



ENVIRONMENTAL IMPACT ASSESSMENT

Retaining wall, deck and associated construction activities
Sounds Foreshore Reserve, Ngawhetawheta Point, Double Cove,
Marlborough Sounds

Nick Bristed

February 2023

Contents

INTRODUCTION BACKGROUND TO THE PROJECT	1
Introduction.....	1
Project background	1
Pre-application consultation	2
LOCALITY AND SITE	3
Broad context and locality	3
Site Description	4
DESCRIPTION OF THE PROPOSED ACTIVITY	7
Retaining wall	7
Access deck.....	9
Earthworks	9
Construction methodology.....	9
ENVIRONMENTAL IMPACT ASSESSMENT	11
Values affected by the proposal	11
Alternative locations, times or designs that could mitigate the adverse effects of the proposal.....	11
Positive effects.....	11
Effects on natural character.....	11
Construction effects	12
Cultural effects	15
Effects on public access.....	15
Operational stormwater and drainage effects	16
Natural hazard effects	16
Summary of potential adverse effects	16
CONSULTATION.....	17
Consultation.....	17
CONSERVATION MANAGEMENT STRATEGIES AND PLANS.....	17
Conservation Act 1987	17
Conservation General Policy.....	17
Nelson Marlborough Conservation Management Strategies.....	18
Marlborough Sounds Maritime Park Management Plan.....	19
Summary and assessment.....	19
CONCLUSION.....	20
APPENDIX A. Application forms	
APPENDIX B. Structural and Geotechnical Assessments	
APPENDIX C. Survey Plan	
APPENDIX D. Pre-application advice records	
APPENDIX E. Design drawings	
APPENDIX F. Construction access plans	

INTRODUCTION BACKGROUND TO THE PROJECT

Introduction

1. Application for Concession is made on behalf of Nick Bristed to the Department of Conservation (“DoC”) in accordance with the Conservation Act 1987 (“the Act”). The application relates to the construction of a new retaining wall to remediate land within public conservation land managed by DoC and provide for the safety of the existing dwelling that is located within private adjoining land following a storm event in July 2021. A new deck to provide access to an existing dwelling is proposed to be located above the retaining wall. Construction activities also form part of the Application, including land disturbance and vegetation clearance. The area relating to this Concession is located at Ngawhetawheta Point, Double Cove, Marlborough Sounds.
2. The purpose of this document is to accompany the completed application forms 1a and 3b (refer to Appendix A) and to provide a description of the proposed activities together with an assessment of environmental impacts of the activity in relation to the relevant provisions of the Act, the Conservation General Policy, Nelson/Marlborough: Conservation Management Strategies and the Marlborough Sounds Maritime Park Management Plan.

Project background

3. The existing dwelling on the site has been used as a bach by the Bristed family since 1980. A building permit for the existing dwelling (referred to as a holiday cottage) was obtained in 1979 (reference 7/00/0313) and construction of the building was completed shortly afterwards. According to the building permit, a 2m wide deck across the front of the ‘cottage’ was authorised by the building permit and constructed to be contained under the roof of the building and referred to as a ‘balcony’ during the building inspection.
4. Other resource consents, which relate to the site include:
 - U120161 – New coastal permit for an existing swing mooring (M3344) east of Double Cove for a 10m long vessel to facilitate access to Lot 29 DP 1153 – consent granted 12 April 2012
 - U100306 – To construct a new ‘L’ shaped jetty totaling 17.0m in length by 1.8m in width to facilitate access to Lot 29 DP 1153 - consent granted 15 October 2010
5. It is noted that in the 1990s, the ‘balcony’ (deck) was extended further to the west towards the foreshore (and into the public conservation land) to a total width of approximately 8m.
6. In July 2021, an unprecedented storm event resulted in a landslide directly adjacent to the dwelling, which destroyed the attached balcony and is putting the dwelling at risk with the head scarp currently located beneath the deck. The landslide also swept away vegetation within this part of the site. Subsequently, large amounts of soil have stockpiled in this part of the site and have temporarily altered the topography of the land.

7. As a result of the damage it sustained during the 2021 storm event, the site has been investigated by relevant technical specialists to ascertain appropriate remediation. The altered geotechnical conditions on the site, requires the land to be remediated, including the construction of a retaining wall on the site's western boundary to repair the slip and support the existing dwelling. Consequently, the dwelling and the site are uninhabitable until the required remediation works are completed.
8. The 'Structural Report' and appended 'Geotechnical Report' dated 27 September 2022, prepared by EDC, and initial geotechnical report titled 'Claim for Natural Disaster (landslip) Damage', dated 1 February 2022, prepared by Tonkin and Taylor are attached as Appendix B.
9. A survey of the land has been undertaken and included in Appendix C. The survey plan identifies that the dwelling has been built to the boundary of the site and the entire deck is located within the adjacent public conservation land.

Pre-application consultation

10. Pre-application discussions in relation to the proposal have been carried out with staff from both Marlborough District Council ("MDC") and DoC.
11. Following discussions with DoC, it was agreed that a 2m deck can be built within public conservation land. This is primarily because the deck is required to access the dwelling. As the retaining wall is required to remediate the land and protect the existing dwelling from any future storm events, the location of the retaining wall within public conservation land was also deemed to be acceptable.
12. MDC has agreed the 2m wide deck previously approved by building consent 7/00/313 is a lawful structure and may be reconstructed under existing use rights.
13. Both MDC and DoC considered that an 8m wide deck similar to what was previously built would not be supported.
14. MDC confirmed that all other works within the adjoining public conservation land would be subject to resource consent (i.e. the retaining wall structure and any associated construction activities, such as vegetation clearance, land disturbance and earthworks). An application for resource consent has been lodged with MDC in parallel with this Application for Concession.
15. Both MDC and DoC advised that any consultation with Iwi would be undertaken by each organisation and would follow the typical statutory consultation and engagement processes in relation to assessing effects of the Project on tangata whenua values and any potential impacts.
16. Written records of pre-application discussion and advice with both MDC and DoC are included in Appendix D.

LOCALITY AND SITE

Broad context and locality

17. The site is located at Ngawhetawheta Point on the Double Cove peninsula in the Queen Charlotte Sound, Marlborough Sounds, approximately 5.8km north of Picton. The site is provided with boat only access with a jetty and boathouse located on the shoreline.
18. Figure 1 shows the location of the site on a satellite image. More detailed property information is shown in Figure 2.

Figure 1. Location of subject site showing wider Marlborough Sounds area



Figure 2. Location of the subject site (outlined in blue and Crown Reserve boundary in white)



Site Description

19. The NZTM GPS coordinates of the location of the proposed activity within the public conservation land are: 1685798.51 5434150.67.
20. The conservation land is classified as the Sounds Foreshore Reserve (“SFR”) as stipulated in the Marlborough Sounds Maritime Park Management Plan (1992).
21. The area is moderately steep (25-35°) topography. The area is vegetated in dense, native bushland.
22. A small dwelling that is used as a bach on the adjoining, private land (Lot 29 Deposited Plan 1153 Block IV Linkwater Survey District, held in Record of Title MB40/203), is accessed via a walking track from the jetty and a walking track from the beach. The dwelling is located mid slope and has been partially benched into the slope at the rear and supported on timber poles at the front (including the 8m wide timber deck). A storage shed, sleep out and water tank are located upslope (east) of the site. A septic tank is located north of the dwelling.
23. Approximately 10m west of the dwelling (i.e. within the SFR), a minor crest has formed where the slope steepens to 40-50°. Below the crest, a thin veneer (<1m thick) of soil is present, where steeply inclined schist bedrock exposures are frequently observed, particularly along the shoreline.
24. The landslide has occurred in the soil above the crest, where rock exposures are not observed. The slip scarp is approximately 10m wide and 10m long, with runout extending to the west, taking the surficial soil and vegetation with it.
25. There is limited, specific information in relation to the biodiversity and terrestrial ecology in this part of the SFR, however, the Marlborough Sounds Resource Management Plan (“MSRMP”) identifies the area to be located within an Area of Regional Significance (4/12). Area 4/12 is described as:

“an area with localised value and no threatened land species. Together areas form very large but fragmented habitat for smaller bird species and more mobile larger species. Some uncommon plant species or species associations which are becoming increasingly uncommon.”
26. The MSRMP does not apply any Landscape Areas or Natural Hazards to this area. The area does not identify any listed archaeological or historic sites. Although the entire SFR is recognised as significant to Māori, there are no specific sites of cultural significance identified in this area.
27. Figures 3 to 6 show the existing site and damage sustained following the 2021 storm event.

Figure 3. View of dwelling with landslip and damaged deck. Source: Tonkin & Taylor site visit photos



Figure 4. View of the shoreline below the dwelling access, showing the steeply inclined schist bedrock. Source EDC site visit photos



Figure 5. View of dwelling and remaining damaged deck, looking north from site access track. Source: EDC site visit photos

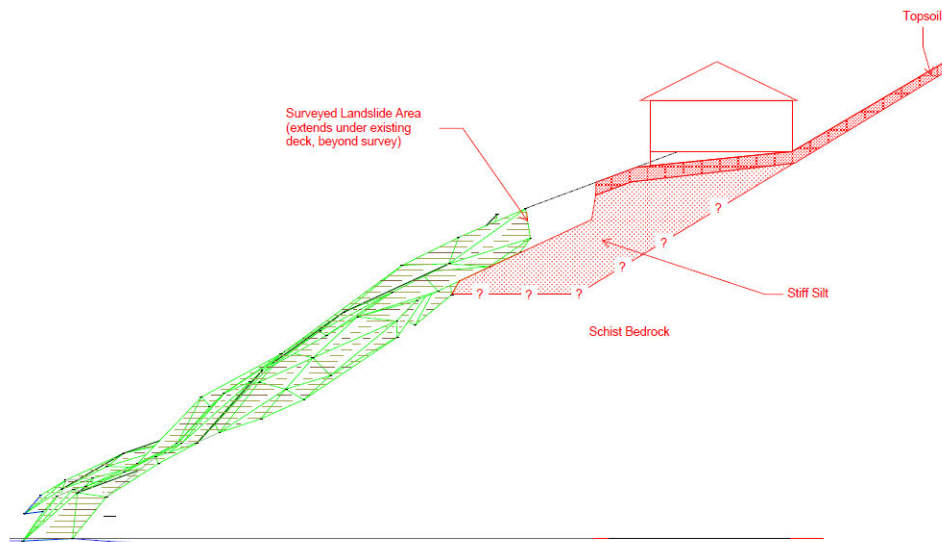


Figure 6. View of head scarp showing predominantly silt material with minor schist cobbles. Source: EDC site visit photos



28. Figure 7 shows a cross section of the soil profile of the site, including the location of the existing dwelling and landslide (shaded green).

Figure 7. Soil profile cross section of the subject site. Source XXX



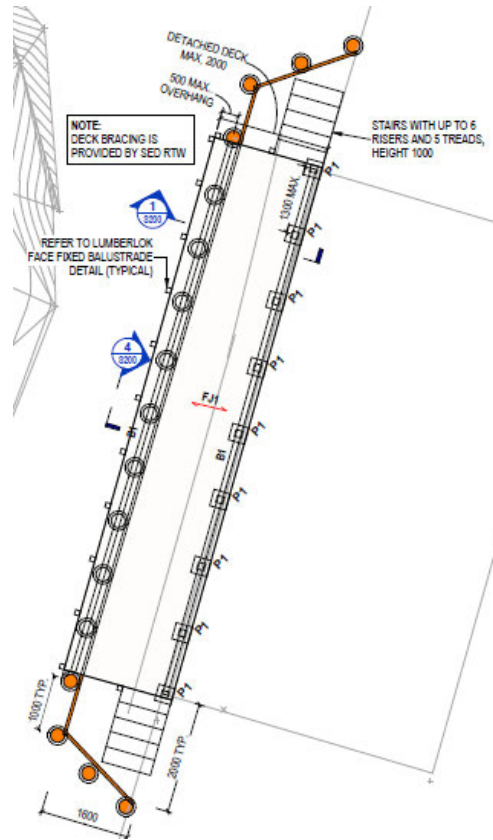
DESCRIPTION OF THE PROPOSED ACTIVITY

29. The Concession Application proposes the construction of a retaining wall, new deck for the existing dwelling and associated construction works including earthworks, land disturbance and vegetation clearance within both the private land and the SFR. The purpose of the proposed activity is to appropriately remediate the land and existing structures that were damaged in the storm of July 2021.

Retaining wall

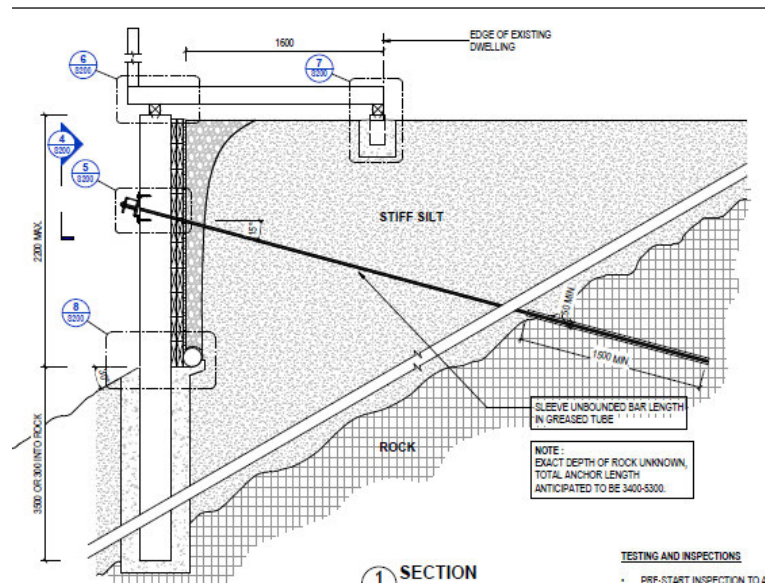
30. The proposed retaining wall will be located 1.6m west of the existing house (i.e. within the SFR) and will extend 2m beyond the north and south sides of the dwelling for a length of 15.7m. Figure 8 shows the proposed location of the retaining wall relative to the existing dwelling. Further details of the proposed retaining wall are included in the design plans attached as Appendix E (Site Plan, Sheet 50683, S100, Rev 0).

Figure 8. Proposed location of the retaining wall in relation to the existing dwelling



31. The maximum height of the retaining wall above ground level will be 2.0m.
32. The retaining wall is to be a tied back, timber pole wall. The tie backs will consist of one row of grouted rock anchors, which are anticipated to be between 3.4m and 5.3m in length and at an angle of 15° through the stiff silt and a minimum of 1.5m into the underlying rock.
33. A 150mm diameter drainage system is proposed to be located behind the retaining wall (at ground level).
34. Figure 9 and Sheet S200 Rev 1 of Appendix E shows a cross section of the proposed retaining wall, including the location of the anchors and drainage system.

Figure 9. Section of the proposed retaining wall showing anchors and drainage system.



Access deck

35. Following pre-application comments from DoC, it is proposed to reinstate a 2m wide and 10m long balcony to the west of the dwelling, and within the SFR as the deck enables primary access into the dwelling. The proposed balcony sits above the retaining wall and consequently is also entirely located within the SFR.
36. The balcony will be founded on shallow piles within the retained soil and be partially supported by the timber poles of the retaining wall. The balcony will cantilever approximately 400mm beyond the retaining wall. Five stairs will lead up to the deck from the north and south ends.
37. A 900mm high timber balustrade with <100mm openings will be erected around the perimeter of the balcony.

Earthworks

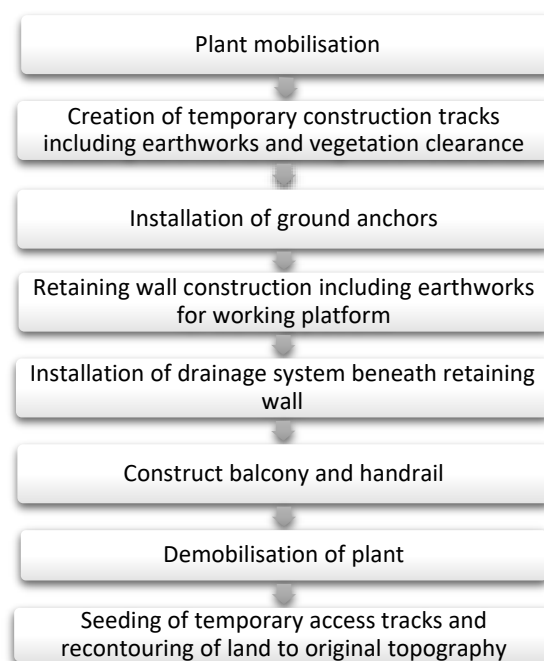
38. Due to the construction of the retaining wall within the existing slope of the land, minimal earthworks are required. Site fill will be used to fill the void at the back of the retaining wall. The height of the fill is a maximum of 2.2m and the approximate volume of the fill required would be 15m³. This is expected to be site won material from drilling of the retaining wall foundation piles. Cutting into the land below natural ground level will not be required.

Construction methodology

39. Due to the landslide extent and the boat only access arrangement to the private land, a specific access route is required to be created in order for construction machinery to safely access the area from the shoreline.

40. A 2.5m wide access track from the beach near the head of the bay, west of the dwelling. The access ramp will be hard right against the existing landslide. The construction of the access track will involve some vegetation clearance.
41. Construction stormwater is proposed to discharge to land from the location of the retaining wall via a downpipe and 100mm diameter PVC pipe to a stabilised stormwater outlet near the base of the gully.
42. Further detail regarding the location of the proposed construction access track and stormwater devices is included in Appendix F
43. The general sequence of construction activities is shown in Figure 10 below.

Figure 10 – General Sequence of Construction Activities (undertaken in stages)



44. Construction earthworks and associated stormwater discharges will be managed in accordance with an Earthworks Management Plan (required to be provided and implemented by the construction contractor). The earthworks management plan will include, as a minimum, a requirement to:
 - manage dust through the use of sprinklers
 - stabilise worked areas as soon as practicable through regenerative planting
 - ceasing work when wind conditions are likely to cause a dust nuisance beyond the boundary of the site if work continued;
 - using silt fences where necessary; and
 - monitoring the site during and after extreme weather events, including the inspection of any erosion and sediment control device.

ENVIRONMENTAL IMPACT ASSESSMENT

45. The following describes and assesses the actual and potential effects that may arise from the proposed activity – including temporary construction effects and ongoing/permanent effects. This includes whether potential effects are positive or adverse and the scale, duration and locality of effects. This assessment sets out measures that are proposed to avoid, and where avoidance is not possible, remedy or mitigate adverse effects on the environment.

Values affected by the proposal

46. The following values are considered to be potentially affected by the proposal:

- Natural character and landscape amenity of the foreshore and coastal environment
- The variety of activities and uses within the foreshore environment
- Indigenous vegetation and ecology
- Habitat protection and management

Alternative locations, times or designs that could mitigate the adverse effects of the proposal

47. The proposed activity and remediation works have been assessed and considered by suitably qualified professionals as presented in Appendix B. The location and design of the proposed structures and construction works are considered to provide the best solution to stabilise and protect the land from future natural hazards and mitigate any adverse effects of the proposed activity on the surrounding environment.

Positive effects

48. The proposed works are essential to ensure the stabilisation of the surrounding land and existing dwelling following a storm event in 2021. The existing dwelling and its ancillary structures will remain unchanged. The proposed balcony will be reduced to a width of 2m and back to its original, lawful size, where it will contribute to the anticipated natural character and coastal environment outcomes of the surrounding area, whilst providing occupants appropriate access to the dwelling.

49. Any vegetation clearance and land disturbance required will be minimised as far as possible and replanted with appropriate native vegetation upon completion of the construction works that will enhance the natural character and landscape values of the area. Overall, it is considered that the proposed remediation works provide a positive response to the surrounding environment whilst minimising adverse effects on the SFR.

Effects on natural character

50. The proposed activity has the potential to have adverse effects on the qualities and features of the Marlborough Sounds coastal environment, including elements such as:

- coastal or freshwater landforms;
 - indigenous flora and fauna, and their habitats; and
 - scenic or landscape values.
51. As previously identified, the site is located within an Area of Regional Significance (4/12), which is defined as *“an area with localised value and no threatened land species. Together areas form very large but fragmented habitat for smaller bird species and more mobile larger species. Some uncommon plant species or species associations which are becoming increasingly uncommon.”*
52. The landslide has resulted in native vegetation being swept away creating a natural ‘scar’ in the landscape. Specifically, the proposed retaining wall and balcony above are 10m long and 2m wide, directly adjoin the existing dwelling on private land. Relative to the surrounding natural area, the scale of the retaining wall is small in scale. As the former deck was much larger than the proposed 2m wide access balcony, there is now opportunity for additional planting to achieve a net gain in native vegetation within the SFR.
53. In order to construct the retaining wall, vegetation clearance and land disturbance will be required for machinery to access the construction area from the foreshore. The vegetation clearance will involve the removal of native bush and trees, however, following the completion of the necessary work, all temporary access tracks created will be replanted with native vegetation that is consistent with the surrounding area and in accordance with the ‘Restoring native vegetation on Sounds Foreshore Reserve,’ March 2019.
54. It is noted that the original topography of the land will not be altered in the long term as a result cultivation and land disturbance that is required as part of the construction works. As there are no identified threatened land species in the Area of Regional Significance 4/12, it is not considered that the proposed activity will have any adverse effects on the habitat of any land species in the relevant parts of the subject site. The proposed activity will be located a sufficient distance from the existing stream, and therefore will not impact on the natural freshwater ecology of this stream.
55. Overall, the proposed activity will have less than minor effects on the natural character of the SFR.

Construction effects

56. The proposed construction activities will be temporary, however, due to the slope of the land and the water only access, tracks that are typically 2.5m wide will need to be formed to enable machinery to safely and appropriately access the retaining wall construction area. The forming of tracks will involve vegetation clearance and some land disturbance including cultivation, which consequently has the potential to have adverse effects on the surrounding natural environment.

Dust effects

57. During construction, there is potential for nuisance dust from construction activities and emissions from machinery to affect the environment in close proximity to the construction area. Dust nuisance includes things like dust deposits on native vegetation and animal habitats. Construction activities that have the potential to result in the generation of dust include stripping of topsoil, excavation of cut material and stockpiling of soil/cut material.
58. As there are no areas of ecological value that are highly sensitive to dust located in the vicinity of the construction works, it is concluded that there are no adverse construction related dust impacts on sensitive receptors or ecological environments.
59. Nevertheless, any dust generation can be avoided by using water to suppress the dust during dry and windy conditions. An earthworks management plan will also be prepared and implemented by the construction contractors to mitigate any adverse effects of construction activities.
60. Overall, any proposed dust generated from the construction works are considered to have adverse effects that are less than minor.

Land disturbance effects

61. Any land disturbance such as excavation / filling, cultivation and vegetation clearance has the potential to have adverse effects on the stability of the land, an increase in run-off and changes to stormwater flow paths, causing erosion and an increase in concentration of sediment in runoff water.
62. Land disturbance during the construction phase of the proposed activity is unavoidable and necessary to construct the retaining wall and access deck.
63. As previously described, the two permanent access tracks from the foreshore to the dwelling have been partially covered by landslide scar/debris. Minor earthworks will be required in these areas to reinstate these tracks to how they were before the storm event.
64. Minimal land disturbance is required to install the retaining wall with the drilling of the pile foundations to a maximum depth of 3.5m. This site won fill will be used to fill behind the retaining wall to cover the rock anchors. It is anticipated to use any surplus soil from the construction works as fill, which avoids the need to transport any additional material onto the SFR. The overall earthworks volume is proposed to be 15m³ (approximate figure), which is considered a small amount given the nature and purpose of the retaining wall.
65. Stormwater control is also an important consideration to the ongoing stability of the land. The operational stormwater and drainage effects assessment in this EIA section provides a detailed summary of these potential effects and how any effects can be mitigated and managed.
66. The proposed construction methodology includes the preparation and implementation of an Earthworks Management Plan that will be prepared by the contractor and provide a

number of measures to manage any effects of an increase in the concentration of suspended sediment at the point of discharge to any receiving water. In addition, any temporary stormwater flow paths will be designed to ensure water is diverted appropriately and minimise the risk of adverse effects on existing structures and infrastructure. The advice of a suitably qualified professional will be sought if any erosion features are encountered during construction.

67. All slopes will be stabilised by appropriate measures following the completion of construction works, including seeding, compacting, drainage and revegetation. If hardfill is required as part of the construction of the retaining wall, it will be placed and compacted in accordance with NZS 4431:2022 and if required, validation testing of the compacted gravel will be undertaken and signed off by a suitably experienced Geotechnical Engineer.
68. Where possible, during construction any cultivation will be parallel to the contour of the land. As presented in the Temporary Site Access and Stormwater Disposal Plan, the proposed access track will follow a route from the foreshore that is of gentle sloping topography before becoming gradually steeper as the track curves around towards the construction site, which runs parallel to the contour of the land. The location of the access track will minimise cultivation at an angle to the contour and any associated land disturbance effects.
69. Overall, it is considered that the proposed land disturbance will have temporary effects on the land, however with mitigation, any adverse effects will be less than minor.

Vegetation clearance effects

70. As previously described, a large amount of vegetation has already been naturally cleared near the proposed retaining wall location due to the land slip. Therefore the majority of the vegetation clearance required is on the temporary construction access tracks. The construction access tracks are necessary to access the construction area of the proposed retaining wall. Due to the slope of the land and health and safety reasons, the access track must follow a certain route, which subsequently requires the clearance of vegetation. Furthermore, despite the subject site being located with an Area of Regional Significance, the area is described as having localised value with no threatened land species.
71. In order to mitigate any adverse effects of vegetation clearance on the surrounding environment, blading or root taking will not be used to clear the vegetation and to protect the surrounding indigenous habitat. Any trees that are felled within close proximity to the sea, will be directionally felled away from the waterbody to ensure that woody vegetation does not enter the sea. In addition, top soil will not be removed to a depth greater than 20mm over more the 15% of the vegetation clearance site. All vegetation material will be taken offsite by boat.
72. All areas of vegetation clearance will be revegetated within 24 months following the completion of construction, where indigenous species will be planted that is consistent

with existing native species, and in accordance with DoC's 'Restoring native vegetation on Sounds Foreshore Reserve' guidance document.

73. Given the vegetation lost as a result of the land slip, it is considered that there will be a net gain in indigenous vegetation within the SFR. Native vegetation is expected to naturally regenerate at the site of the landslip and stockpiled material.
74. Overall, the proposed vegetation clearance is considered to have less than minor effects on the surrounding indigenous vegetation and animal habitats.

Cultural effects

75. The site is not located within any specifically identified areas of cultural significance. Nonetheless, as the location of the works are within the SFR and the coastal environment, and involve the clearance of native vegetation, it is acknowledged that the proposed activities have the potential to impact on tangata whenua values.
76. To mitigate any potential adverse cultural effects, it is proposed to follow any Accidental Discovery Protocols with respect to the discovery of any unexpected findings. Other mitigation methods include:
 - revegetating any areas that have are required to be cleared for the construction access track with appropriate indigenous vegetation;
 - avoiding cutting into the maunga;
 - allowing current awa patterns of movement to be retained (i.e. avoiding any works near the existing stream);
 - maintaining ongoing access to the sea and coastal environment.
77. The applicant is agreeable to this Concession being reviewed by tangata whenua and to undertake any required engagement if DoC deems this necessary.
78. Overall it is considered that the proposed activity will have less than minor effects on cultural values.

Effects on public access

79. Public access from the coastal marine area to the coastal environment will be maintained where possible during construction. For health and safety reasons, the temporary access tracks will only be used for construction machinery and constructors. However, these tracks will only be required for the construction phase and will be revegetated with indigenous planting following the completion of the works.
80. Two permanent access tracks provide access to the existing dwelling – one from the 'beach' at the head of the bay and one from the jetty. Both access tracks have been partially covered by the land slide scar/debris and will be reinstated as part of the construction phase.
81. Overall, it is considered that any adverse effects on public access will be less than minor.

Operational stormwater and drainage effects

82. Given the evident correlation between the landslip and rainfall, stormwater control is considered to a key aspect to the ongoing stability of the site. In the EDC Geotechnical Report included as Appendix B, a number of recommendations are made with respect to stormwater control. As such, the following is proposed to mitigate and manage any effects on operational stormwater:
- a stormwater flow path will be designed to ensure water is diverted appropriately and minimises the risk of adverse effects on existing structures/infrastructure;
 - any service trenches will be backfilled with low permeability materials to avoid preferential pathways for water to enter ground;
 - advice will be sought from an appropriately qualified engineer should any erosion features be encountered during construction; and
 - a good level of vegetation will be maintained across the site during construction and following completion of construction.

Natural hazard effects

83. This part of the SFR is not identified as an area subject to natural hazards.
84. Nevertheless, and as commented in the EDC Geotechnical Report included as Appendix B, it is evident from the recent slip, and evidence of similar historical slips in the vicinity of the site, that the surficial soils are susceptible to instability. The landslide occurred following heavy rainfall, which is a common landslide trigger and is considered to be one of the primary risk factors for future instability, along with large earthquake actions.
85. The existing dwelling is considered to be at risk of damage, as the existing landslide could reactivate further up the slope. Consequently, the retaining structure, along with appropriate surface water and stormwater controls are to be constructed and implemented to reduce to the risk of future failure.
86. Along with other abovementioned mitigation measures to minimise effects on land disturbance, vegetation clearance and operational stormwater and drainage as well as the land remediation and improvements to the safety of the dwelling, overall, it is considered that any natural hazard effects will be positive.

Summary of potential adverse effects

87. Overall, the proposed activity will have positive effects by providing a retaining wall structure that will assist in stabilising the land and protecting the existing dwelling from any future landslides. The proposed 2m wide access deck will maintain access to the existing dwelling, whilst minimising adverse effects on the natural character of the surrounding land. In addition, the proposed activity will provide opportunity for further revegetation and restoration of the SFR and the coastal environment.

88. The temporary construction access tracks and construction activities can be appropriately mitigated to have less than minor effects on the surrounding natural environment, coastal environment and adjoining properties. Where possible, land will be revegetated with suitable indigenous vegetation to assist with stabilising the land, enhancing terrestrial habitats, contributing to the natural character of the surrounding environment and aligning with tangata whenua values.
89. The proposed activity provides for public access from the coastal marine area to be maintained at all times.
90. For the reasons outline above, the overall adverse effects of the proposed activity are considered to be less than minor.

CONSULTATION

Consultation

91. Having regard to the actual and potential effects of the proposed activity, and in respect of parties that may be interested in, of affected by the construction work, consultation has been focused on the MDC and DoC. As previously noted, any tangata whenua consultation will be undertaken in accordance with DoC's iwi consultation practices.

CONSERVATION MANAGEMENT STRATEGIES AND PLANS

Conservation Act 1987

92. The Conservation Act 1987 is an Act to promote the conservation of New Zealand's natural and historic resources, and for that purpose to establish a Department of Conservation, which manages land for conservation, advocates the conservation of natural and historic resources generally and promotes the benefits of conservation of to present and future generations.

Conservation General Policy

93. The General Policy is prepared under section 17C of the Conservation Act 1987 to provide unified policy for the implementation of the following Acts in the First Schedule of the Conservation Act 1987:
 - The Conservation Act 1987
 - The Wildlife Act 1953
 - The Marine Reserves Act 1971
 - The Reserves Act 1977
 - The Wild Animal Control Act 1977
 - The Marine Mammals Protection Act 1978.
94. The General Policy provides guidance for consistent management planning for the wide range of places and resources administered or managed by DoC, including the preparation

of conservation management strategies, conservation management plans and sports fish management plans.

95. Key relevant policies to the proposed activity and SFR include:

- Ensuring that each conservation management strategy and plan includes the identification of indigenous species and their habitats and ecosystems , establishes management objectives for indigenous species and their habitats and ecosystems and restores habitats and ecosystems through locally sourced indigenous species (Policy 4.1)
- Conservation management strategies and plans identify landscapes, landforms, and geological features of international, national or regional significance or of significance to tangata whenua (Policy 4.5)
- Plan and manage activities on public conservation lands and water in ways which avoid or otherwise minimize adverse effects on the quality of ecosystem services (Policy 4.6)
- Management for natural hazards on public conservation lands and waters that include an assessment of the risks to people, places and property (Policy 8)
- Any application for a concession or other authorization will comply with, or be consistent with the objectives of the relevant Act, the statutory purpose for which the place is held and any conservation management strategy or plan (Policy 11.1)
- All activities on public conservation lands and waters which require a concession or other authorization should, where relevant, avoid, remedy or mitigate any adverse effects (including cumulative effects) and maximise any positive effects on natural resources and historical and cultural heritage, and on the benefit and enjoyment of the public, including public access.

Nelson Marlborough Conservation Management Strategies

96. The purpose of the Nelson/Marlborough Conservation Management Strategy (“NMCMS”) is to set out how DoC will manage the areas in its care and its responsibilities for the next decade. The NMCMS identifies the site as a Conservation Area (Inner Sounds Biogeographic Unit and Marlborough Sounds Management Unit).

97. The key strategic directions of the NMCMS that are relevant to the proposed activity are to:

- Maintain biodiversity of native species and to ensure no threatened species are lost
- Preserve a representative range of all landforms, natural features and natural terrestrial and marine ecosystems

98. Relevant objectives and policies are highlighted below:

- Objective: To attain a better representation of the diversity of lowland ecosystems, landscape features and cultural heritage that formerly contributed to the distinctive character of this zone, and to attain a better quality in those already protected.

Marlborough Sounds Maritime Park Management Plan

99. The Marlborough Sounds Maritime Park Management Plan provides a planning strategy to deal with conservation values with objectives forming a strategy framework and policies providing a direct guide for management.

- Objectives 3.2 *“To protect, maintain and enhance the park’s ecological, cultural, recreational and visual values and to plan and manage the park as a regional and national asset” and*
- *“To promote the concept of the park as an entity of economic value to the region, which requires protection and enhancement through sympathetic and proper uses of land and water” and*
- *“To keep the foreshore reserve as natural as possible”*
- Policy 3.3.1.1 *“To protect and encourage the restoration of the indigenous vegetation and its associated indigenous animal life to ensure the survival of the Sounds ecosystem”*
- Policy 3.3.1.5 *“To conserve and enhance the Marlborough Sounds Scenery”*
- Policy 3.3.7.1 *“To provide and maintain only those buildings, structures and facilities compatible with the character of the affected reserve”*
- Policy 3.3.7.2 *“All park buildings, structures and facilities shall be located, designed, upgraded or restored to an acceptable standard in accordance with relevant codes and legislative requirements.”*
- Policy 3.3.7.5 *“All private buildings situated on the foreshore reserve and currently licensed, shall continue to be licensed, provided all conditions of the licence are met and the building(s) are maintained in an acceptable condition, such condition to be at the sole discretion of the board.”*
- Policy 3.3.7.7 *“No further extensions to existing living accommodation will be allowed on foreshore reserve except in exceptional circumstances.”*
- Policy 3.3.7.11 *“All approvals for foreshore structures shall lapse if the structure is not completed within six months of approval being granted.”*
- Policy 3.3.7.16 *“Disturbance to soil or vegetation on foreshore reserves for any other purpose than farming or basic landscaping, requires prior consideration and approval by the Board.”*

Summary and assessment

100. As set out in the above assessment, the proposed activity is consistent with the relevant objectives and policies of the Conservation General Policy, Nelson/Marlborough: Conservation management strategies and the Marlborough Sounds Maritime Park Management Plan.

Other Legislation and Plans

- A land use resource consent application has been submitted to Marlborough District Council under section 88 of the Resource Management Act 1991 to construct the retaining wall and to carry out associated activities on the site and within public conservation land.

CONCLUSION

101. This Concession Application is being made by Nick Bristed under the Conservation Act 1987 to construct a new retaining wall and access deck as well as associated construction activities within public conservation land at Ngawhetawheta Point, Double Cove, Marlborough Sounds.

102. The proposed activity will have less than minor temporary and ongoing effects on the Sounds Foreshore Reserve. The proposal is also consistent with the relevant National and local legislation, objectives and policies the Sounds Foreshore Reserve is governed under.

APPENDIX A. APPLICATION FORMS

Applicant Information Form 1a Notified or Non-notified Process



Department of
Conservation
Te Papa Atawhai

[New Zealand Government](#)

Is this the right application form for me?

This **Applicant Information Form 1a** – Notified or Non-notified Process must be completed for **the following longer term applications** (i.e. not one-off applications):

- Grazing
- Land use: Tenanting and/or using existing DOC facility/structure
- Land use: Use of public conservation land for private commercial facility/structure
- Guiding/Tourism/Recreation: Watercraft activities
- Filming
- Sports events
- Marine reserves application form 11a: Structure in a marine reserve

For other activities use the specific activity application forms that combine applicant and activity information or book a pre-application meeting.

How do I complete this applicant information form?

- Complete all sections of this **applicant information form**.
- In addition, you must complete the **activity application form/s** that you wish to undertake.
- DOC encourages electronic applications (e.g. typed Word document), rather than handwritten applications. Electronic applications are easier to read and less likely to be returned to you for clarification.
- If you need extra space, attach or include extra documents and label them according to the relevant section. Record all attachments in the table at the back of the application information form section **F Attachments**.

How do I submit my application?

Email the following to permissions@doc.govt.nz:

- **Completed applicant information form 1a**
- **Completed activity application form**
- Any other relevant attachments.

If I need help, where do I get more information?

- Check the [DOC webpage for the activity you are applying](#)¹ for.

¹ <https://www.doc.govt.nz/get-involved/apply-for-permits/apply-for-a-permit/>

- Arrange a pre-application meeting (either face to face or over the phone) by contacting the [Department of Conservation Office](#)² closest to where the activity is proposed. You can use [DOC maps](#)³ to identify which District Office you should contact. Or arrange a meeting with any of our [four offices that process concessions](#)⁴ – choose the one closest to where the activity is proposed.
- If your application covers multiple districts, contact the office nearest most of the locations you are applying for, or nearest to locations you have a specific question about.

What happens next?

Once your application forms are received, your application will be assessed by DOC. If your application is complete, DOC will begin processing.

If your application is incomplete it will be returned to you for more information.

Why does DOC ask for this information?

The questions in this application information form and the activity application form/s are designed to cover the requirements set out in conservation legislation. Your answers allow us to assess:

- Your most up-to-date details so that DOC can contact you about your application.
- Your qualifications, resources, skills and experience to adequately conduct the activity on public conservation land.
- Your creditworthiness will help determine whether DOC should extend credit to you and set up a DOC customer accounts receivable credit account for cost recovery. To make this assessment DOC will supply your information to a credit checking agency.

Note:

- Personal information will be managed by DOC confidentially. For further information check [DOC's privacy and security statements](#)⁵.
- Information collected by DOC will be supplied to a debt collection agency in the event of non-payment of payable fees.

What fees will I pay?

You may be required to pay a **processing fee** for this application regardless of whether your application is granted or not. You may request an estimate of the processing fees for your application. If you request an estimate, DOC may require you to pay the reasonable costs of the estimate prior to it being prepared. DOC will not process your application until the estimate has been provided to you. In addition, if you are granted a guiding concession on public conservation land you may be required to pay annual **activity and management fees**. These fees are listed on the [DOC webpage for the activity you are applying](#)⁶ for.

DOC will invoice your processing fees after your application has been considered. If your application is large or complex, DOC may undertake billing at intervals periodically during processing until a decision is made. If you withdraw your application DOC will invoice you for the costs incurred up to the point of your withdrawal.

² www.doc.govt.nz/footer-links/contact-us/office-by-name/

³ <http://maps.doc.govt.nz/mapviewer/index.html?viewer=docmaps>

⁴ <https://www.doc.govt.nz/get-involved/apply-for-permits/contacts>

⁵ <https://www.doc.govt.nz/footer-links/privacy-and-security/>

⁶ <https://www.doc.govt.nz/get-involved/apply-for-permits/apply-for-a-permit/>

Your application will set up a credit account with DOC. See the checklist at the end of the form for the terms and conditions you need to accept for a DOC credit account.

Will my application be publicly notified?

Your application will be publicly notified if:

- It is a license with a term of more than 10 years.
- It is a lease.
- After having regard to the effects of the activity, DOC considers it appropriate to do so.

Public notification will increase the time and cost of processing of your application.

What does DOC require if my application is approved?

If your application is approved DOC requires:

- **Insurance** to indemnify the Minister of Conservation against any claims or liabilities arising from your actions. The level of insurance cover will depend on the activity.
- A copy of your **safety plan** audited by an external expert (e.g. Health and Safety in Employment (Adventure Activity) Regulations 2011 audit or a DOC listed organisation). See the [Safety Plan](#)⁷ information on the DOC website for further information.

Note: DOC/Minister can vary the concession if the information on which the concession was granted contained material inaccuracies. DOC may also recover any costs incurred.

⁷ <https://www.doc.govt.nz/get-involved/apply-for-permits/managing-your-concession/safety-plans/>

A. Applicant details

Legal status of applicant (tick)	<input checked="" type="checkbox"/> Individual (Go to 1)	
	<input type="checkbox"/> Registered company (Go to 2)	<input type="checkbox"/> Trust (Go to 2)
	<input type="checkbox"/> Incorporated society (Go to 2)	<input type="checkbox"/> Other e.g. Educational institutes (Go to 2)

1	Applicant name (individual)		Nick Bristed		
	Phone		Mobile phone	Sec 9(2)(a)	
	Email	Sec 9(2)(a)			
	Physical address	Sec 9(2)(a)		Postcode	Sec 9(2)(a)
	Postal address (if different from above)			Postcode	

2	Applicant name (full name of registered company, trust, incorporated society or other)				
	Trading name (if different from applicant name)				
	NZBN if applicable (to apply go to: https://www.nzbn.govt.nz)		Company, trust or incorporated society registration number		
	Registered office of company or incorporated society (if applicable)				
	Company phone		Company website		
	Contact person and role				
	Phone		Mobile phone		
	Email				
	Postal address			Postcode	
	Street address (if different from postal address)			Postcode	

B. Pre-application meeting

Have you had a pre-application meeting or spoken to someone in DOC?

No	<input type="checkbox"/>
Yes	<input checked="" type="checkbox"/>

- If yes record the:

Date of DOC pre-application meeting	15 September 2022
Name of DOC staff member	Tom Heather
Name of person who had the pre-application meeting with DOC	Nick and Karli Bristed

C. Activity applied for

Tick the **activity application form** applicable to the activity you wish to undertake on public conservation land. Complete the applicant information form and the activity application form and email them with any attachments to permissions@doc.govt.nz

ACTIVITY APPLICATION FORM*	FORM NO.	TICK
Grazing	2a	<input type="checkbox"/>
Land use: Tenanting and/or using existing DOC facility/structure	3a	<input type="checkbox"/>
Land use: Use of public conservation land for private/commercial facility/structure	3b	<input checked="" type="checkbox"/>
Guiding/Tourism/Recreation: Watercraft activities	4b	<input type="checkbox"/>
Filming	5a	<input type="checkbox"/>
Sporting Events	6a	<input type="checkbox"/>
Marine reserves application form: Structure in a marine reserve	11a	<input type="checkbox"/>
Other activities (not covered in the above forms or in the new activity application forms that combine applicant and activity information)	7a	<input type="checkbox"/>

Note: If the activity is not in this list check the activity on the DOC website to find the correct application form or book a pre-application meeting. Application forms that combine applicant and activity information on the DOC website include:

- [Aircraft activities](#)⁸
- [Easements](#)⁹
- [Land based guiding](#)¹⁰

⁸ <https://www.doc.govt.nz/get-involved/apply-for-permits/business-or-activity/aircraft-activities/>

⁹ <https://www.doc.govt.nz/get-involved/apply-for-permits/business-or-activity/access-easements/>

¹⁰ <https://www.doc.govt.nz/get-involved/apply-for-permits/business-or-activity/land-based-guided-activities/>

D. Are you applying for anything else?

Are you submitting any other application forms in relation to this application?

No	<input type="checkbox"/>
Yes	<input checked="" type="checkbox"/>

- If yes, state which application forms:

Forms 1b and 7a

E. Background experience of applicant

Provide relevant information relating to your ability to carry out the proposed activity (e.g. details of previous concessions, membership of professional organisations, and relevant qualifications).

Nick Bristed - Qualified Civil Engineer
Karli Bristed - Qualified Resource Management Planner

F. Attachments

Attachments should *only* be used if there is:

- Not enough space on the form to finish your answer
- You have additional information that supports your answer
- You wish to make an additional request of DOC regarding the application.

Label each document clearly and complete the table below.

Section of the application form the attachment relates to	Document title	Document format (e.g. Word, PDF, Excel, jpg etc.)	Description of attachment
<u>Correct example</u> ✓ D	Locations	PDF	Trust Deed.
<u>Incorrect example</u> ✗ Table	Doc1	Word	Table

G. Checklist

Application checklist	Tick
I have completed all sections of this applicant information form relevant to my application and understand that the form will be returned to me if it is incomplete.	<input checked="" type="checkbox"/>
I certify that the information provided in this applicant information form, and any attached additional forms is, to the best of my knowledge, true and correct.	<input checked="" type="checkbox"/>
I have completed the activity application form .	<input checked="" type="checkbox"/>
I have appropriately labelled all attachments and completed section F Attachments .	<input type="checkbox"/>
I will email permissions@doc.govt.nz my: <ul style="list-style-type: none"> • Completed applicant information form • Completed activity application form/s • Any other attachments. 	<input checked="" type="checkbox"/>

H. Terms and conditions for a credit account with the Department of Conservation

Have you held an account with the Department of Conservation before?	Tick
No	<input checked="" type="checkbox"/>
Yes	<input type="checkbox"/>
If 'yes' under what name	

In ticking this checklist and placing your name below you are acknowledging that you have read and agreed to the terms and conditions for an account with the Department of Conservation

Terms and conditions	Tick
I/We agree that the Department of Conservation can provide my/our details to the Department's Credit Checking Agency to enable it to conduct a full credit check.	<input checked="" type="checkbox"/>
I/We agree that any change which affects the trading address, legal entity, structure of management or control of the applicant's company (as detailed in this application) will be notified in writing to the Department of Conservation within 7 days of that change becoming effective.	<input checked="" type="checkbox"/>
I/We agree to notify the Department of Conservation of any disputed charges within 14 days of the date of the invoice.	<input checked="" type="checkbox"/>
I/We agree to fully pay the Department of Conservation for any invoice received on or before the due date.	<input checked="" type="checkbox"/>
I/We agree to pay all costs incurred (including interest, legal costs and debt recovery fees) to recover any money owing on this account.	<input checked="" type="checkbox"/>
I/We agree that the credit account provided by the Department of Conservation may be withdrawn by the Department of Conservation, if any terms and conditions (as above) of the credit account are not met.	<input checked="" type="checkbox"/>
I/We agree that the Department of Conservation can provide my details to the Department's Debt Collection Agency in the event of non-payment of payable fees.	<input checked="" type="checkbox"/>

Typed applicant name/s	Nick Bristed	Date	14 February 2023
-------------------------------	--------------	-------------	------------------

For Departmental use			
Credit check completed			
Comments:			
Signed		Name	
Approved (Tier 4 manager or above)		Name	



The Department recommends that you contact the Department of Conservation Office closest to where the activity is proposed to discuss the application prior to completing the application forms. Please provide all information requested in as much detail as possible. Applicants will be advised if further information is required before this application can be processed by the Department.

This form is to be used when the proposed activity is the building or use of any private or commercial facility or structure on public conservation land managed by the Department of Conservation. Examples may include lease of land to erect an information centre; authorisation to erect a weather station; or construct or lease a private/commercial campground or lodge. This form is to be completed in conjunction with either Applicant Information Form 1a (longer term concession) or Applicant Information Form 1b (one-off concession) as appropriate.

Please complete this application form, attach Form 1a or Form 1b, and any other applicable forms and information and send to permissions@doc.govt.nz. The Department will process the application and issue a concession if it is satisfied that the application meets all the requirements for granting a concession under the Conservation Act 1987.

If you require extra space for answering please attach and label according to the relevant section.

An ongoing term is required as the retaining wall is permanent in order to protect the land and dwelling behind. Pleasee

A. Description of Activity

Please describe the proposed activity in detail – where the site is located, please use NZTM GPS coordinates where possible, what you intend to use the building for, whether you intend to make any changes to the infrastructure.

Please include the name and status of the public conservation land, the size of the area for which you are applying and why this area has been chosen.

If necessary, attach further information including a map, a detailed site plan and drawings of proposal and label Attachment 3b:A.

Please see attached EIA

B. Alternative sites considered

If your application is to **build, extend or add** to any permanent or temporary structures or facilities on public conservation land, please provide the following details:

- Could this structure or facility be reasonably located outside public conservation land? Provide details of other sites/areas considered.
- Could any potential adverse effects be significantly less (and/or different) in another conservation area or another part of the conservation area to which the application relates? Give details/reasons

Please see attached EIA

C. Larger area

Is the size of the area you are applying for **larger** than the structure/facility **YES / NO**

If **yes**, please detail the size difference in the box below, and answer the following 3 questions, if **no** please go on to the next section:

The retaining wall is an additional structure as it is required to stabilise the land and dwelling behind following a storm event in 2021

Is this necessary for safety or security purposes? **YES / NO**

Is this necessary as an integral part of the activity? **YES / NO**

Is this essential to carrying on the activity? **YES / NO**

If the answer to any of the above is yes, please provide details and attach supporting evidence if necessary and label Attachment 3b:C.

Please see attached EIA

D. Exclusive possession

Do you believe you need **exclusive possession** of the public conservation land on which your structure/building is located, ie no one else can use the land during your use of it? **YES / NO**
(*Exclusive occupation requires a lease which requires public notification of the application*)

If **yes**, please answer the following 3 questions, if no please go to the next section:

Is exclusive possession necessary to protect public safety? **YES / NO**

Is exclusive possession necessary to protect physical security of the activity? **YES / NO**

Is exclusive possession necessary for the competent operation of the activity? **YES / NO**

If the answer to any of the above is yes, please provide details and attach supporting evidence if necessary and label Attachment 3b:D.

E. Technical Specifications (for telecommunications sites only)

Frequencies on which the equipment is to operate

Power to be used (transmitter output)

Polarisation of the signal

Type of antennae

The likely portion of a 24 hour period that transmitting will occur

Heaviest period of use

F. Term

Please detail the length of the term sought (i.e. number of years or months) and why.

Note: An application for a concession for a period over 10 years must be publicly notified, an application for a concession up to 10 years will not be publicly notified unless the adverse effects of the activity are such that it is required, or if an exclusive interest in the land is required.

An ongoing term is required as the retaining wall is permanent in order to protect the land and dwelling behind.

G. Bulk fuel storage

Under the Hazardous Substances and New Organisms Act 1996 (HSNO Act) 'Bulk fuel storage' is considered to be any single container, stationary or mobile, used or unused, that has a capacity in excess of 250 litres of Class 3 fuel types. This includes petrol, diesel, aviation gasoline, kerosene and Jet A1. For more information on Hazardous Substances, go to:

<http://www.business.govt.nz/worksafe/information-guidance/legal-framework/hsno-act-1996>

Do you intend to store fuel in bulk on the land as part of the activity?

YES / NO

If you have answered yes, then please provide full details of how and where you intend to store the fuel, and label any attachments including plans, maps and/or photographs as Attachment 3b:G. If your concession application is approved you will be required to provide a copy of your HSNO compliance certification to the Department before you begin the activity.

H. Environmental Impact Assessment

This section is one of the most important factors that will determine the Department’s decision on the application. Please answer in detail.

In column 1 please list all the locations of your proposal, please use NZTM GPS coordinates where possible. In column 2 list any special features of the environment or the recreation values of that area. Then in column 3 list any effects (positive or adverse) that your activity may have on the values or features in column 2. In column 4 list the ways you intend to mitigate, remedy or avoid any adverse effects noted in column 3. Please add extra information or supporting evidence as necessary and label Attachment 3b:H.

Refer to Steps 1 and 2 in your Guide to Environmental Impact Assessment to help you fill in this section.

Location on public conservation land	Special feature or value	Potential effects of your activity on the feature or value (positive or adverse)	Methods to remedy, mitigate or avoid any adverse effects identified
<i>EG: Tararua Forest Park</i>	<i>Northern rata - threatened species</i>	<i>Damage to the plants by construction</i>	<i>Brief construction and maintenance staff of the location and importance of the species; clearly tape off areas with the species to avoid damage</i>
Sounds Foreshore Reserve NZTM GPS: 1685798.51 5434150.67	Indigenous vegetation and habitat Localised value	Damage to vegetation and habitat by construction and structures	Revegetation of native vegetation where possible. Please see attached EIA

I. Other

Is there any further information you wish to supply in support of your application? Please attach if necessary and label Attachment 3a:l.

Please see attached EIA

Applicant Information Form 1b One-Off Process



Department of
Conservation
Te Papa Atawhai

New Zealand Government

Is this the right application form for me?

This form is to be used for one off activities on public conservation land.

One-off concessions are only available for activities that:

- Have minor effects that can be easily managed.
- Comply with the relevant legislation, conservation management strategy and conservation management plans.
- Have clearly defined limits (e.g. numbers of trips/landings to be authorised by the permit).
- Do not involve permanent structures.
- Do not have a duration of more than 3 months.
- Do not take place in the same location more than once in a 3 year period.

How do I complete this application form?

If the application meets the one-off-concession criteria:

- Complete all sections of this **applicant information form**.
- Complete the **activity application form** for the activity that you wish to undertake.
- DOC encourages electronic applications (e.g. typed Word document), rather than handwritten applications. Electronic applications are easier to read and less likely to be returned to you for clarification.
- If you need extra space, attach or include extra documents and label them according to the relevant section. Record all attachments in the table at the back of the application form section **G Attachments**.

How do I submit my application?

Email the following to permissions@doc.govt.nz:

- **Completed applicant information form**
- **Completed activity application form**
- Any other attachments

If I need help, where do I get more information?

- Check the [DOC webpage for the activity you are applying](#)¹ for.
- Arrange a pre-application meeting (either face to face or over the phone) by contacting the [Department of Conservation Office](#)² closest to where the activity is proposed. You can use [DOC](#)

¹ <https://www.doc.govt.nz/get-involved/apply-for-permits/apply-for-a-permit/>

² www.doc.govt.nz/footer-links/contact-us/office-by-name/

[maps](#)³ to identify which District Office you should contact. Or arrange a meeting with any of our [four offices that process concessions](#)⁴ – choose the one closest to where the activity is proposed.

- If your application covers multiple districts, contact the office nearest most of the locations you are applying for, or nearest to locations you have a specific question about.

What happens next?

Once your application forms are received, your application will be assessed by DOC. If your application is complete, DOC will begin processing.

If your application is incomplete it will be returned to you for more information.

Why does DOC ask for this information?

The questions in this application form are designed to cover the requirements set out in DOC's conservation legislation. Your answers allow us to assess:

- Your most up-to-date details so that DOC can contact you about your application.
- Your qualifications, resources, skills and experience to adequately conduct the activity on public conservation land.
- Your creditworthiness will help determine whether DOC should extend credit to you and set up a DOC customer accounts receivable credit account for cost recovery. To make this assessment DOC will supply your information to a credit checking agency.

Note:

- Personal information will be managed by DOC confidentially. For further information check [DOC's privacy and security statements](#)⁵.
- Information collected by DOC will be supplied to a debt collection agency in the event of non-payment of payable fees.

What fees will I pay?

You may be required to pay a **processing fee** for this application regardless of whether your application is granted or not. In addition, if you are granted a guiding concession on public conservation land you may be required to pay annual **activity and management fees**. These fees are listed on the [DOC's webpage for the activity you are applying](#)⁶ for.

DOC will invoice your processing fees after your application has been considered. If you withdraw your application DOC will invoice you for the costs incurred up to the point of your withdrawal.

Your application will set up a credit account with DOC. See the checklist at the end of the form for the terms and conditions you need to accept for a DOC credit account.

³ <http://maps.doc.govt.nz/mapviewer/index.html?viewer=docmaps>

⁴ <https://www.doc.govt.nz/get-involved/apply-for-permits/contacts>

⁵ <https://www.doc.govt.nz/footer-links/privacy-and-security/>

⁶ <https://www.doc.govt.nz/get-involved/apply-for-permits/apply-for-a-permit/>

What does DOC require if my application is approved?

If your application is approved DOC requires:

- **Insurance** to indemnify the Minister of Conservation against any claims or liabilities arising from your actions. The level of insurance cover will depend on the activity.
- A copy of your **safety plan** audited by an external expert (e.g. Health and Safety in Employment (Adventure Activity) Regulations 2011 audit or a DOC listed organisation). See the [Safety Plan](#)⁷ information on the DOC website for further information.

Note: DOC/Minister can vary the concession if the information on which the concession was granted contained material inaccuracies. DOC may also recover any costs incurred.

⁷ <https://www.doc.govt.nz/get-involved/apply-for-permits/managing-your-concession/safety-plans/>

A. Applicant details

Legal status of applicant (tick)	<input checked="" type="checkbox"/> Individual (Go to 1)	
	<input type="checkbox"/> Registered company (Go to 2)	<input type="checkbox"/> Trust (Go to 2)
	<input type="checkbox"/> Incorporated society (Go to 2)	<input type="checkbox"/> Other e.g. Educational Institutes (Go to 2)

1	Applicant name (individual)		Nick Bristed	
	Phone		Mobile phone	Sec 9(2)(a)
	Email	Sec 9(2)(a)		
	Physical address		Postcode	Sec 9(2)(a)
	Postal address (if different from above)		Postcode	

2	Applicant name (full name of registered company, trust, incorporated society or other)			
	Trading name (if different from applicant name)			
	NZBN if applicable (to apply go to: https://www.nzbn.govt.nz)		Company, trust or incorporated society registration number	
	Registered office of company or incorporated society (if applicable)			
	Company phone		Company website	
	Contact person and role			
	Phone		Mobile phone	
	Email			
	Postal address		Postcode	
	Street address (if different from Postal address)		Postcode	

B. Pre-application meeting

Have you had a pre-application meeting or spoken to someone in DOC?

No	<input type="checkbox"/>
Yes	<input checked="" type="checkbox"/>

- If yes record the:

Date of DOC pre-application meeting	15 September 2022
Name of DOC staff member	Tom Heather
Name of person in applicant organisation who had the pre-application meeting with DOC	Nick Bristed and Karli Bristed

C. One-off criteria

This form can only be used for activities that meet certain criteria – tick the following criteria that this application meets:

Criteria:	TICK
The activity has minor effects that can be easily managed	<input checked="" type="checkbox"/>
The activity complies with the relevant legislation, conservation management strategy, and conservation management plans	<input checked="" type="checkbox"/>
The activity has clearly defined limits (e.g. numbers of trips/landings to be authorised by the permit)	<input checked="" type="checkbox"/>
The activity does not involve permanent structures	<input checked="" type="checkbox"/>
The activity does not have a duration of more than 3 months	<input checked="" type="checkbox"/>
The activity has not been applied for in the same location more than once in a 3 year period	<input checked="" type="checkbox"/>

Note: If all these criteria are not met you are not eligible for a one-off concession. You will need to apply for a longer term concession. Check for the longer term concession application forms on the [DOC activity webpage you are applying](https://www.doc.govt.nz/get-involved/apply-for-permits/apply-for-a-permit/)⁸ for.

⁸ <https://www.doc.govt.nz/get-involved/apply-for-permits/apply-for-a-permit/>

D. Activity applied for

Tick the **activity application form** applicable to the activity you wish to undertake on public conservation land. Complete the applicant information form and the activity application form and email them with any attachments to permissions@doc.govt.nz

ACTIVITY APPLICATION FORM	FORM NO.	TICK
Guiding/Tourism/Recreation: Walking/Hiking/Tramping/Hunting/Fishing/Horses/4WD activities etc	4a	<input type="checkbox"/>
Guiding/Tourism/Recreation: Watercraft activities	4b	<input type="checkbox"/>
Guiding/Tourism/Recreation: Aircraft activities (excluding recreational drone use*)	4c	<input type="checkbox"/>
Filming	5a	<input type="checkbox"/>
Sporting Events	6a	<input type="checkbox"/>
Other (activities that may not be sufficiently covered in the above forms)	7a	<input checked="" type="checkbox"/>

* For recreational drone use applications fill out the [recreational drone use application form and recommended location form/s](#)⁹

E. Are you applying for anything else?

Are you submitting any other application forms in relation to this application?

No	<input type="checkbox"/>
Yes	<input checked="" type="checkbox"/>

If yes, state which application forms:

Forms 1a and 3b

F. Background experience of applicant

Provide relevant information relating to your ability to carry out the proposed activity (e.g. details of previous concessions, membership of professional organisations, and relevant qualifications).

Nick Bristed - Qualified Civil Engineer
Karli Bristed - Qualified Resource Management Planner

⁹ <https://www.doc.govt.nz/get-involved/apply-for-permits/recreational-drone-use/>

G. Attachments

Attachments should *only* be used if there is:

- Not enough space on the form to finish your answer
- You have additional information that supports your answer
- You wish to make an additional request of DOC regarding the application.

Label each document clearly and complete the table below.

Section of the application form the attachment relates to	Document title	Document format (e.g. Word, PDF, Excel, jpg etc.)	Description of attachment
<u>Correct example ✓</u> D	Locations	PDF	Trust Deed
<u>Incorrect example X</u> Table	Doc1	Word	Table
—			

H. Checklist

Application checklist	Tick
I have completed all sections of this applicant information form relevant to my application and understand that the form will be returned to me if it is incomplete.	<input checked="" type="checkbox"/>
I certify that the information provided in this applicant information form, and any attached additional forms is, to the best of my knowledge, true and correct.	<input checked="" type="checkbox"/>
I have completed the activity application form .	<input checked="" type="checkbox"/>
I have appropriately labelled all attachments and completed section G Attachments to match.	<input type="checkbox"/>
I will email permissions@doc.govt.nz my: <ul style="list-style-type: none"> • Completed applicant application form • Completed activity application form/s • Any other attachments. 	<input checked="" type="checkbox"/>

I. Terms and conditions for a credit account with the Department of Conservation

Have you held an account with the Department of Conservation before?	Tick
No	<input checked="" type="checkbox"/>
Yes	<input type="checkbox"/>
If 'yes' under what name	

In ticking this checklist and placing your name below you are acknowledging that you have read and agreed to these terms and conditions for an account with the Department of Conservation

Terms and conditions	Tick
<input checked="" type="checkbox"/> We agree that the Department of Conservation can provide my/our details to the Department's Credit Checking Agency to enable it to conduct a full credit check.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> We agree that any change which affects the trading address, legal entity, structure of management or control of the applicant's company (as detailed in this application) will be notified in writing to the Department of Conservation within 7 days of that change becoming effective.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> We agree to notify the Department of Conservation of any disputed charges within 14 days of the date of the invoice.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> We agree to fully pay the Department of Conservation for any invoice received on or before the due date.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> We agree to pay all costs incurred (including interest, legal costs and debt recovery fees) to recover any money owing on this account.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> We agree that the credit account provided by the Department of Conservation may be withdrawn by the Department of Conservation, if any terms and conditions (as above) of the credit account are not met.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> We agree that the Department of Conservation can provide my details to the Department's Debt Collection Agency in the event of non-payment of payable fees.	<input checked="" type="checkbox"/>

Typed applicant name/s	Nick Bristed	Date	14 February 2023
-------------------------------	--------------	-------------	------------------

For Departmental use			
Credit check completed			
Comments:			
Signed		Name	
Approved (Tier 4 manager or above)		Name	



The Department recommends that you contact the Department of Conservation Office closest to where the activity is proposed to discuss the application prior to completing the application forms. Please provide all information requested in as much detail as possible. Applicants will be advised if further information is required before this application can be processed by the Department.

This form is to be used when your activity does not fall into any of the other categories. It is to be completed in conjunction with either Applicant Information Form 1a (longer term concession) or Applicant Information Form 1b (one-off concession) as appropriate.

- If your application involves guiding clients on public conservation land eg walking, kayaking, 4WD, hunting, aircraft landings, please fill in Forms 4a, 4b and/or Form 4c as applicable.
- If your application includes building, extending or adding to any permanent or temporary structures or facilities on public conservation land, please also fill in Form 3b,
- If your application includes tenancy of any DOC managed buildings (other than overnight usage of huts) please also fill in Form 3a.
- If your application is for access across public conservation land please fill in Form 3c.

Please complete this application form, attach Form 1a or Form 1b, and any other applicable forms and information and send to permissions@doc.govt.nz. The Department will process the application and issue a concession if it is satisfied that the application meets all the requirements for granting a concession under the Conservation Act 1987.

If you require extra space for answering please attach and label according to the relevant section.

A. Description of Activity

Please describe the proposed activity(s) in detail.

Please include the name and status of the public conservation land, the size of the area you are applying for and why this area has been chosen.

Please attach maps of the location and any detailed site plan, any drawings of proposal and label Attachment 7a:A.

Sounds Foreshore Reserve. This land is adjacent to a private dwelling was been damaged in a storm event in 2021. NZTM GPS coordinates are - 1685798.51 5434150.67
Please see attached EIA

B. Term

Please detail the length of the term sought (i.e. number of years or months) and why. If you are applying for a one-off permit please state the specific dates and/or times sought.

Note: An application for a concession for a period over 10 years must be publicly notified, an application for a concession up to 10 years will not be publicly notified unless the adverse effects of the activity are such that it is required, or if an exclusive interest in the land is required.

3 months for construction

C. Bulk fuel storage

Under the Hazardous Substances and New Organisms Act 1996 (HSNO Act) 'Bulk fuel storage' is considered to be any single container, stationary or mobile, used or unused, that has a capacity in excess of 250 litres of Class 3 fuel types. This includes petrol, diesel, aviation gasoline, kerosene and Jet A1. For more information on Hazardous Substances, go to:

<http://www.business.govt.nz/worksafe/information-guidance/legal-framework/hsno-act-1996>

Do you intend to store fuel in bulk on the land as part of the activity?

YES / NO

If you have answered yes, then please provide full details of how and where you intend to store the fuel, and label any attachments including plans, maps and/or photographs as Attachment 7a:C. If your concession application is approved you will be required to provide a copy of your HSNO compliance certification to the Department before you begin the activity.

E. Other

Is there any further information you wish to supply in support of your application? Please attach if necessary and label Attachment 7a:E.

Full EIA attached with further details.

APPENDIX B. STRUCTURAL AND GEOTECHNICAL REPORTS

21 November 2022

Our Ref: 50683 - Rev.1

Attn: Nick and Karli Bristed

Dear Nick and Karli

**RE: Sec 9(2)(a) [REDACTED], DOUBLE COVE
RETAINING WALL DESIGN REPORT**

1.0 INTRODUCTION

Engineering Design Consultants Ltd (EDC) was commissioned by the Bristeds (the Client) to provide a retaining wall design to remediate a slip that occurred on the site.

2.0 MEANS OF COMPLIANCE

2.1 Referenced Standards

The following New Zealand and Australian standards were referenced in the retaining wall design:

- NZS3404:1997 – Steel Structures Standard
- AS4678:2002 – Earth Retaining Structures
- NZS3603:1993 – Timber Structures Standard

2.2 Alternative Solutions

The following alternative solutions were referenced in the retaining wall design:

- Bowles Foundation Analysis & Design 5th Edition, 1996
- Earthquake Geotechnical Engineering Module 6: Earthquake Resistant Foundation Design, 2021
- Design Estimation of The Ultimate Load-Holding Capacity of Ground Anchors, Littlejohn, GS, 1980

3.0 DESIGN METHODOLOGY

3.1 Retaining Wall

Soil parameters were established using on-site testing as presented in the EDC geotechnical report 50683. The site geometry (as presented in Figure 1) has been established from the level survey by Scope Surveying.

Earthquake Geotechnical Engineering Module 6 defines the following ULS load combinations for wall stability:

- $E_{d,stab} = [0.9G]$
- $E_{d,dst} = [1.2G + 1.5F_E + 0.4Q]$ (gravity case)
- $E_{d,dst} = [G + E_u + 0.4Q]$ (earthquake case)

Where:

- $E_{d,stab}$ = design action effect, stabilising
- $E_{d,dst}$ = design action effect, destabilising
- F_E = static earth pressure
- E_u = ultimate earthquake action (pseudo-static earth pressure and wall inertia)
- G = self-weight (dead load)
- Q = imposed action (live load)

The retaining wall design has been undertaken using WALLAP V5.04. In order to undertake the design in general accordance with Earthquake Geotechnical Engineering Module 6, partial factors were applied in the following way:

- **$E_{d,stab}$:** No stabilising gravity loads are present.
- **F_E :** Soil unit weight was increased to 1.5 times that presented in Table 4 on the active side of the wall.
- **E_u :** Design earthquake parameters applied directly.
- **G :** Future deck loads have been applied as presented in Table 4. These consider the possible addition of a future spa applying 6kPa.
- **Q :** No live loads have been considered.

When analysis is completed using WALLAP V5.04, a slope greater than the friction angle of the soil cannot be considered in the model, even in the case of a c-phi soil, where the slope remains stable at angles greater than the friction angle.

To account for the sloping ground on the passive side of the wall, the 'effective' retained height was increased according to a geometric transformation based on the passive wedge and toe slope angles, allowing the sloping ground on the passive side to be modelled with horizontal ground and an increased retained height. The derivation of this geometric transformation is attached to this report. The result of the transformation is to increase the retained height by 0.3 times the total embedment depth, iterating to convergence. Friction between the soil and the wall was neglected in the seismic case. In the static case, interface friction was set to 16 degrees, as per Bowles (1995).

For wall stability, a minimum Factor of Safety (FoS) of 1.5 has been considered for static conditions, and a FoS of 1.0 has been considered for seismic conditions. This is equivalent to applying a strength reduction factor of 0.67 and 1.0 to the soil strength for gravity and seismic loadings respectively, falling within the range indicated within Module 6 for embedded retaining walls.

The proposed retaining wall comprises concrete encased timber poles cast in machine augured holes, spaced at less than three times the auger hole diameter. This means that

the passive resistance provided by the soil downslope of the behave as a continuous diaphragm below the ground.

Assumptions made in the WALLAP Model are listed at the top of the calculation outputs for the static and seismic cases attached to this design report.

3.2 Soil Anchors

The WALLAP model used to design the retaining wall for stability allows the input of struts to the model, allowing the factored anchor force to be determined directly from the model output, considering the worst case from the gravity and earthquake scenarios. The anchor bond length was then designed using first principles. The anchor capacity is defined by:

$$\Phi T = \Phi \pi D L \tau_{ult}$$

Where

Φ = Strength reduction factor

T = The anchor capacity

D = Bonded section grouted diameter

L = Bonded length

τ_{ult} = Ultimate Bond Stress (0.1UCS < 4MPa)

The Uniaxial Compressive Strength (UCS of the schist bedrock has been estimated using Roclab). The software output is attached in

A strength reduction factor of 0.8 (as per AS4678) has been used when checking the anchor capacity against the proof test load (1.5 times the ULS in-service load), corresponding to a safety factor of 1.9 on the in-service governing ULS load.

4.0 DESIGN CRITERIA

4.1 Performance Requirements

The design has been undertaken in general accordance with Earthquake Geotechnical Engineering Practice – Module 6: Earthquake resistant retaining wall design.

The retaining wall has been identified as falling within 'Case 3' in accordance with Earthquake Geotechnical Engineering Module 6. Performance requirements are summarised in Table 1

Retaining Wall Case (Module 6)	Case 3
SLS Performance Requirement	Minor Movement (<25mm)
ULS Performance Requirement	Wall movement should not be so excessive as to cause loss of structural integrity or prevent means of safe egress (e.g. less than 100 mm for normal timber framed construction to NZS 3604)
Design Life	50 years

Table 1: Performance Requirements

4.2 Dead Loads

The dead loads applied in the wall design are presented in Table 2.

Load	Value
Deck Surcharge	6kPa (directly adjacent wall)

Table 2: Dead loads

4.3 Seismic Loads

Seismic loading on the proposed wall has been established in accordance with Earthquake Geotechnical Engineering Practice – Module 6, Section 5. Derivation of the horizontal seismic coefficient, k_h , is summarised in Table 3.

Parameter	Value
Importance Level	IL2
Return Period	500 years
PGA, a_{max} (g)	0.52
Topographic Amplification Factor, A_{topo}	1
Wall Disp. Factor, W_d	1 – Stiff wall
Horizontal Seismic Coefficient, k_h (g)	0.52

Table 3: Horizontal Seismic Coefficient

5.0 GEOLOGY AND SOIL DESIGN PARAMETERS

The soil model presented in Table 4 has been established using the data collected during the EDC geotechnical investigation.

Groundwater has been assumed to be beneath the toe of the retaining wall.

Parameter	Layer 1 (SILT)	Layer 2 (SCHIST)
Bulk Unit Weight (kN/m ³) *1	17	26
Modulus (MPa) *2,4	5	19000
Undrained Shear Strength (kPa) *1	50	-
Effective (drained) Friction Angle (°) *1	25	60
Effective (drained) Cohesion (kPa) *1	5	1400
At-Rest Coefficient of Lateral Earth Pressure	0.6	0.13
Uniaxial Compressive Strength of the Rock Mass (MPa) *4	-	9.7
Poisson's Ratio*3	0.4	0.2

*1 EDC Geotechnical Report

*2 Bowles (1995)

*3 At-rest earth pressure coefficient and Poisson's ratio in normally consolidated soils, Sec 9(2)(a) (ISSMGE)

*4 Roclab V1.032

*5 Calculated using Jakys Law, $K_0=1-\sin(\phi)$

** The parameters from the EDC geotechnical report have been adjusted to account for the possibility of some soil disturbance during the construction of the retaining wall.

Table 4: Model Soil Parameters

6.0 SITE GEOMETRY

The site geometry along Section A-A', identified as the critical cross section for design, is presented in Figure 1.

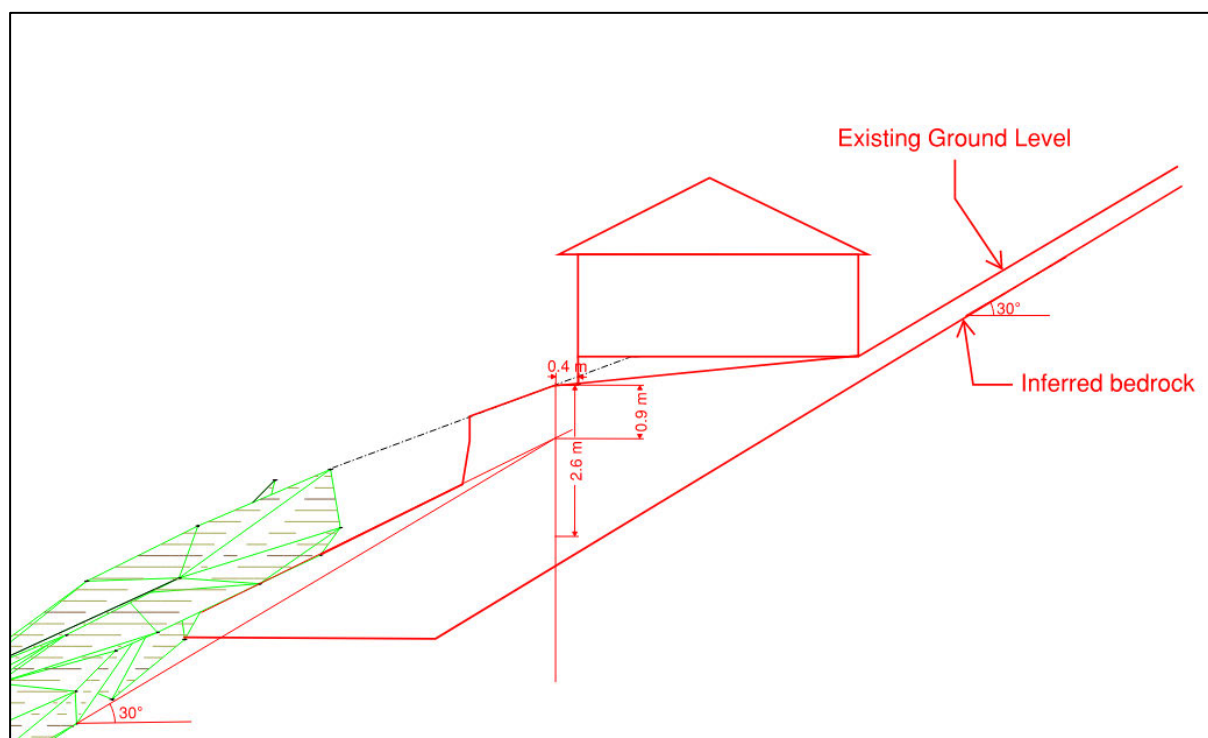


Figure 1: Section A-A' (NTS)

7.0 RETAINING WALL – LOCAL STABILITY

Global stability of the slope upon which the retaining wall will be constructed has been assessed separately in the EDC geotechnical report.

Minimum soldier pile embedment's were determined and are presented in Table 5. The WALLAP calculation outputs for the final design iterations are attached to this report for both the gravity and earthquake case. The tabulated analysis outputs (i.e. minimum embedment at each iteration) are attached also.

Load Case	Minimum Pole Embedment (m)
Gravity	3.5
Earthquake	0.2

Table 5: Minimum Soldier Pile Embedment for Stability

The maximum factored load transferred to the soil anchors is 66kN/m along the wall, occurring in the seismic case (no rock encountered).

In the case that the schist bedrock is encountered before the above embedment is achieved, the post hole excavation may be terminated 300mm into the rock instead.

8.0 SOIL ANCHORS – GEOTECHNICAL STRENGTH

The factored soil anchor load is 66kN per anchor and is governed by the seismic load case where rock is not encountered, as determined in Section 7.0. The required soil anchor geometry is presented in Table 6. Anchors have been designed on the basis that they will be installed 0.7m from the top of the wall and be spaced at 1.5m centres.

Load Case	Value
Anchor Spacing (along wall)	1.0m
Bonded Length	1.5m
Unbonded Length	Unknown, estimated as 2.2 – 4.1m
Total Anchor Length	Unknown, estimated as 3.4 – 5.3m
Bonded diameter	50mm
Installation Angle	-15°

Table 6: Design Soil Anchor Geometry

9.0 DESIGN OF STRUCTURAL ELEMENTS

9.1 Soldier Piles

The maximum factored bending moment and shear force applied to the soldier piles are presented in Table 7.

Load Case	Value
Seismic Factored Moment Demand, M^*_{seismic}	19kNm
Seismic Factored Shear Demand, V^*_{seismic}	71kN
Static Factored Moment Demand, M^*_{static}	19kNm
Static Factored Shear Demand, V^*_{static}	63kN

Table 7: Soldier Pile Loads

250mm diameter SED high density poles were found to be suitable to carry the design retaining wall loads considering the corrosion expected to occur over the life of the retaining wall and limit wall displacements to <20mm in a ULS event. Calculations are appended to this report. As displacements are limited to <25mm in a ULS event, SLS displacements will conform to the performance requirements of a Case 3 wall.

9.2 Lagging

The maximum factored uniformly distributed load (UDL) applied to the soldier piles are presented in Table 7, and have been based on 2 x 200 x 50mm wide boards.

Load Case	Value
Maximum factored static UDL, w^*_{static}	5.6kN/m
Maximum factored seismic UDL, w^*_{seismic}	6.3kN/m

Table 8: Lagging UDL's

200x100 SG8 boards were found to be suitable for carrying the design soil pressures applied to the wall. Substitution for an alternative lagging section may be acceptable subject to approval from the engineer. Substitution with 2 x 200 x 50 (back-to-back) is acceptable.

9.3 Anchor Tendon

Anchor tendons are required to carry up to 100kN per anchor to accommodate proof load testing. The nominated anchor installation contractor should provide an anchor tendon suitable of carrying this load. A Grade 75 R61 22mm all-thread bar has sufficient capacity to carry the load.

9.4 Waling

The waling will need to transfer the 100kN per anchor load into the soldier piles, with the proof load providing the governing load. The details of the proposed waling are presented in Table 9.

Parameter	Value
Section	2 x 100x50 Grade 350 RHS
Location from top of wall	0.7m
Max. distance to adjacent king post	Through King Post OR 75mm offset (max)

Table 9: Waling Details

9.5 Fasteners and Connections

All connections shall be as specified on the EDC design drawing set, dated June 2022.

10.0 TESTING, SUPERVISION AND DOCUMENTATION

The following inspections are required for this project:

- Pre-start inspection to assess the condition of the slope prior to starting construction – 1x visit
- Post hole inspection – 1x visit
- Installation of drainage – 1x visit
- Installation of lagging - 1x visits
- Installation of waling – 1x visits
- Installation of anchors – 1 to 2x visits
- Final Inspection – 1x visit

The contractor is to proof load all installed anchors to 1.5x the design working load, or 100kN for a minimum of 15 minutes. The load can then be reduced to 45kN and 'locked off'.

Evidence of proof loading will be required by the engineer prior to provision of PS4.

EDC will review and approve the anchor proof load testing and pile sets prior the contractor taking equipment off site.

The engineer may, at their sole discretion, accept photographs in lieu of undertaking a site visit in person. This will be considered on a case-by-case basis.

A copy of a Producer Statement 1 is enclosed in Appendix I, and a Safety in Design assessment is enclosed in Appendix J.

11.0 SUMMARY

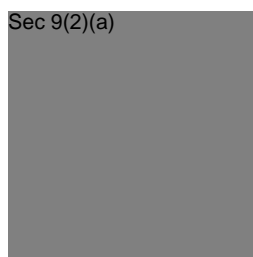
The proposed retaining wall is summarised in Table 10: .

Wall Property	Value
Max. retained height	2.2m
Minimum soldier pile embedment	3.2m or 300mm into bedrock
King post spacing	1.0m
Anchor location	0.7m (from top of wall) Through king pose OR <75mm from nearest king post
Anchor Unbonded Length	Unknown, estimated as 2.2 – 4.1m
Anchor Bonded Length	1.5m
Anchor Spacing	1.0m
Bonded Diameter	50mm
Maximum toe slope	-30°
King Post Section	250 SED HD Poles
Lagging Boards	200x100 SG8 Boards OR 2x200x50 SG8 Boards back-to-back
Waling Section	Grade 350 – 2/100x50PFC

Table 10: Retaining Wall Summary

The above wall suitability is based on the performance required for post construction demands.

REPORT PREPARED BY:



BE(Hons) Nat Res, PG CertProf, MEngNZ
 Geotechnical Engineer

REPORT CHECKED BY:



Gareth B Williams
 MSc(Eng) CPEng CMEngNZ IntPE(NZ) MInstD
 MEIANZ
 Geotechnical Engineer, Director

Encl. Appendices A to G

12.0 LIMITATIONS

Except where required by law, the findings presented as part of this report are for the sole use of our client, as noted above. The findings are not intended for use by other parties, and may not contain sufficient information for the purposes of other parties or other uses. No third party (excluding the local authority) may use or rely upon this report unless authorised by EDC in writing.

To the extent permitted by law, EDC expressly disclaims and excludes liability for any loss, damage, cost or expense suffered by any third party relating to or resulting from the use of, or reliance upon any information contained in this report. It is the responsibility of third parties to independently make enquiries or seek advice in relation to their particular requirements.

Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time. No other warranty, expressed or implied, is made as to the professional advice presented in this report, in regard to its accuracy or completeness.

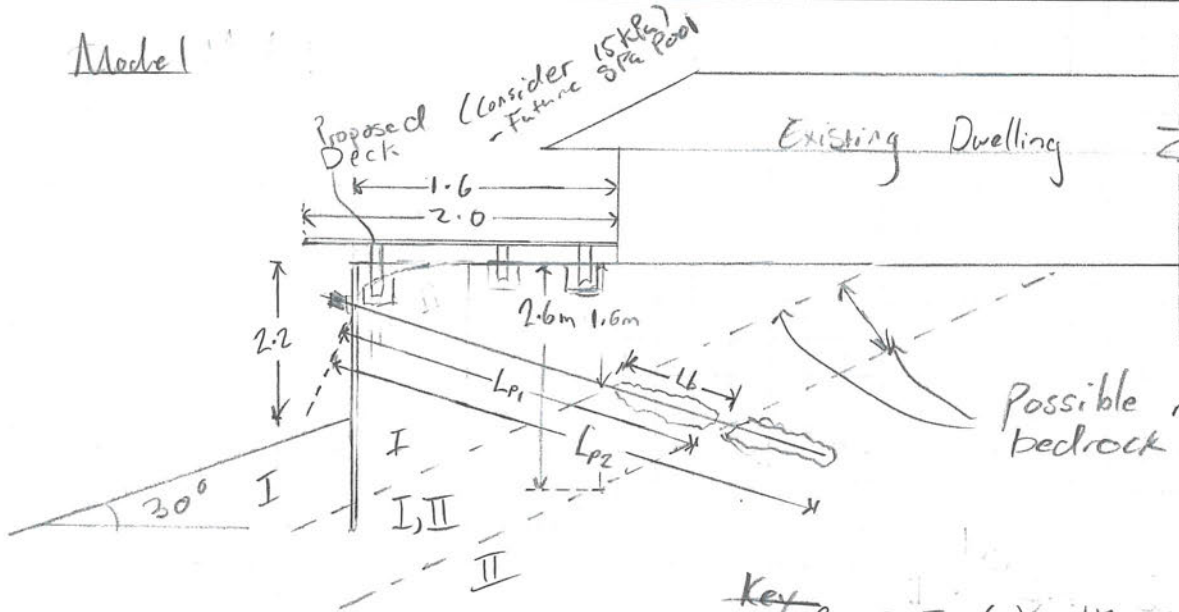
Our opinions and recommendations are based on our comprehension of the current regulatory standards and must not be considered legal opinions. For legal advice, please consult your solicitor. This opinion is not intended to be advice that is covered by the Financial Advisors Act 2010.

The design contained in this report are based on test data by Geotech Consulting Ltd. Inferences are made about the nature and continuity of subsoils away from and beyond the exploratory holes which cannot be guaranteed.

This document includes Appendices. These appendices should be read in conjunction with the main part of the report and this report should not be considered complete without them.

APPENDIX A HAND CALCULATIONS

Model



W SLS: $M_w = 64$
 $a_{max} = 0.2g$
 ULS: $M_w = 703$
 $a_{max} = 0.53g$
 $W_d = 0.5$ (Case 3)

- Key**
- I - Stiff SILT ($\gamma_b = 17 \text{ kN/m}^3$, $S_u = 40 \text{ kPa}$)
 - II - Schist BEDROCK ($\gamma = 26 \text{ kN/m}^3$, $UCL = 5.2 \text{ MPa}$)
 - III - Loose-placed FILL ($\gamma_b = 15 \text{ kN/m}^3$, $S_u = 5 \text{ kPa}$)
- Not present -

Parameters For Static Analysis

Parameters For Seismic Analysis

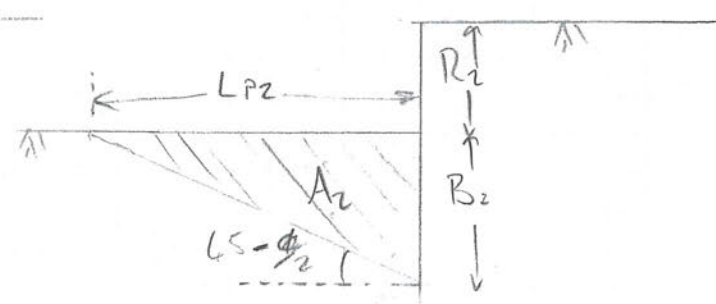
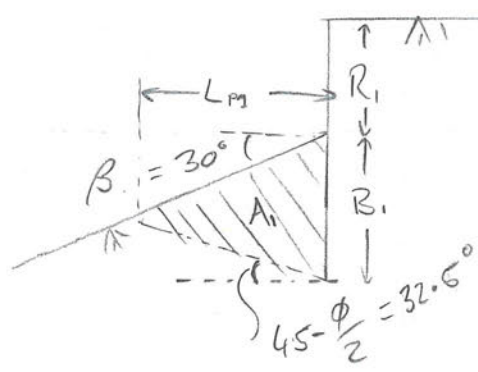
Parameter	I		II		III	
	Passive	Active	Passive	Active	Passive	Active
γ_b (kN/m ³)	15	25.5	-	26	-	22.5
E_s (MPa)	5	5	-	19×10^3	-	1
c / S_u (kPa)	5	5	-	1.4×10^3	-	5
K_0	0.58	0.58	-	0.13	-	0.8
UCL (MPa)	-	-	-	9.7	-	-
ν	0.36	0.36	-	0.19	-	-
ϕ	25	25	-	60	-	-

Parameter	I		II		III	
	Passive	Active	Passive	Active	Passive	Active
γ_b (kN/m ³)	17	17	-	26	-	15
E_s (MPa)	5	5	-	19×10^3	-	0.1
S_u (kPa)	50	50	-	1.4×10^3	-	5
K_0	0.58	0.58	-	0.13	-	0.8
UCL (MPa)	-	-	-	9.7	-	-
ν	0.36	0.36	-	0.19	-	-
ϕ	-	-	-	60	-	-

Determine equivalent horizontal slope for WALLAP

Actual Geometry

Model Geometry



Consider $\phi = 25^\circ$ for silt.

$$L_{p1} = \frac{B_1}{\tan(45 - \frac{\phi}{2}) + \tan(\beta)}$$

$$= \frac{B_1}{0.64 + 0.57}$$

$$= 0.82 B_1$$

$$\therefore A_1 = L_{p1} \times B_1 \times 0.5$$

$$= 0.41 B_1^2$$

$$L_{p2} = B_2 (\tan 32.5)^{-1}$$

$$= 1.6 B_2$$

$$\therefore A_2 = 0.5 B_2 L_{p2}$$

$$= 0.8 B_2^2$$

Determine $B_2 = f(B_1)$ for $A_1 = A_2$

$$0.4 B_1^2 = 0.8 B_2^2$$

$$\therefore B_2 = \sqrt{0.5} B_1$$

$$= 0.71 B_1$$

Level ground embedment 71% of sloped ground embedment.

\therefore Retained height increases by 29%

Iteration procedure:

1. Determine $B_2(i)$ (assume level ground)
2. Increase $R_2(i+1) = R_2(i) + B_2(i) \times 0.29$
3. Determine $B_2(i+1)$
4. Iterate to convergence. ($|R_2(i) - R_2(i+1)| < 0.05 \text{ m}$)

Static Iterations (Wallap) - FOS = 1.05

Iteration #	$R_2(i)$ Retained Height (m)	$B_2(i)$ Min. Embedment (m)	$R_2(i+1) = R_2(i) + 0.29 B_2(i)$ Updated retained height	Δ (m)
1	2.2	1.42	2.61	0.41
2	2.61	1.83	2.85	0.24
3	2.85	2.13	3.01	0.16
4	3.01	2.33	3.11	0.1
5	3.11	2.42	3.17	0.056
6	3.17	2.49	3.20	0.037

$$\Rightarrow \text{Min. 'true' embedment} = (3.17 + 2.49) - 2.2$$

$$= 3.5 \text{ m}$$

\Rightarrow If rock encountered, embed 300mm into Rock

Check Seismic case.

Iteration #	$R_{2(i)}$ Retained Height (m)	$B_2(i)$ Min. Embedment (m)	$R_{2(i+1)} = R_{2(i)} + 0.29 B_{2(i)}$ Updated Retainal Height (m)	Δ (m)
1	2.2	0.2	2.26	0.06
2	2.26	0.2	2.26	0

⇒ Static case governs.

APPENDIX B DESIGN CALCULATIONS – STATIC CASE

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Active side	Soil types	Passive side
1	0.00	1 SILT (active)		2 SILT (passive)

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	SILT (active)	25.50	5000	0.580	NC (0.360)	0.353 (1.388)	3.416 (5.182)	5.000d
2	SILT (passive)	15.30	5000	0.580	NC (0.360)	0.353 (1.388)	3.416 (5.182)	5.000d
3	SCHIST (active)	39.00	1.90E+6	0.130	NC (0.190)	0.061 (0.542)	94.32 (53.877)	1500d
4	SCHIST (passive)	23.00	1.90E+6	0.130	NC (0.190)	0.061 (0.542)	94.32 (53.877)	1500d

Additional soil parameters associated with Ka and Kp

No.	Soil type -- Description	--- parameters for Ka ---			--- parameters for Kp ---		
		Soil friction angle	Wall adhesion coeff.	Back-fill angle	Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	SILT (active)	25.00	0.645	0.00	25.00	0.645	0.00
2	SILT (passive)	25.00	0.645	0.00	25.00	0.645	0.00
3	SCHIST (active)	60.00	0.419	0.00	60.00	0.419	0.00
4	SCHIST (passive)	60.00	0.419	0.00	60.00	0.419	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	-10.00	-10.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Elevation of toe of wall = -5.70
 Maximum finite element length = 0.30
 Youngs modulus of wall E = 1.2000E+07 kN/m2
 Moment of inertia of wall I = 1.2581E-04 m4/m run
 E.I = 1509.7 kN.m2/m run
 Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/ anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre- stress /strut kN	Tension allowed
1	-0.70	1.00	0.000380	200000	4.10	-15.00	45.00	No

SURCHARGE LOADS

Surcharge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge Near edge Far edge	----- kN/m2 -----	----- soil type
1	0.00	0.00(A)	10.00	2.00	7.20	=	N/A

Note: A = Active side, P = Passive side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Excavate to elevation -0.90 on PASSIVE side
2	Install strut or anchor no.1 at elevation -0.70
3	Excavate to elevation -3.17 on PASSIVE side
4	Apply surcharge no.1 at elevation 0.00

FACTORS OF SAFETY and ANALYSIS OPTIONS

Type of structure - Retaining wall

Stability analysis:

Method of analysis - Strength Factor method

Factor on soil strength for calculating wall depth = 1.50

Factor on soil strength for calculating tie force = 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 active side of wall = 20.00 m

Width of excavation on passive side of wall = 20.00 m

Distance to rigid boundary on active side = 20.00 m

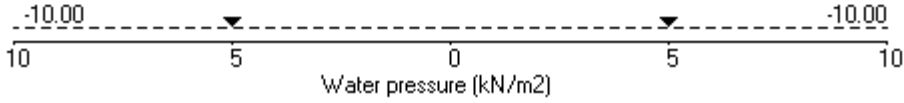
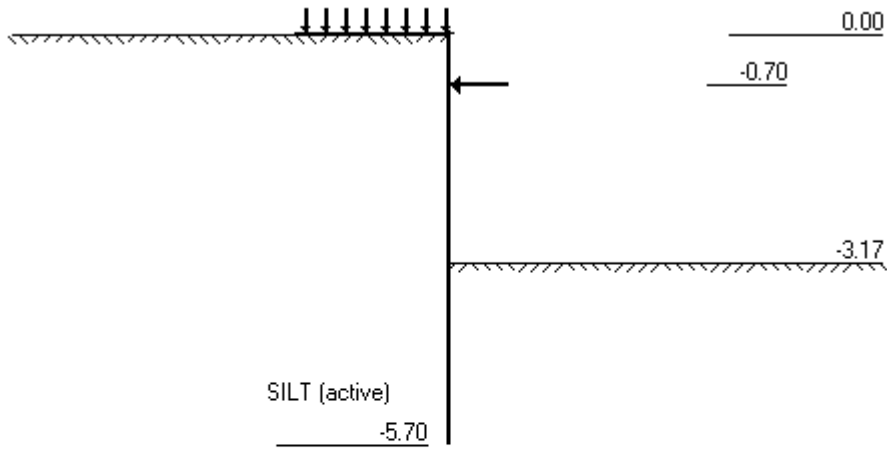
Distance to rigid boundary on passive side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Displacement	Active, Passive	Graph. output pressures
1	Excav. to elev. -0.90 on PASSIVE side	Yes	Yes	Yes
2	Install strut no.1 at elev. -0.70	Yes	Yes	Yes
3	Excav. to elev. -3.17 on PASSIVE side	Yes	Yes	Yes
4	Apply surcharge no.1 at elev. 0.00	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

Units: kN,m

Stage No.4 Apply surcharge no.1 at elev. 0.00



ENGINEERING DESIGN CONSULTANTS Ltd
 Program: WALLAP Version 5.04 Revision A36.B52.R41
 Licensed from GEOSOLVE
 Run ID. 20220808_Double Cove static
 RW 1.6m from dwelling - Double Cove
 Static Analysis

| Sheet No.
 |
 | Job No. 50683
 | Made by : EDC
 | Date:20-10-2022
 | Checked :

Units: kN,m

Stage No. 1 Excavate to elevation -0.90 on PASSIVE side

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

Stage No.	--- G.L. --- Act. Pass.	Strut Elev.	FoS for toe elev. =	Moment of equilib. at elev. Safety	Toe elev. for FoS =	Wall Penetration	Strut force for F=1.000
1	0.00 -0.90	Cant.	2.895	-5.55	-1.27	0.37	

BENDING MOMENT and DISPLACEMENT CALCULATION - Assumptions:

Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Open Tension Crack analysis - No
 Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Active side 20.00 from wall
 Passive 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	Strut forces kN/m
1	0.00	0.00	0.006	-2.06E-03	0.0	-0.0	
2	-0.30	0.00	0.007	-2.06E-03	0.0	0.0	
3	-0.50	0.51	0.007	-2.06E-03	0.1	0.0	
4	-0.70	3.07	0.008	-2.07E-03	0.4	0.1	
5	-0.90	5.63	0.008	-2.10E-03	1.3	0.3	
		-2.29	0.008	-2.10E-03	1.3	0.3	
6	-1.20	-1.74	0.009	-2.18E-03	0.7	0.6	
7	-1.50	-1.24	0.009	-2.30E-03	0.2	0.7	
8	-1.80	-0.83	0.010	-2.45E-03	-0.1	0.7	
9	-2.10	-0.50	0.011	-2.59E-03	-0.3	0.7	
10	-2.40	-0.24	0.012	-2.73E-03	-0.4	0.6	
11	-2.70	-0.06	0.012	-2.84E-03	-0.4	0.5	
12	-2.94	0.03	0.013	-2.92E-03	-0.4	0.4	
13	-3.17	0.10	0.014	-2.98E-03	-0.4	0.3	
14	-3.39	0.14	0.015	-3.02E-03	-0.4	0.3	
15	-3.60	0.17	0.015	-3.05E-03	-0.4	0.2	
16	-3.90	0.19	0.016	-3.08E-03	-0.3	0.1	
17	-4.20	0.19	0.017	-3.10E-03	-0.3	0.1	
18	-4.50	0.18	0.018	-3.11E-03	-0.2	0.0	
19	-4.80	0.18	0.019	-3.11E-03	-0.1	-0.0	
20	-5.10	0.17	0.020	-3.10E-03	-0.1	-0.0	
21	-5.40	0.16	0.021	-3.10E-03	-0.0	-0.0	
22	-5.70	0.16	0.022	-3.10E-03	0.0	-0.0	

(continued)

Stage No.1 Excavate to elevation -0.90 on PASSIVE side

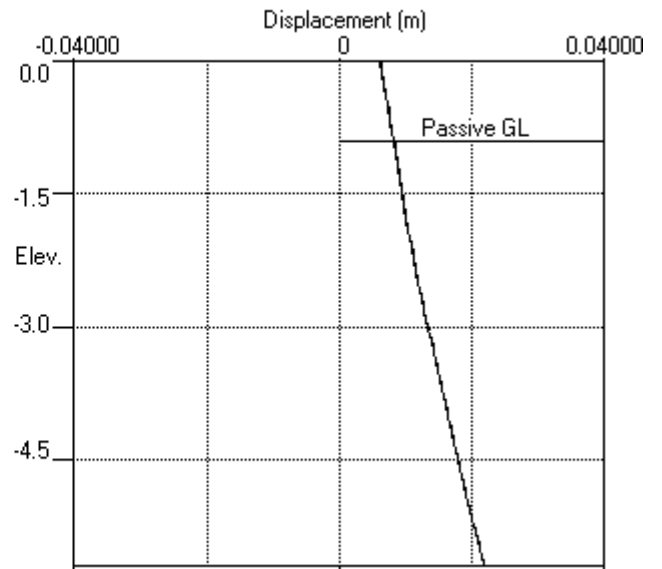
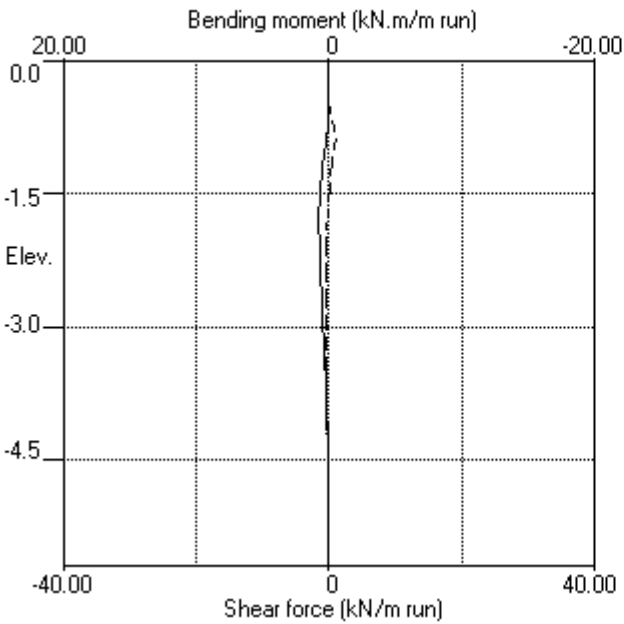
Node no.	Y coord	----- ACTIVE side -----					Total earth pressure kN/m2	Soil stiffness kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2		
1	0.00	0.00	0.00	0.00	25.91	0.00	0.00a	952
2	-0.30	0.00	7.65	0.00	52.04	0.00	0.00a	952
3	-0.50	0.00	12.75	0.00	69.46	0.51	0.51	952
4	-0.70	0.00	17.85	0.00	86.89	3.07	3.07	952
5	-0.90	0.00	22.95	1.15	104.31	5.63	5.63	952
6	-1.20	0.00	30.60	3.85	130.44	9.46	9.46	952
7	-1.50	0.00	38.25	6.54	156.58	13.25	13.25	952
8	-1.80	0.00	45.90	9.24	182.71	17.01	17.01	952
9	-2.10	0.00	53.55	11.94	208.85	20.73	20.73	952
10	-2.40	0.00	61.20	14.63	234.98	24.40	24.40	952
11	-2.70	0.00	68.85	17.33	261.11	28.04	28.04	952
12	-2.94	0.00	74.84	19.44	281.58	30.87	30.87	952
13	-3.17	0.00	80.83	21.55	302.06	33.69	33.69	952
14	-3.39	0.00	86.32	23.49	320.79	36.25	36.25	952
15	-3.60	0.00	91.80	25.42	339.51	38.81	38.81	952
16	-3.90	0.00	99.45	28.12	365.65	42.37	42.37	952
17	-4.20	0.00	107.10	30.81	391.78	45.92	45.92	952
18	-4.50	0.00	114.75	33.51	417.92	49.47	49.47	952
19	-4.80	0.00	122.40	36.21	444.05	53.02	53.02	952
20	-5.10	0.00	130.05	38.91	470.18	56.57	56.57	952
21	-5.40	0.00	137.70	41.60	496.32	60.12	60.12	952
22	-5.70	0.00	145.35	44.30	522.45	63.67	63.67	952

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure kN/m2	Soil stiffness kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2		
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	-0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	-0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	-0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	-0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	-1.20	0.00	0.00	0.00	25.91	7.92	7.92	952
7	-1.50	0.00	4.59	0.00	41.59	11.19	11.19	952
8	-1.80	0.00	9.18	0.00	57.27	14.50	14.50	952
9	-2.10	0.00	13.77	0.00	72.95	17.84	17.84	952
10	-2.40	0.00	18.36	0.00	88.63	21.22	21.22	952
11	-2.70	0.00	22.95	1.15	104.32	24.65	24.65	952
12	-2.94	0.00	27.54	2.77	120.00	28.11	28.11	952
13	-3.17	0.00	31.14	4.04	132.29	30.84	30.84	952
14	-3.39	0.00	34.74	5.30	144.58	33.59	33.59	952
15	-3.60	0.00	38.03	6.47	155.83	36.11	36.11	952
16	-3.90	0.00	41.32	7.63	167.08	38.64	38.64	952
17	-4.20	0.00	45.92	9.25	182.78	42.18	42.18	952
18	-4.50	0.00	50.52	10.87	198.48	45.73	45.73	952
19	-4.80	0.00	55.11	12.49	214.18	49.29	49.29	952
20	-5.10	0.00	59.71	14.11	229.89	52.84	52.84	952
21	-5.40	0.00	64.31	15.73	245.61	56.40	56.40	952
22	-5.70	0.00	68.91	17.35	261.33	59.96	59.96	952
22	-5.70	0.00	73.52	18.97	277.05	63.51	63.51	952

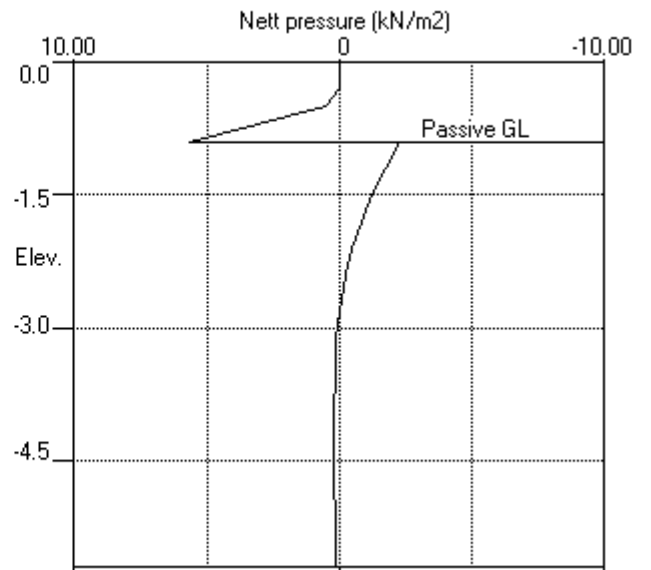
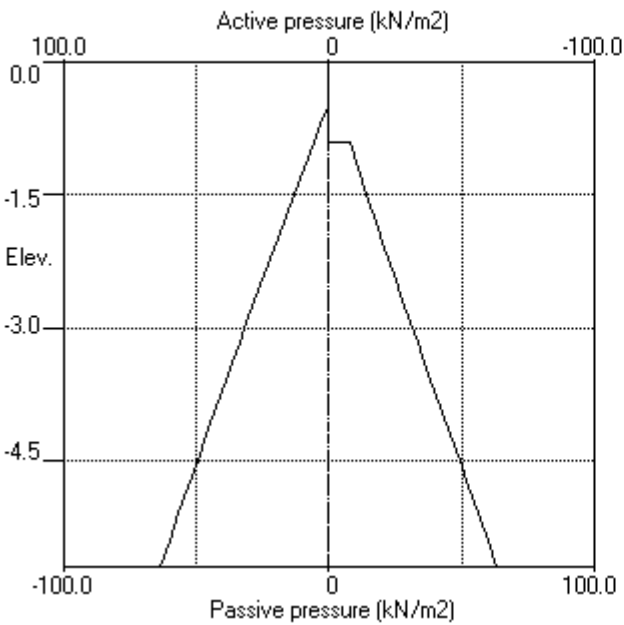
Note: 0.00a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.1 Excav. to elev. -0.90 on PASSIVE side



Stage No.1 Excav. to elev. -0.90 on PASSIVE side



ENGINEERING DESIGN CONSULTANTS Ltd
 Program: WALLAP Version 5.04 Revision A36.B52.R41
 Licensed from GEOSOLVE
 Run ID. 20220808_Double Cove static
 RW 1.6m from dwelling - Double Cove
 Static Analysis

| Sheet No.
 |
 | Job No. 50683
 | Made by : EDC
 | Date:20-10-2022
 | Checked :

Units: kN,m

Stage No. 3 Excavate to elevation -3.17 on PASSIVE side

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

Stage No.	--- G.L. --- Act. Pass.	Strut Elev.	FoS for toe elev. = -5.70	Moment of equil. at elev.	Toe elev. for FoS = 1.500	Wall Penetration	Strut force for F=1.000
3	0.00 -3.17	-0.70	1.534	n/a	-5.55	2.38	11.15

BENDING MOMENT and DISPLACEMENT CALCULATION - Assumptions:

Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Open Tension Crack analysis - No
 Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Active side 20.00 from wall
 Passive 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	Strut forces kN/m
1	0.00	25.91	-0.009	-1.56E-02	0.0	-0.0	
2	-0.30	26.79	-0.004	-1.57E-02	7.9	0.8	
3	-0.50	23.26	-0.001	-1.60E-02	12.9	2.9	
4	-0.70	21.61	0.002	-1.66E-02	17.4	6.0	43.5
		21.61	0.002	-1.66E-02	-26.1	6.0	
5	-0.90	19.68	0.005	-1.70E-02	-22.0	1.2	
6	-1.20	16.68	0.010	-1.67E-02	-16.6	-4.4	
7	-1.50	14.14	0.015	-1.54E-02	-11.9	-8.6	
8	-1.80	12.50	0.020	-1.34E-02	-7.9	-11.6	
9	-2.10	11.99	0.023	-1.10E-02	-4.3	-13.2	
10	-2.40	14.63	0.026	-8.31E-03	-0.3	-14.0	
11	-2.70	17.33	0.028	-5.59E-03	4.5	-13.3	
12	-2.94	19.44	0.029	-3.64E-03	8.8	-11.7	
13	-3.17	21.55	0.030	-2.02E-03	13.7	-9.1	
		-4.35	0.030	-2.02E-03	13.7	-9.1	
14	-3.39	-12.30	0.030	-9.36E-04	11.9	-6.2	
15	-3.60	-12.08	0.031	-2.25E-04	9.2	-3.8	
16	-3.90	-10.09	0.030	3.06E-04	5.9	-1.6	
17	-4.20	-7.85	0.030	4.80E-04	3.2	-0.2	
18	-4.50	-5.56	0.030	4.57E-04	1.2	0.4	
19	-4.80	-3.31	0.030	3.55E-04	-0.1	0.6	
20	-5.10	-1.12	0.030	2.55E-04	-0.8	0.4	
21	-5.40	1.01	0.030	1.97E-04	-0.8	0.2	
22	-5.70	4.30	0.030	1.80E-04	0.0	-0.0	
Strut force at elev. -0.70 =			43.54 kN/m run =			43.54 kN/strut (horiz.)	
						= 45.08 kN/strut (incl.)	

(continued)

Stage No.3 Excavate to elevation -3.17 on PASSIVE side

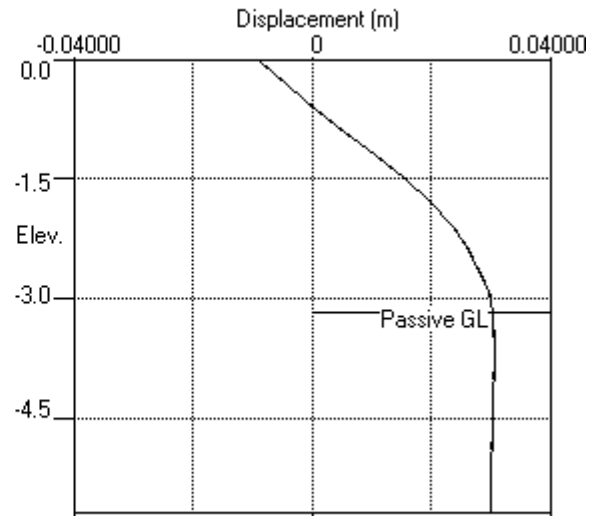
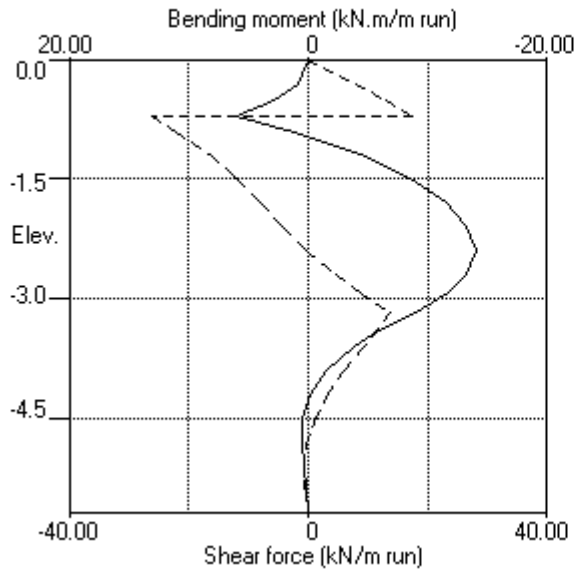
Node no.	Y coord	----- ACTIVE side -----					Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2		
1	0.00	0.00	0.00	0.00	25.91	25.91	25.91p	6563
2	-0.30	0.00	7.65	0.00	52.04	26.79	26.79	828
3	-0.50	0.00	12.75	0.00	69.46	23.26	23.26	828
4	-0.70	0.00	17.85	0.00	86.89	21.61	21.61	828
5	-0.90	0.00	22.95	1.15	104.31	19.68	19.68	828
6	-1.20	0.00	30.60	3.85	130.44	16.68	16.68	828
7	-1.50	0.00	38.25	6.54	156.58	14.14	14.14	828
8	-1.80	0.00	45.90	9.24	182.71	12.50	12.50	828
9	-2.10	0.00	53.55	11.94	208.85	11.99	11.99	828
10	-2.40	0.00	61.20	14.63	234.98	14.63	14.63a	828
11	-2.70	0.00	68.85	17.33	261.11	17.33	17.33a	828
12	-2.94	0.00	74.84	19.44	281.58	19.44	19.44a	828
13	-3.17	0.00	80.83	21.55	302.06	21.55	21.55a	828
14	-3.39	0.00	86.32	23.49	320.79	23.49	23.49a	828
15	-3.60	0.00	91.80	25.42	339.51	25.59	25.59	828
16	-3.90	0.00	99.45	28.12	365.65	29.98	29.98	828
17	-4.20	0.00	107.10	30.81	391.78	34.47	34.47	828
18	-4.50	0.00	114.75	33.51	417.92	39.00	39.00	828
19	-4.80	0.00	122.40	36.21	444.05	43.50	43.50	828
20	-5.10	0.00	130.05	38.91	470.18	47.98	47.98	828
21	-5.40	0.00	137.70	41.60	496.32	52.44	52.44	828
22	-5.70	0.00	145.35	44.30	522.45	57.48	57.48	828

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2		
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	-0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	-0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	-0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	-0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	-1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	-1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	-1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	-2.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	-2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	-2.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	-2.94	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	-3.17	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	-3.39	0.00	3.29	0.00	37.15	25.91	25.91p	1196
15	-3.60	0.00	6.58	0.00	48.38	35.78	35.78	1196
16	-3.90	0.00	11.17	0.00	64.07	37.67	37.67	1196
17	-4.20	0.00	15.76	0.00	79.75	40.07	40.07	1196
18	-4.50	0.00	20.36	0.23	95.44	42.32	42.32	1196
19	-4.80	0.00	24.95	1.85	111.14	44.56	44.56	1196
20	-5.10	0.00	29.55	3.47	126.85	46.81	46.81	1196
21	-5.40	0.00	34.15	5.10	142.56	49.11	49.11	1196
22	-5.70	0.00	38.75	6.72	158.29	51.43	51.43	1196

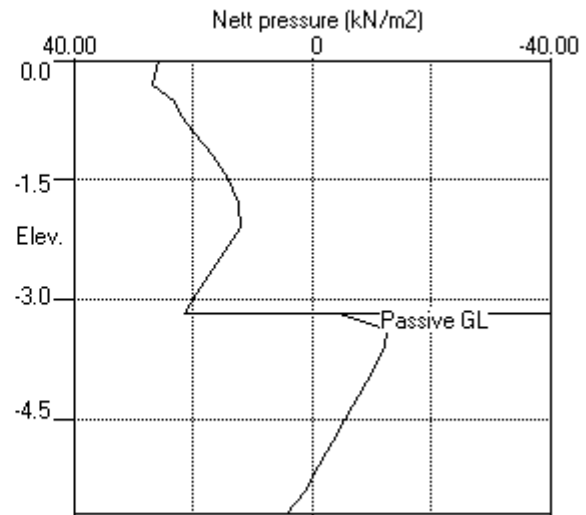
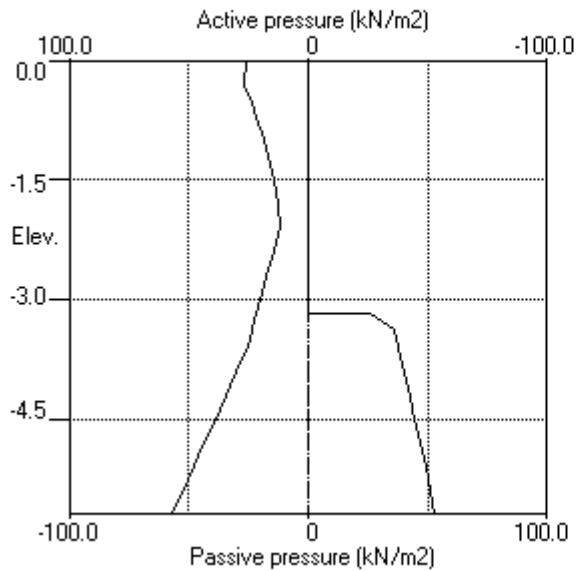
Note: 23.49a Soil pressure at active limit
 25.91p Soil pressure at passive limit

Units: kN,m

Stage No.3 Excav. to elev. -3.17 on PASSIVE side



Stage No.3 Excav. to elev. -3.17 on PASSIVE side



ENGINEERING DESIGN CONSULTANTS Ltd
 Program: WALLAP Version 5.04 Revision A36.B52.R41
 Licensed from GEOSOLVE
 Run ID. 20220808_Double Cove static
 RW 1.6m from dwelling - Double Cove
 Static Analysis

| Sheet No.
 |
 | Job No. 50683
 | Made by : EDC
 | Date:20-10-2022
 | Checked :

 Units: kN,m

Summary of results

STABILITY ANALYSIS according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. ---		Strut Elev.	FoS for toe elev. = -5.70		Toe elev. for FoS = 1.500		Strut force for F=1.000
	Act.	Pass.		Factor of Safety	Moment at elev.	Toe elev.	Wall Penetration	
1	0.00	-0.90	Cant.	2.895	-5.55	-1.27	0.37	
2	0.00	-0.90	-0.70	3.482	n/a	-0.91	0.01	0.07
3	0.00	-3.17	-0.70	1.534	n/a	-5.55	2.38	11.15
4	0.00	-3.17	-0.70	1.500	n/a	-5.70	2.53	14.84

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT CALCULATION - Assumptions:

Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Open Tension Crack analysis - No
 Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Active side 20.00 from wall
 Passive side 20.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment		Shear force	
		maximum m	minimum m	maximum kN.m/m	minimum kN.m/m	maximum kN/m	minimum kN/m
1	0.00	0.006	-0.009	0.0	-0.0	0.0	0.0
2	-0.30	0.007	-0.006	0.8	0.0	8.1	0.0
3	-0.50	0.007	-0.004	3.0	0.0	13.5	0.0
4	-0.70	0.008	-0.003	6.2	0.0	18.6	-27.6
5	-0.90	0.008	-0.001	1.8	0.0	1.3	-24.0
6	-1.20	0.014	0.000	0.6	-5.8	0.7	-18.6
7	-1.50	0.019	0.000	0.7	-10.5	0.2	-13.3
8	-1.80	0.024	0.000	0.7	-13.7	0.0	-8.4
9	-2.10	0.027	0.000	0.7	-15.5	2.5	-4.3
10	-2.40	0.030	0.000	0.6	-16.1	3.7	-0.4
11	-2.70	0.032	0.000	0.5	-15.1	5.8	-0.4
12	-2.94	0.033	0.000	0.4	-13.2	10.6	-0.4
13	-3.17	0.033	0.000	0.3	-10.1	15.8	-0.4
14	-3.39	0.033	0.000	0.3	-6.7	14.2	-0.4
15	-3.60	0.033	0.000	0.2	-3.8	11.2	-0.4
16	-3.90	0.033	0.000	0.1	-1.6	6.9	-0.3
17	-4.20	0.032	0.000	0.3	-0.2	3.4	-0.3
18	-4.50	0.032	0.000	1.0	-0.0	1.2	-0.2
19	-4.80	0.031	0.000	1.0	-0.0	0.1	-0.6
20	-5.10	0.031	0.000	0.6	-0.0	0.0	-1.3
21	-5.40	0.031	0.000	0.2	-0.0	0.0	-1.2
22	-5.70	0.030	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				Shear force			
	maximum kN.m/m	elev.	minimum kN.m/m	elev.	maximum kN/m	elev.	minimum kN/m	elev.
1	0.7	-1.80	-0.0	-5.10	1.3	-0.90	-0.4	-2.94
2	6.2	-0.70	-6.6	-1.80	18.6	-0.70	-24.9	-0.70
3	6.0	-0.70	-14.0	-2.40	17.4	-0.70	-26.1	-0.70
4	5.6	-0.70	-16.1	-2.40	16.0	-0.70	-27.6	-0.70

Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum m	elev.	minimum m	elev.	
1	0.022	-5.70	0.000	0.00	Excav. to elev. -0.90 on PASSIVE side
2	0.022	-5.70	-0.008	0.00	Install strut no.1 at elev. -0.70
3	0.031	-3.60	-0.009	0.00	Excav. to elev. -3.17 on PASSIVE side
4	0.033	-3.39	-0.008	0.00	Apply surcharge no.1 at elev. 0.00

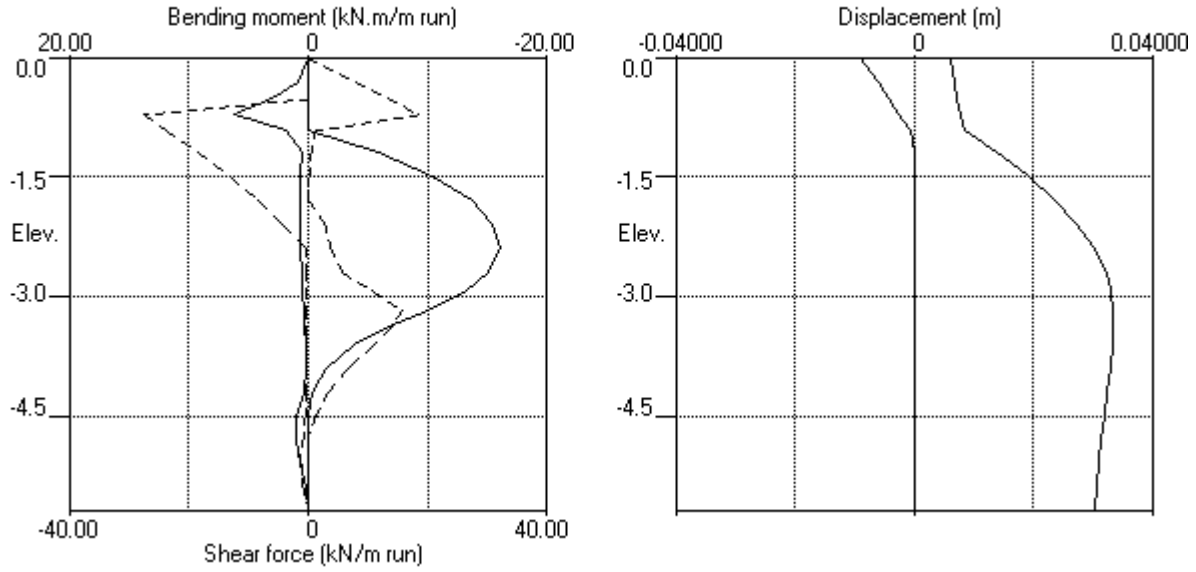
Summary of results (continued)

Strut forces at each stage (horizontal components)

Stage	--- Strut no. 1 ---		
no.	at elev.-0.70		
	kN/m run	kN/strut	
2	43.5	43.5	
3	43.5	43.5	
4	43.6	43.6	

Units: kN,m

Bending moment, shear force, displacement envelopes



Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types	
		Active side	Passive side
1	0.00	1 SILT (active)	2 SILT (passive)
2	-2.50	3 SCHIST (active)	4 SCHIST (passive)

SOIL PROPERTIES

No.	Description	Bulk density kN/m3	Young's Modulus Eh, kN/m2	At rest coeff. Ko	Consol state. NC/OC	Active limit Ka	Passive limit Kp	Cohesion kN/m2
	(Datum elev.)		(dEh/dy)	(dKo/dy)	(Nu)	(Kac)	(Kpc)	(dc/dy)
1	SILT (active)	25.50	5000	0.580	NC (0.360)	0.353 (1.388)	3.416 (5.182)	5.000d
2	SILT (passive)	15.30	5000	0.580	NC (0.360)	0.353 (1.388)	3.416 (5.182)	5.000d
3	SCHIST (active)	39.00	1.90E+6	0.130	NC (0.190)	0.061 (0.542)	94.32 (53.877)	1500d
4	SCHIST (passive)	23.00	1.90E+6	0.130	NC (0.190)	0.061 (0.542)	94.32 (53.877)	1500d

Additional soil parameters associated with Ka and Kp

No.	Description	--- parameters for Ka ---			--- parameters for Kp ---		
		Soil friction angle	Wall adhesion coeff.	Back-fill angle	Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	SILT (active)	25.00	0.645	0.00	25.00	0.645	0.00
2	SILT (passive)	25.00	0.645	0.00	25.00	0.645	0.00
3	SCHIST (active)	60.00	0.419	0.00	60.00	0.419	0.00
4	SCHIST (passive)	60.00	0.419	0.00	60.00	0.419	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3
 Initial water table elevation: Active side = -10.00, Passive side = -10.00
 Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Elevation of toe of wall = -2.80
 Maximum finite element length = 0.16
 Youngs modulus of wall E = 1.2000E+07 kN/m2
 Moment of inertia of wall I = 1.2581E-04 m4/m run
 E.I = 1509.7 kN.m2/m run
 Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/ anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre- stress /strut kN	Tension allowed
1	-0.70	1.00	0.000804	200000	4.10	-15.00	45.00	No

SURCHARGE LOADS

Surcharge 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
1	0.00	0.00(A)	10.00	2.00	7.20	=	N/A

Note: A = Active side, P = Passive side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Excavate to elevation -0.90 on PASSIVE side
2	Install strut or anchor no.1 at elevation -0.70
3	Excavate to elevation -2.50 on PASSIVE side
4	Apply surcharge no.1 at elevation 0.00

FACTORS OF SAFETY and ANALYSIS OPTIONS

Type of structure - Retaining wall

Stability analysis:

Method of analysis - Strength Factor method

Factor on soil strength for calculating wall depth = 1.50

Factor on soil strength for calculating tie force = 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 active side of wall = 20.00 m

Width of excavation on passive side of wall = 20.00 m

Distance to rigid boundary on active side = 20.00 m

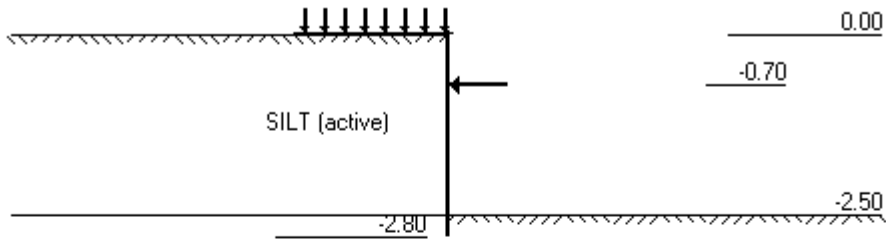
Distance to rigid boundary on passive side = 20.00 m

OUTPUT OPTIONS

Stage no.	Stage description	Displacement	Active, Passive pressures	Graph. output
1	Excav. to elev. -0.90 on PASSIVE side	Yes	Yes	Yes
2	Install strut no.1 at elev. -0.70	Yes	Yes	Yes
3	Excav. to elev. -2.50 on PASSIVE side	Yes	Yes	Yes
4	Apply surcharge no.1 at elev. 0.00	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

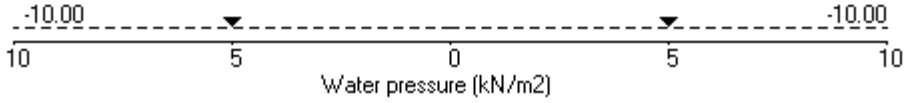
Units: kN,m

Stage No.4 Apply surcharge no.1 at elev. 0.00



SCHIST (active)

SCHIST (passive)



(continued)

Stage No.1 Excavate to elevation -0.90 on PASSIVE side

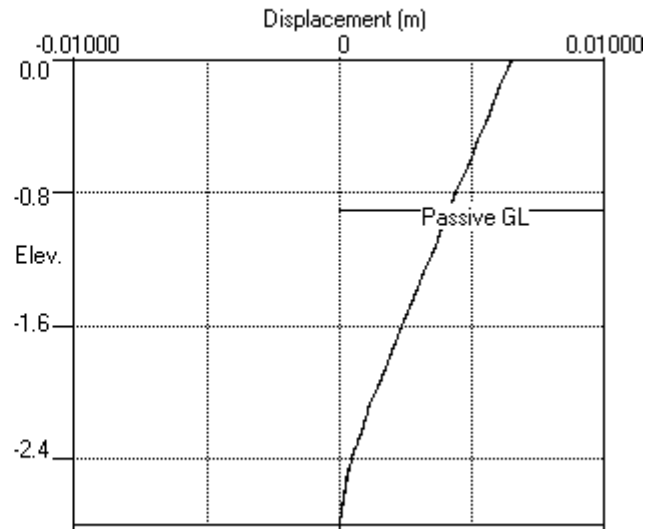
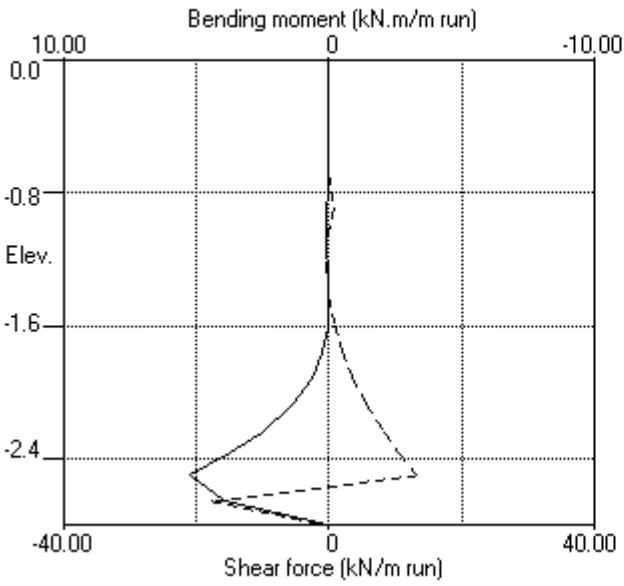
Node no.	Y coord	----- ACTIVE side -----					Total earth pressure kN/m2	Soil stiffness kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2		
1	0.00	0.00	0.00	0.00	25.91	0.00	0.00a	1946
2	-0.16	0.00	4.08	0.00	39.85	0.00	0.00a	1946
3	-0.32	0.00	8.16	0.00	53.78	0.00	0.00a	1946
4	-0.48	0.00	12.24	0.00	67.72	0.00	0.00a	1946
5	-0.59	0.00	15.04	0.00	77.30	0.00	0.00a	1946
6	-0.70	0.00	17.85	0.00	86.89	1.23	1.23	1946
7	-0.80	0.00	20.40	0.25	95.60	3.21	3.21	1946
8	-0.90	0.00	22.95	1.15	104.31	5.19	5.19	1946
9	-1.01	0.00	25.76	2.14	113.89	7.37	7.37	1946
10	-1.12	0.00	28.56	3.13	123.47	9.55	9.55	1946
11	-1.28	0.00	32.64	4.56	137.41	12.71	12.71	1946
12	-1.44	0.00	36.72	6.00	151.35	15.87	15.87	1946
13	-1.60	0.00	40.80	7.44	165.29	19.03	19.03	1946
14	-1.76	0.00	44.88	8.88	179.23	22.19	22.19	1946
15	-1.92	0.00	48.96	10.32	193.16	25.34	25.34	1946
16	-2.08	0.00	53.04	11.76	207.10	28.46	28.46	1946
17	-2.24	0.00	57.12	13.19	221.04	31.54	31.54	1946
18	-2.37	0.00	60.44	14.36	232.37	33.98	33.98	1946
19	-2.50	0.00	63.75	15.53	243.69	36.34	36.34	1946
		0.00	63.75	0.00	86827.89	0.00	0.00a	639322
20	-2.65	0.00	69.60	0.00	87379.64	0.00	0.00a	639322
21	-2.80	0.00	75.45	0.00	87931.39	355.59	355.59	54235803

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure kN/m2	Soil stiffness kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2		
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	-0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	-0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	-0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	-0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	-0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	-0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	-0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	25.91	11.44	11.44	2686
9	-1.01	0.00	1.68	0.00	31.66	11.66	11.66	2686
10	-1.12	0.00	3.37	0.00	37.41	11.88	11.88	2686
11	-1.28	0.00	5.81	0.00	45.77	12.20	12.20	2686
12	-1.44	0.00	8.26	0.00	54.13	12.52	12.52	2686
13	-1.60	0.00	10.71	0.00	62.50	12.85	12.85	2686
14	-1.76	0.00	13.16	0.00	70.86	13.18	13.18	2686
15	-1.92	0.00	15.61	0.00	79.22	13.52	13.52	2686
16	-2.08	0.00	18.06	0.00	87.59	13.89	13.89	2686
17	-2.24	0.00	20.50	0.29	95.95	14.33	14.33	2686
18	-2.37	0.00	22.49	0.99	102.75	14.76	14.76	2686
19	-2.50	0.00	24.48	1.69	109.55	15.32	15.32	2686
		0.00	24.48	0.00	83124.37	290.59	290.59	886474
20	-2.65	0.00	27.93	0.00	83449.85	120.60	120.60	886474
21	-2.80	0.00	31.38	0.00	83775.34	0.00	0.00a	54235803

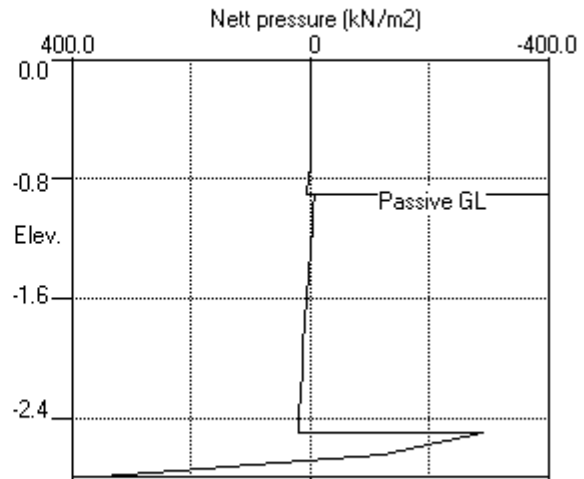
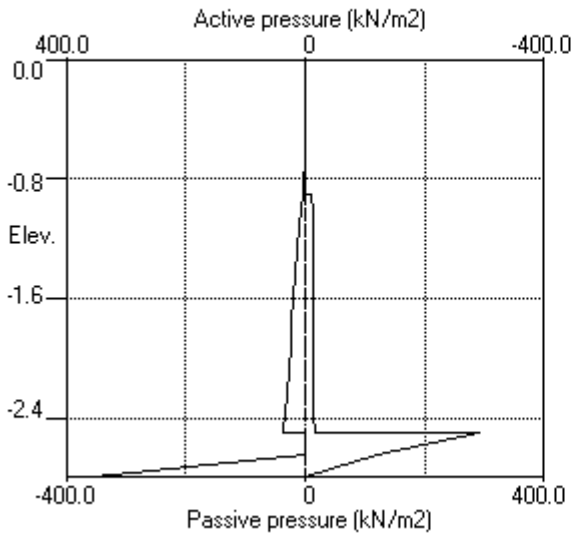
Note: 0.00a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.1 Excav. to elev. -0.90 on PASSIVE side



Stage No.1 Excav. to elev. -0.90 on PASSIVE side



Units: kN,m

Stage No. 3 Excavate to elevation -2.50 on PASSIVE side

STABILITY ANALYSIS according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. --- Act. Pass.	Strut Elev.	FoS for toe elev. = -2.80	Moment of equilib. at elev.	Toe elev. for FoS = 1.500	Wall Penetration	Strut force for F=1.000
3	0.00 -2.50	-0.70	30.750	n/a	-2.50	0.00	4.67

BENDING MOMENT and DISPLACEMENT CALCULATION - Assumptions:

Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Open Tension Crack analysis - No
 Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Active side 20.00 from wall
 Passive 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	Strut forces kN/m	
1	0.00	25.48	-0.007	-3.36E-03	0.0	-0.0		
2	-0.16	28.04	-0.006	-3.37E-03	4.3	0.2		
3	-0.32	25.91	-0.006	-3.44E-03	8.6	1.3		
4	-0.48	23.73	-0.005	-3.67E-03	12.6	3.0		
5	-0.59	22.17	-0.005	-3.94E-03	15.1	4.5		
6	-0.70	21.76	-0.004	-4.33E-03	17.5	6.3	43.5	
7	-0.80	22.16	-0.004	-4.67E-03	-23.8	3.8		
8	-0.90	22.50	-0.003	-4.85E-03	-21.5	1.6		
9	-1.01	22.85	-0.003	-4.88E-03	-19.0	-0.7		
10	-1.12	23.21	-0.002	-4.76E-03	-16.5	-2.6		
11	-1.28	23.82	-0.002	-4.36E-03	-12.7	-5.0		
12	-1.44	24.61	-0.001	-3.74E-03	-8.9	-6.7		
13	-1.60	25.64	-0.000	-2.97E-03	-4.9	-7.8		
14	-1.76	26.96	-0.000	-2.11E-03	-0.6	-8.3		
15	-1.92	28.58	0.000	-1.25E-03	3.8	-8.0		
16	-2.08	30.49	0.000	-4.58E-04	8.5	-7.0		
17	-2.24	32.66	0.000	1.93E-04	13.6	-5.3		
18	-2.37	34.58	0.000	5.58E-04	17.9	-3.2		
19	-2.50	36.60	0.000	7.21E-04	22.6	-0.6		
		-188.63	0.000	7.21E-04	22.6	-0.6		
20	-2.65	-88.15	0.000	7.17E-04	1.8	0.7		
21	-2.80	64.01	0.000	6.83E-04	-0.0	-0.0		
Strut force at elev. -0.70 =			43.48 kN/m run =			43.48 kN/strut (horiz.) =		
						45.01 kN/strut (incl.)		

(continued)

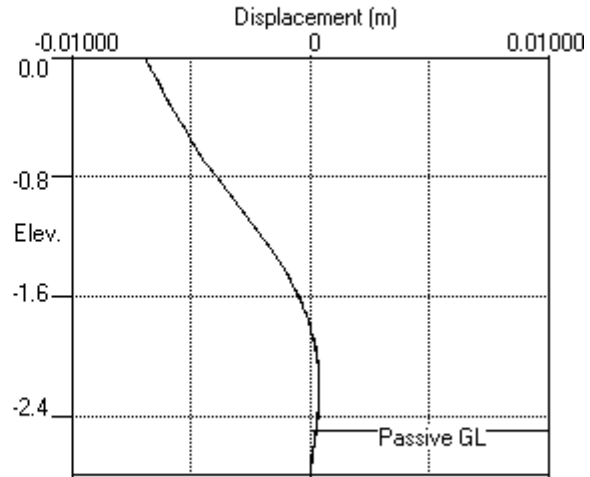
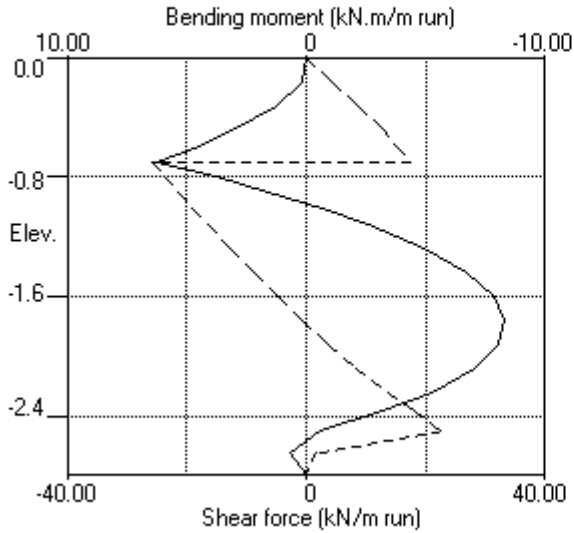
Stage No.3 Excavate to elevation -2.50 on PASSIVE side

Node no.	Y coord	----- ACTIVE side -----					Total earth pressure	Soil stiffness
		Water press.	Vertic -al	Effective Active limit	Effective Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	0.00	0.00	0.00	0.00	25.91	25.48	25.48	1371
2	-0.16	0.00	4.08	0.00	39.85	28.04	28.04	1371
3	-0.32	0.00	8.16	0.00	53.78	25.91	25.91	1371
4	-0.48	0.00	12.24	0.00	67.72	23.73	23.73	1371
5	-0.59	0.00	15.04	0.00	77.30	22.17	22.17	1371
6	-0.70	0.00	17.85	0.00	86.89	21.76	21.76	1371
7	-0.80	0.00	20.40	0.25	95.60	22.16	22.16	1371
8	-0.90	0.00	22.95	1.15	104.31	22.50	22.50	1371
9	-1.01	0.00	25.76	2.14	113.89	22.85	22.85	1371
10	-1.12	0.00	28.56	3.13	123.47	23.21	23.21	1371
11	-1.28	0.00	32.64	4.56	137.41	23.82	23.82	1371
12	-1.44	0.00	36.72	6.00	151.35	24.61	24.61	1371
13	-1.60	0.00	40.80	7.44	165.29	25.64	25.64	1371
14	-1.76	0.00	44.88	8.88	179.23	26.96	26.96	1371
15	-1.92	0.00	48.96	10.32	193.16	28.58	28.58	1371
16	-2.08	0.00	53.04	11.76	207.10	30.49	30.49	1371
17	-2.24	0.00	57.12	13.19	221.04	32.66	32.66	1371
18	-2.37	0.00	60.44	14.36	232.37	34.58	34.58	1371
19	-2.50	0.00	63.75	15.53	243.69	36.60	36.60	1371
		0.00	63.75	0.00	86827.89	85.00	85.00	447443
20	-2.65	0.00	69.60	0.00	87379.64	18.07	18.07	447443
21	-2.80	0.00	75.45	0.00	87931.39	206.93	206.93	10265234

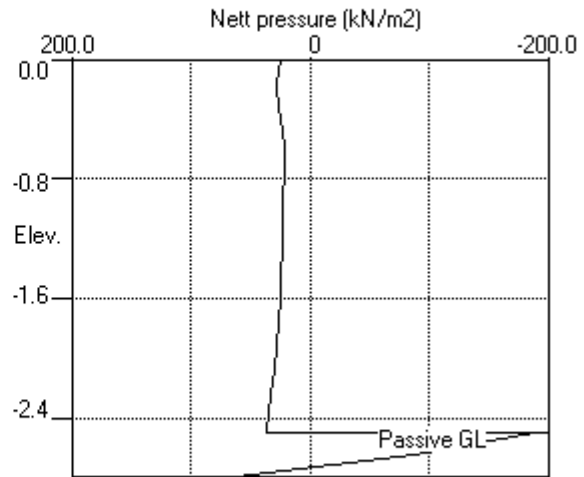
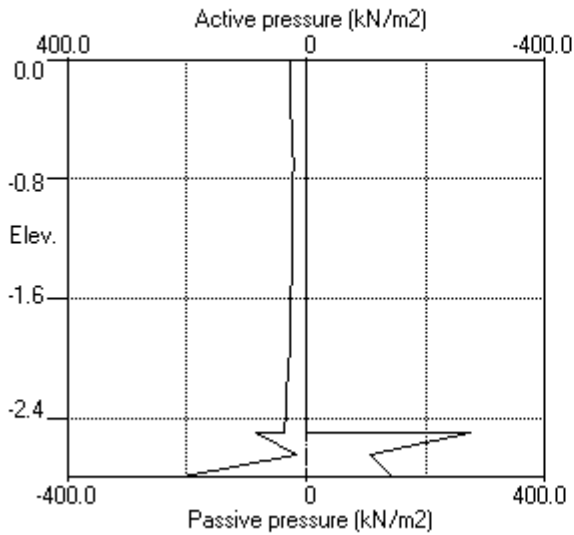
Node no.	Y coord	----- PASSIVE side -----					Total earth pressure	Soil stiffness
		Water press.	Vertic -al	Effective Active limit	Effective Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	-0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	-0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	-0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	-0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	-0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	-0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	-0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	-1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	-1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	-1.28	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	-1.44	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	-1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	-1.76	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	-1.92	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	-2.08	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	-2.24	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18	-2.37	0.00	0.00	0.00	0.00	0.00	0.00	0.0
19	-2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	80815.23	273.63	273.63	5403562
20	-2.65	0.00	3.45	0.00	81140.62	106.22	106.22	5403562
21	-2.80	0.00	6.90	0.00	81466.02	142.92	142.92	10265234

Units: kN,m

Stage No.3 Excav. to elev. -2.50 on PASSIVE side



Stage No.3 Excav. to elev. -2.50 on PASSIVE side



ENGINEERING DESIGN CONSULTANTS Ltd
 Program: WALLAP Version 5.04 Revision A36.B52.R41
 Licensed from GEOSOLVE
 Run ID. 20220808_Double Cove static (shal rock)
 RW 1.6m from dwelling - Double Cove
 Static Analysis

| Sheet No.
 |
 | Job No. 50683
 | Made by : EDC
 | Date:20-10-2022
 | Checked :

 Units: kN,m

Summary of results

STABILITY ANALYSIS according to Strength Factor method

Factor of safety on soil strength

Stage No.	--- G.L. ---		Strut Elev.	FoS for toe elev. = -2.80		Toe elev. for FoS = 1.500		Strut force for F=1.000
	Act.	Pass.		Factor of Safety	Moment at elev.	Toe elev.	Wall Penetration	
1	0.00	-0.90	Cant.	3.750	-2.66	-1.30	0.40	
2	0.00	-0.90	-0.70	58.500	n/a	-0.92	0.02	0.04
3	0.00	-2.50	-0.70	30.750	n/a	-2.50	0.00	4.67
4	0.00	-2.50	-0.70	28.125	n/a	-2.50	0.00	7.00

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT CALCULATION - Assumptions:

Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Open Tension Crack analysis - No
 Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Active side 20.00 from wall
 Passive side 20.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment		Shear force	
		maximum m	minimum m	maximum kN.m/m	minimum kN.m/m	maximum kN/m	minimum kN/m
1	0.00	0.006	-0.007	0.0	-0.0	0.0	0.0
2	-0.16	0.006	-0.007	0.2	0.0	4.4	0.0
3	-0.32	0.006	-0.006	1.3	-0.0	8.7	0.0
4	-0.48	0.005	-0.006	3.0	-0.0	12.8	0.0
5	-0.59	0.005	-0.005	4.6	-0.0	15.4	0.0
6	-0.70	0.005	-0.005	6.4	0.0	17.8	-26.1
7	-0.80	0.004	-0.004	4.0	0.0	0.3	-24.0
8	-0.90	0.004	-0.004	1.7	0.0	0.7	-21.8
9	-1.01	0.004	-0.003	0.1	-0.8	0.1	-19.3
10	-1.12	0.004	-0.003	0.1	-2.8	0.0	-16.8
11	-1.28	0.003	-0.002	0.1	-5.2	0.0	-13.0
12	-1.44	0.003	-0.001	0.0	-6.9	0.0	-9.2
13	-1.60	0.002	-0.001	0.0	-8.1	0.7	-5.0
14	-1.76	0.002	-0.000	0.2	-8.6	1.9	-0.6
15	-1.92	0.002	-0.000	0.7	-8.2	4.4	0.0
16	-2.08	0.001	0.000	1.4	-7.1	9.7	0.0
17	-2.24	0.001	0.000	2.5	-5.4	15.3	0.0
18	-2.37	0.001	0.000	3.7	-4.0	20.1	0.0
19	-2.50	0.000	0.000	5.2	-2.2	25.2	0.0
20	-2.65	0.000	0.000	4.0	-0.4	7.2	-17.6
21	-2.80	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				Shear force			
	maximum kN.m/m	elev.	minimum kN.m/m	elev.	maximum kN/m	elev.	minimum kN/m	elev.
1	5.2	-2.50	-0.0	-0.59	13.2	-2.50	-17.6	-2.65
2	6.4	-0.70	-7.6	-1.76	17.8	-0.70	-25.6	-0.70
3	6.3	-0.70	-8.3	-1.76	22.6	-2.50	-26.0	-0.70
4	6.3	-0.70	-8.6	-1.76	25.2	-2.50	-26.1	-0.70

Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum m	elev.	minimum m	elev.	
1	0.006	0.00	-0.000	-2.80	Excav. to elev. -0.90 on PASSIVE side
2	0.000	-2.24	-0.007	0.00	Install strut no.1 at elev. -0.70
3	0.000	-2.24	-0.007	0.00	Excav. to elev. -2.50 on PASSIVE side
4	0.000	-2.08	-0.007	0.00	Apply surcharge no.1 at elev. 0.00

Run ID. 20220808_Double Cove static (shal rock)
RW 1.6m from dwelling - Double Cove
Static Analysis

| Sheet No.
| Date:20-10-2022
| Checked :

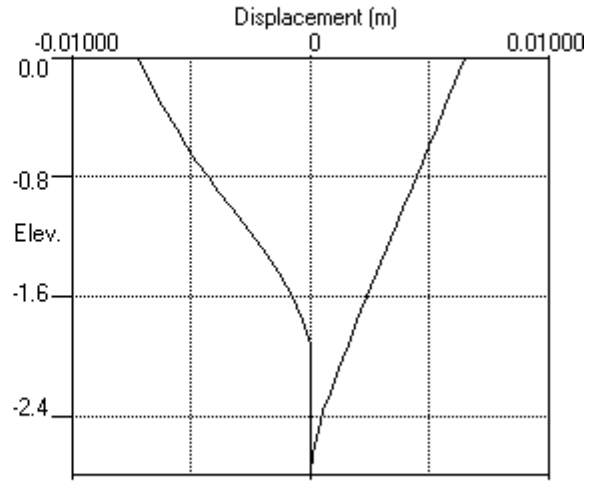
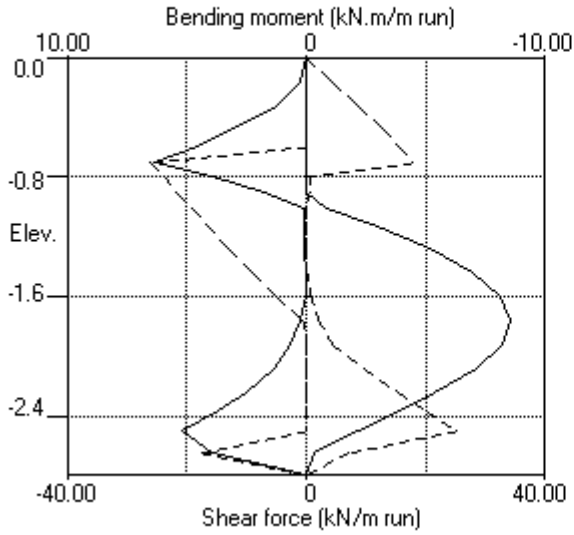
Summary of results (continued)

Strut forces at each stage (horizontal components)

Stage	--- Strut no. 1 ---		
no.	at elev.-0.70		
	kN/m run	kN/strut	
2	43.5	43.5	
3	43.5	43.5	
4	43.5	43.5	

Units: kN,m

Bending moment, shear force, displacement envelopes



ENGINEERING DESIGN CONSULTANTS Ltd
 Program: WALLAP Version 5.04 Revision A36.B52.R41
 Licensed from GEOSOLVE
 Run ID. 20220808_Double Cove static (deep rock)
 RW 1.6m from dwelling - Double Cove
 Static Analysis

| Sheet No.
 |
 | Job No. 50683
 | Made by : EDC
 | Date:20-10-2022
 | Checked :

 Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types	
		Active side	Passive side
1	0.00	1 SILT (active)	2 SILT (passive)
2	-3.50	3 SCHIST (active)	4 SCHIST (passive)

SOIL PROPERTIES

-- Soil type --	Bulk density	Young's Modulus	At rest coeff.	Consol state.	Active limit	Passive limit	Cohesion
No. Description (Datum elev.)	kN/m3	Eh, kN/m2 (dEh/dy)	Ko (dKo/dy)	NC/OC (Nu)	Ka (Kac)	Kp (Kpc)	kN/m2 (dc/dy)
1 SILT (active)	25.50	5000	0.580	NC (0.360)	0.353 (1.388)	3.416 (5.182)	5.000d
2 SILT (passive)	15.30	5000	0.580	NC (0.360)	0.353 (1.388)	3.416 (5.182)	5.000d
3 SCHIST (active)	39.00	1.90E+6	0.130	NC (0.190)	0.061 (0.542)	94.32 (53.877)	1500d
4 SCHIST (passive)	23.00	1.90E+6	0.130	NC (0.190)	0.061 (0.542)	94.32 (53.877)	1500d

Additional soil parameters associated with Ka and Kp

No. Description	--- parameters for Ka ---			--- parameters for Kp ---		
	Soil friction angle	Wall adhesion coeff.	Back-fill angle	Soil friction angle	Wall adhesion coeff.	Back-fill angle
1 SILT (active)	25.00	0.645	0.00	25.00	0.645	0.00
2 SILT (passive)	25.00	0.645	0.00	25.00	0.645	0.00
3 SCHIST (active)	60.00	0.419	0.00	60.00	0.419	0.00
4 SCHIST (passive)	60.00	0.419	0.00	60.00	0.419	0.00

GROUND WATER CONDITIONSDensity of water = 10.00 kN/m³

	Active side	Passive side
Initial water table elevation	-10.00	-10.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Elevation of toe of wall = -3.80
 Maximum finite element length = 0.20
 Youngs modulus of wall E = 1.2000E+07 kN/m²
 Moment of inertia of wall I = 1.2581E-04 m⁴/m run
 E.I = 1509.7 kN.m²/m run
 Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/ anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m ²	Free length m	Inclin -ation (degs)	Pre- stress /strut kN	Tension allowed
1	-0.70	1.00	0.000804	200000	4.10	-15.00	45.00	No

SURCHARGE LOADS

Surcharge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge Near edge	Surcharge Far edge	Equiv. soil type
1	0.00	0.00 (A)	10.00	2.00	7.20	=	N/A

Note: A = Active side, P = Passive side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Excavate to elevation -0.90 on PASSIVE side
2	Install strut or anchor no.1 at elevation -0.70
3	Excavate to elevation -3.17 on PASSIVE side
4	Apply surcharge no.1 at elevation 0.00

FACTORS OF SAFETY and ANALYSIS OPTIONS

Type of structure - Retaining wall

Stability analysis:

Method of analysis - Strength Factor method

Factor on soil strength for calculating wall depth = 1.50

Factor on soil strength for calculating tie force = 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 active side of wall = 20.00 m

Width of excavation on passive side of wall = 20.00 m

Distance to rigid boundary on active side = 20.00 m

Distance to rigid boundary on passive side = 20.00 m

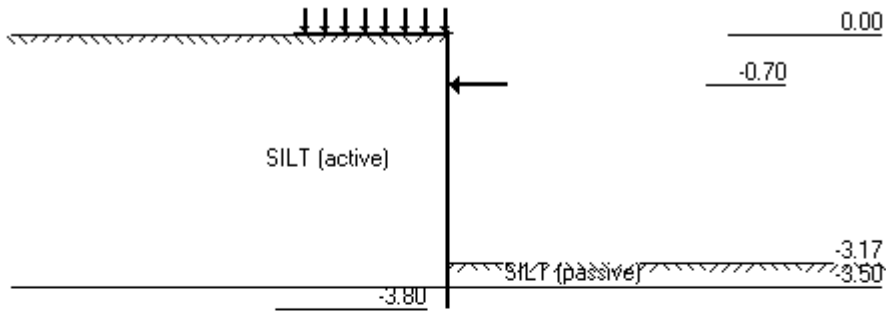
OUTPUT OPTIONS

Stage no.	Stage description	Displacement	Active, Passive pressures	Graph. output
1	Excav. to elev. -0.90 on PASSIVE side	Yes	Yes	Yes
2	Install strut no.1 at elev. -0.70	Yes	Yes	Yes
3	Excav. to elev. -3.17 on PASSIVE side	Yes	Yes	Yes
4	Apply surcharge no.1 at elev. 0.00	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

Program WALLAP - Copyright (C) 2011 by DL Borin, distributed by GEOSOLVE
69 Rodenhurst Road, London SW4, UK. Tel: +44 20 8674 7251

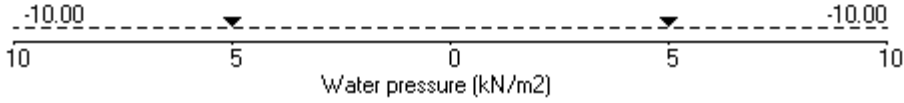
Units: kN,m

Stage No.4 Apply surcharge no.1 at elev. 0.00



SCHIST (active)

SCHIST (passive)



(continued)

Stage No.1 Excavate to elevation -0.90 on PASSIVE side

Node no.	Y coord	----- ACTIVE side -----					Total earth pressure	Soil stiffness
		Water press.	Vertic -al	Effective Active limit	Effective Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	0.00	0.00	0.00	0.00	25.91	0.00	0.00a	1243
2	-0.20	0.00	5.10	0.00	43.33	0.00	0.00a	1243
3	-0.40	0.00	10.20	0.00	60.75	0.00	0.00a	1243
4	-0.55	0.00	14.02	0.00	73.82	0.00	0.00a	1243
5	-0.70	0.00	17.85	0.00	86.89	0.33	0.33	1243
6	-0.90	0.00	22.95	1.15	104.31	3.72	3.72	1243
7	-1.05	0.00	26.78	2.50	117.38	6.25	6.25	1243
8	-1.20	0.00	30.60	3.85	130.44	8.79	8.79	1243
9	-1.40	0.00	35.70	5.64	147.87	12.18	12.18	1243
10	-1.60	0.00	40.80	7.44	165.29	15.59	15.59	1243
11	-1.80	0.00	45.90	9.24	182.71	19.04	19.04	1243
12	-2.00	0.00	51.00	11.04	200.13	22.54	22.54	1243
13	-2.20	0.00	56.10	12.83	217.56	26.12	26.12	1243
14	-2.40	0.00	61.20	14.63	234.98	29.78	29.78	1243
15	-2.60	0.00	66.30	16.43	252.40	33.53	33.53	1243
16	-2.80	0.00	71.40	18.23	269.82	37.36	37.36	1243
17	-2.99	0.00	76.12	19.89	285.94	40.95	40.95	1243
18	-3.17	0.00	80.83	21.55	302.06	44.56	44.56	1243
19	-3.33	0.00	85.04	23.04	316.43	47.75	47.75	1243
20	-3.50	0.00	89.25	24.52	330.80	50.86	50.86	1243
21	-3.65	0.00	89.25	0.00	89232.95	0.00	0.00a	404838
22	-3.80	0.00	95.10	0.00	89784.70	0.00	0.00a	404838
		0.00	100.95	0.00	90336.45	456.71	456.71	1.17E+08

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure	Soil stiffness
		Water press.	Vertic -al	Effective Active limit	Effective Passive limit	Earth pressure		
		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	-0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	-0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	-0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	-1.05	0.00	2.30	0.00	33.75	13.15	13.15	1552
8	-1.20	0.00	4.59	0.00	41.59	14.08	14.08	1552
9	-1.40	0.00	7.65	0.00	52.04	15.32	15.32	1552
10	-1.60	0.00	10.71	0.00	62.50	16.53	16.53	1552
11	-1.80	0.00	13.77	0.00	72.95	17.69	17.69	1552
12	-2.00	0.00	16.83	0.00	83.41	18.79	18.79	1552
13	-2.20	0.00	19.89	0.07	93.86	19.79	19.79	1552
14	-2.40	0.00	22.95	1.15	104.32	20.69	20.69	1552
15	-2.60	0.00	26.01	2.23	114.78	21.48	21.48	1552
16	-2.80	0.00	29.07	3.31	125.23	22.17	22.17	1552
17	-2.99	0.00	31.91	4.31	134.91	22.74	22.74	1552
18	-3.17	0.00	34.74	5.30	144.58	23.29	23.29	1552
19	-3.33	0.00	37.27	6.20	153.22	23.82	23.82	1552
20	-3.50	0.00	39.79	7.09	161.85	24.45	24.45	1552
21	-3.65	0.00	39.79	0.00	84568.32	374.93	374.93	507743
22	-3.80	0.00	43.24	0.00	84893.92	172.03	172.03	507743
		0.00	46.70	0.00	85219.55	0.00	0.00a	1.17E+08

Run ID. 20220808_Double Cove static (deep rock)
RW 1.6m from dwelling - Double Cove
Static Analysis

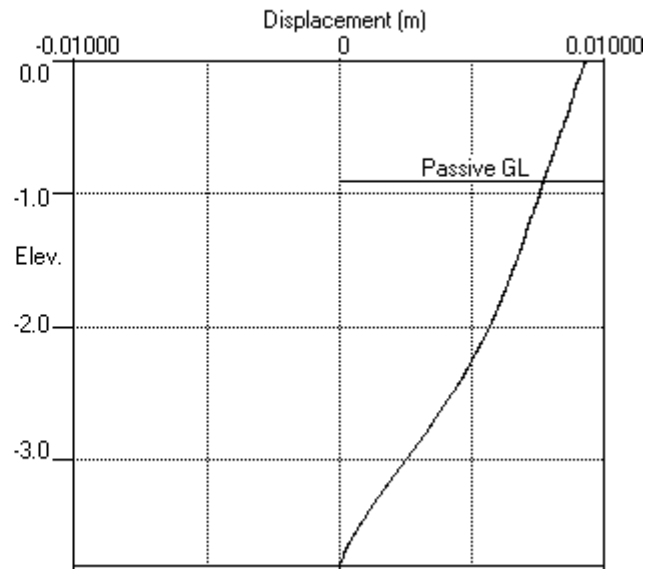
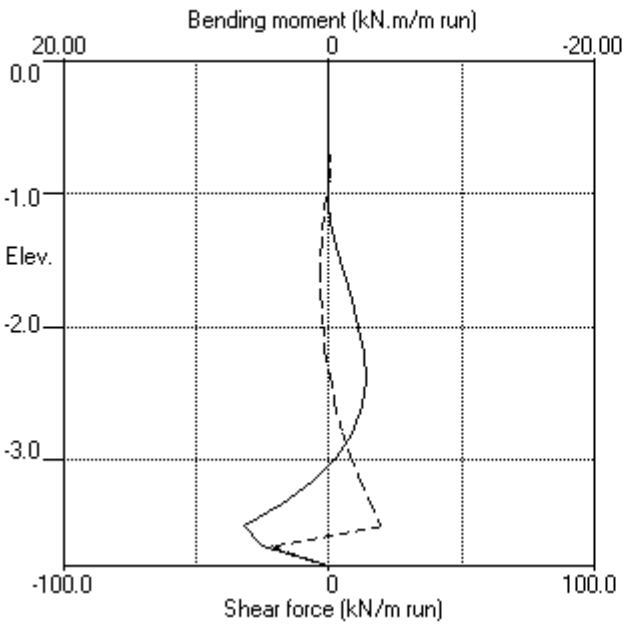
| Sheet No.
| Date:20-10-2022
| Checked :

(continued)

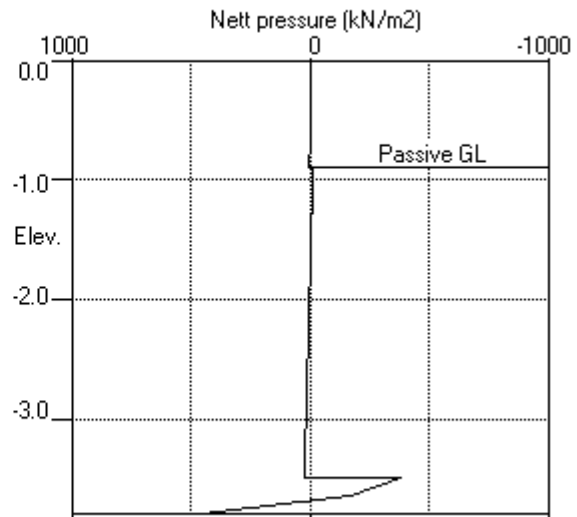
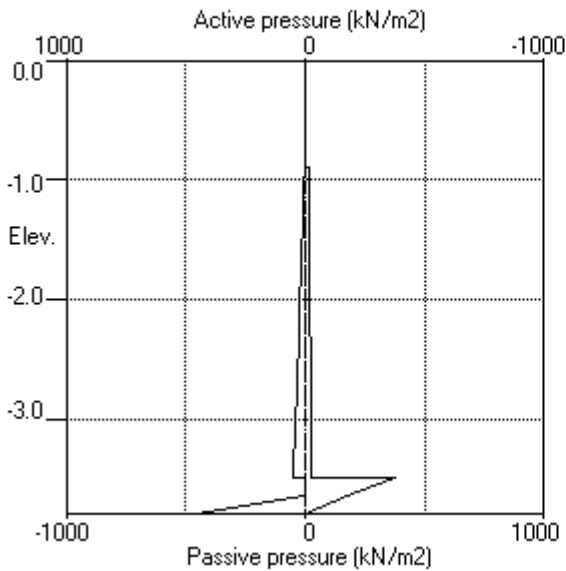
Stage No.1 Excavate to elevation -0.90 on PASSIVE side
Note: 0.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.1 Excav. to elev. -0.90 on PASSIVE side



Stage No.1 Excav. to elev. -0.90 on PASSIVE side



Units: kN,m

Stage No. 3 Excavate to elevation -3.17 on PASSIVE side

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

Stage No.	--- G.L. --- Act. Pass.	Strut Elev.	FoS for toe elev. = -3.80	Moment of equil. at elev.	Toe elev. for FoS = 1.500	Wall Penetr- ation	Strut force for F=1.000 kN/m run
3	0.00 -3.17	-0.70	16.125	n/a	-3.50	0.33	10.59

BENDING MOMENT and DISPLACEMENT CALCULATION - Assumptions:

Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Open Tension Crack analysis - No
 Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Active side 20.00 from wall
 Passive 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	Strut forces kN/m
1	0.00	24.35	-0.003	-5.63E-03	0.0	-0.0	
2	-0.20	25.85	-0.002	-5.65E-03	5.0	0.3	
3	-0.40	22.92	-0.001	-5.80E-03	9.9	1.8	
4	-0.55	20.65	-0.000	-6.06E-03	13.2	3.6	
5	-0.70	18.58	0.001	-6.53E-03	16.1	5.8	43.6
		18.58	0.001	-6.53E-03	-27.4	5.8	
6	-0.90	18.54	0.002	-6.97E-03	-23.7	0.7	
7	-1.05	18.44	0.003	-6.87E-03	-21.0	-2.6	
8	-1.20	18.41	0.004	-6.47E-03	-18.2	-5.6	
9	-1.40	18.62	0.005	-5.51E-03	-14.5	-8.8	
10	-1.60	19.24	0.006	-4.18E-03	-10.7	-11.4	
11	-1.80	20.41	0.007	-2.55E-03	-6.7	-13.1	
12	-2.00	22.17	0.007	-7.60E-04	-2.5	-14.0	
13	-2.20	24.56	0.007	1.09E-03	2.2	-14.0	
14	-2.40	27.56	0.007	2.89E-03	7.4	-13.1	
15	-2.60	31.11	0.006	4.49E-03	13.3	-11.0	
16	-2.80	35.12	0.005	5.73E-03	19.9	-7.8	
17	-2.99	39.09	0.004	6.42E-03	26.8	-3.5	
18	-3.17	43.21	0.003	6.50E-03	34.4	2.2	
		31.10	0.003	6.50E-03	34.4	2.2	
19	-3.33	37.89	0.002	5.93E-03	40.1	8.3	
20	-3.50	43.63	0.001	4.64E-03	46.8	15.4	
		-1008.85	0.001	4.64E-03	46.8	15.4	
21	-3.65	-300.60	0.000	3.32E-03	-51.4	11.1	
22	-3.80	986.29	-0.000	2.77E-03	-0.0	-0.0	
Strut force at elev. -0.70 =			43.56 kN/m run =			43.56 kN/strut (horiz.)	
						45.09 kN/strut (incl.)	

(continued)

Stage No.3 Excavate to elevation -3.17 on PASSIVE side

Node no.	Y coord	----- ACTIVE side -----					Total earth pressure	Soil stiffness
		Water press.	Vertic -al	Effective Active limit	Effective Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
1	0.00	0.00	0.00	0.00	25.91	24.35	24.35	1161
2	-0.20	0.00	5.10	0.00	43.33	25.85	25.85	1161
3	-0.40	0.00	10.20	0.00	60.75	22.92	22.92	1161
4	-0.55	0.00	14.02	0.00	73.82	20.65	20.65	1161
5	-0.70	0.00	17.85	0.00	86.89	18.58	18.58	1161
6	-0.90	0.00	22.95	1.15	104.31	18.54	18.54	1161
7	-1.05	0.00	26.78	2.50	117.38	18.44	18.44	1161
8	-1.20	0.00	30.60	3.85	130.44	18.41	18.41	1161
9	-1.40	0.00	35.70	5.64	147.87	18.62	18.62	1161
10	-1.60	0.00	40.80	7.44	165.29	19.24	19.24	1161
11	-1.80	0.00	45.90	9.24	182.71	20.41	20.41	1161
12	-2.00	0.00	51.00	11.04	200.13	22.17	22.17	1161
13	-2.20	0.00	56.10	12.83	217.56	24.56	24.56	1161
14	-2.40	0.00	61.20	14.63	234.98	27.56	27.56	1161
15	-2.60	0.00	66.30	16.43	252.40	31.11	31.11	1161
16	-2.80	0.00	71.40	18.23	269.82	35.12	35.12	1161
17	-2.99	0.00	76.12	19.89	285.94	39.09	39.09	1161
18	-3.17	0.00	80.83	21.55	302.06	43.21	43.21	1161
19	-3.33	0.00	85.04	23.04	316.43	46.91	46.91	1161
20	-3.50	0.00	89.25	24.52	330.80	50.47	50.47	1161
		0.00	89.25	0.00	89232.95	0.00	0.00a	377314
21	-3.65	0.00	95.10	0.00	89784.70	0.00	0.00a	377314
22	-3.80	0.00	100.95	0.00	90336.45	986.29	986.29	10052703

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure	Soil stiffness
		Water press.	Vertic -al	Effective Active limit	Effective Passive limit	Earth pressure		
		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	-0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	-0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	-0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	-1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	-1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	-1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	-1.60	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
12	-2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	-2.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	-2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	-2.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	-2.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	-2.99	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18	-3.17	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	25.91	12.11	12.11	8403
19	-3.33	0.00	2.52	0.00	34.53	9.02	9.02	8403
20	-3.50	0.00	5.05	0.00	43.16	6.84	6.84	8403
		0.00	5.05	0.00	81291.44	1008.85	1008.85	2800659
21	-3.65	0.00	8.50	0.00	81616.85	300.60	300.60	2800659
22	-3.80	0.00	11.95	0.00	81942.28	0.00	0.00a	10052703

Run ID. 20220808_Double Cove static (deep rock)
RW 1.6m from dwelling - Double Cove
Static Analysis

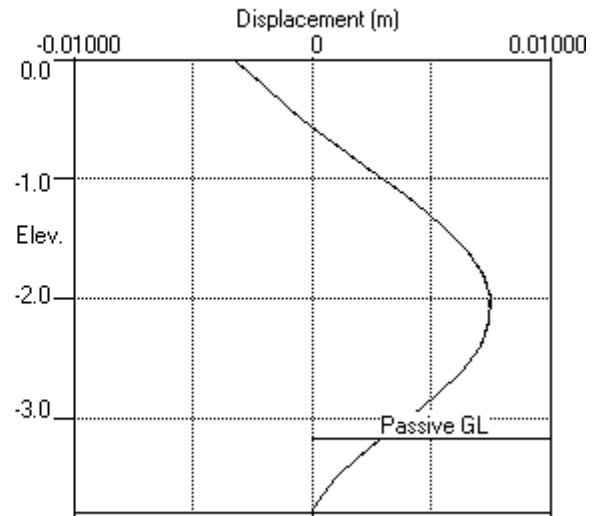
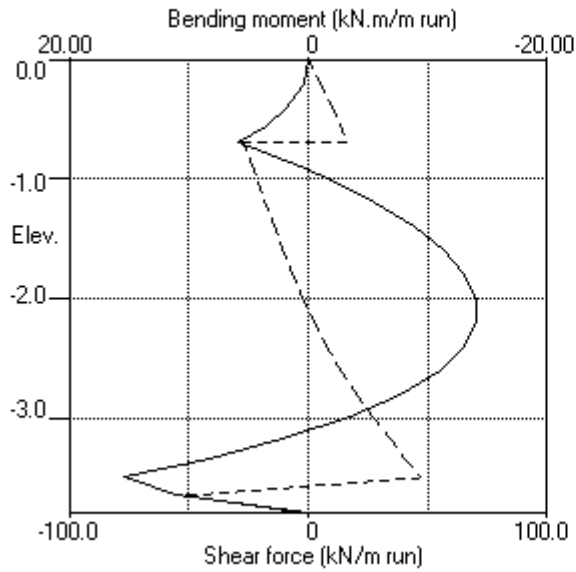
| Sheet No.
| Date:20-10-2022
| Checked :

(continued)

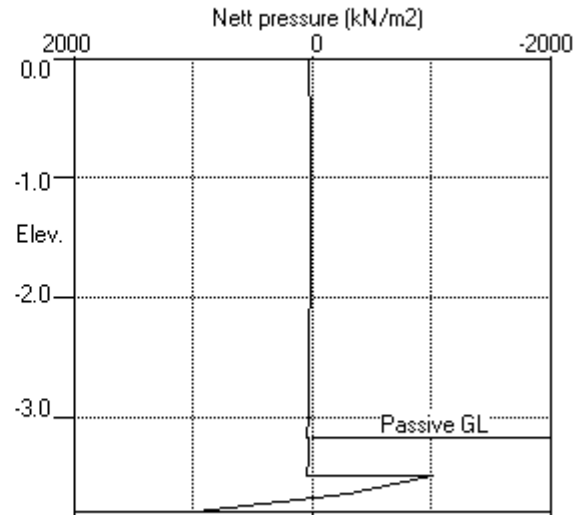
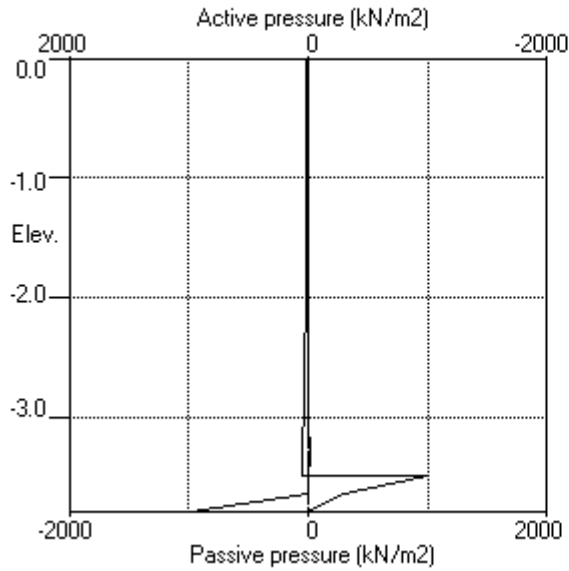
Stage No.3 Excavate to elevation -3.17 on PASSIVE side
Note: 0.00a Soil pressure at active limit
123.45p Soil pressure at passive limit

Units: kN,m

Stage No.3 Excav. to elev. -3.17 on PASSIVE side



Stage No.3 Excav. to elev. -3.17 on PASSIVE side



ENGINEERING DESIGN CONSULTANTS Ltd
 Program: WALLAP Version 5.04 Revision A36.B52.R41
 Licensed from GEOSOLVE
 Run ID. 20220808_Double Cove static (deep rock)
 RW 1.6m from dwelling - Double Cove
 Static Analysis

| Sheet No.
 |
 | Job No. 50683
 | Made by : EDC
 | Date:20-10-2022
 | Checked :

 Units: kN,m

Summary of results

STABILITY ANALYSIS according to Strength Factor method

Factor of safety on soil strength

			FoS for toe elev. = -3.80		Toe elev. for FoS = 1.500		Strut force for F=1.000	
			-----		-----		-----	
Stage No.	--- G.L. --- Act. Pass.	Strut Elev.	Factor of Safety	Moment equilib. at elev.	Toe elev.	Wall Penetr -ation	Strut force kN/m run	
1	0.00 -0.90	Cant.	3.234	-3.66	-1.28	0.38		
2	0.00 -0.90	-0.70	33.750	n/a	-0.92	0.02	0.06	
3	0.00 -3.17	-0.70	16.125	n/a	-3.50	0.33	10.59	
4	0.00 -3.17	-0.70	15.188	n/a	-3.50	0.33	13.88	

Run ID. 20220808_Double Cove static (deep rock)
RW 1.6m from dwelling - Double Cove
Static Analysis

| Sheet No.
| Date:20-10-2022
| Checked :

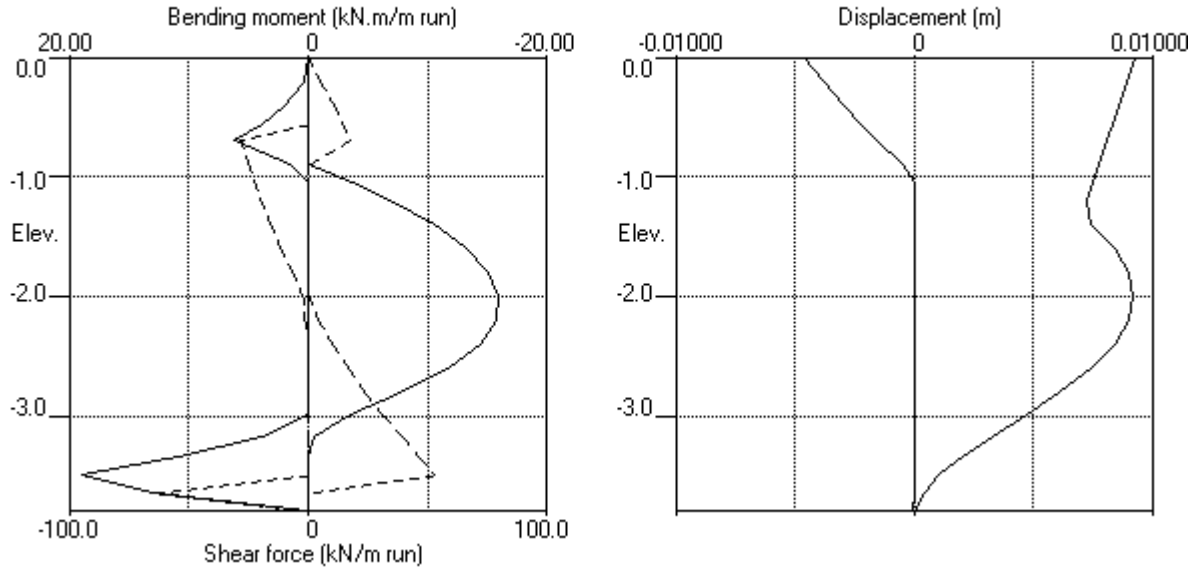
Summary of results (continued)

Strut forces at each stage (horizontal components)

Stage	---	Strut no. 1	---
no.		at elev.-0.70	
		kN/m run	kN/strut
2		43.5	43.5
3		43.6	43.6
4		43.6	43.6

Units: kN,m

Bending moment, shear force, displacement envelopes



APPENDIX C DESIGN CALCULATIONS – SEISMIC CASE

ENGINEERING DESIGN CONSULTANTS Ltd
 Program: WALLAP Version 5.04 Revision A36.B52.R41
 Licensed from GEOSOLVE
 Run ID. 20220808_Double Cove Seismic
 RW 1.6m from dwelling - Double Cove
 Seismic Analysis

| Sheet No.
 |
 | Job No. 50683
 | Made by : EDC
 | Date:20-10-2022
 | Checked :

 Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	----- Soil types -----
		Active side Passive side
1	0.00	1 SILT (active) 2 SILT (passive)

SOIL PROPERTIES

-- Soil type --	Bulk density	Young's Modulus	At rest coeff.	Consol state.	Active limit	Passive limit	Cohesion
No. Description (Datum elev.)	kN/m3	Eh,kN/m2 (dEh/dy)	Ko (dKo/dy)	NC/OC (Nu)	Ka (Kac)	Kp (Kpc)	kN/m2 (dc/dy)
1 SILT (active)	17.00	5000	0.580	NC (0.490)	1.000 (2.000)	1.000 (2.000)	50.00u
2 SILT (passive)	17.00	5000	0.580	NC (0.490)	1.000 (2.000)	1.000 (2.000)	50.00u
3 SCHIST (active)	26.00	1.90E+6	0.130	NC (0.190)	0.061 (0.542)	94.32 (53.877)	1500d
4 SCHIST (passive)	26.00	1.90E+6	0.130	NC (0.190)	0.061 (0.542)	94.32 (53.877)	1500d

Additional soil parameters associated with Ka and Kp

----- Soil type -----	--- parameters for Ka ---			--- parameters for Kp ---		
	Soil friction angle	Wall adhesion coeff.	Back-fill angle	Soil friction angle	Wall adhesion coeff.	Back-fill angle
No. Description						
1 SILT (active)	0.00	0.000	0.00	0.00	0.000	0.00
2 SILT (passive)	0.00	0.000	0.00	0.00	0.000	0.00
3 SCHIST (active)	60.00	0.419	0.00	60.00	0.419	0.00
4 SCHIST (passive)	60.00	0.419	0.00	60.00	0.419	0.00

GROUND WATER CONDITIONSDensity of water = 10.00 kN/m³

	Active side	Passive side
Initial water table elevation	-10.00	-10.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Elevation of toe of wall = -5.70
 Maximum finite element length = 0.30
 Youngs modulus of wall E = 1.2000E+07 kN/m²
 Moment of inertia of wall I = 1.2581E-04 m⁴/m run
 E.I = 1509.7 kN.m²/m run
 Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/ anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m ²	Free length m	Inclin -ation (degs)	Pre- stress /strut kN	Tension allowed
1	-0.70	1.00	0.000804	2.000E+08	4.10	-15.00	45.00	No

SURCHARGE LOADS

Surcharge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge ----- Near edge	Surcharge ----- Far edge	Equiv. soil type
1	0.00	0.00 (A)	10.00	2.00	7.20	=	0

Note: A = Active side, P = Passive side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Excavate to elevation -0.90 on PASSIVE side
2	Install strut or anchor no.1 at elevation -0.70
3	Excavate to elevation -3.20 on PASSIVE side
4	Apply surcharge no.1 at elevation 0.00
5	Apply seismic loading: 0.520g horizontal Line of action of quasi-static seismic force = 0.500 Seismic loading model: Quasi-static loading

FACTORS OF SAFETY and ANALYSIS OPTIONS

Type of structure - Retaining wall

Stability analysis:

Method of analysis - Strength Factor method
 Factor on soil strength for calculating wall depth = 1.20
 Factor on soil strength for calculating tie force = 1.00
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability

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 active side of wall = 20.00 m
 Width of excavation on passive side of wall = 20.00 m

Distance to rigid boundary on active side = 20.00 m
 Distance to rigid boundary on passive side = 20.00 m

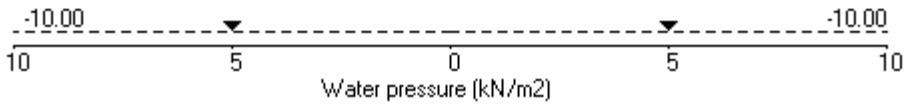
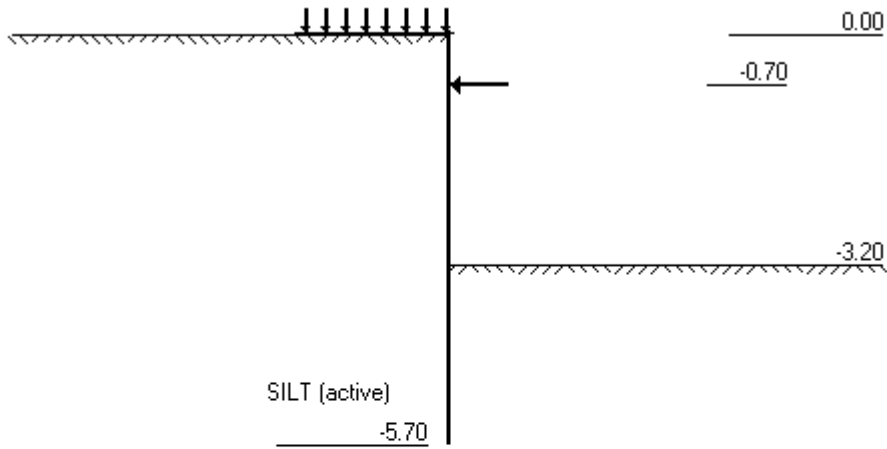
OUTPUT OPTIONS

Stage no.	Stage description	Displacement	Active, Passive pressures	Graph. output
1	Excav. to elev. -0.90 on PASSIVE side	Yes	Yes	Yes
2	Install strut no.1 at elev. -0.70	Yes	Yes	Yes
3	Excav. to elev. -3.20 on PASSIVE side	Yes	Yes	Yes
4	Apply surcharge no.1 at elev. 0.00	Yes	Yes	Yes
5	Quasi-static Seismic load: 0.520g(H)	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

Program WALLAP - Copyright (C) 2011 by DL Borin, distributed by GEOSOLVE
69 Rodenhurst Road, London SW4, UK. Tel: +44 20 8674 7251

Units: kN,m

Stage No.5 Quasi-static Seismic load: 0.520g(H)



(continued)

Stage No.1 Excavate to elevation -0.90 on PASSIVE side

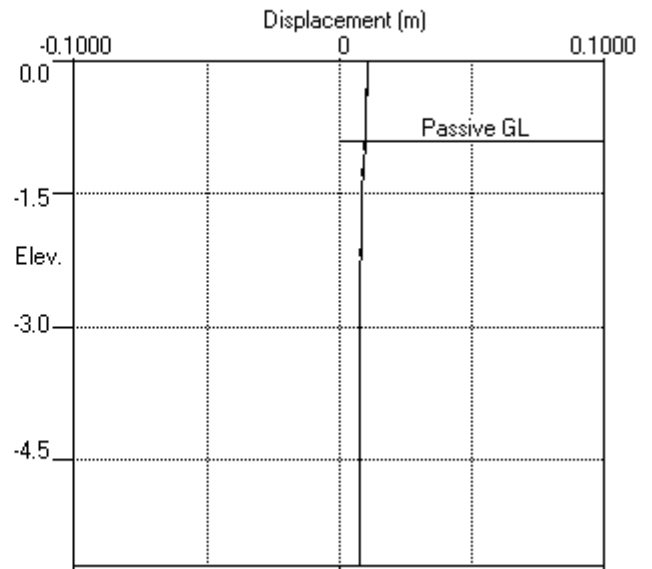
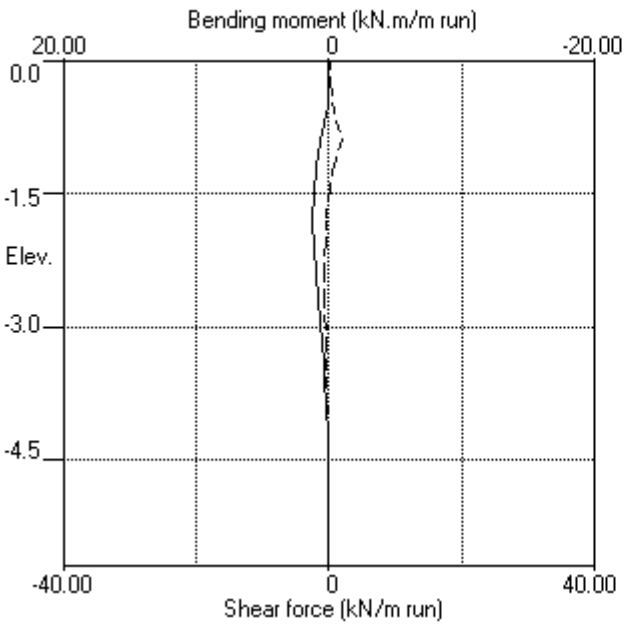
Node no.	Y coord	----- ACTIVE side -----					Total earth pressure kN/m2	Soil stiffness kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2		
1	0.00	Total>	0.00	0.00	99.93	0.00	0.00a	917
2	-0.30	Total>	5.10	1.50m	105.02	1.50	1.50a	917
3	-0.50	Total>	8.50	2.50m	108.41	2.50	2.50a	917
4	-0.70	Total>	11.90	3.50m	111.81	3.50	3.50a	917
5	-0.90	Total>	15.30	4.50m	115.21	4.50	4.50a	917
6	-1.20	Total>	20.40	6.00m	120.31	6.00	6.00a	917
7	-1.50	Total>	25.50	7.50m	125.41	7.50	7.50a	917
8	-1.80	Total>	30.60	9.00m	130.51	9.98	9.98	917
9	-2.10	Total>	35.70	10.50m	135.61	13.15	13.15	917
10	-2.40	Total>	40.80	12.00m	140.71	16.27	16.27	917
11	-2.70	Total>	45.90	13.50m	145.81	19.34	19.34	917
12	-2.95	Total>	50.15	14.75m	150.06	21.87	21.87	917
13	-3.20	Total>	54.40	16.00m	154.31	24.37	24.37	917
14	-3.40	Total>	57.80	17.00m	157.71	26.36	26.36	917
15	-3.60	Total>	61.20	18.00m	161.11	28.34	28.34	917
16	-3.90	Total>	66.30	19.50m	166.21	31.30	31.30	917
17	-4.20	Total>	71.40	21.00m	171.31	34.25	34.25	917
18	-4.50	Total>	76.50	22.50m	176.41	37.19	37.19	917
19	-4.80	Total>	81.60	24.00m	181.51	40.13	40.13	917
20	-5.10	Total>	86.70	25.50m	186.61	43.06	43.06	917
21	-5.40	Total>	91.80	27.00m	191.71	46.00	46.00	917
22	-5.70	Total>	96.90	28.50m	196.81	48.94	48.94	917

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure kN/m2	Soil stiffness kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2		
1	0.00		0.00	0.00	0.00	0.00	0.00	0.0
2	-0.30		0.00	0.00	0.00	0.00	0.00	0.0
3	-0.50		0.00	0.00	0.00	0.00	0.00	0.0
4	-0.70		0.00	0.00	0.00	0.00	0.00	0.0
5	-0.90		0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	99.93	9.63	9.63	1003
6	-1.20	Total>	5.10	1.50m	105.02	9.19	9.19	1003
7	-1.50	Total>	10.20	3.00m	110.11	8.81	8.81	1003
8	-1.80	Total>	15.30	4.50m	115.21	10.95	10.95	1003
9	-2.10	Total>	20.40	6.00m	120.31	13.67	13.67	1003
10	-2.40	Total>	25.50	7.50m	125.41	16.45	16.45	1003
11	-2.70	Total>	30.60	9.00m	130.51	19.29	19.29	1003
12	-2.95	Total>	34.86	10.25m	134.76	21.69	21.69	1003
13	-3.20	Total>	39.11	11.50m	139.01	24.12	24.12	1003
14	-3.40	Total>	42.51	12.50m	142.41	26.07	26.07	1003
15	-3.60	Total>	45.92	13.50m	145.81	28.04	28.04	1003
16	-3.90	Total>	51.02	15.00m	150.91	31.00	31.00	1003
17	-4.20	Total>	56.13	16.50m	156.01	33.98	33.98	1003
18	-4.50	Total>	61.24	18.00m	161.11	36.96	36.96	1003
19	-4.80	Total>	66.35	19.50m	166.21	39.95	39.95	1003
20	-5.10	Total>	71.46	21.00m	171.31	42.94	42.94	1003
21	-5.40	Total>	76.57	22.50m	176.41	45.94	45.94	1003
22	-5.70	Total>	81.68	24.00m	181.52	48.93	48.93	1003

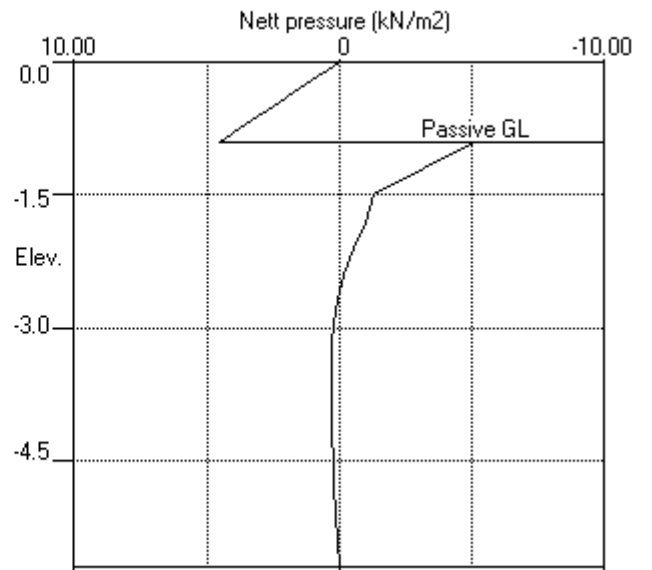
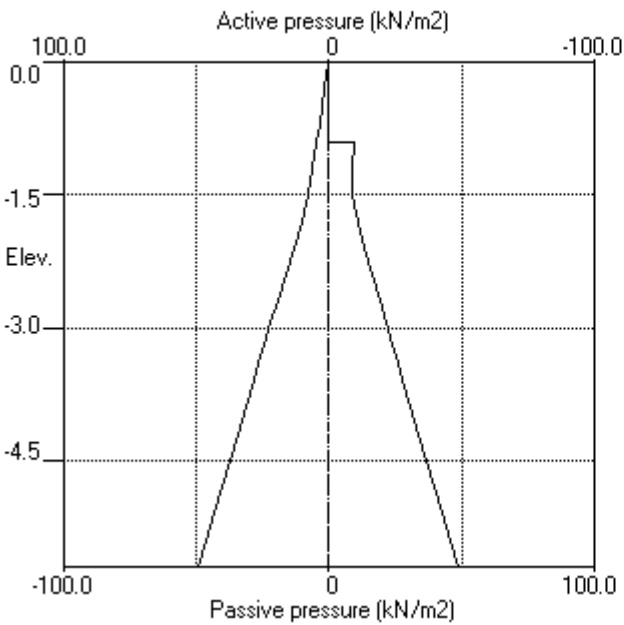
Note: 7.50a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.1 Excav. to elev. -0.90 on PASSIVE side



Stage No.1 Excav. to elev. -0.90 on PASSIVE side



(continued)

Stage No.3 Excavate to elevation -3.20 on PASSIVE side

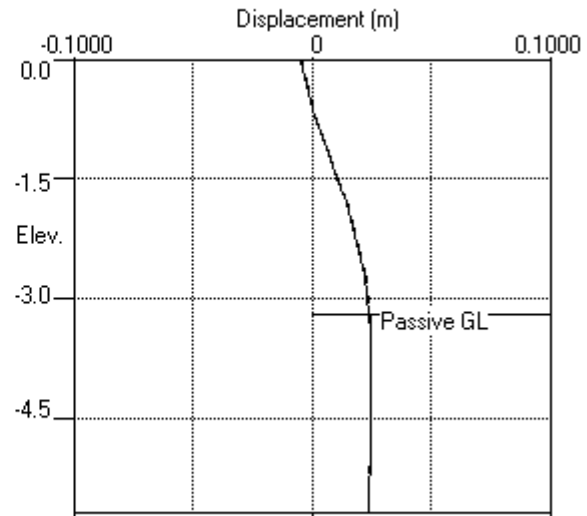
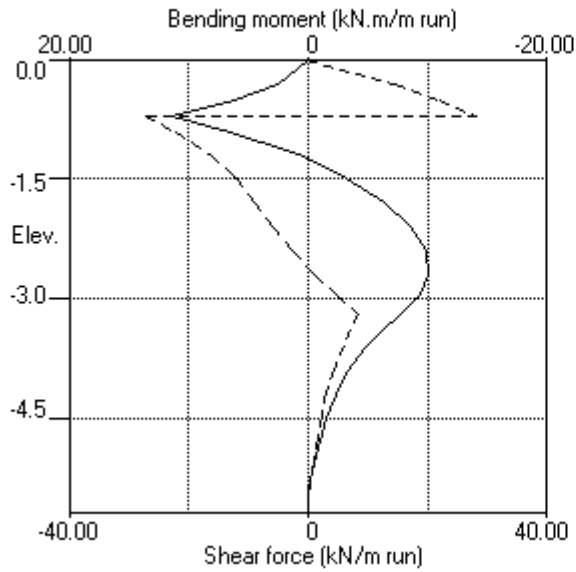
Node no.	Y coord	----- ACTIVE side -----					Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2		
1	0.00	Total>	0.00	0.00	99.93	55.07	55.07	6474
2	-0.30	Total>	5.10	1.50m	105.02	42.49	42.49	6474
3	-0.50	Total>	8.50	2.50m	108.41	33.75	33.75	6474
4	-0.70	Total>	11.90	3.50m	111.81	26.07	26.07	1129
5	-0.90	Total>	15.30	4.50m	115.21	22.58	22.58	1129
6	-1.20	Total>	20.40	6.00m	120.31	16.88	16.88	1129
7	-1.50	Total>	25.50	7.50m	125.41	11.31	11.31	1129
8	-1.80	Total>	30.60	9.00m	130.51	9.00	9.00a	1129
9	-2.10	Total>	35.70	10.50m	135.61	10.50	10.50a	1129
10	-2.40	Total>	40.80	12.00m	140.71	12.00	12.00a	1129
11	-2.70	Total>	45.90	13.50m	145.81	13.50	13.50a	1129
12	-2.95	Total>	50.15	14.75m	150.06	14.75	14.75a	1129
13	-3.20	Total>	54.40	16.00m	154.31	16.00	16.00a	1129
14	-3.40	Total>	57.80	17.00m	157.71	17.00	17.00a	1129
15	-3.60	Total>	61.20	18.00m	161.11	18.00	18.00a	1129
16	-3.90	Total>	66.30	19.50m	166.21	19.50	19.50a	1129
17	-4.20	Total>	71.40	21.00m	171.31	21.00	21.00a	1129
18	-4.50	Total>	76.50	22.50m	176.41	22.50	22.50a	1129
19	-4.80	Total>	81.60	24.00m	181.51	24.00	24.00a	1129
20	-5.10	Total>	86.70	25.50m	186.61	25.50	25.50a	1129
21	-5.40	Total>	91.80	27.00m	191.71	28.00	28.00	1129
22	-5.70	Total>	96.90	28.50m	196.81	31.85	31.85	1129

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure	Soil stiffness coeff.
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2		
1	0.00		0.00	0.00	0.00	0.00	0.00	0.0
2	-0.30		0.00	0.00	0.00	0.00	0.00	0.0
3	-0.50		0.00	0.00	0.00	0.00	0.00	0.0
4	-0.70		0.00	0.00	0.00	0.00	0.00	0.0
5	-0.90		0.00	0.00	0.00	0.00	0.00	0.0
6	-1.20		0.00	0.00	0.00	0.00	0.00	0.0
7	-1.50		0.00	0.00	0.00	0.00	0.00	0.0
8	-1.80		0.00	0.00	0.00	0.00	0.00	0.0
9	-2.10		0.00	0.00	0.00	0.00	0.00	0.0
10	-2.40		0.00	0.00	0.00	0.00	0.00	0.0
11	-2.70		0.00	0.00	0.00	0.00	0.00	0.0
12	-2.95		0.00	0.00	0.00	0.00	0.00	0.0
13	-3.20		0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	99.94	22.95	22.95	1479
14	-3.40	Total>	3.40	1.00m	103.32	23.56	23.56	1479
15	-3.60	Total>	6.80	2.00m	106.71	23.98	23.98	1479
16	-3.90	Total>	11.90	3.50m	111.81	24.34	24.34	1479
17	-4.20	Total>	17.00	5.00m	116.91	24.44	24.44	1479
18	-4.50	Total>	22.11	6.50m	122.01	24.35	24.35	1479
19	-4.80	Total>	27.21	8.00m	127.11	25.43	25.43	1479
20	-5.10	Total>	32.32	9.50m	132.21	27.91	27.91	1479
21	-5.40	Total>	37.43	11.00m	137.31	30.35	30.35	1479
22	-5.70	Total>	42.54	12.50m	142.42	32.35	32.35	1479

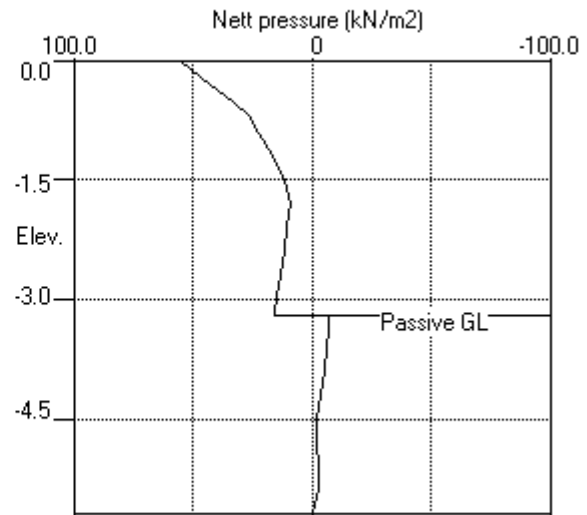
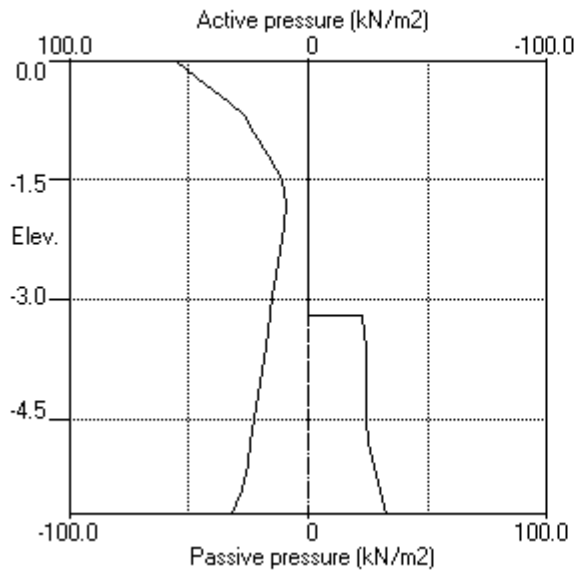
Note: 25.50a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.3 Excav. to elev. -3.20 on PASSIVE side



Stage No.3 Excav. to elev. -3.20 on PASSIVE side



(continued)

Stage No.5 Apply seismic loading:
 0.520g horizontal
 Line of action of quasi-static seismic force = 0.500
 Seismic loading model: Quasi-static loading

Node no.	Y coord	----- ACTIVE side -----					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Effective Active limit	Effective Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3	
1	0.00	Total>	7.20	22.11	5.63	5.63	5.63p	6118
2	-0.30	Total>	12.29	26.64	11.27	11.27	11.27p	6118
3	-0.50	Total>	15.65	28.15	19.16	19.16	19.16p	6118
4	-0.70	Total>	18.98	27.02	26.84	26.84	26.84p	6118
5	-0.90	Total>	22.27	24.67	36.19	26.11	26.11	1081
6	-1.20	Total>	27.13	23.79	46.01	23.79	23.79a	1081
7	-1.50	Total>	31.92	22.20	57.63	22.20	22.20a	1081
8	-1.80	Total>	35.88	19.97	68.87	19.97	19.97a	1081
9	-2.10	Total>	41.40	19.61	80.71	19.61	19.61a	1081
10	-2.40	Total>	46.14	19.24	92.13	19.24	19.24a	1081
11	-2.70	Total>	50.88	18.89	102.97	18.89	18.89a	1081
12	-2.95	Total>	54.85	18.63	113.28	18.63	18.63a	1081
13	-3.20	Total>	58.83	18.36	122.24	18.36	18.36a	1081
		Total>	58.83	40.47	122.24	40.47	40.47a	1081
14	-3.40	Total>	62.03	43.00	130.59	43.00	43.00a	1081
15	-3.60	Total>	65.23	45.53	139.50	45.53	45.53a	1081
16	-3.90	Total>	70.06	49.32	149.76	49.32	49.32a	1081
17	-4.20	Total>	74.90	53.11	161.29	53.11	53.11a	1081
18	-4.50	Total>	79.77	56.90	172.82	56.90	56.90a	1081
19	-4.80	Total>	84.65	60.69	184.35	60.69	60.69a	1081
20	-5.10	Total>	89.55	64.49	195.87	64.49	64.49a	1248
21	-5.40	Total>	94.47	74.55	207.40	74.55	74.55a	1248
22	-5.70	Total>	99.40	85.31	215.87	85.31	85.31a	1248

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Effective Active limit	Effective Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	-0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	-0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	-0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	-0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	-1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	-1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	-1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	-2.10	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	-2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	-2.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	-2.95	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	-3.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	99.13	57.56	57.56	1479
14	-3.40	Total>	3.40	2.08	101.63	58.82	58.82	1479
15	-3.60	Total>	6.80	5.06	102.83	59.82	59.82	1479
16	-3.90	Total>	11.90	8.92	105.70	61.02	61.02	1479
17	-4.20	Total>	17.00	12.67	107.89	62.05	62.05	1479
18	-4.50	Total>	22.11	16.38	109.89	63.02	63.02	1479
19	-4.80	Total>	27.21	20.17	111.96	65.32	65.32	1479
20	-5.10	Total>	32.32	24.37	114.06	69.16	69.16	1479
21	-5.40	Total>	37.43	27.81	116.10	73.04	73.04	1479

(continued)

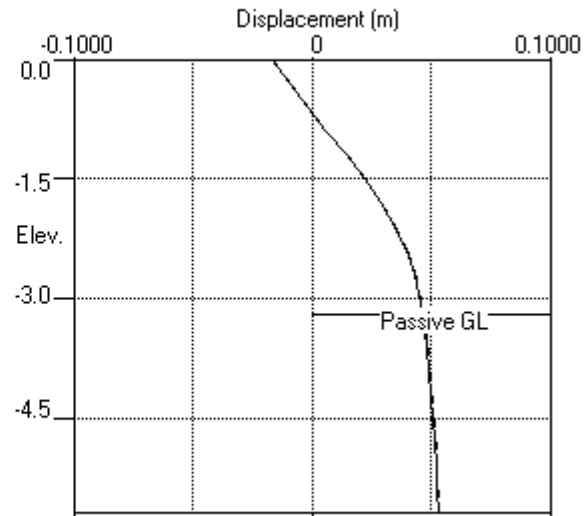
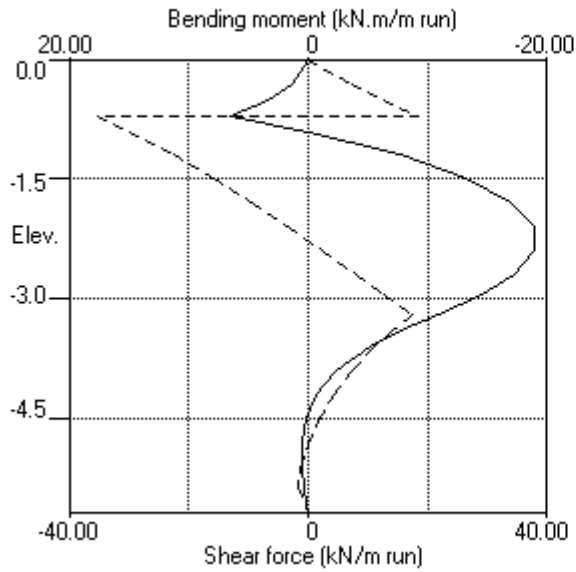
Stage No.5 Apply seismic loading:
 0.520g horizontal
 Line of action of quasi-static seismic force = 0.500
 Seismic loading model: Quasi-static loading

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure	Soil stiffness coeff. kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
22	-5.70	Total>	42.54	30.61	119.21	76.51	76.51	1479

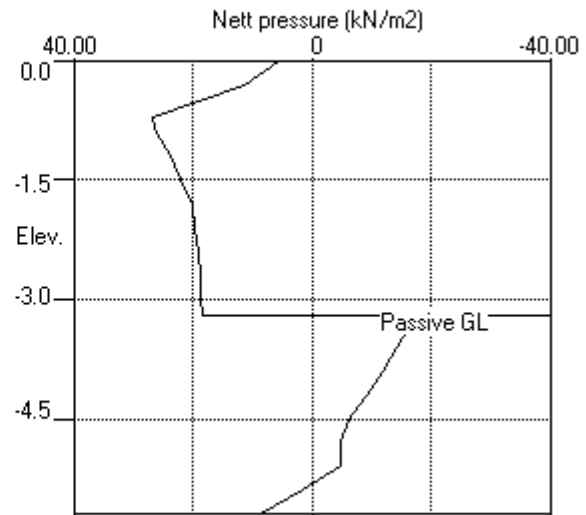
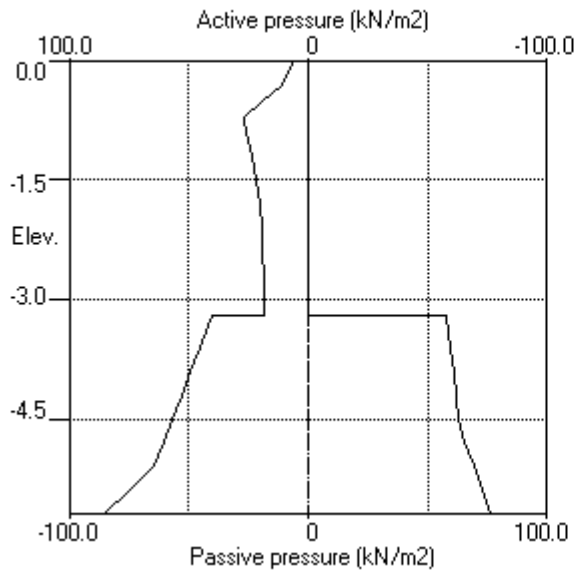
Note: 85.31a Soil pressure at active limit
 26.84p Soil pressure at passive limit

Units: kN,m

Stage No.5 Quasi-static Seismic load: 0.520g(H)



Stage No.5 Quasi-static Seismic load: 0.520g(H)



ENGINEERING DESIGN CONSULTANTS Ltd
 Program: WALLAP Version 5.04 Revision A36.B52.R41
 Licensed from GEOSOLVE
 Run ID. 20220808_Double Cove Seismic
 RW 1.6m from dwelling - Double Cove
 Seismic Analysis

| Sheet No.
 |
 | Job No. 50683
 | Made by : EDC
 | Date:20-10-2022
 | Checked :

 Units: kN,m

Summary of results

STABILITY ANALYSIS according to Strength Factor method

Factor of safety on soil strength
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability

			FoS for toe		Toe elev. for		Strut force	
			elev. = -5.70		FoS = 1.200		for F=1.000	

Stage	--- G.L. ---		Strut	Factor	Moment	Toe	Wall	Strut
No.	Act.	Pass.	Elev.	of	equilib.	elev.	Penetr	force
			Safety	at elev.			-ation	kN/m run
1	0.00	-0.90	Cant.	12.313	-5.60	-0.99	0.09	
2	0.00	-0.90	-0.70		Conditions	not suitable for FoS calc.		
3	0.00	-3.20	-0.70	3.384	n/a	-3.41	0.21	11.49
4	0.00	-3.20	-0.70	3.257	n/a	-3.41	0.21	11.49
5	0.00	-3.20	-0.70	1.270	n/a	-3.77	0.57	50.18

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT CALCULATION - Assumptions:

Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability
 Open Tension Crack analysis - No
 Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Active side 20.00 from wall
 Passive side 20.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment		Shear force	
		maximum m	minimum m	maximum kN.m/m	minimum kN.m/m	maximum kN/m	minimum kN/m
1	0.00	0.011	-0.017	0.0	-0.0	0.0	0.0
2	-0.30	0.011	-0.009	3.0	0.0	17.5	0.0
3	-0.50	0.010	-0.004	7.5	0.0	26.6	0.0
4	-0.70	0.010	0.000	13.6	0.0	33.9	-35.3
5	-0.90	0.010	0.000	7.5	0.0	2.0	-30.0
6	-1.20	0.014	0.000	1.0	-7.7	0.8	-22.5
7	-1.50	0.022	0.000	1.1	-13.3	0.1	-15.6
8	-1.80	0.029	0.000	1.2	-17.0	0.0	-10.2
9	-2.10	0.034	0.000	1.1	-18.9	0.9	-6.3
10	-2.40	0.039	0.000	0.9	-18.9	2.6	-2.7
11	-2.70	0.043	0.000	0.7	-17.3	8.2	-0.6
12	-2.95	0.045	0.000	0.6	-14.7	12.9	-0.6
13	-3.20	0.046	0.000	0.5	-10.9	17.5	-0.5
14	-3.40	0.047	0.000	0.4	-7.7	14.2	-0.5
15	-3.60	0.048	0.000	0.3	-5.1	11.2	-0.4
16	-3.90	0.049	0.000	0.2	-3.4	7.3	-0.3
17	-4.20	0.050	0.000	0.1	-2.3	4.2	-0.2
18	-4.50	0.050	0.000	0.2	-1.5	2.2	-0.1
19	-4.80	0.051	0.000	0.6	-0.9	1.7	-0.1
20	-5.10	0.052	0.000	0.5	-0.5	1.1	-1.1
21	-5.40	0.052	0.000	0.3	-0.0	0.4	-1.5
22	-5.70	0.053	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				Shear force			
	maximum kN.m/m	elev.	minimum kN.m/m	elev.	maximum kN/m	elev.	minimum kN/m	elev.
1	1.2	-1.80	-0.0	-5.70	2.0	-0.90	-0.6	-2.70
2	7.4	-0.70	-4.9	-2.10	20.3	-0.70	-23.1	-0.70
3	11.4	-0.70	-10.1	-2.70	28.2	-0.70	-27.1	-0.70
4	13.6	-0.70	-12.0	-2.40	33.9	-0.70	-34.0	-0.70
5	6.6	-0.70	-18.9	-2.40	18.3	-0.70	-35.3	-0.70

Summary of results (continued)

Maximum and minimum displacement at each stage

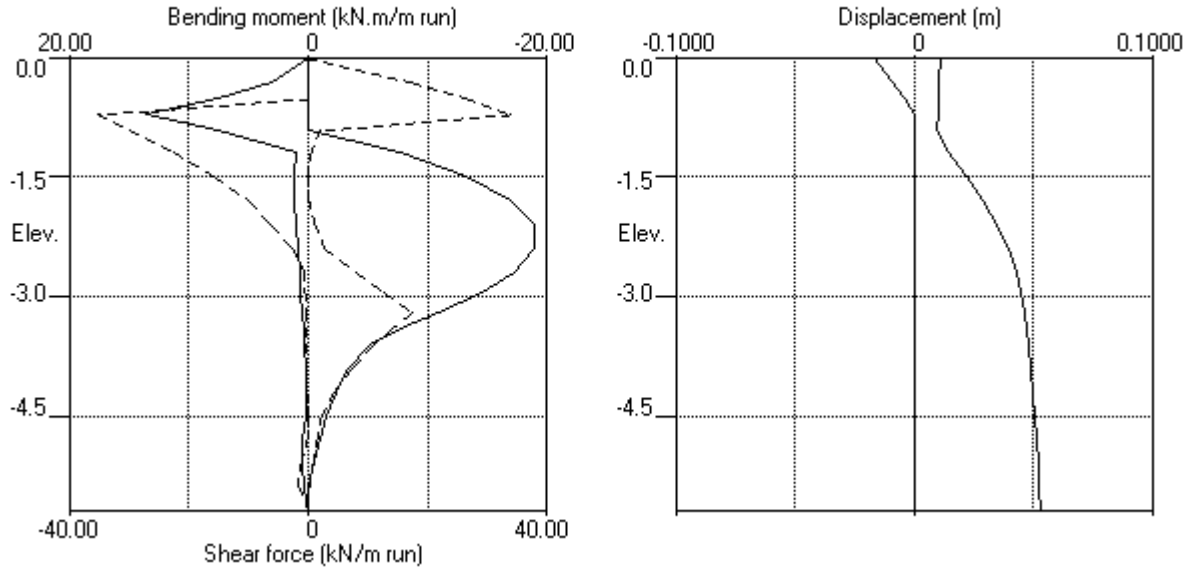
Stage no.	Displacement maximum	Displacement elev.	Displacement minimum	Displacement elev.	Stage description
	m		m		
1	0.011	0.00	0.000	0.00	Excav. to elev. -0.90 on PASSIVE side
2	0.008	-3.60	-0.002	0.00	Install strut no.1 at elev. -0.70
3	0.025	-3.90	-0.005	0.00	Excav. to elev. -3.20 on PASSIVE side
4	0.027	-3.60	-0.006	0.00	Apply surcharge no.1 at elev. 0.00
5	0.053	-5.70	-0.017	0.00	Quasi-static Seismic load: 0.520g(H)

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1	Strut no. 1
	at elev.-0.70	at elev.-0.70
	kN/m run	kN/strut
2	43.5	43.5
3	55.3	55.3
4	68.0	68.0
5	53.6	53.6

Units: kN,m

Bending moment, shear force, displacement envelopes



Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types	
		Active side	Passive side
1	0.00	1 SILT (active)	2 SILT (passive)
2	-2.50	3 SCHIST (active)	4 SCHIST (passive)

SOIL PROPERTIES

No.	Description	Bulk density kN/m3	Young's Modulus Eh, kN/m2	At rest coeff. Ko	Consol state. NC/OC	Active limit Ka	Passive limit Kp	Cohesion kN/m2
(Datum elev.)		(dEh/dy)		(dKo/dy)	(Nu)	(Kac)	(Kpc)	(dc/dy)
1	SILT (active)	17.00	5000	0.580	NC (0.490)	1.000 (2.000)	1.000 (2.000)	50.00u
2	SILT (passive)	17.00	5000	0.580	NC (0.490)	1.000 (2.000)	1.000 (2.000)	50.00u
3	SCHIST (active)	26.00	1.90E+6	0.130	NC (0.190)	0.061 (0.542)	94.32 (53.877)	1500d
4	SCHIST (passive)	26.00	1.90E+6	0.130	NC (0.190)	0.061 (0.542)	94.32 (53.877)	1500d

Additional soil parameters associated with Ka and Kp

No.	Description	--- parameters for Ka ---			--- parameters for Kp ---		
		Soil friction angle	Wall adhesion coeff.	Back-fill angle	Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	SILT (active)	0.00	0.000	0.00	0.00	0.000	0.00
2	SILT (passive)	0.00	0.000	0.00	0.00	0.000	0.00
3	SCHIST (active)	60.00	0.419	0.00	60.00	0.419	0.00
4	SCHIST (passive)	60.00	0.419	0.00	60.00	0.419	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3
 Initial water table elevation Active side Passive side
 -10.00 -10.00
 Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Elevation of toe of wall = -2.80
 Maximum finite element length = 0.16
 Youngs modulus of wall E = 1.2000E+07 kN/m2
 Moment of inertia of wall I = 1.2581E-04 m4/m run
 E.I = 1509.7 kN.m2/m run
 Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/ anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre-stress /strut kN	Tension allowed
1	-0.70	1.00	0.000804	200000	4.10	-15.00	45.00	No

SURCHARGE LOADS

Surcharge no.	Elev.	Distance from wall	Length parallel to wall	Width perpend. to wall	Surcharge		Equiv. soil type
					----- kN/m2 ----- Near edge	----- Far edge	
1	0.00	0.00(A)	10.00	2.00	7.20	=	0

Note: A = Active side, P = Passive side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Excavate to elevation -0.90 on PASSIVE side
2	Install strut or anchor no.1 at elevation -0.70
3	Excavate to elevation -2.50 on PASSIVE side
4	Apply surcharge no.1 at elevation 0.00
5	Apply seismic loading: 0.520g horizontal Line of action of quasi-static seismic force = 0.500 Seismic loading model: Quasi-static loading

FACTORS OF SAFETY and ANALYSIS OPTIONS

Type of structure - Retaining wall

Stability analysis:

Method of analysis - Strength Factor method
 Factor on soil strength for calculating wall depth = 1.50
 Factor on soil strength for calculating tie force = 1.00
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability

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 active side of wall = 20.00 m
 Width of excavation on passive side of wall = 20.00 m

 Distance to rigid boundary on active side = 20.00 m
 Distance to rigid boundary on passive side = 20.00 m

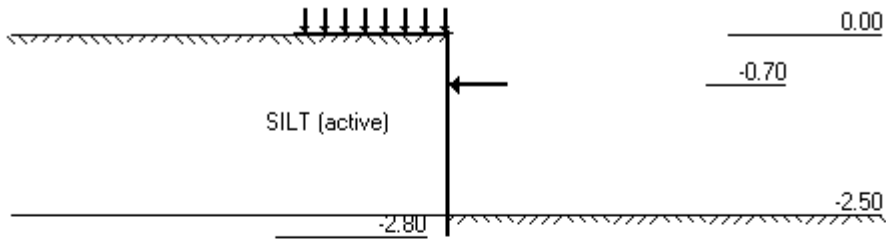
OUTPUT OPTIONS

Stage no.	Stage description	----- Output options -----		
		Displacement Bending mom. Shear force	Active, Passive pressures	Graph. output
1	Excav. to elev. -0.90 on PASSIVE side	Yes	Yes	Yes
2	Install strut no.1 at elev. -0.70	Yes	Yes	Yes
3	Excav. to elev. -2.50 on PASSIVE side	Yes	Yes	Yes
4	Apply surcharge no.1 at elev. 0.00	Yes	Yes	Yes
5	Quasi-static Seismic load: 0.520g(H)	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

Program WALLAP - Copyright (C) 2011 by DL Borin, distributed by GEOSOLVE
 69 Rodenhurst Road, London SW4, UK. Tel: +44 20 8674 7251

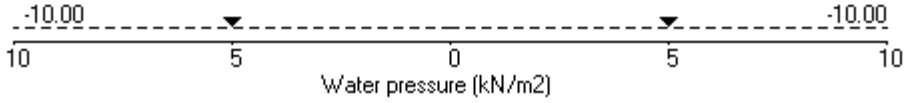
Units: kN,m

Stage No.5 Quasi-static Seismic load: 0.520g(H)



SCHIST (active)

SCHIST (passive)



(continued)

Stage No.1 Excavate to elevation -0.90 on PASSIVE side

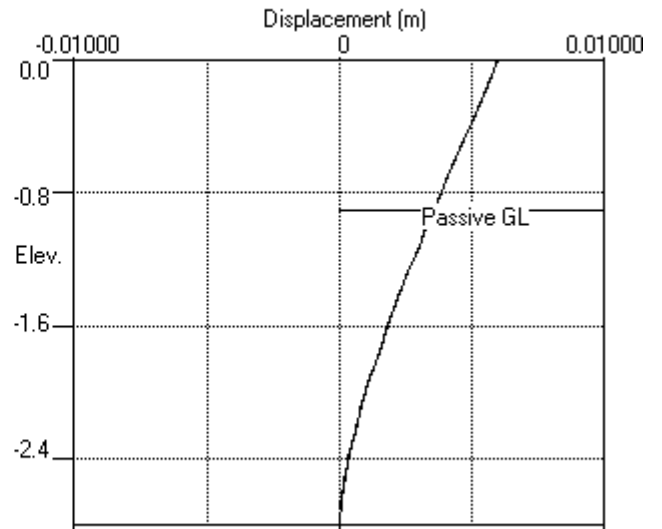
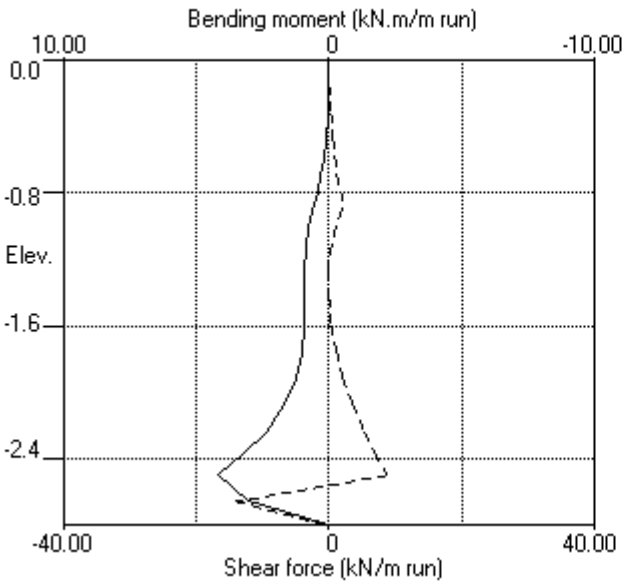
Node no.	Y coord	----- ACTIVE side -----					Total earth pressure kN/m2	Soil stiffness kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective stresses Active limit kN/m2	Effective stresses Passive limit kN/m2	Earth pressure kN/m2		
1	0.00	Total>	0.00	0.00	99.93	0.00	0.00a	2565
2	-0.16	Total>	2.72	0.80m	102.65	0.80	0.80a	2565
3	-0.32	Total>	5.44	1.60m	105.35	1.60	1.60a	2565
4	-0.48	Total>	8.16	2.40m	108.06	2.40	2.40a	2565
5	-0.59	Total>	10.03	2.95m	109.94	2.95	2.95a	2565
6	-0.70	Total>	11.90	3.50m	111.81	3.50	3.50a	2565
7	-0.80	Total>	13.60	4.00m	113.51	4.00	4.00a	2565
8	-0.90	Total>	15.30	4.50m	115.21	4.50	4.50a	2565
9	-1.01	Total>	17.17	5.05m	117.08	5.05	5.05a	2565
10	-1.12	Total>	19.04	5.60m	118.95	5.60	5.60a	2565
11	-1.28	Total>	21.76	6.40m	121.67	6.40	6.40a	2565
12	-1.44	Total>	24.48	7.20m	124.39	8.49	8.49	2565
13	-1.60	Total>	27.20	8.00m	127.11	11.00	11.00	2565
14	-1.76	Total>	29.92	8.80m	129.83	13.48	13.48	2565
15	-1.92	Total>	32.64	9.60m	132.55	15.91	15.91	2565
16	-2.08	Total>	35.36	10.40m	135.27	18.28	18.28	2565
17	-2.24	Total>	38.08	11.20m	137.99	20.58	20.58	2565
18	-2.37	Total>	40.29	11.85m	140.20	22.38	22.38	2565
19	-2.50	Total>	42.50	12.50m	142.41	24.08	24.08	2565
			0.00	42.50	0.00	9106.96	0.00	698103
20	-2.65		0.00	46.40	0.00	11735.68	0.00	698103
21	-2.80		0.00	50.30	0.00	14386.75	275.43	46628375

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure kN/m2	Soil stiffness kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective stresses Active limit kN/m2	Effective stresses Passive limit kN/m2	Earth pressure kN/m2		
1	0.00		0.00	0.00	0.00	0.00	0.00	0.0
2	-0.16		0.00	0.00	0.00	0.00	0.00	0.0
3	-0.32		0.00	0.00	0.00	0.00	0.00	0.0
4	-0.48		0.00	0.00	0.00	0.00	0.00	0.0
5	-0.59		0.00	0.00	0.00	0.00	0.00	0.0
6	-0.70		0.00	0.00	0.00	0.00	0.00	0.0
7	-0.80		0.00	0.00	0.00	0.00	0.00	0.0
8	-0.90		0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	122.56	12.50	12.50	3499
9	-1.01	Total>	1.87	0.55m	102.02	11.49	11.49	3499
10	-1.12	Total>	3.74	1.10m	94.27	10.51	10.51	3499
11	-1.28	Total>	6.46	1.90m	106.37	9.12	9.12	3499
12	-1.44	Total>	9.18	2.70m	109.09	7.79	7.79	3499
13	-1.60	Total>	11.90	3.50m	111.80	6.99	6.99	3499
14	-1.76	Total>	14.62	4.30m	114.53	7.34	7.34	3499
15	-1.92	Total>	17.34	5.10m	117.26	7.76	7.76	3499
16	-2.08	Total>	20.06	5.90m	119.97	8.25	8.25	3499
17	-2.24	Total>	22.78	6.70m	122.69	8.84	8.84	3499
18	-2.37	Total>	24.99	7.35m	124.90	9.42	9.42	3499
19	-2.50	Total>	27.20	8.00m	127.11	10.14	10.14	3499
			0.00	27.20	0.00	11112.61	216.76	961454
20	-2.65		0.00	31.10	0.00	15042.89	87.43	961454
21	-2.80		0.00	35.01	0.00	19007.28	0.00a	46628375

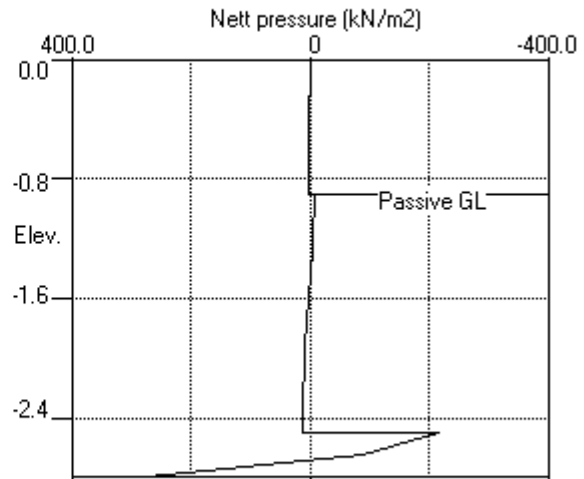
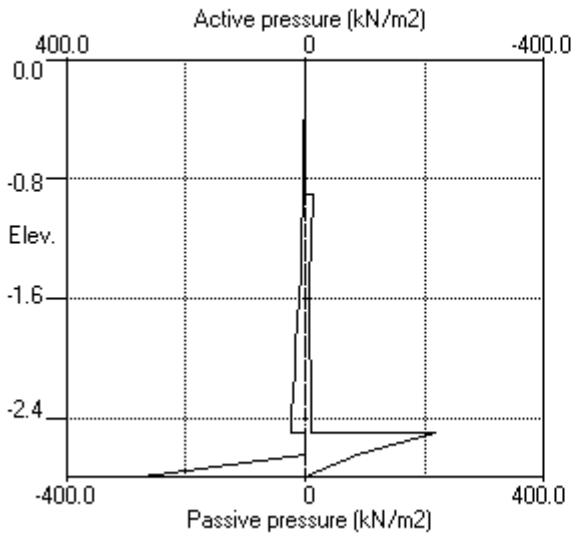
Note: 0.00a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.1 Excav. to elev. -0.90 on PASSIVE side



Stage No.1 Excav. to elev. -0.90 on PASSIVE side



(continued)

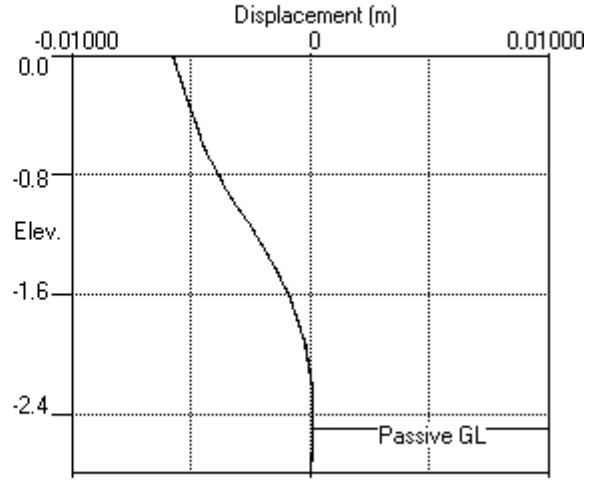
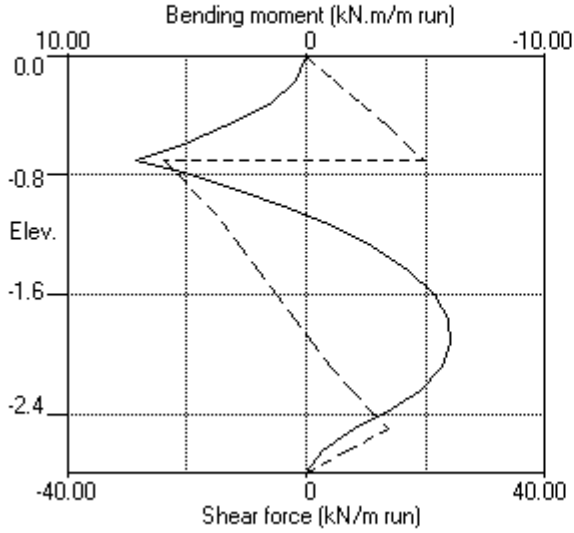
Stage No.3 Excavate to elevation -2.50 on PASSIVE side

Node no.	Y coord	----- ACTIVE side -----					Total earth pressure	Soil stiffness
		Water press.	Vertic -al	Effective Active limit	Effective Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3	
1	0.00	Total>	0.00	0.00	99.93	30.68	1736	
2	-0.16	Total>	2.72	0.80m	102.65	29.54	1736	
3	-0.32	Total>	5.44	1.60m	105.35	28.38	1736	
4	-0.48	Total>	8.16	2.40m	108.06	27.15	1736	
5	-0.59	Total>	10.03	2.95m	109.94	26.23	1736	
6	-0.70	Total>	11.90	3.50m	111.81	25.20	1736	
7	-0.80	Total>	13.60	4.00m	113.51	24.15	1736	
8	-0.90	Total>	15.30	4.50m	115.21	23.02	1736	
9	-1.01	Total>	17.17	5.05m	117.08	21.73	1736	
10	-1.12	Total>	19.04	5.60m	118.95	20.44	1736	
11	-1.28	Total>	21.76	6.40m	121.67	18.63	1736	
12	-1.44	Total>	24.48	7.20m	124.39	18.25	1736	
13	-1.60	Total>	27.20	8.00m	127.11	18.52	1736	
14	-1.76	Total>	29.92	8.80m	129.83	19.01	1736	
15	-1.92	Total>	32.64	9.60m	132.55	19.75	1736	
16	-2.08	Total>	35.36	10.40m	135.27	20.74	1736	
17	-2.24	Total>	38.08	11.20m	137.99	21.99	1736	
18	-2.37	Total>	40.29	11.85m	140.20	23.15	1736	
19	-2.50	Total>	42.50	12.50m	142.41	24.43	1736	
			0.00	42.50	0.00	9106.96	464626	
20	-2.65		0.00	46.40	0.00	11735.68	464626	
21	-2.80		0.00	50.30	0.00	14386.75	9528907	

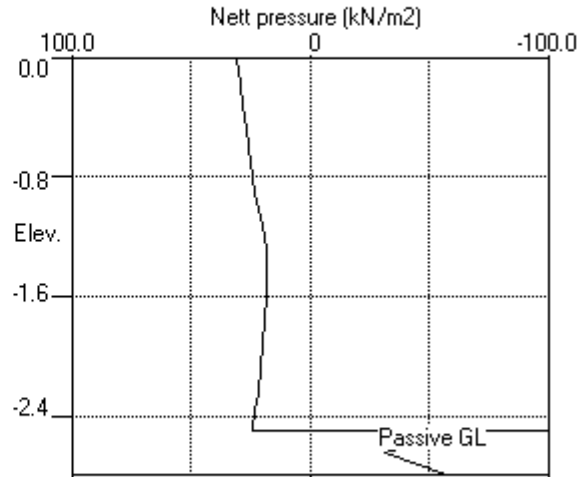
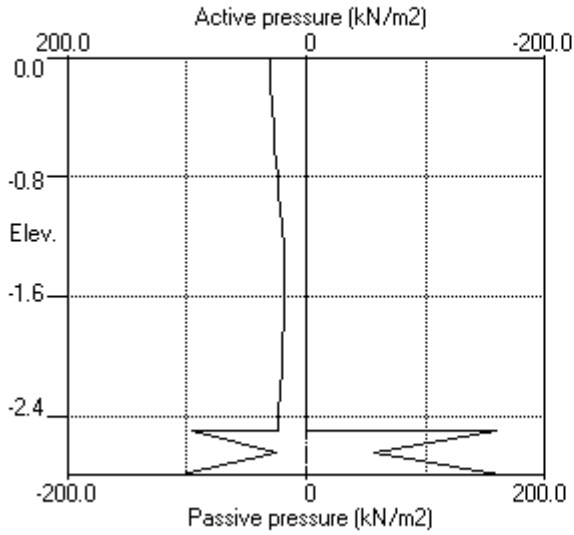
Node no.	Y coord	----- PASSIVE side -----					Total earth pressure	Soil stiffness
		Water press.	Vertic -al	Effective Active limit	Effective Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
2	-0.16	0.00	0.00	0.00	0.00	0.00	0.0	
3	-0.32	0.00	0.00	0.00	0.00	0.00	0.0	
4	-0.48	0.00	0.00	0.00	0.00	0.00	0.0	
5	-0.59	0.00	0.00	0.00	0.00	0.00	0.0	
6	-0.70	0.00	0.00	0.00	0.00	0.00	0.0	
7	-0.80	0.00	0.00	0.00	0.00	0.00	0.0	
8	-0.90	0.00	0.00	0.00	0.00	0.00	0.0	
9	-1.01	0.00	0.00	0.00	0.00	0.00	0.0	
10	-1.12	0.00	0.00	0.00	0.00	0.00	0.0	
11	-1.28	0.00	0.00	0.00	0.00	0.00	0.0	
12	-1.44	0.00	0.00	0.00	0.00	0.00	0.0	
13	-1.60	0.00	0.00	0.00	0.00	0.00	0.0	
14	-1.76	0.00	0.00	0.00	0.00	0.00	0.0	
15	-1.92	0.00	0.00	0.00	0.00	0.00	0.0	
16	-2.08	0.00	0.00	0.00	0.00	0.00	0.0	
17	-2.24	0.00	0.00	0.00	0.00	0.00	0.0	
18	-2.37	0.00	0.00	0.00	0.00	0.00	0.0	
19	-2.50	0.00	0.00	0.00	0.00	0.00	0.0	
		0.00	0.00	0.00	78578.25	158.94	5514613	
20	-2.65	0.00	3.90	0.00	49960.68	56.14	5514613	
21	-2.80	0.00	7.80	0.00	21080.54	162.98	9528907	

Units: kN,m

Stage No.3 Excav. to elev. -2.50 on PASSIVE side



Stage No.3 Excav. to elev. -2.50 on PASSIVE side



Units: kN,m

Stage No. 5 Apply seismic loading:
 0.520g horizontal
 Line of action of quasi-static seismic force = 0.500
 Seismic loading model: Quasi-static loading

STABILITY ANALYSIS according to Strength Factor method

Factor of safety on soil strength
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability

Stage No.	--- G.L. ---	Strut Elev.	FoS for toe elev. = -2.80	Moment of equilib. at elev.	Toe elev. for FoS = 1.500	Wall Penetr-ation	Strut force for F=1.000
5	0.00 -2.50	-0.70	23.625	n/a	-2.50	0.00	35.58

BENDING MOMENT and DISPLACEMENT CALCULATION - Assumptions:

Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability
 Open Tension Crack analysis - No
 Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Active side 20.00 from wall
 Passive 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	Strut forces kN/m
1	0.00	29.23	-0.002	-5.04E-04	0.0	-0.0	
2	-0.16	28.67	-0.002	-5.24E-04	4.6	0.4	
3	-0.32	28.09	-0.002	-6.23E-04	9.2	1.5	
4	-0.48	27.42	-0.002	-8.78E-04	13.6	3.3	
5	-0.59	26.86	-0.002	-1.18E-03	16.6	5.0	
6	-0.70	26.20	-0.002	-1.61E-03	19.5	7.0	43.6
		26.20	-0.002	-1.61E-03	-24.1	7.0	
7	-0.80	25.47	-0.002	-2.00E-03	-21.5	4.7	
8	-0.90	24.66	-0.001	-2.24E-03	-19.0	2.7	
9	-1.01	23.71	-0.001	-2.37E-03	-16.3	0.7	
10	-1.12	22.75	-0.001	-2.36E-03	-13.7	-0.9	
11	-1.28	21.40	-0.000	-2.16E-03	-10.2	-2.8	
12	-1.44	21.48	-0.000	-1.79E-03	-6.8	-4.2	
13	-1.60	22.18	0.000	-1.31E-03	-3.3	-5.0	
14	-1.76	23.07	0.000	-7.77E-04	0.3	-5.2	
15	-1.92	24.18	0.000	-2.44E-04	4.1	-4.9	
16	-2.08	25.49	0.000	2.18E-04	8.1	-3.9	
17	-2.24	26.96	0.000	5.44E-04	12.3	-2.3	
18	-2.37	28.25	0.000	6.61E-04	15.9	-0.4	
19	-2.50	29.55	0.000	6.00E-04	19.6	1.9	
		-329.66	0.000	6.00E-04	19.6	1.9	
20	-2.65	-16.05	0.000	4.53E-04	-6.3	1.1	
21	-2.80	100.11	-0.000	3.99E-04	-0.0	-0.0	
Strut force at elev. -0.70 =			43.57 kN/m run =			43.57 kN/strut (horiz.)	
						=	45.11 kN/strut (incl.)

(continued)

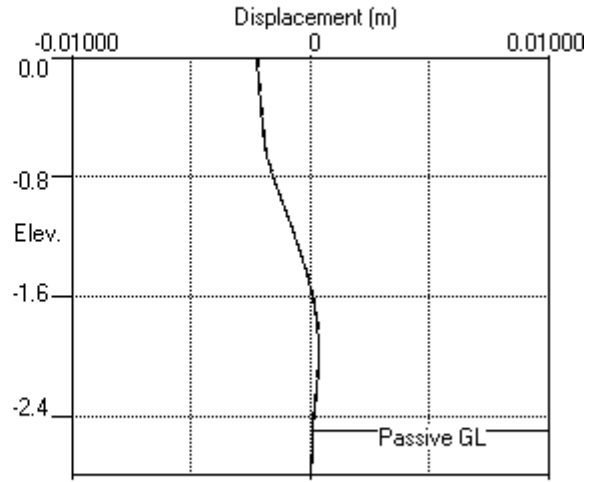
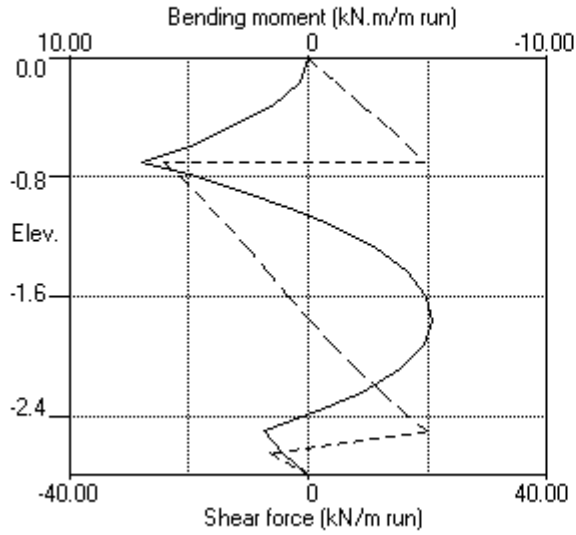
Stage No.5 Apply seismic loading:
 0.520g horizontal
 Line of action of quasi-static seismic force = 0.500
 Seismic loading model: Quasi-static loading

Node no.	Y coord	----- ACTIVE side -----					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3	
1	0.00	Total>	7.20	18.22	102.02	29.23	29.23	2534
2	-0.16	Total>	9.92	18.90	104.25	28.67	28.67	2534
3	-0.32	Total>	12.63	24.43	105.64	28.09	28.09	2534
4	-0.48	Total>	15.32	24.03	107.10	27.42	27.42	2534
5	-0.59	Total>	17.16	22.89	108.05	26.86	26.86	2534
6	-0.70	Total>	18.98	23.67	108.67	26.20	26.20	2534
7	-0.80	Total>	20.63	21.56	108.90	25.47	25.47	2534
8	-0.90	Total>	22.27	21.77	109.01	24.66	24.66	2534
9	-1.01	Total>	24.06	21.84	109.96	23.71	23.71	2534
10	-1.12	Total>	25.84	20.35	111.08	22.75	22.75	2534
11	-1.28	Total>	28.41	17.86	112.39	21.40	21.40	2534
12	-1.44	Total>	30.97	15.39	113.53	21.48	21.48	2534
13	-1.60	Total>	33.51	15.10	114.67	22.18	22.18	2534
14	-1.76	Total>	36.04	14.77	114.97	23.07	23.07	2534
15	-1.92	Total>	38.57	14.48	114.03	24.18	24.18	2534
16	-2.08	Total>	41.09	14.17	113.84	25.49	25.49	2534
17	-2.24	Total>	43.61	13.85	114.95	26.96	26.96	2534
18	-2.37	Total>	45.66	13.60	115.80	28.25	28.25	2534
19	-2.50	Total>	47.72	13.34	117.11	29.55	29.55	2534
			0.00	47.72	0.00	8904.08	70.78	689352
20	-2.65	0.00	51.44	0.00	12412.13	30.15	30.15	4981714
21	-2.80	0.00	55.17	0.00	15948.71	184.58	184.58	4981714

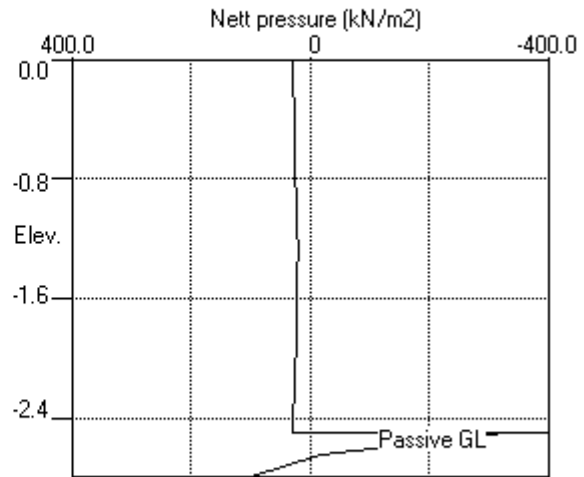
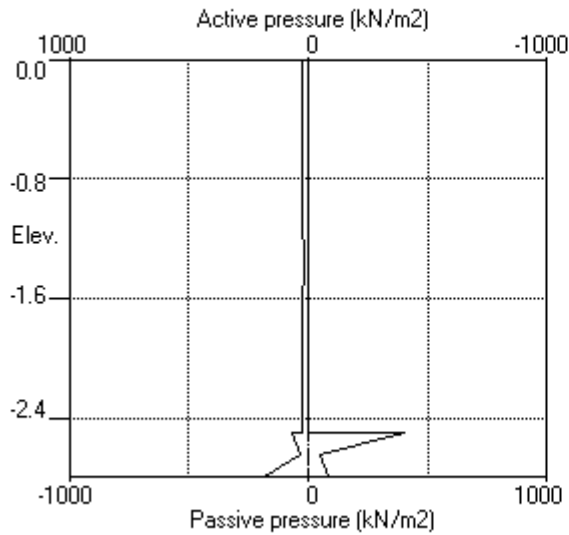
Node no.	Y coord	----- PASSIVE side -----					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3	
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
2	-0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	-0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	-0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	-0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	-0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	-0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	-0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	-1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	-1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	-1.28	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	-1.44	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	-1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	-1.76	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	-1.92	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	-2.08	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	-2.24	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18	-2.37	0.00	0.00	0.00	0.00	0.00	0.00	0.0
19	-2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		0.00	0.00	0.00	78493.22	400.44	400.44	6643991
20	-2.65	0.00	3.90	0.03	49883.77	46.19	46.19	4981714
21	-2.80	0.00	7.80	0.06	21011.84	84.47	84.47	4981714

Units: kN,m

Stage No.5 Quasi-static Seismic load: 0.520g(H)



Stage No.5 Quasi-static Seismic load: 0.520g(H)



ENGINEERING DESIGN CONSULTANTS Ltd
 Program: WALLAP Version 5.04 Revision A36.B52.R41
 Licensed from GEOSOLVE
 Run ID. 20220808_Double Cove seismic (shal rock)
 RW 1.6m from dwelling - Double Cove
 Seismic Analysis

| Sheet No.
 |
 | Job No. 50683
 | Made by : EDC
 | Date:20-10-2022
 | Checked :

 Units: kN,m

Summary of results

STABILITY ANALYSIS according to Strength Factor method

Factor of safety on soil strength
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability

			FoS for toe		Toe elev. for		Strut force	
			elev. = -2.80		FoS = 1.500		for F=1.000	

Stage	--- G.L. ---		Strut	Factor	Moment	Toe	Wall	Strut
No.	Act.	Pass.	Elev.	of	at elev.	elev.	Penetr	force
				Safety			-ation	kN/m run
1	0.00	-0.90	Cant.	12.656	-2.65	-1.15	0.25	
2	0.00	-0.90	-0.70		Conditions	not suitable for FoS calc.		
3	0.00	-2.50	-0.70	57.750	n/a	-2.50	0.00	7.76
4	0.00	-2.50	-0.70	48.750	n/a	-2.50	0.00	7.76
5	0.00	-2.50	-0.70	23.625	n/a	-2.50	0.00	35.58

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT CALCULATION - Assumptions:

- Subgrade reaction model - Boussinesq Influence coefficients
- Soil deformations are elastic until the active or passive limit is reached
- Active limit pressures calculated by Wedge Stability
- Passive limit pressures calculated by Wedge Stability
- Open Tension Crack analysis - No
- Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Active side 20.00 from wall
 Passive side 20.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment		Shear force	
		maximum m	minimum m	maximum kN.m/m	minimum kN.m/m	maximum kN/m	minimum kN/m
1	0.00	0.006	-0.006	0.0	-0.0	0.0	0.0
2	-0.16	0.006	-0.006	0.4	0.0	4.9	0.0
3	-0.32	0.005	-0.006	1.6	0.0	9.7	0.0
4	-0.48	0.005	-0.005	3.5	0.0	14.2	0.0
5	-0.59	0.004	-0.005	5.2	0.0	17.2	0.0
6	-0.70	0.004	-0.005	7.3	0.0	20.1	-24.1
7	-0.80	0.004	-0.004	5.1	0.0	1.6	-21.5
8	-0.90	0.004	-0.004	3.1	0.0	2.0	-19.0
9	-1.01	0.003	-0.003	1.3	0.0	1.2	-16.5
10	-1.12	0.003	-0.003	0.9	-0.9	0.6	-14.2
11	-1.28	0.003	-0.002	0.9	-2.8	0.0	-11.1
12	-1.44	0.002	-0.002	0.9	-4.3	0.0	-8.1
13	-1.60	0.002	-0.001	0.9	-5.4	0.2	-5.4
14	-1.76	0.002	-0.001	1.0	-6.0	1.0	-2.9
15	-1.92	0.001	-0.000	1.2	-6.1	4.1	-0.5
16	-2.08	0.001	-0.000	1.7	-5.7	8.1	0.0
17	-2.24	0.001	-0.000	2.4	-5.1	12.3	0.0
18	-2.37	0.000	0.000	3.2	-4.4	15.9	0.0
19	-2.50	0.000	0.000	4.2	-3.5	19.6	0.0
20	-2.65	0.000	0.000	3.1	-1.5	11.5	-14.1
21	-2.80	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				Shear force			
	maximum kN.m/m	elev.	minimum kN.m/m	elev.	maximum kN/m	elev.	minimum kN/m	elev.
1	4.2	-2.50	-0.0	0.00	8.7	-2.50	-14.1	-2.65
2	7.3	-0.70	-5.7	-1.92	20.1	-0.70	-23.3	-0.70
3	7.1	-0.70	-6.1	-1.92	19.7	-0.70	-23.8	-0.70
4	7.0	-0.70	-5.2	-1.76	19.6	-2.50	-24.1	-0.70
5	7.0	-0.70	-5.2	-1.76	19.6	-2.50	-24.1	-0.70

Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum m	elev.	minimum m	elev.	
1	0.006	0.00	-0.000	-2.80	Excav. to elev. -0.90 on PASSIVE side
2	0.000	-2.50	-0.006	0.00	Install strut no.1 at elev. -0.70
3	0.000	-2.37	-0.006	0.00	Excav. to elev. -2.50 on PASSIVE side
4	0.000	-2.08	-0.002	0.00	Apply surcharge no.1 at elev. 0.00
5	0.000	-2.08	-0.002	0.00	Quasi-static Seismic load: 0.520g(H)

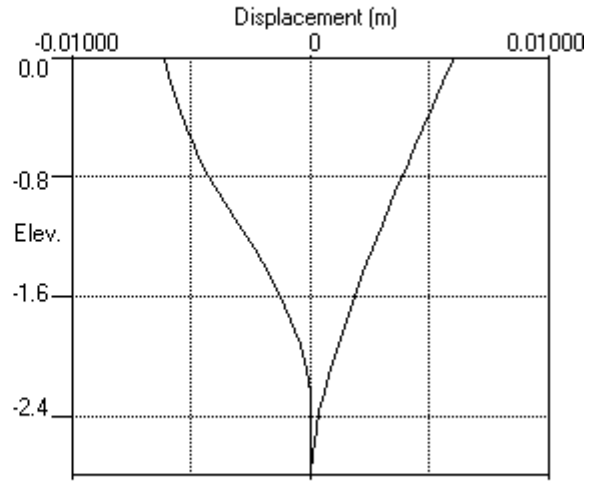
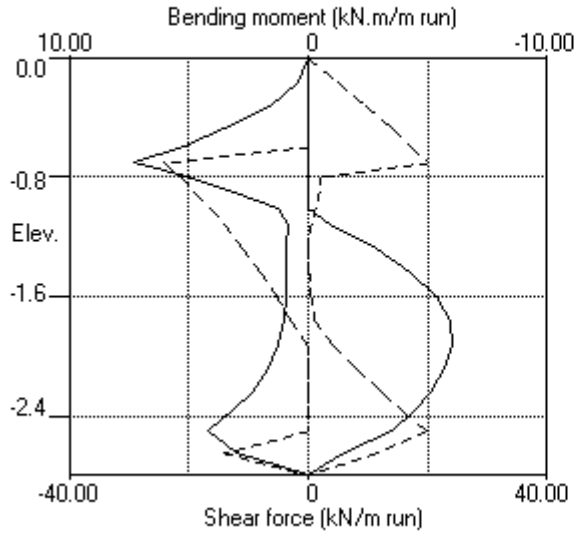
Summary of results (continued)

Strut forces at each stage (horizontal components)

Stage	---	Strut no. 1	---
no.		at elev.-0.70	
		kN/m run	kN/strut
2		43.5	43.5
3		43.5	43.5
4		43.6	43.6
5		43.6	43.6

Units: kN,m

Bending moment, shear force, displacement envelopes



Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum no.	Elevation of top of stratum	Soil types	
		Active side	Passive side
1	0.00	1 SILT (active)	2 SILT (passive)
2	-3.50	3 SCHIST (active)	4 SCHIST (passive)

SOIL PROPERTIES

No.	Description	Bulk density kN/m3	Young's Modulus Eh, kN/m2	At rest coeff. Ko	Consol state. NC/OC	Active limit Ka	Passive limit Kp	Cohesion kN/m2
(Datum elev.)		(dEh/dy)		(dKo/dy)	(Nu)	(Kac)	(Kpc)	(dc/dy)
1	SILT (active)	17.00	5000	0.580	NC (0.490)	1.000 (2.000)	1.000 (2.000)	50.00u
2	SILT (passive)	17.00	5000	0.580	NC (0.490)	1.000 (2.000)	1.000 (2.000)	50.00u
3	SCHIST (active)	26.00	1.90E+6	0.130	NC (0.190)	0.061 (0.542)	94.32 (53.877)	1500d
4	SCHIST (passive)	26.00	1.90E+6	0.130	NC (0.190)	0.061 (0.542)	94.32 (53.877)	1500d

Additional soil parameters associated with Ka and Kp

No.	Description	--- parameters for Ka ---			--- parameters for Kp ---		
		Soil friction angle	Wall adhesion coeff.	Back-fill angle	Soil friction angle	Wall adhesion coeff.	Back-fill angle
1	SILT (active)	0.00	0.000	0.00	0.00	0.000	0.00
2	SILT (passive)	0.00	0.000	0.00	0.00	0.000	0.00
3	SCHIST (active)	60.00	0.419	0.00	60.00	0.419	0.00
4	SCHIST (passive)	60.00	0.419	0.00	60.00	0.419	0.00

GROUND WATER CONDITIONS

Density of water = 10.00 kN/m3

	Active side	Passive side
Initial water table elevation	-10.00	-10.00

Automatic water pressure balancing at toe of wall : No

WALL PROPERTIES

Elevation of toe of wall = -3.81
 Maximum finite element length = 0.20
 Youngs modulus of wall E = 1.2000E+07 kN/m2
 Moment of inertia of wall I = 1.2581E-04 m4/m run
 E.I = 1509.7 kN.m2/m run
 Yield Moment of wall = Not defined

STRUTS and ANCHORS

Strut/ anchor no.	Elev.	Strut spacing m	X-section area of strut sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre- stress /strut kN	Tension allowed
1	-0.70	1.00	0.000804	200000	4.10	-15.00	45.00	No

SURCHARGE LOADS

Surcharge 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
1	0.00	0.00 (A)	10.00	2.00	7.20	=	0

Note: A = Active side, P = Passive side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Excavate to elevation -0.01 on PASSIVE side
2	Install strut or anchor no.1 at elevation -0.70
3	Excavate to elevation -3.20 on PASSIVE side
4	Apply surcharge no.1 at elevation 0.00
5	Apply seismic loading: 0.520g horizontal Line of action of quasi-static seismic force = 0.500 Seismic loading model: Quasi-static loading

FACTORS OF SAFETY and ANALYSIS OPTIONS

Type of structure - Retaining wall

Stability analysis:

Method of analysis - Strength Factor method
 Factor on soil strength for calculating wall depth = 1.50
 Factor on soil strength for calculating tie force = 1.00
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability

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 active side of wall = 20.00 m
 Width of excavation on passive side of wall = 20.00 m

Distance to rigid boundary on active side = 20.00 m
 Distance to rigid boundary on passive side = 20.00 m

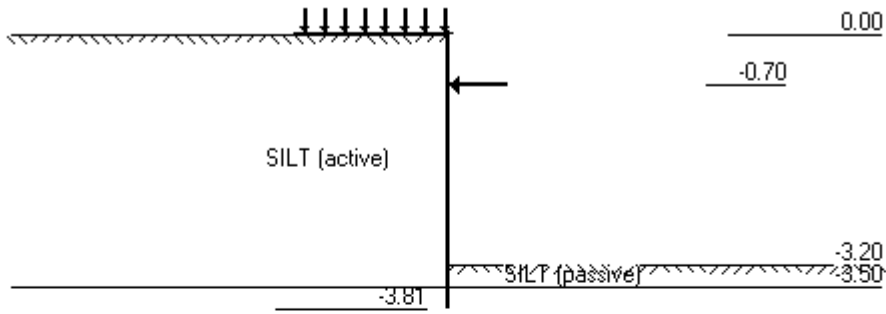
OUTPUT OPTIONS

Stage no.	Stage description	Displacement	Active, Passive pressures	Graph. output
1	Excav. to elev. -0.01 on PASSIVE side	Yes	Yes	Yes
2	Install strut no.1 at elev. -0.70	Yes	Yes	Yes
3	Excav. to elev. -3.20 on PASSIVE side	Yes	Yes	Yes
4	Apply surcharge no.1 at elev. 0.00	Yes	Yes	Yes
5	Quasi-static Seismic load: 0.520g(H)	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

Program WALLAP - Copyright (C) 2011 by DL Borin, distributed by GEOSOLVE
69 Rodenhurst Road, London SW4, UK. Tel: +44 20 8674 7251

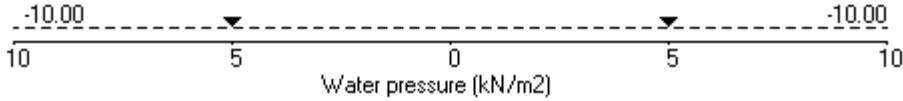
Units: kN,m

Stage No.5 Quasi-static Seismic load: 0.520g(H)



SCHIST (active)

SCHIST (passive)



Units: kN,m

Stage No. 1 Excavate to elevation -0.01 on PASSIVE side

STABILITY ANALYSIS according to Strength Factor method

Factor of safety on soil strength
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability

Stage No.	--- G.L. --- Act.	--- G.L. --- Pass.	Strut Elev.	FoS for toe elev. =	Moment of equil. at elev.	Toe elev. for FoS =	Wall Penetr-ation	Strut force for F=1.000
1	0.00	-0.01	Cant.	-3.81		1.500		

Conditions not suitable for FoS calc.

BENDING MOMENT and DISPLACEMENT CALCULATION - Assumptions:

Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability
 Open Tension Crack analysis - No
 Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Active side 20.00 from wall
 Passive side 20.00 from wall

Node no.	Y coord	Nett pressure kN/m ²	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	0.00	0.00	0.000	6.77E-06	0.0	0.0	
2	-0.01	0.05	0.000	6.77E-06	0.0	0.0	
		-0.05	0.000	6.77E-06	0.0	0.0	
3	-0.21	-0.02	0.000	6.78E-06	-0.0	-0.0	
4	-0.40	-0.02	0.000	6.89E-06	-0.0	-0.0	
5	-0.55	-0.01	0.000	7.15E-06	-0.0	-0.0	
6	-0.70	-0.01	0.000	7.59E-06	-0.0	-0.0	
7	-0.85	-0.01	0.000	8.25E-06	-0.0	-0.0	
8	-1.00	-0.00	0.000	9.13E-06	-0.0	-0.0	
9	-1.20	0.00	0.000	1.06E-05	-0.0	-0.0	
10	-1.40	0.01	0.000	1.26E-05	-0.0	-0.0	
11	-1.60	0.02	0.000	1.50E-05	-0.0	-0.0	
12	-1.80	0.03	0.000	1.77E-05	-0.0	-0.0	
13	-2.00	0.04	0.000	2.06E-05	-0.0	-0.0	
14	-2.20	0.05	0.000	2.36E-05	0.0	-0.0	
15	-2.40	0.07	0.000	2.63E-05	0.0	-0.0	
16	-2.60	0.08	0.000	2.85E-05	0.0	-0.0	
17	-2.80	0.10	0.000	2.97E-05	0.1	-0.0	
18	-3.00	0.12	0.000	2.95E-05	0.1	0.0	
19	-3.20	0.14	0.000	2.73E-05	0.1	0.0	
20	-3.35	0.15	0.000	2.39E-05	0.1	0.0	
21	-3.50	0.16	0.000	1.87E-05	0.1	0.1	
		-3.21	0.000	1.87E-05	0.1	0.1	
22	-3.66	-1.27	0.000	1.31E-05	-0.2	0.0	
23	-3.81	3.87	-0.000	1.07E-05	-0.0	-0.0	

(continued)

Stage No.1 Excavate to elevation -0.01 on PASSIVE side

Node no.	Y coord	----- ACTIVE side -----					Total earth pressure kN/m2	Soil stiffness kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2		
1	0.00	Total>	0.00	0.00	100.01	0.00	0.00a	1494
2	-0.01	Total>	0.17	0.05m	100.18	0.05	0.05a	1494
3	-0.21	Total>	3.49	1.03m	103.50b	1.93	1.93	1494
4	-0.40	Total>	6.80	2.00m	106.81	3.85	3.85	1494
5	-0.55	Total>	9.35	2.75m	109.36	5.33	5.33	1494
6	-0.70	Total>	11.90	3.50m	111.91	6.81	6.81	1494
7	-0.85	Total>	14.45	4.25m	114.46	8.29	8.29	1494
8	-1.00	Total>	17.00	5.00m	117.01	9.77	9.77	1494
9	-1.20	Total>	20.40	6.00m	120.41	11.75	11.75	1494
10	-1.40	Total>	23.80	7.00m	123.81	13.72	13.72	1494
11	-1.60	Total>	27.20	8.00m	127.21	15.70	15.70	1494
12	-1.80	Total>	30.60	9.00m	130.61	17.68	17.68	1494
13	-2.00	Total>	34.00	10.00m	134.01	19.65	19.65	1494
14	-2.20	Total>	37.40	11.00m	137.41	21.63	21.63	1494
15	-2.40	Total>	40.80	12.00m	140.81	23.61	23.61	1494
16	-2.60	Total>	44.20	13.00m	144.21	25.59	25.59	1494
17	-2.80	Total>	47.60	14.00m	147.61	27.57	27.57	1494
18	-3.00	Total>	51.00	15.00m	151.01	29.55	29.55	1494
19	-3.20	Total>	54.40	16.00m	154.41	31.54	31.54	1494
20	-3.35	Total>	56.95	16.75m	156.96	33.02	33.02	1494
21	-3.50	Total>	59.50	17.50m	159.51	34.50	34.50	1494
			0.00	59.50	0.00	86427.05	6.11	396361
22	-3.66	Total>	0.00	63.53	0.00	86807.14	7.60	396361
23	-3.81	Total>	0.00	67.56	0.00	87187.24	10.70	13928412

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure kN/m2	Soil stiffness kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Effective Active limit kN/m2	Effective Passive limit kN/m2	Earth pressure kN/m2		
1	0.00		0.00	0.00	0.00	0.00	0.00	0.0
2	-0.01		0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	100.01	0.10	0.10	1497
3	-0.21	Total>	3.32	0.98m	103.33	1.95	1.95	1497
4	-0.40	Total>	6.63	1.95m	106.64	3.87	3.87	1497
5	-0.55	Total>	9.18	2.70m	109.19	5.34	5.34	1497
6	-0.70	Total>	11.73	3.45m	111.74	6.82	6.82	1497
7	-0.85	Total>	14.28	4.20m	114.29	8.30	8.30	1497
8	-1.00	Total>	16.83	4.95m	116.84	9.78	9.78	1497
9	-1.20	Total>	20.23	5.95m	120.24	11.75	11.75	1497
10	-1.40	Total>	23.63	6.95m	123.64	13.71	13.71	1497
11	-1.60	Total>	27.03	7.95m	127.04	15.68	15.68	1497
12	-1.80	Total>	30.43	8.95m	130.44	17.65	17.65	1497
13	-2.00	Total>	33.83	9.95m	133.84	19.62	19.62	1497
14	-2.20	Total>	37.23	10.95m	137.24	21.58	21.58	1497
15	-2.40	Total>	40.63	11.95m	140.64	23.55	23.55	1497
16	-2.60	Total>	44.03	12.95m	144.04	25.51	25.51	1497
17	-2.80	Total>	47.43	13.95m	147.44	27.47	27.47	1497
18	-3.00	Total>	50.83	14.95m	150.84	29.44	29.44	1497
19	-3.20	Total>	54.23	15.95m	154.24	31.40	31.40	1497
20	-3.35	Total>	56.78	16.70m	156.79	32.87	32.87	1497
21	-3.50	Total>	59.33	17.45m	159.34	34.35	34.35	1497
			0.00	59.33	0.00	86411.05	9.32	397332
22	-3.66	Total>	0.00	63.36	0.00	86791.15	8.87	397332

(continued)

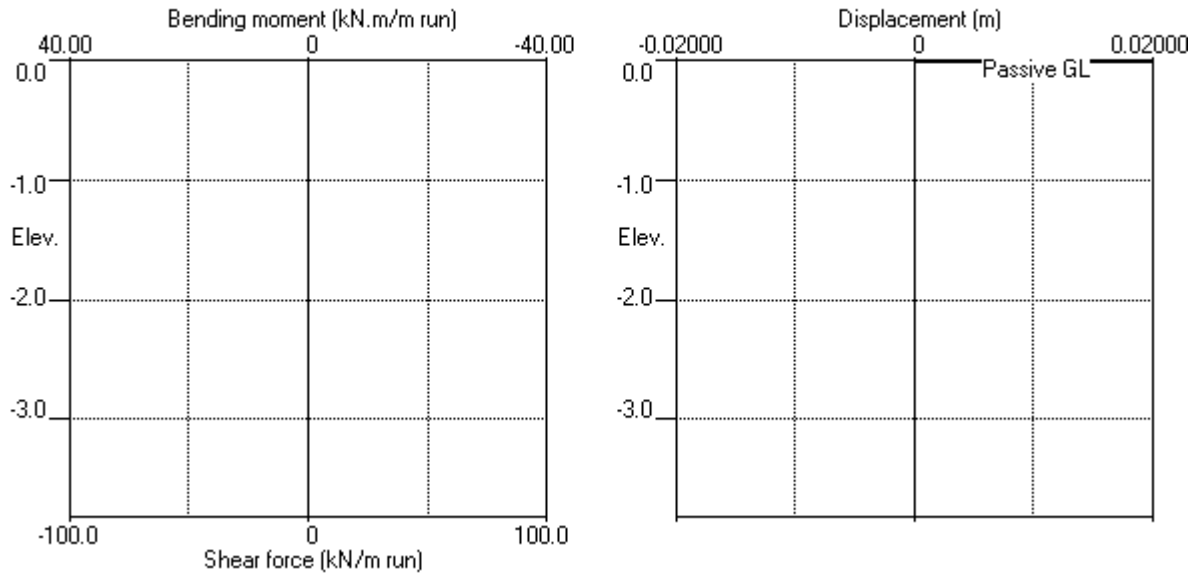
Stage No.1 Excavate to elevation -0.01 on PASSIVE side

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure kN/m2	Soil stiffness kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
23	-3.81	0.00	67.39	0.00	87171.25	6.83	13928412	

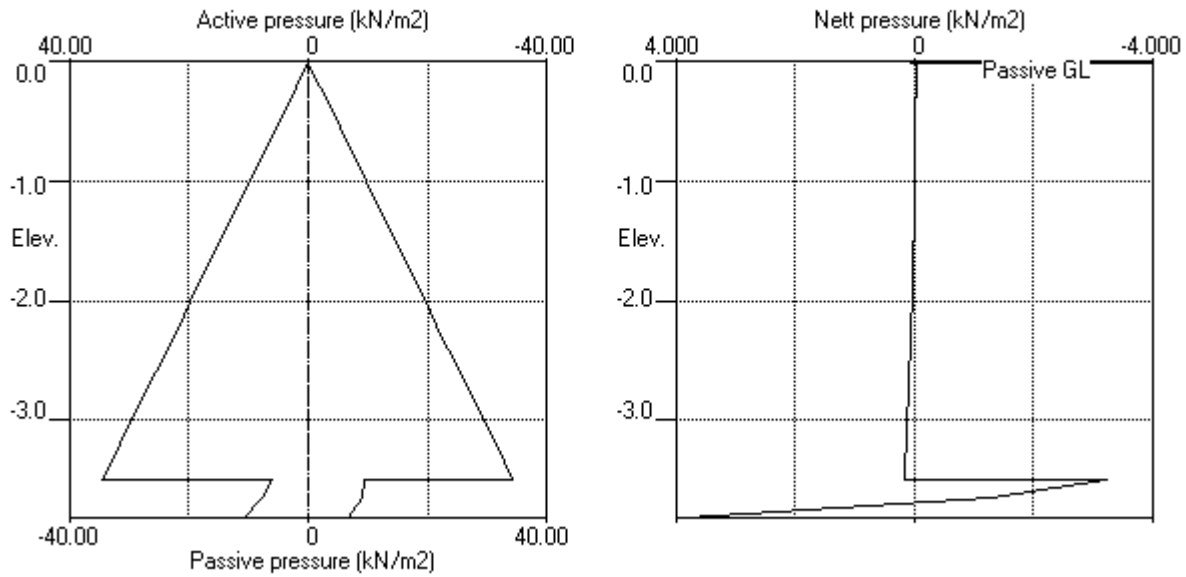
Note: 0.05a Soil pressure at active limit
 123.45p Soil pressure at passive limit
 103.50b Passive limit reduced because of berm

Units: kN,m

Stage No.1 Excav. to elev. -0.01 on PASSIVE side



Stage No.1 Excav. to elev. -0.01 on PASSIVE side



Units: kN,m

Stage No. 3 Excavate to elevation -3.20 on PASSIVE side

STABILITY ANALYSIS according to Strength Factor method

Factor of safety on soil strength
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability

Stage No.	--- G.L. --- Act. Pass.	Strut Elev.	FoS for toe elev. = -3.81	Moment of equil. at elev.	Toe elev. for FoS = 1.500	Wall Penetr- ation	Strut force for F=1.000 kN/m run
3	0.00 -3.20	-0.70	27.000	n/a	-3.47	0.27	11.44

BENDING MOMENT and DISPLACEMENT CALCULATION - Assumptions:

Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability
 Open Tension Crack analysis - No
 Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Active side 20.00 from wall
 Passive 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	Strut forces kN/m
1	0.00	0.00	-0.009	-5.74E-03	0.0	0.0	
2	-0.01	25.54	-0.009	-5.74E-03	0.1	-0.0	
3	-0.21	24.95	-0.008	-5.77E-03	5.1	0.5	
4	-0.40	24.36	-0.006	-5.94E-03	9.9	2.0	
5	-0.55	23.82	-0.006	-6.22E-03	13.5	3.8	
6	-0.70	23.12	-0.005	-6.71E-03	17.0	6.0	43.6
		23.12	-0.005	-6.71E-03	-26.6	6.0	
7	-0.85	22.23	-0.004	-7.12E-03	-23.2	2.3	
8	-1.00	21.22	-0.002	-7.19E-03	-20.0	-0.9	
9	-1.20	19.89	-0.001	-6.84E-03	-15.9	-4.5	
10	-1.40	18.78	0.000	-6.06E-03	-12.0	-7.2	
11	-1.60	18.03	0.001	-4.97E-03	-8.3	-9.2	
12	-1.80	17.76	0.002	-3.66E-03	-4.7	-10.6	
13	-2.00	18.04	0.003	-2.22E-03	-1.2	-11.1	
14	-2.20	18.90	0.003	-7.60E-04	2.5	-11.0	
15	-2.40	20.32	0.003	6.35E-04	6.5	-10.1	
16	-2.60	22.24	0.003	1.85E-03	10.7	-8.4	
17	-2.80	24.59	0.002	2.79E-03	15.4	-5.8	
18	-3.00	27.25	0.002	3.31E-03	20.6	-2.2	
19	-3.20	30.07	0.001	3.29E-03	26.3	2.5	
		18.32	0.001	3.29E-03	26.3	2.5	
20	-3.35	25.52	0.001	2.83E-03	29.6	6.7	
21	-3.50	31.36	0.000	1.94E-03	33.9	11.4	
		-780.27	0.000	1.94E-03	33.9	11.4	
22	-3.66	-131.36	0.000	9.83E-04	-36.8	7.3	
23	-3.81	605.95	-0.000	6.10E-04	0.0	-0.0	
Strut force at elev. -0.70 =			43.63 kN/m run =			43.63 kN/strut (horiz.)	
						45.17 kN/strut (incl.)	

(continued)

Stage No.3 Excavate to elevation -3.20 on PASSIVE side

Node no.	Y coord	----- ACTIVE side -----					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertical	Effective Active limit	Effective Passive limit	Earth pressure		
1	0.00	Total>	0.00	0.00	0.00	0.00	1368	
2	-0.01	Total>	0.17	0.05m	100.03	25.54	1368	
3	-0.21	Total>	3.49	1.03m	106.02	24.95	1368	
4	-0.40	Total>	6.80	2.00m	106.70	24.36	1368	
5	-0.55	Total>	9.35	2.75m	109.26	23.82	1368	
6	-0.70	Total>	11.90	3.50m	111.81	23.12	1368	
7	-0.85	Total>	14.45	4.25m	114.36	22.23	1368	
8	-1.00	Total>	17.00	5.00m	116.92	21.22	1368	
9	-1.20	Total>	20.40	6.00m	120.31	19.89	1368	
10	-1.40	Total>	23.80	7.00m	123.71	18.78	1368	
11	-1.60	Total>	27.20	8.00m	127.11	18.03	1368	
12	-1.80	Total>	30.60	9.00m	130.51	17.76	1368	
13	-2.00	Total>	34.00	10.00m	133.91	18.04	1368	
14	-2.20	Total>	37.40	11.00m	137.31	18.90	1368	
15	-2.40	Total>	40.80	12.00m	140.71	20.32	1368	
16	-2.60	Total>	44.20	13.00m	144.11	22.24	1368	
17	-2.80	Total>	47.60	14.00m	147.51	24.59	1368	
18	-3.00	Total>	51.00	15.00m	150.91	27.25	1368	
19	-3.20	Total>	54.40	16.00m	154.31	30.07	1368	
20	-3.35	Total>	56.95	16.75m	156.86	32.14	1368	
21	-3.50	Total>	59.50	17.50m	159.41	34.10	1368	
			0.00	59.50	0.00	9369.16	0.00a	361021
22	-3.66	Total>	63.53	0.00	10114.49	0.00	0.00a	361021
23	-3.81	Total>	67.56	0.00	10865.98	605.95	605.95	9147272

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertical	Effective Active limit	Effective Passive limit	Earth pressure		
1	0.00	0.00	0.00	0.00	0.00	0.00	0.0	
2	-0.01	0.00	0.00	0.00	0.00	0.00	0.0	
3	-0.21	0.00	0.00	0.00	0.00	0.00	0.0	
4	-0.40	0.00	0.00	0.00	0.00	0.00	0.0	
5	-0.55	0.00	0.00	0.00	0.00	0.00	0.0	
6	-0.70	0.00	0.00	0.00	0.00	0.00	0.0	
7	-0.85	0.00	0.00	0.00	0.00	0.00	0.0	
8	-1.00	0.00	0.00	0.00	0.00	0.00	0.0	
9	-1.20	0.00	0.00	0.00	0.00	0.00	0.0	
10	-1.40	0.00	0.00	0.00	0.00	0.00	0.0	
11	-1.60	0.00	0.00	0.00	0.00	0.00	0.0	
12	-1.80	0.00	0.00	0.00	0.00	0.00	0.0	
13	-2.00	0.00	0.00	0.00	0.00	0.00	0.0	
14	-2.20	0.00	0.00	0.00	0.00	0.00	0.0	
15	-2.40	0.00	0.00	0.00	0.00	0.00	0.0	
16	-2.60	0.00	0.00	0.00	0.00	0.00	0.0	
17	-2.80	0.00	0.00	0.00	0.00	0.00	0.0	
18	-3.00	0.00	0.00	0.00	0.00	0.00	0.0	
19	-3.20	0.00	0.00	0.00	0.00	0.00	0.0	
		Total>	0.00	0.00	99.93	11.75	11.75	10610
20	-3.35	Total>	2.55	0.75m	102.48	6.62	6.62	10610
21	-3.50	Total>	5.10	1.50m	105.03	2.74	2.74	10610
			0.00	5.10	0.00	30934.29	780.27	2979310
22	-3.66	Total>	9.13	0.00	35191.85	131.36	131.36	2979310

(continued)

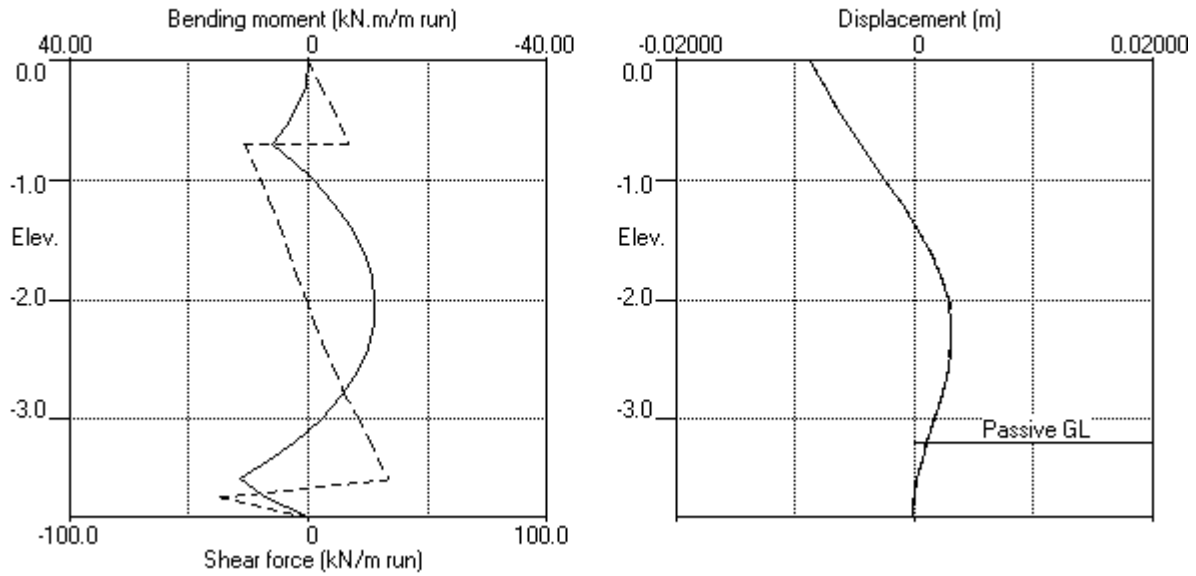
Stage No.3 Excavate to elevation -3.20 on PASSIVE side

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure kN/m2	Soil stiffness coeff. kN/m3
		Water press. kN/m2	Vertic -al kN/m2	Active limit kN/m2	Passive limit kN/m2	Earth pressure kN/m2		
23	-3.81	0.00	13.16	0.00	39487.70	0.00	0.00a 9147272	

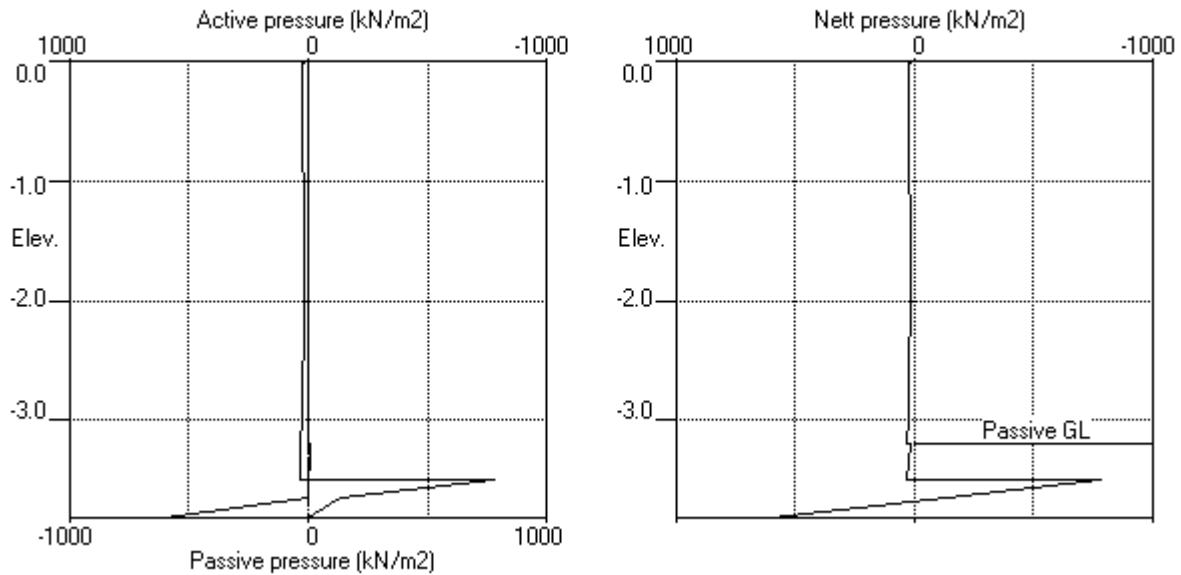
Note: 0.00a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.3 Excav. to elev. -3.20 on PASSIVE side



Stage No.3 Excav. to elev. -3.20 on PASSIVE side



Units: kN,m

Stage No. 5 Apply seismic loading:
 0.520g horizontal
 Line of action of quasi-static seismic force = 0.500
 Seismic loading model: Quasi-static loading

STABILITY ANALYSIS according to Strength Factor method

Factor of safety on soil strength
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability

Stage No.	--- G.L. --- Act. Pass.	Strut Elev.	FoS for toe elev. = -3.81	Moment of equilib. at elev.	Toe elev. for FoS = 1.500	Wall Penetr- ation	Strut force for F=1.000 kN/m run
5	0.00 -3.20	-0.70	9.375	n/a	-3.50	0.30	50.21

BENDING MOMENT and DISPLACEMENT CALCULATION - Assumptions:

Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability
 Open Tension Crack analysis - No
 Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Active side 20.00 from wall
 Passive side 20.00 from wall

Node no.	Y coord	Nett pressure kN/m ²	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Strut forces kN/m
1	0.00	22.11	0.019	4.34E-03	0.0	0.0	
2	-0.01	21.98	0.019	4.34E-03	0.2	0.0	
3	-0.21	23.99	0.019	4.31E-03	4.7	0.5	
4	-0.40	30.50	0.018	4.15E-03	10.0	1.9	
5	-0.55	26.65	0.017	3.87E-03	14.3	3.8	
6	-0.70	27.28	0.017	3.38E-03	18.3	6.2	44.4
		27.28	0.017	3.38E-03	-26.1	6.2	
7	-0.85	26.47	0.016	2.94E-03	-22.0	2.6	
8	-1.00	24.10	0.016	2.83E-03	-18.2	-0.4	
9	-1.20	23.59	0.015	3.09E-03	-13.5	-3.5	
10	-1.40	23.18	0.014	3.71E-03	-8.8	-5.8	
11	-1.60	20.19	0.014	4.55E-03	-4.4	-7.1	
12	-1.80	19.95	0.013	5.52E-03	-0.4	-7.6	
13	-2.00	19.73	0.011	6.50E-03	3.5	-7.2	
14	-2.20	19.49	0.010	7.39E-03	7.5	-6.1	
15	-2.40	19.24	0.008	8.08E-03	11.3	-4.2	
16	-2.60	19.01	0.007	8.46E-03	15.2	-1.6	
17	-2.80	23.68	0.005	8.44E-03	19.4	1.9	
18	-3.00	28.31	0.003	7.91E-03	24.6	6.2	
19	-3.20	32.61	0.002	6.71E-03	30.7	11.8	
		17.90	0.002	6.71E-03	30.7	11.8	
20	-3.35	30.29	0.001	5.31E-03	34.3	16.6	
21	-3.50	39.64	0.000	3.39E-03	39.6	22.1	
		-1311.55	0.000	3.39E-03	39.6	22.1	
22	-3.66	-117.47	0.000	1.62E-03	-71.2	12.4	
23	-3.81	1035.85	-0.000	9.82E-04	-0.0	-0.0	
Strut force at elev.			-0.70 =	44.40 kN/m run =		44.40 kN/strut (horiz.)	
					=	45.97 kN/strut (incl.)	

(continued)

Stage No.5 Apply seismic loading:
 0.520g horizontal
 Line of action of quasi-static seismic force = 0.500
 Seismic loading model: Quasi-static loading

Node no.	Y coord	----- ACTIVE side -----					Total earth pressure	Soil stiffness coeff.	
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure			
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3		
1	0.00	Total>	7.20	22.11	0.00	22.11	22.11a	2268	
2	-0.01	Total>	7.36	21.98	101.77	21.98	21.98a	2268	
3	-0.21	Total>	10.68	23.99	107.39	23.99	23.99a	2268	
4	-0.40	Total>	13.98	30.50	106.79	30.50	30.50a	2268	
5	-0.55	Total>	16.49	26.65	107.47	26.65	26.65a	2268	
6	-0.70	Total>	18.98	27.28	108.23	27.28	27.28a	2268	
7	-0.85	Total>	21.45	26.47	108.91	26.47	26.47a	2268	
8	-1.00	Total>	23.90	24.10	110.02	24.10	24.10a	2268	
9	-1.20	Total>	27.13	23.59	111.83	23.59	23.59a	2268	
10	-1.40	Total>	30.33	23.18	113.25	23.18	23.18a	2268	
11	-1.60	Total>	33.51	20.19	114.93	20.19	20.19a	2268	
12	-1.80	Total>	35.45	19.95	114.19	19.95	19.95a	2268	
13	-2.00	Total>	39.83	19.73	114.25	19.73	19.73a	2268	
14	-2.20	Total>	42.98	19.49	114.56	19.49	19.49a	2268	
15	-2.40	Total>	46.14	19.24	115.64	19.24	19.24a	2268	
16	-2.60	Total>	49.30	19.01	116.41	19.01	19.01a	2268	
17	-2.80	Total>	52.47	18.78	117.23	23.68	23.68	2268	
18	-3.00	Total>	55.64	18.58	117.97	28.31	28.31	2268	
19	-3.20	Total>	58.83	18.36	118.81	32.61	32.61	2268	
		Total>	58.83	40.48	118.81	40.48	40.48a	2268	
20	-3.35	Total>	61.23	42.37	119.55	42.37	42.37a	2268	
21	-3.50	Total>	63.63	44.27	120.99	44.27	44.27a	2268	
			0.00	63.63	0.00	9478.85	0.00	0.00a	614449
22	-3.66		0.00	67.51	0.00	9914.98	15.01	15.01	5772968
23	-3.81		0.00	71.40	0.00	10354.51	1035.85	1035.85	5772968

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		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	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.0
3	-0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.0
4	-0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
5	-0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.0
6	-0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.0
7	-0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.0
8	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
9	-1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
10	-1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
11	-1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
12	-1.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
13	-2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
14	-2.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
15	-2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.0
16	-2.60	0.00	0.00	0.00	0.00	0.00	0.00	0.0
17	-2.80	0.00	0.00	0.00	0.00	0.00	0.00	0.0
18	-3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0
19	-3.20	0.00	0.00	0.00	0.00	0.00	0.00	0.0
		Total>	0.00	0.00	99.33	22.57	22.57	12460

(continued)

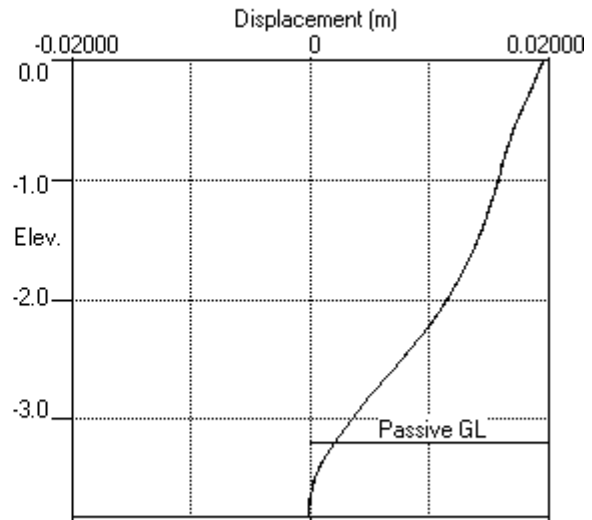
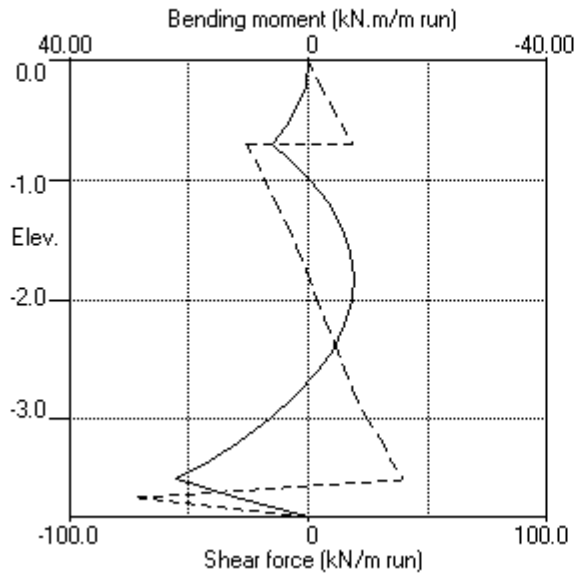
Stage No.5 Apply seismic loading:
 0.520g horizontal
 Line of action of quasi-static seismic force = 0.500
 Seismic loading model: Quasi-static loading

Node no.	Y coord	----- PASSIVE side -----					Total earth pressure	Soil stiffness coeff.
		Water press.	Vertic -al	Active limit	Passive limit	Earth pressure		
		kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m2	kN/m3
20	-3.35	Total>	2.55	1.25	101.22	12.08	12.08	12460
21	-3.50	Total>	5.10	2.57	103.08	4.62	4.62	12460
		0.00	5.10	0.00	30872.54	1311.55	1311.55	3506418
22	-3.66	0.00	9.13	0.00	35105.17	132.47	132.47	5772968
23	-3.81	0.00	13.16	0.00	39375.85	0.00	0.00a	5772968

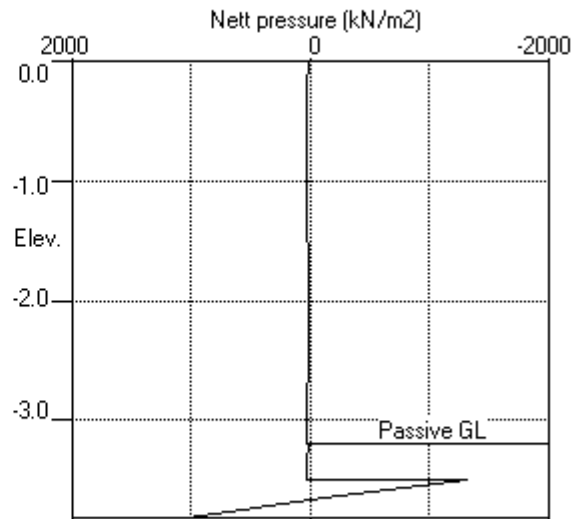
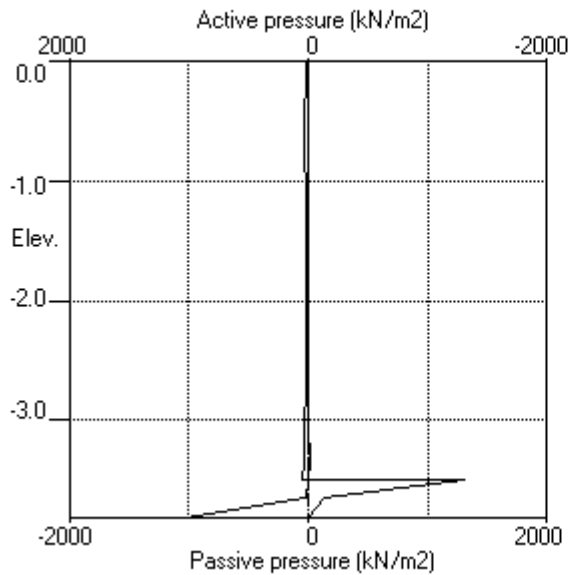
Note: 0.00a Soil pressure at active limit
 123.45p Soil pressure at passive limit

Units: kN,m

Stage No.5 Quasi-static Seismic load: 0.520g(H)



Stage No.5 Quasi-static Seismic load: 0.520g(H)



ENGINEERING DESIGN CONSULTANTS Ltd
 Program: WALLAP Version 5.04 Revision A36.B52.R41
 Licensed from GEOSOLVE
 Run ID. 20220808_Double Cove eq 45kN (deep rock)
 RW 1.6m from dwelling - Double Cove
 Seismic Analysis

| Sheet No.
 |
 | Job No. 50683
 | Made by : EDC
 | Date:20-10-2022
 | Checked :

 Units: kN,m

Summary of results

STABILITY ANALYSIS according to Strength Factor method

Factor of safety on soil strength
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability

			FoS for toe		Toe elev. for		Strut force	
			elev. = -3.81		FoS = 1.500		for F=1.000	

Stage	--- G.L. ---		Strut	Factor	Moment	Toe	Wall	Strut
No.	Act.	Pass.	Elev.	of	equilib.	elev.	Penetr	force
				Safety	at elev.		-ation	kN/m run
1	0.00	-0.01	Cant.		Conditions not suitable for FoS calc.			
2	0.00	-0.01	-0.70	2814.0	n/a	-1.33	1.32	-144.68
3	0.00	-3.20	-0.70	27.000	n/a	-3.47	0.27	11.44
4	0.00	-3.20	-0.70	24.000	n/a	-3.47	0.27	11.44
5	0.00	-3.20	-0.70	9.375	n/a	-3.50	0.30	50.21

Units: kN,m

Summary of results

BENDING MOMENT and DISPLACEMENT CALCULATION - Assumptions:

Subgrade reaction model - Boussinesq Influence coefficients
 Soil deformations are elastic until the active or passive limit is reached
 Active limit pressures calculated by Wedge Stability
 Passive limit pressures calculated by Wedge Stability
 Open Tension Crack analysis - No
 Length of wall perpendicular to section = 1000.00m

Rigid boundaries: Active side 20.00 from wall
 Passive side 20.00 from wall

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment		Shear force	
		maximum m	minimum m	maximum kN.m/m	minimum kN.m/m	maximum kN/m	minimum kN/m
1	0.00	0.019	-0.012	0.0	0.0	0.0	0.0
2	-0.01	0.019	-0.012	0.0	-0.0	0.2	0.0
3	-0.21	0.019	-0.011	0.6	-0.0	5.9	-0.0
4	-0.40	0.018	-0.010	2.3	-0.0	11.5	-0.0
5	-0.55	0.017	-0.010	4.4	-0.0	15.6	-0.0
6	-0.70	0.017	-0.009	7.0	-0.0	19.5	-27.2
7	-0.85	0.016	-0.008	3.7	-0.0	0.0	-23.8
8	-1.00	0.016	-0.007	0.9	-1.3	0.0	-20.5
9	-1.20	0.015	-0.006	0.0	-4.9	0.0	-16.2
10	-1.40	0.014	-0.005	0.0	-7.8	0.0	-12.2
11	-1.60	0.014	-0.004	0.0	-9.8	0.0	-8.3
12	-1.80	0.013	-0.003	0.0	-11.1	0.0	-4.7
13	-2.00	0.011	-0.002	0.0	-11.6	3.5	-1.2
14	-2.20	0.010	-0.001	0.0	-11.2	7.5	0.0
15	-2.40	0.008	-0.001	0.0	-10.1	11.3	0.0
16	-2.60	0.007	-0.000	0.0	-8.4	15.2	0.0
17	-2.80	0.005	-0.000	1.9	-5.8	19.4	0.0
18	-3.00	0.003	-0.000	6.2	-2.7	24.6	0.0
19	-3.20	0.002	-0.000	11.8	-1.8	30.7	0.0
20	-3.35	0.001	0.000	16.6	-1.1	34.3	0.0
21	-3.50	0.000	0.000	22.1	-0.4	39.6	0.0
22	-3.66	0.000	0.000	12.4	-0.0	1.3	-71.2
23	-3.81	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				Shear force			
	maximum kN.m/m	elev.	minimum kN.m/m	elev.	maximum kN/m	elev.	minimum kN/m	elev.
1	0.1	-3.50	-0.0	-2.00	0.1	-3.50	-0.2	-3.66
2	7.0	-0.70	-6.1	-2.00	19.5	-0.70	-24.0	-0.70
3	11.4	-3.50	-11.1	-2.00	33.9	-3.50	-36.8	-3.66
4	15.0	-3.50	-11.6	-2.00	38.7	-3.50	-48.5	-3.66
5	22.1	-3.50	-7.6	-1.80	39.6	-3.50	-71.2	-3.66

Summary of results (continued)

Maximum and minimum displacement at each stage

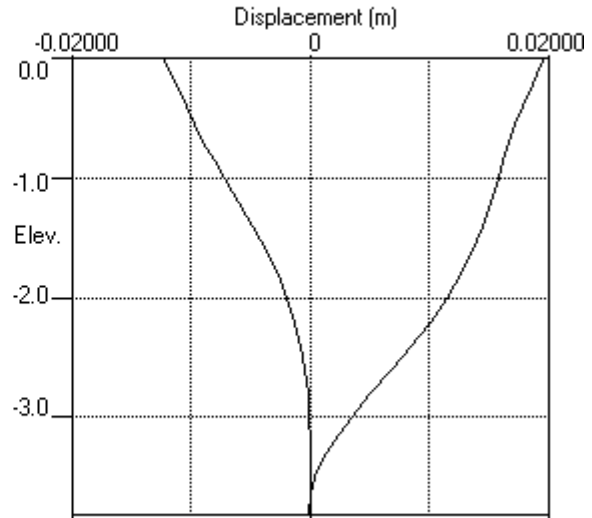
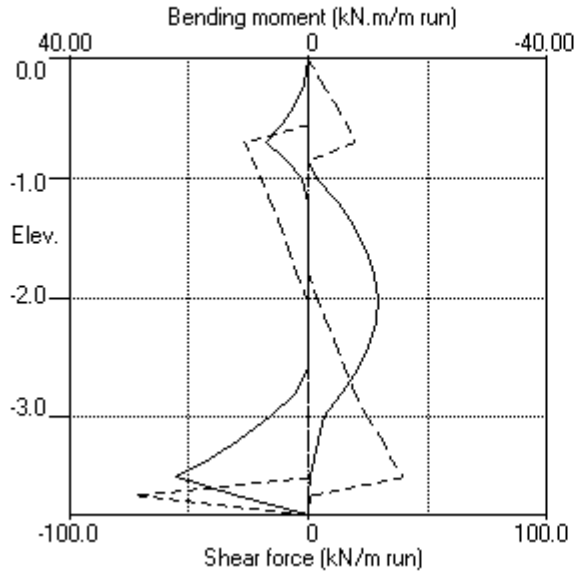
Stage no.	Displacement maximum	Displacement elev.	Displacement minimum	Displacement elev.	Stage description
	m		m		
1	0.000	0.00	-0.000	-3.81	Excav. to elev. -0.01 on PASSIVE side
2	0.000	-3.50	-0.012	0.00	Install strut no.1 at elev. -0.70
3	0.003	-2.40	-0.009	0.00	Excav. to elev. -3.20 on PASSIVE side
4	0.005	-2.00	-0.004	0.00	Apply surcharge no.1 at elev. 0.00
5	0.019	0.00	-0.000	-3.81	Quasi-static Seismic load: 0.520g(H)

Strut forces at each stage (horizontal components)

Stage no.	Strut no. 1	Strut no. 1
	at elev.-0.70	at elev.-0.70
	kN/m run	kN/strut
2	43.5	43.5
3	43.6	43.6
4	43.8	43.8
5	44.4	44.4

Units: kN,m

Bending moment, shear force, displacement envelopes



**APPENDIX D DESIGN CALCULATIONS – WALL ELEMENTS FOR WORST CASE
FROM BOTH STATIC AND SEISMIC**

Design Element: King Post		
Designed: HG		
Reviewed: GW		
<u>Poles</u>		
D	0.25 m	Pole diameter
E	12 GPa	Modulus
Sp	1 m	Pole Spacing
H_wall	2.2 m	Wall Height
Φ	0.85 Poles	Strength Reduction Factor
I	0.00019175 m ⁴	Second Moment of Area
Z	0.00153398	Section Modulus
<u>Load Duration Factor - Strength</u>		
k_1	0.6	Permenant
k_1	0.8	Vehicle
k_1	1	EQ
<u>Material Properties</u>		
fb	37.8 MPa	Characteristic Bending Stress
fc	- MPa	
ft	- MPa	
fs	5.5 MPa	Characteristic Shear Stress
<u>Member Capacity</u>		
Mn	58.0 kNm	EQ
Vn	270.0 kN/m	EQ
Mn	34.8 kNm	Static
Vn	162.0 kN	Static
<u>Factored Member Capacity</u>		
Φ Mn	49.3 kNm/m	EQ
Φ Vn	229.5 kN/m	EQ
Φ Mn	29.6 kNm/m	Static
Φ Vn	137.7 kN/m	Static
<u>Demands</u>		
UDL, w	kN/m	EQ
M*	19.0 kNm	EQ
V*	71.0 kN	EQ
UDL, w	kN/m	Static
M*	22.1 kNm	Static
V*	63.0 kN	Static
<u>Checks</u>		
Φ Mn>M*	TRUE kN	EQ
Φ Vn>V*	TRUE kN	EQ
Φ Mn>M*	TRUE kN	Static
Φ Vn>V*	TRUE kN	Static

Design Element:	Anchor Waler
Designed:	HG
Reviewed:	GW

Proof Load Governs

Member 2 x 100x50 PFC

Φ	0.9	Steel beams
N	2	Number of sections
Z _y	6.94E-05 m ³	Section Modulus
t	5 mm	Section Thickness
w	80 mm	Width of load transfer plate
Pb	160.0 mm	Contact Length

Material Properties

f _b	350 MPa
f _c	350 MPa
f _s	210 MPa

Member Capacity

M _n	24.3 kNm	Static
M _n	24.3 kNm	EQ
V _n	168.0 kN	Static
V _n	168.0 kN	EQ

Factored Member Capacity

ΦM _n	21.9 kNm	Static	
ΦM _n	21.9 kNm	EQ	
ΦV _n	151.2 kN	Static	Vcheck for both bearing plate and waler
ΦV _n	151.2 kN	EQ	

Demands

p*	100 kN	
e	0.2 m	Distance from edge of king post
M*	20 kNm	Static
V*	100 kN	Static

Checks

ΦM _n >M*	TRUE	kN	Static
ΦV _n >V*	TRUE	kN	Static

Design	Lagging Boards		
Designed:	HG		
Reviewed:	GW		
Lagging			
B	0.2	m	Lagging width
H	0.1	m	Lagging thickness
E	8	GPa	Modulus
Sp	1	m	Pole Spacing
H_wall	2.2	m	Wall Height
Φ	0.85	Poles	Strength Reduction Factor
I	1.66667E-05	m ⁴	Second moment of area
Z	0.000333333	m ³	Section Modulus
Load Duration Factor - Strength			
k_1	0.6		Permenant
k_1	0.8		Vehicle
k_1	1		EQ
Material Properties			
fb	14	MPa	
fc	-	MPa	
ft	-	MPa	
fs	8.4	MPa	
Member Capacity			
Mn	4.7	kNm	EQ
Vn	263.9	kN/m	EQ
Mn	2.8	kNm	Static
Vn	158.3	kN	Static
Factored Member Capacity			
Φ Mn	4.0	kNm/m	EQ
Φ Vn	224.3	kN/m	EQ
Φ Mn	2.4	kNm/m	Static
Φ Vn	134.6	kN/m	Static
Demands			
UDL, w	6.2	kN/m	EQ
M*	0.8	kNm	EQ
V*	3.1	kN	EQ
UDL, w	5.6	kN/m	Static
M*	0.7	kNm	Static
V*	2.8	kN	Static
Checks			
Φ Mn>M*	TRUE	kN	EQ
Φ Vn>V*	TRUE	kN	EQ
Φ Mn>M*	TRUE	kN	Static
Φ Vn>V*	TRUE	kN	Static
-Use Double boards 2x 50x200			

Project:	Retaining Wall Anchors - Jetty No. Q5222
Reference:	50683
Designer:	HG
Reviewer:	GW
Anchor Install Angle	15 deg
Height of post	2.2 m
Ground Slope	0 deg
Rock Slope	30 deg
kh	0.52 g
Rock UCS	9.7 MPa
Dominant phi	45 deg
<u>Top Row</u>	
Minimum Anchor Tendon	R61 - Grade - 75 - 22mm - All-Thread Rebar
Tendon Yeild Capacity	147 kN
Phi	45 deg
Gamma	18 kN/m ³
Strength Reduction Factor (on proof load)	0.8
Install Depth (from top of wall)	0.70 m
Anchor Spacing	1 m
Install Angle	15.0 deg
Unbonded length	2.8 m
Demand	66.0 kN
Bonded Length	0.8 m
Total Anchor Length	3.6 m
Factored Capacity	99.0 kN
Horizontal anchor length	3.5 m
Minimum Test Load	99.0 kN
Lock-off Load	66.0 kN
FoS (On in-service demand)	1.88

Problem Inputs

Anchor Grouting Method	Gravity		
Soil Type	Rock		
Φ	0.80		Strength reduction factor
depth to anchor on wall face	0.70	m	
Demand	66.00	kN	
Phi	-	deg	Soil Friction Angle
c'	970.00	kPa	Cohesion
α	1.00		Adhesion Factor
delta	-	deg	Interface friction angle between soil and bonded element
theta	15.00	deg	Angle of anchor measured acutely from the horizontal
c_a	970.00	kPa	Effective cohesion/bond stress
L_b	0.81	m	Length of bonded section
D	0.05	m	Diameter of bonded section
K	4.00	-	Anchor earth pressure coefficient
Unbonded length	0.59	m	
Cap-dem	-	kN	
d	1.06	m	Depth to anchor midpoint
gamma	18.00	kN/m ³	effective unit weight of soil
A bond	0.13	m ²	Surface area of bonded length
sigma'	19.09	kPa	Effective stress at mid-point of bonded length
Bond stress	970.00	kPa	Stess at soil-grout interface
Min. Test Load	99.00	kN	Minimum test load for Permenant Anchors
Total Anchor capacity	123.75	kN	
<u>ΦTotal Anchor capacity</u>	<u>99.00</u>	<u>kN</u>	

APPENDIX E GEOTECHNICAL REPORT

Sec 9(2)(a)

, Double
Cove, Marlborough

Geotechnical Report

Prepared for Nick & Karli Bristead

Project 50683 - Rev.A - 27/09/2022

Engineering Design Consultants Ltd

W: www.edc.co.nz

E: team@edc.co.nz

Christchurch: 15b Leslie Hills Drive, Riccarton

Ph (03) 355 5559

PO Box 9016, Tower Junction, 8011

Auckland: 1st Floor, Unit 1, 100 Bush Rd, Albany

Ph (09) 451 9044

PO Box 118, Albany, 0752

Bay of Plenty: Suite 5, 202 The Strand, Whakatane

Ph (07) 922 0075

PO Box 855, Whakatane, 3158



Revision	Date	Engineer	Description
0	27/09/2022	DT	Final

REPORT PREPARED BY:**REPORT CHECKED BY:**

Sec 9(2)(a)

Delane Traber

BEng Tech

Geotechnical Team Leader - Canterbury

Gareth B Williams

MSc(Eng) CPEng CEngNZ IntPE(NZ) MInstD

MEIANZ

Geotechnical Engineer, Director

Limitations of Report

Except where required by law, the findings presented as part of this report are for the sole use of our client, as noted above. The findings are not intended for use by other parties, and may not contain sufficient information for the purposes of other parties or other uses. No third party (excluding the local authority) may use or rely upon this report unless authorised by EDC in writing.

To the extent permitted by law, EDC expressly disclaims and excludes liability for any loss, damage, cost or expense suffered by any third party relating to or resulting from the use of, or reliance upon any information contained in this report. It is the responsibility of third parties to independently make enquiries or seek advice in relation to their particular requirements.

Our professional services are performed using a degree of care and skill normally exercised, under similar circumstances, by reputable consultants practicing in this field at this time. No other warranty, expressed or implied, is made as to the professional advice presented in this report, in regard to its accuracy or completeness.

Our opinions and recommendations are based on our comprehension of the current regulatory standards and must not be considered legal opinions. For legal advice, please consult your solicitor. This opinion is not intended to be advice that is covered by the Financial Advisors Act 2010.

The recommendations and opinions contained in this report are based on our visual reconnaissance of the site, information from geological maps and upon data from the field investigation as well as the results of in situ testing of soil. Inferences are made about the nature and continuity of subsoils away from and beyond the exploratory holes which cannot be guaranteed. The descriptions detailed on the exploratory hole logs are based on the field descriptions of the soils encountered.

This report includes Appendices. These appendices should be read in conjunction with the main part of the report and this report should not be considered complete without them.

CONTENTS

1.0	Introduction	5
1.1	Project Brief	5
1.2	Proposed Works.....	5
1.3	Existing Reports	5
1.4	Objective/Scope	5
1.5	Additional Information	6
2.0	Site Description	7
2.1	Site Location	7
2.2	Site Walkover.....	7
3.0	Geotechnical Desk Based Study	10
3.1	Geological Mapping	10
3.2	Faults.....	10
3.3	Existing Intrusive Investigation Data	10
3.4	Historical Arial Photographs.....	10
3.5	Liquefaction Susceptibility Maps.....	10
4.0	Intrusive Investigation	11
4.1	Rationale	11
4.2	Intrusive Investigation Summary	11
	4.2.1 Shallow Hand Testing.....	11
4.3	Ground Conditions Encountered	12
	4.3.1 Topsoil	12
	4.3.2 Fill Material.....	12
	4.3.3 Sub Soils.....	12
	4.3.4 Rock	12
	4.3.5 Ground Water	12
	4.3.6 Summary of Ground Conditions.....	12
5.0	Geotechnical Assessment of Intrusive Data	13
5.1	Slope Stability Comment	13
5.2	Material Parameters	13
5.3	Seismic Site Subsoil Classification	13
6.0	Recommendations	14
6.1	Site Restrictions	14
6.2	Proposed Retaining Wall	14
6.3	Stormwater Control.....	14
6.4	General	15
6.5	Ground Inspections	15

6.6 Health and Safety15

7.0 References.....16

Appendix A

‘Claim for Natural Disaster (landslip) Damage’ by Tonkin & Taylor (Job No: 1504000.0006, dated 1 February 2022)

Appendix B

Topographical Survey has been completed by Scope Surveying (Project Number: 22075, Rev.A, dated 22 June 2022)

Appendix C

Hand Auger Log Sheets

Appendix D

Geotechnical Cross Sections

1.0 INTRODUCTION

1.1 Project Brief

Engineering Design Consultants Ltd (EDC) was commissioned by Nick & Karli Bristed in May 2022 to undertake a Geotechnical Investigation at Jetty No. Q5222, Double Cove, Marlborough (LOT 29 DP 1153 Block IV Linkwater SD), henceforth referred to as 'the site'.

1.2 Proposed Works

It is understood that a landslide directly adjacent to the on-site dwelling has destroyed the attached deck, and is putting the dwelling at risk with the head scarp currently located beneath the deck. It is proposed to construct a retaining wall on the site boundary to repair the slip, and support the existing dwelling. A geotechnical assessment is required to assess the site condition and determine an appropriate retaining wall design strategy.

1.3 Existing Reports

An initial assessment and report for the land slip and associated EQC claim titled 'Claim for Natural Disaster (landslip) Damage' was produced by Tonkin & Taylor (Job No: 1504000.0006, dated 1 February 2022). The T&T report forms Appendix A.

A Topographical Survey has been completed by Scope Surveying (Project Number: 22075, Rev.A, dated 22 June 2022) and forms Appendix B.

1.4 Objective/Scope

The objective of this report is to advise on ground conditions, provide geotechnical parameters for design of the proposed retaining wall and advice on appropriate retaining wall types.

In order to achieve the outlined objectives this geotechnical investigation comprised the following scope:

- A geotechnical desktop study to review geological mapping and geotechnical information resources.
- A review of freely-available historical aerial photographs.
- A site walkover.
- A shallow intrusive investigation comprising hand auger boreholes and Shear Vane tests.
- Provision of an interpretive report summarising the above and providing geotechnical parameters for retaining wall design.

This report assesses the condition of the land only and not any existing structures.

1.5 Additional Information

EDC has reviewed the Building Permit for the on-site dwelling, as supplied by the client. These documents indicate that the dwelling is founded on shallow piles. The eastern downslope line of piles was designed to be excavated to competent material (inferred to be below topsoil) and driven to a minimum depth of 0.6m into competent material. No other relevant information was noted.

2.0 SITE DESCRIPTION

2.1 Site Location

The site is located on the Double Dove peninsula, within the Queen Charlotte Sounds, approximately opposite Picton, as shown on Figure 1 below. The site is accessed via a boat only, with a Jetty and boathouse located on the shoreline.

The Google Earth coordinates of the approximate centre of the site are: 41°14'22.0"S 174°01'26.7"E.

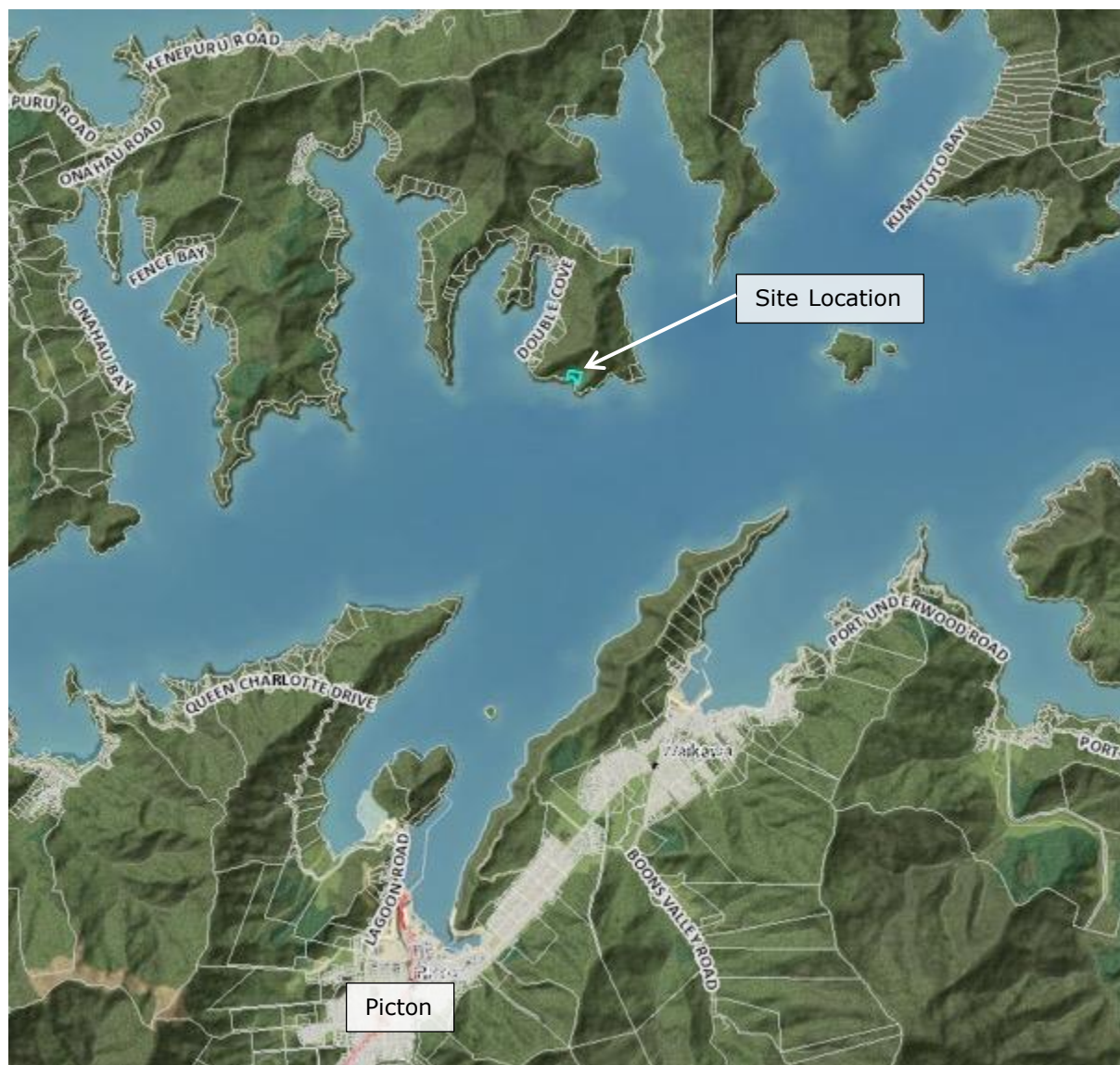


Figure 1: Site Aerial Photo (Courtesy of Marlborough SmartMaps)

2.2 Site Walkover

The site contains a dwelling, accessed via a walking track to the jetty, which is the only site access. Two small sleepouts are located to the east (upslope) of the dwelling. The dwelling appears to be piled on a generally flat platform with a minor cut into the slope, and an approximately 0.5m high un-retained bank at the rear. No guttering is present on

the western (down slope) elevation of the dwelling and it is unclear where the eastern guttering discharges.

The dwelling is located on a naturally flat section of a moderately steep (25-35°), heavily vegetated slope. Approximately 10m east of the dwelling, a minor crest has formed where the slope steepens to 40-50°. Below the crest, a thin veneer (<1m thick) of soil is present, where steeply inclined schist bedrock exposures are frequently observed. This is particularly evident on the shoreline.

The landslide has occurred in the soil above the crest, where rock exposures were not observed. Visual observation of the landslide scarp and debris indicates that the soil matrix is silt with frequent coarse gravel sized, angular schist fragments present. The slip scarp is approximately 10m wide and 10m long, with runout extending to the east, taking the surficial soil and vegetation with it.

A large historical landslide scarp is evident to the north of the dwelling. This scarp is located beyond a minor gully crest and is not considered to pose a risk to the dwelling, but is approximately 15m wide and extends above the dwelling (to the east).

A possible slip was also noted to the south of the dwelling. This feature is located below the dwelling elevation, but was obscured by dense vegetation.

Figures 2 & 3 show the site, taken during EDC's site walkover:



Figure 2: View of the shoreline below the dwelling access, showing the steeply inclined schist bedrock



Figure 3: View of the dwelling and remaining damaged deck, looking north from site access track.



Figure 4: View of landslide debris from the shoreline (exposed schist bedrock on right).



Figure 5: View of the head scarp, showing predominantly silt material with minor schist cobbles.



Figure 6: View of the minor unretained cut face to the rear of the dwelling.

3.0 GEOTECHNICAL DESK BASED STUDY

3.1 Geological Mapping

According to the GNS Geological Unit QMap, available on the New Zealand Geotechnical Database (Earthquake Commission / Ministry of Business, Innovation & Employment, 2016), the site is underlain by Schistose (TZIII) volcanoclastic sandstone, siltstone, mudstone and conglomerate with included volcanics and limestone; minor quartzite, metachert and serpentinite.' (Tcs).

3.2 Faults

The Geological Mapping & GNS Active Fault database contains information regarding active and inactive faults across New Zealand. This map indicates that the Marlborough Sounds is criss-crossed with many inactive concealed faults, the closest of which runs north-south approximately 100m west of the site. Little is known about these faults.

The nearest Active Fault is the Alpine Fault, located approximately 22km south of the site. The alpine fault is one of the major faults in New Zealand.

3.3 Existing Intrusive Investigation Data

The New Zealand Geotechnical Database (NZGD) contains information from previous investigation holes within the local area. However no information is available that is considered relevant to the site.

3.4 Historical Aerial Photographs

Historical aerial photographs available on RetroLens have been reviewed by EDC for the years 1958 through to 1994. This review indicated that the existing jetty and dwelling was constructed pre 1975. Although the images are not high definition, no recent landslide scars or other geotechnical hazards were identified.

3.5 Liquefaction Susceptibility Maps

The site is located outside the scope of the Marlborough District Council Liquefaction Vulnerability Study for Lower Wairā. However given the sites topography and visible basement rock, the liquefaction risk is considered to be Very Low.

4.0 INTRUSIVE INVESTIGATION

4.1 Rationale

To achieve the outlined objectives and taking into account the site access restrictions, shallow hand testing involving hand auger boreholes (HA's) with shear vane testing was considered sufficient to determine ground conditions for the proposed retaining wall design. We undertook hand augers at three locations, in a linear pattern across the building platform and proposed retaining wall location.

4.2 Intrusive Investigation Summary

4.2.1 Shallow Hand Testing

EDC visited the site on 21/06/2022 to undertake a shallow geotechnical investigation in order to determine the subsoil conditions.

Soils have been described generally in accordance with NZGS: Field Description of Soil and Rock. The results of these investigations are shown on the HA Log sheet attached in Appendix C.



Figure 7: Intrusive Investigation Approximate Locations

All hand tests refused on inferred floating gravels at depths of 0.9m to 1.3m. The approximate investigation locations are indicated Figure 7 above.

4.3 Ground Conditions Encountered

4.3.1 Topsoil

Topsoil was found in all of the exploratory holes and was generally 0.4m thick.

4.3.2 Fill Material

No fill Materials were encountered in any of the exploratory holes.

4.3.3 Sub Soils

The sub soils encountered in our intrusive investigation consisted of stiff to very stiff silt with some sand and gravel content. These soils are considered to be colluvium and were also observed in the landslide scarp.

4.3.4 Rock

Surface exposures of steeply inclined schist bedrock were encountered across the site, including the shoreline, access path & lower half of the landslip scar. The schist appeared intact with minimal surface weathering. In addition surface exposures were observed in the historical slip scar to the north of the dwelling.

The precise depth of bedrock at the proposed retaining wall location has not been established, but is estimated at approximately 2.0m.

4.3.5 Ground Water

Groundwater was not encountered during HA drilling.

4.3.6 Summary of Ground Conditions

A cross section summary of the observed and inferred ground profile forms Appendix D.

5.0 GEOTECHNICAL ASSESSMENT OF INTRUSIVE DATA

5.1 Slope Stability Comment

It is evident from the recent slip, and evidence of similar historical slips in the vicinity of the site, that the surficial soils are susceptible to instability. The recent slip occurred following heavy rainfall, which is a common landslide trigger and is considered to be one of the primary risk factors for future instability, along with large earthquake actions.

The existing dwelling is considered to be at risk of damage, as the existing landslide could reactivate further up the slope. As such a retaining structure is required. In addition, it is recommended that appropriate surface water and stormwater controls are implemented to reduce the risk of future failure.

The proposed remediation works do not protect the dwelling from upslope debris (east of the dwelling), and the risk of such failure above the existing dwelling has not been assessed in this report.

5.2 Material Parameters

Based on the ground conditions summarised in Section 4.3, the following indicative soil parameters are recommended for the soils encountered onsite:

Soil Description	Depth to the top of the layer (m)	Thickness (m)	Bulk unit weight γ (kN/m ³)	Effective friction angle ϕ' (°)	Undrained shear strength, s_u [kPa]		Effective cohesion c' (kPa)
					Undisturbed	Remoulded	
TOPSOIL	0.0	0.4	16	23	-	-	-
SILT	0.4	Varies, up to an inferred 2.5m	17	25	120	20	5
SCHIST	Varies	Effective bedrock	26	60	-	-	1400

Table 1: Recommended Soil Parameters

5.3 Seismic Site Subsoil Classification

EDC considers that a seismic site subsoil classification 'Class B – Rock', as defined in NZS:1170.5 is appropriate.

6.0 RECOMMENDATIONS

6.1 Site Restrictions

Site access for the proposed slip remediation & retaining wall construction is a key constraint to the proposed development and should be carefully considered from both a practicality and health & safety perspective. It is noted that all material and equipment must be delivered and transported to the site by boat.

6.2 Proposed Retaining Wall

Following a discussion with the client and review of preliminary comments from the Marlborough District Council, it was proposed to reinstate a 2.0m wide deck to the west of the dwelling, as was consented on the original plans. The proposed deck extends into Department of Conservation (DoC), land and it is understood that preliminary discussions have begun.

To allow construction of the deck, and stabilise the slope supporting the dwelling, EDC propose the construction of an approximately 2.2m high retaining wall is to be located 1.6m west of the dwelling's western elevation. The retaining wall is to be a tied back, timber pole wall. The tie backs will consist of possibly one or two rows of grouted rock anchors. The deck will be founded on shallow piles within the retained soil and be partially supported by the timber poles of the retaining wall. The deck will cantilever approximately 400mm beyond the wall to create a 2.0m wide deck.

Soil parameters for the design of the proposed retaining wall are shown in Table 1.

Any retaining walls required shall be specifically designed by a suitably qualified engineer for actual retained heights and any surcharge load (e.g. additional loads from building, slopes etc) and designs should be in accordance with Building Code and local council requirements .

6.3 Stormwater Control

Given the evident correlation between the observed slip and rainfall, stormwater control is considered to be a key aspect to the ongoing stability of the site. As such:

- A stormwater flow path should be designed to ensure water is diverted appropriately and to minimise the risk of adverse effects on existing structures/infrastructure.
- Service trenches should be backfilled with low permeability materials to avoid preferential pathways for water to enter the ground.
- The advice of a competent engineer should be sought if any erosion features are encountered during construction.
- It is vital that a good level of vegetation is maintained across the site during and post-development.

6.4 General

If hardfill is required, it should be placed and compacted in accordance with NZS 4431:2022. If required, validation testing of the compacted gravel should be undertaken and signed off by a suitably experienced Geotechnical Engineer.

According to the New Zealand Building Code, Ultimate Bearing Capacities should be multiplied by a reduction factor based on the design scenario. The MBIE Earthquake geotechnical engineering practice Module 4 'Earthquake resistant foundation design', suggests 0.45 – 0.60 (EDC recommends 0.60) for all Ultimate Limit State load combinations and the NZBC recommends 0.40 – 0.55 (EDC recommends 0.50) for all other load combinations.

It is the designer's responsibility to ensure that the recommendations of this report are correctly understood and applied. We are happy to discuss the project with the structural engineer or designer and recommend that we review the final design documentation prior to construction.

Advice from a geotechnical engineer should be sought if ground conditions different to those encountered in the intrusive investigation are observed during foundation construction works.

6.5 Ground Inspections

It is recommended that a Chartered Professional Engineer with appropriate geotechnical experience be engaged to supervise the construction of the proposed retaining wall. This is in accordance with normal council practice at the Building Consent stage. It should also be noted that under the Building Act (2004), there are specific requirements for supervision by appropriately qualified personnel.

Inspection requirements should be outlined in the PS1 for the proposed structure.

All inspections will require considerable prior notice due to the remote site location and it should be noted that unless we are given the chance to undertake all appropriate inspections for the items specified in the Building Consent, a Producer Statement (PS4) will not be issued.

6.6 Health and Safety

We recommend that 'Safety in Design' principles are included during the design of the proposed structure/development. It should be noted that all parties involved in construction, including the client have responsibilities under the current 'Health and Safety at Work Act 2015'. This includes ensuring that the chosen contractor is both competent and suitably qualified/experienced to undertake the commissioned works.

EDC would be happy to provide geotechnical/geoenvironmental advice in relation to these issues at any workshops or design meetings for this project. In addition, our Structural and Fire Safety Design Engineers can provide advice as appropriate.

7.0 REFERENCES

Bowles, J. (1997). *Foundation Analysis and Design, 5th Edition*. Peoria, Illinois: McGraw-Hill.

MBIE & NZGS. (2015). *Module 5A: Specification of ground improvement for residential properties in the Canterbury region*. MBIE & NZGS.

Meyerhof, G. (1965). Shallow Foundations. *Journal of the Soil Mechanics and Foundation Division, ASCE, Vol 91*, 21-31.

Peck, R., Hanson, W., & Thornburn, T. (1974). *Foundation Engineering*. New York: John Wiley & Sons.

APPENDIX A

'CLAIM FOR NATURAL DISASTER (LANDSLIP) DAMAGE' BY TONKIN & TAYLOR (JOB NO: 1504000.0006, DATED 1 FEBRUARY 2022)

FMG New Zealand
Via email

Claim for Natural Disaster (landslip) Damage
C. Bristed, Sec 9(2)(a), Double Cove,
Marlborough Sounds, Marlborough
EQC/FMG Claim Number: 30325346

1 Introduction

As requested, Tonkin & Taylor Ltd (T+T) inspected the subject property on 14 September 2021 to assess the claim for natural disaster damage. In particular the visit was undertaken to determine whether physical loss or damage to property is imminent as a direct result of the natural disaster that has occurred.

This claim relates to a rain event that occurred in July 2021

2 Site description

A landslip has occurred downslope of the dwelling located at Sec 9(2)(a) Double Cove, Marlborough. The property is located on a south facing moderately steeply sloping site (slope angle ranges from 25° to 33°). The dwelling is located mid slope, it has been partially benched into the slope at the rear of the dwelling and supported on timber poles at the front of the dwelling (including the timber deck). The site is thickly vegetated with native bush. A storage shed, sleep out and water tank are located upslope of the dwelling, while a septic tank is located to the north of the dwelling.

The published geology of the area¹ indicates that the site is underlain by Caples Group schist (undifferentiated well bedded siltstone / sandstone metamorphosed to schist). A small translational landslide has occurred below the dwelling and has runout and inundated the slope below. The landslide appears to be shallow with the surficial layer of soil sliding on top of the rock beneath. The landslide has damaged the timber deck and resulted in imminent risk to the dwelling.

The location of the landslip and the extent of the damage are shown on the attached sketches and photographs. The conclusions and recommendations in this report are based on a visual assessment of the site only. It must be appreciated that subsurface conditions may vary from those inferred in this report.

Property boundaries are based on LINZ information overlain on aerial imagery.

¹ Begg, J.G.; Johnstone, M.R, Geology of the Wellington area, IGNS, 1 250 000 (2000)

3 Property damage

The damage to the property consists of a 10 m wide landslip (when measured along the property boundary) adjacent to the eastern side of the dwelling which has resulted in:

- Evacuation of insured land;
- Damage to the timber deck;

The damaged timber deck outside the property boundary has been demolished. It is unclear whether the remaining deck within the property boundary is consented. No damage has been noted to the dwelling as the result of the recent landslip.

4 EQC considerations

We consider the damage bullet pointed above to be natural disaster (landslip) damage as defined by the Earthquake Commission Act 1993 (EQC Act).

5 Imminent risk

Within the following 12 months (under normal annual rainfall conditions) and as a direct result of the landslip that has occurred there is an imminent risk of regression of the landslip headscarp resulting in:

- Evacuation of additional insured land; and
- Undermining of dwelling piles resulting in settlement and raking of the dwelling.

6 Conceptual remedial works

The information in the following section is provided solely to Farmers Mutual Group Insurance Ltd (FMG) for claim settlement purposes. The conceptual works are for FMG cost estimation only, to enable FMG to assess the likely costs of repairing the damaged insured property and/or, the cost of preventing damage to insured property that is considered imminent as a direct result of the natural disaster that has occurred. The conceptual scope of works, and drawings, are NOT FOR CONSTRUCTION.

There may be an alternative remedial works solution which is more cost effective or appropriate for the insured and wider property (beyond EQC insured land). It may be possible to implement an alternative solution.

A conceptual remedial works solution that reinstates the land damage to a similar condition and/or removes imminent risk to insured property, would comprise the following:

- Remove damaged timber deck in order to remediate the imminent risk to the dwelling.
- Prepare the working area
- Construct a timber pole retaining wall having the following dimension/characteristics/properties:
 - 19 m long wall
 - 300 mm SED timber poles at 1.0 m centres
 - Minimum pole embedment 4 m, 6 m total pole length

A drawing of this conceptual remedial works solution is shown in Sketch 1.

Additional information for cost estimation:

Construction Issues	Easy	Moderate	Hard	N/A
Construction Access			<input checked="" type="checkbox"/>	
Earthworks required				<input checked="" type="checkbox"/>
Constructability/Reinstatement			<input checked="" type="checkbox"/>	

A building and/or Resource consent, is likely to be required and this should be confirmed with the Local Authority prior to any remedial works being undertaken.

Subsurface investigation, engineering design and subsequent sign off by a chartered professional engineer is likely to be required as part of the building consent application. Regular inspections by a Chartered Engineer may also be necessary during the works to enable sign - off in accordance with the 2004 Building Act and the conditions of the building consent. Failure to obtain the required consents could mean that the building works have to be removed.

All remedial solutions should consider safety in design. Any construction works should be undertaken in a safe and appropriate manner, including the allowance for all necessary protection and temporary stabilisation works as required to ensure the safety of all persons working or present on site during construction.

We estimate the cost (excluding GST) to design and consent the proposed solution will be as follows:

Geotechnical engineering investigation, design and drawings	\$10,000
Survey	\$4,000
Building/Resource consents	\$5,000
Construction observations and Producer Statements	\$3,000
Project Management	\$8,000
TOTAL (Excluding GST)	\$ 30,000*

*The construction cost estimate for the proposed solution will be provided by the cost estimator.

7 Summary of Information

Is this natural disaster damage?	Yes (Landslip)
Land within 8 m of dwelling or appurtenant structures	
Area of insured land damaged :	
Evacuated:	5.0 m ²
Inundated:	Nil
Area of insured land at imminent risk :	
Evacuation:	12.0 m ²
New inundation:	Nil
Re-inundation:	Nil
Main access way within 60 m of dwelling	N/A
Area of insured land damaged on or supporting main access way:	
Evacuated:	Nil
Inundated:	Nil
Area of insured land at imminent risk on or supporting main access way:	
Evacuation:	Nil
New Inundation:	Nil
Re-inundation:	Nil
Retaining walls supporting or protecting insured buildings and/or land located within 60 m of dwelling (or an appurtenant structure)	N/A
Dwelling and appurtenant structure(s)	
Has the dwelling or appurtenant structure been damaged as a result of the natural disaster?	Yes
<ul style="list-style-type: none"> Damage of the timber deck within the property boundary. The deck outside of the property boundary has been demolished. It is unclear whether the remaining deck within the property boundary is consented. 	
Cost to repair damage	TBA*
Is damage to the dwelling (or appurtenant structure) imminent as the direct result of a natural disaster?	Yes
<ul style="list-style-type: none"> Risk of imminent damage to dwelling resulting from undermining of dwelling piles resulting in settlement and raking of the dwelling. 	
Value of imminent risk damage to dwelling (or appurtenant structures)	TBA*
Services within 60 m of dwelling	N/A
Bridges or culverts situated on insured land	N/A
Conceptual remedial works:	
Remove damaged timber deck, stabilise landslip with timber pole retaining wall and rebuild timber deck.	\$30,000 + construction costs* (excluding GST)

*To be assessed by the cost estimator

8 Applicability

This report was produced for FMG for the sole purpose of assisting FMG to determine whether it has any liabilities under the Earthquake Commission Act 1993 and it may not be relied upon in other contexts or for any other purpose, or by any person other than FMG, without our prior written agreement.

Yours sincerely

For Tonkin & Taylor Ltd

Sec 9(2)(a)

Rhys Graafhuis

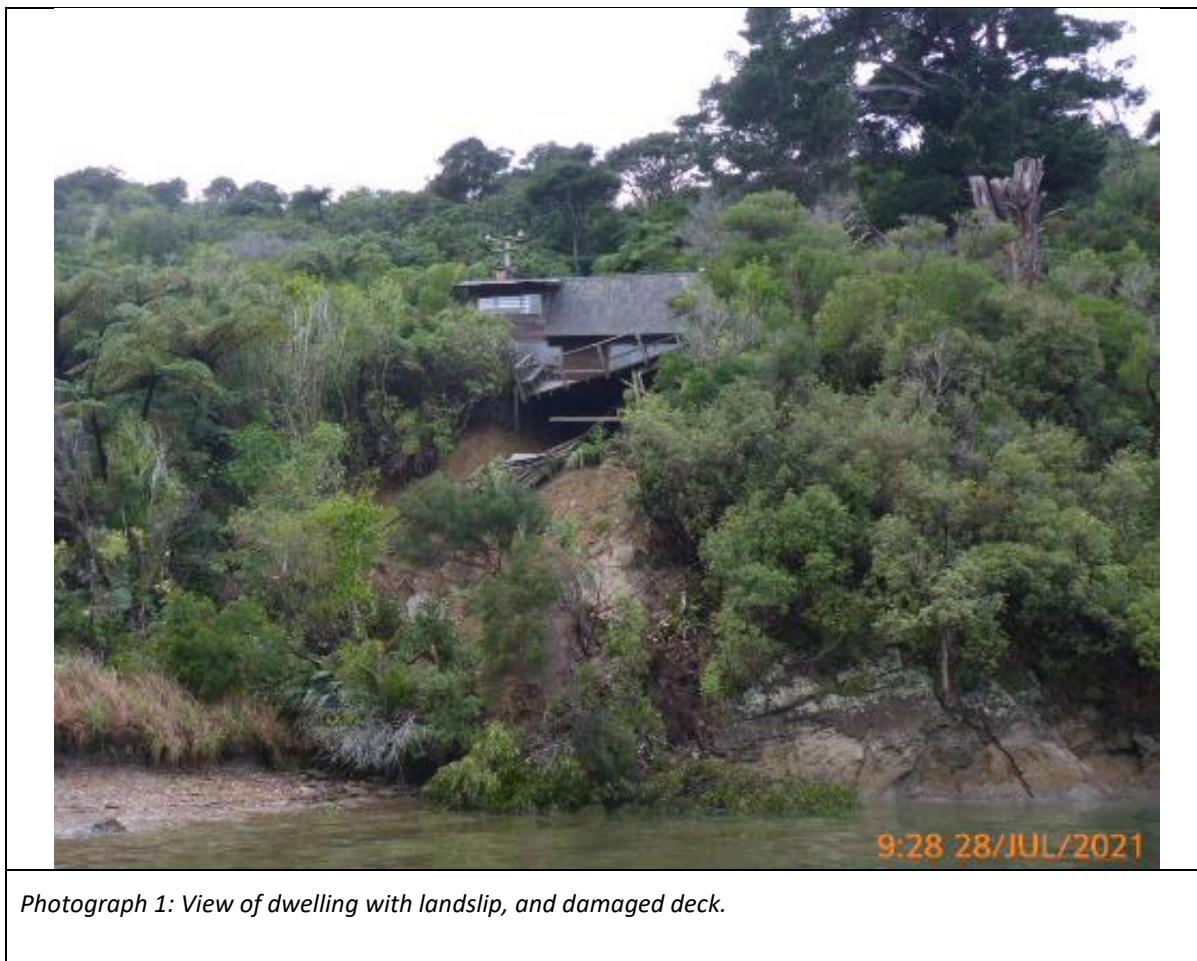
Reviewed by John Leeves and authorised for T+T by John Leeves (Project Director)

Attached: Photographs (1 – 3)
Annotated aerial photograph
Remedial Sketch (1)

1-Feb-22

\\ttgroup.local\files\aklprojects\1504000\1504000.0006\issueddocuments\final v4\tt-fmg-30325346-final report-double covev4.docx

Photographs – 1 to 3 - Q5222, Double Cove, Marlborough Sounds, Marlborough

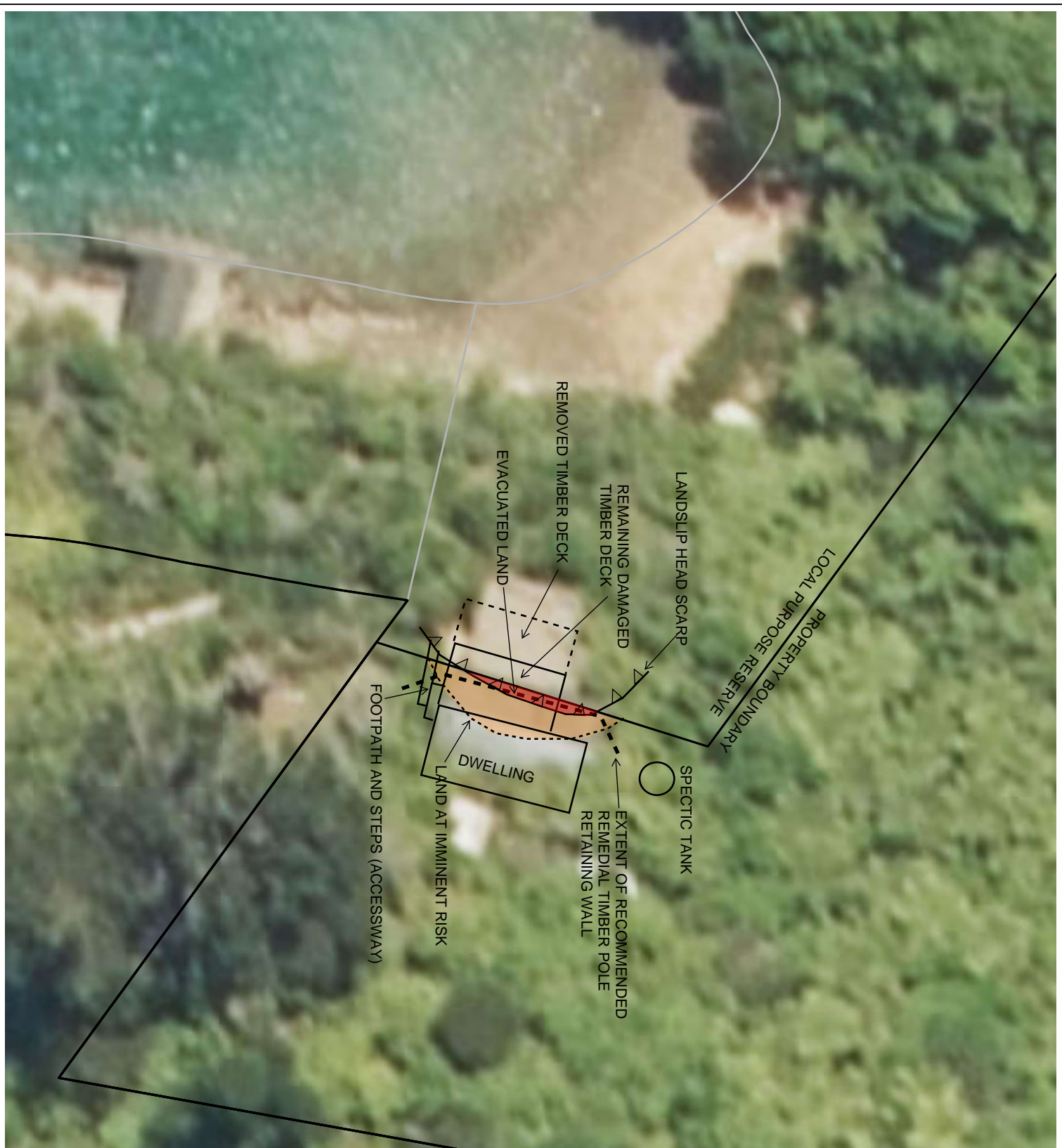









Photograph 2: Damaged timber deck (front portion removed following landslip) and back scarp of landslip.

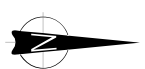
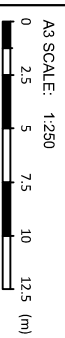


Photograph 3: Underside of timber deck and back scarp of landslip.



LEGEND

-  Property Boundary
-  Parcel Boundary
-  LANDSLIP HEADSCARP
-  EVACUATED LAND
-  LAND AT IMMINENT RISK



1. Parcel Boundary, Property Boundary sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 3.0 New Zealand licence.
 2. World Imagery Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Created On:	16/09/2021
Created By:	RGraahuis
Approved By:	
TT Proj Ref:	1504000.0006
TT Map Ref:	TTMAPREF143463001.902

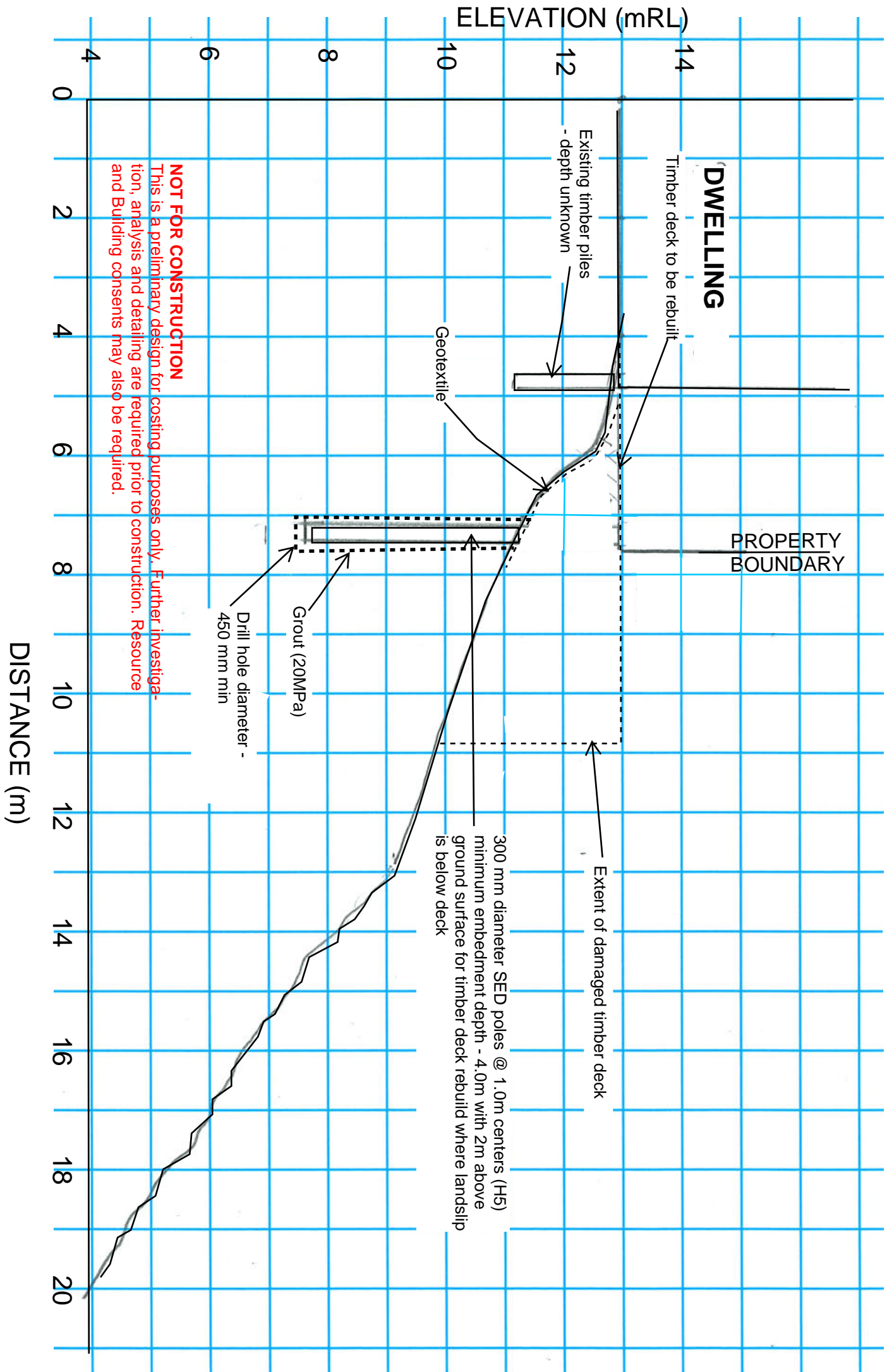


Tonkin+Taylor
 105 Carlton Gore Road, Newmarket, Auckland
www.tonkintaylor.co.nz

FMG
 Q5222 DOUBLE COVE
 Claim no: 30325346

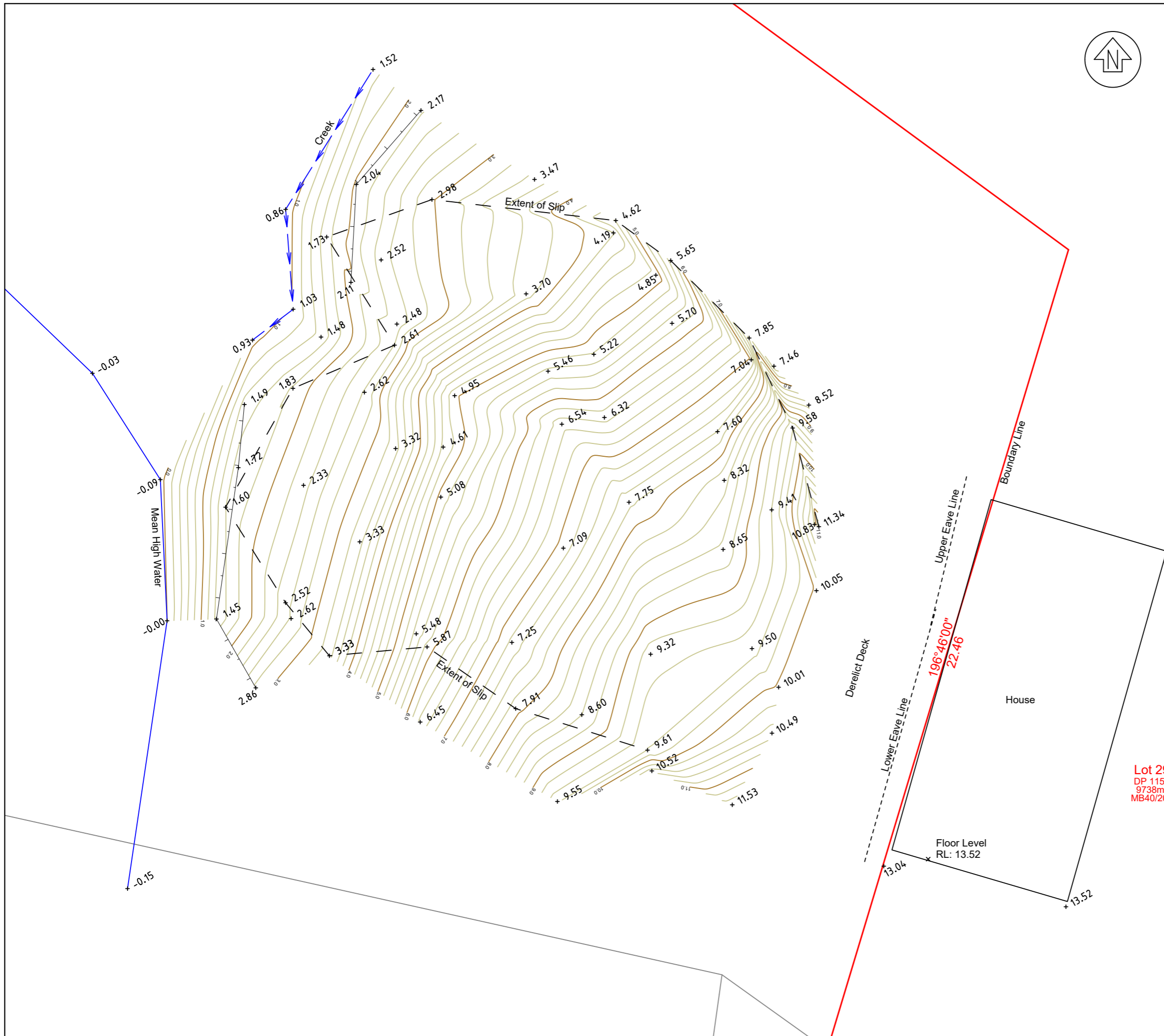
SKETCH 1 CONCEPTUAL REMEDIAL SOLUTION

FMG Claim no: 30325346
Jetty No. Q5222, Double Cove



APPENDIX B

**TOPGRAPHICAL SURVEY HAS BEEN COMPLETED BY SCOPE
SURVEYING (PROJECT NUMBER: 22075, REV.A, DATED 22 JUNE
2022)**



Notes:
 Horizontal Origin
 Mark: IT LXXVII DP 1153
 Marlborough 2000
 Vertical Origin:
 Heights in terms of False Datum
 Contour Interval 0.20m

Client:
Nick Bristed

Project Title:
Lot 29 DP 1153

Sheet Title:
Topographical Survey



7/68 Seymour Street
 Blenheim
 www.scopesurveying.co.nz
 (03) 577 6755

Scale: 1:100 A3

Drawn by: BW

Date: Wed Jun 22 16:17:36 2022

Project No: 22075	Sheet No: 3201	Rev. A
----------------------	-------------------	-----------

Lot 29
 DP 1153
 9738m²
 MB40/203

APPENDIX C

HAND AUGER LOG SHEETS



DRILLED: 21/06/2022 FILE: 50683

HAND AUGER NO.:

HA101

SHEET 1 OF 1

PROJECT: Geotechnical Investigation CLIENT: Karli and Nick Bristed

LOGGED	PROCESSED	CHECKED
DT	WT	-

ADDRESS: Sec 9(2)(a), Double Cove, Marlborough Sounds

BH LOCATION: COORDS: RL GROUND: SHEAR VANE ID#: -

DEPTH (m)	SOIL DESCRIPTION	Strength/density, colour, structure, minor, MAJOR, plasticity, moisture content, other comments	LEGEND	GROUND WATER	SHEAR STRENGTH (kPa)				SOIL SENSITIVITY	SCALA BLOWS (PER 50 mm)		
					Residual	Peak	40	80		120	160	5
GL												
	TOPSOIL: Soft, brown organic SILT with minor fine to medium angular gravel, wet		[Symbol]									
	Becoming firm, pockets of inorganic SILT, occasional root intrusion (~10 mm diameter)		[Symbol]									
	Firm to stiff, light brown SILT with trace fine angular gravel and fine to coarse sand, moist		[Symbol]					2.9				

End of hand auger at 1.0m (UTP on inferred gravel) EOH @ 1.00 m

NOTES:
Groundwater not encountered

ENGINEERING DESIGN CONSULTANTS LTD CIVIL, STRUCTURAL, ENVIRONMENTAL, GEOTECHNICAL AND FIRE ENGINEERS

www.edc.co.nz team@edc.co.nz	SUITE 7,202 THE STRAND PO Box 855, WHAKATANE 3158	PH (07) 922 0075	1st FLOOR, UNIT 1, 100 BUSH ROAD, ALBANY, AUCKLAND	PH (09) 451 9044
---------------------------------	--	------------------	---	------------------

Produced With GERIC Core-GS



DRILLED: 21/06/2022 FILE: 50683

HAND AUGER NO.:

HA102

SHEET 1 OF 1

PROJECT: Geotechnical Investigation CLIENT: Karli and Nick Bristed

LOGGED PROCESSED CHECKED

ADDRESS: Sec 9(2)(a), Double Cove, Marlborough Sounds

DT WT -

BH LOCATION: COORDS:

RL GROUND:

SHEAR VANE ID#: -

DEPTH (m)	SOIL DESCRIPTION	Strength/density, colour, structure, minor, MAJOR, plasticity, moisture content, other comments	LEGEND	GROUND WATER	SHEAR STRENGTH (kPa)		SOIL SENSITIVITY	SCALA BLOWS (PER 50 mm)		
					Residual	Peak		5	10	15
GL	TOPSOIL: Soft, dark brown organic SILT, wet									
	Firm to stiff, mottled orange grey SILT with trace fine angular gravel and fine to coarse sand, moist				Unable To Penetrate					
	Becoming stiff to very stiff with minor gravel									
	Becoming brown mottled bluish grey, no gravel									
1	Becoming very stiff, high plasticity						4.1			
	Becoming SILT with some fine to medium sand, low plasticity									

End of hand auger at 1.30m (UTP on gravel)

EOH @ 1.30 m

NOTES:

Groundwater not encountered

ENGINEERING DESIGN CONSULTANTS LTD

CIVIL, STRUCTURAL, ENVIRONMENTAL, GEOTECHNICAL AND FIRE ENGINEERS

www.edc.co.nz team@edc.co.nz

SUITE 7,202 THE STRAND PO Box 855, WHAKATANE 3158

PH (07) 922 0075

1st FLOOR, UNIT 1, 100 BUSH ROAD, ALBANY, AUCKLAND

PH (09) 451 9044



DRILLED: 21/06/2022 FILE: 50683

HAND AUGER NO.:

HA103

SHEET 1 OF 1

PROJECT: Geotechnical Investigation CLIENT: Karli and Nick Bristed

LOGGED PROCESSED CHECKED

ADDRESS: Sec 9(2)(a), Double Cove, Marlborough Sounds

DT WT -

BH LOCATION: COORDS:

RL GROUND:

SHEAR VANE ID#: -

DEPTH (m)	SOIL DESCRIPTION	Strength/density, colour, structure, minor, MAJOR, plasticity, moisture content, other comments	LEGEND	GROUND WATER	SHEAR STRENGTH (kPa)				SOIL SENSITIVITY	SCALA BLOWS (PER 50 mm)		
					Residual	Peak	40	80		120	160	5
GL												
	TOPSOIL: Soft, brown organic SILT with minor fine to medium angular gravel, wet		[Symbol]									
	Firm to stiff, light brown SILT with trace fine angular gravel and fine to coarse sand, moist		[Symbol]					6.1				
	Becoming SILT with some coarse angular schist gravel		[Symbol]									

End of hand auger at 0.90m (UTP on gravel)

EOH @ 0.90 m

NOTES:

Groundwater not encountered

ENGINEERING DESIGN CONSULTANTS LTD

CIVIL, STRUCTURAL, ENVIRONMENTAL, GEOTECHNICAL AND FIRE ENGINEERS

www.edc.co.nz
team@edc.co.nz

SUITE 7,202 THE STRAND
PO Box 855, WHAKATANE 3158

PH (07) 922 0075

1st FLOOR, UNIT 1, 100 BUSH ROAD,
ALBANY, AUCKLAND

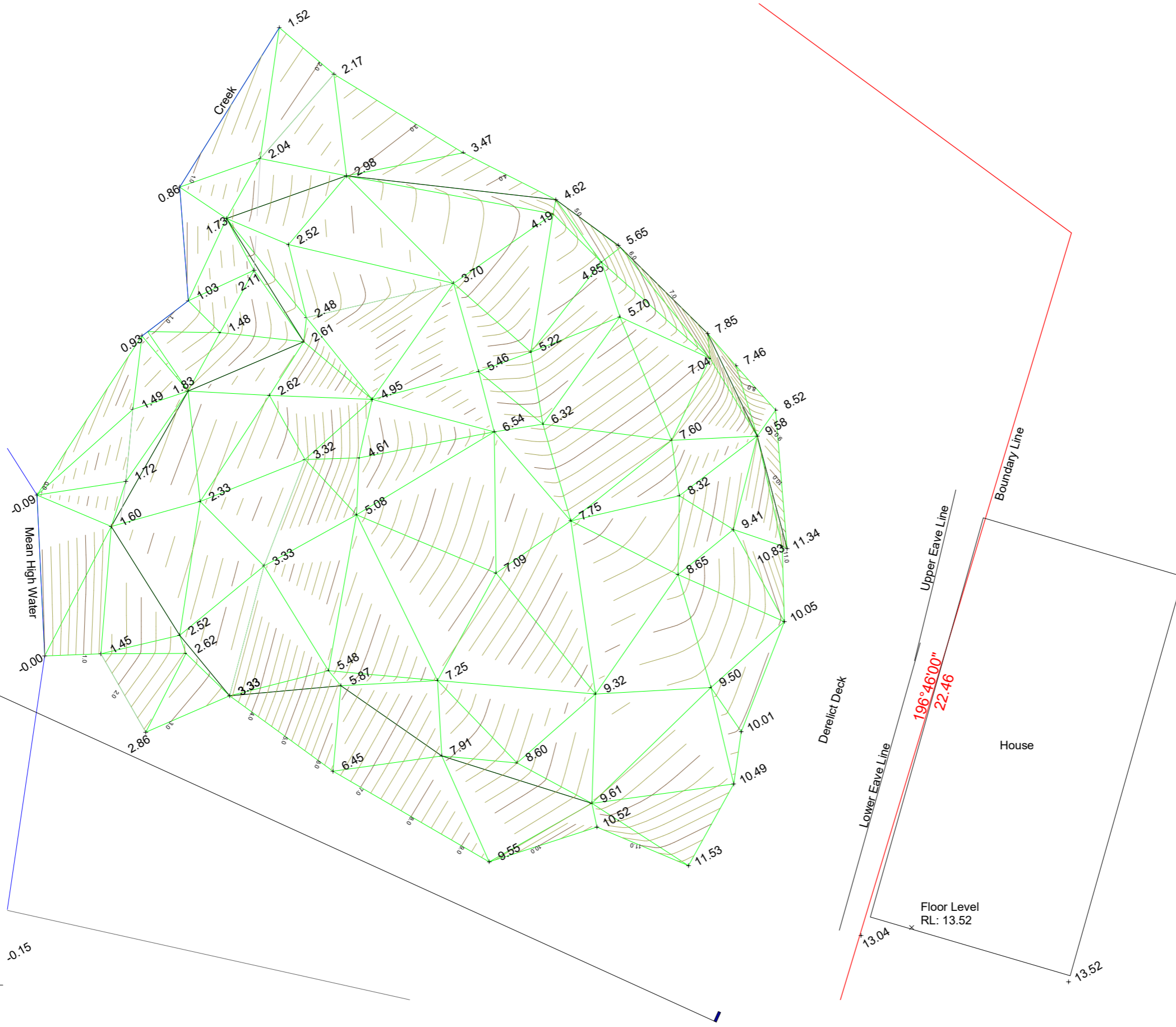
PH (09) 451 9044

APPENDIX D

GEOTECHNICAL CROSS SECTIONS

0 10mm 50 100 200mm 300mm

Original sheet size A1 (840x594)_Rvt18 Plot date: 5/08/2022 1:39:11 pm



GRD. LVL
SCALE @ A1: 1 : 50

No.	DATE	REVISION	BY	CHK
A	27/09/2022	ISSUED FOR DRAFT	DT	

EDC ENGINEERING DESIGN CONSULTANTS
CIVIL | STRUCTURAL | GEOTECHNICAL | ENVIRONMENTAL | FIRE
 Auckland Office: 1st Floor, Unit 1, 100 Bush Road, Albany 0632 (PO Box 118, Albany Village 0755). Ph: 09 451 9044 Fax: 09 415 1280
 Christchurch Office: 15B Leslie Hills Drive, Riccarton, Christchurch 8011 (PO Box 9016, Tower Junction, Christchurch 8149). Ph: 03 355 5559
 Email: team@edc.co.nz Website: www.edc.co.nz

PROJECT: **Sec 9(2)(a), Double Cove, Marlborough Landslid Remediation**
 DRAWING TITLE: **Site Plan & Survey**

DESIGNED:	DT
DRAWN:	DT
REVIEWED:	-
ISSUED DATE:	Sept. 2022

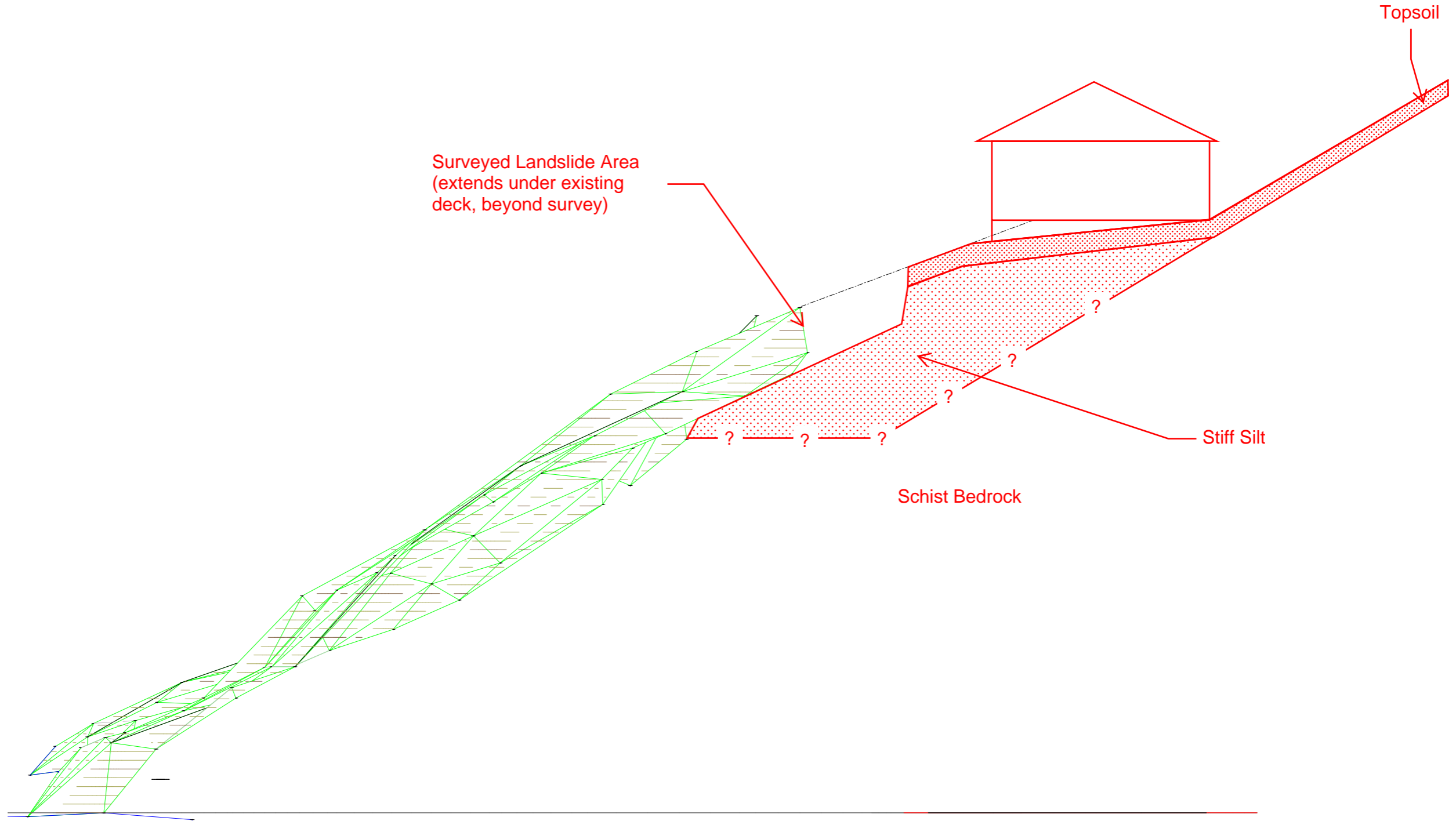
Not To Scale

DRAFT
50683 - Rev.A
THIS DRAWING AND DESIGN SHALL NOT BE REPRODUCED IN ANY FORM WITHOUT THE WRITTEN AUTHORITY OF ENGINEERING DESIGN CONSULTANTS LIMITED - ALL RIGHTS RESERVED

S:\50600\50683 - Jetty No. Q6222, Double Cove - GIR - Received Data\2022\628_Survey\Project1.rvt

Site Soil Profile Cross Section

300mm
200mm
100
50
0 10mm



Section 1
SCALE @ A1: 1 : 50

Original sheet size A1 (840x594)_Rvt18 Plot date: 5/08/2022 1:39:12 pm

No.	DATE	REVISION	BY	CHK
A	27/09/2022	ISSUED FOR DRAFT	DT	

EDC ENGINEERING DESIGN CONSULTANTS
 CIVIL | STRUCTURAL | GEOTECHNICAL | ENVIRONMENTAL | FIRE
 Auckland Office: 1st Floor, Unit 1, 100 Bush Road, Albany 0632 (PO Box 118, Albany Village 0755). Ph: 09 451 9044 Fax: 09 415 1280
 Christchurch Office: 15B Leslie Hills Drive, Riccarton, Christchurch 8011 (PO Box 9016, Tower Junction, Christchurch 8149). Ph: 03 355 5559
 Email: team@edc.co.nz Website: www.edc.co.nz

PROJECT: **Sec 9(2)(a), Double Cove, Marlborough Landslid Remediation**
 DRAWING TITLE: **Geological Cross Section**

DESIGNED:	DT
DRAWN:	DT
REVIEWED:	-
ISSUED DATE:	Sept. 2022

Not To Scale

DRAFT
50683 - Rev.A
 THIS DRAWING AND DESIGN SHALL NOT BE REPRODUCED IN ANY FORM WITHOUT THE WRITTEN AUTHORITY OF ENGINEERING DESIGN CONSULTANTS LIMITED - ALL RIGHTS RESERVED

S:\50600\50683 - Jetty No. Q6222, Double Cove - GIR - Received Data\2022\628_Survey\Project1.rvt

APPENDIX F PS1



Building Code Clause(s)..... **B1, B2**

PRODUCER STATEMENT – PS1 – DESIGN

(Guidance on use of Producer Statements (formerly page 2) is available at www.engineeringnz.org)

ISSUED BY: ENGINEERING DESIGN CONSULTANTS LIMITED (EDC Ref:50683)
(Design Firm)

TO: Nick and Karli Bristed
(Owner/Developer)

TO BE SUPPLIED TO: Marlborough District Council
(Building Consent Authority)

IN RESPECT OF: Retaining Wall and Deck Design
Description of Building Work)

AT: Sec 9(2)(a) Double Cove, Marlborough
(Address)

LOT 29 DP 1153 BLK IV

We have been engaged by the owner/developer referred to above to provide Professional design services - Retaining wall and deck design services in respect of

Extent of Engagement

the requirements of Clause(s) **B1, B2** of the Building Code for

All or Part only (as specified in the attachment to this statement), of the proposed building work.

The design carried out by us has been prepared in accordance with:

Compliance Documents issued by the Ministry of Business, Innovation & Employment **EGEP Module 6**
(verification method / acceptable solution)

and

Alternative solution as per the attached schedule **See DFR**

The proposed building work covered by this producer statement is described in the Design Features Report titled **Engineering Design Consultants Ltd** and numbered **Identified in attached schedule** together with the specification, and other documents set out in the schedule attached to this statement.

On behalf of the Design Firm, and subject to:

- (i) Site verification of the following design assumptions **Refer to attached**
- (ii) All proprietary products meeting their performance specification requirements;

I **believe on reasonable grounds** that a) the building, if constructed in accordance with the drawings, specifications, and other documents provided or listed in the attached schedule, will comply with the relevant provisions of the Building Code and that b), the persons who have undertaken the design have the necessary competency to do so. I also recommend the following level of construction monitoring/observation:

CM1 CM2 CM3 CM4 CM5 (Engineering Categories) or as per agreement with owner/developer (Architectural)

I, **SAM POLSON on behalf of Engineering Design Consultants Ltd am** CPEng **247986**
(Name of Design Professional) Reg Arch

I am a Member of : Engineering New Zealand NZIA and hold the **BE (Hons) CPEng MIMStructE CMEngNZ** following qualifications

The Design Firm issuing this statement holds a current policy of Professional Indemnity Insurance no less than \$200,000*.

The Design Firm is a member of ACENZ:

SIGNED BY **SAM POLSON** ON BEHALF OF **ENGINEERING DESIGN CONSULTANTS LTD**
(Design Firm)

Date 21/11/2022 (signature) Sec 9(2)(a)

Note: This statement shall only be relied upon by the Building Consent Authority named above. Liability under this statement accrues to the Design Firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the Building Consent Authority in relation to this building work, whether in contract, tort or otherwise (including negligence), is limited to the sum of \$200,000.*

This form is to accompany **Form 2 of the Building (Forms) Regulations 2004** for the application of a Building Consent.
THIS FORM AND ITS CONDITIONS ARE COPYRIGHT TO ACENZ, ENGINEERING NEW ZEALAND AND NZIA

21 November 2022

Our Ref: **50683**

SCHEDULE TO PRODUCER STATEMENT (PS1) DESIGN

RE: Sec 9(2)(a) [REDACTED], DOUBLE COVE

The Producer Statement (PS1) – Design has been issued for this project based upon the following.

1.0 PROJECT LIMITATIONS

1. Where this certificate applies to only part of a building, the remaining structure is deemed to be code compliant & competently constructed.
2. All asbestos and contamination related issues are expressly excluded.
3. All restricted building work must be undertaken by an appropriately qualified LBP.

2.0 SITE VERIFICATION REQUIREMENTS

The following items are required to be confirmed on site, by the body responsible for construction monitoring, prior to executing the relevant monitoring of work:

1. Pre-start inspection to assess the condition of the slope prior to starting construction – 1x visit
2. Post hole inspection – 1x visit
3. Installation of drainage – 1x visit
4. Installation of lagging - 1x visits
5. Installation of wailing – 1x visits
6. Installation of anchors – 1 to 2x visits
7. Final Inspection – 1x visit

3.0 MEANS OF COMPLIANCE

3.1 Referenced Standards

The following New Zealand and Australian standards were referenced in the retaining wall design:

- NZS3404:1997 – Steel Structures Standard
- NZS3603:1993 – Timber Structures Standard
- NZS3604 – Timber Framed Buildings

3.2 Alternative Solutions

The following alternative solutions were referenced in the retaining wall design:

- Bowles Foundation Analysis & Design 5th Edition, 1996

- Earthquake Geotechnical Engineering Module 6: Earthquake Resistant Foundation Design, 2021
- AS4678:2002 – Earth Retaining Structures
- Design Estimation of The Ultimate Load-Holding Capacity of Ground Anchors, Littlejohn, GS, 1980

It is the client’s (or their agent’s) responsibility to check what supervision requirements are included within the Building Consent conditions prior to start of construction.

Liability will not be accepted if this is not the case.

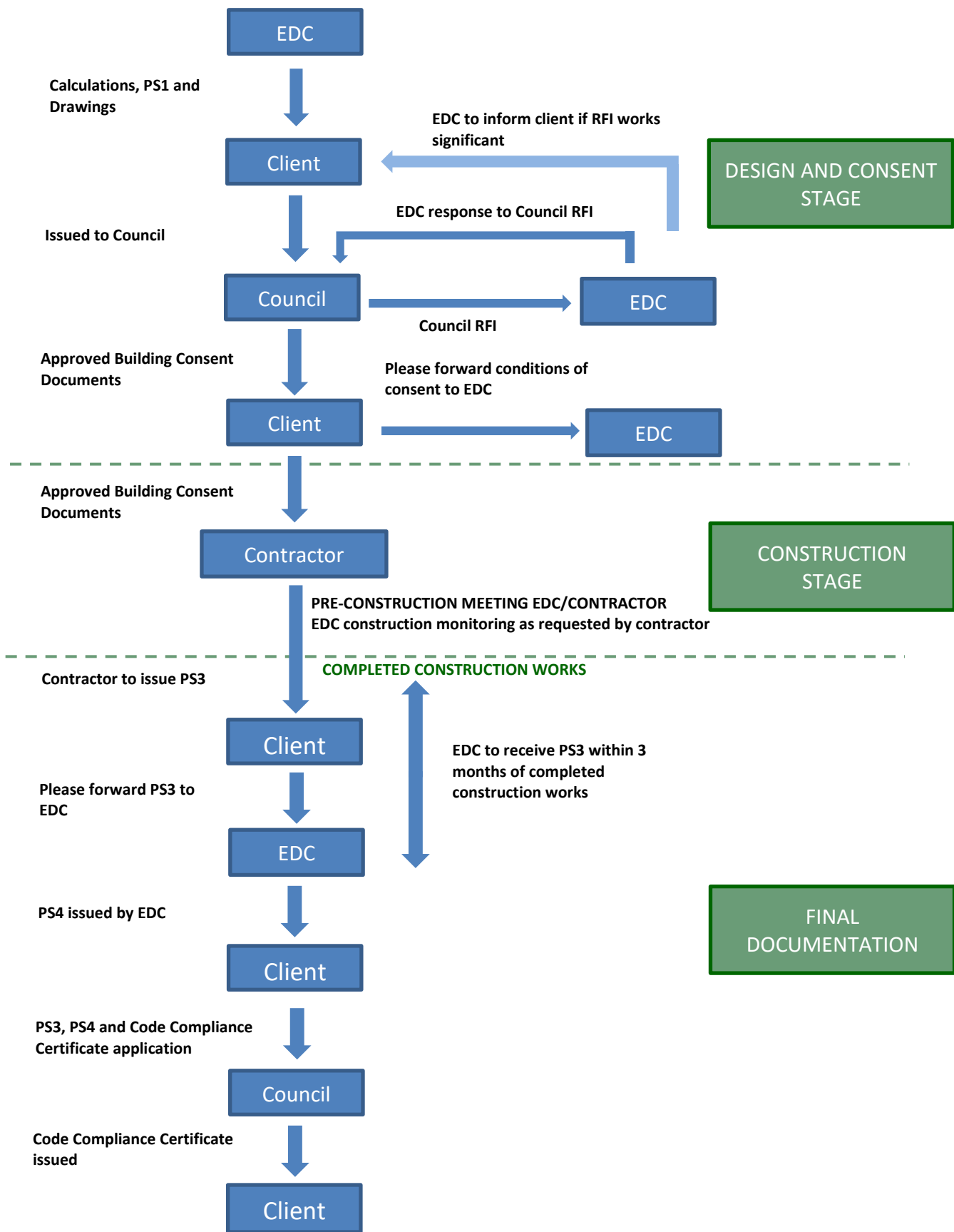
4.0 ATTACHMENTS

Calculations	Appendix A in the attached Design Features Report
Reports	EDC Design Features Report, dated 08/09/2022
Drawings/Markups	S001, S002, S200, S201
Safety in Design and Handover Note	Appendix C in the Design Features Report

5.0 REFERENCED DOCUMENTS

- As noted in design report.

FLOW DIAGRAM OF DOCUMENTATION PROCESS



APPENDIX G SAFETY IN DESIGN

SAFETY IN DESIGN REGISTER



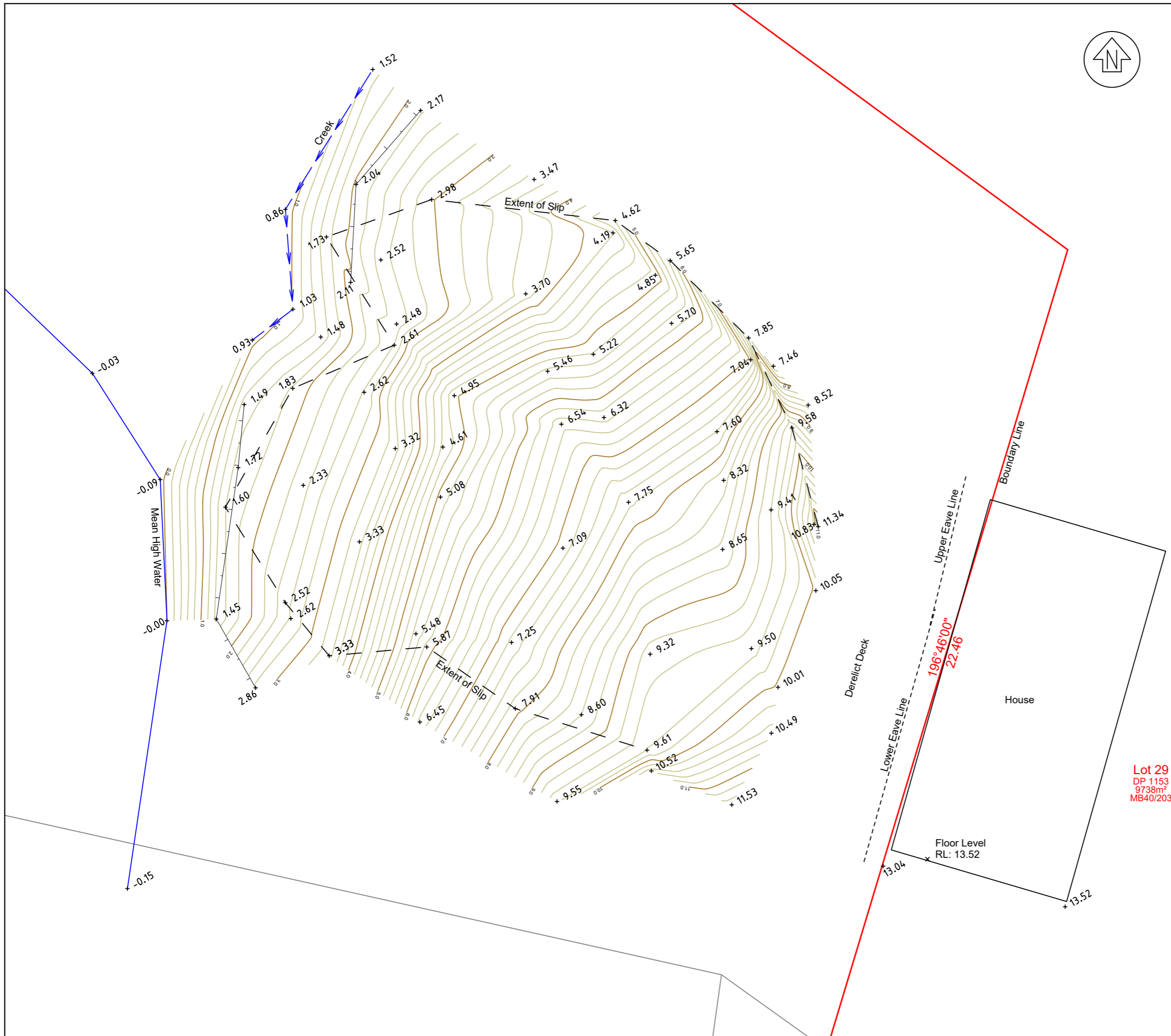
Date: 2022/10/06
 Project Name: Retaining Wall Design
 Job No: 50683

Revision: Rev.0
 Author: HG, GL

Stage of Design /Project: Design

DESIGN RISK				MITIGATION MEASURES				RESIDUAL RISK				HANDOVER NOTES	
Ref	Issue	Consequence	Probability Severity Risk Rating	Risk Owner	Proposed Measure (at time of SID meeting) 1 Eliminate, 2 Minimise (Substitute, Isolate, Engineering Control), 3 Admin Control, 4 PPE)	Probability Severity Risk Rating	Status	Date closed	Status Notes/Actions	Treatment/Controls Required Post Design			
1 Design													
1.01	Design does not fully support the provided	Failure of retaining wall leading to damage/failure of building and injury	2 4 8	EDC	Apply well established design methods	1 4 4	Closed		Design does not fully support the provided	Apply well established design methods			
1.02	Forces exceed those estimated, or forces other than those anticipated and provided to EDC exist	Design is inadequate for true forces, Failure of pile foundation leading to damage/failure of building and injury	1 4 4	EDC	None	1 4 4	Closed		Forces exceed those estimated, or forces other than those anticipated and provided to EDC exist	None			
1.03	Soil parameters used in design are lower than true parameters	Failure of wall leading to partial collapse of access (likeley during earthquake or heavy rainfall)	2 3 6	EDC	Use minimum values from on site testing	2 2 4	Closed		Soil parameters used in design are lower than true parameters	Use minimum values from on site testing			
2 Construction													
2.01	General risks of, but not limited to, fall from height, sound transmission, dust, slips, trips and falls, hazards with standard construction machinery, vehicles, public access, underground and overhead services, excavations, hazardous substances and manual handling.	Injury or death	2 5 10	Contractor	Risks can reasonably be understood and managed by a competent contractor using standard health and safety measures, such as protections from fall from height and PPE. Risk rating varies for each risk, and the competent contractor is to ensure these are suitably low.	1 5 5	Open		General risks of, but not limited to, fall from height, sound transmission, dust, slips, trips and falls, hazards with standard construction machinery, vehicles, public access, underground and overhead services, excavations, hazardous substances and manual handling.	Risks can reasonably be understood and managed by a competent contractor using standard health and safety measures, such as protections from fall from height and PPE. Risk rating varies for each risk, and the competent contractor is to ensure these are suitably low.			
2.02	Toppling of heavy machinery during installation of retaining wall poles	Injury or death	2 5 10	Contactar	Establish clearance zones and suitable working platform, avoid surcharging un-retained slope, stop work and evacuate area if unstable ground is suspected.	1 5 5	Open		Toppling of heavy machinery during installation of retaining wall poles	Establish clearance zones and suitable working platform, avoid surcharging un-retained slope, stop work and evacuate area if unstable ground is suspected.			
2.03	Damage to any existing services	Electrocution, damage to local telecommunications or power grid	2 5 10	Contractor	To have a full brief of any buried or overhead services on-site. Make sure client is aware of any potential close contact and 'cut-off' is done if required. All nearby services to be located prior to starting works.	1 5 5	Open		Damage to any existing services	To have a full brief of any buried or overhead services on-site. Make sure client is aware of any potential close contact and 'cut-off' is done if required. All nearby services to be located prior to starting works.			
2.04	Handling of heavy timber members, risk of instability causing accident and damage.	Crushing, injury, death, damage to retaining structures	2 4 8	Contractor	Contractor to ensure clearance zones and consider risks when establishing a lifting plan.	1 4 4	Open		Handling of heavy timber members, risk of instability causing accident and damage.	Contractor to ensure clearance zones and consider risks when establishing a lifting plan.			
2.05	Site geometry differs from that assumed in design	Failure of retaining wall leading to damage/failure of building and injury	2 4 8	Contractor	Confirm that slope on passie side of wall complies with design assumptions. Ifsite geometry differs from that assumed contact engineer to revise design.	0 4 0	Open		Site geometry differs from that assumed in design	Confirm that slope on passie side of wall complies with design assumptions. Ifsite geometry differs from that assumed contact engineer to revise design.			
2.06	Earthquake During Construction leading to damage to or partial collapse of structure/retained soils leading to injury	Project delays, injury, death	2 5 10	Contractor	Apply appropriate temporary works design	1 5 5	Open		Earthquake During Construction leading to damage to or partial collapse of structure/retained soils leading to injury	Apply appropriate temporary works design			
2.07	Inability to install retaining wall due to unforeseen constraints	Project delays, prevention of project completion	1 3 3	Contractor	Address issues if they arise in conjunction with designer	1 3 3	Open		Inability to install retaining wall due to unforeseen constraints	Address issues if they arise in conjunction with designer			
3 Operation													
2.01	In-service loads exceed those considered in design	Damage to driveway greater than expected	1 4 4	Owner	Retaining wall designed in accordance with best practice load combinations (GEE Module 6)		0	Open		No specific controls identified			
4 Maintenance													
3.01	Higher rates of corrosion than anticipated	Capacity at end of connectins decreases over design life	1 5 5	Owner	Insepct connections periodically for corrosion	1 5 5	Open		Higher rates of corrosion than anticipated	Insepct connections periodically for corrosion			
5 Demolition													
4.01	Future removal	Wall needs to be removed	1 1 1	Owner	Leave piles in the ground rather than removing.	1 1 1			Future removal	Leave piles in the ground rather than removing.			

APPENDIX C. SURVEY PLAN



Notes:
 Horizontal Origin
 Mark: IT LXXVII DP 1153
 Marlborough 2000
 Vertical Origin:
 Heights in terms of False Datum
 Contour Interval 0.20m

Client:
Nick Bristed

Project Title:
Lot 29 DP 1153

Sheet Title:
Topographical Survey



7/68 Seymour Street
 Blenheim
 www.scopesurveying.co.nz
 (03) 577 6755

Scale: **1:100** A3

Drawn by: BW

Date: Wed Jun 22 16:17:36 2022

Project No: 22075	Sheet No: 3201	Rev. A
----------------------	-------------------	-----------

Lot 29
 DP 1153
 9738m²
 MB40/203

APPENDIX D. PRE-APPLICATION RECORDS

----- Forwarded message -----

From: **Tom Heather** <theather@doc.govt.nz>

Date: Fri, 16 Sep 2022 at 3:45 PM

Subject: RE: Pre-application meeting - Foreshore reserve concession + One-off permit

To: Nick Bristed <Sec 9(2)(a)>

Cc: Miranda Van Der Linde <mvanderlinde@doc.govt.nz>

Kia ora Nick and Karli,

Thank you for your time yesterday and we hope it was a useful session for you both.

Below is a recap and additional information requested following on from the pre-application meeting held over Microsoft Teams on the 15th September 2022.

The following application forms (attached) you will be required to complete for your presented proposals on Sounds Foreshore Reserve (SFR):-

- [House front access deck and retaining wall 1a & 3b forms](#)
- [Access track reroute and widening 1b & 7a forms](#)

I have attached guidelines to help you prepare and what to expect with the EIA assessment and restoring native vegetation on SFR.

Also attached are all the relevant legislation and policies the SFR is governed under:-

- Conservation Act 1987
- Conservation General Policy
- [Nelson/Marlborough: Conservation management strategies \(doc.govt.nz\)](#)
- Marlborough Sounds Maritime Park Management Plan

The DOC Sounds District Community team (i.e. Miranda) will follow up with the relevant local iwi for consultation, who may be affected by your applications activities on your behalf.

Activity fees are calculated individually based on different factors in terms of location, size, type and footprint. Only when a application is received can we determine the exact figure. If I could give you a very rough estimate it would be in the region of \$400-\$1000 + gst per annum. Additionally a management fee may also apply, no less than \$250 + gst per annum.

A processing fee for a concession application (approved or declined) can range from \$2000 - \$7000 depending on how complex the application is. From what you have presented so far it would likely be at the lower end of that scale. However, keep in mind a well presented and thorough application will take less time to process and in effect reduce the overall processing costs. A concession term of 10 years or less is likely to be granted if your application is approved, in line with other concessions of this nature. If you seek a term more than 10 years your application will be publicly notified, open to submissions and less likely to be granted. There is an added cost to this too.

A processing fee for a one-off permit is considerably lower, \$130 + gst and may require a bond that is refundable on completion of the permitted works. These are issued for 3 months and may be extended under special circumstances at the discretion of the grantor.

If I have missed anything please don't hesitate to contact myself or Miranda with any further questions or queries. We can also look over your applications before you submit them to permissions@doc.govt.nz. Thank you again and we look forward to receiving your SFR applications.

Have a great weekend.

Ngā mihi,

Tom

Tom Heather

Permissions Advisor | Kaitūtohu
Te Papa Atawhai | Department of Conservation

www.doc.govt.nz



From: Nick Bristed <[redacted] Sec 9(2)(a)>
Sent: Tuesday, 30 August 2022 7:45 pm
To: Tom Heather <theather@doc.govt.nz>
Cc: Miranda Van Der Linde <mvanderlinde@doc.govt.nz>
Subject: Re: Pre-application meeting - Foreshore reserve concession

Hi Tom,

Thanks for getting back to me. I am available Monday between 10:30 and 1:30pm all of Wednesday most of Thursday and all Friday at this stage. Please send a MStTeams invite to [redacted] Sec 9(2)(a)

Yes we will need to reroute the access track and widen it to allow for the construction equipment to get up there.

We have had a little more damage to the property but nothing significant to the main house.

At this stage we are progressing with designing a retaining structure to support the deck and the house and I hope to have some details of that to share when we meet.

If there is any information I can provide in the meantime please let me know.

Cheers,

Nick

On Tue, 30 Aug 2022 at 11:35 AM, Tom Heather <theather@doc.govt.nz> wrote:

Kia ora Nick

Thank you for your email requesting a pre-application meeting for a Sounds Foreshore Reserve (SFR) concession.

My name is Tom Heather and a Permissions Advisor for the Department. I am based in Picton, have access to Microsoft Teams for online meetings and currently available the week starting 12th September. Would this suit you and if so what is your availability during that week?

I'm sorry to see the damage that has been created from the slip back in 2021. Have you been able to reassess your property after the recent rain events? Reports of damage are numerous in the Sounds and we are still hearing more as they come in.

Will your application also include a rerouting of an access path from the jetty to your property? I ask this as a one-off permit for vegetation clearance on SFR may be applicable.

I am on annual leave from tomorrow for a week. Please "reply all" in your return email and Miranda our Sounds Community Ranger will be able to finalise the meeting date and time if I have not heard back from you later today.

Many thanks.

Ngā mihi,

Tom

Tom Heather

Permissions Advisor | Kaitūtohu

Te Papa Atawhai | Department of Conservation

www.doc.govt.nz



Department of
Conservation
Te Papa Atawhai

From: Nick Bristed Sec 9(2)(a)
Sent: Thursday, 18 August 2022 12:05 pm
To: Permissions Christchurch <permissionschristchurch@doc.govt.nz>
Subject: Pre-application meeting - Foreshore reserve concession

Hi, I would like to request a pre-application meeting for a foreshore reserve concession or license.

We were affected by the rain event in July 2021 with a slip taking our deck down the hill and we are looking to rebuild now that the insurance has been sorted out. During our investigations we completed a survey and found that part of the original building was situated over the boundary in the DOC reserve. In order to use the building we need to build safe access and shore up the land from further slips and propose to do this by building a retaining wall and deck that would be in the DOC reserve, approximately 2m of the boundary.

Our Sec 9(2)(a) number is Sec 9(2)(a)

I have attached the insurance report and survey report for reference and below is some discussion with the Marlborough District Council on consent requirements.

I am based in Christchurch and am happy to meet in person or online.

Thanks

Nick

----- Forwarded message -----

From: **dutyplanner** <dutyplanner@marlborough.govt.nz>

Date: Wed, 17 Aug 2022 at 09:15

Subject: Replace storm-damaged deck and construct retaining wall - PN108919 - Duty

Planner Enquiry: REF220711398.

To: Nick Bristed <Sec 9(2)(a)>

Good morning Nick

Thank you for your enquiry. I trust the information provided below will help to clarify the issues surrounding the replacement of a deck and construction of a retaining wall.

File records:

You will be aware from our correspondence to date that Council has looked extensively into the history of the cottage and the related building and planning applications held in the property file. There are gaps in the information but the records show that a building permit was granted in 1979 for the construction of a holiday cottage within the boundary of the property. There is mention in the building permit of the intention to include a 2m wide deck across the front of the cottage. A deck/verandah contained under the roof of the building is shown in a drawing of the cottage. Subsequently in the file there is note of a 2m deck referred to as a 'balcony' being inspected. Correspondence in the file states that the front edge of the deck would be close to the Reserve boundary.

Application was made for a planning consent to erect a building adjoining the Reserve boundary; however, there is no record of the Council's decision on the application. The planning application was lodged before the building application was lodged and granted.

It does not appear a retaining wall was constructed previously as there is no reference to a retaining wall in front of the cottage in either the planning or building application.

The historical photos up until the 1990s show a smaller footprint, likely the building as it was designed, including the 2m deck within the roofline of the building. However, these photos are very blurry. The photos thereafter show a much wider deck (approximately 7.5m). This larger deck crosses the boundary into DOC land and there is no planning or building application on file for it.

Existing use rights and consent requirements:

The onus of demonstrating existing use rights in terms of section 10 of the Resource Management Act 1991 lies with a landowner. Unless you can provide information to show that existing use rights apply to the proposed deck replacement, resource consent will be required.

Although Council's view is that there is insufficient evidence on the Council file to demonstrate existing use rights, you are welcome to provide evidence from your own files. On balance, Council is likely to consider a 2m deck, within the roofline of the building as depicted in the 1979 application, situated on your own land although encroaching the boundary to DOC land will have existing use rights. In that case you may rebuild the 2m deck in accordance with the 1979 plans without requiring consent.

However, you will require consent for the retaining wall or for a deck that is larger or varied in design from the 1979 plans. You will also continue to be subject to the question of whether there is sufficient evidence of existing use. Accordingly, given you must apply for consent to construct the retaining wall (as a result of encroaching setbacks to the DOC boundary) Council would strongly recommend you include the deck and building encroachment in that application.

Location of the cottage:

The location of the cottage and the 2 metre wide deck in relation to the boundary is unclear from the file records. The 1979 building plans do not show the distance of the cottage from the boundary with the Sounds Foreshore Reserve but clearly demonstrate it does not abut the boundary but rather is situated close to the boundary (within the required setbacks). It will therefore be necessary to provide a recent survey plan showing the building in relation to the boundary to support any application for building or resource consent so that in future

the approved location is in accordance with any planning consent and building consent granted.

Please note I have not addressed the situation where the cottage/deck crosses the boundary with DOC land as this requires a separate assessment. I have based my answer on your initial question, replacing the 2m deck that you consider was granted under the 1979 planning and building applications.

Building Consent:

We do not have sufficient information to assess the consent requirements for the retaining wall. We would need to know:

- The height
- Degree of excavation and fill (if any)
- Location (encroachment of setbacks or crossing the boundary into DOC land).

Generally retaining walls require building consent. The construction may also trigger planning consents if there is excavation, fill, encroachment to boundary and vegetative clearance. If they require planning consent, building work cannot commence until it is obtained, even where the building consent is granted.

If the building work is to be over the boundary you will face the difficulty of s75 certification (Building Act 2004). This requires that building work which crosses a boundary generally results in the two properties being held together as one. Depending upon the nature of the design and location of the building work, there may be a possibility that the deck and the retaining wall can be dealt with separately. You are strongly recommended to discuss the design with your builder and a planning agent to clarify your approach having regard to these matters.

If any building work takes place on DOC land there are also further complications of securing DOC permission to apply for a building consent (as only the owner may apply) and to occupy the land. As with the above, Council strongly suggests you take independent advice before commencing discussions with DOC.

Kind regards

Lynn Mullens
Duty Planner
Marlborough District Council
[15 Seymour Street](https://www.marlborough.govt.nz), PO Box 443, Blenheim 7240, New Zealand
Phone: +64 3 520 7400
www.marlborough.govt.nz

Please note my normal working hours are Monday to Thursday from 8 am to 5 pm



From: Nick Bristed <Sec 9(2)(a)>
Sent: Monday, 25 July 2022 4:37 p.m.
To: Lynn Mullens-5255 <Sec 9(2)(a)> <[@marlborough.govt.nz](mailto:Sec 9(2)(a)@marlborough.govt.nz)>
Subject: Re: FW: CM: Re: FW: Replace storm-damaged deck and retaining wall - PN108919 - Duty Planner Enquiry: REF220711398.

Hi Lynn,

That is the deck that was washed down the hill with the slip. The deck has been like that for the past 40 years however we are only looking to reinstate a 2m wide access as per the original request.

I am not sure it is clear on the building permit that the deck was to be behind or on the boarder on the boundary. The letter states that it will be “on the line of the reserve” this could mean within the reserve as in sitting on the reserve area.

The deck would have been in place when the building inspections were completed so I think had there been a different interpretation this would have been addressed at the time but does

not come up I the inspectors notes so presumably was built as agreed.

Cheers,

Nick

On Mon, 25 Jul 2022 at 2:41 PM, Lynn Mullens-5255

<Sec 9(2)(a)@marlborough.govt.nz> wrote:

Sorry – forgot to attach the aerial photo. Here it is



Regards

Lynn

From: dutyplanner
Sent: Monday, 25 July 2022 2:29 p.m.
To: 'Nick Bristed' <Sec 9(2)(a)>
Subject: CM: Re: FW: Replace storm-damaged deck and retaining wall - PN108919 - Duty Planner Enquiry: REF220711398.

Hello Nick

I am still investigating your enquiry. I note from the aerial photo, below, that there appears to be a large structure of some sort in front of the building (orange outline), located entirely on the Sounds Foreshore Reserve. Can you please advise if it is a structure and, if so, what it is? It extends approximately 7m into the Reserve.

The building permit application PN108919_BP62 mentioned a deck of 2m wide in front of the building, which was stated to border on the Reserve boundary. If the orange-outlined area is a structure, it is not in accordance with the building permit.

Kind regards

Lynn Mullens
Duty Planner
Marlborough District Council
[15 Seymour Street](https://www.marlborough.govt.nz), PO Box 443, Blenheim 7240, New Zealand
Phone: +64 3 520 7400
www.marlborough.govt.nz

Please note my normal working hours are Monday to Thursday from 8 am to 5 pm

From: Nick Bristed <Sec 9(2)(a)>
Sent: Wednesday, 20 July 2022 5:55 p.m.
To: dutyplanner <dutyplanner@marlborough.govt.nz>
Subject: Re: FW: Replace storm-damaged deck and retaining wall - PN108919 - Duty Planner Enquiry: REF220711398.

Thank you for looking into this for me. I do not have any documentation outside what is on the property file online. We had a house fire in the 90s and would have lost any paper copies at this time.

We need to progress with designing the retaining structure and the design could be significantly different depending on its location.

Are you able to provide guidance whether it would be accepted to construct a retaining wall and entrance to the property up to 2m in front of the house?

If we can't construct anything in front of the building line I don't think we would be able to meet building code in terms of safe egress which would then impact the viability of the building in its current location.

Cheers,

Nick

On Wed, 20 Jul 2022 at 2:46 PM, dutyplanner <dutyplanner@marlborough.govt.nz> wrote:

Good afternoon Nick

Thanks for your enquiry, attached for ease of reference. I have looked through the property file for your property, reference PN108919, and I have not been able to find the information needed to provide an answer to your questions. I found the following information in the property file:

An application dated 18 April 1979 for a building permit for a holiday cottage was submitted to Council, reference PN108919_BP62. Approval was granted on 1 November 1979.

- There is correspondence in the file for PN108919_BP62 to indicate that application had been made for a planning consent to erect a dwelling on the site.
- There is also a letter from Sec 9(2)(a) stating that he wished to construct the cottage with a 2m veranda, the front line of which would be on the line of the Reserve.
- There is a file for a planning consent, ref. 7/00/0068, which contains very little information and no decision by the Council.
- There was a planning application for a change of use to erect a dwelling submitted on 20 May 1975. It contains a lot of information but no decision by the Council.

If you have a copy of a decision for either of the planning consents mentioned above, it would be help us to respond to your enquiry. It is possible that there were decisions issued but over the years they may have been misfiled and would therefore not be in the scanned version of the paper files. We only have electronic files available now.

Please let me know if you hold any information that may be helpful.

Kind regards

Lynn Mullens

Duty Planner

Marlborough District Council

[15 Seymour Street](#), PO Box 443, Blenheim 7240, New Zealand

Phone: +64 3 520 7400

www.marlborough.govt.nz

Please note my normal working hours are Monday to Thursday from 8 am to 5 pm

From: MDC <mdc@Marlborough.govt.nz>

Sent: Wednesday, 6 July 2022 5:40 p.m.

APPENDIX E. DESIGN DRAWINGS

DECK DESIGN DRAWINGS

JETTY NO. Sec 9(2)(a) [REDACTED], DOUBLE COVE FOR KARLI AND NICK BRISTED

PROJECT: 50683
STRUCTURAL DRAWINGS

SHEET INDEX		
SHEET NO.	DRAWING TITLE	CURRENT REV.
S001	STANDARD NOTES - SHEET 1	0
S002	STANDARD NOTES - SHEET 2	0
S100	DECK AND RETAINING WALL PLAN	1
S200	FOUNDATION DETAILS - SHEET 1	1



CIVIL | STRUCTURAL | GEOTECHNICAL | ENVIRONMENTAL | FIRE

Auckland Office: 1st Floor, Unit 1, 100 Bush Road, Albany 0632 (PO Box 118, Albany Village 0755). Ph: 09 451 9044 Fax: 09 415 1280

Christchurch Office: 15B Leslie Hills Drive, Riccarton, Christchurch 8011 (PO Box 9016, Tower Junction, Christchurch 8149). Ph: 03 355 5559

Whakatane Office: Suite 7, 202 The Strand, Whakatane 3158 (PO Box 855, Whakatane 3158). Ph: 07 922 0075

Email: team@edc.co.nz Website: www.edc.co.nz

GENERAL NOTES:

- THE SPECIFICATION AND DRAWINGS SHALL TAKE PRECEDENCE OVER THESE NOTES AND DETAILS
- THE CONTRACTOR IS TO LOCATE ALL SERVICES BEFORE CONSTRUCTION AND REPORT ALL POSITIONS AND CLASHES IN WRITING TO THE ARCHITECT AND ENGINEER.
- UPON COMPLETION OF WORKS THE CONTRACTOR IS TO REMOVE ALL RUBBISH AND DEBRIS LEAVING SITE CLEAN AND TIDY.
- IT IS THE CONTRACTORS RESPONSIBILITY TO ARRANGE AND PASS ALL NECESSARY COUNCIL & ENGINEERING INSPECTIONS.
- ALL DURABILITY SHALL BE IN ACCORDANCE WITH B2 OF THE NZBC
- EDC DOES NOT** PROVIDE PS4 CERTIFICATES FOR ITEMS NOT INSPECTED BY EDC
- EDC DOES NOT** CERTIFY B2 OF THE BUILDING CODE FOR ANYTHING RELATING TO WATERPROOFING OR WEATHER TIGHTNESS. - REFER COUNCIL FOR THESE INSPECTIONS / CERTIFICATIONS.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE STRUCTURE IN A STABLE CONDITION AND ENSURING NO PART SHALL BE OVERSTRESSED UNDER CONSTRUCTION ACTIVITIES. THIS INCLUDES ALL EXISTING STRUCTURES FORMING PART OF, OR AFFECTED BY, THE WORKS. THE CONTRACTOR SHALL DESIGN ALL TEMPORARY WORKS AND PROVIDE PROPPING TO SUPPORT ALL CAST IN-SITU AND PRECAST CONCRETE WORK UNTIL SUCH CONCRETE HAS REACHED THE REQUIRED STRENGTH
- THE DESIGN ADEQUACY INCORPORATED IN THESE DRAWINGS IS SUBJECT TO THE REQUIREMENTS INCLUDED IN THE SPECIFICATION FOR THE WORKS AND THE DESIGN ASSUMPTIONS INCORPORATED INTO THE CALCULATIONS AND REPORTS FOR THE PROJECT.
- NO CHANGES TO THE DESIGN ARE PERMITTED WITHOUT PRIOR WRITTEN APPROVAL OF THE ENGINEER.
- THE DRAWINGS SHOW THE DESIGN INTENT. SHOP DETAILING IS THE RESPONSIBILITY OF THE CONTRACTOR
- UNLESS OTHERWISE NOTED, ALL LEVELS ARE IN METERS, AND ALL DIMENSIONS AND SIZES ARE IN MILLIMETERS.
- ALL SPECIFICATIONS, CODES AND THE LIKE REFERENCED EITHER DIRECTLY OR BY INFERENCE SHALL BE THE LATEST PUBLISHED VERSIONS AT THE DATE ISSUING THE DRAWING SET.
- DIMENSIONS SHALL NOT BE SCALED FROM DRAWINGS. IF IN DOUBT, ASK ALL DIMENSIONS AND LEVELS SHALL BE CHECKED ON SITE BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
- ALL DISCREPANCIES SHALL BE REFERRED TO THE ARCHITECT OR ENGINEER FOR RESOLUTION BEFORE PROCEEDING WITH THE WORK
- ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE CURRENT CODES OF PRACTICE EXCEPT WHERE VARIED BY THE SPECIFICATION AND / OR DRAWINGS.
- EDC DOES NOT UNDERTAKE OR CHECK SET-OUT OR FINISHED GROUND LEVEL. WE RECOMMEND ALL SET-OUT & FINISHED GROUND LEVELS SHOULD BE DONE BY A REGISTERED SURVEYOR.
- ALL PROPRIETARY PRODUCTS TO BE USED IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS. WHERE PROPRIETARY PRODUCTS ARE SPECIFIED IN THE DOCUMENTS THE CONTRACTOR MAY SUBMIT AN ALTERNATIVE PRODUCT FOR APPROVAL.
- ALL MATTERS PERTAINING TO THE CONSTRUCTION SITE MUST COMPLY IN ALL RESPECTS WITH THE HEALTH AND SAFETY ACT 2015.
- ALL EPOXY DRILLED HOLES ARE TO BE CLEANED OUT BEFORE ADHESIVE IS PLACED, AS PER MANUFACTURER SPECIFICATIONS

INSPECTION OF WORKS:

- 24 HOURS MINIMUM NOTICE IS REQUIRED BY THE ENGINEER FOR INSPECTION OF THE WORKS. THE CONTRACTOR SHALL ARRANGE ATTENDANCE OF THE ENGINEER.
- THE CONTRACTOR MUST BE SATISFIED THAT THE WORKS HAVE BEEN COMPLETED IN ACCORDANCE WITH THE PLANS AND SPECIFICATION BEFORE CONFIRMING AN INSPECTION BY THE ENGINEER.

EXCAVATION:

- WHERE ANY EXCAVATIONS, PILE HOLES (750mmØ OR BIGGER) OR TRENCHES ARE TO BE DEEPER THAN 1.5m AND ENTRY IS REQUIRED, WORKSAFE MUST BE NOTIFIED. ALSO FOR PILE HOLES 500mmØ OR LARGER THAT ARE GREATER THAN 5m DEEP (WITH OR WITHOUT A REQUIREMENT FOR ENTRY), WORKSAFE MUST BE NOTIFIED.
- THE WORK SHALL BE UNDERTAKEN IN A MANNER WHICH CONTROLS SEDIMENT, IN ACCORDANCE WITH THE SEDIMENT CONTROL PLAN.

FOUNDATIONS:

- FOUNDING MATERIAL SHALL BE APPROVED BY THE ENGINEER FOR ULTIMATE BEARING CAPACITY BEFORE CONSTRUCTION OF FOOTINGS. BLINDING CONCRETE, TYPICALLY NOT SHOWN ON THE DRAWINGS, SHALL BE USED WHERE NECESSARY.
- UNLESS A SITE SPECIFIC GEOTECHNICAL REPORT IS PROVIDED BY THE CLIENT ALL FOUNDING STRATA IS ASSUMED TO COMPLY WITH 'GOOD GROUND' TO NZS3604 - LIABILITY WILL NOT BE ACCEPTED SHOULD SOIL PROPERTIES DIFFER FROM THOSE USED IN THE DESIGN.
- ALL WALLS AND COLUMNS SHALL BE CENTERED ON SUPPORTING FOUNDATIONS UNLESS OTHERWISE NOTED ON DRAWINGS.
- SUB GRADE BELOW THE BASECOURSE FOR SLABS SHALL BE SUITABLE MATERIAL COMPACTED TO 95% OF MAXIMUM DRY DENSITY AS DETERMINED BY TEST NZS4402: TEST 4.1.1 OR EQUIVALENT UNLESS NOTED OTHERWISE.
- CURE CONCRETE SLAB USING 'SIKA ANTISOL A' TO MANUFACTURER'S SPECIFICATION. SIKA FILM MAY BE REQUIRED DEPENDING ON SITE CONDITIONS DURING CONCRETE PLACING. CONTACT EDC FOR ADVICE PRIOR TO ORDERING CONCRETE.

CONCRETE:

- ALL WORKMANSHIP AND MATERIAL SHALL COMPLY WITH NZS 3109.
 - CONSTRUCT FALSEWORK AND FORMWORK AS NECESSARY TO PROVIDE THE REQUIRED SUPPORT AND FINISHES. EXCEPT WHERE SPECIFIED OTHERWISE BY THE ARCHITECT, FINISHES SHALL BE IN ACCORDANCE WITH NZS 3114:
- | | |
|---|------------|
| ALL CONCRETE WHICH IS VISIBLE EXTERNALLY OR INTERNALLY IN THE COMPLETED BUILDINGS | F5X FINISH |
| CONCRETE CONCEALED IN THE COMPLETED BUILDING | F1 FINISH |
- MINIMUM CONCRETE STRENGTHS TO BE AS SHOWN ON THE DRAWINGS OR IN ACCORDANCE WITH NZS3101, CHAPTER 3 FOR DURABILITY OR AS PER THE TABLE BELOW, WHICH EVER IS THE GREATER:

ELEMENT	CONCRETE TYPE	28 DAY STRENGTH	MAX. SLUMP	MAX SIZE AGGREGATE
FOUNDATIONS:	NORMAL	25 MPa	100mm	19mm
TIMBER RETAINING WALL	NORMAL	20 MPa	100mm	19mm
GROUND FLOOR SLABS:	NORMAL	30 MPa	100mm	19mm
PROPRIETARY FLOOR TOPPING TO BE AS SPECIFIED BY SUPPLIER BUT NOT LESS THAN:	NORMAL	25 MPa	100mm	19mm
CAST IN-SITU CONCRETE:	NORMAL	25 MPa	100mm	19mm
PRECAST CONCRETE:	NORMAL	30 MPa	100mm	19mm

- REFER ARCHITECTS DRAWINGS FOR DPC / DPM / WATERPROOFING REQUIREMENTS AND DETAILS.
- SIZES OF CONCRETE ELEMENTS DO NOT INCLUDE THICKNESS, OF APPLIED FINISHES OR REBATES TO PRECAST PANELS UNLESS NOTED.
- NO PENETRATIONS, CHASES OR EMBEDMENTS OF PIPES OTHER THAN THOSE SHOWN ON STRUCTURAL DRAWINGS SHALL BE MADE IN CONCRETE MEMBERS WITHOUT THE PRIOR APPROVAL OF ENGINEER.
- PROPRIETY PRECAST COMPONENTS REFERRED TO ON THESE DRAWINGS SHALL BE DESIGNED AND DETAILED BY THE SUPPLIER AND A COPY OF THE DOCUMENTATION SUBMITTED TO THE ENGINEER FOR COMMENT PRIOR TO COMMENCEMENT OF WORK
- ALL BEAMS TO BE FULLY PROPPED DURING CONSTRUCTION UNLESS NOTED OTHERWISE.
- THE CONTRACTOR SHALL SUBMIT PRECAST UNIT SHOP DRAWINGS FOR REVIEW PRIOR TO COMMENCEMENT OF WORK.
- NO CONCRETE TO BE ALLOWED TO FALL MORE THAN 1.5m. IF GREATER THAN 1.5m TREMIE INTO PLACE.
- ALL CONCRETE IS TO BE VIBRATED.
- CURE CONCRETE SLAB USING 'SIKA ANTISOL A' TO MANUFACTURER'S SPECIFICATION. SIKA FILM MAY BE REQUIRED DEPENDING ON SITE CONDITIONS DURING CONCRETE PLACING. CONTACT EDC FOR ADVICE PRIOR TO ORDERING CONCRETE.

REINFORCEMENT:

- ALL REINFORCING SHALL BE MANUFACTURED TO AS/NZS 4671:2001 ALL REINFORCING SHALL BE AS FOLLOWS:

	TYPE
D	GRADE 300E DEFORMED BARS TO AS/NZS 4671:2001 (300 MPa)
R	GRADE 300E PLAIN BARS TO AS/NZS 4671:2001 (300 MPa)
HD	GRADE 500E DEFORMED BARS TO AS/NZS 4671:2001 (500 MPa)
HR	GRADE 500E PLAIN BARS TO AS/NZS 4671:2001 (500 MPa)

MESH TO BE GRADE 500E DUCTILE MESH TO AS/NZS 4671:2001 UNLESS SPECIFICALLY DETAILED OTHERWISE

- ALL GRADE 500E REINFORCEMENT SHALL COMPLY WITH AS/NZS 4671 AND BE MANUFACTURED USING THE MICRO ALLOY PROCESS. QUENCH AND TEMPERED STEEL SHALL NOT BE USED ON THIS PROJECT.
- TYPICAL REINFORCEMENT DESIGNATIONS ARE AS FOLLOWS:
 - 16 - HD20 - 300 EF DENOTES 16NO GRADE 500E DEFORMED 20Ø BARS AT 300 CENTRES IN EACH FACE
 - 9 - R10 - 200 TIES DENOTES 9NO GRADE 300E PLAIN ROUND 10Ø TIES AT 200 CENTRES.
- REINFORCEMENT IS REPRESENTED DIAGRAMMATICALLY ON THE DRAWINGS AND NOT NECESSARILY TO SCALE OR IN TRUE PROJECTION.
- WELDING OF REINFORCEMENT IS NOT PERMITTED UNLESS SHOWN ON THE DRAWINGS OR APPROVED BY ENGINEER. NEVER WELD GRADE 500 REINFORCING. GRADE 300 REINFORCING WELDING TO BE CARRIED OUT TO THE SPECIFIC REQUIREMENTS OF AS/NZS 1554.3.
- MINIMUM COVER SHALL COMPLY WITH NZS4210 TABLE 2E1 AND NZS3101:PART 1:2006 FOR DURABILITY. UNLESS NOTED MINIMUM COVER TO PRINCIPAL REINFORCEMENT SHALL BE TO THE TABLE BELOW:

MAIN REBAR COVER	
EXPOSURE	MINIMUM COVER
CAST AGAINST OR EXPOSED TO EARTH (WITHOUT DPM)	75mm
CAST AGAINST OR EXPOSED TO EARTH (WITH DPM)	50mm
EXPOSED TO WEATHER	40mm
NOT EXPOSED TO WEATHER	35mm
INTERNAL FLOOR SLABS & TOPPING (UNLESS NOTED OTHERWISE):	25mm

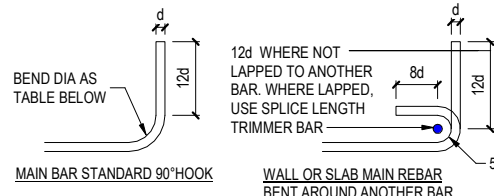
- REINFORCEMENT SPLICES SHALL COMPLY WITH NZS 3101. SPLICE LENGTHS SHALL NOT BE LESS THAN THAT SHOWN IN THE TABLES BELOW (UNLESS NOTED OTHERWISE):

IN-SITU & PRECAST CONCRETE REBAR SPLICE LENGTHS							
BAR SIZE	10	12	16	20	25	28	32
GRADE 300E	350	400	550	700	850	950	1100
GRADE 500E	500	600	800	1000	1200	1350	1550
MESH	ONE MESH BAR SPACING + 50mm						

MASONRY REBAR SPLICE LENGTHS						
BAR SIZE	10	12	16	20	25	
D	VERTICAL	400	500	650	800	1100
	HORIZONTAL	550	650	850	1050	1250
HD	VERTICAL	700	850	1150	1400	1900
	HORIZONTAL	900	1100	1500	1800	2200

- NO REINFORCEMENT SPLICES SHALL BE MADE OTHER THAN THOSE SHOWN ON THE STRUCTURAL DRAWINGS, OR AS OTHERWISE APPROVED BY THE ENGINEER

- BARS PARTIALLY EMBEDDED IN CONCRETE SHALL NOT BE SITE BENT UNLESS SPECIFICALLY SHOWN ON THE DRAWINGS OR APPROVED BY THE ENGINEER. BENDING OF REINFORCEMENT SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF NZS3109 AND THE MANUFACTURER'S WRITTEN RECOMMENDATIONS:



MAIN REBAR BENDS		
STEEL GRADE	BAR DIA (mm)	MINIMUM BEND DIA.
GRADE 300E	6 - 20	5d
GRADE 500E	24 - 32	6d

REINFORCEMENT CONTINUED:

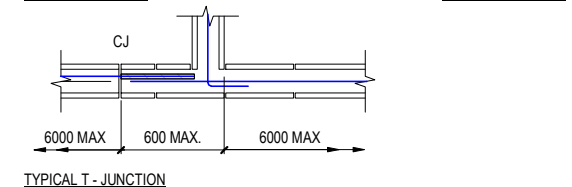
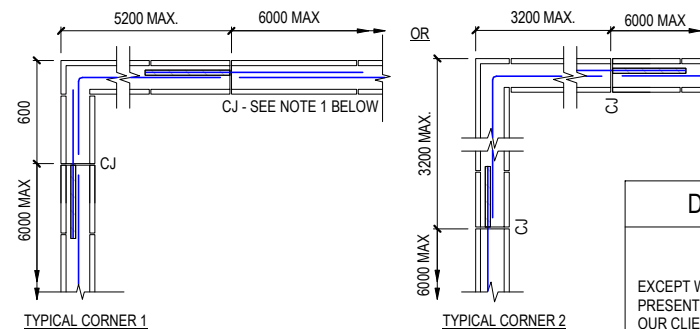
- HOOKS LAPS AND BENDS SHALL COMPLY WITH NZS 3109:

STIRRUP & TIE HOOK BENDS - MINIMUM BEND = 135°			
STEEL GRADE	BAR DIA mm	MINIMUM BEND DIAMETER	
		PLAIN BARS	DEFORMED BARS
300E / 500E	6-20	2d	4d
300E / 500E	24-40	3d	6d

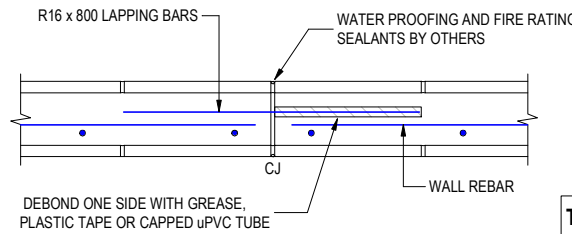
- GRADE 500 REINFORCEMENT SHALL NOT BE BENT ON SITE UNLESS SPECIFICALLY APPROVED BY THE ENGINEER. GRADE 300E BARS MAY BE BENT ON SITE PROVIDED THE MINIMUM RADIUS ABOVE IS MAINTAINED. BENDING SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF NZS3109.

MASONRY:

- MATERIALS AND WORKMANSHIP SHALL COMPLY WITH NZS4210 AND TO NZS4230 MASONRY STANDARD GRADE B.
- ALL MASONRY SHALL BE DIRECTLY SUPERVISED BY A REGISTERED MASON WHO SHALL PROVIDE CONTINUOUS INSPECTION.
- BLOCKWORK CONSTRUCTION TO BE BY LOW OR HIGH LIFT PROCEDURE AS PER NZS4210, WITH CLEAN OUT PORTS PROVIDED AT EVERY VERTICAL BAR AS PER THIS CODE
- ALL MASONRY SHALL BE LAID IN RUNNING BOND UNLESS NOTED TO A MAXIMUM LIFT OF 2.4m.
- ALL CELLS SHALL BE FILLED WITH 17.5MPa GROUT UNLESS NOTED. USE 25MPa IN SEA SPRAY ZONE IN ACCORDANCE WITH NZS3604.
- MINIMUM LAP LENGTH OF REINFORCING BARS TO BE:
40bd FOR GRADE 300 BARS, 60bd FOR GRADE 500 BARS.
- STARTER BAR LOCATION: THE BLOCKLAYER IS TO CHECK FOR CORRECT POSITIONING OF ALL STARTER BARS. STARTER BARS ARE TO BE DRILLED 8xBAR DIAMETER DEEP AND EPOXY GROUDED IN THEIR CORRECT POSITIONS IF OUT OF LINE BY MORE THAN 50mm ALONG THE WALL OR 6mm ACROSS THE WALL.
- ALL BLOCK WALL GROUT TO BE MECHANICALLY VIBRATED.
- MORTAR JOINTS TO BE 10mm WITH BLOCKS FULLY BEDDED AND PERPENDICULARS FILLED. JOINTS TO BE TOOLED AT EXPOSED OR RENDERED SURFACES. CORES SHALL BE CLEANED OF ALL MORTAR FINES AND DROPPINGS THROUGH CLEAN OUT PORTS BEFORE PLACING VERTICAL REINFORCEMENT. AFTER INSPECTION THE FACE SHELLS SHALL BE MORTARED IN AT CLEAN OUT PORTS AND BRACED PRIOR TO GROUTING. GROUT SHALL BE VIBRATED TO ENSURE FILLING OF CORES.
- CONTROL JOINTS SHALL BE PROVIDED AT 6.0M MAXIMUM CENTERS UNLESS SHOWN ON THE DRAWINGS. JOINTS SHALL BE LOCATED TO NZS 4229 AND TO THE APPROVAL OF THE ENGINEER.

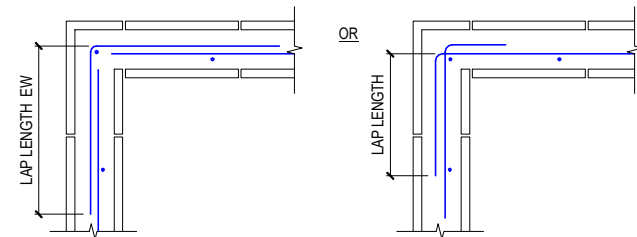


- BLOCKWORK CONTROL JOINT DETAIL:



MASONRY CONTINUED:

- ALL BLOCKWORK HORIZONTAL REINFORCING SHALL LAP ADEQUATELY AT CORNERS AND JUNCTIONS AS INDICATED BELOW:



- WHERE MASONRY IS TO BE CONSTRUCTED ON SUSPENDED CONCRETE WORKS WITHOUT A CORRESPONDING WALL UNDER, THE SUPPORTING WORKS MUST BE FULLY DE-PROPPED BEFORE COMMENCEMENT OF THIS MASONRY UNLESS NOTED. CONSTRUCTION SEQUENCE SHALL BE DISCUSSED AND AGREED BY DESIGN ENGINEER
- REBATES OR CHASES IN LOAD BEARING MASONRY UNITS ARE NOT PERMITTED WITHOUT THE PRIOR APPROVAL OF THE ENGINEER.
- NON-LOAD BEARING WALLS SHALL HAVE A 12mm COMPRESSIBLE JOINT BETWEEN TOP OF WALL AND UNDERSIDE OF SUSPENDED SLABS (OR BEAM OVER) AND WHERE THEY ABUT OTHER STRUCTURAL ELEMENTS (EG. COLUMNS).
- REINFORCEMENT LAPS IN BLOCKWORK TO COMPLY WITH THE TABLE IN THE REINFORCEMENT SECTION.

COORDINATION NOTES

THESE STRUCTURAL DRAWINGS MUST BE READ IN CONJUNCTION WITH THE SPECIFICATIONS, ARCHITECTURAL DRAWINGS AND OTHER CONSULTANTS' DRAWINGS PLUS ANY INSTRUCTIONS ISSUED DURING THE CONTRACT.

REFER ARCHITECTURAL DRAWINGS FOR ALL SET OUT, INCLUDING LEVELS, SET DOWNS, NIBS, REBATES, DUCTS THROUGH FLOORS AND WALLS ETC. AND ALL OTHER SET OUT UNLESS OTHERWISE NOTED. EDC DOES NOT CHECK LEVELS AND SET OUT & WE RECOMMEND THAT YOU ENGAGE A PROFESSIONAL SURVEYOR TO COMPLETE ALL SET OUT. ANY DISCREPANCIES SHALL BE REFERRED TO THE ARCHITECT FOR CLARIFICATION BEFORE PROCEEDING. DO NOT SCALE DRAWINGS.

DISCLAIMER NOTES

EXCEPT WHERE REQUIRED BY LAW, THE INFORMATION PRESENTED IN THESE DRAWINGS IS FOR THE SOLE USE OF OUR CLIENT FOR THIS PARTICULAR PROJECT. THE INFORMATION IS NOT INTENDED FOR USE BY ANY OTHER PARTIES. NO RESPONSIBILITY IS ACCEPTED FOR THE USE OF ANY PART OF THESE DRAWINGS IN ANY OTHER CONTEXT OR FOR ANY OTHER PURPOSES.

OUR PROFESSIONAL SERVICES ARE PERFORMED USING A DEGREE OF CARE AND SKILL NORMALLY EXERCISED, UNDER SIMILAR CIRCUMSTANCES, BY REPUTABLE CONSULTANTS PRACTICING IN THIS FIELD AT THIS TIME. NO OTHER WARRANTY, EXPRESSED OR IMPLIED, IS MADE AS TO THE PROFESSIONAL ADVICE PRESENTED ON THESE DRAWINGS, IN REGARD TO ITS ACCURACY OR COMPLETENESS

DESIGNS SHOWN ON THESE PLANS EXPRESSLY EXCLUDE ALL WEATHER TIGHTNESS DETAILS.

TEMPORARY WORKS ARE THE RESPONSIBILITY OF THE CONTRACTOR UNLESS NOTED OTHERWISE.

SOME COMMON ABBREVIATIONS

GENERAL	CONCRETE & REINFORCEMENT	STEEL	WELDING
COS ES EXTG FL GL LG NTS SED SFL TBA TBC TYP UNO CTRS NO	PC PCP PS RC REBAR B C CAR CJ CVR EF EW FF H NF SC T V	TOS T/O UIS CRS DIA (d) PCD RAD (R)	FW CFW FWAR FSBW SFBW DVBW SBBW DBBW
CHECK ON SITE EQUALLY SPACED EXISTING FINISHED LEVEL GROUND LEVEL LONG NOT TO SCALE SMALL END DIAMETER STRUCTURAL FINISHED LEVEL TO BE ADVISED TO BE CONFIRMED TYPICAL UNLESS NOTED OTHERWISE CENTRE TO CENTRE NUMBER	PRECAST CONCRETE PANEL PRESTRESSED CONCRETE REINFORCED CONCRETE REINFORCEMENT BOTTOM CENTRAL COVER ALL ROUND CONSTRUCTION / CONTROL JOINT COVER EACH FACE EACH WAY FAR FACE HORIZONTAL NEAR FACE SAWCUT STRIP VERTICAL	ALTERNATE BAR REVERSED ALTERNATE BAR STAGGERED LAP AT RANDOM NO LAP STARTER(S) STIRRUP TRIMMER	FILLET WELD CONTINUOUS FILLET WELD FILLET WELD ALL ROUND FULL STRENGTH BUTT WELD SINGLE V BUTT WELD DOUBLE V BUTT WELD SINGLE BEVEL BUTT WELD DOUBLE BEVEL BUTT WELD

THIS DRAWING IS THE COPYRIGHT OF ENGINEERING DESIGN CONSULTANTS LIMITED.

300mm
200mm
100
50
0 10mm

Original sheet size A1 (840x594) Rvt18 Plot date: 28/11/2022 9:37:36 am

S:\5060050683 - Drawings\Structural\Revit_22\5060683 - Double Cove.rvt Double Cove.rvt

STRUCTURAL STEEL:

- ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH NZS 3404 AND AS/NZS 5131 SUBJECT TO RELEVANT SECTIONS OF THE SPECIFICATION.
- READ STRUCTURAL STEELWORK DRAWINGS IN CONJUNCTION WITH ALL OTHER CONTRACT DRAWINGS. ALLOW FOR ALL HOLES, CLEATS, FIXINGS, ETC. AND INDICATE ON SHOP FABRICATION DRAWINGS.
- STRUCTURAL STEELWORK DRAWINGS SHOW THE STRUCTURAL DESIGN INTENT. SHOP FABRICATION DRAWINGS ARE THE CONTRACTORS RESPONSIBILITY.
- ALL BOLTS TO BE HIGH STRENGTH STEEL CLASS 8.8/S TO SPECIFICATION UNLESS NOTED OTHERWISE.
- ALL STEELWORK, EXCEPT FOUNDATION PILES, SHALL BE SURFACE PROTECTIVE TREATED AFTER FABRICATION. REFER TO SPECIFICATION.
- ALL BOLTS, NUTS AND WASHERS, INCLUDING HOLDING-DOWN BOLTS, SHALL BE HOT DIP GALVANISED UNLESS SPECIFICALLY NOTED OTHERWISE. REFER TO SPECIFICATION.
- HOLLOW STEEL SECTIONS:
ALL SQUARE AND RECTANGULAR HOLLOW SECTIONS SHALL BE GRADE 350 UNLESS OTHERWISE INDICATED. CIRCULAR HOLLOW SECTIONS 114. O.D. AND LESS SHALL BE GRADE 250 UNLESS OTHERWISE INDICATED. CIRCULAR HOLLOW SECTIONS BETWEEN 139.7 O.D. AND 457.0 O.D. INCLUSIVE SHALL BE GRADE 350 UNLESS OTHERWISE INDICATED. REFER TO SPECIFICATION.
- HOT ROLLED OPEN SECTIONS, FLATS, PLATES AND FABRICATED SECTIONS SHALL BE GRADE 300 UNLESS OTHERWISE INDICATED. REFER TO SPECIFICATION.
- ALL COLD FORMED SECTIONS INCLUDING COLD ROLLED PURLINS TO CONFORM TO AS 1538 AND SHALL HAVE A MINIMUM YIELD STRESS OF 450 MPA, UNLESS NOTED.
- THE ENDS OF ALL HOLLOW SECTIONS SHALL BE SEALED WITH 3mm MINIMUM STEEL PLATE, SEAL WELDED ALL ROUND, UNLESS NOTED OTHERWISE.
- ALL PLATES SHALL BE 6mm MINIMUM UNLESS OTHERWISE NOTED.
- THE BOLTS, UNLESS NOTED OTHERWISE:
 - GRADE 8.8 HIGH STRENGTH STEEL BOLTS AND NUTS SHALL BE TO AS1250: 'ISO METRIC HIGH STRENGTH STEEL BOLTS'.
 - GRADE 4.6 BOLTS AND NUTS SHALL BE MILD STEEL TO AS1111: 'ISO METRIC HEXAGONAL BOLTS & SCREWS'.
 - METRIC HEXAGONAL BOLTS' AND AS1112: 'ISO METRIC HEXAGONAL NUTS'.
 - COMMON DETAILING COMPONENTS:

EDGE AND END DISTANCE	2d
PITCH DISTANCE	2.5d
GAUGE DISTANCE	70, 90, 140 AS PER AUSC.
 - ALL BOLTS SHALL HAVE AT LEAST ONE WASHER WHICH SHALL BE NOT LESS THAN TWICE THE NOMINAL BOLTS SIZE IN DIAMETER.
 - BOLTS SHALL BE SELECTED SO THAT THE PROJECTION BEYOND THE NUT IS NOT LESS THAN TWO THREADS AND NOT MORE THAN 10mm. BOLTS SHALL BE FULLY TENSIONED IN ACCORDANCE WITH NZS3404.
- BOLT HOLES:
 - HOLES FOR BOLTS SHALL BE DRILLED OR PUNCHED AND NOT GAS CUT.
 - BOLT HOLE SIZING:

STANDARD HOLES	d + 2mm DIAMETER
SLOTTED HOLES	d + 2mm WIDE x 2.5d LONG U.N.O
HD BOLTS	d + 4mm DIAMETER

STRUCTURAL STEEL CONTINUED:

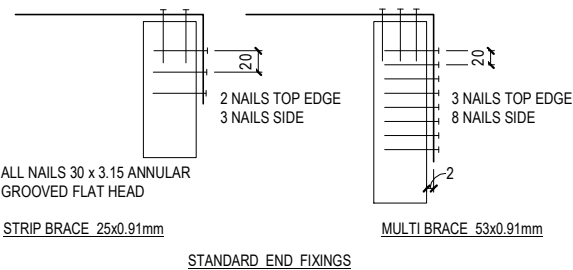
- WELDS:
 - ALL WELDED CONNECTIONS SHALL BE METAL ARC WELDED.
 - ALL WELDING SHALL COMPLY WITH AS 1554: PART 1 UNLESS NOTED.
 - WELDS EXPOSED IN THE COMPLETED BUILDING, PARTICULARLY BUTT WELDS OF STOCK LENGTHS SHALL BE NEATLY FINISHED AND GROUND SMOOTH
 - ALL BUTT WELDS SHALL BE FULL PENETRATION.
 - WELDING OF HOLLOW SECTIONS SHALL INCORPORATE INTERNAL SECTION OR BACKING PLATES AS NECESSARY TO COMPLETE THE SPECIFIED WELD.
 - ALL STRUCTURAL STEEL WELDING SHALL COMPLY WITH AS/NZS 1554 CLASS S.P. ALL WELDS TO BE 6mm MINIMUM CONTINUOUS FILLET WELDS AROUND THE CONNECTED PIECES UNLESS NOTED OTHERWISE
 - ALL WELD SYMBOLS SHOWN ON THE STRUCTURAL DRAWINGS ARE IN ACCORDANCE WITH AS 1101.3:1987.
 - SURFACE PREPARATION AND CORROSION PROTECTION OF STEEL WORK SHALL BE IN ACCORDANCE WITH THE STEELWORK PROTECTION TABLE BELOW. ANY DAMAGE TO THE PROTECTIVE COATING OF STEELWORK SHALL BE MADE GOOD.
 - THE CONTRACTOR SHALL SUBMIT STEELWORK SHOP DRAWING FOR REVIEW PRIOR TO COMMENCEMENT OF WORK.

STEEL PROTECTION:

- PAINT SPECIFICATIONS FOLLOW SNZ TS 3404:2018 BUT REFER TO ARCHITECTURAL SPECIFICATION FOR PAINT FINISH AND COLOUR. PREPARATION AND PAINTING SHALL BE DONE STRICTLY IN ACCORDANCE WITH THE PAINT MANUFACTURERS WRITTEN RECOMMENDATIONS AND IN ACCORDANCE WITH SNZ TS 3404:2018
- THE FOLLOWING SPECIFICATIONS ARE BASED ON A LONG-TERM PROTECTION SYSTEM, GENERALLY 25 YEARS TO FIRST MAJOR MAINTENANCE.

TIMBER:

- ALL TIMBER TO BE MSG8 GRADE RADIATA PINE COMPLYING WITH NZS 3602 AND GRADED TO NZS 3631 UNO.
- MOISTURE CONTENT OF FRAMING TIMBER SHALL NOT EXCEED 25% AT TIME OF INSTALLATION NOR 18% AT TIME OF ENCLOSURE.
- TIMBER TREATMENT SHALL COMPLY WITH THE REQUIREMENTS OF THE NZ TIMBER PRESERVATION COUNCIL. TIMBER TREATMENT FOR SPECIFIC MEMBERS IS TO BE IN ACCORDANCE WITH B2/AS1.
- UNLESS SHOWN OTHERWISE GENERAL CONSTRUCTION DETAILS SHALL COMPLY WITH REQUIREMENTS OF NZS 3604.
- PROVIDE WASHERS FOR BOLTED CONNECTIONS IN LOCATIONS AND TO SIZES REQUIRED BY NZS 3603. RE-TIGHTEN NUTS PRIOR TO ENCLOSURE OF JOINTS.
- PLYWOOD SHALL BE C-D GRADE CONSTRUCTION PLYWOOD CONFORMING TO NZS 3614.
- FOR ALL ASPECTS OF TIMBER FRAME CONSTRUCTION INCLUDING PROPRIETARY STRUCTURAL ELEMENTS, PLYWOOD DIAPHRAGM, WALL BRACING AND FIXINGS, REFER TO ARCHITECTS DRAWINGS /SPECIFICATION.
- TIMBER-TO-TIMBER AND TIMBER-TO-STEEL/CONCRETE/CONCRETE BLOCK CONNECTIONS, INDICATED ON STRUCTURAL DRAWINGS, HAVE BEEN SUBJECT TO SPECIFIC STRUCTURAL DESIGN. CONNECTIONS OTHERWISE SHALL CONFORM TO ARCHITECTS' DETAILS BUT NOWHERE LESS THAN NZS 3604 REQUIREMENTS.
- LUMBERLOK WALL AND ROOF BRACING CONNECTIONS AS SHOWN BELOW. ALL BRACES SHALL BE INSTALLED WITH TENSIONERS TO EACH LINE AND 3 - 30 X 3.15 ANNULAR GROOVED NAILS TO EVERY JOIST, RAFTER, STUD OR NOG THAT THE BRACE PASSES OVER



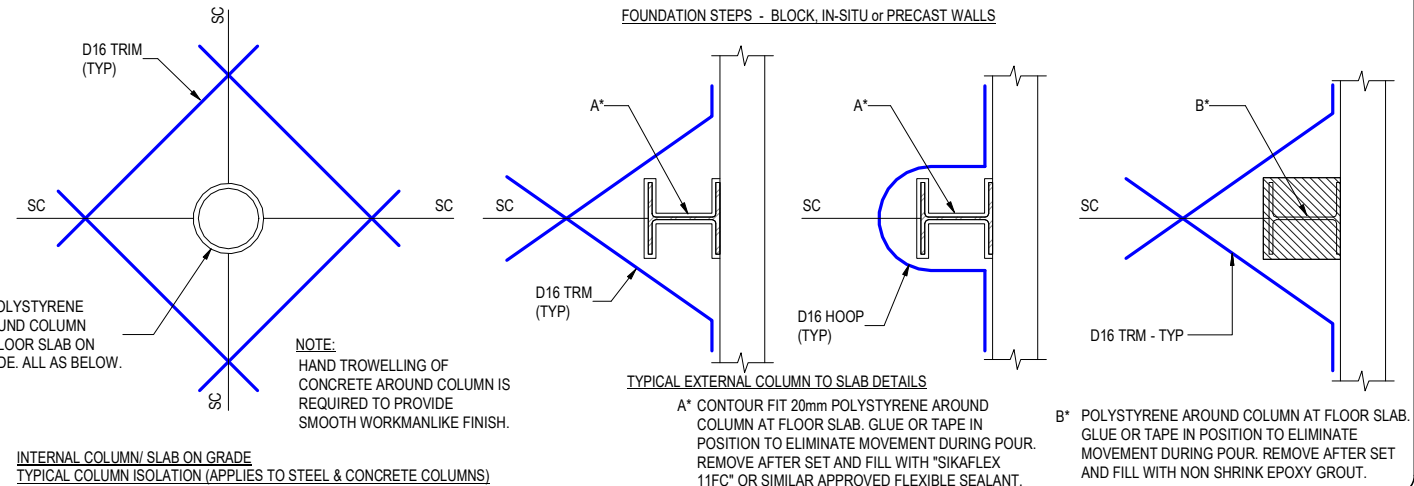
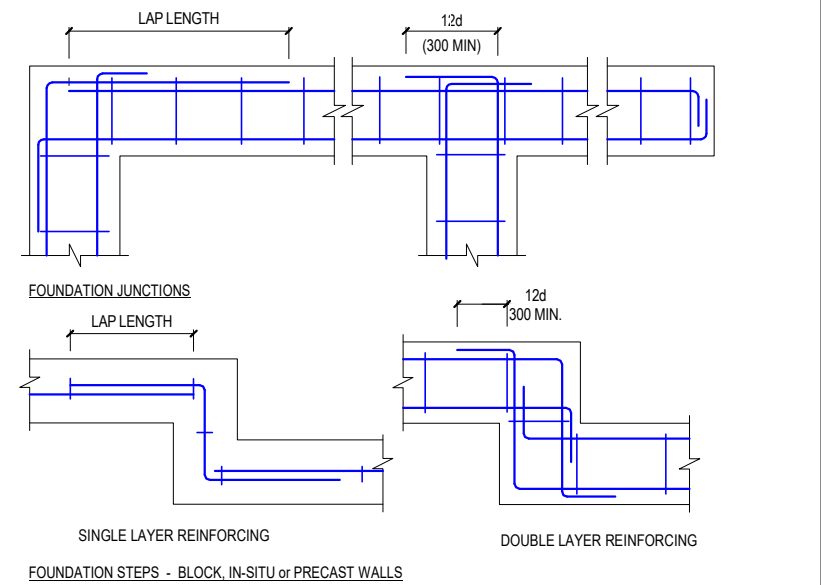
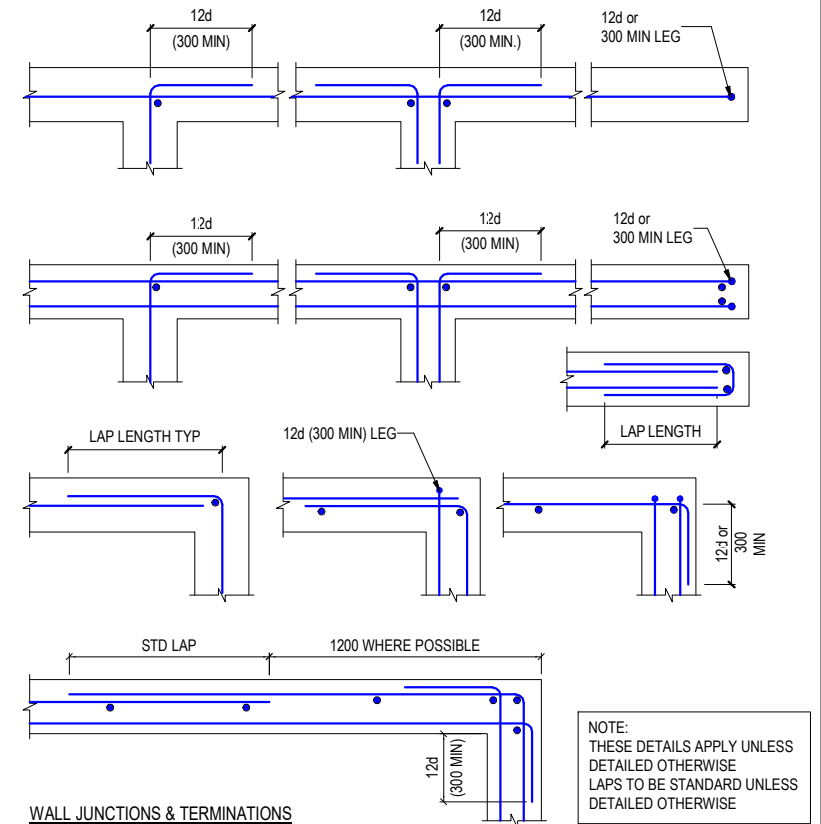
- ALL TIMBER MEMBERS OUTS/ PENETRATIONS TO COMPLY WITH NZS 3604:2011 UNLESS OTHERWISE NOTED

WELDING:

- GENERAL
WELDING SHALL BE UNDERTAKEN BY QUALIFIED WELDING PERSONNEL, IN ACCORDANCE WITH THE REQUIREMENTS OF NZS 3404 AND AS/NZS 1554. WELDS SHALL BE AS DETAILED ON THE DRAWINGS. ADDITIONAL BUTT WELDING OF SHORT LENGTHS SHALL NOT BE DONE WITHOUT THE SPECIFIC WRITTEN APPROVAL OF THE ENGINEER.

THE CONTRACTOR SHALL SUBMIT STEELWORK SHOP DRAWINGS FOR COMMENT PRIOR TO COMMENCEMENT OF WORK.
- WELDING
UNLESS DETAILED OTHERWISE, ALL WELDING IS CATEGORY SP.
- QUALITY
THE STRUCTURAL STEELWORK SUB-CONTRACTOR SHALL PREPARE A QUALITY PLAN(S) TO THE APPROVAL OF THE ENGINEER OR HIS/HER NOMINATED PERSON. ALL WELDING SHALL BE CARRIED OUT IN ACCORDANCE WITH THE QUALIFIED WELDING PROCEDURE APPROVED BY THE ENGINEER.
- INSPECTION
THE STRUCTURAL STEELWORK SUB-CONTRACTOR SHALL ENSURE THAT WELDING IS ESTABLISHED AND CARRIED OUT IN ACCORDANCE WITH THE REQUIREMENTS OF THE STANDARDS, THE DRAWINGS AND SPECIFICATIONS.
- TESTING
REFER TO THE STRUCTURAL SPECIFICATION FOR TESTING REQUIREMENTS.
- DEFECTS
ANY DEFECTIVE WELDS SHALL BE REMOVED AND RECTIFIED IN ACCORDANCE WITH THE ENGINEER'S INSTRUCTIONS. FURTHER WELDING MAY BE SUBJECT TO NON-DESTRUCTIVE TESTING TO BE PAID FOR BY THE STRUCTURAL STEELWORK SUB-CONTRACTOR.
- SITE WELDING
WELDING ON SITE, IF REQUIRED, SHALL BE TO THE SAME STANDARD AS OFF-SITE WORK. ALLOW TO PROVIDE ALL NECESSARY ACCESS SUPPORT, PROTECTION AND EQUIPMENT TO PERFORM THE WORK AS SPECIFIED IN A SAFE AND WORKMANLIKE MANNER.
- CONSUMABLES
REFER TO THE STRUCTURAL SPECIFICATIONS.
- WELDING OF EXISTING MATERIAL
SURFACES OF EXISTING MATERIAL, WHICH ARE TO BE STRENGTHENED, REPAIRED OR WELDED, SHALL BE CLEANED OF DIRT, RUST, AND OTHER FOREIGN MATTER EXCEPT ADHERENT SURFACE PROTECTION. THE PORTIONS OF SUCH SURFACES THAT ARE TO BE WELDED SHALL BE CLEANED THOROUGHLY OF ALL FOREIGN MATTER, INCLUDING PAINT FILM, FOR A DISTANCE OF 50MM FROM EACH SIDE OF THE OUTSIDE LINES OF THE WELDS.
- THE WELDING SEQUENCE SHALL BE CHOSEN SO AS TO MINIMISE DISTORTION OF THE MEMBER AND ENSURE THAT IT REMAINS WITHIN THE APPROPRIATE TOLERANCE LIMITS OF NZS3404.1:2009 SECTION 3.

TYPICAL DETAILS



THIS DRAWING IS THE COPYRIGHT OF ENGINEERING DESIGN CONSULTANTS LIMITED.

No.	DATE	REVISION	BY	CHK
0	09-11-2022	ISSUED FOR CONSENT	RP	SP

EDC ENGINEERING DESIGN CONSULTANTS
 CIVIL | STRUCTURAL | GEOTECHNICAL | ENVIRONMENTAL | FIRE
 Auckland Office: 1st Floor, Unit 1, 100 Bush Road, Albany 0632 (PO Box 118, Albany Village 0755). Ph: 09 451 9044 Fax: 09 415 1280
 Christchurch Office: 15B Leslie Hills Drive, Riccarton, Christchurch 8011 (PO Box 9016, Tower Junction, Christchurch 8149). Ph: 03 355 5559
 Email: team@edc.co.nz Website: www.edc.co.nz

PROJECT: **DECK DESIGN DRAWINGS**
Sec 9(2)(a), DOUBLE COVE FOR KARLI AND NICK BRISTED
 DRAWING TITLE: **STANDARD NOTES - SHEET 2**

DESIGNED:	SM
DRAWN:	RP
REVIEWED:	SP
ISSUED DATE:	NOV. 2022

SCALE AT A1	
1 : 1	
PAPER SPACE SIZE	
1:1 @ A1	

FOR CONSENT
50683 S002 0
 THIS DRAWING AND DESIGN SHALL NOT BE REPRODUCED IN ANY FORM WITHOUT THE WRITTEN AUTHORITY OF ENGINEERING DESIGN CONSULTANTS LIMITED - ALL RIGHTS RESERVED

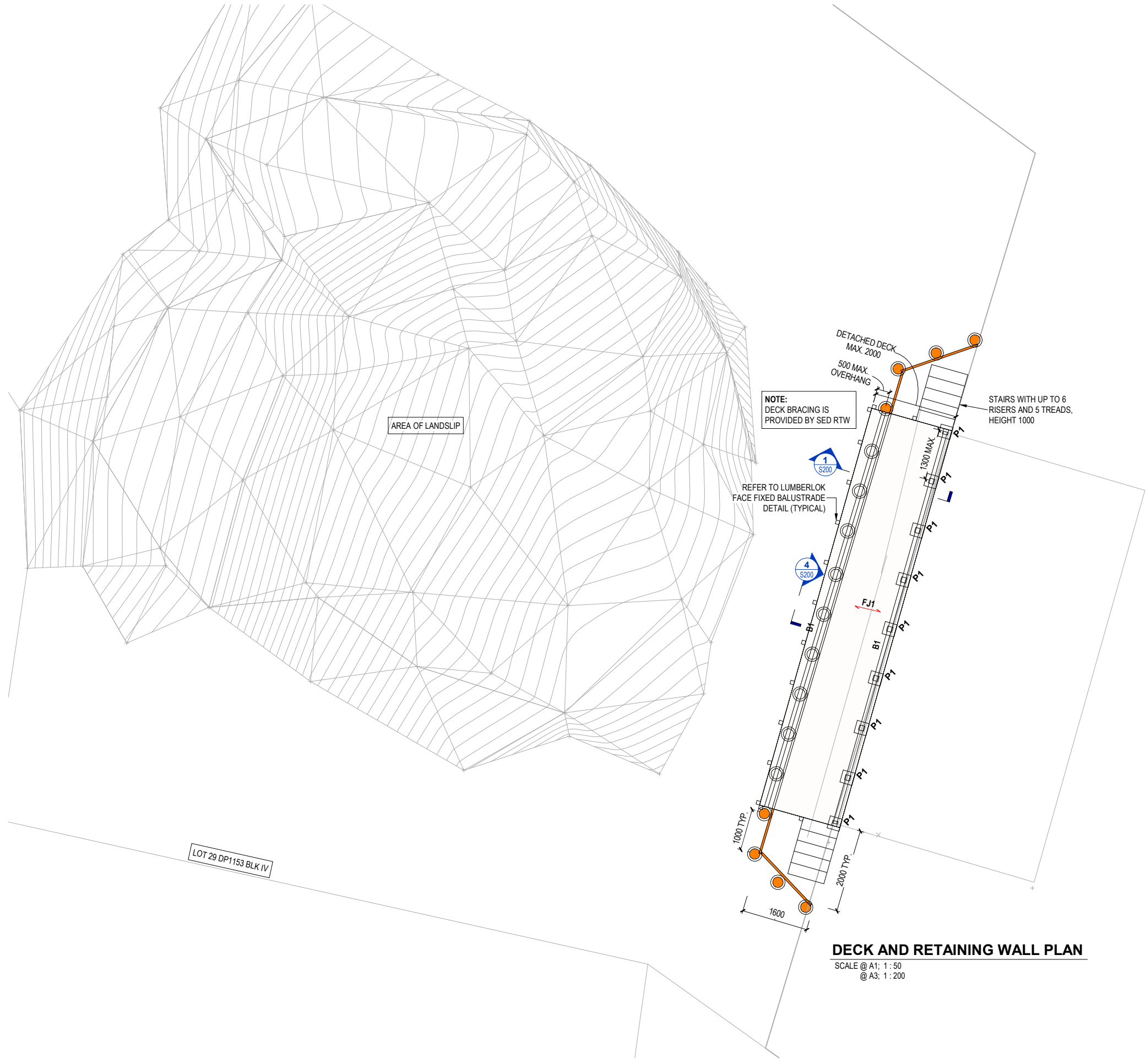
Original sheet size A1 (840x594) Rvt18 Plot date: 28/11/2022 9:37:37 am

S:\50600\50683 - Drawings\Structural\Revit_22\50683 Double Cove.rvt



300mm
200mm
100
50
0 10mm

Original sheet size A1 (840x594)_Rvt18 Plot date: 28/11/2022 9:37:38 am



DECK AND RETAINING WALL PLAN
SCALE @ A1: 1 : 50
@ A3: 1 : 200

- NOTES:**
1. ALL DIMENSIONS TO BE VERIFIED ON SITE BEFORE COMMENCING ANY WORKS.
 2. REFER TO ARCHITECTS DRAWINGS FOR ALL SET OUT DIMENSIONS, LEVELS, FALLS, SLAB SET DOWNS, REBATES, EDGE DETAILS & CAST IN ARCHITECTURAL ITEMS UNLESS NOTED OTHERWISE.
 3. ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH NZS 3404 SUBJECT TO RELEVANT SECTIONS OF THE SPECIFICATION.
 4. MIN 3 BLOWS / 100mm WITH SCALA PENETROMETER
 5. COMPACTED HARDFILL TO HAVE MIN CLEGG IMPACT VALUE 20
 6. $f_c=25\text{MPa}$
 7. EDC STRUCTURAL DRAWINGS TO BE READ IN CONJUNCTION WITH EDC GEOTECHNICAL DRAWINGS.
 8. FOUNDATION DESIGN BASED ON EDC LTD. GEO REPORT DATED 27 SEPT. 2022

FRAMING SCHEDULE	
MARK	DESCRIPTION
B1	90 x 90 H3.2 BEARER

FOUNDATION SCHEDULE	
MARK	DESCRIPTION
P1	125SQ. H5 DECK PILE w/ 300SQ. FOOTING

FJ1 140 x 45 H3.2 FLOOR JOISTS AT 450 CRS.
MAX. 500 CANTILEVER PAST RTW



MAP
SCALE @ A1: 1 : 10
@ A3: 1 : 20

No.	DATE	REVISION	BY	CHK
1	22-11-2022	ISSUED FOR CONSENT	SM	SM
0	09-11-2022	ISSUED FOR CONSENT	RP	SP

EDC ENGINEERING DESIGN CONSULTANTS
CIVIL | STRUCTURAL | GEOTECHNICAL | ENVIRONMENTAL | FIRE
Auckland Office: 1st Floor, Unit 1, 100 Bush Road, Albany 0632 (PO Box 118, Albany Village 0755). Ph: 09 451 9044 Fax: 09 415 1280
Christchurch Office: 15B Leslie Hills Drive, Riccarton, Christchurch 8011 (PO Box 9016, Tower Junction, Christchurch 8149). Ph: 03 355 5559
Email: team@edc.co.nz Website: www.edc.co.nz

PROJECT: **DECK DESIGN DRAWINGS**
Sec 9(2)(a), DOUBLE COVE
FOR KARLI AND NICK BRISTED

DRAWING TITLE: **DECK AND RETAINING WALL PLAN**

DESIGNED:	SM
DRAWN:	RP
REVIEWED:	SP
ISSUED DATE:	NOV. 2022

SCALE AT A1	As indicated
PAPER SPACE SIZE	1:1 @ A1

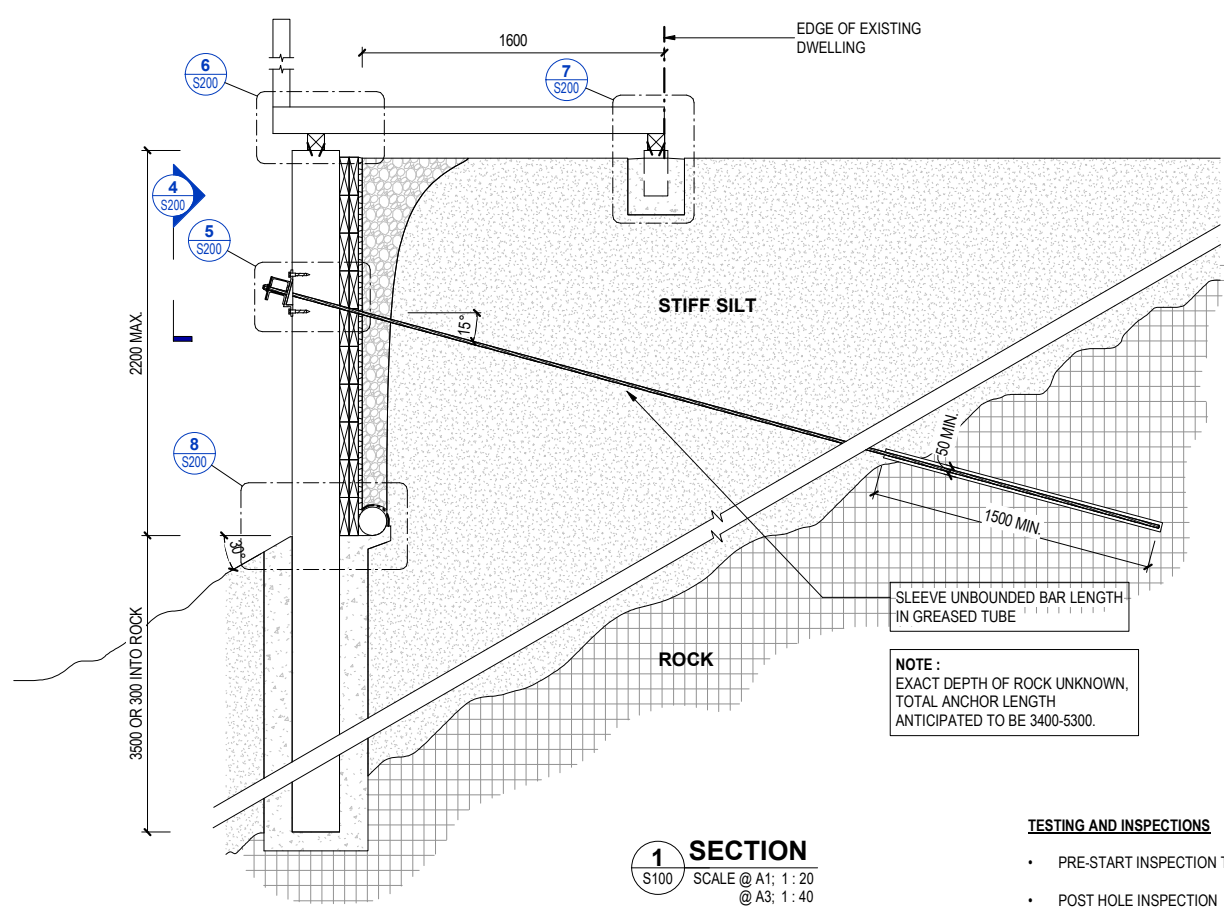
FOR CONSENT

50683 S100 1

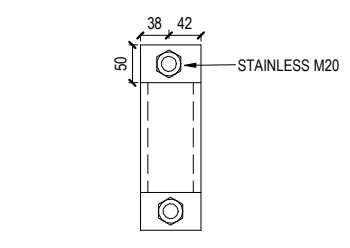
THIS DRAWING AND DESIGN SHALL NOT BE REPRODUCED IN ANY FORM WITHOUT THE WRITTEN AUTHORITY OF ENGINEERING DESIGN CONSULTANTS LIMITED - ALL RIGHTS RESERVED

S:\50600\50683 - Drawings\Structural\Revit_22\50683 Double Cove.rvt

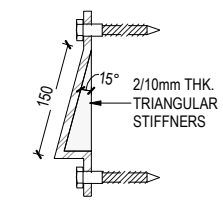
300mm
200mm
100
50
0 10mm



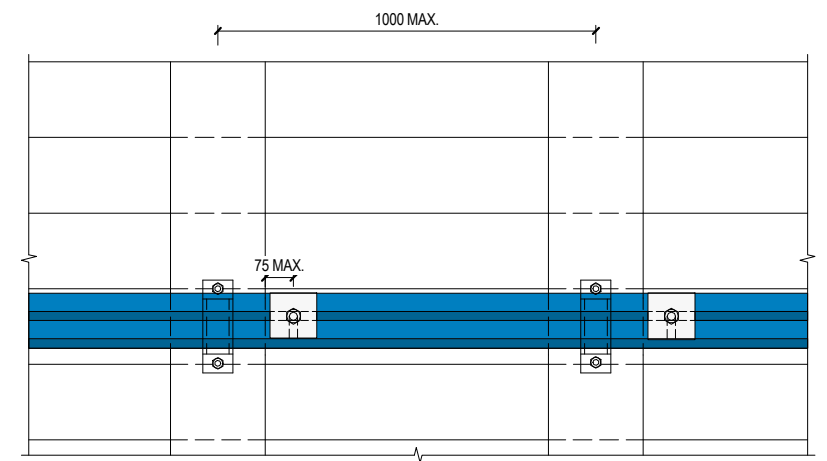
1 SECTION
S100 SCALE @ A1: 1:20
@ A3: 1:40



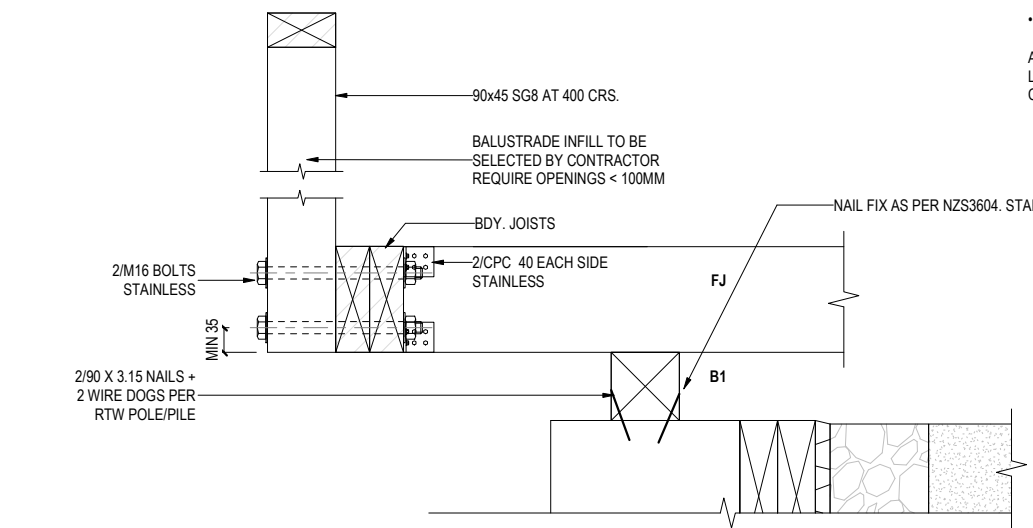
2 BRACKET FRONT
SCALE @ A1: 1:5
@ A3: 1:10



3 BRACKET SIDE
SCALE @ A1: 1:5
@ A3: 1:10



4 ELEVATION
S100 SCALE @ A1: 1:10
@ A3: 1:20



6 BEARER ON RTW
S200 SCALE @ A1: 1:5
@ A3: 1:10

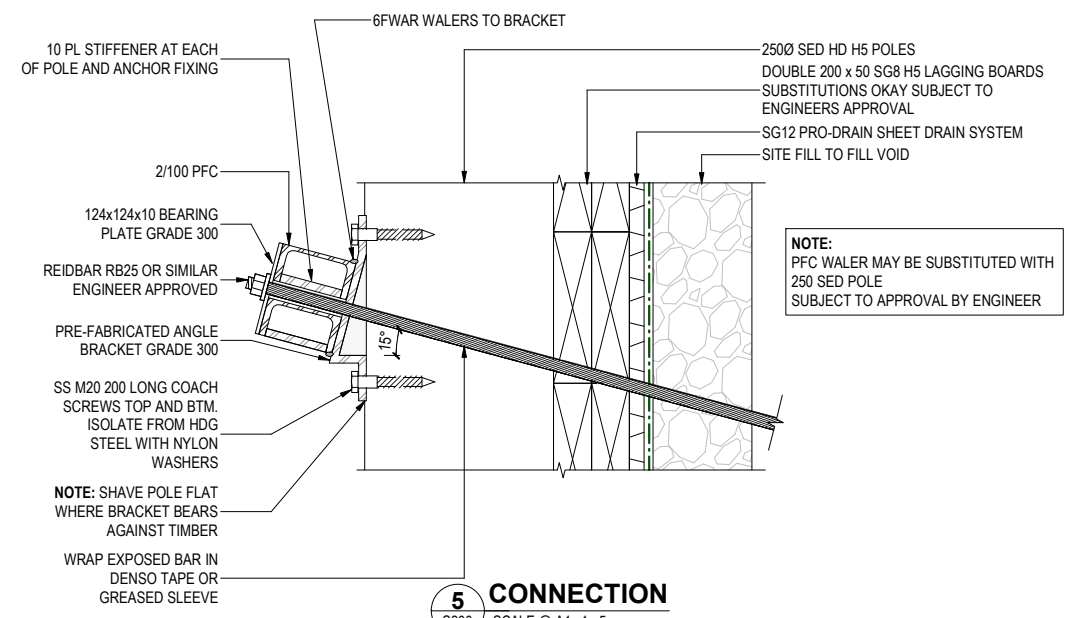
TESTING AND INSPECTIONS

- PRE-START INSPECTION TO ASSESS SLOPE
- POST HOLE INSPECTION
- DRAINAGE INSPECTION
- LAGGING INSPECTION
- WALLING INSPECTION
- ANCHOR INSPECTION
- FINAL INSPECTION

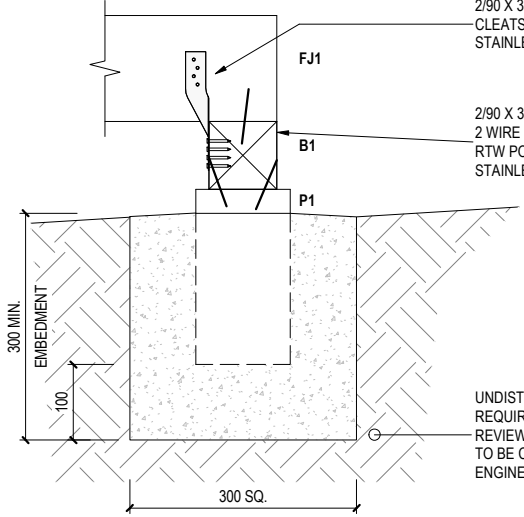
ALL ANCHORS ARE TO BE TESTED TO 100kN AND LOCKED OFF AT 45kN. TESTING SHOULD BE COMPLETED IN ACCORDANCE WITH AS4678-2002.

STEEL PROTECTION

- STEEL SURFACE-SPECIFIC CORROSIVE CATEGORY C3.
- PROVIDE COATING IN ACCORDANCE WITH SNZ TS 3404:2018 TABLE 6.
- HOT DIPPED GALVANISING SYSTEM HDG600 WILL BE SUITABLE FOR A 40 YEAR TIME TO FIRST MAINTENANCE.
- TO ENSURE QUALITY OF COATING AND THICKNESS A GALVANISING TEST CERTIFICATE IS REQUIRED BY EDC.
- GALVANISED BOLTS TO BE SEPARATED FROM STAINLESS WITH PLASTIC/RUBBER WASHERS.
- GREASE GALV. BOLTS THROUGH TREATED TIMBER TO ENSURE SEPARATION.

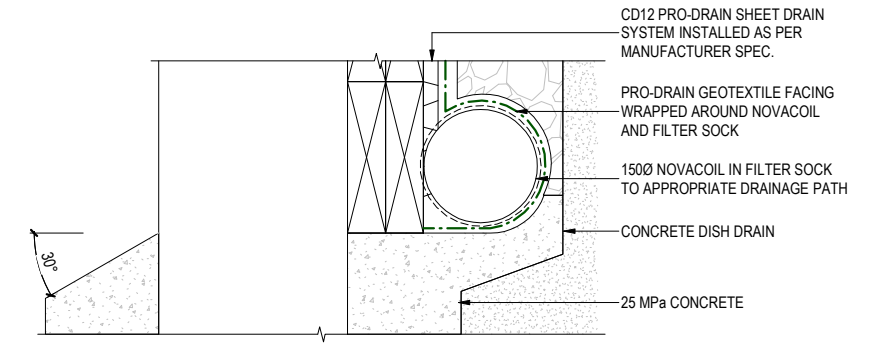


5 CONNECTION
S200 SCALE @ A1: 1:5
@ A3: 1:10



7 DECK PILE
S200 SCALE @ A1: 1:5
@ A3: 1:10

UNDISTURBED SHEAR STRENGTH OF 120kPa REQUIRED. REFER TO EDC GEOTECHNICAL REVIEW LETTER DATED 27 SEPTEMBER 2022. TO BE CONFIRMED BY GEOTECHNICAL ENGINEER.



8 DRAINAGE
S200 SCALE @ A1: 1:5
@ A3: 1:10

Original sheet size A1 (840x594) Rvt18 Plot date: 28/11/2022 9:37:39 am

No.	DATE	REVISION	BY	CHK
1	22-11-2022	ISSUED FOR CONSENT	SM	SM
0	09-11-2022	ISSUED FOR CONSENT	RP	SP

EDC ENGINEERING DESIGN CONSULTANTS
CIVIL | STRUCTURAL | GEOTECHNICAL | ENVIRONMENTAL | FIRE
Auckland Office: 1st Floor, Unit 1, 100 Bush Road, Albany 0632 (PO Box 118, Albany Village 0755). Ph: 09 451 9044 Fax: 09 415 1280
Christchurch Office: 15B Leslie Hills Drive, Riccarton, Christchurch 8011 (PO Box 9016, Tower Junction, Christchurch 8149). Ph: 03 355 5559
Email: team@edc.co.nz Website: www.edc.co.nz

PROJECT: **DECK DESIGN DRAWINGS**
Sec 9(2)(a), DOUBLE COVE FOR KARLI AND NICK BRISTED
DRAWING TITLE: **FOUNDATION DETAILS - SHEET 1**

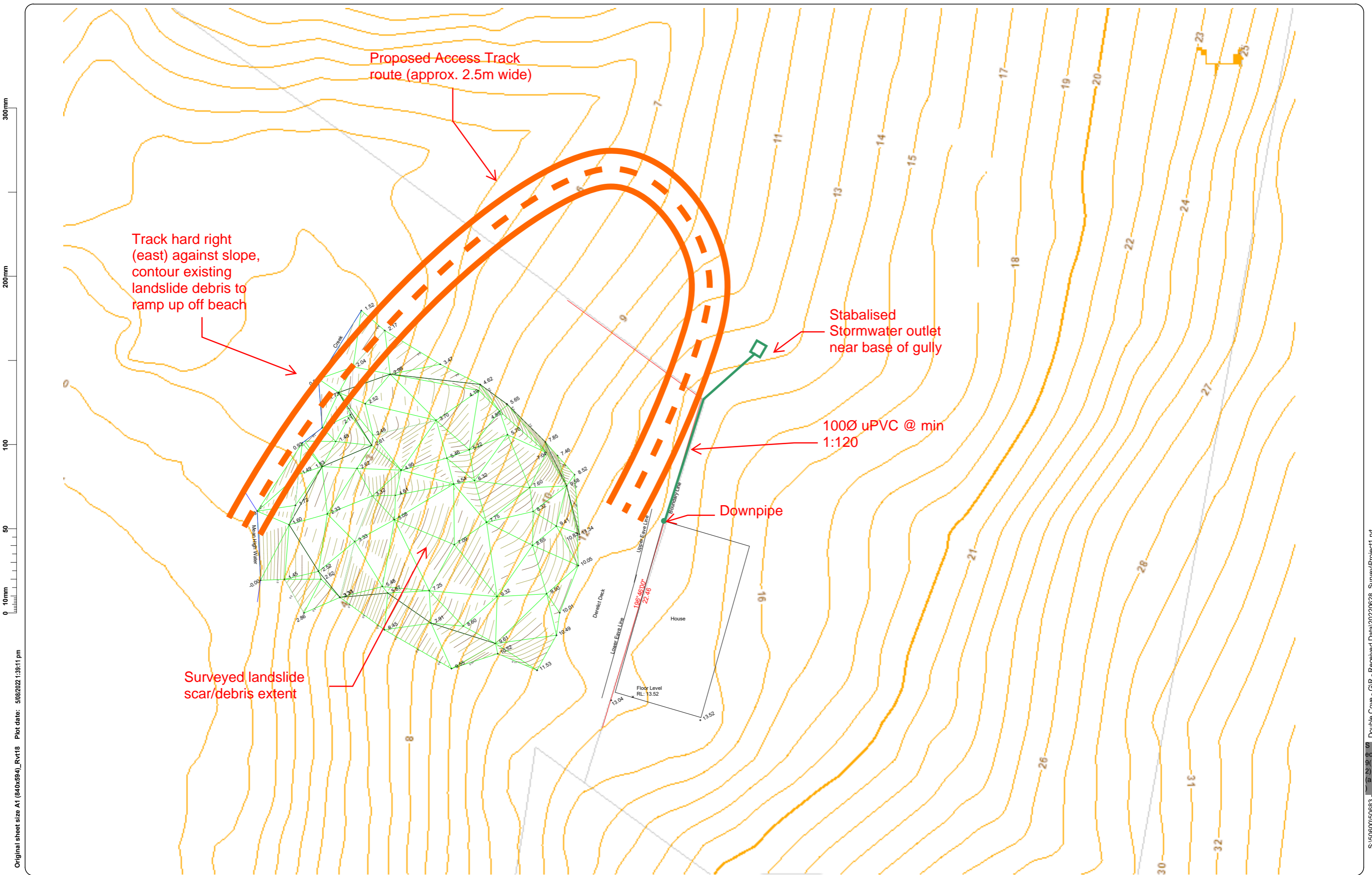
DESIGNED:	HG
DRAWN:	RP
REVIEWED:	SP
ISSUED DATE:	NOV. 2022

SCALE AT A1	As indicated
PAPER SPACE SIZE	1:1 @ A1

FOR CONSENT
50683 S200 1
THIS DRAWING AND DESIGN SHALL NOT BE REPRODUCED IN ANY FORM WITHOUT THE WRITTEN AUTHORITY OF ENGINEERING DESIGN CONSULTANTS LIMITED - ALL RIGHTS RESERVED

S:15060050683 - Double Cove - GID - Drawings\Structural\Revit_22\1506083 - Double Cove.rvt

APPENDIX F. CONSTRUCTION ACCESS PLANS



0 10mm 50 100 200mm 300mm

Original sheet size A1 (840x594)_Rvt18 Plot date: 5/8/2022 1:39:11 pm

S:\50600\50683 - Double Cove - GIR - Received Data\20220628_SurveyProject.rvt

No.	DATE	REVISION	BY	CHK
A	12/10/2022	ISSUED FOR DRAFT	DT	

EDC ENGINEERING DESIGN CONSULTANTS

CIVIL | STRUCTURAL | GEOTECHNICAL | ENVIRONMENTAL | FIRE

Auckland Office: 1st Floor, Unit 1, 100 Bush Road, Albany 0632 (PO Box 118, Albany Village 0755). Ph: 09 451 9044 Fax: 09 415 1280
 Christchurch Office: 15B Leslie Hills Drive, Riccarton, Christchurch 8011 (PO Box 9016, Tower Junction, Christchurch 8149). Ph: 03 355 5559
 Email: team@edc.co.nz Website: www.edc.co.nz

PROJECT: Sec 9(2) (a), Double Cove, Marlborough
Landslid Remediation

DRAWING TITLE: **Temporary Site Access & Stowmwater Disposal Plan**

DESIGNED:	DT/MS
DRAWN:	DT
REVIEWED:	-
ISSUED DATE:	Oct. 2022

Not To Scale

DRAFT

50683 - Rev.A

THIS DRAWING AND DESIGN SHALL NOT BE REPRODUCED IN ANY FORM WITHOUT THE WRITTEN AUTHORITY OF ENGINEERING DESIGN CONSULTANTS LIMITED - ALL RIGHTS RESERVED

As per the clause 3.2.1 of Building code E1/AS1

$$\text{Modified catchment Area} = 0.01 \times i \times A$$

MCA

$$i = 87.5 \text{ mm/hr [NIWA HIRDS R.C.P 8.5 for 2051 - 2100]}$$

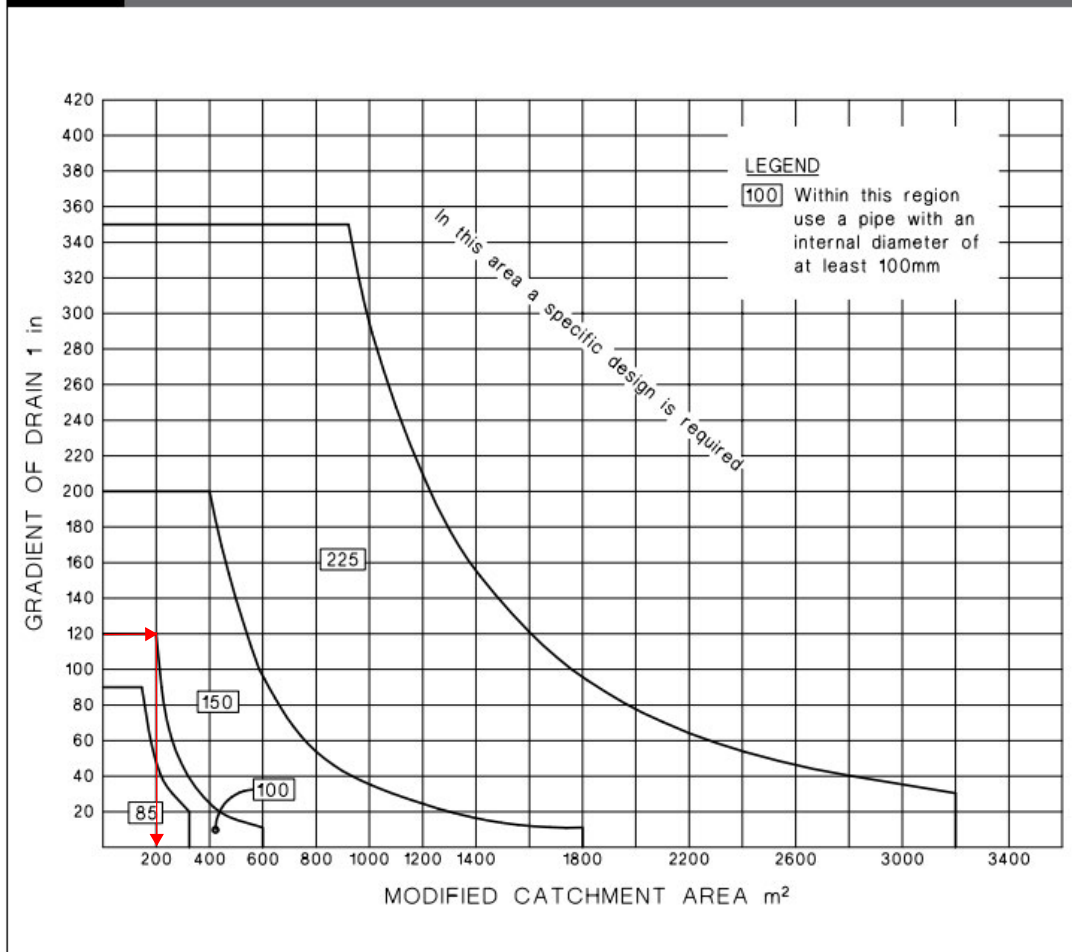
$$A = 48$$

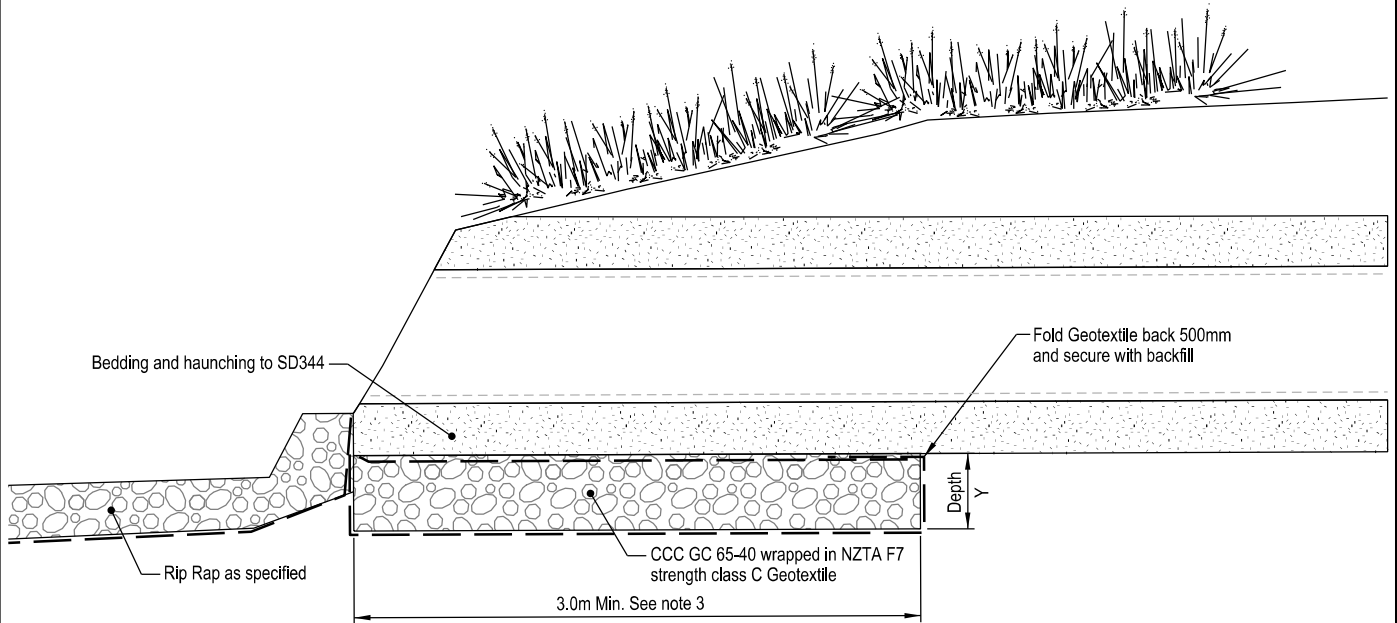
$$\text{MCA} = 0.01 \times 48 \times 87.5 = 42$$

From Figure 03 of Building code E1/AS1 MCA of a 100φ @ flatest grade of 1:120 = 200

∴ 100φ Pvc @ 1:120 is adequate for the roof catchment.

Figure 3: Sizing of Surface Water Drains
Paragraphs 3.2.2 and 3.2.3





SECTION

RAFT DEPTH	
PIPE DIAMETER	DEPTH (Y)
< 300 Ø	300mm
300 - 600 Ø	400mm
> 600 Ø	500mm

NOTES:

1. Suitable for soils with an allowable bearing pressure over 50kPa.
2. Width of raft to match trench width.
3. Extend raft foundation 0.5m minimum past rubber ring joint where within 3.0m of outlet.

