Te Kaunihera o Te Hiku o te Ika
Far North District Council

Office Use Only
Application Number:

Application for resource consent or fast-track resource consent

(Or Associated Consent Pursuant to the Resource Management Act 1991 (RMA)) (If applying for a Resource Consent pursuant to Section 87AAC or 88 of the RMA, this form can be used to satisfy the requirements of Schedule 4). Prior to, and during, completion of this application form, please refer to Resource Consent Guidance Notes and Schedule of Fees and Charges — both available on the Council's web page.

1. Pre-Lodgement Meeting

Have you met with a council Resource Consent representative to discuss this application prior to lodgement? ◯ **Yes** ✔ **No**

2. Type of Consent being applied for

(more than one circle can be ticked):

- ◯ **Land Use**
- ◯ **Fast Track Land Use***
- ◯ **Subdivision**
- ◯ **Consent under National Environmental Standard** (e.g. Assessing and Managing Contaminants in Soil)
- ◯ **Discharge**
- ◯ **Change of Consent Notice (s.221(3))**
- ◯ **Extension of time (s.125)**
- ● **Other (please specify)** Retaining wall

The fast track is for simple land use consents and is restricted to consents with a controlled activity status.

3. Would you like to opt out of the Fast Track Process?

✔ **Yes** ◯ **No**

4. Consultation

Have you consulted with Iwi/Hapū? ◯ **Yes** ✔ **No**

If yes, which groups have you consulted with?	
Who else have you consulted with?	

For any questions or information regarding iwi/hapū consultation, please contact Te Hono at Far North District Council tehonosupport@fndc.govt.nz

5. Applicant Details

Name/s: Annette Wynyard

Email: [redacted]

Phone number:

Postal address:
(or alternative method of service under section 352 of the act)

6. Address for Correspondence

Name and address for service and correspondence (if using an Agent write their details here)

Name/s: William Whetton

Email: [redacted]

Phone number:

Postal address:
(or alternative method of service under section 352 of the act)

**** All correspondence will be sent by email in the first instance. Please advise us if you would prefer an alternative means of communication.***

7. Details of Property Owner/s and Occupier/s

Name and Address of the Owner/Occupiers of the land to which this application relates (where there are multiple owners or occupiers please list on a separate sheet if required)

Name/s: Annette Wynyard

Property Address/ Location: 1 harrys place, kawakawa

Postcode 0210

8. Application Site Details

Location and/or property street address of the proposed activity:

Name/s: Annette Wynyard

Site Address/ Location: 1 harrys place, Kawakawa

Postcode 0210

Legal Description: LOT 7 DP 82909 **Val Number:** 00419-08907

Certificate of title:

Please remember to attach a copy of your Certificate of Title to the application, along with relevant consent notices and/or easements and encumbrances (search copy must be less than 6 months old)

Site visit requirements:

Is there a locked gate or security system restricting access by Council staff? ◯ **Yes** ✔ **No**

Is there a dog on the property? ◯ **Yes** ✔ **No**

Please provide details of any other entry restrictions that Council staff should be aware of, e.g. health and safety, caretaker's details. This is important to avoid a wasted trip and having to re-arrange a second visit.

9. Description of the Proposal:

Please enter a brief description of the proposal here. Please refer to Chapter 4 of the District Plan, and Guidance Notes, for further details of information requirements.

removal of existing failing retaining wall and construction of new engineered retaining wall.

If this is an application for a Change or Cancellation of Consent Notice conditions (s.221(3)), please quote relevant existing Resource Consents and Consent Notice identifiers and provide details of the change(s), with reasons for requesting them.

10. Would you like to request Public Notification?

◯ **Yes** ✔ **No**

11. Other Consent required/being applied for under different legislation

(more than one circle can be ticked):

- (✔) **Building Consent** Enter BC ref # here (if known)
- ( ) **Regional Council Consent (ref # if known)** Ref # here (if known)
- ( ) **National Environmental Standard consent** Consent here (if known)
- ( ) **Other (please specify)** Specify 'other' here

12. National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health:

The site and proposal may be subject to the above NES. In order to determine whether regard needs to be had to the NES please answer the following:

Is the piece of land currently being used or has it historically ever been used for an activity or industry on the Hazardous Industries and Activities List (HAIL) ( ) **Yes** (✔) **No** ( ) **Don't know**

Is the proposed activity an activity covered by the NES? Please tick if any of the following apply to your proposal, as the NESCS may apply as a result. ( ) **Yes** ( ) **No** (✔) **Don't know**

- ( ) **Subdividing land**
- ( ) **Changing the use of a piece of land**
- (✔) **Disturbing, removing or sampling soil**
- ( ) **Removing or replacing a fuel storage system**

13. Assessment of Environmental Effects:

Every application for resource consent must be accompanied by an Assessment of Environmental Effects (AEE). This is a requirement of Schedule 4 of the Resource Management Act 1991 and an application can be rejected if an adequate AEE is not provided. The information in an AEE must be specified in sufficient detail to satisfy the purpose for which it is required. Your AEE may include additional information such as Written Approvals from adjoining property owners, or affected parties.

Your AEE is attached to this application (✔) **Yes**

13. Draft Conditions:

Do you wish to see the draft conditions prior to the release of the resource consent decision? ( ) **Yes** (●) **No**

If yes, do you agree to extend the processing timeframe pursuant to Section 37 of the Resource Management Act by 5 working days? ( ) **Yes** ( ) **No**

14. Billing Details:

This identifies the person or entity that will be responsible for paying any invoices or receiving any refunds associated with processing this resource consent. Please also refer to Council's Fees and Charges Schedule.

Name/s: (please write in full) Annette Wynyard

Email: [redacted]

Phone number: [redacted]

Postal address:
(or alternative method of service under section 352 of the act) [redacted]

Fees Information
An instalment fee for processing this application is payable at the time of lodgement and must accompany your application in order for it to be lodged. Please note that if the instalment fee is insufficient to cover the actual and reasonable costs of work undertaken to process the application you will be required to pay any additional costs. Invoiced amounts are payable by the 20th of the month following invoice date. You may also be required to make additional payments if your application requires notification.

Declaration concerning Payment of Fees
I/we understand that the Council may charge me/us for all costs actually and reasonably incurred in processing this application. Subject to my/our rights under Sections 357B and 358 of the RMA, to object to any costs, I/we undertake to pay all and future processing costs incurred by the Council. Without limiting the Far North District Council's legal rights if any steps (including the use of debt collection agencies) are necessary to recover unpaid processing costs I/we agree to pay all costs of recovering those processing costs. If this application is made on behalf of a trust (private or family), a society (incorporated or unincorporated) or a company in signing this application I/we are binding the trust, society or company to pay all the above costs and guaranteeing to pay all the above costs in my/our personal capacity.

Name: (please write in full) ANNETTE WYNYARD

Signature:
(signature of bill payer) [redacted]

Date 04-09-24

15. Important Information:

Note to applicant
You must include all information required by this form. The information must be specified in sufficient detail to satisfy the purpose for which it is required.
You may apply for 2 or more resource consents that are needed for the same activity on the same form.
You must pay the charge payable to the consent authority for the resource consent application under the Resource Management Act 1991.

Fast-track application
Under the fast-track resource consent process, notice of the decision must be given within 10 working days after the date the application was first lodged with the authority, unless the applicant opts out of that process at the time of lodgement. A fast-track application may cease to be a fast-track

Privacy Information:
Once this application is lodged with the Council it becomes public information. Please advise Council if there is sensitive information in the proposal. The information you have provided on this form is required so that your application for consent pursuant to the Resource Management Act 1991 can be processed under that Act. The information will be stored on a public register and held by the Far North District Council. The details of your application may also be made available to the public on the Council's website, www.fndc.govt.nz. These details are collected to inform the general public and community groups about all consents which have been issued through the Far North District Council.

15. Important information continued...

Declaration

The information I have supplied with this application is true and complete to the best of my knowledge.

Name: (please write in full) William Whetton

Signature: [redacted] Date 30-Aug-2024

A signature is not required if the application is made by electronic means

Checklist (please tick if information is provided)

- ☐ Payment (cheques payable to Far North District Council)
- ☑ A current Certificate of Title (Search Copy not more than 6 months old)
- ☐ Details of your consultation with Iwi and hapū
- ☐ Copies of any listed encumbrances, easements and/or consent notices relevant to the application
- ☐ Applicant / Agent / Property Owner / Bill Payer details provided
- ☑ Location of property and description of proposal
- ☑ Assessment of Environmental Effects
- ☐ Written Approvals / correspondence from consulted parties
- ☑ Reports from technical experts (if required)
- ☐ Copies of other relevant consents associated with this application
- ☐ Location and Site plans (land use) AND/OR
- ☐ Location and Scheme Plan (subdivision)
- ☐ Elevations / Floor plans
- ☐ Topographical / contour plans

Please refer to Chapter 4 of the District Plan for details of the information that must be provided with an application. Please also refer to the RC Checklist available on the Council's website. This contains more helpful hints as to what information needs to be shown on plans.

Environmental Effects Assessment for Retaining Wall Replacement Project

Project Overview

The project at **1 Harrys Place, Kawakawa** involves the removal of an existing retaining wall and the construction of a new retaining wall with a maximum height of 2.5 meters at its highest point. The structure is not close to any waterways, reducing the potential for water-related environmental impacts.

Guidelines for Compliance

Whetton Contracting will adhere to the following guidelines to mitigate environmental impacts during the removal and construction of the retaining wall, while also striving to cause minimal disturbance to any neighbouring properties:

Potential Environmental Effects

1. **Soil Erosion**:
    - **During Removal**: The removal of the existing retaining wall may temporarily destabilize the soil, increasing the risk of soil erosion, particularly on sloped terrain. Although the structure is not near any waterways, erosion could still affect surrounding areas. Whetton Contracting will implement erosion control measures such as silt fences and sediment barriers to prevent soil displacement.
    - **During Construction**: Earthmoving activities could disturb the soil further, potentially leading to increased erosion. Disturbed areas will be stabilized as quickly as possible using methods such as re-vegetation or the application of geotextiles.
2. **Vegetation Disruption**:
    - **Vegetation Removal**: Not applicable
3. **Air Quality**:
    - **Dust Generation**: Dust control measures, such as watering down surfaces or using dust suppressants, will be implemented during construction to protect air quality. Whetton Contracting will also take steps to ensure that dust does not negatively impact neighbouring properties.
    - **Emissions from Machinery**: Whetton Contracting will ensure that all machinery used during construction is well-maintained to minimize emissions. Any impact on air quality is expected to be temporary and manageable with proper controls.

4. **Noise Pollution**:
    - Noise generated during the removal and construction of the retaining wall will comply with local noise standards, which specify acceptable noise levels during certain hours of the day. Construction activities will be scheduled to avoid excessive noise during early mornings, evenings, and weekends. Whetton Contracting will make efforts to reduce noise disturbance to neighbouring properties.

Mitigation Measures

1. **Erosion and Sediment Control**:
    - Install silt fences, sediment traps, and other erosion control measures as needed.
    - Stabilize exposed soil surfaces promptly using native vegetation, mulch, or geotextiles.
2. **Vegetation Management**: Not applicable
3. **Dust and Air Quality Control**:
    - Regularly water down exposed soil and construction areas to suppress dust, with a focus on minimizing impact on neighbouring properties.
    - Use well-maintained machinery to minimize emissions and reduce environmental impact.
4. **Noise Control**:
    - Limit construction activities to approved hours to minimize disturbance.
    - Use noise-dampening techniques and barriers as necessary to comply with noise standards and reduce impact on neighbouring properties.

Whetton Contracting is committed to ensuring that the environmental effects of removing and replacing the retaining wall at **1 Harrys Place, Kawakawa** are managed effectively. By adhering to the guidelines outlined above, and by striving to minimize disturbance to any neighbouring properties, Whetton Contracting will ensure that the project proceeds sustainably and with minimal environmental disruption.

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA39B/981**
Land Registration District	**North Auckland**
Date Issued	31 October 1977

Prior References
NA301/167

Estate	Fee Simple
Area	848 square metres more or less
Legal Description	Lot 7 Deposited Plan 82909

Registered Owners
Annette Te Herenga Wynyard

Interests

10444793.2 Mortgage to ASB Bank Limited - 30.5.2016 at 1:37 pm

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD

Historical Search Copy

R.W. Muir
Registrar-General
of Land

Constituted as a Record of Title pursuant to Sections 7 and 12 of the Land Transfer Act 2017 - 12 November 2018

Identifier	**NA39B/981**
Land Registration District	**North Auckland**
Date Issued	31 October 1977

Prior References
NA301/167

Estate	Fee Simple
Area	848 square metres more or less
Legal Description	Lot 7 Deposited Plan 82909

Original Registered Owners
Annette Te Herenga Wynyard

Interests

D322184.2 Mortgage to The Home Mortgage Company Limited - 20.10.1998 at 2.19 pm

6504172.1 Mortgage to Kiwibank Limited - 21.7.2005 at 9:00 am

6530696.1 Discharge of Mortgage D322184.2 - 1.9.2005 at 9:01 am

8436218.1 Discharge of Mortgage 6504172.1 - 12.3.2010 at 11:11 am

8436218.2 Mortgage to Mortgage Holding Trust Company Limited - 12.3.2010 at 11:11 am

10444793.1 Discharge of Mortgage 8436218.2 - 30.5.2016 at 1:37 pm

10444793.2 Mortgage to ASB Bank Limited - 30.5.2016 at 1:37 pm

References
Prior C/T 301/167

Transfer No.
N/C. Order No. 371905.5

Land and Deeds 69

REGISTER

No. 39B/981

CERTIFICATE OF TITLE UNDER LAND TRANSFER ACT

This Certificate dated the 31st day of October one thousand nine hundred and seventy seven under the seal of the District Land Registrar of the Land Registration District of North Auckland

WITNESSETH that MILDRED RAY GILL of Papakura widow MARIAN DORIS MURPHY of Auckland married woman and WILLIAM HENRY COOKE of Whangarei chartered accountant are

~~xx~~ seised of an estate in fee-simple (subject to such reservations, restrictions, encumbrances, liens, and interests as are notified by memorial underwritten or endorsed hereon) in the land hereinafter described, delineated with bold black lines on the plan hereon, be the several admeasurements a little more or less, that is to say: All that parcel of land containing 848 square metres more or less being Lot 7 Plan 82909 and being part Allotment 132 Parish of Ruapekapeka and part Section 3 Block XVI Kawakawa Survey District

DISTRICT LAND REGISTRAR AUCKLAND, N.Z.

Assistant District Registrar

Interests at date of issue:

454116.3 Mortgage to The Bank of New South Wales - 31.10.1977 at 10.37 o'c

DISCHARGED 551103.1 A.L.R.

559694.1 Transfer to Phillip Duncan Garland of Kawakawa meat inspector and Carol Elizabeth Garland his wife - 2.6.1978 at 2.28 oc.

A.L.R.

559694.2 Mortgage to Her Majesty The Queen - 2.6.1978 at 2.28 oc.

DISCHARGED A.L.R.

A.L.R.

559694.3 Settled under the Joint Family Homes Act 1964 - 2.6.1978 at 2.28 oc.

A.L.R.

B.042245.1 Mortgage to Bank of New Zealand - 11.3.1982 at 12.10 o'c

DISCHARGED A.L.R.

B.976798.3 Transfer to Matthew Spencer of Kawakawa engineer - 10.4.1989 at 9.01 o'c

A.L.R

B.976798.4 Mortgage to The Housing Corporation of New Zealand - 10.4.1989 at 9.01 o'c

Discharged 21.4.92 A.L.R

A.L.R

B.976798.5 Mortgage to The Housing Corporation of New Zealand - 10.4.1989 at 9.01 o'c

Discharged 21.4.92 A.L.R

A.L.R

C.366477.3 Transfer to Ricky Shane Smythe fitter welder and Billy-Jean Stone mother both of Kawakawa - 21.4.1992 at 2.26 o'c

A.L.R.

C.366477.4 Mortgage to The Housing Corporation of New Zealand - 21.4.1992 at 2.26 o'c

DISCHARGED 21.4.95 A.L.R.

A.L.R.

C.848051.2 Mortgage to ASB Bank Limited - 31.5.1995 at 11.47 o'c

DISCHARGED 03 JUL 1997 FOR DLR

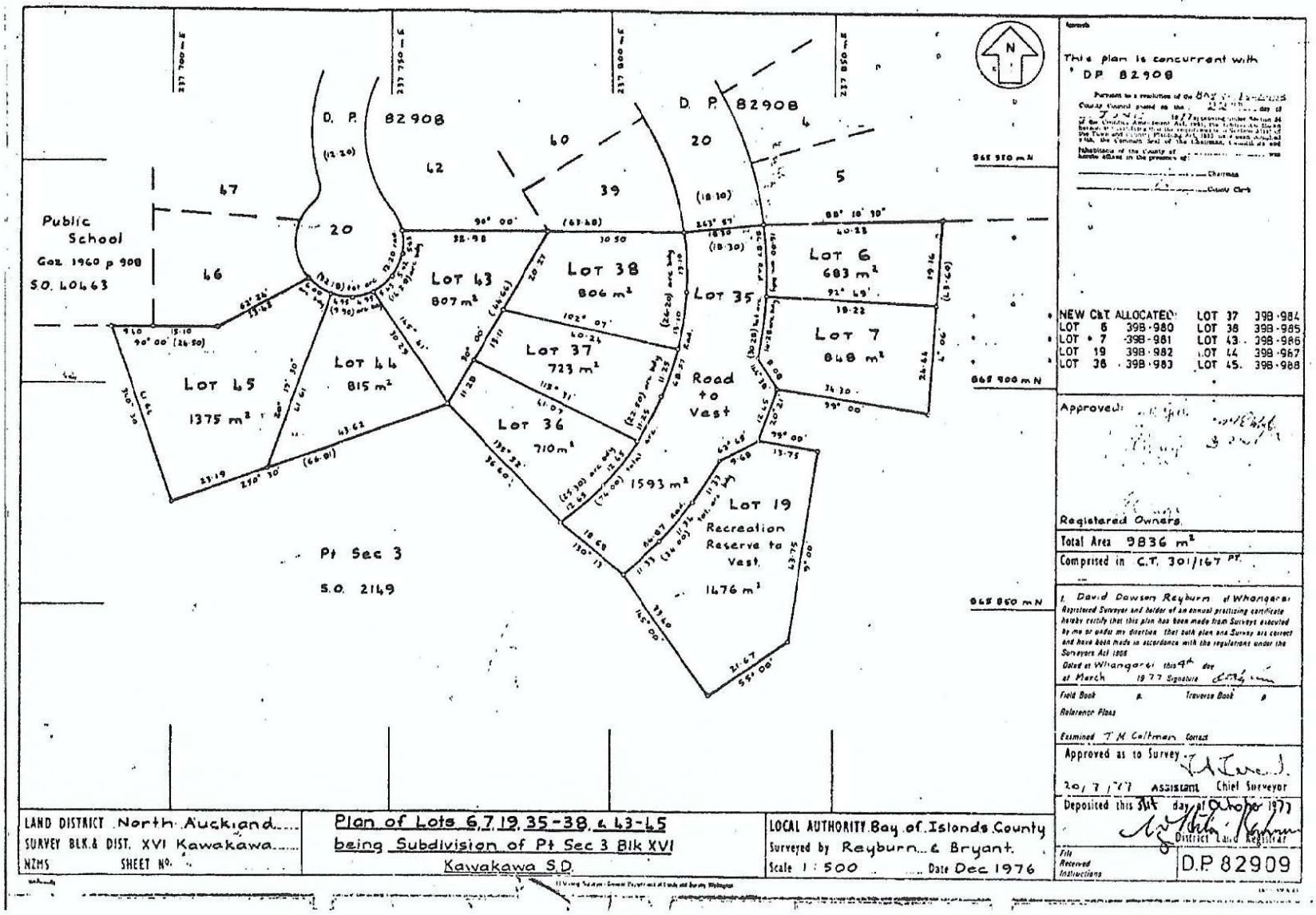
A.L.R.

Measurements are Metric

No. 39B/981

-OVER-

Identifier NA39B/981



This plan is concurrent with DP 82908

Pursuant to a resolution of the Bay of Islands County Council passed on the ... day of June 1977 approving under Section 36 of the Counties Amendment Act, 1961, the subdivision shown on this Plan and pursuant to the requirements of Section 37(1) of that Act, the Common Seal of the Chairman, Councillors and Inhabitants of the County of ... was hereunto affixed in the presence of:

..... Chairman

..... County Clerk

NEW C&T ALLOCATED

LOT 5	398-980	LOT 37	398-984
LOT 6	398-980	LOT 38	398-985
LOT 7	398-981	LOT 43	398-986
LOT 19	398-982	LOT 44	398-987
LOT 38	398-983	LOT 45	398-988

Approved:

Registered Owners

Total Area 9836 m²

Comprised in C.T. 301/167 Pt.

I, David Dawson Reyburn of Whangarei Registered Surveyor and holder of an annual practising certificate hereby certify that this plan has been made from Surveys executed by me or under my direction that such plan and Survey are correct and have been made in accordance with the regulations under the Surveyors Act 1908

Dated at Whangarei this 9th day of March 1977 Signature

Field Book p. Traverse Book p.

Reference Plans

Examined T M Coltman Correct

Approved as to Survey

20/7/77 Assistant Chief Surveyor

Deposited this 31st day of October 1977

District Land Registrar

File

Received

Instructions

D.P. 82909

LAND DISTRICT North Auckland

SURVEY BLK. & DIST. XVI Kawakawa

NZMS SHEET No.

Plan of Lots 6, 7, 19, 35-38, & 43-45 being Subdivision of Pt Sec 3 Blk XVI Kawakawa S.D.

LOCAL AUTHORITY Bay of Islands County

Surveyed by Reyburn & Bryant

Scale 1:500 Date Dec 1976

39B/981

D.165987.2 Transfer to Glyn David Rees and Loraine Margaret Rees
3.7.1997 at 10.55

B. Whenuaroa

forDLR

D322184.1 Transfer to Annette Te Herenga Wynyard

D322184.2 Mortgage to Housing Corporation of New Zealand

All 20.10.1998 at 2.19

for DLR

D523726.1 Transfer of Mortgage D322184.2 to The Home Mortgage Company Limited
14.7.2000 at 11.38

for RGL

Job Ref: 24 077

24 May 2024

Annette Wynyard

RE: GEOTECHNICAL ASSESSMENT AND RETAINING WALL DESIGN AT 1 HARRYS PLACE, KAWAKAWA

1. INTRODUCTION

Haigh Workman Ltd (Haigh Workman) has been commissioned by Annette Wynyard (the client) to undertake a geotechnical investigation and carry out retaining wall design to replace the existing dilapidated concrete block retaining walls adjacent to the driveway /parking area at 1 Harrys Place, Kawakawa. The purpose of the investigation was to assess subsoil conditions and design the replacement timber pole retaining walls.

The scope of this report encompasses the geotechnical suitability in the context of the proposed development as defined in the Short Form Agreement dated 5th April 2024.

2. PROPOSED DEVELOPMENT

The subject site comprises an existing dwelling with a concrete masonry block wall along the southern boundary, supporting fill for the driveway / carpark. This wall has a maximum height of 2.5 m at the western end and has overturned by approximately 3°. There is also a small block wall on the opposite side of the driveway (to east of driveway), approximately 0.7 m high that is dilapidated is proposed to be replaced. (shown on drawing G02)

Another concrete masonry block wall runs along the western boundary (along Gills Drive boundary) which supports the lawn for the subject site. This wall has also overturned however, is not included in the scope of this report.

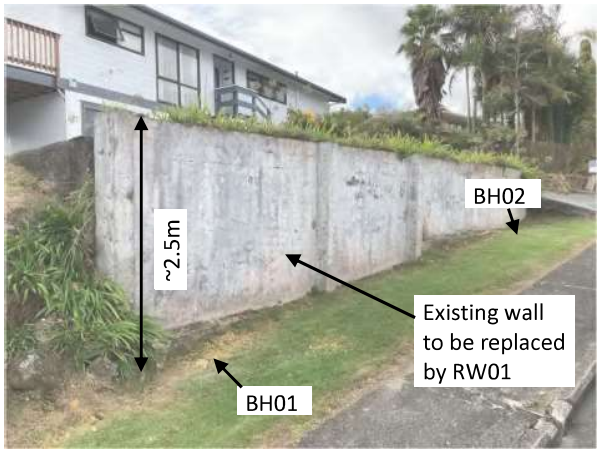
Based on discussions with our client the proposal is to replace the 2 concrete block walls along the southern boundary with new timber pole retaining walls, denoted RW01 and RW02 on the attached plans. (shown on drawing G03)

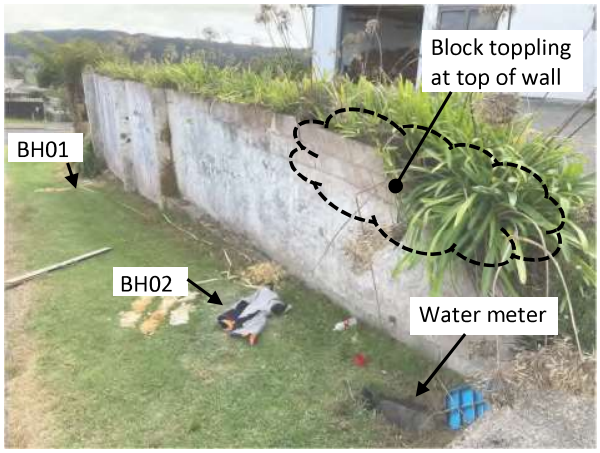
This report includes the design of timber pole retaining walls supporting a maximum cut height of 2.5 m for RW01 and maximum 0.7 m for RW02. Retaining wall RW01 been designed for driveway surcharge and impact loading from vehicles.

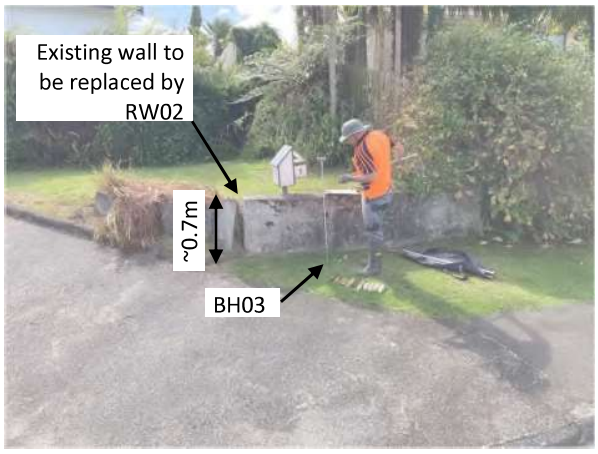
No topographical survey has been carried out for the site and existing ground levels are based on LiDAR from LINZ data service. As such, all proposed levels, retained heights and wall alignments are considered approximate only and must be checked onsite during construction.

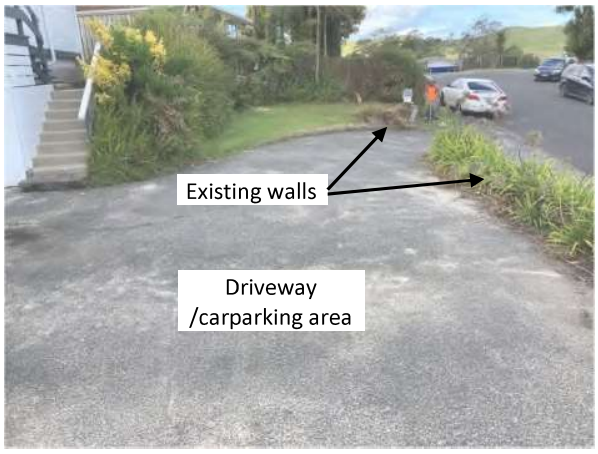
Figure 1: Aerial showing subject site (from Google Earth)

3. SITE PHOTOGRAPHS









4. GEOLOGY

The Institute of Geological & Nuclear Sciences, Map 2, 1:250,000 Scale, 1996: "Geology of the Whangarei Area" shows the subject site to be underlain by Waipapa Group (TJw). The soils of the Waipapa Group comprise massive to thin bedded, lithic volcaniclastic sandstone and argillite of Permian to Jurassic age.

5. GROUND CONDITIONS

Three hand auger boreholes were drilled along the retaining wall alignments to assess the underlying subsoils conditions. Detailed descriptions of the subsoils encountered are given on the attached borehole logs however, a summary of the ground conditions is given in the table below:

Table 1: Summary of Borehole Results

Borehole Number	Topsoil (mbgl)	Non-certified Fill (mbgl)	Residual Soils (mbgl)	Groundwater Observations
BH01	0.0 to 0.1	NE	0.1 to >3.0	Groundwater not Encountered. Moist throughout.
BH02	0.0 to 0.2	NE	0.2 to >3.0	
BH03	NE	0.0 to 0.4	0.4 to >2.0	

Note: Depths measured from existing ground level.
NE = Not Encountered

Groundwater was not encountered in any of the boreholes. The investigation was carried out following a dry season and may be higher during wetter winter conditions.

DESIGN METHODOLOGY

Design has been undertaken using retaining wall analysis software WALLAP, version 6.06 using moment equilibrium methods and the subgrade reaction model. A factor of safety of 1.5 is recommended for stability for static conditions, e.g., toe-kickout and overturning, and soil/shaft interface factors adopt B1/VM4 values for a timber pole.

Failure modes assessed during the design phase include:

- Kick-out.
- Yielding of structural elements.

For structural design of earth retaining structures, the design horizontal ground acceleration to be used in computing seismic inertia forces is as follows (New Zealand Bridge Manual – SP/M/022):

$$C_o g = C_h(T_0) Z R_u g$$

- $C_h(T_0)$ = 1.33 (Class C)
- Z = 0.06 (Paihia/Russell)
- Ru = 1.0 (Importance Level 2, 50-year design life – APE 1/500)

➔ $C_o g$ = 0.08

In accordance with Bridge Manual, the Zru shall not be taken as less than 0.13. Adopting the recommendations within Module 6 – Earthquake Resistant Retaining Wall Design, a wall displacement factor (W_d) of 0.3 can applied for walls facilitating access and services to buildings.

Adopting an a_{max} of 0.19 g (Module 1, Paihia/Russell), $C_o g = a_{max} \times W_d$ = 0.06.

On this basis, a $C_o g$ = 0.08 has been adopted.

Geotechnical design parameters presented in Table 2 below have been adopted in design. The design criteria for the timber pole retaining walls are as follows:

Wall I.D.	Maximum Retained Height (m)	Surcharge (kPa)	Backslope (degrees)
RW01	2.5 m	10 *(driveway)*	N/A
RW02	0.7 m	2.5 *(lawn mowing etc.)*	N/A

**Retaining wall RW01 is at the edge of the driveway therefore has been designed with a crash barrier for light vehicle traffic (Type F) in accordance with AS/NZS 1170.1, i.e. a 30 kN load at 0.5 m above the road level, distributed over a 1.5m length of the wall.*

Table 2: Geotechnical Design Parameters

Soil Unit	Bulk Unit Weight, γ (kN/m³)	Effective Cohesion, c' (kPa)	Effective Friction Angle, φ' (degrees)	Young's Modulus, E (MPa)
Retained Fill	17	3*	26	10
Stiff to Very Stiff Residual Soils	18	5	30	25

**Cohesion is ignored over the upper 1.5 m below the top of the wall.*
***For the crash/impact loading scenario, undrained conditions have been used for the soils on the passive side of the wall, adopting an Su of 75 kPa.*

DESIGN SUMMARY

A summary of the design is presented in Table 3. Design calculations and detailed drawings are attached.

Table 3: Retaining Wall Design Summary

Wall Properties	RW01			RW02
Maximum Height (H)	1.5 m	2.0 m	2.5 m	1.0 m
Pole Spacing (c/c)	1.0 m	1.0 m	1.0 m	1.2 m
Pole type	275 mm SED (High Density)	300 mm SED (High Density)	325 mm SED (High Density)	150 mm SED (High Density)
Embedment Length (L)	2.2 m	2.8 m	3.3	1.8 m
Total Pile Length (H + L)	3.7 m	4.8 m	5.8 m	2.5 m
Encasement (B)	500 mm bored pile, encased in 20 MPa concrete	500 mm bored pile, encased in 20 MPa concrete	500 mm bored pile, encased in 20 MPa concrete	350 mm bored pile, encased in 20 MPa concrete
Timber lagging rails	150 x 50 timber, H5 treated. Double rails below 0.9 m and triple below 2.1 m the top of wall. (refer to detail 1, sheet G04)			150 x 50 timber, H5 treated.

RW01 allows for an extra 300 mm retained height (i.e. out of ground height + 300mm) due to the presence of a shallow water main adjacent to the wall. This is also an allowance for any existing footings that will be removed from the existing concrete block wall.

Seepage drainage must be installed behind the wall, with the drainage pipe outlet directed downslope away from the building. Refer to drawings in Appendix A attached for full details and specifications.

SAFETY IN DESIGN

A safety in design register has been prepared and should be updated during construction when required.

Table 4: Safety in design risk register

Issue	Risk	Proposed mitigation measure
Excavations	Collapse of material and potential to strike people	All 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 timber poles and putting into ground	Falling from height (heavy)	Lifting gear (straps and chains) to be in good condition and certified if required.
Groundwater	If encountered, groundwater will make constructability difficult	We expect holes to remain free of groundwater in the short term.

EXISTING SERVICES

Far North Maps indicates that a public runs parallel to the road, approximately 1.2 m away from the proposed walls as shown on the attached site plan (indicative location only). The effective retained heights allow for this in the design.

However, it is our recommendation that a survey be carried out for this pipe to ascertain the exact alignment and depth before any excavations or retaining wall pile holes are drilled.

6. LIMITATIONS

This letter report has been prepared for the use of Annette Wynyard with respect to the particular brief outlined to us. This letter report is to be used by our Client and their Consultants only. 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.

The retaining wall design and recommendations contained in this report are depended on the satisfactory remediation (i.e. retaining) of the slip along Old Church Road to the south.

Prepared By

Josh Curreen

Geotechnical Engineer
MEngNZ

Reviewed By

Wayne Thorburn

Senior Geotechnical Engineer
CPEng, CMEngNZ

APPENDIX A – Drawings

NOTES:

1. LOT BOUNDARIES AND AERIAL PHOTO INFORMATION TAKEN FROM LAND INFORMATION NEW ZEALAND (LINZ).

Issue	Date	Revision
A	22/05/2024	FIRST ISSUE

DWG: SITE LOCATION PLAN

Scale 1:2000 @A3 | Date MAY 2024

Drawn JMC | Checked WT | Approved WT

File T:\CLIENTS\ANNETTE WYNYARD\JOBS\24 077 - 1 HARRY'S PLACE KAWAKAWA\ENGINEERING\DRAWINGS\24 077 GEO PLANS.DWG

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Project: PROPOSED RETAINING WALLS
1 HARRY'S PLACE, KAWAKAWA

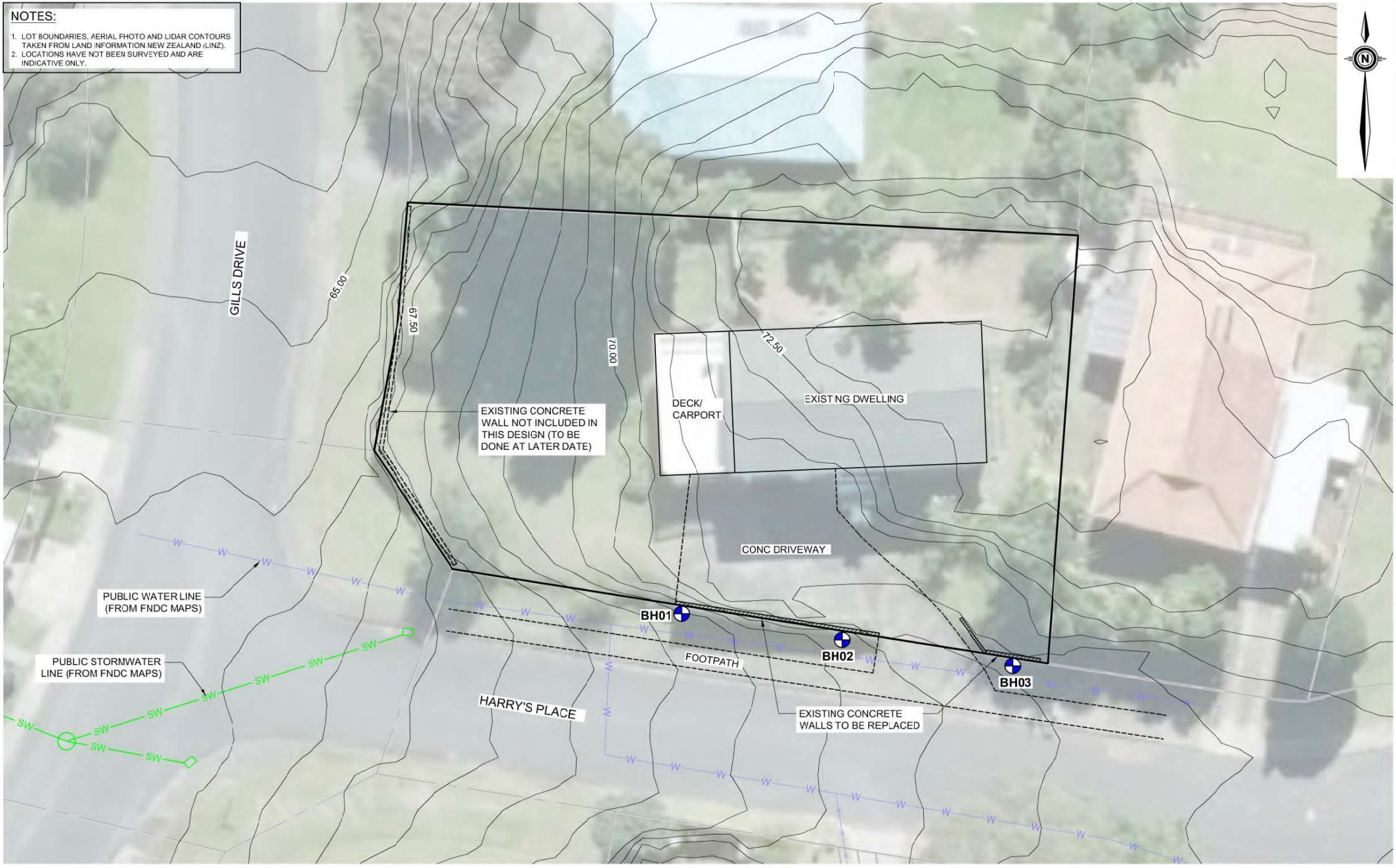
Client: ANNETTE WYNYARD

Project No. 24 077 | RC no. N/A

DWG No. G01

Sheet No. 1 of 6

Plotted By Josh Curreen at 24/05/2024 12:04:08 pm



Issue	Date	Revision
A	22/05/2024	FIRST ISSUE

DWG: SITE INVESTIGATION PLAN

Scale 1:200 @A3 | Date MAY 2024
Drawn JMC | Checked WT | Approved WT
File T:\CLIENTS\ANNETTE WYNYARD\JOBS\24 077 - 1 HARRYS PLACE KAWAKAWA\ENGINEERING\DRAWINGS\24 077 GEO PLANS.DWG

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1 HARRY'S PLACE, KAWAKAWA

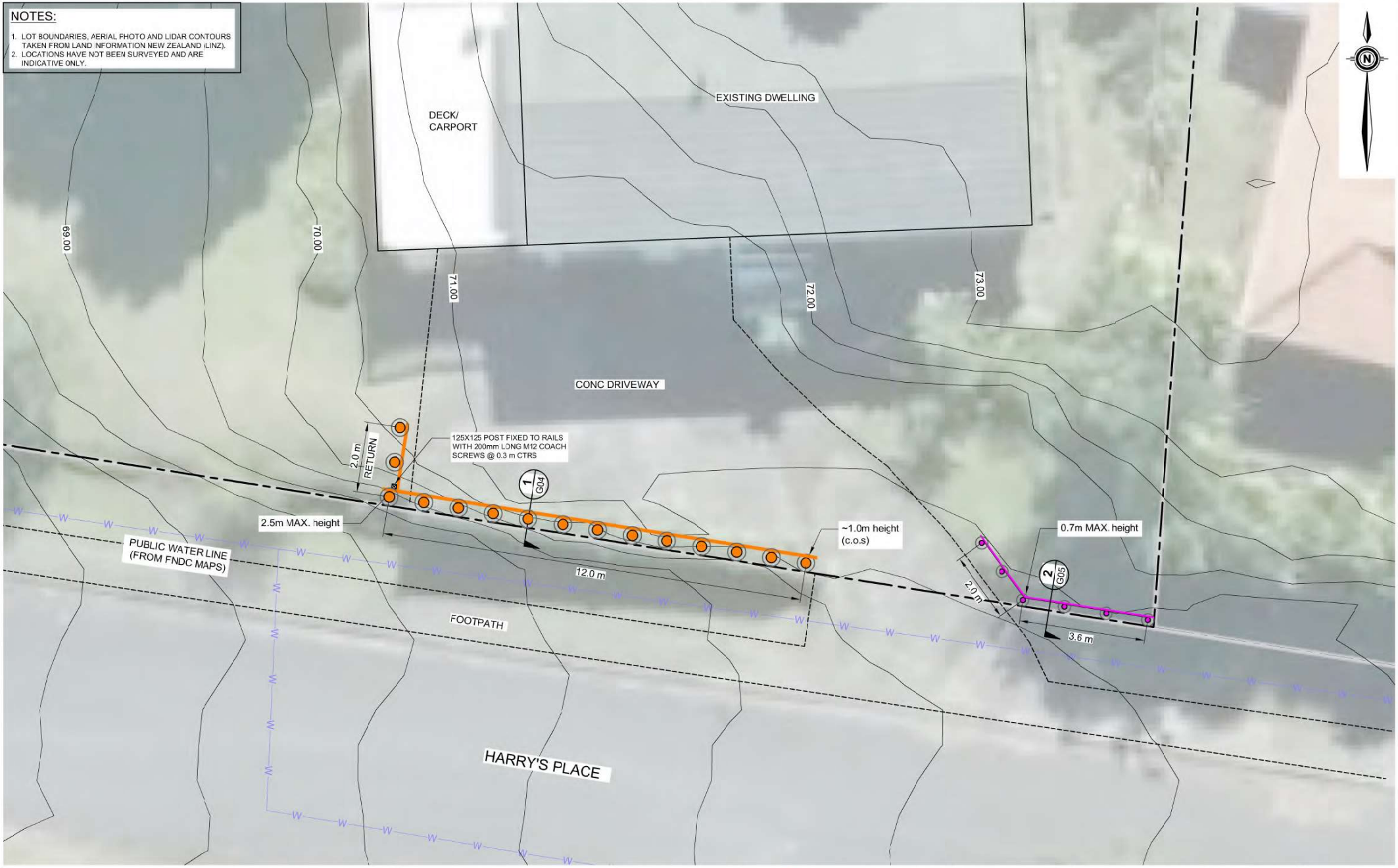
Client: ANNETTE WYNYARD

Project No. 24 077 | RC no. N/A

DWG No. G02

Sheet No. 2 of 6

Plotted By Josh Curreen at 24/05/2024 12:04:30 pm



Issue	Date	Revision
A	22/05/2024	FIRST ISSUE

DWG: PROPOSED RETAINING WALL PLAN

Scale 1:100 @A3 | Date MAY 2024
Drawn JMC | Checked WT | Approved WT
File T:\CLIENTS\ANNETTE WYNYARDJOBS\24 077 - 1 HARRYS PLACE KAWAKAWA\ENGINEERING\DRAWINGS\24 077 GEO PLANS.DWG

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Project: PROPOSED RETAINING WALLS
1 HARRY'S PLACE, KAWAKAWA

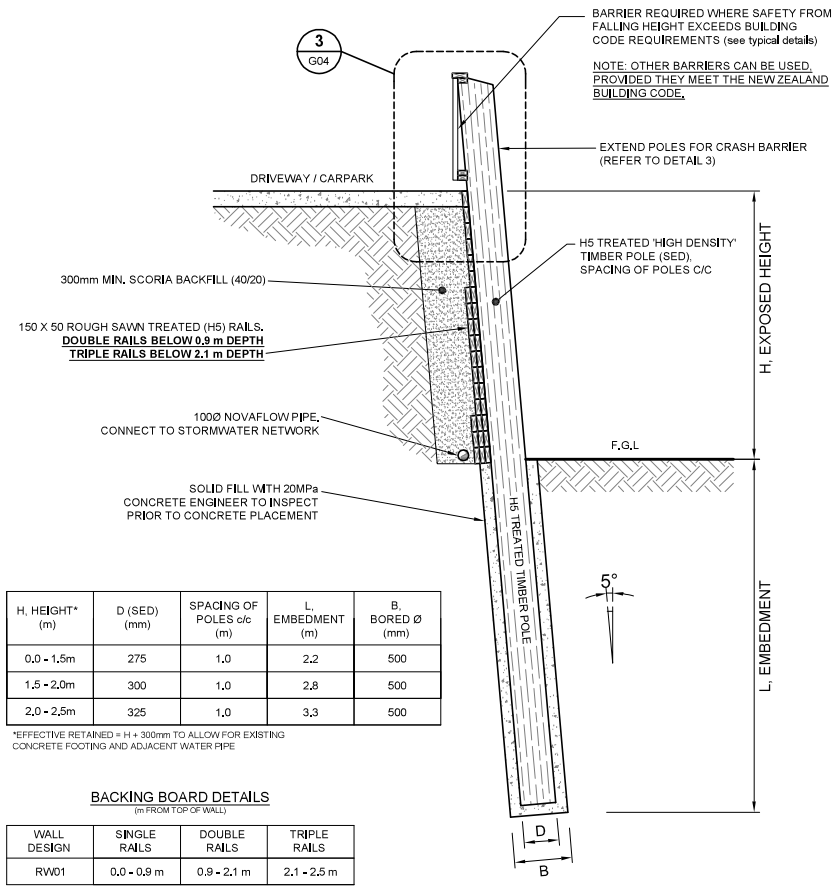
Client: ANNETTE WYNYARD

Project No. 24 077 | RC no. N/A

DWG No. G03

Sheet No. 2 of 6

Plotted By Josh Curreen at 21/08/2024 9:42:17 am



H, HEIGHT* (m)	D (SED) (mm)	SPACING OF POLES c/c (m)	L, EMBEDMENT (m)	B, BORED Ø (mm)
0.0 - 1.5m	275	1.0	2.2	500
1.5 - 2.0m	300	1.0	2.8	500
2.0 - 2.5m	325	1.0	3.3	500

*EFFECTIVE RETAINED = H + 300mm TO ALLOW FOR EXISTING CONCRETE FOOTING AND ADJACENT WATER PIPE

BACKING BOARD DETAILS
(m FROM TOP OF WALL)

WALL DESIGN	SINGLE RAILS	DOUBLE RAILS	TRIPLE RAILS
RW01	0.0 - 0.9 m	0.9 - 2.1 m	2.1 - 2.5 m

(REFER DESIGN REPORT FOR ALL DETAILS)

1 / G03 TYPICAL DETAIL - **RW01**
1 : 50

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.

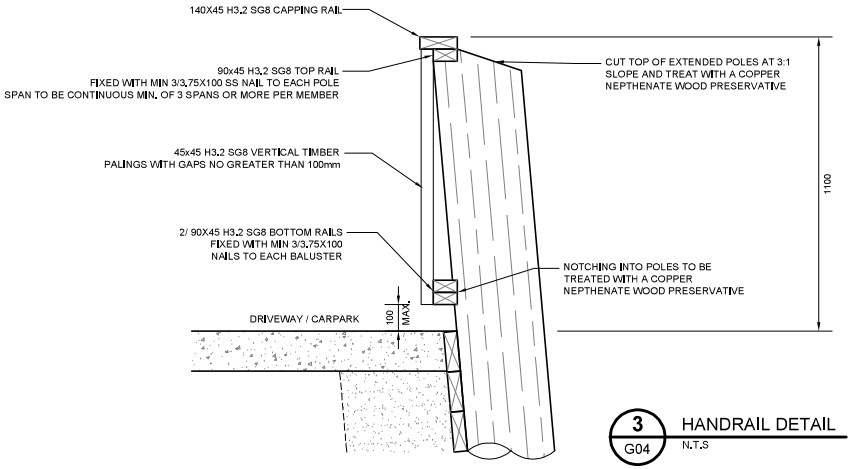
2. MATERIALS:
TIMBER:
TIMBER POLES SHALL BE PEELED RADIATA PINE LOGS COMPLYING WITH THE REQUIREMENT OF NZS 3605 "LOAD BEARING ROUND TIMBER PILES AND POLES" TREATED TO TPA COMMODITY SPECIFICATION H5. ALL TIMBER POLES TO BE HIGH DENSITY.
DIMENSIONS OF POLES ARE SPECIFIED AS MINIMUM SMALL END DIAMETERS.
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.



3 / G04 HANDRAIL DETAIL
N.T.S

Issue	Date	Revision
A	22/05/2024	FIRST ISSUE
B	6/08/2024	REVISED HANDRAIL DETAIL
C	21/08/2024	HANDRAIL FIXED TO POLES

DWG: TYPICAL RETAINING WALL DETAILS **RW01**

Scale: AS SHOWN | Date: AUG 2024
Drawn: JMC | Checked: WT | Approved: WT
File: T:\CLIENTS\ANNETTE WYNYARD\JOBS\24 077 - 1 HARRYS PLACE, KAWAKAWA\ENGINEERING\DRAWINGS\24 077 RW DETAILS_REVC.DWG

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Project: PROPOSED RETAINING WALLS
1 HARRY'S PLACE, KAWAKAWA

Client: ANNETTE WYNYARD

Project No.: 24 077 | RC no.: N/A

DWG No.: **G04**

Sheet No.: **4** of **6**

Plotted By Josh Curreen at 21/08/2024 9:36:13 am

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:
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   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

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   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.
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5. INSTALLATION:
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   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.

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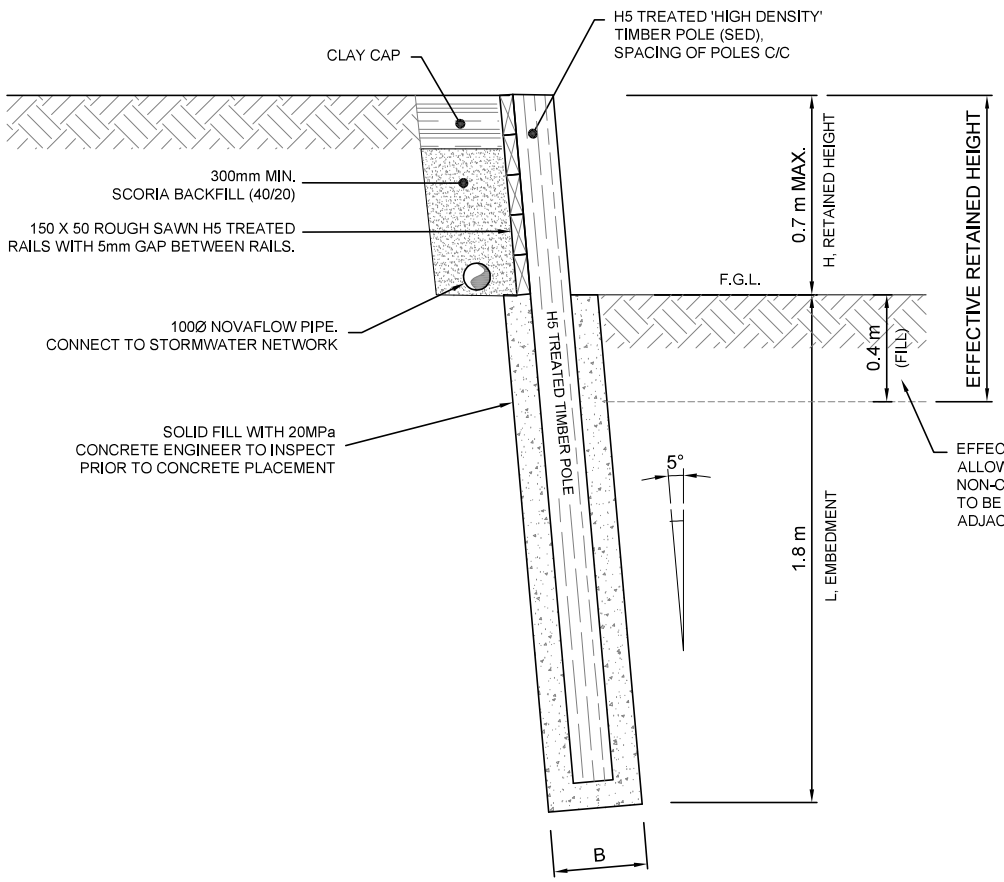
   REMAINING BACKFILL TO WITHIN 300mm OF FINISHED SURFACE LEVEL SHALL BE DRAINED COMPACTED GRANULAR FILL NOT LARGER THAN 65mm DIMENSIONS (eg RUN OF PIT SCORIA OR SIMILAR).
   THE FINISHED SURFACE OF BACKFILL SHALL BE SEALED AGAINST ENTRY OF SURFACE WATER WITH A LAYER OF TOPSOIL, CLAY OR CONCRETE.



H, HEIGHT (m)	D (SED) (mm)	B, BORED Ø (mm)	SPACING OF POLES c/c (m)	L, EMBEDMENT (m)	TOTAL POLE LENGTH (m)
0.7	150	350	1.20	1.9	2.6

Issue	Date	Revision
A	22/05/2024	FIRST ISSUE

DWG: TYPICAL RETAINING WALL DETAILS
RW02

Scale 1: 20 @A3 | Date MAY 2024
Drawn JMC | Checked WT | Approved WT
File T:\CLIENTS\ANNETTE WYNYARD\JOBS\24 077 - 1 HARRYS PLACE, KAWAKAWA\ENGINEERING\DRAWINGS\24 077 RW DETAILS.DWG

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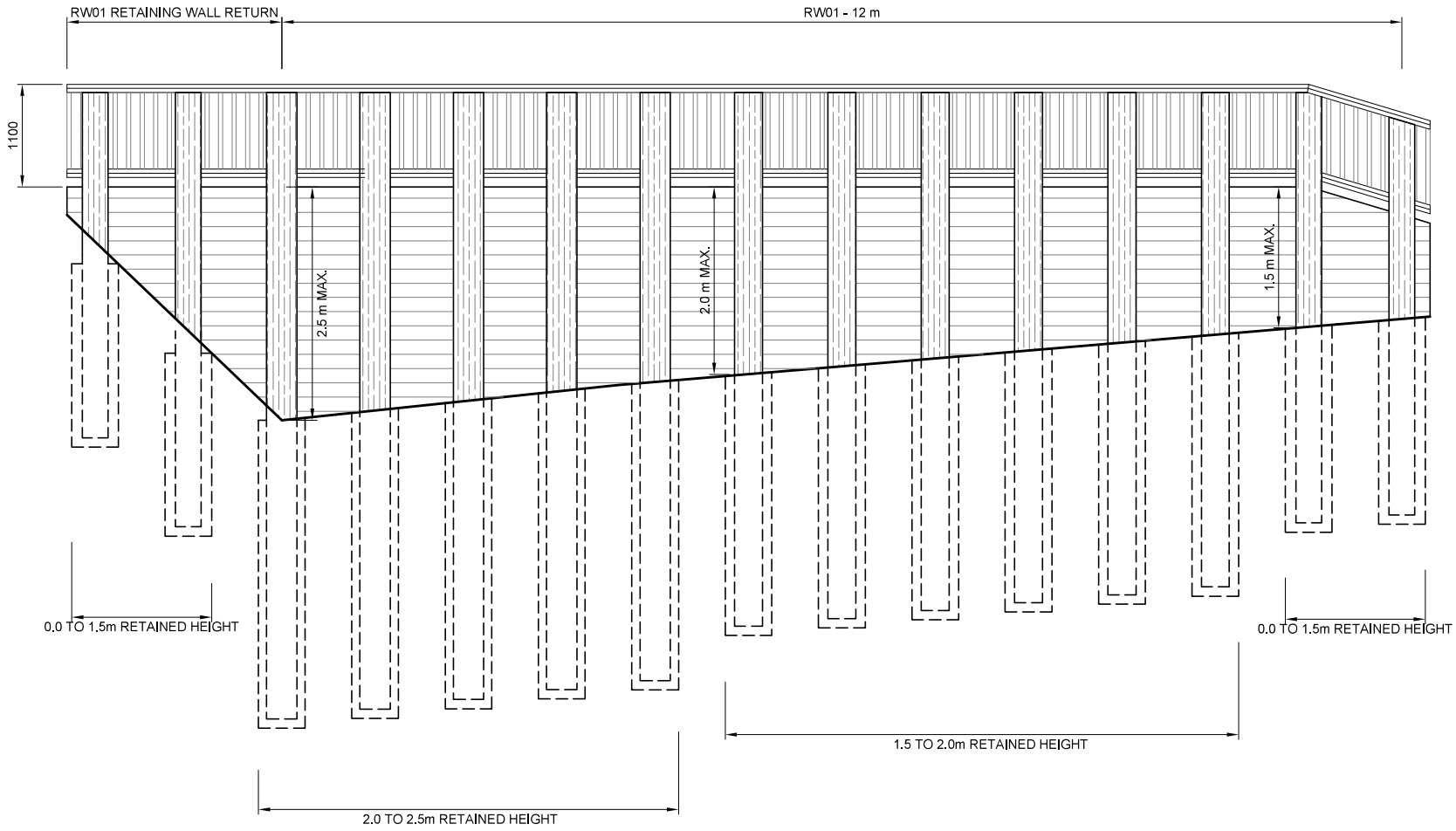
Project: PROPOSED RETAINING WALLS
1 HARRY'S PLACE, KAWAKAWA
Client: ANNETTE WYNYARD
Project No. 24 077 | RC no. N/A

DWG No. **G05**
Sheet No. **5** of **6**

Plotted By Josh Curreen at 24/05/2024 12:03:07 pm



Issue	Date	Revision
A	22/05/2024	FIRST ISSUE
B	6/08/2024	REVISED HANDRAIL DETAIL
C	21/08/2024	HANDRAIL FIXED TO POLES

DWG **RW01** RETAINING WALL ELEVATION

Scale 1 : 50 @ A3 | Date AUG 2024

Drawn JMC | Checked WT | Approved WT

File T:\CLIENTS\ANNETTE WYNYARD\JOBS\24 077 - 1 HARRYS PLACE, KAWAKAWA\ENGINEERING\DRAWINGS\24 077 RW DETAILS_REVC.DWG

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Project PROPOSED RETAINING WALLS
1 HARRY'S PLACE, KAWAKAWA

Client ANNETTE WYNYARD

Project No. 24 077 | RC no. N/A

DWG No. **G06**

Sheet No. **6** of **6**

Plotted By Josh Curreen at 21/08/2024 9:36:44 am

HAIGH WORKMAN LTD
Civil & Structural Engineers

APPENDIX B – Investigation Logs

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New Zealand

HAIGH WORKMAN LTD
Civil & Structural Engineers

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info@haighworkman.co.nz

Borehole Log - BH01

Hole Location: Refer to Site Plan

JOB No. 24 077

CLIENT:	Annette Wynyard	**SITE:**	1 Harry's Place, Kawakawa		
Date Started:	02/05/2024	**DRILLING METHOD:**	Hand Auger	**LOGGED BY:**	JMC
Date Completed:	02/05/2024	**HOLE DIAMETER (mm)**	50mm	**CHECKED BY:**	WT

Soil Description

Based on NZGS Logging Guidelines 2005

TOPSOIL/FILL; clayey SILT, grey brown. Moist, trace rootlets.

Clayey SILT; orange brown streaked light grey. Very stiff, moist, low plasticity. Occasional fine well weathered clasts.
[WAIPAPA GROUP]

At 1.2m: Becoming light grey streaked orange brown.

At 1.8m: 50mm band of fine gravel (limonite stained).

Silty CLAY; light whitish grey streaked orange brown. Very stiff, moist, high plasticity.

Clayey SILT; orange brown. Very stiff, moist, low plasticity.

End of hole at 3.0m (Target depth)

Depth (m): 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

Geology: TS; WAIPAPA GROUP

Graphic Log

Water Level: Groundwater Not Encountered

Sensitivity: 3; 2; 2

Vane Shear and Remoulded Vane Shear Strengths (kPa)

Corrected vane	Remoulded vane
146	43
201+	
201+	
201+	
143	66
169	69

Scala Penetrometer (blows/100mm): 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.
Hand Held Shear Vane S/N: 2220
Scala penetrometer testing not undertaken.

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New Zealand

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Borehole Log - BH02

Hole Location: Refer to Site Plan

JOB No. 24 077

CLIENT:	Annette Wynyard	**SITE:**	1 Harry's Place, Kawakawa		
Date Started:	02/05/2024	**DRILLING METHOD:**	Hand Auger	**LOGGED BY:**	JP
Date Completed:	02/05/2024	**HOLE DIAMETER (mm)**	50mm	**CHECKED BY:**	WT

Soil Description (Based on NZGS Logging Guidelines 2005)	Depth (m)	Geology	Graphic Log	Water Level	Sensitivity	Vane Shear and Remoulded Vane Shear Strengths (kPa)	Scala Penetrometer (blows/100mm)
TOPSOIL/FILL; SILT, minor clay, brownish grey mottled orange. Firm, moist, low plasticity, minor rootlets.	0.0	TS		Groundwater Not Encountered			0 5 10 15 20
SILT; some clay, light whitish grey streaked orange. Very stiff, moist, low plasticity. *[WAIPAPA GROUP]*		WAIPAPA GROUP			4	141 / 34	
SILT; minor clay and fine gravel, light whitish grey streaked orange. Very stiff, moist, low plasticity. *At 0.8m: gravel absent.*	0.5				3	152 / 59	
At 1.5m: trace fine gravel, dark orange.	1.0					UTP	
SILT; minor clay, trace fine to medium gravel (limonite stained), orange mottled light grey. Very stiff, moist, low plasticity.	1.5						
Clayey SILT; light whitish grey streaked light orange. Very stiff, wet, low plasticity.	2.0				3	190 / 72	
SILT; minor clay, trace fine gravel, orange streaked light grey. Very stiff, moist, low plasticity.							
SILT; some clay, light orange streaked whitish grey. Very stiff, moist, low plasticity. *At 2.7m: Becoming light whitish grey streaked light orange.*	2.5				3	155 / 59	
End of hole at 3.0m (Target depth)	3.0					UTP	
	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.
Hand Held Shear Vane S/N: 2278
Scala penetrometer testing not undertaken.

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Borehole Log - BH03

Hole Location: Refer to Site Plan

JOB No. 24 077

CLIENT:	Annette Wynyard	**SITE:**	1 Harry's Place, Kawakawa		
Date Started:	02/05/2024	**DRILLING METHOD:**	Hand Auger	**LOGGED BY:**	JP
Date Completed:	02/05/2024	**HOLE DIAMETER (mm)**	50mm	**CHECKED BY:**	WT

Soil Description

Based on NZGS Logging Guidelines 2005

SILT; minor clay and fine gravel, dark brown and brown mixed orange and pink. Stiff, moist, low plasticity. *[UN-CERTIFIED FILL]*

Clayey SILT; orange and light grey streaked pinkish red. Very stiff, moist, low plasticity. *[WAIPAPA GROUP]*

SILT; some clay, light grey streaked orange. Very stiff, moist, low plasticity

Clayey SILT; light whitish grey streaked orange. Very stiff, moist, moderate plasticity.

At 1.5m: Becoming light orange streaked light whitish grey.

SILT; some clay, light whitish grey streaked light orange. Very stiff, moist, low plasticity.

End of hole at 2.0m (Target depth)

Depth (m): 0.0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

Geology: FILL; WAIPAPA GROUP

Graphic Log

Water Level: Groundwater Not Encountered

Sensitivity: 6, 6, 3

Vane Shear and Remoulded Vane Shear Strengths (kPa): 155, 28; 241+; 196, 31; 172, 59

Scala Penetrometer (blows/100mm): 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.
Hand Held Shear Vane S/N: 2278
Scala penetrometer testing not undertaken.

HAIGH WORKMAN LTD
Civil & Structural Engineers

APPENDIX C – Design Calculations

Project Name: 24 077
Doc No.:

1 Harry's Place

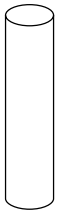
Subject: By: J. Curreen Date: May 2024

RW01 - 1.5m

Verified By: W. Thorburn Date: May 2024

Material Properties for Timber Pole

E =	8.70	GPa	(Young Modulus) [MGS8, NZS3603 Amendement 4, Table 2.3]	
	8.70E+06	kPa		
ρ =	450	kg/m^3	(Density)	
S =	1	m c/c	(Spacing between piles)	0.275 m ϕ
A =	0.059	m^2	(Sectional Area)	
I =	2.80738E-04	m^4	(Area Moment of Inertia) per pile	
EA =	5.167E+05	kN/m = [kN/m^2][m^2]/[m]		
EI =	2442.42	kNm^2/m = [kN/m^2][m^4]/[m]		
w =	0.262	kN/m/m = [kg/m^3][m/s^2][m^2]/[m]		
I	2.807E-04	m^4/m	per unit length of wall	
EI	2.4424E-03	kNm^2/m = [kN/m^2][m^4]/[m] per unit length of wall		



Static Loading Check

	(m)	(kNm/m) BM	(kN/m SF	c/c (m)
Max Height	1.8	10.6	10.8	1
	(1.5m out of ground)			
Load factor =		1.5		

DESIGN (kNm) BM	(kN) SF	fos	disp (mm)	pole size (mm)	Embedmer (m)	Total length (m)
15.9	16.2	1.5	14	275	1.9	3.7

pole design (maximum) (kNm) BM	(kN) SF
30	64
OK	OK

Seismic Loading Check

	(m)	(kNm/m) BM	(kN/m SF	c/c (m)
Max Height	1.8	13.9	14.2	1
	(1.5m out of ground)			
Load factor =		1		

DESIGN (kNm) BM	(kN) SF	fos	disp (mm)	pole size (mm)	Embedmer (m)	Total length (m)
13.9	14.2	1.25	19	275	1.9	3.7

pole design (maximum) (kNm) BM	(kN) SF
30	64
OK	OK

Impact Loading Check (crash barrier) CRITICAL CASE

	(m)	(kNm/m) BM	(kN/m SF	c/c (m)
Max Height	1.5	46.4	42.2	1
Load factor =		1		

DESIGN (kNm) BM	(kN) SF	fos	disp (mm)	pole size (mm)	Embedmer (m)	Total length (m)
46.4	42.2	1.23	n/a	275	2 *(full passive)*	3.5

pole design (maximum) (kNm) BM	(kN) SF	
50	106	*<-For short term loading (k1 = 1.0)*
OK	OK	

Project Name: 24 077
Doc No.:

1 Harry's Place

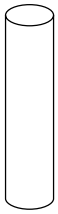
Subject: By: J. Curreen Date: May 2024

RW01 - 2.0m

Verified By: W. Thorburn Date: May 2024

Material Properties for Timber Pole

E =	8.70	GPa	(Young Modulus) [MGS8, NZS3603 Amendement 4, Table 2.3]	
	8.70E+06	kPa		
ρ =	450	kg/m^3	(Density)	
S =	1	m c/c	(Spacing between piles)	0.300 m ϕ
A =	0.071	m^2	(Sectional Area)	
I =	3.97608E-04	m^4	(Area Moment of Inertia) per pile	
EA =	6.150E+05	kN/m = [kN/m^2][m^2]/[m]		
EI =	3459.19	kNm^2/m = [kN/m^2][m^4]/[m]		
w =	0.312	kN/m/m = [kg/m^3][m/s^2][m^2]/[m]		
I	3.976E-04	m^4/m	per unit length of wall	
EI	3.4592E-03	kNm^2/m = [kN/m^2][m^4]/[m] per unit length of wall		



Static Loading Check

	(m)	(kNm/m) BM	(kN/m SF	c/c (m)
Max Height	2.3	20.2	16	1
	(2.0m out of ground)			
Load factor =		1.5		

DESIGN (kNm) BM	(kN) SF	fos	disp (mm)	pole size (mm)	Embedmer (m)	Total length (m)
30.3	24	1.52	29	300	2.5	4.8

pole design (maximum) (kNm) BM	(kN) SF
41	78
OK	OK

Seismic Loading Check

	(m)	(kNm/m) BM	(kN/m SF	c/c (m)
Max Height	2.3	25.9	20.8	1
Load factor =		1		

DESIGN (kNm) BM	(kN) SF	fos	disp (mm)	pole size (mm)	Embedmer (m)	Total length (m)
25.9	20.8	1.25	38	300	2.5	4.8

pole design (maximum) (kNm) BM	(kN) SF
41	78
OK	OK

Impact Loading Check (crash barrier) CRITICAL CASE

	(m)	(kNm/m) BM	(kN/m SF	c/c (m)
Max Height	2	61.5	50.9	1
Load factor =		1		

DESIGN (kNm) BM	(kN) SF	fos	disp (mm)	pole size (mm)	Embedmer (m)	Total length (m)
61.5	50.9	1.27	n/a	300	2.8 *(full passive)*	4.8

pole design (maximum) (kNm) BM	(kN) SF	
69	129	*<-For short term loading (k1 = 1.0)*
OK	OK	

Project Name: 24 077
Doc No.:

1 Harry's Place

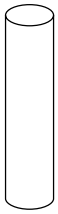
Subject: By: J. Curreen Date: May 2024

RW01 - 2.5m

Verified By: W. Thorburn Date: May 2024

Material Properties for Timber Pole

E =	8.70	GPa	(Young Modulus) [MGS8, NZS3603 Amendement 4, Table 2.3]	
	8.70E+06	kPa		
ρ =	450	kg/m^3	(Density)	
S =	1	m c/c	(Spacing between piles)	0.325 m ϕ
A =	0.083	m^2	(Sectional Area)	
I =	5.47650E-04	m^4	(Area Moment of Inertia) per pile	
EA =	**7.217E+05**	kN/m = [kN/m^2][m^2]/[m]		
EI =	**4764.56**	kNm^2/m = [kN/m^2][m^4]/[m]		
w =	**0.366**	kN/m/m = [kg/m^3][m/s^2][m^2]/[m]		
I	5.477E-04	m^4/m	per unit length of wall	
EI	4.7646E-03	kNm^2/m = [kN/m^2][m^4]/[m] per unit length of wall		



Static Loading Check

	(m)	(kNm/m) BM	(kN/m SF	c/c (m)
Max Height	2.8	34	23.7	1
	(2.5m out of ground)			
Load factor =		1.5		

DESIGN (kNm) BM	(kN) SF	fos	disp (mm)	pole size (mm)	Embedmer (m)	Total length (m)
51	35.55	1.56	32	325	3	5.8

pole design (maximum) (kNm) BM	(kN) SF
53	96
OK	OK

Seismic Loading Check

	(m)	(kNm/m) BM	(kN/m SF	c/c (m)
Max Height	2.8	43.1	30	1
Load factor =		1		

DESIGN (kNm) BM	(kN) SF	fos	disp (mm)	pole size (mm)	Embedmer (m)	Total length (m)
43.1	30	1.28	67	325	3	5.8

pole design (maximum) (kNm) BM	(kN) SF
53	96
OK	OK

Impact Loading Check (crash barrier) CRITICAL CASE

	(m)	(kNm/m) BM	(kN/m SF	c/c (m)
Max Height	2.5	78.9	56.7	1
Load factor =		1		

DESIGN (kNm) BM	(kN) SF	fos	disp (mm)	pole size (mm)	Embedmer (m)	Total length (m)
78.9	56.7	1.35	n/a	325	3.3 *(full passive)*	5.8

pole design (maximum) (kNm) BM	(kN) SF	
88	160	*<-For short term loading (k1 = 1.0)*
OK	OK	

Project	1 Harry's Place, Kawakawa
Client	A. Wynyard
Job No	24 077
Date	23/05/2024
Calculated by:	J. Curreen
Reviewed by:	W. Thorburn
Comments	RW01

Factored load on the plank at the base of the wall = **25.65** **kPa**

From Wallap

2.5 Height (m)
17.1 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	2.1	Height (m)
Lagging depth d =	150	150	14.8	kPa
For a maximum soil pressure of 25.65 kPa. The UDL on lagging "d" =	3.85	kN/m	2	Rails Required
Lagging Span "L" =	1.2	m		
Maximum factored moment M* = 1/8 dL^2	**0.693**	**kNm**	0.9	Height (m)
			7.6	kPa
Under Flexure, calculate the minimum lagging depth for moment capacity			1	Rails Required

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!

Rails	Height
Single	0 to 0.9
Double	0.9 - 2.1
Triple	2.1 - 2.5

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* =	**2.886**	**kN**
Percentage of Shear capacity utilised	50%	

$$V^* = 0.625wL$$

Lagging OK for Shear Capacity!

Use 150 x (3)50 lagging, spanning continuously across a minimum of 2 pole spacings

HAIGH WORKMAN LTD
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Job Title: 1 HARRY'S PLACE

CRASH BARRIER DESIGN

Page 1 of 1
Job No. 24077
Designer JMC
Date MAY 2024

Crash impact load from AS/NZS 1170.1 - Light Traffic (Type F)
→ 30 kN per 1.5m length of wall,
0.5m above top of wall.

$w = 30/1.5 = 20$ kN/m length of wall

$l = 1.0$m (pole spacing)

$BM = \frac{wl^2}{8} = \frac{20 \times 1.0^2}{8} = 2.5$ kN.m

$$*M = 1.5 \times 2.5 = 3.75 \text{ kN.m}$$

For SG8 timber, $f_b = 11.7$ MPa (Try 125mm post)

$\phi M_n = k_1 . \phi . f_b . Z$ (Use duration factor, $k_1 = 1.0$)

$$3.75 = 1.0 \times 0.8 \times 11.7 \times \left(\frac{125 \times d^2}{6 \times 10^6}\right)$$

$\Rightarrow d = \underline{138.7 \text{ mm}}$
(would need 2× posts).

Try $2/125^2$ rails:

$$\phi M_n = 2 \times 1.0 \times 0.8 \times 11.7 \times \left(\frac{125 \times 125^2}{6 \times 10^6}\right)$$
$$= 6.09 \text{ kN.m}$$

$\phi M_n > *M \Rightarrow$ OKAY.
(6.09) (3.75)

Use 2/125×125 SG8 rails
H4 treated, staggered,
continous over min. 2 spans.

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 Retained fill c'=0	1 Retained fill c'=0
2	-1.50	3 Residual Waipapa	3 Residual Waipapa

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	Retained fill c'=0	17.00	10000	0.500	NC (0.250)	0.338 (1.357)	3.148 (4.404)	0.0d
2	Retained fill	17.00	10000	0.500	OC (0.250)	0.338 (1.357)	3.148 (4.404)	3.000d
3	Residual Waipapa	18.00	25000	0.500	OC (0.250)	0.285 (1.238)	3.886 (4.998)	5.000d

Additional soil parameters associated with Ka and Kp

No.	Soil type 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	Retained fill c'=0	26.00	0.640	0.00	26.00	0.312	0.00
2	Retained fill	26.00	0.640	0.00	26.00	0.312	0.00
3	Residual Waipapa	30.00	0.631	0.00	30.00	0.305	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	-6.00	-6.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Soldier Pile Wall
Soldier Pile width = 0.28 m
Soldier Pile spacing = 1.00 m
Passive mobilisation factor = 3.00
Elevation of toe of wall = -3.70
Maximum finite element length = 0.20 m
Youngs modulus of wall E = 8.7000E+06 kN/m2
Moment of inertia of wall I = 2.8070E-04 m4/m run
= 2.8070E-04 m4 per pile
E.I = 2442.1 kN.m2/m run
Yield Moment of wall = Not defined

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	0.20(L)	12.00	3.00	10.00	=	N/A	N/A
2	-1.80	-0.00(R)	12.00	3.00	5.40	=	N/A	N/A

Note: L = Left side, R = Right side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Excavate to elevation -1.80 on RIGHT side
2	Apply surcharge no.1 at elevation 0.00
3	Apply surcharge no.2 at elevation -1.80

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) = 1000.00 m

Width of excavation on Left side of wall = 20.00 m
Width of excavation on Right side of wall = 20.00 m

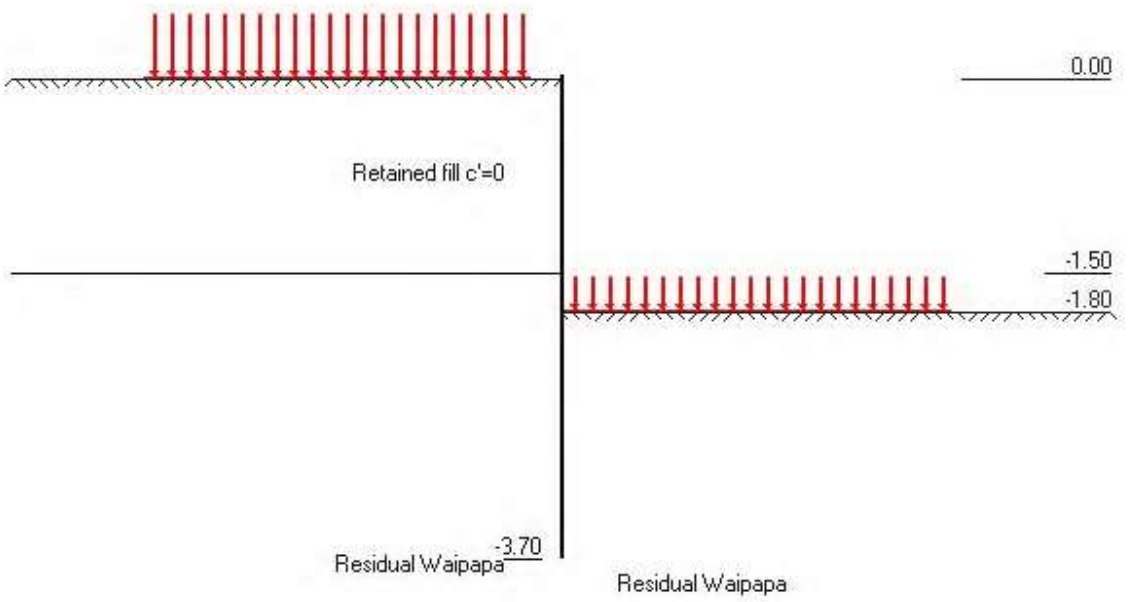
Distance to rigid boundary on Left side = 20.00 m
Distance to rigid boundary on Right side = 20.00 m

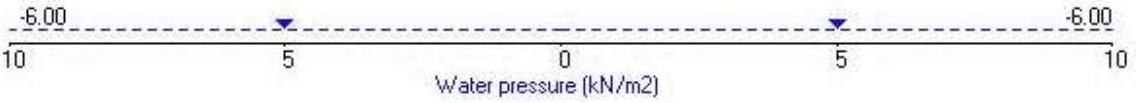
OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Excav. to elev. -1.80 on RIGHT side	Yes	Yes	Yes
2	Apply surcharge no.1 at elev. 0.00	No	No	No
3	Apply surcharge no.2 at elev. -1.80	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.3 Apply surcharge no.2 at elev. -1.80





Units: kN,m

Stage No. 3 Apply surcharge no.2 at elevation -1.80

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	Ground level Act.	Pass.	Prop Elev.	**FoS for toe elev. = -3.70** 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.	1.490	-3.40	***	***	L to R

Legend: *** Result not found

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.28m; spacing = 1.00m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 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	0.014	6.51E-03	0.0	-0.0	
2	-0.20	1.76	0.013	6.51E-03	0.2	0.0	
3	-0.40	3.82	0.012	6.51E-03	0.7	0.1	
4	-0.60	5.49	0.011	6.49E-03	1.7	0.3	
5	-0.80	6.97	0.009	6.44E-03	2.9	0.8	
6	-1.00	8.33	0.008	6.35E-03	4.4	1.5	
7	-1.20	9.62	0.007	6.18E-03	6.2	2.6	
8	-1.35	10.56	0.006	5.99E-03	7.7	3.6	
9	-1.50	11.48	0.005	5.73E-03	9.4	4.9	
		3.77	0.005	5.73E-03	9.4	4.9	
10	-1.65	4.62	0.004	5.38E-03	10.0	6.4	
11	-1.80	5.45	0.003	4.95E-03	10.8	7.9	
		-17.24	0.003	4.95E-03	10.8	7.9	
12	-2.00	-27.78	0.002	4.22E-03	6.3	9.7	
13	-2.20	-38.00	0.002	3.39E-03	-0.3	10.6	
14	-2.40	-21.89	0.001	2.55E-03	-6.3	9.8	
15	-2.60	-8.90	0.001	1.82E-03	-9.4	8.1	
16	-2.80	0.13	0.000	1.24E-03	-10.2	6.1	
17	-3.00	6.17	0.000	8.30E-04	-9.6	4.0	
18	-3.20	10.89	-0.000	5.75E-04	-7.9	2.2	
19	-3.40	15.06	-0.000	4.49E-04	-5.3	0.9	
20	-3.55	17.74	-0.000	4.16E-04	-2.9	0.2	
21	-3.70	20.31	-0.000	4.09E-04	0.0	-0.0	

(continued)

Stage No.3 Apply surcharge no.2 at elevation -1.80

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
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11140
2	-0.20	0.00	5.22	1.76	16.42	1.76	1.76a	11140
3	-0.40	0.00	11.29	3.82	35.55	3.82	3.82a	11140
4	-0.60	0.00	16.21	5.48	51.04	5.49	5.49	2450
5	-0.80	0.00	20.48	6.92	64.46	6.97	6.97	2450
6	-1.00	0.00	24.39	8.25	76.80	8.33	8.33	2450
7	-1.20	0.00	28.11	9.51	88.49	9.62	9.62	2450
8	-1.35	0.00	30.81	10.42	96.99	10.56	10.56	2450
9	-1.50	0.00	33.45	11.31	105.30	11.48	11.48	2450
		0.00	33.45	3.35	154.96	3.77	3.77	6124
10	-1.65	0.00	36.20	4.13	165.63	4.62	4.62	6124
11	-1.80	0.00	38.91	4.91	176.16	5.45	5.45	6124
		0.00	38.91	4.91	145.33	5.45	5.45	6124
12	-2.00	0.00	42.48	5.92	156.78	6.55	6.55	6124
13	-2.20	0.00	46.00	6.93	168.08	7.62	7.62	6124
14	-2.40	0.00	49.50	7.93	179.29	13.34	13.34	6124
15	-2.60	0.00	52.97	8.92	190.41	19.21	19.21	6124
16	-2.80	0.00	56.42	9.90	201.55	23.82	23.82	6124
17	-3.00	0.00	59.85	10.88	212.74	27.49	27.49	6124
18	-3.20	0.00	63.28	11.86	223.89	31.04	31.04	6124
19	-3.40	0.00	66.69	12.83	235.02	34.66	34.66	6124
20	-3.55	0.00	69.25	13.56	243.36	37.19	37.19	6124
21	-3.70	0.00	71.81	14.29	251.69	39.67	39.67	6124

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	-1.35	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	-1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	-1.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	-1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	5.40	0.00	38.79	22.69	22.69	6520
12	-2.00	0.00	9.00	0.00	50.50	34.33	34.33	6520
13	-2.20	0.00	12.59	0.00	62.20	45.62	45.62	6520
14	-2.40	0.00	16.18	0.00	73.88	35.24	35.24	6520
15	-2.60	0.00	19.76	0.00	85.51	28.11	28.11	6520
16	-2.80	0.00	23.32	0.46	97.11	23.69	23.69	6520
17	-3.00	0.00	26.87	1.47	108.66	21.32	21.32	6520
18	-3.20	0.00	30.41	2.48	120.17	20.15	20.15	6520
19	-3.40	0.00	33.93	3.49	131.63	19.61	19.61	6520
20	-3.55	0.00	36.56	4.24	140.20	19.45	19.45	6520
21	-3.70	0.00	39.19	4.99	148.75	19.36	19.36	6520

Note: 3.82a Soil pressure at active limit
123.45p Soil pressure at passive limit

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.	Pass.	Prop Elev.	FoS for toe elev. = -3.70 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.500 Toe elev.	Wall Penetr -ation	Direction of failure
1	0.00	-1.80	Cant.	1.532	-3.43	-3.64	1.84	L to R
2	0.00	-1.80	Cant.	1.320	-3.44	***	***	L to R
3	0.00	-1.80	Cant.	1.490	-3.40	***	***	L to R

Legend: *** Result not found

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.28m; spacing = 1.00m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 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	0.014	0.000	0.0	-0.0	0.0	0.0
2	-0.20	0.013	0.000	0.0	0.0	0.2	0.0
3	-0.40	0.012	0.000	0.1	0.0	0.7	0.0
4	-0.60	0.011	0.000	0.3	0.0	1.7	0.0
5	-0.80	0.009	0.000	0.8	0.0	2.9	0.0
6	-1.00	0.008	0.000	1.5	0.0	4.4	0.0
7	-1.20	0.007	0.000	2.6	0.0	6.2	0.0
8	-1.35	0.006	0.000	3.6	0.0	7.7	0.0
9	-1.50	0.005	0.000	4.9	0.0	9.4	0.0
10	-1.65	0.004	0.000	6.4	0.0	10.0	0.0
11	-1.80	0.003	0.000	7.9	0.0	10.8	0.0
12	-2.00	0.002	0.000	9.7	0.0	6.3	0.0
13	-2.20	0.002	0.000	10.6	0.0	0.0	-2.3
14	-2.40	0.001	0.000	9.8	0.0	0.0	-6.3
15	-2.60	0.001	0.000	8.1	0.0	0.0	-9.4
16	-2.80	0.000	0.000	6.1	0.0	0.0	-10.2
17	-3.00	0.000	0.000	4.0	0.0	0.0	-9.6
18	-3.20	0.000	-0.000	2.2	0.0	0.0	-7.9
19	-3.40	0.000	-0.000	0.9	0.0	0.0	-5.3
20	-3.55	0.000	-0.000	0.2	0.0	0.0	-2.9
21	-3.70	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	Bending moment elev.	Bending moment minimum	Bending moment elev.	Shear force maximum	Shear force elev.	Shear force minimum	Shear force elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	6.4	-2.20	-0.0	0.00	7.0	-1.80	-6.0	-2.60
2	10.5	-2.20	-0.0	0.00	10.6	-1.80	-10.1	-2.80
3	10.6	-2.20	-0.0	0.00	10.8	-1.80	-10.2	-2.80

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum	Displacement elev.	Displacement minimum	Displacement elev.	Stage description
	m		m		
1	0.008	0.00	0.000	0.00	Excav. to elev. -1.80 on RIGHT side
2	0.014	0.00	-0.000	-3.70	Apply surcharge no.1 at elev. 0.00
3	0.014	0.00	-0.000	-3.70	Apply surcharge no.2 at elev. -1.80

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 Retained fill c'=0	1 Retained fill c'=0
2	-1.50	3 Residual Waipapa	3 Residual Waipapa

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	Retained fill c'=0	17.00	10000	0.500	NC (0.250)	0.338 (1.357)	3.148 (4.404)	0.0d
2	Retained fill	17.00	10000	0.500	OC (0.250)	0.338 (1.357)	3.148 (4.404)	3.000d
3	Residual Waipapa	18.00	25000	0.500	OC (0.250)	0.285 (1.238)	3.886 (4.998)	5.000d

Additional soil parameters associated with Ka and Kp

No.	Soil type 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	Retained fill c'=0	26.00	0.640	0.00	26.00	0.312	0.00
2	Retained fill	26.00	0.640	0.00	26.00	0.312	0.00
3	Residual Waipapa	30.00	0.631	0.00	30.00	0.305	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	-6.00	-6.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Soldier Pile Wall
Soldier Pile width = 0.28 m
Soldier Pile spacing = 1.00 m
Passive mobilisation factor = 3.00
Elevation of toe of wall = -3.70
Maximum finite element length = 0.20 m
Youngs modulus of wall E = 8.7000E+06 kN/m2
Moment of inertia of wall I = 2.8070E-04 m4/m run
= 2.8070E-04 m4 per pile
E.I = 2442.1 kN.m2/m run
Yield Moment of wall = Not defined

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	0.20(L)	12.00	3.00	10.00	=	0	N/A
2	-1.80	-0.00(R)	12.00	3.00	5.40	=	0	N/A

Note: L = Left side, R = Right side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Excavate to elevation -1.80 on RIGHT side
2	Apply surcharge no.1 at elevation 0.00
3	Apply surcharge no.2 at elevation -1.80
4	Apply seismic loading: 0.0800g horizontal Line of action of quasi-static seismic force = 0.333 Seismic loading model: Quasi-static loading

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.00
Active limit pressures by Wedge Stability (Seismic Stages only)
Passive limit pressures by Wedge Stability (Seismic Stages only)

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) = 1000.00 m

Width of excavation on Left side of wall = 20.00 m
Width of excavation on Right side of wall = 20.00 m

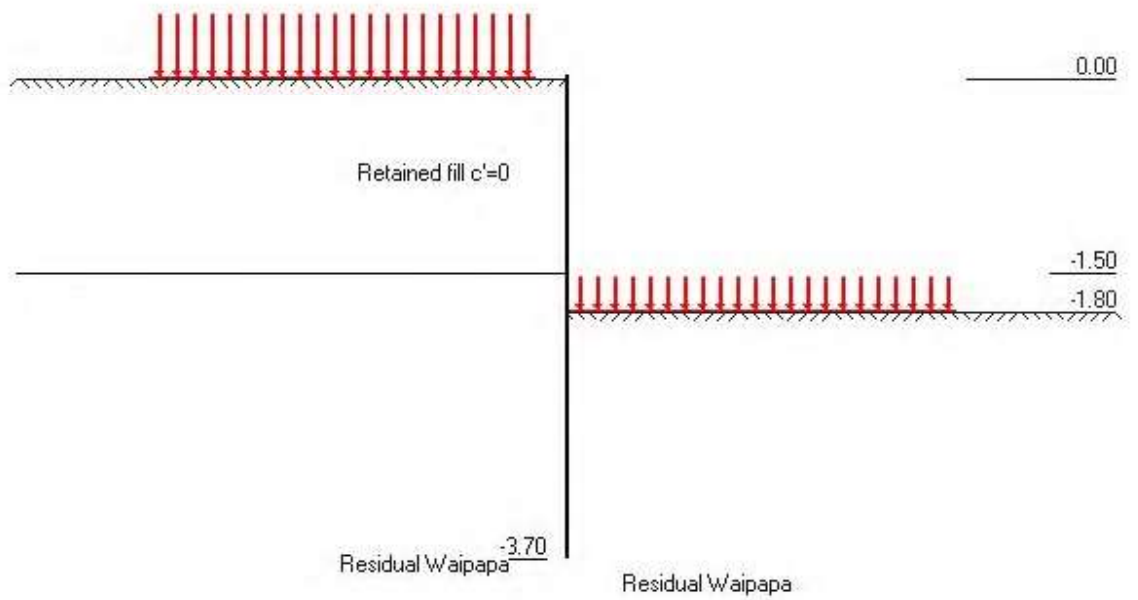
Distance to rigid boundary on Left side = 20.00 m
Distance to rigid boundary on Right side = 20.00 m

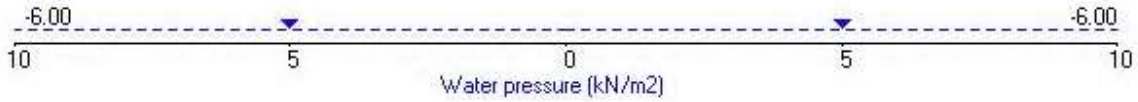
OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Excav. to elev. -1.80 on RIGHT side	Yes	Yes	Yes
2	Apply surcharge no.1 at elev. 0.00	No	No	No
3	Apply surcharge no.2 at elev. -1.80	Yes	Yes	Yes
4	Quasi-static Seismic load: 0.080g(H)	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.4 Quasi-static Seismic load: 0.080g(H)





Units: kN,m

Stage No. 4 Apply seismic loading:
0.0800g horizontal
Line of action of quasi-static seismic force = 0.333
Seismic loading model: Quasi-static loading

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength
Active limit pressures by Wedge Stability (Seismic Stages only)
Passive limit pressures by Wedge Stability (Seismic Stages only)

Stage No.	Ground level Act.	Pass.	Prop Elev.	FoS for toe elev. = -3.70 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr-ation	Direction of failure
4	0.00	-1.80	Cant.	1.258	-3.41	-3.06	1.26	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.28m; spacing = 1.00m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Active limit pressures by Wedge Stability (Seismic Stages only)
Passive limit pressures by Wedge Stability (Seismic Stages only)

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 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	0.019	8.78E-03	0.0	0.0	
2	-0.20	4.44	0.017	8.78E-03	0.4	0.0	
3	-0.40	7.15	0.015	8.77E-03	1.6	0.2	
4	-0.60	6.73	0.014	8.73E-03	3.0	0.7	
5	-0.80	8.50	0.012	8.65E-03	4.5	1.4	
6	-1.00	10.12	0.010	8.49E-03	6.4	2.5	
7	-1.20	11.67	0.009	8.22E-03	8.6	4.0	
8	-1.35	12.78	0.007	7.93E-03	10.4	5.4	
9	-1.50	13.88	0.006	7.55E-03	12.4	7.1	
		4.77	0.006	7.55E-03	12.4	7.1	
10	-1.65	5.89	0.005	7.05E-03	13.2	9.0	
11	-1.80	6.99	0.004	6.43E-03	14.2	11.1	
		-36.17	0.004	6.43E-03	14.2	11.1	
12	-2.00	-39.36	0.003	5.44E-03	6.6	13.2	
13	-2.20	-43.65	0.002	4.33E-03	-1.7	13.9	
14	-2.40	-27.10	0.001	3.24E-03	-8.8	12.7	
15	-2.60	-9.92	0.001	2.29E-03	-12.5	10.4	
16	-2.80	1.40	0.000	1.55E-03	-13.3	7.7	
17	-3.00	8.77	-0.000	1.03E-03	-12.3	5.1	
18	-3.20	14.36	-0.000	7.11E-04	-10.0	2.8	
19	-3.40	19.14	-0.000	5.53E-04	-6.7	1.1	
20	-3.55	22.21	-0.000	5.12E-04	-3.6	0.3	
21	-3.70	25.15	-0.000	5.03E-04	0.0	-0.0	

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Stage No.4 Apply seismic loading:
0.0800g horizontal
Line of action of quasi-static seismic force = 0.333
Seismic loading model: Quasi-static loading

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
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4142
2	-0.20	0.00	5.22	4.44	16.42	4.44	4.44a	4142
3	-0.40	0.00	11.29	7.15	40.17	7.15	7.15a	4142
4	-0.60	0.00	16.21	6.73	64.30	6.73	6.73a	4142
5	-0.80	0.00	20.48	8.50	81.20	8.50	8.50a	4142
6	-1.00	0.00	24.39	10.12	96.74	10.12	10.12a	4142
7	-1.20	0.00	28.11	11.67	111.48	11.67	11.67a	4142
8	-1.35	0.00	30.81	12.78	122.17	12.78	12.78a	4142
9	-1.50	0.00	33.45	13.88	132.65	13.88	13.88a	4142
		0.00	33.45	4.77	142.78	4.77	4.77a	10355
10	-1.65	0.00	36.20	5.89	152.61	5.89	5.89a	10355
11	-1.80	0.00	38.91	6.99	162.31	6.99	6.99a	10355
		0.00	38.91	6.99	133.91	6.99	6.99a	10355
12	-2.00	0.00	42.48	8.44	144.45	8.44	8.44a	10355
13	-2.20	0.00	46.00	9.87	154.87	9.87	9.87a	10355
14	-2.40	0.00	49.50	11.29	165.19	11.85	11.85	10355
15	-2.60	0.00	52.97	12.70	175.44	18.91	18.91	10355
16	-2.80	0.00	56.42	14.10	185.63	24.46	24.46	13105
17	-3.00	0.00	59.85	15.50	195.78	28.79	28.79	13105
18	-3.20	0.00	63.28	16.77	206.96	32.77	32.77	13105
19	-3.40	0.00	66.69	18.01	218.23	36.71	36.71	13105
20	-3.55	0.00	69.25	19.04	225.87	39.43	39.43	13105
21	-3.70	0.00	71.81	20.06	233.50	42.09	42.09	13105

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	-1.35	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	-1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	-1.65	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	-1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	5.40	0.00	43.77	43.16	43.16	25884
12	-2.00	0.00	9.00	0.00	51.04	47.80	47.80	25884
13	-2.20	0.00	12.59	0.00	55.54	53.52	53.52	25884
14	-2.40	0.00	16.18	0.00	65.93	38.96	38.96	25884
15	-2.60	0.00	19.76	0.00	76.29	28.83	28.83	24796
16	-2.80	0.00	23.32	0.00	86.62	23.06	23.06	13105
17	-3.00	0.00	26.87	0.00	96.90	20.02	20.02	13105
18	-3.20	0.00	30.41	0.00	107.12	18.41	18.41	13105
19	-3.40	0.00	33.93	0.00	117.31	17.57	17.57	13105
20	-3.55	0.00	36.56	0.00	121.36	17.22	17.22	13105
21	-3.70	0.00	39.19	0.00	124.95	16.94	16.94	13105

(continued)

Stage No.4 Apply seismic loading:
0.0800g horizontal
Line of action of quasi-static seismic force = 0.333
Seismic loading model: Quasi-static loading

Note: 9.87a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Summary of results

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method
Factor of safety on soil strength
Active limit pressures by Wedge Stability (Seismic Stages only)
Passive limit pressures by Wedge Stability (Seismic Stages only)

Stage No.	Ground level Act.	Pass.	Prop Elev.	FoS for toe elev. = -3.70 Factor of Safety	Moment equilib. at elev.	Toe elev. for FoS = 1.000 Toe elev.	Wall Penetr-ation	Direction of failure
1	0.00	-1.80	Cant.	1.531	-3.43	-2.76	0.96	L to R
2	0.00	-1.80	Cant.	1.320	-3.44	-3.00	1.20	L to R
3	0.00	-1.80	Cant.	1.490	-3.40	-2.80	1.00	L to R
4	0.00	-1.80	Cant.	1.258	-3.41	-3.06	1.26	L to R

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.28m; spacing = 1.00m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached
Active limit pressures by Wedge Stability (Seismic Stages only)
Passive limit pressures by Wedge Stability (Seismic Stages only)

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 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	0.019	0.000	0.0	-0.0	0.0	0.0
2	-0.20	0.017	0.000	0.0	0.0	0.4	0.0
3	-0.40	0.015	0.000	0.2	0.0	1.6	0.0
4	-0.60	0.014	0.000	0.7	0.0	3.0	0.0
5	-0.80	0.012	0.000	1.4	0.0	4.5	0.0
6	-1.00	0.010	0.000	2.5	0.0	6.4	0.0
7	-1.20	0.009	0.000	4.0	0.0	8.6	0.0
8	-1.35	0.007	0.000	5.4	0.0	10.4	0.0
9	-1.50	0.006	0.000	7.1	0.0	12.4	0.0
10	-1.65	0.005	0.000	9.0	0.0	13.2	0.0
11	-1.80	0.004	0.000	11.1	0.0	14.2	0.0
12	-2.00	0.003	0.000	13.2	0.0	6.6	0.0
13	-2.20	0.002	0.000	13.9	0.0	0.0	-2.3
14	-2.40	0.001	0.000	12.7	0.0	0.0	-8.8
15	-2.60	0.001	0.000	10.4	0.0	0.0	-12.5
16	-2.80	0.000	0.000	7.7	0.0	0.0	-13.3
17	-3.00	0.000	-0.000	5.1	0.0	0.0	-12.3
18	-3.20	0.000	-0.000	2.8	0.0	0.0	-10.0
19	-3.40	0.000	-0.000	1.1	0.0	0.0	-6.7
20	-3.55	0.000	-0.000	0.3	0.0	0.0	-3.6
21	-3.70	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	Bending moment elev.	Bending moment minimum	Bending moment elev.	Shear force maximum	Shear force elev.	Shear force minimum	Shear force elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	6.4	-2.20	-0.0	0.00	7.0	-1.80	-6.0	-2.60
2	10.5	-2.20	-0.0	0.00	10.6	-1.80	-10.1	-2.80
3	10.6	-2.20	-0.0	0.00	10.8	-1.80	-10.2	-2.80
4	13.9	-2.20	-0.0	-3.70	14.2	-1.80	-13.3	-2.80

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum	Displacement elev.	Displacement minimum	Displacement elev.	Stage description
	m		m		
1	0.008	0.00	0.000	0.00	Excav. to elev. -1.80 on RIGHT side
2	0.014	0.00	-0.000	-3.70	Apply surcharge no.1 at elev. 0.00
3	0.014	0.00	-0.000	-3.70	Apply surcharge no.2 at elev. -1.80
4	0.019	0.00	-0.000	-3.70	Quasi-static Seismic load: 0.080g(H)

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 Retained fill c'=0	1 Retained fill c'=0
2	-1.50	3 Residual Waipapa	3 Residual Waipapa

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	Retained fill c'=0	17.00	10000	0.500	NC (0.250)	0.338 (1.357)	3.148 (4.404)	0.0d
2	Retained fill	17.00	10000	0.500	OC (0.250)	0.338 (1.357)	3.148 (4.404)	3.000d
3	Residual Waipapa	18.00	25000	0.500	OC (0.490)	1.000 (2.000)	1.000 (2.000)	75.00u

Additional soil parameters associated with Ka and Kp

No.	Soil type 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	Retained fill c'=0	26.00	0.640	0.00	26.00	0.312	0.00
2	Retained fill	26.00	0.640	0.00	26.00	0.312	0.00
3	Residual Waipapa	0.00	0.000	0.00	0.00	0.000	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	-6.00	-6.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Soldier Pile Wall
Soldier Pile width = 0.28 m
Soldier Pile spacing = 1.00 m
Passive mobilisation factor = 3.00
Elevation of toe of wall = -3.50
Maximum finite element length = 0.20 m
Youngs modulus of wall E = 8.7000E+06 kN/m2
Moment of inertia of wall I = 2.8070E-04 m4/m run
= 2.8070E-04 m4 per pile
E.I = 2442.1 kN.m2/m run
Yield Moment of wall = Not defined

HORIZONTAL and MOMENT LOADS/RESTRAINTS

Load no.	Elevation	Horizontal load kN/m run	Moment load kN.m/m run	Moment restraint kN.m/m/rad	Partial factor (Category)
1	0.50	20.00	0	0	N/A

SURCHARGE LOADS

Surch-arge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge Near edge kN/m2	Surcharge Far edge kN/m2	Equiv. soil type	Partial factor/ Category
1	0.00	0.20(L)	12.00	3.50	2.50	=	N/A	N/A

Note: L = Left side, R = Right side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Excavate to elevation -1.50 on RIGHT side
2	Apply surcharge no.1 at elevation 0.00
3	Apply load no.1 at elevation 0.50

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.00

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) = 1000.00 m

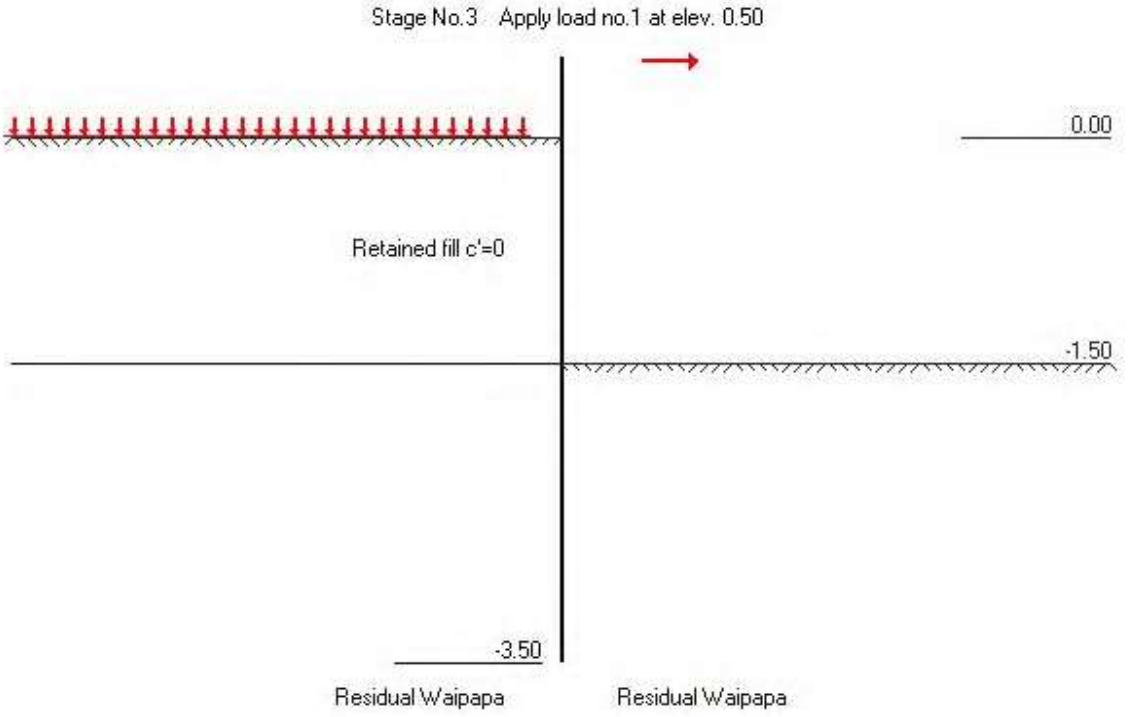
Width of excavation on Left side of wall = 20.00 m
Width of excavation on Right side of wall = 20.00 m

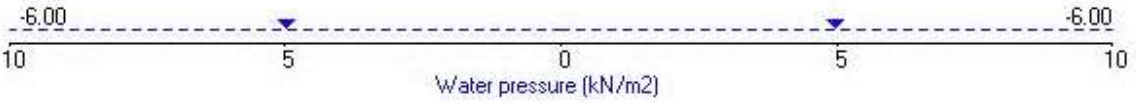
Distance to rigid boundary on Left side = 20.00 m
Distance to rigid boundary on Right side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Excav. to elev. -1.50 on RIGHT side	Yes	Yes	Yes
2	Apply surcharge no.1 at elev. 0.00	No	No	No
3	Apply load no.1 at elev. 0.50	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

Units: kN,m


Stage No.3 Apply load no.1 at elev. 0.50
0.00
Retained fill c'=0
-1.50
-3.50
Residual Waipapa
Residual Waipapa


-6.00
-6.00
10
5
0
5
10
Water pressure (kN/m2)

Units: kN,m

Stage No. 3 Apply load no.1 at elevation 0.50

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	Ground level Act.	Pass.	Prop Elev.	**FoS for toe elev. = -3.50** Factor of Safety	Moment equilib. at elev.	**Toe elev. for FoS = 1.000** Toe elev.	Wall Penetr -ation	Direction of failure
3	0.00	-1.50	Cant.	1.234	-2.78	-3.27	1.77	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.28m; spacing = 1.00m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 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	0.50	0.00	0.074	3.69E-02	20.0	0.0	20.0
2	0.35	0.00	0.068	3.68E-02	20.0	3.0	
3	0.20	0.00	0.063	3.66E-02	20.0	6.0	
4	0.00	0.00	0.056	3.59E-02	20.0	10.0	
5	-0.20	1.30	0.048	3.49E-02	20.1	14.0	
6	-0.40	2.68	0.042	3.36E-02	20.5	18.1	
7	-0.60	3.96	0.035	3.20E-02	21.2	22.2	
8	-0.80	5.18	0.029	3.00E-02	22.1	26.6	
9	-1.00	6.38	0.023	2.76E-02	23.3	31.1	
10	-1.20	7.56	0.018	2.49E-02	24.7	35.9	
11	-1.35	8.43	0.014	2.25E-02	25.9	39.7	
12	-1.50	9.30	0.011	2.00E-02	27.2	43.7	
		-117.57	0.011	2.00E-02	27.2	43.7	
13	-1.65	-119.18	0.008	1.72E-02	9.4	46.4	
14	-1.80	-120.79	0.006	1.44E-02	-8.6	46.4	
15	-2.00	-89.13	0.003	1.07E-02	-29.6	43.0	
16	-2.20	-26.27	0.001	7.54E-03	-41.1	35.3	
17	-2.40	14.95	0.000	5.01E-03	-42.2	26.6	
18	-2.60	28.84	-0.001	3.16E-03	-37.9	18.6	
19	-2.80	36.97	-0.001	1.93E-03	-31.3	11.6	
20	-3.00	42.26	-0.001	1.21E-03	-23.4	6.0	
21	-3.20	46.03	-0.002	8.73E-04	-14.5	2.2	
22	-3.35	48.43	-0.002	7.87E-04	-7.4	0.6	
23	-3.50	50.73	-0.002	7.69E-04	0.0	-0.0	

(continued)

Stage No.3 Apply load no.1 at elevation 0.50

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
1	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	0.00	0.00	0.00	4885
5	-0.20	0.00	3.85	1.30	12.13	1.30	1.30a	4885
6	-0.40	0.00	7.92	2.68	24.95	2.68	2.68a	4885
7	-0.60	0.00	11.71	3.96	36.85	3.96	3.96a	4885
8	-0.80	0.00	15.32	5.18	48.24	5.18	5.18a	4885
9	-1.00	0.00	18.86	6.38	59.37	6.38	6.38a	4885
10	-1.20	0.00	22.34	7.56	70.34	7.56	7.56a	4885
11	-1.35	0.00	24.93	8.43	78.50	8.43	8.43a	4885
12	-1.50	0.00	27.51	9.30	86.62	9.30	9.30a	4885
		Total>	27.51	7.50m	146.46	7.50	7.50a	16273
13	-1.65	Total>	30.23	8.25m	148.83	8.25	8.25a	16273
14	-1.80	Total>	32.94	9.00m	151.20	9.00	9.00a	16273
15	-2.00	Total>	36.54	10.00m	154.35	10.00	10.00a	16273
16	-2.20	Total>	40.13	11.00m	157.49	11.00	11.00a	16273
17	-2.40	Total>	43.72	12.00m	160.62	21.64	21.64	14864
18	-2.60	Total>	47.29	13.00m	163.74	34.34	34.34	14864
19	-2.80	Total>	50.86	14.00m	166.86	43.47	43.47	14864
20	-3.00	Total>	54.43	15.00m	169.98	49.76	49.76	14864
21	-3.20	Total>	57.99	16.00m	173.10	54.53	54.53	14864
22	-3.35	Total>	60.67	16.75m	175.43	57.68	57.68	14864
23	-3.50	Total>	63.33	17.50m	177.76	60.73	60.73	14864

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	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	-0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	-0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	-0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	-0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	-1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	-1.35	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	-1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	125.07	125.07	125.07p	35764
13	-1.65	Total>	2.70	0.75m	127.43	127.43	127.43p	35764
14	-1.80	Total>	5.40	1.50m	129.79	129.79	129.79p	35764
15	-2.00	Total>	9.00	2.50m	132.94	99.13	99.13	35764
16	-2.20	Total>	12.60	3.50m	136.08	37.27	37.27	35764
17	-2.40	Total>	16.20	4.50m	139.23	6.69	6.69	14864
18	-2.60	Total>	19.80	5.50m	142.37	5.50	5.50a	14864
19	-2.80	Total>	23.40	6.50m	145.52	6.50	6.50a	14864
20	-3.00	Total>	27.00	7.50m	148.67	7.50	7.50a	14864
21	-3.20	Total>	30.61	8.50m	151.81	8.50	8.50a	14864
22	-3.35	Total>	33.31	9.25m	154.17	9.25	9.25a	14864

(continued)

Stage No.3 Apply load no.1 at elevation 0.50

		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
23	-3.50	Total>	36.01	10.00m	156.53	10.00	10.00a	14864

Note: 10.00a Soil pressure at active limit
129.79p Soil pressure at passive limit

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.	Pass.	Prop Elev.	**FoS for toe elev. = -3.50** Factor of Safety	Moment equilib. at elev.	**Toe elev. for FoS = 1.000** Toe elev.	Wall Penetr -ation	Direction of failure
1	0.00	-1.50	Cant.	4.828	-3.08	-1.98	0.48	L to R
2	0.00	-1.50	Cant.	4.406	-3.07	-2.01	0.51	L to R
3	0.00	-1.50	Cant.	1.234	-2.78	-3.27	1.77	L to R

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.28m; spacing = 1.00m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 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	0.50	0.074	0.000	0.0	-0.0	20.0	0.0
2	0.35	0.068	0.000	3.0	-0.0	20.0	0.0
3	0.20	0.063	0.000	6.0	-0.0	20.0	0.0
4	0.00	0.056	0.000	10.0	0.0	20.0	0.0
5	-0.20	0.048	0.000	14.0	0.0	20.1	0.0
6	-0.40	0.042	0.000	18.1	0.0	20.5	0.0
7	-0.60	0.035	0.000	22.2	0.0	21.2	0.0
8	-0.80	0.029	0.000	26.6	0.0	22.1	0.0
9	-1.00	0.023	0.000	31.1	0.0	23.3	0.0
10	-1.20	0.018	0.000	35.9	0.0	24.7	0.0
11	-1.35	0.014	0.000	39.7	0.0	25.9	0.0
12	-1.50	0.011	0.000	43.7	0.0	27.2	0.0
13	-1.65	0.008	0.000	46.4	0.0	9.4	0.0
14	-1.80	0.006	0.000	46.4	0.0	0.6	-8.6
15	-2.00	0.003	0.000	43.0	0.0	0.0	-29.6
16	-2.20	0.001	0.000	35.3	0.0	0.0	-41.1
17	-2.40	0.001	0.000	26.6	0.0	0.0	-42.2
18	-2.60	0.001	-0.001	18.6	0.0	0.0	-37.9
19	-2.80	0.001	-0.001	11.6	0.0	0.0	-31.3
20	-3.00	0.001	-0.001	6.0	0.0	0.0	-23.4
21	-3.20	0.001	-0.002	2.2	0.0	0.0	-14.5
22	-3.35	0.001	-0.002	0.6	0.0	0.0	-7.4
23	-3.50	0.001	-0.002	0.0	-0.0	0.0	0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment maximum	Bending moment elev.	Bending moment minimum	Bending moment elev.	Shear force maximum	Shear force elev.	Shear force minimum	Shear force elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	4.2	-1.80	-0.0	0.35	6.5	-1.50	-4.0	-2.60
2	4.7	-1.80	-0.0	0.50	7.4	-1.50	-4.4	-2.60
3	46.4	-1.80	-0.0	-3.50	27.2	-1.50	-42.2	-2.40

Maximum and minimum displacement at each stage

Stage no.	Displacement maximum	Displacement elev.	Displacement minimum	Displacement elev.	Stage description
	m		m		
1	0.006	0.50	0.000	0.50	Excav. to elev. -1.50 on RIGHT side
2	0.007	0.50	0.000	0.50	Apply surcharge no.1 at elev. 0.00
3	0.074	0.50	-0.002	-3.50	Apply load no.1 at elev. 0.50

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 Retained fill c'=0	1 Retained fill c'=0
2	-1.50	2 Retained fill	2 Retained fill
3	-2.00	3 Residual Waipapa	3 Residual Waipapa

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	Retained fill c'=0	17.00	10000	0.500	NC (0.250)	0.338 (1.357)	3.148 (4.404)	0.0d
2	Retained fill	17.00	10000	0.500	OC (0.250)	0.338 (1.357)	3.148 (4.404)	3.000d
3	Residual Waipapa	18.00	25000	0.500	OC (0.250)	0.285 (1.238)	3.886 (4.998)	5.000d

Additional soil parameters associated with Ka and Kp

No.	Soil type 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	Retained fill c'=0	26.00	0.640	0.00	26.00	0.312	0.00
2	Retained fill	26.00	0.640	0.00	26.00	0.312	0.00
3	Residual Waipapa	30.00	0.631	0.00	30.00	0.305	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Left side	Right side
Initial water table elevation	-6.00	-6.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Type of structure = Soldier Pile Wall
Soldier Pile width = 0.30 m
Soldier Pile spacing = 1.00 m
Passive mobilisation factor = 3.00
Elevation of toe of wall = -4.80
Maximum finite element length = 0.25 m
Youngs modulus of wall E = 8.7000E+06 kN/m2
Moment of inertia of wall I = 3.9760E-04 m4/m run
= 3.9760E-04 m4 per pile
E.I = 3459.1 kN.m2/m run
Yield Moment of wall = Not defined

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	0.20(L)	12.00	3.50	10.00	=	N/A	N/A
2	-2.30	-0.00(R)	12.00	3.00	5.40	=	N/A	N/A

Note: L = Left side, R = Right side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Excavate to elevation -2.30 on RIGHT side
2	Apply surcharge no.1 at elevation 0.00
3	Apply surcharge no.2 at elevation -2.30

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) = 1000.00 m

Width of excavation on Left side of wall = 20.00 m
Width of excavation on Right side of wall = 20.00 m

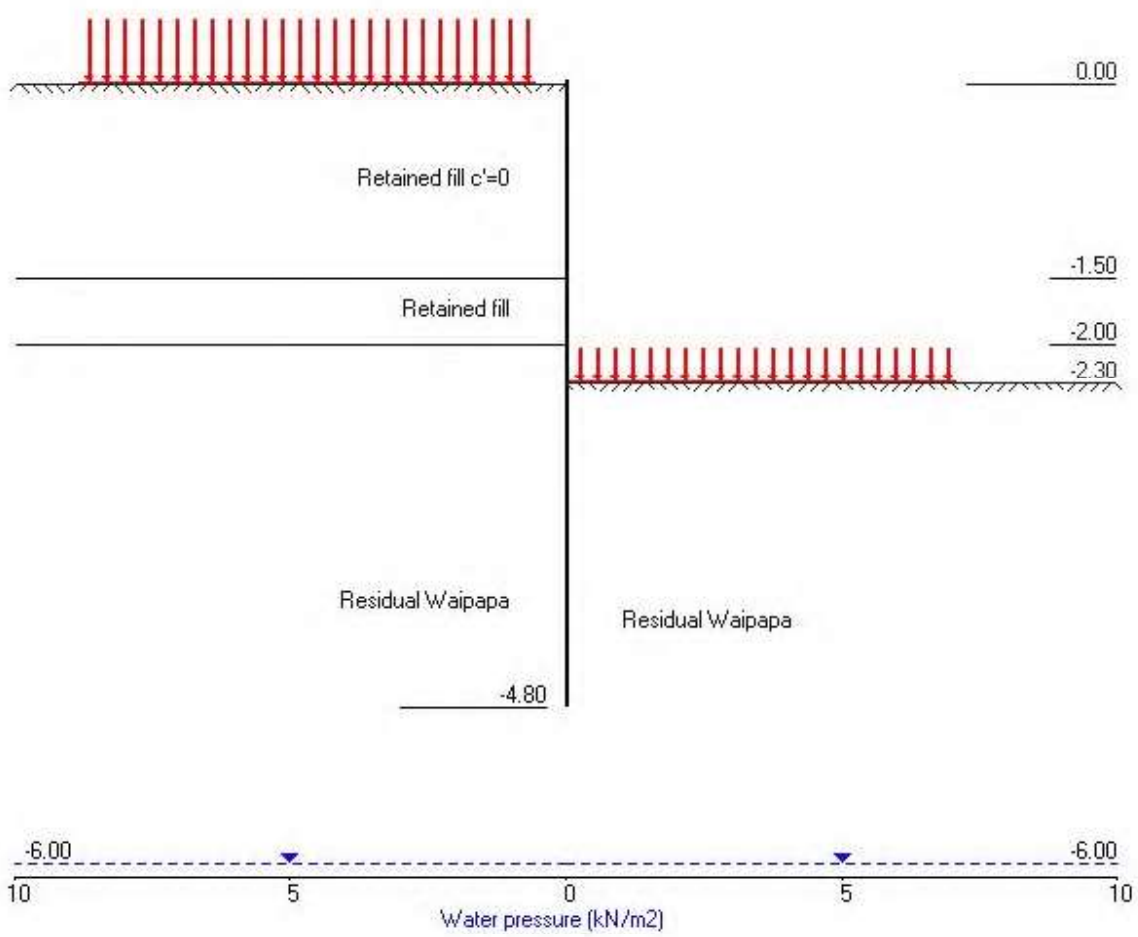
Distance to rigid boundary on Left side = 20.00 m
Distance to rigid boundary on Right side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Output options: Displacement, Bending mom., Shear force	Active, Passive pressures	Graph. output
1	Excav. to elev. -2.30 on RIGHT side	Yes	Yes	Yes
2	Apply surcharge no.1 at elev. 0.00	No	No	No
3	Apply surcharge no.2 at elev. -2.30	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.3 Apply surcharge no.2 at elev. -2.30



Units: kN,m

Stage No. 3 Apply surcharge no.2 at elevation -2.30

STABILITY ANALYSIS of Soldier Pile Wall according to Strength Factor method

Factor of safety on soil strength

Stage No.	Ground level Act.	Pass.	Prop Elev.	**FoS for toe elev. = -4.80** 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.	1.516	-4.43	-4.76	2.46	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Soldier Pile Wall

Analysis options

Soldier Pile width = 0.30m; spacing = 1.00m
Passive mobilisation factor = 3.000
Length of wall perpendicular to section = 1000.00m
Subgrade reaction model - Boussinesq Influence coefficients
Soil deformations are elastic until the active or passive limit is reached

Rigid boundaries: Left side 20.00 from wall
Right side 20.00 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	0.029	1.05E-02	0.0	-0.0	
2	-0.24	2.21	0.026	1.05E-02	0.3	0.0	
3	-0.48	4.52	0.024	1.05E-02	1.1	0.2	
4	-0.72	6.37	0.021	1.04E-02	2.4	0.6	
5	-0.96	8.03	0.019	1.04E-02	4.1	1.3	
6	-1.20	9.59	0.016	1.02E-02	6.2	2.6	
7	-1.35	10.53	0.015	1.01E-02	7.7	3.6	
8	-1.50	11.45	0.013	9.96E-03	9.4	4.9	
		7.38	0.013	9.96E-03	9.4	4.9	
9	-1.63	8.14	0.012	9.76E-03	10.3	6.1	
10	-1.75	8.89	0.011	9.51E-03	11.4	7.5	
11	-1.88	9.63	0.010	9.22E-03	12.6	9.0	
12	-2.00	10.37	0.008	8.86E-03	13.8	10.6	
		6.29	0.008	8.86E-03	13.8	10.6	
13	-2.15	7.10	0.007	8.35E-03	14.8	12.8	
14	-2.30	7.91	0.006	7.75E-03	16.0	15.1	
		-16.51	0.006	7.75E-03	16.0	15.1	
15	-2.47	-26.33	0.005	6.95E-03	12.3	17.5	
16	-2.64	-36.16	0.004	6.04E-03	7.0	19.3	
17	-2.88	-47.36	0.002	4.68E-03	-3.0	20.2	
18	-3.12	-24.41	0.001	3.35E-03	-11.6	18.2	
19	-3.36	-6.86	0.001	2.21E-03	-15.4	14.7	
20	-3.60	4.20	0.000	1.33E-03	-15.7	10.8	
21	-3.84	10.51	0.000	7.11E-04	-13.9	7.1	
22	-4.08	13.87	-0.000	3.23E-04	-11.0	4.1	
23	-4.32	15.26	-0.000	1.19E-04	-7.5	1.8	
24	-4.56	15.74	-0.000	3.99E-05	-3.8	0.5	
25	-4.80	15.94	-0.000	2.40E-05	0.0	-0.0	