CORE
ENGINEERING SOLUTIONS

GEOTECHNICAL COMPLETION REPORT
STAGE 1

Lot 14 DP 374000
51 TE MAIKA ROAD, NGUNGURU

Job Details:	Residential Subdivision – Stage One
Job number:	20-0078
Client:	Traverse Ltd
Site Address:	51 Te Maika Road, Ngunguru
Legal Description:	Lot 14 DP 374000
Date:	18/11/ 2022
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Core Engineering Solutions Limited

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Applicable Consents	SL2100003
Client	Traverse Ltd
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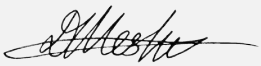
Authoriser Signature	

Please note that NZS4431:1989 has been updated during the course of this project to NZS4431:2022.

This document references both NZS4431:1989 and NZS4431:2022. This is not an error and relates to the change in practices outlined in each of these documents and the timeframe during which earthworks took place.

1. INTRODUCTION

This Geotechnical Completion Report (GCR) has been prepared By Core Engineering Solutions Ltd (CES Ltd) for Traverse Ltd as part of the documentation to be submitted to Whangarei District Council (WDC) on the completion of Stage One of the Te Maika Road subdivision in Ngunguru, located at 51 Te Maika Road, Ngunguru, hereinafter referred to as 'the site'. Stage One comprises of the development of 14 residential lots.

This report addresses the geotechnical engineering aspects of the subdivision development, identifies and discusses geotechnical engineering issues that must be taken into consideration during individual Lot development, and includes a Statement of Professional Opinion (SOPO) that covers the Suitability of the Land for its Intended Purpose. The SOPO includes a summary table, outlining the Geotechnical Design Recommendations from CES Ltd in regard to individual Residential Lots. The SOPO is located within Appendix One.

The subdivision design was prepared by Reyburn & Bryant Limited (R&B Ltd), and the main civil contractor was Clements Contractors Ltd (CC Ltd).

CES Ltd Drawings in this report are based on final contour levels provided by Reyburn and Bryant for the purposes of establishing building setbacks. Final 'AS Built' plans are to be provided by Reyburn and Bryant.

CES Ltd was commissioned to observe and undertake construction monitoring for earthworks and specific design engineering works (eg retaining wall, settlement monitoring, fill compaction).

Subdivision Earthworks were carried out in general accordance with NZS4404:2010 Land Development and Subdivision Infrastructure, and NZS 4431:1989. Compliance with the recent NZS4431:2022 Code of practice for Earth Fill for Residential Development has been adopted where practically possible.

This document has been prepared in general accordance with the Whangarei District Council (WDC) Engineering Standards 2022, with special reference to Site Development Suitability (Geotechnical and Natural Hazards).

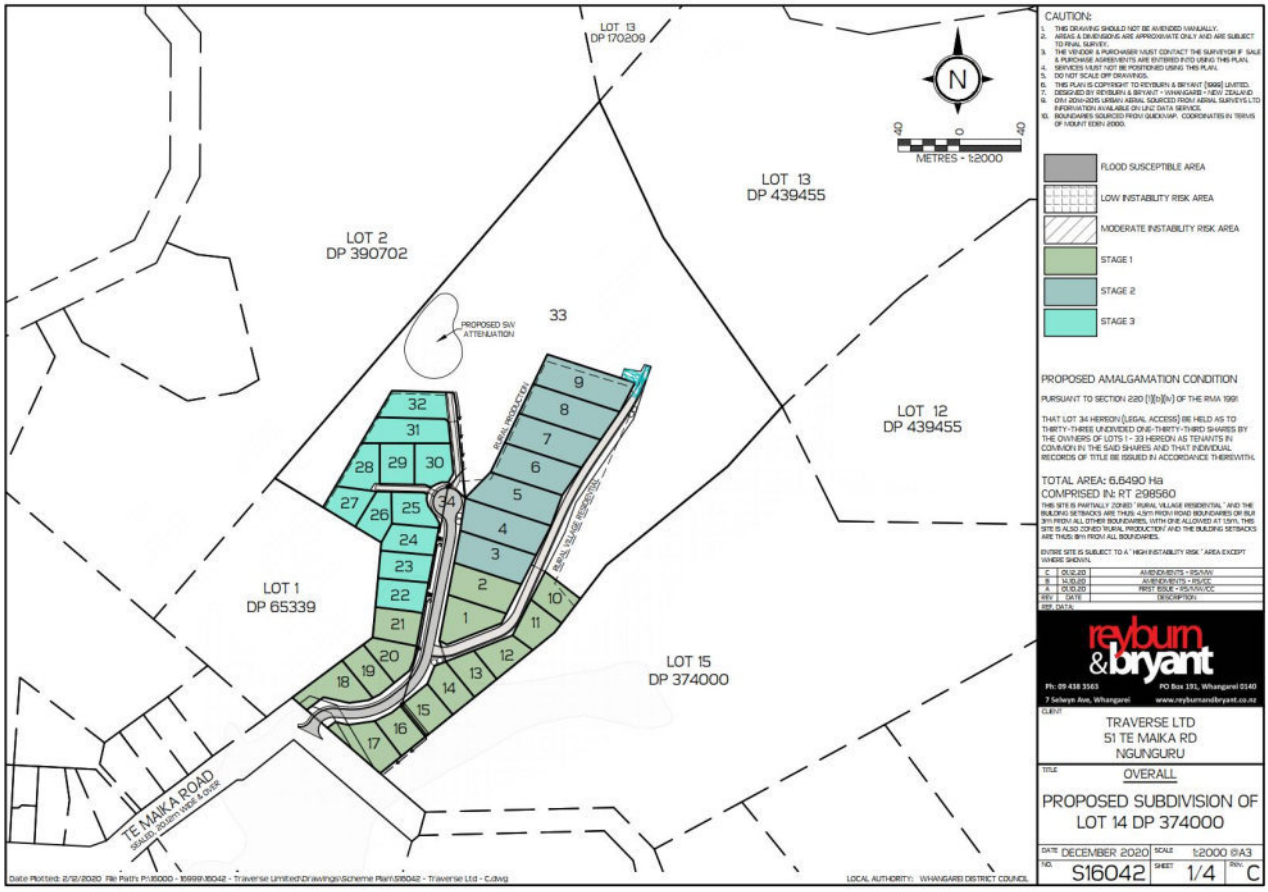


Figure 1 - Map of subdivision, showing various Stages. (Source R&B Ltd)

2. SITE DESCRIPTION

This 66490m² property is located on the northern side at the end of Te Maika Road. The property has a prominent broad crested spur ridgeline which runs down towards the south. The western and north-western boundaries back onto the flank of a ridgeline that runs through the neighbouring properties.

The majority of the lower areas of the subdivision have been raised using fill material harvested from Stage 2 of the development. Earthworks have been carried out in such a manner as to form level or near-level sites throughout the majority of Stages One and Three of the subdivision. No in-fill drainage, such as a drainage blanket, has been placed during construction.

Stage One of this development is mainly level following extensive earth filling over the allotments (Lots 12-21); however, specific items that may affect development within the subdivision are noted below.

2.1 Completed Subdivision

The completed Stage One Subdivision has resulted in the formation of fourteen new residential Lots (Lots 1-2, Lots 10-21 inclusive) that, on completion of the subdivision works and certification from

Council, will be released for individual development. The majority of the sections within this development have been filled using engineered fill to create level building sites.

2.2 Topographical Description Post-Construction

The land within Stage One has undergone significant transformation in order to obtain the finished site profile. Stage One sections have a near-level topography, with lots 10 and 11 being situated partially on the ridge flanks below Stage Two.

Topsoil and non-engineered fill has been removed from the site, however, issues with access and elevated ground levels within Lots 10 to 13 made undercutting all organic material in this area difficult. Substantial amounts of clay fill from the spur (within Stage Two) to the northeast of the site, has been cut and transported down the hill to raise the site and form the new platforms, mitigating the flood hazard and liquefaction risks.

Much of the site is now underlain by Cirtex Gridtex Geocomposite (Duragrid X 40/40). This has been laid and overlapped to the manufacturer's specification. CC Ltd have confirmed to CES Ltd that no penetrations other than those for the Fire Fighting Tanks, infiltrate through the Geocompsite material.

Roading and infrastructure have been constructed. Infrastructure includes, stormwater, wastewater, power and internet (fibre) infrastructure.

Settlement monitoring has been undertaken at a number of locations where the height of fill has exceeded 1.0m which is covered under Section 5.5 of this report.

Four retaining walls have been built within Stage One of the subdivision, with two retaining walls located on the northern side of Lot 1 and two retaining wall on the northern side of Lot 2.

3. PREVIOUS WORK

The following reports on this site have been previously issued:

Engineering Report for Subdivision for the property by Richardson Stevens Consultants (1996) Ltd, Ref: 6886, dated: 5 November 2007 (Amended June 2008)

Geotechnical Assessment Longview Estuary Estate Ngunguru (30 October 2007) Riley Consultants

Subdivision Report 51 Te Maika Road Ngunguru (31 October 2018) Wilton Joubert Consulting Engineers Ref#81048, covering the original initial stage of this development (now known as Stage 2)

The following reports on this development have previously been issued by CES Ltd:

Subdivision Report, Lot 14 DP 374000, 51 Te Maika Road Ngunguru (4/12/2020)

Retaining Wall Design and Calculations (15/12/2020)
Concrete Driveway reinforcing detail (20/05/2022)

4. SITE OPERATIONS

4.1 Construction Works and Programme

The primary works on-site were carried out between January 2021 and August 2022. Earthworks comprised:

Cut and fill earthworks
Installation of Geocomposite materials
Retaining Wall structures construction
Creation and relocation of main drain
Fill old drain
Construction of roads and services (power, telecommunications, stormwater and wastewater, sewers, firefighting tanks etc.)
Topsoil spreading upon completion of the bulk formation and retaining wall construction works
Planting of native seedlings to stabilise ridge flanks

Services such as stormwater, wastewater and firefighting tanks were constructed at the completion of earthworks. Refilling trenches and compaction of excavated areas was monitored by Clements Contractors Ltd.

Utility services (power, telecommunication etc,) were constructed following the completion of the bulk earthworks. Refilling trenches and compaction of excavated areas was monitored by Clements Contractors Ltd.

4.2 Extent of Formation Works

To form the sites with this stage, earthfill has been extracted from the ridgeline within Stage 2 of this development. The works involved undercutting the entire low lying area of any loose vegetation and organic material down to the water table, and then overlaid with a geocomposite material and engineered fill. The extent of the earth fill and earthworks is illustrated within the approved engineering plans and CES Ltd plans appended to this report. Maximum fill depths are indicated to approximately 2.0m in depth.

Stage One land was affected by the site formation works, and final levels are to be supplied with the Reyburn and Bryant As-Built Plans.

4.3 Source of Fill Material

Works were designed to achieve a cut to fill balance with material cut from the sections in Stage Two and used as fill in Stage One and Stage Three. The nature of this material was weathered Waipapa Group, which consisted of mainly silty CLAY with pockets of less weathered material. The insitu strength of the fill material was generally in excess of 140kPa.

4.4 Geocomposite Material

CES Ltd specified the use of Cirtex Gridtex 40/40 Geocomposite throughout this subdivision. Designed specifically for soil stabilisation and reinforcement, Gridtex is a combination Biaxial Geogrid bonded to a non-woven polyester geotextile.

Gridtex underlays much of the bottom part of the subdivision, including Lot 1 and Lots 12-21 within Stage One.

The only penetration through this material within the subdivision are for the fire fighting tanks. CC Ltd have confirmed that no pipes penetrate the Geocomposite material and no repairs have been required across the material, apart from within the location of the two fire fighting tanks.

Installation methodology for the Geocomposite material was observed and checked by CES Ltd during site visits, to ensure that subsoil surfaces were correctly prepared and that manufacturers' specifications were followed in terms of both overlap and installation process.

The geocomposite material continues to act as a stabilising influence for clay fill whilst secondary settlement is active. For this reason only minor and necessary penetration should be made through the geocomposite material, for example driven piles for dwellings, although even these should be bored down to below the depth of the geocomposite material.

The depth to the geocomposite material is sufficient that it should not interfere with minor improvements on the majority of individual Lots. No avoidable excavations or penetrations such as swimming pools, should be allowed to penetrate the geocomposite material.

4.5 Field Control

Compaction acceptance testing was undertaken in line with the guidelines outlined in NZS 4431:1989. The filled portion of the development is generally 2.0m on average in depth with the underlying soils being saturated. The fill material being used was weathered silty clay material from the Waipapa Group geology and was sourced from the ridgeline on-site. This material is well known to be a reliable source for bulk fill, especially when the moisture content is managed appropriately. Fill from the ridge was excavated and transferred immediately to the lower-lying land being raised. The main geotechnical risk for the filled area is related to consolidation/settlement of the underlying alluvial soils, and with the thickness of filling generally

proposed over the site, CES Ltd assessed that provided that the moisture content is managed and a consistent methodology is undertaken that soil compaction of the clay soils would be evaluated through undrained shear strength.

Confirmation of the placement and compaction of fill material was undertaken by CES Ltd technicians at regular intervals during earthworks, using a hand held Pilcon Shear Vane. Pilcon Shear tests were undertaken in accordance with New Zealand Geotechnical Society Guidelines for Hand Held Shear Vane Test, 2001. The placement of the subgrade and installation of the geocomposite fabric was inspected throughout the earthworks stage of the development.

CPT tests were undertaken in four locations within Stage One by Soil & Sample Ltd, using a Pagani TG63-150 CPT machine. These tests were conducted to monitor the change to groundwater levels over the site, in substitution to piezometers due to issues with monitoring stations being damaged during earthworks and to confirm any changes to the underlying subsoil conditions. CPT results are appended to this report.

On completion of the subdivision earthworks, Hand Auger testing was carried out on each of the sections within Stage One. 50mm diameter Hand Auger boreholes were drilled down until the Geocomposite Material was encountered.

Calibrated Pilcon Shear Vanes, used in accordance with New Zealand Geotechnical Society Guideline for Hand Held Shear Vane Test, 2001, was used generally at every 0.2m in the drilled holes, measuring both in situ and remoulded strengths. Corrected results and borelogs are presented in Appendix 5. Topsoil depths were also recorded in these locations.

Samples of the fill material was obtained from across the entire subdivision and the material was sent to Geocivil in Whangarei to undertake Linear Shrinkage testing and determination of the liquid limit, plastic limit, plasticity index and water content. This testing was used to assist with providing an estimation on the expected soil expansivity. Results for this testing are presented in Appendix 5.

Additional hand auger testing was undertaken in September 2022 to establish the depth to groundwater post-earthworks. Four Hand Auger tests were undertaken across the site, two tests within Stage One and two tests within Stage Three in locations where previous subsoil investigations had occurred so that a comparison could be made.

Stage One testing was undertaken on two Lots, Lot 21 and Lot 14 and both tests penetrated until groundwater was encountered. Despite the wet winter conditions present, groundwater was encountered at 4.1m BGL on Lot 14 and 2.5m BGL on Lot 21.

4.6 Compaction Control Requirements

The compaction control criteria adopted methods as described within NZS4431:2022 Earth Fill for Residential Development. The earthfill has been compacted using a sheepsfoot roller and assisted with further compaction from fully loaded Moxy trucks.

Calibrated Pilcon Shear Vanes, used in accordance with New Zealand Geotechnical Society Guideline for Hand Held Shear Vane Test, 2001, were utilised for random testing during earthworks. Construction montironing by CES Ltd encountered undrained shear strength (corrected) of 140kPa within the engineered fill as it was being placed within this stage.

The compaction control criteria adopted methods as described within NZS4431:1989 Earth Fill for Residential Development. Standards New Zealand had not updated NZS 4431when filling commenced, and therefore the old standard applies to this subdivision.

The earthfill has been compacted using a D4 bulldozer and sheepsfoot roller and assisted with further compaction from fully loaded Moxy trucks running across the surface.

The specified requirements by CES Ltd were as follows:

Minimum undrained Vane Shear Strength (measured in situ by hand held shear vane):

General fill:	Minimum single value (factored)	110kPa
	Minimum average value (factored)	140kPa

Maximum Air Voids Percentage (as defined in NZS 4402:1986 Part 1):

General fill:	Maximum single value	10%
	Maximum average value	8%

Adequate compaction was deemed to have been achieved when an undrained shear strength (corrected) of 140kPa has been achieved. Calibrated Pilcon Shear Vanes taken during post earthworks Nuclear Densometer testing by Geocivil, only one hole returned an average shear value of less than 140kPa (Hole 1, 1.0m BGL). This hole was located between Lot 18 and Lot 19, close to the entrance to the subdivision, where 0.8m fill has been placed. This therefore suggests the results returned were indicative of natural ground.

All other Calibrated Pilcon Shear Vanes within Stage One achieved a minimum value of 140kPa. No shear values were outside the minimum single value (110kPa).

Post earthworks laboratory testing of the Waipapa Group fill from the hill indicated a dry density of 1.33 t/m^3. CES Ltd would normally specify a minimum dry density of 95% of dry density, or 1.26 t/m^3. As per NZS 4431:1989, for highly plastic clays though, a slightly lower number may be adopted to reduce post construction swelling of the bulk fill. For this reason, CES Ltd adopted a value of 1.23 t/m^3.

Further confirmation of the placement and compaction of fill was checked by Nuclear Densometer post construction, by Geocivil Ltd.

Only one location within Stage One, Lot 1, failed to achieve the required dry density. Hole 12 (Lot 1, 0.5m BGL) returned a dry density of 1.18 t/m^3 at 0.5mBGL. The second deeper test returned a value of 1.26 t/m^3, meeting specification and throwing up questions of whether this may simply be an anomaly.

From our site monitoring and testing above, CES Ltd is satisded that the engineered fill is suitable compacted to minise any residual settlement in the engineered fill and is suitable for residential development, subject to Section 5.5 of this report.

4.7 Uncertified Fill

All areas of bulk filling that was constructed as part of the subdivision works meets the requirements for certified fill in accordance with NZS4431:1989.

Due to the initial shallow groundwater levels at the base of service trenches, specific testing of the backfill material placed to reinstate the service trench excavations was not thoroughly undertaken. As a result, the material locally associated with the back-fill of trenches, particularly for services such as power supply, telecoms, stormwater and wastewater, cannot be considered to meet the requirements for certified fill in accordance with NZS 4431:1989. It should be understood that services were designed to be installed as shallow as practically possible to minimise issues during construction and to limit backfill overlying these services.

All service trench back-fill material comprises either granular graded hard-fill, and/or cohesive trench excavated spoil. This was generally compacted back into the trenches on completion of the respective service installation. The supporting Producer Statements from the contractors involved are appended to this report. On the basis above, compliance with WDC Policy #0022 shall be strictly complied with on any future development within this stage.

4.8 Settlement Monitoring

Settlement Pads were placed across the entire subdivision in order to monitor the effect of additional soil load. The settlement pads have been placed over Stages 1 and 3 where earthfill has overlaid alluvial deposit. The aim of the settlement monitoring is ensure that settlement over the development is consistent, and rates of movement are decreasing to within the secondary settlement phase. Further discussion and results from settlement monitoring are contained within Section 5.5.

5. EVALUATION OF SITE FOR RESIDENTIAL DEVELOPMENT

The majority of the lower areas of the subdivision have been raised using fill material harvested from Stage 2 of the Development. Earthworks have been carried out in such a manner as to form level or near level sites throughout the subdivision, mainly within Stages 1 and 3. Reyburn and Bryant Ltd are to supply the As-Built Plans finished heights over the entire development.

5.1 General Ground Conditions

All residential Lots within Stage One have been affected by cutting and filling, with cutting exposing the in situ, Waipapa Group soils that underlie the site, and bulk filling generally comprising engineered fill that has been constructed in accordance with NZS4431:2022.

Lots 2,10 and 11 are largely, if not entirely, situated in areas that were subject to bulk excavation (cut) and thus, underlying in situ soils were exposed in these locations prior to topsoil respreading.

Lots 12 to 21 are largely, if not entirely, underlain by bulk engineered fill that was constructed as part of the site formation works.

Lot 1 is situated upon the ground that was subject to both bulk excavation and bulk filling. The southern portion has been earthfilled to create a level building platform and is located on the edge of Holocene Deposits and Waipapa Group geologies.

5.2 Seismic Classification

CES Ltd undertook an assessment of the Seismic Subsoil Class, as per the criteria outlined in NZS 1170.5. Soils on-site varied from soft to stiff soils underlying the engineered fill, and CPT testing prescribed the majority of the soils in this area as cohesive, at depths of less than 20m which aligns with the criteria for a Class C soil (Ref: Table 3.2 of NZS 1170.5).

CES Ltd assesses the site subsoil class as being a Class C – Shallow Soils Site in accordance with Section 3.1.3, NZS1170.5.

5.3 Liquefaction

Reference has been made to the 2017 Geotechnical Modules released by MBIE, EQC and the Ministry for the Environment, Planning and Engineering Guidance for potentially liquefaction-prone land. Previous assessment in regard to liquefaction has been addressed by CES Ltd at the initial application stage for this development (Refer to CES Ltd Subdivision Report as referenced under Section 3 of this report).

Prior to development, the low lying areas of the subdivision at 51 Te Maika Road within Stage 1 encountered soils which had signs of sand from the limited CPT testing conducted. However,

following further CPT testing over the sites in this area the underlying deposited soils are variable over the site and there tend to consist of more clay soils underlying the engineered fill on-site. The introduction of a dense crust along with loading of the softer soils beneath has overall improved ground conditions.

Mitigation steps for liquefaction have included

Lifting ground heights
A dense Engineered clay fill overlying site, capping and stabilising any liquefiable soils beneath the fill
Uncontrolled fill removed
Geocomposite material underlying fill and pipes, reducing differential settlement risk
Drain moved and geocomposite material and engineered fill laid instead

Post-development CPT testing by Soil & Sample Ltd was undertaken on Lot 14, Lot 16, Lot 17 and Lot 21. CPT results indicated a clay layer across the top of the sections with Indicative SBT reading of greater than 2.6, indicating a generally non-liquefiable layer capping Stage One sections to a depth >2.0m. This subdivision lies within an area of the country with a low seismicity risk. In our opinion, following the site earthworks and improvements, CES Ltd is satisfied that the risk of liquefaction within Stage 1 of this development is low.

5.4 Expansive Soils

Underlying soil on this site comprises Engineered Fill and in-situ Waipapa Group material (Lots 1 and 2). Experience with similar soils elsewhere suggests that the site soils are likely to be susceptible to seasonal shrink/swell movements as the ground dries out then wets up in a cyclic manner from summer to winter.

The New Zealand Building code defines 'good ground' in the following manner:

'Good ground means any soil or rock capable of permanently withstanding an ultimate bearing pressure of 300 kPa (i.e. an allowable bearing pressure of 100 kPa using a factor of safety of 3.0), but excludes:

a) Potentially compressible ground such as topsoil, soft soils such as clay which can be moulded easily in the fingers, and uncompacted loose gravel which contains obvious voids,
b) Expansive soils being those that have a liquid limit of more than 50% when tested in accordance with NZS 4402 Test 2.2, and a linear shrinkage of more than 15% when tested, from the liquid limit, in accordance with NZS 4402 Test 2.6, and
c) Any ground which could foreseeably experience movement of 25 mm or greater for any reason including one or a combination of: land instability, ground creep, subsidence, liquefaction, lateral spread, seasonal swelling and shrinking, frost heave, changing ground water level, erosion, dissolution of soil in water, and effects of tree roots.

CES Ltd identified the soils as expansive in our initial site investigations stage and proposed to defer classification until earthworks completion. Since soils are expansive in nature, and the foreseeable movement is expected to be greater than 25mm, therefore soils on-site are not considered to meet the definition prescribed above for 'good ground'.

CES Ltd commissioned Geocivil Ltd to undertake Linear Shrinkage testing and determination of the liquid limit, plastic limit, plasticity index and water content from samples of the Waipapa Group parent material and of the material placed as fill. This form of testing was preferred due to the geology present.

In NZS 3604:2011 expansive soils are defined as those with:

- Liquid Limit, LL > 50% (as tested by NZS4402.2.2:1986)
- Linear Shrinkage, LS > 15% (as tested by NZS4402.2.6:1986)

Within this subdivision, the results of the Linear Shrinkage tests indicate a consistent linear shrinkage of between 12% and 19%. This result is a reflection of the consistency of the parent material and is consistent with the samples taken on other parts of the development, within Stage 2.

Samples returned a Plasticity Index (PI) of between 23 to 45 and a Liquid Limit (LL) ranging from 55 to 85.

From the sample taken on the ridgeline, and the above criteria for expansive soils, we are satisfied that the soils on-site are expansive in nature as the liquid limits exceed the definition above. From further review of the results and use of the Casagrande Plasticity Chart, the soils on-site are assessed as generally a elastic SILT which exhibits low to medium levels of plasticity. The linear shrinkage results were marginally over the threshold for 'good ground' in accordance with NZS3604, therefore soil expansivity of higher than a CLASS S as per NZBC – B1 should be expected. Due to the constant shallow groundwater level and ground level, the seasonal changes of moisture are anticipated to be less severe within this stage.

From the above and experience with the geology present at the site, CES Ltd assesses the soils on-site for this stage of the subdivision as Class M – Moderately Expansive in accordance with NZBC – B1 Structure.

5.5 Static Settlement

The majority of this stage is overlying Holocene Deposits, which are potentially susceptible to elastic and primary consolidation settlement under static gravity loads. The initial subdivision report by CES Ltd, which accompanied the application, stated that ongoing settlement monitoring would be conducted throughout the subdivision along with piezometers to monitor groundwater levels. Subsequent to this, damage to the settlement occurred during earthworks construction which altered the monitoring proposed for the development. In conjunction with the settlement pad monitoring, further analysis has been provided using Settle3, and a secondary check on the

predicted settlement magnitudes using CPT data directly in the CPT interpretation software CPeT-IT. Additional boreholes have also been conducted to confirm the changes to groundwater levels.

Lots 1,10 and 11 are located on sites that have not been cut flat and have a mixture of Waipapa Group hillside flanks and softer Holocene deposits downhill. These allotments are not considered as part of this analysis as the building sites are to be located on the ridge flank. These lots are on areas which transition between two geologies, it is recommended that these foundations be specifically designed by a suitably qualified and experienced engineer.

5.5.1 Settlement Monitoring

CES Ltd has had a total of eight settlement monitoring pads installed in various locations across the subdivision to monitor both the change in height and the rate of change of settlement over time. Initially, four pads were installed in June 2021, and the initial heights were taken on 22 June 2021. During the course of construction, two settlement pads were lost or destroyed by heavy machinery. A further two pads suffered minor damage, causing a variation in results.

Four additional settlement pads were installed in February 2022.

Pads were generally located in areas expected to have the largest amounts of settlement:

MP1 – Boundary between Lot 16 and Lot 17 beside road
MP2 – Centre of Northern Boundary of Lot 16
MP3 – Centre of Boundary between Lot 21 and Lot 22
MP4 – Centre of Boundary between Lot 23 and 24
MP5 – South-western end of Lot 30
MP6 – North-eastern side of Lot 32
MP7 – Centre of Lot 13
MP8 – South-western side of Lot 1

Figure 2 - View of subdivision showing location of settlement pads (Source R&B Ltd)

One pad (MP6) had an initial fall in height over the first month of 85mm. Consultation with R&B Ltd about this result with a consensus this reading is unlikely and was potentially instead caused by damage to the pad. Subsequent monthly changes in height for this pad have all been in the area of 10-13mm, in line with similar rates observed on the remaining pads.

Settlement Pads were monitored for both total settlement and change in the rate of settlement. Initial settlement was highest after settlement pads were installed (~20-30mm per month), decreasing significantly over time (<7mm per month).

Despite the significant separation between settlement pads, settlement rates is highly consistent across the development. MP6 shows the largest settlement over the last four weeks (6.9mm), with MP8 showing the least amount of settlement at 4.1mm. The use of the geocomposite fabric will also assist with any anomalies over the site and ensure a uniform amalgamation of the engineering fill.

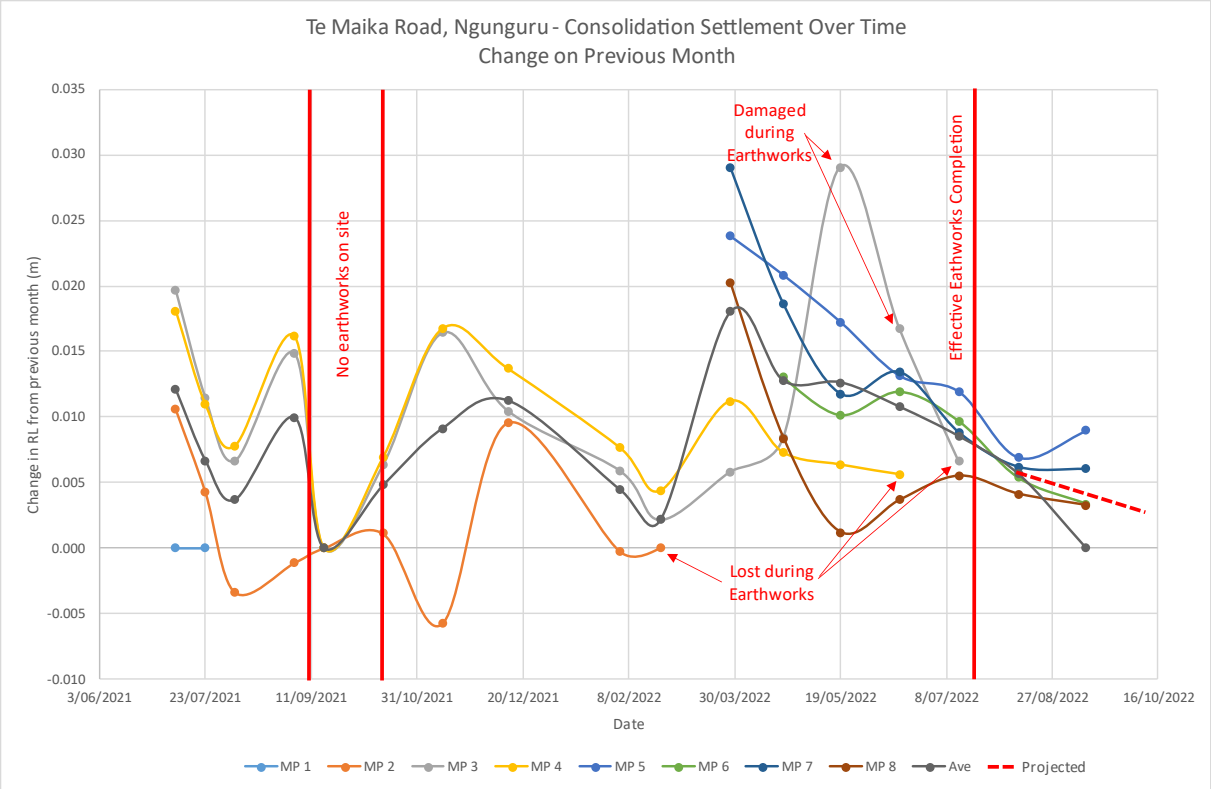


Figure 3 - Graph measuring the rate of change in movement (settlement) from the previous period.RL heights for each of the settlement pads is taken every four weeks and the change from the previous period graphed. (Source CES Ltd)

It is noted that when earthworks stopped during September 2021 and no heavy machinery was working on-site that no significant movement occurred on site. In most instances, settlement ceased, which is a similar observation with recent levels at the site towards the end of the development reducing on a downward trend as site works reduce and heavy machinery leaves the site.

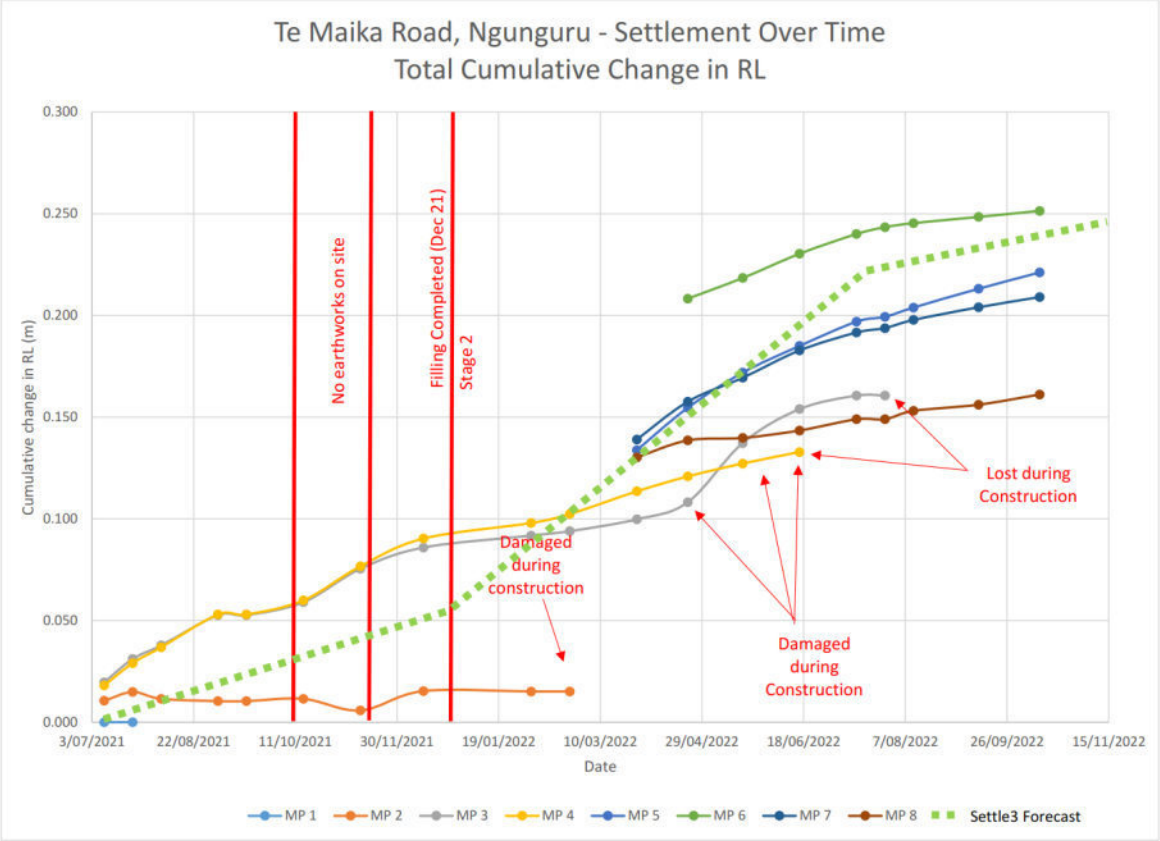


Figure 4 - Graph showing the total movement (settlement) from installation of the settlement pads. (Source CES Ltd)

Total settlement-induced movement at any individually monitored pad on the subdivision has generally been less than 250mm with the rate of change noticeably reducing from July 2022 onwards (1.5 years post earthworks).

In addition to the above, shallow boreholes were conducted within this stage on Lot 14 and Lot 17 to compare the change in groundwater depths. The groundwater depths at these lots ranged from 3.2m to 4.1m below existing ground, this is following an additional 2.0m of engineered fill. Previously in the same locations, groundwater was located at 0.5m below the existing ground pre-earthworks.

At issue of this report, the latest settlement monitoring results encountered a cease in movement within this stage and a further reduction in the rates of settlement.

5.5.2 Settlement Analysis

The initial loading stage from earthfill being laid is expected to have been 40-50mm; with the use of laden Moxy trucks carting and dumping loads over the development. Our comparison of the observed rates and the theoretical rate commences from a known point being at the completion of earth filling within Stage 1 which was towards the end of 2021.

Due to the difficulty with compliance from the contractor with installing piezometers and maintaining settlement pads, a settlement analysis has been undertaken to assist with confirming the anticipated level of settlement over the site. The analysis of predicted levels of settlement has been undertaken using Settle 3D using the CPT data collected by GeoCivil and Perry Geotech, prior to earthworks being conducted on-site. From a review of the CPT interpretative data, the Holocene Deposits beneath the very stiff clay crust are indicated to be normally consolidated to slightly overconsolidated. The depth of Holocene Deposits has been assessed and averaged on the upper limits from the data available in this stage. The additional fill applied over this stage is expected to result in further consolidation of the underlying soils which has been assessed as part of the development earthworks monitoring. The settlement analysis was conducted in nine stages to evaluate the sensitivity of anticipated settlement post-earthworks. These stages are as follows, with anticipated cumulative settlement summarised as follows;

Stage	Time (Years)	Total Settlement	Notes
1	0	0mm	Start of filling
2	0.1year	52.2mm	Post Earthworks
3	0.5year	214.0mm	
4	1year	228.0mm	
5	2years	228.0mm	Assumed12kPa Loading for dwellings
6	10years	290.0mm	No further change
7	50years	290.0mm	
8	100years	290.0mm	

The above results have been included in Figure 4, which shows a comparison to the observed total settlement levels measured on-site. From a comparison of the measured and calculated settlement rates, the rates have generally been consistent, with potentially 50mm of additional movement likely expected with the additional loading from residential development. A further assessment of the settlement was conducted without the 12kPa loading from residential development; this resulted in overall long-term settlement rates being significantly lower.

An additional secondary check using CPeT-IT was conducted using the CPT data undertaken prior to the earthworks stage and applied 2m of engineered fill. From this check, the expected settlement from the application of additional fill generally ranged between 200mm and 300mm, concurring with our settlement analysis above.

Groundwater levels in these areas have shifted approximately 0.7m to 1.1m deeper than pre-development levels. This confirms that the observations from settlement and fill applied have induced changes to groundwater levels. Overall this change in groundwater levels is expected, along with the settlement monitoring showing a reduction in rates of settlement

provides further assurances that the engineered fill is now moved to within the secondary settlement phase.

From the site observations and settlement analysis of both theoretical and observed, CES Ltd is satisfied that the earth fill is within the secondary settlement phase, with rates of settlement gradually decreasing over the coming year. At the current stage, any immediate residential development on the engineered fill shall be suspended and piled to avoid further surcharging to the engineered fill. Piles will need to be pre-augured through the engineered fill and geocomposite to ensure piles extend below the engineered fill layer.

Settlement pads are to continue to be monitored on a 3 monthly basis by Reyburn and Bryant, and shall remain in place over the next two years or until the allotments in which the pads occupy are developed and be supplied to CES Ltd so that potential options for shallow foundations can be considered for any site-specific developments, subject to specific engineering design. This information can then be used to assist any future site-specific development of each site.

Provided the recommendations above are adopted, CES Ltd is satisfied that the risk of instability from subsidence is low.

5.5.3 Secondary Settlement Effects for Underground Services

Settlement rates have generally decreased in the past six months, with on-site council services being installed post-earthworks and supported by a geocomposite beneath the lines. All pipes are surrounded with pipe bedding which will allow for any minor movement. The 1350mm diameter stormwater culvert line which runs through the property has less loading than the surrounding 2.0m of engineered fill; therefore expected, secondary settlement in this location is expected to be less and well supported by geocomposite fabric.

Groundwater recharge is to remain constant from the catchment above and is unlikely to reduce due to the surrounding terrain. However, the use of groundwater bores in the area should be avoided. It is recommended that a Consent Notice be placed at this stage to prevent groundwater bores from being installed.

The use of reinforced gravel rafts is recommended to further manage secondary settlement and shall extend a minimum of 1.0m from the building footprint to manage the transition back to engineering fill. The used of a minimum of 150mm pipe beddings surrounding any underground services should be adopted.

The use of flexible private service connections to scheme services should be adopted, in order to minimise any risk of damage to connections caused by settlement during or after the construction of dwellings.

Site-specific foundation recommendations are contained within Appendix 2 and the conclusion of this report.

5.6 Bearing Capacity

Based upon the results of our testing and our observations during the subdivision construction, CES Ltd is satisfied that all areas of bulk filling meet the requirements of engineered fill as per NZS4431:1989, under which this subdivision was started.

From the subdivision construction monitoring and testing throughout the filled areas within Stages 1 and 3, CES Ltd is satisfied that the engineered fill has a minimum Ultimate Bearing Strength of 300kPa. Further construction monitoring is recommended to be conducted as part of site-specific development works on each new allotment. As required by the Building Code, a strength reduction factor must be applied to the above values in order to determine the dependable values for use in ultimate limit state design; a reduction factor of 0.5 is recommended.

When considering the above, and ignoring the topsoil layer, near surface soils (within 2m of finished ground levels) within each building platform, are generally considered to comply with the requirements of NZS3604:2011, and, with the exception of expansive soil properties, should otherwise be designated as 'good ground'.

5.7 Lot Gradients & Stability

Within Stage One, the majority of residential Lots have been finished with a nearly level or gently sloping gradient. Lots 12 through 17 have a batter on the southeastern side, battering down to the drain on the property boundary. Likewise, there is a batter separating Lots 15 and 16, these are separated by a drain with batter descending down from each Lot.

Lots 2,10 and 11 are predominantly at natural ground slope and are positioned on either the ridgeline or a ridge flank. Lot 1 has a steep batter to the south-west and east, and a terraced retaining wall to the north. Likewise, Lot 2 has batters to the west and east, and retaining north and south of the Lot. Lots 10 and 11 are located on the eastern flanks of the hill and slope down towards the softer Holocene River deposits. These sites will require site-specific assessment at the Building Consent stage by a Geo-professional.

Lots 18 and 19 have had areas of cut undertaken on the northwestern boundary, however, a gentle batter has been achieved to the neighbouring property and beyond in this area and no retaining is required.

Figure 5 - Lot 1 and Lot 2 during the construction phase . Note the location of the retaining walls and batters on the left and right hand sides (west and east). Source CES Ltd.

Pre-development slope stability analysis, as discussed reports listed in Section 3, suggested that the site profile would be safe and stable as a finished state. However as final levels were not known within Lots 1 and 2 of this Stage, a further assessment of the setback requirement to the flanks and retaining structures was deferred to the earthworks completion stage. CES Ltd has undertaken an assessment of the flanks to ascertain a suitable setback from the slopes in accordance with WDC – Land Development Stabilisation – Technical Design Requirements Policy (Dated: April 2018).

5.7.1 Subsoil Conditions

The flank slopes did not indicate any signs of previous instability and are standing at grades of up to 25 degrees. Cut faces within proposed Lot 2 and Stage 2 of the development were left near vertical and exposed by the contractor for the majority of the 2021 winter period. No signs of significant slippages occurred, which provided confidence that the recently exposed, completely weathered material is consistent at depth. DPSH-B testing confirmed the depth to the underlying moderately weathered greywacke.

Due to the lack of evidence of slope failure on the slopes a back analysis was not undertaken and the reliance on parameters used are based on experience with this geology in the area.

5.7.2 Groundwater Conditions

Groundwater has been conservatively assumed to be as shallow as 1.0m below finished ground level for the elevated groundwater level and as shallow as 2.0m below finished ground level at the lower end of the flank for normal groundwater levels.

5.7.3 Site Seismic Characteristics

Ground motion inputs from Table A1 of the NZGS/MBIE Earthquake Geotechnical Engineering Practice Module 1 have been adopted for the purpose of geotechnical engineering assessment within this report. Due to the location of the site, Method 1 of the Module 1 has been adopted to determine the Peak Ground Acceleration (PGA). From Appendix 1 of Module 1, a conservative approach has been taken, and we have adopted the PGA for a 500-year return period of 0.19. This PGA is to be adopted for stability assessment of the ridge flanks.

Module 6 of the MBIE guidance documents has been adopted to calculate the horizontal design acceleration with the position of the building and retaining structures in relation to slopes down the ridgeline as generally considered to be a Class 3 scenario with a Topographical factor of 1.0 and wall displacement factor of 0.5. Based on these guidelines, a minimum PGA for pseudo-static design of 0.095 has been adopted for down the ridgeline where retaining structures have been constructed.

Results of this stability analysis are summarised within Appendix 7. From the analysis, CES Ltd is satisfied that a stable building site is available on each allotment, provided compliance with this report. A minimum building setback of 3.0m to the flanks is to be applied to the building sites and upper-level areas of the existing retaining structures without further stability assessment by a geo-professional.

5.8 Retaining Walls

Seventeen timber pole retaining walls have been constructed across the subdivision, of which four retaining walls are either within or directly adjacent to Stage One. As indicated on the CES Ltd plans (Refer to Appendix 4), fifteen retaining walls have been constructed within or adjacent to Stage Two to form level or gently sloping building platforms on Lots 3-9. Lots 1 and 2 of this Stage have the remaining retaining walls between their boundaries.

Retaining walls have been designed assuming a surface surcharge value of 2.5kPa above each wall. These retaining walls have been designed to accommodate loadings generated by lightweight vehicles (as defined in NZS1170) and do not consider any permanent loads in close

proximity to the walls. A minimum setback of 3.0m horizontally from the upper walls will need to be maintained from any structures to avoid any additional surcharge loads.

Alternatively, specific design advice should be sought from a suitably qualified Chartered Professional Engineer should any structure or foundations be designed to intrude into this setback area.

It is recommended that only limited site formation works take place immediately in front (downslope) of any retaining walls. Any works that require excavation greater than 0.5m deep should be subject to a specific engineering design to ensure that retaining walls are not undermined. Further to this, it is recommended that a minimum setback of 1.5m from the downslope retaining wall be applied for any future development. To illustrate the building setback, a 'Restricted Development Area Plan' has been prepared by CES Ltd and is appended to this report, refer to Appendix 4. Restricted Development Areas are discussed in further detail within Section 5.12 below.

5.9 Piped Services, Service Trenches and Drainage

As indicated within the approved engineering plans for the development, the locations of the council stormwater and sewer reticulation is present. In general, these services are either constructed within road reserves or adjacent to Lot boundaries. As such, we consider it unlikely that such constructed services would be encountered during individual Lot development. Regardless, all building works on individual Lots should be laid out so as not to disturb any nearby services.

Should any site-specific development layouts that encroach near or over these services be unavoidable, foundations must be designed per current WDC Engineering Standards guidelines for building near or over services (WDC Policy #0022).

5.10 Topsoil

Topsoil depths were checked during Hand Auger testing on individual Lots. The topsoil check indicated variable topsoil thicknesses, ranging from 70mm to 300mm. An average thickness of approximately 150mm is anticipated across the subdivision.

5.11 Stormwater Control

A stormwater reticulation system servicing the subdivision was constructed as part of the site formation works. All stormwater run-off from hard-standing areas (driveways, patios, footpaths etc) and any outflow from rainwater tank overflow, should be directed towards the stormwater system for disposal.

On-site stormwater disposal or soakage systems are not recommended unless further site-specific assessment is undertaken by a suitably qualified and experienced engineer. Under no circumstances should stormwater be disposed of by allowing it to flow onto or into the ground in an uncontrolled manner at any location on the subdivision.

5.12 Restricted Development Areas

As mentioned in previous sections, Restricted Development Areas have been imposed on portions of Stage One, specifically Lot 1-2 and Lots 10-17.

These Restricted Development Areas have been imposed due to:

The boundaries of proposed Lots 12-17 are adjacent to open drains and overland flowpaths with batter slopes.
Flanks on the ridgeline being in excess of 20 degrees (Lot 1-2, 10-11)
Lots 1-2 have boundaries with either a batter slope or terraced retaining structures.

Any developments that encroach on into a Restricted Development Area will need to be subject to a specific engineering investigation and design at the Building Consent stage of each development. This is to ensure that future developments will not have an adverse effect on slope stability or retaining wall stability.

Any future developments encroaching into a Restricted Development Area and requiring a specific engineering review should, at a minimum, reference this document and comment on the effect of the encroachment on surrounding areas.

For reference, CES Ltd has prepared a site plan outlining and summarising areas suitable for residential development and recommendations within Appendix 2 and 4 of this report.

6. CONCLUSION

From our assessment of the site and construction monitoring, CES Ltd is satisfied that the proposed new allotments with Stage 1 are suitable for lightweight residential development. A summary of each site is appended to this report for referral for site-specific developments. This report is intended to provide design guidance for the future development of the individual allotments. Should any works deviate from the recommendations of this report, then a site-specific assessment by a Geo-Professional (as defined within the WDCEES) should be undertaken prior to the application for Building Consent, and if required by the Local Authority a peer review provided from another Geo-Professional in support of the application. A summary of the site restrictions are as follows;

<u>Lot 1</u>

- Any future structures within this allotment require a site-specific geotechnical assessment to accompany any Building Consent application.

- Foundations will need to be designed for Class M – Moderately Expansive in accordance with NZBC – B1 Structure.
- All stormwater run-off from hard-standing areas (driveways, patios, footpaths etc) and any outflow from rainwater tank overflow, should be directed towards the stormwater system for disposal.
- On-site stormwater disposal or soakage systems are not recommended unless further site-specific assessment is required by a suitably qualified and experienced engineer.
- No inground swimming pools are to be constructed on-site.

Lot 2

- Buildings are to be setback a minimum of 3.0m from the ridgeline flanks and existing retaining structures within the development. Should any site-specific development on the site encroach into this setback, an assessment by a geo-professional should be undertaken to ensure the site stability.
- A minimum setback of 1.5m from the downslope retaining wall be applied for any future development in front of the existing retaining walls.
- Any developments that encroach on into a Restricted Development Area will need to be subject to a specific engineering investigation and design at the Building Consent stage.
- Foundations will need to be designed for Class M – Moderately Expansive in accordance with NZBC – B1 Structure.
- All stormwater run-off from hard-standing areas (driveways, patios, footpaths etc) and any outflow from rainwater tank overflow should be directed towards the stormwater system for disposal.
- On-site stormwater disposal or soakage systems are not recommended unless further site-specific assessment is required by a suitably qualified and experienced engineer.

Lot 10 and 11

- Lots 10 and 11 are located outside of the areas of fill for this subdivision, and are not underlain by geocomposite material
- Any future structures within this allotment require a site-specific geotechnical assessment to accompany any Building Consent application.
- Foundations will need to be designed for Class M – Moderately Expansive in accordance with NZBC – B1 Structure.
- All stormwater run-off from hard-standing areas (driveways, patios, footpaths etc) and any outflow from rainwater tank overflow, should be directed towards the stormwater system for disposal.
- On-site stormwater disposal or soakage systems are not recommended unless further site-specific assessment is required by a suitably qualified and experienced engineer.

Lot 12 and 13

- Any future structures within this allotment require a site-specific geotechnical assessment to accompany any Building Consent application.

- Piled foundations will be required. It is anticipated that the piles will need to be preaugered through the geogrid fabic. Refer to Section 5.5 of this report. SED design of foundations will be required at Building Consent Stage.
- Foundations will need to be designed for Class M – Moderately Expansive in accordance with NZBC – B1 Structure.
- All stormwater run-off from hard-standing areas (driveways, patios, footpaths etc) and any outflow from rainwater tank overflow, should be directed towards the stormwater system for disposal.
- On-site stormwater disposal or soakage systems are not recommended unless further site-specific assessment is required by a suitably qualified and experienced engineer.
- No inground swimming pools are to be constructed on-site.

Lots 14 to 21

- Piled foundations will be required. It is anticipated that the piles will need to be preaugered through the geogrid fabic. Refer to Section 5.5 of this report. SED design of foundations will be required at Building Consent Stage.
- Foundations will need to be designed for Class M – Moderately Expansive in accordance with NZBC – B1 Structure.
- All stormwater run-off from hard-standing areas (driveways, patios, footpaths etc) and any outflow from rainwater tank overflow, should be directed towards the stormwater system for disposal.
- On-site stormwater disposal or soakage systems are not recommended unless the further site-specific assessment is required by a suitably qualified and experienced engineer.
- No inground swimming pools are to be constructed on-site.

Refer to Appendix 2 for further details on the above summary.

7. APPENDICES

APPENDIX 1 – STATEMENT OF PROFESSIONAL OPINION
APPENDIX 2 – SUMMARY OF GEOTECHNICAL DESIGN RECOMMENDATIONS
APPENDIX 3 – REYBURN & BRYANT LTD SCHEME PLAN
APPENDIX 4 – CORE ENGINEERING SOLUTIONS LTD DRAWINGS SET
APPENDIX 5 – TESTING RESULTS
APPENDIX 6 – GEOTECHNICAL PRODUCER STATEMENT PS4 FOR RETAINING WALLS
APPENDIX 7 – SLOPE STABILITY ANALYSIS RESULTS
APPENDIX 8 – INSPECTION RECORDS
APPENDIX 9 – PRODUCER STATEMENTS FOR CONSTRUCTION FROM CONTRACTOR
APPENDIX 10 –SETTLEMENT ANALYSIS

APPENDIX 1 – STATEMENT OF PROFESSIONAL OPINION

Statement of Professional Opinion on Suitability of Land for Building Construction

Development	Traverse Ltd - Te Maika Road Development
Developer	Traverse Ltd
Location	51 Te Maika Road, Ngunguru, Whangarei
I *(full name)*	David Andrew Leslie
Of *(Name and address of firm)*	Core Engineering Solutions Ltd, 31 Vine Street Whangarei

1 I am a Geo-Professional as defined in Section 1.3 Abbreviations and Definitions and was retained by the Developer as the geo-professional on the above development

2 The extent of my preliminary investigations are described in my Report(s) number ___Subdivision Report Ref :20-0078 _ dated __Rev 01 21/05/2021 __ and the conclusions and recommendations of that/those document(s) have been re-evaluated in the preparation of this report. The extent of my inspections during construction, and the results of all tests and/or re-evaluations carried out are as described in my geotechnical completion report dated _18/11/2022 __.

3 In my professional opinion, not to be construed as a guarantee, I consider that *(delete as appropriate)*:

a. The earth fills shown on the attached Plan No _____EWA16042_____have been placed in compliance with the requirements of the Whangārei District Council and my specification. (However, lots _____10-12 (Stage 1), 29-32 (Stage 3)_____ did not pass final fill specification testing and as a result, specific site investigations and foundation designs will be required here at the time of building consent application)

b. The completed works take into account land slope and foundation stability considerations, subject to the appended foundation recommendations and earthworks restrictions, *(which should be read in conjunction with the appended final site contour plan)*

c. Subject to 3(a) and 3(b) above, the original ground not affected by filling satisfies the description of 'good ground' as described in B1 Acceptable Solutions and Verification Methods and NZS 4229:2013 _☐ Yes ☒ No

(If no, a specific foundation investigation/design will be required at the time of Building Consent)

d. Subject to 3(a) and 3(b) above, the filled ground satisfies the description of 'good ground' as described in NZS 3604:2011 and NZS 4229:2013 ☐ Yes ☒ No

(If no, a specific foundation investigation/design will be required at the time of Building Consent)

e. The original ground not affected by filling and the filled ground are not subject to erosion, subsidence, or slippage in accordance with the

provisions of section 106 of the Resource Management Act 1991 provided that:

i. Compliance with the Subdivison Report and Geotechnical Completion Reports by CES Ltd for this development.

ii. Vibrations and Land Excavations within Stage 1 and 3 for site specific developements, are overseen and undertaken in responsible manner by suitably experienced contractors.

iii.

iv.

4 This professional opinion is furnished to the TA and the Developer for their purposes alone on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any building

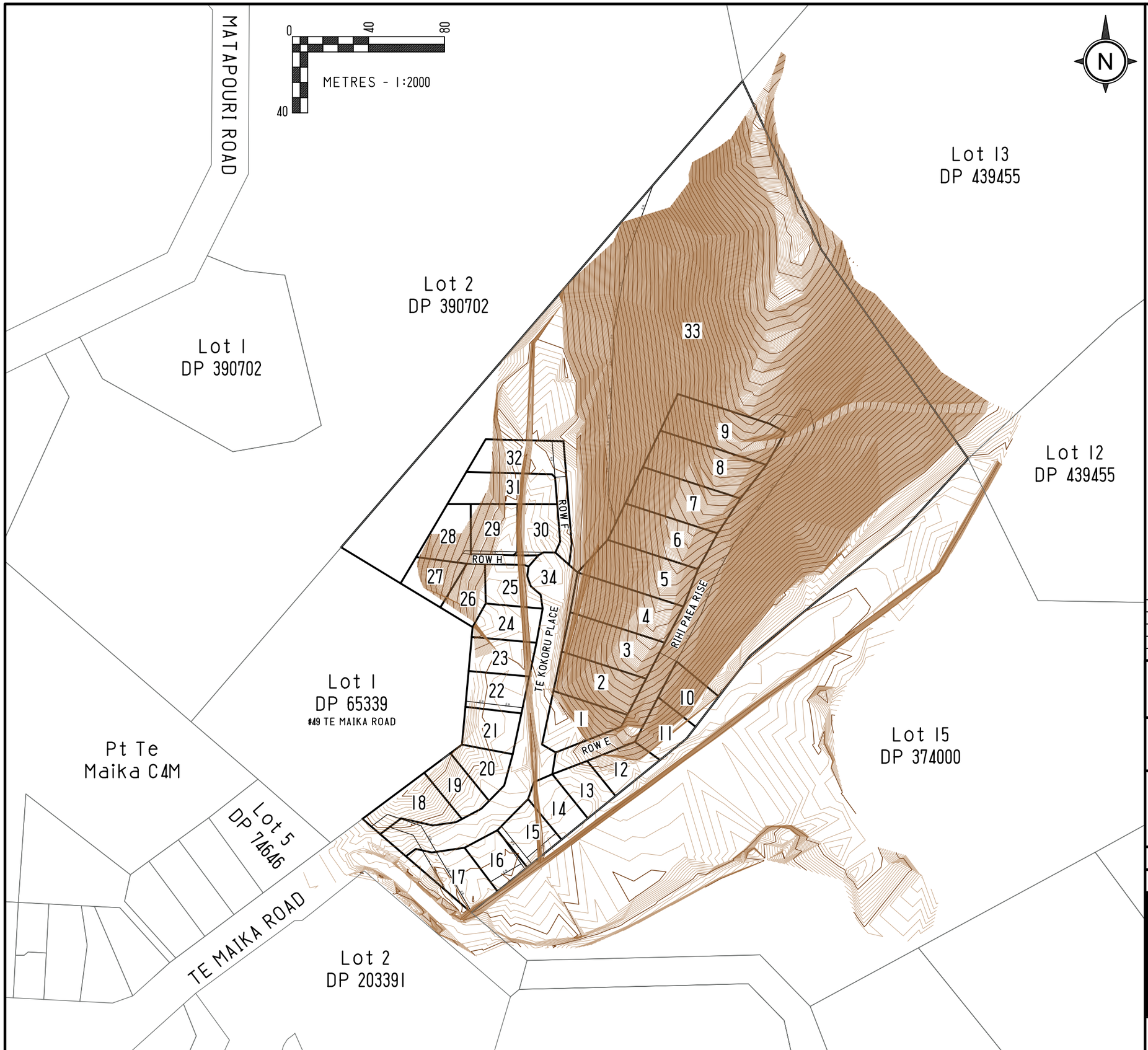
5 This certificate shall be read in conjunction with my geotechnical report referred to in clause 2 above and shall not be copied or reproduced except in conjunction with the full geotechnical completion report

	BEng(Civil), DipEng(Civil),MEMgt(Hons) CMENGNZ, CPEng(Geotechnical/Structural)	18/11/2022
Signature	*Professional Qualifications*	*Date*

APPENDIX 2 – SUMMARY OF GEOTECHNICAL DESIGN RECOMMENDATIONS

Lot No	Area	Anticipated Soil Type	Subdivision Cut Ground present within Lot		Subdivision Filled Ground present within Lot		Unworked Natural Ground Present within Lot	Foundations may be designed to 3604:2011	Shallow Foundations Ultimate Unfactored Bearing Capacity	Expansive Soils Present	Site Soil Classification (as defined in NZBC - B1)	Restricted Development Area Present on Lot	Other Comments
	m^2	In Situ Soil / Engineered Fill	Y/N	Max Depth (m)	Y/N	Max Depth (m approx)	Y/N	Y/N	(kPa)	Y/N	(S, M, H, E)	Y/N/SED	
1	821	Engineered Fill / In-situ Soil	N	-	Y	4-6.0m	N	No, SED Design to account for expansive soils required for buildings within setback lines	SED	Y	M	SED	Piled foundation recommended. An estimated depth of piles 14.0 to 16.0m embedment and designed for end bearing only to support foundations, subject to building loads.
2	923	In Situ Soil	Y	4.0m approx	N	-	Y		300	Y	M	Y	Any development outside of the building restrictions will require further investigations by a suitably qualified engineer in accordance with WDCEES 2022, minimum setback from retaining wall structures and flanks as defined in Appendix 4 of the GCR, any works within this setback will require further review by a Geo-professional
10	550	Engineered Fill	N	-	N	-	Y		SED	Y	M	SED	Piled foundations recommended, allowance for soil creep on slopes > 18 degrees, subject to specific site assessment. Estimated depth of piles 3.0 to 4.0m embedment and designed for end bearing only to support foundations, subject to building loads
11	548	Engineered Fill	N	-	N	-	Y		SED	Y	M	SED	Piled foundations recommended, allowance for soil creep on slopes > 18 degrees, subject to specific site assessment. Estimated depth of piles 3.0 to 4.0m embedment and designed for end bearing only to support foundations, subject to building loads
12	546	Engineered Fill	N	-	Y	2.0	N		SED	Y	M	Y	Piled foundation recommended. Estimated depth of piles 12.0m embedment and designed for end bearing only to support foundations, subject to building loads.
13	500	Engineered Fill	N	-	Y	2.0	N		SED	Y	M	Y	Piled foundation recommended. Estimated depth of piles 12.0m embedment and designed for end bearing only to support foundations, subject to building loads.
14	544	Engineered Fill	N	-	Y	2.0	N		SED	Y	M	Y	Piled foundations will be required. It is anticipated that the piles will need to be pre-augered through the geogrid fabric. Refer to Section 5.5 of this report. SED design of foundations will be required at Building Consent Stage. Estimated depth of piles 12.0m embedment and designed for end bearing only to support foundations, subject to building loads.
15	607	Engineered Fill	N	-	Y	2.0	N		SED	Y	M	Y	Piled foundations will be required. It is anticipated that the piles will need to be pre-augered through the geogrid fabric. Refer to Section 5.5 of this report. SED design of foundations will be required at Building Consent Stage. Estimated depth of piles 12.0m embedment and designed for end bearing only to support foundations, subject to building loads.
16	529	Engineered Fill	N	-	Y	2.0	N		SED	Y	M	Y	Piled foundations will be required. It is anticipated that the piles will need to be pre-augered through the geogrid fabric. Refer to Section 5.5 of this report. SED design of foundations will be required at Building Consent Stage. Estimated depth of piles 14.0m embedment and designed for end bearing only to support foundations, subject to building loads.
17	810	Engineered Fill	N	-	Y	2.0	N		SED	Y	M	Y	Piled foundations will be required. It is anticipated that the piles will need to be pre-augered through the geogrid fabric. Refer to Section 5.5 of this report. SED design of foundations will be required at Building Consent Stage. Estimated depth of piles 14.0m embedment and designed for end bearing only to support foundations, subject to building loads.
18	777	Engineered Fill	N	-	Y	2.0	N		SED	Y	M	N	Piled foundations will be required. It is anticipated that the piles will need to be pre-augered through the geogrid fabric. Refer to Section 5.5 of this report. SED design of foundations will be required at Building Consent Stage. Estimated depth of piles 9.0m embedment and designed for end bearing only to support foundations, subject to building loads.
19	554	Engineered Fill	N	-	Y	2.0	N		SED	Y	M	N	Piled foundations will be required. It is anticipated that the piles will need to be pre-augered through the geogrid fabric. Refer to Section 5.5 of this report. SED design of foundations will be required at Building Consent Stage. Estimated depth of piles 9.0m embedment and designed for end bearing only to support foundations, subject to building loads.
20	529	Engineered Fill	N	-	Y	2.0	N		SED	Y	M	N	Piled foundations will be required. It is anticipated that the piles will need to be pre-augered through the geogrid fabric. Refer to Section 5.5 of this report. SED design of foundations will be required at Building Consent Stage. Estimated depth of piles 12.0m embedment and designed for end bearing only to support foundations, subject to building loads.
21	594	Engineered Fill	N	-	Y	2.0	N		SED	Y	M	N	Piled foundations will be required. It is anticipated that the piles will need to be pre-augered through the geogrid fabric. Refer to Section 5.5 of this report. SED design of foundations will be required at Building Consent Stage. Estimated depth of piles 13.0m embedment and designed for end bearing only to support foundations, subject to building loads.

APPENDIX 3 – REYBURN & BRYANT LTD SCHEME PLAN



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MAJOR CONTOURS @ 1.0m INTERVALS
MINOR CONTOURS @ 0.1m INTERVALS

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT
TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION
LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE
EARTHWORKS ASBUILT
ORIGINAL CONTOURS: OVERALL

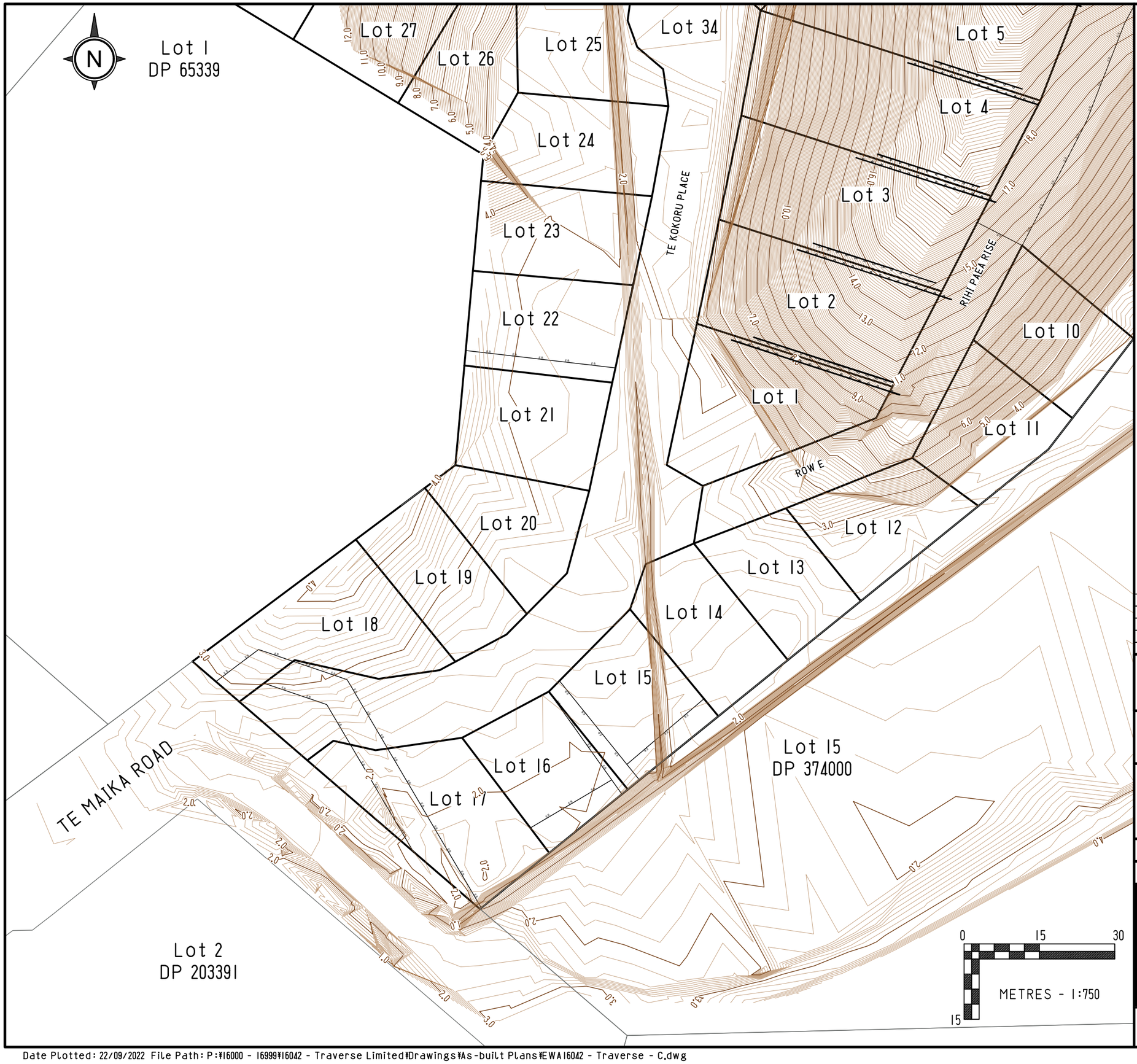
SCALE: 1:2000 @A3

COUNCIL REFERENCE: SL2100003 AND P117722

reyburn & bryant
Ph: 09 438 3563
7 Selwyn Ave, Whangarei
PO Box 191, Whangarei 0140
www.reyburnandbryant.co.nz

DRAWING REF. EWA16042
SHEET 01 OF 19
REV C

Date Plotted: 22/09/2022 File Path: P:¥16000 - 16999¥16042 - Traverse Limited¥Drawings¥As-built Plans¥EWA16042 - Traverse - C.dwg



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- MAJOR CONTOURS @ 1.0m INTERVALS
- MINOR CONTOURS @ 0.1m INTERVALS
- RETAINING WALL : MAX HEIGHT - 1m

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT

TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION

LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE

EARTHWORKS ASBUILT
ORIGINAL CONTOURS

SCALE : 1:750 @A3

COUNCIL REFERENCE : SL2100003 AND P117722

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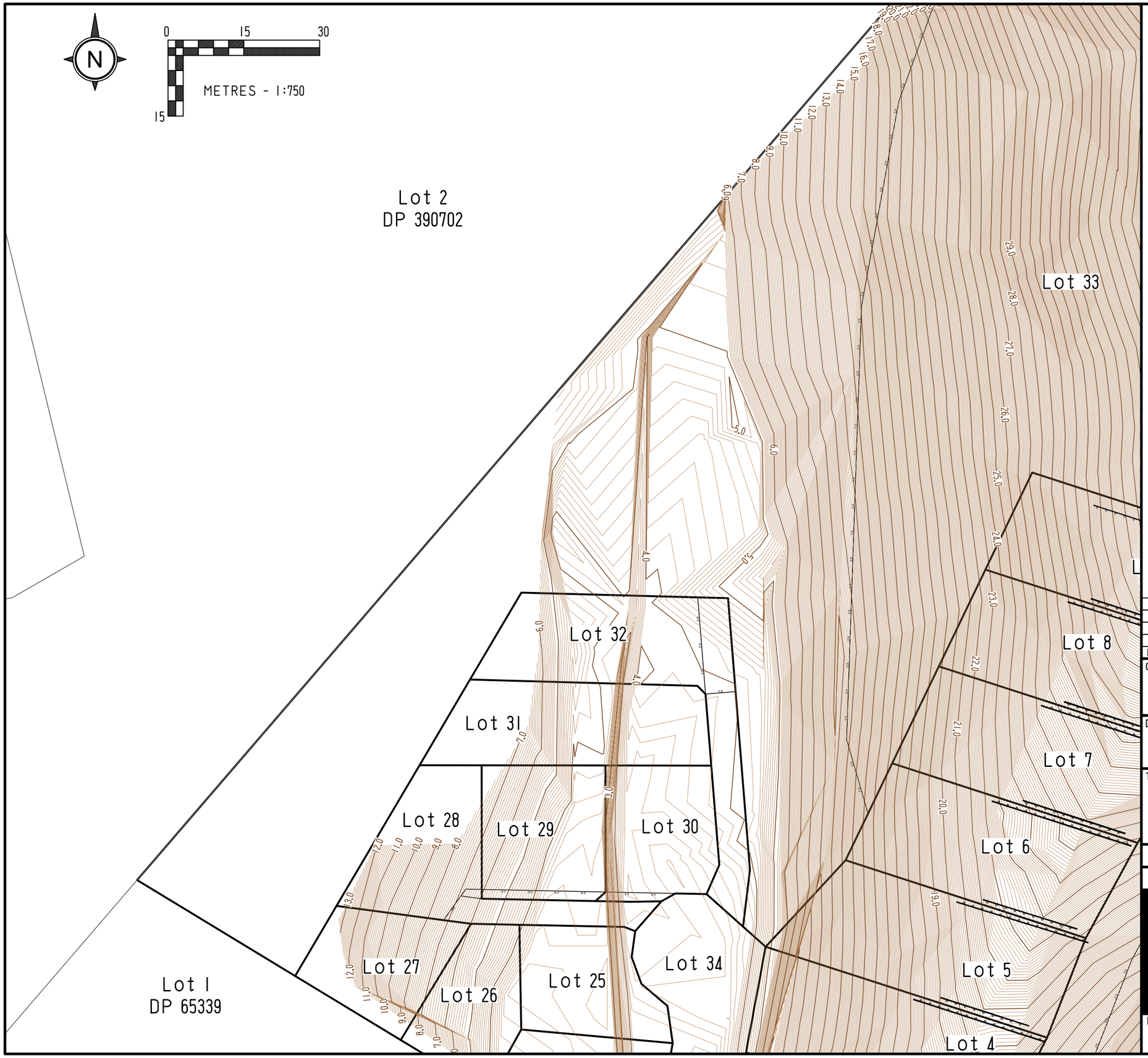
DRAWING REF.	SHEET	REV
EWA16042	02 OF 19	C

Date Plotted: 22/09/2022 File Path: P:¥16000 - 16999¥16042 - Traverse Limited¥Drawings¥As-built Plans¥EWA16042 - Traverse - C.dwg



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- MAJOR CONTOURS @ 1.0m INTERVALS
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- RETAINING WALL : MAX HEIGHT - 1m

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CLIENT

TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION

LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE

EARTHWORKS ASBUILT
ORIGINAL CONTOURS

SCALE : 1:750 @A3

COUNCIL REFERENCE : SL2100003 AND P117722

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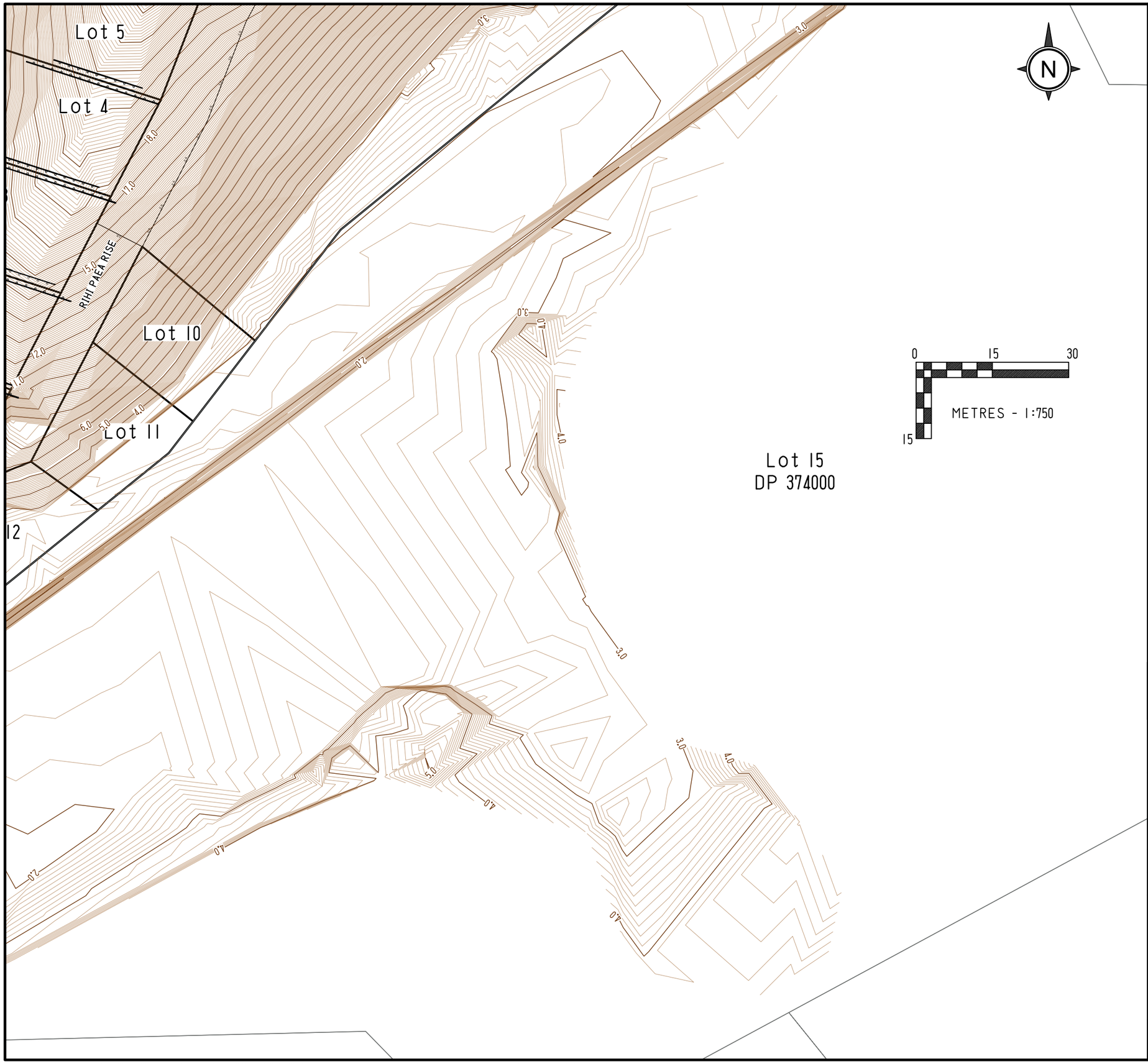
DRAWING REF. EWA16042 | SHEET 03 OF 19 | REV C

Date Plotted: 22/09/2022 File Path: P:¥16000 - 16999¥16042 - Traverse Limited¥Drawings¥As-built Plans¥EWA16042 - Traverse - C.dwg



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MAJOR CONTOURS @ 1.0m INTERVALS
MINOR CONTOURS @ 0.1m INTERVALS
RETAINING WALL : MAX HEIGHT - 1m

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT
TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION
LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE
EARTHWORKS ASBUILT
ORIGINAL CONTOURS

SCALE : 1:750 @A3

COUNCIL REFERENCE : SL2100003 AND P117722

reyburn & bryant
Ph: 09 438 3563
7 Selwyn Ave, Whangarei
PO Box 191, Whangarei 0140
www.reyburnandbryant.co.nz

DRAWING REF.	SHEET	REV
EWA16042	04 OF 19	C

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RETAINING WALL : MAX HEIGHT - 1m

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
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CLIENT
TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION
LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE
EARTHWORKS ASBUILT
ORIGINAL CONTOURS

SCALE : 1:750 @A3

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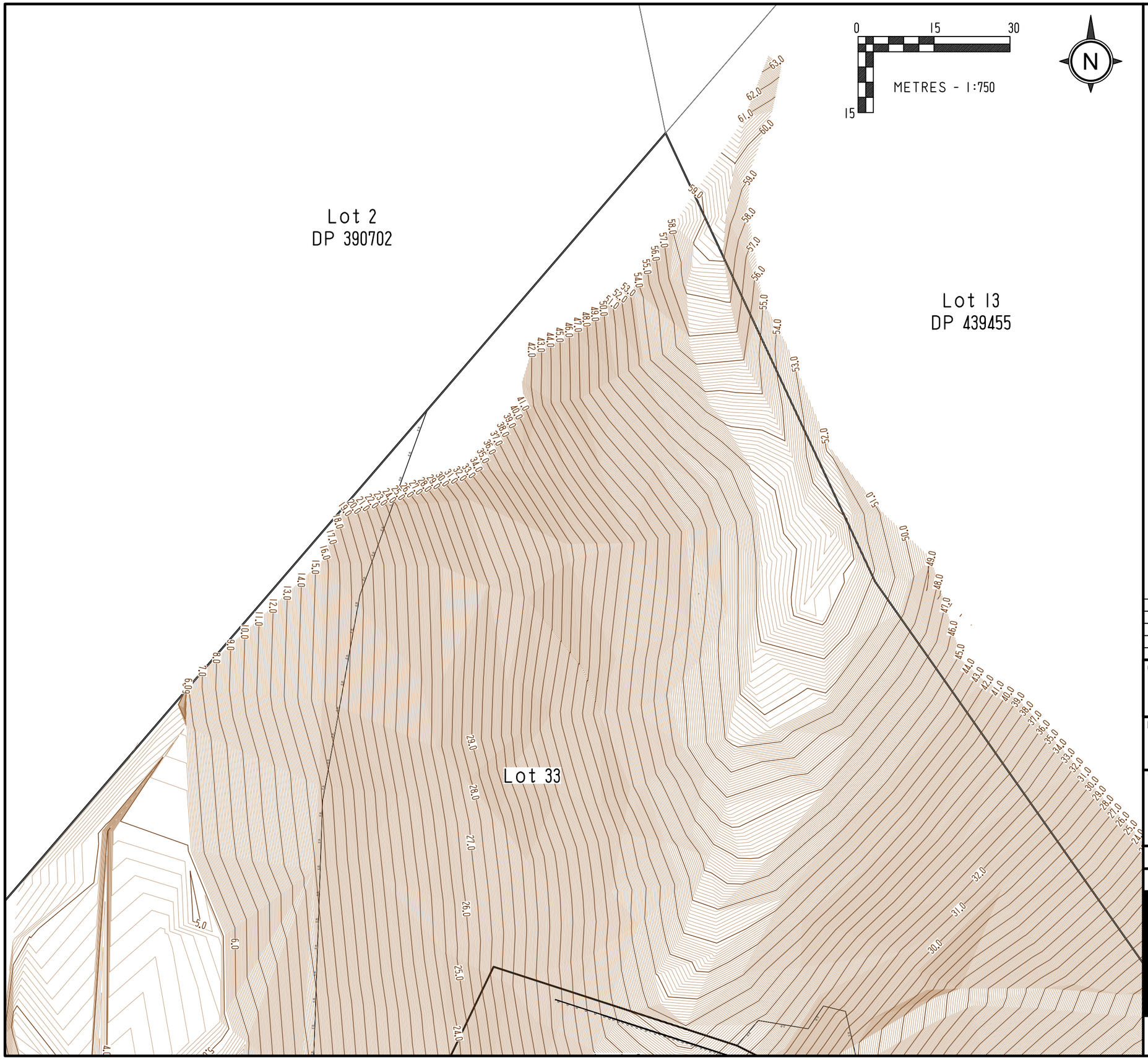
DRAWING REF.	SHEET	REV
EWA16042	05 OF 19	C

Date Plotted: 22/09/2022 File Path: P:¥16000 - 16999¥16042 - Traverse Limited¥Drawings¥As-built Plans¥EWA16042 - Traverse - C.dwg



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MAJOR CONTOURS @ 1.0m INTERVALS
MINOR CONTOURS @ 0.1m INTERVALS
RETAINING WALL : MAX HEIGHT - 1m

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
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CLIENT

TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION

LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE

EARTHWORKS ASBUILT
ORIGINAL CONTOURS

SCALE : 1:750 @A3

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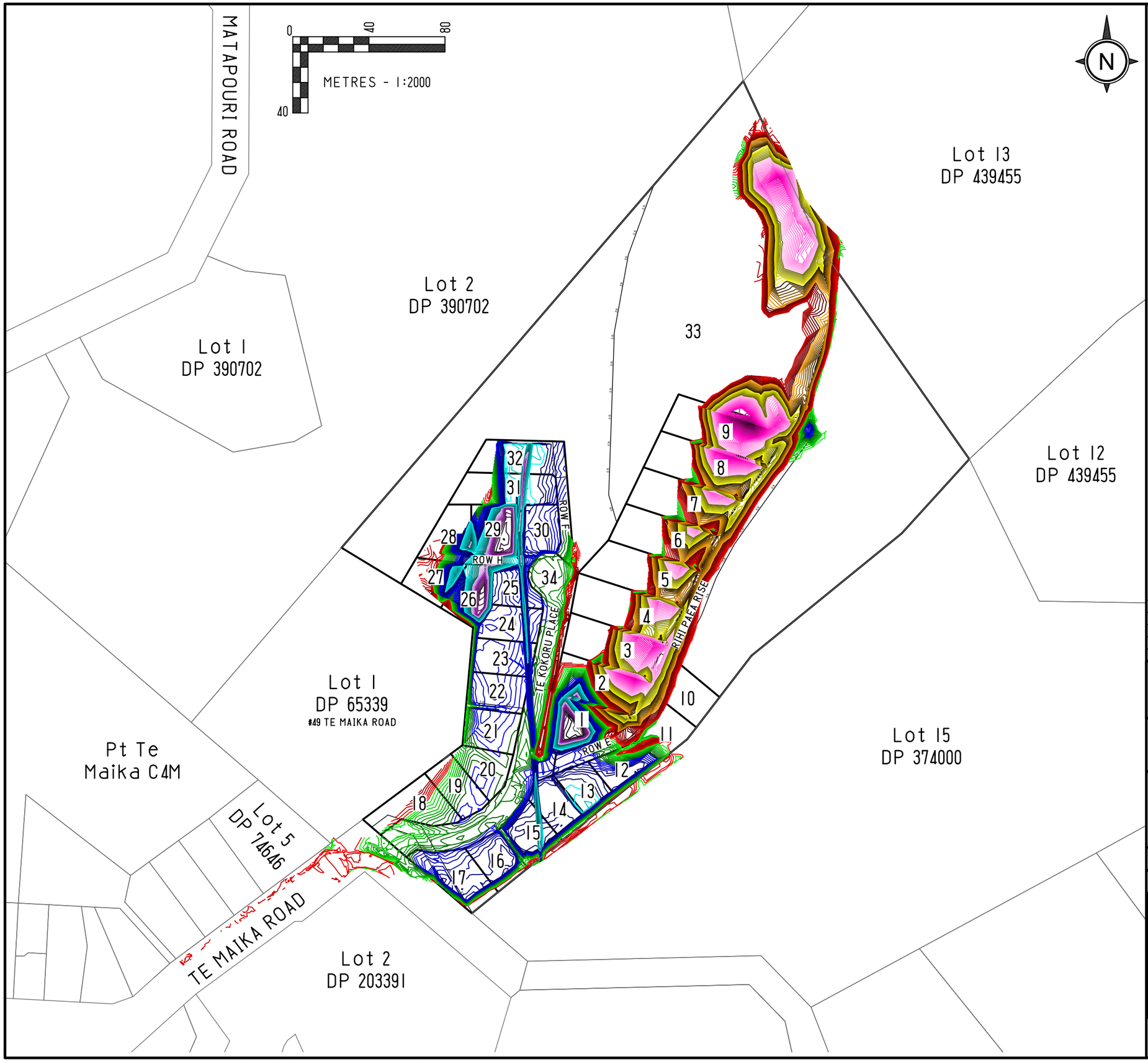
DRAWING REF.	SHEET	REV
EWA16042	06 OF 19	C



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DEPTH OF FILL:

0.00	TO 0.10	1.50	TO 1.60	3.00	TO
0.10	TO 0.20	1.60	TO 1.70	3.10	TO
0.20	TO 0.30	1.70	TO 1.80	3.20	TO
0.30	TO 0.40	1.80	TO 1.90	3.30	TO
0.40	TO 0.50	1.90	TO 2.00	3.40	TO
0.50	TO 0.60	2.00	TO 2.10	3.50	TO
0.60	TO 0.70	2.10	TO 2.20	3.60	TO
0.70	TO 0.80	2.20	TO 2.30	3.70	TO
0.80	TO 0.90	2.30	TO 2.40	3.80	TO
0.90	TO 1.00	2.40	TO 2.50	3.90	TO
1.00	TO 1.10	2.50	TO 2.60	4.00	TO
1.10	TO 1.20	2.60	TO 2.70	4.10	TO
1.20	TO 1.30	2.70	TO 2.80	4.20	TO
1.30	TO 1.40	2.80	TO 2.90	4.30	
1.40	TO 1.50	2.90	TO 3.00		

DEPTH OF CUT:

-0.10	TO -0.20	-3.00	TO -3.10	-5.90	TO
-0.20	TO -0.30	-3.10	TO -3.20	-6.00	TO
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-1.20	TO -1.30	-4.10	TO -4.20	-7.00	
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-1.60	TO -1.70	-4.50	TO -4.60		
-1.70	TO -1.80	-4.60	TO -4.70		
-1.80	TO -1.90	-4.70	TO -4.80		
-1.90	TO -2.00	-4.80	TO -4.90		
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-2.60	TO -2.70	-5.50	TO -5.60		
-2.70	TO -2.80	-5.60	TO -5.70		
-2.80	TO -2.90	-5.70	TO -5.80		
-2.90	TO -3.00	-5.80	TO -5.90		

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT

TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION

LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE

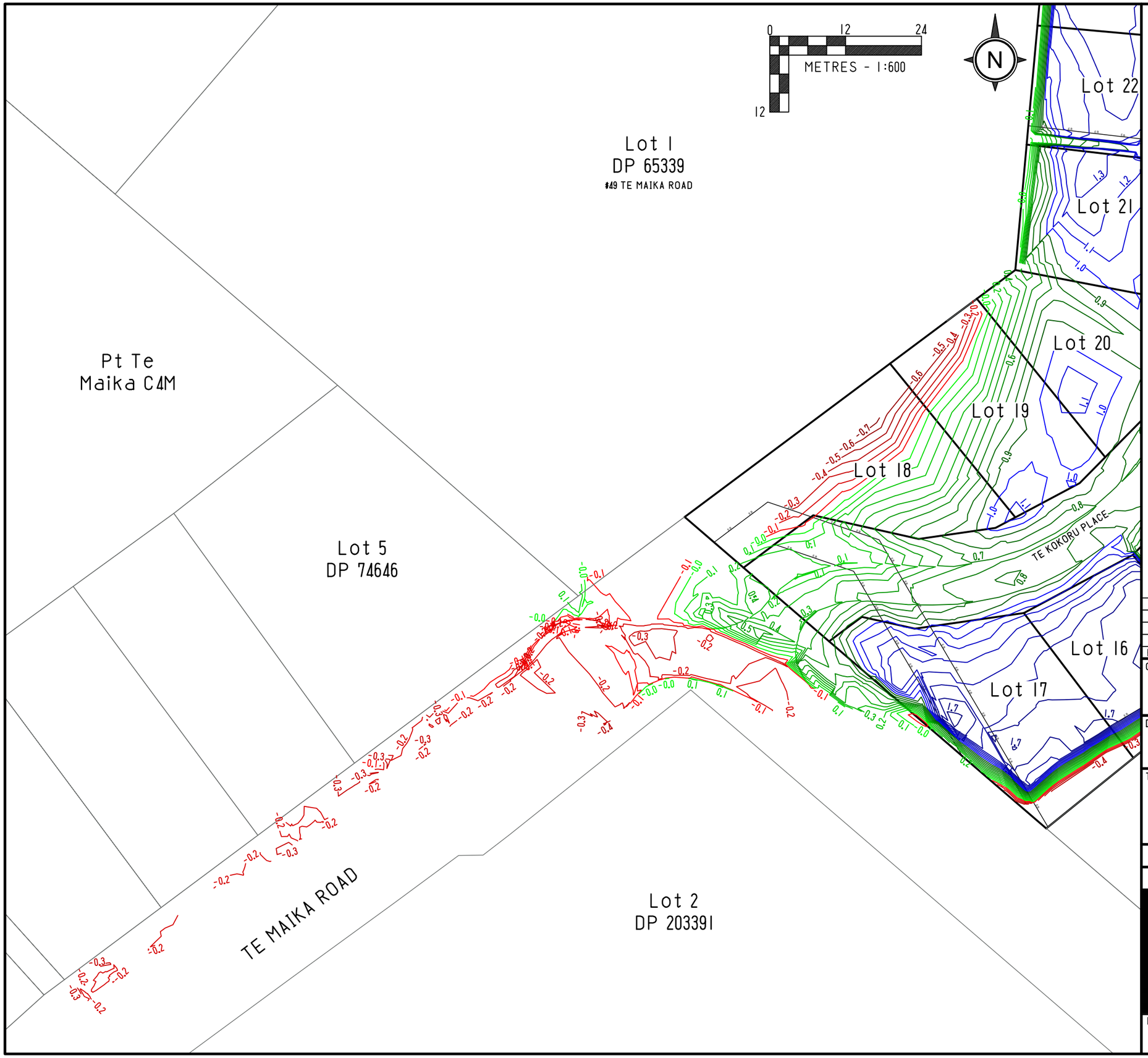
EARTHWORKS ASBUILT
CUTFILL: OVERALL

SCALE: 1:2000 @A3

COUNCIL REFERENCE: SL2100003 AND P117722

reyburn & bryant
Ph: 09 438 3563
7 Selwyn Ave, Whangarei
PO Box 191, Whangarei 0140
www.reyburnandbryant.co.nz

DRAWING REF. EWA16042 | SHEET 07 OF 19 | REV C



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DEPTH OF FILL:

0.00	TO 0.10	1.50	TO 1.60	3.00	TO
0.10	TO 0.20	1.60	TO 1.70	3.10	TO
0.20	TO 0.30	1.70	TO 1.80	3.20	TO
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0.90	TO 1.00	2.40	TO 2.50	3.90	TO
1.00	TO 1.10	2.50	TO 2.60	4.00	TO
1.10	TO 1.20	2.60	TO 2.70	4.10	TO
1.20	TO 1.30	2.70	TO 2.80	4.20	TO
1.30	TO 1.40	2.80	TO 2.90	4.30	
1.40	TO 1.50	2.90	TO 3.00		

DEPTH OF CUT:

-0.10	TO -0.20	-3.00	TO -3.10	-5.90	TO
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-2.80	TO -2.90	-5.70	TO -5.80		
-2.90	TO -3.00	-5.80	TO -5.90		

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT

TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION

LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE

EARTHWORKS ASBUILT
CUTFILL LAYOUT

SCALE: 1:600 @A3

COUNCIL REFERENCE: SL2100003 AND P117722

reyburn & bryant
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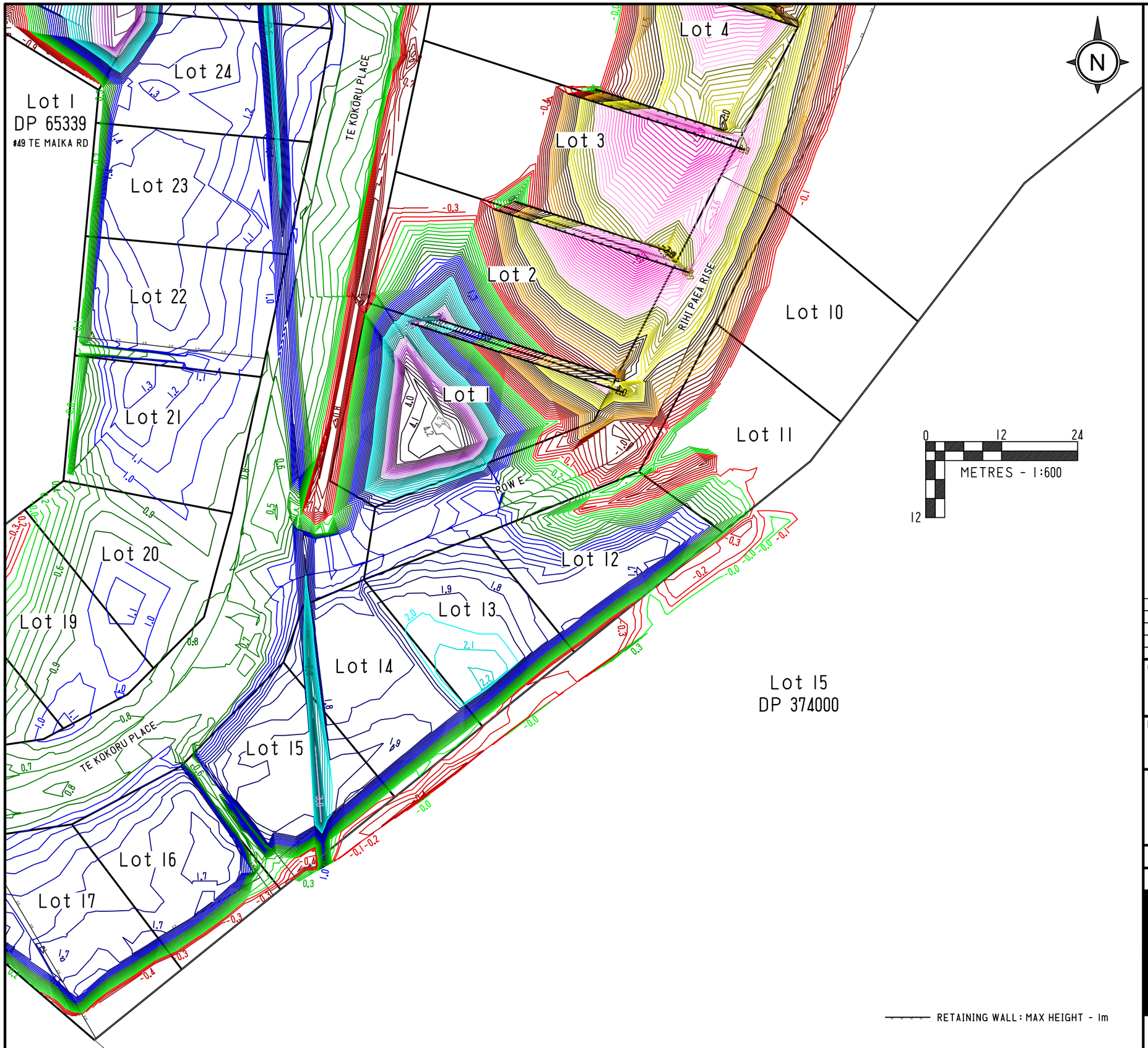
DRAWING REF. EWA16042 | SHEET 08 OF 19 | REV C



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DEPTH OF FILL :

0.00	TO	0.10	1.50	TO	1.60	3.00	TO	
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1.00	TO	1.10	2.50	TO	2.60	4.00	TO	
1.10	TO	1.20	2.60	TO	2.70	4.10	TO	
1.20	TO	1.30	2.70	TO	2.80	4.20	TO	
1.30	TO	1.40	2.80	TO	2.90	4.30		
1.40	TO	1.50	2.90	TO	3.00			

DEPTH OF CUT :

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-2.80	TO	-2.90	-5.70	TO	-5.80			
-2.90	TO	-3.00	-5.80	TO	-5.90			

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT

TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION

LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE

EARTHWORKS ASBUILT
CUTFILL LAYOUT

SCALE : 1:600 @A3

COUNCIL REFERENCE : SL2100003 AND P117722

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DRAWING REF.	SHEET	REV
EWA16042	09 OF 19	C

RETAINING WALL : MAX HEIGHT - Im

CAUTION:

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DEPTH OF FILL :

0.00	TO 0.10	1.50	TO 1.60	3.00	TO
0.10	TO 0.20	1.60	TO 1.70	3.10	TO
0.20	TO 0.30	1.70	TO 1.80	3.20	TO
0.30	TO 0.40	1.80	TO 1.90	3.30	TO
0.40	TO 0.50	1.90	TO 2.00	3.40	TO
0.50	TO 0.60	2.00	TO 2.10	3.50	TO
0.60	TO 0.70	2.10	TO 2.20	3.60	TO
0.70	TO 0.80	2.20	TO 2.30	3.70	TO
0.80	TO 0.90	2.30	TO 2.40	3.80	TO
0.90	TO 1.00	2.40	TO 2.50	3.90	TO
1.00	TO 1.10	2.50	TO 2.60	4.00	TO
1.10	TO 1.20	2.60	TO 2.70	4.10	TO
1.20	TO 1.30	2.70	TO 2.80	4.20	TO
1.30	TO 1.40	2.80	TO 2.90	4.30	
1.40	TO 1.50	2.90	TO 3.00		

DEPTH OF CUT :

-0.10	TO -0.20	-3.00	TO -3.10	-5.90	TO
-0.20	TO -0.30	-3.10	TO -3.20	-6.00	TO
-0.30	TO -0.40	-3.20	TO -3.30	-6.10	TO
-0.40	TO -0.50	-3.30	TO -3.40	-6.20	TO
-0.50	TO -0.60	-3.40	TO -3.50	-6.30	TO
-0.60	TO -0.70	-3.50	TO -3.60	-6.40	TO
-0.70	TO -0.80	-3.60	TO -3.70	-6.50	TO
-0.80	TO -0.90	-3.70	TO -3.80	-6.60	TO
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-2.80	TO -2.90	-5.70	TO -5.80		
-2.90	TO -3.00	-5.80	TO -5.90		

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT

TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION

LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE

EARTHWORKS ASBUILT
CUTFILL LAYOUT

SCALE : 1:600 @A3

COUNCIL REFERENCE : SL2100003 AND P117722

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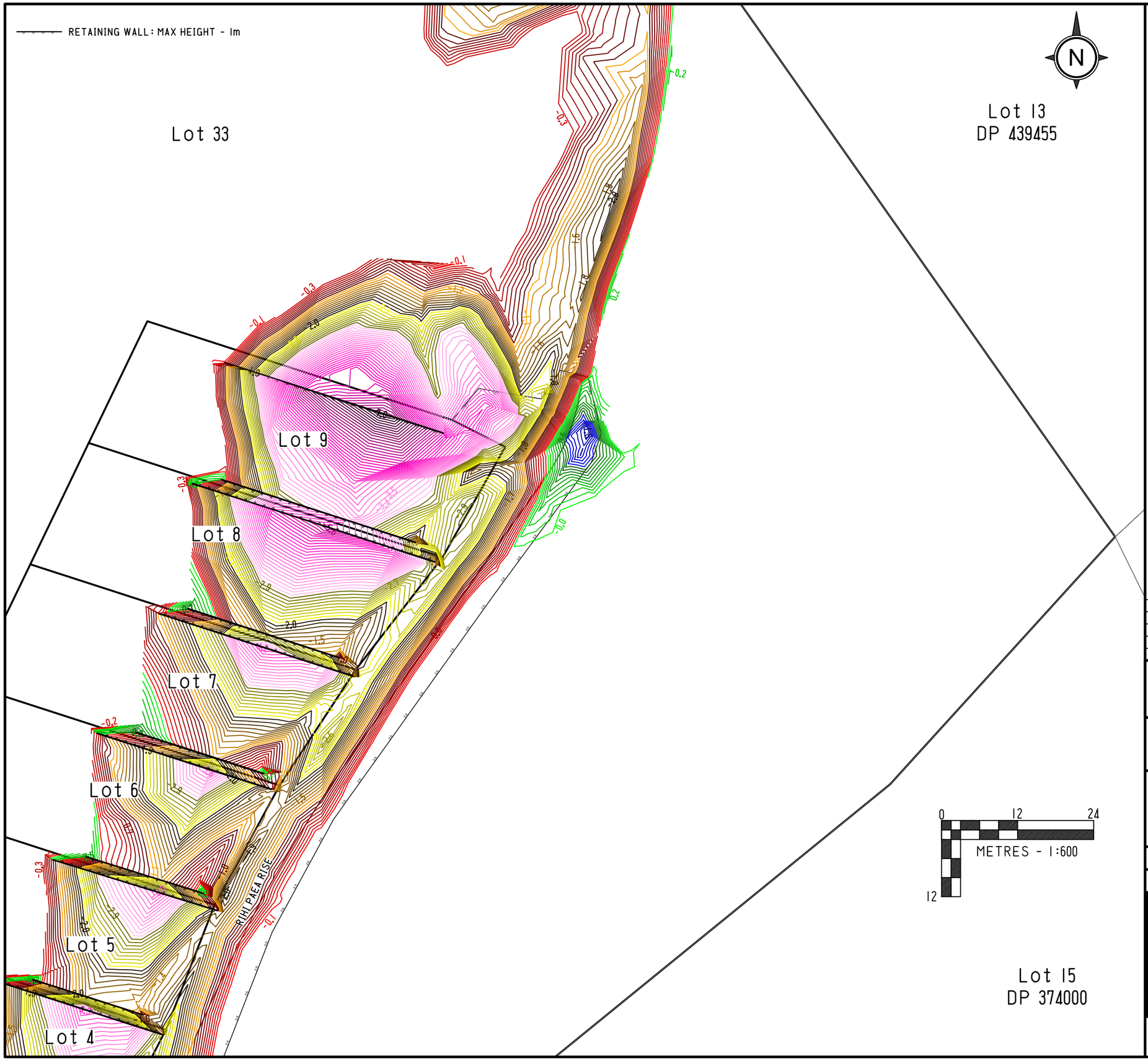
DRAWING REF. EWA16042 | SHEET 10 OF 19 | REV C

RETAINING WALL : MAX HEIGHT - Im



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DEPTH OF FILL :

0.00	TO	0.10	1.50	TO	1.60	3.00	TO	
0.10	TO	0.20	1.60	TO	1.70	3.10	TO	
0.20	TO	0.30	1.70	TO	1.80	3.20	TO	
0.30	TO	0.40	1.80	TO	1.90	3.30	TO	
0.40	TO	0.50	1.90	TO	2.00	3.40	TO	
0.50	TO	0.60	2.00	TO	2.10	3.50	TO	
0.60	TO	0.70	2.10	TO	2.20	3.60	TO	
0.70	TO	0.80	2.20	TO	2.30	3.70	TO	
0.80	TO	0.90	2.30	TO	2.40	3.80	TO	
0.90	TO	1.00	2.40	TO	2.50	3.90	TO	
1.00	TO	1.10	2.50	TO	2.60	4.00	TO	
1.10	TO	1.20	2.60	TO	2.70	4.10	TO	
1.20	TO	1.30	2.70	TO	2.80	4.20	TO	
1.30	TO	1.40	2.80	TO	2.90	4.30		
1.40	TO	1.50	2.90	TO	3.00			

DEPTH OF CUT :

-0.10	TO	-0.20	-3.00	TO	-3.10	-5.90	TO	
-0.20	TO	-0.30	-3.10	TO	-3.20	-6.00	TO	
-0.30	TO	-0.40	-3.20	TO	-3.30	-6.10	TO	
-0.40	TO	-0.50	-3.30	TO	-3.40	-6.20	TO	
-0.50	TO	-0.60	-3.40	TO	-3.50	-6.30	TO	
-0.60	TO	-0.70	-3.50	TO	-3.60	-6.40	TO	
-0.70	TO	-0.80	-3.60	TO	-3.70	-6.50	TO	
-0.80	TO	-0.90	-3.70	TO	-3.80	-6.60	TO	
-0.90	TO	-1.00	-3.80	TO	-3.90	-6.70	TO	
-1.00	TO	-1.10	-3.90	TO	-4.00	-6.80	TO	
-1.10	TO	-1.20	-4.00	TO	-4.10	-6.90	TO	
-1.20	TO	-1.30	-4.10	TO	-4.20	-7.00		
-1.30	TO	-1.40	-4.20	TO	-4.30			
-1.40	TO	-1.50	-4.30	TO	-4.40			
-1.50	TO	-1.60	-4.40	TO	-4.50			
-1.60	TO	-1.70	-4.50	TO	-4.60			
-1.70	TO	-1.80	-4.60	TO	-4.70			
-1.80	TO	-1.90	-4.70	TO	-4.80			
-1.90	TO	-2.00	-4.80	TO	-4.90			
-2.00	TO	-2.10	-4.90	TO	-5.00			
-2.10	TO	-2.20	-5.00	TO	-5.10			
-2.20	TO	-2.30	-5.10	TO	-5.20			
-2.30	TO	-2.40	-5.20	TO	-5.30			
-2.40	TO	-2.50	-5.30	TO	-5.40			
-2.50	TO	-2.60	-5.40	TO	-5.50			
-2.60	TO	-2.70	-5.50	TO	-5.60			
-2.70	TO	-2.80	-5.60	TO	-5.70			
-2.80	TO	-2.90	-5.70	TO	-5.80			
-2.90	TO	-3.00	-5.80	TO	-5.90			

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT

TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION

LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE

EARTHWORKS ASBUILT
CUTFILL LAYOUT

SCALE : 1:600 @A3

COUNCIL REFERENCE : SL2100003 AND P117722

reyburn & bryant
Ph: 09 438 3563
7 Selwyn Ave, Whangarei
PO Box 191, Whangarei 0140
www.reyburnandbryant.co.nz

DRAWING REF.	SHEET	REV
EWA16042	11 OF 19	C

0 12 24

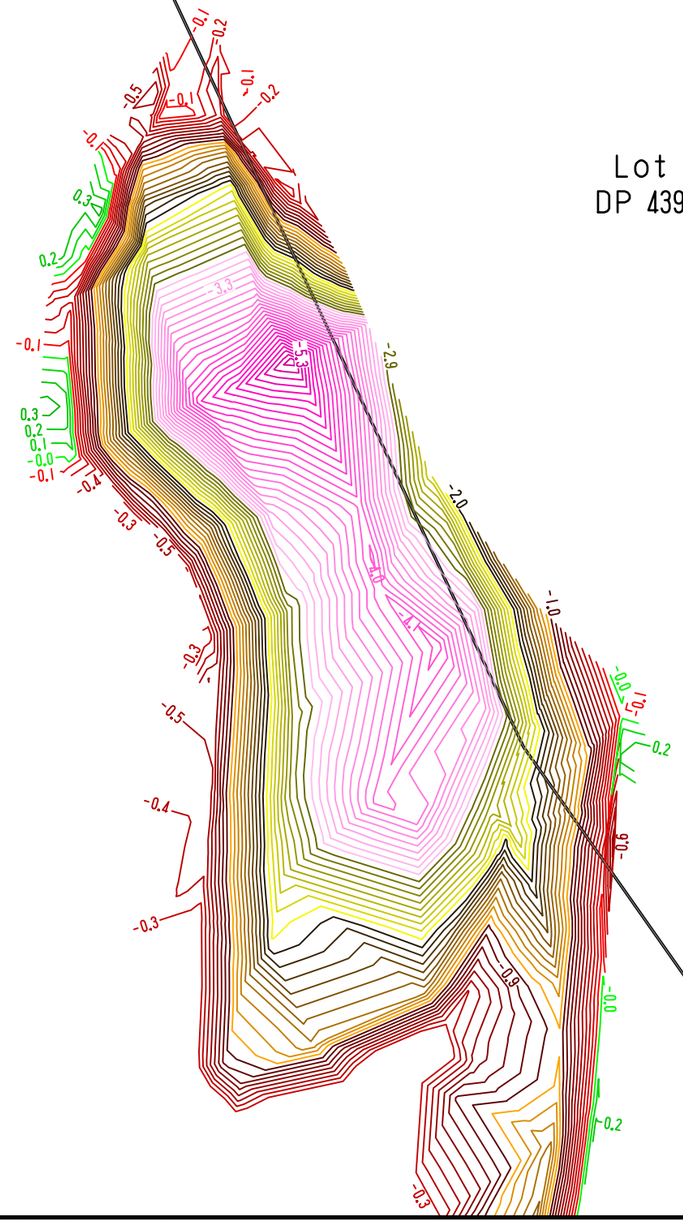
METRES - 1:600

12

N

Lot 2
DP 390702

Lot 13
DP 439455



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DEPTH OF FILL:

0.00	TO 0.10	1.50	TO 1.60	3.00	TO
0.10	TO 0.20	1.60	TO 1.70	3.10	TO
0.20	TO 0.30	1.70	TO 1.80	3.20	TO
0.30	TO 0.40	1.80	TO 1.90	3.30	TO
0.40	TO 0.50	1.90	TO 2.00	3.40	TO
0.50	TO 0.60	2.00	TO 2.10	3.50	TO
0.60	TO 0.70	2.10	TO 2.20	3.60	TO
0.70	TO 0.80	2.20	TO 2.30	3.70	TO
0.80	TO 0.90	2.30	TO 2.40	3.80	TO
0.90	TO 1.00	2.40	TO 2.50	3.90	TO
1.00	TO 1.10	2.50	TO 2.60	4.00	TO
1.10	TO 1.20	2.60	TO 2.70	4.10	TO
1.20	TO 1.30	2.70	TO 2.80	4.20	TO
1.30	TO 1.40	2.80	TO 2.90	4.30	
1.40	TO 1.50	2.90	TO 3.00		

DEPTH OF CUT:

-0.10	TO -0.20	-3.00	TO -3.10	-5.90	TO
-0.20	TO -0.30	-3.10	TO -3.20	-6.00	TO
-0.30	TO -0.40	-3.20	TO -3.30	-6.10	TO
-0.40	TO -0.50	-3.30	TO -3.40	-6.20	TO
-0.50	TO -0.60	-3.40	TO -3.50	-6.30	TO
-0.60	TO -0.70	-3.50	TO -3.60	-6.40	TO
-0.70	TO -0.80	-3.60	TO -3.70	-6.50	TO
-0.80	TO -0.90	-3.70	TO -3.80	-6.60	TO
-0.90	TO -1.00	-3.80	TO -3.90	-6.70	TO
-1.00	TO -1.10	-3.90	TO -4.00	-6.80	TO
-1.10	TO -1.20	-4.00	TO -4.10	-6.90	TO
-1.20	TO -1.30	-4.10	TO -4.20	-7.00	
-1.30	TO -1.40	-4.20	TO -4.30		
-1.40	TO -1.50	-4.30	TO -4.40		
-1.50	TO -1.60	-4.40	TO -4.50		
-1.60	TO -1.70	-4.50	TO -4.60		
-1.70	TO -1.80	-4.60	TO -4.70		
-1.80	TO -1.90	-4.70	TO -4.80		
-1.90	TO -2.00	-4.80	TO -4.90		
-2.00	TO -2.10	-4.90	TO -5.00		
-2.10	TO -2.20	-5.00	TO -5.10		
-2.20	TO -2.30	-5.10	TO -5.20		
-2.30	TO -2.40	-5.20	TO -5.30		
-2.40	TO -2.50	-5.30	TO -5.40		
-2.50	TO -2.60	-5.40	TO -5.50		
-2.60	TO -2.70	-5.50	TO -5.60		
-2.70	TO -2.80	-5.60	TO -5.70		
-2.80	TO -2.90	-5.70	TO -5.80		
-2.90	TO -3.00	-5.80	TO -5.90		

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT

TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION

LOTS 1 - 24 BEING A PROPOSED SUBDIVISION
OF LOT 14 DP 374000

TITLE

EARTHWORKS ASBUILT
CUTFILL LAYOUT

SCALE: 1:600 @A3

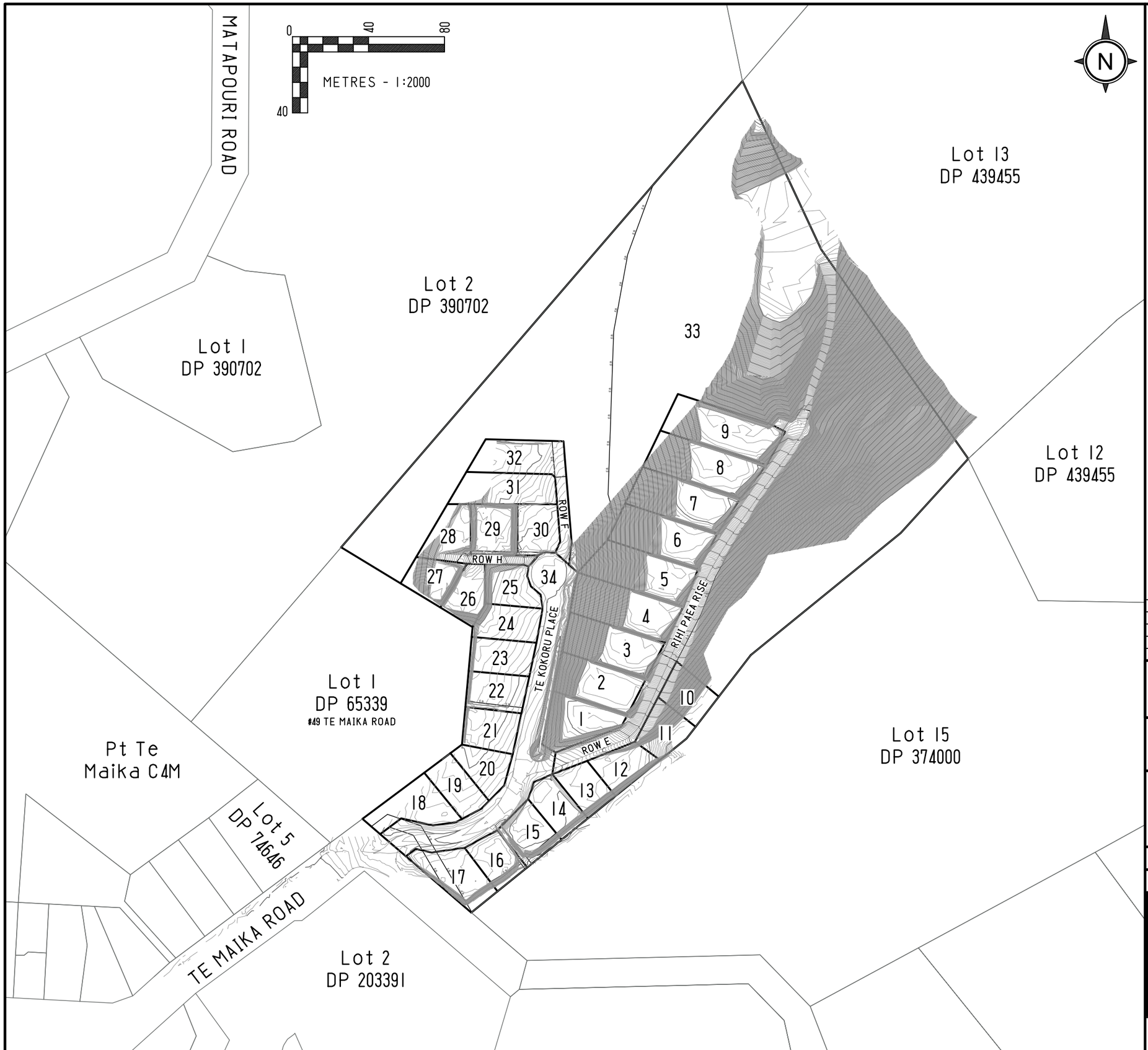
COUNCIL REFERENCE: SL2100003 AND P117722

reyburn & bryant

Ph: 09 438 3563
7 Selwyn Ave, Whangarei
PO Box 191, Whangarei 0140
www.reyburnandbryant.co.nz

DRAWING REF.	SHEET	REV
EWA16042	12 OF 19	C

Date Plotted: 22/09/2022 File Path: P:¥16000 - 16999¥16042 - Traverse Limited¥Drawings¥As-built Plans¥EWA16042 - Traverse - C.dwg



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MAJOR CONTOURS @ 1.0m INTERVALS
MINOR CONTOURS @ 0.1m INTERVALS

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT
TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION
LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE
EARTHWORKS ASBUILT
FINAL CONTOURS: OVERALL

SCALE: 1:2000 @A3

COUNCIL REFERENCE: SL2100003 AND P117722

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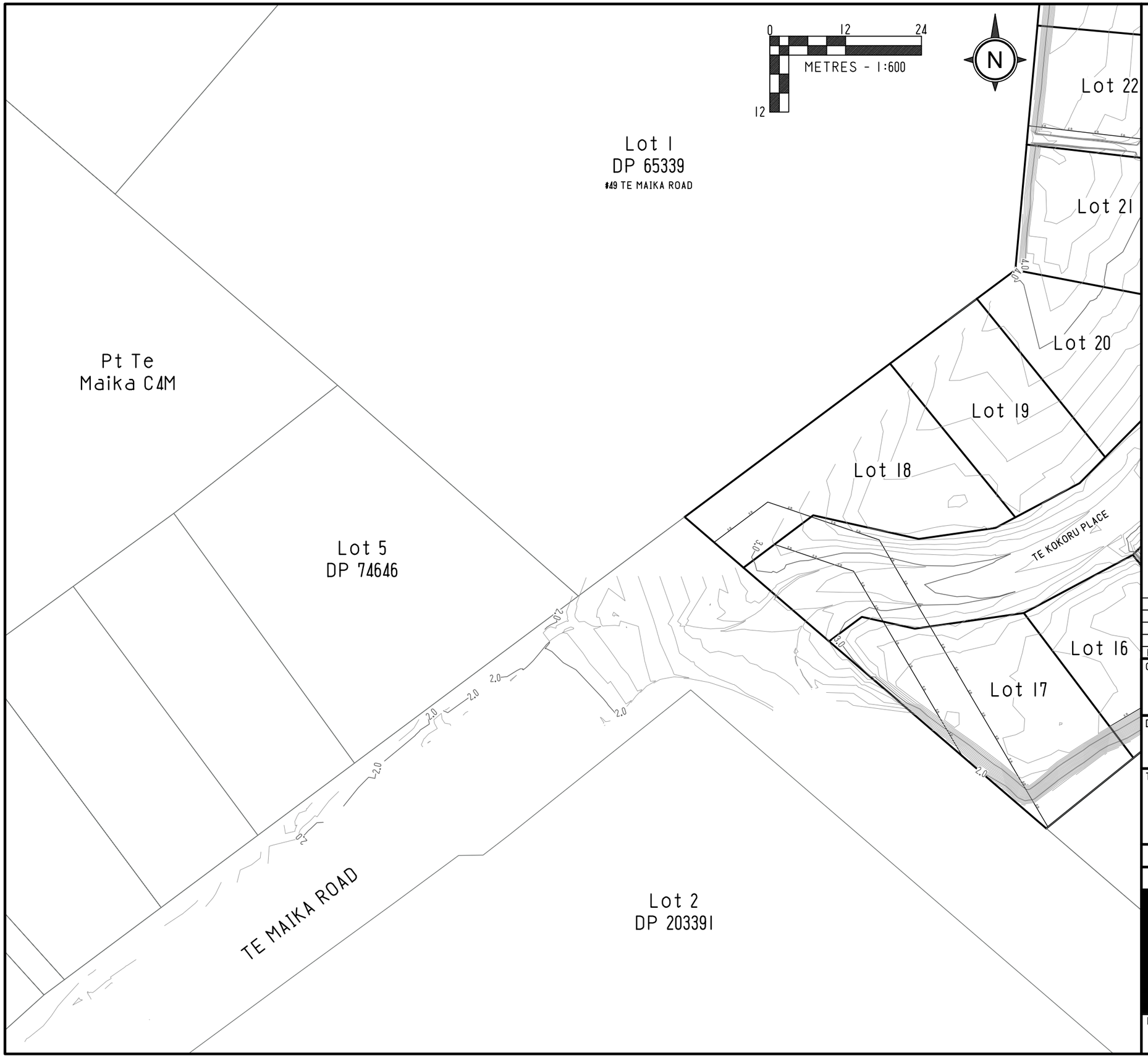
DRAWING REF.	SHEET	REV
EWA16042	13 OF 19	C

Date Plotted: 22/09/2022 File Path: P:¥16000 - 16999¥16042 - Traverse Limited¥Drawings¥As-built Plans¥EWA16042 - Traverse - C.dwg



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MAJOR CONTOURS @ 1.0m INTERVALS
MINOR CONTOURS @ 0.1m INTERVALS

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT
TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION
LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE
EARTHWORKS ASBUILT
FINAL CONTOURS LAYOUT

SCALE: 1:600 @A3

COUNCIL REFERENCE: SL2100003 AND P117722

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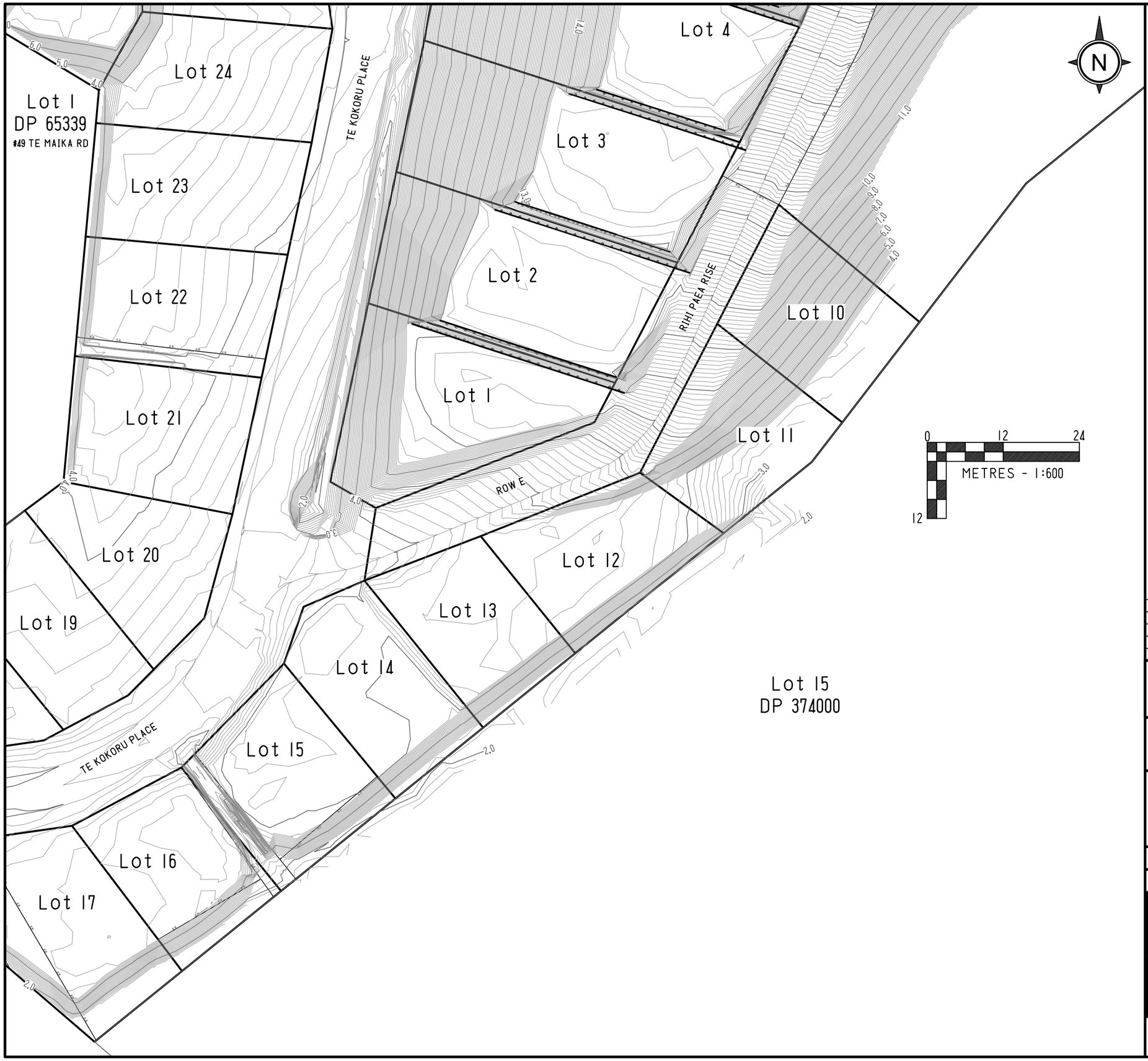
DRAWING REF. EWA16042 | SHEET 14 OF 19 | REV C



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MAJOR CONTOURS @ 1.0m INTERVALS
MINOR CONTOURS @ 0.1m INTERVALS
RETAINING WALL : MAX HEIGHT - 1m

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT
TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION
LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE
EARTHWORKS ASBUILT
FINAL CONTOURS LAYOUT

SCALE : 1:600 @A3

COUNCIL REFERENCE : SL2100003 AND P117722

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PO Box 191, Whangarei 0140
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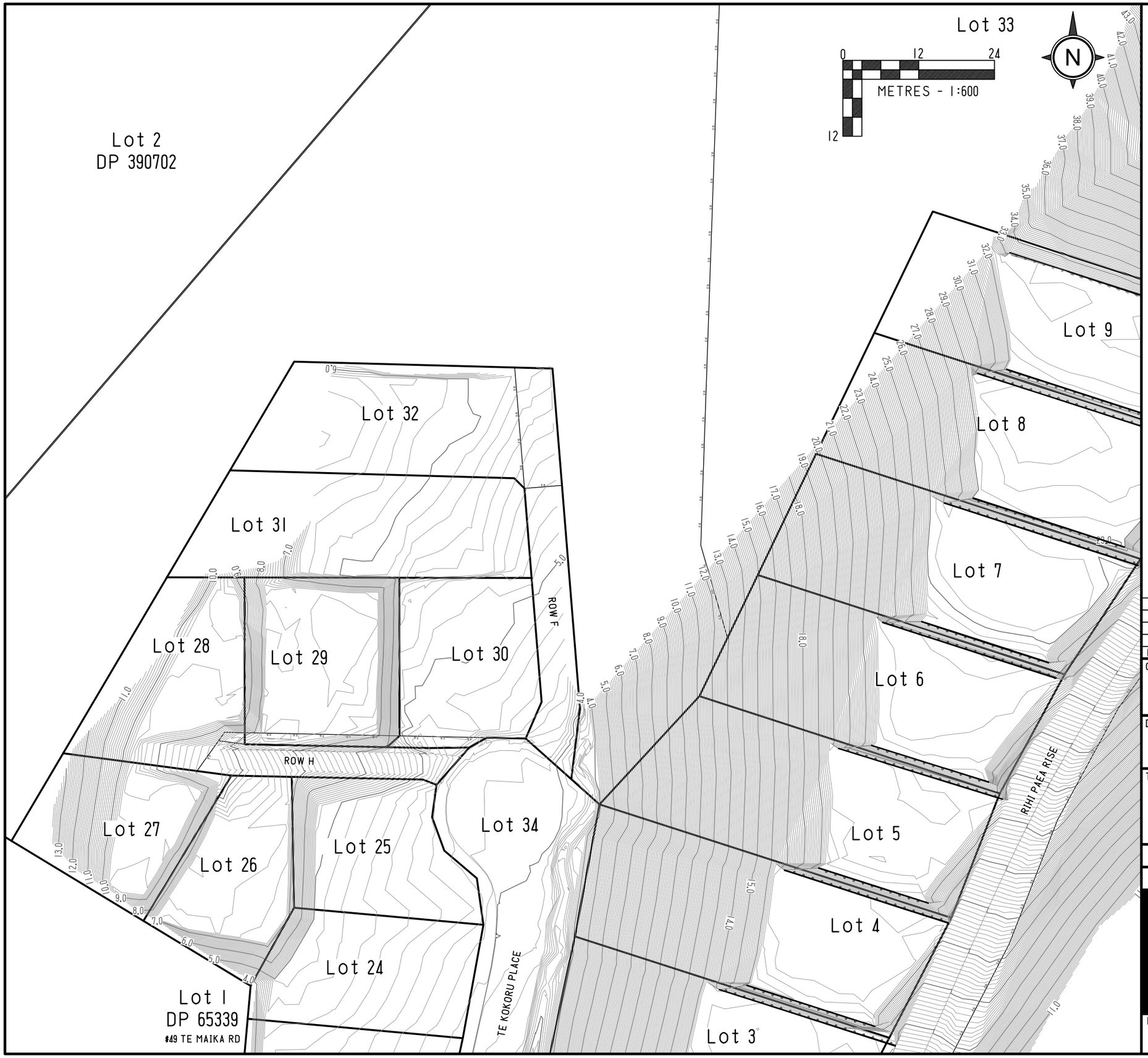
DRAWING REF. EWA16042 | SHEET 15 OF 19 | REV C

Date Plotted: 22/09/2022 File Path: P:¥16000 - 16999¥16042 - Traverse Limited¥Drawings¥As-built Plans¥EWA16042 - Traverse - C.dwg



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- MAJOR CONTOURS @ 1.0m INTERVALS
- MINOR CONTOURS @ 0.1m INTERVALS
- RETAINING WALL: MAX HEIGHT - 1m

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT

TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION

LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE

EARTHWORKS ASBUILT
FINAL CONTOURS LAYOUT

SCALE: 1:600 @A3

COUNCIL REFERENCE: SL2100003 AND P117722

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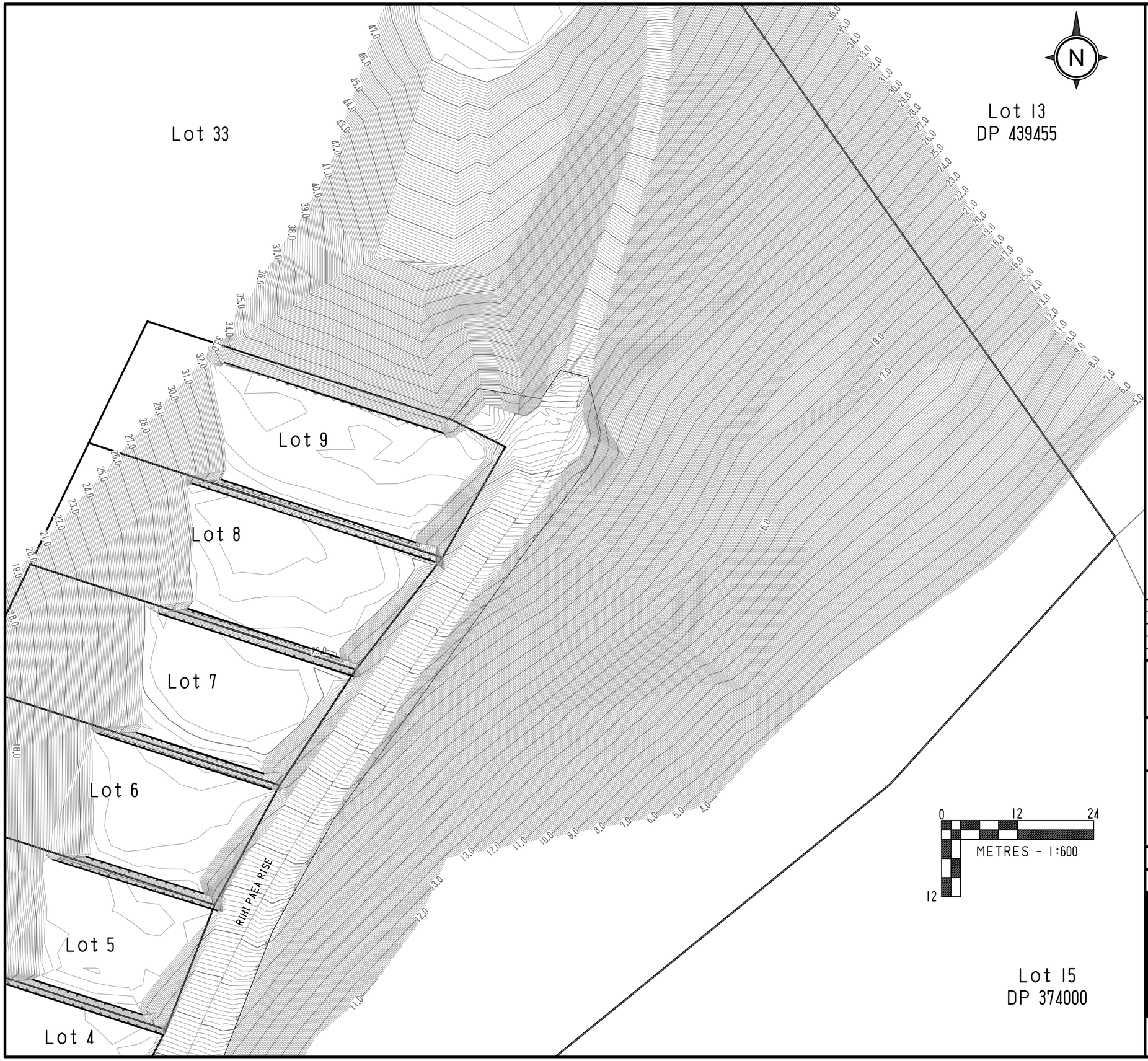
DRAWING REF. EWA16042 | SHEET 16 OF 19 | REV C



CAUTION:

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MAJOR CONTOURS @ 1.0m INTERVALS
MINOR CONTOURS @ 0.1m INTERVALS
RETAINING WALL : MAX HEIGHT - 1m

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT
TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION
LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE
EARTHWORKS ASBUILT
FINAL CONTOURS LAYOUT

SCALE : 1:600 @A3

COUNCIL REFERENCE : SL2100003 AND P117722

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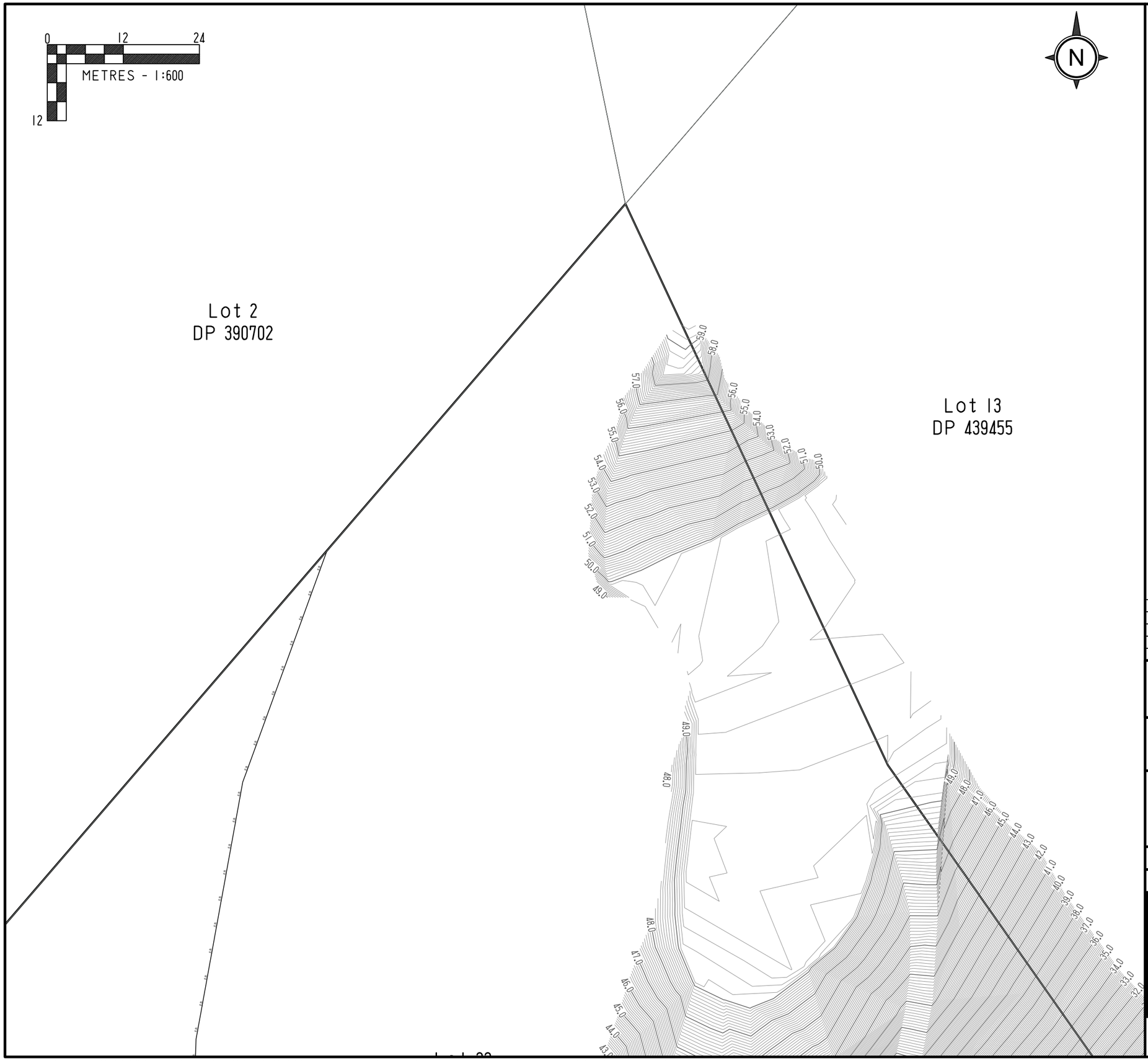
DRAWING REF. EWA16042 | SHEET 17 OF 19 | REV C

Date Plotted: 22/09/2022 File Path: P:¥16000 - 16999¥16042 - Traverse Limited¥Drawings¥As-built Plans¥EWA16042 - Traverse - C.dwg



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MAJOR CONTOURS @ 1.0m INTERVALS
MINOR CONTOURS @ 0.1m INTERVALS

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT
TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION
LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE
EARTHWORKS ASBUILT
FINAL CONTOURS LAYOUT

SCALE: 1:600 @A3

COUNCIL REFERENCE: SL2100003 AND P117722

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7 Selwyn Ave, Whangarei
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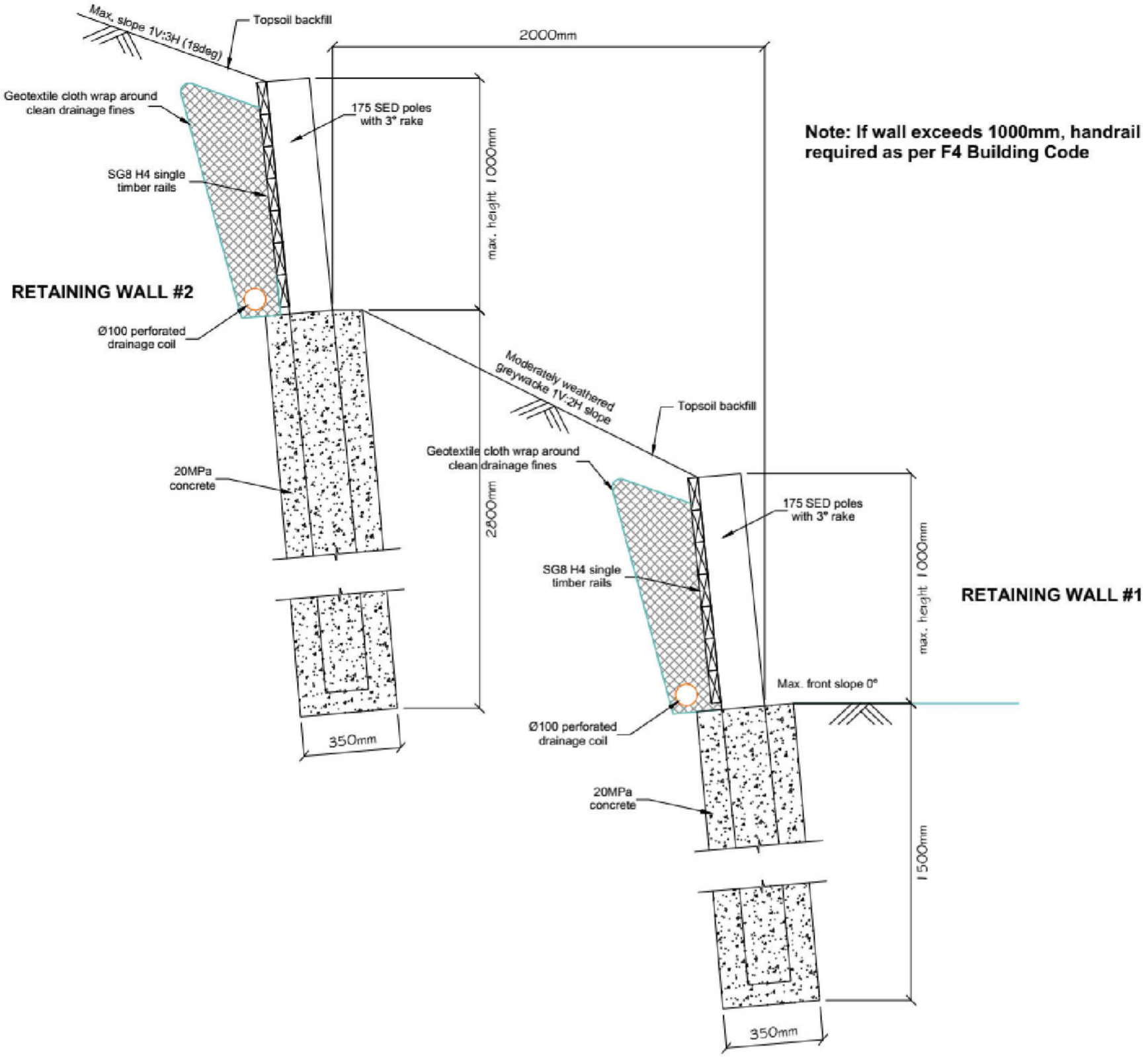
DRAWING REF.	SHEET	REV
EWA16042	18 OF 19	C



Note: If wall exceeds 1000mm, handrail required as per F4 Building Code

CAUTION:

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MAJOR CONTOURS @ 1.0m INTERVALS
MINOR CONTOURS @ 0.1m INTERVALS

REV	DATE	AMENDMENTS
C	22.09.22	RETAINING WALL DETAILS - CK/PD
B	02.09.22	RETAINING WALLS - CK/CC
A	18.08.22	FIRST ISSUE - CK/PD

CLIENT
TRAVERSE LIMITED
51 TE MAIKA ROAD, NGUNGURU

DESCRIPTION
LOTS 1 - 24 BEING A PROPOSED SUBDIVISION OF LOT 14 DP 374000

TITLE
EARTHWORKS ASBUILT
CORE RETAINING WALL DETAILS

N.T.S.

COUNCIL REFERENCE: SL2100003 AND P117722

reyburn & bryant
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www.reyburnandbryant.co.nz

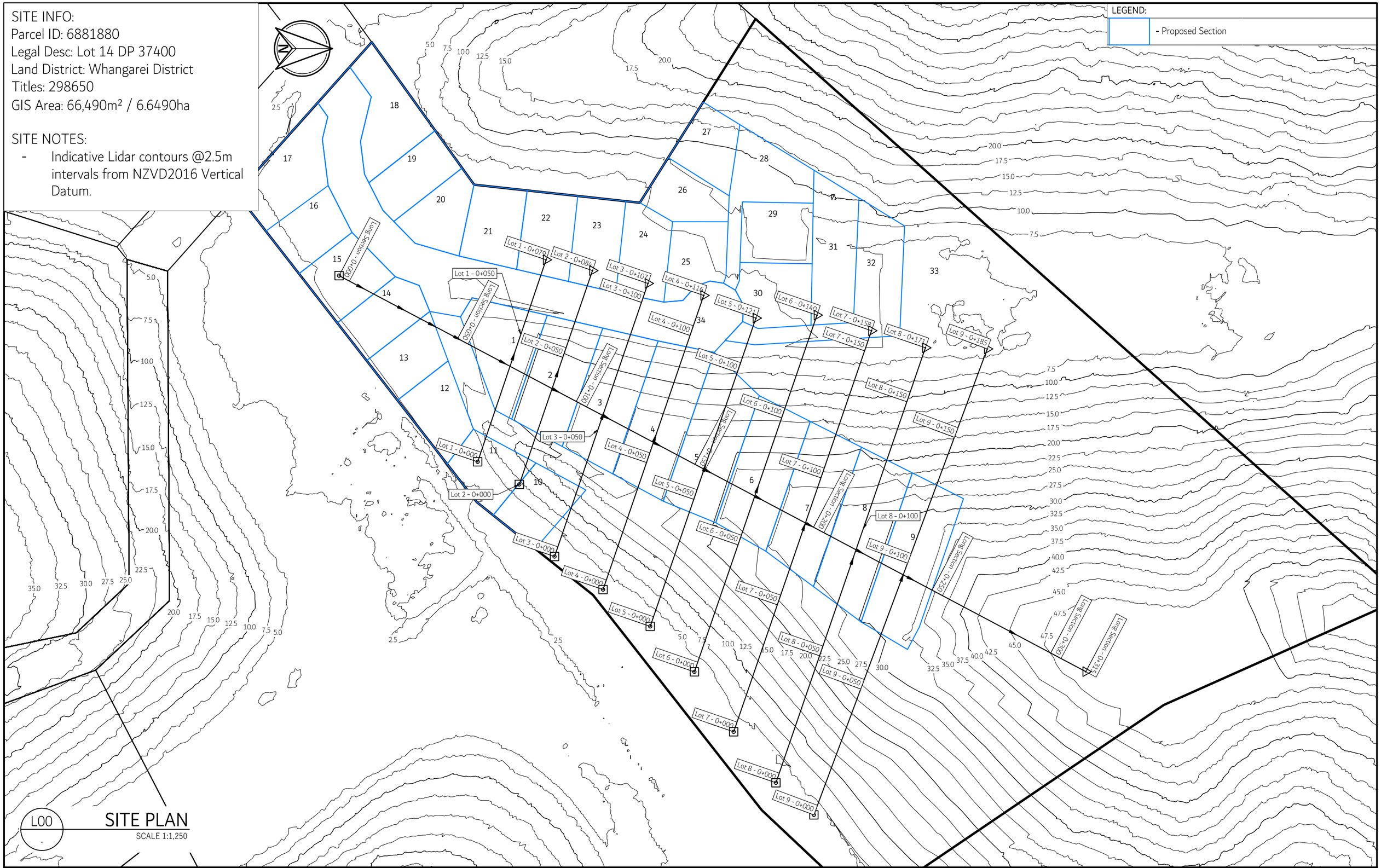
DRAWING REF. EWA16042 | SHEET 19 OF 19 | REV C

APPENDIX 4 – CORE ENGINEERING SOLUTIONS LTD DRAWINGS SET

SITE INFO:
Parcel ID: 6881880
Legal Desc: Lot 14 DP 37400
Land District: Whangarei District
Titles: 298650
GIS Area: 66,490m² / 6.6490ha

SITE NOTES:
- Indicative Lidar contours @2.5m intervals from NZVD2016 Vertical Datum.

LEGEND:
- Proposed Section



L00 SITE PLAN
SCALE 1:1,250

CORE Consulting Engineers
ENGINEERING SOLUTIONS
Structural | Geotechnical | Civil

T: 09 553 3660
jobs@coreeng.nz
Level 1, 31 Vine Street,
Whangarei 0110

Rev	Date	Notes
A	16/08/22	Original Issue

CLIENT: Traverse Ltd

LOCATION: 51 Te Maika Road, Ngunguru

PROJECT DESCRIPTION: PROPOSED SUBDIVISION

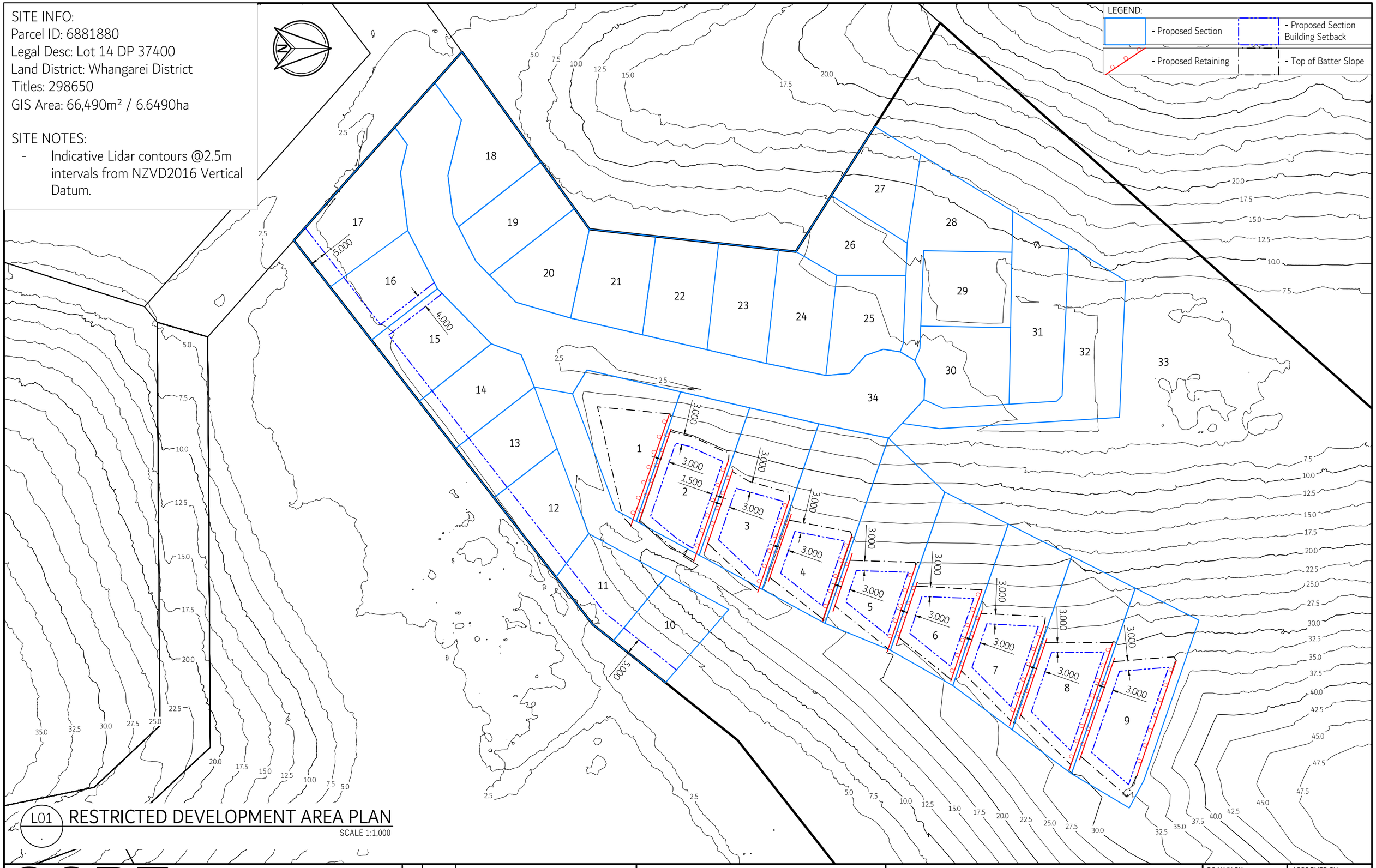
SHEET TITLE: SITE PLAN

DRAWN BY:	APPROVED BY:
LJM	DL
ORIGINAL: A3	SCALE: 1:1,250
FILE: 20-0078	SHEET: L00

SITE INFO:
Parcel ID: 6881880
Legal Desc: Lot 14 DP 37400
Land District: Whangarei District
Titles: 298650
GIS Area: 66,490m² / 6.6490ha

SITE NOTES:
- Indicative Lidar contours @2.5m intervals from NZVD2016 Vertical Datum.

LEGEND:
- Proposed Section
- Proposed Section Building Setback
- Proposed Retaining
- Top of Batter Slope



L01 RESTRICTED DEVELOPMENT AREA PLAN
SCALE 1:1,000

CORE ENGINEERING SOLUTIONS
Consulting Engineers
Structural | Geotechnical | Civil

T: 09 553 3660
jobs@coreeng.nz
Level 1, 31 Vine Street,
Whangarei 0110

Rev	Date	Notes
A	16/08/22	Original Issue

CLIENT: Traverse Ltd

LOCATION: 51 Te Maika Road, Ngunguru

PROJECT DESCRIPTION: PROPOSED SUBDIVISION

SHEET TITLE: RESTRICTED DEVELOPMENT AREA PLAN

DRAWN BY:	APPROVED BY:
LJM	DL
ORIGINAL: A3	SCALE: 1:1,000
FILE: 20-0078	SHEET: L01

SITE INFO:
Parcel ID: 6881880
Legal Desc: Lot 14 DP 37400
Land District: Whangarei District
Titles: 298650
GIS Area: 66,490m² / 6.6490ha

SITE NOTES:
- Indicative Lidar contours @2.5m intervals from NZVD2016 Vertical Datum.

LEGEND:
- Proposed Section
- Proposed Retaining
- Proposed Section Building Setback
- SED Build Area

L02 STAGE 1 PLAN
SCALE 1:1,000

CORE Consulting Engineers
ENGINEERING SOLUTIONS
Structural | Geotechnical | Civil

T: 09 553 3660
jobs@coreeng.nz
Level 1, 31 Vine Street,
Whangarei 0110

Rev	Date	Notes
A	16/08/22	Original Issue

CLIENT: Traverse Ltd

LOCATION: 51 Te Maika Road, Ngunguru

PROJECT DESCRIPTION: PROPOSED SUBDIVISION

SHEET TITLE: STAGE 1 PLAN

DRAWN BY:	APPROVED BY:
LJM	DL
ORIGINAL: A3	SCALE: 1:1,000
FILE: 20-0078	SHEET: L02

SITE INFO:
Parcel ID: 6881880
Legal Desc: Lot 14 DP 37400
Land District: Whangarei District
Titles: 298650
GIS Area: 66,490m² / 6.6490ha

SITE NOTES:
- Indicative Lidar contours @2.5m intervals from NZVD2016 Vertical Datum.

LEGEND:
- Proposed Section
- Proposed Section Building Setback

Surface Analysis: Elevation Ranges

Number	Color	Minimum Elevation (m)	Maximum Elevation (m)	2D Area (m²)
1		-8.000	-6.001	58.1
2		-6.000	-4.001	897.9
3		-4.000	-2.001	4823.8
4		-2.000	-0.001	17742.2
5		0.001	2.000	17292.9
6		2.001	4.000	2370.3
7		4.001	6.000	190.3
8		6.001	8.000	1.6

L05 EARTHWORKS PLAN
SCALE 1:1,000

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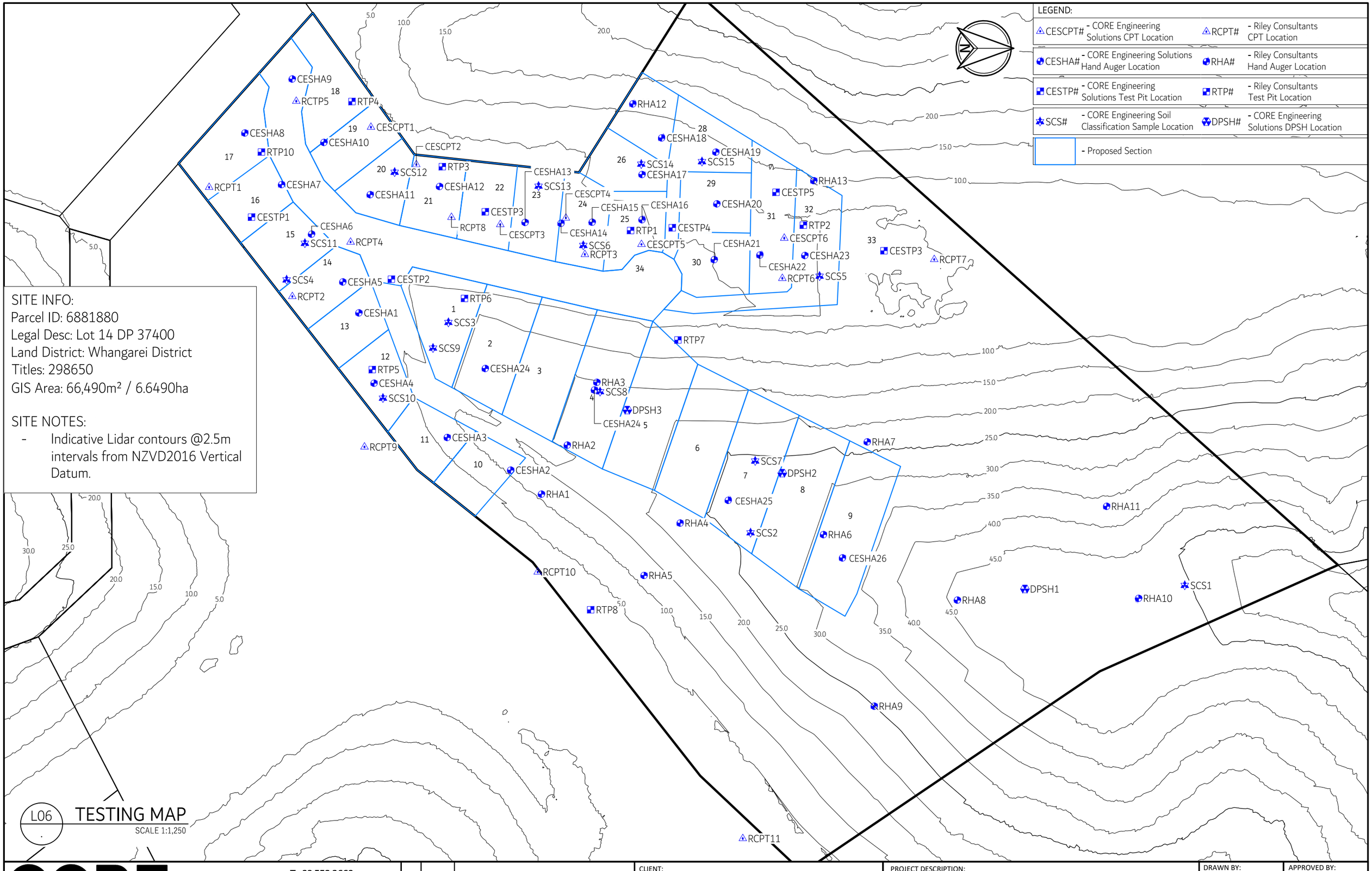
Structural | Geotechnical | Civil
T: 09 553 3660
jobs@coreeng.nz
Level 1, 31 Vine Street, Whangarei 0110

Rev	Date	Notes
A	16/08/22	Original Issue

CLIENT: Traverse Ltd
LOCATION: 51 Te Maika Road, Ngunguru
PROJECT DESCRIPTION: PROPOSED SUBDIVISION
SHEET TITLE: EARTHWORKS PLAN

DRAWN BY:	APPROVED BY:
LJM	DL
ORIGINAL: A3	SCALE: 1:1,000
FILE: 20-0078	SHEET: L05



SITE INFO:
Parcel ID: 6881880
Legal Desc: Lot 14 DP 37400
Land District: Whangarei District
Titles: 298650
GIS Area: 66,490m² / 6.6490ha

SITE NOTES:
- Indicative Lidar contours @2.5m intervals from NZVD2016 Vertical Datum.

L06 TESTING MAP
SCALE 1:1,250

CORE ENGINEERING SOLUTIONS
Consulting Engineers
Structural | Geotechnical | Civil
T: 09 553 3660
jobs@coreeng.nz
Level 1, 31 Vine Street,
Whangarei 0110

Rev	Date	Notes
A	16/08/22	Original Issue

CLIENT: Traverse Ltd
LOCATION: 51 Te Maika Road, Ngunguru
PROJECT DESCRIPTION: PROPOSED SUBDIVISION
SHEET TITLE: TESTING MAP
DRAWN BY: LJM
APPROVED BY: DL
ORIGINAL: A3
SCALE: 1:1,250
FILE: 20-0078
SHEET: L06

APPENDIX 5 – TESTING RESULTS

Soil & Sample Ltd

Level 1 - 31 Vine Street
http://www.soilandsample.nz

Project: **Te Maika Road Ngunguru Subdivision**
Location: **Stage One**

Core Engineering Solution Ltd

Level 1 - 31 Vine Street

CPT: cpt4 lot 14

Total depth: 16.66 m

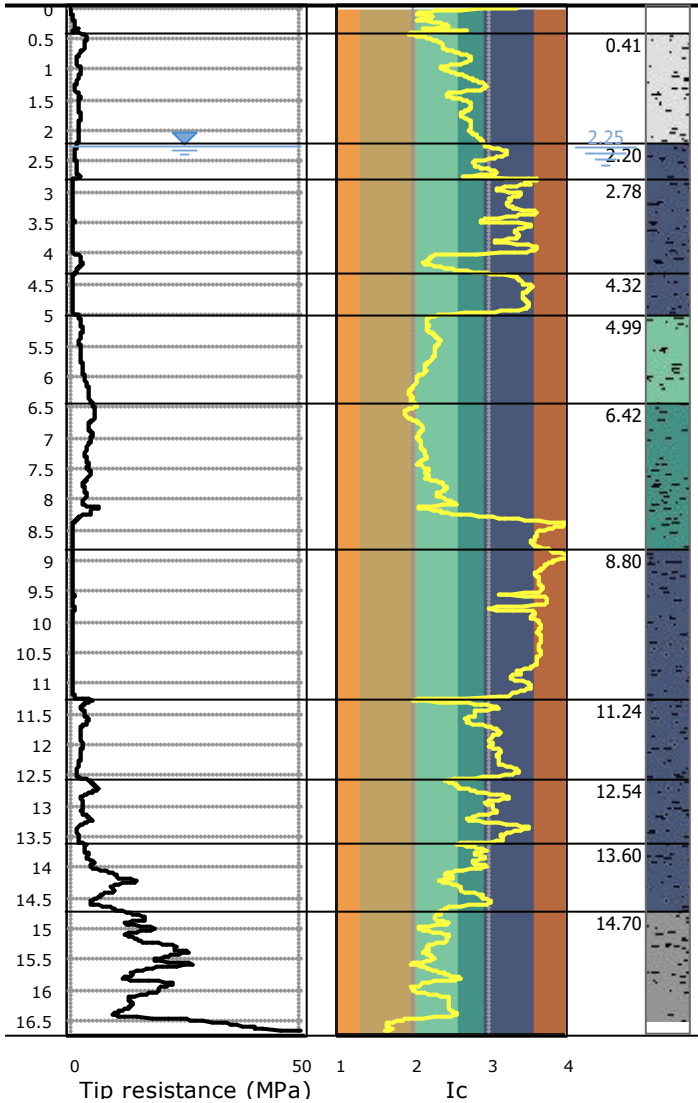
Coords: lat -35.625945° lon 174.517138°

Cone Type: 10cm2 50MPa

Cone Operator: Stuart Gemmell

Project: **Te Maika Road Ngunguru Subdivision**

Location: **Stage One**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.41	Very dense/stiff soil	2.0	4.65E-7	7.8	-	-	-	26.7	48.0	264.2	9.6	22.3	19.0
2.20	Clay	1.2	1.17E-8	6.0	-	-	-	16.1	45.5	164.0	3.6	8.3	19.0
2.78	Clay	0.7	2.40E-7	3.6	-	-	-	7.4	25.4	59.0	1.1	2.5	19.0
4.32	Clay	0.4	5.61E-9	2.3	-	-	-	1.6	17.4	38.3	0.6	1.4	19.0
4.99	Silty sand & sandy silt	2.7	3.31E-6	8.0	28.2	29.8	32.2	33.5	35.9	-	-	-	19.0
6.42	Clay & silty clay	3.2	2.92E-6	10.2	-	-	-	39.1	49.8	110.0	1.1	2.6	19.0
8.80	Clay	0.4	5.09E-10	3.3	-	-	-	0.7	21.5	36.6	0.3	0.7	19.0
11.24	Clay	2.4	1.73E-7	12.1	-	-	-	29.5	85.9	302.3	2.3	5.4	19.0
12.54	Clay	3.0	3.88E-8	14.8	-	-	-	37.3	104.5	388.0	2.8	6.4	19.0
13.60	Clay	6.7	1.12E-7	28.0	-	-	-	90.4	175.4	923.0	6.2	14.4	19.0
14.70	Very dense/stiff soil	16.7	2.15E-6	53.6	213.6	61.1	41.8	220.6	267.8	-	-	-	19.0

Core Engineering Solution Ltd

Level 1 - 31 Vine Street

CPT: cpt 1 lot 17

Total depth: 14.78 m

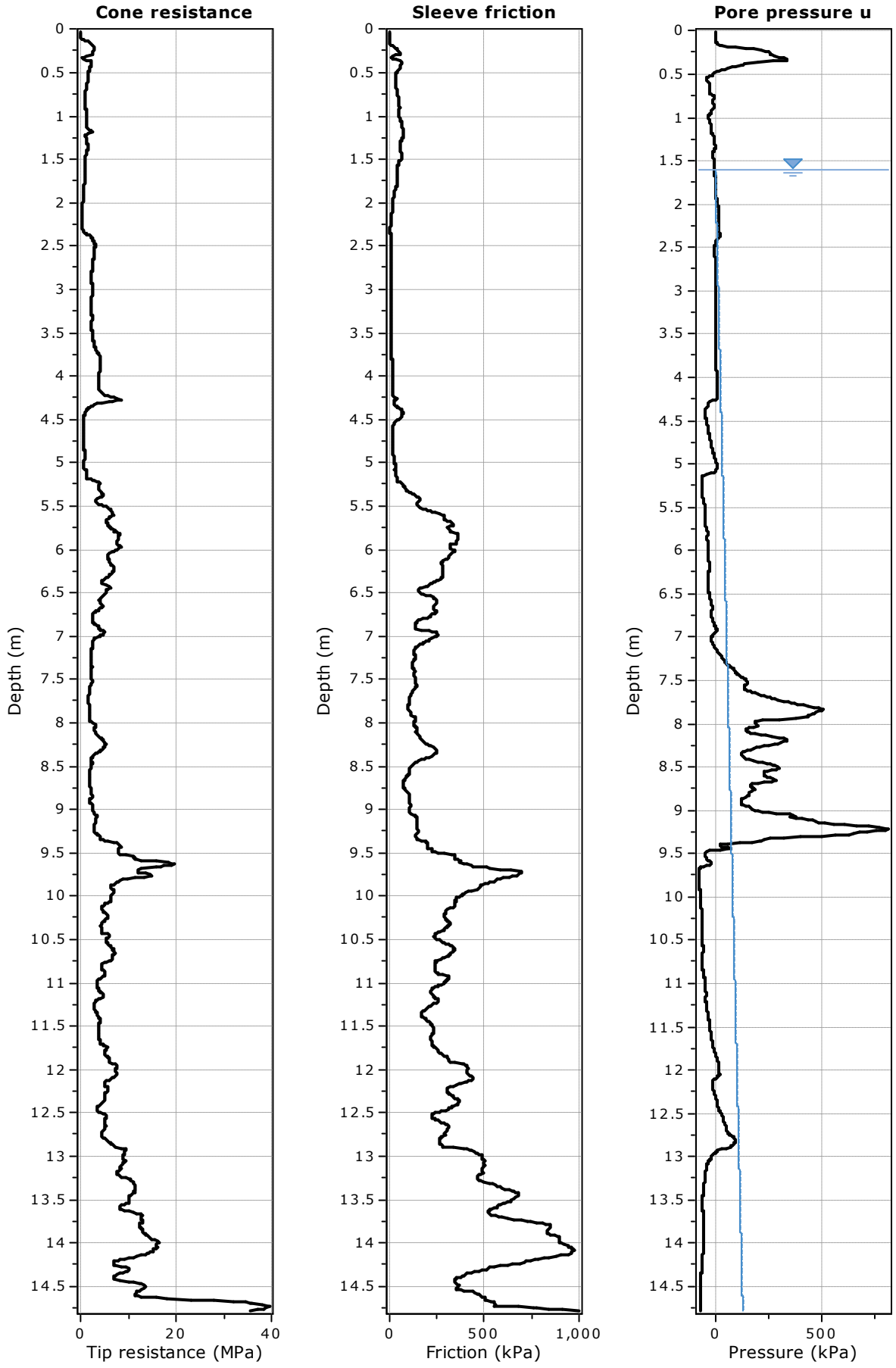
Coords: lat -35.62615° lon 174.516722°

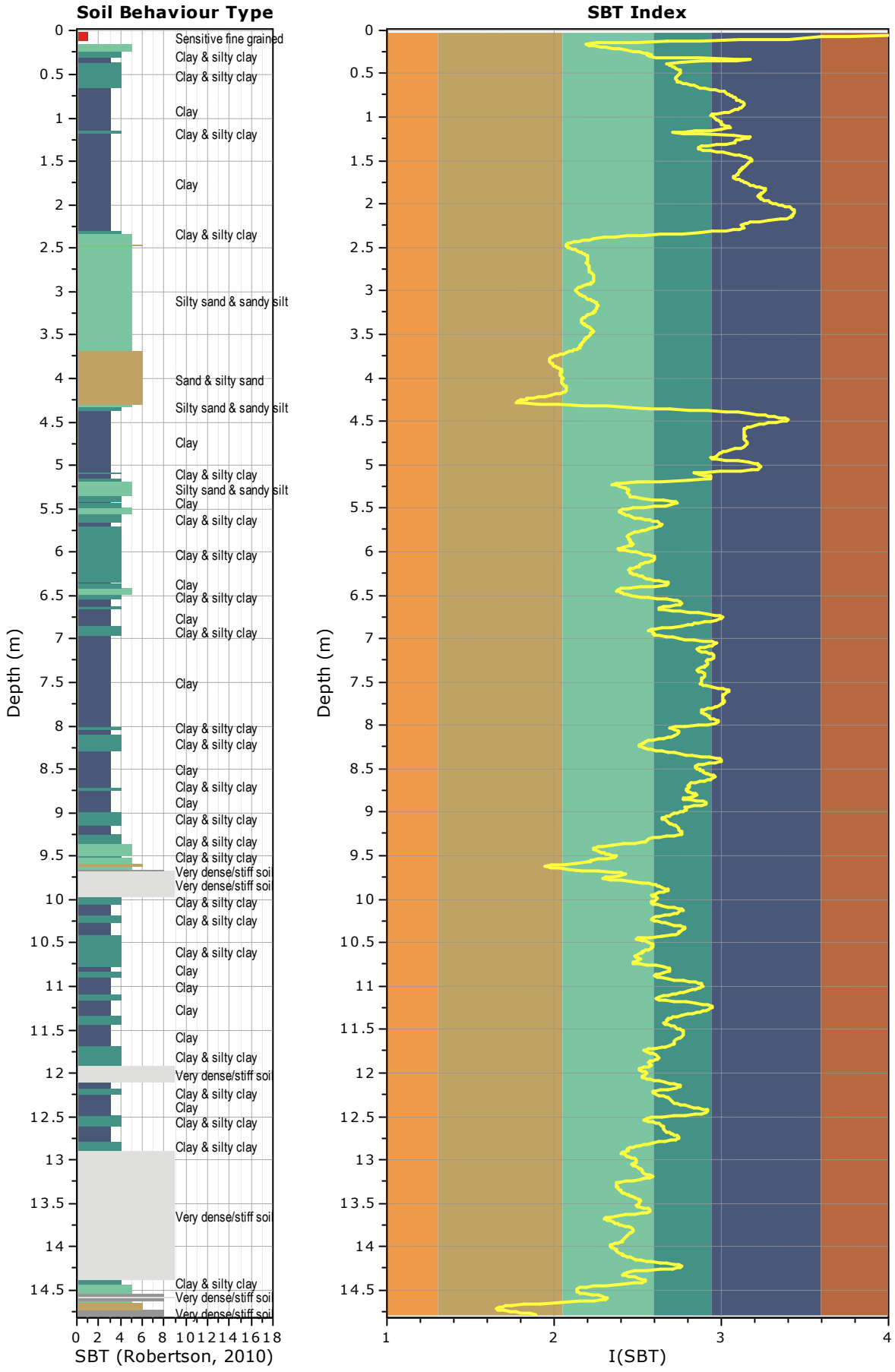
Cone Type: 10 cm2 50MPa

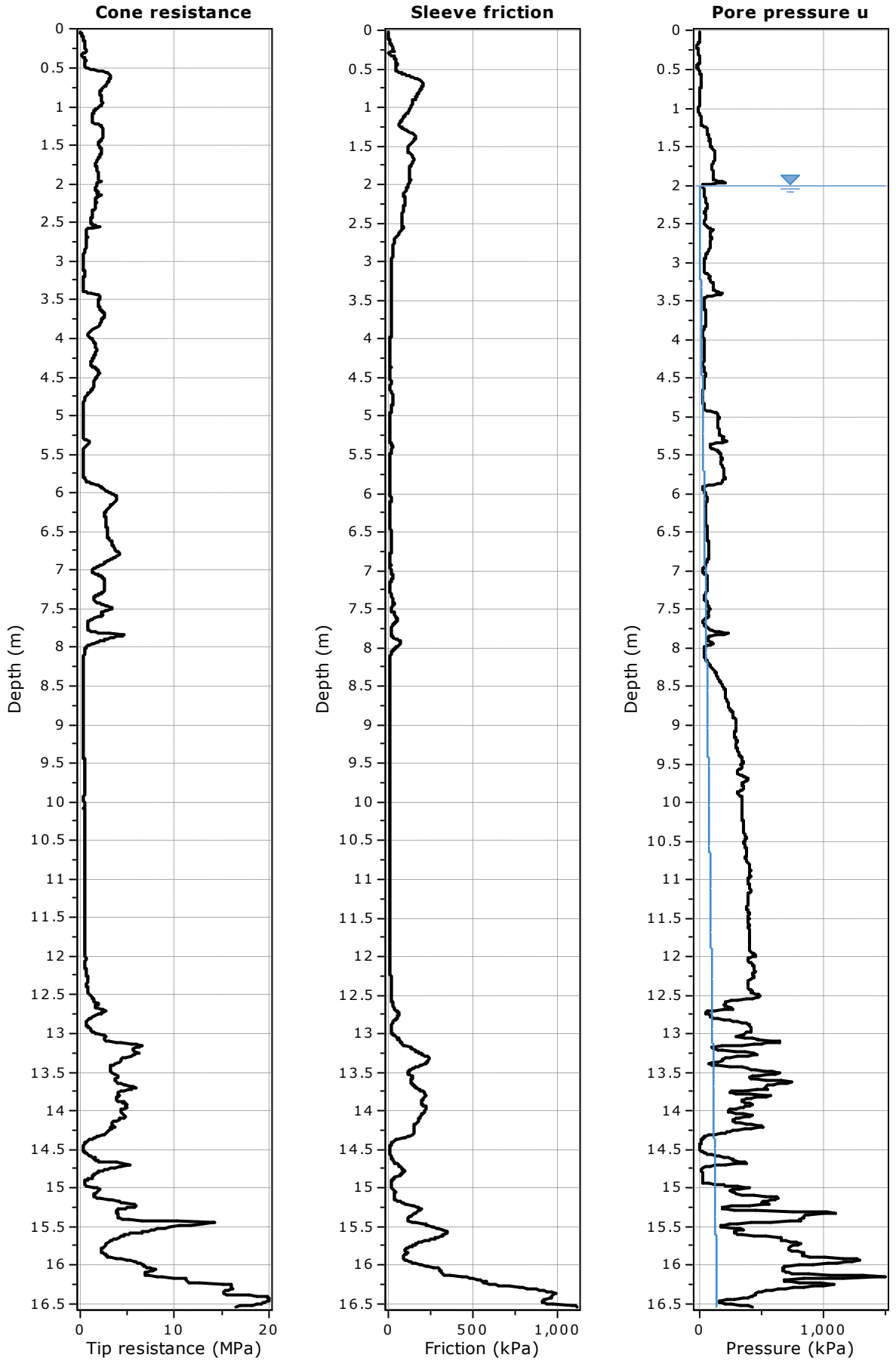
Cone Operator: Stuart Gemmell

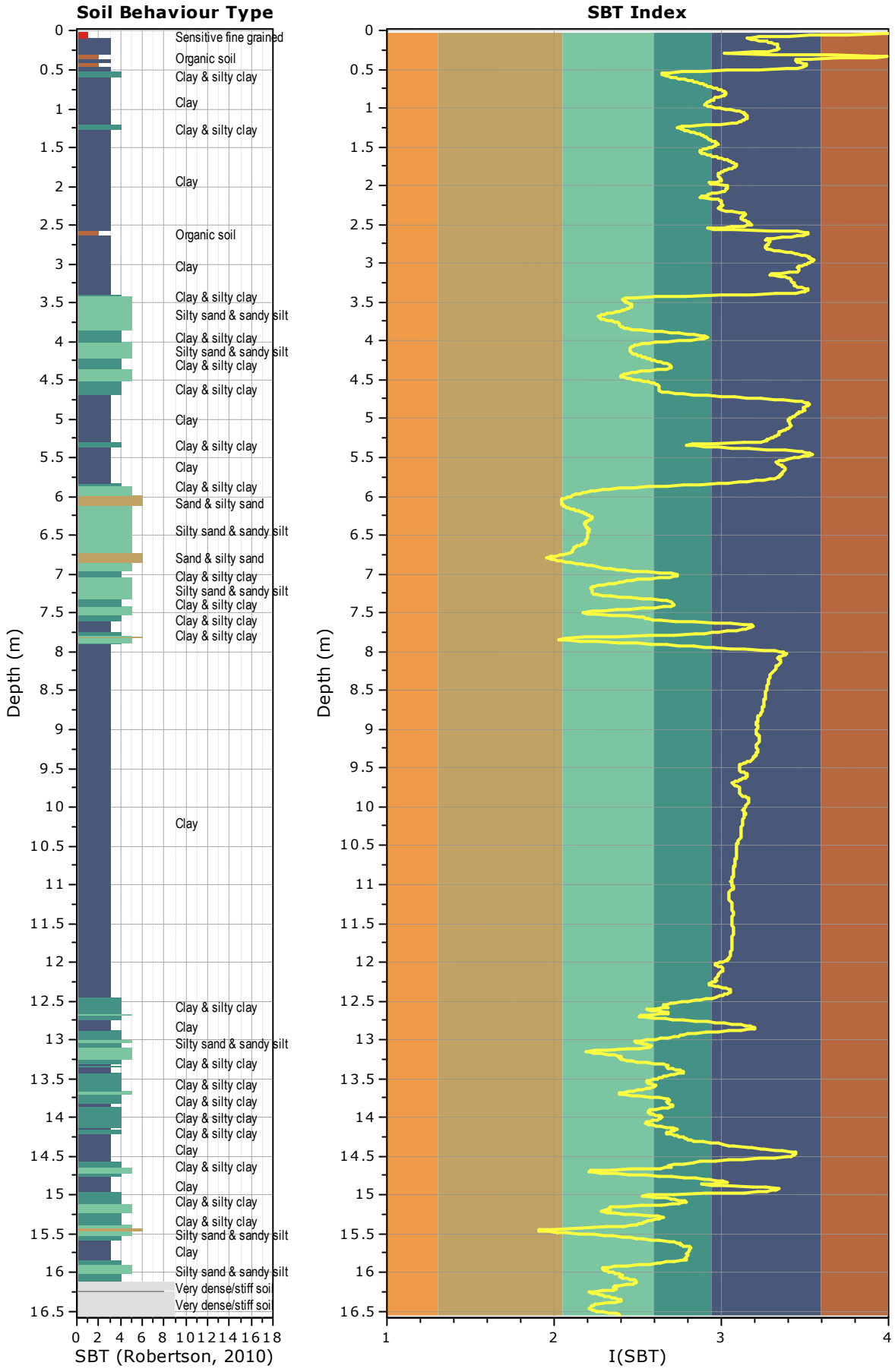
Project: Te Maika Road Ngunguru Subdivision

Location: Stage One




Soil Behaviour Type
Depth (m)
SBT (Robertson, 2010)
Sensitive fine grained
Clay & silty clay
Clay
Silty sand & sandy silt
Sand & silty sand
Very dense/stiff soil
SBT Index
I(SBT)


Cone resistance
Sleeve friction
Pore pressure u
Depth (m)
Tip resistance (MPa)
Friction (kPa)
Pressure (kPa)


Soil Behaviour Type
SBT Index
Depth (m)
Depth (m)
Sensitive fine grained
Organic soil
Clay & silty clay
Clay
Clay & silty clay
Clay
Organic soil
Clay
Clay & silty clay
Silty sand & sandy silt
Clay & silty clay
Silty sand & sandy silt
Clay & silty clay
Clay & silty clay
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Clay & silty clay
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Clay & silty clay
Sand & silty sand
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Clay & silty clay
Clay
Clay & silty clay
Clay
Clay & silty clay
Clay & silty clay
Silty sand & sandy silt
Clay
Silty sand & sandy silt
Very dense/stiff soi
Very dense/stiff soi
SBT (Robertson, 2010)
I(SBT)

Core Engineering Solution Ltd

Level 1 - 31 Vine Street

CPT: cpt 3 lot 21

Total depth: 14.27 m

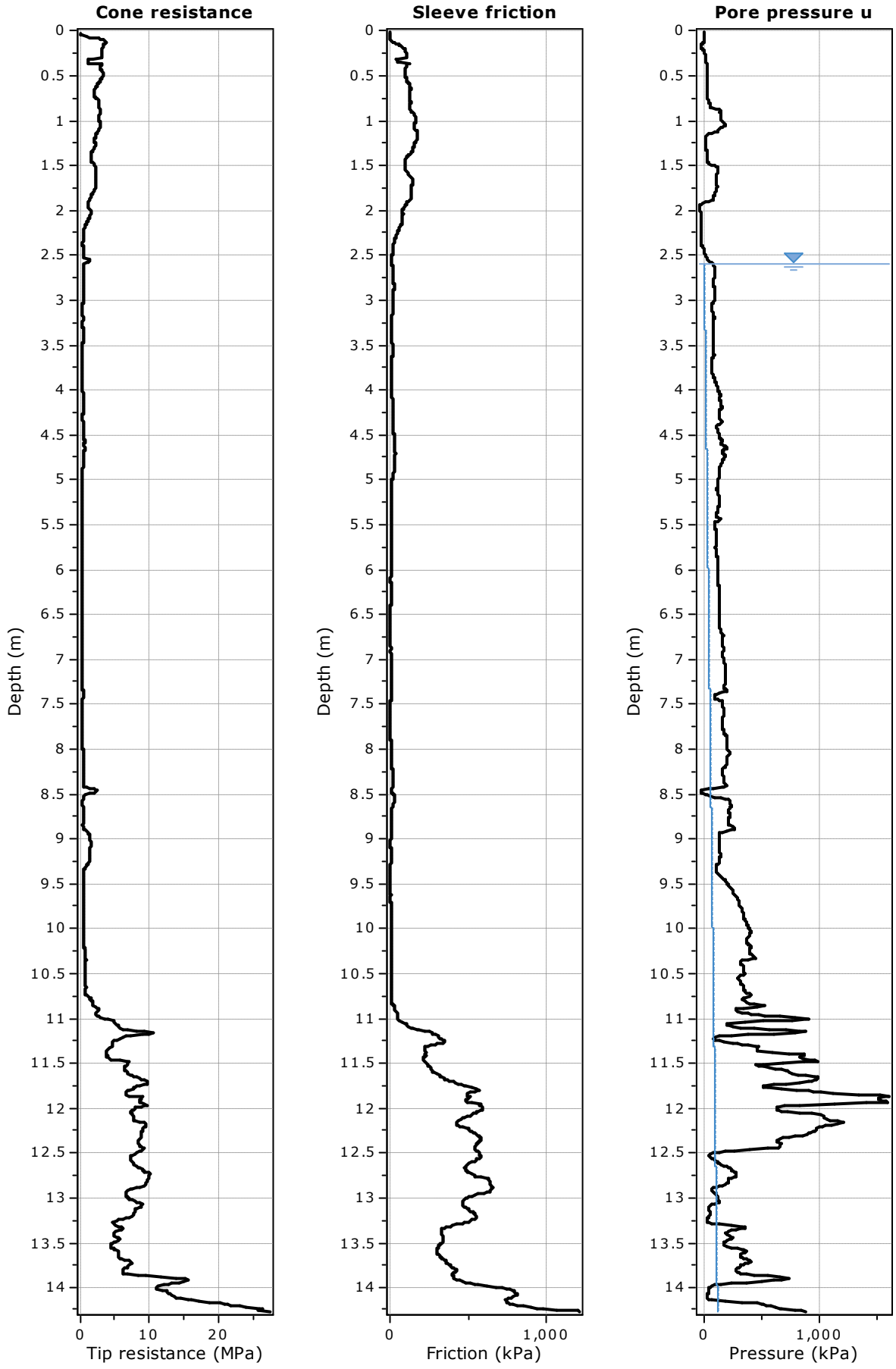
Coords: lat -35.625502° lon 174.516995°

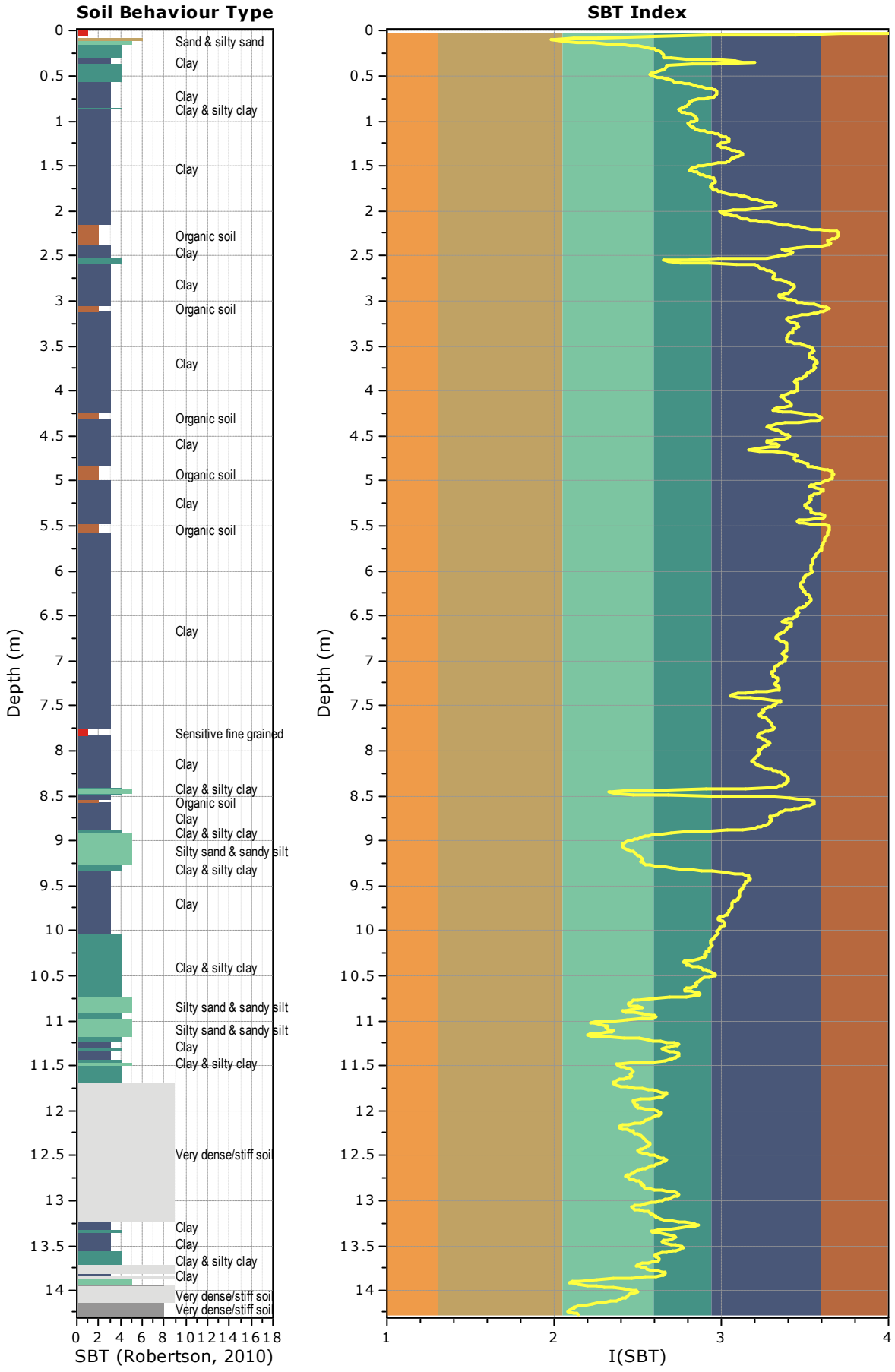
Cone Type: 10 cm2 50MPa

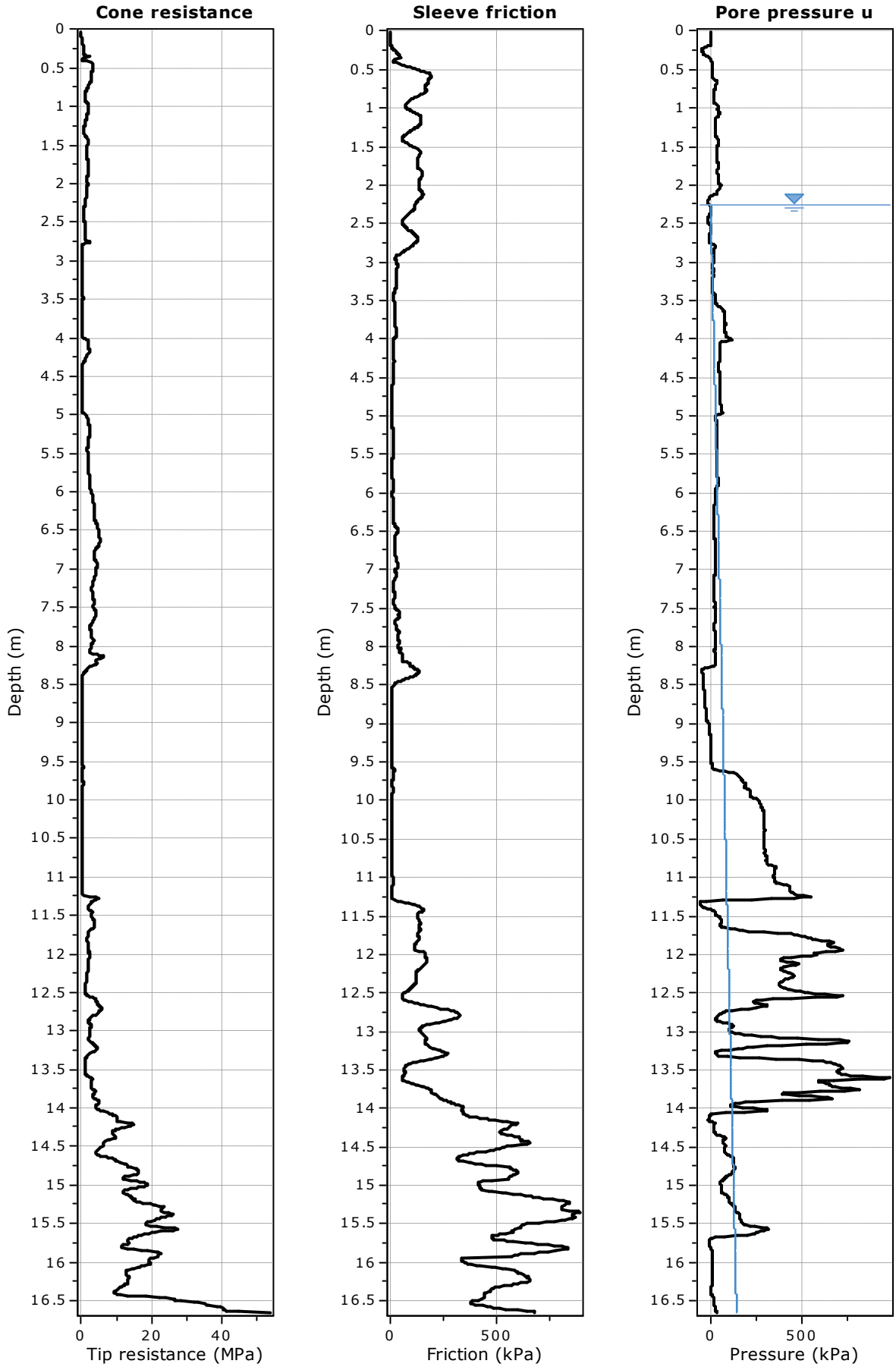
Cone Operator: Stuart Gemmell

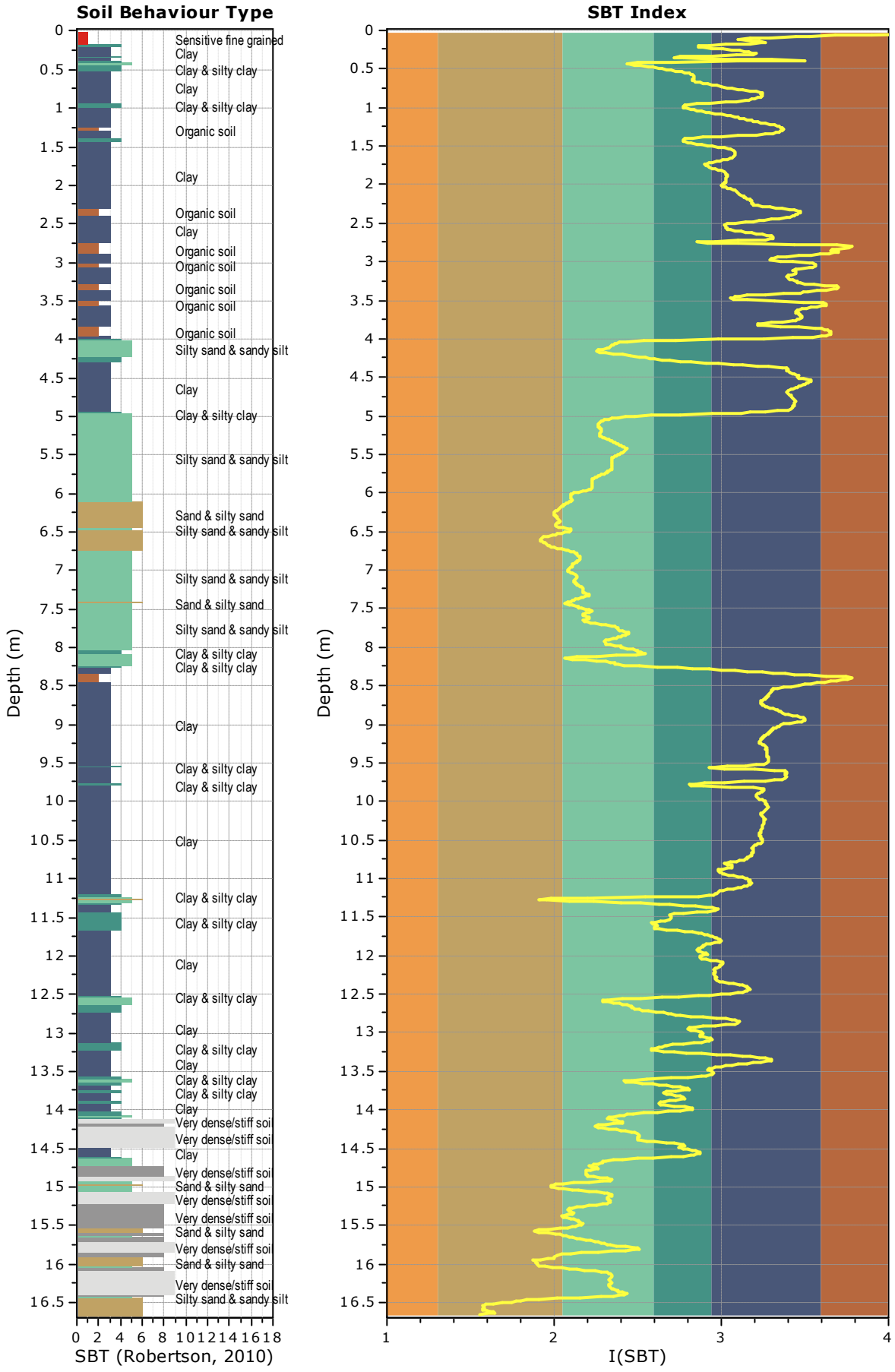
Project: Te Maika Road Ngunguru Subdivision

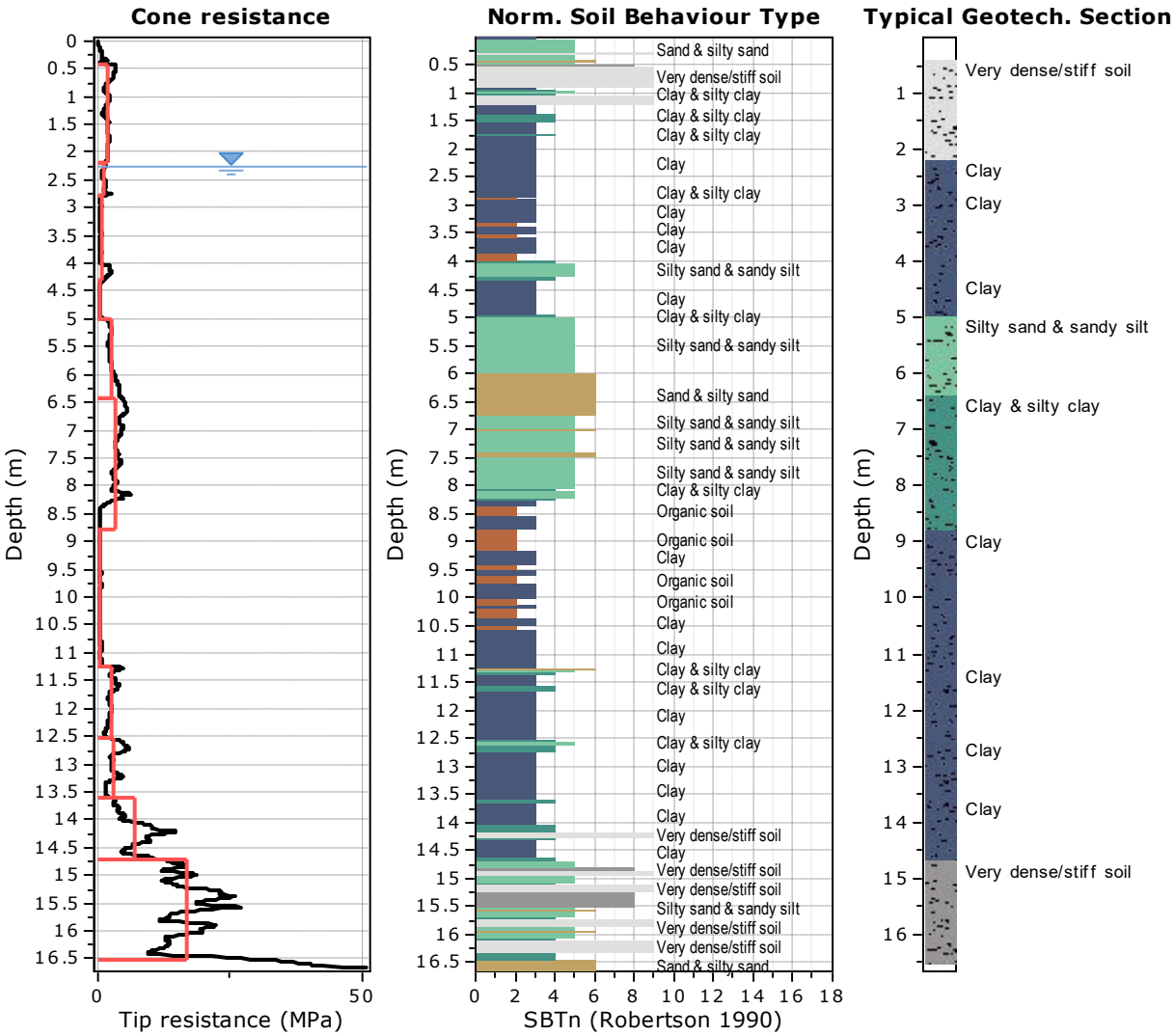
Location: Stage One




Soil Behaviour Type
SBT Index
Depth (m)
SBT (Robertson, 2010)
I(SBT)
Sand & silty sand
Clay
Clay & silty clay
Organic soil
Silty sand & sandy silt
Sensitive fine grained
Very dense/stiff soil


Cone resistance
Sleeve friction
Pore pressure u
Depth (m)
Tip resistance (MPa)
Friction (kPa)
Pressure (kPa)


Soil Behaviour Type
SBT Index
Depth (m)
SBT (Robertson, 2010)
I(SBT)
Sensitive fine grained
Clay
Clay & silty clay
Organic soil
Silty sand & sandy silt
Sand & silty sand
Very dense/stiff soil



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.41 (m), **End depth:** 2.20 (m)

Description: Very dense/stiff soil

Basic results	Estimation results	
Total cone resistance: 1.95 ±0.60 MPa	Permeability: 4.65E-07 ±1.47E-06 m/s	Constrained Mod.: 26.72 ±8.08 MPa
Sleeve friction: 127.27 ±35.56 kPa	N_{60}: 7.78 ±1.60 blows	Go: 48.05 ±8.50 MPa
Ic: 2.63 ±0.22	Es: 0.00 ±0.00 MPa	Su: 264.22 ±77.34 kPa
SBT_n: 9	Dr (%): 0.00 ±0.00	Su ratio: 9.64 ±5.07
SBTn description: Very dense/stiff soil	φ (degrees): 0.00 ±0.00 °	O.C.R.: 22.26 ±11.71
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 2.20 (m), **End depth:** 2.78 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 1.19 ±0.34 MPa	Permeability: 1.17E-08 ±1.32E-08 m/s	Constrained Mod.: 16.07 ±4.80 MPa
Sleeve friction: 97.89 ±25.05 kPa	N_{60}: 6.02 ±1.33 blows	Go: 45.48 ±6.89 MPa
Ic: 3.00 ±0.16	Es: 0.00 ±0.00 MPa	Su: 163.95 ±48.94 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 3.58 ±0.95
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 8.26 ±2.20
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 2.78 (m), **End depth:** 4.32 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.74 ±0.63 MPa	Permeability: 2.40E-07 ±6.36E-07 m/s	Constrained Mod.: 7.41 ±9.55 MPa
Sleeve friction: 26.62 ±17.80 kPa	N_{60}: 3.60 ±1.51 blows	Go: 25.37 ±4.89 MPa
Ic: 3.15 ±0.45	Es: 0.00 ±0.00 MPa	Su: 58.98 ±25.43 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 1.09 ±0.41
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 2.53 ±0.96
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 4.32 (m), **End depth:** 4.99 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.37 ±0.16 MPa	Permeability: 5.61E-09 ±2.85E-08 m/s	Constrained Mod.: 1.57 ±2.42 MPa
Sleeve friction: 10.24 ±3.54 kPa	N_{60}: 2.25 ±0.61 blows	Go: 17.40 ±2.77 MPa
Ic: 3.39 ±0.21	Es: 0.00 ±0.00 MPa	Su: 38.34 ±17.96 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.59 ±0.28
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 1.37 ±0.64
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 4.99 (m), **End depth:** 6.42 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 2.70 ±0.76 MPa	Permeability: 3.31E-06 ±3.00E-06 m/s	Constrained Mod.: 33.49 ±6.30 MPa
Sleeve friction: 11.64 ±2.14 kPa	N_{60}: 8.03 ±1.52 blows	Go: 35.93 ±4.62 MPa
Ic: 2.17 ±0.13	Es: 28.19 ±3.62 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 29.83 ±3.55	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 32.23 ±0.41 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 6.42 (m), **End depth:** 8.80 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 3.22 ±1.59 MPa	Permeability: 2.92E-06 ±3.71E-06 m/s	Constrained Mod.: 39.07 ±20.52 MPa
Sleeve friction: 34.93 ±27.81 kPa	N_{60}: 10.17 ±3.63 blows	Go: 49.85 ±14.83 MPa
Ic: 2.50 ±0.63	Es: 0.00 ±0.00 MPa	Su: 109.96 ±133.06 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 1.12 ±1.37
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 2.58 ±3.16
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 8.80 (m), **End depth:** 11.24 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.45 ±0.11 MPa	Permeability: 5.09E-10 ±7.74E-10 m/s	Constrained Mod.: 0.70 ±0.53 MPa
Sleeve friction: 8.84 ±2.65 kPa	N_{60}: 3.31 ±0.47 blows	Go: 21.48 ±3.21 MPa
Ic: 3.61 ±0.19	Es: 0.00 ±0.00 MPa	Su: 36.63 ±14.19 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.32 ±0.12
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 0.73 ±0.27
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 8 ::.

Code: Layer_8 **Start depth:** 11.24 (m), **End depth:** 12.54 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 2.43 ±0.78 MPa	Permeability: 1.73E-07 ±9.14E-07 m/s	Constrained Mod.: 29.45 ±12.06 MPa
Sleeve friction: 122.44 ±37.45 kPa	N_{60}: 12.11 ±2.24 blows	Go: 85.94 ±14.28 MPa
Ic: 3.00 ±0.26	Es: 0.00 ±0.00 MPa	Su: 302.31 ±97.85 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 2.32 ±0.80
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 5.35 ±1.84
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 9 ::.

Code: Layer_9 **Start depth:** 12.54 (m), **End depth:** 13.60 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 3.03 ±1.32 MPa	Permeability: 3.88E-08 ±8.10E-08 m/s	Constrained Mod.: 37.25 ±20.49 MPa
Sleeve friction: 171.54 ±82.18 kPa	N_{60}: 14.81 ±4.36 blows	Go: 104.47 ±25.97 MPa
Ic: 3.00 ±0.28	Es: 0.00 ±0.00 MPa	Su: 388.04 ±188.31 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 2.77 ±1.40
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 6.39 ±3.24
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 10 ::.

Code: Layer_10 **Start depth:** 13.60 (m), **End depth:** 14.70 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 6.73 ±3.17 MPa	Permeability: 1.12E-07 ±1.53E-07 m/s	Constrained Mod.: 90.43 ±44.34 MPa
Sleeve friction: 374.44 ±173.82 kPa	N_{60}: 27.97 ±9.94 blows	Go: 175.39 ±51.56 MPa
Ic: 2.73 ±0.20	Es: 0.00 ±0.00 MPa	Su: 922.96 ±452.22 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 6.24 ±3.18
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 14.41 ±7.33
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 11 ::.

Code: Layer_11 **Start depth:** 14.70 (m), **End depth:** 16.51 (m)

Description: Very dense/stiff soil

Basic results	**Estimation results**	
Total cone resistance: 16.74 ±4.56 MPa	Permeability: 2.15E-06 ±3.71E-06 m/s	Constrained Mod.: 220.62 ±53.99 MPa
Sleeve friction: 594.61 ±152.30 kPa	N_{60}: 53.57 ±9.62 blows	Go: 267.85 ±36.81 MPa
Ic: 2.30 ±0.18	Es: 213.62 ±33.18 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 8	Dr (%): 61.13 ±6.50	Su ratio: 0.00 ±0.00
SBTn description: Very dense/stiff soil	φ (degrees): 41.80 ±0.98 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.00 ±0.00 kN/m³	

Summary table of mean values

From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.41	1.79	4.65E-07	7.8	0.0	0.0	0.0	26.7	48.0	264.2	9.6	22.3	19.0
2.20		(±1.47E-06)	(±1.6)	(±0.0)	(±0.0)	(±0.0)	(±8.1)	(±8.5)	(±77.3)	(±5.1)	(±11.7)	(±0.0)
2.20	0.58	1.17E-08	6.0	0.0	0.0	0.0	16.1	45.5	164.0	3.6	8.3	19.0
2.78		(±1.32E-08)	(±1.3)	(±0.0)	(±0.0)	(±0.0)	(±4.8)	(±6.9)	(±48.9)	(±1.0)	(±2.2)	(±0.0)
2.78	1.54	2.40E-07	3.6	0.0	0.0	0.0	7.4	25.4	59.0	1.1	2.5	19.0
4.32		(±6.36E-07)	(±1.5)	(±0.0)	(±0.0)	(±0.0)	(±9.5)	(±4.9)	(±25.4)	(±0.4)	(±1.0)	(±0.0)
4.32	0.67	5.61E-09	2.3	0.0	0.0	0.0	1.6	17.4	38.3	0.6	1.4	19.0
4.99		(±2.85E-08)	(±0.6)	(±0.0)	(±0.0)	(±0.0)	(±2.4)	(±2.8)	(±18.0)	(±0.3)	(±0.6)	(±0.0)
4.99	1.43	3.31E-06	8.0	28.2	29.8	32.2	33.5	35.9	0.0	0.0	0.0	19.0
6.42		(±3.00E-06)	(±1.5)	(±3.6)	(±3.6)	(±0.4)	(±6.3)	(±4.6)	(±0.0)	(±0.0)	(±0.0)	(±0.0)
6.42	2.38	2.92E-06	10.2	0.0	0.0	0.0	39.1	49.8	110.0	1.1	2.6	19.0
8.80		(±3.71E-06)	(±3.6)	(±0.0)	(±0.0)	(±0.0)	(±20.5)	(±14.8)	(±133.1)	(±1.4)	(±3.2)	(±0.0)
8.80	2.44	5.09E-10	3.3	0.0	0.0	0.0	0.7	21.5	36.6	0.3	0.7	19.0
11.24		(±7.74E-10)	(±0.5)	(±0.0)	(±0.0)	(±0.0)	(±0.5)	(±3.2)	(±14.2)	(±0.1)	(±0.3)	(±0.0)
11.24	1.30	1.73E-07	12.1	0.0	0.0	0.0	29.5	85.9	302.3	2.3	5.4	19.0
12.54		(±9.14E-07)	(±2.2)	(±0.0)	(±0.0)	(±0.0)	(±12.1)	(±14.3)	(±97.9)	(±0.8)	(±1.8)	(±0.0)
12.54	1.06	3.88E-08	14.8	0.0	0.0	0.0	37.3	104.5	388.0	2.8	6.4	19.0
13.60		(±8.10E-08)	(±4.4)	(±0.0)	(±0.0)	(±0.0)	(±20.5)	(±26.0)	(±188.3)	(±1.4)	(±3.2)	(±0.0)
13.60	1.10	1.12E-07	28.0	0.0	0.0	0.0	90.4	175.4	923.0	6.2	14.4	19.0
14.70		(±1.53E-07)	(±9.9)	(±0.0)	(±0.0)	(±0.0)	(±44.3)	(±51.6)	(±452.2)	(±3.2)	(±7.3)	(±0.0)
14.70	1.81	2.15E-06	53.6	213.6	61.1	41.8	220.6	267.8	0.0	0.0	0.0	19.0
16.51		(±3.71E-06)	(±9.6)	(±33.2)	(±6.5)	(±1.0)	(±54.0)	(±36.8)	(±0.0)	(±0.0)	(±0.0)	(±0.0)

Depth values presented in this table are measured from free ground surface

Core Engineering Solution Ltd

Level 1 - 31 Vine Street

CPT: cpt 2 lot 16

Total depth: 16.54 m

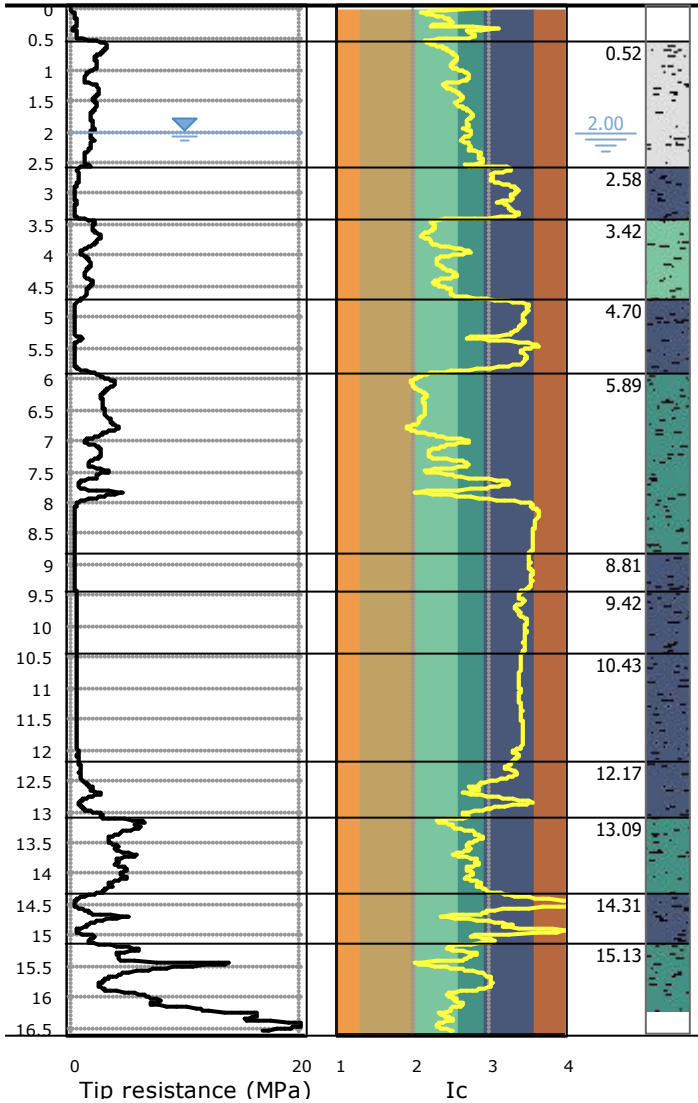
Coords: lat -35.625995° lon 174.516975°

Cone Type: 10 cm2 50MPa

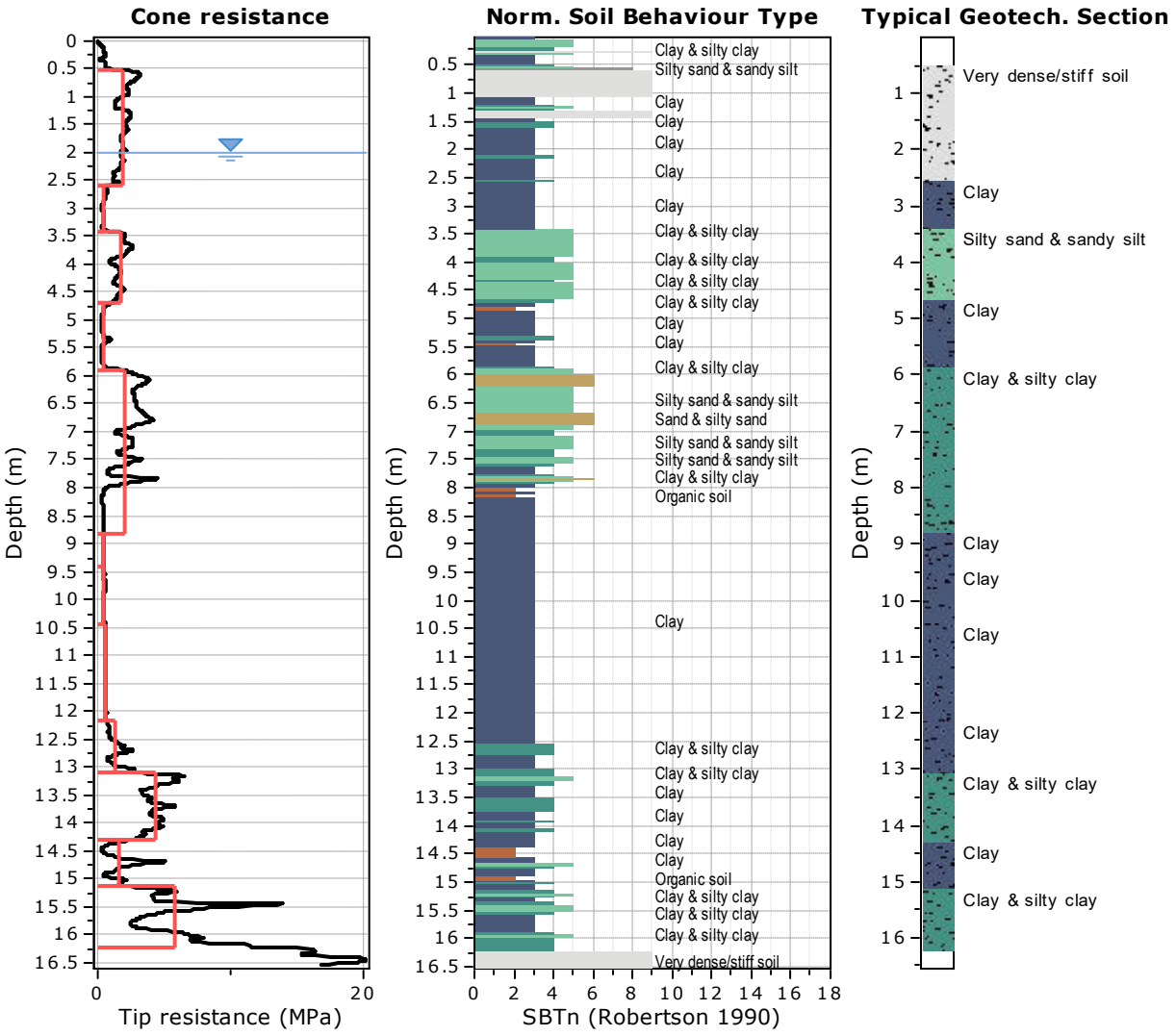
Cone Operator: Stuart Gemmell

Project: **Te Maika Road Ngunguru Subdivision**

Location: **Stage One**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.52	Very dense/stiff soil	1.9	1.82E-7	7.9	-	-	-	26.9	48.8	269.8	8.9	20.6	19.0
2.58	Clay	0.5	3.50E-9	2.8	-	-	-	4.5	23.0	63.0	1.3	3.1	19.0
3.42	Silty sand & sandy silt	1.7	7.96E-7	5.7	23.3	27.3	32.7	22.2	29.1	-	-	-	19.0
4.70	Clay	0.5	9.28E-9	2.7	-	-	-	2.5	20.1	48.4	0.7	1.6	19.0
5.89	Clay & silty clay	2.0	1.79E-6	6.8	-	-	-	22.9	34.6	93.8	1.0	2.4	19.0
8.81	Clay	0.4	4.24E-10	3.0	-	-	-	0.5	19.1	33.6	0.3	0.8	19.0
9.42	Clay	0.5	5.81E-10	3.1	-	-	-	0.8	21.7	43.3	0.4	0.9	19.0
10.43	Clay	0.6	6.38E-10	4.0	-	-	-	1.0	24.4	50.5	0.4	0.9	19.0
12.17	Clay	1.3	1.38E-8	6.8	-	-	-	10.6	44.2	155.3	1.1	2.6	19.0
13.09	Clay & silty clay	4.3	8.15E-8	18.6	-	-	-	56.7	117.5	565.5	3.9	9.1	19.0
14.31	Clay	1.5	3.93E-8	8.1	-	-	-	13.5	52.1	153.2	1.0	2.3	19.0
15.13	Clay & silty clay	5.9	3.35E-7	23.2	-	-	-	76.8	138.1	725.7	4.5	10.5	19.0



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.52 (m), **End depth:** 2.58 (m)

Description: Very dense/stiff soil

Basic results	Estimation results	
Total cone resistance: 1.95 ±0.50 MPa	Permeability: 1.82E-07 ±3.57E-07 m/s	Constrained Mod.: 26.87 ±7.07 MPa
Sleeve friction: 119.87 ±35.33 kPa	N_{60}: 7.86 ±1.42 blows	Go: 48.83 ±6.63 MPa
Ic: 2.65 ±0.16	Es: 0.00 ±0.00 MPa	Su: 269.81 ±69.42 kPa
SBT_n: 9	Dr (%): 0.00 ±0.00	Su ratio: 8.90 ±4.56
SBTn description: Very dense/stiff soil	φ (degrees): 0.00 ±0.00 °	O.C.R.: 20.55 ±10.52
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 2.58 (m), **End depth:** 3.42 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.50 ±0.16 MPa	Permeability: 3.50E-09 ±1.21E-08 m/s	Constrained Mod.: 4.51 ±3.14 MPa
Sleeve friction: 27.72 ±15.82 kPa	N_{60}: 2.84 ±0.80 blows	Go: 22.97 ±5.04 MPa
Ic: 3.22 ±0.14	Es: 0.00 ±0.00 MPa	Su: 62.99 ±23.13 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 1.35 ±0.52
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 3.11 ±1.19
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 3.42 (m), **End depth:** 4.70 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 1.67 ±0.44 MPa	Permeability: 7.96E-07 ±7.59E-07 m/s	Constrained Mod.: 22.19 ±6.00 MPa
Sleeve friction: 13.40 ±2.16 kPa	N_{60}: 5.69 ±0.97 blows	Go: 29.12 ±2.66 MPa
Ic: 2.39 ±0.16	Es: 23.33 ±1.89 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 27.33 ±3.08	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 32.72 ±0.42 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 4.70 (m), **End depth:** 5.89 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.46 ±0.24 MPa	Permeability: 9.28E-09 ±4.45E-08 m/s	Constrained Mod.: 2.51 ±3.77 MPa
Sleeve friction: 13.26 ±6.78 kPa	N_{60}: 2.67 ±0.85 blows	Go: 20.09 ±4.31 MPa
Ic: 3.34 ±0.25	Es: 0.00 ±0.00 MPa	Su: 48.39 ±27.41 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.71 ±0.40
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 1.64 ±0.91
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 5.89 (m), **End depth:** 8.81 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 1.96 ±1.23 MPa	Permeability: 1.79E-06 ±2.56E-06 m/s	Constrained Mod.: 22.92 ±16.81 MPa
Sleeve friction: 16.99 ±13.12 kPa	N_{60}: 6.80 ±2.74 blows	Go: 34.64 ±10.84 MPa
Ic: 2.70 ±0.63	Es: 0.00 ±0.00 MPa	Su: 93.77 ±88.54 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 1.03 ±0.99
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 2.38 ±2.29
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 8.81 (m), **End depth:** 9.42 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.41 ±0.01 MPa	Permeability: 4.24E-10 ±2.65E-11 m/s	Constrained Mod.: 0.54 ±0.04 MPa
Sleeve friction: 6.96 ±0.04 kPa	N_{60}: 3.00 ±0.00 blows	Go: 19.11 ±0.25 MPa
Ic: 3.54 ±0.02	Es: 0.00 ±0.00 MPa	Su: 33.61 ±1.16 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.33 ±0.01
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 0.75 ±0.02
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 9.42 (m), **End depth:** 10.43 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.49 ±0.02 MPa	Permeability: 5.81E-10 ±8.41E-11 m/s	Constrained Mod.: 0.84 ±0.14 MPa
Sleeve friction: 7.83 ±0.40 kPa	N_{60}: 3.06 ±0.24 blows	Go: 21.73 ±0.55 MPa
Ic: 3.45 ±0.04	Es: 0.00 ±0.00 MPa	Su: 43.33 ±3.29 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.39 ±0.04
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 0.90 ±0.08
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 8 ::.

Code: Layer_8 **Start depth:** 10.43 (m), **End depth:** 12.17 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.57 ±0.03 MPa	Permeability: 6.38E-10 ±6.06E-11 m/s	Constrained Mod.: 1.01 ±0.11 MPa
Sleeve friction: 8.55 ±0.29 kPa	N_{60}: 4.00 ±0.00 blows	Go: 24.37 ±0.77 MPa
Ic: 3.41 ±0.03	Es: 0.00 ±0.00 MPa	Su: 50.48 ±2.98 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.41 ±0.02
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 0.95 ±0.05
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 9 ::.

Code: Layer_9 **Start depth:** 12.17 (m), **End depth:** 13.09 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 1.33 ±0.65 MPa	Permeability: 1.38E-08 ±2.01E-08 m/s	Constrained Mod.: 10.62 ±10.96 MPa
Sleeve friction: 26.42 ±15.12 kPa	N_{60}: 6.82 ±2.27 blows	Go: 44.20 ±12.50 MPa
Ic: 3.09 ±0.26	Es: 0.00 ±0.00 MPa	Su: 155.31 ±92.00 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 1.14 ±0.67
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 2.64 ±1.55
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 10 ::.

Code: Layer_10 **Start depth:** 13.09 (m), **End depth:** 14.31 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 4.31 ±0.91 MPa	Permeability: 8.15E-08 ±1.38E-07 m/s	Constrained Mod.: 56.73 ±12.74 MPa
Sleeve friction: 171.50 ±41.19 kPa	N_{60}: 18.60 ±2.49 blows	Go: 117.45 ±13.68 MPa
Ic: 2.74 ±0.15	Es: 0.00 ±0.00 MPa	Su: 565.54 ±119.60 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 3.94 ±0.92
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 9.10 ±2.11
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 11 ::.

Code: Layer_11 **Start depth:** 14.31 (m), **End depth:** 15.13 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 1.54 ±1.10 MPa	Permeability: 3.93E-08 ±1.15E-07 m/s	Constrained Mod.: 13.48 ±16.35 MPa
Sleeve friction: 41.85 ±31.62 kPa	N_{60}: 8.12 ±3.60 blows	Go: 52.06 ±23.89 MPa
Ic: 3.29 ±0.49	Es: 0.00 ±0.00 MPa	Su: 153.16 ±117.07 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.99 ±0.77
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 2.29 ±1.77
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 12 ::.

Code: Layer_12 **Start depth:** 15.13 (m), **End depth:** 16.23 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 5.85 ±2.91 MPa	Permeability: 3.35E-07 ±9.89E-07 m/s	Constrained Mod.: 76.77 ±39.12 MPa
Sleeve friction: 212.40 ±125.21 kPa	N_{60}: 23.21 ±8.56 blows	Go: 138.08 ±43.20 MPa
Ic: 2.67 ±0.25	Es: 0.00 ±0.00 MPa	Su: 725.66 ±361.36 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 4.55 ±2.30
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 10.50 ±5.30
	Unit weight: 19.00 ±0.00 kN/m³	

Summary table of mean values

From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.52	2.06	1.82E-07	7.9	0.0	0.0	0.0	26.9	48.8	269.8	8.9	20.6	19.0
2.58		(±3.57E-07)	(±1.4)	(±0.0)	(±0.0)	(±0.0)	(±7.1)	(±6.6)	(±69.4)	(±4.6)	(±10.5)	(±0.0)
2.58	0.84	3.50E-09	2.8	0.0	0.0	0.0	4.5	23.0	63.0	1.3	3.1	19.0
3.42		(±1.21E-08)	(±0.8)	(±0.0)	(±0.0)	(±0.0)	(±3.1)	(±5.0)	(±23.1)	(±0.5)	(±1.2)	(±0.0)
3.42	1.28	7.96E-07	5.7	23.3	27.3	32.7	22.2	29.1	0.0	0.0	0.0	19.0
4.70		(±7.59E-07)	(±1.0)	(±1.9)	(±3.1)	(±0.4)	(±6.0)	(±2.7)	(±0.0)	(±0.0)	(±0.0)	(±0.0)
4.70	1.19	9.28E-09	2.7	0.0	0.0	0.0	2.5	20.1	48.4	0.7	1.6	19.0
5.89		(±4.45E-08)	(±0.9)	(±0.0)	(±0.0)	(±0.0)	(±3.8)	(±4.3)	(±27.4)	(±0.4)	(±0.9)	(±0.0)
5.89	2.92	1.79E-06	6.8	0.0	0.0	0.0	22.9	34.6	93.8	1.0	2.4	19.0
8.81		(±2.56E-06)	(±2.7)	(±0.0)	(±0.0)	(±0.0)	(±16.8)	(±10.8)	(±88.5)	(±1.0)	(±2.3)	(±0.0)
8.81	0.61	4.24E-10	3.0	0.0	0.0	0.0	0.5	19.1	33.6	0.3	0.8	19.0
9.42		(±2.65E-11)	(±0.0)	(±0.0)	(±0.0)	(±0.0)	(±0.0)	(±0.3)	(±1.2)	(±0.0)	(±0.0)	(±0.0)
9.42	1.01	5.81E-10	3.1	0.0	0.0	0.0	0.8	21.7	43.3	0.4	0.9	19.0
10.43		(±8.41E-11)	(±0.2)	(±0.0)	(±0.0)	(±0.0)	(±0.1)	(±0.5)	(±3.3)	(±0.0)	(±0.1)	(±0.0)
10.43	1.74	6.38E-10	4.0	0.0	0.0	0.0	1.0	24.4	50.5	0.4	0.9	19.0
12.17		(±6.06E-11)	(±0.0)	(±0.0)	(±0.0)	(±0.0)	(±0.1)	(±0.8)	(±3.0)	(±0.0)	(±0.0)	(±0.0)
12.17	0.92	1.38E-08	6.8	0.0	0.0	0.0	10.6	44.2	155.3	1.1	2.6	19.0
13.09		(±2.01E-08)	(±2.3)	(±0.0)	(±0.0)	(±0.0)	(±11.0)	(±12.5)	(±92.0)	(±0.7)	(±1.6)	(±0.0)
13.09	1.22	8.15E-08	18.6	0.0	0.0	0.0	56.7	117.5	565.5	3.9	9.1	19.0
14.31		(±1.38E-07)	(±2.5)	(±0.0)	(±0.0)	(±0.0)	(±12.7)	(±13.7)	(±119.6)	(±0.9)	(±2.1)	(±0.0)
14.31	0.82	3.93E-08	8.1	0.0	0.0	0.0	13.5	52.1	153.2	1.0	2.3	19.0
15.13		(±1.15E-07)	(±3.6)	(±0.0)	(±0.0)	(±0.0)	(±16.3)	(±23.9)	(±117.1)	(±0.8)	(±1.8)	(±0.0)
15.13	1.10	3.35E-07	23.2	0.0	0.0	0.0	76.8	138.1	725.7	4.5	10.5	19.0
16.23		(±9.89E-07)	(±8.6)	(±0.0)	(±0.0)	(±0.0)	(±39.1)	(±43.2)	(±361.4)	(±2.3)	(±5.3)	(±0.0)

Depth values presented in this table are measured from free ground surface

Core Engineering Solution Ltd

Level 1 - 31 Vine Street

CPT: cpt 1 lot 17

Total depth: 14.78 m

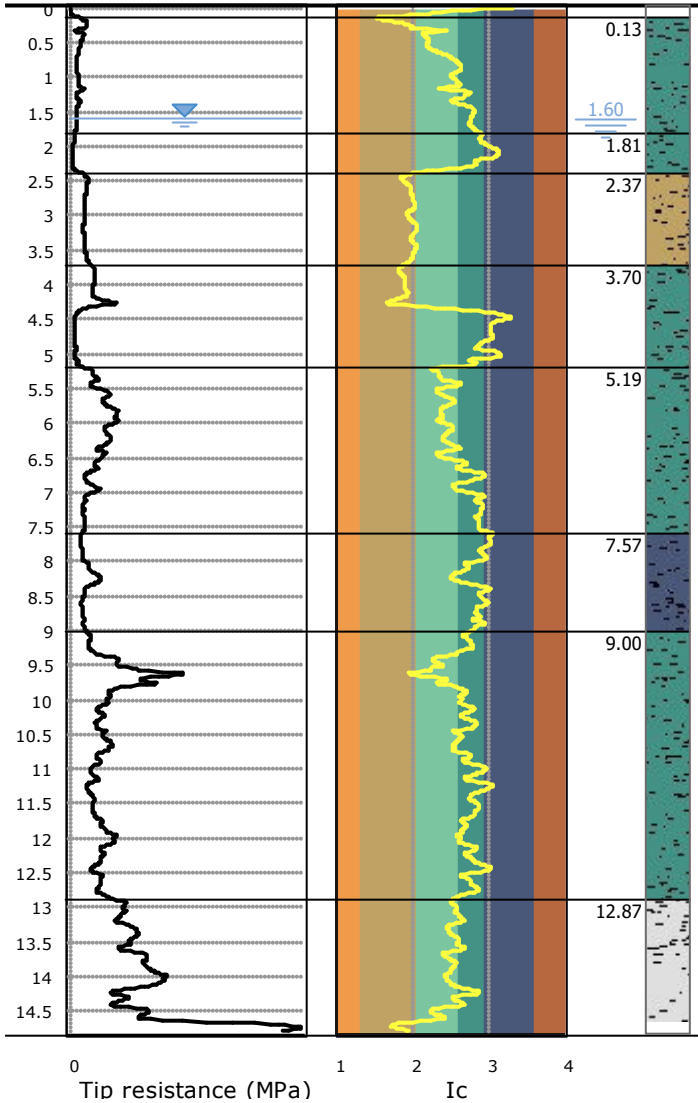
Coords: lat -35.62615° lon 174.516722°

Cone Type: 10 cm2 50MPa

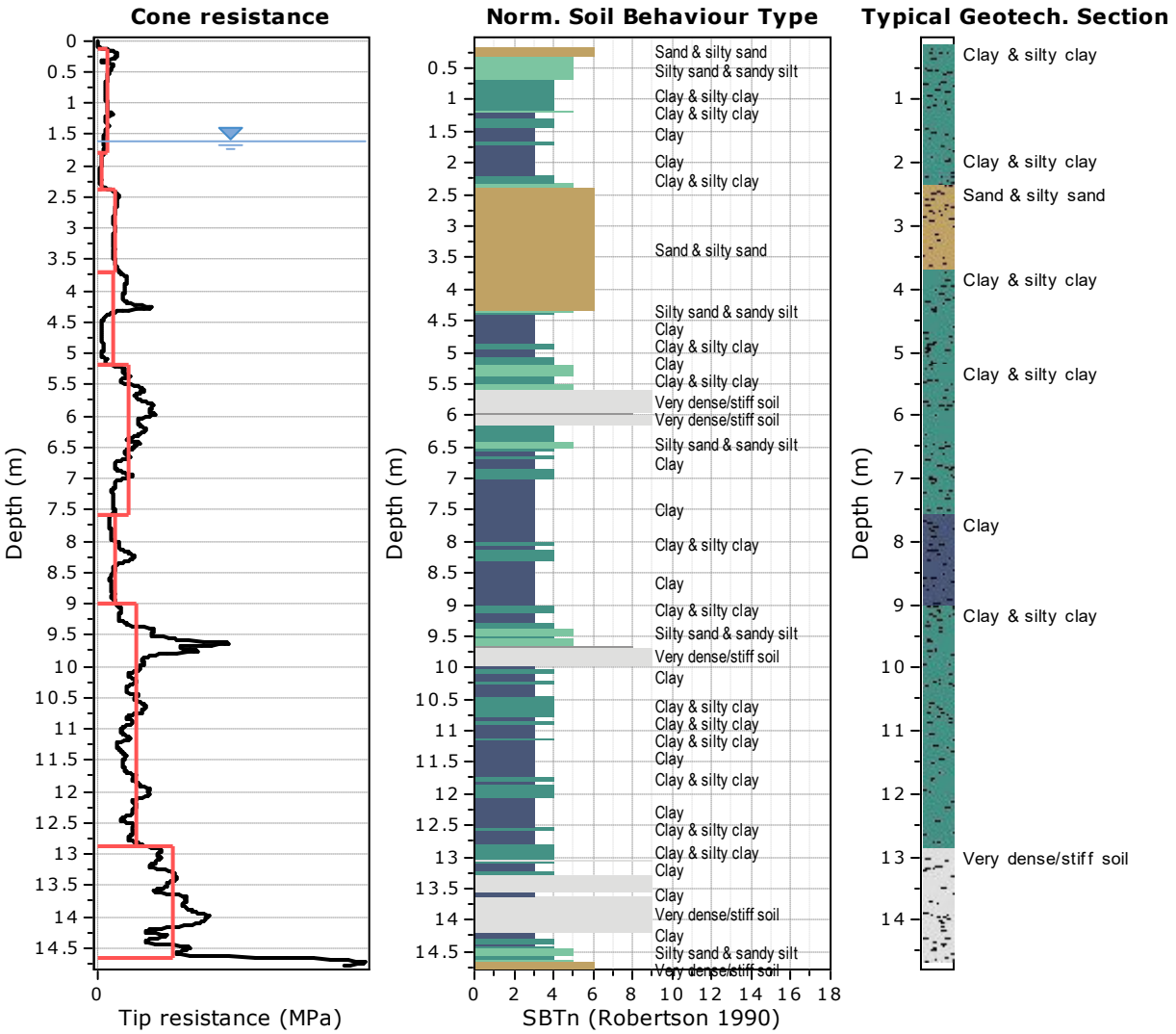
Cone Operator: Stuart Gemmell

Project: **Te Maika Road Ngunguru Subdivision**

Location: **Stage One**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.13	Clay & silty clay	1.4	3.85E-6	4.9	-	-	-	18.0	27.5	161.6	6.0	13.9	19.0
1.81	Clay & silty clay	0.5	9.28E-8	2.4	-	-	-	5.8	16.3	61.3	1.7	4.0	19.0
2.37	Sand & silty sand	2.5	8.71E-6	6.5	21.6	34.1	32.5	27.0	27.5	-	-	-	19.0
3.70	Clay & silty clay	2.4	9.63E-6	7.0	-	-	-	22.6	34.5	108.4	1.8	4.1	19.0
5.19	Clay & silty clay	4.5	2.70E-7	17.3	-	-	-	61.8	100.9	619.3	8.0	18.6	19.0
7.57	Clay	2.5	3.34E-8	11.7	-	-	-	33.5	78.4	341.7	3.7	8.6	19.0
9.00	Clay & silty clay	5.7	2.64E-7	22.9	-	-	-	75.6	140.7	711.5	6.2	14.3	19.0
12.87	Very dense/stiff soil	10.9	2.78E-7	41.0	-	-	-	148.7	236.2	1487.2	10.9	25.2	19.0



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.13 (m), **End depth:** 1.81 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 1.39 ±0.51 MPa	Permeability: 3.85E-06 ±1.67E-05 m/s	Constrained Mod.: 17.97 ±5.50 MPa
Sleeve friction: 46.33 ±15.99 kPa	N_{60}: 4.85 ±1.11 blows	Go: 27.52 ±5.63 MPa
Ic: 2.47 ±0.31	Es: 0.00 ±0.00 MPa	Su: 161.60 ±36.68 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 6.00 ±1.64
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 13.86 ±3.79
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.81 (m), **End depth:** 2.37 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 0.51 ±0.21 MPa	Permeability: 9.28E-08 ±3.45E-07 m/s	Constrained Mod.: 5.75 ±3.55 MPa
Sleeve friction: 14.06 ±9.25 kPa	N_{60}: 2.42 ±0.60 blows	Go: 16.31 ±3.88 MPa
Ic: 2.90 ±0.21	Es: 0.00 ±0.00 MPa	Su: 61.32 ±17.60 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 1.74 ±0.56
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 4.02 ±1.29
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 2.37 (m), **End depth:** 3.70 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 2.49 ±0.28 MPa	Permeability: 8.71E-06 ±3.62E-06 m/s	Constrained Mod.: 27.04 ±2.07 MPa
Sleeve friction: 7.36 ±1.80 kPa	N_{60}: 6.50 ±0.66 blows	Go: 27.49 ±2.10 MPa
Ic: 1.99 ±0.05	Es: 21.57 ±1.65 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 34.11 ±1.93	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 32.49 ±0.53 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 3.70 (m), **End depth:** 5.19 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 2.36 ±1.86 MPa	Permeability: 9.63E-06 ±1.54E-05 m/s	Constrained Mod.: 22.58 ±16.24 MPa
Sleeve friction: 23.86 ±14.01 kPa	N_{60}: 6.97 ±3.54 blows	Go: 34.50 ±8.19 MPa
Ic: 2.50 ±0.57	Es: 0.00 ±0.00 MPa	Su: 108.44 ±43.11 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 1.79 ±0.67
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 4.14 ±1.54
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 5.19 (m), **End depth:** 7.57 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 4.54 ±1.84 MPa	Permeability: 2.70E-07 ±2.76E-07 m/s	Constrained Mod.: 61.82 ±25.90 MPa
Sleeve friction: 210.45 ±83.36 kPa	N_{60}: 17.26 ±5.38 blows	Go: 100.87 ±24.83 MPa
Ic: 2.59 ±0.21	Es: 0.00 ±0.00 MPa	Su: 619.26 ±276.54 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 8.04 ±3.79
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 18.56 ±8.75
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 7.57 (m), **End depth:** 9.00 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 2.55 ±0.93 MPa	Permeability: 3.34E-08 ±4.87E-08 m/s	Constrained Mod.: 33.48 ±13.08 MPa
Sleeve friction: 129.81 ±44.70 kPa	N_{60}: 11.65 ±3.09 blows	Go: 78.35 ±15.25 MPa
Ic: 2.86 ±0.14	Es: 0.00 ±0.00 MPa	Su: 341.67 ±133.51 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 3.71 ±1.43
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 8.57 ±3.31
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 9.00 (m), **End depth:** 12.87 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 5.67 ±2.72 MPa	Permeability: 2.64E-07 ±1.01E-06 m/s	Constrained Mod.: 75.62 ±34.97 MPa
Sleeve friction: 294.13 ±108.26 kPa	N_{60}: 22.92 ±7.18 blows	Go: 140.71 ±31.31 MPa
Ic: 2.69 ±0.19	Es: 0.00 ±0.00 MPa	Su: 711.51 ±273.01 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 6.18 ±2.64
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 14.28 ±6.10
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 8 ::.

Code: Layer_8 **Start depth:** 12.87 (m), **End depth:** 14.65 (m)

Description: Very dense/stiff soil

Basic results	Estimation results	
Total cone resistance: 10.89 ±2.60 MPa	Permeability: 2.78E-07 ±3.66E-07 m/s	Constrained Mod.: 148.67 ±36.14 MPa
Sleeve friction: 602.02 ±188.96 kPa	N_{60}: 41.04 ±7.90 blows	Go: 236.21 ±41.93 MPa
Ic: 2.53 ±0.13	Es: 0.00 ±0.00 MPa	Su: 1487.24 ±363.13 kPa
SBT_n: 9	Dr (%): 0.00 ±0.00	Su ratio: 10.91 ±2.66
SBTn description: Very dense/stiff soil	φ (degrees): 0.00 ±0.00 °	O.C.R.: 25.19 ±6.13
	Unit weight: 19.00 ±0.00 kN/m³	

Summary table of mean values

From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.13	1.68	3.85E-06	4.9	0.0	0.0	0.0	18.0	27.5	161.6	6.0	13.9	19.0
1.81		(±1.67E-05)	(±1.1)	(±0.0)	(±0.0)	(±0.0)	(±5.5)	(±5.6)	(±36.7)	(±1.6)	(±3.8)	(±0.0)
1.81	0.56	9.28E-08	2.4	0.0	0.0	0.0	5.8	16.3	61.3	1.7	4.0	19.0
2.37		(±3.45E-07)	(±0.6)	(±0.0)	(±0.0)	(±0.0)	(±3.6)	(±3.9)	(±17.6)	(±0.6)	(±1.3)	(±0.0)
2.37	1.33	8.71E-06	6.5	21.6	34.1	32.5	27.0	27.5	0.0	0.0	0.0	19.0
3.70		(±3.62E-06)	(±0.7)	(±1.6)	(±1.9)	(±0.5)	(±2.1)	(±2.1)	(±0.0)	(±0.0)	(±0.0)	(±0.0)
3.70	1.49	9.63E-06	7.0	0.0	0.0	0.0	22.6	34.5	108.4	1.8	4.1	19.0
5.19		(±1.54E-05)	(±3.5)	(±0.0)	(±0.0)	(±0.0)	(±16.2)	(±8.2)	(±43.1)	(±0.7)	(±1.5)	(±0.0)
5.19	2.38	2.70E-07	17.3	0.0	0.0	0.0	61.8	100.9	619.3	8.0	18.6	19.0
7.57		(±2.76E-07)	(±5.4)	(±0.0)	(±0.0)	(±0.0)	(±25.9)	(±24.8)	(±276.5)	(±3.8)	(±8.8)	(±0.0)
7.57	1.43	3.34E-08	11.7	0.0	0.0	0.0	33.5	78.4	341.7	3.7	8.6	19.0
9.00		(±4.87E-08)	(±3.1)	(±0.0)	(±0.0)	(±0.0)	(±13.1)	(±15.3)	(±133.5)	(±1.4)	(±3.3)	(±0.0)
9.00	3.87	2.64E-07	22.9	0.0	0.0	0.0	75.6	140.7	711.5	6.2	14.3	19.0
12.87		(±1.01E-06)	(±7.2)	(±0.0)	(±0.0)	(±0.0)	(±35.0)	(±31.3)	(±273.0)	(±2.6)	(±6.1)	(±0.0)
12.87	1.78	2.78E-07	41.0	0.0	0.0	0.0	148.7	236.2	1487.2	10.9	25.2	19.0
14.65		(±3.66E-07)	(±7.9)	(±0.0)	(±0.0)	(±0.0)	(±36.1)	(±41.9)	(±363.1)	(±2.7)	(±6.1)	(±0.0)

Depth values presented in this table are measured from free ground surface

Core Engineering Solution Ltd

Level 1 - 31 Vine Street

CPT: cpt 3 lot 21

Total depth: 14.27 m

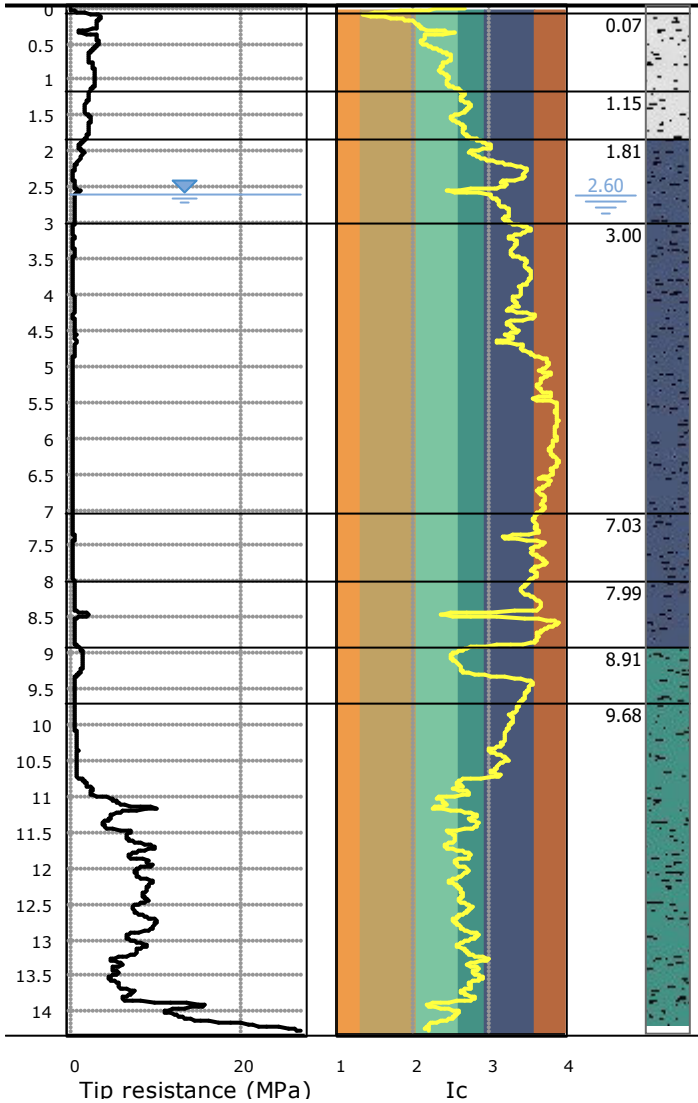
Coords: lat -35.625502° lon 174.516995°

Cone Type: 10 cm2 50MPa

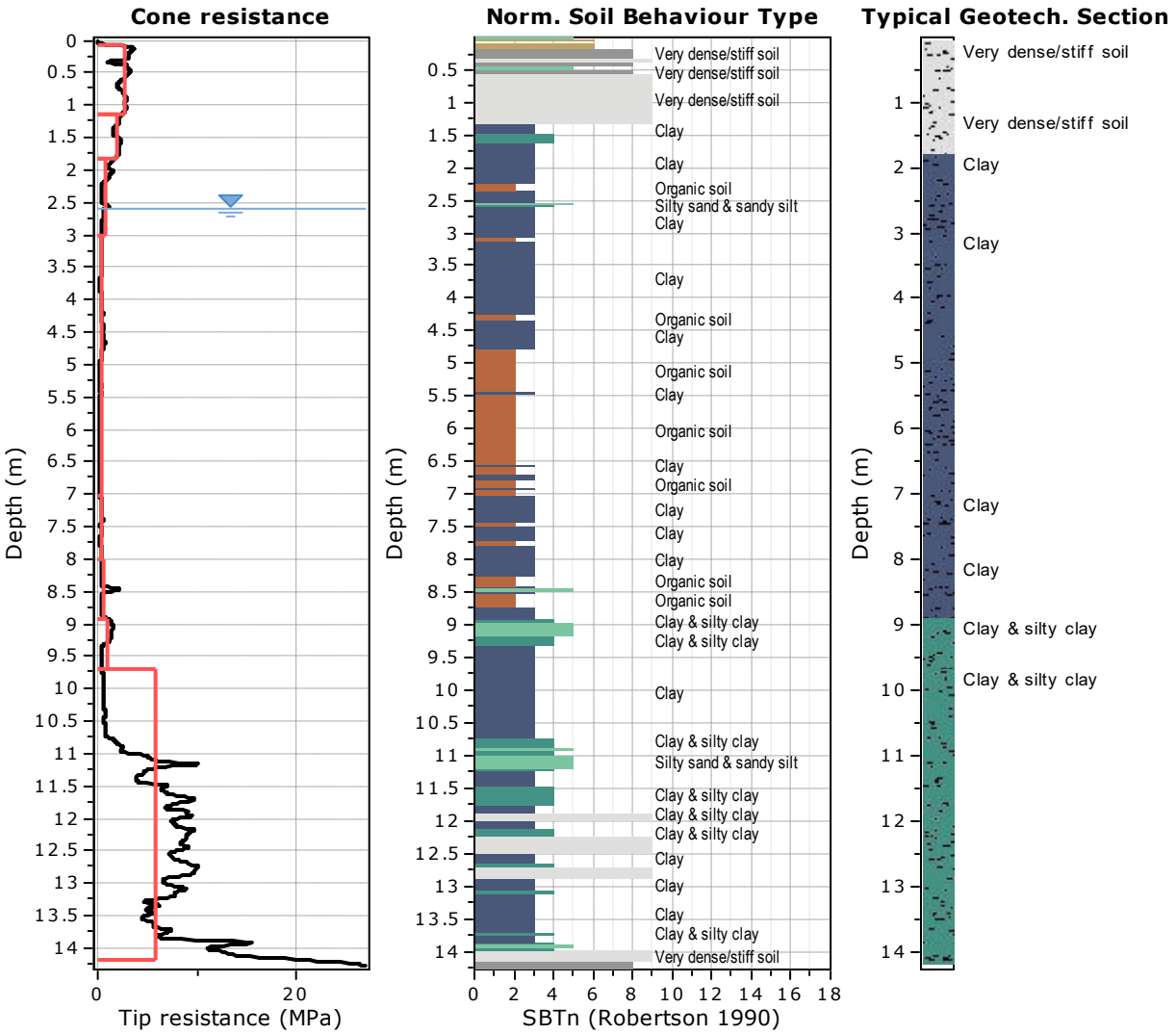
Cone Operator: Stuart Gemmell

Project: **Te Maika Road Ngunguru Subdivision**

Location: **Stage One**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.07	Very dense/stiff soil	2.7	1.55E-5	8.6	-	-	-	34.6	43.8	351.7	15.4	35.5	19.0
1.15	Very dense/stiff soil	2.0	8.60E-8	8.4	-	-	-	27.8	52.1	283.6	8.7	20.0	19.0
1.81	Clay	0.7	1.44E-8	3.8	-	-	-	8.1	28.8	95.1	2.2	5.2	19.0
3.00	Clay	0.3	4.48E-10	2.3	-	-	-	1.0	17.8	31.4	0.5	1.1	19.0
7.03	Clay	0.3	3.94E-10	2.2	-	-	-	0.5	15.4	25.9	0.3	0.6	19.0
7.99	Clay	0.5	2.12E-8	3.4	-	-	-	2.5	24.3	42.5	0.4	1.0	19.0
8.91	Clay & silty clay	0.9	6.04E-8	4.1	-	-	-	6.4	23.2	75.5	0.7	1.6	19.0
9.68	Clay & silty clay	5.8	1.21E-7	23.7	-	-	-	77.2	144.6	770.1	5.6	12.9	19.0



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.07 (m), **End depth:** 1.15 (m)

Description: Very dense/stiff soil

Basic results	Estimation results	
Total cone resistance: 2.70 ±0.52 MPa	Permeability: 1.55E-05 ±7.92E-05 m/s	Constrained Mod.: 34.63 ±7.54 MPa
Sleeve friction: 113.99 ±41.55 kPa	N_{60}: 8.64 ±1.55 blows	Go: 43.76 ±11.24 MPa
Ic: 2.26 ±0.28	Es: 0.00 ±0.00 MPa	Su: 351.70 ±62.13 kPa
SBT_n: 9	Dr (%): 0.00 ±0.00	Su ratio: 15.35 ±1.81
SBTn description: Very dense/stiff soil	φ (degrees): 0.00 ±0.00 °	O.C.R.: 35.47 ±4.18
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.15 (m), **End depth:** 1.81 (m)

Description: Very dense/stiff soil

Basic results	Estimation results	
Total cone resistance: 2.01 ±0.24 MPa	Permeability: 8.60E-08 ±4.64E-08 m/s	Constrained Mod.: 27.79 ±3.42 MPa
Sleeve friction: 133.64 ±25.35 kPa	N_{60}: 8.36 ±0.81 blows	Go: 52.13 ±4.64 MPa
Ic: 2.65 ±0.07	Es: 0.00 ±0.00 MPa	Su: 283.55 ±34.85 kPa
SBT_n: 9	Dr (%): 0.00 ±0.00	Su ratio: 8.68 ±1.31
SBTn description: Very dense/stiff soil	φ (degrees): 0.00 ±0.00 °	O.C.R.: 20.05 ±3.03
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 1.81 (m), **End depth:** 3.00 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.72 ±0.40 MPa	Permeability: 1.44E-08 ±4.17E-08 m/s	Constrained Mod.: 8.07 ±6.70 MPa
Sleeve friction: 46.97 ±37.02 kPa	N_{60}: 3.79 ±1.66 blows	Go: 28.76 ±10.36 MPa
Ic: 3.11 ±0.24	Es: 0.00 ±0.00 MPa	Su: 95.09 ±58.11 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 2.24 ±1.62
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 5.18 ±3.75
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 3.00 (m), **End depth:** 7.03 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.32 ±0.10 MPa	Permeability: 4.48E-10 ±3.77E-10 m/s	Constrained Mod.: 1.00 ±0.97 MPa
Sleeve friction: 12.79 ±7.77 kPa	N_{60}: 2.26 ±0.52 blows	Go: 17.85 ±4.68 MPa
Ic: 3.61 ±0.22	Es: 0.00 ±0.00 MPa	Su: 31.45 ±16.20 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.47 ±0.28
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 1.09 ±0.64
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 7.03 (m), **End depth:** 7.99 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.32 ±0.06 MPa	Permeability: 3.94E-10 ±2.56E-10 m/s	Constrained Mod.: 0.46 ±0.28 MPa
Sleeve friction: 4.80 ±1.32 kPa	N_{60}: 2.24 ±0.43 blows	Go: 15.39 ±1.92 MPa
Ic: 3.60 ±0.11	Es: 0.00 ±0.00 MPa	Su: 25.85 ±7.98 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.27 ±0.09
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 0.63 ±0.20
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 7.99 (m), **End depth:** 8.91 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.54 ±0.40 MPa	Permeability: 2.12E-08 ±8.91E-08 m/s	Constrained Mod.: 2.49 ±6.10 MPa
Sleeve friction: 13.49 ±6.40 kPa	N_{60}: 3.44 ±1.12 blows	Go: 24.35 ±5.13 MPa
Ic: 3.51 ±0.33	Es: 0.00 ±0.00 MPa	Su: 42.52 ±24.10 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.41 ±0.23
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 0.95 ±0.54
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 8.91 (m), **End depth:** 9.68 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 0.88 ±0.45 MPa	Permeability: 6.04E-08 ±7.37E-08 m/s	Constrained Mod.: 6.42 ±6.13 MPa
Sleeve friction: 4.90 ±0.69 kPa	N_{60}: 4.10 ±1.09 blows	Go: 23.24 ±5.07 MPa
Ic: 3.02 ±0.43	Es: 0.00 ±0.00 MPa	Su: 75.54 ±54.00 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 0.69 ±0.50
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 1.59 ±1.16
	Unit weight: 19.00 ±0.00 kN/m³	

.:: Layer No: 8 ::.

Code: Layer_8 **Start depth:** 9.68 (m), **End depth:** 14.17 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 5.82 ±3.87 MPa	Permeability: 1.21E-07 ±2.33E-07 m/s	Constrained Mod.: 77.15 ±55.40 MPa
Sleeve friction: 318.89 ±239.47 kPa	N_{60}: 23.69 ±14.12 blows	Go: 144.58 ±83.52 MPa
Ic: 2.78 ±0.28	Es: 0.00 ±0.00 MPa	Su: 770.10 ±523.38 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 5.60 ±3.74
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 12.93 ±8.64
	Unit weight: 19.00 ±0.00 kN/m³	

Summary table of mean values

From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.07	1.08	1.55E-05	8.6	0.0	0.0	0.0	34.6	43.8	351.7	15.4	35.5	19.0
1.15		(±7.92E-05)	(±1.5)	(±0.0)	(±0.0)	(±0.0)	(±7.5)	(±11.2)	(±62.1)	(±1.8)	(±4.2)	(±0.0)
1.15	0.66	8.60E-08	8.4	0.0	0.0	0.0	27.8	52.1	283.6	8.7	20.0	19.0
1.81		(±4.64E-08)	(±0.8)	(±0.0)	(±0.0)	(±0.0)	(±3.4)	(±4.6)	(±34.8)	(±1.3)	(±3.0)	(±0.0)
1.81	1.19	1.44E-08	3.8	0.0	0.0	0.0	8.1	28.8	95.1	2.2	5.2	19.0
3.00		(±4.17E-08)	(±1.7)	(±0.0)	(±0.0)	(±0.0)	(±6.7)	(±10.4)	(±58.1)	(±1.6)	(±3.8)	(±0.0)
3.00	4.03	4.48E-10	2.3	0.0	0.0	0.0	1.0	17.8	31.4	0.5	1.1	19.0
7.03		(±3.77E-10)	(±0.5)	(±0.0)	(±0.0)	(±0.0)	(±1.0)	(±4.7)	(±16.2)	(±0.3)	(±0.6)	(±0.0)
7.03	0.96	3.94E-10	2.2	0.0	0.0	0.0	0.5	15.4	25.9	0.3	0.6	19.0
7.99		(±2.56E-10)	(±0.4)	(±0.0)	(±0.0)	(±0.0)	(±0.3)	(±1.9)	(±8.0)	(±0.1)	(±0.2)	(±0.0)
7.99	0.92	2.12E-08	3.4	0.0	0.0	0.0	2.5	24.3	42.5	0.4	1.0	19.0
8.91		(±8.91E-08)	(±1.1)	(±0.0)	(±0.0)	(±0.0)	(±6.1)	(±5.1)	(±24.1)	(±0.2)	(±0.5)	(±0.0)
8.91	0.77	6.04E-08	4.1	0.0	0.0	0.0	6.4	23.2	75.5	0.7	1.6	19.0
9.68		(±7.37E-08)	(±1.1)	(±0.0)	(±0.0)	(±0.0)	(±6.1)	(±5.1)	(±54.0)	(±0.5)	(±1.2)	(±0.0)
9.68	4.49	1.21E-07	23.7	0.0	0.0	0.0	77.2	144.6	770.1	5.6	12.9	19.0
14.17		(±2.33E-07)	(±14.1)	(±0.0)	(±0.0)	(±0.0)	(±55.4)	(±83.5)	(±523.4)	(±3.7)	(±8.6)	(±0.0)

Depth values presented in this table are measured from free ground surface

Whangarei Laboratory
166 Bank Street,
Whangarei
M: 021 0263 7711
E: martin@geocivil.co.nz

TEST REPORT

Lab Job No: 8550-004

Your ref.: -

Date of Issue: 31/10/2022

Date of Re-Issue: -

Page: 1 of 3

Test Report No. WRE8550-004-R001

PROJECT: **Te Maika Road - Compaction testing - 21/10/2022**

CLIENT: Core Engineering Solutions
Level 1, 31 Vine Street

ATTENTION: Stuart Gemmell

TEST METHODS: Determination of the field dry density & water content using a nuclear densometer – Direct Transmission
NZS 4407:2015 Test 4.2
Hand Held Shear Vane Test
NZGS: August 2001
Determination of the Water Content of soils
NZS 4402:1986 Test 2.1
Determination of the Dry density / water content relationship – New Zealand Standard Compaction
NZS 4402: 1986 Test 4.1.1

SAMPLING METHOD: Hand sampled – Sampling not accredited

TEST RESULTS: As per attached sheets

M. Adams
General Manager

J. Agnew
Approved Signatory

ACCREDITED IANZ TESTING LABORATORY

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

Geocivil Laboratory
Northland - Wellington - Christchurch - Otago
P: 09 438 4417
E: info@geocivil.co.nz

NUCLEAR DENSOMETER READINGS

NZS 4407:2015 Test 4.2, 4.3

Lab Job No:	8550-004	**Tested By:**	L.C / D.O
Client:	Core Engineering Solutions	**Date:**	21/10/2022
Job:	51 Te Maika Road	**Checked By:**	M.A
Location:	Ngunguru	**Date:**	31/10/2022
REF:	-	**Page:**	2 of 3
Report No:	WRE8550-004-R001		

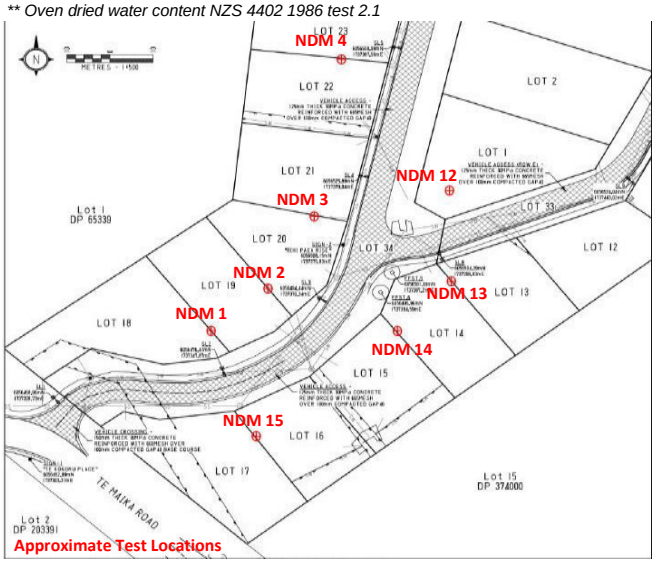
Material: Silty CLAY, traces of fine sands, reddish brown and yellowish brown.

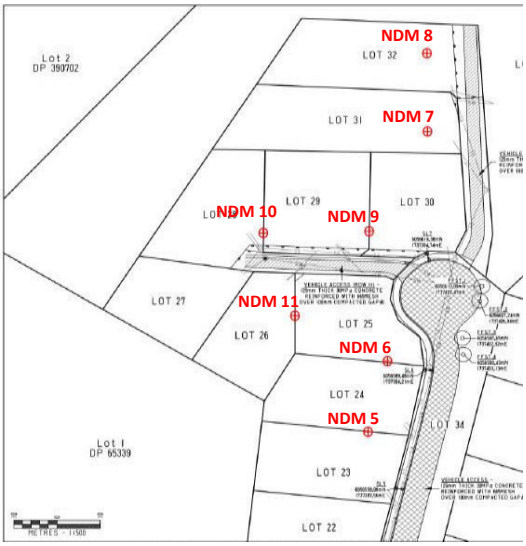
Solid Density (assumed): 2.72 t/m^3 **Max dry Density (assumed)*:** 1.33 t/m^3

Date	Site No	Depth Below GL (m)	Bulk Density t/m^3	Dry Density t/m^3	Water Content %**	% Air Voids	% Compaction	Probe Depth (mm)	Vane Shear Strength (corrected) kPa		Comments
21/10/2022	1	0.5	1.79	1.33	35.2	5	100	300	170/69	>243	-35.62583, 174.51667
21/10/2022		1.0	1.92	1.41	36.4	0	106	300	111/35	132/31	-35.62586, 174.51672
21/10/2022	2	0.5	1.84	1.39	32.3	4	105	250	153/49	>243	-35.62581, 174.51681
21/10/2022		1.0	1.70	1.24	37.1	9	93	300	222/55	225/73	-35.62578, 174.51681
21/10/2022	3	0.5	1.88	1.39	35.3	0	104	300	>243	>243	-35.62556, 174.51692
21/10/2022		1.0	1.89	1.44	31.1	2	108	300	>243	>243	-35.62556, 174.51692
21/10/2022	4	0.5	1.89	1.41	33.7	1	106	300	>243	>243	-35.62519, 174.51700
21/10/2022		1.0	1.74	1.27	37.5	6	95	300	>243	>243	-35.62517, 174.51703
21/10/2022	5	0.5	1.76	1.27	38.4	4	96	300	142/52	170/62	-35.62506, 174.51708
21/10/2022		1.0	1.67	1.18	41.0	8	89	300	135/49	125/38	-35.62506, 174.51708
21/10/2022	6	0.5	1.73	1.29	34.2	9	97	300	146/45	173/49	-35.62492, 174.51711
21/10/2022		1.0	1.76	1.32	33.0	8	99	300	118/31	128/52	-35.62489, 174.51714
21/10/2022	7	0.5	1.80	1.35	33.6	5	101	300	121/31	146/42	-35.62433, 174.51717
21/10/2022		1.0	1.84	1.34	38.0	0	100	300	125/59	125/45	-35.62436, 174.51717
21/10/2022	8	0.5	1.80	1.29	39.4	2	97	250	229/66	173/52	-35.62422, 174.51717
21/10/2022		1.0	1.74	1.32	31.8	9	99	300	90/21	83/17	-35.62422, 174.51717
21/10/2022	9	0.5	1.76	1.34	31.4	9	101	300	90/17	128/24	-35.62458, 174.51692
21/10/2022		1.0	1.77	1.36	30.1	9	102	300	101/21	101/24	-35.62458, 174.51692
21/10/2022	10	0.5	1.80	1.27	42.1	0	95	300	153/62	159/76	-35.62458, 174.51669
21/10/2022		1.0	1.76	1.29	36.4	5	97	300	173/66	211/69	-35.62458, 174.51669
21/10/2022	11	0.5	1.78	1.28	39.5	3	96	300	170/62	153/62	-35.62481, 174.51678
21/10/2022		1.0	1.78	1.23	44.6	0	92	300	142/52	139/55	-35.62481, 174.51675
21/10/2022	12	0.5	1.64	1.18	39.1	11	89	300	142/45	156/42	-35.6255, 174.51733
21/10/2022		1.0	1.78	1.26	41.0	2	95	300	146/52	135/38	-35.6255, 174.51736
21/10/2022	13	0.5	1.77	1.27	39.9	3	95	300	139/66	149/69	-35.62581, 174.51733
21/10/2022		1.0	1.86	1.36	36.6	0	102	300	>243	>243	-35.62583, 174.51733
21/10/2022	14	0.5	1.79	1.26	41.8	1	95	300	>243	>243	-35.62592, 174.51719
21/10/2022		1.0	1.76	1.25	40.6	3	94	300	>243	>243	-35.62592, 174.51719
21/10/2022	15	0.5	1.84	1.38	32.9	4	104	300	222/73	>243	-35.62617, 174.51678
21/10/2022		1.0	1.81	1.35	34.1	4	101	300	159/31	159/35	-35.62617, 174.51681

** Max dry density assumed on single point Standard Compaction test NZS 4402: 1986 Test 4.1.1*

*** Oven dried water content NZS 4402 1986 test 2.1*





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DETERMINATION OF DRY DENSITY/ WATER CONTENT RELATIONSHIP
NEW ZEALAND STANDARD COMPACTION

NZS 4402:1986 Test 4.1.1

Lab Job No:	8550-004	**Sample No.:**	WRE8550-004-S031
Client:	Core Engineering Solutions	**Tested By:**	D.O
Project:	Te Maika Road	**Date:**	23/10/2022
Location:	Ngunguru	**Checked By:**	M.A
		Date:	31/10/2022
Date Received:	21/10/2022	**Page:**	3 of 3
Report No:	WRE8550-004-R001		
REF:	-		
Sampling Method:	Hand sampled – Sampling not accredited	**Sampled By:**	D.O
Date Sampled:	21/10/2022		
Compaction used:	New Zealand Standard Compaction Test performed on: Whole sample		

History: As received

Sample Description: Blended material from NDM testpits; Silty CLAY, traces of fine sands, reddish brown. / Clayey SILT, minor fine-medium sands, yellowish brown.

Total mass of sample: 12,000 g

Mass retained on 19.0mm BS test sieve: 0 g

Bulk Density	**(t/m^3)**	**1.813**
Water Content	**(%)**	**36.3**
Dry Density	**(t/m^3)**	**1.33**
Solid Density (Assumed)	**(t/m^3)**	**2.72**
Air Voids	**(%)**	**3**
Shear Vane Reading	**(kPa)**	**143/67**

Comments: Sample tested at an assumed Optimum Water Content

J. Agnew
Approved Signatory

Whangarei Laboratory
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TEST REPORT

Lab Job No: 8690-001

Your ref.: -

Date of Issue: 4/10/2022

Date of Re-Issue: -

Page: 1 of 9

Test Report No. WRE8690-001-R003

PROJECT: **Te Maika Road - Laboratory Testing**

CLIENT: Core Engineering Solutions
Level 1, 31 Vine Street

ATTENTION: Stuart Gemmell

TEST METHODS: Determination of the liquid & plastic limits, plasticity index and water content
NZS 4402:1986 Tests 2.1,2.2,2.3,2.4
Determination of the Linear Shrinkage
NZS 4402:1986 Test 2.6

SAMPLING METHOD: Sampled by client – Sampling not accredited

TEST RESULTS: As per attached sheets

N. Krissansen
Laboratory Technician

S. Kokich
Approved Signatory

ACCREDITED IANZ TESTING LABORATORY

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

Geocivil Laboratory
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DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402:1986 Test 2.2,2.3,2.4

Lab Job No:	8690-001	**Sample No.:**	WRE8690-001-S009
Client:	Core Engineering Solutions	**Tested By:**	A.A
Location:	Te Maika Road Lot 1, Stage 1	**Date Tested:**	28/09/2022
		Checked By:	N.K
Date Received:	6/09/2022	**Date Checked:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	2 of 9
REF:	-		
Sampling Method:	Sampled by client – Sampling not accredited	**Sampled By:**	Client
Date Sampled:	Unknown		

Test Details:

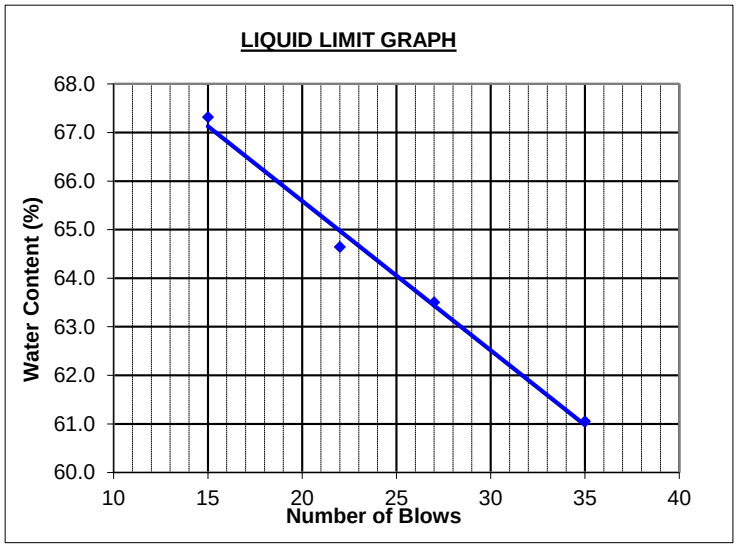
Test performed on: Fraction passing 425μm sieve

Sample history: As received

Description of Sample: Clayey SILT, traces of rootlets, light red brown mottled black and light brown, moist

	Liquid Limit				Plastic Limit	
No. of blows	15	22	27	35		
Water content (%)	67.3	64.6	63.5	61.1	37.4	37.4

NWC	**34.4**
Liquid Limit	**64**
Plastic Limit	**37**
Plasticity Index	**27**



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DETERMINATION OF THE LINEAR SHRINKAGE

NZS 4402:1986 Test 2.6

Lab Job No:	8690-001	**Sample No:**	WRE8690-001-S009
Client:	Core Engineering Solutions	**Tested By:**	A.A
Location:	Te Maika Road Lot 1, Stage 1	**Date:**	28/09/2022
		Checked By:	N.K
Date Received:	6/09/2022	**Date:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	3 of 9
REF:	-		

Test performed on: Fraction passing 425mm sieve
History: As received

Description of Sample: Clayey SILT, traces of rootlets, light red brown mottled black and light brown, moist

Linear shrinkage	**12**

S. Kokich
Approved Signatory

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DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402:1986 Test 2.2,2.3,2.4

Lab Job No:	8690-001	**Sample No.:**	WRE8690-001-S010
Client:	Core Engineering Solutions	**Tested By:**	A.A
Location:	Te Maika Road Lot 12, Stage 1	**Date Tested:**	28/09/2022
		Checked By:	N.K
Date Received:	6/09/2022	**Date Checked:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	4 of 9
REF:	-		
Sampling Method:	Sampled by client – Sampling not accredited	**Sampled By:**	Client
Date Sampled:	Unknown		

Test Details:

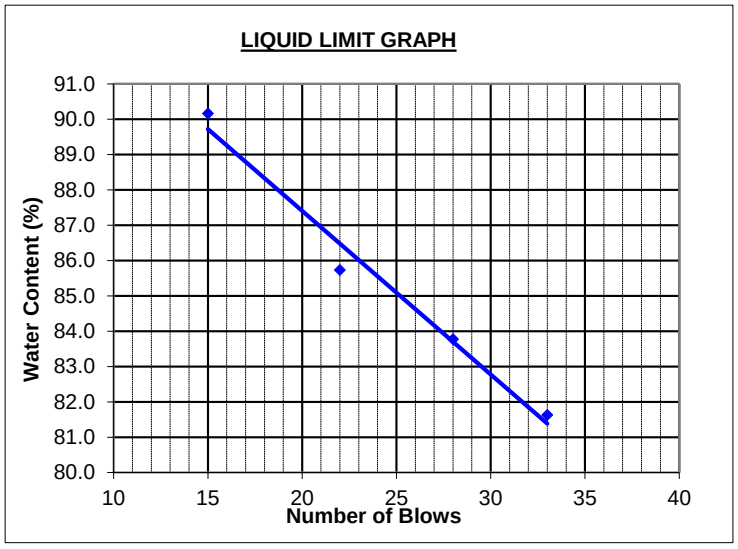
Test performed on: Fraction passing 425μm sieve

Sample history: As received

Description of Sample: Silty CLAY, minor fine sands, traces of rootlets, orange brown mottled red and dark brown, moist

	Liquid Limit				Plastic Limit	
No. of blows	15	22	28	33		
Water content (%)	90.2	85.7	83.8	81.6	39.8	39.7

NWC	**43.5**
Liquid Limit	**85**
Plastic Limit	**40**
Plasticity Index	**45**



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DETERMINATION OF THE LINEAR SHRINKAGE

NZS 4402:1986 Test 2.6

Lab Job No:	8690-001	**Sample No:**	WRE8690-001-S010
Client:	Core Engineering Solutions	**Tested By:**	A.A
Location:	Te Maika Road Lot 12, Stage 1	**Date:** **Checked By:**	28/09/2022 N.K
Date Received:	6/09/2022	**Date:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	5 of 9
REF:	-		

Test performed on: Fraction passing 425mm sieve
History: As received

Description of Sample: Silty CLAY, minor fine sands, traces of rootlets, orange brown mottled red and dark brown, moist

Linear shrinkage	**17**

S. Kokich
Approved Signatory

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DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402:1986 Test 2.2,2.3,2.4

Lab Job No:	8690-001	**Sample No.:**	WRE8690-001-S011
Client:	Core Engineering Solutions	**Tested By:**	A.A
Location:	Te Maika Road Lot 15, Stage 1	**Date Tested:**	29/09/2022
		Checked By:	N.K
Date Received:	6/09/2022	**Date Checked:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	6 of 9
REF:	-		
Sampling Method:	Sampled by client – Sampling not accredited	**Sampled By:**	Client
Date Sampled:	Unknown		

Test Details:

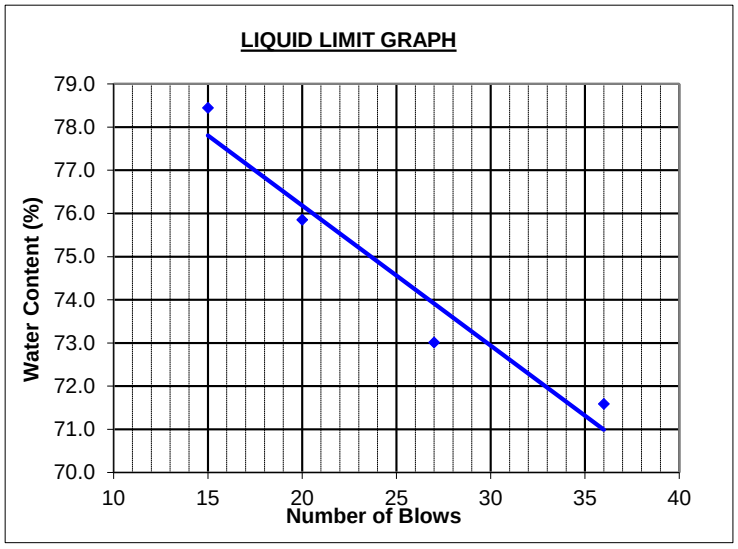
Test performed on: Fraction passing 425μm sieve

Sample history: As received

Description of Sample: Silty CLAY, traces of fine sands and rootlets, reddy brown mottled dark brown pink, moist

	Liquid Limit				Plastic Limit	
No. of blows	15	20	27	36		
Water content (%)	78.4	75.9	73.0	71.6	39.9	39.8

NWC	**40.6**
Liquid Limit	**75**
Plastic Limit	**40**
Plasticity Index	**35**



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DETERMINATION OF THE LINEAR SHRINKAGE

NZS 4402:1986 Test 2.6

Lab Job No:	8690-001	**Sample No:**	WRE8690-001-S011
Client:	Core Engineering Solutions	**Tested By:**	A..A
Location:	Te Maika Road Lot 15, Stage 1	**Date:**	29/09/2022
		Checked By:	N.K
Date Received:	6/09/2022	**Date:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	7 of 9
REF:	-		

Test performed on: Fraction passing 425mm sieve
History: As received

Description of Sample: Silty CLAY, traces of fine sands and rootlets, reddy brown mottled dark brown pink, moist

Linear shrinkage	**16**

S. Kokich
Approved Signatory

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DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402:1986 Test 2.2,2.3,2.4

Lab Job No:	8690-001	**Sample No.:**	WRE8690-001-S012
Client:	Core Engineering Solutions	**Tested By:**	A.A
Location:	Te Maika Road Lot 20, Stage 1	**Date Tested:**	29/09/2022
		Checked By:	N.K
Date Received:	6/09/2022	**Date Checked:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	8 of 9
REF:	-		
Sampling Method:	Sampled by client – Sampling not accredited	**Sampled By:**	Client
Date Sampled:	Unknown		

Test Details:

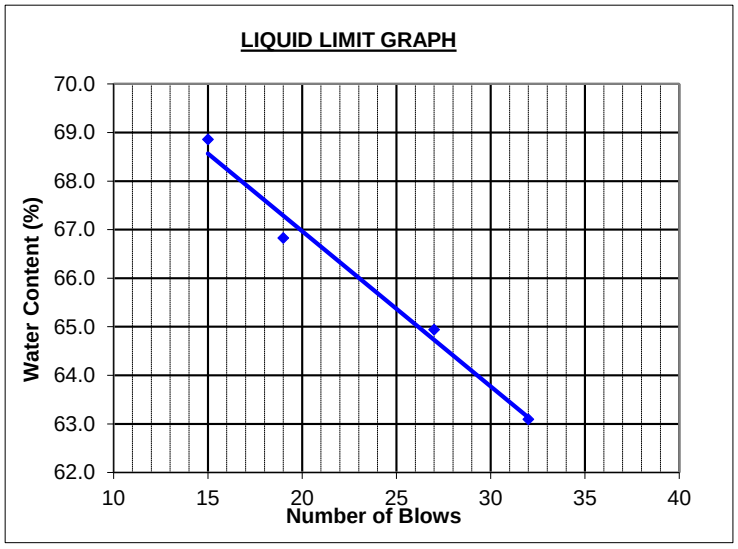
Test performed on: Fraction passing 425μm sieve

Sample history: As received

Description of Sample: Silty CLAY, some sand and gravels to 60mm, traces of rootlets, yellow brown mottled red dark brown and grey, moist

	Liquid Limit				Plastic Limit	
No. of blows	15	19	27	32		
Water content (%)	68.9	66.8	64.9	63.1	31.0	31.0

NWC	**29.5**
Liquid Limit	**65**
Plastic Limit	**31**
Plasticity Index	**34**



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DETERMINATION OF THE LINEAR SHRINKAGE

NZS 4402:1986 Test 2.6

Lab Job No:	8690-001	**Sample No:**	WRE8690-001-S012
Client:	Core Engineering Solutions	**Tested By:**	A.A
Location:	Te Maika Road Lot 20, Stage 1	**Date:**	29/09/2022
		Checked By:	N.K
Date Received:	6/09/2022	**Date:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	9 of 9
REF:	-		

Test performed on: Fraction passing 425mm sieve
History: As received

Description of Sample: Silty CLAY, some sand and gravels to 60mm, traces of rootlets, yellow brown mottled red dark brown and grey, moist

Linear shrinkage	**15**

S. Kokich
Approved Signatory

Whangarei Laboratory
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E: martin@geocivil.co.nz

TEST REPORT

Lab Job No: 8690-001

Your ref.: -

Date of Issue: 4/10/2022

Date of Re-Issue: -

Page: 1 of 9

Test Report No. WRE8690-001-R003

PROJECT: **Te Maika Road - Laboratory Testing**

CLIENT: Core Engineering Solutions
Level 1, 31 Vine Street

ATTENTION: Stuart Gemmell

TEST METHODS: Determination of the liquid & plastic limits, plasticity index and water content
NZS 4402:1986 Tests 2.1,2.2,2.3,2.4
Determination of the Linear Shrinkage
NZS 4402:1986 Test 2.6

SAMPLING METHOD: Sampled by client – Sampling not accredited

TEST RESULTS: As per attached sheets

N. Krissansen
Laboratory Technician

S. Kokich
Approved Signatory

ACCREDITED IANZ TESTING LABORATORY

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

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DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402:1986 Test 2.2,2.3,2.4

Lab Job No:	8690-001	**Sample No.:**	WRE8690-001-S009
Client:	Core Engineering Solutions	**Tested By:**	A.A
Location:	Te Maika Road Lot 1, Stage 1	**Date Tested:**	28/09/2022
		Checked By:	N.K
Date Received:	6/09/2022	**Date Checked:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	2 of 9
REF:	-		
Sampling Method:	Sampled by client – Sampling not accredited	**Sampled By:**	Client
Date Sampled:	Unknown		

Test Details:

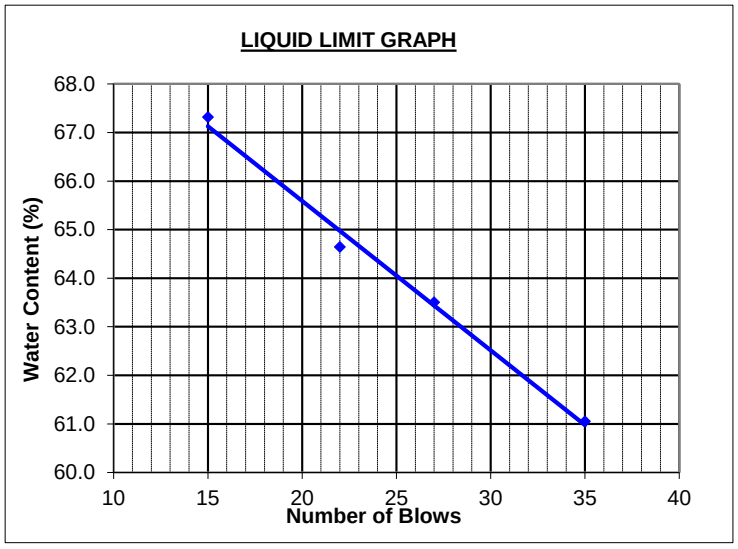
Test performed on: Fraction passing 425μm sieve

Sample history: As received

Description of Sample: Clayey SILT, traces of rootlets, light red brown mottled black and light brown, moist

	Liquid Limit				Plastic Limit	
No. of blows	15	22	27	35		
Water content (%)	67.3	64.6	63.5	61.1	37.4	37.4

NWC	**34.4**
Liquid Limit	**64**
Plastic Limit	**37**
Plasticity Index	**27**



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DETERMINATION OF THE LINEAR SHRINKAGE

NZS 4402:1986 Test 2.6

Lab Job No:	8690-001	**Sample No:**	WRE8690-001-S009
Client:	Core Engineering Solutions	**Tested By:**	A.A
Location:	Te Maika Road Lot 1, Stage 1	**Date:**	28/09/2022
		Checked By:	N.K
Date Received:	6/09/2022	**Date:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	3 of 9
REF:	-		

Test performed on: Fraction passing 425mm sieve
History: As received

Description of Sample: Clayey SILT, traces of rootlets, light red brown mottled black and light brown, moist

Linear shrinkage	**12**

S. Kokich
Approved Signatory

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DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402:1986 Test 2.2,2.3,2.4

Lab Job No:	8690-001	**Sample No.:**	WRE8690-001-S010
Client:	Core Engineering Solutions	**Tested By:**	A.A
Location:	Te Maika Road Lot 12, Stage 1	**Date Tested:**	28/09/2022
		Checked By:	N.K
Date Received:	6/09/2022	**Date Checked:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	4 of 9
REF:	-		
Sampling Method:	Sampled by client – Sampling not accredited	**Sampled By:**	Client
Date Sampled:	Unknown		

Test Details:

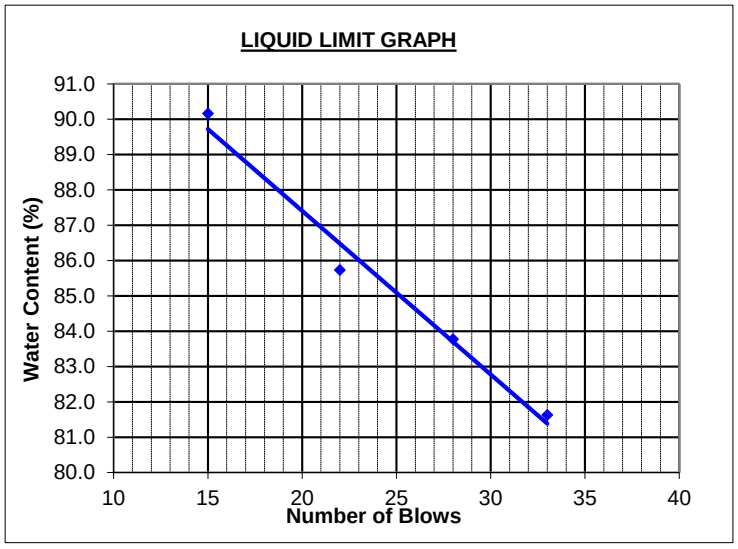
Test performed on: Fraction passing 425μm sieve

Sample history: As received

Description of Sample: Silty CLAY, minor fine sands, traces of rootlets, orange brown mottled red and dark brown, moist

	Liquid Limit				Plastic Limit	
No. of blows	15	22	28	33		
Water content (%)	90.2	85.7	83.8	81.6	39.8	39.7

NWC	**43.5**
Liquid Limit	**85**
Plastic Limit	**40**
Plasticity Index	**45**



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DETERMINATION OF THE LINEAR SHRINKAGE

NZS 4402:1986 Test 2.6

Lab Job No:	8690-001	**Sample No:**	WRE8690-001-S010
Client:	Core Engineering Solutions	**Tested By:**	A.A
Location:	Te Maika Road Lot 12, Stage 1	**Date:** **Checked By:**	28/09/2022 N.K
Date Received:	6/09/2022	**Date:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	5 of 9
REF:	-		

Test performed on: Fraction passing 425mm sieve
History: As received

Description of Sample: Silty CLAY, minor fine sands, traces of rootlets, orange brown mottled red and dark brown, moist

Linear shrinkage	**17**

S. Kokich
Approved Signatory

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DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402:1986 Test 2.2,2.3,2.4

Lab Job No:	8690-001	**Sample No.:**	WRE8690-001-S011
Client:	Core Engineering Solutions	**Tested By:**	A.A
Location:	Te Maika Road Lot 15, Stage 1	**Date Tested:**	29/09/2022
		Checked By:	N.K
Date Received:	6/09/2022	**Date Checked:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	6 of 9
REF:	-		
Sampling Method:	Sampled by client – Sampling not accredited	**Sampled By:**	Client
Date Sampled:	Unknown		

Test Details:

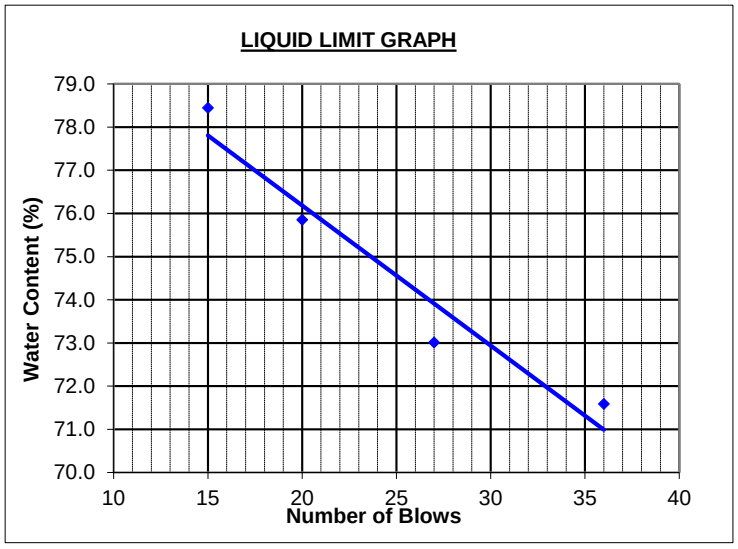
Test performed on: Fraction passing 425μm sieve

Sample history: As received

Description of Sample: Silty CLAY, traces of fine sands and rootlets, reddy brown mottled dark brown pink, moist

	Liquid Limit				Plastic Limit	
No. of blows	15	20	27	36		
Water content (%)	78.4	75.9	73.0	71.6	39.9	39.8

NWC	**40.6**
Liquid Limit	**75**
Plastic Limit	**40**
Plasticity Index	**35**



S. Kokich
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DETERMINATION OF THE LINEAR SHRINKAGE

NZS 4402:1986 Test 2.6

Lab Job No:	8690-001	**Sample No:**	WRE8690-001-S011
Client:	Core Engineering Solutions	**Tested By:**	A..A
Location:	Te Maika Road Lot 15, Stage 1	**Date:**	29/09/2022
		Checked By:	N.K
Date Received:	6/09/2022	**Date:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	7 of 9
REF:	-		

Test performed on: Fraction passing 425mm sieve
History: As received

Description of Sample: Silty CLAY, traces of fine sands and rootlets, reddy brown mottled dark brown pink, moist

Linear shrinkage	**16**

S. Kokich
Approved Signatory

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DETERMINATION OF THE LIQUID & PLASTIC LIMITS, PLASTICITY INDEX & WATER CONTENT

NZS 4402:1986 Test 2.2,2.3,2.4

Lab Job No:	8690-001	**Sample No.:**	WRE8690-001-S012
Client:	Core Engineering Solutions	**Tested By:**	A.A
Location:	Te Maika Road Lot 20, Stage 1	**Date Tested:**	29/09/2022
		Checked By:	N.K
Date Received:	6/09/2022	**Date Checked:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	8 of 9
REF:	-		
Sampling Method:	Sampled by client – Sampling not accredited	**Sampled By:**	Client
Date Sampled:	Unknown		

Test Details:

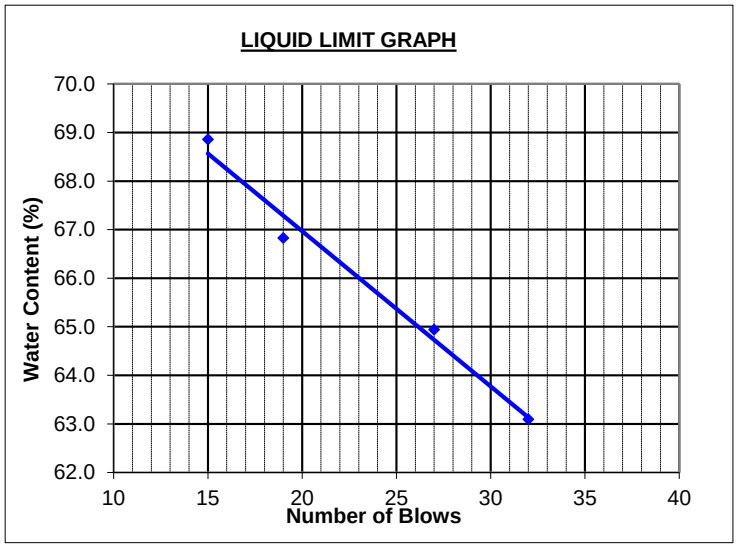
Test performed on: Fraction passing 425μm sieve

Sample history: As received

Description of Sample: Silty CLAY, some sand and gravels to 60mm, traces of rootlets, yellow brown mottled red dark brown and grey, moist

	Liquid Limit				Plastic Limit	
No. of blows	15	19	27	32		
Water content (%)	68.9	66.8	64.9	63.1	31.0	31.0

NWC	**29.5**
Liquid Limit	**65**
Plastic Limit	**31**
Plasticity Index	**34**



S. Kokich
Approved Signatory

Geocivil Laboratory
Northland - Wellington - Christchurch - Otago
P: 09 438 4417
E: info@geocivil.co.nz

DETERMINATION OF THE LINEAR SHRINKAGE

NZS 4402:1986 Test 2.6

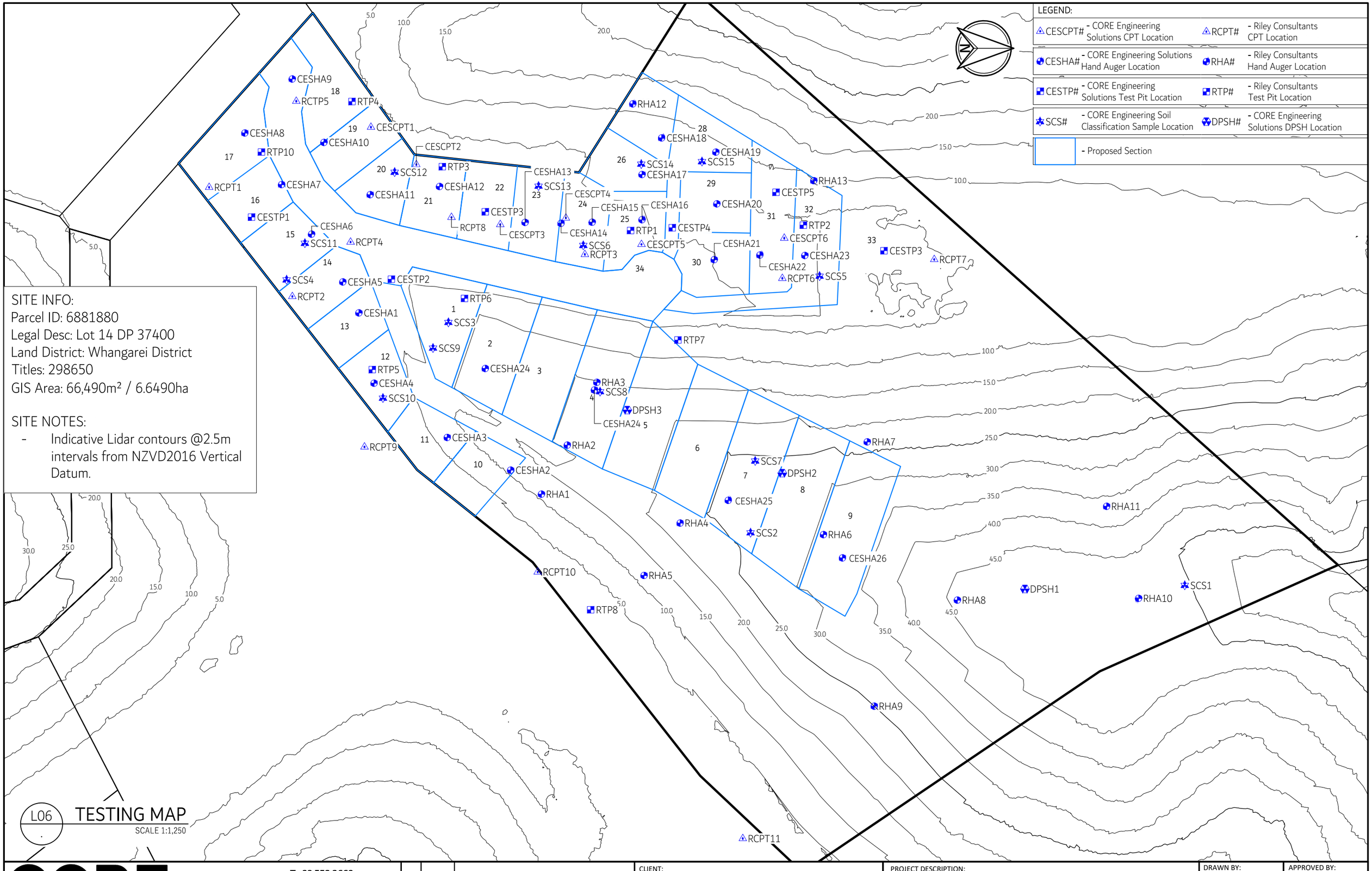
Lab Job No:	8690-001	**Sample No:**	WRE8690-001-S012
Client:	Core Engineering Solutions	**Tested By:**	A.A
Location:	Te Maika Road Lot 20, Stage 1	**Date:**	29/09/2022
		Checked By:	N.K
Date Received:	6/09/2022	**Date:**	4/10/2022
Report No:	WRE8690-001-R003	**Page:**	9 of 9
REF:	-		

Test performed on: Fraction passing 425mm sieve
History: As received

Description of Sample: Silty CLAY, some sand and gravels to 60mm, traces of rootlets, yellow brown mottled red dark brown and grey, moist

Linear shrinkage	**15**

S. Kokich
Approved Signatory



SITE INFO:
Parcel ID: 6881880
Legal Desc: Lot 14 DP 37400
Land District: Whangarei District
Titles: 298650
GIS Area: 66,490m² / 6.6490ha

SITE NOTES:
- Indicative Lidar contours @2.5m intervals from NZVD2016 Vertical Datum.

L06 TESTING MAP
SCALE 1:1,250

CORE ENGINEERING SOLUTIONS
Consulting Engineers
Structural | Geotechnical | Civil
T: 09 553 3660
jobs@coreeng.nz
Level 1, 31 Vine Street,
Whangarei 0110

Rev	Date	Notes
A	16/08/22	Original Issue

CLIENT: Traverse Ltd
LOCATION: 51 Te Maika Road, Ngunguru
PROJECT DESCRIPTION: PROPOSED SUBDIVISION
SHEET TITLE: TESTING MAP
DRAWN BY: LJM
APPROVED BY: DL
ORIGINAL: A3
SCALE: 1:1,250
FILE: 20-0078
SHEET: L06

CORE
ENGINEERING SOLUTIONS

SITE PLAN

JOB NO.: 20-0078

CLIENT:	TRAVERSE LTD
PROJECT:	TE MAIKA RD, NGUNGURU - SUBDIVISION
LOCATION:	TE MAIKA RD, NGUNGURU

CORE ENGINEERING SOLUTIONS

INVESTIGATION LOG

HOLE NO.: CESHA24

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737430mE, 6056546mN

START DATE: 09/08/2022

END DATE: 09/08/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 100mm)	VANE SHEAR STRENGTH (kPa) Vane: V03	Values	WATER
TOPSOIL; greyish. Wet; high plasticity.		0.0	TS				
Silty CLAY; orange with white flecks and black (topsoil). Moist; high plasticity.		0.2				126 35	
		0.4				123 39	
		0.6				118 32	
EOH: 2.70m		0.8					
		1.0		1			
		1.2		1			
		1.4		2			
		1.6		2			
		1.8		2			
		2.0		4			
		2.2		3			
		2.4		3			
		2.6		4			
		2.8		4			
		3.0		4			
		3.2		4			
		3.4		5			
		3.6		6			
		3.8		6			
				7			

Groundwater Not Encountered

PHOTO(S)

REMARKS

BH lot 1

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

CORE ENGINEERING SOLUTIONS

INVESTIGATION LOG

HOLE NO.: CESHA2

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737469mE, 6056556mN

START DATE: 09/08/2022

END DATE: 09/08/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: V03	Values	WATER
Clayey TOPSOIL; greyish brown and orange mix. Moist; high plasticity.		0.2				126 55	Groundwater Not Encountered
Silty CLAY; orange and tan brown. Moist; high plasticity; 0.6m black flecks.		0.4 0.6 0.8 1.0 1.2 1.4				197 50 205 63 213 87	
Silty CLAY; dark peach orange brown with black flecks. Moist; high plasticity.		1.6 1.8				166 50 158 47	
EOH: 2.00m		2.0					

Scala Penetrometer: 2 4 6 8 10 12 14 16 18

Vane Shear Strength (kPa): 50 100 150 200

PHOTO(S)

REMARKS

BH lot 10

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

CORE ENGINEERING SOLUTIONS

INVESTIGATION LOG

HOLE NO.: CESHA3

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737456mE, 6056532mN

START DATE: 09/08/2022

END DATE: 09/08/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: V03	Values	WATER
Clayey TOPSOIL; grey orange and brown mix. Moist; high plasticity.		0.0	TS	2 4 6 8 10 12 14 16 18	50 100 150 200		
Silty CLAY; orange and tan brown. Moist; high plasticity; 0.5m more orange in colour.		0.2				221+	
		0.4				-	
		0.6				221+	
		0.8				-	
		1.0				221+	
		1.2				-	
		1.4				189	
		1.6				103	
		1.8				142	
		2.0				50	
EOH: 2.00m						150	
						55	

Groundwater Not Encountered

PHOTO(S)

REMARKS

BH lot 11

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

INVESTIGATION LOG

CORE ENGINEERING SOLUTIONS

HOLE NO.: CESHA4

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737436mE, 6056505mN

START DATE: 09/08/2022

END DATE: 09/08/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: V03	Values	WATER
TOPSOIL; light greyish brown. Moist; high plasticity.		0	TS	2 4 6 8 10 12 14 16 18	50 100 150 200		Groundwater Not Encountered
Silty CLAY; orange and tan brown. Moist; high plasticity; 1m white flecks 1.9m unable to penetrate.		0.2				166	
						63	
		0.4					
		0.6				221+	
						-	
		0.8				221+	
						-	
		1.0					
		1.2				158	
						82	
		1.4				126	
						60	
		1.6					
		1.8				221+	
EOH: 1.90m						-	

PHOTO(S)

REMARKS

BH lot 12

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

CORE ENGINEERING SOLUTIONS

INVESTIGATION LOG

HOLE NO.: CESHA1

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737410mE, 6056499mN

START DATE: 22/07/2022

END DATE: 22/07/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: V03	Values	WATER
Clayey TOPSOIL; light brown. Moist; high plasticity; Organic matter present.		0	TS	2 4 6 8 10 12 14 16 18	50 100 150 200		
CLAY, with some silt; light tan brown. Moist; high plasticity.							
CLAY, with some silt; orange with white and black flecks. Moist; high plasticity; lightens with depth.		0.2				221+	
		0.4				-	
		0.6				174	
						76	
		0.8				145	
		1.0				60	Groundwater Not Encountered
Silty CLAY; dark orange red with white flecks. Moist; high plasticity.		1.2				221+	
						-	
		1.4				189	
Silty CLAY; red with white flecks. Moist; high plasticity.						95	
		1.6					
		1.8				197	
						95	
EOH: 2.00m		2.0				166	
						79	
		2.2					
		2.4					

PHOTO(S)

REMARKS

BH lot 13

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

CORE ENGINEERING SOLUTIONS

INVESTIGATION LOG

HOLE NO.: CESHA5

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737398mE, 6056493mN

START DATE: 22/07/2022

END DATE: 22/07/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: V03	Values	WATER
TOPSOIL; dark greyish. Moist; high plasticity; organic matter present.		0.0	TS	2 4 6 8 10 12 14 16 18	50 100 150 200		
CLAY; reddish orange with white and black flecks. Moist; high plasticity.		0.2				166 50	
		0.4				221+ -	
		0.6				221+ -	
		0.8				221+ -	
		1.0					
		1.2					
Silty CLAY; tan brown. Moist; high plasticity.		1.4				213 104	
CLAY; red/ orange with black and white flecks. Moist; high plasticity.		1.6				142 60	
		1.8				123 44	
EOH: 2.00m		2.0					
		2.2					
		2.4					

Groundwater Not Encountered

PHOTO(S)

REMARKS

BH lot 14

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

CORE ENGINEERING SOLUTIONS

INVESTIGATION LOG

HOLE NO.: CESHA6

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737380mE, 6056481mN

START DATE: 22/07/2022

END DATE: 22/07/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: V03	Values	WATER
TOPSOIL; dark brown. Moist; high plasticity.		0.0	TS				
Silty CLAY; red orange with black and white flecks. Moist; high plasticity.		0.2				221+	
		0.4				-	
		0.6				221+	
		0.8				-	
		1.0				166	
CLAY; tan orange with white flecks. Moist; high plasticity.		1.2				55	
		1.4				221+	
		1.6				-	
		1.8				161	
Silty CLAY; reddish orange. Moist; high plasticity.		2.0				71	
EOH: 2.00m		2.2				174	
		2.4				55	
						177	
						76	

Groundwater Not Encountered

PHOTO(S)

REMARKS

BH lot 15

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

CORE ENGINEERING SOLUTIONS

INVESTIGATION LOG

HOLE NO.: CESHA7

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737362mE, 6056470mN

START DATE: 22/07/2022

END DATE: 22/07/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: V03	Values	WATER
TOPSOIL; dark greyish brown. Moist; high plasticity.		0.0	TS	2 4 6 8 10 12 14 16 18	50 100 150 200		
Silty CLAY; orange with white flecks. Moist; high plasticity; lighter with depth.		0.2				55	
		0.4				28	
		0.6				197	
		0.8				87	
		1.0				134	
		1.2				35	
		1.4				221+	
		1.6				-	
		1.8				150	
		2.0				60	
EOH: 2.00m		2.2				202	
		2.4				76	
						221+	
						-	

Groundwater Not Encountered

PHOTO(S)

REMARKS

BH lot 16

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

CORE ENGINEERING SOLUTIONS

INVESTIGATION LOG

HOLE NO.: CESHA8

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737342mE, 6056456mN

START DATE: 22/07/2022

END DATE: 22/07/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: V03	Values	WATER
TOPSOIL; dark brown. Moist; high plasticity.		0.0	TS	2 4 6 8 10 12 14 16 18	50 100 150 200	158 69	Groundwater Not Encountered
Silty CLAY; orange and tan brown. Moist; high plasticity.		0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6				145 38 155 35 186 98 118 63	
Silty CLAY; dark grey brown with tan brown. Moist; high plasticity.		1.8				158 63	
EOH: 2.00m		2.0 2.2 2.4				142 32	

PHOTO(S)

REMARKS

BH lot 17

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

INVESTIGATION LOG

CORE ENGINEERING SOLUTIONS

HOLE NO.: CESHA9

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737322mE, 6056474mN

START DATE: 10/08/2022

END DATE: 10/08/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm) 2 4 6 8 10 12 14 16 18	VANE SHEAR STRENGTH (kPa) Vane: 19 50 100 150 200	Values	WATER
TOPSOIL; grey brown. Moist; high plasticity.		0.0	TS				
Silty CLAY; orange tan brown. Moist; high plasticity; 0.5m fawn brown with grey flecks.		0.2				185+	
		0.4				-	
		0.6				185+	Groundwater Not Encountered
		0.8				-	
Silty CLAY, with some gravel; grey and orange/tan brown. Moist; high plasticity; 0.9 unable to penetrate. EOH: 0.90m						UTP -	

PHOTO(S)

REMARKS

BH lot 18

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

CORE ENGINEERING SOLUTIONS

INVESTIGATION LOG

HOLE NO.: CESHA10

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737346mE, 6056486mN

START DATE: 10/08/2022

END DATE: 10/08/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: 19	WATER
TOPSOIL; greyish brown. Moist; high plasticity.		0.2			185+	Groundwater Not Encountered
Silty CLAY; light reddish brown with white flex. Moist; high plasticity; 1.6m Wet.		0.4 0.6 0.8 1.0 1.2 1.4 1.6			185+ 135 85 135 127	
Silty CLAY; fawn and grey. Wet; high plasticity.		1.8 2.0			19 114	
EOH: 2.10m					45	

PHOTO(S)

REMARKS

BH lot 19

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

CORE ENGINEERING SOLUTIONS

INVESTIGATION LOG

HOLE NO.: CESHA11

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737365mE, 6056503mN

START DATE: 10/08/2022

END DATE: 10/08/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm) 2 4 6 8 10 12 14 16 18	VANE SHEAR STRENGTH (kPa) Vane: 19 50 100 150 200	Values	WATER
GRAVEL; dark grey. Moist.		0.0					Groundwater Not Encountered
Silty CLAY; reddish/ orange brown. Moist; high plasticity; 0.6m unable to penetrate.		0.2				185+	
EOH: 0.60m		0.4				185+	
		0.6				-	
		0.8					
		1.0					
		1.2					
		1.4					
		1.6					
		1.8					

PHOTO(S)

REMARKS

BH Lot 20
This site has been used to store piles of metal used during earthworks and had to scrap back gravel.
BH lot 20

WATER

- ▼ Standing Water Level
- ▷ Out flow
- ◁ In flow

INVESTIGATION TYPE

- ☑ Hand Auger
- ☐ Test Pit

CORE ENGINEERING SOLUTIONS

INVESTIGATION LOG

HOLE NO.: H RCPT2 (Piezo

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737401mE, 6056478mN

START DATE: 27/09/2022

END DATE: 27/09/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Clayey TOPSOIL; brown. Moist; high plasticity.		0.0	TS	2 4 6 8 10 12 14 16 18	50 100 150 200 Values	
Silty CLAY; orange tan brown. Dry; high plasticity.		0.2 – 2.6				
Silty CLAY; greyish. Moist; high plasticity.		2.8 – 3.2				
Peat (plastic) SAND; black. Wet; high plasticity.		3.4 – 3.8				
Silty SAND; dark grey. Wet; low plasticity; 4.1m saturated. EOH: 4.10m		4.0 – 4.8				◁

PHOTO(S)

REMARKS

Peizo Lot 14

Post Earthworks Peizo testing to establish depth to ground water - 27/09/2022

WATER

- ▼ Standing Water Level
- ▷ Out flow
- ◁ In flow

INVESTIGATION TYPE

- ☑ Hand Auger
- ☐ Test Pit

CORE ENGINEERING SOLUTIONS

INVESTIGATION LOG

HOLE NO.: H RCPT8 (Piezo

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737378mE, 6056539mN

START DATE: 27/09/2022

END DATE: 27/09/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa)	WATER
Clayey TOPSOIL, with some silt and gravel; brown. Moist; high plasticity.		0.0	TS	2 4 6 8 10 12 14 16 18	Vane: 50 100 150 200 Values	
Silty CLAY; orange tan brown. Moist; high plasticity; 2.2m Wet 2.3m Geogrid .		0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8, 2.0, 2.2				
Silty CLAY; grey. Wet; high plasticity; 2.5m Saturated. EOH: 2.50m		2.4, 2.6, 2.8				◁

PHOTO(S)

REMARKS

Peizo Lot 21

Post Earthworks Peizo testing to establish depth to ground water - 27/09/2022

WATER

- ▼ Standing Water Level
- ▷ Out flow
- ◁ In flow

INVESTIGATION TYPE

- ☑ Hand Auger
- ☐ Test Pit

CORE ENGINEERING SOLUTIONS

INVESTIGATION LOG

HOLE NO.: CESHA12

CLIENT: TRAVERSE LTD

PROJECT: TE MAIKA RD, NGUNGURU - SUBDIVISION

JOB NO.: 20-0078

SITE LOCATION: TE MAIKA RD, NGUNGURU

CO-ORDINATES: 1737369mE, 6056529mN

START DATE: 10/08/2022

END DATE: 10/08/2022

LOGGED BY: RL

MATERIAL DESCRIPTION (See Classification & Symbology sheet for details)	SAMPLES	DEPTH (m)	LEGEND	SCALA PENETROMETER (Blows / 0mm)	VANE SHEAR STRENGTH (kPa) Vane: 19	WATER
TOPSOIL; greyish brown. Moist; high plasticity.		0.0	TS	2 4 6 8 10 12 14 16 18	50 100 150 200 Values	Groundwater Not Encountered
Silty CLAY; orange and tan brown. Moist; high plasticity.		0.2			185+	
		0.4			-	
		0.6			185+	
		0.8			-	
		1.0			185+	
Silty CLAY; tan brown with black flecks. Moist; high plasticity; 1.9m Reddish brown.		1.2			-	
		1.4			185+	
		1.6			-	
		1.8			139	
		2.0			40	
EOH: 2.10m					185+	
					-	
					185+	
					-	

PHOTO(S)

REMARKS

BH lot 21

WATER

- Standing Water Level
- Out flow
- In flow

INVESTIGATION TYPE

- [x] Hand Auger
- [ ] Test Pit

APPENDIX 6 – GEOTECHNICAL PRODUCER STATEMENT PS4 FOR RETAINING WALLS

APPENDIX 7 – SLOPE STABILITY ANALYSIS RESULTS

A stability assessment was undertaken to ensure the long-term slope stability of the site as required under Section 2.2.3.3 of the WDC EES and in accordance with the WDC Land Development Stabilisation – Technical Design Requirements (WDC LDS). As outlined in WDC LDS, a minimum factor of safety for land stabilisation design is required for the following design conditions;

- Normal Long Term Groundwater Conditions = 1.5 FOS
- Extreme Groundwater Conditions = 1.3 FOS
- Seismic Conditions in 500 year Return Period Event = 1.1 FOS

CES Ltd adopted extremely conservative groundwater levels for "SLIDE" Slope Stability parameters. Steeper slopes are marked on the WDC GIS Hazards Maps as being at a high risk for instability. For this reason, CES Ltd adopted a worst-case scenario.

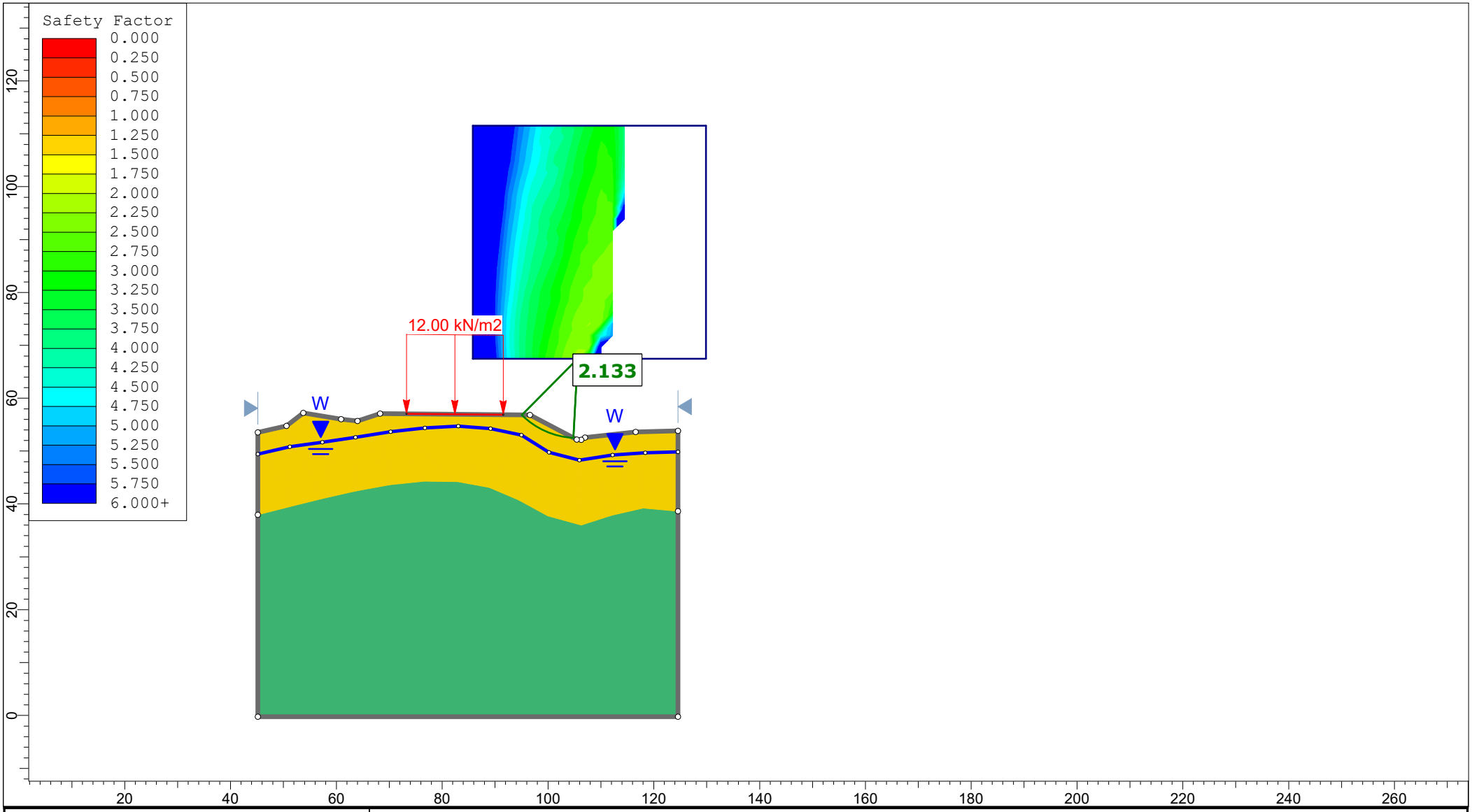
The Morgenstern-Price method has been adopted for the calculation of the factor of safety.

From the above information and assessment of the geomorphology, a section through the site has been developed using the above design conditions as scenarios using limited equilibrium software "Slide" version 6 by Rocscience. The underlying geomorphology is completely to highly weathered greywacke which gradually becomes weathered at depth. To determine the transition of the weathered material, DPSH testing was conducted at the top end of the flanks. Allowance for residential housing and roading surcharges are to be applied as part of the assessment of post-development conditions. Back-analysis of the site has been undertaken at the pre-development stage using both site observations and previous assessments within similar Waipapa Group ground conditions to validate the soil parameters used for the stability assessment. From this and the back-analysis, the following soil parameters were adopted for the stability assessment;

Soil Unit	Soil Unit Density Weight (kN/m^3)	Angle of Internal Friction (ϕ')	Cohesion (kPa)
Completely Weathered GW	18	32	5
Highly Weathered GW	18	34	10

From our stability assessment, multiple sections through the site were analysed using the above parameters and design conditions set by WDC, and from this, compliant factors of safety (FoS) were achieved. From the assessment above, the following recommendations are proposed for this development;

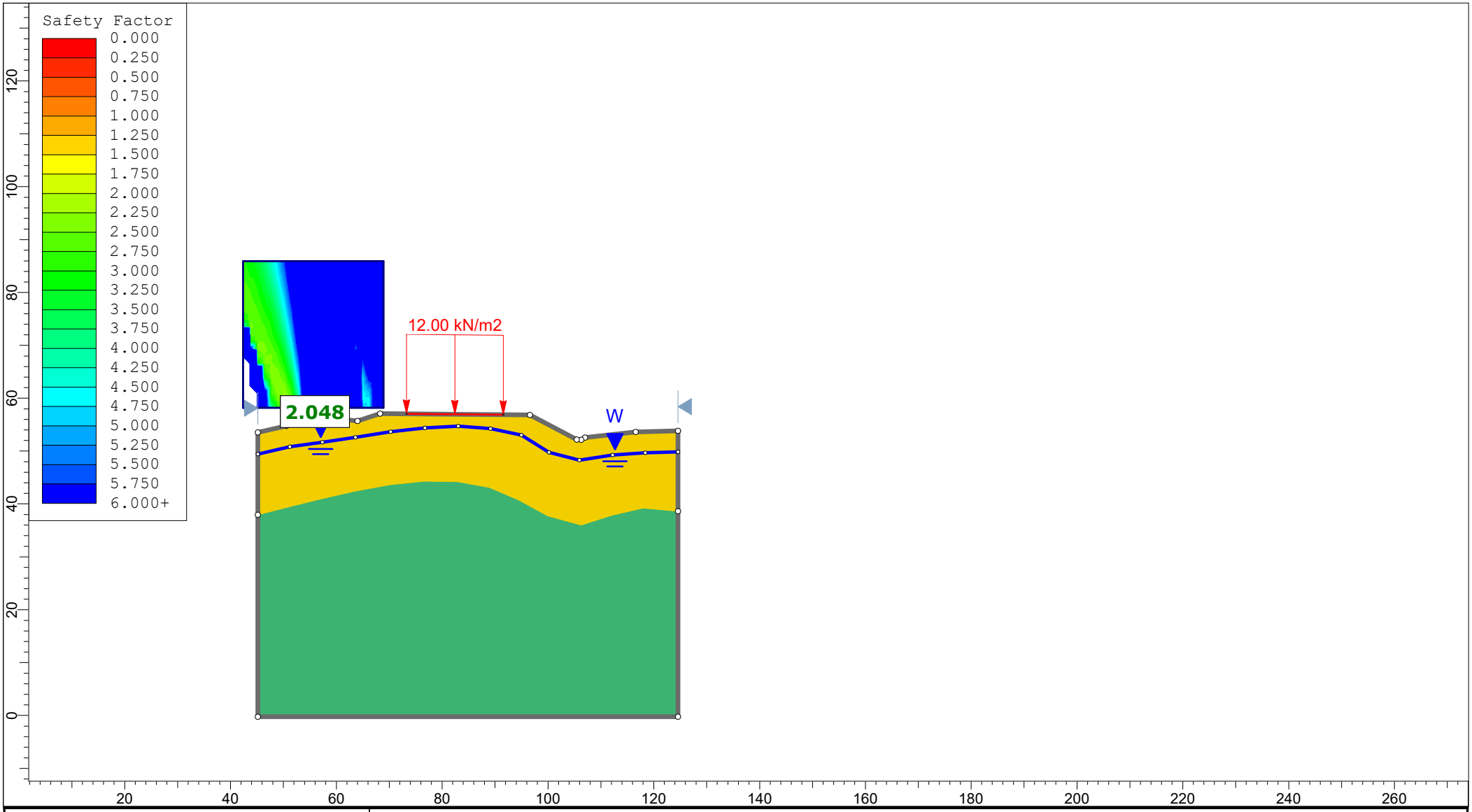
- 3.0m setback to the ridgeline flanks to any buildings within this stage unless further site-specific assessment is undertaken by a Geo-Professional. (Ref: Appendix 4)



CORE ENGINEERING SOLUTIONS

51 Te Maika Road, Ngunguru			
Analysis Description	Lot 1 - LR		
Drawn By	Liam MacMenigall	*Scale* 1:1000	*Company* Core Engineering Solutions
Date	29/09/2022		*Job No.* 20-0078

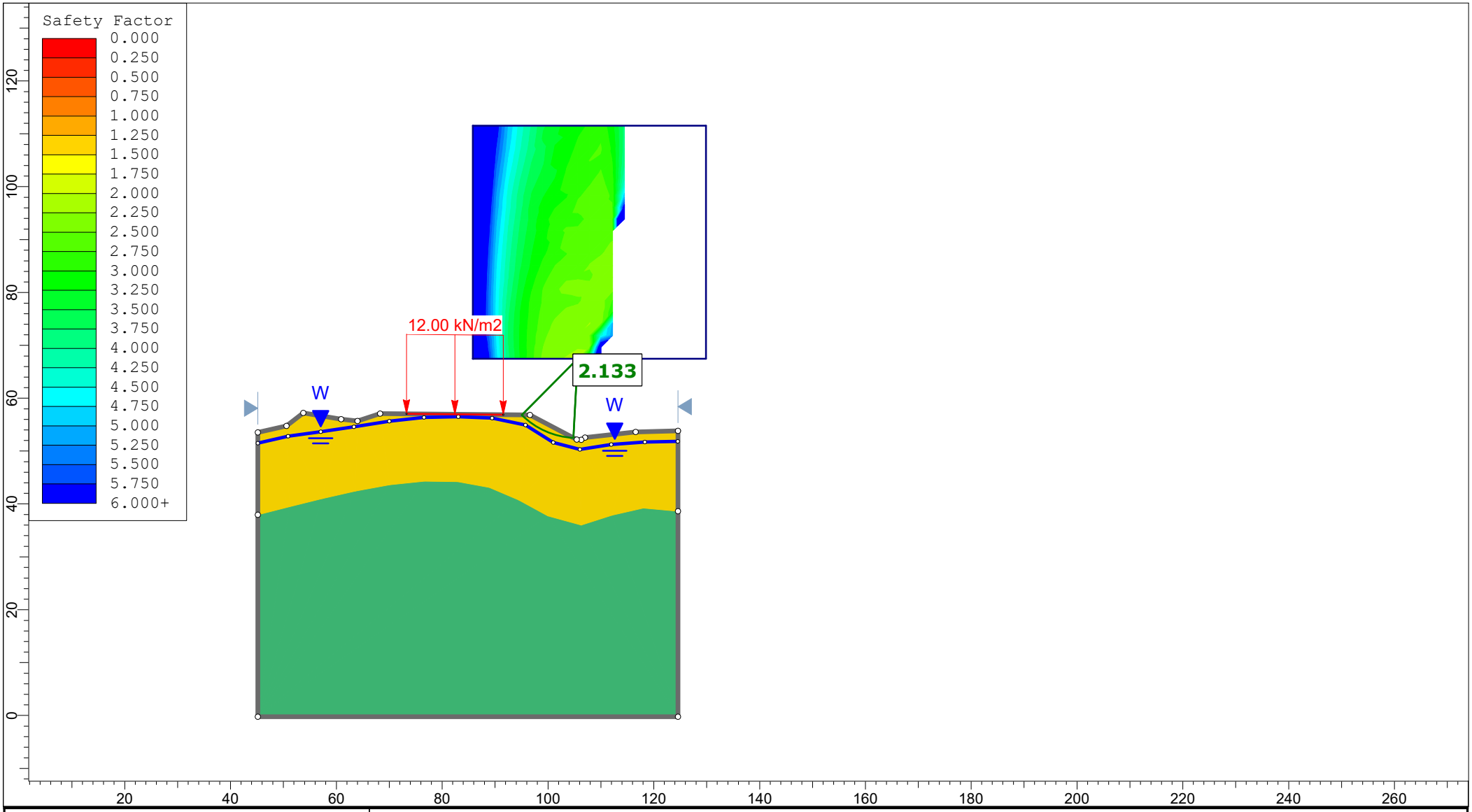
SLIDEINTERPRET 9.019



CORE ENGINEERING SOLUTIONS

51 Te Maika Road, Ngunguru			
Analysis Description	Lot 1 - RL		
Drawn By	Liam MacMenigall	*Scale* 1:1000	*Company* Core Engineering Solutions
Date	29/09/2022		*Job No.* 20-0078

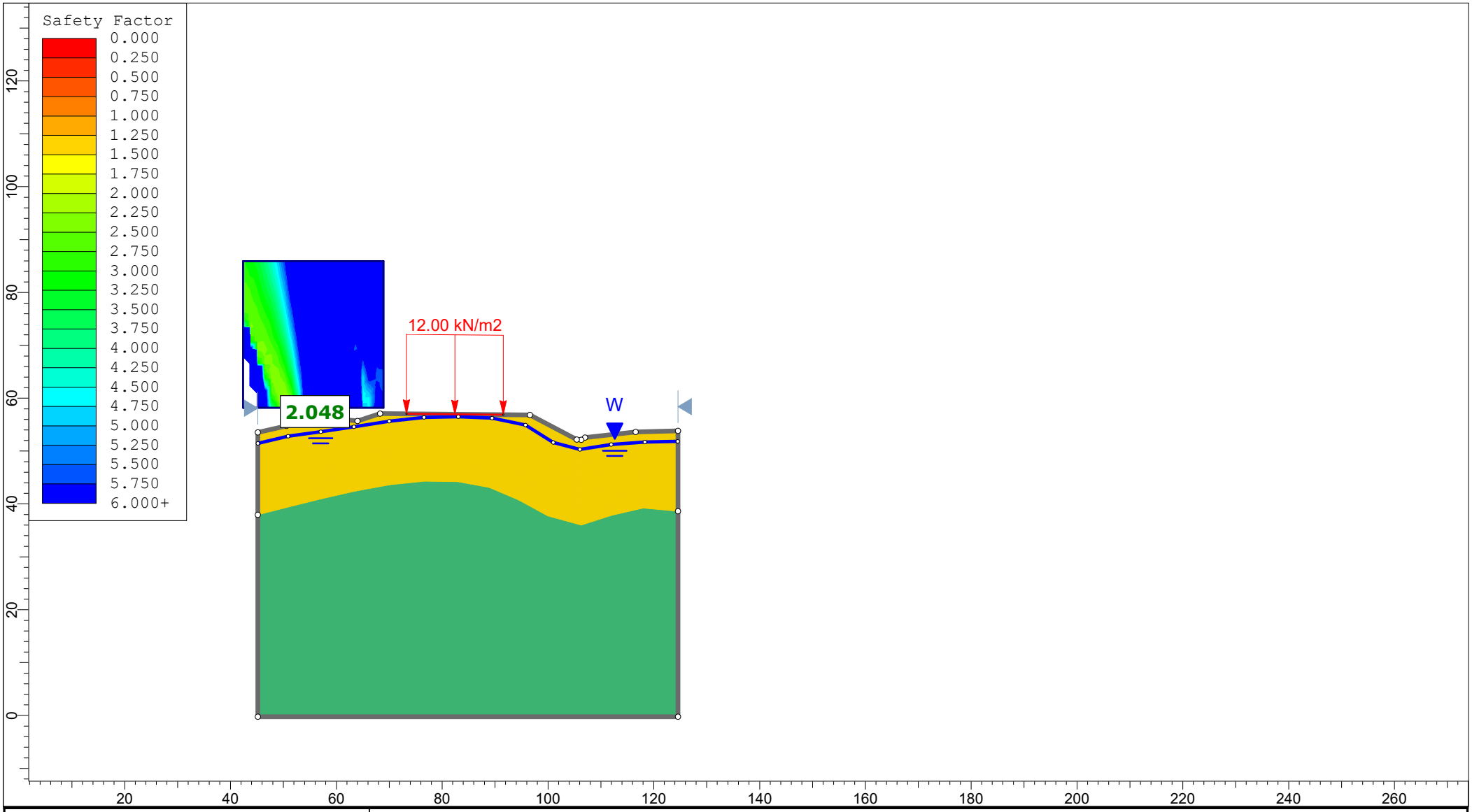
SLIDEINTERPRET 9.019



CORE ENGINEERING SOLUTIONS

51 Te Maika Road, Ngunguru			
Analysis Description	Lot 1 - LR - EG		
Drawn By	Liam MacMenigall	*Scale* 1:1000	*Company* Core Engineering Solutions
Date	29/09/2022		*Job No.* 20-0078

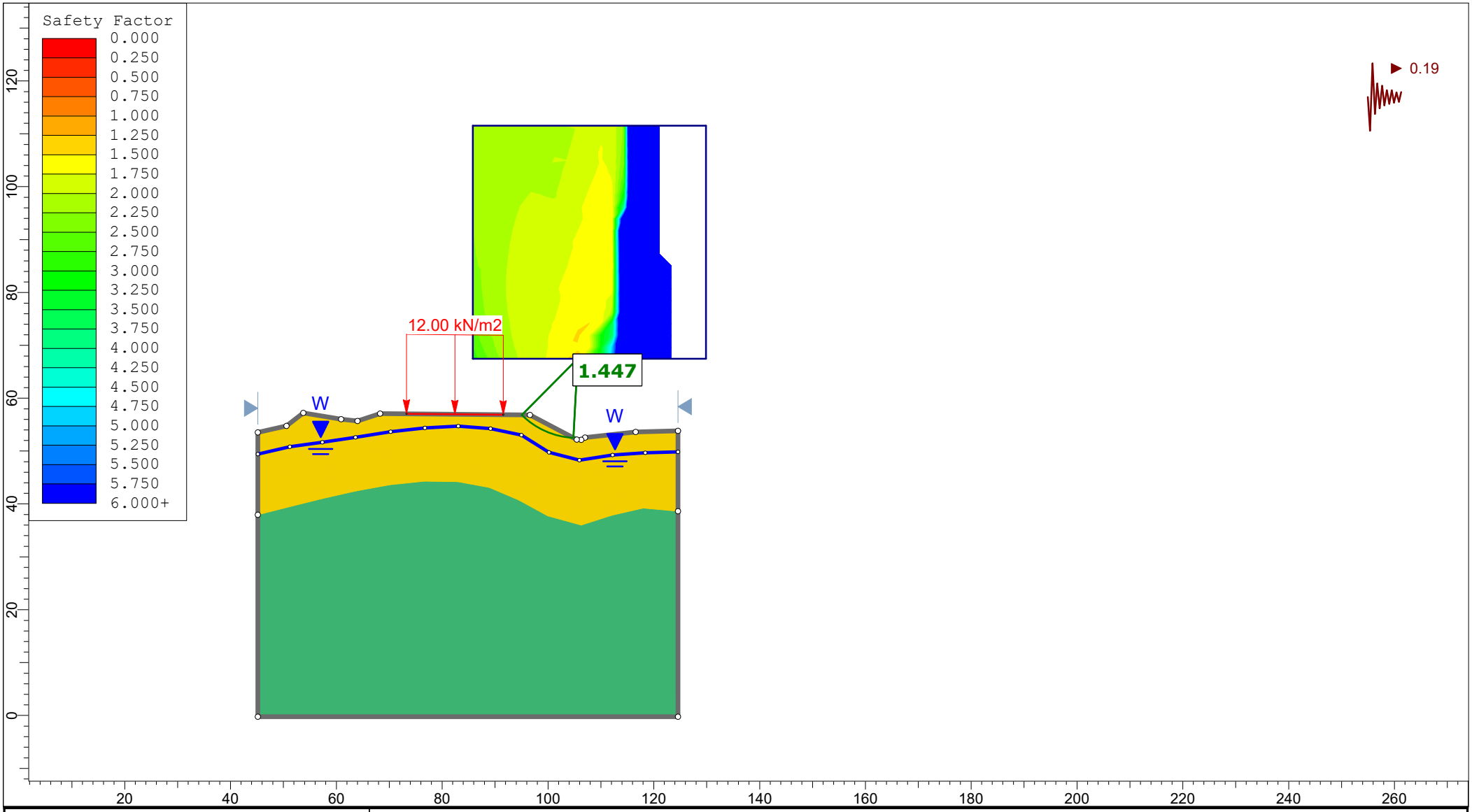
SLIDEINTERPRET 9.019



CORE ENGINEERING SOLUTIONS

51 Te Maika Road, Ngunguru			
Analysis Description	Lot 1 - RL - EG		
Drawn By	Liam MacMenigall	*Scale* 1:1000	*Company* Core Engineering Solutions
Date	29/09/2022		*Job No.* 20-0078

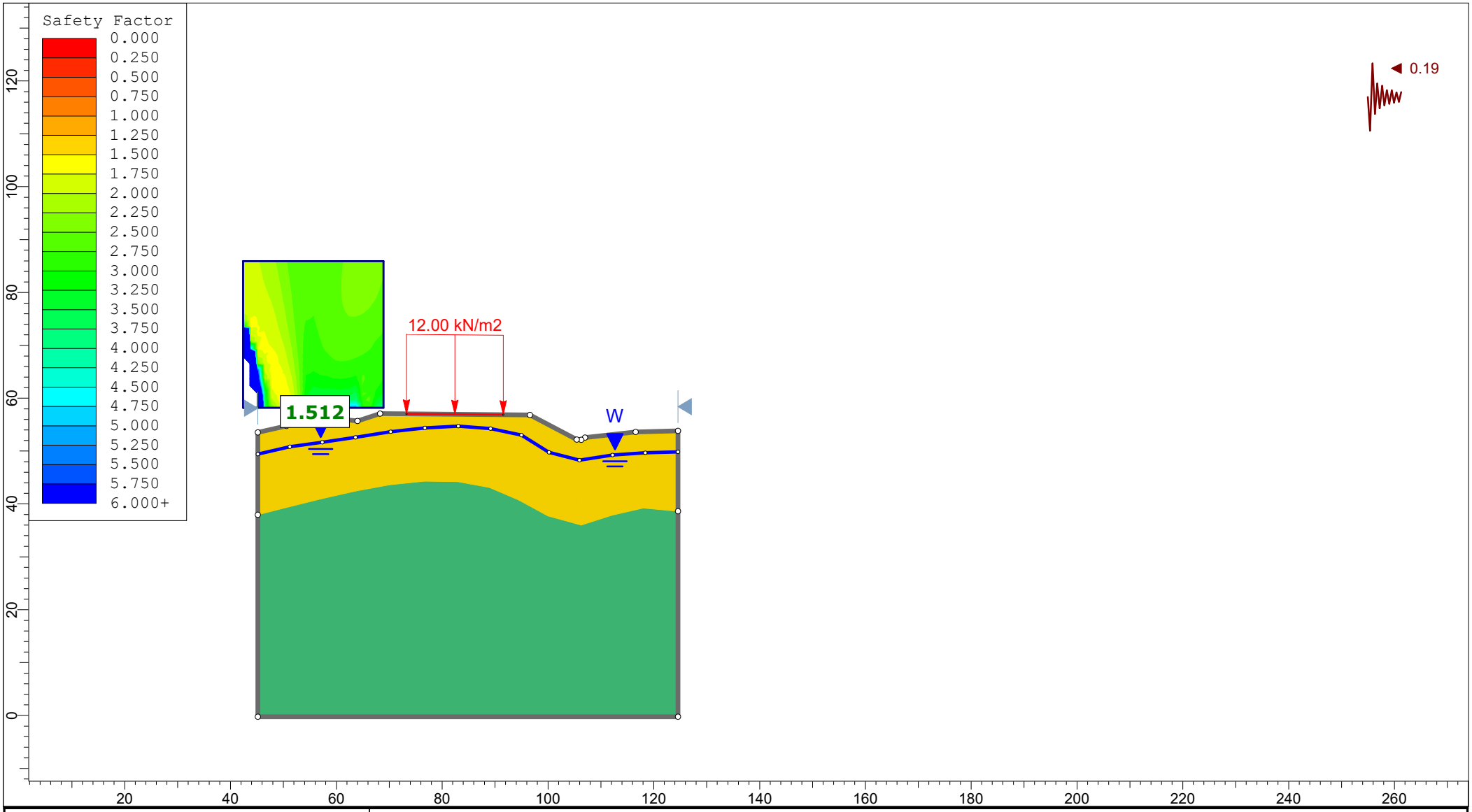
SLIDEINTERPRET 9.019



CORE ENGINEERING SOLUTIONS

51 Te Maika Road, Ngunguru			
Analysis Description	Lot 1 - LR - Seismic		
Drawn By	Liam MacMenigall	*Scale* 1:1000	*Company* Core Engineering Solutions
Date	29/09/2022		*Job No.* 20-0078

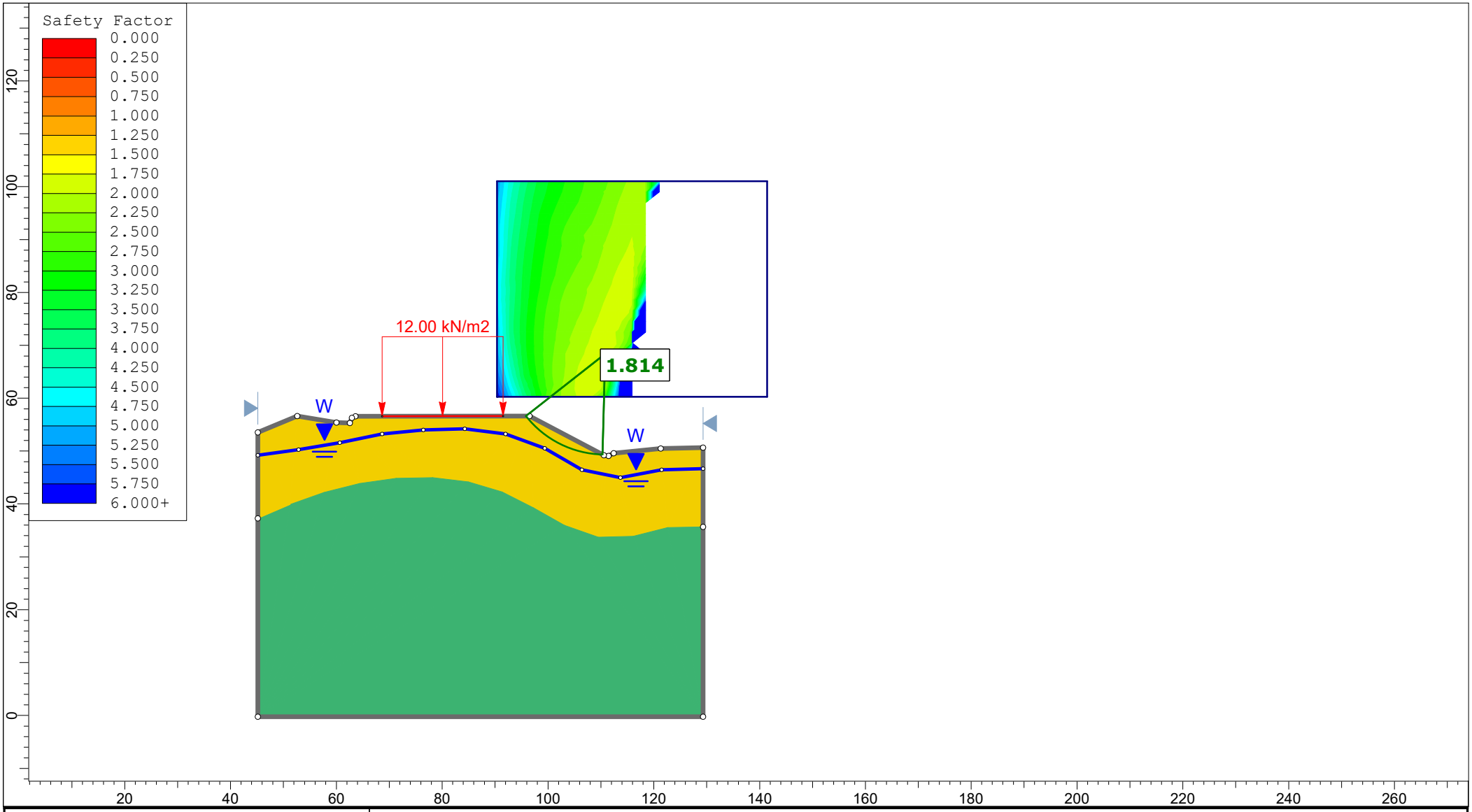
SLIDEINTERPRET 9.019



CORE ENGINEERING SOLUTIONS

51 Te Maika Road, Ngunguru			
Analysis Description	Lot 1 - RL - Seismic		
Drawn By	Liam MacMenigall	*Scale* 1:1000	*Company* Core Engineering Solutions
Date	29/09/2022		*Job No.* 20-0078

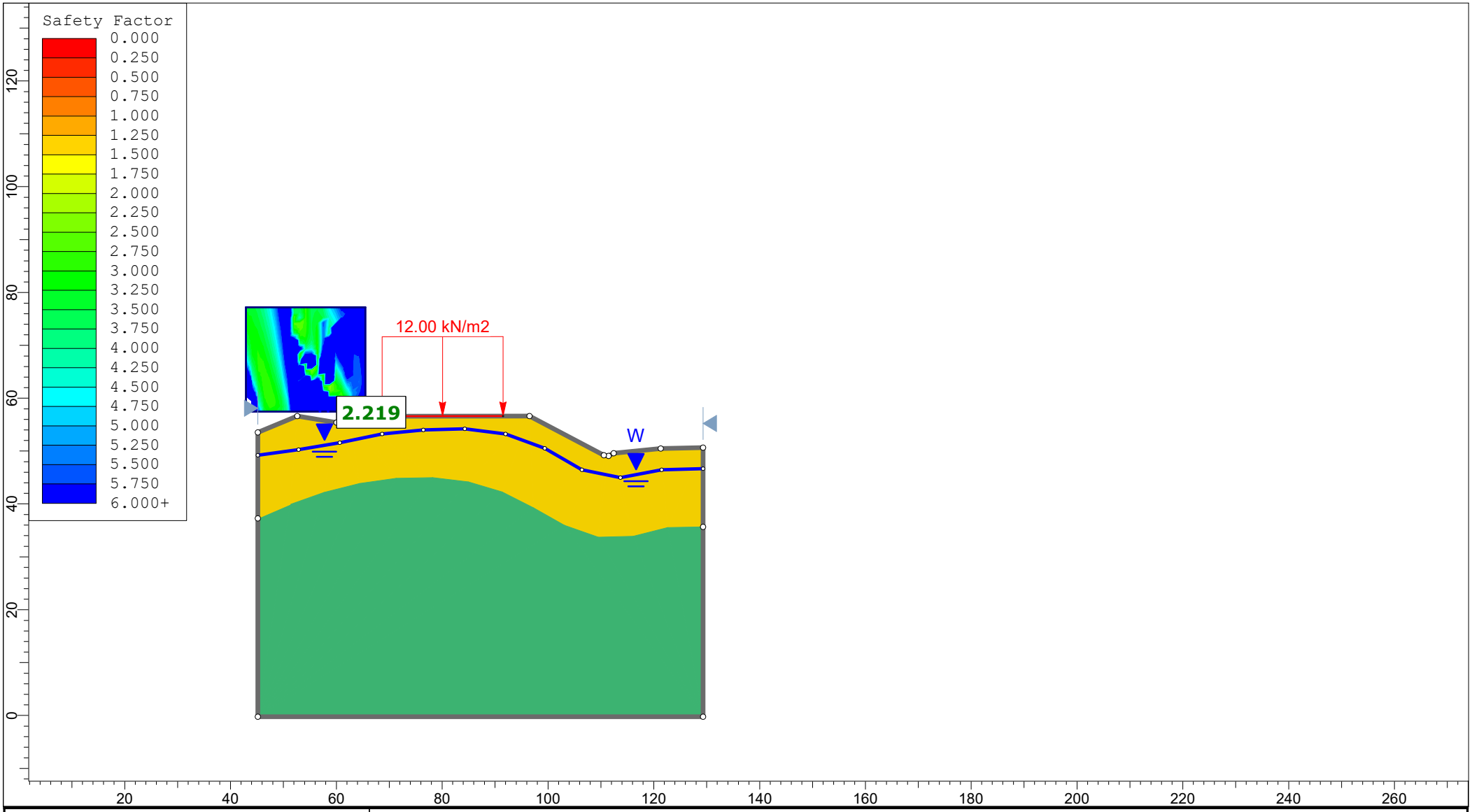
SLIDEINTERPRET 9.019



CORE ENGINEERING SOLUTIONS

51 Te Maika Road, Ngunguru			
Analysis Description	Lot 2 - LR		
Drawn By	Liam MacMenigall	*Scale* 1:1000	*Company* Core Engineering Solutions
Date	29/09/2022		*Job No.* 20-0078

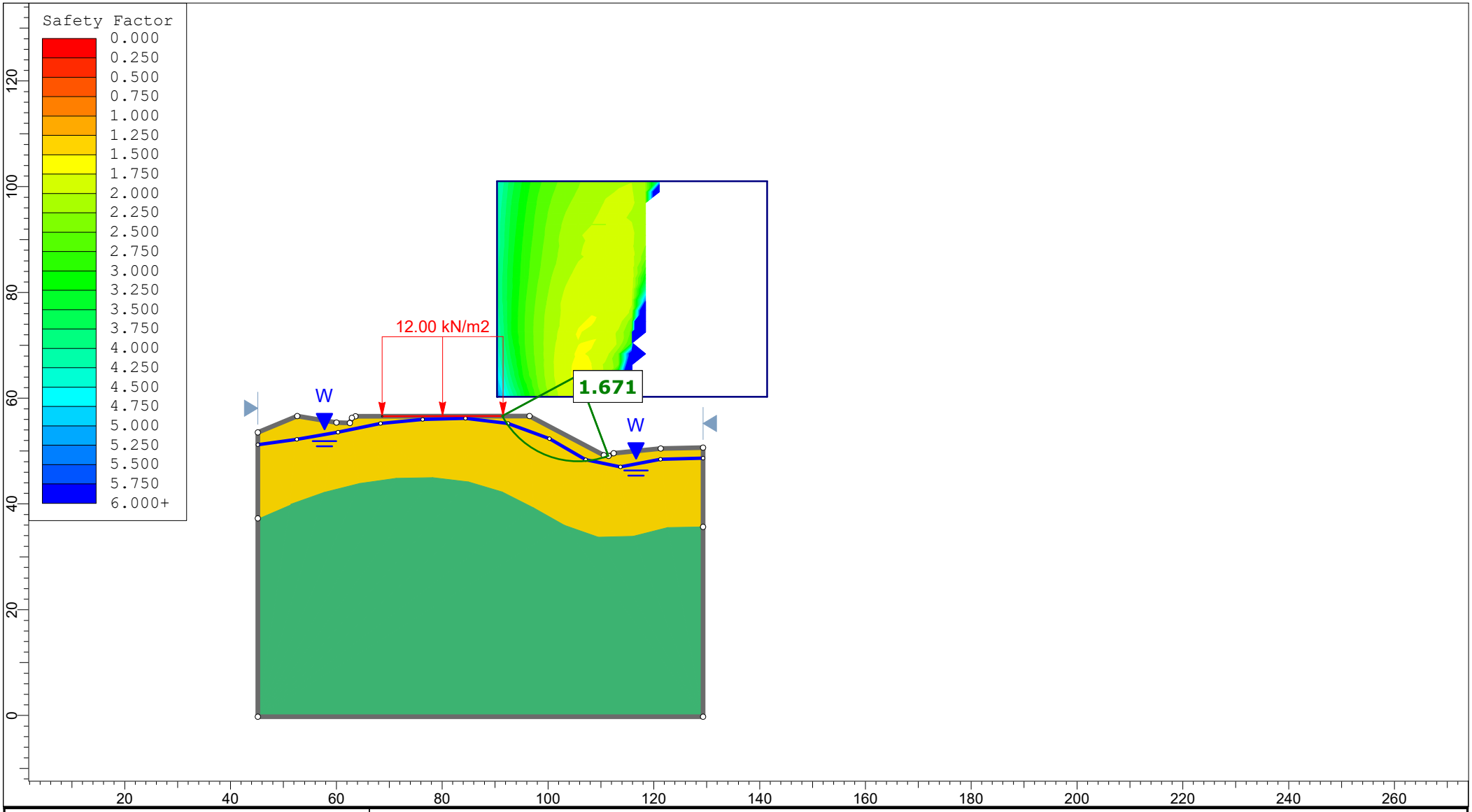
SLIDEINTERPRET 9.019



CORE ENGINEERING SOLUTIONS

SLIDEINTERPRET 9.019

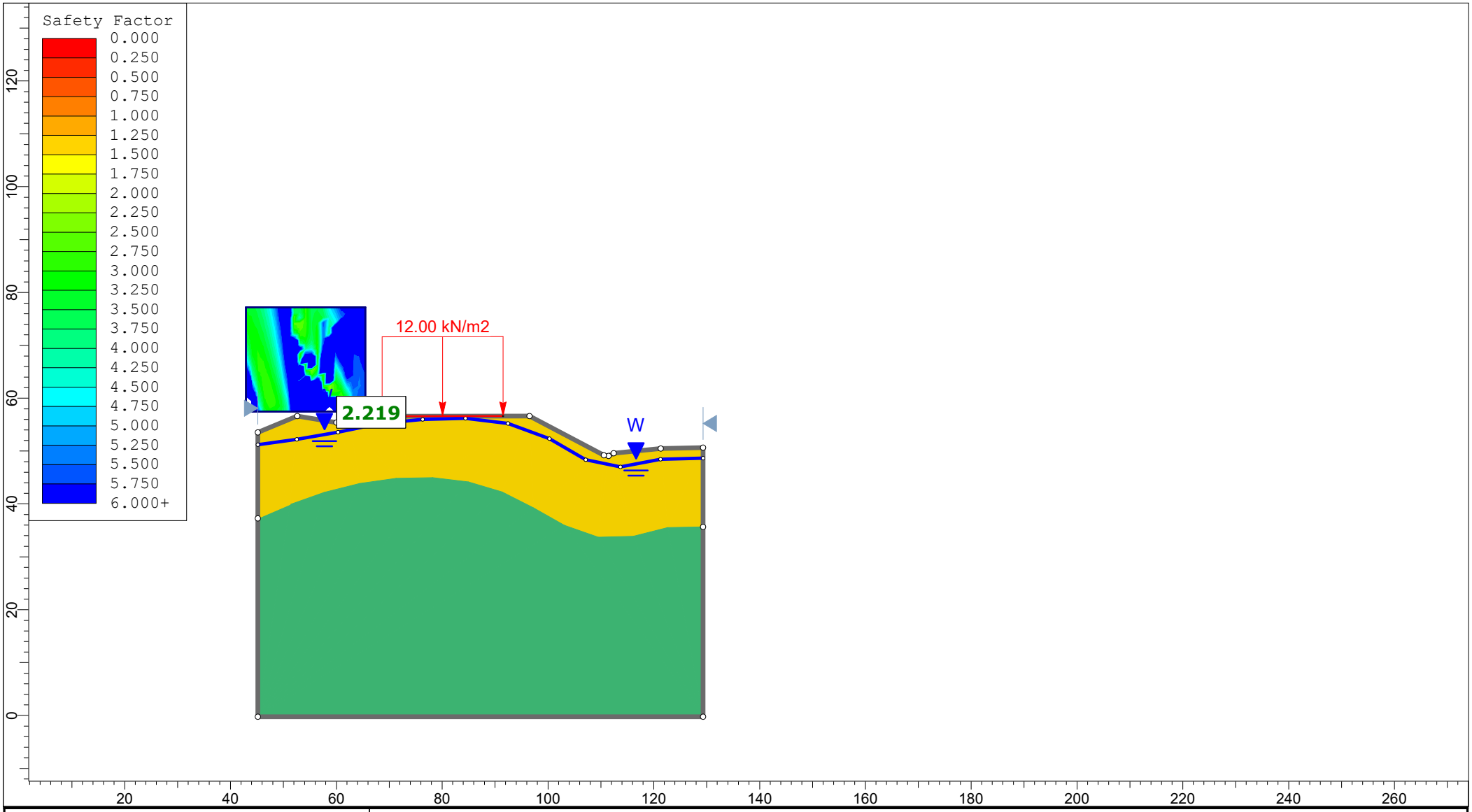
51 Te Maika Road, Ngunguru			
Analysis Description	Lot 2 - RL		
Drawn By	Liam MacMenigall	*Scale* 1:1000	*Company* Core Engineering Solutions
Date	29/09/2022		*Job No.* 20-0078



CORE ENGINEERING SOLUTIONS

51 Te Maika Road, Ngunguru			
Analysis Description	Lot 2 - LR - EG		
Drawn By	Liam MacMenigall	*Scale* 1:1000	*Company* Core Engineering Solutions
Date	29/09/2022		*Job No.* 20-0078

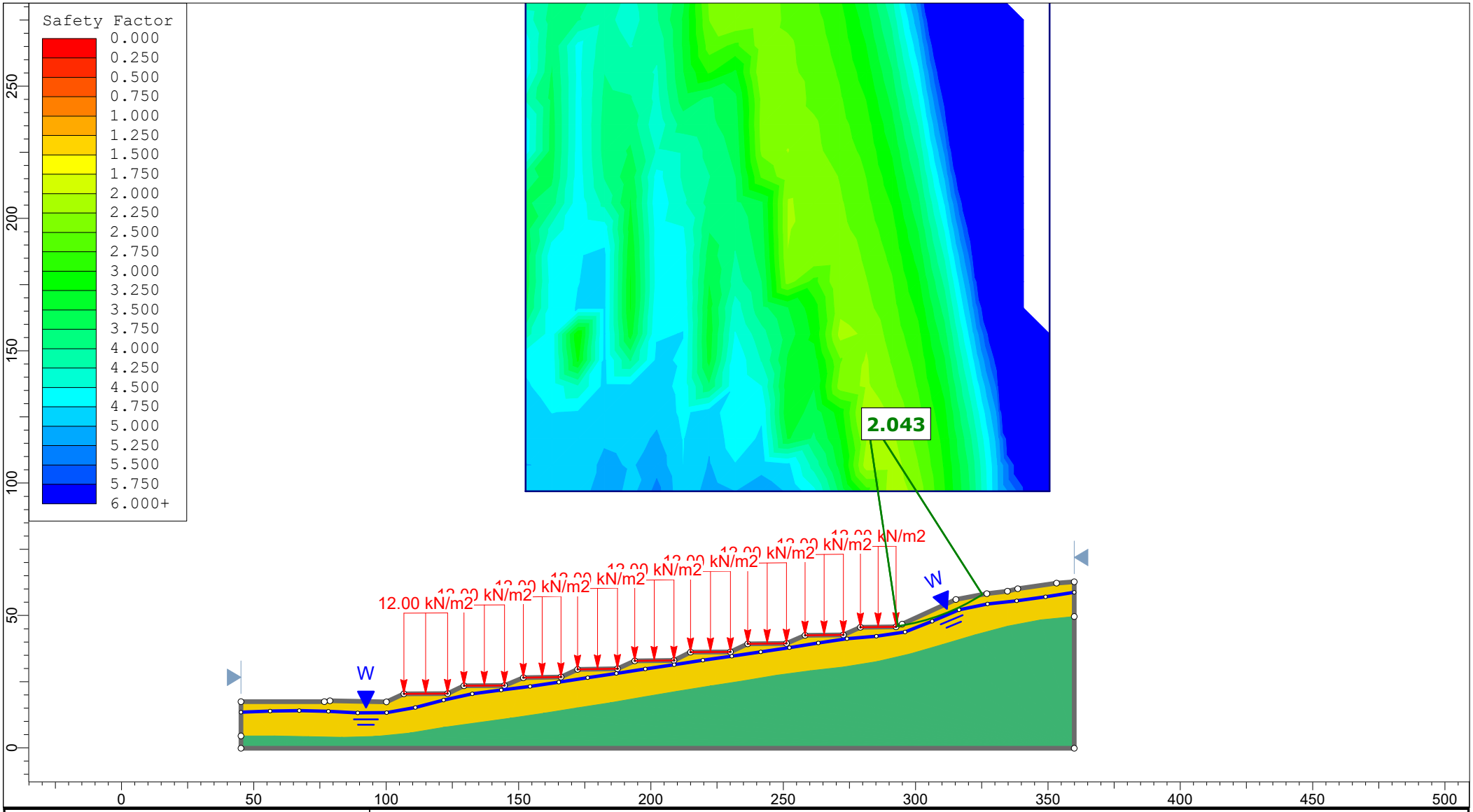
SLIDEINTERPRET 9.019



CORE ENGINEERING SOLUTIONS

SLIDEINTERPRET 9.019

51 Te Maika Road, Ngunguru			
Analysis Description	Lot 2 - RL - EG		
Drawn By	Liam MacMenigall	*Scale* 1:1000	*Company* Core Engineering Solutions
Date	29/09/2022		*Job No.* 20-0078

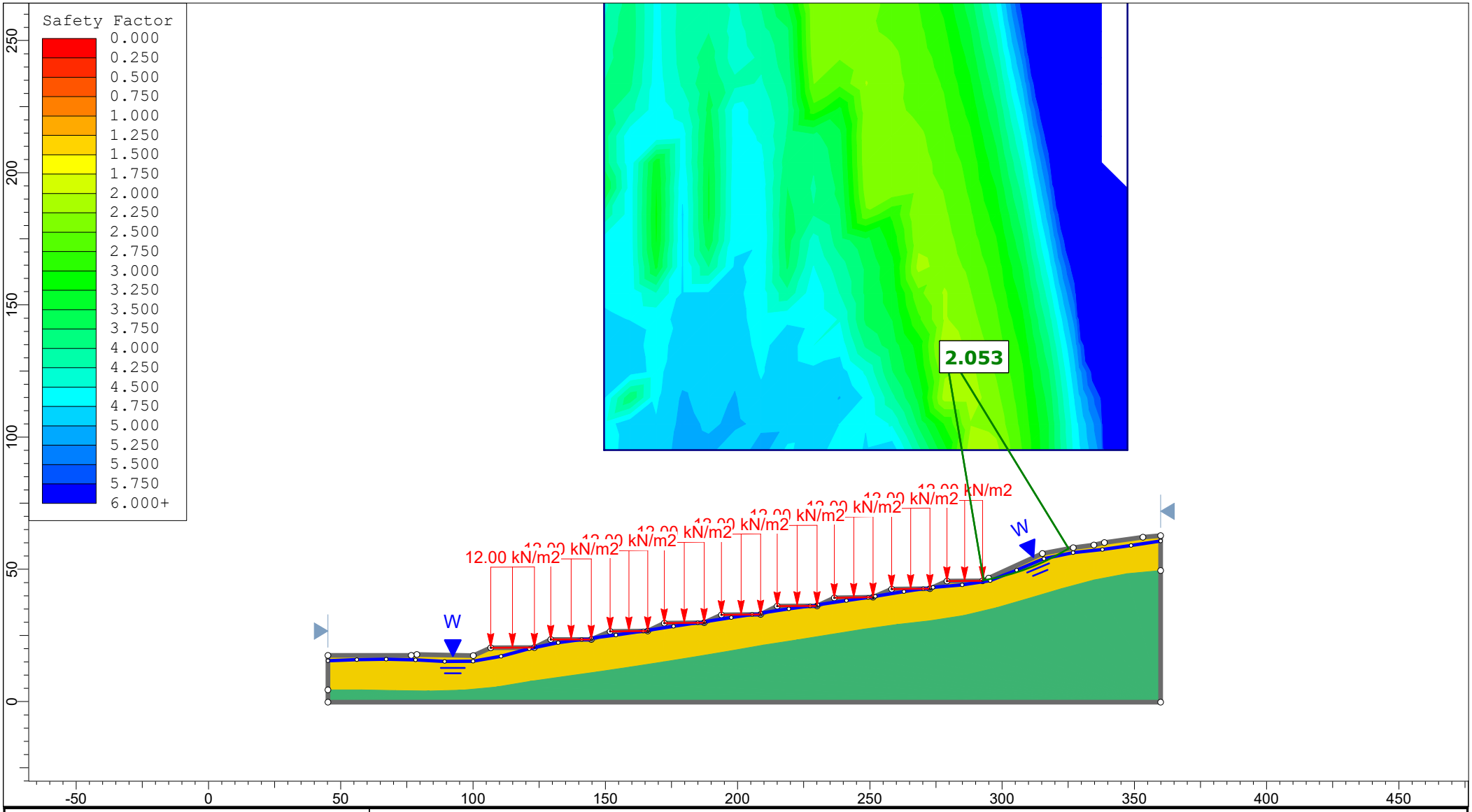


CORE ENGINEERING SOLUTIONS

SLIDEINTERPRET 9.019

51 Te Maika Road, Ngunguru

Analysis Description	Long Section - RL		
Drawn By	Liam MacMenigall	*Scale*	1:2000
Company	Core Engineering Solutions		
Date	29/09/2022	*Job No.*	20-0078

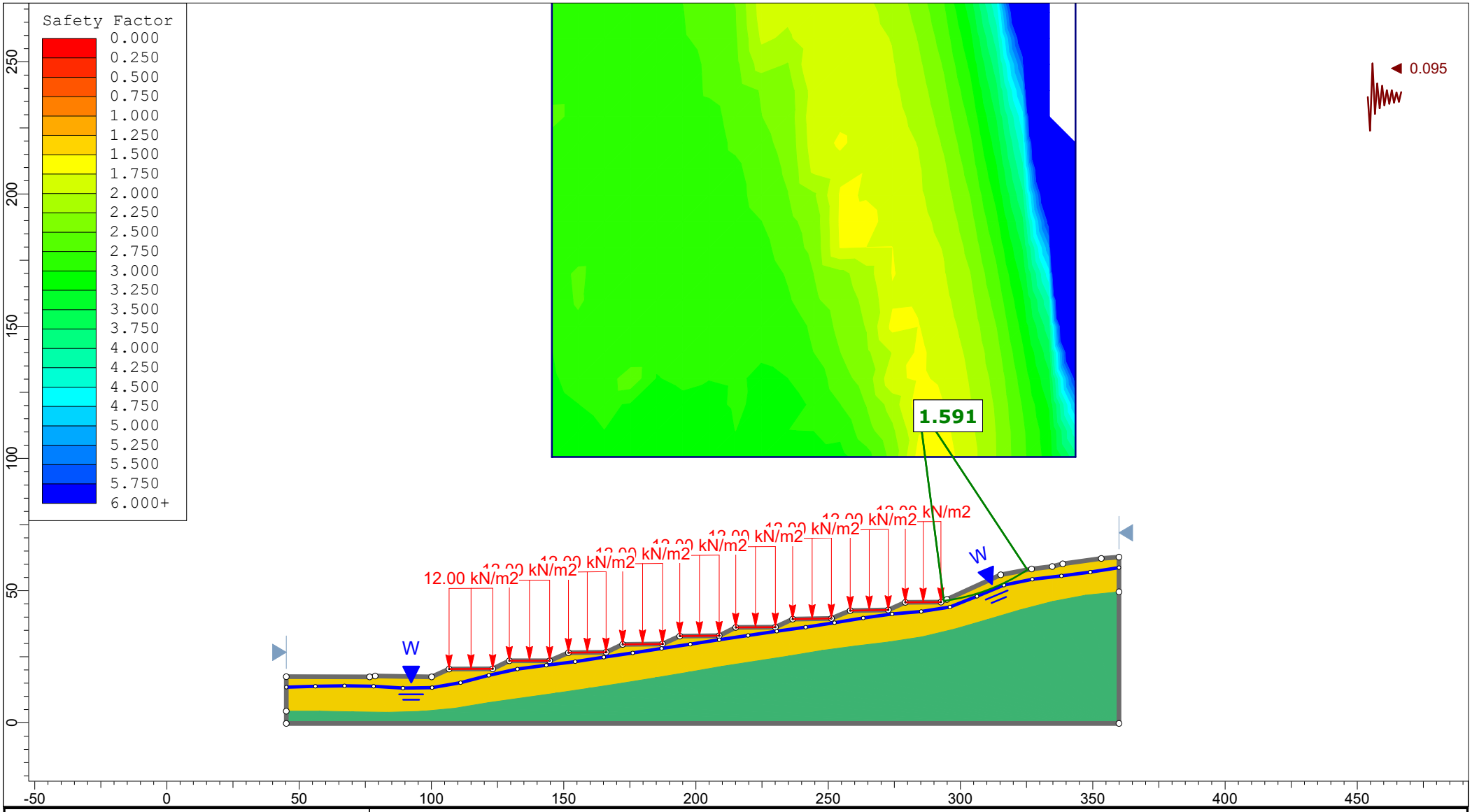


CORE ENGINEERING SOLUTIONS

SLIDEINTERPRET 9.019

51 Te Maika Road, Ngunguru

Analysis Description	Long Section - RL - EG		
Drawn By	Liam MacMenigall	*Scale* 1:2000	*Company* Core Engineering Solutions
Date	29/09/2022		*Job No.* 20-0078



CORE ENGINEERING SOLUTIONS

SLIDEINTERPRET 9.019

51 Te Maika Road, Ngunguru			
Analysis Description	Long Section - RL - Seismic		
Drawn By	Liam MacMenigall	*Scale* 1:2000	*Company* Core Engineering Solutions
Date	29/09/2022		*Job No.* 20-0078

APPENDIX 8 – INSPECTION RECORDS

Date	Staff	Purpose	Notes
10/08/2022	SG, RL	Hand Auger Testing on remaining Stage One Lots	7 ton digger parked on recently (2 weeks) poured roadway
20/07/2022	SG, GO	inspection of Fire Tank Cantilever	Inspection for cantilevers for Fire Tanks, approved for pour, Shear Vanes
19/07/2022	SG	Drone Flyover of site, progress inspection	Shear Vanes
15/06/2022	SG	Progrss Inspection	Shear Vanes
11/06/2022	SG	Progress Inspection (Saturday)	Shear Vanes
25/05/2022	SG, RL	CPT Testing	Shear Vanes
23/05/2022	SG	Progress Inspection, Drone Flyover	Good progress with pouring roads, two more settlement pads damaged
3/05/2022	SG	Progress Inspection	Shear Vanes
2/05/2022	SG	Progress Inspection	Shear Vanes
6/04/2022	SG	Progress Inspection	Shear Vanes
31/03/2022	SG	Progress Inspection, Drone Flyover	Shear Vanes
14/03/2022	SG	Progress Inspection, Drone Flyover	Shear Vanes
25/02/2022	SG	DPSH Testing on hill Lots, Drone Flyover	Shear Vanes
22/02/2022	SG	Progress Inspection	Shear Vanes, Delivered Replacement Settlement Pads
14/02/2022	SG	Progress Inspection	Shear Vanes
8/02/2022	SG	Progress Inspection	Shear Vanes
18/01/2022	SG	Progress Inspection	Shear Vanes
12/01/2022	SG	Progress Inspection, Drone Flyover	Shear Vanes
9/12/2021	SG	Inspection - Retaining Walls, Drone Flyover	Shear Vanes
25/11/2021	SG	Inspection - Retaining Walls, Drone Flyover	Shear Vanes
16/11/2021	SG	Inspection - Retaining Walls, Drone Flyover	Shear Vanes
2/11/2021	SG	Inspection - Retaining Walls, Drone Flyover	Inspection cuts. Standing vertical, highly weathered to moderately weathered, Shear Vanes
11/10/2021	SG	Progress Inspection, Drone Flyover	Shear Vanes
14/09/2021	SG	Progress Inspection	Shear Vanes
10/09/2021	SG	Progress Inspection	Shear Vanes
3/09/2021	SG	Progress Inspection	Shear Vanes
11/08/2021	SG	Progress Inspection	Shear Vanes
19/07/2021	SG	Progress Inspection, Drone Flyover	Shear Vanes
16/06/2021	SG	Progress Inspection, Drone Flyover	Shear Vanes
4/05/2021	SG	Progress Inspection, Drone Flyover	Shear Vanes
30/04/2021	SG	Progress Inspection, Drone Flyover	Shear Vanes
27/04/2022	SG	Progress Inspection, Photos no drone	Shear Vanes
21/04/2021	SG	Progress Inspection, Drone Flyover	Progress inspection for mat. Wet conditions causing issues carting materials from the hill sites
15/04/2021	SG DL	Meeting regarding Drainage	Shear Vanes
14/04/2021	SG	Progress Inspection, Drone Flyover	Drone flyover and progress inspection
12/04/2021	SG	Progress Inspection	Met site manager, shear vanes in a number of locations
9/04/2021	SG, DL	Progress Inspection	Site walkover with Kent, review of site, Large Digger buried on site

Note: Earthworks monitoring has been conducted under NZS4431:1989. The summary above and supplementary documents have been supplied with this report. Further records are kept on file at CES Ltd.

APPENDIX 9 – PRODUCER STATEMENTS FOR CONSTRUCTION FROM CONTRACTOR

Schedule 6 – Form of Producer Statement – Construction

ISSUED BY	**Clements Contractors Ltd**	*(Contractor)*
TO	**Traverse Ltd**	*(Principal)*
IN RESPECT OF	**Traverse Ltd - Te Maika Road Development**	*(Description of Contract Works)*
AT	**51 Te Maika Rd, Ngunguru, Whangarei**	*(Address)*

Clements Contractors Ltd *(Contractor)* has contracted to **Traverse Ltd** *(Principal)* to carry out and complete certain building works in accordance with a Contract titled **Traverse Ltd – Te Maika Road Development** ('the Contract')

I **Ryan Hayward** *(Duly Authorised Agent)* a duly authorised representative of **Clements Contractors Ltd** *(Contractor)* believe on reasonable grounds that **Clements Contractors Ltd** *(Contractor)* has carried out and completed:

☐ All

☒ Part only as specified in the attached particulars of the contract works in accordance with the Contract

Earthworks

Date **3 August 2022**

(Signature of Authorised Agent on behalf of)

Clements Contractors Ltd

(Contractor)

32 Westwood Lane, Maunu

(Address)

Schedule 6 – Form of Producer Statement – Construction

ISSUED BY	**Clements Contractors Ltd**	*(Contractor)*
TO	**Traverse Ltd**	*(Principal)*
IN RESPECT OF	**Traverse Ltd - Te Maika Road Development**	*(Description of Contract Works)*
AT	**51 Te Maika Rd, Ngunguru, Whangarei**	*(Address)*

Clements Contractors Ltd *(Contractor)* has contracted to **Traverse Ltd** *(Principal)* to carry out and complete certain building works in accordance with a Contract titled **Traverse Ltd – Te Maika Road Development** ('the Contract')

I **Ryan Hayward** *(Duly Authorised Agent)* a duly authorised representative of **Clements Contractors Ltd** *(Contractor)* believe on reasonable grounds that **Clements Contractors Ltd** *(Contractor)* has carried out and completed:

☐ All

☒ Part only as specified in the attached particulars of the contract works in accordance with the Contract

Placement and overlapping of Geo Composite material, and reinstatement to manufacturers specification where material has been cut to install services

Date **3 August 2022**

(Signature of Authorised Agent on behalf of)

Clements Contractors Ltd

(Contractor)

32 Westwood Lane, Maunu

(Address)

Schedule 6 – Form of Producer Statement – Construction

ISSUED BY	**Clements Contractors Ltd**	*(Contractor)*
TO	**Traverse Ltd**	*(Principal)*
IN RESPECT OF	**Traverse Ltd - Te Maika Road Development**	*(Description of Contract Works)*
AT	**51 Te Maika Rd, Ngunguru, Whangarei**	*(Address)*

Clements Contractors Ltd *(Contractor)* has contracted to **Traverse Ltd** *(Principal)* to carry out and complete certain building works in accordance with a Contract titled **Traverse Ltd – Te Maika Road Development** ('the Contract')

I **Ryan Hayward** *(Duly Authorised Agent)* a duly authorised representative of **Clements Contractors Ltd** *(Contractor)* believe on reasonable grounds that **Clements Contractors Ltd** *(Contractor)* has carried out and completed:

☐ All

☒ Part only as specified in the attached particulars of the contract works in accordance with the Contract

Retaining Walls

Date **3 August 2022**

(Signature of Authorised Agent on behalf of)

Clements Contractors Ltd

(Contractor)

32 Westwood Lane, Maunu

(Address)

SIXTH SCHEDULE

FORM OF PRODUCER STATEMENT – CONSTRUCTION

ISSUED BY: **Webb Contracting Ltd**
(Contractor)

TO: **Traverse LTD - Clements Contractors**
(Principal)

TO BE SUPPLIED TO: **Whangarei District Council**
(Territorial authority)

IN RESPECT OF: **51 Te Maika Road DP374000**
(Description of Contract Works)

AT: **51 Te Maika Road, Ngunguru, Whangarei.**
(Address)

Webb Contracting Ltd *(Contractor)* has contracted to **Traverse Limited** *(Principal)* to carry out and complete certain building works in accordance with a contract, titled **Traverse - Lot 51 Te Maika Road** ("the contract")

I **Jake Pattison** *(Duly Authorized Agent)* a duly authorized representative of **Webb Contracting Ltd** *(Contractor)* believe on reasonable grounds that **Webb Contracting Ltd** *(Contractor)* has carried out and completed

☐ All

■ Part only as specified in the attached particulars of the building works in accordance with the contract.
Laying of Ø1350mm Stormwater line
Lance Smith - Certifying Drainlayer #20798

……..... Date 2nd August 2022
(Signature of Authorized Agent on behalf of)

Webb Contracting Ltd
(Contractor)

247 Three Mile Bush Road, Kamo, Whangarei 0145
(Address)

APPENDIX 10 –SETTLEMENT ANALYSIS

ENGINEERING SOLUTIONS

Te Maika Road
Core Engineering Solutions Ltd

Table of Contents

Settle3 Analysis Information

Te Maika Road

Project Settings

Document Name	Project 3
Project Title	Te Maika Road
Analysis	Riley CPT 1
Author	Stuart Gemmell
Company	Core Engineering Solutions Ltd
Date Created	18/10/2022, 12:25:44 pm
Last saved with Settle3 version	5.017
Stress Computation Method	Boussinesq
Stress Units	Metric, stress as kPa
Settlement Units	centimeters
Time-dependent Consolidation Analysis	
Time Units	years
Permeability Units	meters/year

Advanced Settings

Start of secondary consolidation (% of primary)	95
Min. stress for secondary consolidation (% of initial)	1
Reset time when load changes for secondary consolidation	No
Minimum settlement ratio for subgrade modulus	0.9
Use average poisson's ratio to calculate layered stresses	
Update Cv in each time step (improves consolidation accuracy)	
Ignore negative effective stresses in settlement calculations	
Add field points to load edges	

Soil Profile

Layer Option	Horizontal Soil Layers
Vertical Axis	Depth below ground surface

Stage Settings

Stage #	Name	Time [years]
1	Stage 1	0
2	Stage 2 - Load	0.1
3	Stage 3	0.5
4	Stage 4	1
5	Stage 5 - GCR Stage	1.5
6	Stage 6 - Build	2
7	Stage 7 - 10 Years	10
8	Stage 8 - 50 Years	50
9	Stage 9 - 100 Years	100

Results

Time taken to compute: 1.79143 seconds

Stage: Stage 1 = 0 y

Data Type	Minimum	Maximum
Total Settlement [cm]	0	0
Total Consolidation Settlement [cm]	0	0
Virgin Consolidation Settlement [cm]	0	0
Recompression Consolidation Settlement [cm]	0	0
Immediate Settlement [cm]	0	0
Secondary Settlement [cm]	0	0
Loading Stress ZZ [kPa]	0	0
Loading Stress XX [kPa]	0	0
Loading Stress YY [kPa]	0	0
Effective Stress ZZ [kPa]	0	165.624
Effective Stress XX [kPa]	0	165.624
Effective Stress YY [kPa]	0	165.624
Total Stress ZZ [kPa]	0	165.624
Total Stress XX [kPa]	0	165.624
Total Stress YY [kPa]	0	165.624
Modulus of Subgrade Reaction (Total) [kPa/m]	0	0
Modulus of Subgrade Reaction (Immediate) [kPa/m]	0	0
Modulus of Subgrade Reaction (Consolidation) [kPa/m]	0	0
Total Strain	0	0
Pore Water Pressure [kPa]	0	4.85595
Excess Pore Water Pressure [kPa]	0	0
Degree of Consolidation [%]	0	0
Pre-consolidation Stress [kPa]	0.2695	164.668
Over-consolidation Ratio	1	1
Void Ratio	0	0
Permeability [m/y]	0.002943	0.01962
Coefficient of Consolidation [m^2/y]	1	2
Hydroconsolidation Settlement [cm]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	0

Stage: Stage 2 - Load = 0.1 y

Data Type	Minimum	Maximum
Total Settlement [cm]	0	5.22337
Total Consolidation Settlement [cm]	0	5.22337
Virgin Consolidation Settlement [cm]	0	5.22337
Recompression Consolidation Settlement [cm]	0	0
Immediate Settlement [cm]	0	0
Secondary Settlement [cm]	0	0
Loading Stress ZZ [kPa]	0	9.25
Loading Stress XX [kPa]	-2.05437	6.97776
Loading Stress YY [kPa]	-1.60152	7.5127
Effective Stress ZZ [kPa]	0	174.869
Effective Stress XX [kPa]	-2.05437	170.82
Effective Stress YY [kPa]	-1.60152	171.63
Total Stress ZZ [kPa]	0	174.869
Total Stress XX [kPa]	-2.05437	170.82
Total Stress YY [kPa]	-1.60152	171.63
Modulus of Subgrade Reaction (Total) [kPa/m]	0	244.935
Modulus of Subgrade Reaction (Immediate) [kPa/m]	0	0
Modulus of Subgrade Reaction (Consolidation) [kPa/m]	0	244.935
Total Strain	0	0.0074
Pore Water Pressure [kPa]	0	14.1059
Excess Pore Water Pressure [kPa]	0	9.25
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [kPa]	0.2695	173.913
Over-consolidation Ratio	1	1
Void Ratio	0	0
Permeability [m/y]	0.002943	0.01962
Coefficient of Consolidation [m^2/y]	1	2
Hydroconsolidation Settlement [cm]	0	0
Average Degree of Consolidation [%]	0	90
Undrained Shear Strength	-1.11022e-16	0.361802

Stage: Stage 3 = 0.5 y

Data Type	Minimum	Maximum
Total Settlement [cm]	0	21.3768
Total Consolidation Settlement [cm]	0	21.3768
Virgin Consolidation Settlement [cm]	0	21.3768
Recompression Consolidation Settlement [cm]	0	0
Immediate Settlement [cm]	0	0
Secondary Settlement [cm]	0	0
Loading Stress ZZ [kPa]	0	37
Loading Stress XX [kPa]	-8.21746	27.9111
Loading Stress YY [kPa]	-6.40609	30.0508
Effective Stress ZZ [kPa]	0	202.603
Effective Stress XX [kPa]	-8.21746	186.408
Effective Stress YY [kPa]	-6.40609	189.648
Total Stress ZZ [kPa]	0	202.603
Total Stress XX [kPa]	-8.21746	186.408
Total Stress YY [kPa]	-6.40609	189.648
Modulus of Subgrade Reaction (Total) [kPa/m]	0	236.803
Modulus of Subgrade Reaction (Immediate) [kPa/m]	0	0
Modulus of Subgrade Reaction (Consolidation) [kPa/m]	0	236.803
Total Strain	0	0.0296
Pore Water Pressure [kPa]	0	32.606
Excess Pore Water Pressure [kPa]	0	27.75
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [kPa]	0.2695	201.647
Over-consolidation Ratio	1	1
Void Ratio	0	0
Permeability [m/y]	0.002943	0.01962
Coefficient of Consolidation [m^2/y]	1	2
Hydroconsolidation Settlement [cm]	0	0
Average Degree of Consolidation [%]	0	90
Undrained Shear Strength	0	1.36239

Stage: Stage 4 = 1 y

Data Type	Minimum	Maximum
Total Settlement [cm]	0	22.8267
Total Consolidation Settlement [cm]	0	22.8267
Virgin Consolidation Settlement [cm]	0	22.8267
Recompression Consolidation Settlement [cm]	0	0
Immediate Settlement [cm]	0	0
Secondary Settlement [cm]	0	0
Loading Stress ZZ [kPa]	0	37
Loading Stress XX [kPa]	-8.21746	27.9111
Loading Stress YY [kPa]	-6.40609	30.0508
Effective Stress ZZ [kPa]	0	202.603
Effective Stress XX [kPa]	-8.21746	186.408
Effective Stress YY [kPa]	-6.40609	189.648
Total Stress ZZ [kPa]	0	202.603
Total Stress XX [kPa]	-8.21746	186.408
Total Stress YY [kPa]	-6.40609	189.648
Modulus of Subgrade Reaction (Total) [kPa/m]	0	221.229
Modulus of Subgrade Reaction (Immediate) [kPa/m]	0	0
Modulus of Subgrade Reaction (Consolidation) [kPa/m]	0	221.229
Total Strain	0	0.037
Pore Water Pressure [kPa]	0	4.85595
Excess Pore Water Pressure [kPa]	0	9.56706e-14
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [kPa]	0.2695	201.647
Over-consolidation Ratio	1	1
Void Ratio	0	0
Permeability [m/y]	0.002943	0.01962
Coefficient of Consolidation [m^2/y]	1	2
Hydroconsolidation Settlement [cm]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	1.36239

Stage: Stage 5 - GCR Stage = 1.5 y

Data Type	Minimum	Maximum
Total Settlement [cm]	0	22.8267
Total Consolidation Settlement [cm]	0	22.8267
Virgin Consolidation Settlement [cm]	0	22.8267
Recompression Consolidation Settlement [cm]	0	0
Immediate Settlement [cm]	0	0
Secondary Settlement [cm]	0	0
Loading Stress ZZ [kPa]	0	37
Loading Stress XX [kPa]	-8.21746	27.9111
Loading Stress YY [kPa]	-6.40609	30.0508
Effective Stress ZZ [kPa]	0	202.603
Effective Stress XX [kPa]	-8.21746	186.408
Effective Stress YY [kPa]	-6.40609	189.648
Total Stress ZZ [kPa]	0	202.603
Total Stress XX [kPa]	-8.21746	186.408
Total Stress YY [kPa]	-6.40609	189.648
Modulus of Subgrade Reaction (Total) [kPa/m]	0	221.229
Modulus of Subgrade Reaction (Immediate) [kPa/m]	0	0
Modulus of Subgrade Reaction (Consolidation) [kPa/m]	0	221.229
Total Strain	0	0.037
Pore Water Pressure [kPa]	0	4.85595
Excess Pore Water Pressure [kPa]	0	5.5633e-29
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [kPa]	0.2695	201.647
Over-consolidation Ratio	1	1
Void Ratio	0	0
Permeability [m/y]	0.002943	0.01962
Coefficient of Consolidation [m^2/y]	1	2
Hydroconsolidation Settlement [cm]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	1.36239

Stage: Stage 6 - Build = 2 y

Data Type	Minimum	Maximum
Total Settlement [cm]	0	28.4198
Total Consolidation Settlement [cm]	0	28.4198
Virgin Consolidation Settlement [cm]	0	28.4198
Recompression Consolidation Settlement [cm]	0	0
Immediate Settlement [cm]	0	0
Secondary Settlement [cm]	0	0
Loading Stress ZZ [kPa]	0	49
Loading Stress XX [kPa]	-8.23403	33.7253
Loading Stress YY [kPa]	-6.41964	36.4818
Effective Stress ZZ [kPa]	0	209.005
Effective Stress XX [kPa]	-8.23403	186.91
Effective Stress YY [kPa]	-6.41964	190.287
Total Stress ZZ [kPa]	0	209.005
Total Stress XX [kPa]	-8.23403	186.91
Total Stress YY [kPa]	-6.41964	190.287
Modulus of Subgrade Reaction (Total) [kPa/m]	0	221.229
Modulus of Subgrade Reaction (Immediate) [kPa/m]	0	0
Modulus of Subgrade Reaction (Consolidation) [kPa/m]	0	221.229
Total Strain	0	0.0410968
Pore Water Pressure [kPa]	0	16.8527
Excess Pore Water Pressure [kPa]	-4.72999e-34	12
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [kPa]	0.2695	208.081
Over-consolidation Ratio	1	1
Void Ratio	0	0
Permeability [m/y]	0.002943	0.01962
Coefficient of Consolidation [m^2/y]	1	2
Hydroconsolidation Settlement [cm]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	1.58598

Stage: Stage 7 - 10 Years = 10 y

Data Type	Minimum	Maximum
Total Settlement [cm]	0	29.0468
Total Consolidation Settlement [cm]	0	29.0468
Virgin Consolidation Settlement [cm]	0	29.0468
Recompression Consolidation Settlement [cm]	0	0
Immediate Settlement [cm]	0	0
Secondary Settlement [cm]	0	0
Loading Stress ZZ [kPa]	0	49
Loading Stress XX [kPa]	-8.23403	33.7253
Loading Stress YY [kPa]	-6.41964	36.4818
Effective Stress ZZ [kPa]	0	209.005
Effective Stress XX [kPa]	-8.23403	186.91
Effective Stress YY [kPa]	-6.41964	190.287
Total Stress ZZ [kPa]	0	209.005
Total Stress XX [kPa]	-8.23403	186.91
Total Stress YY [kPa]	-6.41964	190.287
Modulus of Subgrade Reaction (Total) [kPa/m]	0	221.229
Modulus of Subgrade Reaction (Immediate) [kPa/m]	0	0
Modulus of Subgrade Reaction (Consolidation) [kPa/m]	0	221.229
Total Strain	0	0.049
Pore Water Pressure [kPa]	0	4.85595
Excess Pore Water Pressure [kPa]	-6.39232e-13	1.95969e-13
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [kPa]	0.2695	208.081
Over-consolidation Ratio	1	1
Void Ratio	0	0
Permeability [m/y]	0.002943	0.01962
Coefficient of Consolidation [m^2/y]	1	2
Hydroconsolidation Settlement [cm]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	1.58598

Stage: Stage 8 - 50 Years = 50 y

Data Type	Minimum	Maximum
Total Settlement [cm]	0	29.0468
Total Consolidation Settlement [cm]	0	29.0468
Virgin Consolidation Settlement [cm]	0	29.0468
Recompression Consolidation Settlement [cm]	0	0
Immediate Settlement [cm]	0	0
Secondary Settlement [cm]	0	0
Loading Stress ZZ [kPa]	0	49
Loading Stress XX [kPa]	-8.23403	33.7253
Loading Stress YY [kPa]	-6.41964	36.4818
Effective Stress ZZ [kPa]	0	209.005
Effective Stress XX [kPa]	-8.23403	186.91
Effective Stress YY [kPa]	-6.41964	190.287
Total Stress ZZ [kPa]	0	209.005
Total Stress XX [kPa]	-8.23403	186.91
Total Stress YY [kPa]	-6.41964	190.287
Modulus of Subgrade Reaction (Total) [kPa/m]	0	221.229
Modulus of Subgrade Reaction (Immediate) [kPa/m]	0	0
Modulus of Subgrade Reaction (Consolidation) [kPa/m]	0	221.229
Total Strain	0	0.049
Pore Water Pressure [kPa]	0	4.85595
Excess Pore Water Pressure [kPa]	-8.75943e-14	2.85724e-13
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [kPa]	0.2695	208.081
Over-consolidation Ratio	1	1
Void Ratio	0	0
Permeability [m/y]	0.002943	0.01962
Coefficient of Consolidation [m^2/y]	1	2
Hydroconsolidation Settlement [cm]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	1.58598

Stage: Stage 9 - 100 Years = 100 y

Data Type	Minimum	Maximum
Total Settlement [cm]	0	29.0468
Total Consolidation Settlement [cm]	0	29.0468
Virgin Consolidation Settlement [cm]	0	29.0468
Recompression Consolidation Settlement [cm]	0	0
Immediate Settlement [cm]	0	0
Secondary Settlement [cm]	0	0
Loading Stress ZZ [kPa]	0	49
Loading Stress XX [kPa]	-8.23403	33.7253
Loading Stress YY [kPa]	-6.41964	36.4818
Effective Stress ZZ [kPa]	0	209.005
Effective Stress XX [kPa]	-8.23403	186.91
Effective Stress YY [kPa]	-6.41964	190.287
Total Stress ZZ [kPa]	0	209.005
Total Stress XX [kPa]	-8.23403	186.91
Total Stress YY [kPa]	-6.41964	190.287
Modulus of Subgrade Reaction (Total) [kPa/m]	0	221.229
Modulus of Subgrade Reaction (Immediate) [kPa/m]	0	0
Modulus of Subgrade Reaction (Consolidation) [kPa/m]	0	221.229
Total Strain	0	0.049
Pore Water Pressure [kPa]	0	4.85595
Excess Pore Water Pressure [kPa]	-2.57377e-13	7.89042e-14
Degree of Consolidation [%]	0	100
Pre-consolidation Stress [kPa]	0.2695	208.081
Over-consolidation Ratio	1	1
Void Ratio	0	0
Permeability [m/y]	0.002943	0.01962
Coefficient of Consolidation [m^2/y]	1	2
Hydroconsolidation Settlement [cm]	0	0
Average Degree of Consolidation [%]	0	100
Undrained Shear Strength	0	1.58598

Loads

1. Fill Load: "Fill Load 1"

Label	Fill Load 1
Load Type	Flexible
Area of Load	55000 m2
Load	37 kPa

Advanced Staging

Stage	Load Factor	Depth [m]
Stage 1 = 0 y	0	0
Stage 2 - Load = 0.1 y	0.25	0
Stage 3 = 0.5 y	1	0
Stage 4 = 1 y	1	0
Stage 5 - GCR Stage = 1.5 y	1	0
Stage 6 - Build = 2 y	1	0
Stage 7 - 10 Years = 10 y	1	0
Stage 8 - 50 Years = 50 y	1	0
Stage 9 - 100 Years = 100 y	1	0

Coordinates

X [m]	Y [m]
-100	0
175	0
175	200
-100	200

2. Rectangular Load: "Rectangular Load 2"

Length	12 m
Width	20 m
Rotation angle	0 degrees
Load Type	Flexible
Area of Load	240 m2
Load	12 kPa
Depth	0 m
Installation Stage	Stage 6 - Build = 2 y

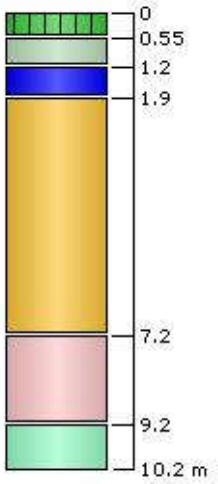
Coordinates

X [m]	Y [m]
14	95
26	95
26	115
14	115

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [m]	Depth [m]	Drained at Bottom
1	Silty sand and sandy silt	0.55	0	No
2	Clay & silty clay1	0.65	0.55	No
3	Clay	0.7	1.2	No
4	Clay & silty clay2	5.3	1.9	No
5	Clay & silty clay3	2	7.2	No
6	Very dense/stiff soil	1	9.2	No



Soil Properties

Property	Silty sand and sandy silt	Clay & silty clay1	Clay	Clay & silty clay2
Color				
Unit Weight [kN/m3]	15.69	15.69	15.69	15.69
Saturated Unit Weight [kN/m3]	19.61	19.61	19.61	19.61
K0	1	1	1	1
Primary Consolidation	Enabled	Enabled	Enabled	Enabled
Material Type	Linear	Linear	Linear	Linear
mv [m2/kN]	0.001	0.0008	0.0006	0.0006
mvur [m2/kN]	0.001	0.0008	0.0006	0.0006
Cv [m2/y]	2	1	1	1
Cvr [m2/y]	-	-	-	-
B-bar	1	1	1	1
Undrained Su A [kN/m2]	0	0	0	0
Undrained Su S	0.2	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8	0.8
Piezo Line ID	1	0	0	0

Property	Clay & silty clay3	Very dense/stiff soil
Color		
Unit Weight [kN/m3]	15.69	19.12
Saturated Unit Weight [kN/m3]	21.57	21.57
K0	1	1
Primary Consolidation	Enabled	Enabled
Material Type	Linear	Linear
mv [m2/kN]	0.0006	0.0003
mvur [m2/kN]	0.0006	0.0003
Cv [m2/y]	1	1
Cvr [m2/y]	-	-
B-bar	1	1
Undrained Su A [kN/m2]	0	0
Undrained Su S	0.2	0.2
Undrained Su m	0.8	0.8
Piezo Line ID	0	0

Groundwater

Groundwater method	Piezometric Lines
Water Unit Weight	9.81 kN/m3

Piezometric Line Entities

ID	Depth (m)
1	0 m

Query

Query Lines

Line #	Query Line Name	Start Location	End Location	Horizontal Divisions	Vertical Divisions
1	Query Line 1	2.284, 105.076	37.284, 105.076	20	Auto: 53

Field Point Grid

Number of points	362
Expansion Factor	2

Grid Coordinates

X [m]	Y [m]
312.5	337.5
312.5	-137.5
-237.5	-137.5
-237.5	337.5