Kahuna No. 1 Pty Ltd

Geotechnical Assessment

Yamba Gardens Residential Estate

52-54 Miles Street, Yamba

Report No. RGS31546.1-AP

19 August 2022

REGIONAL GEOTECHNICAL SOLUTIONS

REGIONAL GEOTECHNICAL SOLUTIONS

Manning-Great Lakes
Port Macquarie
Coffs Harbour

RGS31546.1-AP

19 August 2022

Kahuna No. 1 Pty Ltd
C/o: Garrard Building Pty Limited
PO Box 538
YAMBA NSW 2464

Attention: Neil Garrard

Dear Neil

RE: Yamba Gardens Residential Estate – 52-54 Miles Street, Yamba
Geotechnical Assessment

As requested, Regional Geotechnical Solutions Pty Ltd (RGS) has undertaken a geotechnical assessment at 52-54 Miles Street, Yamba NSW (Lots 46 and 47 DP751395) where a residential development is proposed.

Presented herein are comments regarding consolidation settlement and the influence of the fill surcharge on the groundwater levels surrounding the site.

If you have any questions regarding this project, please contact the undersigned.

For and on behalf of **Regional Geotechnical Solutions Pty Ltd**

Prepared by

Simon Keen

Associate Geotechnical Engineer

Reviewed by

Adam Holzhauser

Principal Geotechnical Engineer

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1 INTRODUCTION

Regional Geotechnical Solutions Pty Ltd (RGS) have undertaken a geotechnical assessment for a residential subdivision that is proposed to be constructed at 52-54 Miles Street, Yamba.

The development involves the placement of between 1.5 and 3m of fill across the site. RGS has previously undertaken geotechnical and site contamination assessments at the site. We understand that Clarence Valley Council has requested further assessments be undertaken to provide comments on the following:

- The potential for consolidation settlement due to the placement of between 1.5 and 3m of controlled fill;
- An estimate of potential consolidation settlement, and the approximate lateral extents to which the settlement is predicted to occur; and
- Potential influence of the fill surcharge on existing groundwater levels.

2 METHODOLOGY

Field work for the assessment was undertaken under the direction of an Associate Geotechnical Engineer from RGS on 12 and 13 July 2022 and included the following:

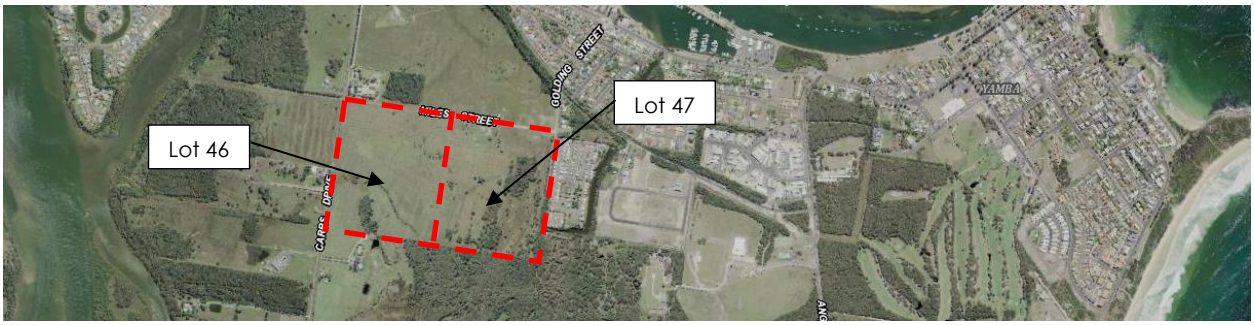
- Observation of site features and surrounding features relevant to the geotechnical conditions of the site; and
- Completion of 8 Cone Penetration Tests (CPTs) which were pushed to practical refusal at depths of between 4.38 and 12.76m.

Engineering logs of the CPTs are presented in Appendix A. Test locations are shown on the attached Figure 1 and were obtained by measurements to prominent site features.

3 SITE CONDITIONS

3.1 Surface Conditions

The approximately 42ha rectangular site is bound by Miles Street to the north, Carrs Drive to the west, Golding Street to the east, and by rural-residential lots and bushland to the south. A satellite image that illustrates the site location and site setting is shown below.



Site location and setting is illustrated on the NSW Government 'Six Maps'. The approximate boundary of the site is shown by a red box. The extents of the portion of the site covered by this assessment are shown on Figure 1.

The site is located within a region characterised by low lying sand flats with localised swampy areas in lower lying areas and depressions across the site. The provided survey indicates that site levels are generally between about RL1.0 to 1.4m (AHD) with lower lying depressions and drainage lines having elevations of between about 0.5 to 1.0m. The intermittent drainage lines drain to both the northeast towards the Clarence River and to the southwest towards Oyster Channel.

Fill has been placed in the western and central portions of the site, the extents of which are illustrated on Figure 1.

3.2 Subsurface Conditions & Geology

The 1:25,000 Yamba Quaternary Geology Map indicates that the site is predominantly underlain by a Holocene tidal-delta flat that comprises marine sand, silt, clay, shell and gravel. The lower lying drainage lines that are located at the site are underlain by a Holocene saline swamp that comprises organic mud, peat, clay, silt and sand, that overlies the tidal-delta flat outlined above.

It is understood that rockfill was placed during the initial stages of fill placement in the west and central portions of the site. The CPTs were therefore undertaken around the perimeter of the existing fill and in portions of the site where fill is yet to be placed.

A summary of the conditions encountered within the CPTs is presented below:

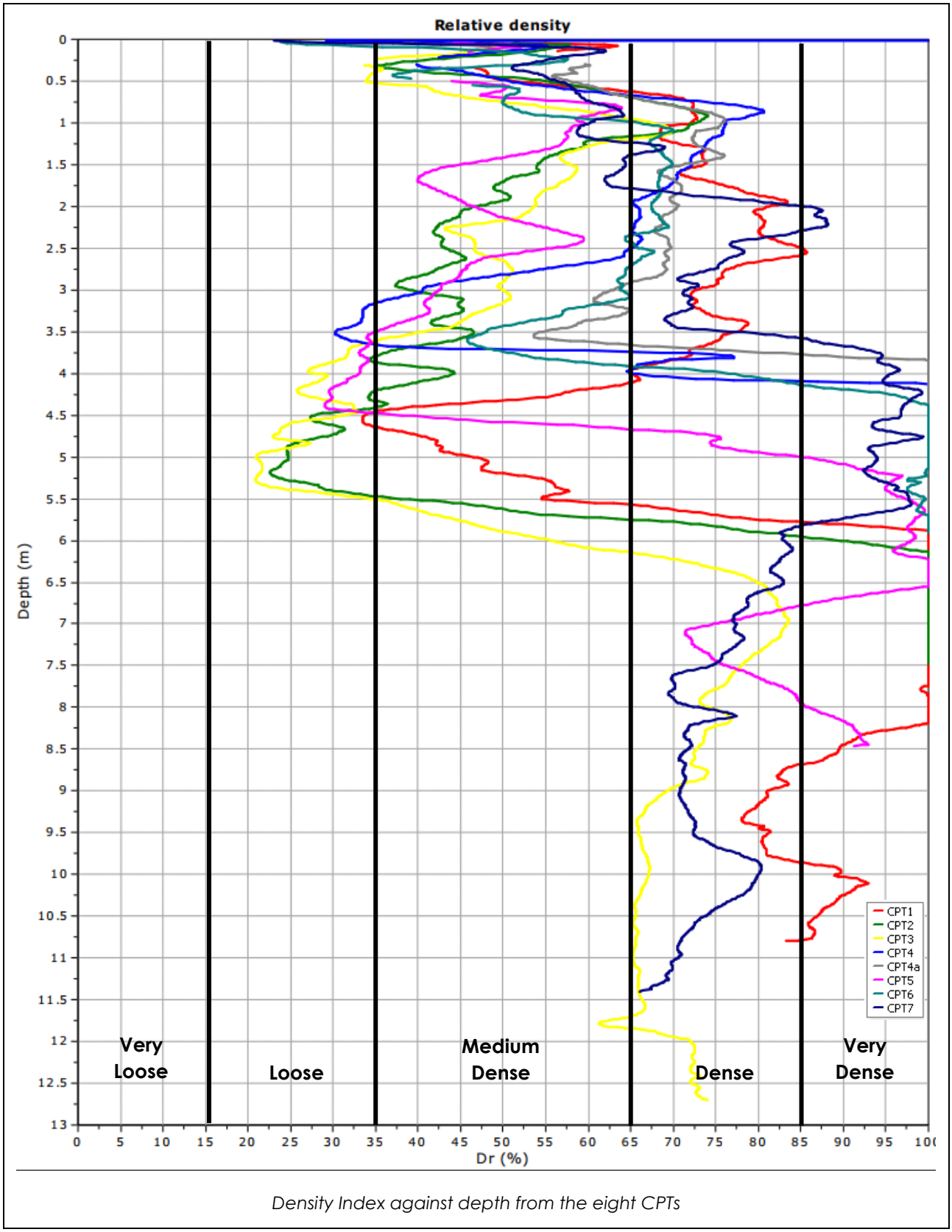
- The upper approximately 0.4 to 0.55m of the profile comprises Silty SAND, Sandy SILT, CLAY and Silty CLAY. The materials are generally medium dense with firm clay and silt lenses up to 300mm thick. A 100mm soft clay lens was encountered in CPT3;
- Between about 0.55 and between about 6.0m the profile generally comprises medium dense to dense SAND, Silty SAND and Sandy SILT. Loose material was encountered between about 3 and 5.5m in CPT2, CPT3, CPT4 and CPT5; and
- Between 6m and the maximum depth of the investigation (12.76m in CPT3) dense to very dense Silty SAND was encountered that resulted in practical CPT refusal.

A plot of the density index against depth is presented below.

Groundwater was measured within all eight tests at the locations presented in Table 1. Groundwater levels do fluctuate due to inclement weather, seasonal variations, tidal influences, or due to reasons that may not have been apparent at the time of the site investigation.

Table 1: Measured Groundwater Depths

CPT1	CPT2	CPT3	CPT4	CPT4a	CPT5	CPT6	CPT7
0.4	0.5	0.7	0.3	0.3	0.5	0.9	0.2



Density Index against depth from the eight CPTs

4 SETTLEMENT

A preliminary estimate of the potential elastic and consolidation settlement has been undertaken based on the data obtained from the CPTs. The analysis has been undertaken using the proprietary software CPeT-IT which estimates the potential primary and secondary settlements based on the procedures presented within '*Guide to Cone Penetration Testing for Geotechnical Engineering – 6th Edition*' by Robertson & Cabal (2014).

The analysis indicates that as a result of the application of a 60kPa surcharge (i.e. 3m of fill compacted to achieve a unit weight of 20kN/m^3) the following is predicted to occur within the materials encountered within the investigation:

- Elastic settlement of up to about 15mm;
- Primary consolidation settlement of generally between about 10 and 15mm, with the areas around CPT3 being predicted to undergo 25mm of primary consolidation; and
- Secondary consolidation settlement of less than about 5mm.

Elastic settlement will occur as the surcharge load is applied. Consolidation settlement would be expected to occur over a period of months or potentially years and the analysis indicates that it is likely to primarily occur within the upper 5.5m of the soil profile. The lateral extent of consolidation settlement is expected to be less than about 5m from the edge of the fill mound.

5 INFLUENCE OF FILL SURCHARGE ON GROUNDWATER LEVELS

The development includes the placement of up to about 3m of fill over the existing marine sand and silt deposits. The fill is expected to be placed progressively over many months with small height increases (i.e. fill lifts) applied over large areas, rather than the full surcharge being applied over a short period. Groundwater was measured during the site investigation at depths of between 0.2 and 0.9m.

The marine soils below the groundwater level that underlie the site comprise two components – the soil particles themselves and water. Consolidation settlement occurs due to the reduction in volume of the saturated soil because of the increase in total stress and the drainage of excess pore water pressure. On this basis, at sites that experience large consolidation settlements there is the potential that the groundwater level surrounding the applied load/surcharge to be influenced and can rise.

Groundwater levels would be expected to fluctuate at the site by up to about 1m due to tidal influences and in response to rainfall and particularly extended rainfall events. On this basis and due to the limited predicted consolidation settlement, the influence of the fill surcharge on the groundwater levels on surrounding sites is expected to be negligible.

6 LIMITATIONS

This report comprises the results of an investigation carried out for a specific purpose and client as defined in the document. The report should not be used by other parties or for purposes or projects other than those assumed and stated within the report, as it may not contain adequate or appropriate information for applications other than those assumed or advised at the time of its preparation. The contents of the report are for the sole use of the client and no responsibility or liability will be accepted to any third party. The report should not be reproduced either in part or in full, without the express permission of Regional Geotechnical Solutions Pty Ltd.

Geotechnical site investigation is based on data collection, judgment, experience, and opinion. By its nature, it is less exact than other engineering disciplines. The findings presented in this report and used as the basis for the recommendations presented herein were obtained using normal, industry accepted geotechnical design practises and standards. To our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points.

The recommended depth and properties of any soil, rock, groundwater, or other material referred to in this report is an engineering estimate based on the information available at the time of its writing. The estimate is influenced and limited by the fieldwork method and testing carried out in the site investigation, and other relevant information as has been made available. In cases where information has been provided to Regional Geotechnical Solutions for the purposes of preparing this report it has been assumed that the information is accurate and appropriate for such use. No responsibility is accepted by Regional Geotechnical Solutions for inaccuracies within any data supplied by others.

If site conditions encountered during construction vary significantly from those discussed in this report, Regional Geotechnical Solutions Pty Ltd should be contacted for further advice.

This report alone should not be used by contractors as the basis for preparation of tender documents or project estimates. Contractors using this report as a basis for preparation of tender documents should avail themselves of all relevant background information regarding the site before deciding on selection of construction materials and equipment.

For and on behalf of **Regional Geotechnical Solutions Pty Ltd**

Prepared by

Simon Keen

Associate Geotechnical Engineer

Reviewed by

Adam Holzhauser

Principal Geotechnical Engineer

Figures

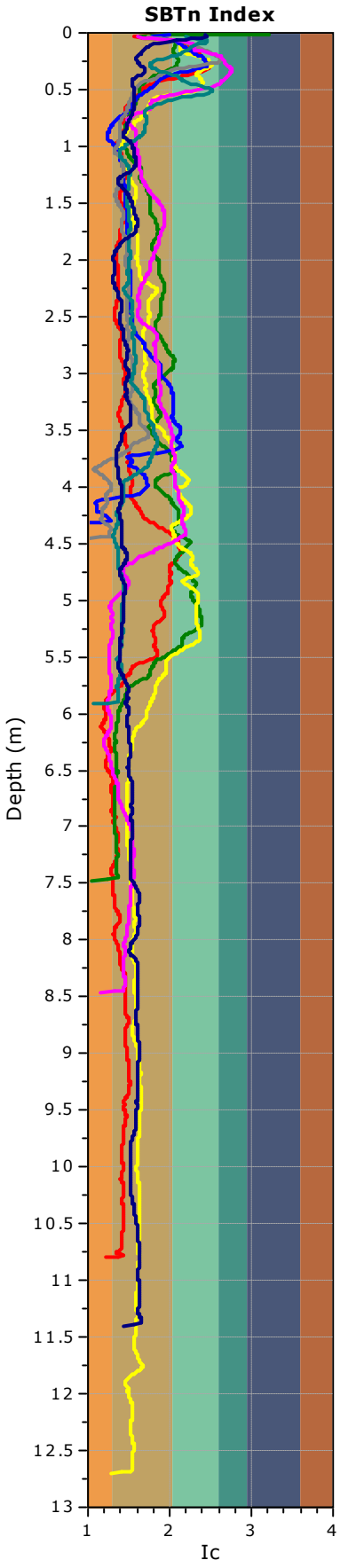
REGIONAL GEOTECHNICAL SOLUTIONS	**Client:**	Kahuna No. 1 Pty Ltd	Job No.	RGS31546.1
	Project:	Yamba Gardens Residential Estate	Drawn By:	SK
			Scale:	NTS
		52-54 Miles Street, Yamba	Date:	16-Aug-22
	Title:	Test Location Plan	Drawing No.	**Figure 1**

Appendix A

Results of Site Investigations

REGIONAL GEOTECHNICAL SOLUTIONS

Project: RGS31546.1 Proposed Residential Subdivision
Location:



REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT1

Total depth: 10.86 m, Date: 12/07/2022

Surface Elevation: 0.00 m

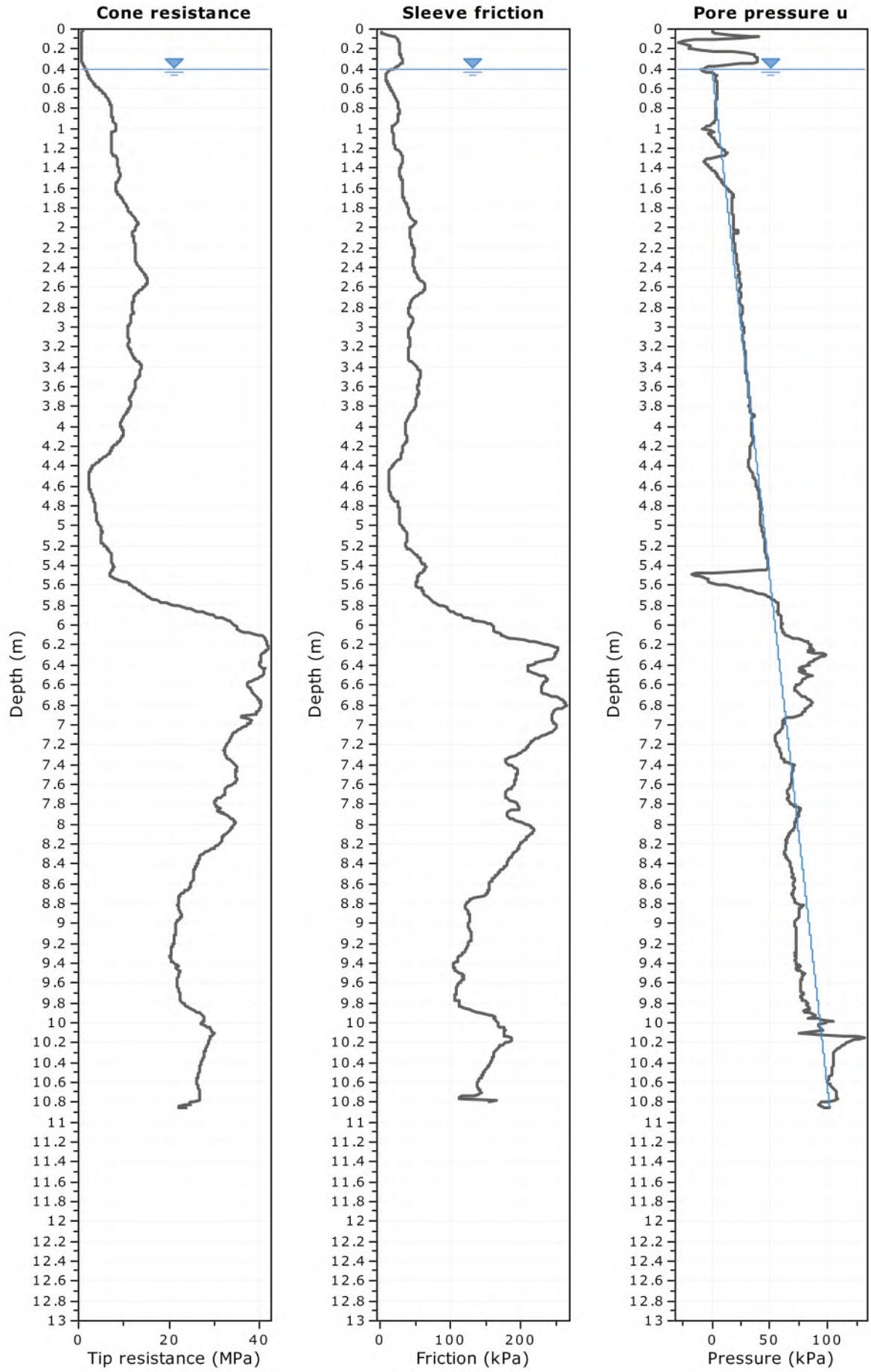
Coords: X:532853.00, Y:6743292.00

Cone Type: C10CFIP.C19137

Cone Operator: Newsyd Geotechnical Testing

Project: **RGS31546.1 Proposed Residential Subdivision**

Location: **52-54 Miles Street, Yamba**



REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT1
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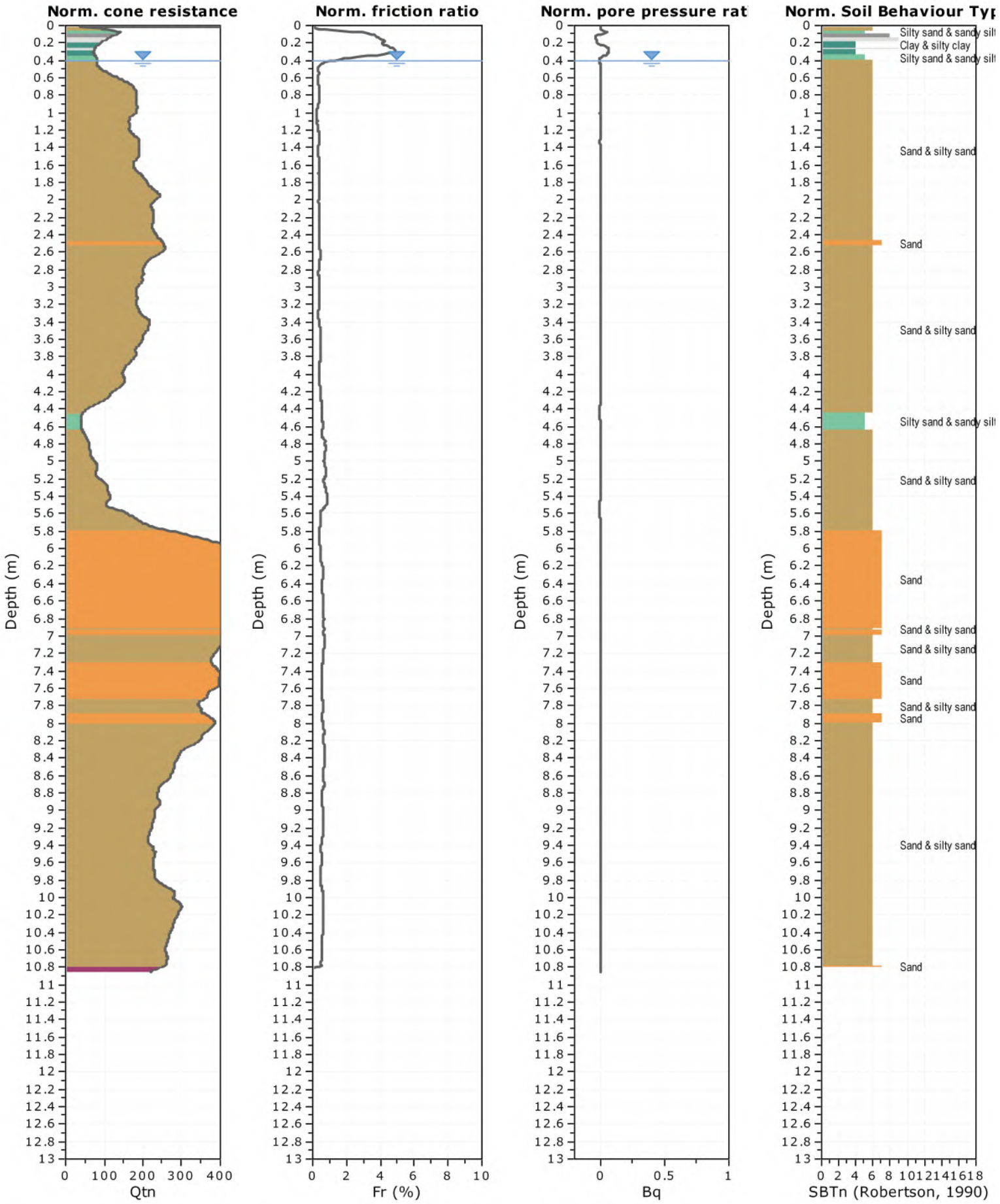
Surface Elevation: 0.00 m
Coords: X:532853.00, Y:6743292.00
Cone Type: C10CFIP.C19137
Cone Operator: Newsyd Geotechnical Testing

Project: RGS31546.1 Proposed Residential Subdivision
Location: 52-54 Miles Street, Yamba



REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT1
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Surface Elevation: 0.00 m
Coords: X:532853.00, Y:6743292.00
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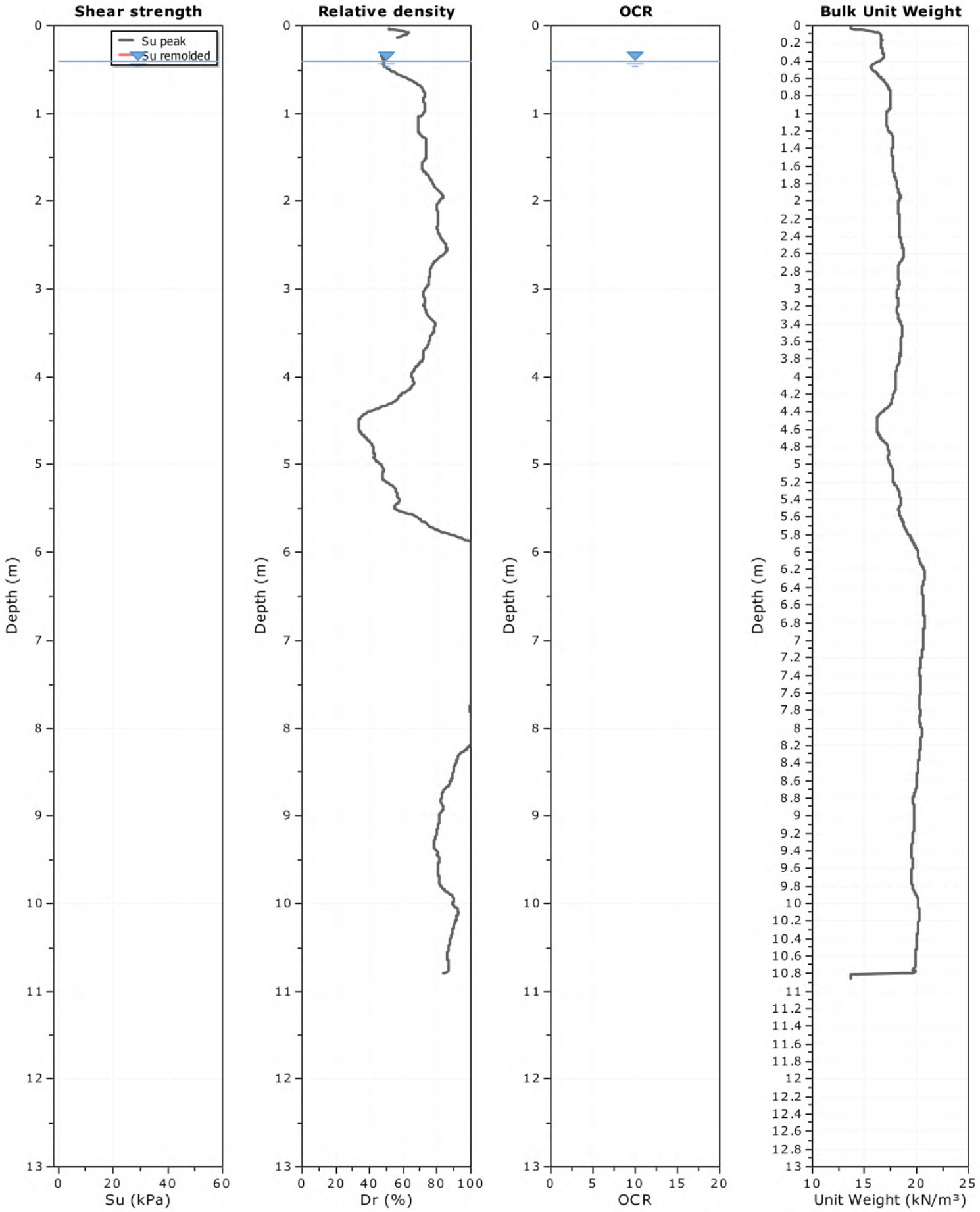
Cone Operator: Newsyd Geotechnical Testing

Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**



REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT2
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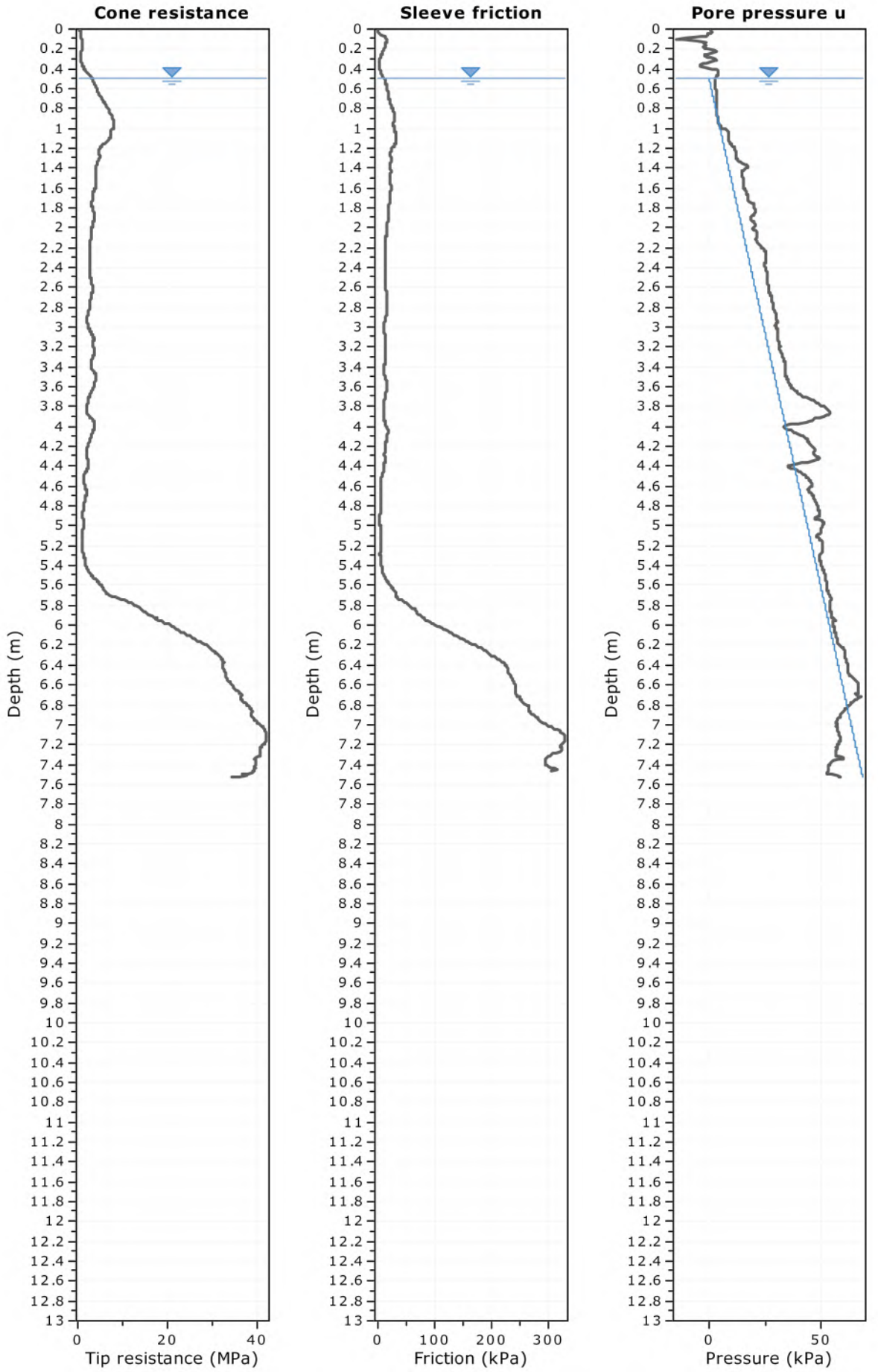
Surface Elevation: 0.00 m
Coords: X:532793.00, Y:6743207.00
Cone Type: C10CFIP.C19137
Cone Operator: Newsyd Geotechnical Testing

Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**



REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT2
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Surface Elevation: 0.00 m
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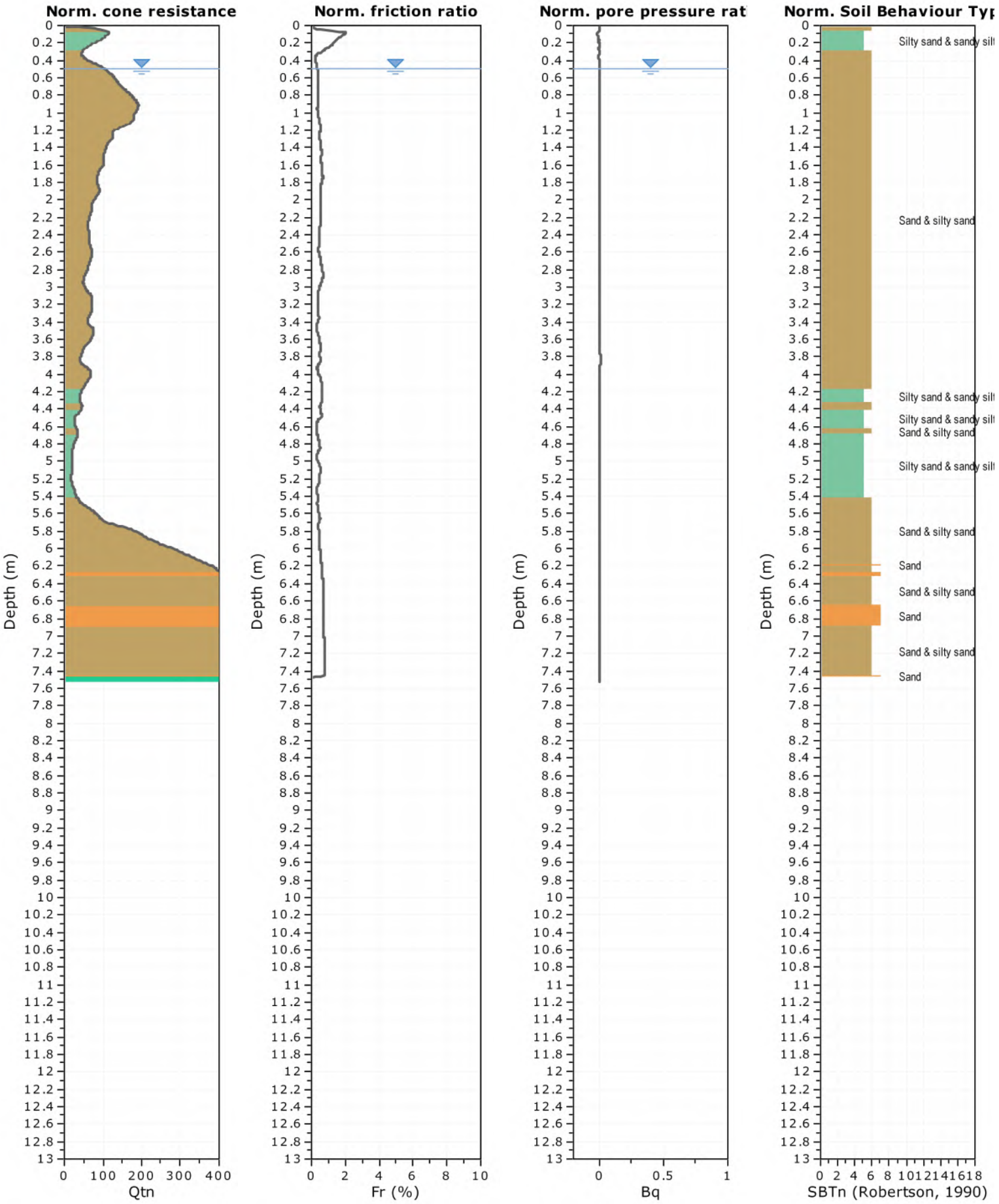
Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**



REGIONAL GEOTECHNICAL SOLUTIONS

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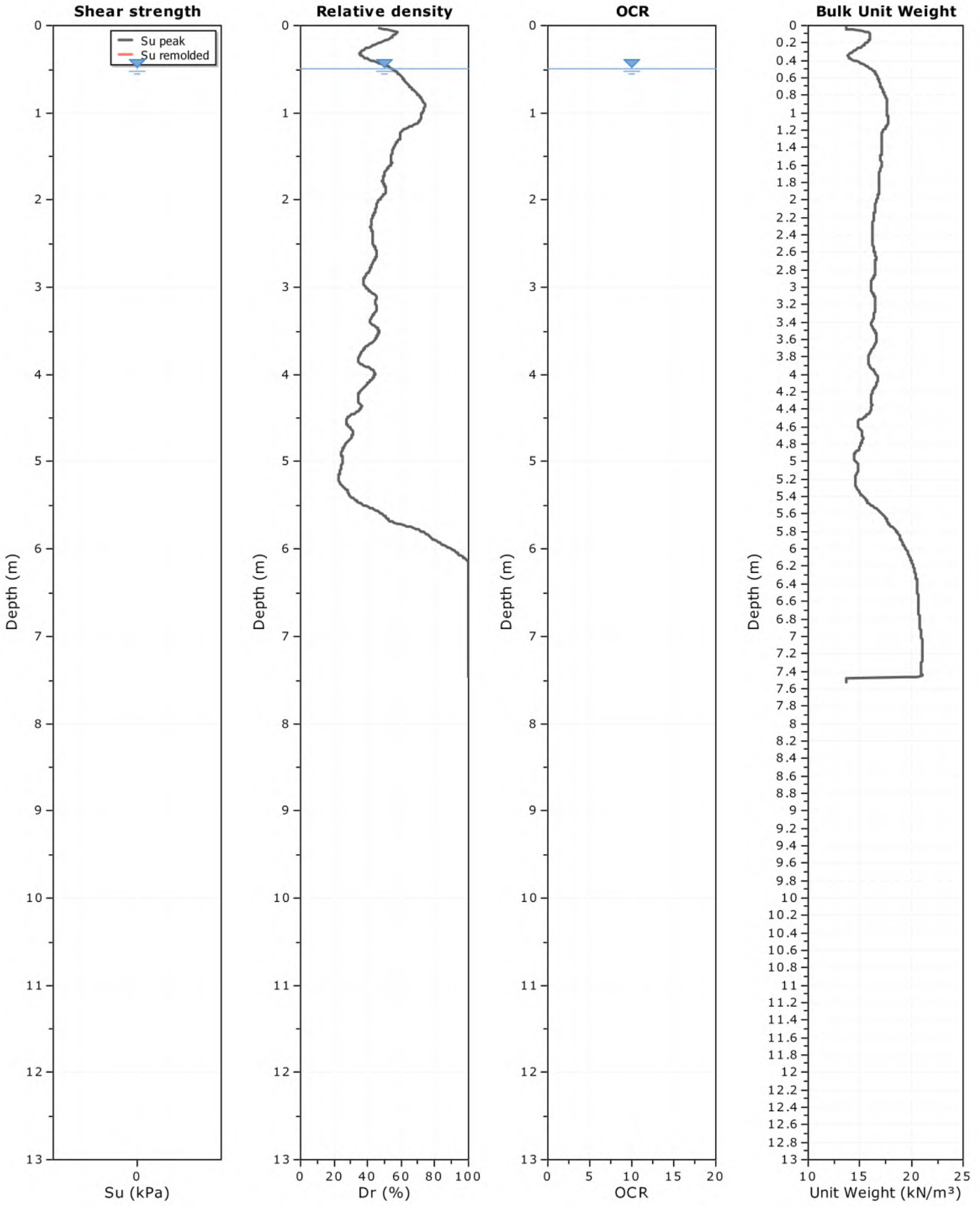
Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**



REGIONAL GEOTECHNICAL SOLUTIONS

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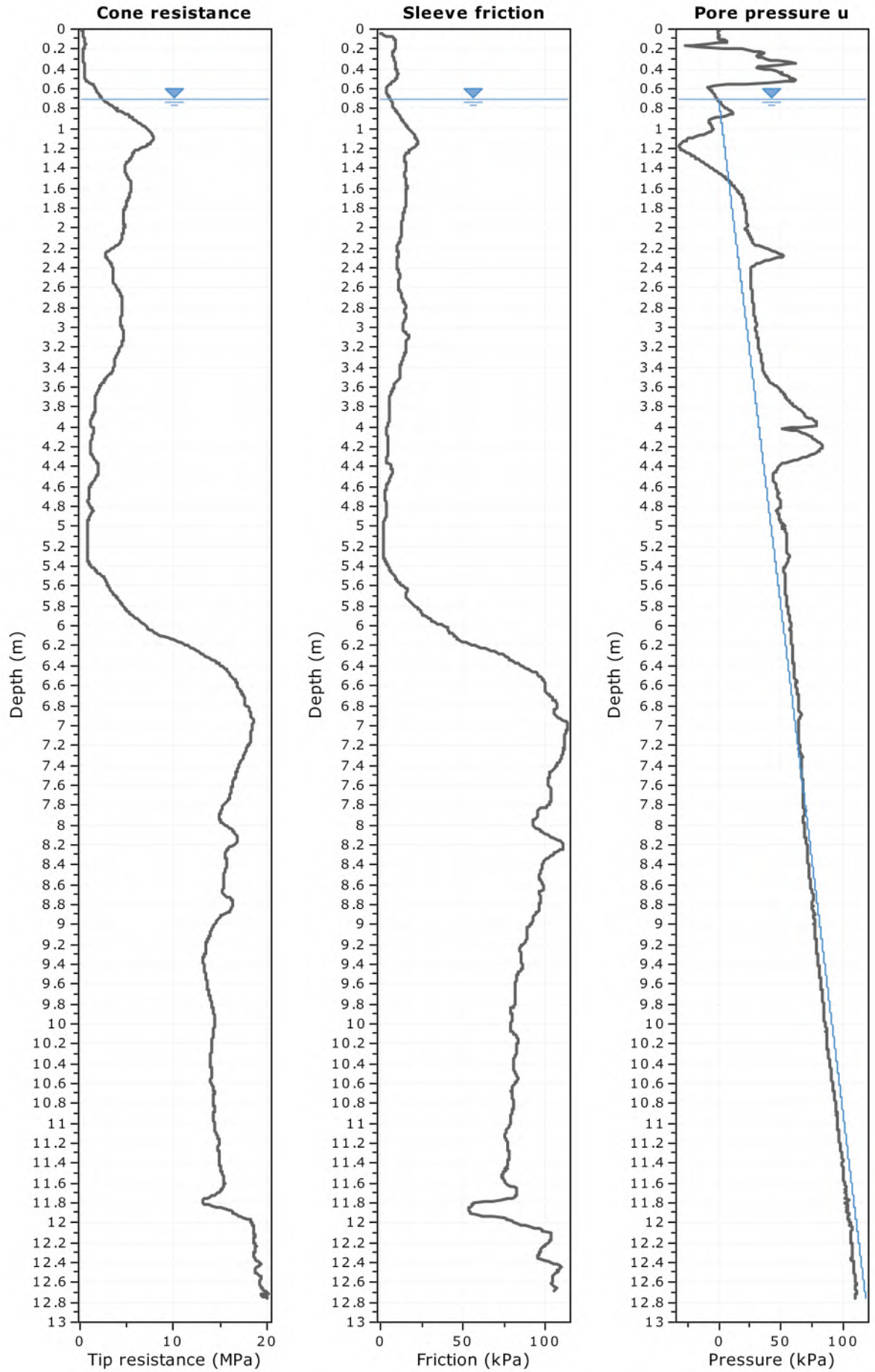
Cone Operator: Newsyd Geotechnical Testing

Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**



REGIONAL GEOTECHNICAL SOLUTIONS

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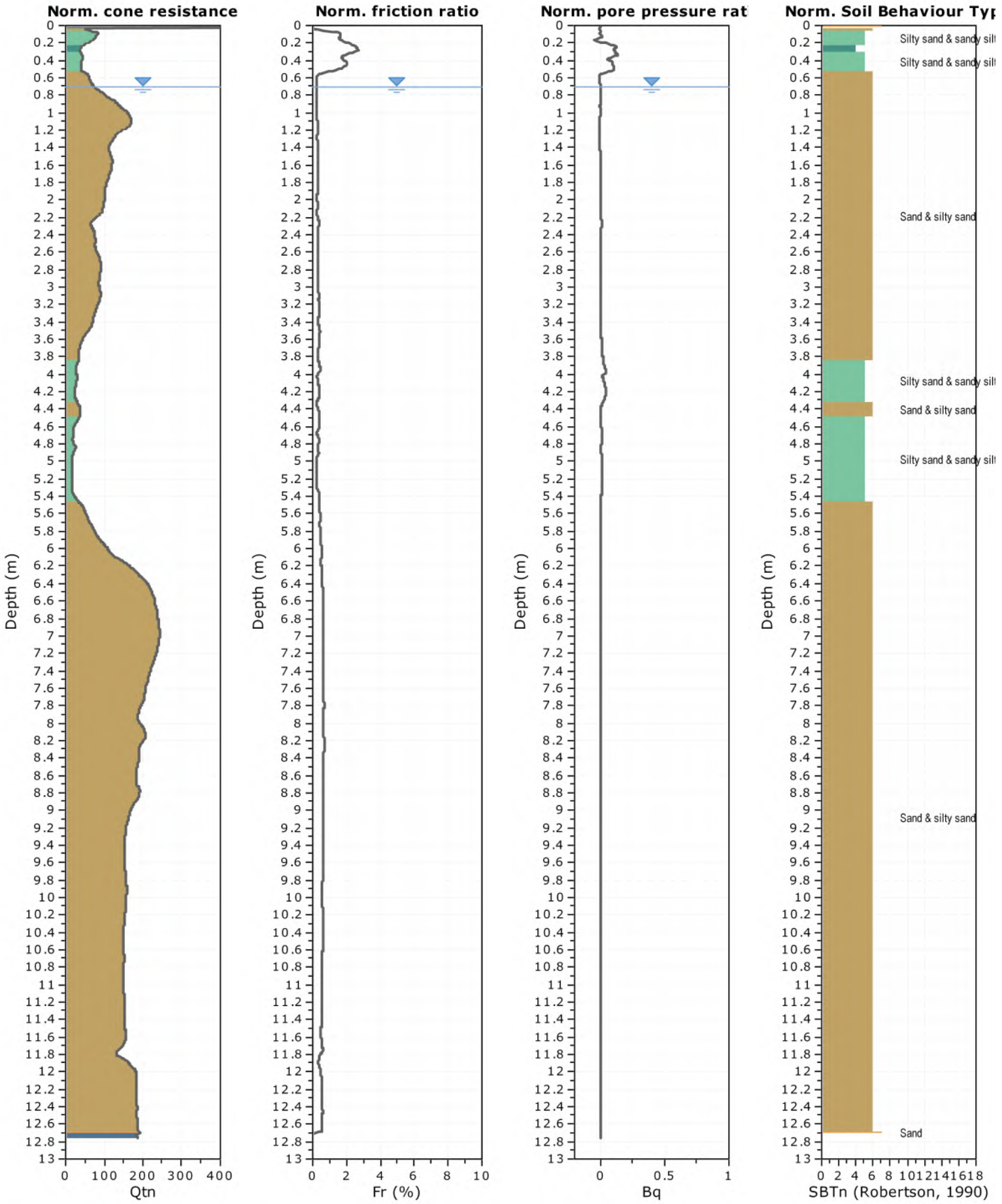
Cone Operator: Newsyd Geotechnical Testing

Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**



REGIONAL GEOTECHNICAL SOLUTIONS

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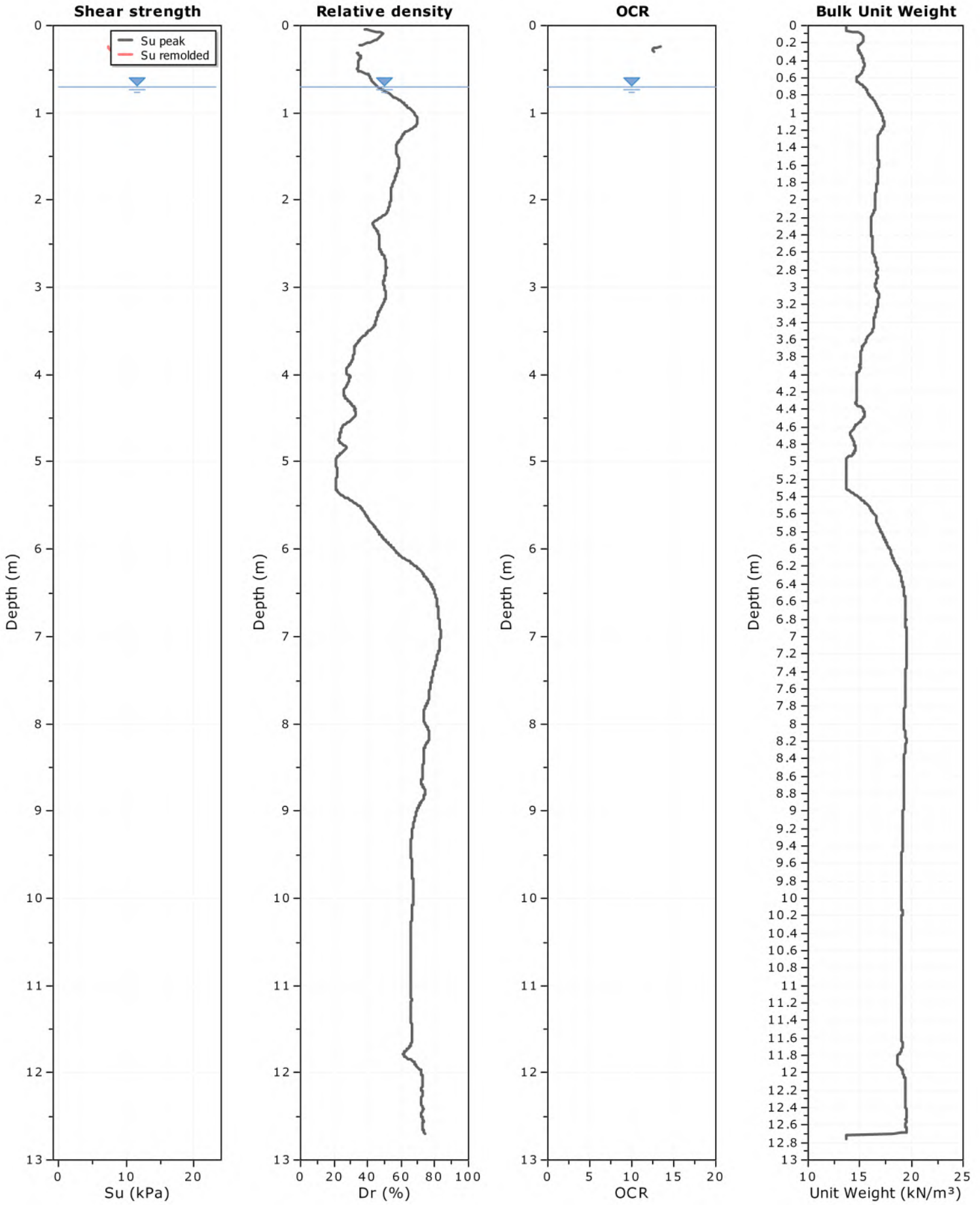
Cone Operator: Newsyd Geotechnical Testing

Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**



REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT4
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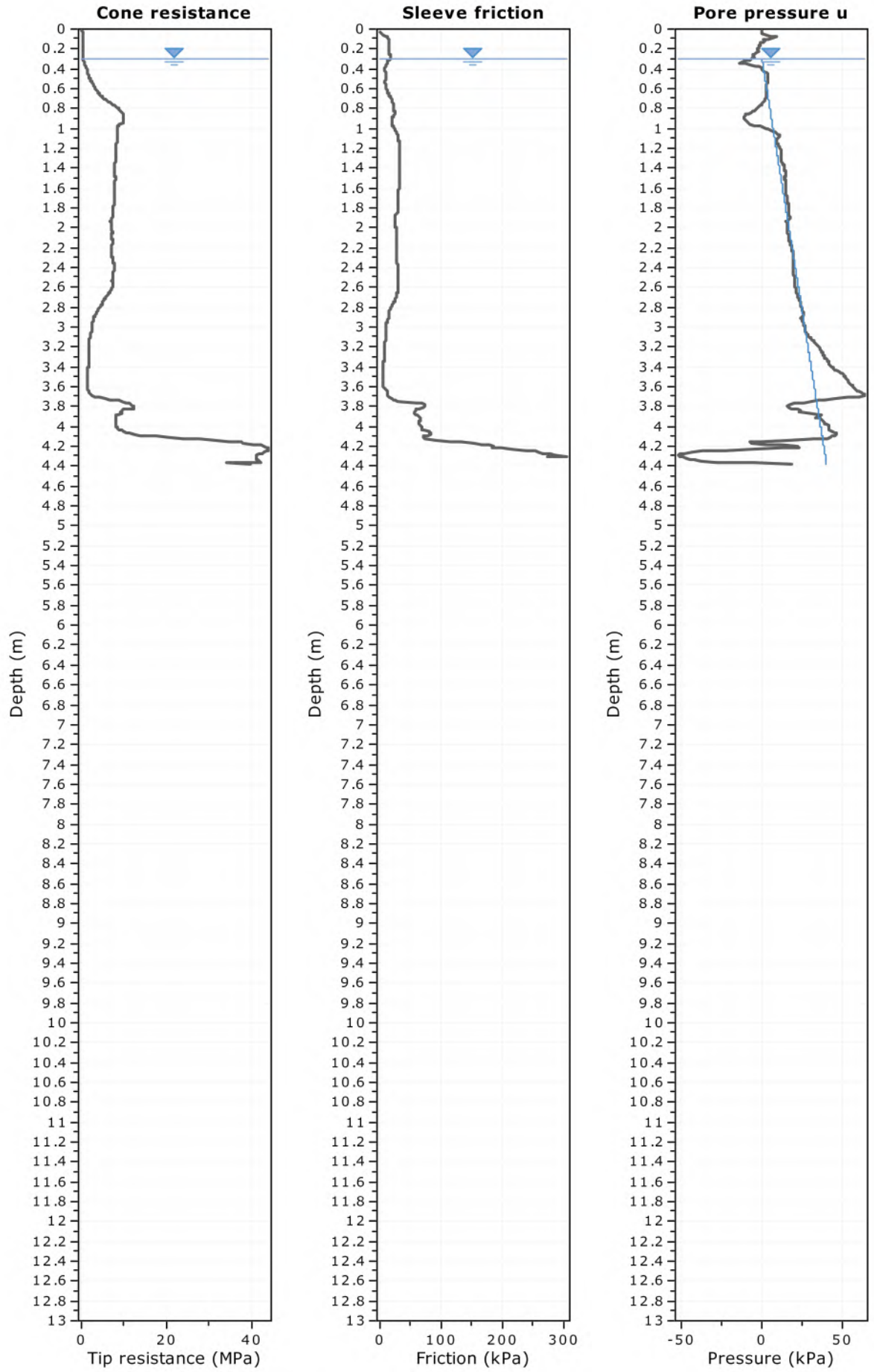
Surface Elevation: 0.00 m
Coords: X:532486.00, Y:6743055.00
Cone Type: C10CFIP.C19137
Cone Operator: Newsyd Geotechnical Testing

Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**



REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT4
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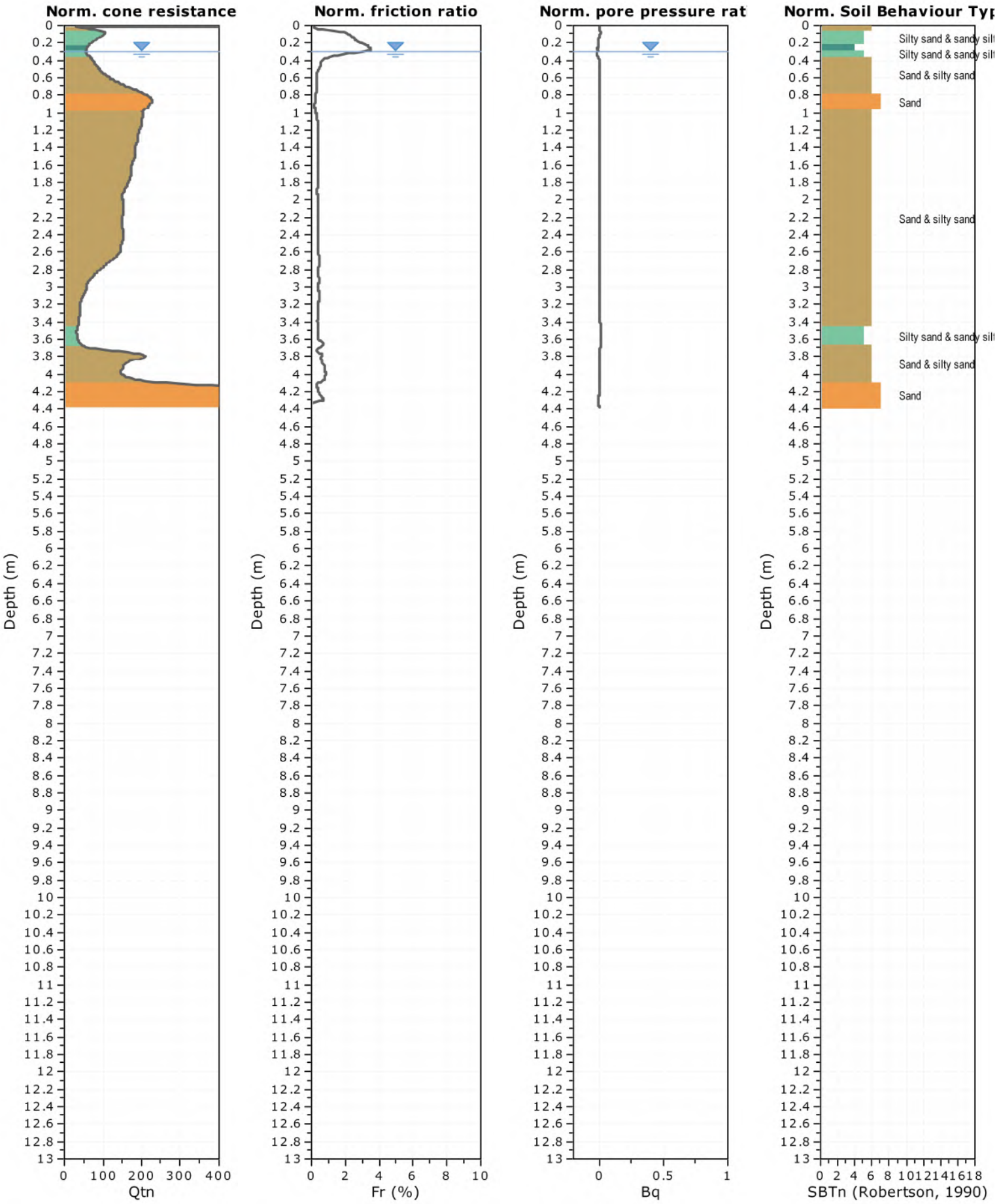
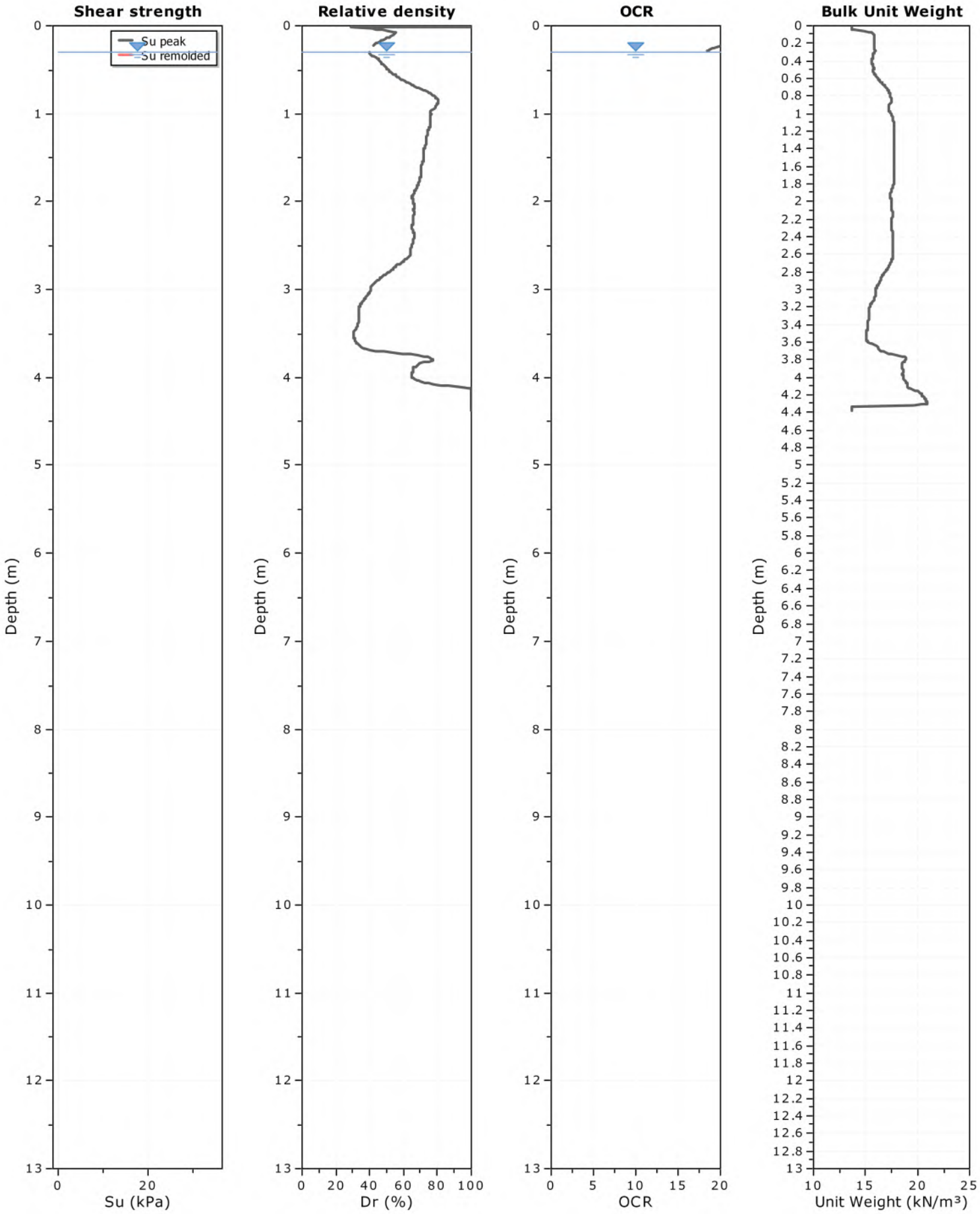
Surface Elevation: 0.00 m
Coords: X:532486.00, Y:6743055.00
Cone Type: C10CFIP.C19137
Cone Operator: Newsyd Geotechnical Testing

Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**

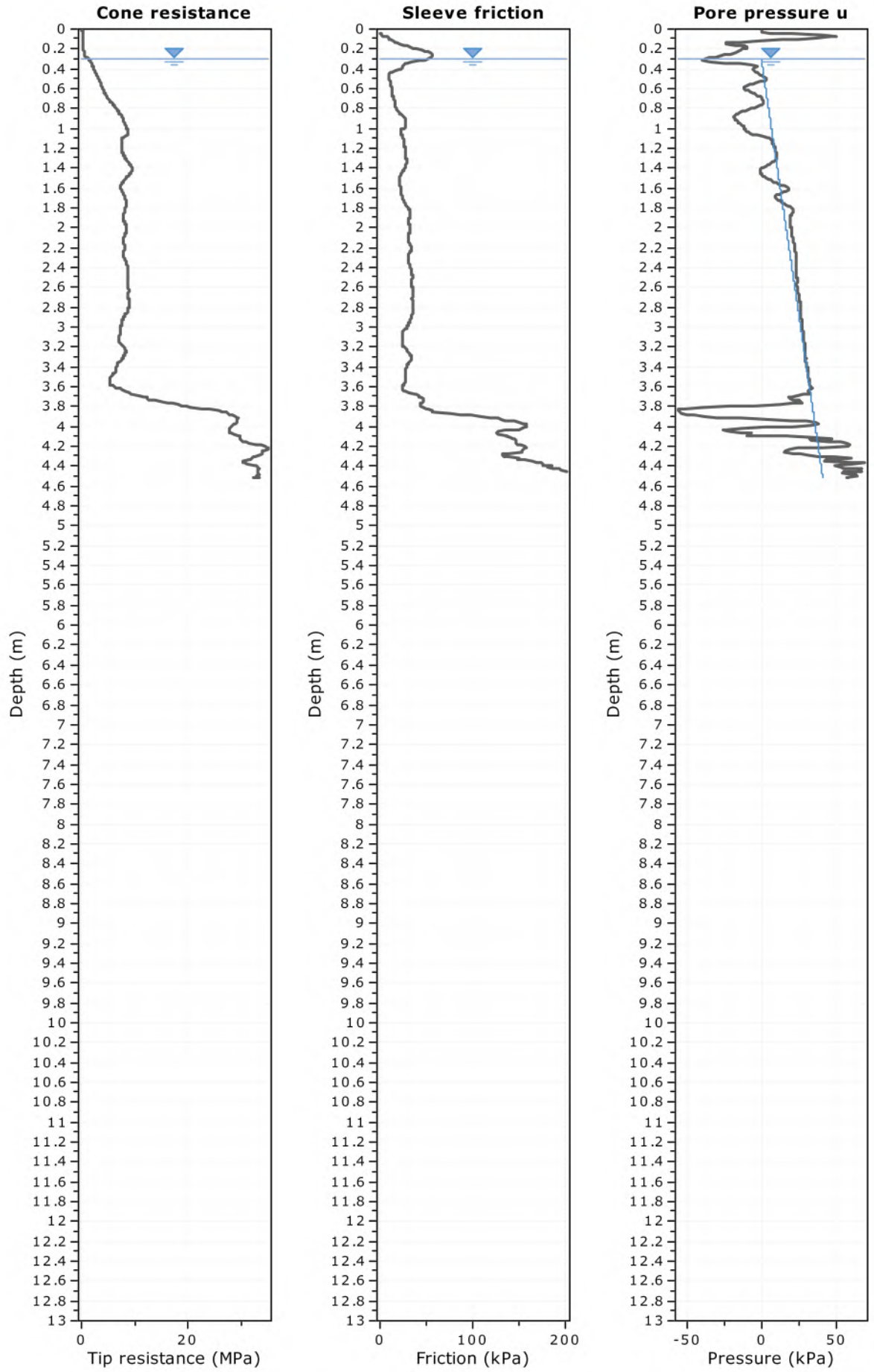



Shear strength
Su peak
Su remolded
Relative density
OCR
Bulk Unit Weight
Depth (m)
Su (kPa)
Dr (%)
OCR
Unit Weight (kN/m³)

REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT4a
Total depth: 4.52 m, Date: 12/07/2022
Surface Elevation: 0.00 m
Coords: X:532478.00, Y:6743033.00
Cone Type: C10CFIP.C19137
Cone Operator: Newsyd Geotechnical Testing

Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**



REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT4a
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Project: **RGS31546.1 Proposed Residential Subdivision**
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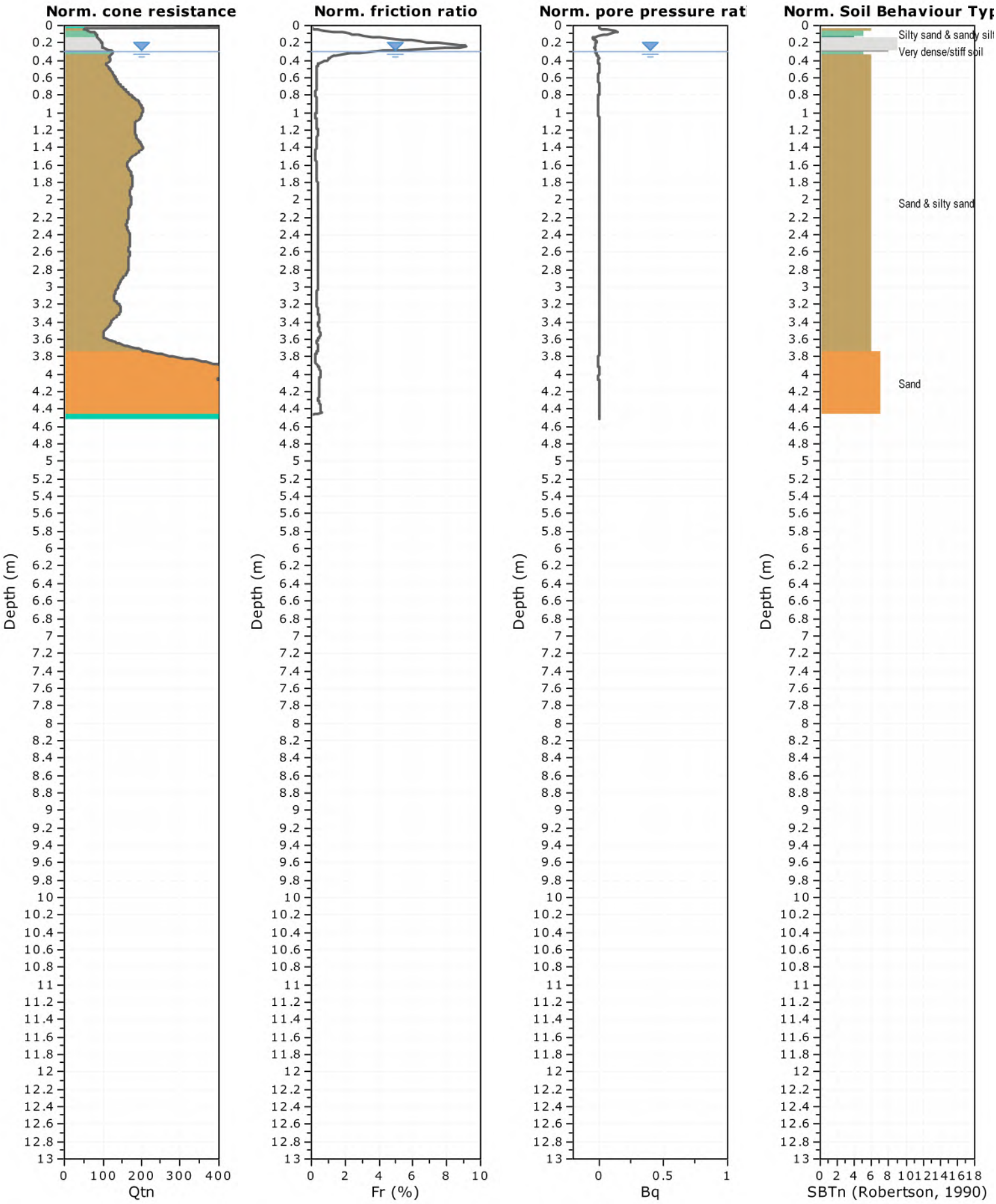
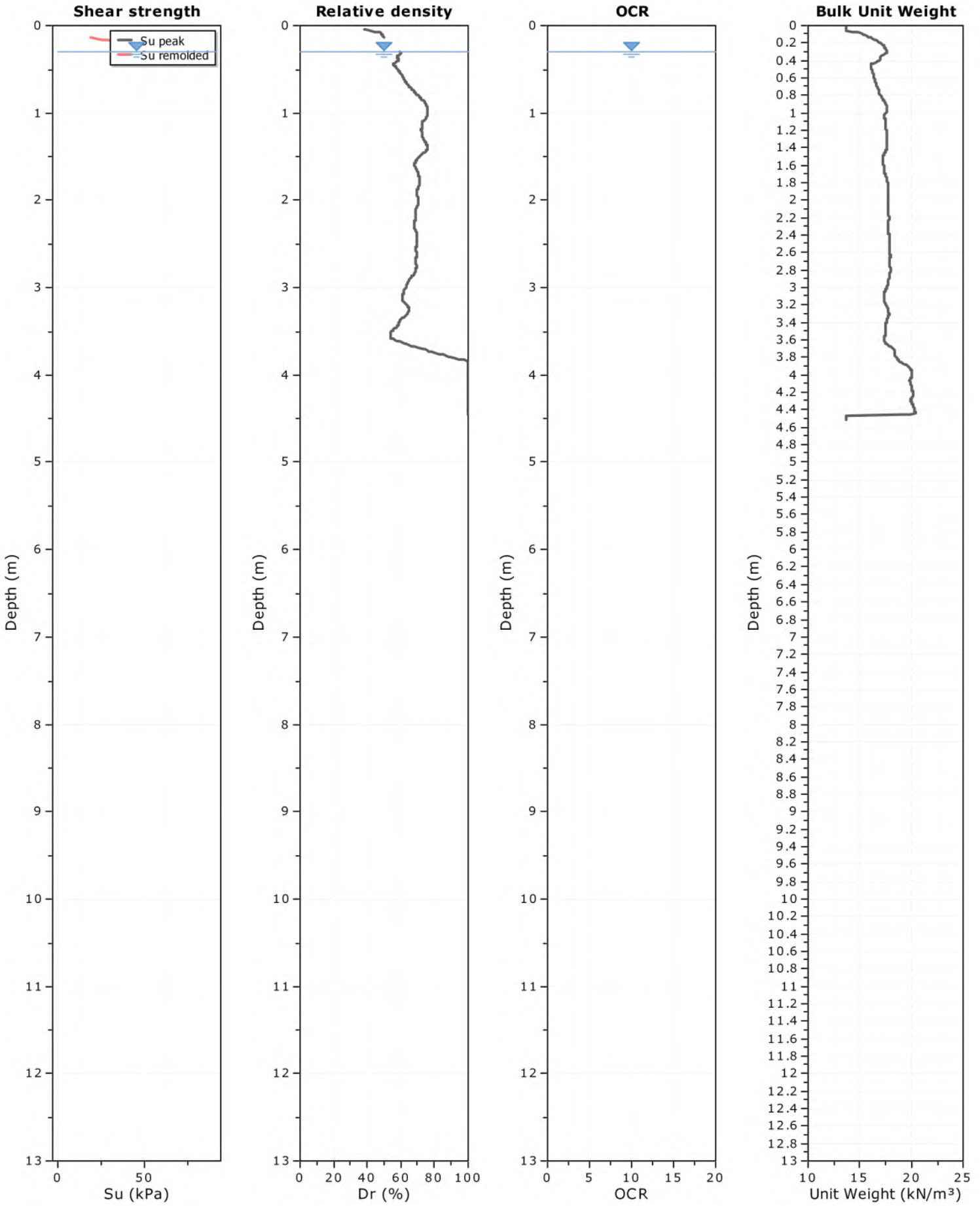
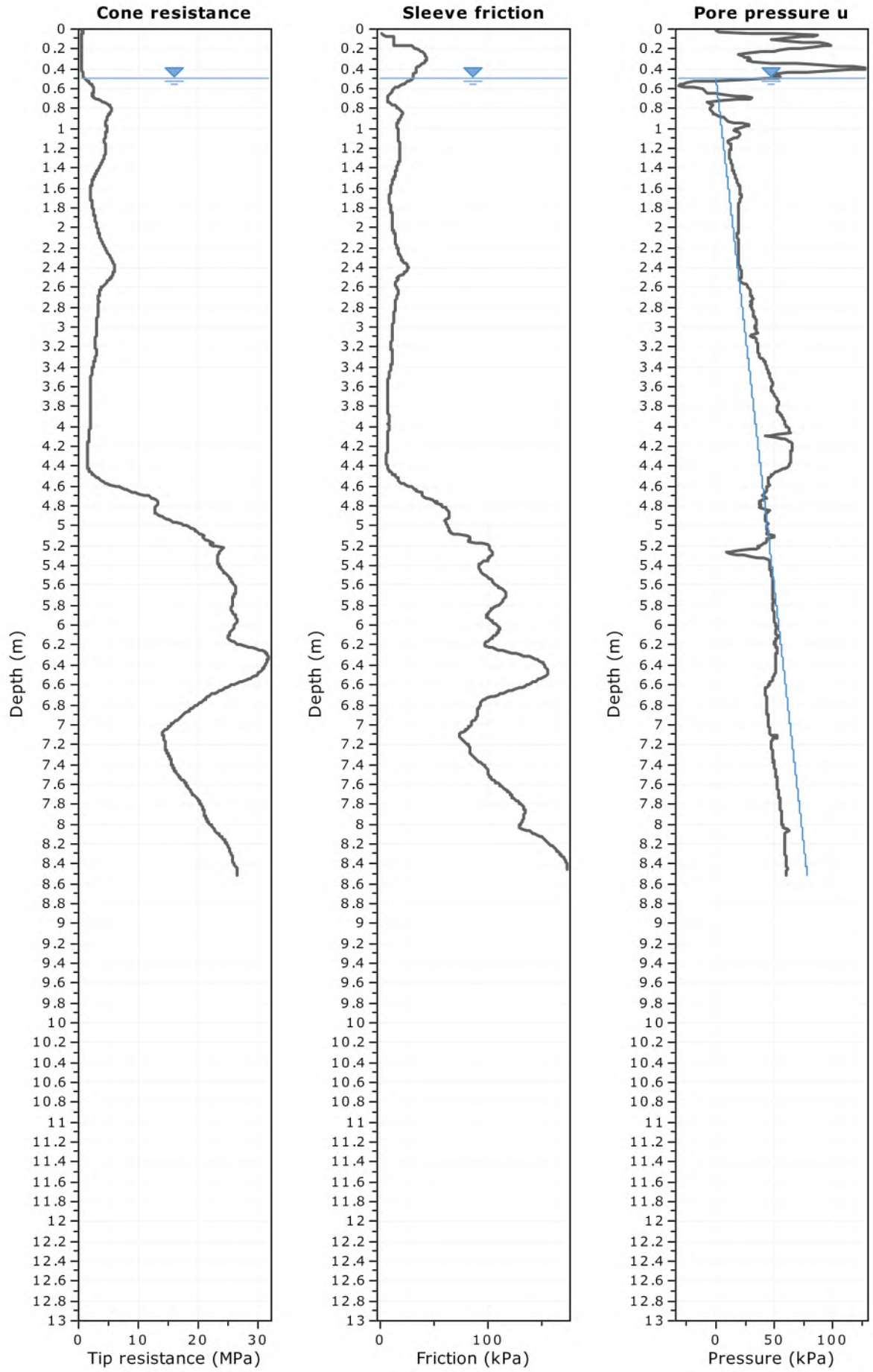



Shear strength
Su peak
Su remolded
Depth (m)
Su (kPa)
Relative density
Dr (%)
OCR
OCR
Bulk Unit Weight
Unit Weight (kN/m³)

REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT5
Total depth: 8.51 m, Date: 12/07/2022
Surface Elevation: 0.00 m
Coords: X:532235.00, Y:6743086.00
Cone Type: C10CFIP.C19137
Cone Operator: Newsyd Geotechnical Testing

Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**



REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT5
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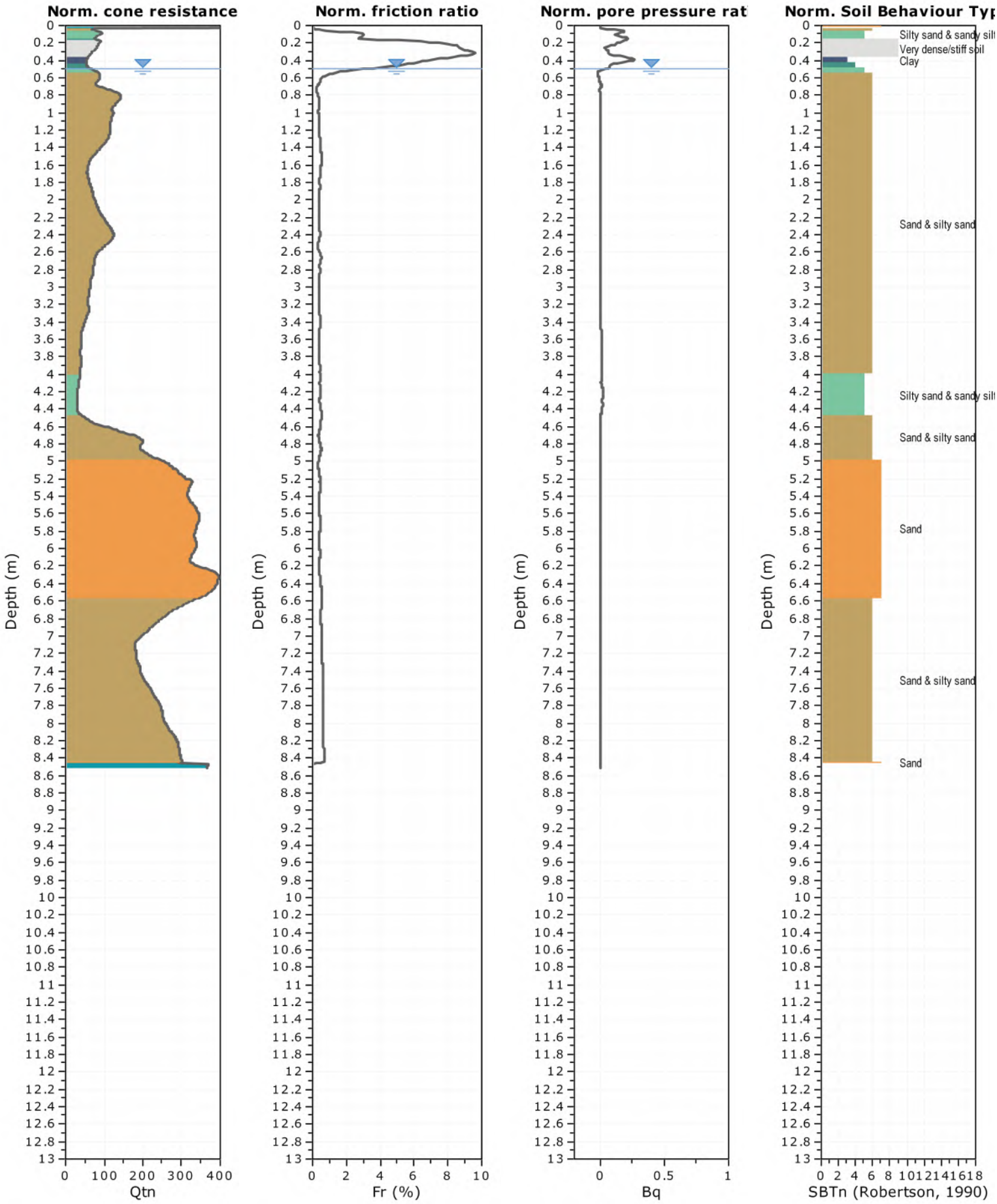
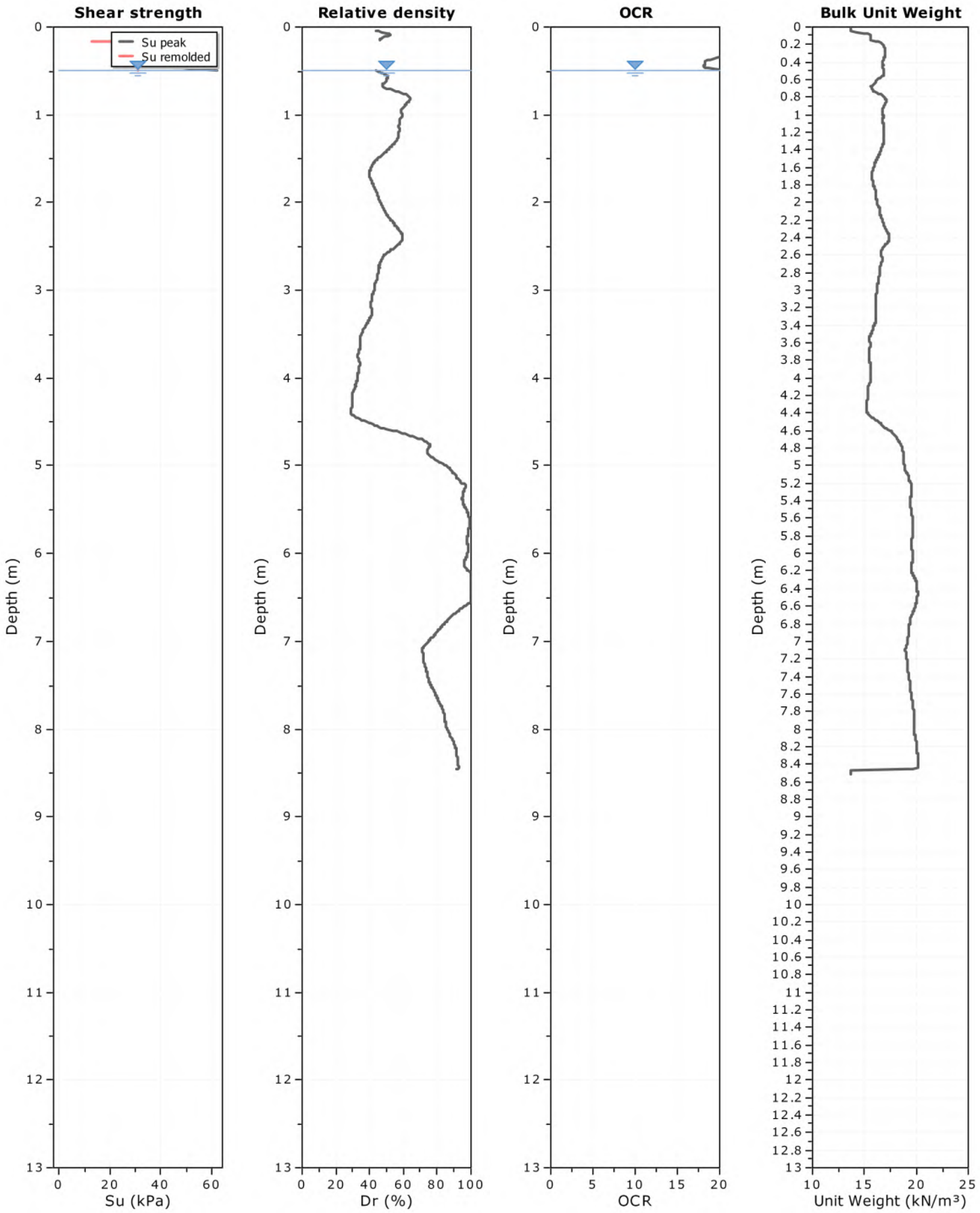
Surface Elevation: 0.00 m
Coords: X:532235.00, Y:6743086.00
Cone Type: C10CFIP.C19137
Cone Operator: Newsyd Geotechnical Testing

Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**




Shear strength
Su peak
Su remolded
Depth (m)
Su (kPa)
Relative density
Dr (%)
OCR
OCR
Bulk Unit Weight
Unit Weight (kN/m³)

REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT6
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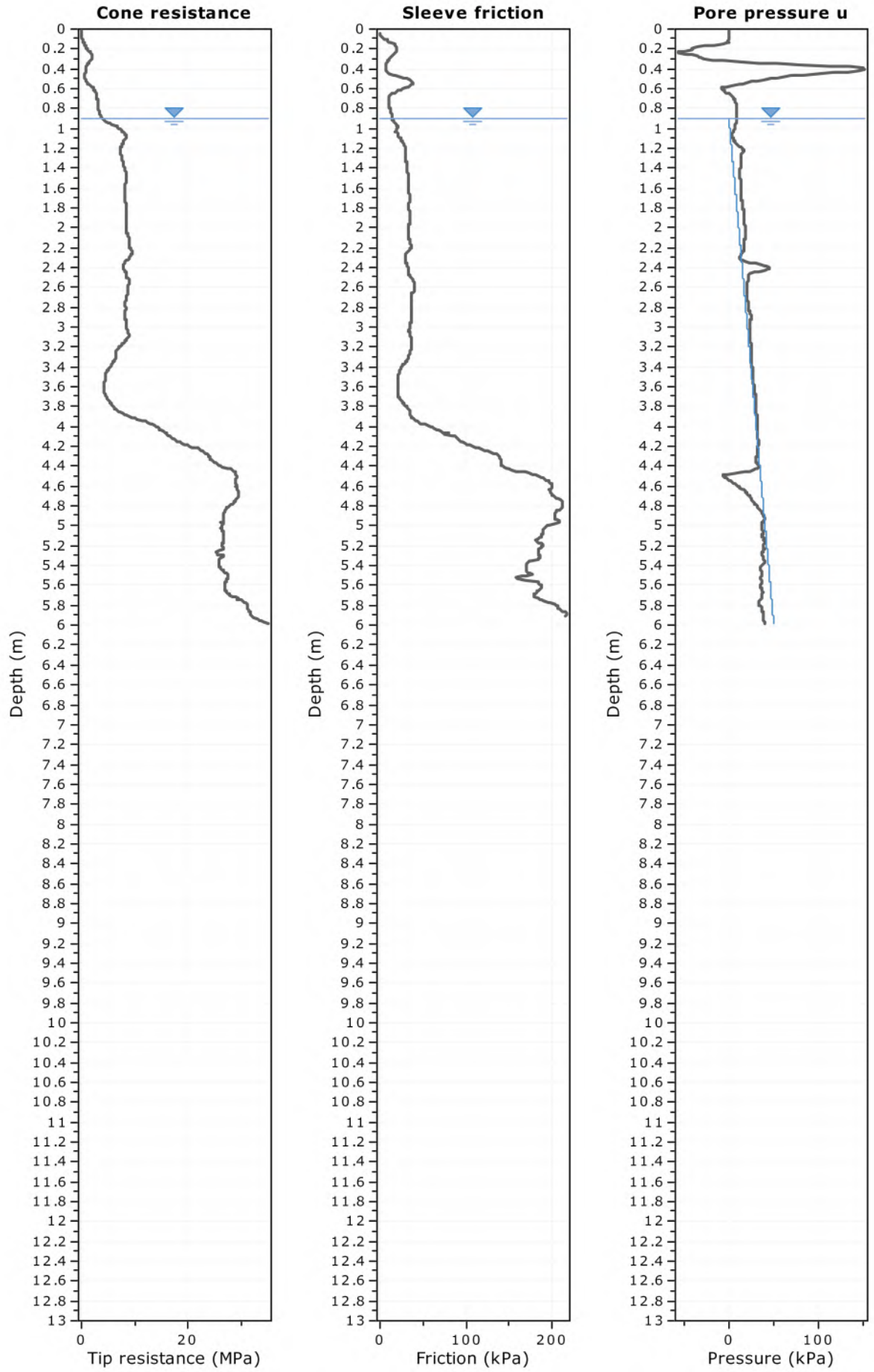
Surface Elevation: 0.00 m
Coords: X:532260.00, Y:6743458.00
Cone Type: C10CFIP.C19137
Cone Operator: Newsyd Geotechnical Testing

Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**



REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT6
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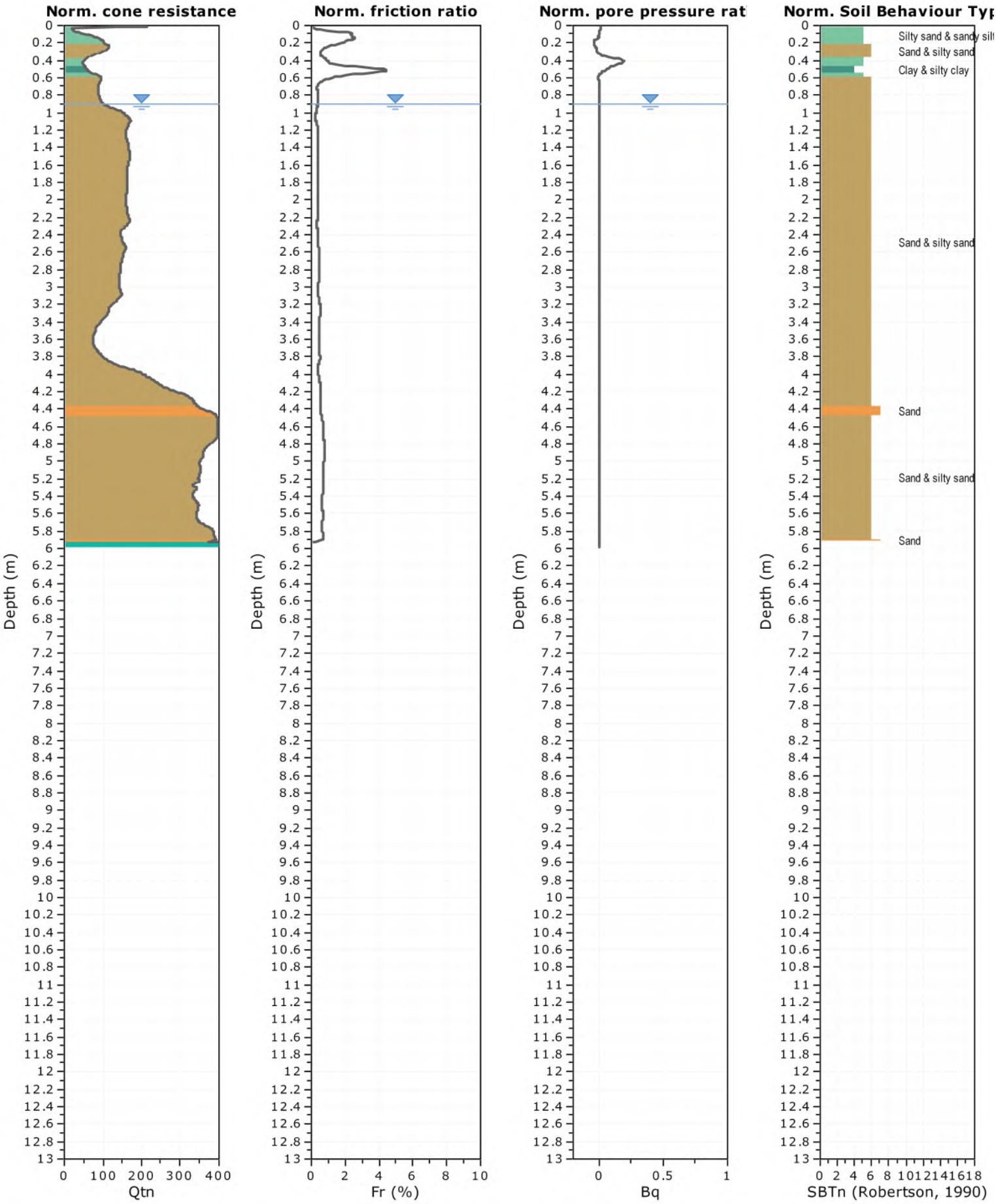
Surface Elevation: 0.00 m
Coords: X:532260.00, Y:6743458.00
Cone Type: C10CFIP.C19137
Cone Operator: Newsyd Geotechnical Testing

Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**



REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT6
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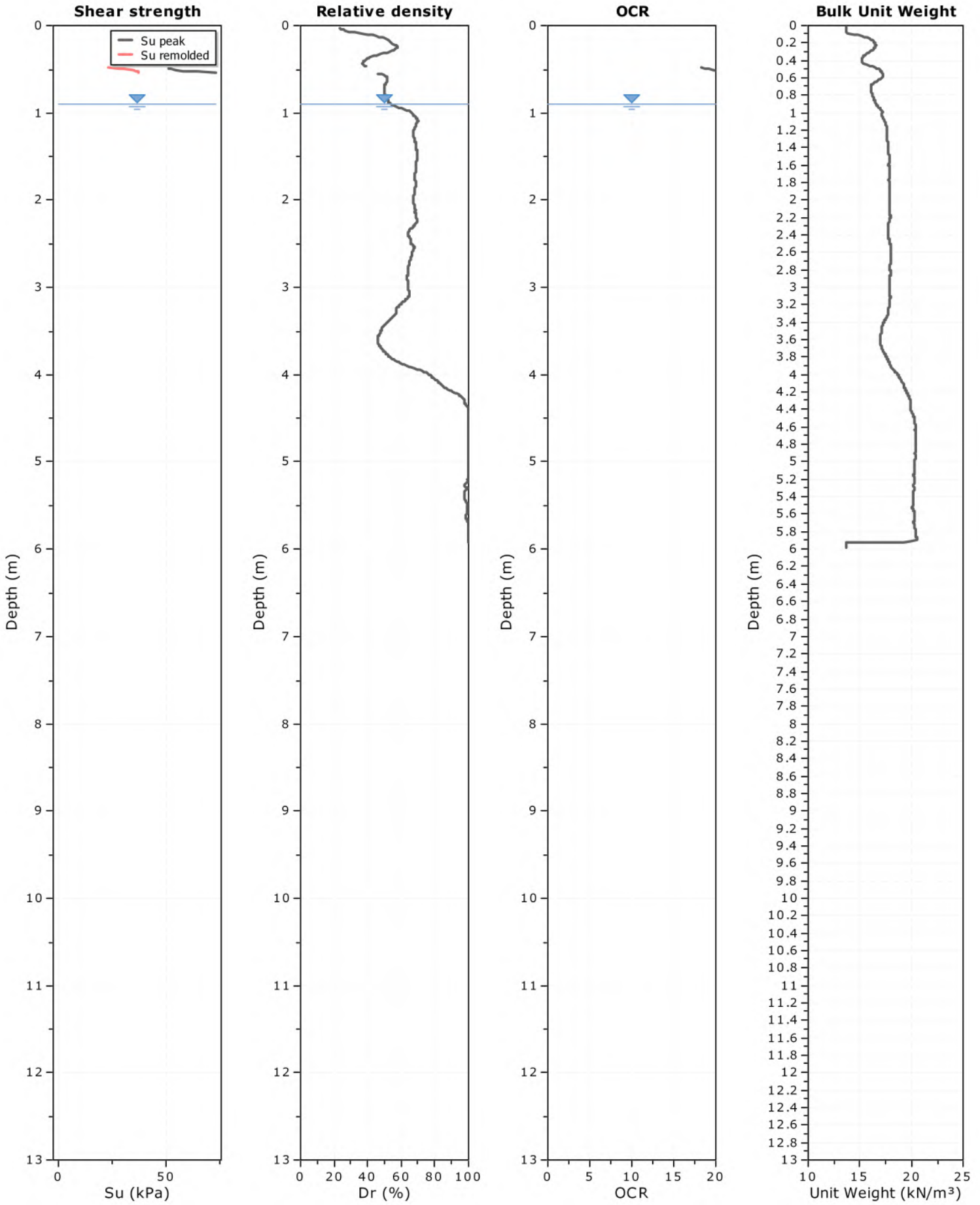
Surface Elevation: 0.00 m
Coords: X:532260.00, Y:6743458.00
Cone Type: C10CFIP.C19137
Cone Operator: Newsyd Geotechnical Testing

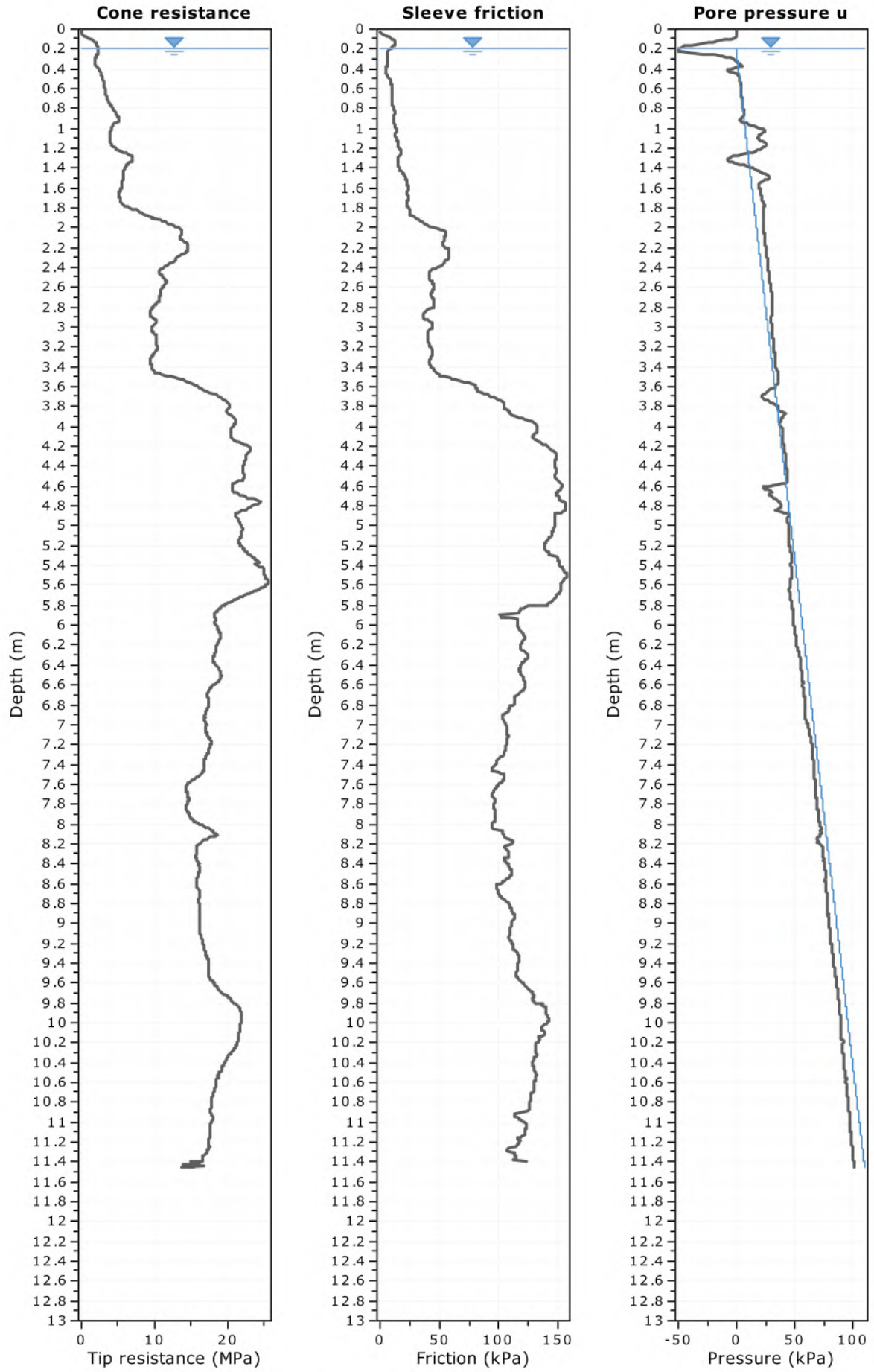
Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**



REGIONAL GEOTECHNICAL SOLUTIONS

CPT: CPT7
Total depth: 11.46 m, Date: 12/07/2022
Surface Elevation: 0.00 m
Coords: X:532561.00, Y:6743407.00
Cone Type: C10CFIP.C19137
Cone Operator: Newsyd Geotechnical Testing

Project: **RGS31546.1 Proposed Residential Subdivision**
Location: **52-54 Miles Street, Yamba**



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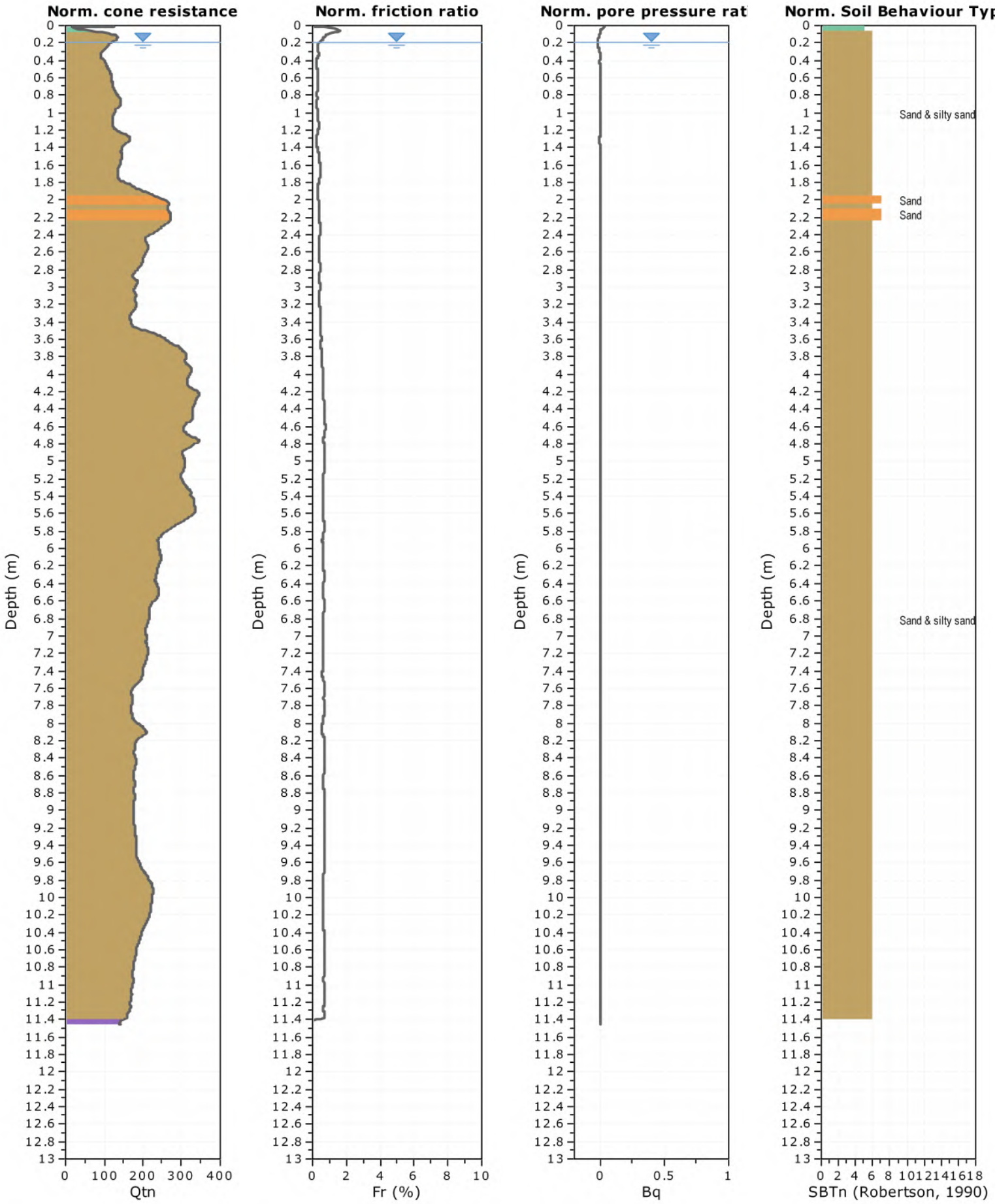

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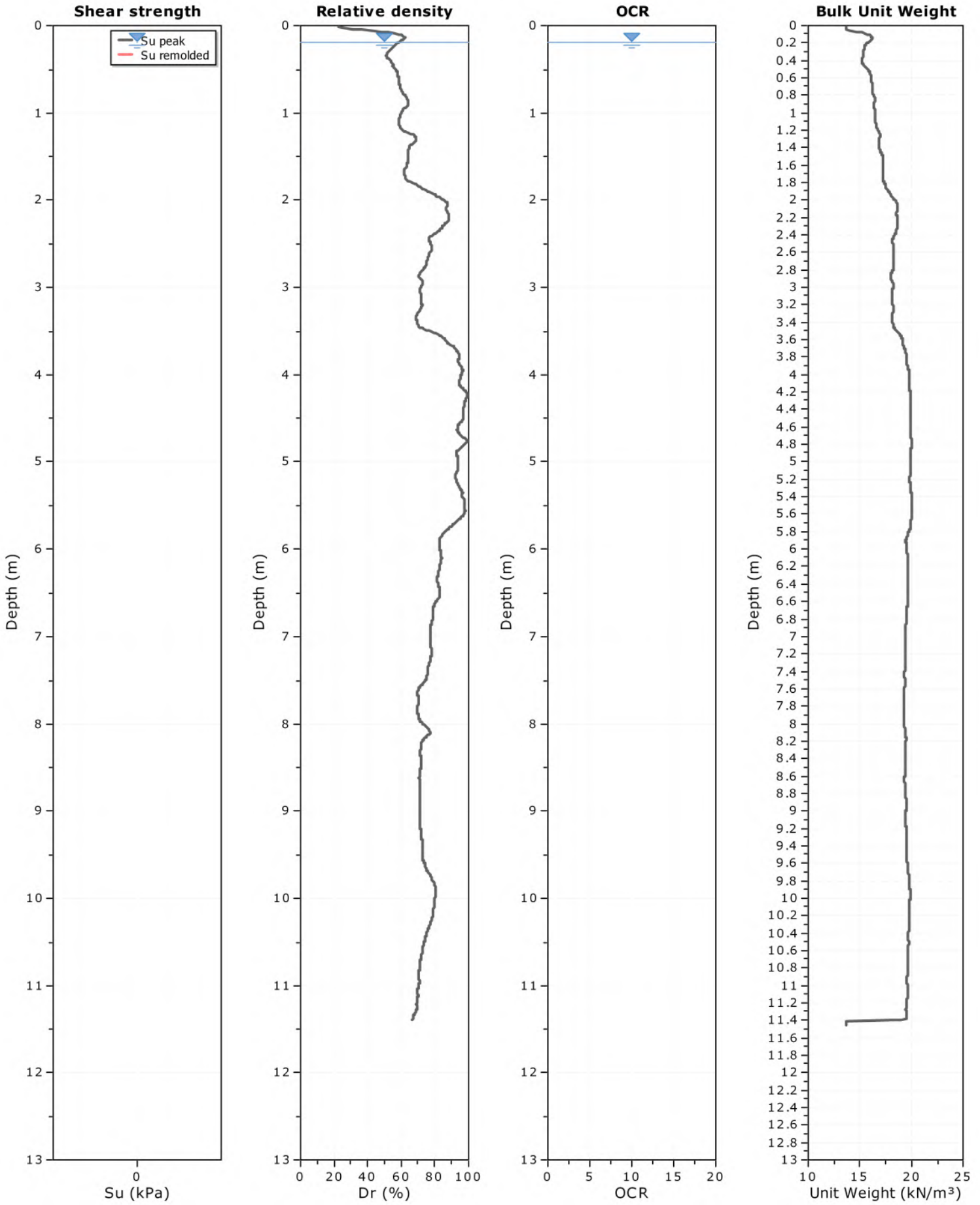

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Memorandum

To	Andrew Fletcher afletcher@surveyorsnorthcoast.com.au	A Fletcher & Associates	
From	Dana Wilson	**Date**	24 Aug 2022
Subject	Interim Results of Groundwater level monitoring Proposed redevelopment of West Yamba Miles and Cox Street, Yamba	**Project No.**	89980.02
		Memo Ref	R.003.Rev0

Monitoring Period	March to July 2022
Monitoring Event	Round 1 interim datalogger download Monitoring to continue three-monthly
Monitoring Locations	Monitoring wells 301, 303, 305, 306 Loggers installed in 302 and 304 in July 2022 and will be downloaded at next quarterly monitoring event Well locations shown on Drawing 1 Bore logs attached
Water Level and Rainfall Plots	Refer Figure 1 (Rev0) It should be noted that groundwater levels are affected by factors such climatic conditions and soil permeability and will therefore vary with time.
Comments	Groundwater levels recorded slightly above ground level for Bores 301, 303, 305 and 306 on 30 March 2022 following/during 162 mm rainfall event. Further trend analysis to be conducted as part of future detailed studies

Douglas Partners Pty Ltd

Dana Wilson

Dana Wilson
Senior Associate

Reviewed by

Scott McFarlane
Principal

Limitations

The above interim advice is provided for the exclusive use of A Fletcher & Associates, agent for Dougherty Bros Pty Ltd. Further details and limitations associated with the work will be provided in our report to follow.

Attachments:
About this Report
Sampling Methods
Soil Descriptions
Symbols and Abbreviations
Borehole Logs (Bores 301 to 306)
Figure 1: Groundwater Level vs Rainfall (March 2022 to July 2022)
Drawing 1 – Test Location Plan

About this Report

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Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Sampling Methods

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Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are generally based on Australian Standard AS1726:2017, Geotechnical Site Investigations. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	19 - 63
Medium gravel	6.7 - 19
Fine gravel	2.36 – 6.7
Coarse sand	0.6 - 2.36
Medium sand	0.21 - 0.6
Fine sand	0.075 - 0.21

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

The proportions of secondary constituents of soils are described as follows:

In fine grained soils (>35% fines)

Term	Proportion of sand or gravel	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	>30%	Sandy Clay
With	15 – 30%	Clay with sand
Trace	0 - 15%	Clay with trace sand

In coarse grained soils (>65% coarse)
- with clays or silts

Term	Proportion of fines	Example
And	Specify	Sand (70%) and Clay (30%)
Adjective	>12%	Clayey Sand
With	5 - 12%	Sand with clay
Trace	0 - 5%	Sand with trace clay

In coarse grained soils (>65% coarse)
- with coarser fraction

Term	Proportion of coarser fraction	Example
And	Specify	Sand (60%) and Gravel (40%)
Adjective	>30%	Gravelly Sand
With	15 - 30%	Sand with gravel
Trace	0 - 15%	Sand with trace gravel

The presence of cobbles and boulders shall be specifically noted by beginning the description with ‘Mix of Soil and Cobbles/Boulders’ with the word order indicating the dominant first and the proportion of cobbles and boulders described together.

Soil Descriptions

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	VS	<12
Soft	S	12 - 25
Firm	F	25 - 50
Stiff	St	50 - 100
Very stiff	VSt	100 - 200
Hard	H	>200
Friable	Fr	-

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	Density Index (%)
Very loose	VL	<15
Loose	L	15-35
Medium dense	MD	35-65
Dense	D	65-85
Very dense	VD	>85

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Extremely weathered material – formed from in-situ weathering of geological formations. Has soil strength but retains the structure or fabric of the parent rock;
- Alluvial soil – deposited by streams and rivers;
- Estuarine soil – deposited in coastal estuaries;
- Marine soil – deposited in a marine environment;
- Lacustrine soil – deposited in freshwater lakes;
- Aeolian soil – carried and deposited by wind;
- Colluvial soil – soil and rock debris transported down slopes by gravity;
- Topsoil – mantle of surface soil, often with high levels of organic material.
- Fill – any material which has been moved by man.

Moisture Condition – Coarse Grained Soils

For coarse grained soils the moisture condition should be described by appearance and feel using the following terms:

- Dry (D) Non-cohesive and free-running.
- Moist (M) Soil feels cool, darkened in colour.
  Soil tends to stick together.
  Sand forms weak ball but breaks easily.
- Wet (W) Soil feels cool, darkened in colour.
  Soil tends to stick together, free water forms when handling.

Moisture Condition – Fine Grained Soils

For fine grained soils the assessment of moisture content is relative to their plastic limit or liquid limit, as follows:

- ‘Moist, dry of plastic limit’ or ‘w <PL’ (i.e. hard and friable or powdery).
- ‘Moist, near plastic limit’ or ‘w ≈ PL (i.e. soil can be moulded at moisture content approximately equal to the plastic limit).
- ‘Moist, wet of plastic limit’ or ‘w >PL’ (i.e. soils usually weakened and free water forms on the hands when handling).
- ‘Wet’ or ‘w ≈LL’ (i.e. near the liquid limit).
- ‘Wet’ or ‘w >LL’ (i.e. wet of the liquid limit).

Symbols & Abbreviations

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Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	Pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	Lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

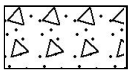
Symbols & Abbreviations

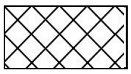
Graphic Symbols for Soil and Rock

General

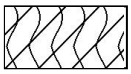

Asphalt

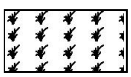

Road base

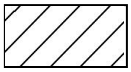

Concrete

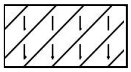

Filling

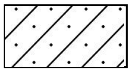
Soils


Topsoil

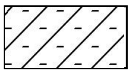

Peat

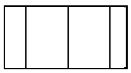

Clay

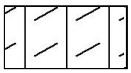

Silty clay

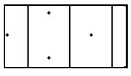

Sandy clay

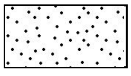

Gravelly clay

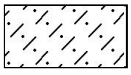

Shaly clay

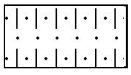

Silt


Clayey silt


Sandy silt

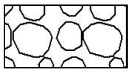

Sand

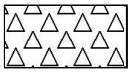

Clayey sand


Silty sand


Gravel

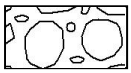

Sandy gravel


Cobbles, boulders

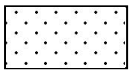

Talus

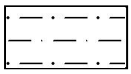
Sedimentary Rocks

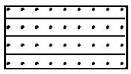

Boulder conglomerate

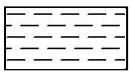

Conglomerate


Conglomeratic sandstone

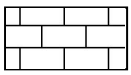

Sandstone


Siltstone

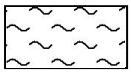

Laminite

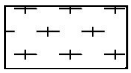

Mudstone, claystone, shale

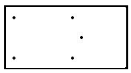

Coal


Limestone

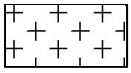
Metamorphic Rocks

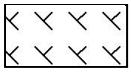

Slate, phyllite, schist

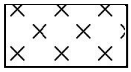

Gneiss

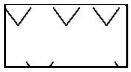

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

BOREHOLE LOG

CLIENT: Dougherty Bros Pty Ltd c/- A Fletcher
PROJECT: Proposed Development of West Yamba
LOCATION: Miles and Cox Street, Yamba

SURFACE LEVEL: 1.46 AHD
EASTING: 532341.2
NORTHING: 6743904.6
DIP/AZIMUTH: 90°/--

BORE No: 301
PROJECT No: 89980.02
DATE: 16/2/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	FILL - Silty sand, moist		D	0.1	E			Stickup = 0.78m From 0m to 0.2m, concrete From 0m to 0.4m, 50mm Diameter Class 18 PVC blank From 0.2m to 0.4m, bentonite
	0.6	CLAY - Orange-brown, possible fill, M>Wp		D	0.5	E		▼	
	1	SAND - Light grey, fine to medium grained, saturated		D	1.0	E			From 0.4m to 2.9m, gravel From 0.4m to 2.9m, 50mm Diameter Class 18 PVC Screen
	2			D	1.5	E			
	2.5	Trace silt from 2.5m SILTY SAND - Brown, fine to medium (possibly indurated), saturated		D	2.0	E			
	3			D	2.5	E			End Cap
	3.0	Bore discontinued at 3.0m, limit of investigation		D	3.0	E			

RIG: Ground Test 100 **DRILLER:** Hickman **LOGGED:** Hickman **CASING:** HW to 3.0m

TYPE OF BORING: Solid flight auger with TC-bit, rotary with mud to termination

WATER OBSERVATIONS: Free groundwater observed from about 0.6m

REMARKS: Bore flushed following piezometer installation. Top of PVC casing level 2.24 AHD. Well completed with above ground monument.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Dougherty Bros Pty Ltd c/- A Fletcher
PROJECT: Proposed Development of West Yamba
LOCATION: Miles and Cox Street, Yamba

SURFACE LEVEL: 1.38 AHD
EASTING: 532870
NORTHING: 6743768
DIP/AZIMUTH: 90°/--

BORE No: 302
PROJECT No: 89980.02
DATE: 1/7/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	TOPSOIL - Dark grey clayey silt, M=Wp		D	0.1	E			Stickup = 0.96m From 0m to 0.2m, concrete
		SILTY SAND - Brown, fine to medium, wet		D	0.5	E			From 0.2m to 0.5m, bentonite
								▼	From 0m to 1.45m, 50mm Diameter Class 18 PVC blank
	1.5	SAND - Light grey, fine to medium, saturated		D	1.0	E			From 0.5m to 2.95m, gravel
				D	2.0	E			From 1.45m to 2.95m, Class 18 PVC Screen with stainless steel exterior mesh (pre-packed screen)
	3.0	Bore discontinued at 3.0m, limit of investigation		D	3.0	E			End Cap

RIG: Ground Test 100 **DRILLER:** Hickman **LOGGED:** Hickman **CASING:** HW to 3.0m

TYPE OF BORING: Solid flight auger with TC-bit, rotary with mud to termination

WATER OBSERVATIONS: Free groundwater observed from about 0.8m

REMARKS: Bore flushed following piezometer installation. Top of PVC casing level 2.33 AHD. Well completed with above ground monument.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Dougherty Bros Pty Ltd c/- A Fletcher
PROJECT: Proposed Development of West Yamba
LOCATION: Miles and Cox Street, Yamba

SURFACE LEVEL: 1.60 AHD
EASTING: 533071.8
NORTHING: 6743343.9
DIP/AZIMUTH: 90°/--

BORE No: 303
PROJECT No: 89980.02
DATE: 20/12/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		TOPSOIL - Dark brown sandy silt grass covered, moist		D	0.1	E			Stickup = 0.73m From 0m to 0.2m, concrete
	0.2	SAND - Light grey fine to medium grained sand, moist		D	0.5	E		▼	From 0.2m to 1m, bentonite
	1			D	1.0	E			From 0m to 2.0m, 50mm Diameter Class 18 PVC blank
				D	1.5	E			
	2								From 1.0m to 4.0m, gravel
	3								From 2.0m to 4.0m, 50mm Diameter Class 18 PVC Screen
	3.5	SILTY SAND - Brown, fine to medium indurated							
	4				4.0				End Cap
				S			4,6,8 N = 14		
	4.45	Bore discontinued at 4.45m, limit of investigation			4.45				

RIG: Ground Test 100 **DRILLER:** Hickman **LOGGED:** Hickman **CASING:** HW to 4.0m

TYPE OF BORING: Solid flight auger with TC-bit, rotary with mud to termination

WATER OBSERVATIONS: Free groundwater observed from about 0.6m

REMARKS: Bore flushed following piezometer installation. Top of PVC casing level 2.32 AHD. Well completed with above ground monument.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Dougherty Bros Pty Ltd c/- A Fletcher
PROJECT: Proposed Development of West Yamba
LOCATION: Miles and Cox Street, Yamba

SURFACE LEVEL: 1.12 AHD
EASTING: 532978
NORTHING: 6742887
DIP/AZIMUTH: 90°/--

BORE No: 304
PROJECT No: 89980.02
DATE: 30/6/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
1		CLAYEY SILT - Dark grey, M>Wp		D	0.1	E			Stickup = 0.71m From 0m to 0.2m, concrete
	0.2	SAND - Fine to medium, grey, wet							
		From 0.5m, becoming red brown, saturated		D	0.5	E		▼	From 0.2m to 0.8m, bentonite
0	1			D	1.0	E			From 0m to 1.5m, 50mm Diameter Class 18 PVC blank
				D	1.5	E			
-1	2			D	2.0	E			From 0.8m to 3.0m, gravel
									From 1.5m to 3.0m, Class 18 PVC Screen with stainless steel exterior mesh (pre-packed screen)
	3			D	3.0	E			End Cap
-2	3.0	Bore discontinued at 3.0m, limit of investigation							
	4								
-3									

RIG: Ground Test 100 **DRILLER:** Hickman **LOGGED:** Hickman **CASING:** HW to 3.0m

TYPE OF BORING: Solid flight auger with TC-bit, rotary with mud to termination

WATER OBSERVATIONS: Free groundwater observed from about 0.7m

REMARKS: Bore flushed following piezometer installation. Top of PVC casing level 1.83 AHD. Well completed with above ground monument.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Dougherty Bros Pty Ltd c/- A Fletcher
PROJECT: Proposed Development of West Yamba
LOCATION: Miles and Cox Street, Yamba

SURFACE LEVEL: 1.43 AHD
EASTING: 532668.1
NORTHING: 6743414.3
DIP/AZIMUTH: 90°/--

BORE No: 305
PROJECT No: 89980.02
DATE: 20/12/2021
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.2	TOPSOIL / Silty Sand - Dark brown sandy silt, grass covered, moist		D	0.1	E			Stickup = 0.78m From 0m to 0.2m, concrete
		SAND - Light grey fine to medium grained sand, trace silt, wet							From 0.2m to 0.5m, bentonite
		From 0.4m, saturated		D	0.5	E		▼	From 0m to 1.0m, 50mm Diameter Class 18 PVC blank
	1			D	1.0	E			
				D	1.5	E			
	2								From 0.5m to 4.0m, gravel
									From 1.0m to 4.0m, 50mm Diameter Class 18 PVC Screen
	3								
	4				4.0				End Cap
				S			5,7,9 N = 16		
	4.45	Bore discontinued at 4.45m, limit of investigation			4.45				

RIG: Ground Test 100 **DRILLER:** Hickman **LOGGED:** Hickman **CASING:** HW to 4.0m

TYPE OF BORING: Solid flight auger with TC-bit, rotary with mud to termination

WATER OBSERVATIONS: Free groundwater observed from about 0.4m

REMARKS: Bore flushed following piezometer installation. Top of PVC casing level 2.21 AHD. Well completed with above ground monument.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Dougherty Bros Pty Ltd c/- A Fletcher
PROJECT: Proposed Development of West Yamba
LOCATION: Miles and Cox Street, Yamba

SURFACE LEVEL: 1.23 AHD
EASTING: 532176.6
NORTHING: 6742969.9
DIP/AZIMUTH: 90°/--

BORE No: 306
PROJECT No: 89980.02
DATE: 16/2/2022
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.3	TOPSOIL - Sandy silt, dark grey, saturated		D	0.1	E		▼	Stickup = 0.89m From 0m to 0.2m, concrete
		SAND - Grey, fine to medium grained, trace silt, saturated		D	0.5	E			From 0m to 0.5m, 50mm Diameter Class 18 PVC blank From 0m to 0.5m, bentonite
	1			D	1.0	E			1
				D	1.5	E			
	2			D	2.0	E			2 From 0.5m to 3.0m, gravel From 0.5m to 3.0m, 50mm Diameter Class 18 PVC Screen
				D	2.5	E			
	3								3 End Cap
	3.0	Bore discontinued at 3.0m, limit of investigation		D	3.0	E			
	4								4

RIG: Ground Test 100 **DRILLER:** Hickman **LOGGED:** Hickman **CASING:** HW to 3.0m

TYPE OF BORING: Solid flight auger with TC-bit, rotary with mud to termination

WATER OBSERVATIONS: Free groundwater observed from about 0.2m

REMARKS: Bore flushed following piezometer installation. Top of PVC casing level 2.12 AHD. Well completed with above ground monument.

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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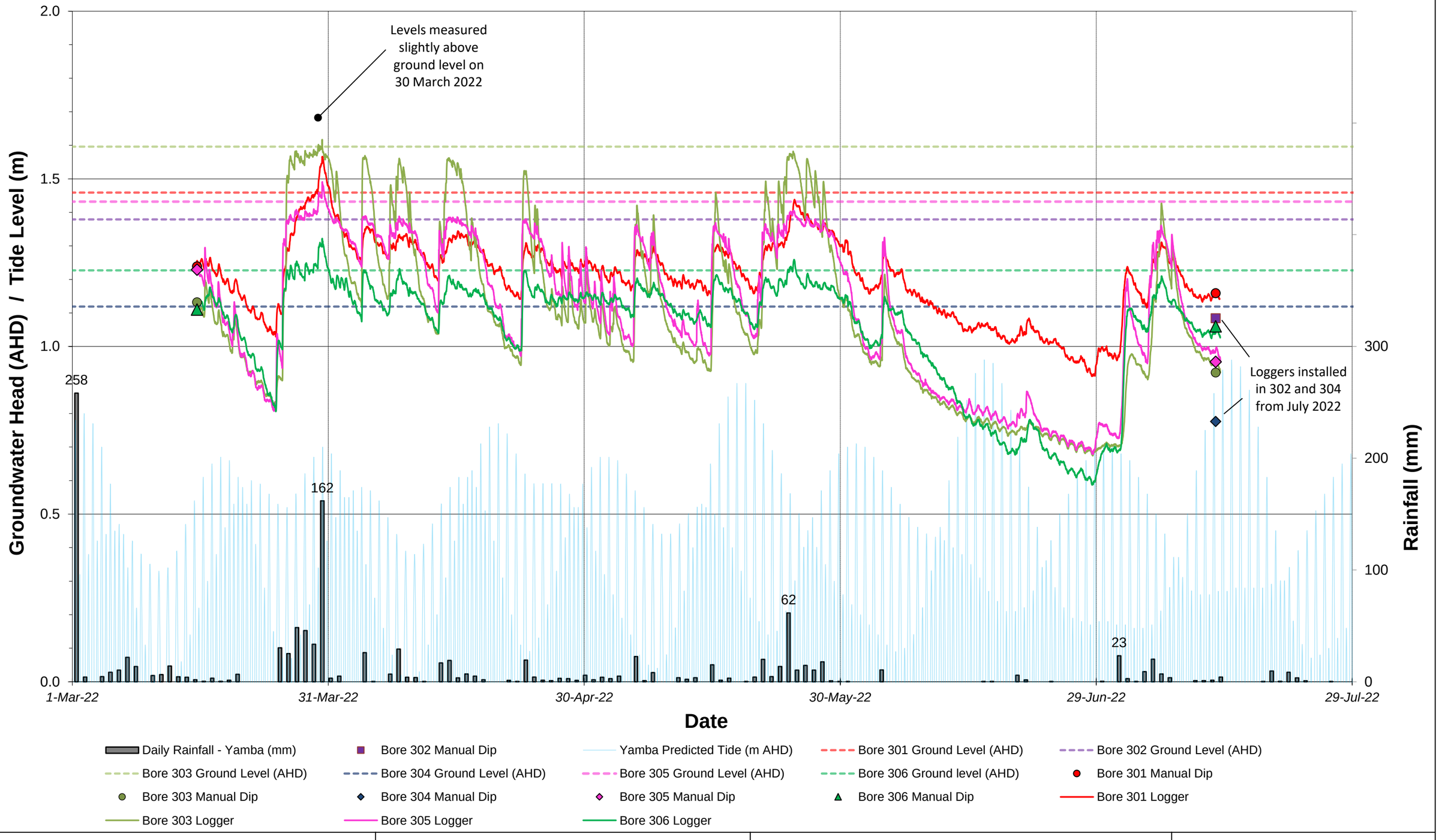
Geotechnics / Environment / Groundwater



Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Dougherty Bros C/- A Fletcher and Associates		**Groundwater Level vs Rainfall (March 2022 to July 2022)** **Proposed Redevelopment of West Yamba** **Miles and Cox Street, Yamba**	PROJECT NO: 89980.02
OFFICE: Newcastle	DRAWN BY: DEW		FIGURE NO: 1
SCALE: N/A	DATE: 24 August 2022		REVISION: 0

Drawing adapted from Metromap Aerial dated 24/04/2020.
Monitoring well locations were located using dGPS.

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Dougherty Bros c/o A Fletcher & Associates	
OFFICE: Newcastle	DRAWN BY: JCL
SCALE: 1:10000 @ A3	DATE: 24.August.2022

TITLE: **Test Location Plan**
Proposed Development of West Yamba
Miles and Cox Street, Yamba

PROJECT:	89980.02
DRAWING No:	1
REVISION:	0

REGIONAL GEOTECHNICAL SOLUTIONS

Manning-Great Lakes
Port Macquarie
Coffs Harbour

RGS31546.1-AB

26 July 2018

Garrard Building Pty Ltd
PO Box 538
YAMBA NSW 2464

Attention: Neil Garrard

Dear Neil

RE: Proposed Residential Development – 52-54 Miles Street, Yamba NSW
Preliminary Geotechnical Assessment

1 INTRODUCTION

Regional Geotechnical Solutions Pty Ltd (RGS) has undertaken a geotechnical assessment for a development that is proposed to be constructed at 52-54 Miles Street, Yamba NSW (Lots 46 and 47 DP751395).

The proposed development is understood to involve large scale earthworks to raise the site levels to at least RL3m AHD (fill depths of generally 1.5 to 2m) which will allow the site to be subdivided for residential development. Specific details such as final fill depths, the type of fill material or the proposed lot layout have not yet been provided. It has been assumed that either single or double storey residential structures are likely to be constructed at the site following earthworks.

The purpose of the work as presented herein was to provide comments and recommendations on the following:

- Subsurface profile including depth of topsoil, presence of marine clays or silts, and groundwater level (where encountered) in the upper approximately 1m of the subsurface profile;
- Thickness of unsuitable materials (including topsoil, silt deposits or low strength marine clays, etc.) that would require stripping prior to fill placement;
- Preliminary earthworks recommendations; and
- In-situ permeability for stormwater infiltration pond design (design to be undertaken by others).

2 METHODOLOGY

Field work for the assessment was undertaken by a Geotechnical Engineer on 26 June 2018 and included:

- Observation of site features and surrounding features relevant to the geotechnical conditions of the site;
- Eleven test pits (TP1 to TP11) with a 2 tonne excavator to depths of between 1 and 1.35m;
- Dynamic Cone Penetrometer (DCP) testing adjacent to selected test pits; and
- In-situ falling head permeability testing adjacent to TP5 and TP7.

Engineering logs of the test pits and the in-situ permeability test result sheets are attached. The locations of the test pits are illustrated on Figure 1 and were measured with a hand held GPS. The test locations were nominated by Paul Paskins of Mortons Urban Solutions.

3 SITE CONDITIONS

3.1 Surface Conditions

The approximately 42ha rectangular site is bound by Miles Street to the north, Carrs Drive to the west, Golding Street to the east, and by rural-residential lots and bushland to the south. An aerial photograph that illustrates the site location and site setting is shown below.

Site location and setting is illustrated on the NSW Government 'Six Maps'. The approximate boundary of the site is shown by a red box

The site is located within a region characterised by low lying sand flats with localised swamp deposits in lower lying areas and depressions across the site. The provided survey indicates that site levels are generally between about RL1.0 to 1.4m (AHD) with lower lying depressions and drainage lines having elevations of between about 0.5 to 1.0m. The intermittent drainage lines drain to both the northeast towards the Clarence River and to the southwest towards Oyster Channel. In addition to the drainage lines, surface waters were observed to be ponding in a number of lower

areas across the site and the extents of the larger areas are estimated approximately on Figure 1. These areas were untrafficable on the day of the site investigation. Smaller untrafficable areas were also scattered across the site in localised depressions.

Two residential dwellings are located in the northeast of the site. Typical site photographs are presented below.

<table>
<tr>
<td> 
Looking west from the southeast corner of the site. Groups of trees are scattered across this area.</td>
<td> 
Looking south across the northwest portion of the site. This area was trafficable</td>
</tr>
<tr>
<td> 
A row of trees can be seen which are located on the edge of a drainage line in the southwest of the site that drains into Oyster Channel</td>
<td> 
Looking north from the central portion of the site at open farmland. Lower lying depressions were untrafficable.</td>
</tr>
</table>

Untrafficable boggy ground near the central portion of the southern boundary

Surface water ponding in the southwest portion of the site

A row of trees is present on the edge of a drainage line in the southwest of the site. Water was present within the drainage line

Looking south along the eastern site boundary. Boggy areas were encountered in lower lying portions of the site.

3.2 Subsurface Conditions

The 1:25,000 Yamba Quaternary Geology Map indicates that the site is predominantly underlain by a Holocene tidal-delta flat that comprises marine sand, silt, clay, shell and gravel. The lower lying drainage lines that are located at the site are underlain by a Holocene saline swamp that comprises organic mud, peat, clay, silt and sand, that overlies the tidal-delta flat outline above.

The subsurface conditions encountered within the test pits are summarised in Table 1. Test pit logs and photographs of each of the test pits are attached.

Table 1: Summary of Subsurface Conditions Encountered in Test Pits

Material Name	Material Description	Depth to Base of Material Layer (m)										
		TP1	TP2	TP3	TP4	TP5	TP6	TP7	TP8	TP9	TP10	TP11
Topsoil	Silty SAND, dark grey, higher organic content in the upper approximately 50mm.	0.2	0.25	--	--	0.25	0.2	0.25	--	--	0.25	0.2
	Sandy SILT was encountered in TP3 and TP9, and Sandy CLAY in TP4 and TP8			0.1	0.2				0.15	0.25		
Alluvial Clay	Silty CLAY, medium to high plasticity, firm	--	--	0.4	0.4	--	--	--	0.35	0.55	--	--
Alluvial Sand	SAND, fine to medium grained, medium dense to dense	≥1.1	≥1.2	≥1.1	≥1.1	≥1.3	≥1.0	≥1.2	≥1.3	≥1.3	≥1.1	≥1.3

Notes: -- indicates that the material was not encountered at the test location
≥ indicates that the base of the material layer was not encountered at the test location

Groundwater was encountered within all the test pits excavated during the investigation. Groundwater levels do fluctuate due to inclement weather, seasonal variations, tidal influences, or due to reasons that may not have been apparent at the time of the site investigation. A summary of the groundwater levels inflows encountered during the investigation is presented in Table 2.

Table 2: Summary of Groundwater Inflow Depths

Summary of Groundwater Inflow Depths (m)										
TP1	TP2	TP3	TP4	TP5	TP6	TP7	TP8	TP9	TP10	TP11
0.7	0.9	0.7	0.65	0.9	0.8	1.0	0.95	0.7	0.8	0.8

4 PROPOSED DEVELOPMENT

The proposed development is understood to involve raising the site level to above RL3m (AHD) and subdividing the approximately 42Ha site for residential development which will include the construction of roads, the installation of underground services and likely single and/or double storey residential dwellings.

Earthworks associated with the development will include the placement of generally between 1.5 to 2m of imported fill and at this stage it is understood that a source of fill material has not yet been confirmed. Two stormwater detention ponds are proposed at the site within the general vicinity of TP3 and TP5 and localised excavations (after fill placement) are likely to be required for the construction water/sewer services and the like.

5 SITE APPRECIATION & GEOTECHNICAL CONSTRAINTS

The site is generally underlain by 0.2 to 0.25m of sandy topsoil that overlies medium dense to dense sands. Alluvial clays were encountered within four of the eleven test pits to depths of between 0.35 and 0.55m and the overlying topsoil within these areas comprises clay and silt materials. The clay materials can be generalised as being located within or closely adjacent to the naturally lower lying areas of the site that are identified on Figure 1. Groundwater inflows were encountered within all eleven test pits at depths of between 0.65 and 1.0m.

Several geotechnical constraints have been identified during the assessment that will need to be addressed during the planning and design stages of the development as well as during construction. A summary of the identified constraints is presented below. Further details and recommendations are presented in subsequent sections of this report.

- The site is poorly drained. The test pit investigation was undertaken after a wet weather event and surface waters were present within lower lying areas of the site. Untrafficable 'boggy' areas were identified to be surrounding the surface waters and in isolated depressions that are scattered across the site. Initial site preparation works will be critical to improve drainage conditions during the initial stages of construction;
- Between 200 and 250mm of topsoil was generally encountered within the test pits that were excavated during the investigation. The topsoil was generally a Silty SAND material with a high organic content within the upper approximately 100mm. CLAY and SILT topsoil materials were encountered within four of the test pits that overlie low strength clays as discussed below;
- Firm normally consolidated clays were encountered within four of the eleven test pits excavated during the investigation. This material is likely to undergo both elastic and consolidation settlement during and following fill placement;
- The site investigation was undertaken with a small tracked excavated and the test pits were terminated within wet sands at depths of between 1 and 1.3m. Deeper investigations involving either boreholes or Cone Penetration Tests (CPTs) have not been undertaken and there is the potential for thick normally consolidated clay deposits to be located at depth. If present these layers would likely undergo consolidation settlement due to the surcharge load that is to be applied by the fill and the proposed structures both during and post construction; and
- Groundwater was encountered at depths of between 0.65 and 1.0m. Careful consideration will therefore be required during the planning of the initial fill placement and with the selection and maintenance of haul roads and high trafficked areas.

6 EARTHWORKS

6.1 Site Preparation

Surface waters and saturated 'boggy' ground is present over large portions of the site. The site is poorly drained and extended delays should be expected during the initial stages of earthworks during and after rainfall events and potentially after king tides. The implementation of good site drainage during the initial stages of the development will reduce the risk and extent of delays and will be essential for the successful completion of the initial earthworks stages at the site. The principle aim of the drainage is to promote controlled surface water run-off, reduce the velocity of flow and to reduce the potential for water to pond. During the initial stages of earthworks it may be necessary to construct localised sump points and swale drains to enable surface water to be

pumped and removed from the site. Given the size of the site and extent of works it may be necessary to construct multiple onsite sedimentation basin as part of the overall site erosion and sediment control plan.

Earthworks should be carefully planned and scheduled to maintain suitable cross-falls so as to promote controlled runoff of surface water. Adequate silt control and dissipation measures will need to be employed to reduce the potential for silt entering the storm water system to the south and west of the site. An earthworks management plan (EMP), including an erosion and sediment control plan should be prepared prior to site works commencing.

6.2 Stripping, Fill Placement & Compaction Control

6.2.1 Stripping Options

Site preparation works will therefore generally require the removal of vegetation including the stripping of all organic and root affected material. Any deleterious material or material that appears potentially contaminated should also be stripped and disposed of. These materials are not considered suitable for reuse as engineered fill and should be disposed of offsite, pending appropriate waste classification or exemption, or stockpiled on site where appropriate for later reuse in landscaping areas only.

Based on the results of the assessment and following discussions with you, two options are presented to address the required degree of stripping of unsuitable materials at the site:

Option 1 – Stripping of Organic Rich Materials & Alluvial Clays

This option involves stripping the upper organic rich topsoil and the underlying firm alluvial clay materials that were encountered to depths of up to 0.55m. Based on the results of the site investigation, areas of the site that are not underlain by shallow alluvial clay deposits are likely to require stripping of about 100mm of organic rich materials, however, thicker organic layers may be encountered between the test pit locations.

Option 1 is the preferred option as it removes the risk of consolidation settlement post construction of the shallow alluvial clay layers.

Option 2 – Stripping of organic rich materials only

This option includes stripping the upper organic rich topsoil materials that have an estimated thickness of about 100mm based on the result of the test pits, without removing the firm clay materials that were encountered within TP3, TP4, TP8 and TP9. Selection of this option will involve accepting the risk of differential settlements across the site due to the likely consolidation of the firm alluvial clay layer, however, the degree of risk could be reduced by undertaking regular monitoring of the surface height of the fill (relative to a fixed point outside of the site) over a period of months and potentially years after the completion of earthworks. If this option is selected then it is recommended that the extents of the firm alluvial clay layer which are likely to be identifiable following the initial stripping be recorded by a surveyor.

6.2.2 Fill Placement & Compaction Control

Where fill is required to raise the site to design levels for the placement of high level footings or pavements, following removal of topsoil and other unsuitable materials as discussed above the following outlines the recommended fill placement procedures:

- The site has a shallow water table and careful consideration will be required during the design of the earthworks program to reduce the potential for construction traffic to 'pump' water up into the shallow subgrade soils and the lower fill layers. It is therefore recommended that nominated haul routes be selected and an allowance be made for the placement of rock bridging layers within these areas. It is also recommended that only static compaction be used until at least 1.2m of fill has been placed;
- After unsuitable material has been stripped to expose the underlying alluvial soils (either Option 1 or Option 2 as outlined in Section 6.2.1), the exposed natural subgrade should be proof roll tested (with a large grader, loaded water cart or the like) in the presence of a suitably experienced geotechnical practitioner to highlight any soft, wet or excessively deflecting areas. Where these are encountered, it is recommended that a Geotechnical Engineer be engaged to provide advice regarding appropriate remedial measures and the required extents. Such measures will be dependent on the depth of the water table, the thickness and type of the low strength material, the depth of fill that is to be placed, and the end use of the area (i.e. supporting structures or pavements, etc.). Remedial measures may include:
    - Removing the low strength material and replacing with granular fill such as select fill, crushed concrete or pavement gravel (DGS40);
    - Rock bridging layers which would typically comprise about 400mm of very high strength clean angular no fines rock with a particle size of between about 50 and 150mm, or alternatively clean crushed concrete. The bridging layer should be fully wrapped in a heavy duty geofabric such as Bidim A34 or equivalent;
    - Placement of a 40kN biaxial or triaxial geogrid over the exposed material and covered with at least say 300mm of granular fill; and
    - A combination of some of the above measures.
- Due to the shallow water table it is recommended that two 300mm thick layers of clean granular fill be placed across the site to provide a suitable platform to aid in the placement of the overlying fill layers;
- If a rock bridging layer (wrapped in geofabric) or a geogrid layer is to be placed at the site (as discussed above) consideration should be given to the potential implications to future excavation of service trenches such as sewer/water etc.;
- Where filling is required beneath structures, approved fill should be placed in layers not exceeding 250 mm loose thickness and compacted to a minimum dry density ratio of not less than 98% of standard compaction. Clay fill should be placed and maintained within ±2% of standard optimum moisture content. Unless non-reactive fill is used the surface movement characteristics may change significantly and the site classification should be revised;
- Where filling is required beneath pavement layers, suitable fill should be placed in layers not exceeding 300 mm loose thickness and compacted to a minimum dry density ratio of 95% standard compaction, with the upper 300mm of the subgrade being compacted to at least 100% SMDD. Clay fill should be placed and maintained within 2% of standard optimum moisture content; and

- Where filling is required on batters, the material should be over-placed, compacted, and then trimmed back to the required batter to ensure that compaction is achieved to edge of batter.

In accordance with AS3798-2007, it is recommended that Level 1 control be implemented for areas of the site that are filled to support structures, while areas of the site that are filled to support pavements should be filled under Level 2 supervision and testing. Level 1 control will be required to avoid the future residential lots being classified as Class 'P' sites in accordance with AS2870-2011 '*Residential Slabs and Footings*'.

6.2.3 Deep Consolidation Settlements

As discussed in Section 5, the preliminary geotechnical investigation presented herein was limited to a depth of 1.3m. The site is located within the Clarence coastal delta and is underlain by deep alluvial and marine deposits that extend to depths of up to at least about 30 to 40m. There is therefore a risk that normally consolidated marine clays underlie the site at depth which may undergo consolidation settlement due to the loads imposed by the fill and the residential structures.

The amount of consolidation settlement and the lateral extent and potential for deep seated differential settlements have not been assessed as part of this assessment and would require deep geotechnical investigations, laboratory testing and detailed analysis. Consolidation settlements would be expected to be induced during fill placement and may continue to occur for a number of months and potentially years after the completion of bulk earthworks at the site.

7 STORMWATER INFILTRATION

Two falling head infiltration tests were undertaken within the alluvial sands at the site. The locations of the tests are nominated on Figure 1 as TP5 and TP7. The testing indicated that the alluvial sands have an infiltration rate of between about 2 x 10^{-4}m/s and 7 x 10^{-4}m/s. Calculation sheets are attached.

The site is considered suitable for bioretention of stormwater and it is recommended that a design infiltration rate of 2 x 10^{-4}m/s be adopted.

8 LIMITATIONS

The findings presented in the report and used as the basis for recommendations presented herein were obtained using normal, industry accepted geotechnical and pavement design practises and standards. To our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points. If site conditions encountered during construction vary significantly from those discussed in this report, Regional Geotechnical Solutions Pty Ltd should be contacted for further advice.

This report alone should not be used by contractors as the basis for preparation of tender documents or project estimates. Contractors using this report as a basis for preparation of tender documents should avail themselves of all relevant background information regarding the site before deciding on selection of construction materials and equipment.

If you have any questions regarding this project, or require any additional consultations, please contact the undersigned.

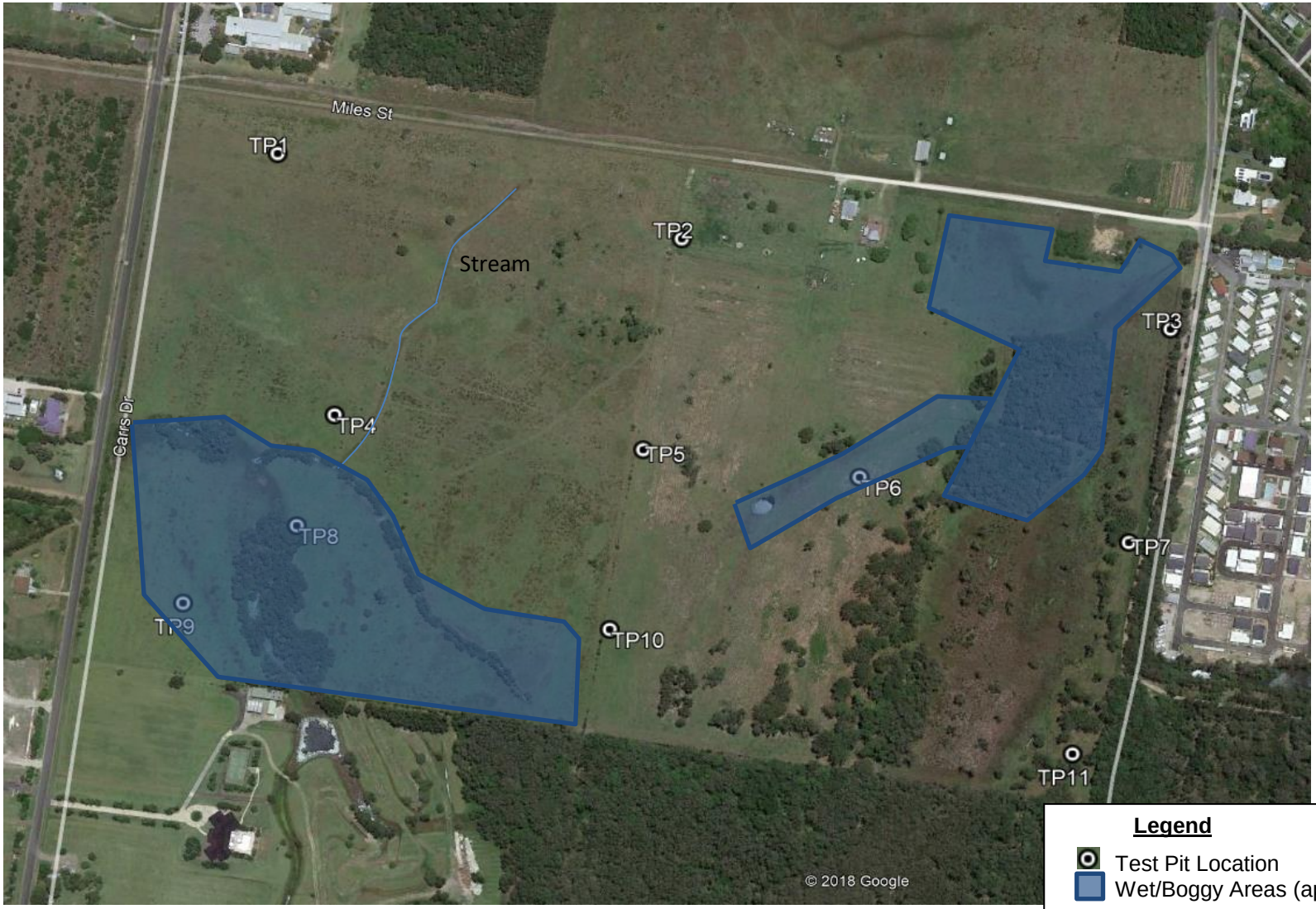
For and on behalf of

Regional Geotechnical Solutions Pty Ltd

Simon Keen

Senior Geotechnical Engineer

Attachments: Figure 1 – Test Pit Location Plans
Test Pit Logs & Photographs



REGIONAL GEOTECHNICAL SOLUTIONS	**Client:**	Garrard Building PTY LTD	Job No.	RGS31546.1
	Project:	Proposed Development 52-54 Miles Street Yamba NSW	Drawn By:	LD
			Date:	9-Jul-18
	Title:	Test Pit Location Plan	Drawing No.	**FIGURE 1**

ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT:	Garrad Building Pty Ltd	**TEST PIT NO:**	**TP1**
PROJECT NAME:	Proposed Development	**PAGE:**	1 of 1
SITE LOCATION:	52-54 Miles Street, Yamba	**JOB NO:**	RGS31546.1
TEST LOCATION:	Refer to Figure 1	**LOGGED BY:**	LD
		DATE:	26/6/18

EQUIPMENT TYPE:	2t Excavator		**EASTING:**	532334 m	**SURFACE RL:**
TEST PIT LENGTH:	1.6 m	**WIDTH:**	0.3 m	**NORTHING:** 6743389 m	**DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
Excavator	2:09:00 PM			0.5		SM	**TOPSOIL:** Silty SAND, fine to medium grained, dark grey	M		DCP (0-1.7m)	1 1	TOPSOIL
						SP	0.20m **SAND:** Fine to medium grained, grey, some Silt	M	MD		2 3 3 3	ALLUVIAL SOIL
				1.0		SP	0.60m **SAND:** Fine to medium grained, pale grey	W			4 4	
						SP	0.80m **SAND:** Fine to medium grained, grey		D		4 6 6	
				1.5			1.10m Hole Terminated at 1.10 m				6 5 5 4 3 2	

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

TP1 encountered 0.2m of topsoil overlying sand. Groundwater was encountered at 0.7m.

Excavated material from TP1

	Client:	Garrard Building Pty Ltd	Job No.	RGS31546.1
	Project:	Proposed Residential Development	Drawn By:	SK
			Scale:	NTS
		52-54 Miles Street, Yamba	Date:	26-Jul-18
	Title:	Test Pit Photographs - TP1	Drawing No.	

ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT:	Garrad Building Pty Ltd	**TEST PIT NO:**	**TP2**
PROJECT NAME:	Proposed Development	**PAGE:**	1 of 1
SITE LOCATION:	52-54 Miles Street, Yamba	**JOB NO:**	RGS31546.1
TEST LOCATION:	Refer to Figure 1	**LOGGED BY:**	LD
		DATE:	26/6/18

EQUIPMENT TYPE: 2t Excavator **EASTING:** 532669 m **SURFACE RL:**
TEST PIT LENGTH: 1.6 m **WIDTH:** 0.3 m **NORTHING:** 6743315 m **DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
Excavator	10:00:00 AM			0		SM	**TOPSOIL:** Silty SAND, fine to medium grained, dark grey	M		DCP (0-1.6m)	2	TOPSOIL:GRASS
											2	
											2	
							0.25m					
						SP	**SAND:** Fine to medium grained, grey, with some Silt	M	MD		3	ALLUVIAL SOIL
											2	
				0.5			0.50m					
						SP	**SAND:** Fine to medium grained, pale grey, pale yellow				2	
											3	
											2	
											3	
								W			5	Test Pit collapsing below water table
				1.0							4	
											4	
							1.20m					
							Hole Terminated at 1.20 m				2	
											3	
											4	
				1.5							5	

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

TP2 encountered 0.25m of topsoil overlying sand. Groundwater was encountered at 0.9m.

Excavated material from TP2

	Client:	Garrard Building Pty Ltd	Job No.	RGS31546.1
	Project:	Proposed Residential Development	Drawn By:	SK
			Scale:	NTS
		52-54 Miles Street, Yamba	Date:	26-Jul-18
	Title:	Test Pit Photographs - TP2	Drawing No.	

ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT:	Garrad Building Pty Ltd	**TEST PIT NO:**	**TP3**
PROJECT NAME:	Proposed Development	**PAGE:**	1 of 1
SITE LOCATION:	52-54 Miles Street, Yamba	**JOB NO:**	RGS31546.1
TEST LOCATION:	Refer to Figure 1	**LOGGED BY:**	LD
		DATE:	26/6/18

EQUIPMENT TYPE: 2t Excavator **EASTING:** **SURFACE RL:**

TEST PIT LENGTH: 1.6 m **WIDTH:** 0.3 m **NORTHING:** **DATUM:** AHD

Drilling and Sampling					Material description and profile information						Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
Excavator	1:30:00 PM					ML	**TOPSOIL:** Sandy SILT, low plasticity, dark brown	M > w_P		DCP (0-0.7m)	1	TOPSOIL
							0.10m					
						CH	**Silty CLAY:** Medium to high plasticity, grey, pale brown	M > w_P	F		3	ALLUVIAL SOIL
											12	
											5	
							0.40m					
						SM	**Silty SAND:** Fine to medium grained, grey	W	D		6	
				0.5							8	
							0.60m					
						SP	**SAND:** Fine to medium grained, pale grey				10	
				1.0								
							1.10m					
							Hole Terminated at 1.10 m					
				1.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		**UCS (kPa)**
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

TP3 encountered 0.1m of topsoil overlying firm clay to 0.4m, overlying sand. Groundwater was encountered at 0.7m.

Excavated material from TP3

	Client:	Garrard Building Pty Ltd	Job No.	RGS31546.1
	Project:	Proposed Residential Development	Drawn By:	SK
			Scale:	NTS
		52-54 Miles Street, Yamba	Date:	26-Jul-18
	Title:	Test Pit Photographs - TP3	Drawing No.	

ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT:	Garrad Building Pty Ltd	**TEST PIT NO:**	**TP4**
PROJECT NAME:	Proposed Development	**PAGE:**	1 of 1
SITE LOCATION:	52-54 Miles Street, Yamba	**JOB NO:**	RGS31546.1
TEST LOCATION:	Refer to Figure 1	**LOGGED BY:**	LD
		DATE:	26/6/18

EQUIPMENT TYPE: 2t Excavator **EASTING:** 532384 m **SURFACE RL:**
TEST PIT LENGTH: 1.7 m **WIDTH:** 0.3 m **NORTHING:** 6743163 m **DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
Excavator	2:40:00 PM					CL	**TOPSOIL:** Sandy CLAY, medium plasticity, dark grey	M > w_P				TOPSOIL
						CL	0.20m **Sandy Silty CLAY:** Medium plasticity, grey, brown, with trace coarse gravel	M < w_P	F	HP	100	ALLUVIAL SOIL
				0.5		SP	0.40m **SAND:** Fine to medium grained, pale grey, pale brown	M	MD	HP	90	
				1.0			1.10m	W				
				1.5			Hole Terminated at 1.10 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

TP4 encountered 0.2m of topsoil overlying firm clay to 0.4m, overlying sand. Groundwater was encountered at 0.65m.

Excavated material from TP4

	Client:	Garrard Building Pty Ltd	Job No.	RGS31546.1
	Project:	Proposed Residential Development	Drawn By:	SK
			Scale:	NTS
		52-54 Miles Street, Yamba	Date:	26-Jul-18
	Title:	Test Pit Photographs - TP4	Drawing No.	

ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT:	Garrad Building Pty Ltd	**TEST PIT NO:**	**TP5**
PROJECT NAME:	Proposed Development	**PAGE:**	1 of 1
SITE LOCATION:	52-54 Miles Street, Yamba	**JOB NO:**	RGS31546.1
TEST LOCATION:	Refer to Figure 1	**LOGGED BY:**	LD
		DATE:	26/6/18

EQUIPMENT TYPE:	2t Excavator		**EASTING:**	532634 m	**SURFACE RL:**
TEST PIT LENGTH:	2.0 m	**WIDTH:**	0.3 m	**NORTHING:** 6743129 m	**DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
Excavator	10:30:00 AM					SM	**TOPSOIL:** Silty SAND, fine to medium grained, dark grey	M				TOPSOIL:GRASS
						SM	0.25m **SAND:** Fine to medium grained, grey, with some Silt	M	MD			ALLUVIAL SOIL
				0.5		SP	0.40m **SAND:** Fine to medium grained, pale grey, pale brown	W				
				1.0		SP	1.00m **SAND:** Fine to medium grained, grey, pale brown		D			
				1.5			1.30m Hole Terminated at 1.30 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		**UCS (kPa)**
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

TP5 encountered 0.25m of topsoil overlying sand. Groundwater was encountered at 0.9m.

Excavated material from TP5

	Client:	Garrard Building Pty Ltd	Job No.	RGS31546.1
	Project:	Proposed Residential Development	Drawn By:	SK
			Scale:	NTS
		52-54 Miles Street, Yamba	Date:	26-Jul-18
	Title:	Test Pit Photographs - TP5	Drawing No.	

ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT:	Garrad Building Pty Ltd	**TEST PIT NO:**	**TP6**
PROJECT NAME:	Proposed Development	**PAGE:**	1 of 1
SITE LOCATION:	52-54 Miles Street, Yamba	**JOB NO:**	RGS31546.1
TEST LOCATION:	Refer to Figure 1	**LOGGED BY:**	LD
		DATE:	26/6/18

EQUIPMENT TYPE: 2t Excavator **EASTING:** 532813 m **SURFACE RL:**
TEST PIT LENGTH: 1.7 m **WIDTH:** 0.3 m **NORTHING:** 6743105 m **DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
Excavator	11:40:00 AM					SM	**TOPSOIL:** Clayey Silty SAND, fine grained, grey, dark grey	M	L	DCP (0-1.4m)	1 1	TOPSOIL
							0.20m					
						SP	**SAND:** Fine to medium grained, grey, with some silt	M	MD		2 3 3	ALLUVIAL SOIL
				0.5			0.50m					
						SP	**SAND:** Fine to medium grained, pale grey, pale brown				4 4 4	
								W			4	
				1.0			1.00m				5	
							Hole Terminated at 1.00 m				6 6 7 5	
				1.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

TP6 encountered 0.2m of topsoil overlying sand. Groundwater was encountered at 0.8m.

Excavated material from TP6

	Client:	Garrard Building Pty Ltd	Job No.	RGS31546.1
	Project:	Proposed Residential Development	Drawn By:	SK
			Scale:	NTS
		52-54 Miles Street, Yamba	Date:	26-Jul-18
	Title:	Test Pit Photographs - TP6	Drawing No.	

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP7

CLIENT: Garrad Building Pty Ltd
PAGE: 1 of 1
PROJECT NAME: Proposed Development
JOB NO: RGS31546.1
SITE LOCATION: 52-54 Miles Street, Yamba
LOGGED BY: LD
TEST LOCATION: Refer to Figure 1
DATE: 26/6/18

EQUIPMENT TYPE: 2t Excavator
EASTING: 533034 m
SURFACE RL:
TEST PIT LENGTH: 1.7 m
WIDTH: 0.3 m
NORTHING: 6743047 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
Excavator	12:50:00 PM			0		SM	**TOPSOIL:** Silty SAND, fine to medium grained, dark grey	M		DCP (0-1.3m)	2	TOPSOIL:GRASS
											3	
							0.25m				2	
						SM	**SAND:** Fine to medium grained, grey, with some silt and trace of roots	M	MD			ALLUVIAL SOIL
											3	
				0.5			0.50m				4	
						SP	**SAND:** Fine to medium grained, grey, pale brown				4	
											5	
							0.80m				4	
						SP	**SAND:** Fine to medium grained, pale grey, pale brown				5	
											7	
				1.0				W	D		6	
							1.20m				8	
							Hole Terminated at 1.20 m				7	
				1.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

TP7 encountered 0.25m of topsoil overlying sand. Groundwater was encountered at 1m.

Excavated material from TP7

	Client:	Garrard Building Pty Ltd	Job No.	RGS31546.1
	Project:	Proposed Residential Development	Drawn By:	SK
			Scale:	NTS
		52-54 Miles Street, Yamba	Date:	26-Jul-18
	Title:	Test Pit Photographs - TP7	Drawing No.	

ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT:	Garrad Building Pty Ltd	**TEST PIT NO:**	**TP8**
PROJECT NAME:	Proposed Development	**PAGE:**	1 of 1
SITE LOCATION:	52-54 Miles Street, Yamba	**JOB NO:**	RGS31546.1
TEST LOCATION:	Refer to Figure 1	**LOGGED BY:**	LD
		DATE:	26/6/18

EQUIPMENT TYPE: 2t Excavator **EASTING:** 532348 m **SURFACE RL:**
TEST PIT LENGTH: 1.6 m **WIDTH:** 0.3 m **NORTHING:** 6743066 m **DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
Excavator	3:40:00 PM					CL	**TOPSOIL:** Silty CLAY, medium plasticity, dark grey	M > w_P		HP	100	TOPSOIL:GRASS
							0.15m					
						CH	**Silty CLAY:** High plasticity, grey, mottled pale brown	M > w_P	F	HP	100	ALLUVIAL SOIL
							0.35m					
				0.5		SC	**SAND:** Fine to medium grained, pale grey, pale brown, with trace clay	M	MD			
				1.0			1.00m	W				
						SP	**SAND:** Fine to medium grained, grey					
							1.30m					
				1.5			Hole Terminated at 1.30 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

TP8 encountered 0.15m of topsoil overlying firm clay to 0.35m, overlying sand. Groundwater was encountered at 0.95m.

Excavated material from TP8

	Client:	Garrard Building Pty Ltd	Job No.	RGS31546.1
	Project:	Proposed Residential Development	Drawn By:	SK
			Scale:	NTS
		52-54 Miles Street, Yamba	Date:	26-Jul-18
	Title:	Test Pit Photographs - TP8	Drawing No.	

ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT:	Garrad Building Pty Ltd	**TEST PIT NO:**	**TP9**
PROJECT NAME:	Proposed Development	**PAGE:**	1 of 1
SITE LOCATION:	52-54 Miles Street, Yamba	**JOB NO:**	RGS31546.1
TEST LOCATION:	Refer to Figure 1	**LOGGED BY:**	LD
		DATE:	26/6/18

EQUIPMENT TYPE: 2t Excavator **EASTING:** 532256 m **SURFACE RL:**
TEST PIT LENGTH: 1.6 m **WIDTH:** 0.3 m **NORTHING:** 6742998 m **DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
Excavator	4:00:00 PM			0		ML	**TOPSOIL:** Clayey SILT, low plasticity, dark brown, with trace of fine grained sand	M > w_P				TOPSOIL:GRASS
							0.25m					
				0.5		CH	**Silty CLAY:** High plasticity, grey, orange-brown, with some rootlets	M > w_P	F	HP	80	ALLUVIAL
							0.55m					
						SP	**SAND:** Fine to medium grained, pale grey, pale brown	M	MD			
				1.0			1.00m					
						SP	**SAND:** Fine to medium grained, grey, pale brown					
							1.35m	W				
				1.5			Hole Terminated at 1.35 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

TP9 encountered 0.25m of topsoil overlying firm clay to 0.55m, overlying sand. Groundwater was encountered at 0.7m.

Excavated material from TP9

	Client:	Garrard Building Pty Ltd	Job No.	RGS31546.1
	Project:	Proposed Residential Development	Drawn By:	SK
			Scale:	NTS
		52-54 Miles Street, Yamba	Date:	26-Jul-18
	Title:	Test Pit Photographs - TP9	Drawing No.	

ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT:	Garrad Building Pty Ltd	**TEST PIT NO:**	**TP10**
PROJECT NAME:	Proposed Development	**PAGE:**	1 of 1
SITE LOCATION:	52-54 Miles Street, Yamba	**JOB NO:**	RGS31546.1
TEST LOCATION:	Refer to Figure 1	**LOGGED BY:**	LD
		DATE:	26/6/18

EQUIPMENT TYPE: 2t Excavator **EASTING:** 532605 m **SURFACE RL:**
TEST PIT LENGTH: 2.0 m **WIDTH:** 0.3 m **NORTHING:** 6742975 m **DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
Excavator	11:00:00 AM					SM	**TOPSOIL:** Silty SAND, fine to medium grained, dark grey	M				TOPSOIL:GRASS
							0.25m					
						SM	**SAND:** FIne to medium grained, grey, with some silt	M	MD			ALLUVIAL SOIL
							0.45m					
				0.5		SP	**SAND:** Fine to medium grained, pale grey, pale brown	W				
							0.90m					
						SP	**SAND:** Fine to medium grained, grey, pale brown					
				1.0								
							1.10m					
							Hole Terminated at 1.10 m					
				1.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

TP10 encountered 0.25m of topsoil overlying sand. Groundwater was encountered at 0.8m.

Excavated material from TP10

	Client:	Garrard Building Pty Ltd	Job No.	RGS31546.1
	Project:	Proposed Residential Development	Drawn By:	SK
			Scale:	NTS
		52-54 Miles Street, Yamba	Date:	26-Jul-18
	Title:	Test Pit Photographs - TP10	Drawing No.	

ENGINEERING LOG - TEST PIT

REGIONAL GEOTECHNICAL SOLUTIONS

CLIENT:	Garrad Building Pty Ltd	**TEST PIT NO:**	**TP11**
PROJECT NAME:	Proposed Development	**PAGE:**	1 of 1
SITE LOCATION:	52-54 Miles Street, Yamba	**JOB NO:**	RGS31546.1
TEST LOCATION:	Refer to Figure 1	**LOGGED BY:**	LD
		DATE:	26/6/18

EQUIPMENT TYPE:	2t Excavator		**EASTING:**	532987 m	**SURFACE RL:**
TEST PIT LENGTH:	1.6 m	**WIDTH:**	0.3 m	**NORTHING:** 6742868 m	**DATUM:** AHD

Drilling and Sampling					Material description and profile information						Field Test		
METHOD	WATER	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
Excavator	1:10:00 PM					SM	**TOPSOIL:** Clayey Silty SAND, fine to medium grained, dark grey	M		DCP (0-0.9m)	2 2	TOPSOIL:GRASS
						SM	0.20m **Silty SAND:** Fine to medium grained, grey	M	MD		2	ALLUVIAL SOIL
				0.5		SP	0.30m **SAND:** Fine to medium grained, pale grey, pale brown				1 4 4	
									D		7 7	
								W			6	
				1.0		SP	0.90m **SAND:** Fine to medium grained, pale brown					
							1.30m					
				1.5			Hole Terminated at 1.30 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		**UCS (kPa)**
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density		
V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

TP11 encountered 0.2m of topsoil overlying sand. Groundwater was encountered at 0.8m.

Excavated material from TP11

	Client:	Garrard Building Pty Ltd	Job No.	RGS31546.1
	Project:	Proposed Residential Development	Drawn By:	SK
			Scale:	NTS
		52-54 Miles Street, Yamba	Date:	26-Jul-18
	Title:	Test Pit Photographs - TP11	Drawing No.	

FALLING HEAD INFILTRATION TEST - CASED HOLE

CLIENT: Garrard Building Pty Limited
PROJECT: Proposed Residential Development
LOCATION: 52-54 Miles Street, Yamba NSW

Job No.: RGS31546.1
Date: 26-Jun-18
By: LD

REGIONAL GEOTECHNICAL SOLUTIONS

Test number:	TP5	Test Location:	Refer to Figure 1
Hole radius (m):	0.35	Surface RL:	Not measured
Hole depth(m):	0.54	Casing stickup(m):	0.00
Depth to water table (m):	Unknown	Water table RL(m)	Unknown

Reading	Time elapsed (min)	Depth to water (m)	Height of water (m)
1	0.5	0.094	0.45
2	1	0.156	0.38
3	2	0.175	0.83
4	3	0.200	0.80
5	4	0.211	0.79
6	5	0.240	0.76
7	8.5	0.298	0.70
8	10	0.316	0.68
9	12.5	0.344	0.66
10	15	0.369	0.63
11	29	0.459	0.54
12	30	0.470	0.53
13	35	0.540	0.46
14			
15			

Calculations

Constant loss time period:

Reading 1:	2	Time 1:	1	Height 1:	0.384
Reading 2:	7	Time 2:	8.5	Height 2:	0.702

Total time (min): 7.50

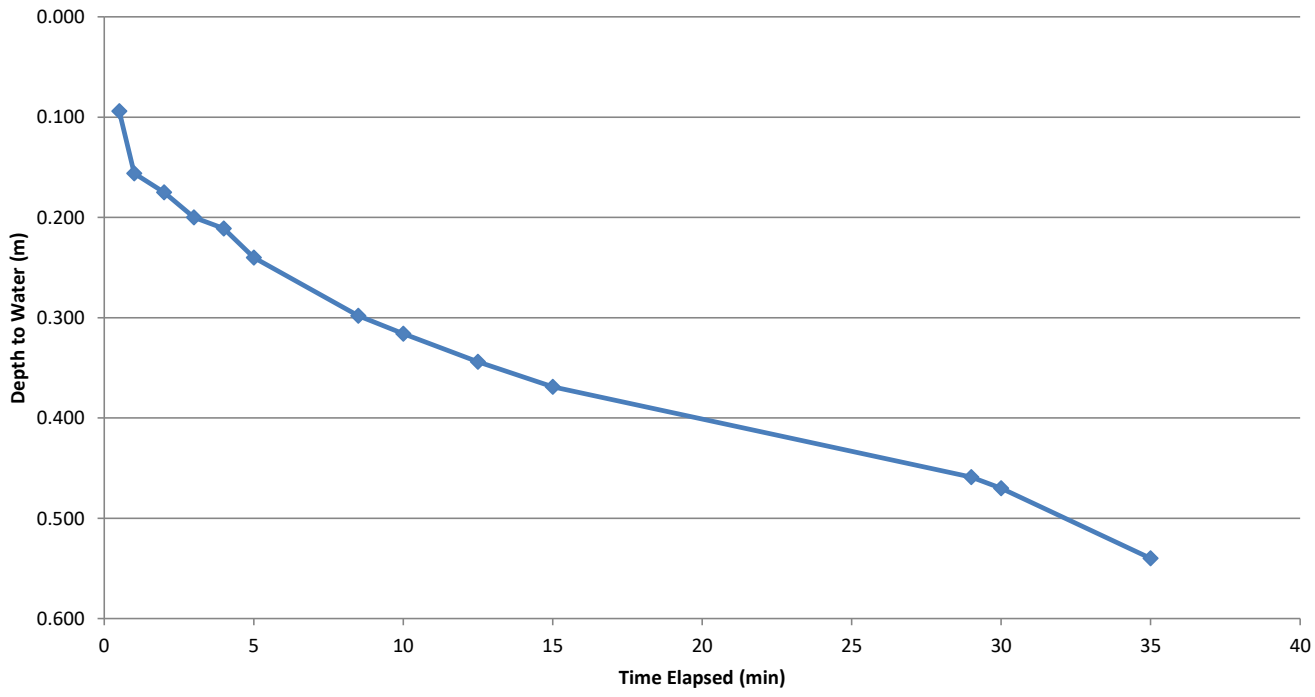
Total head loss (m): 0.318

In situ Permeability:

$$K = \frac{(Height\ 2 - Height\ 1)}{(Time\ 2 - Time 1)}$$

K= 7.07E-04 m/sec

(x 10m/sec)



FALLING HEAD INFILTRATION TEST - CASED HOLE

CLIENT: Garrard Building Pty Limited
PROJECT: Proposed Residential Development
LOCATION: 52-54 Miles Street, Yamba NSW

Job No.: RGS31546.1
Date: 26-Jun-18
By: LD

REGIONAL GEOTECHNICAL SOLUTIONS

Test number:	TP7	Test Location:	Refer to Figure 1
Hole radius (m):	0.35	Surface RL:	Not measured
Hole depth(m):	0.54	Casing stickup(m):	0.00
Depth to water table (m):	Unknown	Water table RL(m)	Unknown

Reading	Time elapsed (min)	Depth to water (m)	Height of water (m)
1	0.5	0.040	0.50
2	1	0.063	0.48
3	1.5	0.084	0.46
4	2	0.099	0.44
5	3	0.134	0.41
6	4	0.165	0.38
7	5	0.192	0.35
8	7.5	0.234	0.31
9	10	0.272	0.27
10	15	0.343	0.20
11	21	0.395	0.15
12	24	0.434	0.11
13	27	0.460	0.08
14	30	0.494	0.05
15			

Calculations

Constant loss time period:

Reading 1:	7	Time 1:	5	Height 1:	0.348
Reading 2:	14	Time 2:	30	Height 2:	0.046

Total time (min): 25.00

Total head loss (m): -0.302

In situ Permeability:

$$K = \frac{(Height\ 2 - Height\ 1)}{(Time\ 2 - Time 1)}$$

K= 2.01E-04 m/sec

(x 10m/sec)