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Geotechnical Report

Dayna Hamilton

849 State Highway 1, Kaikoura

June 2023 Issue 01 Our ref: 9295

Contents

Appendices

Document Control

Issue	Date	Detail	Author	Reviewed	Approved
01	29/09/23	Issued to Client	JJ	RE	RE

1 Summary

Smart Alliances Ltd have carried out a geotechnical appraisal of the proposed subdivision at 849 State highway 1, Kaikoura (PT LOT 1 DP 10540) for Dayna Hamilton (Client). It is considered that the site is suitable for the proposed residential subdivision, provided that all the recommendations outlined herein are adhered to.

Foundations: It is considered that the proposed building site is suitable for a residential development and for construction on conventional foundations designed and constructed in accordance with NZS 3604:2011 at a depth of 200 mm below ground level. Alternatively, foundation systems can be engineer designed with reference to the attached test results. Given that the subsoil profile is dominated by river gravels we do not consider the subsoils at the site to be susceptible to liquefaction or lateral spread.

Wastewater: There is suitable ground conditions and separation distances from potential receptors for a wastewater management system to be installed at the site. A potential system including but not limited to, a primary system discharging to a discharge control trench or secondary system discharging to drip line would be suitable.

Stormwater Management: We have completed an assessment of the site to determine its suitability for stormwater disposal via ground soakage. It is considered that the proposed subdivision is suitable for stormwater disposal by ground soakage. It is recommended specific design of the soak pit(s) be carried out at the time of building consent lodgement. The soak pit(s) should be designed and constructed in accordance with 9.0.5 and 9.0.6 of Clause E1 of the NZ Building Code.

Flooding: A flood assessment has been conducted by Environment Canterbury. The proposed build site is outside of the 500 YRI flood hazard area and in the specified build site, is a permitted activity.

General comment relating to access, excavation, filling, removal of vegetation, wastewater and water supply are provided.

2 Introduction

Our Client proposes to subdivide their land at 849 State Highway 1, Hapuku Kaikoura (PT LOT 1 DP 10540). The current site is 0.55 hectares in size. The proposed subdivision will see the site split into two sections. Section one is the existing residence on 2.536Ha and section two at 2.46Ha.

The purpose of this report is to present the results of the site investigation carried out in relation to the foundation conditions, wastewater, stormwater and potential geotechnical hazards for the subdivision. The site investigation plan is presented in Appendix A of this report. The site investigation was carried out on 23th of June 2023.

3 Location & Site Description

The property is located at 849 State Highway 1, Kaikoura and is approximately 5 hectares in size. The property is bounded by native bush and the Hapuku River approximately 200m north, state highway 1 to the east and farm land/ bush to the south/ west. State highway 1 Hapuku bridge is approximately 270m north east from the site boundary. The existing residence is located on the proposed lot 1, with the new Lot 2 positioned to the east. The site is highest at the access point and maintains that level for approximately 60m noth and then begins to gently step down in a series of shallow terraces towards the Hapuku River.

The property is accessed directly from State Highway 1. Access is provided in the southeastern corner of the site. Within the property is native bush to the north with the rest of the site populated meadows/ grassland and occasional trees and bushes, these appear to be associated with historical fluvial deposits/ ridges / rough ground.

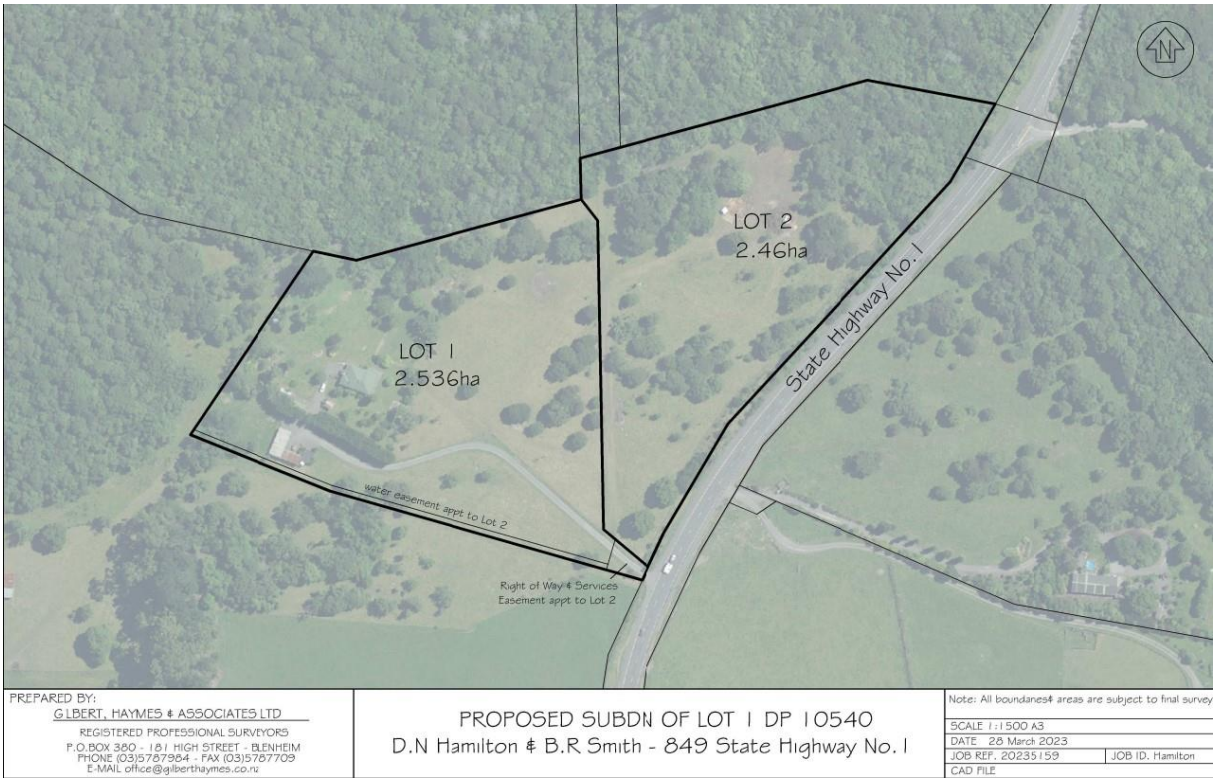

Figure:1 Proposed subdivision plan taken from Gilbert Haymes associates.


Photographs:1 Looking from site access across proposed build site. 2 looking east, across shallow terrace to the north of build site (machine can be seen in both as reference).


Photographs: 3 Looking towards bushes and trees typical at the site. 4 looking south from the banks of the Hapuku River towards site.

4 Geological Setting and Assessment

The geological map for the area (Rattenbury et al. 2006) indicates that the subject site is predominantly underlain by Holocene River deposits, further description includes sand gravels and silt.

The soil profile across the three trial pits consisted of TOPSOIL – 200mm, underlain by SAND or GRAVEL proved to 2.2m bgl (TP1). A full trial pit log in included in appendix C.

The Kaikoura area is a highly tectonically active region and is part of what is commonly known as the Marlborough Fault Zone which includes at least 8 active faults capable of generating a Magnitude 7 or greater earthquake. The closest known fault, the Hope Fault (Mt Fyffe) is located in excess of 800m north of the subject property. The site falls outside of the identified Kaikoura District fault avoidance zone.

Large earthquakes have occurred post European settlement, namely the 1848 M7.5 Marlborough earthquake and the 1888 M7.0-7.3 North Canterbury earthquake. However, these events did not generate the level of earthquake shaking and resulting damage within the Kaikoura region than that experienced from the 2016 M7.8 Kaikoura earthquake. The majority of damage to buildings in the area was shaking-related or from differential

settlement of older style foundations. No land damage resulting from this event was noted within the site.

A geotechnical assessment of the property was conducted, which included the visual assessment of the property together with invasive testing. A total of 6 Scala Penetrometer tests and three machine dug trial pits were conducted. This was to determine the bearing capacity and the strata of the underlying soils. The locations of the testing positions are indicated on the attached site plan in Appendix A.

5 Foundation Conditions

A total of 6 Scala Penetrometer Tests, labelled PT1 to PT6, were undertaken during site visits on the 23th of June 2023 within the proposed sub-division.

The results were interpreted using the procedure presented by MJ Stockwell in 'Determination of Allowable Bearing Pressure Under Small Structures' – NZ Engineering, June 1977. The testing indicated that the subsoil profile exhibited a soil bearing resistance of 300kPa (ultimate bearing capacity) at depths of 200mm below ground level. A full set of the Scala Penetrometer results is attached as Appendix B.

Liquefaction is the loss of soil strength and stiffness during earthquake shaking events where the pore water pressures in the soil rise quicker than the soil can drain. Liquefaction is more frequently observed in geologically young (Holocene aged deposits), saturated and loose granular soils. Given the origin and nature of the subsoils encountered on the site, the risk of liquefaction is considered low.

On the basis of the foregoing, it is considered that the proposed building site is suitable for a residential development and for construction on conventional foundations designed and constructed in accordance with NZS 3604:2011 at a minimum depth of 200mm below ground level. Alternatively, foundation systems can be engineer designed with reference to the attached test results. Suitable foundation systems would include, but not limited to, waffle slab/pod floor type foundation systems.

Smart Alliances considers other sites are feasible however a geomorphological risk assessment would be required to ascertain flood risk and minimum floor heights.

The conclusions and recommendations reported on have been on subsurface tests using hand-operated equipment. Although the opinions expressed in this report are based on the interpolation and the extrapolation between the test locations, no guarantee as to the validity of this inference or the nature and continuity of the subsurface materials can be made, and the possibility that variation from the assumed conditions between the test locations may occur cannot be ruled out.

6 Access

Existing access from State Highway one is to be shared via an easement. Constructing access to the build platform and parking is considered minimal. It is not anticipated vegetation removal will be required other than topsoil.

7 Excavation, Filling and Removal of Vegetation

Given the gently sloped site topography, it is not envisaged that substantial excavation or filling will be required on site, besides the excavation required to form the foundations. The expected excavation and removal of vegetation are not likely to cause stability issues provided best management practices are adhered to.

8 Wastewater

As no reticulated wastewater network is available in the area, all wastewater generated from any future dwelling will need to be managed and treated by a suitable on-site wastewater management system. The proposed new allotment was assessed to determine the site suitability for on-site wastewater disposal. The site has been assessed according to the relevant New Zealand Standard for On-site Domestic Wastewater Management (AS/NZS1547:2012) and the Canterbury Land and Water Regional Plan Volume 1 by Environment Canterbury.

8.1 Site and Soil Evaluation

The site was assessed by means of a desktop review of the available information, a visual assessment of the site and the intrusive investigation by means of machine-excavated test pits. The general site topography of the proposed allotment is relatively flat. The site is well vegetated with grasses and is exposed to sun and wind to allow for adequate evapotranspiration to occur.

Potential Land Application Areas (LAA's) were identified in the open grassed shallow terrace area north of the proposed build site. The area is relatively flat, well vegetated and exposed to sun and wind. Please note that this does not exclude the use of other areas as potential LAA's. The final LAA location should be determined once the location and bedroom number /occupation of any future dwelling is known. The preferred location and sizing should be confirmed at the Building Consent stage.

Three machine-excavated test pits were conducted. The profiles of the test pits are outlined in Section 4 and the full logs are presented in Appendix C. The subsoil profile consists of 200mm of topsoil overlying SAND and GRAVEL. The soils encountered on site correspond to a Category 1 soil, as per the soil category classifications provided in AS/NZS1547:2012. Groundwater was not encountered.

8.1.1 Assessment of Site Constraints

The closest known borehole (BT27/5028) is located approximately 400m from the proposed LLA. Groundwater was not encountered during the site investigation. The ponding of effluent is unlikely provided the LAA is sized appropriately.

The potential LAA is currently in an open area and vegetated with grass. It is also well exposed to wind and sun.

8.2 Wastewater System Design

The results of the site and soil evaluation indicated that the site is suitable for the on-site disposal of wastewater given the site constraints and the soil conditions.

Sufficient area is available for the disposal and to meet the minimum setback distances of 20m from open water courses and a vertical setback of 1m from the expected groundwater level.

Suitable systems would include a Primary system to distribution trenches or a secondary treatment unit with disposal to drip lines. Sizing of the potential system and disposal area will be dependent on the number of occupants/bedrooms of any potential future dwelling and the design, in accordance with AS/NZS1547:2012, should be finalised at Building Consent stage.

As the proposed allotment will be less than 4 hectares, the potential wastewater management system would not satisfy the permitted activity conditions under Rule 5.8 of the proposed Land and Water Regional Plan (LWRP) and a resource consent with Environment Canterbury for the discharge would be required.

9 Proposed Stormwater Management

No reticulated stormwater network is available within the immediate vicinity of the site. An assessment of the of the site was conducted to determine the suitability of the natural ground to received and dispose of residential stormwater. Three test pits, labelled TP1 - TP3, were excavated on site. The profiles of which are presented in Section 4 of this report. The soil profile corresponds to a Category 1 soil, as per the AS/NZS1547:2012 classification. Groundwater was not encountered during the investigation.

Given the available open space within the proposed allotment, the depth to groundwater and the nature and expected permeability of the soils encountered on site, it is considered that the proposed allotment is suitable for stormwater disposal by ground soakage. It is recommended specific design of the soak pit(s) be carried out at the time of building consent lodgement. The soak pit(s) should be designed and constructed in accordance with 9.0.5 and 9.0.6 of Clause E1 of the NZ Building Code.

Photo:5 Spoil pile Trial pit 1. Photo 6 Trial pit 2 base.

10 Water Supply

It is understood that our Client proposes to connect to the town mains located on the far side (west) of Skevington Road.

11 Addressing Section 106 of the RMA (1991)

Section 106 of the RMA requires an assessment of a subdivision proposal in regard to the risk of natural hazards to the property concerned. In 2017 the natural hazards to be assessed were broadened to include:

'Any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment.'

The relevant natural hazards to this proposal are:

Earthquake and subsidence – Due to the presence of gravels to depth we do not consider the subsoils at the site to be susceptible to liquefaction or lateral spreading.

Site specific shallow geotechnical testing has been carried out for the potentially developable area within the proposed new lot (identified in appendix A). The recommendations outlined in Section 6 are considered suitable to support a building consent application provided it is lodged within 3 years of the date on this report.

Should a building consent be lodged for a residential development on the proposed site in the future or in a different location, standard site specific shallow geotechnical testing and analysis should be carried out once building plans are formed.

Flooding – A flood hazard assessment was carried out by Environment Canterbury which is attached in appendix D of this report. The report recommends the build site which is recommended in this report is the most suitable area for a residence. Constructing a new dwelling within this overlay is a permitted activity under the district plan if it is located on land outside of High Flood Hazard Areas and has a finished floor level that is at least 300 mm above the 500 year ARI flood level. It specifies any of the lower area of the site would be subject to a geomorphological assessment. The report also states that any additional increase in height that the floor is built to will provide additional protection against extreme flood and aggradation events.

The risk from the other natural hazards outlined above are considered to either be non-applicable or less than minor due to the location, geology and topography of the site.

12 Conclusions

Based on the above assessment completed by Smart Alliances Ltd, it is considered that the site is suitable for the proposed subdivision, and for residential development provided that all recommendations outlined herein are adhered to.

The conclusions and recommendations reported are based on a visual appraisal of the site and subsurface tests obtained from hand operated penetrometer and machine-excavated test pits to meet the requirements of the client's brief. No site-specific Cone Penetrometer Testing (CPT's) or sampling and analysis of laboratory data was carried out and this report does not assert to completely quantify and qualify all the site geotechnical properties.

Although the opinions expressed in this report are based on the interpolation and extrapolation between the test locations, no guarantee as to the validity of this inference or the nature and continuity of the subsurface materials can be made, and the possibility that variation from the assumed conditions between the test locations may occur cannot be ruled out. If substantial variation between the assumed conditions expressed in this report is encountered, then it is recommended that Smart Alliances be consulted in order to establish whether any revisions to the recommendations for the proposed development should be adopted.

13 Limitations

This report has been prepared for Dayna Hamilton (our Clients) with respect to geotechnical investigations in support of their application for Resource Consent from Kaikoura District Council relating to the scope of work and address. The report is valid for a period of three years from the dates of issue. The reliance by other parties on the information or opinions in the report shall, without our prior review and agreement in writing, be at such parties' sole risk.

The recommendations expressed herein have been prepared with respect to the scope of work at the site and should not be taken out of context.

This report may not be read or reproduced except in its entirety.

14 References

1. Rattenbury, M.S., Townsend, D.B., and Johnston, M.R. (compilers) 2006. *Geology of the Kaikoura area*. Institute of Geological & Nuclear Sciences 1:250 000 Geological Map 13. 1 Sheet + 70p. Lower Hutt, New Zealand.
2. Guideline for the Field Classification and Description of Soils and Rock for Engineering Purposes NZ Geotechnical Society Inc December. 2005.
3. Yetton, M.D. and McCahon, I.F., June 2009: Earthquake Hazard Assessment for Kaikoura. Environment Canterbury Report R09/31 ISBN 978-1-86937-960-5
4. Barrell, D. J. A. 2014. General distribution and characteristics of active faults and folds in the Kaikoura District, North Canterbury, *GNS Science Consultancy Report* 2014/210. 59 p.
5. Litchfield, N.J., Morgenstern, R., Van Dissen, R.J., Langridge, R.M. Pettinga, J.R., Jack, H., Barrel, D.J.A and Villamor, P. 2019. Updated assessment of active faults in the Kaikoura District. *GNS Science Consultancy Report* 2018/141. 71p.
6. US Geotechnical Extreme Events Reconnaissance (GEER) Association, 10 June 2017. General Reconnaissance of the Mw7.8 2016 Kaikoura New Zealand Earthquake, Version 1.0
7. Golder Associates (NZ) Ltd, 17 September 2019. Liquefaction Study for Kaikoura District, 1894330_7407-003-R-Rev2

SMART ALLIANCES LTD

John Paul Jones
Geo-environmental Engineer

Richard Evans
Chartered Professional Engineer

Appendix A: Drawings

1
C01

SITE PLAN

Scale 1 : 1000

Do not scale from this drawing.
Verify all dimensions on site prior to construction.

REV	DATE	DESCRIPTION
0	30.06.23	REPORT

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1st Floor, Riverview House, 10 High Street, Blenheim, New Zealand
Website - www.smartalliances.co.nz
Phone - 03 579 6211

PROJECT
HAMILTON SUBDIVISION
849 STATE HIGHWAY 1

CLIENT
D HAMILTON

DRAWING
SITE PLAN

ORIGIN DATE
30.06.23

PROJECT STATUS
REPORT

SCALE (A3)
As indicated

REVISION DATE
30.06.23

DWG NO.
9295-C01

REVISION
0

P:\9295-Hamilton Subdivision, 849 Kincaid Road, Kaikoura\06-Drawings (Smart Alliances)\01-Working Drawings (DWG Files)\9295-DRG-CIVIL-01.rvt

Appendix B: Scala Penetrometer Test Results

smartalliances
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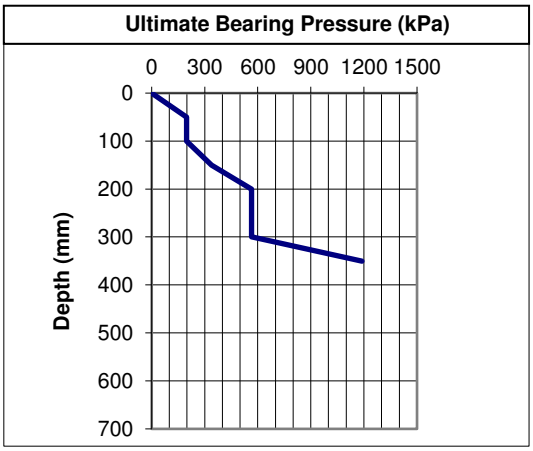
Project:	**894 State Highway 1**		
Client:	**Dayna Hamilton**		
Ref:	**9295**	**Eng:**	**JJ**
Date:	**23/06/2023**	**Sheet:**	**1 of 2**

PENETROMETER TEST RESULTS

Notes: Groundwater was not encountered.

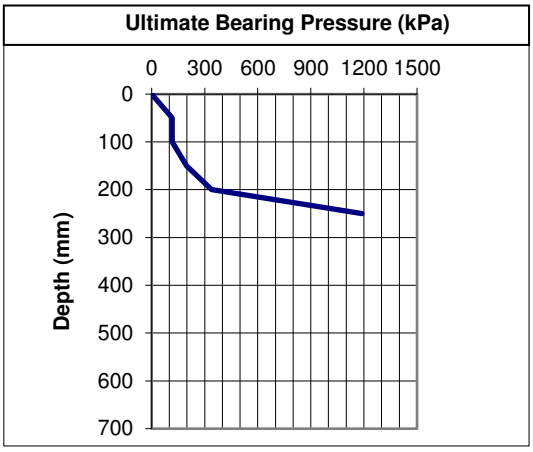
Test 1

No. of	e (mm/blow)	Soil bearing	Depth (mm)
START	0	**0**	0
1	50	**198**	50
1	50	**198**	100
2	25	**339**	150
4	13	**565**	200
4	13	**565**	250
4	13	**565**	300
10	5	**1189**	350
Refusal			



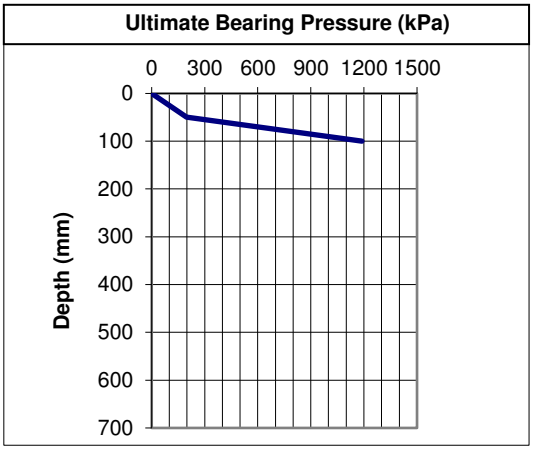
Test 2

No. of	e (mm/blow)	Soil bearing	Depth (mm)
START	0	**0**	0
0.5	100	**115**	50
0.5	100	**115**	100
1	50	**198**	150
2	25	**339**	200
10	5	**1189**	250
Refusal			



Test 3

No. of	e (mm/blow)	Soil bearing	Depth (mm)
START	0	**0**	0
1	50	**198**	50
10	5	**1189**	100
Refusal			



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P.O. BOX 546 BLENHEIM NEW ZEALAND

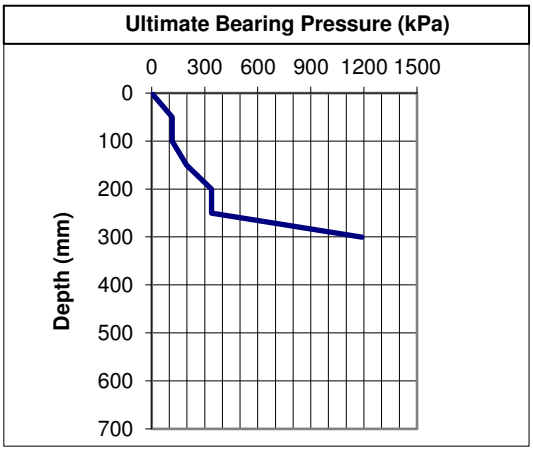
Project:	**894 State Highway 1**		
Client:	**Dayna Hamilton**		
Ref:	**9295**	**Eng:**	**JJ**
Date:	**23/06/2023**	**Sheet:**	**2 of 2**

PENETROMETER TEST RESULTS

Notes: Groundwater was not encountered.

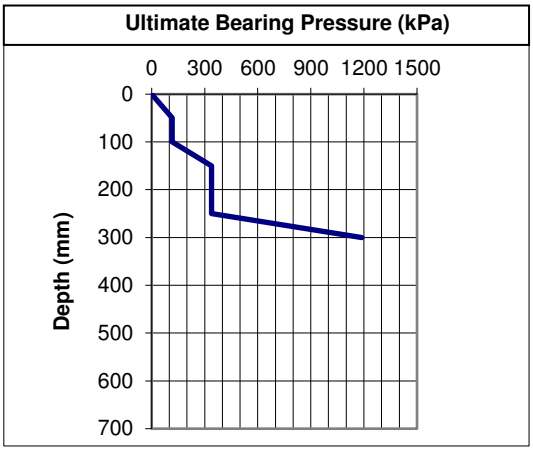
Test 4

No. of	e (mm/blow)	Soil bearing	Depth (mm)
START	0	**0**	0
0.5	100	**115**	50
0.5	100	**115**	100
1	50	**198**	150
2	25	**339**	200
2	25	**339**	250
10	5	**1189**	300
Refusal			



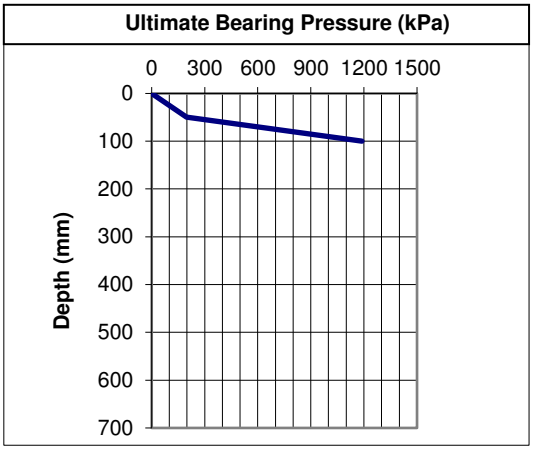
Test 5

No. of	e (mm/blow)	Soil bearing	Depth (mm)
START	0	**0**	0
0.5	100	**115**	50
0.5	100	**115**	100
2	25	**339**	150
2	25	**339**	200
2	25	**339**	250
10	5	**1189**	300
Refusal			



Test 6

No. of	e (mm/blow)	Soil bearing	Depth (mm)
START	0	**0**	0
1	50	**198**	50
10	5	**1189**	100
Refusal			



Appendix C: Soil Logs

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Client: Dayna Hamilton
Project: 849 State highway 1
Location: Hapuku
Job Number: 8461
Test Pit: TP1
Date: 23.06.23
Logged by: JJ
Page: 1 of 1

Legend:
GRAVEL
TOPSOIL

DEPTH (mm)	GRAPHIC LOG	DESCRIPTION	PHOTOGRAPH
0 – 200		Sandy TOPSOIL with gravel and ocasional cobbles	
200 – 1000		Sandy GRAVEL with cobbles. Black, frequent rootlets, sand is fine to coarse, gravel is fine to coarse angular to subrounded. Cobbles < 200mm	
1000 – 2200		Sandy GRAVEL with cobbles and boulders. Brown, sand is fine coarse, gravel is fine to coarse angular to sub-rounded. Cobbles are fine to coarse angular to subrounded, boulders are Su and gular and subrounded < 500mm. @ 1.8 boulder in south end of pit, machine unable to remove.	

NOTES:
Groundwater was not encountered.

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Client: Dayna Hamilton
Project: 849 State highway 1
Location: Hapuku
Job Number: 8461
Test Pit: TP2
Date: 23.06.23
Logged by: JJ
Page: 1 of 1

Legend:
TOPSOIL
SAND

DEPTH (mm)	GRAPHIC LOG	DESCRIPTION	PHOTOGRAPH
0 – 200		Sandy TOPSOIL with gravel and ocasional cobbles	
200 – 300		Gravely SAND. Sand is fine to course. Gravel is fine to coarse, angular to sub-rounded, cobbles < 150mm Mixed lithologies.	
300 – 1200		Gravely SAND. Sand is fine to course. Gravel is fine to coarse, angular to sub-rounded, cobbles and boulders sub rounded <400mm Mixed lithologies.	

NOTES:
Groundwater was not encountered.

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E: info@smartalliances.co.nz
W: www.smartalliances.co.nz

Client: Dayna Hamilton
Project: 849 State highway 1
Location: Hapuku
Job Number: 8461
Test Pit: TP3
Date: 23.06.23
Logged by: JJ
Page: 1 of 1

Legend:
TOPSOIL
SAND

DEPTH (mm)	GRAPHIC LOG	DESCRIPTION	PHOTOGRAPH
0 – 200		Sandy TOPSOIL with gravel and ocasional cobbles	
200 – 300		Gravely SAND. Sand is fine to course. Gravel is fine to coarse, angular to sub-rounded, cobbles < 150mm Mixed lithologies.	
300 – 1200		Gravely SAND. Sand is fine to course. Gravel is fine to coarse, angular to sub-rounded, cobbles and boulders sub rounded <400mm Mixed lithologies.	

NOTES:
Groundwater was not encountered.

Appendix D: Environment Canterbury Flood Assessment.

Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz

www.ecan.govt.nz

19 April 2023

Philip Morton
phil@gilberthaymes.co.nz

Dear Phil

FLOOD HAZARD ASSESSMENT – LOT 1 DP 10540, 849 SH1, KAIKOURA

The property is adjacent to the southern banks of the Hāpuku River, near the Puhi Puhi River confluence and on the Hāpuku River floodplain (see Location map). It is potentially susceptible to flooding from the Hāpuku River during large flood events.

Hāpuku River

The 130 km^2 Hāpuku catchment drains the Seaward Kaikoura Range to the coast via the Hāpuku River, and the large Puhi Puhi River tributary which enters the Hāpuku River upstream of the SH1 road bridge. In major flood events, the steep and braided Hāpuku and Puhi Puhi rivers transport large quantities of gravel. Consequently, a change in the Hāpuku River course (to follow previously abandoned river channels on the floodplain) is quite possible. This has occurred historically to form the Hāpuku River floodplain.

River control works on the Hāpuku River include stopbanks, echelon (flow return) banks and vegetated berm areas. However, the dynamic nature of the Hāpuku River means the works are only designed to provide 'protection' from floods with an Average Recurrence Interval (ARI) of up to around 20 years. In larger events these works are likely to be overwhelmed, with aggradation further increasing the likelihood of flows onto the floodplain. Vegetated berm areas, forming part of the river control works, run along the northern boundary of the property, and include the northernmost portion of the property closest to SH1.

LiDAR and computational modelling

In 2012 and 2016/17 LiDAR (Light Detection and Ranging) data was acquired for the Kaikoura area. This LiDAR data was collected using a scanner mounted on an aircraft that measures the ground level at approximately one point every square metre, enabling high resolution digital elevation maps to be generated (see LiDAR map for 2017 land elevations).

LiDAR data for the property (see LiDAR map) indicate that the southern portion of the property is on a more elevated terrace. Geomorphic and flood hazard mapping indicates that this elevated terrace has the lowest risk of future flood damage.

LiDAR data has also enabled detailed flood modelling to be undertaken. A computational hydraulic model of the Hāpuku River is summarised in an Environment Canterbury Technical Report (Kekerengu, Hāpuku and Oaro floodplain investigation, Report No. R19/04, January 2019) that is available online (https://www.ecan.govt.nz/data/document-library/?Search=PU1C%2F8569).

This report indicates that a 500 year ARI flood flow (incorporating climate change to 2120) in the Hāpuku River should be reasonably well contained by the existing fairway and adjacent floodplain, and flood water should not reach the property. However, it also states …

Our Ref: 23460
Contact: Michelle Wild

"Given that the models used in this study have fixed beds, it is not possible to determine all possible 500 year ARI flood scenarios – particularly now that there is a considerable supply of additional sediment being stored in the upper catchment of these rivers due to the 2016 Kaikōura earthquake sequence. Climate change and sea level rise may also have an impact on rivers and their outlets to the sea. Care should therefore be taken when interpreting these model results.'

The large volume of Hāpuku landslide material entering the Hāpuku River system post-2016 Kaikoura Earthquake Sequence could potentially cause the bed levels in the Hāpuku River to rise, and consequently increase flood levels.

As scour, erosion, aggradation, and avulsion (movement of the main river channels) are not included in the fixed bed model, it is not possible to properly determine the likelihood of a river avulsion and floodwater being diverted towards the property for a 500 year ARI flood event based on this model.

Floor level
The property is within the Kaikoura District Plan 'Non-Urban Flood Assessment Overlay'. Constructing a new dwelling within this overlay is a permitted activity under the district plan if it is located on land outside of High Flood Hazard Areas and has a finished floor level that is at least 300 mm above the 500 year ARI flood level. High Flood Hazard Areas are defined as areas where the water depth (m) x velocity (m/s) is greater than or equal to 1 or where depths are greater than 1 m in a 500 year ARI flood event.

Based on the modelling, previous geomorphic/flood hazard mapping, and LiDAR data:

- the elevated southern terrace on the property is likely to be outside the High Flood Hazard Area. Any future dwelling located on this elevated terrace should be constructed outside of any depressions and swales and meet the NZ Building Code standard. A setback of at least 15 m from the terrace edge is also recommended.

- The area below the elevated southern terrace is more susceptible to flood inundation. The likelihood of flood inundation, and whether this area should be considered a High Flood Hazard Area, is currently unknown due to the considerable uncertainty regarding the Hāpuku landslide material travelling along the river system. This landslide material is likely to exacerbate channel aggradation, channel avulsion (movement of the main river channel location) and floodplain scour/erosion in the Hāpuku River. It is therefore recommended that a geomorphic assessment be undertaken for any proposed dwelling located on this less elevated area of the property.

Any additional increase in height that the floor is built to will provide additional protection against extreme flood and aggradation events.

When using the information provided in this letter, it is important that the following points are understood:

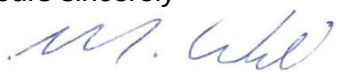
- The information is limited to what Environment Canterbury currently has available. The District Council or local residents may have further information about flooding at the property.
- Environment Canterbury's understanding of flooding at the property may change in the future as further investigations are carried out and new information becomes available.
- It is assumed that any flood protection works will be maintained to at least their current standard in the future.
- Stopbank failure can occur at flows less than the design standard, and the location of bank failure/overtopping may affect flood depths at the property.
- Flood depths can also be affected by changes to the bed levels in the water courses (e.g. aggradation or scour), floodplain topography (e.g. roads, earthworks, aggradation or scour),

structures on the floodplain (e.g. fences, buildings, culverts), vegetation (e.g. hedges, crops), and antecedent soil conditions.

The prediction of flood depths requires many assumptions and is not an exact science.

If you have any concerns or questions please contact me.

Yours sincerely



Michelle Wild
SENIOR SCIENTIST (Flooding)

Cc: Kaikoura District Council

Encl: Location map
LiDAR (ground level) map

Our Ref: 23460
Contact: Michelle Wild