

Before Kaipara District Council

In the Matter of the Resource Management Act 1991 (**RMA**)

And

In the Matter of an application for Private Plan Change 84 (**PC84**) by **MANGAWHAI HILLS LIMITED** to rezone 218.3 ha of land between Tara Road, Cove Road, Moir Road and Old Waipu Road, Mangawhai from Rural Zone to the Mangawhai Hills Development Area.

Evidence of Lee Buhagiar on behalf of Mangawhai Hills Limited

(Geotechnical Engineer)

Dated 29 April 2024

Jeremy Brabant
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Introduction

1. My full name is Lee Buhagiar. I am a principal geotechnical engineer at Tetra Tech Coffey NZ (Tetra Tech). I graduated with a Bachelor of Civil Engineering (first class honours) from the University of Auckland in 2000 and completed a post-graduate course in advanced geotechnical earthquake engineering at the University of Canterbury in 2017. I am a chartered professional geotechnical engineer, an international professional engineer (APEC), a high-risk producer statement author for Auckland Council, and I am on the Engineering New Zealand Natural Disaster Recovery Panel.
2. I have 16 years' experience as a geotechnical engineering consultant. I have worked for Tetra Tech for 13 years, 5 in Auckland and 8 years in Christchurch. In Christchurch I was a member of the Christchurch City Council Port Hills slope stability team and carried out life safety assessments on landslips across Canterbury, Hurunui, and Kaikoura. I am now the team leader for the emerging professional geotechnical team in the Auckland office, managing a team of 10 engineering geologists and geotechnical engineers. The Tetra Tech Auckland team of geotechnical engineers and engineering geologists have over 40 years' experience in land development subdivisions in Waitemata Group and Northern Allochthon geology. As an approved reviewer for Tetra Tech, I am responsible for technical review and authorisation of geotechnical investigations for resource consent, and specific design of landslide remediation and retaining walls. Most recently I have been working on EQC landslide assessments in Auckland and Northland, geotechnical assessments for solar farms across NZ, and geotechnical investigations for electrical substations and transmission lines across the north Island of NZ and in Papua New Guinea.
3. Tetra Tech was instructed by Mangawhai Hills Ltd in December 2022 to carry out a geotechnical desktop study report to support the proposed plan change application. Our desktop report included a geomorphological assessment, and a review of the Wiley Geotechnical report for the site. I am familiar with the area to which the application for resource consent

relates. I visited the site on 14 June 2022 and have more recently reviewed Mangawhai Hills' documents of observed slope stability in February 2023, and the 2020 Wiley Geotechnical report for the Causeway Church development, located at the eastern end of the site, Lot 1 DP 15117.

4. Although this is not a hearing before the Environment Court, I record that I have read and agree to and abide by the Environment Court's Code of Conduct for Expert Witnesses as specified in the Environment Court's Practice Note 2023. This evidence is within my area of expertise, except where I state that I rely upon the evidence of other expert witnesses as presented to this hearing. I have not omitted to consider any material facts known to me that might alter or detract from the opinions expressed.

Scope of Evidence

5. My evidence will address the following:
 - a. Summarise the key findings of the Tetra Tech geotechnical desktop study report.
 - b. Respond to the geotechnical components of the 12 April 2024 Section 42A Report. Namely: Geotechnical natural hazards e.g. liquefaction and land stability.
 - c. Respond to Submitters, relevant to my area of expertise.
 - d. Conclusions.

Geotechnical assessment

6. Tetra Tech prepared a geotechnical desktop study report in support of the plan change application, dated 16 December 2022. The scope of our geotechnical desktop study was a site walkover, geomorphological mapping, and a review of the Wiley Geotechnical report for the site. Our desktop study included 5 piezocone penetration tests (CPTs) east of the site, and 4 hand-augered boreholes (HAs) southwest of the site, retrieved from the NZ geotechnical database.

7. The Tetra Tech geotechnical desktop study concludes that there were no high risk geohazards at the site in areas where proposed building was planned, and the site was suitable for the proposed development, subject to detailed geotechnical investigations and analyses for resource consent, to enable selection of suitable building platforms, as per the PC84 provisions.

Response to s 42A Report

8. I have reviewed the s42A Report and the technical reports relevant to my area of expertise.
9. The s42A report summarises previous geotechnical reporting that has been carried out on the site, including the Wiley and Tetra Tech Reports. The s42A report raises issues with the scope of previous reporting and relies on a Council commissioned review of the Tetra Tech Report by the Council's geotechnical consultant, Mr Sands of Hawthorn Geddes.
10. Mr Sands identified a number of areas of the site that are potentially exposed to moderate to high slope instability and other low-lying areas that may be subject to settlement and/or liquefaction. The S42A Report notes Mr Sands conclusion that based on the areas of 'high geotechnical hazard risk (stability)', "it is likely that portions of the land designated as Proposed Residential Development on the Mangawhai Hills Structure Plan are not suitable for high-density development, and better align with lifestyle blocks sized lots at 1 to 2 hectares".
11. The S42A report relies on the revised mapping produced by Mr Sands, and the recommendation that "further geotechnical investigation is made to verify the suitability of the land to support the proposed density, or that alternatively the structure plan be revised". The s42A report recommends three options as being appropriate to address the geotechnical issues identified by Mr Sands, these being:
 - a. For the applicant to provide additional geotechnical information to enable the rezoning and associated Structure Plan to occur with confidence that those parts of the site currently identified by Mr

Sands as being potentially unsuitable for residential development are not exposed to significant geotechnical hazards.

- b. Confirm the plan change and structure plan as proposed and rely on the subdivision process to be informed by more detailed geotechnical investigations. The s42A report recommends that a matter of discretion relating to geotechnical or natural hazard matters is added to the subdivision rule.
 - c. That areas identified by Mr Sands as being potentially exposed to either high slope instability or moderate settlement/liquefaction risk are shown as being suitable for a lower density of housing i.e., 1 ha rural lifestyle blocks.
12. For reasons addressed in this evidence, I do not agree with the conclusions of Mr Sands, specifically the high-risk hazard map, which does not match his observed instability map. Nor is there any evidence in the site testing to suggest there is any risk from soft ground or liquefaction.
13. I commence by observing that my assessment of the geotechnical hazards at the site is similar to the 2019 Engeo Assessment referenced in the Section 42A report. My assessment is that the site is considered to have a low to moderate risk of slope instability, with the exception of two identified areas with a moderate to high risk of instability. These two areas are shown on the attached Site Hazard Plan, and I recommend that the Mangawhai Hills Structure plan is updated to reflect these areas with the inclusion of specific provisions to ensure that these areas avoid built development without specific geotechnical consideration. It should be noted that this does not mean these areas cannot be built on. Residential developments could be carried out in these areas, with sufficient engineering investigation and design.
14. The site has a low risk of liquefaction. The Tauranga Group soils are fine grained and non-liquefiable.
15. Geomorphology assessments and geological hazard mapping are one of the most important tools in a slope stability assessment. In this regard, in my

opinion the level of testing sought by the reporting planner and council's expert is not necessary to support a plan change, and the proposed development PC84 provisions and s106 of the RMA are appropriate to manage potential stability effects and ensure that geotechnically stable building designs are provided.

16. Notwithstanding my opinion above, further testing has been undertaken. My response to the geotechnical issues raised in the Section 42A report includes a review of additional deep geotechnical testing, 15 new piezocone penetration tests, and a review of the Causeway Church (Lot 1 DP15117) geotechnical report. I will also present an updated geomorphological study, which details Tetra Tech's observed instability on the site. The Geotechnical Investigation Site Plan, new CPT results and updated geomorphological maps are attached to this evidence.
17. The Causeway Church report review enables further consideration of the 60Ha area not yet directly investigated because it is not owned by Mangawhai Hills Ltd (so intrusive ground investigations have not been carried out). Based on this review the additional 60Ha of land is considered suitable for the proposed development.
18. My response will also address the questions raised in Council's geotechnical review by Mr Sands, these being:
 - a. What geohazards are present at the property, and how do these limit development in the Proposed Residential Areas.
 - b. Identify on plan the locality of any active and historic, large-scale, and small-scale slope instability.
 - c. Address global stability, and the effects of future, high-density largescale residential development.
 - d. Are there areas over the property that are not suitable for significant modification due to stability risk and are better suited to a larger lot size.
 - e. What, if any setbacks are likely to be put in place from active slope movement and steeper slopes, and what restrictions does this apply to the net developable area.
 - f. What slopes (angles) are suitable for residential development.

- g. What restrictions are appropriate on earthworks.
- h. What restrictions are there on stormwater management, and how does this relate to slope instability.
- i. What areas, if any are underlain by soft soils and prone to consolidation settlement, and how does this potentially limit residential development in the Proposed Residential Areas.
- j. What areas, if any are prone to liquefaction and lateral spreading, and how do these hazards potentially limit future residential development in the Proposed Residential Areas.

Response to Council geotechnical questions

19. On 8 April 2024, the applicant was provided with a copy of the council geotechnical review of PC84, which as above recommended that the applicant undertake further engineering assessment to support the plan change application and address several queries. I respond to these points below.
20. To limit repetition, I emphasise that PC84 provisions will ensure that geotechnically suitable building platforms will be required to be demonstrated following detailed geotechnical investigation at the time of subdivision. Further assessment of these areas will be carried out at the resource consent stage, after detailed geotechnical investigation and analyses. For ease of reference I refer to these requirements as “Detailed Assessment”.

What geohazards are present at the property, and how do these limit development in the Proposed Residential Areas.

21. Geohazards present on the property are as detailed in the Wiley geotechnical report, being expansive soils and slope stability.
22. Unlike the neighbouring Northern Allochthon geology, the site’s Pakiri Formation (Waitemata Group) geology is known to be relatively stable, similar to the East Coast Bays Formation (ECBF). The main difference

between ECBF and Pakiri Formation is the volcanic content. Pakiri Formation rock can be stronger due to cementation of volcanoclastic material and can be more expansive due to the volcanic minerals smectite and allophane.

23. Expansive soils will be addressed by ensuring a minimum foundation depth at detailed design stage. This is common practice in Auckland.
24. Observed slope stability on the site comprises soil creep and historic instability, as shown in the attached Site Geomorphology Plan. Soil creep is not considered to be a high-risk hazard and can be addressed in a similar manner to expansive soils. Observed historic deep seated slope instability on the site is attributed to historic movement of nearby inactive fault zones. Slope stability is not considered to be a high risk to the proposed development and will be addressed in the resource and building consent stages.
25. Two steep and potentially unstable areas have been identified as having a moderate to high risk of slope instability. These areas are recommended to be mapped as no build areas on the Mangawhai Hills Structure Plan with updates to the Mangawhai Hills Development Area provisions to ensure that these areas are not built on and instead, rehabilitated. Subject to these recommendations, I consider that the plan change area is suitable for the proposed rezoning.

Identify on plan the locality of any active and historic, large-scale, and small-scale slope instability.

26. I have attached a plan showing areas of observed slope instability. I have identified two areas of steep terrain which could be considered as having a moderate to high risk of shallow slope instability, and these areas will be further refined at the resource consent stage, after detailed geotechnical investigation and analyses. Building setbacks will be applied as required through the requirement to demonstrate a geotechnically stable building platform at time of subdivision.

27. I note the site was subject to a significant rainfall event in February 2023. I understand the 24 February 2023 rainfall event dropped 400mm of rainfall in 24 hours, with most of this in a 6–9-hour period. This is understood to be in excess of a 100-year event. Despite the significance of this event only minor areas of slippage were observed by Mangawhai Hills, as attached.

Address global stability, and the effects of future, high-density largescale residential development.

28. I would not characterise the proposed development on the Site as high-density, large-scale residential development. The proposed plan change will enable low impact development, with low density, 1-2 story dwellings at a maximum density of 1 dwelling per 1000m².
29. The proposed PC84 provisions requiring Detailed Assessment will ensure that geotechnically suitable building platforms will be demonstrated at the time of subdivision.
30. In my opinion based on the assessments I have undertaken, the risk of global slope instability on the site is low. Slope stability will be considered in detail at the resource consent stage, through detailed assessment. My site walkover and geomorphological mapping did not identify any recent deep-seated global stability and it is considered unlikely in the Pakiri Formation soils. Historic observed global instability is attributed to historic movement of the nearby inactive faults.

Are there areas over the property that are not suitable for significant modification due to stability risk and are better suited to a larger lot size.

31. There are some areas on the site that would likely require significant modification to provide stable building platforms. These areas are located on southern slopes which from both an urban design perspective (refer to urban design evidence) and geotechnical perspective are recommended to be mapped as no build areas.
32. For remaining areas that are identified as 'residential' areas, PC84 provisions will require Detailed Assessment. For these reasons I consider

that there is sufficient provision in place to not require a larger minimum lot size to be applied across the plan change area, which would be an unnecessarily crude method to adopt.

What, if any setbacks are likely to be put in place from active slope movement and steeper slopes, and what restrictions does this apply to the net developable area.

33. Applying blanket setbacks is not an appropriate response. As referred to above, Detailed Assessment will be required by PC84 provisions, and I am of the opinion that this will ensure that geotechnically suitable building platforms are demonstrated. Further, I recommend that the areas mapped as having a moderate to high risk of slope instability are included in the structure plan with appropriate associated provisions.

What slopes (angles) are suitable for residential development.

34. In my experience, slopes less than 15° are suitable for residential development. Where slopes are greater than 15°, these can have a higher susceptibility to soil creep and shallow movement and require detailed geotechnical design.
35. PC84 includes provisions that require Detailed Assessment. I consider that these provisions along with s106 of the RMA are robust enough, to ensure that development on areas greater than 15 degrees in slope can be appropriately mitigated from a geotechnical perspective, if required.

What restrictions are appropriate on earthworks.

36. No earthworks are proposed as part of the plan change application.
37. PC84 provisions limit earthworks to 100m³ per 1000m² of lot size. All earthworks should be carried out in accordance with the recommendations and specifications in the geotechnical reports prepared for resource consent. Suitable provisions are in place as part of PC84 to adequately manage earthworks.

What restrictions are there on stormwater management, and how does this relate to slope instability.

38. I have reviewed the PC84 provisions for stormwater management, which specify all stormwater disposal to be in accordance with Kaipara District Council Standards 2011. Given this requirement, I am confident there will be no adverse effects to slope stability.

What areas, if any are underlain by soft soils and prone to consolidation settlement, and how does this potentially limit residential development in the Proposed Residential Areas.

39. 15 additional piezocone penetration tests (CPTs) have been carried out on the site, see attached results. The results are presented with a second set, with a cone resistance scale reduced to 10MPa to show the strength of residual and alluvial clay soils.
40. Clay soils with a cone resistance of 0.5MPa to 1MPa are designated firm, while clay with a cone resistance greater than 1MPa is considered stiff. Based on all testing results reviewed to date, soils on the site are firm to stiff. No significant soft soils have been encountered. Consolidation settlement is dependent on building loads and is considered to be low risk for the proposed development. The site is considered suitable for the proposed zoning sought by PC84.

What areas, if any are prone to liquefaction and lateral spreading, and how do these hazards potentially limit future residential development in the Proposed Residential Areas.

41. Based on a review of all investigation data, the Tauranga Group soils are fine grained, which are not liquefiable. The site has a low liquefaction risk and is suitable for the proposed development.

Response to Submitters

42. I have read the submission that is relevant to my area of expertise, and I briefly address the following key points raised in the submissions.

43. Submission point 41.1 notes the presence of steep terrain, waterways and wetlands and their primary concerns are regarding earthworks and the potential destabilisation of land, particularly along Tara Road.
44. The body of this evidence addressed matters raised with regards to land instability hazards. Subject to the inclusion of recommended changes to provisions, I remain of the review that the site is suitable for the proposed plan change.

Conclusions

45. As per the Wiley Geotechnical and Tetra Tech Coffey plan change reports, the site is considered suitable for the proposed development.
46. While the Wiley report was for a smaller development area, the principles are the same, and the Tetra Tech Coffey report reviewed this with the new development in mind.
47. The plan change includes provisions which seek that future development is low impact, with 'large lot' low density housing and includes large portions of the development area that will be left as no build areas and conservation areas. These areas will include steep land and areas with ecological value.
48. Subdivision earthworks will be relatively minimal, with the main works comprising the access roads and provisions are in place to adequately manage earthworks. Each lot will have a maximum allowable volume of earthworks and a designated building platform with building setbacks as required based on the detailed geotechnical assessments that will be carried out at resource consent stage.
49. I disagree with the HG assessment of high risk of slope instability. The site is predominantly stable Waitemata Group soils (Pakiri Formation) and while areas of soil creep and instability have been observed, these do not pose an unmanageable risk for the proposed development.
50. My response to the geotechnical issues raised in the Section 42A report includes a review of additional deep geotechnical testing, 15 new piezocone

penetration tests, and a review of the Causeway Church (Lot 1 DP15117) geotechnical report. This additional work supports my original assessment.

51. I have reviewed the recommended provisions set out in the planning evidence and consider that these will appropriately address potential hazard effects within the areas identified as 'moderate to high-risk instability'.

Lee Buhagiar
BE(Hons) CPEng IntPE(NZ)

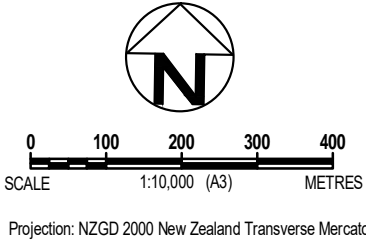
Dated 29 April 2024

Attachments:

- Geotechnical Investigation Site Plan
- 2024 CPT results
- Site Geomorphology
- Site Hazard Map
- February 2023 landslides



revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	RZ	LB	24.04.24



drawn	RZ
approved	LB
date	24.04.2024
scale	AS SHOWN
original size	A3

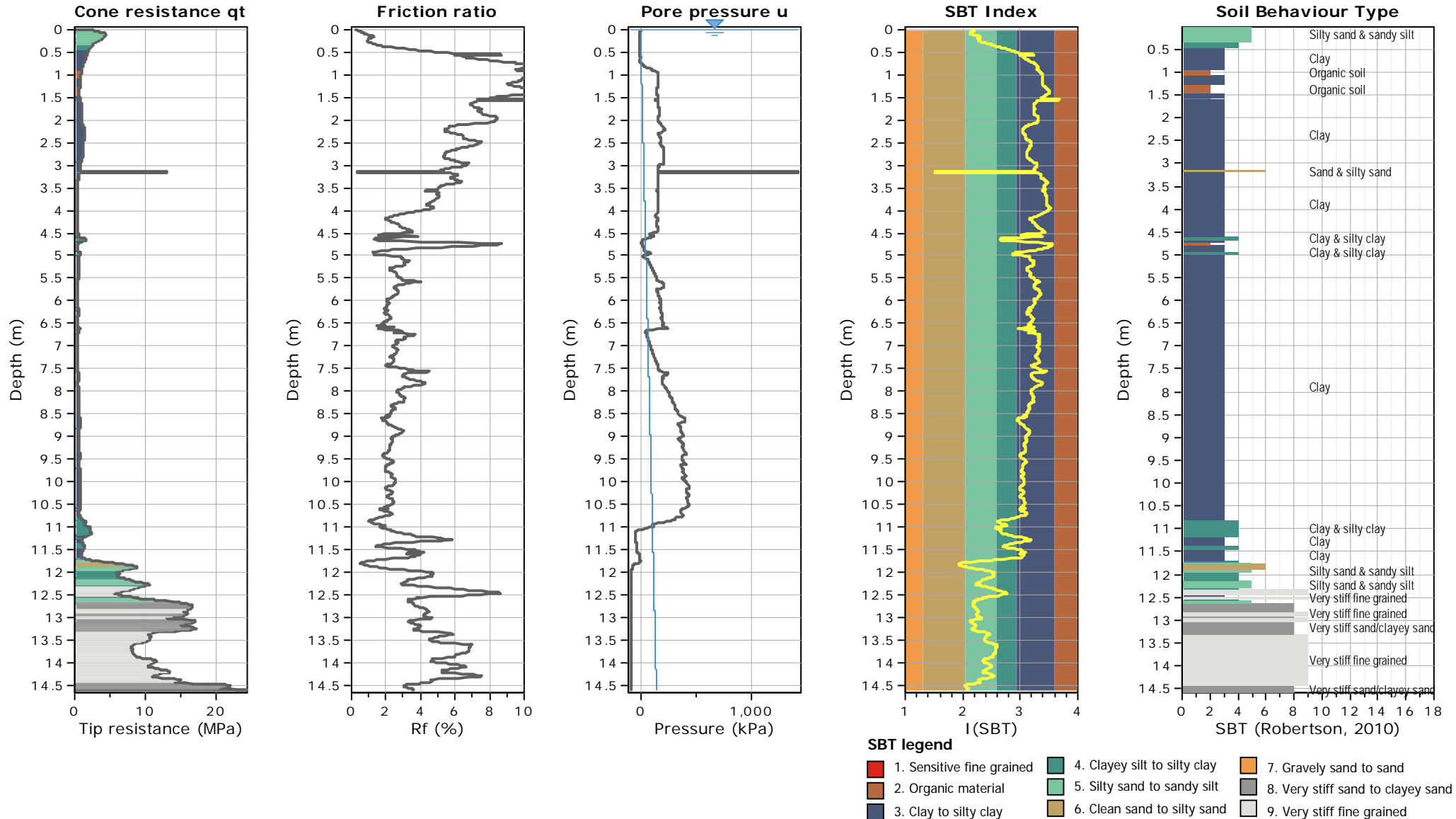


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project:	MANGAWHAI HILLS, TARA RD, MANGAWHAI		
title:	GEOTECHNICAL INVESTIGATION SITE PLAN		
project no:	773-AKLGE305593	figure no:	01
rev:	A		



Project: Mangawhai Hills Plan Change

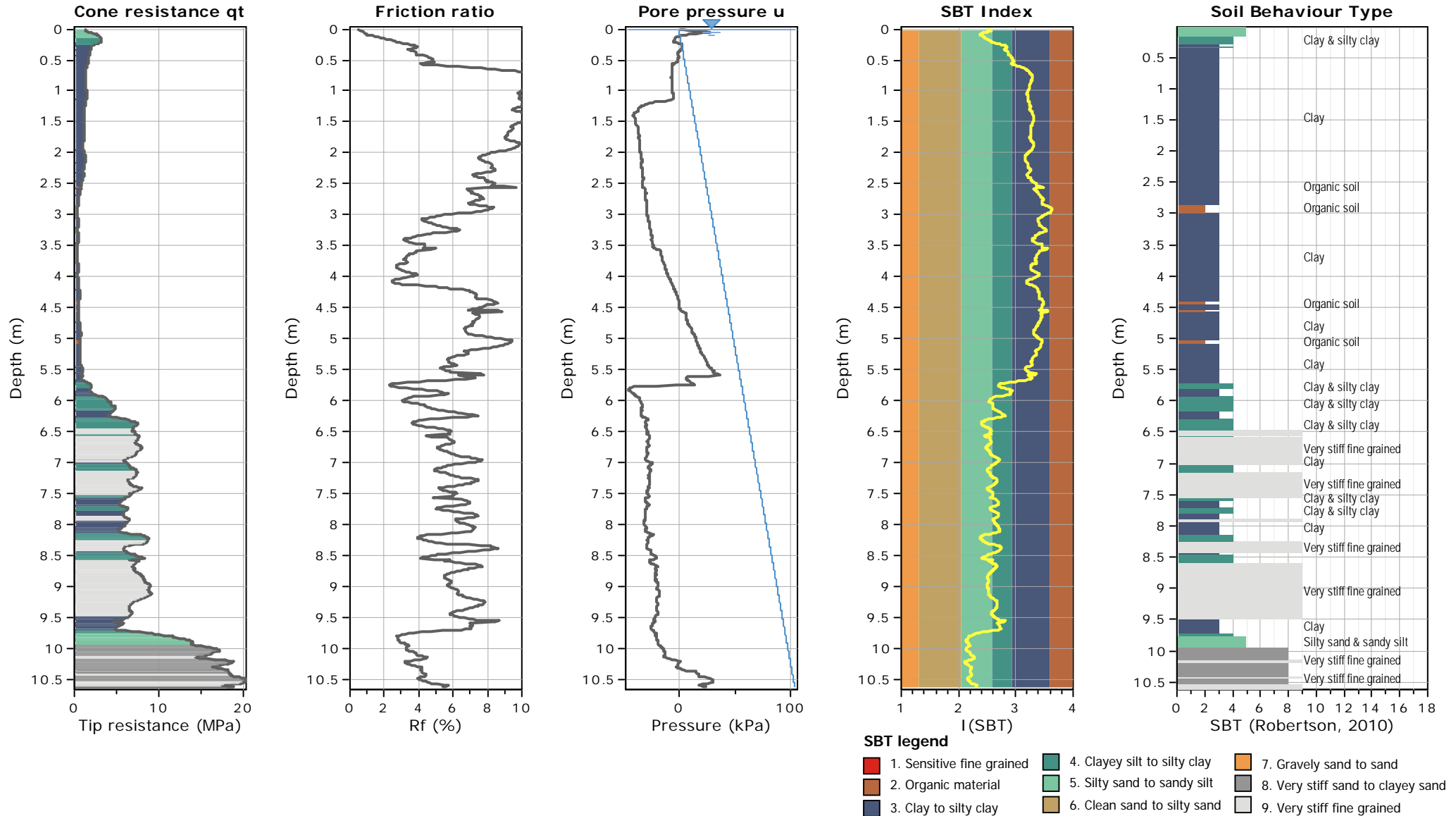
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Project: Mangawhai Hills Plan Change

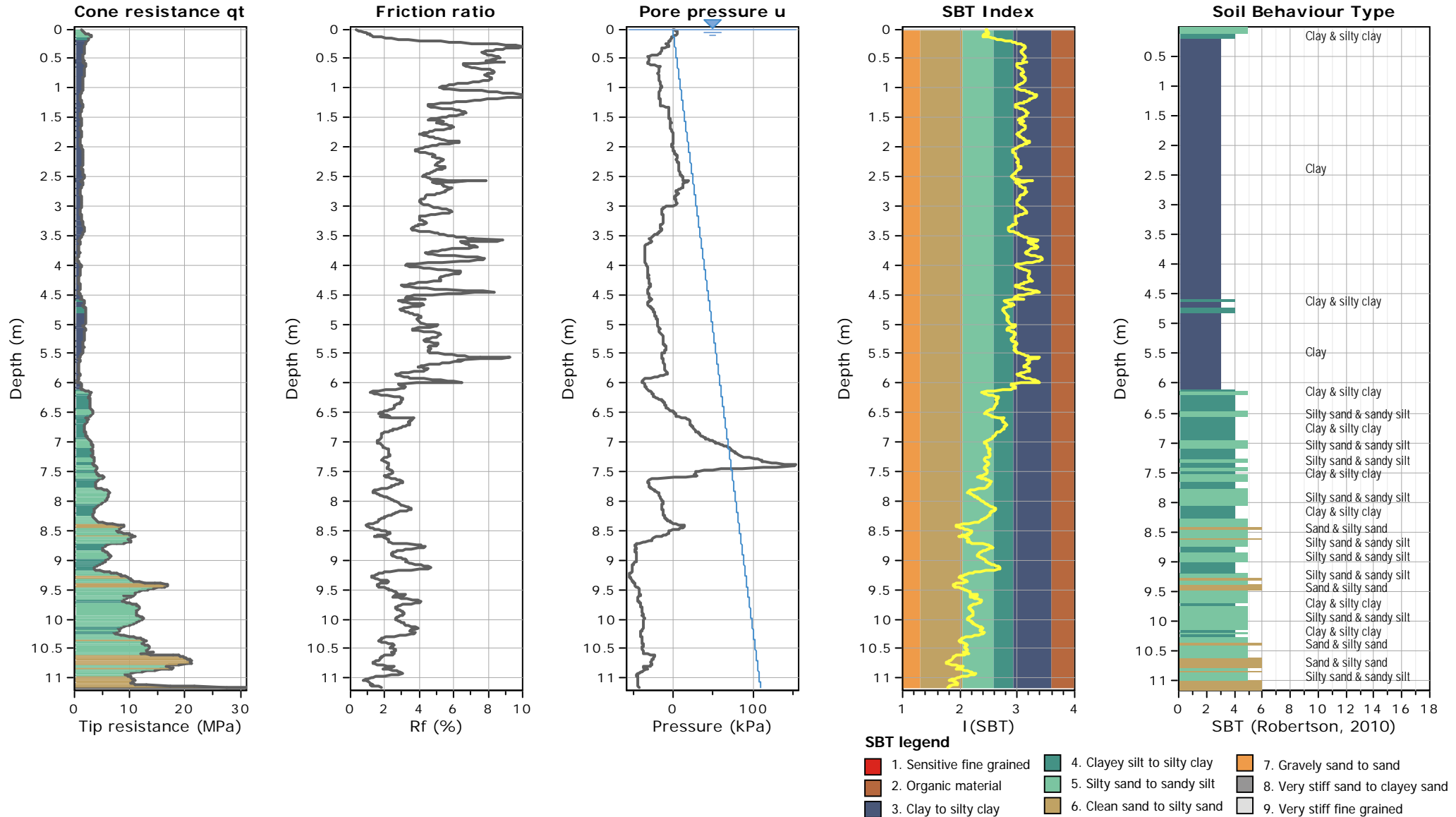
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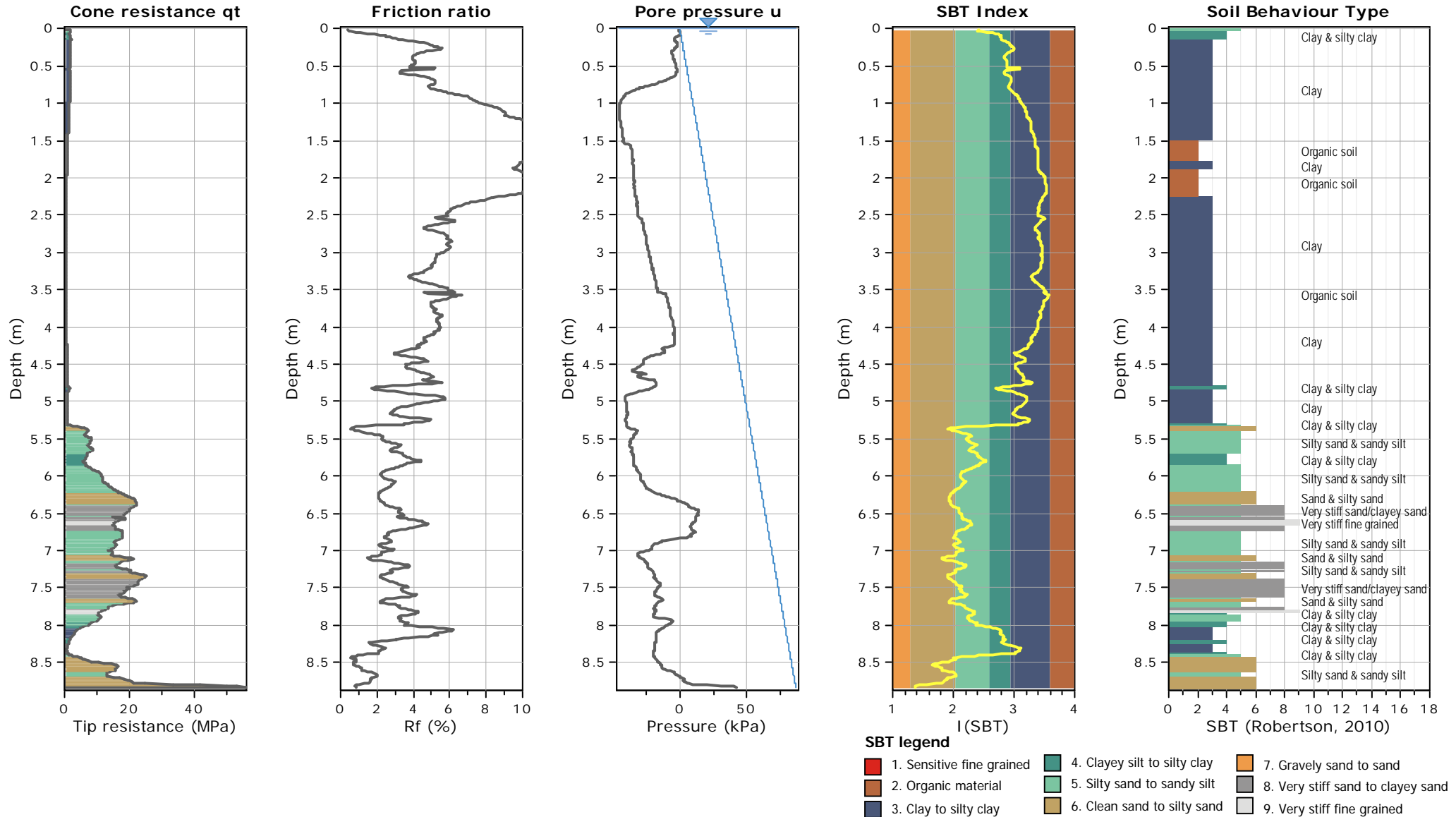
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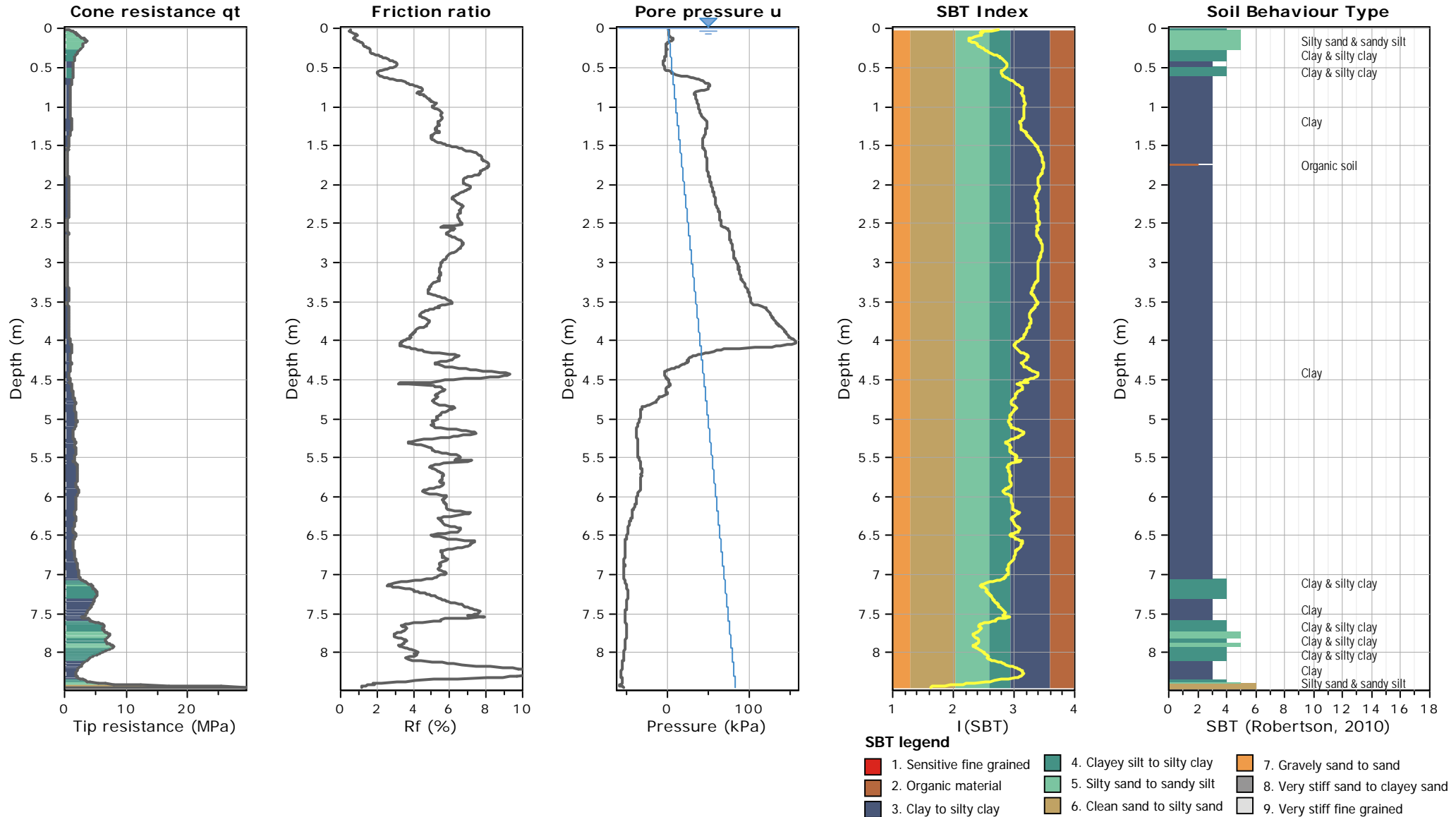
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Project: Mangawhai Hills Plan Change

Location: Mangawhai





TETRA TECH
COFFEY

Tetra Tech Coffey NZ
Level 4, 25 Teed Street
Newmarket
www.tetrattechcoffey.com

CPT: CPT06

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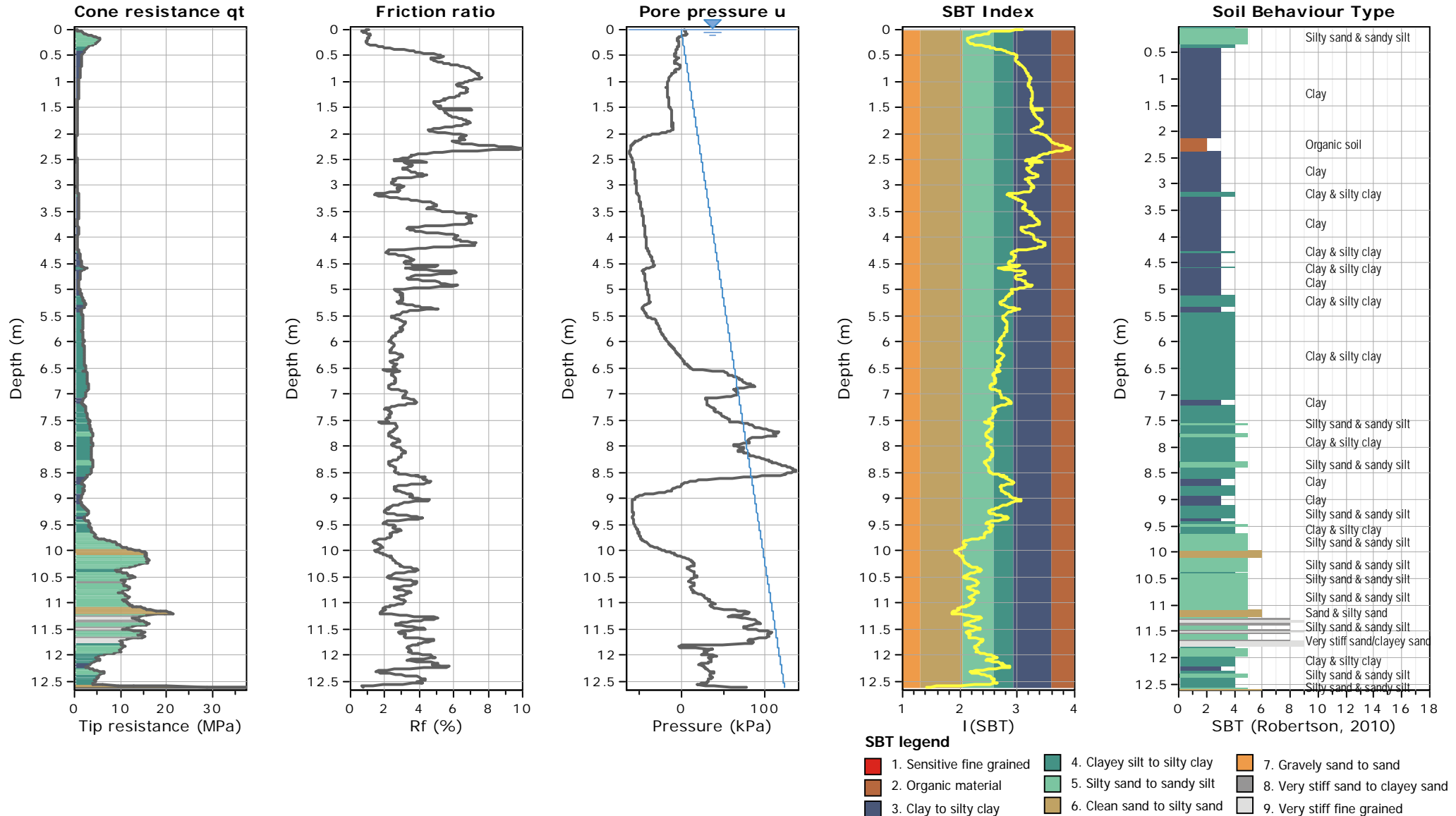
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Cone Operator:

Project: Mangawhai Hills Plan Change

Location: Mangawhai





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Tetra Tech Coffey NZ
Level 4, 25 Teed Street
Newmarket
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CPT: CPT07

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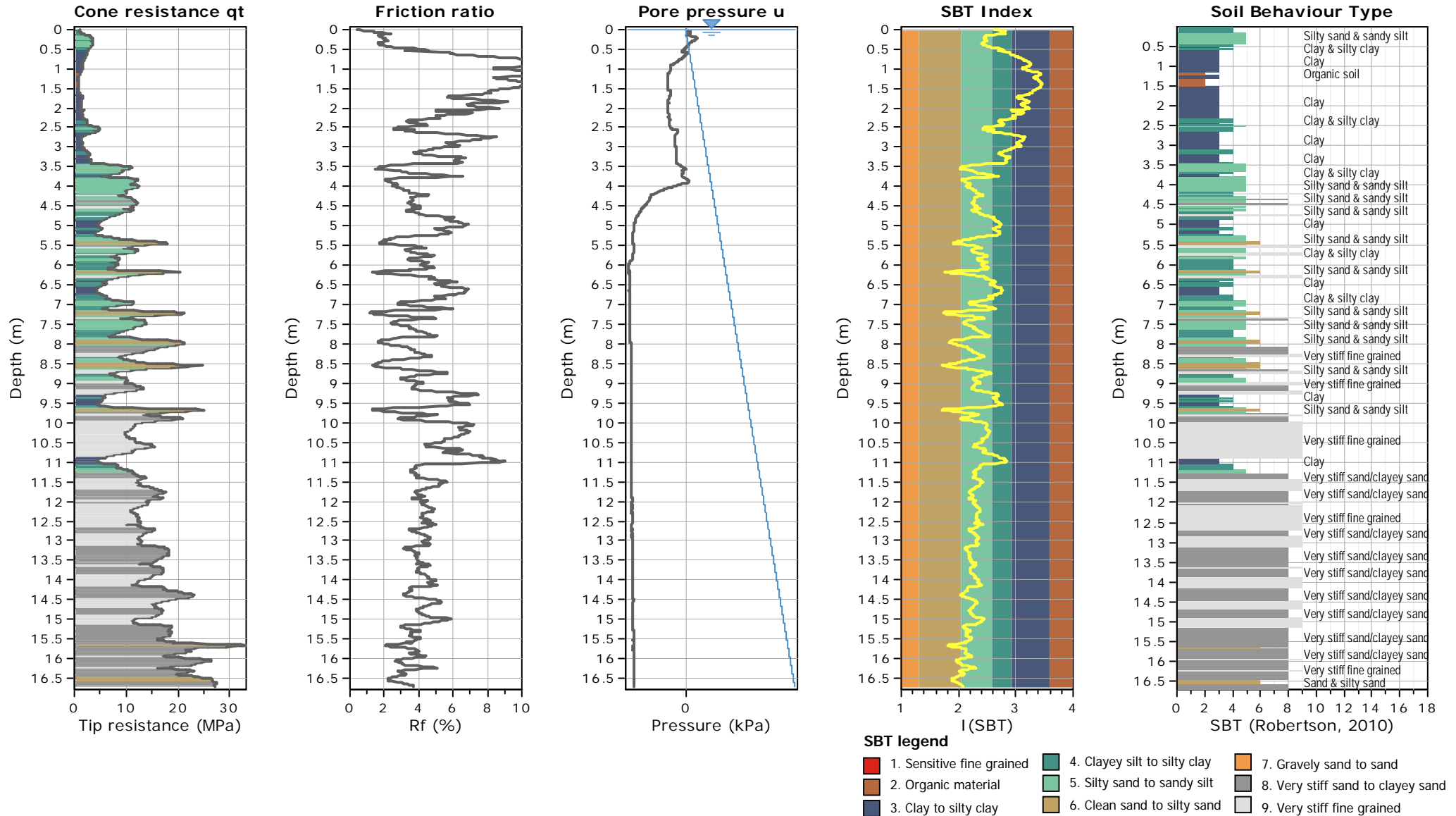
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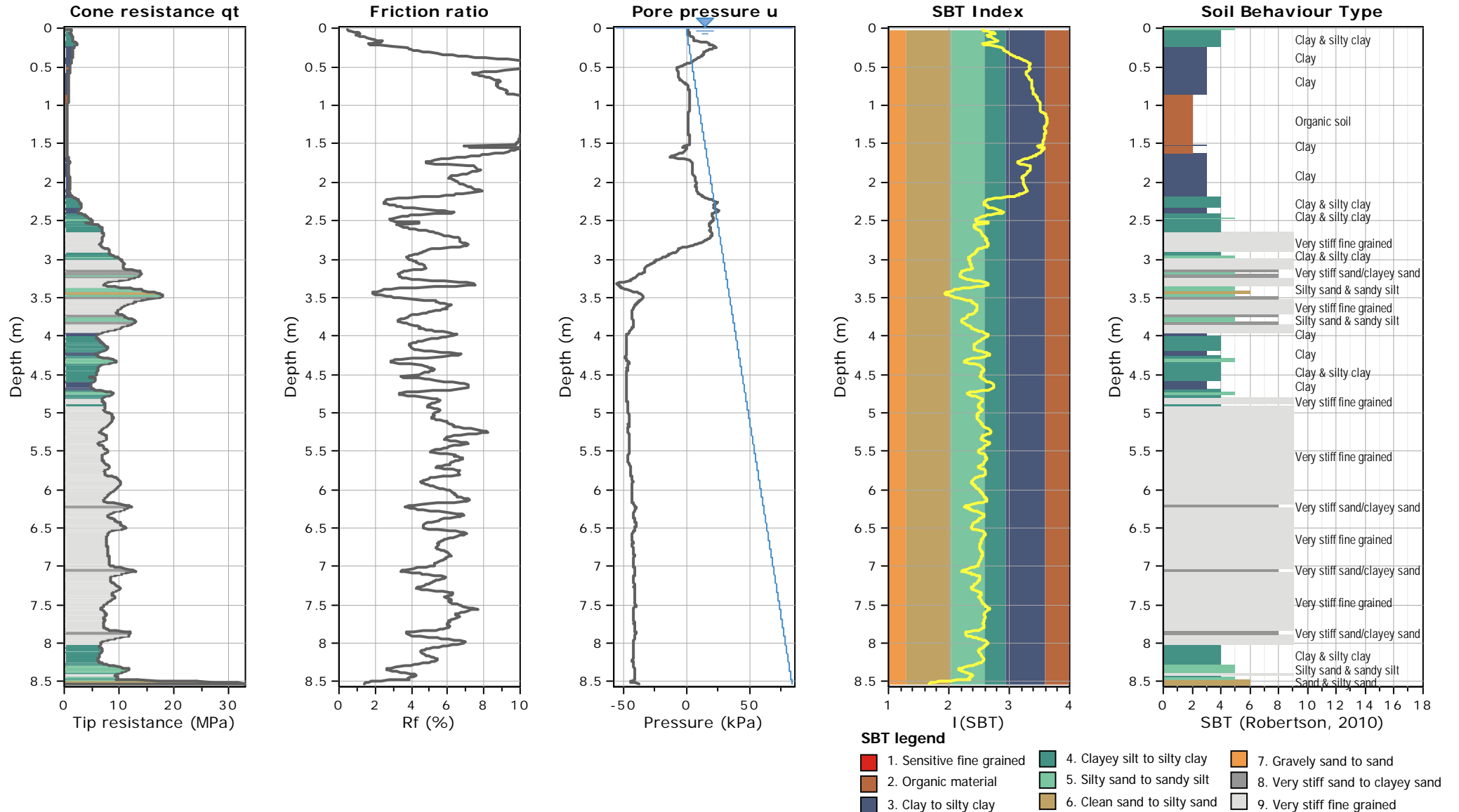
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Location: Mangawhai

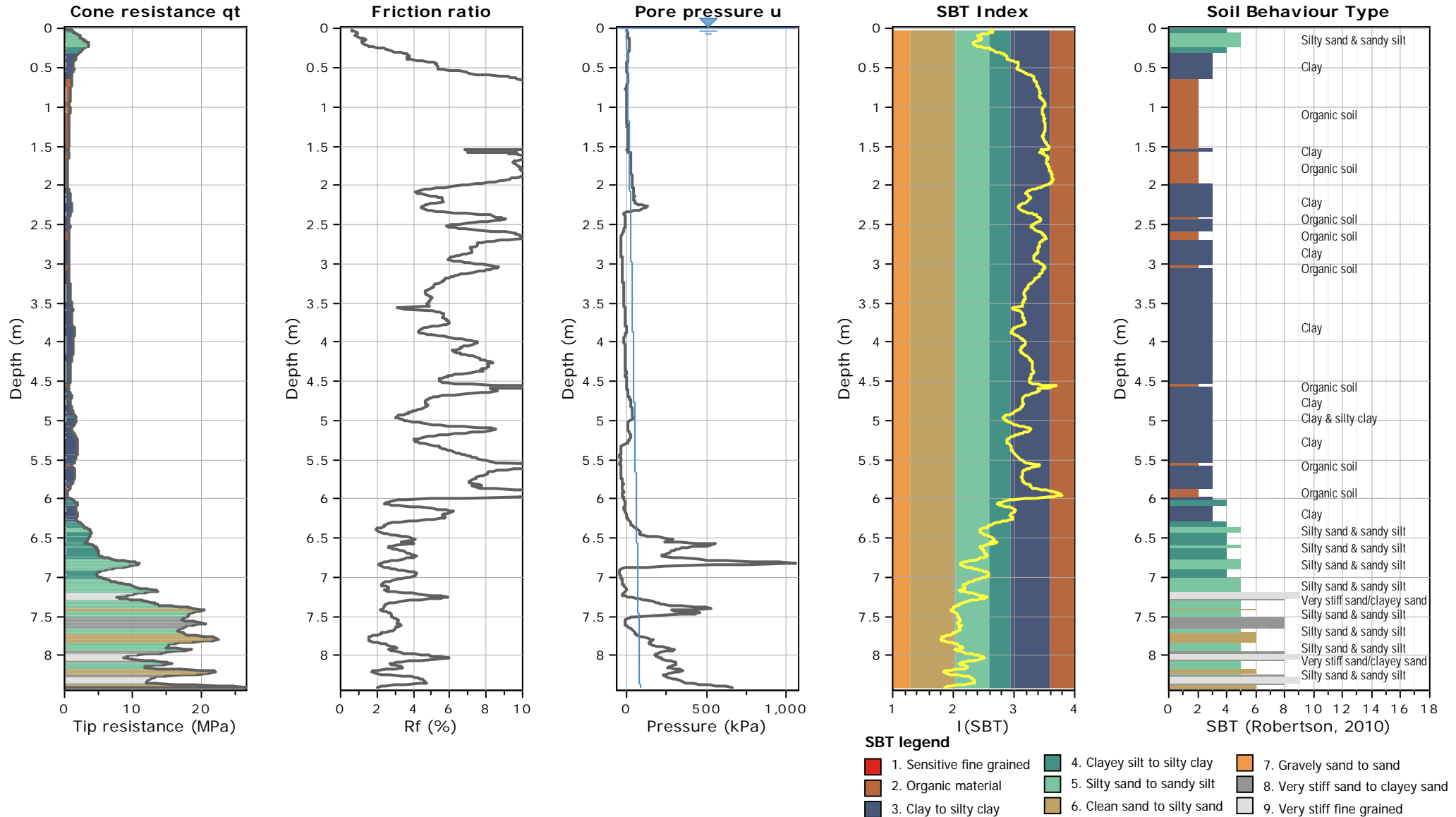






Project: Mangawhai Hills Plan Change

Location: Mangawhai





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Tetra Tech Coffey NZ
Level 4, 25 Teed Street
Newmarket
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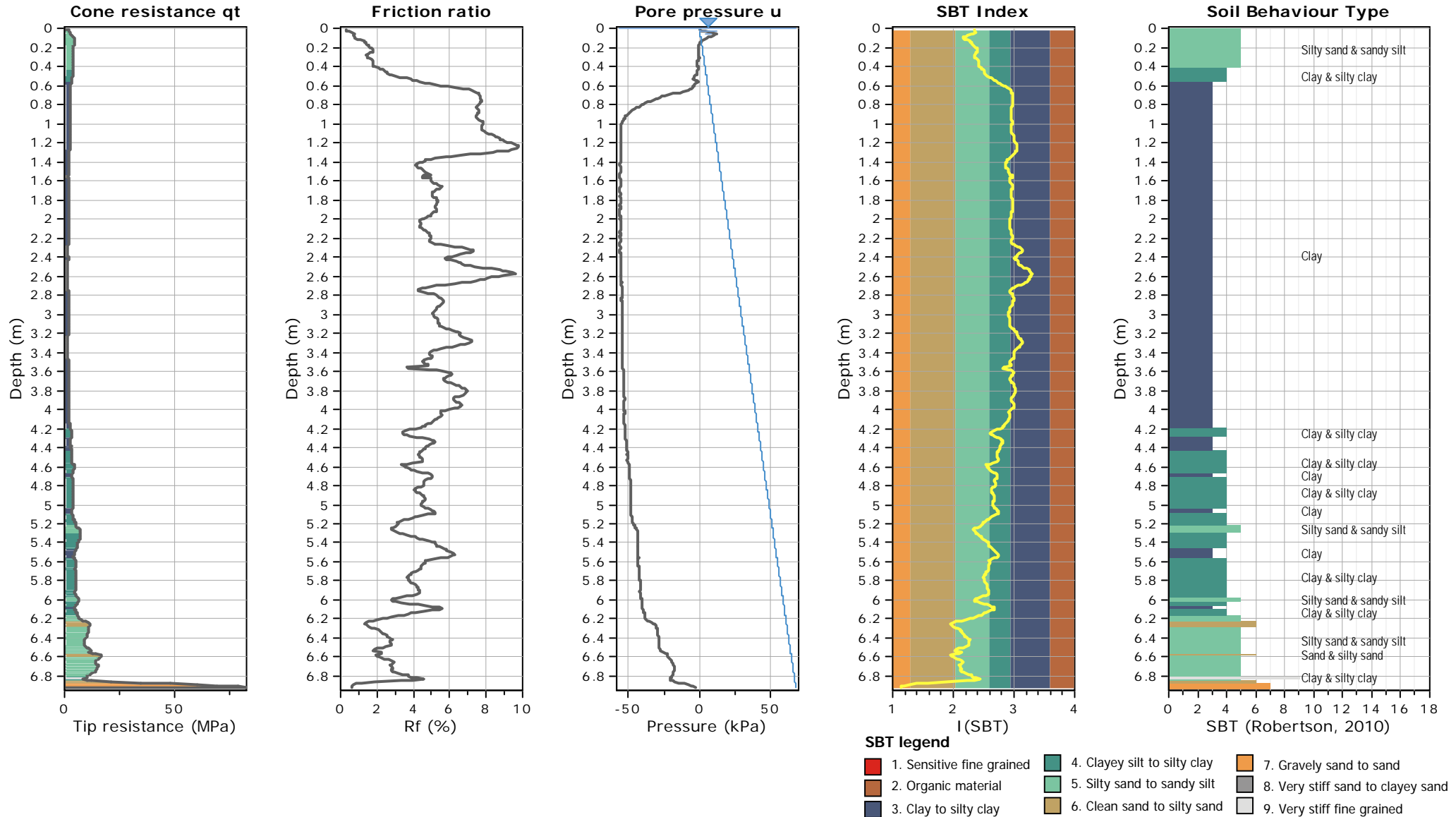
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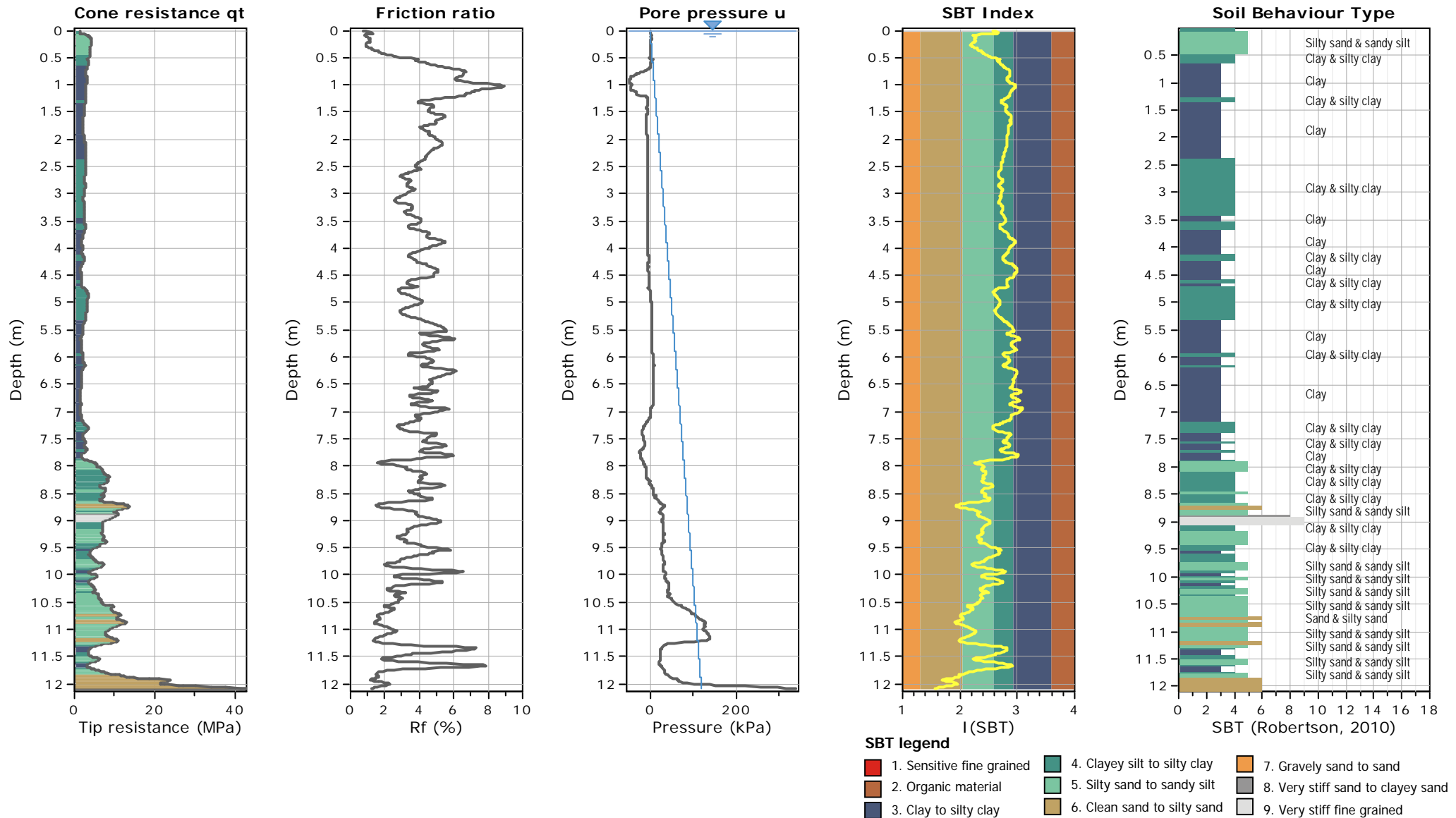
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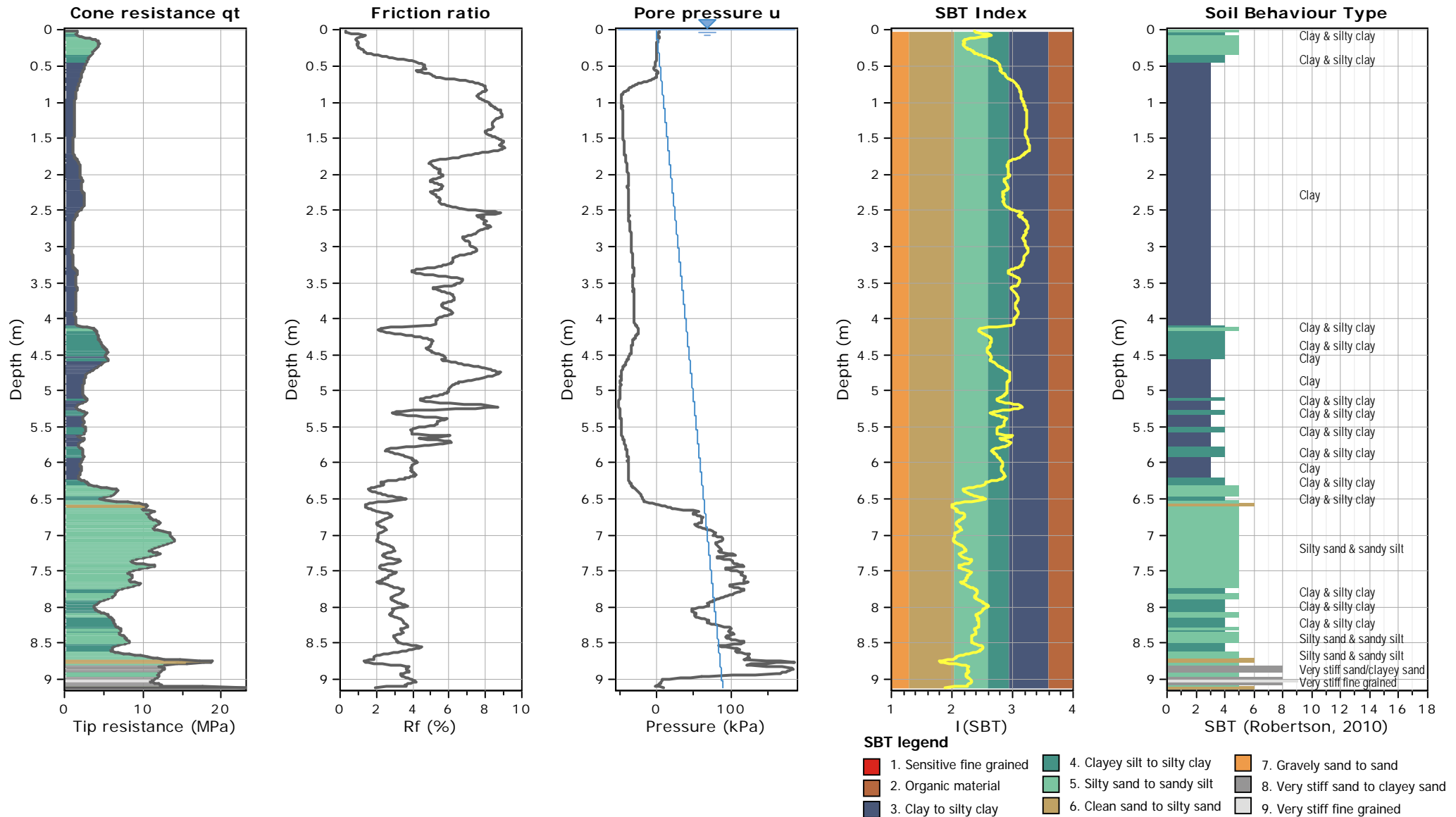
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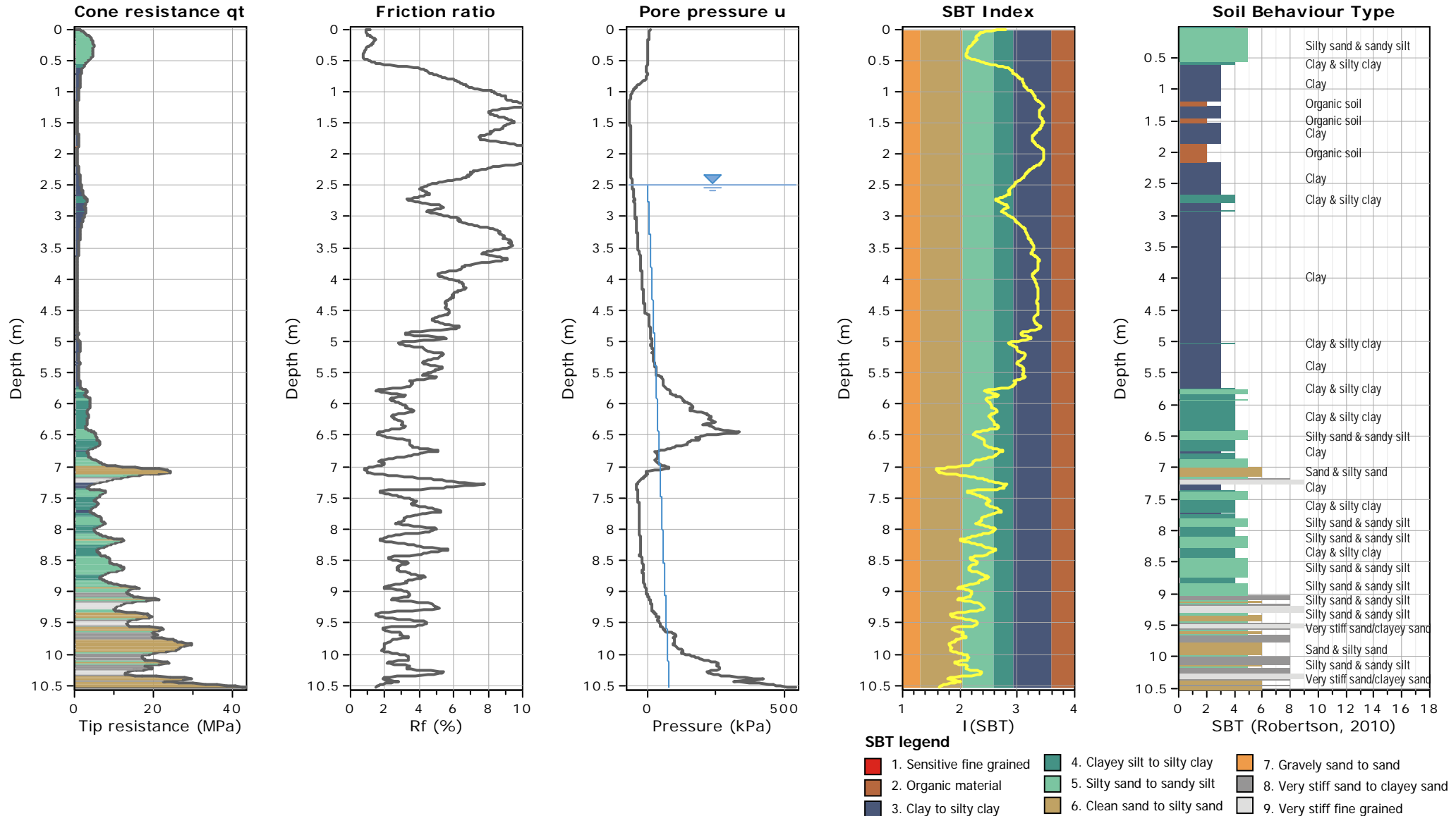
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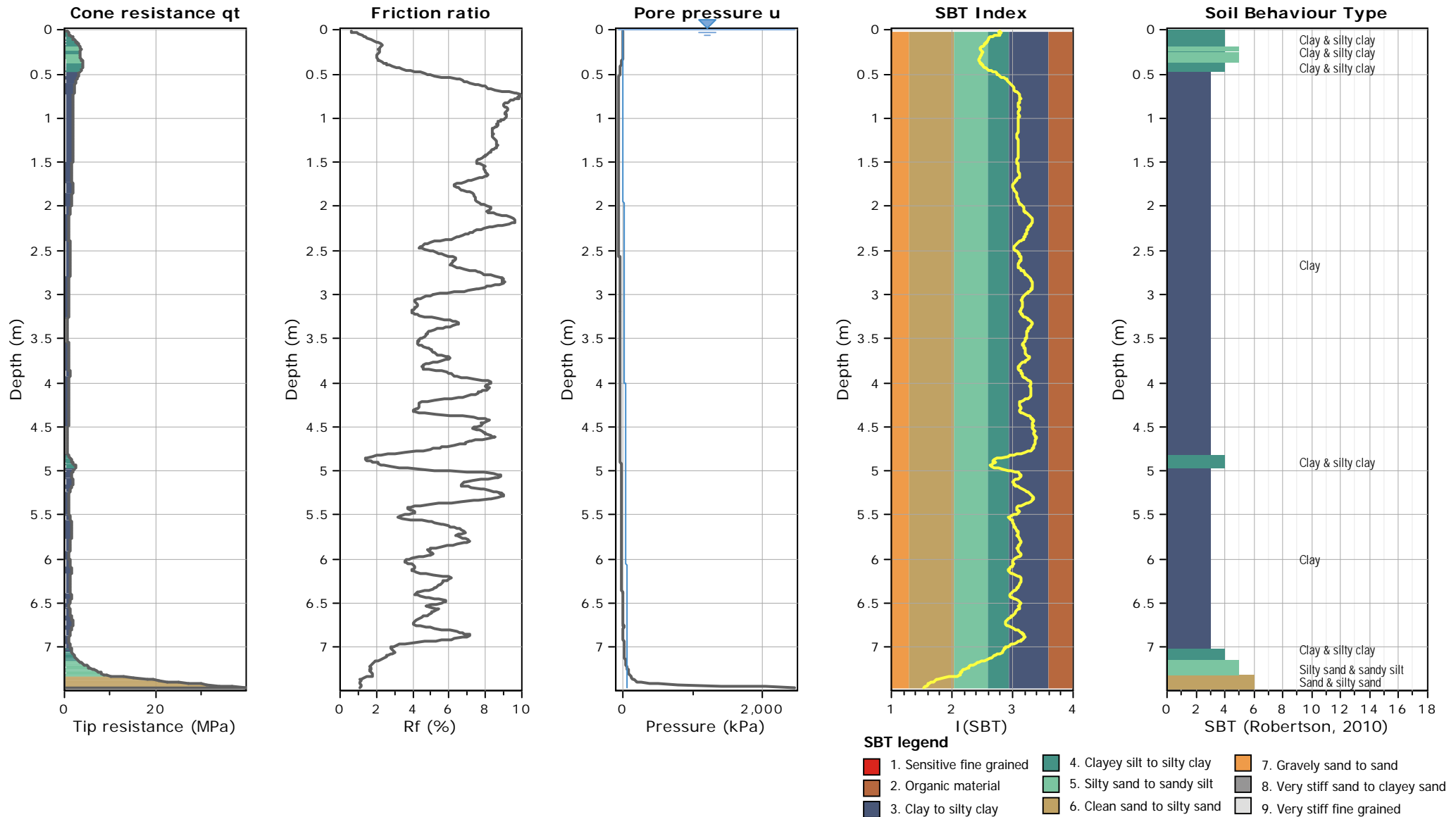
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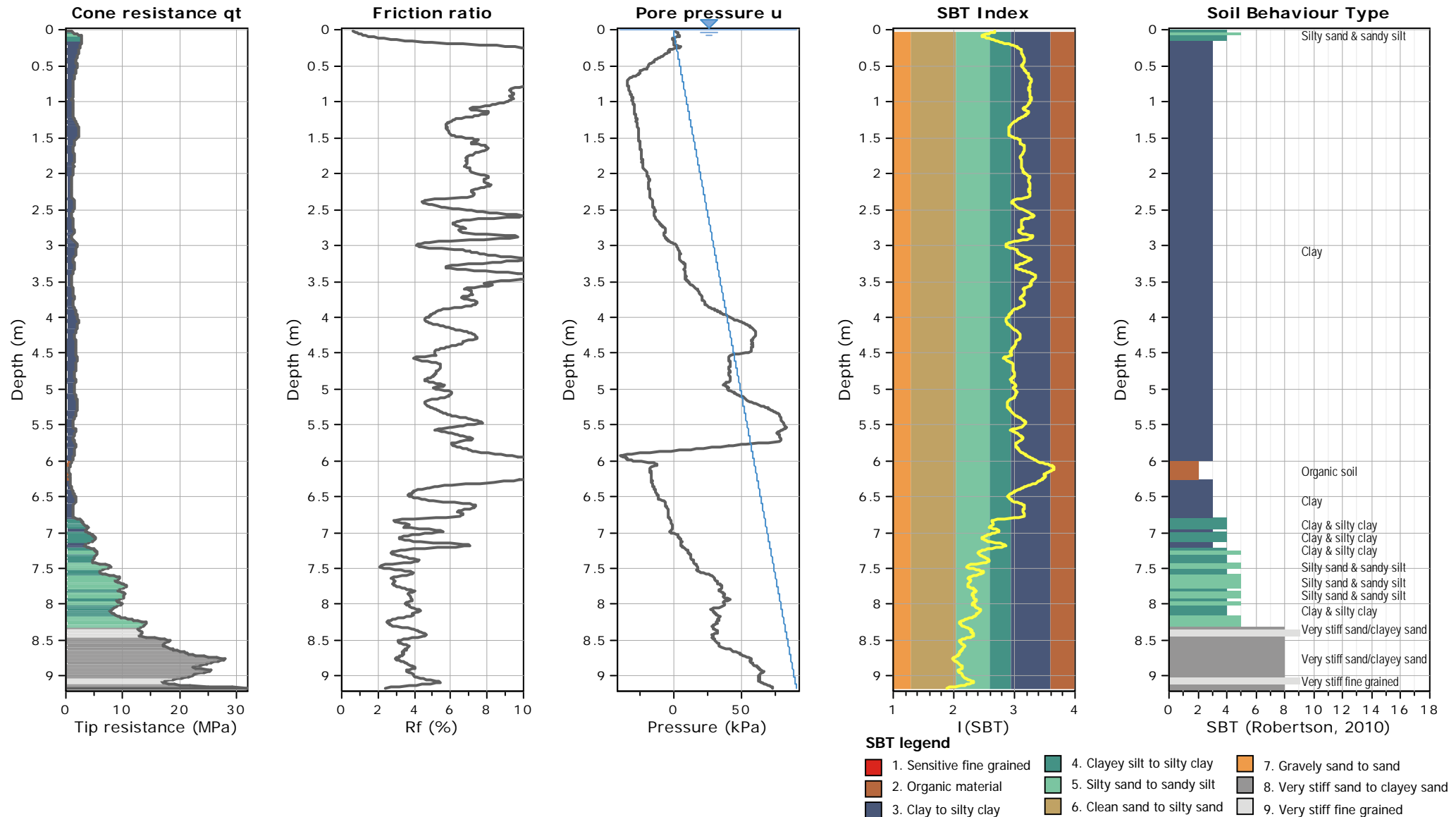
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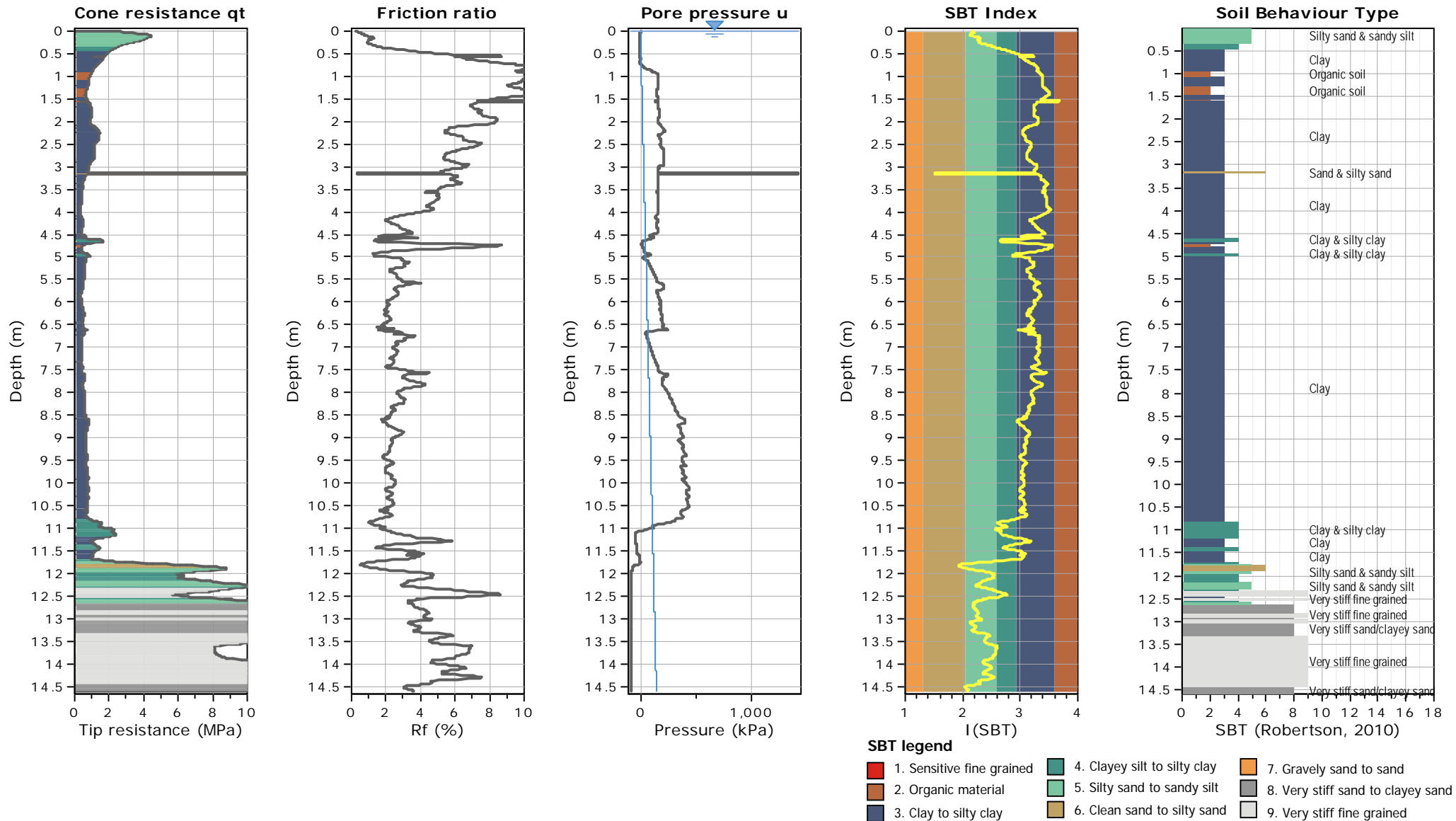
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Project: Mangawhai Hills Plan Change

Location: Mangawhai





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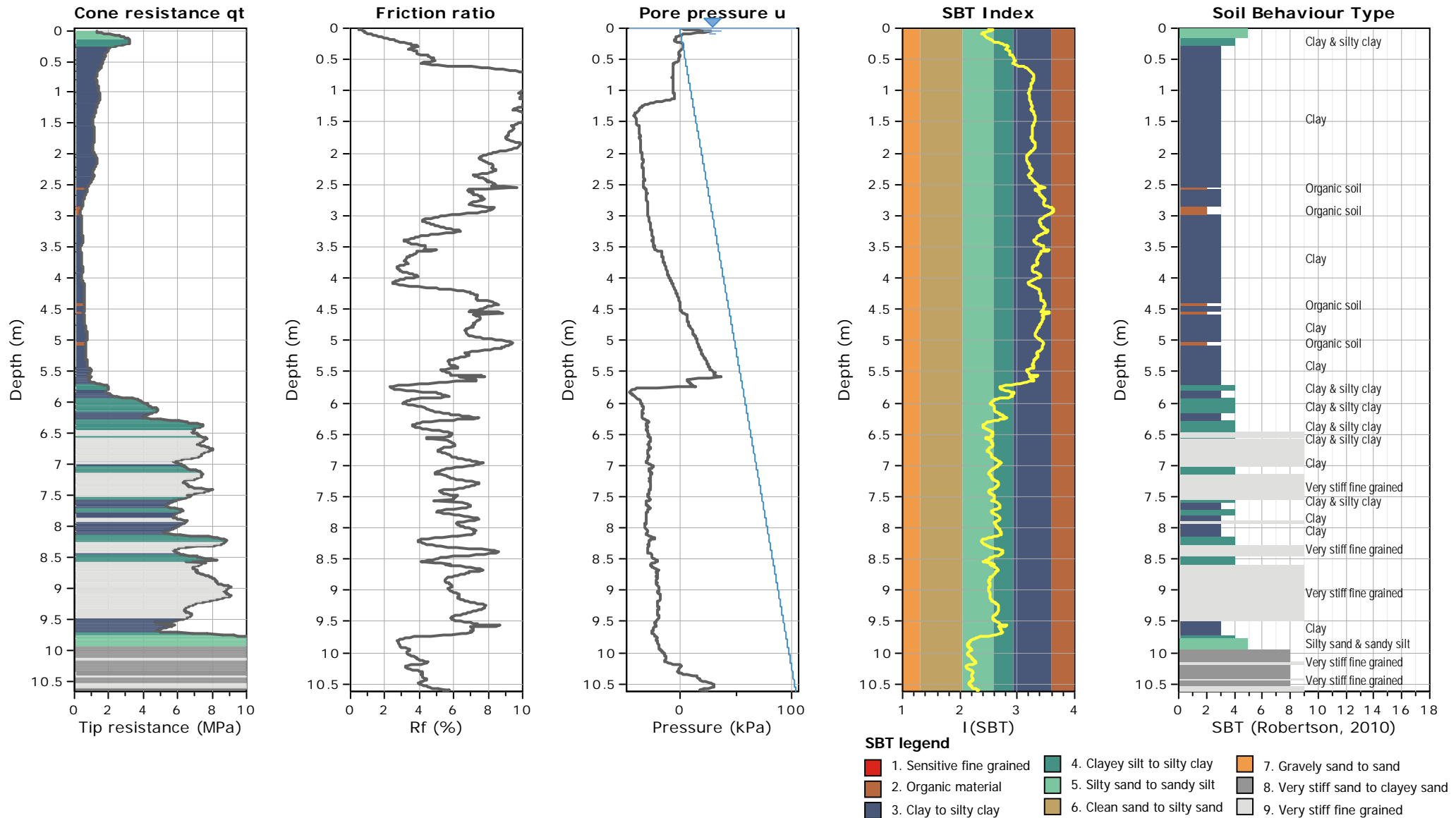
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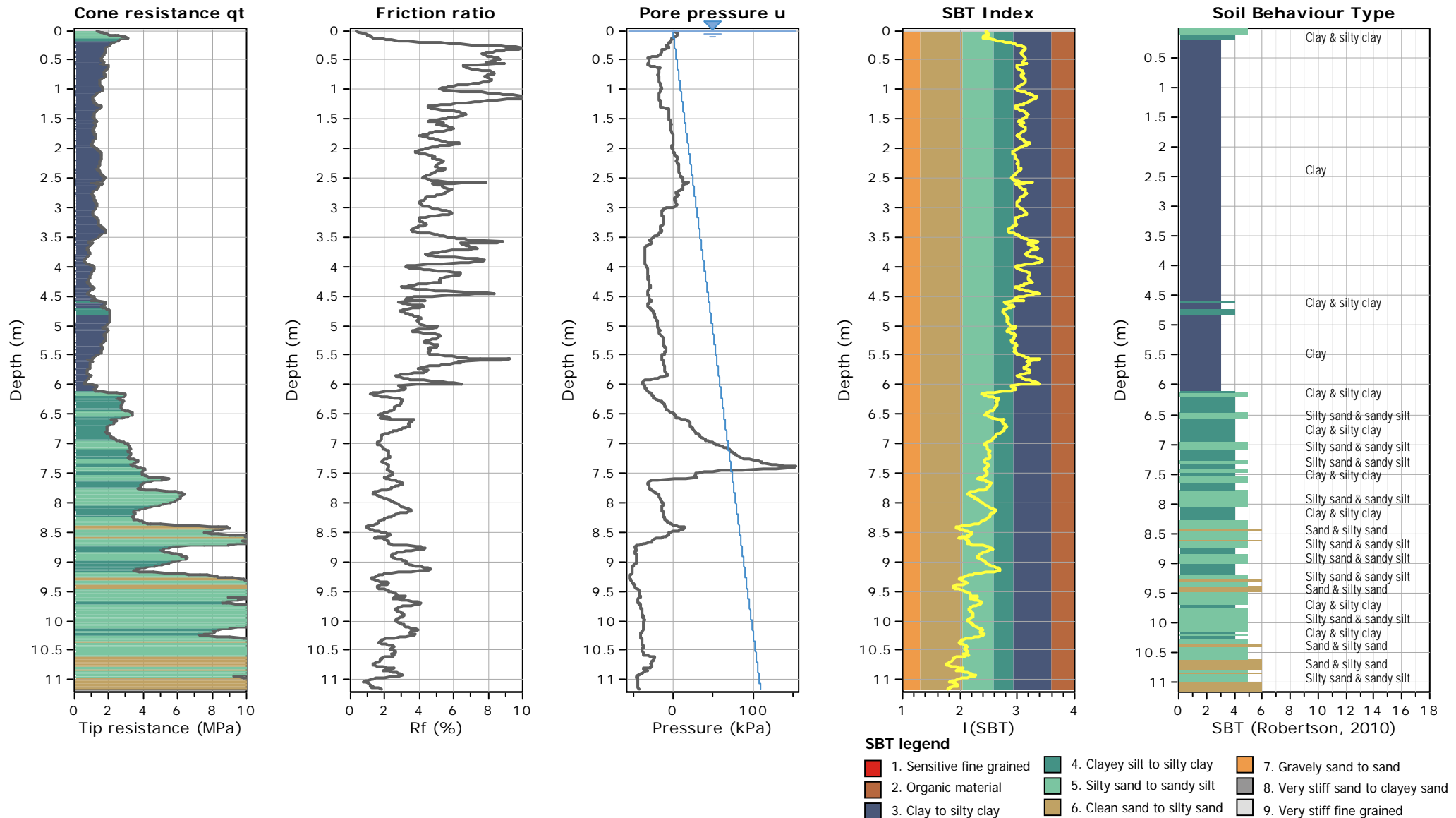
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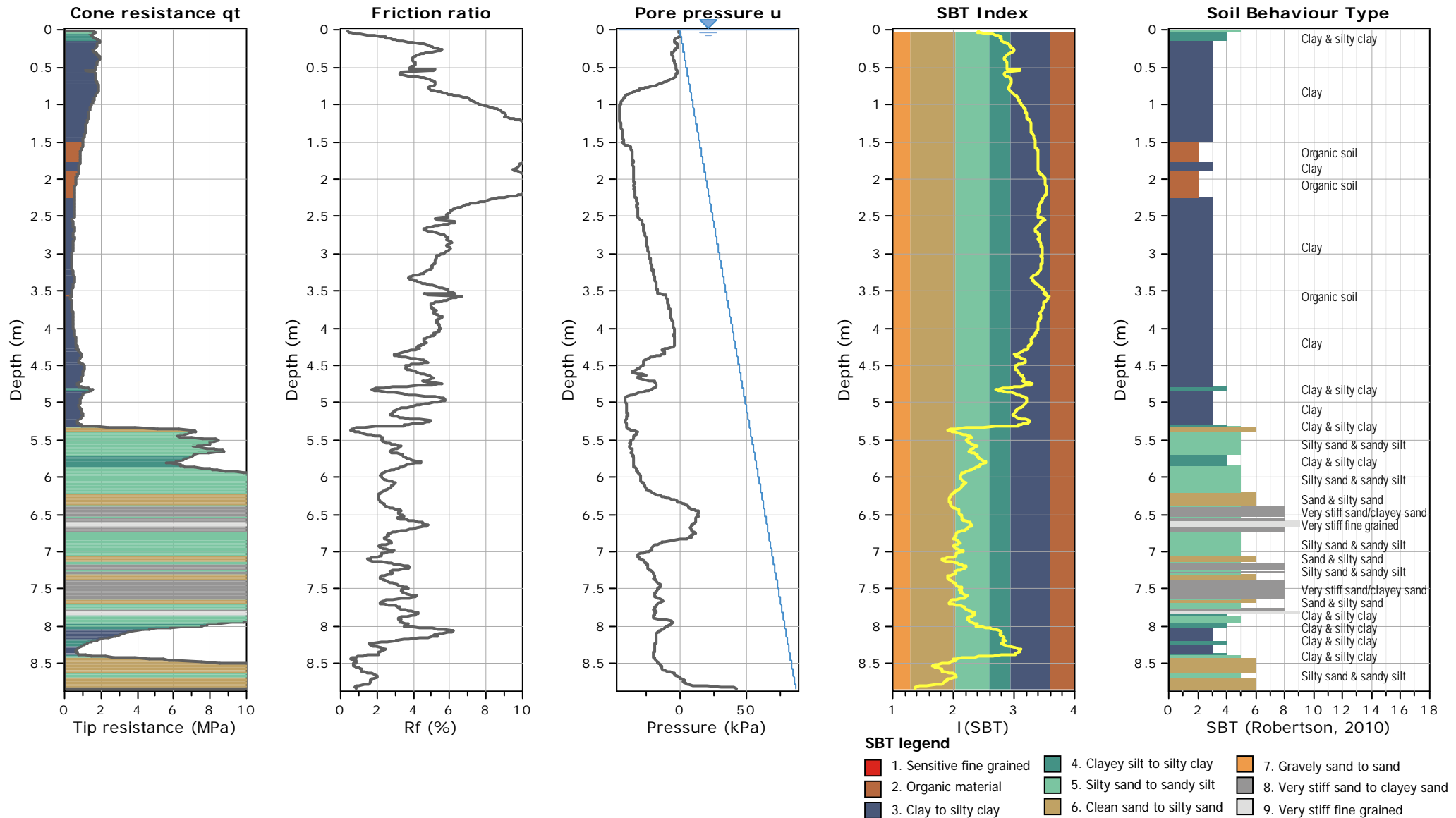
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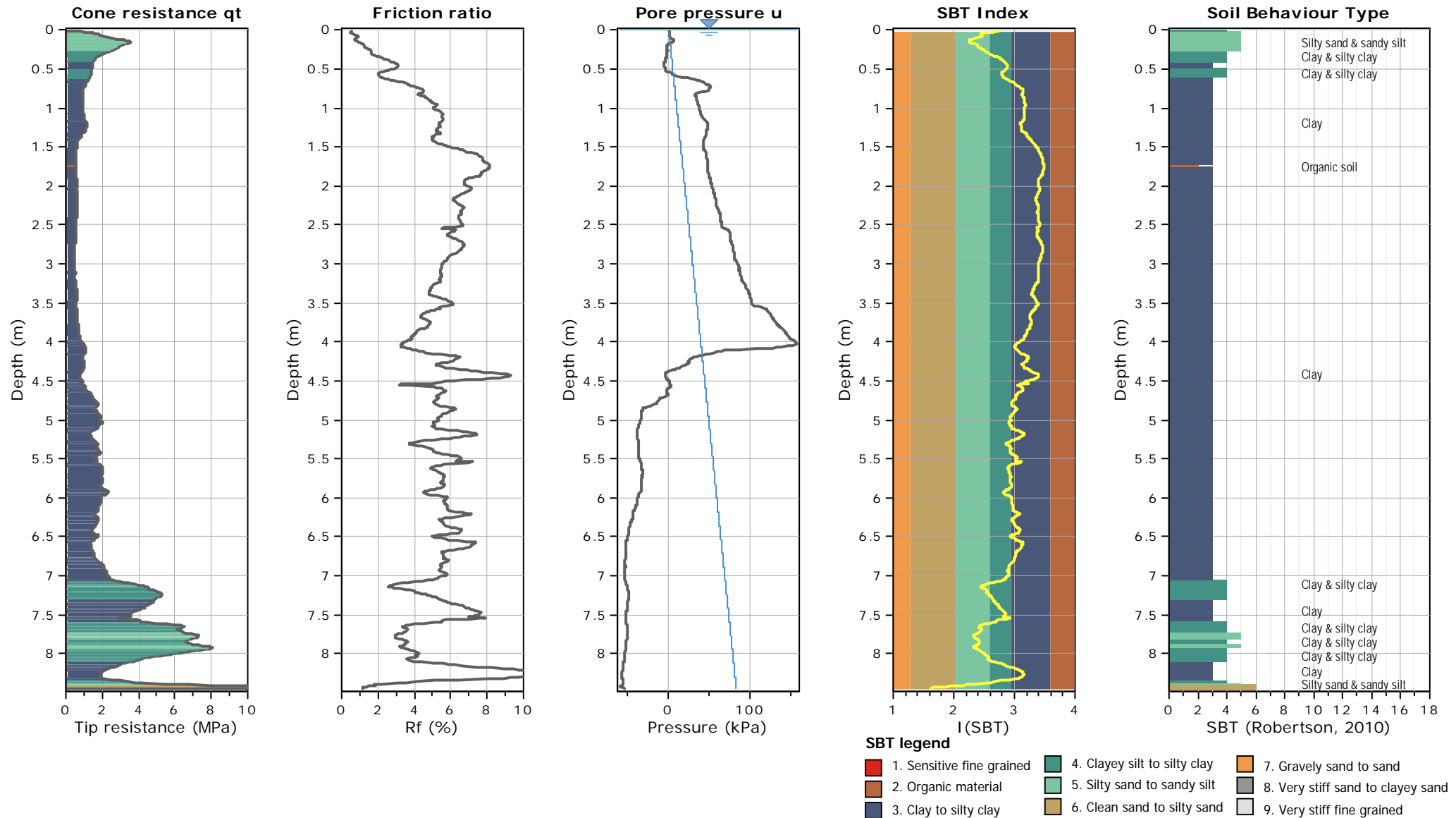
Project: Mangawhai Hills Plan Change

Location: Mangawhai



Project: Mangawhai Hills Plan Change

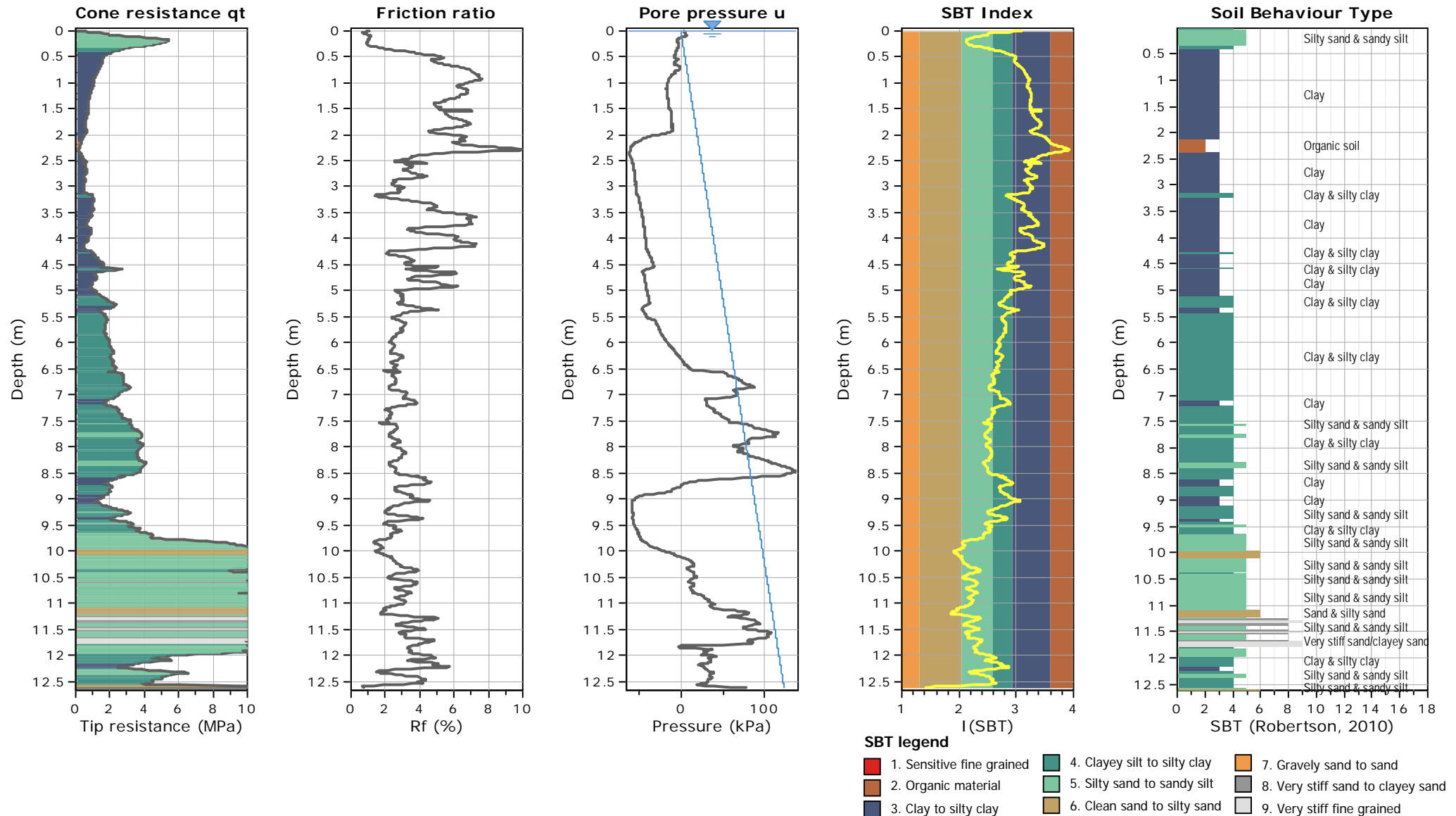
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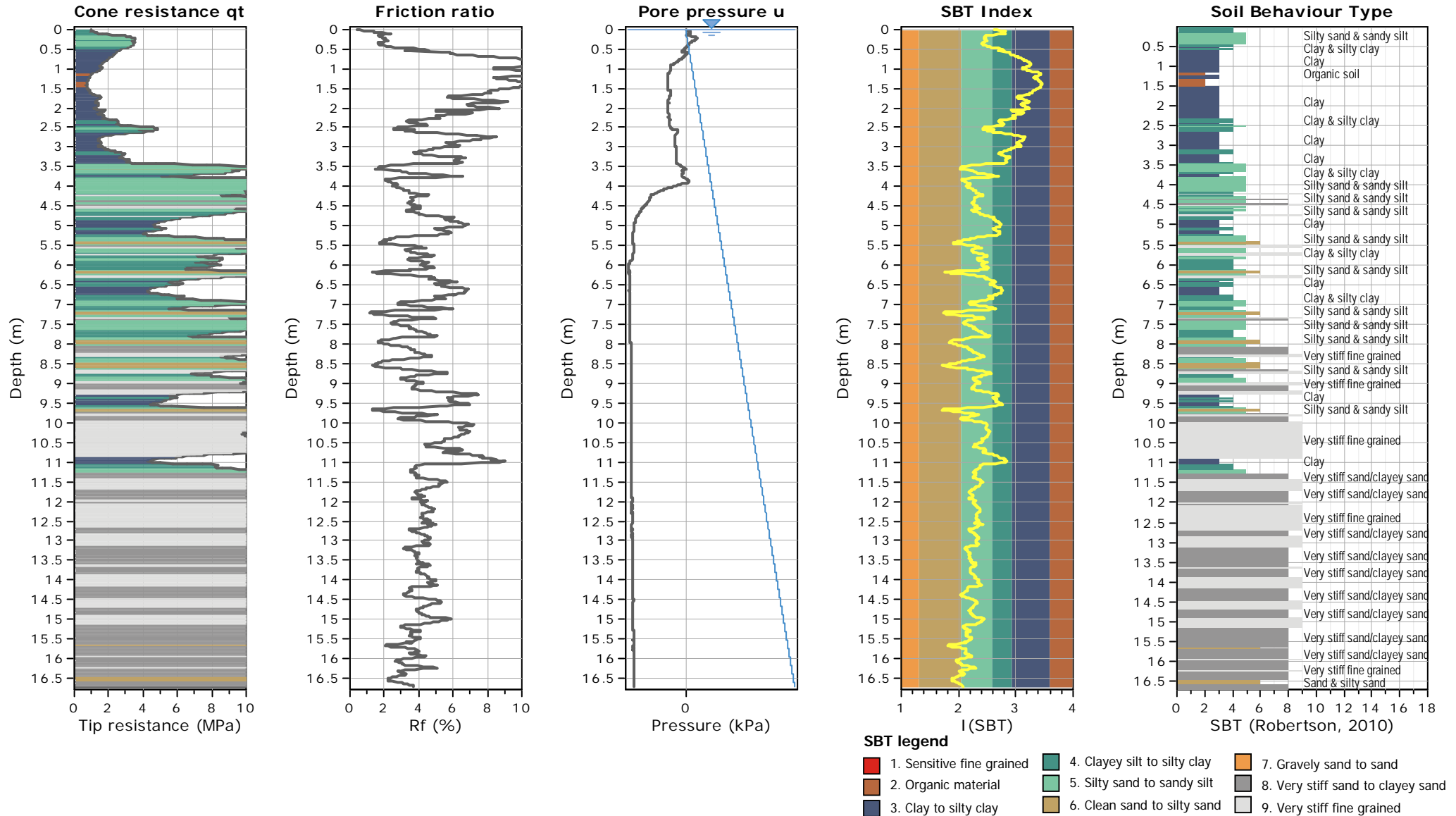
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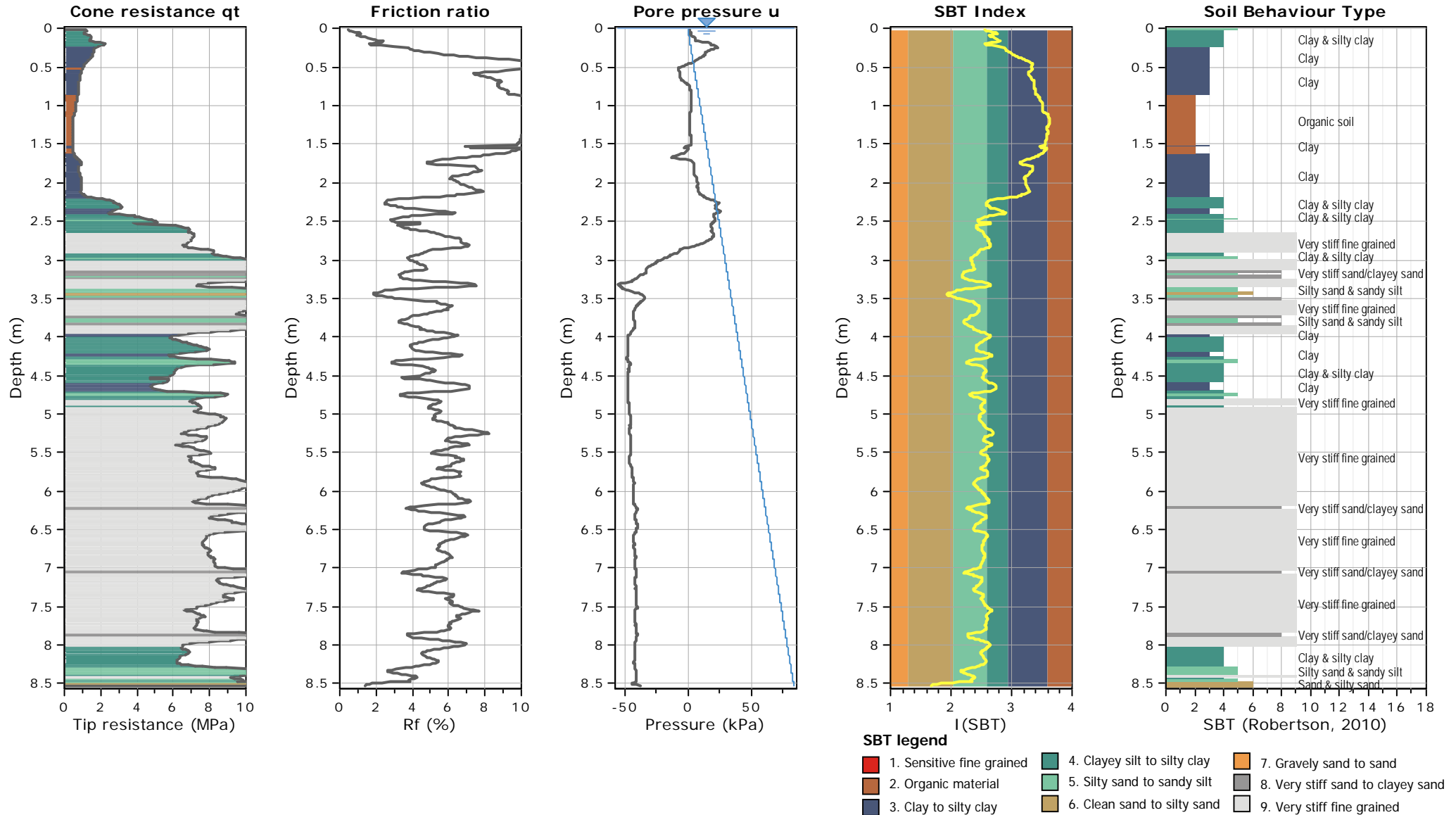




Project: Mangawhai Hills Plan Change

Location: Mangawhai

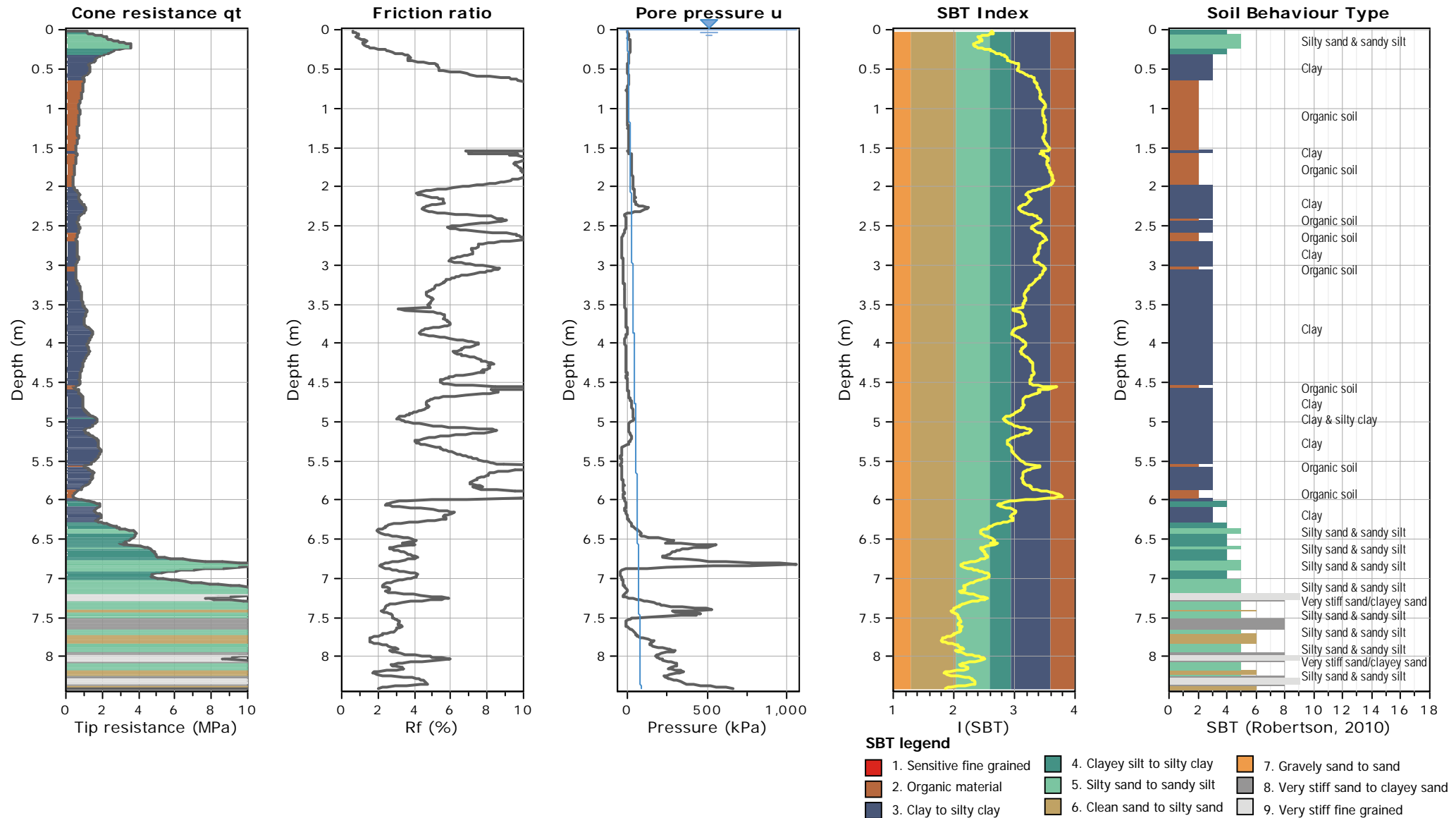






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CPT: CPT10

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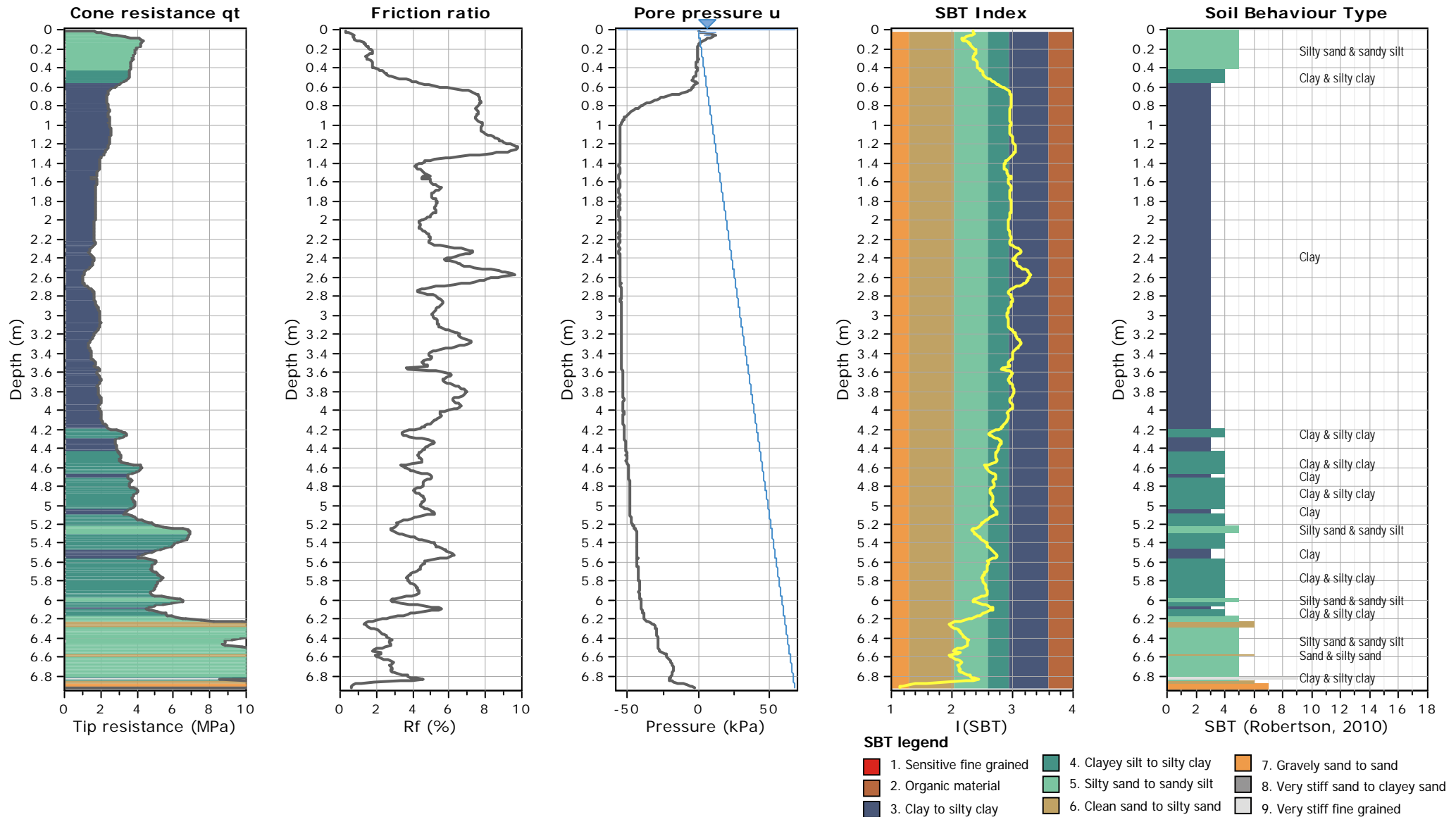
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Level 4, 25 Teed Street
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CPT: CPT11

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Surface Elevation: 0.00 m

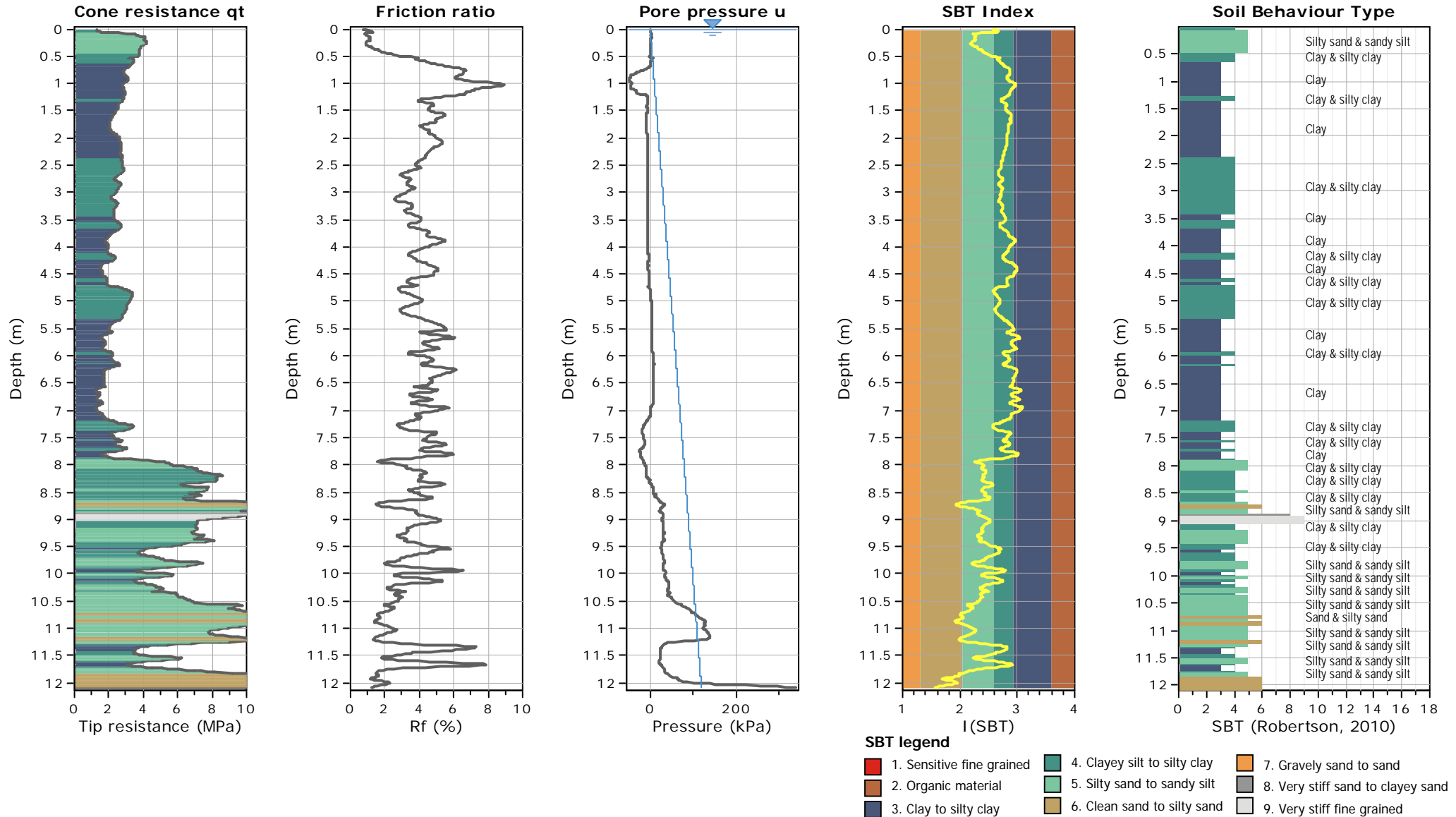
Coords: X:0.00, Y:0.00

Cone Type:

Cone Operator:

Project: Mangawhai Hills Plan Change

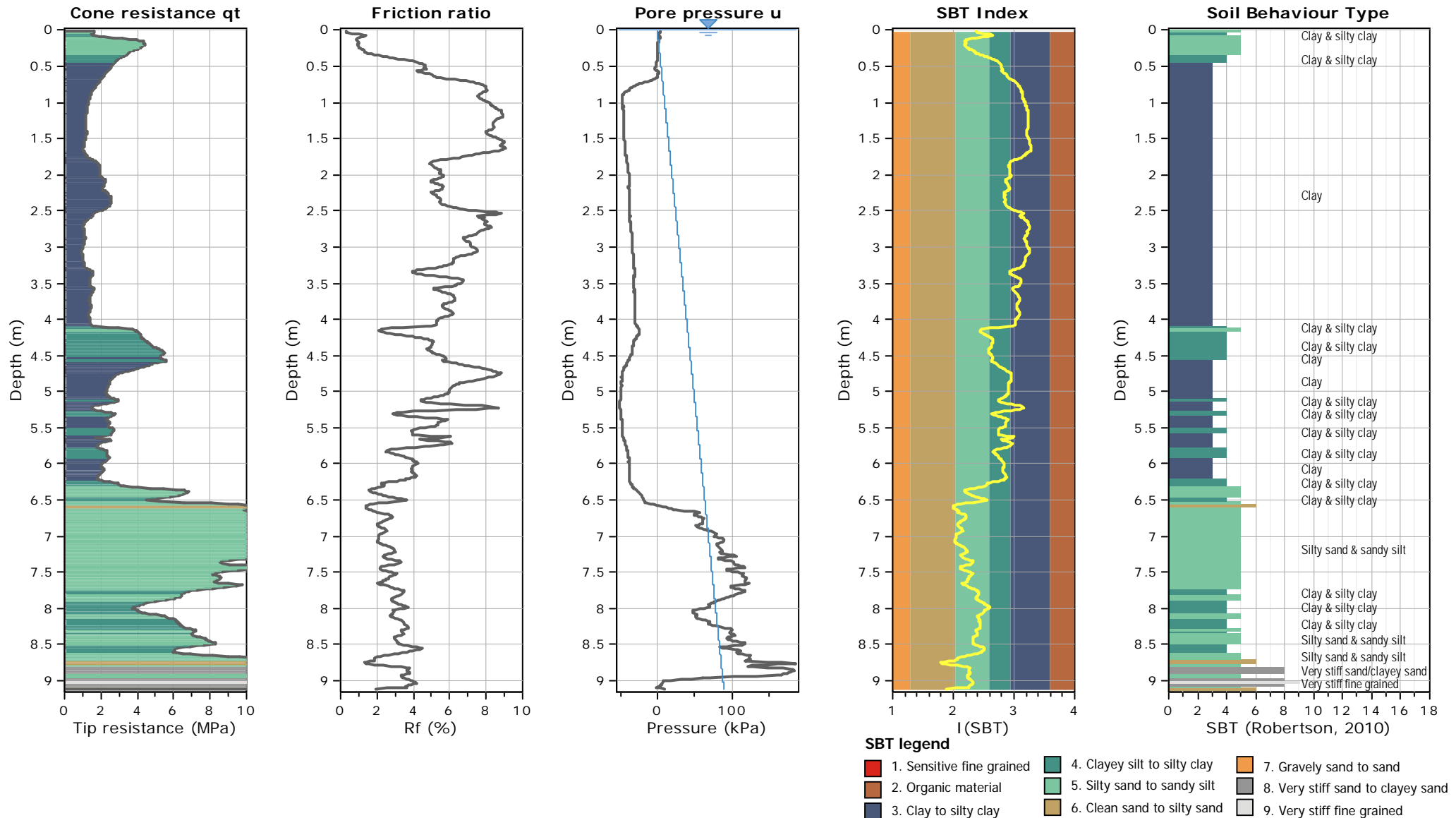
Location: Mangawhai





Project: Mangawhai Hills Plan Change

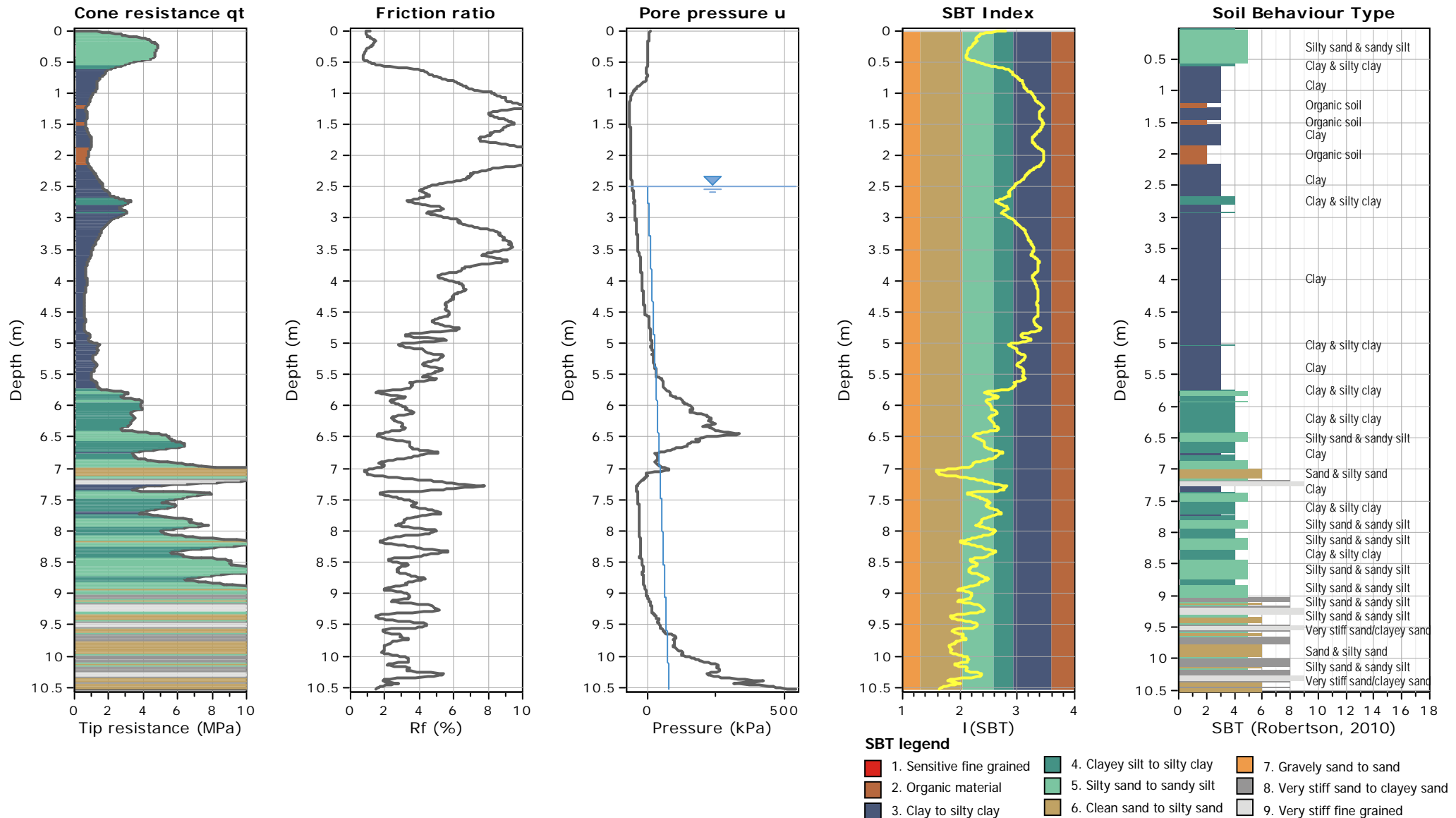
Location: Mangawhai





Project: Mangawhai Hills Plan Change

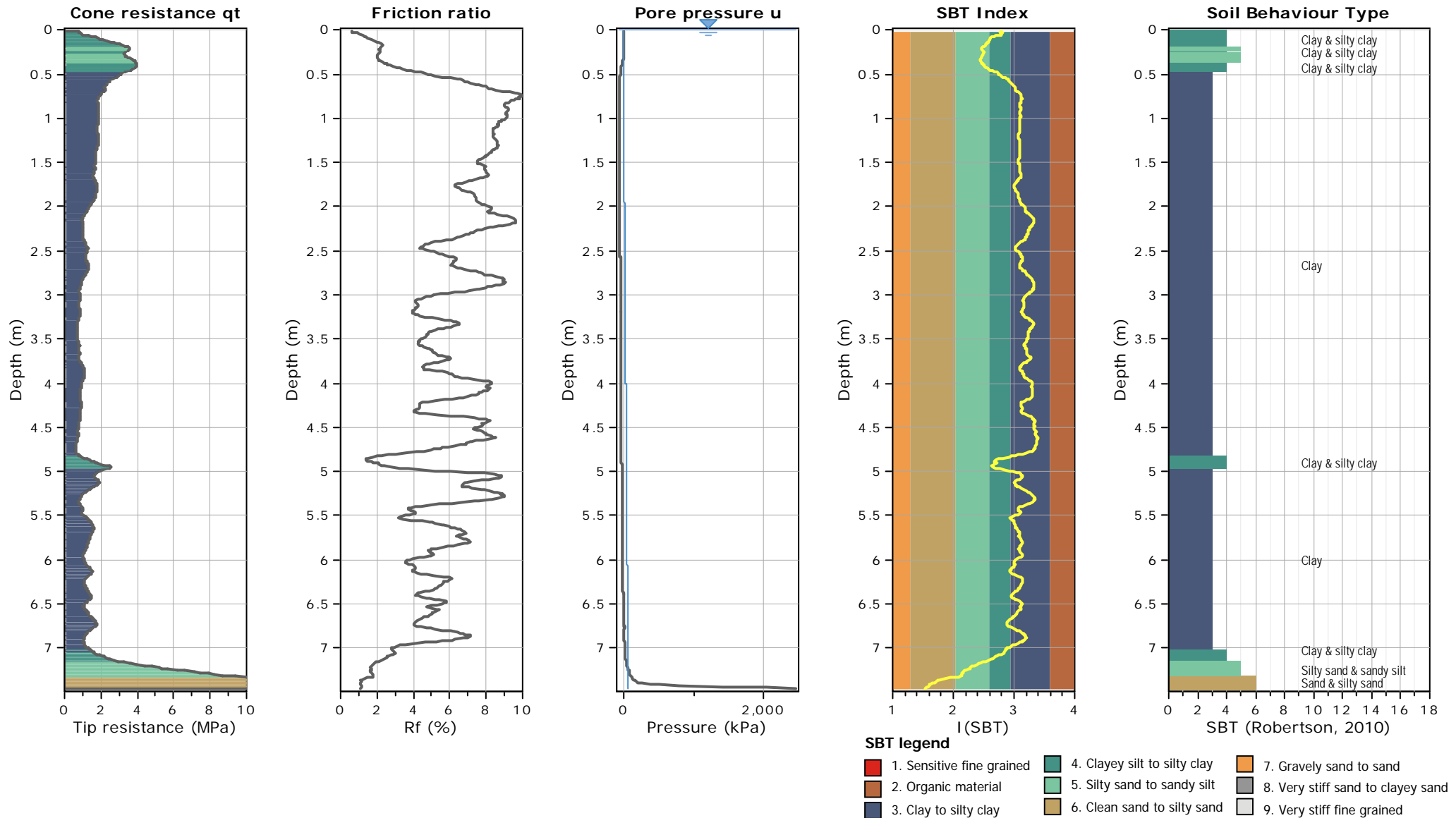
Location: Mangawhai





Project: Mangawhai Hills Plan Change

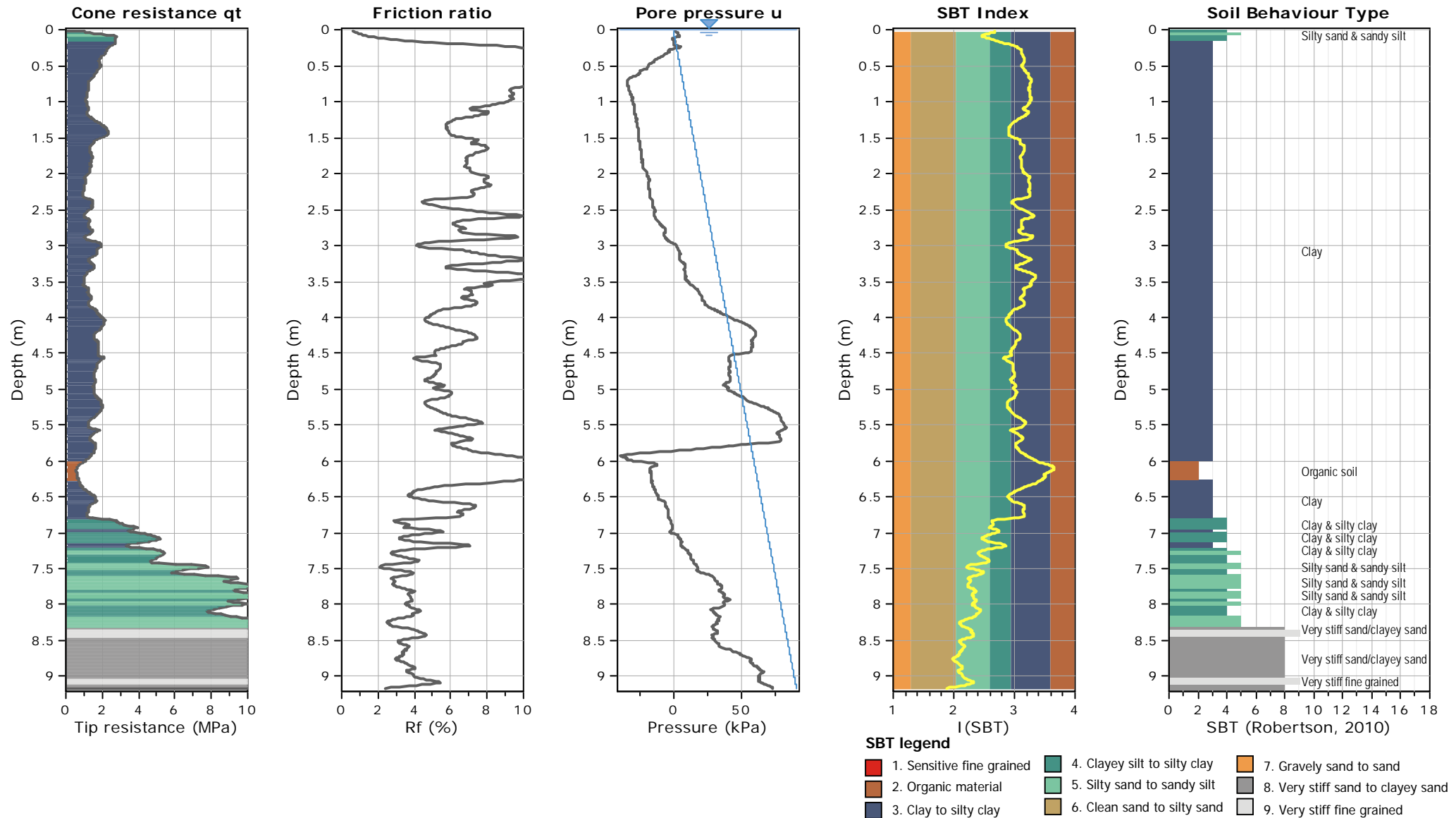
Location: Mangawhai

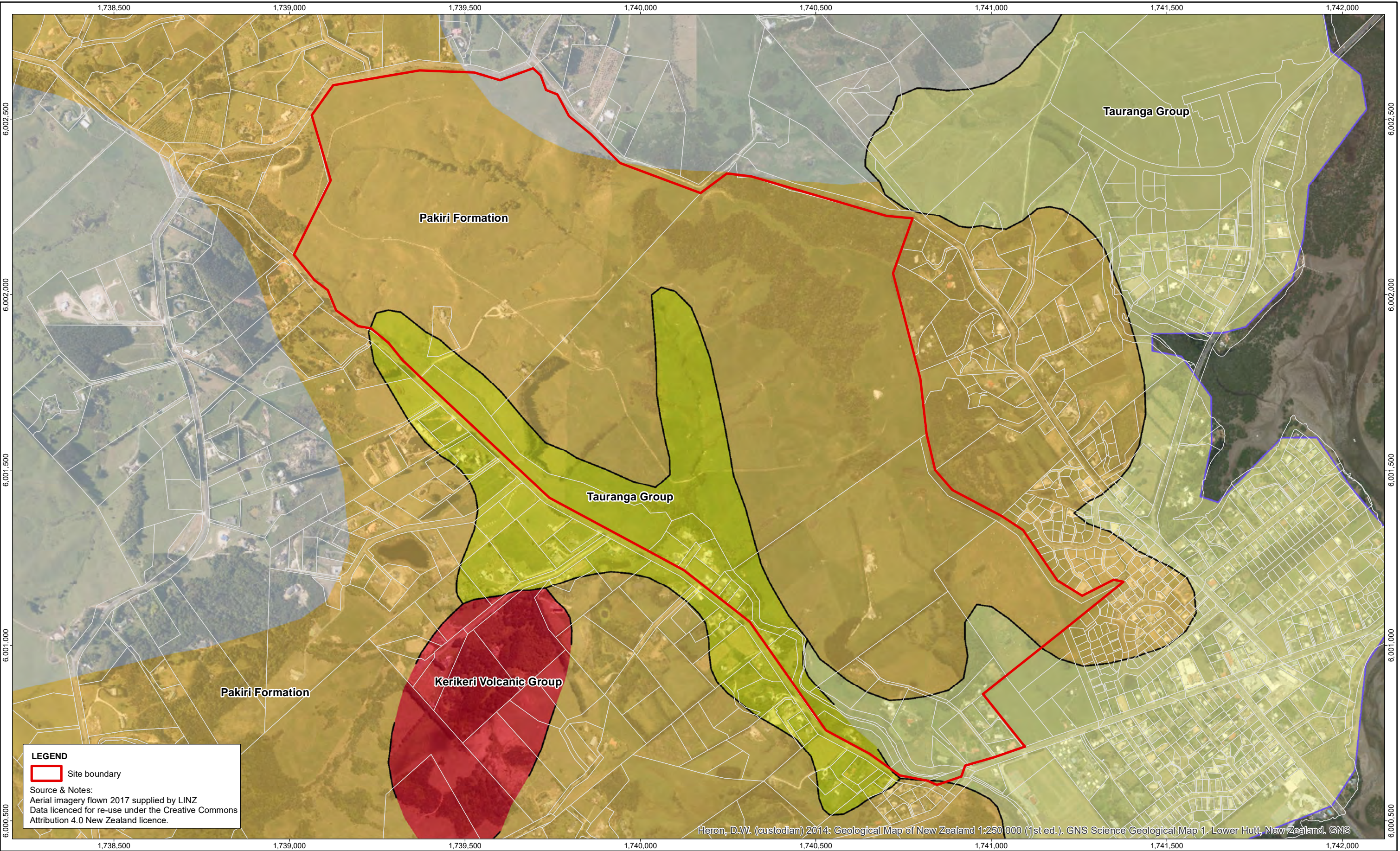




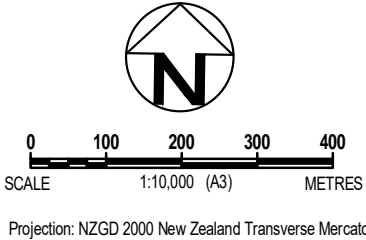
Project: Mangawhai Hills Plan Change

Location: Mangawhai





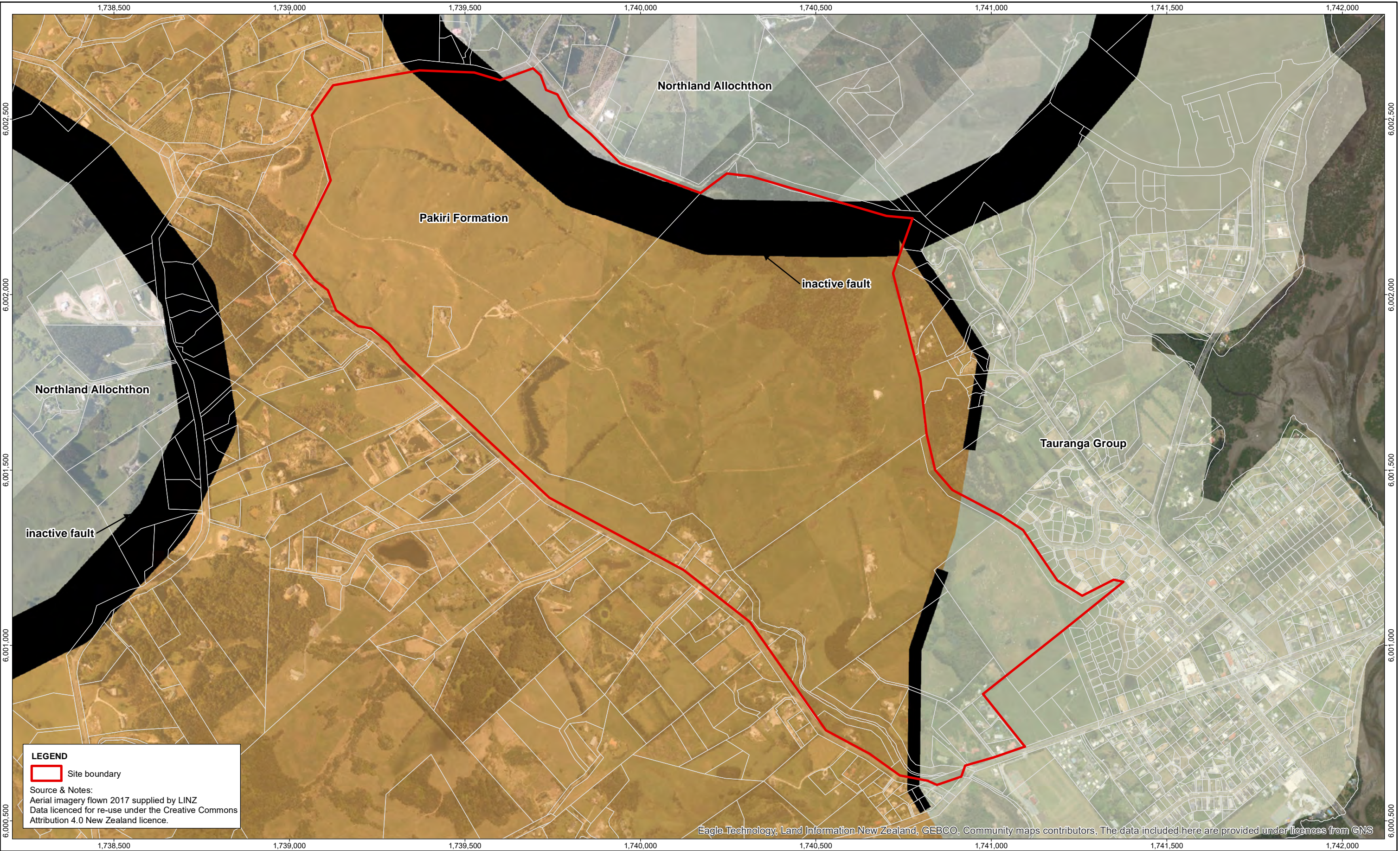
revision	no.	description		drawn	approved	date
	A	ORIGINAL ISSUE		RZ	LB	24.04.24



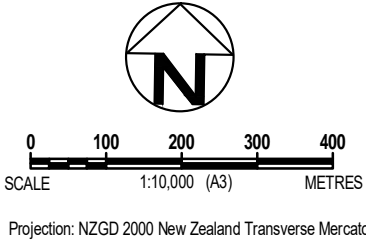
drawn	RZ
approved	LB
date	24.04.2024
scale	AS SHOWN
original size	A3



client:	MANGAWHAI HILLS LTD.		
project:	MANGAWHAI HILLS, TARA RD, MANGAWHAI		
title:	SITE GEOLOGY		
project no:	773-AKLGE305593	figure no:	03
rev:	A		



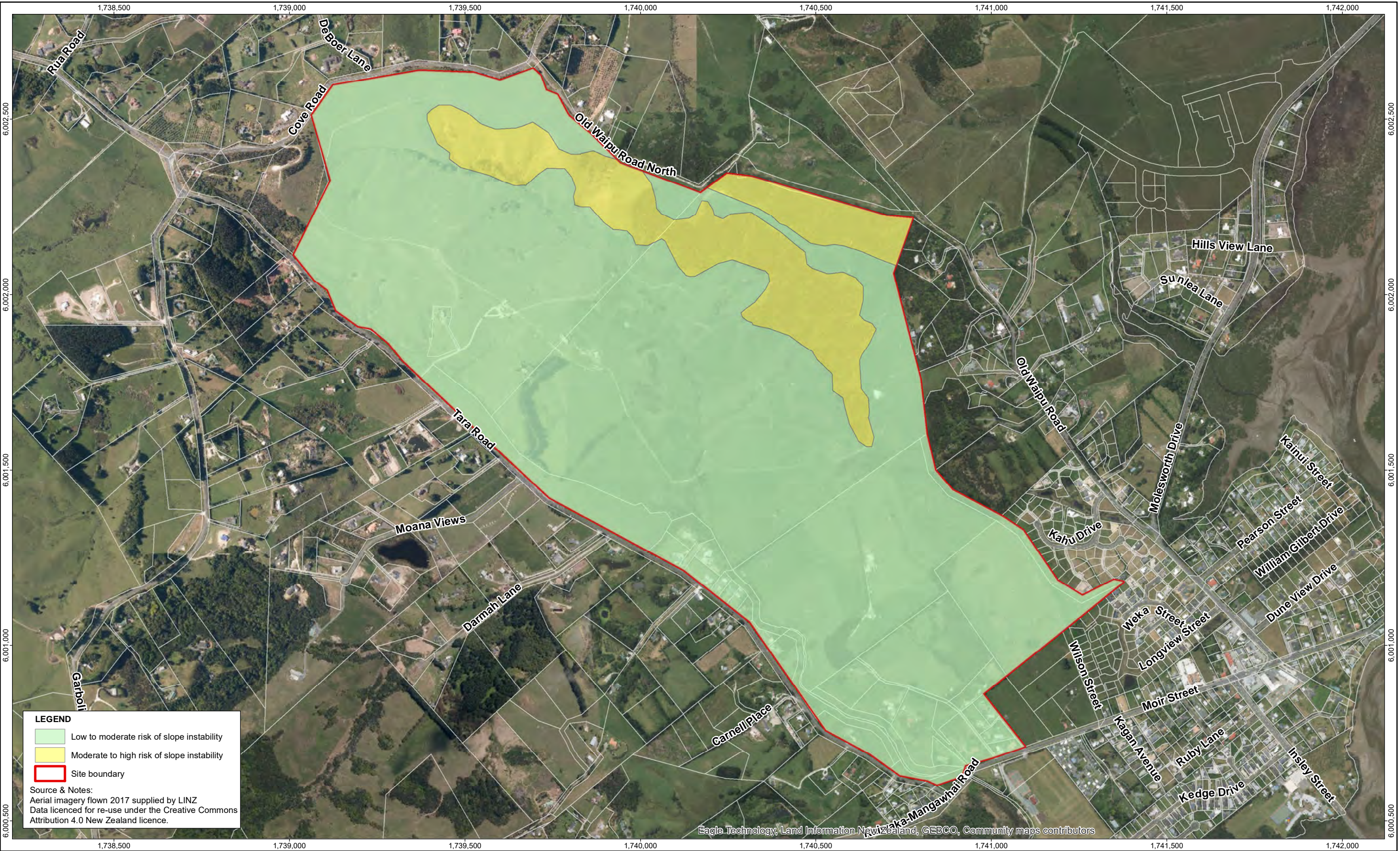
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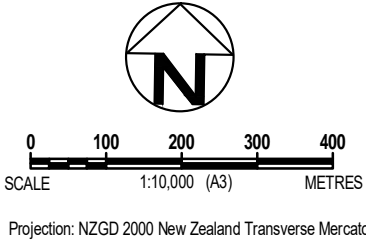
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approved	LB
date	24.04.2024
scale	AS SHOWN
original size	A3



client:	MANGAWHAI HILLS LTD.		
project:	MANGAWHAI HILLS, TARA RD, MANGAWHAI		
title:	SITE GEOLOGY		
project no:	773-AKLGE305593	figure no:	04
		rev:	A



revision	no.	description		drawn	approved	date
	A	ORIGINAL ISSUE		RZ	LB	26.04.24



drawn	RZ
approved	LB
date	26.04.2024
scale	AS SHOWN
original size	A3



client:	MANGAWHAI HILLS LTD.		
project:	MANGAWHAI HILLS, TARA RD, MANGAWHAI		
title:	SITE HAZARD PLAN		
project no:	773-AKLGE305593	figure no:	05
		rev:	A

Mangawhai Hills 24th Feb 2023 Storm Damage

