HAIGH WORKMAN LTD
Civil & Structural Engineers

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 1 of 127 - 11/04/2022 - NZBTC

Geotechnical Investigation and Retaining Wall Design Report

Proposed Dwelling at 36 Old Hospital Road

Whangaroa, Lot 1 DP 184536

For Peter Morgan

Haigh Workman reference 19 123

October 2019

Phone: +64 9 407 8327 • Fax: +64 9 407 8378 • info@haighworkman.co.nz • www.haighworkman.co.nz

PO Box 89 • 6 Fairway Drive • Kerikeri 0245 • New Zealand

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 2 of 127 - 11/04/2022 - NZBTC

Revision History

Revision №	Issued By	Description	Date
A	John Power	Issue	29/10/2019

Prepared By

John Power

Engineering Geologist
Member NZGS

Wayne Thorburn

Senior Geotechnical Engineer
CPEng, CMEngNZ

Approved By

John Papesch

Director
MEngNZ

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 3 of 127 - 11/04/2022 - NZBTC

TABLE OF CONTENTS

Revision History i

Executive Summary 3

1 Introduction 4

1.1 Project Brief and Scope 4

1.2 Proposed Development 4

2 Site Description 5

2.1 Site Description 5

3 Geology 7

3.1 Published Geology 7

4 Ground Investigations 8

4.1 Subsurface Investigations 8

4.2 Ground Conditions 8

5 Geotechnical Assessment 10

5.1 Geotechnical Design Parameters 10

5.2 Slope Stability Assessment 11

5.3 Timber pole retaining walls 13

5.4 RW01 – Timber Pole Wall Design (Western wall supporting fill) 14

5.5 RW02 - Timber Pole Wall Design (Eastern boundary wall supporting excavation) 15

5.6 RW03 – Timber Pole Wall (Studio wall supporting excavation) 16

6 Geotechnical Recommendations 17

6.1 General 17

6.2 Shrink Swell Soil Characteristics 18

6.3 Seismic Site Subsoil Category 18

6.4 Foundation Design 18

6.5 Masonry Retaining Wall 19

7 Construction 20

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 4 of 127 - 11/04/2022 - NZBTC

7.1 Earthworks 20
7.2 Wetting of Floor Slab (Slab-on-grade foundations) 22
7.3 Geotechnical Review 22
7.4 Construction Observations 22
7.5 Underground / Overhead Services 23
7.6 Stormwater Disposal 23
7.7 Safety in Design 24

8 Limitations 24

Appendix A – Drawings 26

Appendix B – Hand Auger Logs 27

Appendix C – Cone Penetrometer Test Logs - CPTs 28

Appendix D – Slope Stability Outputs 29

Appendix E – Retaining Wall Calculations 30

Appendix F – Concept Drawings 31

Appendix G – Advisory Note 32

TABLES

Table 1 - Geological Legend 7
Table 2 - Summary of Borehole Results 9
Table 3 - Geotechnical Design Parameters 11
Table 4 - Design Factors of Safety (FOS) 12
Table 5 - Stability Results 13
Table 6 - Retaining Wall Design Summary (RW01) 15
Table 7 - Retaining Wall Design Summary (RW01-B) 15
Table 8 - Retaining Wall Design Summary (RW02 and RW02-B) 16
Table 9 - Retaining Wall Design Summary (RW03 and RW03-B) 17
Table 10 - Safety in design risk register 24

FIGURES

Figure 1 - Site Location and Site Features 6
Figure 2 - Geological Map Extract (1:250,000) 7

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 5 of 127 - 11/04/2022 - NZBTC

Executive Summary

Haigh Workman Ltd (Haigh Workman) has been commissioned by Peter Morgan (the 'Client') to undertake a geotechnical investigation for a proposed residential dwelling and separate studio/shed at 29 Old Hospital Road, Whangaroa (Lot 1, DP 184536). Ground conditions encountered during the geotechnical investigation confirmed the published geology maps, with Tupou Complex underlying the site. Some non-certified fill was identified on the site, as shown on the appended drawings.

Slope stability analyses were undertaken based on the geotechnical investigation data topographical survey to assess the existing site condition and proposed conditions. The results of the analyses are presented in Section 5.2. The concept plans show timber pole retaining walls to support cut excavations around the boundary of the site, cuts beneath the proposed studio, and to support fill material along the eastern side of the proposed dwelling. Design of the timber pole retaining wall are detailed within Section 5. Drilling may be difficult if the retaining wall pile holes encounter the hard / completely weathered Tupou Complex and may require specialist drilling equipment to achieve the final embedment. We recommend that some test drill holes are undertaken during construction to ensure the ground conditions match those presented within this report.

Imported granular hardfill is preferred as backfill for RW01 as wall deflections will likely occur during construction due to the material being at effective stress parameters immediately, allowing shallow foundations to support the dwelling structure. Specific foundation design will be required if the site-won material is used as backfill behind RW01. Specific foundation design may also be required to deal with interaction with RW03, located beneath the studio depending on proximity to the wall. Further details are provided in Section 6. A section of RW02, located along the southern boundary, has been designed to accommodate the basement excavation in the south-eastern corner of the proposed dwelling, as detailed within Section 5.5.

We recommended that foundations be designed as per the recommendation in Section 6. Shallow foundation design should be designed in accordance with AS 2870 and SH/AS1 for class *'H', 'highly expansive'* soil. Deep foundations should be designed as per MBIE Acceptable Solutions and Verification Methods (B1/VM4), refer Section 6.4 for further details.

Concept drawings indicate some earthworks across the site will be required as part of the proposed development. The drawings indicate that as part of the development for the dwelling, studio, driveway, hardstand areas and landscaping, that up to 413.97m³ of cut and up to 102.54m³ of fill will be required. Imported granular fill (GAP40/GAP65) is recommended behind RW01, site-won material can be used behind RW01-B and elsewhere onsite, provided the fill is not placed on steep western slopes. Further testing details are provided in Section 7.1.3.

This report should be read in full to understand the geotechnical implications for the foundation design and specific structural engineering requirements. Recommended construction observations are provided in Section 7.4.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 6 of 127 - 11/04/2022 - NZBTC

1 Introduction

1.1 Project Brief and Scope

Haigh Workman Ltd (Haigh Workman) has been commissioned by Peter Morgan (the 'Client') to undertake a geotechnical investigation for a proposed residential dwelling at 29 Old Hospital Road, Whangaroa (Lot 1, DP 184536). This report presents the information gathered during the site investigation, interpretation of data obtained and site-specific geotechnical recommendations relevant to the site.

The scope of this report encompasses the geotechnical suitability in the context of the proposed development as defined in the Short Form Agreement signed 21 July 2019. This appraisal has been designed to assess the subsoil conditions for foundation design and identify geotechnical constraints for the proposed development.

This report provides the following:

- A summary of the published geology with reference to the geotechnical investigations undertaken;
- Analysis of the data obtained from site investigations, providing a ground model and geotechnical design parameters;
- Undertake detailed slope stability analysis for the proposed development and timber pole retaining wall design (structural design of the basement walls will be reported separately);
- Foundation recommendations and;
- Identification of any additional geotechnical risks and/or hazards.

1.2 Proposed Development

We understand that the Client intends to develop the site for residential end-use with the construction of a two-storey dwelling and a separate studio/shed. This geotechnical investigation and report consider the geotechnical aspects of the proposed development, with particular reference to the proposed development location, refer Figure 1 and Drawing 19 123/P1.

Based on drawings provided to us by the Client, we understand the proposed dwelling is to be located toward the southeast limit of the property on generally moderately steep west facing slopes with slope angles across the dwelling development area of between 0° to 16°. The proposed studio/shed is to be located towards the northeast corner of the property with slope angles across the development area of between 0° to 18° (refer Figure 1 below & Appended Drawings). As part of the development, we understand that several timber pole retaining walls are to be constructed to support proposed cuts and fill placement. We also understand that two concrete block retaining walls are to be constructed as part of the dwelling and studio/shed development.

Should the proposed development vary from the proposals described above and/or be relocated outside of the investigated area, further investigation and/or amendments to the recommendations made in this report may be required.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 7 of 127 - 11/04/2022 - NZBTC

2 Site Description

2.1 Site Description

The property is legally described as Lot 1, Deposited Plan 184536 with a total land area of 1,864m². The site is generally triangular in plan shape and currently comprises an undeveloped block of residential land. The site is located on the western side of a generally north to south trending ridge spur. The property is located on the inside of a hairpin bend formed by Old Hospital Road, as a result, the property is bordered to the north, east and west by Old Hospital Road and to the south by an existing residential property. Beyond Old Hospital Road, existing residential developments occupy most of the neighbouring Lots. From the eastern property boundary and Old Hospital Road, the site slopes to the west and northwest at moderate slope angles before becoming increasingly steep to the west, falling to the western property boundary and Old Hospital Road below at slope angles of up to 30°.

At the time of our investigation, the proposed development area comprised generally mown lawn areas across the eastern half of the site with some perimeter planting around the property boundaries. The western half of the site is steeper, with slope angles of between 16° to 30°, these steep slopes are typically vegetated with small scrub and long grass with some established trees and scrub across the southwestern corner of the property. An existing road crossing and short drive access is located off Old Hospital Road along the eastern property boundary.

At the time of our walkover survey, there was no evidence of recent instability across the proposed development area. However, evidence of historic slope instability is highlighted by the break in the slope across the site, with slope angles increasing from 16° to up to 40° towards the west. The crest of the slope break likely indicates an old head scarp, with evacuated landslide material likely to have been removed through erosional processes down the small valley to the west of the site, now dominated by Old Hospital Road, refer Figure 1. No imminent risk of instability to the proposed development areas was identified.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 8 of 127 - 11/04/2022 - NZBTC

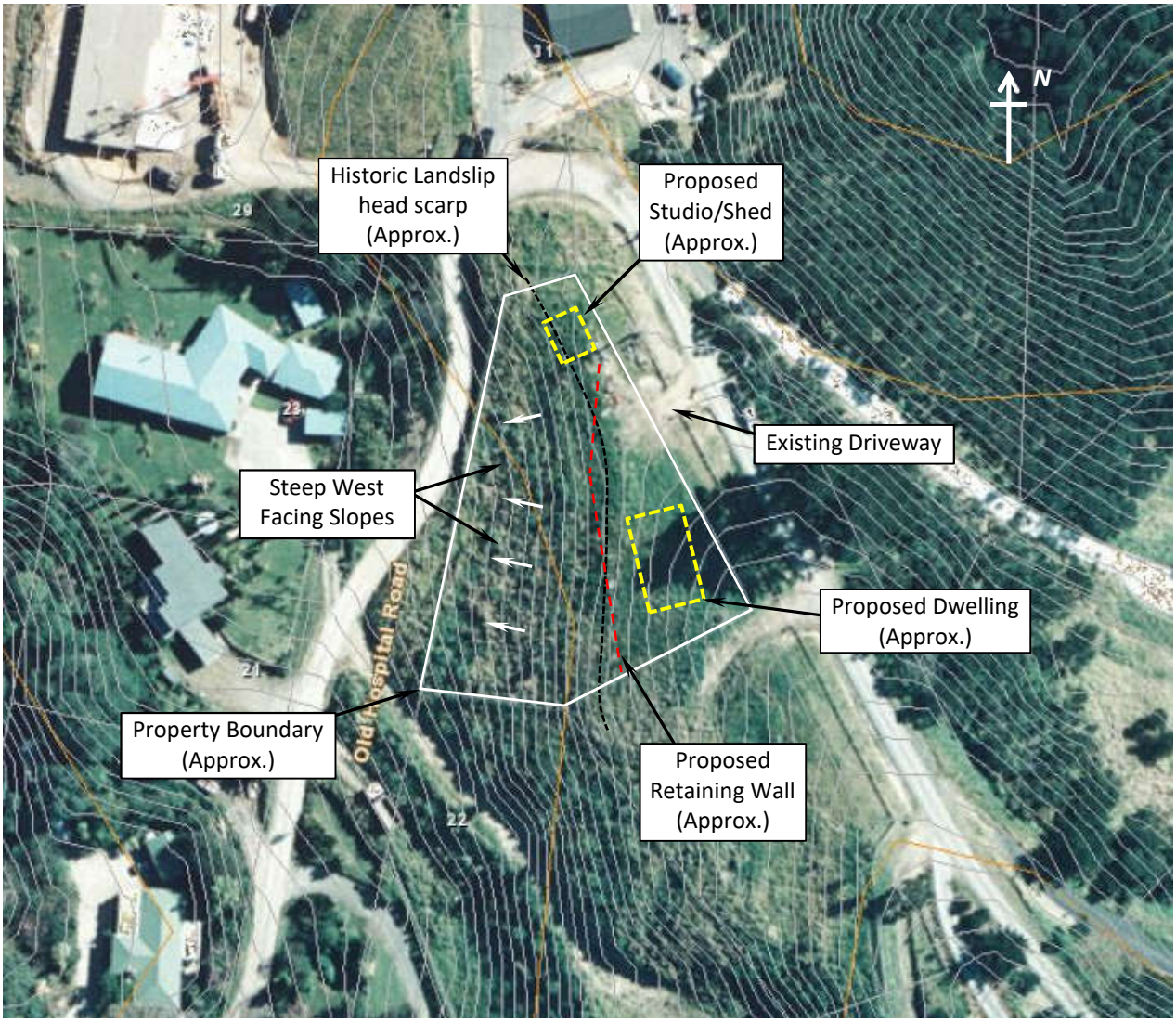


Figure 1 - Site Location and Site Features

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 9 of 127 - 11/04/2022 - NZBTC

3 Geology

3.1 Published Geology

Sources of Information:

- Institute of Geological & Nuclear Sciences, 1:250,000 Scale, 2009: "*Geology of the Whangarei area*";
- NZMS 290 Sheet P04/05, 1: 100,000 scale, 1980: *"Soil map of Whangaroa-Kaikohe area".*

The site is within the bounds of the GNS Geological Map 2 "Geology of the Whangarei area", 1:250,000 scale*. The published geology shows the site to be underlain by strongly indurated, poorly stratified conglomerate, sandstone and argillite, of the Tupou Complex (Ku). The Tupou Complex are part of the Northland Allochthon. The Tupou Complex are of Early Cretaceous age.

An exert of the geological map is shown in Figure 2, with geological units presented in Table 1.

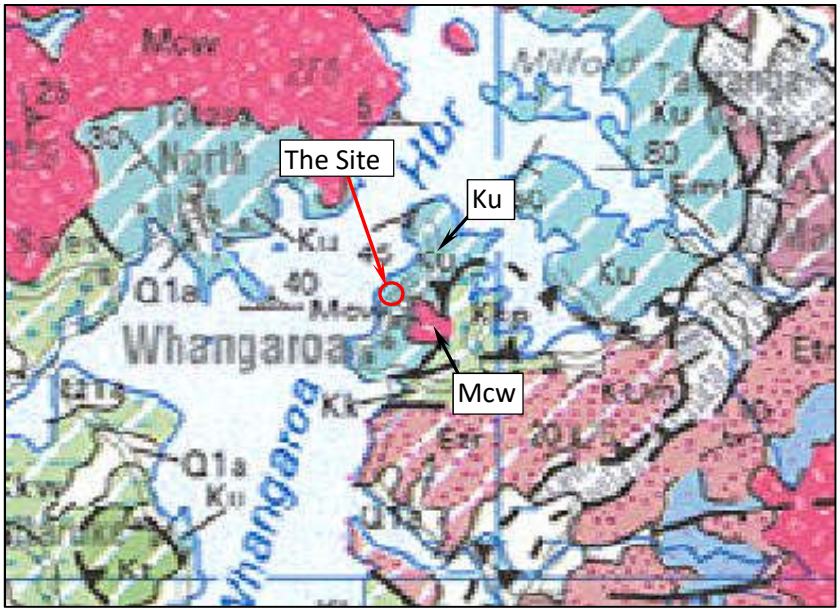


Figure 2 - Geological Map Extract (1:250,000)

Table 1 - Geological Legend

Symbol	Unit Name	Description
Ku	Tupou Complex (Northland Allochthon)	Strongly indurated, massive sandstone and thin-bedded sandstone and mudstone with interbedded conglomerate; minor chert.
Mcw	Wairakau Volcanic Centre (Coromandel Group)	Weakly bedded, laharic andesitic tuff breccia with minor andesitic flows and intercalated volcaniclastic sandstone and mudstone. Subvolcanic intrusive andesite and andesite and diorite dikes.

* Edbrooke, S.W; Brook, F.J. (compilers) 2009. Geology of the Whangarei area.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 10 of 127 - 11/04/2022 - NZBTC

Further reference to the published New Zealand land inventory maps, indicate the Tupou Complex comprises a deep weathering profile of up to 10m deep, weathering to light coloured clay. The New Zealand land inventory soil map indicates the soils comprise Marua brown clay loam (MRrH + MRH) that are well to moderately well drained.

4 Ground Investigations

4.1 Subsurface Investigations

Haigh Workman undertook geotechnical investigations on 8 August 2019. The investigations comprised the drilling of six hand auger boreholes (BH1 to BH6), located across the proposed development area. In addition, five cone penetrometer test (CPT) investigations (CPT01 to CPT05) were undertaken as part of the site investigation.

4.1.1 *Hand Auger Boreholes*

Hand auger boreholes were advanced to depths of between 1.4 to 2.8 metres below ground level (mbgl). Scala penetrometer tests undertaken at the base of selected hand auger boreholes and were advanced to a maximum depth of 3.4mbgl (BH1). The purpose of the hand auger boreholes was to visually log the soil being extracted from the ground and to undertake insitu testing during advancement of the holes. A hand shear vane with 19 mm blade was used to measure the Vane Shear Strength of the in-situ material. Vane shear tests were undertaken at 0.5m intervals during the advancement of the hand augers.

All shear strengths shown on the appended logs are Vane Shear Strengths in accordance with the NZGS; “Test Method for determining the Vane Shear Strength of a Cohesive Soil using a Hand-held Shear Vane”, 2001.

All investigations undertaken were logged in accordance with the New Zealand Geotechnical Society, “Guidelines for the Field Classification and Description of Soil and Rock for Engineering Purposes” (2005). Investigation borehole logs with Scala penetrometer results are included on the appended hand auger borehole logs in Appendix B.

Groundwater was not encountered during the hand auger investigation.

4.1.2 *Cone Penetrometer Tests*

Underground Investigation Ltd provided a cone penetration rig attached to a remote controlled, rubber tracked machine to test and record ground information. five cone penetration tests (CPTs) were completed. Testing was undertaken until anchor pull-out or upon excessive tilt on the probe. A maximum depth of 7.37mbgl was achieved at CPT01 location. The purpose of the CPT testing was to get deeper soil data to develop a ground model for the site.

4.2 Ground Conditions

Based on the results of the geotechnical investigation conducted by Haigh Workman, review of published geological maps and interpreted from the CPT soundings, it is considered that the natural soils directly underlying the site comprise natural soils of the Tupou Complex to a maximum encountered depth of 2.8mbgl

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 11 of 127 - 11/04/2022 - NZBTC

(BH1). CPT tests indicate that residual (very stiff) soils and completely to highly weathered Tupou Complex can be expected to depths of up to 7.37mbgl (CPT01).

Five of the six hand auger boreholes encountered a thin (0.2m to 0.3m) veneer of topsoil overlying the natural soils of the Kerikeri Volcanic Group. BH1 encountered 1.1m of non-certified fill overlying a thin (0.2m) veneer of buried topsoil. Underlying the no-certified fill and buried topsoil, soils of the Tupou Complex were encountered.

Ground conditions encountered during the geotechnical investigation confirmed the published geology maps, with Tupou Complex underlying the site. Based on the investigation logs, it is considered that a blanket of non-certified fill encountered within BH1 exists in the central area of the site, near the crest of the steep slope. It is considered likely that the non-certified fill encountered was placed during earthworks as part of the road development and creation of the existing road crossing and driveway. There is no clear distinction between the non-certified fill material and Tupou Complex soils on the CPT soundings.

Subsoil conditions on the site have been interpolated between test locations and some variation between testing positions are likely. Hand auger borehole logs and CPT soundings are presented within Appendix B and Appendix C respectively. Geological models have been developed based on the investigation and are presented in Appendix A. Table 2 below summarises the materials encountered, with depth to base of each unit provided.

Table 2 - Summary of Borehole Results

Borehole Number	Topsoil	Non-Certified Fill Material (including buried topsoil) (m)	Stiff to Very stiff Tupou Complex Soil (m)	Hard / Completely to highly weathered Tupou Complex (m)	Groundwater Observations (mbgl)
BH1	NA	0.0m to 1.3m	1.3m to 2.8m	>3.4m**	NE
BH2	0.2m	NE	0.2m to 1.8m	NA	NE
BH3	0.2m	NE	0.2m to 2.6m	>2.9m**	NE
BH4	0.2m	NE	0.2m to 1.6m	>2.2m**	NE
BH5	0.3m	NE	0.3m to 1.4m	>1.8m**	NE
BH6	0.2m	NE	0.2m to 2.0m	NA	NE
CPT01	-	-	0.0m to 7.37m	>7.37m	-
CPT02	-	-	0.0m to 6.74m	>6.74m	-
CPT03	-	-	0.0m to 4.72m	>4.72m	-
CPT04	-	-	0.0m to 4.82m	>4.82m	4.8*
CPT05	-	-	0.0m to 3.92m	>3.92m	-

NE: Not Encountered
NA: Not Applicable
- No physical soil sample collected
** Measured straight after testing and groundwater level is not likely to have equalised.*
*** Inferred from Scala penetrometer results.*

4.2.1 *Non-certified Fill Material*

A veneer of non-certified fill material was encountered within borehole BH1, comprising up to 1.1m of light brown and light brownish orange, very stiff clayey silt with trace fine gravel content. The non-certified fill material was generally moist and of low to medium plasticity. Below the fill material, a thin (0.2m) veneer of

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 12 of 127 - 11/04/2022 - NZBTC

buried topsoil was encountered. Below the non-certified fill material and buried topsoil, natural soils of the Tupou Complex were encountered. The non-certified fill material was most likely placed during earthworks associated with the construction of Old Hospital Road and development of the existing road crossing and driveway.

4.2.2 *Topsoil*

A thin veneer of topsoil was encountered within boreholes BH2 to BH6. Topsoil was encountered to a maximum depth of 0.3mbgl (BH5) and comprised a dark brown, firm silt, with minor fibrous organic content. The topsoil was generally moist to wet and having no plasticity. Below the topsoil, natural cohesive soils of the Tupou Complex were encountered.

4.2.3 *Tupou Complex*

Below a thin veneer of topsoil, and below the non-certified fill in BH1, soils encountered were found to be generally consistent and have been interpreted as being soils belonging to the Tupou Complex to a maximum encountered depth of 2.3mbgl (BH2). The natural soils were generally described as being very stiff clayey silt and silt. The soils were typically light brownish orange, light orange and light grey with mottles and streaks of orange. Soils were generally moist and of low to medium plasticity.

Vane shear strengths tests were recorded in excess of 100kPa, indicative of very stiff soils. Recorded vane shear strengths are shown on the appended borehole logs.

CPT soundings indicate generally very stiff (100-200 kPa) soils underlain by hard (>200 kPa) soils at depths of below 3.9m to 7.3mbgl. We have inferred the hard (>200 kPa) soils to be completely to highly weathered Tupou Complex with the depth to these soils inferred to be at the termination depth of the CPTs.

4.2.4 *Groundwater*

Groundwater was not encountered during our site investigations. No evidence was observed of groundwater seepage during the drilling of the hand auger boreholes. During drilling, soil moisture observations were recorded with soils noted at being dry to moist. Measurement of CPT hole CPT04 at the completion of testing indicated groundwater was at 4.8mbgl.

Conditions at the time of our site investigation were generally dry and no surface water features were observed. Groundwater levels can and do fluctuate and higher groundwater levels may be encountered following periods of prolonged or heavy rainfall.

5 *Geotechnical Assessment*

5.1 Geotechnical Design Parameters

Geotechnical design parameters recommended in this report are based on in-situ test results, empirical relationships and local experience. Refer

Table 3 below for soil parameters adopted within this report. Depths for the units are shown in Table 2.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 13 of 127 - 11/04/2022 - NZBTC

Table 3 - Geotechnical Design Parameters

Soil Unit	Bulk Unit Weight γ (kN/m^3)	Peak Undrained Shear Strength S_u (kPa)	Effective Cohesion c' (kPa)	Effective Friction Angle φ' (degrees)
Non-certified Fill Material	17	50	3	28
Engineered granular hardfill	20	-	0	38
Tupou Complex (Stiff soil)	18	75	3	29
Tupou Complex (Very stiff soil)	18	100	7	32
Tupou Complex (Highly weathered)	19	>200	10	32

5.2 Slope Stability Assessment

The natural ground conditions across the site were found to be generally consistent, i.e. very stiff natural soils of the Tupou Complex underlain by very stiff to hard highly weathered Tupou Complex.

During our site walkover survey, no evidence of slope instability was identified across the proposed development area. However, evidence of historic slope instability was observed with a relic head scarp extending across the site from south to north. The relic head scarp is marked by a break in the slope, with slope angles increasing from 14° to 16° to slopes of 25° to 40° (refer Figure 1). At present, the existing slopes are considered to be stable and are not considered to propose any imminent risk of instability to the proposed development area.

We recommend that the steep west facing slopes remain vegetated and that further planting be considered across the slope. We also recommend that ongoing monitoring of the steep slopes are considered.

5.2.1 *Geological Ground Model*

A geological ground model has been developed based on the site investigation data. The ground conditions across the site are generally consistent with slope angles across the proposed development area in the order of 0° to 15° becoming steeper down slope of the development site. The purpose of developing the geological ground model was to assist with foundation design, slope stability analyses, and retaining wall design.

Two geological sections were developed for use in stability analysis (Section A-A' & B-B'), one through the proposed dwelling area and one through the proposed studio/shed area, refer Appendix A. The ground surface was determined by tape and clinometer survey, undertaken as part of our site investigations.

Cross sections used during stability analysis have been adapted from geological sections in conjunction with preliminary design drawings provided by the client.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 14 of 127 - 11/04/2022 - NZBTC

5.2.2 *Seismic Hazard*

Anticipated peak ground accelerations have been estimated assuming Site Class C, as per NZS 1170.5. The seismic coefficients for geotechnical design are based on the NZTA Bridge Manual SP/M/022 (NZBM) and NZS1170. Assuming a design working life of 50 years with an importance level 2, the return period of an earthquake would be 1 in 500 years. Accordingly, the ULS peak ground acceleration for seismic analysis is 0.12 g.

5.2.3 *Stability Analysis*

Slope stability analyses were undertaken using computer software by Rocscience, Slide (Version 2018 8.024). Groundwater level has been assessed using the steady state finite element module within Slide, with boundary conditions based on observations made during the site investigations. The purpose of the stability modelling was to assess the overall global stability for the proposed development site, including elevated groundwater conditions, and during a ULS seismic event. Selected outputs are presented in Appendix D. The criteria adopted for assessing the global stability is outlined in Table 4 below.

5.2.4 *Modelling Philosophy*

The model was developed with the proposed development plan provided by the Client. The proposed development plans show a timber pole retaining wall supporting a cut face upslope of the proposed dwelling adjacent the eastern and southern property boundaries. The concept plans also show a second timber pole retaining wall extending across the west facing slope, below the proposed dwelling and hardstand areas. We understand that the proposed dwelling will involve the excavation of a basement by cutting into the existing site, with retaining structures (concrete block retaining walls) supporting the excavations includes as part of the proposed dwelling. We also understand that a second concrete block retaining wall is proposed as part of the development of the proposed studio/shed.

A surcharge of 20kPa representing the load of the proposed dwelling has been applied across the building platform locations. For the proposed studio/shed, a surcharge of 10kPa has been applied with an additional surcharge of 25kPa representing the proposed 25,000 litre water tanks to be placed below the proposed studio/shed.

Table 4 - Design Factors of Safety (FOS)

Load Case	Design Factor of Safety	Groundwater Conditions
Static - Existing Conditions	≥ 1.5	Highest credible groundwater level
Static - Proposed development	≥ 1.5	Highest credible groundwater level
Static - Elevated groundwater	≥ 1.2	Groundwater near surface
Seismic, 0.12 g	≥ 1.1	Highest credible groundwater level

5.2.5 *Stability Analysis Results*

Two sections were analysed to assess the global stability of the site, taking into account the proposed development. Slope stability results are presented in Table 5 below. Section A represents the dwelling location and Section B the studio/shed location.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 15 of 127 - 11/04/2022 - NZBTC

Table 5 - Stability Results

Section I.D.	Scenario	Result	Required	Outcome	Notes
A-A' - Dwelling	Proposed Dwelling - Long term static	1.50	1.5	OK	Steady state groundwater level
	Proposed Dwelling - Extreme GWL	1.19	1.2	OK	Steady state GW – 1.0m to 2.0m below surface
	Proposed Dwelling - Seismic 0.12g	1.17	1.1	OK	Steady state groundwater level
B-B' - Studio	Proposed Studio/Shed - Long term static	1.54	1.5	OK	Steady state groundwater level
	Proposed Studio/Shed - Extreme GWL	1.40	1.2	OK	Steady state GW – 1.0m to 2.0m below surface
	Proposed Studio/Shed - Seismic 0.12g	1.29	1.1	OK	Steady state groundwater level

The stability results show acceptable factors of safety are achieved below for the proposed site cuts and building loads under conditions analysed provided retaining structures are installed to support the proposed cut faces, building platforms and areas of fill placement.

In order to achieve acceptable FOS of ≥1.5 for the proposed cut face adjacent the eastern property boundary, a retaining wall is required to support the proposed cut face. Similarly, a retaining wall is required below and to the west of the proposed dwelling in order to provide support to the proposed building platform and proposed placed fill that will form part of the building platform.

5.3 Timber pole retaining walls

Timber pole retaining walls are required to support cut and fills across the site. Geotechnical design parameters presented in Table 3 have been adopted in design. Timber pole retaining walls have been designed using computer software, Wallap (Version 6.06), with bending moment and shear forces being calculated using the subgrade reaction model. The bending moment and shear forces provided in the following sections are factored values.

Under seismic conditions the wall has been designed using undrained soil parameters, with horizontal coefficient estimated using the methods presented in New Zealand Bridge Manual (SP/M/022, Third Edition) – Section 6.2.3. The design is based on the damage control limit state, therefore the horizontal coefficient adopted = 0.17. The seismic earth pressures have been estimated using Mononobe-Okabe method for yielding / flexible walls (deflection is greater than 0.5% of the height of the wall), with horizontal loads applied evenly down the length of the unbalanced height. Retained heights are shown on the drawings provided by Dawson Design 18 086, attached in Appendix F. Selected calculations have been provided in Appendix E, presenting the critical cases only.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 16 of 127 - 11/04/2022 - NZBTC

Drilling may be difficult if the holes encounter the hard / completely weathered Tupou Complex and may require specialist drilling equipment to achieve the final embedment. We recommend that some test drill holes are undertaken during construction to ensure the ground conditions match those presented within this report.

Appropriate drainage measures must be installed behind all retaining walls to ensure that hydrostatic pressures cannot build up behind them. The drainage measures should be installed to ensure that any water collected by the drains can drain freely, under gravity alone, from the deepest portion of any wall to the drain outlet.

5.4 RW01 – Timber Pole Wall Design (Western wall supporting fill)

A retaining wall is required to support the dwelling building platform and hardstand area. The wall is approximately 45m in length, with retained heights varying from 0.2 m to approximately 3.0m. Based on the topographical survey and proposed cleared ground level for the proposed building platform (RL101 m), the retaining will support up to 3.0 m of fill. Based on drawings provided, RW01 extends approximately north to south across the west facing slope. The proposed wall is located approximately 1.0 m from the proposed dwelling and decking foundations, therefore interaction between the retaining wall and foundations will need to be considered during detailed foundation design, this is further detailed in Section 6.

RW01 has been designed with variable heights adjacent to the dwelling, taking into account the dwelling surcharge (assumed 10 kPa) located approximately 1.0 m from the retaining wall, with an additional 5 kPa pedestrian surcharge applied directly behind the wall. The wall has also been designed to account for the sloping ground at the toe of the wall by applying a negative surcharge within Wallap to consider the loss of passive support. Granular hardfill (GAP40/65) will be used as backfill adjacent to the dwelling, as a result we consider the static deflection due to backfilling will occur during construction when the material is placed due to granular fill being at effective stress immediately, i.e. pore pressures will dissipate during compaction. The wall design allows for a maximum of 10 mm deflection from surcharge loading under static conditions and 25 mm for seismic loading.

An extra design was undertaken for the wall which extends towards the north from the dwelling, where there will be no additional long-term surcharge effect, i.e. no dwelling is located behind the wall. This has been designed as retaining wall RW01-B. For RW01-B, it is likely the cut material will be used as backfill, deflections are likely to occur over a longer period of time due to the fine-grained nature of the soil and relaxation over time, i.e. soils behaving undrained and excess pores pressures will take time to dissipate. Pole sizes for RW01 have been selected to reduce deflections to tolerable limits due to the proximity of the dwelling and to account for any long-term effects.

A summary of the design is presented in Table 6. Design drawings and detailed calculations are provided in Appendix A and Appendix E, respectively.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 17 of 127 - 11/04/2022 - NZBTC

Table 6 - Retaining Wall Design Summary (RW01)

Wall Properties	RW01 – Granular Hardfill Backfill			
Maximum Height (H)	<1.0 m	1.0 m to 2.0 m	2.0 to 2.5 m	2.5m to 3.0m
Pole Spacing (c/c)	1.2 m	1.2 m	1.2 m	1.2 m
Pole type	High Density, 150 mm SED, H5 treated	High Density, 300 mm SED, H5 treated	High Density, 350 mm SED, H5 treated	High Density, 425 mm SED, H5 treated
Embedment Length (L)	2.0 m (minimum)	4.0 m (minimum)	4.5 m (minimum)	5.0 m (minimum)
Total Pile Length (H + L)	3.0 m	6.0 m	7.0 m	8.0 m
Encasement	0.45 m bored pile, encased in 20 MPa concrete	0.6 m bored pile, encased in 20 MPa concrete	0.6 m bored pile, encased in 20 MPa concrete	0.6 m bored pile, encased in 20 MPa concrete
Deflection Bending Moment Shear Force	< 10 mm 3 kNm 6 kN	<10 mm (static) 22 kNm 19 kN	10 mm (static) 44 kNm 28 kN	10 mm (static) 77 kNm 39 kN
Timber Lagging rails (from top of wall) – spanning continuously across a minimum of 2 poles.	Refer Appendix A – Typical Retaining Wall Sections			

Table 7 - Retaining Wall Design Summary (RW01-B)

Wall Properties	RW01-B (Engineered clay backfill)
Maximum Height (H)	<2.5 m
Pole Spacing (c/c)	1.2 m
Pole type	High Density, 350 mm SED, H5 treated
Embedment Length (L)	4.5 m (minimum)
Total Pile Length (H + L)	7.0 m
Encasement	0.6 m bored pile, encased in 20 MPa concrete
Timber Lagging rails (from top of wall) – spanning continuously across a minimum of 2 poles.	Refer Appendix A – Typical Retaining Wall Sections

5.5 RW02 - Timber Pole Wall Design (Eastern boundary wall supporting excavation)

A retaining wall is required to support the cut face to the east and south above the proposed dwelling. No instability of the existing slope, upslope of the site cut is expected. The wall is approximately 32 m in length, with retained heights varying from 0.5 m to approximately 1.8 m. A portion of the wall has been designed to accommodate the basement excavation for the dwelling, this portion has been designed as RW02-B.

RW02 has been designed with variable heights adjacent to the dwelling, taking into account a 5 kPa pedestrian surcharge applied directly behind the wall. The wall design allows for a maximum of 25 mm deflection under static conditions and 50 mm for seismic loading.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 18 of 127 - 11/04/2022 - NZBTC

RW02-B has been designed allowing for the loss of passive support due to the basement excavation located within the passive wedge (refer RW02-B location). This has been done within Wallap by applying a berm excavation, resulting in poles increasing in length and diameter.

A summary of the design is presented in Table 8. Design drawings and detailed calculations are provided in Appendix A and Appendix E, respectively.

Table 8 - Retaining Wall Design Summary (RW02 and RW02-B)

Wall Properties	RW02		RW02-B
Maximum Height (H)	<1.0	1.0 m to 1.8 m (maximum)	1.0 m (maximum)
Pole Spacing (c/c)	1.2 m	1.2 m	1.2 m
Pole type	High Density, 150 mm SED, H5 treated	High Density, 200 mm SED, H5 treated	High Density, 350 mm SED, H5 treated
Embedment Length (L)	1.5 m	2.2 m (minimum)	7.0 m
Total Pile Length (H + L)	2.5 m	4.0 m	8.0 m
Encasement	0.45 m bored pile, encased in 20 MPa concrete	0.45 m bored pile, encased in 20 MPa concrete	0.60 m bored pile, encased in 20 MPa concrete
Timber Lagging rails (from top of wall) – spanning continuously across a minimum of 2 poles.	Refer Appendix A – Typical Retaining Wall Sections		

5.6 RW03 – Timber Pole Wall (Studio wall supporting excavation)

A retaining wall is required to support the cut face below the studio building located near the northern boundary of the site. The wall is located beneath the studio, supporting a cut excavation to create a level platform for two water tanks and an excavation along the northern side of the studio. The wall is approximately 23 m in length, with retained heights varying from 0.3 m to approximately 2.3 m.

RW03 has been designed with variable heights adjacent to the studio, taking into account a 10 kPa surcharge applied directly behind the wall when located beneath the studio, and 5 kPa pedestrian surcharge for the wall located along the northern side of the studio (RW03-B). The wall design allows for a maximum of 25 mm deflection under static conditions and 50 mm for seismic loading.

A summary of the design is presented in Table 9. Design drawings and detailed calculations are provided in Appendix A and Appendix E, respectively.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 19 of 127 - 11/04/2022 - NZBTC

Table 9 - Retaining Wall Design Summary (RW03 and RW03-B)

Wall Properties	RW03	RW03-B
Maximum Height (H)	<1.7 m	2.3 m (maximum)
Pole Spacing (c/c)	1.2 m	1.2 m
Pole type	High Density, 200 mm SED, H5 treated	High Density, 200 mm SED, H5 treated
Embedment Length (L)	2.3 m (minimum)	2.8 m (minimum)
Total Pile Length (H + L)	4.0 m	5.0 m
Encasement	0.45 m bored pile, encased in 20 MPa concrete	0.45 m bored pile, encased in 20 MPa concrete
Timber Lagging rails (from top of wall) – spanning continuously across a minimum of 2 poles.	Refer Appendix A – Typical Retaining Wall Sections	

6 Geotechnical Recommendations

6.1 General

Concept drawings indicate the proposed dwelling will comprise a two-storey dwelling with a subfloor basement under the proposed dwelling. We understand that the proposed development will involve the excavation of a basement by cutting into the existing site, with retaining structures (basement walls) supporting the excavations included as part of the proposed dwelling. Based on these drawings it is envisaged that the proposed structure will be supported on shallow foundations comprising concrete slab on-grade type foundation with deepened edge beams or strip footings. Drawings provided indicate that part of the dwelling structure (1st floor deck and portico) will be supported by columns and likely connected to a shallow footing (subject to structural demand, i.e. wind loading effects).

In order to create the building platform for the dwelling, a cut into the existing slope is required, with a maximum retained height of 2.89 m supported by a concrete block retaining wall incorporated as part of the dwelling structure, refer appended drawings for details. Based on drawings provided, we understand that some fill placement will be required as part of the formation of the building platform and will comprise granular hardfill (GAP40 or GAP65). A cleared ground level of RL 101 m is required, as shown on appended drawings.

We also understand that the proposed development will involve the construction of a studio with the excavation of the building platform by cutting into the existing slope at the northern end of the site. The proposed studio is intended to be supported on timber pole foundations with an excavated basement below. Based on drawings provided, we understand that part of the proposed studio/shed is to be founded on founded on shallow piled foundations.

We understand that the excavated basement below the studio/shed will be for the storage of two 25,000 litre water tanks. Based on drawings provided, the exposed basement cuts will be retained by a timber pole retaining wall while the upper cut required for the proposed studio/shed is to be supported by a concrete block retaining structure as part of the studio construction.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 20 of 127 - 11/04/2022 - NZBTC

Based on our findings, we consider the non-certified fill material encountered below the proposed studio development area as not suitable to support foundations and will need to be removed and replaced with granular hardfill (GAP40) to provide a suitable founding material for slab-on-grade foundations. Below the non-certified fill, the natural ground conditions are expected to be consistent across the proposed development area and are considered suitable for supporting foundations subject to ground verification during construction. It is considered that the natural in situ soils below the non-certified fill material will be suitable for foundations, as per the recommendations provided in Section 6.4.

Based on the drawings provided, it is considered that the non-certified fill material is likely to be removed as part of the site cut and excavations. We recommend that the final subgrade level be inspected by a geotechnical engineer to confirm that all unsuitable material have been removed, i.e. topsoil and non-certified fill material and a suitable subgrade has been achieved immediately below the proposed dwelling and studio/shed footprints. All foundation excavations are to be inspected to confirm subsoils are as per this report and suitable for foundations.

Exposed soils should not be left exposed longer than necessary to avoid damage to the subgrade, e.g. cracking during summer or saturation during heavy rainfall. Once inspected, the subgrade should be covered with 100mm of granular hardfill or polythene.

6.2 Shrink Swell Soil Characteristics

Based on experience of similar soils elsewhere, the near surface very stiff Tupou Complex soils are considered as highly susceptible to swelling and shrinking under seasonal variations of water content. For the purposes of design, the site may be designated as Highly reactive (Class H1) in accordance with AS2870:2011, allowing for characteristic ground movement of between 40 mm to 60 mm.

6.3 Seismic Site Subsoil Category

The site conditions have been assessed to be consistent with seismic subsoil Class C (Shallow site soils) in accordance with NZS1170.5:2004.

6.4 Foundation Design

Foundation design will need to take into consideration the interaction between the dwelling and studio foundations and proposed retaining walls. We recommended that foundations located along the western side of the dwelling be designed as per Sections 0 and 6.4.1 due to interactions with the retaining wall and potential for settlement behind the wall due to deflection.

Shallow foundation design should be designed in accordance with AS 2870 and SH/AS1 (MBIE Simple House Acceptable Solution) for class *'H', 'highly expansive'* soil. An ultimate bearing capacity of 300kPa can be adopted for limit state design for shallow foundations. Deep foundations should be designed as per MBIE Acceptable Solutions and Verification Methods (B1/VM4). The following recommendations are provided:

- Ultimate bearing capacity of 300kPa;
    - Geotechnical strength reduction factor – 0.5;

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 21 of 127 - 11/04/2022 - NZBTC

- Soil expansivity class – Site Class H1 (highly reactive soils);
- Minimum foundation depth for strip footings on level ground is 575 mm below finished ground level for light weight cladding buildings or 775 mm below finished ground level for masonry clad buildings (refer SH/AS1 – Simple House Acceptable Solution);

- Minimum foundation depth for concrete encased pile foundations is 1.0 m to take into account the highly expansive soils (refer AS2870);
- Deep piles (embedment length five times greater than pile diameter) may adopt a base resistance value of 900 kPa and skin friction value of 50 kPa if founded into the very stiff soils;
  - Geotechnical strength reduction factor B1/VM4 – 0.45;
- Seismic class – Site Class C (shallow soil site).

Although the building will be partially founded on cut and imported granular hardfill, we recommend the foundations are consistent across the entire structure to ensure consistent performance, i.e. shallow foundations should be adopted across the entire structure using a constant embedment depth.

Bearing capacity values included in this report are in accordance with B1/VM4 and are for vertical loads only and do not take in to account horizontal shear or moment actions.

6.4.1 *Leading Edge Pile Design – Studio*

The proposed studio is located over RW03, which is required to create a level platform for the water tanks. If foundations are within the active wedge behind the wall (approximately 1.2 m from the back of the wall) then interaction between the foundations and the retaining wall need to be considered. The drawings provided indicate the pole foundations will be outside the active wedge, however we still recommend that the pole foundation embedment in this zone be equal to the height to the retaining wall, i.e. at least 1.7 m embedment, subject to confirmation on the location of the studio foundation poles in relation to the retaining wall.

6.5 Masonry Retaining Wall

Masonry retaining walls are shown to support excavations for the dwelling and the studio structures. Retaining walls that are incorporated into the structure should be designed for 'at-rest' (k_0) earth pressure conditions, adopting a (k_0) = 0.5 where there is no sloping ground surcharge above the wall. The design of all retaining structures can be designed using the parameters provided in Table 3. Design of the retaining walls can be undertaken using the methods presented in Module 6 – Earthquake resistant retaining wall design (MBIE and NZGS), with load factors taken from NZS1170 and geotechnical strength reduction factors as per B1/VM4.

Appropriate drainage measures must be installed behind all retaining walls to ensure that hydrostatic pressures cannot build up behind them. The drainage measures should be installed to ensure that any water collected by the drains can drain freely, under gravity alone, from the deepest portion of any wall to the drain outlet.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 22 of 127 - 11/04/2022 - NZBTC

7 Construction

7.1 Earthworks

Concept drawings indicate some earthworks across the site will be required as part of the proposed development. The drawings indicate that as part of the development for the dwelling, studio/shed, driveway, hardstand areas and landscaping, that up to 413.97m³ of cut and up to 102.54m³ of fill will be required.

It is our understanding the cut material will be re-used as fill behind RW01-B only. Provided the cut material is at optimum condition and the material is compacted to an engineered standard, then the material will be suitable to support as backfill. If site won material is used behind RW01 then laboratory testing of the material to be used as fill will be required to determine the optimum moisture content. The laboratory testing required will be as follows:

- 1x standard compaction curve (to determine the optimum maximum dry density and moisture content);
- 2x Atterberg limit tests (to confirm the liquid and plastic limits of the soil, i.e. plastic limit is considered optimum).

If the material needs to be conditioned then it may be more efficient to remove the material from the site and use granular hardfill (GAP40/GAP65) imported from a local quarry source. Further testing details are provided in Section 7.1.3.

7.1.1 *Excavations*

Based on the concept drawings provided by the client, we understand that earthworks will comprise a site cut and excavation to create a building platform for the proposed dwelling (CGL 101 m) and excavations for the proposed driveway, landscaping, hardstand areas and studio. We understand that cuts up to 2.89m may be required to form the building platform for the proposed dwelling with further cuts near the eastern and southern property boundaries. It is envisaged that site cuts for the development of the proposed dwelling building platform will be retained by a concrete block retaining wall, incorporated as part of the dwelling structure. We also understand that a separate timber pole retaining wall with a maximum retained height of 2.0m that is set-back approximately 1.2m from the proposed dwelling. The proposed timber pole retaining wall is not intended to be incorporated into the dwelling structure.

We also understand that cuts and excavations associated with the proposed studio/shed will be supported by a concrete block retaining wall and a lower timber pole retaining wall with maximum retained heights of 2.2m and 1.6m respectively.

Final subgrade levels should be inspected by a geotechnical engineer to confirm that a suitable subgrade has been achieved below the proposed dwelling and studio footprints.

7.1.2 *Temporary Excavations*

The cut faces are expected to be temporarily stable. However, we recommend that excavated faces are left open and unsupported for the shortest duration possible and that construction of the retaining structures take

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 23 of 127 - 11/04/2022 - NZBTC

places immediately following excavation. Consideration should be given to staging the excavation so that this can be achieved.

If for unforeseen circumstances, the excavated face must be left open, appropriate temporary support measures and protection against wet weather must be put in place. Work must be undertaken to ensure that surface water is not allowed to pond and infiltrate the ground surface on or immediately above the excavated face.

Current industry safe working practices should be followed at all times when working near cut faces.

7.1.3 *Filling*

Based on drawings provided, we understand that the placement of fill as part of the development will be required to form part of the building platform for the proposed dwelling. Drawings indicate that up to 102.54m³ of fill is required, which will be made up imported granular hardfill behind RW01 and beneath the dwelling, and site won material behind RW01-B. Drawings indicate that the placed fill will be supported by a timber pole retaining wall (RW01 and RW01-B) that will extend roughly south to north across the existing slope. We understand that the proposed retaining wall is to have a maximum retained height of 3.0m.

Laboratory testing of the material is recommended prior to filling to ensure the material is appropriate to be used as fill (refer Section 7.1 for testing requirements). Following confirmation of the material, and if deemed suitable for re-use as fill, the fill will require frequent monitoring during placement to ensure fill material has been placed and compacted to an engineered standard and can be signed off by Haigh Workman as certified fill.

In-situ testing of the material should be undertaken by a suitably qualified geotechnical engineer at regular lifts. i.e. inspection at preplacement and every 500 mm thereafter (or as agreed between the Client and Engineer). Testing of placed fill material below or near the proposed buildings shall meet the following specification:

- Vane shear strength testing comprising an average of ten tests of 140kPa with no single vane shear test of less than 120kPa.
- Testing shall also include air void testing with a minimum of ten consecutive tests with an average of 10% air voids with no single test greater than 12%.
- Fill material shall have a moisture content as near as possible to optimum and shall be between the limits of 2% below and 4% above optimum moisture content.

If granular hardfill (GAP40) is preferred, the testing requirement remains the same as above, i.e. In-situ testing of the material should be undertaken by a Chartered Professional Engineer at regular lifts. i.e. inspection at preplacement and every 500 mm thereafter (or as agreed between the Client and Engineer). Testing of placed fill material below or near the proposed buildings shall meet the following specification:

- Average maximum dry density = 95%, with no single value less than 90% over 10 consecutive tests (standard compaction curve to be provided by the quarry source);

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 24 of 127 - 11/04/2022 - NZBTC

- Average Clegg impact value = 25 with no single value less than 20 over 10 consecutive tests.

Testing will be at the discretion of the Engineer responsible for providing certification that the fill material is certified for engineered fill.

All grass coverings, topsoil layers and loose materials must be removed below any proposed areas of intended fill placement. Any fill placed around the building platform or beneath any proposed structures, will need verification of compaction and confirmation by the engineer that settlement caused by filling will not adversely affect the proposed structures.

Any other filling outside the building platforms, and not supporting the accessway or used as fill behind the wall can adopt a slightly lower specification, as follows:

- Vane shear strength testing comprising an average of ten tests of 100kPa with no single vane shear test of less than 70 kPa.

7.2 Wetting of Floor Slab (Slab-on-grade foundations)

With potentially expansive sites, it is important that the soils at slab subgrade are not permitted to dry out as they may be susceptible to re-swell on wetting (in the months after pouring the slab), exerting significant swelling pressures and potentially causing damage to the floor slab. We therefore recommend that any prepared pad be inspected by a geotechnical engineer and promptly covered with at least 100mm of GAP20 type material or similar and that the area is periodically wet down for at least one week prior to slab placement. Similarly, it is essential that footing trenches are not permitted to become desiccated over time. Ideally footing trenches should be left open for the shortest possible time prior to pour and should be protected by covering/lining trenches with polythene or similar within 24 hours of excavation. These measures will reduce the risk of 'hogging' and cracking of the slab.

7.3 Geotechnical Review

We recommend that the consent drawings are submitted to either ourselves, or another professional geotechnical engineer who is familiar with the contents of this report, once they are ready for to submission to Council for approval. We recommend this review is carried out in order to check the compatibility of the design with the recommendations given within this report.

7.4 Construction Observations

Specific engineering inspections of retaining walls, building platform preparation and/or foundation construction with certification by a Producer Statement, PS4, are often required by Council and outlined in the Building Consent. These observations are generally required to ensure that the foundation soils exposed at the time of construction are consistent with the assumptions made in this geotechnical report.

We consider the following specific items will need to be observed at the time of construction to ensure the foundation soils are consistent with the assumptions made in this geotechnical report:

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 25 of 127 - 11/04/2022 - NZBTC

1. Observe the ground conditions exposed on the prepared building platform, confirm exposed soils are suitable for shallow foundations and observe foundation excavations to confirm suitable ground conditions;
2. Observe and test the compaction of placed fill material at regular intervals during filling;
3. Observe retaining wall construction, including pile hole excavation, installation of timber lagging and drainage media.
4. Observe all foundation excavations, strip or pile foundations.

Provision should be allowed for modifying the foundation solution at this time, should unforeseen ground conditions be encountered.

Haigh Workman are able to carry out the engineering inspections and provide the PS4 documentation if required. Provision should be made for the recommendations of this report to change if the ground conditions encountered vary from those expected. Prior notification of at least 48 hours ahead of any site inspection is appreciated.

Should any required inspections not be completed, then any required PS4 documentation may not be obtained for the work which may result in a Code Compliance Certificate being withheld. We strongly recommend that all required inspections as stated on the Building Consent inspections are undertaken by a suitably qualified engineer.

7.5 Underground / Overhead Services

At the time of writing, no known underground services cross beneath the proposed development area. Where it is intended for the installation of underground services, we recommend that all services are installed prior to foundation excavations and construction and that all services are designed to be outside the influence of foundation excavations.

We recommend that any new services are accurately located on site and the depth to invert be determined prior to the commencement of foundation excavations.

7.6 Stormwater Disposal

All stormwater shall be piped well away from any proposed building platforms and away from any steep slopes to avoid over saturation of the subsoils and to maintain stability across the site. All stormwater overflow drainages should be well channelled away from the development platforms.

We recommend that stormwater overflows be discharged in a dispersive, controlled manner downslope of the proposed development. Under no circumstances should concentrated flows of stormwater flows be allowed to outlet along the existing slopes immediately to the north or east of the proposed development.

To ensure that stormwater does not adversely affect site stability, it is important that all stormwater runoff from the proposed development including, roof, deck, driveway and other sealed areas, is collected by means of sealed pipes and discharged in a controlled manner, preferably into an existing stormwater reticulation system should one be available. Under no circumstances should stormwater be discharged on to the steep east facing slopes below the proposed development.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 26 of 127 - 11/04/2022 - NZBTC

7.7 Safety in Design

A tabulated Safety in Design register is provided in Table 10. This safety in design risk register should be updated and kept live during construction.

Table 10 - Safety in design risk register

Issue	Risk	Proposed mitigation measure
Excavations	Collapse of material and potential to strike people	Earthworks to be staged where possible and cuts to remain open for the smallest possible duration. No one to work immediately adjacent to the cut or during poor weather conditions.
Open auger holes	Falling from height	No holes to remain open overnight. No one allowed to walk around the construction site, other than those who understand site hazards. Holes should be backfilled with concrete as soon as possible.
Lifting poles into ground	Falling poles from height	Lifting gear (straps and chains) to be in good condition. All chains and lifting hooks to be certified.
Cutting poles and timber lagging	Cuts to self	Only staff who are appropriate trained with the gear to cut timber. When chainsaws and other saws are being used staff should keep well away from the work area.
Groundwater	If encountered, groundwater will make constructability difficult	We expect holes to remain free of groundwater in the short term. Holes not to remain open overnight and should be backfilled as soon as possible with concrete. Pumping may be required.

8 *Limitations*

This report has been prepared for the use of Peter Morgan with respect to the particular brief outlined to us. This report is to be used by our Client and their Consultants and may be relied upon when considering geotechnical advice. Furthermore, this report may be utilised in the preparation of building and/or resource consent applications with local authorities. The information and opinions contained within this report shall not be used in other context for any other purpose without prior review and agreement by Haigh Workman Ltd.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 27 of 127 - 11/04/2022 - NZBTC

The recommendations given in this report are based on site data from discrete locations. If any changes are made, we must be allowed to review the new development proposal to ensure that the recommendations of this report remain valid Inferences about the subsoil conditions away from the test locations have been made but cannot be guaranteed. We have inferred an appropriate geotechnical model that can be applied for our analyses. However, variations in ground conditions from those described in this report could exist across the site. Should conditions encountered differ to those outlined in this report we ask that we be given the opportunity to review the continued applicability of our recommendations.

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 28 of 127 - 11/04/2022 - NZBTC

Appendix A – Drawings

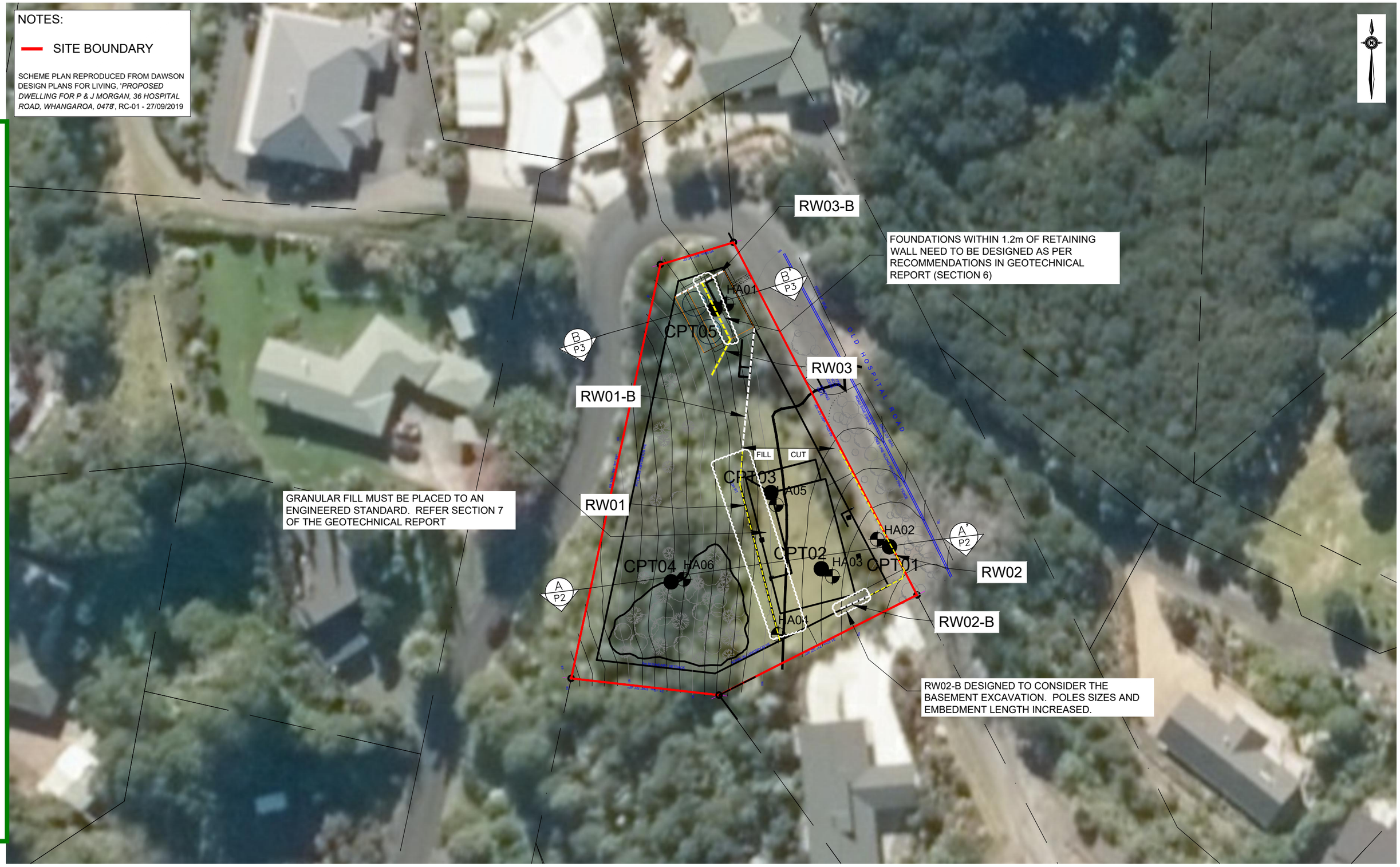
Drawing No.	Title	Scale
19 123/P1	Site Features and Borehole Location Plan	1:2000
19 123/P2	Geological Section A – A'	1:200
19 123/P3	Geological Section A – A'	1:200
19 123/P4	Typical Timber Pole Wall Detail – RW01 & RW01-B	Not to Scale
19 123/P5	Typical Timber Pole Wall Detail – RW02 & RW02-B	Not to Scale
19 123/P6	Typical Timber Pole Wall Detail – RW03 & RW03-B	Not to Scale
SKETCH	Sketch mark up on Dawson Design Drawing	1:200

FNDC - Approved Building Consent Document - BUC-2022-988-0 - Pg 29 of 127 - 11/04/2022 - NZBTC

NOTES:

SITE BOUNDARY

SCHEME PLAN REPRODUCED FROM DAWSON DESIGN PLANS FOR LIVING, '*PROPOSED DWELLING FOR P & J MORGAN, 36 HOSPITAL ROAD, WHANGAROA, 0478*', RC-01 - 27/09/2019



Issue	Date	Revision
A	23/10/2019	FIRST ISSUE

DWG GEOTECHNICAL INVESTIGATION AND SITE FEATURES PLAN

Scale 1:500 @A3 — 5 2.5 0 5 10 15 m — Date 23/10/2019

Drawn WT — Checked JP — Approved JP

File X:\19 JOBS\19 123 PETER MORGAN\ENGINEERING\DRAWINGS\19 123 - GEO REPORT.DWG

HAIGH WORKMAN LTD Civil & Structural Engineers
6 Fairway Drive
Kerikeri, BOI.
T: 09 407 8327
F: 09 407 8378
E: info@haighworkman.co.nz

DIMENSIONS MUST NOT BE SCALE MEASURED FROM THESE DRAWINGS. THE CONTRACTOR SHALL CHECK & VERIFY ALL DIMENSIONS INCLUDING, SITE LEVELS, HEIGHTS AND ANGLES ON SITE PRIOR TO COMMENCING ANY WORK. THE COPYRIGHT TO THESE DRAWINGS AND ALL PARTS THERE OF REMAIN THE PROPERTY OF HAIGH WORKMAN. ©2006

Project 36 Old Hospital Road, Whangaroa
Lot 1 DP 184536

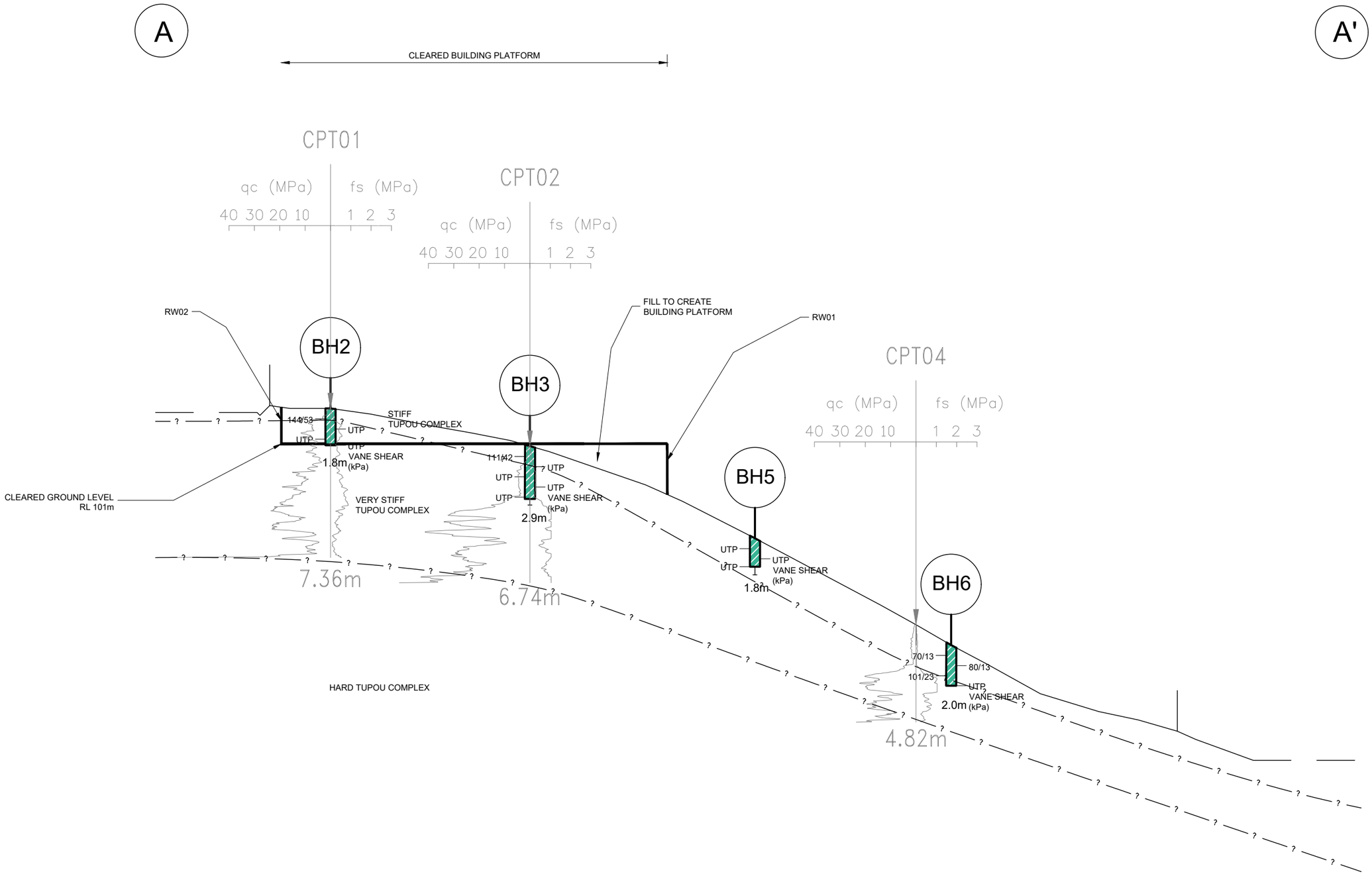
Client Peter Morgan

Project No. 19 123 — RC no.

DWG No. P1

Sheet No. 1 of 6

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 30 of 127 - 11/04/2022 - NZBTC



Issue	Date	Revision
A	23/10/2019	FIRST ISSUE

DWG Geological Cross Section A - A'

Scale 1:200 @A3 | 2 1 0 2 4 6 m | Date 23/10/2019

Drawn WT | Checked WT | Approved JP

File X:\19 JOBS\19 123 PETER MORGAN\ENGINEERING\DRAWINGS\19 123_GEO DRAWINGS\19 123_GEO.DWG

HAIGH WORKMAN LTD
Civil & Structural Engineers
6 Fairway Drive
Kerikeri, BOI.
T: 09 407 8327
F: 09 407 8378
E: info@haighworkman.co.nz

DIMENSIONS MUST NOT BE SCALE MEASURED FROM THESE DRAWINGS. THE CONTRACTOR SHALL CHECK & VERIFY ALL DIMENSIONS INCLUDING, SITE LEVELS, HEIGHTS AND ANGLES ON SITE PRIOR TO COMMENCING ANY WORK. THE COPYRIGHT TO THESE DRAWINGS AND ALL PARTS THERE OF REMAIN THE PROPERTY OF HAIGH WORKMAN. ©2019

Project: Geotechnical Investigation
36 Old Hospital Road, Kaeo (Lot 1, DP 184536)

Client: Peter Morgan

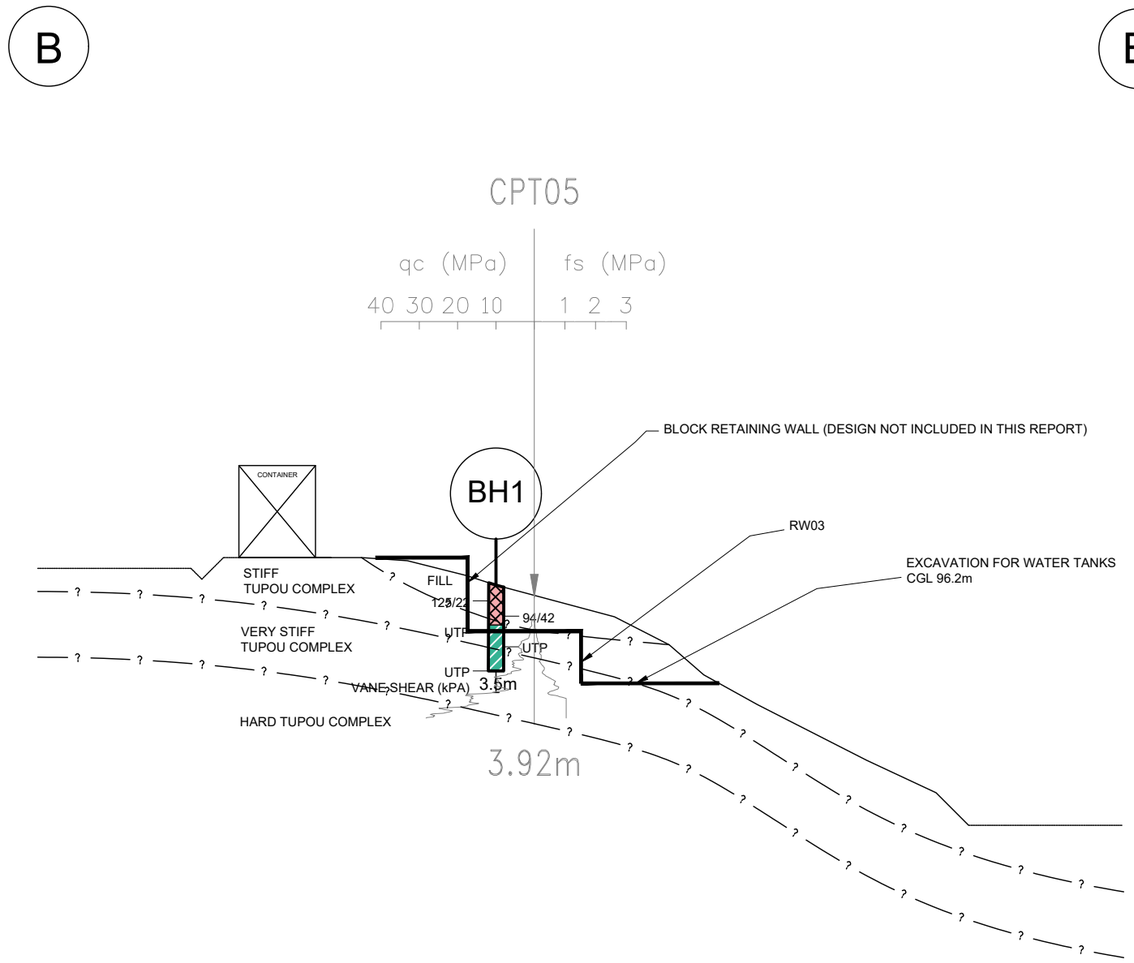
Project No. 19 123 | RC no.

DWG No. P2

Sheet No. 2 of 6

Plotted By Wayne Thorburn at 23/10/2019 3:33:37 PM

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 31 of 127 - 11/04/2022 - NZBTC



Issue	Date	Revision
A	23/10/2019	FIRST ISSUE

DWG Geological Cross Section B - B'

Scale 1:200 @A3 (2 1 0 2 4 6 m)

Date 23/10/2019

Drawn OT | Checked WT | Approved JP

File X:\19 JOBS\19 123 PETER MORGAN\ENGINEERING\DRAWINGS\19 123_GEO DRAWINGS\19 123_GEO.DWG

HAIGH WORKMAN LTD
Civil & Structural Engineers
6 Fairway Drive
Kerikeri, BOI.
T: 09 407 8327
F: 09 407 8378
E: info@haighworkman.co.nz

DIMENSIONS MUST NOT BE SCALE MEASURED FROM THESE DRAWINGS. THE CONTRACTOR SHALL CHECK & VERIFY ALL DIMENSIONS INCLUDING, SITE LEVELS, HEIGHTS AND ANGLES ON SITE PRIOR TO COMMENCING ANY WORK. THE COPYRIGHT TO THESE DRAWINGS AND ALL PARTS THERE OF REMAIN THE PROPERTY OF HAIGH WORKMAN. ©2019

Project: Geotechnical Investigation
36 Old Hospital Road, Kaeo (Lot 1, DP 184536)

Client: Peter Morgan

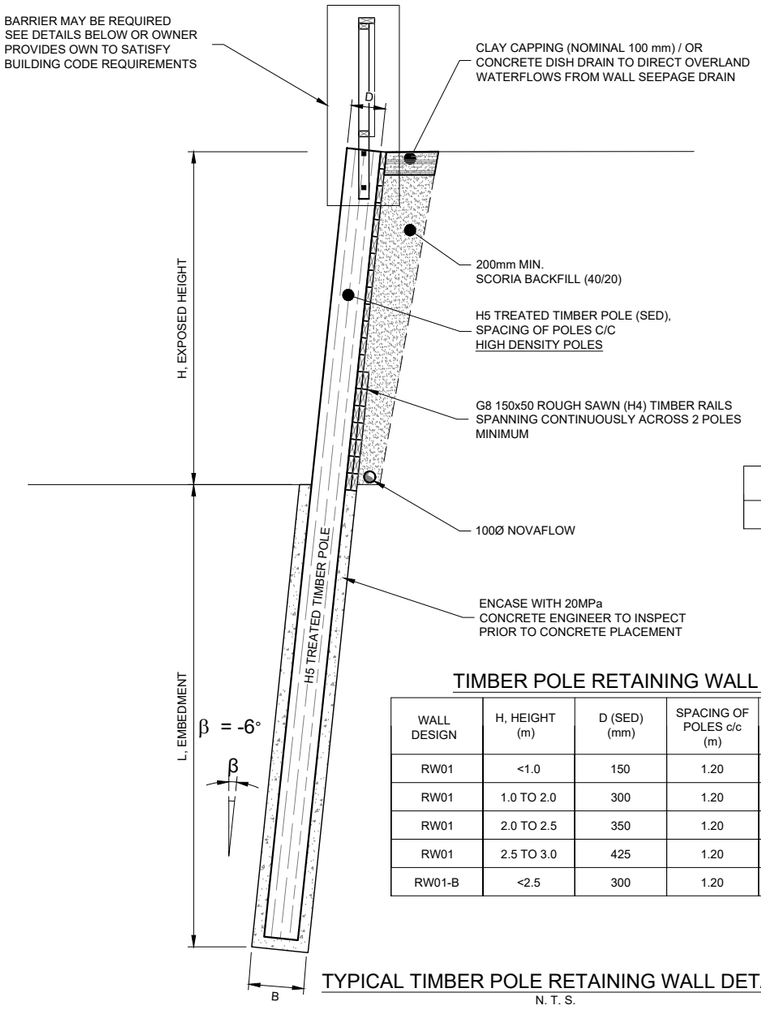
Project No. 19 123 | RC no.

DWG No. P3

Sheet No. 3 of 6

Plotted By Wayne Thorburn at 23/10/2019 3:33:37 PM

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 32 of 127 - 11/04/2022 - NZBTC



TYPICAL TIMBER POLE RETAINING WALL DETAIL
N. T. S.

NOTE:

1. TO BE CONSTRUCTED IN ACCORDANCE WITH B1 GUIDANCE ON BARRIER DESIGN (MARCH 2012).
2. BARRIER DETAILS SUITABLE FOR BARRIERS SERVING ONE DWELLING UNIT ONLY.

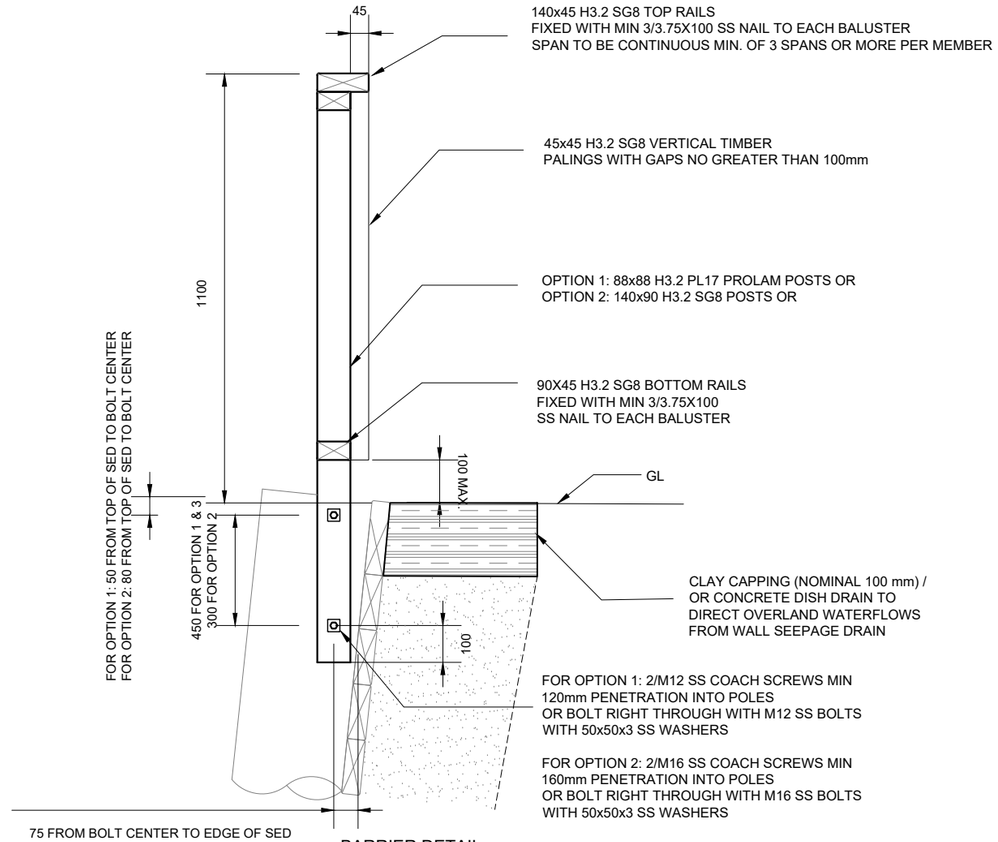
BACKING BOARD DETAILS

(m FROM TOP OF WALL)

WALL DESIGN	SINGLE RAILS	DOUBLE RAILS	TRIPLE RAILS
ALL	0.00 - 1.2	1.2-2.7	2.7-3.0

TIMBER POLE RETAINING WALL DETAILS

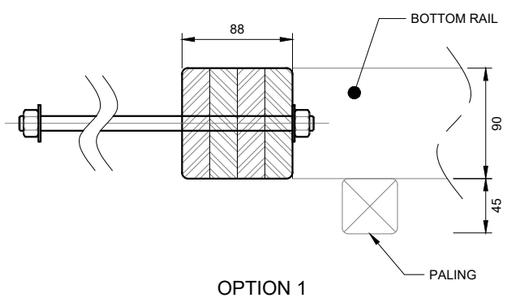
WALL DESIGN	H, HEIGHT (m)	D (SED) (mm)	SPACING OF POLES c/c (m)	L, EMBEDMENT (m)	B, BORED Ø (mm)
RW01	<1.0	150	1.20	2.0	450
RW01	1.0 TO 2.0	300	1.20	4.0	600
RW01	2.0 TO 2.5	350	1.20	4.5	600
RW01	2.5 TO 3.0	425	1.20	5.0	600
RW01-B	<2.5	300	1.20	4.5	600



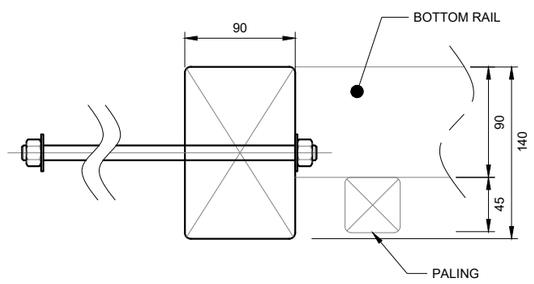
BARRIER DETAIL
N. T. S.

IMPORTANT NOTE:

1. PROLAM GRADE: PL17 H3.2 88x88
   RADIATA PINE: SG8 H3.2 140x90
2. BOTTOM RAIL, PALING AND POST CONFIGURATION SHOULD BE AS PER DETAIL SHOWN BELOW
3. SED POLE NOT SHOWN FOR CLARITY
4. PROLAM LAMINATION MUST BE PERPENDICULAR TO BOLT



OPTION 1



OPTION 2

TIMBER SPECIFICATION NOTES:

1. CAUTION:
   DEEP EXCAVATIONS UNSUPPORTED DURING CONSTRUCTION MAY BE HAZARDOUS PARTICULARLY WHEN WORKING IN CONFINED SPACES. THE DEPARTMENT OF LABOUR'S EXCAVATION GUIDE GIVES RECOMMENDED SAFETY PROCEDURES FOR SUCH SITUATIONS. THE EXCAVATION AND EARTHWORKS CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT ADEQUATELY ALL PERSONS AND PROPRETY LIABLE TO THE BE AFFECTED BY THE EXCAVATION AND EARTHWORKS OPERATIONS.
2. MATERIALS:
   TIMBER:
   TIMBER POLES SHALL BE PEELED RADIATA PINE LOGS COMPLYING WITH THE REQUIREMENT OF NZS 3605 "LOAD BEARING ROUND TIMBER PILES AND POLES" TREATED TO TPA COMMODITY SPECIFICATION H5. ALL TIMBER POLES TO BE HIGH DENSITY.
   DIMENSIONS OF POLES ARE SPECIFIED AS MINIMUM SMALL END DIAMETERS.
   ACTUAL DIAMETERS WILL BE GREATER DUE TO TAPER AND TIMBER GRADING. SAWN TIMBER IN GROUND CONTACT SHALL BE RADIATA PILE TREATED TO SPECIFICATION H4.
   ALL TIMBER SHALL HAVE TPA IDENTIFICATION BRANDS VISIBLE WHEN DELIVERED TO THE SITE AND SHALL BE PROTECTED AGAINST DAMAGE DURING STORAGE AND HANDLING
3. CONCRETE:
   CONCRETE FOR FOUNDATION BACKFILL SHALL BE ORDINARY GRADE CONCRETE COMPLYING WITH NZS 3109 'SPECIFICATION FOR CONCRETE', AND WITH A 28-DAY STRENGTH OF 20 MPa.
   CONCRETE SHALL BE PLACED UNDER AND AROUND POLES AND WELL COMPACTED BY VIBRATING. POLES SHALL BE TEMPORARILY PROPPED AND PROTECTED AGAINST DISTURBANCE FOR AT LEAST TWO DAYS AFTER PLACEMENT OF CONCRETE
4. EXCAVATION:
   EXCAVATION IN STAGES TO ALLOW FOR TEMPORARY SUPPORT DURING CONSTRUCTION IS REQUIRED. NO MORE THAN 3.0m OF UNSUPPORTED SLOPE SHALL EXIST AT ANY ONE TIME.
   EXCAVATION FOR POLES SHALL BE TAKEN OUT BY AUGERING TO THE DIMENSIONS DETAILED, WITH ALL SURPLUS SOIL BEING DISPOSED OF AWAY FROM THE SITE.
   ALLOWANCE SHALL BE MADE IN POSITIONING AUGERED HOLES FOR THE SLOPE OF THE WALL AND FOR CONCRETE TO SURROUND THE POLES. DRIVING OF POLES IS NOT ACCEPTABLE AS AN ALTERNATIVE TO AUGERING. POLES SHALL BE INSTALLED AS SOON AS POSSIBLE AFTER EXCAVATION. EXCAVATIONS FOR POLES SHALL BE FREE OF WATER AND LOOSE MATERIAL BEFORE CONCRETING. IF NECESSARY THE CONTRACTOR SHALL ALLOW FOR HANDCLEANING AND PUMPING OF EXCAVATION.
5. INSTALLATION:
   DRIVING OF POLES IS NOT ACCEPTABLE AS AN ALTERNATIVE TO AUGERING. FIXING OF HORIZONTAL TIMBERS TO POLES SHALL UTILISE GALVANISED NAILS AS DETAILED. TIMBERS SHALL BE LAYED IN POSITION COMMENCING AT THE BOTTOM OF THE WALL WITH JOINTS BETWEEN TIMBERS STAGGERED BETWEEN THE POLES BY USE OF SHORT TIMBERS AT ENDS OF ALTERNATIVE ROWS. IF CUTTING IS NECESSARY THE EXPOSED SURFACES SHALL BE FLOODED WITH A COPPER NAPTHENATE TYPE OF WOOD PRESERVATIVE.
   CARE SHALL BE TAKEN IN SELECTING AND LAYING HORIZONTAL TIMBERS TO MAINTAIN THE SPECIFIED MINIMUM THICKNESS OF TIMBERS, PARTICULARLY NEAR THE BASE OF THE WALL AND TO ACHIEVE NEAT STRAIGHT LINES AT THE TOP OF THE WALL.
6. BACKFILLING:
   A PERFORATED OR OPEN JOINTED SUBSOIL DRAIN SHALL BE LAID AND SURROUNDED IN FINE GRANULAR MATERIAL WITH THE INVERT BELOW LOWER GROUND LEVELS AND LED TO A FREE OUTLET AT A POINT OF SAFE DISCHARGE.
   REMAINING BACKFILL TO WITHIN 300mm OF FINISHED SURFACE LEVEL SHALL BE DRAINED COMPACTED GRANULAR FILL NOT LARGER THAN 65mm DIMENSIONS (eg RUN OF PIT SCORIA OR SIMILAR).
   THE FINISHED SURFACE OF BACKFILL SHALL BE SEALED AGAINST ENTRY OF SURFACE WATER WITH A LAYER OF TOPSOIL, CLAY OR CONCRETE.

Issue	Date	Revision
A	23/10/2019	FIRST ISSUE

DWG TYPICAL TIMBER POLE WALL DETAIL RW01

Scale N. T. S. | Date 23/10/2019
Drawn WT | Checked JP | Approved JP
File X:\19 JOBS\19 123 PETER MORGAN\ENGINEERING\DRAWINGS\19 123_RW01_FINAL.DWG

HAIGH WORKMAN LTD
Civil & Structural Engineers
6 Fairway Drive
Kerikeri, BOI.
T: 09 407 8327
F: 09 407 8378
E: info@haighworkman.co.nz

DIMENSIONS MUST NOT BE SCALE MEASURED FROM THESE DRAWINGS. THE CONTRACTOR SHALL CHECK & VERIFY ALL DIMENSIONS INCLUDING, SITE LEVELS, HEIGHTS AND ANGLES ON SITE PRIOR TO COMMENCING ANY WORK. THE COPYRIGHT TO THESE DRAWINGS AND ALL PARTS THERE OF REMAIN THE PROPERTY OF HAIGH WORKMAN. ©2006

Project PROPOSED DWELLING AND STUDIO
36 OLD HOSPITAL ROAD, WHANGAROA

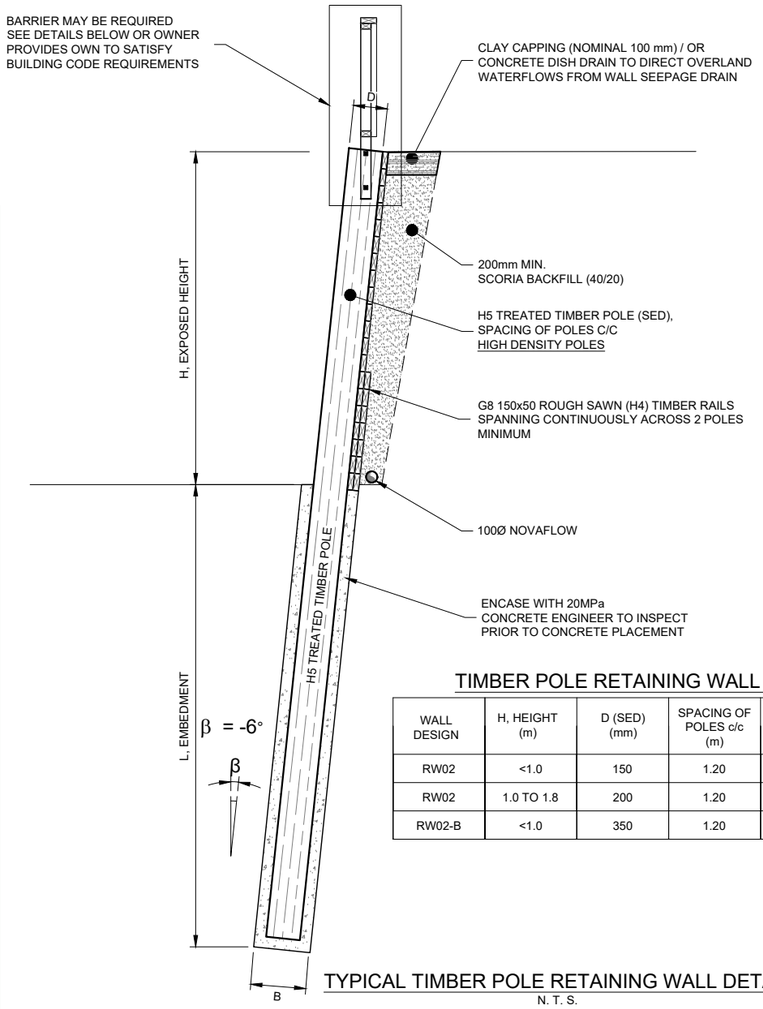
Client PETER MORGAN

Project No. 19 123 | RC no.

DWG No. P4

Sheet No. 4 of 6

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 33 of 127 - 11/04/2022 - NZBTC



TYPICAL TIMBER POLE RETAINING WALL DETAIL
N. T. S.

NOTE:

1. TO BE CONSTRUCTED IN ACCORDANCE WITH B1 GUIDANCE ON BARRIER DESIGN (MARCH 2012).
2. BARRIER DETAILS SUITABLE FOR BARRIERS SERVING ONE DWELLING UNIT ONLY.

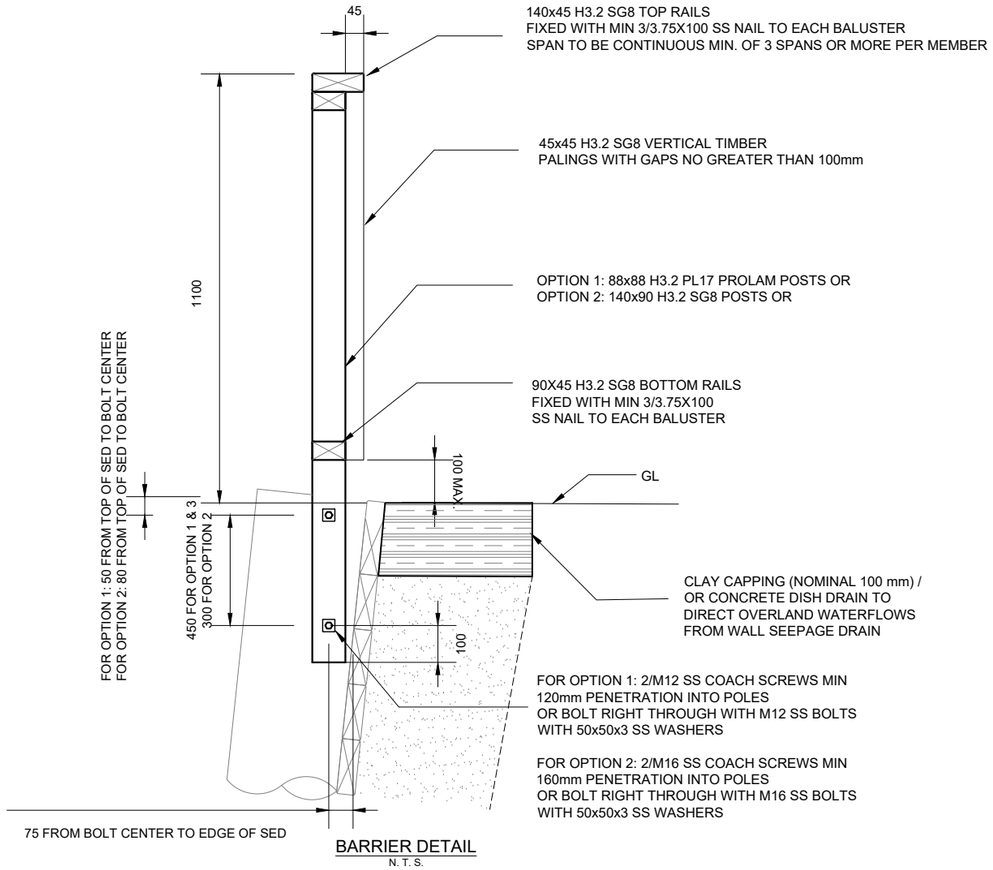
BACKING BOARD DETAILS

(m FROM TOP OF WALL)

WALL DESIGN	SINGLE RAILS	DOUBLE RAILS
ALL	0.00 - 1.65	1.65-1.80

TIMBER POLE RETAINING WALL DETAILS

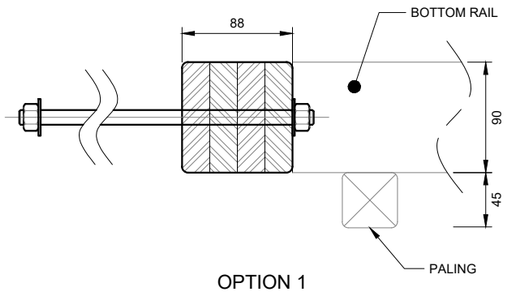
WALL DESIGN	H, HEIGHT (m)	D (SED) (mm)	SPACING OF POLES c/c (m)	L, EMBEDMENT (m)	B, BORED Ø (mm)
RW02	<1.0	150	1.20	1.5	450
RW02	1.0 TO 1.8	200	1.20	2.2	450
RW02-B	<1.0	350	1.20	7.0	600



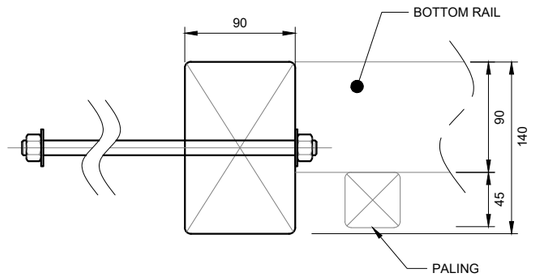
BARRIER DETAIL
N. T. S.

IMPORTANT NOTE:

1. PROLAM GRADE: PL17 H3.2 88x88
   RADIATA PINE: SG8 H3.2 140x90
2. BOTTOM RAIL, PALING AND POST CONFIGURATION SHOULD BE AS PER DETAIL SHOWN BELOW
3. SED POLE NOT SHOWN FOR CLARITY
4. PROLAM LAMINATION MUST BE PERPENDICULAR TO BOLT



OPTION 1



OPTION 2

TIMBER SPECIFICATION NOTES:

1. CAUTION:
   DEEP EXCAVATIONS UNSUPPORTED DURING CONSTRUCTION MAY BE HAZARDOUS PARTICULARLY WHEN WORKING IN CONFINED SPACES. THE DEPARTMENT OF LABOUR'S EXCAVATION GUIDE GIVES RECOMMENDED SAFETY PROCEDURES FOR SUCH SITUATIONS. THE EXCAVATION AND EARTHWORKS CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT ADEQUATELY ALL PERSONS AND PROPRETY LIABLE TO THE BE AFFECTED BY THE EXCAVATION AND EARTHWORKS OPERATIONS.
2. MATERIALS:
   TIMBER:
   TIMBER POLES SHALL BE PEELED RADIATA PINE LOGS COMPLYING WITH THE REQUIREMENT OF NZS 3605 "LOAD BEARING ROUND TIMBER PILES AND POLES" TREATED TO TPA COMMODITY SPECIFICATION H5. ALL TIMBER POLES TO BE HIGH DENSITY.
   DIMENSIONS OF POLES ARE SPECIFIED AS MINIMUM SMALL END DIAMETERS.
   ACTUAL DIAMETERS WILL BE GREATER DUE TO TAPER AND TIMBER GRADING. SAWN TIMBER IN GROUND CONTACT SHALL BE RADIATA PILE TREATED TO SPECIFICATION H4.
   ALL TIMBER SHALL HAVE TPA IDENTIFICATION BRANDS VISIBLE WHEN DELIVERED TO THE SITE AND SHALL BE PROTECTED AGAINST DAMAGE DURING STORAGE AND HANDLING
3. CONCRETE:
   CONCRETE FOR FOUNDATION BACKFILL SHALL BE ORDINARY GRADE CONCRETE COMPLYING WITH NZS 3109 'SPECIFICATION FOR CONCRETE', AND WITH A 28-DAY STRENGTH OF 20 MPa.
   CONCRETE SHALL BE PLACED UNDER AND AROUND POLES AND WELL COMPACTED BY VIBRATING. POLES SHALL BE TEMPORARILY PROPPED AND PROTECTED AGAINST DISTURBANCE FOR AT LEAST TWO DAYS AFTER PLACEMENT OF CONCRETE
4. EXCAVATION:
   EXCAVATION IN STAGES TO ALLOW FOR TEMPORARY SUPPORT DURING CONSTRUCTION IS REQUIRED. NO MORE THAN 3.0m OF UNSUPPORTED SLOPE SHALL EXIST AT ANY ONE TIME.
   EXCAVATION FOR POLES SHALL BE TAKEN OUT BY AUGERING TO THE DIMENSIONS DETAILED, WITH ALL SURPLUS SOIL BEING DISPOSED OF AWAY FROM THE SITE.
   ALLOWANCE SHALL BE MADE IN POSITIONING AUGERED HOLES FOR THE SLOPE OF THE WALL AND FOR CONCRETE TO SURROUND THE POLES. DRIVING OF POLES IS NOT ACCEPTABLE AS AN ALTERNATIVE TO AUGERING. POLES SHALL BE INSTALLED AS SOON AS POSSIBLE AFTER EXCAVATION. EXCAVATIONS FOR POLES SHALL BE FREE OF WATER AND LOOSE MATERIAL BEFORE CONCRETING. IF NECESSARY THE CONTRACTOR SHALL ALLOW FOR HANDCLEANING AND PUMPING OF EXCAVATION.
5. INSTALLATION:
   DRIVING OF POLES IS NOT ACCEPTABLE AS AN ALTERNATIVE TO AUGERING. FIXING OF HORIZONTAL TIMBERS TO POLES SHALL UTILISE GALVANISED NAILS AS DETAILED. TIMBERS SHALL BE LAYED IN POSITION COMMENCING AT THE BOTTOM OF THE WALL WITH JOINTS BETWEEN TIMBERS STAGGERED BETWEEN THE POLES BY USE OF SHORT TIMBERS AT ENDS OF ALTERNATIVE ROWS. IF CUTTING IS NECESSARY THE EXPOSED SURFACES SHALL BE FLOODED WITH A COPPER NAPTHENATE TYPE OF WOOD PRESERVATIVE.
   CARE SHALL BE TAKEN IN SELECTING AND LAYING HORIZONTAL TIMBERS TO MAINTAIN THE SPECIFIED MINIMUM THICKNESS OF TIMBERS, PARTICULARLY NEAR THE BASE OF THE WALL AND TO ACHIEVE NEAT STRAIGHT LINES AT THE TOP OF THE WALL.
6. BACKFILLING:
   A PERFORATED OR OPEN JOINTED SUBSOIL DRAIN SHALL BE LAID AND SURROUNDED IN FINE GRANULAR MATERIAL WITH THE INVERT BELOW LOWER GROUND LEVELS AND LED TO A FREE OUTLET AT A POINT OF SAFE DISCHARGE.
   REMAINING BACKFILL TO WITHIN 300mm OF FINISHED SURFACE LEVEL SHALL BE DRAINED COMPACTED GRANULAR FILL NOT LARGER THAN 65mm DIMENSIONS (eg RUN OF PIT SCORIA OR SIMILAR).
   THE FINISHED SURFACE OF BACKFILL SHALL BE SEALED AGAINST ENTRY OF SURFACE WATER WITH A LAYER OF TOPSOIL, CLAY OR CONCRETE.

Issue	Date	Revision
A	23/10/2019	FIRST ISSUE

DWG TYPICAL TIMBER POLE WALL DETAIL RW02

Scale N. T. S. | Date 23/10/2019
Drawn WT | Checked JP | Approved JP
File X:\19 JOBS\19 123 PETER MORGAN\ENGINEERING\DRAWINGS\19 123_RW01.DWG

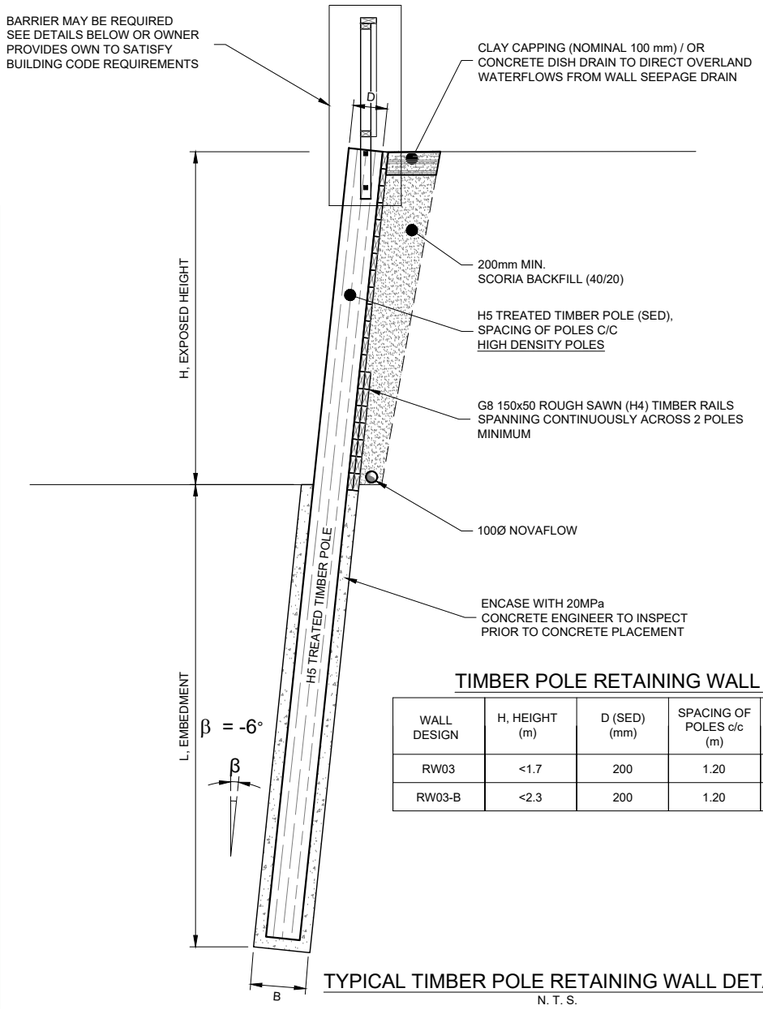
HAIGH WORKMAN LTD
Civil & Structural Engineers
6 Fairway Drive
Kerikeri, BOI.
T: 09 407 8327
F: 09 407 8378
E: info@haighworkman.co.nz

DIMENSIONS MUST NOT BE SCALE MEASURED FROM THESE DRAWINGS. THE CONTRACTOR SHALL CHECK & VERIFY ALL DIMENSIONS INCLUDING, SITE LEVELS, HEIGHTS AND ANGLES ON SITE PRIOR TO COMMENCING ANY WORK. THE COPYRIGHT TO THESE DRAWINGS AND ALL PARTS THERE OF REMAIN THE PROPERTY OF HAIGH WORKMAN. ©2006

Project PROPOSED DWELLING AND STUDIO
36 OLD HOSPITAL ROAD, WHANGAROA
Client PETER MORGAN
Project No. 19 123 | RC no.

DWG No. P5
Sheet No. 5 of 6

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 34 of 127 - 11/04/2022 - NZBTC



TYPICAL TIMBER POLE RETAINING WALL DETAIL
N. T. S.

NOTE:

1. TO BE CONSTRUCTED IN ACCORDANCE WITH B1 GUIDANCE ON BARRIER DESIGN (MARCH 2012).
2. BARRIER DETAILS SUITABLE FOR BARRIERS SERVING ONE DWELLING UNIT ONLY.

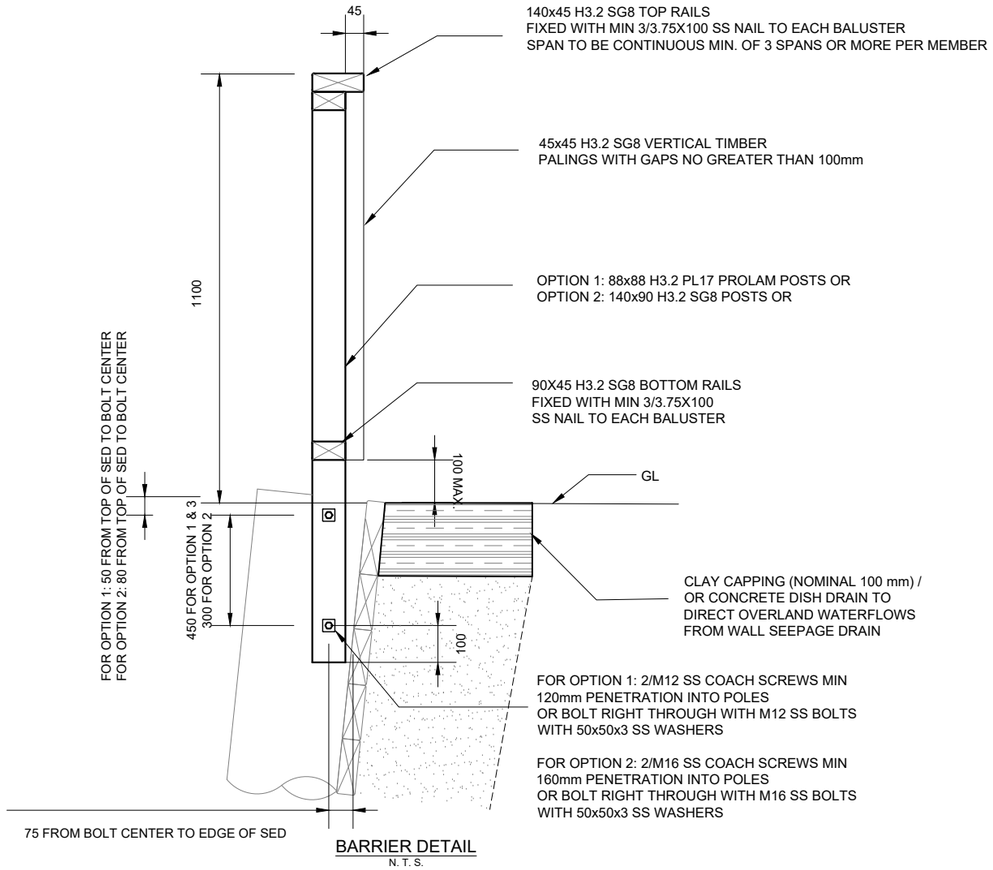
BACKING BOARD DETAILS

(m FROM TOP OF WALL)

WALL DESIGN	SINGLE RAILS	DOUBLE RAILS
ALL	0.00 - 1.65	1.65-2.30

TIMBER POLE RETAINING WALL DETAILS

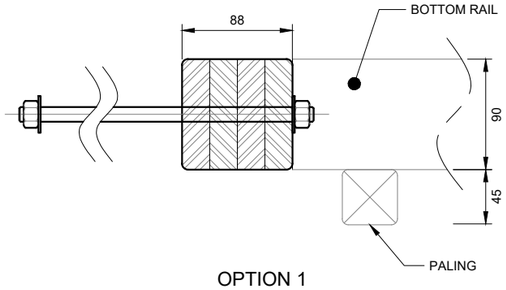
WALL DESIGN	H, HEIGHT (m)	D (SED) (mm)	SPACING OF POLES c/c (m)	L, EMBEDMENT (m)	B, BORED Ø (mm)
RW03	<1.7	200	1.20	2.3	450
RW03-B	<2.3	200	1.20	2.8	450



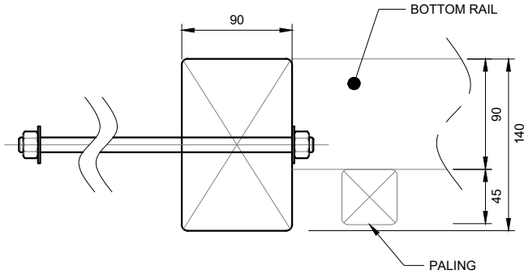
BARRIER DETAIL
N. T. S.

IMPORTANT NOTE:

1. PROLAM GRADE: PL17 H3.2 88x88
   RADIATA PINE: SG8 H3.2 140x90
2. BOTTOM RAIL, PALING AND POST CONFIGURATION SHOULD BE AS PER DETAIL SHOWN BELOW
3. SED POLE NOT SHOWN FOR CLARITY
4. PROLAM LAMINATION MUST BE PERPENDICULAR TO BOLT



OPTION 1



OPTION 2

TIMBER SPECIFICATION NOTES:

1. CAUTION:
   DEEP EXCAVATIONS UNSUPPORTED DURING CONSTRUCTION MAY BE HAZARDOUS PARTICULARLY WHEN WORKING IN CONFINED SPACES. THE DEPARTMENT OF LABOUR'S EXCAVATION GUIDE GIVES RECOMMENDED SAFETY PROCEDURES FOR SUCH SITUATIONS. THE EXCAVATION AND EARTHWORKS CONTRACTOR SHALL TAKE ALL NECESSARY PRECAUTIONS TO PROTECT ADEQUATELY ALL PERSONS AND PROPRETY LIABLE TO THE BE AFFECTED BY THE EXCAVATION AND EARTHWORKS OPERATIONS.
2. MATERIALS:
   TIMBER:
   TIMBER POLES SHALL BE PEELED RADIATA PINE LOGS COMPLYING WITH THE REQUIREMENT OF NZS 3605 "LOAD BEARING ROUND TIMBER PILES AND POLES" TREATED TO TPA COMMODITY SPECIFICATION H5. ALL TIMBER POLES TO BE HIGH DENSITY.
   DIMENSIONS OF POLES ARE SPECIFIED AS MINIMUM SMALL END DIAMETERS.
   ACTUAL DIAMETERS WILL BE GREATER DUE TO TAPER AND TIMBER GRADING. SAWN TIMBER IN GROUND CONTACT SHALL BE RADIATA PILE TREATED TO SPECIFICATION H4.
   ALL TIMBER SHALL HAVE TPA IDENTIFICATION BRANDS VISIBLE WHEN DELIVERED TO THE SITE AND SHALL BE PROTECTED AGAINST DAMAGE DURING STORAGE AND HANDLING
3. CONCRETE:
   CONCRETE FOR FOUNDATION BACKFILL SHALL BE ORDINARY GRADE CONCRETE COMPLYING WITH NZS 3109 'SPECIFICATION FOR CONCRETE', AND WITH A 28-DAY STRENGTH OF 20 MPa.
   CONCRETE SHALL BE PLACED UNDER AND AROUND POLES AND WELL COMPACTED BY VIBRATING. POLES SHALL BE TEMPORARILY PROPPED AND PROTECTED AGAINST DISTURBANCE FOR AT LEAST TWO DAYS AFTER PLACEMENT OF CONCRETE
4. EXCAVATION:
   EXCAVATION IN STAGES TO ALLOW FOR TEMPORARY SUPPORT DURING CONSTRUCTION IS REQUIRED. NO MORE THAN 3.0m OF UNSUPPORTED SLOPE SHALL EXIST AT ANY ONE TIME.
   EXCAVATION FOR POLES SHALL BE TAKEN OUT BY AUGERING TO THE DIMENSIONS DETAILED, WITH ALL SURPLUS SOIL BEING DISPOSED OF AWAY FROM THE SITE.
   ALLOWANCE SHALL BE MADE IN POSITIONING AUGERED HOLES FOR THE SLOPE OF THE WALL AND FOR CONCRETE TO SURROUND THE POLES. DRIVING OF POLES IS NOT ACCEPTABLE AS AN ALTERNATIVE TO AUGERING. POLES SHALL BE INSTALLED AS SOON AS POSSIBLE AFTER EXCAVATION. EXCAVATIONS FOR POLES SHALL BE FREE OF WATER AND LOOSE MATERIAL BEFORE CONCRETING. IF NECESSARY THE CONTRACTOR SHALL ALLOW FOR HANDCLEANING AND PUMPING OF EXCAVATION.
5. INSTALLATION:
   DRIVING OF POLES IS NOT ACCEPTABLE AS AN ALTERNATIVE TO AUGERING. FIXING OF HORIZONTAL TIMBERS TO POLES SHALL UTILISE GALVANISED NAILS AS DETAILED. TIMBERS SHALL BE LAYED IN POSITION COMMENCING AT THE BOTTOM OF THE WALL WITH JOINTS BETWEEN TIMBERS STAGGERED BETWEEN THE POLES BY USE OF SHORT TIMBERS AT ENDS OF ALTERNATIVE ROWS. IF CUTTING IS NECESSARY THE EXPOSED SURFACES SHALL BE FLOODED WITH A COPPER NAPTHENATE TYPE OF WOOD PRESERVATIVE.
   CARE SHALL BE TAKEN IN SELECTING AND LAYING HORIZONTAL TIMBERS TO MAINTAIN THE SPECIFIED MINIMUM THICKNESS OF TIMBERS, PARTICULARLY NEAR THE BASE OF THE WALL AND TO ACHIEVE NEAT STRAIGHT LINES AT THE TOP OF THE WALL.
6. BACKFILLING:
   A PERFORATED OR OPEN JOINTED SUBSOIL DRAIN SHALL BE LAID AND SURROUNDED IN FINE GRANULAR MATERIAL WITH THE INVERT BELOW LOWER GROUND LEVELS AND LED TO A FREE OUTLET AT A POINT OF SAFE DISCHARGE.
   REMAINING BACKFILL TO WITHIN 300mm OF FINISHED SURFACE LEVEL SHALL BE DRAINED COMPACTED GRANULAR FILL NOT LARGER THAN 65mm DIMENSIONS (eg RUN OF PIT SCORIA OR SIMILAR).
   THE FINISHED SURFACE OF BACKFILL SHALL BE SEALED AGAINST ENTRY OF SURFACE WATER WITH A LAYER OF TOPSOIL, CLAY OR CONCRETE.

Issue	Date	Revision
A	23/10/2019	FIRST ISSUE

DWG TYPICAL TIMBER POLE WALL DETAIL RW03

Scale N. T. S. | Date 23/10/2019
Drawn WT | Checked JP | Approved JP
File X:\19 JOBS\19 123 PETER MORGAN\ENGINEERING\DRAWINGS\19 123_RW01.DWG

HAIGH WORKMAN LTD
Civil & Structural Engineers
6 Fairway Drive
Kerikeri, BOI.
T: 09 407 8327
F: 09 407 8378
E: info@haighworkman.co.nz

DIMENSIONS MUST NOT BE SCALE MEASURED FROM THESE DRAWINGS. THE CONTRACTOR SHALL CHECK & VERIFY ALL DIMENSIONS INCLUDING, SITE LEVELS, HEIGHTS AND ANGLES ON SITE PRIOR TO COMMENCING ANY WORK. THE COPYRIGHT TO THESE DRAWINGS AND ALL PARTS THERE OF REMAIN THE PROPERTY OF HAIGH WORKMAN. ©2006

Project PROPOSED DWELLING AND STUDIO
36 OLD HOSPITAL ROAD, WHANGAROA

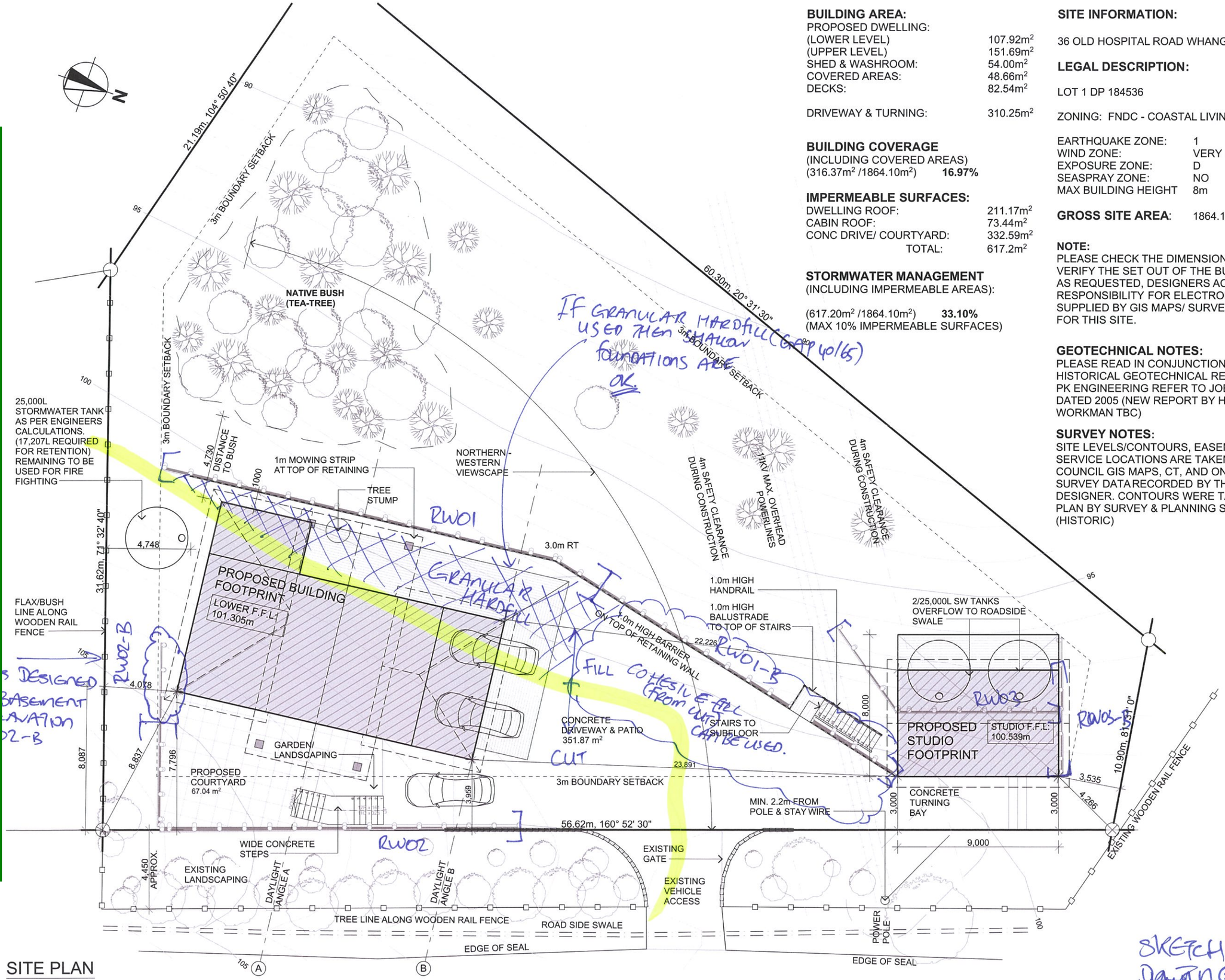
Client PETER MORGAN

Project No. 19 123 | RC no.

DWG No. P6

Sheet No. 6 of 6

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 35 of 127 - 11/04/2022 - NZBTC



SITE PLAN
Scale 1:200

OLD HOSPITAL ROAD

THIS DRAWING AND THE DESIGN IT COVERS SHALL REMAIN THE PROPERTY AND COPYRIGHT OF DAWSON DESIGN LIMITED.

BUILDING AREA:

PROPOSED DWELLING:	
(LOWER LEVEL)	107.92m²
(UPPER LEVEL)	151.69m²
SHED & WASHROOM:	54.00m²
COVERED AREAS:	48.66m²
DECKS:	82.54m²
DRIVEWAY & TURNING:	310.25m²

BUILDING COVERAGE
(INCLUDING COVERED AREAS)
(316.37m² /1864.10m²) **16.97%**

IMPERMEABLE SURFACES:

DWELLING ROOF:	211.17m²
CABIN ROOF:	73.44m²
CONC DRIVE/ COURTYARD:	332.59m²
TOTAL:	617.2m²

STORMWATER MANAGEMENT
(INCLUDING IMPERMEABLE AREAS):

(617.20m² /1864.10m²) **33.10%**
(MAX 10% IMPERMEABLE SURFACES)

SITE INFORMATION:

36 OLD HOSPITAL ROAD WHANGAROA 0478

LEGAL DESCRIPTION:

LOT 1 DP 184536

ZONING: FNDC - COASTAL LIVING

EARTHQUAKE ZONE:	1
WIND ZONE:	VERY HIGH
EXPOSURE ZONE:	D
SEASPRAY ZONE:	NO
MAX BUILDING HEIGHT	8m

GROSS SITE AREA: 1864.10m²

NOTE:
PLEASE CHECK THE DIMENSIONS TO VERIFY THE SET OUT OF THE BUILDING IS AS REQUESTED, DESIGNERS ACCEPT NO RESPONSIBILITY FOR ELECTRONIC DATA SUPPLIED BY GIS MAPS/ SURVEYOR PLAN FOR THIS SITE.

GEOTECHNICAL NOTES:
PLEASE READ IN CONJUNCTION WITH HISTORICAL GEOTECHNICAL REPORT BY PK ENGINEERING REFER TO JOB NO. 05-69 DATED 2005 (NEW REPORT BY HAIGH WORKMAN TBC)

SURVEY NOTES:
SITE LEVELS/CONTOURS, EASEMENTS AND SERVICE LOCATIONS ARE TAKEN FROM COUNCIL GIS MAPS, CT, AND ON SITE SURVEY DATA RECORDED BY THE DESIGNER. CONTOURS WERE TAKEN FROM PLAN BY SURVEY & PLANNING SOLUTIONS (HISTORIC)

DAWSON DESIGN plans for living

0800 406 161 (09) 432 9188
info@dawsondesign.co.nz

PO BOX 1140, WHANGAREI, 0140

www.dawsondesign.co.nz

NOTES

CONTRACTOR TO CHECK ALL DIMENSIONS & CONDITIONS ON SITE BEFORE COMMENCING WORK.

DO NOT SCALE.

WORK ONLY TO FIGURED DIMENSIONS. IN THE EVENT OF A DISCREPANCY CONTACT THE DESIGNER.

TITLE

SITE PLAN

ISSUE DATE	27/09/2019
JOB NO.	18086
DRAWN BY	DF
CHECKED BY	CD

PROJECT

PROPOSED NEW DWELLING FOR

JENNY ANN EMMANUEL

36 OLD HOSPITAL ROAD WHANGAROA 0478

REVISIONS

NO.	REVISION	DATE
1	SK-01	22.11.2018

SCALE
1:200

DRAWING CODE	DRAWING ISSUE
102	RC-01

SKETCH DRAWING

PRELIMINARY ONLY - NOT FOR CONSTRUCTION

W-Thorburn / Haigh Workman

Appendix B – Hand Auger Logs

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 36 of 127 - 11/04/2022 - NZBTC

PO Box 89, 0245
6 Fairway Drive
Kerikeri, 0230
New Zealand

HAIGH WORKMAN LTD
Civil & Structural Engineers

Phone 09 407 8327
Fax 09 407 8378
www.haighworkman.co.nz
info@haighworkman.co.nz

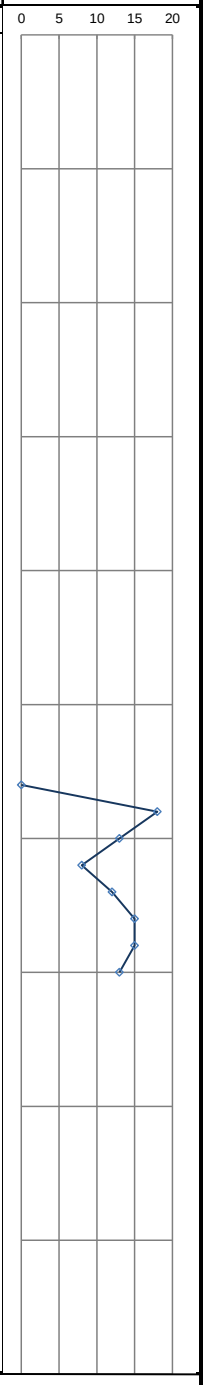
Borehole Log - BH1

Hole Location: Refer to Site Plan

JOB No. 19 123

CLIENT:	Peter Morgan	**SITE:**	36 Old Hospital Road, Whangaroa		
Date Started:	08/08/2019	**DRILLING METHOD:**	Hand Auger	**LOGGED BY:**	JP
Date Completed:	08/08/2019	**HOLE DIAMETER (mm)**	50mm	**CHECKED BY:**	OT

Soil Description (Based on NZGS Logging Guidelines 2005)	Depth (m)	Geology	Graphic Log	Water Level	Sensitivity	Corrected Shear Vane Strength (kPa)	Scala Penetrometer (blows/100mm)
Clayey **SILT**, trace fine gravel; light brown and light brownish orange, mottled orange, white and brown, speckled black. Very stiff, moist, low to medium plasticity. [Fill]	0.0	FILL		Groundwater Not Encountered	6	125 / 22	
0.9m: becomes light orangish brown, speckled orange, black and pinkish red.	0.5				2	94 / 42	
SILT, minor clay; brown to dark brown, mottled orange. Stiff, moist to wet, low plasticity. [Buried Topsoil]	1.0	T.S.					
Clayey **SILT**, trace fine gravel; light brown, mottled orange and yellow. Very stiff, moist, low plasticity. [Tupou Complex]		TUPOU COMPLEX					
SILT, some clay; light orange, streaked orange and light yellow. Very stiff, dry to moist, low plasticity.	1.5					UTP	
1.6m: becomes light orange and light grey, streaked orange. Minor black speckles.							
1.9m: limonite staining, trace weakly cemented clasts, black and dark orange.							
SILT, minor clay; light orange and light grey, streaked orange, speckled black. Very stiff, dry to moist, low plasticity.	2.0					UTP	
2.4m: becomes light grey, streaked light orange and dark orange, speckled black.	2.5					UTP	
End of hole at 2.8m (UTP)						UTP	
	3.0						
	3.5						
	4.0						
	4.5						



LEGEND

TOPSOIL | CLAY | SILT | SAND | GRAVEL | FILL

Corrected shear vane reading
Remoulded shear vane reading
Scala Penetrometer

Note: UTP = Unable to penetrate. T.S. = Topsoil.
Shear Vane S/N: 2220
Scala penetrometer testing undertaken from 2.8m to 3.4m.

Average Soil Sensitivity 3.9

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 37 of 127 - 11/04/2022 - NZBTC

PO Box 89, 0245
6 Fairway Drive
Kerikeri, 0230
New Zealand

HAIGH WORKMAN LTD
Civil & Structural Engineers

Phone 09 407 8327
Fax 09 407 8378
www.haighworkman.co.nz
info@haighworkman.co.nz

Borehole Log - BH2

Hole Location: Refer to Site Plan

JOB No. 19 123

CLIENT:	Peter Morgan	**SITE:**	36 Old Hospital Road, Whangaroa		
Date Started:	08/08/2019	**DRILLING METHOD:**	Hand Auger	**LOGGED BY:**	JP
Date Completed:	08/08/2019	**HOLE DIAMETER (mm)**	50mm	**CHECKED BY:**	OT

Soil Description (Based on NZGS Logging Guidelines 2005)	Depth (m)	Geology	Graphic Log	Water Level	Sensitivity	Corrected Shear Vane Strength (kPa)	Scala Penetrometer (blows/100mm)
SILT, trace clay; brown to dark brown, streaked orange. Stiff, moist to wet, no plasticity. Rootlets. [Topsoil]	0.0	T.S.		Groundwater Not Encountered			
Clayey **SILT**; brownish orange to light orange. Very stiff, moist, medium plasticity. Trace rootlets. [Tupou Complex] 0.4m: becomes light brownish grey and light orange, streaked orange. No rootlets. 0.6: becomes light grey and light orange, streaked orange. Dry to moist, low to medium plasticity.	0.5	TUPOU COMPLEX			3	144 53	
SILT, some clay; light grey and light orange, streaked orange. Very stiff, moist, low plasticity. 1.4m: becomes light greenish grey, streaked orange and dark orange.	1.0					UTP UTP	
SILT, minor fine gravel, minor clay; light orange and light grey, streaked dark orange and black. Very stiff, moist, low plasticity. Gravel: weakly cemented clasts, limonite and manganese nodules.	1.5					UTP	
End of hole at 1.8m (UTP)	2.0						
	2.5						
	3.0						
	3.5						
	4.0						
	4.5						

Scala Penetrometer scale: 0 5 10 15 20

LEGEND

TOPSOIL CLAY SILT SAND GRAVEL FILL

Corrected shear vane reading
Remoulded shear vane reading
Scala Penetrometer

Note: UTP = Unable to penetrate. T.S. = Topsoil.
Shear Vane S/N: 2220
Scala penetrometer testing not undertaken.

Average Soil Sensitivity 2.7

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 38 of 127 - 11/04/2022 - NZBTC

PO Box 89, 0245
6 Fairway Drive
Kerikeri, 0230
New Zealand

HAIGH WORKMAN LTD
Civil & Structural Engineers

Phone 09 407 8327
Fax 09 407 8378
www.haighworkman.co.nz
info@haighworkman.co.nz

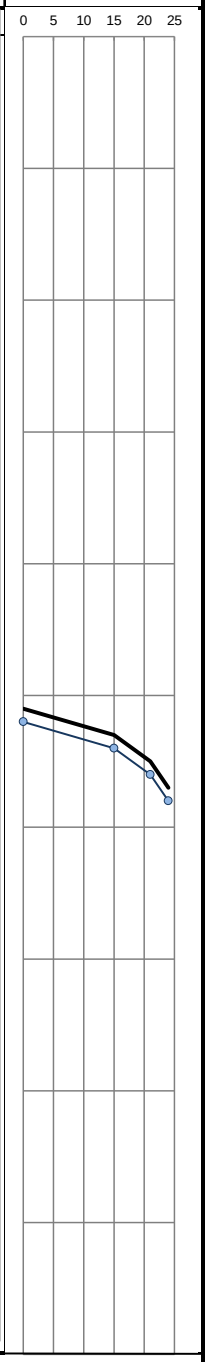
Borehole Log - BH3

Hole Location: Refer to Site Plan

JOB No. 19 123

CLIENT:	Peter Morgan	**SITE:**	36 Old Hospital Road, Whangaroa		
Date Started:	08/08/2019	**DRILLING METHOD:**	Hand Auger	**LOGGED BY:**	JP
Date Completed:	08/08/2019	**HOLE DIAMETER (mm)**	50mm	**CHECKED BY:**	OT

Soil Description (Based on NZGS Logging Guidelines 2005)	Depth (m)	Geology	Graphic Log	Water Level	Sensitivity	Corrected Shear Vane Strength (kPa)	Scala Penetrometer (blows/100mm)
SILT, trace clay; dark brown to brown. Firm, moist to wet, low plasticity. Rootlets. [Topsoil]	0.0	T.S.		Groundwater Not Encountered			
Clayey **SILT**; light brownish orange and light orange, streaked orange. Very stiff, moist, medium plasticity. [Tupou Complex]					3	111 / 42	
0.5m: becomes light orange and light brownish grey, streaked orange, speckled black.	0.5						
0.7m: becomes light grey and light orange, streaked orange.							
SILT, some clay, trace fine gravel; light yellowish orange and orange, streaked dark orange. Very stiff, moist, low plasticity. Weakly cemented clasts.	1.0					UTP	
1.2m: becomes light orange, streaked dark orange, speckled black.						UTP	
1.8m: becomes dry to moist.	1.5						
SILT, minor clay, trace weakly cemented clasts; light orangish brown and light greyish green, streaked dark orange. Very stiff, moist, low plasticity.	2.0					UTP	
2.4: becomes light grey and light orange, speckled black.	2.5					UTP UTP	
End of hole at 2.6m (UTP)	3.0						
	3.5						
	4.0						
	4.5						



LEGEND

TOPSOIL | CLAY | SILT | SAND | GRAVEL | FILL

Corrected shear vane reading
Remoulded shear vane reading
Scala Penetrometer

Note: UTP = Unable to penetrate. T.S. = Topsoil.
Shear Vane S/N: 2220
Scala penetrometer testing undertaken from 2.6m to 2.9m.

Average Soil Sensitivity 2.7

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 39 of 127 - 11/04/2022 - NZBTC

PO Box 89, 0245
6 Fairway Drive
Kerikeri, 0230
New Zealand

HAIGH WORKMAN LTD
Civil & Structural Engineers

Phone 09 407 8327
Fax 09 407 8378
www.haighworkman.co.nz
info@haighworkman.co.nz

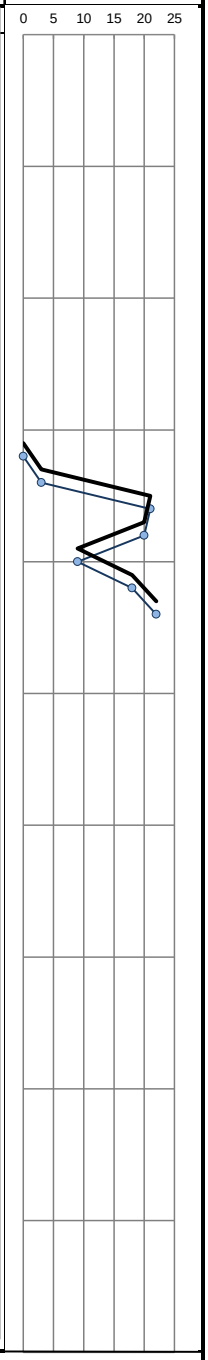
Borehole Log - BH4

Hole Location: Refer to Site Plan

JOB No. 19 123

CLIENT:	Peter Morgan	**SITE:**	36 Old Hospital Road, Whangaroa		
Date Started:	08/08/2019	**DRILLING METHOD:**	Hand Auger	**LOGGED BY:**	JP
Date Completed:	08/08/2019	**HOLE DIAMETER (mm)**	50mm	**CHECKED BY:**	OT

Soil Description (Based on NZGS Logging Guidelines 2005)	Depth (m)	Geology	Graphic Log	Water Level	Sensitivity	Corrected Shear Vane Strength (kPa)	Scala Penetrometer (blows/100mm)
SILT, minor clay; dark brown to brown. Firm, moist, low plasticity. Some rootlets. [Topsoil]	0.0	T.S.		Groundwater Not Encountered			
Clayey **SILT**; brownish orange to orange, streaked light brown, speckled black. Very stiff, moist, low to medium plasticity. [Tupou Complex]		TUPOU COMPLEX			3		
0.4m: becomes orange, streaked light brownish orange.	0.5					105 / 30	
0.7m: light greyish brown & light orange, streaked orange. Moist to wet.							
SILT, some clay, trace fine gravel (weakly cemented clasts); brownish orange and orange, streaked light grey and dark orange. Very stiff, moist to wet, low plasticity.						UTP	
1.1m: becomes light orange, mottled dark orange and light grey. Moist.	1.0						
1.3m: becomes light orange and light grey, streaked orange. Dry to moist.						UTP	
	1.5					UTP	
End of hole at 1.6m (UTP)	2.0						
	2.5						
	3.0						
	3.5						
	4.0						
	4.5						



LEGEND

TOPSOIL | CLAY | SILT | SAND | GRAVEL | FILL

Corrected shear vane reading
Remoulded shear vane reading
Scala Penetrometer

Note: UTP = Unable to penetrate. T.S. = Topsoil.
Shear Vane S/N: 2220
Scala penetrometer testing undertaken from 1.6m to 2.2m.

Average Soil Sensitivity 3.5

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 40 of 127 - 11/04/2022 - NZBTC

PO Box 89, 0245
6 Fairway Drive
Kerikeri, 0230
New Zealand

HAIGH WORKMAN LTD
Civil & Structural Engineers

Phone 09 407 8327
Fax 09 407 8378
www.haighworkman.co.nz
info@haighworkman.co.nz

Borehole Log - BH5

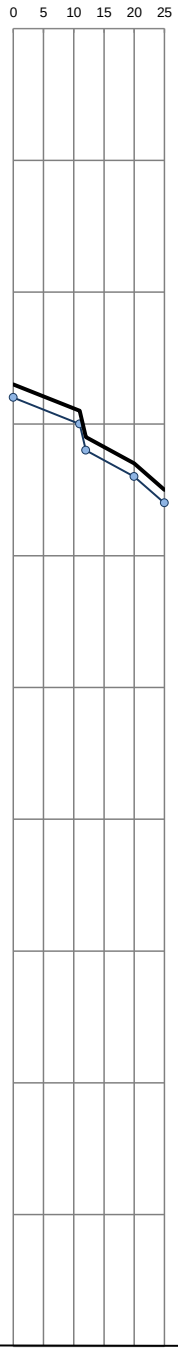
Hole Location: Refer to Site Plan

JOB No. 19 123

CLIENT:	Peter Morgan	**SITE:**	36 Old Hospital Road, Whangaroa		
Date Started:	08/08/2019	**DRILLING METHOD:**	Hand Auger	**LOGGED BY:**	JP
Date Completed:	08/08/2019	**HOLE DIAMETER (mm)**	50mm	**CHECKED BY:**	OT

Soil Description (Based on NZGS Logging Guidelines 2005)	Depth (m)	Geology	Graphic Log	Water Level	Sensitivity	Corrected Shear Vane Strength (kPa)
SILT, minor clay; dark brown to brown. Firm, moist to wet, low plasticity. Some rootlets. [Topsoil]	0.0	T.S.		Groundwater Not Encountered		
Clayey **SILT**; light brown and light orange, streaked brown. Very stiff, moist, low to medium plasticity. [Tupou Complex]		TUPOU COMPLEX				UTP
1.5m: becomes light orange streaked orange, mottled dark orange.	0.5					
SILT, some clay; light orange and light brownish orange, mottled dark orange. Very stiff, moist, low plasticity.						
0.8m: becomes light orange and light grey, streaked dark orange.						
0.9m: becomes light grey, streaked orange.						
SILT, trace clay; light grey, streaked orange. Very stiff, moist, low plasticity.	1.0					UTP
End of hole at 1.4m (UTP)						UTP
	1.5					
	2.0					
	2.5					
	3.0					
	3.5					
	4.0					
	4.5					

Scala Penetrometer (blows/100mm)



LEGEND

TOPSOIL | CLAY | SILT | SAND | GRAVEL | FILL

Corrected shear vane reading
Remoulded shear vane reading
Scala Penetrometer

Note: UTP = Unable to penetrate. T.S. = Topsoil.
Shear Vane S/N: 2220
Scala penetrometer testing undertaken from 1.4m to 1.8m.

Average Soil Sensitivity N/A

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 41 of 127 - 11/04/2022 - NZBTC

PO Box 89, 0245
6 Fairway Drive
Kerikeri, 0230
New Zealand

HAIGH WORKMAN LTD
Civil & Structural Engineers

Phone 09 407 8327
Fax 09 407 8378
www.haighworkman.co.nz
info@haighworkman.co.nz

Borehole Log - BH6

Hole Location: Refer to Site Plan

JOB No. 19 123

CLIENT:	Peter Morgan	**SITE:**	36 Old Hospital Road, Whangaroa		
Date Started:	08/08/2019	**DRILLING METHOD:**	Hand Auger	**LOGGED BY:**	JP
Date Completed:	08/08/2019	**HOLE DIAMETER (mm)**	50mm	**CHECKED BY:**	OT

Soil Description (Based on NZGS Logging Guidelines 2005)	Depth (m)	Geology	Graphic Log	Water Level	Sensitivity	Corrected Shear Vane Strength (kPa)	Scala Penetrometer (blows/100mm)
SILT, minor clay; dark brown to brown. Firm, moist, low plasticity. Rootlets.	0.0	T.S.		Groundwater Not Encountered			
Clayey **SILT**; light brownish orange and light orange. Very stiff, moist, low to medium plasticity.					3	152 / 44	
0.6m: becomes light orange, streaked orange, mottled light orange brown.	0.5						
SILT, some clay, trace fine gravel (weakly cemented clasts); light brownish grey and light orange, streaked orange. Very stiff, moist, low plasticity.					4	155 / 36	
1.2m: becomes light grey and light orange, streaked orange.	1.0					UTP	
SILT, minor clay; light grey, streaked orange and dark orange. Very stiff, moist, low plasticity.	1.5						
1.8m: becomes light grey and light orange, streaked orange.						UTP	
End of hole at 2.0m (UTP)	2.0						
	2.5						
	3.0						
	3.5						
	4.0						
	4.5						

Scala Penetrometer scale: 0 5 10 15 20

LEGEND

TOPSOIL CLAY SILT SAND GRAVEL FILL

Corrected shear vane reading
Remoulded shear vane reading
Scala Penetrometer

Note: UTP = Unable to penetrate. T.S. = Topsoil.
Shear Vane S/N: 2220
Scala penetrometer testing not undertaken.

Average Soil Sensitivity 3.9

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 42 of 127 - 11/04/2022 - NZBTC

Appendix C – Cone Penetrometer Test Logs - CPTs

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 43 of 127 - 11/04/2022 - NZBTC

CPT Test Information

Test Hole Number	CPT01	Job Identifier	HW - Old Hospital Road, Whangaroa
Test Date	8/08/2019	Operator	Craig Greenfield
CPT Rig Type	Georig 220 with Screw Anchors	Cone Type	Nova Cone 100MPa
Cone Serial Number	5325	Battery Voltage Start	6.03
Start Recording	9:30:00 AM	Finish Recording	9:45:00 AM
Pre Drill Depth		Ground Water Depth	None
Data Interval	20mm	Total Penetration Depth (m)	7.367
Date of Last Calibration		Metres To Next Calibration	1221
		Test ended due to:	Tip Pressure/Tilt Angle

Zero Value Change % FSO

	Point Resistance	Pore Pressure	Sleeve Friction
End of test with tip loosened	0.04%	0.09%	0.02%

Dissipation Testing

Test No	Depth (m)	Duration (secs)	Comments

Notes and Comments

Data loss (typically at rod change points). Either deleted or averaged

qc	fs	u
2.54	0.54-0.56	5.52
3.58	1.54	
4.54	2.54-2.56	
6.62	3.56	
	5.56	
	6.64-6.66	

FNDC - Approved Building Consent Document - EBC-2022-9880 - Pg 44 of 127 - 11/04/2022 - NZBTC

FNDC - Approved Building Consent Document - EBC-2022-9880 - Pg 45 of 127 - 11/04/2022 - NZBTC

UNDERGROUND INVESTIGATION

CPT Test Information

Test Hole Number	CPT03	Job Identifier	HW - Old Hospital Road, Whangaroa
Test Date	8/08/2019	Operator	Craig Greenfield
CPT Rig Type	Georig 220 with Screw Anchors	Cone Type	Nova Cone 100MPa
Cone Serial Number	5325	Battery Voltage Start	5.98
Start Recording	10:30:00 AM	Finish Recording	11:10:00 AM
Pre Drill Depth		Ground Water Depth	none
Data Interval	20mm	Total Penetration Depth (m)	6.75
Date of Last Calibration		Metres To Next Calibration	1214
		Test ended due to:	Tip Pressure

Zero Value Change % FSO

	Point Resistance	Pore Pressure	Sleeve Friction
End of test with tip loosened	0.01%	0.03%	0.20%

Dissipation Testing

Test No	Depth (m)	Duration (secs)	Comments

Notes and Comments

Data loss corrected (typically at rod change points). Either deleted or averaged

qc	fs	u
0.58	0.58	
1.54-1.56	1.52-1.54	
2.52-2.54	2.5	
3.58		
4.58		
6.56		

UNDERGROUND INVESTIGATION

CPT Test Information

Test Hole Number	CPT03	Job Identifier	HW - Old Hospital Road, Whangaroa
Test Date	8/08/2019	Operator	Craig Greenfield
CPT Rig Type	Georig 220 with Screw Anchors	Cone Type	Nova Cone 100MPa
Cone Serial Number	5325	Battery Voltage Start	6.57
Start Recording	12:05:00 PM	Finish Recording	12:22:00 PM
Pre Drill Depth		Ground Water Depth	none
Data Interval	20mm	Total Penetration Depth (m)	4.722
Date of Last Calibration		Metres To Next Calibration	1207
		Test ended due to:	Anchor Failure

Zero Value Change % FSO

	Point Resistance	Pore Pressure	Sleeve Friction
End of test with tip loosened	0.03%	0.04%	0.12%

Dissipation Testing

Test No	Depth (m)	Duration (secs)	Comments

Notes and Comments

	qc	fs	u
Data loss (typically at rod change points). Either deleted or averaged	1.56 3.52 4.52	1.52	

FNDC - Approved Building Consent Document - EBC-2022-9880 - Pg 46 of 127 - 11/04/2022 - NZBTC

UNDERGROUND INVESTIGATION

CPT Test Information

Test Hole Number	CPT04	Job Identifier	HW - Old Hospital Road, Whangaroa
Test Date	8/08/2019	Operator	Craig Greenfield
CPT Rig Type	Georig 220 with Screw Anchors	Cone Type	Nova Cone 100MPa
Cone Serial Number	5325	Battery Voltage Start	6.49
Start Recording	2:00:00 PM	Finish Recording	2:16:00 PM
Pre Drill Depth		Ground Water Depth	4.8
Data Interval	20mm	Total Penetration Depth (m)	4.83
Date of Last Calibration		Metres To Next Calibration	1202
		Test ended due to:	Tilt Angle

Zero Value Change % FSO

	Point Resistance	Pore Pressure	Sleeve Friction
End of test with tip loosened	0.03%	0.02%	0.06%

Dissipation Testing

Test No	Depth (m)	Duration (secs)	Comments

Notes and Comments

Data loss (typically at rod change points). Either deleted or averaged

qc	fs	u
0.34	0.34	
4.36	2.34	
	4.4	

FNDC - Approved Building Consent Document - EBC-2022-9880 - Pg 47 of 127 - 11/04/2022 - NZBTC

UNDERGROUND INVESTIGATION

CPT Test Information

Test Hole Number	CPT05	Job Identifier	HW - Old Hospital Road, Whangaroa
Test Date	8/08/2019	Operator	Craig Greenfield
CPT Rig Type	Georig 220 with Screw Anchors	Cone Type	Nova Cone 100MPa
Cone Serial Number	5325	Battery Voltage Start	6.42
Start Recording	3:15:00 PM	Finish Recording	3:51:00 PM
Pre Drill Depth	0.7	Ground Water Depth	none
Data Interval	20mm	Total Penetration Depth (m)	3.937
Date of Last Calibration		Metres To Next Calibration	1197
		Test ended due to:	Anchor Failure

Zero Value Change % FSO

	Point Resistance	Pore Pressure	Sleeve Friction
End of test with tip loosened	0.03%	0.02%	0.06%

Dissipation Testing

Test No	Depth (m)	Duration (secs)	Comments

Notes and Comments

	qc	fs	u
Data loss (typically at rod change points). Either deleted or averaged	3.54	1.54	

FNDC - Approved Building Consent Document - EBC-2022-9880 - Pg 48 of 127 - 11/04/2022 - NZBTC

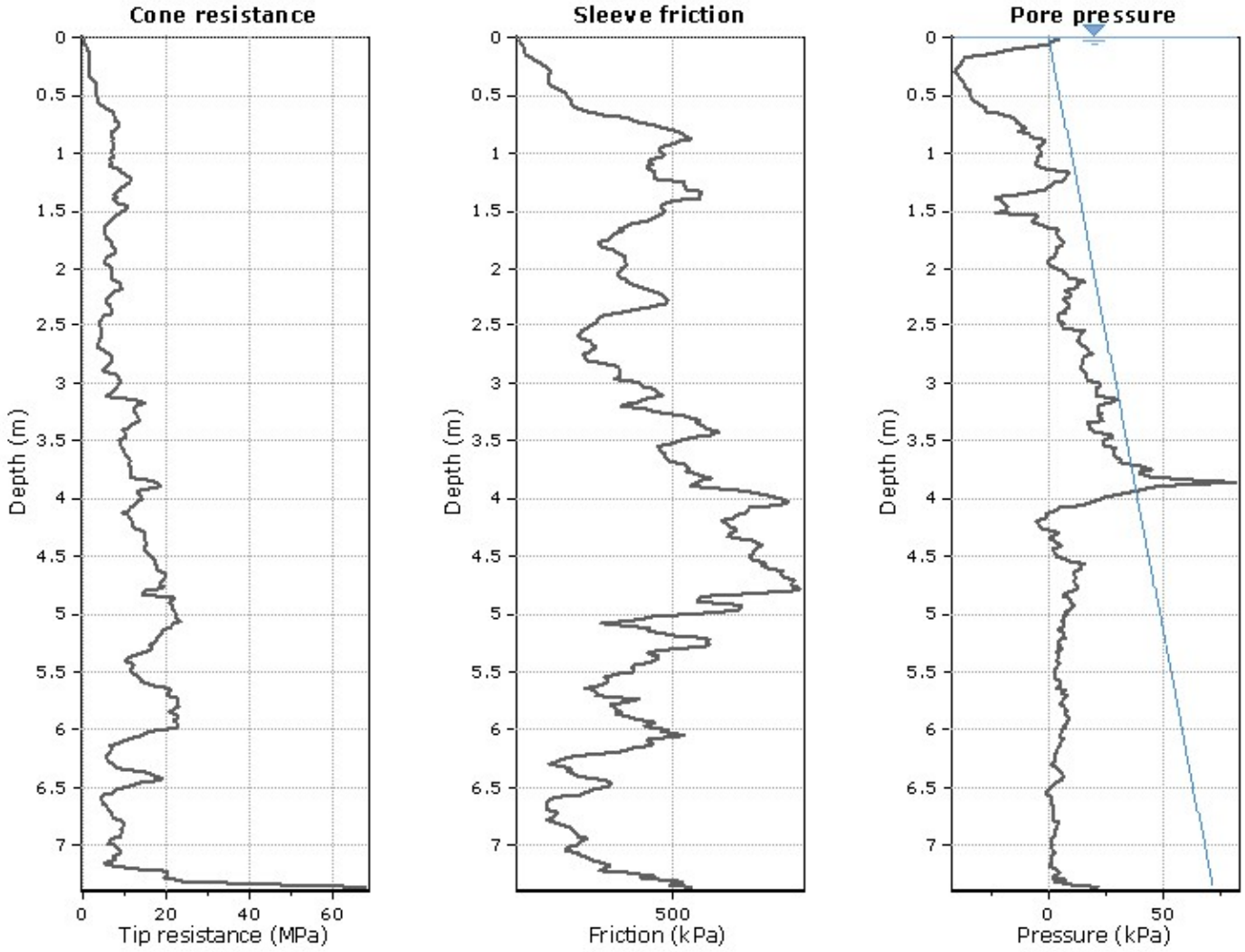
FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 49 of 127 - 11/04/2022 - NZBTC

Underground Investigation Limited

CPT: CPT1

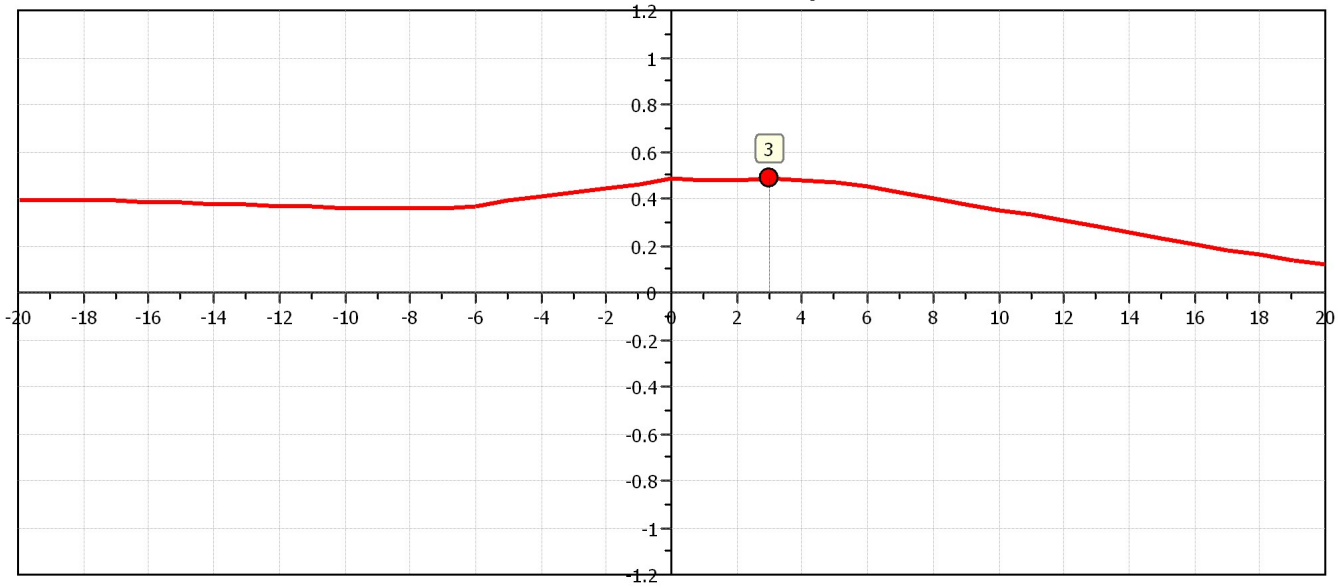
Total depth: 7.36 m, Date: 9/08/2019
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project:
Location:



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

Cross correlation between qc & fs

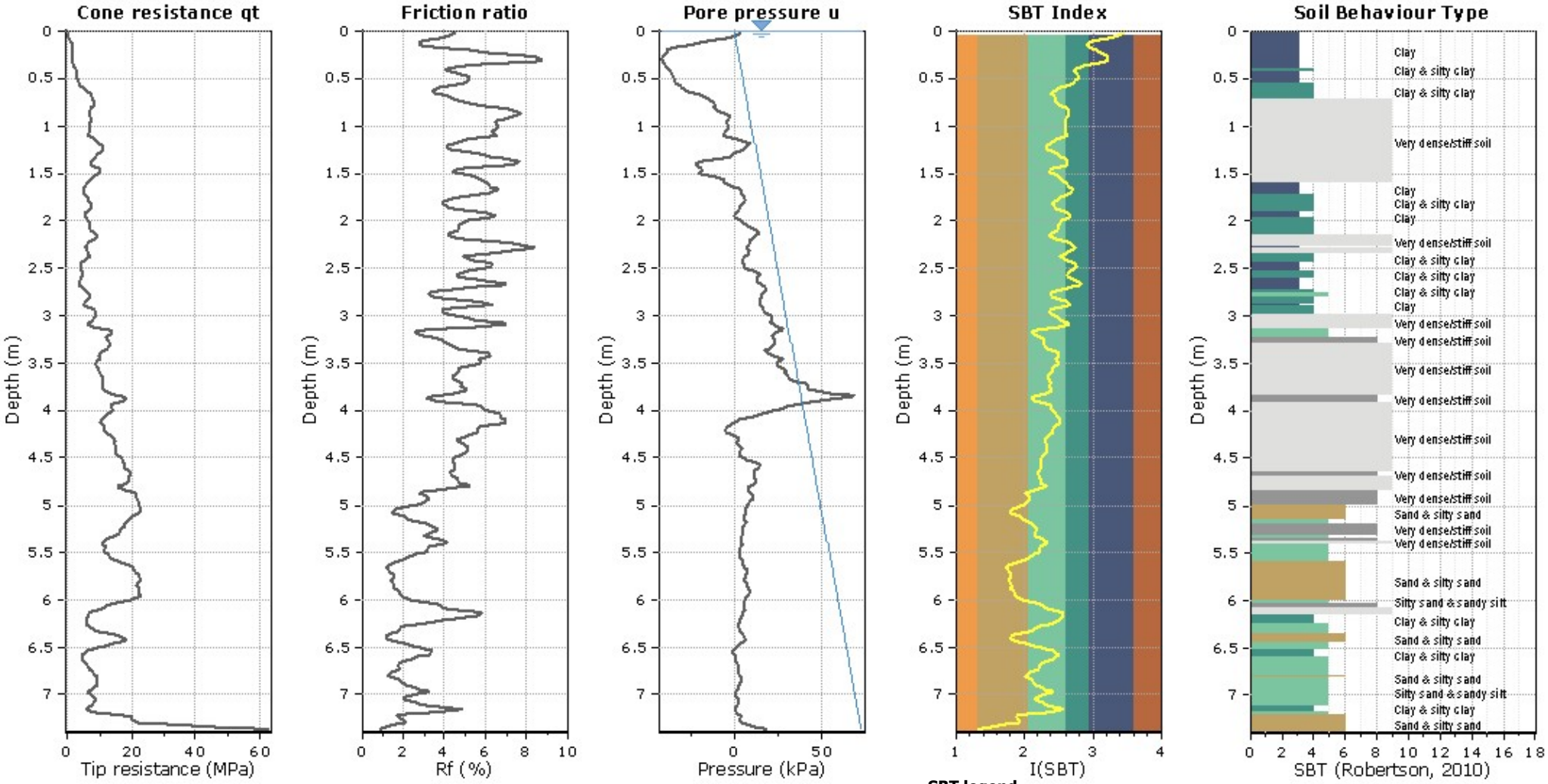


Underground Investigation Limited

CPT: CPT1

Total depth: 7.36 m, Date: 9/08/2019
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

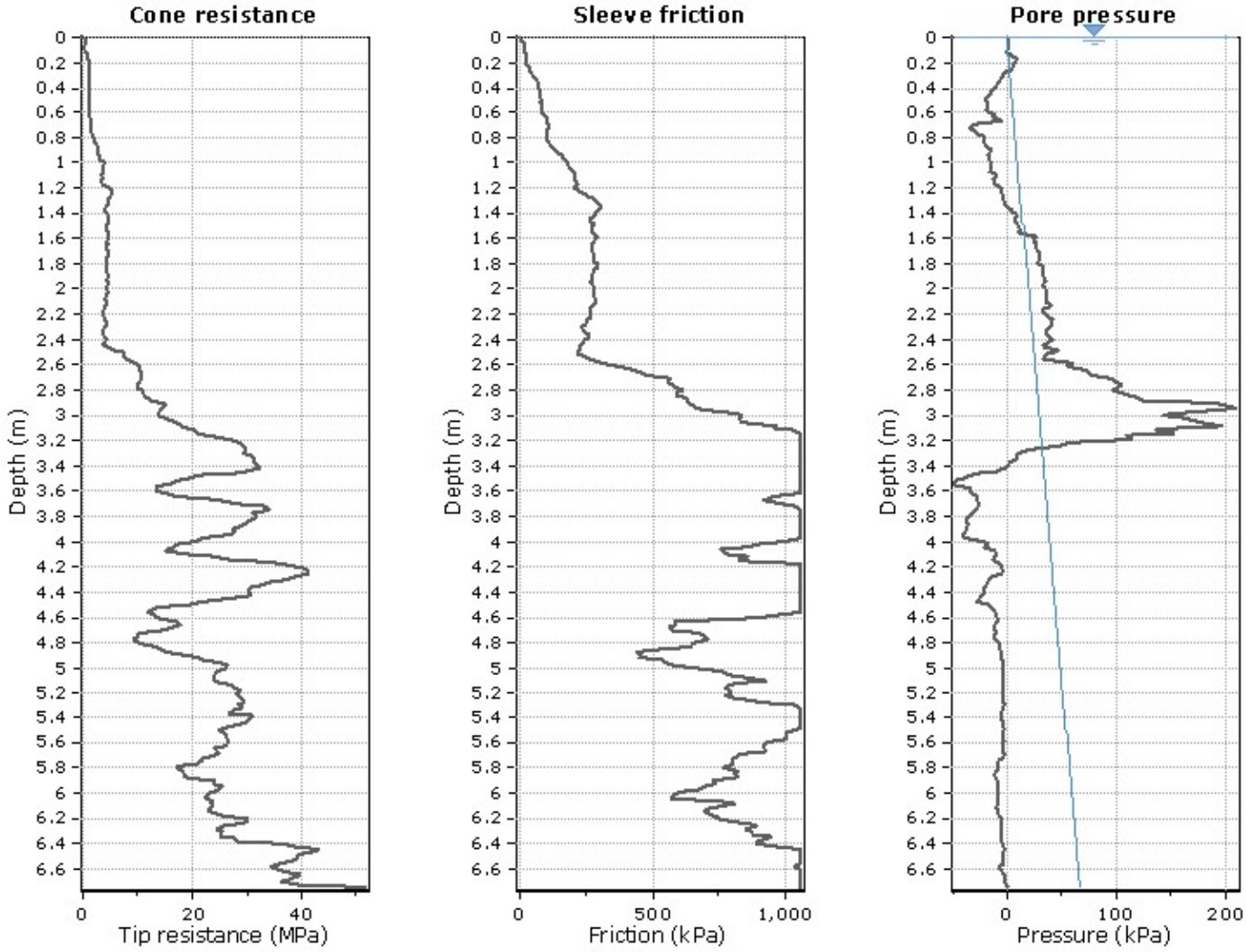
Project:
Location:



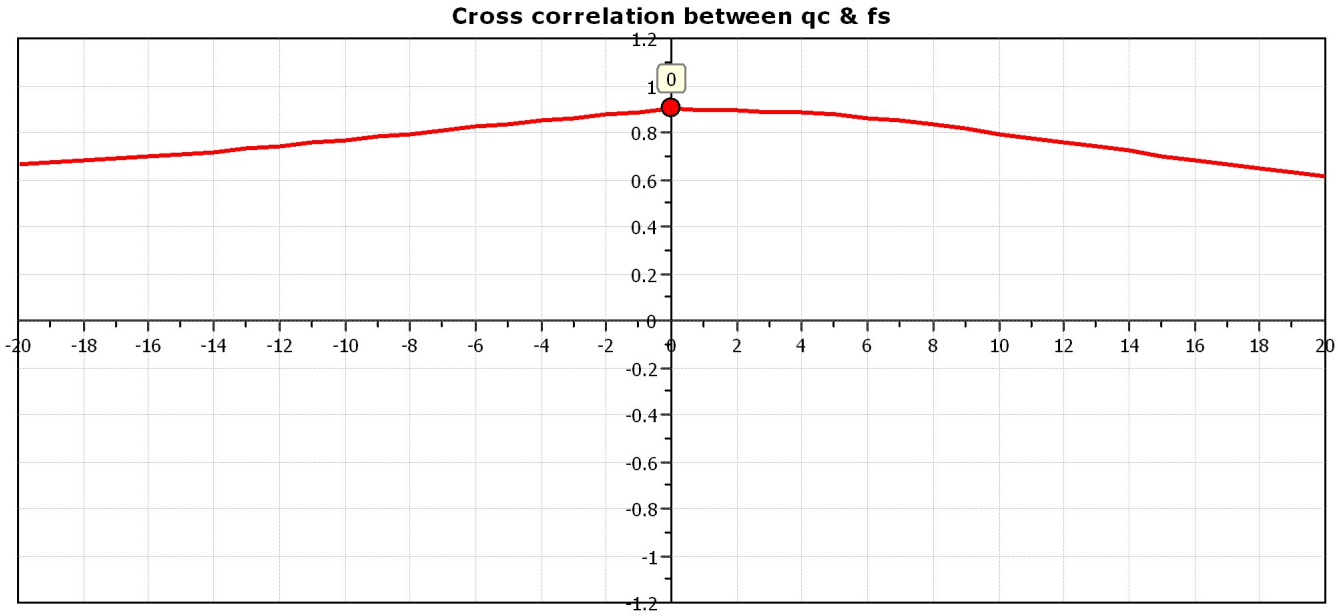
SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 51 of 127 - 11/04/2022 - NZBTC



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

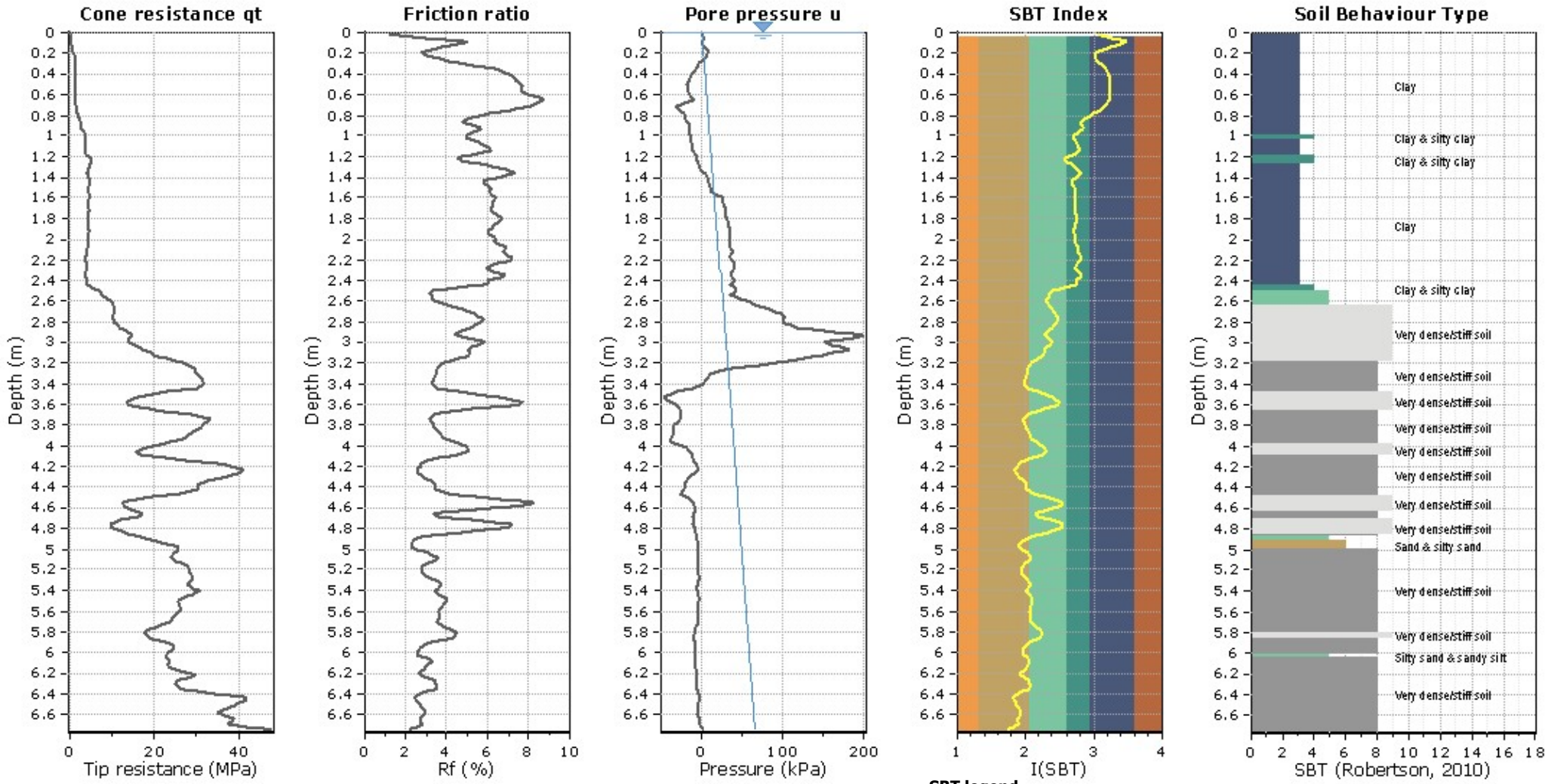


Underground Investigation Limited

CPT: CPT2

Total depth: 6.74 m, Date: 9/08/2019
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

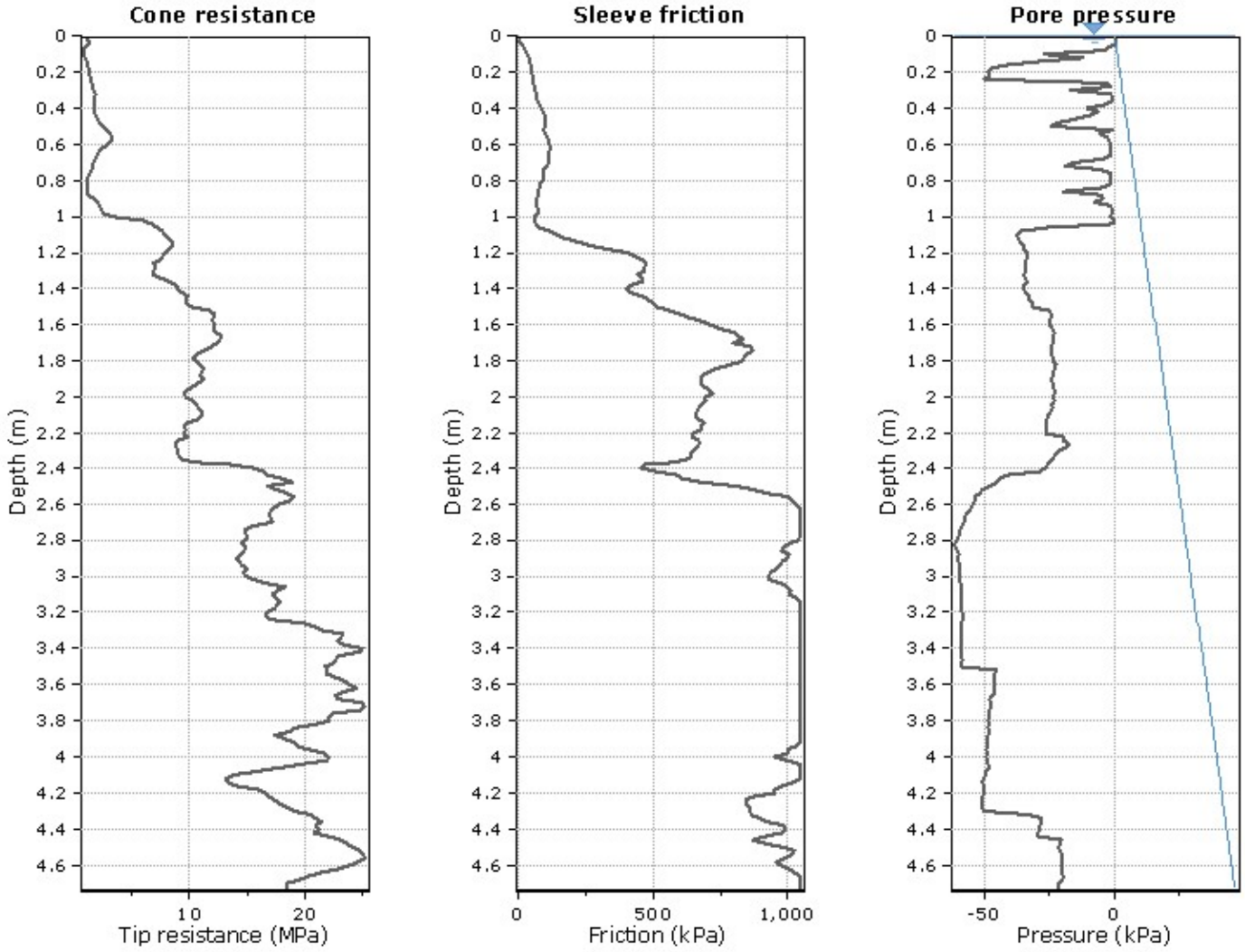
Project:
Location:



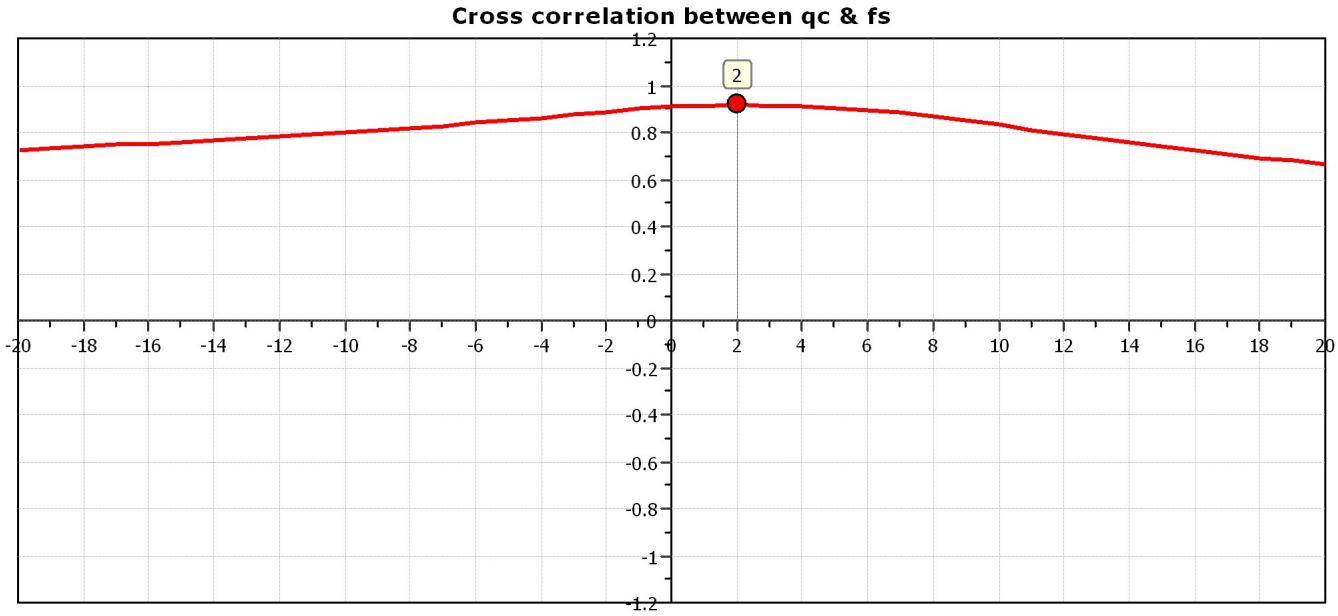
SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 53 of 127 - 11/04/2022 - NZBTC



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

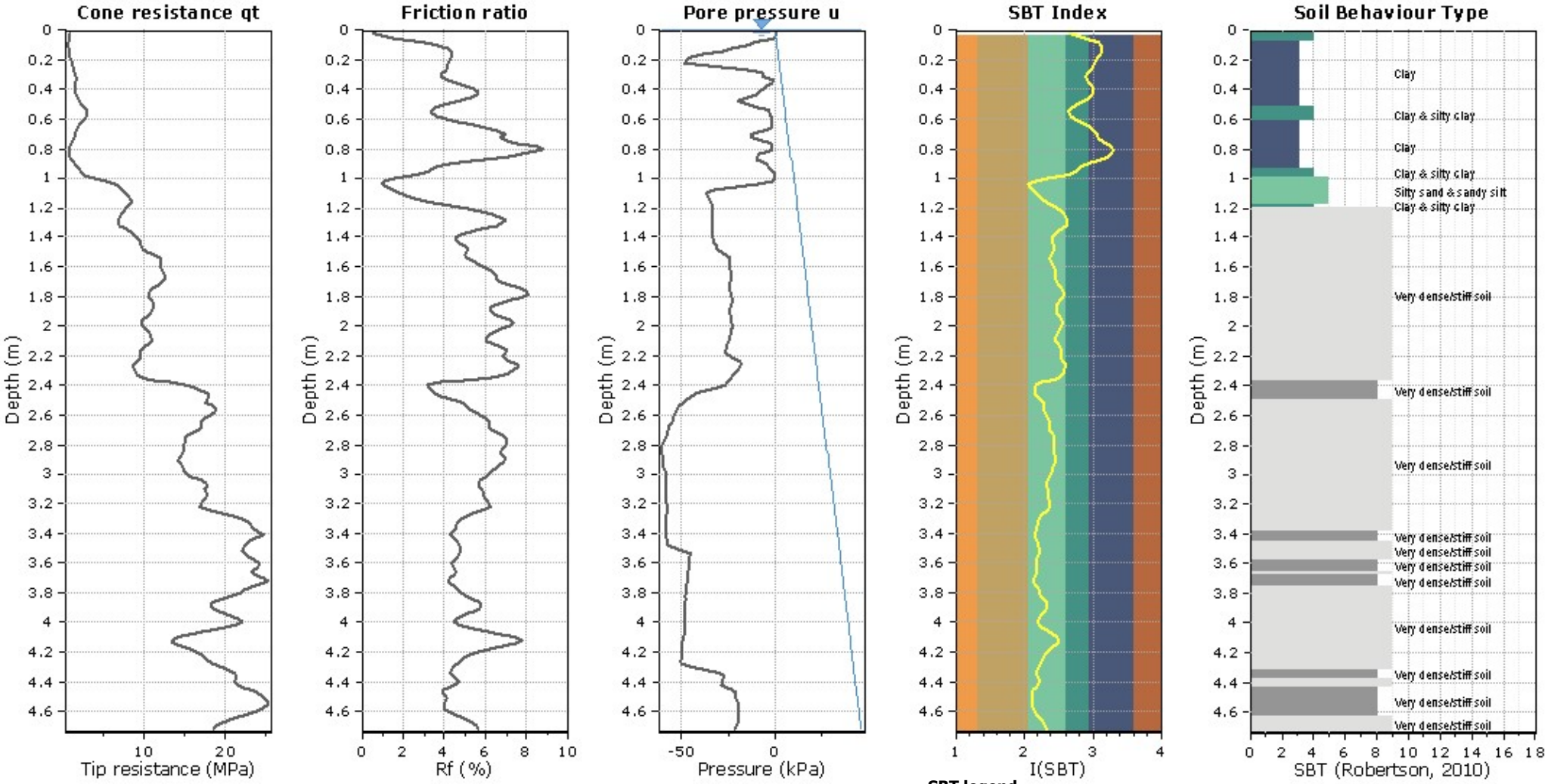


Underground Investigation Limited

CPT: CPT3

Total depth: 4.72 m, Date: 9/08/2019
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

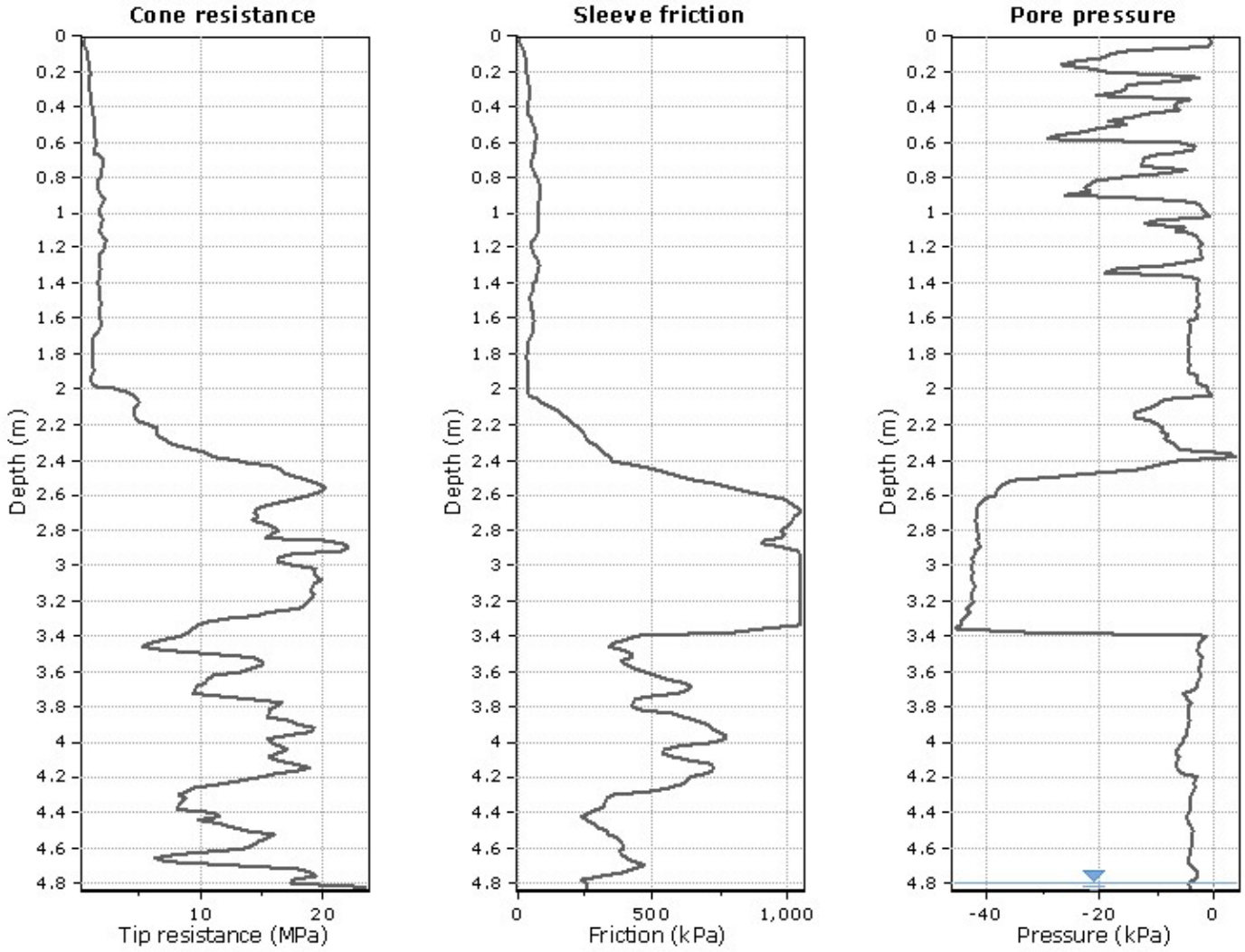
Project:
Location:



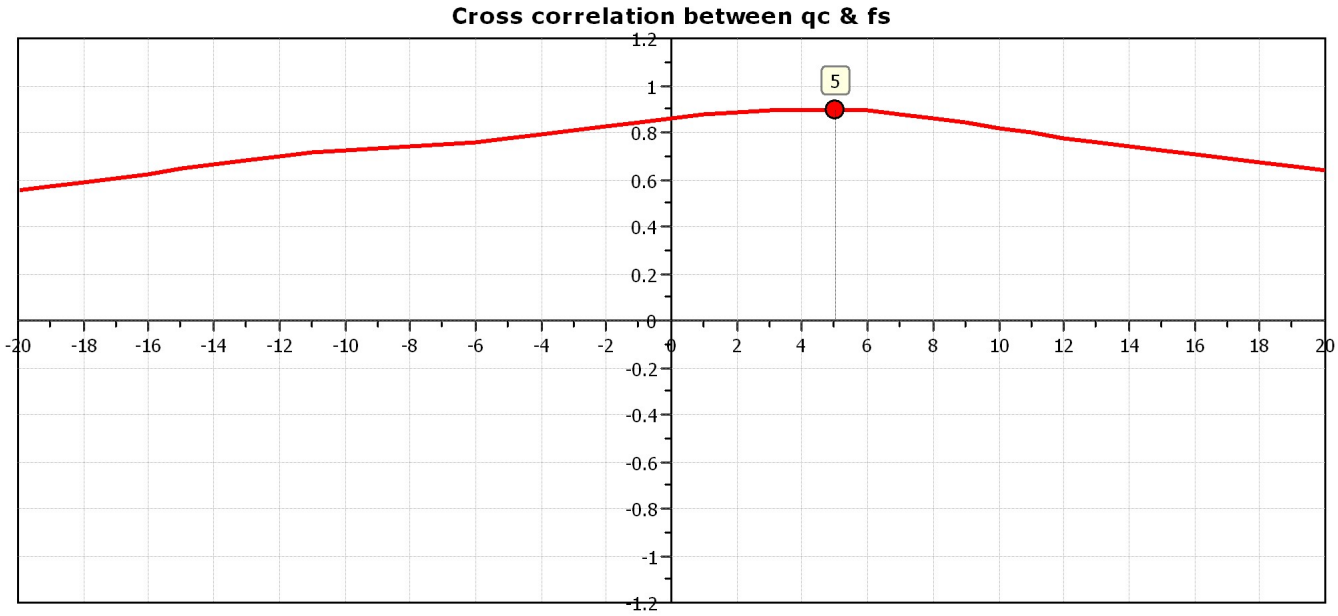
SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 55 of 127 - 11/04/2022 - NZBTC



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

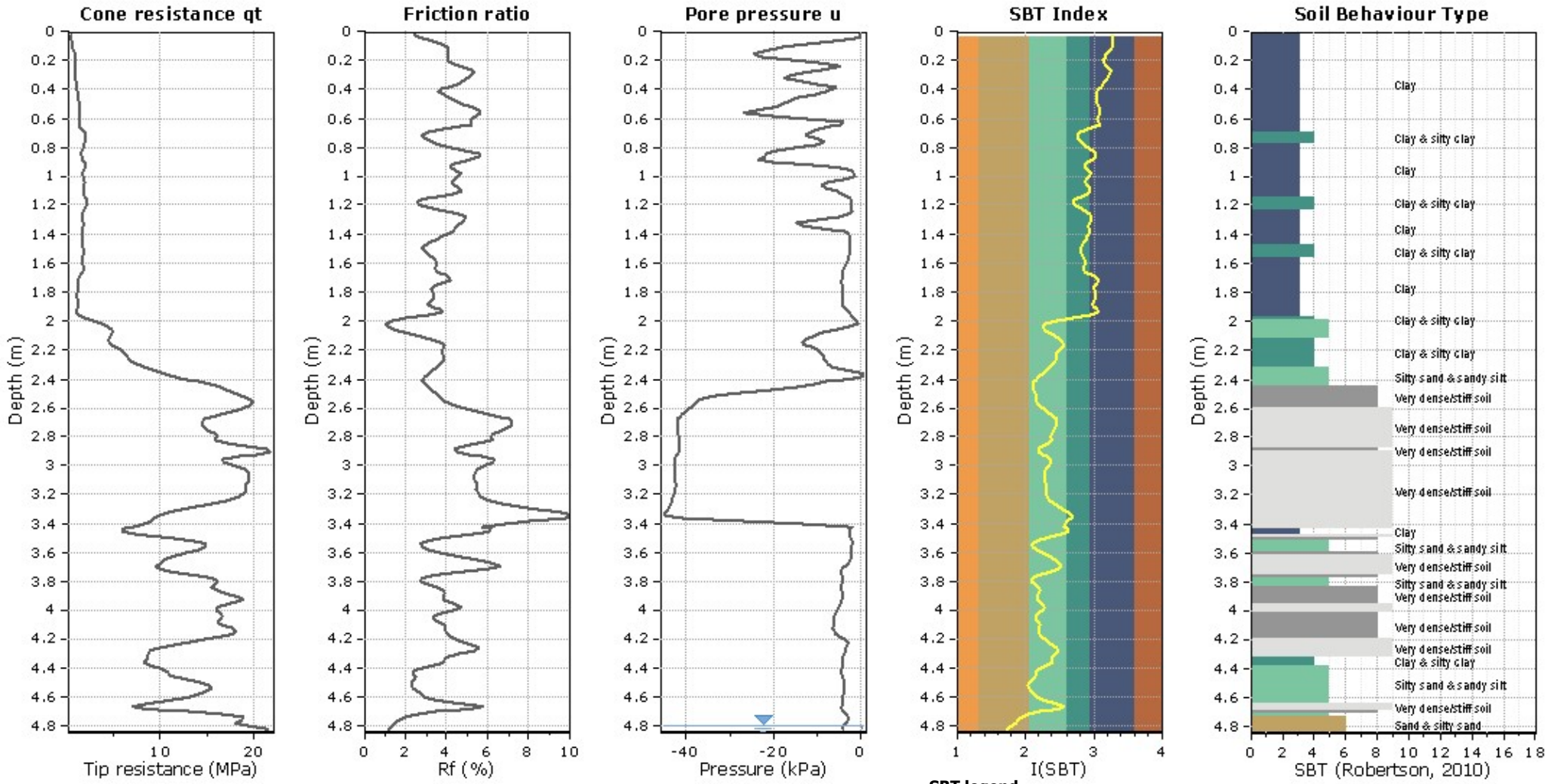


Underground Investigation Limited

CPT: CPT4

Total depth: 4.82 m, Date: 9/08/2019
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

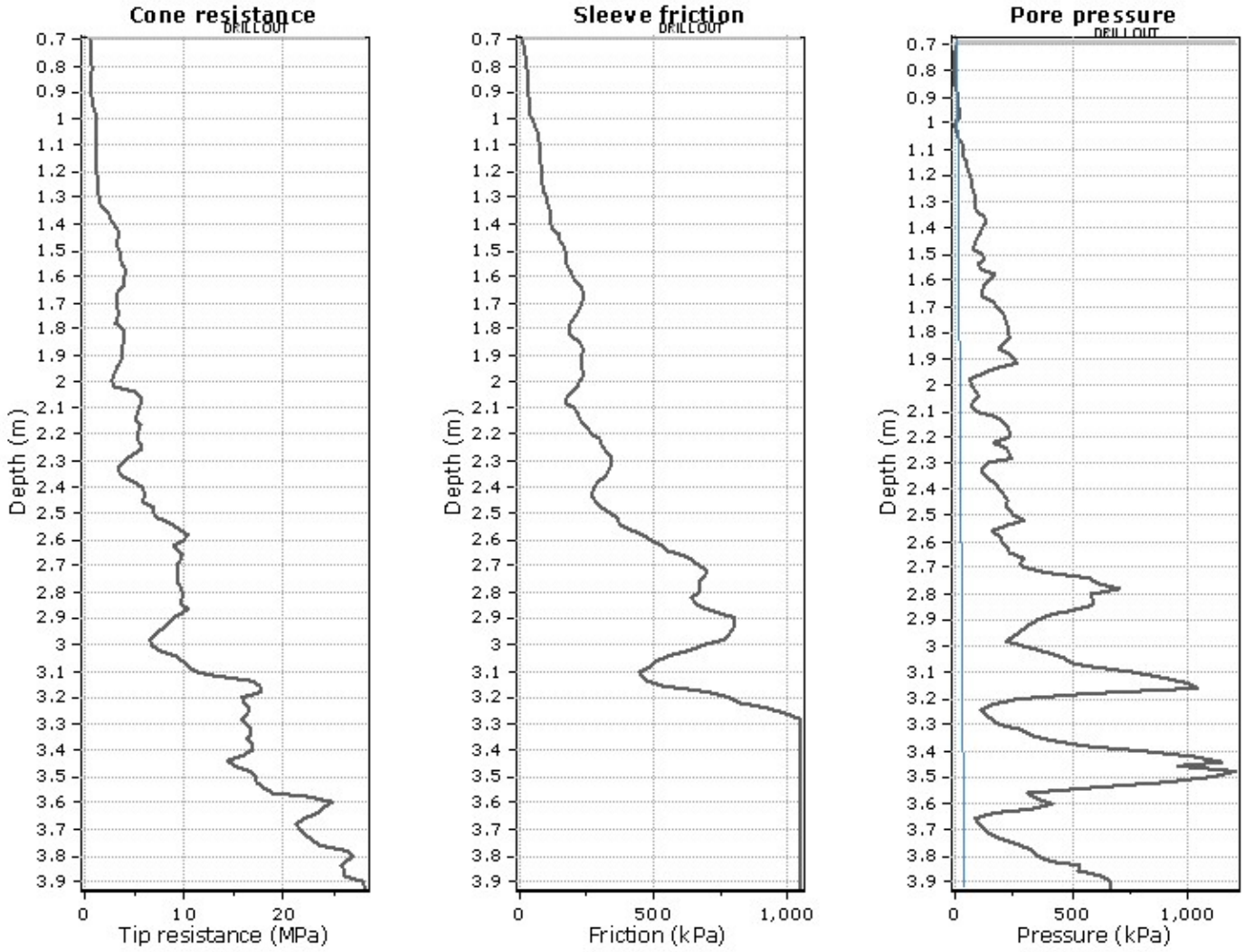
Project:
Location:



SBT legend

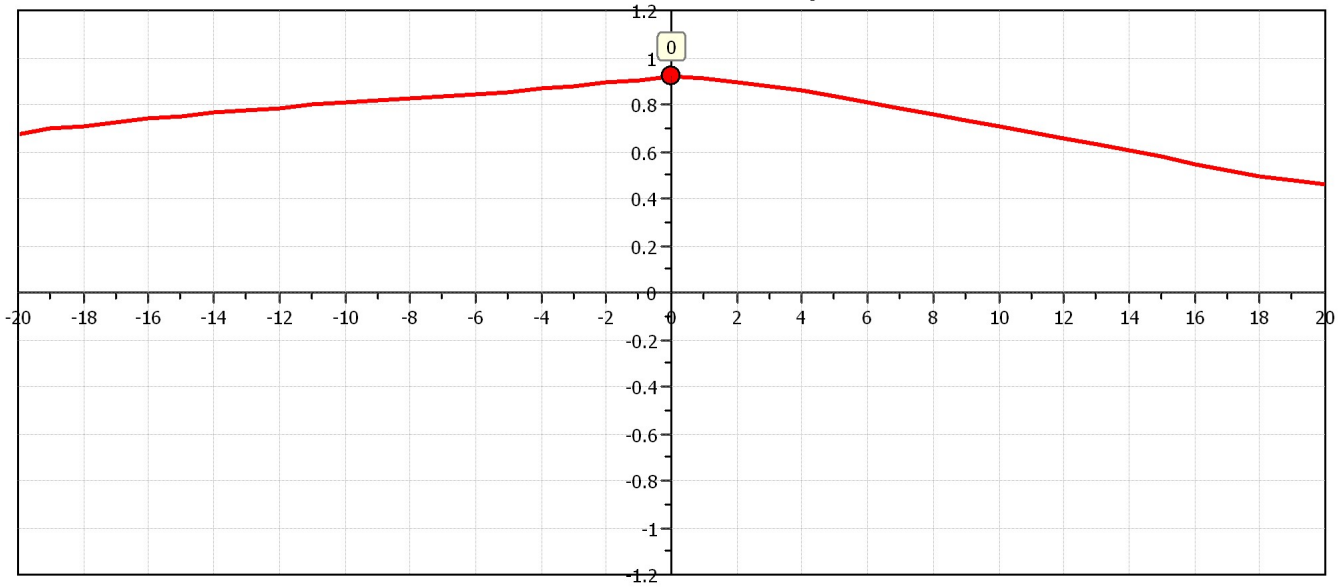
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 57 of 127 - 11/04/2022 - NZBTC



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

Cross correlation between qc & fs

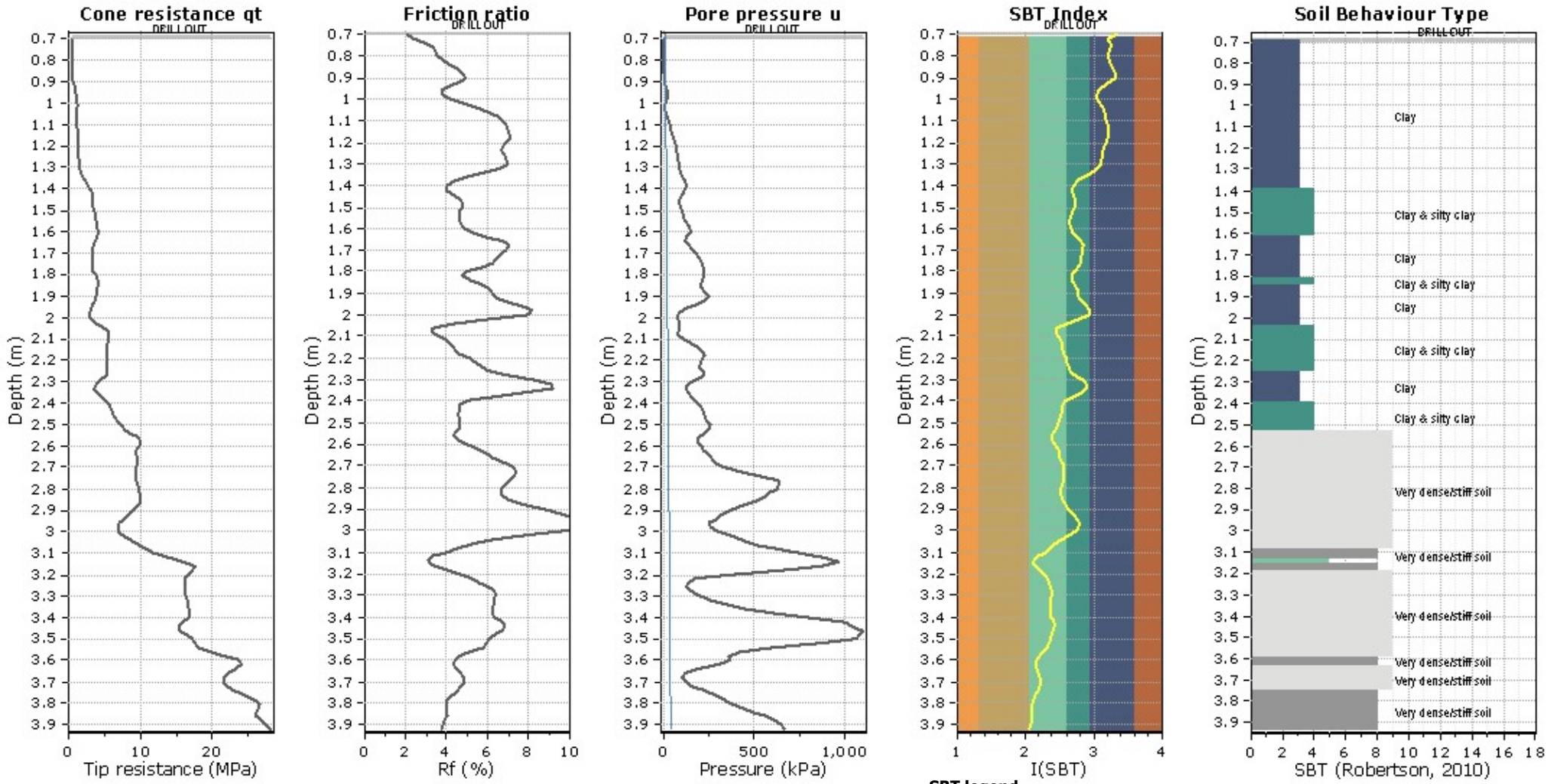


Underground Investigation Limited

CPT: CPT5

Total depth: 3.92 m, Date: 9/08/2019
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type: Uknown
Cone Operator: Uknown

Project:
Location:



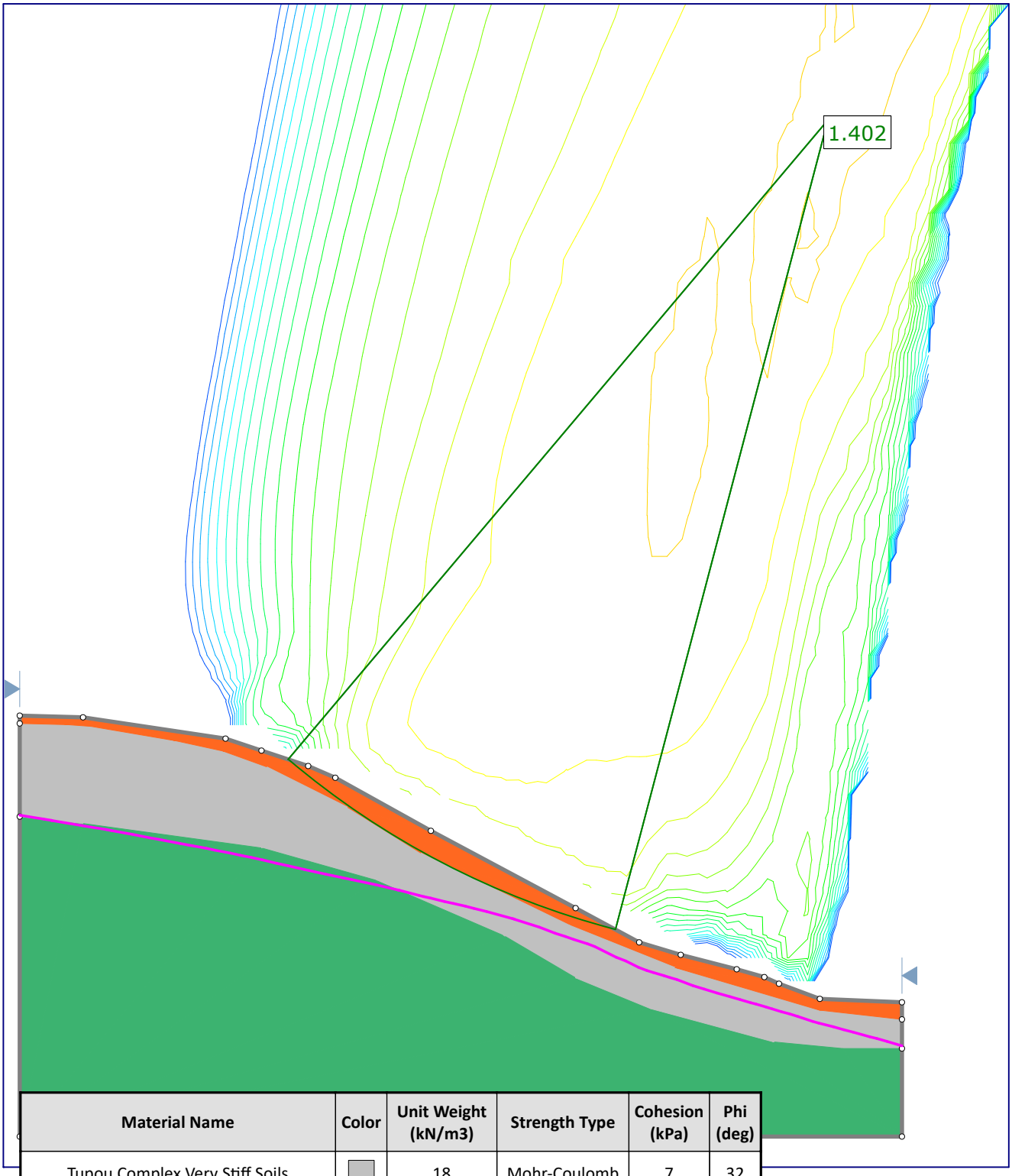
SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

Appendix D – Slope Stability Outputs

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 59 of 127 - 11/04/2022 - NZBTC

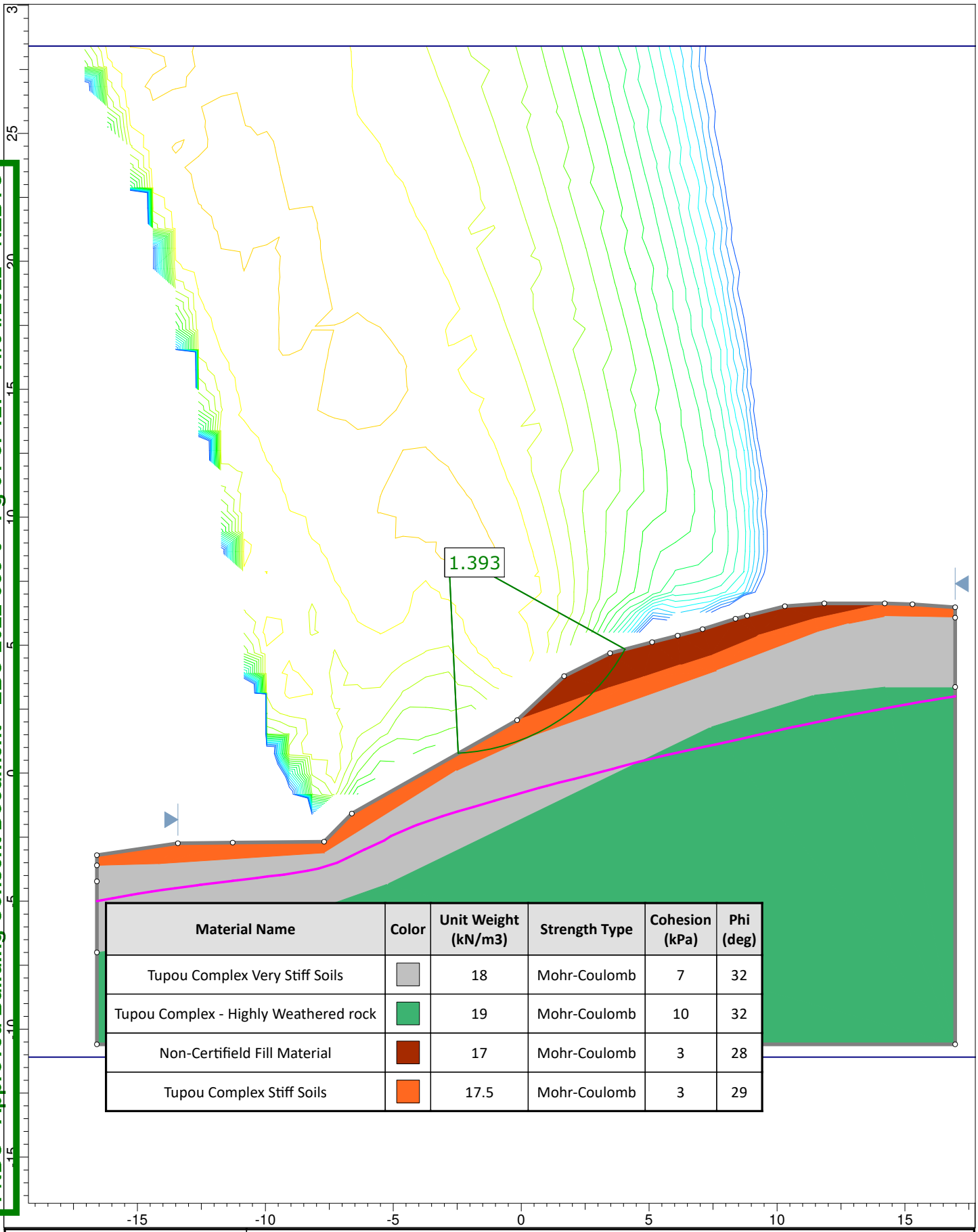
FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 60 of 127 - 11/04/2022 - NZBTC



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Tupou Complex Very Stiff Soils		18	Mohr-Coulomb	7	32
Tupou Complex - Highly Weathered rock		19	Mohr-Coulomb	10	32
Tupou Complex Stiff Soils		17.5	Mohr-Coulomb	3	29

rocscience	Project: Peter Morgan		
	Analysis Description: Existing Site - Assumed Groundwater		
	Drawn By: J. Power	Scale: 1:400	Company: Haigh Workman Ltd
SLIDEINTERPRET 8.020	Date: 28/08/2019		File Name: 1 - circ - assumed gw.slmd

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 61 of 127 - 11/04/2022 - NZBTC



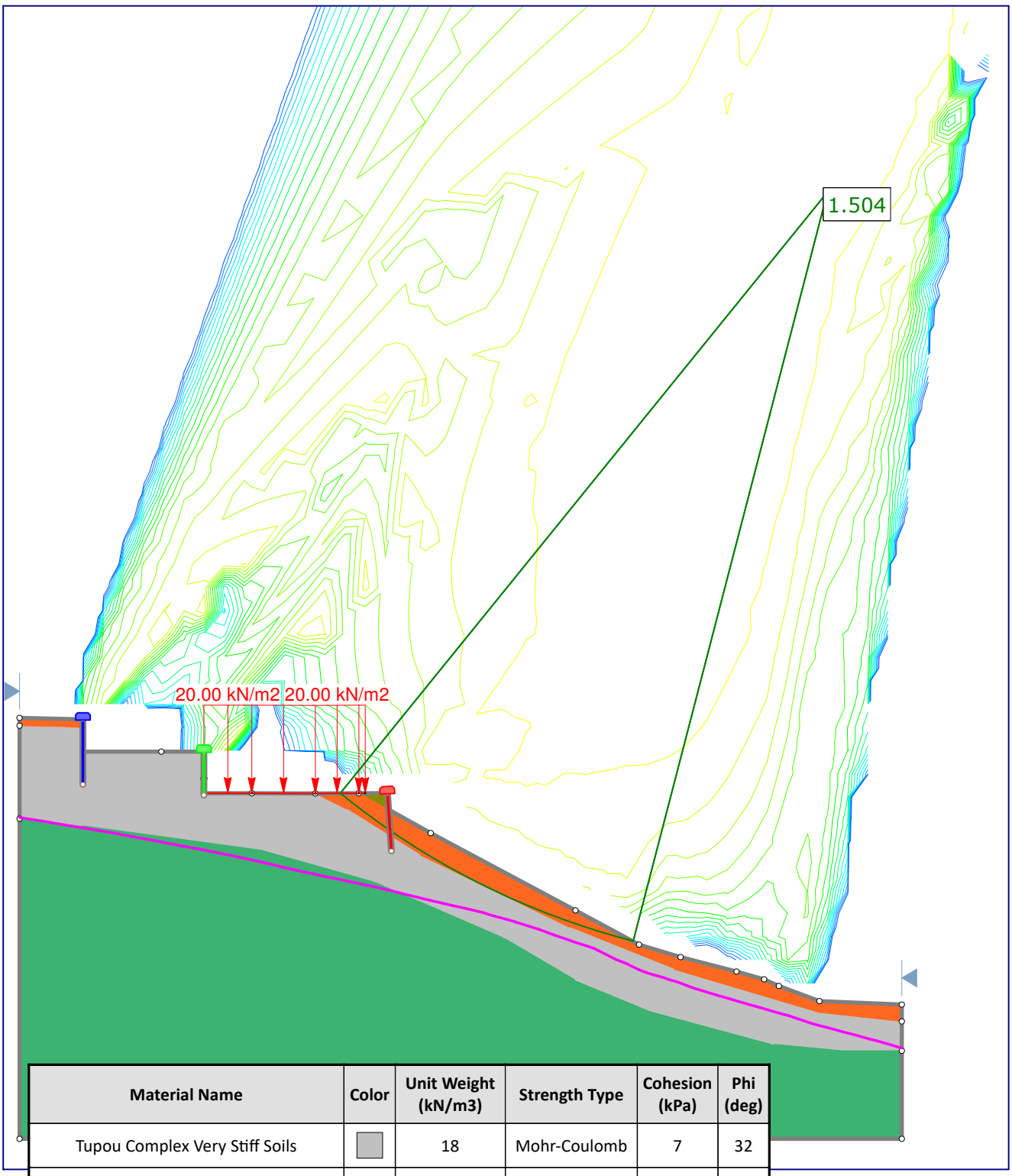
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Tupou Complex Very Stiff Soils		18	Mohr-Coulomb	7	32
Tupou Complex - Highly Weathered rock		19	Mohr-Coulomb	10	32
Non-Certifield Fill Material		17	Mohr-Coulomb	3	28
Tupou Complex Stiff Soils		17.5	Mohr-Coulomb	3	29

rocscience

SLIDEINTERPRET 8.020

Project	Peter Morgan		
Analysis Description	Existing Site - Assumed Groundwater		
Drawn By J. Power	*Scale* 1:200	*Company* Haigh Workman Ltd	
Date 28/08/2019		*File Name* 1 - Circ - Assumed GW.slmd	

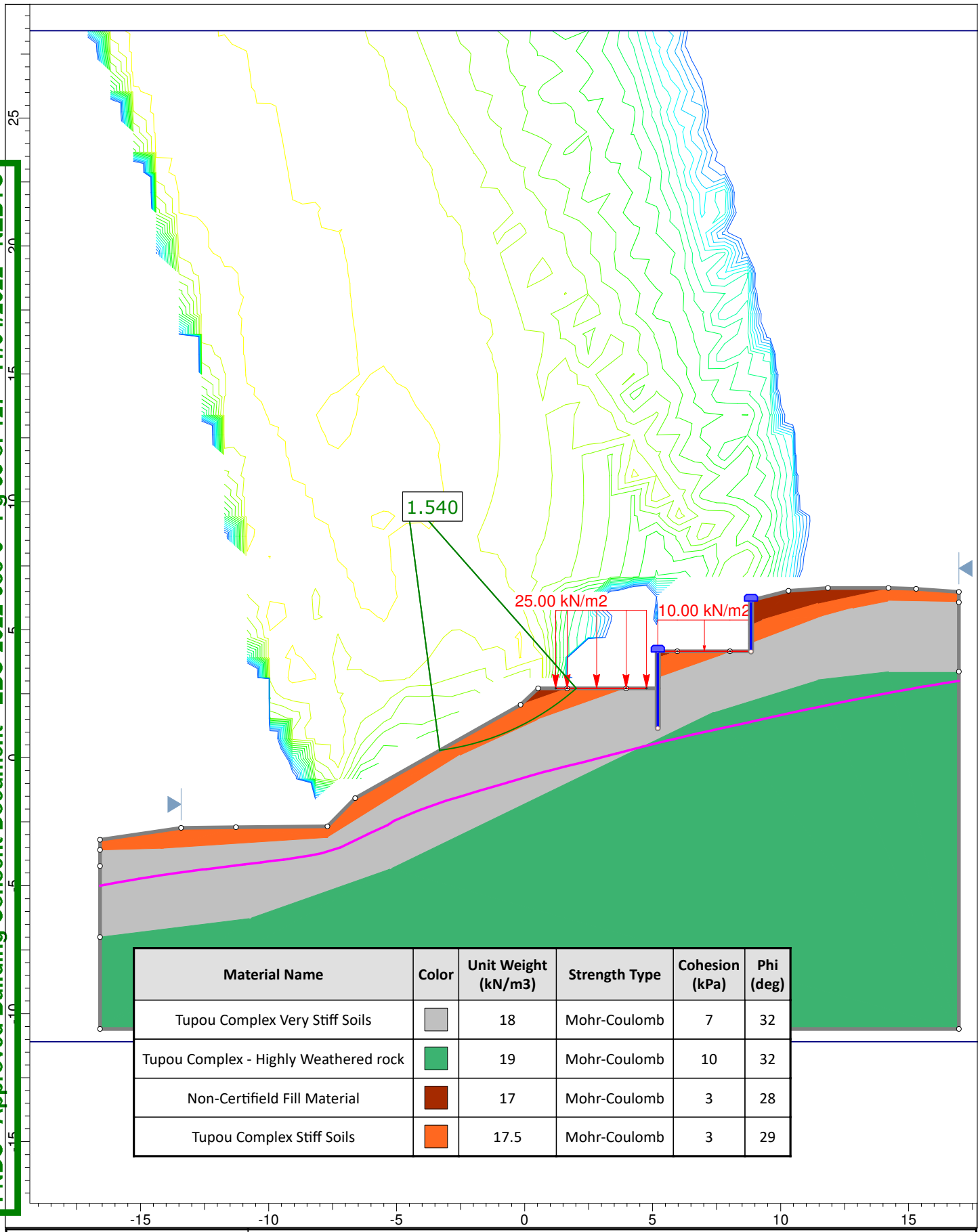
FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 62 of 127 - 11/04/2022 - NZBTC



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Tupou Complex Very Stiff Soils		18	Mohr-Coulomb	7	32
Tupou Complex - Highly Weathered rock		19	Mohr-Coulomb	10	32
Tupou Complex Stiff Soils		17.5	Mohr-Coulomb	3	29
Engineered Fill		18.5	Mohr-Coulomb	5	32

rocscience	Project: Peter Morgan		
	Analysis Description: Proposed - Assumed GW with Surcharge & Support		
	Drawn By: J. Power	Scale: 1:400	Company: Haigh Workman Ltd
SLIDEINTERPRET 8.020	Date: 18/10/2019		File Name: 2 - circ - assumed gw + surcharge.slmd

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 63 of 127 - 11/04/2022 - NZBTC



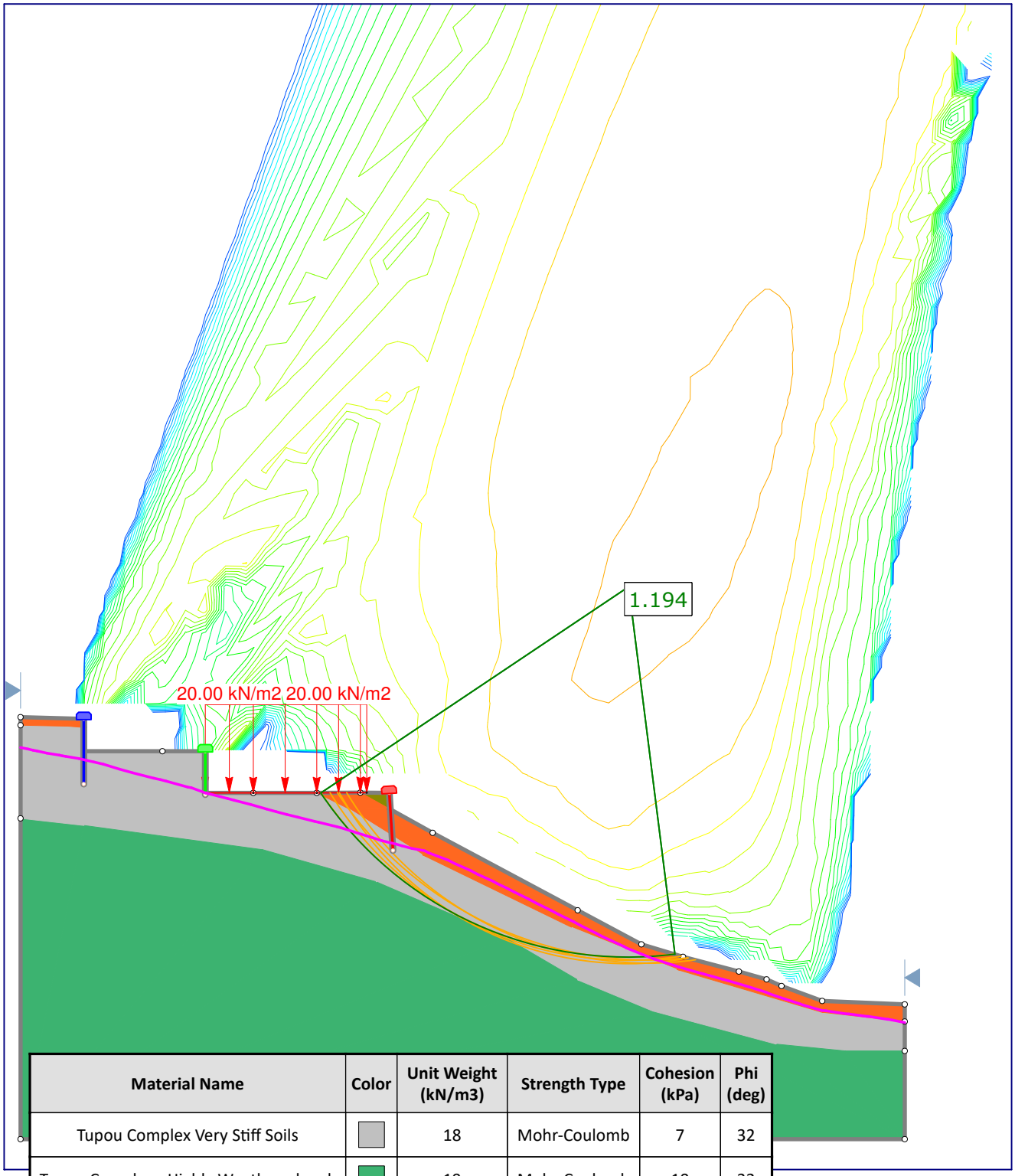
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Tupou Complex Very Stiff Soils		18	Mohr-Coulomb	7	32
Tupou Complex - Highly Weathered rock		19	Mohr-Coulomb	10	32
Non-Certifield Fill Material		17	Mohr-Coulomb	3	28
Tupou Complex Stiff Soils		17.5	Mohr-Coulomb	3	29

rocscience

SLIDEINTERPRET 8.020

Project	Peter Morgan		
Analysis Description	Proposed - Assumed GW with Surcharge & Support		
Drawn By	J. Power	Scale 1:200	Company Haigh Workman Ltd
Date	18/10/2019		File Name 2 - Circ - Assumed GW + Surcharge & Support.slmd

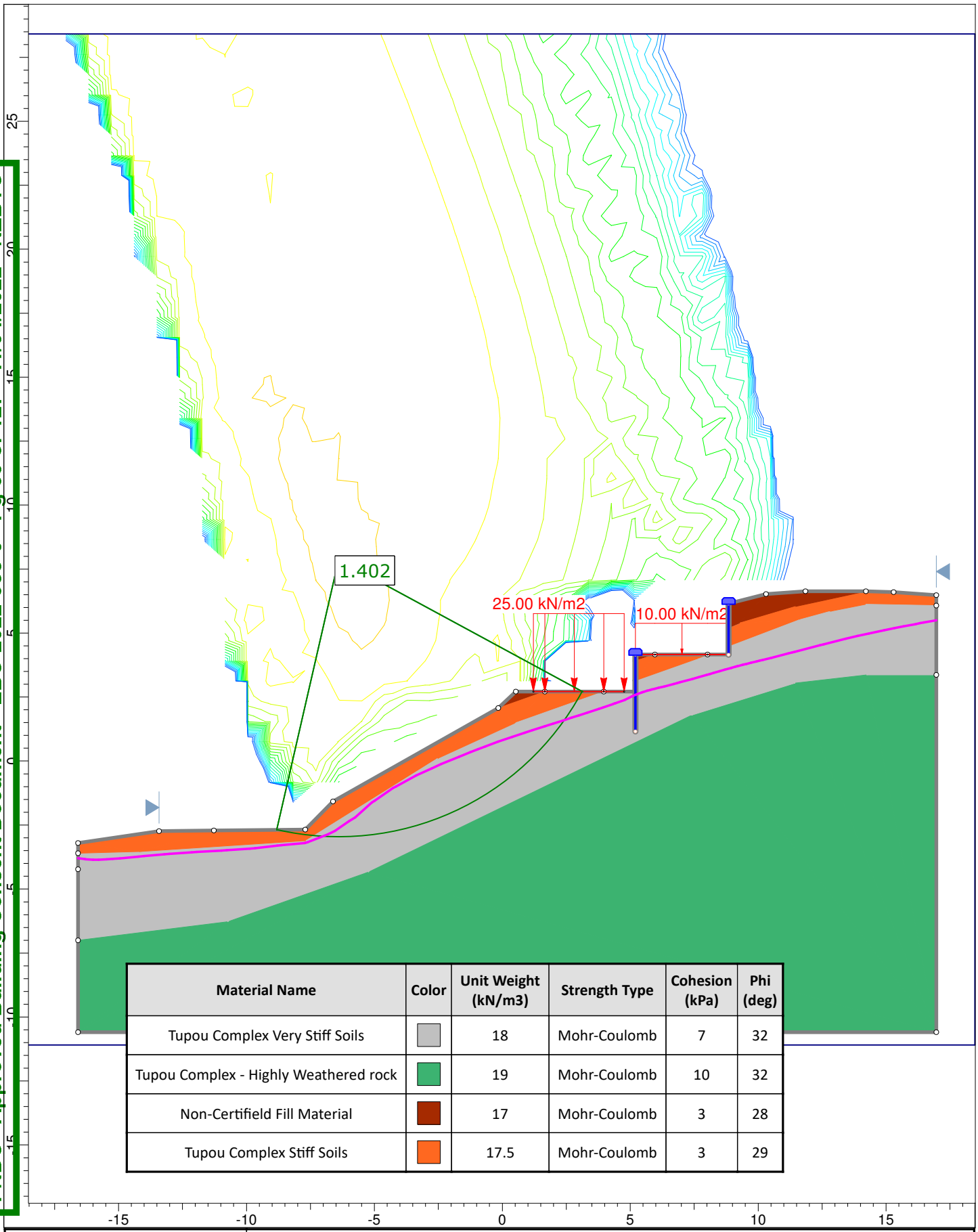
FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 64 of 127 - 11/04/2022 - NZBTC



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Tupou Complex Very Stiff Soils		18	Mohr-Coulomb	7	32
Tupou Complex - Highly Weathered rock		19	Mohr-Coulomb	10	32
Tupou Complex Stiff Soils		17.5	Mohr-Coulomb	3	29
Engineered Fill		18.5	Mohr-Coulomb	5	32

rocscience	Project: Peter Morgan		
	Analysis Description: Proposed - Extreme GW with Surcharge & Support		
	Drawn By: J. Power	Scale: 1:400	Company: Haigh Workman Ltd
SLIDEINTERPRET 8.020	Date: 18/10/2019		File Name: 3 - circ - extreme gw + surcharge.slmd

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 65 of 127 - 11/04/2022 - NZBTC

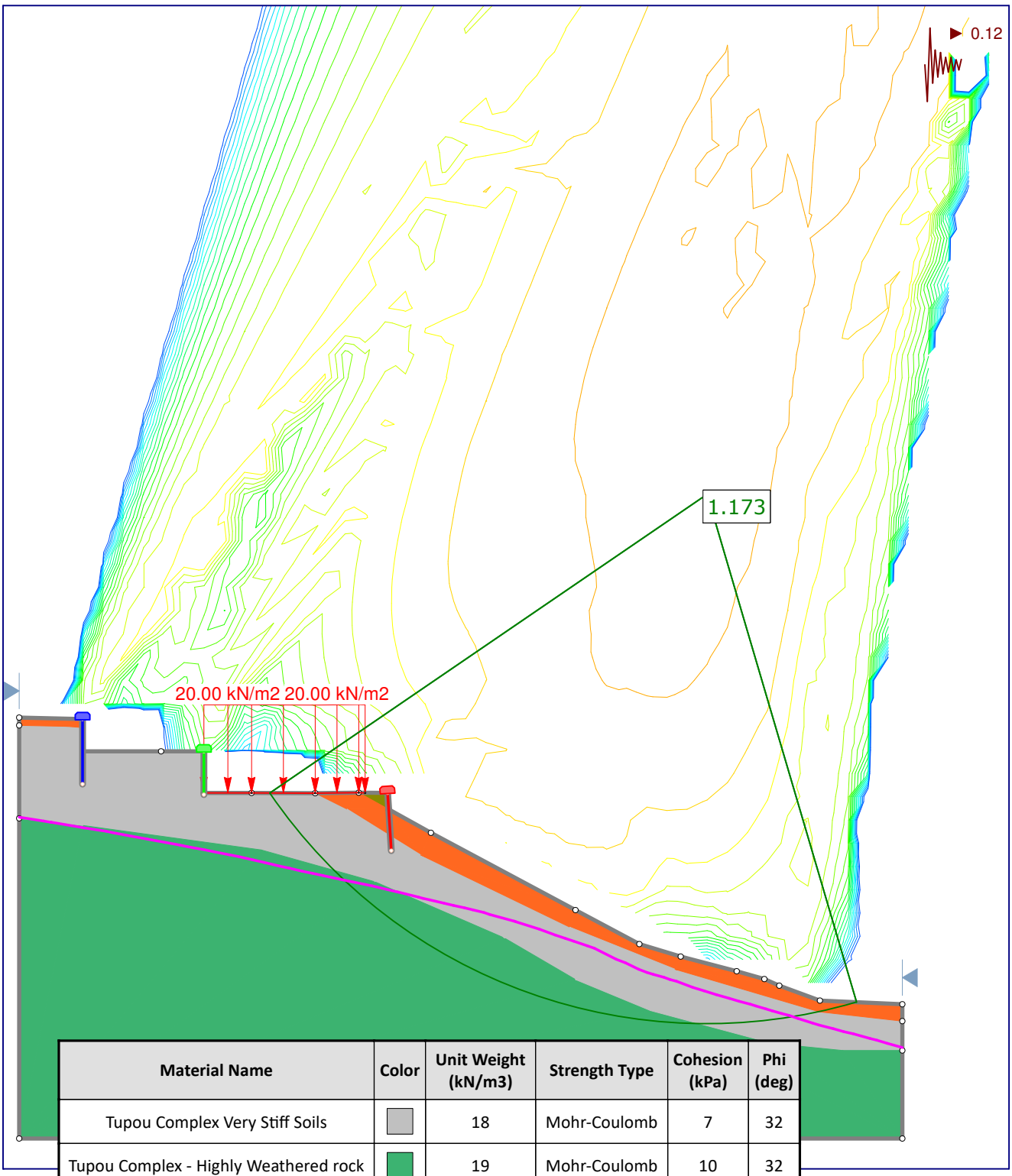


Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Tupou Complex Very Stiff Soils		18	Mohr-Coulomb	7	32
Tupou Complex - Highly Weathered rock		19	Mohr-Coulomb	10	32
Non-Certifield Fill Material		17	Mohr-Coulomb	3	28
Tupou Complex Stiff Soils		17.5	Mohr-Coulomb	3	29

rocscience

SLIDEINTERPRET 8.020

Project	Peter Morgan		
Analysis Description	Proposed - Extreme GW with Surcharge & Support		
Drawn By	J. Power	Scale 1:200	Company Haigh Workman Ltd
Date	28/08/2019		File Name 3 - Circ - Extreme GW + Surcharge & Support.slmd



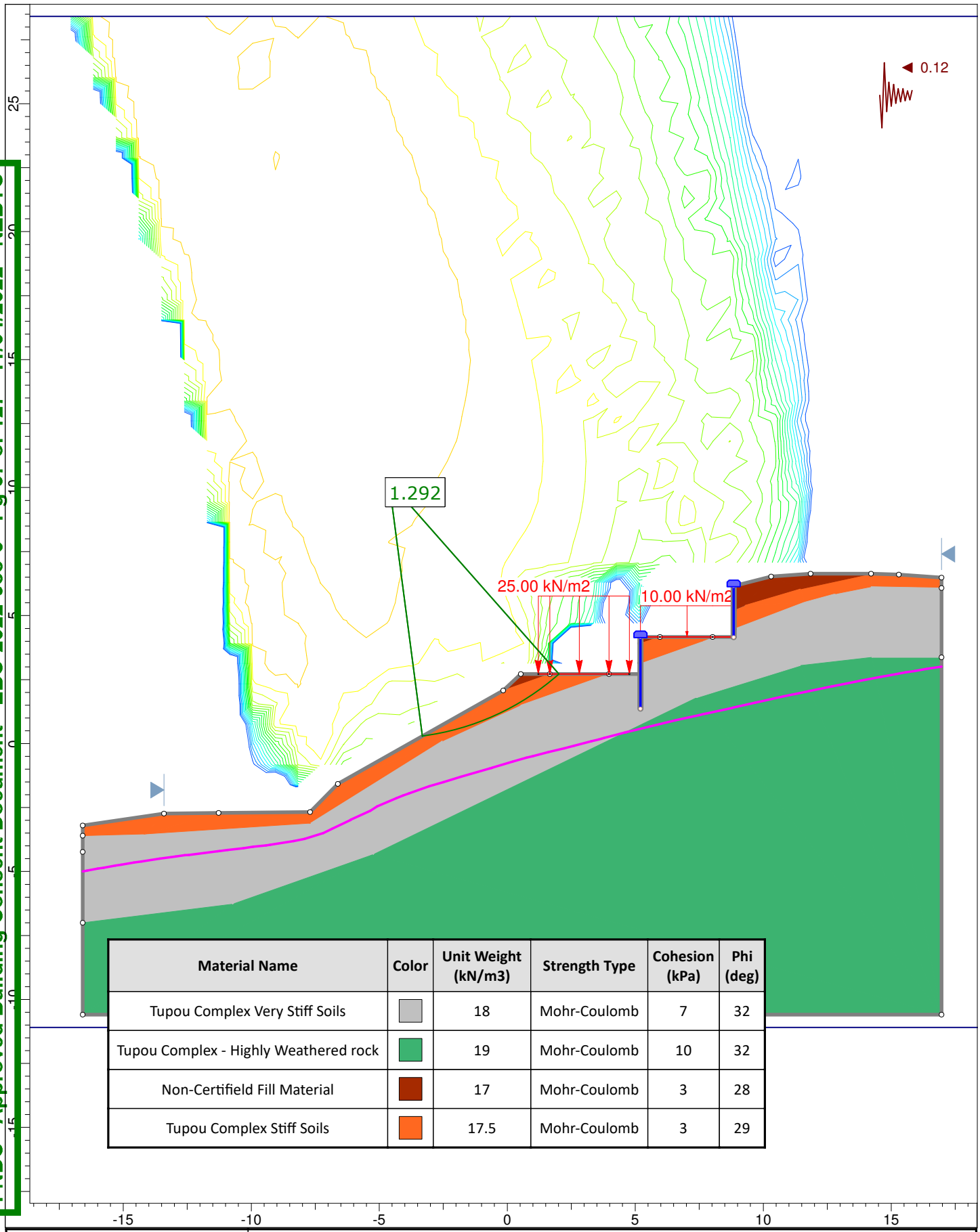
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Tupou Complex Very Stiff Soils		18	Mohr-Coulomb	7	32
Tupou Complex - Highly Weathered rock		19	Mohr-Coulomb	10	32
Tupou Complex Stiff Soils		17.5	Mohr-Coulomb	3	29
Engineered Fill		18.5	Mohr-Coulomb	5	32

rocscience

SLIDEINTERPRET 8.020

Project	Peter Morgan		
Analysis Description	Proposed - Seismic - Assumed GW with Surcharge & Support		
Drawn By	J. Power	Scale 1:400	Company Haigh Workman Ltd
Date	18/10/2019		File Name 4 - circ - seismic - assumed gw + surcharge.slmd

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 67 of 127 - 11/04/2022 - NZBTC



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Tupou Complex Very Stiff Soils		18	Mohr-Coulomb	7	32
Tupou Complex - Highly Weathered rock		19	Mohr-Coulomb	10	32
Non-Certifield Fill Material		17	Mohr-Coulomb	3	28
Tupou Complex Stiff Soils		17.5	Mohr-Coulomb	3	29

rocscience

SLIDEINTERPRET 8.020

Project	Peter Morgan		
Analysis Description	Proposed - Seismic - Assumed GW with Surcharge & Support		
Drawn By	J. Power	Scale 1:200	Company Haigh Workman Ltd
Date	28/08/2019		File Name 4 Circ - Seismic - Assumed GW + Surcharge & Support.slmd

Appendix E – Retaining Wall Calculations

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 68 of 127 - 11/04/2022 - NZBTC

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 69 of 127 - 11/04/2022 - NZBTC

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types: Left side	Soil types: Right side
1	-3.00	1 Stiff Soils	1 Stiff Soils
2	-5.00	2 Very stiff soils	2 Very stiff soils
3	-9.00	3 Hard	3 Hard

SOIL PROPERTIES

-- Soil type -- No.	Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Stiff Soils	18.00	20000	0.530	OC (0.350)	0.311 (1.296)	3.485 (4.674)	3.000d
2	Very stiff soils	18.00	30000	0.470	OC (0.350)	0.262 (1.182)	4.331 (5.331)	7.000d
3	Hard	19.00	50000	0.470	OC (0.350)	0.262 (1.182)	4.331 (5.331)	10.00d
4	Fill	20.00	50000	0.384	OC (0.350)	0.200 (0.000)	6.199 (0.000)	

Additional soil parameters associated with Ka and Kp

------- Soil type ------- No.	Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Stiff Soils	28.00	0.636	0.00	28.00	0.306	0.00
2	Very stiff soils	32.00	0.625	0.00	32.00	0.298	0.00
3	Hard	32.00	0.625	0.00	32.00	0.298	0.00
4	Fill	38.00	0.606	0.00	38.00	0.285	0.00

GROUND WATER CONDITIONS

Density of water = 9.810 kN/m3

	Left side	Right side
Initial water table elevation	-10.00	-10.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Soldier Pile Wall
Soldier Pile width = 0.60 m
Soldier Pile spacing = 1.20 m
Passive mobilisation factor = 3.00
Elevation of toe of wall = -8.00
Maximum finite element length = 0.40 m
Youngs modulus of wall E = 1.2100E+07 kN/m2
Moment of inertia of wall I = 1.6770E-03 m4/m run
= 2.0124E-03 m4 per pile
E.I = 20292 kN.m2/m run
Yield Moment of wall = Not defined

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 70 of 127 - 11/04/2022 - NZBTC

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge kN/m2 Near edge	Surcharge kN/m2 Far edge	Equiv. soil type	Partial factor/ Category
1	0.00	1.00(L)	14.00	9.00	10.00	=	N/A	N/A
2	0.00	0.00(L)	14.00	1.00	5.00	=	N/A	N/A
3	-3.00	-0.00(R)	14.00	20.00	0.00	-191.00	N/A	N/A

Note: L = Left side, R = Right side
A trapezoidal surcharge is defined by two values:
N = at edge near to wall, F = at edge far from wall

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Excavate to elevation -3.00 on RIGHT side
2	Apply surcharge no.3 at elevation -3.00 No analysis at this stage
3	Change EI of wall to 16148 kN.m2/m run Yield moment not defined Reset wall displacements to zero at this stage
4	Fill to elevation 0.00 on LEFT side with soil type 4
5	Change EI of wall to 16148 kN.m2/m run Yield moment not defined Reset wall displacements to zero at this stage
6	Apply surcharge no.1 at elevation 0.00
7	Apply surcharge no.2 at elevation 0.00

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.50

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on Left side of wall = 50.00 m
Width of excavation on Right side of wall = 50.00 m

Distance to rigid boundary on Left side = 50.00 m
Distance to rigid boundary on Right side = 50.00 m

OUTPUT OPTIONS

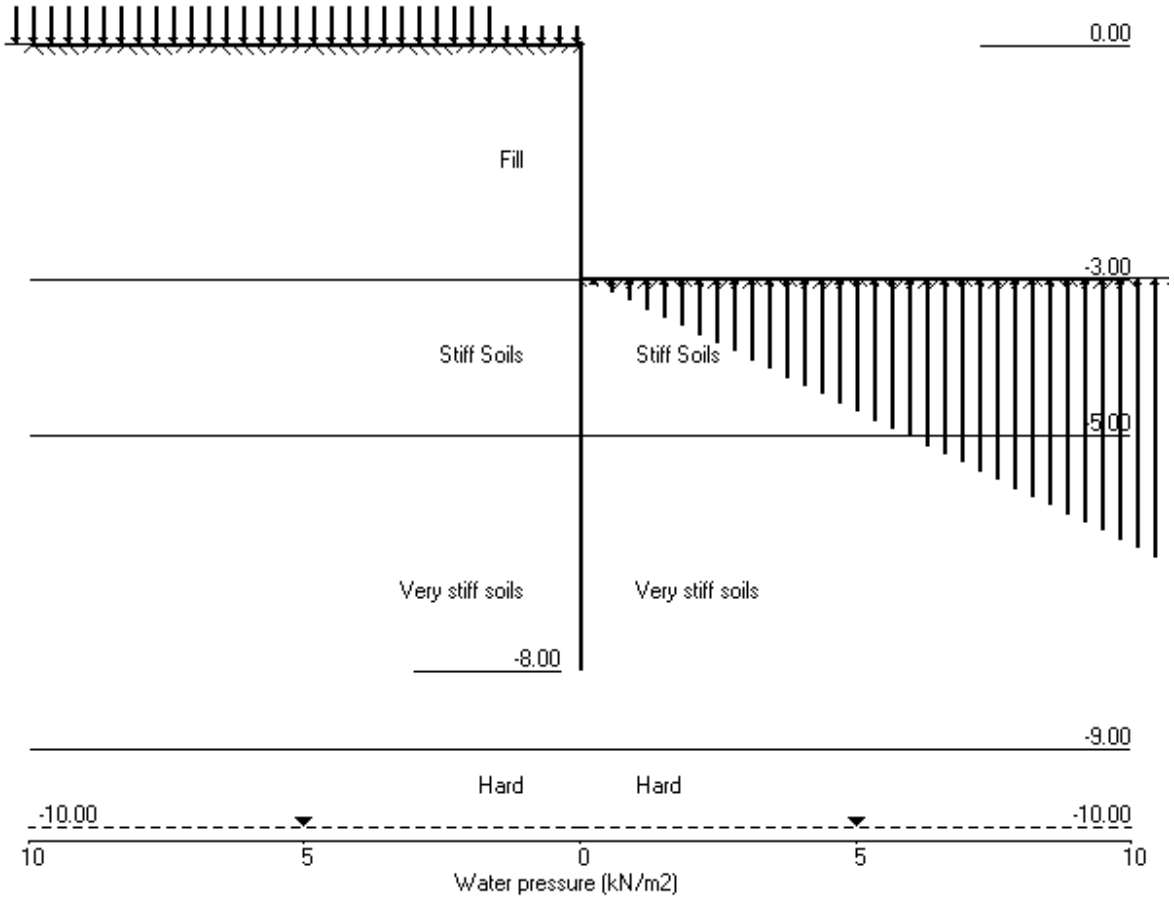
Stage no.	Stage description	Output options: Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Excav. to elev. -3.00 on RIGHT side	Yes	Yes	Yes
2	Apply surcharge no.3 at elev. -3.00	No	No	No
3	Change EI of wall to 16148kN.m2/m run	No	No	No
4	Fill to elev. 0.00 on LEFT side	No	No	No
5	Change EI of wall to 16148kN.m2/m run	No	No	No
6	Apply surcharge no.1 at elev. 0.00	No	No	No
7	Apply surcharge no.2 at elev. 0.00	No	No	No
*	Summary output	Yes	-	Yes

Program WALLAP - Copyright (C) 2019 by DL Borin, distributed by GEOSOLVE
150 St. Alphonsus Road, London SW4 7BW, UK www.geosolve.co.uk

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 71 of 127 - 11/04/2022 - NZBTC

```
HAIGH WORKMAN LTD                                          | Sheet No.
Program: WALLAP  Version 6.06  Revision A52.B71.R56        | Job No.  19 123
                              Licensed from GEOSOLVE       | Made by :    WT
Data filename/Run ID: WALLAP3m                             |
Peter Morgan                                               | Date:25-10-2019
RW01_Hardfill                                              | Checked :
-------------------------------------------------------------------------------
                                                      Units: kN,m
```

Stage No.7 Apply surcharge no.2 at elev. 0.00



FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 72 of 127 - 11/04/2022 - NZBTC

Units: kN,m

Stage No. 7 Apply surcharge no.2 at elevation 0.00

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = -8.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation	Direction of failure
7	0.00	-3.00	Cant.	1.531	-7.58	-7.83	4.83	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.60m; spacing = 1.20m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Left side 50.00 from wall
Right side 50.00 from wall

*** Wall displacements reset to zero at stage 5

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m	EI of wall kN.m2/m
1	0.00	1.00	0.010	2.23E-03	0.0	0.0		16148
2	-0.40	2.62	0.009	2.23E-03	0.7	0.1		16148
3	-0.80	4.32	0.008	2.23E-03	2.1	0.7		16148
4	-1.20	6.04	0.007	2.21E-03	4.2	1.9		16148
5	-1.60	7.74	0.006	2.19E-03	6.9	4.1		16148
6	-2.00	9.43	0.005	2.14E-03	10.4	7.5		16148
7	-2.40	11.08	0.005	2.07E-03	14.5	12.5		16148
8	-2.70	12.31	0.004	2.00E-03	18.0	17.4		16148
9	-3.00	13.54	0.003	1.92E-03	21.9	23.3		16148
		3.12	0.003	1.92E-03	21.9	23.3		
10	-3.30	-7.64	0.003	1.80E-03	21.2	29.9		16148
11	-3.60	-18.43	0.002	1.67E-03	17.3	35.7		16148
12	-4.00	-32.88	0.002	1.44E-03	7.0	42.0		16148
13	-4.40	-24.72	0.001	1.17E-03	-4.5	42.9		16148
14	-4.70	-11.42	0.001	9.56E-04	-9.9	40.5		16148
15	-5.00	-0.81	0.001	7.50E-04	-11.8	37.0		16148
		-22.64	0.001	7.50E-04	-11.8	37.0		
16	-5.30	-10.84	0.000	5.63E-04	-16.8	32.4		16148
17	-5.60	-2.28	0.000	4.02E-04	-18.8	26.9		16148
18	-6.00	4.89	0.000	2.34E-04	-18.2	19.3		16148
19	-6.40	8.56	0.000	1.18E-04	-15.5	12.4		16148
20	-6.80	10.03	0.000	4.77E-05	-11.8	6.9		16148
21	-7.20	10.22	0.000	1.10E-05	-7.8	3.0		16148
22	-7.60	9.78	0.000	-2.92E-06	-3.8	0.7		16148
23	-8.00	9.10	0.000	-5.67E-06	0.0	0.0		---

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 73 of 127 - 11/04/2022 - NZBTC

(continued)

Stage No.7 Apply surcharge no.2 at elevation 0.00

LEFT side

Node no.	Y coord	Water press.	Vertic -al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	0.00	0.00	5.00	1.00	30.99	1.00	1.00a	11722
2	-0.40	0.00	13.11	2.62	81.28	2.62	2.62a	11722
3	-0.80	0.00	21.59	4.32	133.82	4.32	4.32a	11722
4	-1.20	0.00	30.20	6.04	187.20	6.04	6.04a	11722
5	-1.60	0.00	38.74	7.74	240.13	7.74	7.74a	11722
6	-2.00	0.00	47.15	9.43	292.26	9.43	9.43a	11722
7	-2.40	0.00	55.44	11.08	343.67	11.08	11.08a	11722
8	-2.70	0.00	61.60	12.31	381.83	12.31	12.31a	11722
9	-3.00	0.00	67.70	13.54	419.70	13.54	13.54a	11722
		0.00	67.70	17.15	250.00	17.15	17.15a	4689
10	-3.30	0.00	73.17	18.85	269.06	18.85	18.85a	4689
11	-3.60	0.00	78.61	20.53	288.01	20.53	20.53a	4689
12	-4.00	0.00	85.81	22.77	313.11	22.77	22.77a	4689
13	-4.40	0.00	92.97	25.00	338.06	25.10	25.10	4689
14	-4.70	0.00	98.32	26.66	356.69	32.55	32.55	4689
15	-5.00	0.00	103.64	28.31	375.27	39.00	39.00	4689
		0.00	103.64	18.83	486.22	28.59	28.59	7033
16	-5.30	0.00	108.96	20.22	509.24	35.15	35.15	7033
17	-5.60	0.00	114.26	21.61	532.20	40.52	40.52	7033
18	-6.00	0.00	121.31	23.45	562.75	46.17	46.17	7682
19	-6.40	0.00	128.35	25.29	593.24	50.54	50.54	7682
20	-6.80	0.00	135.38	27.13	623.67	54.06	54.06	7682
21	-7.20	0.00	142.40	28.97	654.08	57.10	57.10	7682
22	-7.60	0.00	149.41	30.80	684.46	59.92	59.92	7682
23	-8.00	0.00	156.42	32.63	714.82	62.67	62.67	7682

RIGHT side

Node no.	Y coord	Water press.	Vertic -al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	-0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	-0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	-1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	-1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	-2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	-2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	-2.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	-3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	14.02	14.02	14.02p	8821
10	-3.30	0.00	3.58	0.00	26.49	26.49	26.49p	8821
11	-3.60	0.00	7.16	0.00	38.97	38.97	38.97p	8821
12	-4.00	0.00	11.94	0.00	55.65	55.65	55.65p	8821
13	-4.40	0.00	16.76	1.32	72.43	49.82	49.82	8821
14	-4.70	0.00	20.40	2.45	85.11	43.97	43.97	8821
15	-5.00	0.00	24.07	3.59	97.90	39.81	39.81	8821
		0.00	24.07	0.00	141.55	51.22	51.22	13231
16	-5.30	0.00	27.78	0.00	157.63	45.99	45.99	13231
17	-5.60	0.00	31.54	0.00	173.91	42.80	42.80	13231
18	-6.00	0.00	36.63	1.31	195.98	41.28	41.28	7682
19	-6.40	0.00	41.84	2.67	218.54	41.98	41.98	7682
20	-6.80	0.00	47.17	4.06	241.63	44.03	44.03	7682
21	-7.20	0.00	52.64	5.49	265.29	46.88	46.88	7682

(continued)

Stage No.7 Apply surcharge no.2 at elevation 0.00

		RIGHT side						
			Effective stresses				Total	Coeff. of
Node no.	Y coord	Water press.	Vertic -al	Active limit	Passive limit	Earth pressure	earth pressure	subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
22	-7.60	0.00	58.24	6.96	289.55	50.14	50.14	7682
23	-8.00	0.00	63.98	8.46	314.41	53.57	53.57	7682

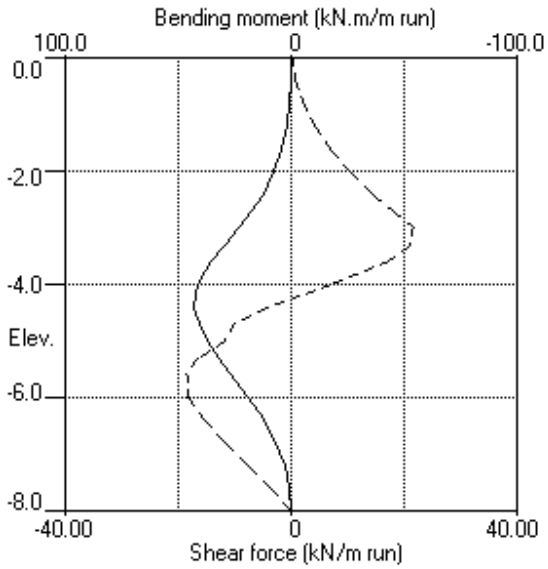
Note: 22.77a Soil pressure at active limit
55.65p Soil pressure at passive limit

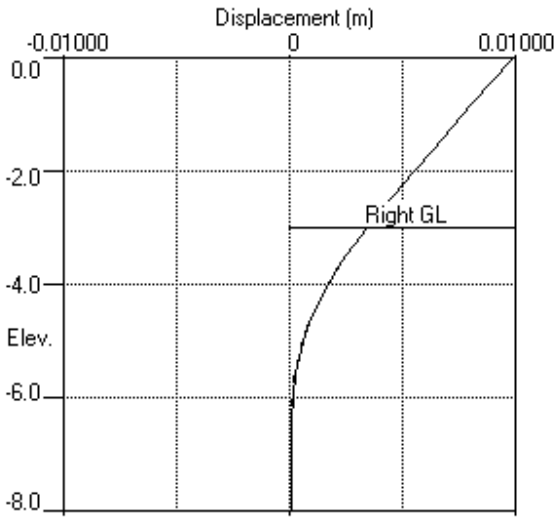
FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 74 of 127 - 11/04/2022 - NZBTC

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 75 of 127 - 11/04/2022 - NZBTC

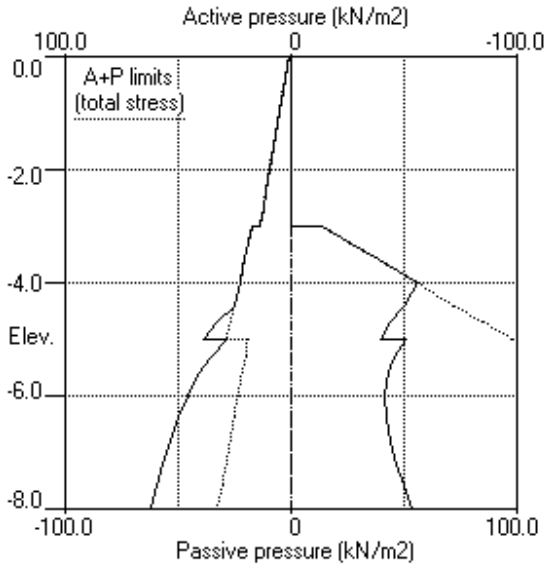
```
HAIGH WORKMAN LTD                                          | Sheet No.
Program: WALLAP  Version 6.06  Revision A52.B71.R56        | Job No.  19 123
                              Licensed from GEOSOLVE       | Made by :    WT
Data filename/Run ID: WALLAP3m                             |
Peter Morgan                                               | Date:25-10-2019
RW01_Hardfill                                              | Checked :
-----------------------------------------------------------------------------
                                                      Units: kN,m
```

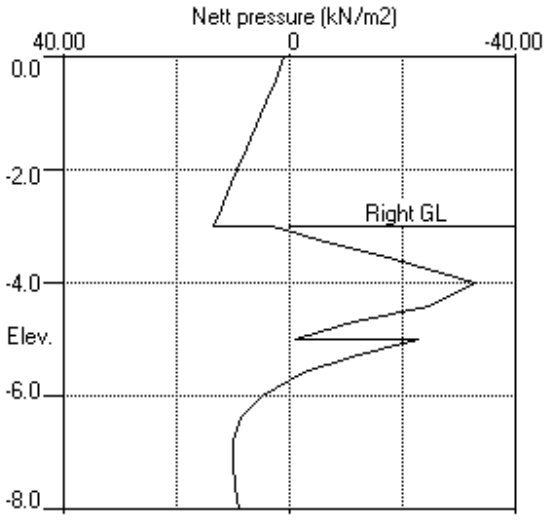
Stage No.7 Apply surcharge no.2 at elev. 0.00





Stage No.7 Apply surcharge no.2 at elev. 0.00





FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 76 of 127 - 11/04/2022 - NZBTC

Units: kN,m

Summary of results

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = -8.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation	Direction of failure
1	-3.00	-3.00	Cant.	Conditions not suitable for FoS calc.				
2	-3.00	-3.00		No analysis at this stage				
3	-3.00	-3.00		No analysis at this stage				
4	0.00	-3.00	Cant.	1.640	-7.58	-7.35	4.35	L to R
5	0.00	-3.00		No analysis at this stage				
6	0.00	-3.00	Cant.	1.572	-7.59	-7.64	4.64	L to R
7	0.00	-3.00	Cant.	1.531	-7.58	-7.83	4.83	L to R

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 77 of 127 - 11/04/2022 - NZBTC

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.60m; spacing = 1.20m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Left side 50.00 from wall
Right side 50.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum	Displacement minimum	Bending moment maximum	Bending moment minimum	Shear force maximum	Shear force minimum
		m	m	kN.m/m	kN.m/m	kN/m	kN/m
1	0.00	0.010	0.000	0.0	0.0	0.0	0.0
2	-0.40	0.009	0.000	0.1	0.0	0.7	0.0
3	-0.80	0.008	0.000	0.7	0.0	2.1	0.0
4	-1.20	0.007	0.000	1.9	0.0	4.2	0.0
5	-1.60	0.006	0.000	4.1	0.0	6.9	0.0
6	-2.00	0.005	0.000	7.5	0.0	10.4	0.0
7	-2.40	0.005	0.000	12.5	0.0	14.5	0.0
8	-2.70	0.004	0.000	17.4	0.0	18.0	0.0
9	-3.00	0.003	0.000	23.3	0.0	21.9	0.0
10	-3.30	0.003	0.000	29.9	0.0	21.2	0.0
11	-3.60	0.002	0.000	35.7	0.0	17.3	0.0
12	-4.00	0.002	0.000	42.0	0.0	7.0	0.0
13	-4.40	0.001	0.000	42.9	0.0	0.0	-5.5
14	-4.70	0.001	0.000	40.5	0.0	0.0	-9.9
15	-5.00	0.001	0.000	37.0	0.0	0.0	-11.8
16	-5.30	0.000	0.000	32.4	0.0	0.0	-16.8
17	-5.60	0.000	0.000	26.9	0.0	0.0	-18.8
18	-6.00	0.000	0.000	19.3	0.0	0.0	-18.2
19	-6.40	0.000	0.000	12.4	0.0	0.0	-15.5
20	-6.80	0.000	0.000	6.9	0.0	0.0	-11.8
21	-7.20	0.000	0.000	3.0	0.0	0.0	-7.8
22	-7.60	0.000	0.000	0.7	0.0	0.0	-3.8
23	-8.00	0.000	0.000	0.0	0.0	0.0	0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum	elev.	Bending moment minimum	elev.	Shear force maximum	elev.	Shear force minimum	elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
2	No calculation at this stage							
3	No calculation at this stage							
4	31.7	-4.00	0.0	0.00	18.0	-3.00	-13.4	-5.60
5	No calculation at this stage							
6	36.2	-4.40	0.0	0.00	19.8	-3.00	-15.6	-5.60
7	42.9	-4.40	0.0	0.00	21.9	-3.00	-18.8	-5.60

Summary of results (continued)

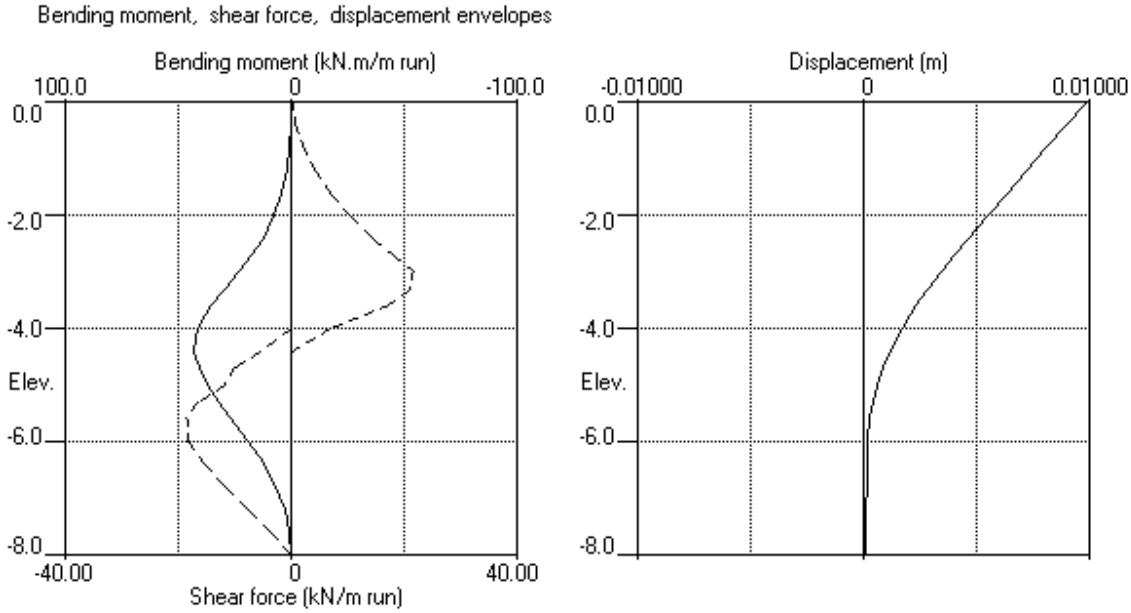
Maximum and minimum displacement at each stage

Stage no.	Displacement maximum (m)	elev.	minimum (m)	elev.	Stage description
1	0.000	0.00	0.000	0.00	Excav. to elev. -3.00 on RIGHT side
2	No calculation at this stage				Apply surcharge no.3 at elev. -3.00
3	Wall displacements reset to zero				Change EI of wall to 16148kN.m2/m run
4	0.027	0.00	0.000	0.00	Fill to elev. 0.00 on LEFT side
5	Wall displacements reset to zero				Change EI of wall to 16148kN.m2/m run
6	0.004	0.00	0.000	0.00	Apply surcharge no.1 at elev. 0.00
7	0.010	0.00	0.000	0.00	Apply surcharge no.2 at elev. 0.00

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 78 of 127 - 11/04/2022 - NZBTC

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 79 of 127 - 11/04/2022 - NZBTC

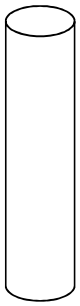
```
HAIGH WORKMAN LTD                                          | Sheet No.
Program: WALLAP  Version 6.06  Revision A52.B71.R56        | Job No.  19 123
                              Licensed from GEOSOLVE       | Made by :    WT
Data filename/Run ID: WALLAP3m                             |
Peter Morgan                                               | Date:25-10-2019
RW01_Hardfill                                              | Checked :
-------------------------------------------------------------------------------
                                                      Units: kN,m
```



FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 80 of 127 - 11/04/2022 - NZBTC

Material Properties for Timber Pole

E =	12.10	GPa	(Young Modulus) [MGS8, NZS3603 Amendement 4, Table 2.3]	
	1.21E+07	kPa		
ρ =	450	kg/m^3	(Density)	
S =	1.2	m c/c	(Spacing between piles)	0.425 m ϕ
A =	0.142	m^2	(Sectional Area)	
I =	1.60150E-03	m^4	(Area Moment of Inertia) per pile	
EA =	**1.430E+06**	kN/m = [kN/m^2][m^2]/[m]		
EI =	**16148.41**	kNm^2/m = [kN/m^2][m^4]/[m]		
w =	**0.522**	kN/m/m = [kg/m^3][m/s^2][m^2]/[m]		
I	1.335E-03	m^4/m	per unit length of wall	
EI	1.6148E-02	kNm^2/m = [kN/m^2][m^4]/[m] per unit length of wall		



	(m)	(kNm/m) BM	(kN/m SF	c/c (m)
Max Height	3	42.9	21.9	1.2

Load factor = 1.5

DESIGN (kNm) BM	(kN) SF	fos	disp (mm)	pole size (mm)	Embedmer (m)	Total length (m)
77.22	39.42	1.531	10	425	5	8

pole design (maximum) (kNm) BM	(kN) SF
119	155
OK	OK

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 81 of 127 - 11/04/2022 - NZBTC

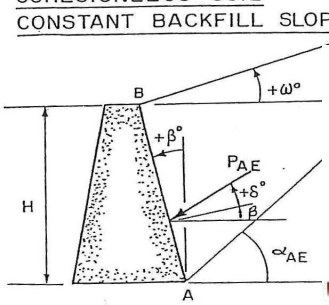
EARTH PRESSURE UNDER EARTHQUAKE BY MONONOBE-OKABE METHOD

-- for Yielding or Flexible Walls (δ > 0.5% x Height of Wall)

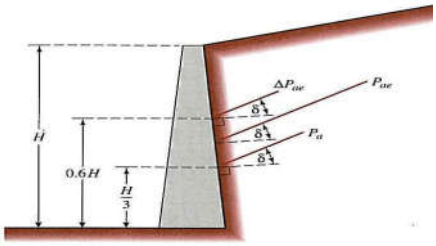
Module 6 for loadings

$C_0 = k_h$	0.17	g
$\theta = \tan^{-1}(k_h/(1-k_v))$	9.648045316	(Assume kv = 0)
ω	0.00	º
ϕ	30	º
β	-6	º
δ	20	º = 0.66667 ϕ
$\cos\theta$	0.985855847	
$\cos^2\beta$	0.9890738	
$\cos^2(\phi-\beta-\theta)$	0.802967061	
$\cos(\delta+\beta+\theta)$	0.916026695	
$\sin(\phi+\delta)$	0.766044443	
$\sin(\phi-\omega-\theta)$	0.347785968	
$\cos(\beta-\omega)$	0.994521895	
K_{AE}	**0.378673936**	

MONONOBE-OKABE EARTHQUAKE
EARTH PRESSURE
COHESIONLESS SOIL
CONSTANT BACKFILL SLOPE



FAILURE PLANE FOR EARTHQUAKE LOADING



▼ **FIGURE 11.4** Location of the line of action of P_{ae}

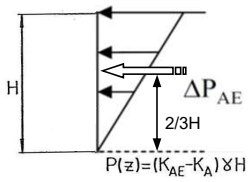
$\cos^2(\phi-\beta)$	0.654508497	
$\cos^2\beta$	0.9890738	
$\cos(\delta+\beta)$	0.970295726	
$\sin(\phi+\delta)$	0.766044443	
$\sin(\phi-\omega)$	0.5	
$\cos(\omega-\beta)$	0.994521895	
K_A	**0.256683428**	

$$K_{AE} = \frac{\cos^2(\phi-\beta-\theta)}{\cos\theta\,\cos^2\beta\,\cos(\delta+\beta+\theta)\left[1+\sqrt{\frac{\sin(\phi+\delta)\,\sin(\phi-\omega-\theta)}{\cos(\delta+\beta+\theta)\,\cos(\beta-\omega)}}\right]^2}$$

Coulomb equation for earth pressure:

$$K_A = \frac{\cos^2(\phi-\beta)}{\cos^2\beta\,\cos(\delta+\beta)\left[1+\sqrt{\frac{\sin(\phi+\delta)\,\sin(\phi-\omega)}{\cos(\delta+\beta)\,\cos(\omega-\beta)}}\right]^2}$$

γ	18	kN/m^3
H (Unbalanced Height)	3.00	m
ΔK_{AE}	0.12	
ΔP_{AE}	**9.88**	**kN/m**
Location of ΔP_{AE}	2.00	m from base



$\Delta P_{AE} = \frac{1}{2}\Delta K_{AE}\gamma H^2$
where $\Delta K_{AE} = K_{AE} - K_A$

Flexible Wall (from Mononobe–Okabe Theory)

Seed & Whitman (1970)

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 82 of 127 - 11/04/2022 - NZBTC

Project	Old Hospital Road - RW01
Client	Peter Morgan
Job No	19 123
Date	23/10/2019
Calculated by:	W. Thorburn
Reviewed by:	J. Papesch
Comments	Lagging Desing

Factored load on the plank at the base of the wall = 25.73 kPa

From Wallap	
3	Height (m)
17.2	kPa
1.5	Load factor
3	Rails Required

Structural Design of Lagging to NZS 3603:1993

Timber Lagging: Structural actions

Lagging width b =	50	50		Height (m)
Lagging depth d =	150	150		kPa
For a maximum soil pressure of 25.725 kPa. The UDL on lagging "d" =	3.86	kN/m		Load factor
Lagging Span "L" =	1.2	m		Rails Required
Maximum factored moment M* = 1/8 dL^2	**0.695**	**kNm**		

Under Flexure, calculate the minimum lagging depth for moment capacity

Bending Stress, f_b =	11.7	MPa
Shear Stress, f_s =	2.4	MPa
No of parallel support elements, n =	3	
Strength Reduction Factor, ϕ =	0.8	
Duration Factor, k_1 =	0.6	
Parallel Support Factor , k_4 =	1.00	
Grid System Factor, k_5 =	1.00	
Section modulus of lagging, Z = bd^2/6 =	187500	mm^3
$\phi M_n = \phi k_1 k_4 k_5 f_b Z$ =	**1.053**	**kNm**
Percentage of lagging moment capacity utilised	66%	

Lagging OK for Moment Capacity!

Check for Shear Capacity

For 150 x 50 lagging. Shear surface area =	5000.0	mm^2	
$\phi V_n = \phi k_1 k_4 k_5 f_s A_s$ =	**5.760**	**kN**	
Compare with V* =	**2.894**	**kN**	$V^* = 0.625wL$
Percentage of Shear capacity utilised	50%		

Lagging OK for Shear Capacity!

LAGGING

0-1.2m	**Use 150 x (1)50 lagging, spanning continuously across a minimum of 2 pole spacings**
1.2-2.7m	**Use 150 x (2)50 lagging, spanning continuously across a minimum of 2 pole spacings**
2.7-3.0m	**Use 150 x (3)50 lagging, spanning continuously across a minimum of 2 pole spacings**

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 83 of 127 - 11/04/2022 - NZBTC

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types: Left side	Soil types: Right side
1	0.00	1 Stiff Soils	1 Stiff Soils
2	-5.00	2 Very stiff soils	2 Very stiff soils
3	-9.00	3 Hard	3 Hard

SOIL PROPERTIES

-- Soil type -- No.	Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Stiff Soils	18.00	20000	0.530	OC (0.350)	0.311 (1.296)	3.485 (4.674)	3.000d
2	Very stiff soils	18.00	30000	0.470	OC (0.350)	0.262 (1.182)	4.331 (5.331)	7.000d
3	Hard	19.00	50000	0.470	OC (0.350)	0.262 (1.182)	4.331 (5.331)	10.00d
4	Fill	18.00	10000	0.500	NC (0.350)	0.285 (1.238)	3.878 (4.985)	0.0d

Additional soil parameters associated with Ka and Kp

------- Soil type ------- No.	Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Stiff Soils	28.00	0.636	0.00	28.00	0.306	0.00
2	Very stiff soils	32.00	0.625	0.00	32.00	0.298	0.00
3	Hard	32.00	0.625	0.00	32.00	0.298	0.00
4	Fill	30.00	0.631	0.00	30.00	0.302	0.00

GROUND WATER CONDITIONS

Density of water = 9.810 kN/m3

	Left side	Right side
Initial water table elevation	-10.00	-10.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Soldier Pile Wall
Soldier Pile width = 0.45 m
Soldier Pile spacing = 1.20 m
Passive mobilisation factor = 3.00
Elevation of toe of wall = -4.00
Maximum finite element length = 0.20 m
Youngs modulus of wall E = 1.2100E+07 kN/m2
Moment of inertia of wall I = 6.5450E-05 m4/m run
= 7.8540E-05 m4 per pile
E.I = 791.95 kN.m2/m run
Yield Moment of wall = Not defined

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 84 of 127 - 11/04/2022 - NZBTC

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge ----- kN/m2 ----- Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	0.00	1.00(L)	14.00	9.00	10.00	=	N/A	N/A
2	0.00	0.00(L)	14.00	10.00	5.00	=	N/A	N/A
3	-1.00	-0.00(R)	14.00	20.00	0.00	-191.00	N/A	N/A

Note: L = Left side, R = Right side
A trapezoidal surcharge is defined by two values:
N = at edge near to wall, F = at edge far from wall

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Change EI of wall to 791.95 kN.m2/m run Yield moment not defined No adjustments to wall displacements
2	Excavate to elevation -1.80 on RIGHT side
3	Apply surcharge no.2 at elevation 0.00

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.50

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on Left side of wall = 50.00 m
Width of excavation on Right side of wall = 50.00 m

Distance to rigid boundary on Left side = 50.00 m
Distance to rigid boundary on Right side = 50.00 m

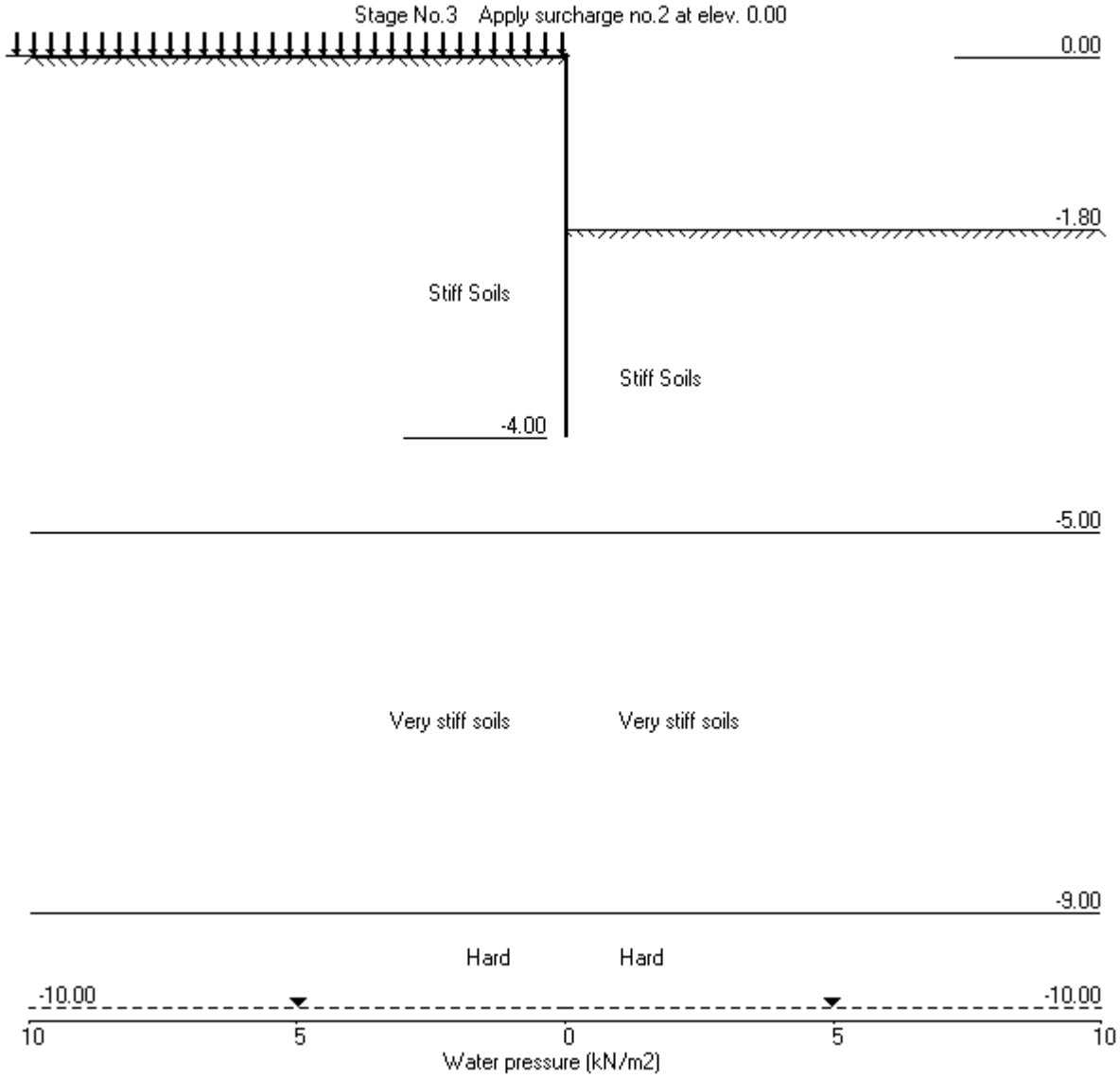
OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Change EI of wall to 791.95kN.m2/m run	No	No	No
2	Excav. to elev. -1.80 on RIGHT side	Yes	Yes	Yes
3	Apply surcharge no.2 at elev. 0.00	No	No	No
*	Summary output	Yes	-	Yes

Program WALLAP - Copyright (C) 2019 by DL Borin, distributed by GEOSOLVE
150 St. Alphonsus Road, London SW4 7BW, UK www.geosolve.co.uk

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 85 of 127 - 11/04/2022 - NZBTC

```
HAIGH WORKMAN LTD                                          | Sheet No.
Program: WALLAP  Version 6.06  Revision A52.B71.R56        | Job No.  19 123
                              Licensed from GEOSOLVE       | Made by :    WT
Data filename/Run ID: WALLAPcut                            |
Peter Morgan                                               | Date:21-10-2019
RW02                                                       | Checked :
-------------------------------------------------------------------------------
                                                   Units: kN,m
```



FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 86 of 127 - 11/04/2022 - NZBTC

Units: kN,m

Stage No. 3 Apply surcharge no.2 at elevation 0.00

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = -4.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation	Direction of failure
3	0.00	-1.80	Cant.	1.512	-3.76	-3.96	2.16	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.45m; spacing = 1.20m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Left side 50.00 from wall
Right side 50.00 from wall

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
1	0.00	0.00	0.013	5.51E-03	0.0	0.0	
2	-0.20	0.00	0.012	5.51E-03	0.0	0.0	
3	-0.40	0.00	0.011	5.51E-03	0.0	0.0	
4	-0.60	1.02	0.010	5.51E-03	0.1	0.0	
5	-0.80	2.14	0.009	5.51E-03	0.4	0.1	
6	-1.00	3.25	0.007	5.47E-03	1.0	0.2	
7	-1.20	4.37	0.006	5.39E-03	1.7	0.5	
8	-1.40	5.49	0.005	5.22E-03	2.7	0.9	
9	-1.60	6.60	0.004	4.92E-03	3.9	1.5	
10	-1.80	7.72	0.003	4.41E-03	5.3	2.5	
		-6.30	0.003	4.41E-03	5.3	2.5	
11	-2.00	-17.74	0.002	3.66E-03	2.9	3.5	
12	-2.20	-17.53	0.002	2.74E-03	-0.6	3.8	
13	-2.40	-7.26	0.001	1.83E-03	-3.1	3.4	
14	-2.60	-0.77	0.001	1.08E-03	-3.9	2.6	
15	-2.80	2.75	0.001	5.26E-04	-3.7	1.8	
16	-3.00	4.19	0.001	1.55E-04	-3.0	1.1	
17	-3.20	4.32	0.001	-6.59E-05	-2.1	0.6	
18	-3.40	3.71	0.001	-1.79E-04	-1.3	0.3	
19	-3.60	2.76	0.001	-2.27E-04	-0.7	0.1	
20	-3.80	1.69	0.001	-2.40E-04	-0.2	0.0	
21	-4.00	0.59	0.001	-2.41E-04	0.0	-0.0	

LEFT side

Node no.	Y coord	Water press. kN/m2	Effective stresses Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2	Total earth pressure kN/m2	Coeff. of subgrade reaction kN/m3
1	0.00	0.00	5.00	0.00	31.45	0.00	0.00a	7771
2	-0.20	0.00	8.60	0.00	44.00	0.00	0.00a	7771
3	-0.40	0.00	12.20	0.00	56.54	0.00	0.00a	7771
4	-0.60	0.00	15.80	1.02	69.09	1.02	1.02a	7771

(continued)

Stage No.3 Apply surcharge no.2 at elevation 0.00

LEFT side

Node no.	Y coord	Water press.	Effective stresses: Vertic -al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
5	-0.80	0.00	19.40	2.14	81.63	2.14	2.14a	7771
6	-1.00	0.00	22.99	3.25	94.16	3.25	3.25a	7771
7	-1.20	0.00	26.59	4.37	106.69	4.37	4.37a	7771
8	-1.40	0.00	30.18	5.49	119.21	5.49	5.49a	7771
9	-1.60	0.00	33.77	6.60	131.73	6.60	6.60a	7771
10	-1.80	0.00	37.36	7.72	144.23	7.72	7.72a	7771
11	-2.00	0.00	40.94	8.83	156.73	8.83	8.83a	7771
12	-2.20	0.00	44.53	9.95	169.22	10.48	10.48	7771
13	-2.40	0.00	48.11	11.06	181.70	15.71	15.71	7771
14	-2.60	0.00	51.69	12.17	194.17	19.72	19.72	7771
15	-2.80	0.00	55.26	13.28	206.63	22.76	22.76	7771
16	-3.00	0.00	58.83	14.39	219.08	25.13	25.13	7771
17	-3.20	0.00	62.40	15.50	231.51	27.07	27.07	7771
18	-3.40	0.00	65.97	16.61	243.94	28.77	28.77	7771
19	-3.60	0.00	69.53	17.71	256.36	30.36	30.36	7771
20	-3.80	0.00	73.09	18.82	268.78	31.90	31.90	7771
21	-4.00	0.00	76.65	19.93	281.18	33.43	33.43	7771

RIGHT side

Node no.	Y coord	Water press.	Effective stresses: Vertic -al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	-0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	-0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	-0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	-0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	-1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	-1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	-1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	-1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	14.02	14.02	14.02p	19937
11	-2.00	0.00	3.60	0.00	26.57	26.57	26.57p	19937
12	-2.20	0.00	7.20	0.00	39.12	28.01	28.01	19937
13	-2.40	0.00	10.80	0.00	51.67	22.97	22.97	19937
14	-2.60	0.00	14.40	0.59	64.21	20.49	20.49	19937
15	-2.80	0.00	18.00	1.70	76.76	20.01	20.01	19937
16	-3.00	0.00	21.60	2.82	89.31	20.94	20.94	19937
17	-3.20	0.00	25.20	3.94	101.86	22.75	22.75	19937
18	-3.40	0.00	28.80	5.06	114.40	25.06	25.06	19937
19	-3.60	0.00	32.40	6.18	126.95	27.59	27.59	19937
20	-3.80	0.00	36.00	7.30	139.50	30.21	30.21	19937
21	-4.00	0.00	39.60	8.42	152.05	32.84	32.84	19937

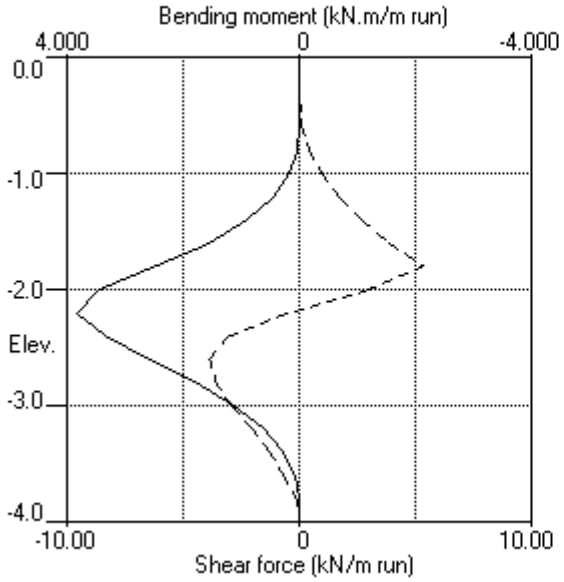
Note: 8.83a Soil pressure at active limit
26.57p Soil pressure at passive limit

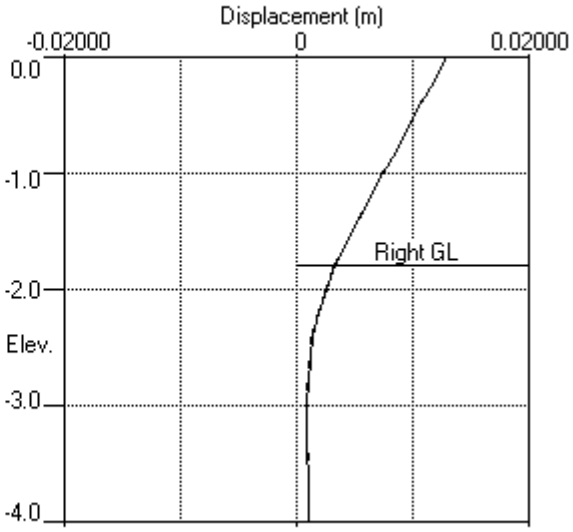
FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 87 of 127 - 11/04/2022 - NZBTC

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 88 of 127 - 11/04/2022 - NZBTC

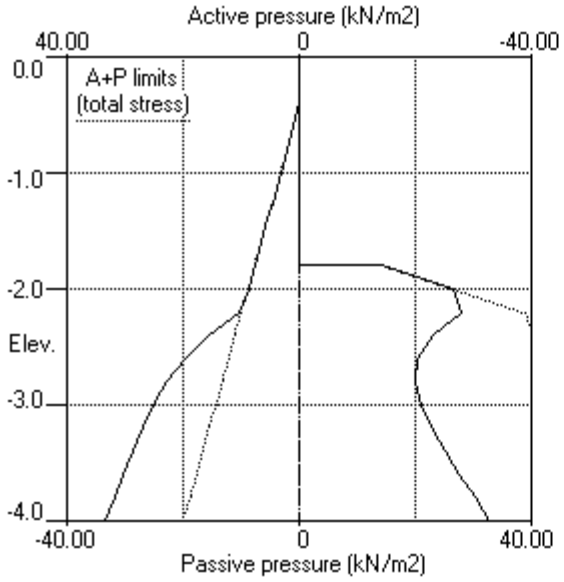
```
HAIGH WORKMAN LTD                                          | Sheet No.
Program: WALLAP  Version 6.06  Revision A52.B71.R56        | Job No.  19 123
                              Licensed from GEOSOLVE       | Made by :    WT
Data filename/Run ID: WALLAPcut                            |
Peter Morgan                                               | Date:21-10-2019
RW02                                                       | Checked :
-------------------------------------------------------------------------------
                                                      Units: kN,m
```

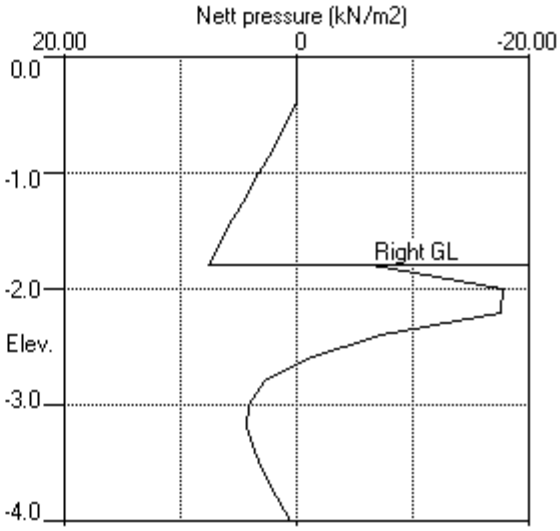
Stage No.3 Apply surcharge no.2 at elev. 0.00





Stage No.3 Apply surcharge no.2 at elev. 0.00





Units: kN,m

Summary of results

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = -4.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation	Direction of failure
1	0.00	0.00	Cant.	Conditions not suitable for FoS calc.				
2	0.00	-1.80	Cant.	1.696	-3.76	-3.54	1.74	L to R
3	0.00	-1.80	Cant.	1.512	-3.76	-3.96	2.16	L to R

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 89 of 127 - 11/04/2022 - NZBTC

HAIGH WORKMAN LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A52.B71.R56 | Job No. 19 123
Licensed from GEOSOLVE | Made by : WT
Data filename/Run ID: WALLAPcut |
Peter Morgan | Date:21-10-2019
RW02 | Checked :

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.45m; spacing = 1.20m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Left side 50.00 from wall
Right side 50.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum	Displacement minimum	Bending moment maximum	Bending moment minimum	Shear force maximum	Shear force minimum
		m	m	kN.m/m	kN.m/m	kN/m	kN/m
1	0.00	0.013	0.000	0.0	0.0	0.0	0.0
2	-0.20	0.012	0.000	0.0	0.0	0.0	0.0
3	-0.40	0.011	0.000	0.0	-0.0	0.0	0.0
4	-0.60	0.010	0.000	0.0	-0.0	0.1	0.0
5	-0.80	0.009	0.000	0.1	0.0	0.4	0.0
6	-1.00	0.007	0.000	0.2	0.0	1.0	0.0
7	-1.20	0.006	0.000	0.5	0.0	1.7	0.0
8	-1.40	0.005	0.000	0.9	0.0	2.7	0.0
9	-1.60	0.004	0.000	1.5	0.0	3.9	0.0
10	-1.80	0.003	0.000	2.5	0.0	5.3	0.0
11	-2.00	0.002	0.000	3.5	0.0	2.9	0.0
12	-2.20	0.002	0.000	3.8	0.0	0.0	-0.7
13	-2.40	0.001	0.000	3.4	0.0	0.0	-3.1
14	-2.60	0.001	0.000	2.6	0.0	0.0	-3.9
15	-2.80	0.001	0.000	1.8	0.0	0.0	-3.7
16	-3.00	0.001	0.000	1.1	0.0	0.0	-3.0
17	-3.20	0.001	0.000	0.6	0.0	0.0	-2.1
18	-3.40	0.001	0.000	0.3	0.0	0.0	-1.3
19	-3.60	0.001	0.000	0.1	0.0	0.0	-0.7
20	-3.80	0.001	0.000	0.0	0.0	0.0	-0.2
21	-4.00	0.001	0.000	0.0	-0.0	0.0	0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum	elev.	Bending moment minimum	elev.	Shear force maximum	elev.	Shear force minimum	elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
2	2.0	-2.20	-0.0	-0.60	3.4	-1.80	-2.0	-2.60
3	3.8	-2.20	-0.0	-0.40	5.3	-1.80	-3.9	-2.60

Maximum and minimum displacement at each stage

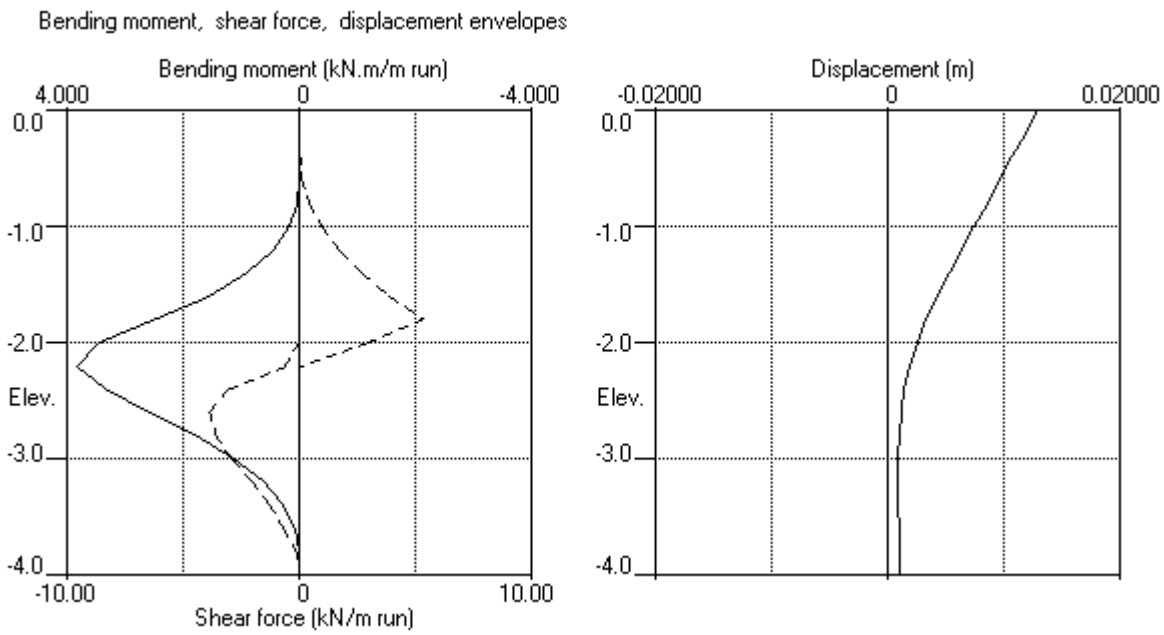
Stage no.	Displacement maximum	elev.	Displacement minimum	elev.	Stage description
	m		m		
1	0.000	0.00	0.000	0.00	Change EI of wall to 791.95kN.m2/m run
2	0.007	0.00	0.000	0.00	Excav. to elev. -1.80 on RIGHT side
3	0.013	0.00	0.000	0.00	Apply surcharge no.2 at elev. 0.00

Summary of results (continued)

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 91 of 127 - 11/04/2022 - NZBTC

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 92 of 127 - 11/04/2022 - NZBTC

```
HAIGH WORKMAN LTD                                          | Sheet No.
Program: WALLAP  Version 6.06  Revision A52.B71.R56        | Job No.  19 123
                              Licensed from GEOSOLVE       | Made by :    WT
Data filename/Run ID: WALLAPcut                            |
Peter Morgan                                               | Date:21-10-2019
RW02                                                       | Checked :
-------------------------------------------------------------------------------
                                                      Units: kN,m
```



FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 93 of 127 - 11/04/2022 - NZBTC

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types: Left side	Soil types: Right side
1	0.00	1 Stiff Soils	1 Stiff Soils
2	-5.00	2 Very stiff soils	2 Very stiff soils
3	-9.00	3 Hard	3 Hard

SOIL PROPERTIES

No.	Soil type Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Stiff Soils	18.00	20000	0.530	OC (0.350)	0.311 (1.296)	3.485 (4.674)	3.000d
2	Very stiff soils	18.00	30000	0.470	OC (0.350)	0.262 (1.182)	4.331 (5.331)	7.000d
3	Hard	19.00	50000	0.470	OC (0.350)	0.262 (1.182)	4.331 (5.331)	10.00d
4	Fill	18.00	10000	0.500	NC (0.350)	0.285 (1.238)	3.878 (4.985)	0.0d

Additional soil parameters associated with Ka and Kp

No.	Soil type Description	Ka: Soil friction angle	Ka: Wall adhesion coeff.	Ka: Back-fill angle	Kp: Soil friction angle	Kp: Wall adhesion coeff.	Kp: Back-fill angle
1	Stiff Soils	28.00	0.636	0.00	28.00	0.306	0.00
2	Very stiff soils	32.00	0.625	0.00	32.00	0.298	0.00
3	Hard	32.00	0.625	0.00	32.00	0.298	0.00
4	Fill	30.00	0.631	0.00	30.00	0.302	0.00

GROUND WATER CONDITIONS

Density of water = 9.810 kN/m3

	Left side	Right side
Initial water table elevation	-10.00	-10.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Soldier Pile Wall
Soldier Pile width = 0.60 m
Soldier Pile spacing = 1.20 m
Passive mobilisation factor = 3.00
Elevation of toe of wall = -8.00
Maximum finite element length = 0.40 m
Youngs modulus of wall E = 1.2100E+07 kN/m2
Moment of inertia of wall I = 6.1380E-04 m4/m run
= 7.3656E-04 m4 per pile
E.I = 7427.0 kN.m2/m run
Yield Moment of wall = Not defined

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 94 of 127 - 11/04/2022 - NZBTC

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge ----- kN/m2 ----- Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	0.00	1.00(L)	14.00	9.00	10.00	=	N/A	N/A
2	0.00	0.00(L)	14.00	10.00	5.00	=	N/A	N/A
3	-1.00	-0.00(R)	14.00	20.00	0.00	-191.00	N/A	N/A

Note: L = Left side, R = Right side
A trapezoidal surcharge is defined by two values:
N = at edge near to wall, F = at edge far from wall

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Change EI of wall to 7427.0 kN.m2/m run Yield moment not defined No adjustments to wall displacements
2	Excavate to elevation -1.00 on RIGHT side
3	Excavate to elevation -1.00 on RIGHT side Toe of berm at elevation -3.90 Width of top of berm = 1.00 Width of toe of berm = 1.10
4	Apply surcharge no.2 at elevation 0.00

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.50

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on Left side of wall = 50.00 m
Width of excavation on Right side of wall = 50.00 m

Distance to rigid boundary on Left side = 50.00 m
Distance to rigid boundary on Right side = 50.00 m

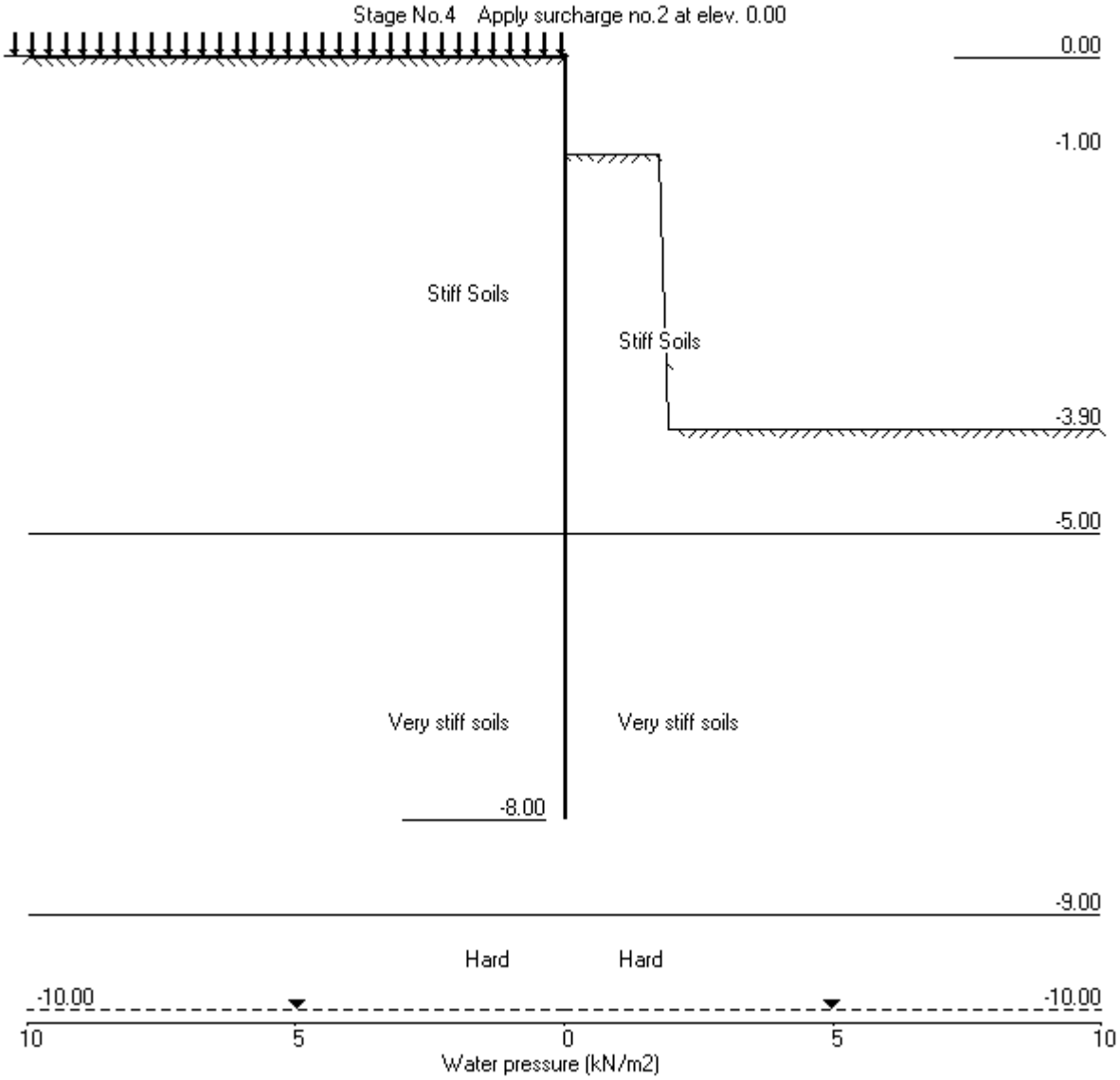
OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Change EI of wall to 7427.0kN.m2/m run	No	No	No
2	Excav. to elev. -1.00 on RIGHT side	Yes	Yes	Yes
3	Excav. to elev. -1.00 on RIGHT side	No	No	No
4	Apply surcharge no.2 at elev. 0.00	No	No	No
*	Summary output	Yes	-	Yes

Program WALLAP - Copyright (C) 2019 by DL Borin, distributed by GEOSOLVE
150 St. Alphonsus Road, London SW4 7BW, UK www.geosolve.co.uk

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 95 of 127 - 11/04/2022 - NZBTC

```
HAIGH WORKMAN LTD                                          | Sheet No.
Program: WALLAP  Version 6.06  Revision A52.B71.R56        | Job No.  19 123
                              Licensed from GEOSOLVE       | Made by :    WT
Data filename/Run ID: WALLAPBASEMENT                       |
Peter Morgan                                               | Date:21-10-2019
RW02A                                                      | Checked :
-------------------------------------------------------------------------------
                                                   Units: kN,m
```



FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 96 of 127 - 11/04/2022 - NZBTC

Units: kN,m

Stage No. 4 Apply surcharge no.2 at elevation 0.00

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = -8.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation	Direction of failure
4	0.00	-1.00	Cant.	1.614	-7.46	-7.51	6.51	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.60m; spacing = 1.20m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Left side 50.00 from wall
Right side 50.00 from wall

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
1	0.00	0.00	0.045	1.06E-02	0.0	-0.0	
2	-0.40	0.00	0.041	1.06E-02	0.0	0.0	
3	-0.70	1.58	0.038	1.06E-02	0.2	0.1	
4	-1.00	3.25	0.035	1.06E-02	1.0	0.3	
5	-1.30	4.93	0.032	1.06E-02	2.2	0.7	
6	-1.60	6.60	0.028	1.06E-02	3.9	1.6	
7	-2.00	8.83	0.024	1.04E-02	7.0	3.8	
8	-2.40	11.06	0.020	1.01E-02	11.0	7.3	
9	-2.80	13.28	0.016	9.63E-03	15.9	12.7	
10	-3.20	15.50	0.012	8.74E-03	21.6	20.1	
		-17.77	0.012	8.74E-03	21.6	20.1	
11	-3.55	-20.64	0.009	7.64E-03	14.9	26.5	
		-36.20	0.009	7.64E-03	14.9	26.5	
12	-3.90	-41.03	0.007	6.31E-03	1.4	30.0	
		-11.77	0.007	6.31E-03	1.4	30.0	
13	-4.15	-12.46	0.006	5.30E-03	-1.7	30.0	
		-25.18	0.006	5.30E-03	-1.7	30.0	
14	-4.40	-20.61	0.004	4.31E-03	-7.4	28.8	
		-20.86	0.004	4.31E-03	-7.4	28.8	
15	-4.70	-9.30	0.003	3.21E-03	-11.9	25.6	
16	-5.00	-1.07	0.002	2.26E-03	-13.5	21.6	
		-7.63	0.002	2.26E-03	-13.5	21.6	
17	-5.30	0.36	0.002	1.47E-03	-14.5	17.2	
18	-5.60	5.13	0.001	8.71E-04	-13.7	12.9	
19	-6.00	7.90	0.001	3.13E-04	-11.1	7.8	
20	-6.40	8.55	0.001	-3.64E-06	-7.8	4.0	
21	-6.80	7.39	0.001	-1.52E-04	-4.6	1.5	
22	-7.20	5.53	0.001	-2.01E-04	-2.1	0.3	
23	-7.60	3.07	0.001	-2.05E-04	-0.3	-0.1	
24	-8.00	-1.39	0.001	-2.02E-04	0.0	-0.0	

(continued)

Stage No.4 Apply surcharge no.2 at elevation 0.00

LEFT side

Node no.	Y coord	Water press.	Vertic -al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
			Effective stresses					
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	0.00	0.00	5.00	0.00	31.45	0.00	0.00a	4709
2	-0.40	0.00	12.20	0.00	56.54	0.00	0.00a	4709
3	-0.70	0.00	17.60	1.58	75.36	1.58	1.58a	4709
4	-1.00	0.00	22.99	3.25	94.16	3.25	3.25a	4709
5	-1.30	0.00	28.38	4.93	112.95	4.93	4.93a	4709
6	-1.60	0.00	33.77	6.60	131.73	6.60	6.60a	4709
7	-2.00	0.00	40.94	8.83	156.73	8.83	8.83a	4709
8	-2.40	0.00	48.11	11.06	181.70	11.06	11.06a	4709
9	-2.80	0.00	55.26	13.28	206.63	13.28	13.28a	4709
10	-3.20	0.00	62.40	15.50	231.51	15.50	15.50a	4709
11	-3.55	0.00	68.64	17.44	253.26	17.44	17.44a	4709
12	-3.90	0.00	74.87	19.37	274.98	19.37	19.37a	4709
13	-4.15	0.00	79.32	20.75	290.48	21.18	21.18	4709
14	-4.40	0.00	83.76	22.14	305.96	29.19	29.19	4709
15	-4.70	0.00	89.09	23.79	324.53	37.26	37.26	4709
16	-5.00	0.00	94.41	25.44	343.09	43.82	43.82	4709
		0.00	94.41	16.42	446.23	35.30	35.30	7063
17	-5.30	0.00	99.73	17.81	469.27	41.62	41.62	7063
18	-5.60	0.00	105.05	19.20	492.30	46.41	46.41	7063
19	-6.00	0.00	112.14	21.05	522.99	51.08	51.08	7449
20	-6.40	0.00	119.22	22.91	553.67	54.75	54.75	14118
21	-6.80	0.00	126.30	24.76	584.34	57.52	57.52	14118
22	-7.20	0.00	133.38	26.61	615.01	59.94	59.94	14118
23	-7.60	0.00	140.46	28.46	645.68	62.06	62.06	30040
24	-8.00	0.00	147.54	30.31	676.35	63.18	63.18	30040

RIGHT side

Node no.	Y coord	Water press.	Vertic -al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
			Effective stresses					
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	-0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	-0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00b	0.00	0.00	5643
5	-1.30	0.00	5.40	0.00	0.00b	0.00	0.00	5643
6	-1.60	0.00	10.80	0.00	0.00b	0.00	0.00	5643
7	-2.00	0.00	18.00	-0.01	0.00b	0.00	0.00p	5643
8	-2.40	0.00	25.20	-0.01	-0.00b	-0.00	-0.00p	5643
9	-2.80	0.00	32.40	-0.01	0.00b	0.00	0.00p	5643
10	-3.20	0.00	39.60	-0.01	-0.00b	-0.00	-0.00p	5643
		0.00	39.60	8.41	33.27b	33.27	33.27p	5643
11	-3.55	0.00	45.90	10.37	38.08b	38.08	38.08p	5643
		0.00	45.90	10.37	53.64b	53.64	53.64p	5643
12	-3.90	0.00	52.20	12.33	60.41b	60.41	60.41p	5643
		0.00	52.20	12.33	31.15b	31.15	31.15p	5643
13	-4.15	0.00	56.70	13.73	33.64b	33.64	33.64p	5643
		0.00	56.70	13.73	46.36b	46.36	46.36p	5643
14	-4.40	0.00	61.20	15.13	49.80b	49.80	49.80p	5643
		0.00	61.20	15.13	62.74b	50.04	50.04	5643
15	-4.70	0.00	66.60	16.80	67.93b	46.55	46.55	5643
		0.00	66.60	16.80	81.06b	46.55	46.55	5643
16	-5.00	0.00	72.00	18.48	87.26b	44.89	44.89	5643
		0.00	72.00	10.56	179.59b	42.93	42.93	8465

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 97 of 127 - 11/04/2022 - NZBTC

(continued)

Stage No.4 Apply surcharge no.2 at elevation 0.00

		RIGHT side						
			Effective stresses				Total	Coeff. of
Node no.	Y coord	Water press.	Vertic -al	Active limit	Passive limit	Earth pressure	earth pressure	subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
17	-5.30	0.00	77.40	11.97	191.62b	41.26	41.26	8465
		0.00	77.40	11.97	165.35b	41.26	41.26	8465
18	-5.60	0.00	82.81	13.38	175.74b	41.28	41.28	8465
		0.00	82.81	13.38	190.34b	41.28	41.28	8465
19	-6.00	0.00	90.01	15.27	205.33b	43.17	43.17	8465
		0.00	90.01	15.27	220.96b	43.17	43.17	8465
20	-6.40	0.00	97.21	17.15	237.10b	46.20	46.20	14118
		0.00	97.21	17.15	251.66b	46.20	46.20	14118
21	-6.80	0.00	104.41	19.03	268.79b	50.13	50.13	14118
		0.00	104.41	19.03	282.42b	50.13	50.13	14118
22	-7.20	0.00	111.61	20.92	300.41b	54.41	54.41	14118
		0.00	111.61	20.92	313.23b	54.41	54.41	14118
23	-7.60	0.00	118.82	22.80	332.00b	58.99	58.99	30040
		0.00	118.82	22.80	344.09b	58.99	58.99	30040
24	-8.00	0.00	126.02	24.68	363.53b	64.57	64.57	30040

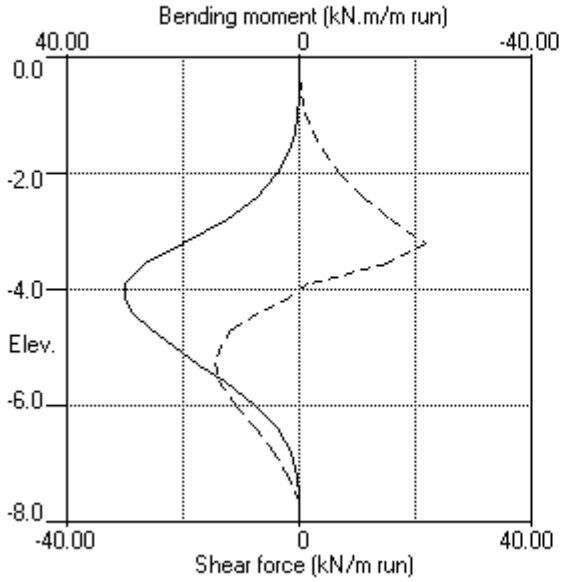
Note: 19.37a Soil pressure at active limit
49.80p Soil pressure at passive limit
363.53b Passive limit reduced because of berm

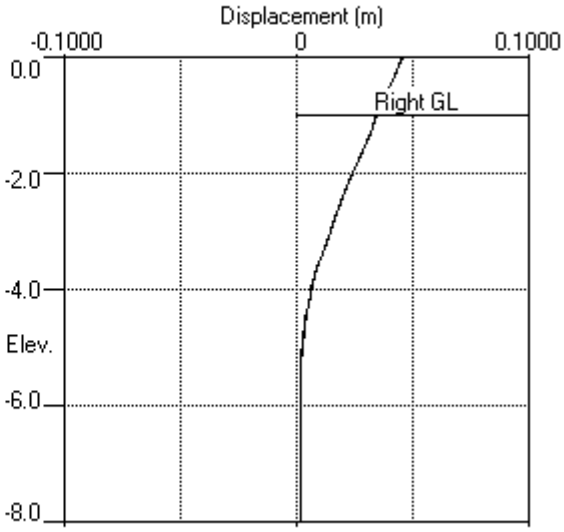
FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 98 of 127 - 11/04/2022 - NZBTC

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 99 of 127 - 11/04/2022 - NZBTC

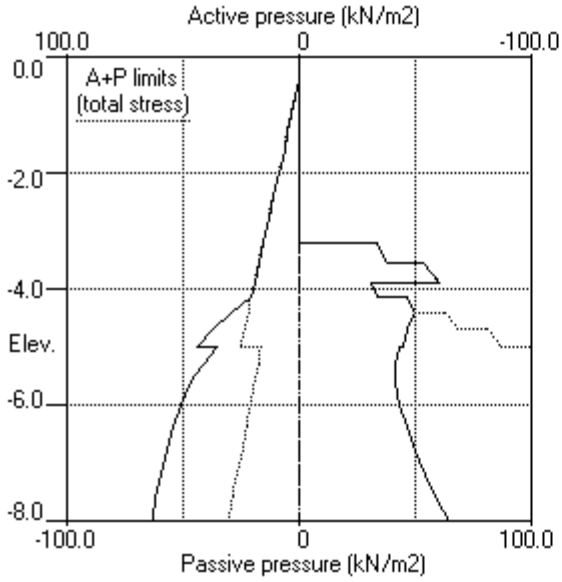
```
HAIGH WORKMAN LTD                                          | Sheet No.
Program: WALLAP  Version 6.06  Revision A52.B71.R56        | Job No.  19 123
                              Licensed from GEOSOLVE       | Made by :    WT
Data filename/Run ID: WALLAPBASEMENT                       |
Peter Morgan                                               | Date:21-10-2019
RW02A                                                      | Checked :
-------------------------------------------------------------------------------
                                                      Units: kN,m
```

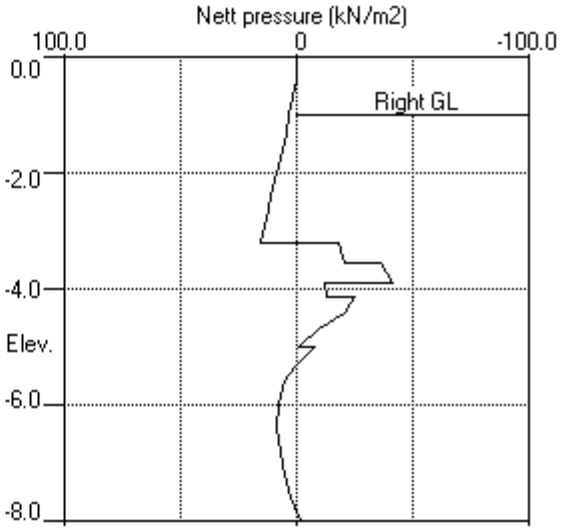
Stage No.4 Apply surcharge no.2 at elev. 0.00





Stage No.4 Apply surcharge no.2 at elev. 0.00





Units: kN,m

Summary of results

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = -8.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation	Direction of failure
1	0.00	0.00	Cant.	Conditions not suitable for FoS calc.				
2	0.00	-1.00	Cant.	6.700	-7.19	-1.51	0.51	L to R
3	0.00	-1.00	Cant.	1.714	-7.46	-7.13	6.13	L to R
4	0.00	-1.00	Cant.	1.614	-7.46	-7.51	6.51	L to R

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 100 of 127 - 11/04/2022 - NZBTC

HAIGH WORKMAN LTD | Sheet No.
Program: WALLAP Version 6.06 Revision A52.B71.R56 | Job No. 19 123
Licensed from GEOSOLVE | Made by : WT
Data filename/Run ID: WALLAPBASEMENT |
Peter Morgan | Date:21-10-2019
RW02A | Checked :

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.60m; spacing = 1.20m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Left side 50.00 from wall
Right side 50.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum	Displacement minimum	Bending moment maximum	Bending moment minimum	Shear force maximum	Shear force minimum
		m	m	kN.m/m	kN.m/m	kN/m	kN/m
1	0.00	0.045	0.000	0.0	-0.0	0.0	0.0
2	-0.40	0.041	0.000	0.0	-0.0	0.0	0.0
3	-0.70	0.038	0.000	0.1	0.0	0.2	0.0
4	-1.00	0.035	0.000	0.3	0.0	1.0	0.0
5	-1.30	0.032	0.000	0.7	0.0	2.2	0.0
6	-1.60	0.028	0.000	1.6	0.0	3.9	0.0
7	-2.00	0.024	0.000	3.8	0.0	7.0	-0.3
8	-2.40	0.020	0.000	7.3	0.0	11.0	-0.5
9	-2.80	0.016	0.000	12.7	0.0	15.9	-0.5
10	-3.20	0.012	0.000	20.1	-0.1	21.6	-0.5
11	-3.55	0.009	0.000	26.5	-0.3	14.9	-0.4
12	-3.90	0.007	0.000	30.0	-0.4	1.4	-1.3
13	-4.15	0.006	0.000	30.0	-0.4	0.1	-3.6
14	-4.40	0.004	0.000	28.8	-0.3	0.4	-7.4
15	-4.70	0.003	0.000	25.6	-0.2	0.8	-11.9
16	-5.00	0.002	0.000	21.6	0.0	1.3	-13.5
17	-5.30	0.002	0.000	17.2	0.0	0.7	-14.5
18	-5.60	0.002	0.000	12.9	0.0	0.3	-13.7
19	-6.00	0.002	0.000	7.8	0.0	0.0	-11.1
20	-6.40	0.002	0.000	4.0	0.0	0.0	-7.8
21	-6.80	0.002	0.000	1.5	0.0	0.0	-4.6
22	-7.20	0.002	0.000	0.3	0.0	0.0	-2.1
23	-7.60	0.001	0.000	0.1	-0.1	0.0	-0.3
24	-8.00	0.001	0.000	0.0	-0.0	0.0	0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum	elev.	minimum	elev.	Shear force maximum	elev.	minimum	elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
2	0.6	-6.00	-0.4	-4.15	1.3	-5.00	-0.5	-2.80
3	21.7	-3.90	-0.1	-7.60	17.5	-3.20	-9.9	-5.30
4	30.0	-4.15	-0.1	-7.60	21.6	-3.20	-14.5	-5.30

Summary of results (continued)

Maximum and minimum displacement at each stage

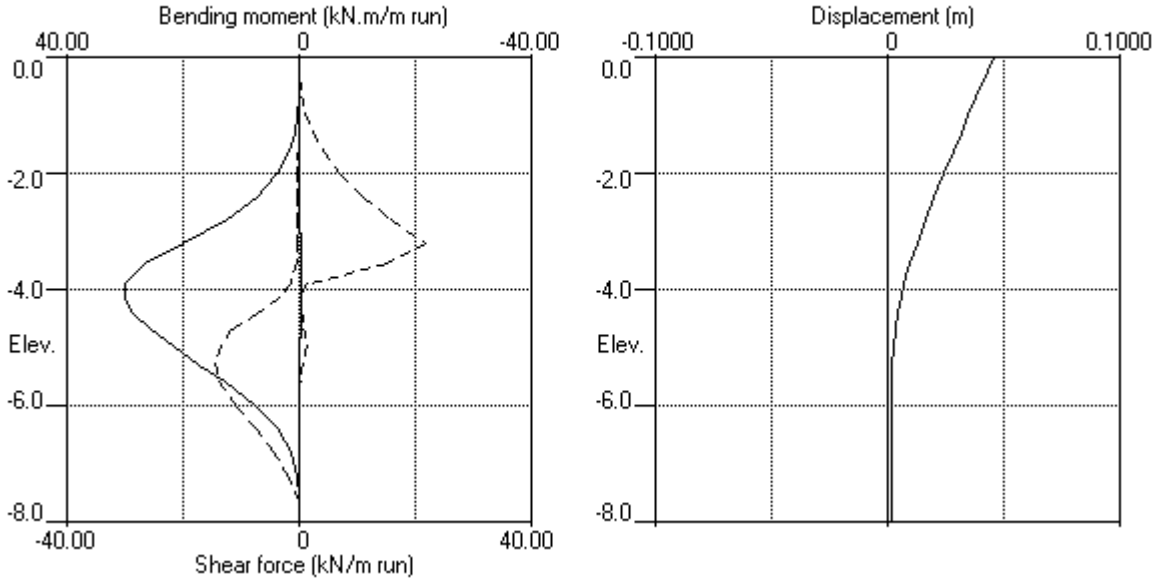
Stage no.	Displacement maximum (m)	elev.	minimum (m)	elev.	Stage description
1	0.000	0.00	0.000	0.00	Change EI of wall to 7427.0kN.m2/m run
2	0.003	0.00	0.000	0.00	Excav. to elev. -1.00 on RIGHT side
3	0.031	0.00	0.000	0.00	Excav. to elev. -1.00 on RIGHT side
4	0.045	0.00	0.000	0.00	Apply surcharge no.2 at elev. 0.00

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 102 of 127 - 11/04/2022 - NZBTC

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 103 of 127 - 11/04/2022 - NZBTC

```
HAIGH WORKMAN LTD                                          | Sheet No.
Program: WALLAP  Version 6.06  Revision A52.B71.R56        | Job No.  19 123
                              Licensed from GEOSOLVE       | Made by :    WT
Data filename/Run ID: WALLAPBASEMENT                       |
Peter Morgan                                               | Date:21-10-2019
RW02A                                                      | Checked :
-------------------------------------------------------------------------------
                                                      Units: kN,m
```

Bending moment, shear force, displacement envelopes



FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 104 of 127 - 11/04/2022 - NZBTC

Project	Old Hospital Road - RW02
Client	Peter Morgan
Job No	19 123
Date	23/10/2019
Calculated by:	W. Thorburn
Reviewed by:	J. Papesch
Comments	Lagging Desing

Factored load on the plank at the base of the wall = 13.25 kPa

From Wallap	
1.8	Height (m)
8.8	kPa
1.5	Load factor
2	Rails Required

Structural Design of Lagging to NZS 3603:1993

Timber Lagging: Structural actions

Lagging width b =	50	50		Height (m)
Lagging depth d =	150	150		kPa
For a maximum soil pressure of 13.245 kPa. The UDL on lagging "d" =	1.99	kN/m		Load factor
Lagging Span "L" =	1.2	m		Rails Required
Maximum factored moment M* = 1/8 dL^2	**0.358**	**kNm**		

Under Flexure, calculate the minimum lagging depth for moment capacity

Bending Stress, f_b =	11.7	MPa
Shear Stress, f_s =	2.4	MPa
No of parallel support elements, n =	2	
Strength Reduction Factor, ϕ =	0.8	
Duration Factor, k_1 =	0.6	
Parallel Support Factor , k_4 =	1.00	
Grid System Factor, k_5 =	1.00	
Section modulus of lagging, Z = bd^2/6 =	125000	mm^3
$\phi M_n = \phi k_1 k_4 k_5 f_b Z$ =	**0.702**	**kNm**
Percentage of lagging moment capacity utilised	51%	

Lagging OK for Moment Capacity!

Check for Shear Capacity

For 150 x 50 lagging. Shear surface area =	5000.0	mm^2	
$\phi V_n = \phi k_1 k_4 k_5 f_s A_s$ =	**5.760**	**kN**	
Compare with V* =	**1.490**	**kN**	$V^* = 0.625wL$
Percentage of Shear capacity utilised	26%		

Lagging OK for Shear Capacity!

LAGGING

0-1.65m **Use 150 x (1)50 lagging, spanning continuously across a minimum of 2 pole spacings**

1.65-1.8m **Use 150 x (2)50 lagging, spanning continuously across a minimum of 2 pole spacings**

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 105 of 127 - 11/04/2022 - NZBTC

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types: Left side	Soil types: Right side
1	0.00	1 Stiff Soils	1 Stiff Soils
2	-1.50	2 Very stiff soils	2 Very stiff soils
3	-4.00	3 Hard	3 Hard

SOIL PROPERTIES

-- Soil type -- No.	Description (Datum elev.)	Bulk density kN/m3	Young's Modulus Eh,kN/m2 (dEh/dy)	At rest coeff. Ko (dKo/dy)	Consol state. NC/OC (Nu)	Active limit Ka (Kac)	Passive limit Kp (Kpc)	Cohesion kN/m2 (dc/dy)
1	Stiff Soils	18.00	20000	0.530	OC (0.350)	0.311 (1.296)	3.485 (4.674)	3.000d
2	Very stiff soils	18.00	30000	0.470	OC (0.350)	0.262 (1.182)	4.331 (5.331)	7.000d
3	Hard	19.00	50000	0.470	OC (0.350)	0.262 (1.182)	4.331 (5.331)	10.00d
4	Fill	18.00	10000	0.500	NC (0.350)	0.285 (1.238)	3.878 (4.985)	0.0d

Additional soil parameters associated with Ka and Kp

------- Soil type ------- No.	Description	--- parameters for Ka --- Soil friction angle	Wall adhesion coeff.	Back-fill angle	--- parameters for Kp --- Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	Stiff Soils	28.00	0.636	0.00	28.00	0.306	0.00
2	Very stiff soils	32.00	0.625	0.00	32.00	0.298	0.00
3	Hard	32.00	0.625	0.00	32.00	0.298	0.00
4	Fill	30.00	0.631	0.00	30.00	0.302	0.00

GROUND WATER CONDITIONS

Density of water = 9.810 kN/m3

	Left side	Right side
Initial water table elevation	-10.00	-10.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Soldier Pile Wall
Soldier Pile width = 0.60 m
Soldier Pile spacing = 1.20 m
Passive mobilisation factor = 3.00
Elevation of toe of wall = -5.00
Maximum finite element length = 0.30 m
Youngs modulus of wall E = 1.2100E+07 kN/m2
Moment of inertia of wall I = 6.5450E-05 m4/m run
= 7.8540E-05 m4 per pile
E.I = 791.95 kN.m2/m run
Yield Moment of wall = Not defined

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 106 of 127 - 11/04/2022 - NZBTC

SURCHARGE LOADS

Surch -arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge ----- kN/m2 ----- Near edge	Far edge	Equiv. soil type	Partial factor/ Category
1	0.00	0.00(L)	14.00	9.00	10.00	=	N/A	N/A
2	0.00	0.00(L)	14.00	10.00	5.00	=	N/A	N/A
3	-1.70	-4.00(R)	14.00	20.00	0.00	-191.00	N/A	N/A

Note: L = Left side, R = Right side
A trapezoidal surcharge is defined by two values:
N = at edge near to wall, F = at edge far from wall

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Change EI of wall to 791.95 kN.m2/m run Yield moment not defined No adjustments to wall displacements
2	Excavate to elevation -2.30 on RIGHT side
3	Apply surcharge no.2 at elevation 0.00

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.50

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - Subgrade reaction model using Influence Coefficients
Open Tension Crack analysis? - No
Non-linear Modulus Parameter (L) = 0 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on Left side of wall = 50.00 m
Width of excavation on Right side of wall = 50.00 m

Distance to rigid boundary on Left side = 50.00 m
Distance to rigid boundary on Right side = 50.00 m

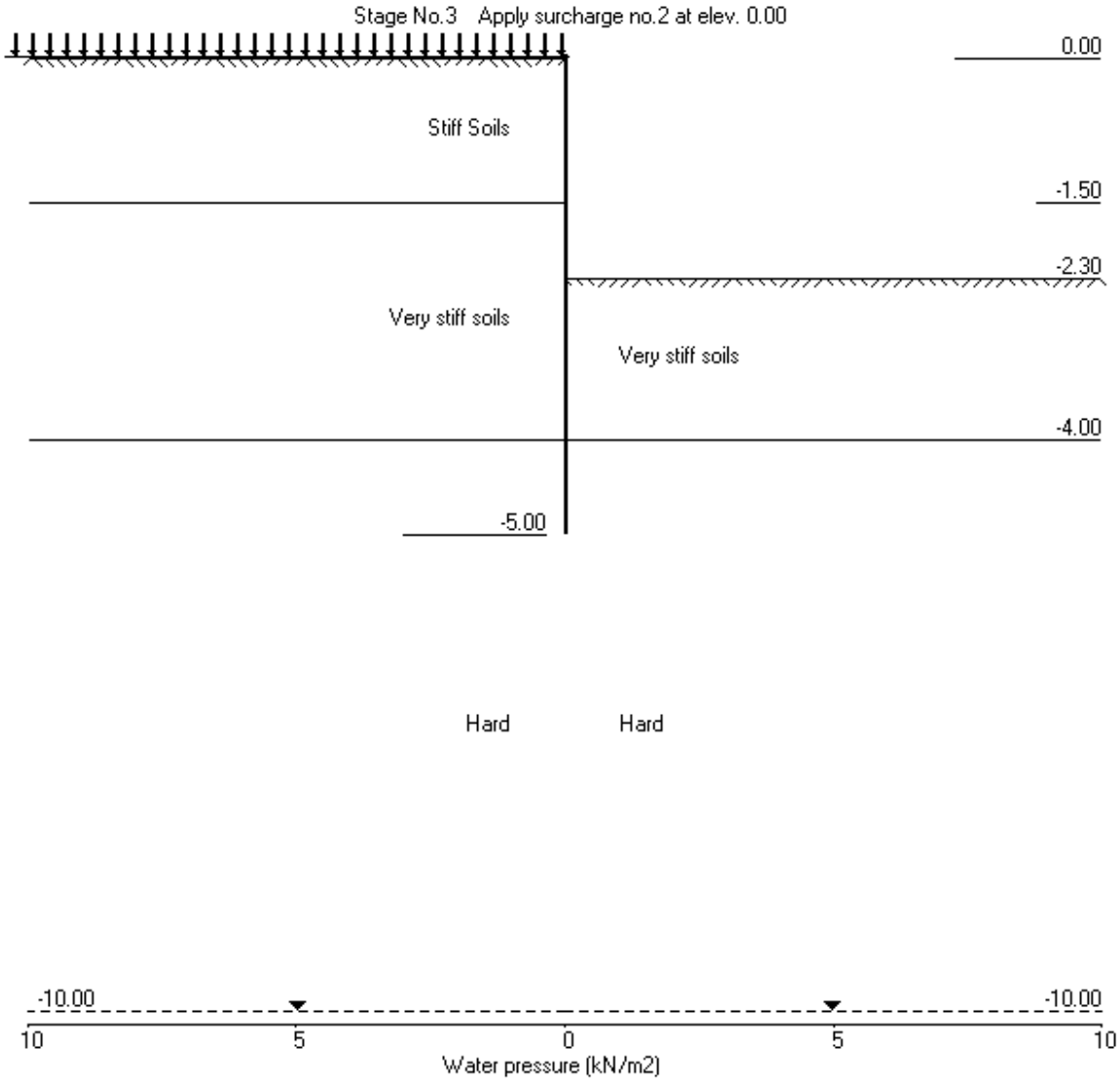
OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Change EI of wall to 791.95kN.m2/m run	No	No	No
2	Excav. to elev. -2.30 on RIGHT side	Yes	Yes	Yes
3	Apply surcharge no.2 at elev. 0.00	No	No	No
*	Summary output	Yes	-	Yes

Program WALLAP - Copyright (C) 2019 by DL Borin, distributed by GEOSOLVE
150 St. Alphonsus Road, London SW4 7BW, UK www.geosolve.co.uk

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 107 of 127 - 11/04/2022 - NZBTC

```
HAIGH WORKMAN LTD                                          | Sheet No.
Program: WALLAP  Version 6.06  Revision A52.B71.R56        | Job No.  19 123
                              Licensed from GEOSOLVE       | Made by :    WT
Data filename/Run ID: WALLAPSTUDIOB                        |
Peter Morgan                                               | Date:23-10-2019
RW03_B                                                     | Checked :
-----------------------------------------------------------------------------
                                                   Units: kN,m
```



FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 108 of 127 - 11/04/2022 - NZBTC

Units: kN,m

Stage No. 3 Apply surcharge no.2 at elevation 0.00

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = -5.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation	Direction of failure
3	0.00	-2.30	Cant.	1.871	-4.67	-4.08	1.78	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.60m; spacing = 1.20m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Left side 50.00 from wall
Right side 50.00 from wall

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
1	0.00	0.00	0.018	7.36E-03	0.0	-0.0	
2	-0.30	0.00	0.016	7.36E-03	0.0	-0.0	
3	-0.60	1.02	0.013	7.36E-03	0.2	0.0	
4	-0.90	2.70	0.011	7.33E-03	0.7	0.1	
5	-1.20	4.37	0.009	7.21E-03	1.8	0.5	
6	-1.50	6.05	0.007	6.88E-03	3.3	1.2	
		0.09	0.007	6.88E-03	3.3	1.2	
7	-1.80	1.50	0.005	6.22E-03	3.6	2.3	
8	-2.05	2.67	0.003	5.35E-03	4.1	3.2	
9	-2.30	3.84	0.002	4.13E-03	4.9	4.5	
		-33.48	0.002	4.13E-03	4.9	4.5	
10	-2.50	-28.77	0.002	2.94E-03	-1.3	4.9	
11	-2.70	-8.75	0.001	1.81E-03	-5.1	4.1	
12	-3.00	4.72	0.001	6.27E-04	-5.7	2.2	
13	-3.30	7.77	0.001	9.00E-05	-3.8	0.7	
14	-3.60	7.04	0.001	-1.53E-05	-1.6	-0.1	
15	-3.80	7.14	0.001	3.67E-05	-0.2	-0.3	
16	-4.00	7.56	0.001	9.73E-05	1.3	-0.2	
		-3.92	0.001	9.73E-05	1.3	-0.2	
17	-4.25	-2.55	0.001	1.23E-04	0.5	0.0	
18	-4.50	-1.18	0.001	1.11E-04	0.0	0.1	
19	-4.75	-0.03	0.001	9.62E-05	-0.1	0.0	
20	-5.00	1.01	0.001	9.12E-05	0.0	-0.0	

(continued)

Stage No.3 Apply surcharge no.2 at elevation 0.00

LEFT side

Node no.	Y coord	Water press.	Vertic -al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	0.00	0.00	5.00	0.00	31.45	0.00	0.00a	7453
2	-0.30	0.00	10.40	0.00	50.27	0.00	0.00a	7453
3	-0.60	0.00	15.80	1.02	69.09	1.02	1.02a	7453
4	-0.90	0.00	21.19	2.70	87.89	2.70	2.70a	7453
5	-1.20	0.00	26.59	4.37	106.69	4.37	4.37a	7453
6	-1.50	0.00	31.98	6.05	125.47	6.05	6.05a	7453
		0.00	31.98	0.09	175.81	0.09	0.09a	11180
7	-1.80	0.00	37.36	1.50	199.12	1.50	1.50a	11180
8	-2.05	0.00	41.84	2.67	218.53	2.67	2.67a	11180
9	-2.30	0.00	46.32	3.84	237.93	3.84	3.84a	11180
10	-2.50	0.00	49.90	4.78	253.43	7.45	7.45	11180
11	-2.70	0.00	53.47	5.71	268.92	14.16	14.16	11180
12	-3.00	0.00	58.83	7.11	292.13	20.51	20.51	27843
13	-3.30	0.00	64.18	8.51	315.31	24.31	24.31	27843
14	-3.60	0.00	69.53	9.91	338.46	26.35	26.35	14667
15	-3.80	0.00	73.09	10.84	353.89	28.00	28.00	11794
16	-4.00	0.00	76.65	11.77	369.30	29.78	29.78	11794
		0.00	76.65	8.23	385.29	25.41	25.41	19657
17	-4.25	0.00	81.35	9.45	405.63	28.06	28.06	19657
18	-4.50	0.00	86.04	10.68	425.95	30.74	30.74	19657
19	-4.75	0.00	90.73	11.91	446.25	33.37	33.37	19657
20	-5.00	0.00	95.41	13.13	466.55	35.95	35.95	19657

RIGHT side

Node no.	Y coord	Water press.	Vertic -al	Active limit	Passive limit	Earth pressure	Total earth pressure	Coeff. of subgrade reaction
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	-0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	-0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	-0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	-1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	-1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	-1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	-2.05	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	-2.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	37.32	37.32	37.32p	43516
10	-2.50	0.00	3.60	0.00	52.91	36.23	36.23	43516
11	-2.70	0.00	7.20	0.00	68.50	22.91	22.91	43516
12	-3.00	0.00	12.60	0.00	91.89	15.80	15.80	27843
13	-3.30	0.00	18.00	0.00	115.28	16.54	16.54	27843
14	-3.60	0.00	23.40	0.00	138.67	19.32	19.32	14667
15	-3.80	0.00	27.00	0.00	154.26	20.86	20.86	11794
16	-4.00	0.00	30.60	0.00	169.85	22.22	22.22	11794
		0.00	30.60	0.00	185.85	29.33	29.33	19657
17	-4.25	0.00	35.35	0.00	206.42	30.61	30.61	19657
18	-4.50	0.00	40.10	0.00	226.99	31.93	31.93	19657
19	-4.75	0.00	44.85	0.00	247.57	33.39	33.39	19657
20	-5.00	0.00	49.60	1.15	268.15	34.94	34.94	19657

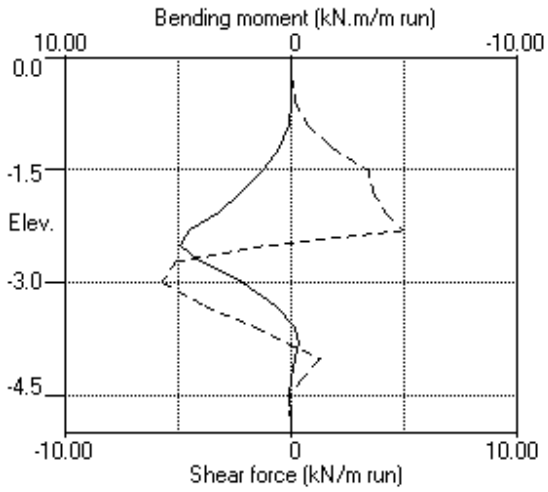
Note: 3.84a Soil pressure at active limit
37.32p Soil pressure at passive limit

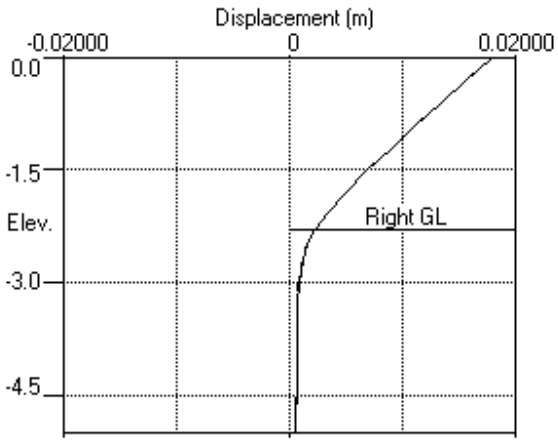
FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 109 of 127 - 11/04/2022 - NZBTC

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 110 of 127 - 11/04/2022 - NZBTC

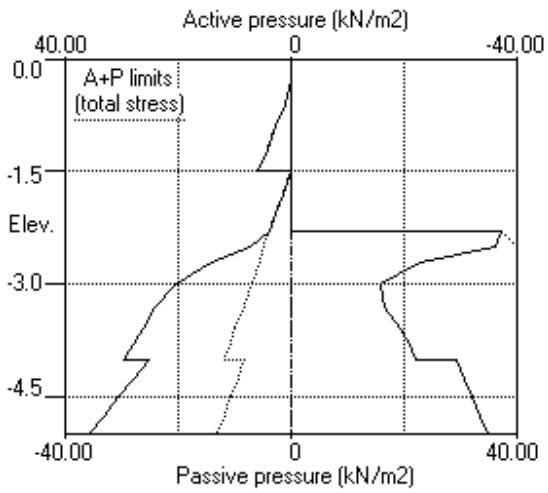
```
HAIGH WORKMAN LTD                                          | Sheet No.
Program: WALLAP  Version 6.06  Revision A52.B71.R56        | Job No.  19 123
                              Licensed from GEOSOLVE       | Made by :    WT
Data filename/Run ID: WALLAPSTUDIOB                        |
Peter Morgan                                               | Date:23-10-2019
RW03_B                                                     | Checked :
-----------------------------------------------------------------------------
                                                     Units: kN,m
```

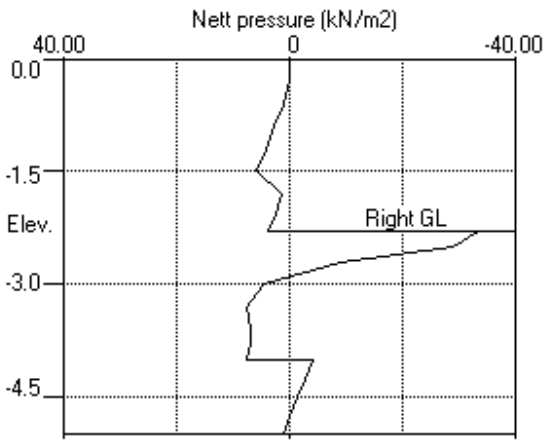
Stage No.3 Apply surcharge no.2 at elev. 0.00





Stage No.3 Apply surcharge no.2 at elev. 0.00





Units: kN,m

Summary of results

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = -5.00 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation	Direction of failure
1	0.00	0.00	Cant.	Conditions not suitable for FoS calc.				
2	0.00	-2.30	Cant.	2.074	-4.68	-3.72	1.42	L to R
3	0.00	-2.30	Cant.	1.871	-4.67	-4.08	1.78	L to R

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 111 of 127 - 11/04/2022 - NZBTC

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 112 of 127 - 11/04/2022 - NZBTC

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.60m; spacing = 1.20m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 20.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Left side 50.00 from wall
Right side 50.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement maximum	Displacement minimum	Bending moment maximum	Bending moment minimum	Shear force maximum	Shear force minimum
		m	m	kN.m/m	kN.m/m	kN/m	kN/m
1	0.00	0.018	0.000	0.0	-0.0	0.0	0.0
2	-0.30	0.016	0.000	0.0	-0.0	0.0	0.0
3	-0.60	0.013	0.000	0.0	0.0	0.2	0.0
4	-0.90	0.011	0.000	0.1	0.0	0.7	0.0
5	-1.20	0.009	0.000	0.5	0.0	1.8	0.0
6	-1.50	0.007	0.000	1.2	0.0	3.3	0.0
7	-1.80	0.005	0.000	2.3	0.0	3.6	0.0
8	-2.05	0.003	0.000	3.2	0.0	4.1	0.0
9	-2.30	0.002	0.000	4.5	0.0	4.9	0.0
10	-2.50	0.002	0.000	4.9	0.0	0.0	-1.3
11	-2.70	0.001	0.000	4.1	0.0	0.0	-5.1
12	-3.00	0.001	0.000	2.2	0.0	0.0	-5.7
13	-3.30	0.001	0.000	0.7	0.0	0.0	-3.8
14	-3.60	0.001	0.000	0.0	-0.1	0.0	-1.6
15	-3.80	0.001	0.000	0.0	-0.3	0.2	-0.2
16	-4.00	0.001	0.000	0.0	-0.2	1.3	0.0
17	-4.25	0.001	0.000	0.1	0.0	0.5	0.0
18	-4.50	0.001	0.000	0.1	0.0	0.0	-0.1
19	-4.75	0.001	0.000	0.0	0.0	0.0	-0.2
20	-5.00	0.001	0.000	0.0	-0.0	0.0	0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum	elev.	Bending moment minimum	elev.	Shear force maximum	elev.	Shear force minimum	elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
2	2.4	-2.50	-0.2	-3.80	2.7	-2.30	-2.8	-3.00
3	4.9	-2.50	-0.3	-3.80	4.9	-2.30	-5.7	-3.00

Maximum and minimum displacement at each stage

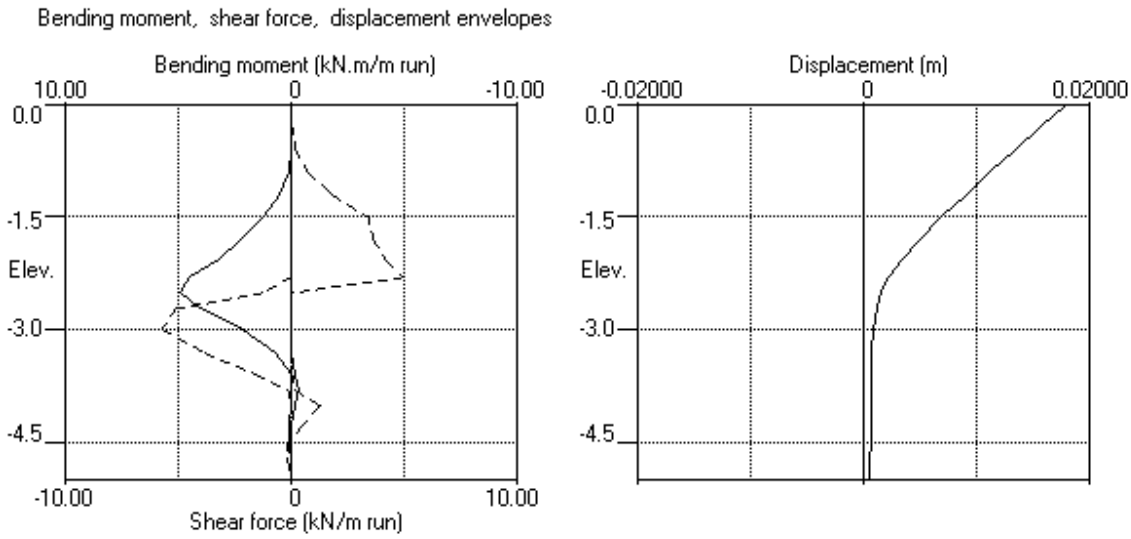
Stage no.	Displacement maximum	elev.	Displacement minimum	elev.	Stage description
	m		m		
1	0.000	0.00	0.000	0.00	Change EI of wall to 791.95kN.m2/m run
2	0.009	0.00	0.000	0.00	Excav. to elev. -2.30 on RIGHT side
3	0.018	0.00	0.000	0.00	Apply surcharge no.2 at elev. 0.00

Summary of results (continued)

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 113 of 127 - 11/04/2022 - NZBTC

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 114 of 127 - 11/04/2022 - NZBTC

```
HAIGH WORKMAN LTD                                          | Sheet No.
Program: WALLAP  Version 6.06  Revision A52.B71.R56        | Job No.  19 123
                              Licensed from GEOSOLVE       | Made by :    WT
Data filename/Run ID: WALLAPSTUDIOB                        |
Peter Morgan                                               | Date:23-10-2019
RW03_B                                                     | Checked :
-------------------------------------------------------------------------------
                                                       Units: kN,m
```



FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 115 of 127 - 11/04/2022 - NZBTC

Project	Old Hospital Road - RW03
Client	Peter Morgan
Job No	19 123
Date	23/10/2019
Calculated by:	W. Thorburn
Reviewed by:	J. Papesch
Comments	Lagging Desing

Factored load on the plank at the base of the wall = 23.33 kPa

From Wallap	
2.3	Height (m)
15.6	kPa
1.5	Load factor
2	Rails Required

Structural Design of Lagging to NZS 3603:1993

Timber Lagging: Structural actions

Lagging width b =	50	50		Height (m)
Lagging depth d =	150	150		kPa
For a maximum soil pressure of 23.328 kPa. The UDL on lagging "d" =	3.50	kN/m		Load factor
Lagging Span "L" =	1.2	m		Rails Required
Maximum factored moment M* = 1/8 dL^2	**0.630**	**kNm**		

Under Flexure, calculate the minimum lagging depth for moment capacity

Bending Stress, f_b =	11.7	MPa
Shear Stress, f_s =	2.4	MPa
No of parallel support elements, n =	2	
Strength Reduction Factor, ϕ =	0.8	
Duration Factor, k_1 =	0.6	
Parallel Support Factor , k_4 =	1.00	
Grid System Factor, k_5 =	1.00	
Section modulus of lagging, Z = bd^2/6 =	125000	mm^3
$\phi M_n = \phi k_1 k_4 k_5 f_b Z$ =	**0.702**	**kNm**
Percentage of lagging moment capacity utilised	90%	

Lagging OK for Moment Capacity!

Check for Shear Capacity

For 150 x 50 lagging. Shear surface area =	5000.0	mm^2
$\phi V_n = \phi k_1 k_4 k_5 f_s A_s$ =	**5.760**	**kN**
Compare with V* =	**2.624**	**kN**
Percentage of Shear capacity utilised	46%	

$$V^* = 0.625wL$$

Lagging OK for Shear Capacity!

LAGGING

0-1.65m **Use 150 x (1)50 lagging, spanning continuously across a minimum of 2 pole spacings**

1.65-2.3m **Use 150 x (2)50 lagging, spanning continuously across a minimum of 2 pole spacings**

Appendix F – Concept Drawings

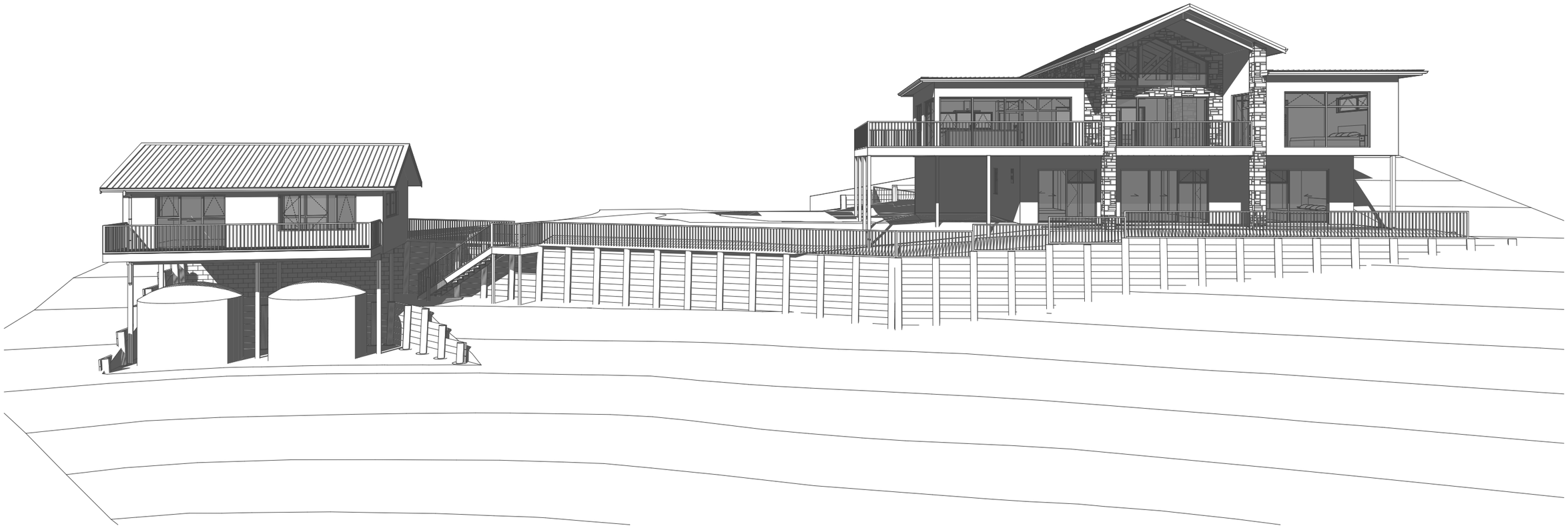
FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 116 of 127 - 11/04/2022 - NZBTC

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 117 of 127 - 11/04/2022 - NZBTC

PROPOSED DWELLING FOR

P & J MORGAN

36 OLD HOSPITAL ROAD
WHANGAROA 0478



RC-01 - 27/09/2019

DAWSON DESIGN

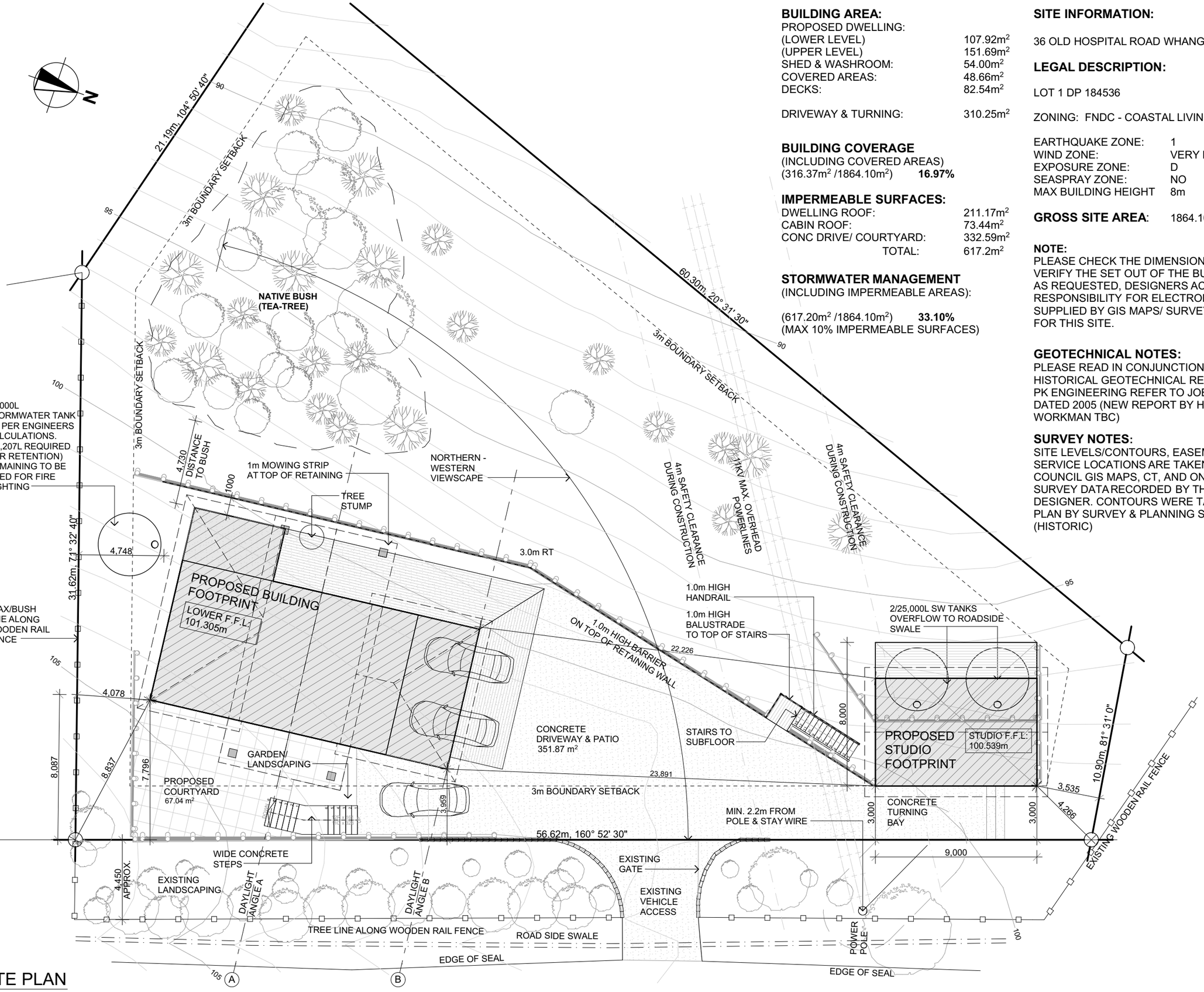
plans for living

PO Box 1140, Whangarei, Northland
p: 09 432 9188 m: 027 695 7808 e: info@dawsondesign.co.nz w: **dawsondesign.co.nz**

ADNZ Architectural Designers New Zealand

LICENSED BUILDING PRACTITIONER www.dbh.govt.nz BUILDING CONFIDENCE

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 118 of 127 - 11/04/2022 - NZBTC



SITE PLAN

Scale 1:200

BUILDING AREA:

PROPOSED DWELLING:	
(LOWER LEVEL)	107.92m²
(UPPER LEVEL)	151.69m²
SHED & WASHROOM:	54.00m²
COVERED AREAS:	48.66m²
DECKS:	82.54m²
DRIVEWAY & TURNING:	310.25m²

BUILDING COVERAGE
(INCLUDING COVERED AREAS)
(316.37m² /1864.10m²) **16.97%**

IMPERMEABLE SURFACES:

DWELLING ROOF:	211.17m²
CABIN ROOF:	73.44m²
CONC DRIVE/ COURTYARD:	332.59m²
TOTAL:	617.2m²

STORMWATER MANAGEMENT
(INCLUDING IMPERMEABLE AREAS):

(617.20m² /1864.10m²) **33.10%**
(MAX 10% IMPERMEABLE SURFACES)

SITE INFORMATION:

36 OLD HOSPITAL ROAD WHANGAROA 0478

LEGAL DESCRIPTION:

LOT 1 DP 184536

ZONING: FNDC - COASTAL LIVING

EARTHQUAKE ZONE:	1
WIND ZONE:	VERY HIGH
EXPOSURE ZONE:	D
SEASPRAY ZONE:	NO
MAX BUILDING HEIGHT	8m

GROSS SITE AREA: 1864.10m²

NOTE:
PLEASE CHECK THE DIMENSIONS TO VERIFY THE SET OUT OF THE BUILDING IS AS REQUESTED, DESIGNERS ACCEPT NO RESPONSIBILITY FOR ELECTRONIC DATA SUPPLIED BY GIS MAPS/ SURVEYOR PLAN FOR THIS SITE.

GEOTECHNICAL NOTES:
PLEASE READ IN CONJUNCTION WITH HISTORICAL GEOTECHNICAL REPORT BY PK ENGINEERING REFER TO JOB NO. 05-69 DATED 2005 (NEW REPORT BY HAIGH WORKMAN TBC)

SURVEY NOTES:
SITE LEVELS/CONTOURS, EASEMENTS AND SERVICE LOCATIONS ARE TAKEN FROM COUNCIL GIS MAPS, CT, AND ON SITE SURVEY DATA RECORDED BY THE DESIGNER. CONTOURS WERE TAKEN FROM PLAN BY SURVEY & PLANNING SOLUTIONS (HISTORIC)

DAWSON DESIGN plans for living

0800 406 161 (09) 432 9188
info@dawsondesign.co.nz

PO BOX 1140, WHANGAREI, 0140

www.dawsondesign.co.nz

NOTES

CONTRACTOR TO CHECK ALL DIMENSIONS & CONDITIONS ON SITE BEFORE COMMENCING WORK.

DO NOT SCALE.

WORK ONLY TO FIGURED DIMENSIONS. IN THE EVENT OF A DISCREPANCY CONTACT THE DESIGNER.

TITLE

SITE PLAN

ISSUE DATE	27/09/2019
JOB NO.	18086
DRAWN BY	DF
CHECKED BY	CD

PROJECT

PROPOSED NEW DWELLING FOR

JENNY ANN EMMANUEL

36 OLD HOSPITAL ROAD WHANGAROA 0478

REVISIONS

NO.	REVISION	DATE
1	SK-01	22.11.2018

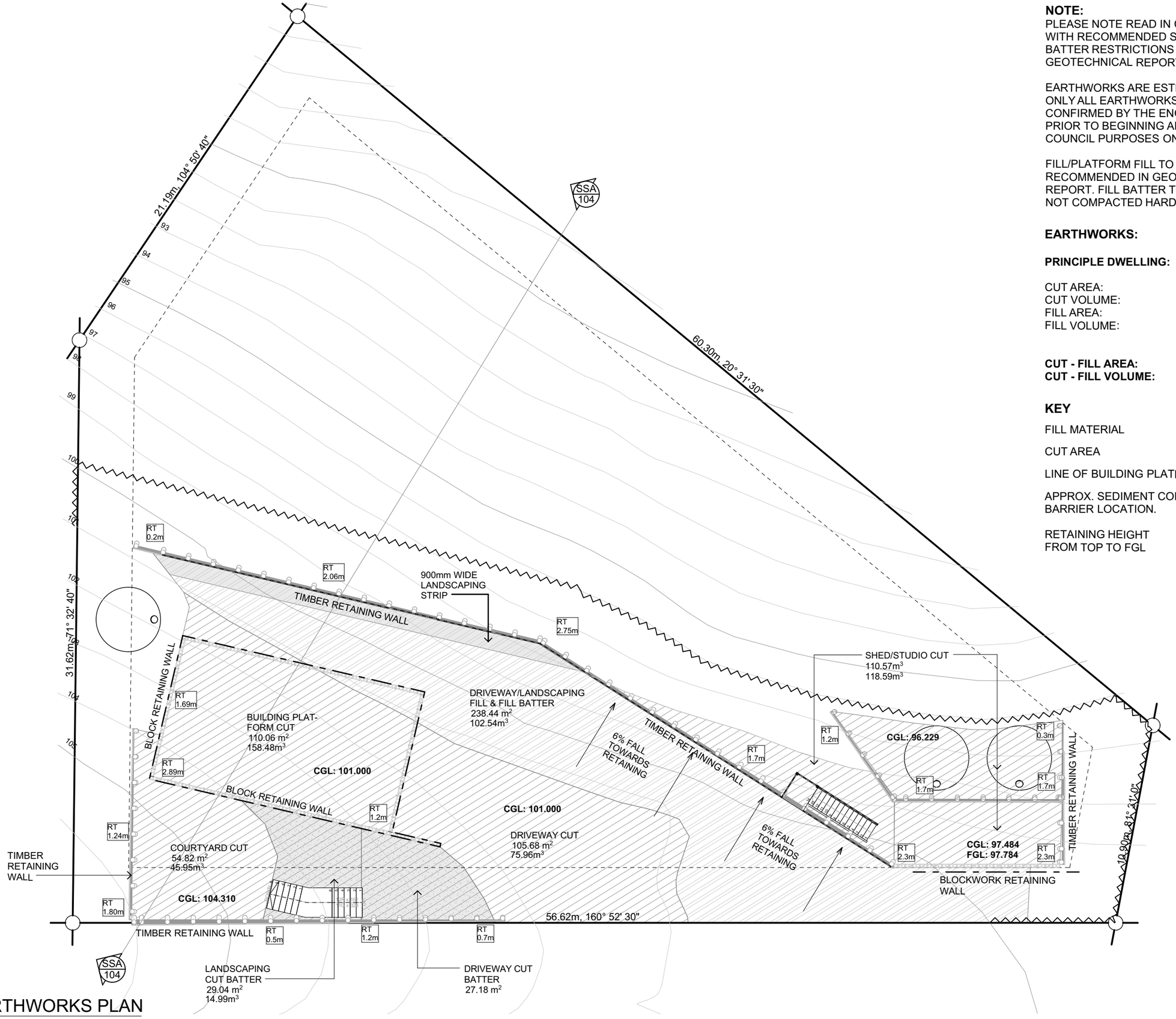
SCALE
1:200

DRAWING CODE	DRAWING ISSUE
102	RC-01

THIS DRAWING AND THE DESIGN IT COVERS SHALL REMAIN THE PROPERTY AND COPYRIGHT OF DAWSON DESIGN LIMITED.

PRELIMINARY ONLY - NOT FOR CONSTRUCTION

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 119 of 127 - 11/04/2022 - NZBTC



EARTHWORKS PLAN

Scale 1:200

NOTE:
PLEASE NOTE READ IN CONJUNCTION WITH RECOMMENDED SITE CUT/FILL AND BATTER RESTRICTIONS SET OUT BY THE GEOTECHNICAL REPORT.

EARTHWORKS ARE ESTIMATED/ INDICITIVE ONLY ALL EARTHWORKS ARE TO BE CONFIRMED BY THE ENGINEER AND CLIENT PRIOR TO BEGINNING ANY SITE WORK. FOR COUNCIL PURPOSES ONLY.

FILL/PLATFORM FILL TO BE AS PER RECOMMENDED IN GEOTECHNICAL REPORT. FILL BATTER TO BE TOPSOIL ONLY NOT COMPACTED HARDFILL.

EARTHWORKS:

PRINCIPLE DWELLING:

CUT AREA:	443.83m²
CUT VOLUME:	413.97m³
FILL AREA:	248.36m²
FILL VOLUME:	102.54m³
CUT - FILL AREA:	**-195.47m²**
CUT - FILL VOLUME:	**-311.43m³**

KEY

FILL MATERIAL

CUT AREA

LINE OF BUILDING PLATFORM

APPROX. SEDIMENT CONTROL BARRIER LOCATION.

RETAINING HEIGHT FROM TOP TO FGL — RT X.Xm

DAWSON DESIGN plans for living

0800 406 161 (09) 432 9188
info@dawsondesign.co.nz

PO BOX 1140, WHANGAREI, 0140

www.dawsondesign.co.nz

NOTES

CONTRACTOR TO CHECK ALL DIMENSIONS & CONDITIONS ON SITE BEFORE COMMENCING WORK.

DO NOT SCALE.

WORK ONLY TO FIGURED DIMENSIONS. IN THE EVENT OF A DISCREPANCY CONTACT THE DESIGNER.

TITLE

EARTHWORKS PLAN

ISSUE DATE	27/09/2019
JOB NO.	18086
DRAWN BY	DF
CHECKED BY	CD

PROJECT

PROPOSED NEW DWELLING FOR

JENNY ANN EMMANUEL

36 OLD HOSPITAL ROAD WHANGAROA 0478

REVISIONS

NO.	REVISION	DATE
1	SK-01	22.11.2018

SCALE 1:200

DRAWING CODE	DRAWING ISSUE
102	RC-01

THIS DRAWING AND THE DESIGN IT COVERS SHALL REMAIN THE PROPERTY AND COPYRIGHT OF DAWSON DESIGN LIMITED.

PRELIMINARY ONLY - NOT FOR CONSTRUCTION

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 120 of 127 - 11/04/2022 - NZBTC

SITE SECTION A

Scale 1:100

THIS DRAWING AND THE DESIGN IT COVERS SHALL REMAIN THE PROPERTY AND COPYRIGHT OF DAWSON DESIGN LIMITED.

PRELIMINARY ONLY - NOT FOR CONSTRUCTION

DAWSON DESIGN
plans for living

0800 406 161 (09) 432 9188
info@dawsondesign.co.nz

PO BOX 1140, WHANGAREI, 0140

www.dawsondesign.co.nz

NOTES

CONTRACTOR TO CHECK ALL DIMENSIONS & CONDITIONS ON SITE BEFORE COMMENCING WORK.

DO NOT SCALE.

WORK ONLY TO FIGURED DIMENSIONS. IN THE EVENT OF A DISCREPANCY CONTACT THE DESIGNER.

TITLE

SITE SECTION A

ISSUE DATE	27/09/2019
JOB NO.	18086
DRAWN BY	DF
CHECKED BY	CD

PROJECT

PROPOSED NEW DWELLING FOR

JENNY ANN EMMANUEL

36 OLD HOSPITAL ROAD WHANGAROA 0478

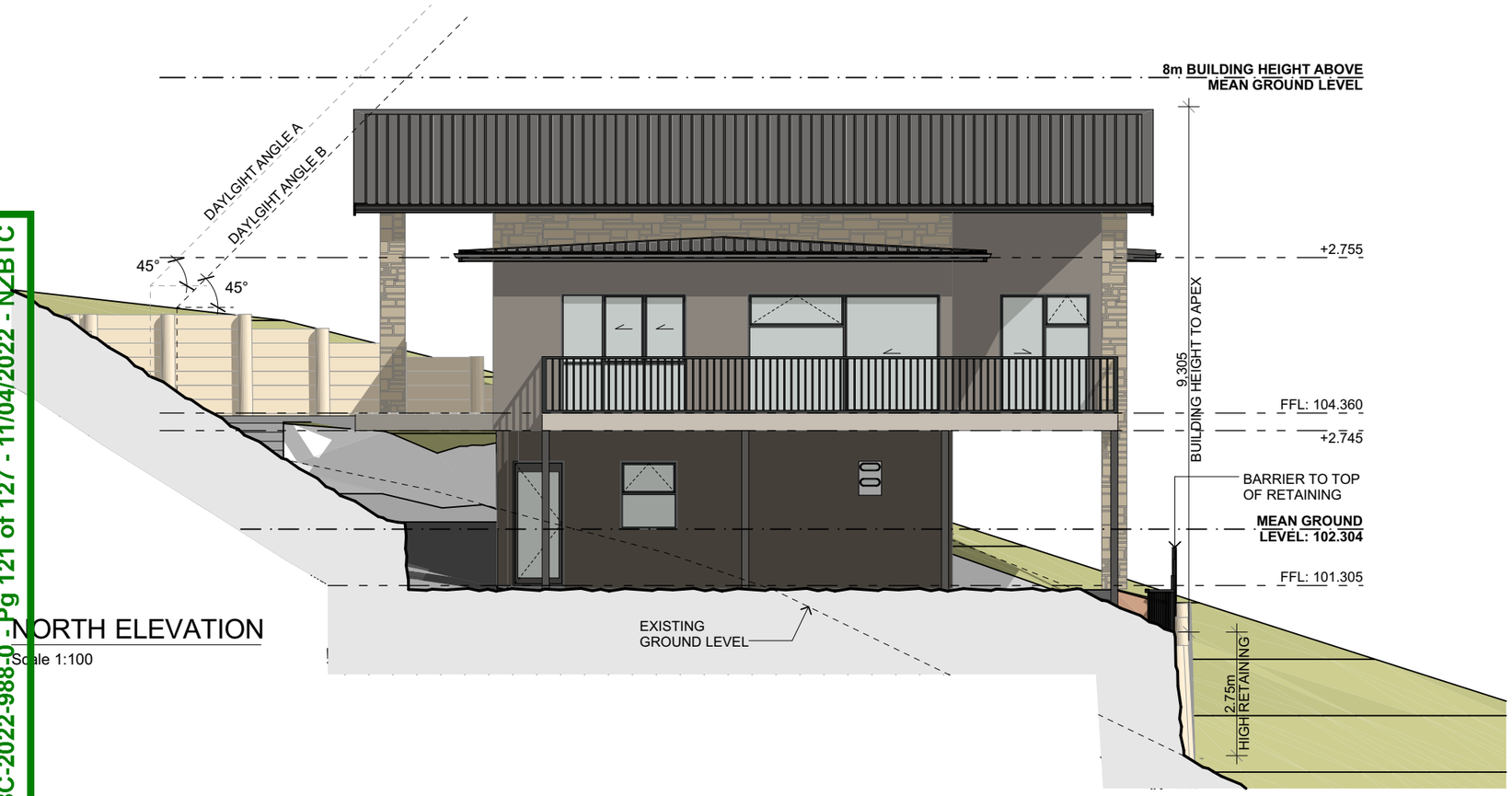
REVISIONS

NO.	REVISION	DATE
1	SK-01	22.11.2018

SCALE
1:100

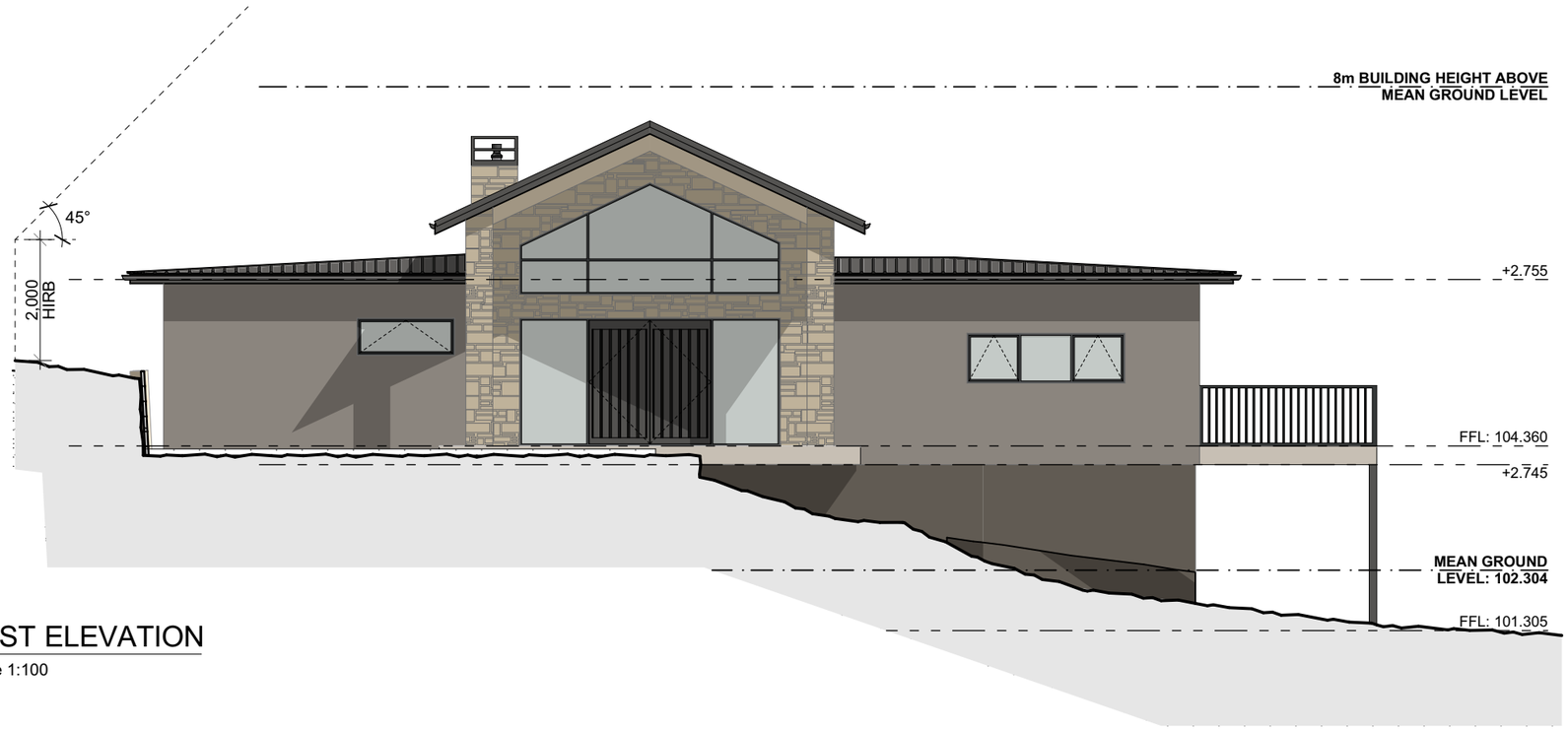
DRAWING CODE	DRAWING ISSUE
104	RC-01

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 121 of 127 - 11/04/2022 - NZBTC



NORTH ELEVATION

Scale 1:100



EAST ELEVATION

Scale 1:100

ELEVATION NOTES

1 ROOFING
0.4 BMT COLORSTEEL MAXX METALCRAFT T-RIB TRAPEZOIDAL PROFILED ROOFING WITH 0.5 BMT COLORSTEEL SOFT EDGE FLASHINGS TO MATCH INSTALL TO MANUFACTURERS SPECIFICATIONS.

2 FASCIA SPOUTING & DOWNPIPES
METALCRAFT 155 (OR SIM) COLORSTEEL MAXX FASCIA WITH MARLEY TYPHOON (OR SIM) GUTTER WITH 80Ø mm MARLEY UPVC DOWNPIPES INSTALL TO MANUFACTURERS RECOMMENDATIONS.

3 SOFFIT LINING
JAMES HARDIE 4.5mm HARDIEFLEX FIBRE CEMENT SOFFIT LINING INSTALL TO MANUFACTURERS RECOMMENDATIONS.

4 75mm AAC PANEL CLADDING SYSTEM (20mm CAVITY)
SELECTED HEBEL POWERPANEL+ 75mm AAC PANEL CLADDING SYSTEM OVER 20mm CAVITY ON SELECTED BULDING WRAP INSTALL TO MANUFACTURERS RECOMMENDATIONS. WITH PLASTERED FINISH.

5 20 SERIES BLOCK (PLASTERED)
SELECTED BLOCK WALLS WITH PLASTERED FINISH. INSTALL TO MANUFACTURERS RECOMMENDATIONS. WITH PLASTERED FINISH.

6 BAGGED SCHIST (20mm CAVITY)
SELECTED DESIGNER SCHIST OVER 20mm CAVITY ON SELECTED BULDING WRAP INSTALL TO MANUFACTURERS RECOMMENDATIONS. WITH BAGGED RENDER FINISH (T.B.C)

7 JOINERY
POWDER COATED ALUMINIUM JOINERY DOUBLE GLAZED WITH SILL SUPPORT BARS, POWDER COATED HEAD FLASHINGS TO MATCH SILL FLASHINGS. TO CAVITY FIXED CLADDINGS H3.1 TIMBER REVEALS. INSTALL TO MANUFACTURERS RECOMMENDATIONS.

BUILDING ENVELOPE RISK MATRIX		
NORTH & EAST ELEVATIONS		
Risk Factor	**Risk Severity**	**Risk Score**
Wind zone (per NZS 3604)	Very high risk	2
Number of storeys	High risk	2
Roof/wall intersection design	Very high risk	5
Eaves width	High risk	2
Envelope complexity	High risk	3
Deck design	High risk	4
Total Risk Score:		**18**

DAWSON DESIGN plans for living

0800 406 161 (09) 432 9188
info@dawsondesign.co.nz

PO BOX 1140, WHANGAREI, 0140

www.dawsondesign.co.nz

NOTES

CONTRACTOR TO CHECK ALL DIMENSIONS & CONDITIONS ON SITE BEFORE COMMENCING WORK.

DO NOT SCALE.

WORK ONLY TO FIGURED DIMENSIONS. IN THE EVENT OF A DISCREPANCY CONTACT THE DESIGNER.

TITLE

NORTH & EAST ELEVATIONS

ISSUE DATE	27/09/2019
JOB NO.	18086
DRAWN BY	DF
CHECKED BY	CD

PROJECT

PROPOSED NEW DWELLING FOR

JENNY ANN EMMANUEL

36 OLD HOSPITAL ROAD WHANGAROA 0478

REVISIONS

NO.	REVISION	DATE
1	SK-01	22.11.2018

SCALE 1:100

DRAWING CODE	DRAWING ISSUE
203	RC-01

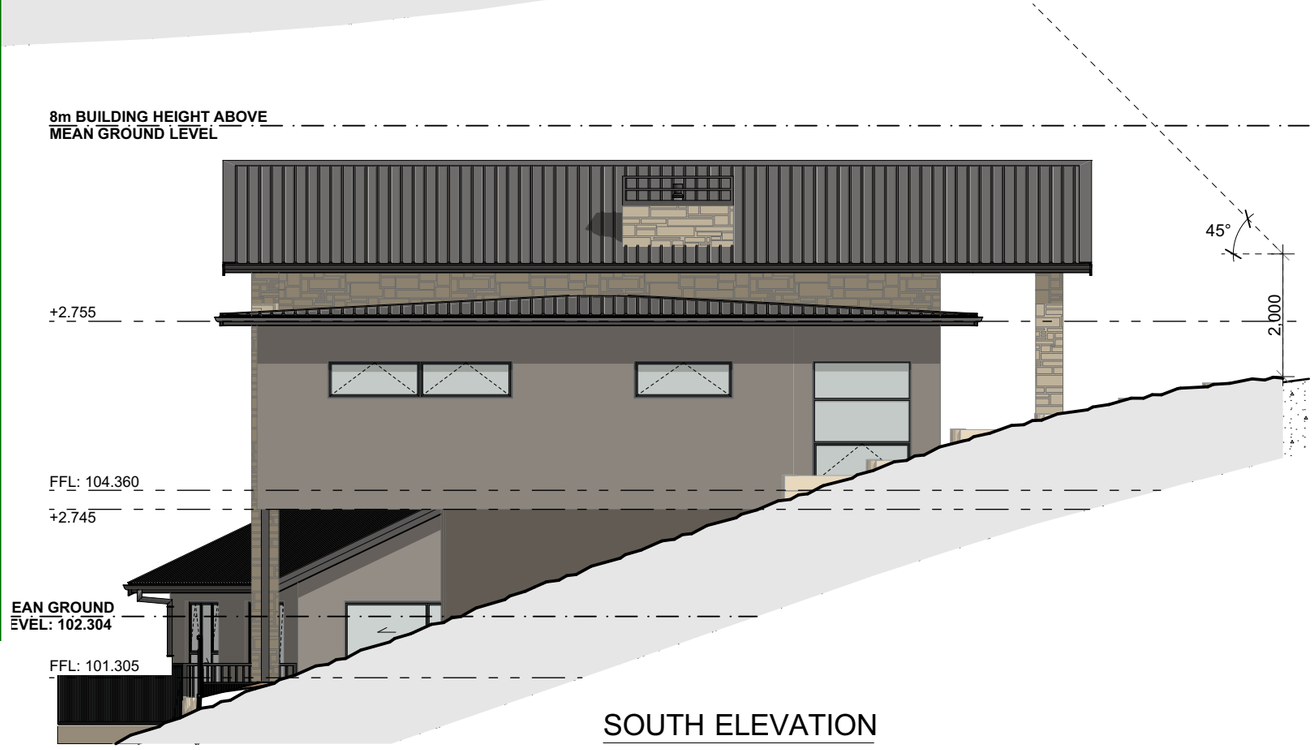
THIS DRAWING AND THE DESIGN IT COVERS SHALL REMAIN THE PROPERTY AND COPYRIGHT OF DAWSON DESIGN LIMITED.

PRELIMINARY ONLY - NOT FOR CONSTRUCTION

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 122 of 127 - 11/04/2022 - NZBTC

WEST ELEVATION

Scale 1:100



SOUTH ELEVATION

Scale 1:100

ELEVATION NOTES

1 ROOFING
0.4 BMT COLORSTEEL MAXX METALCRAFT T-RIB TRAPEZOIDAL PROFILED ROOFING WITH 0.5 BMT COLORSTEEL SOFT EDGE FLASHINGS TO MATCH INSTALL TO MANUFACTURERS SPECIFICATIONS.

2 FASCIA SPOUTING & DOWNPIPES
METALCRAFT 155 (OR SIM) COLORSTEEL MAXX FASCIA WITH MARLEY TYPHOON (OR SIM) GUTTER WITH 80Ømm MARLEY UPVC DOWNPIPES INSTALL TO MANUFACTURERS RECOMMENDATIONS.

3 SOFFIT LINING
JAMES HARDIE 4.5mm HARDIEFLEX FIBRE CEMENT SOFFIT LINING INSTALL TO MANUFACTURERS RECOMMENDATIONS.

4 75mm AAC PANEL CLADDING SYSTEM (20mm CAVITY)
SELECTED HEBEL POWERPANEL+ 75mm AAC PANEL CLADDING SYSTEM OVER 20mm CAVITY ON SELECTED BULDING WRAP INSTALL TO MANUFACTURERS RECOMMENDATIONS. WITH PLASTERED FINISH.

5 20 SERIES BLOCK (PLASTERED)
SELECTED BLOCK WALLS WITH PLASTERED FINISH. INSTALL TO MANUFACTURERS RECOMMENDATIONS. WITH PLASTERED FINISH.

6 BAGGED SCHIST (20mm CAVITY)
SELECTED DESIGNER SCHIST OVER 20mm CAVITY ON SELECTED BULDING WRAP INSTALL TO MANUFACTURERS RECOMMENDATIONS. WITH BAGGED RENDER FINISH (T.B.C)

7 JOINERY
POWDER COATED ALUMINIUM JOINERY DOUBLE GLAZED WITH SILL SUPPORT BARS, POWDER COATED HEAD FLASHINGS TO MATCH SILL FLASHINGS. TO CAVITY FIXED CLADDINGS H3.1 TIMBER REVEALS. INSTALL TO MANUFACTURERS RECOMMENDATIONS.

BUILDING ENVELOPE RISK MATRIX		
NORTH & EAST ELEVATIONS		
Risk Factor	**Risk Severity**	**Risk Score**
Wind zone (per NZS 3604)	Very high risk	2
Number of storeys	High risk	2
Roof/wall intersection design	Very high risk	5
Eaves width	High risk	2
Envelope complexity	High risk	3
Deck design	High risk	4
Total Risk Score:		**18**

DAWSON DESIGN plans for living

0800 406 161 (09) 432 9188
info@dawsondesign.co.nz

PO BOX 1140, WHANGAREI, 0140

www.dawsondesign.co.nz

NOTES

CONTRACTOR TO CHECK ALL DIMENSIONS & CONDITIONS ON SITE BEFORE COMMENCING WORK.

DO NOT SCALE.

WORK ONLY TO FIGURED DIMENSIONS. IN THE EVENT OF A DISCREPANCY CONTACT THE DESIGNER.

TITLE

SOUTH & WEST ELEVATIONS

ISSUE DATE	27/09/2019
JOB NO.	18086
DRAWN BY	DF
CHECKED BY	CD

PROJECT

PROPOSED NEW DWELLING FOR

JENNY ANN EMMANUEL

36 OLD HOSPITAL ROAD WHANGAROA 0478

REVISIONS

NO.	REVISION	DATE
1	SK-01	22.11.2018

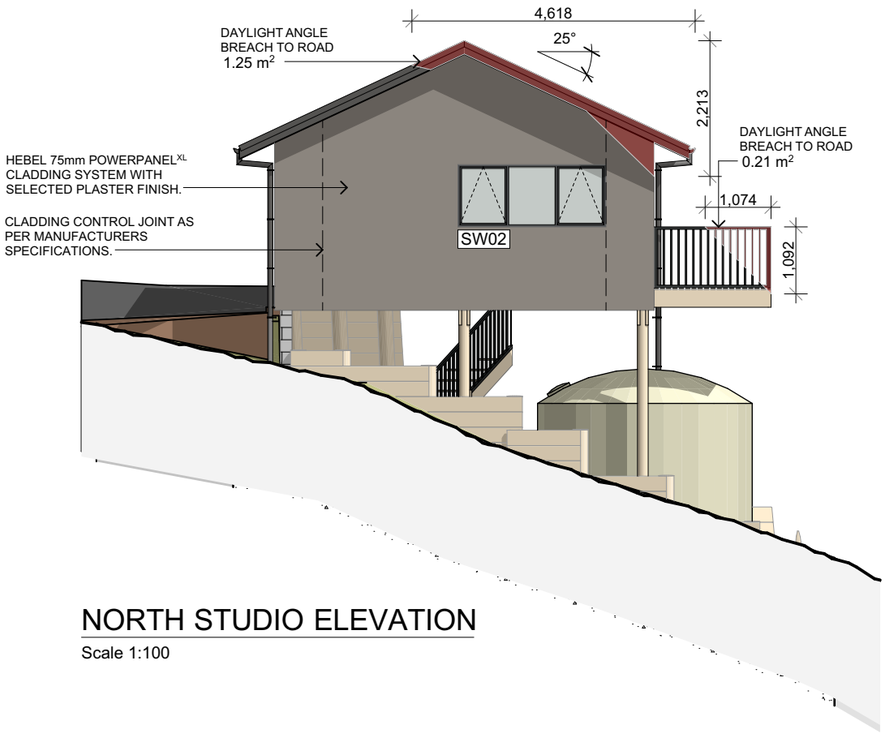
SCALE 1:100

DRAWING CODE	DRAWING ISSUE
204	RC-01

THIS DRAWING AND THE DESIGN IT COVERS SHALL REMAIN THE PROPERTY AND COPYRIGHT OF DAWSON DESIGN LIMITED.

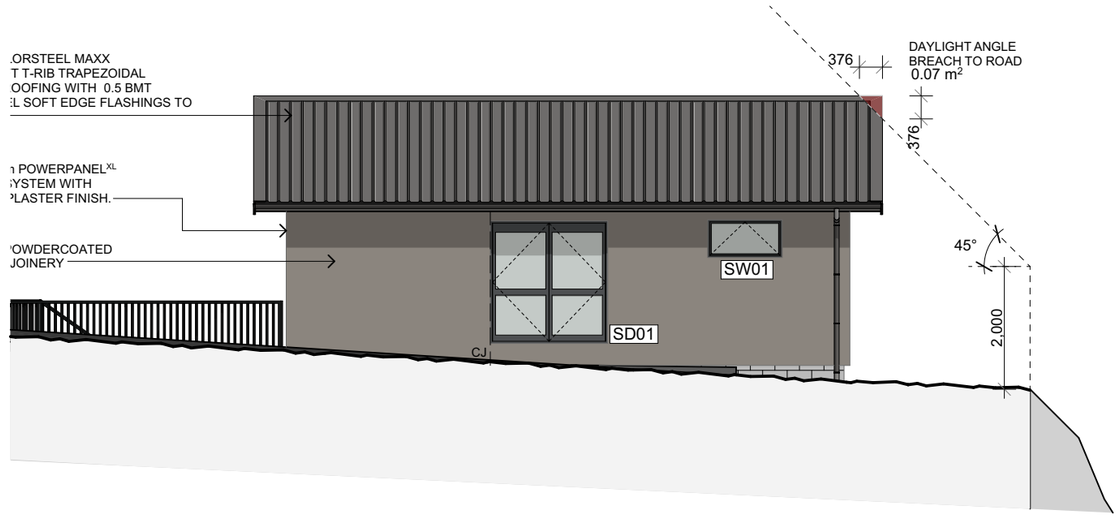
PRELIMINARY ONLY - NOT FOR CONSTRUCTION

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 123 of 127 - 11/04/2022 - NZBTC



NORTH STUDIO ELEVATION

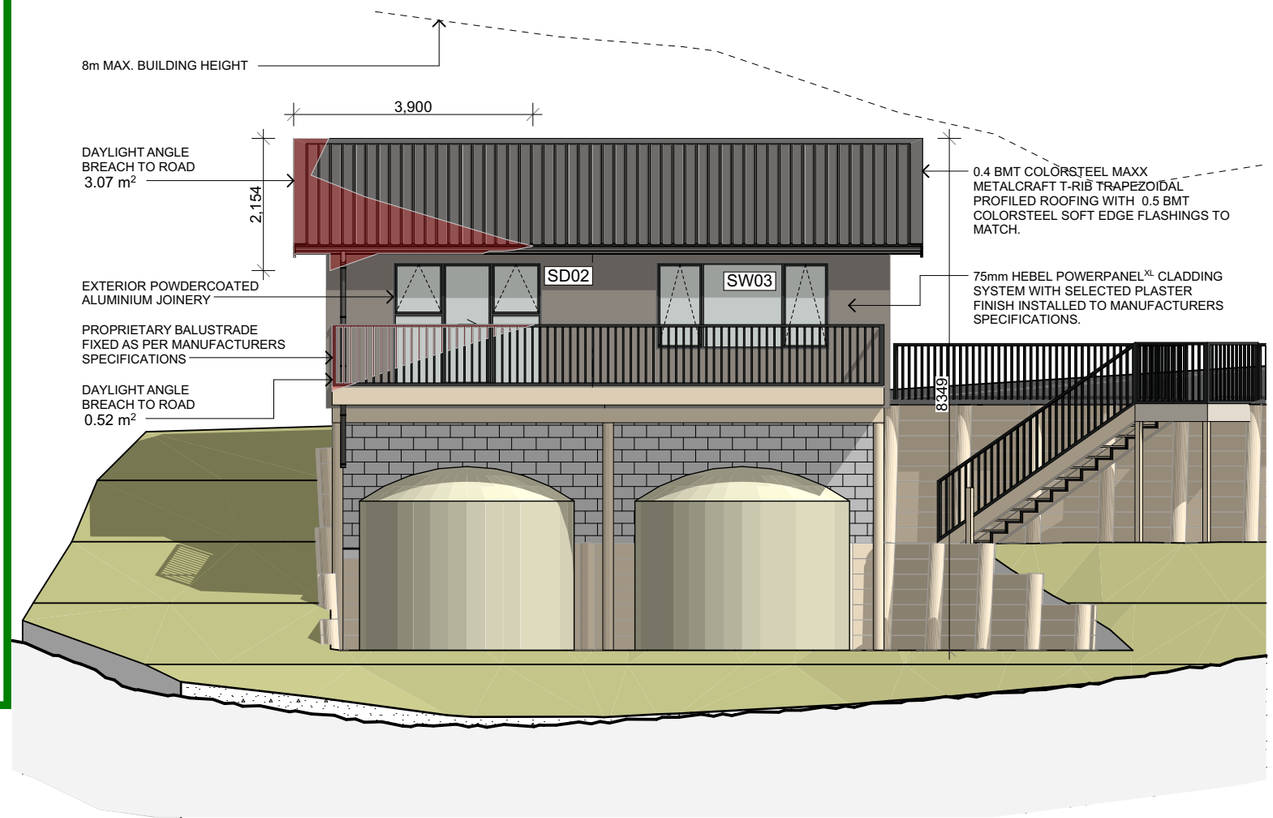
Scale 1:100



EAST STUDIO ELEVATION

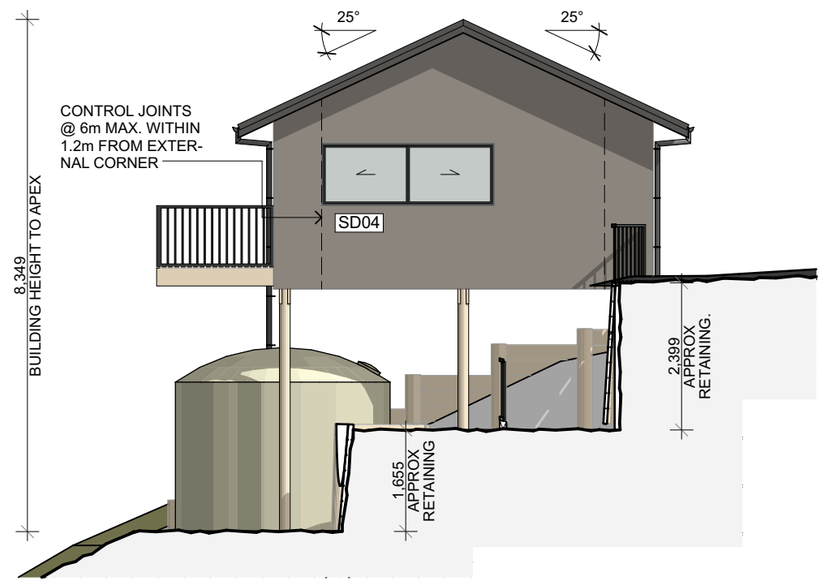
Scale 1:100

BUILDING ENVELOPE RISK MATRIX		
ALL ELEVATIONS		
Risk Factor	**Risk Severity**	**Risk Score**
Wind zone (per NZS 3604)	Very high risk	2
Number of storeys	Low risk	0
Roof/wall intersection design	Low risk	0
Eaves width	Medium risk	1
Envelope complexity	Low risk	0
Deck design	High risk	4
Total Risk Score:		**7**



WEST STUDIO ELEVATION

Scale 1:100



SOUTH STUDIO ELEVATION

Scale 1:100

THIS DRAWING AND THE DESIGN IT COVERS SHALL REMAIN THE PROPERTY AND COPYRIGHT OF DAWSON DESIGN LIMITED.

PRELIMINARY ONLY - NOT FOR CONSTRUCTION

DAWSON DESIGN plans for living

0800 406 161 (09) 432 9188
info@dawsondesign.co.nz

PO BOX 1140, WHANGAREI, 0140

www.dawsondesign.co.nz

NOTES

CONTRACTOR TO CHECK ALL DIMENSIONS & CONDITIONS ON SITE BEFORE COMMENCING WORK.

DO NOT SCALE.

WORK ONLY TO FIGURED DIMENSIONS. IN THE EVENT OF A DISCREPANCY CONTACT THE DESIGNER.

TITLE

STUDIO ELEVATIONS

ISSUE DATE	27/09/2019
JOB NO.	18086
DRAWN BY	DF
CHECKED BY	CD

PROJECT

PROPOSED NEW DWELLING FOR

JENNY ANN EMMANUEL

36 OLD HOSPITAL ROAD WHANGAROA 0478

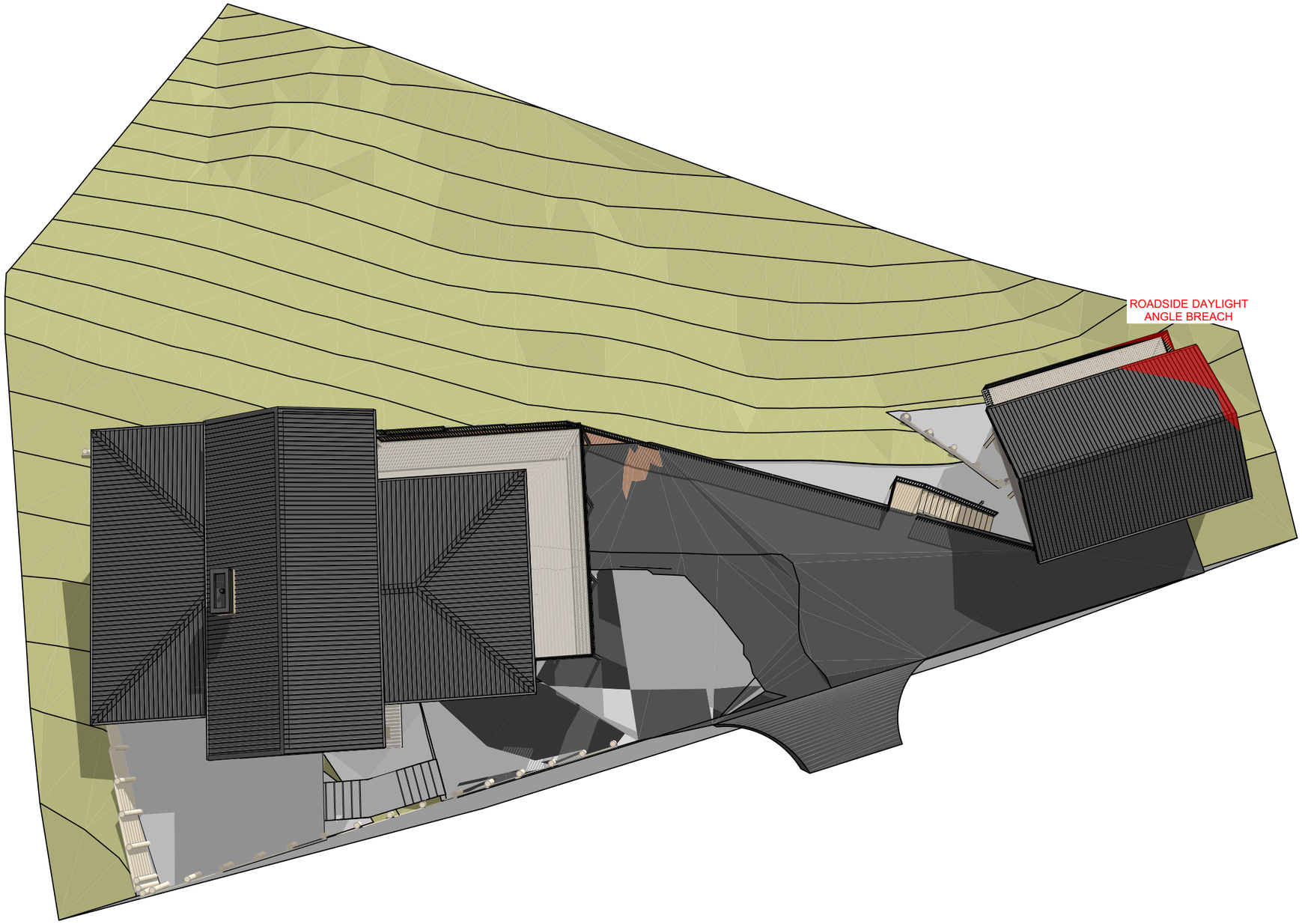
REVISIONS

NO.	REVISION	DATE
1	SK-01	22.11.2018

SCALE 1:100

DRAWING CODE	DRAWING ISSUE
302	RC-01

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 124 of 127 - 11/04/2022 - NZBTC



DISTRICT PLAN BREACHES

Scale 1:30

DAWSON DESIGN
plans for living

0800 406 161 (09) 432 9188
info@dawsondesign.co.nz

PO BOX 1140, WHANGAREI, 0140

www.dawsondesign.co.nz

NOTES

CONTRACTOR TO CHECK ALL DIMENSIONS & CONDITIONS ON SITE BEFORE COMMENCING WORK.

DO NOT SCALE.

WORK ONLY TO FIGURED DIMENSIONS. IN THE EVENT OF A DISCREPANCY CONTACT THE DESIGNER.

TITLE

HIRB BREACHES

ISSUE DATE	27/09/2019
JOB NO.	18086
DRAWN BY	DF
CHECKED BY	CD

PROJECT

PROPOSED NEW DWELLING FOR

JENNY ANN EMMANUEL

36 OLD HOSPITAL ROAD
WHANGAROA 0478

REVISIONS

NO.	REVISION	DATE
1	SK-01	22.11.2018

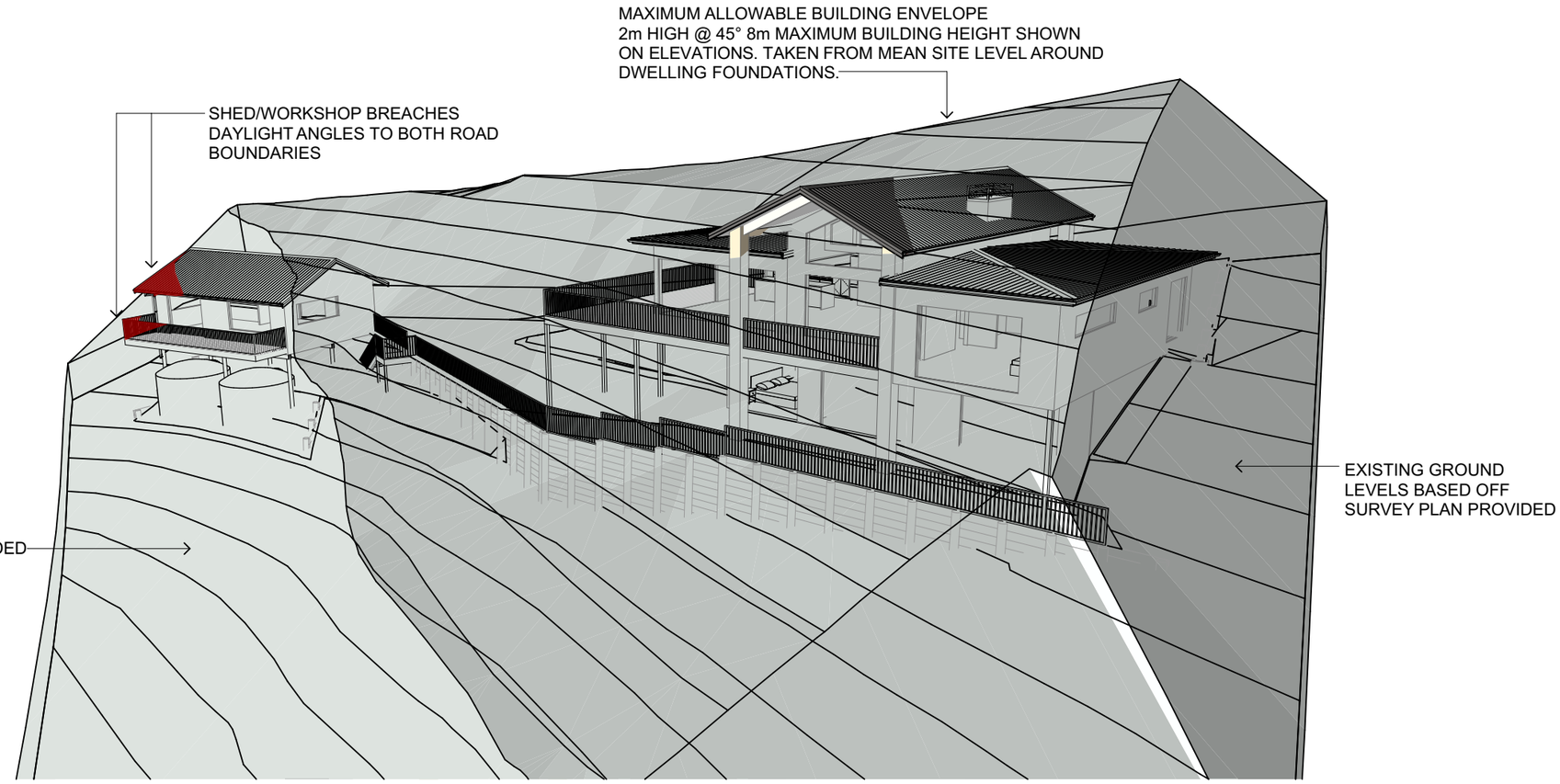
SCALE
1:30

DRAWING CODE	DRAWING ISSUE
205	RC-01

THIS DRAWING AND THE DESIGN IT COVERS SHALL REMAIN THE PROPERTY AND COPYRIGHT OF DAWSON DESIGN LIMITED.

PRELIMINARY ONLY - NOT FOR CONSTRUCTION

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 125 of 127 - 11/04/2022 - NZBTC



DISTRICT PLAN BREACHES 2

Scale 1:50

DAWSON DESIGN
plans for living

0800 406 161 (09) 432 9188
info@dawsondesign.co.nz

PO BOX 1140, WHANGAREI, 0140

www.dawsondesign.co.nz

NOTES

CONTRACTOR TO CHECK ALL DIMENSIONS & CONDITIONS ON SITE BEFORE COMMENCING WORK.

DO NOT SCALE.

WORK ONLY TO FIGURED DIMENSIONS. IN THE EVENT OF A DISCREPANCY CONTACT THE DESIGNER.

TITLE

HIRB BREACHES

ISSUE DATE	27/09/2019
JOB NO.	18086
DRAWN BY	DF
CHECKED BY	CD

PROJECT

PROPOSED NEW DWELLING FOR

JENNY ANN EMMANUEL

36 OLD HOSPITAL ROAD
WHANGAROA 0478

REVISIONS

NO.	REVISION	DATE
1	SK-01	22.11.2018

SCALE
1:50

DRAWING CODE	DRAWING ISSUE
206	RC-01

THIS DRAWING AND THE DESIGN IT COVERS SHALL REMAIN THE PROPERTY AND COPYRIGHT OF DAWSON DESIGN LIMITED.

PRELIMINARY ONLY - NOT FOR CONSTRUCTION

Appendix G – Advisory Note

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 126 of 127 - 11/04/2022 - NZBTC

HAIGH WORKMAN LTD
Civil & Structural Engineers

FNDC - Approved Building Consent Document - EBC-2022-988-0 - Pg 127 of 127 - 11/04/2022 - NZBTC

IMPORTANT ADVISORY NOTE

PRODUCER STATEMENT – CONSTRUCTION REVIEW (PS4)

The Building Consent Authority (BCA) frequently requires Producer Statements–Construction Review (PS4) to be submitted to the BCA in order for a Code of Compliance Certificate (CCC) to be issued. A PS4 is usually required for each specialist area. The requirement for a consultant to issue a PS4 related to their area of work will appear as a condition in the Building Consent documents.

It is the consent holder's responsibility to notify Haigh Workman Limited for geotechnical construction monitoring and testing required for subsequent issue of a PS4. An initial inspection of stripped or excavated ground must take place before any fill or blinding concrete is placed. Retrospective site monitoring of completed or partially completed geotechnical work is not possible and a PS4 will not be issued without all the required observations.

In order to secure our construction monitoring services and avoid delays on site, Haigh Workman Limited require at least 48 hours' notice prior to the time the site visit is required. Construction monitoring is limited to items that have been recommended, designed and detailed by Haigh Workman Limited. We are unable to inspect non-consented or unauthorised work. Haigh Workman Limited do not carry out construction monitoring or issue PS4's for work that has been recommended, designed or detailed by other consultants without prior review and approval from Haigh Workman Limited. Haigh Workman Limited cannot issue a PS4 where construction monitoring and/or testing have been carried out by any other consultant. The PS4 must be sought from the consultant who carried out those inspections.

The full Building Consent, with stamped plans with consent numbers (or a legible copy of the same) including all amendments, shall be made available to us during inspections. Construction monitoring will not be undertaken until the documentation is available or provided to us prior to our site visit.

Unless stated otherwise in our terms of engagement, the fees associated with construction monitoring and the issue of PS4's are separate from any work carried out prior to commencement of construction. We are able to provide a fee estimate for this work if required. Our normal terms of trade require payment of fees monthly during the inspection period and full settlement prior to release of any PS4.