Centuria Funds Management (NZ) Limited

GEOTECHNICAL SUITABILITY REPORT FOR PROPOSED SUBDIVISION

124 Tauroa Street, Whangarei

Project Reference: 18155
March 2, 2023

Document Control

Version	Date	Issued For / Comments
A	2/03/2023	Issued for Consent
		Choose an item.

Version	Issued For	Prepared By	Reviewed & Authorized By
A	Issued for Consent	**Jack Mackay-Neal** Engineering Geologist *BSc, PMEG*	**Conor Pullman** Chartered Engineering Geologist *BSc, PGDipSci, CMEngNZ (PEngGeol)*

Executive Summary

Based on the investigation and appraisal of the site reported herein, the vacant site, Lot 3 to be created by the proposed subdivision has been assessed as suitable for residential or commercial development.

A numerical slope stability analysis undertaken for the site indicates that the proposed building platform is stable under a surcharge load of 12kPa. Further slope stability analysis and specific geotechncial assessment will be required for the site if future development extends beyond the suitable area indicated in the investigation plan, building loads exceed a surcharge load of 12kPa, or fills exceed 1m in depth.

Additionally, specific foundation design will be required to address the expansive soils identified at the sites.

Adequate provision for access to the proposed site is provided in the scheme plan and access to building site can be formed with only minor earthworks required.

A site-specific geotechnical assessment should be carried out to support the design and building consent for any future buildings constructed at the lot. This report should not be supplied to council in support of building consent.

CONTENTS

1 INTRODUCTION

LDE Ltd has been engaged by Centuria Funds Management (NZ) Limited to undertake a geotechnical suitability assessment for a proposed subdivision at 124 Tauroa Street, Whangarei (Figure 1).

The proposed subdivision will create three lots from the existing site. The proposed scheme plan is shown in Figure 2 below and attached as Appendix A. Proposed Lot 1 and Lot 2 contain existing buildings. This reporting considers the vacant Lot 3 of the proposed subdivision only.

The purpose of the investigation was to determine the geotechnical suitability of the new vacant lots for development in accordance with the Resource Management Act (1991) and the Whangarei District Council (WDC) Engineering Standards (ES, 2022). The scope of our suitability assessment included consideration of any existing or potential geotechnical hazards at the nominated building site, consideration of engineering requirements for residential construction, and the servicing of each building site with respect to access, wastewater, and stormwater disposal.

2 PROPOSED DEVELOPMENT

The proposed subdivision intends to subdivide Lot 2 DP 209868 into three separate Lots (Figure 1). Lots 1 and 2 are intended to contain the existing KFC and Bunnings commercial operations within the site, with Lot 3 consisting of the remainder of the existing property and is the subject of this reporting. Lots 1 and 2 are not discussed further in this reporting.

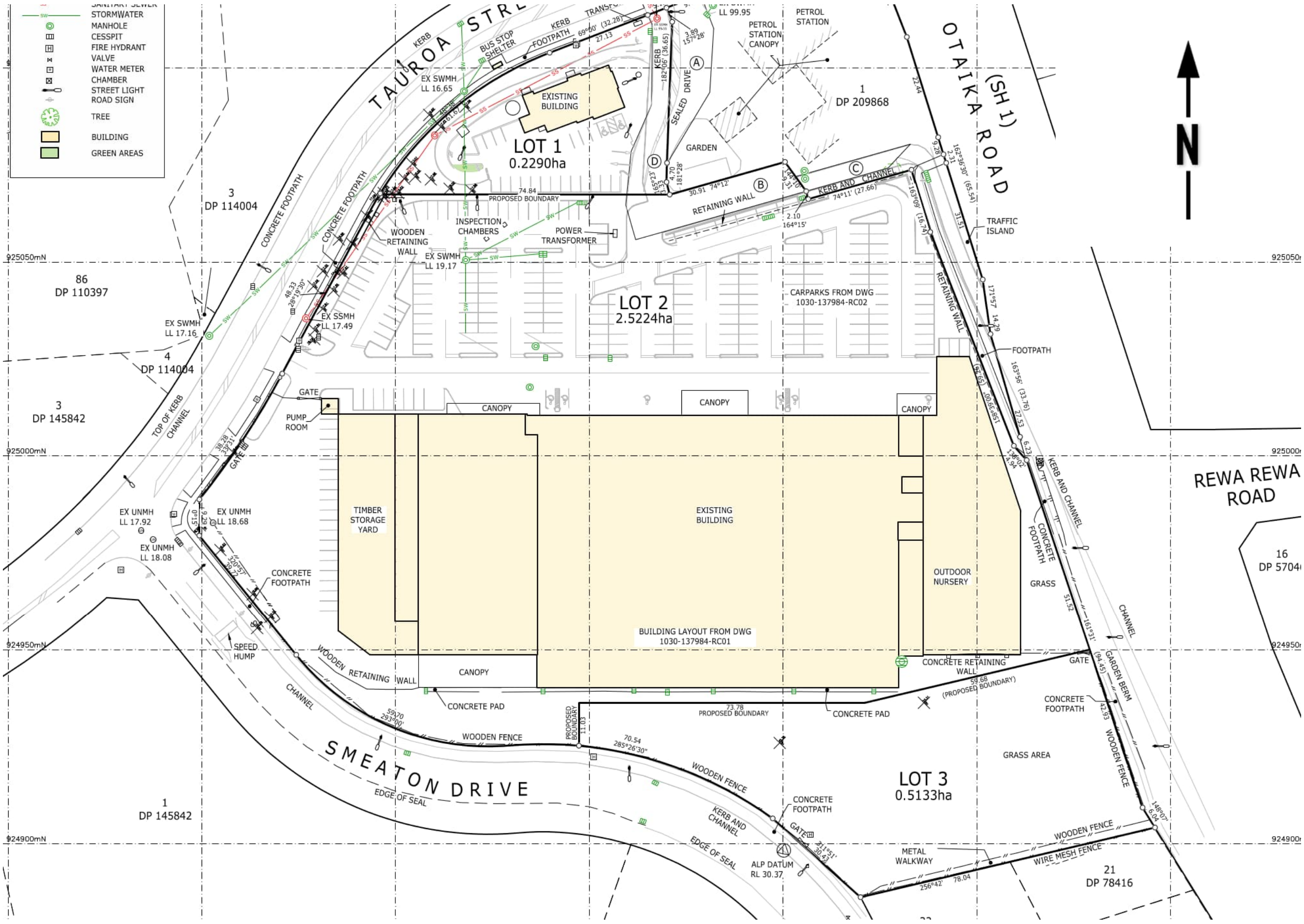


Figure 1: Proposed scheme plan. Modified from supplied Harrison Greirson plans.

3 Desktop Study

3.1 Site Description

Lot 2 DP 209868 is a commercial property located in the Whangarei suburb of Raumanga, approximately 3km south-southwest of the Whangarei CBD (Figure 2). Lot 3 of the proposed development is irregular in shape and occupies some 5133m^2. The site is gently sloping, consisting of a planar terrace of approximately 6° in the eastern third of the site, steepening to some 26° in the narrow portion at the west of the site. Elevations of the site range from between 31m at the southernmost point of the lot to 22m along the northern property boundary. Presently the site is in pasture, with minor trees and bushes located along the southern property boundary and is otherwise unimproved. The site may be accessed from Smeaton Drive by an unformed vehicle crossing.

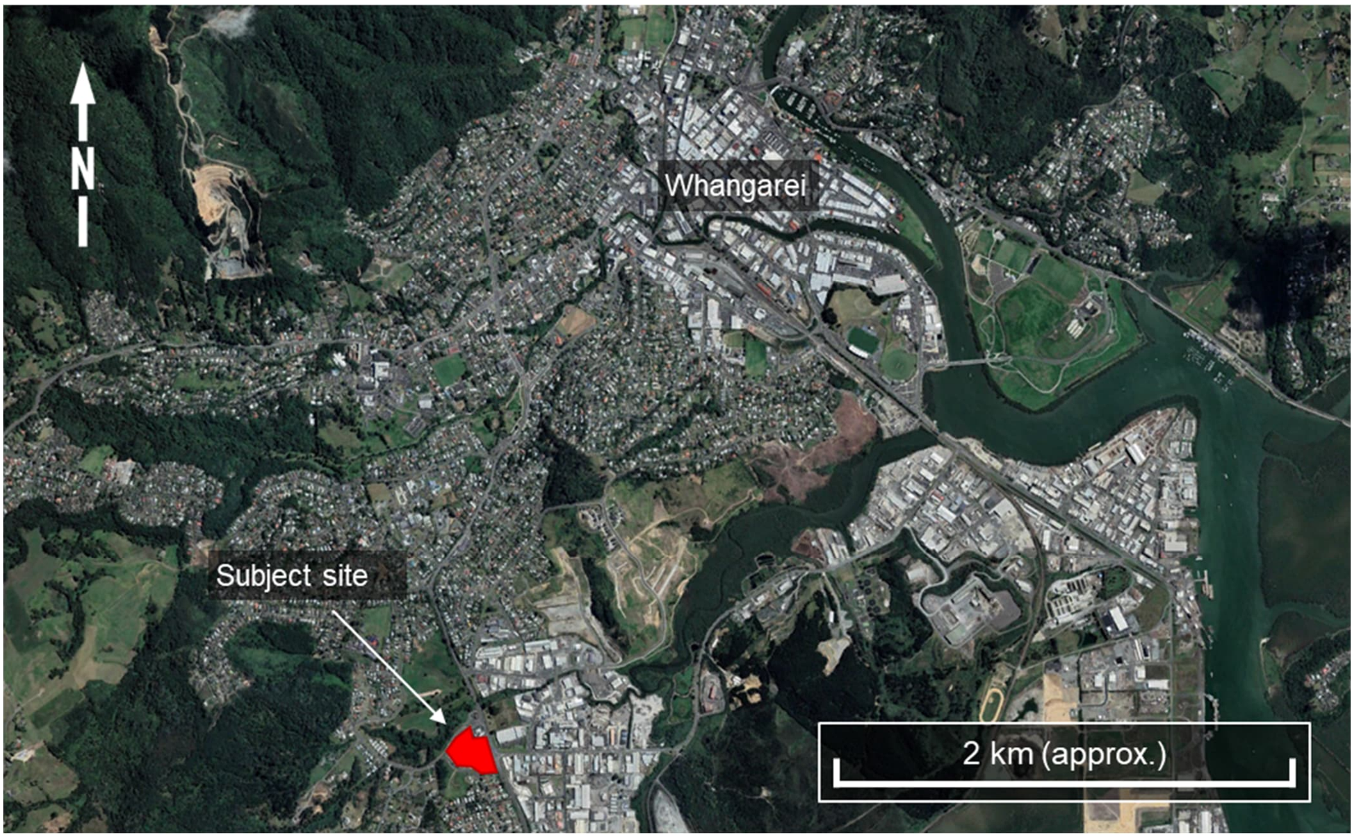


Figure 2: Location of the site (indicated in red) relative to Whangarei township. Imagery from Google Earth

3.2 GIS Mapping

A review of relevant WDC[1] and NRC[2] GIS mapping was undertaken for the site. The review identified that the site is mapped as within the high and moderate slope instability zones (Figure 3). The proposed building platform is largely located within the moderate instability zone. The site is not mapped as susceptible to any other natural hazards by either territorial authority. The property has available connections to council reticulated services. Further discussion of servicing the site is addressed further in a separate LDE Civil Infrastructure Report (reference 18155, dated 20/12/22).

[1] WDC – GIS Maps. https://gismaps.wdc.govt.nz/GISMapsGallery/
[2] NRC Local Maps. https://localmaps.nrc.govt.nz/LocalMapsGallery/

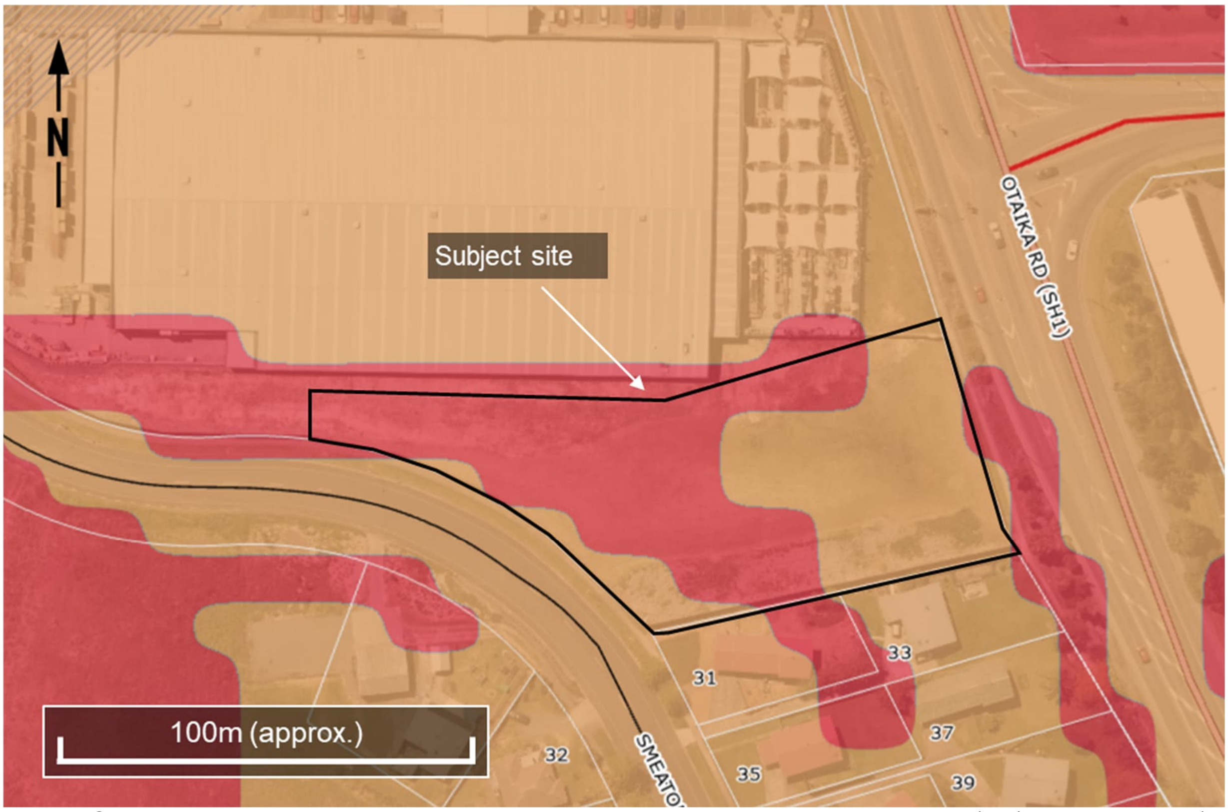


Figure 3: WDC mapped slope instability at the site. The site is situated across both the high (red) and moderate (orange) instability zones.

3.3 Historical Imagery Review

A review of historical and recent aerial imagery has been undertaken, with images sourced from Retrolens[3] and Google Earth. Initial aerial photography of the site from 1942 shows the site as unimproved and in pasture, with sporadic low-lying vegetation (Figure 4). This site condition persists across all aerial photography until 1986 where earthworks have been undertaken at the site. The imagery shows that a batter slope has been formed along the southern edge of the site, with a less steep platform formed in the northeastern corner of the site. It is not clear if the earthworks involved the placement of fill or occurred as cut only (Figure 5).

No aerial photography is available for the site between 1986 and 1999, however no changes to the site are apparent in the 1999 aerial imagery. Construction of the neighbouring Bunnings was complete by 2006. Further earthworks to the site have occurred, forming a cut batter of approximately 1V:5H along the northern extent of the property. Additionally, between 1999 and 2012 a cut batter was formed near to the southern property boundary, cut at approximately 1V:4H. In 2021 the northern edge of the site was partially cleared of vegetation and minor soil, with the spoil placed at the top of the same batter slope (Figure 6). No other changes have occurred to the site. Across all aerial imagery the site has remained unimproved, with changes to the site consisting of earthworks only. No evidence of slope instability is apparent across any of the aerial imagery.

[3] Retrolens – Historical Imagery Resource. https://retrolens.co.nz/map/. Imagery licensed by LINZ CC-BY 3.0.

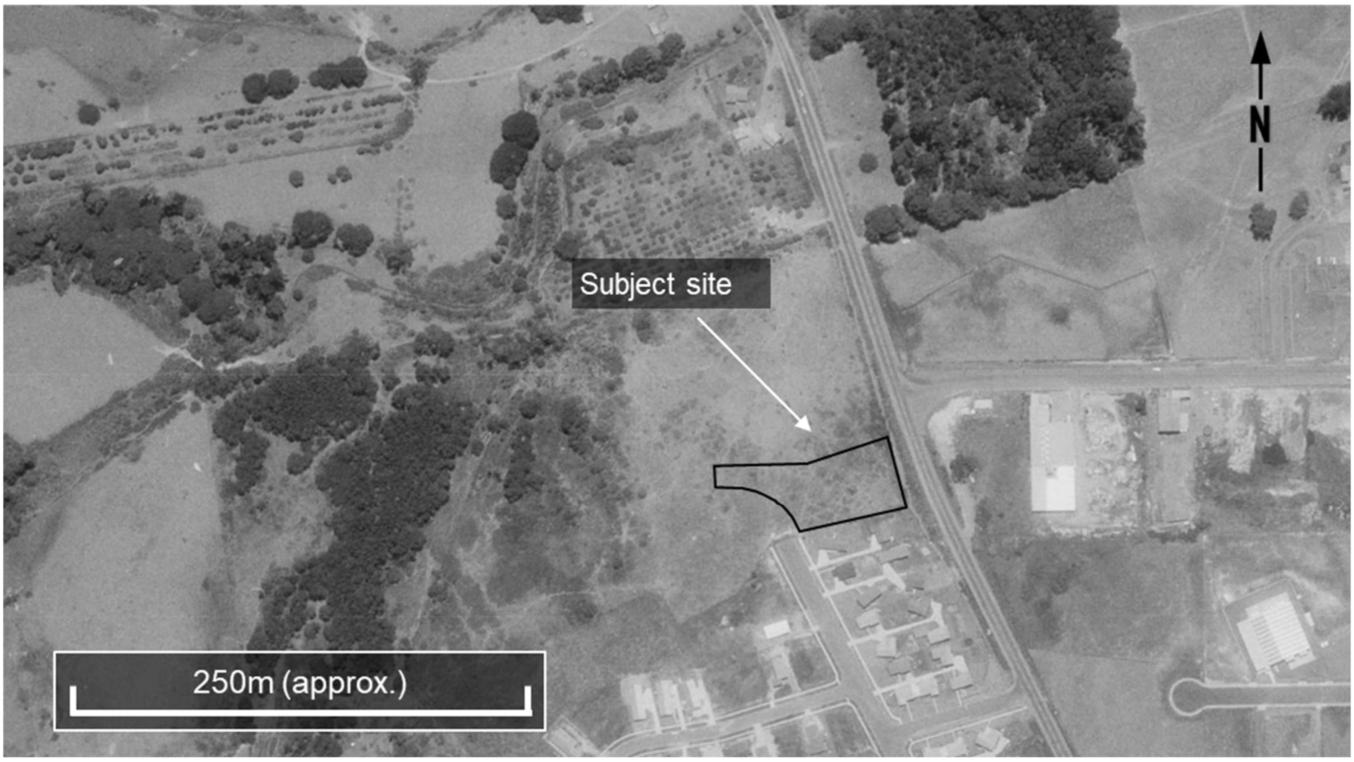


Figure 4: 1978 Retrolens imagery showing grass and vegetation on the site.

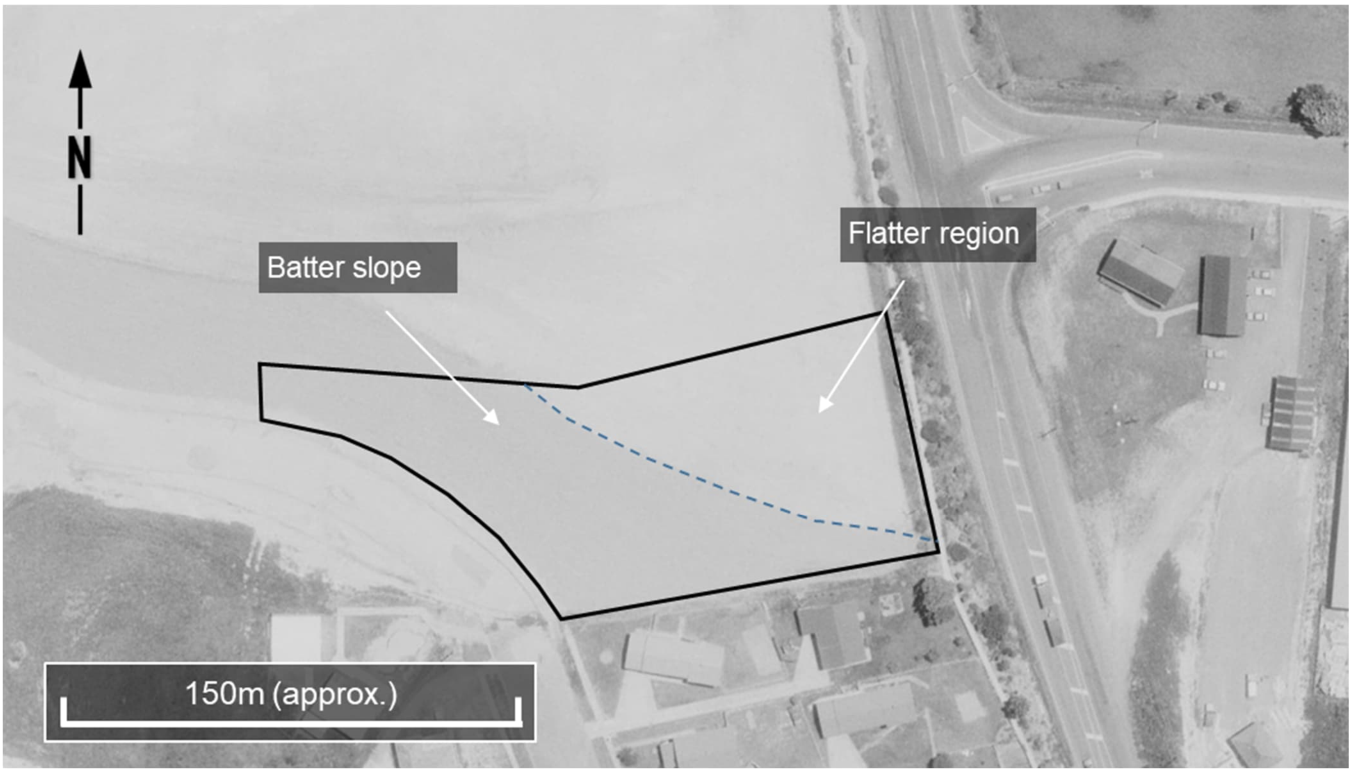


Figure 5: 1986 Retrolens imagery depicting the site cleared with earthworks having occurred.

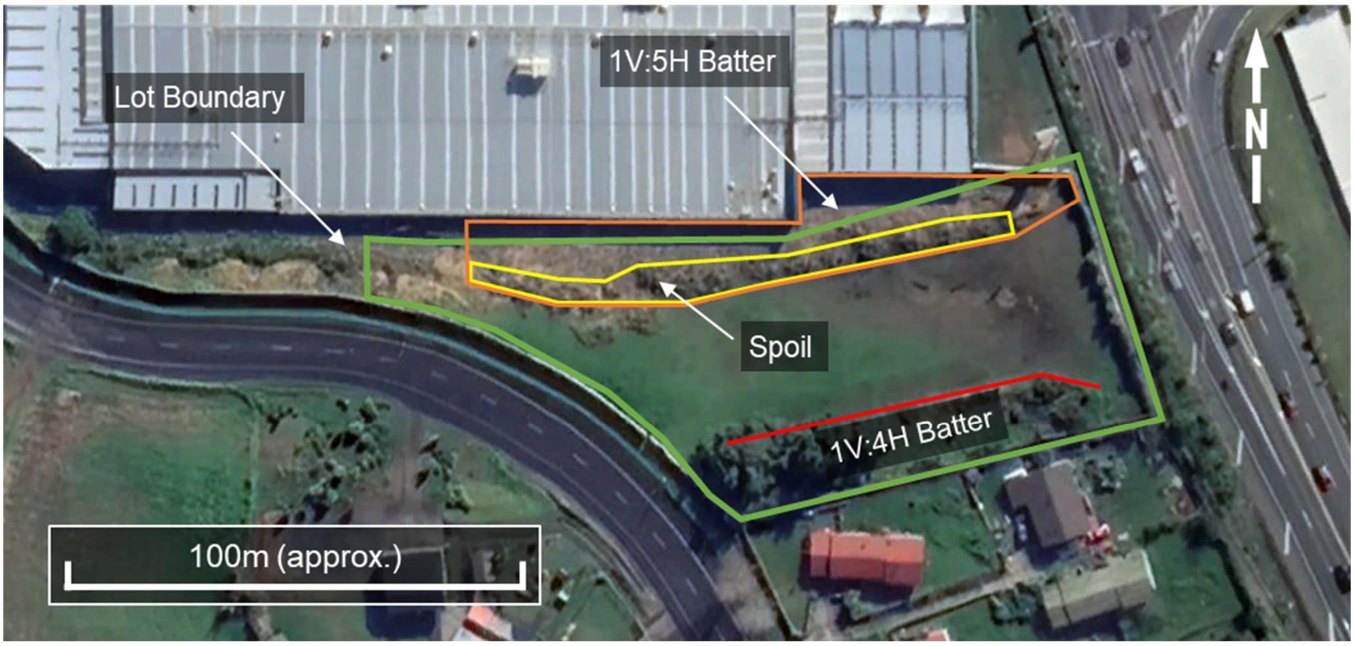


Figure 6: 2022 Google Earth imagery of the site. The 1V:5H cut batter formed at the time of Bunnings construction is outlined in orange. Spoil placed in 2021 from clearing of the site is outlined in yellow, with the approximate extent of the toe of the cut batter at the south of the site shown in red.

3.4 Past Reporting

A previous report was completed by Tonkin and Taylor for the neighbouring Bunnings development titled "Proposed Bunnings Warehouse Project, Tauroa Street, Whangarei Geotechnical Investigation", dated August 2004. This reporting considered the geotechnical considerations for the construction of Bunnings and included testing across the site. The reporting also includes testing from the initial development of the site in the 1980s. No report is available for the initial 1980s earthworks at the site; however, the geotechnical testing data is available. The report concludes that the site is not subject to deep-seated instability based on the absence of deformation of Smeaton Drive and the nearby footpath. A slope stability analysis was also undertaken on the nearby steep batter slope, which was determined to be stable provided a 5m deep retaining wall was constructed. This analysis is not considered appropriate for the proposed building platform which is located away from slopes this steep.

Testing as part of this previous reporting within, or nearby to Lot 3 included three test pits and a machine borehole put down to 10m across the site. A triaxial test was also performed on a mudstone sample from the machine borehole at 4.2m depth. Each testing location is shown in the investigation plan These testing locations are shown on the investigation plan in Appendix B. Testing logs and data are shown in Appendix E.

3.5 Site Geology

The 1:250,000 geological map of the region shows the site as being underlain by the Melange of Northland Allochthon, described as "*Melange, comprising a matrix of sheared mudstone with included tectonic blocks of Northland Allochthon, Te Kuiti Group and Waitemata Group lithologies*".

4 Ground Conditions

4.1 Subsurface Investigations

Our investigation of the site included the following work:

- Two 50mm hand augered boreholes (HA01 to HA02) put down to a target depth of 5m or refusal. Measurements of the peak undrained shear strength were taken at 200mm intervals within cohesive soils encountered down through the boreholes using a calibrated shear vane. A Scala penetrometer test was put down from the base of each borehole. Results are shown on the corresponding borehole logs.

The locations of the subsurface investigations are on the Geotechnical Investigation Plan in Appendix B. Logs of the boreholes and penetrometer tests are presented in Appendix C.

The field work was completed in February 2023.

4.2 Subsurface Conditions

In summary, our investigations generally encountered a profile of moderate strength residual soils and high strength completely weathered mudstone, consistent with the mapped Melange of Northland Allochthon bedrock and previous testing at the site.

Topsoil was encountered at the surface in HA02 to a depth of 150mm, comprising moist, slightly organic clayey silt.

Residual soil was encountered from the surface of HA01 or below topsoil in HA02, comprising stiff, highly plastic, silty clay or clayey silt soil. Shear strengths through this unit were typically >80kPa in the upper 1.6m of the soil profile, increasing to >120kPa below this. A minimum shear strength of 61kPa was recorded in HA01 at 1.6m depth and 0.6m depth in HA02.

Completely weathered Melange of Northland Allochthon mudstone was encountered below the residual soil, from 2.0m and 2.5m in HA01 and HA02 respectively. In HA01 between 2.0m and 3.3m the soil consisted of a highly plastic clayey silt. Shear strengths within this material tended to exceed 160kPa, with the lowest recording of 139kPa measured at 2.4m depth. Below 3.3m depth in HA01 and 2.5m depth in HA02 the material became hard, with all recorded shear strengths in excess of 200kPa, or otherwise unable to penetrate with the shear vane. The soil was found to comprise hard, high plasticity, silt with some clay and persisted to the base of each hand auger borehole.

Scala penetrometer testing from the base of HA01 resulted in 6 – 8 blows/50mm penetration from the base of each borehole to 5.05m depth, sharply increasing below this to refusal (≥10 blows/50mm penetration) by 5.35m depth. In HA02 Scala refusal was identified at the base of the hand auger borehole at 3.1m depth. This may be indicative of a transition to highly weathered rock.

Bedrock was not encountered in the investigation. Based on the geomorphology of the site and our experience in this unit, it is expected that slightly weathered to fresh bedrock lies at some 8 – 10m depth below the site.

4.3 Soil Moisture Profile and Groundwater Conditions

Testing was performed in February of 2023 in exceptionally wet conditions for the season. Accordingly, we expect the soil conditions to be wetter than those expected during climatic norms.

The soils beneath the building site were moist to wet down to 1.7m depth, becoming dry below this. In HA01 a wet horizon was encountered between 1.6 and 2.0m, becoming moist below this.

Groundwater was not encountered in any of the boreholes; however, we expect the permanent groundwater table to lie some8m – 10m below the surface of the subject site based on the elevation of the hill relative to the surrounding watercourses.

The moisture content of the near surface soils is expected to be higher during the winter months or extended periods of wet weather resulting in their saturation at times. The extent of the wetting front will be dependent on the duration of the period of rainfall but may extend down some 1m to 2m of the surface. Similarly, the groundwater table is expected to rise some 1m to 2m during extended periods of wet weather. In our opinion complete saturation of the slope is unlikely to occur.

4.4 Seismic Subsoil Category

We consider that the site is a Class C shallow soil site as defined by NZS 1170.5 (2004) “Structural Design Actions: Part 5: Earthquake actions – New Zealand”, based on the >3m depth of soil at the site.

5 Natural Hazards and Ground Deformation Potential

5.1 Definition and Legislation

This section summarises our assessment of the natural hazards within the property as broadly required by Section 106 of the Resource Management Act (1991 and subsequent amendments) and including geotechnical hazards given Section 71(3) of the Building Act (2004). This includes erosion, inundation, subsidence, and slippage.

This section also includes our assessment of ground beneath the building site which is outside the definition of “Good Ground” as defined by NZS3604 (2011) “Timber Framed Buildings”.

5.2 Slope Instability

5.2.1 Visual Stability Assessment

The proposed building platform is located on a planar terrace sloping approximately 6° to the north, with steeper slopes located upslope to the south. A walkover of the site and review of aerial imagery did not identify any evidence of past slope failures or terracettes at, or nearby to the site. Given for the potential for significant loadings from future construction and vehicle traffic on the slopes and the known instability in the wider area a numerical slope stability analysis was undertaken. The selected slope cross-section considers the steepest slopes through the proposed building platform and additional loads on the slope from neighbouring buildings and Smeaton Drive.

5.2.2 Assessment Methodology

The stability of the site has been assessed based on the geomorphology of the surrounding slopes and assessment of a cross section developed of the underlying engineering geology in the Rocscience computer programme Slide2.

Soil parameters for the analyses were determined based on a back analysis of the existing cut batters at the site and a triaxial test performed on a mudstone sample from the past reporting at the site.

The design groundwater cases reviewed for the purpose of this report are the long-term groundwater condition (expected normal winter groundwater condition) and extreme ground groundwater condition (combination of long-term groundwater condition coupled with a wetting front due to a high intensity rain event) and a total saturation event of the entire hillside.

Seismic loads utilised to assess the potential for instability relating from seismic events have been based on the MBIE Earthquake Geotechnical Practice Module 1 (dated November 2021, Rev 1). A ULS event was modelled with 0.19g of ground acceleration in the seismic case.

The location of the cross section is shown on the investigation plan in Appendix B and printouts of the stability analyses are attached to this report in Appendix D.

5.2.3 Stability Assessment

The assessed cross-section was developed to include both the steepest slope profile, indicative future development loads and existing loads from nearby buildings and roadways, representing the worst-case scenario to be modelled. The cross-section extends from Smeaton Drive in the south, to approximately the centre of the garden centre of Bunnings in the north. Significant groundwater was not encountered in either our hand auger testing or previous testing at the site and has been modelled at 10m depth at the top of the section and 7m depth at the base of the section. In the extreme groundwater scenario, a wetting front has been modelled to saturate both the residual soil and completely weathered mudstone at the site, up to 3m depth. In the total saturation scenario, the entire slope profile has been assumed to be saturated. The southern extent of Bunnings has been modelled with a retaining wall 1m high with under piles of 1m length of 20kN/m strength in the absence of original design parameters. Surcharge loads modelled in the cross section include a 12kPa surcharge on Smeaton Drive, 5kPa surcharge for the residential dwelling upslope of the proposed building platform, 12kPa surcharge for a future building on the site and 15kPa surcharge for Bunnings. These surcharges represent the worst-case scenario for loading from vehicular traffic and the loads imparted on the ground from existing and proposed buildings.

Parameters used in the analyses are presented below in Table 1, these parameters were determined from both back analysis of the rear cut batter and triaxial testing completed at the site as part of previous reporting.

Table 1: Soil parameters for slide analysis

Layer/Lithology	Depth to top of layer	Unit Weight (kN/m^3)	Cohesion (kPa)	Phi (°)
Residual Soil	Surficial	18	2	20
Completely Weathered Mudstone	1.5m – 2.6m	18	2	22
Highly Weathered Mudstone	3.2m – 5.4m	20	0	27

5.2.4 Analysis Results

Results of the numerical slope stability analysis and generally accepted Factors of Safety are presented below in Table 2. Modelling of the slope indicates that slope failures are modelled to occur in all scenarios at within the cut batter at the southern boundary of the site. In none of the scenarios are these failures modelled to enter the proposed building platform, including the low probability complete saturation scenario.

At the time of LDE's site investigations, the cut batter at the south of the site had not failed in the recent exceptionally wet summer and Cyclone Gabrielle intense rainfall event. We therefore consider that the adopted soil parameters in the slope stability analysis to be conservative and that for the modelled development the proposed building platform is stable.

If future developments are likely to exceed surcharges modelled in this analysis, cut slopes are formed, or fill is to be placed higher than 1m above existing grade additional assessment and stability analysis shall be required.

Table 2: Generally accepted Factor of Safety for analysis types.

Analysis	Minimum Factor of Safety required	Modelled FS results (at building platform)
Long-term Groundwater	1.5	>1.5
Extreme Groundwater	1.3	>1.3
Seismic Loading	1.1	>1.1

5.3 Compressible Ground and Consolidation Settlement

Outside of topsoil no potentially compressible materials were encountered in our testing of the site. Accordingly, all topsoil should be stripped or piled through from beneath any future development at the site to prevent settlement from occurring.

5.4 Ground Shrinkage and Swelling Potential

Plastic soils can be subject to shrinkage and swelling due to soil moisture content variations which can result in apparent heaving and settlement of buildings, particularly between seasons. The magnitude of movement is a function of the reactivity of the clay minerals and the amount of clay as a fraction near surface soils. These factors are in turn associated with geological origin and the degree and nature of in-situ weathering.

The near surface soils at the site were found to be highly plastic and predominantly clay. Based on our experience and past laboratory testing in similar geological conditions, we expect that the soils are highly expansive. The site is therefore outside the definition of ‘Good Ground’ as defined in NZS3604 (2011).

Without further site-specific laboratory testing to classify the soils, we recommended that design of concrete slab foundations assume Class H1 (highly reactive) in accordance with AS2870 (2011). Specific recommendations for foundation design are given in Section 6 below.

5.5 Conclusions

From our assessment of the natural hazard and ground deformation risks presented to the proposed development we consider that the site is suitable for development, provided that the recommendations given in Section 6 are adopted.

6 ENGINEERING RECOMMENDATIONS

6.1 Site Preparation and Earthworks

The proposed building platform at the site is gently sloping and is unlikely to require significant earthworks to form a suitable platform for construction. If construction requires significant earthworks a geotechnical analysis should be undertaken to determine the suitability of the proposed works. No cut batters more than 1.5m height should be formed at the site without specific geotechnical assessment or retaining by a suitably engineered retaining wall.

6.1.1 Fills

Earth fills for building platforms should be limited to 1m depth and should be battered at a maximum of 1V:3H without specific geotechnical assessment. Where fills are expected to exceed 1m above existing grade a specific geotechnical assessment shall be undertaken.

All fill forming part of the building platform needs to be placed in a controlled manner to an engineering specification that follows the general methodology given in NZS 4431 (2022) “Engineered fill construction for lightweight structures”. This includes the design, inspection and certification of the fill by a Chartered Professional Engineer or Professional Engineering Geologist. This will be particularly important to enable the building proposed for the site to be able to be constructed in accordance with NZS3604 (2011) “Timber Framed Buildings”.

The following specification is recommended for earth fills:

1. All topsoil and unsuitable materials, including low strength ground, uncontrolled fill, rubbish etc shall be stripped from the footprint area of the fill.

2. Where fill is placed on subgrade slopes steeper than 1V:5H the subgrade shall be benched. Fill should not be placed on slopes steeper than 1V:3H without specific assessment.

3. The stripped subgrade surface should be inspected by the certifying engineer prior to placing any fill.

4. Compaction control should be principally in terms of a minimum allowable shear strength and maximum allowable air voids. Where fills are less than 1m deep, minimum shear strength and visual observation only may be appropriate. Recommended compaction control criteria are presented in the table below.

5. The testing frequency and specification should be confirmed with the contractor prior to commencing work.

Site won material is not expected to be suitable for placement as earth fill, therefore imported fill material will be required for the site. Provision should be made to ensure that the earthworks are conducted with due respect for the weather, particularly due to the low permeability and high plasticity of the underlying ground. Any fill should not be placed on to wet ground, especially if ponded water is present.

Table 3: Recommended fill compaction criteria

Undrained shear strength – for compacted clays		
	Minimum single value	140kPa
Air voids percentage		
	Average value not more than	10%
	Maximum single value	12%
Clegg Impact Value (CIV) – for compacted gravels		
	Minimum single value	25

6.1.2 Access Road Construction

Access to the proposed building platform is expected to be formed without significant earthworks. A vehicle crossing designed in accordance with the WDC ES (2022) will also be required for the site.

6.1.3 Site Contouring and Topsoiling

As soon as possible, all final cut-slopes and fill slopes should be covered with topsoil a minimum of 0.10m thick to prevent the ground from drying out readily resulting in the development of cracks.

The finished ground level should be graded so that water cannot pond against, beneath or around any future building or retaining walls for the economic life of structures. To achieve this, it will be important that the building platform beneath the topsoil grades away from the site.

Contouring should avoid the potential for concentration and discharge of surface water over point locations which could result in soil erosion or instability.

6.2 Preliminary Foundation Design Recommendations

Preliminary foundation recommendations are provided below for information only. A site and building specific geotechnical assessment, including more detailed investigation, should be undertaken to support design and building consent for future buildings at the lot.

Based on our investigation and appraisal of the building site, we expect that conventional shallow pile, concrete slab-on-grade, or raft-slab foundations will be suitable for the sites, with a geotechnical ultimate bearing capacity of 300kPa available from the surface of natural ground.

Due to the presence of expansive soils, the sites are not considered ‘Good Ground” as defined in NZS3604 (2011).

Shallow pile foundations designed in accordance with NZS3604 (2011) are expected to be suitable, provided that all piles are deepened to a minimum embedment of 0.9m below cleared ground level.

Conventional slab-on-grade foundations may be adopted without specific design in accordance with B1/AS1 Section 3.2: ‘Slab-on-ground on expansive soils’, for site Class H (highly expansive).

If foundations are intended to be a non-NZS3604 type design, then all foundations shall require specific engineering design. Raft-slab foundations are expected to be suitable for the site, subject to specific design in accordance with AS2870 (2011) and the recommendations of BRANZ Study Report 120A. Design should assume Class H1 (highly reactive) and a 500-year characteristic surface movement (y_s) of 68mm. This has been for the design ULS event.

Expansive soil site classifications may be revised at the building consent stage subject to laboratory testing and taking into account finished platform levels and the effects of any cuts or fills.

6.3 Stormwater Management

Stormwater management for the proposed lot is addressed in a separate LDE report.

7 Section 106 Statement

Subject to adoption in full of the recommendations within this report, it is our opinion in terms of Section 106 of the Resource Management Act that;

1. the land in respect of which a consent is sought, or any structure on that land, is not and is not likely to be subject to material damage by one or more natural hazards; and
2. any subsequent use that is likely to be made of the land is not likely to accelerate, worsen, or result in material damage to the land, other land or structures by one or more natural hazards: and
3. sufficient provision has been made for legal and physical access to each allotment to be created by the subdivision.

8 Limitations

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

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

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

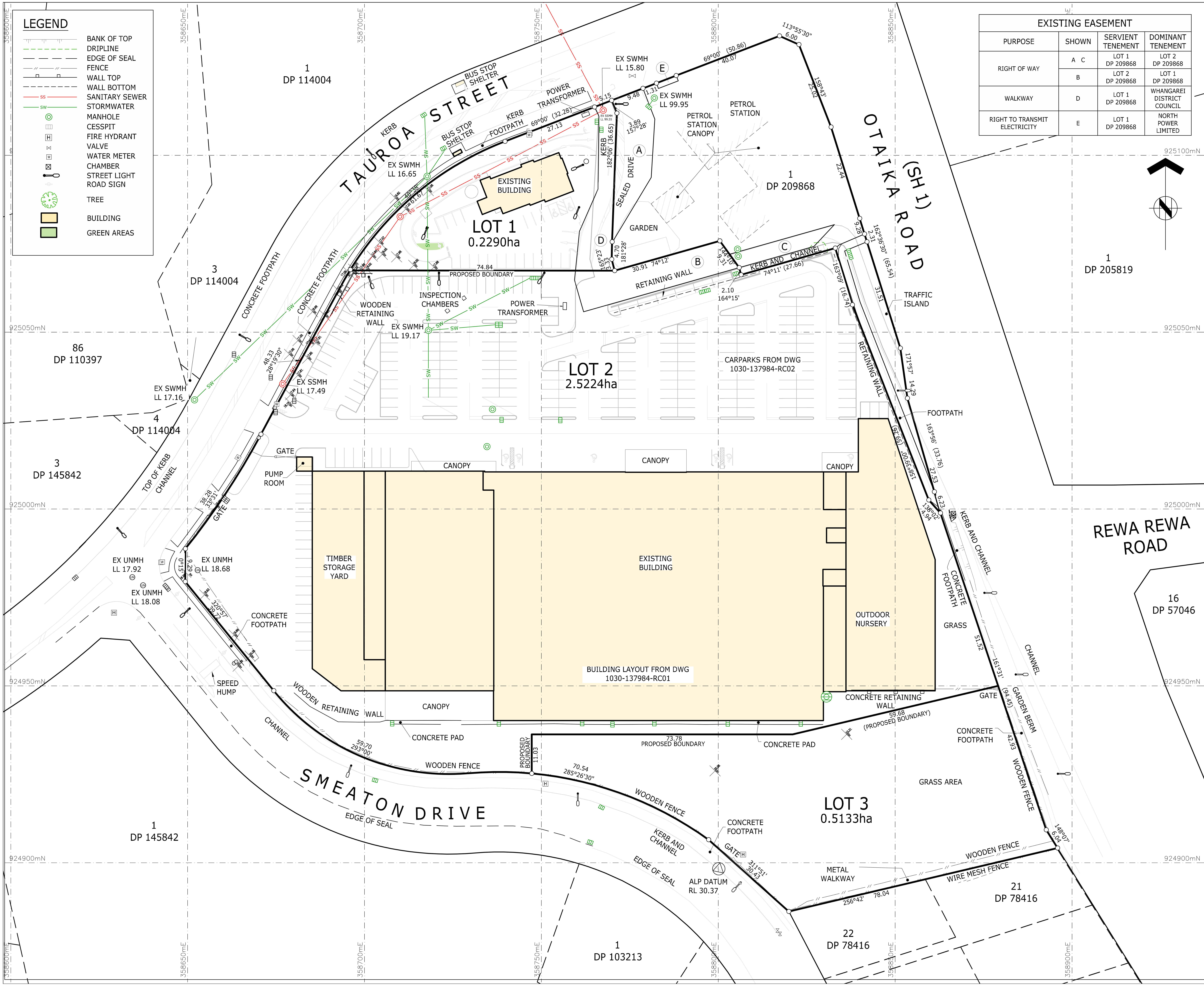
Opinions given in this report are based on visual methods and subsurface investigations at discrete locations designed to the constraints of the project scope to provide the best assessment of the environment. It must be appreciated that the nature and continuity of the subsurface materials between these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

Appendix A

Subdivision Scheme Plan

LEGEND

- BANK OF TOP
- DRIPLINE
- EDGE OF SEAL
- FENCE
- WALL TOP
- WALL BOTTOM
- SANITARY SEWER
- STORMWATER
- MANHOLE
- CESSPIT
- FIRE HYDRANT
- VALVE
- WATER METER
- CHAMBER
- STREET LIGHT
- ROAD SIGN
- TREE
- BUILDING
- GREEN AREAS



EXISTING EASEMENT

PURPOSE	SHOWN	SERVIENT TENEMENT	DOMINANT TENEMENT
RIGHT OF WAY	A C	LOT 1 DP 209868	LOT 2 DP 209868
	B	LOT 2 DP 209868	LOT 1 DP 209868
WALKWAY	D	LOT 1 DP 209868	WHANGAREI DISTRICT COUNCIL
RIGHT TO TRANSMIT ELECTRICITY	E	LOT 1 DP 209868	NORTH POWER LIMITED

ASSOCIATION OF CONSULTING ENGINEERS NEW ZEALAND

ACENZ

ISO 9001 QUALITY ASSURED

NOTES

1. LEVELS ARE IN TERMS OF MEAN SEA LEVEL.
   ORIGIN OF LEVELS
   SS 420
   RL 33.39m
2. COORDINATES ARE IN TERMS NEW ZEALAND GEODETIC DATUM 2000 MT EDEN CIRCUIT
   ORIGIN OF COORDINATES
   SS 420
   924789.48 mN
   358849.28 mE
3. CONTOURS ARE AT 0.2m INTERVALS. CONTOURS SHOWN ON THIS PLAN HAVE BEEN ELECTRONICALLY COMPUTED FROM SPOT HEIGHT DETERMINATIONS AND MAY NOT REPRESENT THE TRUE GROUND LEVELS. ANY CRITICAL HEIGHTS SHOULD BE CHECKED ON SITE PRIOR TO DESIGN AND CONSTRUCTION COMMENCING.
4. THIS PLAN HAS BEEN CARRIED OUT TO TOPOGRAPHICAL STANDARDS. ALL LEVELS SHOWN ARE CORRECT AT TIME OF SURVEY. CRITICAL DIMENSIONS AND LEVELS SHOULD BE VERIFIED.
5. BOUNDARIES SHOWN ON THIS PLAN ARE ADOPTED FROM DP 209868 AND HAVE NOT BEEN SURVEYED. A BOUNDARY DEFINITION SURVEY SHOULD BE CARRIED OUT TO ESTABLISH EXACT BOUNDARY POSITIONS ON SITE.
6. ALL EASEMENTS, COVENANTS AND OTHER LEGAL INSTRUMENTS ASSOCIATED WITH THIS SITE MAY NOT BE SHOWN ON THIS PLAN. AN INVESTIGATION OF THE MOST CURRENT LEGAL RECORDS SHOULD BE UNDERTAKEN PRIOR TO DESIGN AND CONSTRUCTION COMMENCING.
7. SERVICES POSITIONS AND ALIGNMENT MAY HAVE BEEN OBTAINED FROM THIRD PARTY RECORDS AND SHOULD BE VERIFIED ON SITE PRIOR TO CONSTRUCTION COMMENCING. HARRISON GRIERSON DOES NOT IN ANY WAY GUARANTEE THE ACCURACY OF ANY UNDERGROUND SERVICE SHOWN ON THIS PLAN.
8. THIS PLAN MAY NOT PROVIDE ENOUGH INFORMATION FOR HEIGHT TO BOUNDARY CALCULATIONS. WHERE ANY PROPOSED BUILDING OR PART THEREOF IS REQUIRED TO MEET COUNCIL'S HEIGHT IN RELATION TO BOUNDARY CONTROLS, HARRISON GRIERSON SHOULD BE CONSULTED.
9. THESE NOTES ARE AN INTEGRAL PART OF THIS PLAN.
10. THIS PLAN IS ISSUED FOR A SPECIFIC PROJECT AND MAY NOT BE ALTERED OR USED FOR ANY OTHER PURPOSE WITHOUT THE PRIOR WRITTEN CONSENT OF HARRISON GRIERSON.
11. LEGAL DESCRIPTION
    LOT 2 DP 209868
    COMPRISED IN CT NA 137C/747
    TOTAL AREA 3.2645ha

HG
AUCKLAND OFFICE
LEVEL 4, 96 ST GEORGES BAY ROAD
PARNELL AUCKLAND 1052
T +64 9 917 5000
W www.harrisongrierson.com

REF	REVISIONS	BY	DATE
A	CLIENT ISSUE	SJW	02.11.22

PROJECT:

124 TAUROA STREET LIMITED
TAUROA STREET
WHANGAREI

TITLE:

SCHEME PLAN

	DATE:	SIGNED:	
ORIGINATOR: MSB	13.03.15		PLOT BY: HSJ
DRAWN: IZC	12.10.22		PLOT DATE: 02.11.22
CHECKED: ANP	12.10.22		SURVEY BY: ANP
APPROVED: SJW	02.11.22		SURVEY DATE: 10.10.22

ISSUE STATUS: CLIENT ISSUE

PROJECT No: A2213176.00
SCALES: 1:200-A1 1:400-A2
A1

DRAWING No: 2213176-HG-XX-DR-XX-G-SC02
REV A

APPENDIX B

GEOTECHNICAL INVESTIGATION PLAN

LEGEND

Geotechnical Investigation
- Test Pit
- Hand auger + Scala
- Machine borehole
- Cross Section Line
- Lot Boundary
- Suitable Area
- Proposed Building Platform

Contours
- Major - 5m
- Minor - 1m

0 10 20 30 40 m

SCALE A3: 1:500

NOTES
1. Aerial basemap and property boundaries sourced from LINZ Data Service (CC-BY 4.0).
2. Topographic contours derived from NRC LiDAR DEM (2018-2019 survey).
3. Geotechnical investigation and proposed building platform located approximately only.
4. Suitable building area based on stability analysis only.

CLIENT
Centuria Funds Management (NZ) Ltd

PROJECT
Lot 3
124 Tauroa Street, Whangarei

DRAWING TITLE
Geotechnical Investigation Plan

LAND DEVELOPMENT & ENGINEERING LTD.

PROJECT REF	DRAWING REF	REVISION
18155	G01	A
DATE	PREPARED BY	CHECKED BY
28/02/2023	JMN	CP

FILE PATH
M-FILES\LDE - Project\Base Data v4.1.qgz

APPENDIX C

GEOTECHNICAL INVESTIGATION DATA

Hand Auger Borehole Log

LDE LAND DEVELOPMENT & ENGINEERING

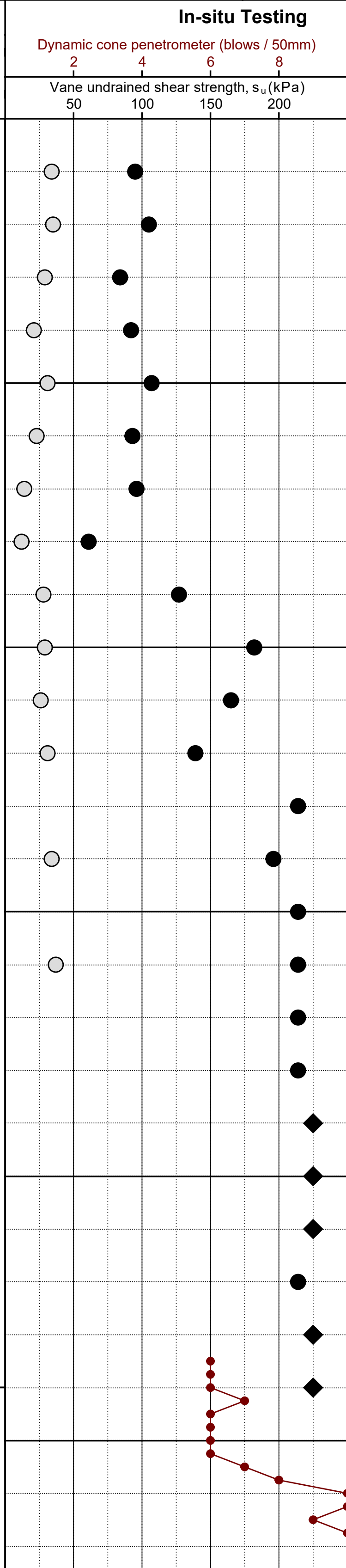
Method: 50mm Hand Auger

Test ID:	HA01
Project ID:	18155
Sheet:	1 of 1

Client:	Augusta Funds Management Ltd	**Coordinates:**	6042668mN, 1718361mE	**Test Date:**	22/02/2023
Project:	Geotechical Investigation for New Commerical Building	**System:**	NZTM	**Logged By:**	JMN
Location:	124 Tauroa Street, Whangarei	**Elevation:**	Ground	**Prepared By:**	JMN
Test Site:	5m south of northern flat platform edge	**Located By:**	Phone GPS	**Checked By:**	CP

Depth (m)	Geology	Material Description	Water
0.00 – 2.00	Residual Soil - Melange	CLAY with some silt; light orangish grey. Stiff; moist; high plasticity 0.40m - 1.50m: Becoming light grey with light orange streaks 0.80m: Becoming silty 1.20m: Dark reddish brown streaks 1.50m - 1.60m: Becoming light reddish brown 1.60m - 2.00m: Becoming light brown with light reddish brown and light grey streaks 1.80m: Becoming very stiff	Groundwater Not Encountered
2.00 – 3.30	CW Mudstone - Melange	Clayey SILT; dark reddish brown with light grey streaks. Very stiff; moist; high plasticity 2.40m - 2.60m: Becoming light brown with light grey streaks 2.60m - 2.90m: Becoming light grey 2.90m - 3.30m: Becoming hard; grey with large dark reddish grey and light orangish brown spots	
3.30 – 4.80	CW Mudstone - Melange	SILT with some clay; dark grey with orange streaks on relict joints. Hard; dry; high plasticity; friable 3.80m - 4.80m: Becoming dark reddish grey	

In-situ Testing



Values: Vane ID: 713, peak / residual (sensitivity)

Depth (m)	Values
0.2	95 / 34 (2.8)
0.4	105 / 35 (3.0)
0.6	84 / 29 (2.9)
0.8	92 / 21 (4.4)
1.0	107 / 31 (3.5)
1.2	93 / 23 (4.0)
1.4	96 / 14 (6.9)
1.6	61 / 12 (5.1)
1.8	127 / 28 (4.5)
2.0	182 / 29 (6.3)
2.2	165 / 26 (6.3)
2.4	139 / 31 (4.5)
2.6	214+
2.8	196 / 34 (5.8)
3.0	214+
3.2	214 / 37 (5.8)
3.4	214+
3.6	214+
3.8	UTP
4.0	UTP
4.2	UTP
4.4	214+
4.6	UTP
4.8	UTP

Hole Depth: 4.80m	**Termination:** Auger spinning on hard material at 4.7m

Remarks: Material sticky between 1.6m and 2.0m.

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

Legend: Vane peak; Vane residual; Vane UTP; Standing water level; Groundwater inflow; Groundwater outflow. UTP = Unable to Penetrate

Generated with CORE-GS by Geroc - HAxTP Log v9.1 - 23/02/2023 10:36:05 am

Hand Auger Borehole Log

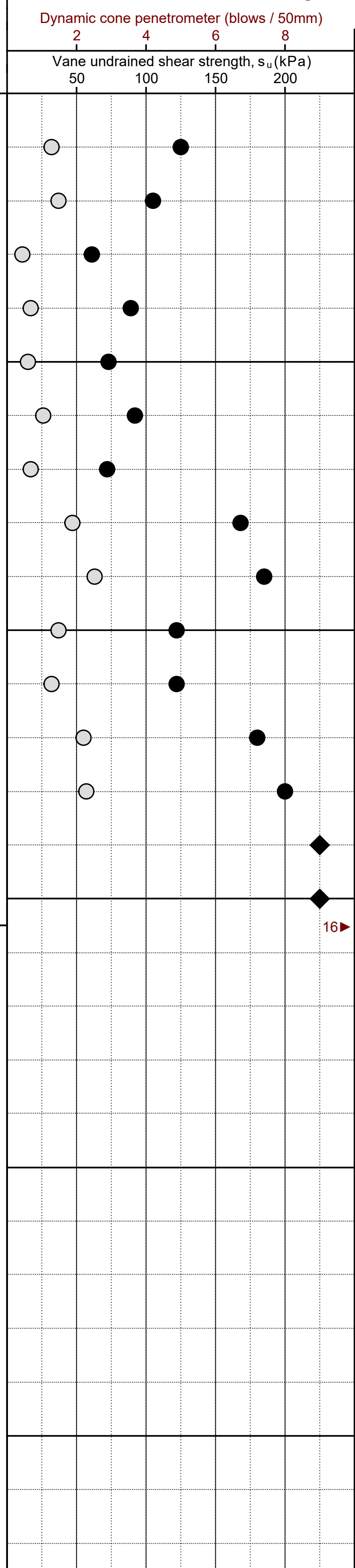
Method: 50mm Hand Auger

Test ID:	HA02
Project ID:	18155
Sheet:	1 of 1

Client:	Augusta Funds Management Ltd	**Coordinates:**	6042638mN, 1718351mE	**Test Date:**	22/02/2023
Project:	Geotechical Investigation for New Commerical Building	**System:**	NZTM	**Logged By:**	JMN
Location:	124 Tauroa Street, Whangarei	**Elevation:**	Ground	**Prepared By:**	JMN
Test Site:	Approx centre of southern boundary	**Located By:**	Phone GPS	**Checked By:**	CP

Depth (m)	Geology	Material Description	Water
0.00	Top soil	Slightly organic clayey SILT; dark brown. Very stiff; moist; high plasticity; rootlets	Groundwater Not Encountered
	Residual Soil - Melange	Silty CLAY; light orangish grey with orange streaks. Stiff; moist; high plasticity	
	Residual Soil - Melange	Clayey SILT; light grey with orangish grey streaks. Stiff; moist; high plasticity	
	Residual Soil - Melange	Silty CLAY; light brown with light orange and light grey streaks. Stiff; moist; high plasticity	
		1.70m - 2.00m: Becoming very stiff; dark reddish brown	
		2.00m - 2.15m: Becoming grey with reddish brown streaks	
		2.15m - 2.50m: Becoming dark brownish grey with reddish brown streaks	
2.5	CW Mudstone - Melange	Clayey SILT; dark reddish grey with grey streaks. Hard; moist; high plasticity	
		2.80m - 3.00m: Becoming brown with dark grey and dark reddish grey streaks	
		3.00m - 3.10m: Becoming dark reddish brown with very large dark grey bands	

In-situ Testing



Values — Vane ID: 713, peak / residual (sensitivity)

Depth (m)	Values
0.2	125 / 32 (3.9)
0.4	105 / 37 (2.8)
0.6	61 / 11 (5.5)
0.8	89 / 17 (5.2)
1.0	73 / 15 (4.9)
1.2	92 / 26 (3.5)
1.4	72 / 17 (4.2)
1.6	168 / 47 (3.6)
1.8	185 / 63 (2.9)
2.0	122 / 37 (3.3)
2.2	122 / 32 (3.8)
2.4	180 / 55 (3.3)
2.6	200 / 57 (3.5)
2.8	UTP
3.0	UTP

Hole Depth: 3.10m

Termination: Auger spinning on hard material at 3.1m

Remarks:

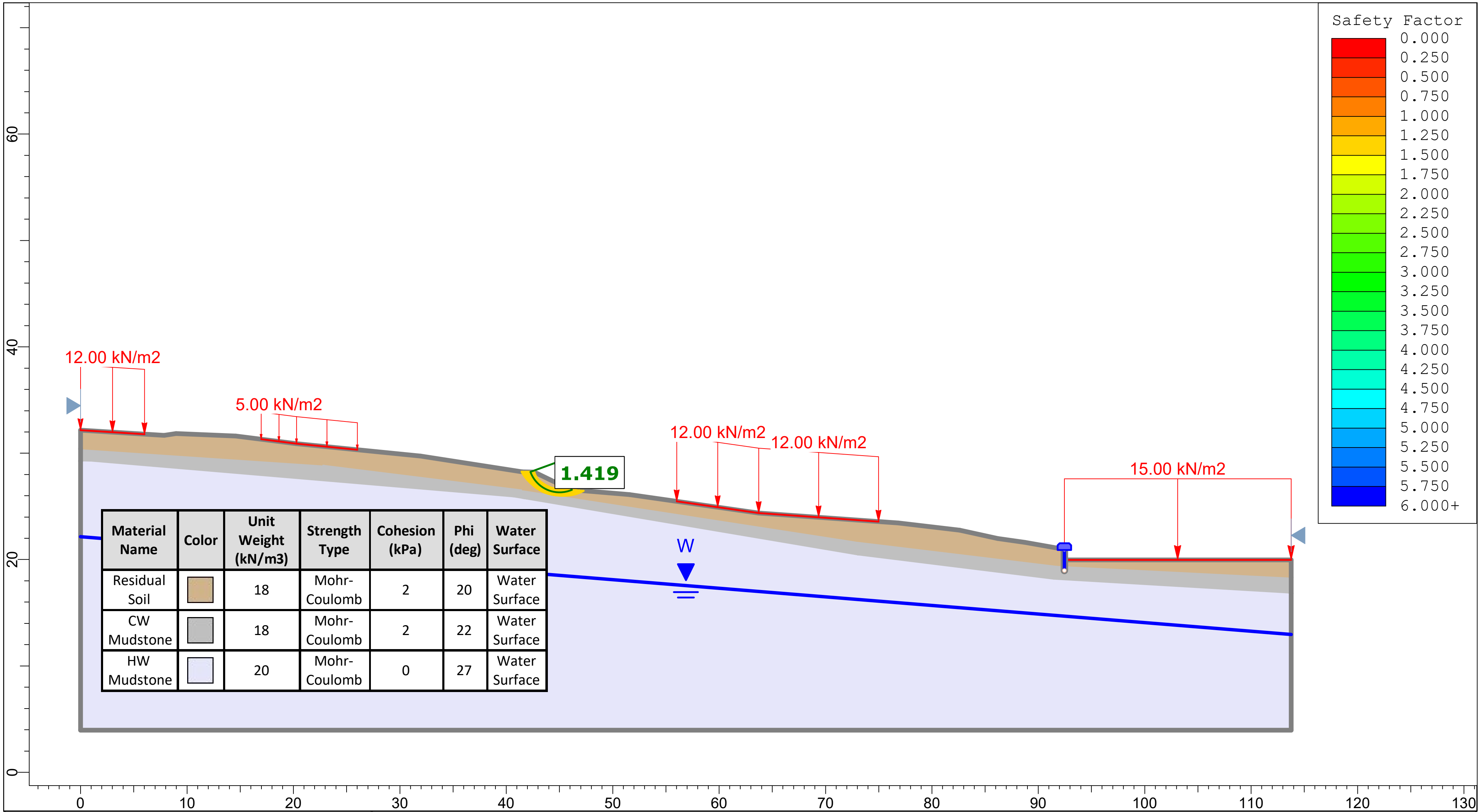
Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

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

UTP = Unable to Penetrate

Appendix D

Stability Analyses



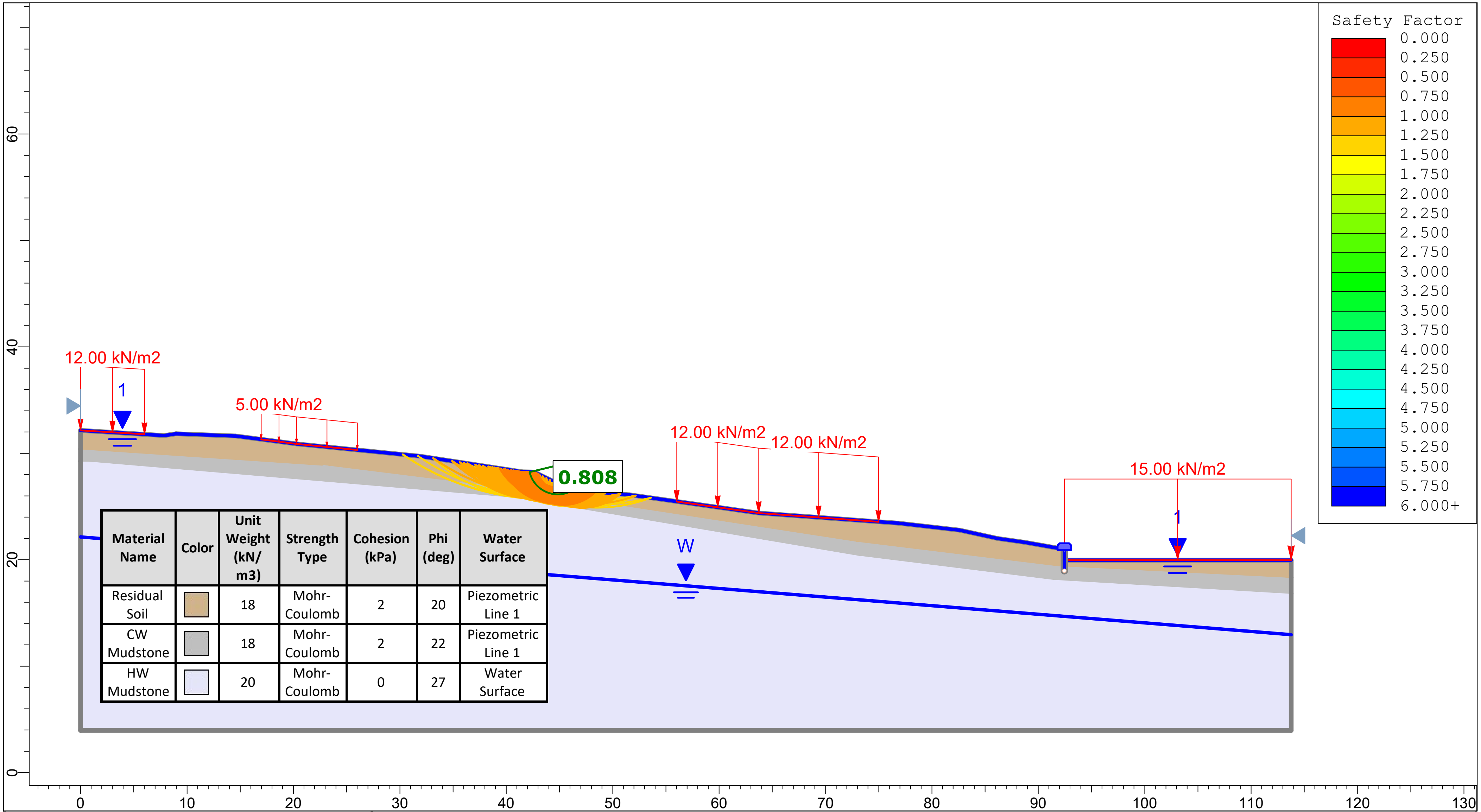
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface
Residual Soil		18	Mohr-Coulomb	2	20	Water Surface
CW Mudstone		18	Mohr-Coulomb	2	22	Water Surface
HW Mudstone		20	Mohr-Coulomb	0	27	Water Surface

LAND DEVELOPMENT & ENGINEERING LTD.

SLIDEINTERPRET 9.023

Project	Lot 3, 124 Tauroa Street, Raumanga
Scenario Longterm Groundwater	*Analysis* Circular - FS < 1.5
Drawn By JMN	*Date* 23/02/2023

C:\Users\j.mackay\Desktop\18155 Slide1.slmd

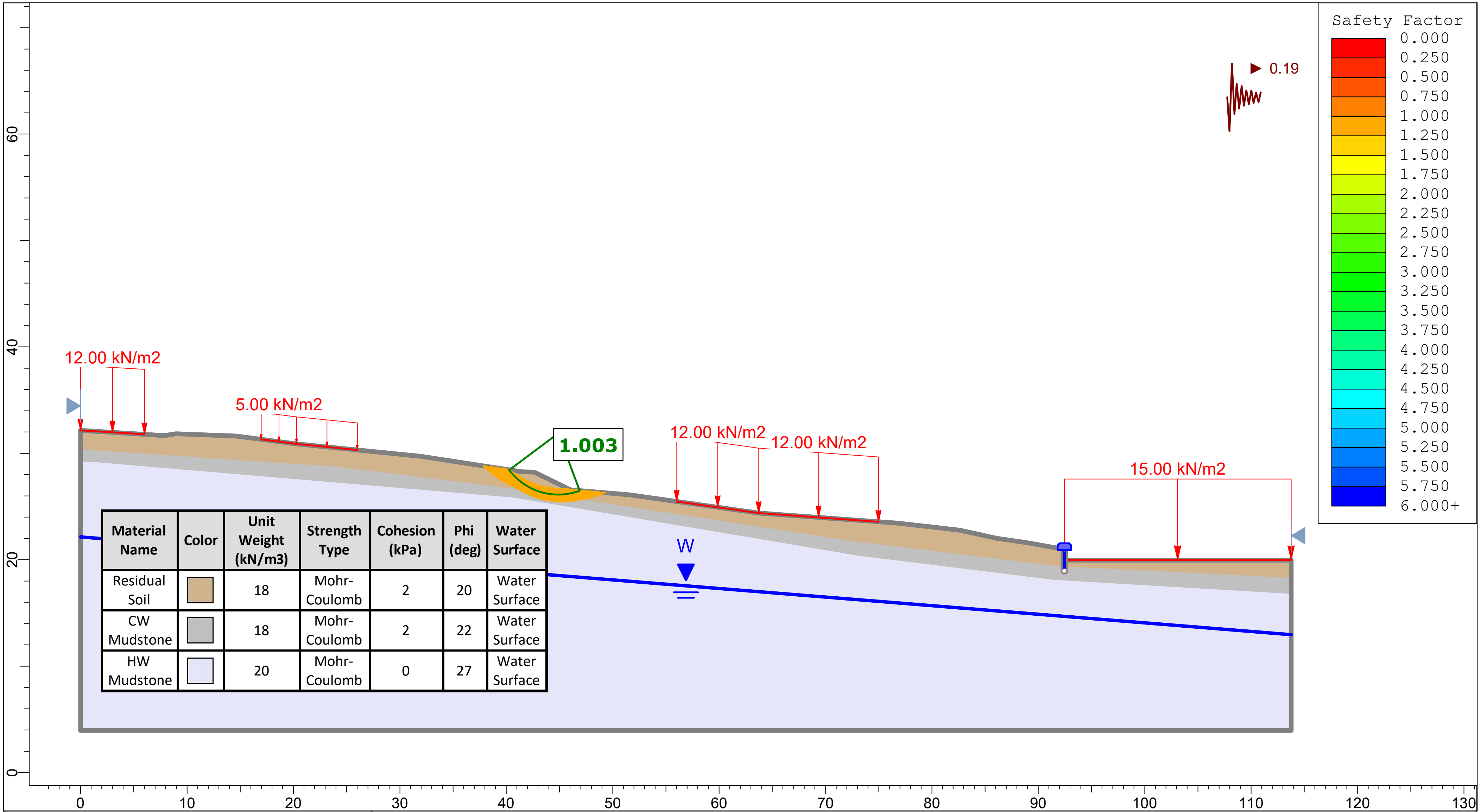


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface
Residual Soil		18	Mohr-Coulomb	2	20	Piezometric Line 1
CW Mudstone		18	Mohr-Coulomb	2	22	Piezometric Line 1
HW Mudstone		20	Mohr-Coulomb	0	27	Water Surface

LAND DEVELOPMENT & ENGINEERING LTD.

SLIDEINTERPRET 9.023

Project	Lot 3, 124 Tauroa Street, Raumanga
Scenario	Extreme Wetting Front
Analysis	Circular - FS < 1.3
Drawn By	JMN
Date	23/02/2023
	C:\Users\j.mackay\Desktop\18155 Slide1.slmd

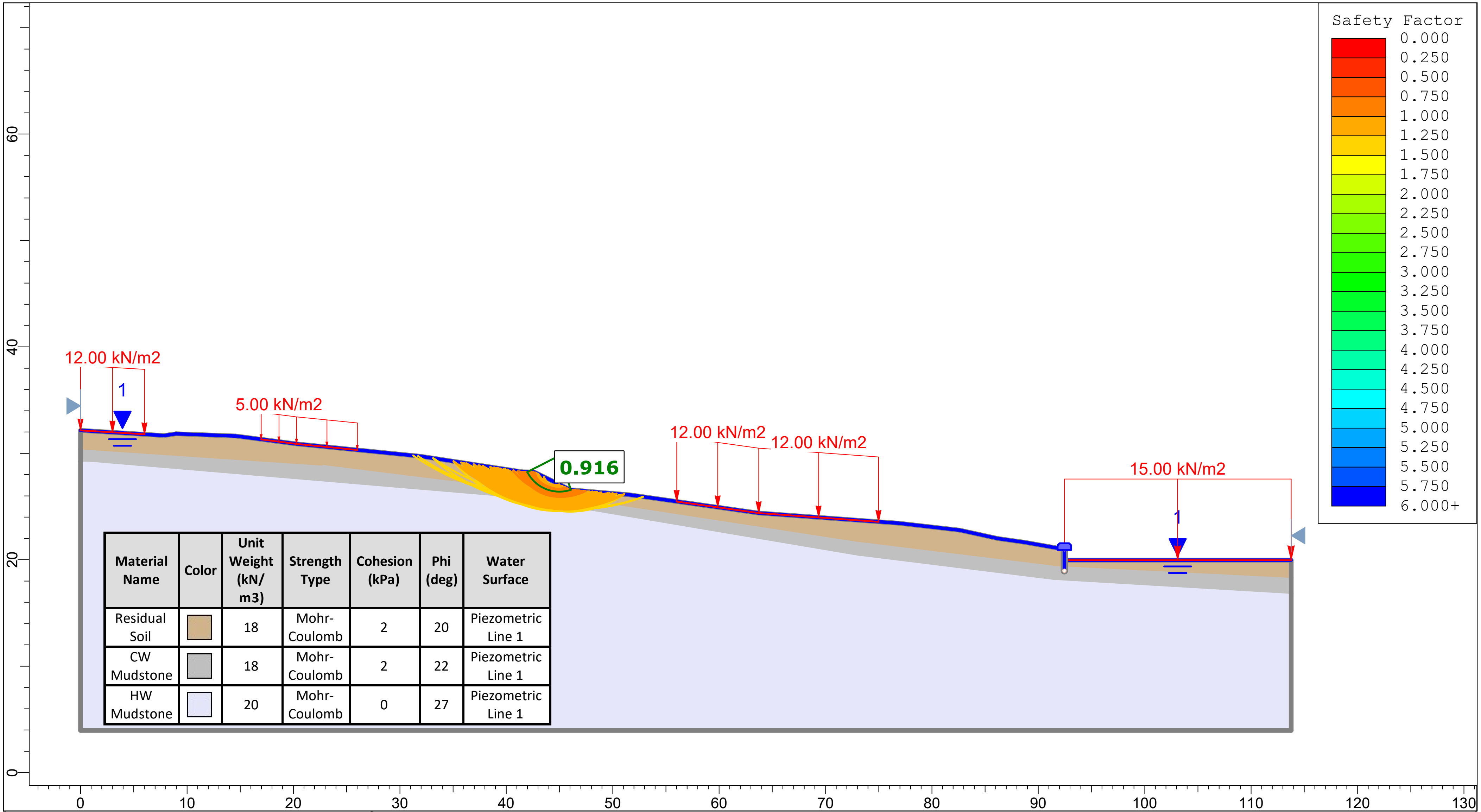


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface
Residual Soil		18	Mohr-Coulomb	2	20	Water Surface
CW Mudstone		18	Mohr-Coulomb	2	22	Water Surface
HW Mudstone		20	Mohr-Coulomb	0	27	Water Surface

LAND DEVELOPMENT & ENGINEERING LTD.

SLIDEINTERPRET 9.023

Project	Lot 3, 124 Tauroa Street, Raumanga
Scenario Seismic	*Analysis* Circular - FS < 1.1
Drawn By JMN	*Date* 23/02/2023
C:\Users\j.mackay\Desktop\18155 Slide1.slmd	

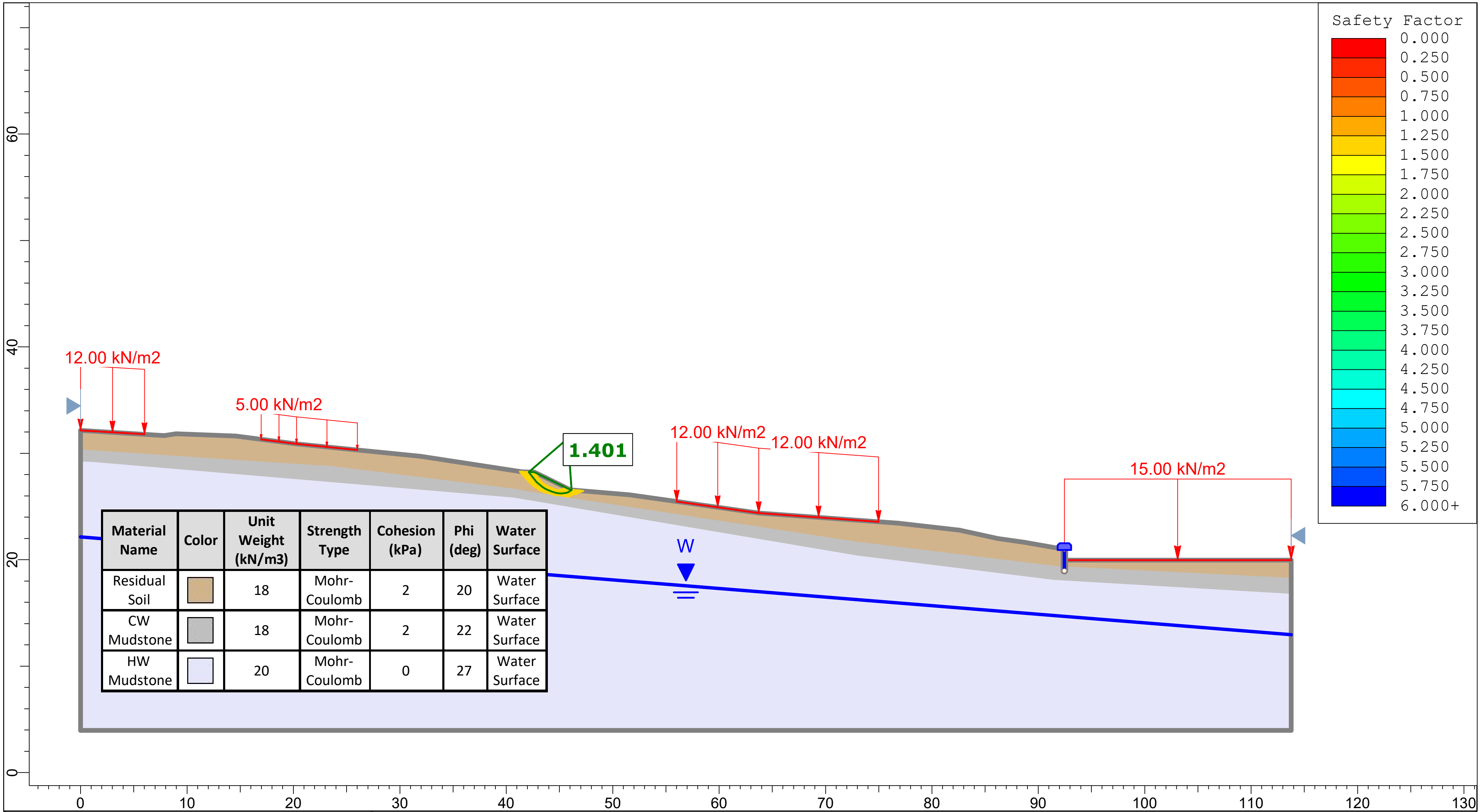


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface
Residual Soil		18	Mohr-Coulomb	2	20	Piezometric Line 1
CW Mudstone		18	Mohr-Coulomb	2	22	Piezometric Line 1
HW Mudstone		20	Mohr-Coulomb	0	27	Piezometric Line 1

LAND DEVELOPMENT & ENGINEERING LTD.

SLIDEINTERPRET 9.023

Project Lot 3, 124 Tauroa Street, Raumanga	
Scenario Total Saturation	*Analysis* Circular - FS < 1.3
Drawn By JMN	*Date* 23/02/2023
C:\Users\j.mackay\Desktop\18155 Slide1.slmd	



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface
Residual Soil		18	Mohr-Coulomb	2	20	Water Surface
CW Mudstone		18	Mohr-Coulomb	2	22	Water Surface
HW Mudstone		20	Mohr-Coulomb	0	27	Water Surface

LAND DEVELOPMENT & ENGINEERING LTD.

SLIDEINTERPRET 9.023

Project
Lot 3, 124 Tauroa Street, Raumanga

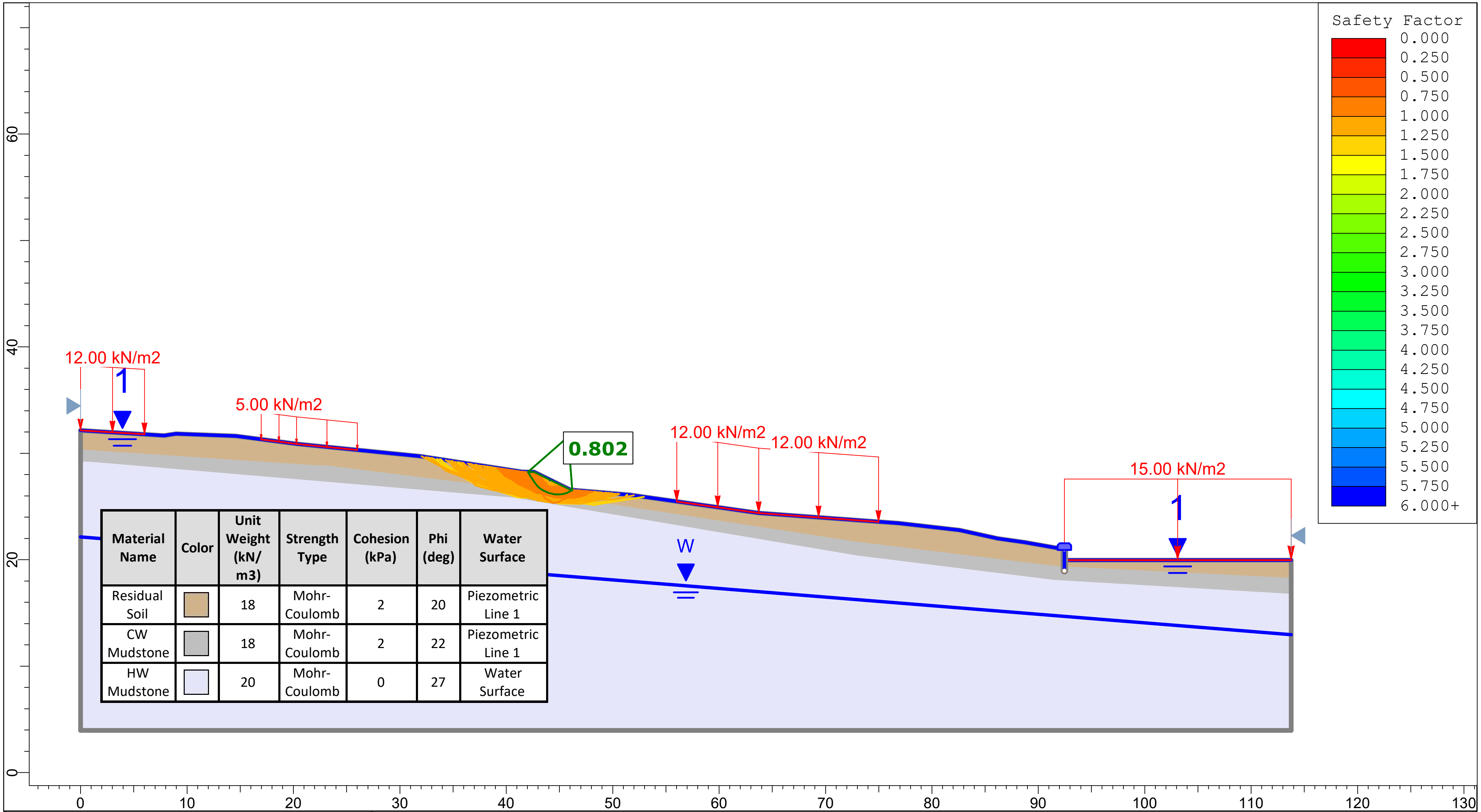
Scenario
Longterm Groundwater

Analysis
Non-Circular - FS < 1.5

Drawn By
JMN

Date
23/02/2023

C:\Users\j.mackay\Desktop\18155 Slide1.slmd

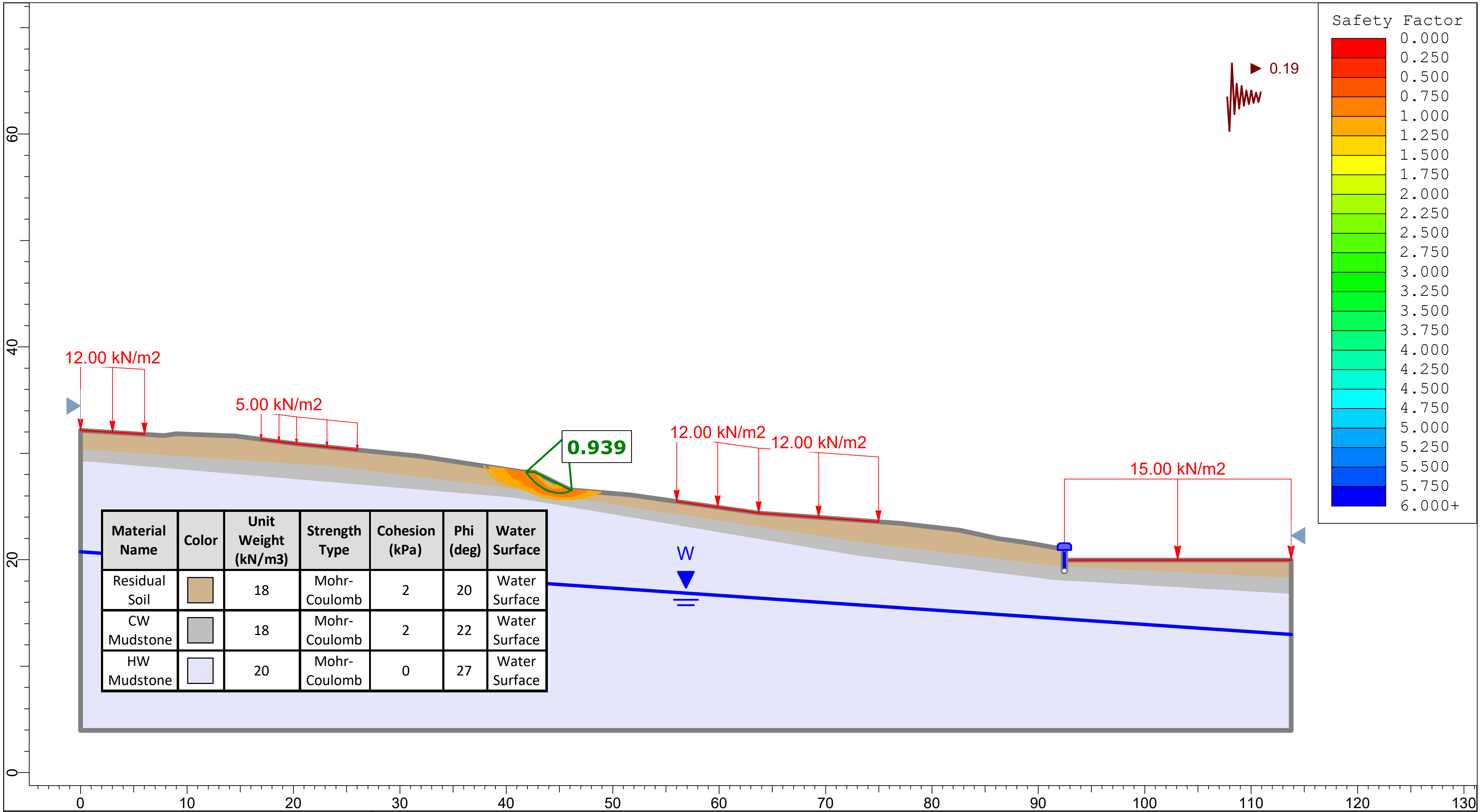


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface
Residual Soil		18	Mohr-Coulomb	2	20	Piezometric Line 1
CW Mudstone		18	Mohr-Coulomb	2	22	Piezometric Line 1
HW Mudstone		20	Mohr-Coulomb	0	27	Water Surface

LAND DEVELOPMENT & ENGINEERING LTD.

SLIDEINTERPRET 9.023

Project	Lot 3, 124 Tauroa Street, Raumanga
Scenario	Extreme Wetting Front
Analysis	Non-Circular - FS < 1.3
Drawn By	JMN
Date	23/02/2023
	C:\Users\j.mackay\Desktop\18155 Slide1.slmd



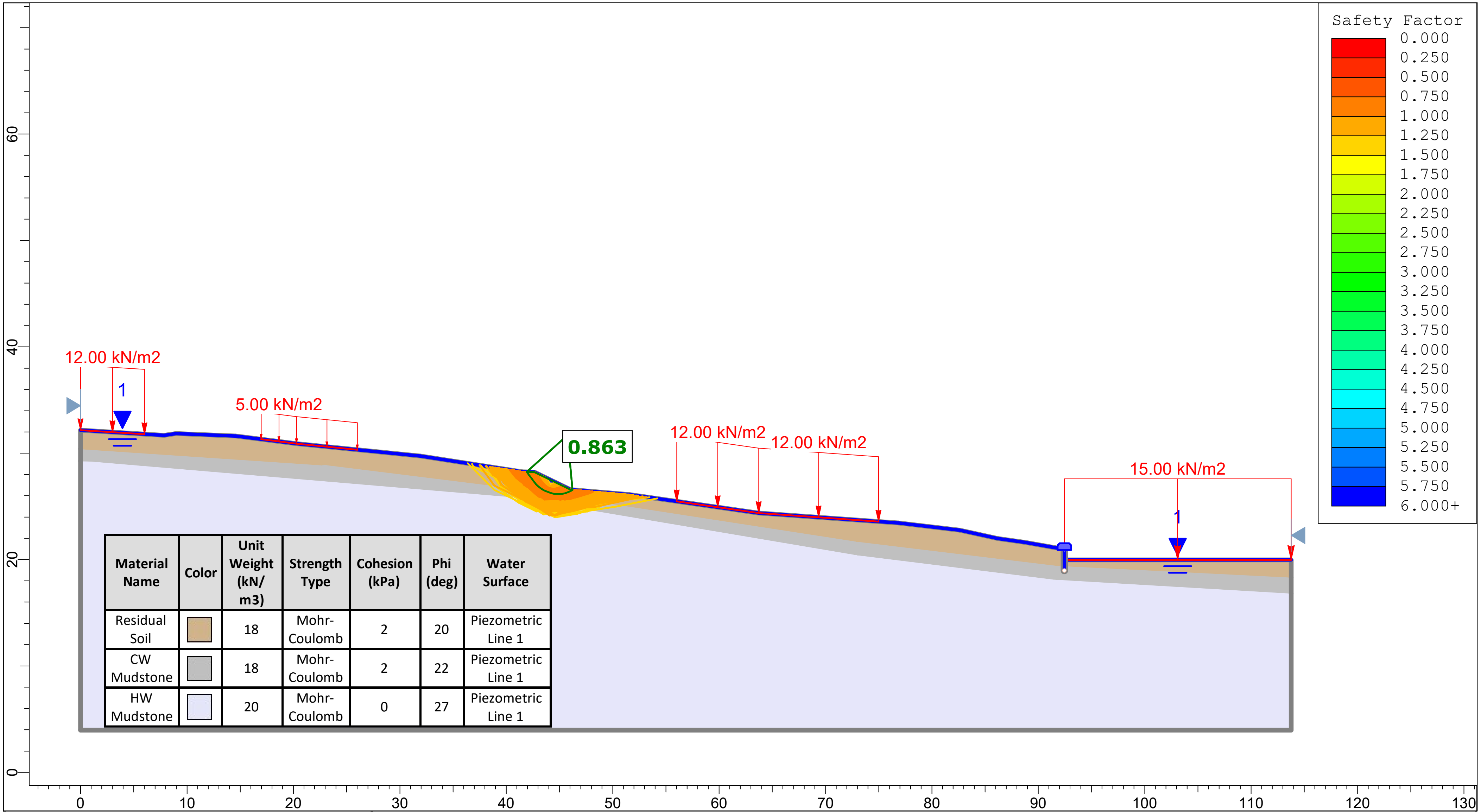
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface
Residual Soil		18	Mohr-Coulomb	2	20	Water Surface
CW Mudstone		18	Mohr-Coulomb	2	22	Water Surface
HW Mudstone		20	Mohr-Coulomb	0	27	Water Surface

LAND DEVELOPMENT & ENGINEERING LTD.

SLIDEINTERPRET 9.023

Project	Lot 3, 124 Tauroa Street, Raumanga
Scenario	Seismic
Analysis	Non-Circular - FS < 1.1
Drawn By	JMN
Date	23/02/2023

C:\Users\j.mackay\Desktop\18155 Slide1.slmd



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface
Residual Soil		18	Mohr-Coulomb	2	20	Piezometric Line 1
CW Mudstone		18	Mohr-Coulomb	2	22	Piezometric Line 1
HW Mudstone		20	Mohr-Coulomb	0	27	Piezometric Line 1

LAND DEVELOPMENT & ENGINEERING LTD.

SLIDEINTERPRET 9.023

Project	Lot 3, 124 Tauroa Street, Raumanga
Scenario	Total Saturation
Analysis	Non-Circular - FS < 1.1
Drawn By	JMN
Date	23/02/2023
	C:\Users\j.mackay\Desktop\18155 Slide1.slmd

APPENDIX E

EXTERNAL DATA

TONKIN & TAYLOR LTD

EXCAVATION LOG

EXCAVATION No: TP9
Location: Refer to Site Plan
SHEET 1 OF 1

PROJECT: Bunnings Warehouse		LOCATION: Tauroa Street, Whangarei		JOB No:	21969
CO-ORDINATES	mN mE	EXPOSURE TYPE:	Test Pit	HOLE STARTED:	24/08/04
		EQUIPMENT:	Hitachi EX100	HOLE FINISHED:	24/08/04
R.L.	m	OPERATOR:	Ross Taylor	LOGGED BY:	M.E.F.G
DATUM		DIMENSIONS:	0.9m(L)x2.5m(W)x3.5m(D)	CHECKED BY:	

EXCAVATION TESTS: SAMPLES, TESTS	WATER	DEPTH (m)	ENGINEERING DESCRIPTION: SOIL NAME, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, SECONDARY AND MINOR COMPONENTS	MOISTURE CONDITION / WEATHERING	STRENGTH / DENSITY CLASSIFICATION	GEOLOGICAL: ORIGIN TYPE, MINERAL COMPOSITION, DEFECTS, STRUCTURE
	DRY ON COMPLETION	0–0.5	SILT, clayey, moderately plastic, light grey mottled orange brown, limonite staining, friable.	D	VSt	COMPLETELY WEATHERED NORTHERN ALLOCHTHON
• 159/29kPa • 204/29kPa • 223+kPa • UTP		0.5–2.5	CLAY, silty, highly plastic, dark grey mottled purple/brown, numerous smooth bedding planes.		H	-Shear surfaces parallel on relic bedding planes, dip direction 050° dip 6°
		2.5–3.5	MUDSTONE and SILTSTONE, intermixed and interbedded, dark grey mottled, dark purple brown, dry crumbly when excavated.	EXW/VW VW/W		MODERATELY WEATHERED NORTHERN ALLOCHTHON
		3.5	END OF TEST PIT AT 3.5m Excavator struggling to penetrate.	W/MS		

SKETCH

SITE: SOUTHDALE COMMERCIAL CENTRE, WHANGAREI	BOREHOLE No. 1
JOB No: 6338 DATE DRILLED: 30/5/84 RL GROUND: 28.40m	SHEET 1 OF 1

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	SAMPLE NUMBER
TOPSOIL				
CLAY, silty slightly organic, stiff, dark yellow - light grey. Fibreous root inclusions - organic staining fissured/blocky structure		1	● ●	1, 2
- less silt			▮	3
- more silt light grey with yellow staining		2, 3	● ●	4, 5
SILT, clayey, stiff, light grey with red-brown pockets (Completely weathered Onerahi Chaos)		4	● ●	6, 7
SILT, clayey, hard, dk. grey (moderately weathered Onerahi Chaos)			▮	8
SILT, slightly clayey, hard, dark grey with red/brown pockets. Blocky, shattered structure - weakly cemented		5	●	9
- moderately cemented dark grey/ green with red/brown pockets		6	◉	10
Slickenside planes becoming too tight to distinguish		7	◉	11
		8	◉	12
(Onerahi Chaos)		9	◉ ◉ ◉	13, 14, 15
End of borehole at 10.0m		10		

UNDRAINED SHEAR STRENGTH K Pa

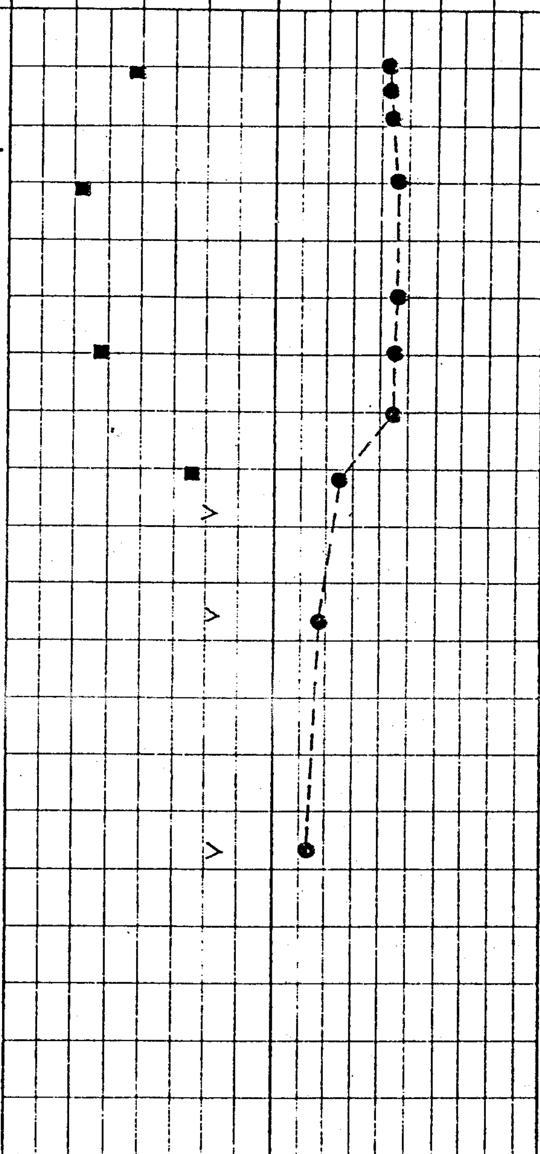
laboratory vane tests

50 100 150

NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%)

W_p W W_L

20 40 60 80 100



NOTES: ✳ = Slickenside fracture

DRILL METHOD: DRILLING RIG (FAILING 1250)

TONKIN & TAYLOR CONSULTING CIVIL AND FOUNDATION ENGINEERS

SITE: SOUTHDALE COMMERCIAL CENTRE, WHANGAREI

JOB No: 6338 DATE DRILLED: 1/6/84 RL GROUND: 27.44m

BOREHOLE No. 2

SHEET 1 OF 1

DESCRIPTION OF SOIL	DEPTH (m)	SAMPLE NUMBER
TOPSOIL and silt matrix		
CLAY, slightly silty very slightly organic, stiff, yellow and light grey		1
Fibreous roots and pockets of organic staining	1	2
- more silty with light grey and light yellow staining	2	3
SILT slightly clayey, stiff, light grey with dark yellow staining		4
- hard fragments and red/brown staining. Completely weathered. Onerahi Chaos Series - shattered structure.	3	5
Silt - slightly clayey, stiff-hard weakly cemented, dark grey with red/brown and light grey pockets	4	
- Hard - moderately cemented	5	6, 7
- Sample lost	6	
		8
(Moderately weathered) (Onerahi Chaos Series)	7	9, 10
	8	11, 12, 13
- rounded brown and white gravel inclusions	9	
	10	14, 15
	11	16, 17
End of borehole at 11.8m	12	
	13	

UNDRAINED SHEAR STRENGTH K Pa

NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%) W_p W W_L

NOTES: * Slickenside fracture

DRILL METHOD: DRILLING RIG (FAILING 1250)

TONKIN & TAYLOR CONSULTING CIVIL AND FOUNDATION ENGINEERS

SITE: SOUTHDALE COMMERICAL CENTRE, WHANGAREI

PIT No. P1

JOB No: 6338 DATE DRILLED: MAY 1984 RL GROUND: 27.5

SHEET 1 OF 1

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE		UNDRAINED SHEAR STRENGTH K Pa Hand held shear vane 50 100 150	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%) Wp W WL
TOPSOIL, firm, dark grey to black						
CLAY, firm, becoming stiff, dark and light yellow with occasional hard grey lumps - contains shear surfaces (appears to be weathered Onerahi material)		1.0 2.0				
CLAY, hard, dark grey - water running out of local fissures on sides of pit (not very fast) (weathered Onerahi Series)		3.0 4.0				
End of pit at 4.4m						

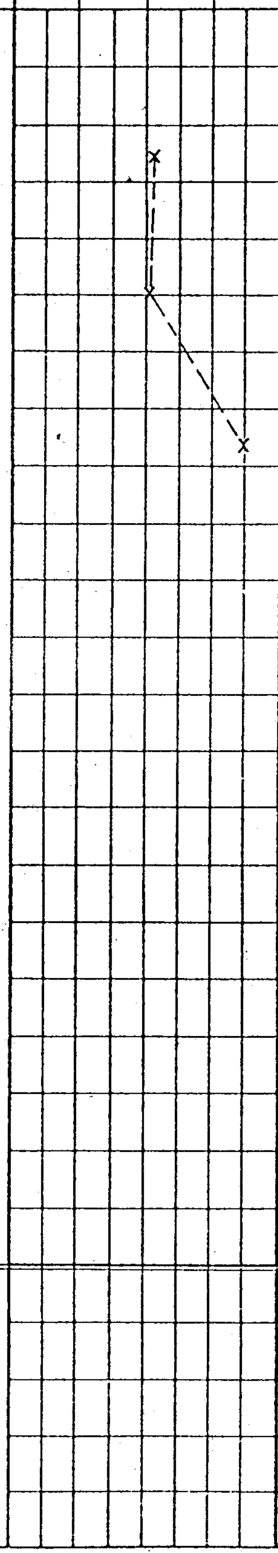
NOTES:

DRILL METHOD: Track-mounted Digger

TONKIN & TAYLOR CONSULTING CIVIL AND FOUNDATION ENGINEERS

SITE: SOUTHDALE COMMERCIAL CENTRE, WHANGAREI	PIT No. P6
JOB No: 6338 DATE DRILLED: MAY 1984 RL GROUND: 28.5	SHEET 1 OF 1

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	UNDRAINED SHEAR STRENGTH K Pa — HAND HELD SHEAR VANE (50 100 150)	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%) Wp W WL
TOPSOIL, firm, dark grey					
CLAY, high plasticity, - relatively dry, firm to stiff becoming harden with depth, light and dark yellow mottles.		1.0			
- Becomes stiff-hard		2.0			
local water seepage at a number of locations in walls of pit →					
		3.0			
CLAY, hard, light grey becoming grey. Some loose fractures and shear planes. (Onerahi Chaos)		4.0			
END OF PIT AT 4.4 m		5.0			



NOTES:

DRILL METHOD: TRACK MOUNTED DIGGER

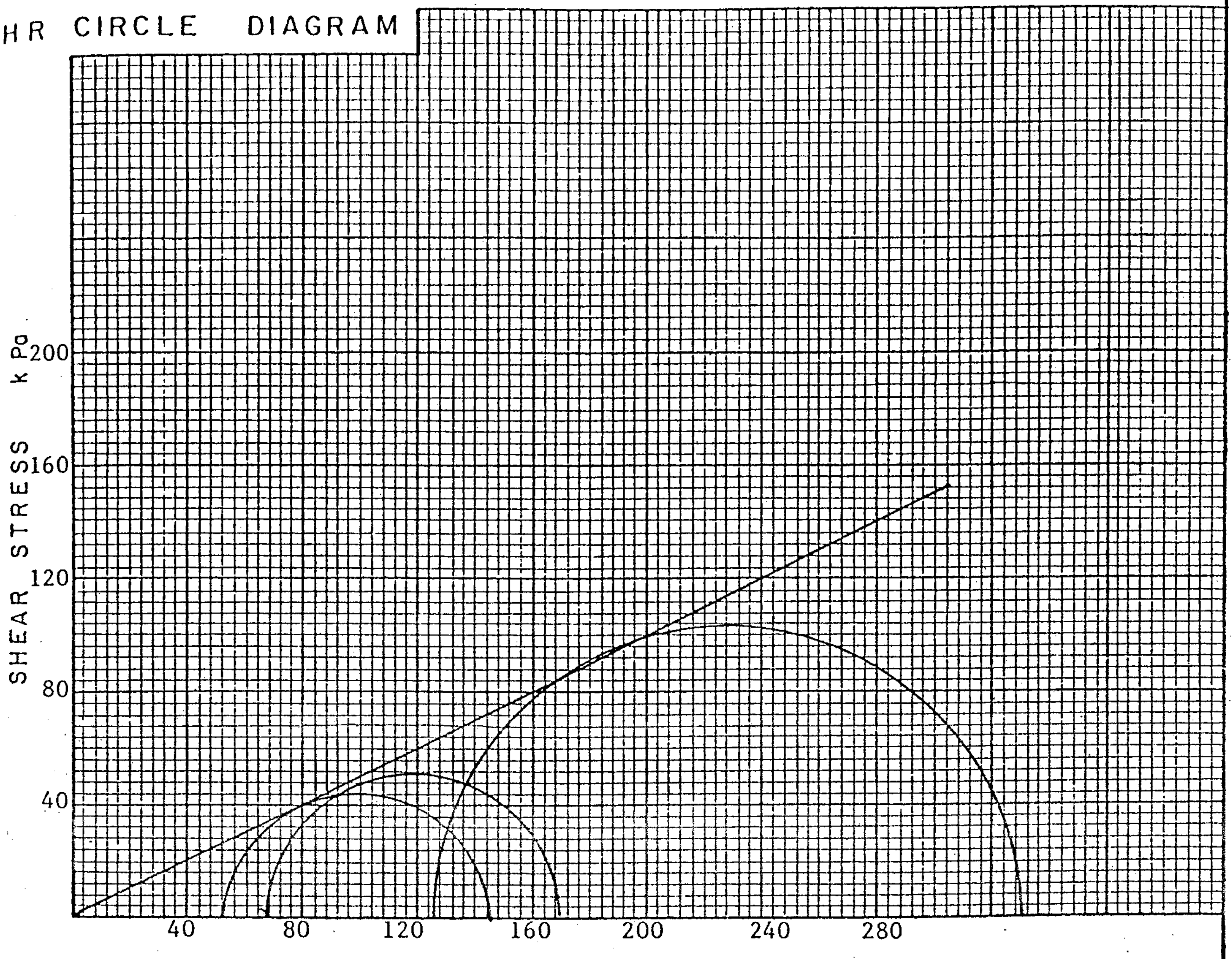
TONKIN & TAYLOR CONSULTING CIVIL AND FOUNDATION ENGINEERS

TRIAXIAL TEST

BORE/~~PIT~~ 1
SAMPLE 8
DEPTH 4.2 m

SITE SOUTHDALE JOB No. 6338

MOHR CIRCLE DIAGRAM



TEST METHOD: Consolidated Undrained Triaxial Test with pore pressure measurement.

DETAILS OF TESTS

INITIAL SOIL PROPERITES		CONSOLIDATION STAGE			FAILURE VALUES			
BULK DENSITY ρ t/m³	WATER CONTENT %	CELL PRESSURE kPa	BACK PRESSURE kPa	EFFECTIVE CONSOLIDATION PRESSURE σ_3' kPa	DEVIATOR STRESS $\sigma_1 - \sigma_3$ kPa	PORE PRESSURE CHANGE DURING SHEARING Δu kPa	MINOR PRINCIPAL EFFECTIVE STRESS σ'_3 kPa	STRAIN %
2.06	25.2	600	550	50	88	-5	55	11.1
2.06	25.2	600	500	100	99	32	68	1.2
2.09	25.2	600	400	200	207	75	125	5.9

TEST RESULTS
Angle of shearing resistance ϕ' = 27°
Apparent cohesion c' = 0KPa

REMARKS
Back pressure used to achieve saturation.
No Membrane Correction applicable.
Sample diameter = 38mm
Rate of test determined by Engineer

TONKIN & TAYLOR CONSULTING CIVIL AND FOUNDATION ENGINEERS PLATE No. 1