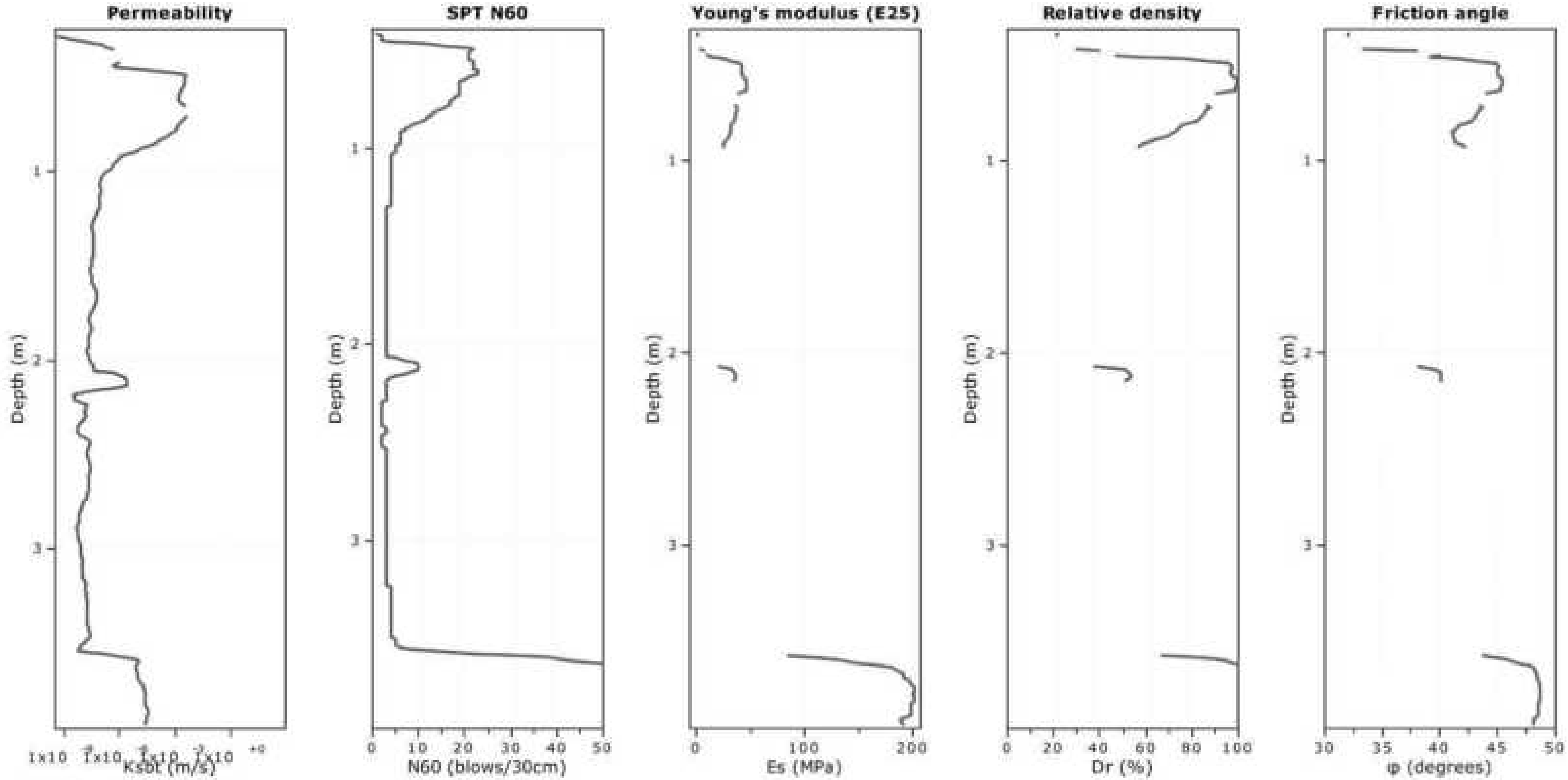
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

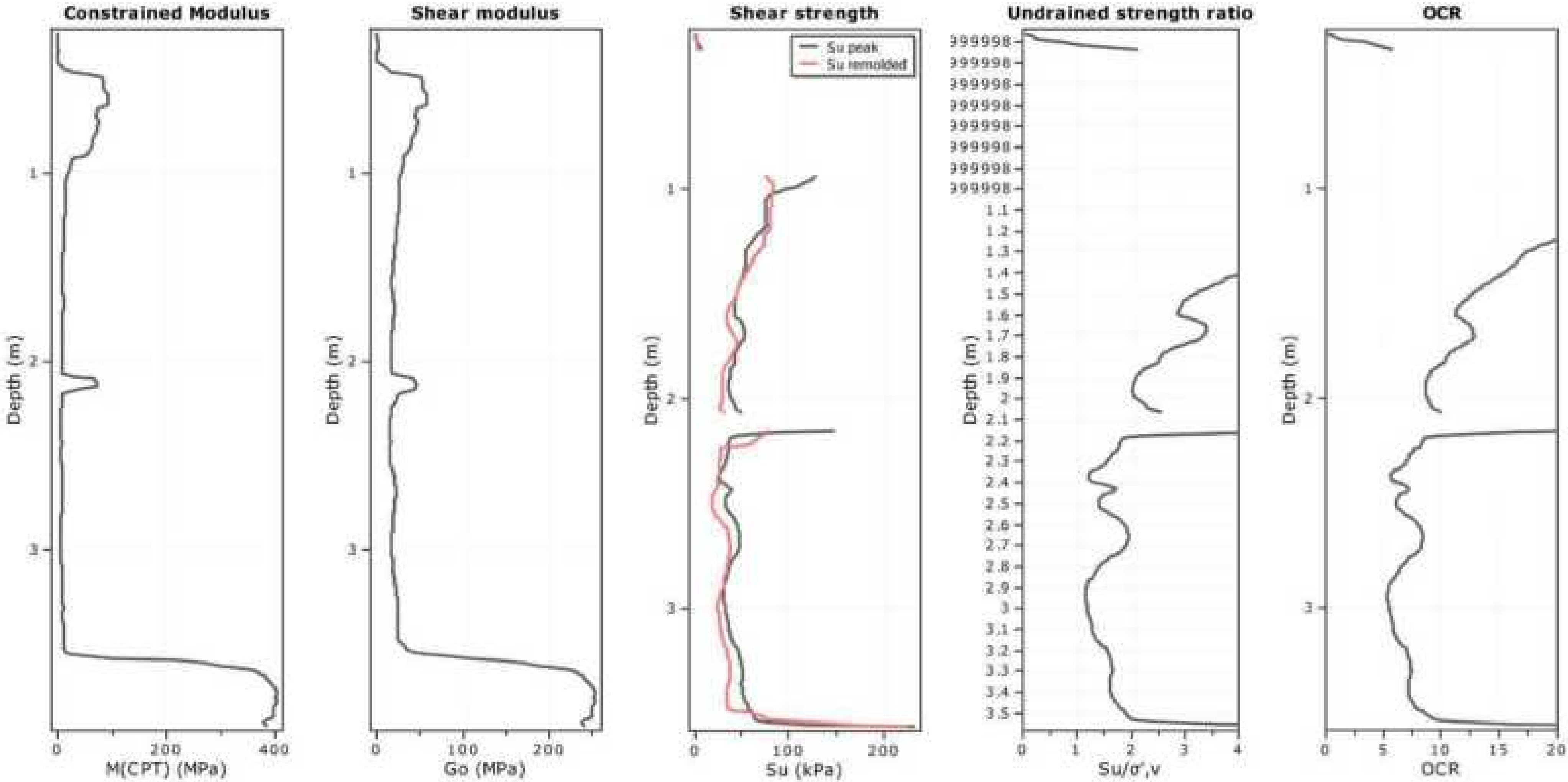
CPT: A7-03
Total depth: 3.93 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters

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



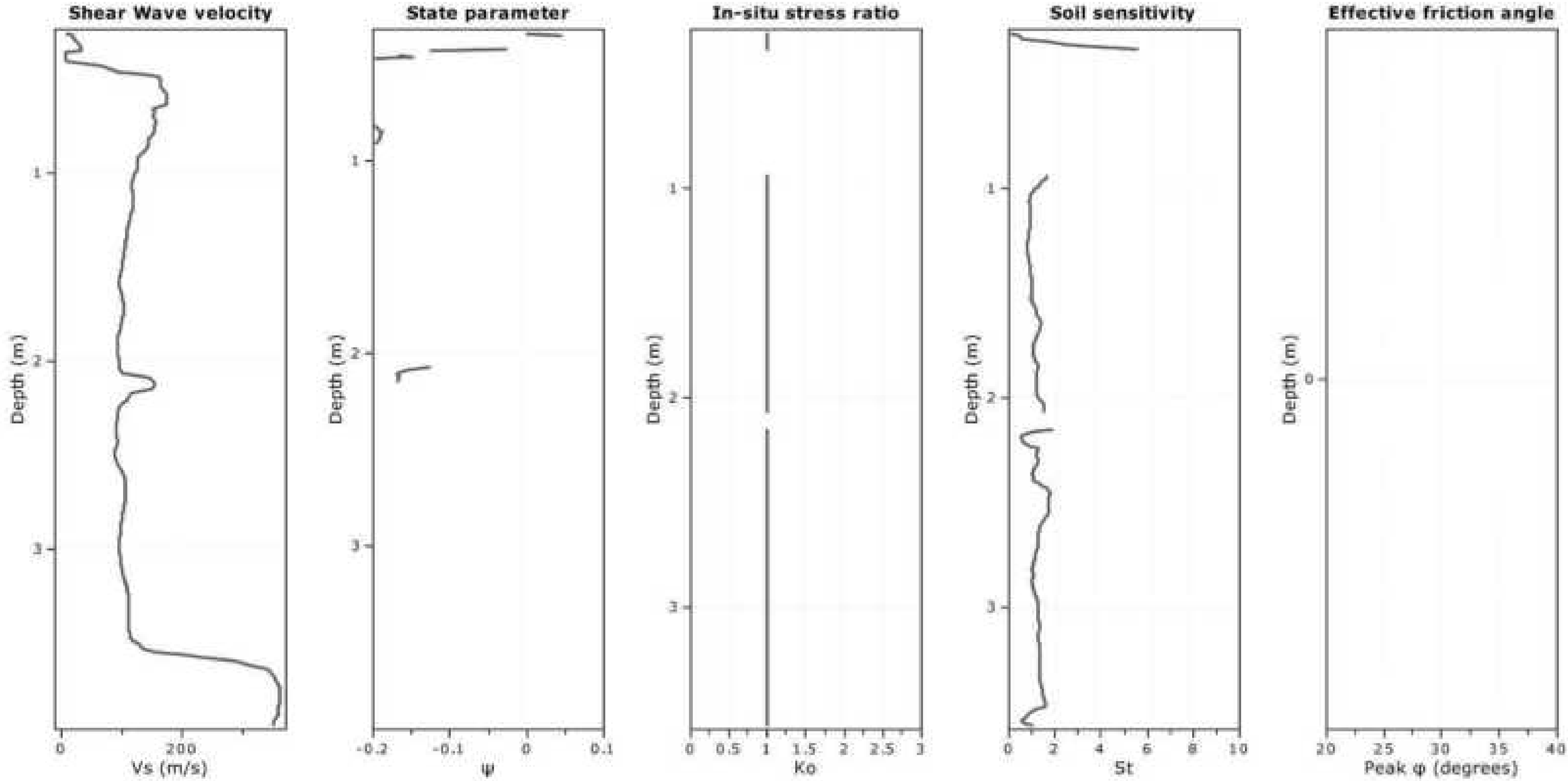
Calculation parameters

Constrained modulus: Based on variable alpha using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable alpha using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

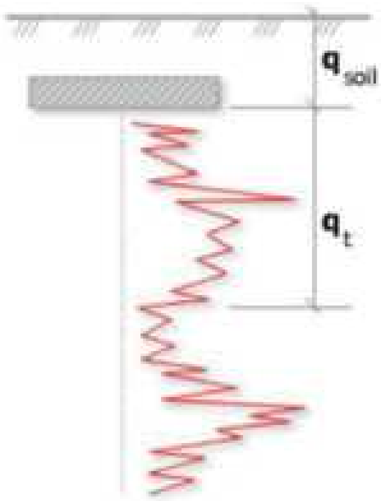
CPT: A7-03
Total depth: 3.93 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters

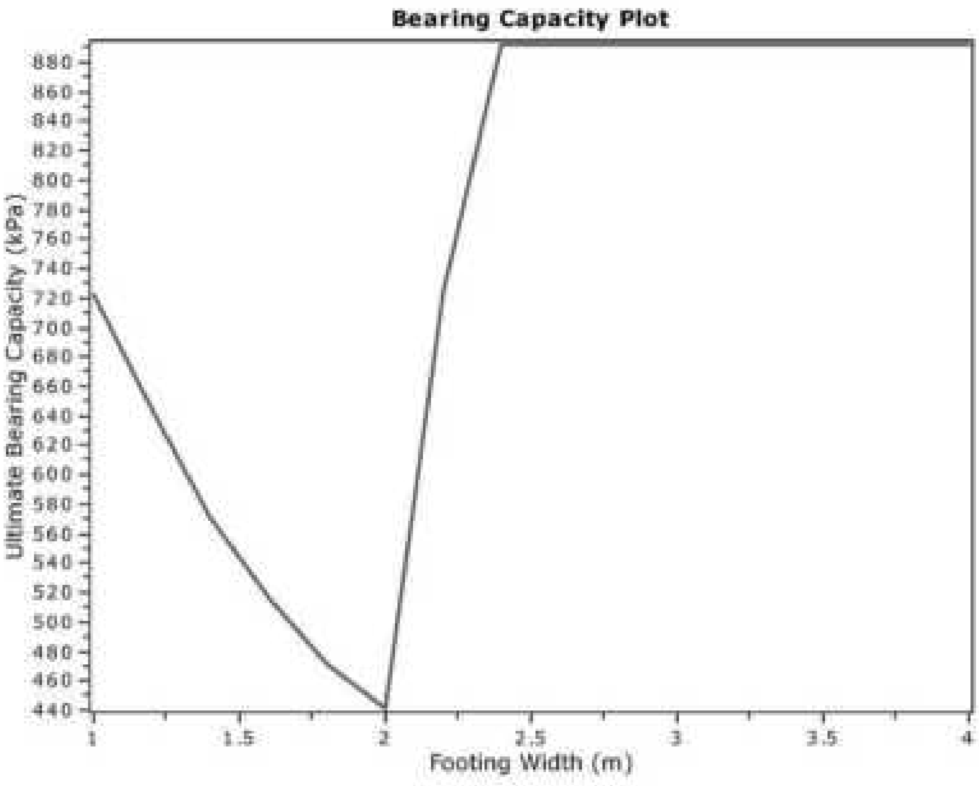
Soil Sensitivity factor, N_S: 7.00
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \, ¼ q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	3.56	0.20	9.50	722.11
2	1.20	0.50	2.30	3.18	0.20	9.50	645.50
3	1.40	0.50	2.60	2.81	0.20	9.50	571.95
4	1.60	0.50	2.90	2.53	0.20	9.50	515.65
5	1.80	0.50	3.20	2.31	0.20	9.50	472.01
6	2.00	0.50	3.50	2.16	0.20	9.50	441.57
7	2.20	0.50	3.80	3.57	0.20	9.50	723.14
8	2.40	0.50	4.10	4.41	0.20	9.50	891.97
9	2.60	0.50	4.40	4.41	0.20	9.50	891.97
10	2.80	0.50	4.70	4.41	0.20	9.50	891.97
11	3.00	0.50	5.00	4.41	0.20	9.50	891.97
12	3.20	0.50	5.30	4.41	0.20	9.50	891.97
13	3.40	0.50	5.60	4.41	0.20	9.50	891.97
14	3.60	0.50	5.90	4.41	0.20	9.50	891.97
15	3.80	0.50	6.20	4.41	0.20	9.50	891.97
16	4.00	0.50	6.50	4.41	0.20	9.50	891.97

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

:: N_{SPT} (blows per 30 cm) ::

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

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

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

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

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

:: Relative Density, Dr (%) ::

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

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

:: State Parameter, ψ ::

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

:: Drained Friction Angle, φ (°) ::

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

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

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

If $I_c \geq 2.20$

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

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

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

:: Soil Sensitivity, S_t ::

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

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

:: Peak Friction Angle, φ' (°) ::

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

(applicable for 0.10<Bq<1.00)

References

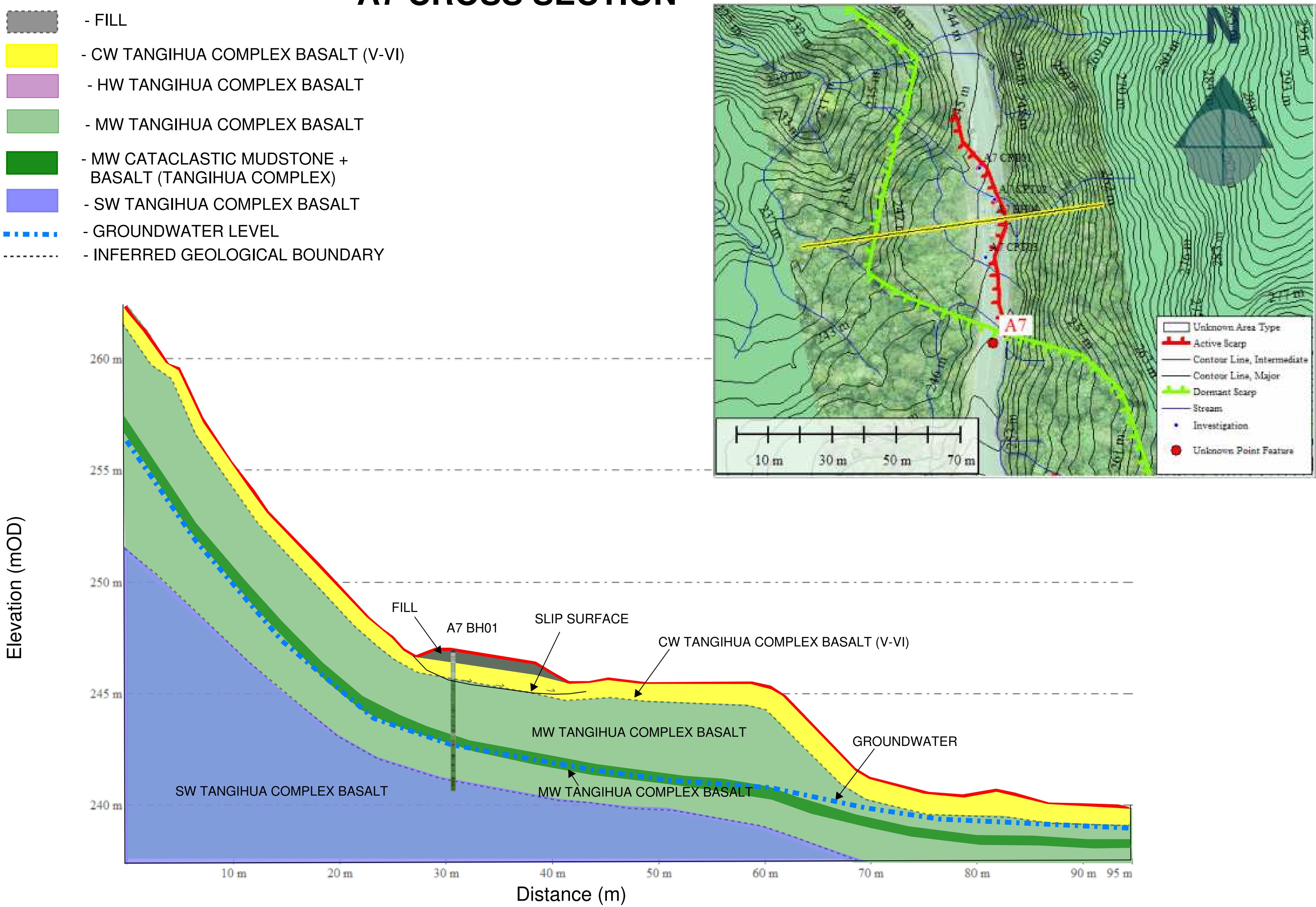
• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

Appendix B

Conceptual Geological Cross Section

A7 CROSS SECTION



Appendix C

Tilt Sensor and Rainfall Data

Inclinometer Data

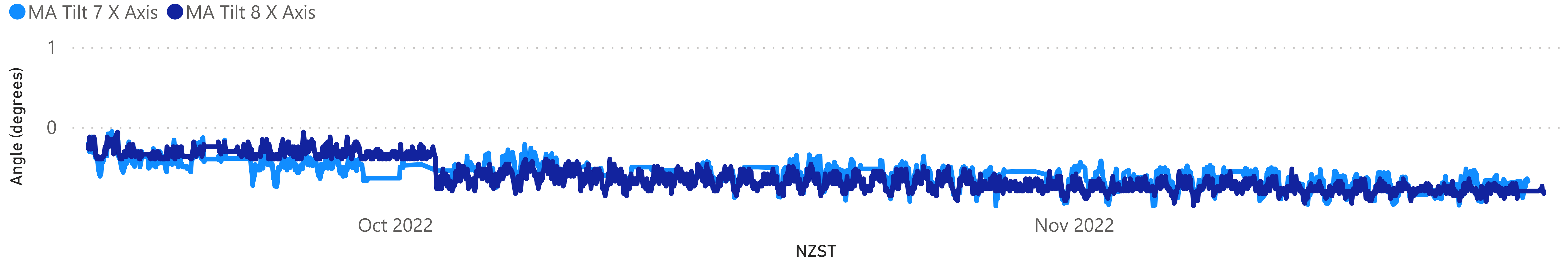
Mangamuka Gorge - Site A7 (T7 - T8)

9/17/2022 11/22/2022

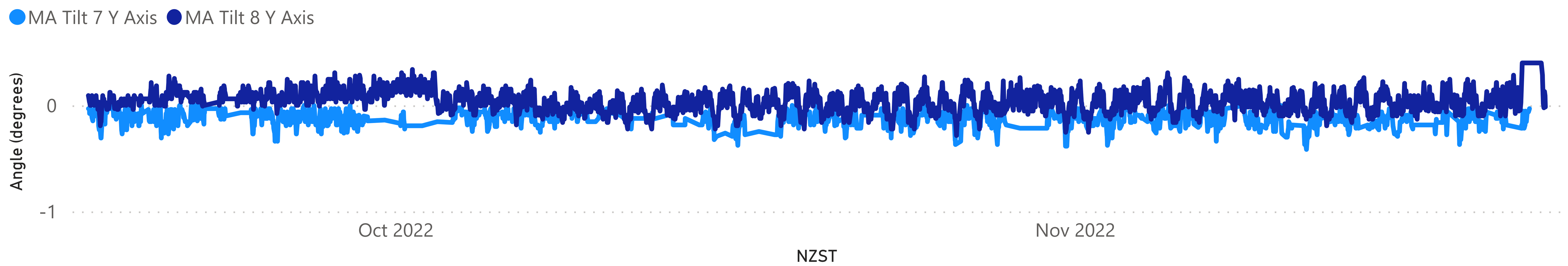
TARP

Site	Level
A07	

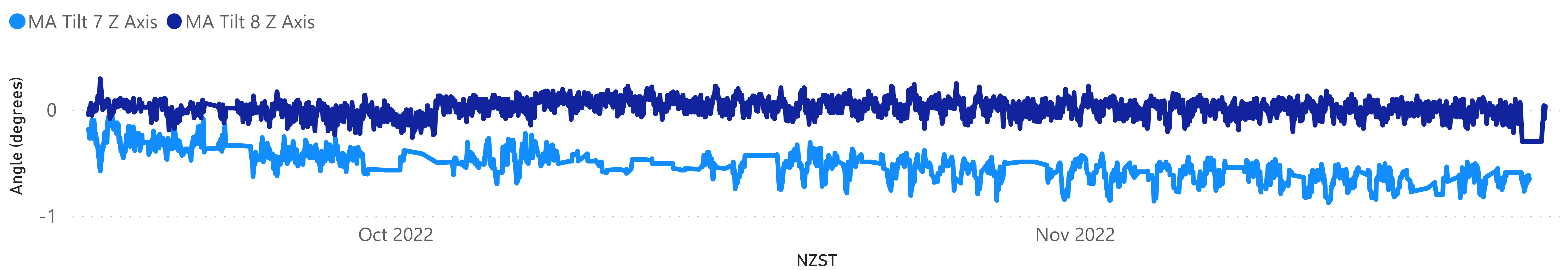
MA Tilt 7 X Axis and MA Tilt 8 X Axis by NZST



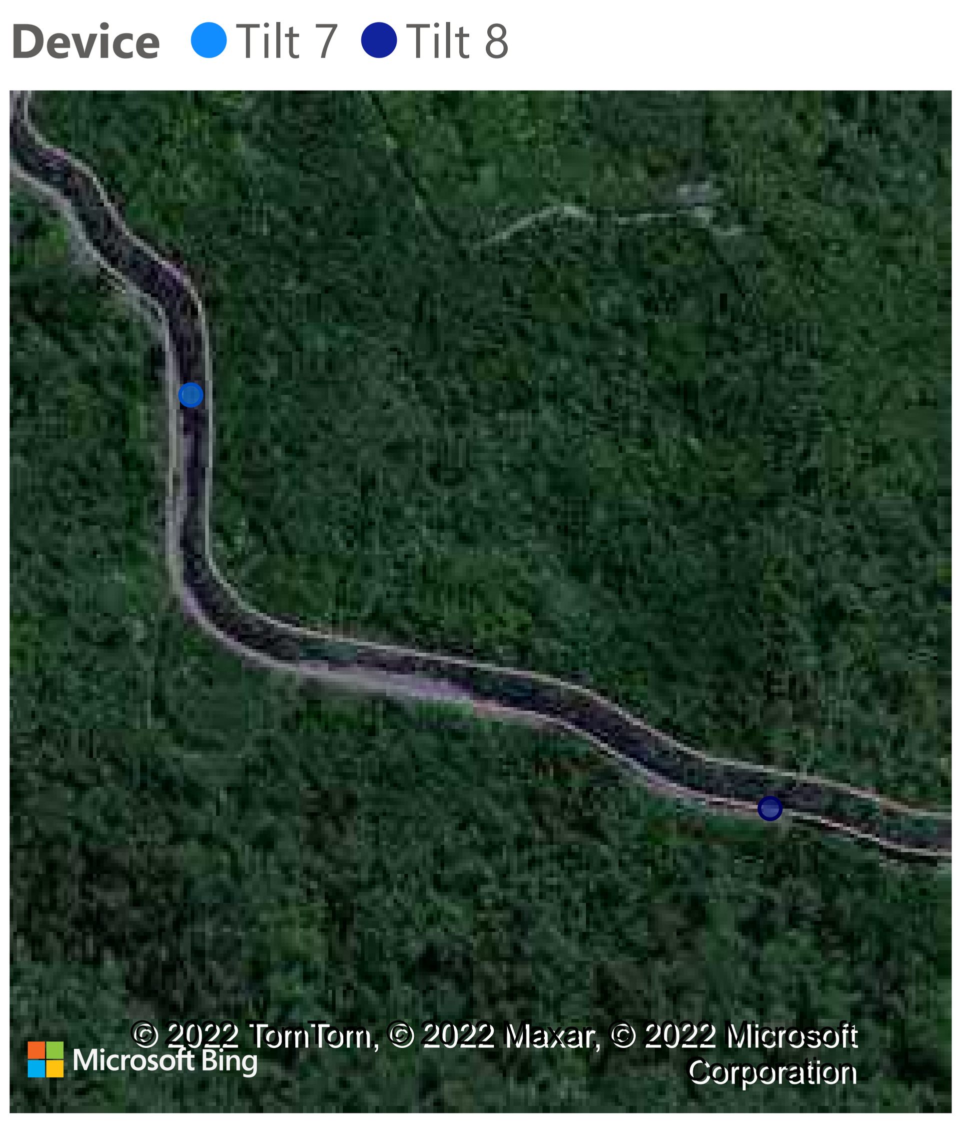
MA Tilt 7 Y Axis and MA Tilt 8 Y Axis by NZST



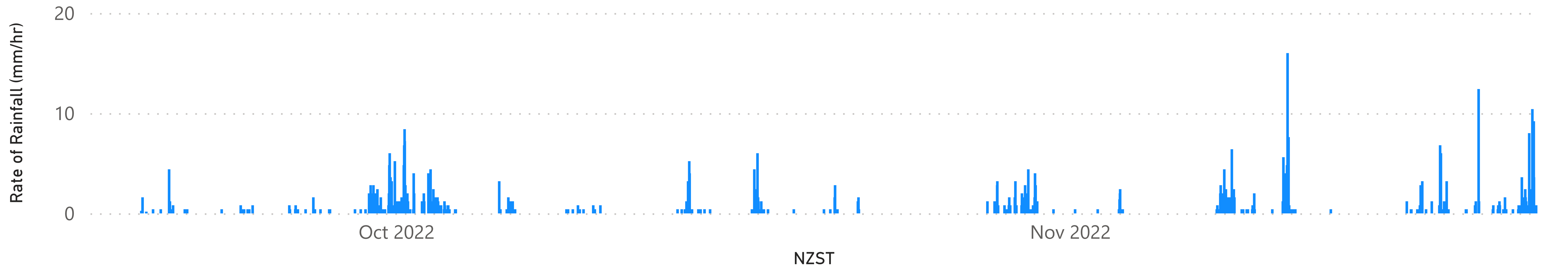
MA Tilt 7 Z Axis and MA Tilt 8 Z Axis by NZST

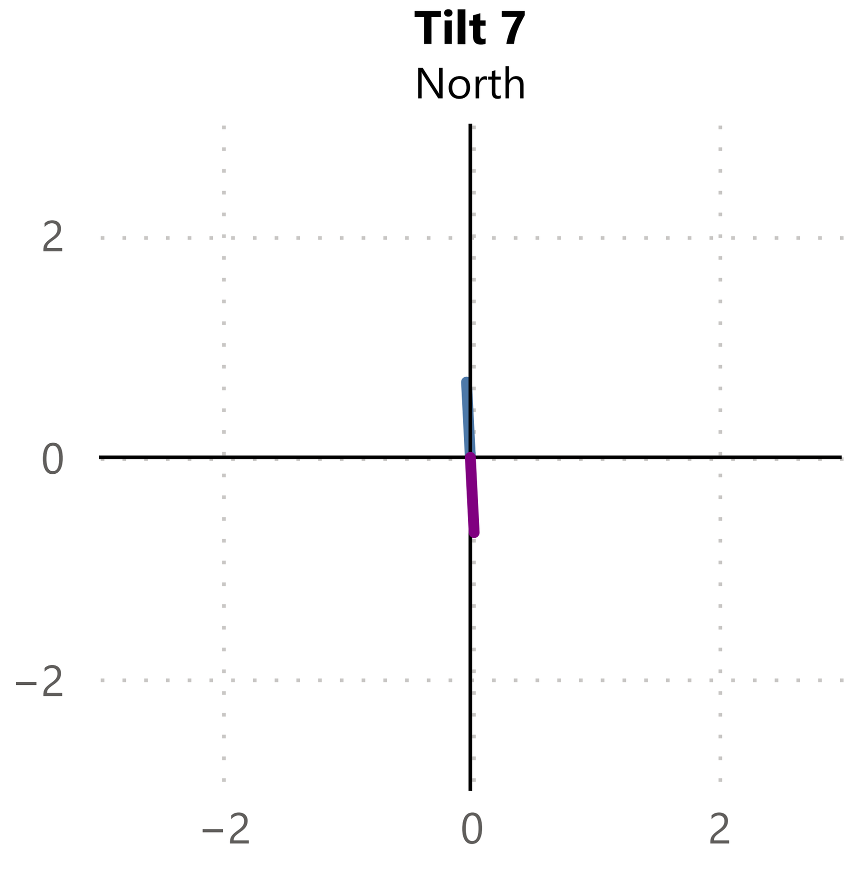


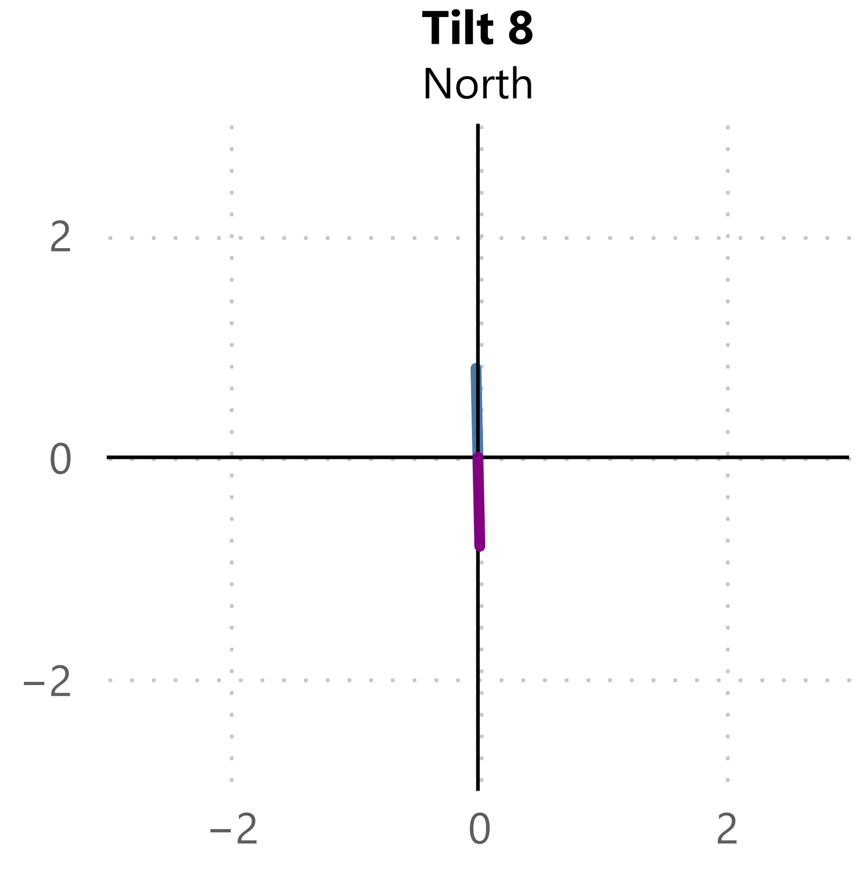
Device



Rate of Rainfall (mm/hr) by NZST



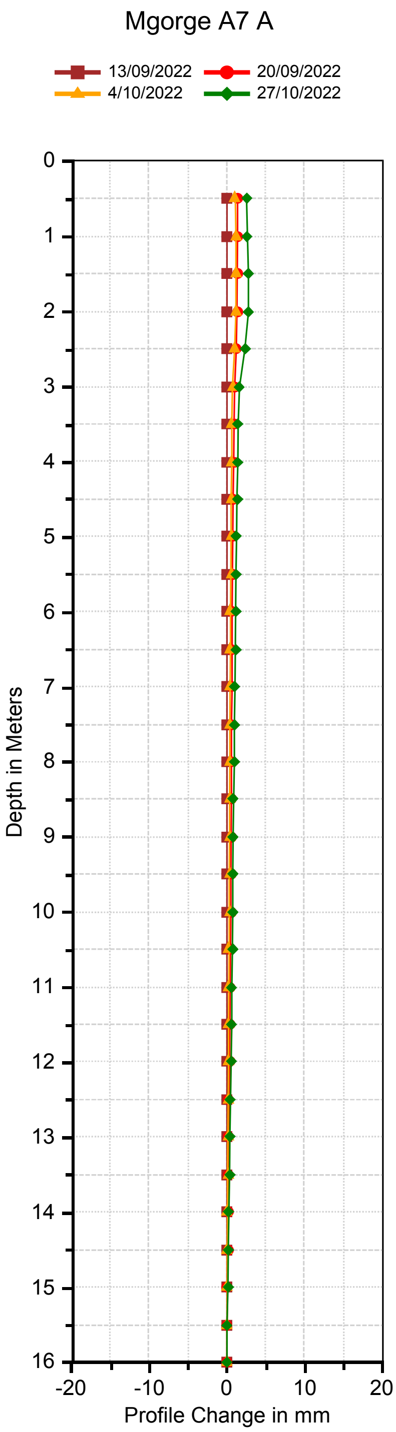




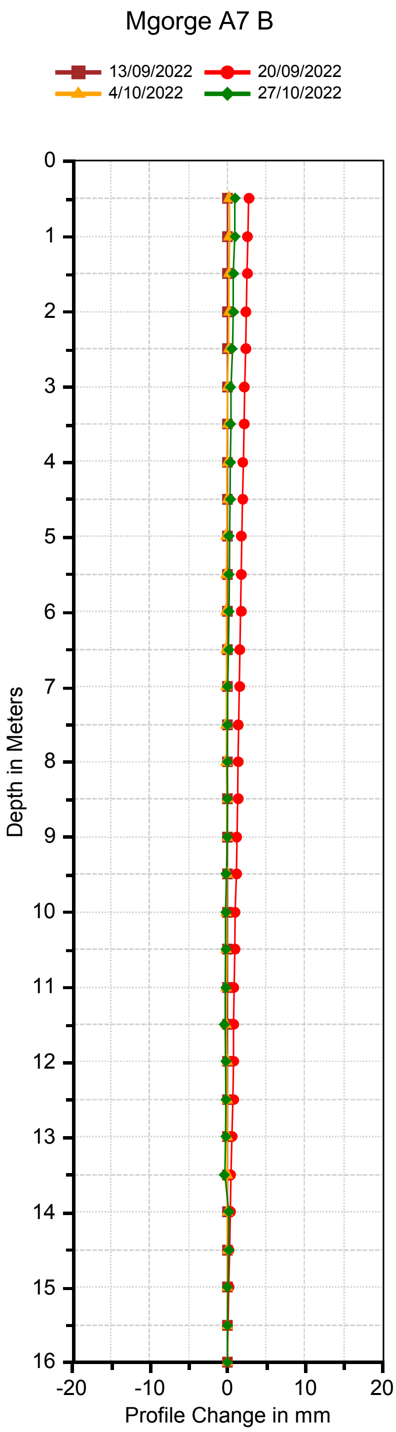
LEGEND

Actual Tilt Direction

Estimated Land Direction



Mgorge A7 A
13/09/2022
20/09/2022
4/10/2022
27/10/2022
Depth in Meters
Profile Change in mm



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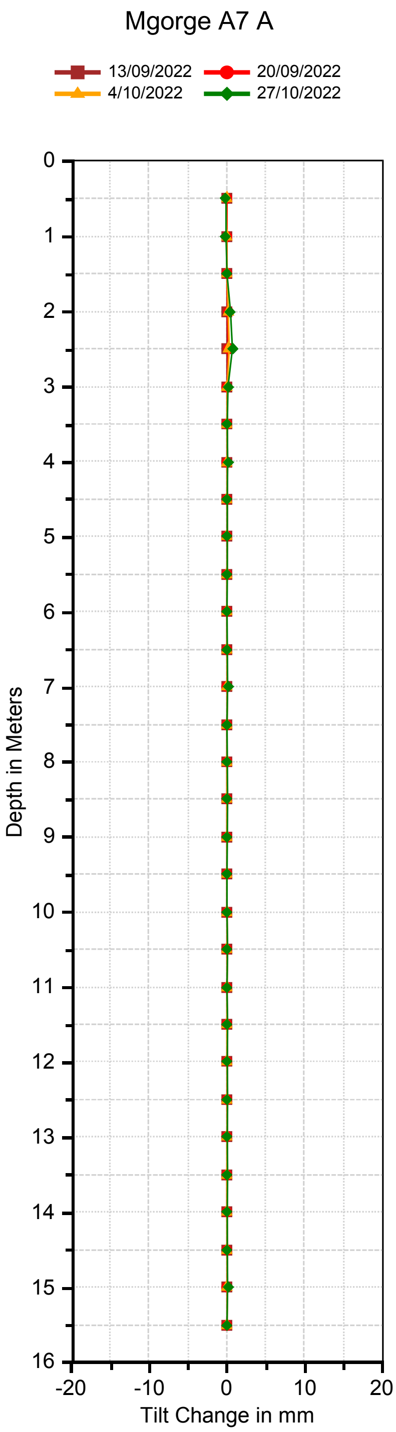
4/10/2022
27/10/2022
Depth in Meters
Profile Change in mm



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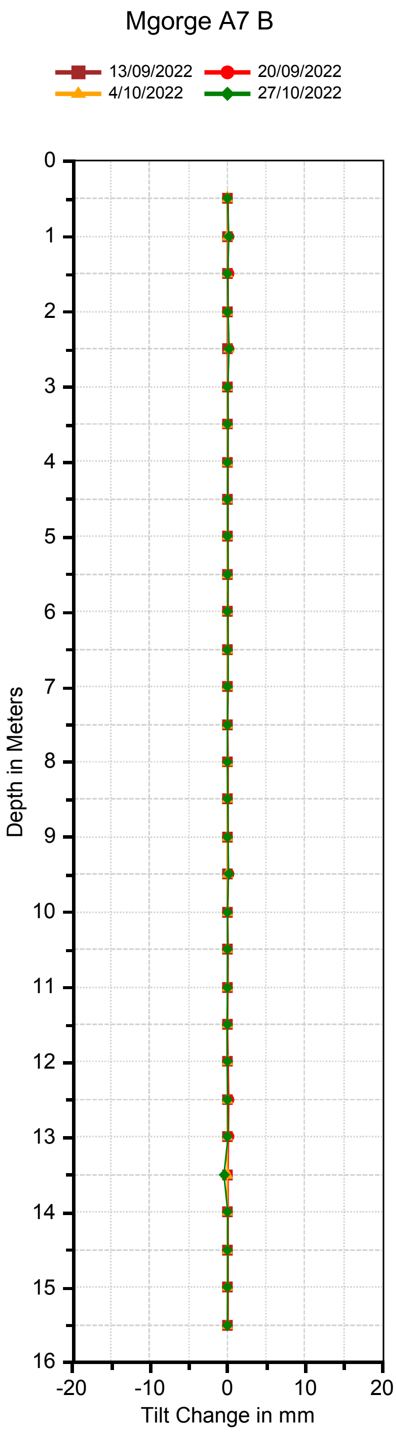
20/09/2022
4/10/2022
27/10/2022
Depth in Meters
Tilt Change in mm



Mgorge A7 B
13/09/2022
20/09/2022
4/10/2022
27/10/2022
Depth in Meters
Tilt Change in mm

wsp.com/nz

Project Number: 1-11240.00

NZTA Northland Resilience and Emergency Works- August 2022-10012/22A5

22 December 2022

CONFIDENTIAL

Interpretive Geotechnical Investigation Report

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Matt Leggett

Aaron George

Approved for release by
Shaun Grieve

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Revision Details

Revision	Details

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for New Zealand Transport Agency ('**Client**') in relation to Mangamuka Gorge Slips Emergency Works ('**Purpose**'). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

1 Introduction

Two storm events in July and August have caused widespread flooding and associated landsliding across much of Northland. Following the August rain event WSP were engaged by Waka Kotahi to form part of the emergency response and undertake an urgent geotechnical investigation along a section of State Highway (SH) 1 through Mangamuka Gorge. A total of 12 underslips have been identified requiring significant geotechnical analysis and associated permanent remedial measures.

This report covers the investigation and assessment at site 10012/22A5 (henceforth referred to as A5) and provides a recommended solution. The Site A5 is located at approximately 22 km south of the northern extent of the study area at RS119 PR13.507, approximately 20 km southeast Kaitaia.

The failure mechanism of at the site is likely being driven by elevated groundwater within the completely weathered Tangihua Complex unit as a result of the recent storm events, leading to the initial evacuation of the road shoulder and later regression of headscarp back into live lane.

The site location is shown below in Figure 1-1 together with other slip sites.

Figure 1-1: *10012/22A5 Site location Plan*

2 Regional Geology

The 1:250 000 scale QMAP seamless digital data (GNS, 2013) indicates the site area to be underlain by the Undifferentiated Tangihua Complex in Northland Allochthon comprising basalt pillow lava, with subvolcanic intrusives of basalt, dolerite and gabbro; locally incorporating siliceous mudstone (Figure 2-1). The Tangihua Complex has been emplaced onto New Zealand through convergent plate tectonics and sea floor sliding. As a result, the material has been historically sheared with the rock underlying the site expected to be highly fractured and degraded through original emplacement processes and further modified by weathering.

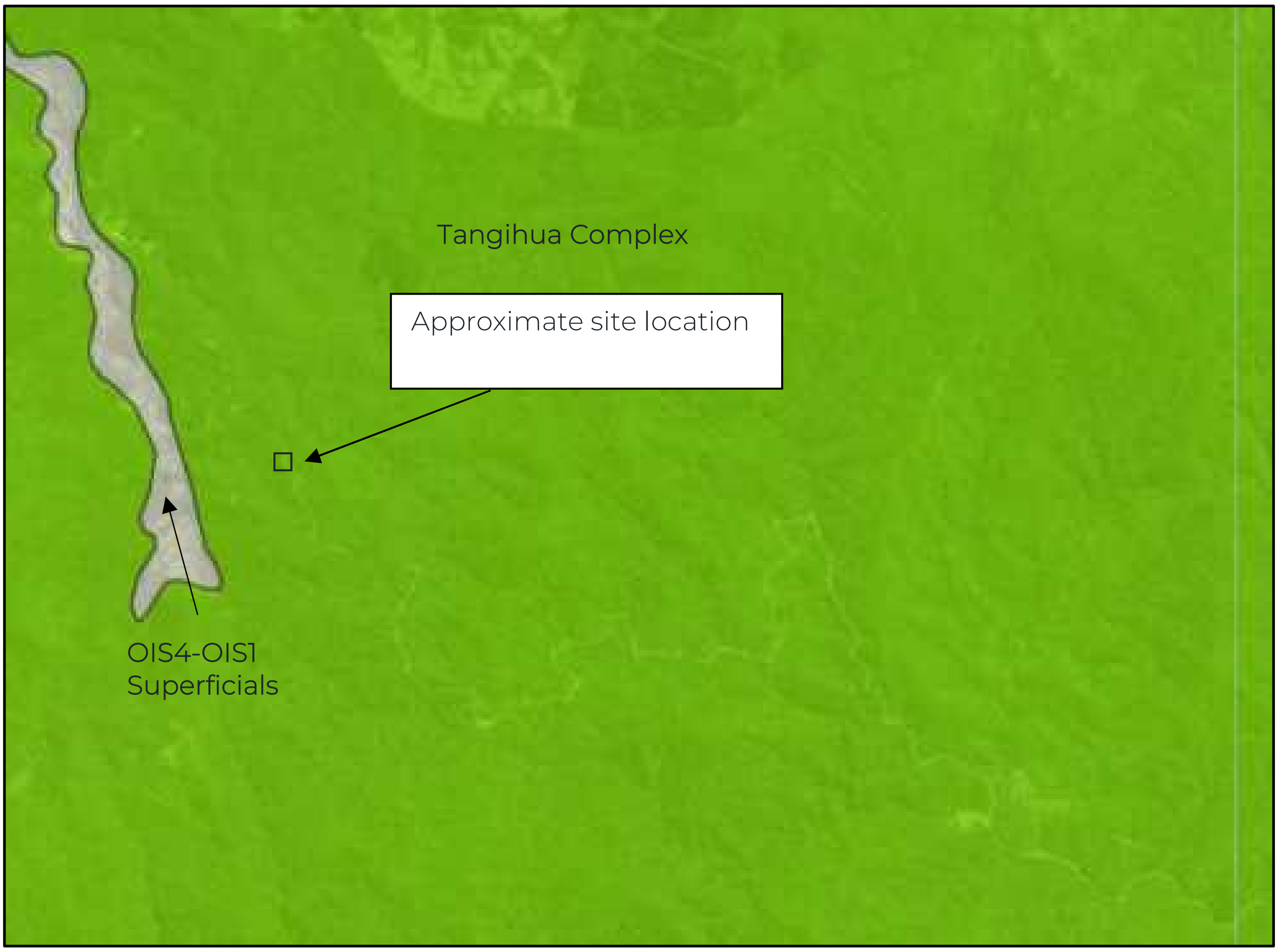


Figure 2-1: Regional geology

3 Site Investigation

Between 4th and 7th September 2022, a geotechnical investigation was undertaken to identify sub-surface ground conditions and to begin development of a ground model that will help inform the options for remedial measures required at site A5 The works comprised the following:

A single rotary cored borehole (BH) was completed to a depth of 22m, with standard penetration tests (SPTs) at 1.5m intervals.

- Installation of two piezometers (shallow and deep) upon completion of BH01. The screen zone for piezo 01 is between 18.0m and 22.0m depth and the screen zone for Piezo 02 is between 7.5m and 9.5m depth.
- Three Cone penetration tests (CPTs) were refused to a maximum depth of 24.39m.
- The intrusive drilling works was undertaken by Drillforce Limited including the boreholes, CPT's as well as the installation of inclinometer tubing for monitoring ground movement and piezometers for groundwater, all under the supervision of WSP site staff.
- The intrusive drilling works was undertaken by Drillforce Ltd with all of the boreholes logged by WSP onsite staff in accordance with the NZGS *Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes*, December 2005 and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1. Borehole and CPT locations displayed on Figure 3-1 below with logs displayed in Appendix A.

- Tiltmeters were installed on the ground surface by WSP Research staff to obtain Realtime monitoring of surface movements.
- Monitoring of the piezometers and inclinometers was undertaken by GeoCivil Ltd under direction of WSP staff.

Figure 3-1: Exploratory hole location plan

3.1 Observations

During the site investigation an initial inspection of the headscarp was completed by WSP, with a later inspection then carried out on 21st September. The inspections identified the following:

- The headscarp total length is approximately 65m. Along the affected section, the carriageway is flanked to the east by a cut slope dipping at approximately 35 degrees with a drainage channel adjacent to the upslope. To the west, the shoulder drops away toward densely vegetated bush below.
- After the initial failure, the headscarp was located 300mm from the live lane with no visible cracking in the road. During the first round of site inspection (4th to 7th September) the slip headscarp had regressed 1.5m, with the centre of the slip up to 1.2m into the northbound lane. At the time of writing this report no further regression of the headscarp has occurred. However, additional tension cracking has begun to form at the southern end of the slip, 1m further towards the centreline. The current length of affected road is 35m. The slip will continue to regress if not treated, with potential to threaten the entirety of the road.

  The visible headscarp is 20m in height and inferred to extend 50m downslope with evacuated material up to 100m downslope from the headscarp. The grade of slope is approximately 1v:2h. The damaged section of road is general level with a gentle incline (4°-5°) gradient. The upslope has a slope grade of 1.5H:1V.

- No surface seepage was observed during the site investigation.

4 Geomorphological Mapping

A terrain evaluation is presented below in Figure 4-1. Geomorphological mapping undertaken from both Lidar and aerial photography as well as site observations. The wider site area is comprised of steep slopes of approximately 20° – 30 ° and includes historical slip features manifesting as large gullies extending from the slope above to the stream below. 2

A gully is located through the centre of the slip with a culvert beneath the road. Several smaller slips are indicated to be present both up and down slope and are centred near the drainage pathway.

it is expected that the material underlying the site and surrounding area will consist of colluvial soils resulting from recent and historical movement.

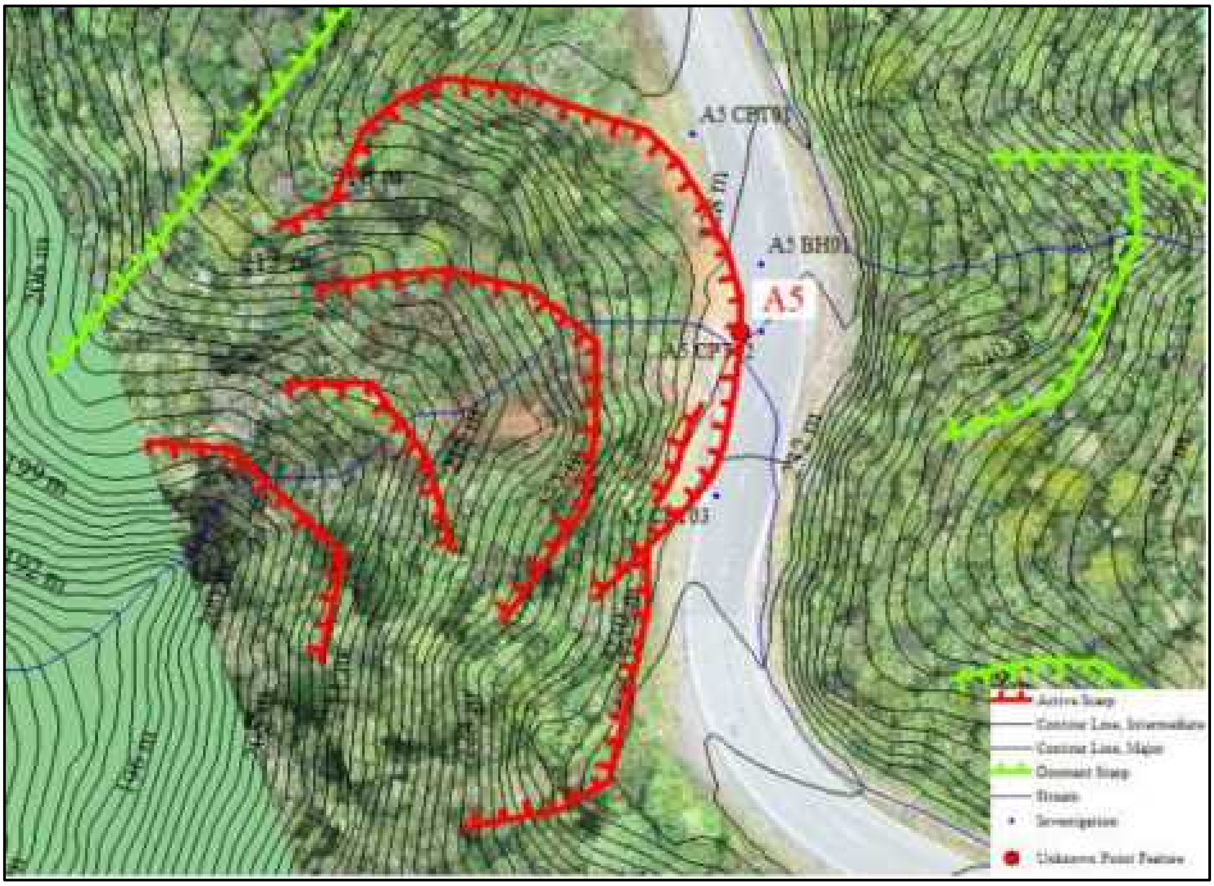


Figure 4-1: Geomorphological map

5 Ground Model

Table 5-1 below summarises the ground model for site A5. A conceptual geological cross section is presented within Appendix B.

Table 5-1: A5 Ground Model

Lithology	Top (m bgl)	Base (m bgl)	Total thickness (m)	SPT N Value	GSI
Fill	0.0	0.90-1.10*	0.9-1.10*	2*-46*	-
Completely Weathered Tangihua Complex MUDSTONE/CATACLASTIC ROCK (V)	0.90-1.10*	6.45-7.80*	3.00* -6.70*	4*-18*	-
Highly Degraded Tangihua Complex MUDSTONE/CATACLSTIC ROCK (IV)	6.45-7.80*	9.80*-19.95	5.80-13.50	6*-49*	10-20
Moderately degraded Tangihua Complex MUDSTONE/CATACLSTIC ROCK (III)	9.80*-19.95	21.23-23.80*(**)	1.28- 6.40*	10*- 50+*	20-30
Slightly weathered Tangihua Complex CATACLSTIC DOLERITE	21.23	Not Proven	-	50+	40-50

* Inferred from CPT results.

** Where base proven

Fill was encountered within BH01 and inferred to be present in within all CPTs, to a depth ranging from 0.90 to 1.10m. The material is described as Asphalt and Subgrade, dark bluish grey, gravel is angular, fine to coarse, well graded, slightly weathered basalt.

Completely weathered Tangihua Complex material was encountered from 0.90m to 6.45m within BH01 and inferred to be represented within all CPTs with a maximum thickness of 6.70m (CPT03). The material is predominately described as firm, silty CLAY or clayey SILT with variable quantities of subangular to subrounded, DOLERITE and MUDSTONE gravel.

Highly degraded Tangihua Complex material (degraded by original allochthon emplacement) was encountered from 6.45m to 19.95m within BH01 with a layer of moderately weathered rock between 9.45m and 10.30m depth. Material inferred to be represented within all CPTs with a maximum thickness of 13.50m (BH01). Material described dark reddish-brown MUDSTONE and brown DOLERITE, extremely weak, with some iron staining on defect surfaces. Proportions of sedimentary/igneous material vary throughout this unit.

Moderately degraded Tangihua Complex III Rock was encountered within BH01 from 19.95m to 21.23m, described as reddish brown MUDSTONE and brown DOLERITE, Very weak to weak with iron staining on the defect surfaces and zeolite veining. Proportions of mudstone and dolerite clast vary throughout this unit. Moderately weathered surface inferred to be encountered within CPT01, CPT02 and CPT03 at 17.4m, 9.80m and 11.3m respectively. CPT02 depth to moderately degraded surface consistent with horizon of “fresher” rock encountered within BH01.

Slightly weathered Tangihua Complex DOLERITE was encountered from 21.23m depth and extended to the full depth of the investigation at 22.50m. Material described as light blue grey to purple brown, porphyritic DOLERITE sheared with MUDSTONE, strong with much iron staining and zeolite veining. Top of surface inferred to be represented at 23.80m within CPT01.

Three groundwater monitoring visits have been carried out so far between 27th October and 2nd December 2022. Results are presented below in Table 5-2.

Table 5-2: BH01 Groundwater Monitoring Results

BH	Date	Piezo 1 Depth to GW (mbgl)	Lithology	Piezo 2 Depth to GW (mbgl)	Lithology
BHA5-1	27/10/2022	18.39	Highly to moderately weathered Tangihua Complex	8.98	Highly weathered Tangihua Complex
	18/11/2022	18.07		5.74	Completely weathered Tangihua Complex
	2/12/2022	16.26		6.26	

5.1 Instrumentation Summary

Tilt sensors data and rainfall sensors data is presented within Appendix C, collected from 24th September 2022. Tilt sensor positions shown below on Figure 5-1.

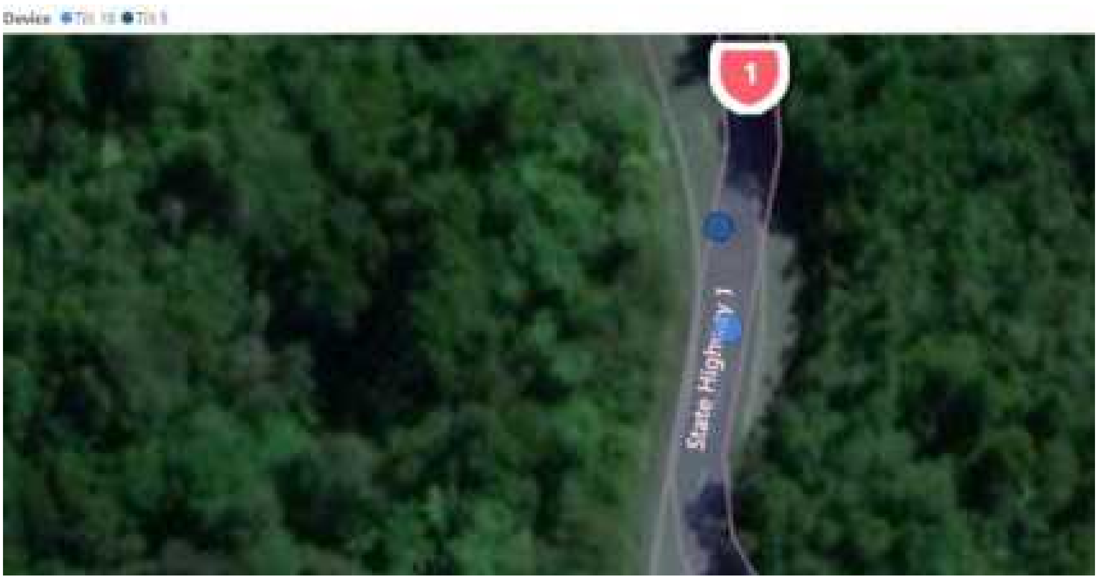


Figure 2-1: Tilt sensor position A5

No significant tilt sensor movements have been identified to date at site A5, with peaks and troughs typically displaying cyclic changes in temperature.

6 Conclusions and Recommendations

6.1 Conclusions

An underslip has occurred at A5, resulting in a loss of shoulder and subsequent damage to a 25m section of state highway. The slip is triggered by progressive saturation of the ground. There is an immediate risk of complete evacuation of the road following the next significant rainfall event.

6.2 Recommendations

Based on the available geotechnical information, it is recommended a concrete pile wall is constructed at the site, to be socketed into competent bedrock. Wall geometry and additional support requirements to be discussed in design report. Estimated construction costs for this solution would likely be between $1.5m-$2.5m.

Additional instrumentation should be installed above the road to monitor any movement of potential features up slope.

Further information provided within October 2022 Storm Response Options Update- Memo no.2 including discounted solutions.

7 Limitation

This report has been prepared for the benefit of NZTA only and is based on limited investigation and visual inspection only. Given the complex geological setting changes in ground condition could occur across the site that differ from those summarised within this report.

Appendix A

Borehole Logs
CPT Report

Borehole No. BH22A5

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279882 E 988022 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	22.5 m
Project No.:	1-11244.00	*R.L.:*	228.536 m	*Inclination:*	Vertical
Location:	Slip 22A5 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

Column headings: GEOLOGY | MAIN DESCRIPTION / DETAIL DESCRIPTION | R.L. (m) | DEPTH (m) | GRAPHIC LOG | TESTS: SPT 'N' VALUE; SPT BLOW COUNTS OR SHEAR VALUE | ROCK STRENGTH | ROCK WEATHERING | ROCK DEFECT SPACING | DEFECT DIP (degrees 0–90) | DEFECTS / NOTES / OTHER TESTS | CORE: SAMPLE TYPE; TCR (%); RQD (%) | DRILLING: DRILLING METHOD; CASING; BASE OF HOLE & WATER LEVEL | INSTALLATION DETAILS

R.L. scale: 228, 226, 224, 222, 220. Depth scale: 1, 2, 3, 4, 5, 6, 7, 8, 9.

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION
Fill	ASPHALT
Fill	Fine to coarse GRAVEL; dark grey and bluish grey. Very dense, moist; angular, well graded, fine to medium, slightly weathered BASALT [Gap 40 SUBGRADE].
TANGIHUA COMPLEX	Silty CLAY, trace gravel; reddish orange mottled brown with trace dark brown. Firm, moist, highly plastic; gravel, fine to medium, subrounded. [Completely Weathered]. 1.10 - 1.50m - Core loss; No sample recovered.
TANGIHUA COMPLEX	Silty CLAY, some gravel; light brown mottled orange. Soft, moist, highly plastic; gravel, fine to medium, subrounded. [Completely Weathered]. 1.65 - 1.95m - Core loss; No sample recovered.
TANGIHUA COMPLEX	Silty CLAY, some gravel; light brown mottled orange. Soft, moist, highly plastic; gravel, fine to medium, subrounded. [Completely Weathered DOLERITE].
TANGIHUA COMPLEX	Silty CLAY, trace gravel; light brown. Firm, moist, highly plastic; gravel, fine to medium. [Completely Weathered].
TANGIHUA COMPLEX	Silty CLAY, minor gravel; reddish brown mottled light brown. Firm, moist, highly plastic; gravel, fine to medium, subangular [Completely Weathered]. 4.10-4.30m - Soft, wet.
TANGIHUA COMPLEX	Clayey SILT, some gravel; light brown. Firm, moist, highly plastic; gravel, fine to medium subrounded, completely weathered mudstone [Completely Weathered MUDSTONE]. 4.70 - 4.95m - Core loss; No sample recovered.
TANGIHUA COMPLEX	Clayey SILT, some gravel; light brown. Firm, moist, highly plastic; gravel, fine to medium subrounded, completely weathered mudstone [Completely Weathered MUDSTONE].
TANGIHUA COMPLEX	Clayey SILT, some gravel; dark reddish brown mottled red. Firm, moist, highly plastic; gravel, fine to medium, subangular, completely weathered dolerite [Completely Weathered DOLERITE].
TANGIHUA COMPLEX	Clayey SILT, some gravel; light brown mottled dark reddish brown. Firm, moist, highly plasticity; gravel, fine to medium, subangular, completely weathered dolerite and mudstone [completely weathered MUDSTONE].
TANGIHUA COMPLEX	Highly degraded cataclastic dark reddish brown MUDSTONE (85%) sheared with light brown DOLERITE (15%). Extremely weak Weathered to Silty CLAY, some gravel; stiff, moist, highly plastic; relic rock mass texture; gravel, fine to medium, angular, iron and manganese staining on defect surfaces; breaks into fine to medium fragments on handling. 9.25 - 9.45m - Core loss; No sample recovered.

Tests (SPT):

SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE
1	1// 0/1/0/0
6	1// 1/1/2/2
4	1// 1/1/1/1
3	0// 0/1/1/1
12	3// 3/3/3/3
17	4// 3/4/5/5

Rock strength / weathering: CW; VW HW; VW MW

Core:

SAMPLE TYPE	TCR (%)
HQ	73
SPT	33
HQ	100
SPT	100
HQ	100
SPT	44
HQ	100
SPT	100
HQ	100
SPT	100
HQ	100
SPT	56
HQ	76

Drilling method: HQ Size, Triple Tube, Wireline Rotary Coring

Notes:
Borehole terminated within SW Dolerite. Piezometer installed on completion.Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	4/09/2022	*Finished:*	7/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A5

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279882 E 988022 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	228.536 m
Location:	Slip 22A5 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000

Depth: 22.5 m
Inclination: Vertical

GEOLOGY: TANGIHUA COMPLEX

R.L. (m): 218, 216, 214, 212, 210
DEPTH (m): 11, 12, 13, 14, 15, 16, 17, 18, 19

MAIN DESCRIPTION / DETAIL DESCRIPTION
Moderately degraded cataclastic light yellow brown MUDSTONE (80%) sheared with reddish brown BASALT (20%). Very weak. Recovered as angular to subangular GRAVEL; gravel, fine to medium, angular; iron and manganese staining on defect surfaces; breaks into fine to medium fragments on handling.*(continued)*
10.3 - 10.5m - Core loss; No sample recovered.
Highly degraded cataclastic reddish brown MUDSTONE (60%) sheared with light brown BASALT (40%). Extremely weak. Weathered to Silty CLAY, some gravel; very sitff, moist, highly plastic; gravel, fine, angular; breaks into fine to medium fragments on handling.
11.90-12.00m - Wet.
Highly degraded cataclastic reddish brown MUDSTONE (70%) sheared with light brown MUDSTONE (30%). Very weak. Weathered to Silty CLAY, some gravel; stiff, moist, highly plasticity; gravel, fine, angular; breaks into fine to medium fragments on handling.
13.25- 13.50m - Core loss; No sample recovered.
Highly degraded cataclastic reddish brown MUDSTONE (70%) sheared with light brown MUDSTONE (30%). Very weak. Weathered to Silty CLAY, some gravel; stiff, moist, highly plasticity; gravel, fine, angular; breaks into fine to medium fragments on handling.
16.05 - 16.50m - Core loss; No sample recovered.
Highly degraded cataclastic reddish brown MUDSTONE (90%) sheared with light brown DOLERITE (10%). Extremely weak; extremely closely spaced defects; breaks into fine to medium fragments on handling. Weathered into Clayey SILT, minor sand and gravel; very stiff, moist, low plastic; sand, fine; gravel, fine to medium, subangular, highly weathered mudstone and dolerite.
Highly degraded cataclastic light brown MUDSTONE, Weak. Weathered into Silty CLAY, minor sand and gravel; very stiff, moist, highly plasticity; sand, fine; gravel, fine, angular, highly weathered mudstone; breaks into fine to medium fragments on handling.

TESTS

SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE
23	4// 3/6/7/7
13	4// 3/2/3/4
14	2// 2/3/4/5
34	7// 7/7/9/11
24	6// 6/6/6/6
28	7// 5/7/7/9
49	10// 9/10/13/13

ROCK STRENGTH	ROCK WEATHERING
VW	MW
VW	HW

ROCK DEFECT SPACING | DEFECT DIP degrees 0 90 | DEFECTS / NOTES / OTHER TESTS

CORE

SAMPLE TYPE	TCR (%)	RQD (%)
HQ	76	
SPT	100	
HQ	100	
SPT	100	
HQ	76	
SPT	100	
HQ	100	
SPT	100	
HQ	57	
SPT	100	
HQ	100	
SPT	450	
HQ	100	0
SPT	100	

DRILLING

DRILLING METHOD: HQ Size, Triple Tube, Wireline Rotary Coring

CASING | BASE OF HOLE & WATER LEVEL | INSTALLATION DETAILS

Notes:
Borehole terminated within SW Dolerite. Piezometer installed on completion.Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	4/09/2022	*Finished:*	7/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A5

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279882 E 988022 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	22.5 m
Project No.:	1-11244.00	*R.L.:*	228.536 m	*Inclination:*	Vertical
Location:	Slip 22A5 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m)	DEPTH (m)	GRAPHIC LOG	TESTS: SPT 'N' VALUE	TESTS: SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING	DEFECT DIP (degrees 0–90)	DEFECTS / NOTES / OTHER TESTS	CORE: SAMPLE TYPE	CORE: TCR (%)	CORE: RQD (%)	DRILLING METHOD	CASING	BASE OF HOLE & WATER LEVEL	INSTALLATION DETAILS
TANGIHUA COMPLEX	Moderately degraded cataclastic light brown grey DOLERITE (50%) sheared with dark reddish brown MUDSTONE 50%). Weak. Weathered into gravelly CLAY, minor sand very stiff, moist, highly plasticity; sand, fine; gravel, fine to coarse, angular, moderately weathered, dolerite, moderately strong.*(continued)*	208	21		50+	34// 35/15 for 25mm	W W	MW MW	C C		19.95-21.23m - Possible the shear zones of deep-seated landslip	HQ HQ SPT	86 86 100	0 0	HQ Size, Triple Tube, Wireline Rotary Coring			
	Slightly weathered, brown mottled grey and brownish orange cataclastic DOLERITE (70%) sjeared with dark red brown MUDSTONE (30%). Weak to moderately strong; moderately closely spaced, gentle inclined, undulating smooth; Iron and manganese staining on defect surfaces, relict vertical shearing with zeolite alteration.		22				S	SW	MW	J40 J50 J10	21.45m - J, 40° 21.55m - J, 50° 22.30m - J, 10°	HQ	100	50				
	END OF BOREHOLE AT 22.5m - Target Criteria Achieved	206 204 202 200	23 24 25 26 27 28 29															

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 1/12/22

Notes:
Borehole terminated within SW Dolerite. Piezometer installed on completion.Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	4/09/2022	*Finished:*	7/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A5

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279882 E 988022 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	22.5 m
Project No.:	1-11244.00	*R.L.:*	228.536 m	*Inclination:*	Vertical
Location:	Slip 22A5 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A5.1
0.00 - 3.45m.

Photo BH22A5.2
3.45 - 6.45m.

Notes:
Borehole terminated within SW Dolerite. Piezometer installed on completion.Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	4/09/2022	*Finished:*	7/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.
Scale 1:50 @ A4

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279882 E 988022 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	22.5 m
Project No.:	1-11244.00	*R.L.:*	228.536 m	*Inclination:*	Vertical
Location:	Slip 22A5 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A5.3
6.45 - 9.20m.

Photo BH22A5.4
9.20 - 12.45m.

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 1/12/22

Notes:
Borehole terminated within SW Dolerite. Piezometer installed on completion.Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	4/09/2022	*Finished:*	7/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.
Scale 1:50 @ A4

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279882 E 988022 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	22.5 m
Project No.:	1-11244.00	*R.L.:*	228.536 m	*Inclination:*	Vertical
Location:	Slip 22A5 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A5.5
12.45 - 15.45m

Photo BH22A5.6
15.45 -18.80m.

Notes:
Borehole terminated within SW Dolerite. Piezometer installed on completion.Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	4/09/2022	*Finished:*	7/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279882 E 988022 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	22.5 m
Project No.:	1-11244.00	*R.L.:*	228.536 m	*Inclination:*	Vertical
Location:	Slip 22A5 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

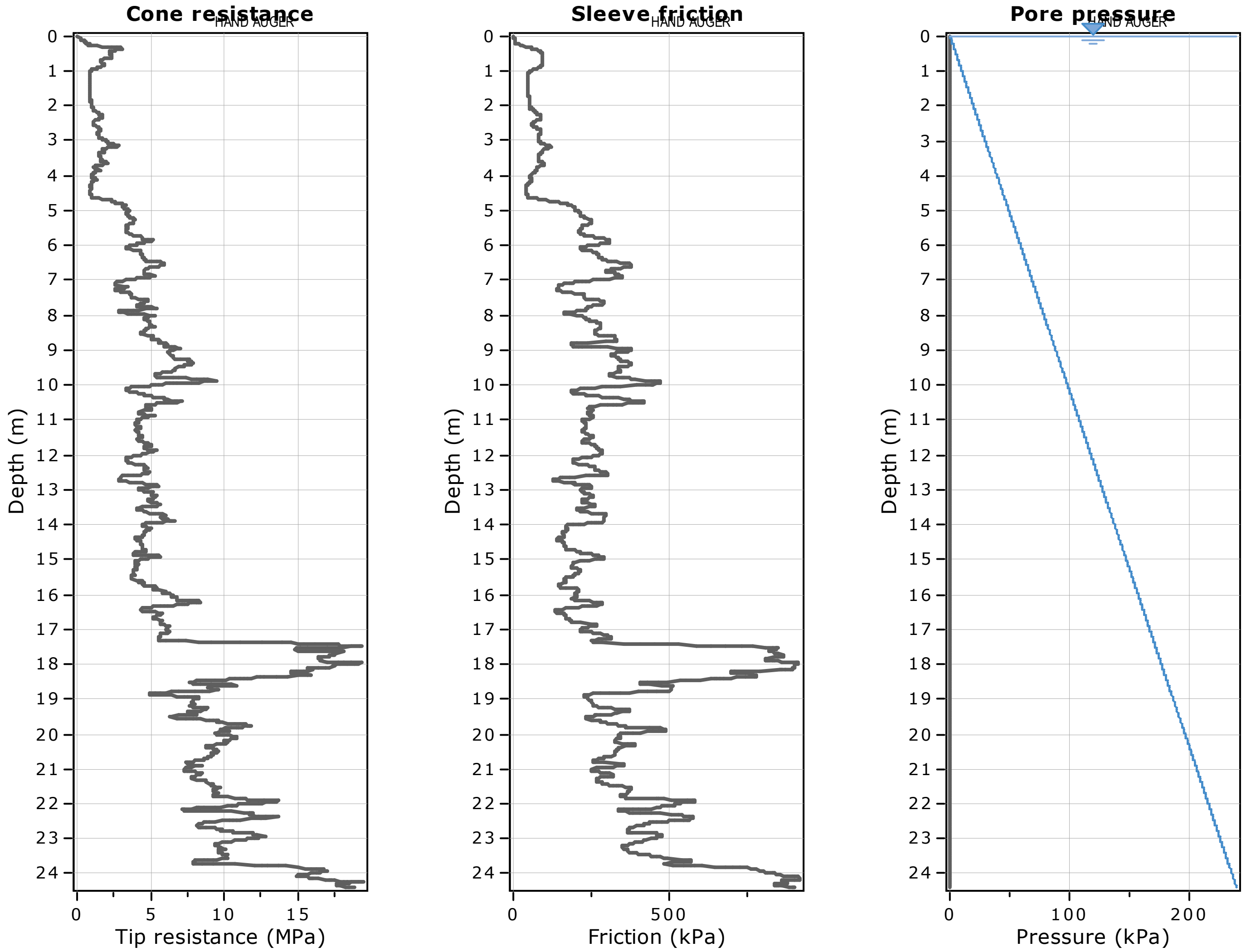
PHOTOGRAPHS

Photo BH22A5.7
18.80 - 21.40m.

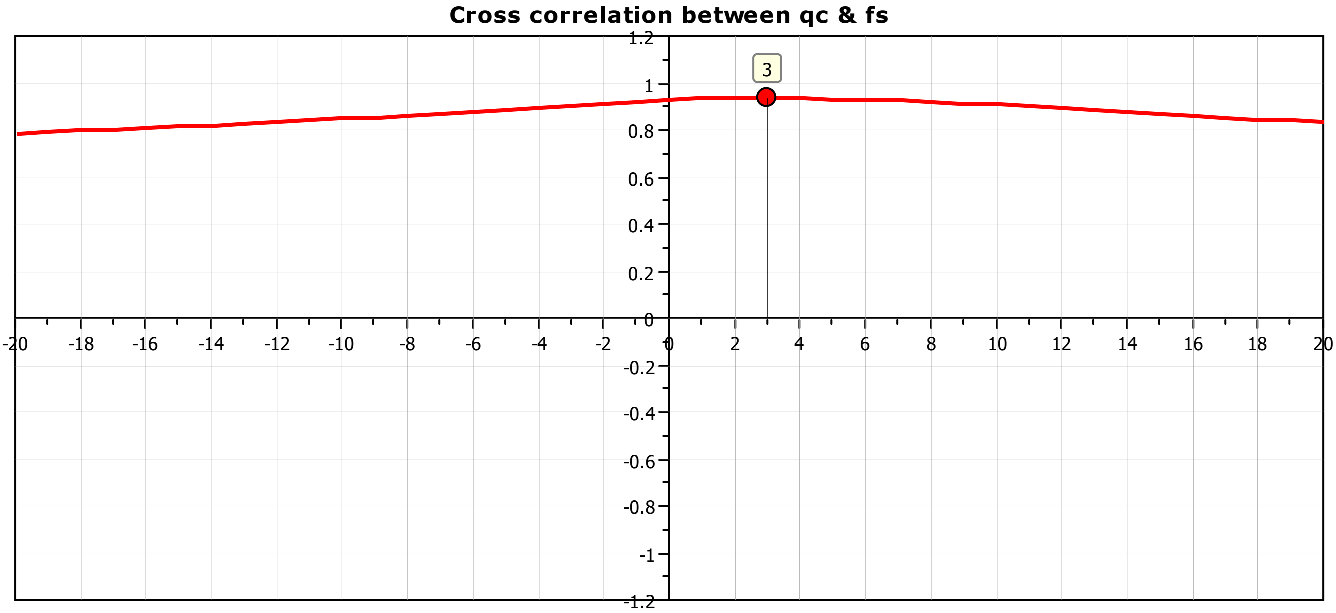
Photo BH22A5.8
21.40 - 22.50m

Notes:
Borehole terminated within SW Dolerite. Piezometer installed on completion.Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

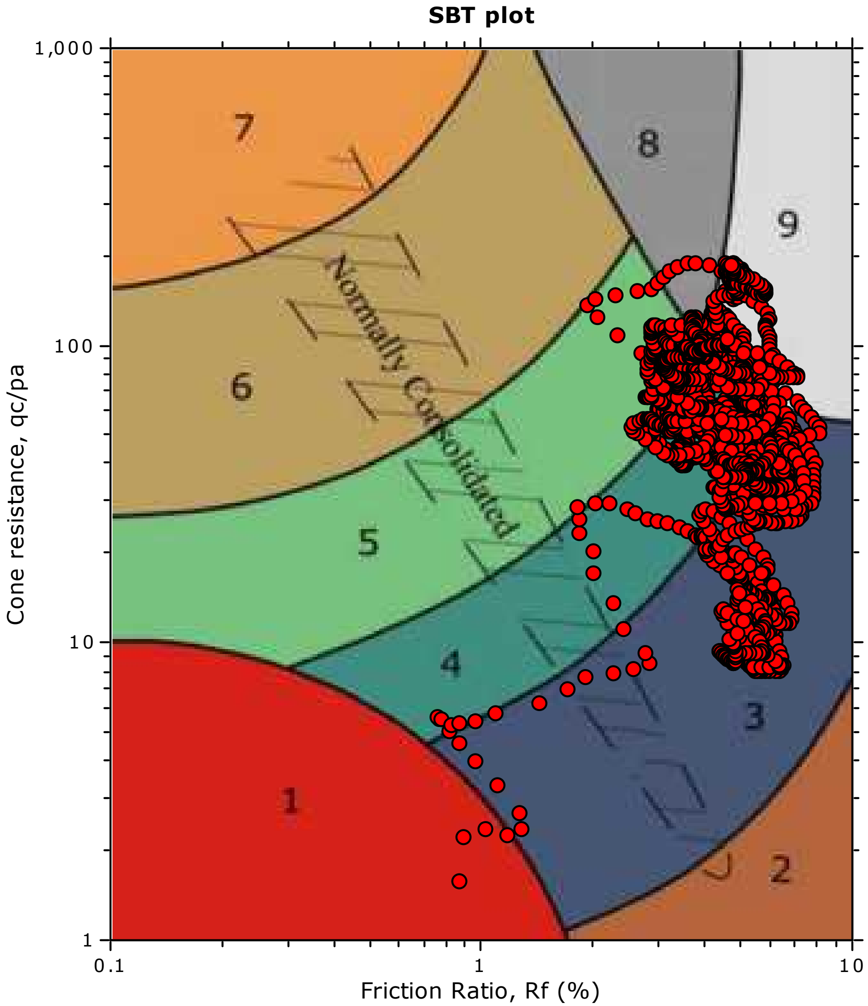
Started:	4/09/2022	*Finished:*	7/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

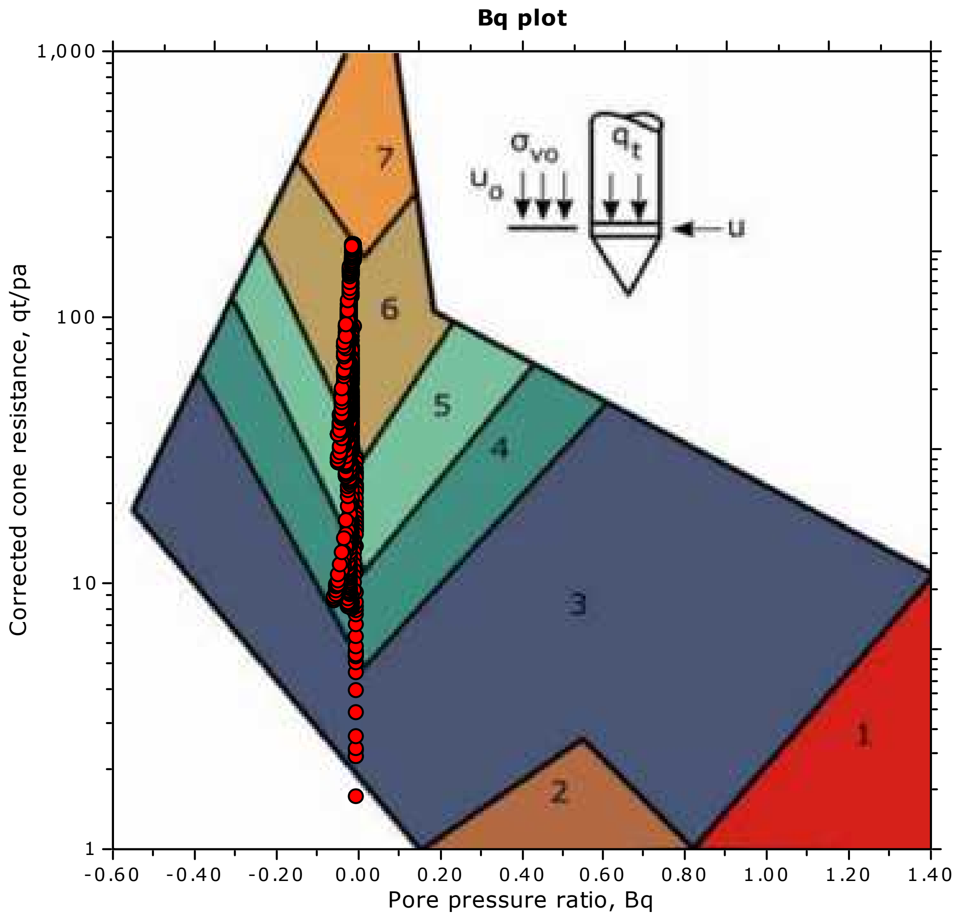


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

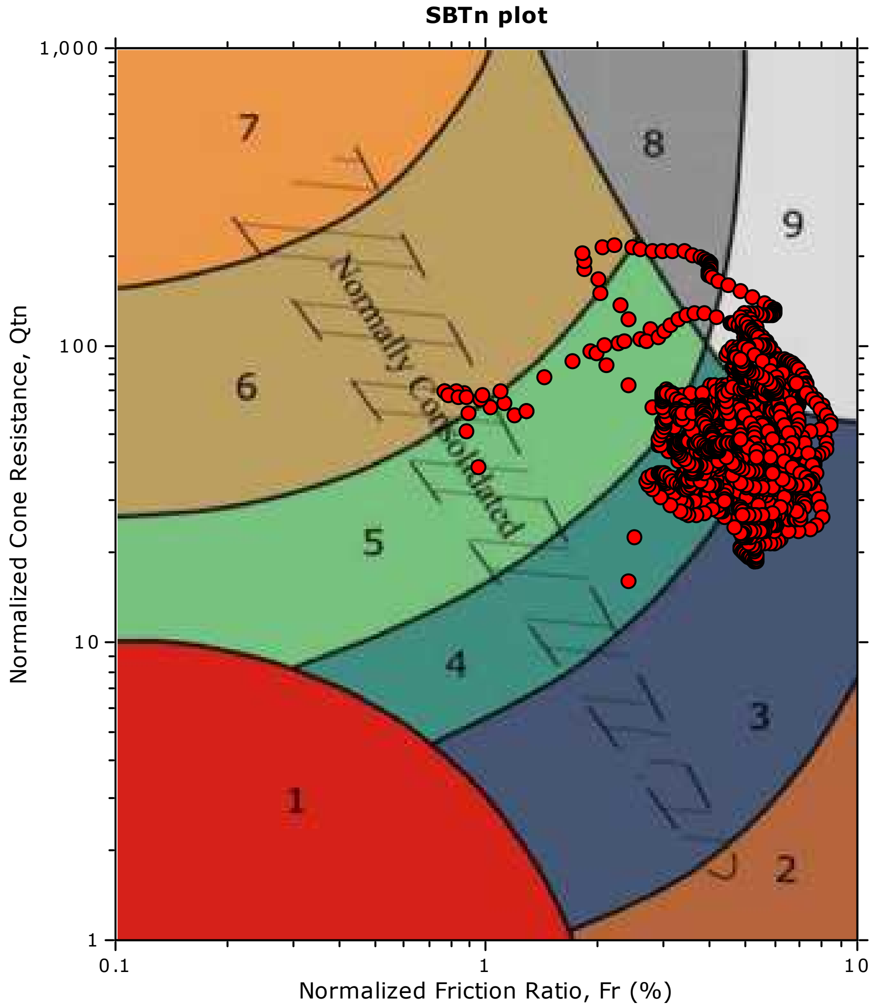


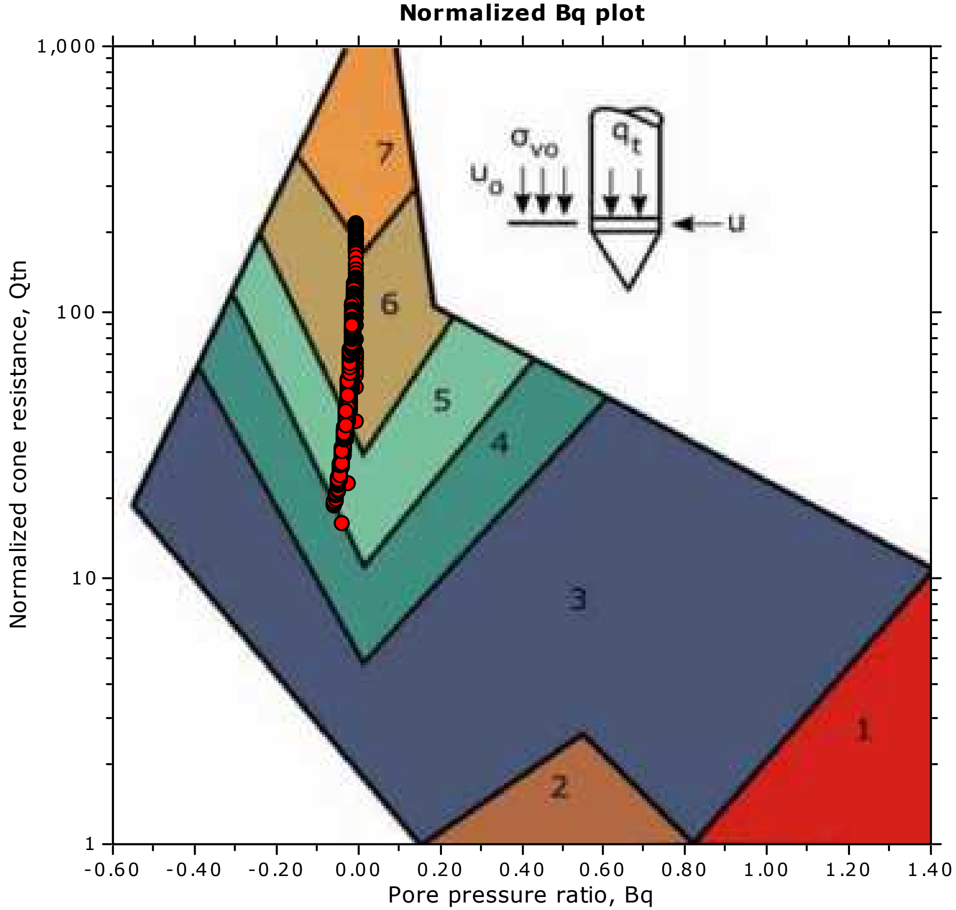


SBT legend

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

SBT - Bq plots (normalized)





SBTn legend

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

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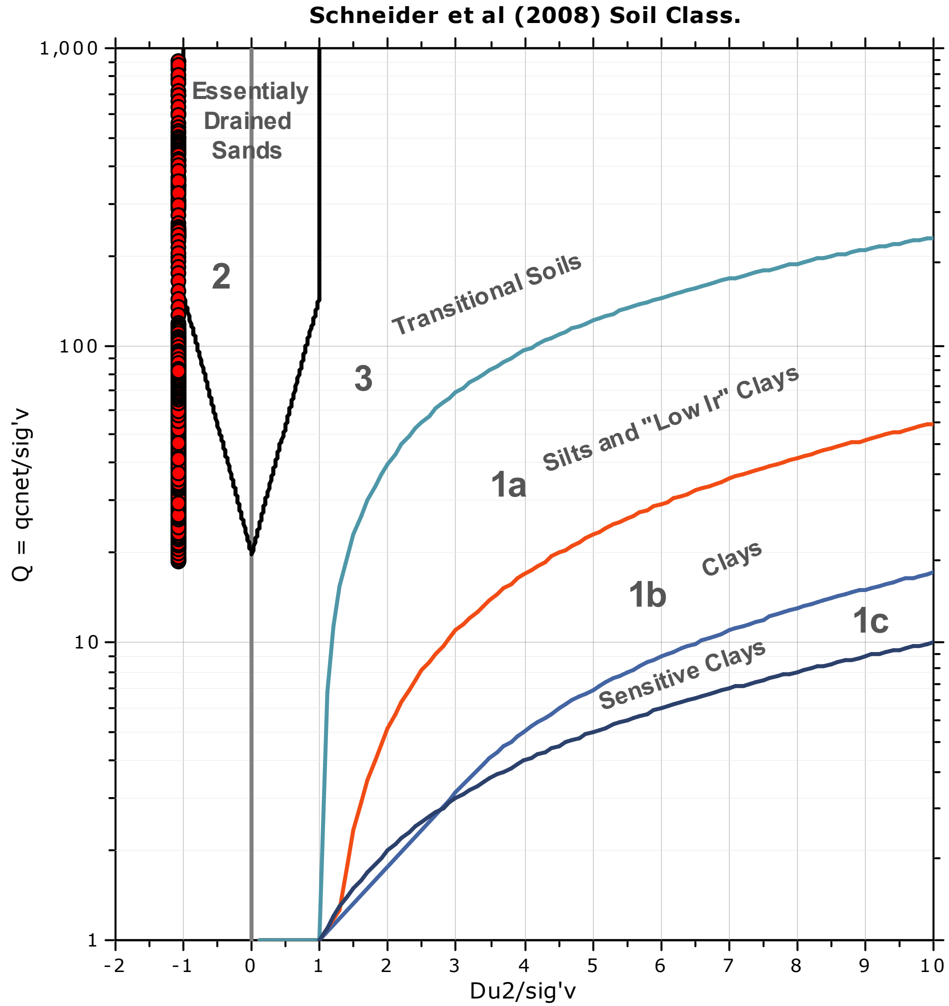
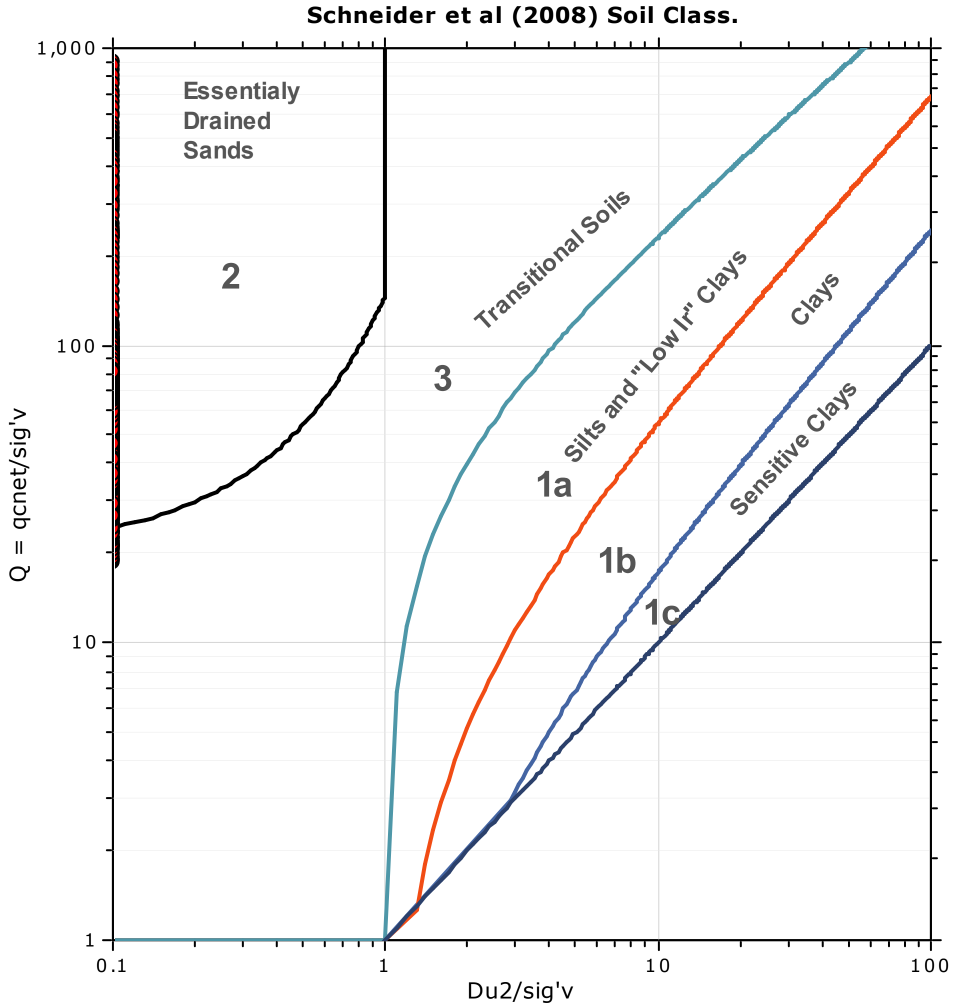
http://www.geologismiki.gr

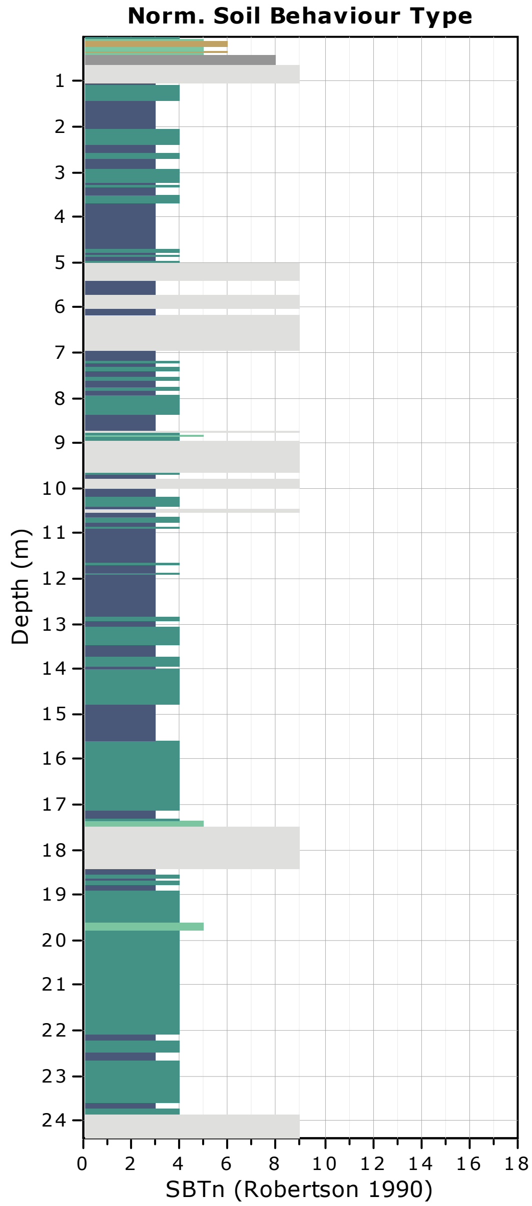
CPT: CPTA5-01
Total depth: 24.39 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

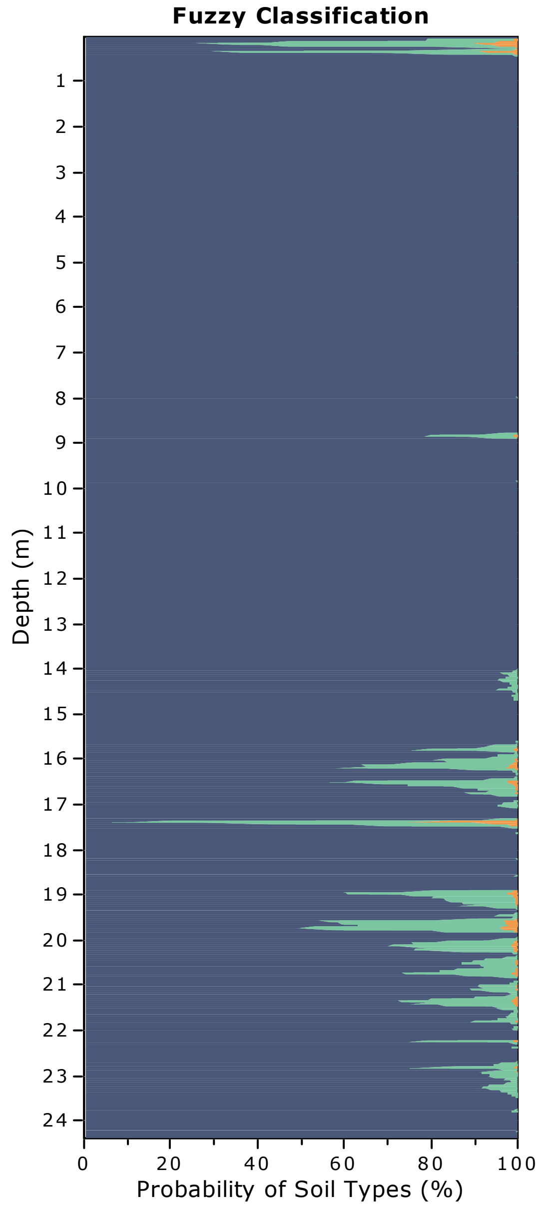
Project:
Location:

Bq plots (Schneider)






Norm. Soil Behaviour Type
Depth (m)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
Probability of Soil Types (%)

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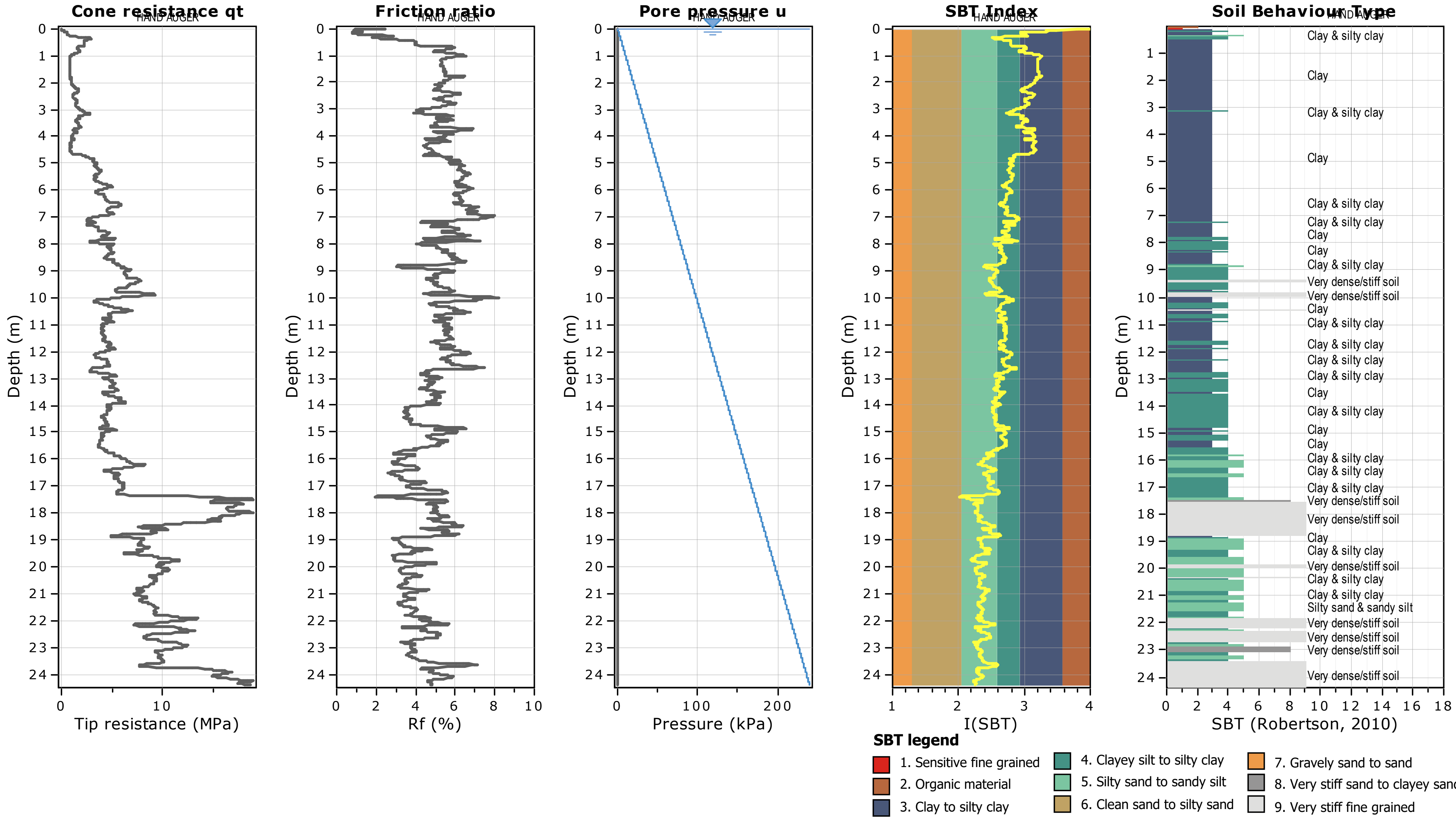
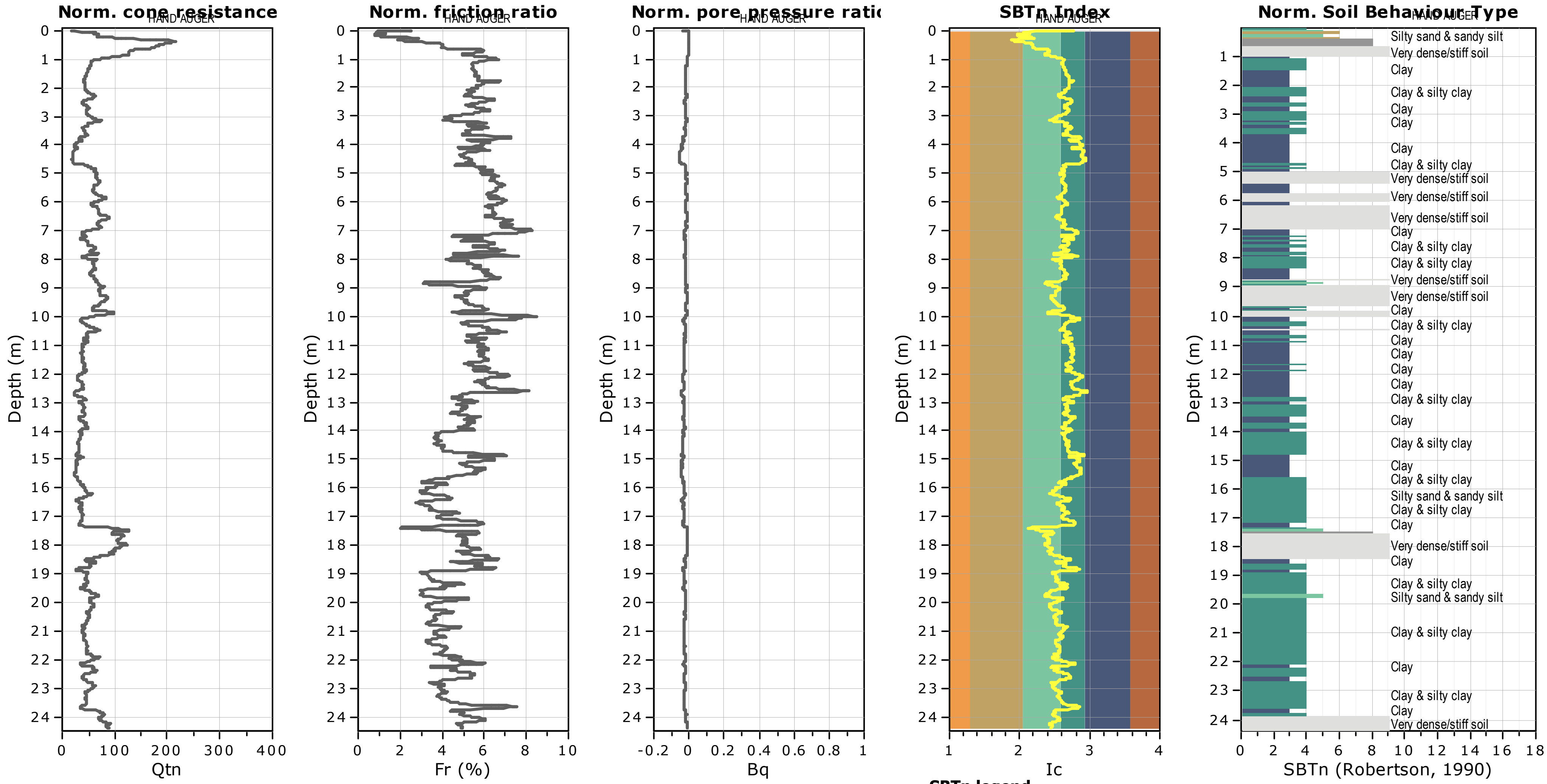
CPT: CPTA5-01
Total depth: 24.39 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



CPT: CPTA5-01
Total depth: 24.39 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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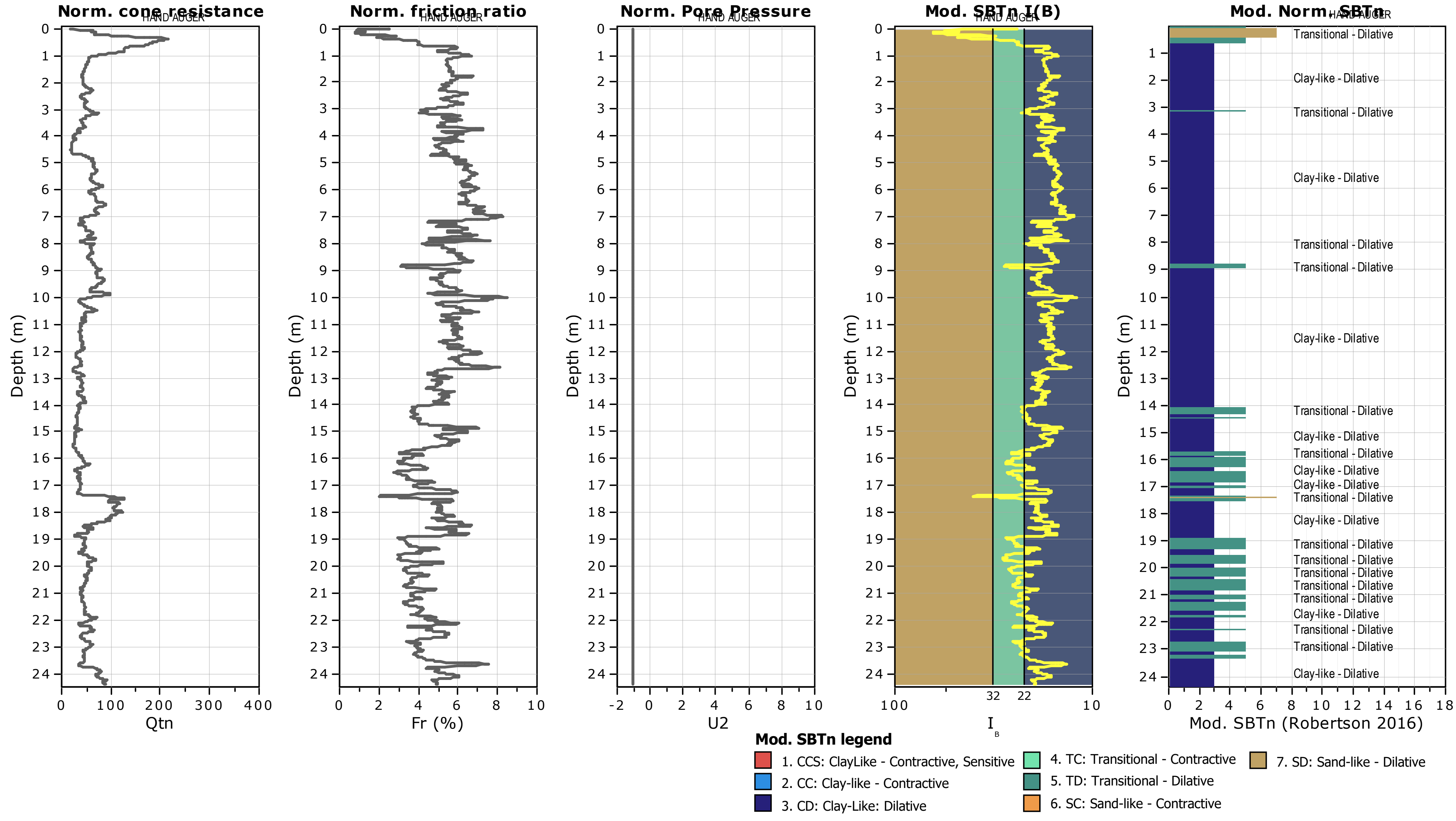
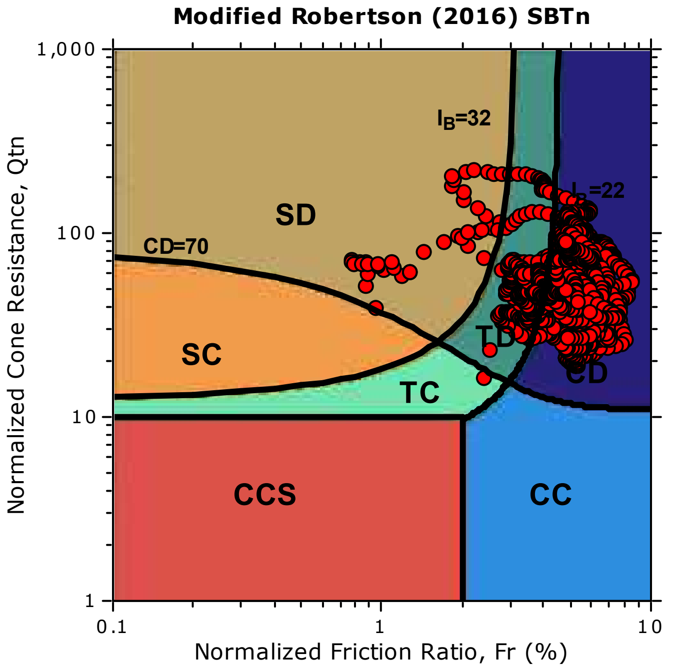
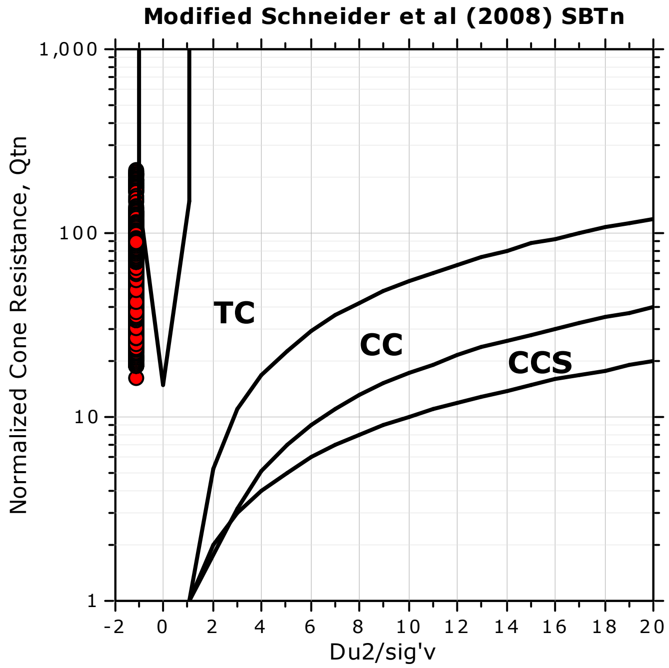
CPT: CPTA5-01
Total depth: 24.39 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

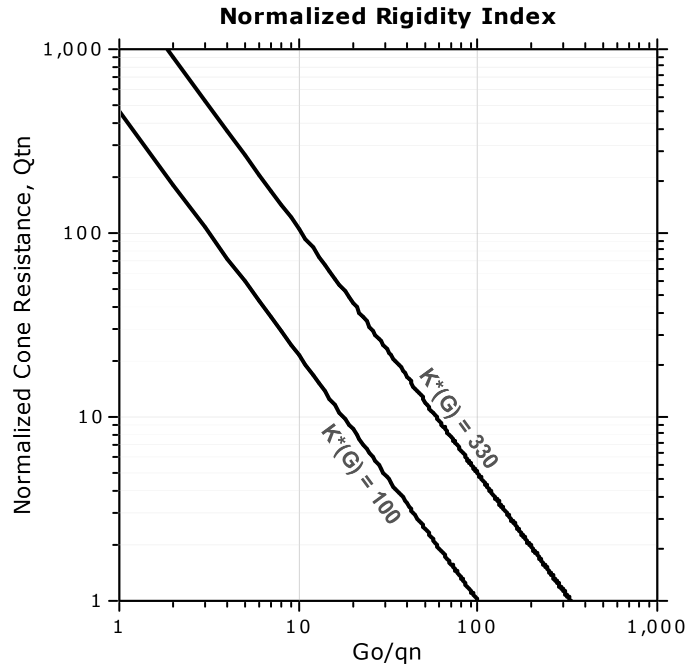
Project:
Location:



Updated SBTn plots







CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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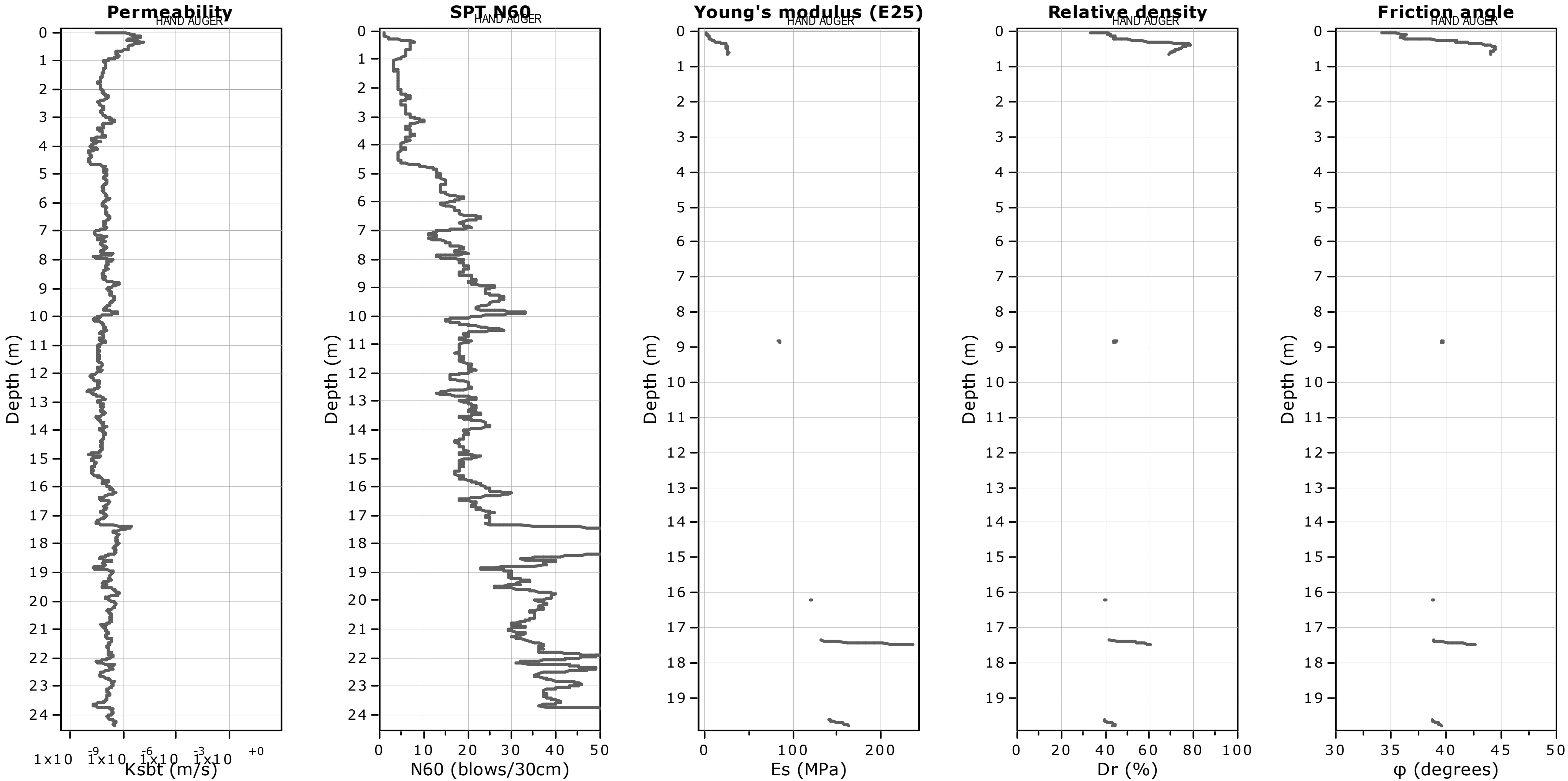
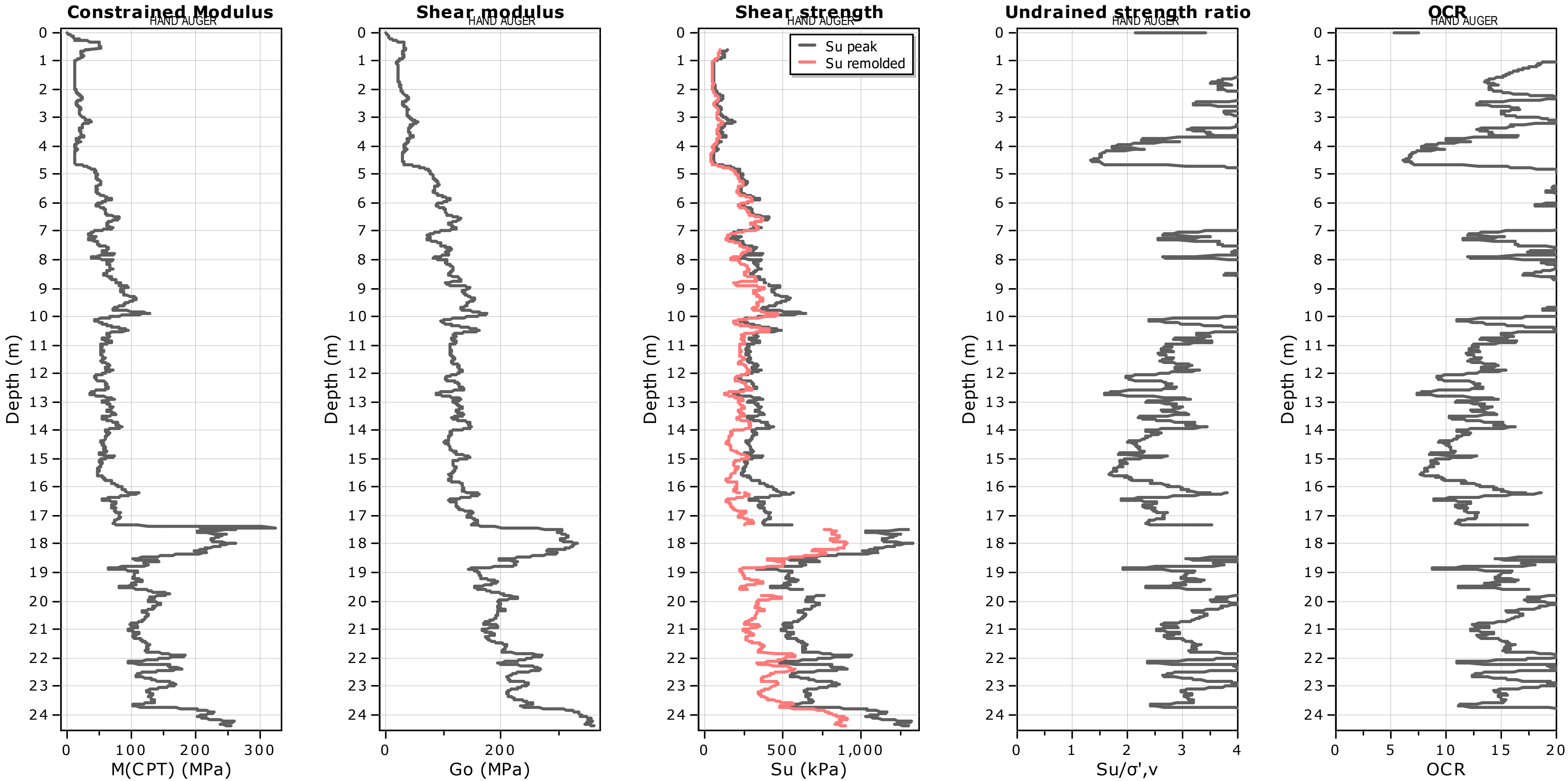
http://www.geologismiki.gr

CPT: CPTA5-01
Total depth: 24.39 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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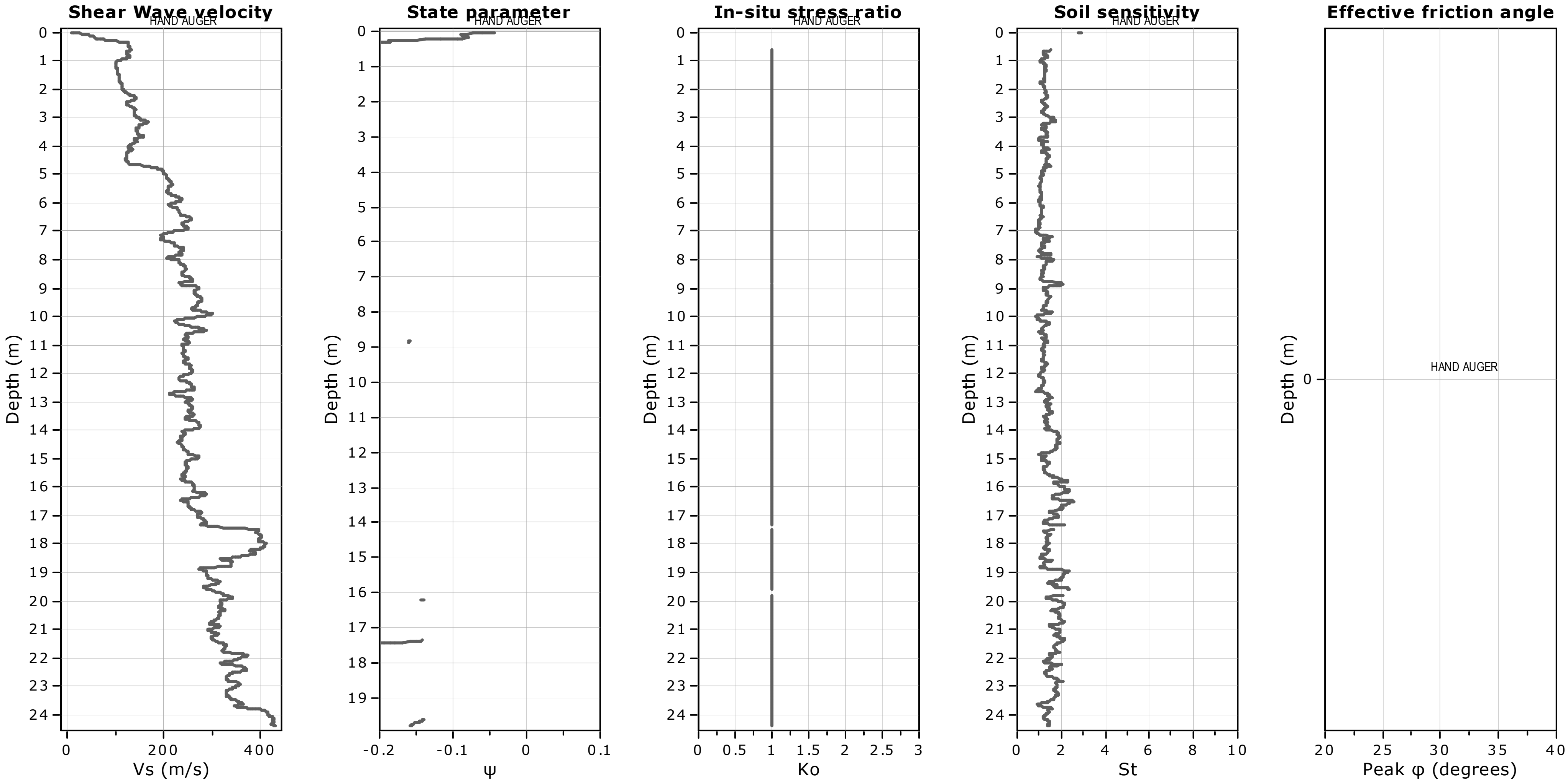
CPT: CPTA5-01
Total depth: 24.39 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

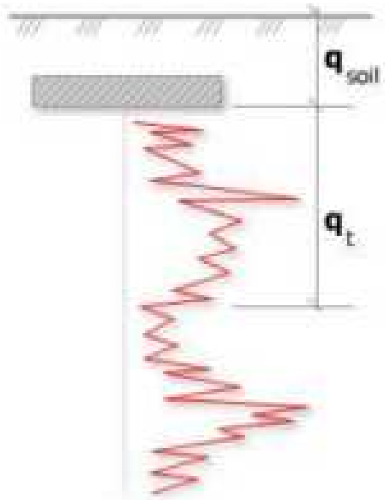
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

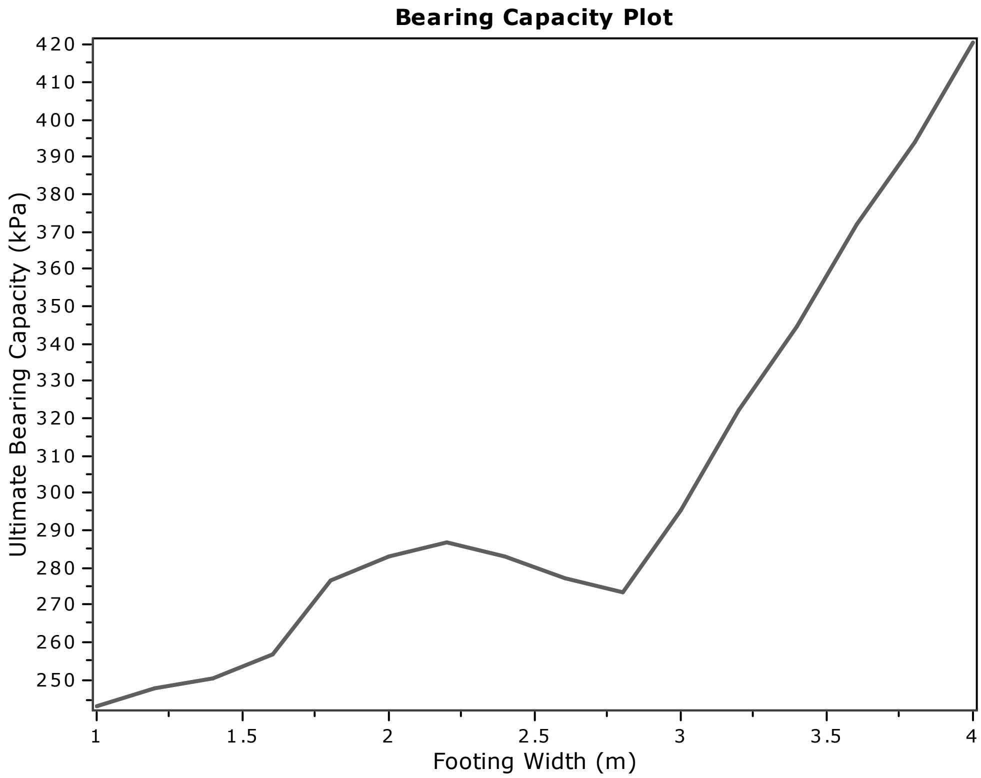
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

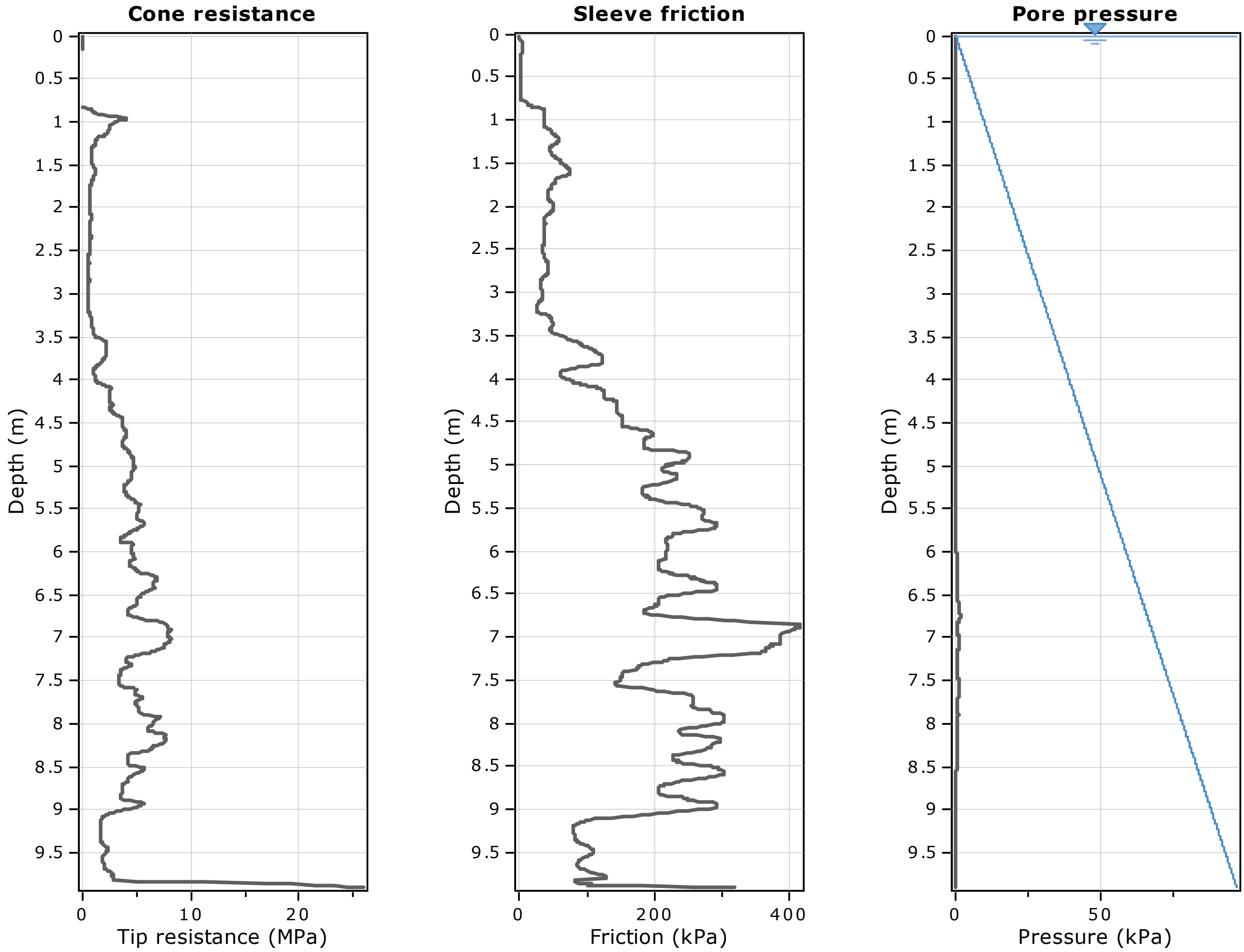
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

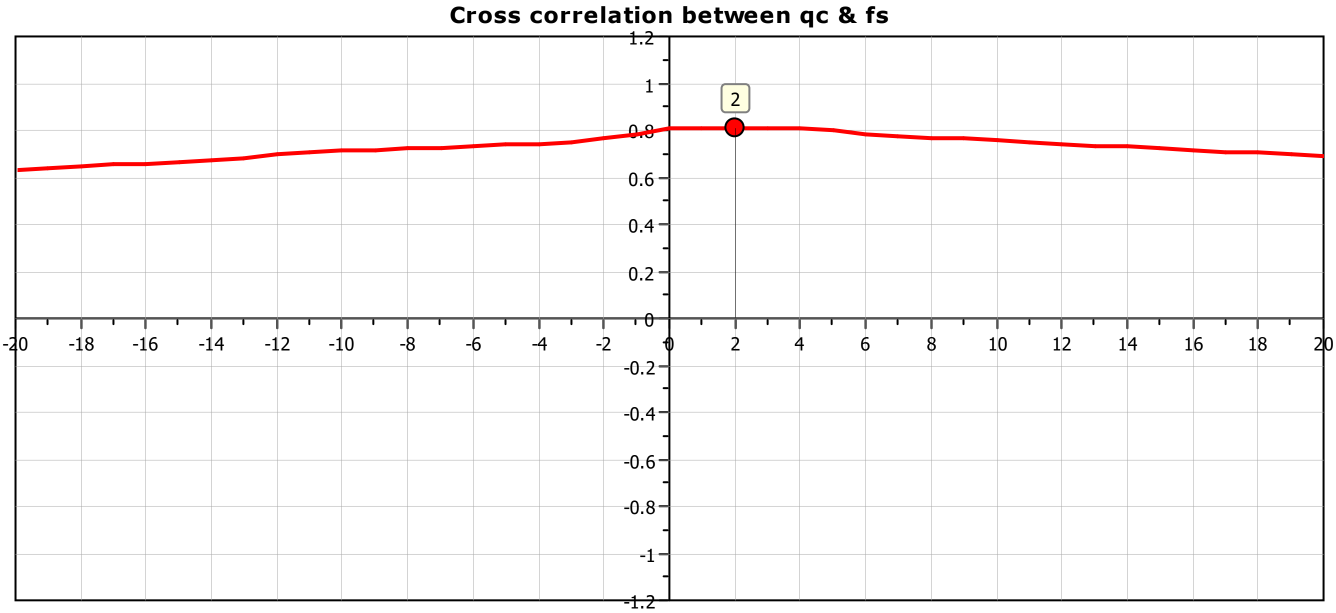


:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.17	0.20	9.50	242.88
2	1.20	0.50	2.30	1.19	0.20	9.50	247.63
3	1.40	0.50	2.60	1.20	0.20	9.50	250.41
4	1.60	0.50	2.90	1.24	0.20	9.50	257.00
5	1.80	0.50	3.20	1.34	0.20	9.50	276.87
6	2.00	0.50	3.50	1.37	0.20	9.50	282.96
7	2.20	0.50	3.80	1.39	0.20	9.50	286.89
8	2.40	0.50	4.10	1.37	0.20	9.50	283.12
9	2.60	0.50	4.40	1.34	0.20	9.50	277.26
10	2.80	0.50	4.70	1.32	0.20	9.50	273.43
11	3.00	0.50	5.00	1.43	0.20	9.50	295.33
12	3.20	0.50	5.30	1.56	0.20	9.50	322.03
13	3.40	0.50	5.60	1.68	0.20	9.50	344.68
14	3.60	0.50	5.90	1.81	0.20	9.50	372.02
15	3.80	0.50	6.20	1.92	0.20	9.50	393.72
16	4.00	0.50	6.50	2.06	0.20	9.50	420.75

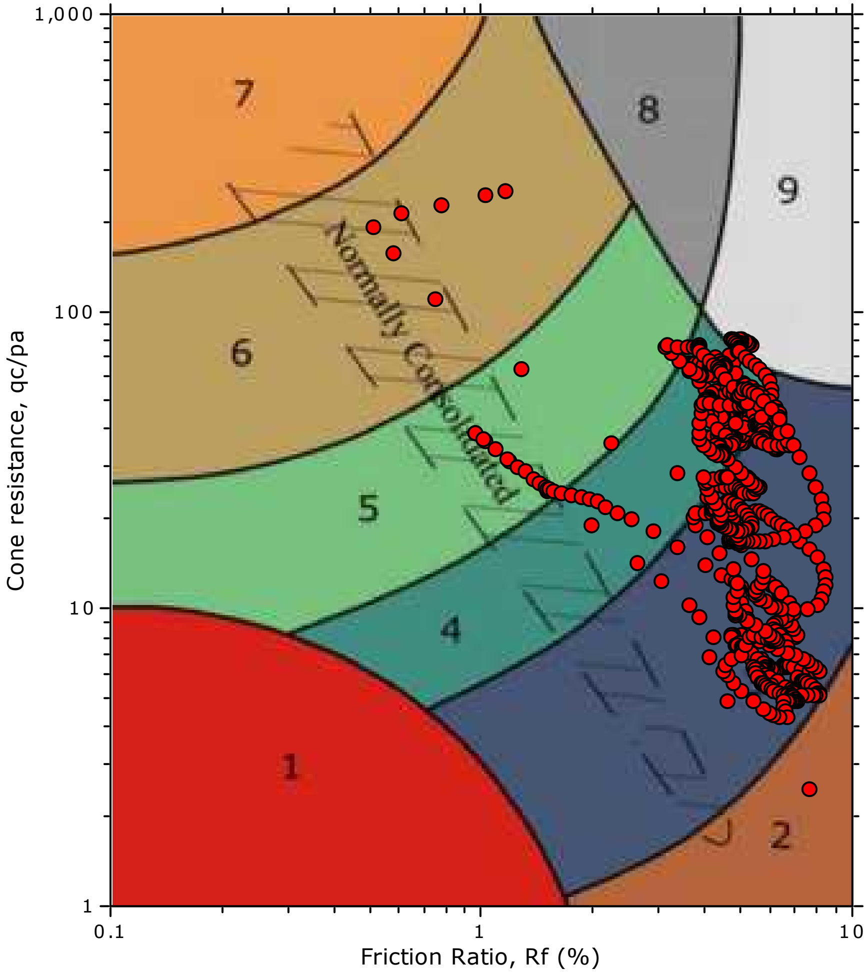


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

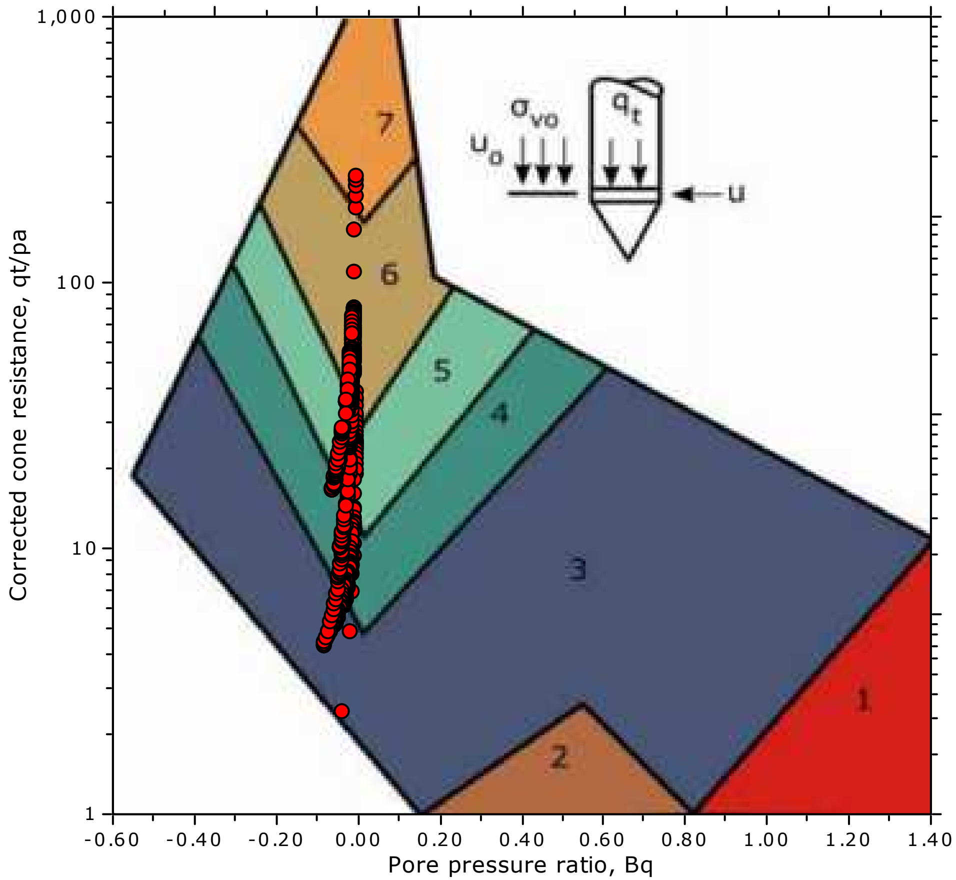


SBT - Bq plots

SBT plot



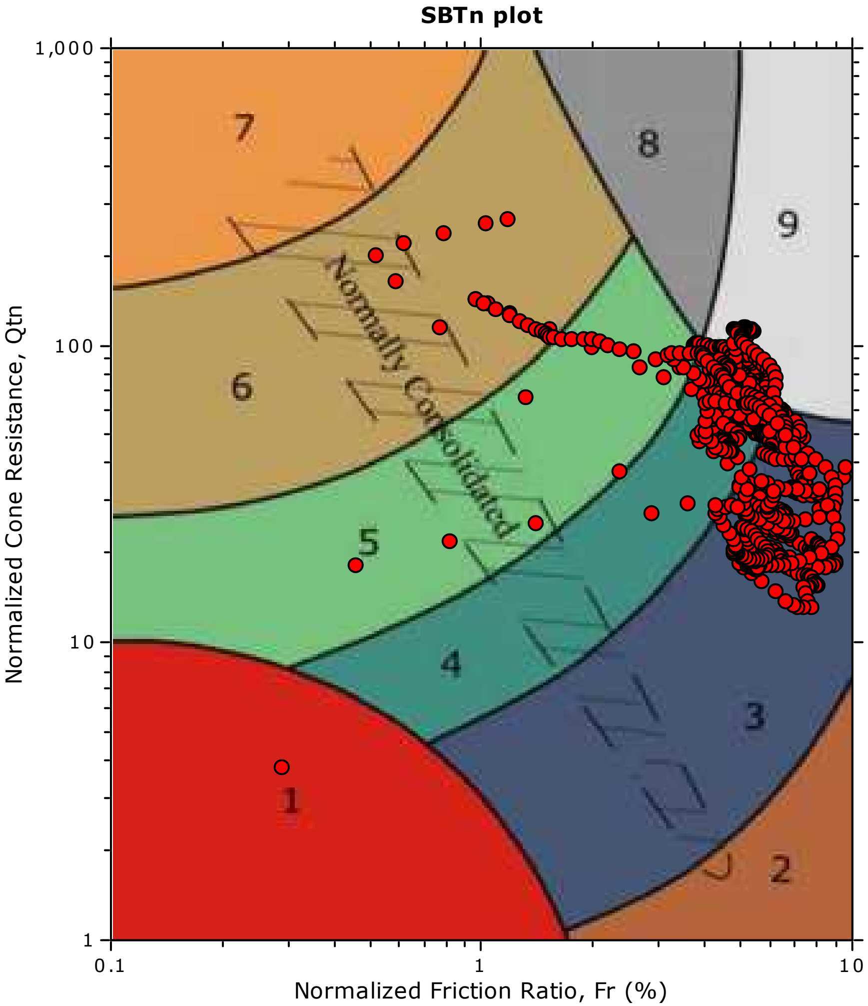
Bq plot

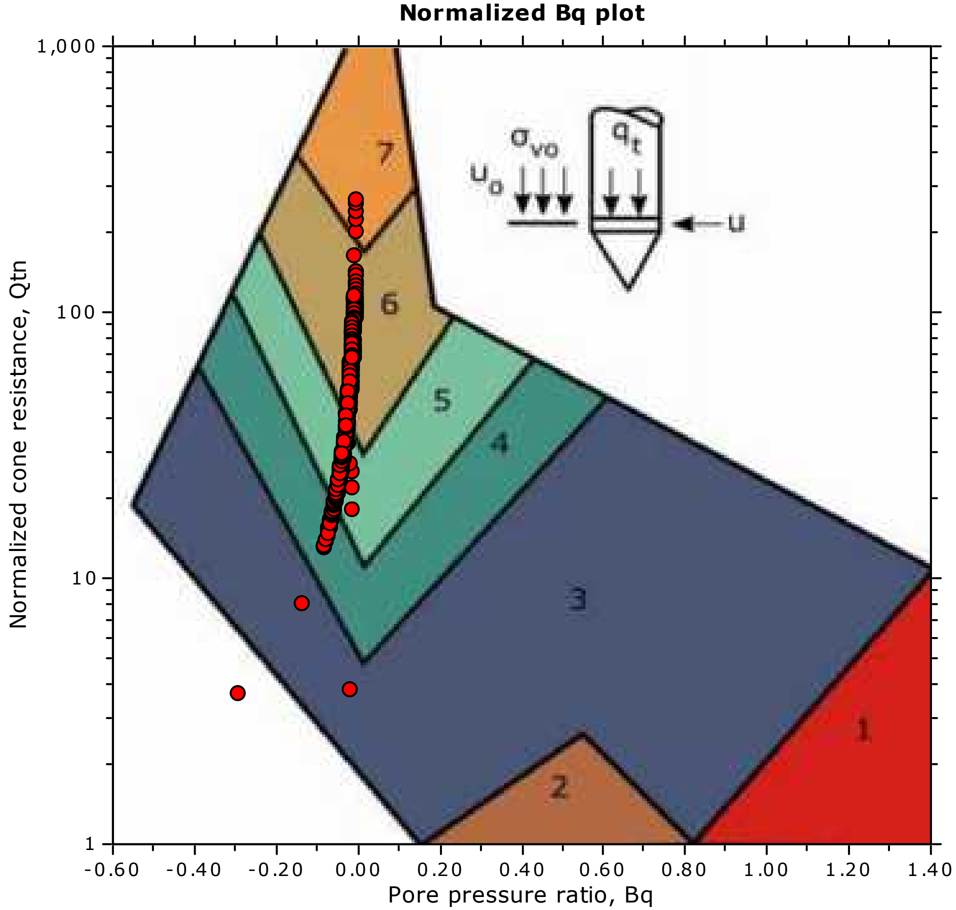


SBT legend

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

SBT - Bq plots (normalized)

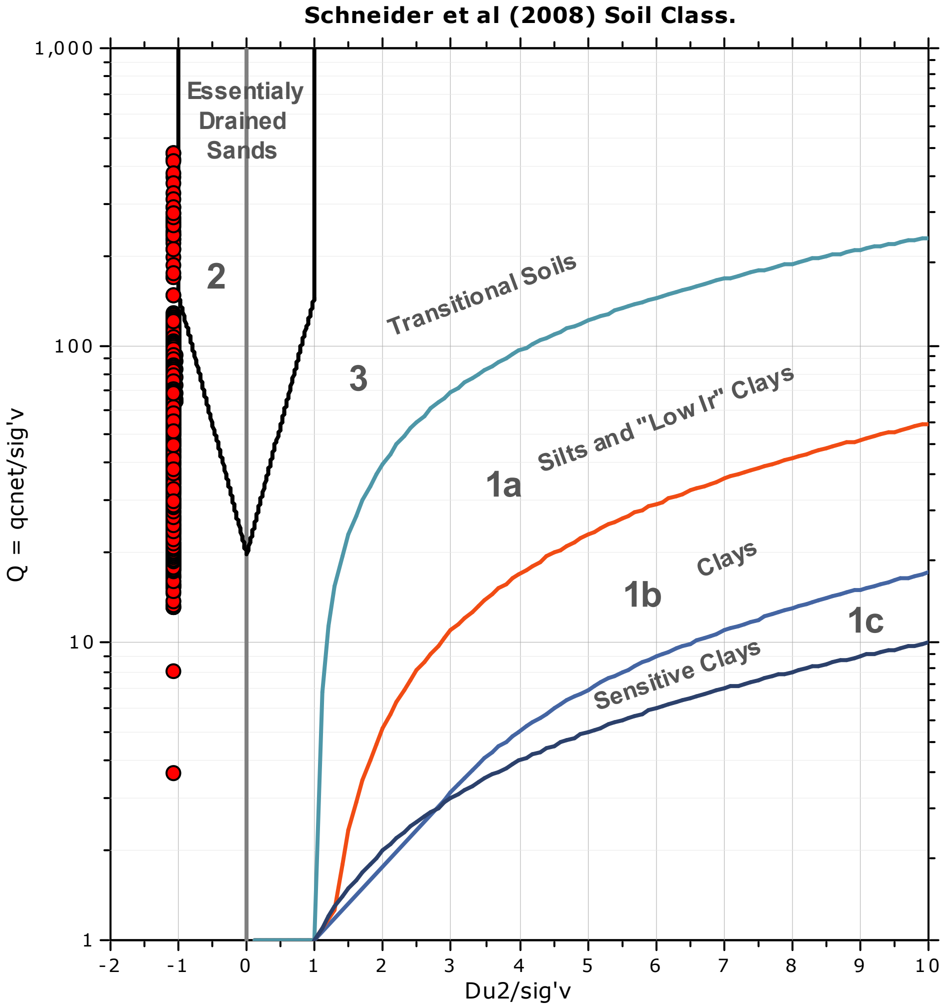


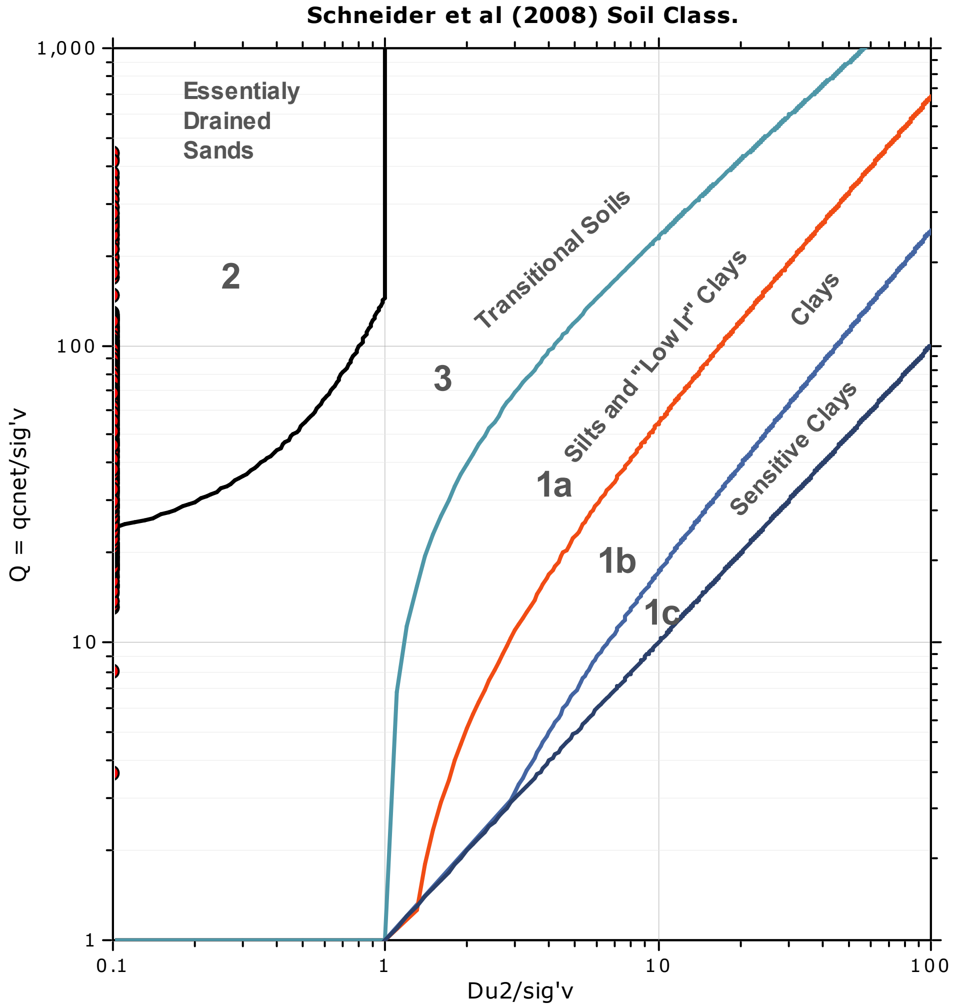


SBTn legend

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

Bq plots (Schneider)





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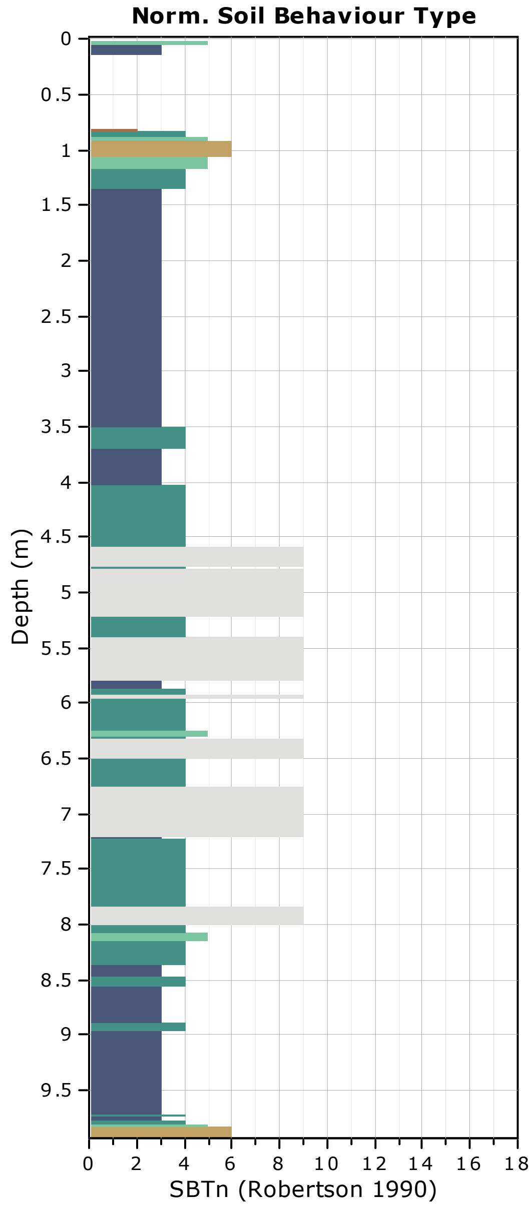
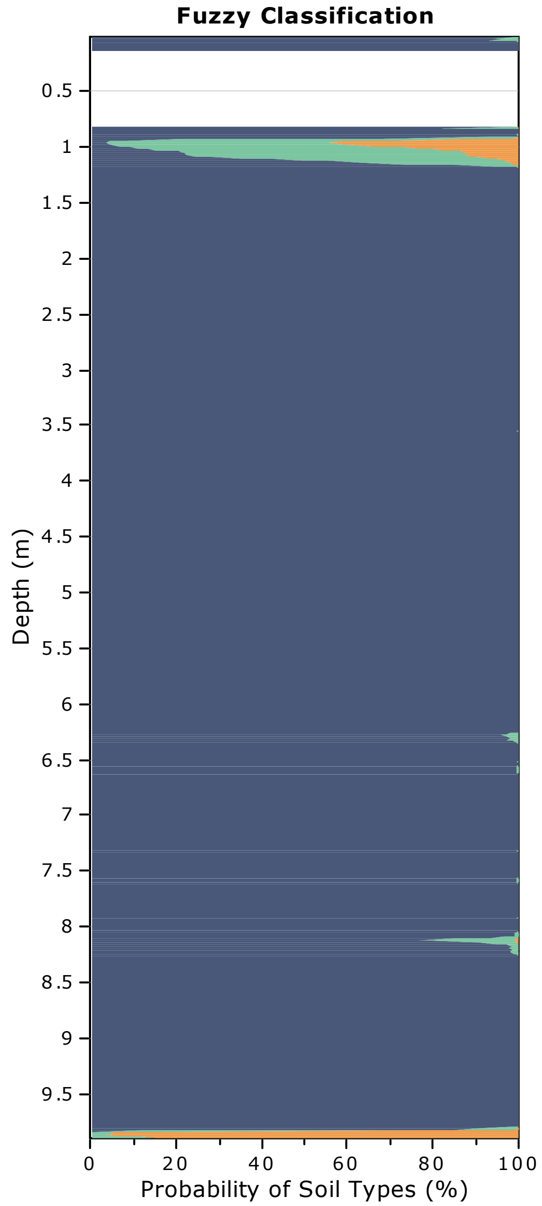
CPT: CPTA5-02
Total depth: 9.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:





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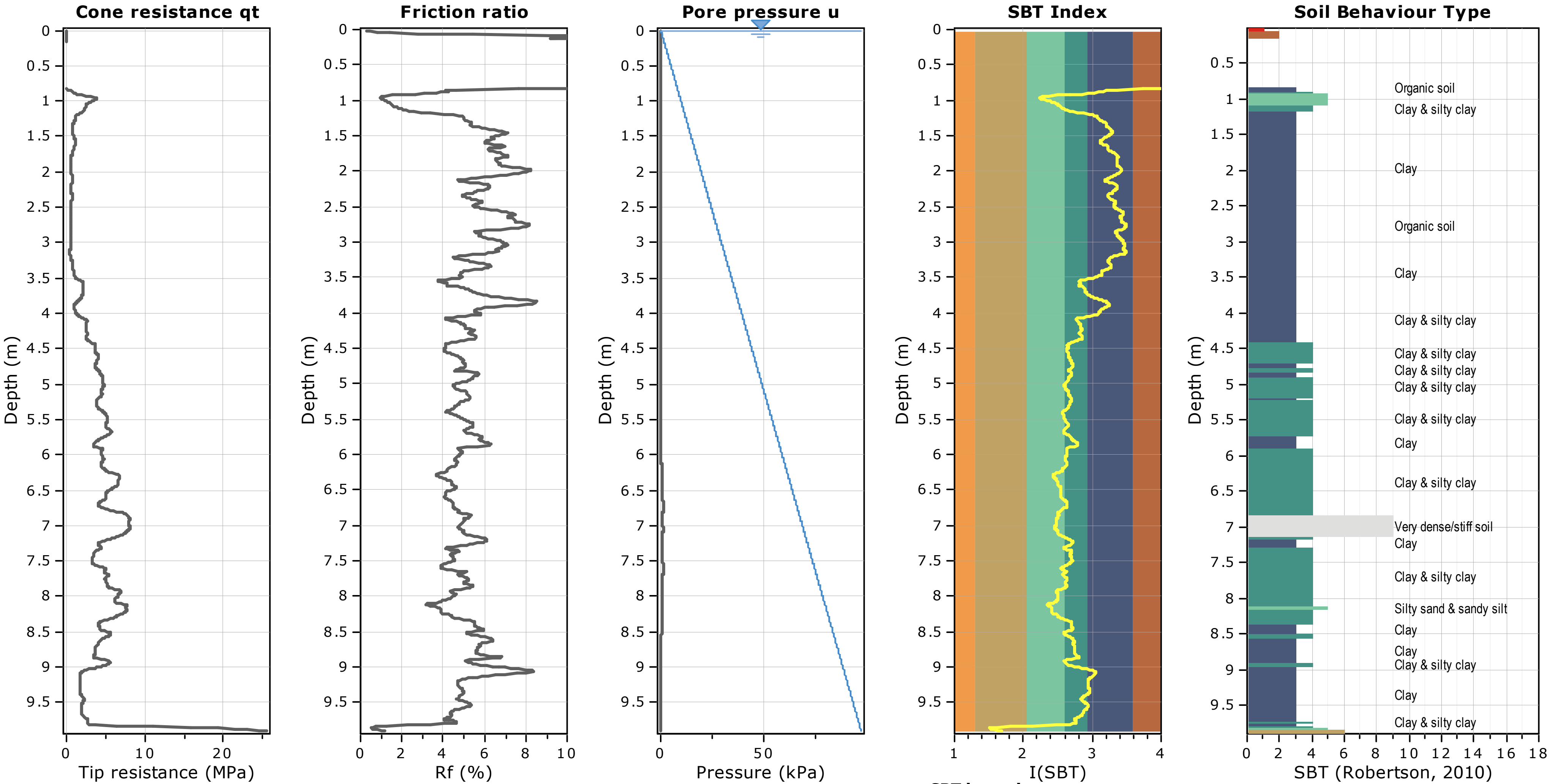
CPT: CPTA5-02
Total depth: 9.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBT legend

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

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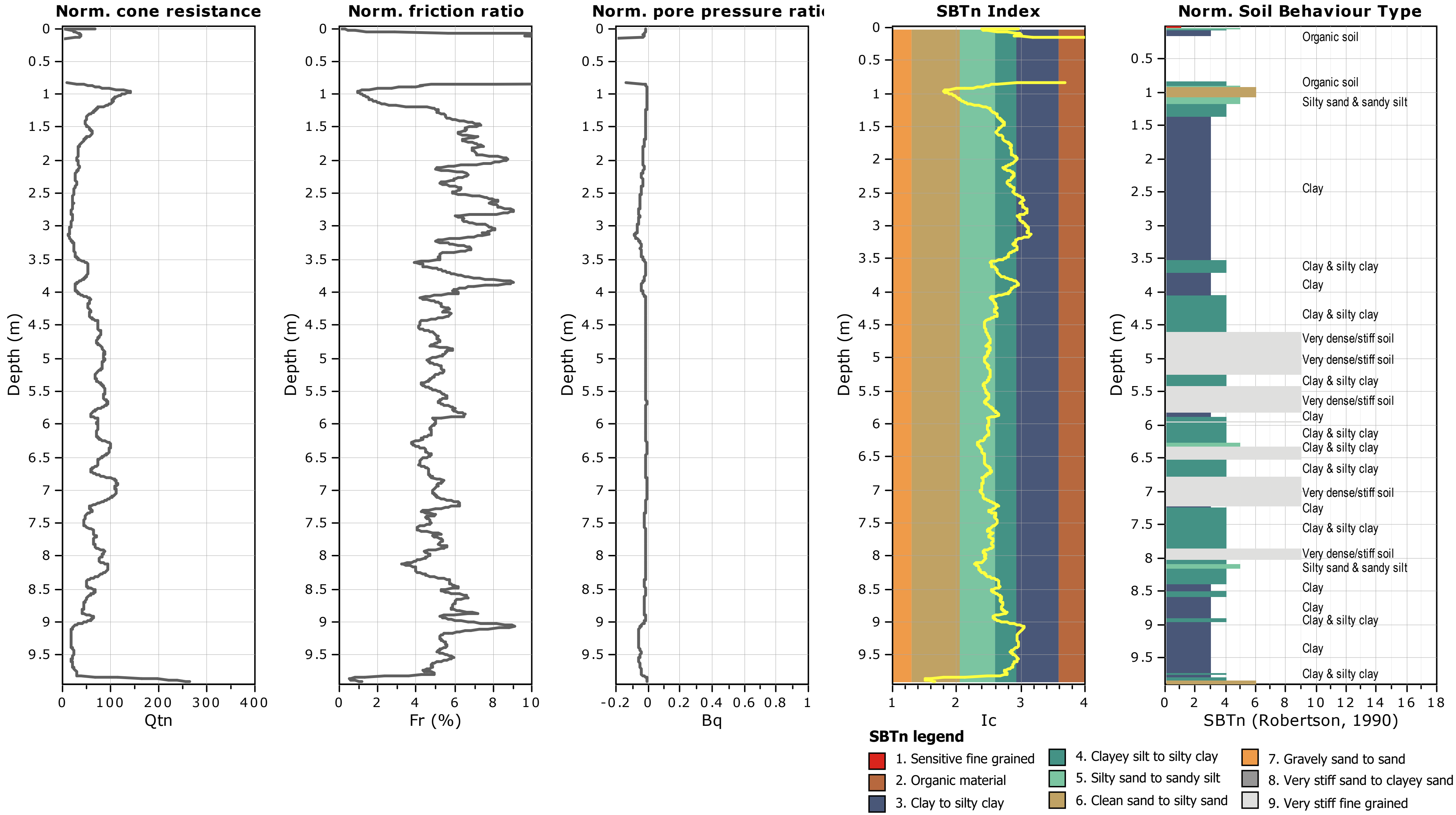
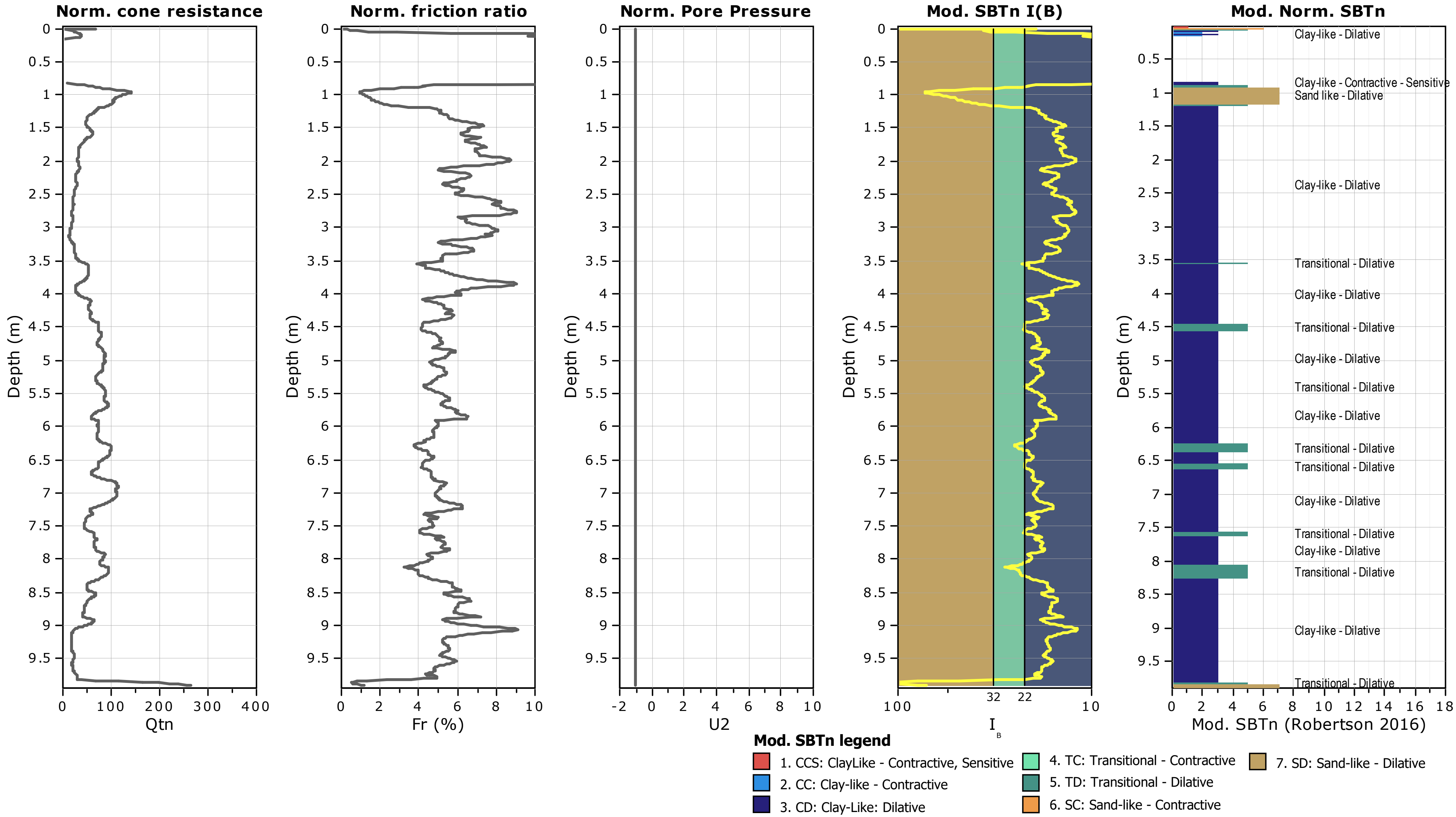
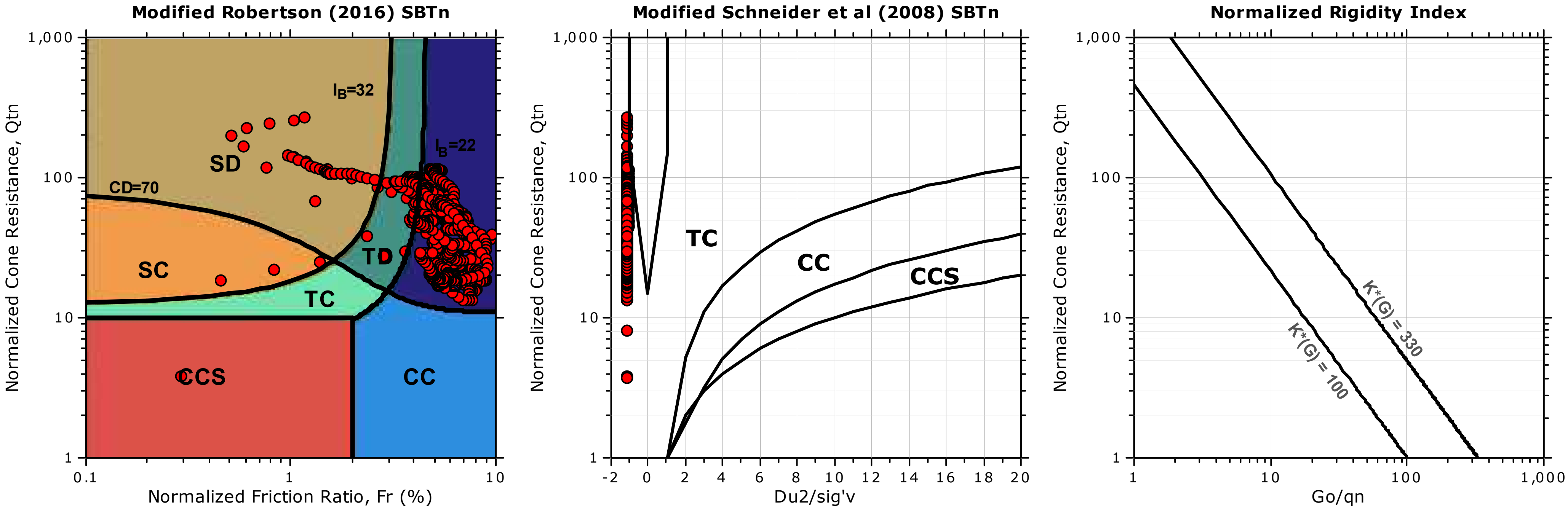
CPT: CPTA5-02
Total depth: 9.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:




Norm. cone resistance
Norm. friction ratio
Norm. Pore Pressure
Mod. SBTn I(B)
Mod. Norm. SBTn
Depth (m)
Qtn
Fr (%)
U2
I_B
Mod. SBTn (Robertson 2016)
Clay-like - Dilative
Clay-like - Contractive - Sensitive
Sand like - Dilative
Transitional - Dilative
Mod. SBTn legend
1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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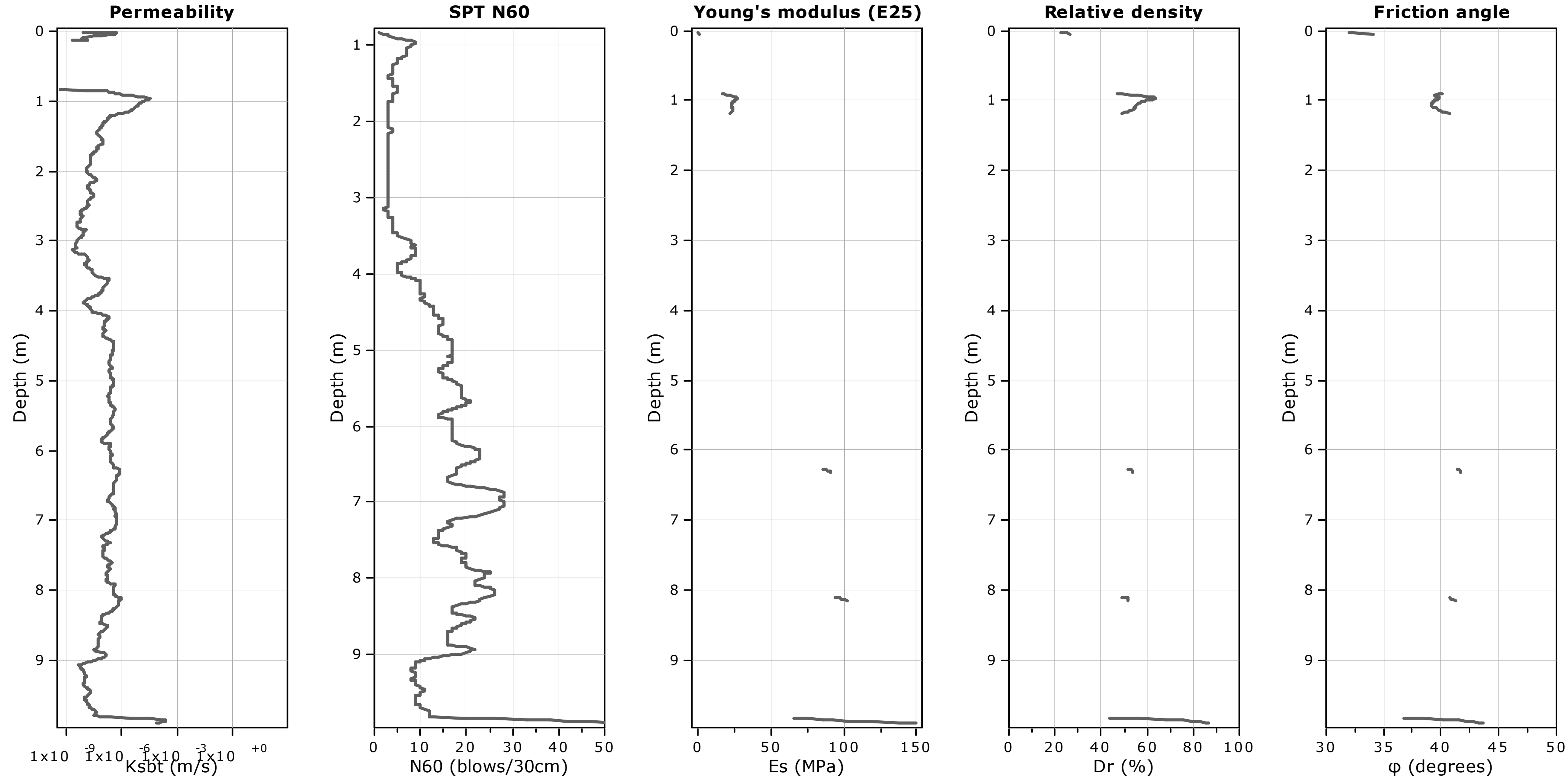
CPT: CPTA5-02
Total depth: 9.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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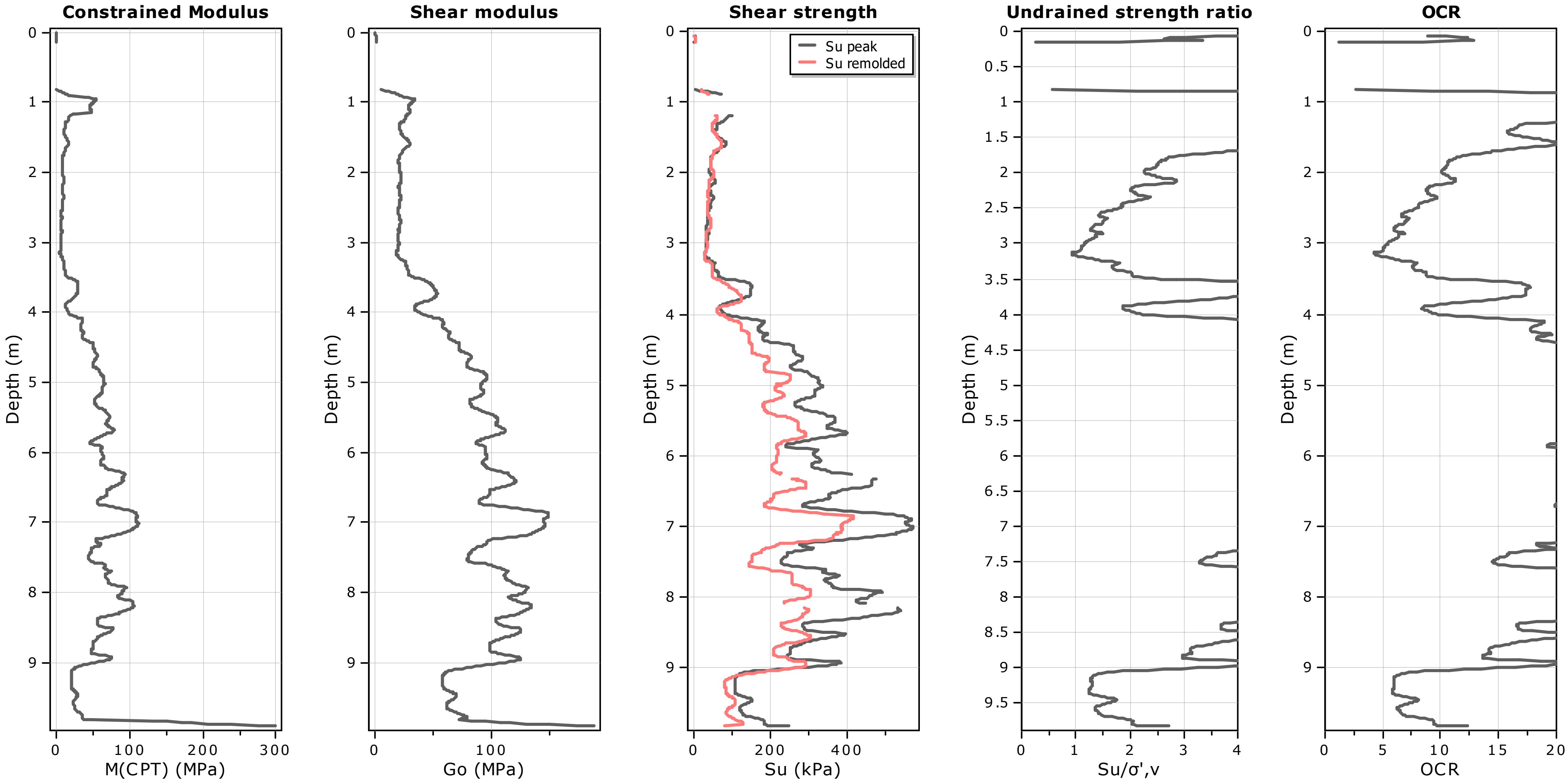
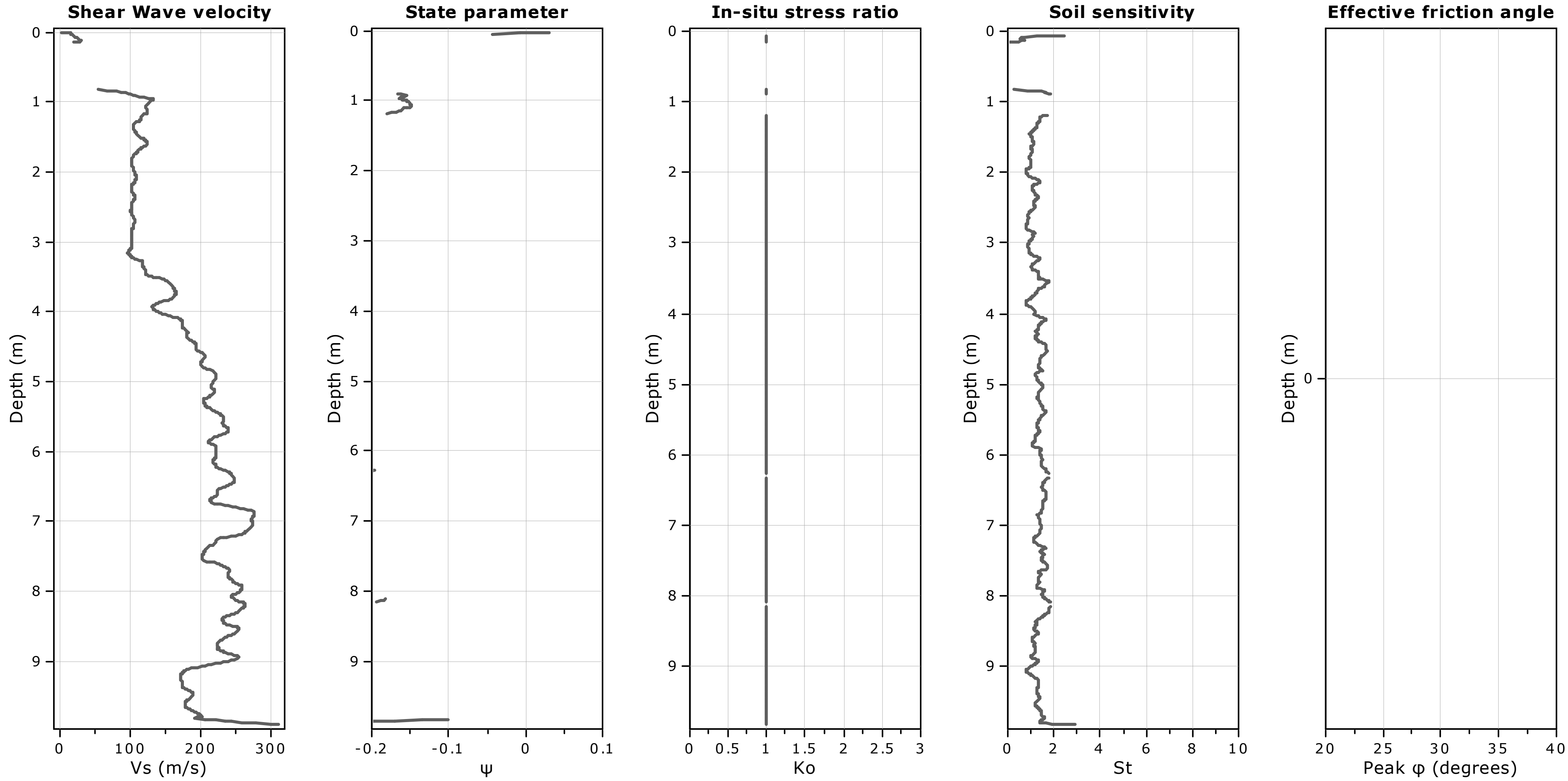
CPT: CPTA5-02
Total depth: 9.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

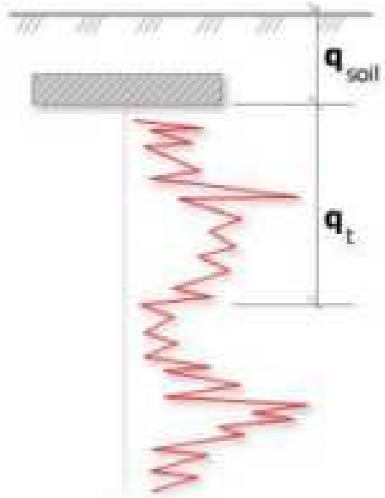
OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

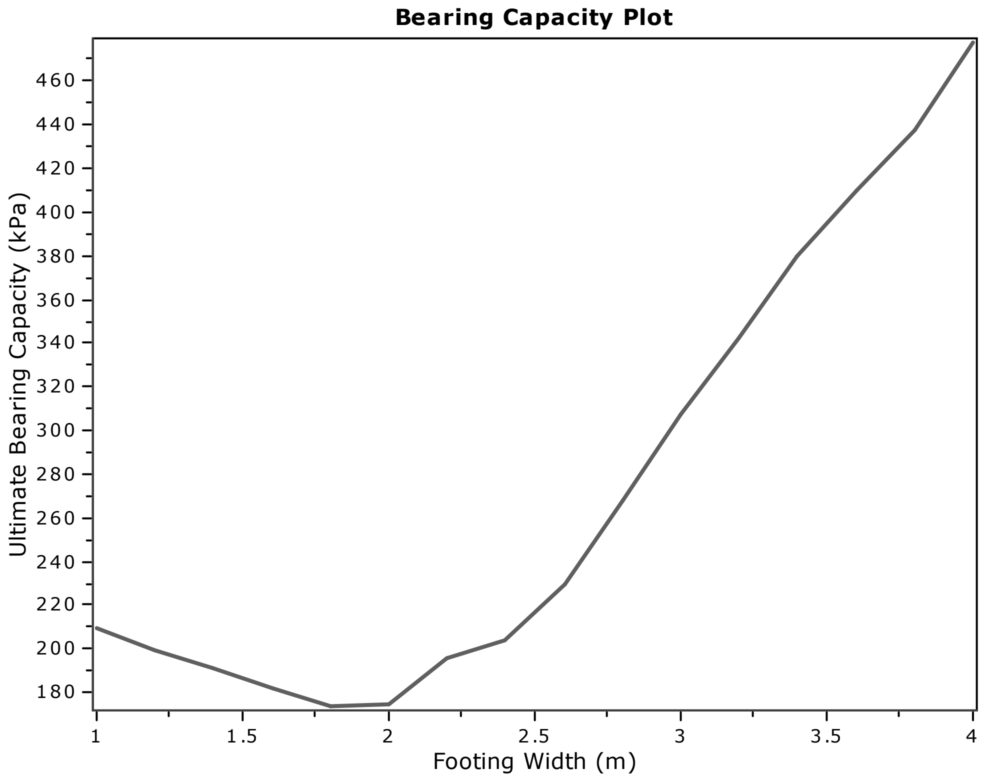
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

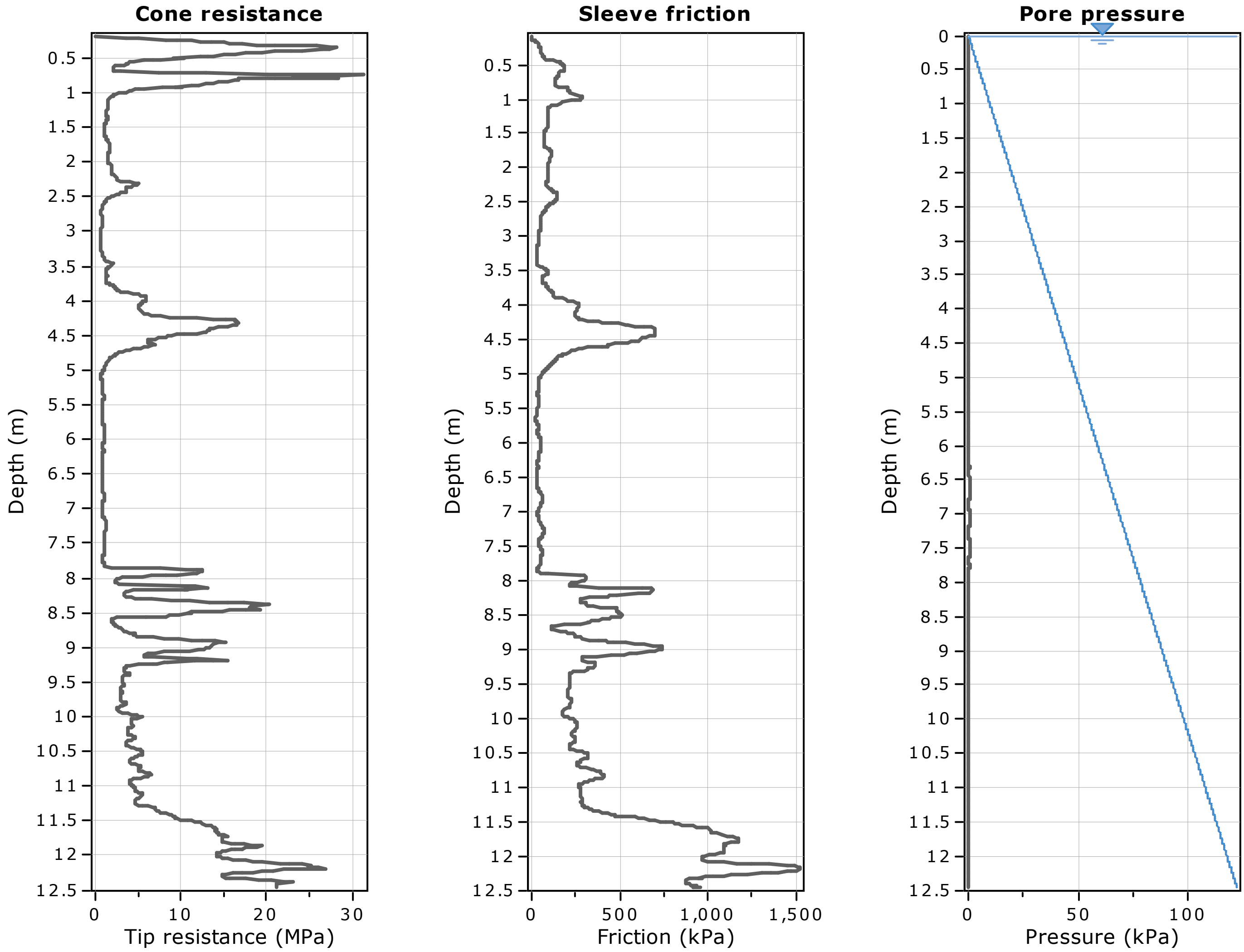
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

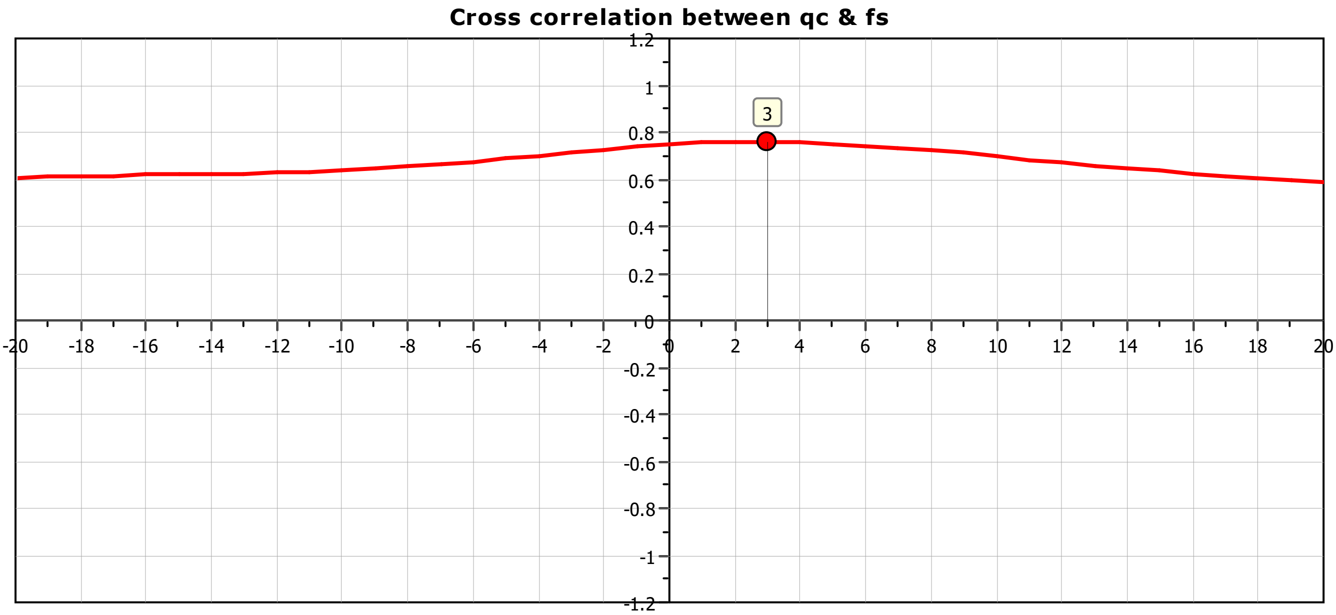


:: Tabular results ::

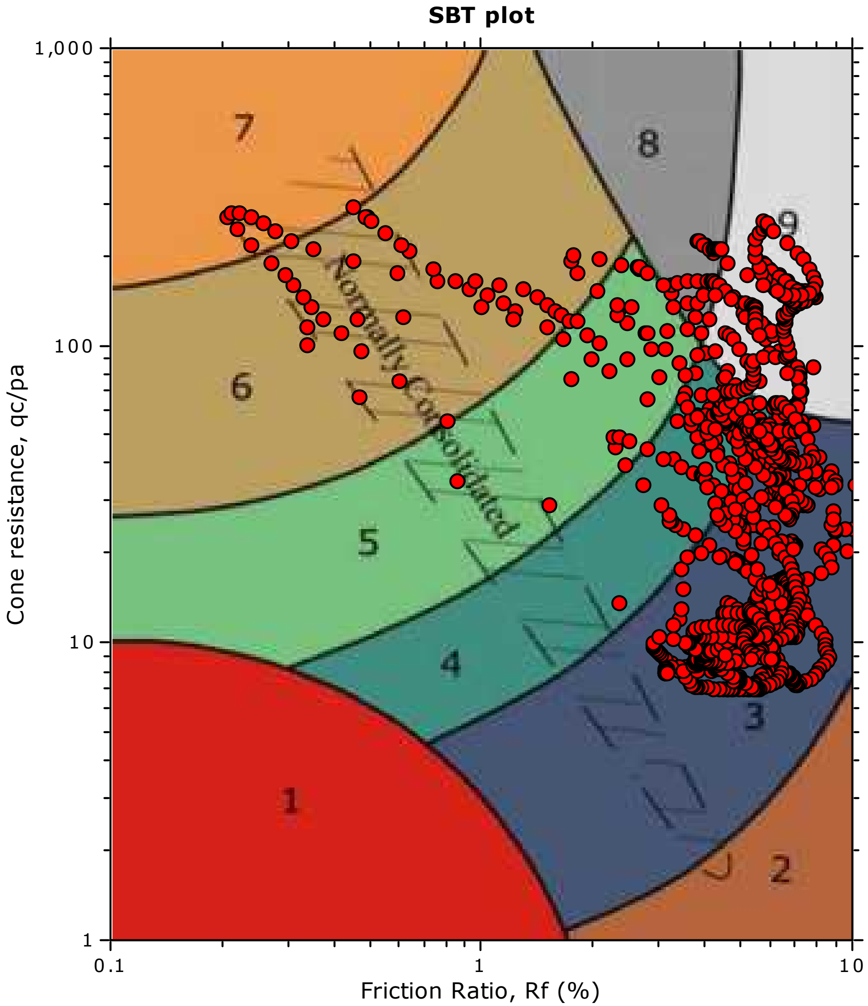
No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.00	0.20	9.50	208.90
2	1.20	0.50	2.30	0.95	0.20	9.50	198.93
3	1.40	0.50	2.60	0.91	0.20	9.50	190.58
4	1.60	0.50	2.90	0.86	0.20	9.50	181.55
5	1.80	0.50	3.20	0.82	0.20	9.50	173.58
6	2.00	0.50	3.50	0.82	0.20	9.50	174.32
7	2.20	0.50	3.80	0.93	0.20	9.50	195.88
8	2.40	0.50	4.10	0.97	0.20	9.50	204.00
9	2.60	0.50	4.40	1.10	0.20	9.50	229.07
10	2.80	0.50	4.70	1.29	0.20	9.50	267.64
11	3.00	0.50	5.00	1.49	0.20	9.50	307.12
12	3.20	0.50	5.30	1.66	0.20	9.50	342.31
13	3.40	0.50	5.60	1.85	0.20	9.50	379.59
14	3.60	0.50	5.90	2.00	0.20	9.50	410.17
15	3.80	0.50	6.20	2.14	0.20	9.50	437.31
16	4.00	0.50	6.50	2.34	0.20	9.50	477.74

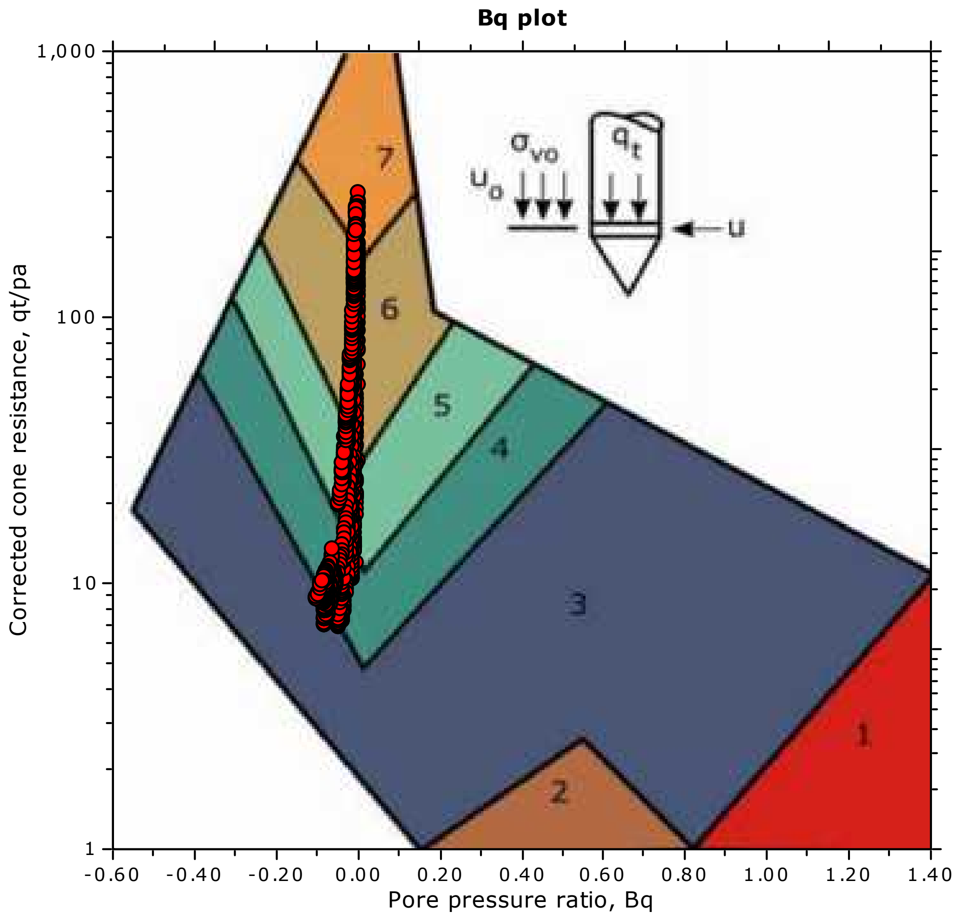


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

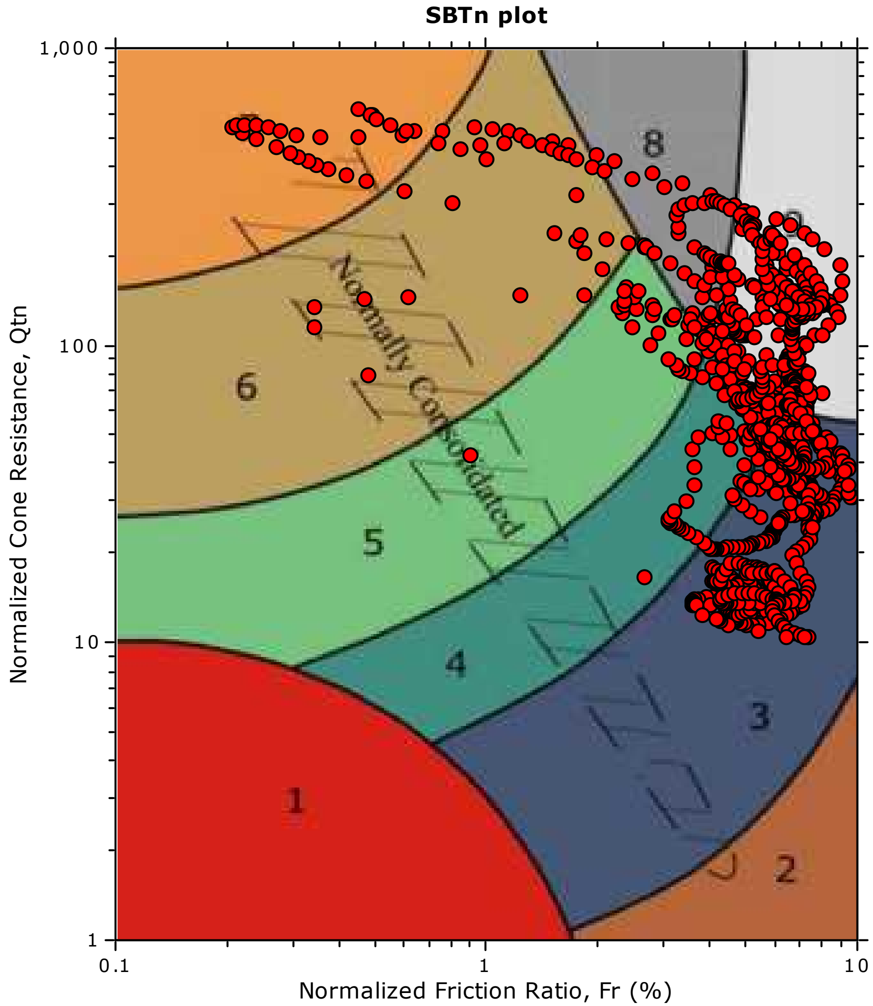


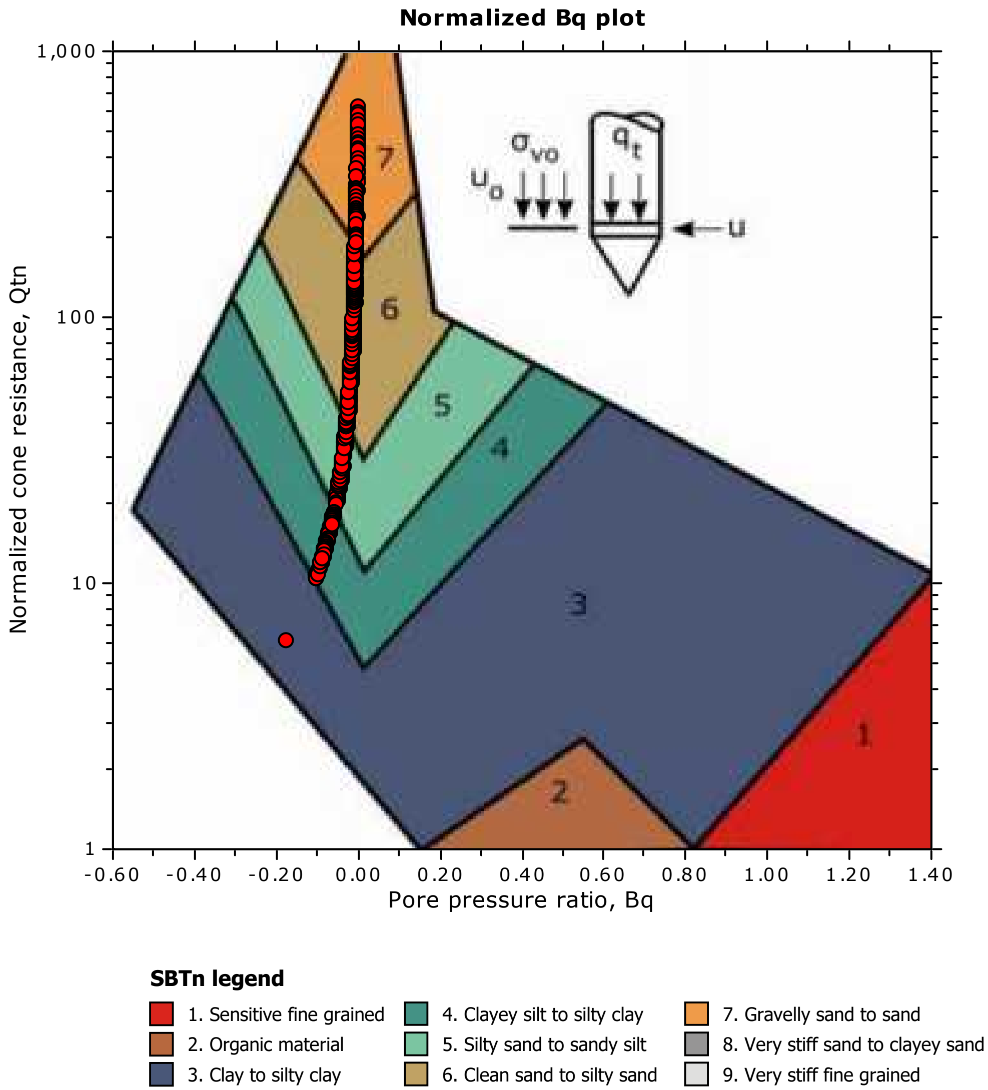


SBT legend

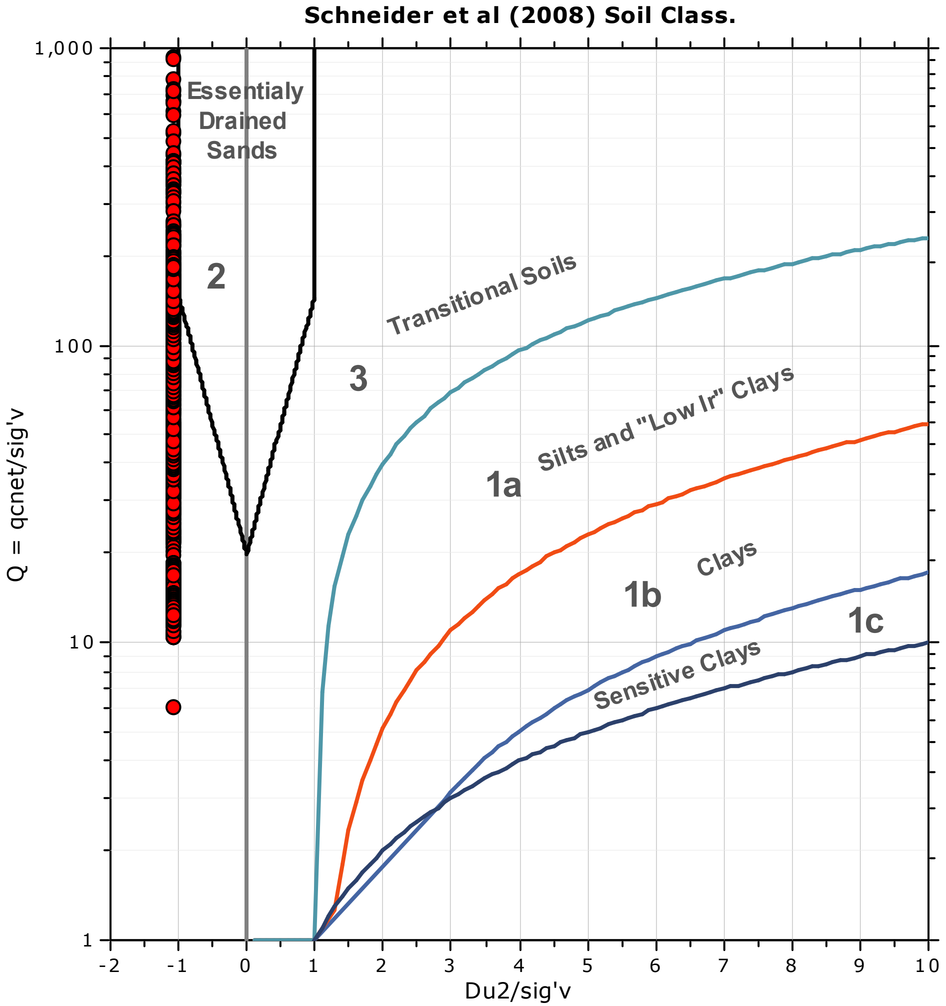
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

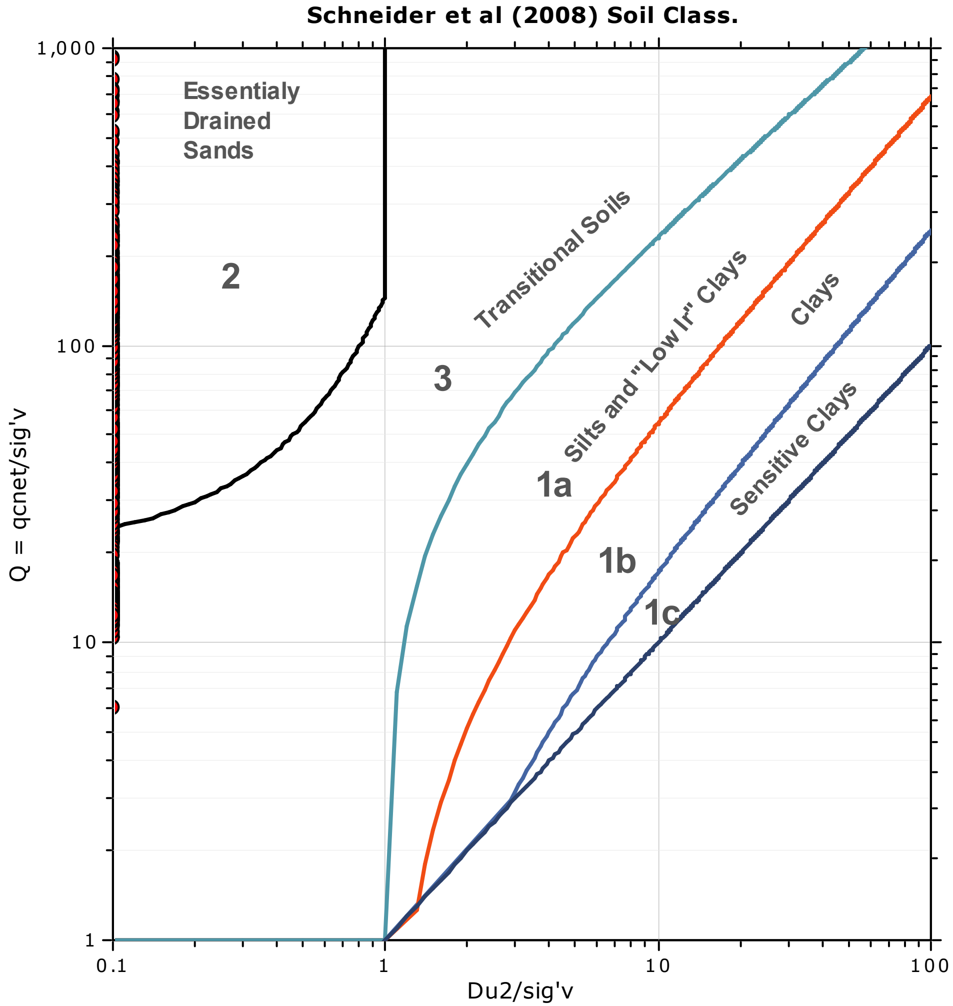
SBT - Bq plots (normalized)

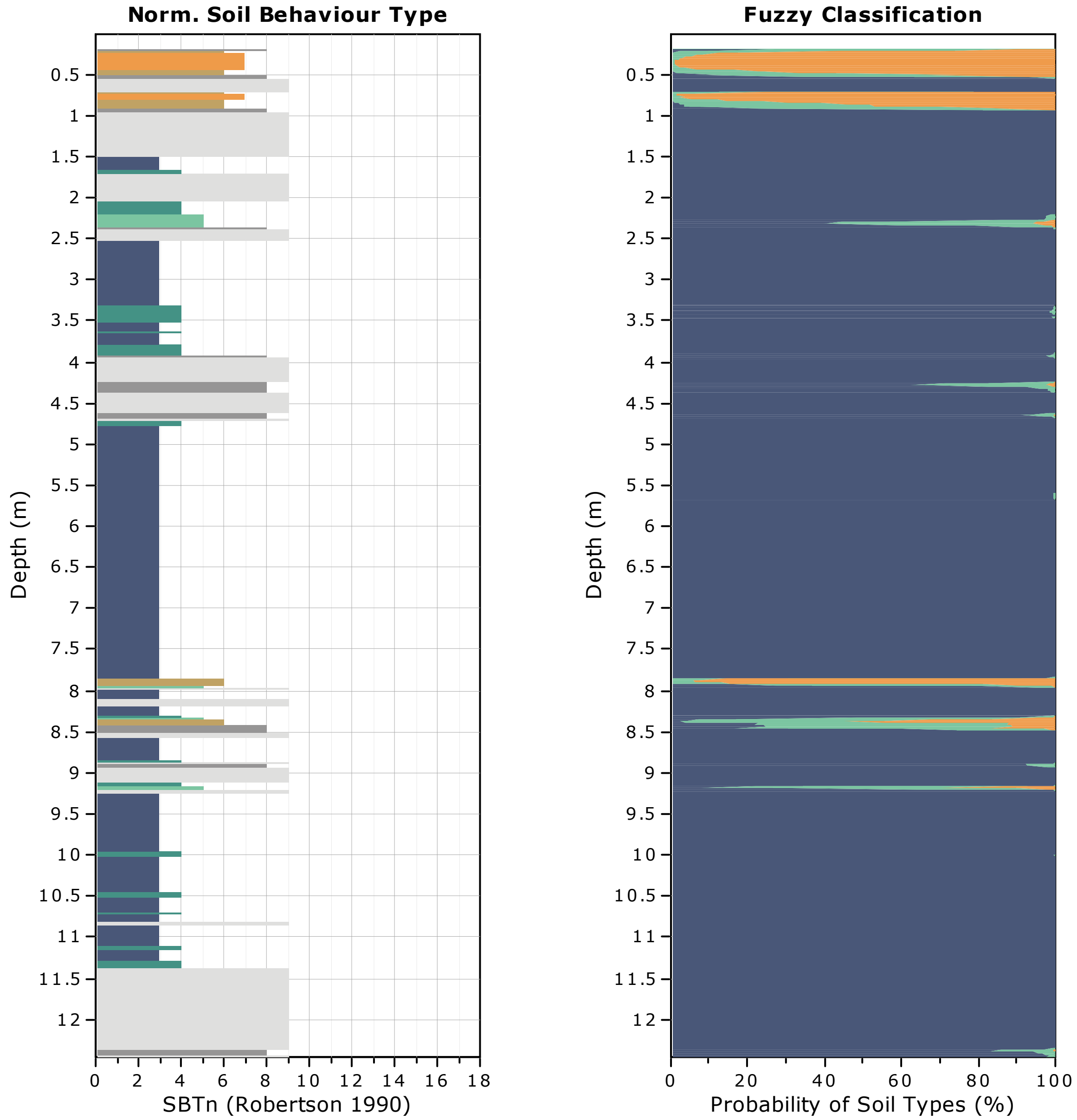




Bq plots (Schneider)






Norm. Soil Behaviour Type
Depth (m)
SBTn (Robertson 1990)
Fuzzy Classification
Depth (m)
Probability of Soil Types (%)

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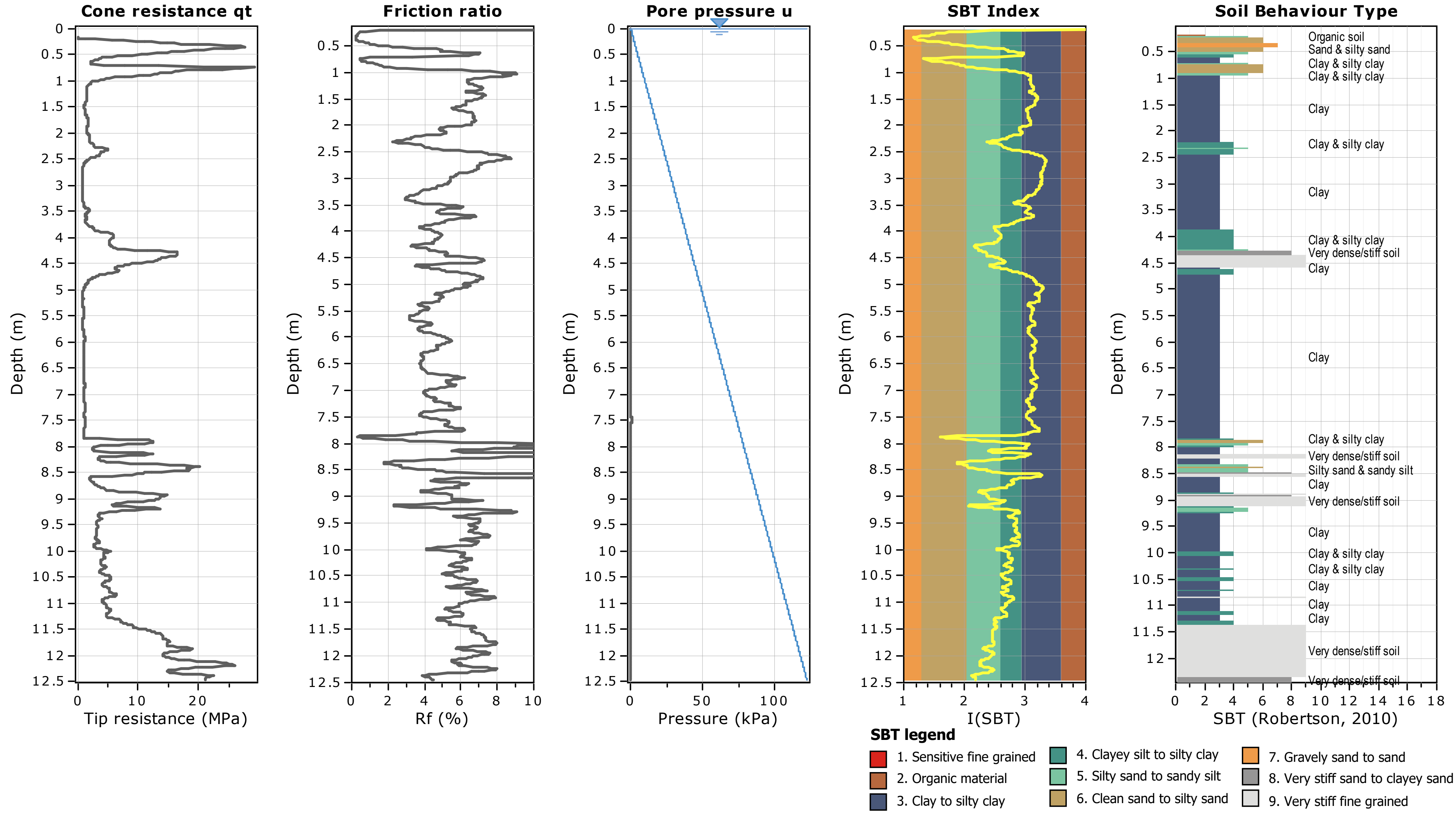
CPT: CPTA5-03
Total depth: 12.46 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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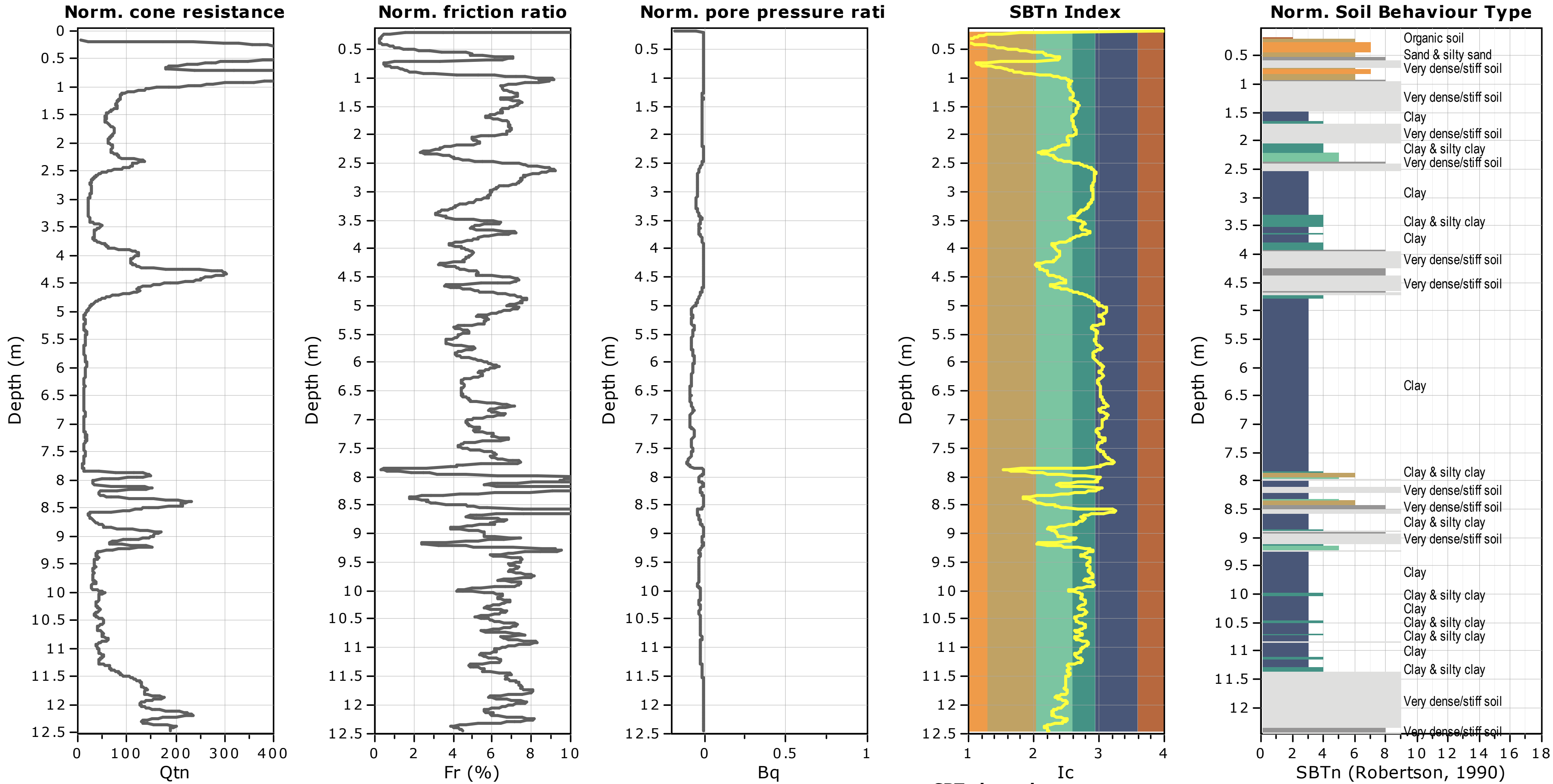
CPT: CPTA5-03
Total depth: 12.46 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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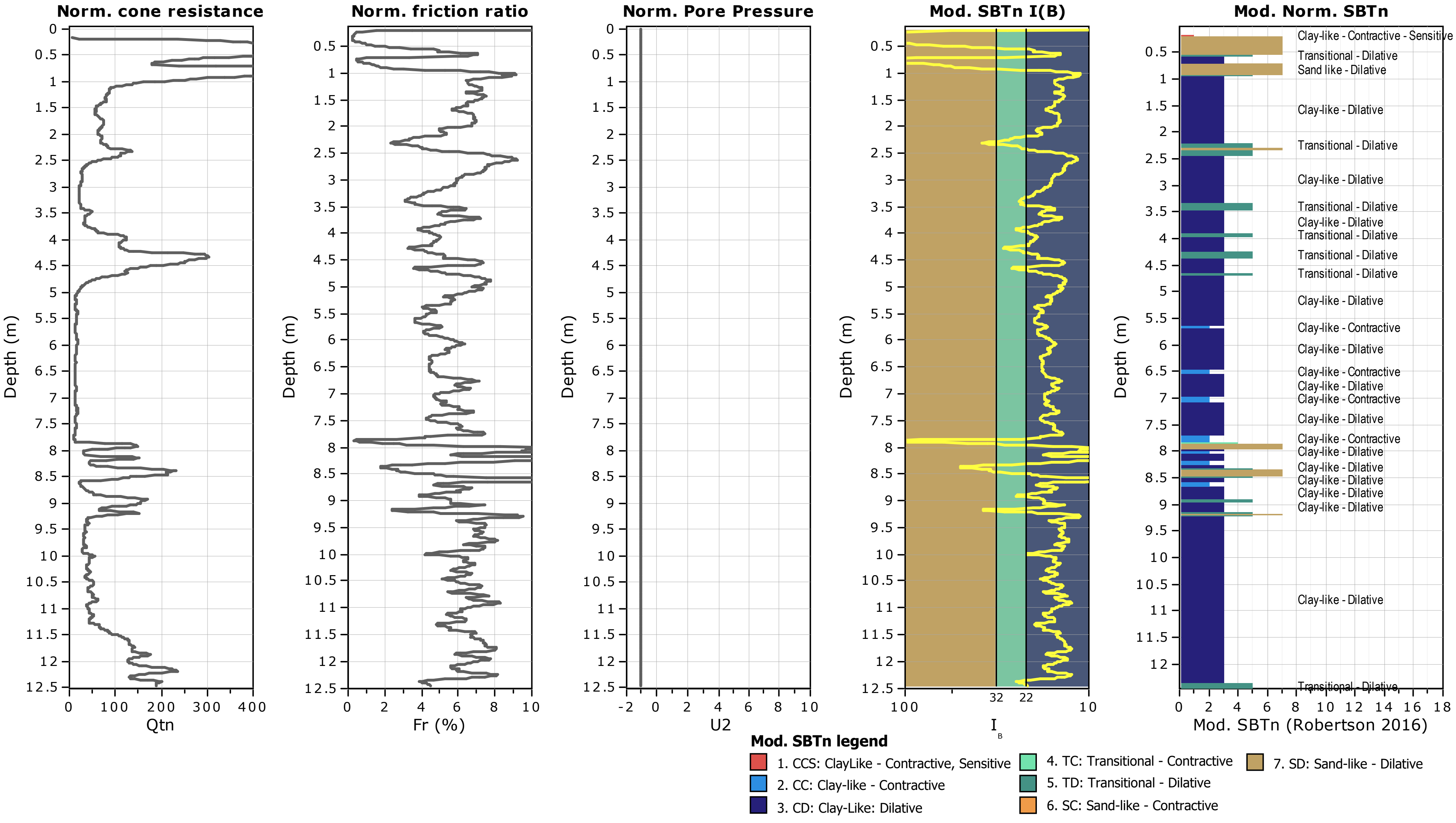
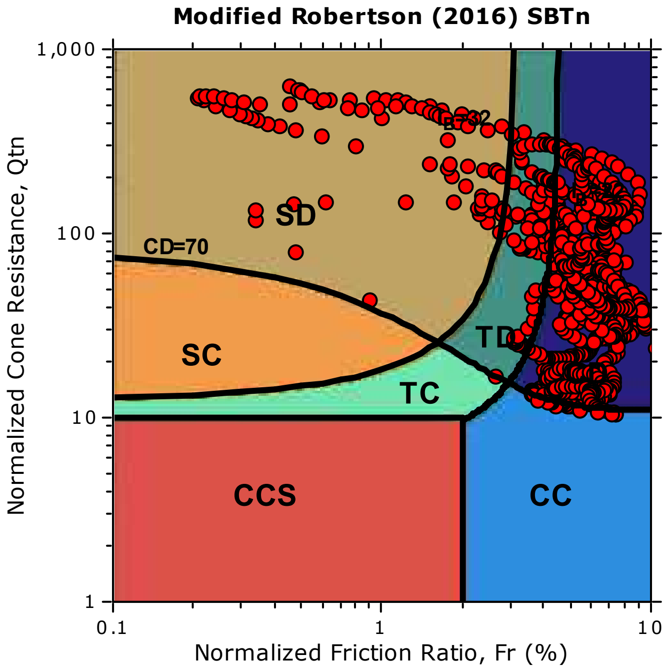
http://www.geologismiki.gr

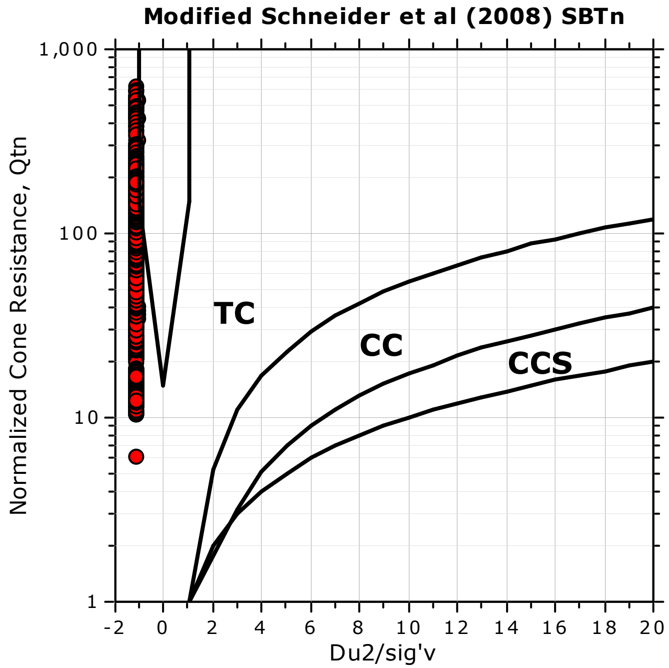
CPT: CPTA5-03
Total depth: 12.46 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

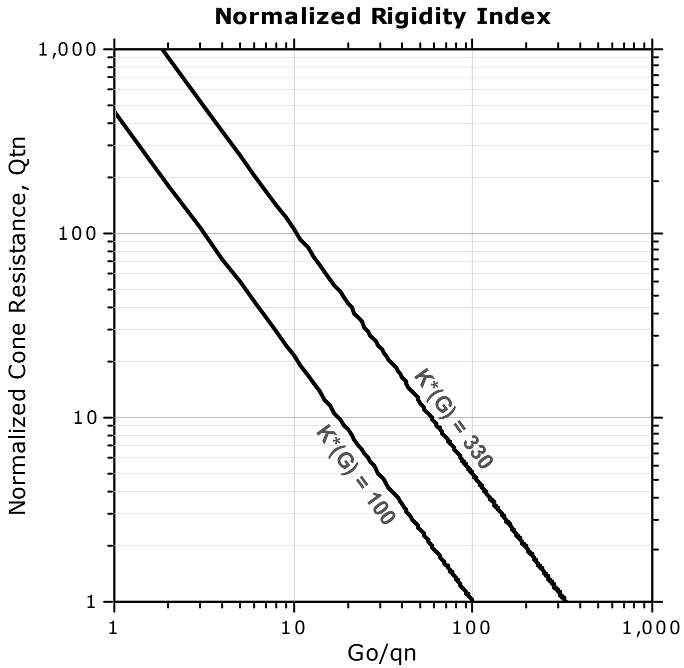
Project:
Location:



Updated SBTn plots







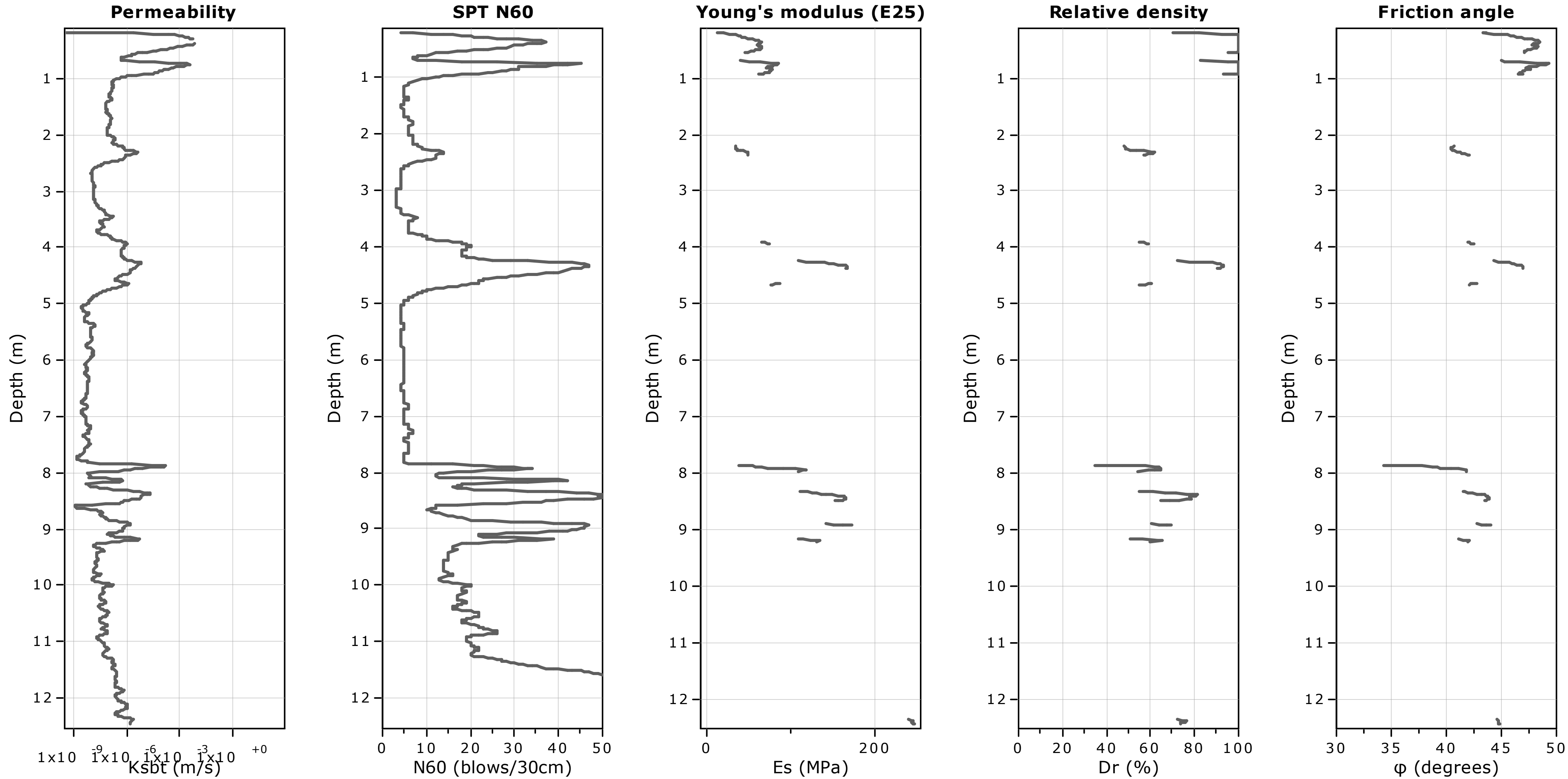
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: CPTA5-03
Total depth: 12.46 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

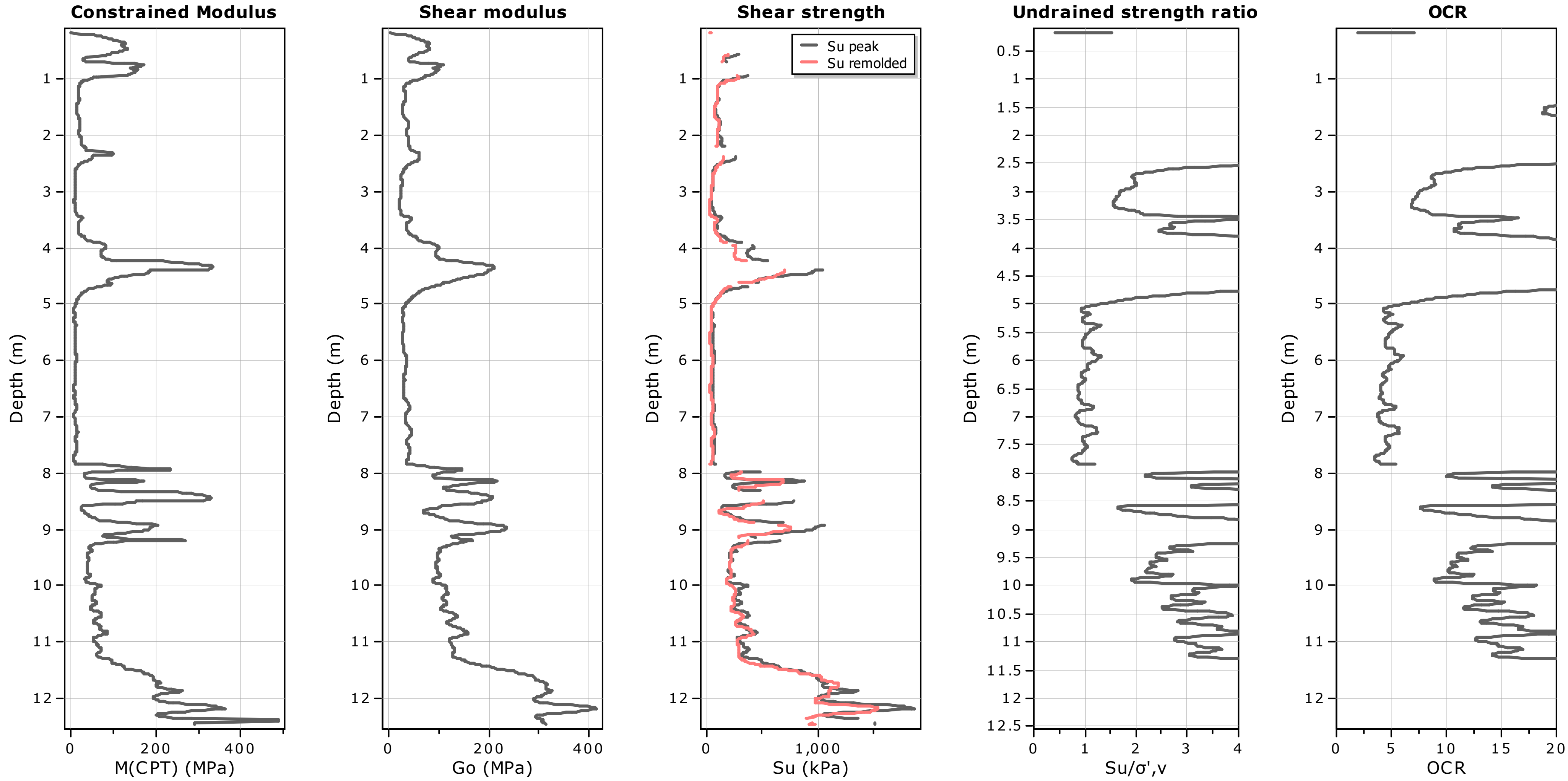


Calculation parameters
Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)
User defined estimation data

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: CPTA5-03
Total depth: 12.46 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



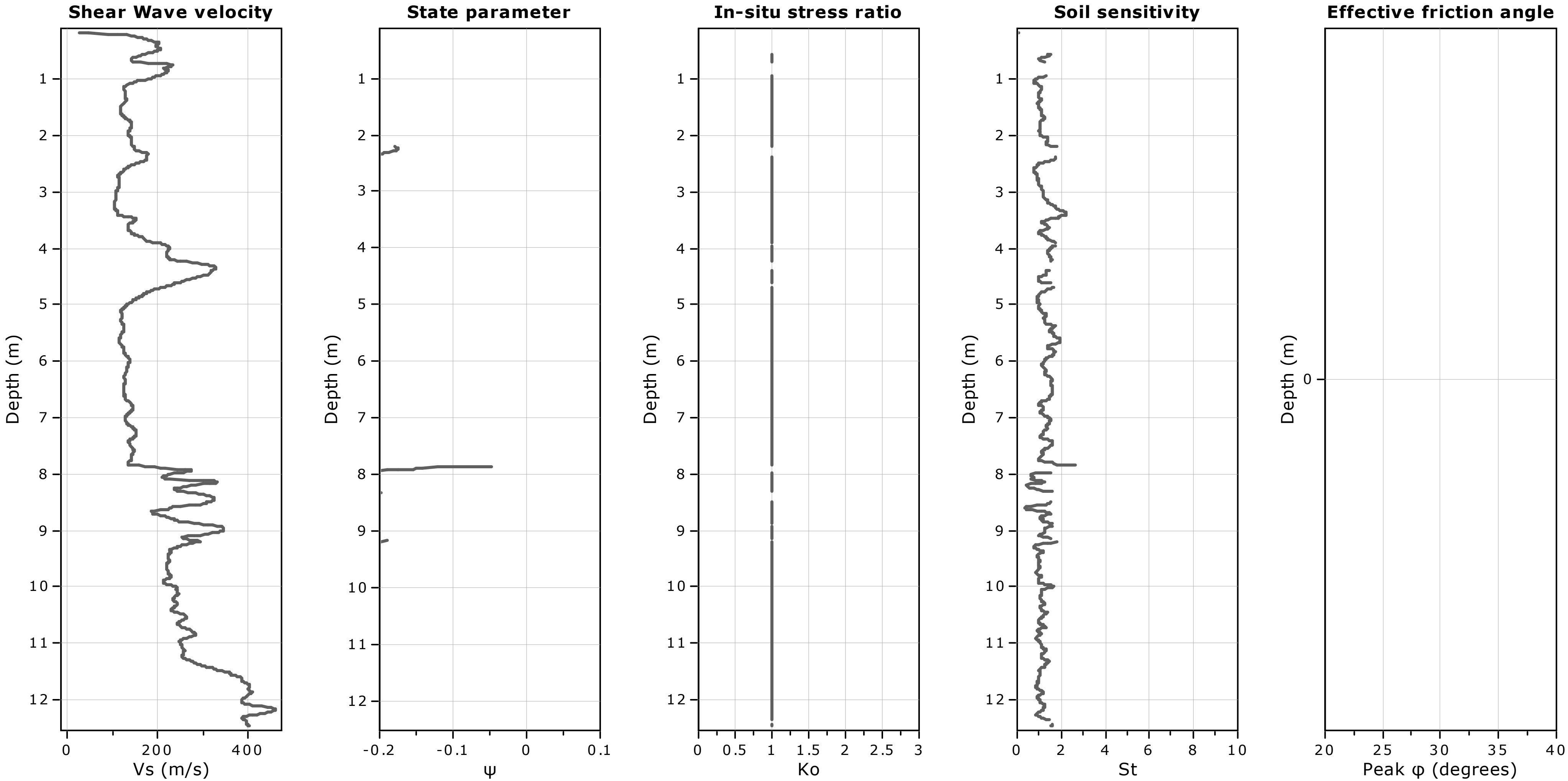
Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: CPTA5-03
Total depth: 12.46 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

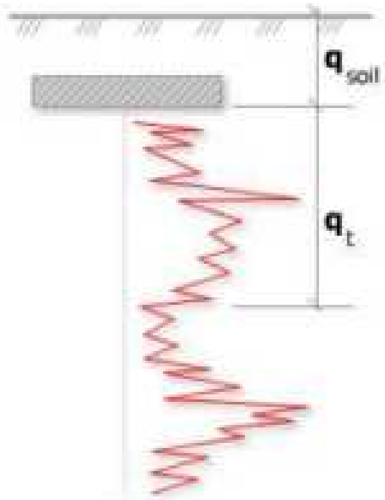
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

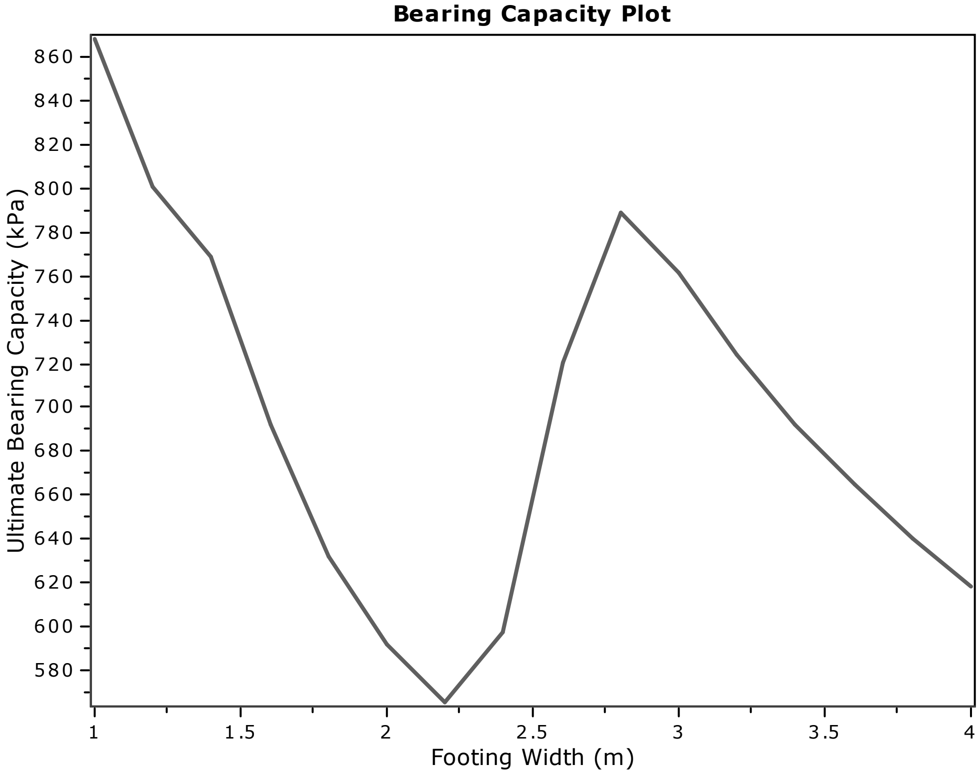
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	4.29	0.20	9.50	868.34
2	1.20	0.50	2.30	3.96	0.20	9.50	800.74
3	1.40	0.50	2.60	3.80	0.20	9.50	769.22
4	1.60	0.50	2.90	3.41	0.20	9.50	691.77
5	1.80	0.50	3.20	3.11	0.20	9.50	632.20
6	2.00	0.50	3.50	2.91	0.20	9.50	591.94
7	2.20	0.50	3.80	2.78	0.20	9.50	565.33
8	2.40	0.50	4.10	2.94	0.20	9.50	596.93
9	2.60	0.50	4.40	3.56	0.20	9.50	720.94
10	2.80	0.50	4.70	3.90	0.20	9.50	788.96
11	3.00	0.50	5.00	3.76	0.20	9.50	761.68
12	3.20	0.50	5.30	3.57	0.20	9.50	724.26
13	3.40	0.50	5.60	3.42	0.20	9.50	692.63
14	3.60	0.50	5.90	3.28	0.20	9.50	664.53
15	3.80	0.50	6.20	3.16	0.20	9.50	640.58
16	4.00	0.50	6.50	3.04	0.20	9.50	617.87

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

:: N_{SPT} (blows per 30 cm) ::

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

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

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

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

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

:: Relative Density, Dr (%) ::

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

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

:: State Parameter, ψ ::

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

:: Drained Friction Angle, φ (°) ::

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

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

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

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

If $I_c \geq 2.20$

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

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

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

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

:: Soil Sensitivity, S_t ::

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

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

:: Peak Friction Angle, φ' (°) ::

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

(applicable for $0.10 < B_q < 1.00$)

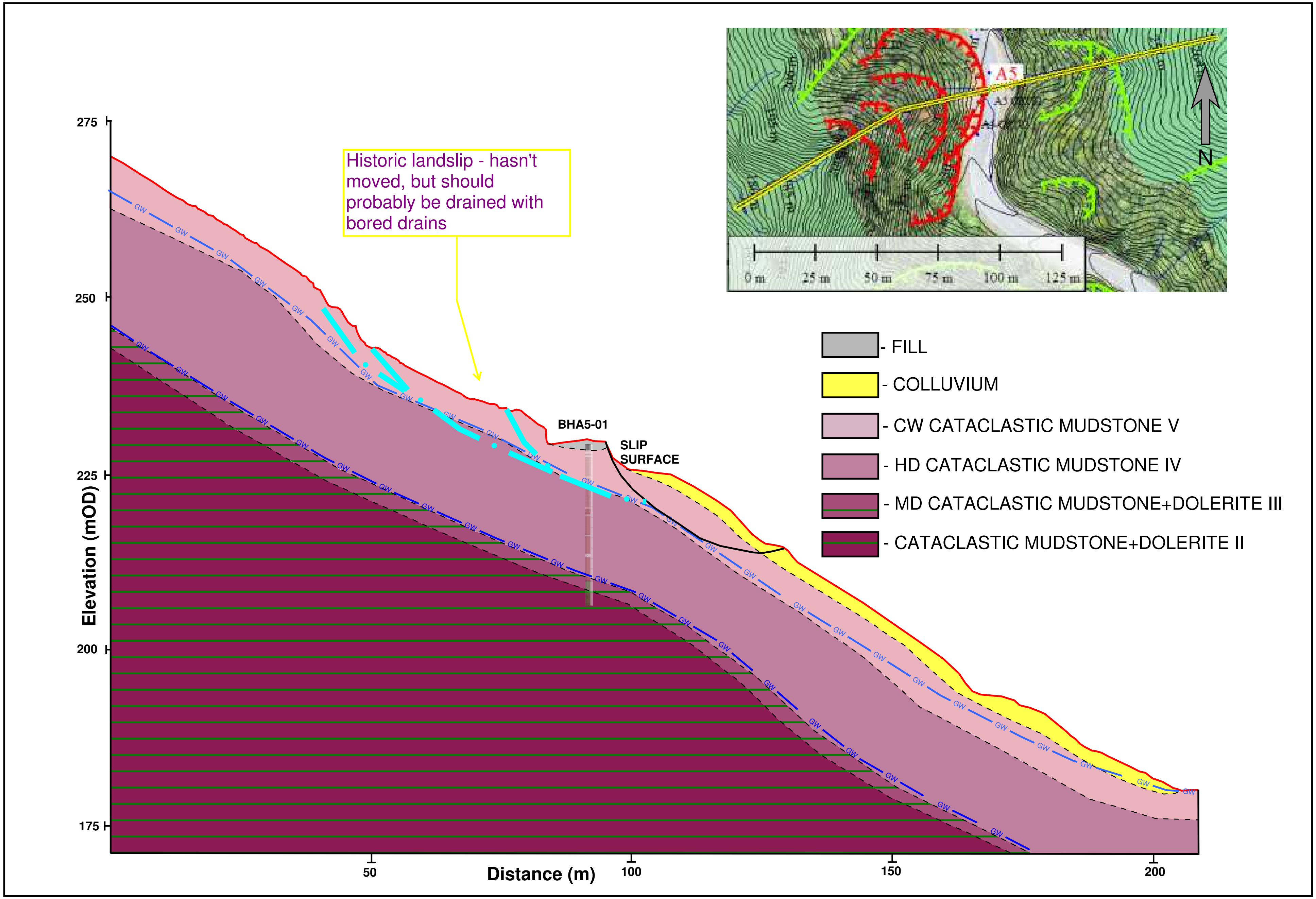
References

• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

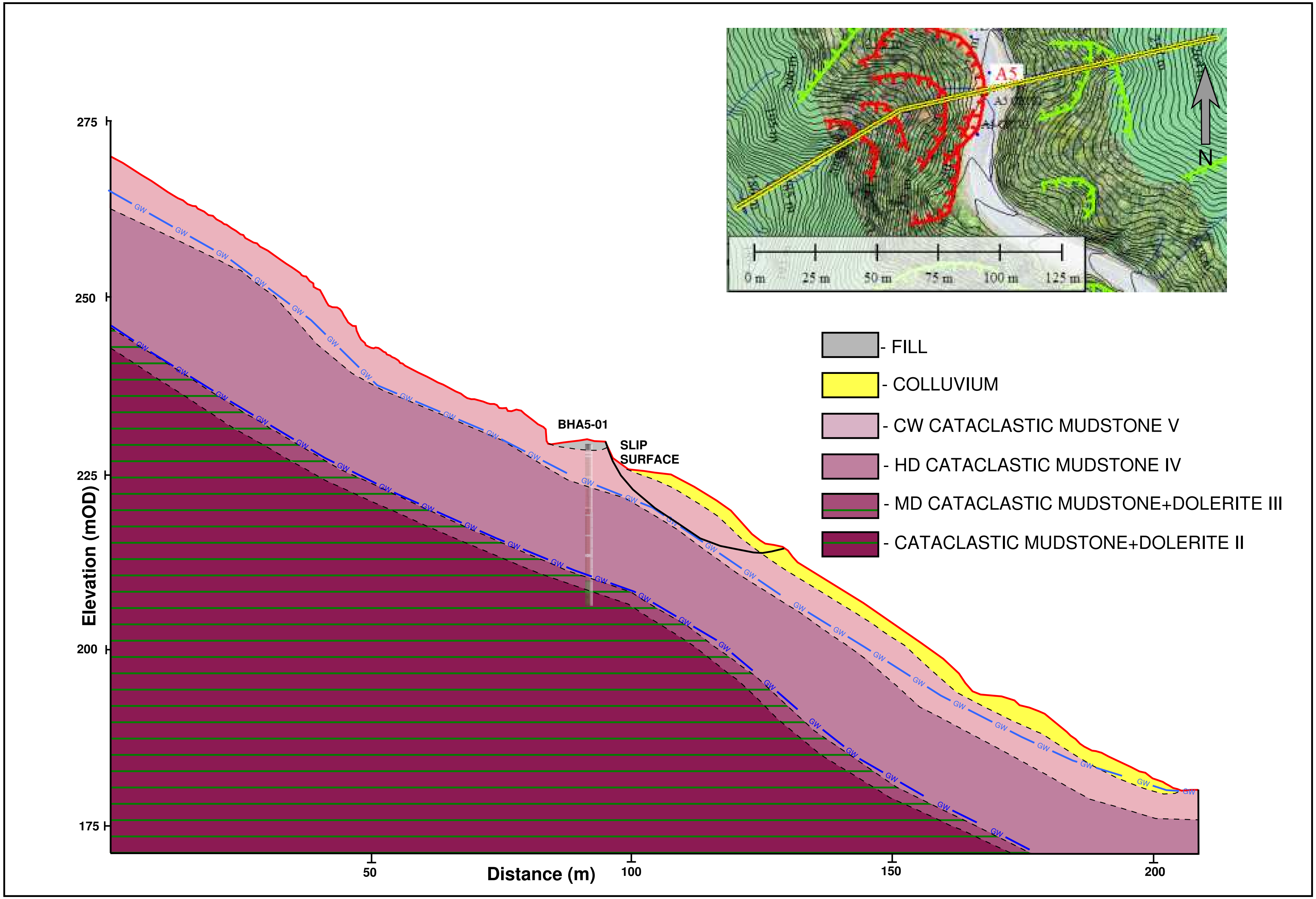
• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

Appendix B

Conceptual Geological Cross Section



wsp Level 3, The Westhaven 100 Beaumont Street Auckland 1010 New Zealand	Project: NZTA Northland Resilience and Emergency Works- Mangamuka SH1	Job number: 1-11240.00
	Description: 22A5- Conceptual Geological Cross Section	Revision: 001
	Drawn by: ML	Checked by:	Date: 05/12/2022



wsp Level 3, The Westhaven 100 Beaumont Street Auckland 1010 New Zealand	Project: NZTA Northland Resilience and Emergency Works- Mangamuka SH1		Job number: 1-11240.00
	Description: 22A5- Conceptual Geological Cross Section		Revision: 001
	Drawn by: ML	Checked by:	Date: 05/12/2022

Appendix C

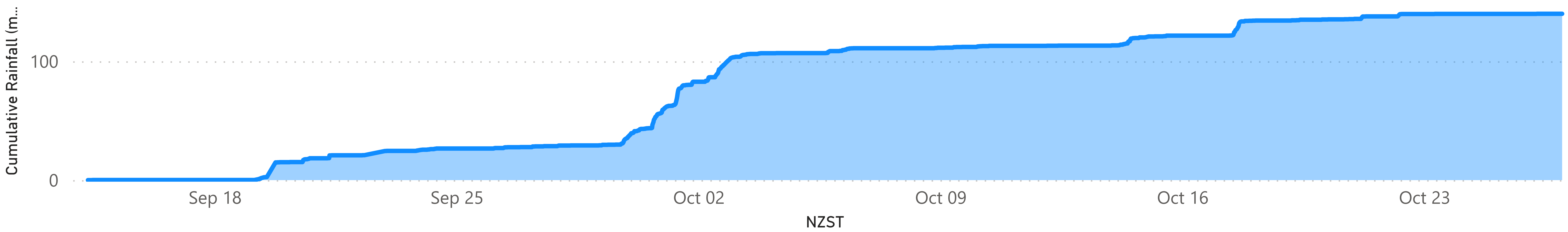
Tilt Sensor and Rainfall Data

Mangamuka Gorge

NZST

9/14/2022 10/26/2022

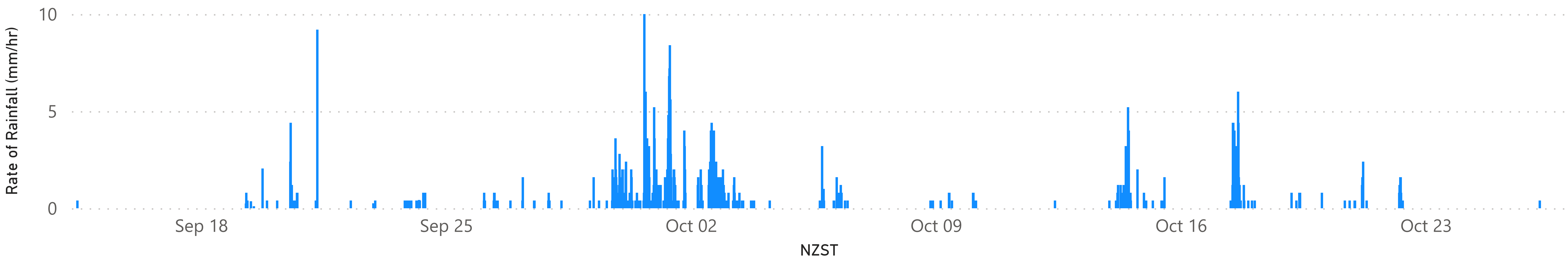
Cumulative Rainfall (mm) since 14/09/2022 by NZST



140.00

Cumulative Rainfall (mm) during sliced period

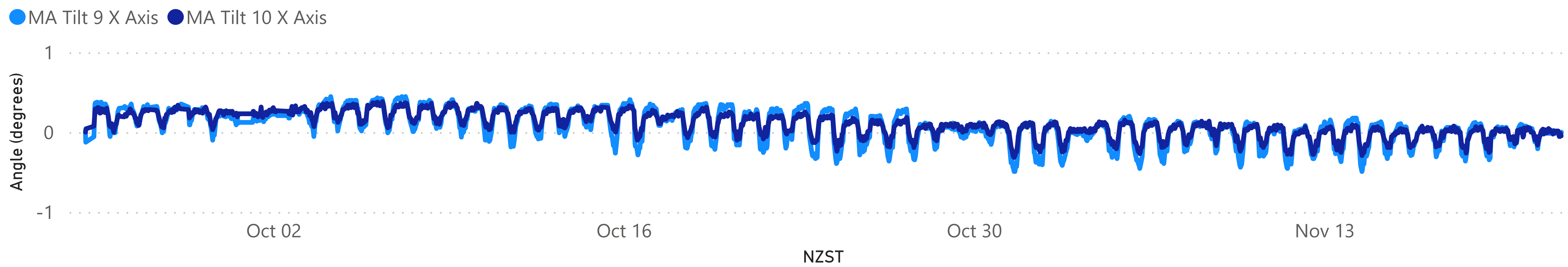
Rate of Rainfall (mm/hr) by NZST



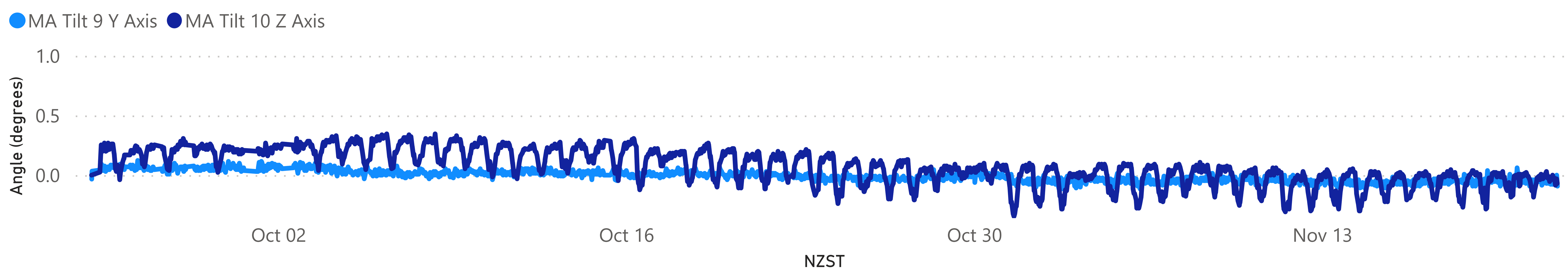
Mangamuka Gorge - Site A5 (T9 - T10)

9/17/2022 | 11/22/2022

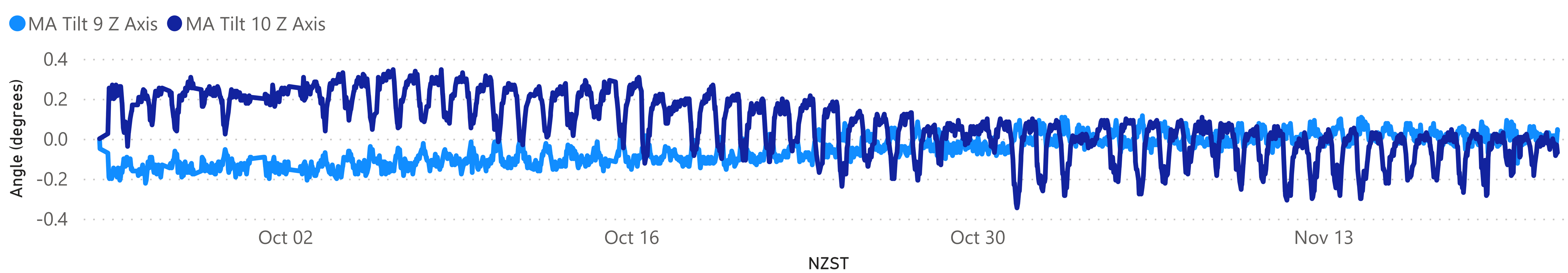
MA Tilt 9 X Axis and MA Tilt 10 X Axis by NZST



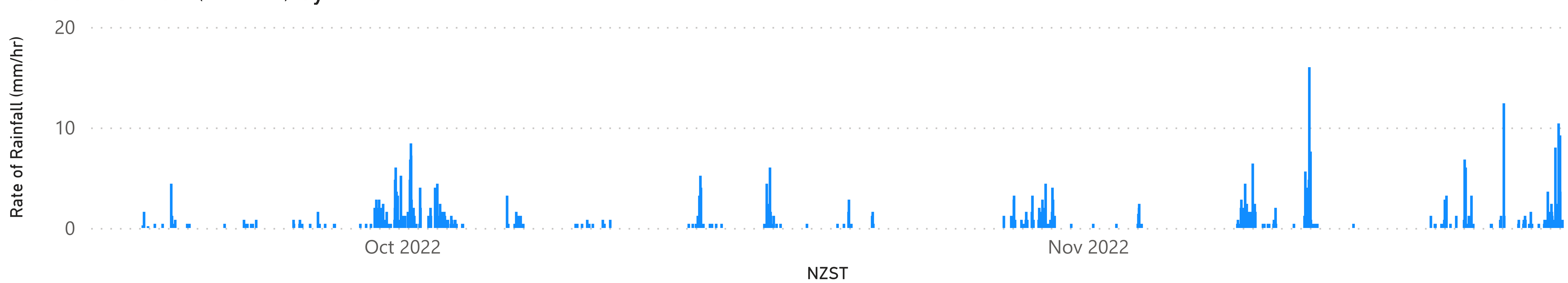
MA Tilt 9 Y Axis and MA Tilt 10 Z Axis by NZST



MA Tilt 9 Z Axis and MA Tilt 10 Z Axis by NZST

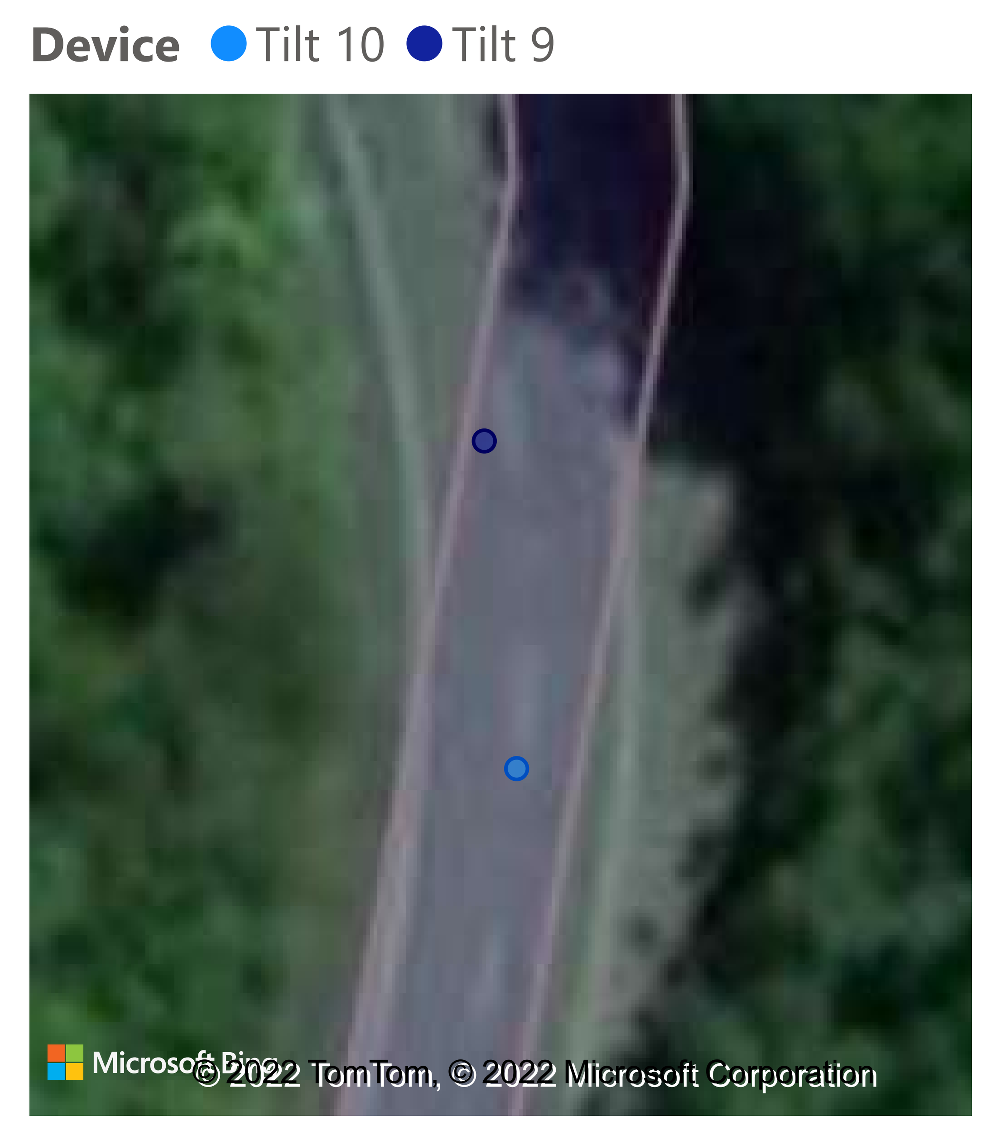


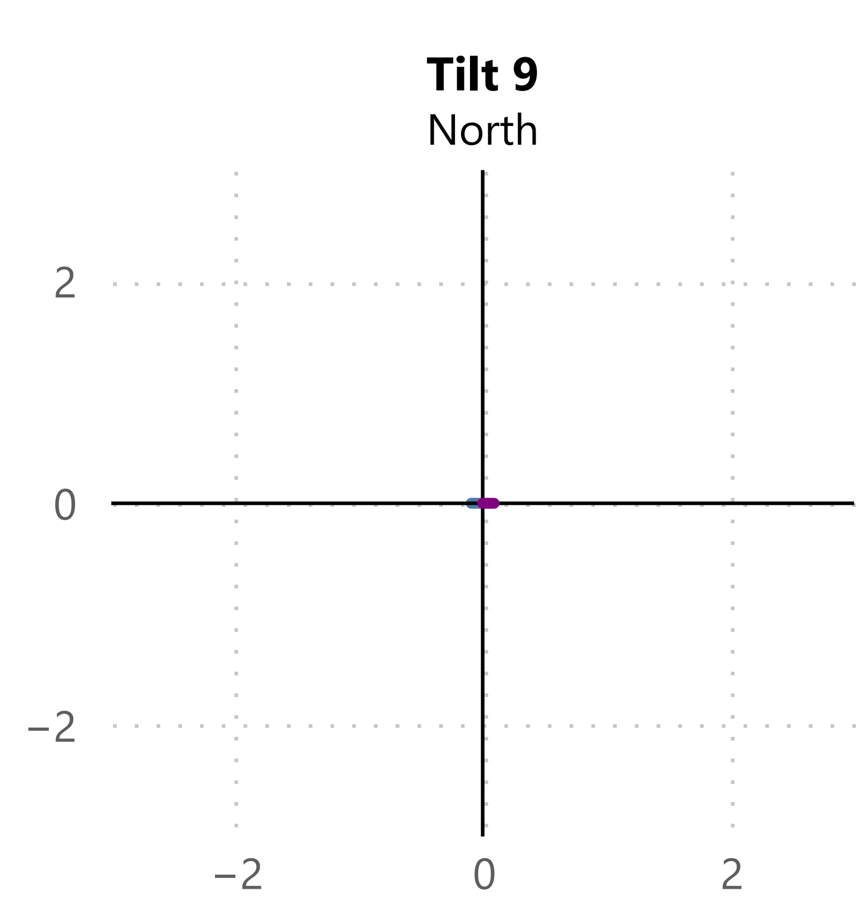
Rate of Rainfall (mm/hr) by NZST

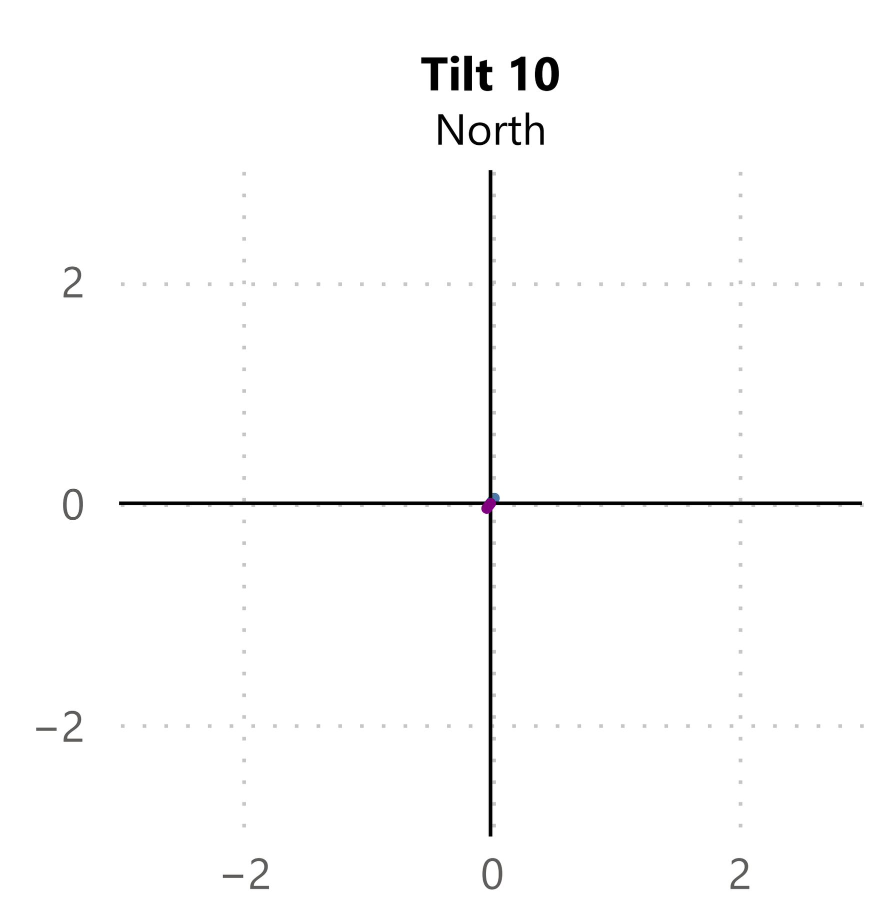


TARP

Site	Level
A05	







LEGEND

Actual Tilt Direction

Estimated Land Direction

wsp.com/nz

Project Number: 1-11240.00

NZTA Northland Resilience and Emergency Works- August 2022- 10081/22A4

28 November 2022

CONFIDENTIAL

Interpretive Geotechnical Investigation Report

WSP

150 YEARS IN AOTEAROA

Contact Details

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Reviewed by
Shaun Grieve

Approved for release by
Shaun Grieve

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Revision Details

Revision	Details

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for New Zealand Transport Agency ('**Client**') in relation to Mangamuka Gorge Slips Emergency Works ('**Purpose**'). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

1 Introduction

Two storm events in July and August have caused widespread flooding and associated landsliding across much of Northland. Following the August rain event WSP were engaged by Waka Kotahi to form part of the emergency response and undertake an urgent geotechnical investigation along a section of State Highway (SH) 1 through Mangamuka Gorge. A total of 12 underslips have been identified requiring significant geotechnical analysis and associated permanent remedial measures.

This report covers the investigation and assessment at site 10081/22A4 (henceforth referred to as A4) and provides a recommended solution. The site A4 is located at SH01N RS119 PR13.507, 2.5km southeast of the northern extent of Mangamuka Gorge, approximately 21.5 km southeast Kaitaia.

Slumping of the northbound lane has occurred with minor deformation and cracking extending into the southbound lane and along the centreline. The landslide is an underslip likely caused by a material saturation resulting from the recent storm events and long-term undercutting by Victoria River near the base of the slope reducing the global stability of the hillside. The cracking was first observed in July (refer to July 2022 Storm Event Initial Advice – Memo no.1)

The site location is shown below in Figure 1-1 together with the other slip sites.

Figure 1-1: 10081/22A4 *Site location Plan.*

2 Regional Geology

The 1:250 000 scale QMAP seamless digital data (GNS, 2013) indicates the site area to be underlain by the Undifferentiated Tangihua Complex in Northland Allochthon comprising basalt pillow lava, with subvolcanic intrusives of basalt, dolerite and gabbro; locally incorporating siliceous mudstone. Late Pleistocene to Holocene estuary, river and swamp deposits are indicated to be present downslope associated with Victoria River] (Figure 2-1).

The Tangihua Complex has been emplaced onto New Zealand through convergent plate tectonics and sea floor sliding. As a result, the material has been historically sheared with the rock underlying the site expected to be highly fractured and degraded through original emplacement processes and further modified by weathering.

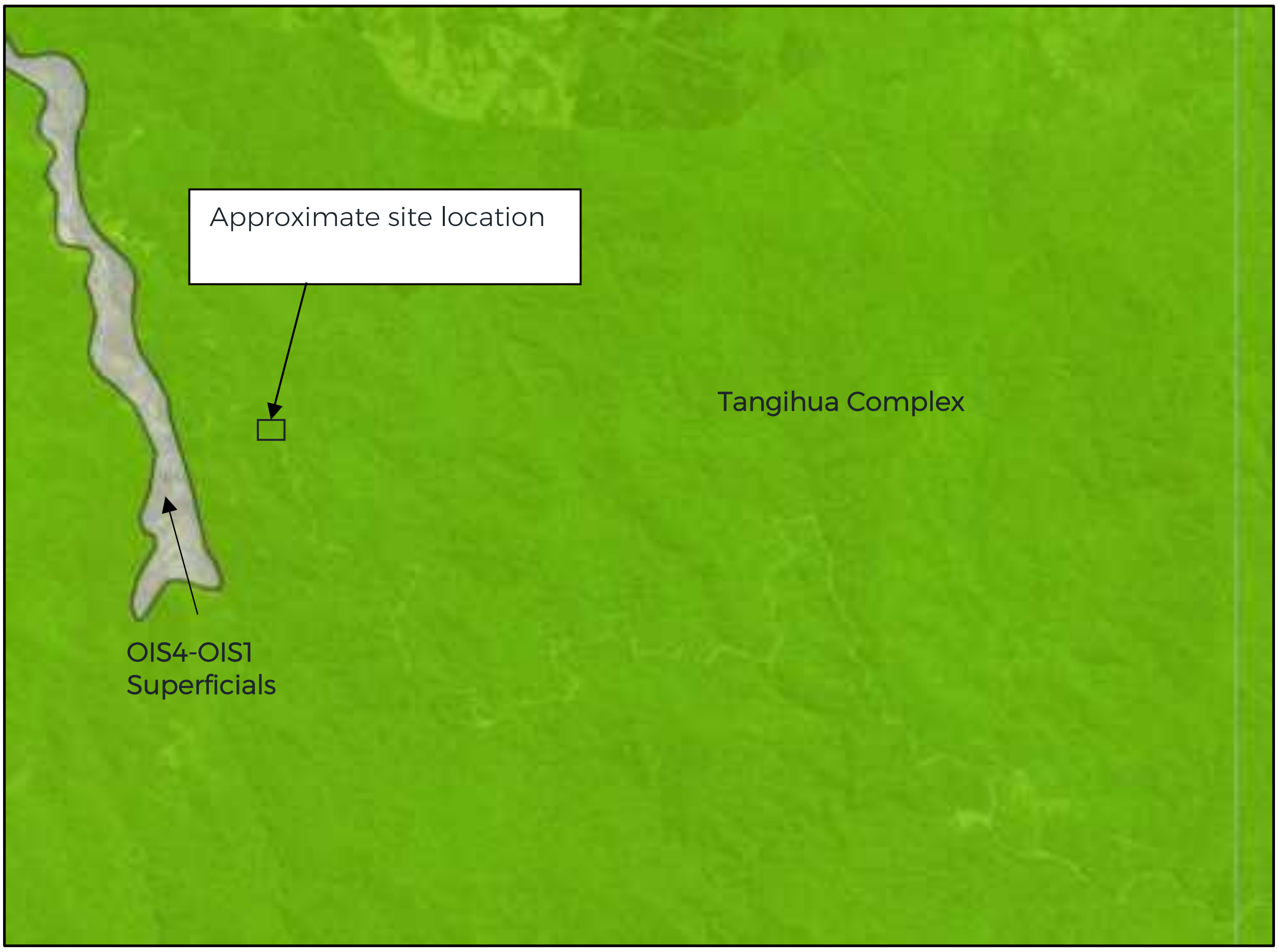

Figure 2-1: Regional geology

3 Site Investigation

Between 6th and 13th September 2022, a geotechnical investigation was undertaken to identify sub-surface ground conditions and to help inform the options for remedial measures required at site A4 The works comprised the following:

A single rotary cored borehole (BH) was completed to a depth of 25.0mbgl, with standard penetration tests (SPTs) at 1.5m intervals.

- Installation of BH inclinometer upon completion of BH01.
- Three Cone penetration tests (CPTs) taken to a maximum depth of 19.62mbgl.

- The intrusive drilling works was undertaken by Drillforce Limited including the boreholes, CPT's as well as the installation of inclinometer tubing for monitoring ground movement and piezometers for groundwater, all under the supervision of WSP site staff.
- Wash bore piezometer to be installed at a later date.
- The intrusive drilling works was undertaken by Geocivil Limited with all of the boreholes logged in accordance with the NZGS *Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes*, December 2005 and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1. Borehole and CPT locations displayed on Figure 3-1 below with logs displayed in Appendix A.
- Tiltmeters were installed on the ground surface by WSP Research staff to obtain Realtime monitoring of surface movements.
- Monitoring of the inclinometer to date has been undertaken by GeoCivil Ltd under direction of WSP staff.

Figure 3-1: Exploratory hole location plan

3.1 Observations

During the site investigation, the slip was inspected on 7th September by WSP. The inspection identified the following:

- The visible headscarp is 75m in length with the height of slip estimated to be 30m. The grade of slope is approximately 1v:2.5h. The damaged section of road is general level grade of 1v:15h sloping down from southeast to northwest.

- Most of the movement to date has occurred at the northern end of the site, where the northbound lane has slumped by 400mm with some minor depression within the southbound lane. The southern extent of the headscarp is assumed to cross the road 70m east of the main area of settlement. At the time of inspection only tension cracking is visible through this area.
- There has been up to 100mm of horizontal movement downslope to date.
- Additional tension cracking has started to form at the centreline following the axis of the road alignment.
- This section road has been patched previously.
- No surface seepage during the site investigation.
- Without treating, the slip is likely to continue to slump, with an imminent risk of complete evacuation of the northbound lane.

4 Geomorphological Mapping

A terrain evaluation is presented below in Figure 4-1. Geomorphological mapping undertaken from both Lidar and aerial photography as well as site observations. The wider site area is comprised of steep slopes of approximately 20° – 30° and includes historic slip features manifesting as large gullies extending from the slope above to the stream below.

It's expected that the material underlying the site and surrounding area to consist of colluvial soils resulting from recent and historical movement. The main headscarp in inferred to extend 5m into the upslope, with two small gullies present at either end of the site providing a drainage pathway to Victoria River 400mm downslope. Historical failure surfaces are also indicated to be present both up and down slope.

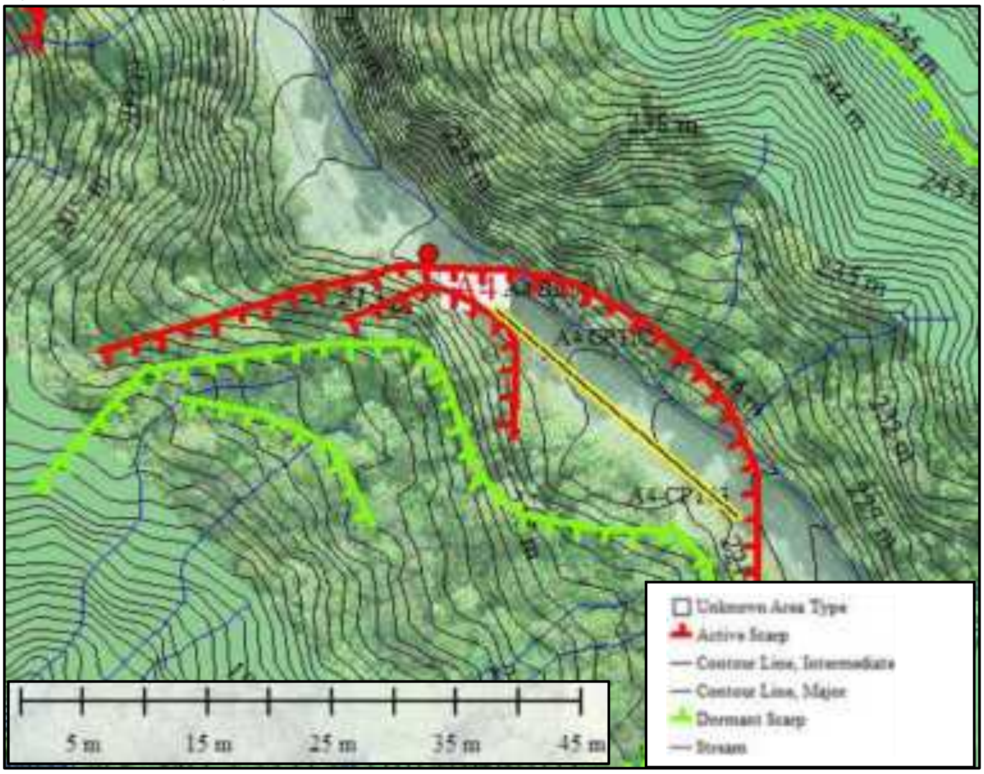

Figure 4-1: Geomorphological map

5 Ground Model

Table 5-1 below summarises the ground model for site A4. A conceptual geological cross section is presented within Appendix B.

Table 5-1: A4 Ground Model

Lithology	Top (m bgl)	Base (m bgl)	Total thickness (m)	SPT N Value	GSI
FILL	0.00	1.00-1.10*	1.00-1.10*	4*-65*	-
COLLUVIUM	1.00-1.10*	3.10*-5.60	2.10*-4.60	2-28*	-
Completed Weathered Tangihua Complex DOLERITE	3.10*-5.60	6.20*-8.75	2.70*-3.15	3-13	-
Highly Weathered Tangihua Complex DOLERITE	6.20*-8.75	19.65**	10.90	7*-50+	10-20
Moderately Weathered Tangihua Complex DOLERITE	19.65	23	3.35	50+	40-50
Slightly Weathered Tangihua Complex DOLERITE	23	-	Not Proven	50+	60-70

* Inferred from CPT results. CPTs

** Where proven

Fill was encountered from surface within BH01 and inferred to be present within all CPTs. The material is described as sandy GRAVEL of basalt, dolerite, and greywacke with minor fines, loose to very dense.

Colluvium was encountered at 1.00mBGL within BH01 and inferred to be present within all CPTs. The material is predominantly described as silty CLAY with trace organics and subangular to subrounded gravels of basalt, mudstone. A boulder of intact rock is inferred to be present between 1.70m and 1.80m depth within CPT01. Colluvium thickness varies from 2.10m (CPT03) to 4.60m (BH01)

Completely weathered Tangihua Complex material was encountered at 4.60mBGL within BH01 and inferred to be present within all CPTs, described as silty CLAY, firm with some sand, trace gravel of basalt and parent rock structure,. Material thickness varies from 270m (CPT02) to 3.15m (BH01).

CPT boundaries between the Colluvium and Completely weathered bedrock are difficult to infer given the similarities in material properties. It's reasonable to expect the thicknesses of these materials to vary across the site.

Highly weathered Tangihua Complex material was encountered at 8.75mBGL within BH01 and inferred to be present within all CPTs, described predominantly as silty SAND with some gravel, zeolite, iron alteration and occasional layers of intact rock. Material thickness where proven is 10.90m (BH01). It is assumed that CPT01 & CPT02 refused within this unit with CPT03 possibly refusing on the underlying moderately weathered material surface.

Moderately weathered Tangihua Complex material was encountered at 19.65mBGL within BH01, described as light brown mottled black and white DOLERITE, moderately strong, relict shearing with zeolite, polished surfaces, iron staining. Material thickness is 3.35m (BH01).

Slightly weathered Tangihua Complex DOLERITE was encountered from 23.00mBGL down to the machine borehole termination depth of 25.00mBGL within BH01, described light blue grey mottled black and white DOLERITE, strong, relict shearing with some zeolite and iron staining.

No groundwater monitoring data is currently available at the site. Vibrating wire piezometer to be installed at a later stage.

5.1 Instrumentation Summary

Tilt sensor and rainfall gauge data is presented within Appendix C, collected from 3rd November 2022. Tilt sensor positions shown below on Figure 5-1.

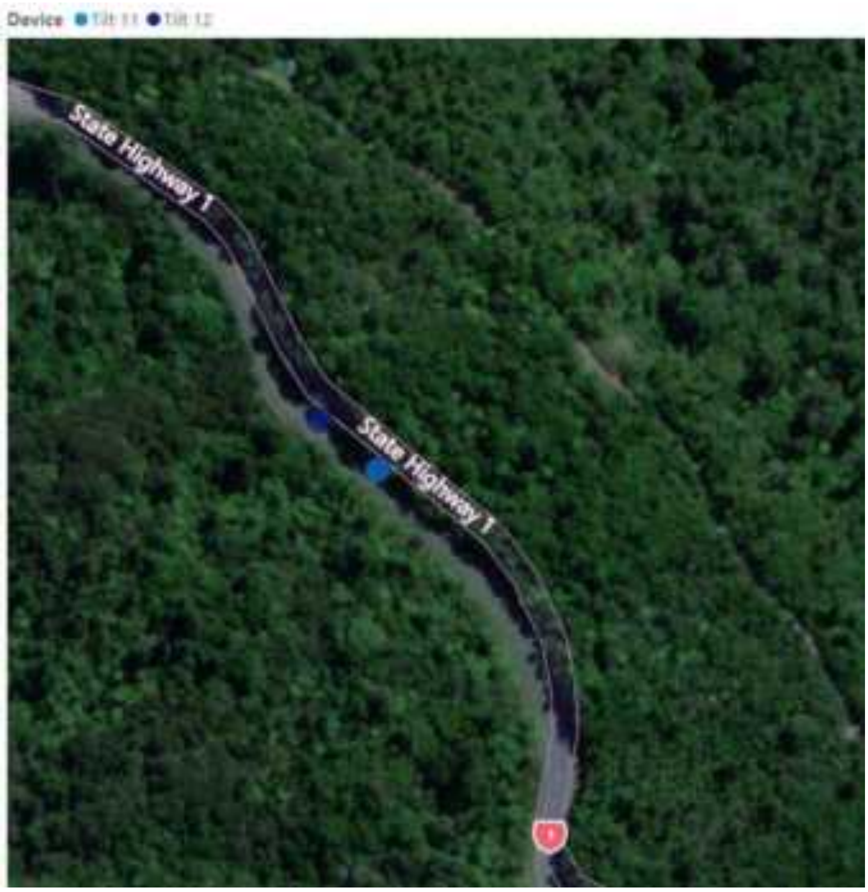

Figure 5-1: A4 tilt sensor positioning

Two significant periods of movement have been identified at near surface between 14th September and 29th November 2022, results summarised below in Table 5-2. Tilt sensor MA Tilt 11 went offline on 21st November 2022.

Table 5-2: A4 tilt sensor movements

Date	Sensor	Direction	Movement (°)	Maximum rainfall intensity (mm/hr)
29/09/22	MA Tilt 11	X	-0.14	0.50
		Y	0.60	
		Z	-0.66	
02/10/22	MA Tilt 11	X	-0.76	1.60
		Y	-0.24	
		Z	+0.23	

The above movements do not coincide with a rainfall event. It is therefore determined that the movements near surface are as a result of external factors. No movements have been identified at MA Tilt 12 to date with trends for both sensors generally displaying cyclic changes in temperature affecting instrumentation hardware.

At completion of the borehole (BH01), inclinometer casing was installed to 23.0m depth for subsequent monitoring. Inclinometer monitoring initially has been carried out between 28th October and 18th November 2022. Results are presented within Appendix C.

The inclinometer information to date is inconclusive, with the A and B profile graph possibly showing minor movement initiating at 19mBGL (1mm movement at surface). A potential failure plane approximate to this depth is consistent with a zone of core loss recorded on the geotechnical log at the highly weathered/moderately weathered Tangihua Complex boundary. However, this could also be evidence of instrumentation drift.

Inclinometer readings to continue over the coming weeks.

6 Conclusions and Recommendations

6.1 Conclusions

- An underslip has occurred at site A4. Deformation is most prominent on the downslope side of the road with additional tension cracking along the centreline and 70m east (thought to be the eastern extent of the failure surface).
- The depth of the failure surface is currently unknown with minor movements identified at 19mBGL within the inclinometer. There is an imminent risk of evacuation of approximately half the road (northbound lane) following the next significant rainfall event given the features observed downslope.

6.2 Recommendations

Based on the available geotechnical information it is recommended to adopt a do minimum option (as per initial works currently in progress) comprising the following:

- Top up slump and level.
- Improve drainage.
- Seal cracking along centreline.

The cost for these works is relatively low, ranging from $500k to $1mil. The site is likely to continue to slump/creep following extended periods of heavy rainfall, as seen previously, requiring frequent improvements and maintenance.

Further information provided within October 2022 Storm Response Options Update- Memo no.2 including discounted solutions.

7 Limitation

This report has been prepared for the benefit of NZTA only and is based on limited investigation and visual inspection only. Given the complex geological setting changes in ground condition could occur across the site that differ from those summarised within this report.

Appendix A

Borehole Logs
CPT Report

Borehole No. BH22A4

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279806 E 988125 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	25 m
Project No.:	1-11244.00	*R.L.:*	221.056 m	*Inclination:*	Vertical
Location:	Slip 22A4 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m)	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	SAMPLE TYPE	TCR (%)
FILL	ASPHALT								
FILL	GAP40. Subgrade. Subangular to subrounded Basalt and Greywacke. Minor fine to coarse sand, well graded. Bluish grey mottled grey.							HQ	100
COLLUVIUM	Silty SAND with minor gravel; light brown mottled black brown orange. Loose, moist, no plasticity; gravel, fine subrounded, friable, basalt.	220	1						
COLLUVIUM	1.75 - 1.95 m CORE LOSS; No sample recovered.			13	2// 1/4/4/4			SPT	100
COLLUVIUM	Silty SAND with minor gravel; light brown mottled black brown orange. Loose, moist, fine; gravel, fine subrounded, friable, basalt.		2						
COLLUVIUM	2.30 - 2.50 m CORE LOSS; No sample recovered.							HQ	78
COLLUVIUM	Silty CLAY some trace gravel; light brown mottled orange dark brown. Very soft, wet, high plasticity; gravel, fine subrounded, friable, basalt and organics.	218	3						
COLLUVIUM	3.10 - 3.45 m CORE LOSS; No sample recovered.			4	0// 1/1/1/1			SPT	81
COLLUVIUM	Silty CLAY some trace fine gravel. Light brown mottled orange dark brown; very soft, wet, high plasticity. Gravel is BASALT.							HQ	100
COLLUVIUM	Silty CLAY with some fine gravel; light brown mottled orange redish brown. Very soft, moist, high plasticity.		4						
COLLUVIUM	4.15 - 4.50 m CORE LOSS; No sample recovered.								
COLLUVIUM	Clayey SILT with trace fine sand and fine gravel; light orange brown mottled dark brown trace white. Very soft, moist, High plasticity. some altered zeolite.			2	0// 0/0/1/1				
COLLUVIUM	Clayey SILT with trace fine sand and fine gravel; dark brown trace white. Very soft, moist, High plasiticity. organics.	216	5					HQ	67
COLLUVIUM	Silty CLAY some trace gravel; light brown mottled orange dark brown; very soft, wet, high plasticity. Gravel is BASALT.								
TANGIHUA COMPLEX	Silty CLAY some trace gravel; light brown mottled orange dark brown; very soft, wet, high plasticity. Gravel is BASALT. [Completely Weathered BASALT]						CW		
TANGIHUA COMPLEX	5.65 - 6.00 CORE LOSS; No sample recovered.		6				CW		
TANGIHUA COMPLEX	Silty CLAY some trace gravel; light brown mottled orange dark brown; extremely weak, very soft, wet, high plasticity. Gravel is BASALT. [Completely Weathered BASALT]			4	0// 1/1/1/1		CW	SPT	100
TANGIHUA COMPLEX	6.20 - 6.45 CORE LOSS; No sample recovered.						CW		
TANGIHUA COMPLEX	Silty CLAY some trace gravel; light brown mottled orange dark brown; firm to stiff, moist, plastic. Gravel is BASALT. [Completely weathered BASALT]	214	7				CW	HQ	44
TANGIHUA COMPLEX				13	0// 2/3/4/4		CW	SPT	100
TANGIHUA COMPLEX			8				CW	HQ	100
TANGIHUA COMPLEX	Highly weathered light red brown mottled orange brown, white BASALT, Extremely weak. Weathered to sandy SILT, light mottled reddish brown medium dense, moist, non-plastic, zeolite alteration.	212	9			EW	HW		
TANGIHUA COMPLEX				24	5// 4/6/7/7	EW	HW	SPT	100
TANGIHUA COMPLEX						EW	HW	HQ	100

DRILLING METHOD: HQ Size, Triple Tube, Wireline Rotary Coring

DEFECT DIP degrees 0 90

Notes:

Borehole terminated within SW Dolerite. Inclinometer installed on completion. Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	7/09/2022	*Finished:*	13/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A4

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279806 E 988125 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	221.056 m
Location:	Slip 22A4 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000

Depth: 25 m *Inclination:* Vertical

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m)	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	DEFECT DIP (degrees 0–90)	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD
TANGIHUA COMPLEX	Highly weathered light red brown mottled orange brown, white BASALT, Extremely weak. Weathered to sandy SILT, light mottled reddish brown medium dense, moist, non-plastic, zeolite alteration.*(continued)*									HQ	100		HQ Size, Triple Tube, Wireline Rotary Coring
				28	7// 6/6/7/9					SPT	100		
	10.80 - 10.95 m CORE LOSS; No sample recovered.	210	11										
	Highly weathered light red brown mottled orange brown, white BASALT, Extremely weak. Weathered to sandy SILT, light mottled reddish brown very dense, moist, non-plastic, zeolite alteration.									HQ	67		
			12	50+	10// 14/18 for 55mm					SPT	100		
	12.30 - 12.35 m CORE LOSS												
	Highly weathered light red brown mottled orange brown, white BASALT, Extremely weak. Weathered to sandy SILT, light mottled reddish brown very dense, moist, non-plastic iron and zeolite alteration.	208	13							HQ	100		
				50+	23// 17/19/14 for 45mm					SPT	100		
			14			EW	HW			HQ	100		
		206	15	29	11// 5/5/8/11					SPT	100		
	Highly weathered light red brown mottled orange brown, white BASALT, Extremely weak. Weathered to Silty SAND, light mottled reddish brown, weakly cemented, very dense, moist, non-plastic iron and zeolite alteration.		16							HQ	100		
				50+	28// 25/25					SPT	100		
		204	17							HQ	0		
										HQ	54		
			18	50+	50					SPT	100		
	18.85 - 19.45 CORE LOSS	202	19							HQ	100		
	Highly weathered light red brown mottled orange brown, white BASALT, Extremely weak. Weathered to Silty SAND, light mottled reddish brown, weakly cemented, very dense, moist, non-plastic iron and zeolite alteration.					EW	HW	J20, J30	19.46m - J, 20°	SC			
				50+	50	MS	MW	J60, J85, J30, J40	19.65m - J, 60°, SM, PL, N 19.73m - J, 85°	HQ	100	56	

Notes:
Borehole terminated within SW Dolerite. Inclinometer installed on completion. Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	7/09/2022	*Finished:*	13/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A4

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279806 E 988125 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	221.056 m
Location:	Slip 22A4 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000

Depth: 25 m
Inclination: Vertical

Columns: GEOLOGY | MAIN DESCRIPTION / DETAIL DESCRIPTION | R.L. (m) | DEPTH (m) | GRAPHIC LOG | TESTS: SPT 'N' VALUE, SPT BLOW COUNTS OR SHEAR VALUE | ROCK STRENGTH | ROCK WEATHERING | ROCK DEFECT SPACING | DEFECT DIP (degrees 0–90) | DEFECTS / NOTES / OTHER TESTS | CORE: SAMPLE TYPE, TCR (%), RQD (%) | DRILLING: DRILLING METHOD, CASING, BASE OF HOLE & WATER LEVEL | INSTALLATION DETAILS

Geology: TANGIHUA COMPLEX

Depth (m)	Main description / detail description	Rock strength	Rock weathering
20.0 – 23.0	Moderately weathered light brown mottled black and white DOLERITE, moderately strong, relict shearing with zeolite, polished surfaces, iron staining.*(continued)*	MS	MW
23.0 – 25.0	Slightly weathered light blue grey mottled black and white DOLERITE, strong, relict shearing with zeolite.	S	SW
25.0	END OF BOREHOLE AT 25m - Target Criteria Achieved		

Depth scale (m): 21, 22, 23, 24, 25, 26, 27, 28, 29

Tests: SPT 'N' value 50+; SPT blow counts 16 (at approx. 21.2 m)

Defects / Notes / Other tests:
- 19.87m - J, 30°, RO, UN
- 20.00m - J, 40°, N
- 20.15m - J, 42°
- 20.18m - J, 82°
- 22.20m - J, 40°
- 22.50m - J, 45°
- 22.69m - J, 48°
- 24.20m - J, 45°
- 24.58m - J, 40°
- 24.71m - J, 45°
- 24.85m - J, 3°

Defect dip plot labels: J40, J42, J82, J40, J45, J48, J45, J40, J45, J3

Core:

Sample type	TCR (%)	RQD (%)
HQ	100	56
SC		
HQ	100	74
HQ	100	91
HQ	100	97

Drilling method: HQ Size, Triple Tube, Wireline Rotary Coring

Notes:
Borehole terminated within SW Dolerite. Inclinometer installed on completion. Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	7/09/2022	*Finished:*	13/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A4

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279806 E 988125 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	25 m
Project No.:	1-11244.00	*R.L.:*	221.056 m	*Inclination:*	Vertical
Location:	Slip 22A4 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A4.2
BOX 02 - 3.95 -7.50m

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 29/11/22

Notes:		*Started:*	7/09/2022	*Finished:*	13/09/2022
Borehole terminated within SW Dolerite. Inclinometer installed on completion. Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.		*Drilling Co.:*	DFNZ	*Drilling Rig:*	Canter Rig
		Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279806 E 988125 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	25 m
Project No.:	1-11244.00	*R.L.:*	221.056 m	*Inclination:*	Vertical
Location:	Slip 22A4 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A4.3
BOX 03 - 7.50 - 10.50m

Photo BH22A4.4
BOX 04 - 10.50 - 13.50m

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 29/11/22

Notes:
Borehole terminated within SW Dolerite. Inclinometer installed on completion. Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	7/09/2022	*Finished:*	13/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279806 E 988125 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	25 m
Project No.:	1-11244.00	*R.L.:*	221.056 m	*Inclination:*	Vertical
Location:	Slip 22A4 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

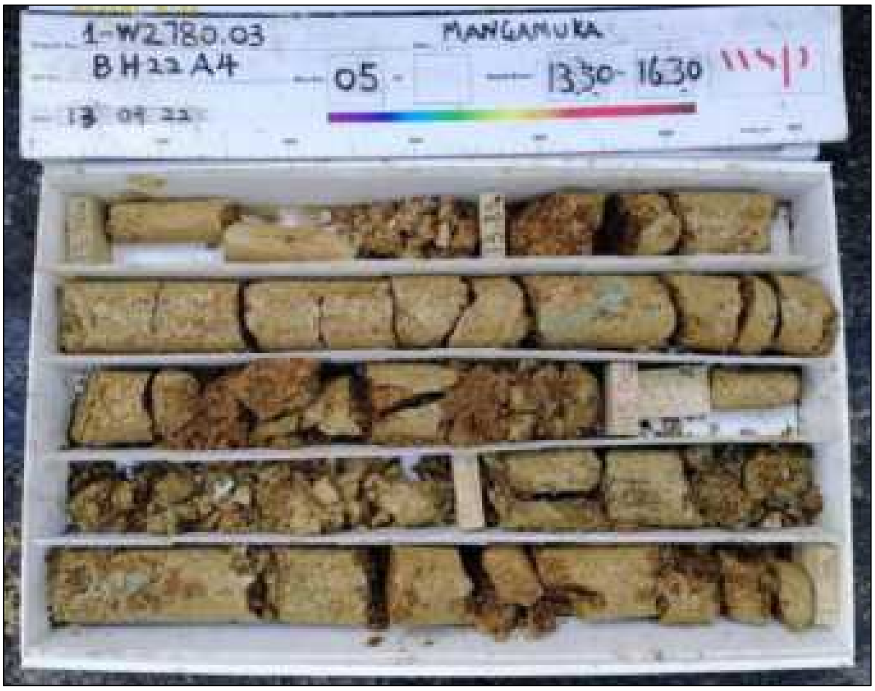

Photo BH22A4.5
BOX 05 - 13.50 - 16.30m

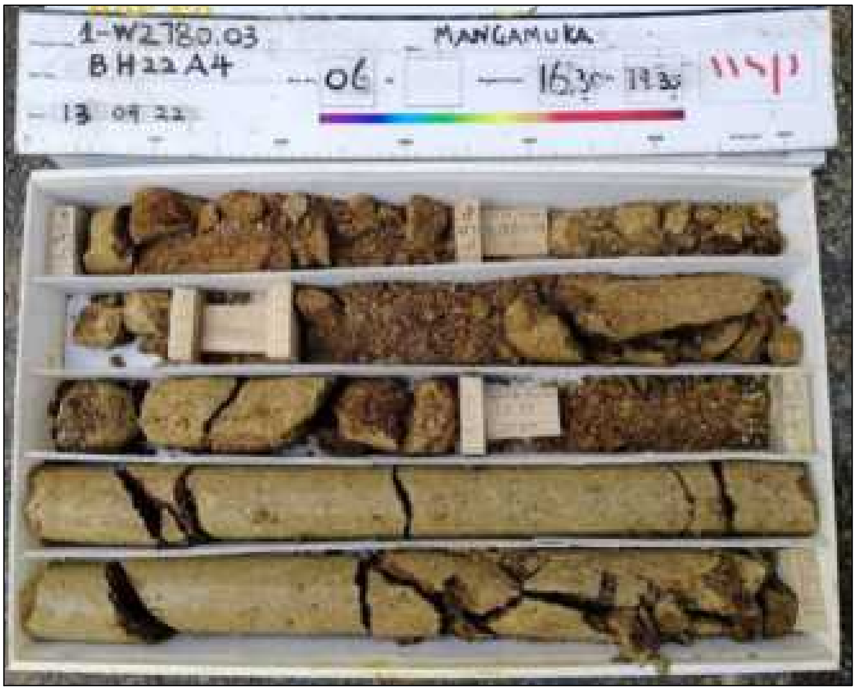

Photo BH22A4.6
BOX 06 - 16.30 -19.35m

Notes:
Borehole terminated within SW Dolerite. Inclinometer installed on completion. Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	7/09/2022	*Finished:*	13/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.
Scale 1:50 @ A4

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279806 E 988125 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	25 m
Project No.:	1-11244.00	*R.L.:*	221.056 m	*Inclination:*	Vertical
Location:	Slip 22A4 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A4.7
BOX 07 - 19.35 - 22.15m

Photo BH22A4.8
BOX 08 - 22.15 - 25.00m

Notes:
Borehole terminated within SW Dolerite. Inclinometer installed on completion. Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	7/09/2022	*Finished:*	13/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

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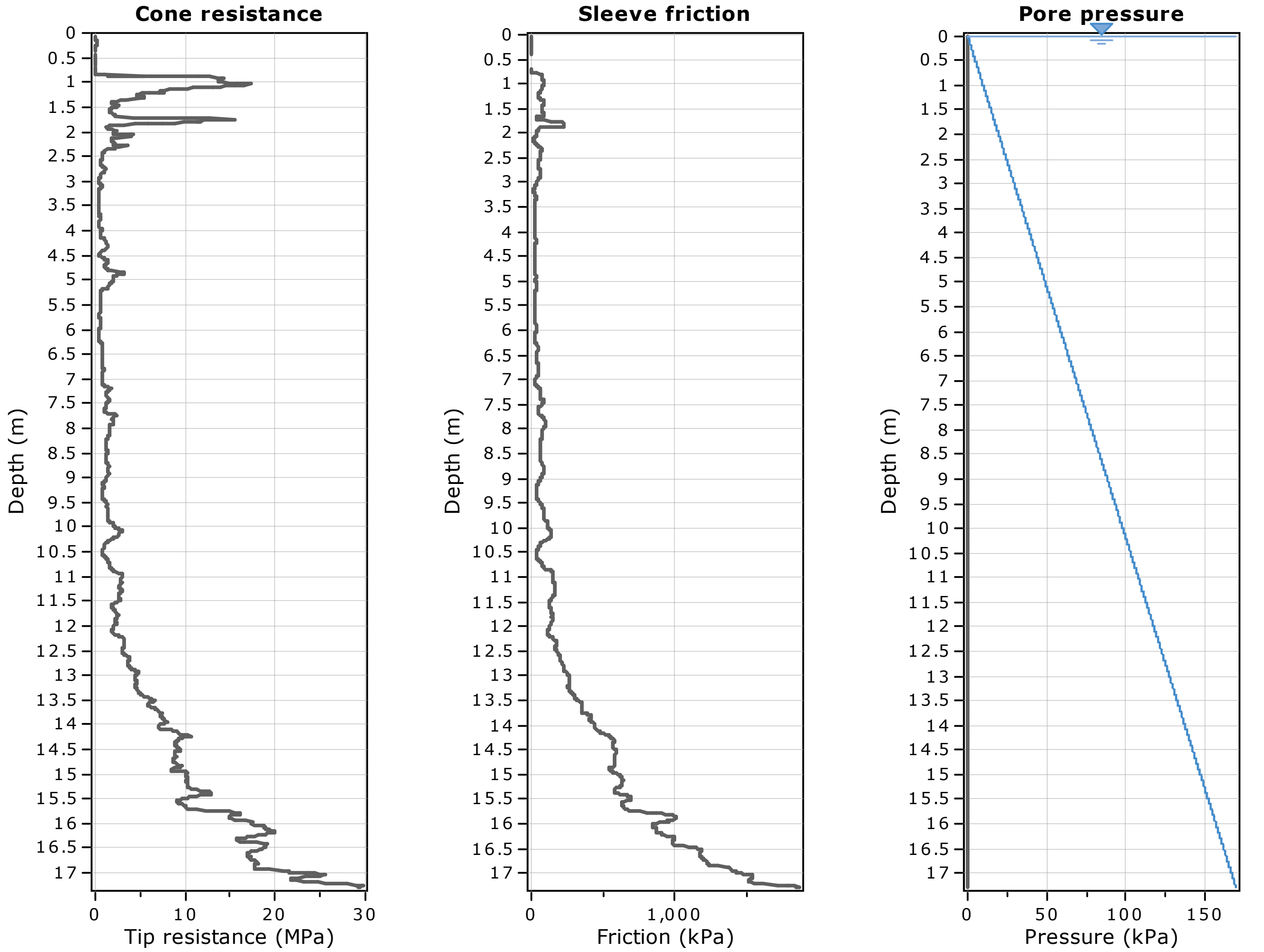
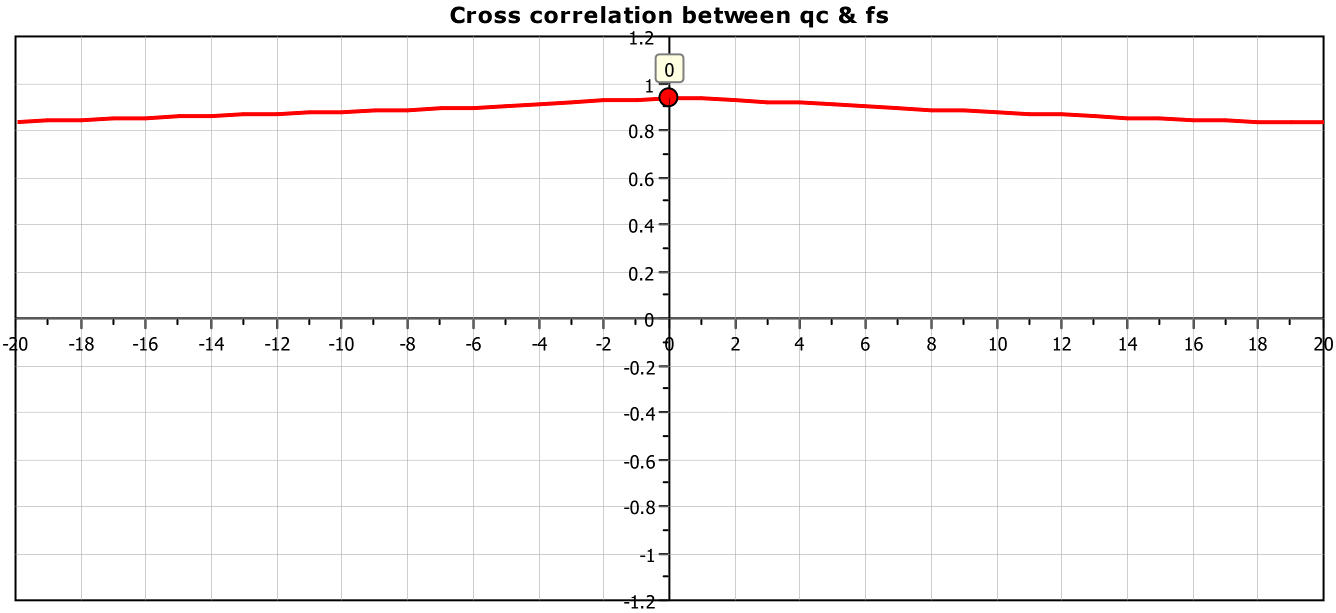
CPT: A4-CPT01
Total depth: 17.29 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

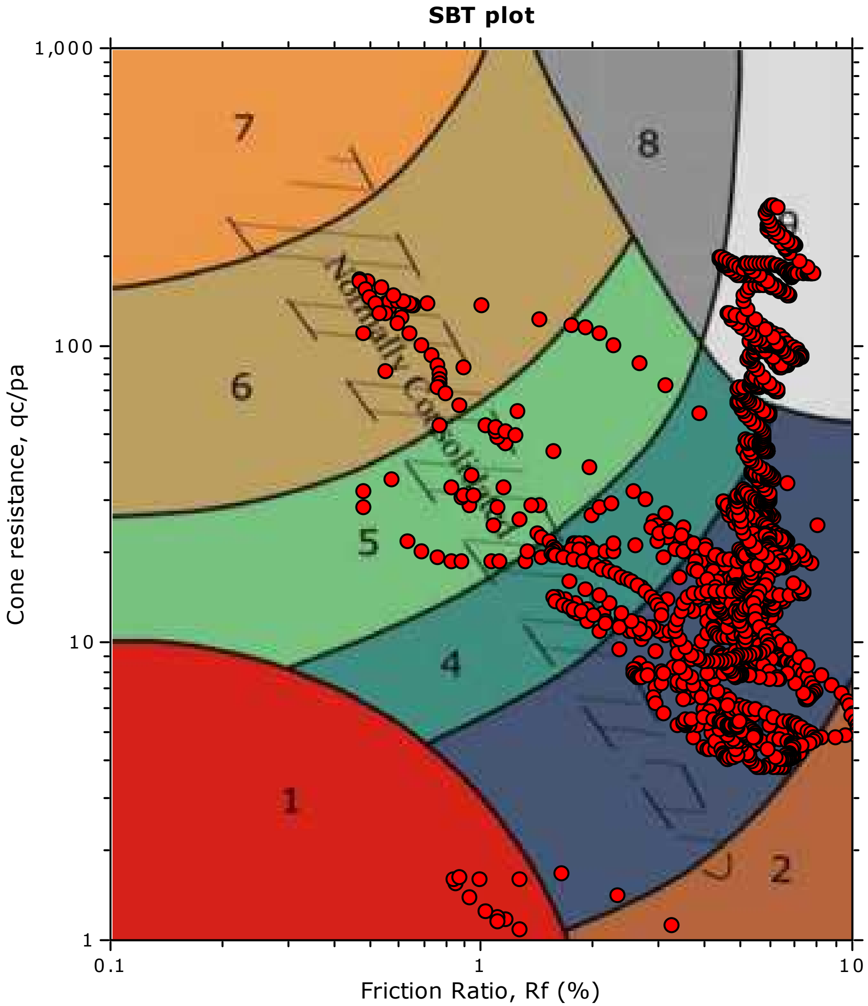
Project:
Location:

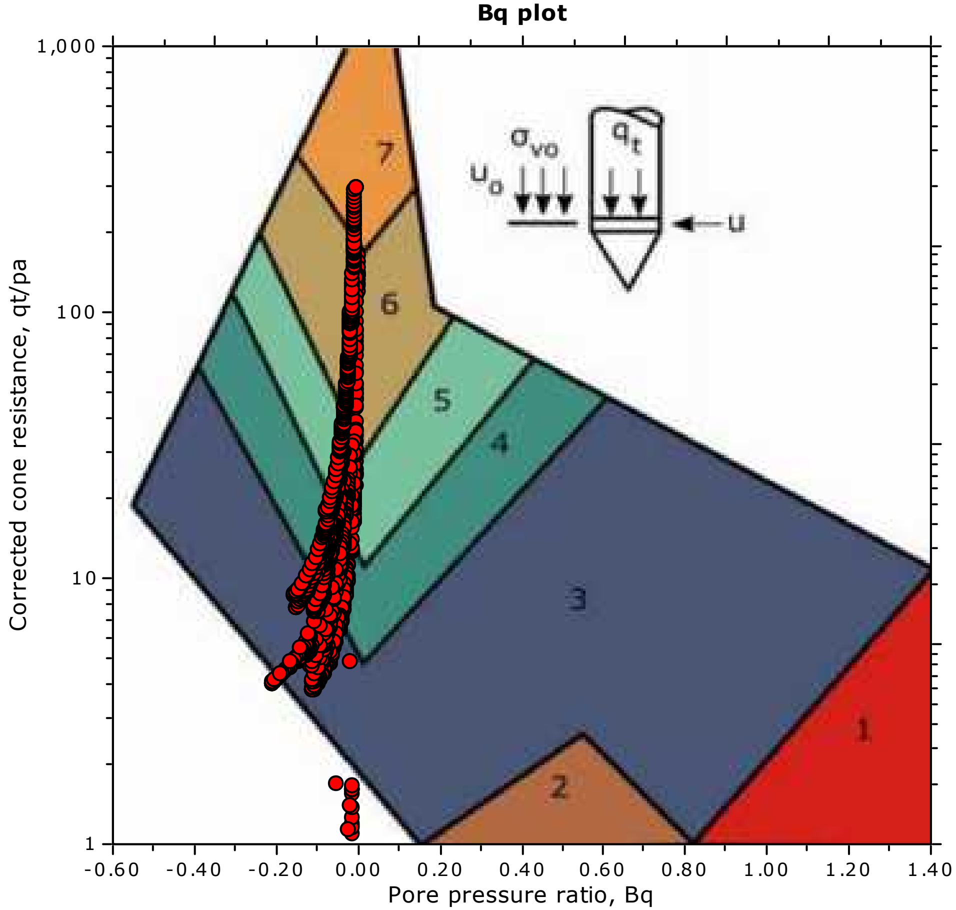


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

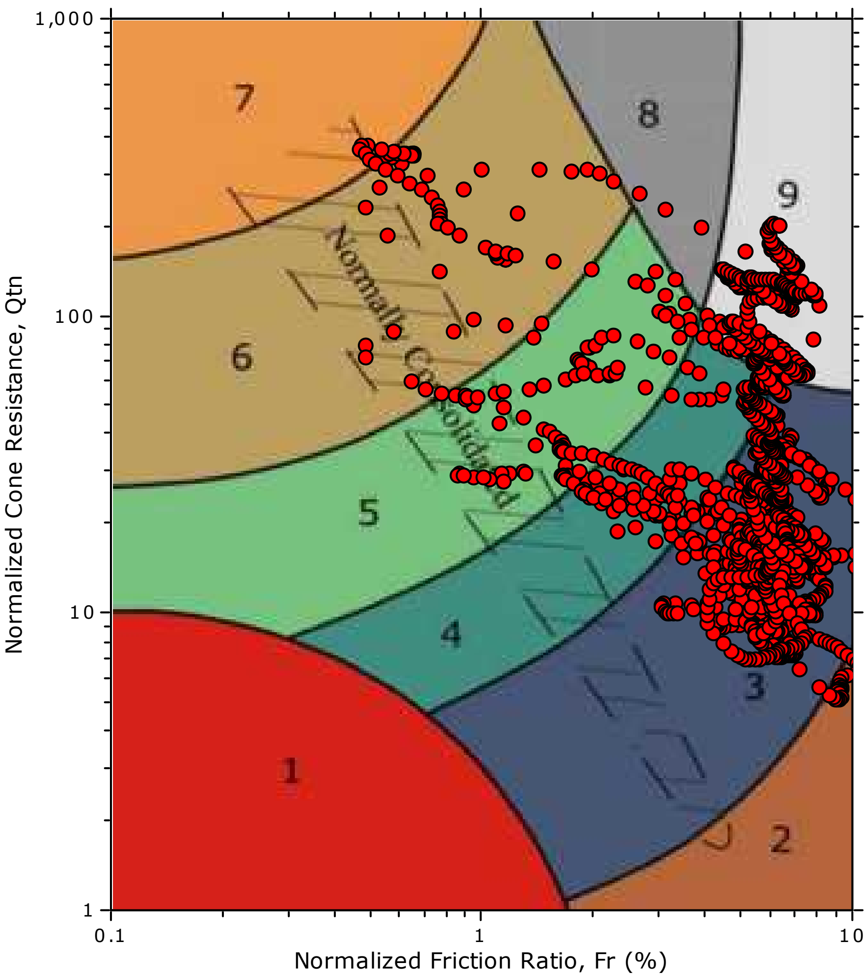


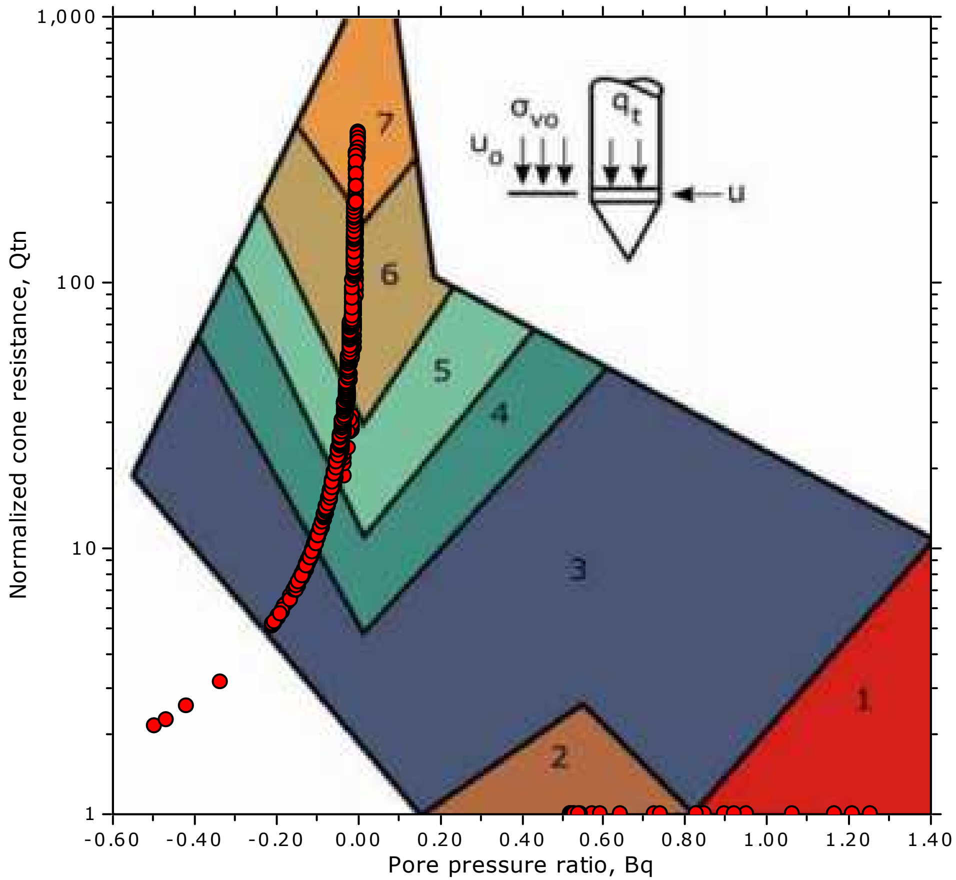


SBT legend

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

SBT - Bq plots (normalized)

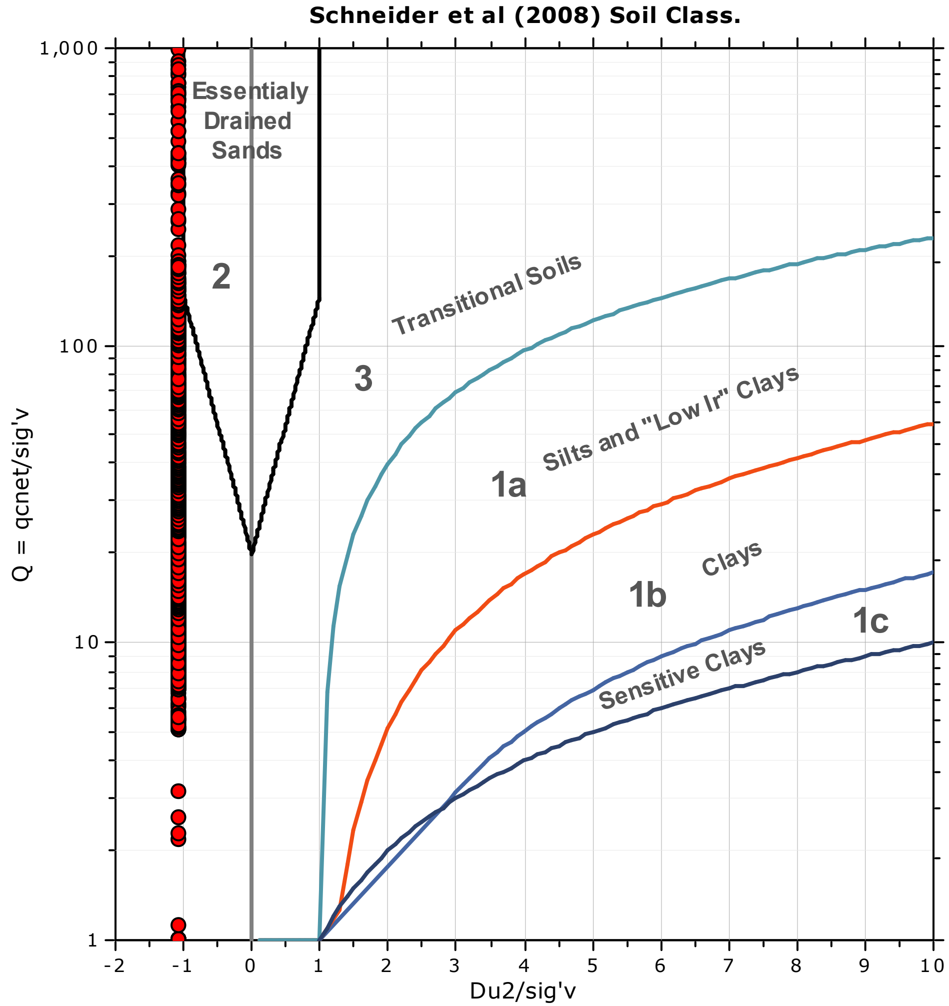


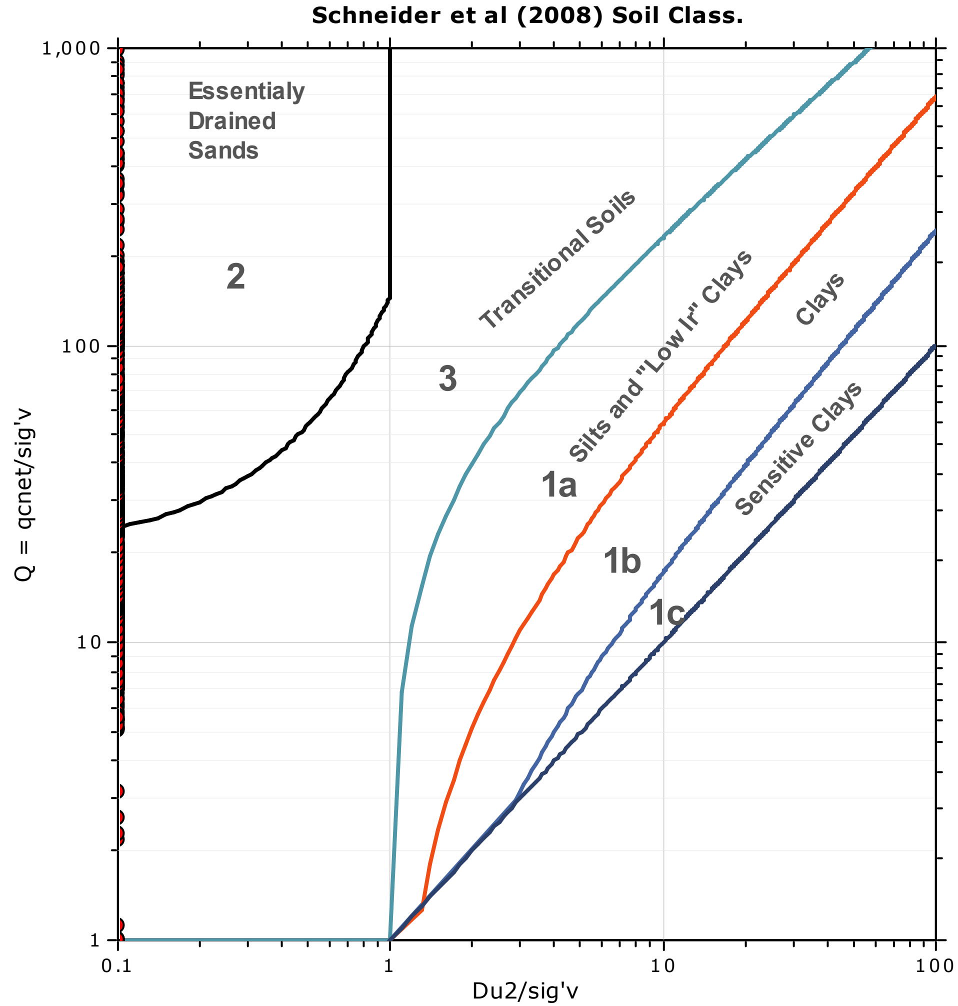


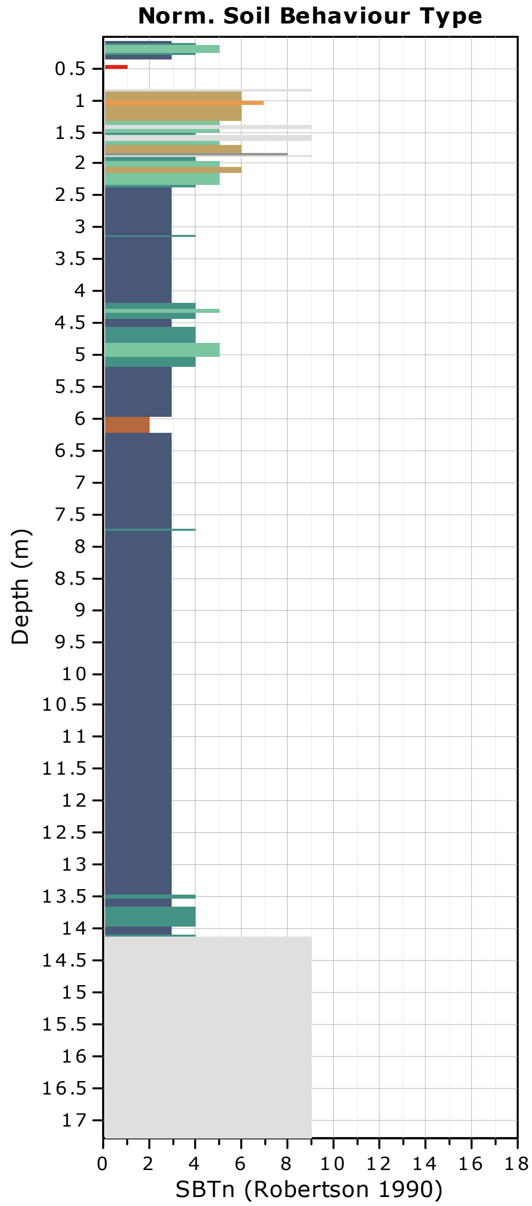
SBTn legend

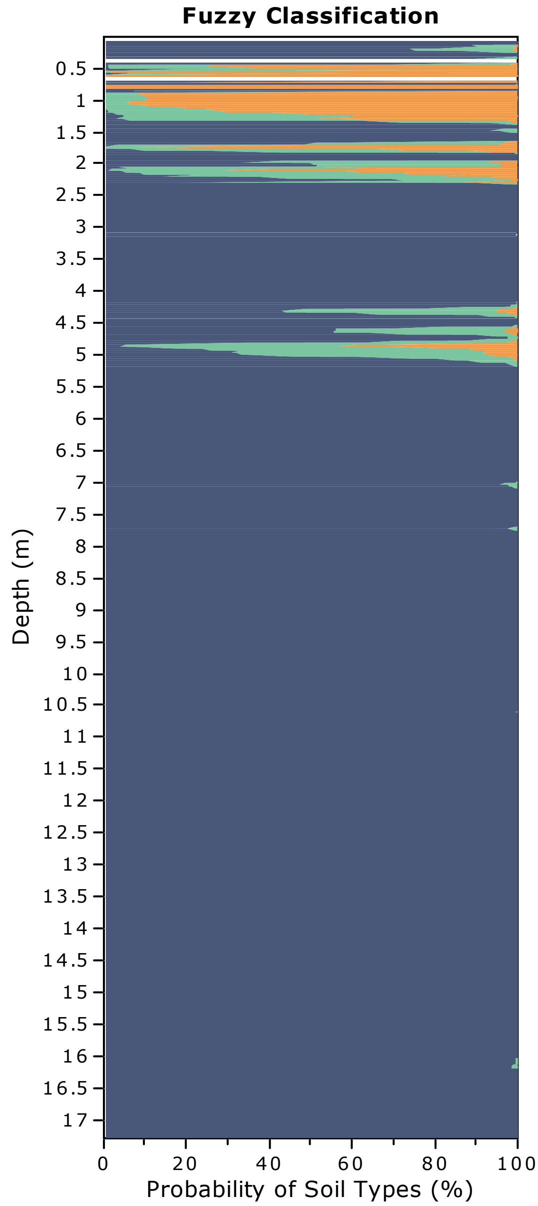
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

Bq plots (Schneider)






Norm. Soil Behaviour Type
Depth (m)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
Probability of Soil Types (%)

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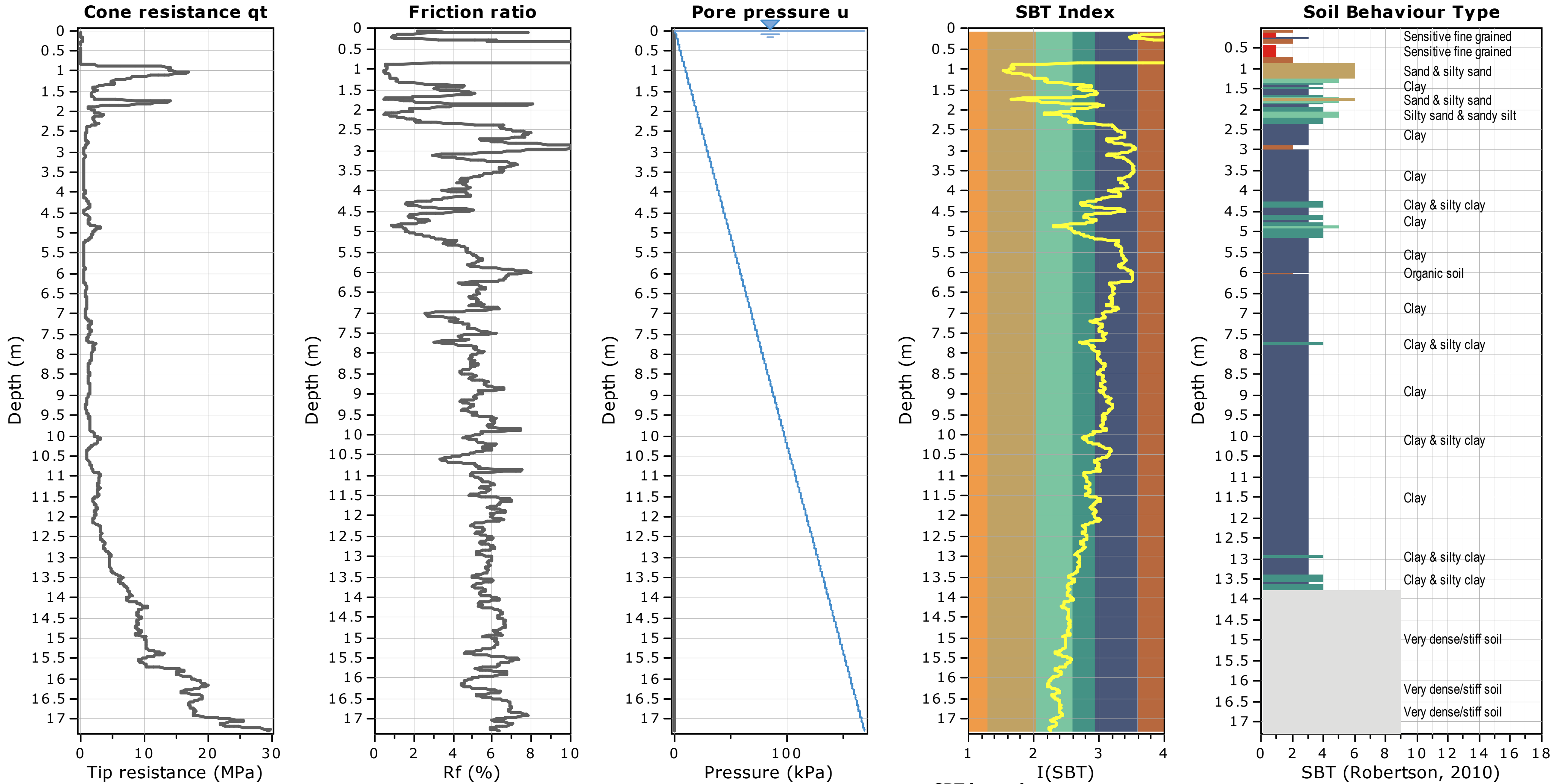
http://www.geologismiki.gr

CPT: A4-CPT01
Total depth: 17.29 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



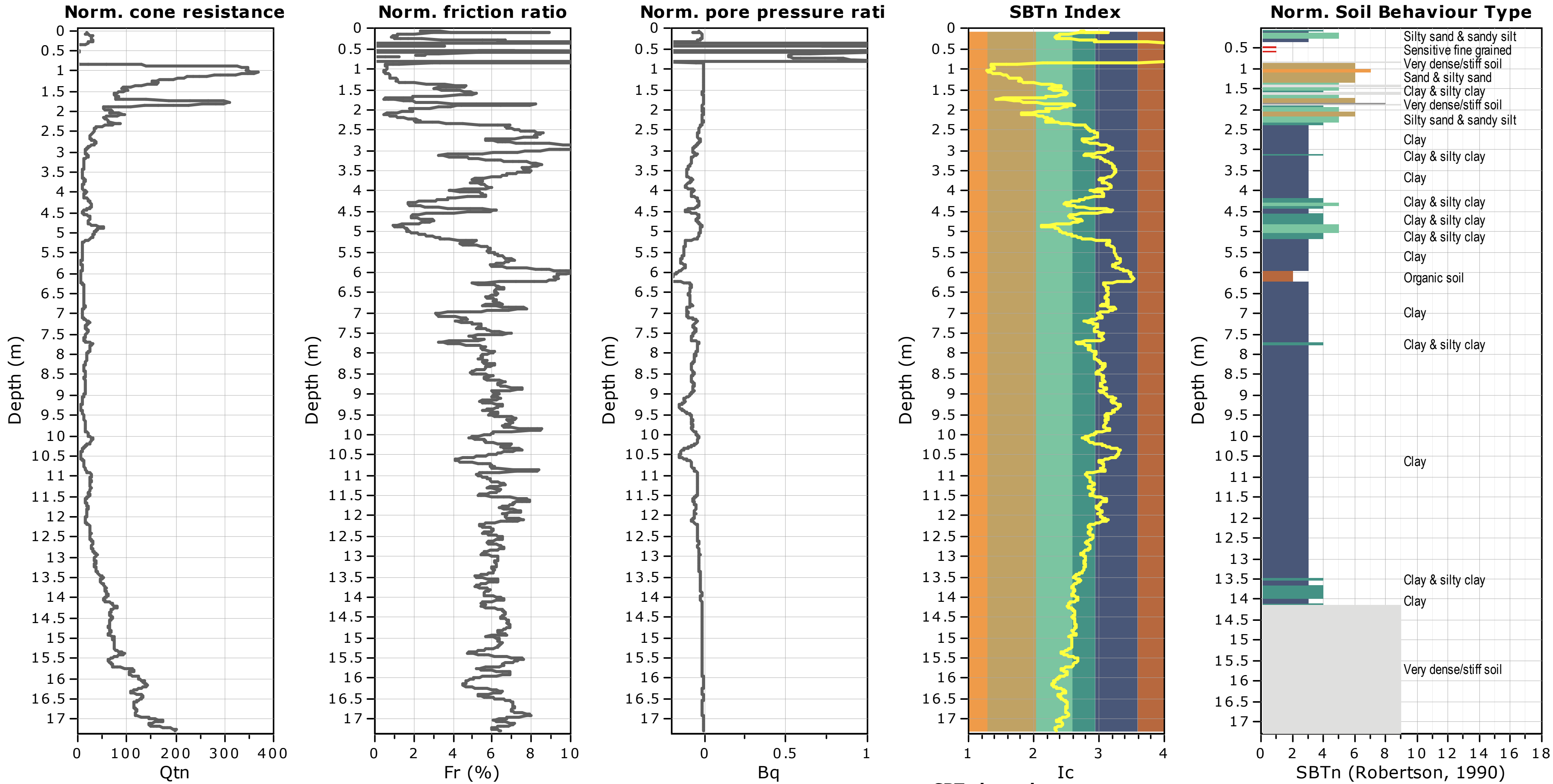
SBT legend

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

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

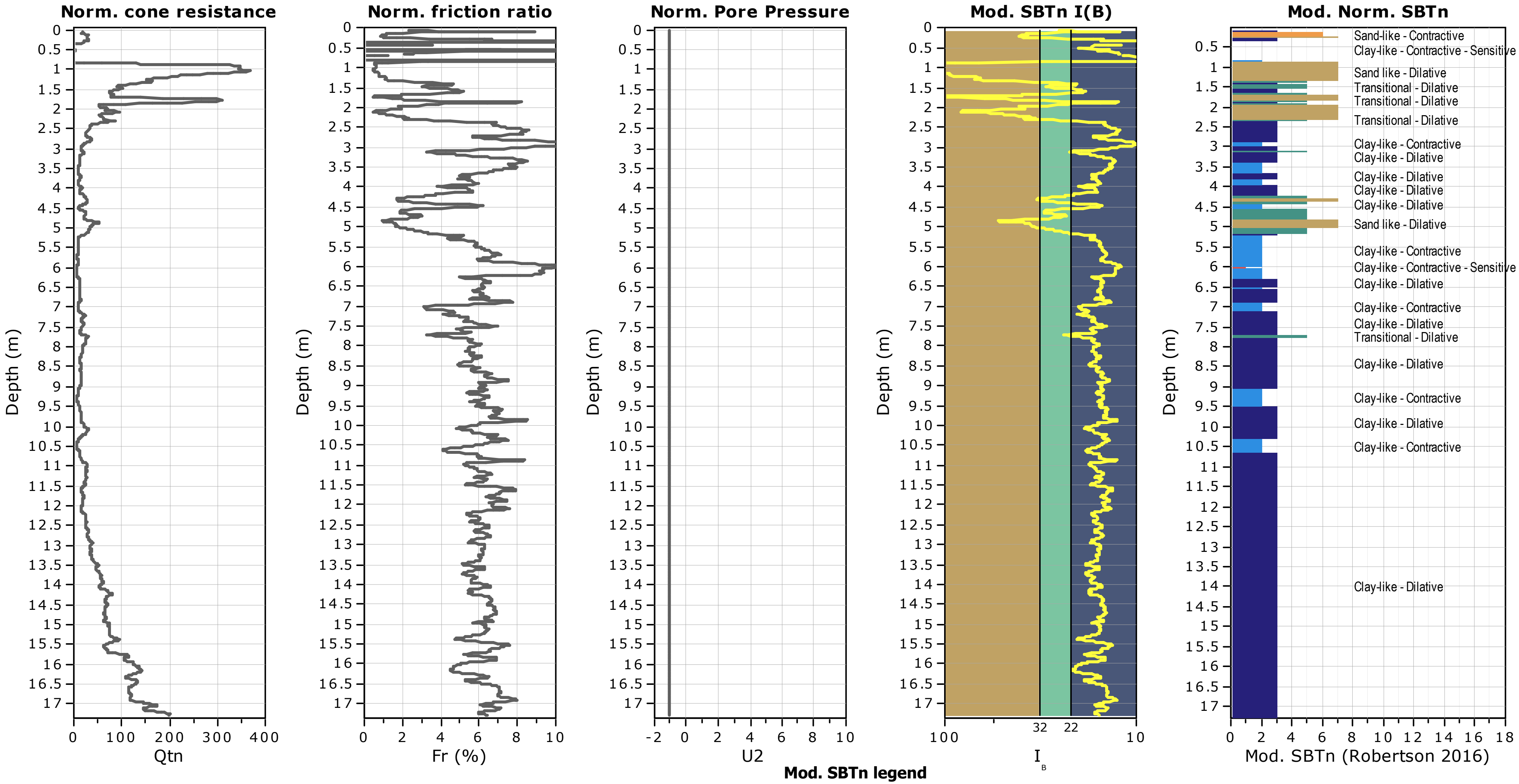
CPT: A4-CPT01
Total depth: 17.29 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

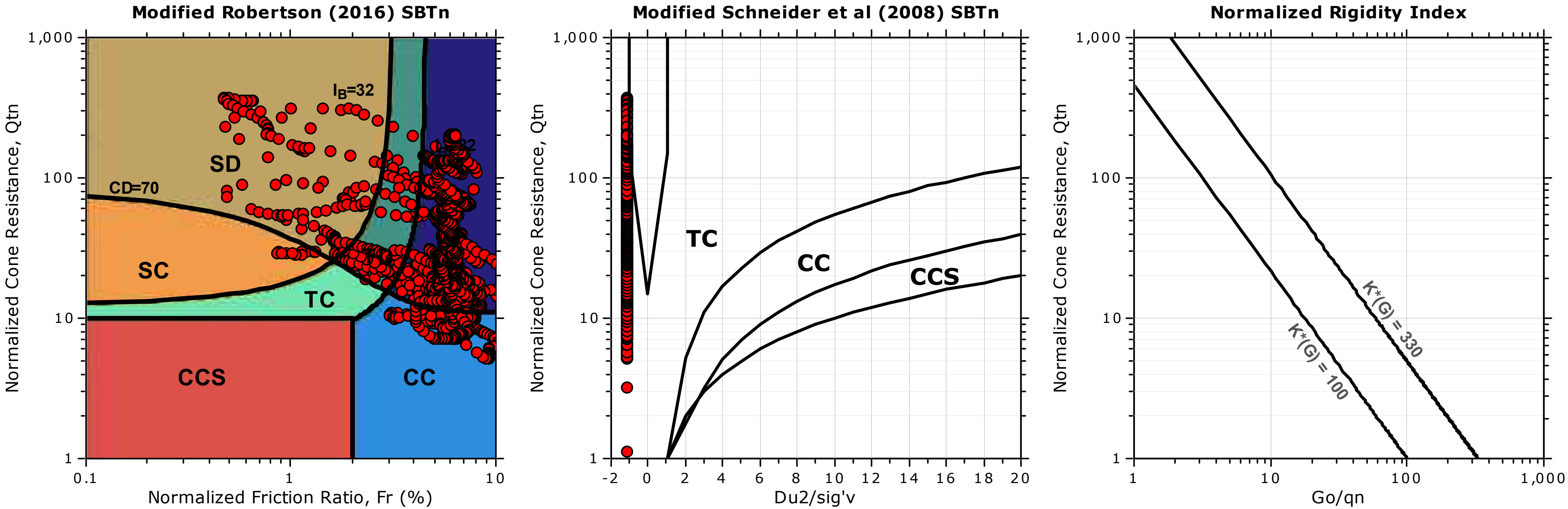
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained



Mod. SBTn legend

1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

Updated SBTn plots



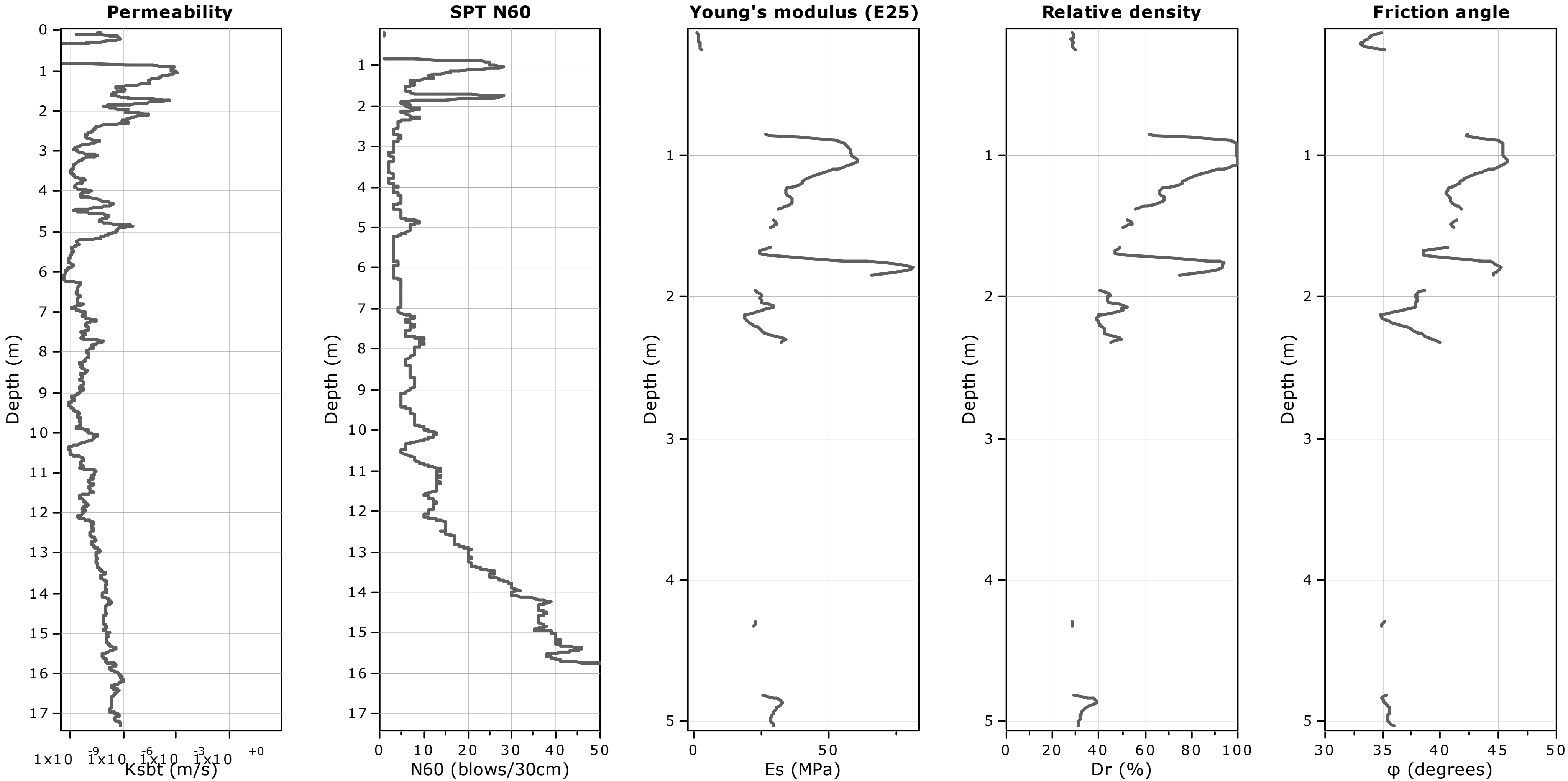
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A4-CPT01
Total depth: 17.29 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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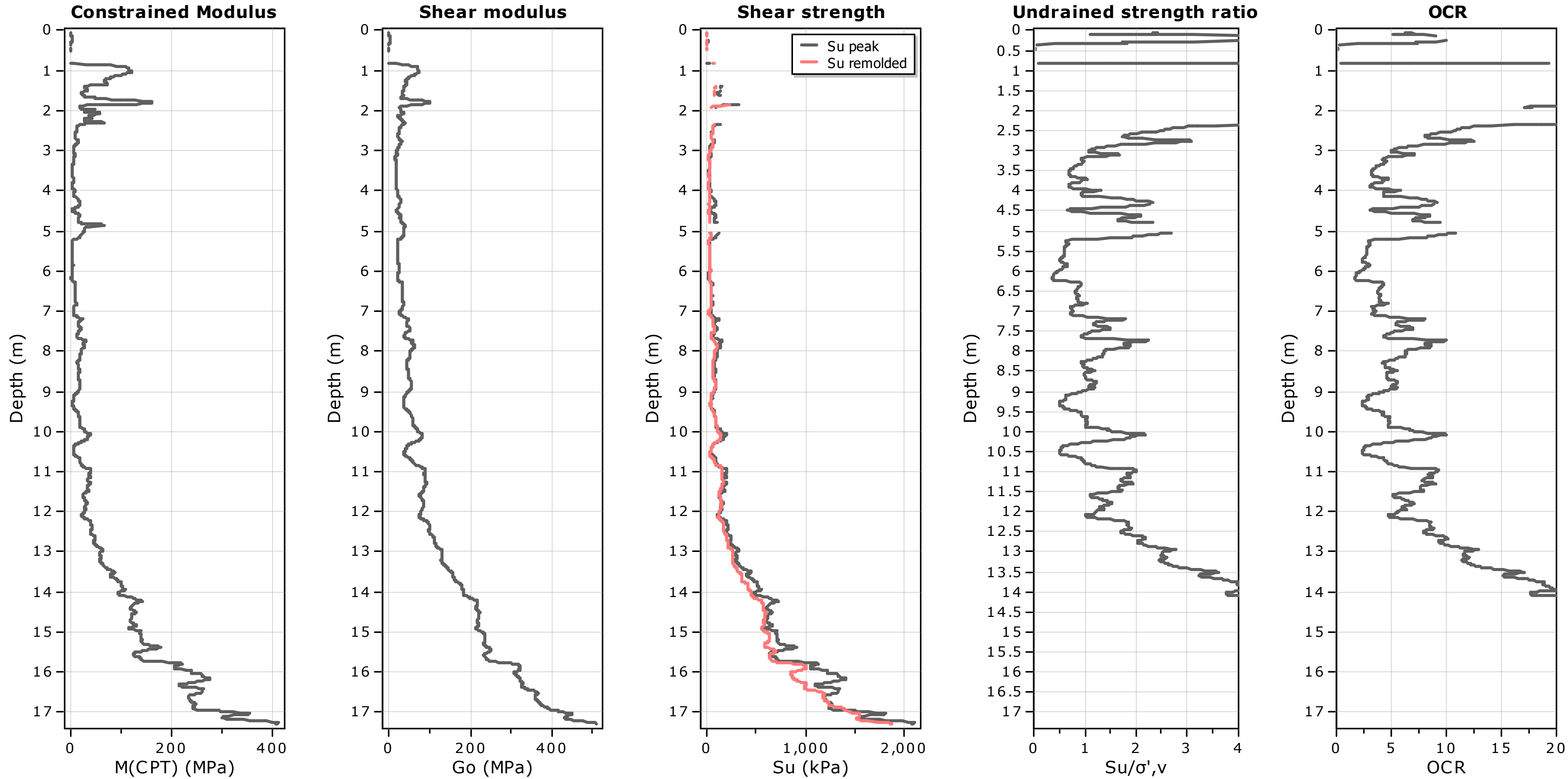
CPT: A4-CPT01
Total depth: 17.29 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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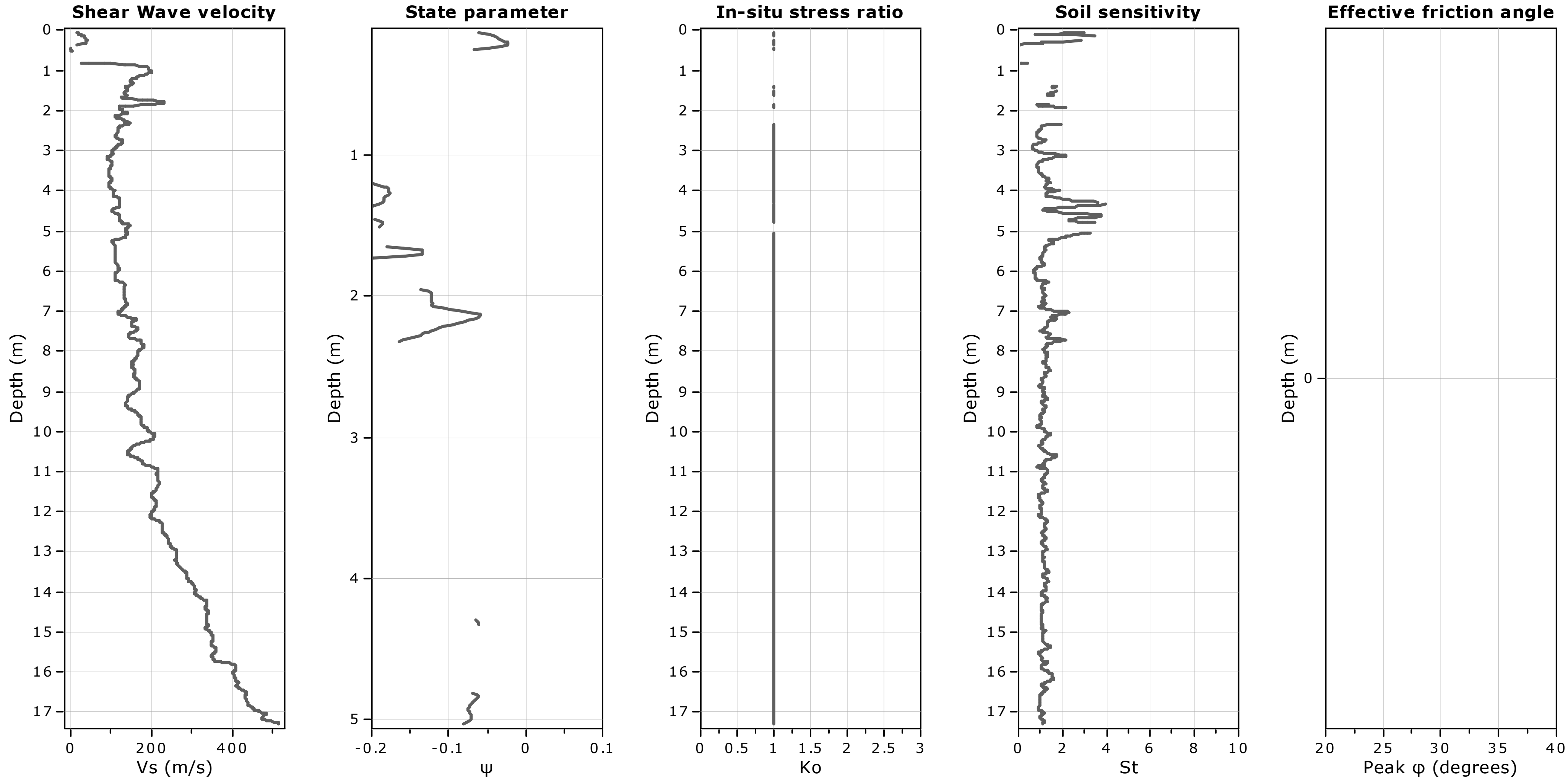
CPT: A4-CPT01
Total depth: 17.29 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

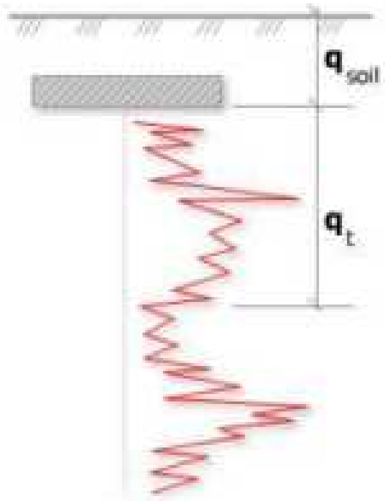
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

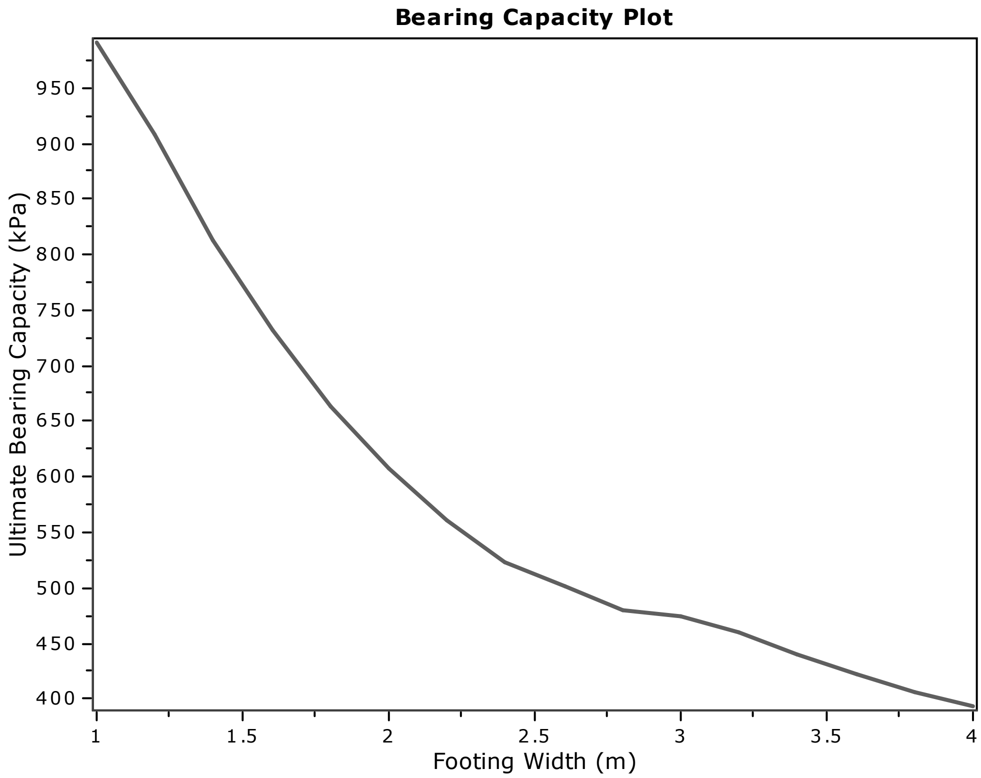
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

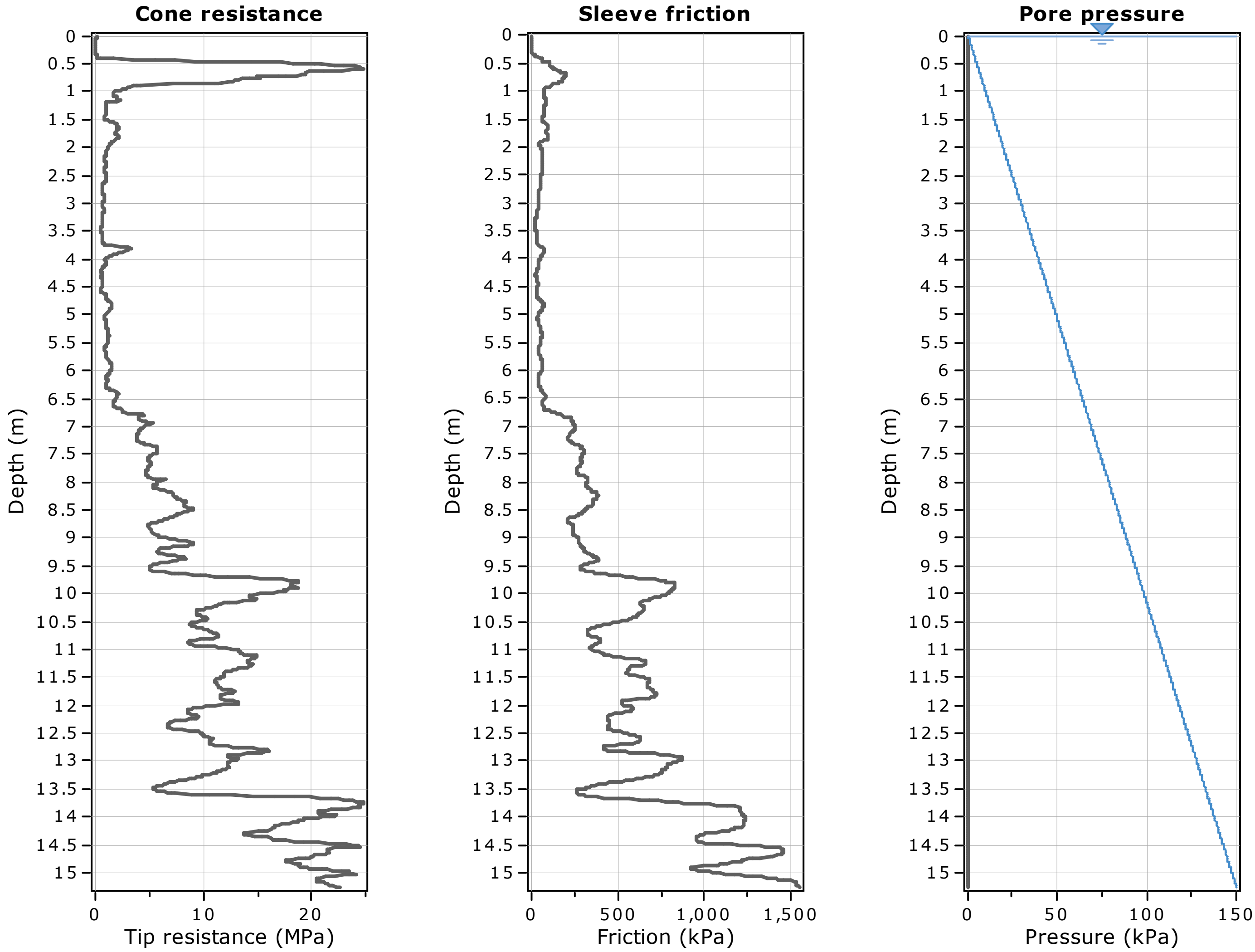
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

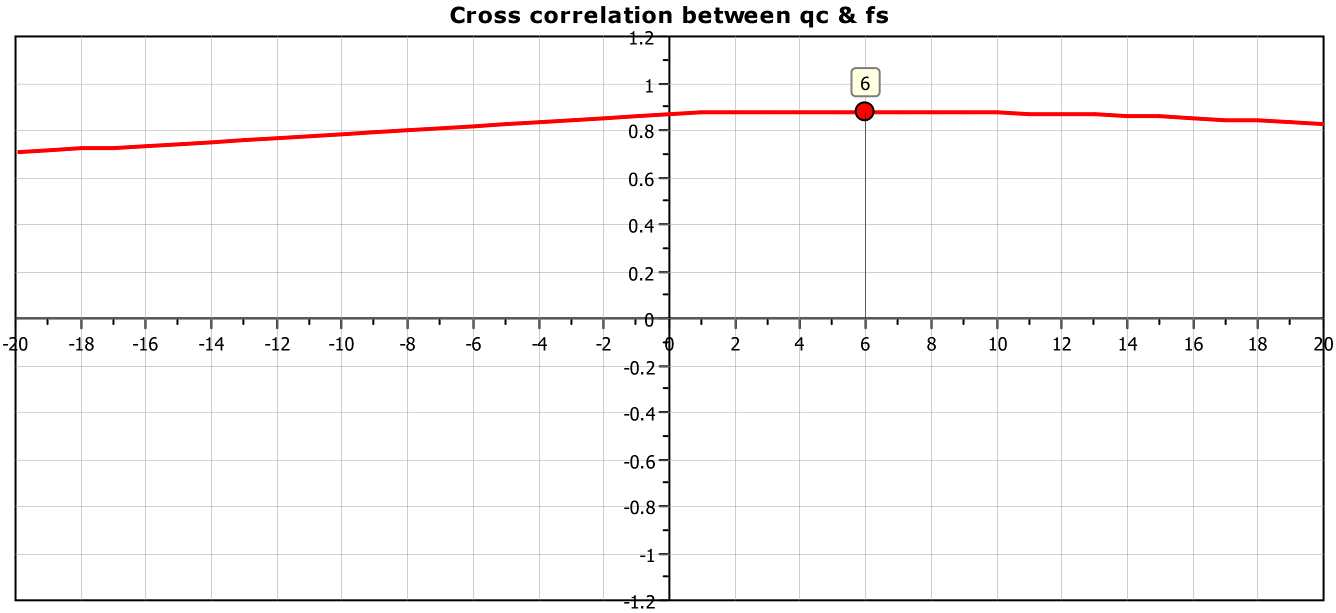


:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	4.91	0.20	9.50	991.14
2	1.20	0.50	2.30	4.49	0.20	9.50	907.95
3	1.40	0.50	2.60	4.02	0.20	9.50	813.79
4	1.60	0.50	2.90	3.61	0.20	9.50	731.38
5	1.80	0.50	3.20	3.27	0.20	9.50	663.39
6	2.00	0.50	3.50	2.99	0.20	9.50	606.78
7	2.20	0.50	3.80	2.76	0.20	9.50	560.87
8	2.40	0.50	4.10	2.57	0.20	9.50	523.84
9	2.60	0.50	4.40	2.46	0.20	9.50	501.37
10	2.80	0.50	4.70	2.35	0.20	9.50	479.50
11	3.00	0.50	5.00	2.33	0.20	9.50	474.55
12	3.20	0.50	5.30	2.25	0.20	9.50	460.49
13	3.40	0.50	5.60	2.15	0.20	9.50	440.27
14	3.60	0.50	5.90	2.06	0.20	9.50	422.32
15	3.80	0.50	6.20	1.98	0.20	9.50	405.44
16	4.00	0.50	6.50	1.92	0.20	9.50	393.44



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



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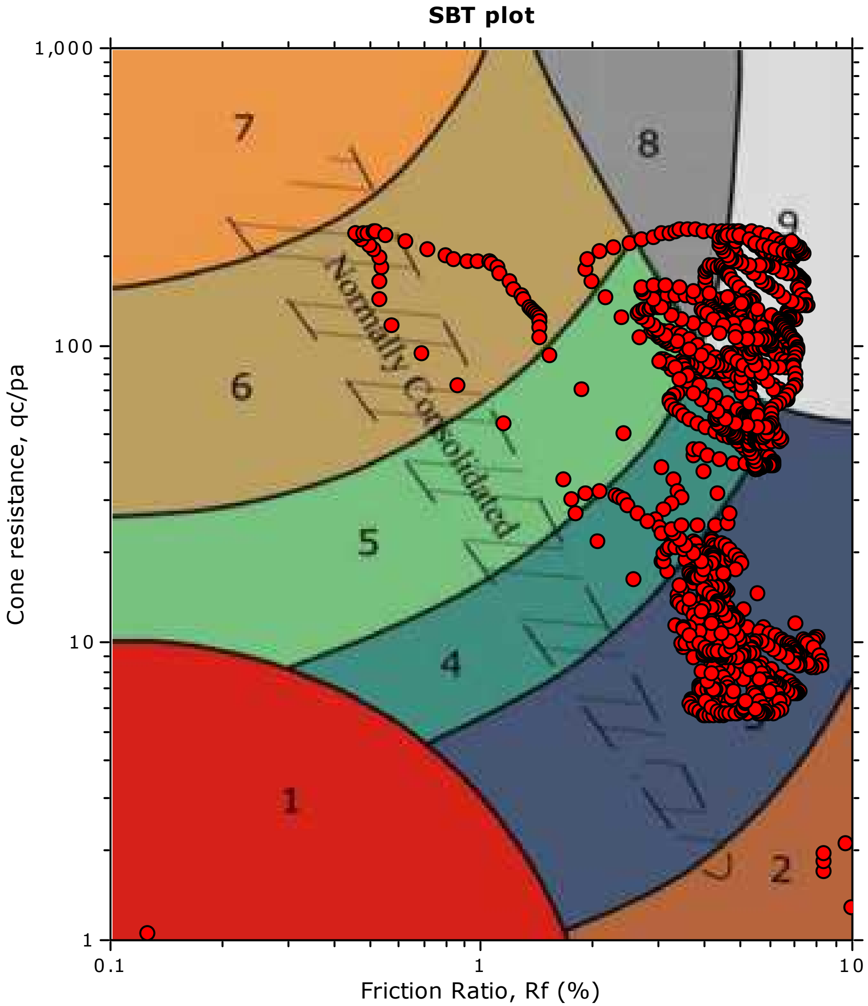
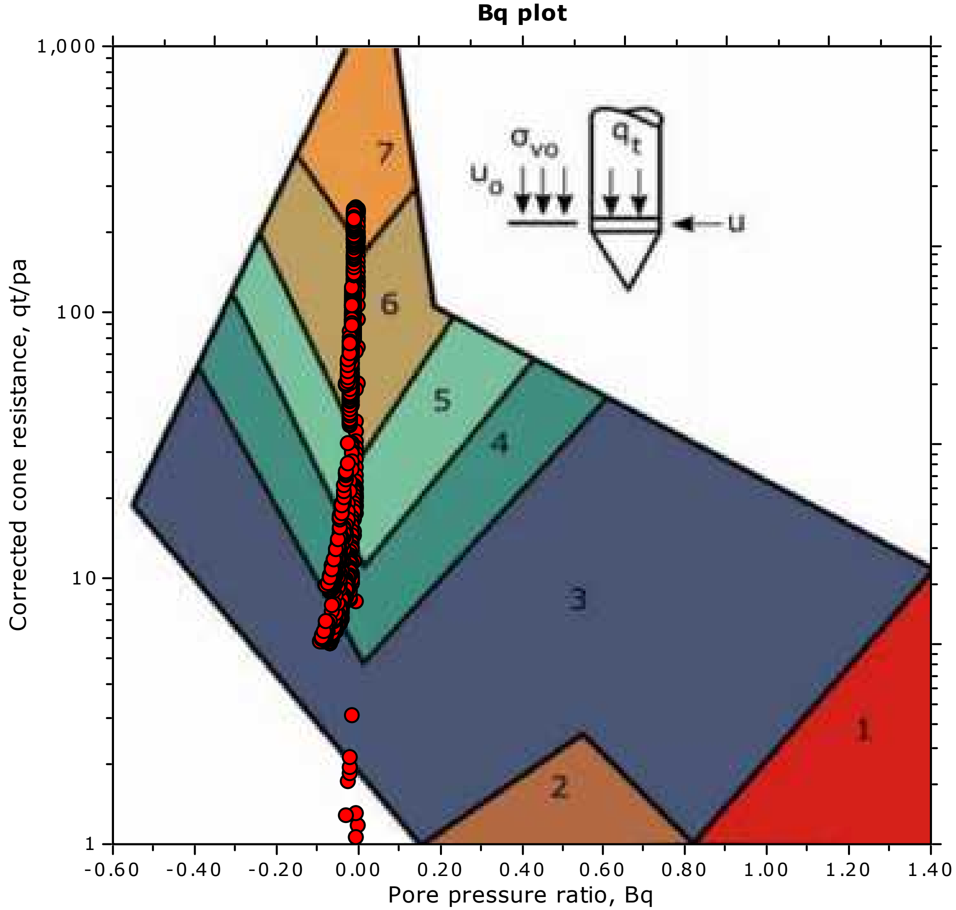
CPT: A4-CPT02
Total depth: 15.26 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

SBT - Bq plots



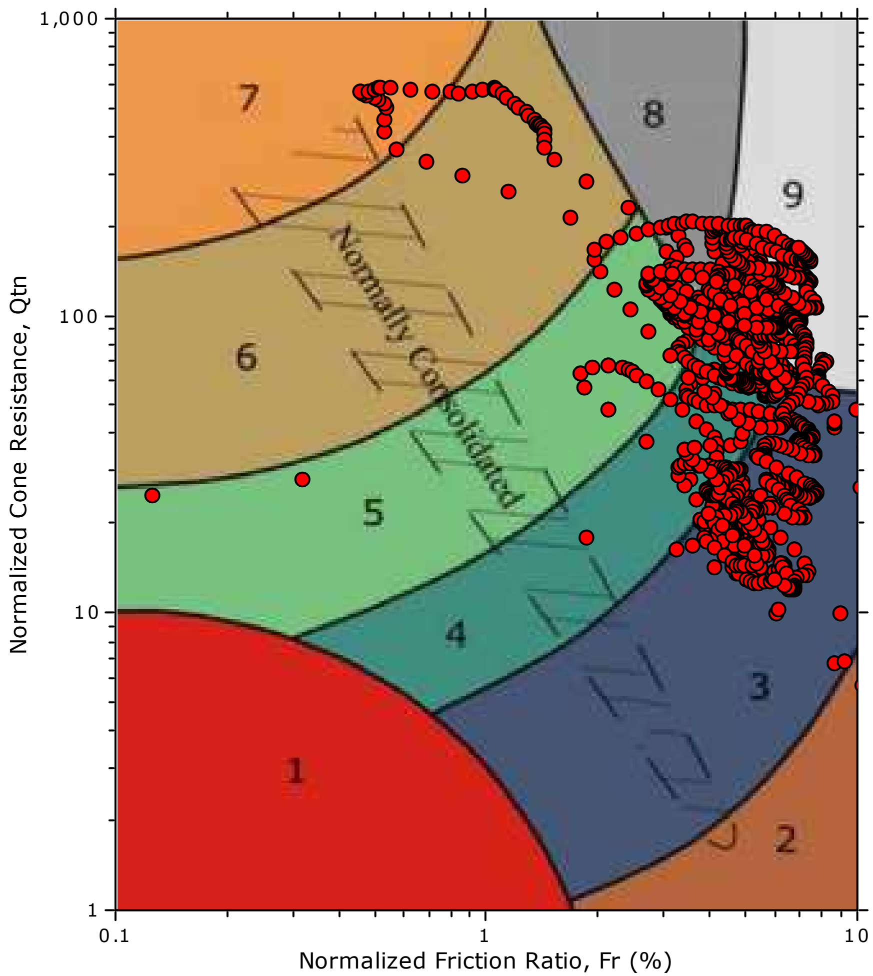


SBT legend

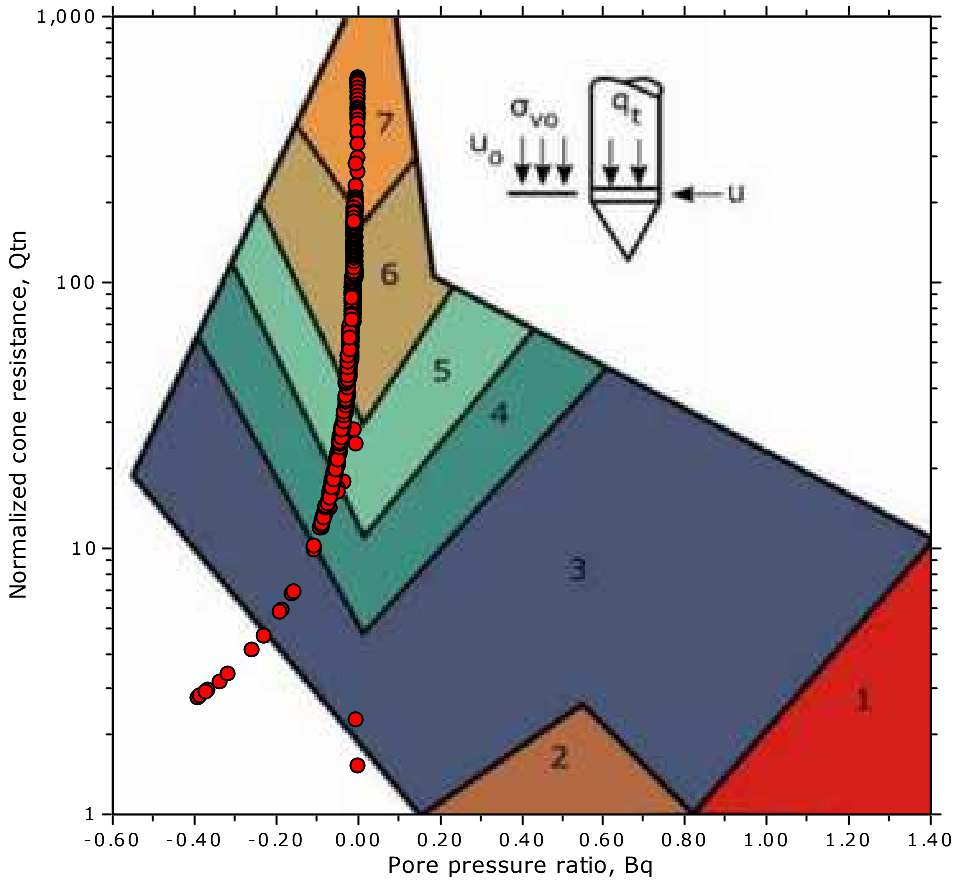
- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty clay
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravelly sand to sand
- 8. Very stiff sand to clayey sand
- 9. Very stiff fine grained

SBT - Bq plots (normalized)

SBTn plot



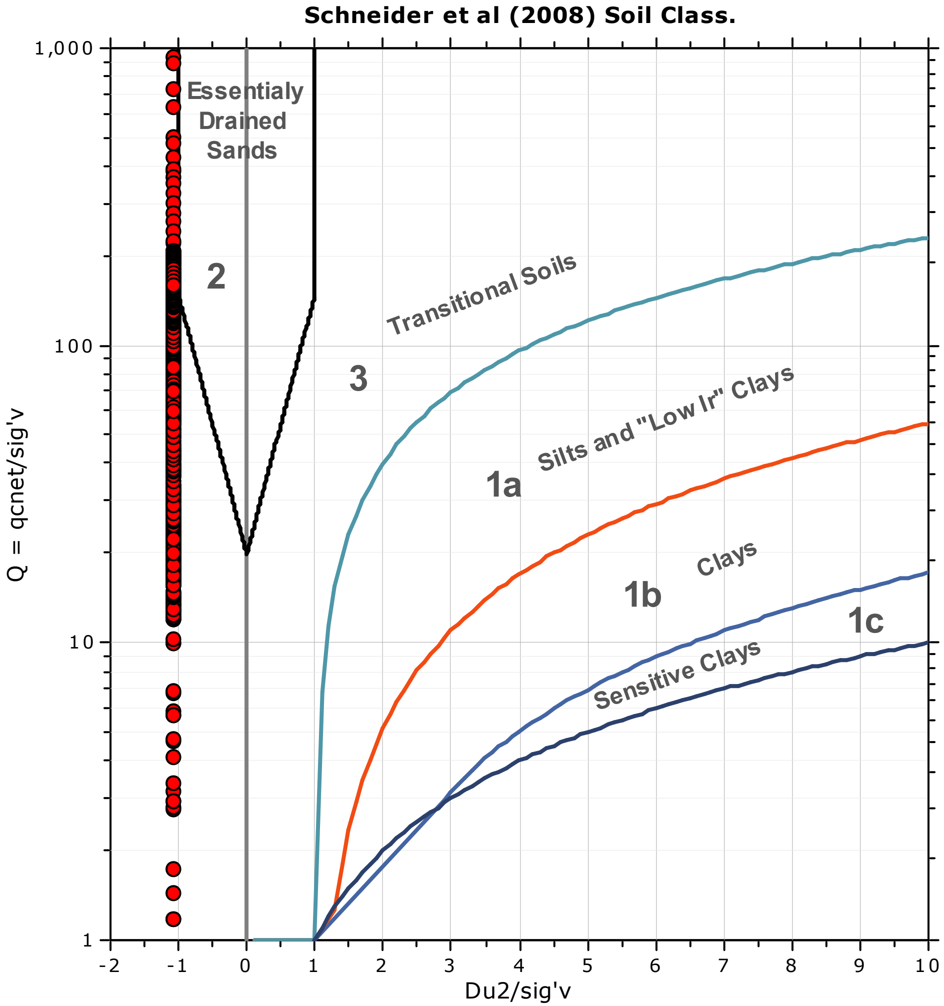
Normalized Bq plot

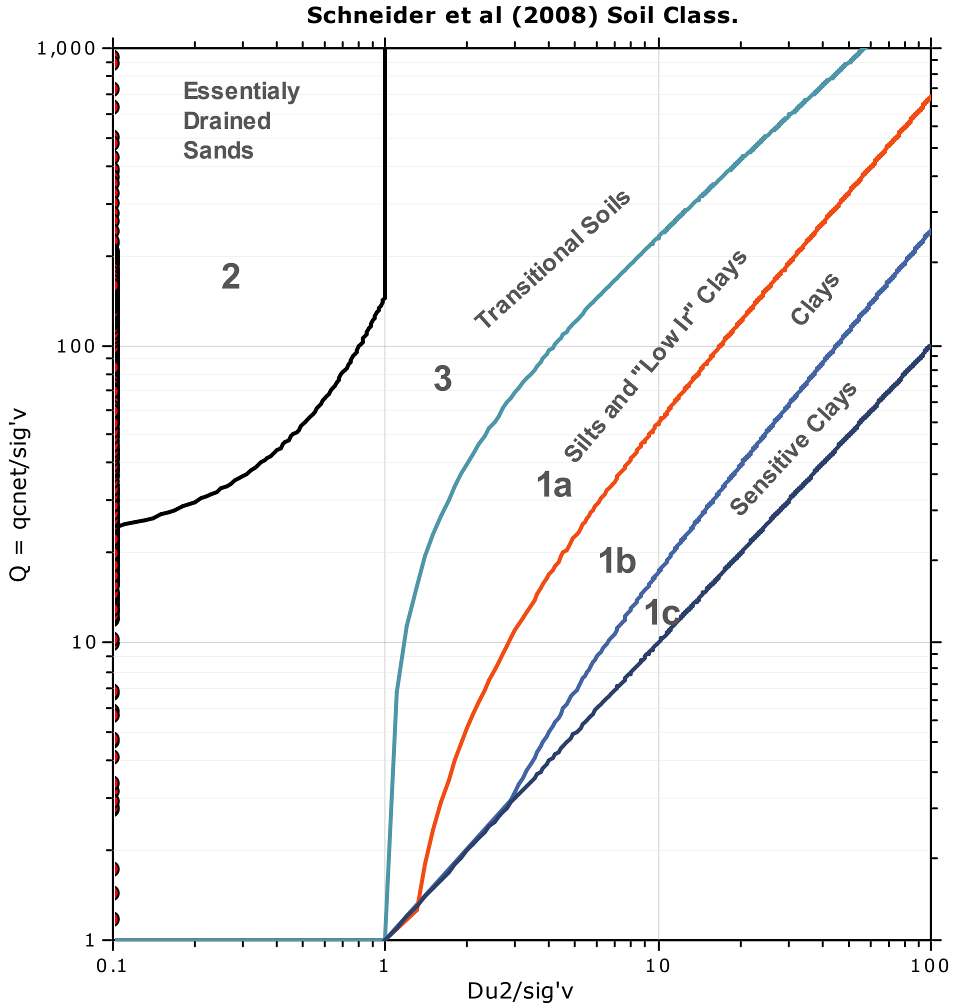


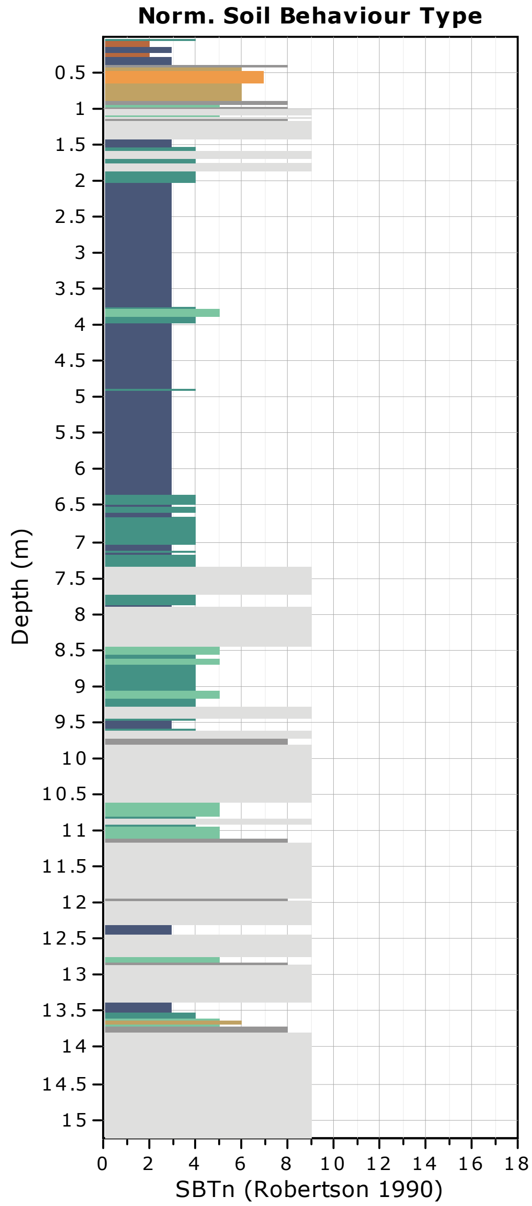
SBTn legend

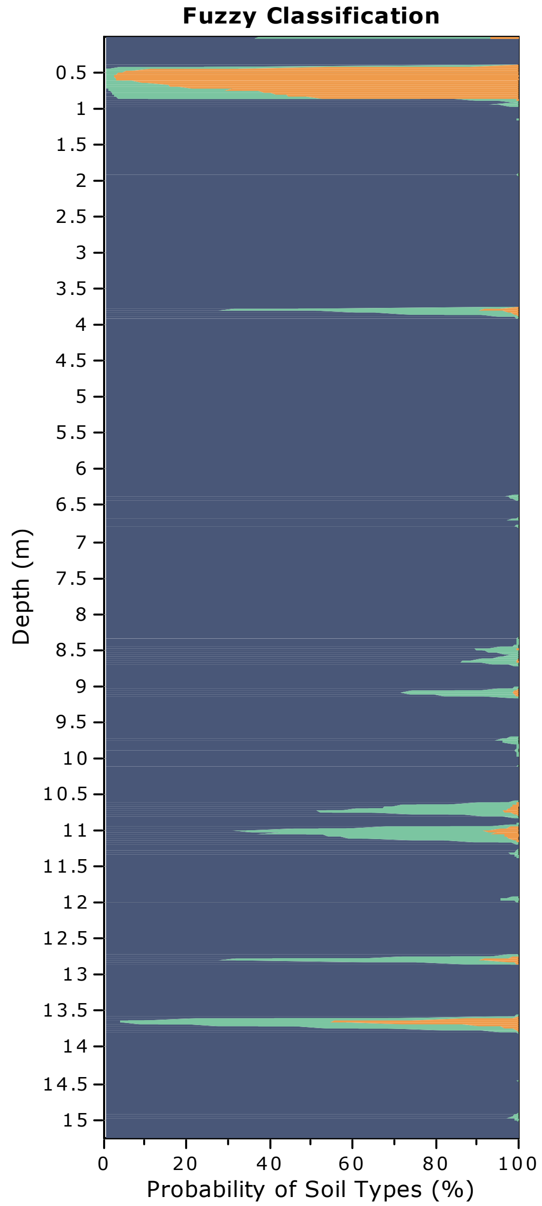
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

Bq plots (Schneider)






Norm. Soil Behaviour Type
Depth (m)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
11.5
12
12.5
13
13.5
14
14.5
15
0 2 4 6 8 10 12 14 16 18
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
11.5
12
12.5
13
13.5
14
14.5
15
0 20 40 60 80 100
Probability of Soil Types (%)

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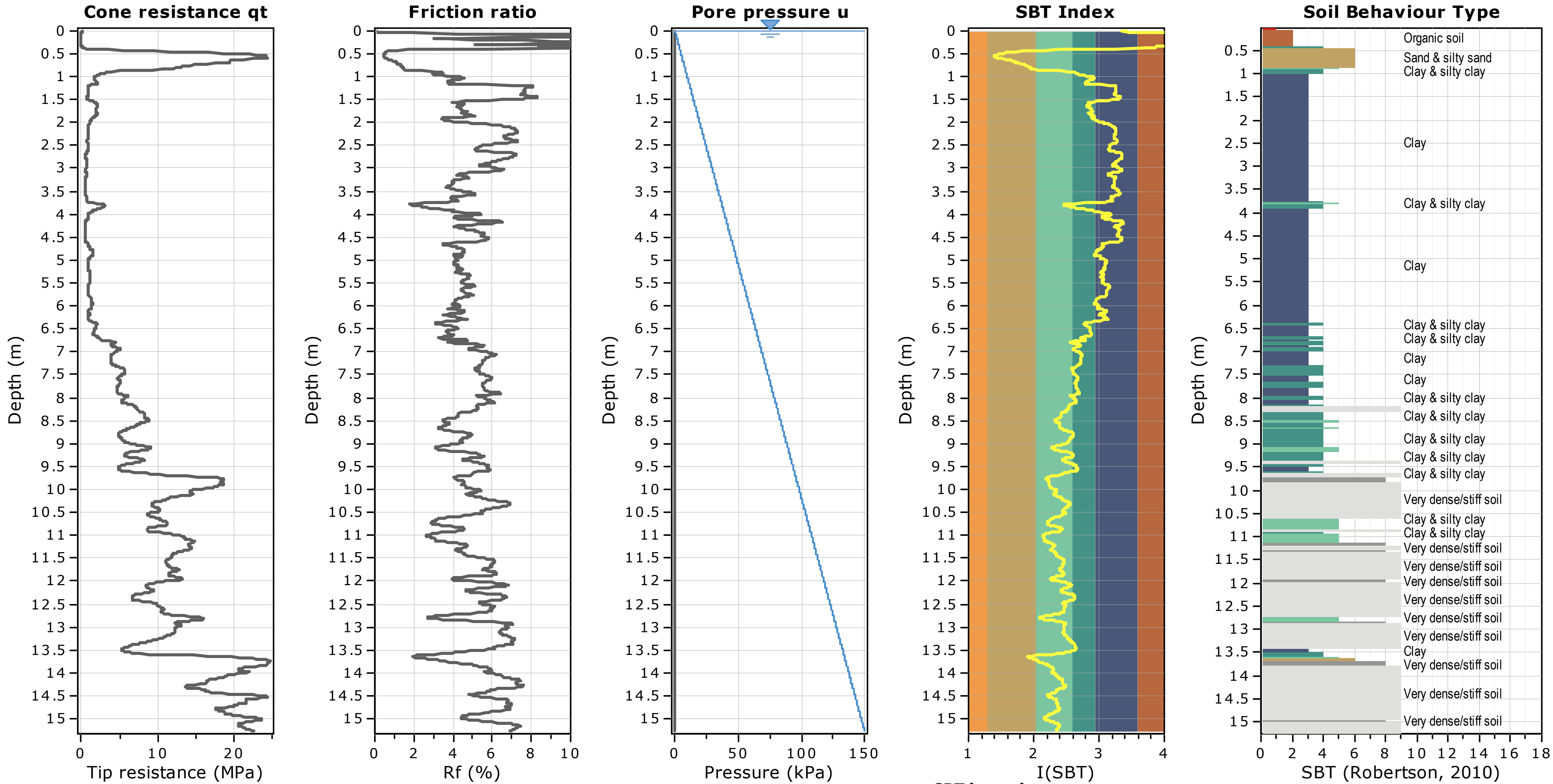
CPT: A4-CPT02
Total depth: 15.26 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBT legend

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

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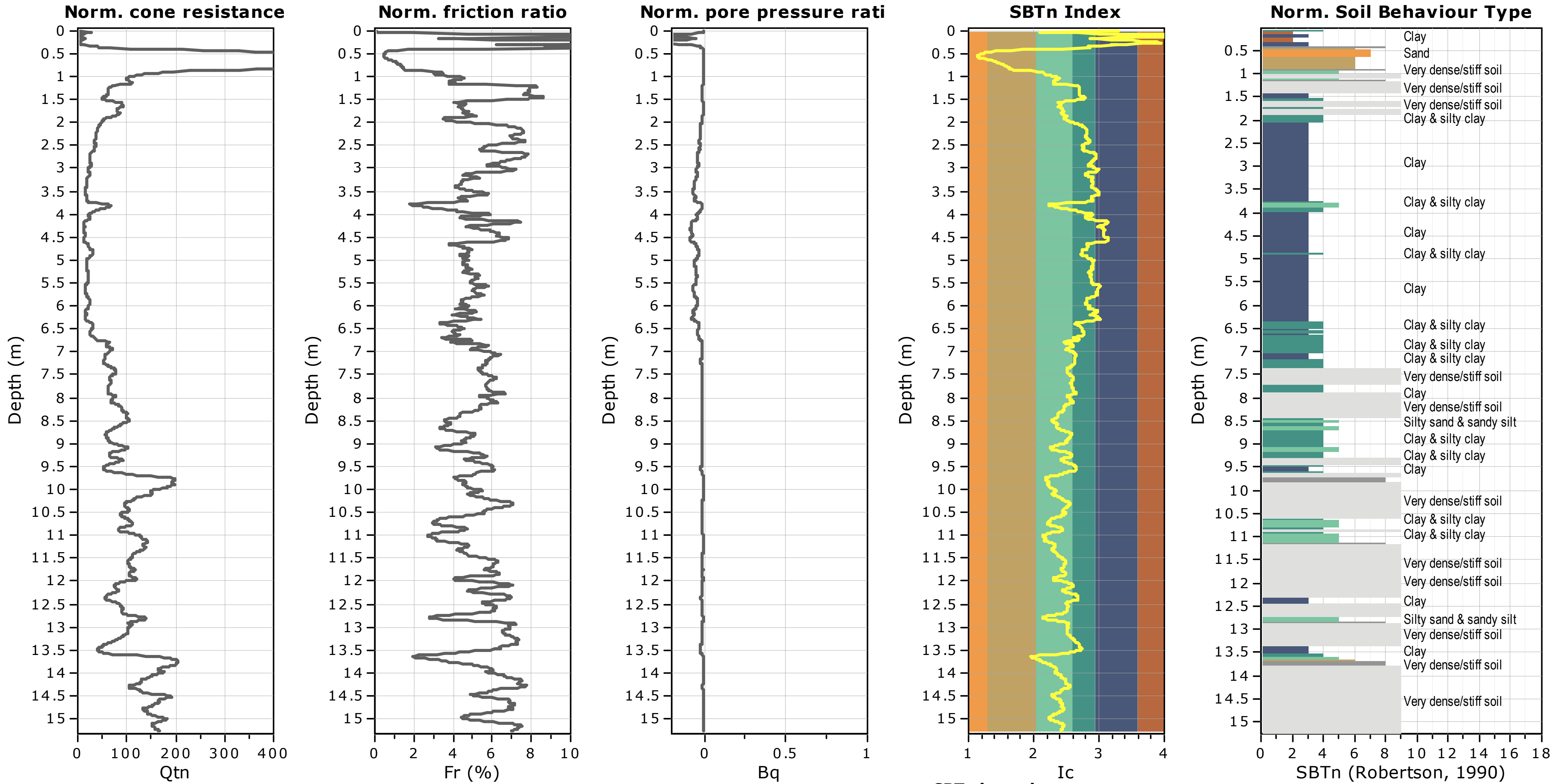
CPT: A4-CPT02
Total depth: 15.26 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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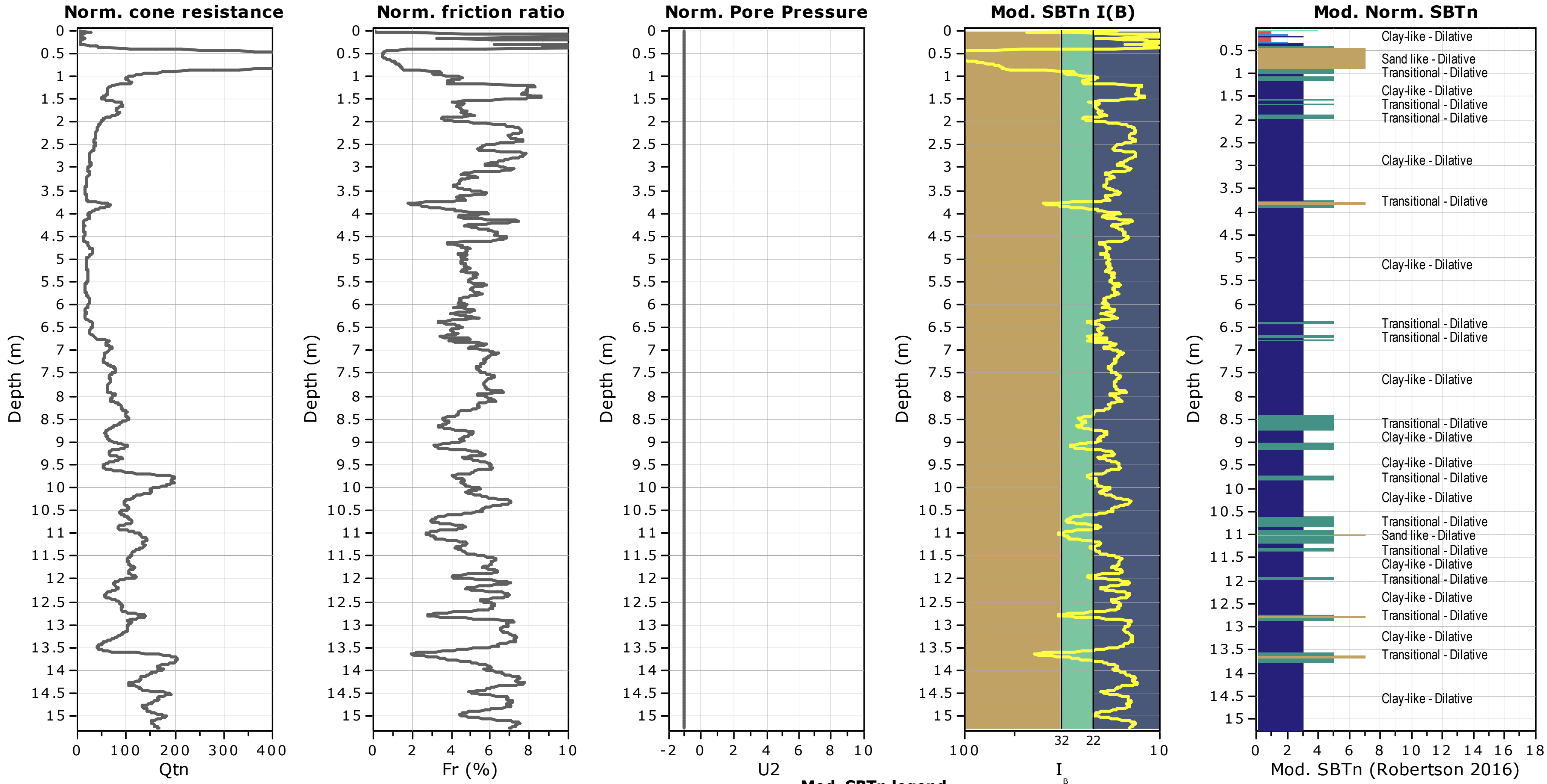
CPT: A4-CPT02
Total depth: 15.26 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Mod. SBTn legend

- 1. CCS: ClayLike - Contractive, Sensitive
- 2. CC: Clay-like - Contractive
- 3. CD: Clay-Like: Dilative
- 4. TC: Transitional - Contractive
- 5. TD: Transitional - Dilative
- 6. SC: Sand-like - Contractive
- 7. SD: Sand-like - Dilative

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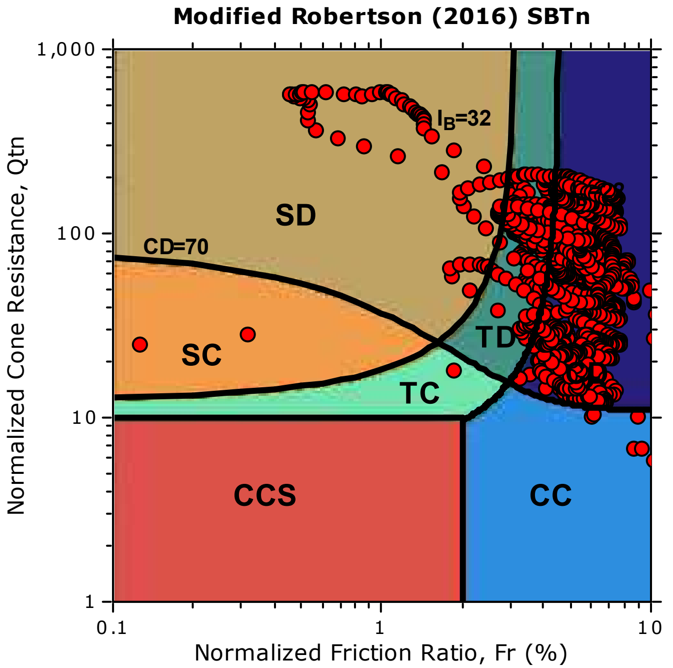
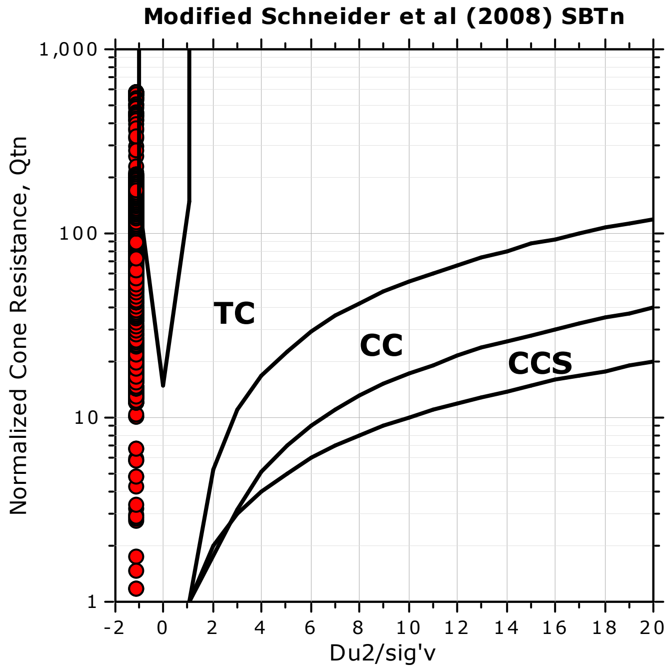
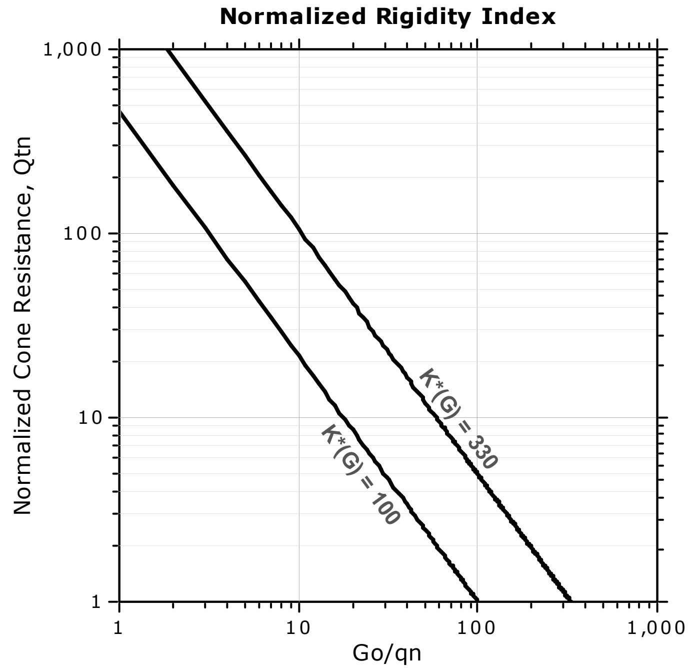
CPT: A4-CPT02
Total depth: 15.26 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

Updated SBTn plots







CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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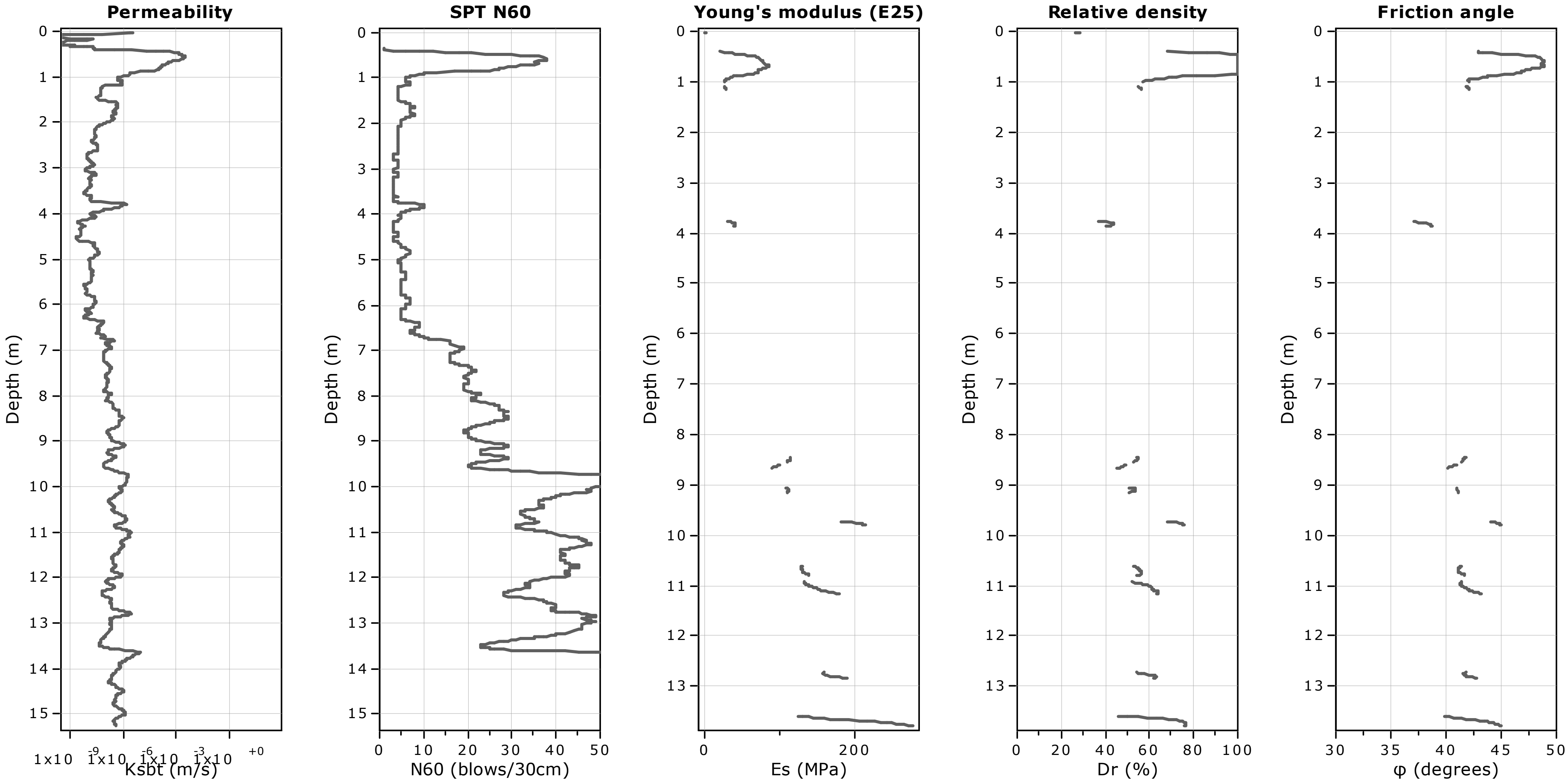
CPT: A4-CPT02
Total depth: 15.26 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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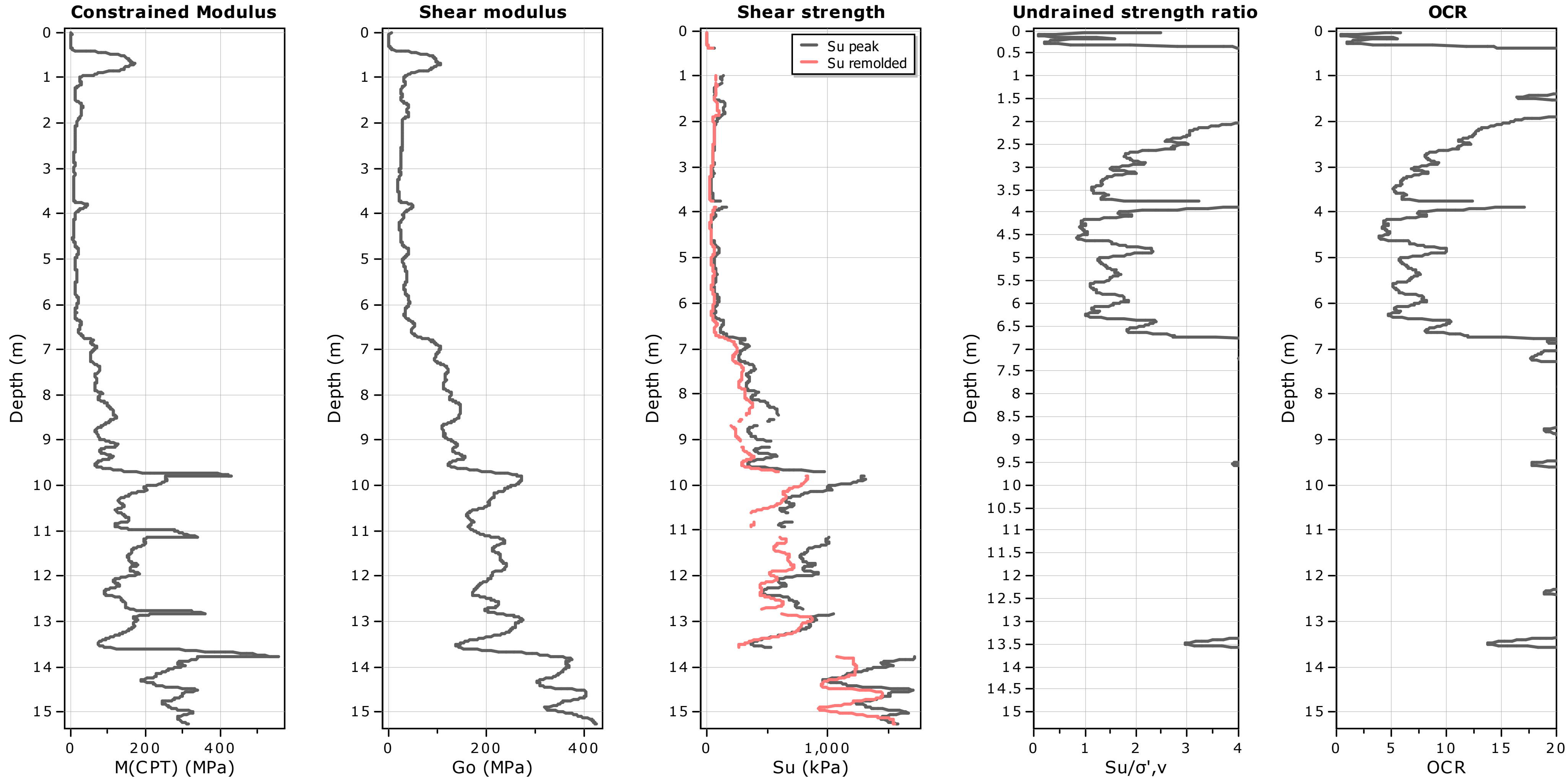
CPT: A4-CPT02
Total depth: 15.26 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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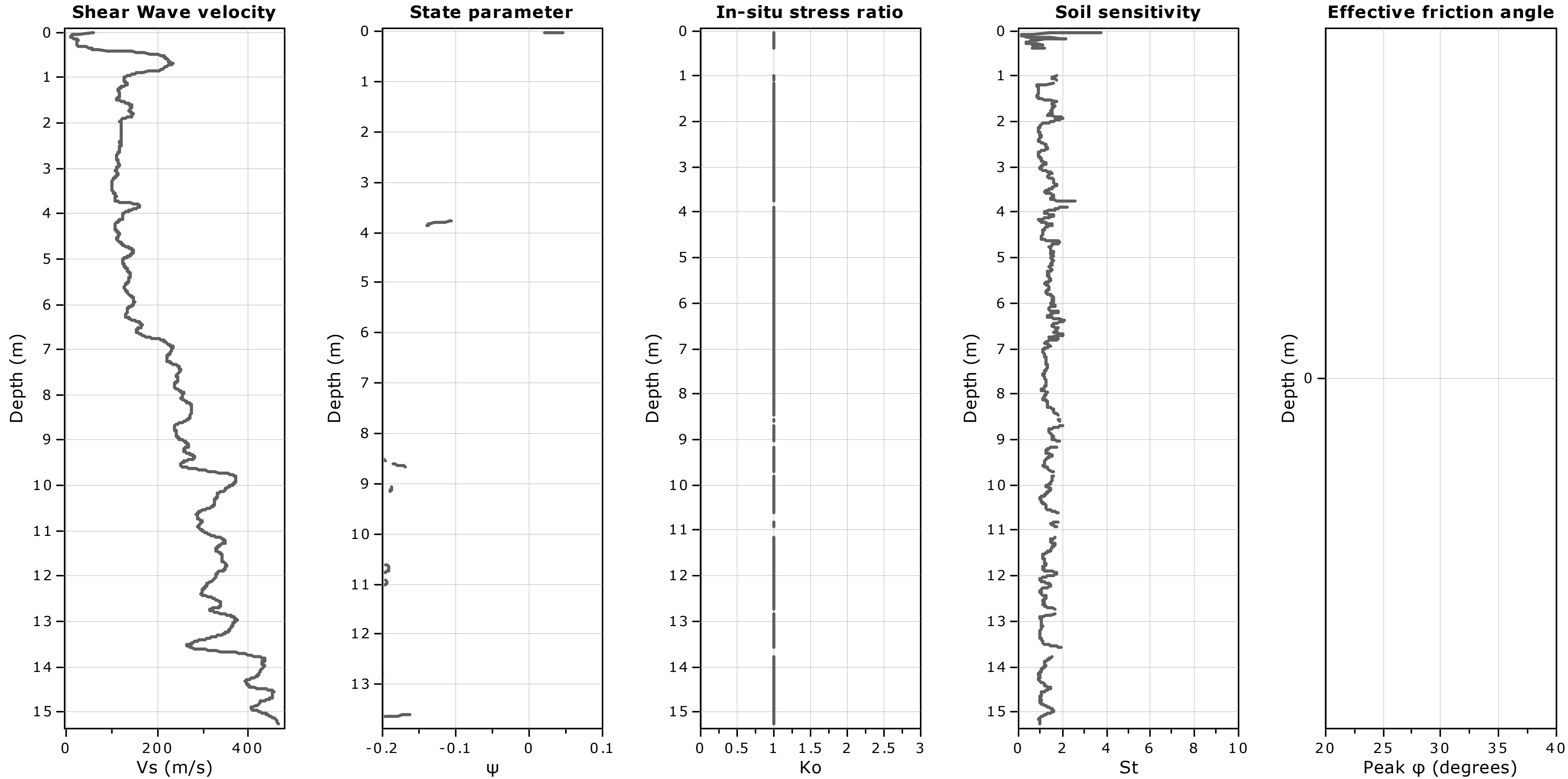
CPT: A4-CPT02
Total depth: 15.26 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

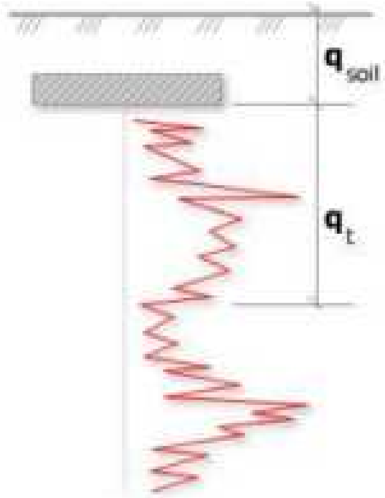
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

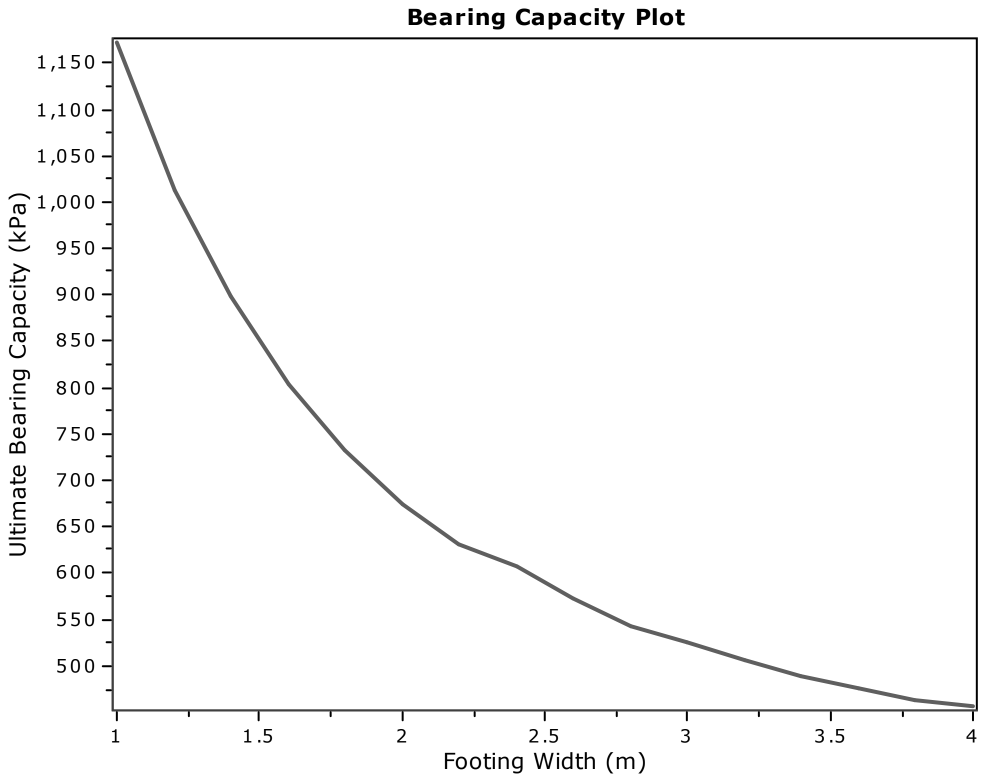
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

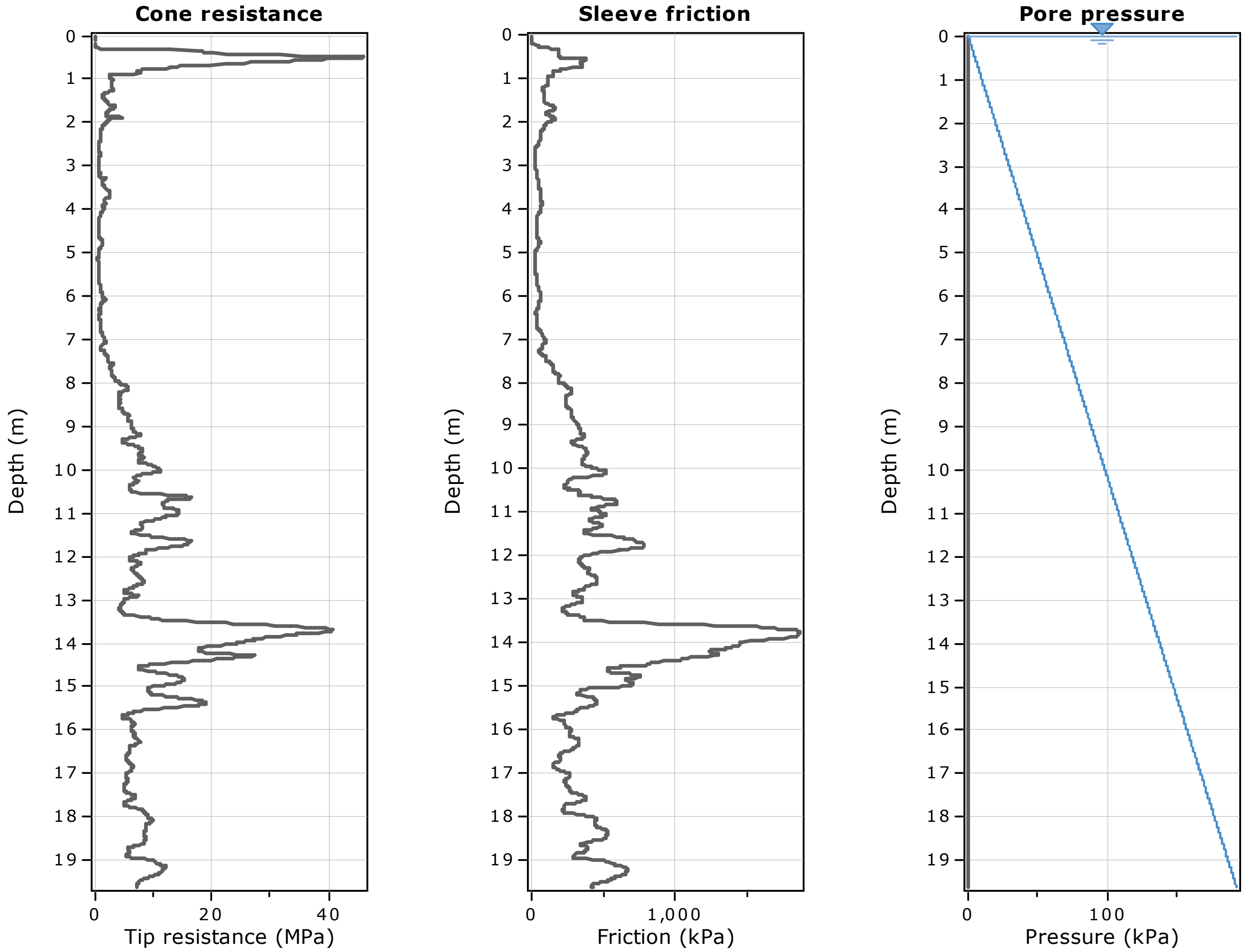
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

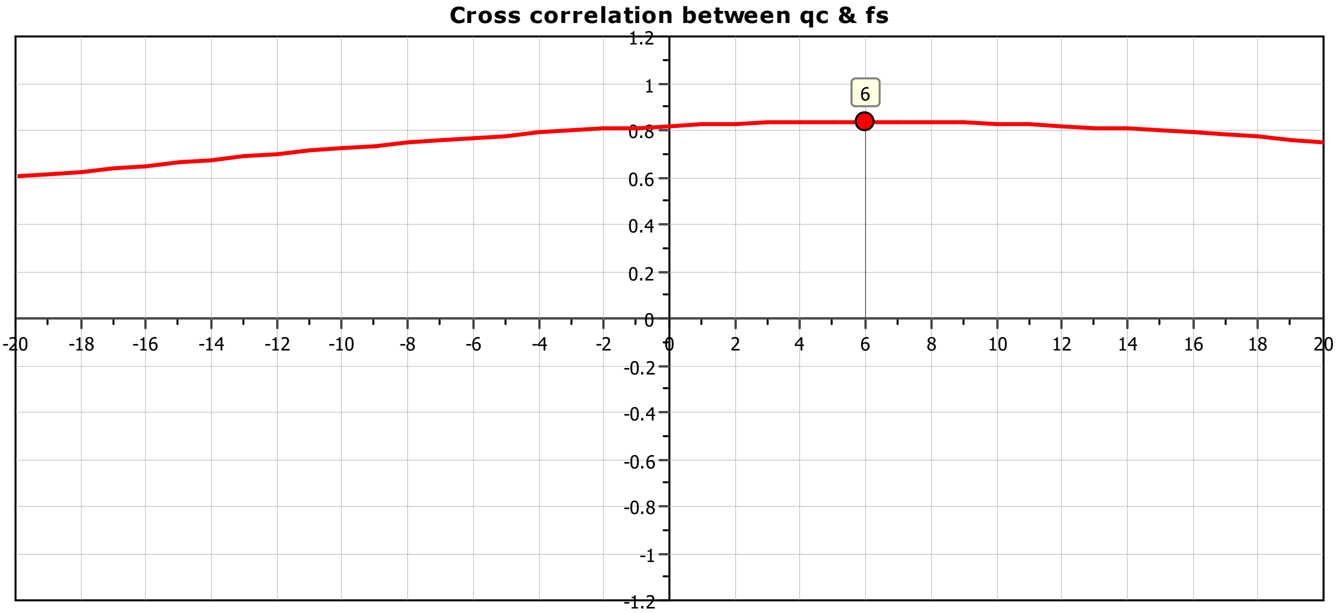


:: Tabular results ::

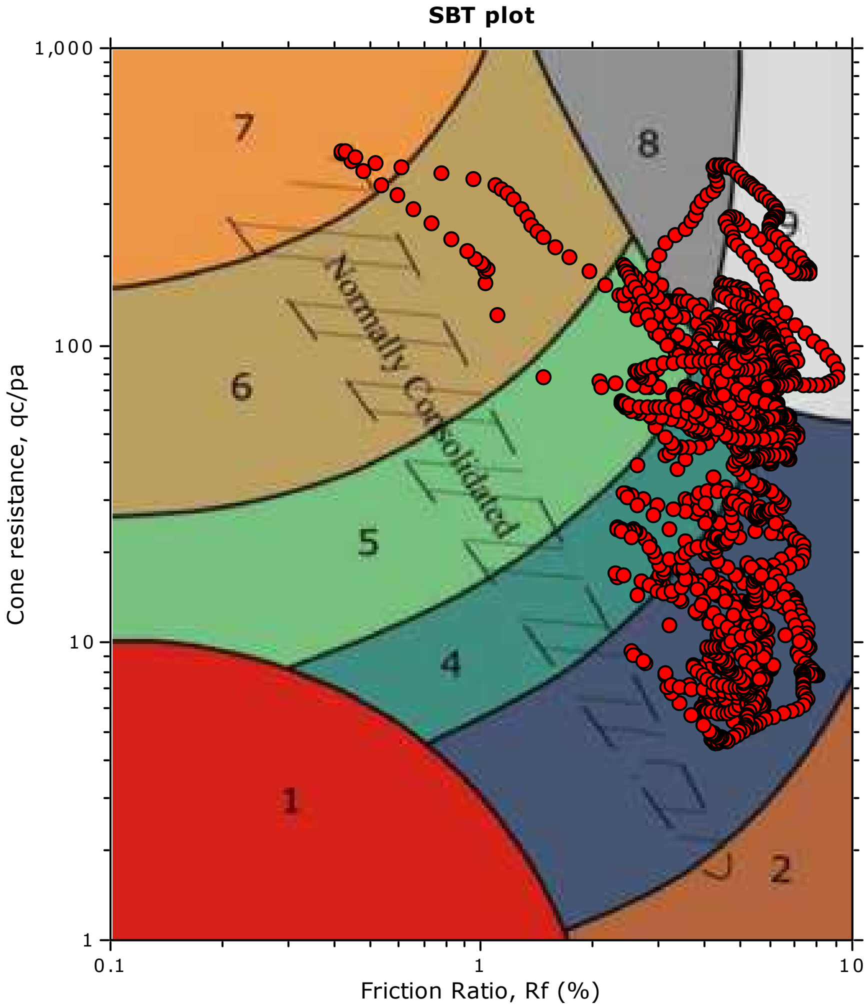
No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	5.81	0.20	9.50	1172.30
2	1.20	0.50	2.30	5.01	0.20	9.50	1012.10
3	1.40	0.50	2.60	4.45	0.20	9.50	899.28
4	1.60	0.50	2.90	3.97	0.20	9.50	804.24
5	1.80	0.50	3.20	3.62	0.20	9.50	733.07
6	2.00	0.50	3.50	3.32	0.20	9.50	673.36
7	2.20	0.50	3.80	3.11	0.20	9.50	631.60
8	2.40	0.50	4.10	2.99	0.20	9.50	607.92
9	2.60	0.50	4.40	2.81	0.20	9.50	571.81
10	2.80	0.50	4.70	2.66	0.20	9.50	542.20
11	3.00	0.50	5.00	2.57	0.20	9.50	524.26
12	3.20	0.50	5.30	2.48	0.20	9.50	504.90
13	3.40	0.50	5.60	2.40	0.20	9.50	488.98
14	3.60	0.50	5.90	2.33	0.20	9.50	474.84
15	3.80	0.50	6.20	2.27	0.20	9.50	463.51
16	4.00	0.50	6.50	2.23	0.20	9.50	456.23

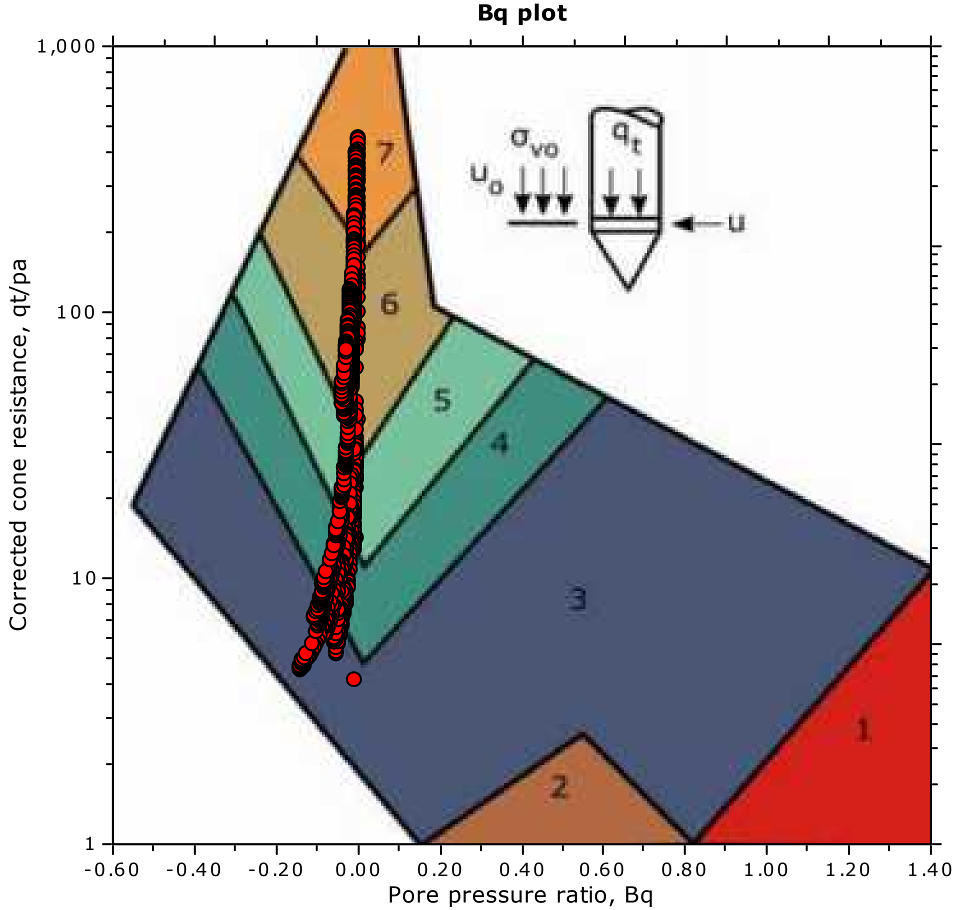


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

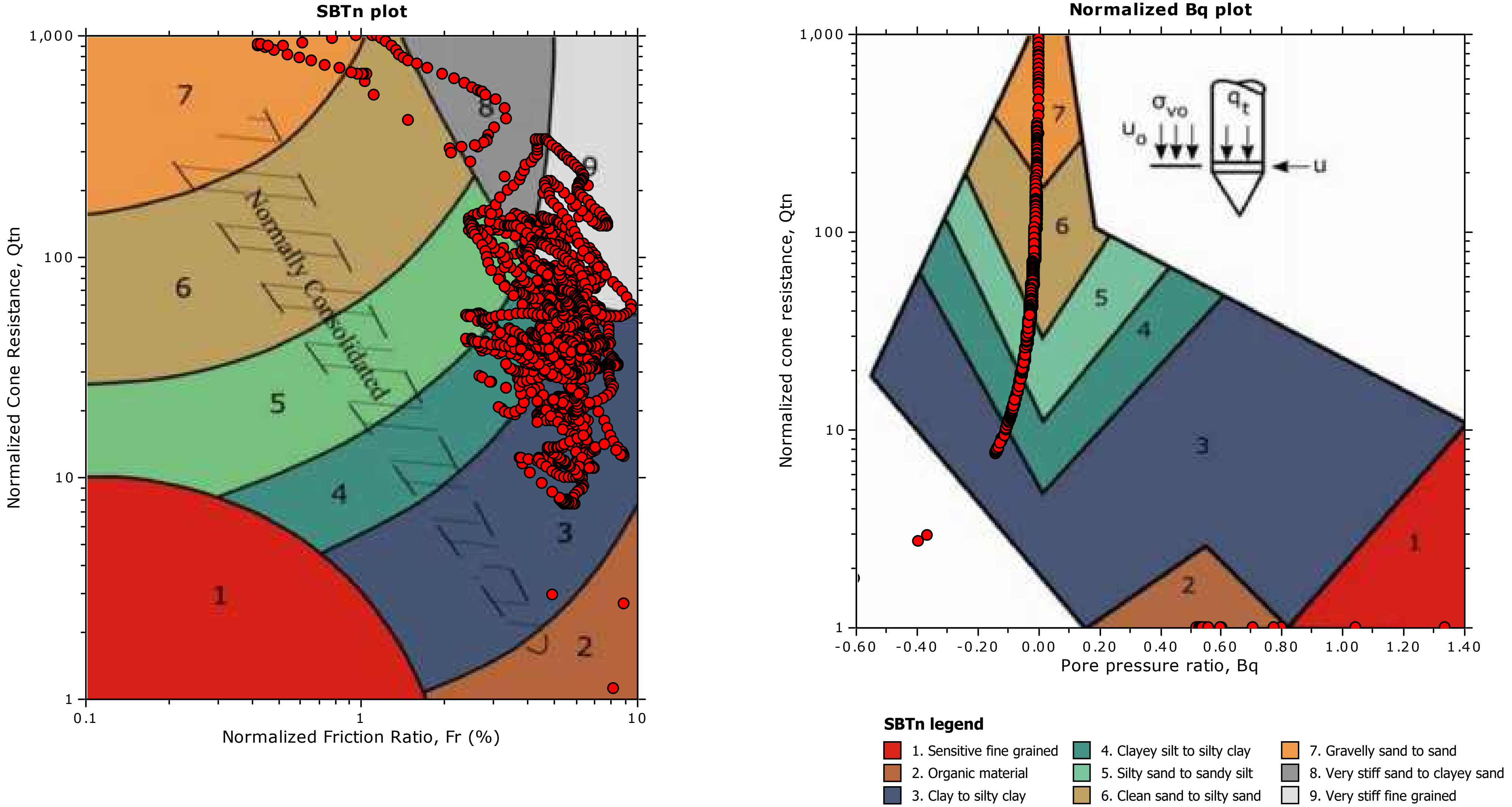




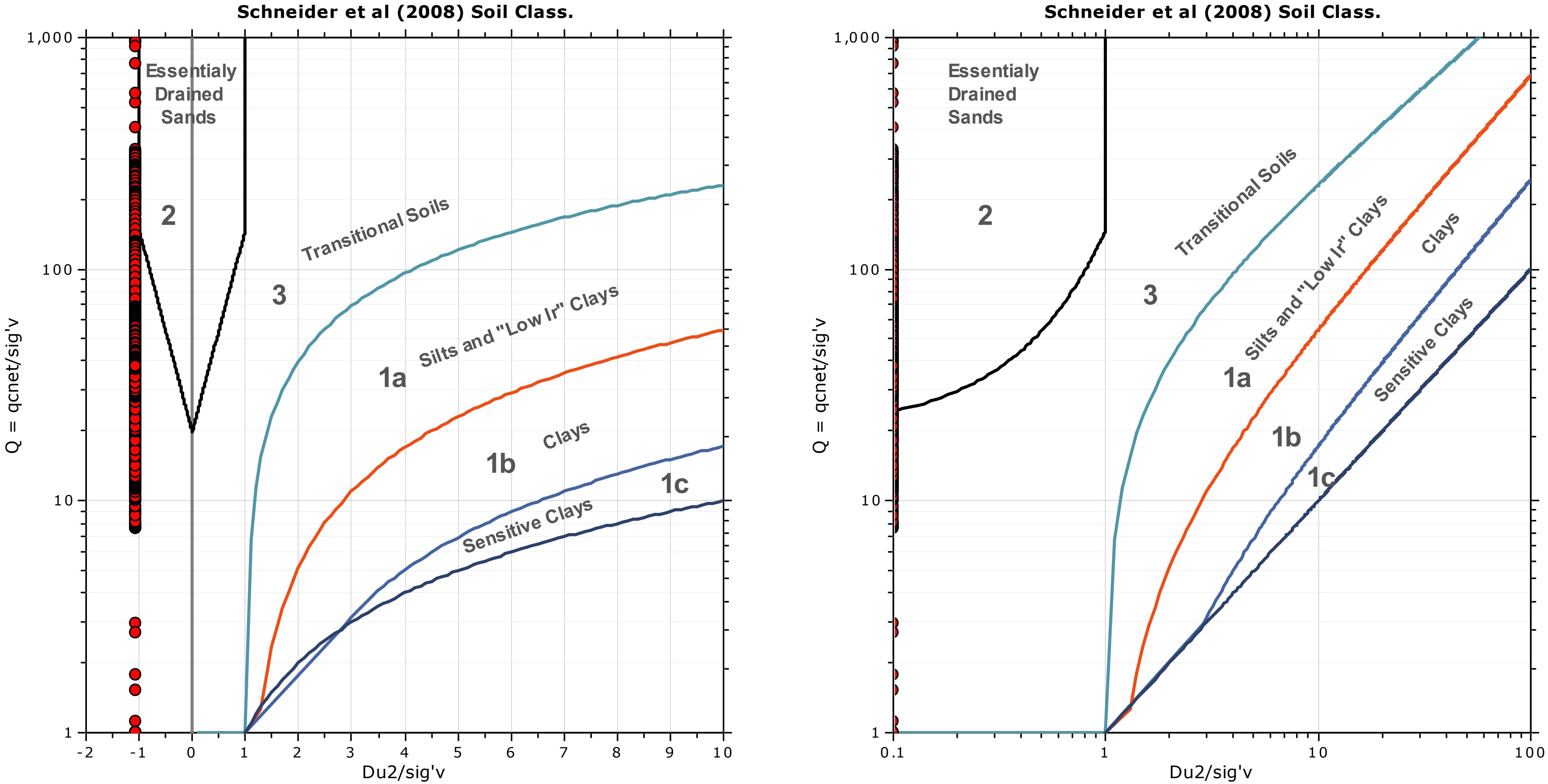
SBT legend

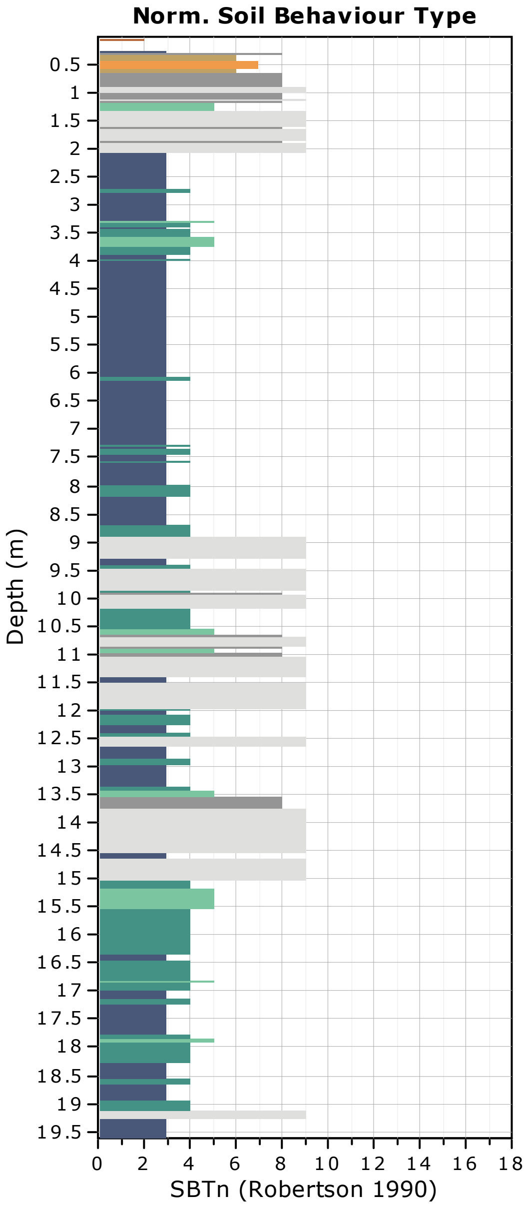
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

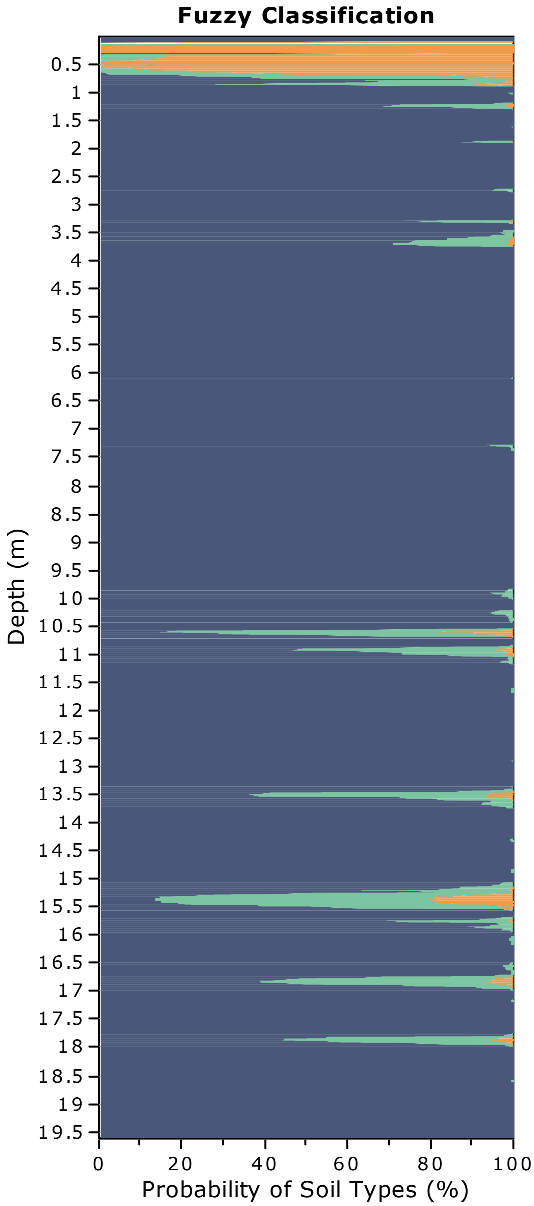
SBT - Bq plots (normalized)



Bq plots (Schneider)




Norm. Soil Behaviour Type
Depth (m)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
Probability of Soil Types (%)

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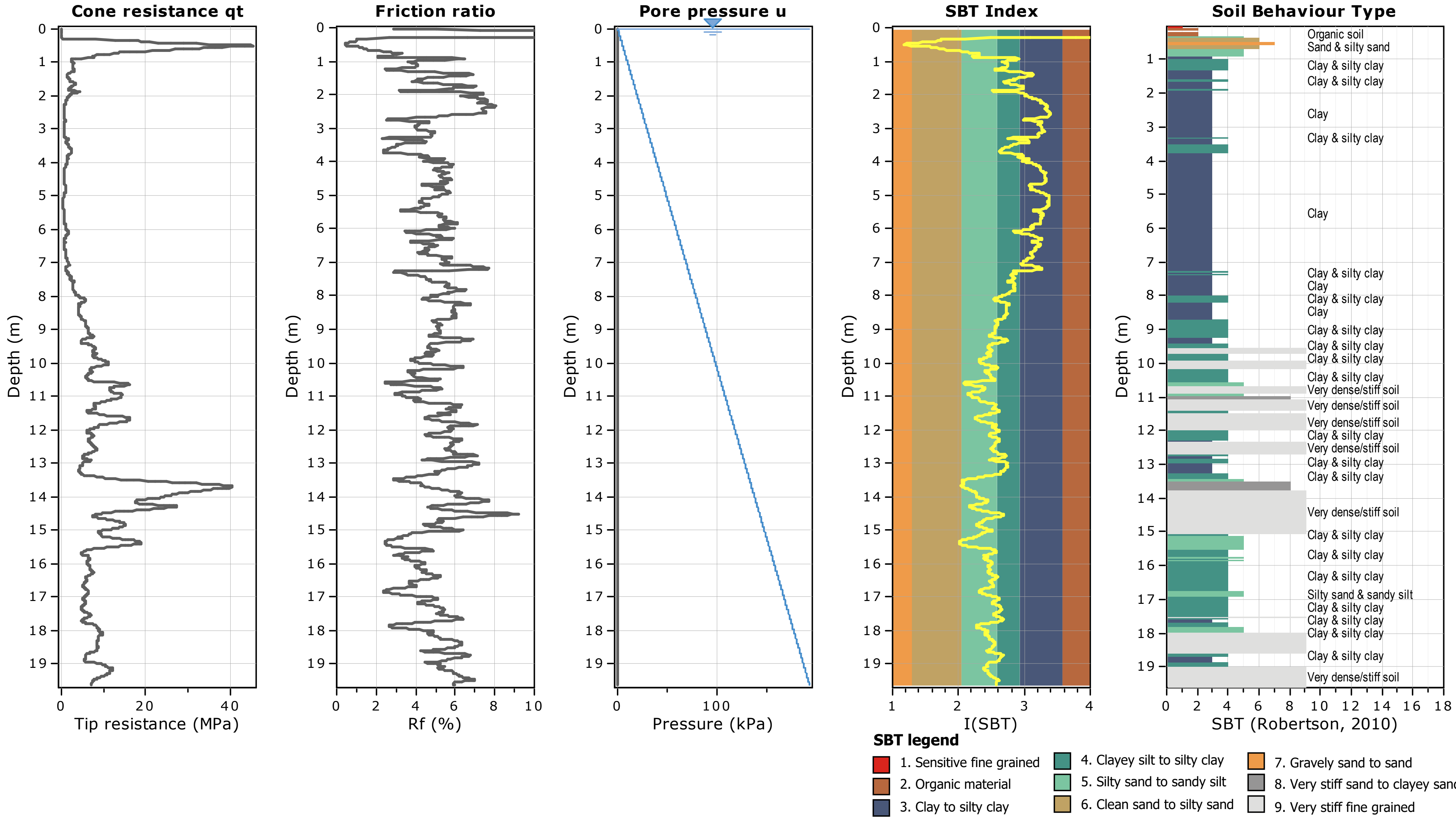
CPT: A4-CPT03
Total depth: 19.62 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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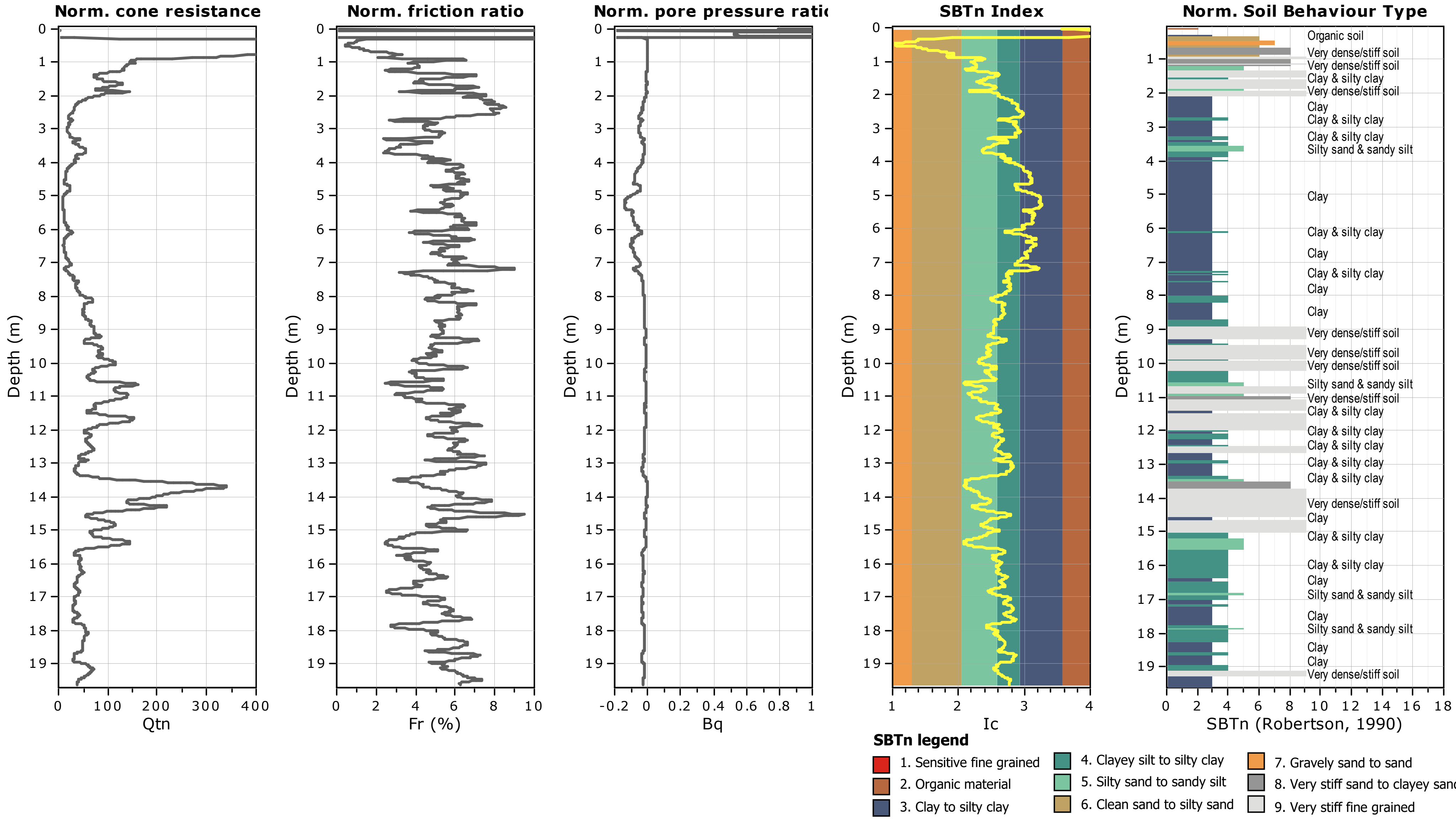
CPT: A4-CPT03
Total depth: 19.62 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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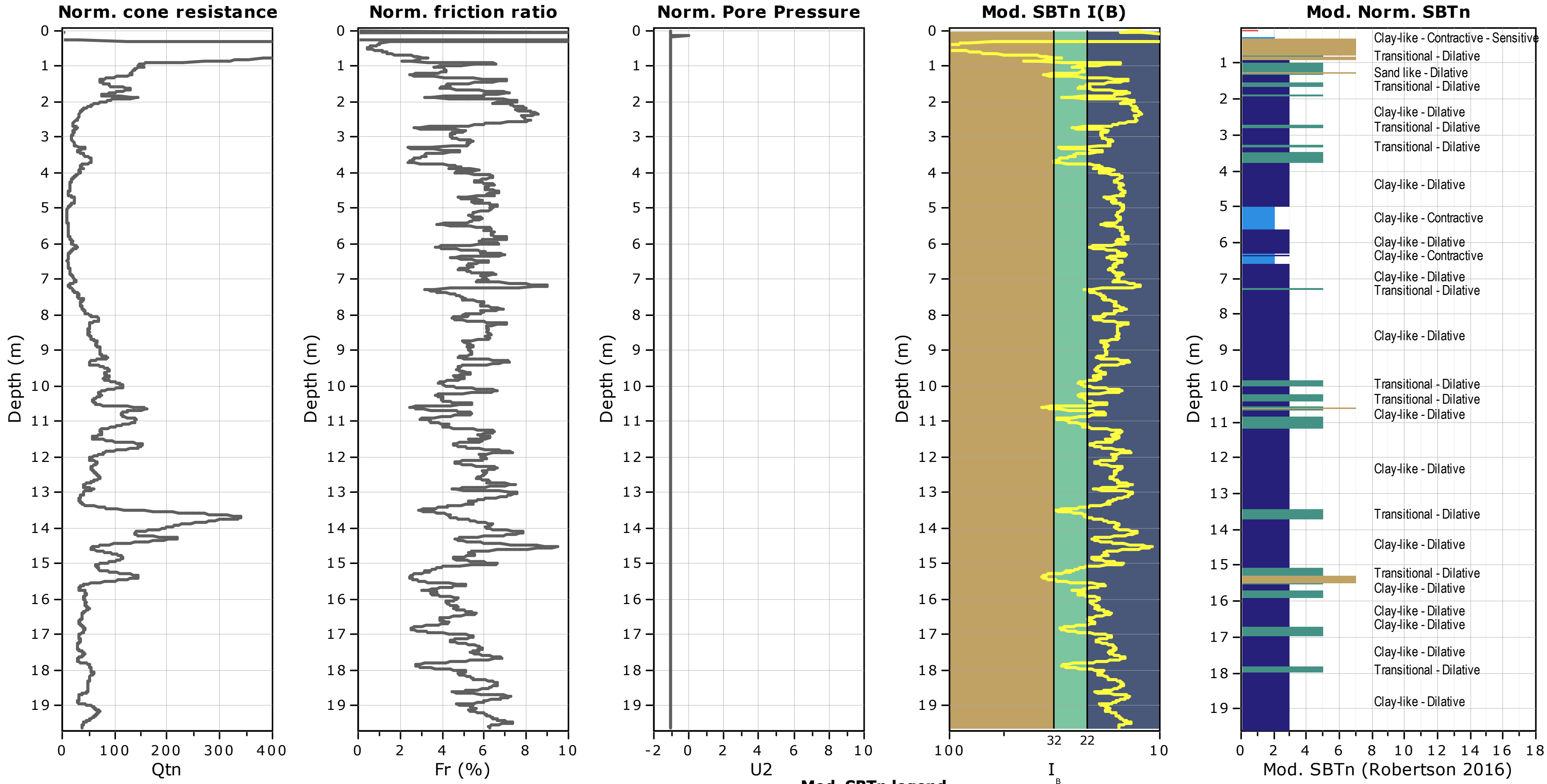
CPT: A4-CPT03
Total depth: 19.62 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

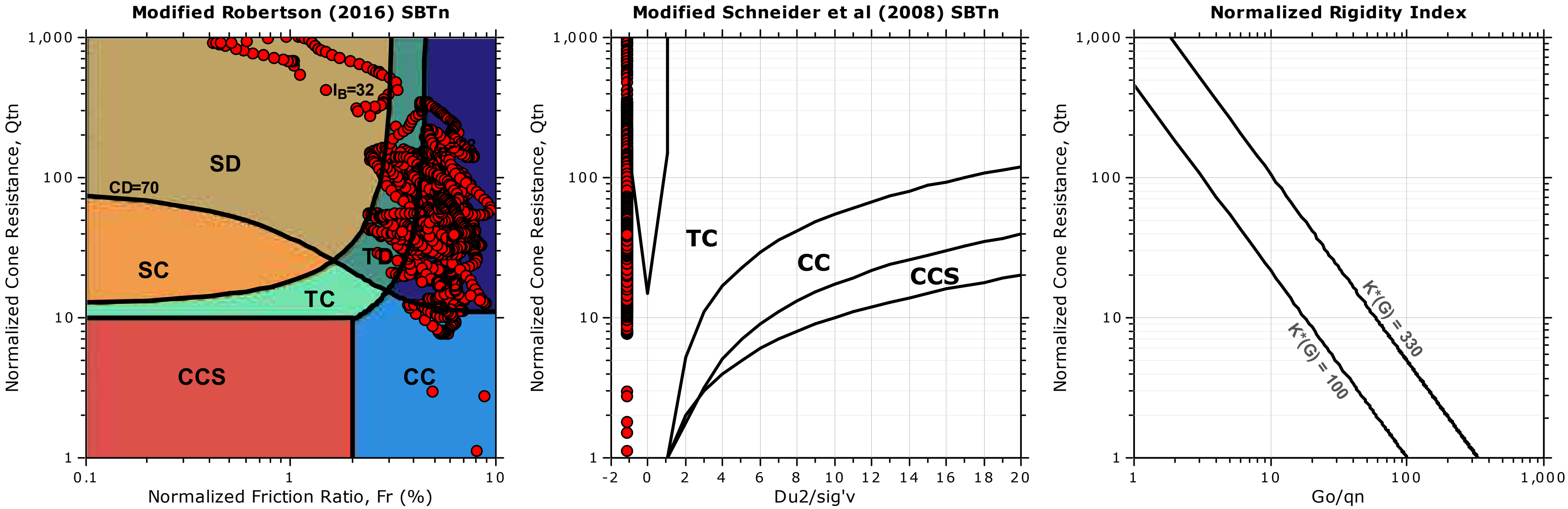
Project:
Location:



Mod. SBTn legend

1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

Updated SBTn plots



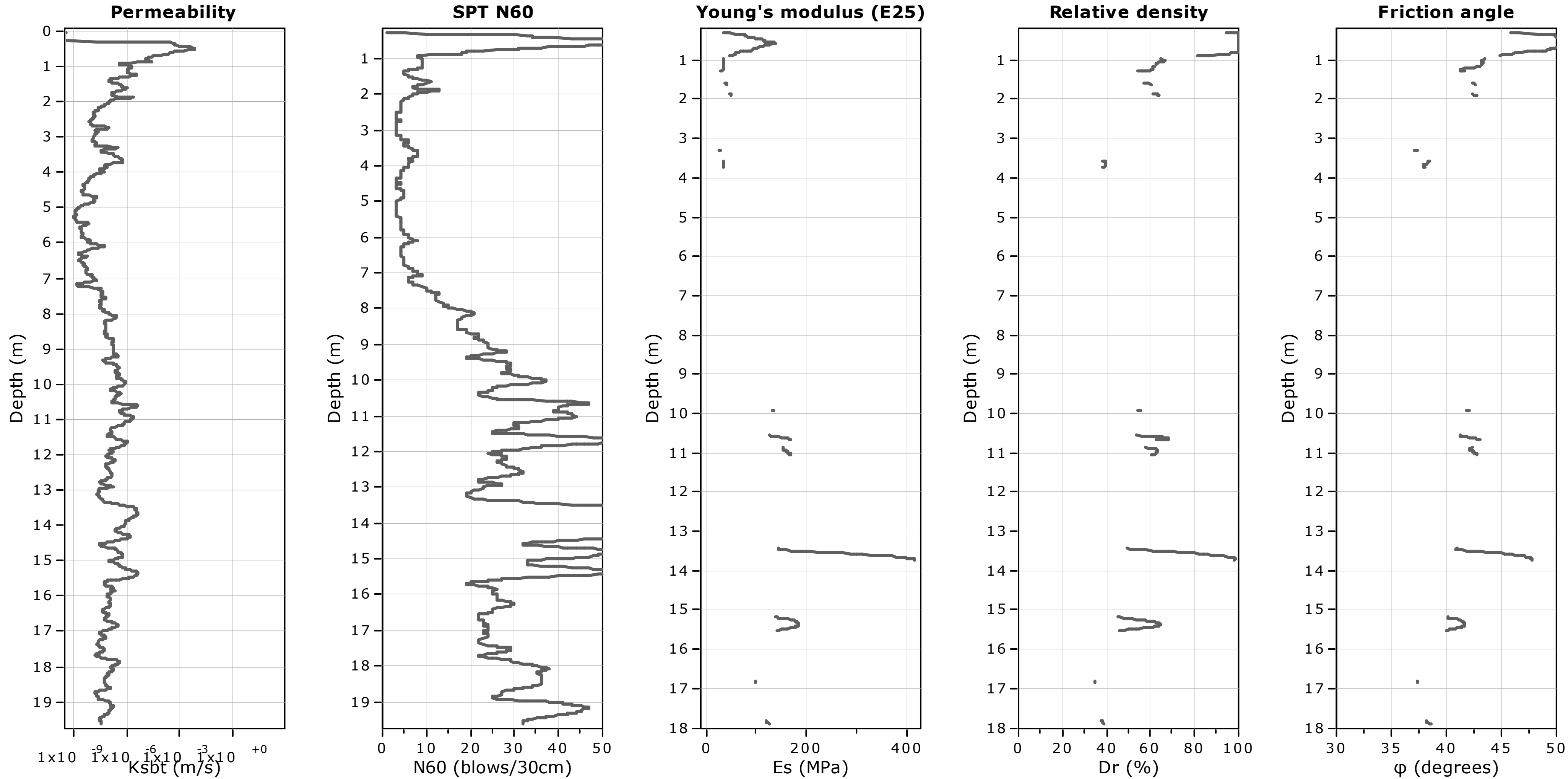
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

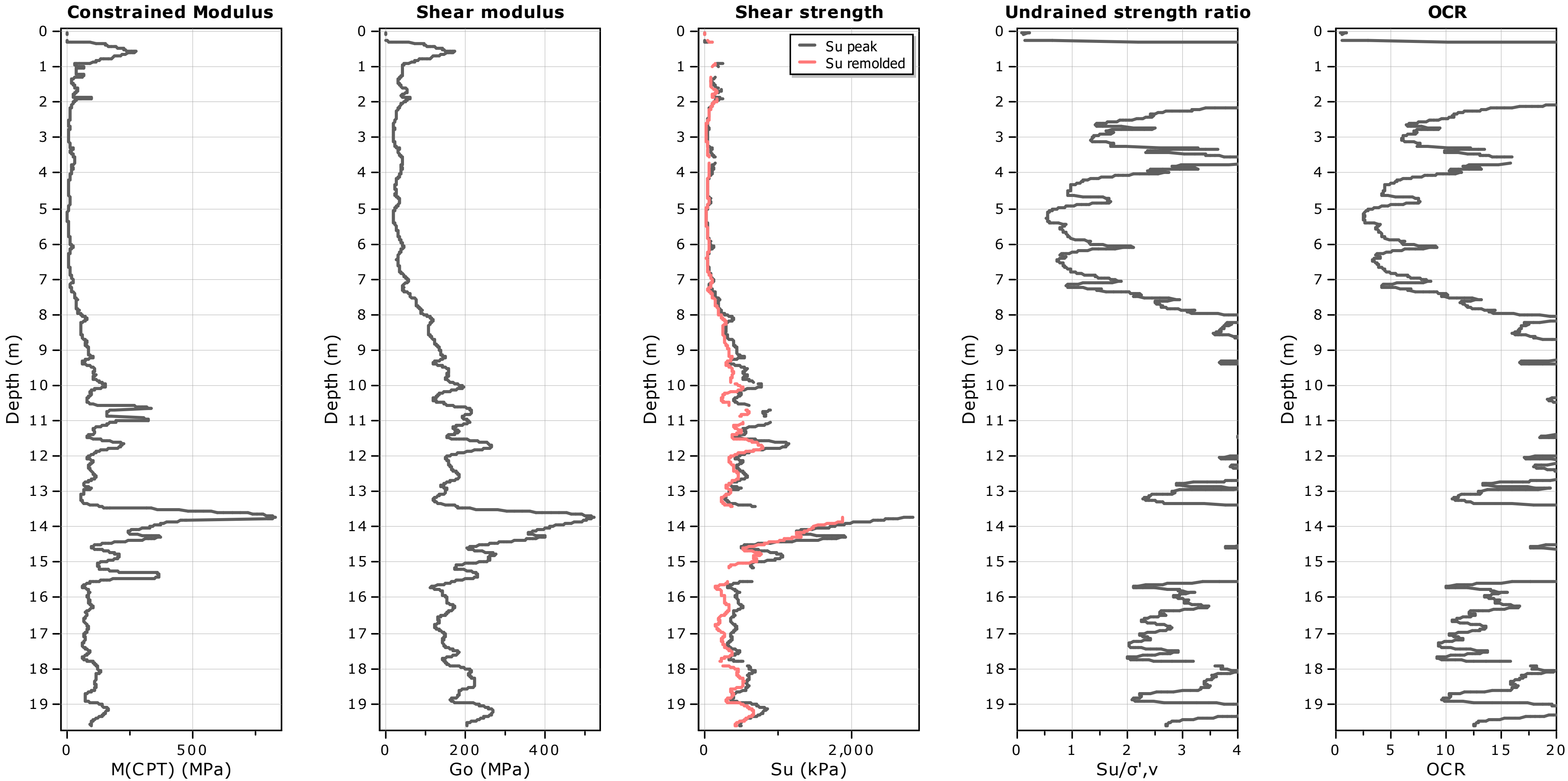
CPT: A4-CPT03
Total depth: 19.62 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters

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



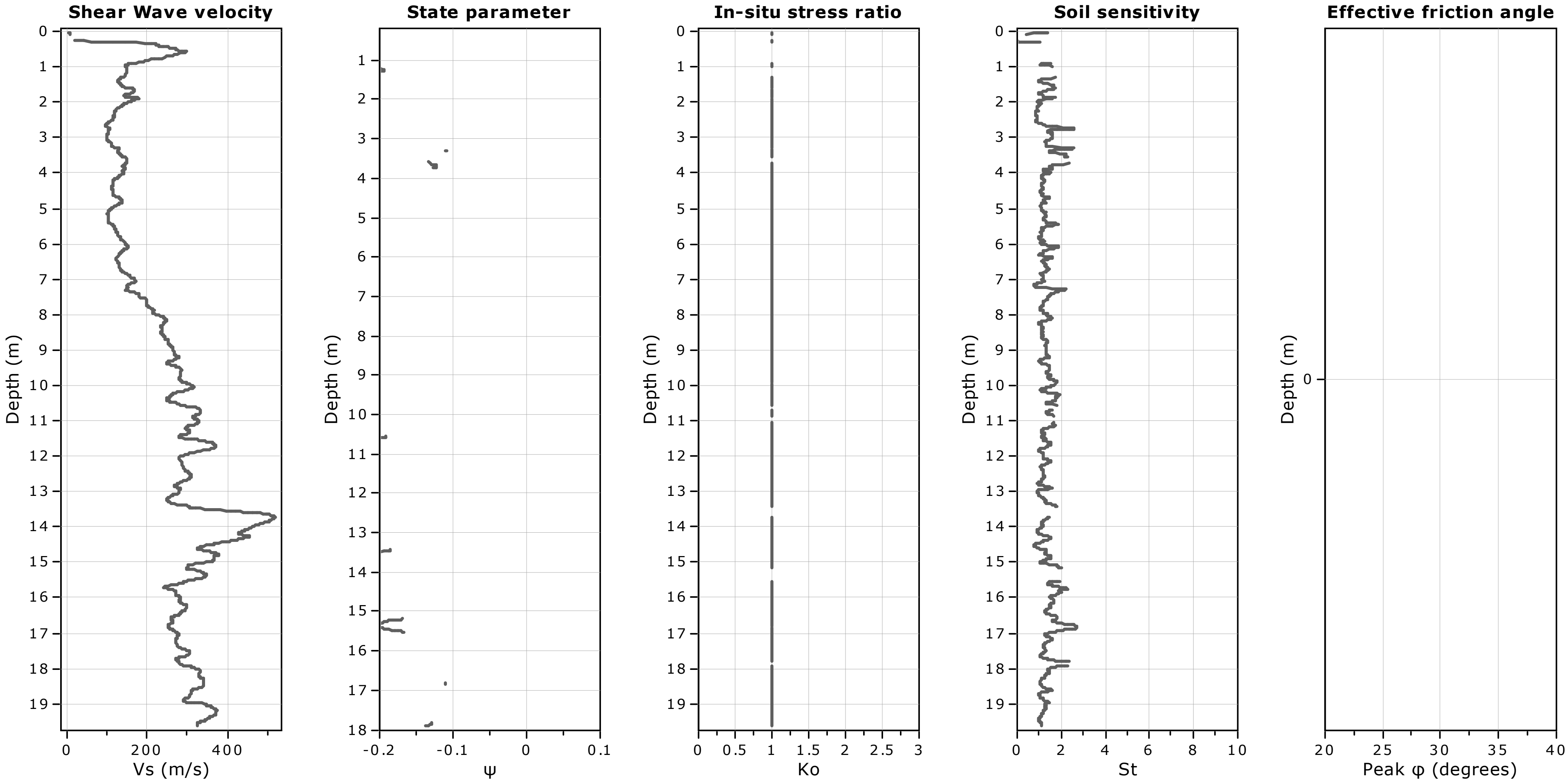
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

CPT: A4-CPT03
Total depth: 19.62 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

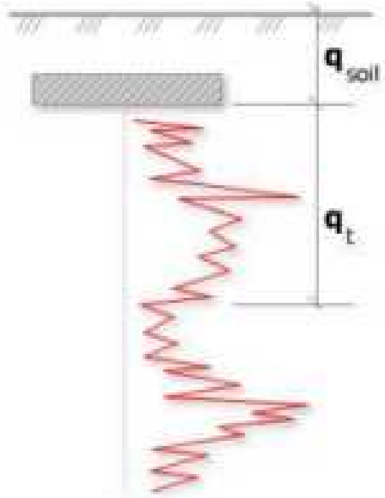
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

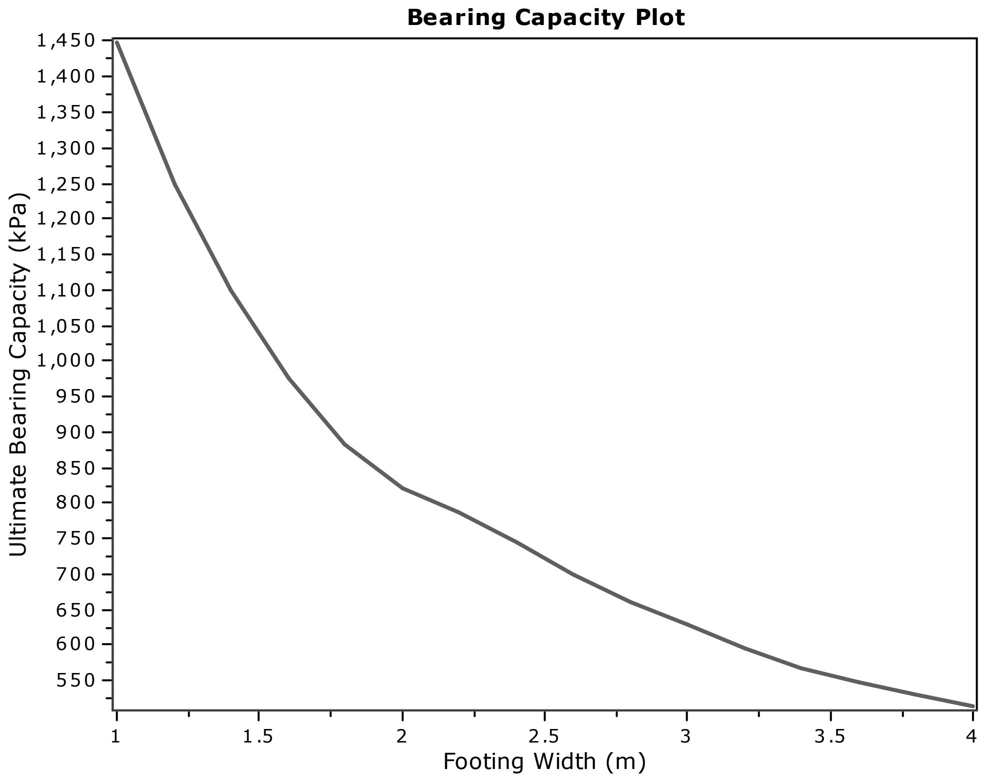
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	7.20	0.20	9.50	1448.55
2	1.20	0.50	2.30	6.20	0.20	9.50	1249.71
3	1.40	0.50	2.60	5.45	0.20	9.50	1098.50
4	1.60	0.50	2.90	4.83	0.20	9.50	975.81
5	1.80	0.50	3.20	4.37	0.20	9.50	883.03
6	2.00	0.50	3.50	4.06	0.20	9.50	821.09
7	2.20	0.50	3.80	3.88	0.20	9.50	785.79
8	2.40	0.50	4.10	3.67	0.20	9.50	743.69
9	2.60	0.50	4.40	3.45	0.20	9.50	698.54
10	2.80	0.50	4.70	3.25	0.20	9.50	659.24
11	3.00	0.50	5.00	3.09	0.20	9.50	628.31
12	3.20	0.50	5.30	2.93	0.20	9.50	595.70
13	3.40	0.50	5.60	2.79	0.20	9.50	568.48
14	3.60	0.50	5.90	2.68	0.20	9.50	546.38
15	3.80	0.50	6.20	2.61	0.20	9.50	531.93
16	4.00	0.50	6.50	2.52	0.20	9.50	513.87

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

:: N_{SPT} (blows per 30 cm) ::

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

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

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

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

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

:: Relative Density, Dr (%) ::

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

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

:: State Parameter, ψ ::

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

:: Drained Friction Angle, φ (°) ::

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

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

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

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

If $I_c \geq 2.20$

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

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

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

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

:: Soil Sensitivity, S_t ::

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

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

:: Peak Friction Angle, φ' (°) ::

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

(applicable for $0.10 < B_q < 1.00$)

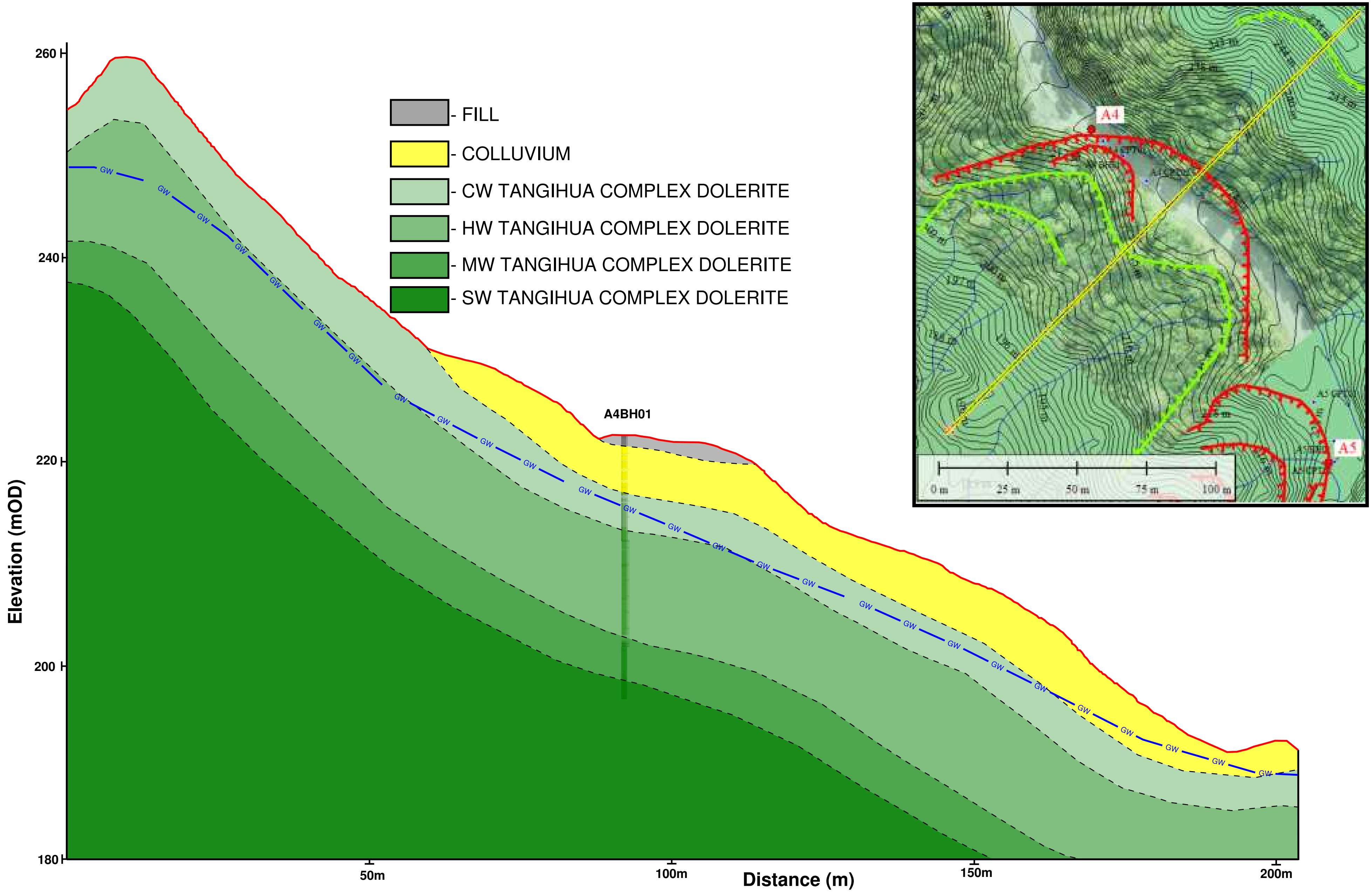
References

• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

Appendix B

Conceptual Geological Cross Section



wsp Level 3, The Westhaven 100 Beaumont Street Auckland 1010 New Zealand	Project: NZTA Northland Resilience and Emergency Works- Mangamuka SH1	Job number: 1-11240.00
	Description: 22A4- Geological Cross Section	Revision: 001
	Drawn by: ML / Checked by:	Date: 29/11/2022

Appendix C

Rainfall Data

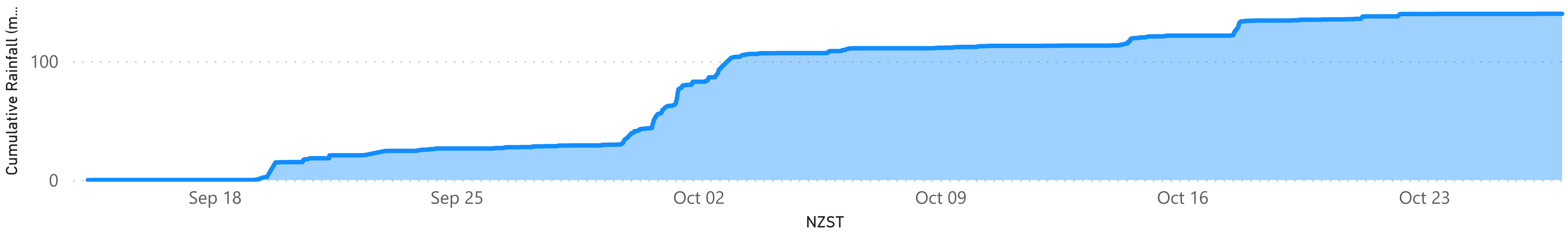
Inclinometer Data

Mangamuka Gorge

NZST

9/14/2022 10/26/2022

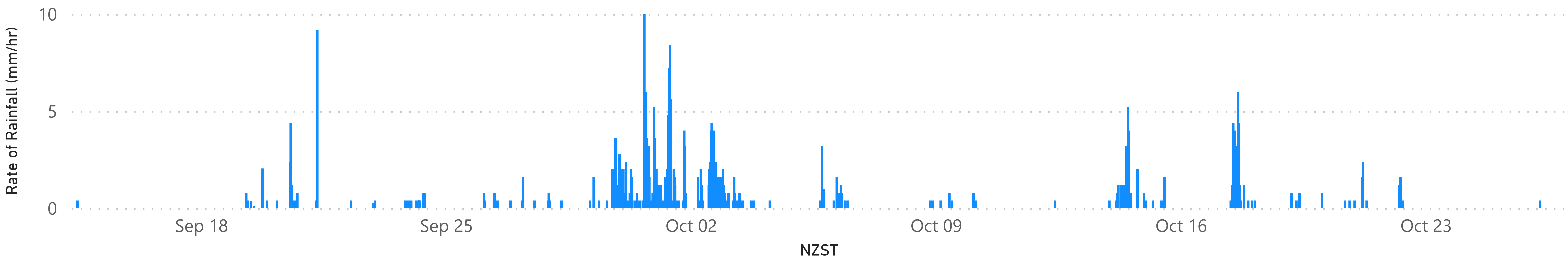
Cumulative Rainfall (mm) since 14/09/2022 by NZST



140.00

Cumulative Rainfall (mm) during sliced period

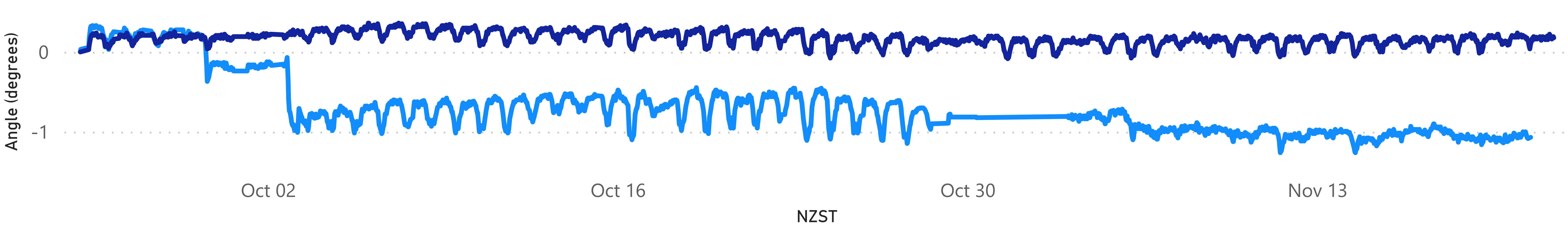
Rate of Rainfall (mm/hr) by NZST



Mangamuka Gorge - Site A4 (T11 - T12)

9/17/2022 11/22/2022

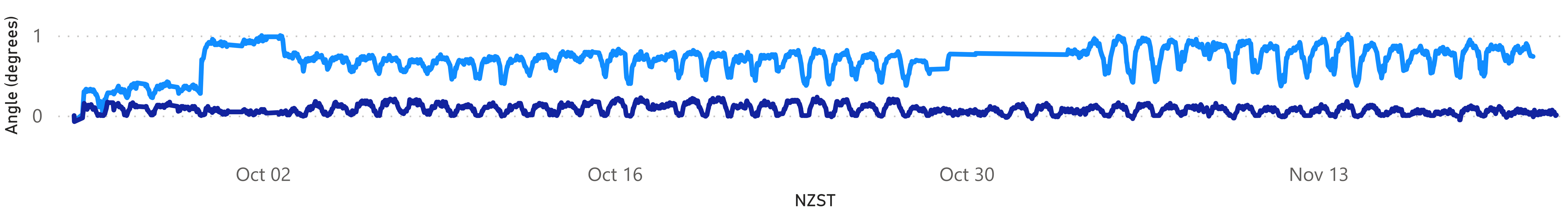
MA Tilt 11 X Axis and MA Tilt 12 X Axis by NZST



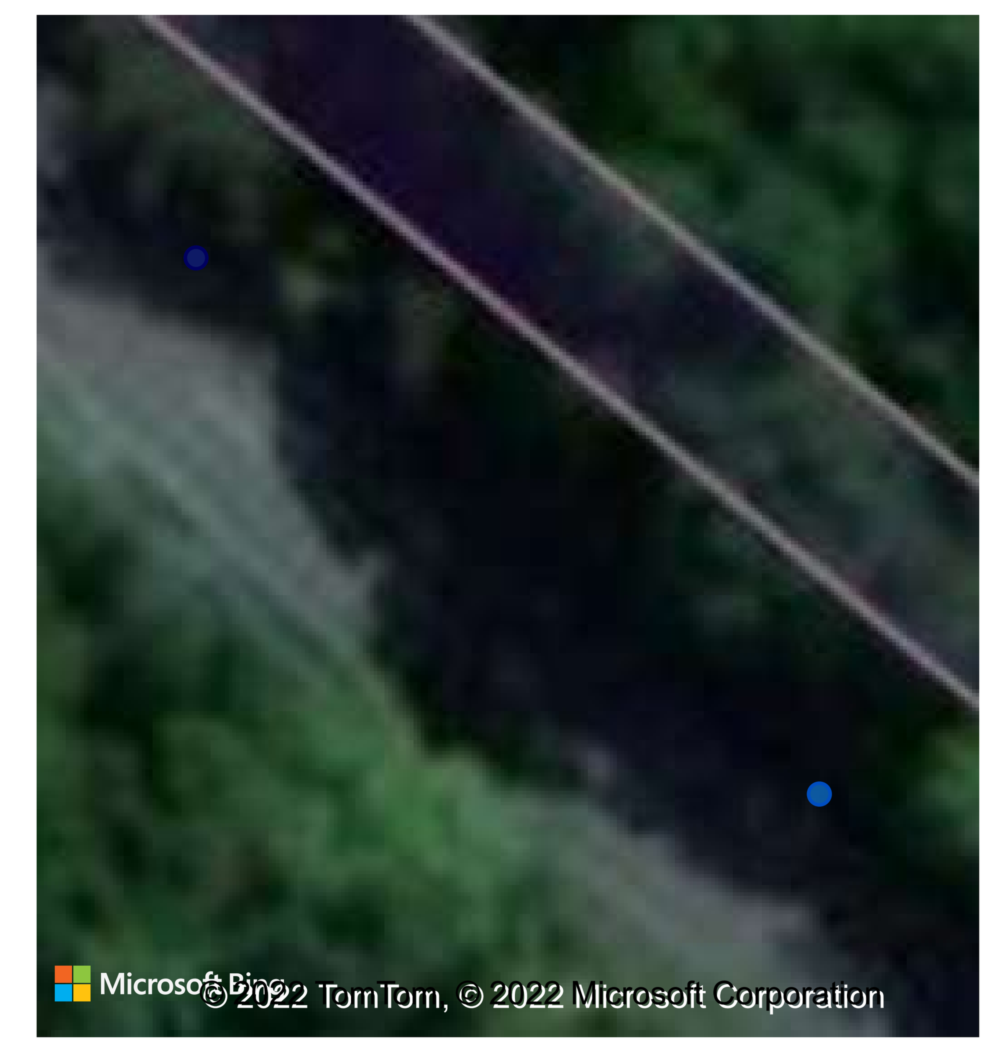
TARP

Site	Level
A04	

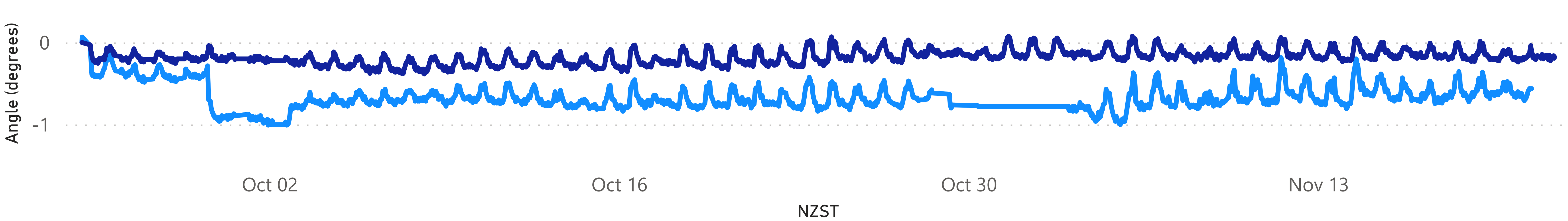
MA Tilt 11 Y Axis and MA Tilt 12 Y Axis by NZST



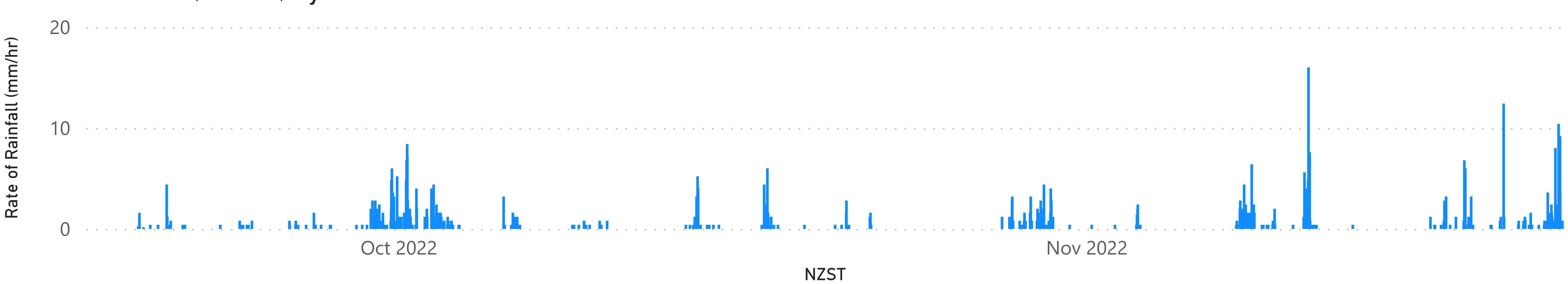
Device ● Tilt 11 ● Tilt 12



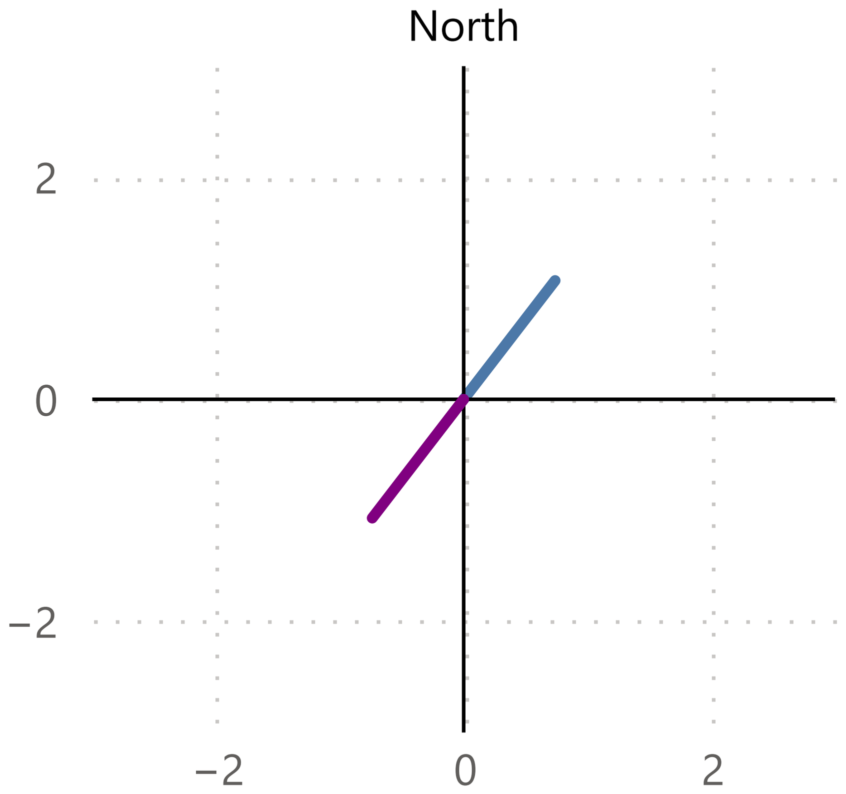
MA Tilt 11 Z Axis and MA Tilt 12 Z Axis by NZST



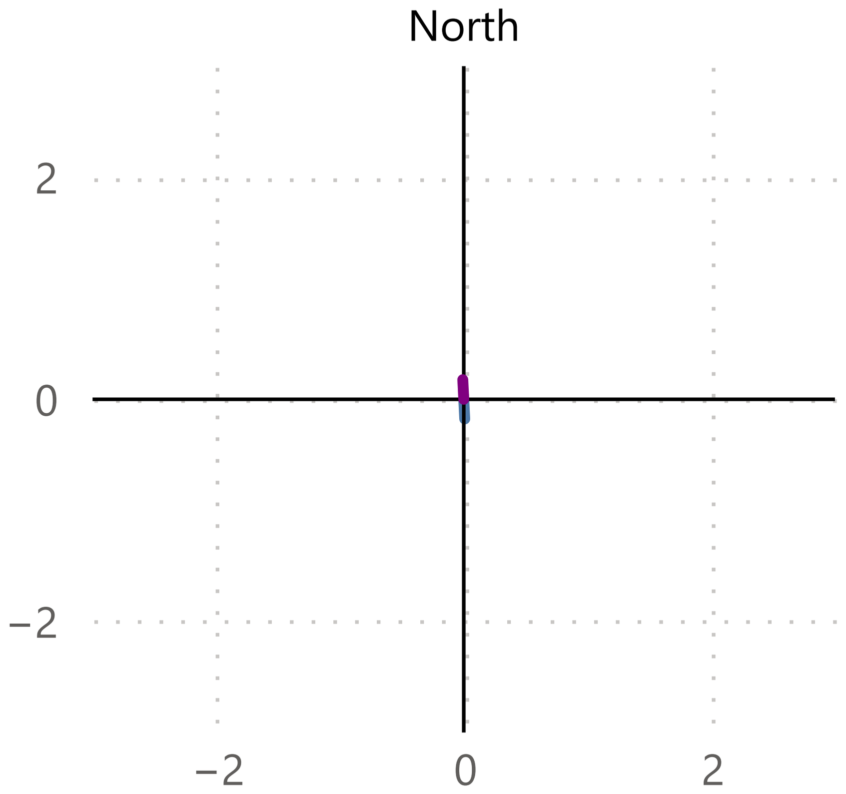
Rate of Rainfall (mm/hr) by NZST



Tilt 11
North



Tilt 12
North

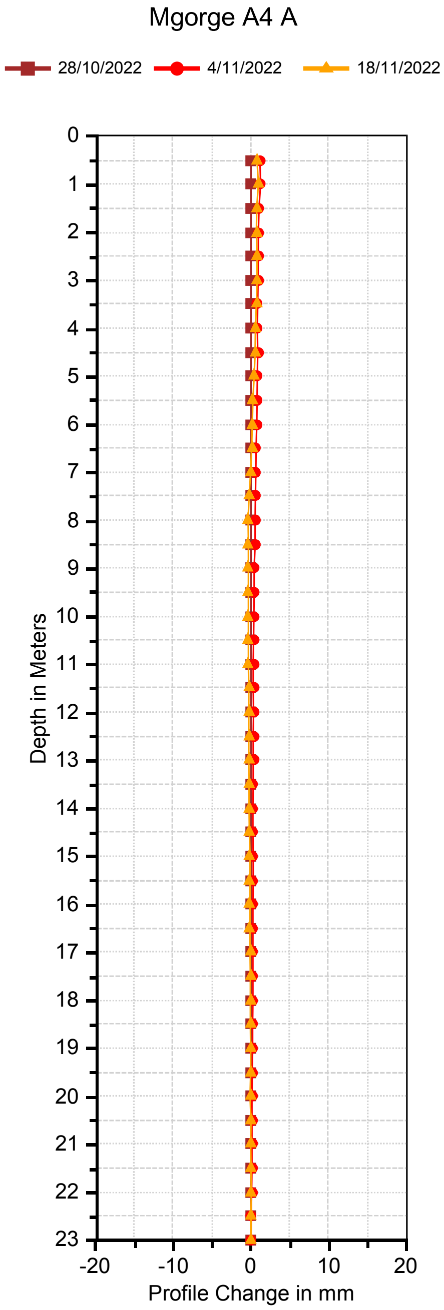


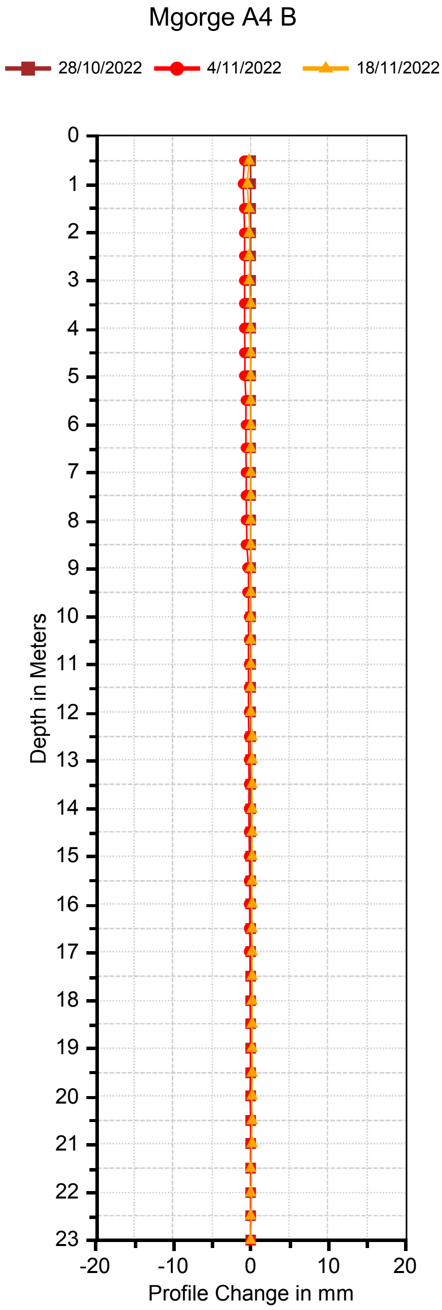
LEGEND

Actual Tilt Direction

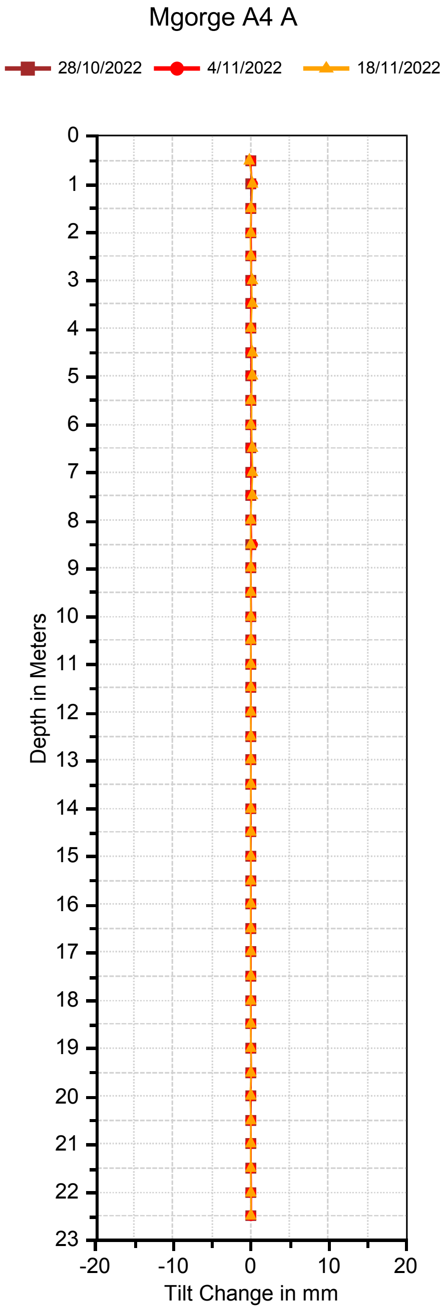
Estimated Land Direction

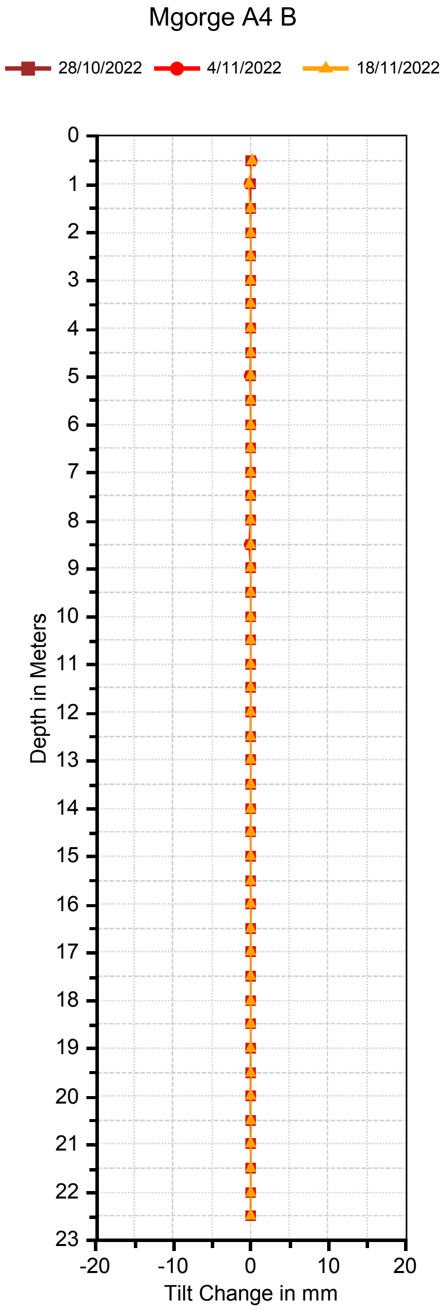
Whangarei Lab
166 Bank Street
Whangarei
Ph 09 438 4417





Whangarei Lab
166 Bank Street
Whangarei
Ph 09 438 4417





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Project Number: 1-11240.00

NZTA Northland Resilience and Emergency Works- August 2022- 10035/22A3

24 November 2022

CONFIDENTIAL

Interpretive Geotechnical Investigation Report

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Approved for release by
Shaun Grieve

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00	22/11/2022	Hui Qiao	Matt Leggett	Shaun Grieve	Final

Revision Details

Revision	Details

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Disclaimers and Limitations

This report (‘**Report**’) has been prepared by WSP exclusively for New Zealand Transport Agency (‘**Client**’) in relation to Mangamuka Gorge Slips Emergency Works (‘**Purpose**’). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

1 Introduction

Two storm events in July and August have caused widespread flooding and associated landsliding across much of Northland. Following the August rain event WSP were engaged by Waka Kotahi to form part of the emergency response and undertake an urgent geotechnical investigation along a section of State Highway (SH) 1 through Mangamuka Gorge. A total of 12 underslips have been identified requiring significant geotechnical analysis and associated permanent remedial measures.

This report covers the investigation and assessment at site 10035/22A3 (henceforth referred to as A3) and provides a recommended remedial solution. The Site A3 is located approximately 2.5km south of the northern extent of the Mangamuka Gorge at RS119 RP 13.33, approximately 18km southeast Kaitaia. Following periods of prolong rainstorm events in July and August, a deep-seated movement has occurred causing significant slumping affecting the entire road along this section of SH1.

The landslide is likely caused by a material saturation resulting from the recent storm events and undercutting by Victoria River near the base of the slope. The site location is shown below in Figure 1-1 together with other slip sites.

Figure 1-1: *10035/22A3 Site location Plan*

2 Regional Geology

The 1:250 000 scale QMAP seamless digital data (GNS, 2013) indicates the site area to be underlain by the Undifferentiated Tangihua Complex in Northland Allochthon comprising basalt pillow lava, with subvolcanic intrusives of basalt, dolerite and gabbro; locally incorporating siliceous mudstone. Late Pleistocene to Holocene estuary, river and swamp deposits are indicated to be present downslope associated with Victoria River (Figure 2-1).

The Tangihua Complex has been emplaced onto New Zealand through convergent plate tectonics and sea floor sliding. As a result, the material has been historically sheared with the rock underlying the site expected to be highly fractured and degraded through original emplacement processes and further modified by weathering.

Figure 2-1: Regional geology

3 Site Investigation

Between 15th and 16th September 2022, a targeted geotechnical investigation was undertaken to inform the remedial measures required at site A3. The works comprised the following:

- Two rotary cored boreholes (BH01 & BH02) taken to a depth of 28.6m and 27.0m respectively, with Standard penetration tests (SPTs) at 1.5m intervals for each borehole.
- Installation of BH inclinometer upon completion of BHA3-1 and BH22A3-2.
- One washed borehole (BH03) was carried out to a depth of 22.0m. Two piezometers (piezo 01 (deeper) & Piezo 02 (shallower) were installed. The screen zone for piezo 01 is between 18.0 and 22.0m bgl and the screen zone for Piezo 02 is between 4.00 and 11.50m bgl.
- Four Cone penetration tests (CPT01-CPT04) were carried out on the site and refused at 13.34m, 15.84m, 19.21m and 19.86m respectively.
- The intrusive drilling works was undertaken by Drillforce Limited including the boreholes, CPT's as well as the installation of inclinometer tubing for monitoring ground movement and piezometers for groundwater, all under the supervision of WSP site staff.
- All the boreholes were logged in accordance with the NZGS *Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes*, December 2005 and Rock for Engineering Purposes, December 2005 & Engineering & Development in

Hazardous Terrain 2001, pg. 365, Table 1. Borehole and CPT locations displayed on Figure 3-1 below with logs displayed in Appendix A.

- Tiltmeters were installed on the ground surface by WSP Research staff to obtain Realtime monitoring of surface movements.
- Monitoring of the piezometers and inclinometers was undertaken by GeoCivil Ltd under direction of WSP staff.

Figure 3-1: Exploratory hole location plan

3.1 Observations

During the site investigation, the slip was inspected from 15th to 16th September 2022 and 3rd to 4th October by WSP. The inspection identified the following:

- Along the affected section, the carriageway is flanked to the north by a cut slope dipping at approximately 36 degrees toward SH1 and a drainage channel and culvert. To the south the shoulder drops away toward densely vegetation bush below.
- The total length of affected road is 70m with the height of slip estimated to be 22 m. The grade of slope is approximately 1V: 3H. The damaged section of road is general level with a gentle gradient of 3°.
- Surface seepage was not noted during the site investigation.
- This section road has not been patched previously.
- The headscarp extends across the entirety of the road with slumping also visible within the upslope. There has been up to 420mm of vertical settlement with 38mm of horizontal movement downslope.

- During the period of the site investigation surface monitoring pins needed to be reset several times with movements continuing after significant rainfall.
- Two gullies are located at either end of site which channel water towards Victoria River below.
- Additional tension cracking has further progressed towards the centreline and the slip is likely to continue to regress if not treated, with potential for the whole road to evacuate.

4 Geomorphological Mapping

A terrain evaluation is presented below in Figure 4-1. Geomorphological mapping undertaken from both Lidar and aerial photography as well as site observations. The site area is comprised of steep slopes of approximately 30° - 40° and includes historic slip features manifesting as large gullies extending from the slope above to the river below. The affected section of road appears to be located within a larger active slip. This section of the road is slowing creeping downwards caused by slip movements.

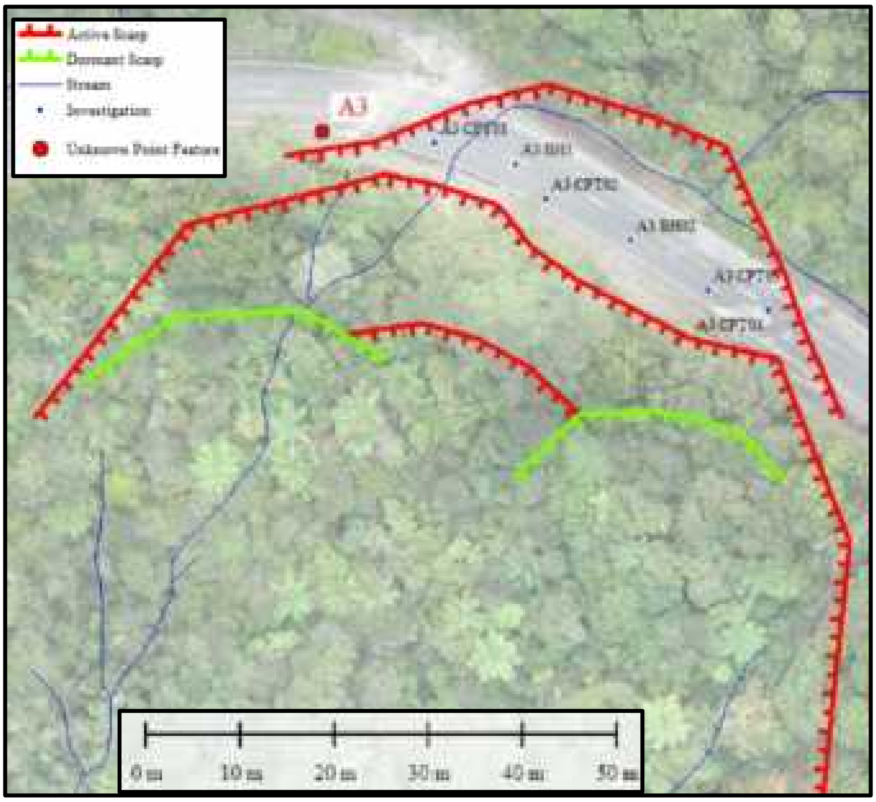


Figure 4-1: Geomorphological map

5 Ground Model

Table 5-1 below summarises the ground model for site A3. A conceptual geological cross section is presented within Appendix B.

Table 5-1 – Ground Model

Lithology	Top (m bgl)	Base (m bgl)	Total thickness (m)	SPT N Value	GSI
Fill	0.0	0.6	0.8*- 1.1*	3* - 13*	-
Colluvium	0.6	1.65	0.8* - 5.5*	2* - 16*	-
Completely Weathered Tangihua Complex DOLERITE	0.6	14.6 – 15.37	1.1* - 16.9*	6*- 26*	-
Highly Weathered Tangihua Complex DOLERITE	15.37 - 16.5	20.37 - 24.0	13.5* - 19.86*	20*- 50+	20-30
Moderately Weathered Tangihua Complex DOLERITE	20.37 - 24	25.37-28.6	4*-5*	50+	40-60
Slightly Weathered Tangihua Complex DOLERITE	25.37	27	Not proven	60+	70-80

* Inferred from CPT results. CPTs

Fill was encountered within both the boreholes and inferred to be present in within all CPTs. The maximum thickness of fill encountered within the machine borehole was 0.6m. The material is described as Asphalt and Subgrade, dark bluish grey, gravel is angular, fine to coarse, well graded, slightly weathered basalt.

Colluvium was encountered within BH22A03-2 and inferred to be present within CPT01, CPT03 and CPT04. The material was not encountered in BH22A3-1 and not inferred to be present within CPT02. The material is described as sandy SILT or CLAY with some subangular to subrounded basalt gravels and with trace of organics. Colluvium thickness varies from 1.15m (BH22A3-2) to 3.70m (CPT03).

Completely weathered Tangihua Complex material was encountered within both the boreholes and inferred to be present within all CPTs with a maximum thickness of 12.44m inferred in CPT02. The material is predominantly described as silty CLAY comprising variable quantities of sand and fine to medium, subangular and subrounded basalt or dolerite.

Moderately weathered Tangihua Complex dolerite was encountered within both Boreholes A3-1 and A3-2 with a maximum thickness of 5.0m encountered in A3-2. The material is mostly described as moderately weathered, light brown, very weak to weak, highly fractured, iron staining was observed on the defect surfaces.

Slightly weathered Tangihua Complex dolerite was only encountered in A3-2 from 25.37m to the base of the hole. The material is described as light bluish grey porphyrite dolerite, strong, with zeolite veining.

All CPTs inferred to refuse within highly weathered Tangihua Complex dolerite.

Three groundwater monitoring visits have been carried out so far between 27th October and 18th November 2022. Results summarised below in Table 5-2. A shallow perched water table is located within the completely weathered Tangihua Complex with a deeper water table near the completely weathered to highly weathered rock interface.

Table 5-2: Groundwater Monitoring Results

BH	Date	Piezo 1- depth to GW (mbgl)	Lithology	Piezo 2- depth to GW (mbgl)	Lithology
BHA3-2	27/10/22	11.86	CW to HW Tangihua Complex	5.93	Completely Weathered Tangihua Complex
	4/11/22	-		6.10	
	18/11/22	12.70		6.05	

5.1 Instrumentation Summary

Tilt sensors data and rainfall sensors data is presented within Appendix C, collected from 14th September 2022. Tilt sensor positions shown below on Figure 5-1.

Figure 5-1: A3 Tilt sensor positioning

Mangamuka gorge experienced 72mm of rain between 5pm 29/09/22 and 12am 03/10/22, resulting in the following movements at MA tilt sensor:

- -1.14° MA Tilt 13 X Axis
- -0.40° MA Tilt 13 Y Axis
- 0.78° MA Tilt 13 Z Axis

The resultant trajectory has been estimated and shows a circular movement leading to the back tilting of the monitoring device.

This is located near the eastern extent of site approximate to BHA3-2. Movement is expected to have occurred through fill or colluvial material close to the surface and may correspond to movement deeper in the ground.

No further significant movement was identified to date, with trends generally displaying cyclic changes in temperature.

At completion of both boreholes, two inclinometers were installed on site to a depth of 28.6m (BH01) and 27.0m (BH02). 3no. monitoring visits have been completed so far between 28/10/22 and 18/11/22. Results are presented within Appendix C.

No deep movements have been identified within the inclinometers related to the primary headscarp on site. However, A3-BH01 inclinometer shows minor movement (up to 2mm) in the A direction at 22m and at 12m in the B direction. This may represent incremental creep of the hillside which is consistent with historical movements in the area or may be an error caused by instrumentation drift. Monitoring visits will continue on site over the coming weeks.

6 Recommendations

A deep-seated landslide has occurred as site A3. The headscarp extends across the entirety of the road with slumping also visible within the upslope. There has been up to 420mm of vertical settlement with 38mm of horizontal movement downslope. Minor deep-seated movements have been observed with the inclinometer results at depth, although these are not assumed to be related to the failure through the road surface.

There is an immediate risk of complete evacuation of the road following the next significant rainfall event. Based on the available geotechnical information it is recommended a concrete pile wall is constructed at the site, to be socketed into highly weathered bedrock or better. Wall geometry and additional support requirements to be discuss is separate design report. Estimated construction costs for this solution would likely be between $2m-$4m. This solution would effectively be a permanent fix with very little maintenance costs.

Further information provided within October 2022 Storm Response Options Update- Memo no.2 including discounted solutions.

7 Limitation

This report has been prepared for the benefit of NZTA only and is based on limited investigation and visual inspection only. Given the complex geological setting changes in ground condition could occur across the site that differ from those summarised within this report.

Appendix A

Borehole Logs
CPT Report

Borehole No. BH22A3-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279692 E 988245 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	211.474 m
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000

Depth: 28.6 m
Inclination: -90°
Azimuth: 0°

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m)	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK WEATHERING	SAMPLE TYPE	TCR (%)
FILL	ASPHALT						HQ	100
FILL	Fine to coarse GRAVEL; bluish grey mottled grey. Very dense; subangular, well graded, BASALT [Gap 40 Subgrade].							
TANGIHUA COMPLEX	Silty CLAY, some sand, trace gravel; light brown speckled white with trace dark reddish brown. Soft, moist, highly plastic; sand, fine; gravel, fine, subangular, completely weathered dolerite [Completely Weathered]	210	1					
TANGIHUA COMPLEX	CLAY some silt, trace sand and gravel; light brown mottled reddish brown and dark brown with trace speckled white. Firm, moist, highly plastic; sand, fine; gravel, fine, subrounded, completely weathered dolerite [Completely Weathered]. 2.30-2.45m - Saturated.		2	8	5// 2/2/2/2	CW	SPT	56
TANGIHUA COMPLEX	Silty CLAY, some sand, trace gravel; light brown mottled dark brown. Firm, moist, highly plastic; sand, fine; gravel, fine, subrounded, completely weathered dolerite [Completely Weathered] 2.45-2.75m - moist					CW	HQ	76
TANGIHUA COMPLEX	2.75 - 3.00m - Core loss; No sample recovered.		3			CW		
TANGIHUA COMPLEX	Silty CLAY, some sand, trace gravel; light brown mottled dark brown. Soft, moist, highly plastic; sand, fine; gravel, fine, sub-rounded, completely weathered dolerite [Completely Weathered].	208		4	1// 1/1/1/1	CW	SPT	100
TANGIHUA COMPLEX	Silty CLAY, some sand, trace gravel; brown mottled orange with trace dark brown. Soft, moist, highly plastic; sand, fine; gravel, fine, completely weathered dolerite; iron stainings [Completely Weathered] 3.55-3.65m - Saturated. 3.65-6.30m - Moist.	206	4 5 6	4	1// 0/1/1/2	CW	HQ SPT HQ	100 100 100
TANGIHUA COMPLEX	6.30 - 6.45m - Core loss; No sample recovered.			6	2// 1/1/2/2	CW	SPT	67
TANGIHUA COMPLEX	Silty CLAY, minor sand, trace gravel; light brown mottled orange and dark brown, white and greenish grey. Soft, moist, highly plastic; sand, fine; gravel, fine, subrounded, completely weathered dolerite; iron and manganese staining [Completely Weathered]. 7.30-7.40m - Saturated. 7.40-7.80m - Moist 7.50-7.80m - Light brown mottled brownish orange, white and dark brown.	204	7			CW	HQ	100
TANGIHUA COMPLEX	7.80 - 7.95m - Core loss; No sample recovered.			4	1// 0/1/1/2	CW	SPT	67
TANGIHUA COMPLEX	Silty CLAY, minor sand, trace gravel; light brown mottled orange and dark brown, white and greenish grey. Soft, moist, highly plasticity; sand, fine; gravel, fine, completely weathered dolerite; iron and manganese staining [Completely Weathered] 8.40-9.20m - Light brown mottled orange, white and dark brown.		8 9			CW	HQ	100
TANGIHUA COMPLEX	9.2 - 9.45m- Core loss; No sample recovered.	202		4	0// 1/1/1/1	CW	SPT	44
TANGIHUA COMPLEX	Silty CLAY; light brown mottled brownish orange and dark brown. Firm, moist, highly plastic; iron and manganese staining[Completely Weathered].					CW	HQ	100

Other column headings: GRAPHIC LOG; TESTS; ROCK STRENGTH; ROCK DEFECT SPACING; DEFECT DIP (degrees, 0–90); DEFECTS / OTHER TESTS; CORE; RQD (%); DRILLING; DRILLING METHOD: HQ Size, Triple Tube, Wireline Rotary Coring; CASING; BASE OF HOLE & WATER LEVEL: SWL 3.30m 16/09, SWL 3.30m 15/09; INSTALLATION DETAILS.

Notes:
Borehole located within southbound lane approximately 3m from headscarp.
Borehole terminated within MW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	15/09/2022	*Finished:*	16/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A3-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279692 E 988245 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	211.474 m
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000

Depth: 28.6 m
Inclination: -90°
Azimuth: 0°

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m)	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	SAMPLE TYPE	TCR (%)
TANGIHUA COMPLEX	Silty CLAY; light brown mottled brownish orange and dark brown. Firm, moist, highly plastic; iron and manganese staining[Completely Weathered].*(continued)*						CW	HQ	100
				6	1// 1/1/2/2			SPT	100
		200	11					HQ	100
	Clayey SILT, trace sand; light brown mottled orange with trace dark brown and white. Stiff, moist, highly plastic; sand, fine [Completely Weathered].		12	9	1// 2/2/2/3			SPT	100
		198	13					HQ	100
	13.65 - 13.95m- Core loss; No sample recovered.			13	2// 2/3/3/5			SPT	100
	Clayey SILT, trace sand; light brown mottled orange with trace dark brown and white. Stiff, moist, highly plastic; sand, fine [Completely Weathered].		14					HQ	100
	Silty fine to coarse SAND, trace of clay and gravel; brown mottled brownish orange with trace speckled white. Medium dense, moist; gravel, fine, subrounded, completely weathered dolerite; iron and manganese staining; relict rock mass fabric [Completely Weathered].								
	Clayey SILT, minor sand, trace of gravel; brown mottled brownish orange speckled white and dark brown. Stiff, moist, highly plastic; sand, fine; gravel, fine, completely weathered dolerite; iron and manganese staining [Completely Weathered].	196	15	19	4// 3/4/6/8			SPT	100
			16					HQ	86
	16.35 - 16.50m - Core loss; No sample recovered.								
	Highly weathered, light brown mottled brown and light yellowish grey, DOLERITE. Extremely weak. Weathered to Sandy SILT, minor clay; very stiff, moist, low plasticity, sand, fine to coarse; relict rock mass fabric.		17	33	8// 6/7/9/11	EW	HW	SPT	100
		194						HQ	57
	17.55 - 18.00m - Core loss; No sample recovered.								
	Highly weathered, light brown mottled dark brown and white, DOLERITE. Extremely weak. Weathered to Silty CLAY, minor sand; very stiff, wet, highly plasticity; sand, fine; iron and manganese stainings; relict rock mass fabric.		18	34	8// 5/6/9/14			SPT	100
	Highly weathered, light brown mottled brown with speckled white, DOLERITE. Extremely weak. Weathered to Silty fine to coarse SAND, some gravel, trace clay; very dense, moist; gravel, fine, subrounded, completely weathered dolerite; iron and manganese staining [Highly Weathered DOLERITE].		19					HQ	100
		192		50+	18// 14/14/22			SPT	100
								HQ	100

Other column headings: GRAPHIC LOG; TESTS; ROCK DEFECT SPACING; DEFECT DIP degrees 0 90; DEFECTS / NOTES / OTHER TESTS; CORE; RQD (%); DRILLING; DRILLING METHOD: HQ Size, Triple Tube, Wireline Rotary Coring; CASING; BASE OF HOLE & WATER LEVEL; INSTALLATION DETAILS

Notes:
Borehole located within southbound lane approximately 3m from headscarp.
Borehole terminated within MW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	15/09/2022	*Finished:*	16/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A3-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279692 E 988245 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	28.6 m
Project No.:	1-11244.00	*R.L.:*	211.474 m	*Inclination:*	-90°
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000	*Azimuth:*	0°

Column headings: GEOLOGY · MAIN DESCRIPTION / DETAIL DESCRIPTION · R.L. (m) · DEPTH (m) · GRAPHIC LOG · TESTS: SPT 'N' VALUE · SPT BLOW COUNTS OR SHEAR VALUE · ROCK STRENGTH · ROCK WEATHERING · ROCK DEFECT SPACING · DEFECT DIP (degrees, 0–90) · DEFECTS / NOTES / OTHER TESTS · CORE: SAMPLE TYPE · TCR (%) · RQD (%) · DRILLING: DRILLING METHOD · CASING · BASE OF HOLE & WATER LEVEL · INSTALLATION DETAILS

Geology: TANGIHUA COMPLEX

Drilling method: HQ Size, Triple Tube, Wireline Rotary Coring

Depth scale: 21, 22, 23, 24, 25, 26, 27, 28, 29 m; R.L. scale: 190, 188, 186, 184, 182 m

Main description / detail description	SPT 'N' value	SPT blow counts	Rock strength	Rock weathering	Defects / notes / other tests	Sample type	TCR (%)	RQD (%)
Highly weathered, light brown mottled brown with speckled white, DOLERITE. Extremely weak. Weathered to Silty fine to coarse SAND, some gravel, trace clay; very dense, moist; gravel, fine, subrounded, completely weathered dolerite; iron and manganese staining [Highly Weathered DOLERITE].*(continued)*	50+	16// 14/15/21	EW	HW		HQ SPT	100 100	
Highly weathered, light brown mottled dark brown, DOLERITE. Extreme weak. Weathered to Silty fine to coarse SAND, minor gravel; very dense, wet; gravel, fine, subrounded, highly weathered dolerite.			EW	HW	21.38-24.00m - Rock sample easily broken by hand due to pre-existing defects.	HQ	84	0
22.30 - 22.50m - Core loss; No sample recovered.			EW	HW		SC	0	
Highly weathered, light brown mottled dark brown, DOLERITE. Extreme weak. Weathered to Silty fine to coarse SAND, minor gravel, light brown mottled dark brown. very dense, wet; gravel, fine, subrounded, highy weathered Dolerite.	50+	50 for initial 130mm	EW	HW		HQ	88	0
22.73 - 24.00m - Core loss; No sample recovered.			EW	HW				
Moderately weathered, light brown mottled dark brown, DOLERITE. Very weak; extremely to closely spaced, gently to sub-vertical; undulating smooth defects; iron and manganese staining; zeolite veining.			VW	MW	24.60m - J, 88°, SM, ST 24.70m - J, 30°, SL, UN 25.20m - J, 12°, SM, UN	HQ	90	50
25.35 - 25.50m - Core loss; No sample recovered.					25.30-25.50m - Possible crushed zone.			
Moderately weathered, light brown mottled dark brown DOLERITE. Weak; closely to moderately closely spaced, sub-horizontial to steeply inclined; undulating rough defects; frequent iron and manganese staining and zeolite veining.			W	MW	25.40m - J, 50°, SL, UN 25.84m - J, 12°, RO, PL 25.86m - J, 12°, SM, UN 25.90m - J, 35°, SM, UN 25.96m - J, 46°, SM, ST 26.30m - CZ	HQ	100	18
Moderately weathered, light brown, DOLERITE. Moderately strong; closely to moderately closely spaced, sub-horizontal to steeply inclined; undulating smooth defects; zeolite veneer and veining; occasional iron staining.			MS	MW	27.60m - J, 32°, SM, UN 27.90m - J, 12°, SM, PL 28.10m - J, 10°, SL, PL 28.25m - J, 90°, SM, UN	HQ	100	19
END OF BOREHOLE AT 28.6m - Target Criteria Achieved								

Notes:

Borehole located within southbound lane approximately 3m from headscarp.
Borehole terminated within MW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	15/09/2022	*Finished:*	16/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A3-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279692 E 988245 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	28.6 m
Project No.:	1-11244.00	*R.L.:*	211.474 m	*Inclination:*	-90°
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000	*Azimuth:*	0°

PHOTOGRAPHS

Photo BH22A3-1.1
BOX01: 0.00 - 3.45m.

Photo BH22A3-1.2
3.45 - 6.30m.

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 22/11/22

Notes:
Borehole located within southbound lane approximately 3m from headscarp.
Borehole terminated within MW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	15/09/2022	*Finished:*	16/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

PHOTOGRAPHS

Photo BH22A3-1.3
6.30 -9.95m.

Photo BH22A3-1.4
9.55 - 12.30m.

Notes:
Borehole located within southbound lane approximately 3m from headscarp.
Borehole terminated within MW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	15/09/2022	*Finished:*	16/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279692 E 988245 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	28.6 m
Project No.:	1-11244.00	*R.L.:*	211.474 m	*Inclination:*	-90°
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000	*Azimuth:*	0°

PHOTOGRAPHS

Photo BH22A3-1.5
12.30 - 15.10m.

Photo BH22A3-1.6
15.10 - 18.45m.

Notes:
Borehole located within southbound lane approximately 3m from headscarp.
Borehole terminated within MW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	15/09/2022	*Finished:*	16/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.
Scale 1:50 @ A4

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279692 E 988245 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	28.6 m
Project No.:	1-11244.00	*R.L.:*	211.474 m	*Inclination:*	-90°
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000	*Azimuth:*	0°

PHOTOGRAPHS

Photo BH22A3-1.7
18.45 - 21.38m.

Photo BH22A3-1.8
21.38 - 24.60m.

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 22/11/22

Notes:
Borehole located within southbound lane approximately 3m from headscarp.
Borehole terminated within MW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	15/09/2022	*Finished:*	16/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A3-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279692 E 988245 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	28.6 m
Project No.:	1-11244.00	*R.L.:*	211.474 m	*Inclination:*	-90°
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000	*Azimuth:*	0°

PHOTOGRAPHS

Photo BH22A3-1.9
24.60 -28.00m.

Photo BH22A3-1.10
28.00 - 28.60m.

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 22/11/22

Notes:
Borehole located within southbound lane approximately 3m from headscarp.
Borehole terminated within MW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	15/09/2022	*Finished:*	16/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A3-2

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279705 E 988236 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	212.29 m
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016

Depth: 27 m
Inclination: Vertical

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m)	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK WEATHERING	SAMPLE TYPE	TCR (%)
FILL	Asphalt						DT	100
FILL	Gravelly CLAY, light brown grey, compacted, moist. Gravel is angular to subrounded fine to coarse basalt, greywacke.	212					HQ	100
FILL	Angular to subangular fine to coarse GRAVEL of basalt, greywacke, light grey. [Granular FILL]							
COLLUVIUM	Sandy SILT with some fine to coarse subangular gravel of basalt and partings of clay, light orange brown mottled light brown grey, firm, moist, low plasticity.		1				HQ	100
COLLUVIUM	CLAY trace organics, light orange brown, firm, moist, high plasticity.							
TANGIHUA COMPLEX	Silty CLAY with trace fine sand & organics, light orange brown mottled yellow brown, black, firm, moist, high plasticity. [Completely weathered]			4	1// 1/1/1/1	CW	SPT	69
		210	2				HQ	81
	2.80-3.00m - becoming very soft, wet.		3	7	2// 1/2/2/2		SPT	60
	Silty fine to medium SAND with some subangular fine to medium gravel of highly weathered basalt, light red brown mottled black, moist, loose. [Completely weathered]	208	4				HQ	86
	CORE LOSS 4.35m - 4.50m							
	Silty fine to medium SAND with some subangular fine to medium gravel of highly weathered basalt, light red brown mottled black, moist, loose. [Completely weathered]			5	3// 1/2/1/1		SPT	65
	Sandy SILT with some subangular fine to medium gravel of highly weathered basalt, light red brown mottled black, sand is fine to medium, firm, moist. [Completely weathered]		5				HQ	62
	Silty fine to medium SAND with some subangular fine to medium gravel of highly weathered basalt, light red brown mottled black, moist, loose. [Completely weathered]							
	Silty CLAY, light orange brown mottled light brown, white, firm, moist, high plasticity. [Completely weathered]	206	6	6	0// 1/1/2/2		SPT	90
			7				HQ	100
				9	3// 2/2/2/3		SPT	100
	Silty CLAY with trace fine sand and basalt gravel, light orange brown mottled light brown, white, firm, moist, high plasticity. [Completely weathered]	204	8				HQ	100
			9	7	2// 1/2/2/2		SPT	100
							HQ	100

Other column headings: GRAPHIC LOG; TESTS; ROCK STRENGTH; ROCK DEFECT SPACING; DEFECT DIP degrees 0 90; DEFECTS / NOTES / OTHER TESTS; CORE; RQD (%); DRILLING; DRILLING METHOD; CASING; BASE OF HOLE & WATER LEVEL; INSTALLATION DETAILS

Drilling method: HQ Size, Triple Tube, Wireline Rotary Coring

Casing: PQ

Notes:
Borehole located within northbound lane approximately 3m from headscarp.
Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 &

Started:	3/10/2022	*Finished:*	4/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	ML	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A3-2

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279705 E 988236 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	27 m
Project No.:	1-11244.00	*R.L.:*	212.29 m	*Inclination:*	Vertical
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016		

Column headings: GEOLOGY | MAIN DESCRIPTION / DETAIL DESCRIPTION | R.L. (m) | DEPTH (m) | GRAPHIC LOG | TESTS: SPT 'N' VALUE, SPT BLOW COUNTS OR SHEAR VALUE | ROCK STRENGTH | ROCK WEATHERING | ROCK DEFECT SPACING | DEFECT DIP (degrees 0–90) | DEFECTS / NOTES / OTHER TESTS | CORE: SAMPLE TYPE, TCR (%), RQD (%) | DRILLING: DRILLING METHOD, CASING, BASE OF HOLE & WATER LEVEL | INSTALLATION DETAILS

Geology: TANGIHUA COMPLEX

Main description / detail description:

- Silty CLAY with trace fine sand and basalt gravel, light orange brown mottled light brown, white, firm, moist, high plasticity. [Completely weathered]*(continued)*
  - 11.40-11.51m - becoming soft, wet.
  - 12.85-13.35m - becoming soft, wet.
  - 13.95-14.24m - becoming soft.
- Highly weathered light brown mottled light grey brown BASALT. Weathered to weakly cemented silty fine to medium SAND, zeolite.
- Highly weathered light brown mottled light grey brown BASALT. Weathered to weakly cemented silty fine to medium SAND with some intact subangular fine to coarse basalt gravel, zeolite.
- Highly weathered light brown mottled light grey brown BASALT. Weathered to weakly cemented silty fine to medium SAND, zeolite.

Scales: Depth (m): 11, 12, 13, 14, 15, 16, 17, 18, 19; R.L. (m): 202, 200, 198, 196, 194

Rock weathering: CW (to approx. 15.4 m); HW (below)

Tests:

SPT 'N' Value	SPT Blow Counts or Shear Value
10	3// 1/3/3/3
12	3// 2/2/3/5
13	3// 2/3/3/5
24	3// 3/5/6/10
N=50+	15// 11/11/18/10 for 50mm
N=50+	16// 18/20/12 for 30mm
N=50+	20// 12/10/10/12 for 30mm

Core:

Sample Type	TCR (%)	RQD (%)
HQ	100	
SPT	100	
HQ	100	
SPT	100	
HQ	100	
SPT	100	
HQ	100	
SPT	100	
HQ	86	
SPT	100	
HQ	67	
SC		
HQ	100	
SPT	89	

Drilling method: HQ Size, Triple Tube, Wireline Rotary Coring

Base of hole & water level: SWL 7.50m 4/10

Notes:
Borehole located within northbound lane approximately 3m from headscarp.
Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 &

Started:	3/10/2022	*Finished:*	4/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	ML	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.
Scale 1:50 @ A4

Borehole No. BH22A3-2

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279705 E 988236 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	212.29 m
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016

Depth: 27 m
Inclination: Vertical

GEOLOGY: TANGIHUA COMPLEX

DEPTH (m)	MAIN DESCRIPTION / DETAIL DESCRIPTION	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING
– 20.30	Highly weathered light brown mottled light grey brown BASALT. Weathered to weakly cemented silty fine to medium SAND, zeolite.*(continued)*		HW	
20.30 – 20.40	Moderately weathered to highly weathered light brown mottled orange brown DOLERITE, very weak to weak, iron staining, zeolite veining.	W	MW	MW
20.40 – 20.55	CORE LOSS 20.40m - 20.55m			
20.55 – 20.70	Moderately weathered to highly weathered light brown mottled orange brown DOLERITE, very weak to weak, iron staining, zeolite veining.	W	MW	MW
20.70 – 23.35	Moderately weathered light brown DOLERITE, weak, iron staining, zeolite veining. 21.13-21.18m - moderately weathered to slightly weathered, moderately strong.	W	MW	MW
23.35 – 23.48	Moderately weathered to highly weathered light brown mottled orange brown DOLERITE, very weak to weak, iron staining, zeolite veining.	VW	HW	MW
23.48 – 25.35	Moderately weathered light brown DOLERITE, weak, iron staining, zeolite veining.	W	MW	MW
25.35 – 27.00	Slightly weathered light blue grey DOLERITE, strong, zeolite veining.	S	SW	MW
27.00	END OF BOREHOLE AT 27m - Target Criteria Achieved			

R.L. (m): 192, 190, 188, 186, 184
DEPTH (m): 21, 22, 23, 24, 25, 26, 27, 28, 29

TESTS: SPT 'N' VALUE; SPT BLOW COUNTS OR SHEAR VALUE

DEFECT DIP (degrees 0–90): J50, J72, J68, J69, J64, J40, J58, J26, J82, J73, J52, J10, J64, J45, J60, J38, J73, J55

DEFECTS / OTHER TESTS

20.30m - J, 50°, SM, PL, N
20.55m - J, 72°, SM, PL, VN
21.47m - J, 68°, SM, PL, N
22.50m - J, 69°, SM, PL, N
22.74m - J, 64°, SM, PL, N
22.97m - J, 40°, SM, PL, N
23.75m - J, 58°, SM, PL, N
24.04m - J, 26°, SM, UN, N
24.21m - SHZ
24.34m - J, 82°, SM, UN, N
25.07m - J, 73°, SM, UN, N
25.58m - J, 52°, SM, UN, N, Zeolite
26.03m - J, 10°, SM, UN, N
26.11m - J, 64°, SM, UN, N, penetrative limonite
26.28m - J, 45°, SM, UN, N, penetrative limonite
26.46m - J, 60°, SM, UN, VN, penetrative limonite
26.60m - J, 38°, SM, UN, VN, penetrative limonite
26.65m - J, 73°, SM, UN, N, penetrative limonite
26.77m - J, 55°, SM, UN, N, penetrative limonite

CORE

SAMPLE TYPE	TCR (%)	RQD (%)
HQ		16
HQ		16
HQ	87	81
HQ	100	43
HQ	100	70
HQ	100	100

DRILLING

DRILLING METHOD: HQ Size, Triple Tube, Wireline Rotary Coring

CASING; BASE OF HOLE & WATER LEVEL; INSTALLATION DETAILS

Notes:
Borehole located within northbound lane approximately 3m from headscarp.
Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 &

Started:	3/10/2022	*Finished:*	4/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	ML	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A3-2

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279705 E 988236 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	27 m
Project No.:	1-11244.00	*R.L.:*	212.29 m	*Inclination:*	Vertical
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016		

PHOTOGRAPHS

Notes:		*Started:*	3/10/2022	*Finished:*	4/10/2022
Borehole located within northbound lane approximately 3m from headscarp. Inclinometer installed on completion. Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 &		*Drilling Co.:*	DFNZ	*Drilling Rig:*	Canter Rig
		Logged by:	ML	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279705 E 988236 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	27 m
Project No.:	1-11244.00	*R.L.:*	212.29 m	*Inclination:*	Vertical
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016		

PHOTOGRAPHS

Notes:
Borehole located within northbound lane approximately 3m from headscarp.
Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 &

Started:	3/10/2022	*Finished:*	4/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	ML	*Checked by:*	ML

Borehole No. BH22A3-2

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279705 E 988236 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	27 m
Project No.:	1-11244.00	*R.L.:*	212.29 m	*Inclination:*	Vertical
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016		

PHOTOGRAPHS

Notes:		*Started:*	3/10/2022	*Finished:*	4/10/2022
Borehole located within northbound lane approximately 3m from headscarp. Inclinometer installed on completion. Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 &		*Drilling Co.:*	DFNZ	*Drilling Rig:*	Canter Rig
		Logged by:	ML	*Checked by:*	ML

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279705 E 988236 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	27 m
Project No.:	1-11244.00	*R.L.:*	212.29 m	*Inclination:*	Vertical
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016		

PHOTOGRAPHS

Notes:
Borehole located within northbound lane approximately 3m from headscarp.
Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 &

Started:	3/10/2022	*Finished:*	4/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	ML	*Checked by:*	ML

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279705 E 988236 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	27 m
Project No.:	1-11244.00	*R.L.:*	212.29 m	*Inclination:*	Vertical
Location:	Slip 22A3 Mangamuka Range	*Datum:*	NZ Vertical Datum 2016		

PHOTOGRAPHS

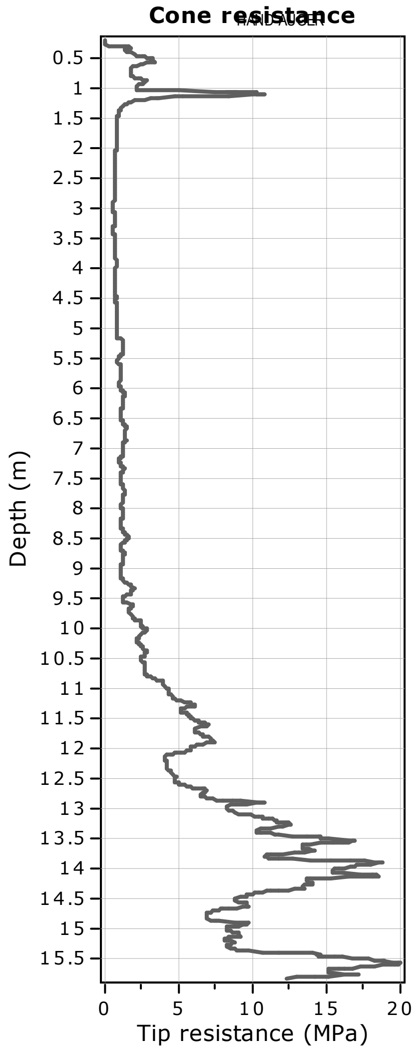
Notes:
Borehole located within northbound lane approximately 3m from headscarp.
Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 &

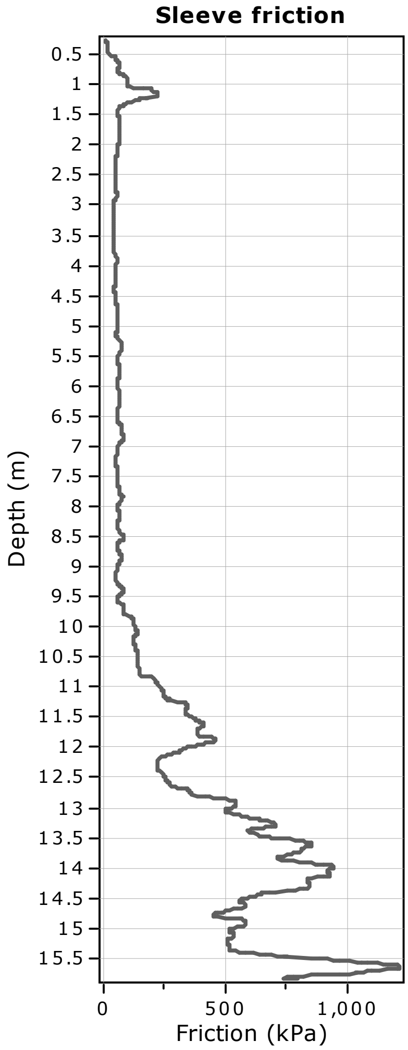
Started:	3/10/2022	*Finished:*	4/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	ML	*Checked by:*	ML

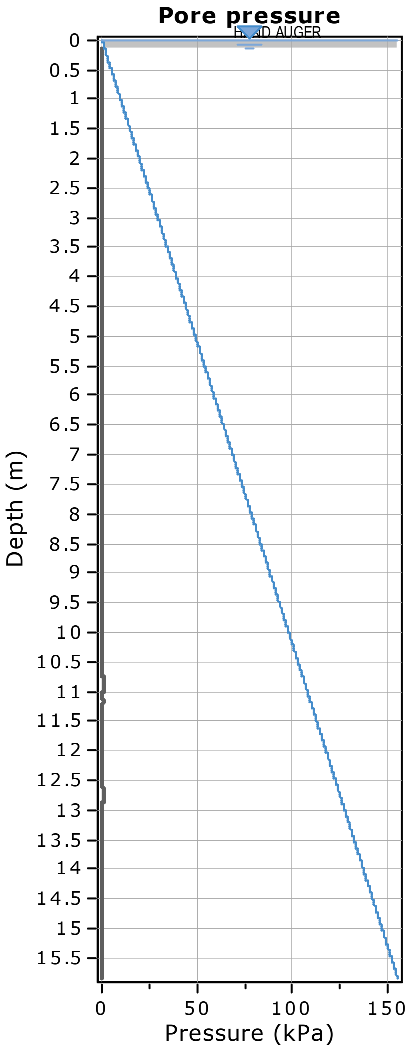
CPT: A3 CPT01

Total depth: 15.84 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

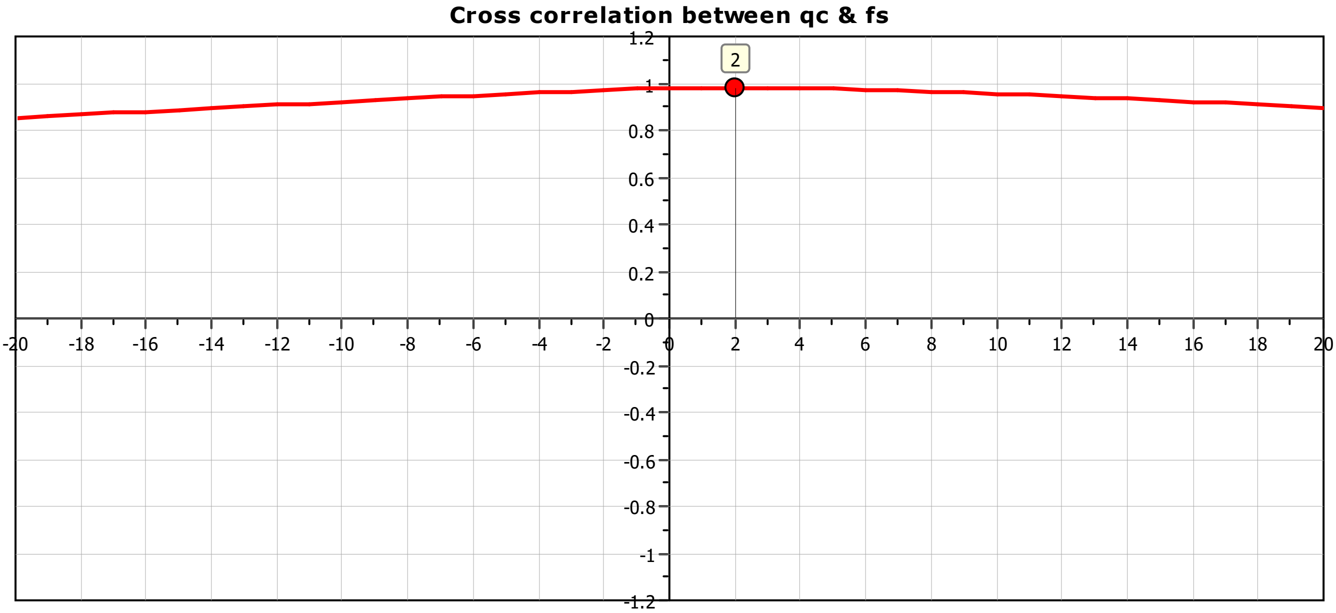
Project:
Location:







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



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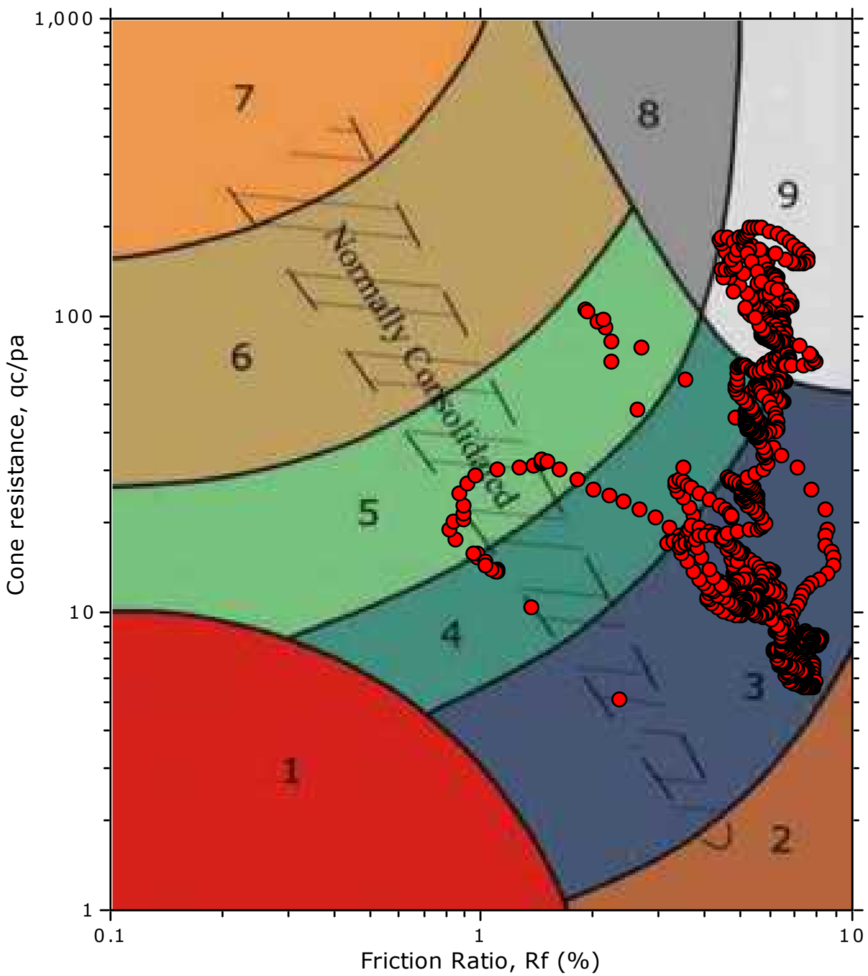
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A3 CPT01
Total depth: 15.84 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

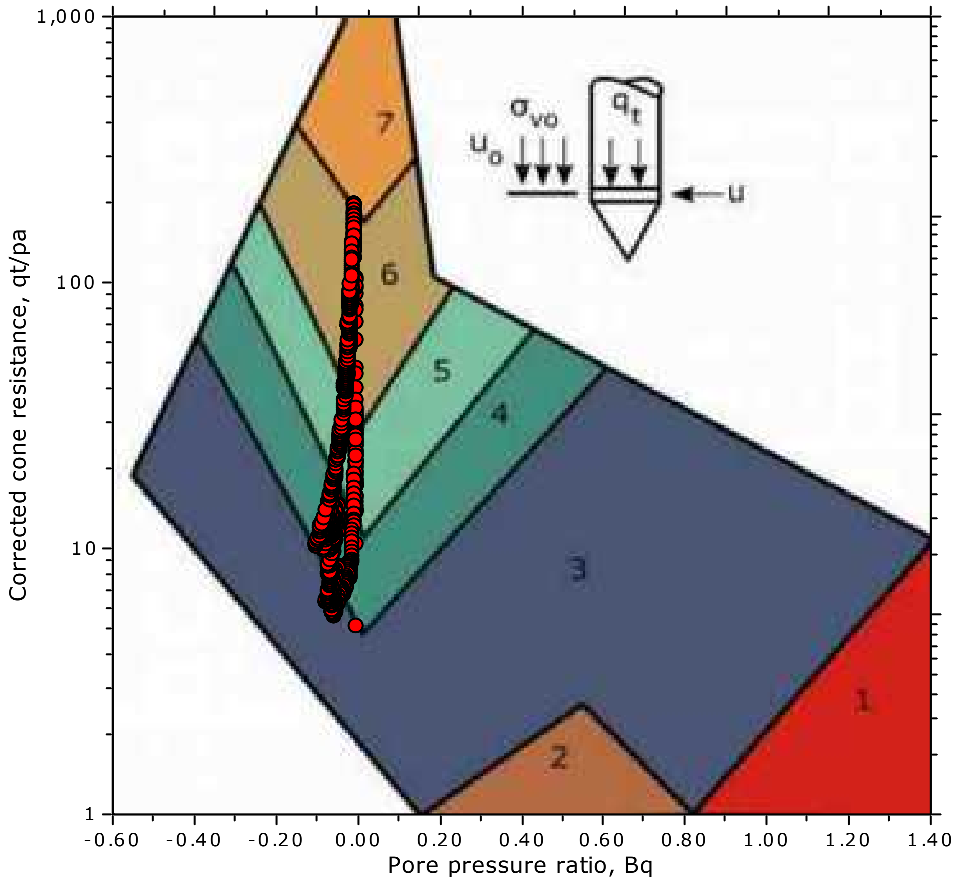
Project:
Location:

SBT - Bq plots

SBT plot



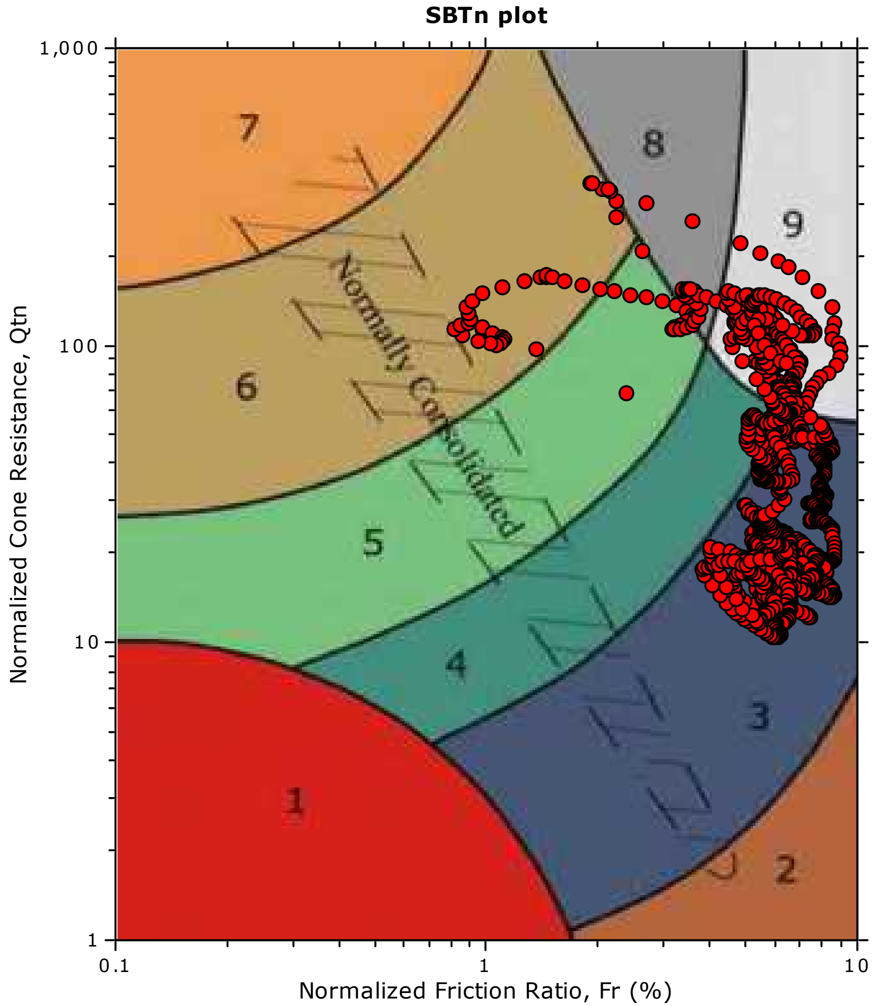
Bq plot

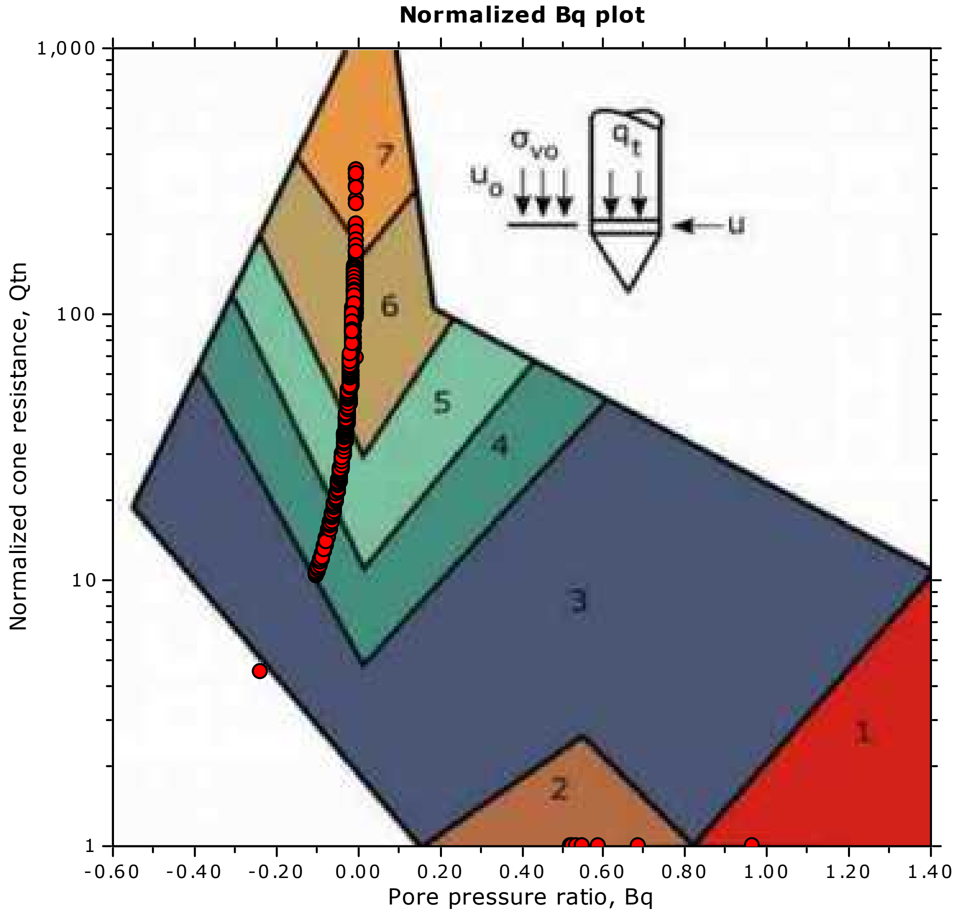


SBT legend

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

SBT - Bq plots (normalized)

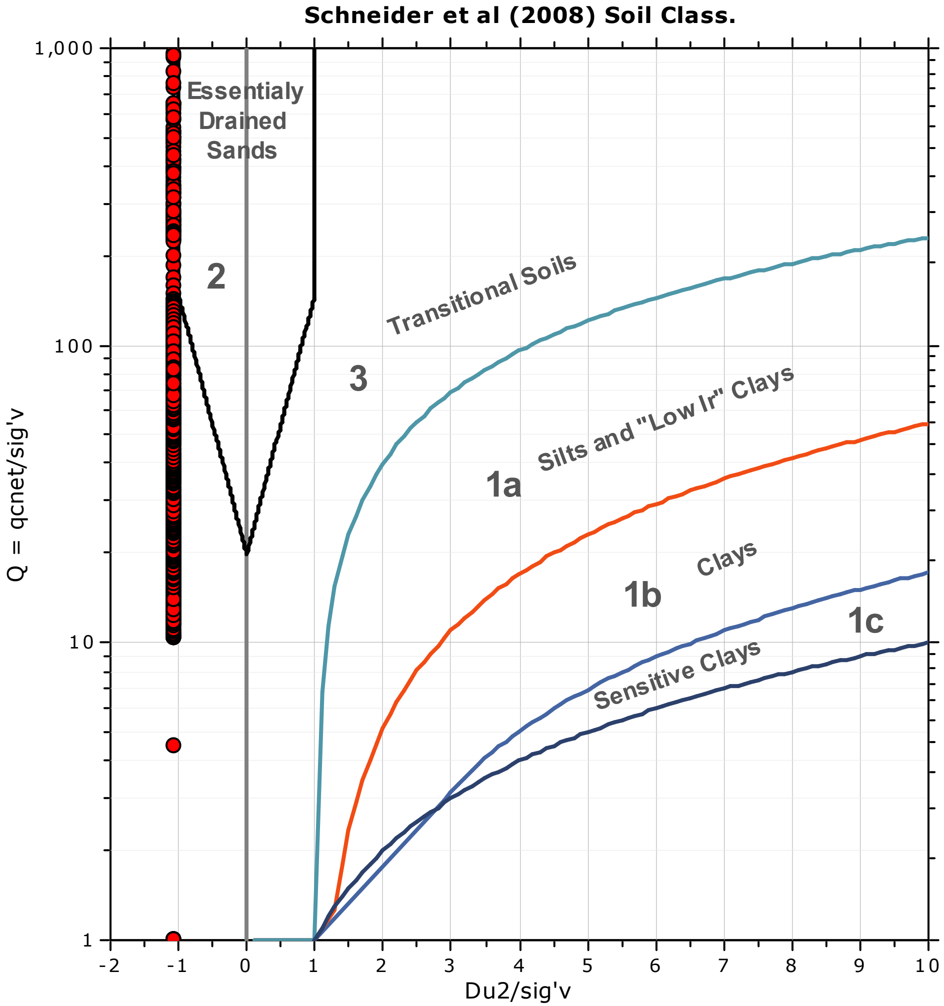


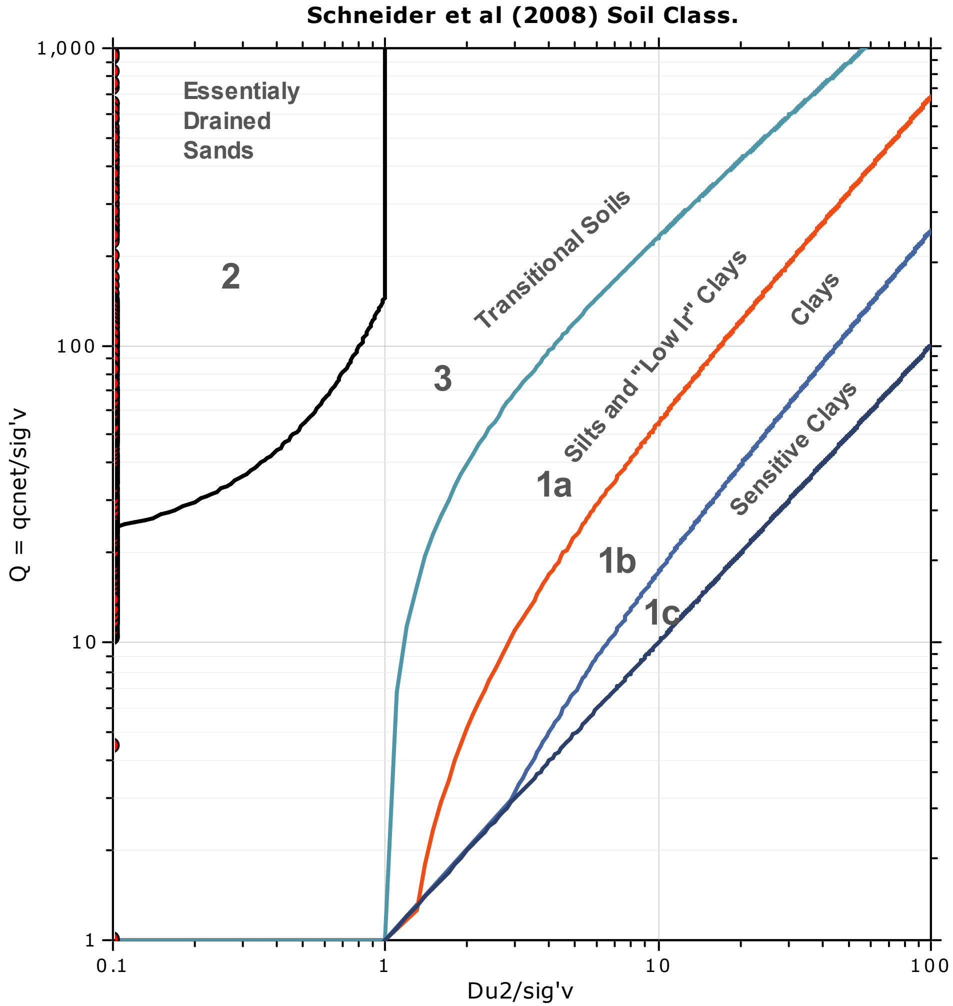


SBTn legend

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

Bq plots (Schneider)





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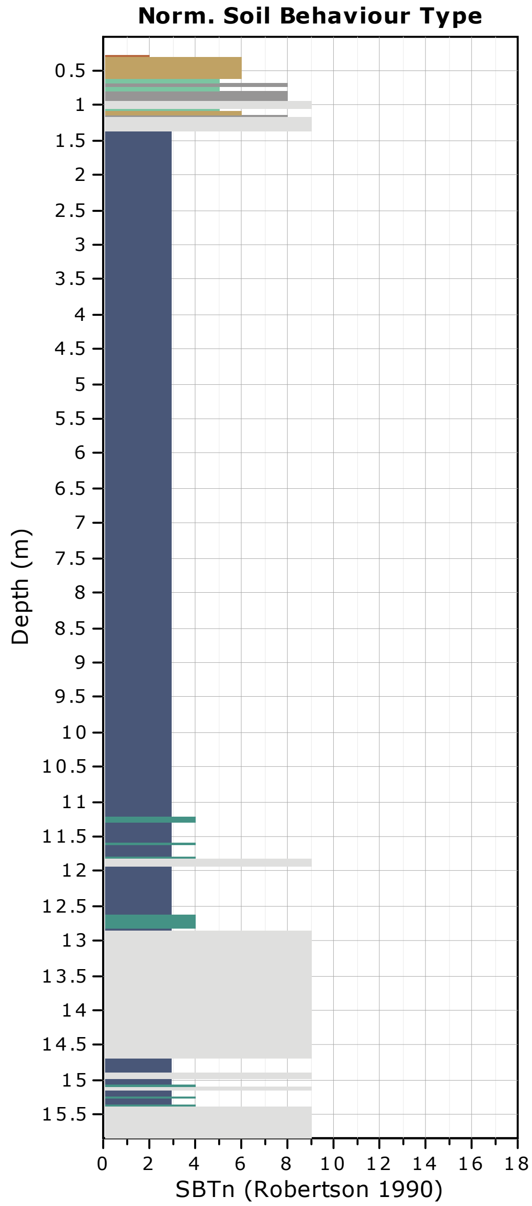
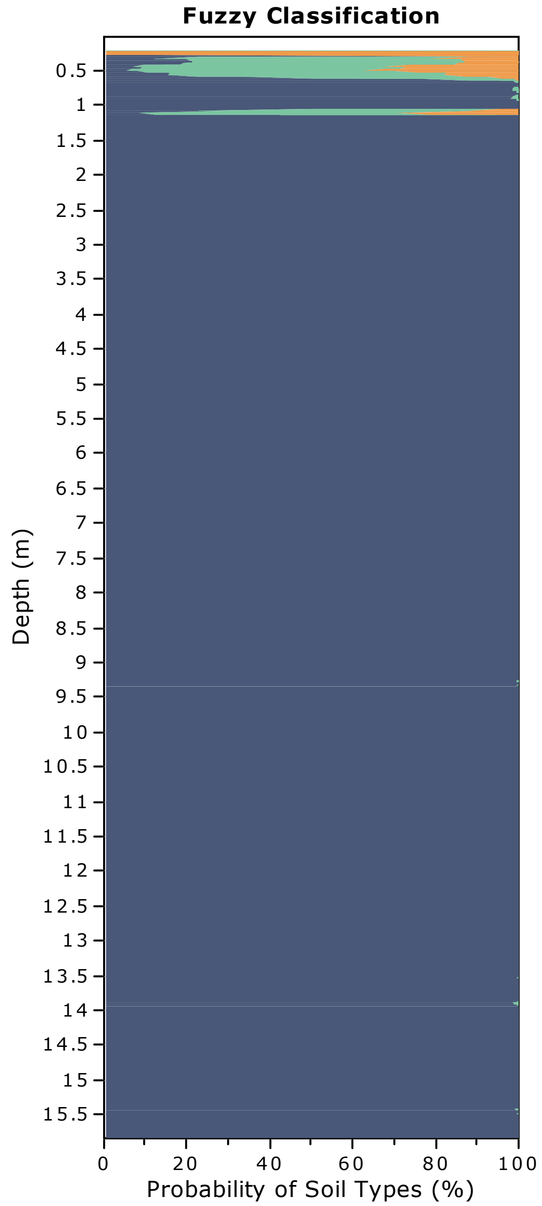
CPT: A3 CPT01
Total depth: 15.84 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:





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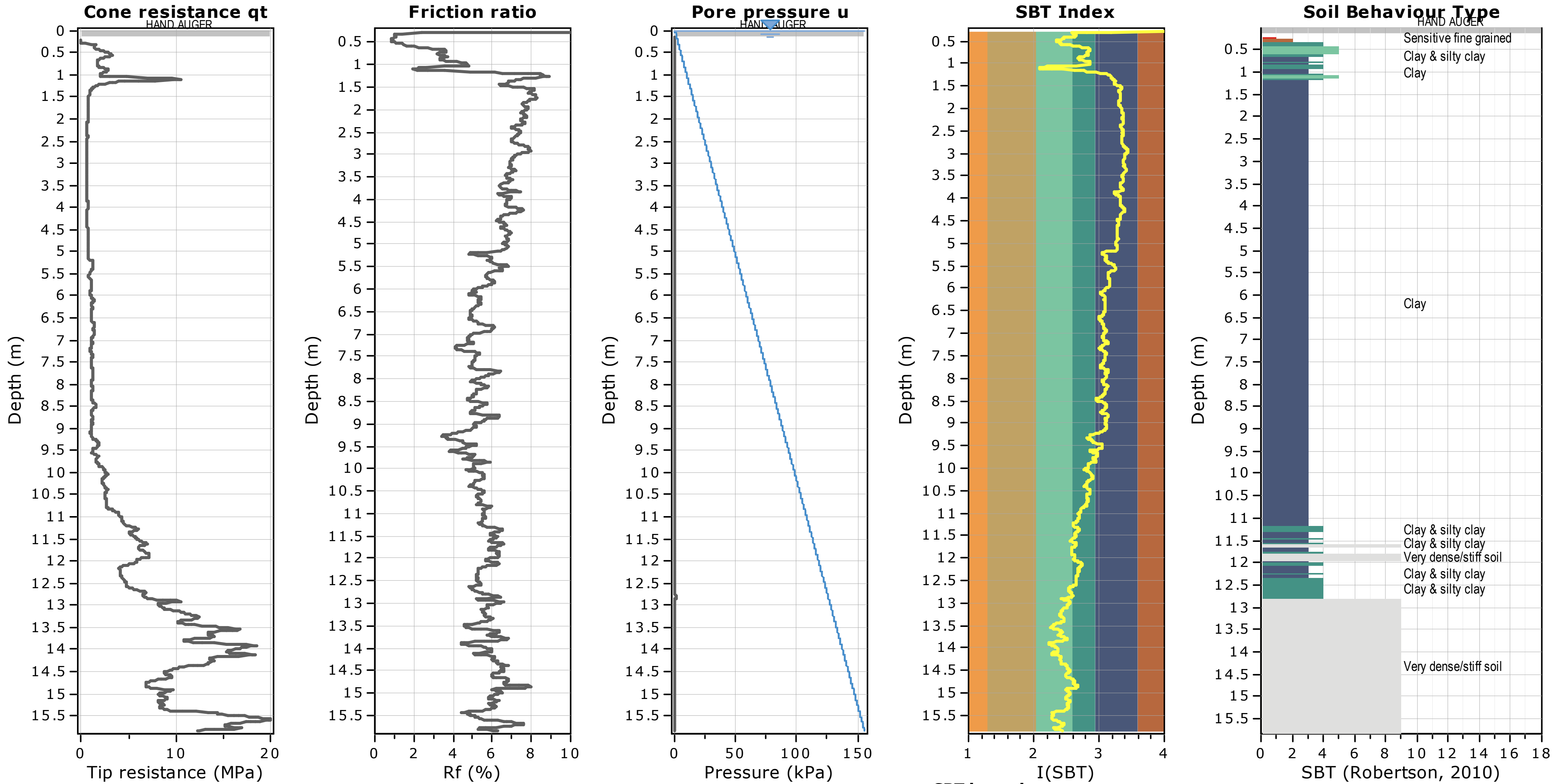
CPT: A3 CPT01
Total depth: 15.84 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBT legend

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

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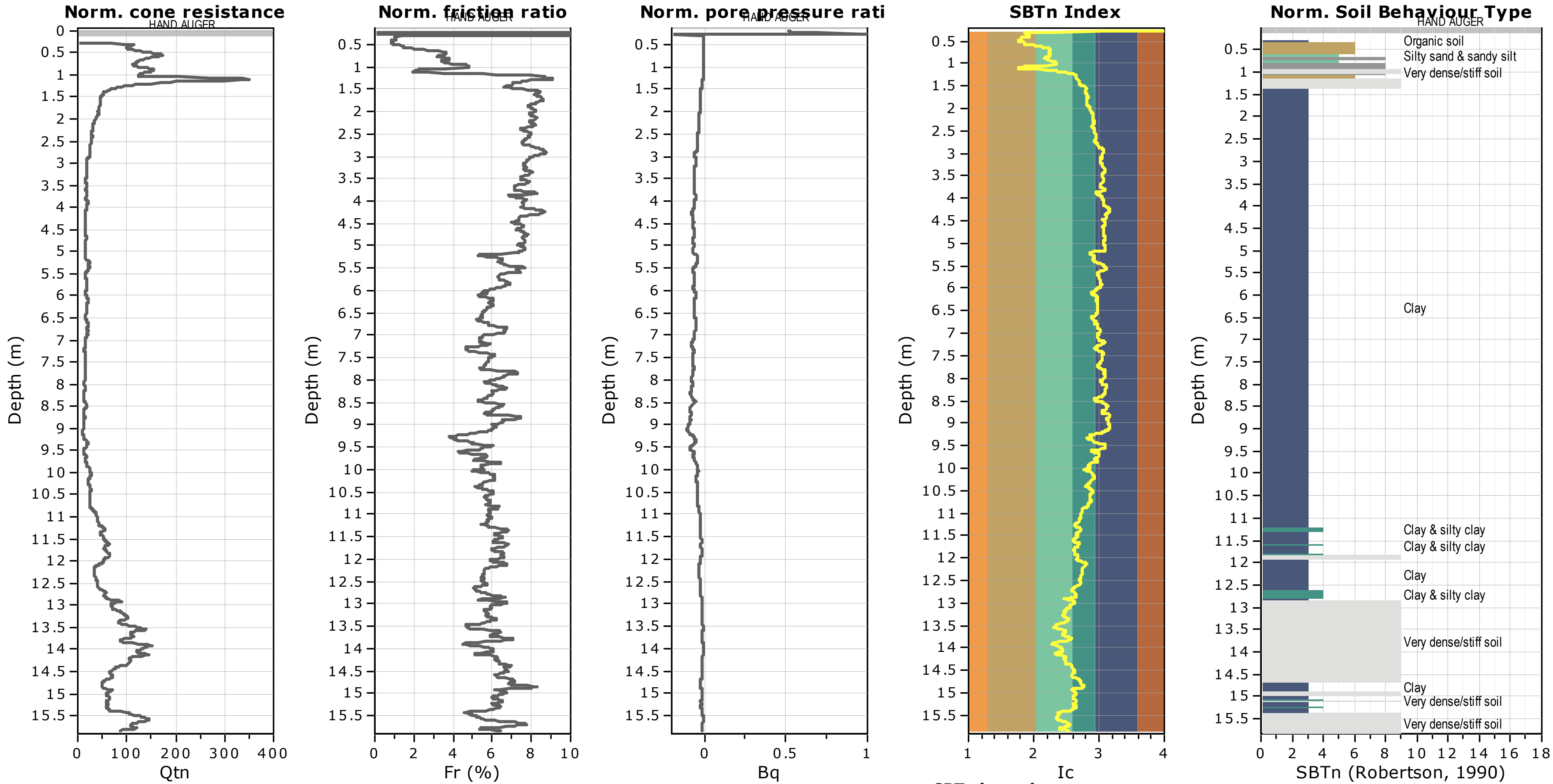
CPT: A3 CPT01
Total depth: 15.84 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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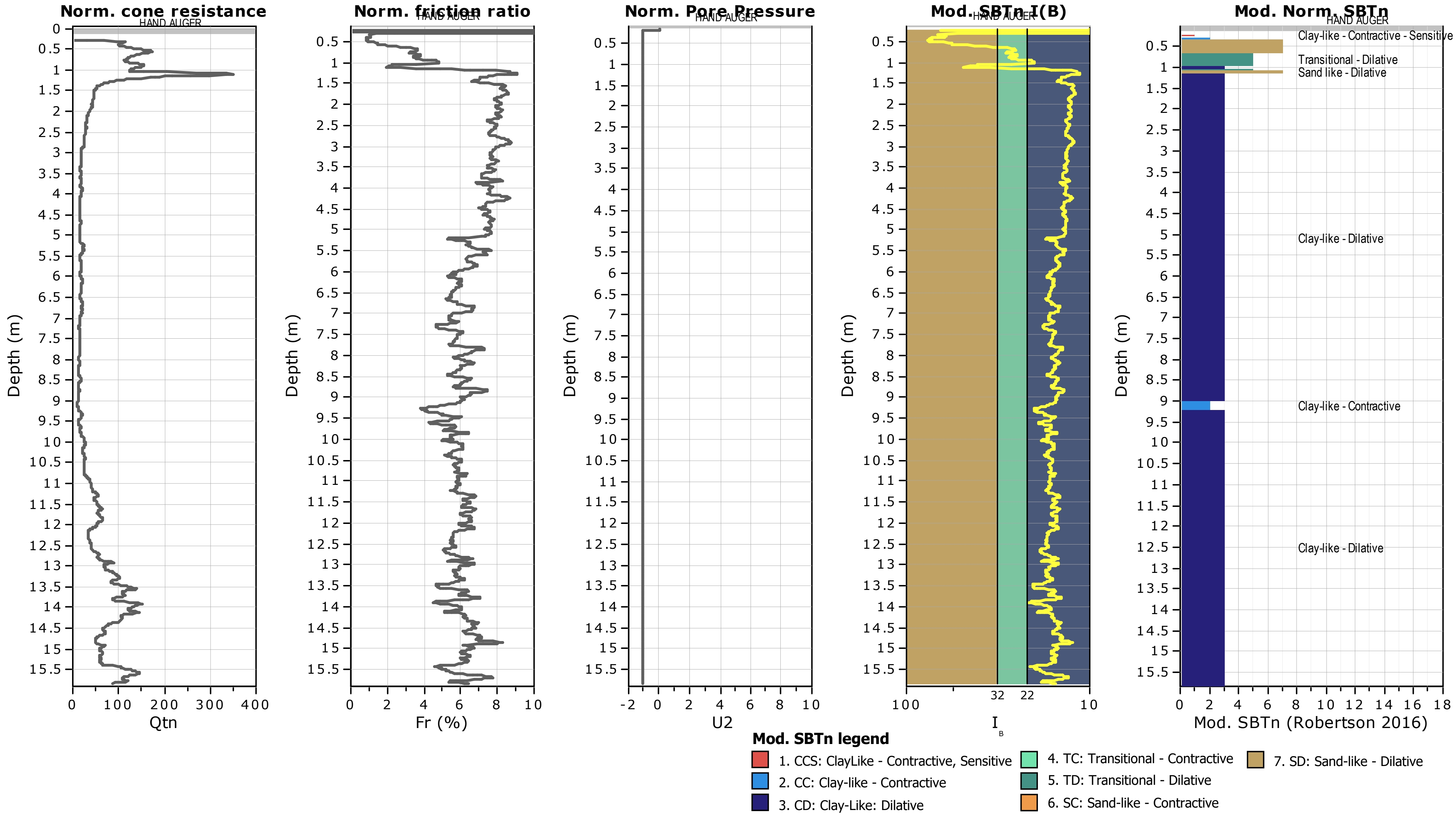
CPT: A3 CPT01
Total depth: 15.84 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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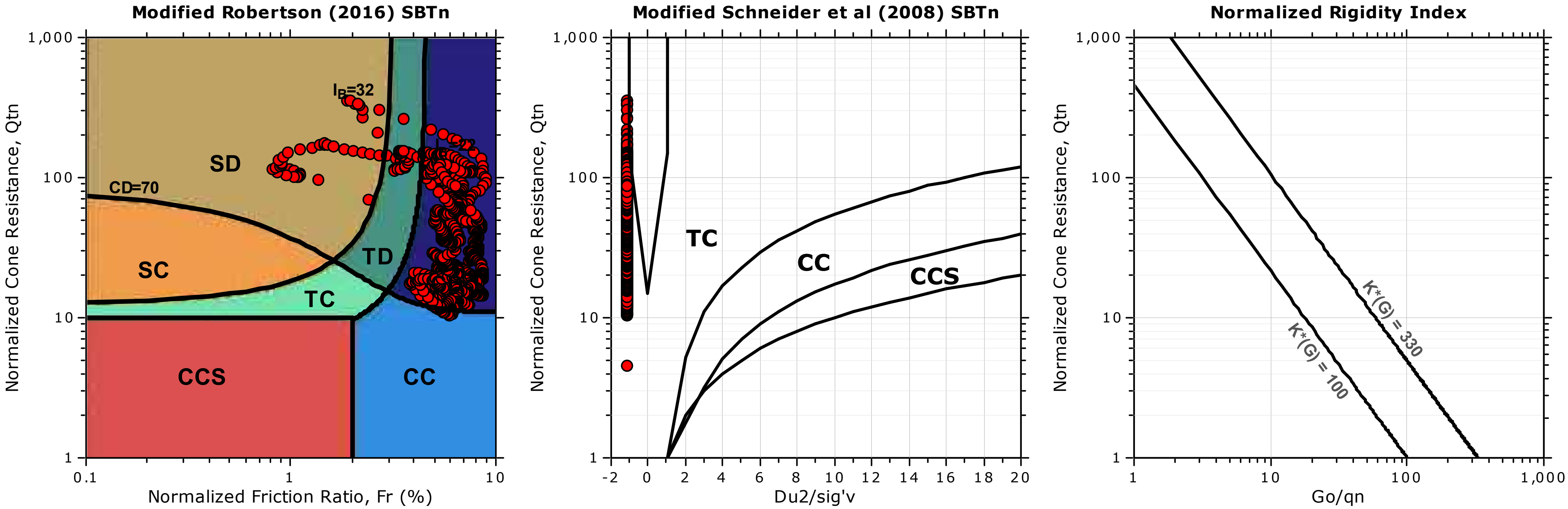
CPT: A3 CPT01
Total depth: 15.84 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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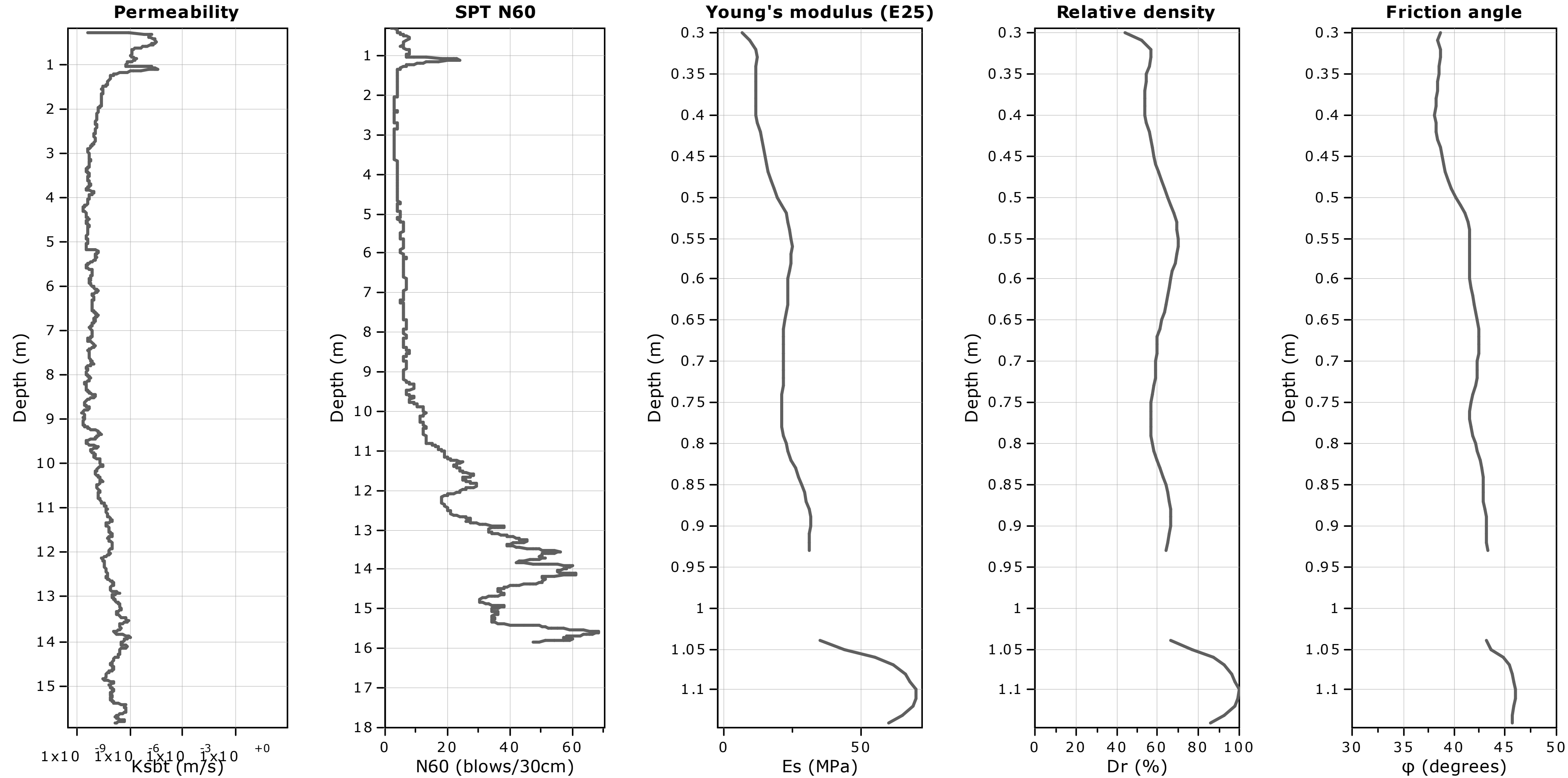
CPT: A3 CPT01
Total depth: 15.84 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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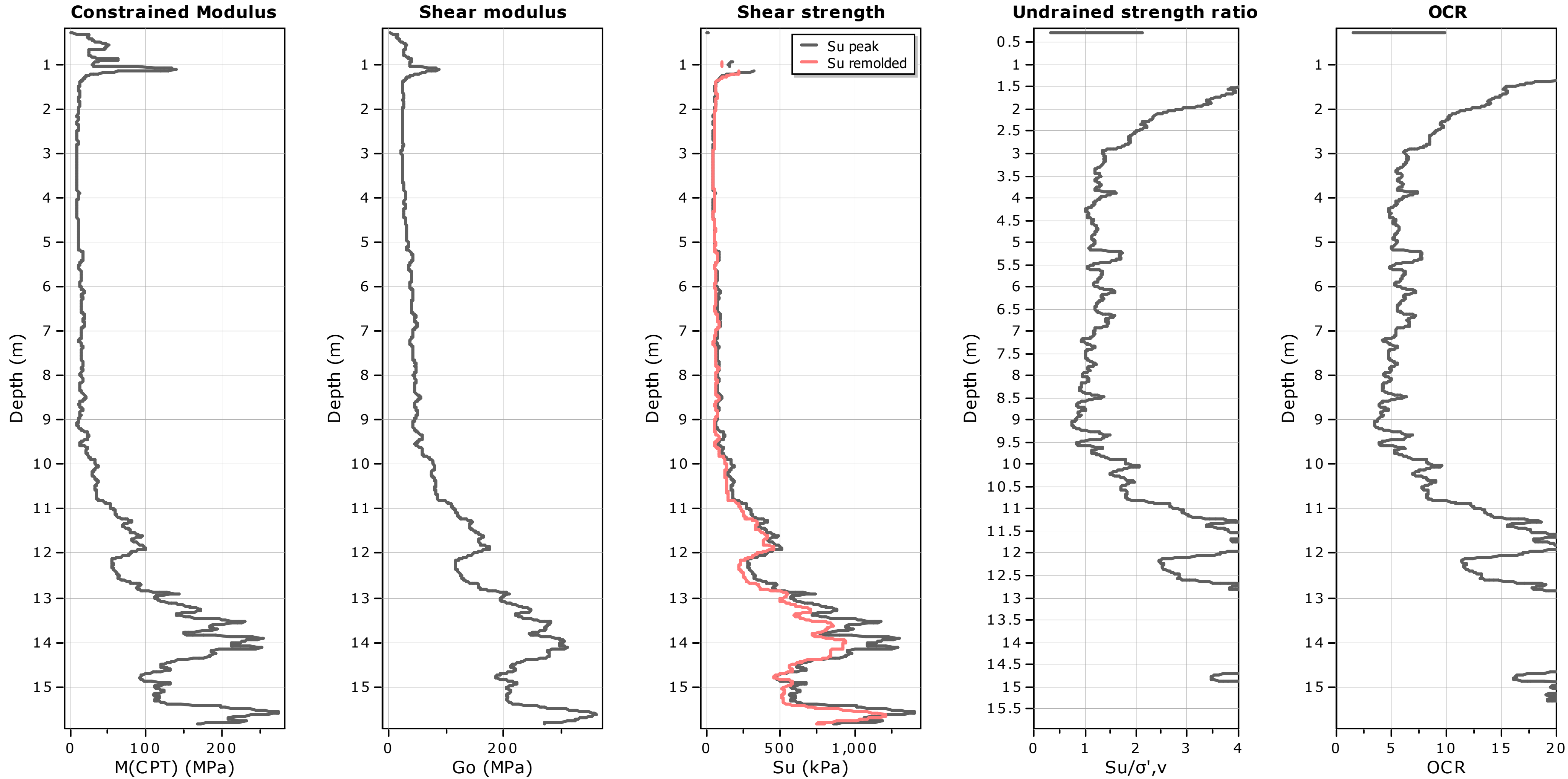
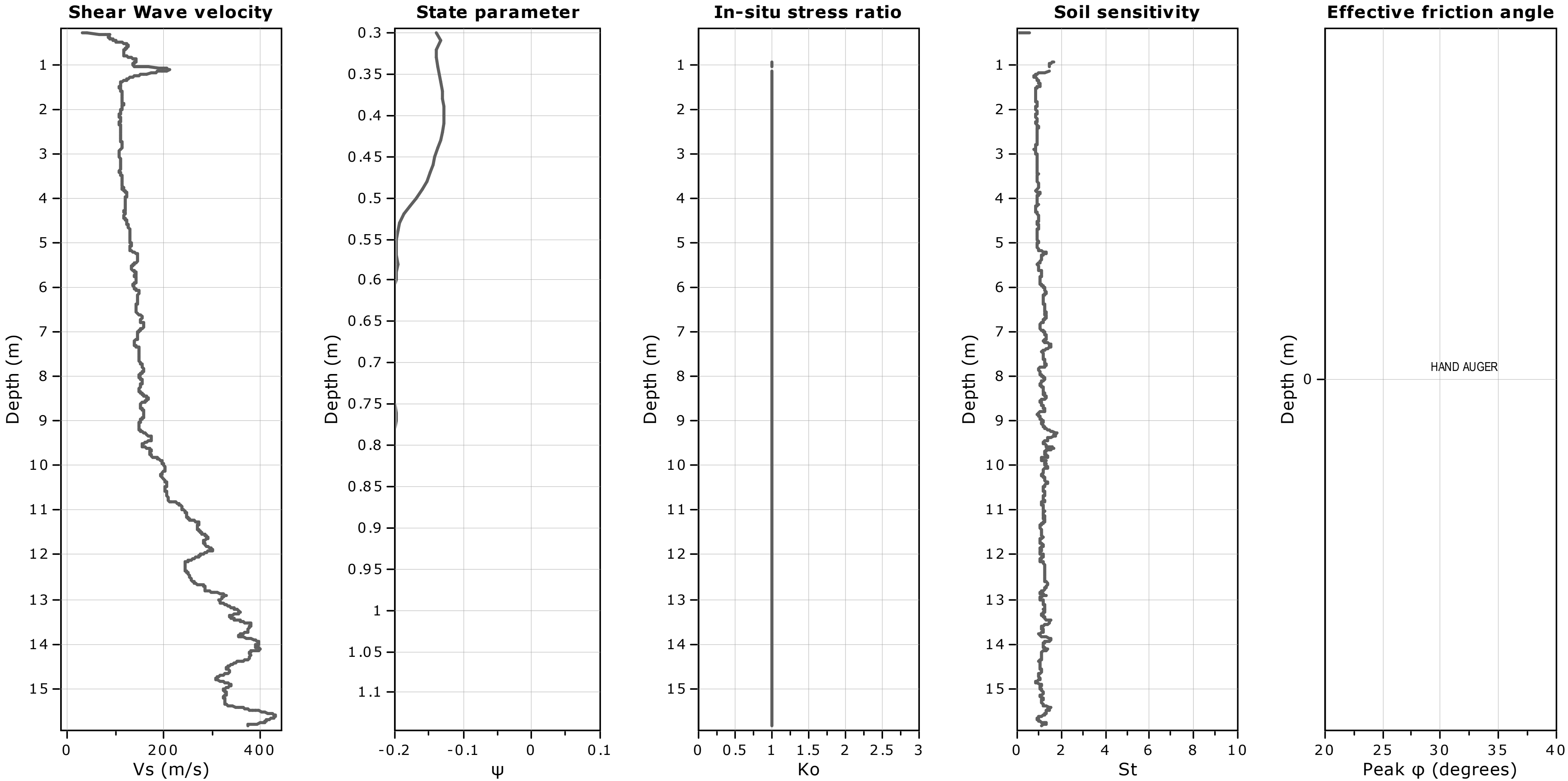
CPT: A3 CPT01
Total depth: 15.84 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

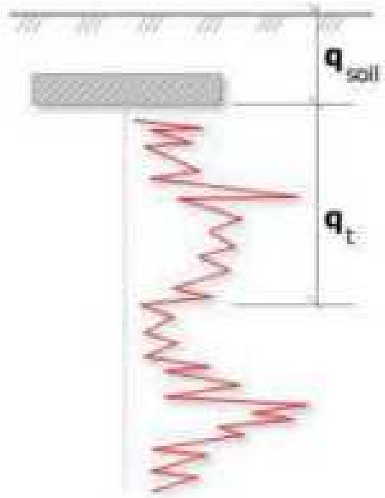
OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

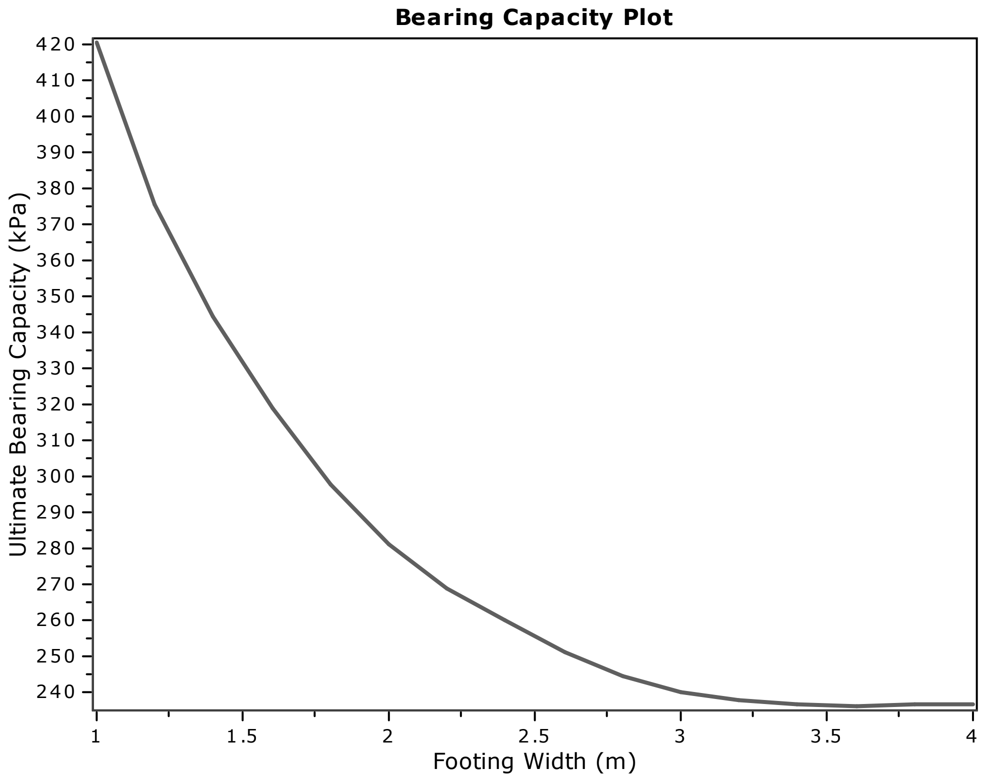
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



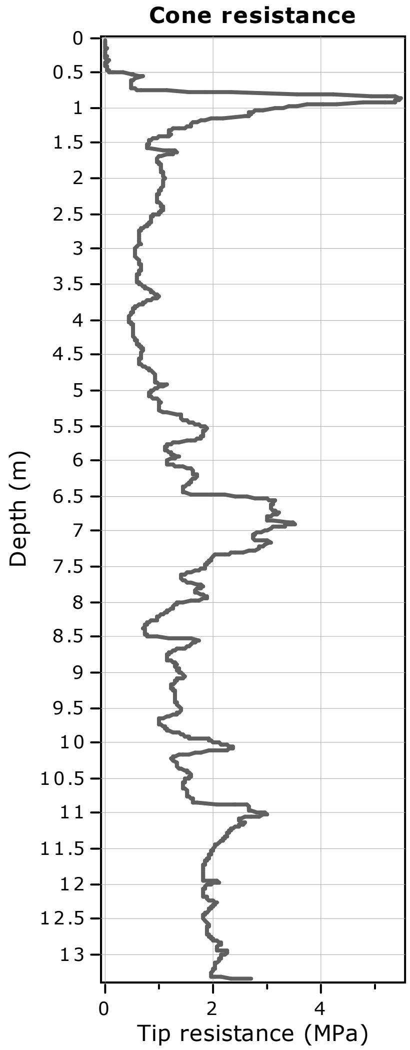
:: Tabular results ::

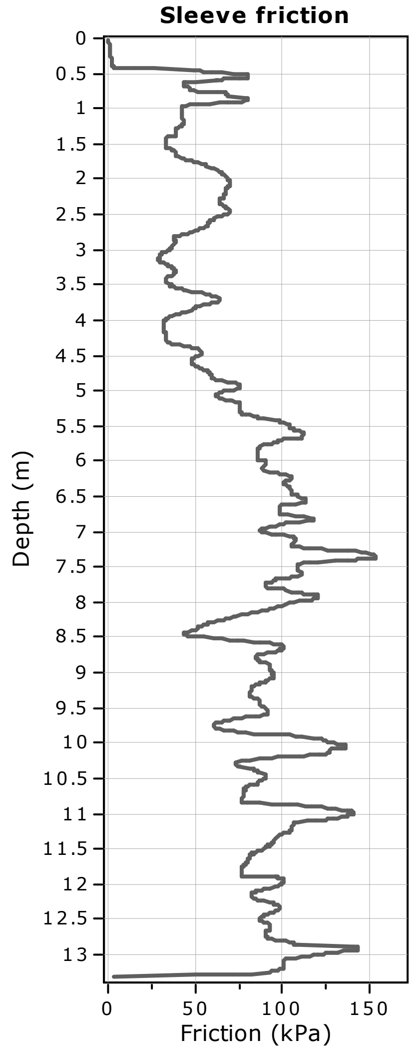
No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	2.05	0.20	9.50	420.49
2	1.20	0.50	2.30	1.83	0.20	9.50	375.77
3	1.40	0.50	2.60	1.67	0.20	9.50	344.49
4	1.60	0.50	2.90	1.55	0.20	9.50	319.12
5	1.80	0.50	3.20	1.44	0.20	9.50	298.11
6	2.00	0.50	3.50	1.36	0.20	9.50	281.48
7	2.20	0.50	3.80	1.30	0.20	9.50	268.80
8	2.40	0.50	4.10	1.25	0.20	9.50	259.86
9	2.60	0.50	4.40	1.21	0.20	9.50	251.00
10	2.80	0.50	4.70	1.18	0.20	9.50	244.66
11	3.00	0.50	5.00	1.15	0.20	9.50	239.99
12	3.20	0.50	5.30	1.14	0.20	9.50	238.07
13	3.40	0.50	5.60	1.14	0.20	9.50	237.09
14	3.60	0.50	5.90	1.13	0.20	9.50	236.27
15	3.80	0.50	6.20	1.14	0.20	9.50	236.60
16	4.00	0.50	6.50	1.14	0.20	9.50	236.82

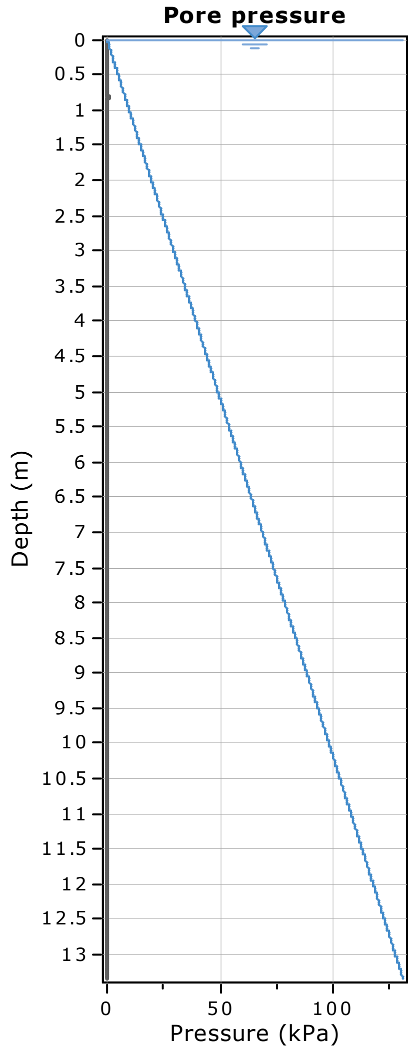
CPT: A3 CPT02

Total depth: 13.34 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

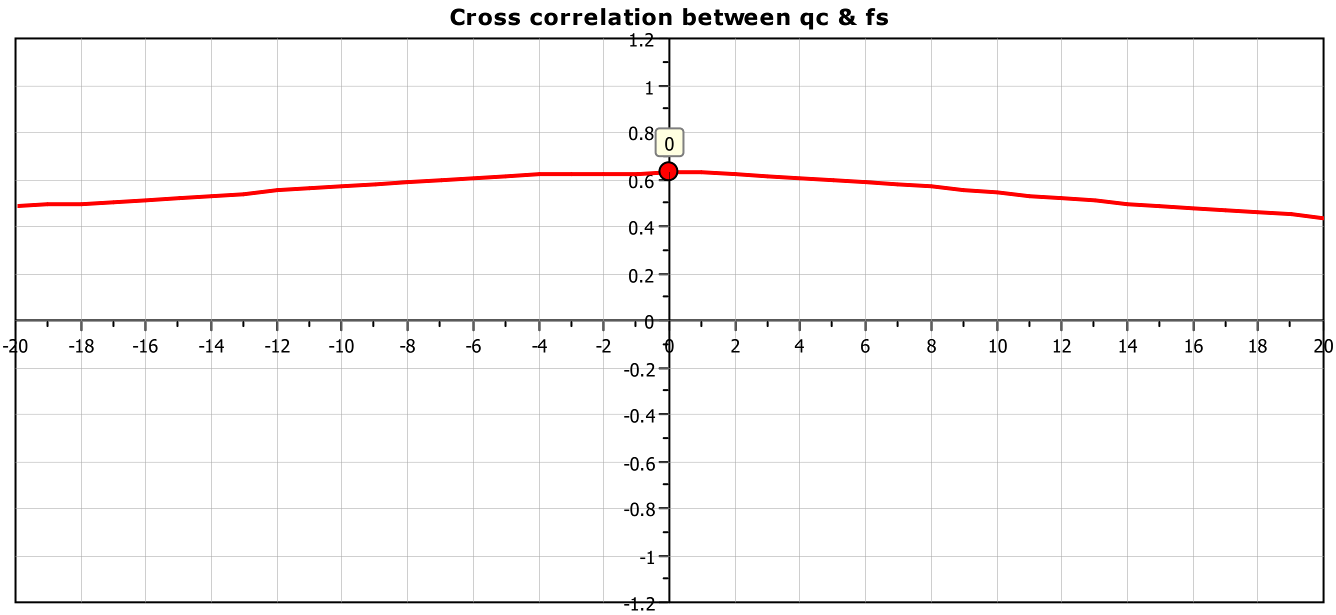
Project:
Location:



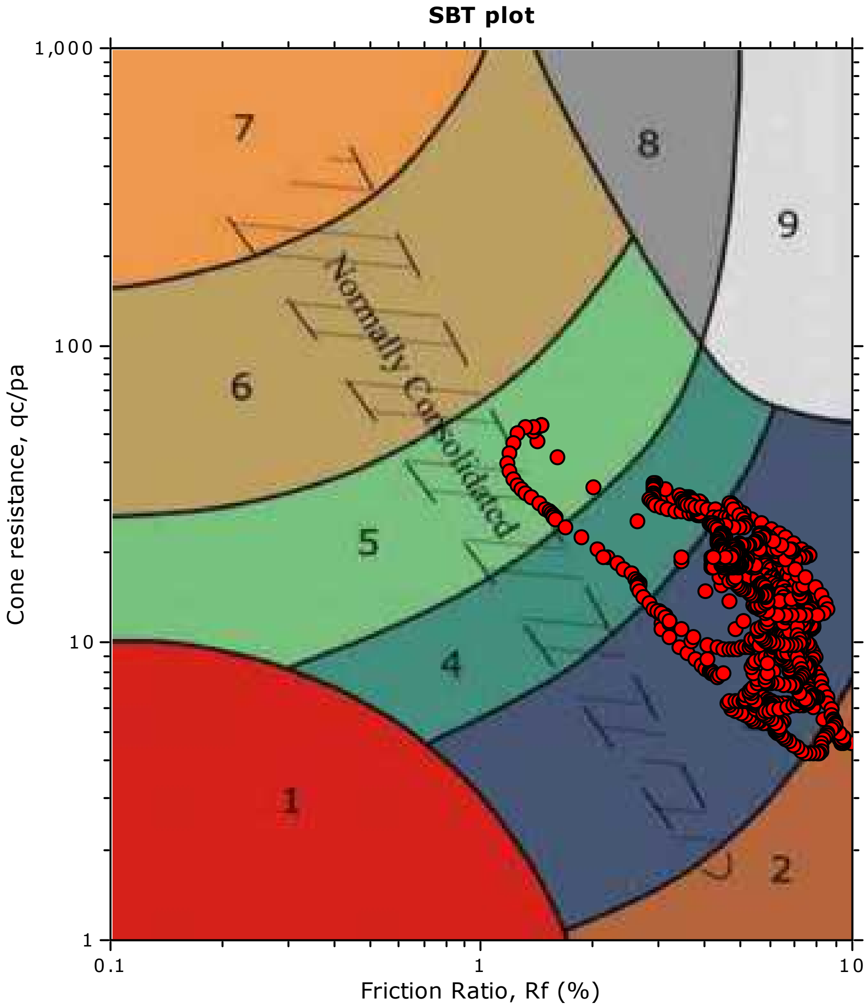


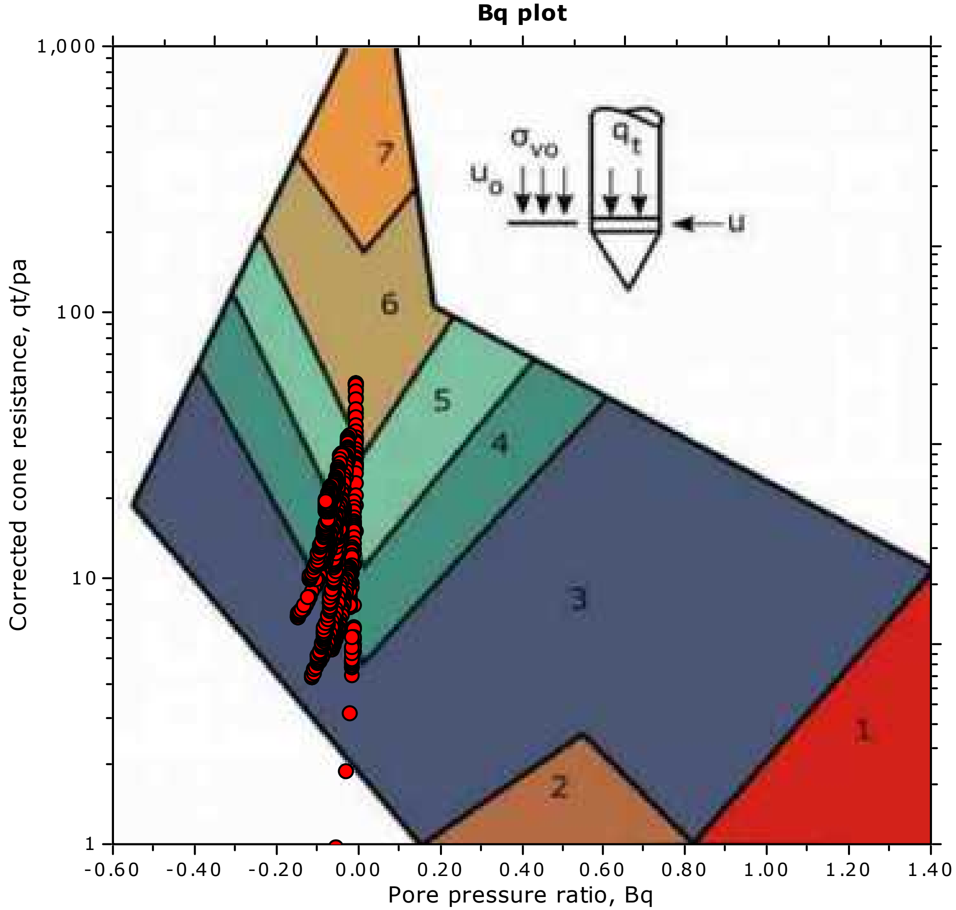


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots



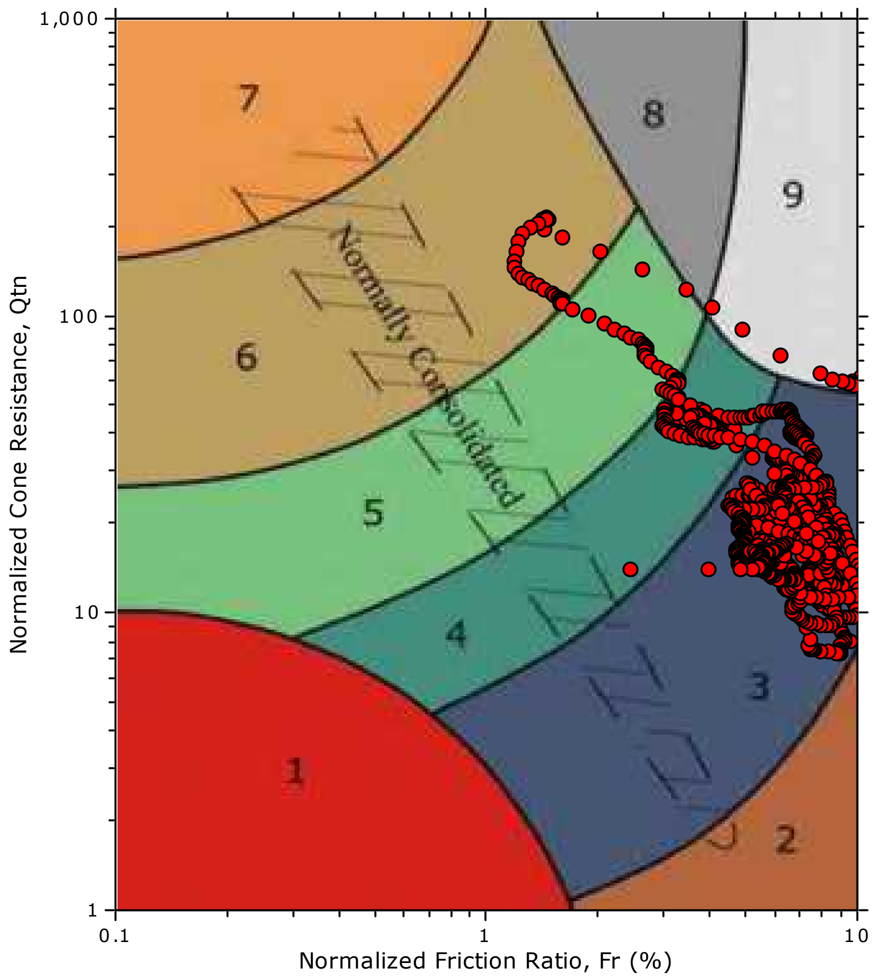


SBT legend

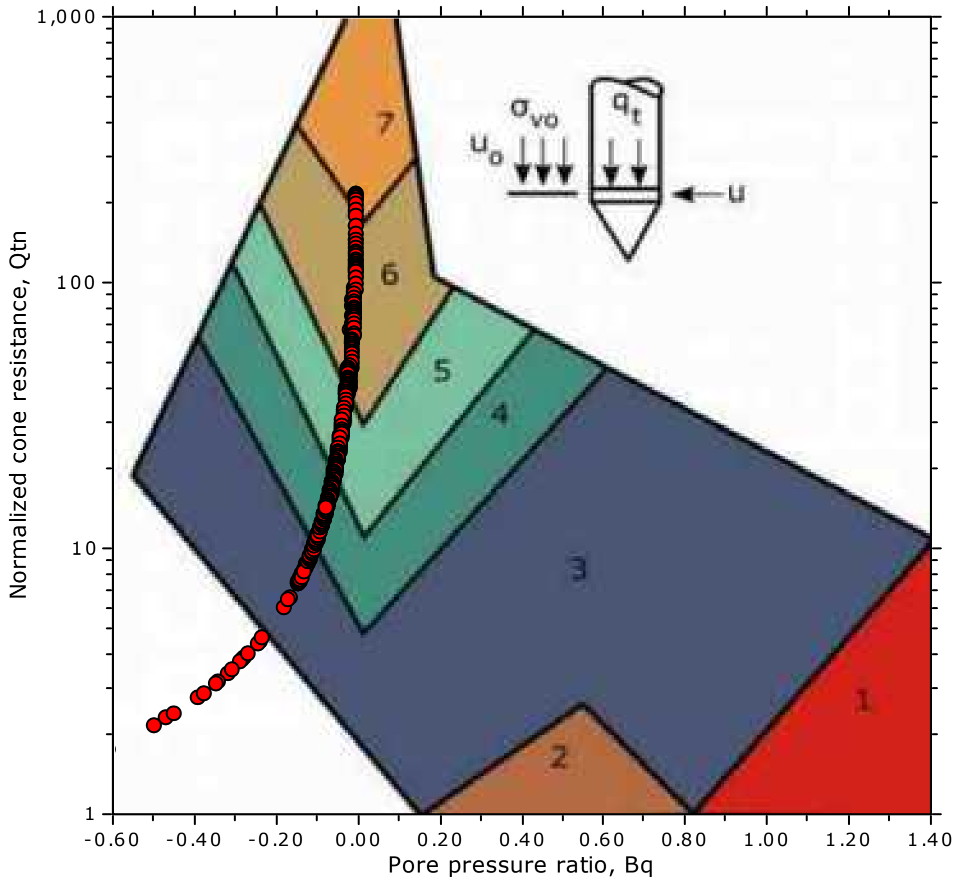
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

SBT - Bq plots (normalized)

SBTn plot



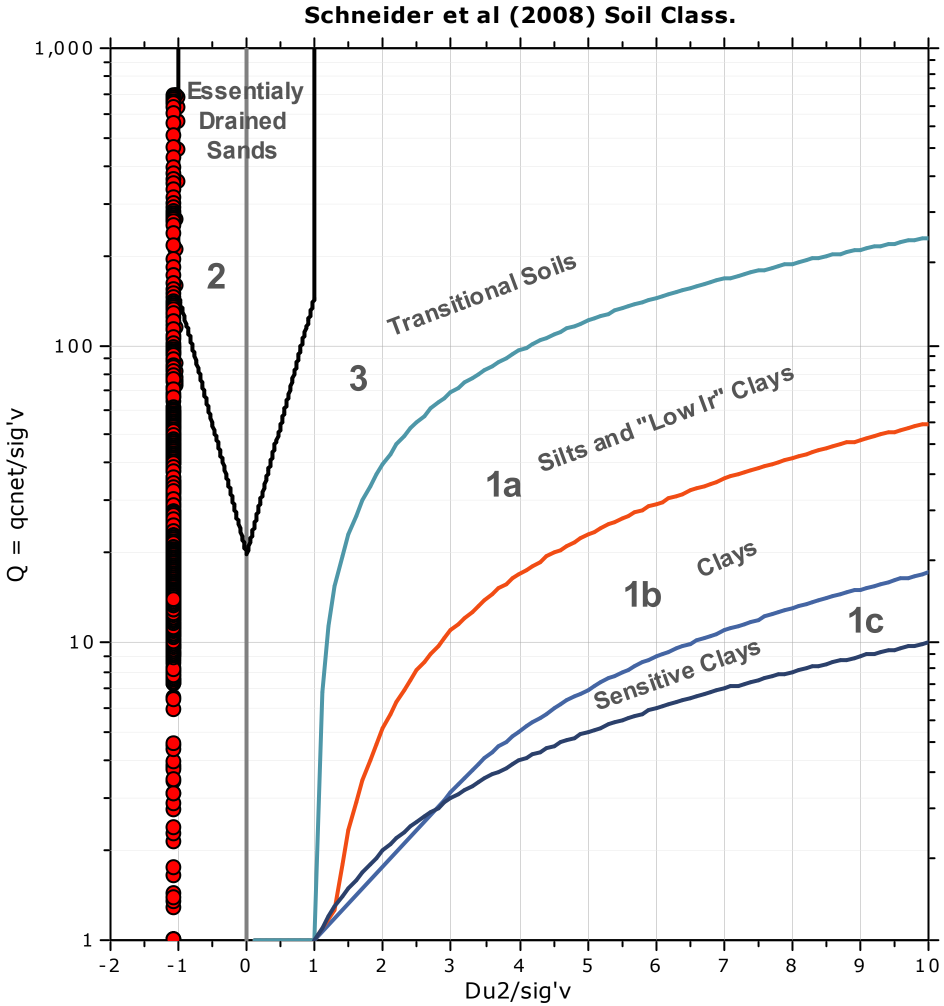
Normalized Bq plot

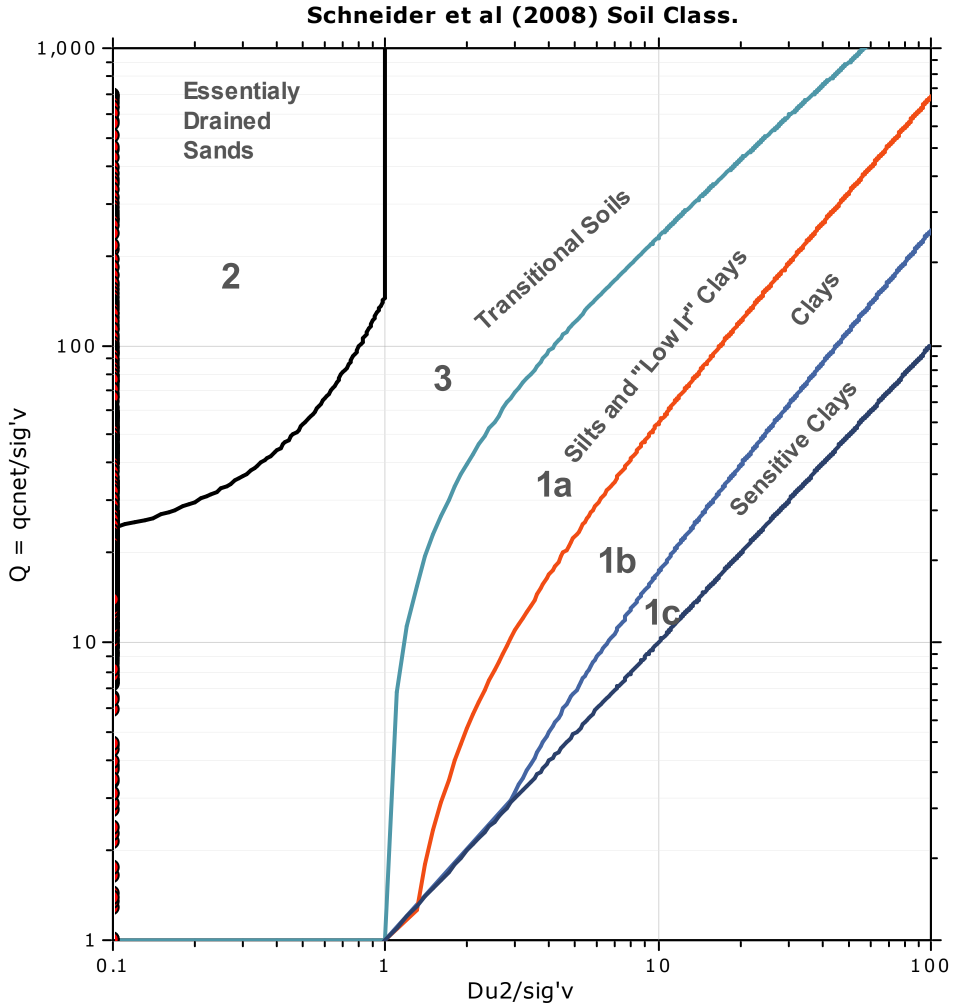


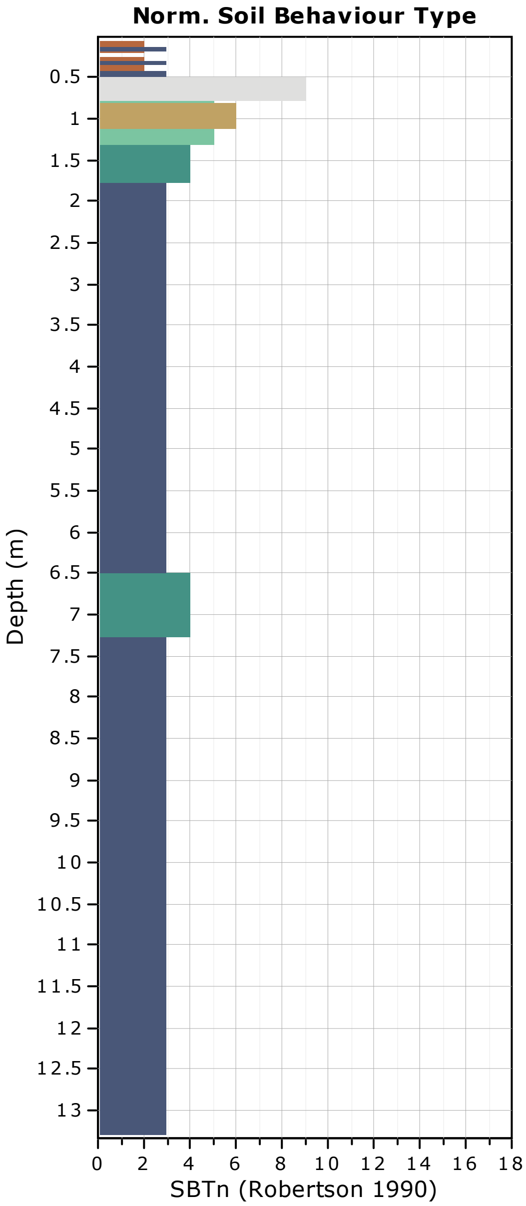
SBTn legend

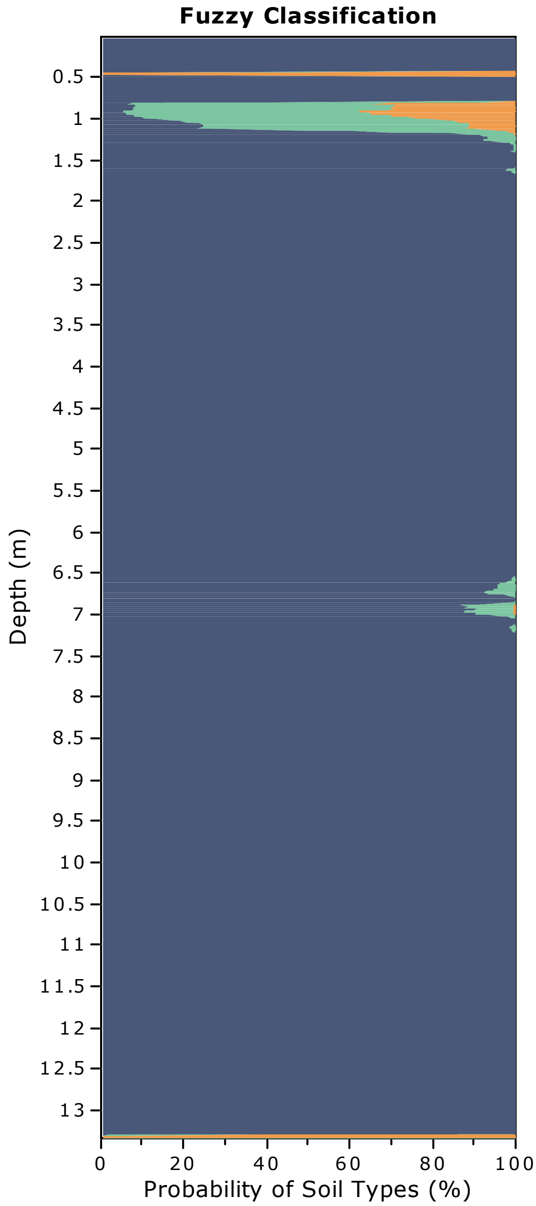
- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty clay
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravelly sand to sand
- 8. Very stiff sand to clayey sand
- 9. Very stiff fine grained

Bq plots (Schneider)



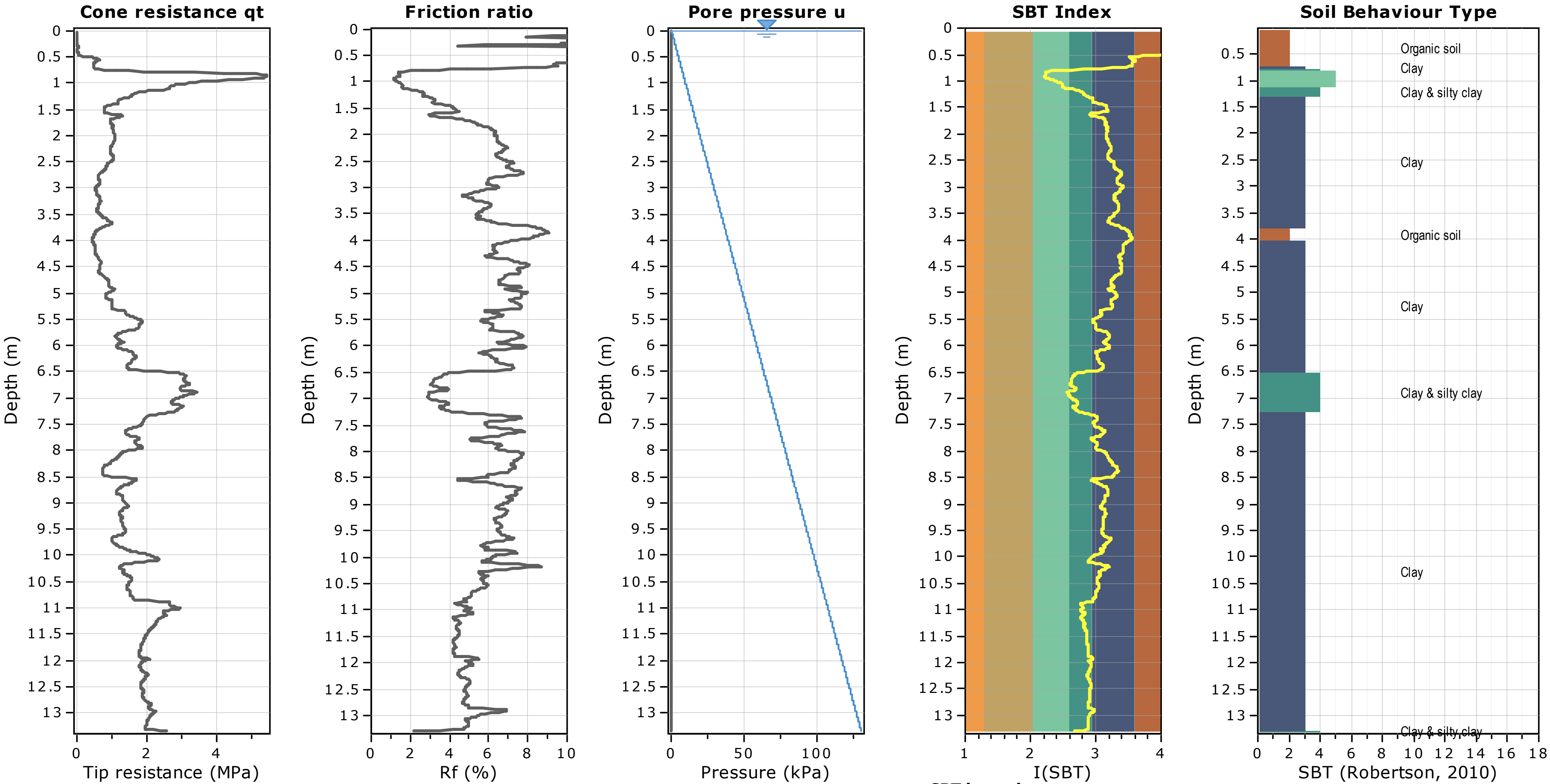



Norm. Soil Behaviour Type
Depth (m)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
11.5
12
12.5
13
0 2 4 6 8 10 12 14 16 18
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
11.5
12
12.5
13
0 20 40 60 80 100
Probability of Soil Types (%)

CPT: A3 CPT02
Total depth: 13.34 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBT legend

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

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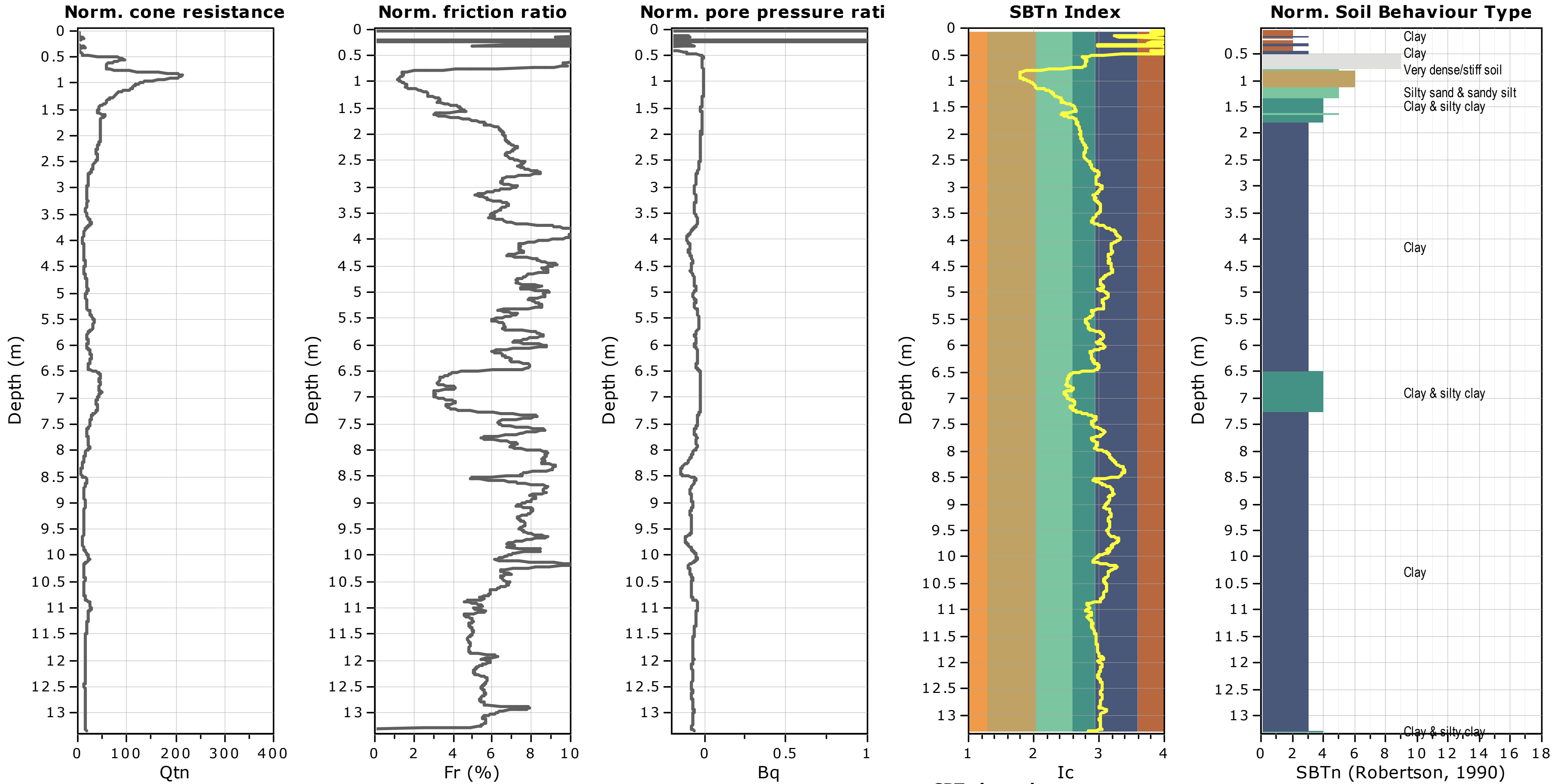
CPT: A3 CPT02
Total depth: 13.34 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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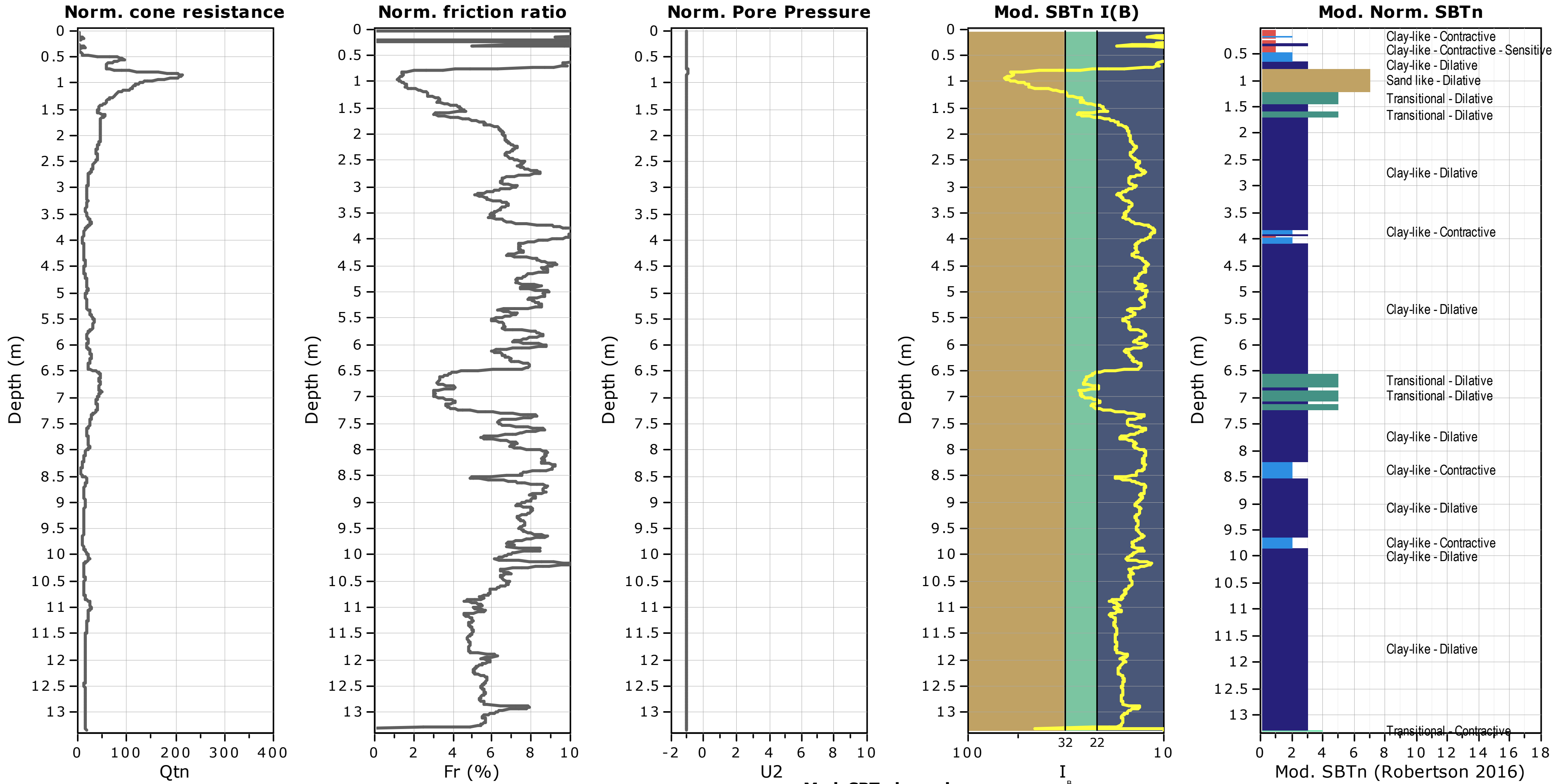
CPT: A3 CPT02
Total depth: 13.34 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

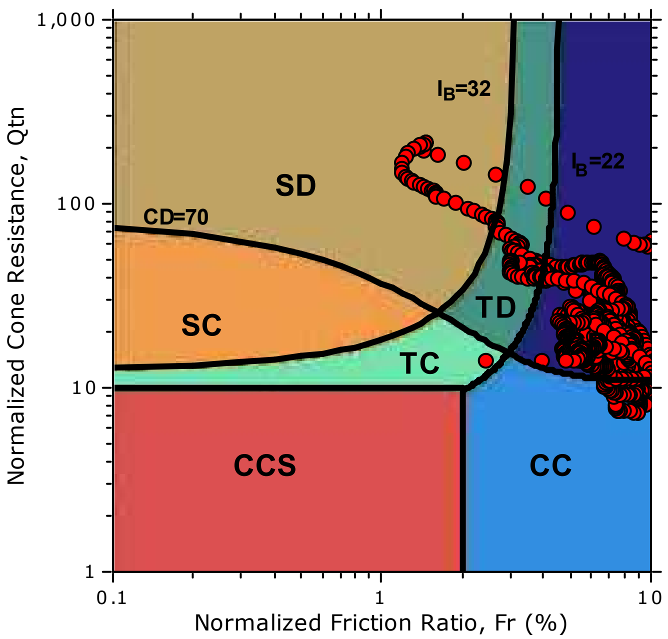
Project:
Location:

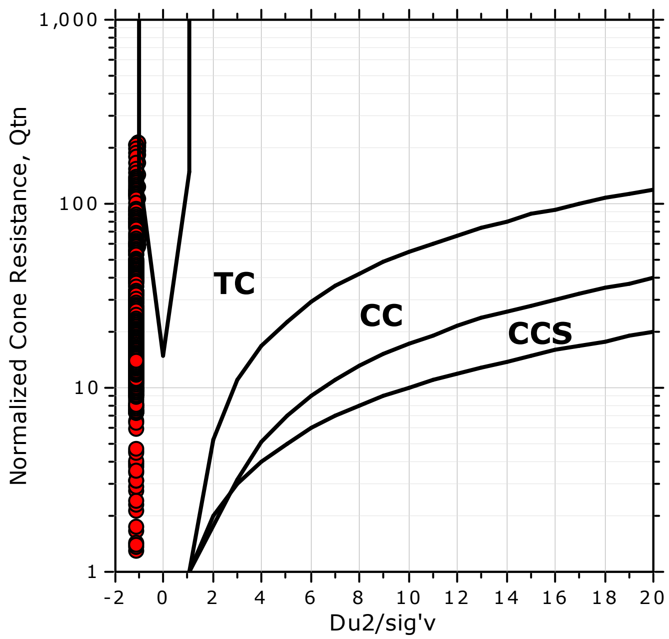


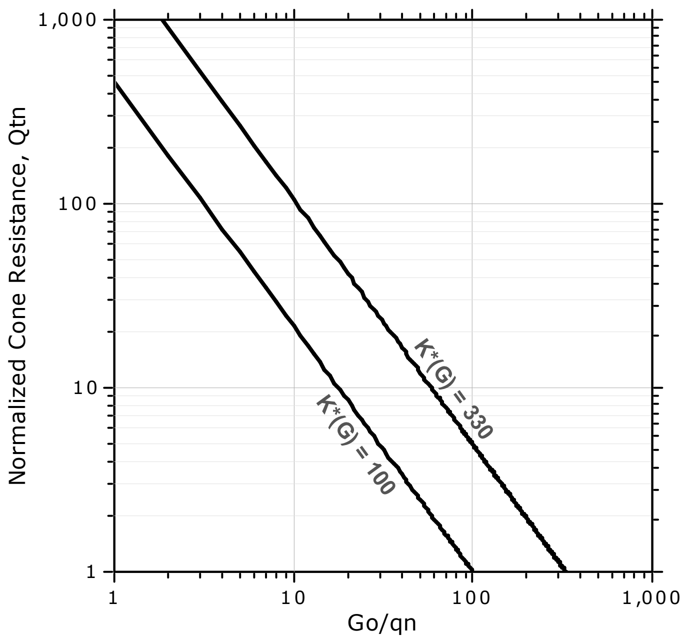
Mod. SBTn legend

- 1. CCS: ClayLike - Contractive, Sensitive
- 2. CC: Clay-like - Contractive
- 3. CD: Clay-Like: Dilative
- 4. TC: Transitional - Contractive
- 5. TD: Transitional - Dilative
- 6. SC: Sand-like - Contractive
- 7. SD: Sand-like - Dilative

Updated SBTn plots

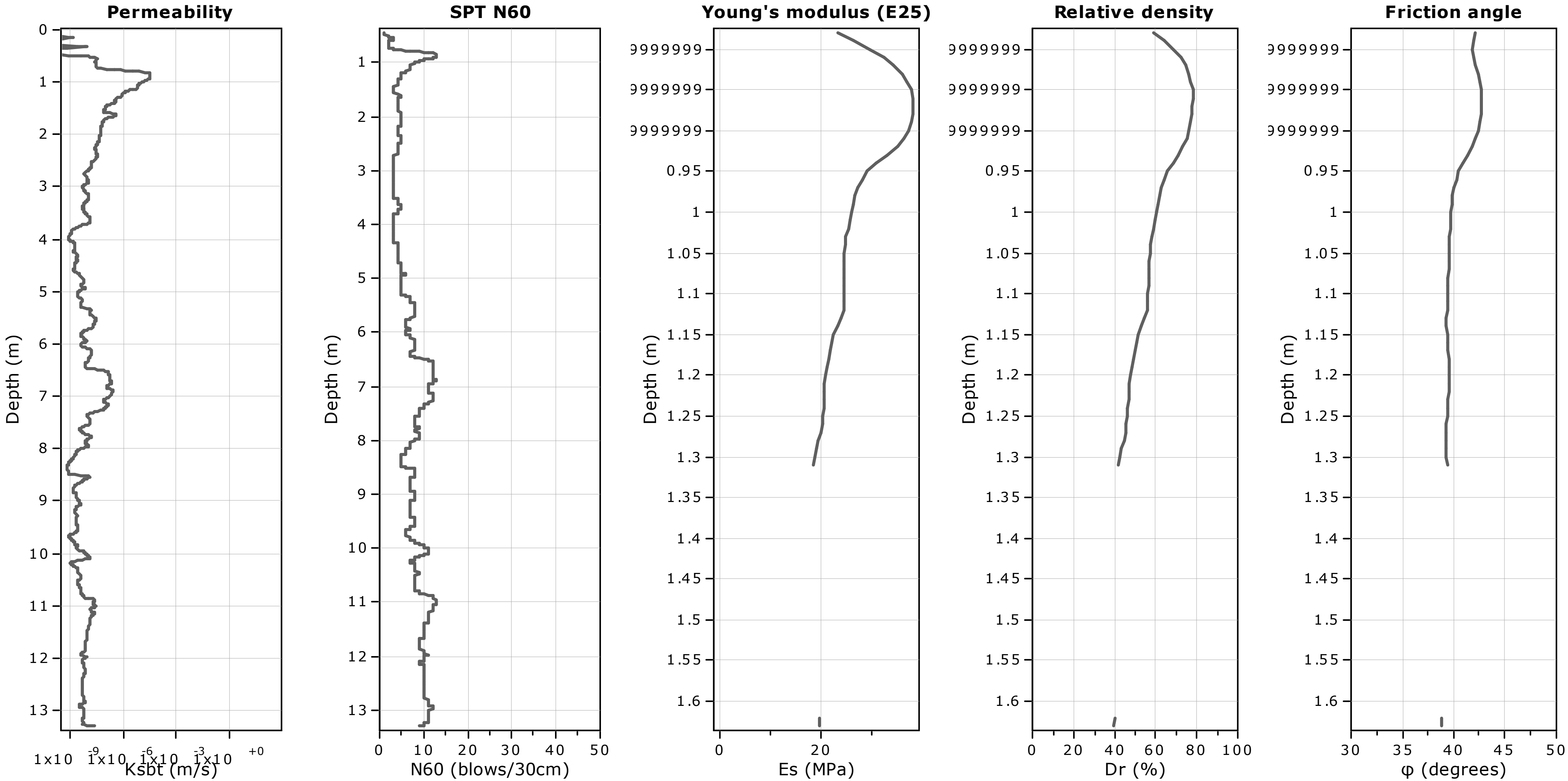






CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)



Calculation parameters

Permeability: Based on SBT_n

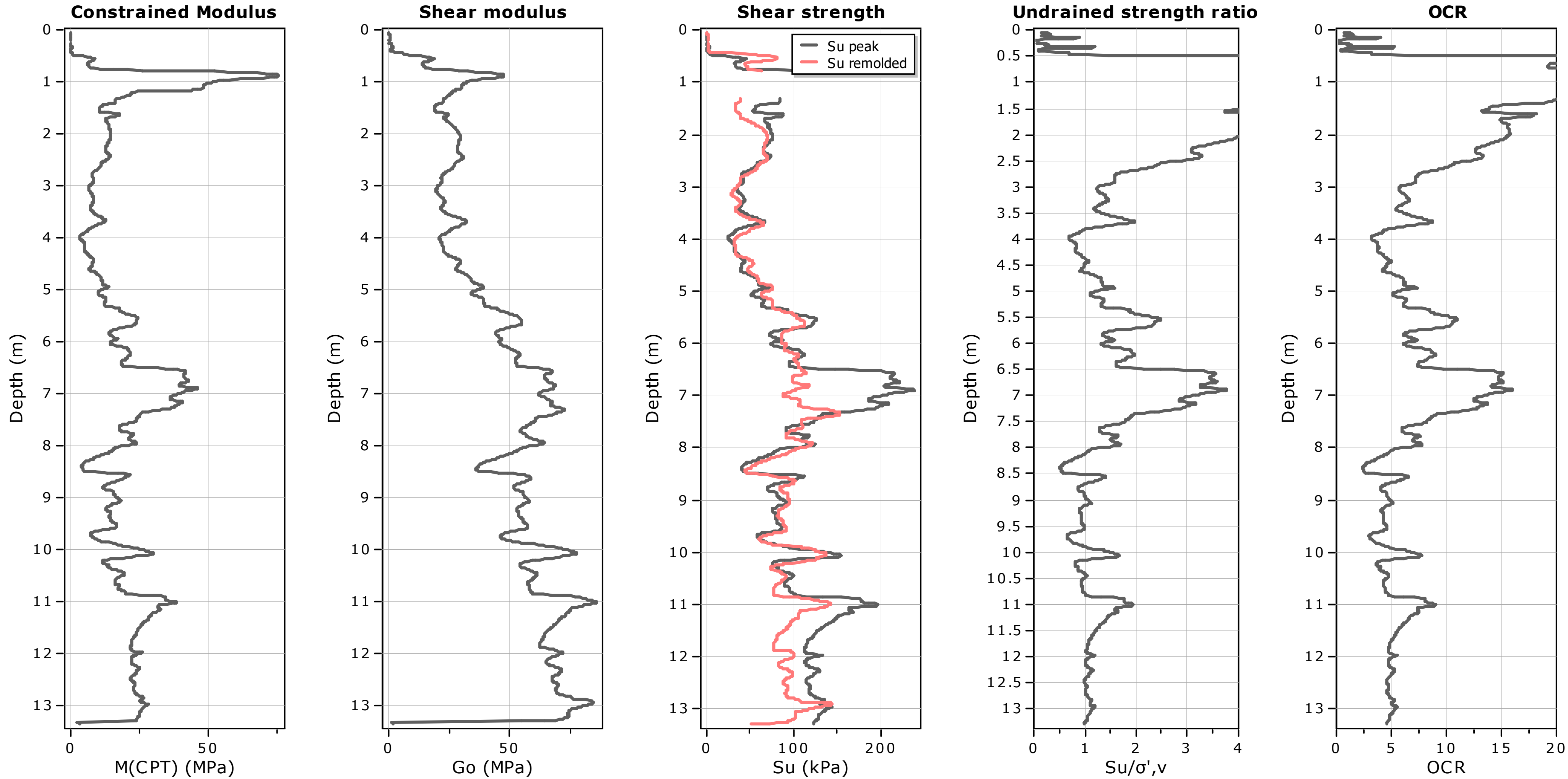
SPT N_{60}: Based on I_c and q_t

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

Relative density constant, C_{Dr}: 350.0

Phi: Based on Kulhawy & Mayne (1990)

User defined estimation data



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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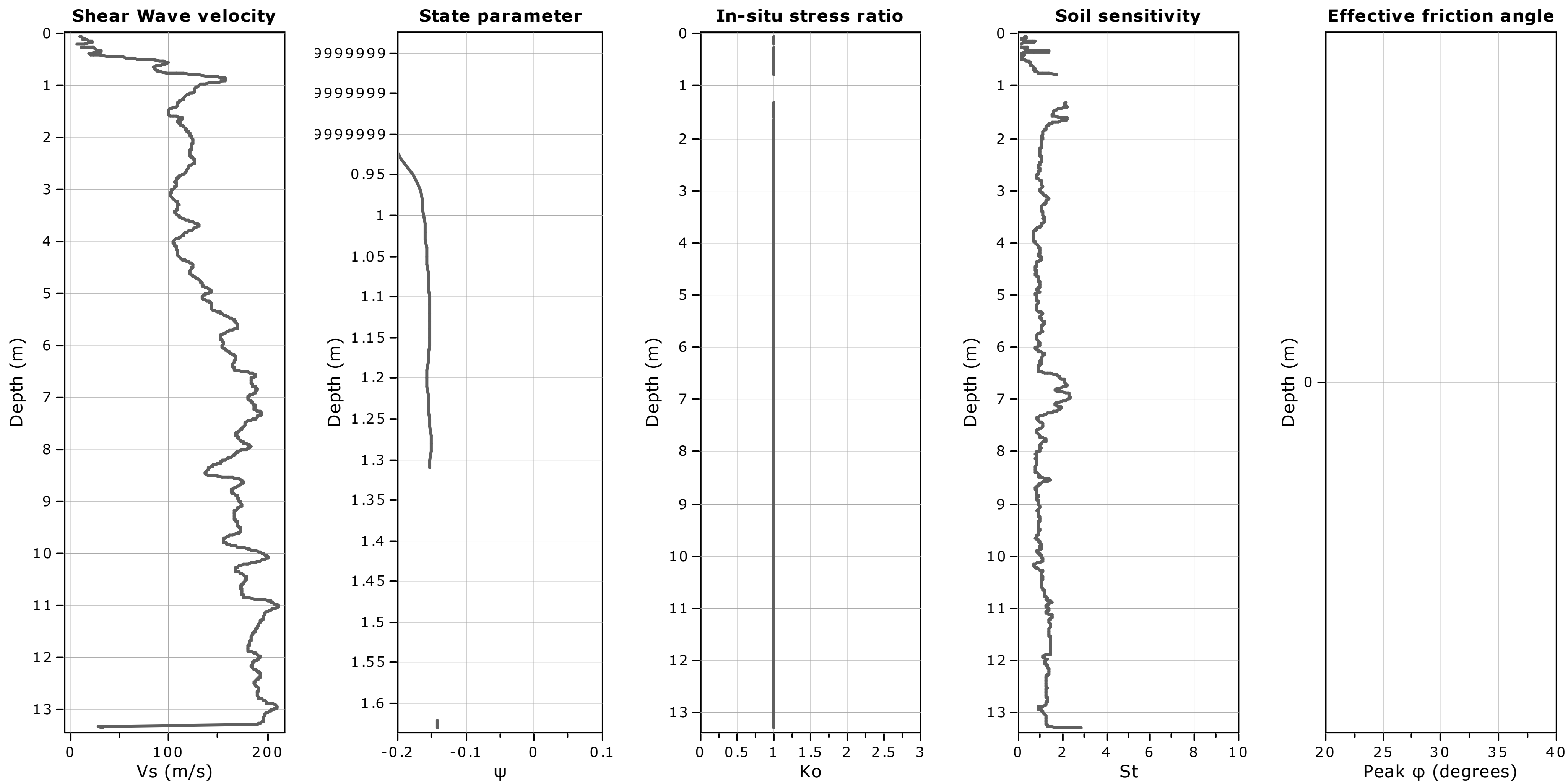
CPT: A3 CPT02
Total depth: 13.34 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

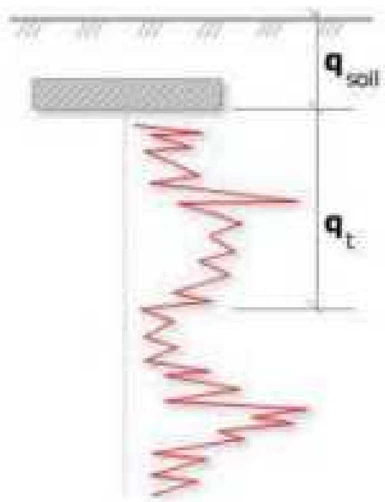
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

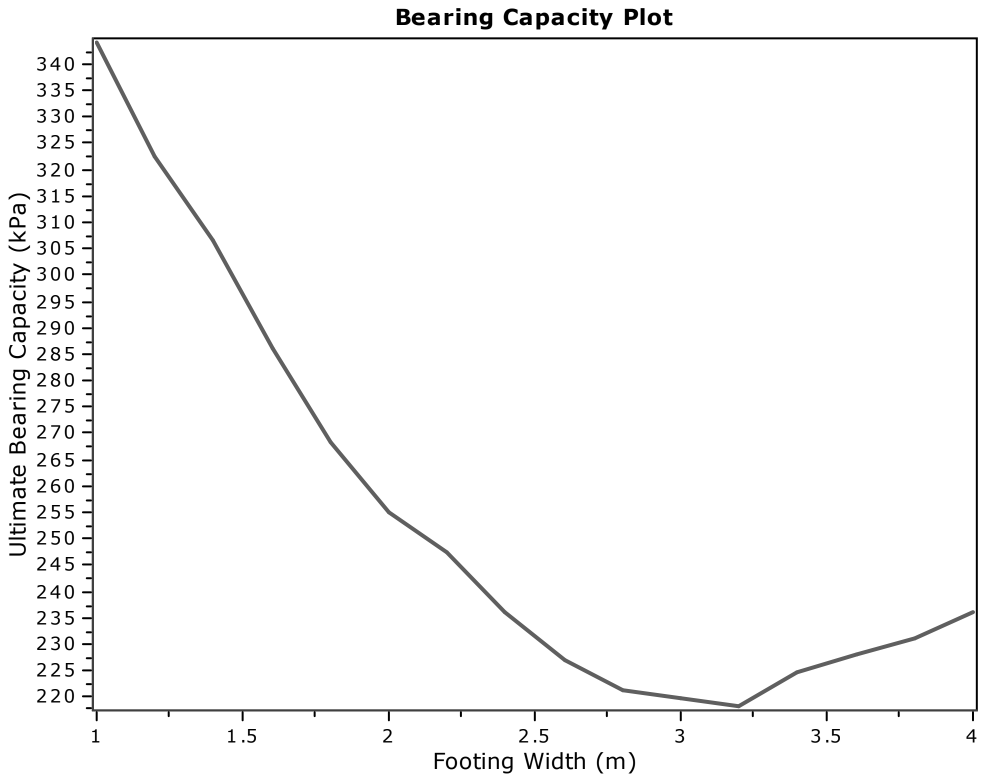
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.67	0.20	9.50	344.10
2	1.20	0.50	2.30	1.57	0.20	9.50	322.67
3	1.40	0.50	2.60	1.48	0.20	9.50	306.38
4	1.60	0.50	2.90	1.38	0.20	9.50	286.00
5	1.80	0.50	3.20	1.29	0.20	9.50	268.39
6	2.00	0.50	3.50	1.23	0.20	9.50	255.08
7	2.20	0.50	3.80	1.19	0.20	9.50	247.60
8	2.40	0.50	4.10	1.13	0.20	9.50	235.88
9	2.60	0.50	4.40	1.09	0.20	9.50	227.13
10	2.80	0.50	4.70	1.06	0.20	9.50	221.28
11	3.00	0.50	5.00	1.05	0.20	9.50	219.66
12	3.20	0.50	5.30	1.04	0.20	9.50	218.23
13	3.40	0.50	5.60	1.08	0.20	9.50	224.57
14	3.60	0.50	5.90	1.09	0.20	9.50	228.19
15	3.80	0.50	6.20	1.11	0.20	9.50	231.20
16	4.00	0.50	6.50	1.13	0.20	9.50	236.20

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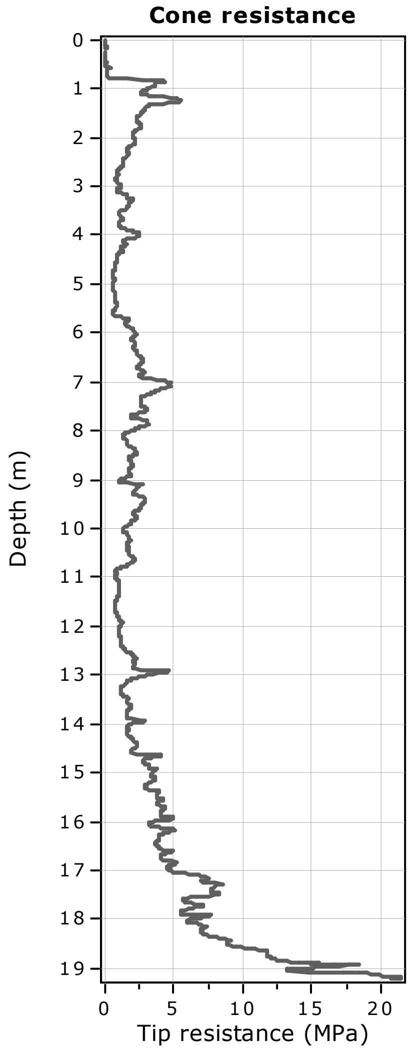
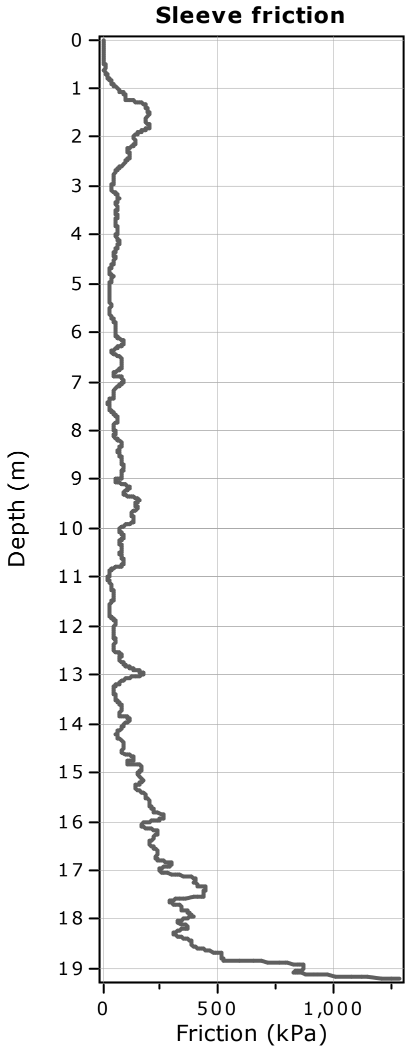
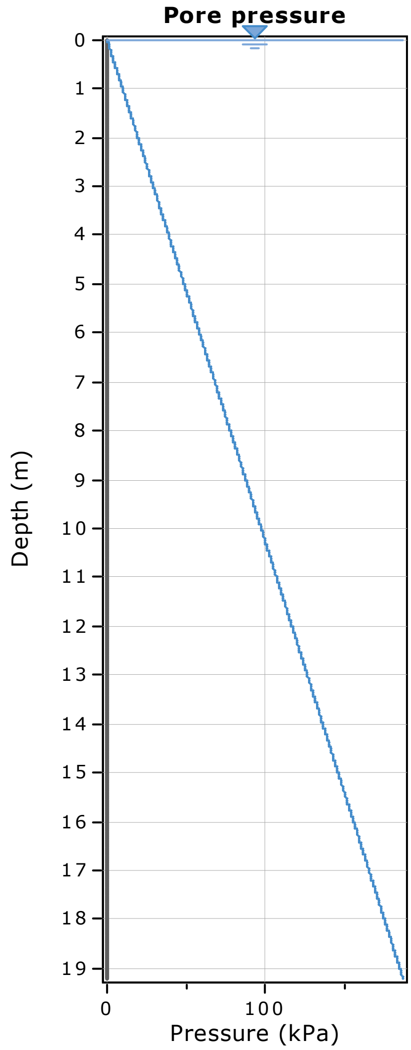
CPT: A3 CPT03
Total depth: 19.21 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

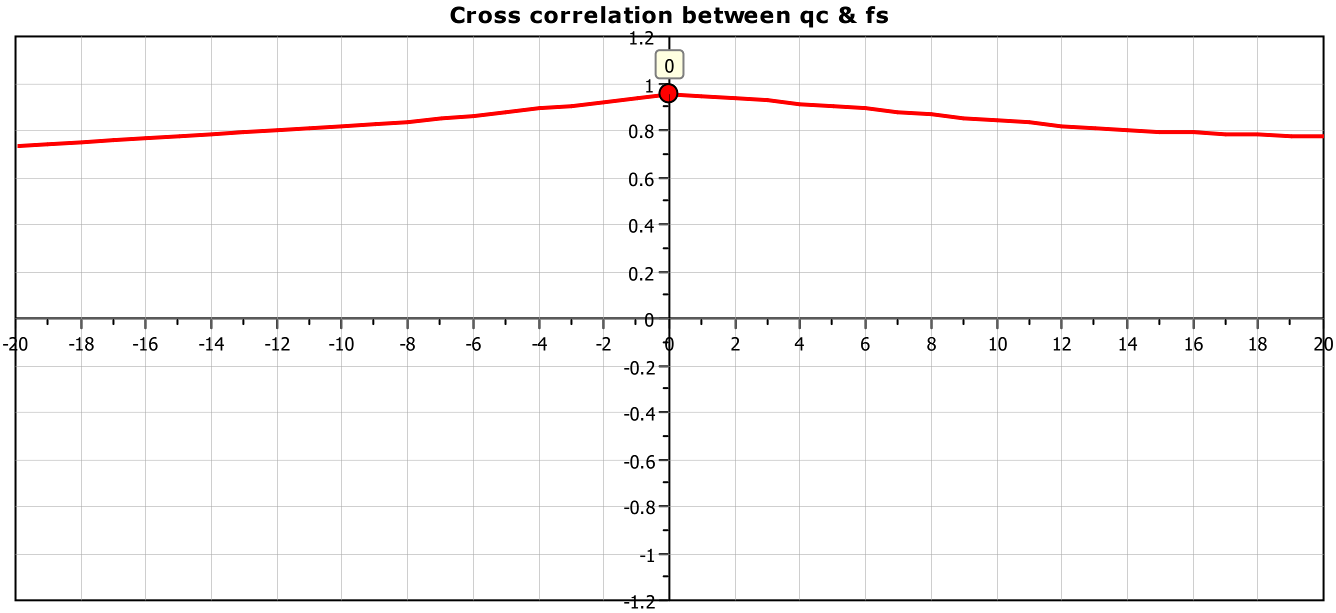
Project:
Location:



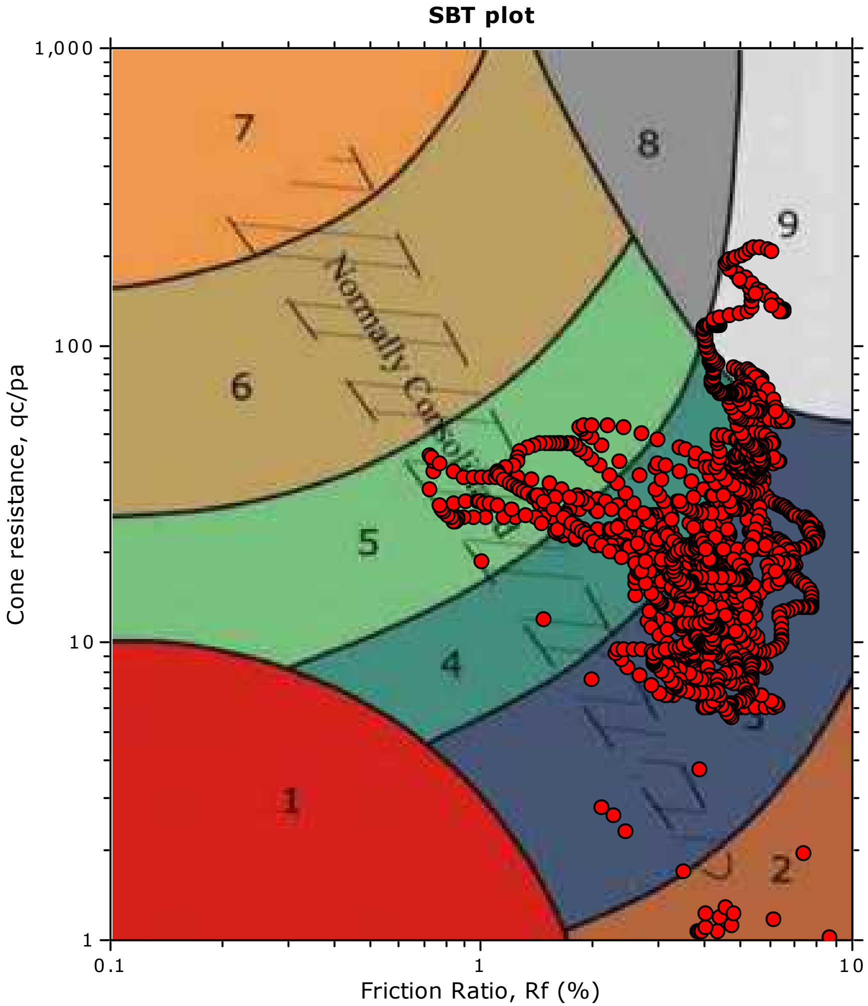


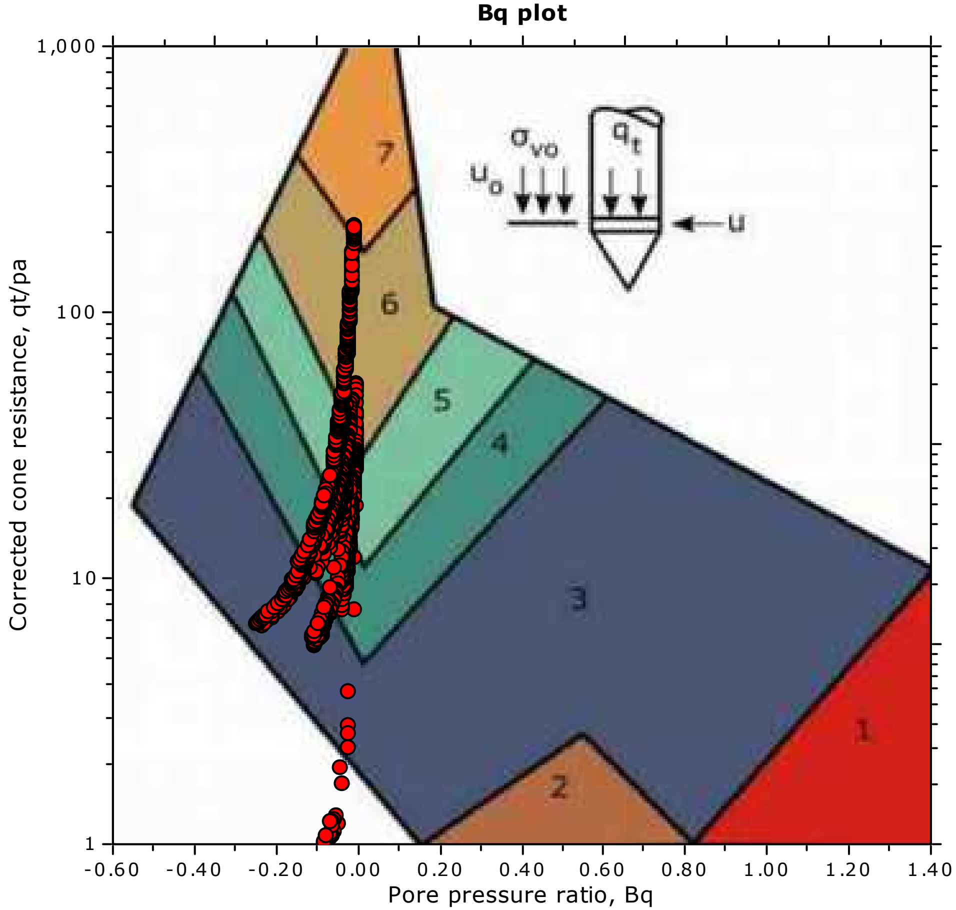


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots





SBT legend

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

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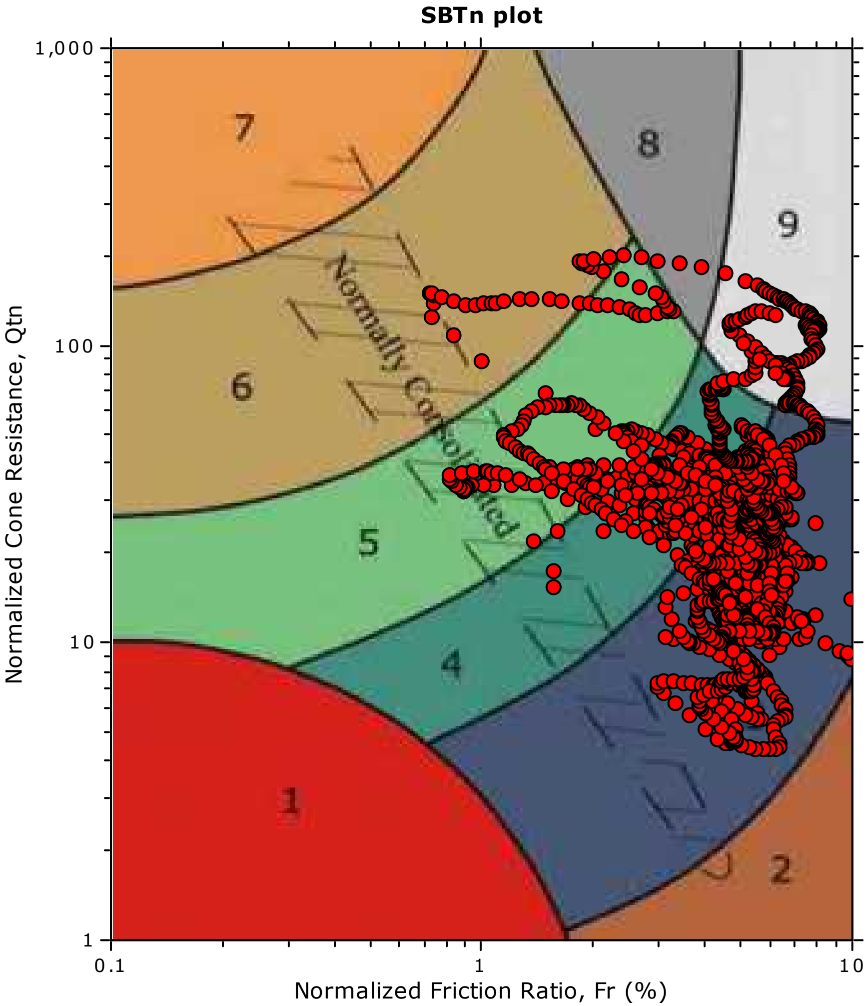
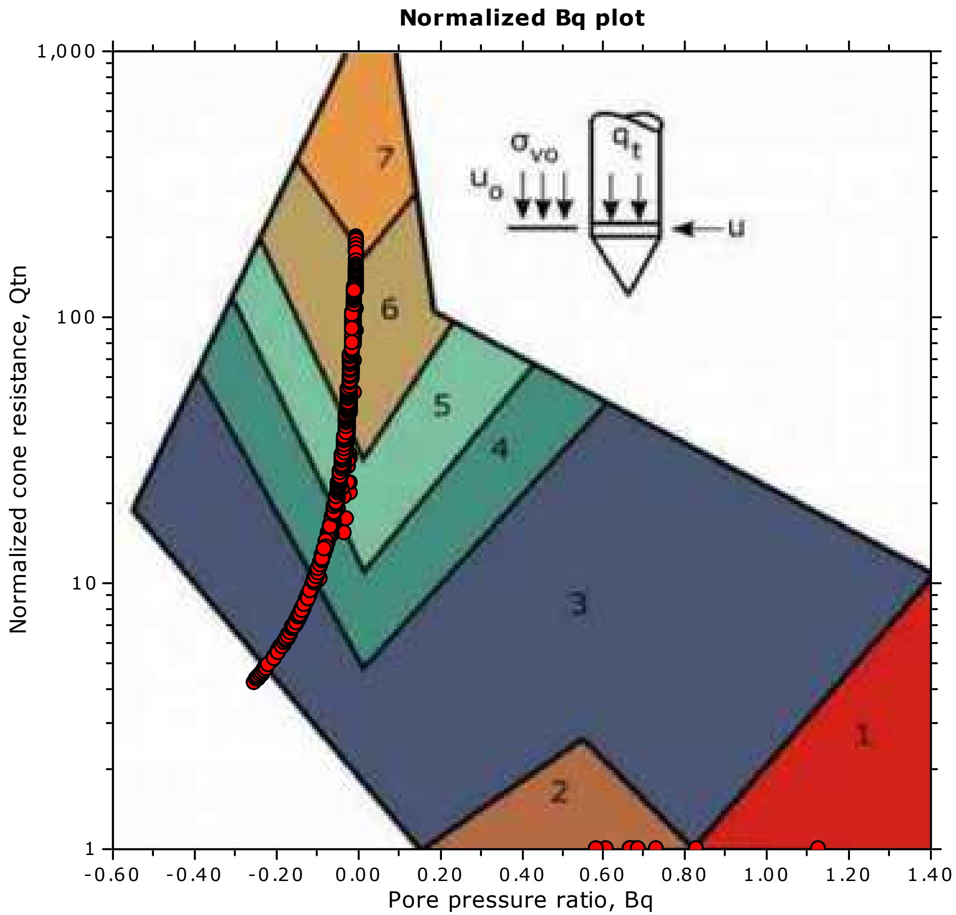
CPT: A3 CPT03
Total depth: 19.21 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

SBT - Bq plots (normalized)

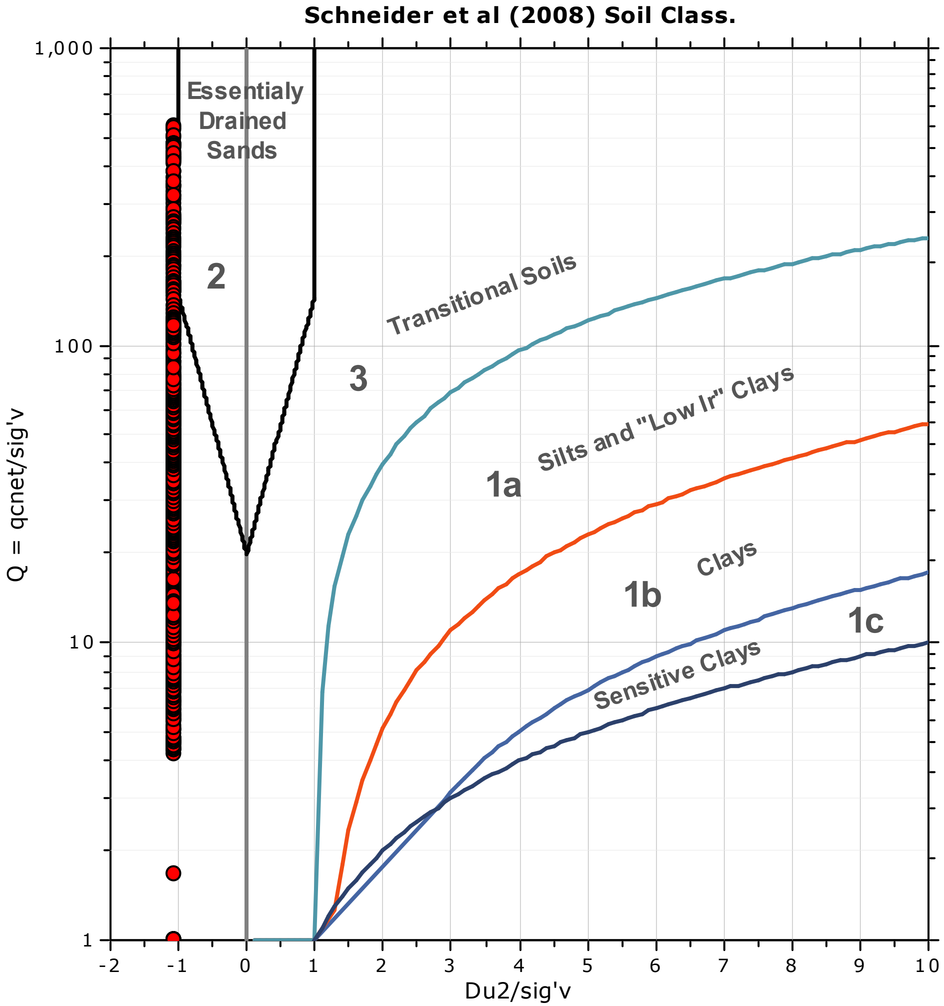


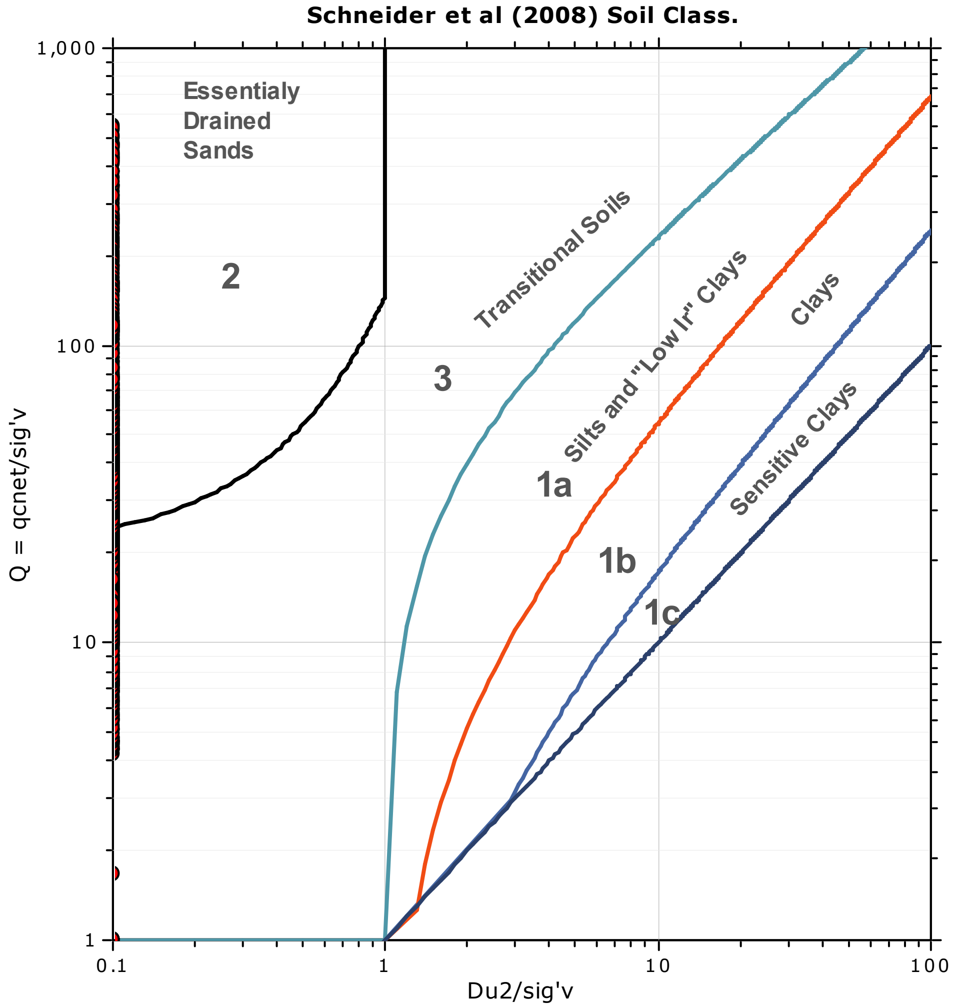


SBTn legend

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

Bq plots (Schneider)





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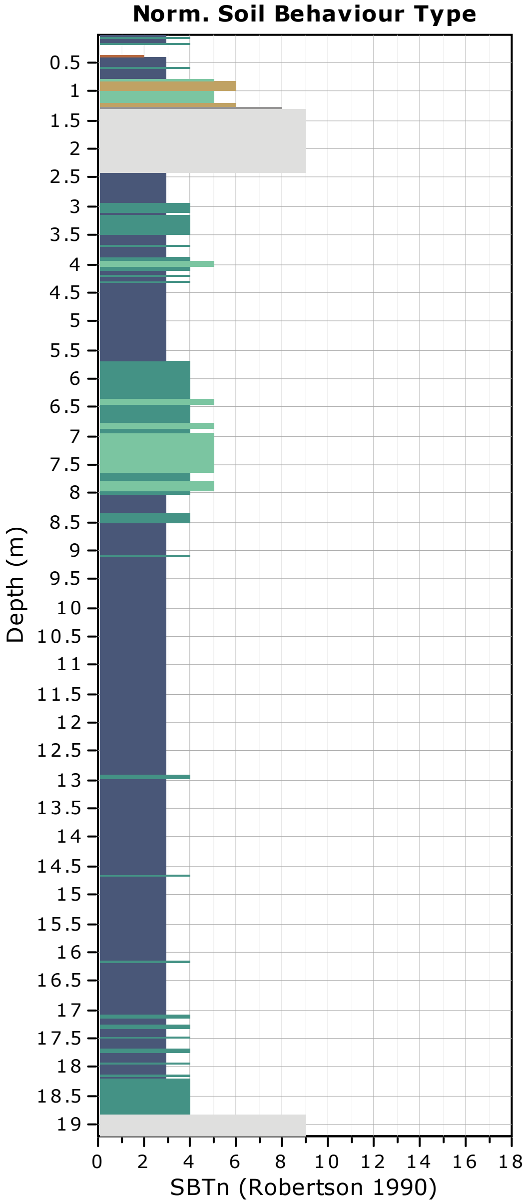
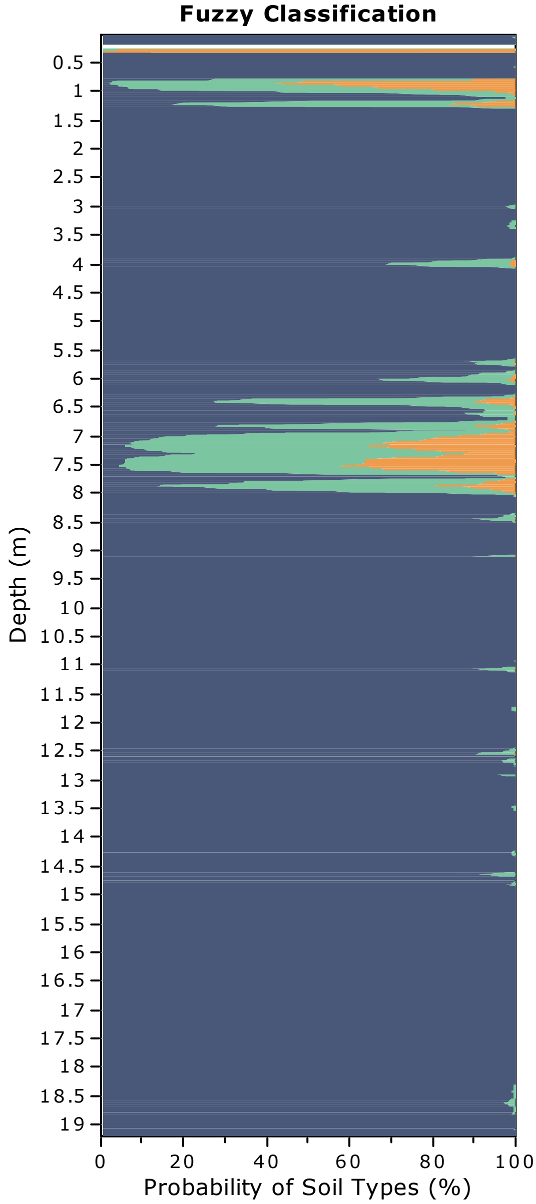
CPT: A3 CPT03
Total depth: 19.21 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

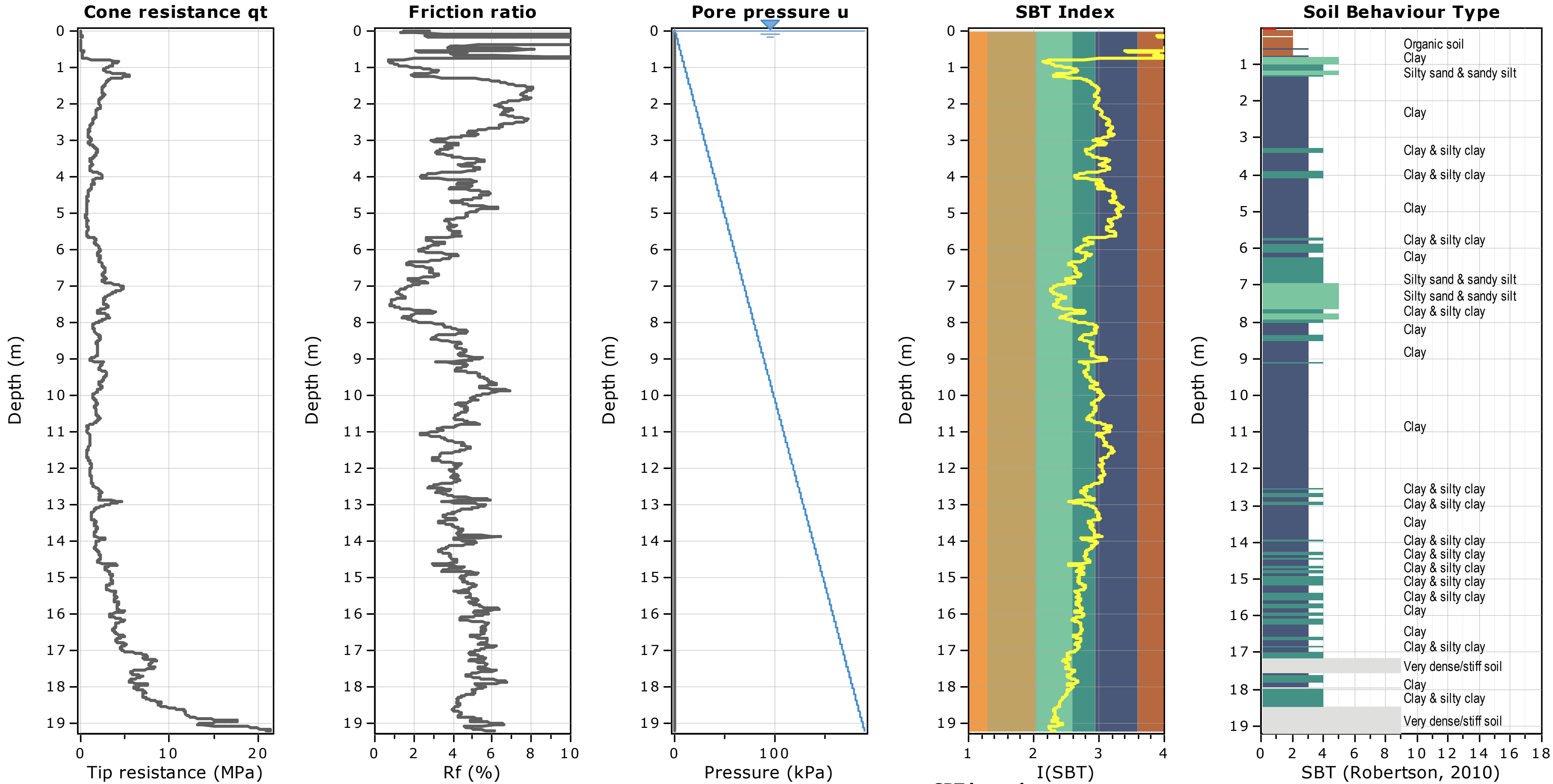
Project:
Location:





CPT: A3 CPT03
Total depth: 19.21 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBT legend

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

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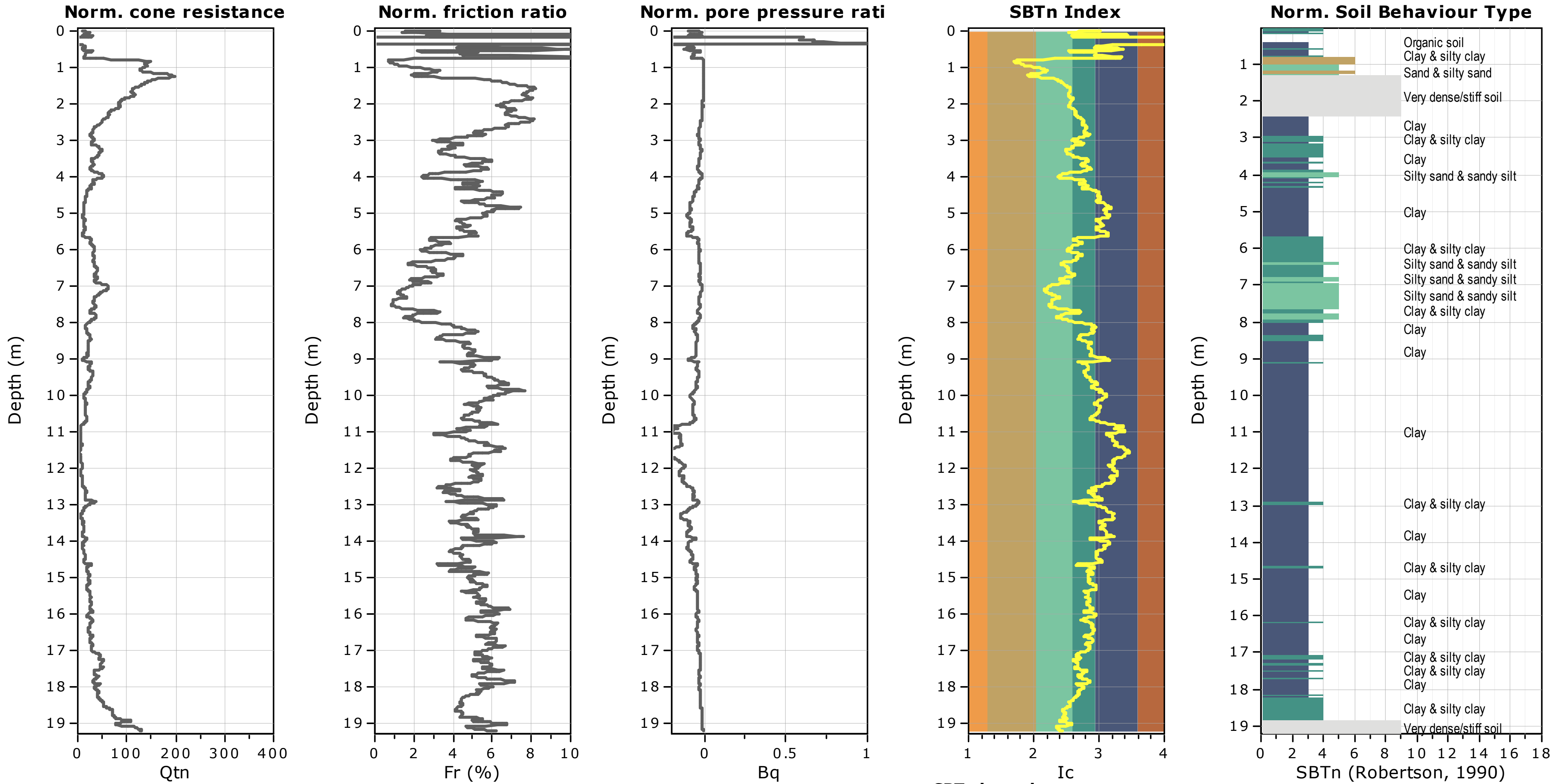
CPT: A3 CPT03
Total depth: 19.21 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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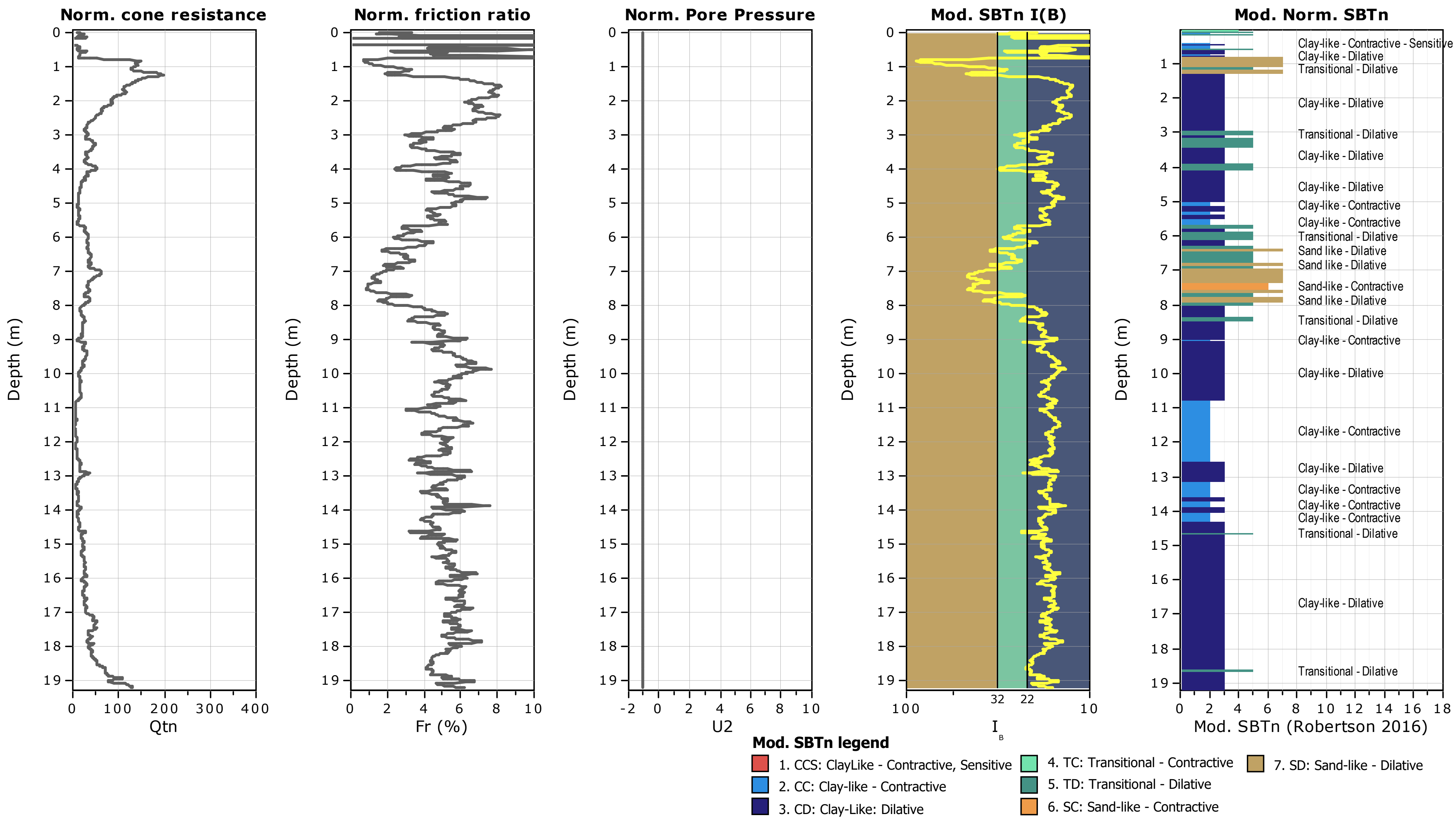
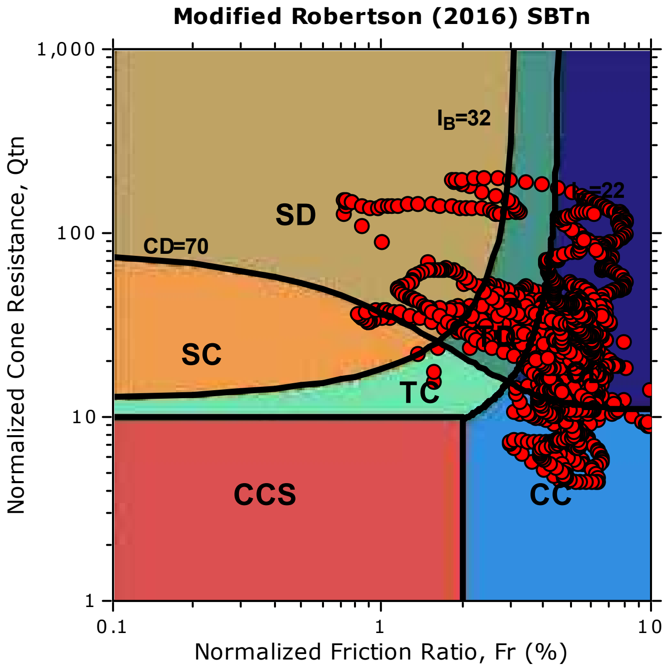
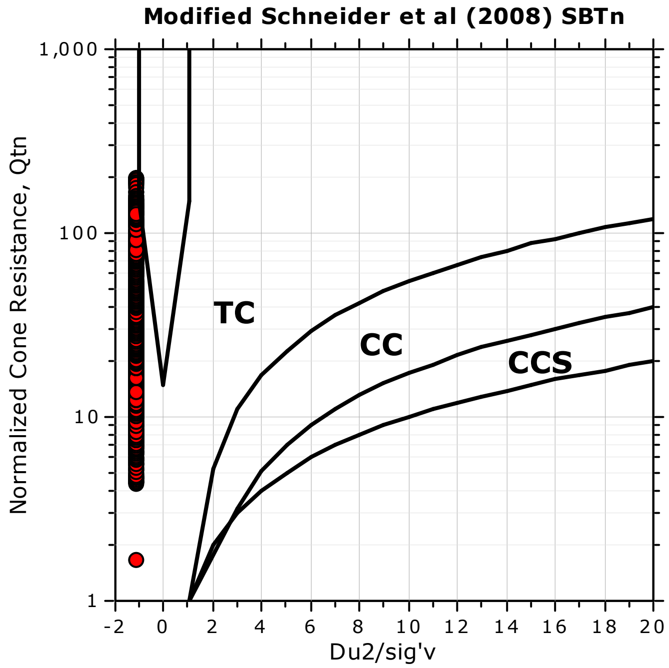
CPT: A3 CPT03
Total depth: 19.21 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

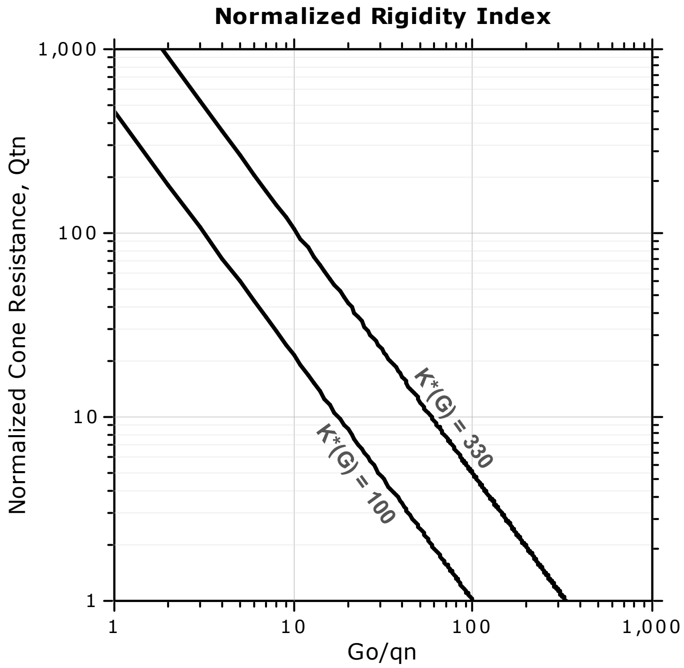
Project:
Location:



Updated SBTn plots





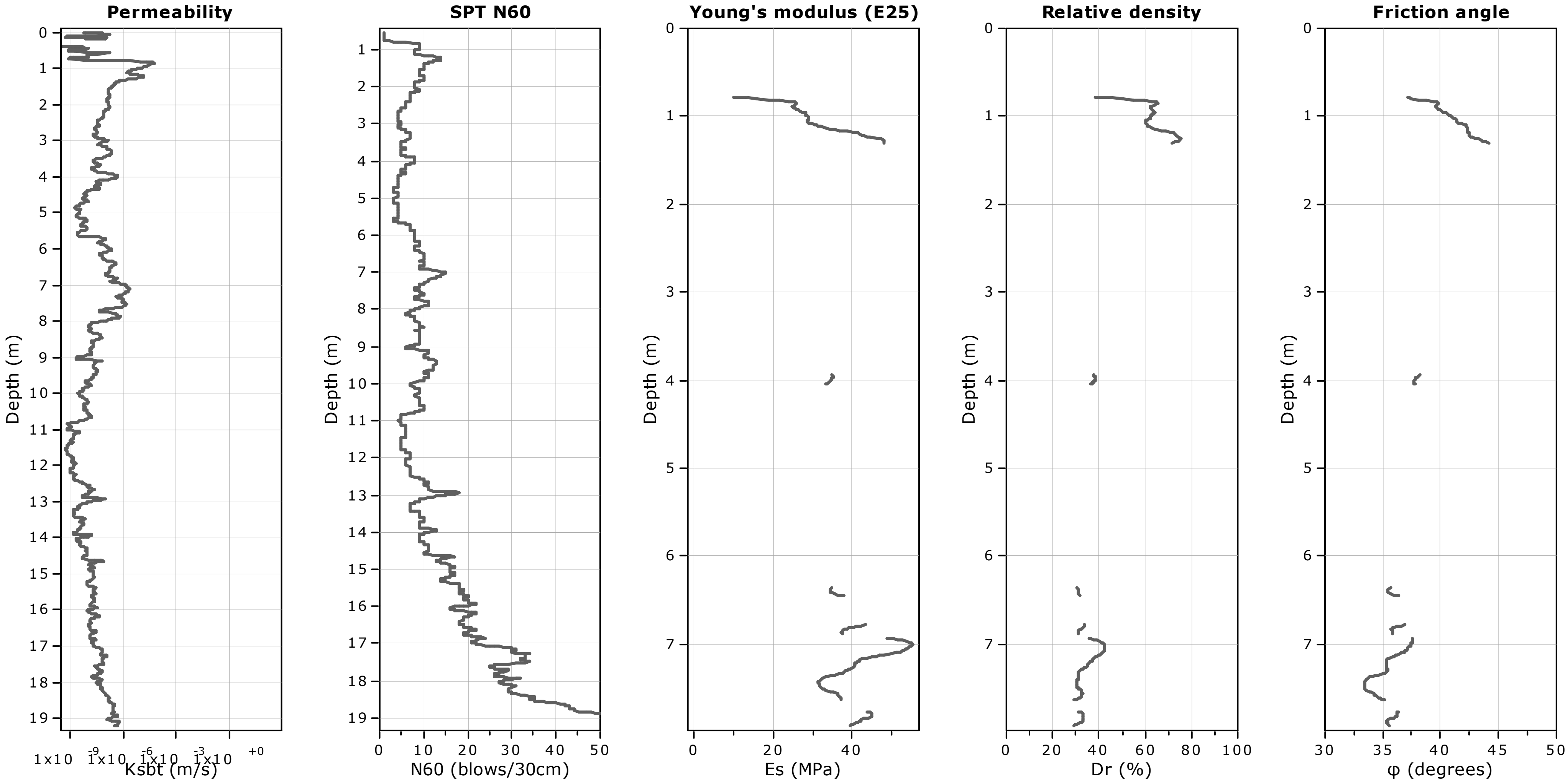


CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CPT: A3 CPT03
Total depth: 19.21 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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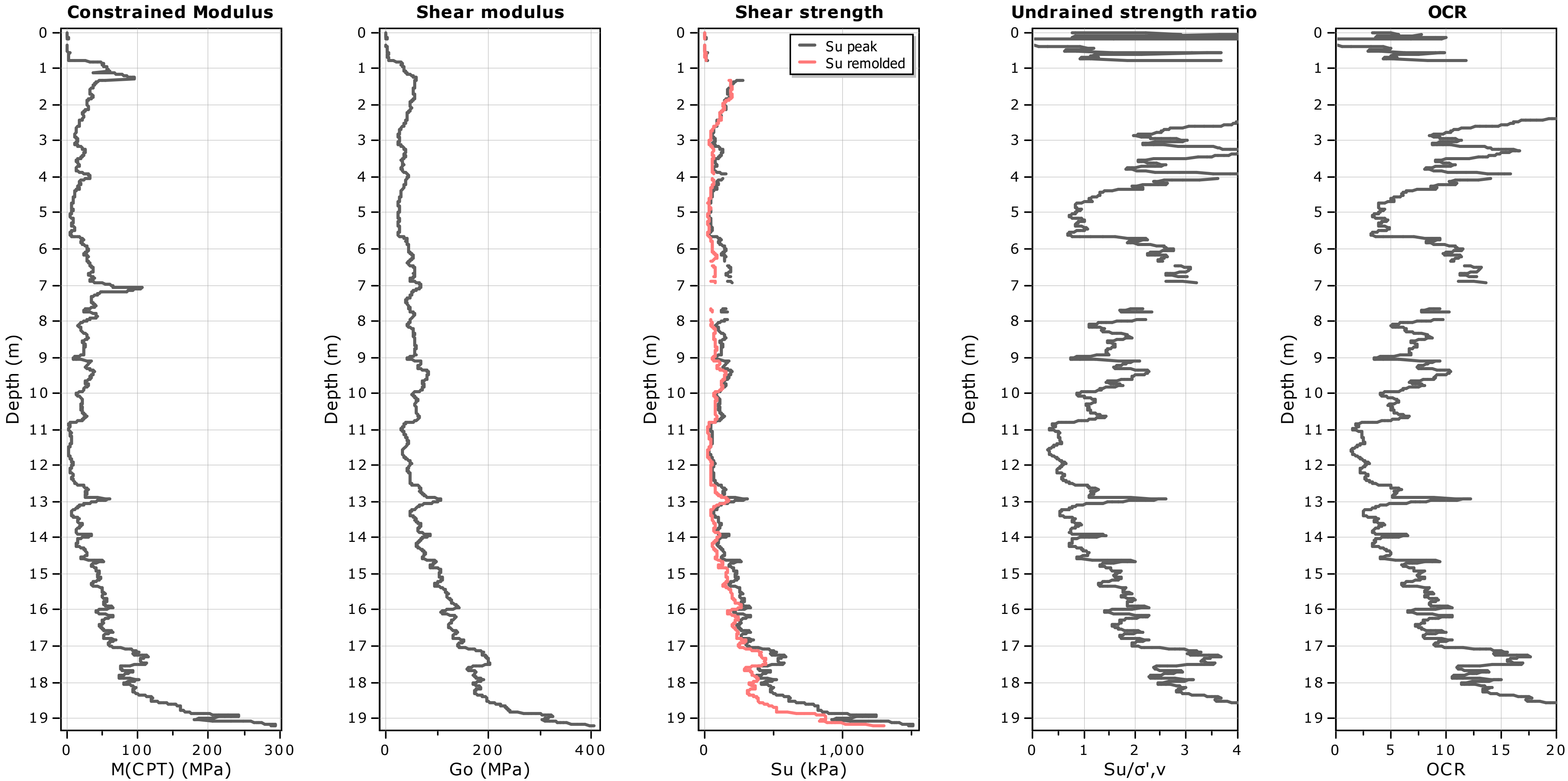
CPT: A3 CPT03
Total depth: 19.21 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters

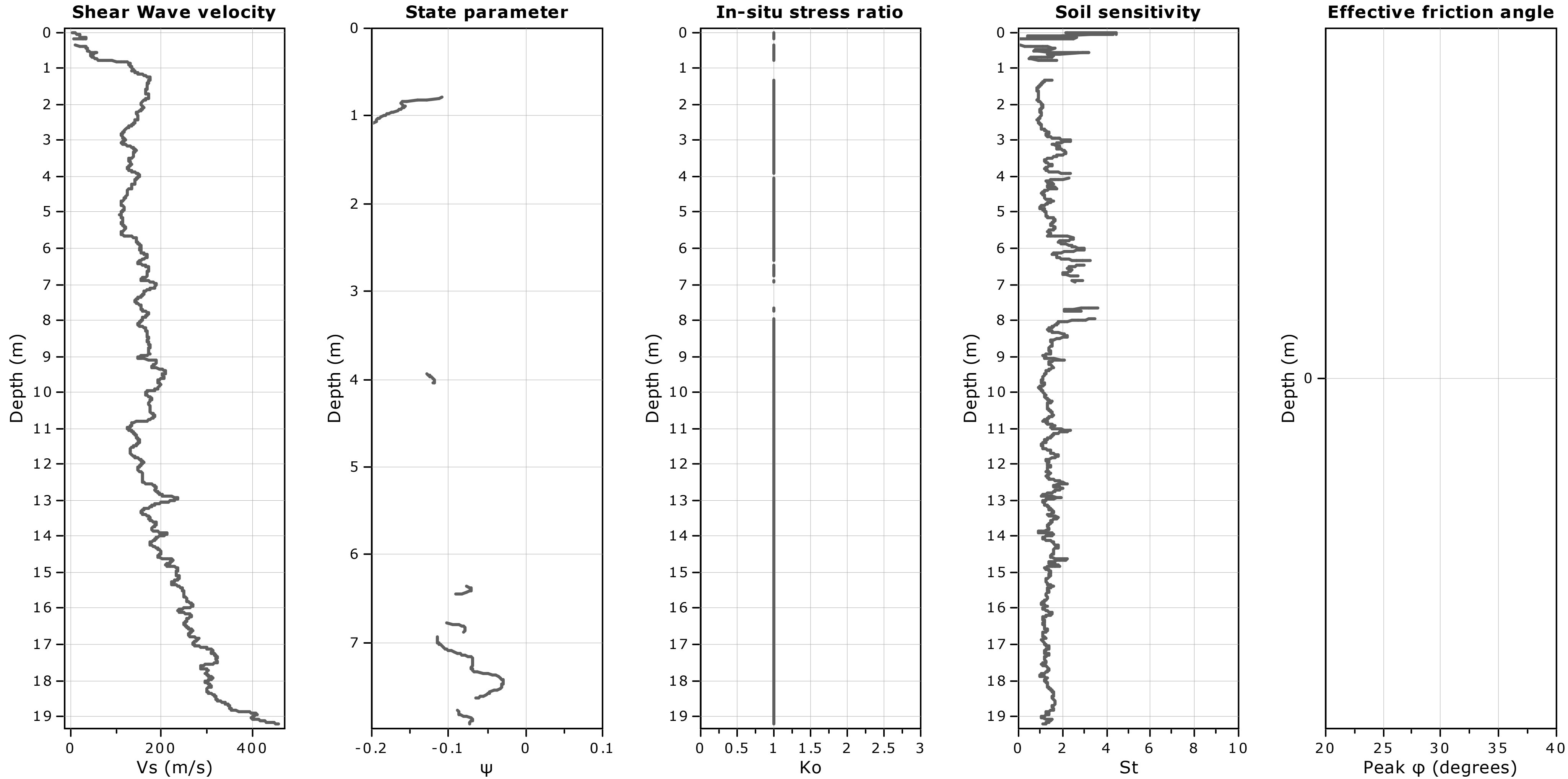
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

CPT: A3 CPT03

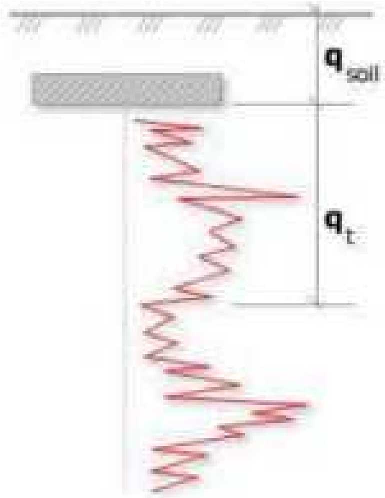
Total depth: 19.21 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters

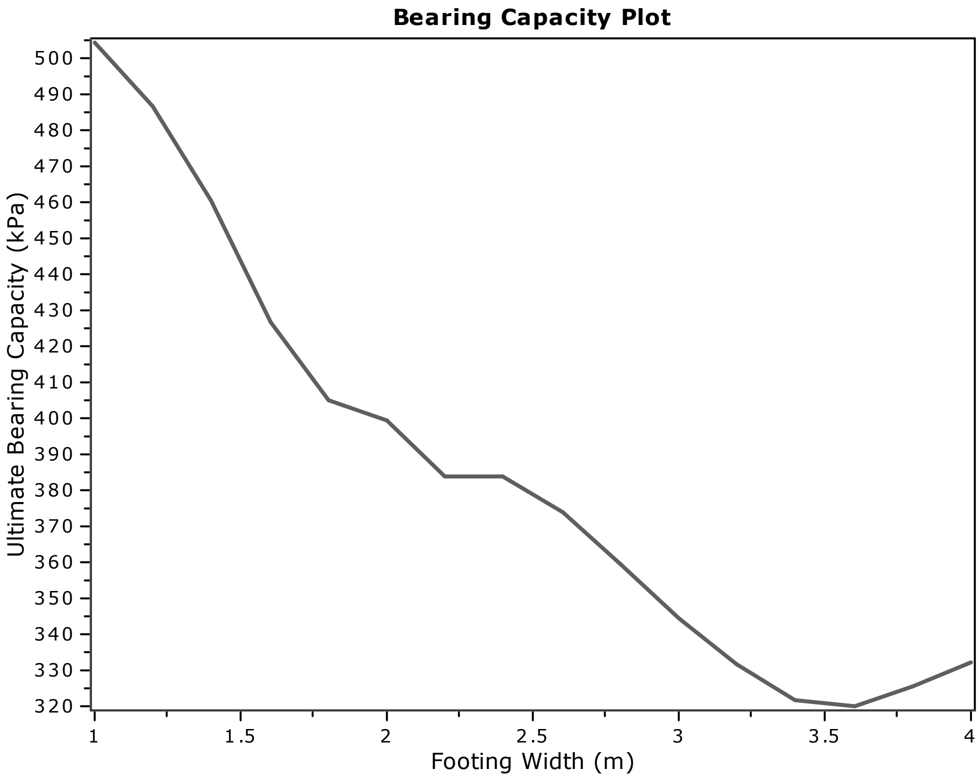
Soil Sensitivity factor, N_S: 7.00
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	2.48	0.20	9.50	504.55
2	1.20	0.50	2.30	2.39	0.20	9.50	486.67
3	1.40	0.50	2.60	2.26	0.20	9.50	460.82
4	1.60	0.50	2.90	2.09	0.20	9.50	426.63
5	1.80	0.50	3.20	1.98	0.20	9.50	405.42
6	2.00	0.50	3.50	1.95	0.20	9.50	399.86
7	2.20	0.50	3.80	1.87	0.20	9.50	384.31
8	2.40	0.50	4.10	1.87	0.20	9.50	384.23
9	2.60	0.50	4.40	1.82	0.20	9.50	374.38
10	2.80	0.50	4.70	1.75	0.20	9.50	359.71
11	3.00	0.50	5.00	1.68	0.20	9.50	344.84
12	3.20	0.50	5.30	1.61	0.20	9.50	332.20
13	3.40	0.50	5.60	1.56	0.20	9.50	321.73
14	3.60	0.50	5.90	1.55	0.20	9.50	320.27
15	3.80	0.50	6.20	1.58	0.20	9.50	325.66
16	4.00	0.50	6.50	1.62	0.20	9.50	332.68

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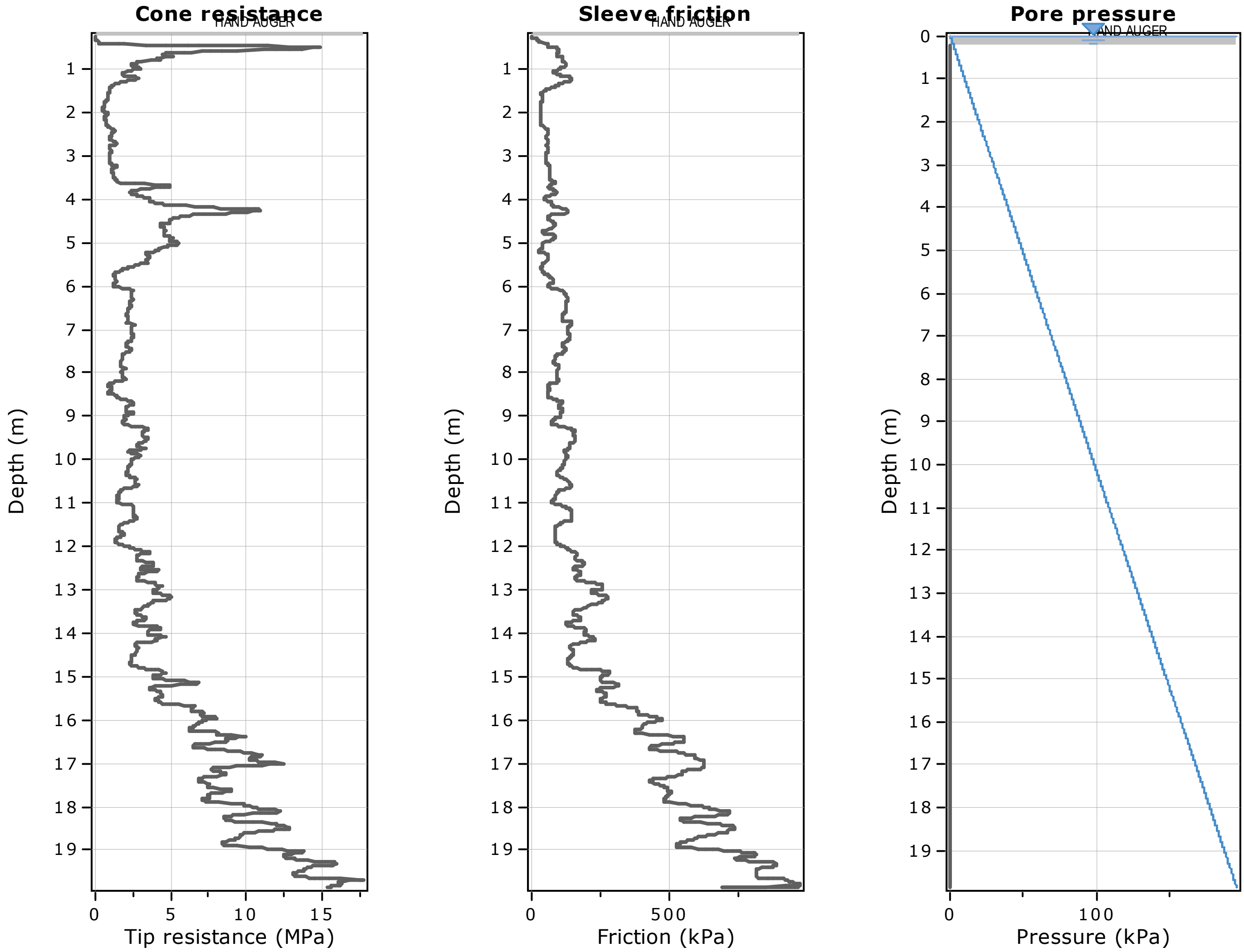
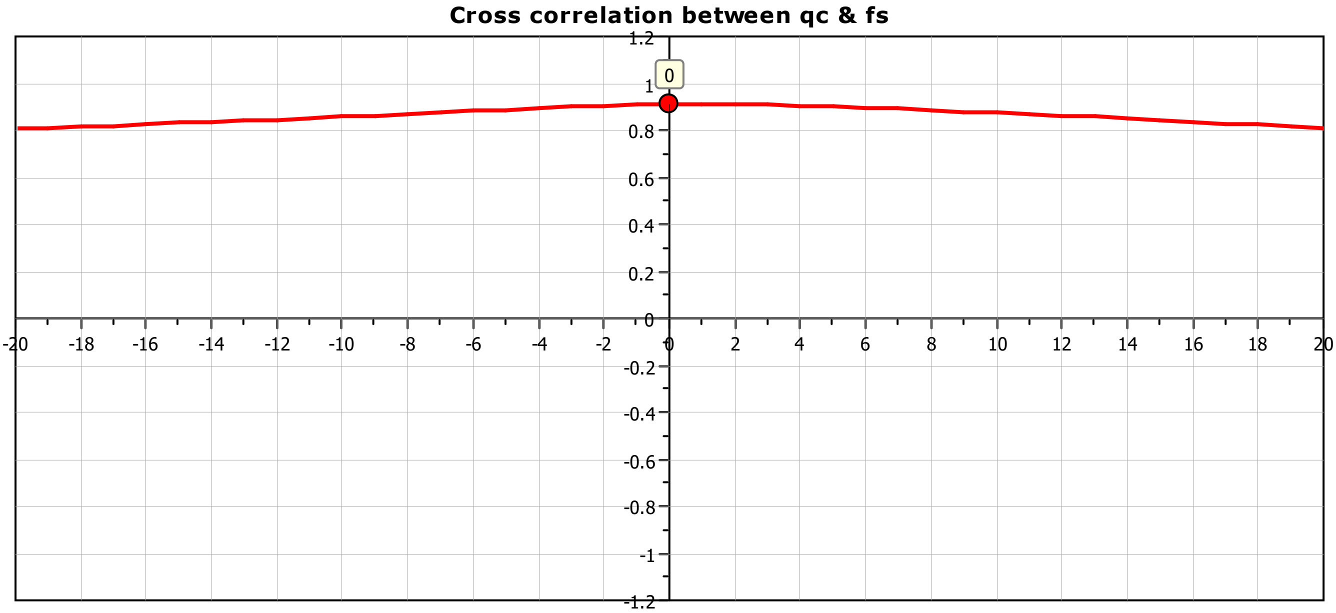
CPT: A3 CPT04
Total depth: 19.86 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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



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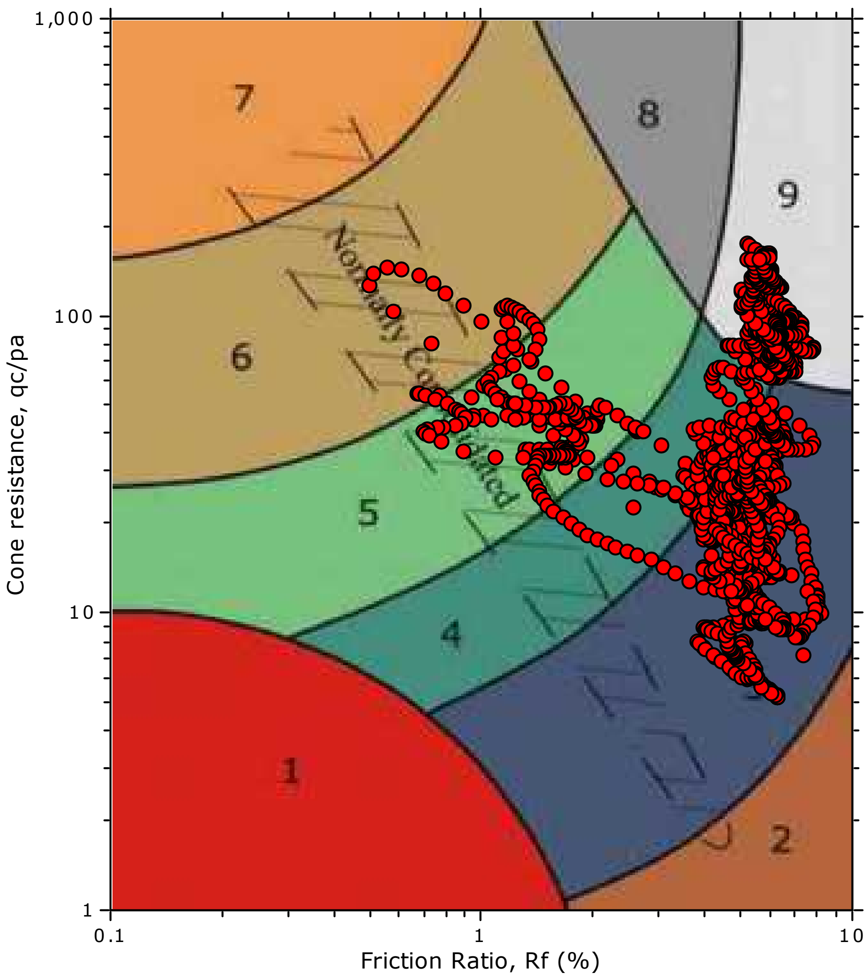
CPT: A3 CPT04
Total depth: 19.86 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

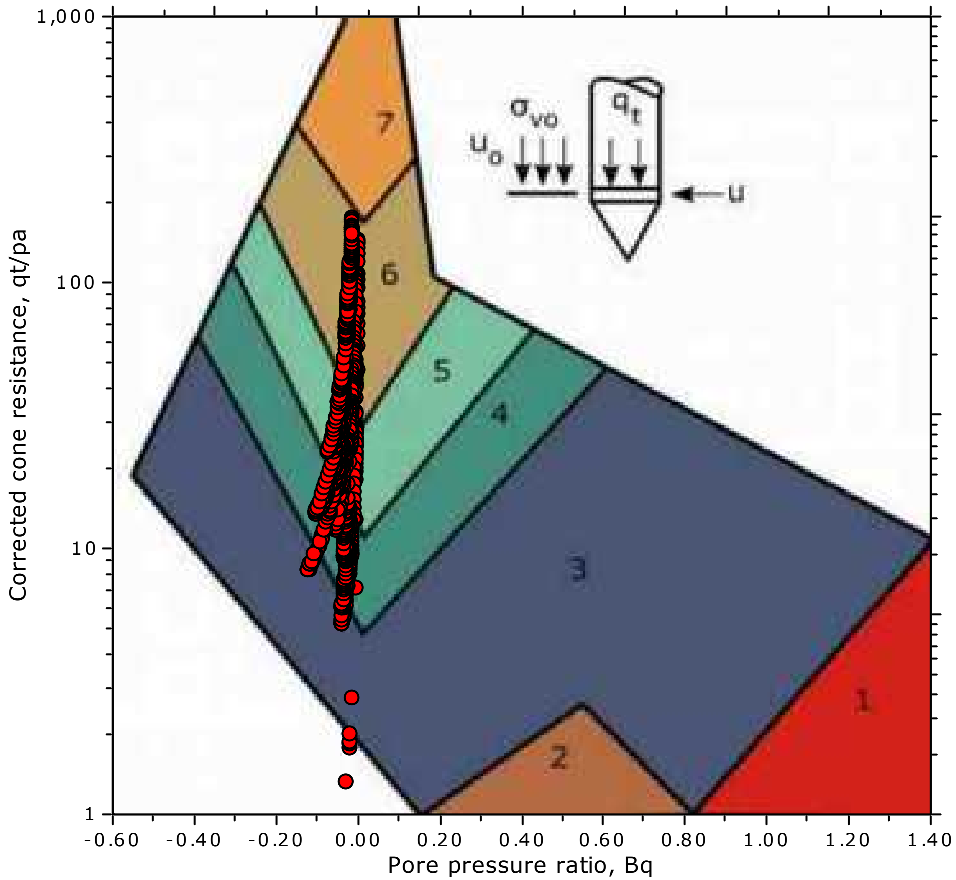
Project:
Location:

SBT - Bq plots

SBT plot



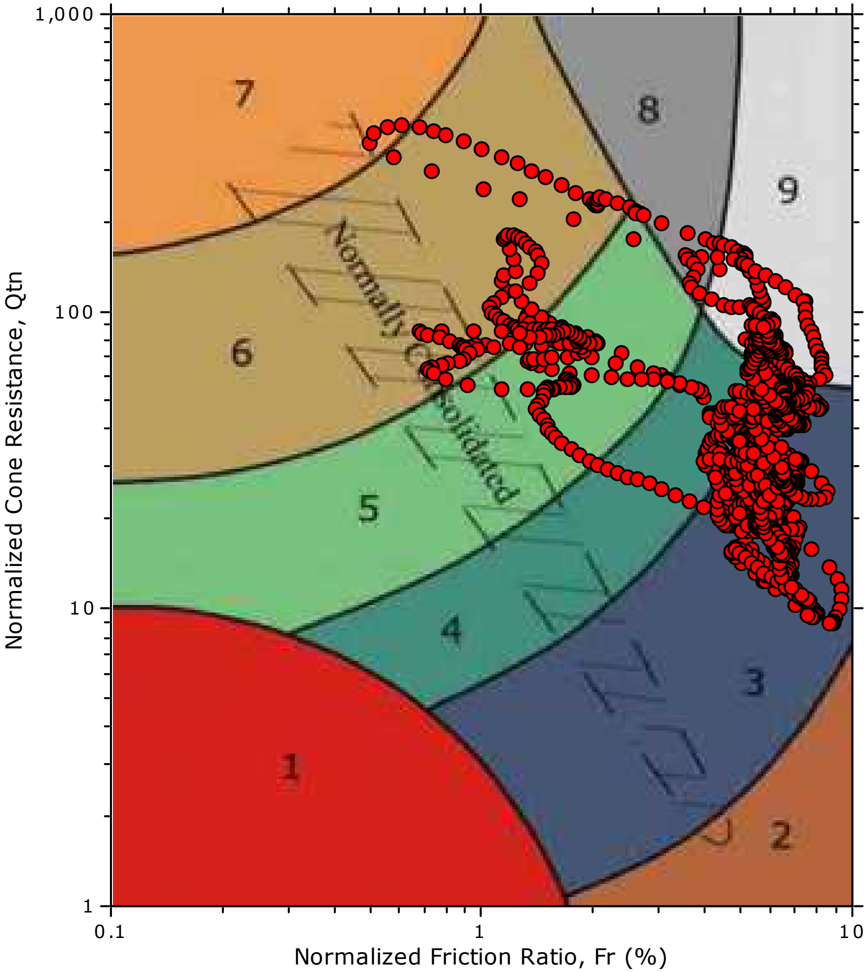
Bq plot

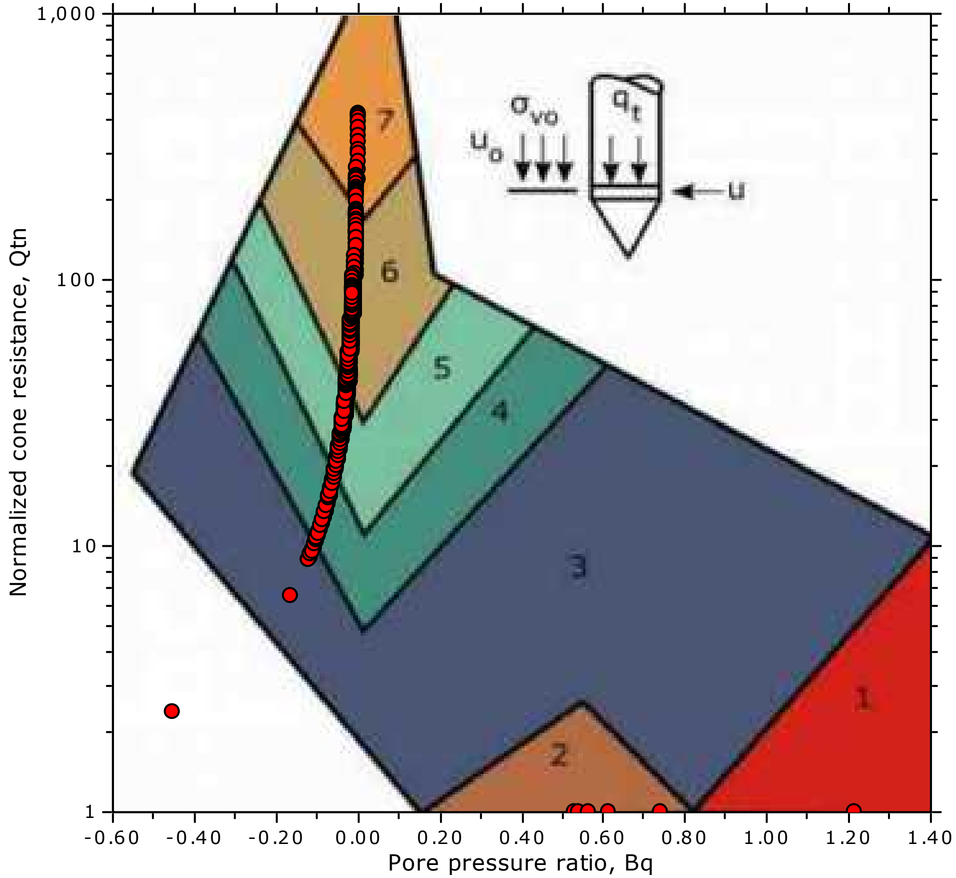


SBT legend

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

SBT - Bq plots (normalized)

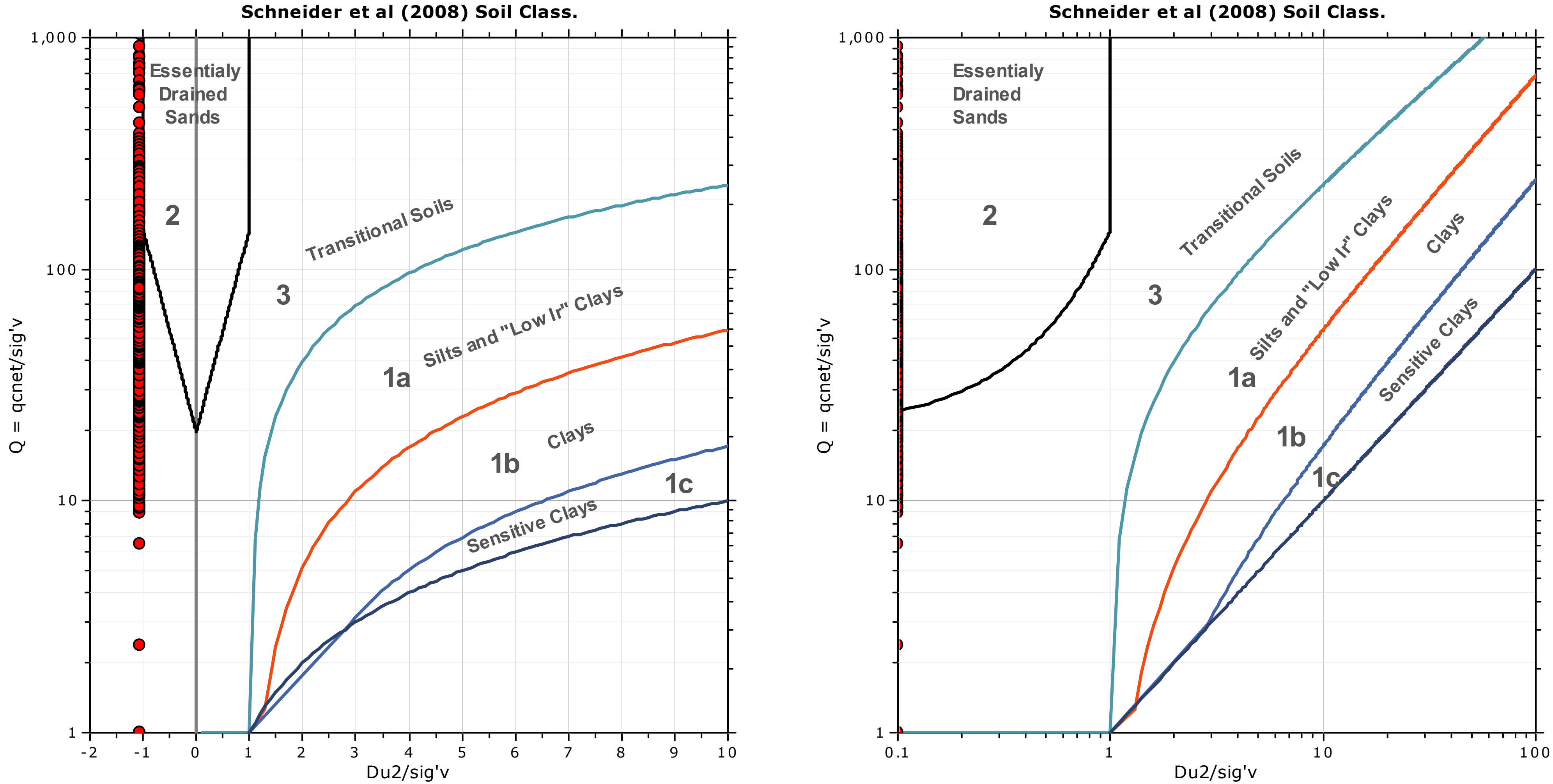


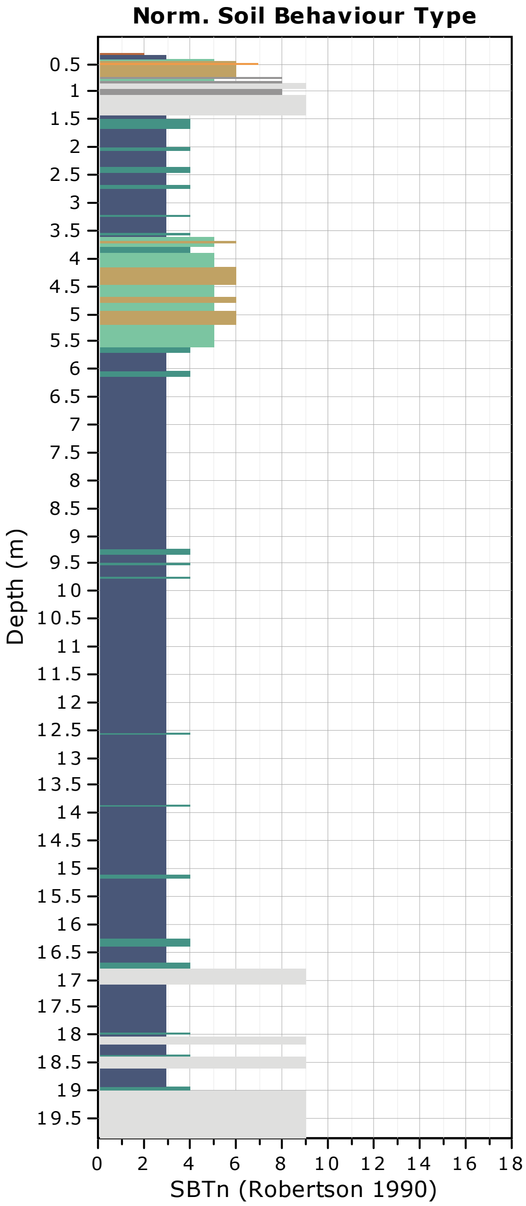


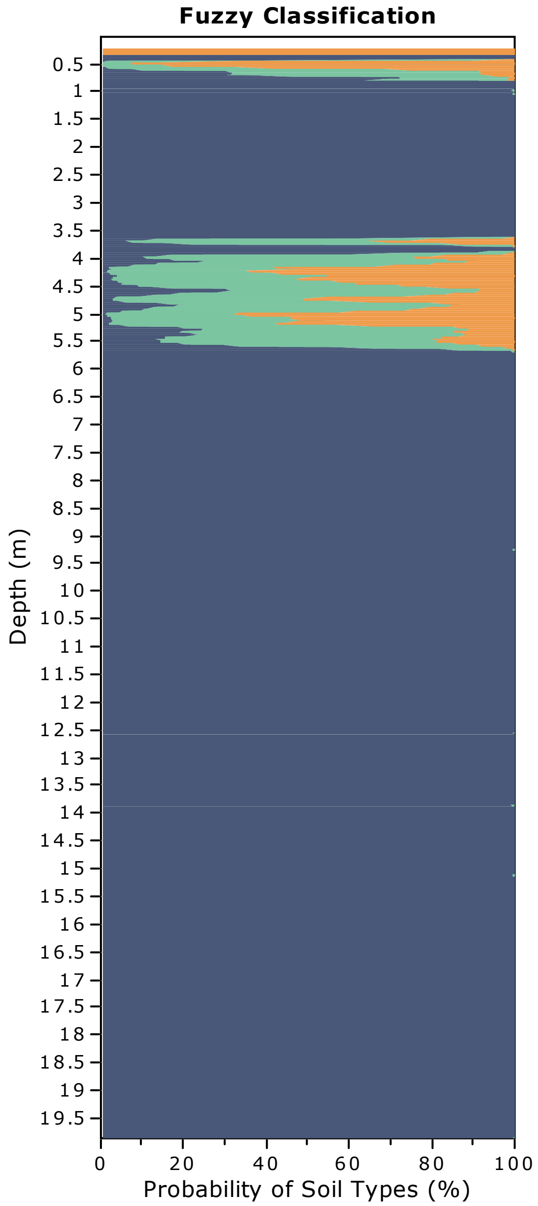
SBTn legend

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

Bq plots (Schneider)




Norm. Soil Behaviour Type
Depth (m)
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
Probability of Soil Types (%)

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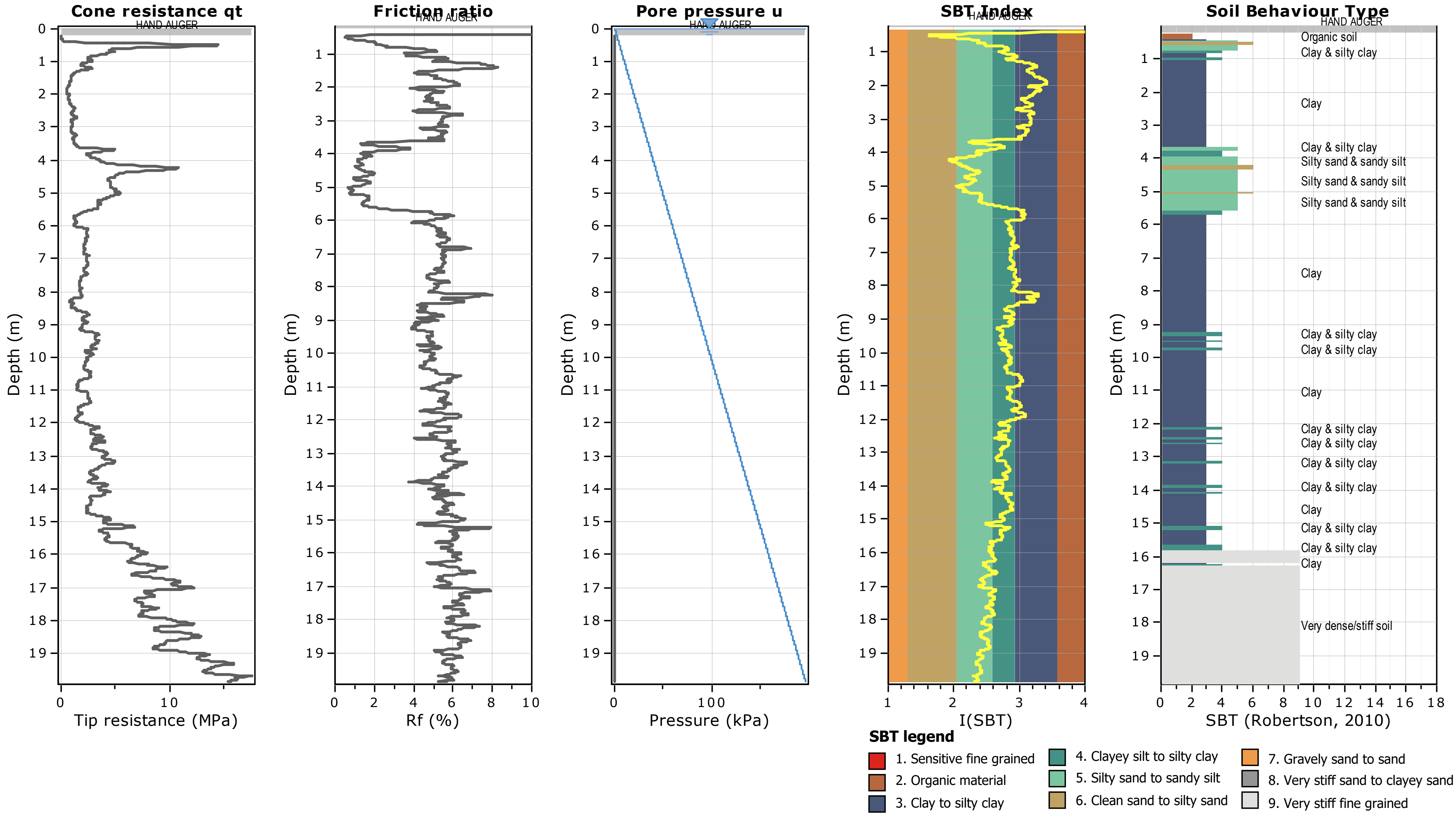
CPT: A3 CPT04
Total depth: 19.86 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

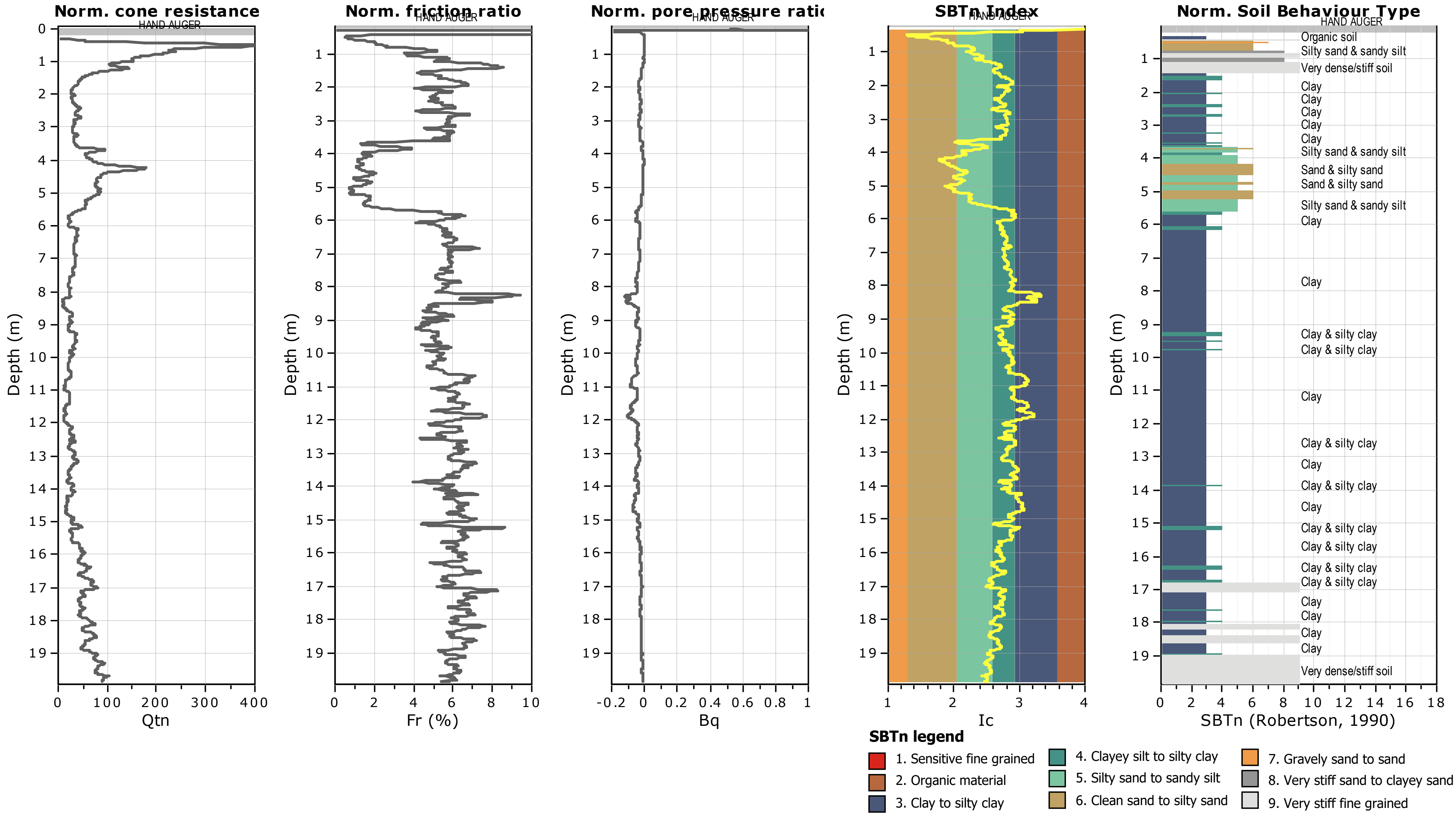
Project:
Location:



CPT: A3 CPT04

Total depth: 19.86 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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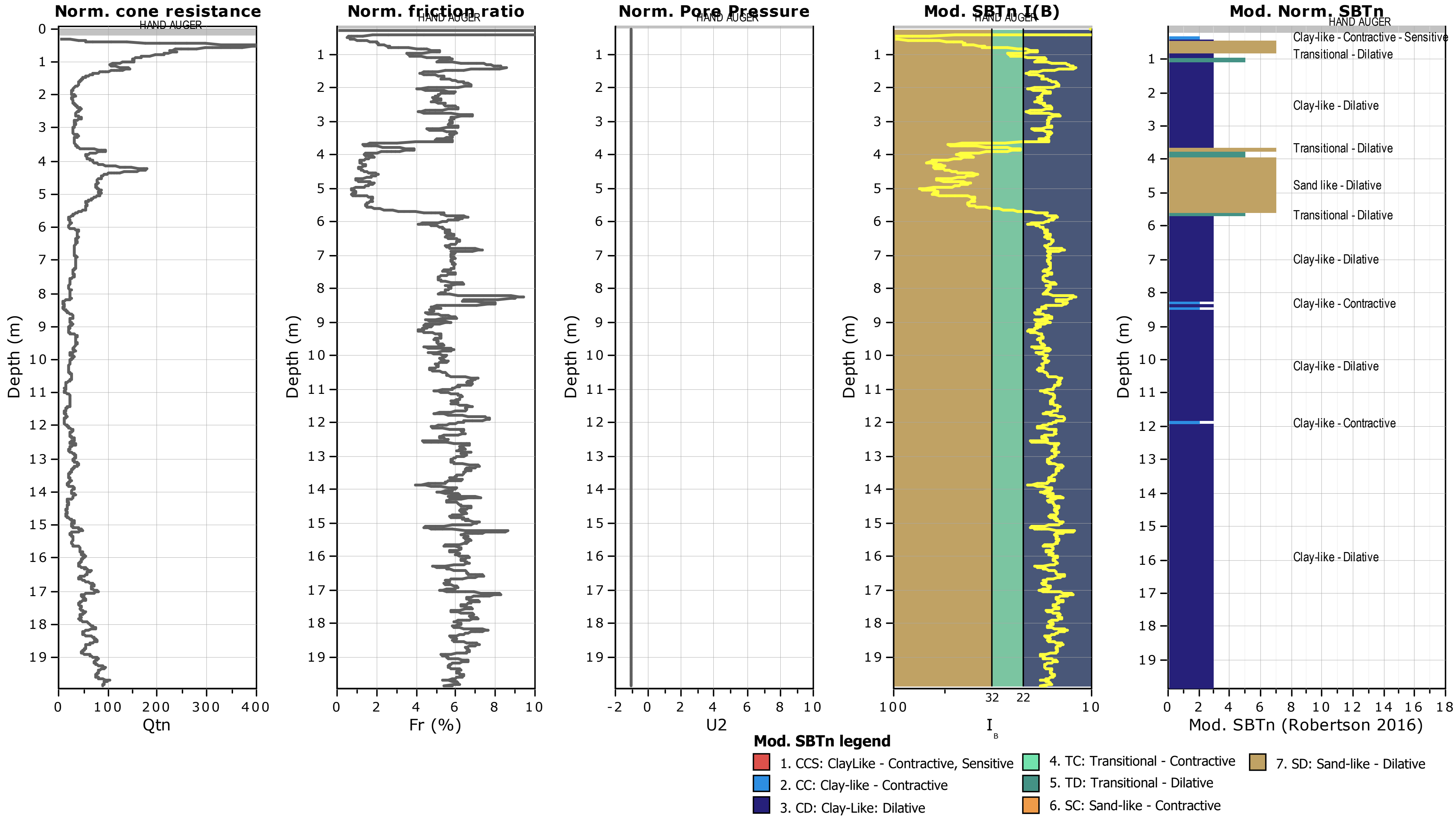
CPT: A3 CPT04
Total depth: 19.86 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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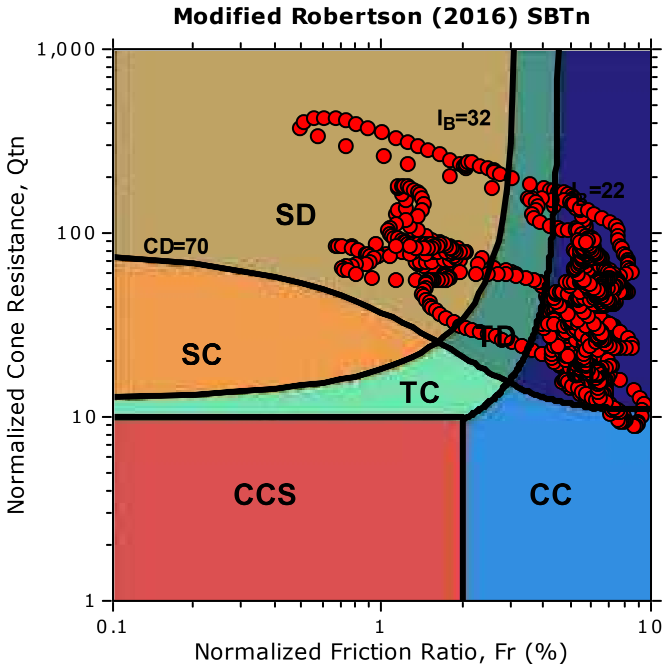
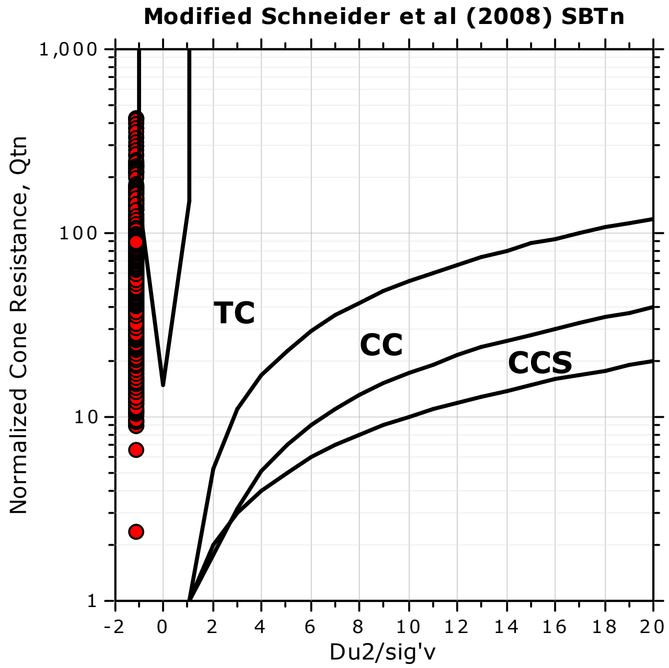
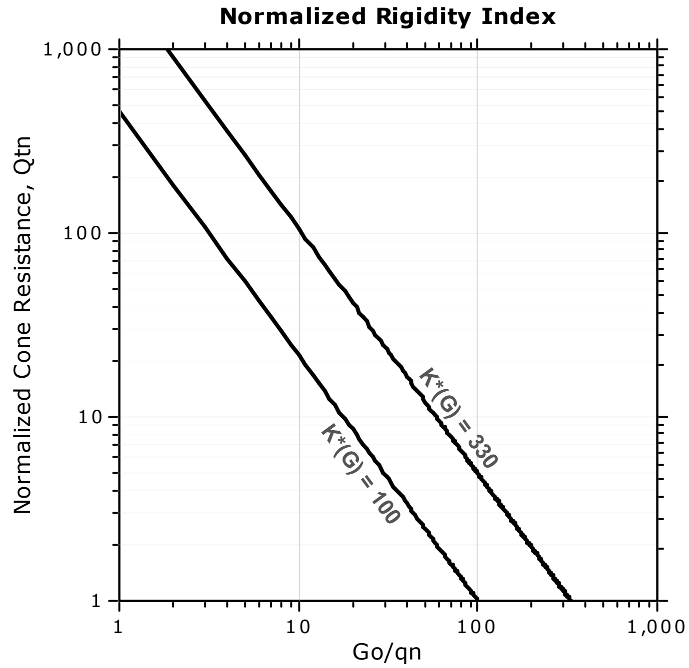
CPT: A3 CPT04
Total depth: 19.86 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

Updated SBTn plots







CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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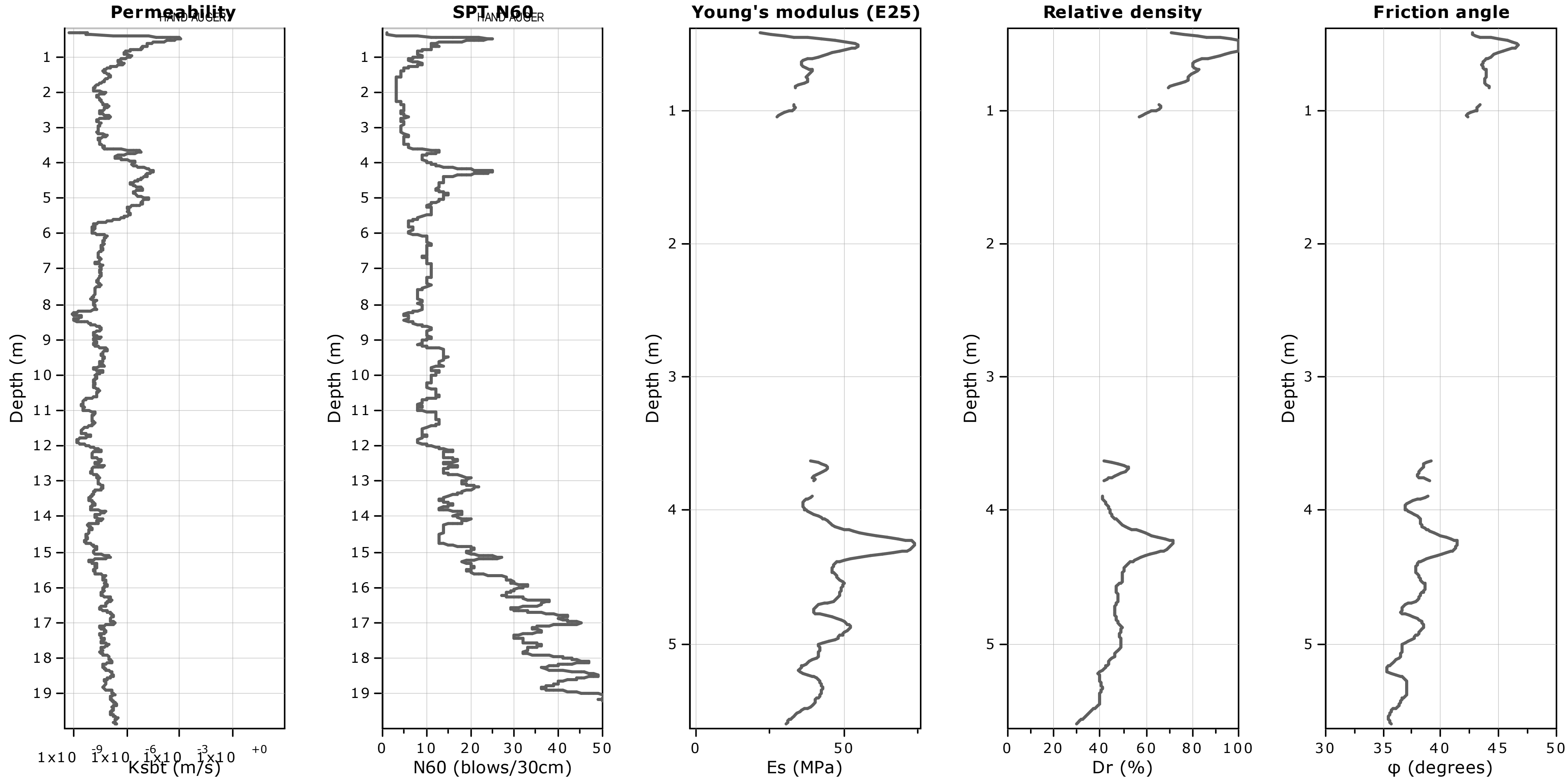
CPT: A3 CPT04
Total depth: 19.86 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

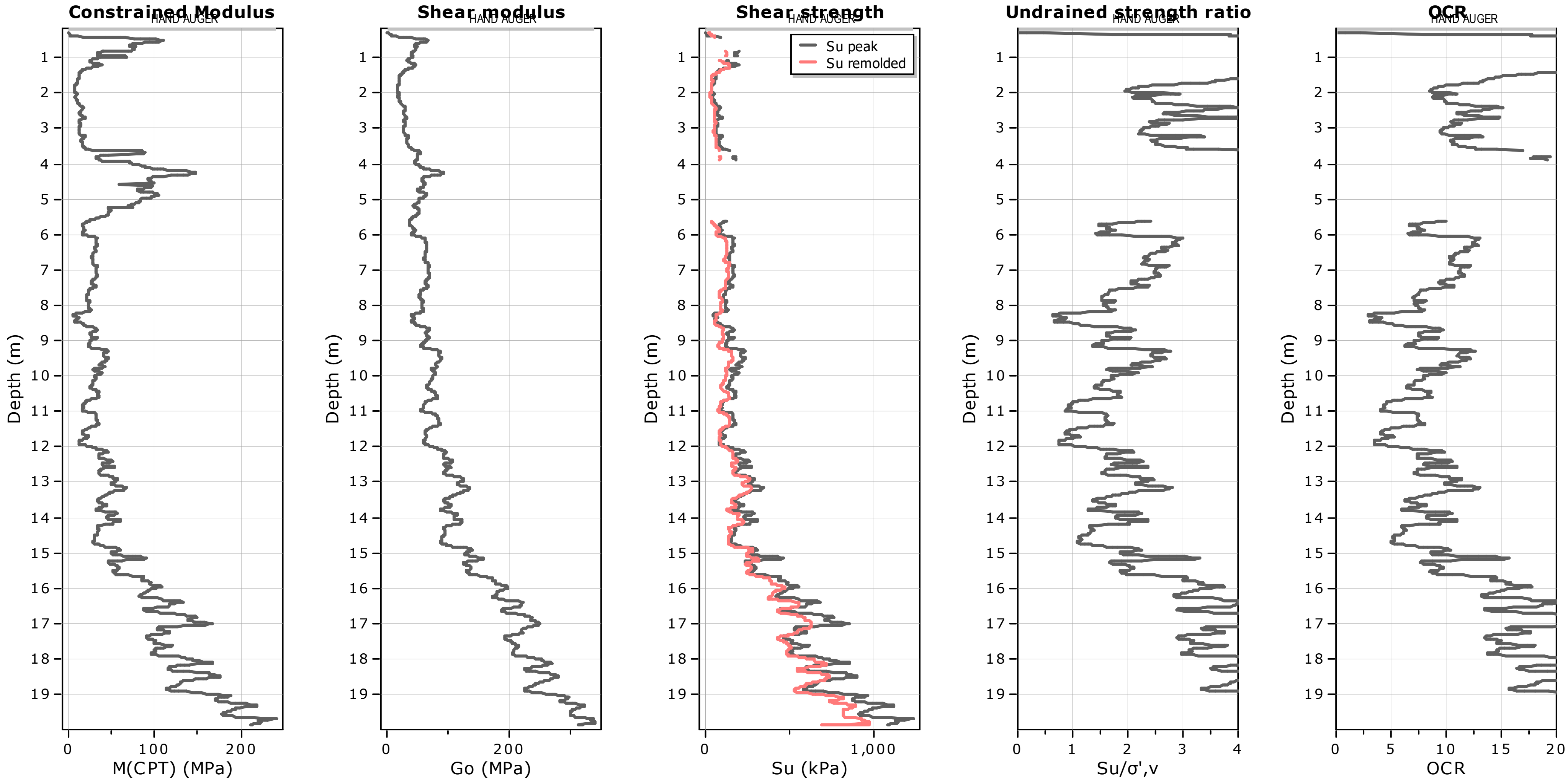
Project:
Location:



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

CPT: A3 CPT04
Total depth: 19.86 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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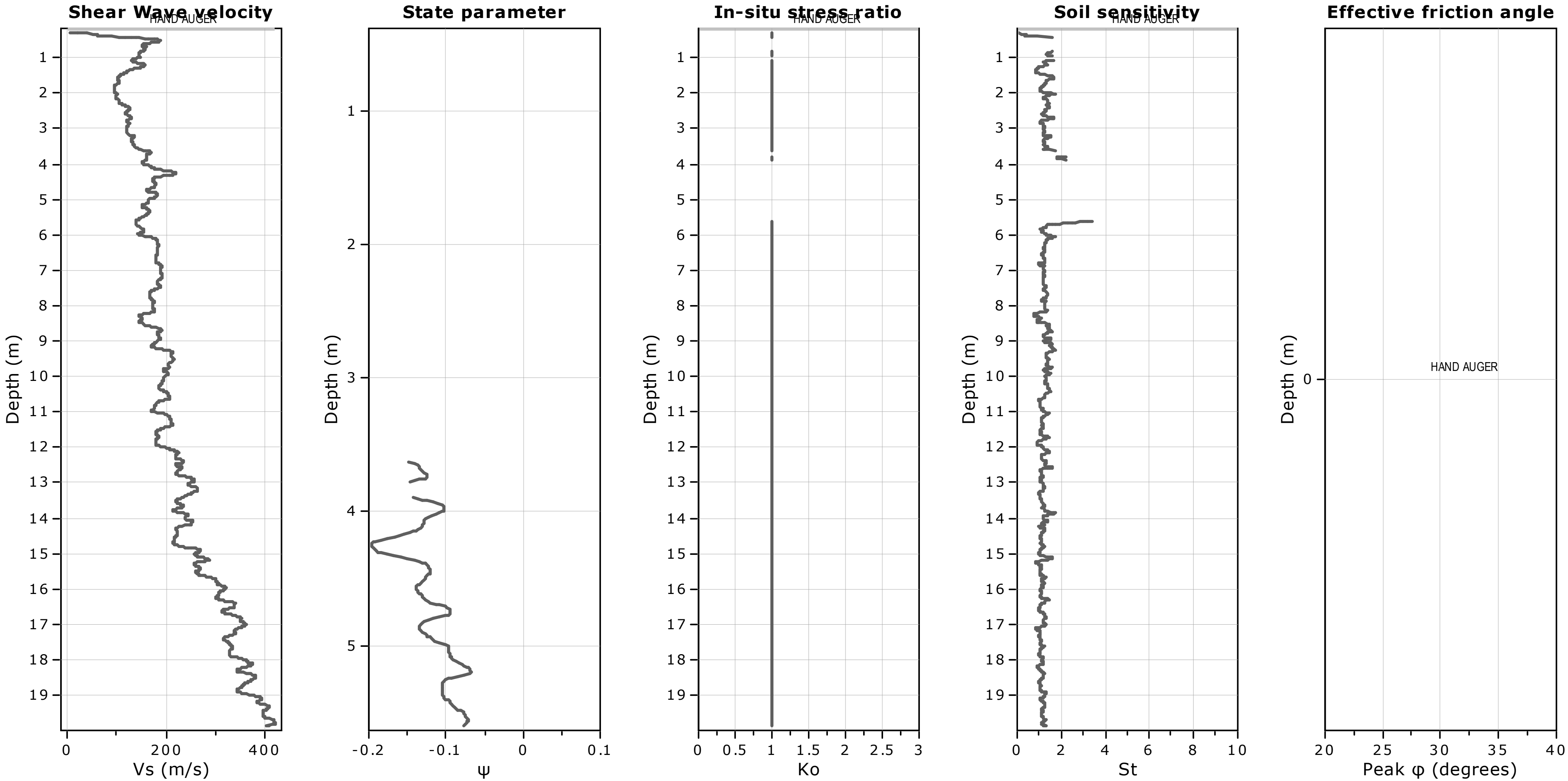
CPT: A3 CPT04
Total depth: 19.86 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

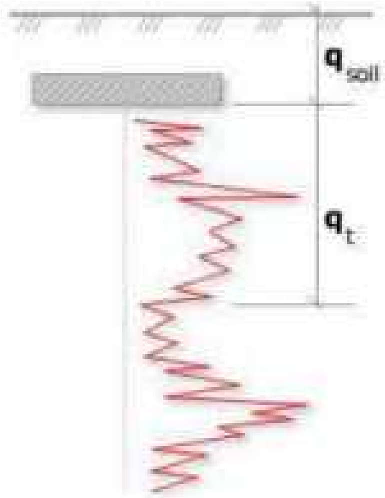
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

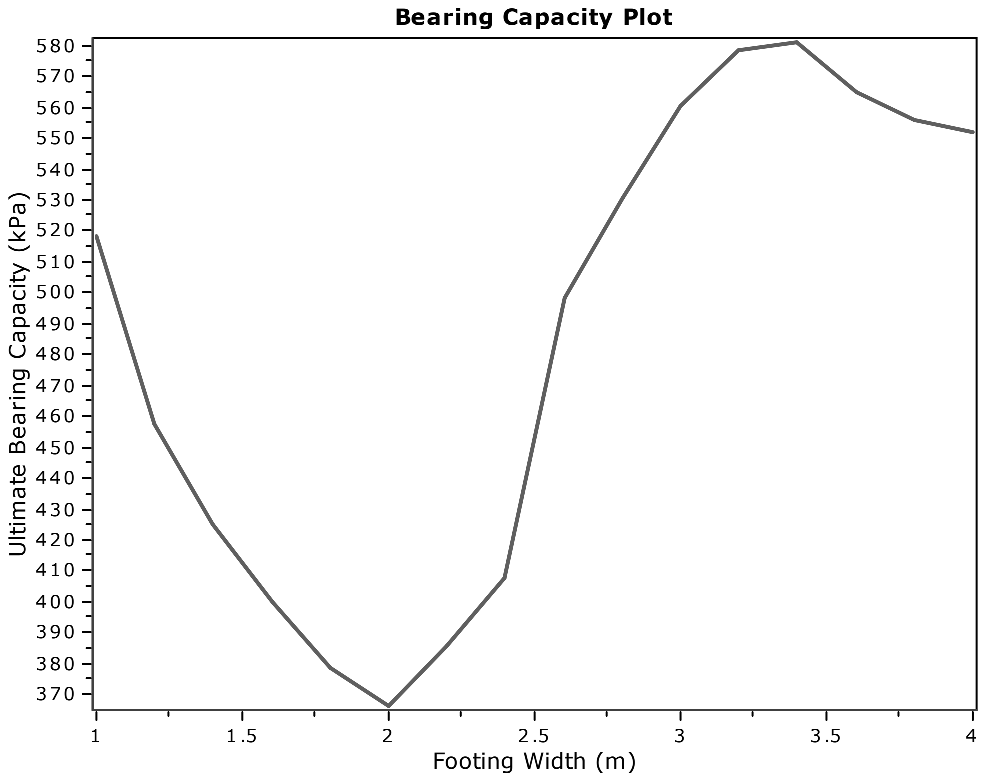
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	2.54	0.20	9.50	518.15
2	1.20	0.50	2.30	2.24	0.20	9.50	457.50
3	1.40	0.50	2.60	2.08	0.20	9.50	425.22
4	1.60	0.50	2.90	1.95	0.20	9.50	400.25
5	1.80	0.50	3.20	1.85	0.20	9.50	378.69
6	2.00	0.50	3.50	1.78	0.20	9.50	366.29
7	2.20	0.50	3.80	1.88	0.20	9.50	385.71
8	2.40	0.50	4.10	1.99	0.20	9.50	407.72
9	2.60	0.50	4.40	2.44	0.20	9.50	498.43
10	2.80	0.50	4.70	2.61	0.20	9.50	530.85
11	3.00	0.50	5.00	2.76	0.20	9.50	560.57
12	3.20	0.50	5.30	2.85	0.20	9.50	578.75
13	3.40	0.50	5.60	2.86	0.20	9.50	581.12
14	3.60	0.50	5.90	2.78	0.20	9.50	564.97
15	3.80	0.50	6.20	2.73	0.20	9.50	555.57
16	4.00	0.50	6.50	2.71	0.20	9.50	551.89

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

:: N_{SPT} (blows per 30 cm) ::

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

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

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

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

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

:: Relative Density, Dr (%) ::

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

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

:: State Parameter, ψ ::

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

:: Drained Friction Angle, φ (°) ::

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

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

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

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

If $I_c \geq 2.20$

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

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

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

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

:: Soil Sensitivity, S_t ::

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

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

:: Peak Friction Angle, φ' (°) ::

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

(applicable for $0.10 < B_q < 1.00$)

References

• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

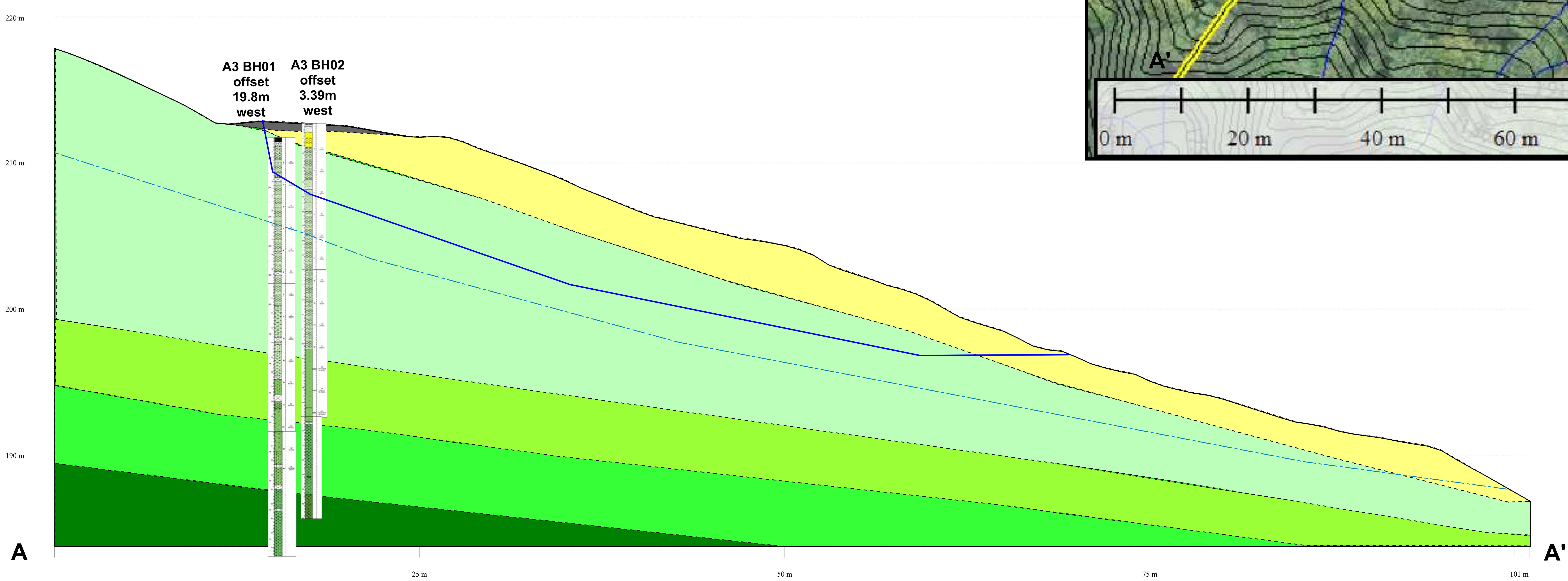
Appendix B

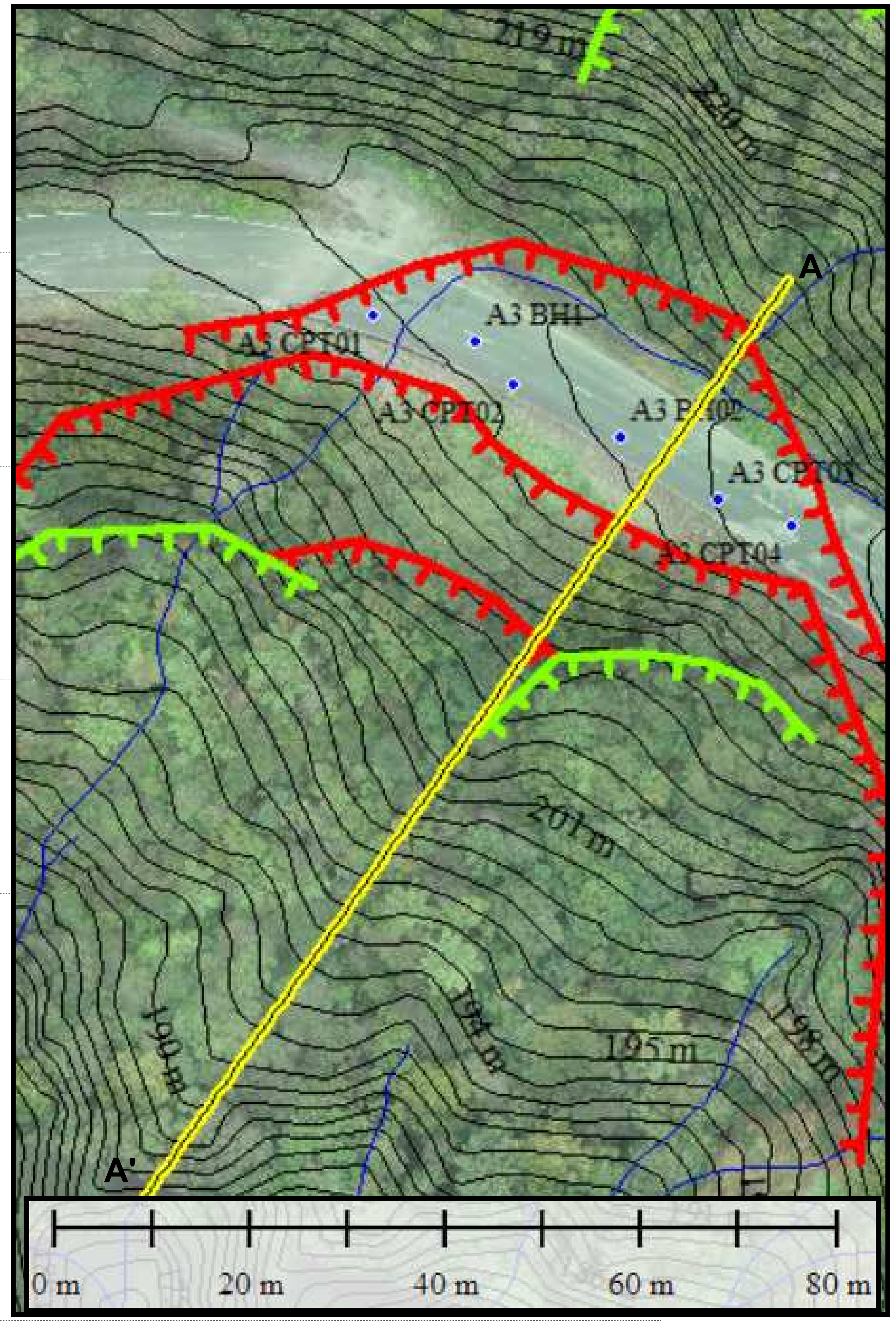
Conceptual Geological Cross Section

From Pos: 279719.473, 988250.515

A3 Cross section

LENGEND	
	INFERED GOLOGICAL BOUNDARY
	GROUNDWATER LEVEL
	CURRENT GROUND LEVEL (LIDAR)
	FILL
	COLLUVIUM
	COMPLETELT WEATHERED TANGIHUA COMPLEX DOLRITE
	HIGHLY WEATHEREDTANGIHUA COMPLEX DOLRITE
	MODERATELT WEATHERED TANGIHUA COMPLEX DOLRITE
	SLIGHTLY WEATHERED TANGIHUA COMPLEX DOLRITA





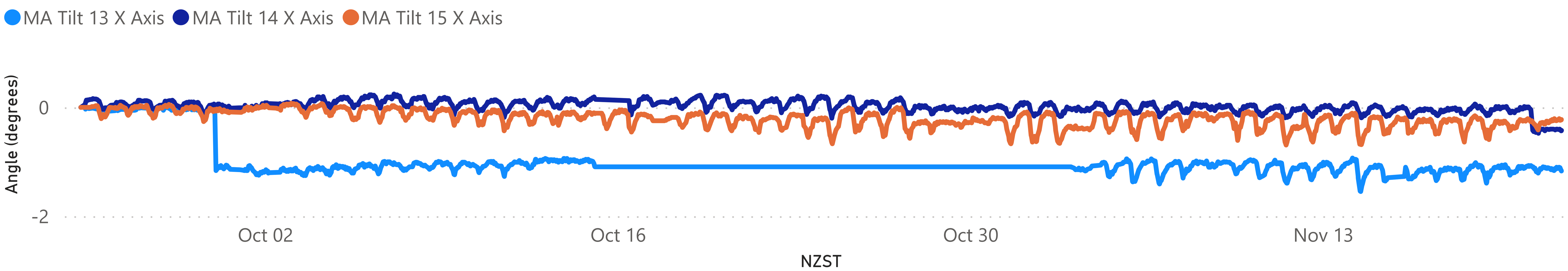
Appendix C

Tilt Sensor and Rainfall Data
Inclinometer Data

Mangamuka Gorge - Site A3 (T13 - T15)

9/14/2022 11/22/2022

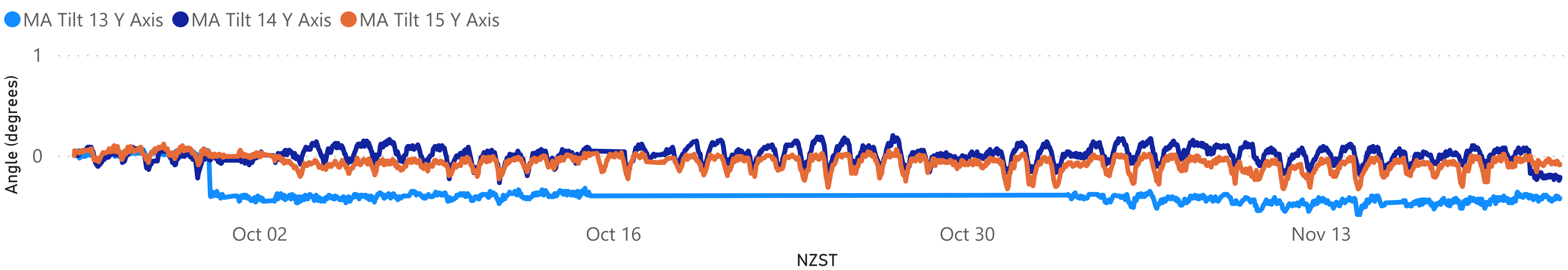
MA Tilt 13 X Axis, MA Tilt 14 X Axis and MA Tilt 15 X Axis by NZST

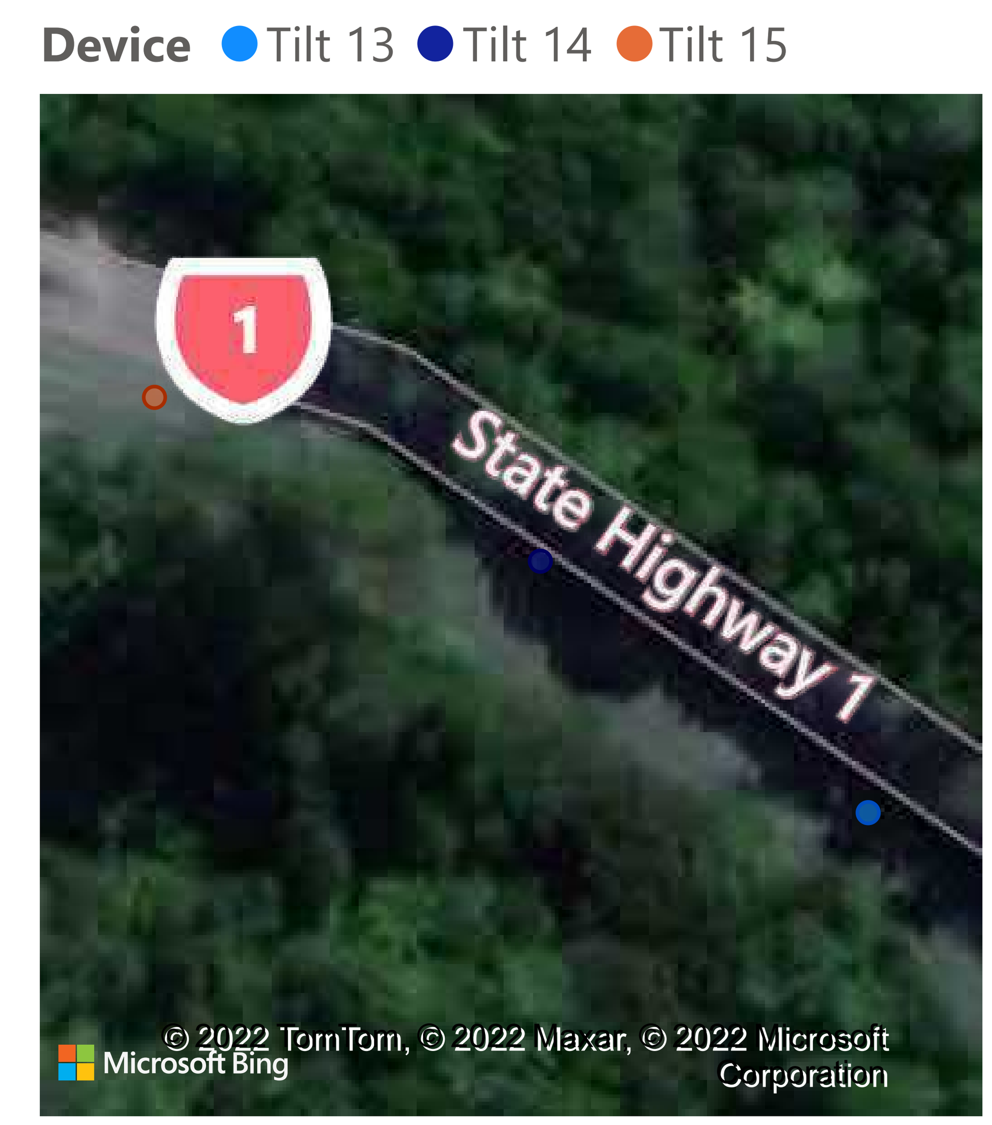


TARP

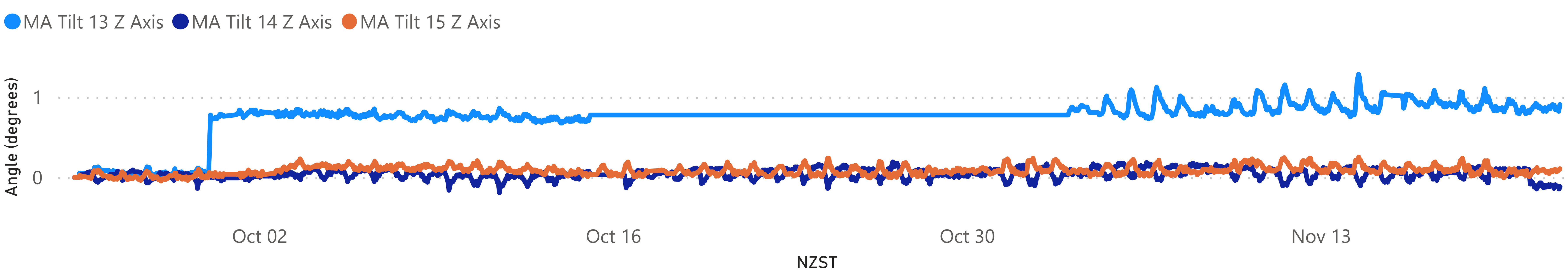
Site	Level
A03	

MA Tilt 13 Y Axis, MA Tilt 14 Y Axis and MA Tilt 15 Y Axis by NZST

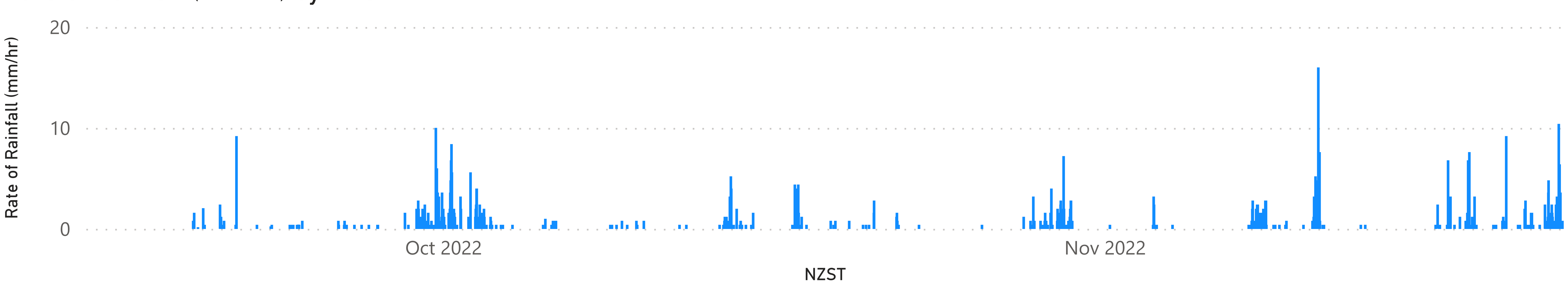


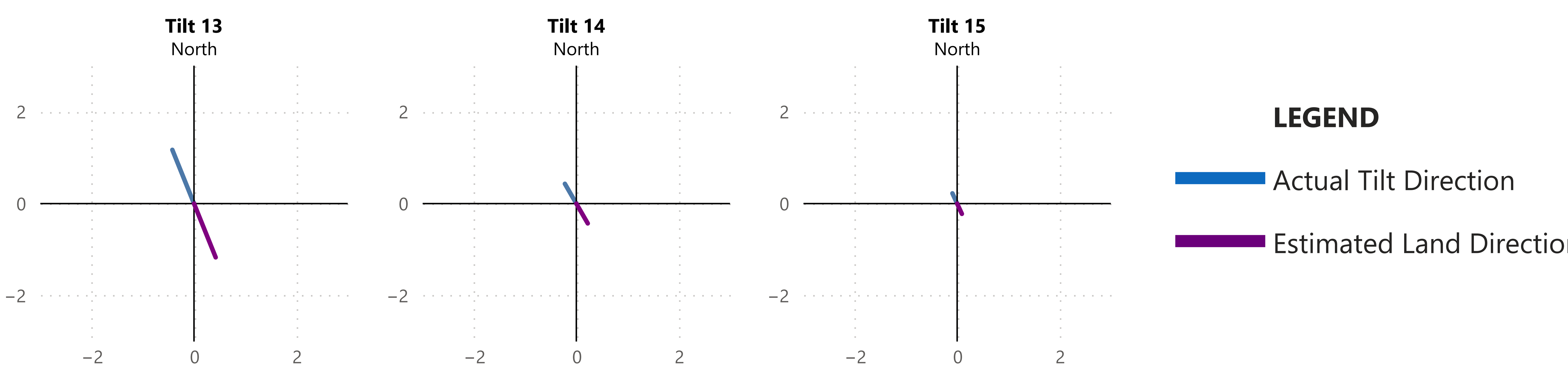


MA Tilt 13 Z Axis, MA Tilt 14 Z Axis and MA Tilt 15 Z Axis by NZST



Rate of Rainfall (mm/hr) by NZST





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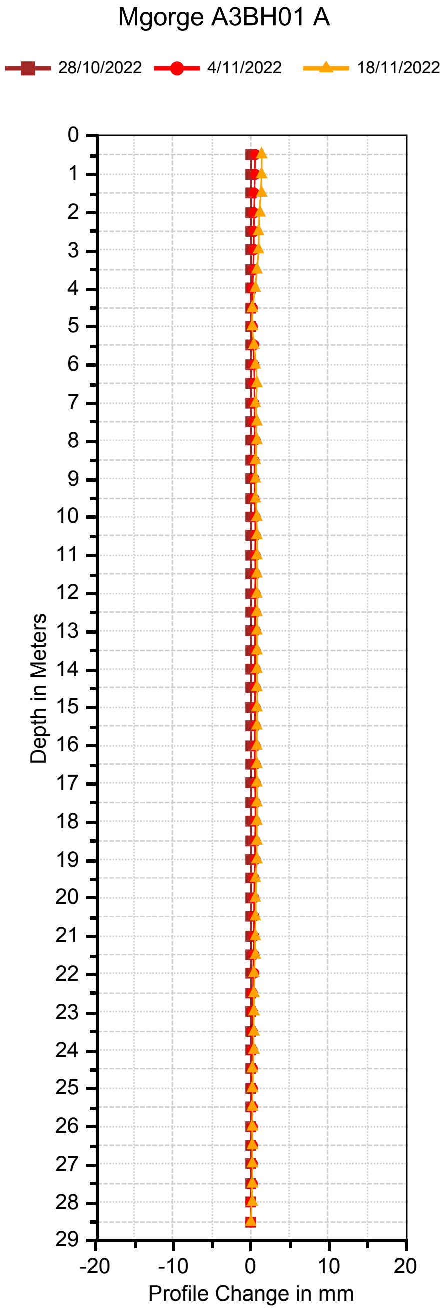
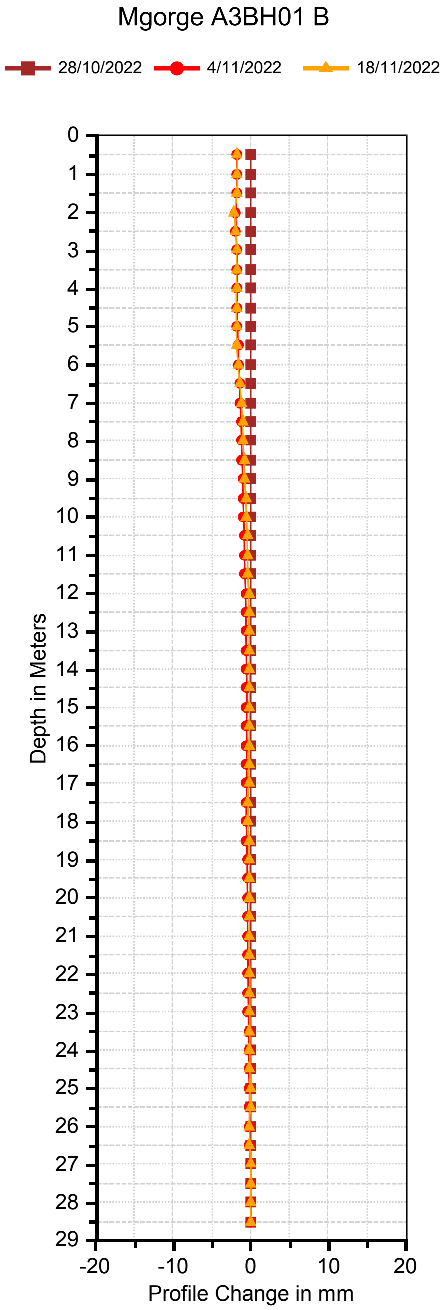
166 Bank Street
Whangarei
Ph 09 438 4417





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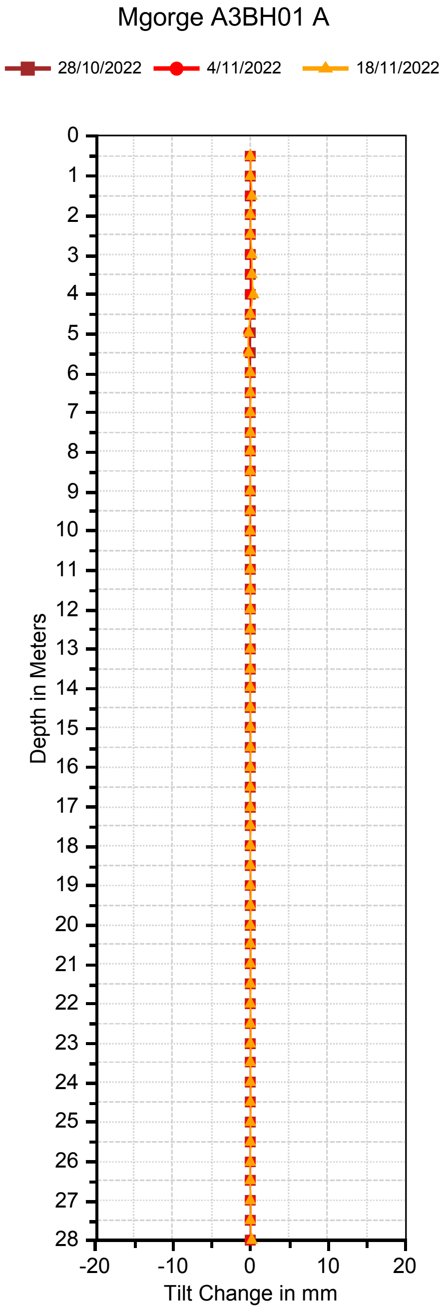

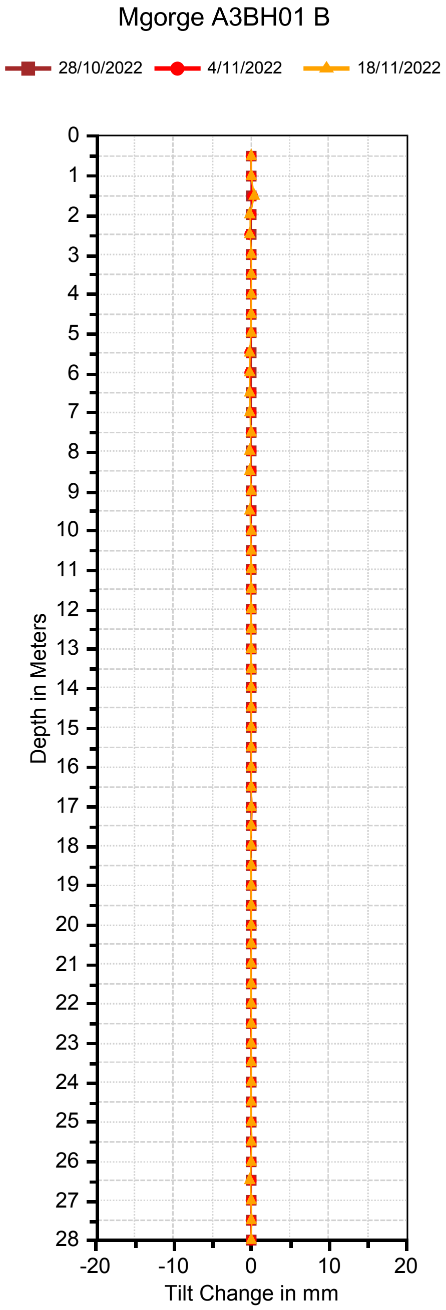

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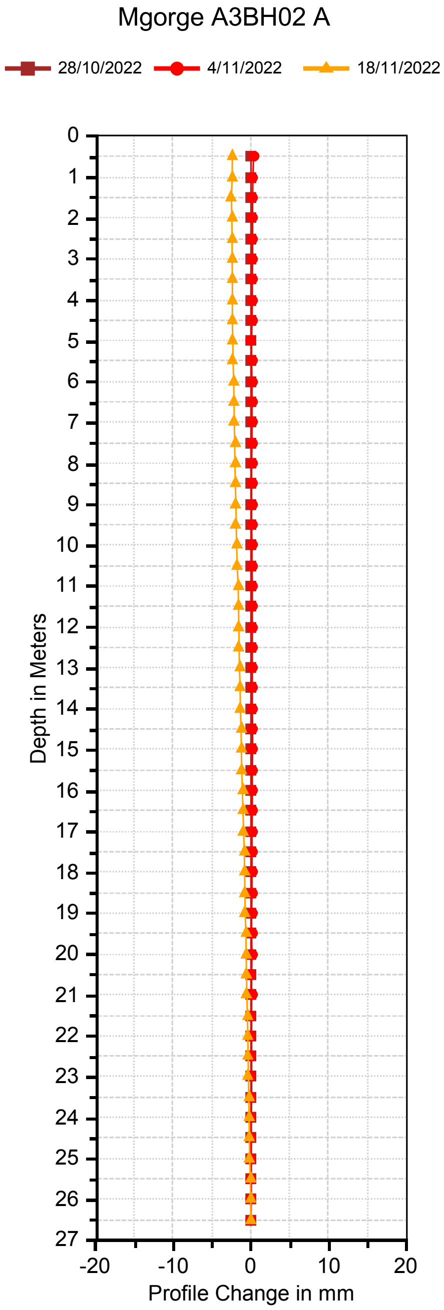

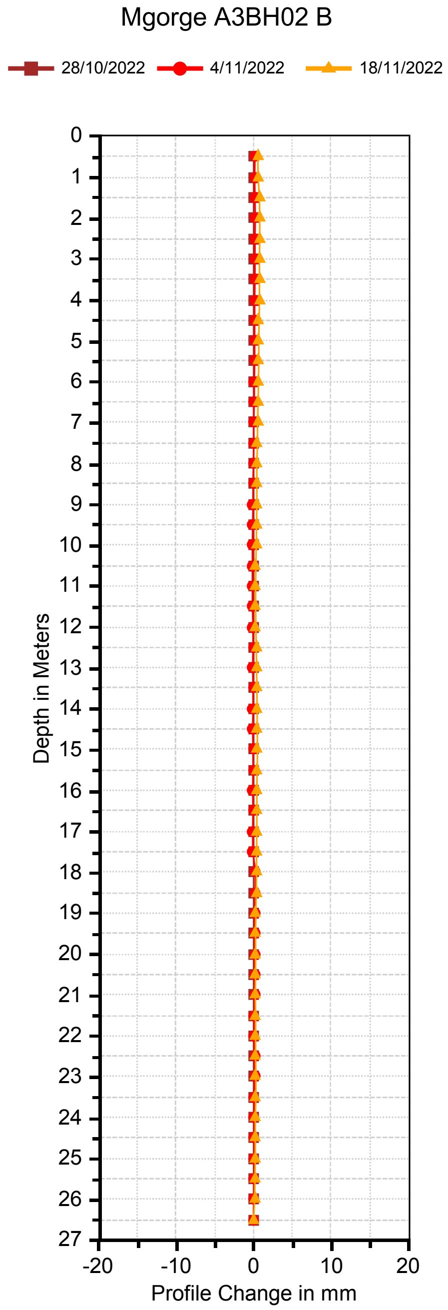

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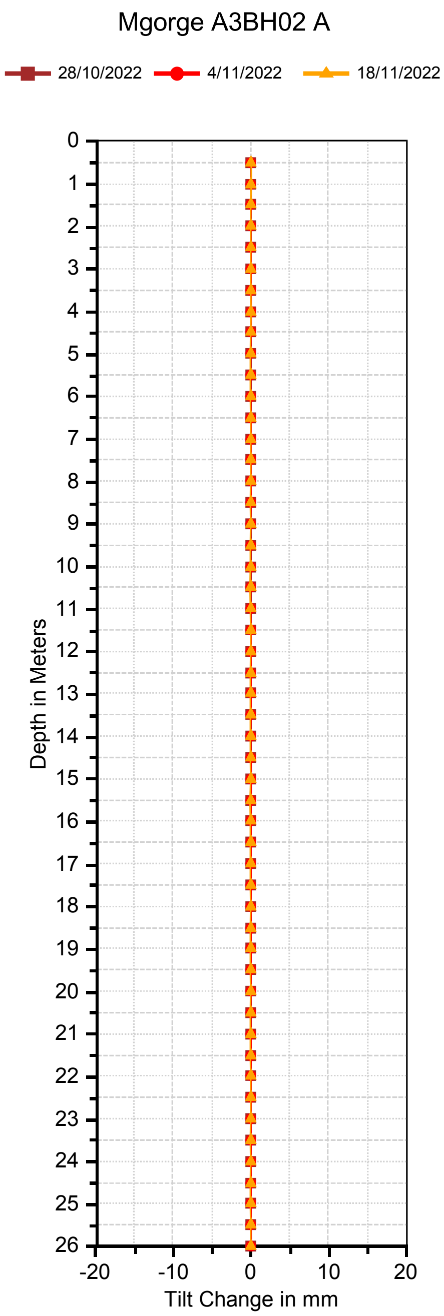

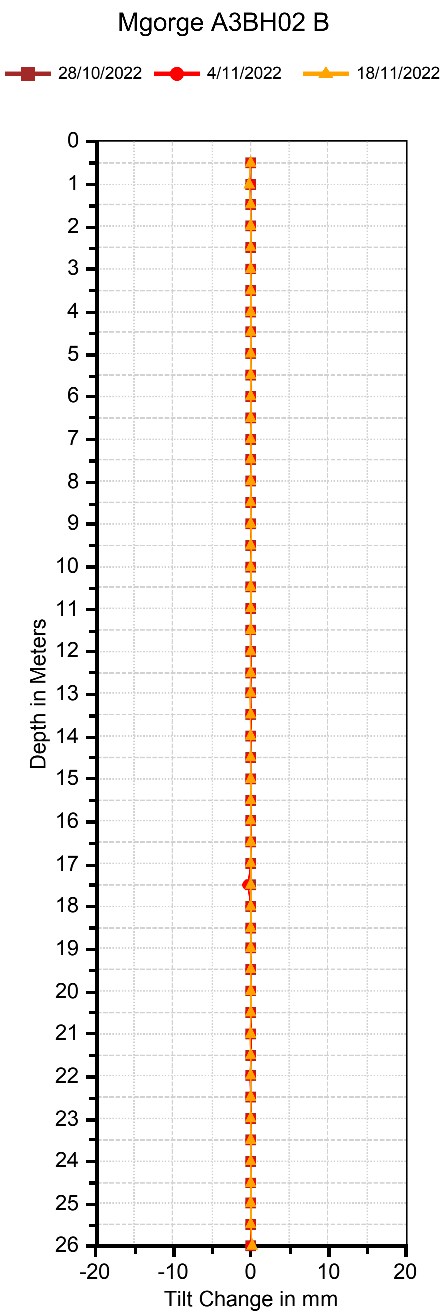

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NZTA Northland Resilience and Emergency Works- August 2022- 10163/22A13

25 November 2022

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Interpretive Geotechnical Investigation Report

Contact Details

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Revision Details

Revision	Details

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for New Zealand Transport Agency ('**Client**') in relation to Mangamuka Gorge Slips Emergency Works ('**Purpose**'). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

1 Introduction

Two storm events in July and August have caused widespread flooding and associated landsliding across much of Northland. Following the August rain event WSP were engaged by Waka Kotahi to form part of the emergency response and undertake an urgent geotechnical investigation along a section of State Highway (SH) 1 through Mangamuka Gorge. A total of 12 underslips have been identified requiring significant geotechnical analysis and associated permanent remedial measures.

This report covers the investigation and assessment at site 10163/22A13 (henceforth referred to as A13) and provides a recommended solution. The site A13 is located at SH01N RS119 PR4.604, approximately 21.5 km southeast Kaitaia. This section of road traverses ancient colluvial terrace of the southern end of the gorge, which is generally flatter than the areas further east. The damaged section of road has gentle to moderately incline of (9˚ - 10˚) gradient.

The failure mechanism of at the site is likely being driven by elevated groundwater within the colluvial unit as a result of the recent storm events, leading to the regression of headscrap back into the live lane.

Additional historical deformation features are located immediately north and south of the site, propagating across the road, related to the incremental creep of the broader area down slope.

The site location is shown below in Figure 1-1 together with other slip sites.

Figure 1-1: *10163/22A13 Site location Plan.*

2 Regional Geology

The 1:250 000 scale QMAP seamless digital data (GNS, 2013) indicates the site area to be underlain by the Undifferentiated Tangihua Complex in Northland Allochthon comprising basalt pillow lava, with subvolcanic intrusives of basalt, dolerite and gabbro; locally incorporating siliceous mudstone. (Figure 2-1).

The Tangihua Complex has been emplaced onto New Zealand through convergent plate tectonics and sea floor sliding. As a result, the material has been historically sheared with the rock underlying the site expected to be highly fractured and degraded through original emplacement processes and further modified by weathering.

Figure 2-1: Regional geology

3 Site Investigation

Between 19th and 28th September 2022, a targeted geotechnical investigation was undertaken to inform the remedial measures required at site A13. The works comprised the following:

- A single rotary cored borehole (BH) was completed to a depth of 30.0m bgl, with standard penetration tests (SPTs) at 1.5m intervals.
- Installation of BH inclinometer upon completion of BH01.
- One wash borehole (A13BH02) was drilled and installed with a single piezometer.
- Two Cone penetration tests (CPTs) taken to a maximum depth of 13.08m bgl.

- The intrusive drilling works was undertaken by Drillforce Limited including the boreholes, CPT's as well as the installation of inclinometer tubing for monitoring ground movement and piezometers for groundwater, all under the supervision of WSP site staff.
- The intrusive drilling works was undertaken by Geocivil Limited with all of the boreholes logged in accordance with the NZGS *Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes*, December 2005 and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1. Borehole and CPT locations displayed on Figure 3-1 below with logs displayed in Appendix A.
- Tiltmeters were installed on the ground surface by WSP Research staff to obtain Realtime monitoring of surface movements.
- Monitoring of the piezometers and inclinometers to date has been undertaken by GeoCivil Ltd under direction of WSP staff.

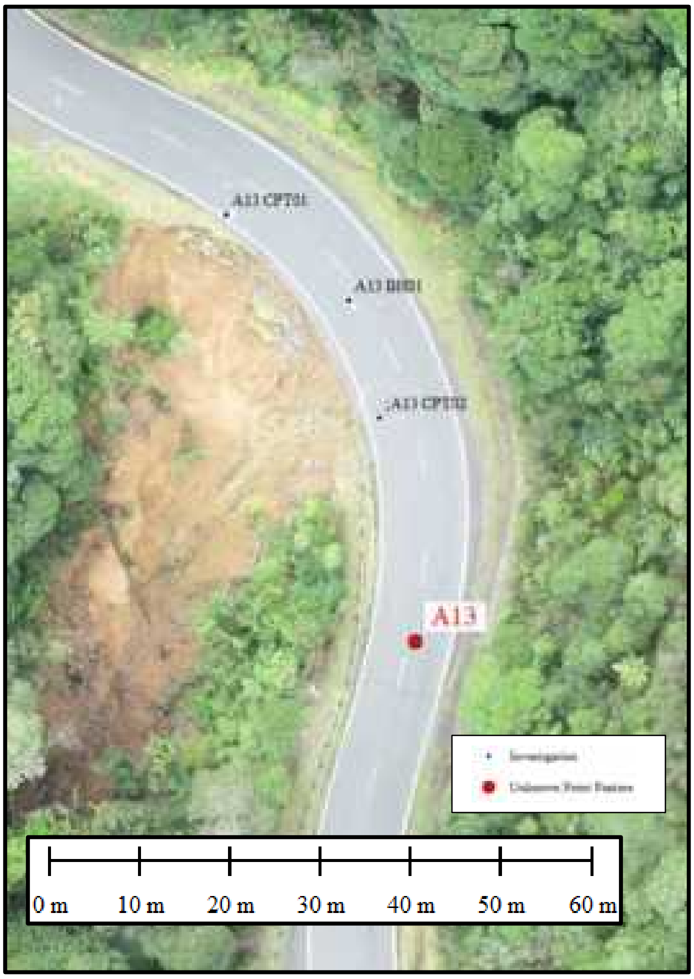

Figure 3-1: Exploratory hole location plan

3.1 Observations

During the site investigation, the slip was inspected between 19th and 21st, and then again between 27th and 28th September by WSP. The inspection identified the following:

- The visible headscarp is 35m in length with the height of slip estimated to be 10m. The grade of slope is approximately 1V:2H. The damaged section of road is general level with a gentle to moderately incline of (9° - 10°) gradient.

- Additional tension cracking is located 22m north and 11m south of the slip, propagating perpendicular to the road alignment. This is believed to be related to the incremental creep of the broader area down slope.
- The damaged road is located approximately 100m above the Mangamuka stream with the slopes below heavily vegetated in native bush.
- At the time of site investigation, the northbound shoulder has lost 1.1m of shoulder with the headscarp terminating approximately 300mm from the live lane. At the time of the inspection there is no visible deformation within the road. However, the slip is likely to continue to regress if not treated, with potential to threaten the entirety of the road.
- This section road has been patched previously.
- No surface seepage during the site investigation.

4 Geomorphological Mapping

A terrain evaluation is presented below in Figure 4-1. Geomorphological mapping undertaken from both Lidar and aerial photography as well as site observations. The site area is comprised of steep slopes of approximately 20° – 30° and includes historic slip features manifesting as large gullies extending from the slope above to the stream below. It's expected that the material underlying the site and surrounding area to consist of colluvial soils resulting from recent and historical movement.

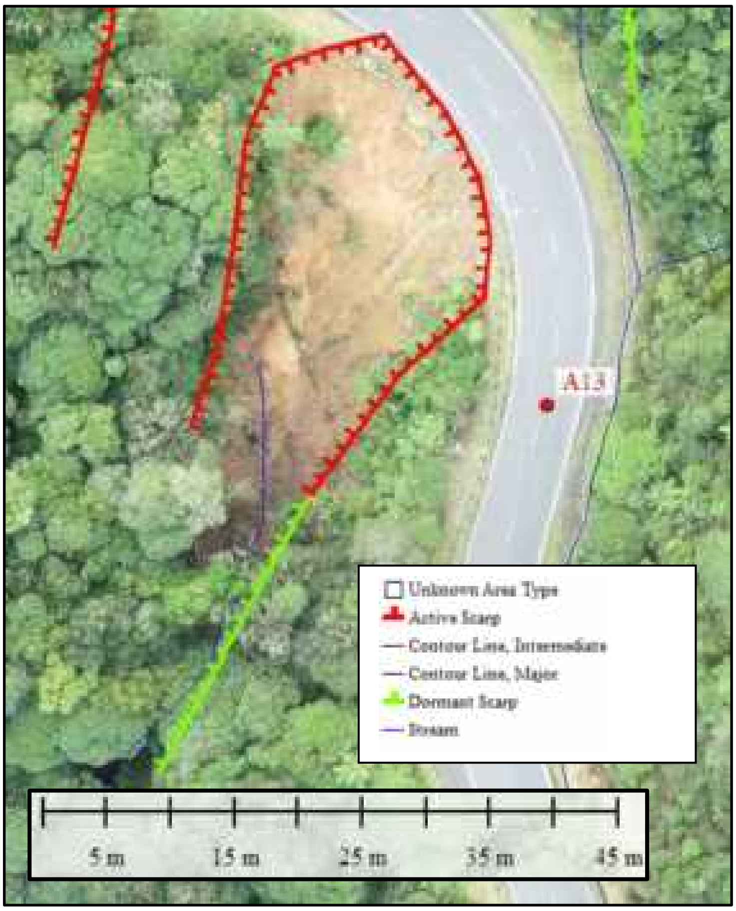

Figure 4-1: Geomorphological map

5 Ground Model

Table 5-1 below summarises the ground model for site A13. A conceptual geological cross section is presented within Appendix B.

Table 5-1: A13 Ground Model

Lithology	Top (m bgl)	Base (m bgl)	Total thickness (m)	SPT N Value	GSI
FILL	0.0 0.0*	1.0 0.9*	0.9*-1.0	2*-13*	-
COLLUVIUM	1.0 0.9*	3.6 3.6*	2.6-2.7*	3*-4*	-
Completed Degraded Tangihua MUDSTONE/CATACLSTIC ROCK	3.6 3.6*	11.9 12.2*	8.3-8.6*	3*-27*	-
HIGHLY Degraded Tangihua Complex MUDSTONE/CATACLSTIC ROCK	11.9 12.2*	24.0 -	12.1	4*-27*	10-20
Moderately Degraded Tangihua MUDSTONE/CATACLSTIC ROCK	24	28.5	4.0	50+	20-40
Slightly Weathered Tangihua Complex MUDSTONE/CATACLSTIC ROCK	28.5	-	Not Proven	60+	60-70

* Inferred from CPT results. CPTs

Fill was encountered within BH01 and inferred to be present in within CPT 01, to a depth ranging from 0.9 to 1.0m. The material is described as Asphalt and Subgrade, dark bluish grey, gravel is angular, fine to coarse, well graded, slightly weathered basalt.

Colluvium was encountered within BH01 and inferred to be present in within CPT01, with the maximum thickness of 3.6m encountered within BH01. The material is classified predominately as a soft to firm, becoming very stiff with depth, silty clay/clayey silt, with variable quantities of sand and gravel.

Completely Degraded Tangihua Complex material was encountered at 3.60m to 11.7mbgl within BH01 and inferred to be present within CPT01, described as silty CLAY/CLAY with variable quantities of sand and gravel. The strength of the material is generally firm. The thickness of material varies from 8.00 m (BH01) to 7.80m (CPT01).

Highly degraded material was encountered within BH01 and inferred to be present with CPT01 with a maximum thickness of 12.1m encountered in BH01. From 11.9m to 19.5mbgl, the material is strongly degraded/ sheared, which is potentially influenced by fault systems locally within the Tangihua Complex. The material was recovered and described predominantly as subangular to subrounded, fine to coarse gravel, with iron staining on the gravel surfaces. Based on the corresponding SPT number, this stratum is very dense and likely fairly intact in situ. Below 19.5mbgl, the material, described predominantly as brown DOLERITE and dark reddish-brown MUDSTONE, extremely weak to very weak, with some iron staining on defect surfaces. Proportions of sedimentary/igneous material vary throughout this unit.

CPT 01 inferred to refuse on highly degraded Tangihua Complex surface.

Moderately Degraded Cataclastic Tangihua Complex was encountered at 24.0mbgl within BH01 with a thickness of 5.0m. Material described as brown DOLERITE and dark reddish-brown MUDSTONE, extremely weak to strong, Proportions of sedimentary/igneous material vary throughout this unit.

Slightly weathered Tangihua Complex Rock II was encountered from 28.5mbgl down to the machine borehole termination depth of 30.0m bgl within BH01, described as predominantly as dark reddish-brown MUDSTONE sheared with brown DOLERITE with some zeolite and iron staining.

Three groundwater readings were carried out between 28th October and 18th November, results are summarised below in Table 5-2.

Table 5-2: Groundwater Monitoring Results

BH	Date	Depth to GW (mbgl)	Lithology
BHA13-1	28/10/2022	5.2	Completely Degraded Tangihua Complex
	04/11/2022	5.42	
	18/11/2022	5.41	

5.1 Instrumentation Summary

At completion of the borehole (BH01), inclinometer casing was installed to 29.5m depth for subsequent monitoring. Inclinometer monitoring initially has been carried out over a period of three weeks following installation. Results are presented within Appendix C.

Both A and B profile graphs indicate minor movements at 4.5mbgl and around 20mbgl.

The probe measurements so far indicate minimal movements have occurred in the A direction (up to 2mm), parallel to the downslope feature, with more movement being recorded in the B direction (up to 4mm), perpendicular with the headscarp and parallel with the wider grade of the hillside. This possibly coincides with the linear tension cracking north and south of the headscarp, which propagate perpendicular to road alignment.

The movement at 4.5m depth is assumed to initiate within the colluvium, with the deep movement possibly coinciding with the highly fractures rock and zones of core loss encountered during the drilling of A13-BH01. Inclinometer readings to continue over the coming weeks.

6 Conclusions and Recommendations

6.1 Conclusions

An underslip has occurred at A13, resulting in a loss of shoulder and large evacuation down slope. The slip is caused by progressive saturation of the ground. There is an immediate risk of complete evacuation of the road following the next significant rainfall event.

The tension cracking immediately north and south of the main failure likely coincides with gradual creep of the broader hillside. These features are identified as a low risk of significant movement and will likely continue to creep incrementally and require occasional levelling.

6.2 Recommendations

Based on the available geotechnical information, it is recommended a concrete pile wall is constructed at the site, to be socketed into competent bedrock. Wall geometry and additional support requirements to be discussed in design report. Estimated construction costs for this solution would likely be between $1.5m-$2.5m. This solution would effectively be a permanent fix with very little maintenance costs.

Further information provided within October 2022 Storm Response Options Update- Memo no.2 including discounted solutions.

7 Limitation

This report has been prepared for the benefit of NZTA only and is based on limited investigation and visual inspection only. Given the complex geological setting changes in ground condition could occur across the site that differ from those summarised within this report.

Appendix A

Borehole Logs
CPT Report

Borehole No. BH22A13

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	282953 E 986697 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	116.5 m
Location:	Slip 22A13 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000
Depth:	30 m	*Inclination:*	Vertical

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION
	ASPHALT
FILL	Fine to Coarse GRAVEL, minor silt; bluish grey mottled light brown. Very dense, wet, Gravel, subangular, well graded basalt [Gap 40 subgrade].
COLLUVIUM	Silty CLAY, trace sand; light brown mottled brownish orange. Firm, moist, highly plastic; sand, medium to coarse.
	Silty CLAY, trace sand and organics; light greenish grey mottled green. Firm, moist, highly plastic; sand fine, organics, fibrous rootlets; strong organic ordour.
	Silty CLAY, trace sand; light brown mottled greenish grey. Firm, moist, highly plastic; sand, fine.
	Silty CLAY, minor sand, trace gravel; light brown mottled orange and dark brown. Firm, moist, highly plastic; sand, fine; gravel, fine, subround, highly weathered, extremely weak basalt.
	CLAY, some silt; dark reddish brown mottled brown. Firm, moist, highly plastic.
	Silty CLAY, minor gravel, trace sand; light brown mottled brownish orange and reddish brown. Soft, wet, highly plastic; sand, fine to coarse, gravel, fine, subangular and subrounded, completely weathered dolerite and mudstone.
	CLAY, some silt; dark reddish brown mottled brown. Firm, moist, highly plastic.
	Silty CLAY, trace sand; light brown. Very soft, wet, highly plastic; sand, fine; gravel, fine, angular, highly weathered, extremely weak gravel. 2.35-2.70m - Soft, wet.
	2.70 - 3.00m - Core loss; No sample recovered.
TANGIHUA COMPLEX	Silty CLAY, trace sand and organics; light greenish grey mottled green. Firm, moist, highly plastic; sand fine, organics, fibrous rootlets; strong organic ordour.
	Silty CLAY, some gravel and sand; light brown mottled brown. Firm, moist, highly plastic; sand, medium to coarse; gravel, fine, highly weathered Dolerite [Completely Weathered]. 3.90-4.30m - Soft, wet.
	Silty CLAY, minor sand, trace gravel; light brown. Firm, moist, highly plastic, sand, coarse; gravel, fine, completely weathered dolerite.
	Silty CLAY, some sand; light brown. Firm, moist highly plastic; sand, fine [Completely Weathered].
TANGIHUA COMPLEX COMPLEX	Silty CLAY, minor sand, trace gravel; light brown mottled dark brown. Soft, wet; highly plastic; sand, fine; gravel, fine, subrounded, completely weathered dolerite [Completely Weathered].
	Silty CLAY, some sand; light brown mottled dark brown. Firm, moist, highly plastic; sand, fine to coarse [Completely Weathered].

R.L. (m): 116, 114, 112, 110, 108 — DEPTH (m): 1, 2, 3, 4, 5, 6, 7, 8, 9

SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE
5	2// 1/1/1/2
6	2// 1/1/2/2
5	0// 1/1/2/1
4	0// 0/1/1/2
1	1// 0/0/1/0
1	0// 1/0/0/0

ROCK WEATHERING: CW

DEFECT DIP degrees 0 90

SAMPLE TYPE	TCR (%)
HQ	100
SPT	78
HQ	71
SPT	67
HQ	100
SPT	62
HQ	100
SPT	67
HQ	100
SPT	100
HQ	100
SPT	100
HQ	100

DRILLING METHOD: HQ Size, Triple Tube, Wireline Rotary Coring

BASE OF HOLE & WATER LEVEL: SWL 9.00m 21/09; SWL 9.50m 28/09

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	19/09/2022	*Finished:*	28/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Borehole No. BH22A13

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	282953 E 986697 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	116.5 m
Location:	Slip 22A13 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000

Depth: 30 m
Inclination: Vertical

Depth (m)	R.L. (m)	Main Description / Detail Description	SPT 'N' Value	SPT Blow Counts	Rock Strength	Rock Weathering	Defects / Notes / Other Tests	Sample Type	TCR (%)	RQD (%)	Base of Hole & Water Level
10.0–11.80	106	Silty CLAY, minor sand, trace gravel; light brown mottled brownish orange and dark brown. Soft, moist, highly plastic; sand, fine; gravel, subangular, completely weathered dolerite [Completely Weathered].	2	0// 0/0/1/1		CW		HQ / SPT / HQ	100 / 100 / 100	/ / 0	SWL 10.95m 27/09
11.80–11.90		11.80-11.90m - Firm.				CW					
11.90–12.43		Recovered as medium to coarse GRAVEL; bluish grey. Very dense, moist; gravel, poorly sorted, slightly weathered dolerite; iron staining on gravel surfaces.	50+	23// 16/13/12/9 for 50mm	W	SW	11.90-19.50m - Highly sheared possibly faulted Tangihua Complex.	SC	0		
12.43–13.50	104	12.43 - 13.50m - Core loss; No sample recovered.			W	SW		HQ	5	0	
13.50–14.20		Recovered as medium to coarse GRAVEL; bluish grey. Very dense, moist; gravel, subrounded to subangular, slightly weathered dolerite; iron staining on gravel surfaces.	50+	22// 16/30/4 for 20mm	W	SW		SC	0		
14.20–15.00	102	14.20 - 15.00m - Core loss; No sample recovered.			W	SW		HQ	34	0	
15.00–15.10		Recovered as medium to coarse GRAVEL; bluish grey. Very dense, moist; gravel, subrounded, slightly weathered dolerite; iron staining on gravel sufaces.			W	SW					
15.10–16.10		15.10 - 16.10m - Core loss; No sample recovered.			W	SW		HQ	33	0	
16.10–17.90	100	Recovered as fine to coarse GRAVEL; light brown. Very dense, moist; gravel, subrounded, moderately weathered dolertie; iron staining on the gravel surfaces.	50+	25 for initial 95mm	VW	MW		SC / HQ	0 / 86	/ 0	
17.90–18.00		17.90 - 18.00m - Core loss; No sample recovered.			W	SW					
18.00–18.30	98	Recovered as medium to coarse GRAVEL; bluish grey. Very dense, moist; gravel, subrounded, slightly weathered dolerite; iron staining on gravel sufaces.			W	SW		HQ	20	0	
18.30–19.50		18.30 - 19.50m - Core loss; No sample recovered.			W	SW					
19.50–19.60		Clayey SILT; dark reddish brown. Hard, moist, highly plastic [Highly weathered].	50+	17// 16/24/10 for 20mm		HW		SPT	31		
19.60–20.00		Clayey fine to coarse SAND, minor gravel; light brown. Hard, moist; gravel, fine subagular to			EW	HW		HQ	100	0	

Drilling Method: HQ Size, Triple Tube, Wireline Rotary Coring

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	19/09/2022	*Finished:*	28/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Borehole No. BH22A13

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	282953 E 986697 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	116.5 m
Location:	Slip 22A13 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000

Depth: 30 m
Inclination: Vertical

Columns: GEOLOGY | MAIN DESCRIPTION / DETAIL DESCRIPTION | R.L. (m) | DEPTH (m) | GRAPHIC LOG | TESTS: SPT 'N' VALUE, SPT BLOW COUNTS OR SHEAR VALUE | ROCK STRENGTH | ROCK WEATHERING | ROCK DEFECT SPACING | DEFECT DIP (degrees 0–90) | DEFECTS / NOTES / OTHER TESTS | CORE: SAMPLE TYPE, TCR (%), RQD (%) | DRILLING: DRILLING METHOD, CASING, BASE OF HOLE & WATER LEVEL | INSTALLATION DETAILS

R.L. (m): 96, 94, 92, 90, 88
DEPTH (m): 21, 22, 23, 24, 25, 26, 27, 28, 29

Main Description / Detail Description

- subrounded, completely weathered dolerite [Highly weathered].
- 19.60 - 19.82m - Core loss; No sample recovered.
- Highly weathered, brown, DOLERITE. Extreme weak; extremely close to very closely speaced, steeply to very steeply inclined, undulating smooth to rough defects; iron staining on defect surfaces. [clayey fine to coarse sand; very dense, moist]. *(continued)*
- Highly degraded, cataclastic reddish brown MUDSTONE (80%) sheared with dark brown DOLERITE (20%). Extremely weak; extremely close defects. [Silty fine to coarse SAND; very dense, moist; sand, fine to coarse].
- Highly degraded, cataclastic brown DOLERITE (90%) sheared with dark reddish brown MUDSTONE (10%). Extremely weak; extremely close spaced defects; iron staining on defect surfaces. [clayey fine to coarse SAND; very dense, moist].
- 22.40 - 22.50m - Core loss; No sample recovered.
- Recovered as medium to coarse GRAVEL; dark reddish brown. Very dense, moist; gravel, finet to medium, subangular, gap graded, moderately weathered mudstone.
- 22.60 - 23.40m - Core loss; No sample recovered.
- Recovered as medium to coarse GRAVE; dark reddish brown. Very dense, moist; gravel, poorly sorted, subrounded, moderately weathered mudstone.
- Moderately weathered, brown, DOLERITE. very weak; extremely closely spaced defects; iron staining on defect surfaces.
- Moderately weathered, reddish brown MUDSTONE (80%) sheared with dark brown DOLERITE (20%). Very weak; breaks into fine to coarse fragments on handling.
- Moderately weathered, brown, DOLERITE. Very weak; extremely closely to closely spaced, sub-horizontal to sub-vertical, stepped and planer rough defects; iron staining on defect surfaces.
- 25.38 - 25.50m - Core loss; No sample recovered.
- Moderately weathered, brown, DOLERITE. Very weak; extremely closely spaced; breaks into coarse fragments on handling.
- Moderately weathered, Cataclastic brown DOLERITE (85%) sheared with dark reddish brown MUDSTONE (15%). extremely weak; extremely closely speaced defects; breaks into fine to corase fragments on handling. [Silty CLAY, minor sand; very stiff, moist, highly plastic; sand, fine].
- 26.60 - 27.00m - Core loss; No sample recovered.
- Moderately weathered, catalastic reddish brown MUDSTONE (80%) sheared with dark brown DOLERITE (20%). Moderately strong; extremely closely spaced, gently inclined, undulating smooth defects.
- Slightly weathered, cataclastic reddish brown MUDSTONE (80%) sheared with dark brown DOLERITE (20%). Strong; extremely closely to closely spaced, sub-horizontal to very gentle inclined, stepped rough to undulating smooth defects.
- 28.18 - 28.50m - Core loss; No sample recovered.
- Slightly weathered, cataclastic reddish brown MUDSTONE (80%) sheared with dark brown DOLERITE (20%). Very strong; closely to moderately wide spaced, sub-horizontal to very steeply inclined, undulating rough defect; occasional iron staining on defect surfaces; zeolite veining.

END OF BOREHOLE AT 30m - Target Depth Reached

Rock Strength / Weathering

Rock Strength	Rock Weathering
EW	HW
VW	MW
S	SW

Defect Dip

J5, J7, J70, J80, J15, J8, J3, J50, J80, J20

Defects / Notes / Other Tests

- 22.60-23.40m - Potential cavity.
- 23.40-23.95m - Potential crush zone.
- 24.30-24.70m - Potential crush zone.
- 24.80m - J, 5°, RO, ST
- 24.90m - J, 7°, RO, PL
- 24.92m - J, 7°, RO, PL
- 25.30m - J, 70°, SM, UN
- 25.35m - J, 80°, SM, PL
- 27.10m - J, 15°, SM, UN
- 27.40m - J, 8°, RO, UN
- 27.48m - J, 3°, SM, UN
- 27.60m - CZ
- 27.85m - J, 3°, SM, PL
- 28.80m - J, 50°, SM, ST
- 28.90m - J, 80°, RO, UN
- 29.65m - J, 20°, SM, PL

Core

Sample Type	TCR (%)	RQD (%)
HQ	100	0
HQ	93	0
HQ	47	0
HQ	92	0
HQ	73	0
HQ	79	19
HQ	100	79

Drilling Method: HQ Size, Triple Tube, Wireline Rotary Coring

Notes
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	19/09/2022	*Finished:*	28/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Borehole No. BH22A13

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	282953 E 986697 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	30 m
Project No.:	1-11244.00	*R.L.:*	116.5 m	*Inclination:*	Vertical
Location:	Slip 22A13 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

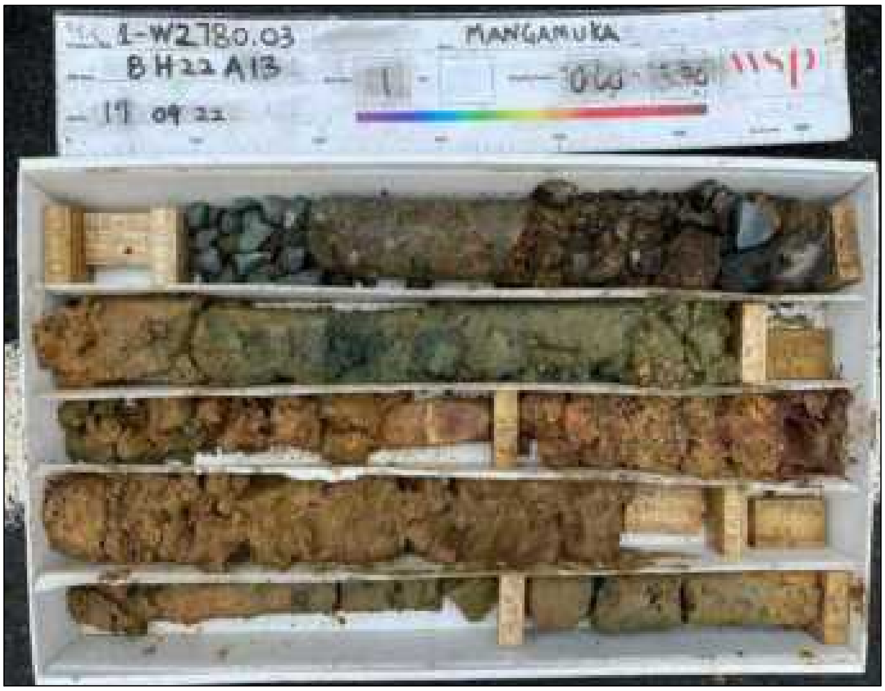

Photo BH22A13.1
BOX01: 0.00 - 3.70m.

Photo BH22A13.2
BOX02: 3.70 - 6.60m.

BOREHOLE SOIL/ROCK LOG A4 - WSP 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 24/11/22

Notes:
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Logged by:	HQ	*Checked by:*	ML

Borehole No. BH22A13

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	282953 E 986697 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	30 m
Project No.:	1-11244.00	*R.L.:*	116.5 m	*Inclination:*	Vertical
Location:	Slip 22A13 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A13.3
BOX03: 6.60 - 9.95m.

Photo BH22A13.4
BOX04: 9.55 - 13.55m.

Notes:
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Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	282953 E 986697 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	30 m
Project No.:	1-11244.00	*R.L.:*	116.5 m	*Inclination:*	Vertical
Location:	Slip 22A13 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A13.5
BOX05: 13.50 - 19.82m.

Photo BH22A13.6
BOX06: 19.82 - 23.50m.

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	19/09/2022	*Finished:*	28/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Borehole No. BH22A13

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	282953 E 986697 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	30 m
Project No.:	1-11244.00	*R.L.:*	116.5 m	*Inclination:*	Vertical
Location:	Slip 22A13 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Photo BH22A13.7
BOX07: 23.50 - 26.50m.

Photo BH22A13.8
BOX08: 26.50 - 30.00m.

Notes:
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

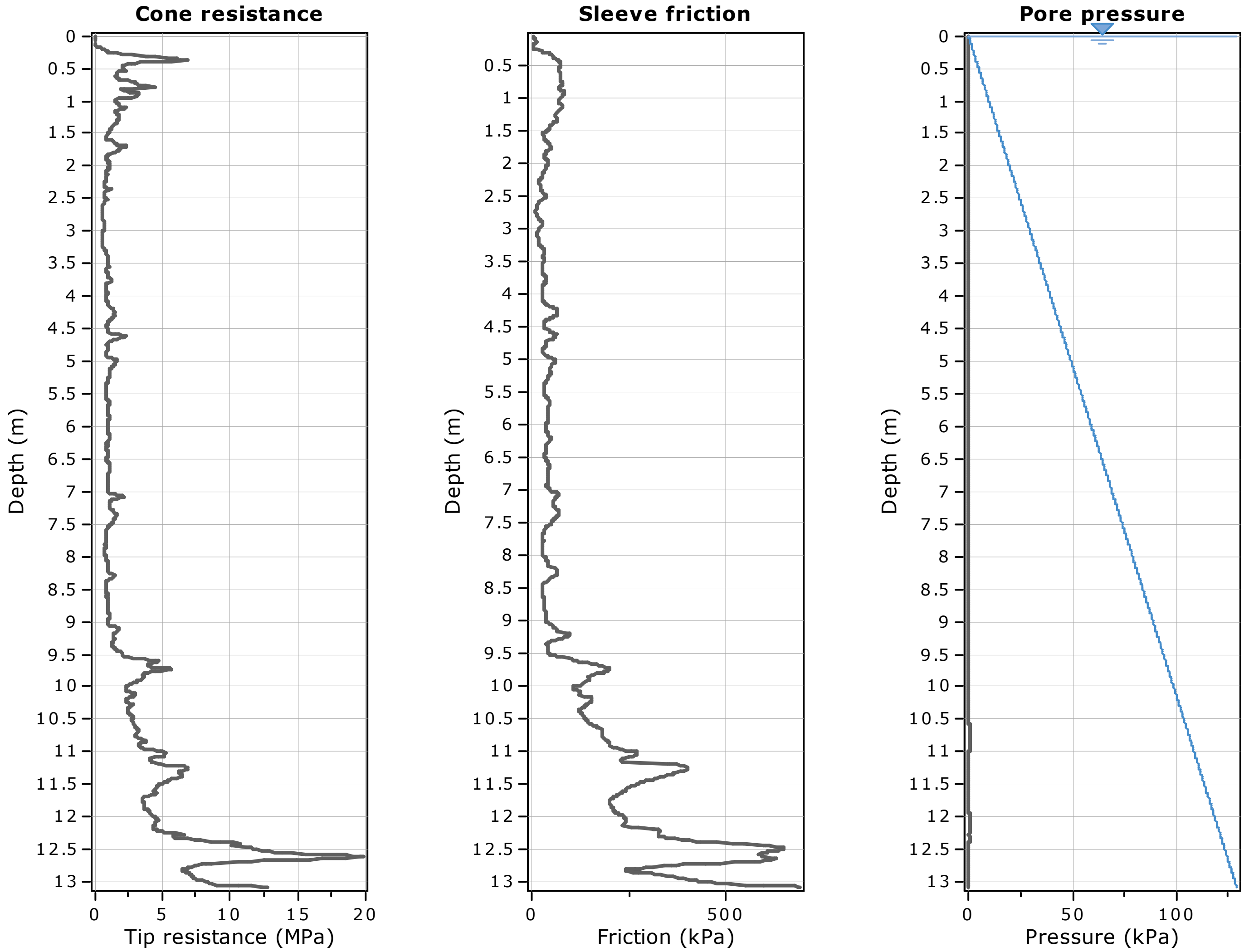
Started:	19/09/2022	*Finished:*	28/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.
Scale 1:50 @ A4

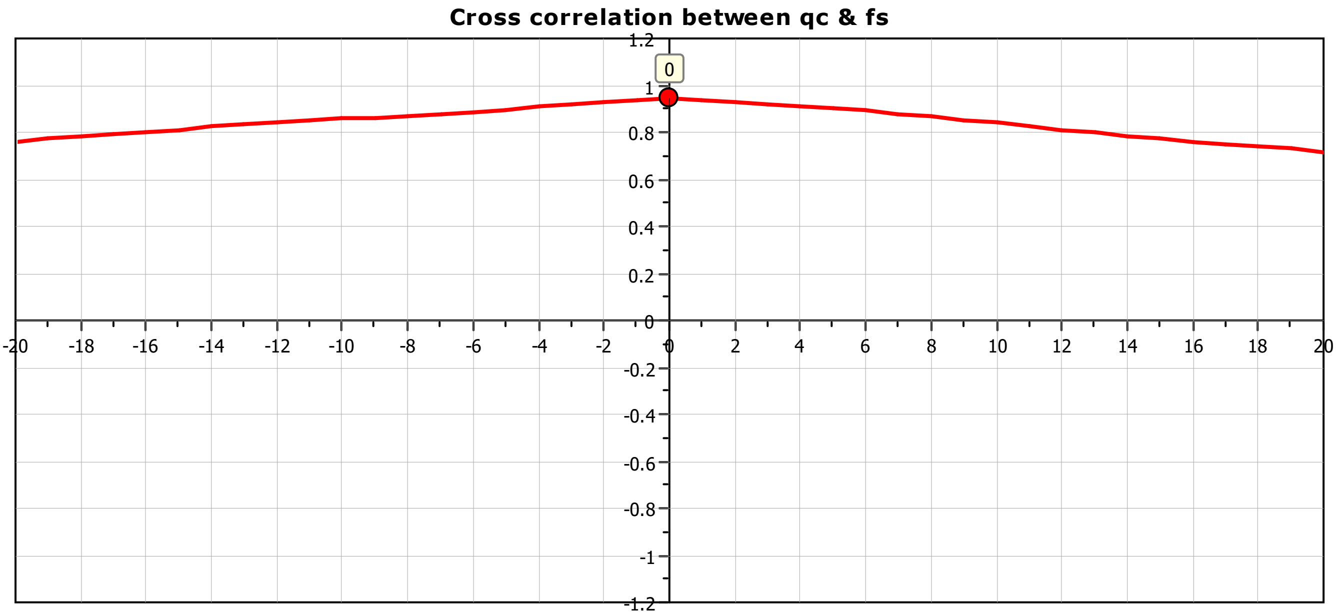
GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A13-CPT01
Total depth: 13.08 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

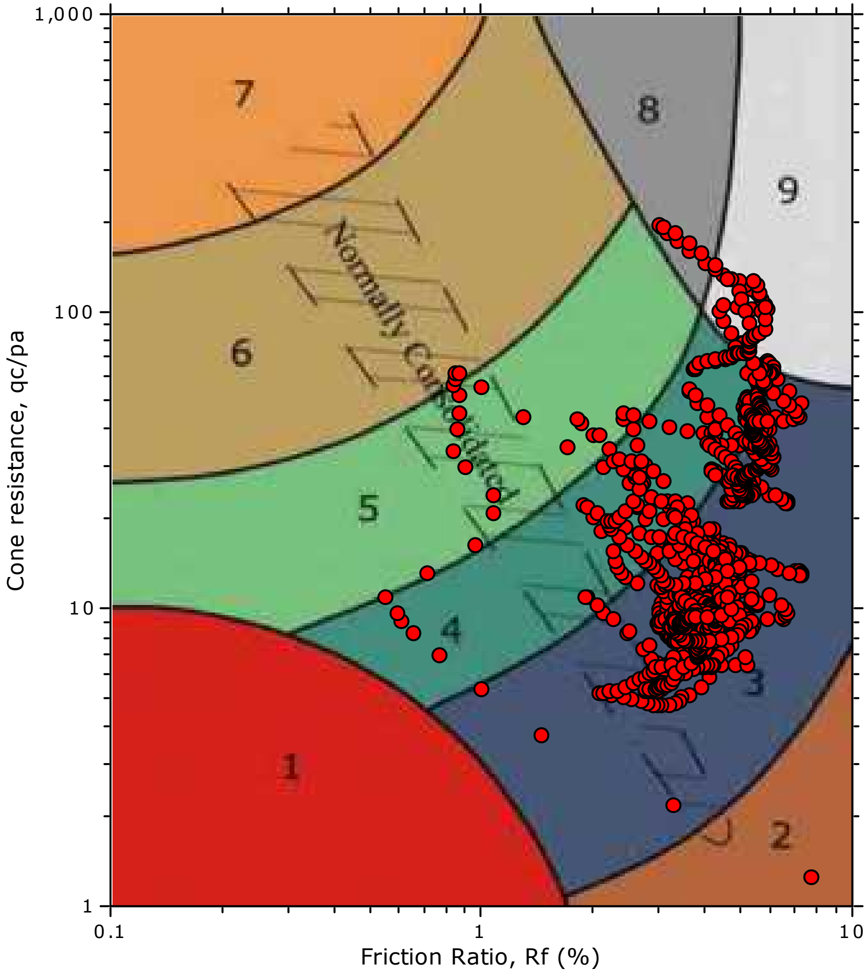


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

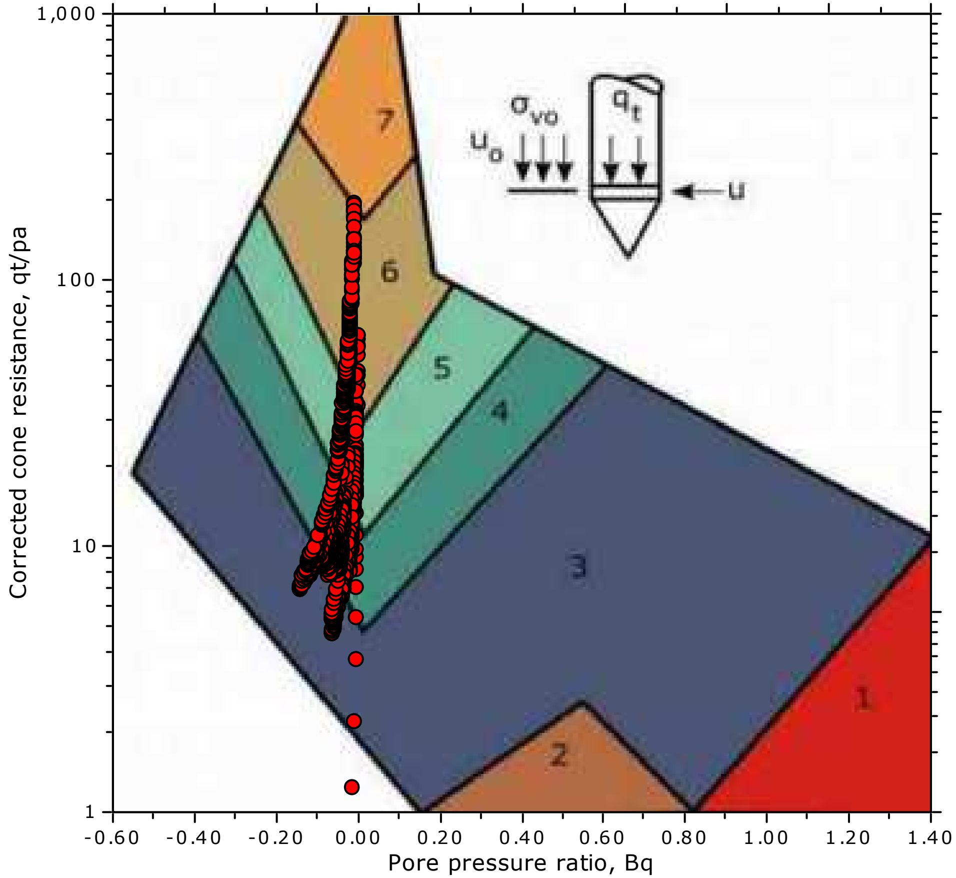


SBT - Bq plots

SBT plot



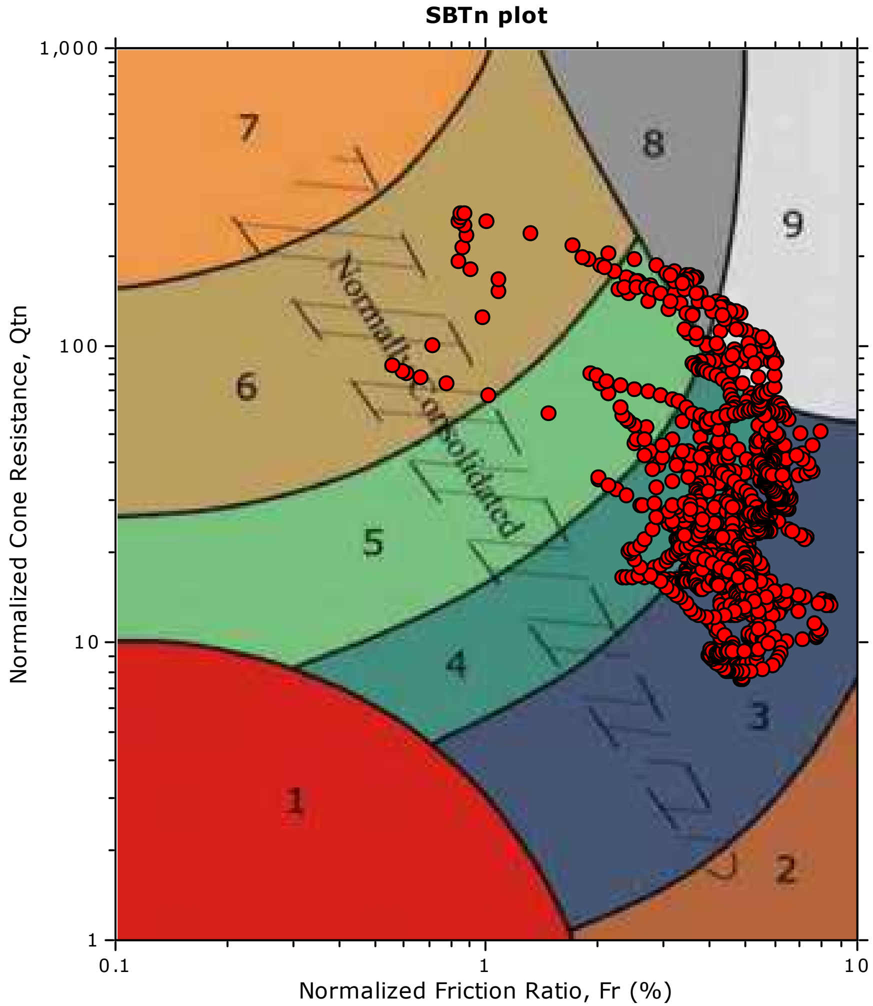
Bq plot

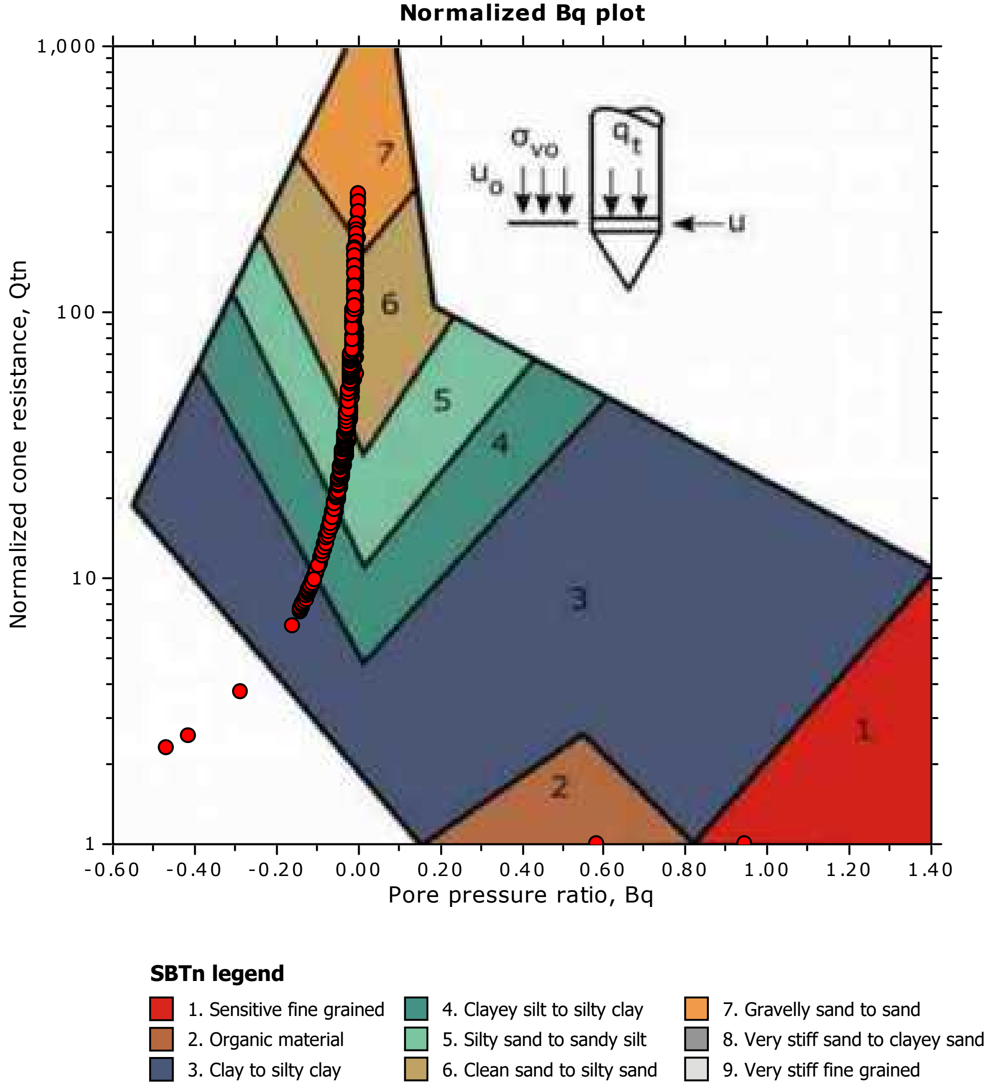


SBT legend

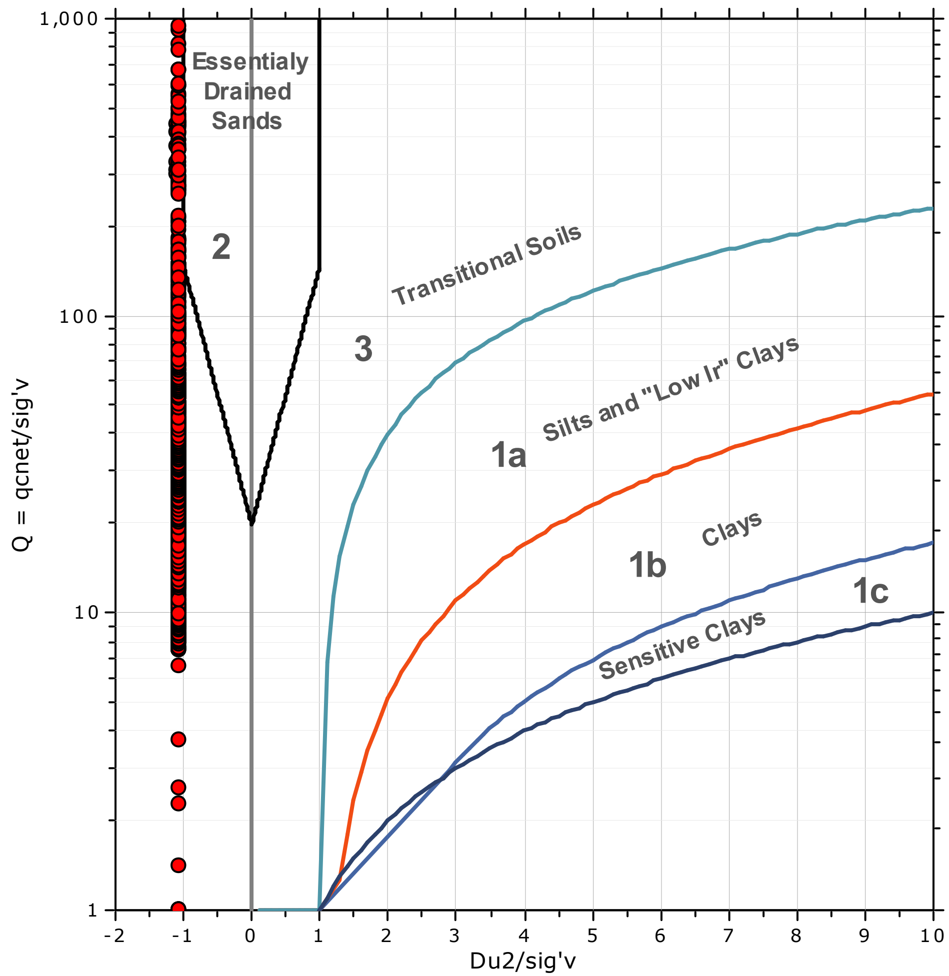
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

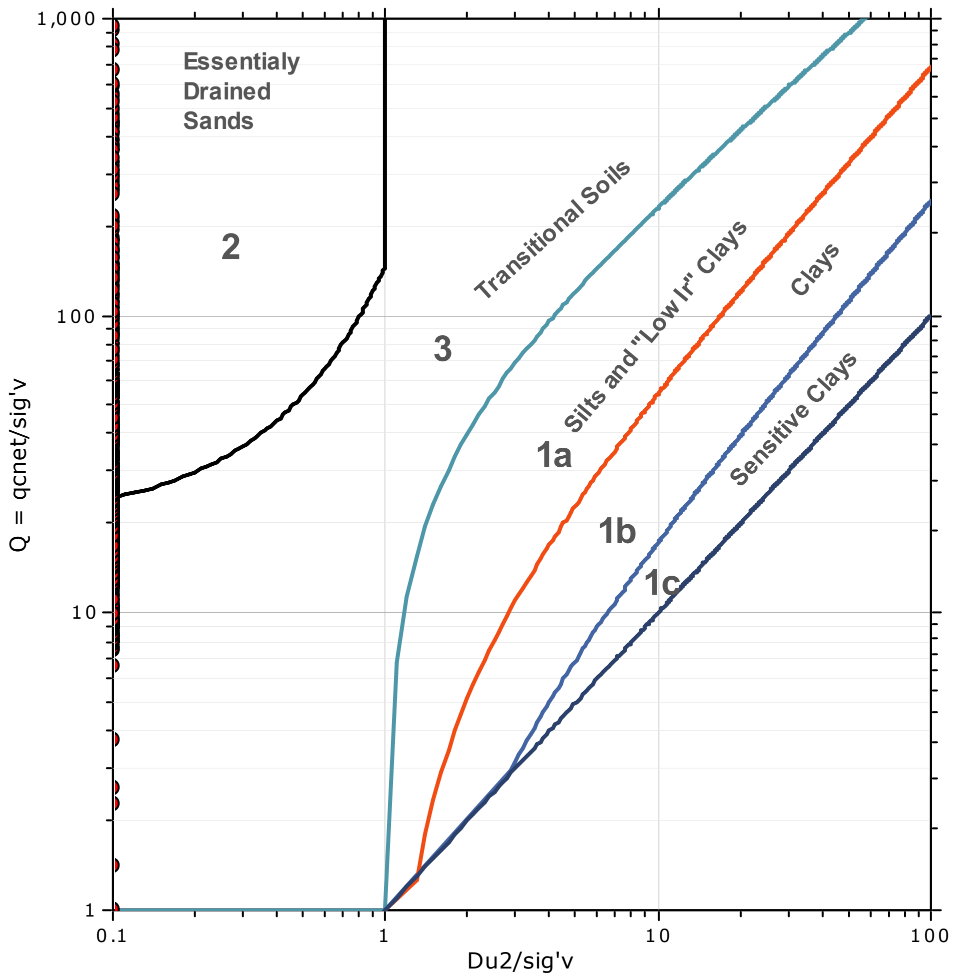
SBT - Bq plots (normalized)





Bq plots (Schneider)





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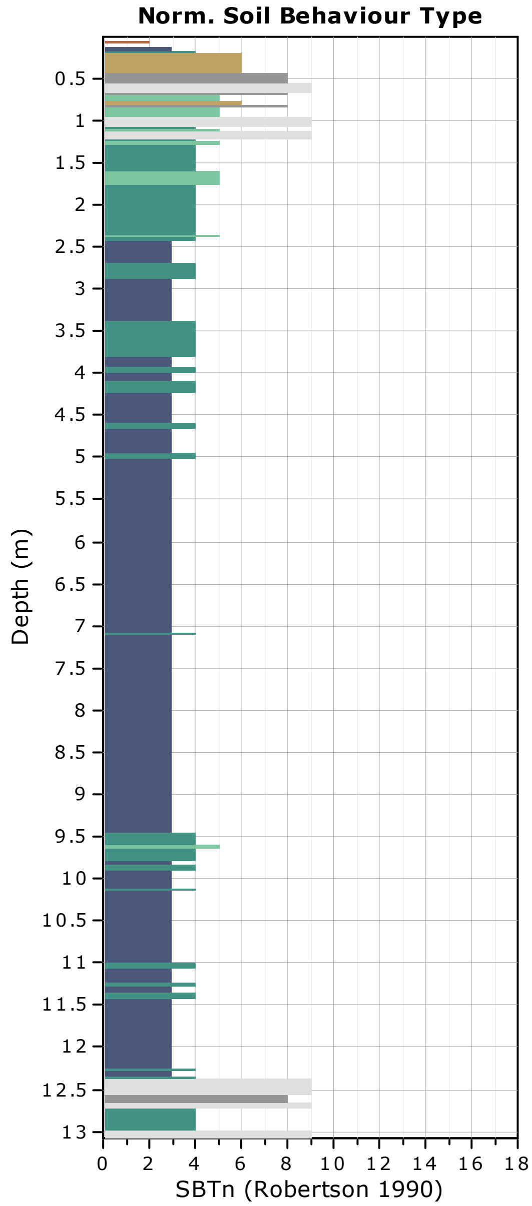
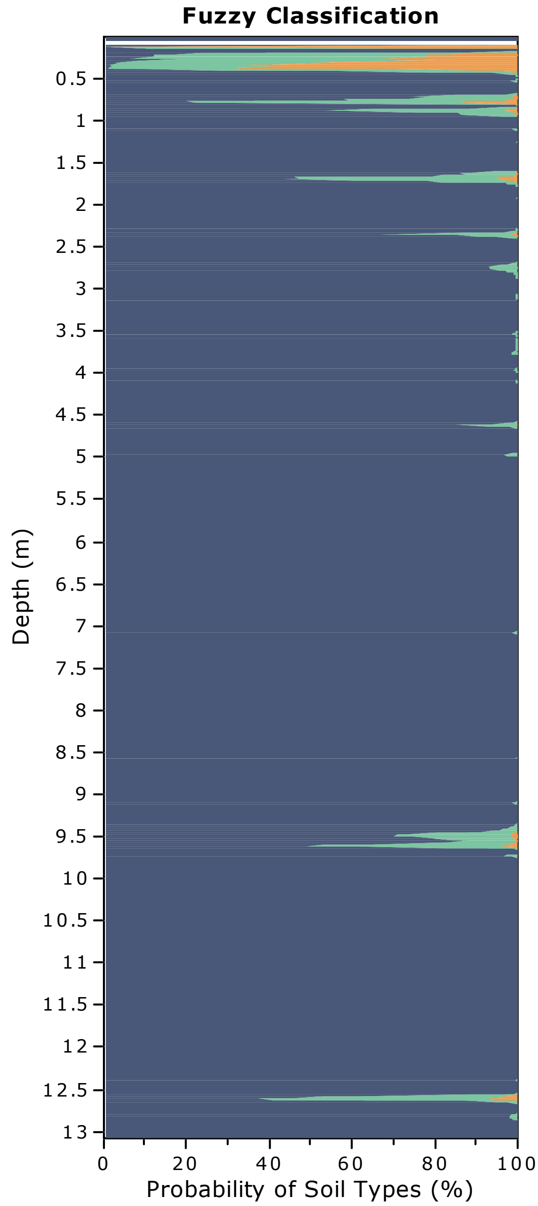
CPT: A13-CPT01
Total depth: 13.08 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:





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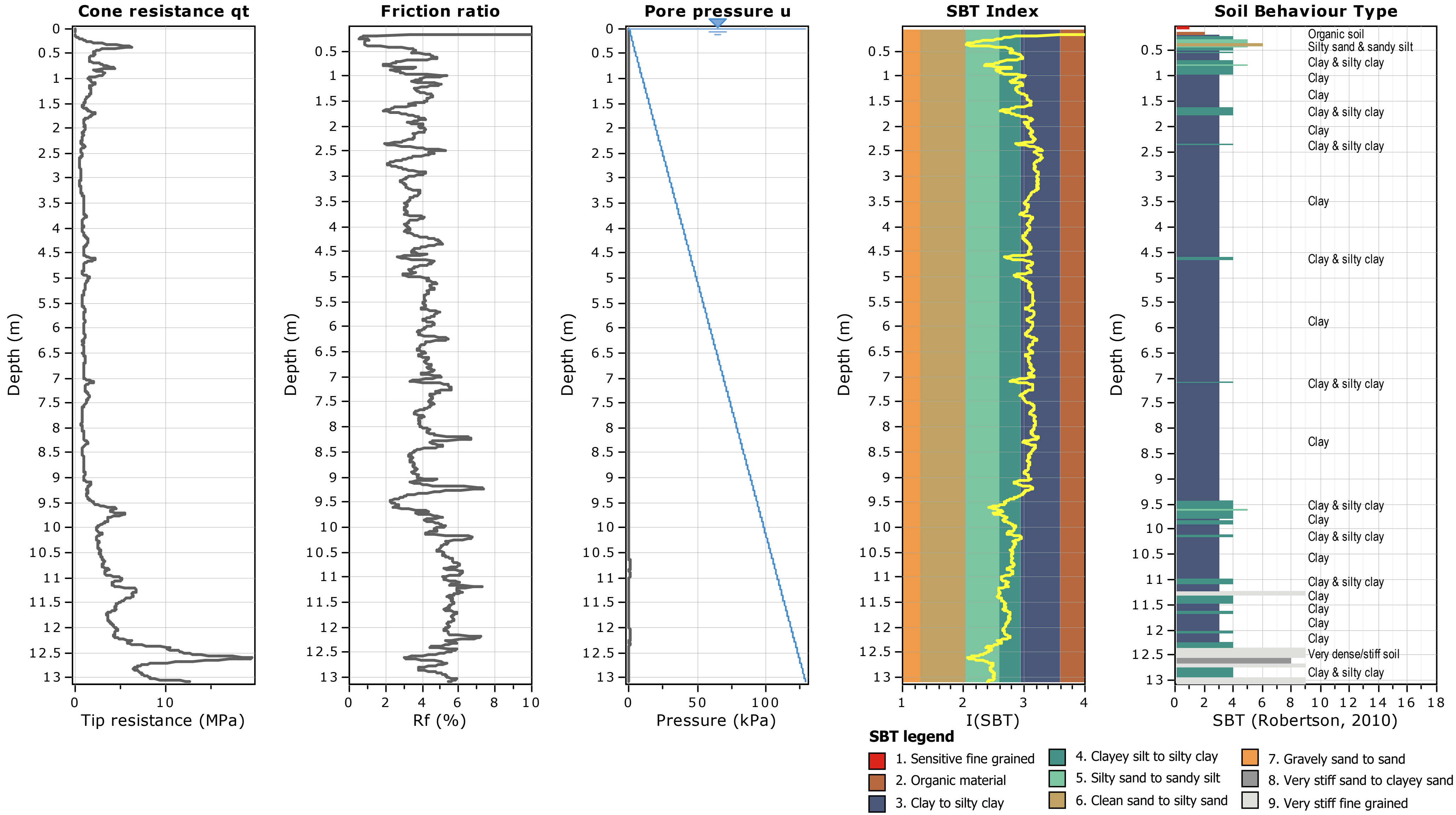
Merarhias 56
http://www.geologismiki.gr

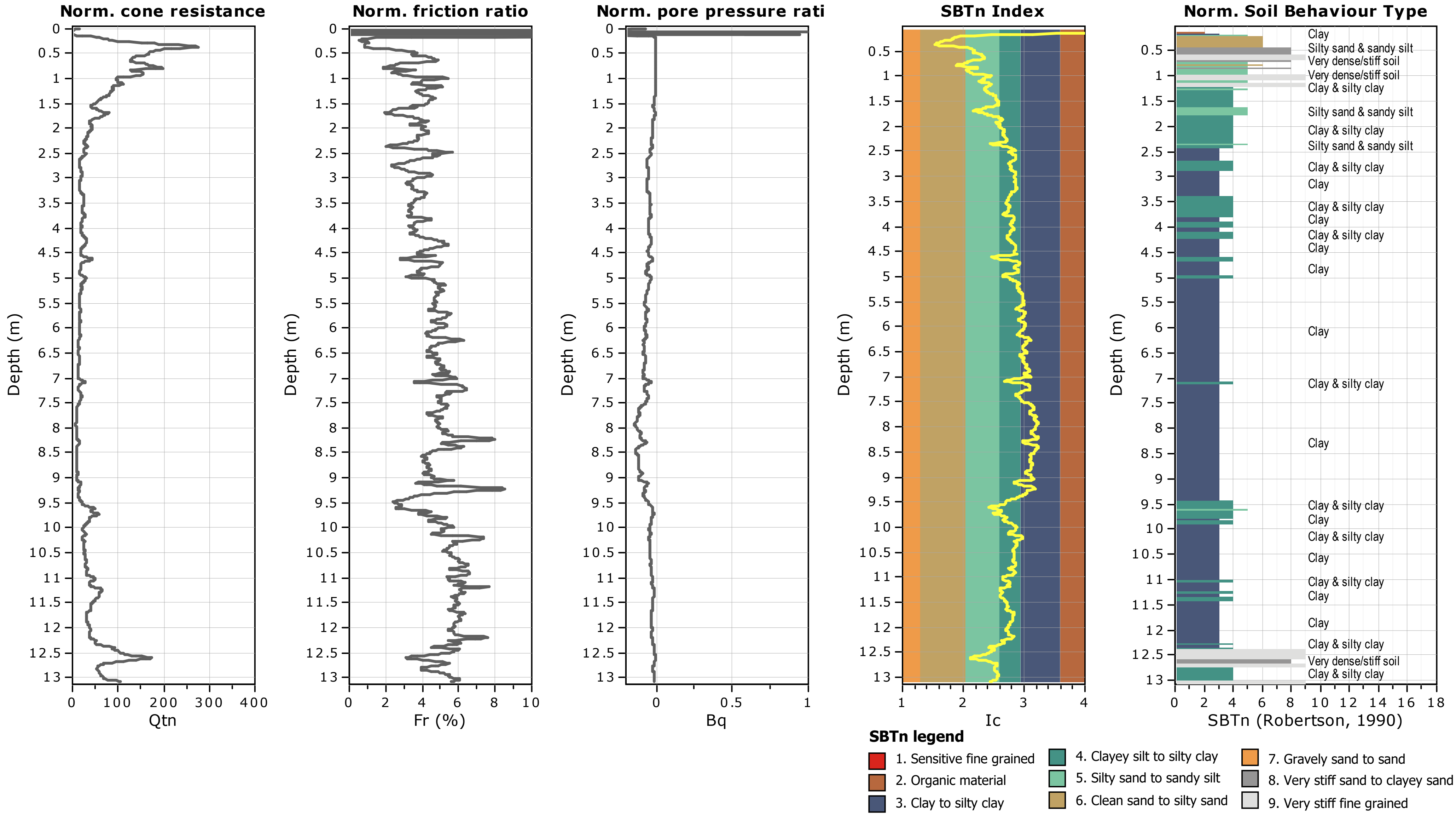
CPT: A13-CPT01
Total depth: 13.08 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



CPT: A13-CPT01
Total depth: 13.08 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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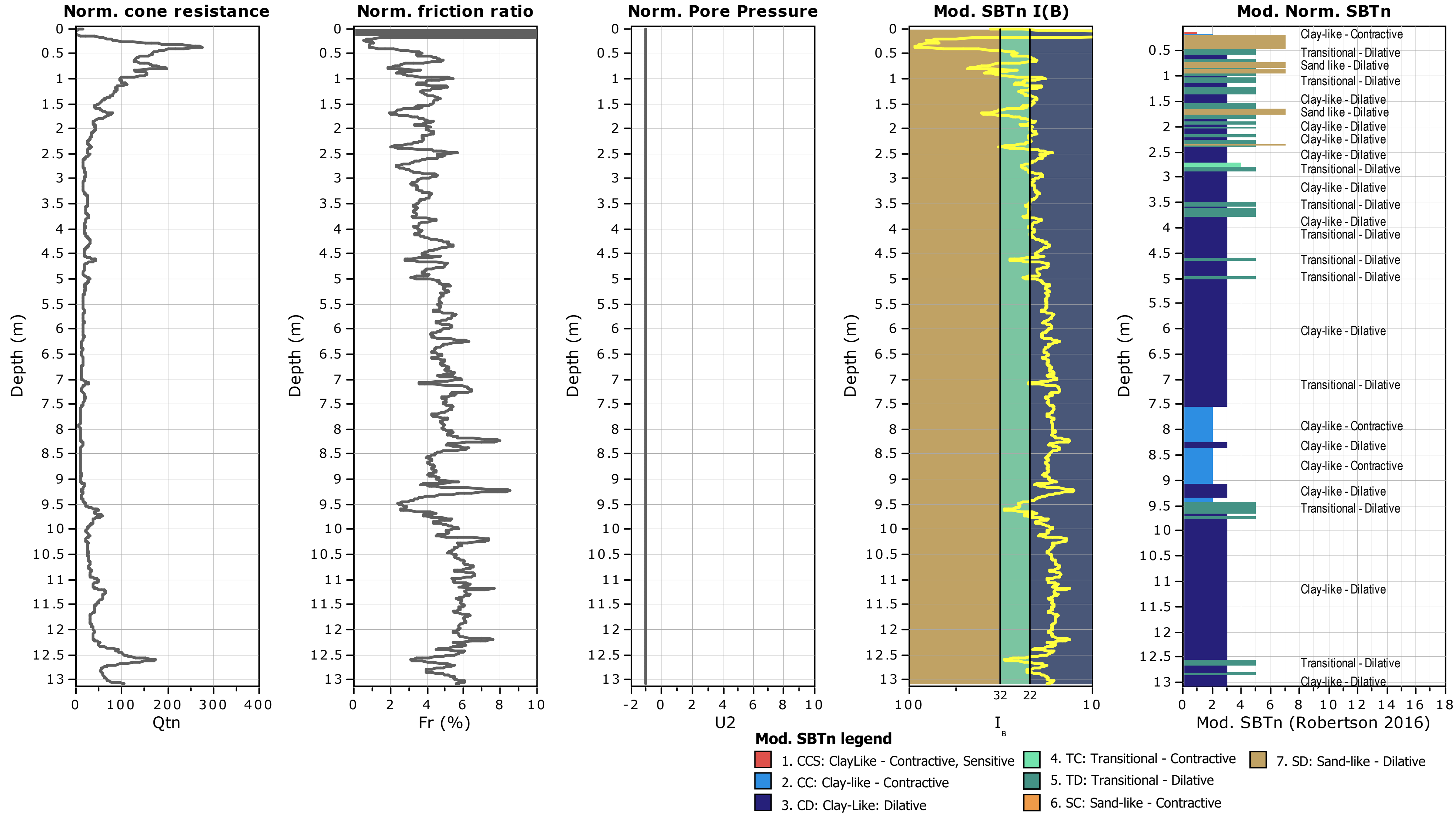
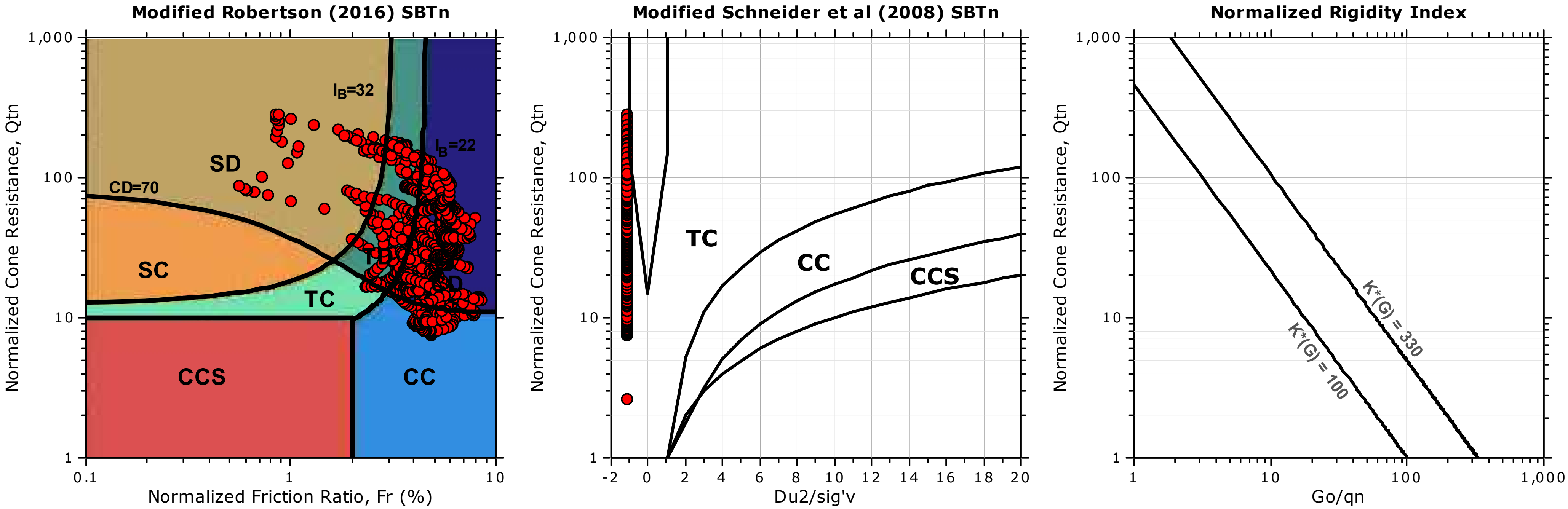
CPT: A13-CPT01
Total depth: 13.08 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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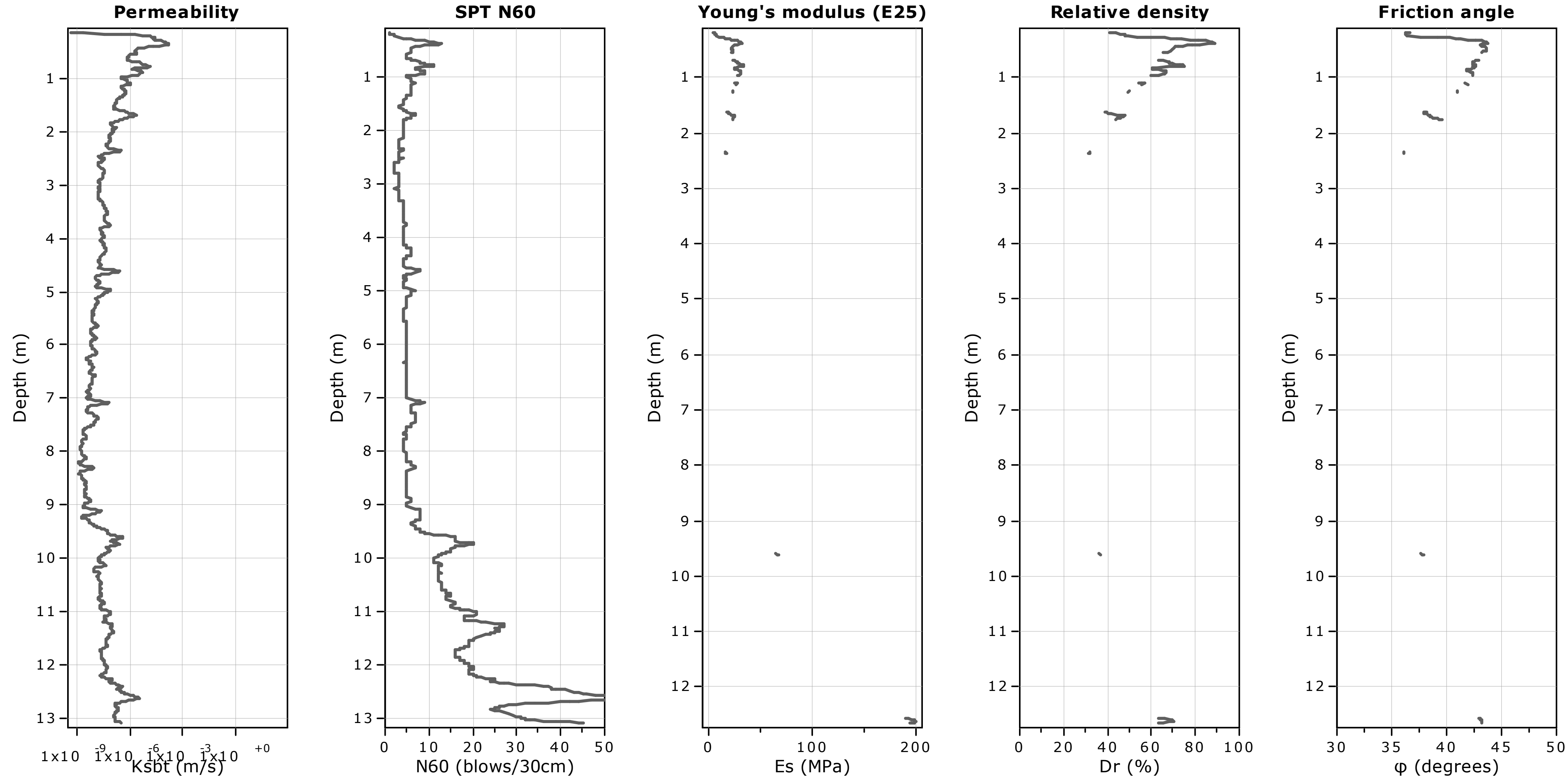
CPT: A13-CPT01
Total depth: 13.08 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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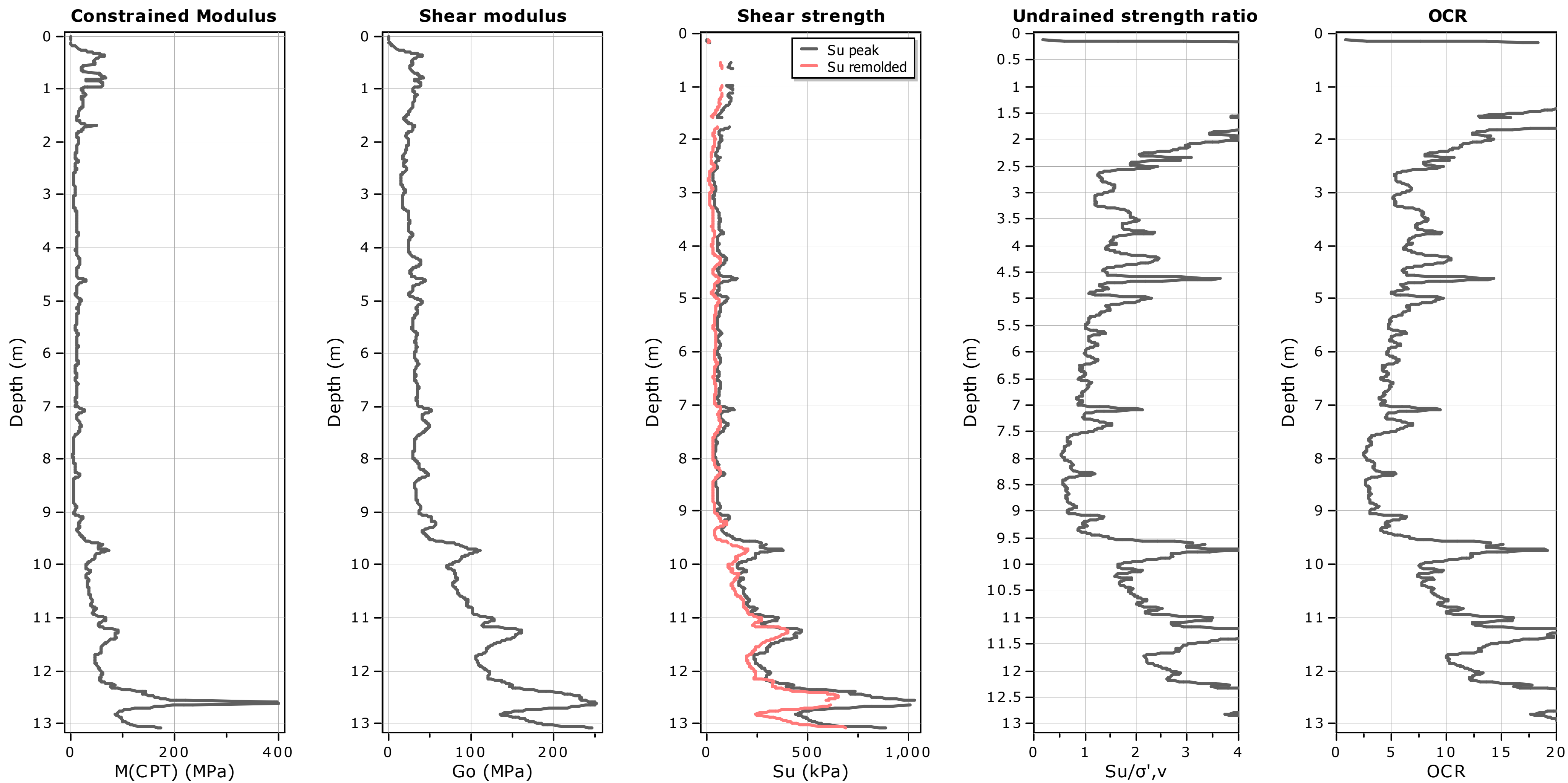
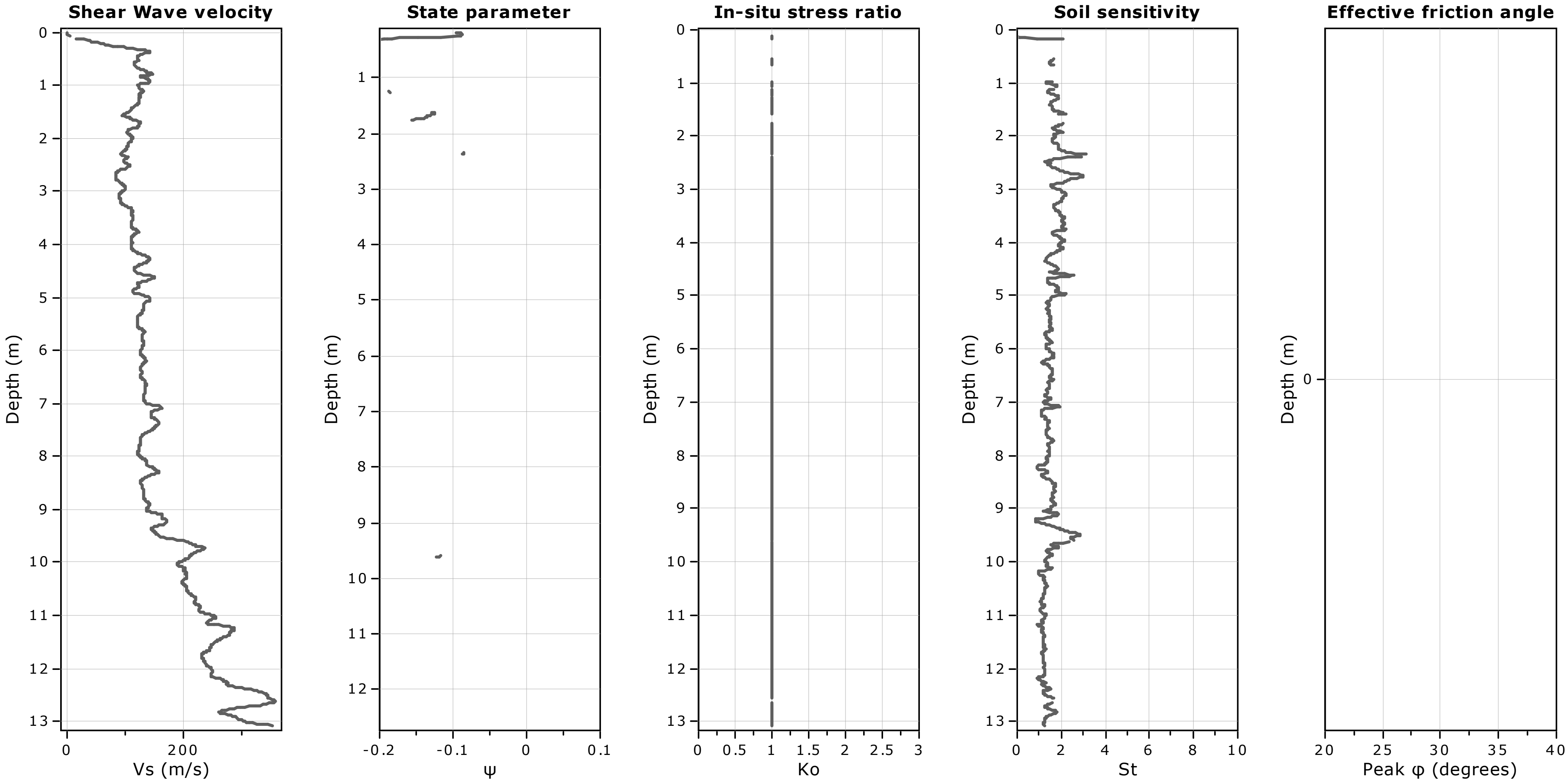
http://www.geologismiki.gr

CPT: A13-CPT01
Total depth: 13.08 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



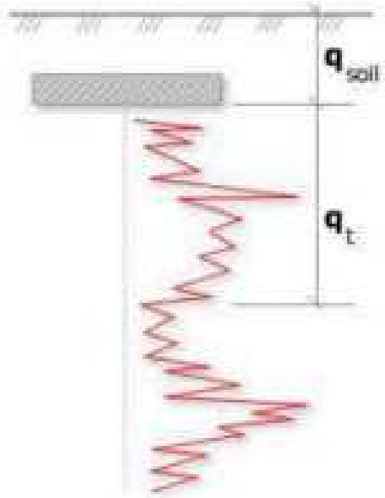
Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14
OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

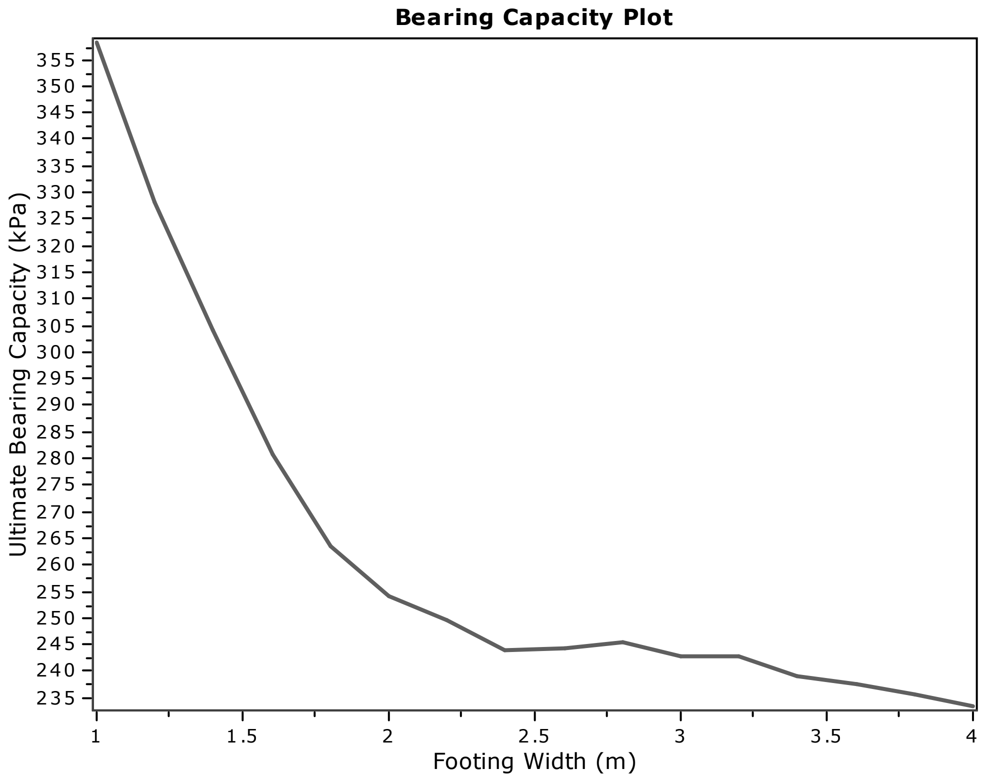
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.74	0.20	9.50	358.21
2	1.20	0.50	2.30	1.59	0.20	9.50	327.96
3	1.40	0.50	2.60	1.47	0.20	9.50	304.04
4	1.60	0.50	2.90	1.36	0.20	9.50	280.89
5	1.80	0.50	3.20	1.27	0.20	9.50	263.63
6	2.00	0.50	3.50	1.22	0.20	9.50	254.18
7	2.20	0.50	3.80	1.20	0.20	9.50	249.64
8	2.40	0.50	4.10	1.17	0.20	9.50	243.77
9	2.60	0.50	4.40	1.17	0.20	9.50	244.28
10	2.80	0.50	4.70	1.18	0.20	9.50	245.47
11	3.00	0.50	5.00	1.17	0.20	9.50	242.90
12	3.20	0.50	5.30	1.17	0.20	9.50	242.84
13	3.40	0.50	5.60	1.15	0.20	9.50	239.20
14	3.60	0.50	5.90	1.14	0.20	9.50	237.43
15	3.80	0.50	6.20	1.13	0.20	9.50	235.63
16	4.00	0.50	6.50	1.12	0.20	9.50	233.39

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

:: N_{SPT} (blows per 30 cm) ::

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

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

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

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

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

:: Relative Density, Dr (%) ::

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

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

:: State Parameter, ψ ::

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

:: Drained Friction Angle, φ (°) ::

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

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

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

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

If $I_c \geq 2.20$

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

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

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

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

:: Soil Sensitivity, S_t ::

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

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

:: Peak Friction Angle, φ' (°) ::

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

(applicable for $0.10 < B_q < 1.00$)

References

• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

Appendix B

Conceptual Geological Cross Section

From Pos: 282954.707, 986721.425
LENGEND
INFERED GOLOGICAL BOUNDARY
GROUNDWATER LEVEL
CURRENT GROUND LEVEL (LIDAR)
FILL
COLLUVIUM
COMPLETELY WEATHERED TANGIHUA COMPLEX DOLRITE
HIGHLY SHEARED POSSIBLY FAULTED TANGIHUA COMPLEX
HIGHLY WEATHEREDTANGIHUA COMPLEX DOLRITE + MUDSTONE
135 m
130 m
125 m
120 m
115 m
110 m
105 m
100 m
95 m
10 m
20 m
30 m
40 m
50 m
60 m
70 m
81 m
A13 BH01
offset 1.0m
northeast
10.0m
Slip Surface
DEEP SEATED SHEAR SURFACE
Highly sheared possibly faulted Tangihua Complex
A13 CPT01
A13 BH01
A13 CPT02
A13
0 m
10 m
30 m
50 m
70 m

Appendix C

Rainfall Data

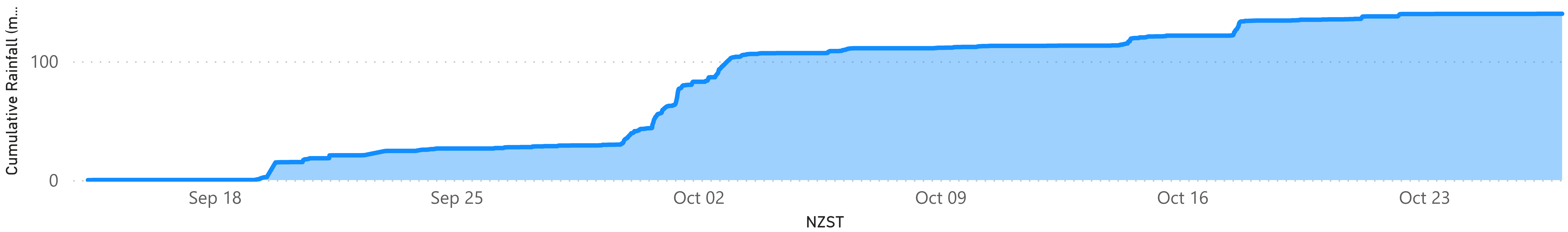
Inclinometer Data

Mangamuka Gorge

NZST

9/14/2022 10/26/2022

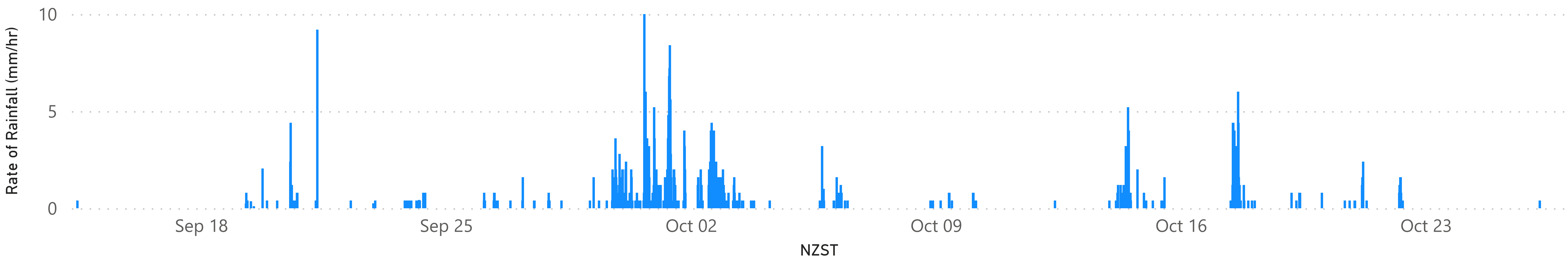
Cumulative Rainfall (mm) since 14/09/2022 by NZST



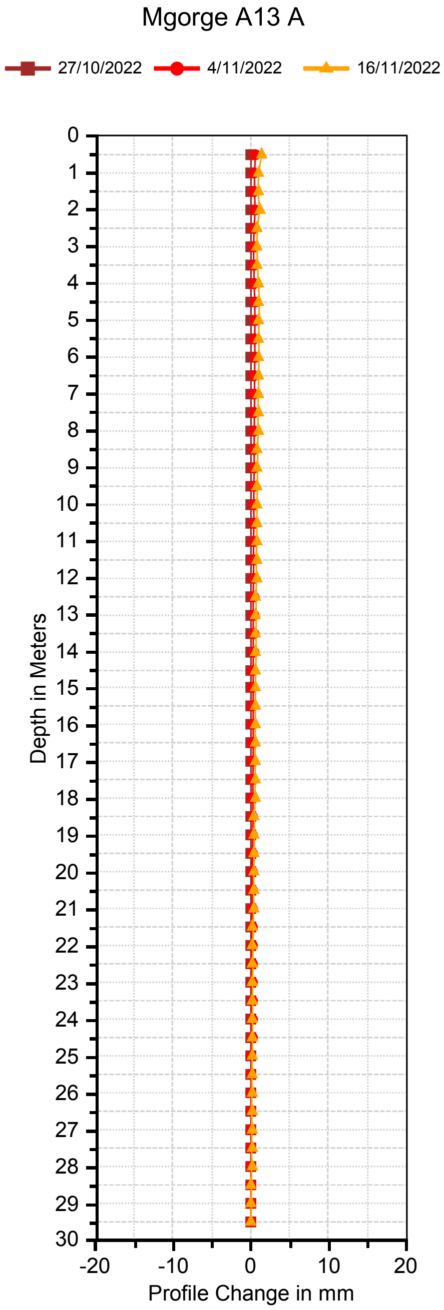
140.00

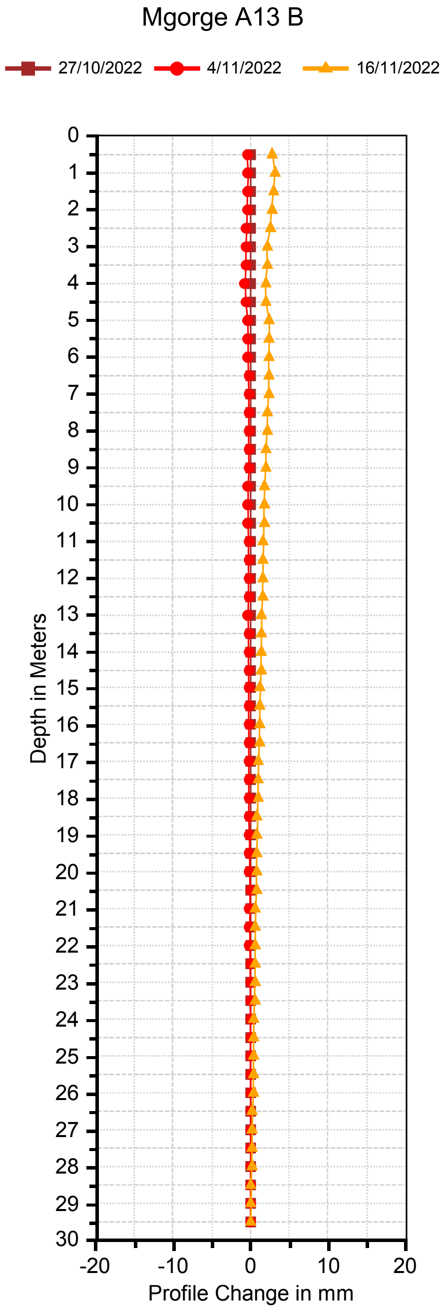
Cumulative Rainfall (mm) during sliced period

Rate of Rainfall (mm/hr) by NZST



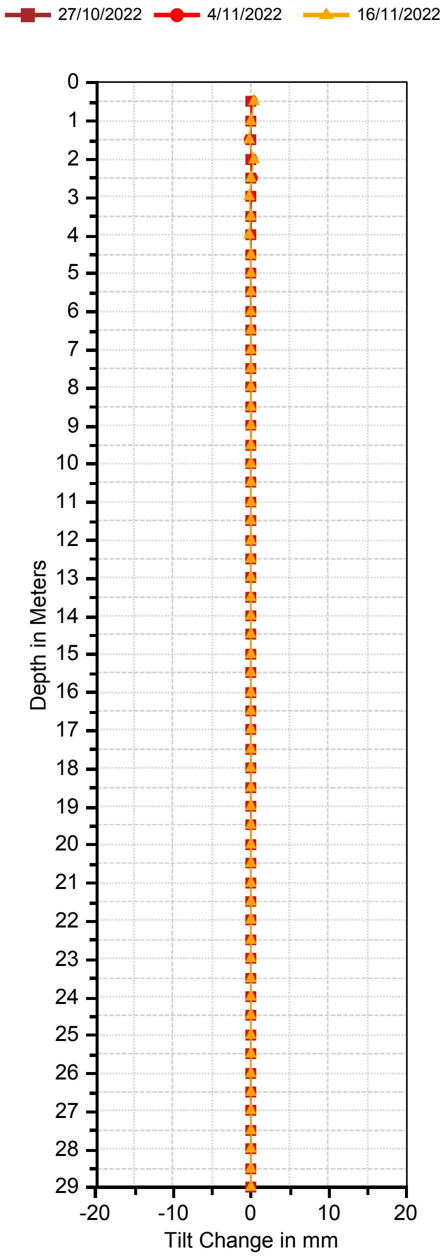
Whangarei Lab
166 Bank Street
Whangarei
Ph 09 438 4417



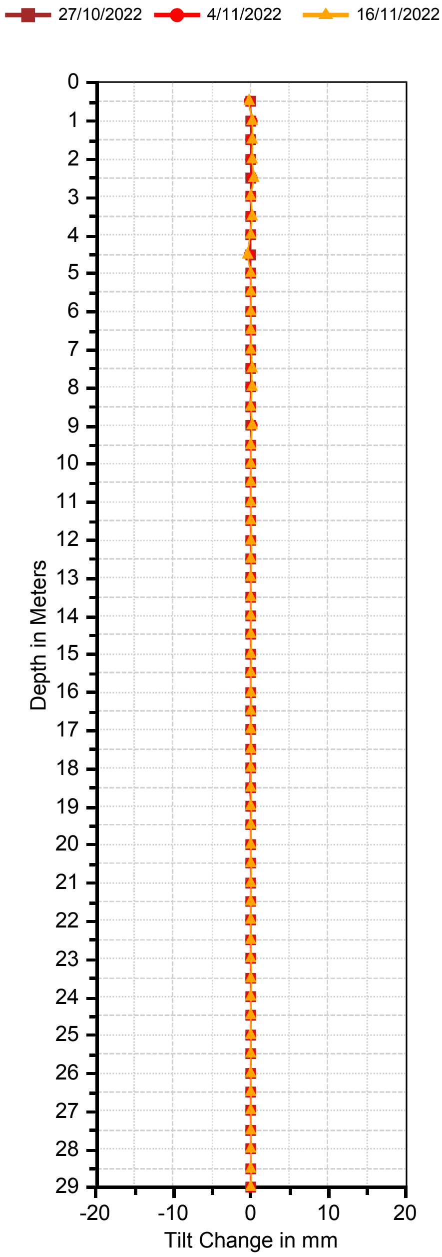


Whangarei Lab
166 Bank Street
Whangarei
Ph 09 438 4417

Mgorge A13 A



Mgorge A13 B



wsp.com/nz

Project Number: 1-11240.00

NZTA Northland Resilience and Emergency Works- August 2022- 11010/22A1 & 11011/22A2

25 November 2022

CONFIDENTIAL

Interpretive Geotechnical Investigation Report

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Reviewed by
Aaron George

Approved for release by
Shaun Grieve

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Revision	Date	Author	Reviewed by	Approved by	Status
00	23/11/2022	Matt Leggett	Aaron George	Shaun Grieve	Final

Revision Details

Revision	Details

Contents

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for New Zealand Transport Agency ('**Client**') in relation to Mangamuka Gorge Slips Emergency Works ('**Purpose**'). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

1 Introduction

Two storm events in July and August have caused widespread flooding and associated landsliding across much of Northland. Following the August rain event WSP were engaged by Waka Kotahi to form part of the emergency response and undertake an urgent geotechnical investigation along a section of State Highway (SH) 1 through Mangamuka Gorge. A total of 12 underslips have been identified requiring significant geotechnical analysis and associated permanent remedial measures.

This report covers the investigation and assessment at site 11010/22A1 & 11011/22A2 henceforth referred to as A1 & A2 and provides a recommended remedial solution for the combined sites. A1 & A2 are 25m apart and located 2km southeast of the northern extent of Mangamuka Gorge at RS119 RP 12.67, approximately 17km southeast of Kaitaia.

A deep-seated movement has occurred causing significant slumping affecting the southern road shoulder with the A2 headscarp terminating at the edge of seal. The landslide is an underslip likely caused by a material saturation resulting from the recent storm events and long-term undercutting by Victoria River near the base of the slope reducing the global stability of the hillside. The site location is shown below in Figure 1-1 together with the other slip sites.

Figure 1-1: 11011/22A2 Site location Plan

2 Regional Geology

The 1:250 000 scale QMAP seamless digital data (GNS, 2013) indicates the site area to be underlain by the Undifferentiated Tangihua Complex in Northland Allochthon comprising basalt pillow lava, with subvolcanic intrusives of basalt, dolerite and gabbro; locally incorporating siliceous mudstone. Late Pleistocene to Holocene estuary, river and swamp deposits are indicated to be present downslope associated with Victoria River] (Figure 2-1).

The Tangihua Complex has been emplaced onto New Zealand through convergent plate tectonics and sea floor sliding. As a result, the material has been historically sheared with the rock underlying the site expected to be highly fractured and degraded through original emplacement processes and further modified by weathering.

Figure 2-1: Regional geology

3 Site Investigation

Between 2rd September and 4th November 2022, a geotechnical investigation was undertaken to identify sub-surface ground conditions and to help inform the options for remedial measures required at site A1 & A2 The works comprised the following:

- A single rotary cored borehole (A2BH01) was completed to a depth of 24.0m, with standard penetration tests (SPTs) at 1.5m intervals.
- Installation of BH inclinometer upon completion of BH01.
- One washed borehole (A2BH02) drilled to a depth of 14.70m with dual groundwater piezometer installed upon completion (piezo 01 deeper & piezo 02 shallower). The screen zone for piezo 01 is between 7.40m and 14.70m depth and the screen zone for piezo 02 is between 1.00m and 6.00m depth.
- Six cone penetration tests (A1CPT01-03 & A2CPT01-03) to a maximum depth of 22.52m.
- The intrusive drilling works were undertaken by Drillforce Limited including the boreholes, CPT's as well as the installation of inclinometer tubing for monitoring ground movement and piezometers for groundwater, all under the supervision of WSP site staff.
- All the boreholes were logged in accordance with the NZGS *Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes*, December 2005 and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg. 365, Table 1. Borehole and CPT locations displayed on Figure 3-1 below with logs displayed in Appendix A.

- Tiltmeters were installed on the ground surface by WSP Research staff to obtain Realtime monitoring of surface movements.
- Monitoring of the piezometers and inclinometers was undertaken by GeoCivil Ltd under direction of WSP staff.

Figure 3-1: Exploratory hole location plan

3.1 Observations

The slip was inspected on 23rd September 2022 by WSP. The inspection identified the following:

- The total length of visible headscarp is 65m with the A1 and A2 features joining 4m downslope from the centre of the site. The height of the A2 slip is estimated to be 10m with a grade of slope approximately 1.5H:1V.
- At the time of inspection, the headscarp of the slip is located 400mm (A2) to 1m (A1) from the southbound lane. There has been up to 1m of vertical settlement immediately downslope. This is no evidence of regression and undermining the road currently.
- 100m downslope from A2 is another area of evacuation which is depositing sediment into Victoria River below. Between this feature and the failure at road level are many felled mature trees and localised scarps. If left untreated there is a high risk for partially or complete evacuation of the road.
- There is far less evidence of movement immediately downslope from A1. However, there is still a high risk of significant movement at this area of site during future storm events.

- On 1st October 2022 between 8am and 10am a heavy rainfall event occurred on site (10mm/hr) and the site crew were pulled off the hill due to immediate risk of instability. Adjacent ground exposures became spongy and fully saturated with surface water running through the road surface and upslope material. Surface monitoring pins also dropped locally.

4 Geomorphological Mapping

A terrain evaluation is presented below in Figure 4-1. Geomorphological mapping was undertaken from both Lidar and historic aerial photography as well as site walkover observations.

The site area is comprised of moderate to steep slopes of approximately 20° - 40° and includes historic slip features manifesting as large gullies extending from the slope above to the river below. A lower scarp is visible 100m below the road and it's expected that the material underlying the site and surrounding area to consist of colluvial soils transported as a result of historical movements further upslope. Victoria River is located 150m downslope from the road. A drainage channel runs approximate to the centre of the A1 & A2 headscarp and inferred historical movements surrounding the study area.

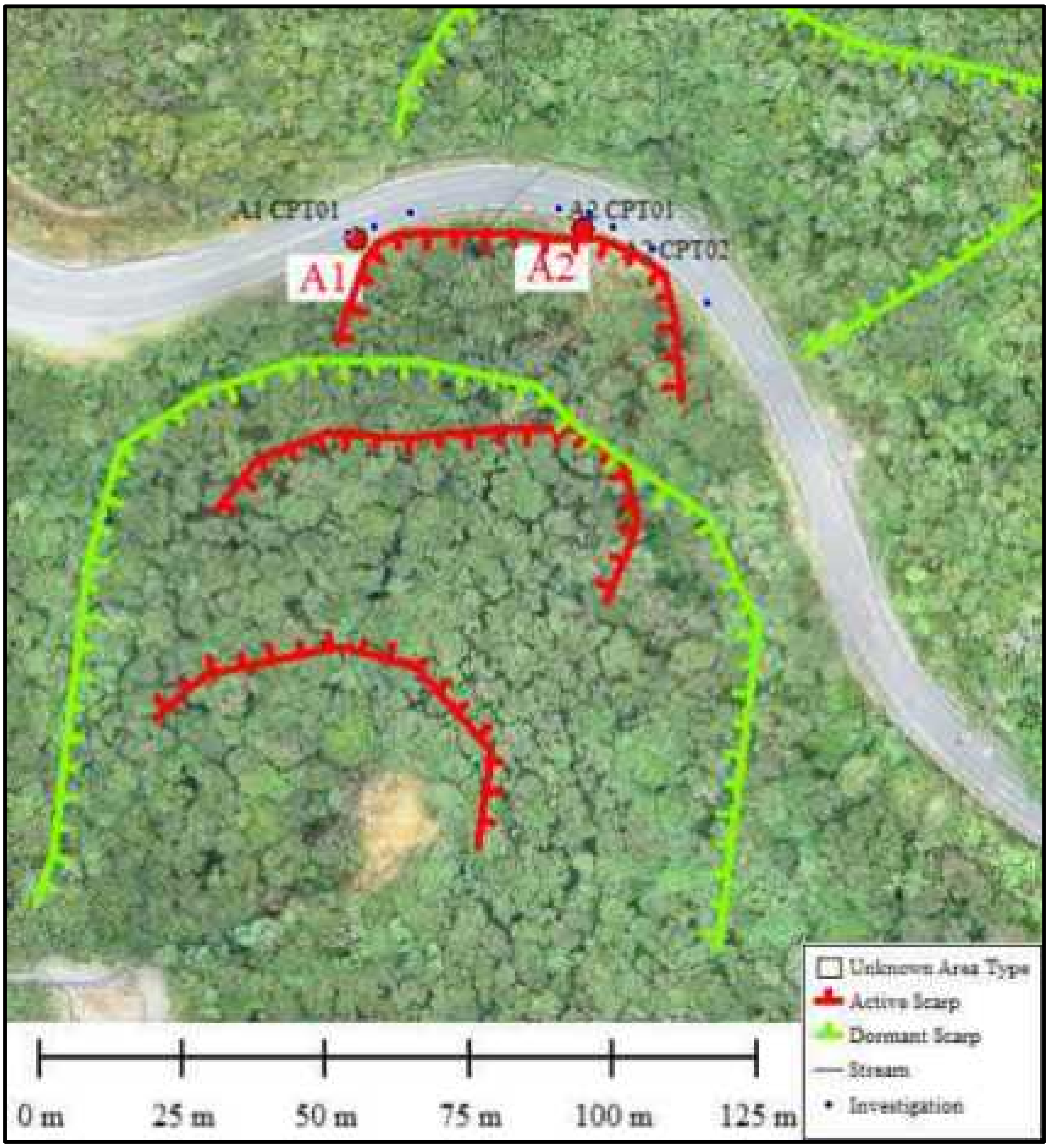


Figure 4-1: Geomorphological map

5 Ground Model

Table 5-1 below summarises the ground model for site A1 & A2. Separate ground models have been created as only CPTs have been conducted at site A1. A conceptual geological cross section for both sites is presented within Appendix B.

Table 5-1: A1 & A2 ground model

Site	Lithology	Top (mbgl)	Base (mbgl)	Total thickness (m)	SPT N Value	GSI
A1	FILL	0.00	0.80*-1.00*	0.80*-1.00*	2*-10*	-
	COLLUVIUM	0.80*-1.00*	2.90-3.80*	1.90*-3.00*	0*-5*	-
	Completely Weathered Tangihua Complex	2.90*	6.00*	3.10*	4*-13*	-
	Highly Weathered Tangihua Complex DOLERITE	3.20*-6.00*	15.40*-19.10**	12.60*-13.10*	5*-37	0-10
	MODERATELY Degraded Tangihua Complex MUDSTONE/CATACLSTIC DOLERITE (III)	15.40* - 19.10*	-	Not Proven	10-50+	20-30
A2	FILL	0.00	0.30-0.40*	0.30-0.40*	5*-45*	-
	COLLUVIUM	0.30-0.40*	2.70*4.50	2.40*-4.20	2-8*	-
	Completely Weathered Tangihua Complex	4.00*-4.50	4.95-7.00*	0.45-3.00*	5*-15*	-
	Highly Weathered Tangihua Complex DOLERITE	2.70*-4.95	15.66**	10.71	6*-50+	0-10
	MODERATELY Degraded Tangihua Complex MUDSTONE/CATACLSTIC DOLERITE (III)	15.66	21.49	5.83	39-50+	20-30
	Tangihua Complex MUDSTONE/CATACLSTIC ROCK (II)	21.49	22.06	0.57	50+	30-50
	Moderately Weathered Tangihua Complex DOLERITE	22.06	22.36		50+	30-50
	Slightly Weathered Tangihua Complex DOLERITE	22.36	-	Not Proven		50-70

* Inferred from CPT results.

** Where base proven.

5.1 Site A1 Ground Summary

All stratigraphy has been inferred from CPT information.

Fill inferred to be present from surface to 0.80m and 1.00m depth (CPT01 and CPT02).

Colluvium inferred to be present from 0.80m, extending to a maximum depth of 3.80m (CPT01), with a thickness of 3.00m. From 2.20m to 2.60m depth a spike was recorded within CPT01. This is expected to represent a boulder of intact basalt/dolerite which has migrated downslope as part of a previous movement.

Completely weathered Tangihua Complex material inferred to be present within CPT02 only between 2.90m and 6.00m, with a thickness of 3.10m. CPT Soil Behaviour Type estimated to be silty CLAY (Robertson 2010). This is consistent with completely weathered material identified with A2BH01.

CPT inferred boundaries between the Colluvium and Completely weathered bedrock are difficult to infer given the similarities in material properties. It's reasonable to expect the thicknesses of these materials to vary across the site.

Highly weathered Tangihua Complex material inferred to be present within all CPTs, encountered between 3.20m and 6.00m, with a thickness of 12.60m to 13.10m, where base of strata proven. CPT Soil Behaviour Type estimated to be stiff silty CLAY (Robertson 2010). This is consistent with highly weathered material identified with A2BH01.

Moderately Degraded Cataclastic Tangihua Complex III inferred to be present within CPT01 & CPT02, encountered at 15.40m and 19.10m respectively. It is assumed the CPTs refused within this unit. CPT Soil Behaviour Type estimated to be very stiff/very dense soil (Robertson 2010). This is consistent with moderately degraded/weathered material identified with A2BH01.

5.2 Site A2 Ground Summary

Fill was encountered from surface within BH01 and inferred to be present within all CPTs. The material is described as sandy GRAVEL of basalt, dolerite, and greywacke with minor fines, medium dense to very dense.

Colluvium was encountered at 0.30mBGL within BH01 and inferred to be present within all CPTs. The material is predominantly described as silty CLAY with trace organics and subangular to subrounded gravels of basalt, mudstone. A boulder of intact light blue BASALT was encountered between 4.20m and 5.00m within BH01. Colluvium thickness varies from 2.40m (CPT01) to 4.20m (BH01)

Completely weathered Tangihua Complex material was encountered at 4.50mBGL within BH01 and inferred to be present within CPT02, described as silty CLAY with some sand and trace gravel, firm. Material thickness varies from 0.45m (BH0T03 1) to 3.00m (CPT03).

CPT inferred boundaries between the Colluvium and Completely weathered bedrock are difficult to infer given the similarities in material properties. It's reasonable to expect the thicknesses of these materials to vary across the site.

Highly weathered to moderately weathered Tangihua Complex material was encountered at 4.95m within BH01 and inferred to be present within all CPTs, described predominantly as gravelly SAND with some zeolite and fines and occasional layers of intact rock. Material thickness where proven is 10.71m (BH01). It is assumed the CPTs refused within this unit.

Moderately Degraded Cataclastic Tangihua Complex III was encountered at 15.66mBGL within BH01 with a thickness of 5.83. Material described as cataclastic very weak MUDSTONE sheared with moderately weathered DOLERITE with zeolite alternation. Proportions of sedimentary/igneous material vary throughout this unit.

Cataclastic Tangihua Complex II Rock was encountered at 21.49mBGL within BH01 described as slightly weathered cataclastic mudstone, weak sheared with light blue grey porphyritic DOLERITE, moderately strong, zeolite alteration.

Moderately to slightly weathered Tangihua Complex was encountered at 22.06mBGL within BH01 described as light brown to light blue grey porphyritic DOLERITE, moderately strong to strong, zeolite alternation. The base of thick strata was not proven.

Three groundwater monitoring visits have been carried out so far between 27th October and 18th November 2022. Results summarised below in Table 5-2. A shallow perched water table is located within the Colluvium with a deeper water table near the highly weathered/moderately weathered rock interface.

Table 5-2: Groundwater monitoring results

BH	Date	Piezo 1- depth to GW (mbgl)	Lithology	Piezo 2- depth to GW (mbgl)	Lithology
	27/10/22	13.12		2.18	
BHA2-2	4/11/22	13.11	HW to MW Tangihua Complex	2.05	Colluvium
	18/11/22	12.56		2.43	

5.3 Instrumentation Summary

5.3.1 Site A1

Tilt sensor and rainfall gauge data is presented within Appendix C, collected from 3rd November 2022. Tilt sensor positions shown below on Figure 5-1.

Figure 5-1: A1 tilt sensor positioning

Mangamuka gorge experienced up to 122mm/hr of rainfall between 7am 22/11/22 and 6pm 22/11/22, resulting in the following movements at MA tilt sensor:

- -0.35° MA Tilt 20 X Axis
- 0.32° MA Tilt 20 Z Axis

The resultant trajectory has been estimated to show minor settlement and movement downslope.

This is located near the centre of site approximate to A1-CPT2. Movement is expected to have occurred through fill or colluvial material close to the surface and may correspond to movement deeper in the ground.

No further significant movement has been identified to date, with trends generally displaying cyclic changes in temperature affecting instrumentation hardware.

5.3.2 Site A2

Tilt sensor and rainfall gauge data is presented within Appendix C, collected from 3rd November 2022. Tilt sensor positions shown below on Figure 5-2.

Figure 5-2: A2 tilt sensor positioning

Mangamuka gorge experienced up to 12mm/hr of rainfall between 7am 22/11/22 and 6pm 22/11/22, resulting in the following movements at MA tilt sensor:

- -0.52° MA Tilt 27 X Axis
- 0.23° MA Tilt 20 Z Axis

The resultant trajectory has been estimated to show minor settlement and movement downslope.

This is located near the centre of site approximate to A2-BH01. Movement is expected to have occurred through fill or colluvial material close to the surface and may correspond to movement deeper in the ground. Movement mechanism and timing coincides with that shown in section 5.3.1 above.

The sensor has been offline since 1st November 2022 due to water damage and will be replaced shortly. No further significant movement was identified to date, with trends generally displaying cyclic changes in temperature that affect the instrument hardware.

At completion of BH01, an inclinometer was installed on site to a depth of 23m. 3no. monitoring visits have been completed so far between 28/10/22 and 18/11/22. Results are presented within Appendix C.

No movement has been identified within the inclinometer to date, consistent with there being no current deformation on the road. Inclinometer monitoring visits are to continue in the coming weeks.

6 Conclusions and Recommendations

6.1 Conclusions

- An underslip has occurred at site A1 & A2. The headscarp extends across the two sites with slumping up to 1m visible at the edge of road seal.
- The depth of the failure surface is currently unknown with no movements identified to date within the inclinometer. Despite this, there is an immediate risk of partial or complete evacuation of the road following the next significant rainfall event given the features observed downslope and close proximity of the headscarp to the road.

6.2 Recommendations

Based on the available geotechnical information it is conceptually recommended a cantilever soldier pile wall is constructed at A1 & A2 slip site, consisting of 310mm 97kg/m UC H-piles socketed within competent bedrock. Piles to be formed within 600mm dia. Bored holes. Lagging to be concrete. This conceptual recommendation is subject to detailed design to be undertaken at a later stage.

Further information will be provided within October 2022 Storm Response Options Update- Memo no.2 including discounted solutions.

7 Limitation

This report has been prepared for the benefit of Waka Kotahi (NZTA) only and is based on limited site investigation and visual inspection only. Given the complex geological setting, changes in ground condition are likely to occur across the site that differ from those summarised within this report.

Appendix A

Borehole Logs
CPT Report

Borehole No. BH22A2-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279249 E 988592 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	24 m
Project No.:	1-11244.00	*R.L.:*	163.59 m	*Inclination:*	Vertical
Location:	Slip 22A2 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m)	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK WEATHERING	DEFECTS / NOTES / OTHER TESTS
FILL	ASPHALT.						
FILL	Sandy GRAVEL with minor fines, light brown grey, compacted, very dense. Sand is fine to coarse. Gravel is angular to subrounded fine to coarse basalt, greywacke, sandstone. 0.25-0.30m - layer of uncompacted sandy GRAVEL, dark grey.						
COLLUVIUM	Silty CLAY with trace organics and gravels of subrounded fine highly weathered basalt, light orange brown mottled black, firm, moist highly plastic.		1				
COLLUVIUM	Silty CLAY with trace organics and gravels of subrounded fine highly weathered basalt, light red brown, firm, moist highly plastic.	162					
COLLUVIUM	Silty CLAY with trace organics and gravels of subrounded fine highly weathered basalt, light orange brown mottled black, firm, moist highly plastic.			6	1// 1/2/1/2		
COLLUVIUM	CORE LOSS 1.95m - 2.71m. Fines washed during drilling		2				
COLLUVIUM	Silty CLAY with some fine subangular to rounded gravels of highly weathered basalt + mudstone, light brown mottled light grey, soft, moist to wet.		3				
COLLUVIUM	Gravelly CLAY, light orange brown mottled dark brown. Gravel is subangular to subrounded fine to coarse highly weathered to moderately weathered basalt, mudstone, soft to firm, moist.	160	4	2	1// 0/1/1/0		
COLLUVIUM	Boulder of moderately weathered light blue grey BASALT, strong. Recovered as fine to coarse GRAVEL.						
TANGIHUA COMPLEX	Silty CLAY with some sand and trace gravel, light brown mottled yellow brown, black, firm, moist, iron staining. [Completely Weathered]			6	3// 1/2/2/1	CW	
TANGIHUA COMPLEX	Highly weathered light orange brown mottled yellow grey, black DOLERITE, sheared. Weathered to sandy SILT with some fine to medium extremely weak clasts, zeolite, iron staining.	158	5 6	15	4// 2/3/4/6	HW	
TANGIHUA COMPLEX	Highly weathered light orange brown mottled yellow grey, black DOLERITE, sheared. Weathered to gravelly SAND with some silt. Gravel is subangular fine to medium extremely weak zeolite, iron staining.	156	7	10	3// 3/2/2/3	HW	
TANGIHUA COMPLEX	CORE LOSS 7.95m - 8.09m.		8				
TANGIHUA COMPLEX	Highly weathered light orange brown mottled yellow grey, black DOLERITE, sheared. Weathered to gravelly SAND with some silt. Gravel is subangular fine to medium extremely weak zeolite, iron staining.					HW	8.34m - J, 88°, SM, UN, VN, clay veneer (<1mm) 8.37m - J, 72°, SM, UN, VN 8.44m - SHZ
TANGIHUA COMPLEX	Moderately weathered light blue grey to light orange brown DOLERITE, weak, sheared. Recovered as gravel with trace clay, zeolite veining, iron staining. Fines likely washed out during drilling.		9			MW	8.88m - J, 74°, SM, UN, N
TANGIHUA COMPLEX	Highly weathered light orange brown mottled yellow grey, black DOLERITE, sheared. Weathered to gravelly SAND with some silt. Gravel is subangular fine to medium extremely weak zeolite, iron staining.	154		13	8// 2/4/3/4	HW	
TANGIHUA COMPLEX	CORE LOSS 9.45m - 9.68m.					HW	

CORE

SAMPLE TYPE	TCR (%)
DT	100
HQ	100
HQ	100
SPT	78
HQ	28
SPT	69
HQ	89
HQ	100
HQ	67
SPT	100
HQ	100
SPT	100
HQ	100
SPT	89
HQ	63
HQ	89
SPT	60
HQ	58

DRILLING METHOD: HQ Size, Triple Tube, Wireline Rotary Coring

Column headings: GEOLOGY; MAIN DESCRIPTION / DETAIL DESCRIPTION; R.L. (m); DEPTH (m); GRAPHIC LOG; TESTS: SPT 'N' VALUE, SPT BLOW COUNTS OR SHEAR VALUE; ROCK STRENGTH; ROCK WEATHERING; ROCK DEFECT SPACING; DEFECT DIP (degrees 0 90); DEFECTS / NOTES / OTHER TESTS; CORE: SAMPLE TYPE, TCR (%), RQD (%); DRILLING: DRILLING METHOD, CASING, BASE OF HOLE & WATER LEVEL; INSTALLATION DETAILS

Notes:
Borehole located within northbound lane approximately 3m from headscarp. Borehole terminated within SW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	29/09/2022	*Finished:*	2/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	ML	*Checked by:*	AG

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A2-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279249 E 988592 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	163.59 m
Location:	Slip 22A2 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000

Depth: 24 m
Inclination: Vertical

GEOLOGY: TANGIHUA COMPLEX

Depth (m)	Main description / detail description	SPT 'N' value	SPT blow counts	Rock strength	Rock weathering	Rock defect spacing	Sample type	TCR (%)	RQD (%)
to 10.10	Highly weathered light blue grey to light orange brown DOLERITE, weak, sheared. Recovered as gravel with trace clay, zeolite veining, iron staining. Fines likely washed out during drilling.*(continued)*						HQ	29	
10.10 - 10.50	CORE LOSS 10.10m - 10.50m.						HQ	0	
10.50 - 11.80	Highly weathered light orange brown mottled light yellow grey DOLERITE, sheared. Weathered to gravelly SILT with some fine to coarse sand. Gravel is angular to subangular fine to medium extremely weak.	11	7// 3/2/3/3		HW		SPT / HQ / HQ	76 / 100 / 100	
11.80 - 11.96	CORE LOSS 11.80m - 11.96m.						HQ	50	
11.96 - 12.50	Slightly weathered to moderately weathered light blue grey stained orange brown DOLERITE, moderately strong. Recovered as angular to subangular fine to coarse gravel.	N=50+	26// 23/27	MS	SW		SPT	100	
12.50 - 13.45	Moderately weathered to highly weathered light brown mottled light blue grey, light yellow grey DOLERITE, weak, moderately sheared, zeolite veining.			VW	MW		HQ	100	25
13.45 - 14.15	Highly weathered light orange brown mottled light yellow grey DOLERITE, very weak highly sheared, zeolite veining, iron staining.	N=50+	44// 20/20/10 for 40mm	VW	HW		SC		
14.15 - 14.50	Highly weathered light orange brown mottled light yellow grey DOLERITE, sheared. Weathered to clayey SILT with some basalt clasts. Zone of concentrated zeolite.			VW	HW		HQ	100	
14.50 - 15.65	Highly weathered light orange brown mottled light yellow grey DOLERITE, very weak highly sheared, zeolite veining, iron staining.	N=50+	14// 12/13/14/11 for 60mm	VW	HW		SPT	100	
15.65 - 18.05	Moderately weathered light brown cataclastic DOLERITE (70%) sheared with dark red brown MUDSTONE (30%), very weak, zeolite veining.	N=50+	20// 12/10/20/2 for 15mm	VW	MW		HQ / SPT / HQ / HQ	66 / 100 / 81 / 100	
18.05 - 18.45	Moderately degraded cataclastic dark red brown MUDSTONE (80%) sheared with moderately weathered light brown DOLERITE (20%). Very weak, zeolite veining.	39	11// 5/10/11/13	EW	MW		SPT	100	
18.45 - 19.15	Moderately weathered light brown cataclastic DOLERITE (85%) sheared with dark red brown MUDSTONE (15%), Very weak, zeolite veining.			VW	MW	MW	HQ	100	
19.15 - 19.50	Moderately degraded cataclastic dark red brown MUDSTONE, very weak, absence of zeolite veining.			VW	MW	MW			
19.50 - 20.00	Moderately weathered light brown cataclastic DOLERITE (85%) sheared with dark red brown MUDSTONE (15%), very weak, zeolite veining.	N=50+	33	VW	MW	MW	SC / HQ	100	

R.L. (m) markers: 11 m depth; 152; 12; 13; 150; 14; 15; 148; 16; 17; 146; 18; 19; 144

Defect dip: J81, J22, J40, J55, J86, J69, J15, J73, J70, J74, J48

DEFECTS / NOTES / OTHER TESTS

12.39m - J, 81°, SM, PL, N
12.56m - J, 22°, SM, PL, T
12.85m - J, 40°, SM, PL, N
13.11m - J, 55°, SM, PL, VN
13.13m - J, 86°, SM, UN, VN
13.23m - J, 69°, SM, PL, VN
13.36m - J, 15°, SM, PL, VN
15.82m - J, 73°, SM, PL, VN
18.72m - J, 70°, SM, PL, VN
18.93m - J, 74°, SM, PL, VN
SPT:Non-standard, bouncing.
19.67m - J, 48°, SM, PL, VN

Drilling method: HQ Size, Triple Tube, Wireline Rotary Coring

Base of hole & water level: SWL 4.80m 1/10

Notes:
Borehole located within northbound lane approximately 3m from headscarp. Borehole terminated within SW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	29/09/2022	*Finished:*	2/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	ML	*Checked by:*	AG

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A2-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279249 E 988592 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	163.59 m
Location:	Slip 22A2 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000

Depth: 24 m
Inclination: Vertical

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD	BASE OF HOLE & WATER LEVEL
TANGIHUA COMPLEX	Moderately degraded cataclastic dark red brown MUDSTONE (75%) sheared with moderately weathered light brown DOLERITE (25%), very weak, trace zeolite veining.*(continued)*											HQ Size, Triple Tube, Wireline Rotary Coring	SWL 4.60m 2/10
	Moderately weathered light brown cataclastic DOLERITE (90%) sheared with dark red brown MUDSTONE (10%), very weak, zeolite veining.	21	N=50+	50	VW	MW	MW	20.52m - J, 76°, SM, UN, VN 20.64m - J, 78°, SM, UN, VN 20.98m - J, 15°, SM, PL, N SPT:Non-standard, bouncing. 21.32m - J, 43°, SM, PL, N	HQ SC	100			
	Slightly weathered weathered cataclastic dark red brown MUDSTONE (80%), weak sheared with light blue grey porphyritic DOLERITE (20%), moderaretely strong, zeolite veining.	22			W	SW	MW	21.48m - J, 34°, SM, PL, VN 21.96m - SHZ	HQ	100	66		
	Moderately weathered light brown DOLERITE, weak, zeolite veining				W	MW	MW	22.07m - J, 72°, SM, PL, N					
	Slightly weathered light blue grey DOLERITE, strong, relict shearing with zeolite.	23			S	SW	MW	22.64m - J, 48°, SM, PL, N 22.86m - J, 15°, SM, UN, N, limonite stained 23.00m - J, 75°, SM, PL, VN 23.38m - J, 55°, SM, PL, N 23.52m - J, 20°, SM, PL, N, limonite stained	HQ	100	65		
	END OF BOREHOLE AT 24m - Target Criteria Achieved	24											

R.L. (m): 142, 140, 138, 136, 134
Depth (m) scale: 21, 22, 23, 24, 25, 26, 27, 28, 29

Defect dip (degrees 0–90): J76, J78, J15, J43, J34, J72, J48, J15, J75, J55, J20

Notes:
Borehole located within northbound lane approximately 3m from headscarp. Borehole terminated within SW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	29/09/2022	*Finished:*	2/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	ML	*Checked by:*	AG

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A2-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279249 E 988592 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	24 m
Project No.:	1-11244.00	*R.L.:*	163.59 m	*Inclination:*	Vertical
Location:	Slip 22A2 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Notes:
Borehole located within northbound lane approximately 3m from headscarp. Borehole terminated within SW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	29/09/2022	*Finished:*	2/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	ML	*Checked by:*	AG

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A2-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279249 E 988592 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	24 m
Project No.:	1-11244.00	*R.L.:*	163.59 m	*Inclination:*	Vertical
Location:	Slip 22A2 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Notes:
Borehole located within northbound lane approximately 3m from headscarp. Borehole terminated within SW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	29/09/2022	*Finished:*	2/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	ML	*Checked by:*	AG

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279249 E 988592 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	24 m
Project No.:	1-11244.00	*R.L.:*	163.59 m	*Inclination:*	Vertical
Location:	Slip 22A2 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Notes:
Borehole located within northbound lane approximately 3m from headscarp. Borehole terminated within SW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	29/09/2022	*Finished:*	2/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	ML	*Checked by:*	AG

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A2-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279249 E 988592 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	24 m
Project No.:	1-11244.00	*R.L.:*	163.59 m	*Inclination:*	Vertical
Location:	Slip 22A2 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

PHOTOGRAPHS

Notes:

Borehole located within northbound lane approximately 3m from headscarp. Borehole terminated within SW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	29/09/2022	*Finished:*	2/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	ML	*Checked by:*	AG

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A2-1

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	279249 E 988592 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	24 m
Project No.:	1-11244.00	*R.L.:*	163.59 m	*Inclination:*	Vertical
Location:	Slip 22A2 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000		

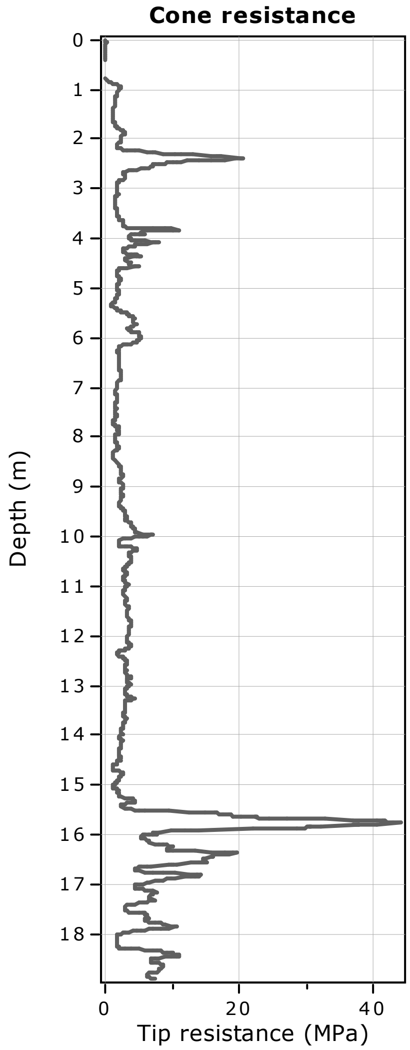
PHOTOGRAPHS

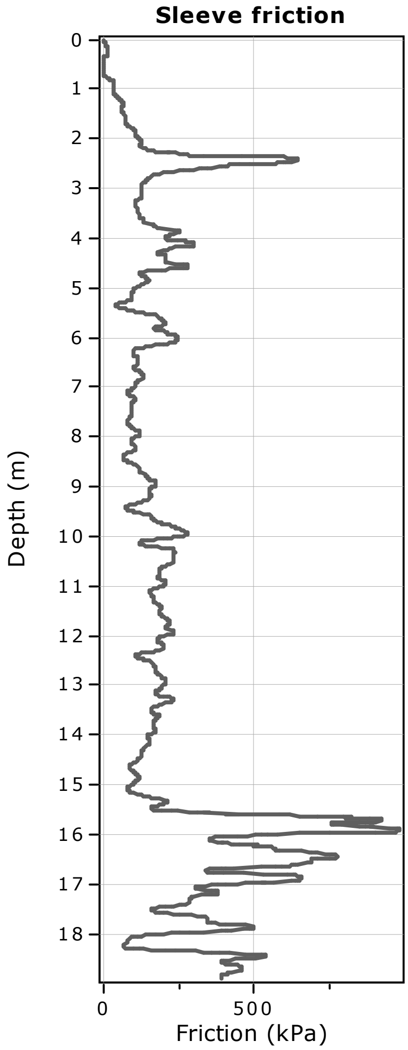
Notes:
Borehole located within northbound lane approximately 3m from headscarp. Borehole terminated within SW Dolerite. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

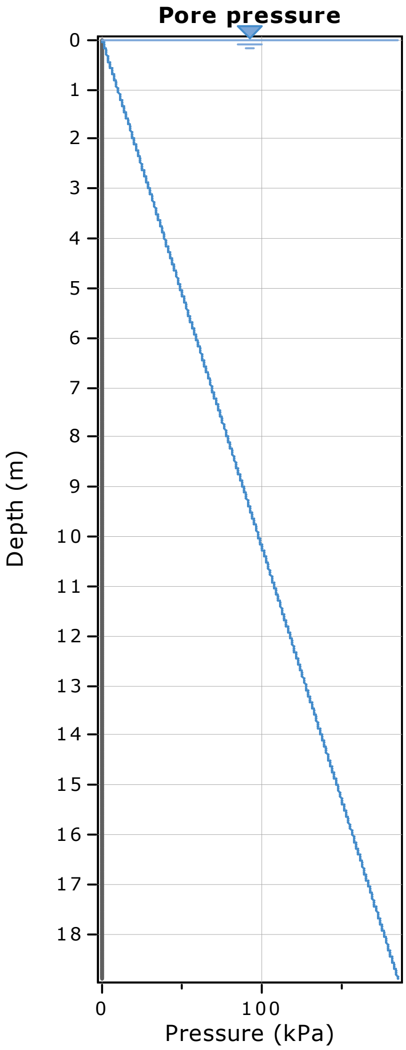
Started:	29/09/2022	*Finished:*	2/10/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	ML	*Checked by:*	AG

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

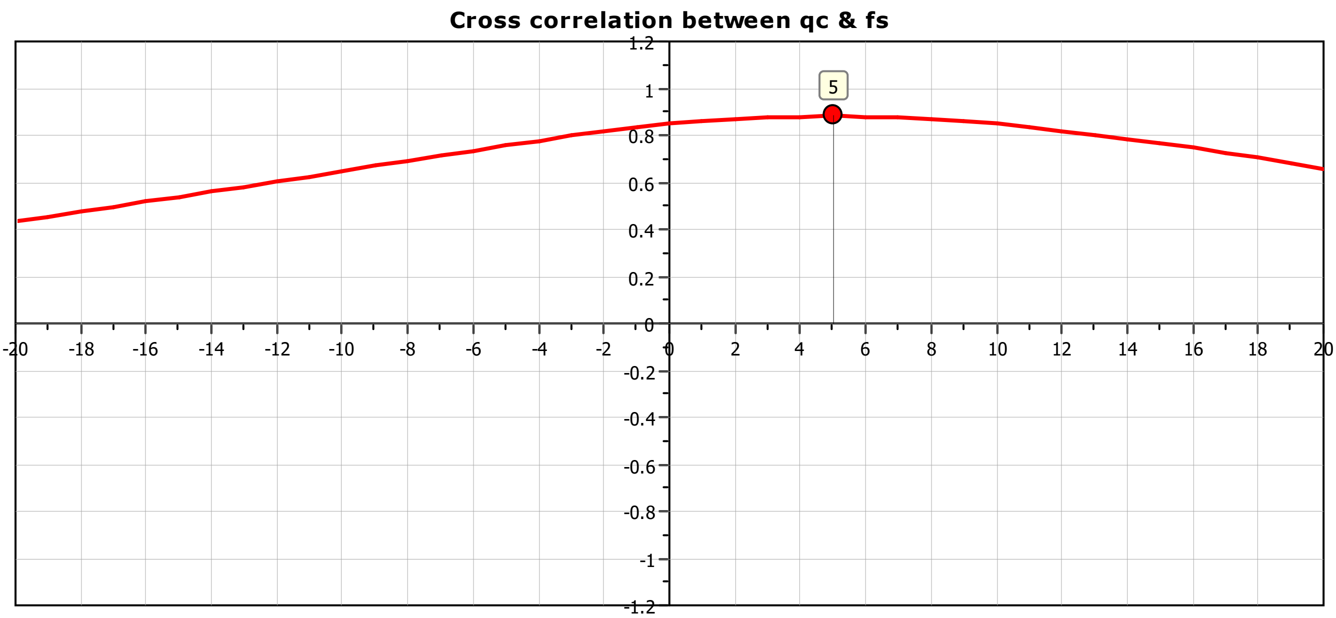
Scale 1:50 @ A4



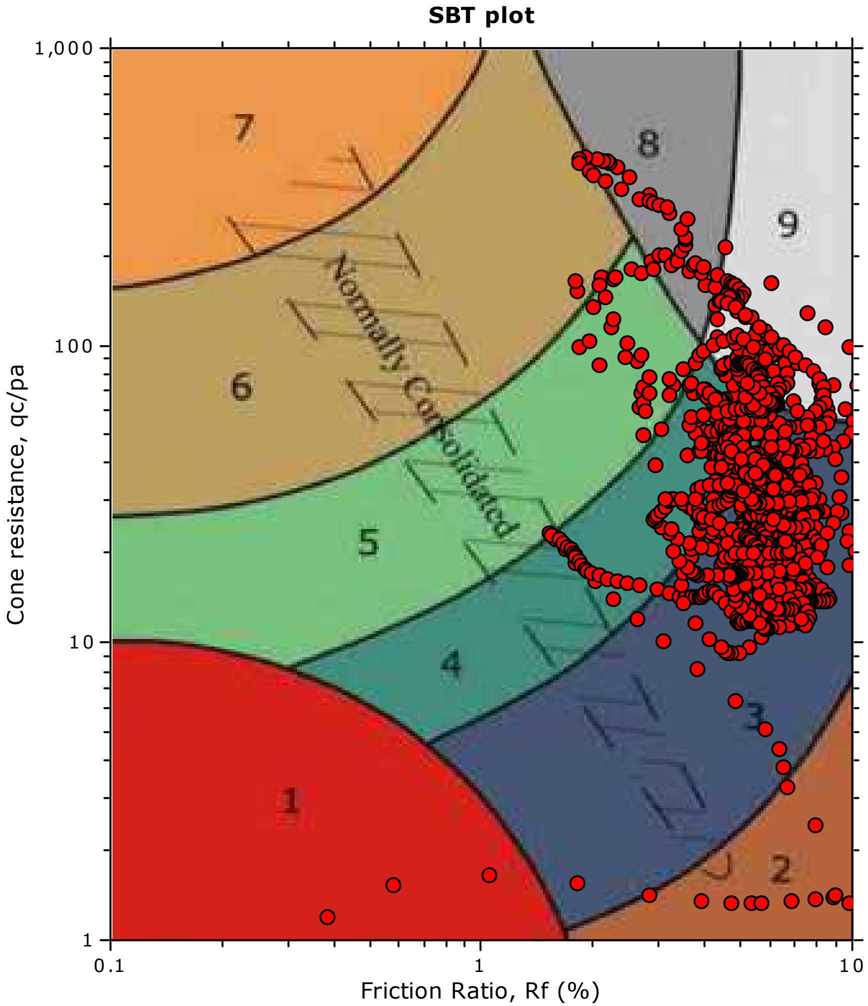


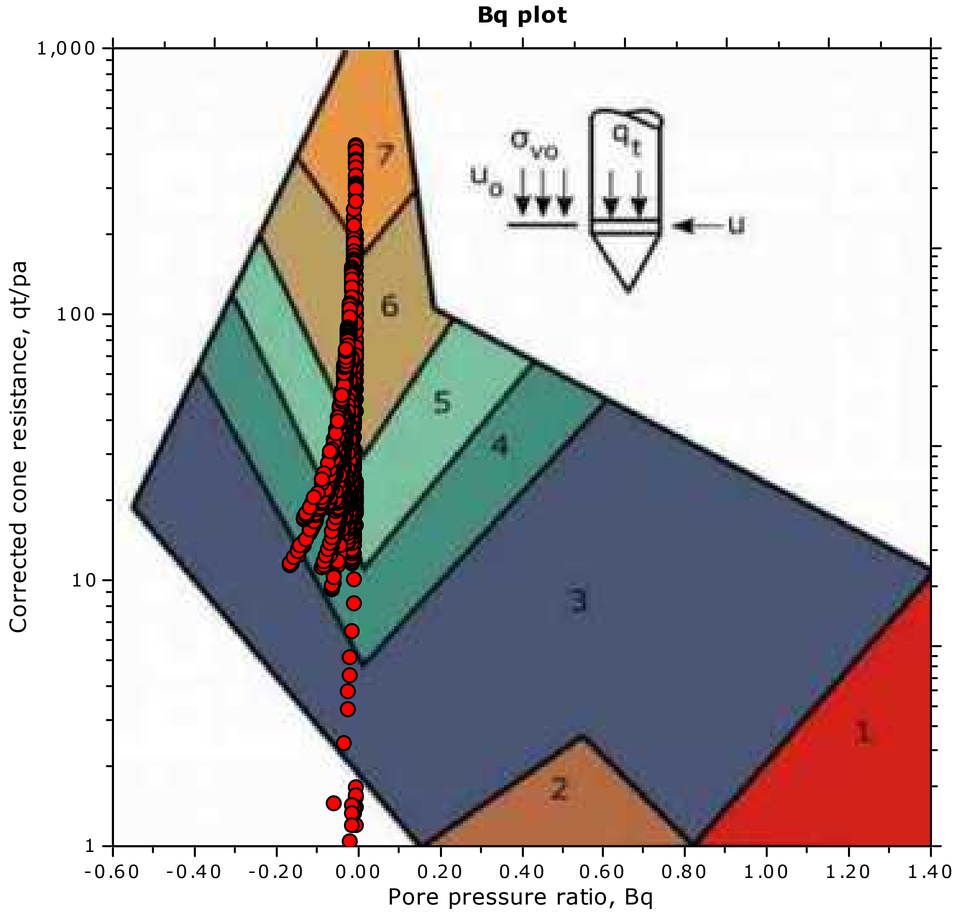


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

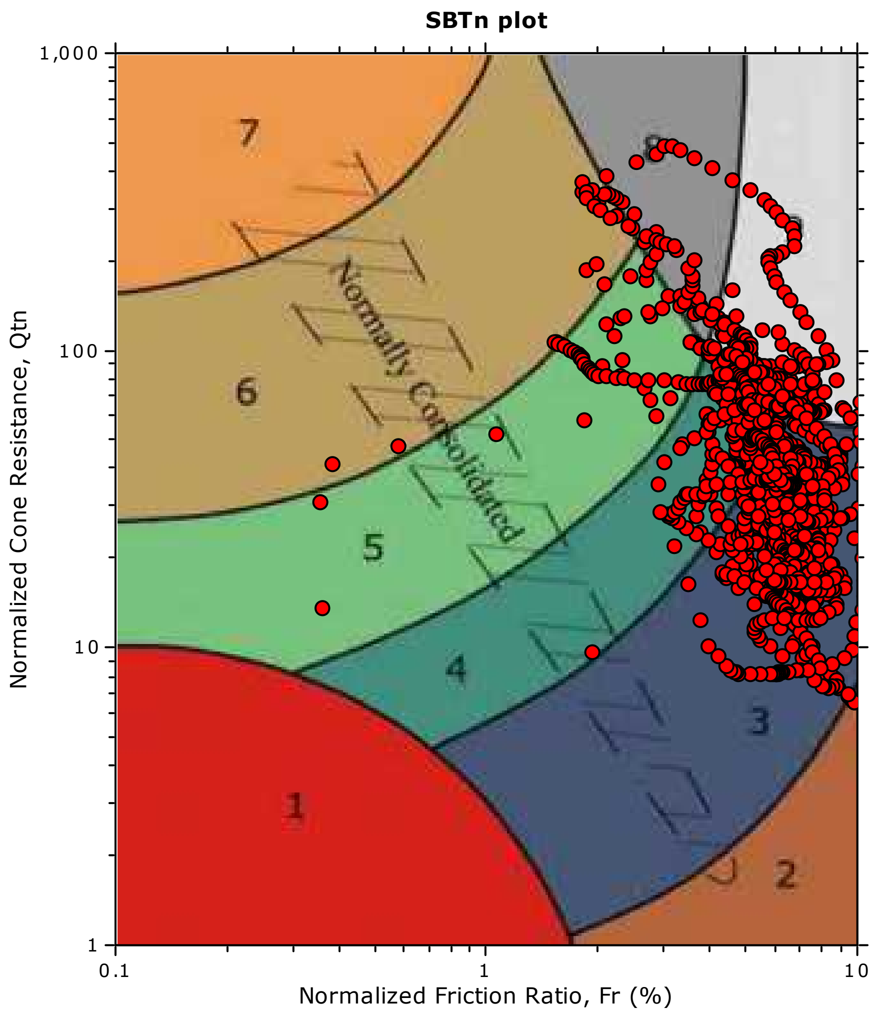


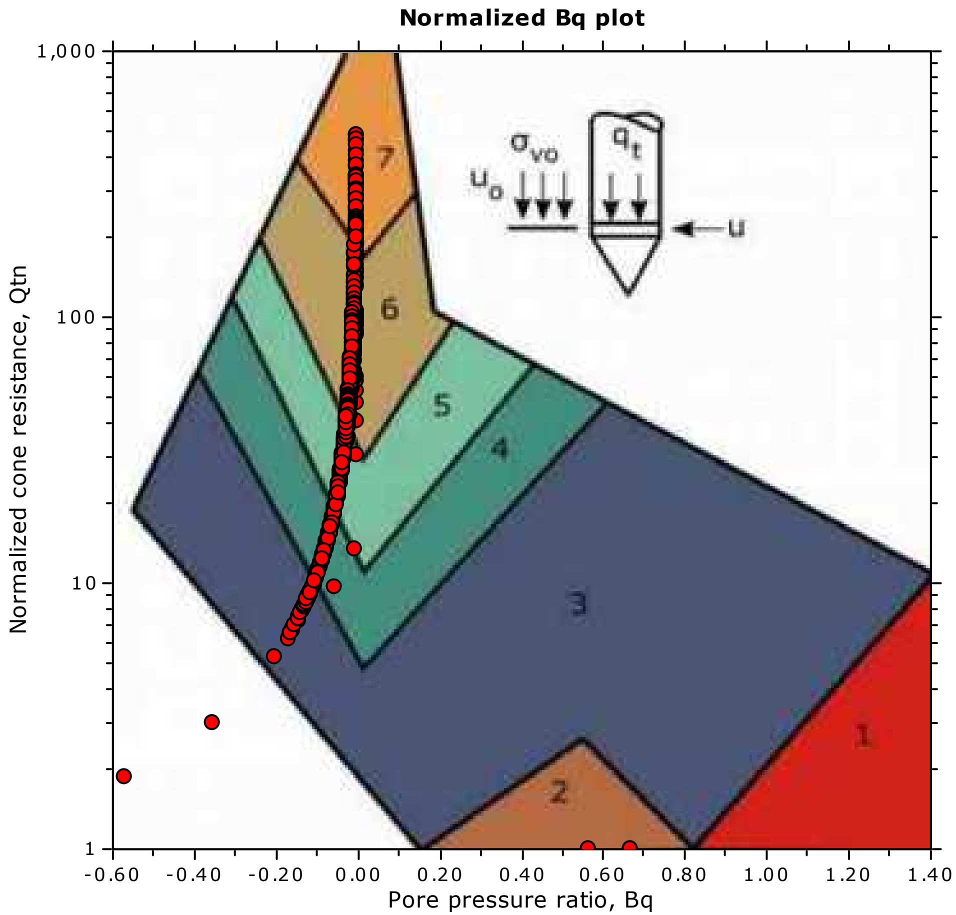


SBT legend

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

SBT - Bq plots (normalized)





SBTn legend

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

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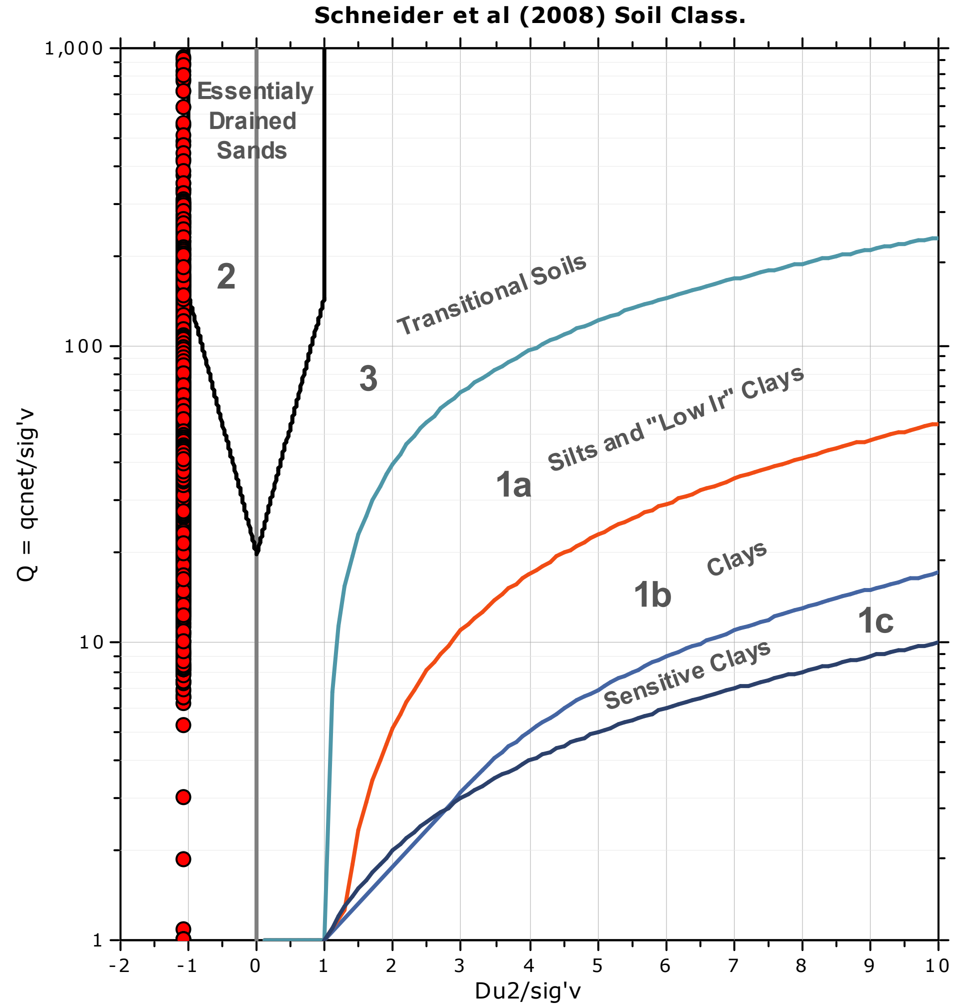
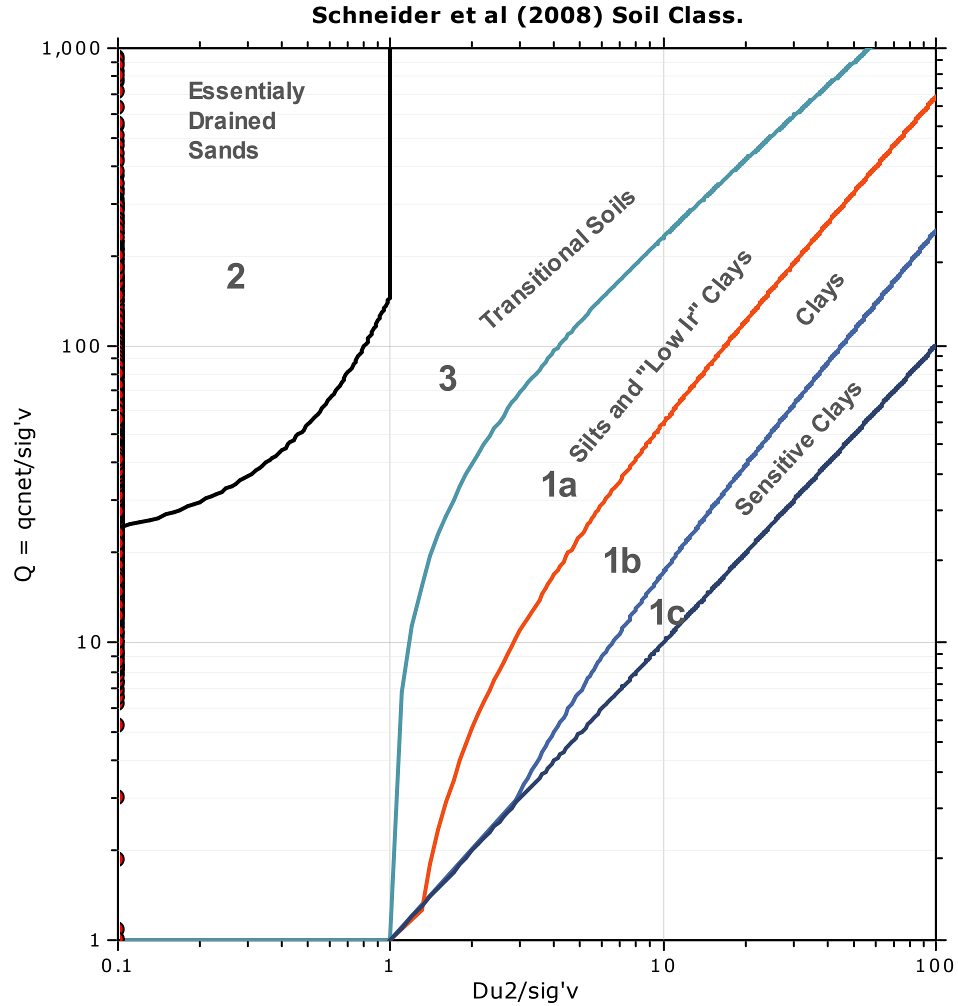
http://www.geologismiki.gr

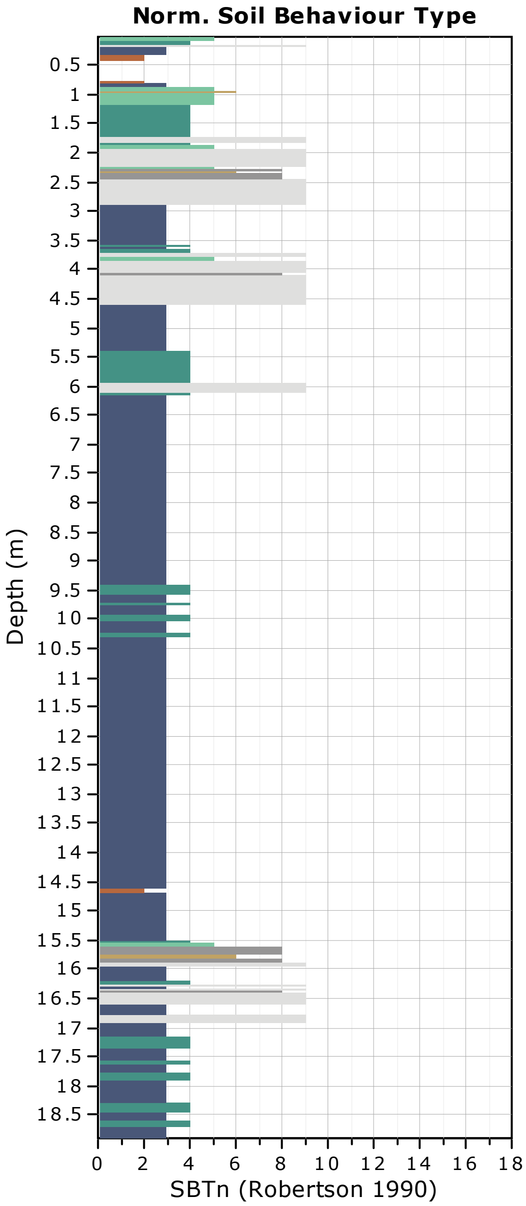
CPT: A1-CPT01
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

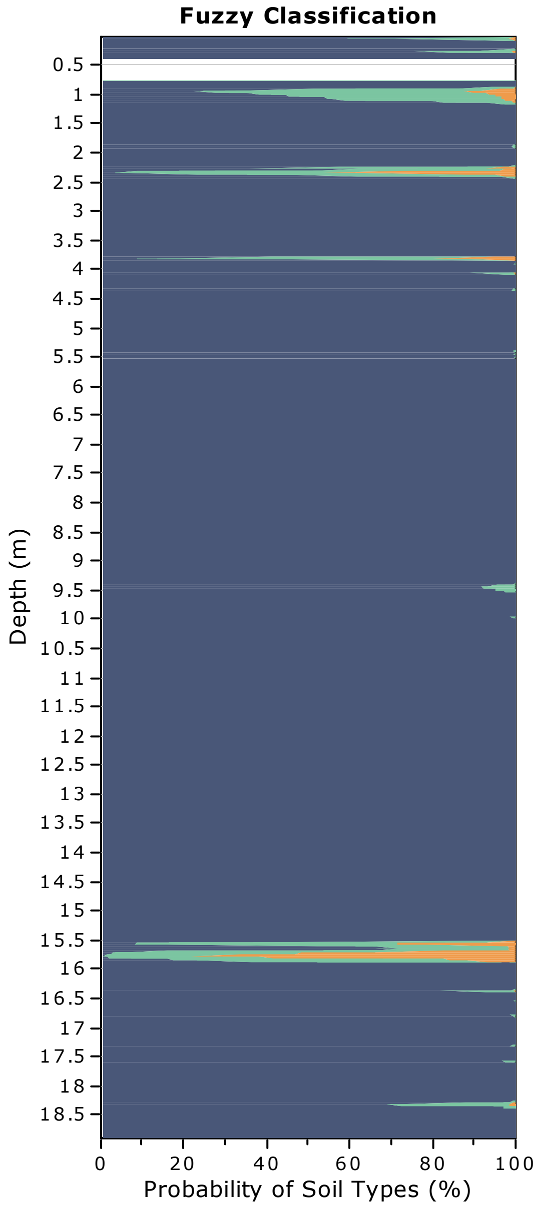
Project:
Location:

Bq plots (Schneider)






Norm. Soil Behaviour Type
Depth (m)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
11.5
12
12.5
13
13.5
14
14.5
15
15.5
16
16.5
17
17.5
18
18.5
0 2 4 6 8 10 12 14 16 18
SBTn (Robertson 1990)


Fuzzy Classification
Depth (m)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
11.5
12
12.5
13
13.5
14
14.5
15
15.5
16
16.5
17
17.5
18
18.5
0 20 40 60 80 100
Probability of Soil Types (%)

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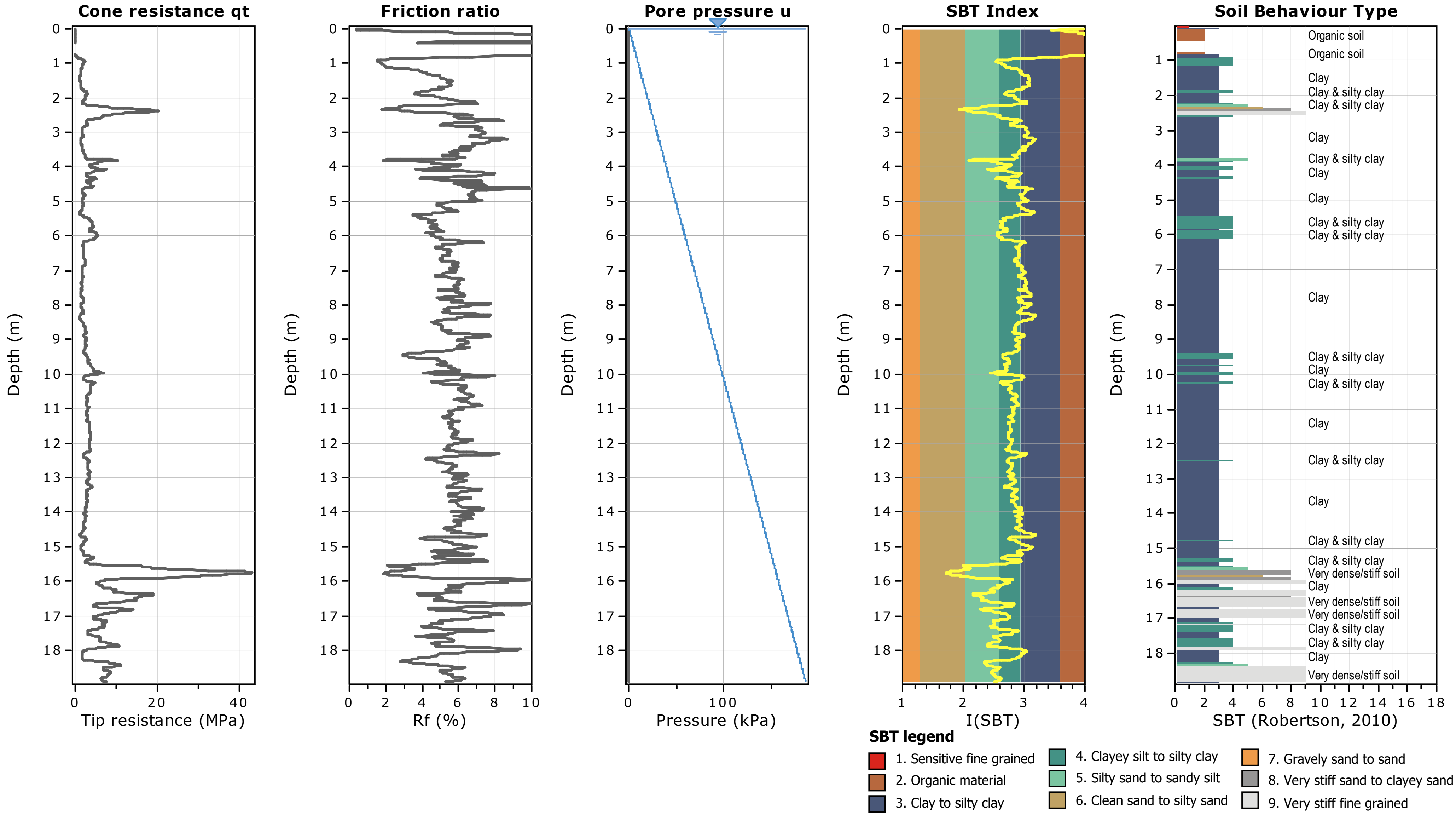
CPT: A1-CPT01
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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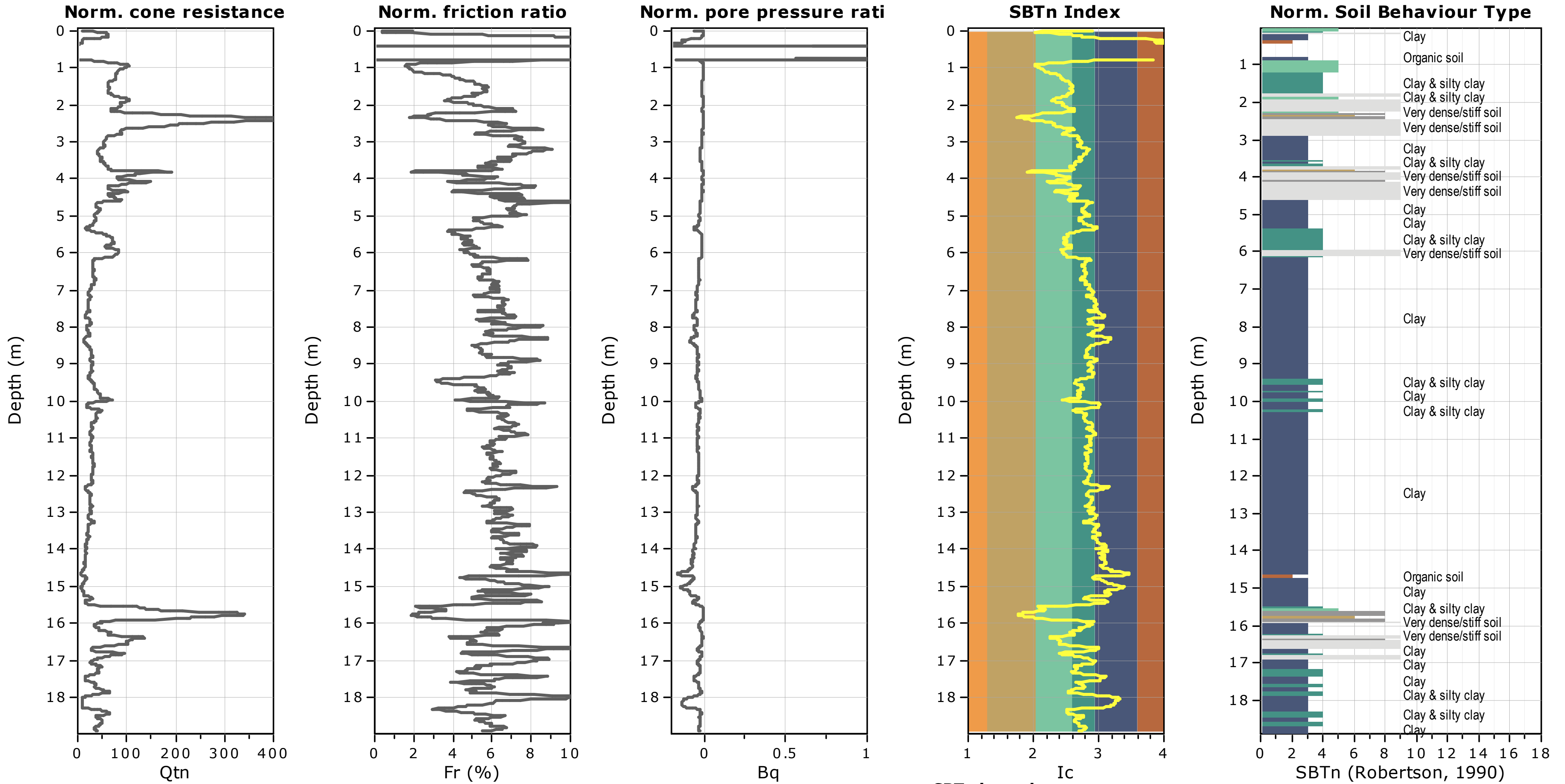
CPT: A1-CPT01
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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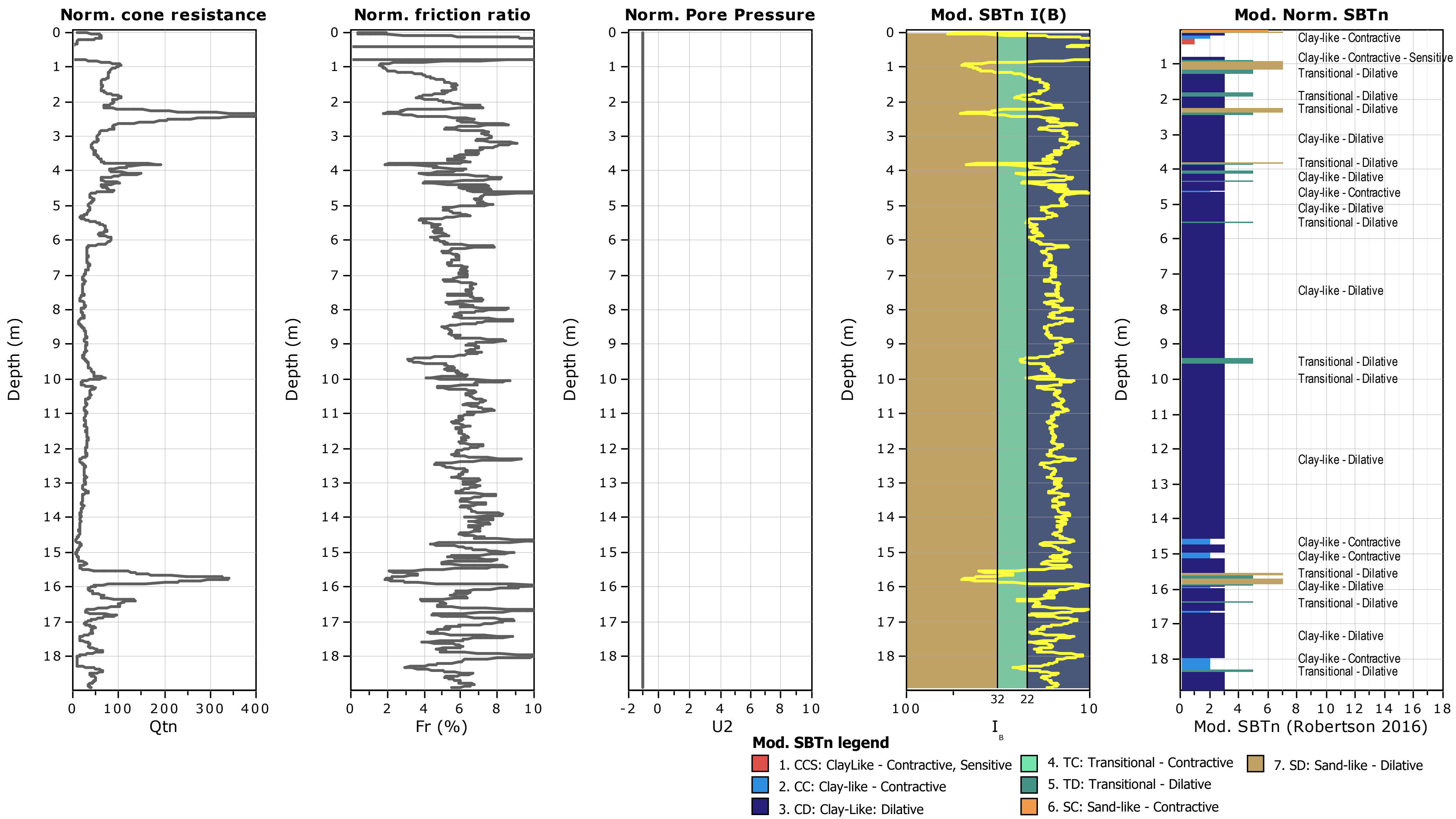
CPT: A1-CPT01
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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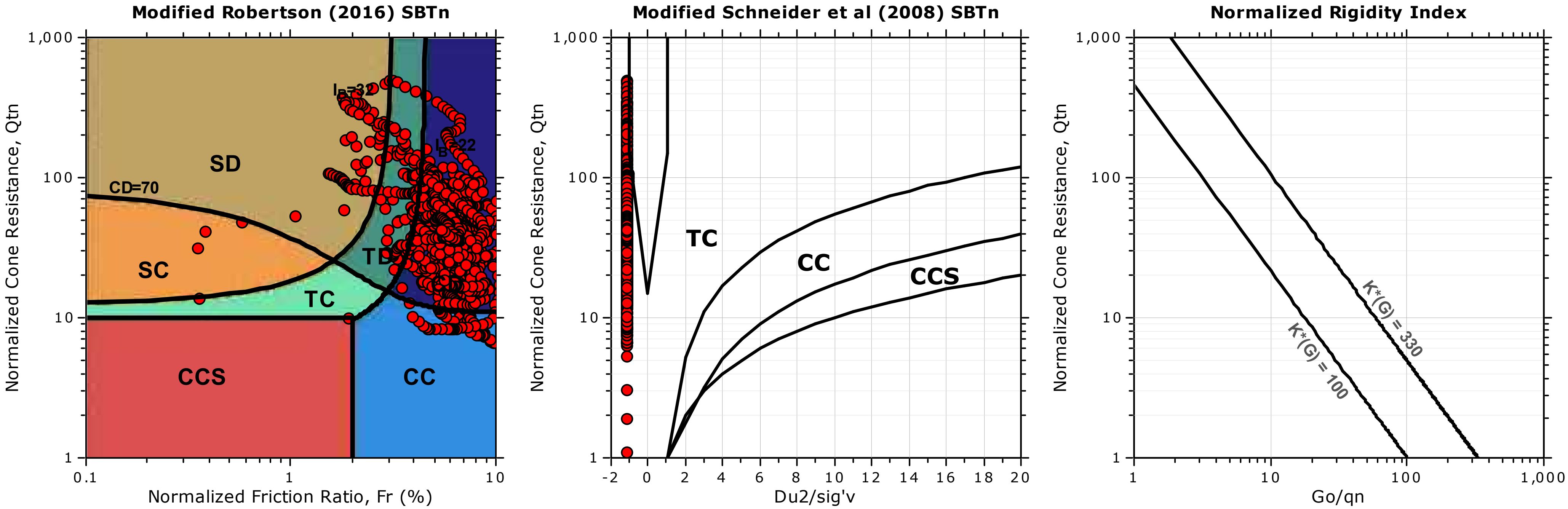
CPT: A1-CPT01
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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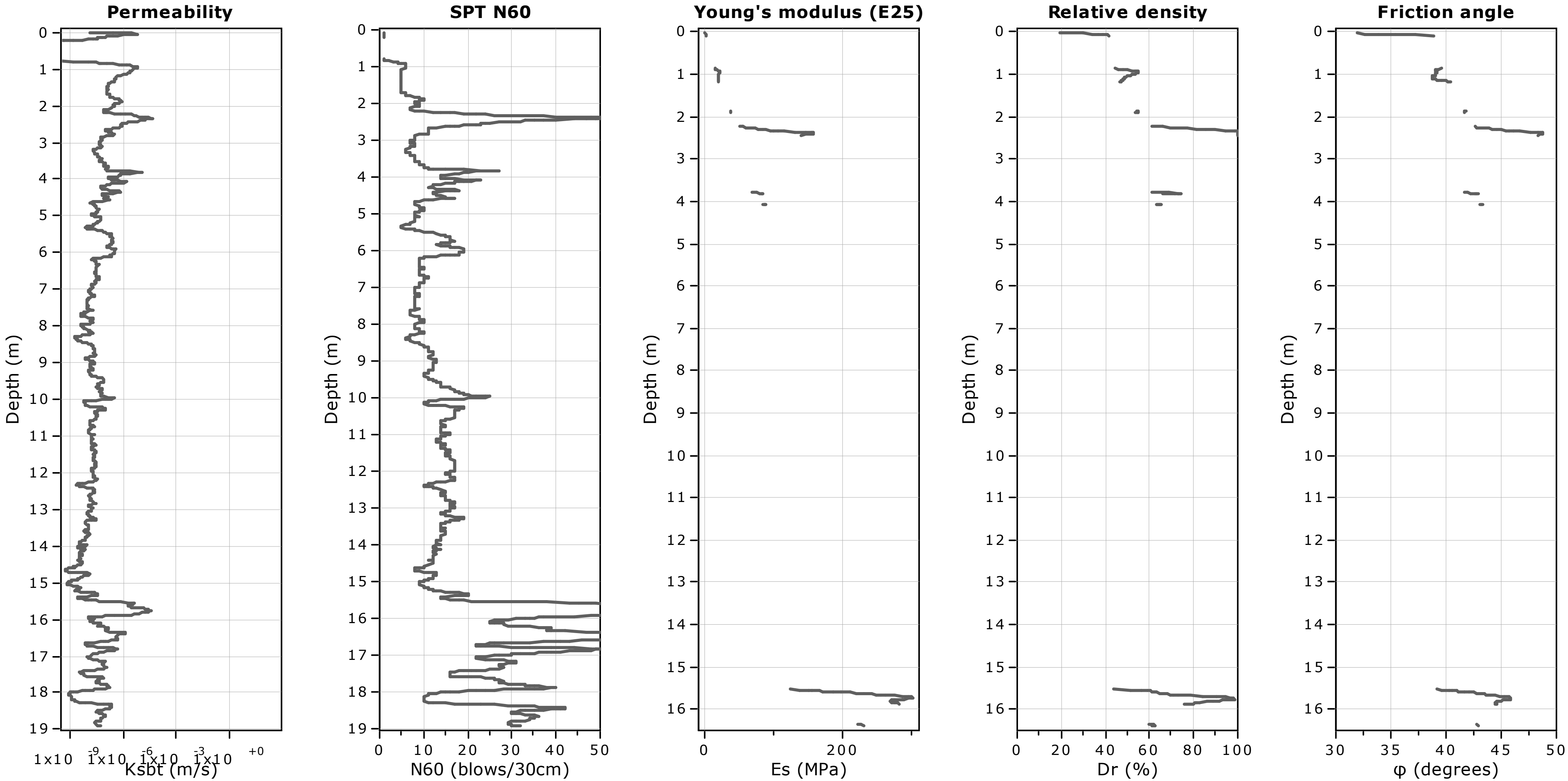
CPT: A1-CPT01
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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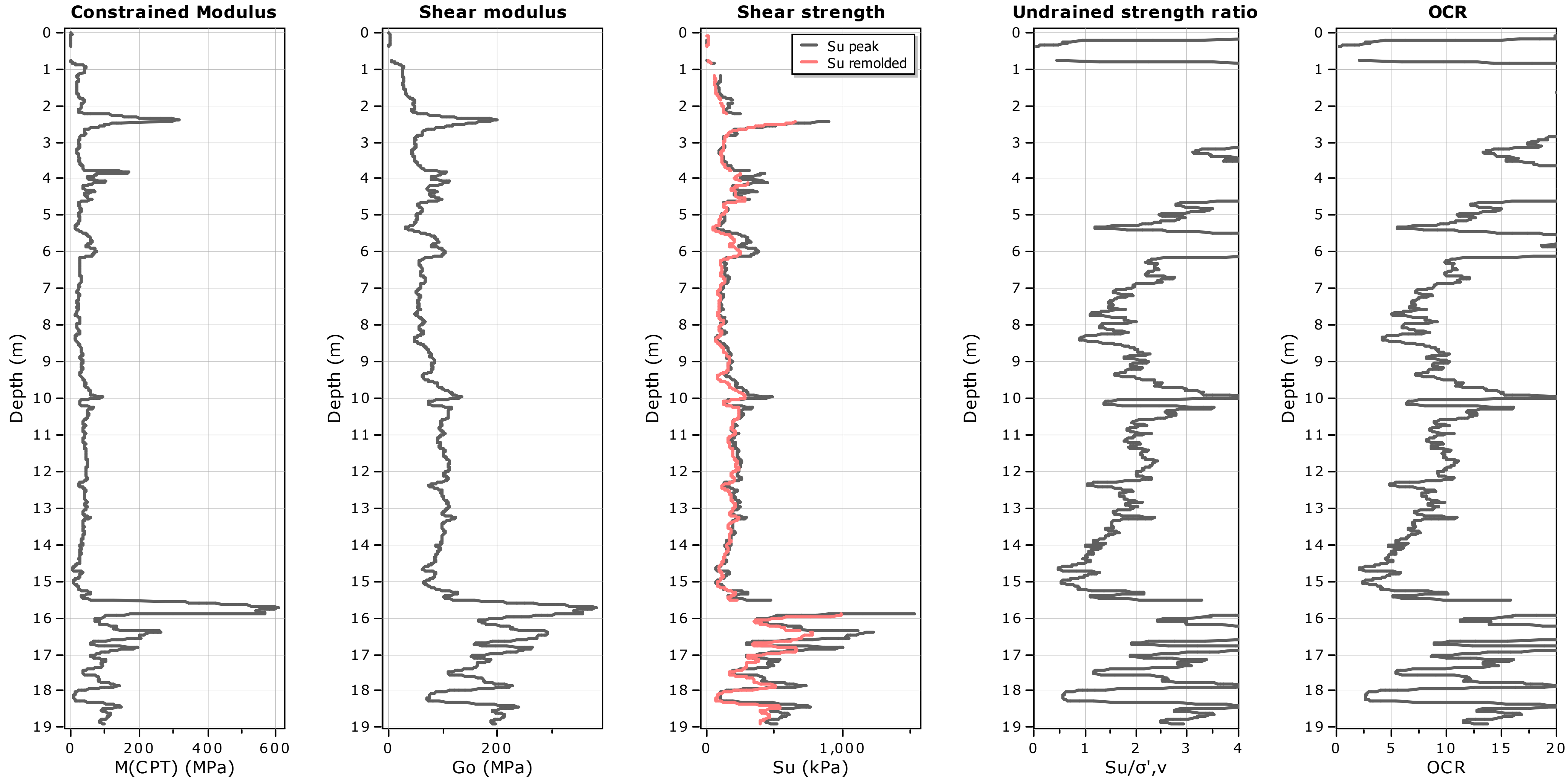
CPT: A1-CPT01
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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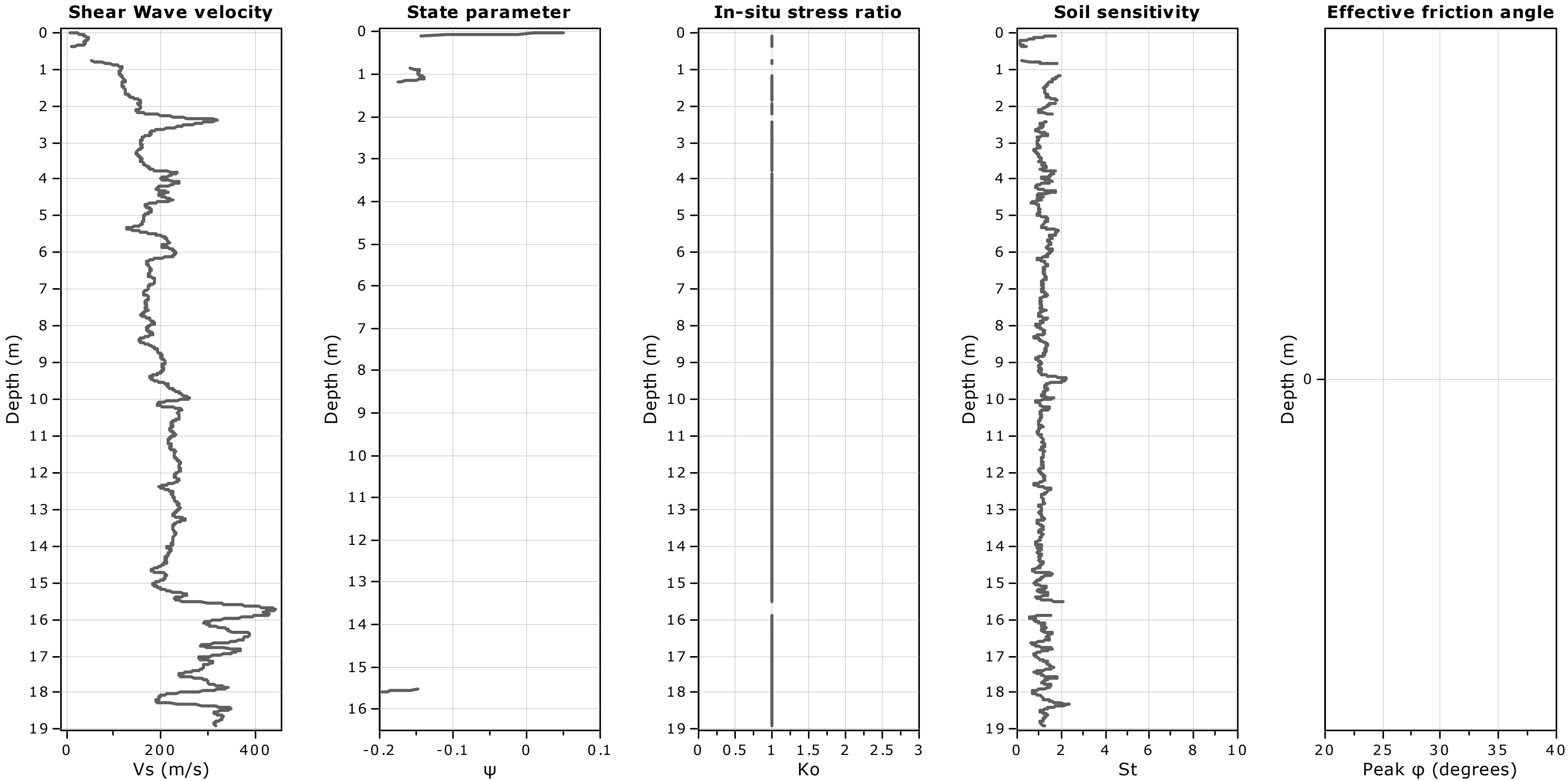
CPT: A1-CPT01
Total depth: 18.90 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

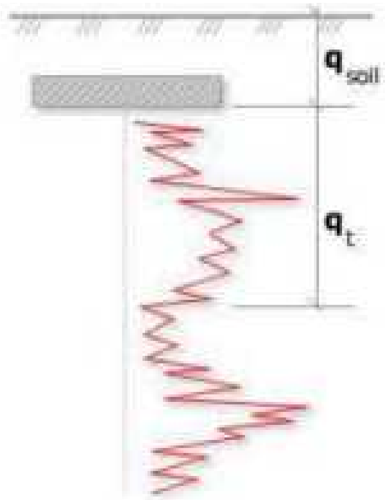
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

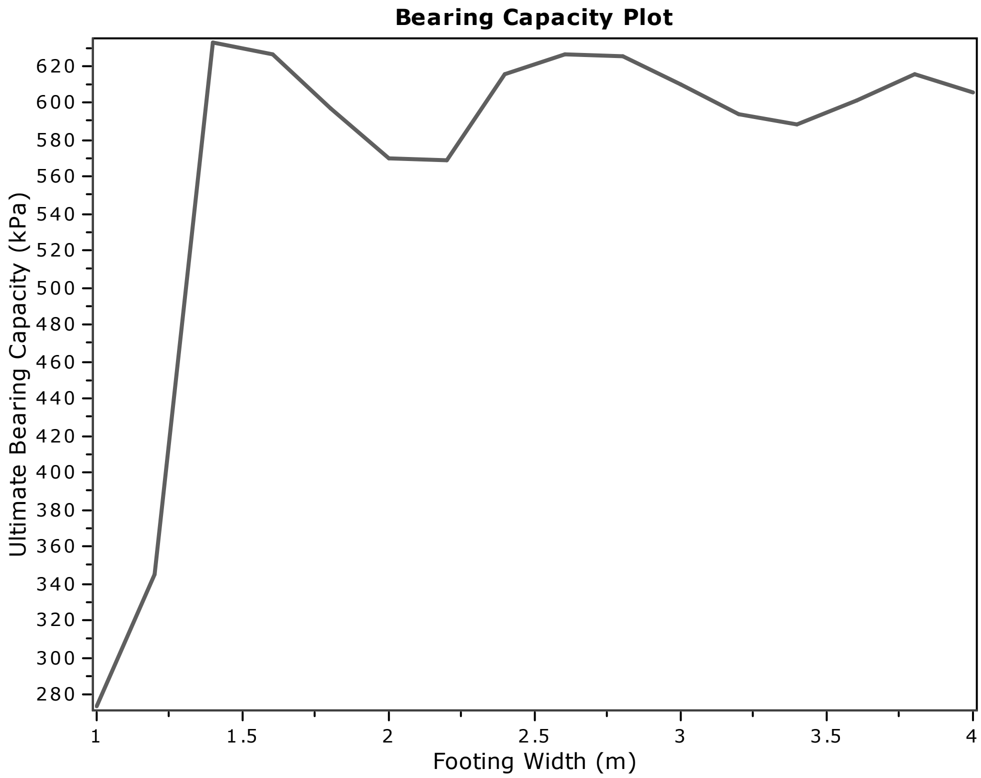
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

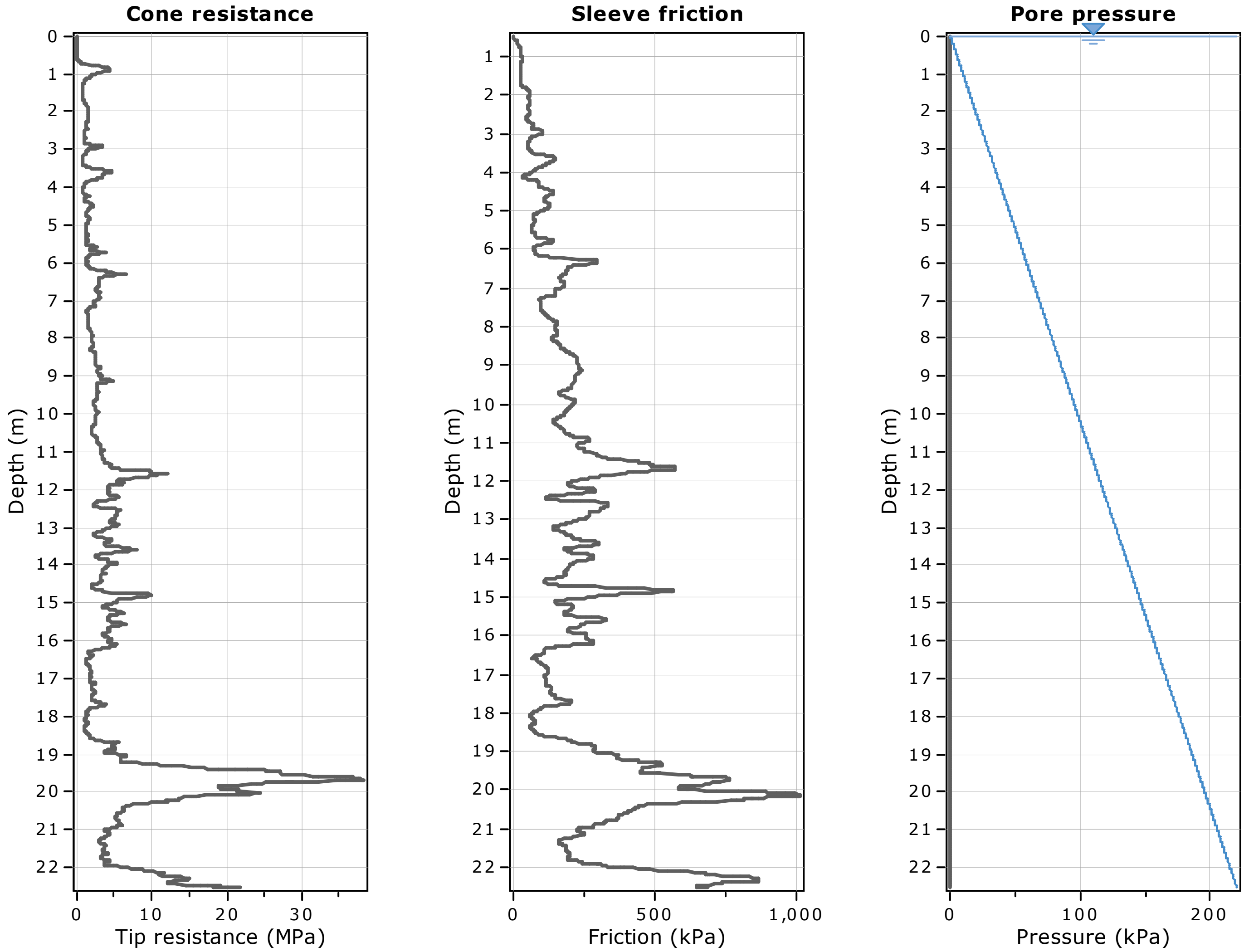
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

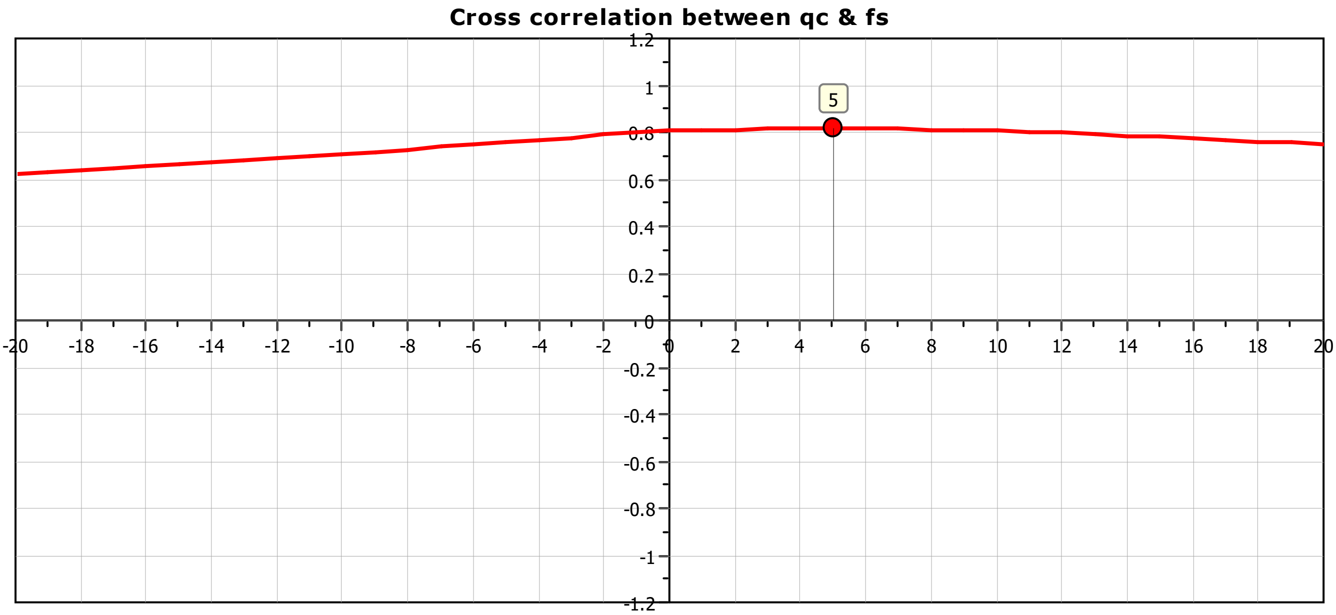


:: Tabular results ::

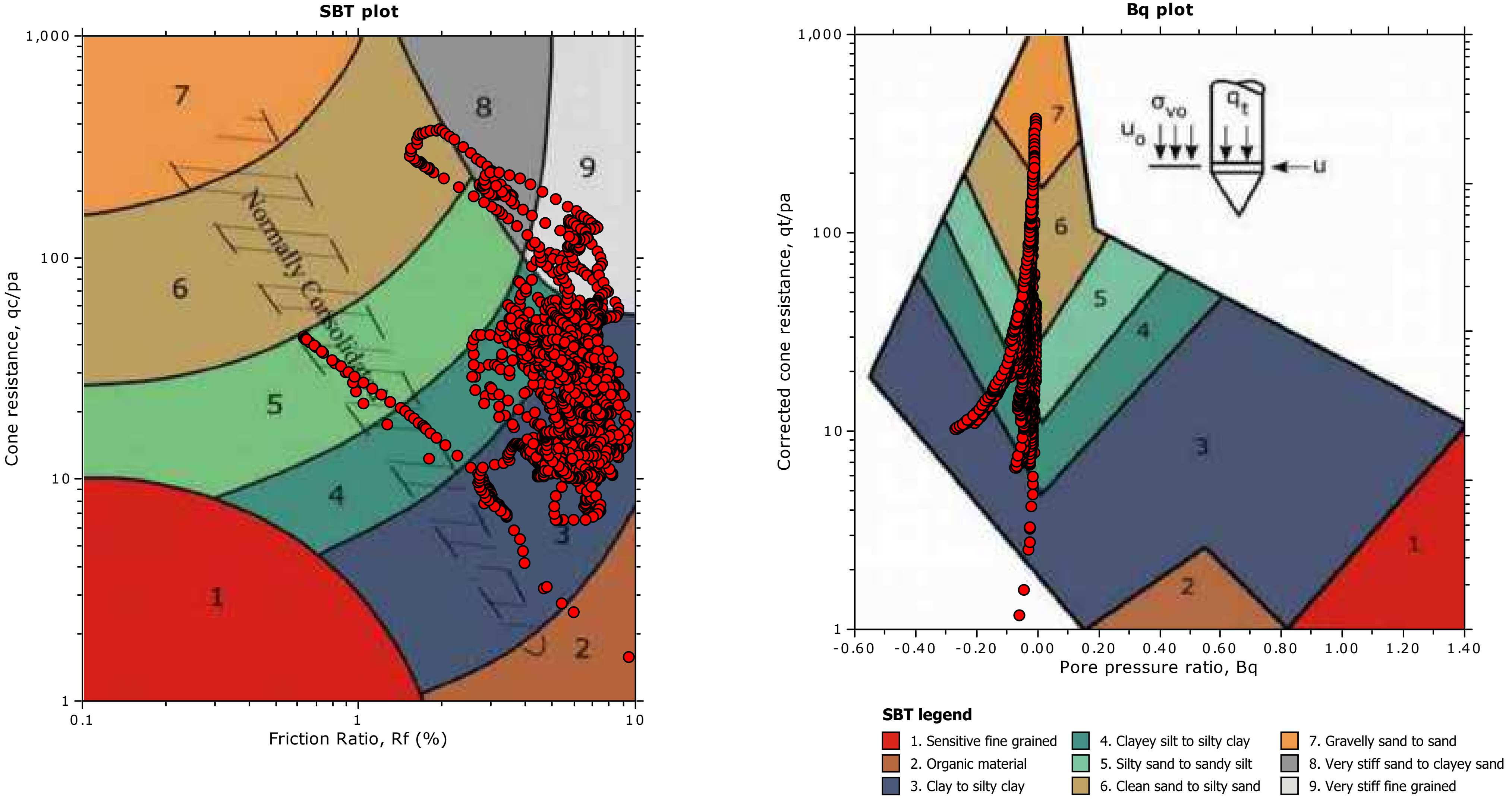
No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.32	0.20	9.50	273.70
2	1.20	0.50	2.30	1.68	0.20	9.50	344.67
3	1.40	0.50	2.60	3.11	0.20	9.50	632.49
4	1.60	0.50	2.90	3.08	0.20	9.50	626.14
5	1.80	0.50	3.20	2.94	0.20	9.50	596.71
6	2.00	0.50	3.50	2.80	0.20	9.50	569.53
7	2.20	0.50	3.80	2.80	0.20	9.50	568.78
8	2.40	0.50	4.10	3.03	0.20	9.50	615.16
9	2.60	0.50	4.40	3.08	0.20	9.50	626.34
10	2.80	0.50	4.70	3.08	0.20	9.50	624.72
11	3.00	0.50	5.00	3.00	0.20	9.50	609.95
12	3.20	0.50	5.30	2.92	0.20	9.50	593.99
13	3.40	0.50	5.60	2.89	0.20	9.50	588.00
14	3.60	0.50	5.90	2.96	0.20	9.50	601.01
15	3.80	0.50	6.20	3.03	0.20	9.50	615.02
16	4.00	0.50	6.50	2.98	0.20	9.50	605.04



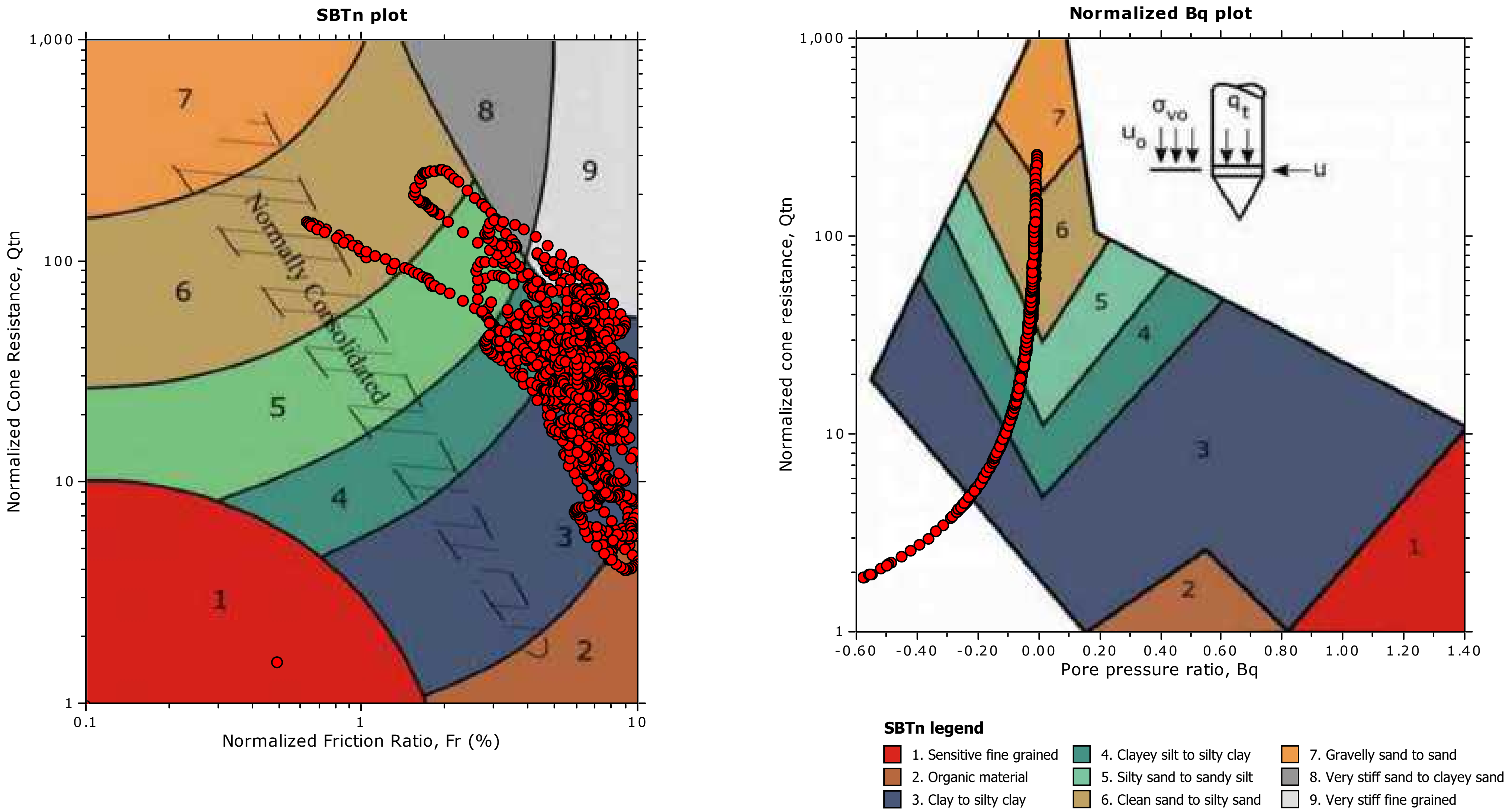
The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



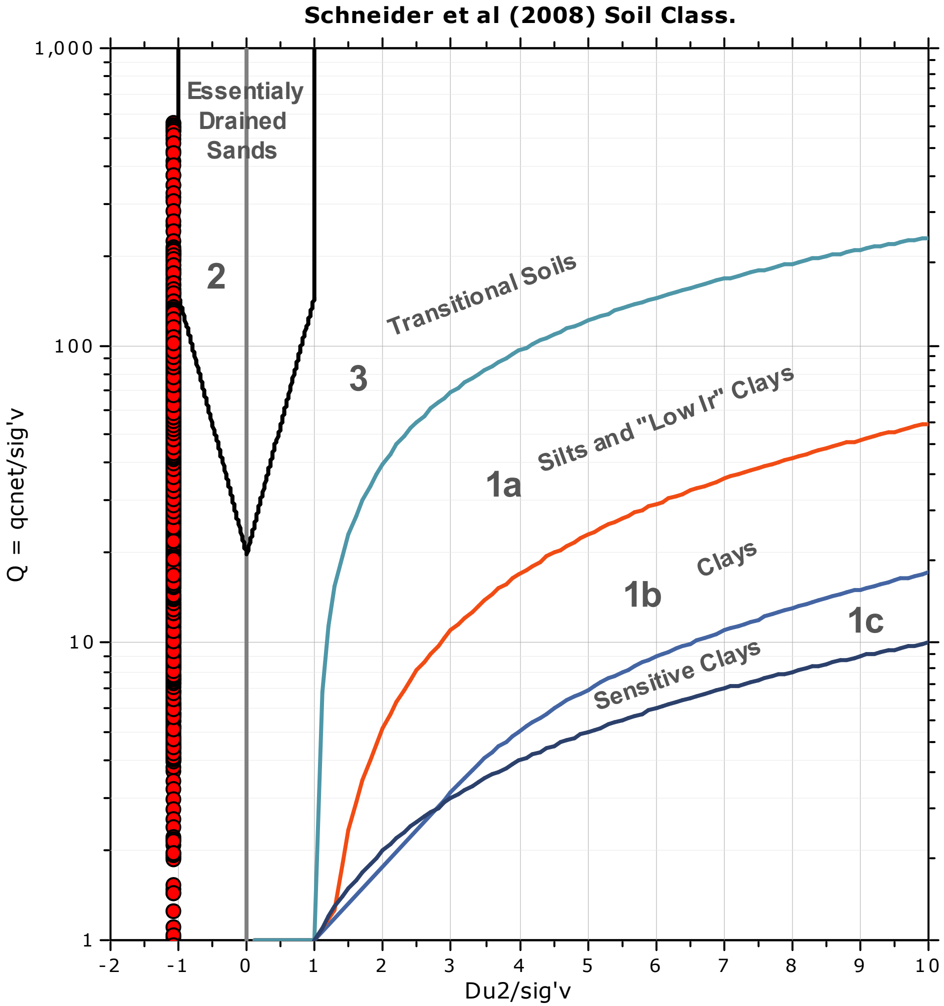
SBT - Bq plots

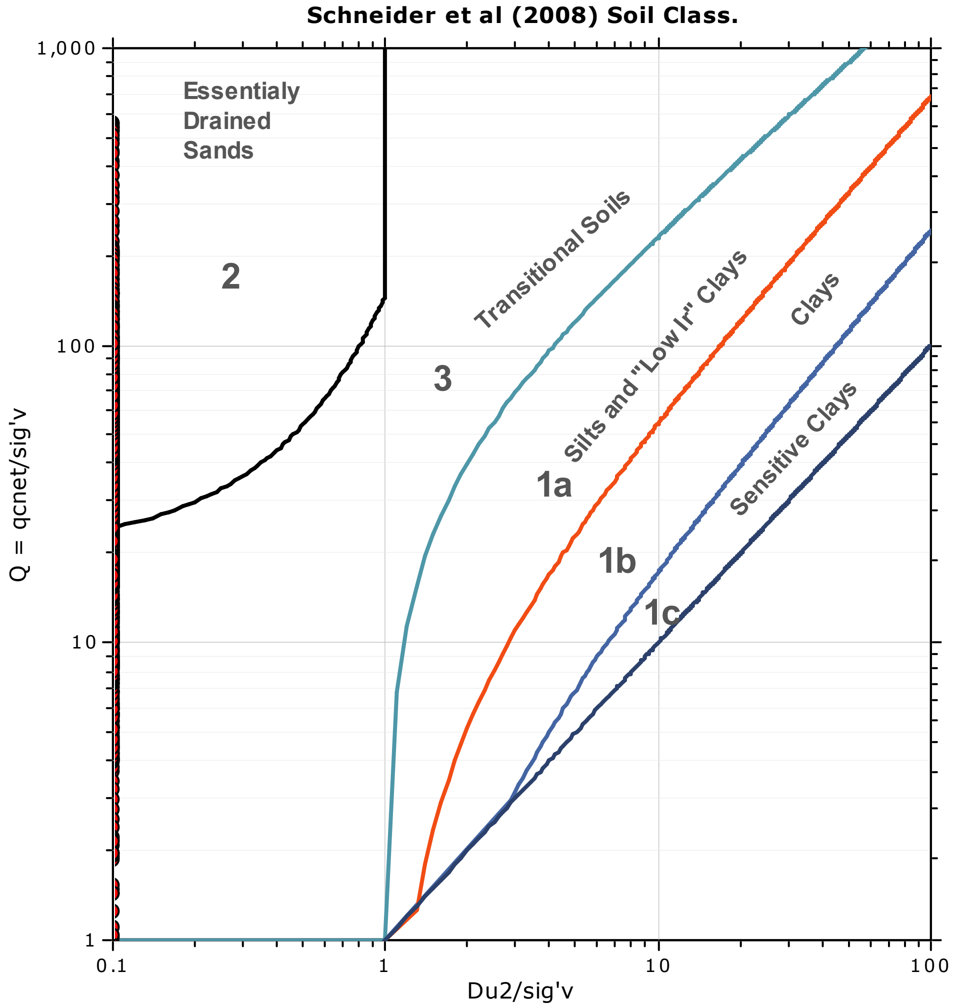

SBT plot
Cone resistance, qc/pa
1,000
100
10
1
0.1
1
10
Friction Ratio, Rf (%)
7
8
9
6
5
4
3
2
1
Normally Consolidated
Bq plot
Corrected cone resistance, qt/pa
1,000
100
10
1
-0.60
-0.40
-0.20
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
Pore pressure ratio, Bq
7
6
5
4
3
2
1
u
SBT legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

SBT - Bq plots (normalized)



Bq plots (Schneider)





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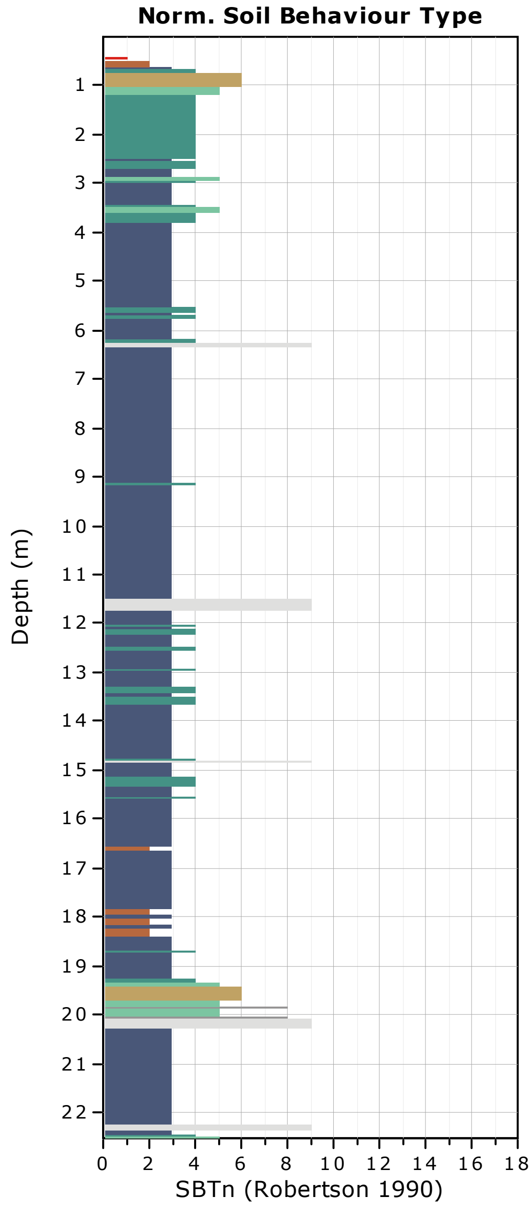
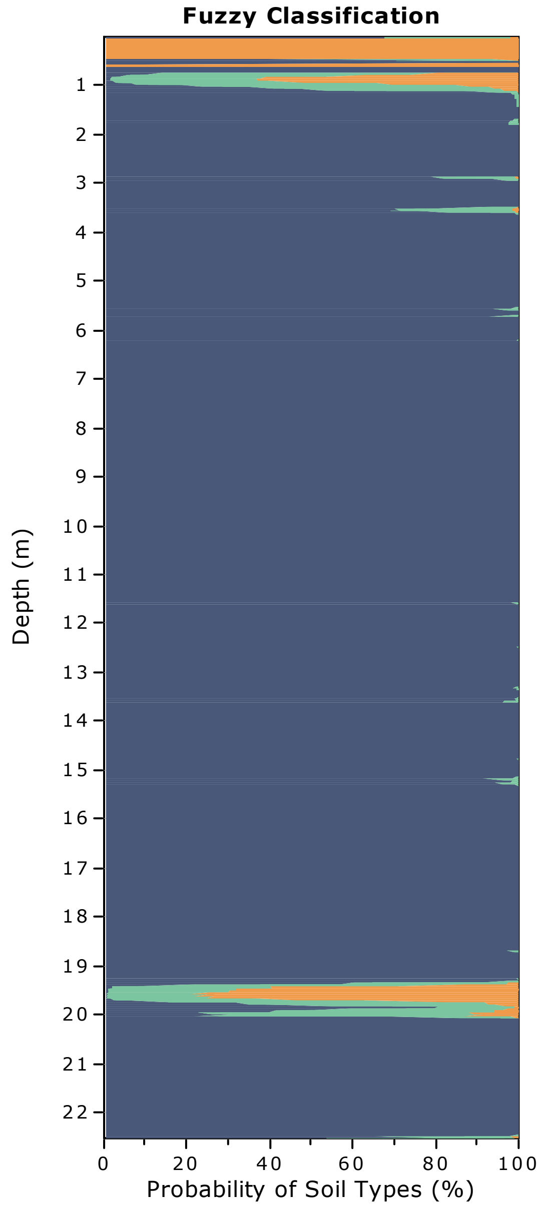
http://www.geologismiki.gr

CPT: A1-CPT02
Total depth: 22.52 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:





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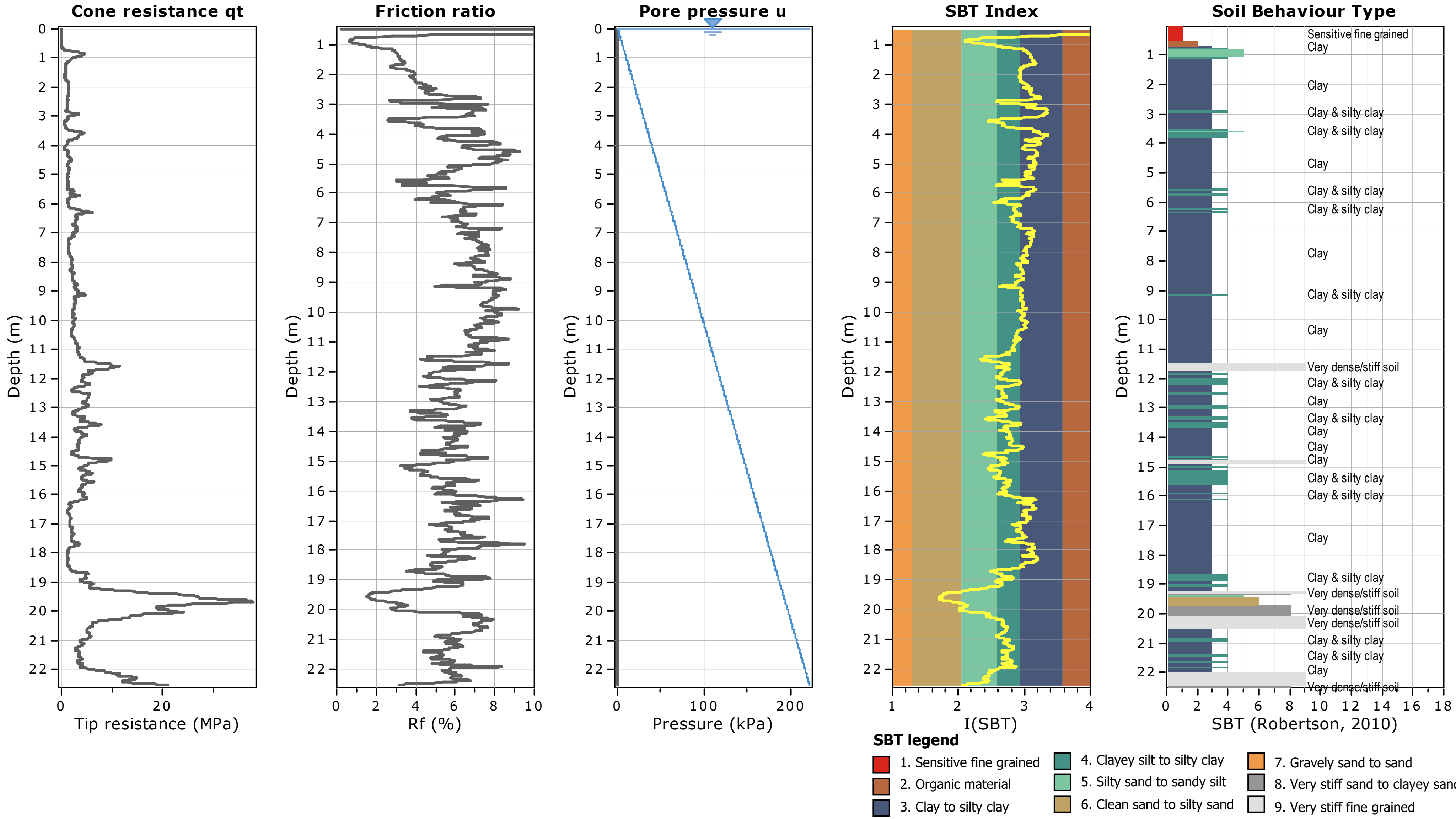
CPT: A1-CPT02
Total depth: 22.52 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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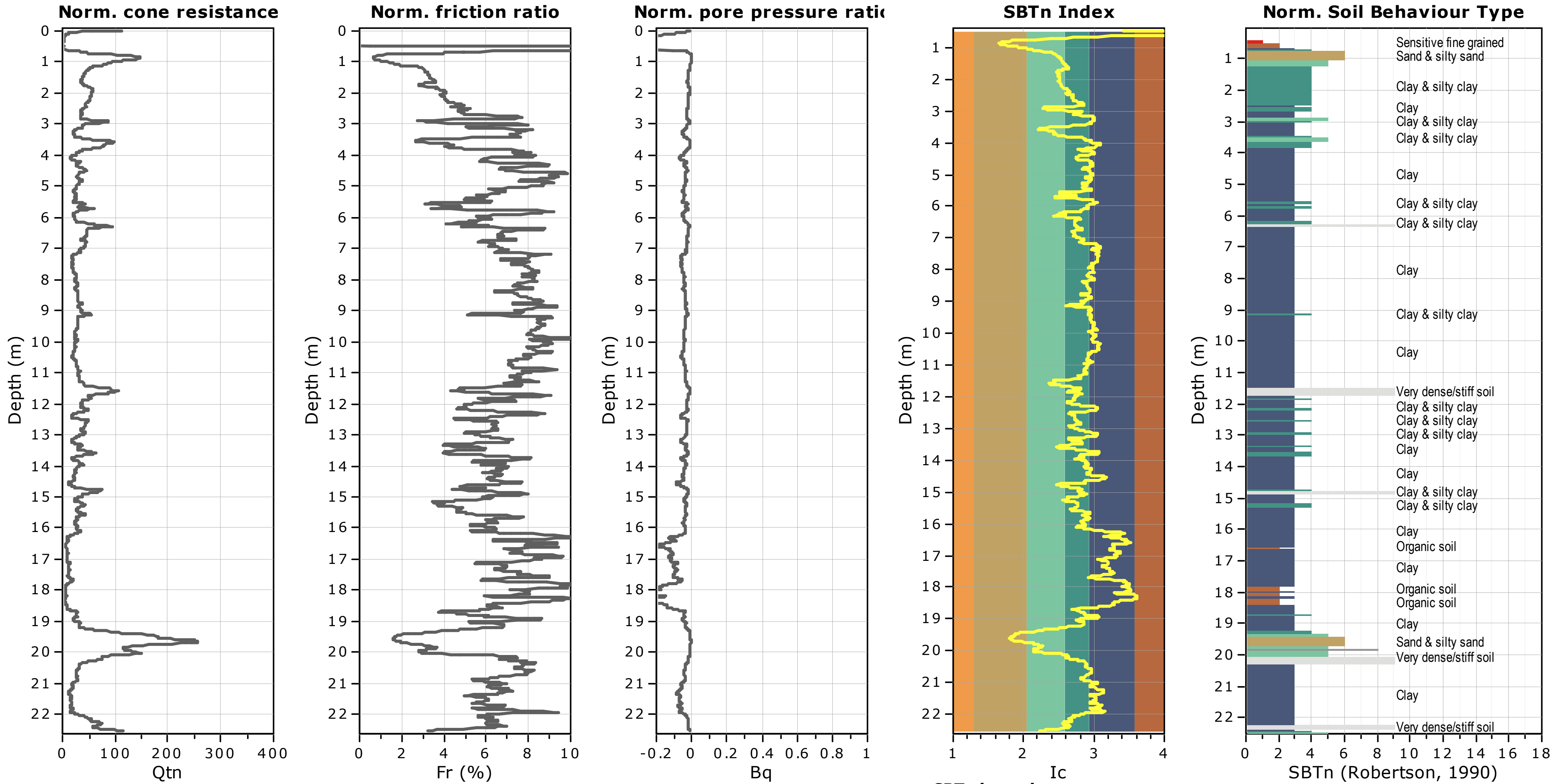
CPT: A1-CPT02
Total depth: 22.52 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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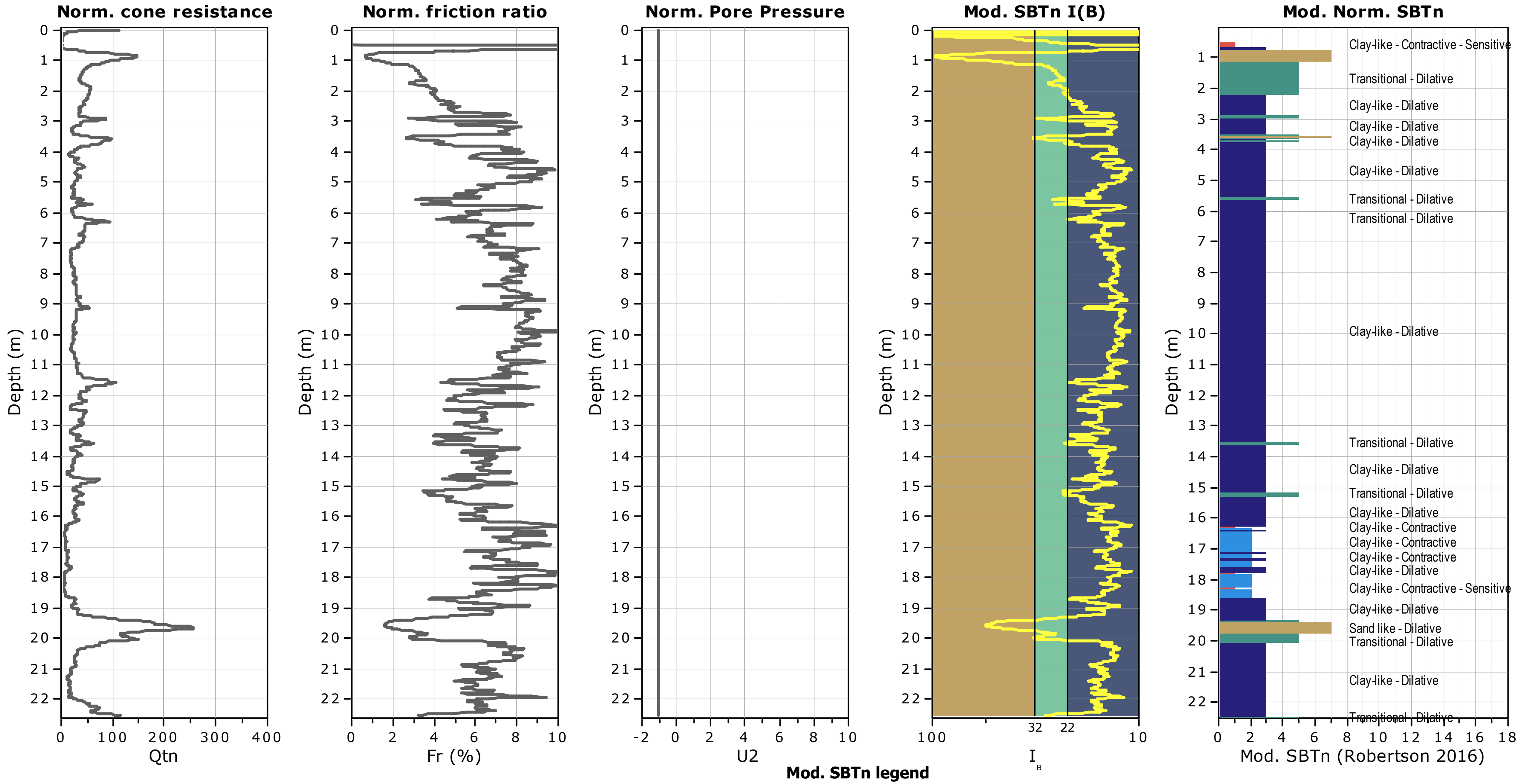
http://www.geologismiki.gr

CPT: A1-CPT02
Total depth: 22.52 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

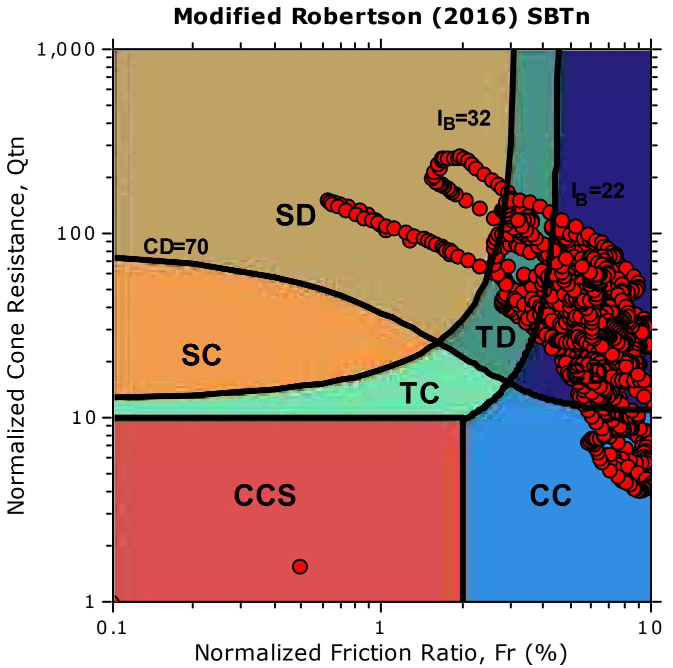
Project:
Location:

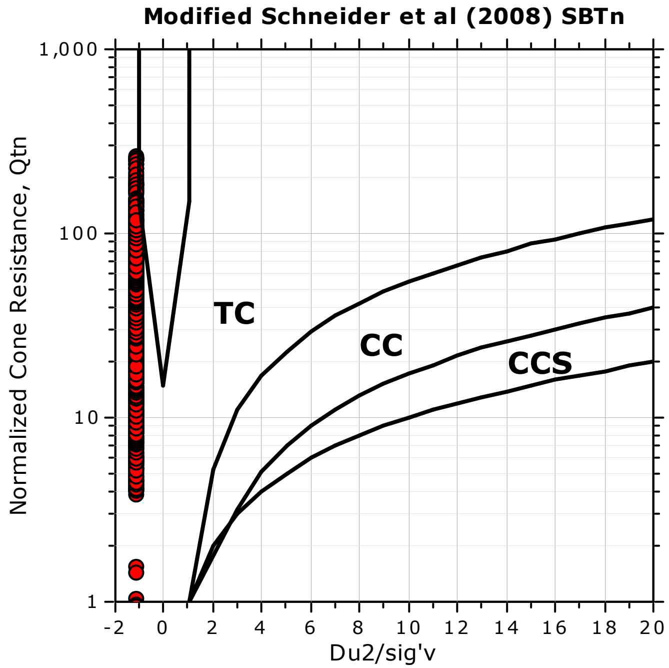


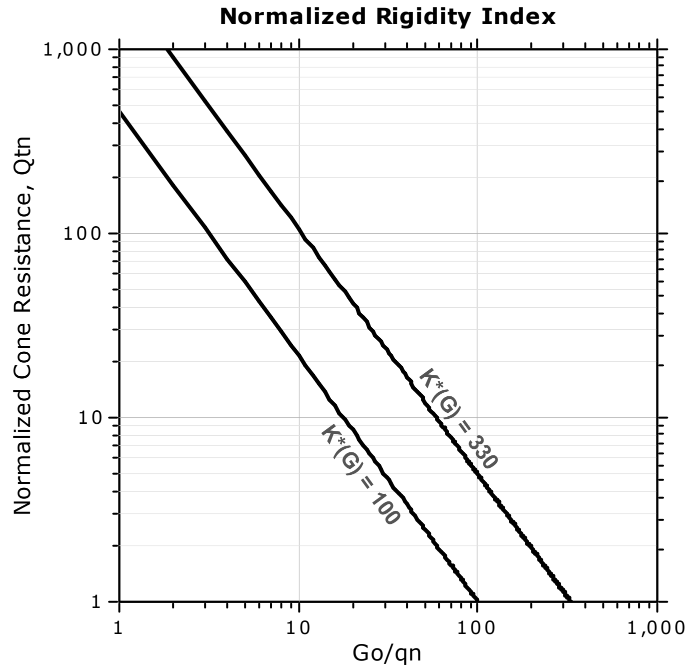
Mod. SBTn legend

- 1. CCS: ClayLike - Contractive, Sensitive
- 2. CC: Clay-like - Contractive
- 3. CD: Clay-Like: Dilative
- 4. TC: Transitional - Contractive
- 5. TD: Transitional - Dilative
- 6. SC: Sand-like - Contractive
- 7. SD: Sand-like - Dilative

Updated SBTn plots







CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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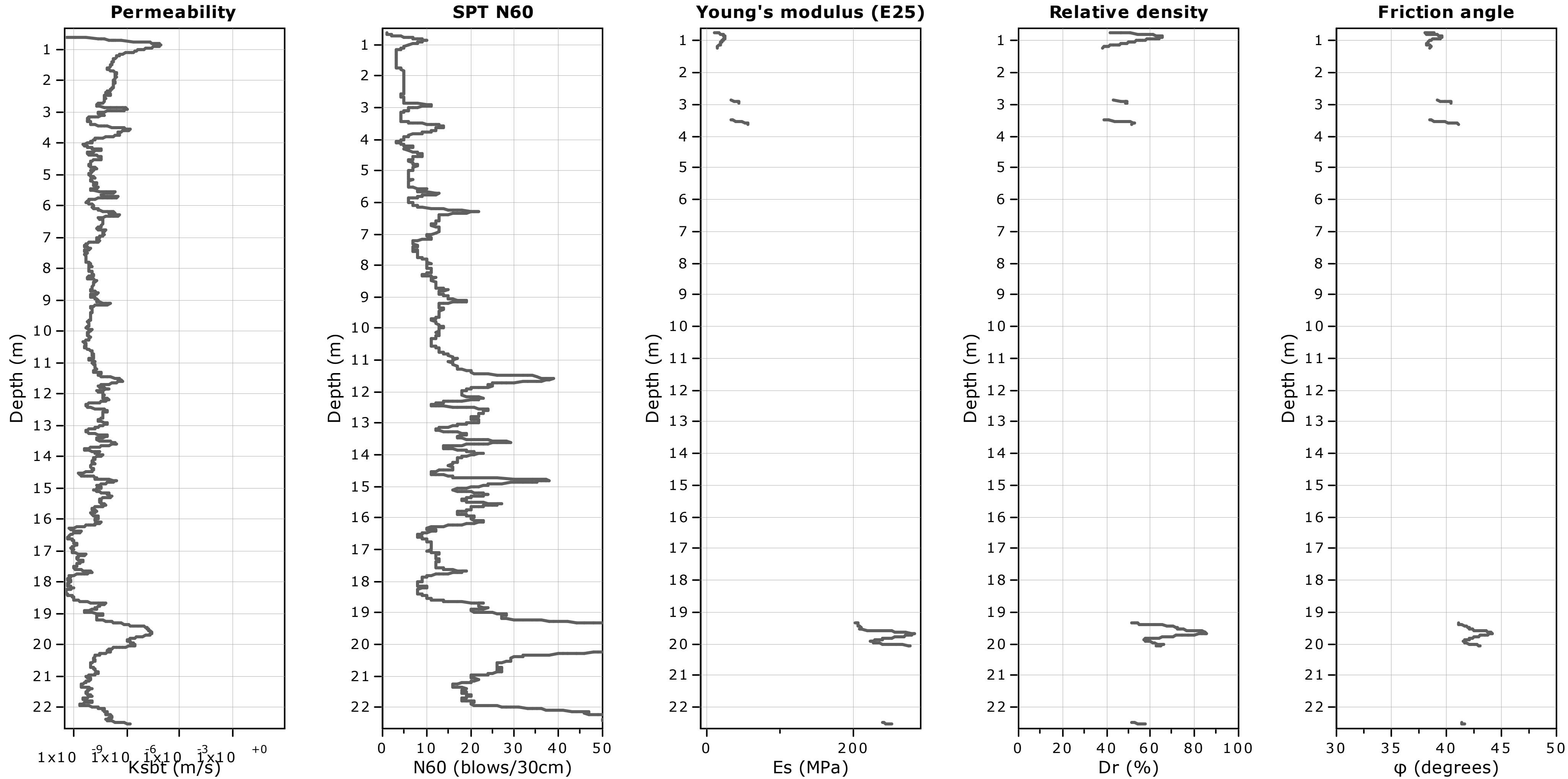
CPT: A1-CPT02
Total depth: 22.52 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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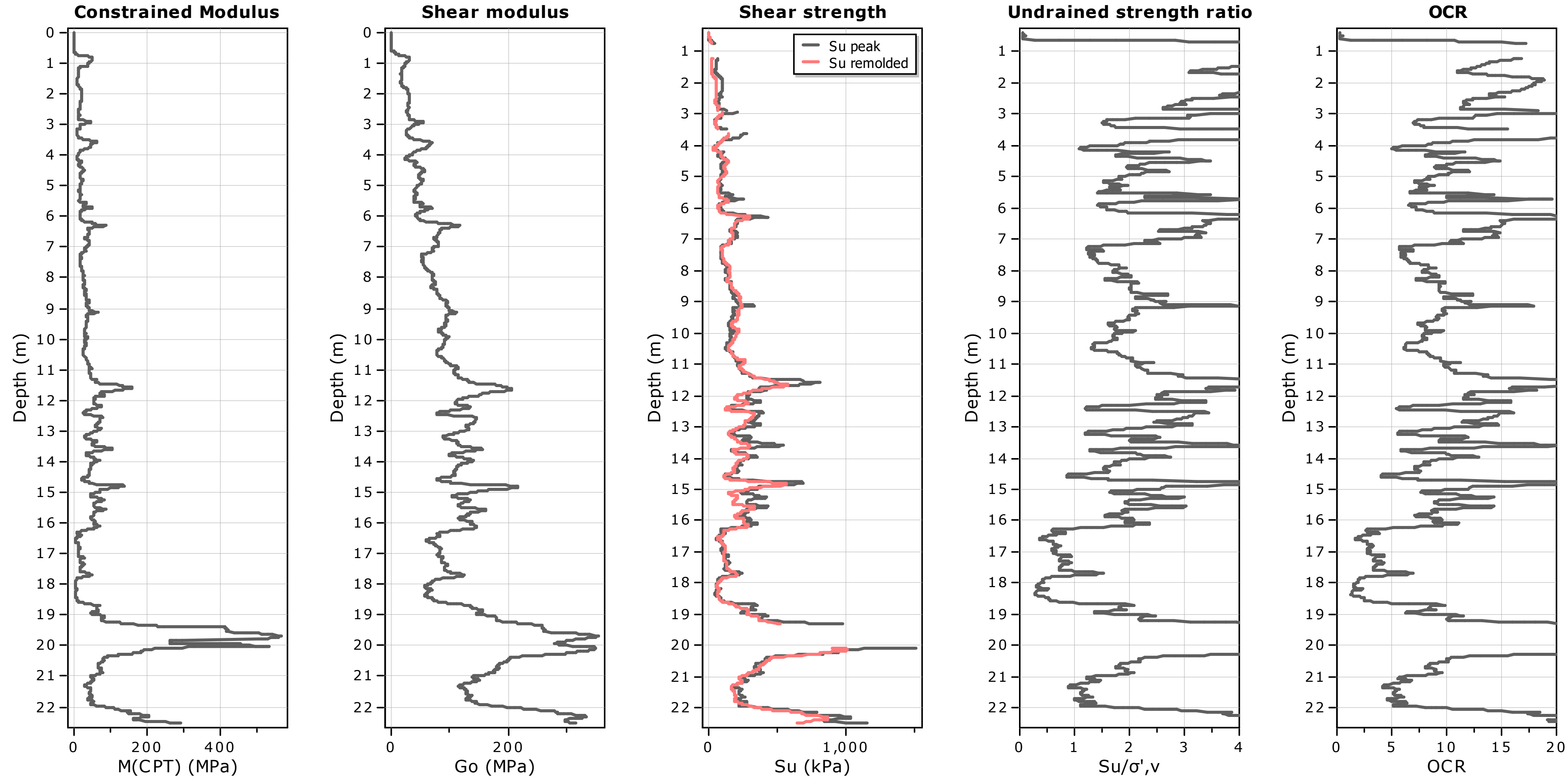
CPT: A1-CPT02
Total depth: 22.52 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

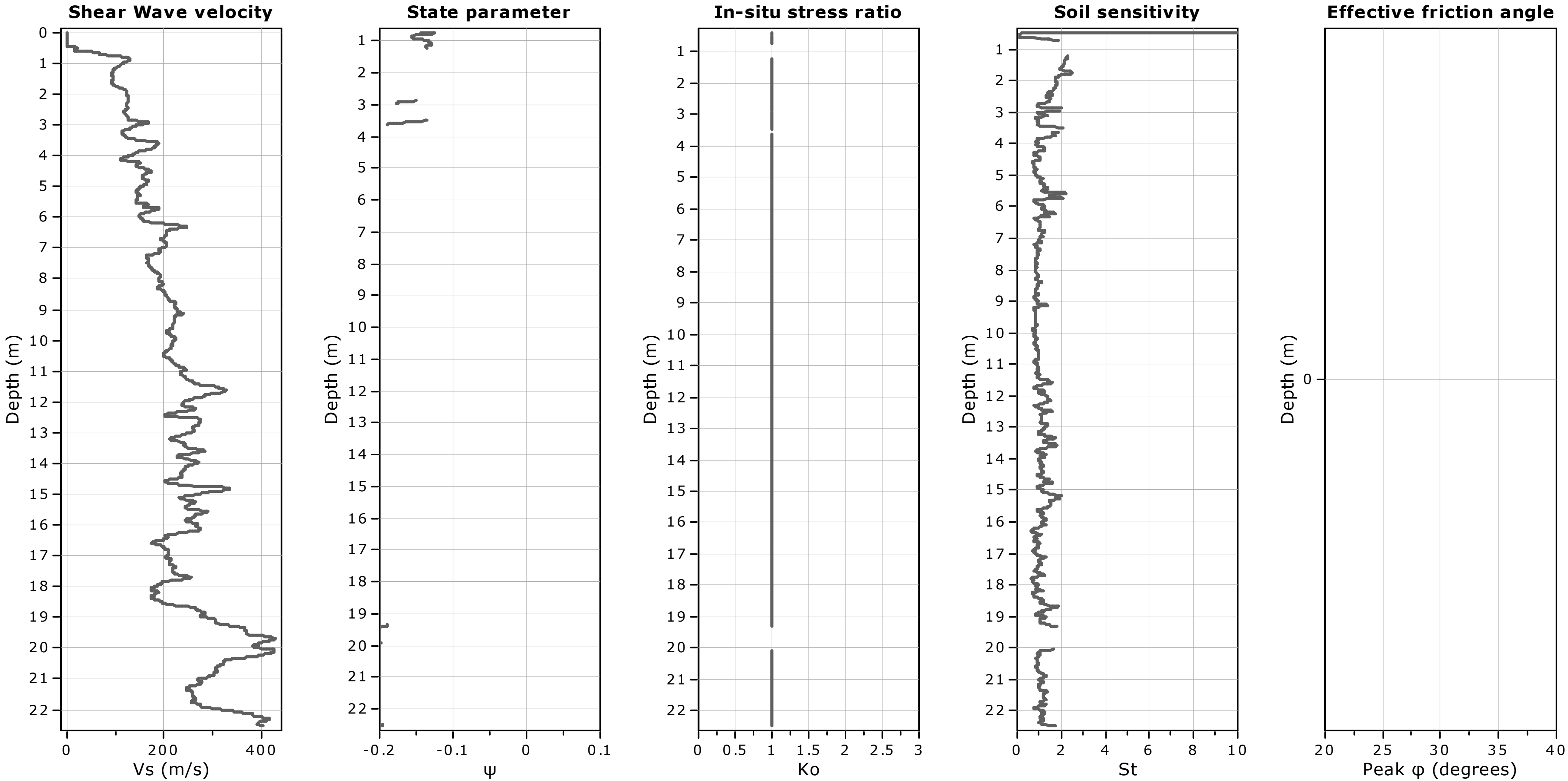
Project:
Location:



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

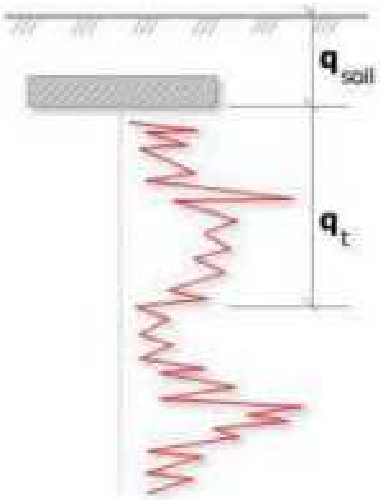
OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

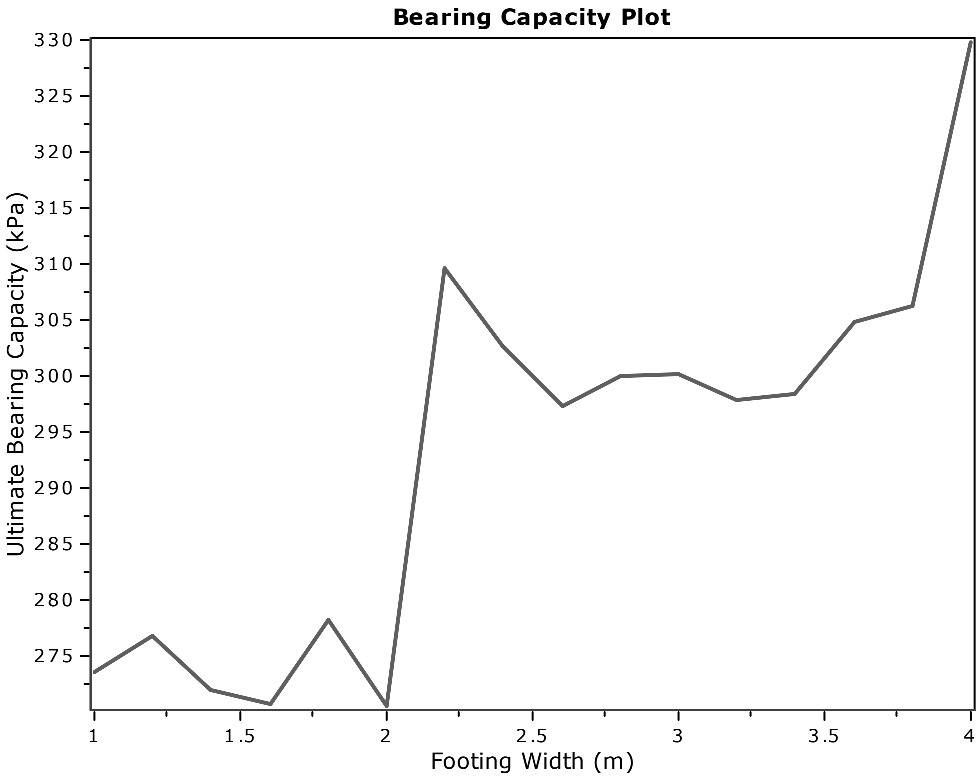
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

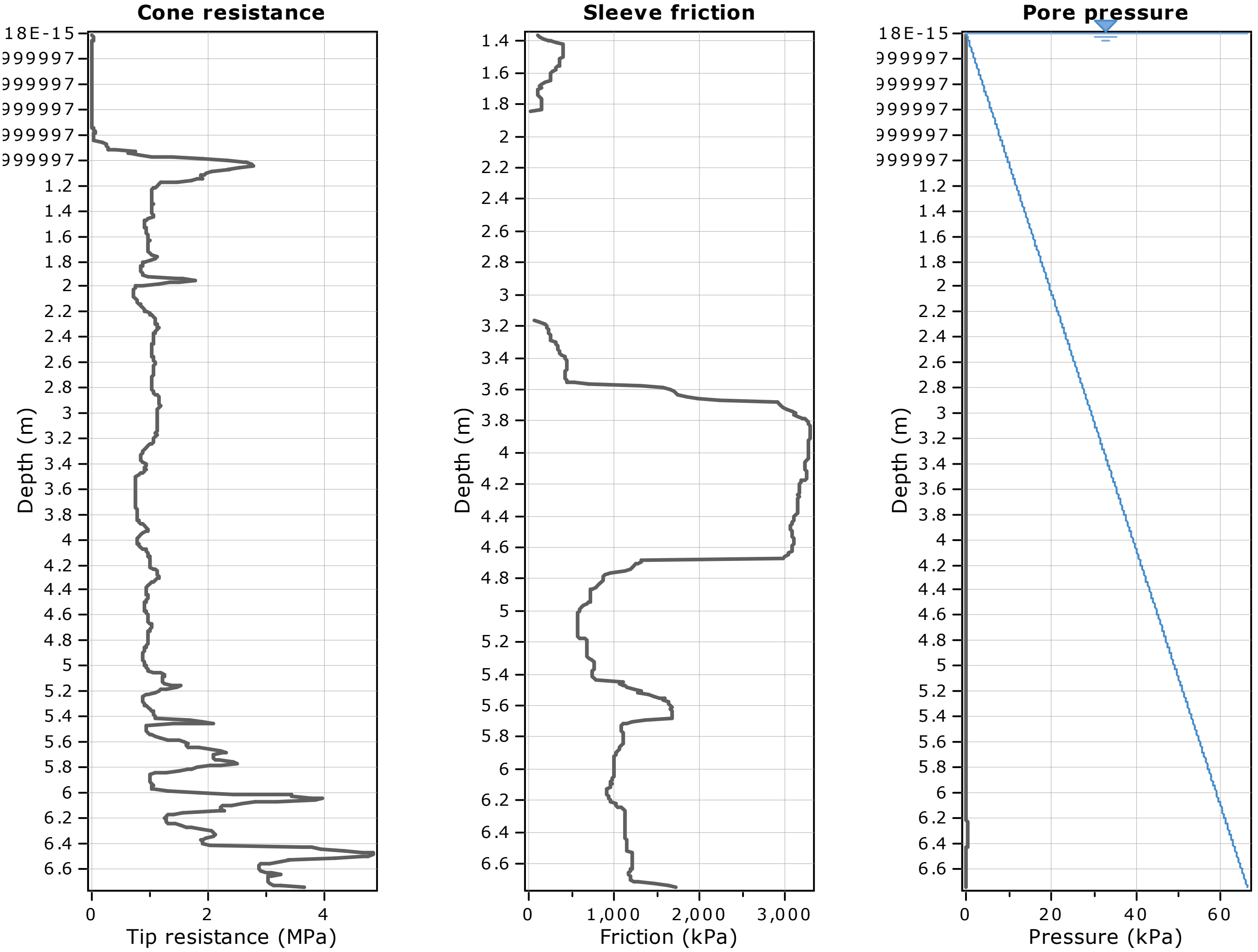
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

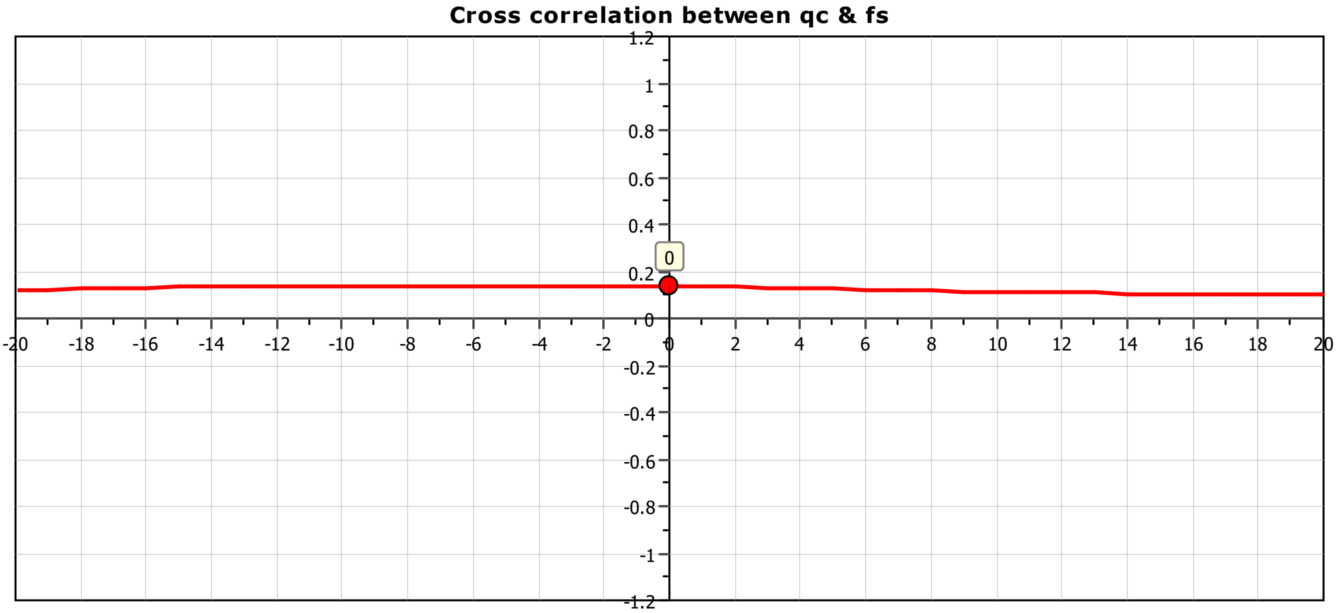


:: Tabular results ::

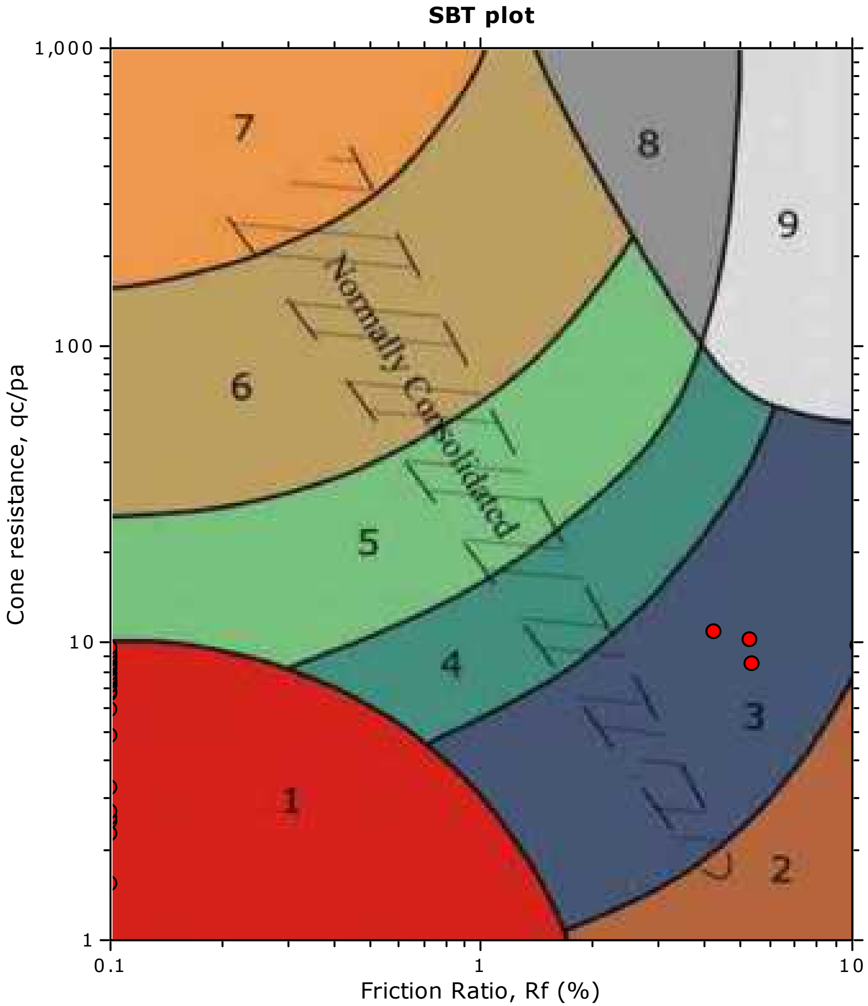
No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.32	0.20	9.50	273.55
2	1.20	0.50	2.30	1.34	0.20	9.50	276.76
3	1.40	0.50	2.60	1.31	0.20	9.50	272.06
4	1.60	0.50	2.90	1.31	0.20	9.50	270.77
5	1.80	0.50	3.20	1.34	0.20	9.50	278.32
6	2.00	0.50	3.50	1.31	0.20	9.50	270.54
7	2.20	0.50	3.80	1.50	0.20	9.50	309.76
8	2.40	0.50	4.10	1.47	0.20	9.50	302.81
9	2.60	0.50	4.40	1.44	0.20	9.50	297.43
10	2.80	0.50	4.70	1.45	0.20	9.50	300.11
11	3.00	0.50	5.00	1.45	0.20	9.50	300.30
12	3.20	0.50	5.30	1.44	0.20	9.50	297.84
13	3.40	0.50	5.60	1.45	0.20	9.50	298.51
14	3.60	0.50	5.90	1.48	0.20	9.50	304.93
15	3.80	0.50	6.20	1.48	0.20	9.50	306.31
16	4.00	0.50	6.50	1.60	0.20	9.50	329.89

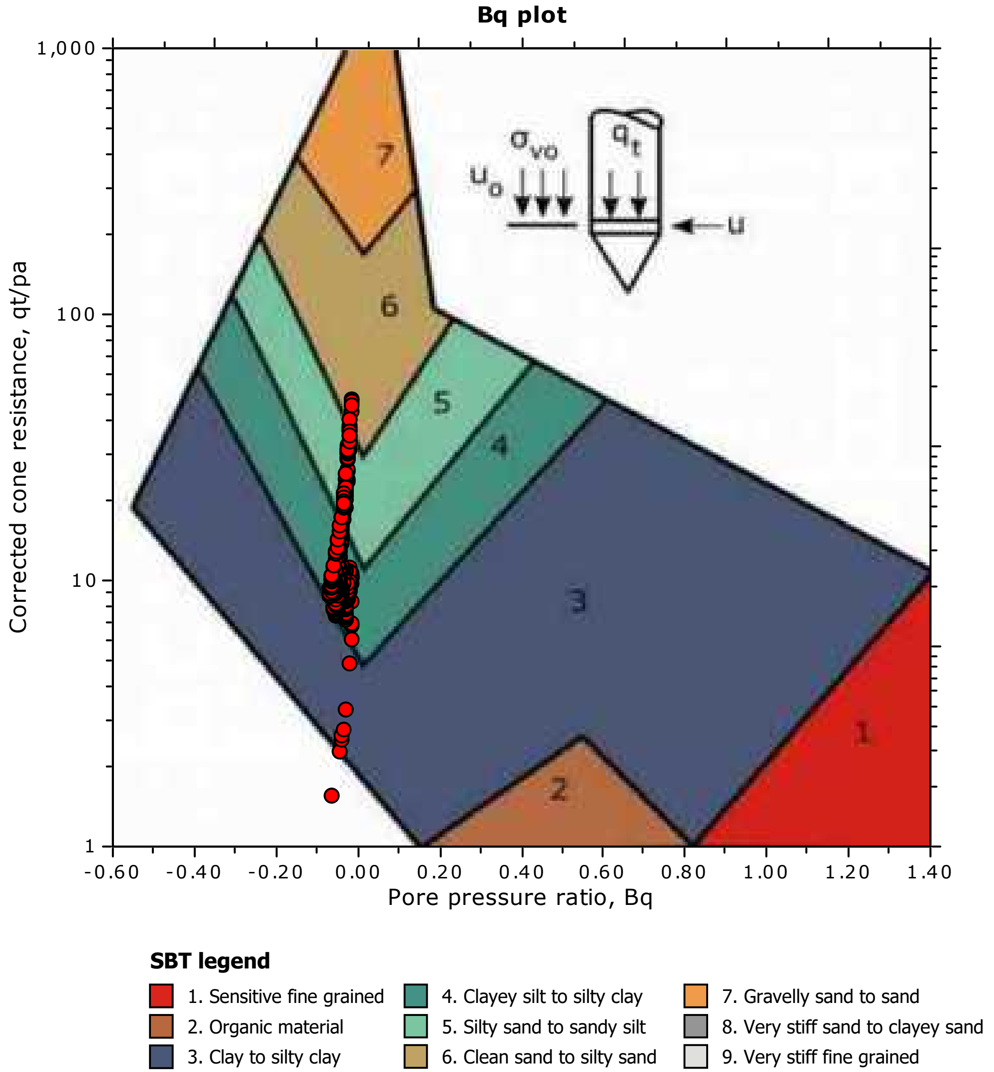


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots


SBT plot
Cone resistance, qc/pa
Friction Ratio, Rf (%)
1,000
100
10
1
0.1
1
10
7
8
9
6
5
4
3
2
1
Normally Consolidated


Bq plot
Corrected cone resistance, qt/pa
Pore pressure ratio, Bq
1,000
100
10
1
-0.60
-0.40
-0.20
0.00
0.20
0.40
0.60
0.80
1.00
1.20
1.40
7
6
5
4
3
2
1
u
SBT legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

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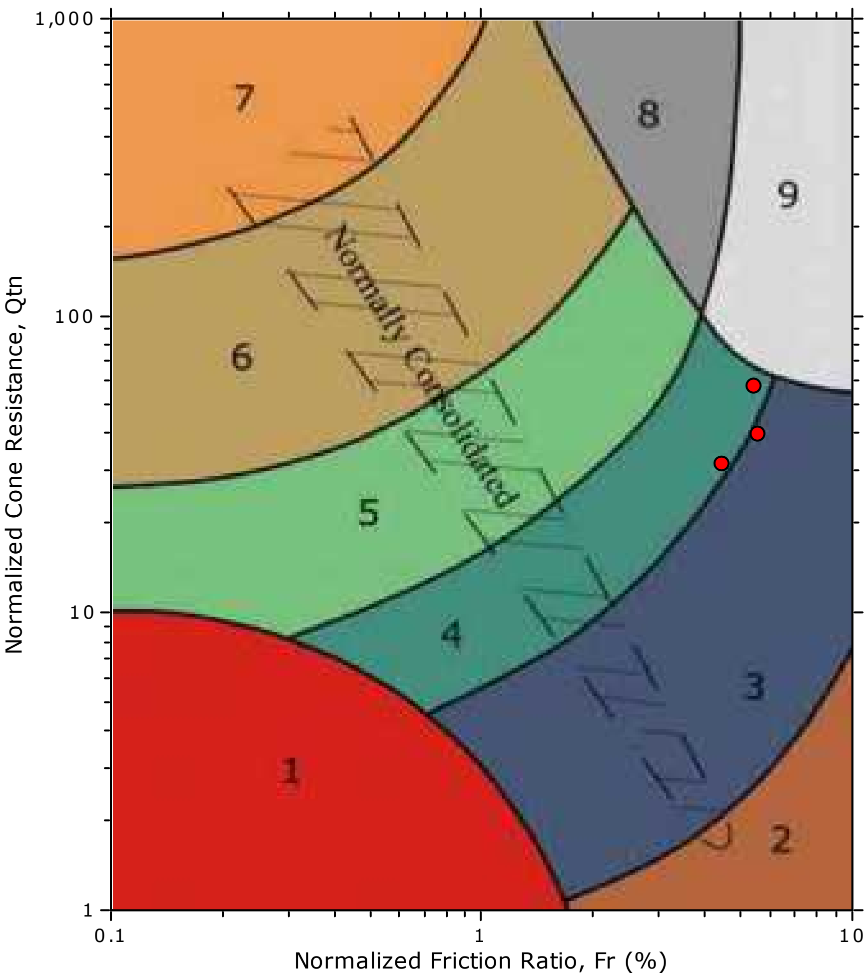
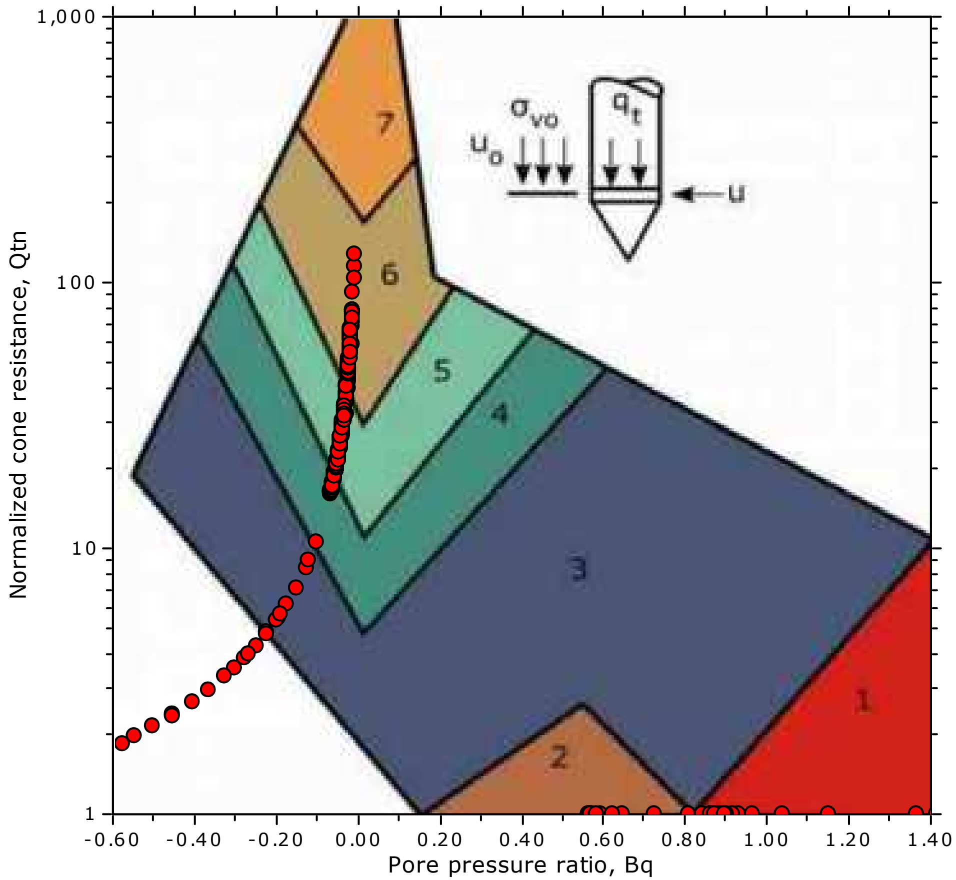
CPT: A1-CPT03
Total depth: 6.75 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

SBT - Bq plots (normalized)

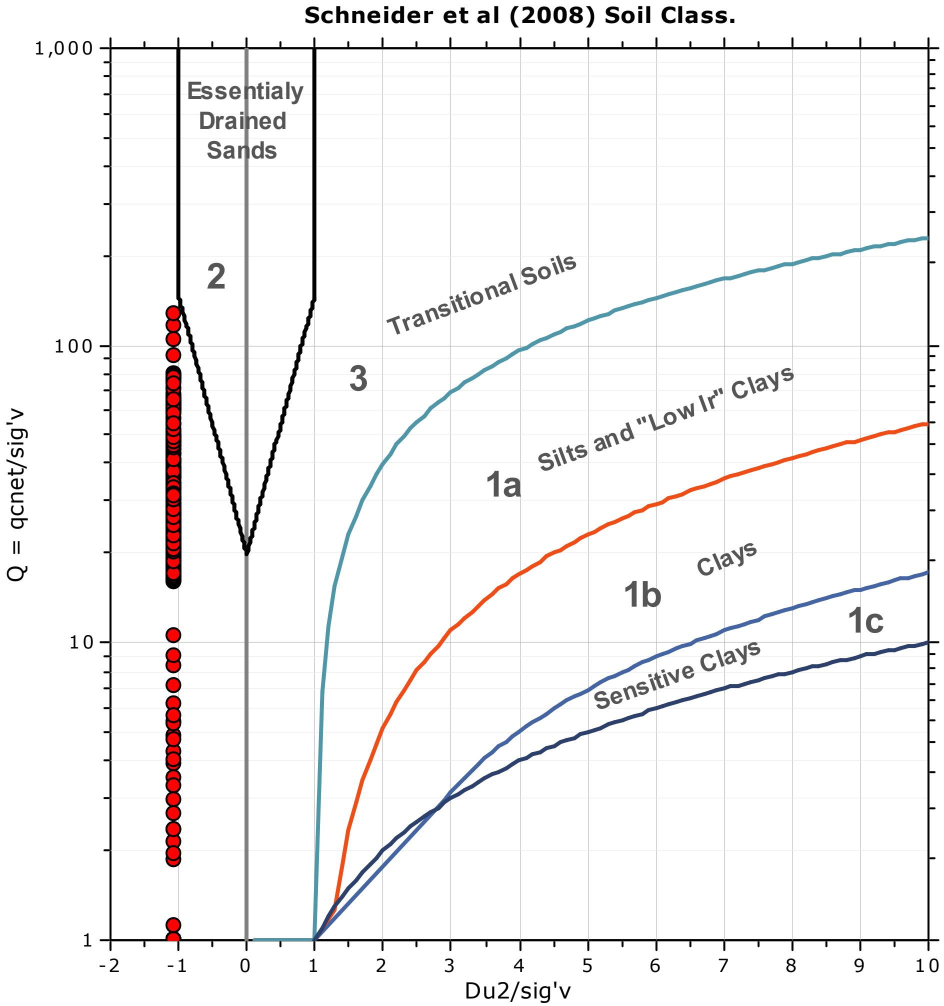


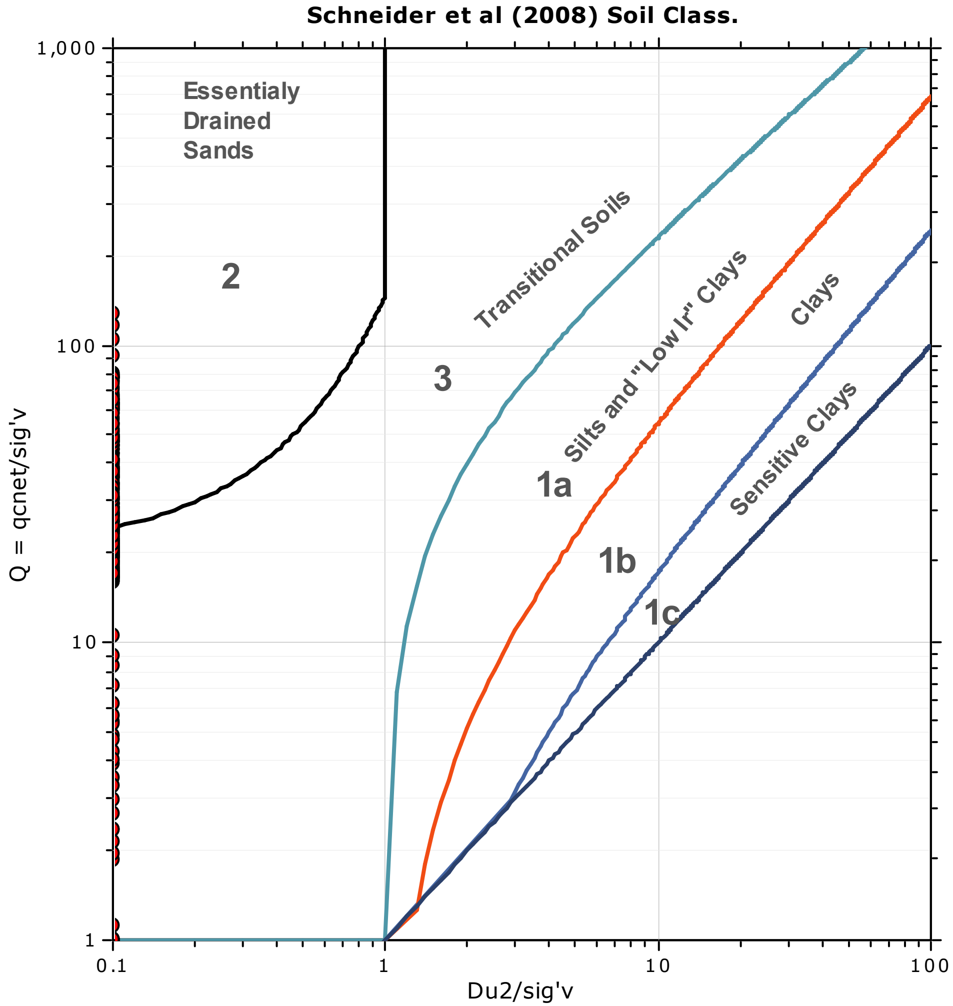


SBTn legend

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

Bq plots (Schneider)





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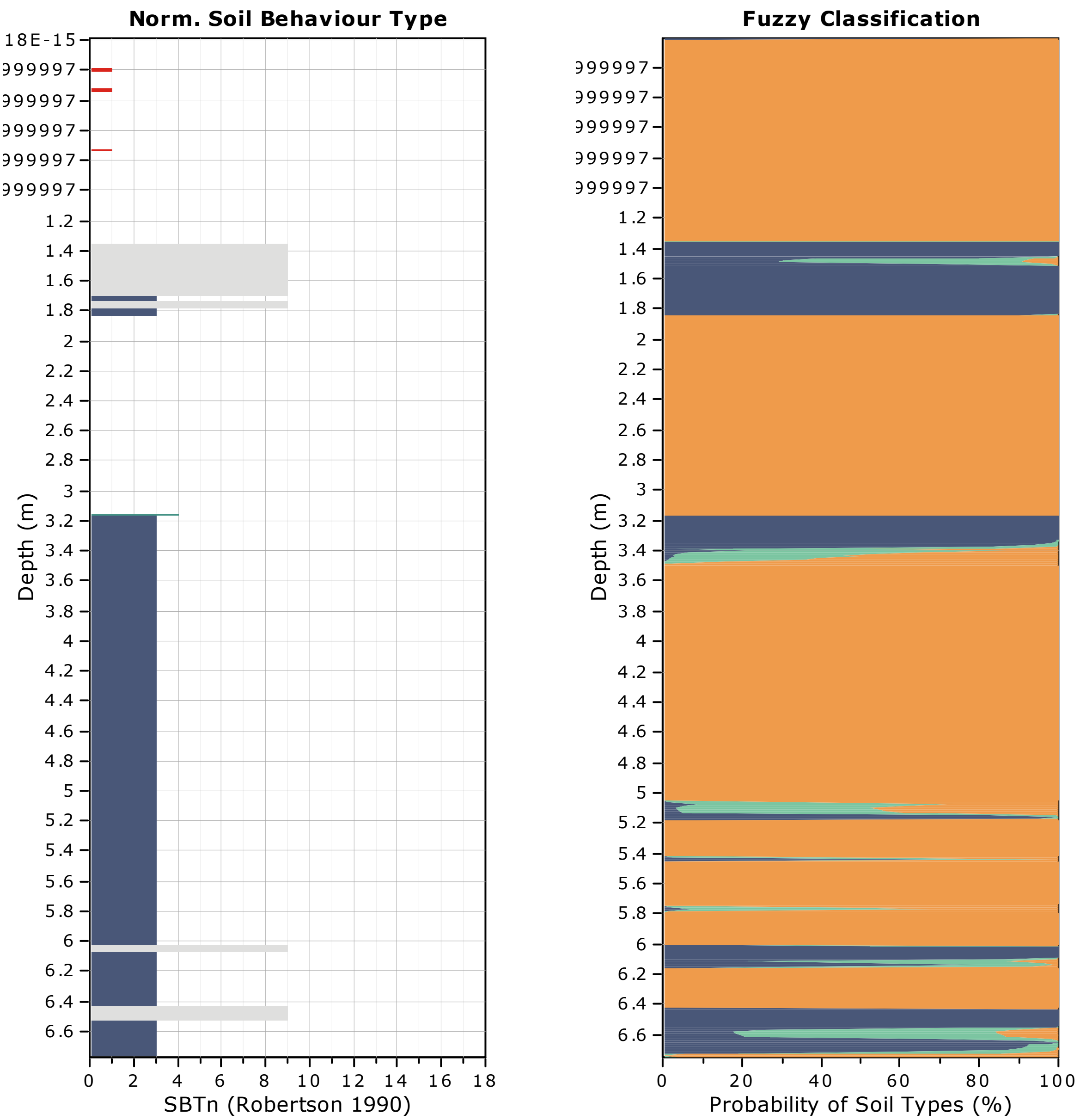
CPT: A1-CPT03
Total depth: 6.75 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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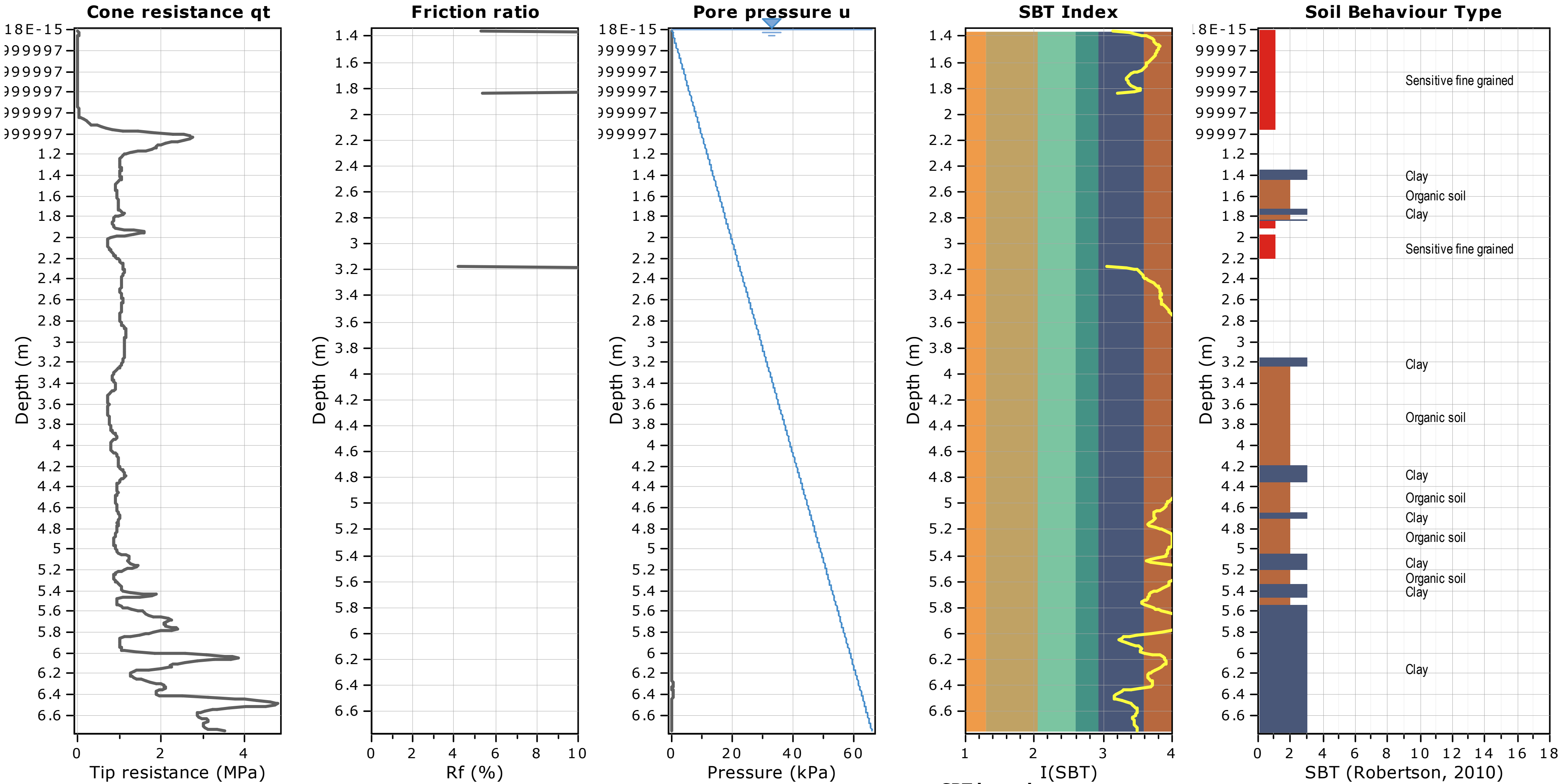
CPT: A1-CPT03
Total depth: 6.75 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBT legend

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

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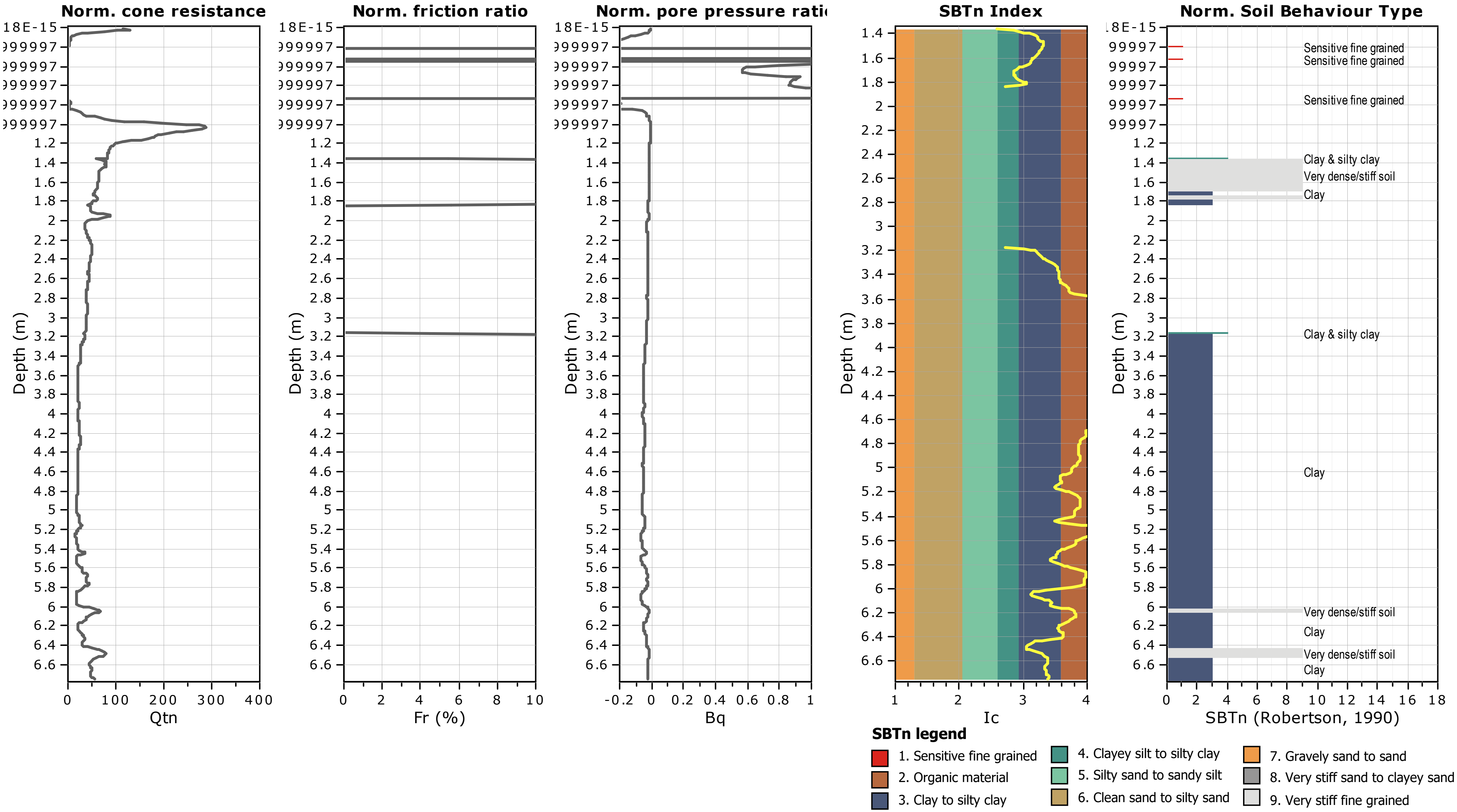
CPT: A1-CPT03
Total depth: 6.75 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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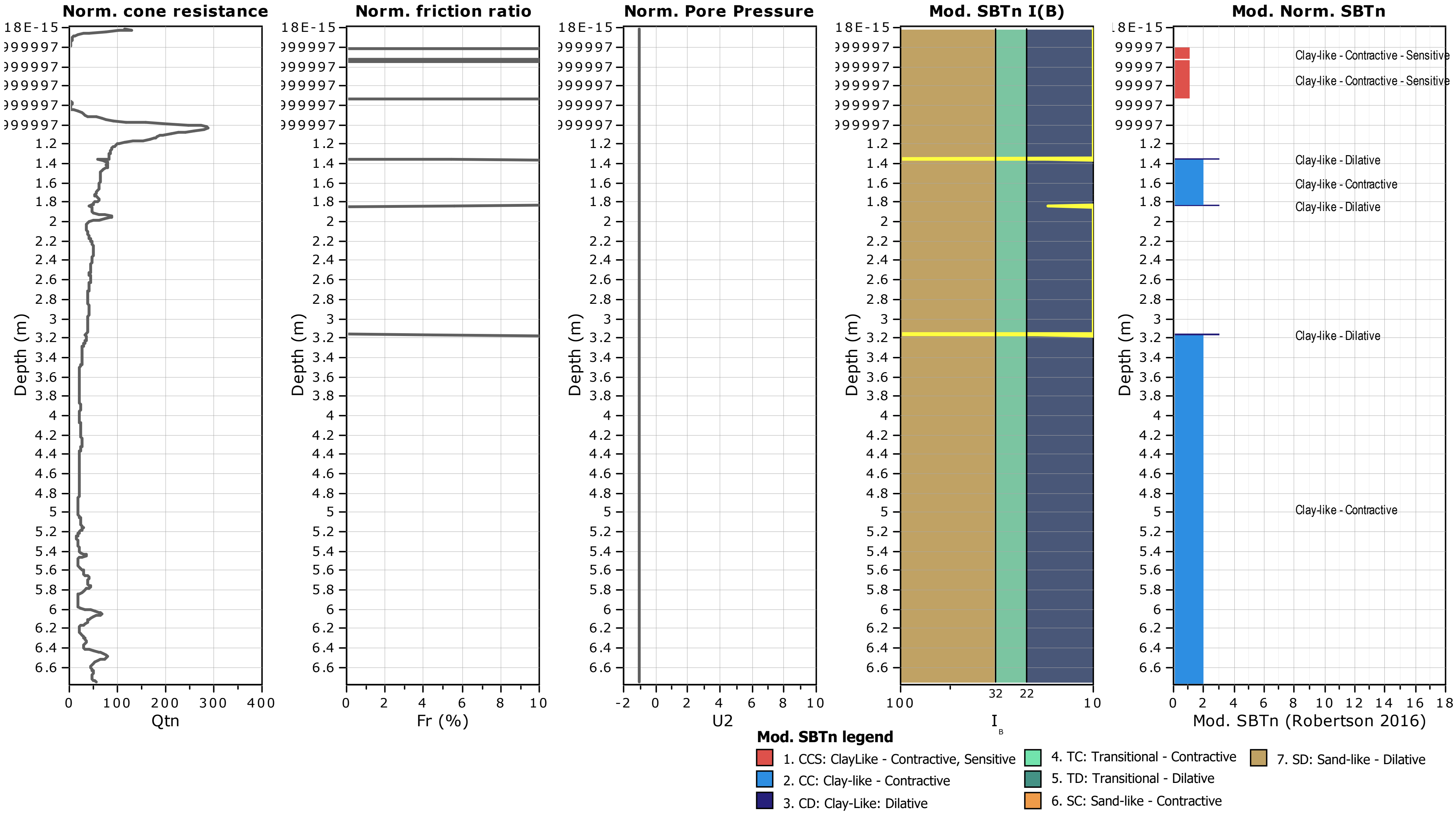
CPT: A1-CPT03
Total depth: 6.75 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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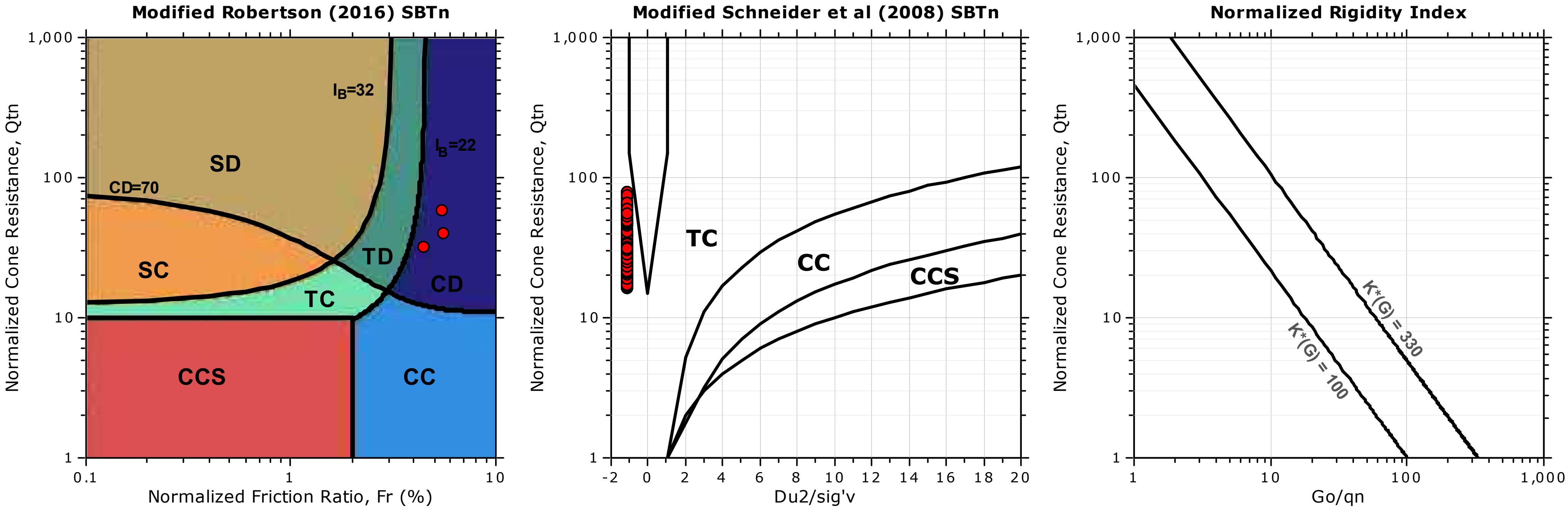
CPT: A1-CPT03
Total depth: 6.75 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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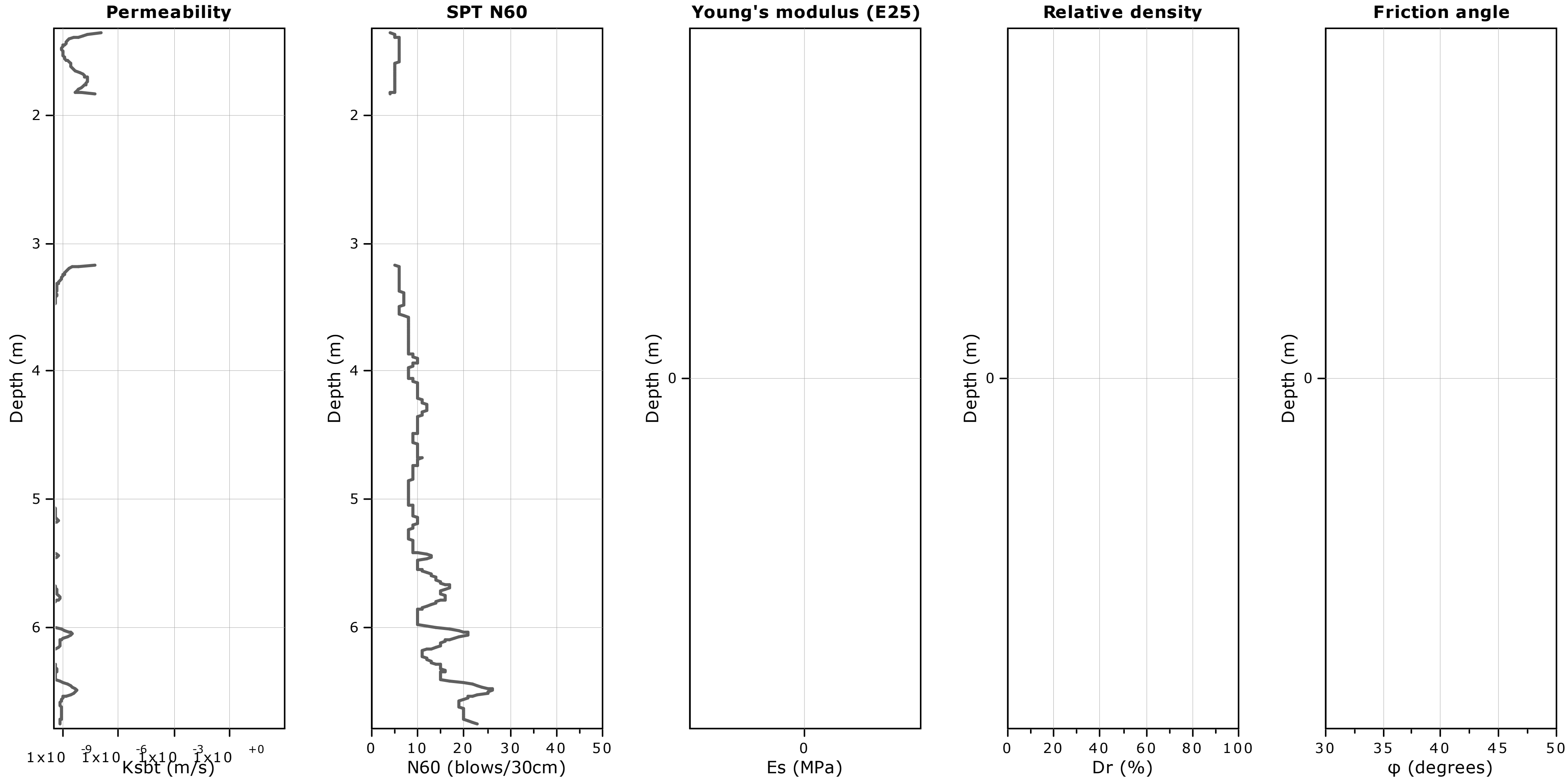
CPT: A1-CPT03
Total depth: 6.75 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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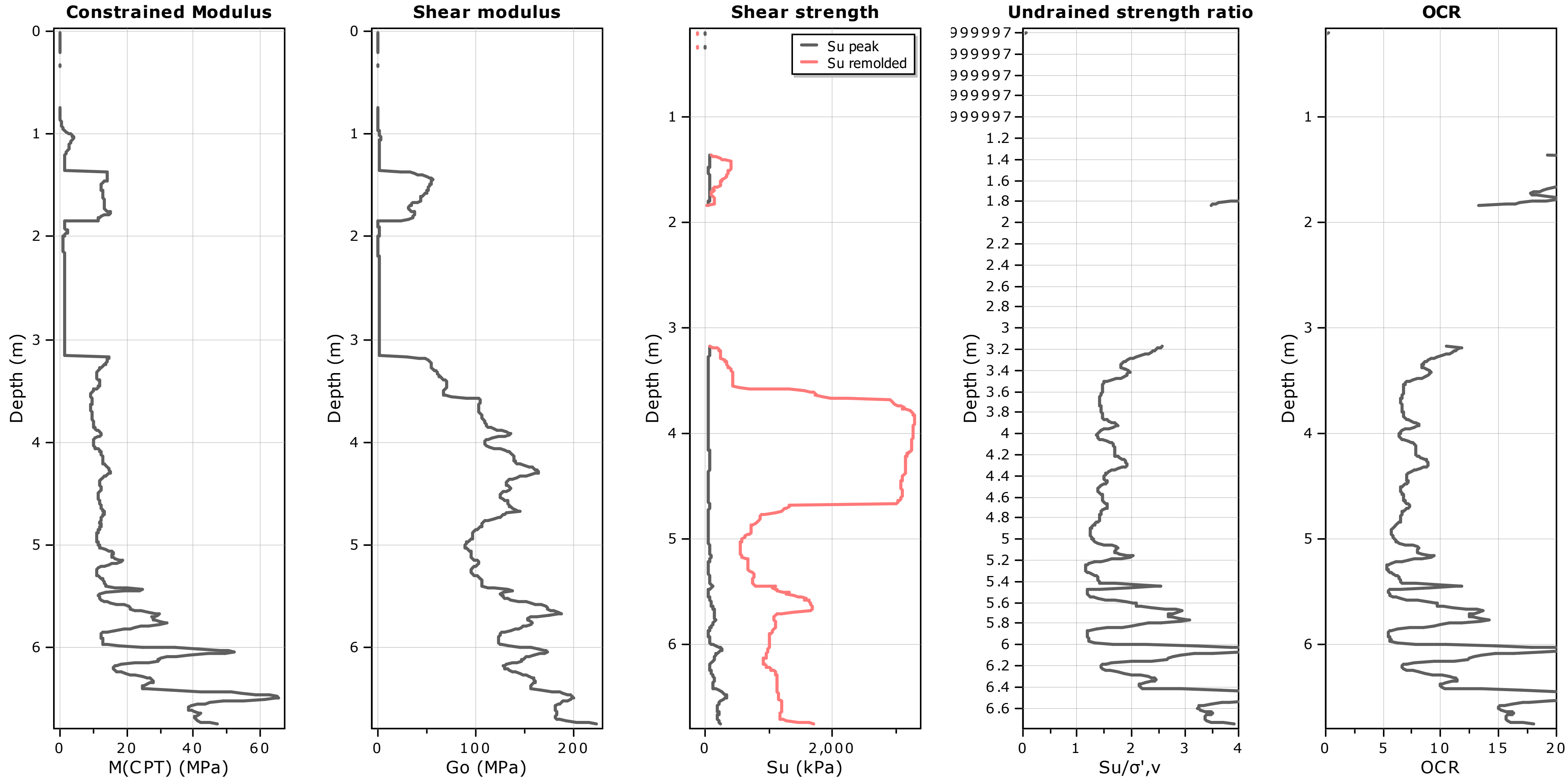
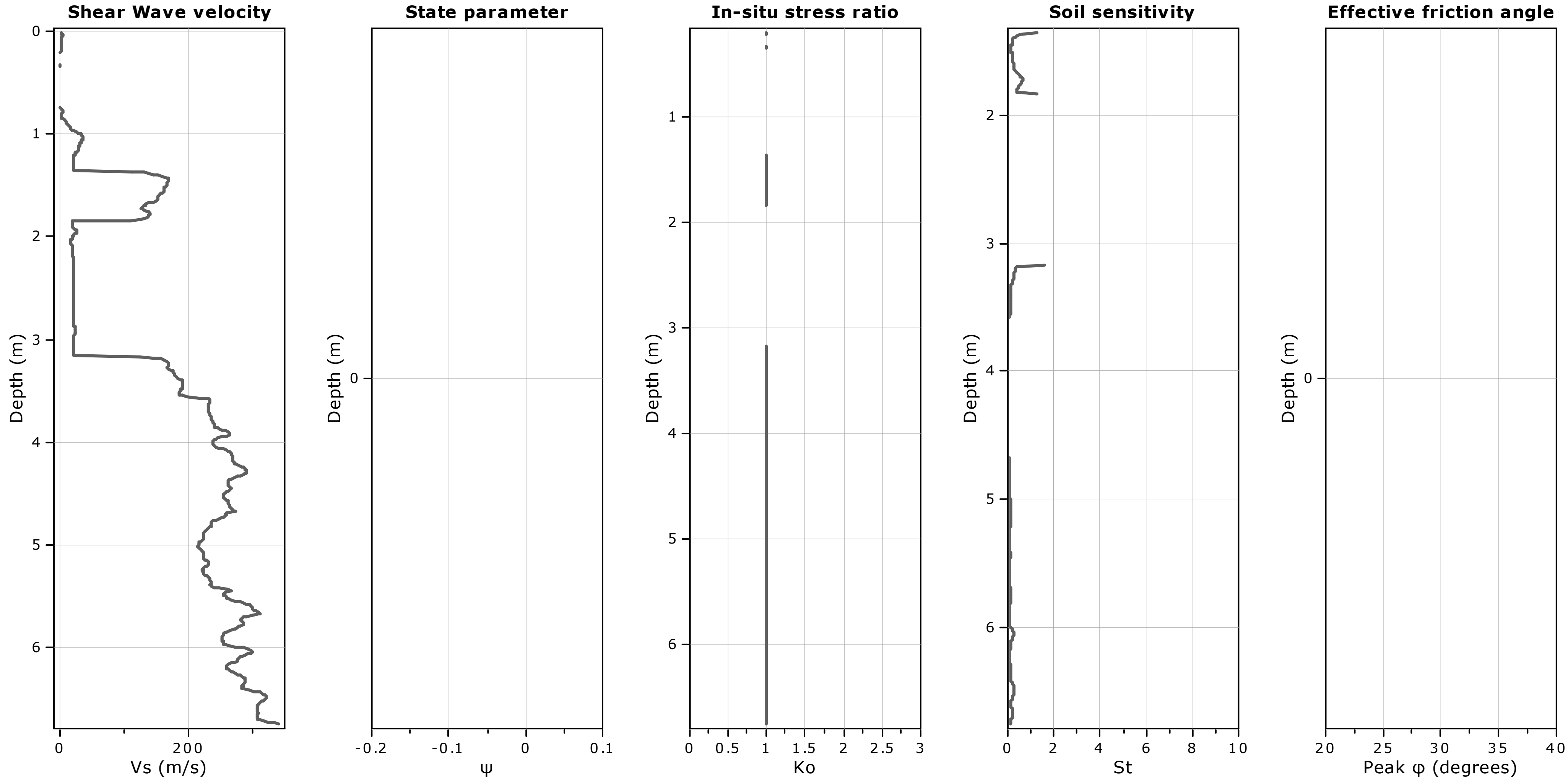
CPT: A1-CPT03
Total depth: 6.75 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

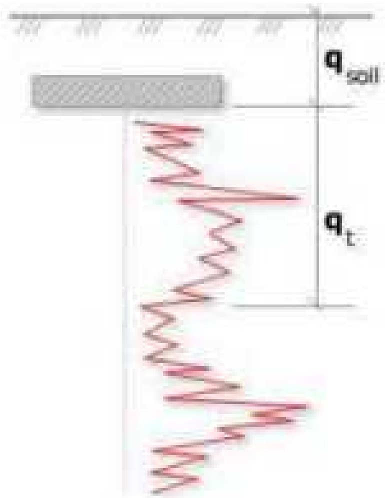
OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

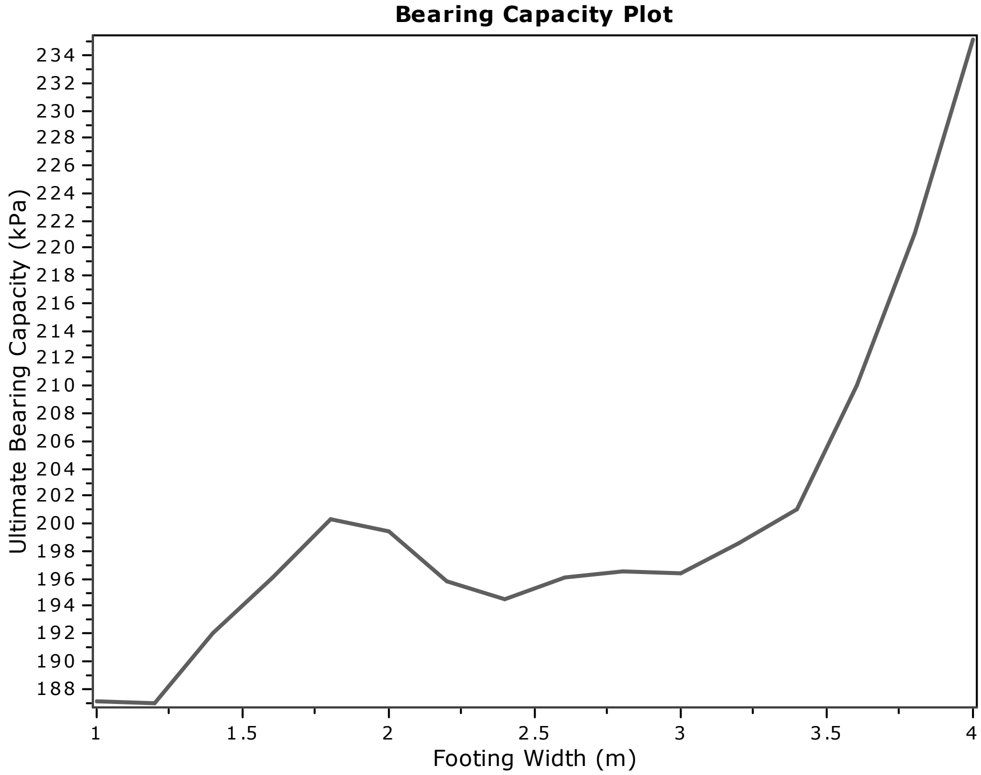
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.89	0.20	9.50	187.01
2	1.20	0.50	2.30	0.89	0.20	9.50	186.92
3	1.40	0.50	2.60	0.91	0.20	9.50	191.95
4	1.60	0.50	2.90	0.93	0.20	9.50	196.01
5	1.80	0.50	3.20	0.95	0.20	9.50	200.30
6	2.00	0.50	3.50	0.95	0.20	9.50	199.42
7	2.20	0.50	3.80	0.93	0.20	9.50	195.81
8	2.40	0.50	4.10	0.93	0.20	9.50	194.51
9	2.60	0.50	4.40	0.93	0.20	9.50	196.14
10	2.80	0.50	4.70	0.93	0.20	9.50	196.46
11	3.00	0.50	5.00	0.93	0.20	9.50	196.43
12	3.20	0.50	5.30	0.95	0.20	9.50	198.52
13	3.40	0.50	5.60	0.96	0.20	9.50	201.06
14	3.60	0.50	5.90	1.00	0.20	9.50	210.09
15	3.80	0.50	6.20	1.06	0.20	9.50	221.05
16	4.00	0.50	6.50	1.13	0.20	9.50	235.19

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

:: N_{SPT} (blows per 30 cm) ::

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

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

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

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

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

:: Relative Density, Dr (%) ::

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

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

:: State Parameter, ψ ::

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

:: Drained Friction Angle, φ (°) ::

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

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

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

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

If $I_c \geq 2.20$

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

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

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

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

:: Soil Sensitivity, S_t ::

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

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

:: Peak Friction Angle, φ' (°) ::

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

(applicable for $0.10 < B_q < 1.00$)

References

• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

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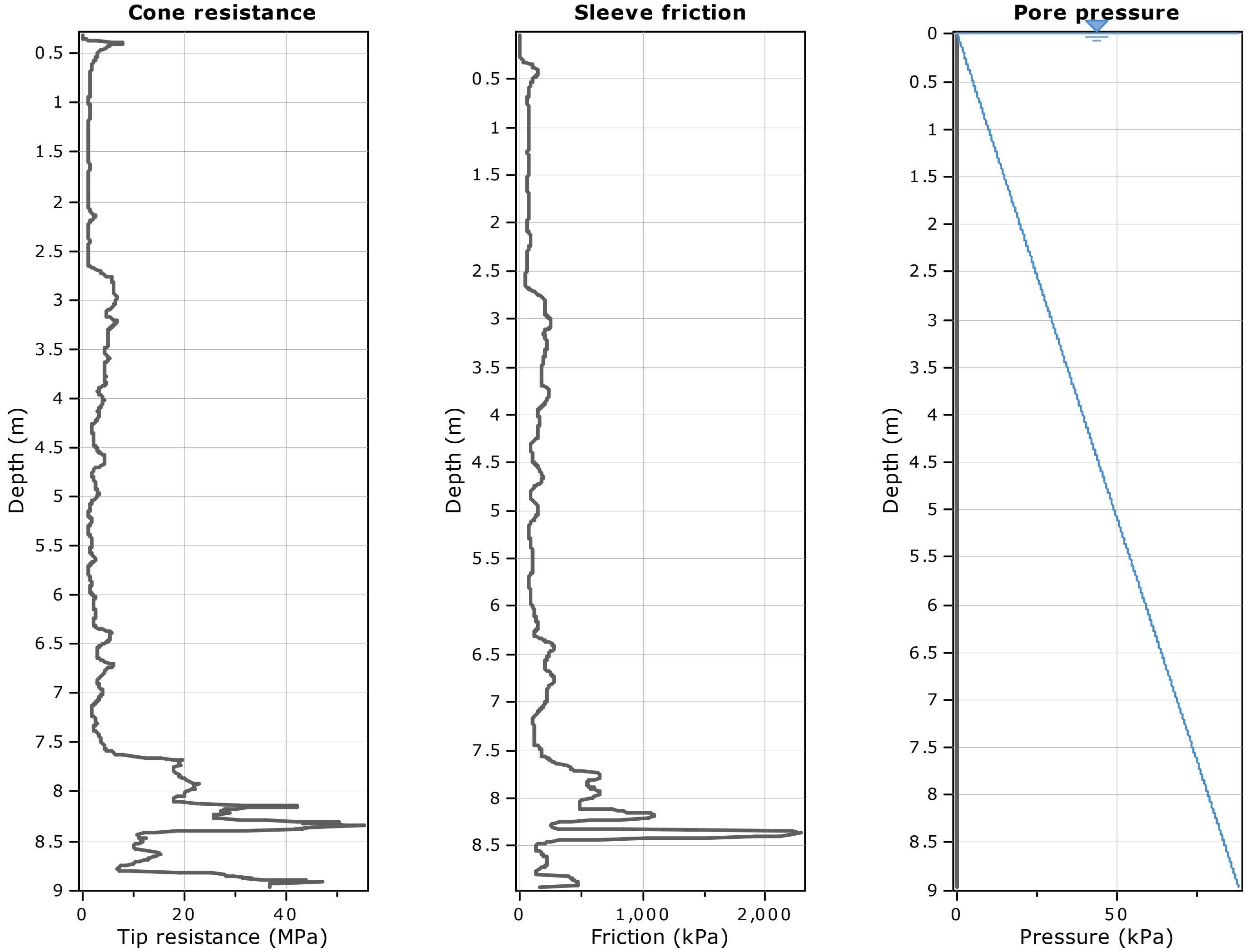
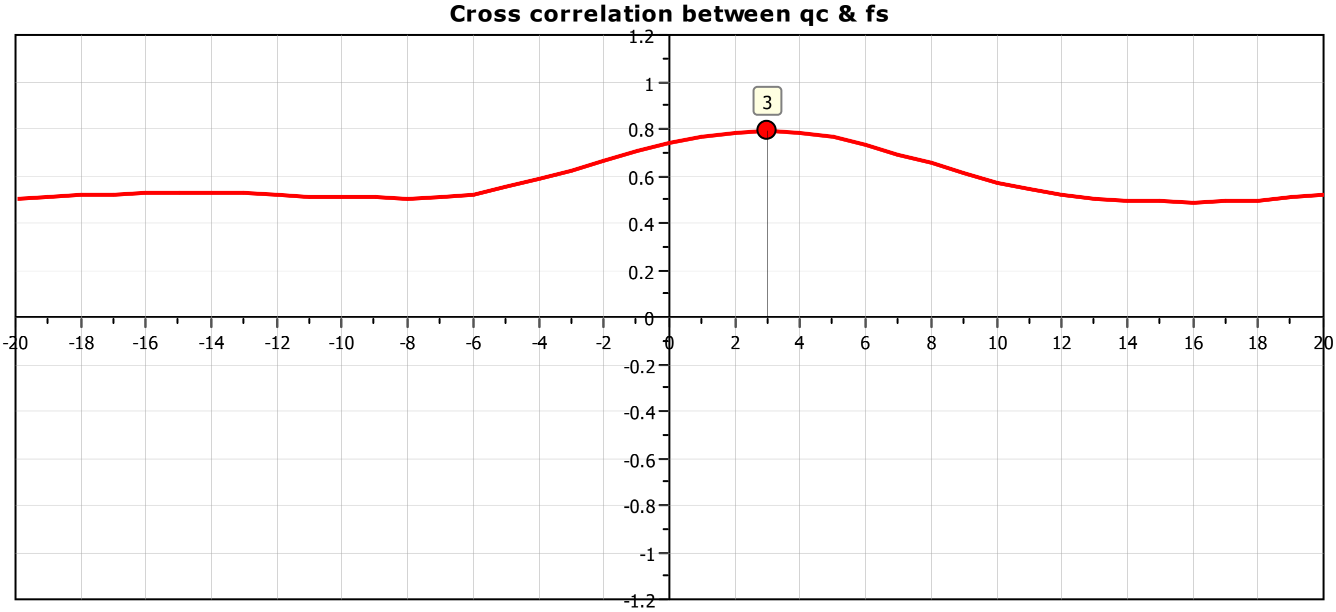
CPT: A2-CPT01
Total depth: 8.97 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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



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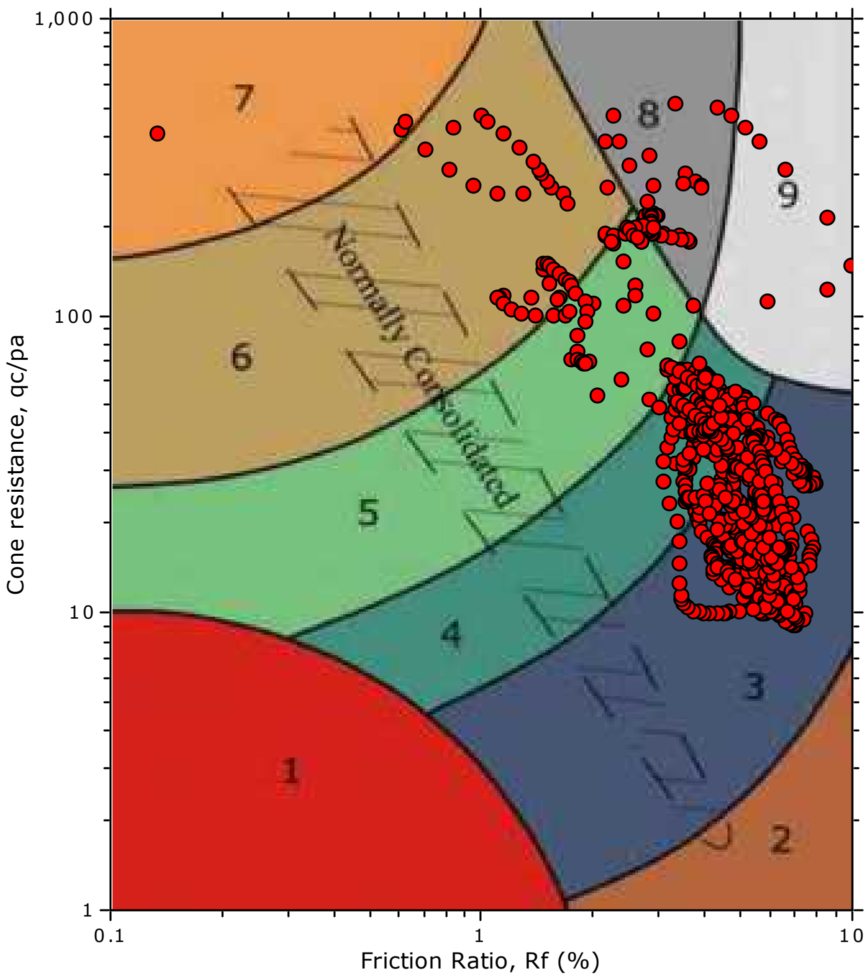
CPT: A2-CPT01
Total depth: 8.97 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

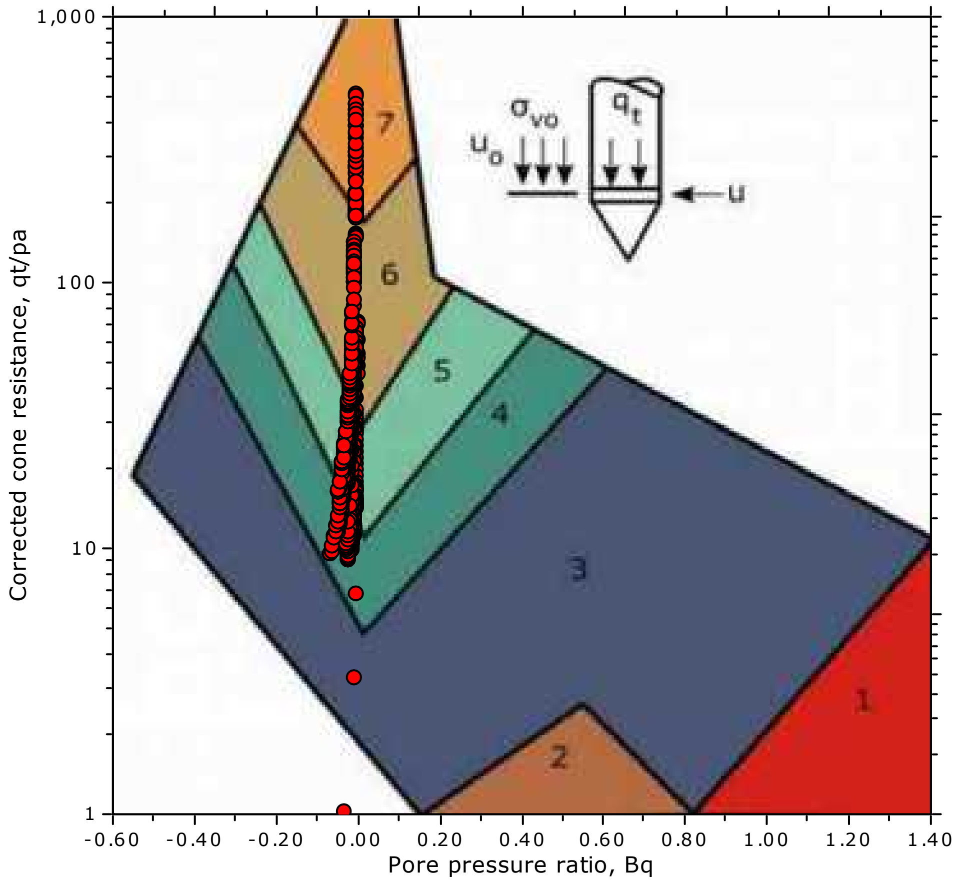
Project:
Location:

SBT - Bq plots

SBT plot



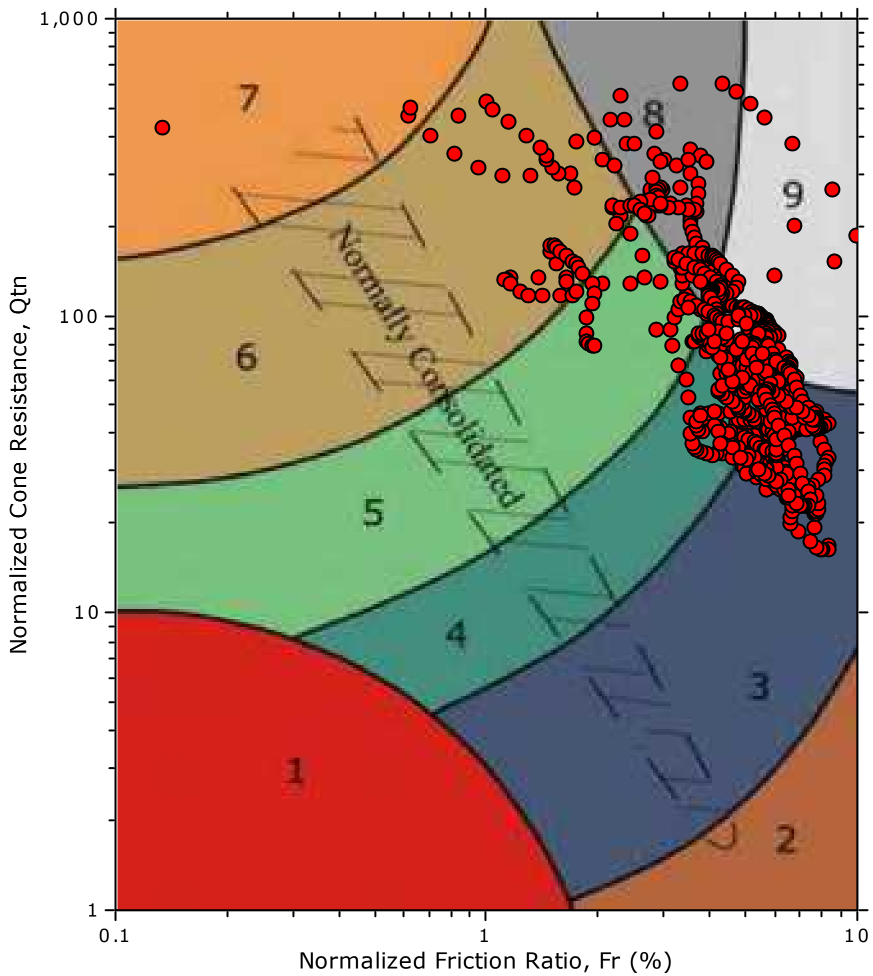
Bq plot

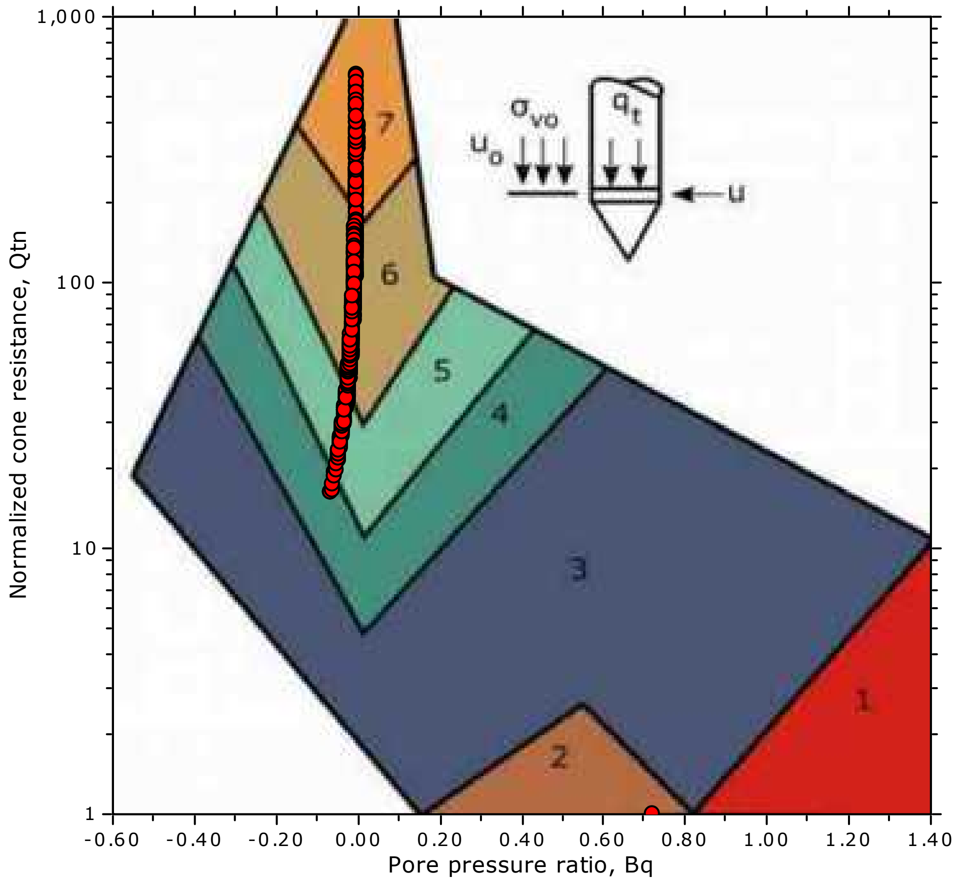


SBT legend

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

SBT - Bq plots (normalized)





SBTn legend

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

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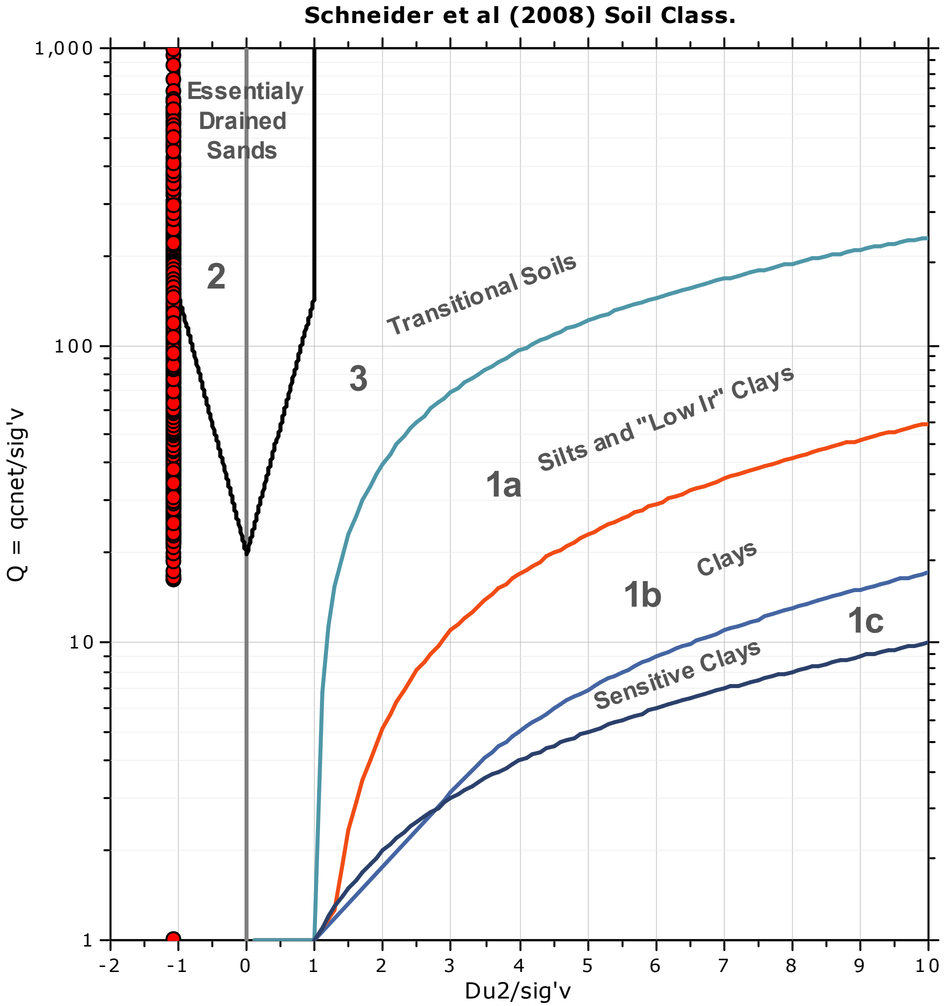
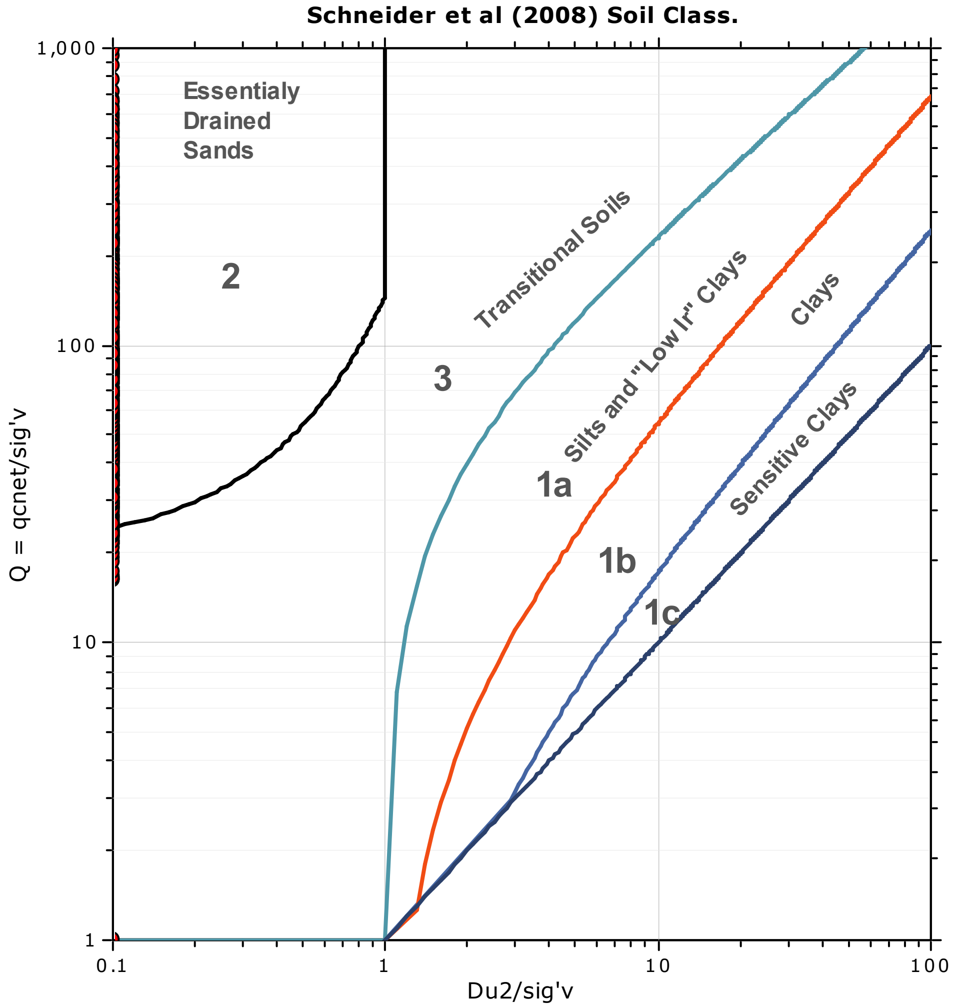
CPT: A2-CPT01
Total depth: 8.97 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

Bq plots (Schneider)





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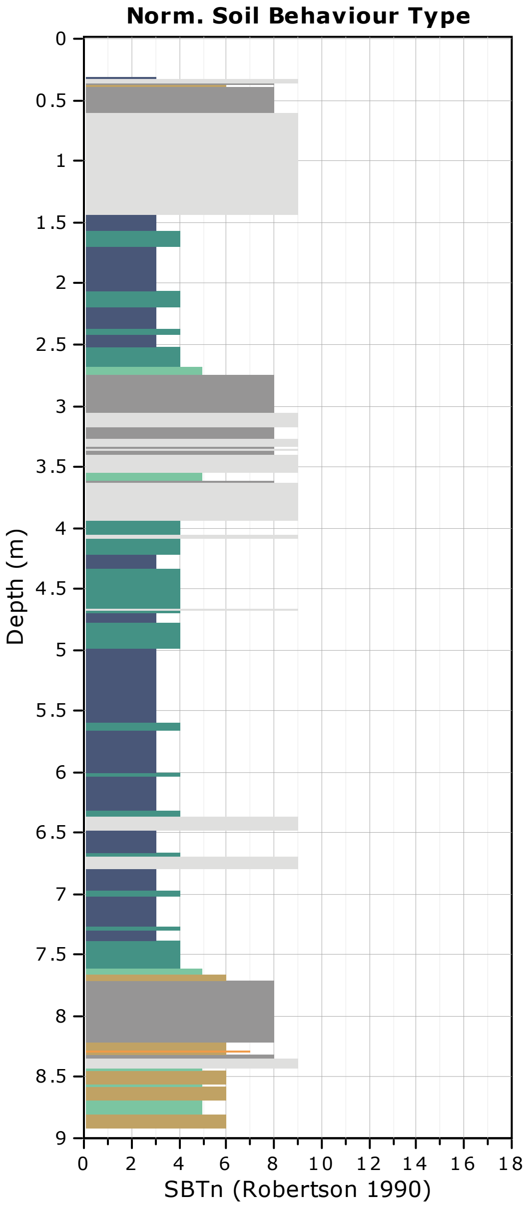
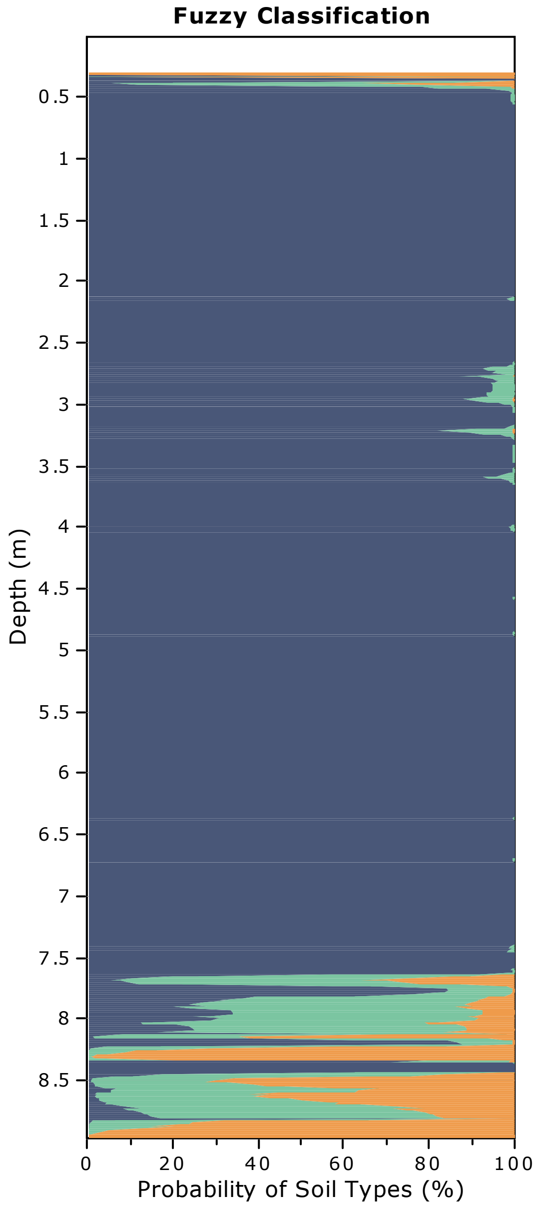
CPT: A2-CPT01
Total depth: 8.97 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:





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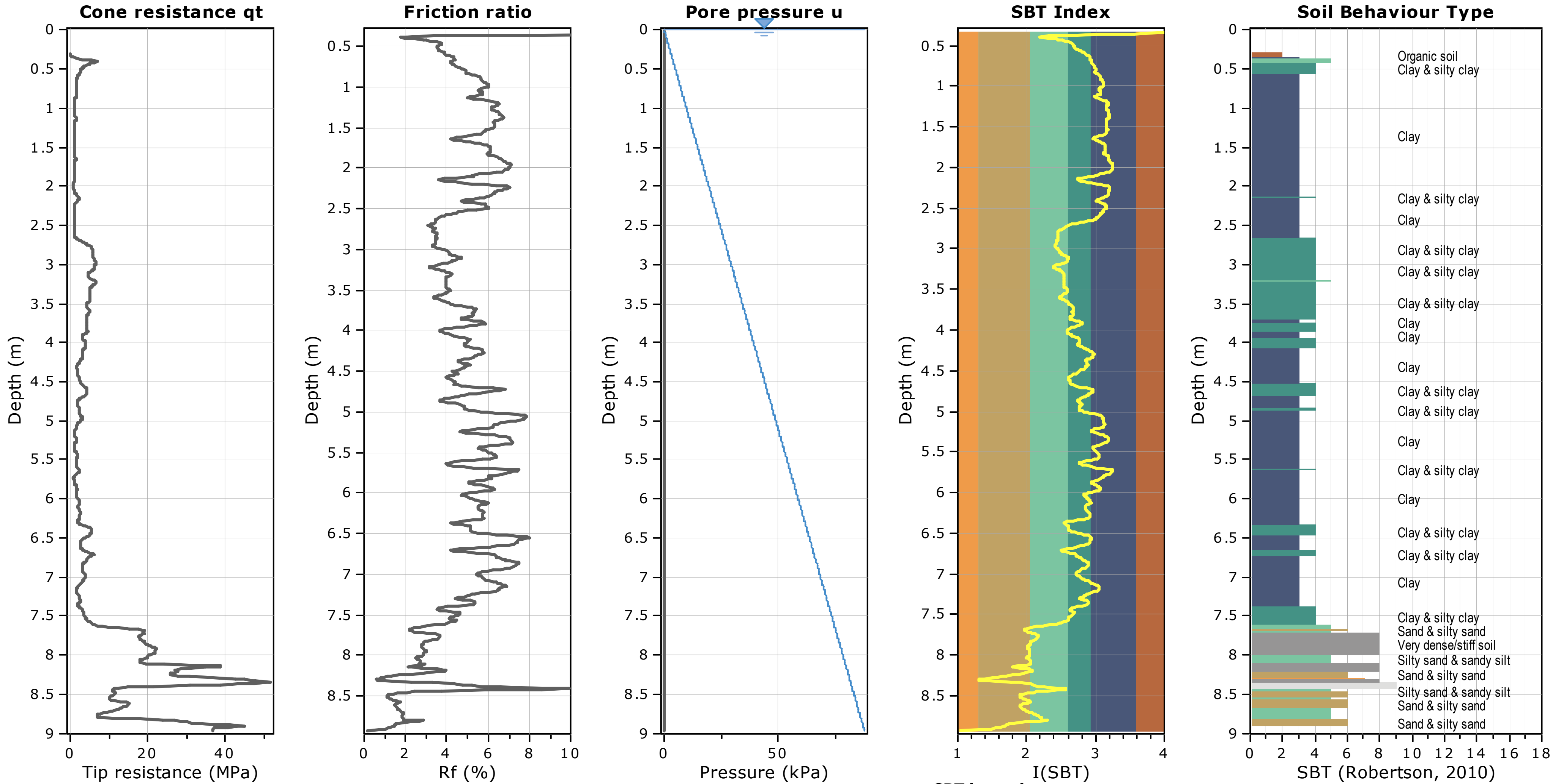
CPT: A2-CPT01
Total depth: 8.97 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



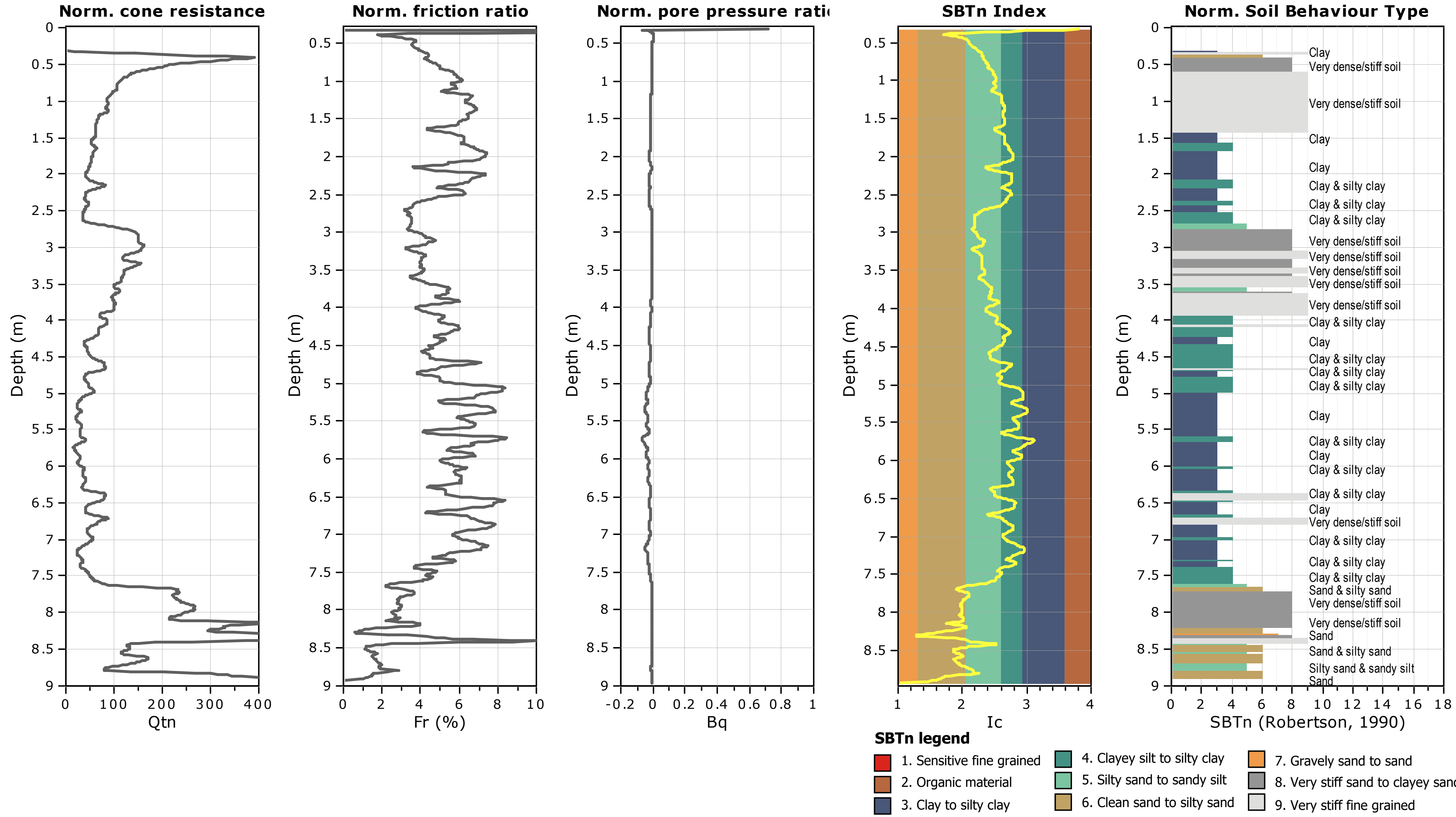
SBT legend

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

CPT: A2-CPT01

Total depth: 8.97 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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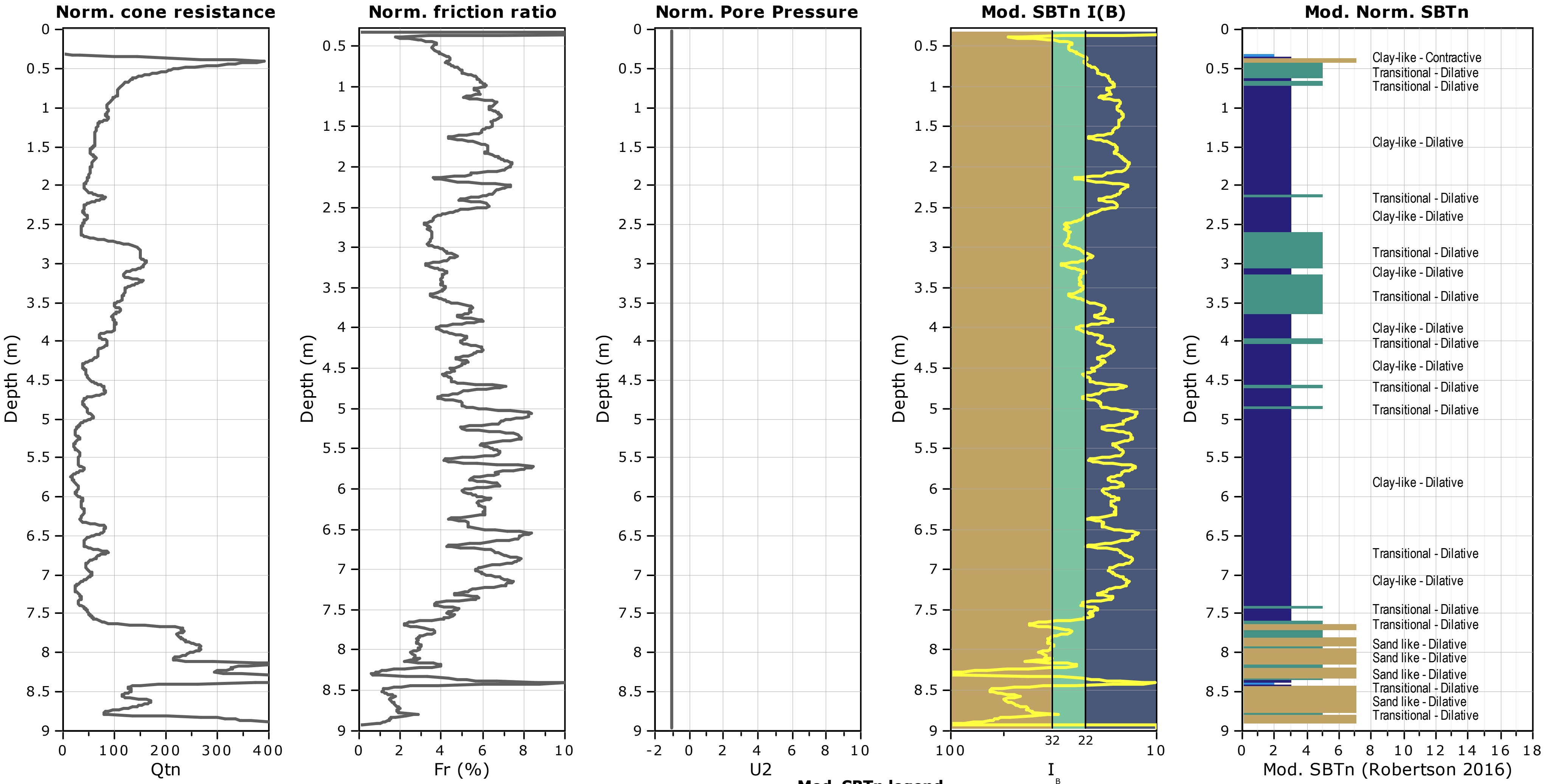
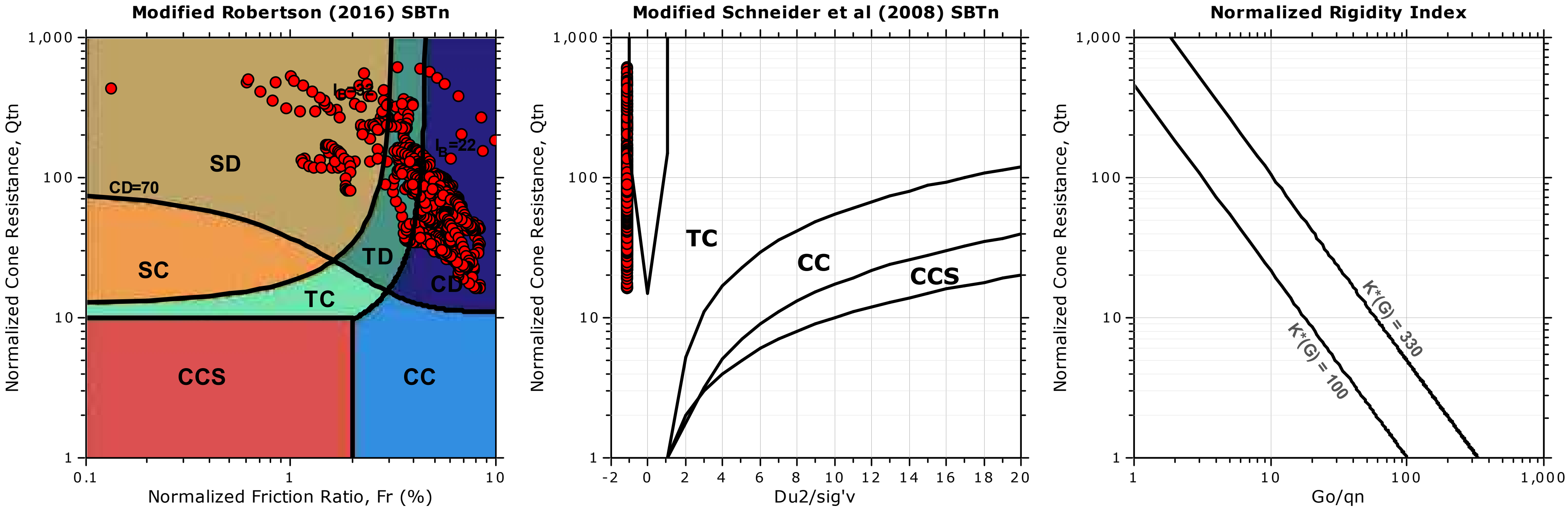
CPT: A2-CPT01
Total depth: 8.97 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Mod. SBTn legend
1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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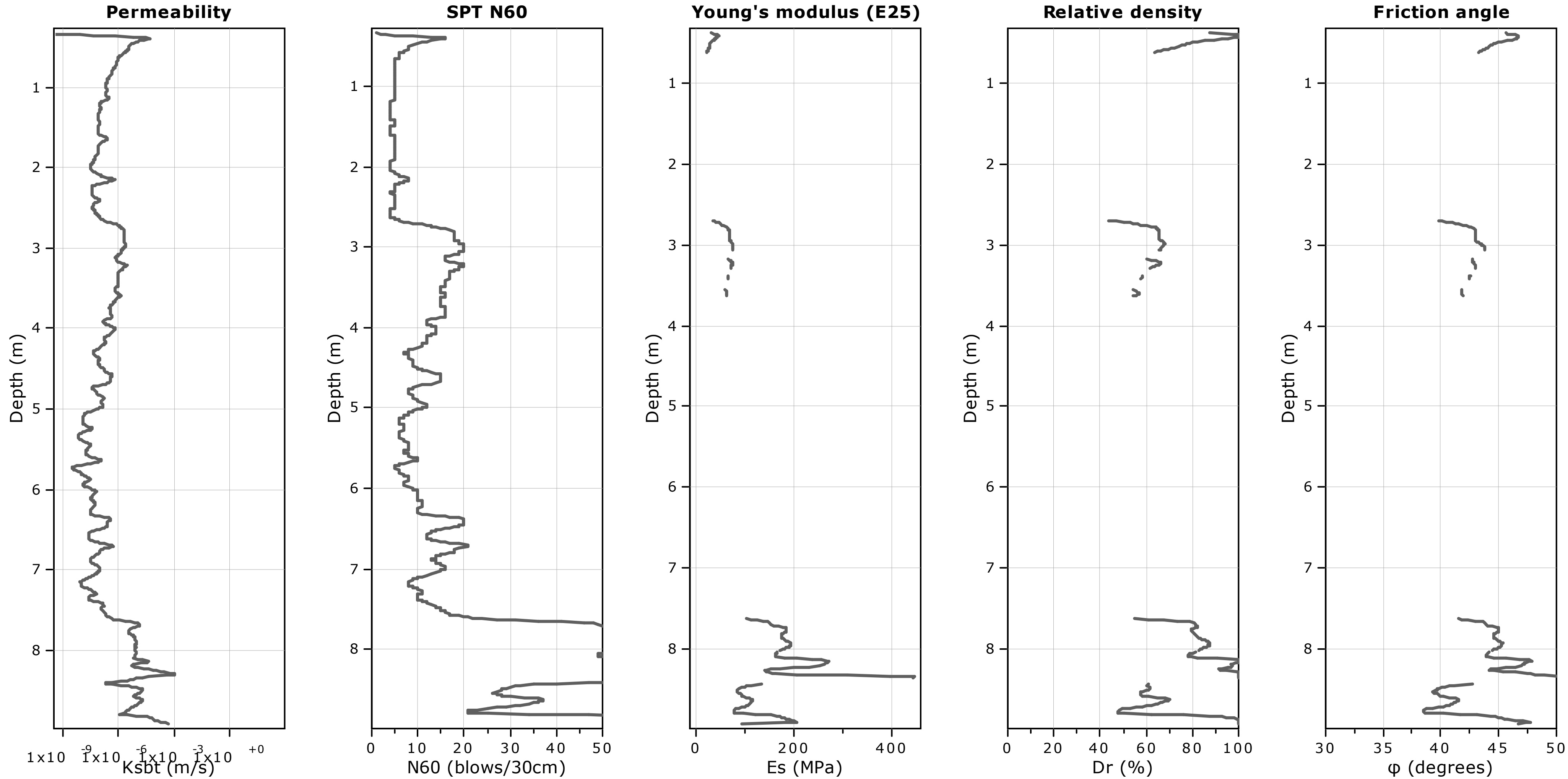
CPT: A2-CPT01
Total depth: 8.97 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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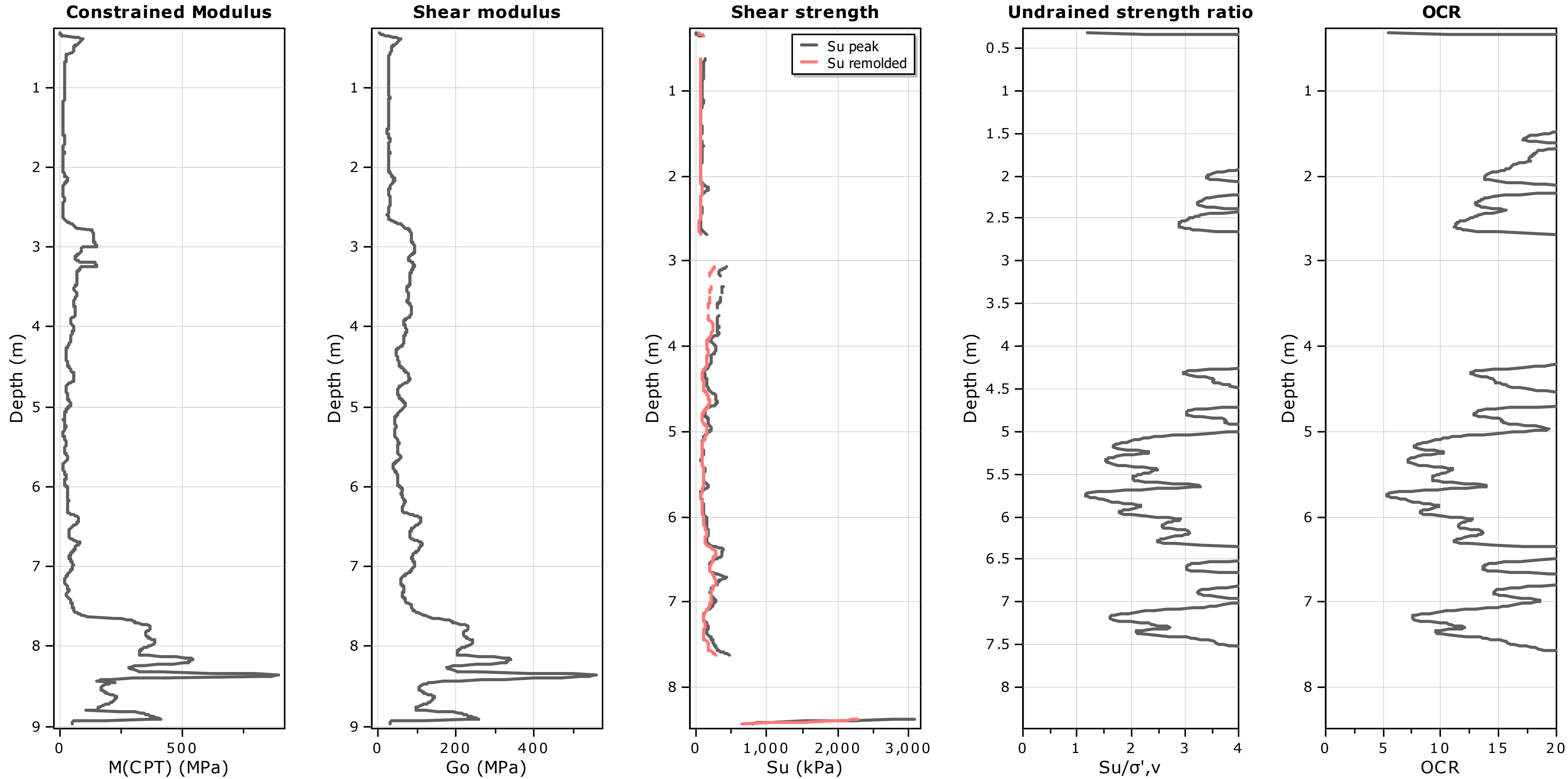
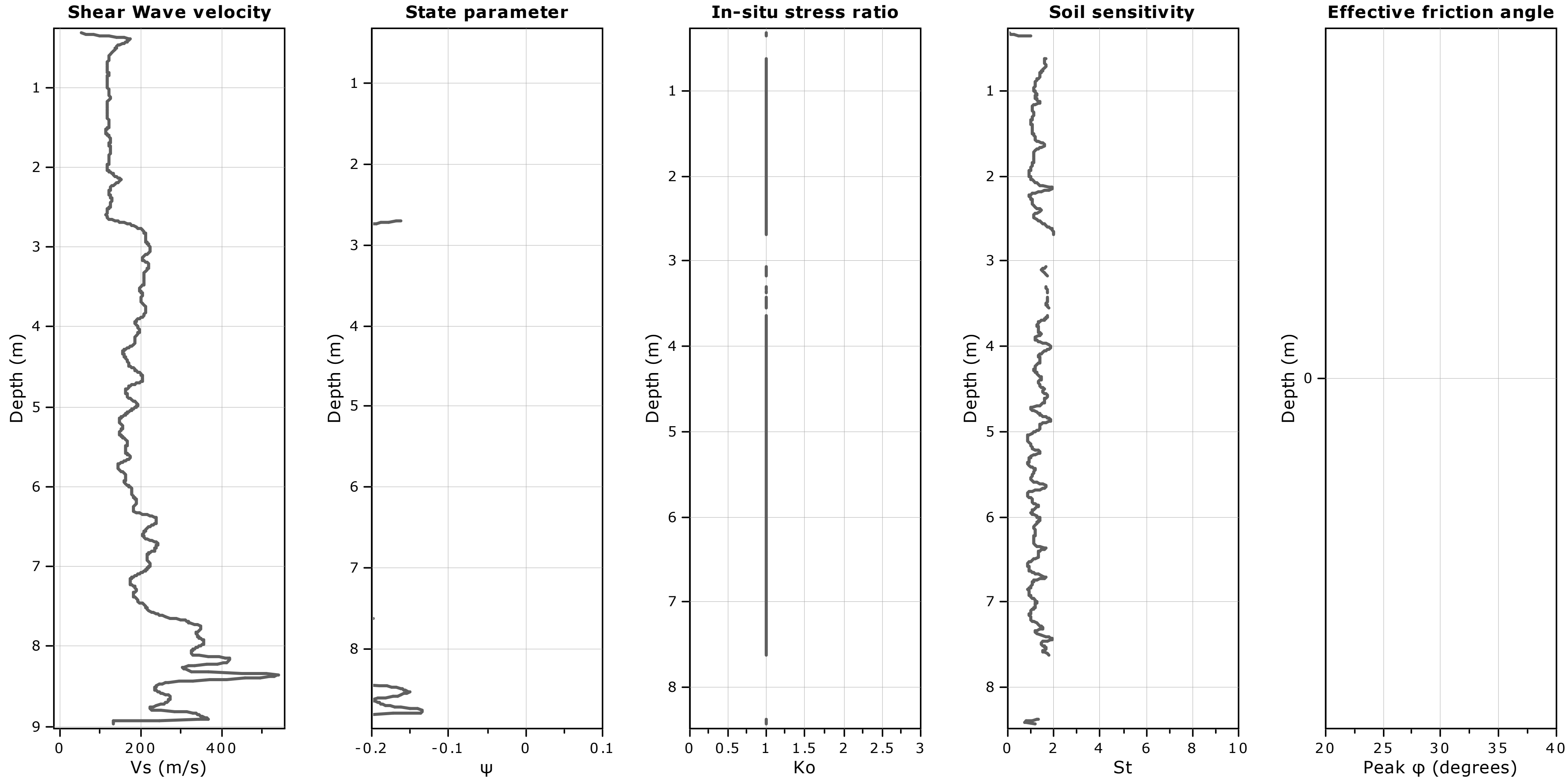
CPT: A2-CPT01
Total depth: 8.97 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

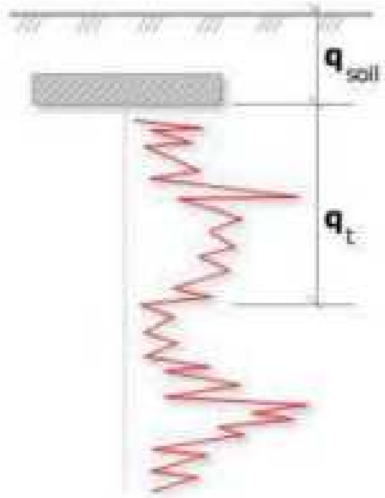
OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

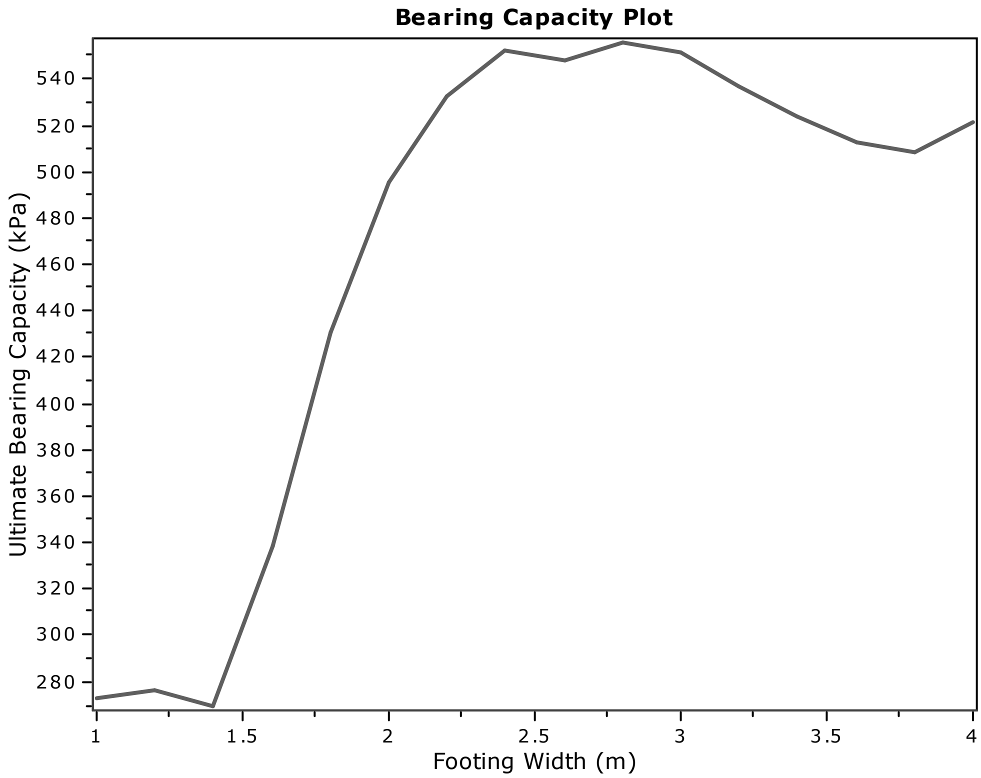
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

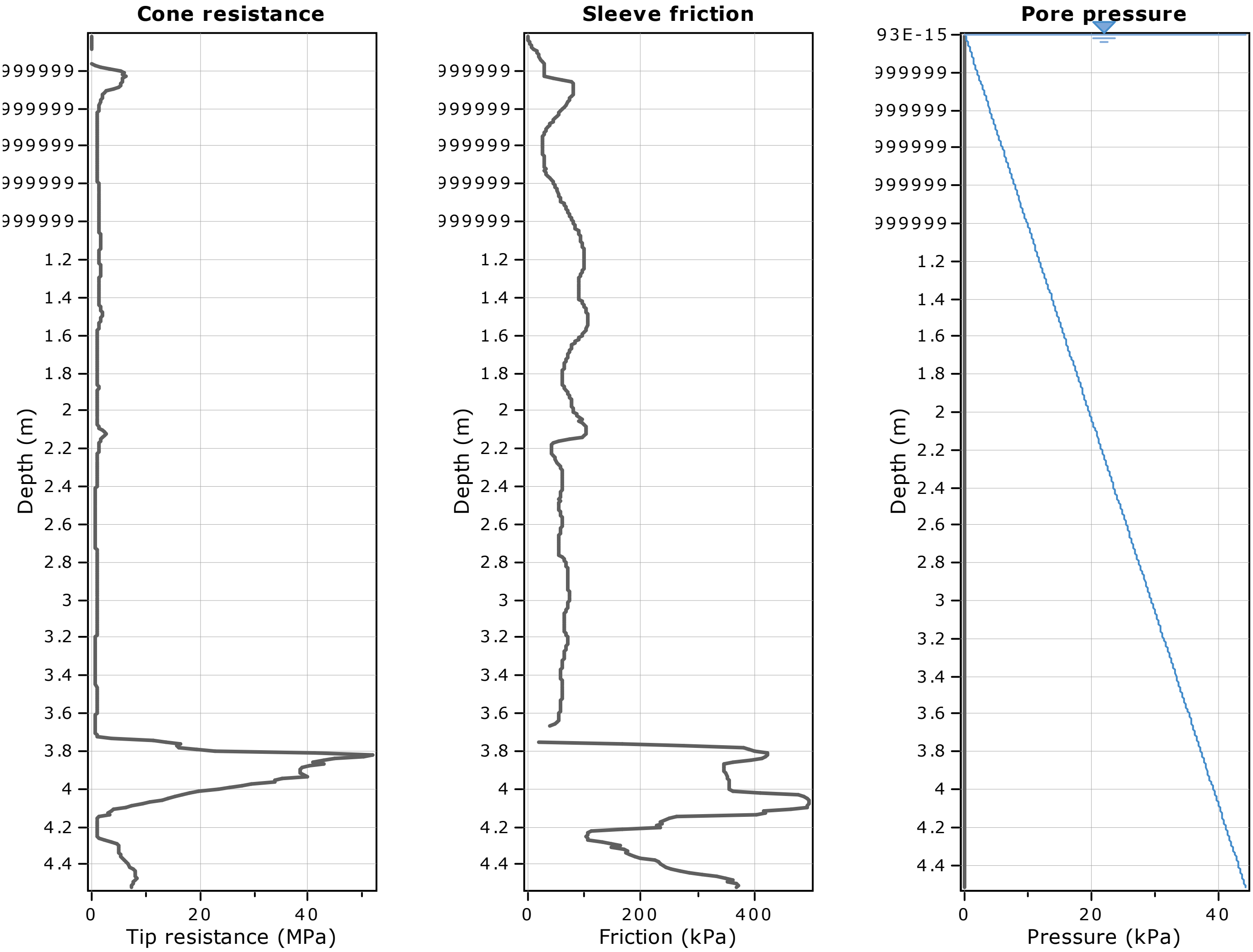
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

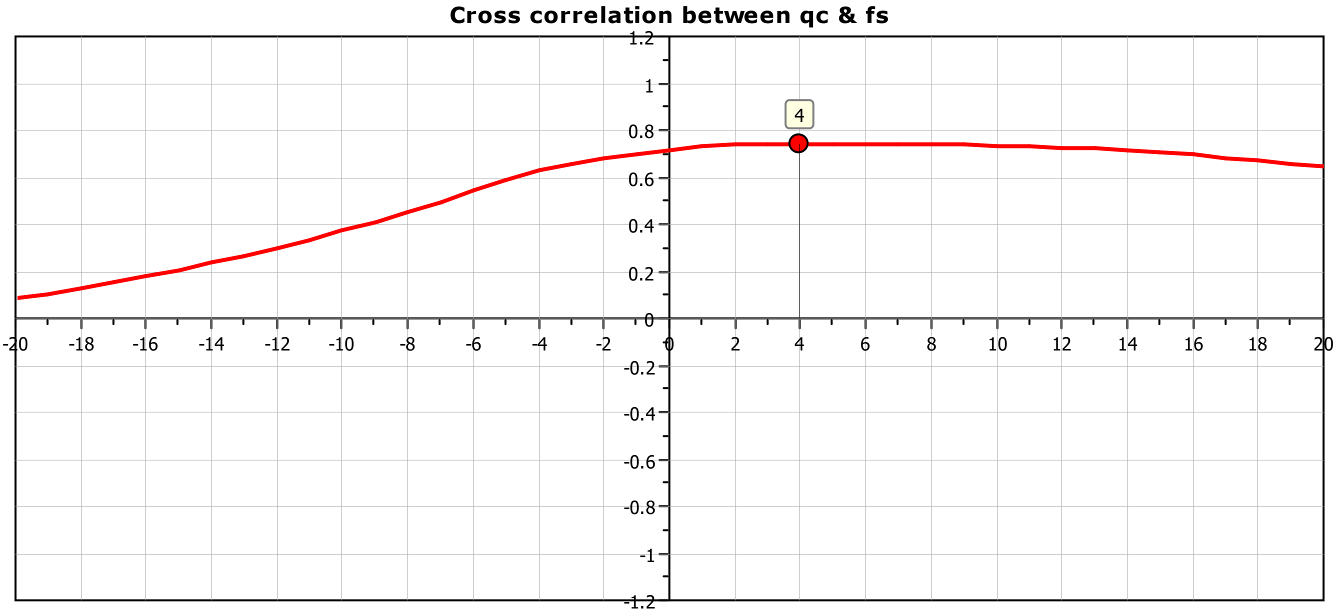


:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.32	0.20	9.50	272.73
2	1.20	0.50	2.30	1.33	0.20	9.50	275.89
3	1.40	0.50	2.60	1.30	0.20	9.50	269.21
4	1.60	0.50	2.90	1.64	0.20	9.50	338.10
5	1.80	0.50	3.20	2.11	0.20	9.50	430.59
6	2.00	0.50	3.50	2.43	0.20	9.50	495.67
7	2.20	0.50	3.80	2.62	0.20	9.50	532.86
8	2.40	0.50	4.10	2.71	0.20	9.50	552.31
9	2.60	0.50	4.40	2.69	0.20	9.50	547.73
10	2.80	0.50	4.70	2.73	0.20	9.50	555.93
11	3.00	0.50	5.00	2.71	0.20	9.50	551.92
12	3.20	0.50	5.30	2.64	0.20	9.50	537.26
13	3.40	0.50	5.60	2.57	0.20	9.50	524.22
14	3.60	0.50	5.90	2.52	0.20	9.50	512.97
15	3.80	0.50	6.20	2.49	0.20	9.50	508.43
16	4.00	0.50	6.50	2.56	0.20	9.50	521.17

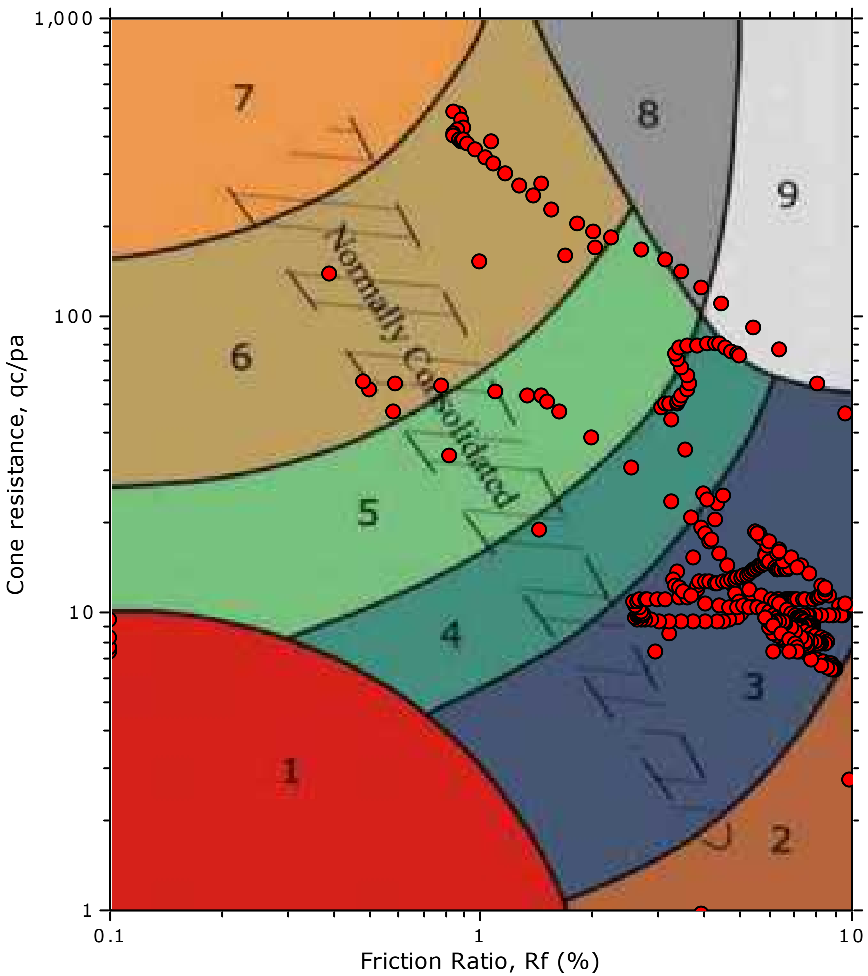


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

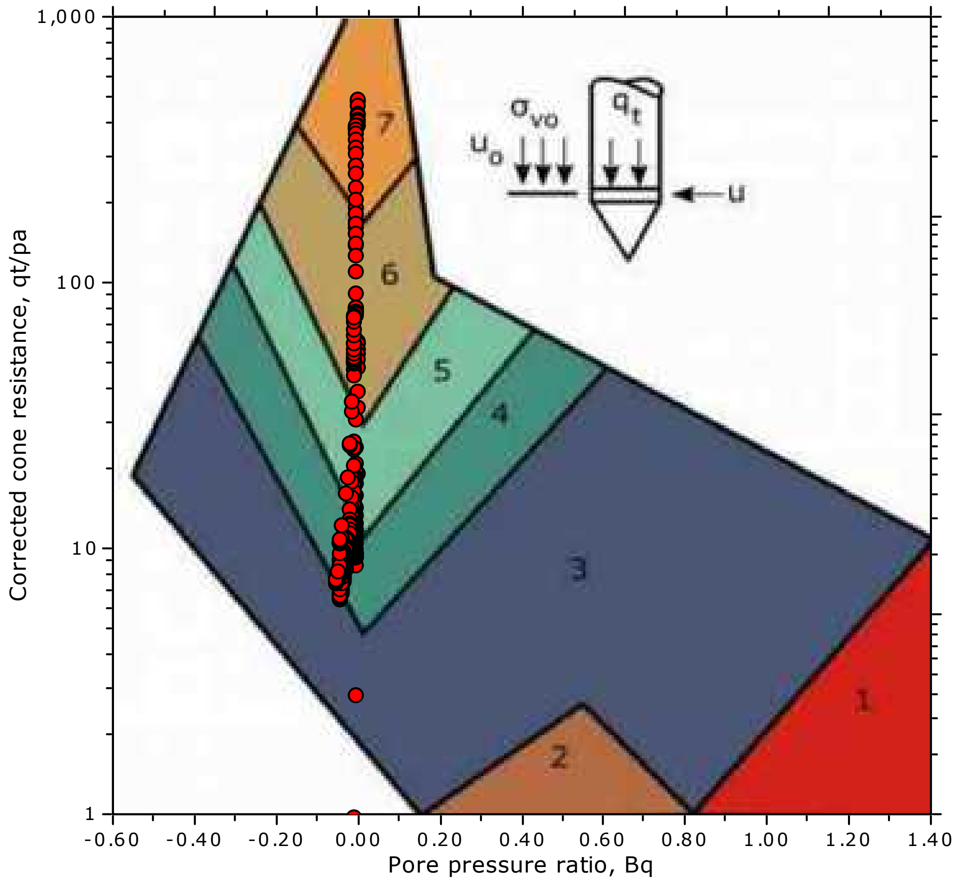


SBT - Bq plots

SBT plot



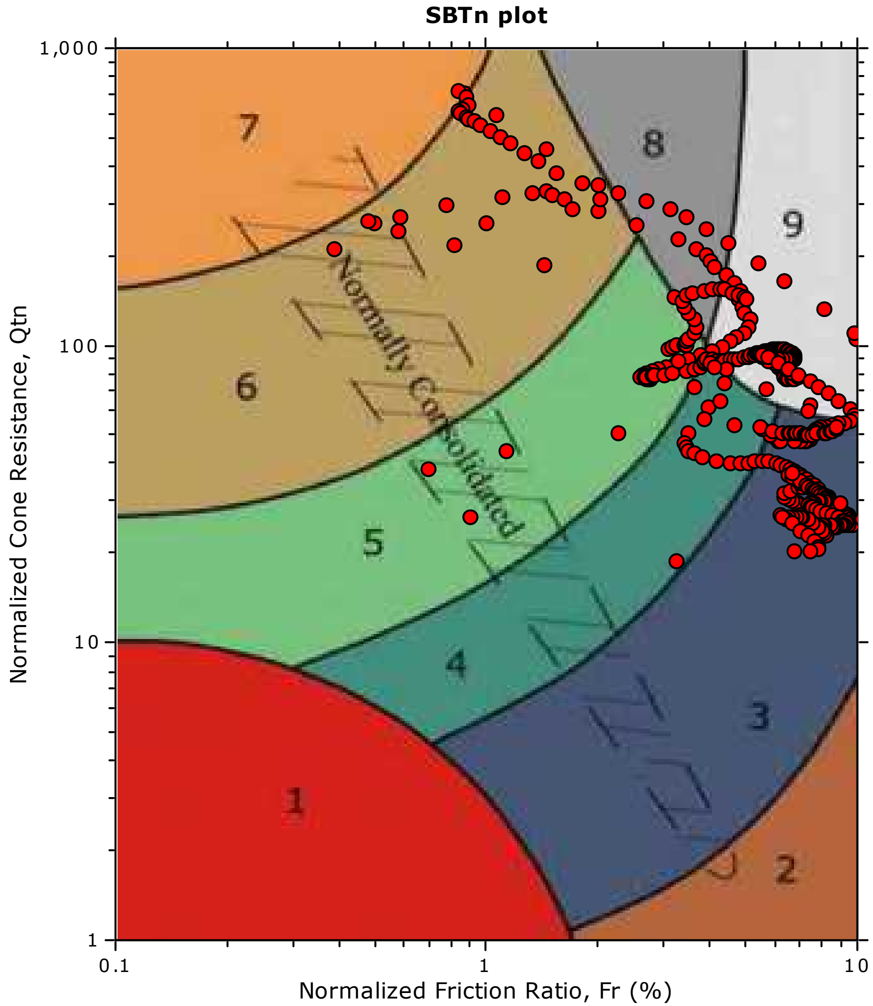
Bq plot

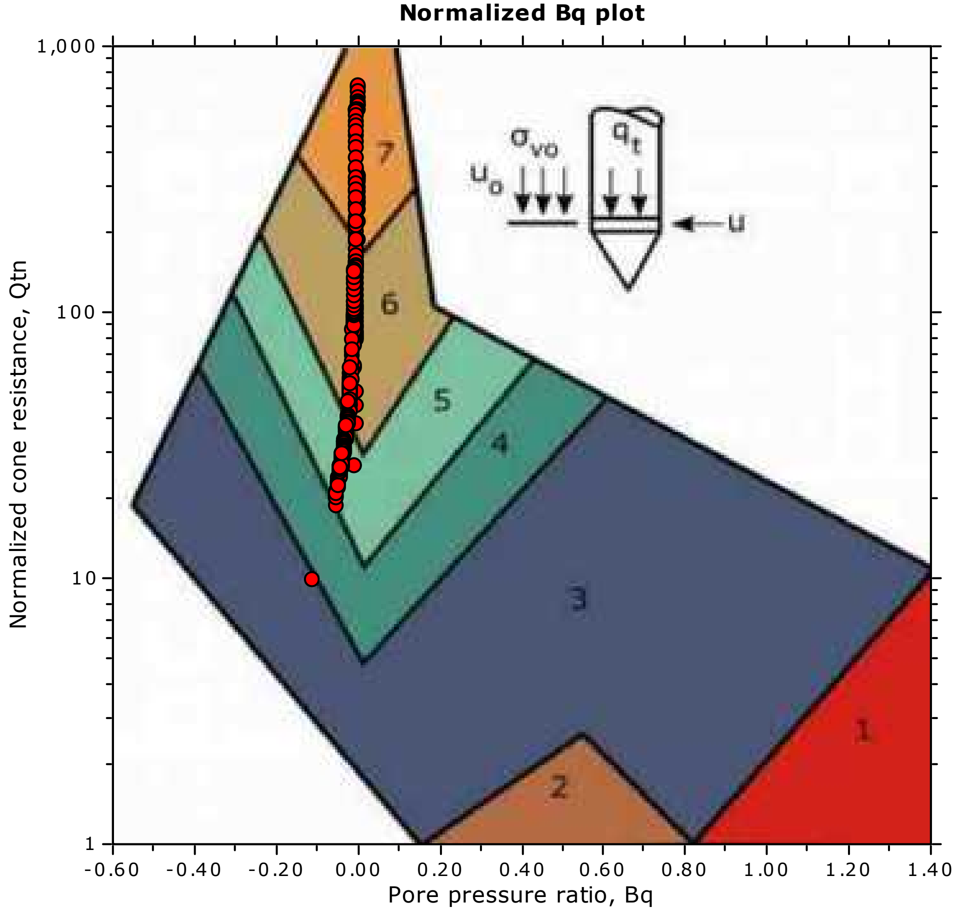


SBT legend

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

SBT - Bq plots (normalized)

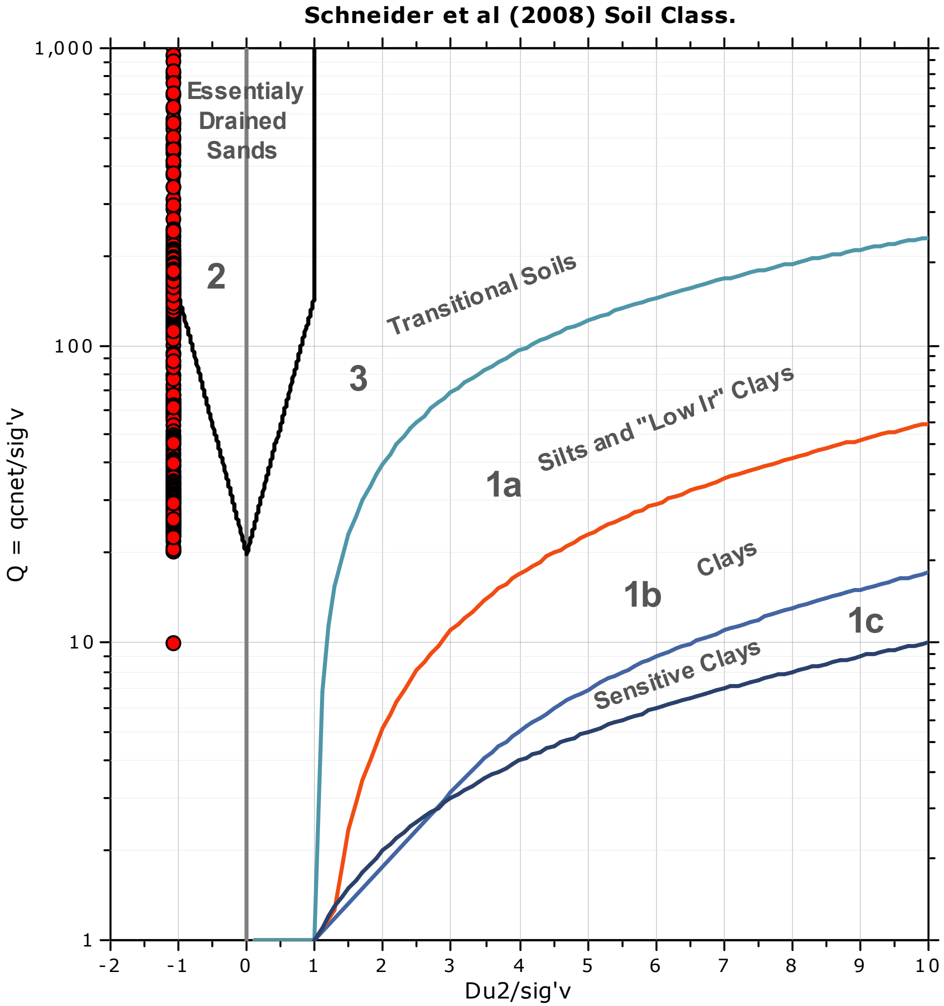


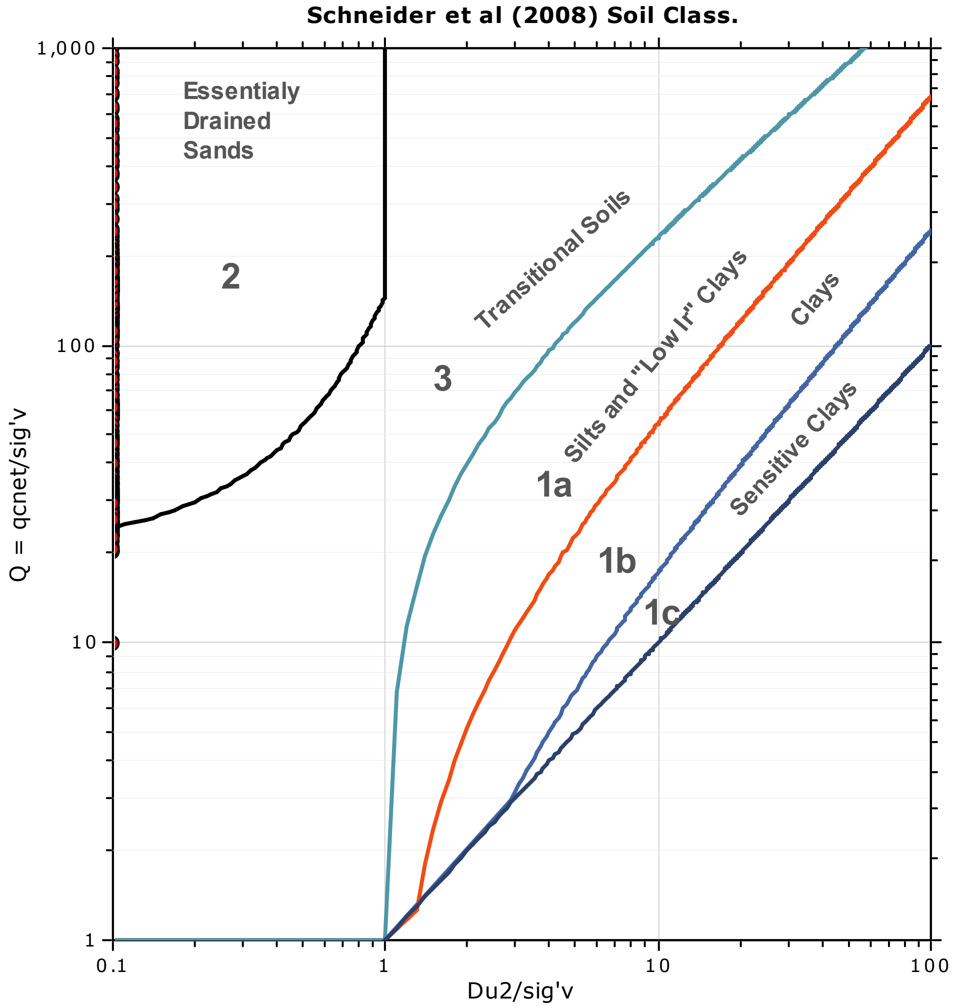


SBTn legend

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

Bq plots (Schneider)





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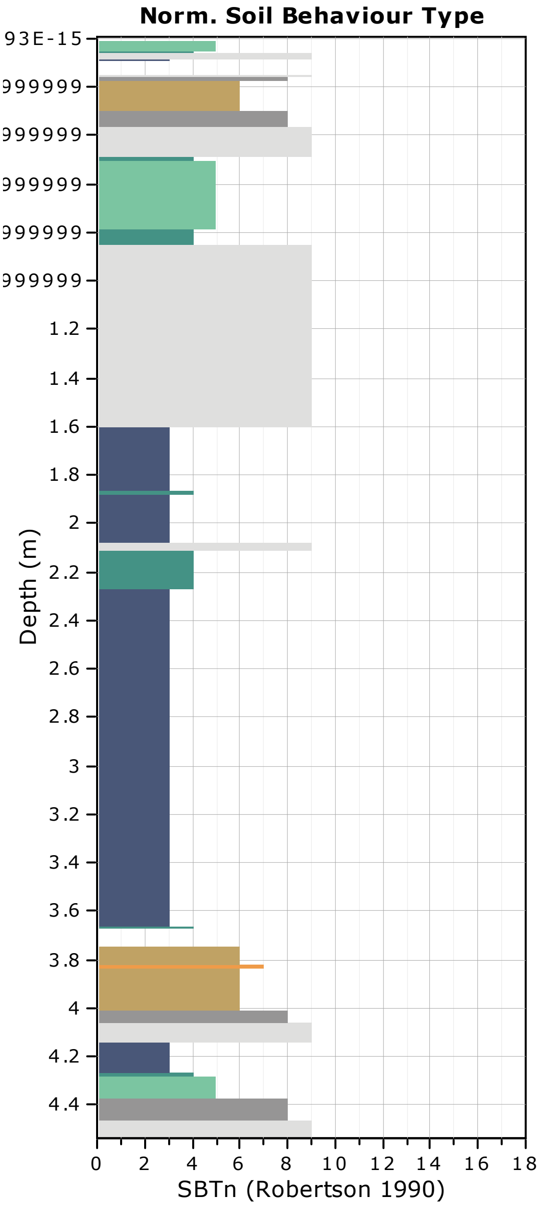
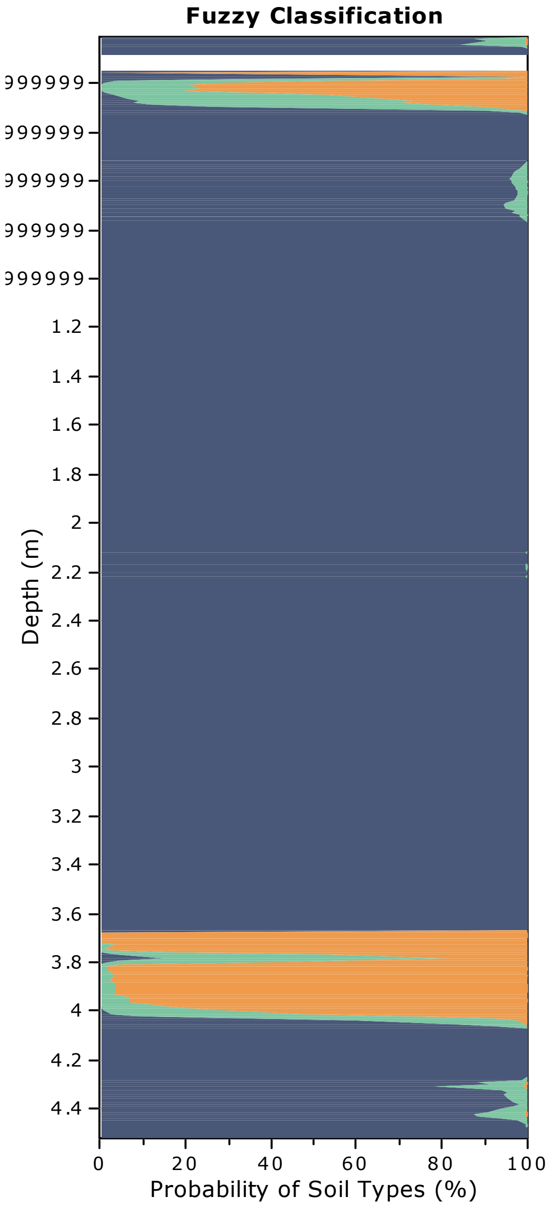
CPT: A2-CPT02
Total depth: 4.52 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:





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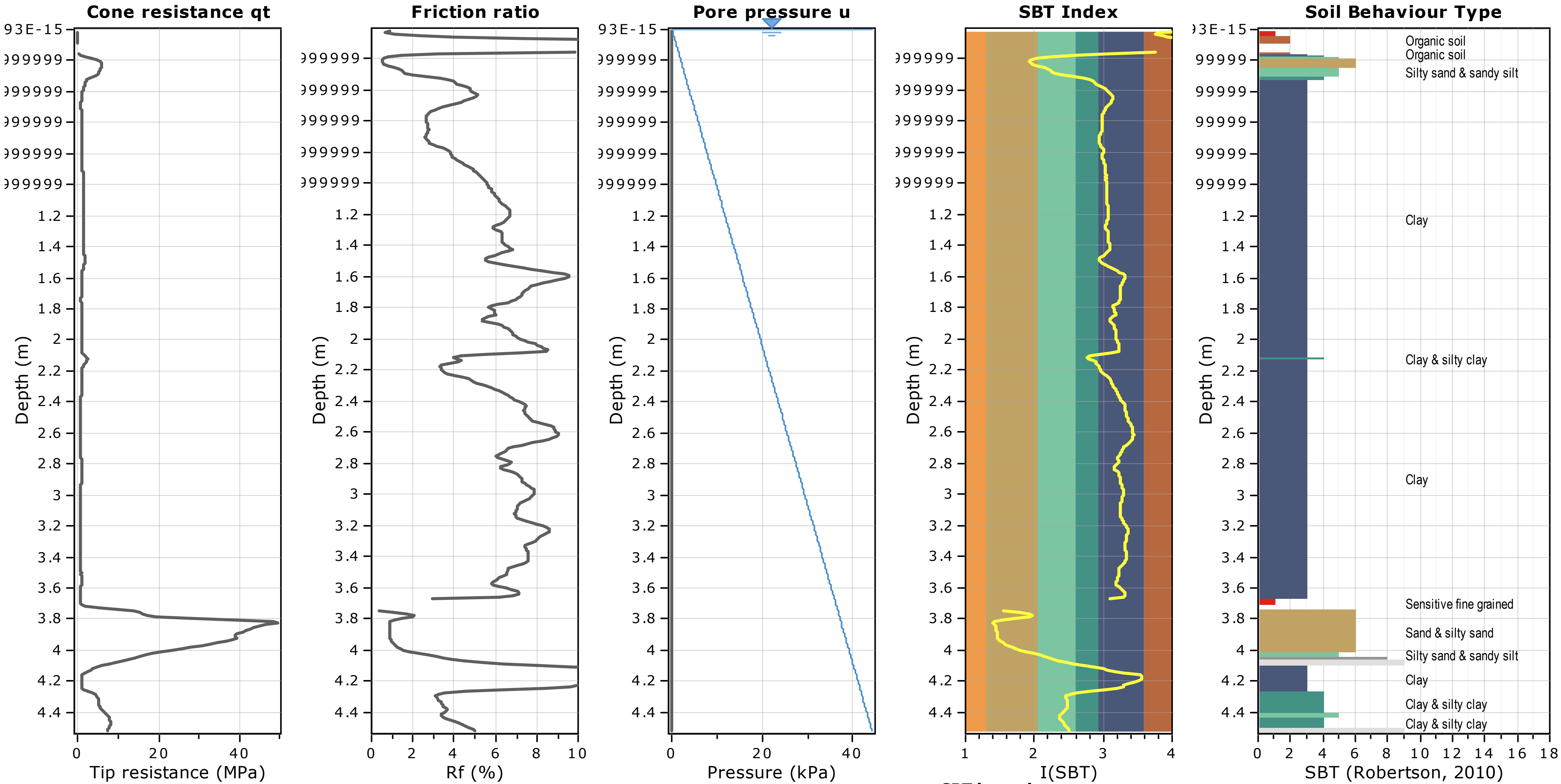
CPT: A2-CPT02
Total depth: 4.52 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBT legend

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

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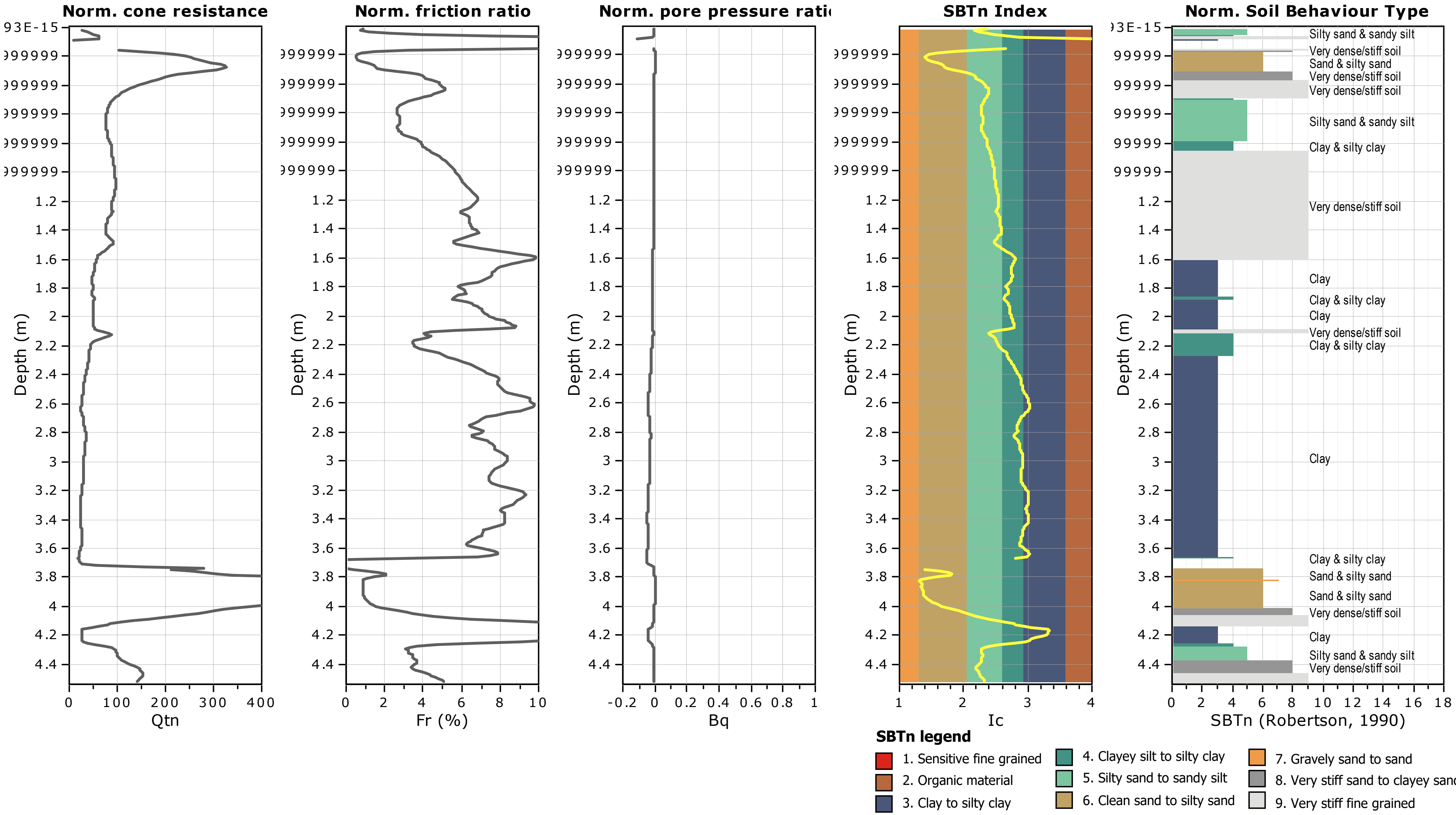
CPT: A2-CPT02
Total depth: 4.52 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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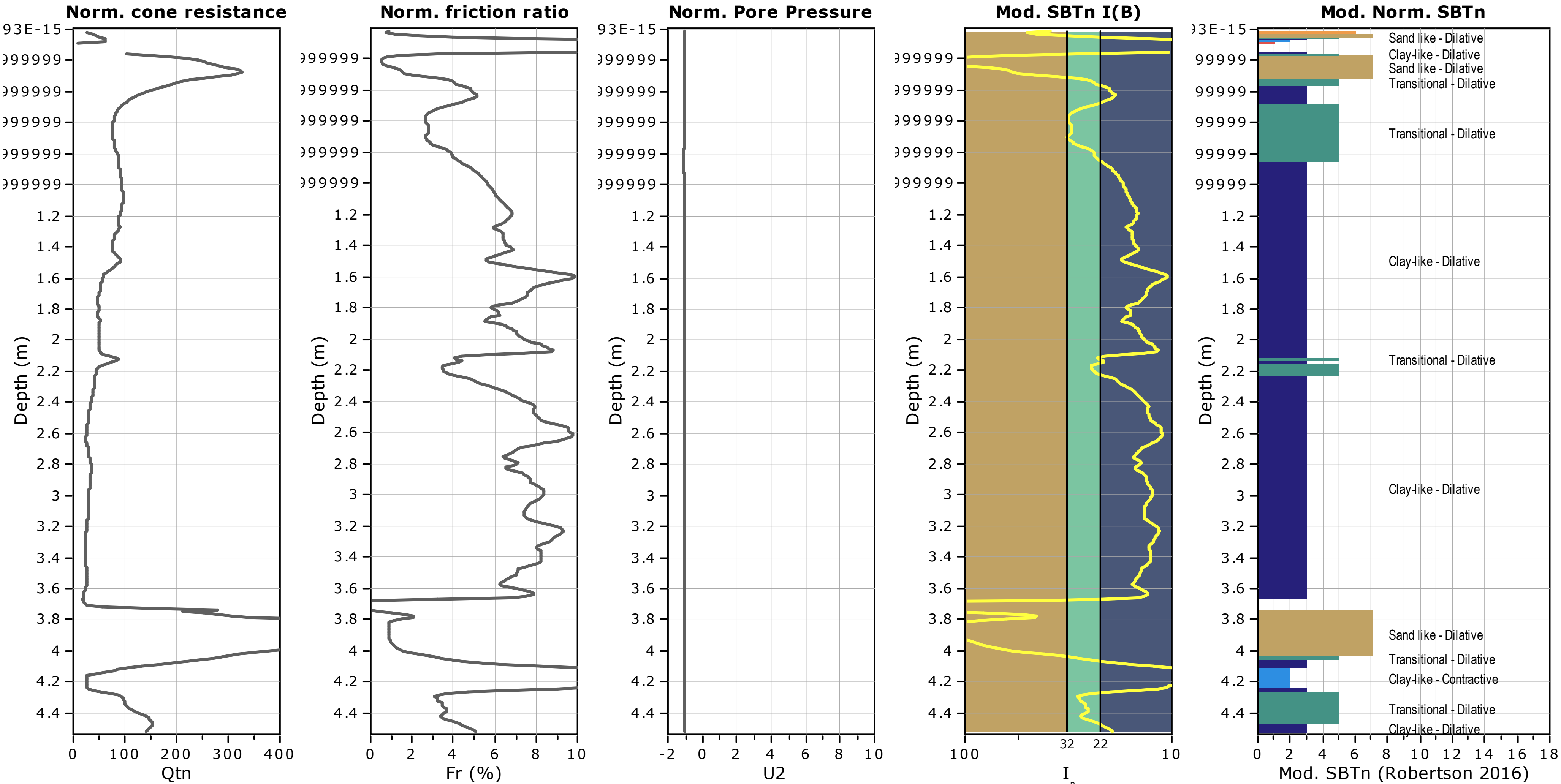
CPT: A2-CPT02
Total depth: 4.52 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Mod. SBTn legend
1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

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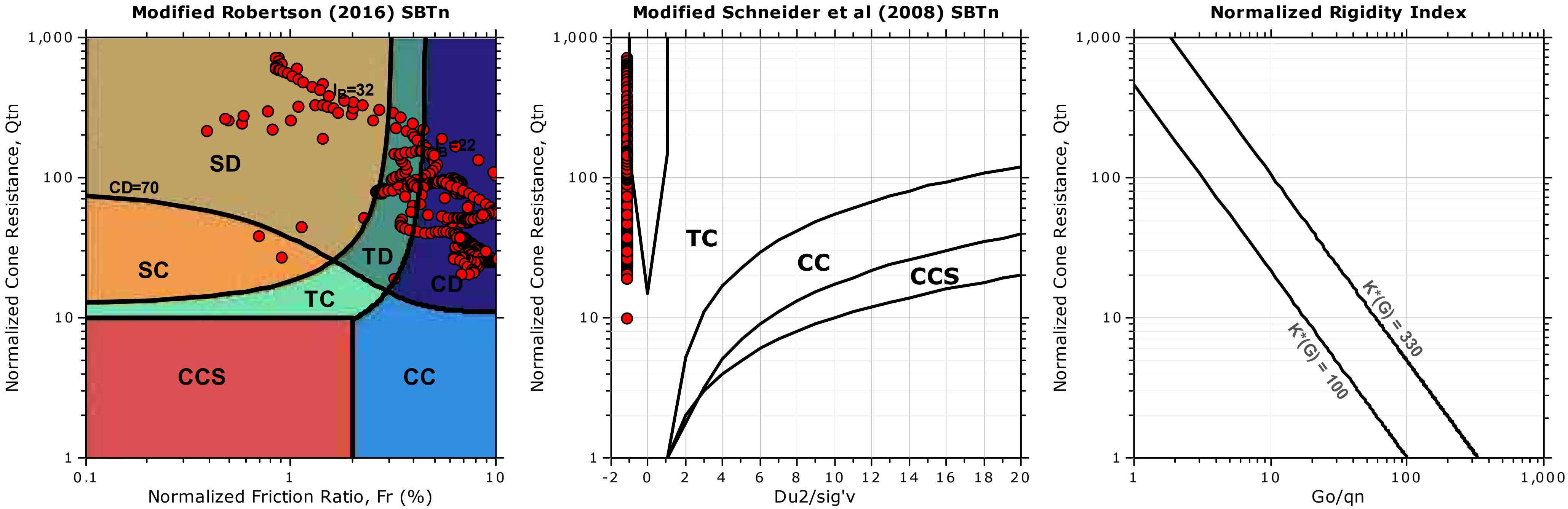
CPT: A2-CPT02
Total depth: 4.52 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

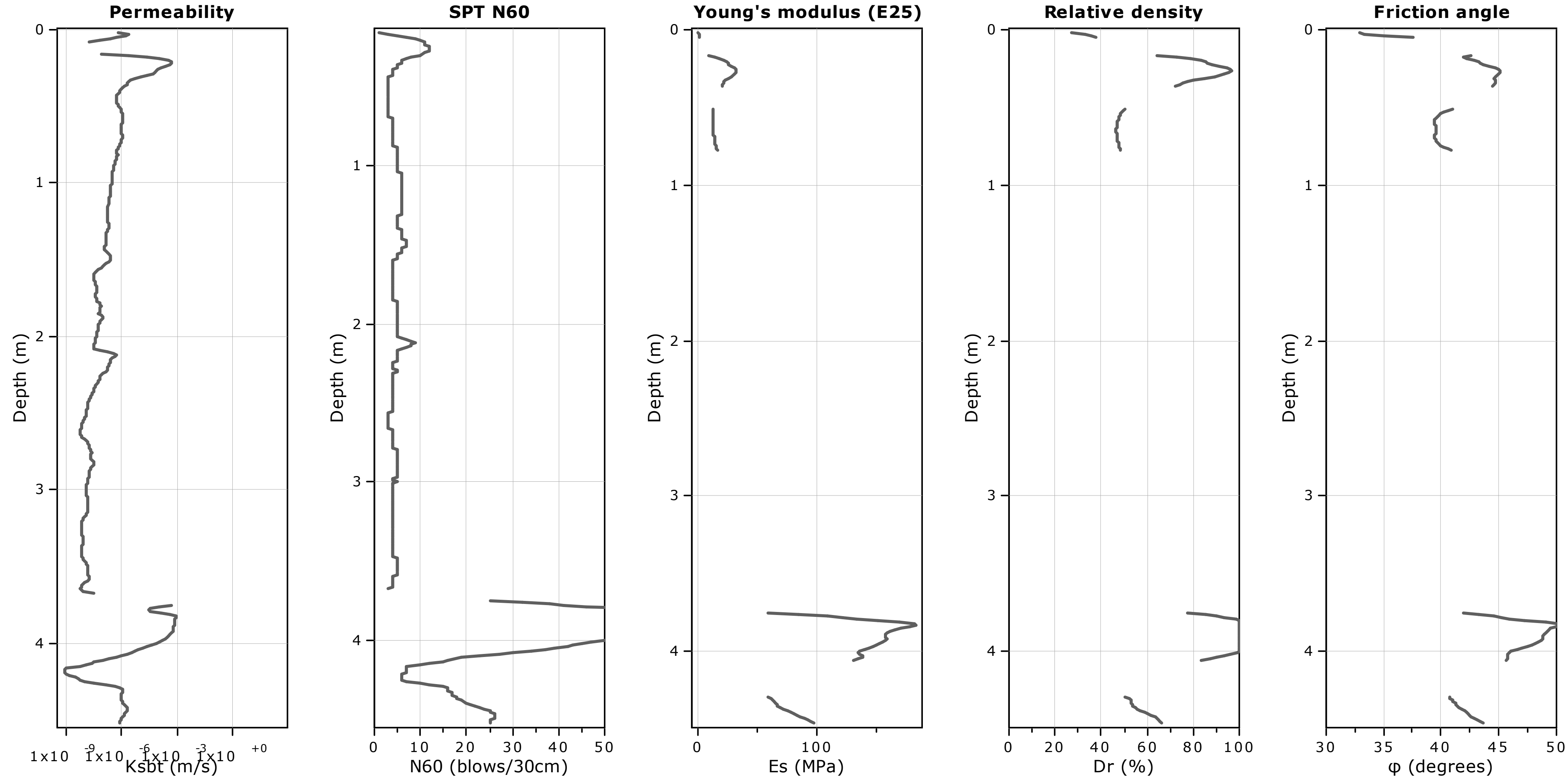
Project:
Location:

Updated SBTn plots



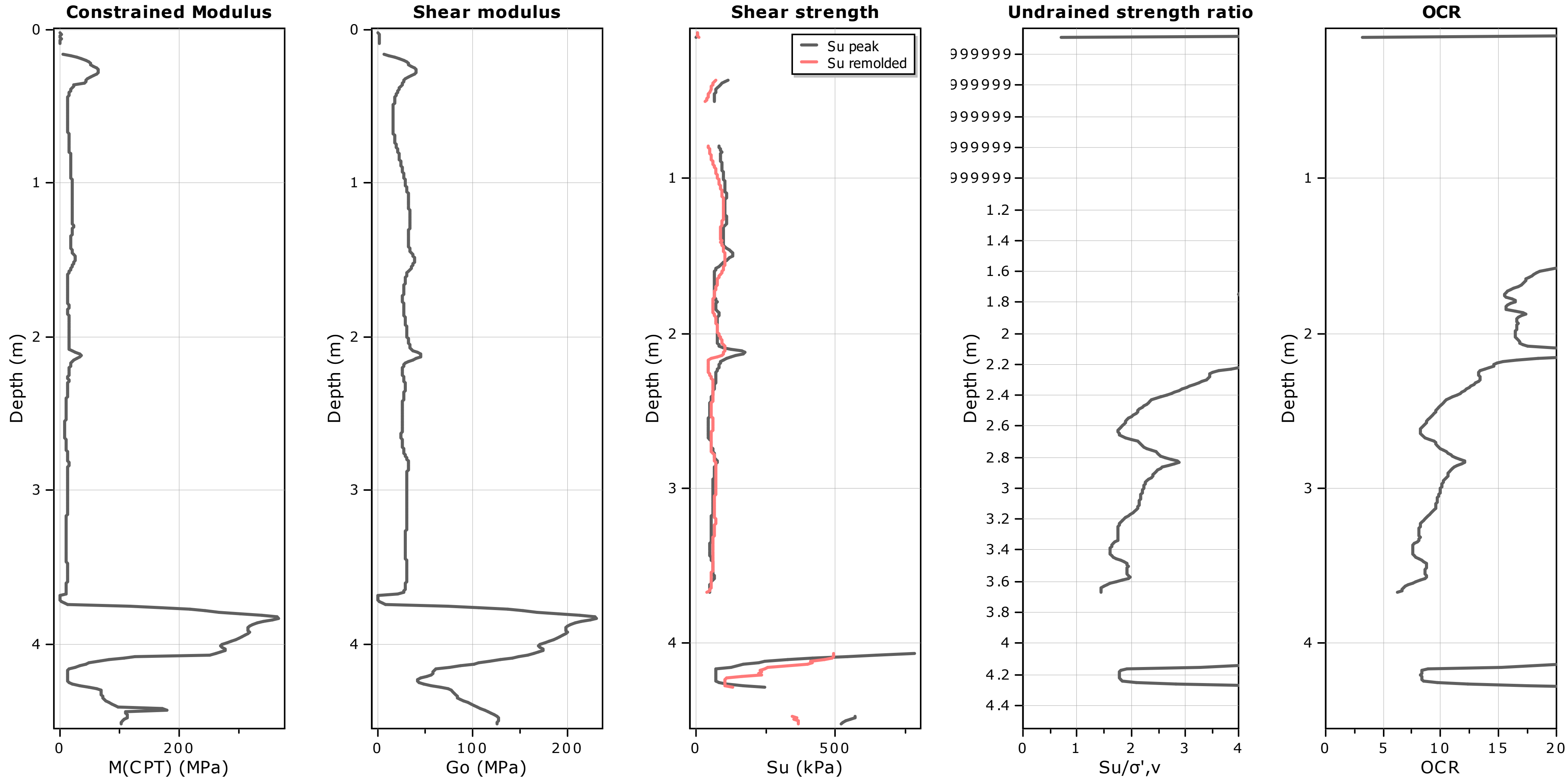
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)



Calculation parameters

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



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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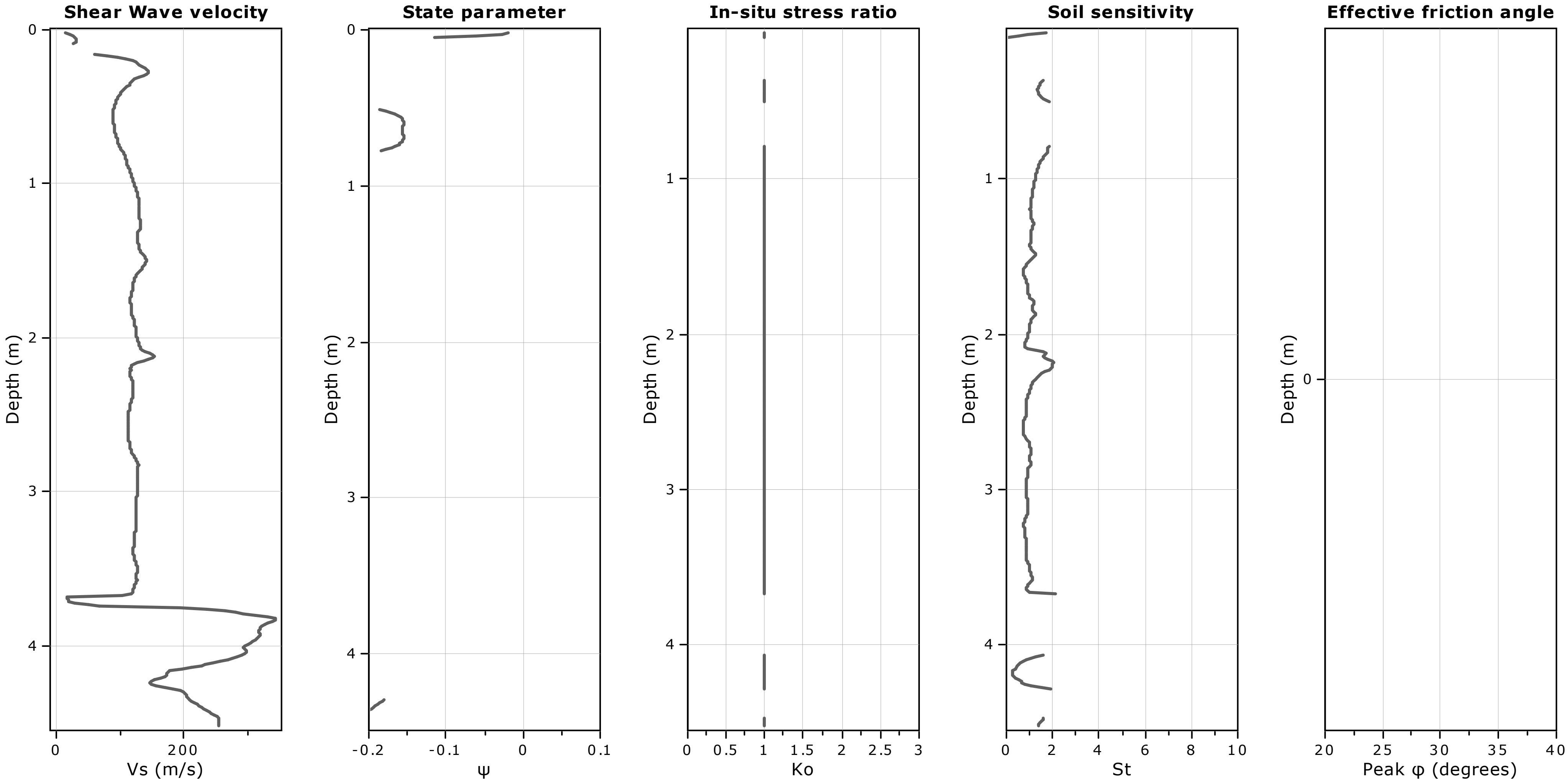
CPT: A2-CPT02
Total depth: 4.52 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

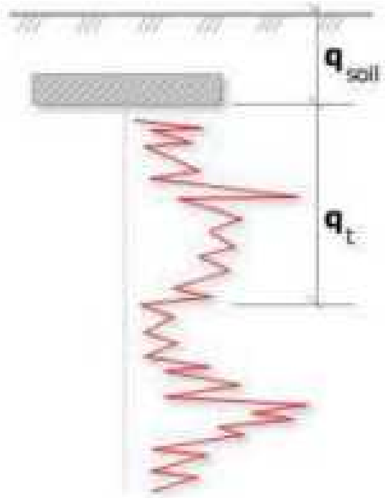
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

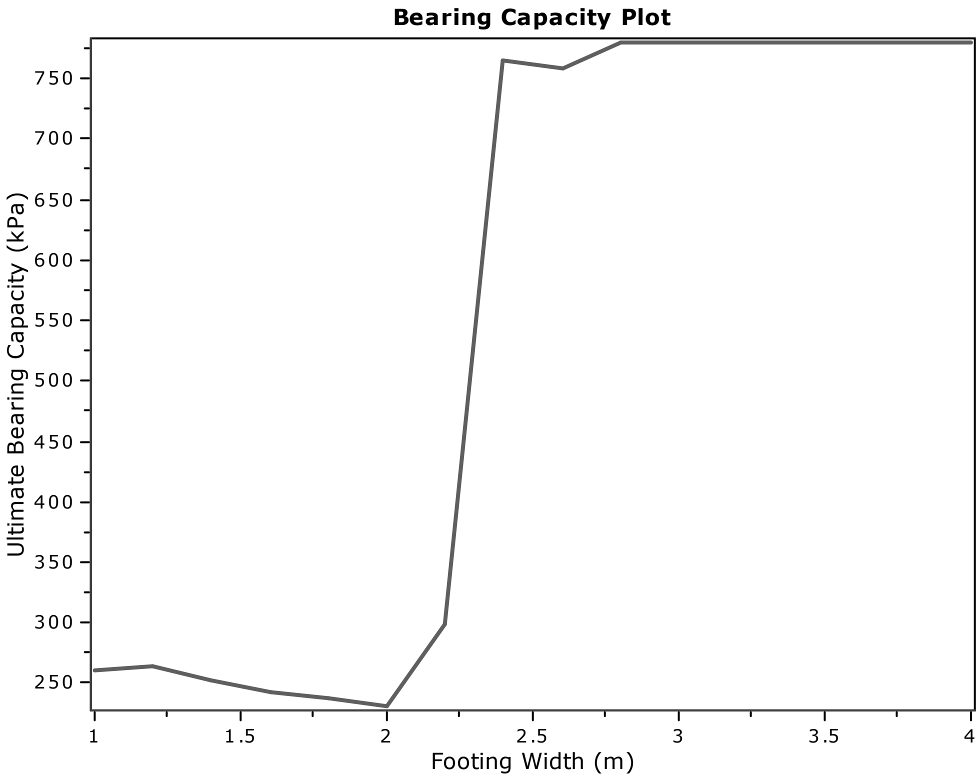
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

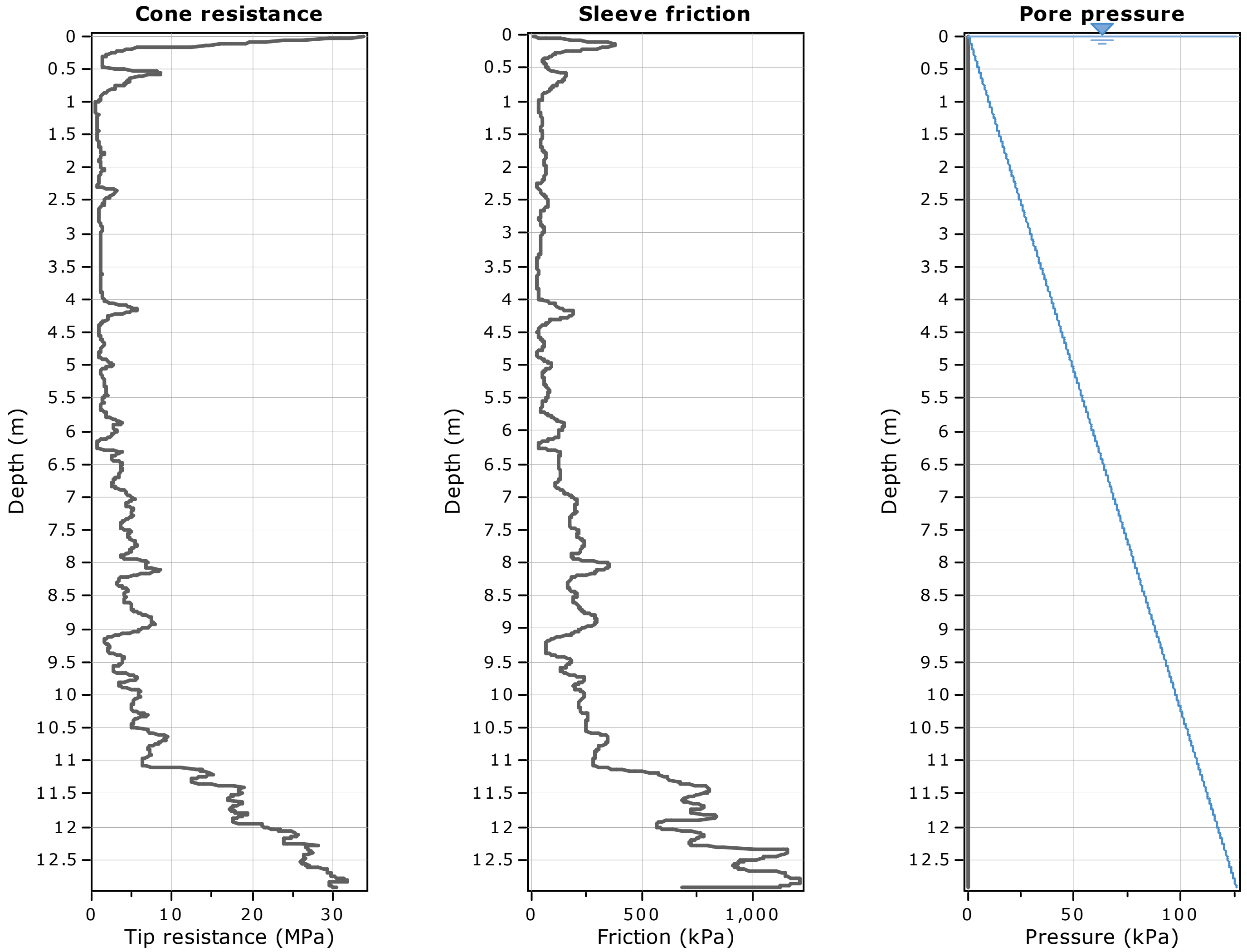
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

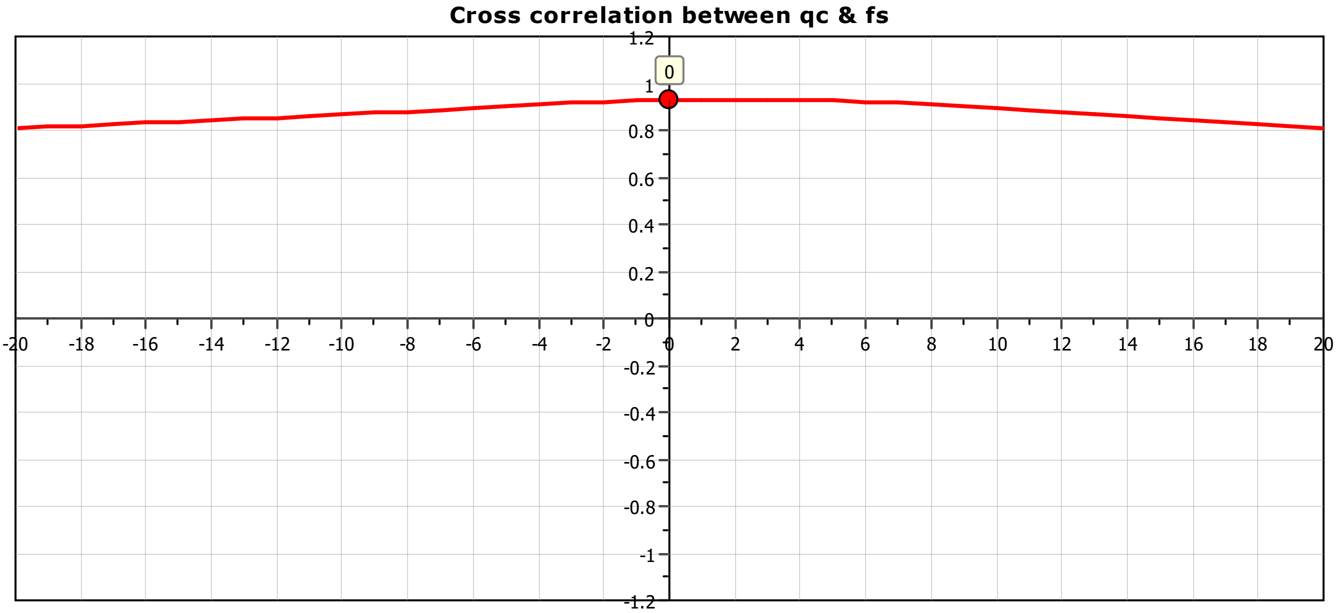


:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.25	0.20	9.50	260.13
2	1.20	0.50	2.30	1.27	0.20	9.50	264.19
3	1.40	0.50	2.60	1.21	0.20	9.50	251.45
4	1.60	0.50	2.90	1.17	0.20	9.50	242.70
5	1.80	0.50	3.20	1.14	0.20	9.50	237.09
6	2.00	0.50	3.50	1.11	0.20	9.50	230.74
7	2.20	0.50	3.80	1.44	0.20	9.50	298.23
8	2.40	0.50	4.10	3.78	0.20	9.50	764.98
9	2.60	0.50	4.40	3.74	0.20	9.50	757.91
10	2.80	0.50	4.70	3.85	0.20	9.50	780.20
11	3.00	0.50	5.00	3.85	0.20	9.50	780.20
12	3.20	0.50	5.30	3.85	0.20	9.50	780.20
13	3.40	0.50	5.60	3.85	0.20	9.50	780.20
14	3.60	0.50	5.90	3.85	0.20	9.50	780.20
15	3.80	0.50	6.20	3.85	0.20	9.50	780.20
16	4.00	0.50	6.50	3.85	0.20	9.50	780.20



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



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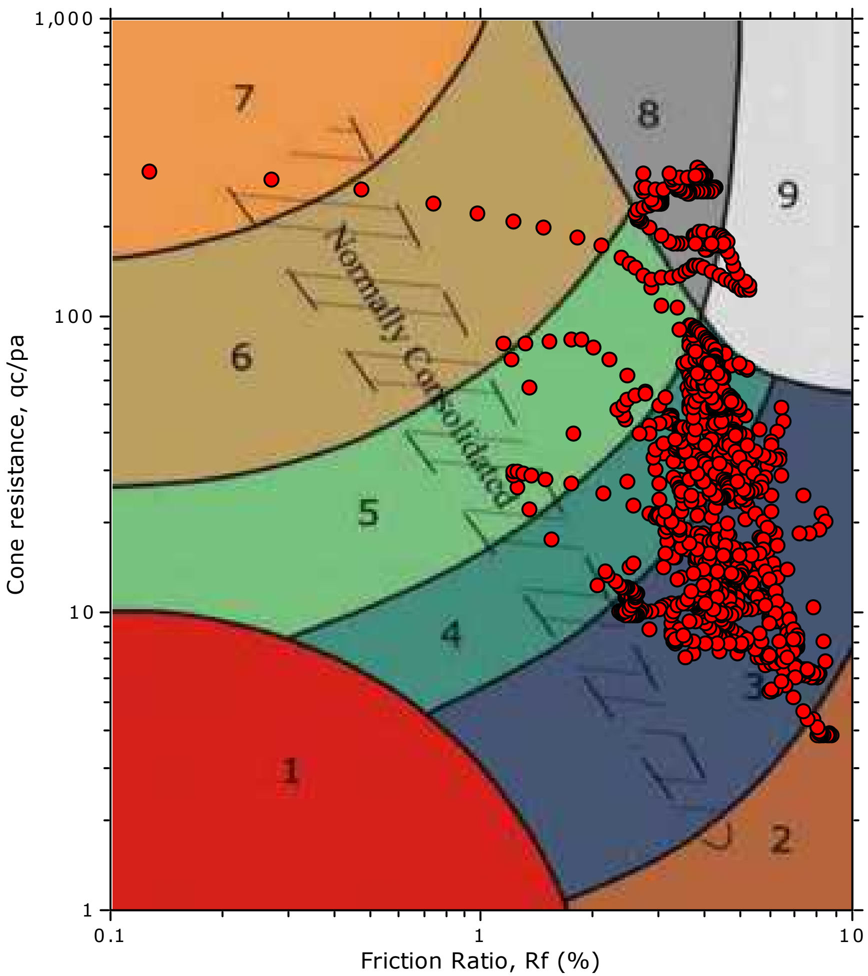
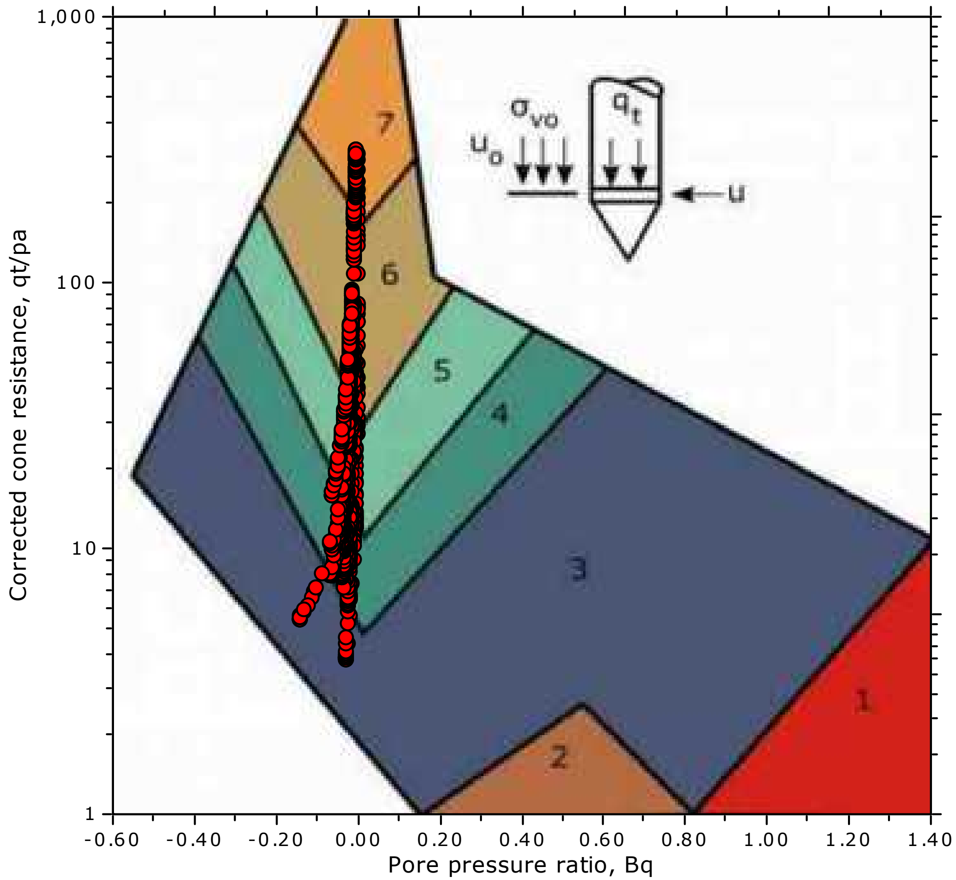
CPT: A2-CPT03
Total depth: 12.92 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

SBT - Bq plots

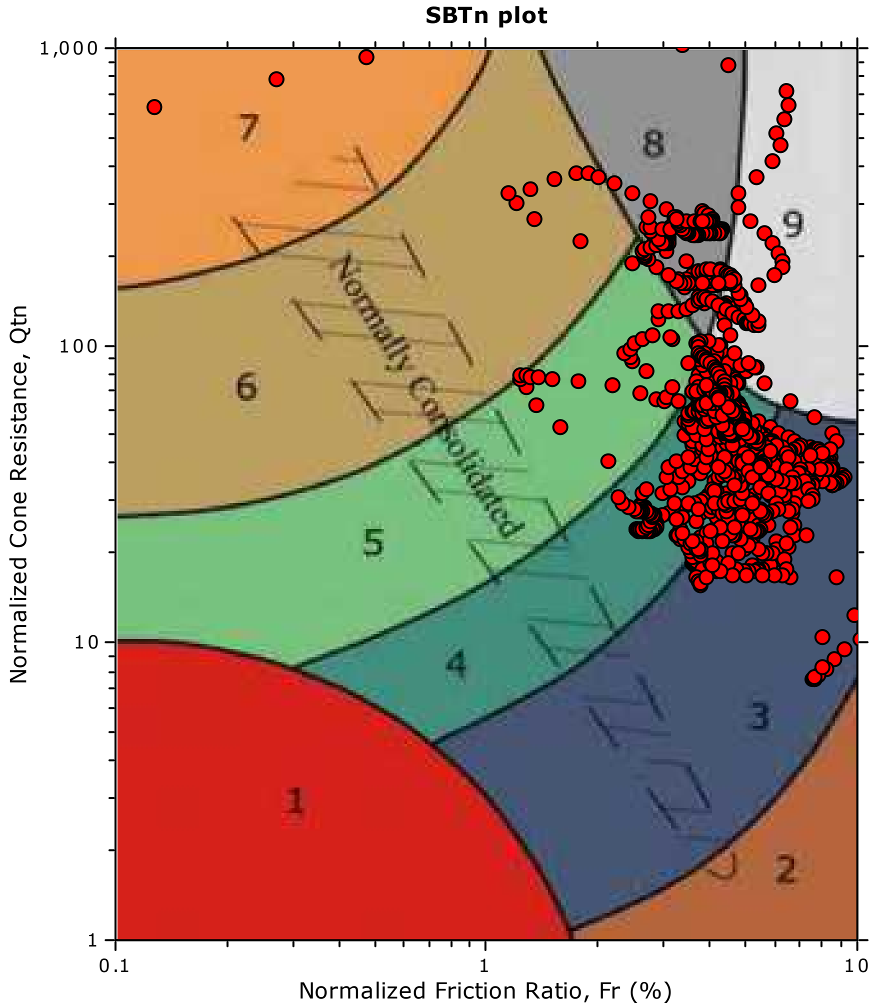


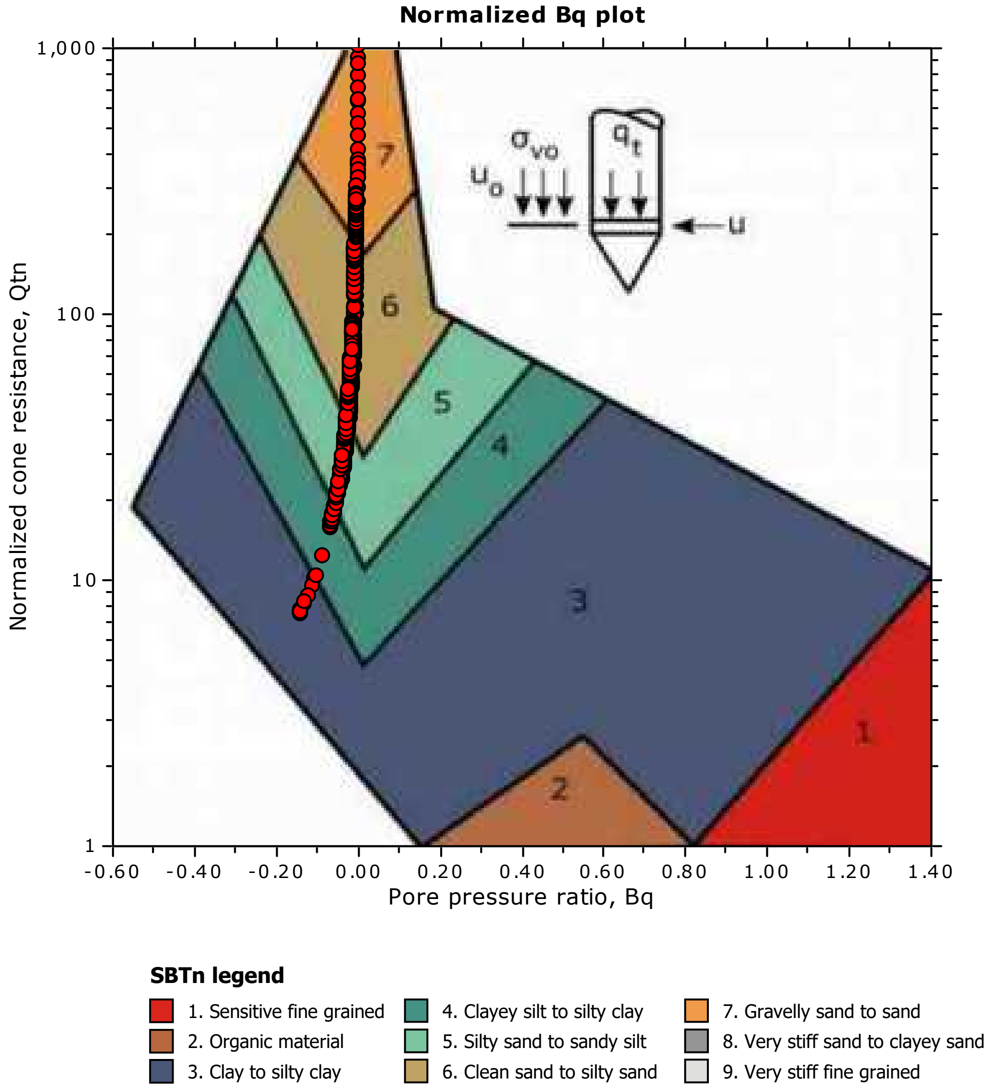


SBT legend

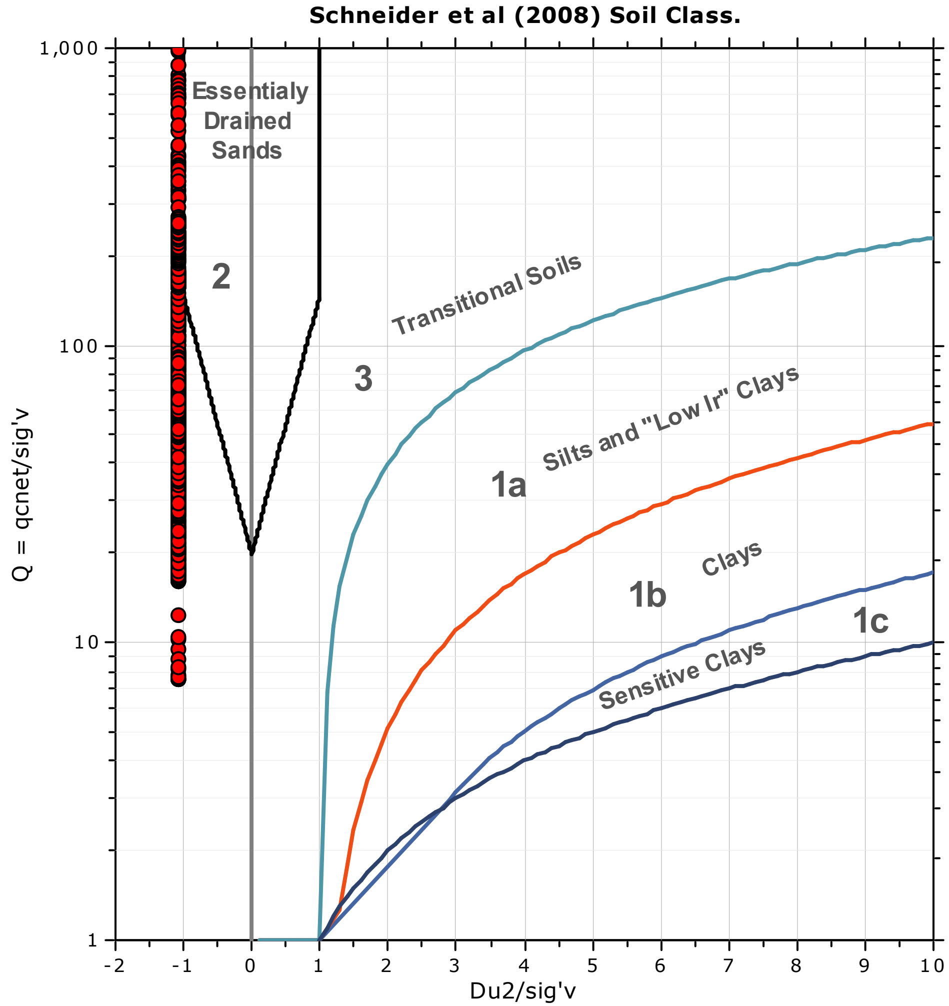
- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty clay
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravelly sand to sand
- 8. Very stiff sand to clayey sand
- 9. Very stiff fine grained

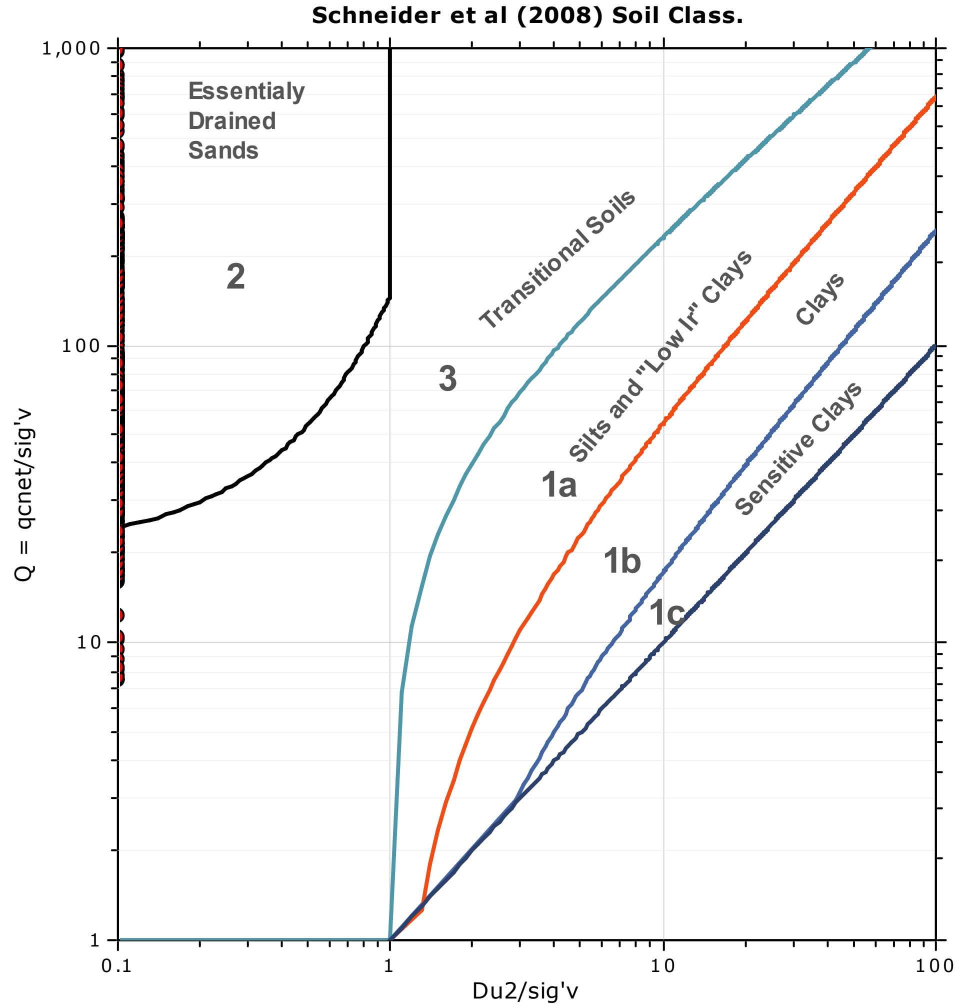
SBT - Bq plots (normalized)





Bq plots (Schneider)

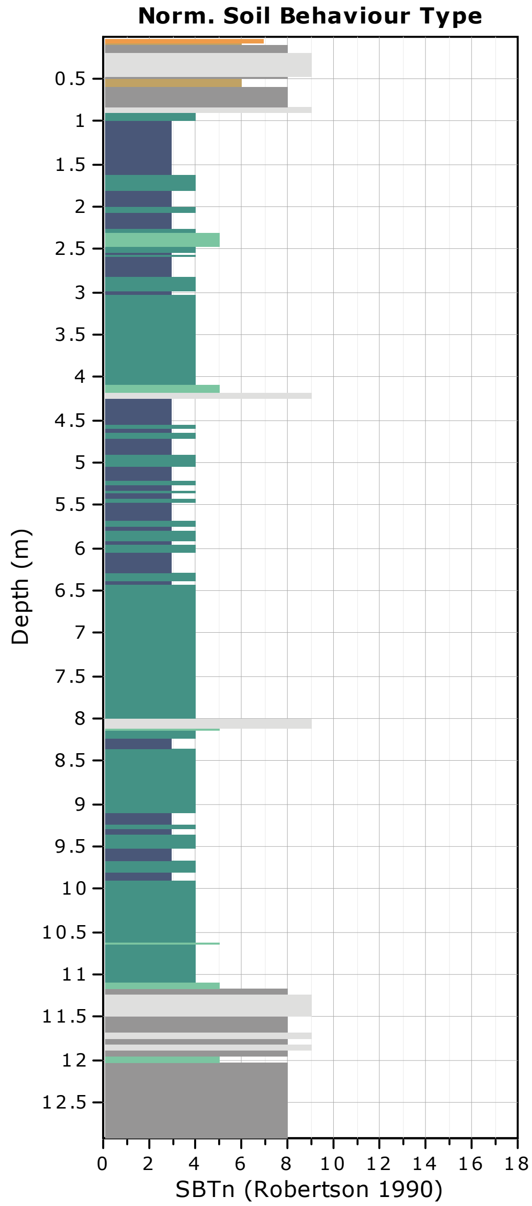


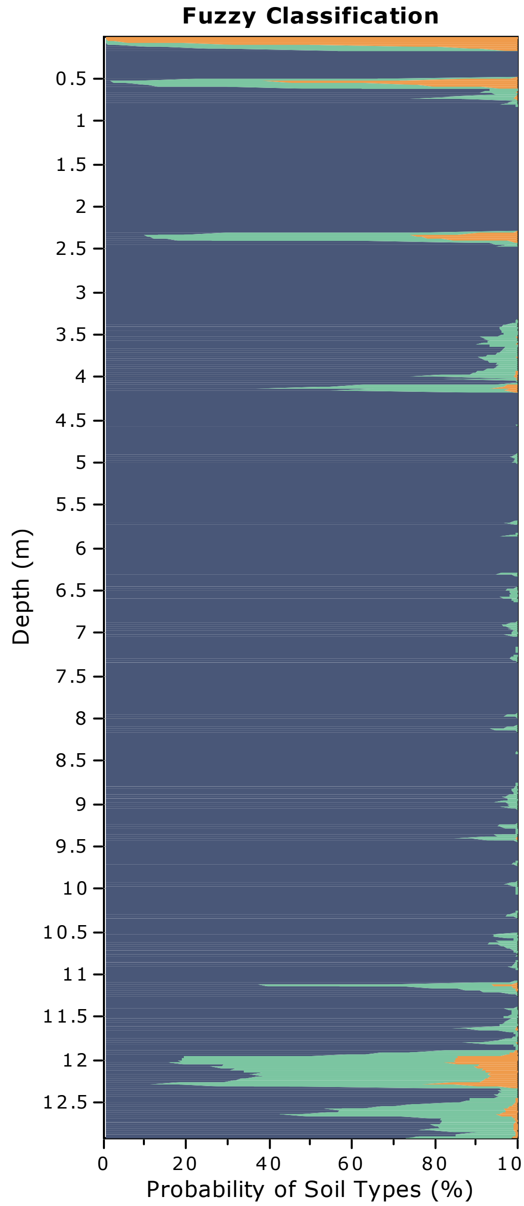


GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A2-CPT03
Total depth: 12.92 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

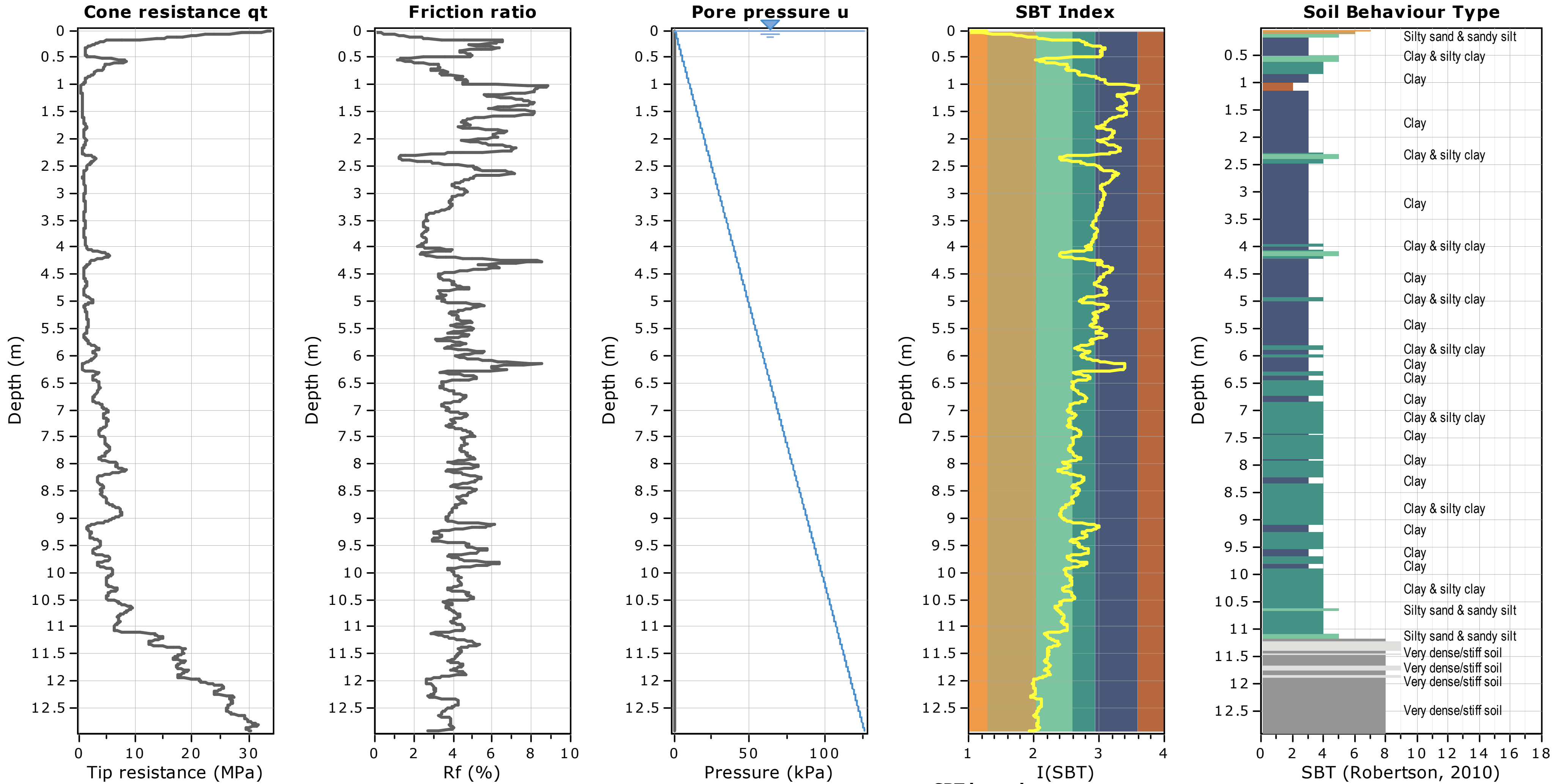




GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A2-CPT03
Total depth: 12.92 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



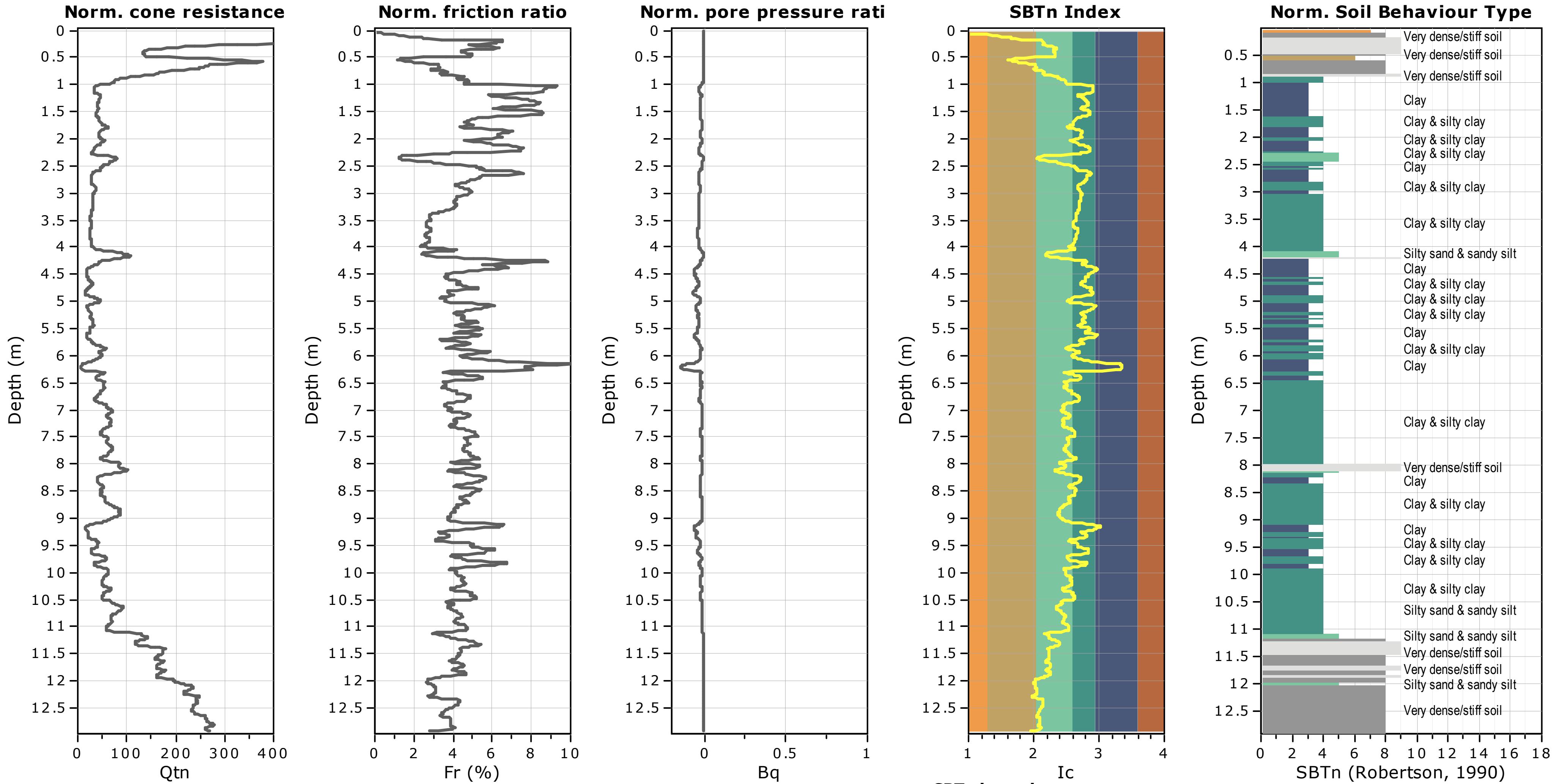
SBT legend

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

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A2-CPT03
Total depth: 12.92 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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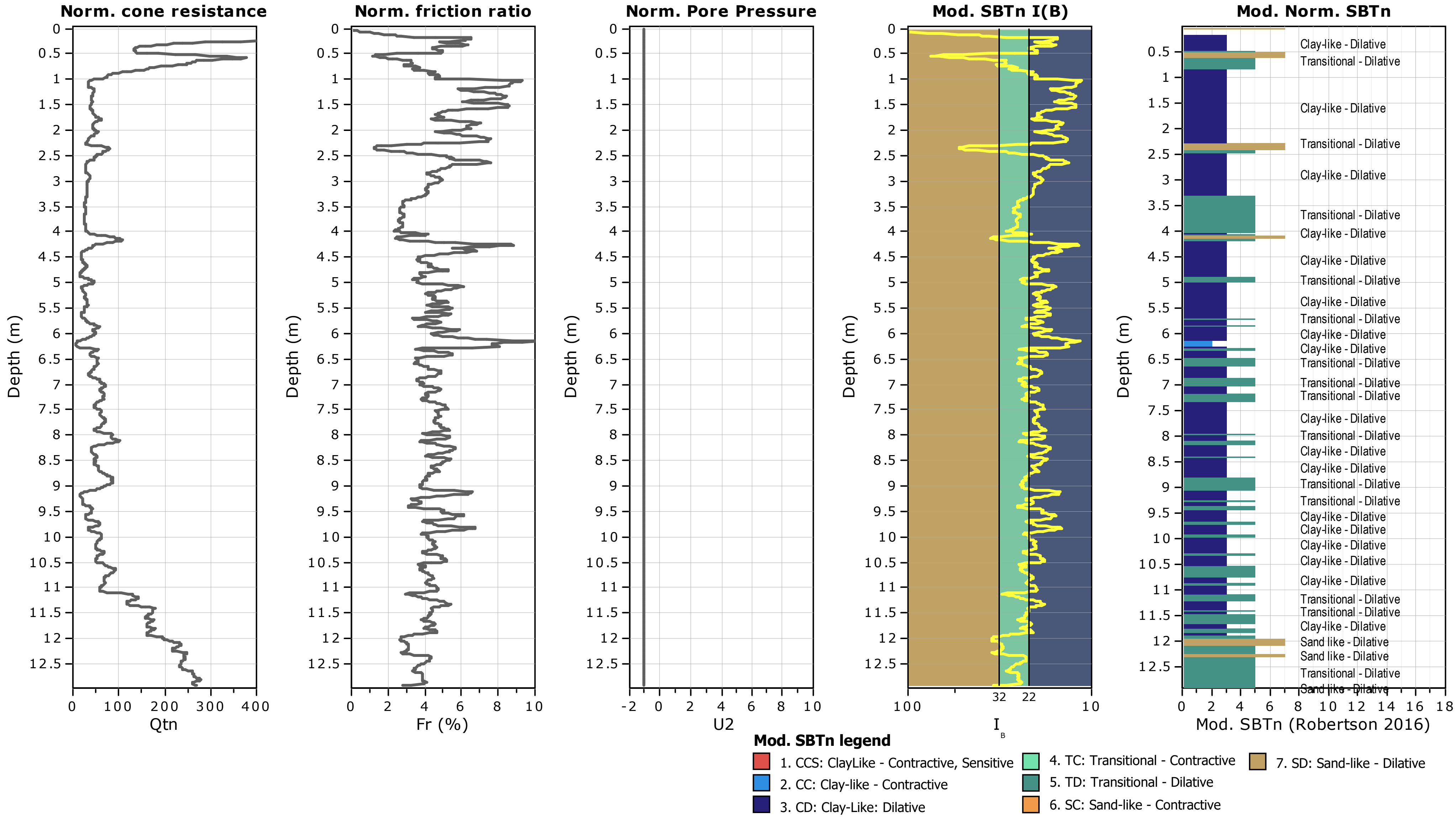
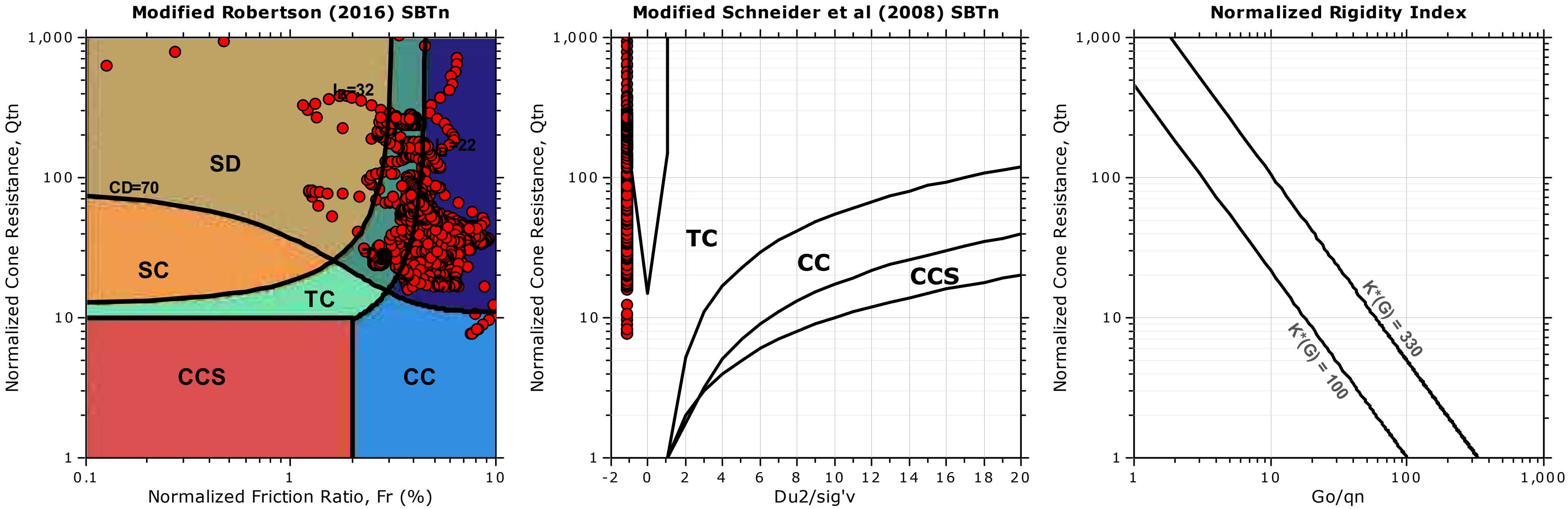
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A2-CPT03
Total depth: 12.92 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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Geotechnical Engineers
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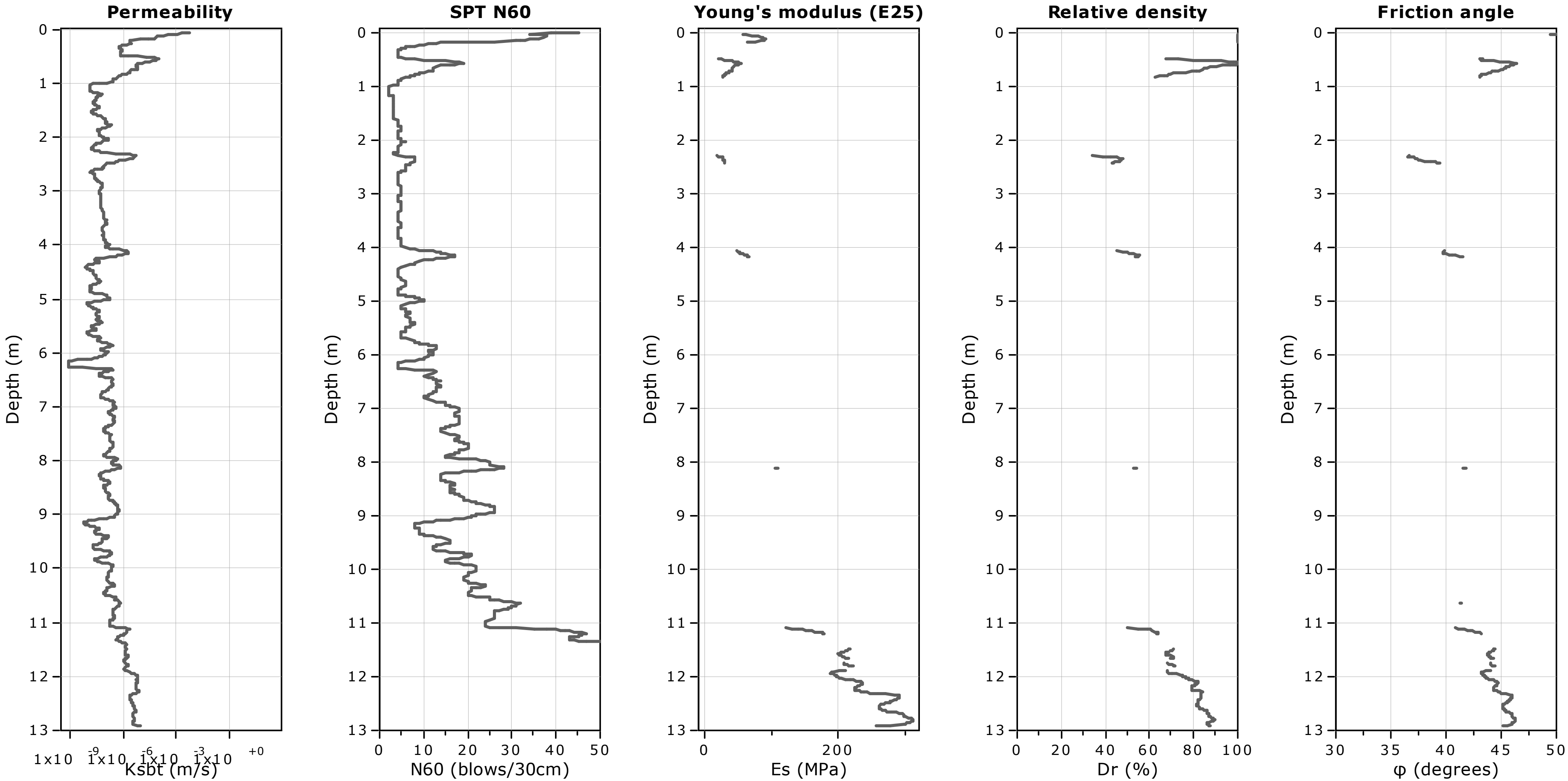
http://www.geologismiki.gr

CPT: A2-CPT03
Total depth: 12.92 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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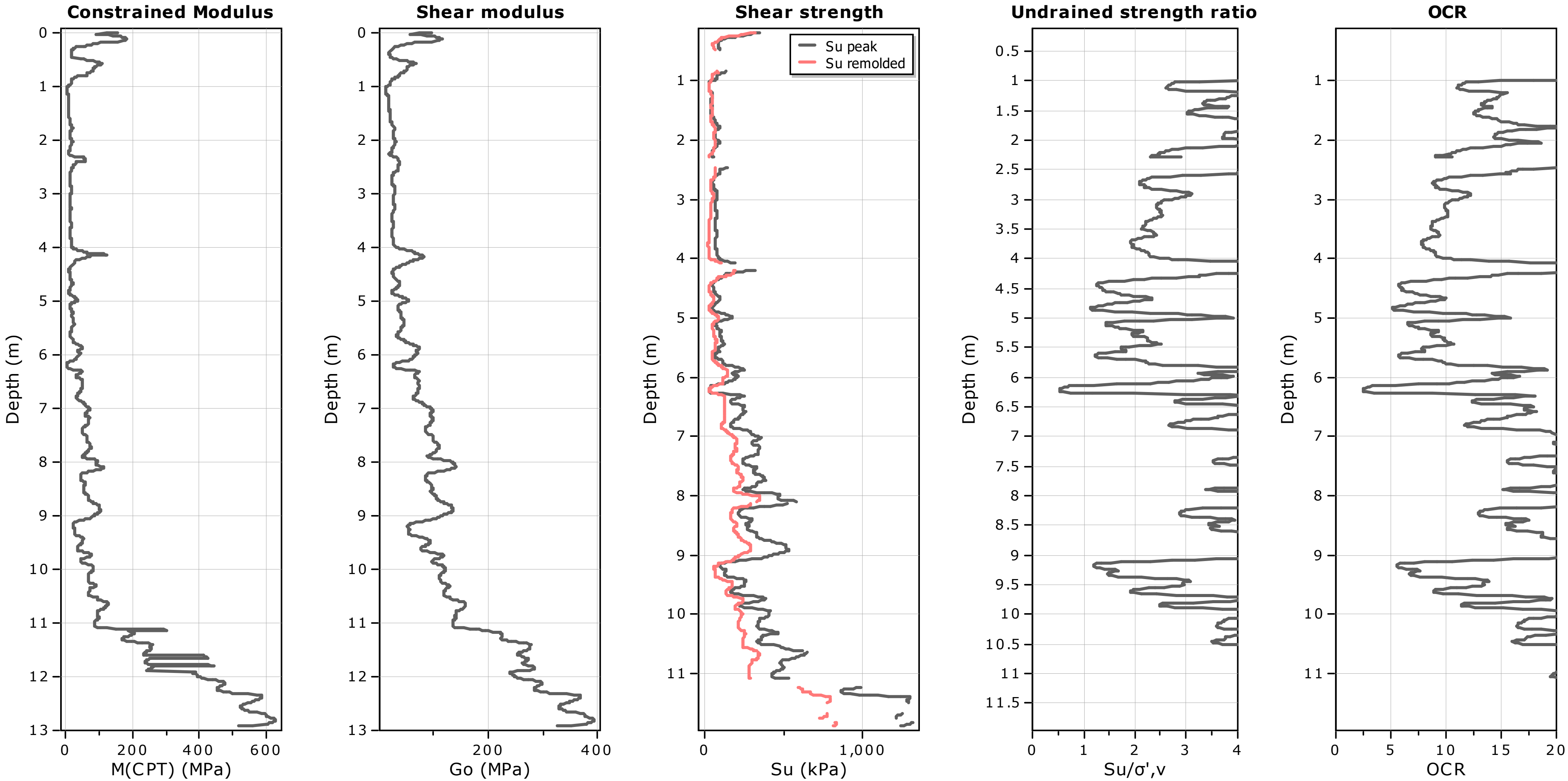
CPT: A2-CPT03
Total depth: 12.92 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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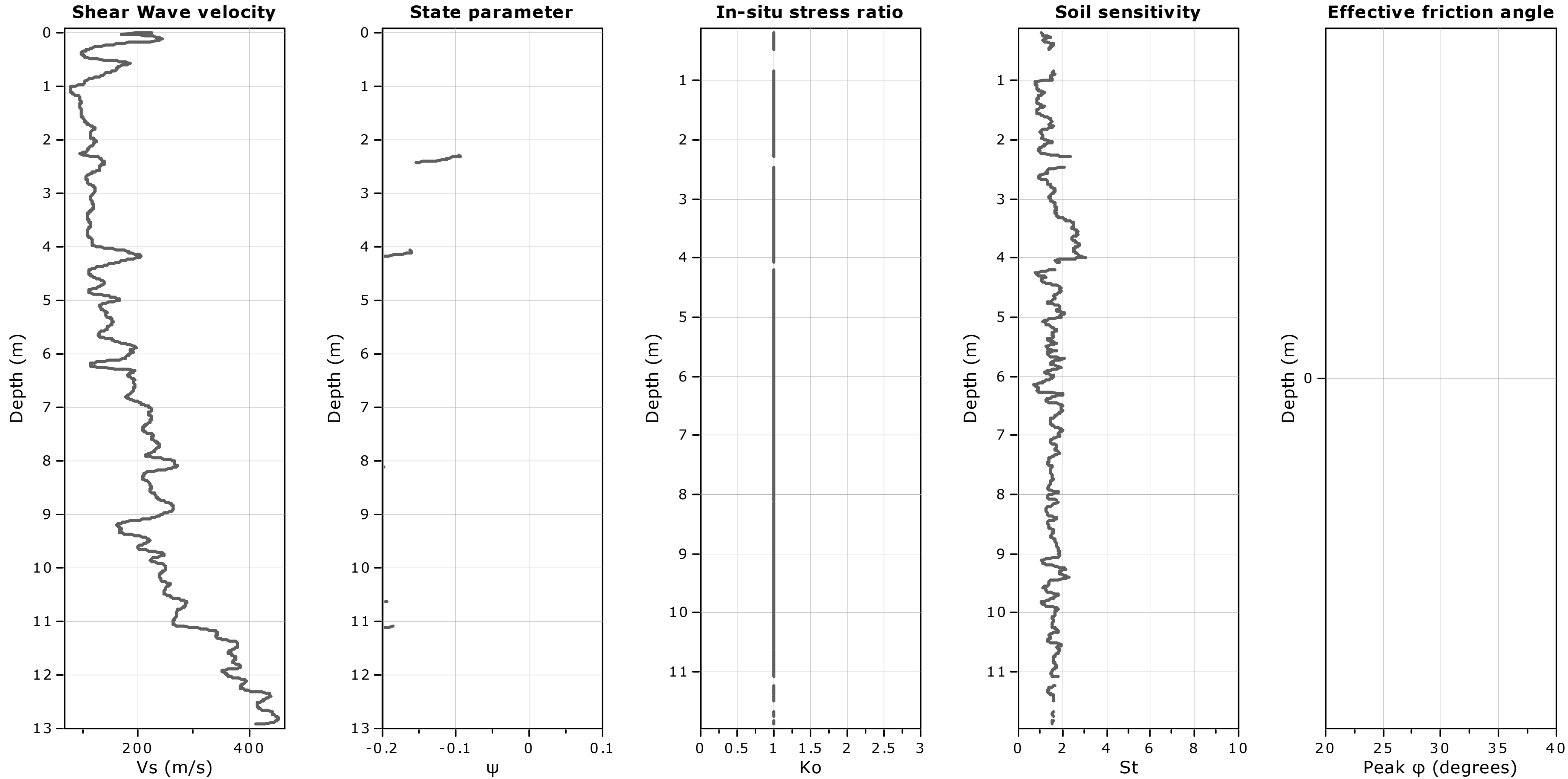
Merarhias 56
http://www.geologismiki.gr

CPT: A2-CPT03
Total depth: 12.92 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



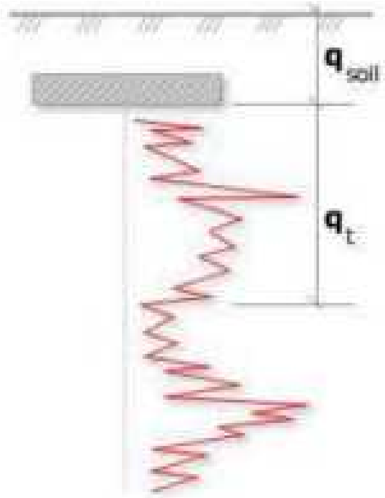
Calculation parameters

Soil Sensitivity factor, N_S: 7.00
User defined estimation data

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A2-CPT03
Total depth: 12.92 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

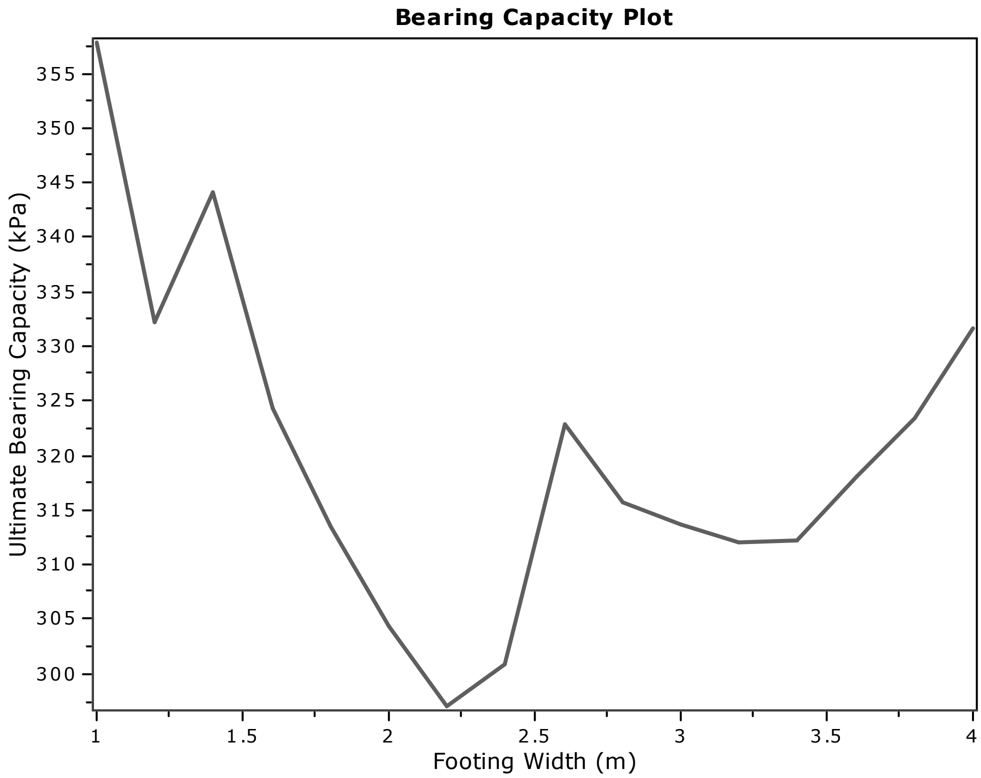
Project:
Location:



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.74	0.20	9.50	357.86
2	1.20	0.50	2.30	1.61	0.20	9.50	332.19
3	1.40	0.50	2.60	1.67	0.20	9.50	344.11
4	1.60	0.50	2.90	1.57	0.20	9.50	324.26
5	1.80	0.50	3.20	1.52	0.20	9.50	313.51
6	2.00	0.50	3.50	1.47	0.20	9.50	304.38
7	2.20	0.50	3.80	1.44	0.20	9.50	297.02
8	2.40	0.50	4.10	1.46	0.20	9.50	300.81
9	2.60	0.50	4.40	1.57	0.20	9.50	322.92
10	2.80	0.50	4.70	1.53	0.20	9.50	315.64
11	3.00	0.50	5.00	1.52	0.20	9.50	313.68
12	3.20	0.50	5.30	1.51	0.20	9.50	312.01
13	3.40	0.50	5.60	1.51	0.20	9.50	312.14
14	3.60	0.50	5.90	1.54	0.20	9.50	318.02
15	3.80	0.50	6.20	1.57	0.20	9.50	323.38
16	4.00	0.50	6.50	1.61	0.20	9.50	331.71

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

:: N_{SPT} (blows per 30 cm) ::

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

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

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

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

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

:: Relative Density, Dr (%) ::

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

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

:: State Parameter, ψ ::

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

:: Drained Friction Angle, φ (°) ::

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

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

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

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

If $I_c \geq 2.20$

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

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

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

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

:: Soil Sensitivity, S_t ::

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

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

:: Peak Friction Angle, φ' (°) ::

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

(applicable for $0.10 < B_q < 1.00$)

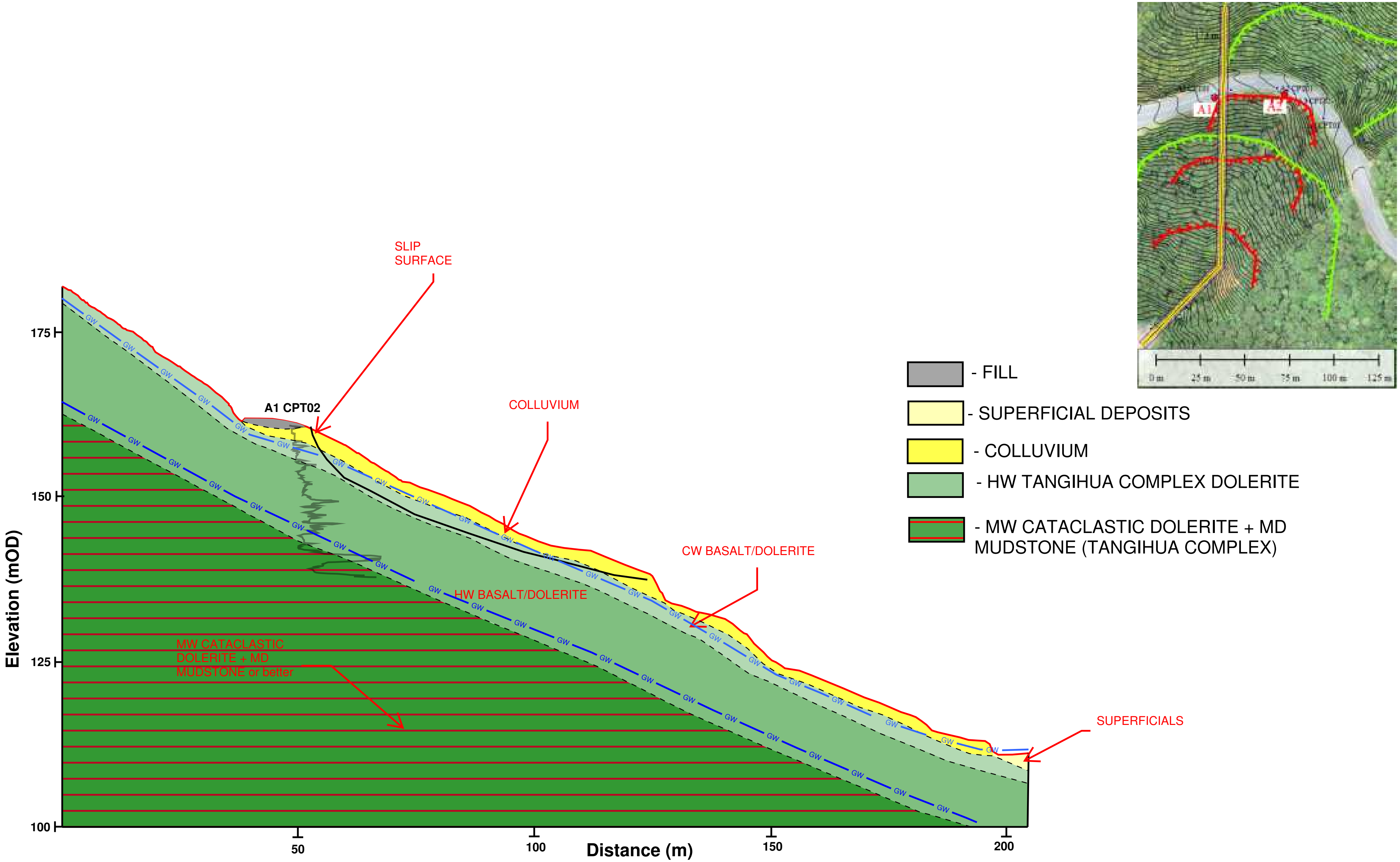
References

• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

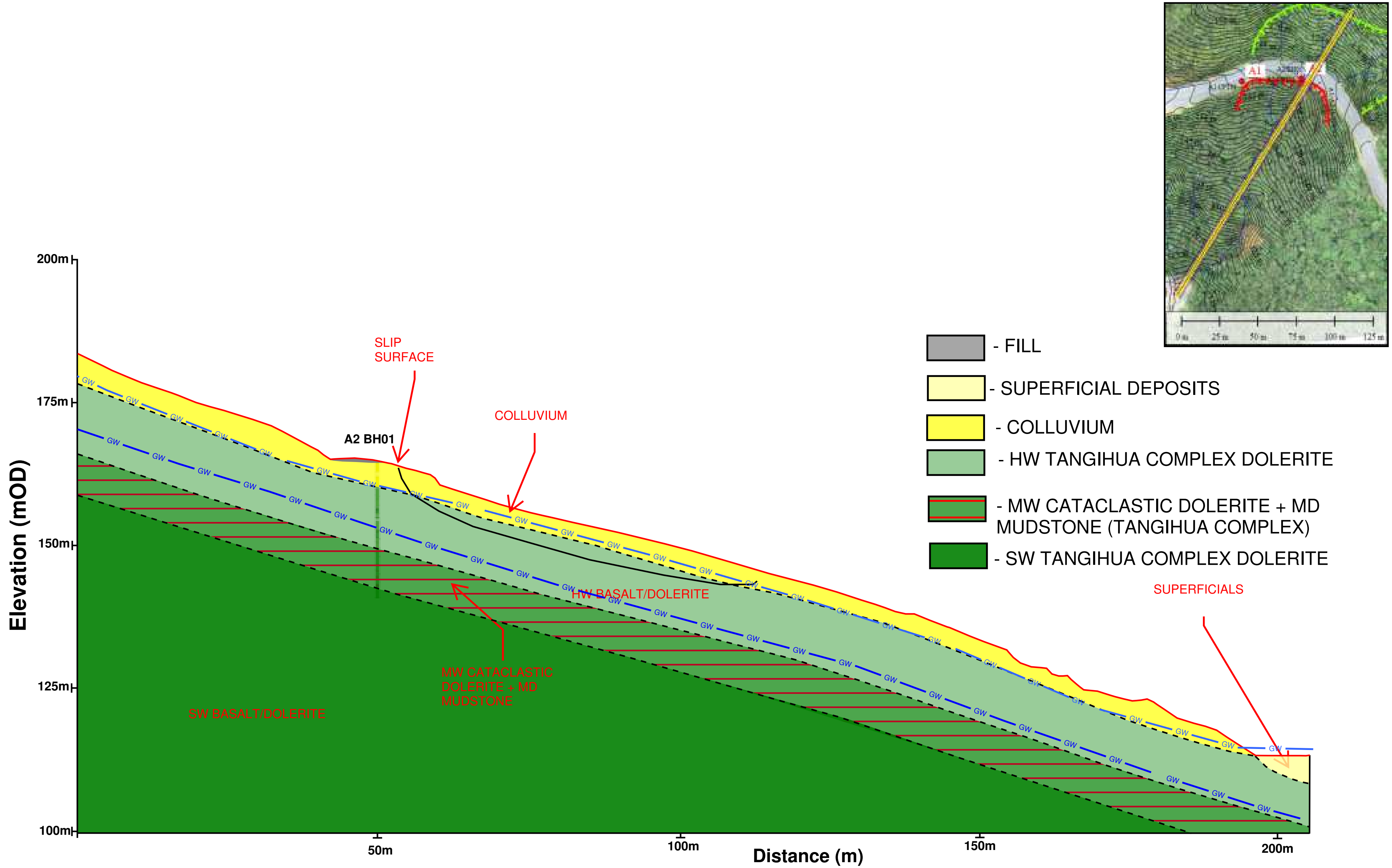
Appendix B

Conceptual Geological Cross Section



Level 3, The Westhaven
100 Beaumont Street
Auckland 1010
New Zealand

Project: NZTA Northland Resilience and Emergency Works- Mangamuka, SH1		Job number: 1-11240.00
Description: A1 Conceptual Cross Section		Revision:
Drawn by: MWL	Checked by:	Date: 24/11/2022



Level 3, The Westhaven
100 Beaumont Street
Auckland 1010
New Zealand

Project: NZTA Northland Resilience and Emergency Works- Mangamuka, SH1		Job number: 1-11240.00
Description: A2 Conceptual Cross Section		Revision:
Drawn by: MWL	Checked by:	Date: 24/11/2022

Appendix C

Tilt Sensor and Rainfall Data
Inclinometer Data

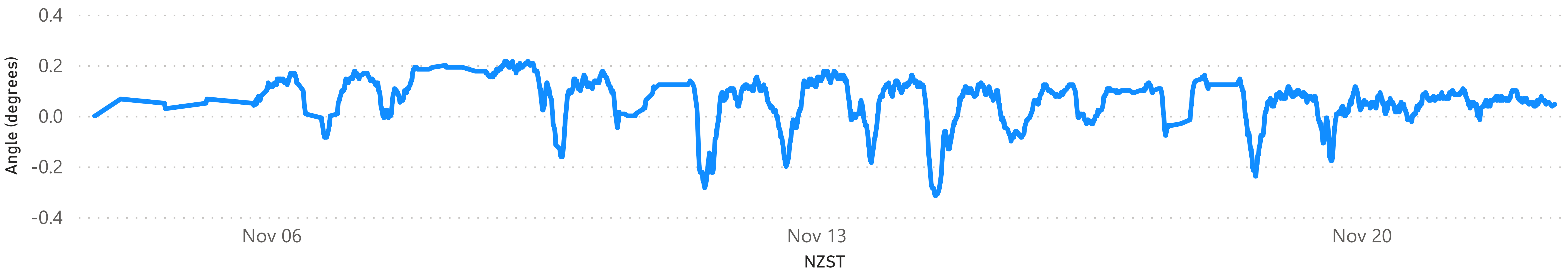
Mangamuka Gorge - Site A1 (T20)

9/26/2022 | 11/22/2022

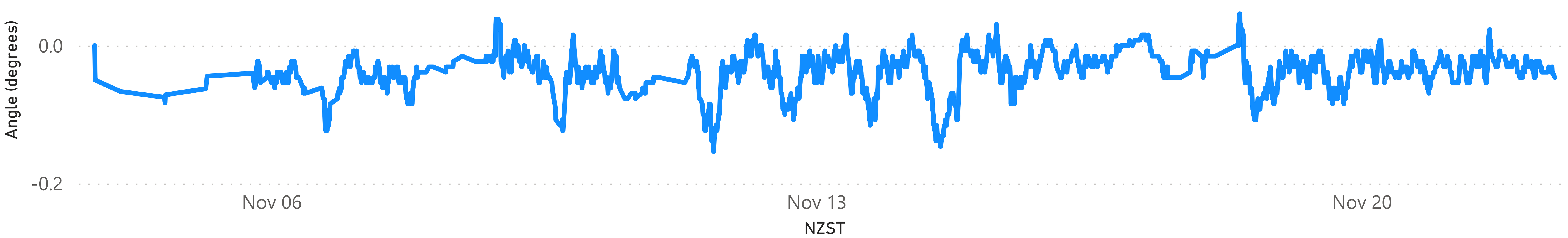
TARP

Site	Level
A01	

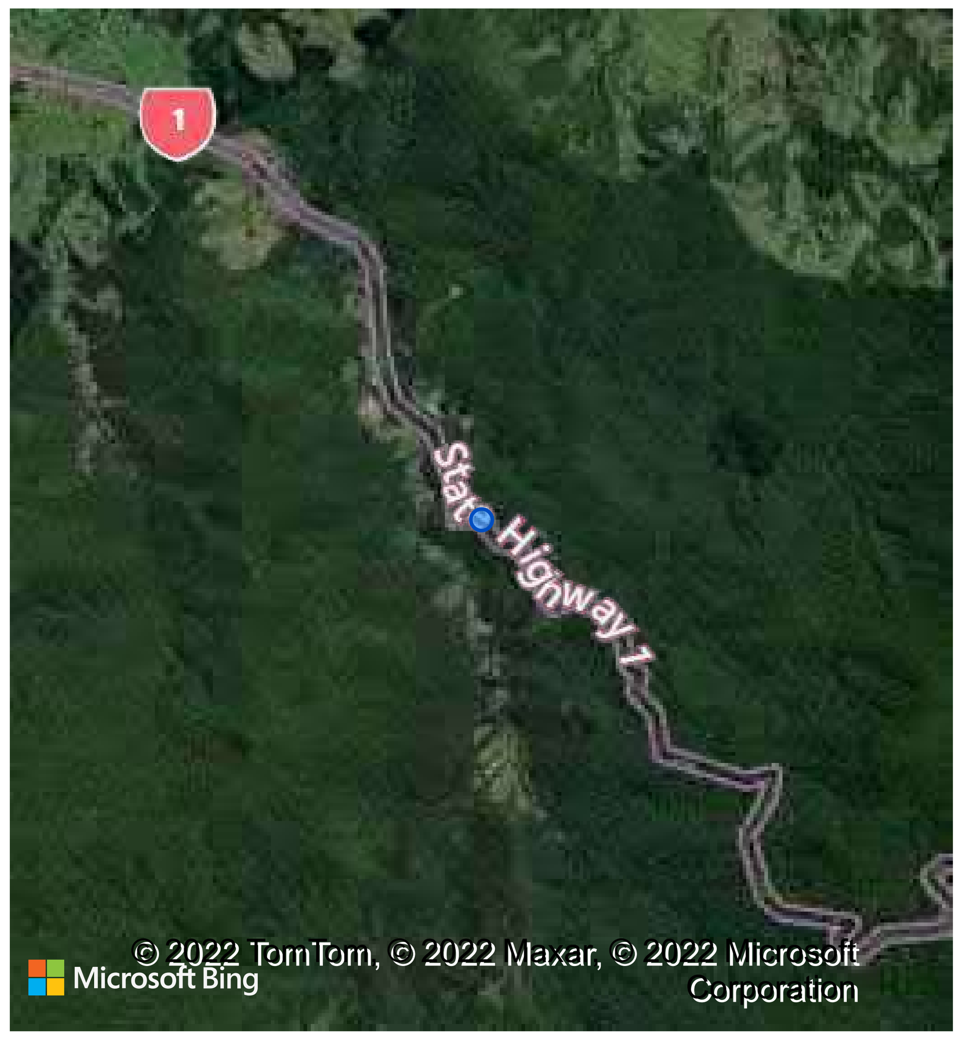
MA Tilt 20 X Axis by NZST



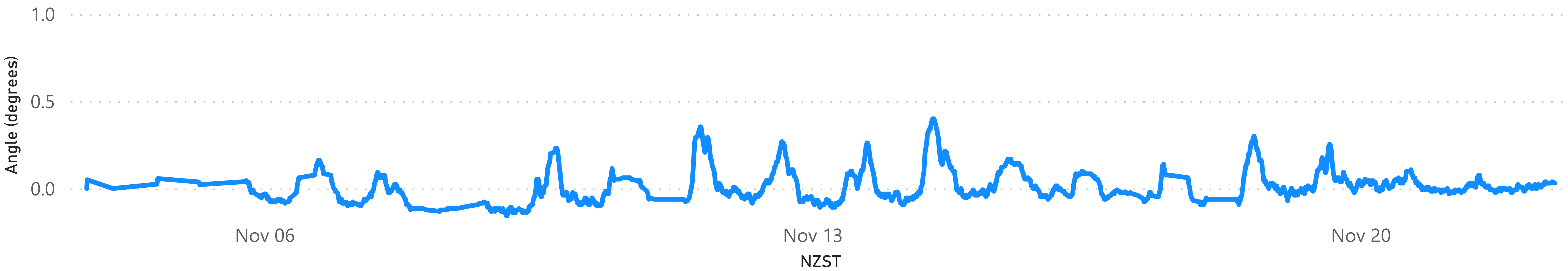
MA Tilt 20 Y Axis by NZST



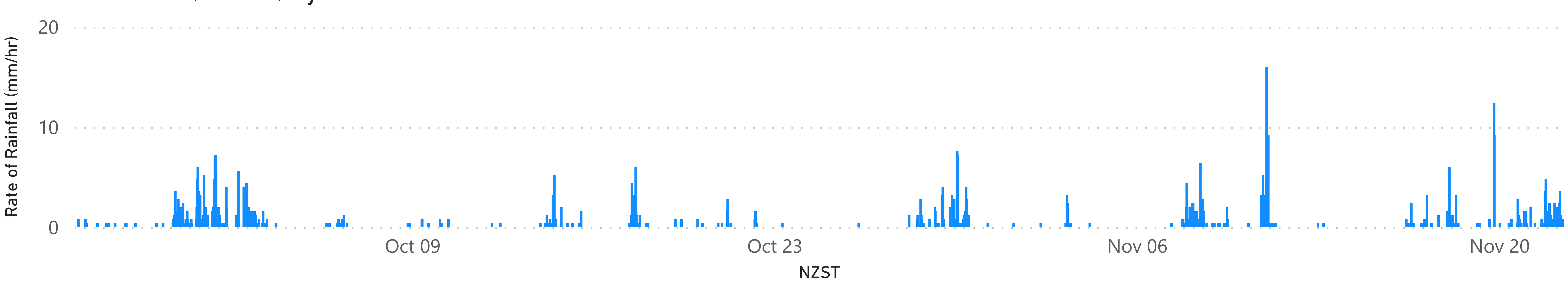
Device ● Tilt 20



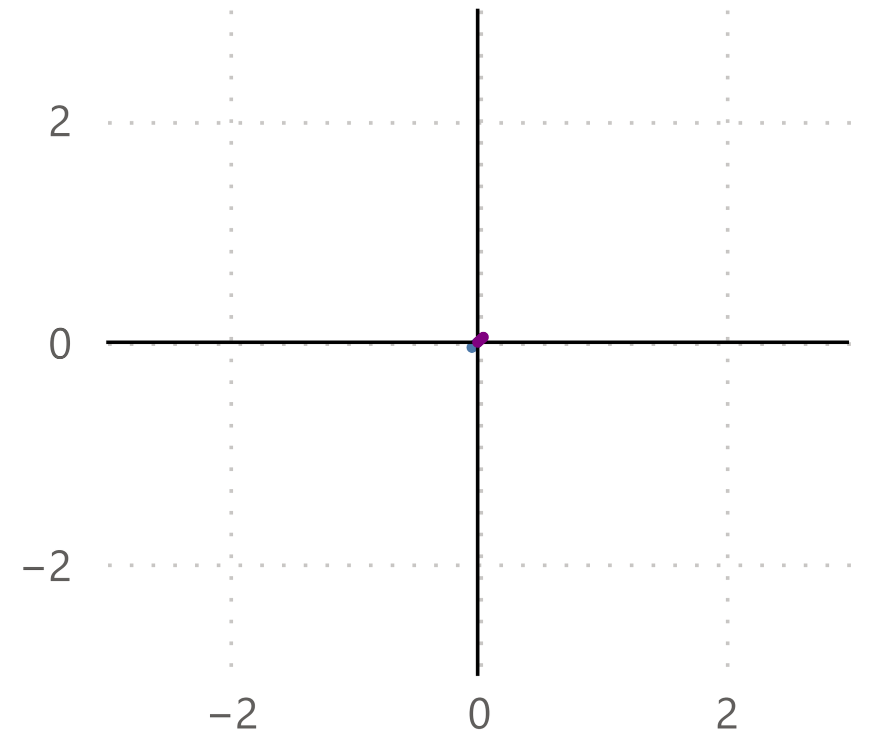
MA Tilt 20 Z Axis by NZST



Rate of Rainfall (mm/hr) by NZST



Tilt 20
North



LEGEND

Actual Tilt Direction

Estimated Land Direction

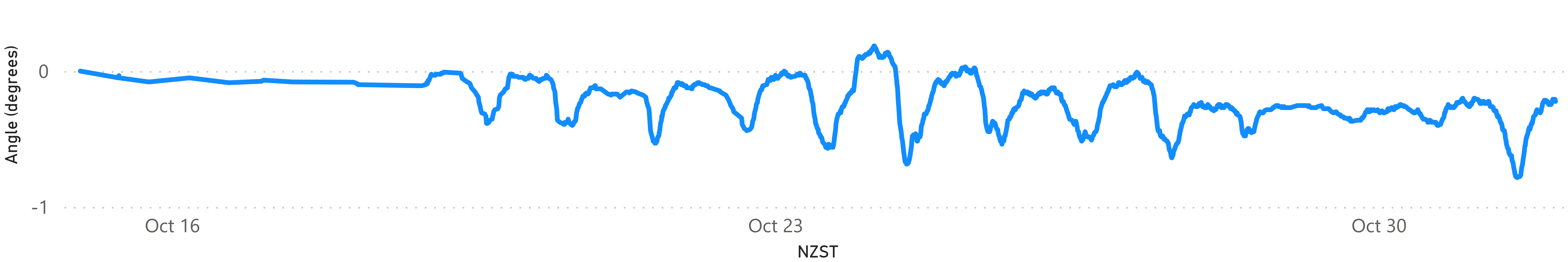
Mangamuka Gorge - Site A2 (T27)

9/17/2022 11/22/2022

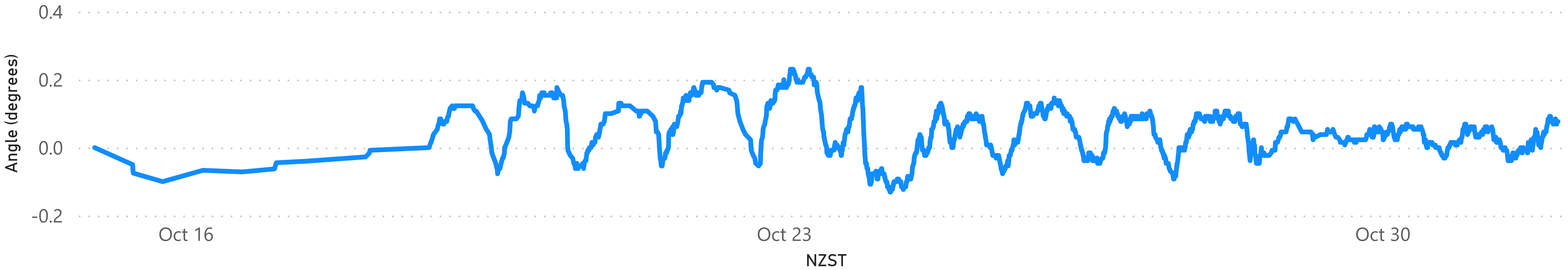
TARP

Site	Level
A02	

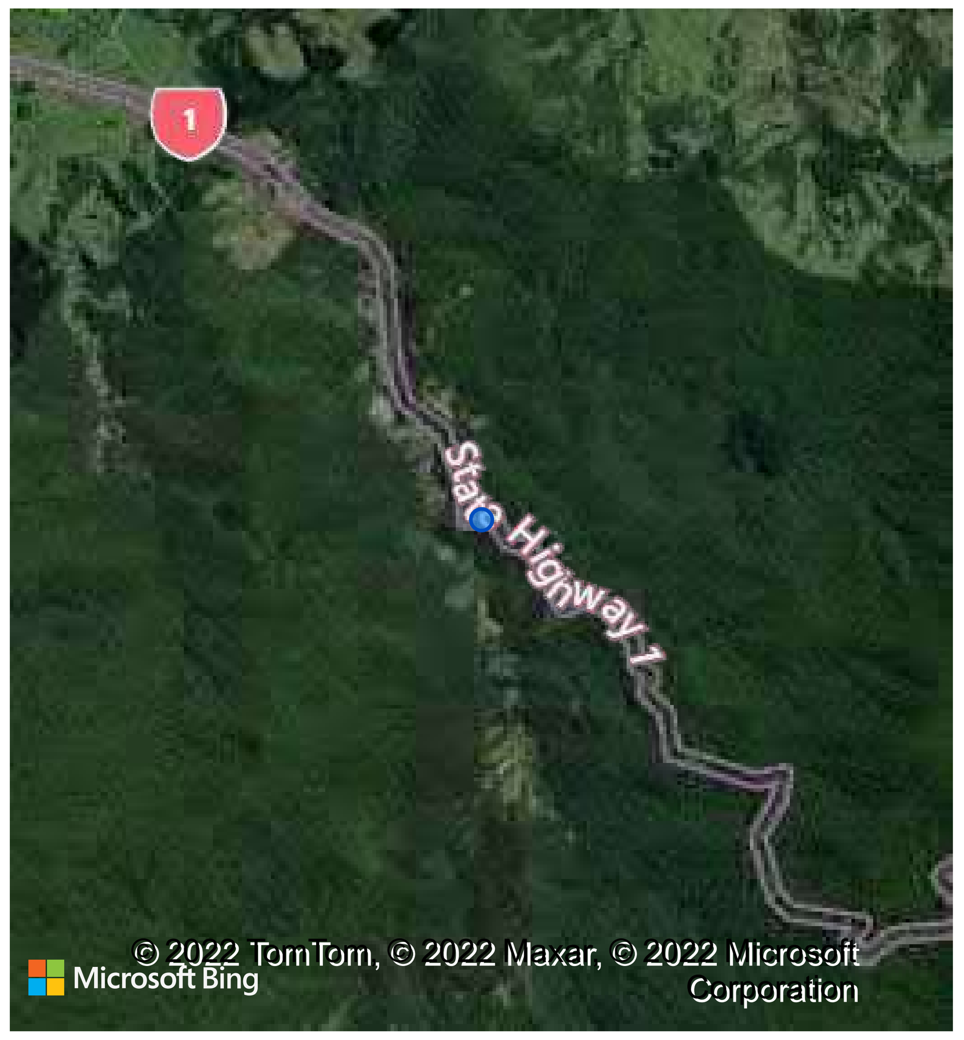
MA Tilt 27 X Axis by NZST



MA Tilt 27 Y Axis by NZST

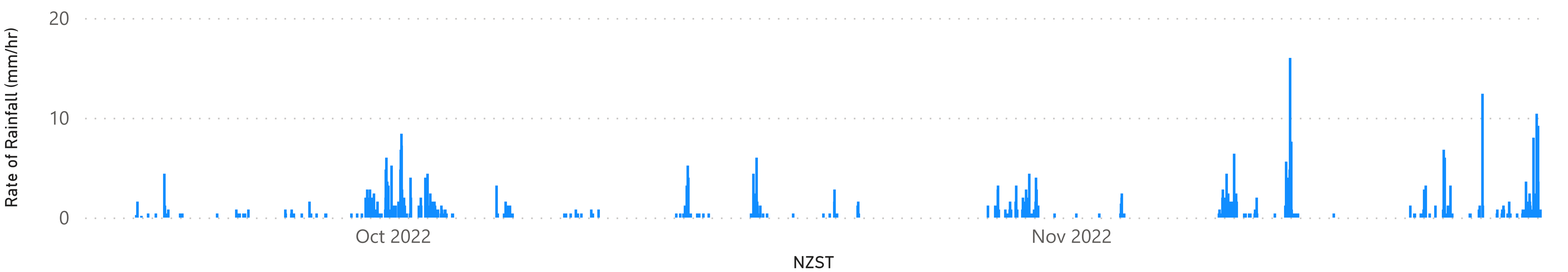


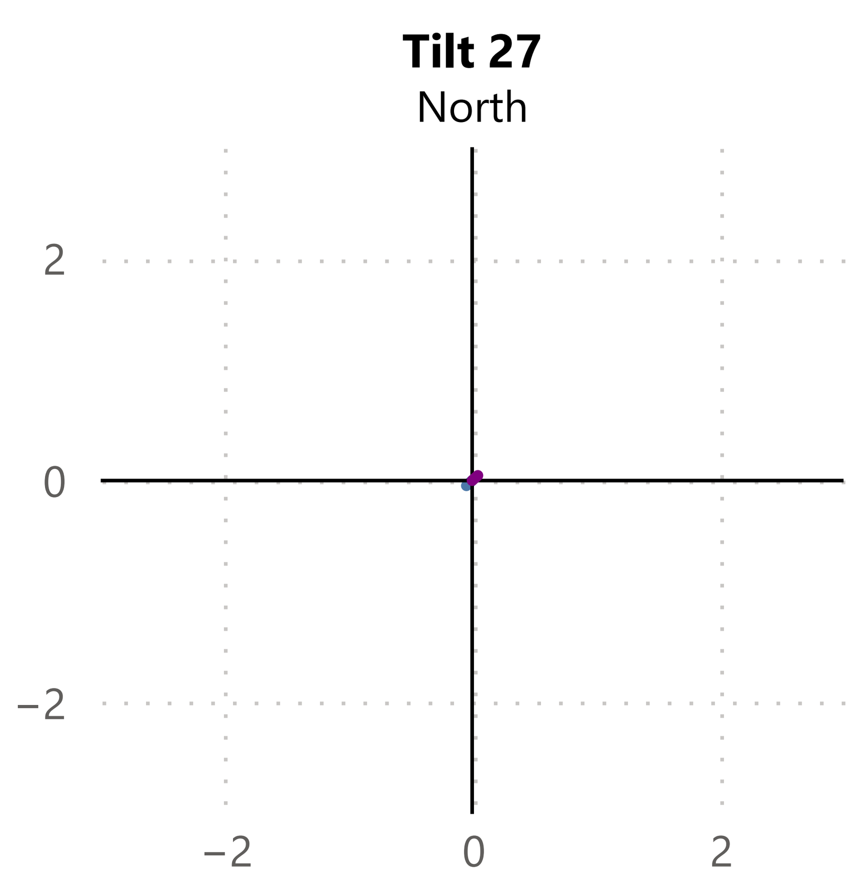
Device Tilt 27



MA Tilt 27 Z Axis by NZST

Rate of Rainfall (mm/hr) by NZST



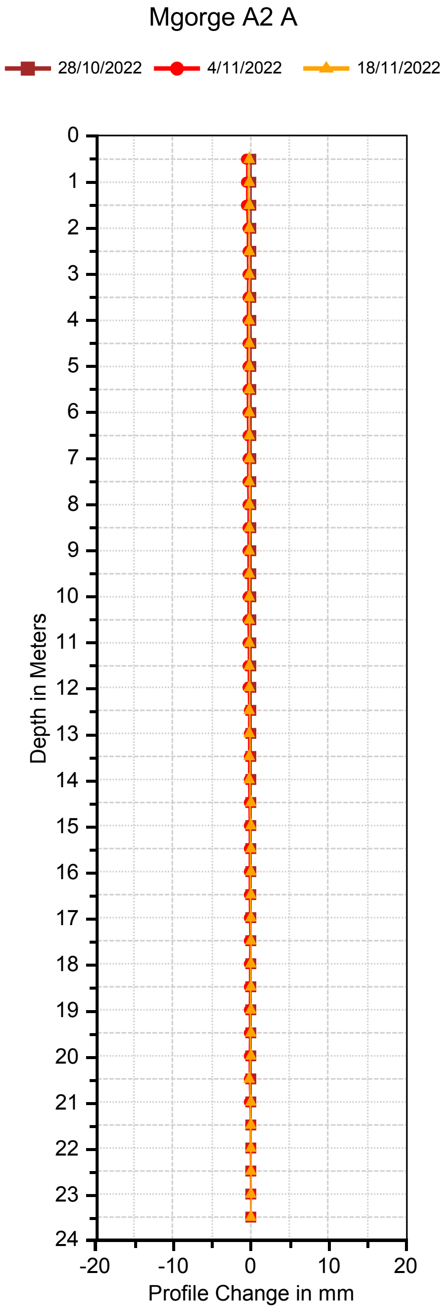


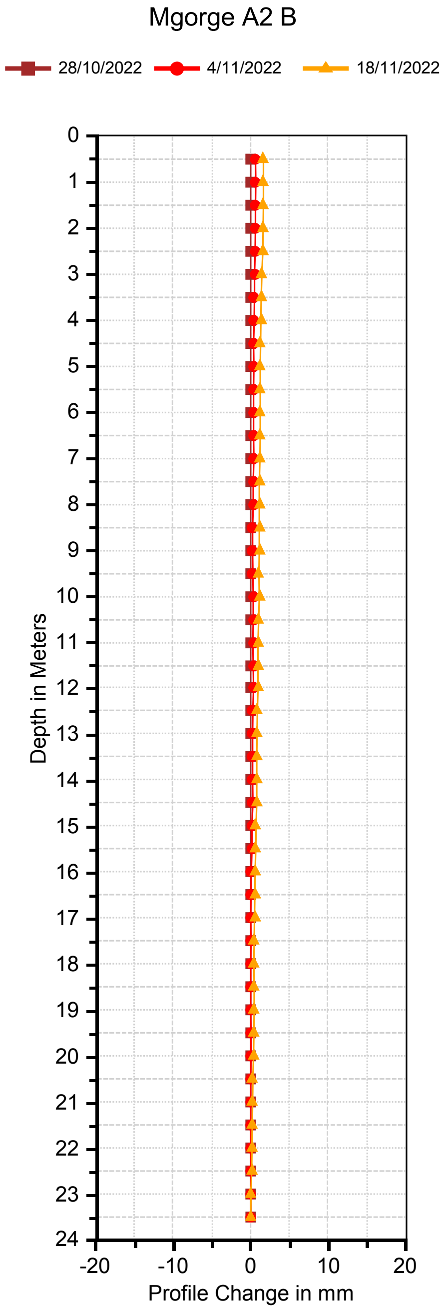
LEGEND

Actual Tilt Direction

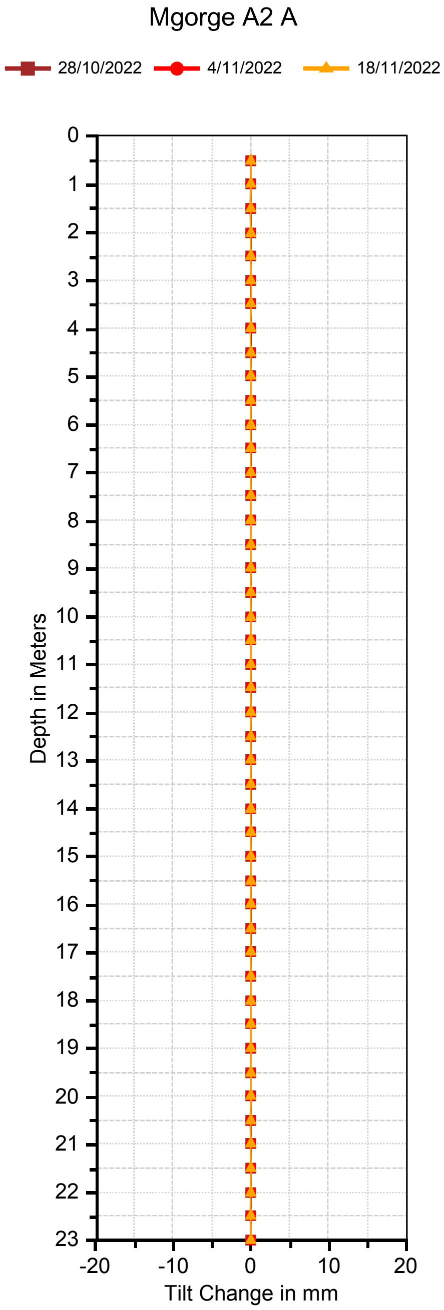
Estimated Land Direction

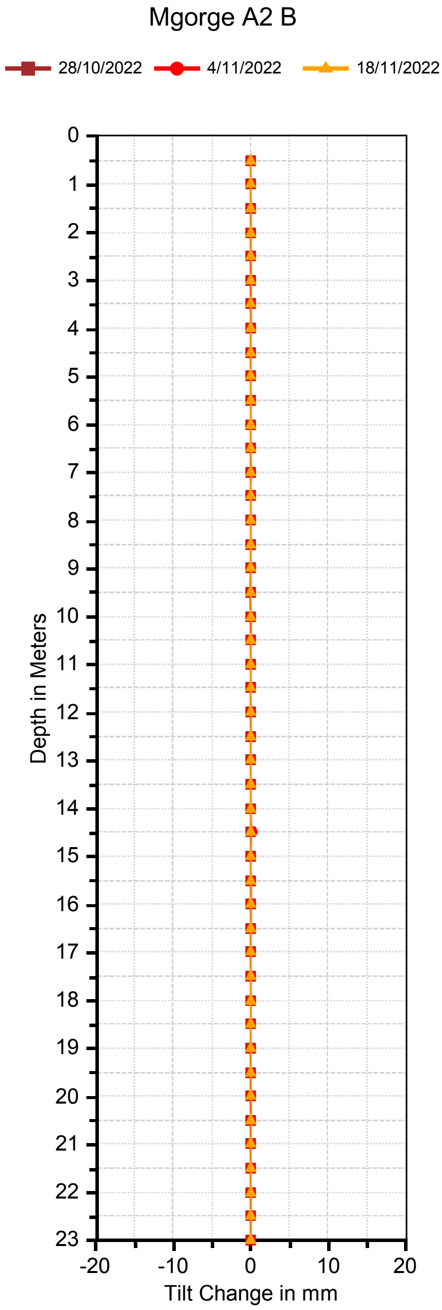
Whangarei Lab
166 Bank Street
Whangarei
Ph 09 438 4417





Whangarei Lab
166 Bank Street
Whangarei
Ph 09 438 4417





wsp.com/nz

Project Number: 1-11240.00

NZTA Northland Resilience and Emergency Works- August 2022- 10052/22A12

24 November 2022

CONFIDENTIAL

150 YEARS IN AOTEAROA

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Aaron George

Approved for release by
Shaun Grieve

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Revision	Date	Author	Reviewed by	Approved by	Status
00	22/11/2022	HQ	AG	SG	Final

Revision Details

Revision	Details

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Disclaimers and Limitations

This report ('**Report**') has been prepared by WSP exclusively for New Zealand Transport Agency ('**Client**') in relation to Mangamuka Gorge Slips Emergency Works ('**Purpose**'). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any reliance on or use of this Report, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Report by any third party.

1 Introduction

Two storm events in July and August have caused widespread flooding and associated landsliding across much of Northland. Following the August rain event WSP were engaged by Waka Kotahi to form part of the emergency response and undertake an urgent geotechnical investigation along a section of State Highway (SH) 1 through Mangamuka Gorge. A total of 12 underslips have been identified requiring significant geotechnical analysis and permanent remedial measures.

This report covers the investigation and assessment at site - 10052/22A12 (henceforth referred to as A12). The Site A12 is located close to the southern extent of the Mangamuka Ranges section of SH 1 at RS134 RP 4.473, approximately 22km southeast Kaitaia.

The landslide is an underslip likely triggered by water saturation of slope material resulting from storm events in July and August. The site location is shown below in Figure 1-1 together with the other slip sites.

Figure 1-1: *10052/22A12 Site location Plan*

2 Regional Geology

The 1:250 000 scale QMAP seamless digital data (GNS, 2013) indicates the site area to be underlain by the Tangihua Complex of the Northland Allochthon comprising basalt pillow lava, with subvolcanic intrusives of basalt, dolerite, and gabbro; locally incorporating siliceous mudstone (Figure 2-1). The Tangihua Complex has been emplaced onto New Zealand through convergent plate tectonics and sea floor sliding. As a result, the material has been historically sheared with the rock underlying the site expected to be highly fractured and degraded through original emplacement processes and further modified by weathering.

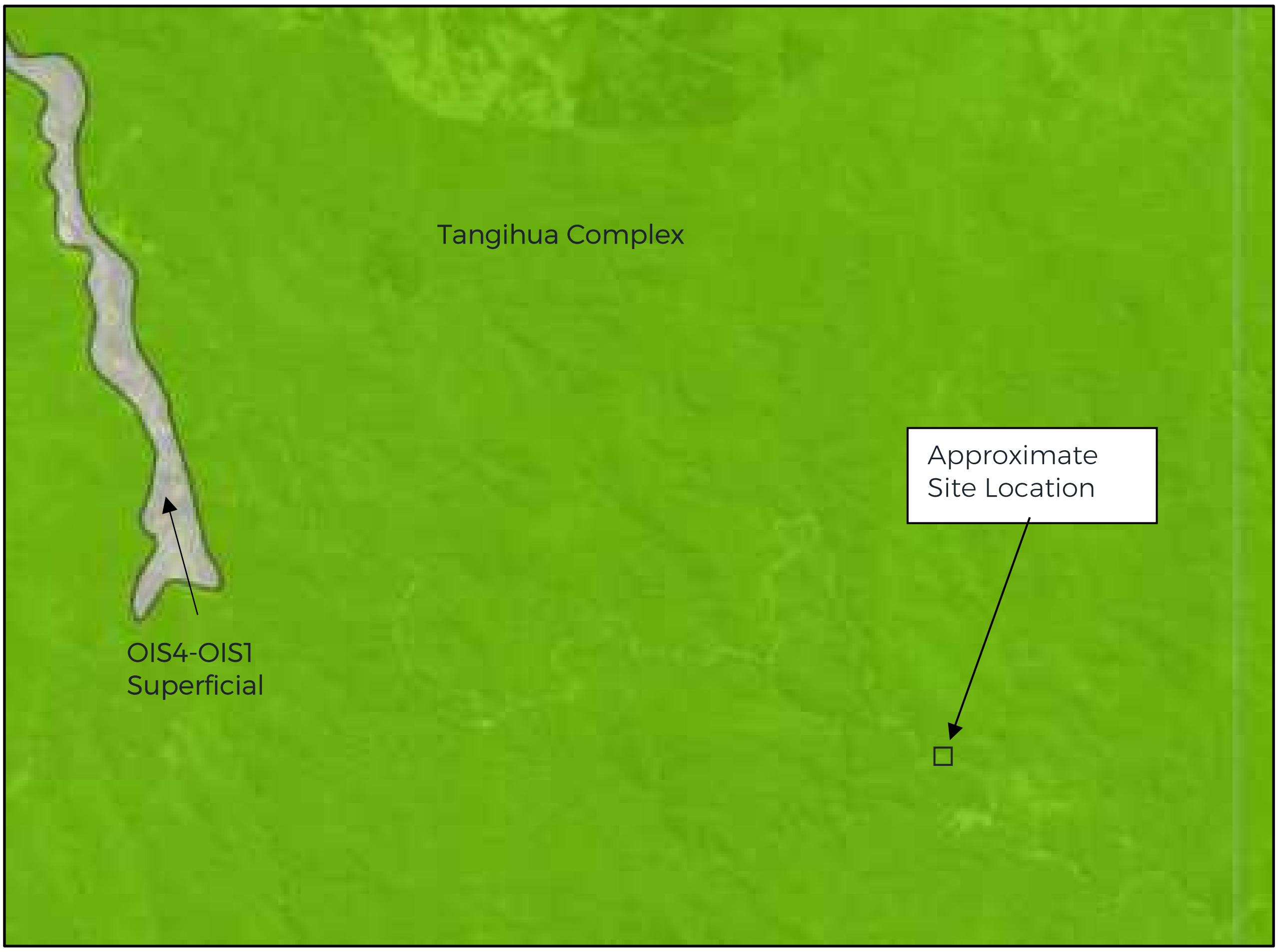

Figure 2-1: Regional Geology (GNS, 2012)

3 Site Investigation

Between 17th and 19th September 2022, a geotechnical investigation was undertaken to identify sub-surface ground conditions and to help inform the options for remedial measures required at site A12 The works comprised the following:

- A single rotary cored borehole (BH) was completed to a depth of 11.6mbgl, with standard penetration tests (SPTs) at 1.5m intervals.
- Installation of BH inclinometer upon completion of BH01.
- Three Cone penetration tests (CPTs)taken to a maximum depth of 9.45mbgl.
- One wash borehole (A12BH02) was drilled and installed with a single piezometer.
- The intrusive drilling works was undertaken by Drillforce Limited including the boreholes, CPT's as well as the installation of inclinometer tubing for monitoring ground movement and piezometers for groundwater, all under the supervision of WSP site staff.
- All the boreholes were logged in accordance with the NZGS *Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes*, December 2005 and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg. 365, Table 1. Borehole and CPT locations displayed on Figure 3-1 below with logs displayed in Appendix A.
- Tiltmeters were installed on the ground surface by WSP Research staff to obtain Realtime monitoring of surface movements.

- Monitoring of the piezometers and inclinometers was undertaken by GeoCivil Ltd under direction of WSP staff.

Figure 3-1: Exploratory hole location plan

3.1 Observations

During the site investigation, the slip was inspected on 17th and 19th September 2022 by WSP. The inspection identified the following:

- The landslide extended some 23m downslope, to the southwest of the road affecting approximately a 63m length of the highway with tension cracking and headscarps. The grade of slope below the road is approximately 3H:1V.
- Along the affected section, the highway is flanked to the north by a small cut slope into the steep natural slopes that extend above. The base of the cut slope incorporates a drainage channel feeding into a culvert. Of note this position of the highway crosses the head of a gully feature where the slip has occurred.
- This section of road is sloping at approximately 5° to the southeast.
- At the time of inspection, the northbound lane had lost 1.2m of pavement because of the road being undermined. Additional tension cracking has further regressed towards the centreline and the slip is likely to continue to regress over time if not remediated, with the potential to threaten the entirety of the road.
- There has been up to 200 mm of vertical settlement/heave with 200mm of horizontal movement associated with the downslope movement.
- Surface seepage was not noted during the site investigation.

4 Geomorphological Mapping

A terrain evaluation is presented below in Figure 4-1. Geomorphological mapping undertaken from both Lidar and aerial photography as well as site observations. The site area is comprised of steep slopes of approximately 30° - 40° and includes historic slip features manifesting as large gullies extending from the slope above to the river below. The affected section of road appears to be located within a larger active slip. This section of the road is slowing creeping downwards caused by slip movements.

Figure 4-1: Geomorphological map

5 Ground Model

Table 5-1 below summarises the ground model for site A12. A conceptual geological cross section is presented within Appendix B.

Table 5-1 – Ground Model

Lithology	Top (mbgl)	Base (mbgl)	Total thickness (m)	SPT N Value	GSI
Fill	0.0	0.5	0.4* - 1.1*	*5 – 42*	-
Colluvium	0.5	6.0	4.0*- 5.9*	*3 – 18*	-
Highly Degraded Tangihua Complex MUDSTONE/CATACLASTIC ROCK (IV)	6.00	6.45	0.0*- 2.0m*	*9 - 18*	-

MODERATELY Degraded Tangihua Complex MUDSTONE/CATACLSTIC ROCK (III)	6.45	10.1	0.5* - 2.6m*	*18 – 39*	-
Slightly Weathered Tangihua Complex MUDSTONE/CATACLASTIC ROCK (II)	10.1	11.6	Not proven	*50 – 70+*	30-40

* Inferred from CPT results. CPTs

Fill was encountered within BH01 and inferred to be present in within all CPTs, to a depth ranging from 0.4 to 1.1m. The material is described as asphalt and sub-basecourse, comprised of dark bluish grey, gravel that is angular, fine to coarse, well graded, slightly weathered basalt.

Colluvium was encountered within BH01 and inferred to be present within All CPTs, to a depth ranging from 4.0 to 5.9m. The material is classified predominately as a soft to firm, becoming very stiff with depth, silty clay/clayey silt, consisting variable quantities of sand and gravel.

Highly degraded material was encountered within BH01 and inferred to be present within all CPTs with a maximum thickness of 2.0m encountered in CPT03. The material is classified as gravelly silt, having variable quantities of clay.

Moderately degraded Tangihua Complex rock was encountered within BH01 comprising dark reddish-brown mudstone, weak with clasts predominantly of porphyritic dolerite. It is important to note that we recorded an SPT N value of 0 at 9mbgl. A potential deep seated shear surface was inferred at this depth (refer to the conceptual geological cross section at Appendix B).

Slightly weathered cataclastic volcanic rock was encountered in BH01 from 10.1mbgl to the base of the borehole. The material was described as reddish-brown mudstone and basalt, strong, with iron staining and zeolite veneer on the defect surfaces and zeolite veining.

All CPTs inferred to refuse on moderately degraded Tangihua Complex surface.

Three groundwater monitoring visits have been carried out so far between 27th October and 18th November 2022. Results summarised below in Table 5-2. Due to difficulties during drilling only one piezometer was installed.

Table 5-2: Groundwater monitoring results

BH	Date	Depth to GW (mbgl)	Lithology
BHA12-2	27/10/22	3.17	COLLUVIUM
	04/10/22	3.69	
	18/11/22	3.62	

5.1 Instrumentation Summary

Tilt sensors data and rainfall sensors data is presented within Appendix C, collected from 14th September 2022. Tilt sensor positions shown below on Figure 5-1.

Figure 5-1: A12 Tilt Senor Positioning

Mangamuka gorge experienced 21mm of rain between 4am 02/10/22 and 4am 03/10/22, resulting in the following movements at MA tilt sensor:

- -0.81° MA Tilt 17 X-Axis
- -0.2° MA Tilt 17 Y-Axis
- 0.54 MA Tilt 17 Z-Axis

The resultant trajectory has been estimated and shows a circular movement leading to the back tilting of the monitoring device.

This is located near the southern extent of site approximate to BHA12. Movement is expected to have occurred through fill or colluvial material close to the surface and may correspond to movement deeper in the ground.

No further significant movement was identified to date, with trends generally displaying cyclic changes in temperature.

At completion of the borehole (BH01), inclinometer casing was installed to 11.6m depth for subsequent monitoring. Inclinometer monitoring was carried out over a period of two and half weeks following installation. The probe measurements so far indicate minimal movements have occurred during this period, however there are some indications of very minor movement at 4.5mbgl and 9.5mbgl. The shallower movement is within the colluvium soil and the deeper movement is suggestive of movement within a historical landslide feature.

6 Recommendations

There is an immediate risk of complete evacuation of the road following the next significant rainfall event. Based on the available geotechnical information it is recommended a concrete pile wall is constructed at the site, to be socketed into competent bedrock. Wall geometry and additional support requirements to be discussed in design report.

Further information provided within October 2022 Storm Response Options Update- Memo no.2 including discounted solutions.

7 Limitation

This report has been prepared for the benefit of NZTA only and is based on limited investigation and visual inspection only. Given the complex geological setting changes in ground condition could occur across the site that differ from those summarised within this report.

Appendix A

Borehole Logs
CPT Report

Appendix B

Conceptual Geological Cross Section

Appendix C

Tilt Sensor and Rainfall Data

Inclinometer Data

wsp.com/nz

Appendix A

Borehole Logs

CPT Report

Borehole No. BH22A12

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	282892 E 986775 N
Client:	Waka Kotahi	*Ref. Grid:*	NZTM
Project No.:	1-11244.00	*R.L.:*	126.765 m
Location:	Slip 22A12 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000

Depth: 11.6 m
Inclination: -90°
Azimuth: 0°

Column headings: GEOLOGY | MAIN DESCRIPTION / DETAIL DESCRIPTION | R.L. (m) | DEPTH (m) | GRAPHIC LOG | TESTS: SPT 'N' VALUE, SPT BLOW COUNTS OR SHEAR VALUE | ROCK STRENGTH | ROCK WEATHERING | ROCK DEFECT SPACING | DEFECT DIP degrees 0 90 | DEFECTS / NOTES / OTHER TESTS | CORE: SAMPLE TYPE, TCR (%), RQD (%) | DRILLING: DRILLING METHOD, CASING, BASE OF HOLE & WATER LEVEL | INSTALLATION DETAILS

R.L. (m) scale: 126, 124, 122, 120, 118. Depth (m) scale: 1, 2, 3, 4, 5, 6, 7, 8, 9.

Fill

- ASPHALT
- Fine to coarse GRAVEL; dark bluish grey. Very dense, moist; gravel, angular, well grade, slightly weathered, strong basalt [Gap 40 Subgrade].

Colluvium

- Silty CLAY, some gravel, trace sand; dark reddish brown mottled light brown. Firm, wet , highly plastic; gravel, fine to medium, subrounded and subangular, completely weathered mudstone and dolerite.
- 1.30 - 1.50m - Core loss; No sample recovered.
- Silty CLAY, some gravel, trace sand; dark reddish brown mottled light brown. Firm, wet , highly plastic; gravel, fine to medium, subrounded and subangular, completely weathered mudstone and dolerite; sand, fine.
- 1.80 - 1.95m - Core loss; No sample recovered.
- Silty CLAY, minor sand, some gravel; drak reddish brown mottled light brown and greenish grey. Firm, wet, highly plastic; sand, fine; gravel, fine to medium, subround and subangular, completely weathered mudstone and dolerite.
- 2.65-3.20m - Very soft, saturated.
- 2.70 - 3.00m - Core loss; No sample recovered.
- Silty CLAY, minor sand, some gravel; dark reddish brown. Very soft, saturated, highly plastic; sand, fine; gravel, fine, completely weathered, extremely weak dolerite.
- Clayey SILT, minor sand and gravel, trace of organics; greenish grey. Firm, wet, highly plastic; sand, fine; gravel, fine, completely weathered dolerite; organics, fibrous, roolets; strong organic ordour.
- 3.30 - 3.45m - Core loss; No sample recovered.
- Clayey SILT, minor sand and gravel, trace of organics; greenish grey. Firm, wet, highly plastic; sand, fine; gravel, fine, completely weathered dolerite; organics, fibrous, roolets; strong organic ordour.
- Silty CLAY, trace sand; greenish grey. Very stiff, wet, highly plastic; sand, fine.
- 4.50-4.60m - Light brownish orange.
- Silty CLAY, minor sand & gravel; dark reddish brown mottled light brown. Very soft, wet, highly plastic; sand, fine; gravel, fine to medium, subangular, completely weater mudstone and dolerite
- 4.95-5.15m - Saturated.
- Silty CLAY, some sand, minor gravel; dark reddish brown mottled light brown. Very soft, wet, highly plastic; sand, fine; gravel, fine to medium, subangular and subangular, higly weathered mudstone and dolerite.

Tangihua Complex

- Gravelly SILT, some clay, minor sand; dark reddish brown. Firm, wet, low plasticity; gravel, fine to medium, subangular, completely weathered mudstone and dolerite; sand, fine to medium [Highly degraded].
- Moderately degraded cataclastic dark reddish brown MUDSTONE (80%) sheared with dark brown BASALT (20%). Extremely weak to very weak; extremley to closely spaced, gently to steeply inclined, planar slickensided to rough defect; iron staining on the defect surfaces; zeolite veining.
- 7.30 - 7.50m - Core loss; No sample recovered.
- Moderately degraded cataclastic dark reddish brown MUDSTONE (85%) sheared with dark brown BASALT (15%). Weak; extremley to closely spaced, gently to steeply inclined, undulating smooth to rough defect; occasional iron staining on the defect surfaces; zeolite veining.
- Highly degraded cataclastic dark reddish brown MUDSTONE (85%) sheared with dark brown BASALT (15%). Extremely weak. Weathered to gravelly SILT, some clay; very stiff, wet, low plasticity; gravel, fine to medium, subangular, highly weathered mudstone and basalt].

Tests

SPT 'N' Value	SPT Blow Counts or Shear Value
5	1// 2/1/1/1
1	0// 0/0/0/1
1	0// 0/0/0/1
11	2// 2/3/2/4
50+	13// 15/20/15/4 for 45mm
0	0// 0/0/0/0

Rock strength / weathering

Rock Strength	Rock Weathering
	CW
ES	MW
VW	MW
EW	MW

Defects / Notes / Other Tests

- 6.75m - CZ
- 8.55m - CZ

Core

Sample Type	TCR (%)	RQD (%)
HQ	87	
SPT	67	
HQ	71	
SPT	67	
HQ	100	
SPT	100	
HQ	100	
SPT	100	
HQ	81	22
SC	0	
HQ	100	15
SC	0	
HQ	100	19

Drilling

Drilling Method: HQ Size, Triple Tube, Wireline Rotary Coring

Base of Hole & Water Level: SWL 3.40m 18/09; SWL 4.50m 19/09

Notes:

Borehole located within northbound lane approximately 4.8m from headscarp. Borehole terminated within SL MUDSTONE. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	17/09/2022	*Finished:*	19/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A12

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	282892 E 986775 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	11.6 m
Project No.:	1-11244.00	*R.L.:*	126.765 m	*Inclination:*	-90°
Location:	Slip 22A12 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000	*Azimuth:*	0°

GEOLOGY	MAIN DESCRIPTION / DETAIL DESCRIPTION	R.L. (m)	DEPTH (m)	SPT 'N' VALUE	SPT BLOW COUNTS OR SHEAR VALUE	ROCK STRENGTH	ROCK WEATHERING	ROCK DEFECT SPACING	DEFECT DIP (degrees 0–90)	DEFECTS / NOTES / OTHER TESTS	SAMPLE TYPE	TCR (%)	RQD (%)	DRILLING METHOD	CASING	BASE OF HOLE & WATER LEVEL	INSTALLATION DETAILS
Tangihua Complex	Slightly weathered cataclastic reddish brown MUDSTONE (70%) sheared with dark brown BASALT (30%). Strong; closely spaced, moderately to sub-vertical, undulating slickensided to rough defects; iron staining and zeolite veneer on the defect surfaces; zeolite veining.	116	11	50+	10 for initial 20mm	MS	SW	MW	J80, J30, 3	10.15m - J, 80°, RO, UN 10.28m - J, 30°, RO, UN 10.85m - J, 3°, SM, ST	HQ SC HQ	100 0 100	19 94				
	END OF BOREHOLE AT 11.6m - Target Criteria Achieved	114, 112, 110, 108	12, 13, 14, 15, 16, 17, 18, 19														

Notes:
Borehole located within northbound lane approximately 4.8m from headscarp. Borehole terminated within SL MUDSTONE. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	17/09/2022	*Finished:*	19/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Borehole No. BH22A12

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	282892 E 986775 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	11.6 m
Project No.:	1-11244.00	*R.L.:*	126.765 m	*Inclination:*	-90°
Location:	Slip 22A12 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000	*Azimuth:*	0°

PHOTOGRAPHS

Photo BH22A12.1
BOX01: 0.00 - 3.60m.

Photo BH22A12.2
BOX02: 3.60 - 6.45m.

Notes:
Borehole located within northbound lane approximately 4.8m from headscarp. Borehole terminated within SL MUDSTONE. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	17/09/2022	*Finished:*	19/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

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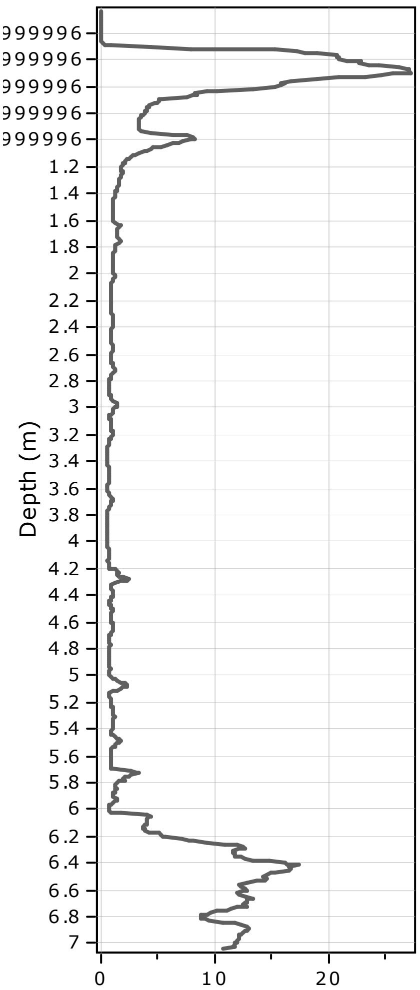
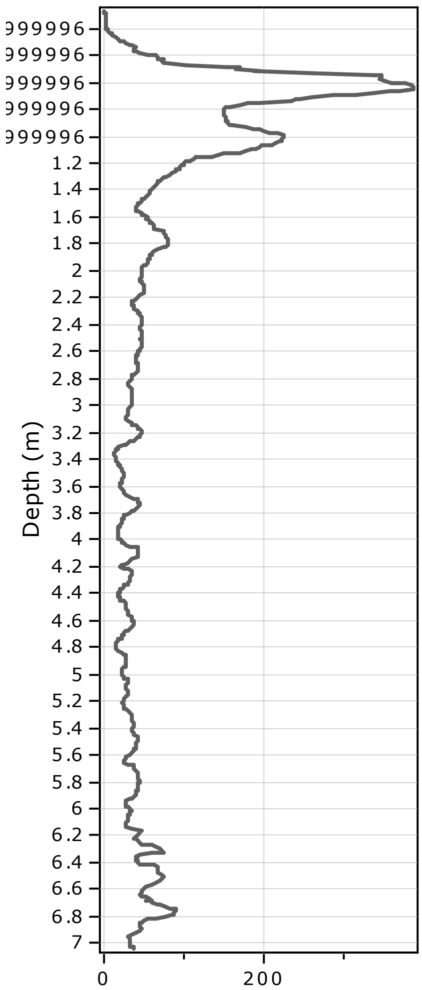
CPT: A12-CPT01
Total depth: 7.04 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

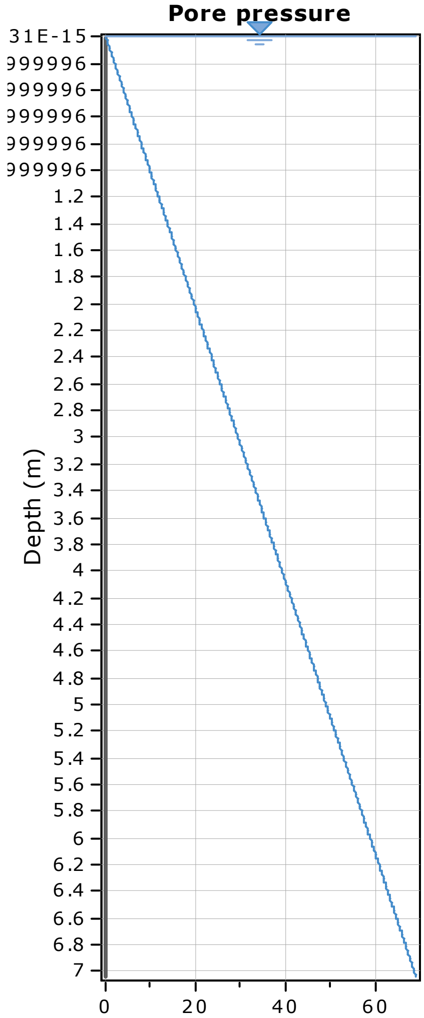
Cone resistance



Sleeve friction

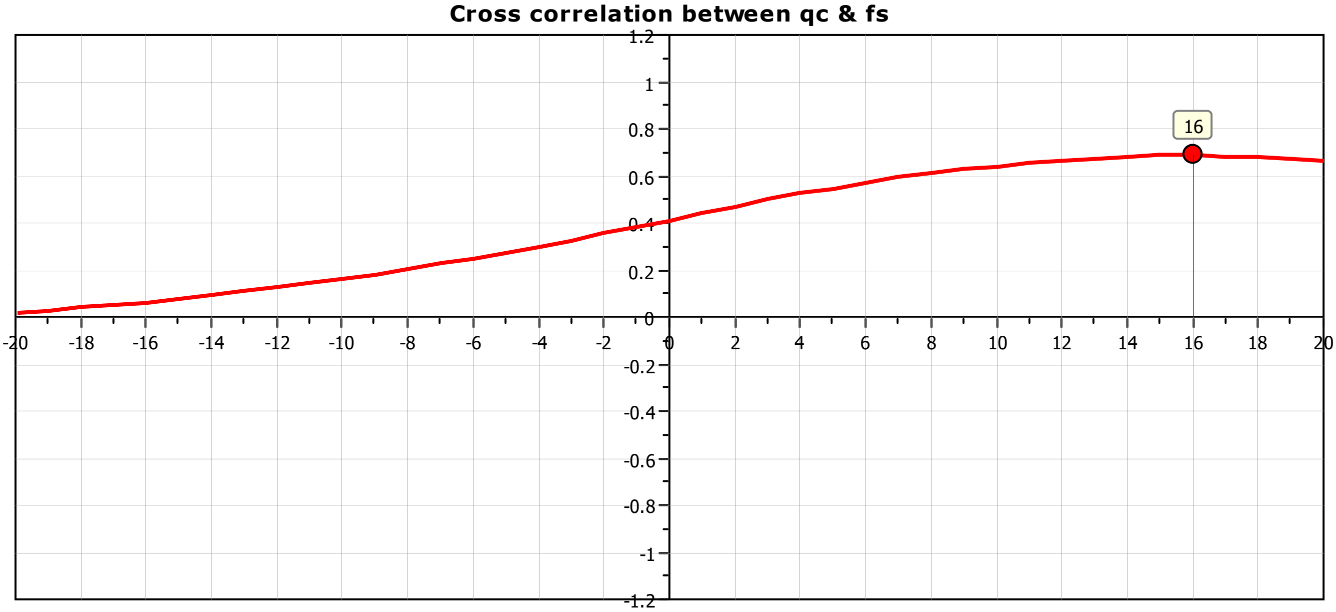


Pore pressure



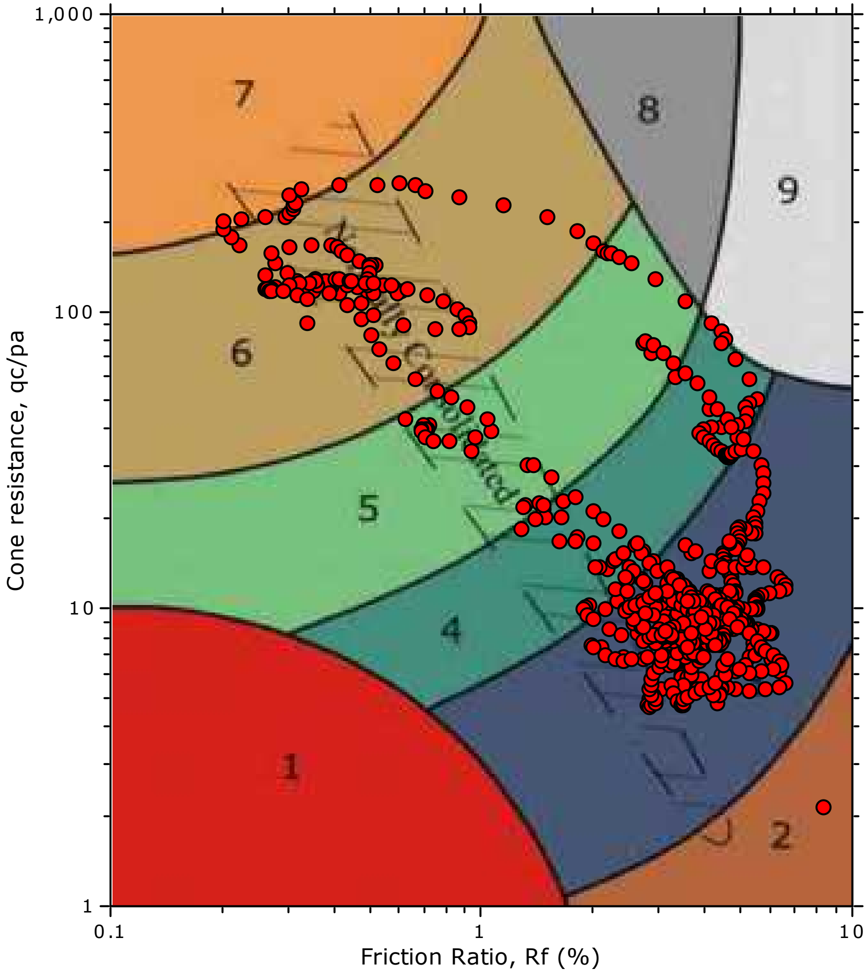
The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

Cross correlation between qc & fs

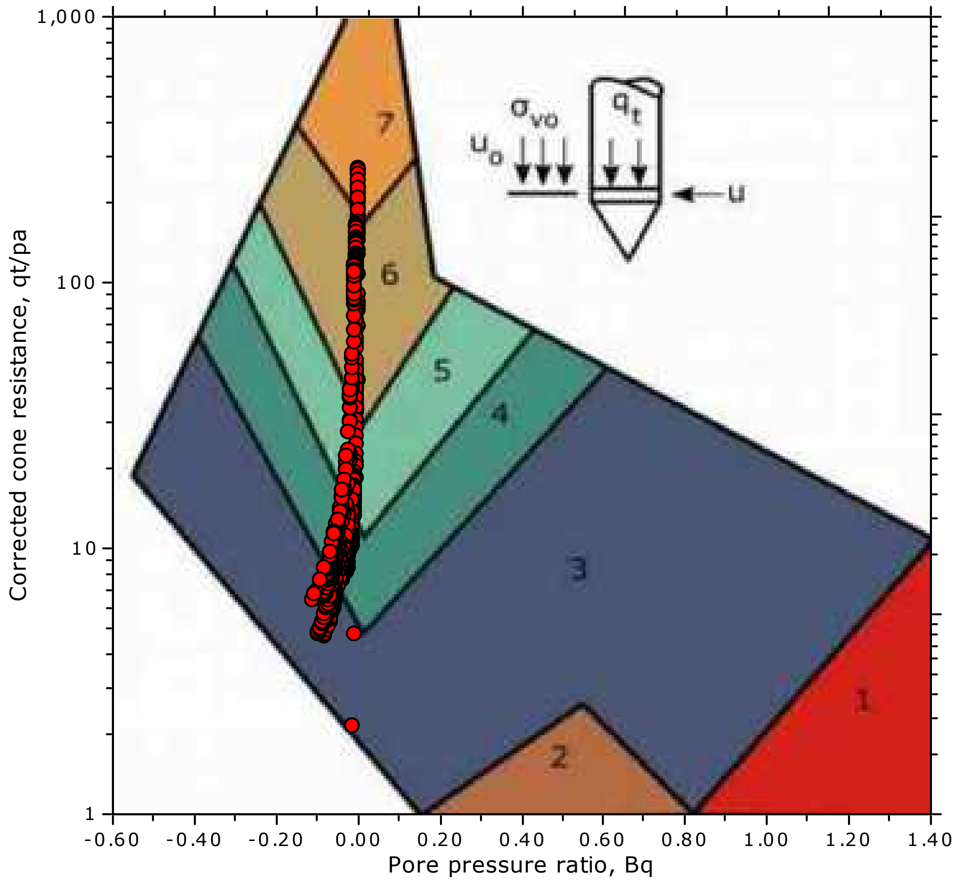


SBT - Bq plots

SBT plot



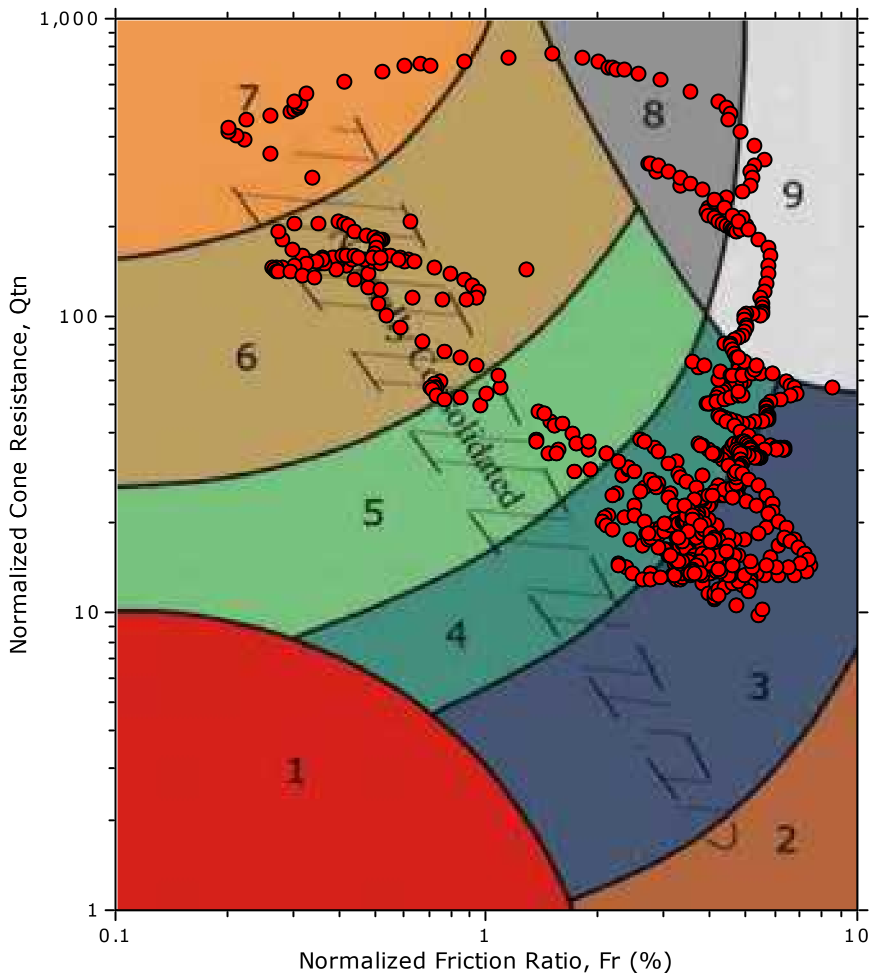
Bq plot

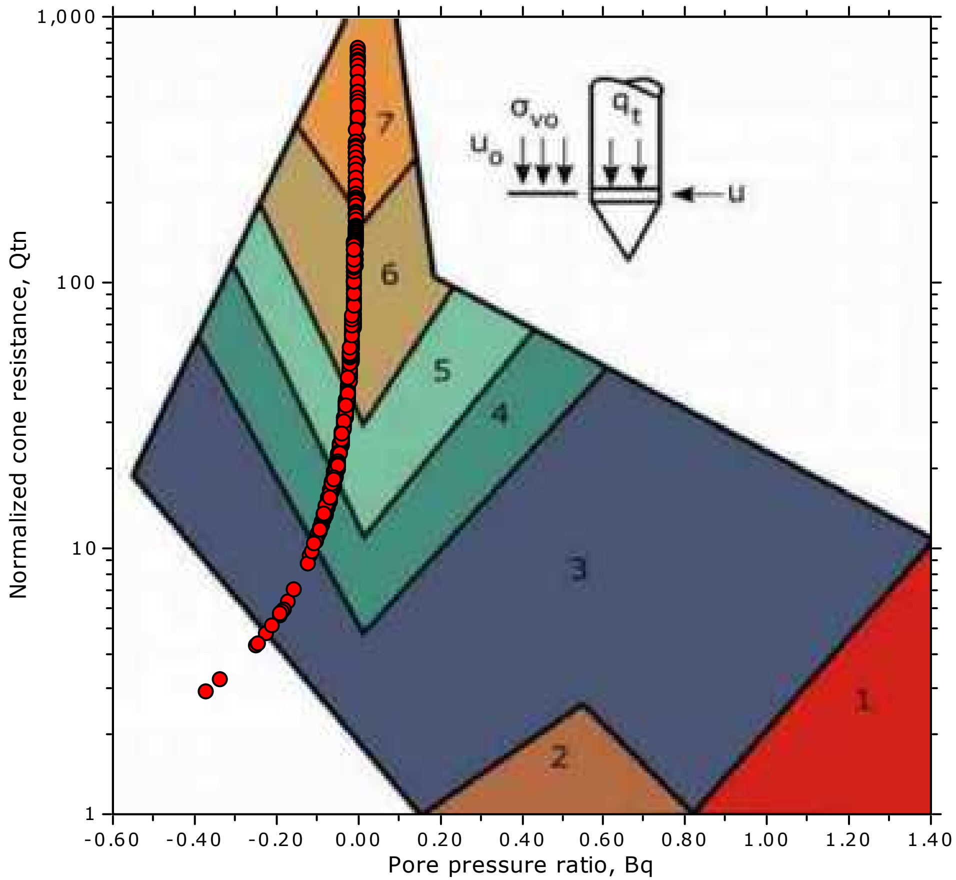


SBT legend

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

SBT - Bq plots (normalized)

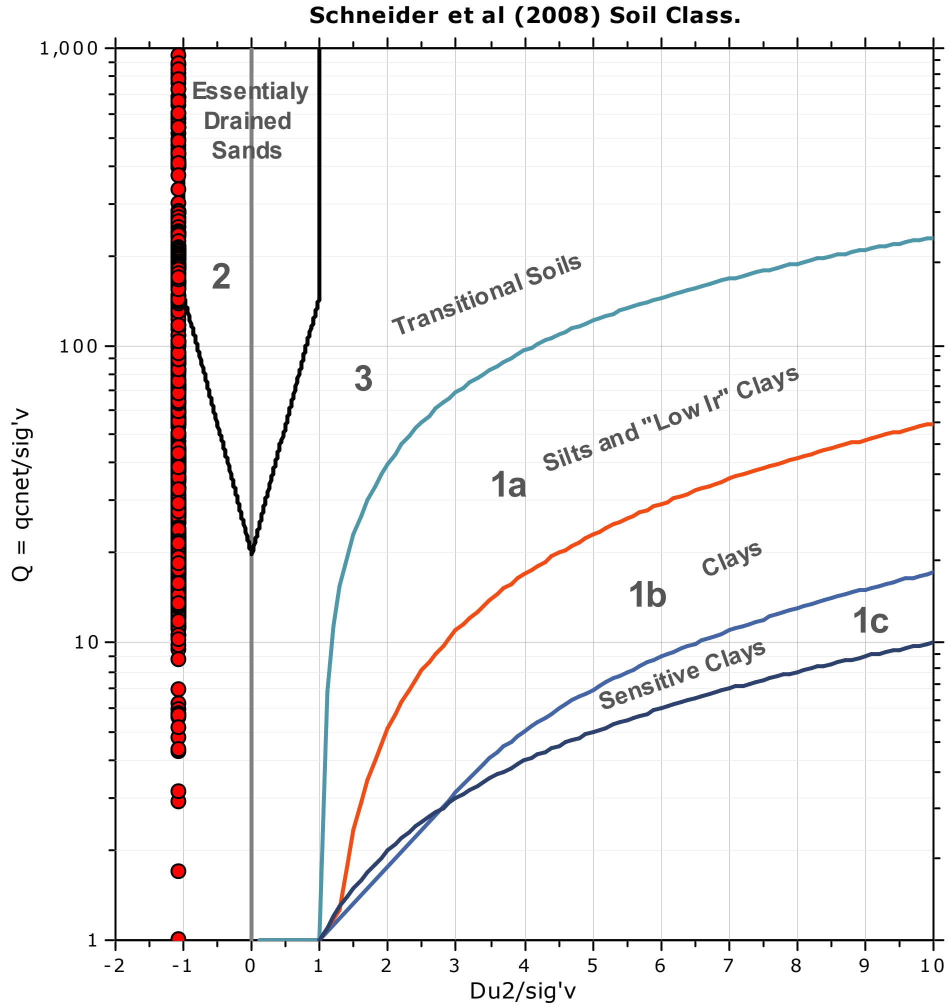


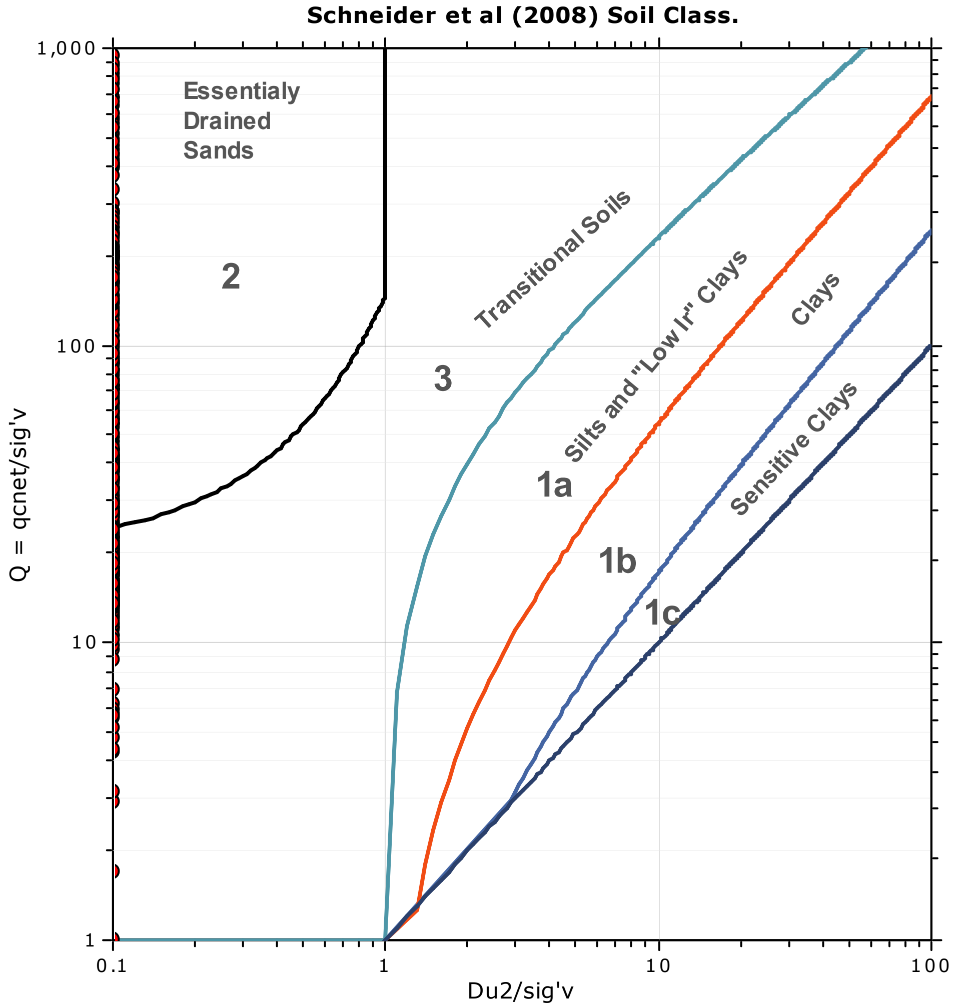


SBTn legend

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

Bq plots (Schneider)





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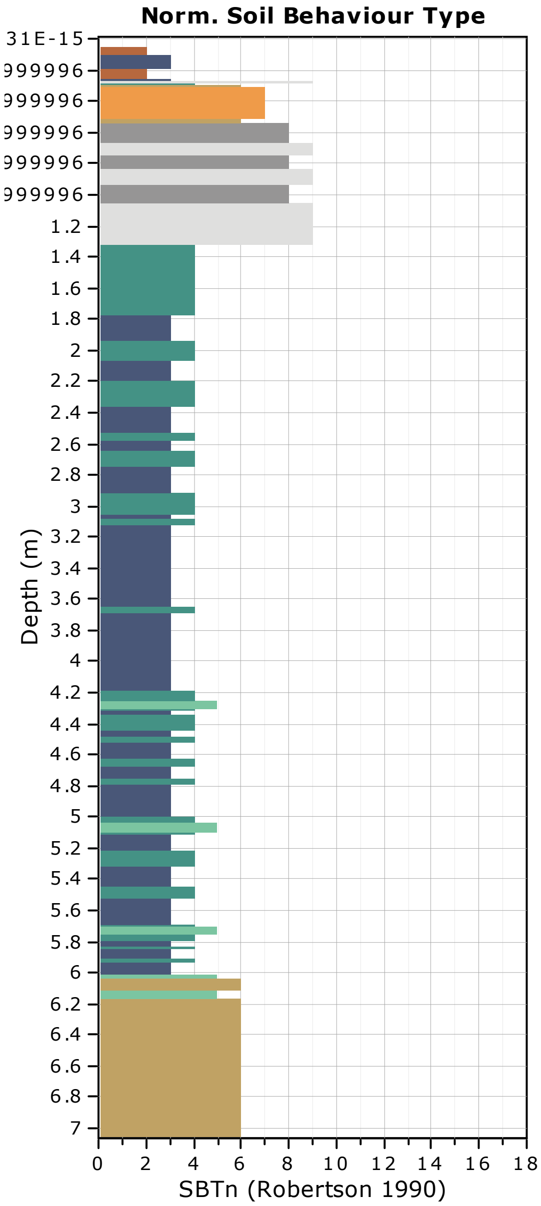
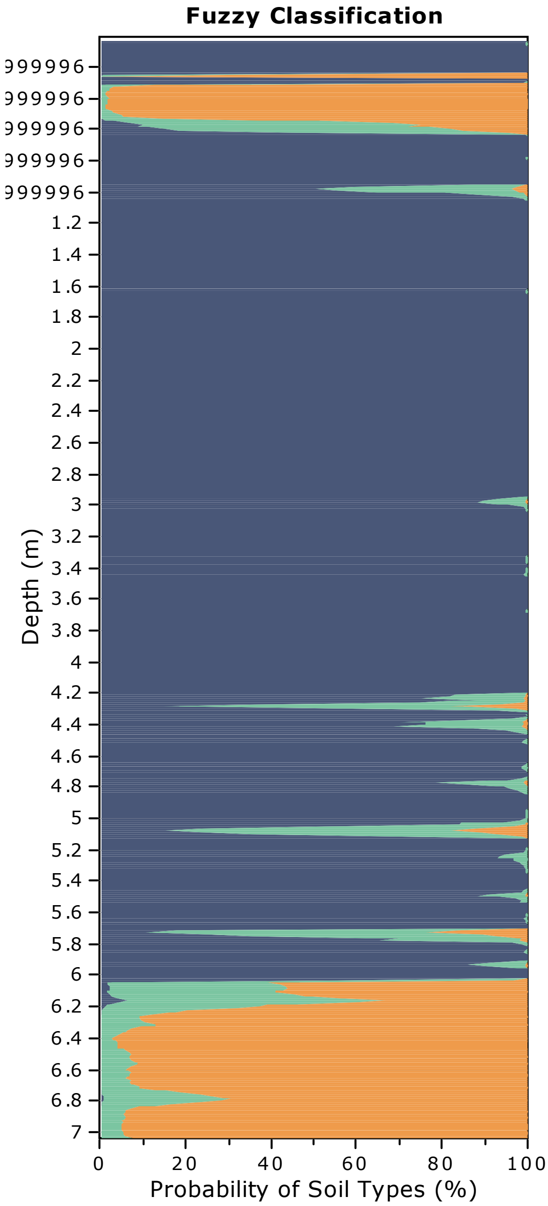
CPT: A12-CPT01
Total depth: 7.04 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:





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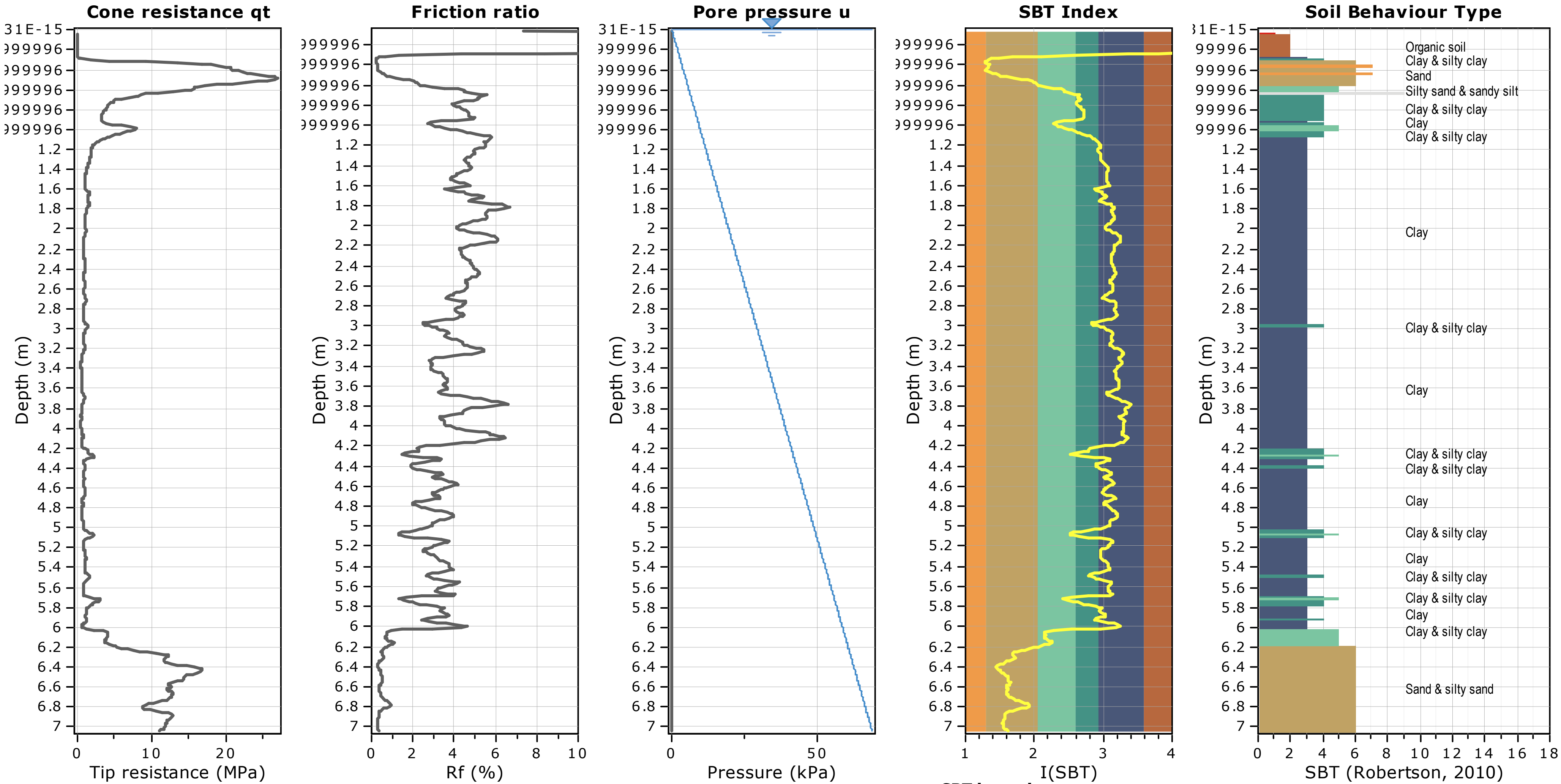
CPT: A12-CPT01
Total depth: 7.04 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBT legend

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

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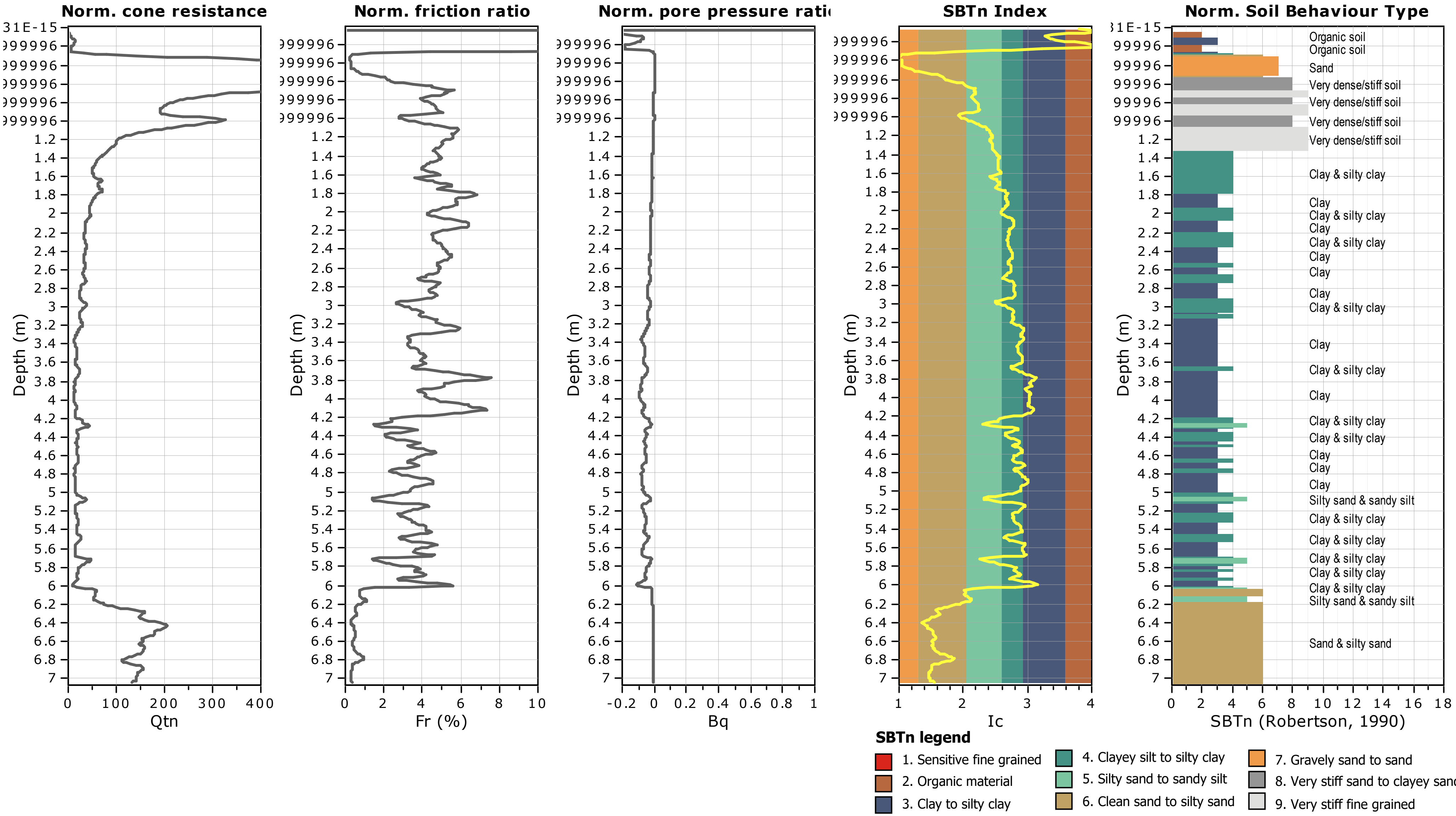
CPT: A12-CPT01
Total depth: 7.04 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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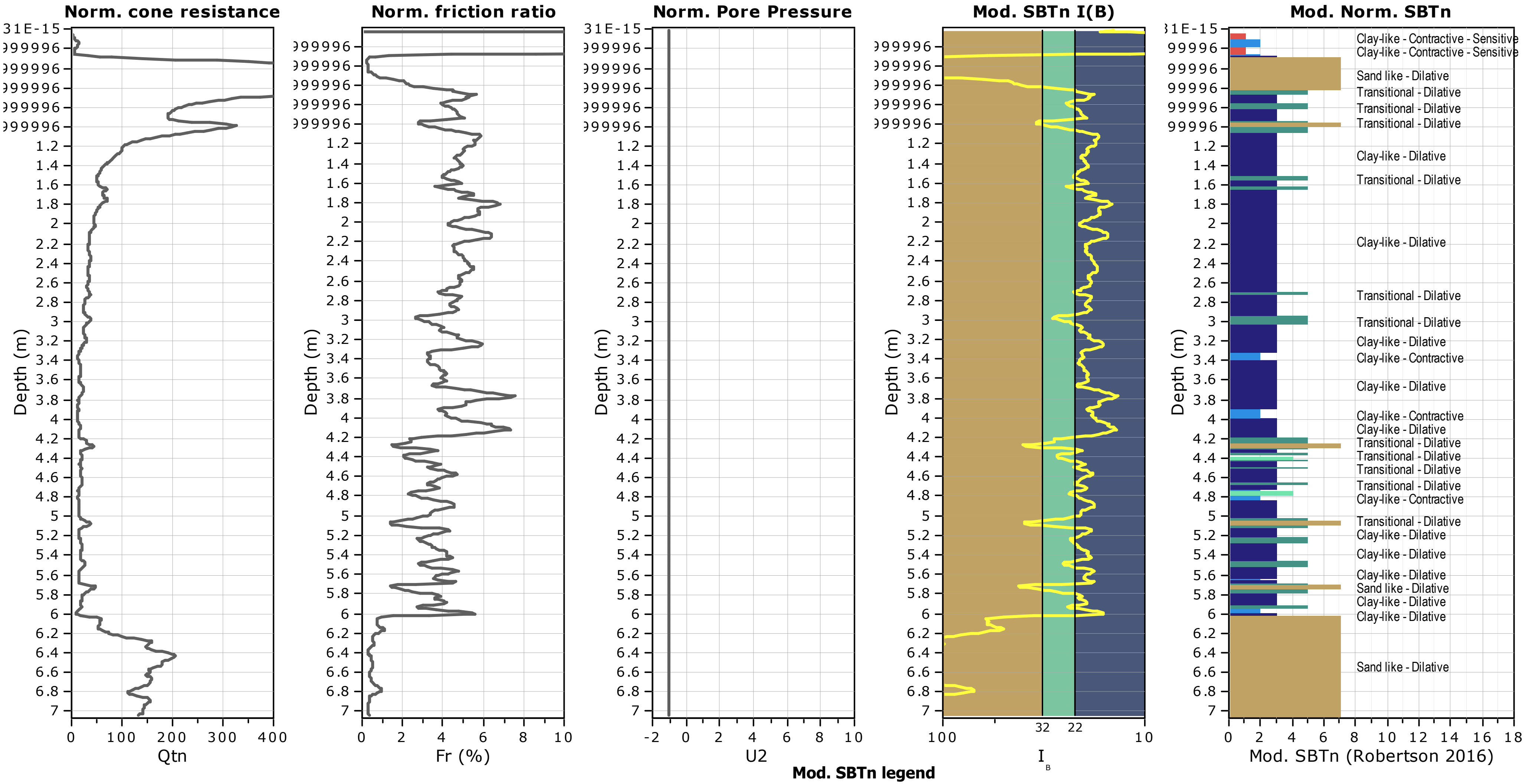
CPT: A12-CPT01
Total depth: 7.04 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

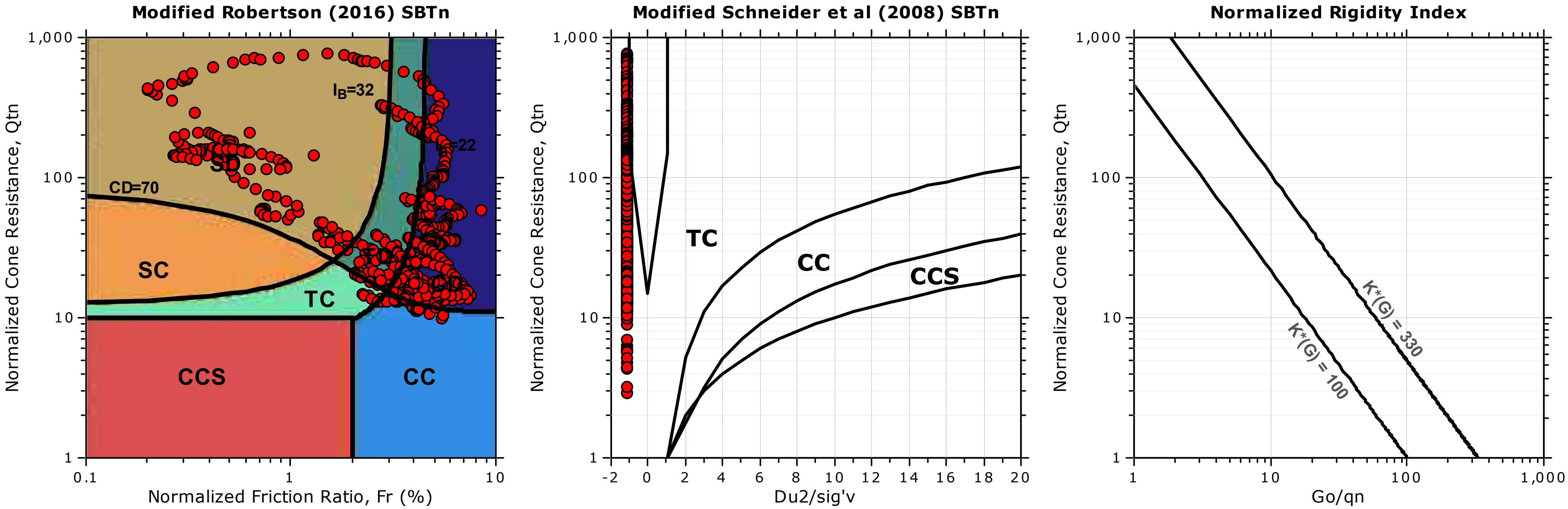
Project:
Location:



Mod. SBTn legend

1. CCS: ClayLike - Contractive, Sensitive
2. CC: Clay-like - Contractive
3. CD: Clay-Like: Dilative
4. TC: Transitional - Contractive
5. TD: Transitional - Dilative
6. SC: Sand-like - Contractive
7. SD: Sand-like - Dilative

Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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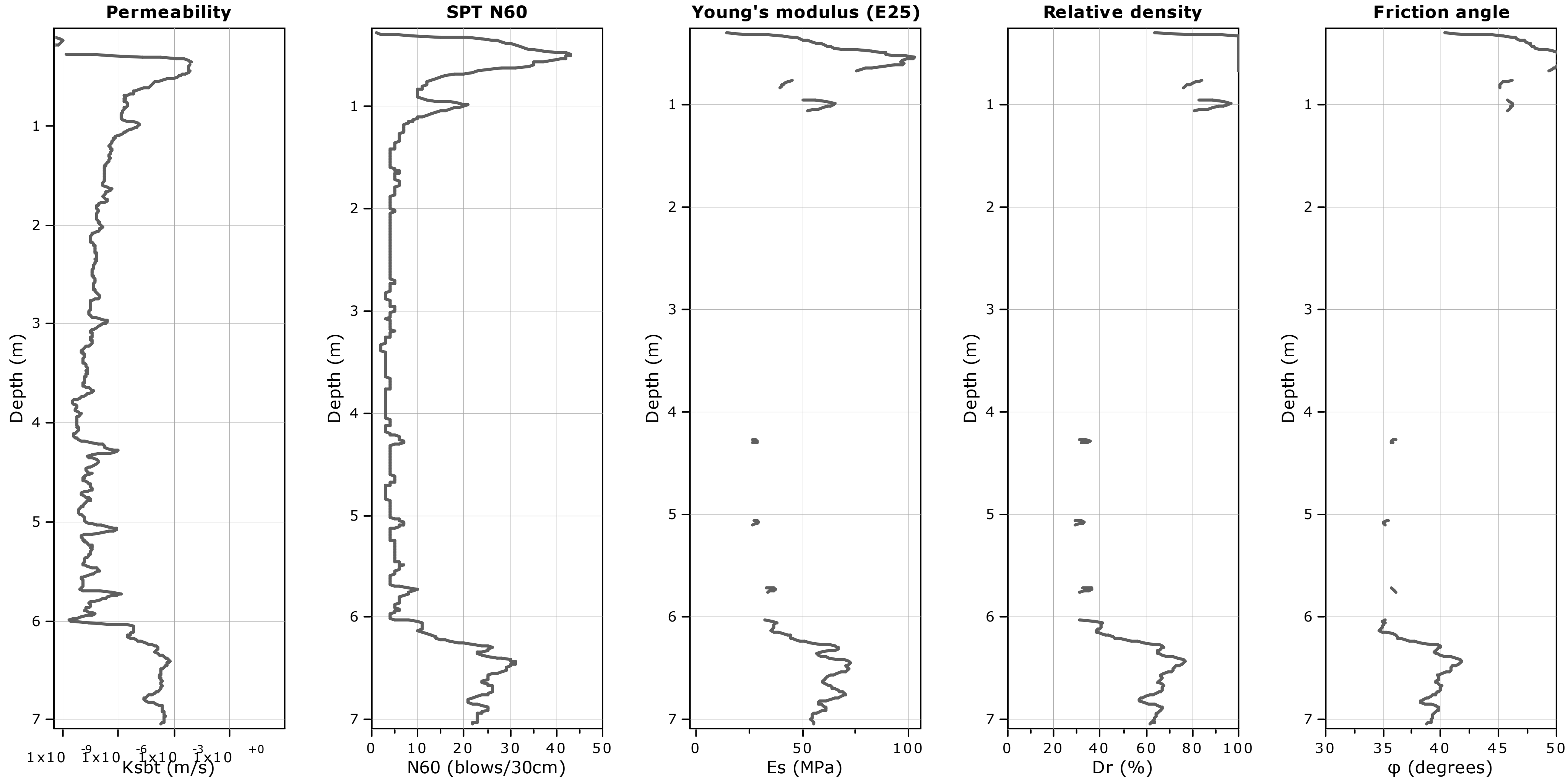
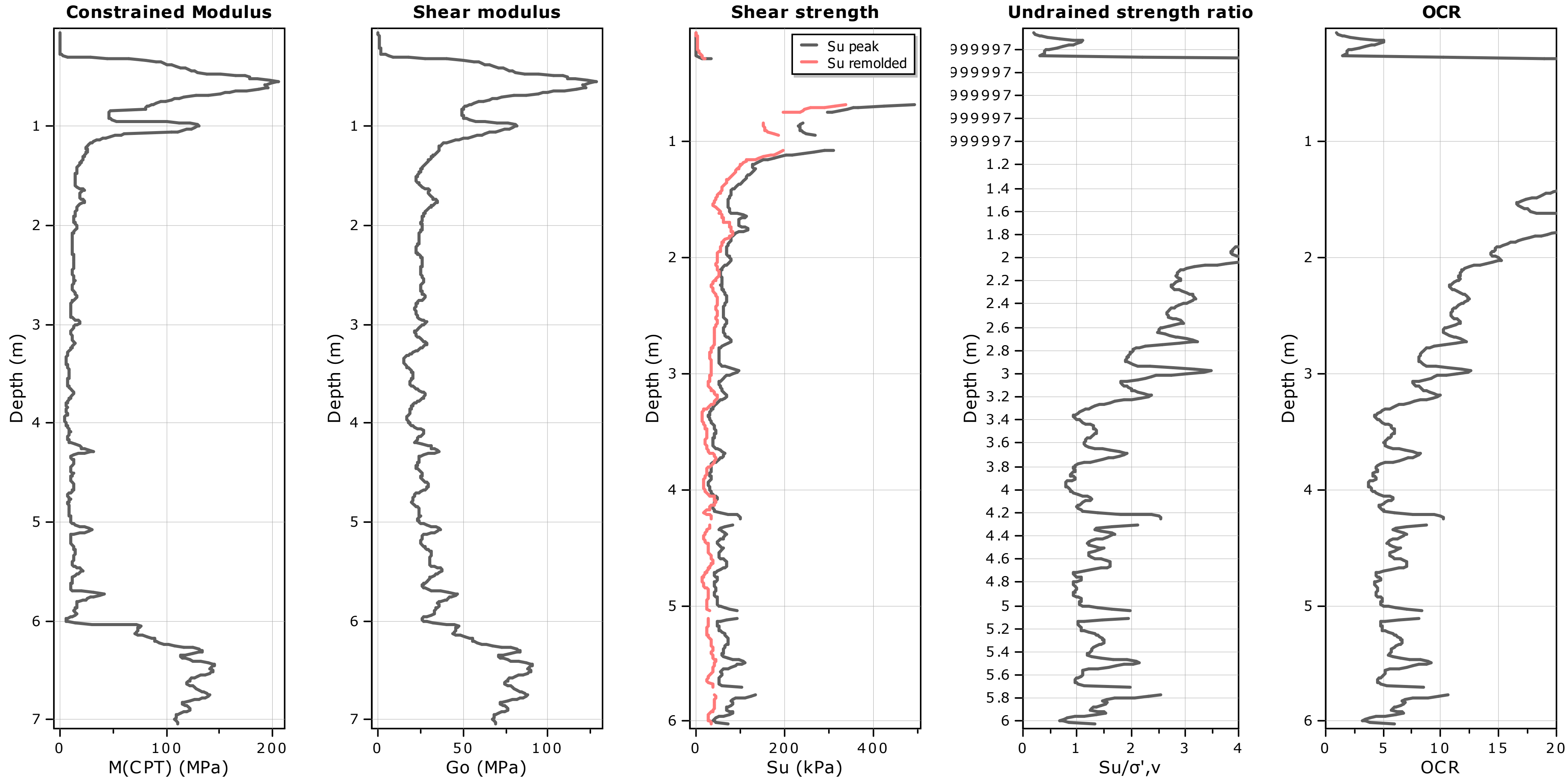
CPT: A12-CPT01
Total depth: 7.04 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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



Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

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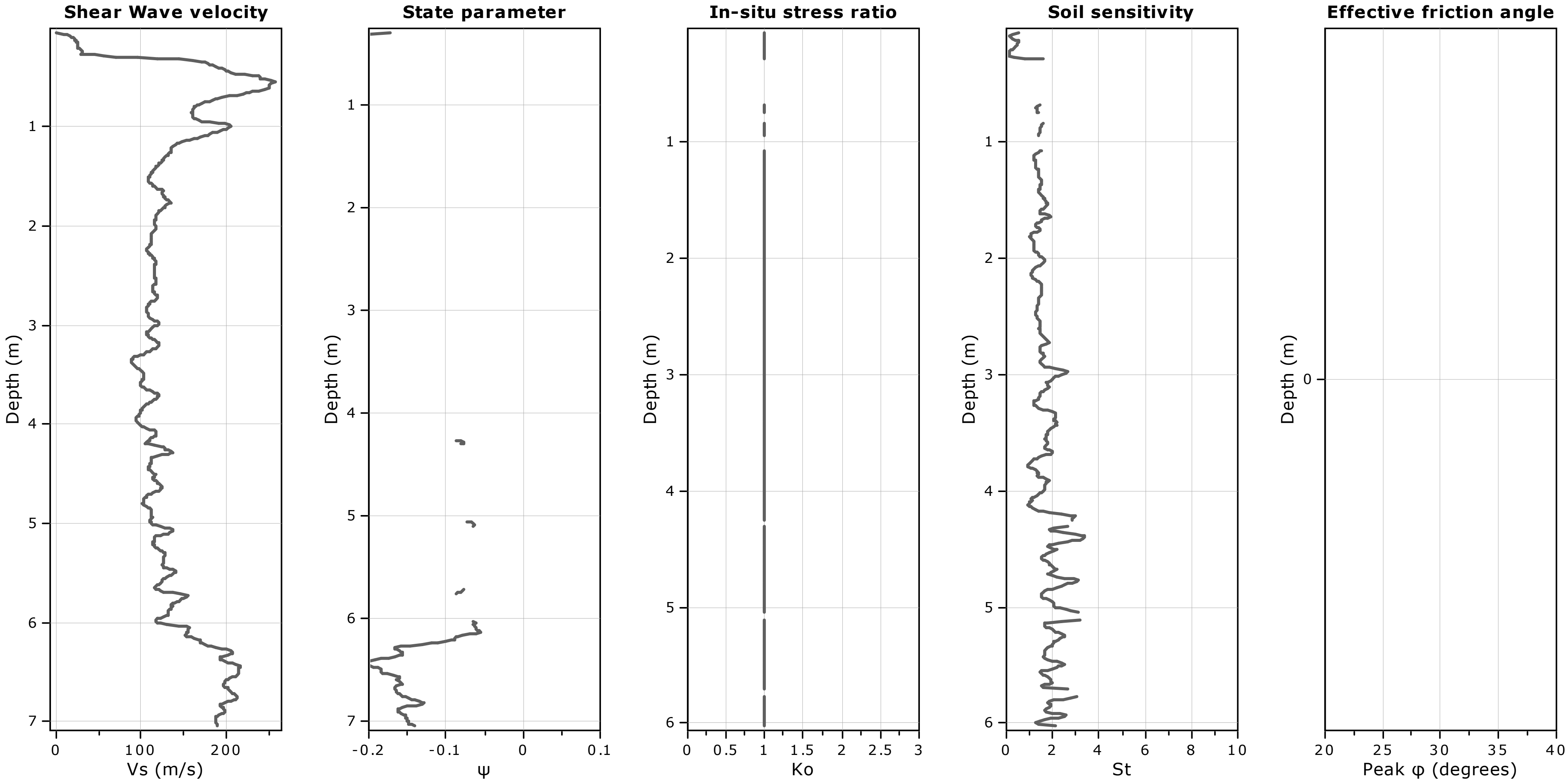
CPT: A12-CPT01
Total depth: 7.04 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

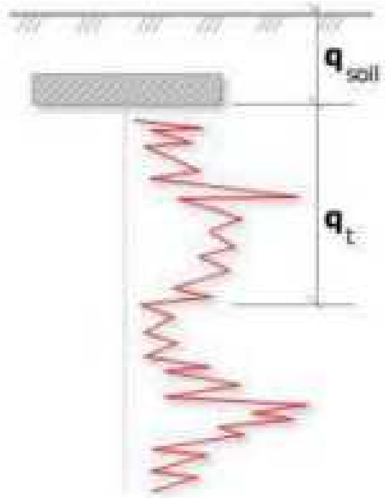
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

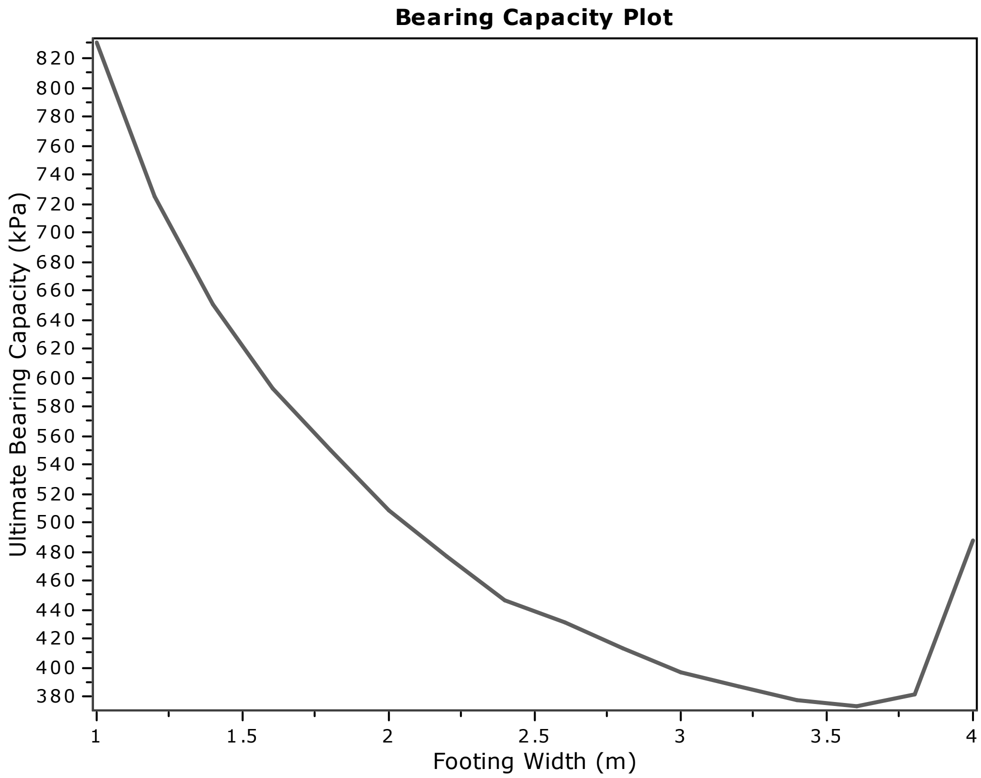
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

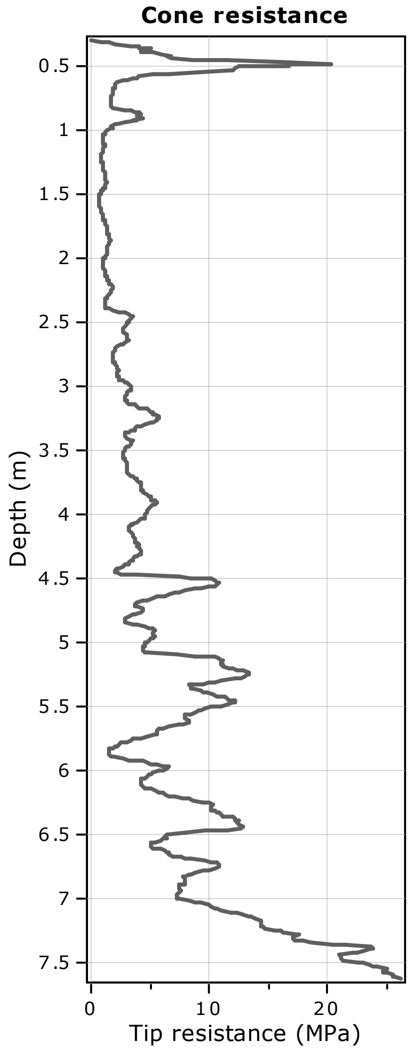
$$Q_{ult} = R_k \times q_t + q_{soil}$$

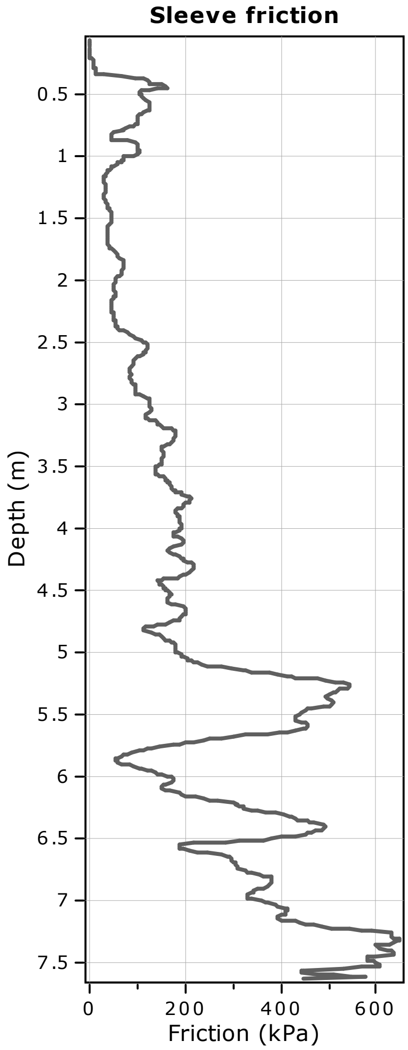
where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

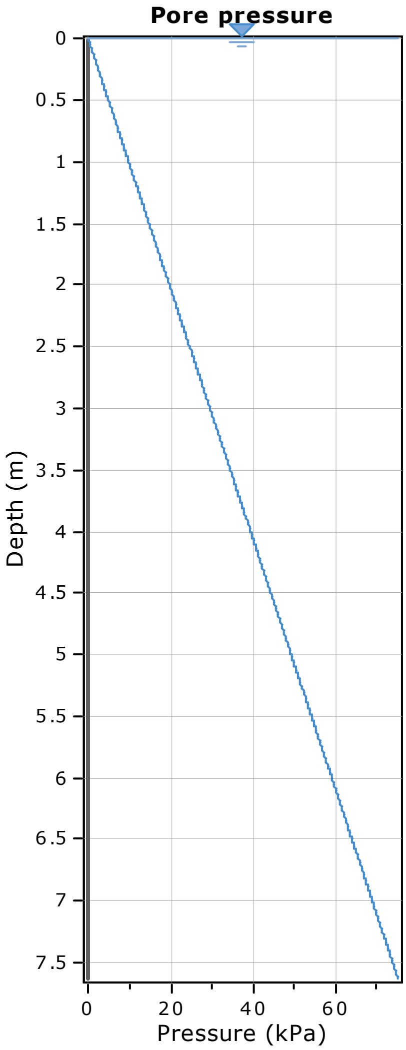


:: Tabular results ::

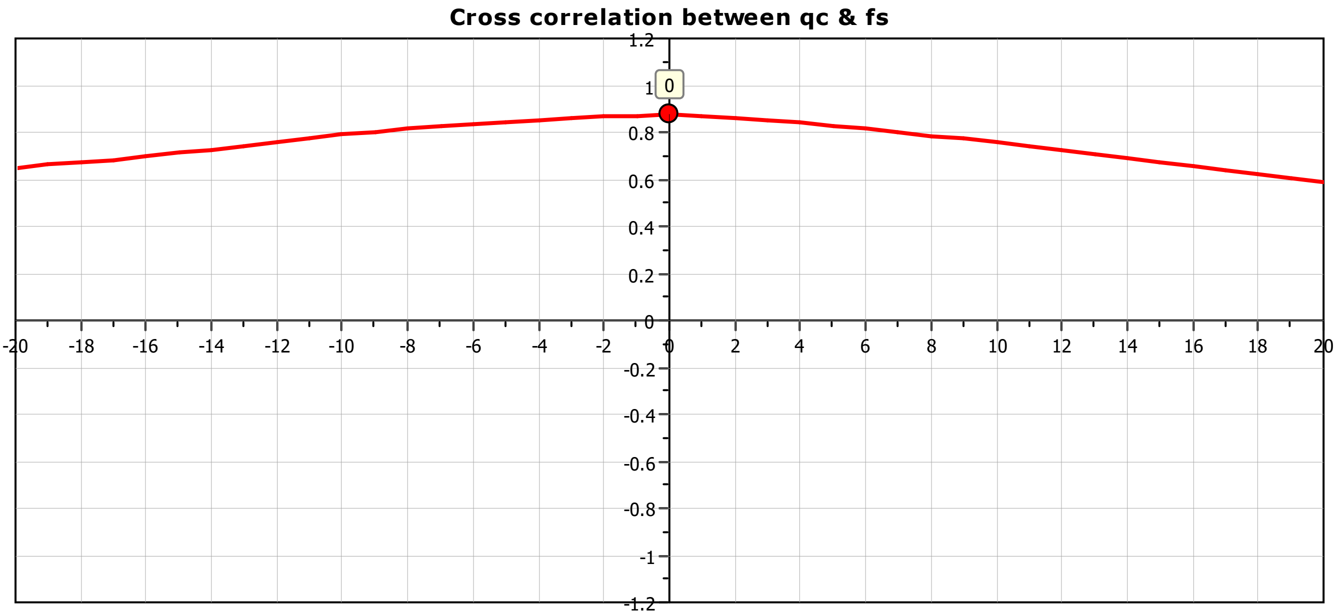
No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	4.11	0.20	9.50	831.71
2	1.20	0.50	2.30	3.58	0.20	9.50	725.46
3	1.40	0.50	2.60	3.21	0.20	9.50	650.96
4	1.60	0.50	2.90	2.92	0.20	9.50	593.44
5	1.80	0.50	3.20	2.70	0.20	9.50	550.48
6	2.00	0.50	3.50	2.50	0.20	9.50	508.96
7	2.20	0.50	3.80	2.34	0.20	9.50	476.57
8	2.40	0.50	4.10	2.19	0.20	9.50	447.11
9	2.60	0.50	4.40	2.11	0.20	9.50	431.05
10	2.80	0.50	4.70	2.02	0.20	9.50	413.87
11	3.00	0.50	5.00	1.93	0.20	9.50	396.50
12	3.20	0.50	5.30	1.89	0.20	9.50	386.86
13	3.40	0.50	5.60	1.84	0.20	9.50	377.86
14	3.60	0.50	5.90	1.82	0.20	9.50	373.51
15	3.80	0.50	6.20	1.86	0.20	9.50	382.41
16	4.00	0.50	6.50	2.39	0.20	9.50	488.45



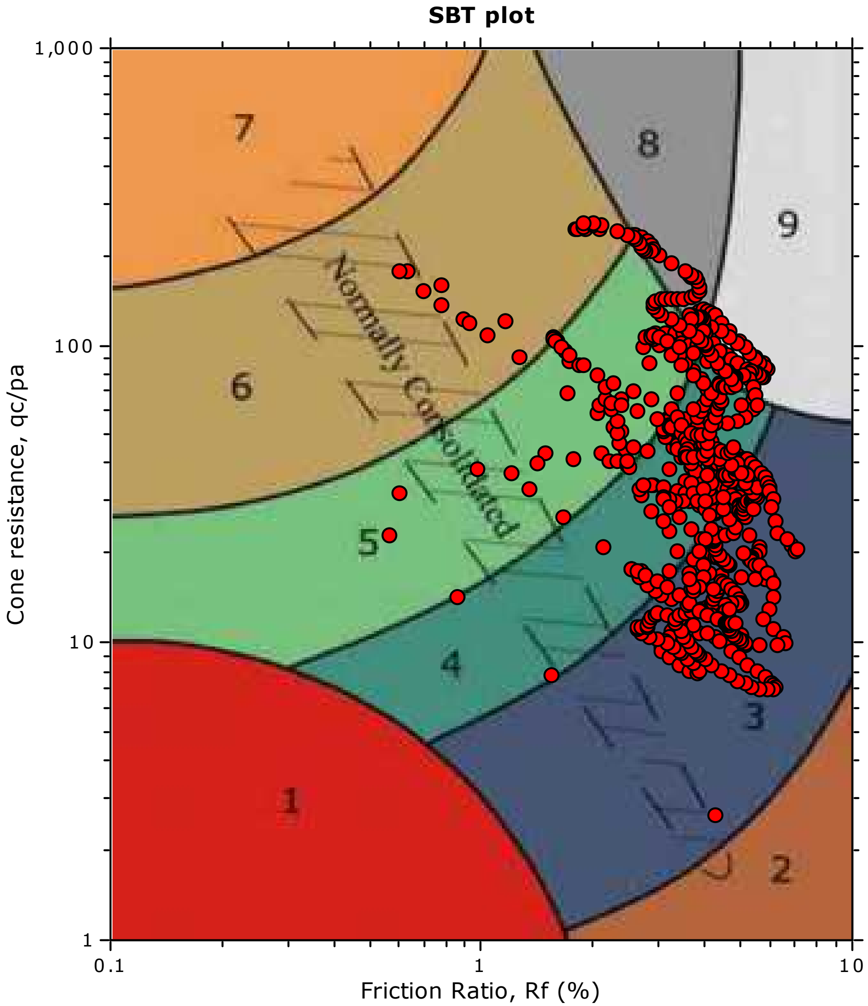


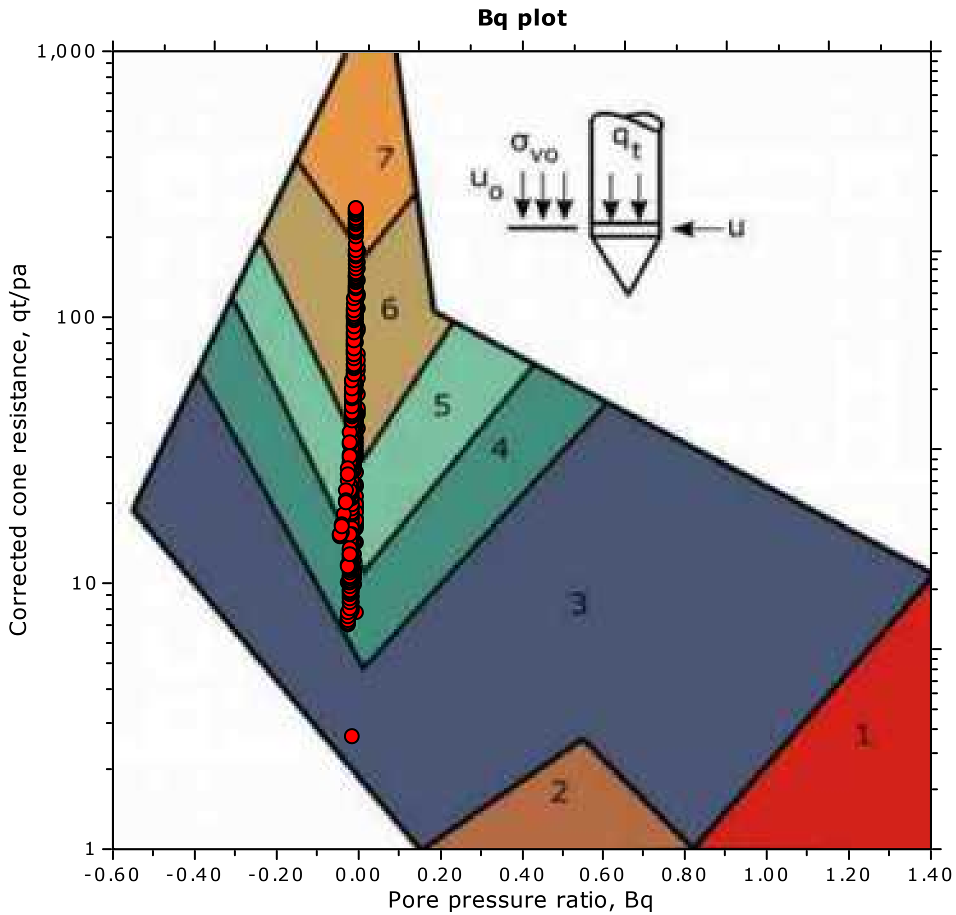


The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



SBT - Bq plots

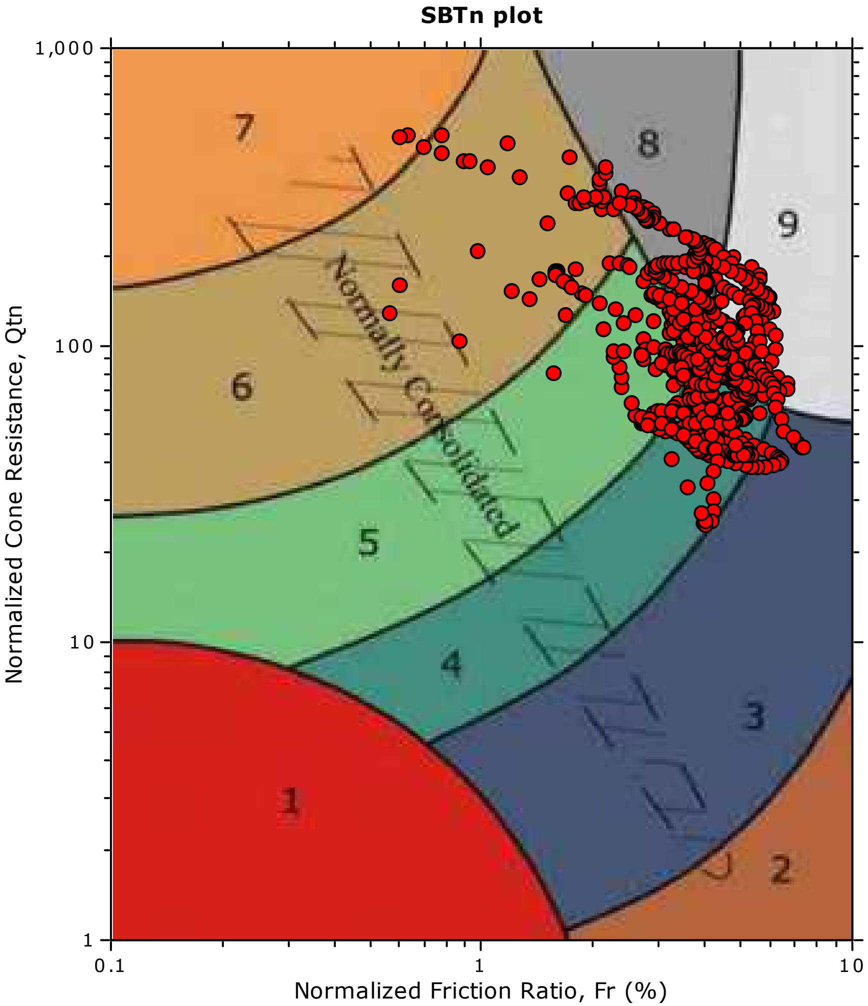


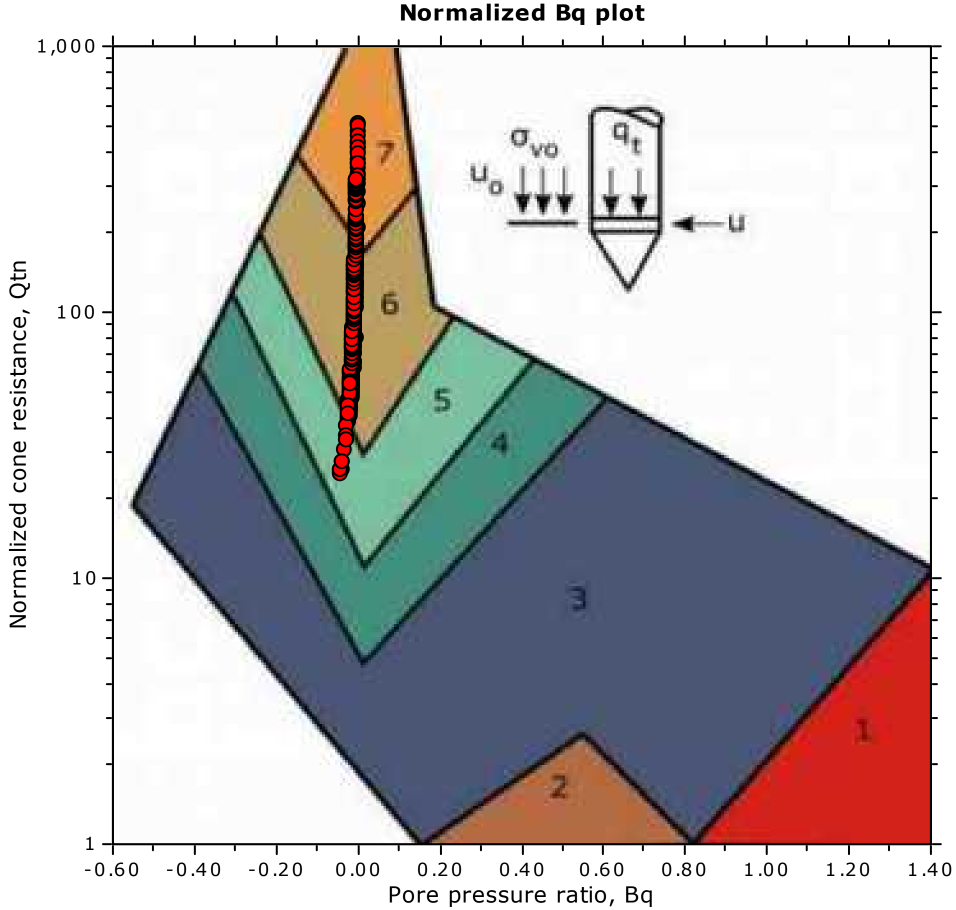


SBT legend

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

SBT - Bq plots (normalized)

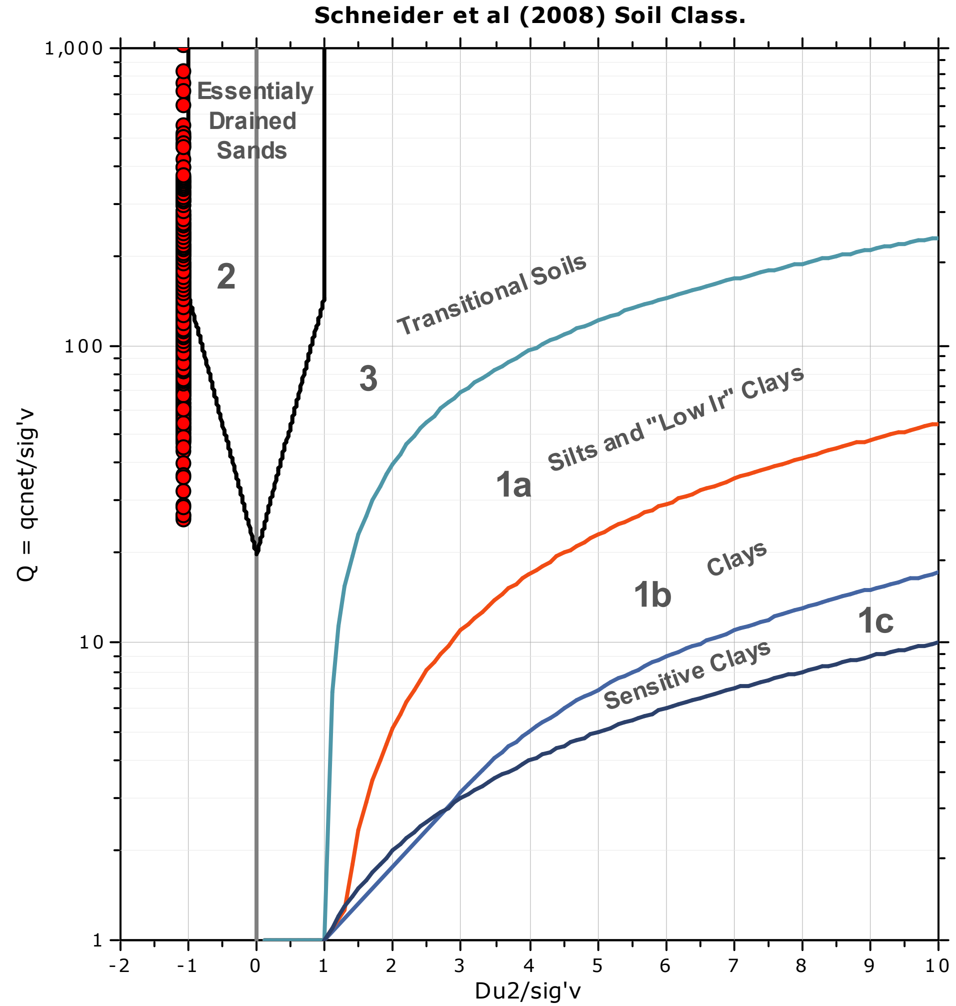


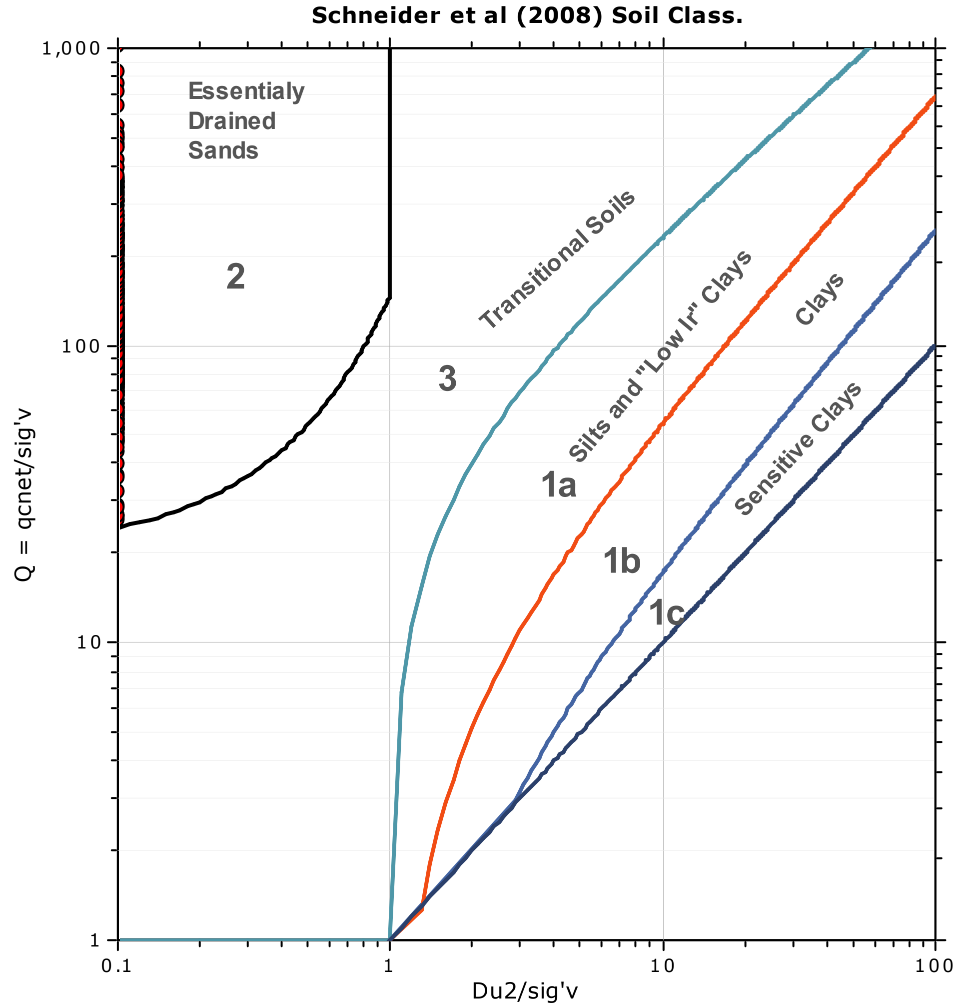


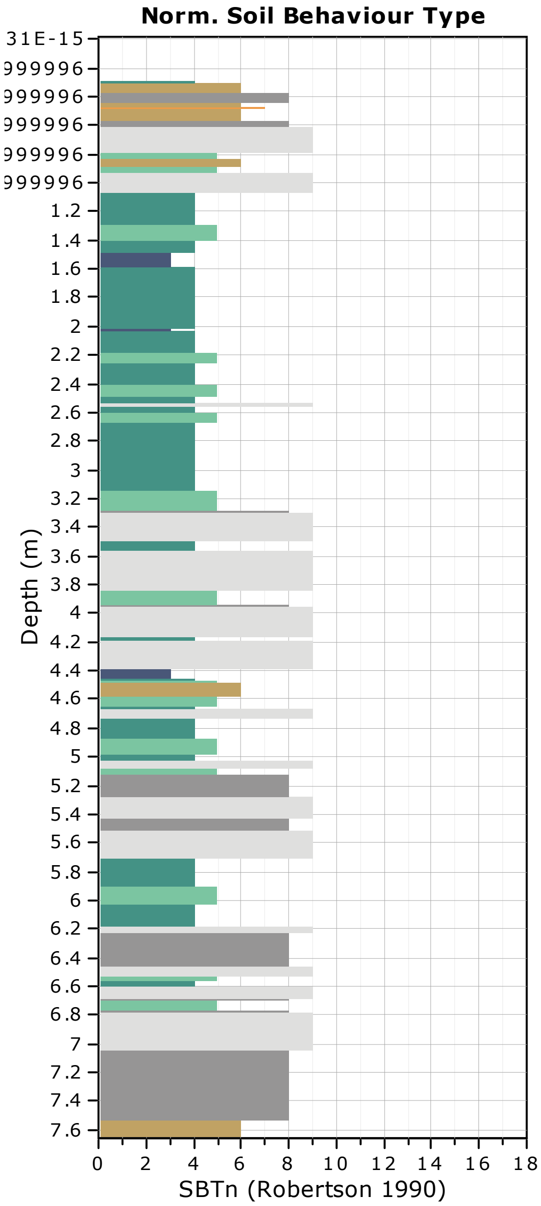
SBTn legend

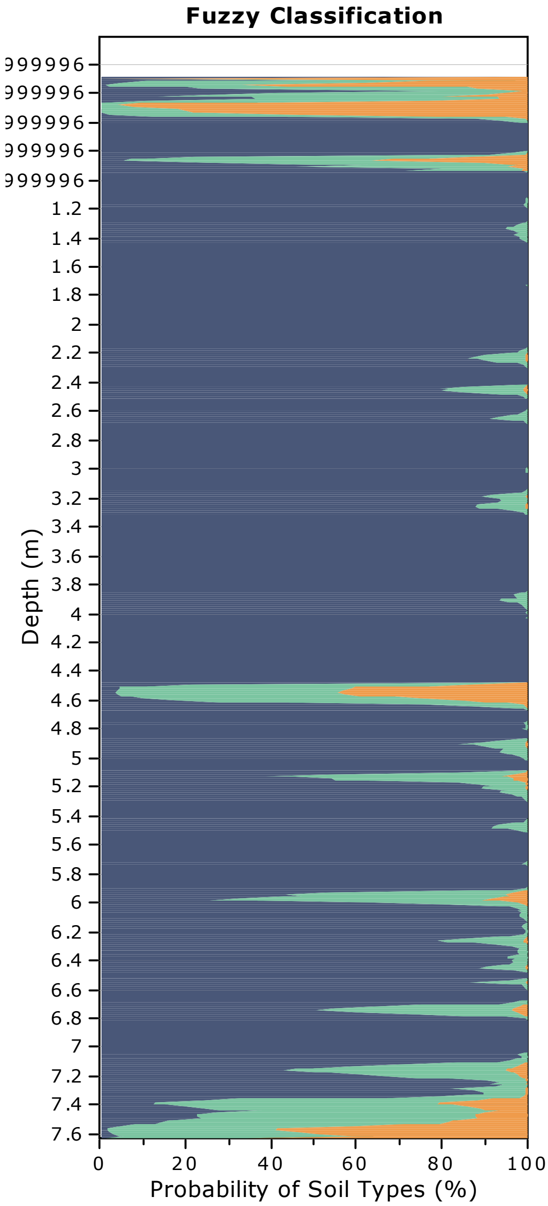
- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty clay
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravelly sand to sand
- 8. Very stiff sand to clayey sand
- 9. Very stiff fine grained

Bq plots (Schneider)






Norm. Soil Behaviour Type
Depth (m)
SBTn (Robertson 1990)
0
2
4
6
8
10
12
14
16
18


Fuzzy Classification
Depth (m)
Probability of Soil Types (%)
0
20
40
60
80
100

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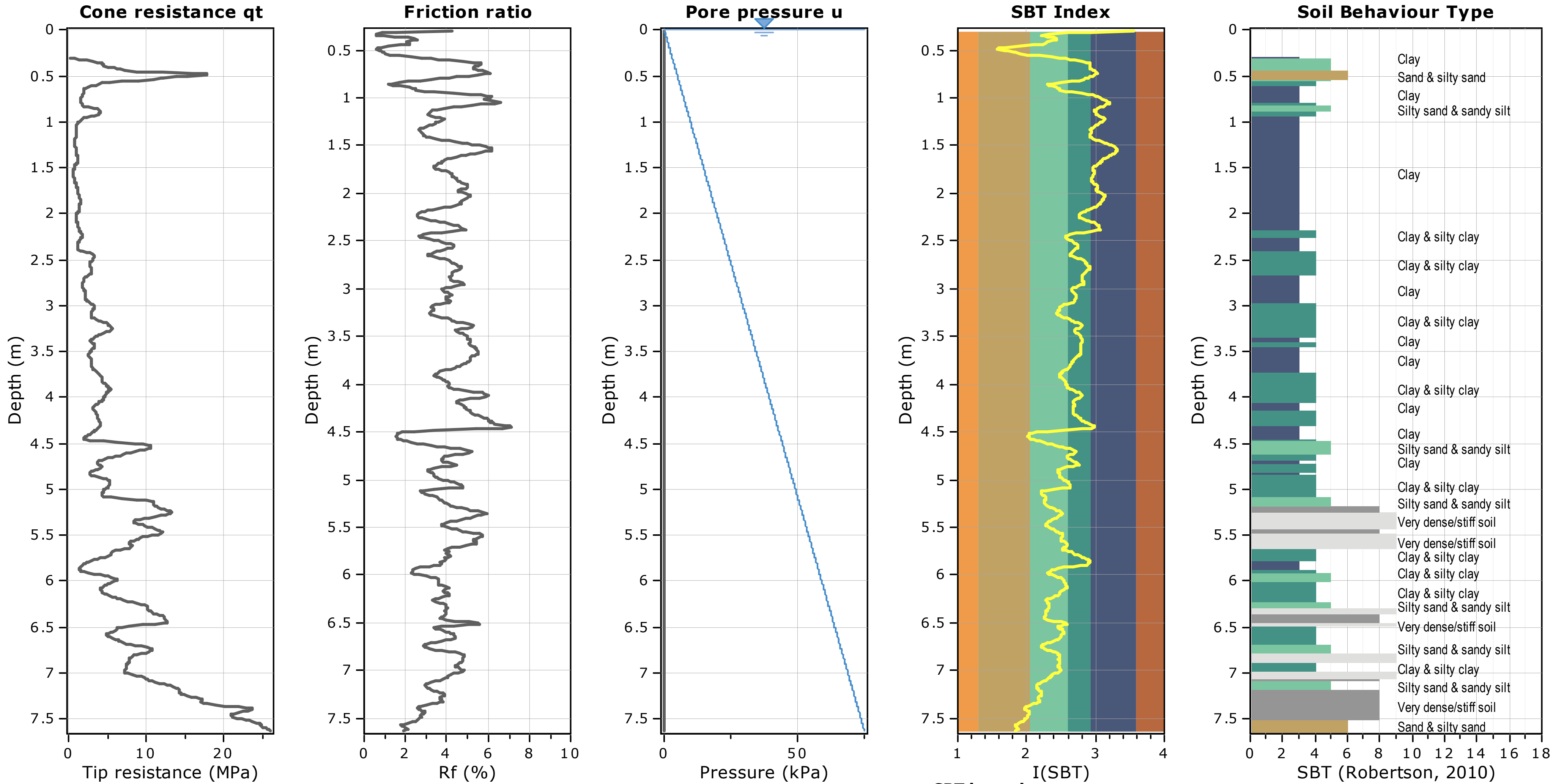
CPT: DataA12-CPT02
Total depth: 7.63 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBT legend

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

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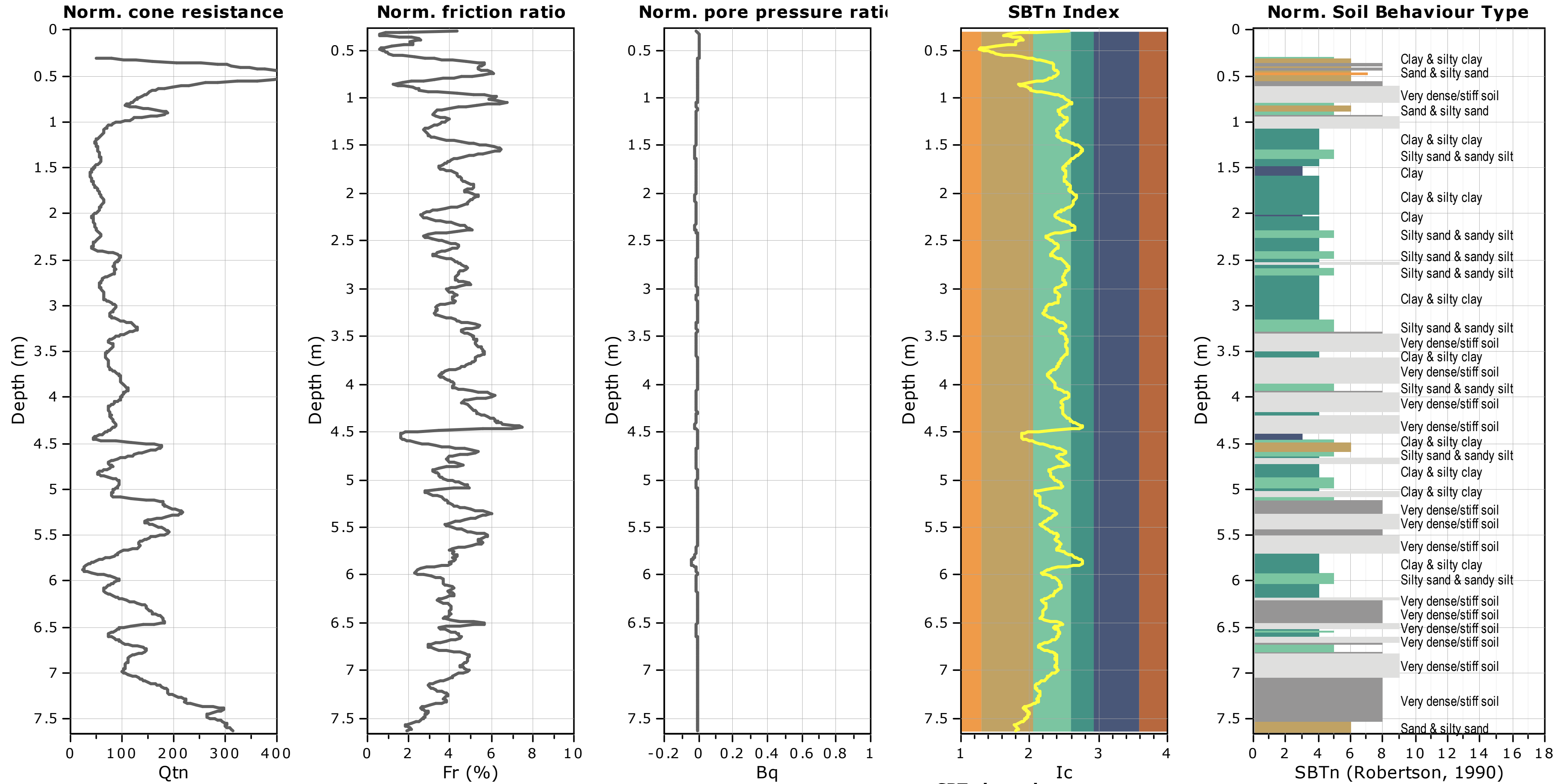
CPT: DataA12-CPT02
Total depth: 7.63 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBTn legend

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

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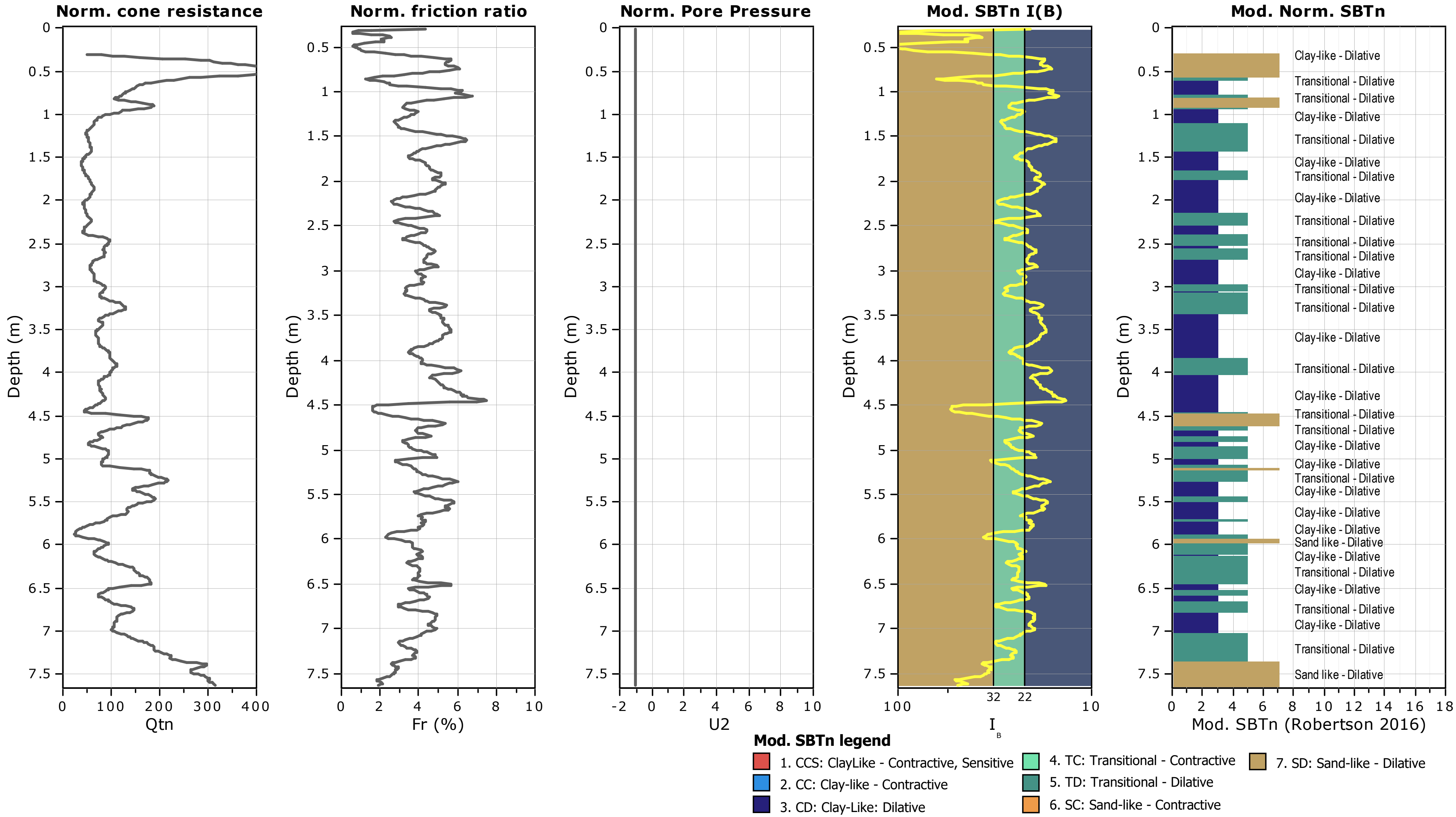
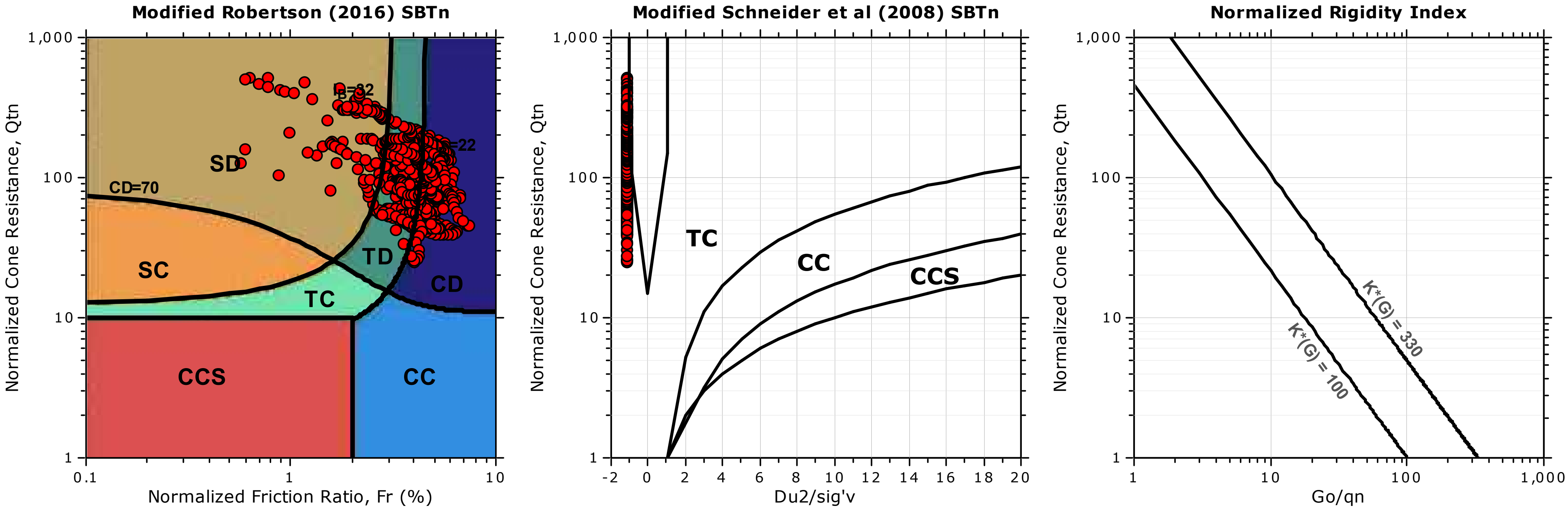
CPT: DataA12-CPT02
Total depth: 7.63 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Updated SBTn plots



CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

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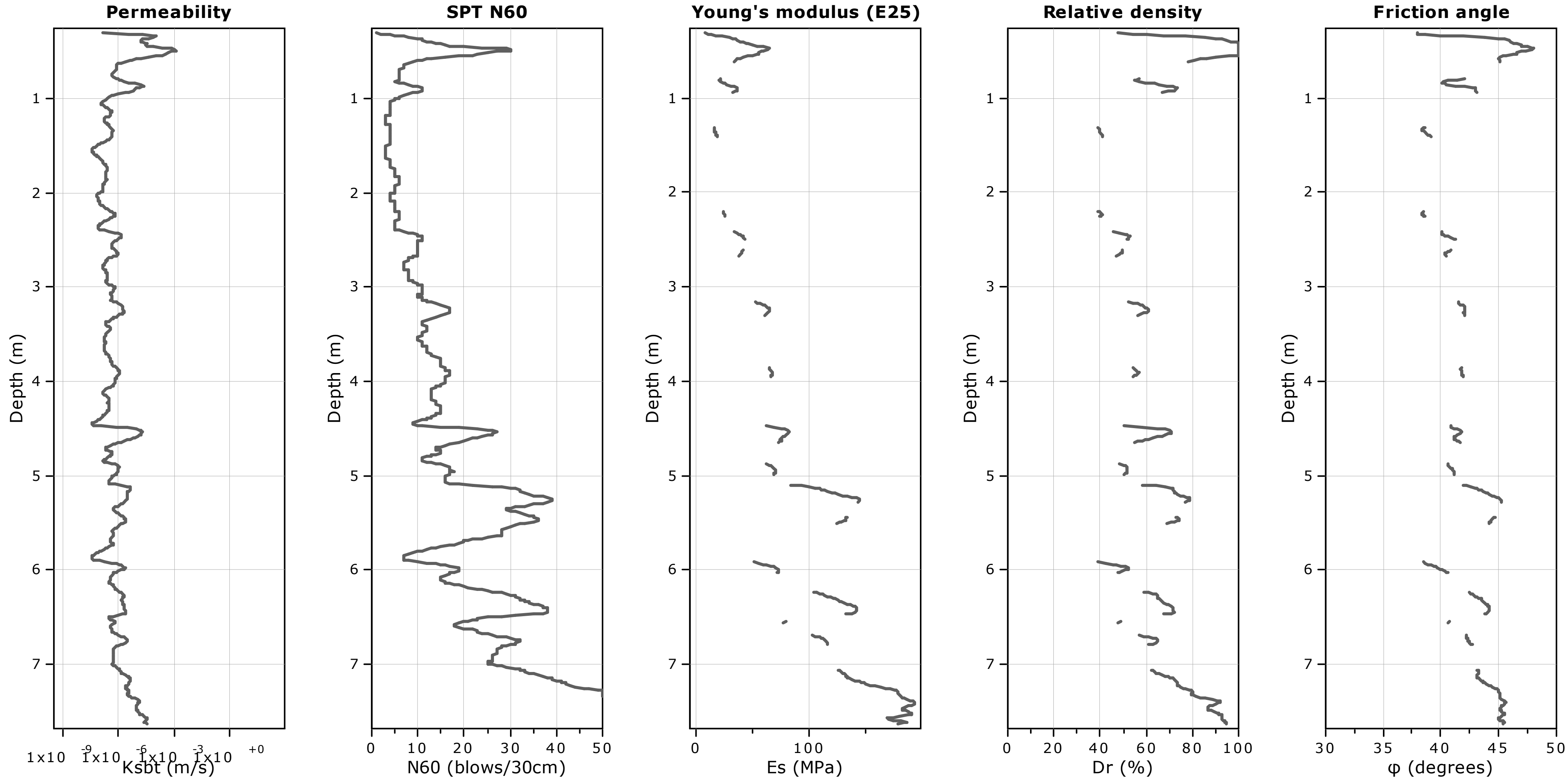
CPT: DataA12-CPT02
Total depth: 7.63 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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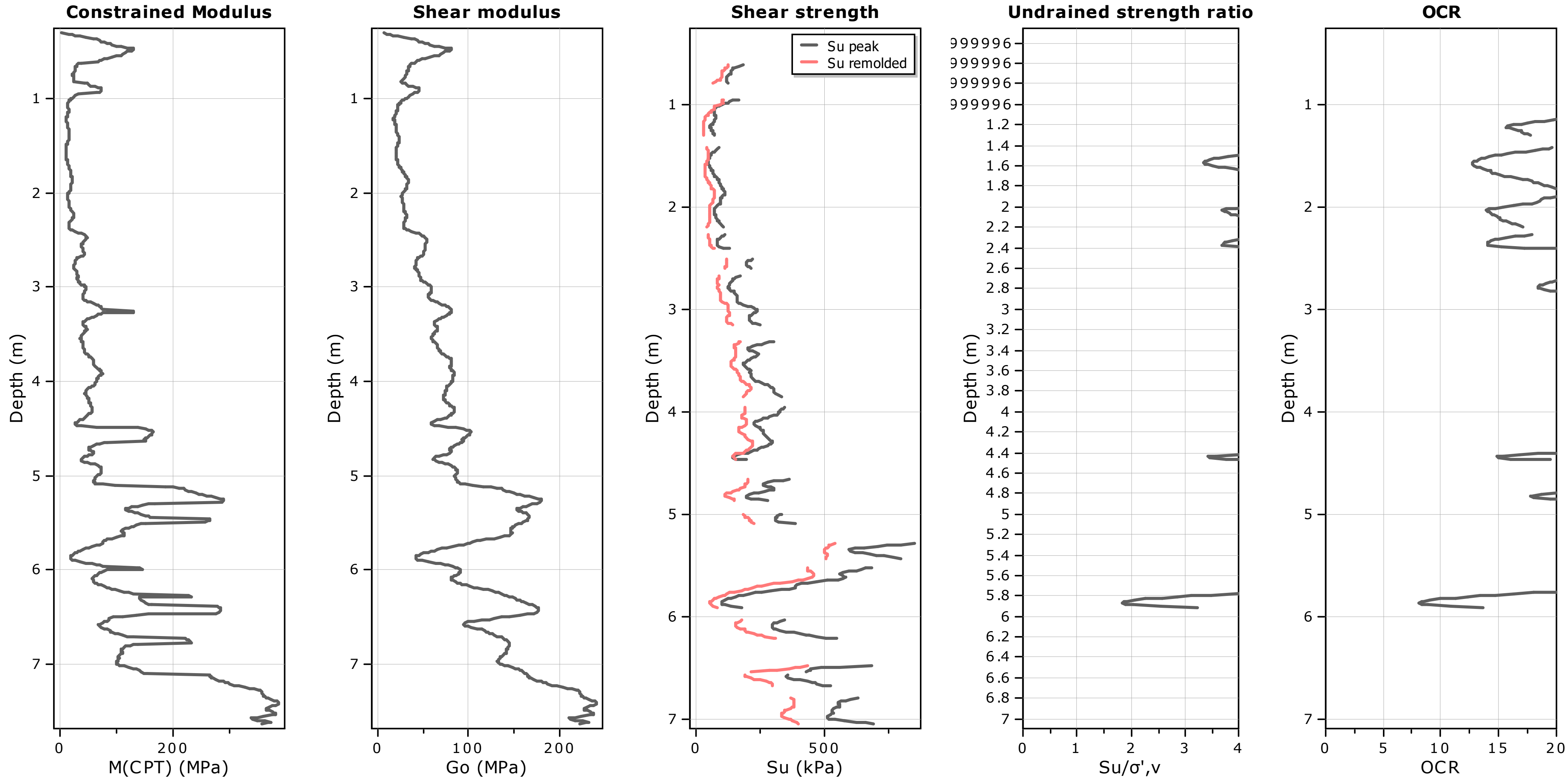
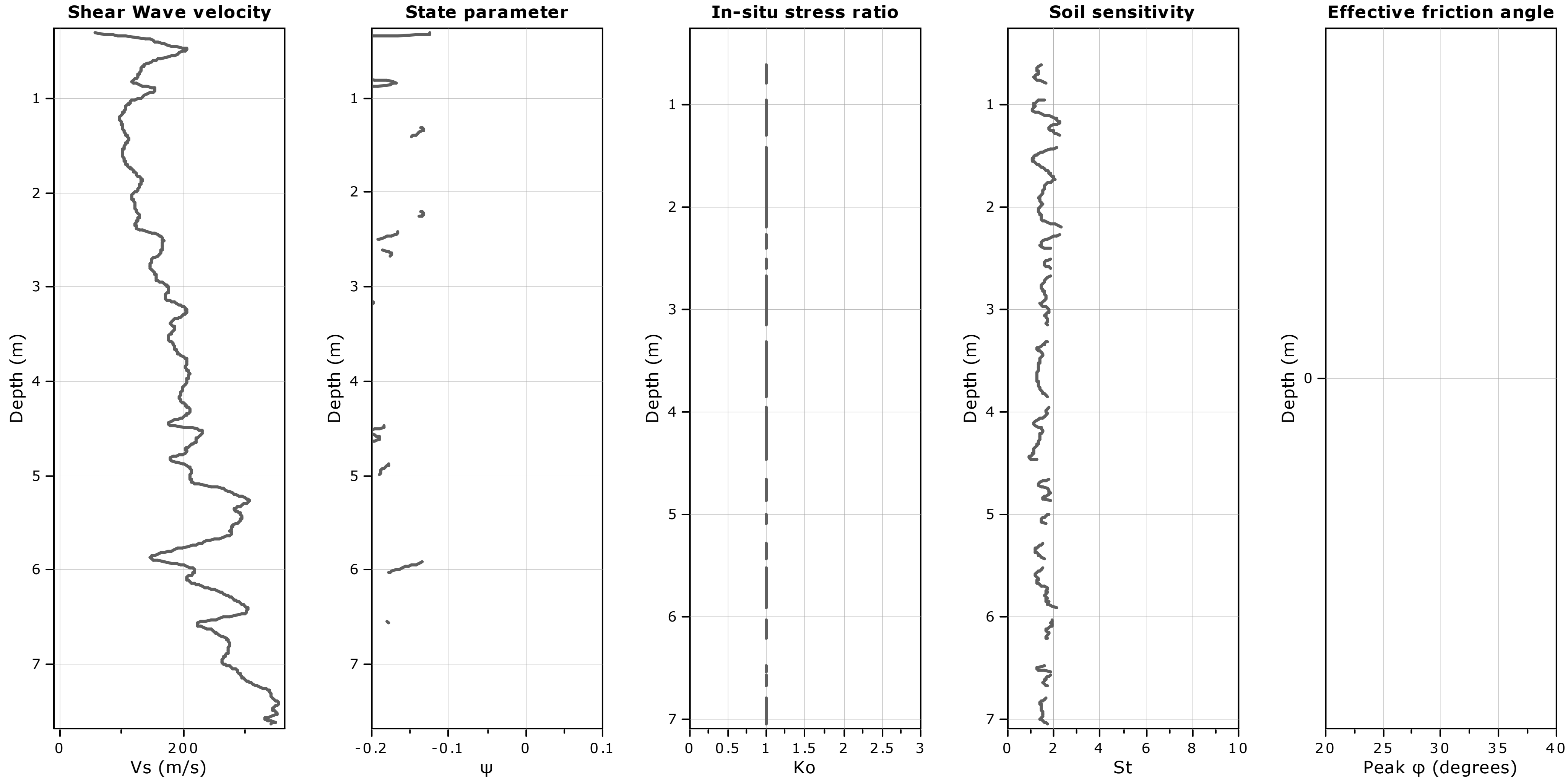
CPT: DataA12-CPT02
Total depth: 7.63 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

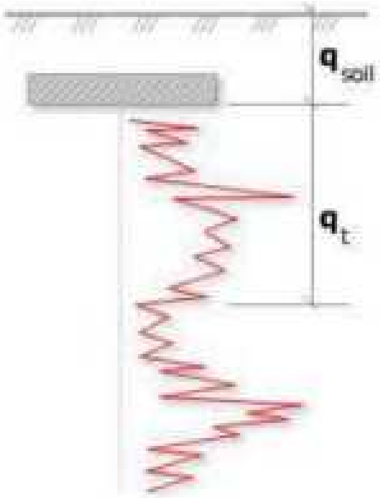
OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

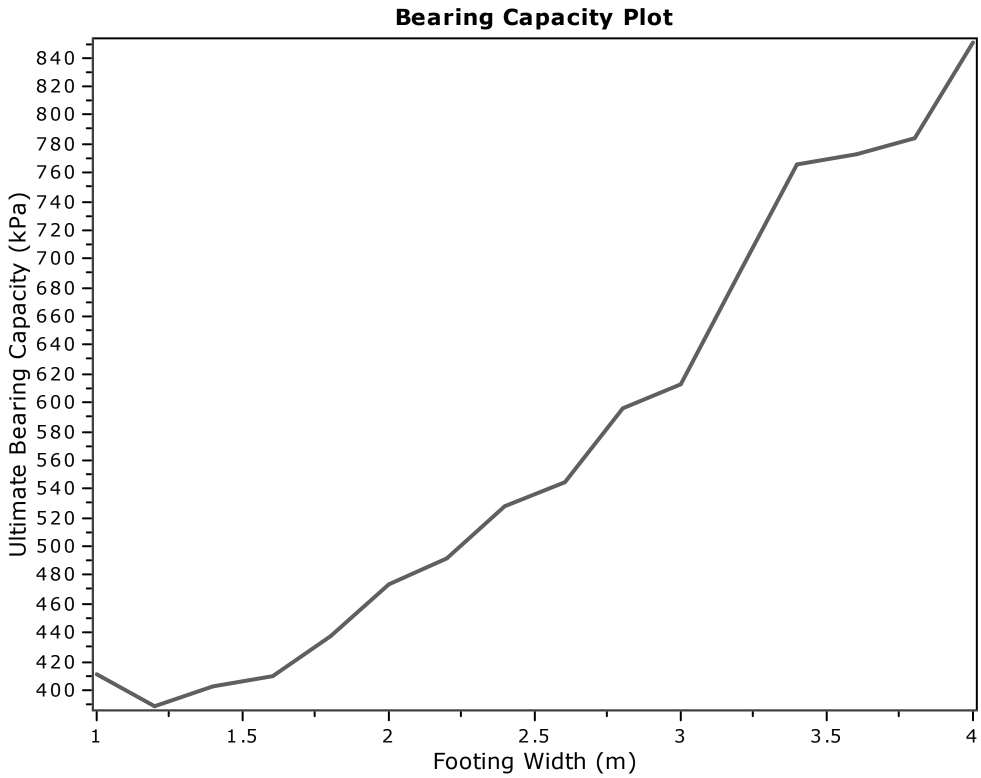
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

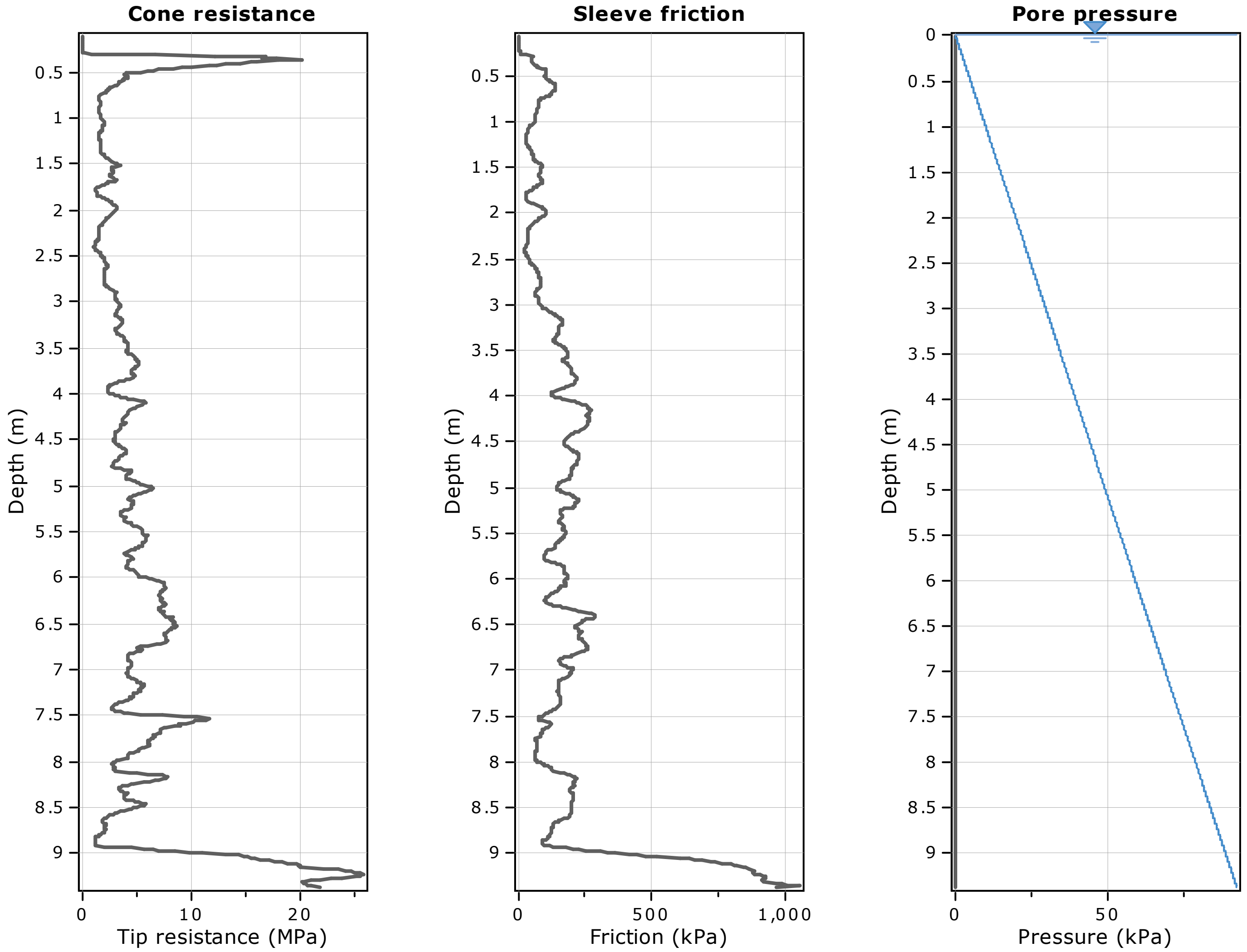
$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing

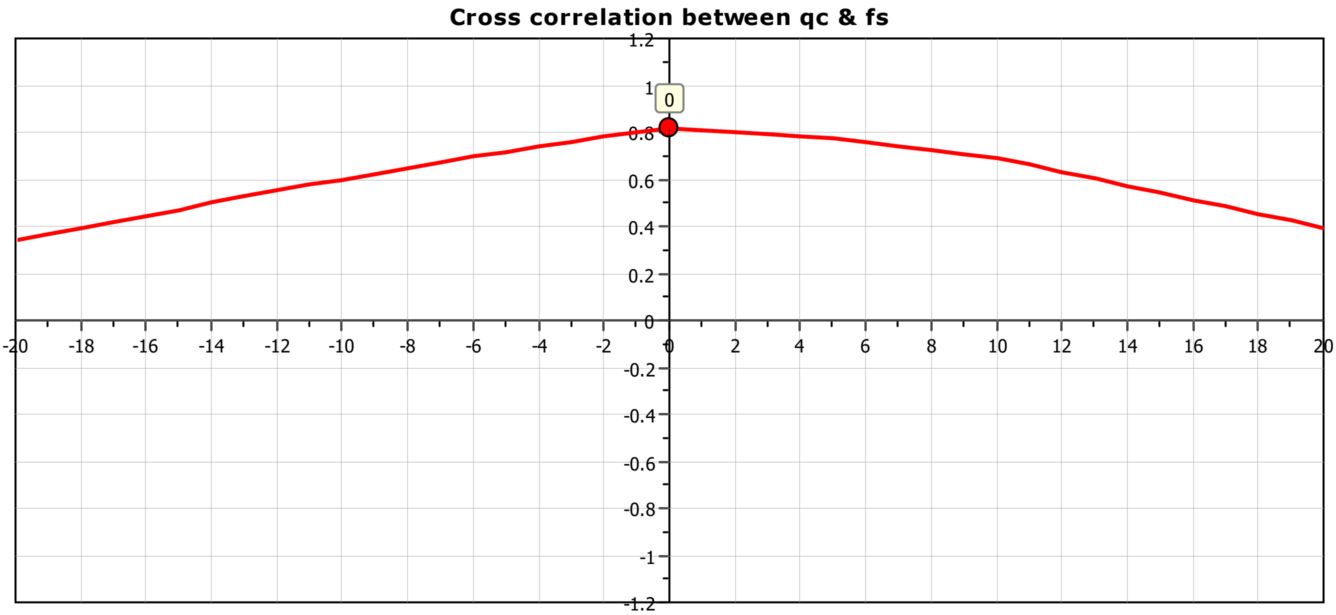


:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	2.01	0.20	9.50	410.56
2	1.20	0.50	2.30	1.90	0.20	9.50	388.80
3	1.40	0.50	2.60	1.97	0.20	9.50	402.61
4	1.60	0.50	2.90	2.00	0.20	9.50	410.33
5	1.80	0.50	3.20	2.14	0.20	9.50	437.25
6	2.00	0.50	3.50	2.32	0.20	9.50	473.59
7	2.20	0.50	3.80	2.41	0.20	9.50	491.50
8	2.40	0.50	4.10	2.59	0.20	9.50	527.58
9	2.60	0.50	4.40	2.67	0.20	9.50	544.07
10	2.80	0.50	4.70	2.93	0.20	9.50	595.70
11	3.00	0.50	5.00	3.02	0.20	9.50	612.76
12	3.20	0.50	5.30	3.40	0.20	9.50	689.72
13	3.40	0.50	5.60	3.78	0.20	9.50	766.09
14	3.60	0.50	5.90	3.82	0.20	9.50	773.36
15	3.80	0.50	6.20	3.87	0.20	9.50	784.38
16	4.00	0.50	6.50	4.21	0.20	9.50	850.75



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



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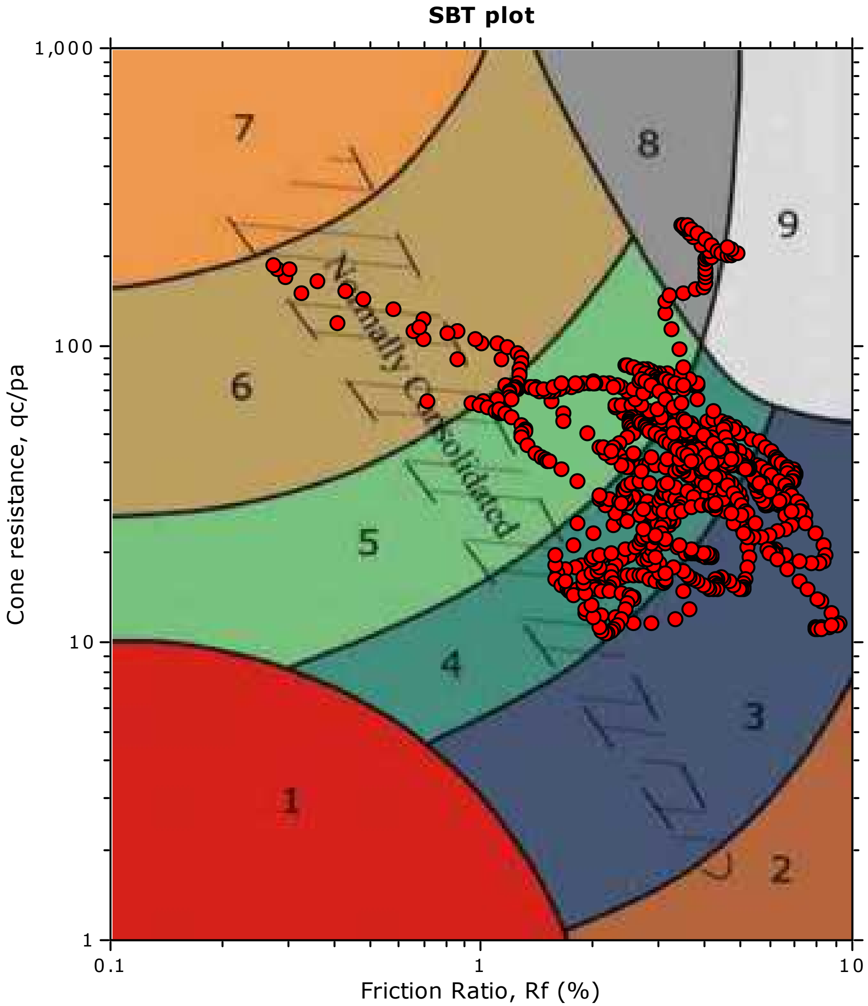
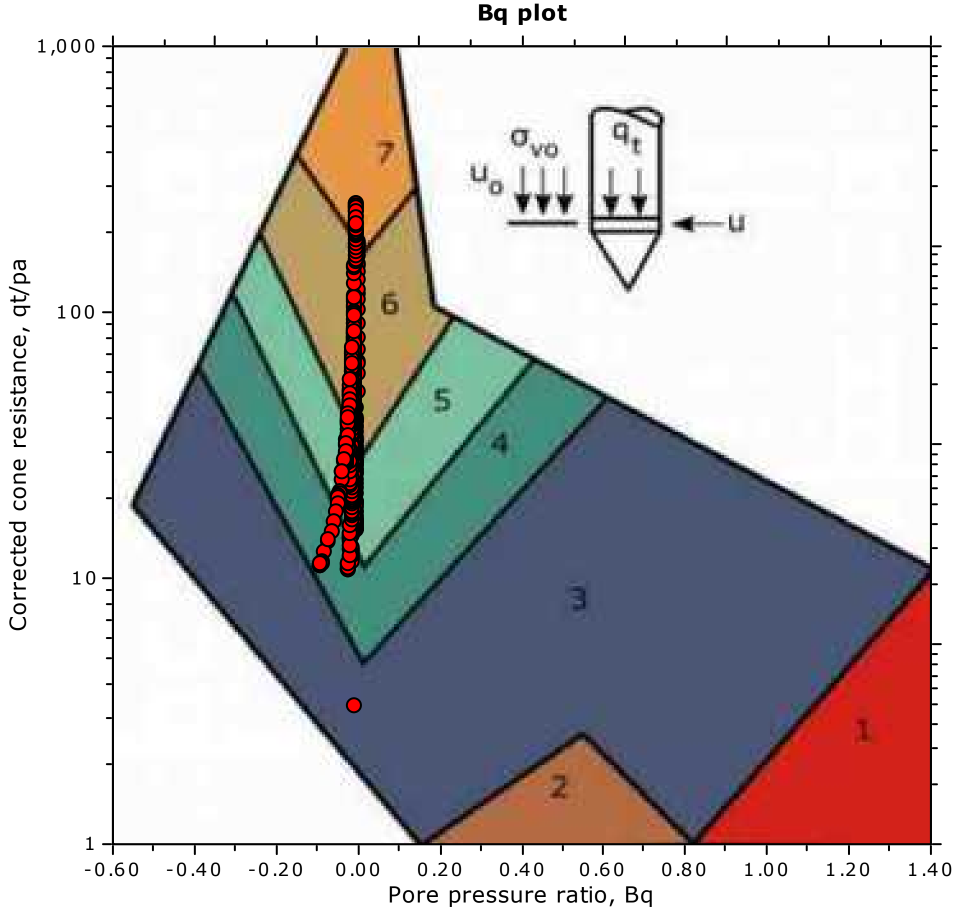
CPT: A12-CPT03
Total depth: 9.37 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

SBT - Bq plots





SBT legend

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

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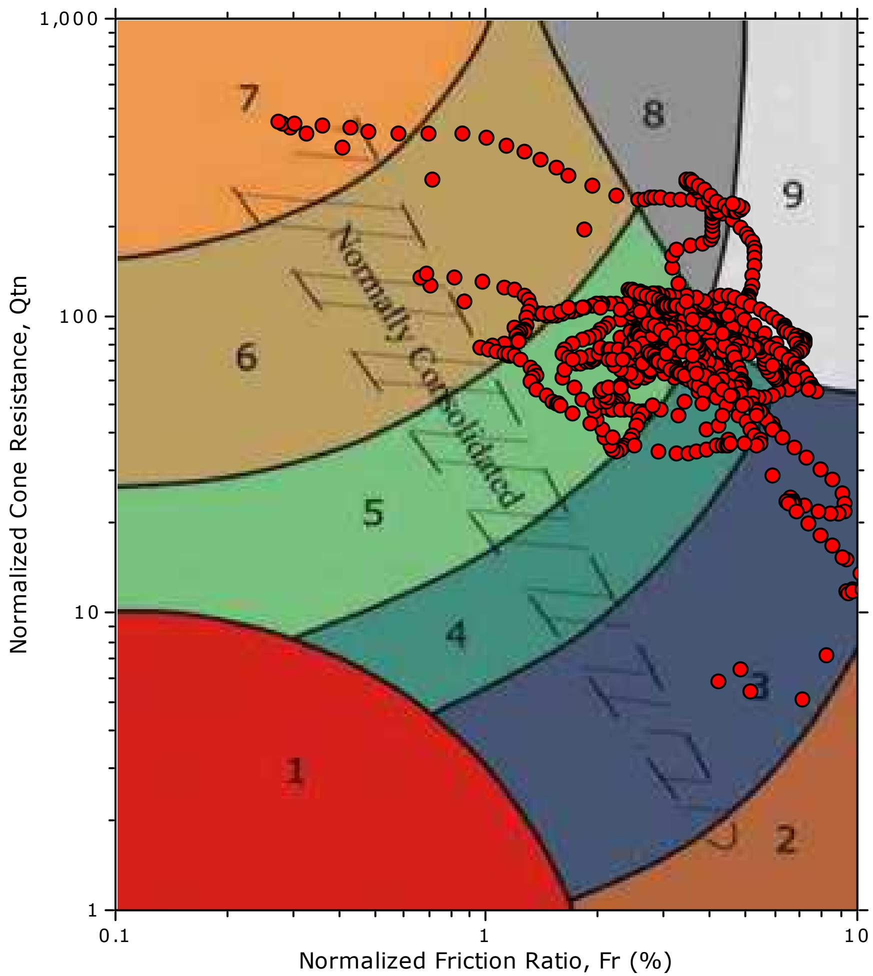
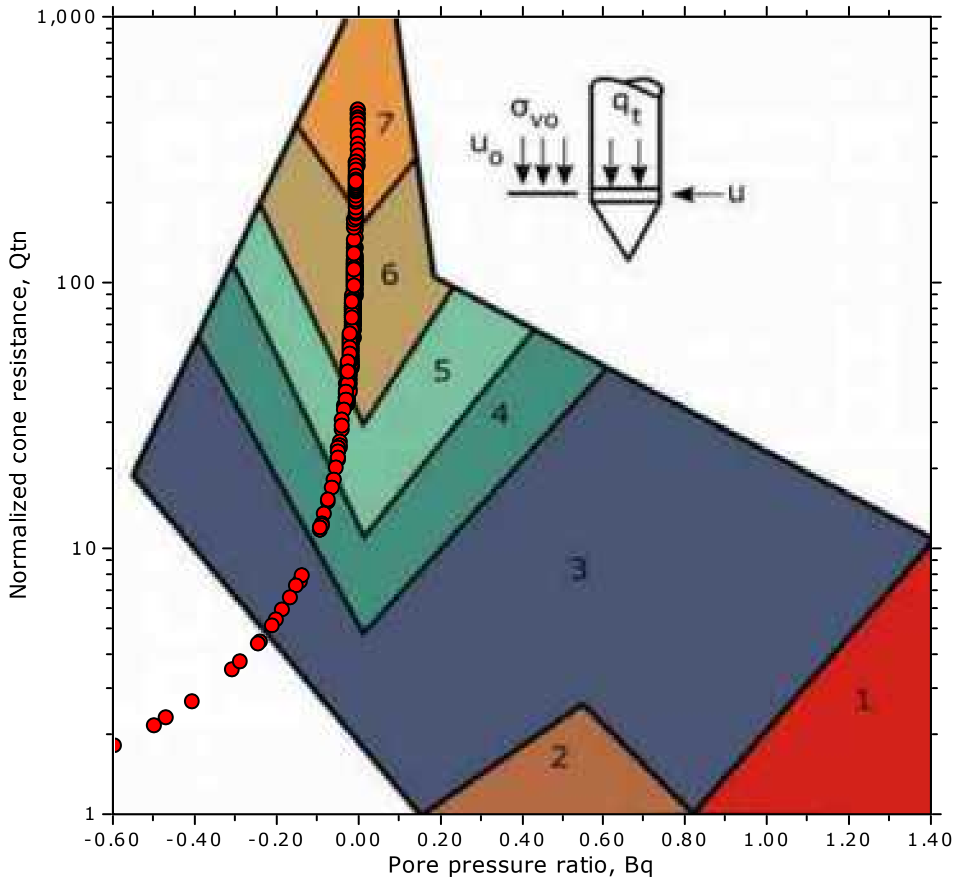
CPT: A12-CPT03
Total depth: 9.37 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:

SBT - Bq plots (normalized)

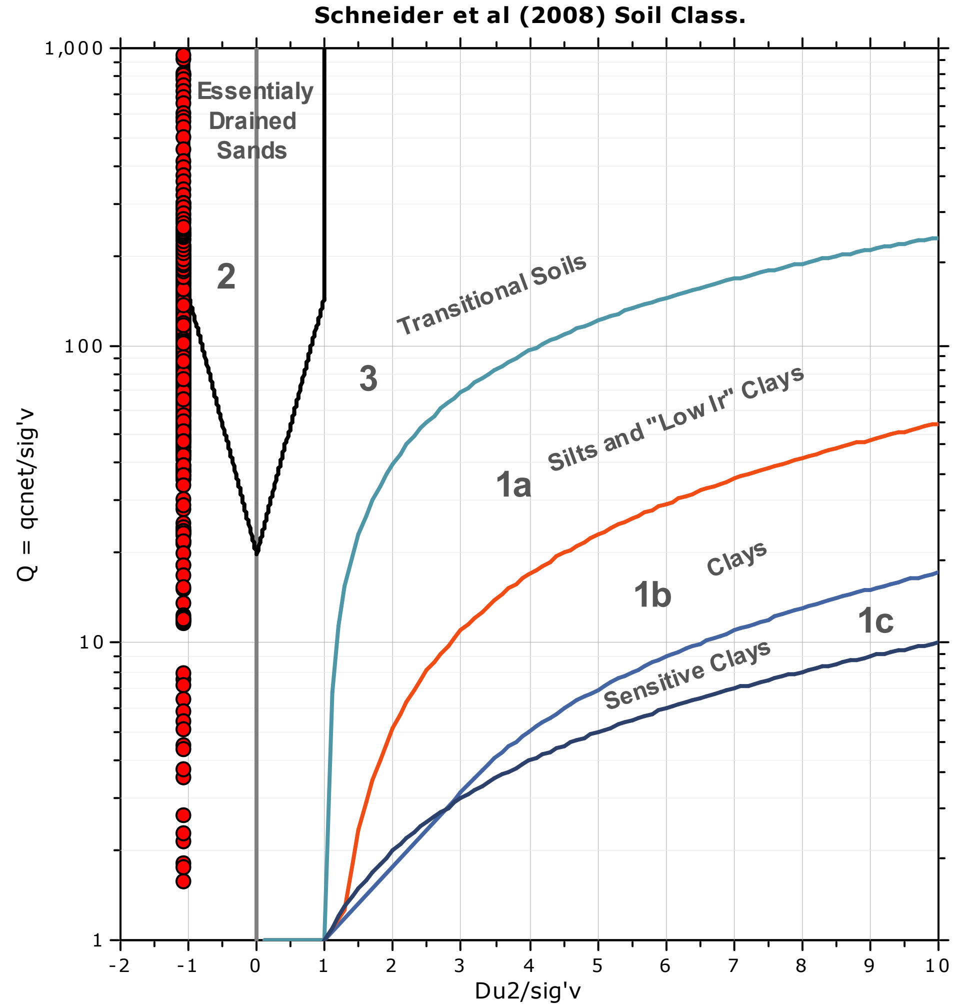


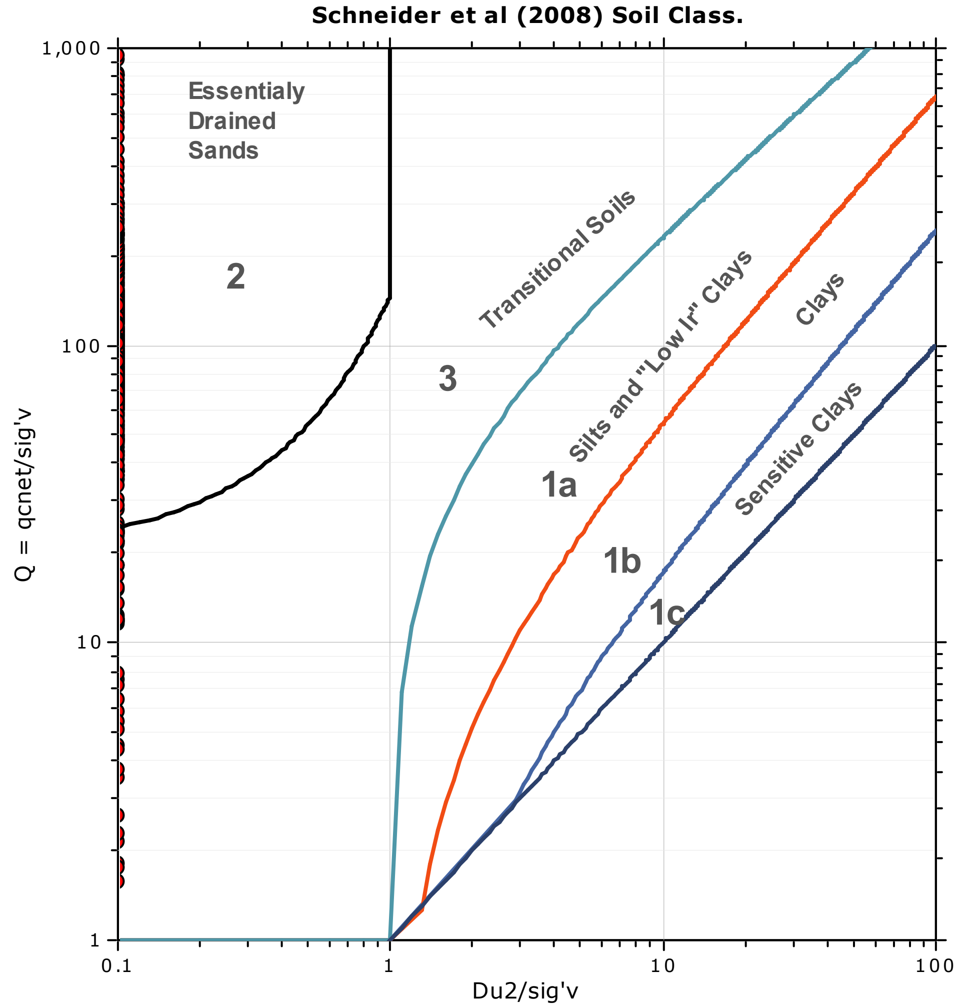


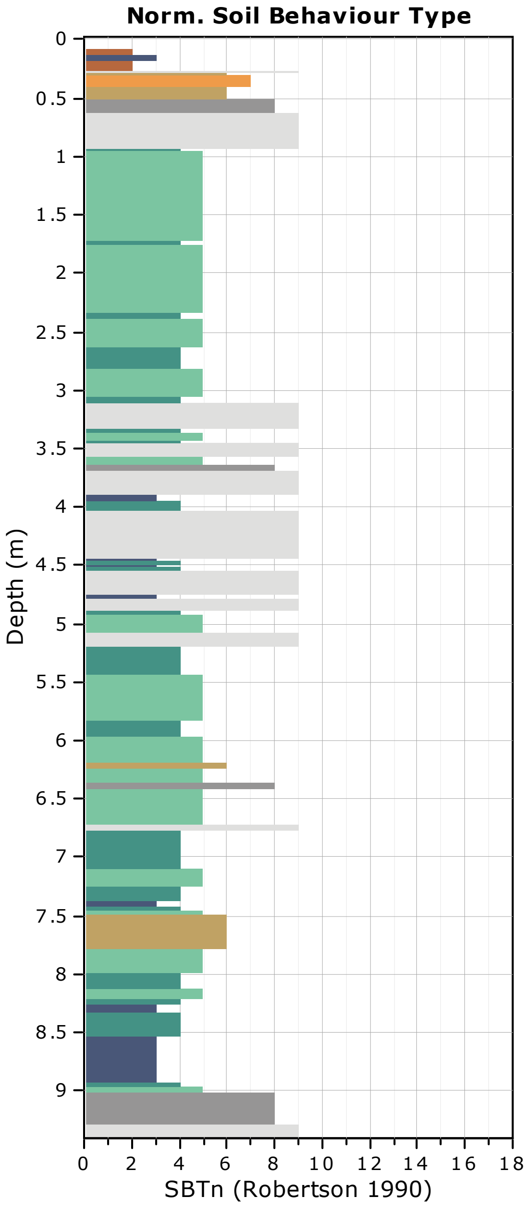
SBTn legend

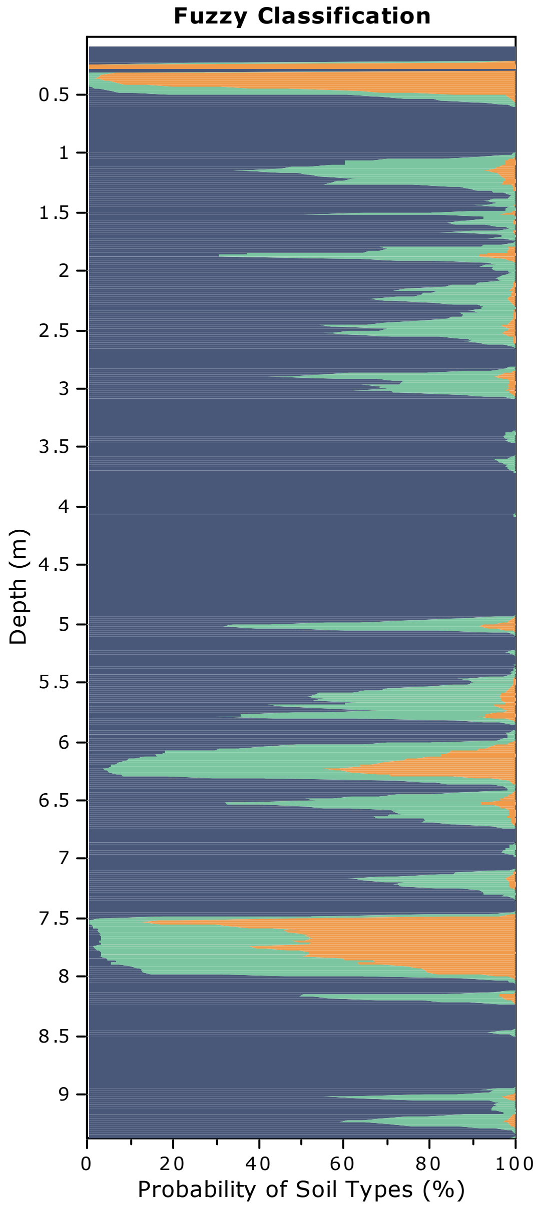
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravelly sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

Bq plots (Schneider)






Norm. Soil Behaviour Type
Depth (m)
SBTn (Robertson 1990)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
0 2 4 6 8 10 12 14 16 18


Fuzzy Classification
Depth (m)
Probability of Soil Types (%)
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
0 20 40 60 80 100

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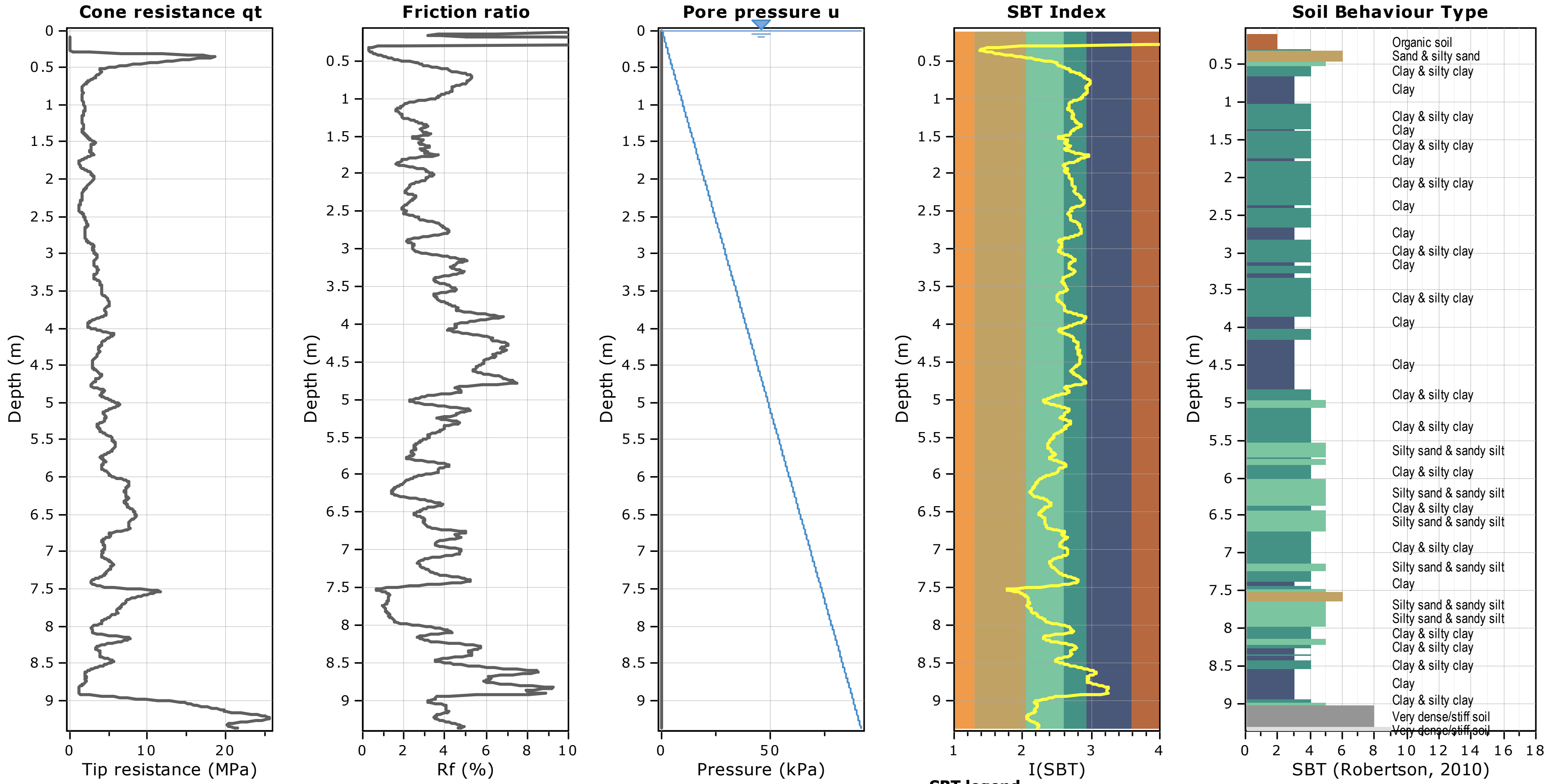
CPT: A12-CPT03
Total depth: 9.37 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



SBT legend

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

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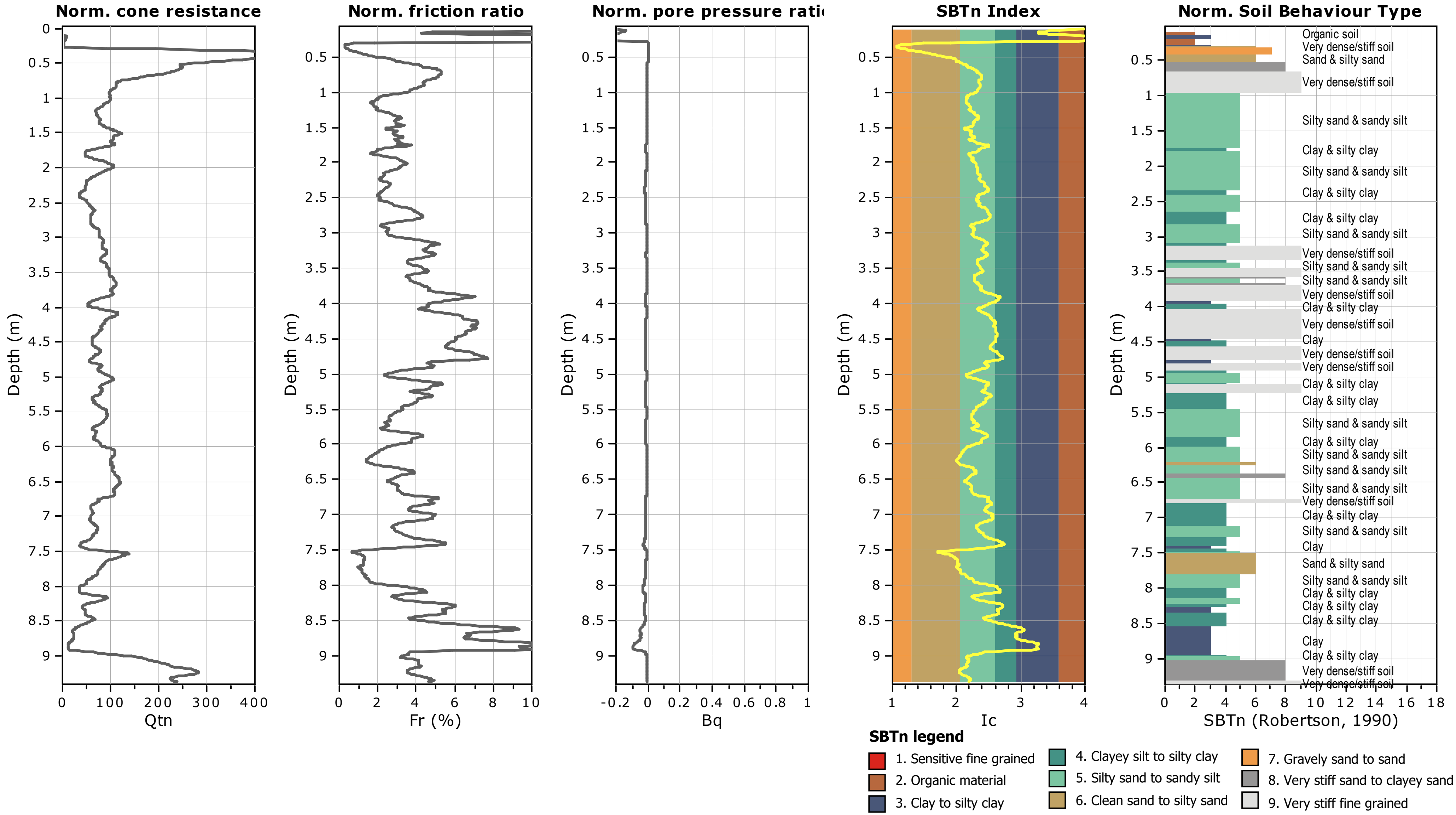
CPT: A12-CPT03
Total depth: 9.37 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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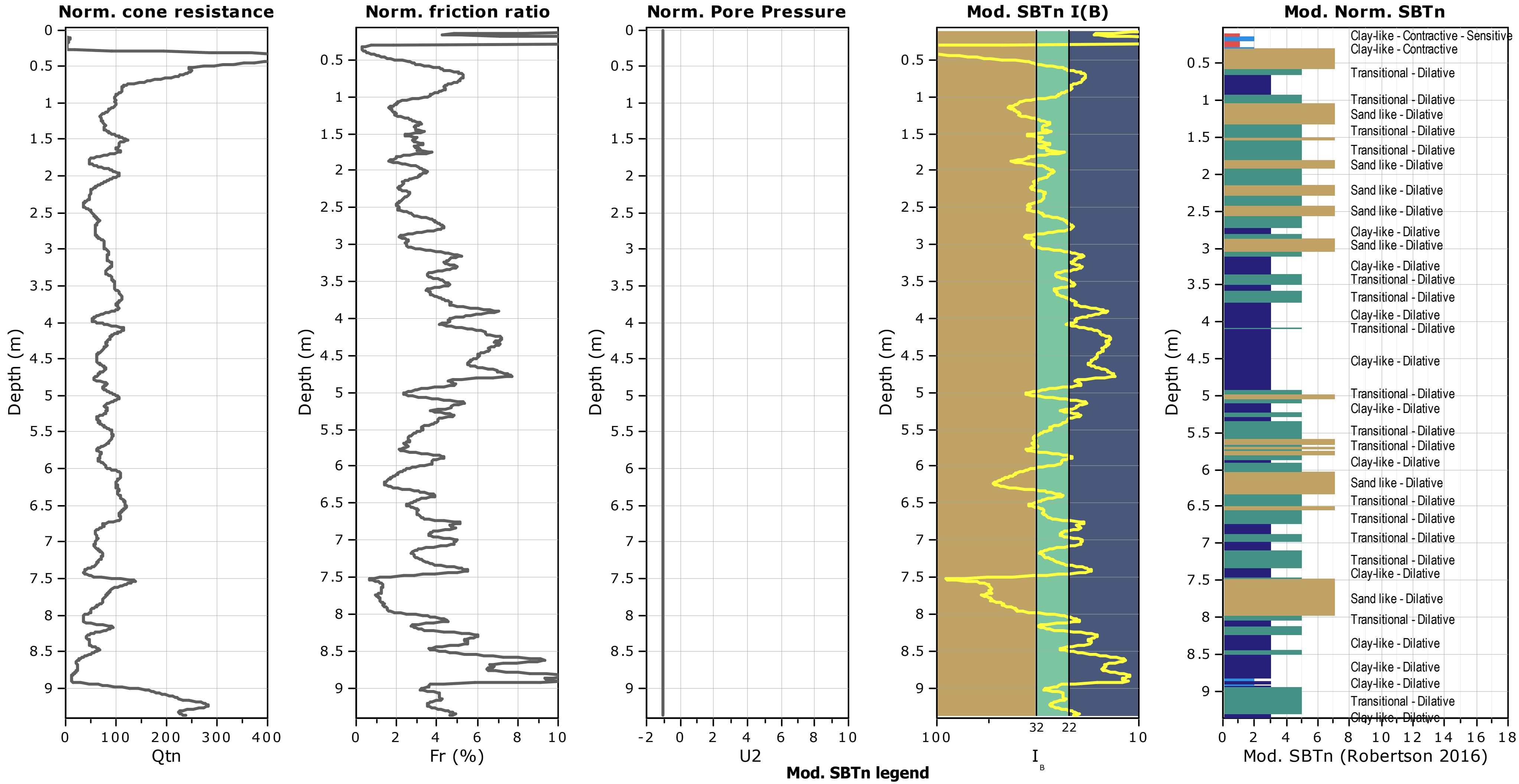
CPT: A12-CPT03
Total depth: 9.37 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

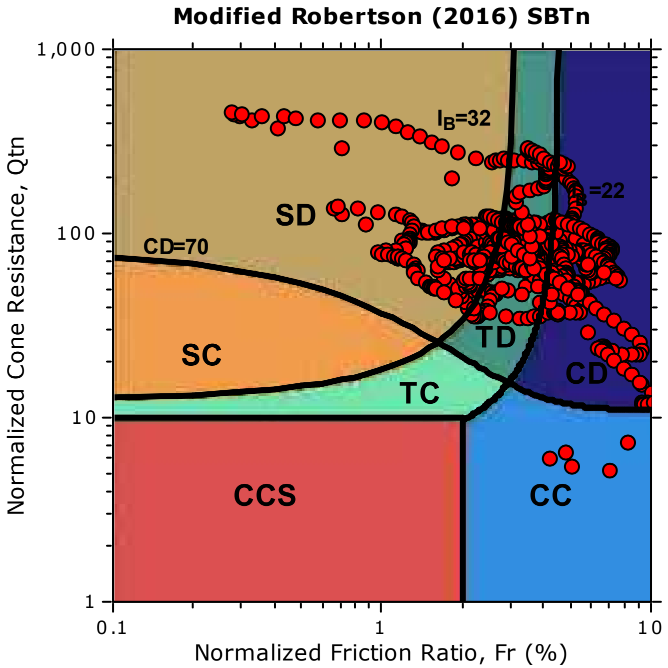
Project:
Location:

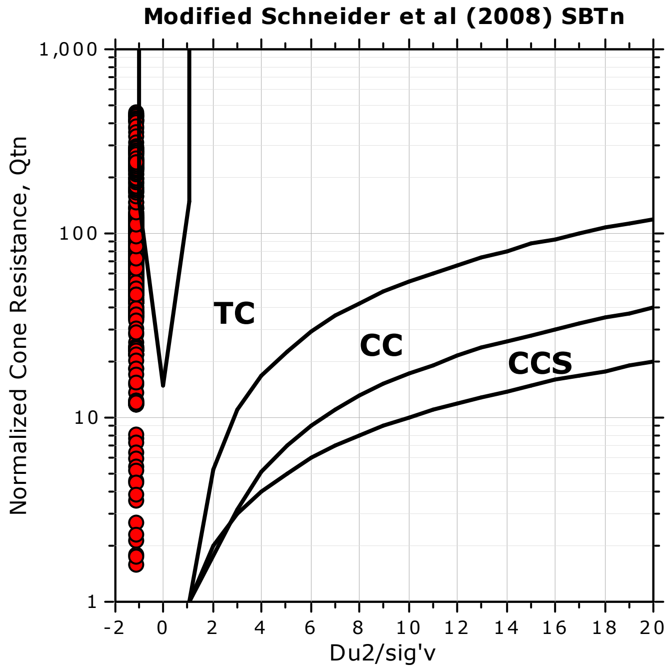


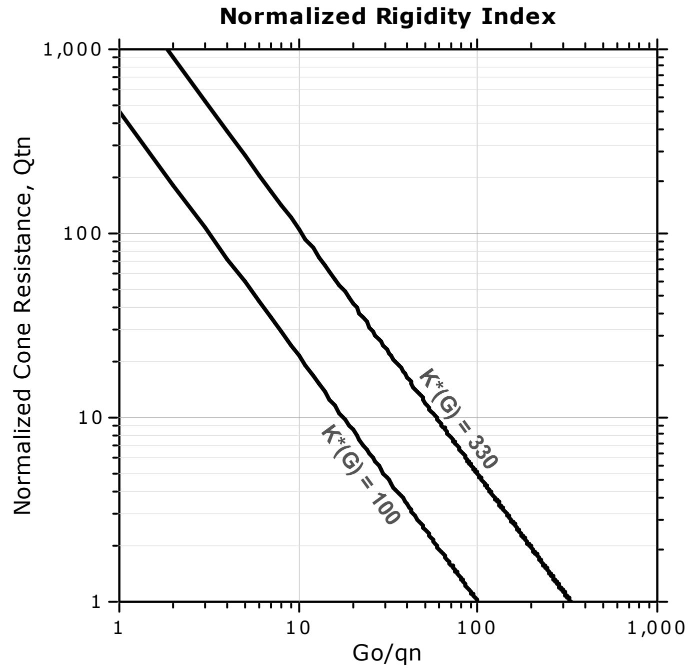
Mod. SBTn legend

- 1. CCS: ClayLike - Contractive, Sensitive
- 2. CC: Clay-like - Contractive
- 3. CD: Clay-Like: Dilative
- 4. TC: Transitional - Contractive
- 5. TD: Transitional - Dilative
- 6. SC: Sand-like - Contractive
- 7. SD: Sand-like - Dilative

Updated SBTn plots







CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

GeoLogismiki
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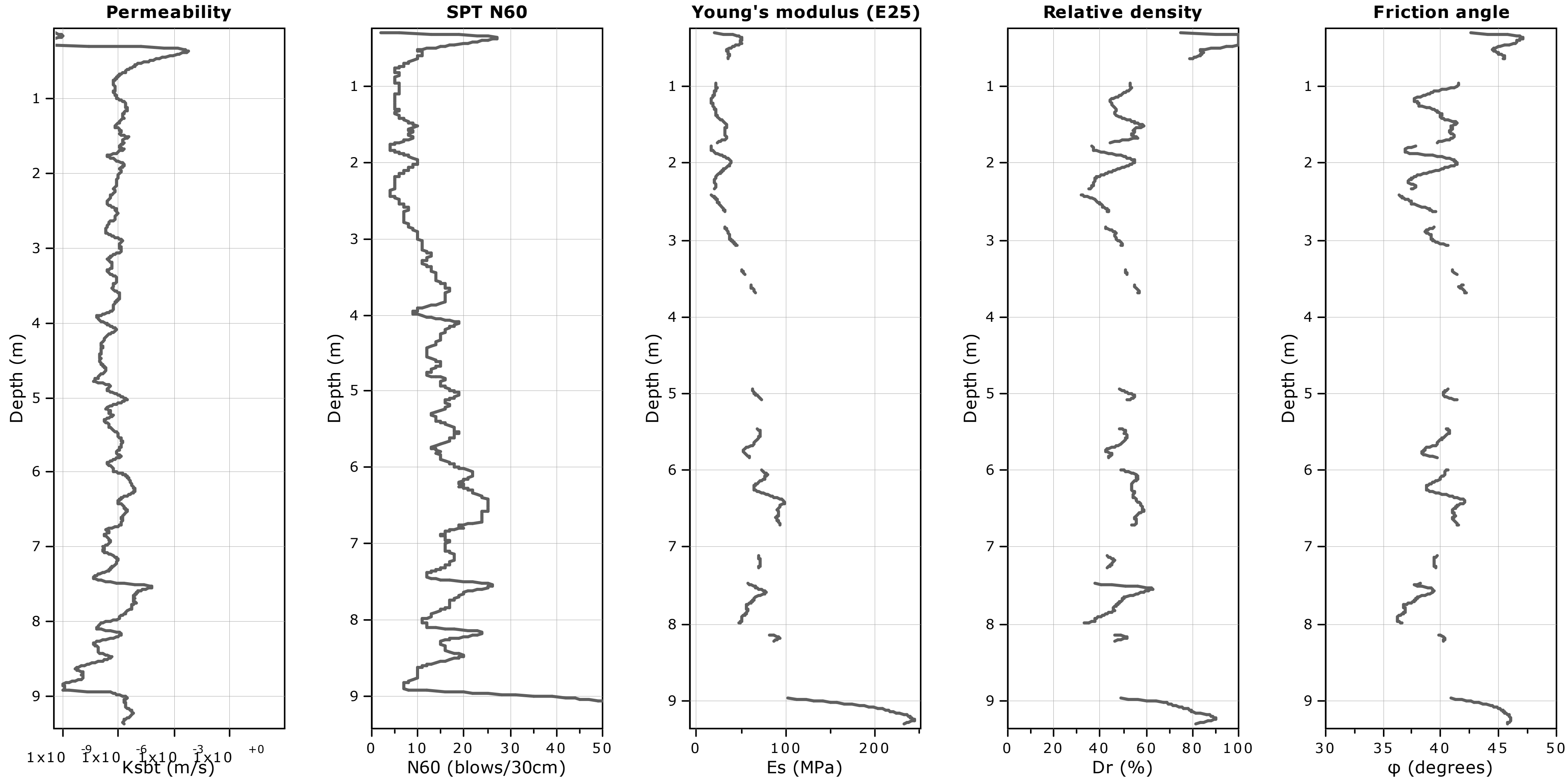
Merarhias 56
http://www.geologismiki.gr

CPT: A12-CPT03
Total depth: 9.37 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



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

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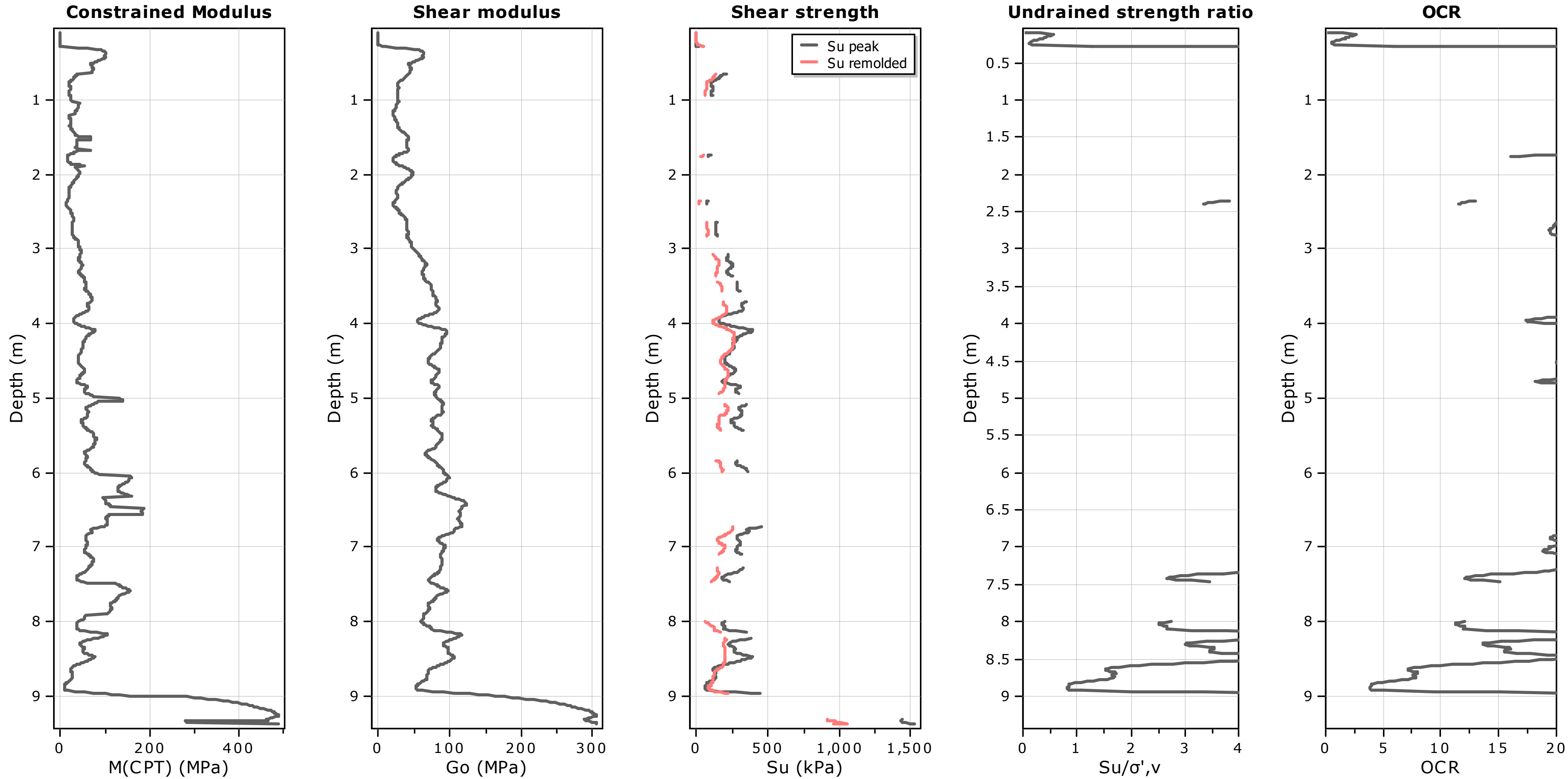
CPT: A12-CPT03
Total depth: 9.37 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project:
Location:



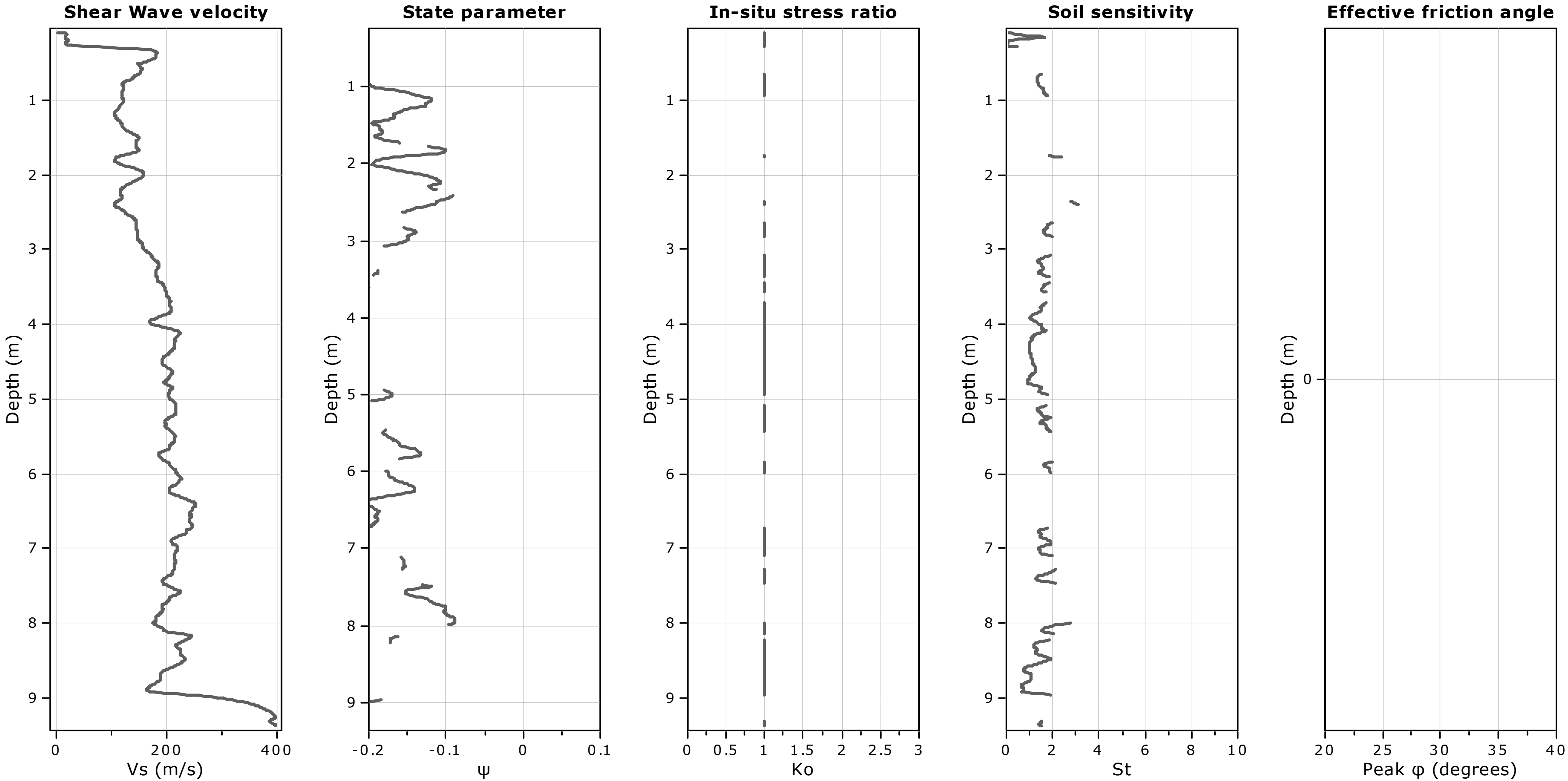
Calculation parameters
Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: 14

OCR factor for clays, N_{kt}: 0.33
User defined estimation data
Flat Dilatometer Test data

GeoLogismiki
Geotechnical Engineers
Merarhias 56
http://www.geologismiki.gr

CPT: A12-CPT03
Total depth: 9.37 m, Date: 17/10/2022
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

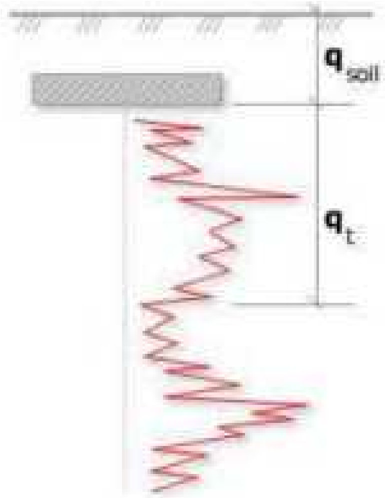
Project:
Location:



Calculation parameters

Soil Sensitivity factor, N_S: 7.00

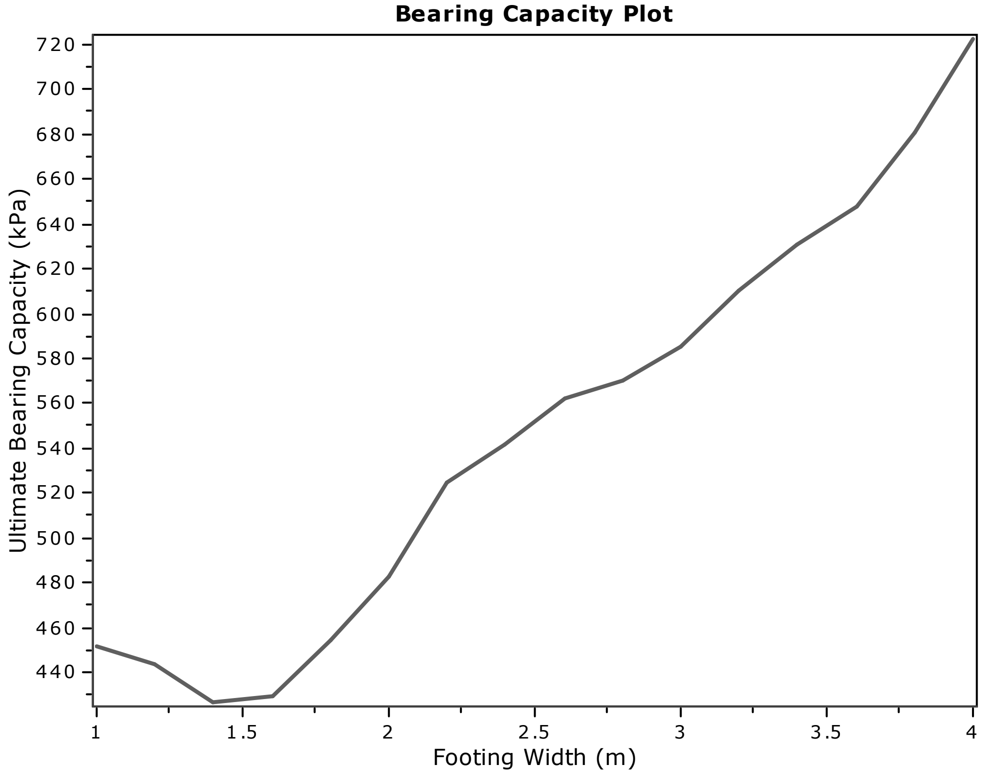
User defined estimation data



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	2.21	0.20	9.50	451.75
2	1.20	0.50	2.30	2.17	0.20	9.50	443.45
3	1.40	0.50	2.60	2.09	0.20	9.50	426.90
4	1.60	0.50	2.90	2.10	0.20	9.50	429.98
5	1.80	0.50	3.20	2.23	0.20	9.50	454.77
6	2.00	0.50	3.50	2.37	0.20	9.50	482.91
7	2.20	0.50	3.80	2.58	0.20	9.50	524.68
8	2.40	0.50	4.10	2.66	0.20	9.50	541.31
9	2.60	0.50	4.40	2.76	0.20	9.50	562.34
10	2.80	0.50	4.70	2.81	0.20	9.50	570.51
11	3.00	0.50	5.00	2.88	0.20	9.50	585.05
12	3.20	0.50	5.30	3.00	0.20	9.50	610.15
13	3.40	0.50	5.60	3.11	0.20	9.50	631.07
14	3.60	0.50	5.90	3.19	0.20	9.50	647.54
15	3.80	0.50	6.20	3.36	0.20	9.50	680.99
16	4.00	0.50	6.50	3.56	0.20	9.50	722.47

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

:: Unit Weight, g (kN/m³) ::

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

where g_w = water unit weight

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

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

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

:: N_{SPT} (blows per 30 cm) ::

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

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

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

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

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

:: Relative Density, Dr (%) ::

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

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

:: State Parameter, ψ ::

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

:: Drained Friction Angle, φ (°) ::

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

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

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

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

If $I_c \geq 2.20$

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

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

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

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

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

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

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

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

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

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

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

:: Overconsolidation Ratio, OCR ::

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

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

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

:: In situ Stress Ratio, Ko ::

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

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

:: Soil Sensitivity, S_t ::

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

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

:: Peak Friction Angle, φ' (°) ::

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

(applicable for $0.10 < B_q < 1.00$)

References

• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

Borehole No. BH22A12

Project:	Waka Kotahi Northland Emergency Resilience	*Coordinates:*	282892 E 986775 N		
Client:	Waka Kotahi	*Ref. Grid:*	NZTM	*Depth:*	11.6 m
Project No.:	1-11244.00	*R.L.:*	126.765 m	*Inclination:*	-90°
Location:	Slip 22A12 Mangamuka Range	*Datum:*	NZ Geodetic Datum 2000	*Azimuth:*	0°

PHOTOGRAPHS

Photo BH22A12.3
BOX03: 6.45 - 10.10m.

Photo BH22A12.4
BOX04: 10.10 - 11.60m.

BOREHOLE SOIL/ROCK LOG A4 1-11244.00 WAKA KOTAHI 2022 EMERGENCY SLIPS.GPJ WSP-OPUS2018_TEM.GDT 26/10/22

Notes:
Borehole located within northbound lane approximately 4.8m from headscarp. Borehole terminated within SL MUDSTONE. Inclinometer installed on completion.
Logged in accordance with NZGS Guideline of the Field Classification and Description of Soil and Rock for Engineering Purposes, December 2005 & Engineering & Development in Hazardous Terrain 2001, pg 365, Table 1.

Started:	17/09/2022	*Finished:*	19/09/2022
Drilling Co.:	DFNZ	*Drilling Rig:*	Canter Rig
Logged by:	HQ	*Checked by:*	ML

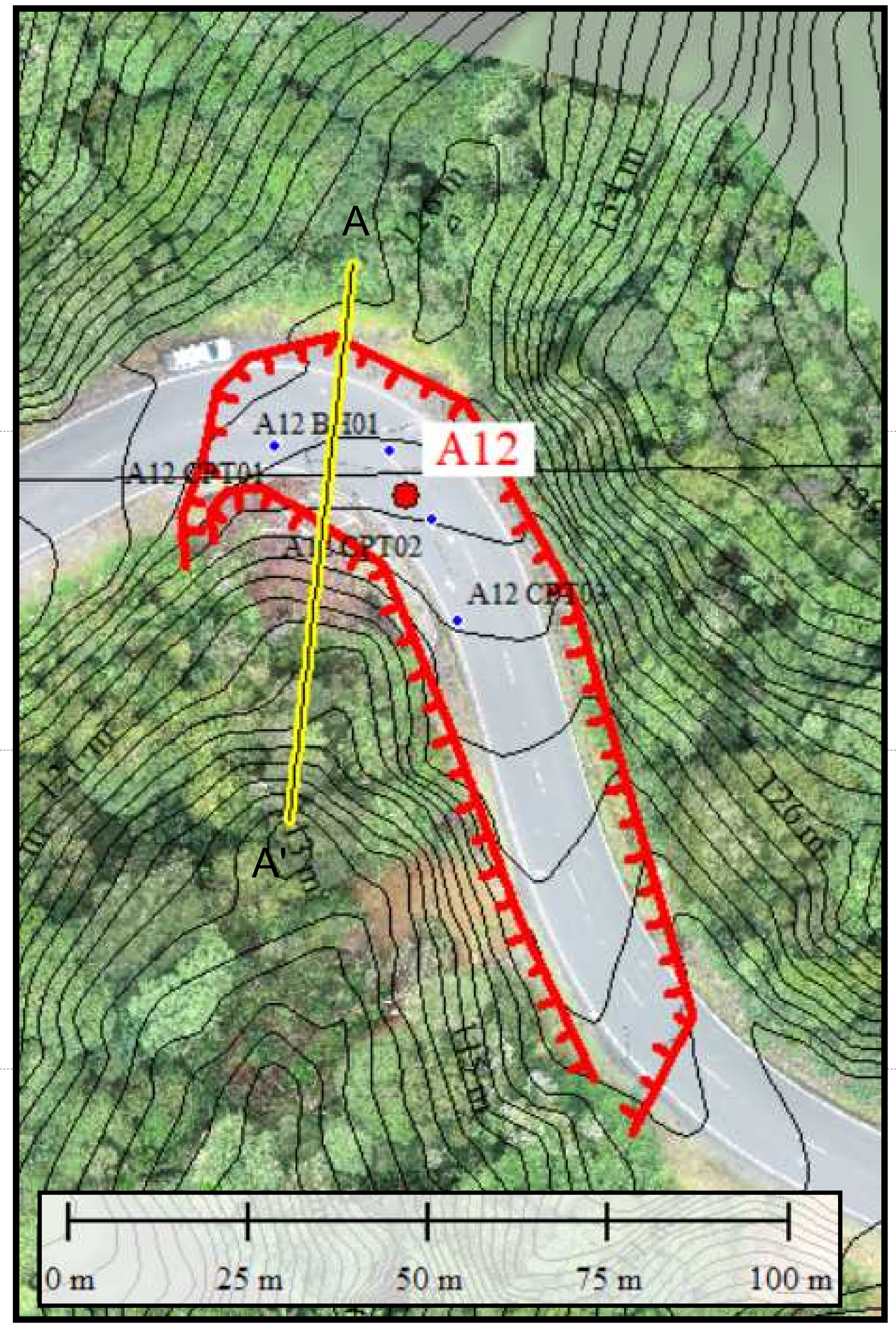
Logged in accordance with NZ Geotechnical Society Guidelines (2005). See attached key sheet for explanation of symbols.

Scale 1:50 @ A4

Appendix B

Conceptual Geological Cross Section

A12 CROSS SECTION



From Pos: 282892.582, 986795.474
To Pos: 282883.780, 986744.661
140 m
135 m
130 m

Appendix C

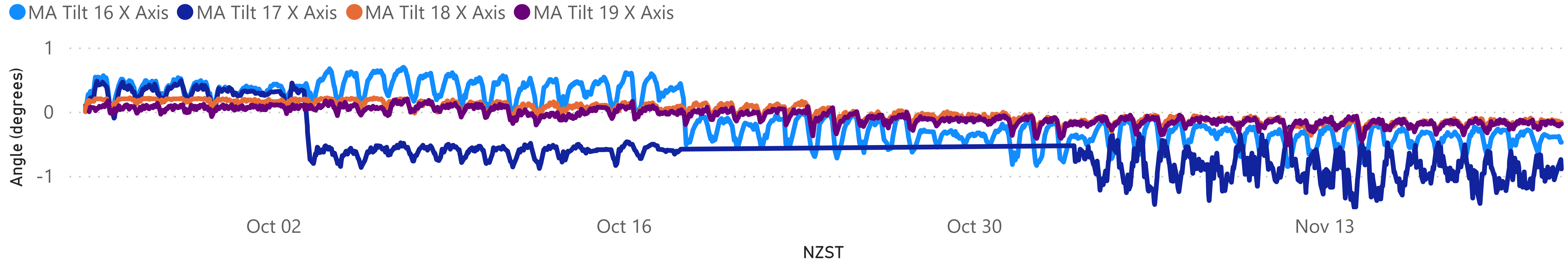
Tilt Sensor and Rainfall Data

Inclinometer Data

Mangamuka Gorge - Site A12 (T16 - T19)

9/17/2022 11/22/2022

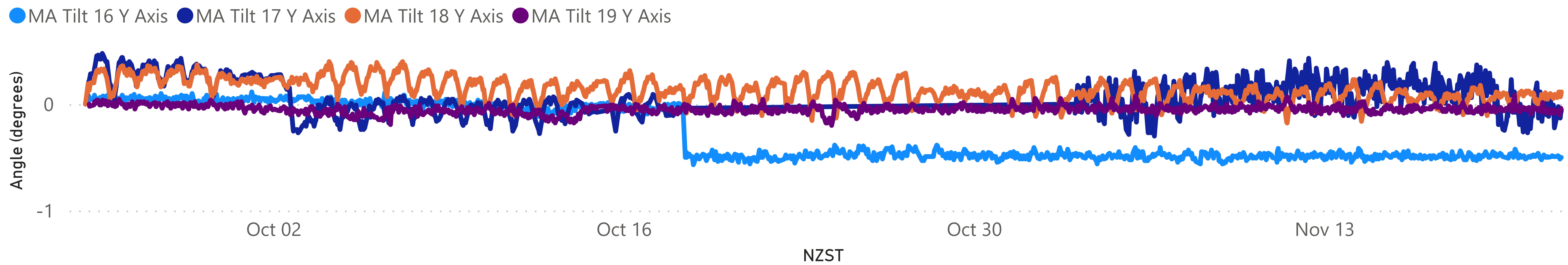
MA Tilt 16 X Axis, MA Tilt 17 X Axis, MA Tilt 18 X Axis and MA Tilt 19 X Axis by NZST

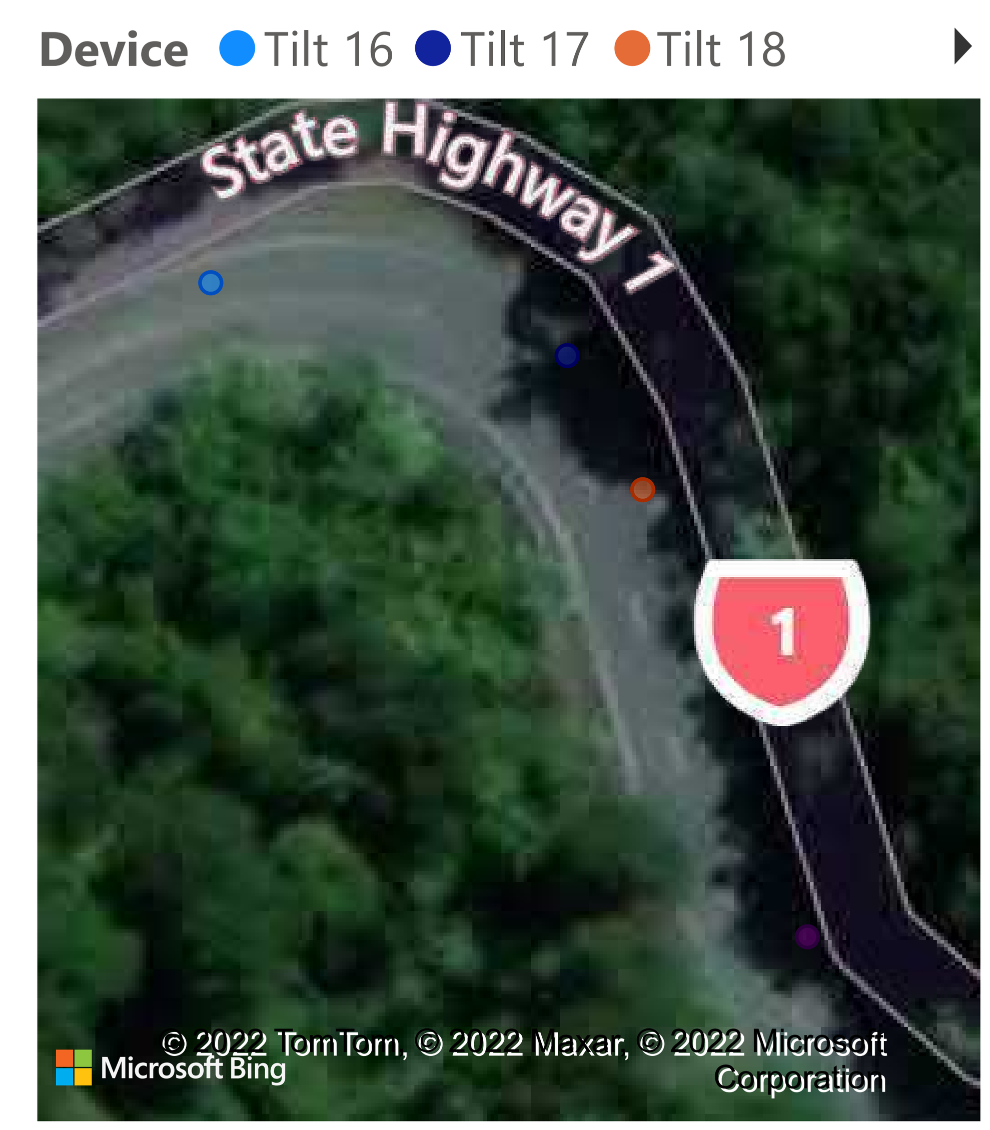


TARP

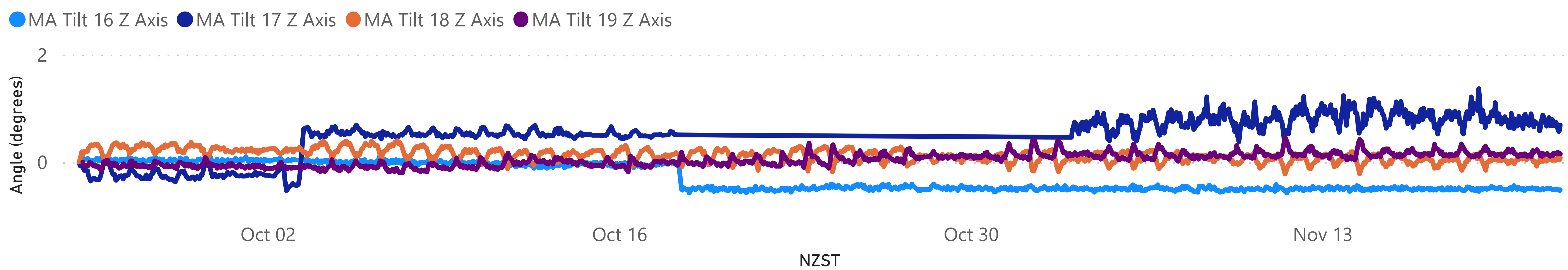
Site	Level
A12	

MA Tilt 16 Y Axis, MA Tilt 17 Y Axis, MA Tilt 18 Y Axis and MA Tilt 19 Y Axis by NZST

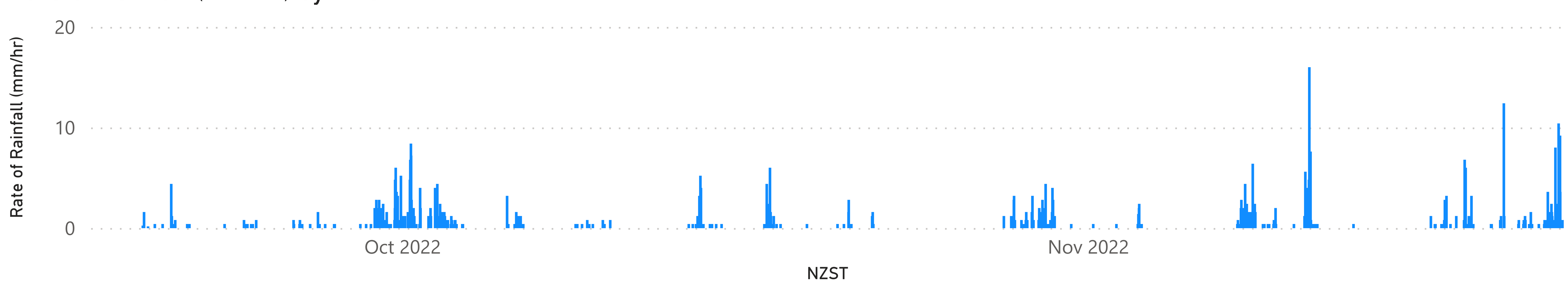


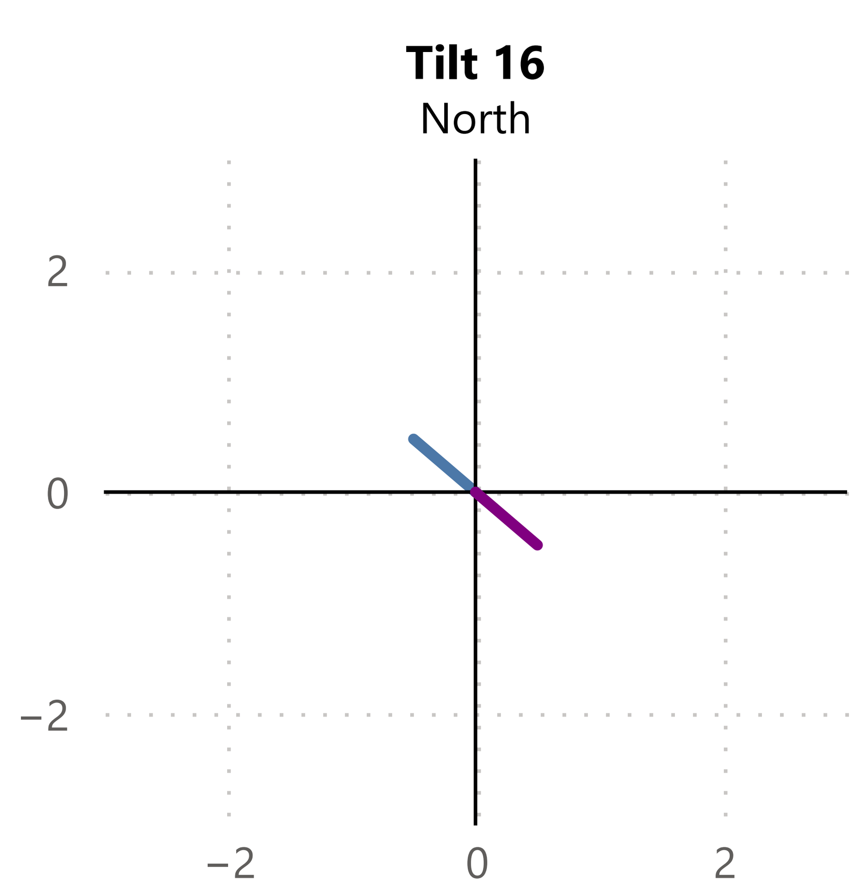


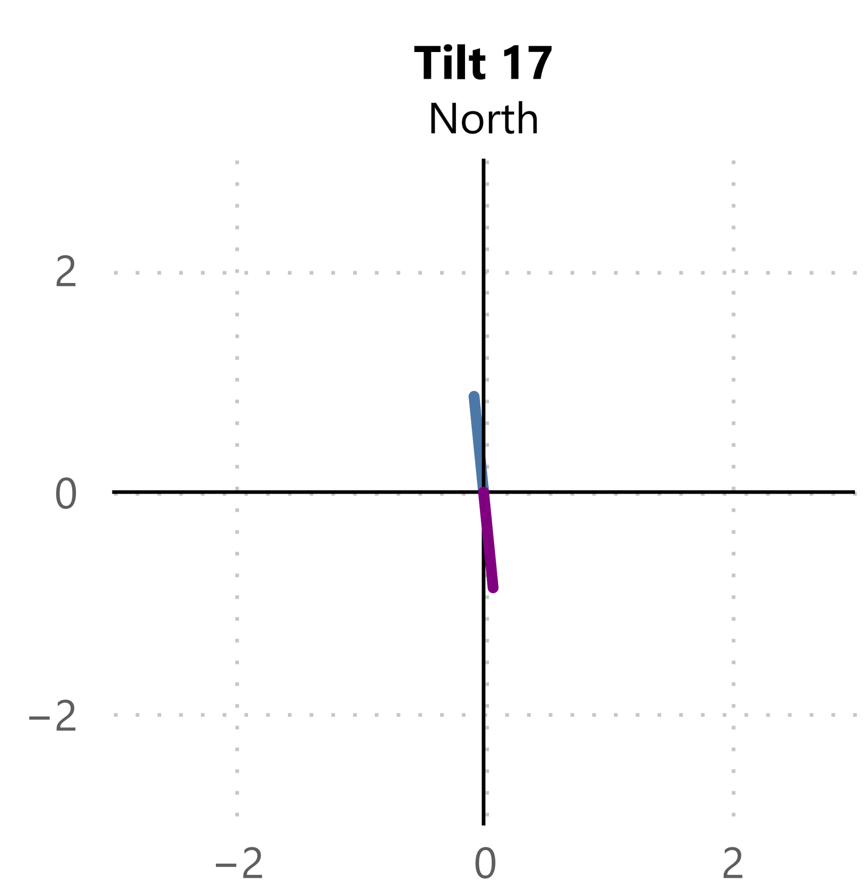
MA Tilt 16 Z Axis, MA Tilt 17 Z Axis, MA Tilt 18 Z Axis and MA Tilt 19 Z Axis by NZST

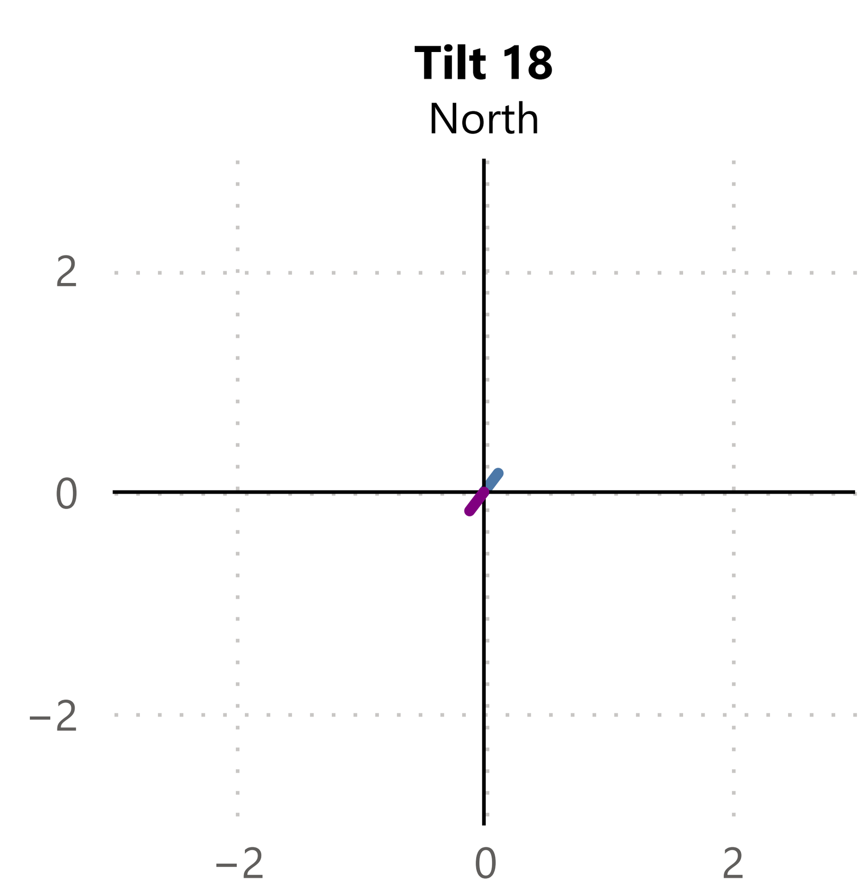


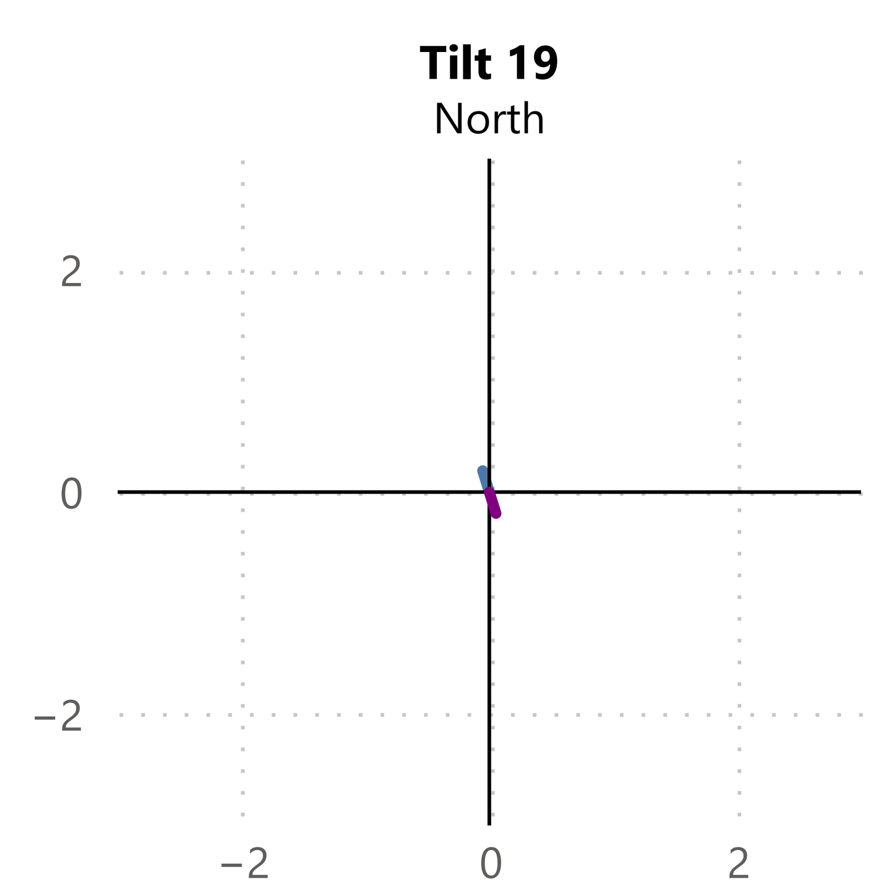
Rate of Rainfall (mm/hr) by NZST









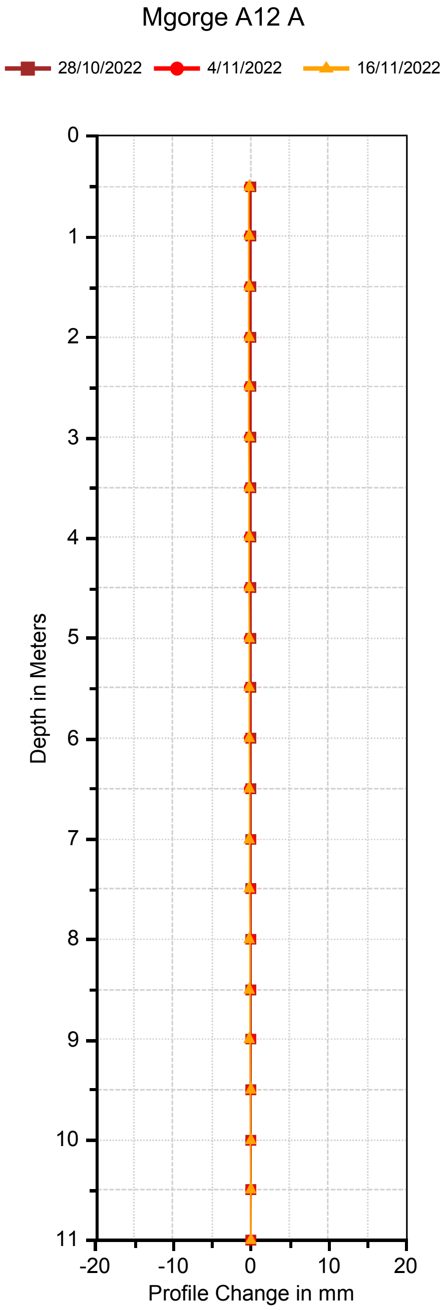


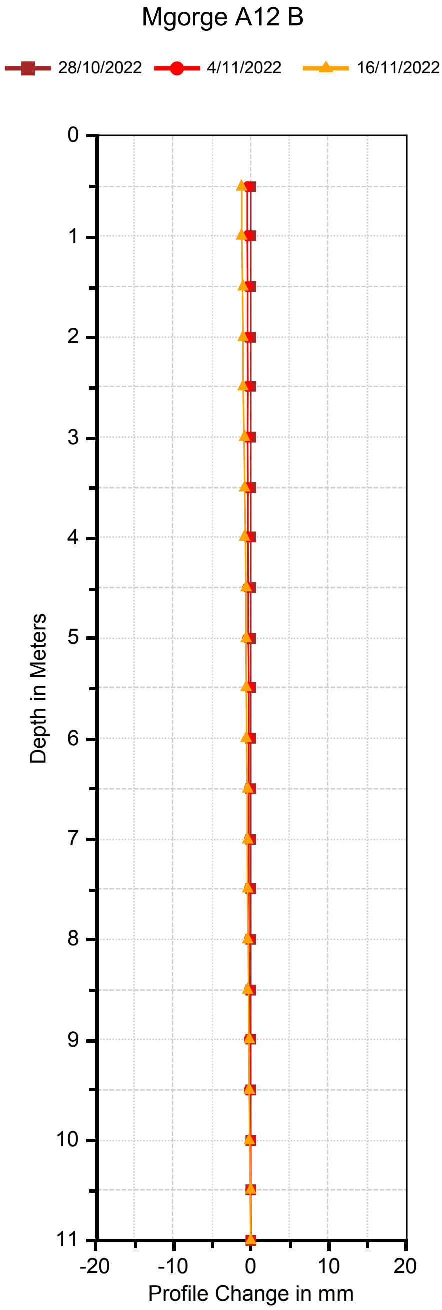
LEGEND

Actual Tilt Direction

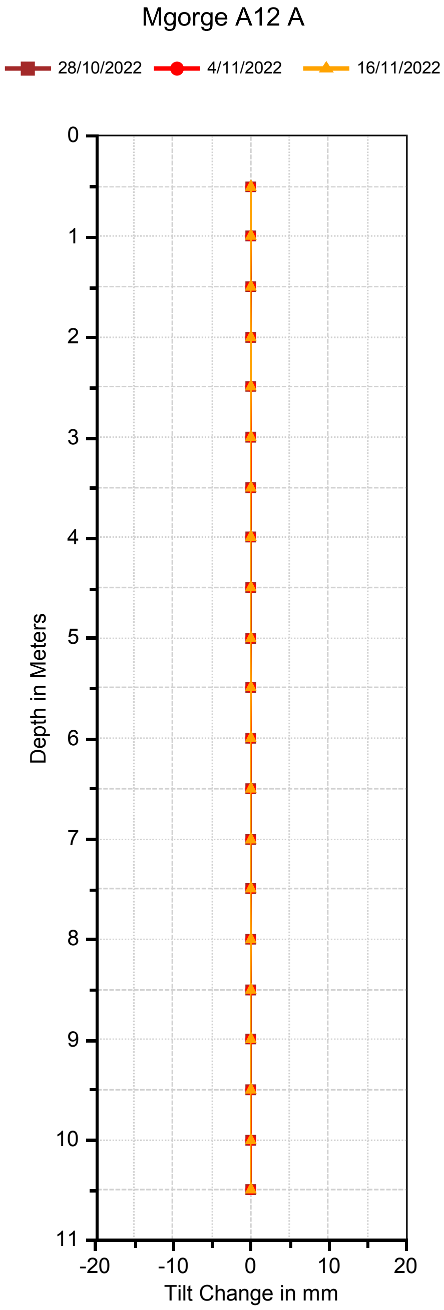
Estimated Land Direction

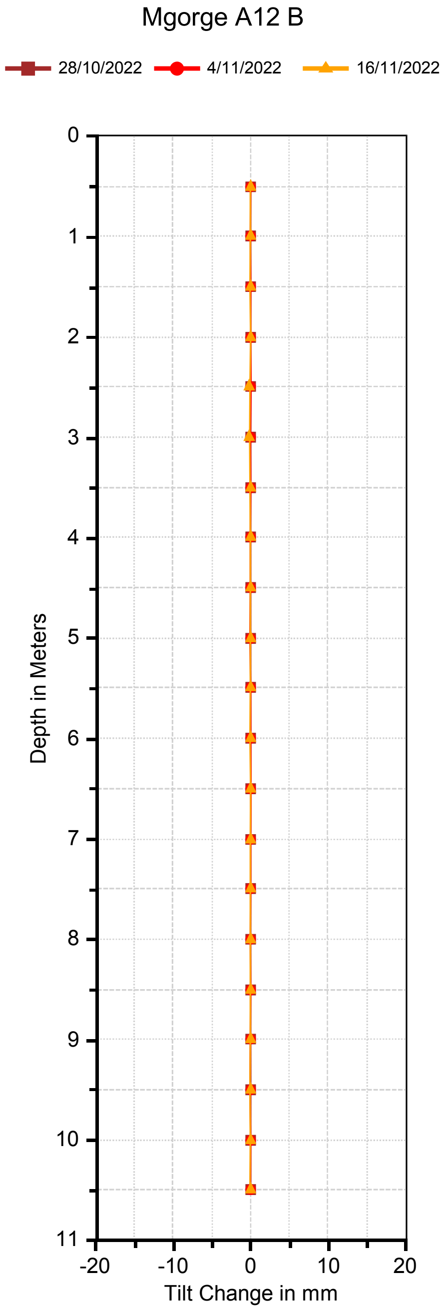
Whangarei Lab
166 Bank Street
Whangarei
Ph 09 438 4417





Whangarei Lab
166 Bank Street
Whangarei
Ph 09 438 4417





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ADDENDUM 1 – ASSESSMENT OF ENVIRONMENTAL EFFECTS -RESOURCE CONSENT PACKAGE 4A

ADDENDUM 1 – ASSESSMENT OF ENVIRONMENTAL EFFECTS -RESOURCE CONSENT PACKAGE 1B