Christchurch City Council

Resource Consents Unit

Application for Resource Consent: Subdivision

Resource Management Act 1991 – Form 9

Submit this form online at: onlineservices.ccc.govt.nz; or
Email to: resourceconsentapplications@ccc.govt.nz; or
Deliver to: Resource Consents Unit, Christchurch City Council, 53 Hereford Street, Christchurch; or
Send to: Resource Consents Unit, Christchurch City Council, PO Box 73013, Christchurch Mail Centre, Christchurch, 8154

For enquiries phone: (03) 941 8999 or email DutyPlanner@ccc.govt.nz

About this form

This form is used to apply for a subdivision consent under Section 88 of the Resource Management Act 1991, and any associated land use consent that may be required. It must be accompanied by a Record of Title, plans and other supporting information.

A deposit must be paid before processing will commence (refer to the Resource Management Fee Schedule). An invoice will be issued when the application has been received.

Applications are checked for completeness prior to acceptance. Please ensure that you have compiled your documents carefully to avoid delays accepting your application. A checklist is included at the end of this form.

Please also refer to the important information contained in Sections 12 and 13 of this form.

1. Pre-application discussions

Have you had a pre-application meeting or discussion with any Council staff about this proposal?	☑ Yes	☐ No
If yes, what was the name of the planner or other staff member(s)?	Rachel Cottam	
Date of pre-application meeting (if applicable):	10 Oct 2022	
Meeting reference number:	Pre708108	

2. Application site

Street address:	130 Bowenvale Avenue Cashmere
Legal description: *(as at the date of application)*	Part Lot 2 DP 33462

3. Applicant details

*Please note that the **applicant** is responsible for the fees associated with this application, unless specified otherwise in Section 5. Where there is an agent, it is the Council's practice to communicate with both the agent and the applicant.*

Full name (including middle name):			
OR			
Registered Company / Trust / Organisation name:	Bowenvale GCO Ltd		
Contact person / Trustee names:	Cameron McCarthy		
Landline:		Mobile :	0225 274 976
Email:	planning@s5s.nz		
Postal Address:	Level 26 Hsbc Tower, 188 Quay Street,, Auckland, 1010 , New Zealand		

The applicant is the: ☑ Owner ☐ Occupier ☐ Lessee ☐ Prospective purchaser of the application site

☐ Other (please specify):

4. Agent / Surveyor

Name of Agent:	Sonja Perrin		
Name of firm:	Sonja Perrin Town Planners		
Landline:		Mobile :	02102223434
Email:	sonjaperrin@outlook.com		
Postal Address:	18 Marsden Street Heathcote Valley Christchurch		

5. Invoicing details

All consent-related invoices are to be made out to:

☑ Applicant *(Their full details must be provided in section 3 above)*

☐ Agent

☐ Existing 'on-account' customer Account customer name:

☐ Other (specify below)

Name:	
Email:	
Postal Address:	

Note: Any refunds will be paid to the receipted name.

6. Owners and occupiers of the application site

The full name and postal address of each owner and occupier of the application site (if different to the applicant):

7. Description of proposal

Describe the proposed subdivision activity:

35 Lot Fee Simple Lot Subdivision with associated Earthworks
Residential Dwelling with attached garage on proposed Lot 34 of the subdivision

Summary:

Subdivision type: ☑ Fee simple ☐ Boundary adjustment ☐ Cross lease ☐ Unit titles

Number of lots: 35

Subdivision activity: ☐ Controlled ☐ Restricted Discretionary ☐ Discretionary ☑ Non-complying

Resulting land use non-compliances? ☑ Yes ☐ No

8. Areas of non-compliance and assessment of effects

Outline the manner in which the proposal will comply (or does not comply) with the rules of the District Plan, regulations in any relevant National Environmental Standards, and relevant sections of the Resource Management Act.

An assessment of effects on the environment (Schedule 4 RMA) must be completed to a level of detail that corresponds with the scale and significance of the effects that the proposed activity may have on the environment. *Please make sure your assessment covers all the matters of discretion or control in the District Plan and NES for the rules breached / triggered.*

A report covering these matters may be attached as a separate document.

Refer AEE

9. National Environment Standard (NES)

This section relates to the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NES).

The NES includes regulations controlling **soil disturbance, change of use, subdivision and removal/replacement of fuel storage systems** on properties which have been used either now or in the past for a hazardous activity or industry (known as HAIL) that may have resulted in contamination of the soil.

Please answer the following questions to determine whether the NES applies to your proposal.

Is the application site listed on Environment Canterbury's Listed Land Use Register (LLUR)? www.llur.ecan.govt.nz. If YES, please include a copy of the LLUR statement with your application.	☐ Yes	☑ No
If the site is not listed on the LLUR, is an activity described on the Hazardous Substances and Industries List (HAIL) currently being undertaken on the piece of land to which this application relates, or is it more likely than not to have ever been undertaken on the land? The HAIL list is available at: https://environment.govt.nz/publications/hazardous-activities-and-industries-list-hail/	☐ Yes	☑ No
Type of HAIL activity:		

If the answer to either of the above questions is YES, then the NES may apply, depending on the proposed activity. Please identify whether the application involves any of the activities below.
(If the answer to both of the above questions is NO, you do not need to answer the remaining questions in this section).

Does the application involve subdivision of the land?	☒ Yes	☐ No
Will the proposed activity involve disturbance of more than 25m³ of soil (per 500m² of disturbed area)?	☐ Yes	☐ No
Volume of soil disturbance:		
Will the proposed activity involve removal of more than 5m³ of soil (per 500m² of disturbed area) from the site?	☐ Yes	☐ No
Volume of soil removal:		

Does the application involve changing the use of the land to one which, because the land has been subject to a HAIL activity, is reasonably likely to harm human health? (e.g. service station to office, orchard to residential)	☐ Yes	☐ No

You will need to establish whether the proposed activity complies with the NES.

- Subdividing or changing the land use will require resource consent if the permitted activity requirements of the NES are not complied with. These include provision of a Preliminary Site Investigation carried out by a suitably qualified and experienced practitioner.
- Soil disturbance or removal exceeding the specified volumes requires resource consent.

Does the proposed activity require resource consent under the NES?	☐ Yes	☐ No

If the answer is YES, an assessment of the application under the NES must be provided as part of your Assessment of Effects on the Environment (refer Section 8 above). A Detailed Site Investigation may be required.

10. Other Applications

Have you applied for, or are you required to apply for, any other **resource consents** for this project, either from the Christchurch City Council or Environment Canterbury, and if so, what type?

		Has been applied for:	Is required to be applied for:	Has been obtained:	Reference no. (if applicable):
Christchurch City Council	Subdivision Consent	☐	☐	☐	
	Other Land Use Consent	☐	☐	☐	
Environment Canterbury	Water Permit	☐	☐	☐	
	Discharge Permit	☑	☐	☐	
	Coastal Permit	☐	☐	☐	

OR

☐ No additional resource consents are needed for the proposed activity.

Have you applied for a **Project Information Memorandum (PIM)** or a **building consent** for this project?	☐ Yes	☑ No
If yes, what is the project number (BCN number)?		

11. Declaration

I have completed all relevant sections of this form (including the checksheet in Section 14), and I understand that my application may be returned as incomplete if it does not include all of the relevant information.

I understand that the fees paid on lodgement **are a deposit only**, and that the Council will invoice all costs actually and reasonably incurred in processing this application.

All of the information provided with this application is, to the best of my knowledge, true and correct. I understand that all information submitted as part of an application is required to be kept available for public record, therefore the public (including business organisations, media and other units of the Council) may view this application, once submitted. It may also be made available to the public on the Council's website. If there is sensitive information in your application please let us know.

Signature of Applicant (or person authorised to sign on behalf of applicant)**:**

Date 13/3/2023 Print name Sonja Perrin

If you are signing this application on behalf of a company/trust/other entity (the applicant), you are declaring that you are duly authorised to sign on behalf of the applicant to make such an application.

Privacy information

The Council is subject to the Privacy Act 1993. For a full privacy statement see: https://ccc.govt.nz/the-council/how-the-council-works/privacy-statement/. If you would like to request access to, or correction of, your details, please contact us.

12. Fee information

The required deposit must be paid before processing of the application will start. A further invoice will be issued when processing has been completed if the cost of processing exceeds the deposit paid. If the processing cost is less than the deposit a refund will be issued to the **person who paid the fee**.

Where the application fee is to be charged to an **account holder** no deposit is required. Instead the actual fees will be invoiced on completion of processing.

Interim invoices may be issued on a monthly basis up until the issue of the section 224 certificate, including where the applicant is an account holder.

The Resource Management Fees Schedule can be viewed at: https://ccc.govt.nz/consents-and-licences/resource-consents/resource-management-fees/

DEBT RECOVERY – Where an invoiced amount has not been paid by the stated due date, the Council may commence debt recovery action. The Council reserves the right to charge interest, payable from the date the debt became due, and recover costs incurred in pursuing recovery to the debt.

MONITORING FEES – Please note that if this application is approved you will be required to meet the costs of monitoring any conditions applying to the consent, pursuant to Section 35 of the Resource Management Act 1991.

DEVELOPMENT CONTRIBUTIONS – Your development, if granted, may also incur development contributions under the Local Government Act 2002 in accordance with the Council's Development Contributions Policy. Any development contributions payable will be invoiced to the applicant.

13. Additional notes for the applicant

1. This application is for resource consent under the Resource Management Act 1991. When processing the application the Council can only consider relevant matters under the Resource Management Act. Please be aware that there may be a range of other matters which could affect your ability to carry out the proposed development or activity, and it is your responsibility to investigate these.
2. You may apply for two or more resource consents that are needed for the same activity on the same form.
3. The written approval of persons the Council considers may be adversely affected by the proposal may be required as part of the application, if it is to be processed on a non-notified basis. This will be determined after the application has been lodged and assessed, and a site visit carried out.
4. Consultation with neighbours and other affected persons is at the discretion of and is the responsibility of the applicant.
5. The costs incurred in receiving and checking incomplete applications are invoiced to the applicant. To avoid delays and cost please ensure that you submit a complete application.
6. If further information is required after your application is accepted, you will be advised as soon as possible and processing of the application will be suspended until the information is received.
7. Please make sure all of the information supplied is accurate. Inaccurate information can cause difficulties at a later date, such as additional costs, delays and legal proceedings initiated by the Council and/or by other persons.
8. If resource consent is granted the applicant has a legal obligation to comply with any conditions of the consent.

14. Checklist

This checklist has been produced to assist you in the preparation and lodgement of your application. The provision of correct and accurate information will ensure that delays are kept to a minimum. Please complete all sections using **Y** where the information is provided, or **N** where the information is not required.

[ ] **a. Application Form P-050**

[ ] Completed and **signed** application form, including a full description of the proposal, a list of the ways in which it does not comply with the Christchurch District Plan and/or NES, and an assessment of effects on the environment.

[ ] **b. Location of Application Site**

[ ] Copy of current Record of Title less than 3 months old, including any consent notices, covenants or other encumbrances to which the Council is a party. (*Note: The Council can obtain this from Land Information New Zealand on your behalf)*

[ ] **c. Application Fee / Deposit**

[ ] Fees payable and internet banking details are set out in the Resource Management Fee Schedule. An invoice will be issued when the application is received.

[ ] **d. Plan**

Application plans should include the following information on the face of the plan in an easily read and interpreted manner:

[ ] The address of the property

[ ] Net areas for all new allotments, together with areas in access

[ ] The position of all new boundaries, including clearly labelled allotment dimensions for all boundaries, e.g. 27.9 Bdy.

[ ] All trees and areas of substantial vegetation are to be shown in their location on the plan, together with the type of the tree if known (refer to Subdivision Bulletin No.11)

[ ] A comprehensive set of levels for vacant areas and on adjoining properties in terms of the CBD Datum.

[ ] The location of outdoor living areas with dimensions and areas shown

[ ] Building setback dimensions (including setbacks from access to garages)

[ ] Existing crossings, kerb and channel

[ ] Service easements clearly labelled

[ ] Right of way easements clearly dimensioned as to width for the full length

[ ] All topographical features, terraces, buildings, clearly labelled as to be removed or being retained

[ ] The location of all overhead power and phone lines crossing the property and the location of the pole on the footpath

[ ] A 'Memorandum of Easements' where applicable

[ ] The plan scale and original print size

[ ] The location of existing fences and walls

[ ] The floor area of buildings on site

[ ] Existing water, stormwater and wastewater reticulation

[ ] Road kerb and channel

[ ] Street trees, power poles, electricity and telephone pillars

[ ] Locations and areas of new reserves to be created, including any esplanade reserves and esplanade strips

[ ] Locations and areas of any part of the bed of a river or lake to be vested in the Council

[ ] Locations and areas of any land within the coastal marine area

[ ] Locations and areas of land to be vested as new roads

[ ] **e. Geotechnical reports**

[ ] Land stability

[ ] Liquefaction

[ ] Statement of Professional Opinion (refer Part 4 IDS)

[ ]	**f.**	**Contamination report**
	[ ]	Consultation with Environmental Health Officer, Christchurch City Council
[ ]	**g.**	**Stormwater discharge**
	[ ]	Covered by IGSC (complete checksheet A, Subdivision Bulletin 21)
	[ ]	Discharge consent from ECan
	[ ]	Banks Peninsula requirements confirmed by ECan
[ ]	**h.**	**Excavation / Fill**
	[ ]	Areas of excavation/fill, volumes and retaining structures shown
	[ ]	Compliance with the earthworks rules in Chapter 8 of the District Plan
	[ ]	Whether a separate land use consent has been applied for and granted, or will be required
[ ]	**i.**	**Reserves**
	[ ]	Reserves shown on plan have been confirmed by the Parks Unit
	[ ]	Whether reserves to vest will include easements (existing or new)
	[ ]	Councils approval under s239 RMA required
[ ]	**j.**	**Esplanades**
	[ ]	Complies with District Plan
	[ ]	Consultation with Parks Unit for any reduction
[ ]	**k.**	**Road widening**
	[ ]	Designating Authority consultation, acquisition or not
[ ]	**l.**	**Consultation with other agencies**
	[ ]	Orion - availability of power
	[ ]	Transpower - Electricity Transmission Corridors
	[ ]	Waka Kotahi (NZ Transport Agency) - State Highways
	[ ]	Mahaanui Kurataiao Ltd (MKT) – issues of significance to Tangata Whenua

Note: *This is a preliminary checksheet only. It is general in nature and does not cover all rules in the District Plan, nor is all of the information relevant to all types of application. Please check with the Council if you are unsure of the information requirements for your particular application. Please also note that the detailed technical review of your application may reveal the need for you to supply further information, in which case you will be advised as soon as possible.*

AMALGAMATION CONDITIONS:

That Lot 500 hereon (Legal Access) be held as to seven undivided one-seventh shares by the owners of Lots 28-34 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 501 hereon (Legal Access) be held as to fifteen undivided one-fifteen shares by the owners of Lots 3-17 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 502 hereon (Legal Access) be held as to four undivided one-fourth shares by the owners of Lots 14-17 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 503 hereon (Legal Access) be held as to ten undivided one-tenth shares by the owners of Lots 4-13 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 100, 101, 102 & 103 hereon be held as to thirty-five undivided one-thirty-fifth shares by the owners of Lots 1-35 hereon as tenants in common in the said shares and that individual records of title issue.

NOTES :

1. SCHEME PLAN ONLY, AREAS & DIMENSIONS ARE APPROXIMATE & SUBJECT TO FINAL SURVEY.
2. ADDITIONAL EASEMENTS FOR PUBLIC INFRASTRUCTURE WILL BE REQUIRED. LOCATION TO BE CONFIRMED AT DETAILED ENGINEERING STAGE.

BUILDING PLATFORM
BDY OFFSET - 4m (FRONT) & 1.8m (SIDE & REAR)

(1) **STAGE NUMBER**

STAGING:

1 Lots 1, 28-35, 500, 2000 & Part 1000
2 Lots 2-13, 501 & Part 100
3 Lots 14-17, Part 100, 101, 502, 2001 & 2002
4 Lots 18-27, 102, 103, Part 1000, 2003 & 2004

MEMORANDUM OF EASEMENTS

Nature	Burdened Land (Servient)		Benefited Land (Dominant)
	Lot No.	Shown	
Right of Way & All Services	500	A	28-34
	501	B	3-17
	502	C	14-17
	503	D	4-13
Right for Access & Maintenance	2002	F	1-35
	2003	I	1-35
	2004	J	1-35
	100	G	1-35
	101	H	1-35
	102	K	1-35
	103	L	1-35

SCHEDULE OF EASEMENTS IN GROSS

Nature	Burdened Land (Servient)		Grantee
	Lot No.	Shown	
Right to Drain Water	35	E	Christchurch City Council

REV	DATE	REVISION DETAILS	ISSUED
L	23/02/23	BUILDING PLATFORMS	TL
K	1/02/23	TURNING HEADS JOALS	TL
J	17/01/23	STAGING ADDED	TL

BASECO
Land Development Consultants

CLIENT
BOWENVALE GCO LTD

PROJECT
130 BOWENVALE AVE

DRAWING TITLE
PROPOSED SUBDIVISION OF PARTS
LOT 2 DP 33462

STATUS	***SCALE***	***SIZE***
FOR INFORMATION	1:750	A1

PROJECT	***DRAWING NO***	***REVISION***
1037	SC-01	L

Assessment of Environmental Effects

Prepared by Sonja Perrin, Senior Planner

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1.0 Site and Surrounding Area

The application site is located at 130 Bowenvale Avenue, Cashmere and is held in Certificate of Title CB34A/555 known as Part Lot 2 DP 33462 with a total area of 5.0894ha. The site comprises of two (2) areas (3.9048ha), both known as Part Lot 2 DP 33462 with the lots being separated by Rights of Way giving access to 160 Bowenvale Avenue (Lot 2 DP37778), Section 2 SP 483645 and Lot 1 DP 37778. The property is held under fee-simple ownership by Bowenvale GCO Limited. Refer **Appendix 1.**

The two (2) areas are intersected by three (3) access strips that give access to Lot 1 and Lot 2 DP37778 and Section 2 SO 483605 which is held under different ownership and it is proposed that these strips become part of the proposed subdivision. The access strips are not functional on the ground and only shown on the title plans , since there is no bridge over the waterway. Lot 1 DP37778 gains access further down Bowenvale Avenue via an existing bridge and is not dependent on the access strips as shown on the Title Plan.

Discussions is currently well advanced with the owners and their solicitors for these access strips to be included in the proposed subdivision. A road is proposed that will run through the property and will give access to the said properties instead of the access strips. The Applicant is currently seeking legal advice as to what is required to remove the caveat and what needs to be formed and provided to remove this Caveat. Council will also be seeking legal advice. **Refer email – Appendix 11**

The application property is vacant, and the ecological survey has determined that there are 11 vegetation and habitats present across the site with a mixture of native and pest plants. Further details are provided in the report attached as **Appendix 3.**

The site has a relatively steep slope with a series of gullies and ridges and waterways as shown in **Fig 4 and 5.**

The site does not have physical access from Bowenvale Avenue, due to the Sibley's Drain Branch No. 15 which is classified as a network waterway which separates the road and the site. A network waterway is a man-made open channel within the ground containing continuous flow or not, for the purposes of capturing and directing water and forms part of drains or drains into the public stormwater network of the coastal environment. There are additional waterways present on the site which has been accommodated in the proposal and which will be discussed in detail as part of this application. Refer **Fig. 4 and 5**

The area north-east of the application site is zoned for residential purposes and is currently vacant and the area directly east, is zone Rural Port Hills Zone and vacant.

The site is located in the Cashmere suburb of Christchurch, located on the northern side of the Port Hills and approximately 5 kilometres from the City Centre which makes it highly accessible to and from the City Centre. Cashmere offers extensive views over Christchurch City and the Alps and its proximity to the Port Hills makes it a favourite for recreational activities, being close to a number of walking and biking tracks and the Christchurch Adventure Park. Refer **Fig 1.**

The application site is located in the eastern part of Cashmere and adjacent to residential sites. Refer **Fig 2.** Cashmere and surrounding area were greatly affected by the 2010/2011 earthquakes and hazard

assessments after the earthquakes identified some parts of the application to be within rockfall hazard areas and hills. A number of boulders (33) were recorded on-site in 2011 and the rockfall assessment provided with this application has suggested mitigation with the installation of a rockfall fence. The impact of the hazards will be discussed in further detail in this report. Refer **Appendix 4.**

Bowenvale Avenue is accessed from Centaurus Road. Bowenvale Avenue is essentially a Cul-de-Sac for motor vehicles and the furthest property that can be access by a vehicle is Lot 1 DP 37778 via a bridge over the network waterway which is situated beyond the application property. Bowenvale Avenue extends into the Bowenvale Bike and walking track.

The application property is a 15min walk from the nearest bus stop in Centaurus Road.

There are various options in terms of cycle lanes and cycle ways that link the property with Christchurch City and biking to the city would take approximately 20min.

There are two Primary Schools (Cashmere Primary and Thorrington) and one the Cashmere Secondary school in the area that serves a population of 6 453 (Cashmere West and Cashmere East – 2018 New Zealand Census). It is estimated that the population has grown to 6710 as of June 2021 (Wikipedia).

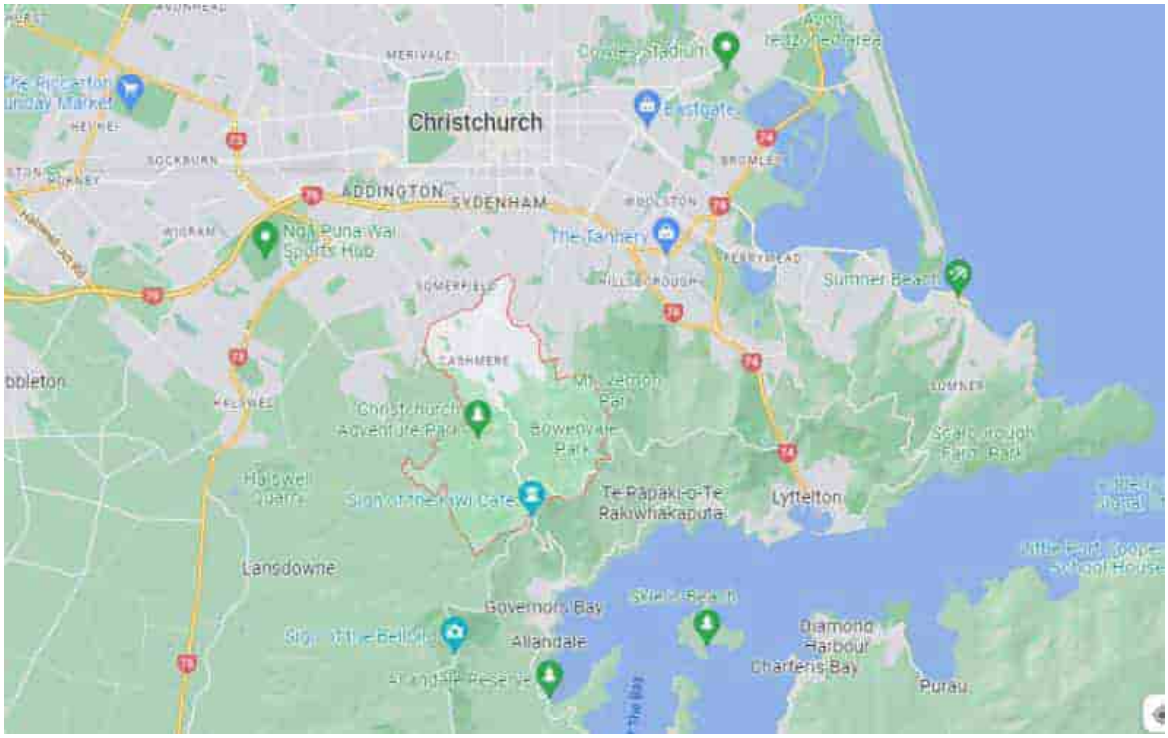


Figure 1: Locality of Cashmere in relation to Christchurch City Centre

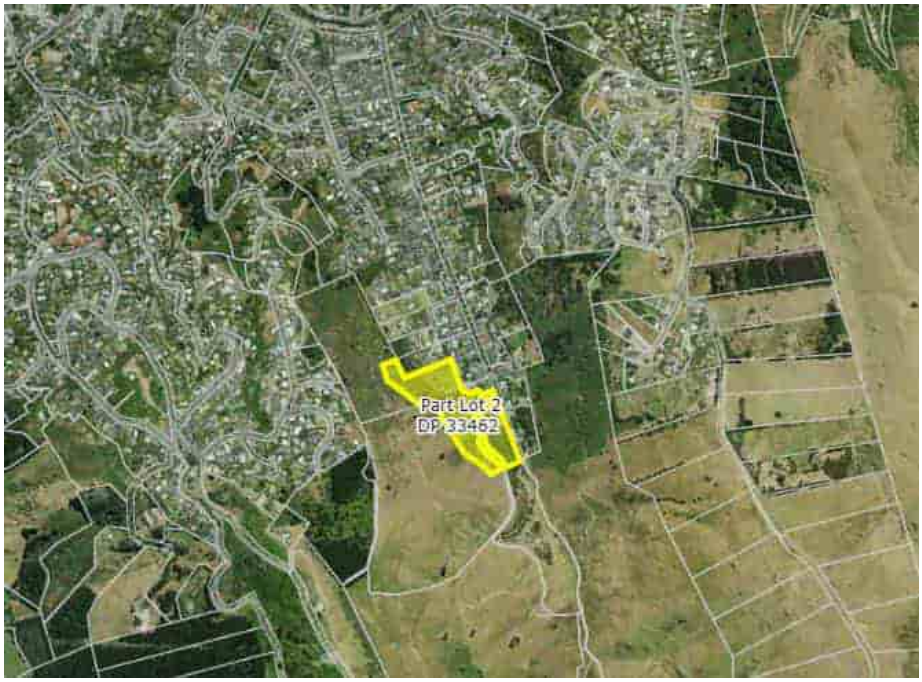


Figure 2: Site Locality

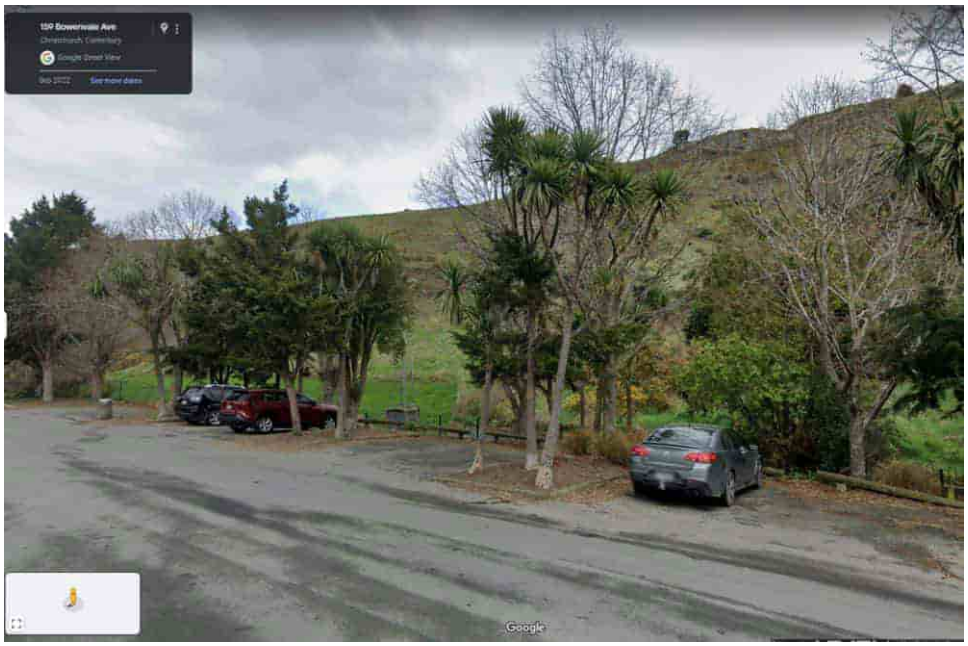


Figure 3: Street View -Bowenval Avenue

Figure 4: Environmental and Hill Waterways

Figure 5: Environmental and Hill Waterways

2.0 Background and Proposal

There are two (2) historic Resource Consents registered at Council for the property. The first resource consent was for the excavation of soil for geotechnical testing (RMA/2006/470) and Resource Consent (RMA92010586 or RMSA/2007/3221) was lodged with Christchurch City Council in 2007

for the establishment of 21 lots, but was later withdrawn. These applications were lodged prior to the 2010/2011 earthquakes.

A pre-application meeting was held with Council on the 10th of October 2022 and documents included as part of this report was a result from this meeting.

The proposed development of the property will entail:

- Subdivision of 35 lots into 4 stages and associated earthworks with retaining.
- Extension and installation of new of infrastructure services;
- Removal of street trees in Bowenvale Avenue to obtain access to the site;
- The construction of a bridge over the environmental waterway that will serve as the main access to the subdivision;
- Removal of lizards after a Permit has been obtained from the Department of Conservation and mitigation measures;
- Construction of a rockfall fence;
- Landscaping
- The establishment of a residential dwelling to be located on Lot 34
- Establishment of a Residents Association which will be responsible for the maintenance of the rockfall fence and other communal areas within the subdivision which will not be vested with Council.

Proposed Lots and Stages

The subdivision will consist of 35 residential lots with sizes well above the minimum requirement of 650m^2 as shown in the attached Scheme Plan and is subject to final survey. Building platforms are shown on the proposed lots.

The subdivision will be staged:

Stage 1: Lot 1, 28-35, 500, 2000 and part of Lot 1000.

Stage 2: Lots 2-13, 501 and Part of Lot 100

Stage 3: Lots 14-17, Part 100, 101, 502, 2001 and 2002

Stage 4: Lots 18-27, 102, 103, Part 1000, 2003 and 2004

Table 1: Lot sizes (Subject to survey)

Lot	**Size (m2)**
Lot 1	665
Lot 2	654
Lot 3	686
Lot 4	650
Lot 5	722
Lot 6	992
Lot 7	1100
Lot 8	1382
Lot 9	2121
Lot 10	1728

Lot 11	1795
Lot 12	1404
Lot 13	1486
Lot 14	1402
Lot 15	1060
Lot 16	1108
Lot 17	1760
Lot 18	1068
Lot 19	774
Lot 20	700
Lot 21	781
Lot 22	1744
Lot 23	905
Lot 24	752
Lot 25	717
Lot 26	655
Lot 27	655
Lot 28	655
Lot 29	651
Lot 30	654
Lot 31	656
Lot 32	655
Lot 33	675
Lot 34	916
Lot 35	734
Lot 100 Rockfall fence	7372
Lot 101 Rockfall fence	479
Lot 102 Rockfall fence	195
Lot 103 Rockfall fence	241
Lot 500 Access Lot	903
Lot 501 Access Lot	401
Lot 502 Access Lot	543
Lot 503 Access Lot	694
Lt 1000 Road to vest	4060
Lot 2000 Local Purpose Reserve -Stormwater	3566
Lot 2001 Local Purpose Reserve - Stormwater	510
Lot 2002 Local Purpose Reserve - Stormwater	498
Lot 2003 Local Purpose Reserve - Stormwater	821
Lot 2004 Local Purpose Reserve - Stormwater	604

Lots 100-103 have been set aside for a rockfall fence that will be constructed to mitigate any rockfall hazards. These lots will be amalgamated as shown on the **Scheme Plan- Appendix 2.**

Lots 500-503 are access lots. Each of these lots will be held in shares by the number of lots that will gain access from them as shown on the scheme plan in the amalgamation conditions.

Lots 2000-2004 accommodates the existing environmental and hill waterways.

Easement for the rockfall fence will be registered over Lots 2002-2004 and finalised at s223 stage.

Refer Appendix 2 – Scheme Plan

General Earthworks, Earthworks for Bridge and Retaining (Gabion Wall Design)

Earthworks to the site is limited to avoid any destabilisation of the area and roads and access are generally parallel to the contours of the site.

The area over which earthwork are to occur is 8770m2, with an estimated cut of 9500m3 and fill of 2650m3. Soil to be removed from site is estimated to be 6850m3. Earthworks are mainly required for the formation of the road and access lots.

A breakdown of earthworks for the various stages is contained in the engineering Report, attached as **Appendix 8.**

The earthworks include fill that will be required for the establishment of the bridge as illustrated by the **Earthworks Cut/Fill Plan in Appendix 9.**

Retaining will be necessary as part of the subdivision. A retaining wall of between1-2m high is proposed between Lot 2000 (Environmental Waterway - Reserve) and Lot 500 (Access Lot) – Stage 1.

Other retaining proposed are Gabion Stabilised Batter along the road (Lot 1000) in front of Lot 19 and Lot 25 and along access Lot 502 in front of Lot 16 and along access Lot 503 in front of Lot 11. **Refer Proposed Contour Plan Appendix 9.**

Details of the proposed gabion retaining walls are contained in the **Conceptual Gabion Wall Design Report attached as Appendix 15.**

The proposed earthworks are also discussed further in the Geotechnical Report (**Appendix 13**)

Infrastructure and Services

All infrastructure that will serve the proposed subdivision will be connected to mains located within Bowenvale Avenue.

Vehicle crossing, Bridge, Road and Access Lots

Access to the site – Bridge:

The subdivision is dependent on a bridge to be constructed over Sibley's drain, since there is no other direct access from Bowenvale Road to the site.

The vehicle crossing at the bridge will be installed in accordance with the technical standards for Residential Vehicle Crossings.

The bridge over Sibley's Drain will be constructed to provide access to the application property and the proposed lots. Structural Drawings for the bridge are attached as **Appendix 6** and was prepared by the Viden Group Consulting engineers. A bridge specific Geotechnical report was compiled to inform the structural design and is attached as **Appendix 17.**

The bridge will have a width of 6.6m (excluding barriers) with a length of 8.8m over the waterway and makes provision for a 1:50 year flood level. As previously discussed, fill around the bridge will be required, whilst augured concrete piles of 2.5m below ground level to rock will be installed within the waterway setback.

Once ECan Consent and the subdivision consent is obtained, a building consent for the bridge will be lodged. All details with regard service ducts and connection details will be addressed at building consent stage and engineering approval.

An ECan consent was lodged on 9 February 2023 (CRC233392, CRC233394 & CRC233395):

- To temporarily take and use of non-consumptive water and to divert the flow of water in the waterways
- To discharge of construction phase stormwater, to discharge non-consumptive water taken, to discharge sediment and contaminants, to discharge dust suppressants to land and water
- To undergo earthworks and vegetation clearance within the riparian margin
- To disturb and reclaim the bed of a river

The application was returned but was relodged on the 7th of March 2023.

Access to the proposed lots:

Road to vest – Stage 1 and 4

Access to the new lots from the bridge are proposed via a 15m road to be vested with Council and shown as Lot 1000 (4080m^2) on Scheme Plan Rev L. This road, once completed, will provide access to the neighbouring properties and will "replace" the access strips. Refer **Appendix 7** (for illustration purposes only) which shows the new road in relation to the access strips. The part of the road that will give access to Lots 1, 28-34, 500, 2000 will be formed as part of Stage 1 and the remainder of the road will be formed as part of Stage 4.The formed width of the road will be 6.76m and will include a footpath on one side of the road.

Access Lot 500 – Stage 1

Lot 500 will serve Stage 1, which comprises of 7 lots. The legal width of this access lot will be 6.5m and the formed width 4.65m with passing bays (5.5m).

Access Lot 501 – Stage 2

Stage 2 of the subdivision (Lots 2-13) will gain access from access Lot 501 and this access lot will serve 12 lots. Lot 501 (access lot) will connect to the part of the road that is to be formed as part of Stage 1. The legal width of the access lot will be 8m wide where it connects with the road to vest and then narrows to 6m. The formed width will vary between 4.5-5.5m with passing bays.

Access Lot 502 – Stage 3

Access Lot 502 will serve 4 lots and the legal width of the access lot is 6m with a formed width of 4m with passing bays.

Refer Infrastructure Report and associated plans – **Appendix 8 and 9**

Stormwater:

Existing stormwater from the site and the waterways discharges into Sibley's Drain. Details of the drain is contained in the infrastructure report.

Where possible, the existing waterways are maintained as part of the subdivision with the hill waterways accommodated in Reserve lots (10m wide) with building platforms provided that

complies with the 10m setbacks required for these waterways. Stormwater from the hill waterways and exiting the reserve areas will be reticulated once it reaches the road and a stormwater pipe will be installed within Lot 30 to transport the stormwater to Sibley's Drain.

Sibley's drain no 15 will mostly maintain its' existing path through the 10m wide reserve area provided between Lots 14 and 15 and through Lot 2001, whereafter the stormwater will be reticulated along the road until it reaches Sibley's Drain (Lot 2000).

Refer **Stormwater Plan – Appendix 9**

On-site attenuation is proposed based on 5m^3 per 100m^2 increase in impervious area as per Christchurch City Council's Onsite stormwater mitigation guide for sites less than 1000m^2 and 5.7m^3 per 100m^2 increase in impervious area for sites larger than 1000m^2.

Further details on the stormwater for the proposed subdivision is contained in the **Infrastructure report – Appendix 8.**

Wastewater:

There is an existing gravity wastewater pipe (150mm diameter) located approximately 50m north of the site, which will be extended to the area where the bridge is to be installed.

A wastewater capacity certificate was issued on the 22nd of February 2023 (RMA/2023/3434 - **Appendix 10**), advising that the area falls within a wastewater capacity constraints area. It is proposed that the development will be serviced via a low -pressure system as further detailed in the Infrastructure Report **(Appendix 8)** and a wastewater layout plan is provided in **Appendix 9.**

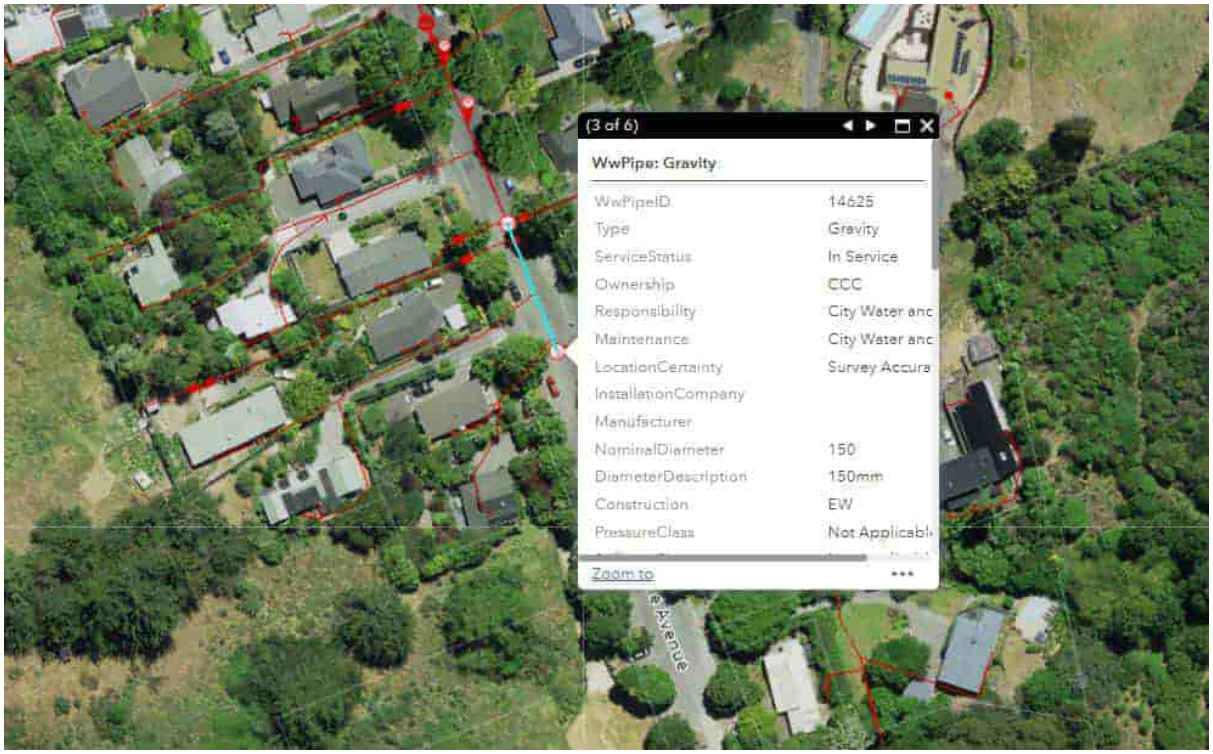


Figure 6: Location of existing Wastewater infrastructure in Bowenvale Avenue

Water:

There is an existing 180mm PE100 waterpipe located within Bowenvale Avenue and is approximately 30m north from the site. It is proposed to connect to this pipe and extend the pipe to the where the bridge is proposed.

Further details regarding water provision are contained in the Infrastructure report – **Appendix 8** and a water reticulation plan for the subdivision is contained in **Appendix 9.**

Fire Fighting water:

As part of the provision of water to the subdivision that will have unrestricted supply, five (5) fire hydrants will be provided to achieve the minimum distance of 135m to any dwelling. Refer Infrastructure report for further details – **Appendix 8.**

Power, Telecommunication and Street lighting:

Power and telecommunication reticulation is available in the vicinity of the site.

A street lighting plan for the subdivision will be provided at detailed engineering stage when the design for the road and access lots are available.

Figure 7: Location of existing Water Infrastructure in Bowenvale Avenue

Removal of Street Trees for access to Site:

An application for the street tree removal to obtain access to the site was lodged (RMA/2022/3830), but has now been withdrawn and it is requested that the removal of the street trees be dealt with as part of the subdivision application. The AEE prepared for the removal of the street trees is attached to this application as **Annexure A** with the Arboricultural Report attached as **Appendix 5**. In summary, it is proposed that 5 trees be removed of which four are Cabbage trees and one Totara tree which is located within Bowenvale Avenue.

Aquatic Ecology:

An aquatic ecology report was prepared by Aquatic Ecology Limited dated 9 September 2022 and that the proposed development will not have a direct impact on the freshwater and wetland ecology with the appropriate erosion and sedimentation control.

Permanent surface water was observed in the upper reaches of the Bowenvale stream and adjacent to the application site but not within. The report indicated that the probability of any wetland existing in the application site to be very low.

Council records show a potential wet area as shown below, but the aquatic ecology report confirms that there are no wetland areas/ponding within the site and the gradient of the site makes ponding highly unlikely.

The report is attached as **Appendix 12.**

Figure 8: Council records showing wet area

Lizard and Habitat Assessment – Ecological Assessment

An ecological assessment of the lizard and habitat was conducted by Wildlands. The report concluded that the application property is dominated by exotic vegetation and habitats. Pest plants and weeds

are common on the site. Only one indigenous vegetation type (pohuehue vineland) is present on the site and provide a habitat for at least one threatened lizard species. The reminder of the site provides a habitat for one threatened invertebrate and several non-threatened indigenous birds.

The report proposes that vegetation clearance be undertaken outside the breeding season (Aug – Feb). The establishment of reserve areas as a part of the subdivision will offset the loss of these habitats.

It has been confirmed that the bridge can be established prior to the lizard being relocated.

The report further proposed a number of mitigation factors:

- Mowing of area to encourage lizards to move out of the area where the bridge is to be established, Lizard Management Plan and a Wildlife Permit in terms of vegetation removal and re-landscaping.
- Establishment of pohuehue vineland in the reserve areas.
- Removal of pest plants and replanting with indigenous species within the lots earmarked for the rockfall fence.
- Clearance of vegetation needs to take place outside the breeding season (Aug -Feb)
- Stacking of cleared vegetation and wait for it to die so that any invertebrate can disperse.
- Translocating other species
- Habitat restoration

The report is attached as **Appendix 3.**

Geotechnical Findings

A Geotechnical Report and a s106 RMA, assessment was compiled by Engeo and is attached as **Appendix 13**. The report contains details regarding rockfall, earthflow instability, management of soil erosion, earthworks and stormwater as well as road subgrade.

Th report concluded that with the mitigating measures proposed, risk from natural hazards will be acceptably low.

Rockfall Assessment Report and Maintenance

The application site is located in the Rockfall Management Area 1 and 2 Hazard Overlays of the Christchurch District Plan and required a rockfall assessment which was prepared by Engeo and is attached as **Appendix 4.**

Scaling and boulder removal will be considered as a first option or bolting where boulders cannot be removed. In addition, a Rockfall Fence is the chosen mitigating measure and the process for the design of the fence is detailed in the assessment. After installation of the rockfall fence further geotechnical testing and reporting will be required to complete a s106 assessment for the rockfall hazard and a SOPO be provided.

During the pre-application meeting, concerns were raised as to the maintenance of the Rockfall fence.

The Applicant has opted for the establishment of a Residents Association for the development which will manage the maintenance of the fence as well as other communal responsibilities. A draft copy of the Constitution of the proposed Residents Association is attached as **Appendix 14.** The Constitution and the Maintenance Schedule will be finalised once the subdivision application is approved.

NES – LLUR Contaminated Soil

The site is not listed under the LLUR as contaminated; however Council confirmed a pre-liminary site investigation wax required as part of the subdivision application. The Preliminary Site Investigation (PSI) concluded that no evidence could be found to suggest that the area may have been used for activities which could have resulted in contamination under the NES. The area was mainly used for grazing the past.

Refer **Appendix 16 - PSI**

Landscaping

A concept landscape plan is attached as **Appendix 19** and was prepared by DCM Urban.

1.5m high "rod top" fencing is proposed between Sibley's Drain and the new proposed access lot (Stage 1)

Surfaces proposed for the road and footpath is asphalt, with flush paving areas where the access lots joins the road surface.

The below shows the internal fencing considered between lots, but with 1m height for 3m from the road/access lot boundary with an increase to 1.8m for the remainder of the boundary.

Figure 9: Possible internal boundary fencing between lots

Establishment of a residential dwelling on Lot 34

As part of the subdivision application, the Applicant intends to construct a residential dwelling with an attached garage on proposed Lot 34. The area in which Lot 34 is located is zoned for the Remainder of Port Hills and Banks Peninsula Slope Instability Management Area and is not subject to any rockfall area.

This application will address any non-compliances that will be created by the new proposed dwelling. A building consent for the dwelling will be lodged at the same time as the subdivision and landuse application.

The proposed new dwelling is located in Stage 1 and will get access off the access lot. Lot 34 is 916m^2 in size in accordance with the Scheme Plan. The lot size will be confirmed with final survey.

The dwelling will be developed over three (3) levels with the garage, entry and stairs on the first level, the media/loungeroom, kitchen, scullery dining and living area and WC on the second level and the 3 bedrooms and 2 bathrooms on the third level.

Concrete retaining walls will be constructed along the driveway to retain the driveway. Earthworks outside the building platform on Lot 34 is estimated at 540m^3 and cut expected to be 1.95m deep The driveway will have a fall of 1:6. The retaining walls will have a height of 1.14m (Refer Sheet A00002) and is less than 6m^2 (part that falls within the road setback).

Sibleys' Drain No 15 runs through Lot 34, but this waterway will be diverted and accommodated in the stormwater network proposed for the subdivision as shown on Sheet EN-400- Engineering drawings **- Appendix 9.**

3.0 Reasons for Consent

3.1 Christchurch District Plan

Zone

Residential Hills Zone

Other Notations

- Christchurch International Airport Protection Surfaces

  The CIAPS contains rules related to building height and the proposal does not involve building structures that will be considered to have an impact on the Airport Protection Surfaces.

  As such, there is no further discussion on this control hereon.

- Network Waterway – (Environmental Waterway)
- Water body Setback (Hill Waterway)

Natural Hazards

- Liquefaction Management Area
- Remainder of Port Hills and Banks Peninsula Slope Instability Management area.
- Rockfall Management Area 1
- Rockfall management Area 2

3.2 Assessment of Standards

The following table provides an assessment of the planning rules under the Christchurch District Plan: Operative in 2016, as it relates to the application site for the proposed subdivision as well as the dwelling that is to be established on Lot 34.

Table 2: Assessment of Standards

Rule/Standard	Performance Standards	Proposal	Consent Required
Chapter 14 – Residential Hills Zone – Subdivision and proposed dwelling on Lot 34			
P1 Residential Activity	a. No more than one heavy vehicle shall be stored on the site of the residential activity. b. Any motor vehicles or boats to be repaired or stored shall be owned by the people living on the site	The proposal will comply with the standards and no heavy vehicles will be stored on the sites and no repair or storage of any vehicles or boats that is not owned by the owner.	**Permitted**
C1 Fences	Fences that do not meet Rule 14.7.2.9 1.8m – road boundary	**Dwelling and Subdivision** All fences will comply with the height requirements.	**Permitted**
14.7.2.1 Site Density	Minimum net site area – 650m2	The development will create residential lots that complies with the minimum net site area. Refer **Table 1**	**Permitted**
14.7.2.2 Site Coverage	Maximum percentage of net site area – 35% for residential activities **Excluded are:** - **Fences, walls retaining walls,** - Eaves, overhangs up to 600mm and gutters 200mm - Uncovered swimming pools up to 800mm in height above ground	The site is vacant and any fences and walls to be stablished are excluded. **Bridge and Retaining - Subdivision:** The proposed bridge is greater than 800mm from the ground and larger than 6m2 and the retaining counts towards the coverage of the site which is less than the 35%. The bridge and	**Permitted**

Rule/Standard	Performance Standards	Proposal	Consent Required
	- Deck, terraces, porches, verandas, bay or box windows: no more than 800mm above ground (uncovered/unroofed) Covered and greater than 800mm above ground and more than 6m2 in total	retaining are small structures in relation to the overall size of the property and it is not necessary to provide a detailed area. **Dwelling on proposed Lot 34** The architectural drawings show a proposed coverage of 22.05%. See Sheet A0002.	
14.7.2.4 Daylight Recession Planes	2.3m - Appendix 14.16.2	**Dwelling on proposed Lot 34** There is a recession plane breach on the southern side of the property as shown on Sheet A0002.	**Restricted Discretionary Activity (RD13)**
14.7.2.5 Minimum Building Setback from internal boundaries	All buildings – 1.8m measured from gutters Accessory building less than 10.1m in length – Nil Decks Terraces no higher than 300mm above ground level within 1m of the boundary -1m All other buildings adjacent to an access or party of an access. Excluded- 200mm guttering from a wall	**Dwelling on proposed Lot 34** All setbacks are in accordance with the requirements. The garage is less than 10.1m long along the southern boundary.	**Permitted**
14.7.2.7 Minimum setback for living area windows and balconies facing internal boundaries	Setback for Living area windows – 4m if next to access, setback to be measured from far side	**Dwelling on proposed Lot 34** No living area windows are within 4m of the internal boundaries	**Permitted**
14.7.2.8 Road Boundary setback	Building – 4m Garage not facing road - 2m with additional requirements	**Dwelling on proposed Lot 34** The garage is not facing the road. Setback of 4m for the garage is maintained	**Permitted**
14.7.2.9 Street Scene	Road Fencing – 1.8m height	**Dwelling on proposed Lot 34** No fencing higher than 1.8m is proposed on the road boundary	**Permitted**
14.7.2.10	Roof finishes to not exceed 30% light reflectivity	**Dwelling on proposed Lot 34**	**Permitted**

Rule/Standard	Performance Standards	Proposal	Consent Required
Building reflectivity		Note re 30% reflectivity is shown on the Roof Plan – Sheet A0106	
14.7.2.11 Water supply for fire fighting	Sufficient water for firefighting.	**Subdivision and Dwelling on proposed Lot 34** Fire water will be available when the water network is extended as part of the subdivision. Water supply is available.	**Permitted**
Chapter 6.6 – City and Settlement Water Body Setbacks			
6.6.4 a vi Network Waterway Water body setback	Waterbody setback width – 5 metres measured from the banks of the waterway Activities controlled is earthworks: Buildings or other structures (including impervious surfaces); maintenance and enhancement	The Network waterway – Sibley's Drain runs and Sibley's Drain Branch no. 15 is located south of the application property and a bridge will have to be constructed over this waterway which will require earthworks Sibley's Drain No 15 will be diverted into the stormwater network where is crosses into Lot 34.	**Restricted Discretionary RD2**
6.6.4 a vii Hill waterway	Waterbody setback width – 10m	All building platforms have been proposed outside the 10m hill waterway setback. No gabion retaining is proposed within the 10m setbacks. The most northern hill waterway will be diverted into the stormwater network once it reaches the road. Rockfall fence will be constructed over the hill waterways. Internal boundary fencing is not provided for as part of this application in the waterway setbacks	**Restricted Discretionary Activity RD2**

Rule/Standard	Performance Standards	Proposal	Consent Required
6.6.4.1 (P5) Impervious surfaces	Not exceed 10% of total area of impervious surfaces	The proposal does not involve the establishment of more than 10% impervious area along any of the waterways.	**Permitted**
6.6.4.1 (P6) Fences	Fences built over waterbody no more than 20% solid Shall allow access Not be closer than 3m or a 1/3rd of the normal setback No greater than 20% solid structure Exception: Where a legal road is established, the activity specific standards shall not apply	The rockfall fence is to be built over the waterway and cannot maintain the 3m or a 1/3rd setback from the waterway.	**Restricted Discretionary (RD2)**
6.6.4.1 (P7) Culvert Crossings for network waterways	Shall be designed in accordance with Council's standards	No culverts are proposed	**Permitted**
6.6.4.3 (RD1) Earthworks not exempted in 6.6.3h and not provided for in Rule 6.6.4.1 (P1)	Earthworks for the establishment of a bridge	Earthworks (fill) and cut for piles are required for the establishment of the bridge. Refer bridge design and engineering drawings. Earthworks for supporting structures of Rockfall fence	**Restricted Discretionary (RD1)**
6.6.4.3 b (RD2) New buildings and other structure not provided for under P2-P7	New bridge over waterway	New bridge over waterway	**Restricted Discretionary (RD2)**
Chapter 5 - Hazards			
5.5.1 Liquefaction hazard	Any subdivision that creates an additional vacant lot/s	The proposed subdivision will create vacant lots within the liquefaction hazard area	**Controlled Activity (C1)**
5.6.1.1a Slope Instability Management Areas	**Remainder of Port Hills and Banks Peninsula Slope Instability Management Area** **a. Subdivision** **a. Earthworks**	The proposal is for a subdivision. Building platforms have been identified for each lot.	**Restricted Discretionary (RD3)**

Rule/Standard	Performance Standards	Proposal	Consent Required
		Earthworks -Refer to earthworks Chapter 9 assessment	
	b. Hazard mitigation works of hazard removal works	Rockfall mitigation will be required – Refer Rockfall Assessment report.	**Restricted Discretionary Activity (RD9)**
	h. New infrastructure and earthworks associated	The subdivision will require new infrastructure to be developed. Refer earthworks Chapter 9 assessment.	
	i. Retaining walls which is more than 6m2 and higher than 1.8m	Retaining wall along the Sibley's Drain and Gabion retaining walls	**Does not comply with P12)**
	n. Any building or structure not listed in activities not listed in activities a. to m.	Rockfall fence and proposed dwelling on Lot 34. Relevant chapters within zone	
	<u>Rockfall Management Area 1</u>		
	a. Subdivision	The proposal is for a subdivision. AIFR not yet issued.	**Non-Complying Activity (NC3)**
	b. Earthworks	Earthworks	**Non-Complying Activity (NC6)**
	c. Hazard mitigation works of hazard removal works	Rockfall mitigation will be required – Refer Rockfall Assessment report.	**Restricted Discretionary Activity (RD6)**
	h. New infrastructure and earthworks associated	The subdivision will require new infrastructure to be developed.	**Restricted Discretionary Activity (RD25)**
	i. Retaining walls which more than 6m2 and higher than 1.8m	Retaining wall along the Sibley's Drain and Gabion retaining walls	**Restricted Discretionary Activity (RD31)**
	n. Any building or structure not listed in	Rockfall fence.	

Rule/Standard	Performance Standards	Proposal	Consent Required
	activities not listed in activities a. to m.		**Non-Complying (NC18)**
	<u>Rockfall Management Area 2</u> **a. Subdivision**	The proposal is for a subdivision. AIFR not yet issued.	**Restricted Discretionary Activity (RD1)**
	b. Earthworks	Earthworks	**Restricted Discretionary Activity (RD4)**
	c. Hazard mitigation works of hazard removal works	Rockfall mitigation will be required – Refer Rockfall Assessment report.	**Restricted Discretionary Activity (RD13)**
	h. New infrastructure and earthworks associated	The subdivision will require new infrastructure to be developed. Refer earthworks Chapter 9 assessment.	**Restricted Discretionary Activity (RD26**
	i. Retaining walls which more than 6m2 and higher than 1.8m	Retaining wall along the Sibley's Drain and Gabion retaining walls	**Does not comply with P10**
	n. Any building or structure not listed in activities not listed in activities a. to m.	Rockfall fence. Relevant chapters within zone	**Restricted Discretionary Activity (RD37)**
Chapter 8.9 – Earthworks			
8.9.2.1 Earthworks not for the purpose of the repair of land used for residential purposes	Earthworks shall not exceed 20m³ for residential purposes in accordance with Table 9 Earthworks shall not exceed 0.6m depth Earthworks shall not occur on land which has a gradient that is steeper than 1:6 Mechanical equipment and hours	**Subdivision earthworks:** Estimated earthworks for the formation of the road and accessways is 9500m³ and fill of 2650m³. Earthworks will be deeper than 0.6m for the formation of roads access lots and installation of new services. The application property has a general gradient of 1: 2.8 (35%). Fall of 50m over 140m. Earthworks shall comply with the compaction	**Restricted Discretionary Activity (RD1)**

Rule/Standard	Performance Standards	Proposal	Consent Required
	Filling should be clean fill. Earthworks within 5m of a heritage item	requirements, undertaken within the hours 07:00 and 19:00. Filling will be clean fill and there are no heritage items within the application property. **Earthworks outside the building platform for the dwelling on Lot 34** Earthworks for the proposed dwelling on Lot 34 calculates to 540.23m3. Earthworks will exceed 0.6m depth Gradient of the site is 1:2.8 (35.7%)	
Chapter 7 – Transport			
7.4.3.4 Manoeuvring for parking	- Onto an arterial road - Collector road with 3 or more parking - 6 or more parking - Heavy vehicle parking - Local street in central city core - Main distributor in central city with 3 or more parking spaces - Local street outside the central city serving six or more parking spaces	**Dwelling on Proposed Lot 34** The proposed dwelling will get access from an access lot. No on-site manoeuvring required	**Permitted**
7.4.3.7 Access Design	**Dwelling:** Any activity with vehicle access – Appendix 7.5.7 - Table 7.5.7.1 Vehicle access for 1 residential units – 3m legal width, 2.7m minimum formed width, 4.5m maximum formed width Visibility splay – 2m x 1.5m Gradient of access – 1 in 4 (25%) **Subdivision:** Minimum requirements for private ways	**Dwelling on Proposed Lot 34** The dwelling will get access from an access lot These standards are not relevant to access lots Visibility splay does not apply to access lots The gradient of the driveway is 1:6 All access lots complies with the minimum legal and formed requirements	**Permitted** **Permitted**

Rule/Standard	Performance Standards	Proposal	Consent Required
	4-8 lots -3.6m legal, 3m min formed, 6m max formed 9-15 lots – 5m legal, 4m min formed, 6m max formed Vehicle accesses longer than 50m with formed width less than 5.5m – passing bay min width of 5,5m every 50m Vehicle access serving more than 9 units – 1.5m pedestrian footpath and legal access shall increase with 1.5m	**Lot 500** – 7 lots – 6.5m legal, 4.65m with passing bay, 5.5m **Lot 501 and 503** – 12 lots – 6-8m legal width,4.5-5.5 formed width with passing bays **Lot 502** – 4 lots – 6m legal width, 4m formed width with passing bays **Lot 501 and 503** serves 12 lots. Legal width required is 5m. 6m-8m is provided. Legal access is 1.5m more than what is required, but no footpath provided	**Does not comply**
Chapter 8 – Subdivision			
8.5.1.2 Subdivision providing for residential activity in the Residential Hill zone (C6)	Activity standards 8.6.1-8.6.9 and 8.6.12 An identified building area must be shown not less than 100m2 and not greater than 2000m2, curtilage area contiguous to area identified above and not less than 200m2 and no greater than 4000m2 and be able to link vehicle access to a formed road.	Building platforms have been shown for all proposed lots and is not less than 100m2 and not more than 2000m2 and all residential lots can link their vehicle access to a formed road.	**Restricted Discretionary (RD2)**
8.6.1 – Minimum net site area and dimensions	Residential Hill Zone 650m2 Min dimensions 16mx 18m	All residential lots are larger than 650m2 All lots achieve the minimum dimensions	**Permitted**
8.6.3 – Access	All sites shall have access to and from a formed road and the access has to comply with Appendix 8.10.2 and the standards in Chapter 7	A new road is to be formed and vested and will link with Bowenvale Avenue. The access Lot 501and 503 does not provide for a separate footpath	**Does not comply**
8.6.4 - Roads	Standards set out in Appendix 8.10.3 and Chapter 7 **Local Road** – Residential Min-16m, Max 20m, 2 lanes, Hill zone may only require one footpaths.	The proposed road is 266m long and serves 12 lots and gives access to 3 access lots. Legal width is 15m. Does not qualify for the 14m road width due to its length. The roadway width is 6.76m wide formed.	**Does not comply** **Discretionary Activity (8.10.3 (3))**

Rule/Standard	Performance Standards	Proposal	Consent Required
8.6.5 – Pedestrian access ways	1.5m legal and formed width	A pedestrian footpath will be provided in the road reserve and will be 1.5m wide	**Complies**
8.6.7 – Water Supply	Connection to a safe potable water supply Sufficient water for firefighting	The proposed subdivision is able to connect to a safe potable water supply and fire fighting water will be sufficient	**Complies**
8.6.8 – Wastewater Disposal	All allotments shall be provided with the ability to connect to a wastewater system	All allotments will be able to connect to a wastewater system, although restricted at present. Wastewater certificate has been provided	**Complies**
8.6.9 – Stormwater Disposal	All allotments shall manage of surface water from all impervious surfaces.	Stormwater from all allotment will be managed and mitigated	**Complies**

3.2 Reasons for Consent

The reasons for which land use and subdivision resource consents are required under the Christchurch District Plan include:

Land Use under section 9 of the RMA

Consent is required as a **Restricted Discretionary Activity** for the new proposed dwelling located in the Residential Hill zone for

- a recession plane non-compliance on the southern boundary of the new lot (14.7.2.4 - RD13),
- earthworks of 540m^3 and deeper than 0.6m and in an area that has a gradient of 1:28 and (8.9.2.1 – RD1)
- located within the Sibley's no15 Waterway setback (which will be diverted with the subdivision) (6.6.4a vi -RD2).

Consent is required as a **Restricted Discretionary Activity** to

- construct a Bridge within the 5m waterway setback of Sibley's Drain- water setback (6.6.4.3 b - RD2)
- conduct Earthworks within the 5m waterway setback for the construction of the Bridge (6.6.4.3 – RD1)
- construct a Rockfall Fence within the 10m hill waterway setback (6.6.4.1 - RD2)

Consent is required as a **Restricted Discretionary Activity** to

- mitigate rockfall hazard in the Slope Instability Management Area (5.6.1.1.a.c – RD9)
- construct retaining walls which is more than 6m2 and higher than 1.8m within the Slope Instability Management Area (5.6.1.1.a.i).
- mitigate rockfall hazard in the Rockfall Management Area 1 (5.6.1.1.a.c – RD6)
- develop new infrastructure in the Rockfall Management Area 1 (5.6.1.1.a.h) – RD25)

- build retaining walls which is more than 6m2 and higher than 1.8m in the rockfall Management Area I (5.6.1.1.a.i – RD31)
- conduct earthworks (cut of 9500m³ and fill of 2650m³ over an area of 8770m2) for the formation of the road and access lots of the subdivision within the Rockfall Management Area II (5.6.1.1.a.b- RD4)
- mitigate rockfall hazard in the Rockfall Management Area II (5.6.1.1.a.c – RD13)
- develop new infrastructure in the Rockfall Management Area II (5.6.1.1.a.h) – RD26)
- construct retaining walls which is more than 6m2 and higher than 1.8m within the Rockfall Management Area II (5.6.1.1.a.i – is not P10).
- construct a Rockfall Fence within the Rockfall Management Area I (5.6.1.1.n – RD37)

Consent is required as a **Restricted Discretionary Activity** to

- conduct earthworks (cut of 9500m³ and fill of 2650m³ over an area of 8770m2), do cut that is deeper than 0.6m and in an area which is steer than 1:6 for the formation of the road and access lots of the subdivision within the residential zone _(8.9.2.1 – RD1)

Consent is required as a **Discretionary Activity** to

- construct a road to vest to serve the subdivision with a roadway width of less than 7m (6.76m) (8.6.4 - Appendix 8.10.3.3 – D)

Consent is required as a **Non-complying Activity** to

- conduct earthworks (cut of 9500m³ and fill of 2650m³ over an area of 8770m2) for the formation of the road and access lots of the subdivision within the Rockfall Management Area I (5.6.1.1.b – NC6)
- construct a Rockfall Fence within the Rockfall Management Area I (5.6.1.1.n – NC18)

Subdivision under section 11 of the RMA

Consent is required for subdivision within the Liquefaction Management Area as a **Controlled Activity** for the creation of additional vacant lots.

Consent is required for subdivision as a **Restricted Discretionary Activity**

- in the Remainder of Port Hills and Banks Peninsula Slope Instability Management Area (5.6.1.1.a – RD3) and
- in the Rockfall Management Area II (5.6.1.1.a -RD1)
- that does not comply with Rule 8.6.3 (Access) and 8.6.4 (Roads) – (8.5.1.2 – RD2)

Consent is required for subdivision as a **Non-Complying Activity**

- in the Rockfall Management Area I (5.6.1.1.a – NC3)

3.3 Activity Status

The land use component of the proposal involves multiple triggers for consent. Where there is an overlap between the consents and / or the effects of the activities – so that consideration of one could affect the outcome of another – the appropriate practice is to treat the applications together.

The land use consent status for the new proposed residential dwelling to be established on Lot 34 is a **Restricted Discretionary Activity.**

The land use consent status for the bridge and rockfall fence and earthworks in waterway setbacks and for rockfall fence, retaining walls and earthworks, mitigation of hazards and new infrastructure in a hazard area Rockfall Management Area I, is a **Non-Complying Activity**

The subdivision component of the proposal to create 35 residential allotments in the Rockfall Management Area I, is a **Non-Complying Activity**

For the purpose of determining the notification path, as the implementation of one resource consent will affect the other, the land use and subdivision components (excluding the dwelling proposed on Lot 34) are treated as a bundle, as a **Non-Complying Activity.**

For the purposes of the substantive decision, those should be considered sequentially, with a decision on the land use consent first under s9 of the RMA, and then the subdivision consent under s11 of the RMA in light of the approved resource consent.

As such, the decisions on these applications are overall considered as follows:

- Land use (s9), non-complying activity, and
- Subdivision (s11), non-complying activity.

4.0 Assessment of Environmental Effects

The following section will provide an assessment of effects resulting from the proposal on the wider environment and adjoining properties.

4.1 Permitted Baseline

The permitted baseline may be considered and the council has the discretion to disregard those effects. The Christchurch District Plan provides for:

The land is zoned Residential Hill Zone, being a zone that is intended to be used principally for residential purposes.

Compliance with the allowable site sizes for the Residential Hill Zone and the availability of reticulated services which includes water, wastewater and the management of stormwater.

The proposed development is treated as an integrated package and requires resource consent for multiple non-compliances with the development standards and rules of the Christchurch District Plan.

The construction of a Rockfall fence can remove the rockfall hazard from the property and result in the hazard areas being removed from the District Plan.

A permitted baseline therefore applies to the above where the parts of the development which are within the permitted thresholds are not assessed below, and only the effects beyond the permitted thresholds are considered appropriate and assessed in this Report such the building of a bridge and Rockfall fence in the waterways and hazard area and the land disturbance (earthworks).

4.2 Receiving Environment

The receiving environment beyond the subject site includes permitted activities under the relevant plans, lawfully established activities (via existing use rights or resource consent), and any unimplemented resource consents that are likely to be implemented. The effects of any unimplemented consents on the subject site that are likely to be implemented (and which are not being replaced by the current proposal) also form part of this reasonably foreseeable receiving environment. This is the environment within which the adverse effects of this application must be assessed.

Section 1 of this report "Site and Surrounding Area" describes the receiving environment in which the adverse effects of the proposed activity will be considered.

The receiving environment is not expected to be quite different from what is lawfully established presently as there are no unimplemented consents that I am aware of at the time of preparing this report to take into consideration. There has been an article in the media regarding a possible development of a property at the end of Bowenvale Avenue where 12 lots may be established, but it uncertain whether this application has been lodged.

4.3 Trade Competition

Trade competition or the effects of trade competition are not relevant to the consideration of this proposal.

4.4 Positive Effects

The proposal provides for:

- single residential dwellings on a Fee Simple lot in an area which is mostly occupied by single residential dwellings
- will meet government requirements for more housing development close to the city.
- the area has been included in the qualifying matters under Plan Change 14 and will remain an area where single residential dwellings are dominant and provides for alternative accommodation other than multi-units which is the predominant type of housing currently developed in Christchurch City and envisaged with Plan Change 14.
- Thirty Five additional residential units which can accommodate families will be created within walking distance of outdoor recreational areas and public transport.
- The area is a highly sought after area and vacant land for residential dwellings is not readily available.

4.5 Written Approvals

No written approvals have been obtained for this proposal. It is not expected that written approvals will be necessary, due to the property zoned for residential purposes and all matters creating non-compliances in terms of hazards, can be mitigated.

4.6 Matters of Discretion

Subdivision, Earthworks, Hazards and Waterways

Only those effects that relate to matters that are within the council's discretion are considered in this assessment. These include:

- **For earthworks and new structures within the waterways and setbacks, the matters under 6.6.4.3:**

  All water body classifications
  1. Natural hazards - Rule 6.6.7.1
  2. Natural values - Rule 6.6.7.2
  3. Maintenance access - Rule 6.6.7.5

  Additional for Environmental Asset Waterways
  1. Amenity and character - Rule 6.6.7.3
  2. Cultural values - Rule 6.6.7.4

  Additional for Hill Waterways
  1. Cultural values - Rule 6.6.7.4

  Exception for sites adjoining Downstream Waterways with features intervening between the site and the waterway
  1. Where a:
     1. legal road; or
     2. esplanade reserve; or
     3. esplanade strip wider than 10 metres

exists between a Downstream Waterway and a site being assessed, Council's discretion with respect to that part of the site separated from the water body is restricted to Natural hazards - Rule 6.6.7.1

- **For Slope instability Management Areas – RD1-RD49, the matters under 5.6.1.6:**

1. The Council's discretion is limited to the following matters:
    1. effects of natural hazards on people and property;
    2. location, size and design of allotments, structures, roads, access, services or foundations in relation to natural hazard risk;
    3. location, scale and design of buildings in relation to natural hazard risk;
    4. clearance or retention of vegetation or other natural features that mitigate natural hazard risk;
    5. timing, location, scale and nature of earthworks;
    6. earthworks method;
    7. potential for the proposal to exacerbate natural hazard risk;
    8. benefits of infrastructure and performance of critical infrastructure following a natural hazard event; and
    9. mitigation of effects as they impact slope instability hazards.
2. Restricted discretionary activities RD1 to RD49 will be assessed against the following criteria:
    1. Whether the proposal and associated hazard mitigation works:
        1. can be shown, based on evaluation by a Chartered Professional Engineer with experience in geotechnical engineering, using best practice methods, to increase the stability of land and/or protect structures and buildings and their occupants;
        2. can be shown, based on evaluation by a Chartered Professional Engineer with experience in geotechnical engineering, using best practice methods, to achieve an acceptable risk to life or property, including the extent to which an Annual Individual Fatality Risk of 10^{-4} (1 in 10,000) or better can be achieved; and
        3. will have appropriate monitoring procedures applied, with inspections and maintenance undertaken and reported to the Council.
    1. Whether, due to the sensitive nature of the proposed activity (for example, childcare centre, playground, hospital), an Annual Individual Fatality Risk lower than 10^{-4} is appropriate.
    2. Whether development of the site transfers risk to another site.
    3. Whether the location and design of proposed building platforms, access, earthworks, retaining walls and services to the site are the most appropriate considering the risk of natural hazards on the site.
    4. Provision for ground strengthening, foundation design, protection structures and the ability of these to be incorporated into the subdivision consent as conditions or consent notices.
    5. The extent that surface or subsurface drainage patterns and stormwater management are impacted as a result of hazard mitigation works, and whether these have an effect on the site or surrounding sites.
    6. Where critical infrastructure is involved, whether the infrastructure is designed in a way to continue to operate safely in the event of a significant natural hazard occurring, including containment of any hazardous substances associated with that infrastructure.

7. For infrastructure generally, the extent of benefits associated with that infrastructure, whether there is a functional or operational requirement for that location and whether there are any practical alternatives.
8. Whether or not the work would be carried out under the supervision of either a Chartered Professional Engineer with experience in geotechnical engineering or a Professional Engineering Geologist (IPENZ registered).
9. For RD34, RD36, RD37, RD38, RD39 and RD40 only, where the use and storage of hazardous substances are involved, whether the facility is designed in a way to manage the residual risks of adverse effects from hazardous substances to acceptable levels in the event of a significant natural hazard event occurring.

- **For earthworks in a residential area, the matters under 8.9.4:**

8.9.4.1 Nuisance

1. The extent to which any potential dust nuisance, sedimentation and water or wind erosion effects can be avoided or mitigated.
2. The extent to which effects on neighbouring properties, and on the road network, of heavy vehicle and other vehicular traffic generated as a result of earthworks can be avoided or mitigated.
3. The extent to which any potential changes to the patterns of surface drainage or subsoil drains can be avoided or mitigated if those changes would put the site or adjoining land at higher risk of drainage problems, inundation run-off, flooding, or raise that site's or adjoining land's water table.
4. Whether any change in ground level would be likely to impact on trees in terms of access to water and drainage.
5. The extent of any potential adverse effects on the quality of groundwater and whether any such can be avoided or mitigated.
6. The extent to which any adverse effects from noise and vibration associated with earthworks and land improvement can be avoided or mitigated, and the effectiveness of any methods to mitigate such effects.

8.9.4.3 Land stability

1. Whether the earthworks affect the stability of adjoining land and its susceptibility to subsidence or erosion upon excavation taking place.
2. The extent of any alteration to natural ground levels in the vicinity and, consequently, to the height and bulk of buildings that may be erected on the site.
3. Whether the earthworks affect the future development potential of land for permitted activities, taking account of the nature of filling material proposed and the degree of compaction.

8.9.4.6 Amenity

1. The level of alteration to existing ground levels and the degree to which the resultant levels are consistent with the surrounding environment.
2. The resultant effects that result from the earthworks in terms of visual amenity, landscape context and character, views, outlook, overlooking and privacy.

8.9.4.7 Indigenous biodiversity, natural character, and landscape features

1. The relevant matters of discretion in Rules 9.1.5.2, 9.2.8.1, 9.2.8.3 and 6.6.7.

- **For vehicle access design, the matters under 7.4.4.9**

1. Whether the driveway serves more than one site and the extent to which other users of the driveway may be adversely affected.
2. Whether there are any adverse effects on the safety and amenity values of neighbouring properties and/or the function of the transport network.
3. The effects on the safety and security of people using the facility.
4. Whether the access disrupts, or results in conflicts with, active frontages, convenient and safe pedestrian circulation and cycling flows or will inhibit access for emergency service vehicles where on-site access is required.
5. Whether the safety of pedestrians, particularly the aged and people whose mobility is restricted, will be compromised by the length of time needed to cross a wider driveway.
6. Whether the legal width of access is restricted by the boundaries of an existing site and/or an existing building.
7. Where the access exceeds the maximum gradient standards, in addition to i. to vi. above:
    1. whether the gradient will make the use of the access impracticable, including inhibiting access for emergency service vehicles where on-site access is required.
    2. whether the drainage facilities are adequately designed and will not cause adverse effects on neighbouring sites.

- **For subdivision, the matters under 8.8.3 (Roads)**

- Whether the provision, location, design, safety and efficiency of any road, frontage road, corner rounding, intersections or landscaping, including the formation and construction, is suited to the development it serves.
- Whether new roads or upgrades to existing roads are required, including in relation to any network utility, state highway or rail line.
- Whether new roads are appropriately routed and integrate safely and efficiently with the existing road network.
- Whether new or upgraded roads are satisfactorily designed and constructed, including providing a safe environment for road users and pedestrians, and are acceptable to the Council.
- Whether subdivision layout and new or upgraded roads provide for public transport, cycling and walking, where appropriate, including access to reserves, facilities, commercial areas, and public transport facilities.

4.7 Assessment

Earthworks and Buildings within the Waterways

Earthworks, fences (Rockfall fence) and building (Bridge) will not impact on the capability of the flow of water within the waterways. Where possible the natural position waterways have been maintained and the rockfall fence will be designed in such a manner as to avoid placing any permanent structure such as a posts within the waterway. The relevant waterway setbacks have been maintained for this development and any proposed new dwelling or structure that may

encroach into the waterway setbacks will require a further assessment and resource consent and where appropriate raised floor levels or structural engineering intervention.

The areas around the waterways will be improved in terms of vegetation as proposed in the ecological report and further detailed design of the landscape plan and all pest plants will be removed.

The bridge design has taken the below principles into consideration to avoid any interference with the drainage:

- No part of the bridge or other proposed obstructions within five metres to the existing weir.
- Clearance from soffit of the proposed bridge to waterway structure – 200mm allowed.
- No structural connection to or reliance on the existing structure.
- Abutments placed a minimum of one metre back from the edge of the waterway structure.
- Bored piles to minimise impact on the existing waterway walls and transfer structural loads below the waterway structure.
- Freeboard clearance from the bridge soffit to the 2% AEP peak flood level of RL 26.09, based on information provided by CCC – 565mm allowed.

Any stormwater from the waterways will be accommodated in a stormwater reticulated system once it reaches the road as shown in the engineering plans.

The Lizard and Habitat Assessment – Ecological Assessment has made certain recommendations to ensure that any effects on the environment and the areas around the waterways are mitigated and the aquatic ecological report has confirmed that there are no wetland areas within the application site.

The proposal will improve the areas around the waterways by ways of re-landscaping with the most appropriate vegetation, creating habitats where native species can thrive. The are where the bridge is to be established is already a man-made weir.

The proposal does not affect any cultural practises or customary use.

Access to the waterways for maintenance purposes will be from the road and access can be obtained onto these areas by the public if required. The waterways are located in steep areas and it is not envisaged that it will be frequented by the public.

Slope Instability Management Areas

A full Geotechnical Report and a Rockfall Assessment have been provided as part of the application.

The Geotechnical Report has identified rockfall, earthflow land sliding and soil erosion as the primary risks to the site.

Mitigation measures have been investigated and a rockfall fence is the most appropriate mechanism to reduce risk to the site and properties.

Earthflow instability has been tested and is low, but there is evidence of earthflow instability within the southern part of the site that could affect some lots and landslides could be triggered by heavy rain events. Further testing will be required at building consent stage.

Erosion is evident on-site (tunnel gullies, rilling and gullies) and are mainly contained within the waterway areas which are excluded from development and for which large setbacks have been

provided for. These areas will be developed as Reserve areas and will remain to function as overland flow paths for stormwater.

Earthworks in the residential zone

Earthworks are required to form the proposed subdivision and associated roads, bridge, access lots, installation of services, retaining and the rockfall fence.

A Sediment & Erosion Control Plan is provided as part of the engineering plans demonstrating how earthworks will be conducted in stages and what mitigating measures will be put in place. A detailed construction methodology including mitigation measures, certification details and necessary supervision of the works will be provided by the contractors ahead of any works commencing.
Once works convene, they will be completed in a timely manner to minimise the duration when grounds are exposed.

Erosion and sediment control are proposed to be applied alongside the eastern boundaries of all roads and access lots where most of the earthworks will occur.

Any excavations deeper than 1.5m be approved by a geotechnical engineer during earthworks construction.

The works proposed will be undertaken progressively and in stages and to weather conditions where in extreme rain and wind works will be managed by contractors while working with the Council monitoring team. With engineering design and details of the construction methodology of the proposed cut and fill areas including any support structures and compaction, the proposed earthworks will not exacerbate the potential instability of land.

Staging and progressive stabilisation will further minimise the amount of exposed ground at any one time, thereby minimising the potential for erosion, particularly during rain.

Reuse of the cut within the fill areas will reduce effects of moving earth to and from the site, but the geotechnical report has recommended that laboratory testing will be required to confirm that the soil is suitable to be used as engineered fill.

Erosion and sediment control devices will be inspected to ensure effective operation on a regular basis with increased monitoring during times of heavy rainfall. Visual checks will be conducted to ensure the quality of water in the receiving environment is not compromised. Checks will be undertaken by the contractor's project supervisor and site engineer and a Council representative through the monitoring process. The checks include inspection for construction entrance, any silt ponds for correct operation and damage.

A detailed methodology for the earthworks and construction management is proposed to be developed by the contractors for certification by the Council, ahead of any works commencing and after a decision is made on this application.

The scale of development works will therefore be closely managed and monitored and any adverse effects are therefore considered to be less than minor.

Sources of dust include stripping, stockpiling and re-spreading topsoil, and windblown materials from stockpiles. Removal of topsoil by excavation, loading onto trucks and movement of machinery along a constant track especially in dry conditions are further contributors.

To control dust exposed areas are proposed to be dampened with a water cart or other suitable system, and if effects cannot be managed works are to cease until conditions are suitable. Contractors

will be attentive to wind directions with respect to sensitive receivers, to avoid works when nuisance can be heightened.

Any stockpiles of topsoil will be covered when not in use by hay in the short term and then grass after a period of time, and dampened, if required.

Any dust generation or nuisance will be limited and appropriately managed through site management techniques so the permitted New Zealand and District Plan standards are met.

The resulting effects would therefore be less than minor.

Heavy machinery use can cause excessive noise and unpleasant vibration.

To minimise noise, all engine mufflers, track linkages and other noise making parts are in good working condition and not prone to making excessive noise. This is supported by compliance with noise standards (NZS 6803P:1984 - The Measurement and Assessment of Noise from Construction, Maintenance and Demolition Work). Contractors will regularly check machinery for compliance with the requirements.

Similar to controlling dust, wind direction will be observed by contractors and used to avoid noise disruption to sensitive receivers i.e. owners and occupants of the residential sites.

Vibration by machinery is unlikely and limited to compaction which will be minimal as there is limited fill required for this proposal. Given the area of works subject of the current application has been modified, any nuisance will be unlikely.

Any noise or vibration related nuisances will be temporary and appropriately managed through site management techniques so the relevant standards are met. These will ensure any resulting effects are less than minor in scale.

Vehicle Access Design and Road Design

A preliminary Traffic Safety Report is attached as Appendix 19.

Work within Bowenvale will be required to extend a footpath and slow traffic approaching the access to the subdivision.

During the pre-application meeting Council indicated the following:

Only one footpath (1.5m wide) can be provided on one side of the road.

No footpath is necessary for the access lot that serves more than 9 lots (Lot 503), because the 6m wide access proposed is a low use access and pedestrian and vehicle traffic can be easily accommodated.

The turning circle at the end of the road does not comply with the minimum requirements, but it should be noted that the road will become a through road to the neighbouring property and therefore the turning area can not be considered permanent. The topography of the site further limits a larger turning area. The turning area will be able to accommodate a 10.3 rigid truck with the design based on the Auckland Transport standards.

Manoeuvring for each access lot is shown in the Traffic Report.

Passing bays will be provided as recommended in the traffic report.

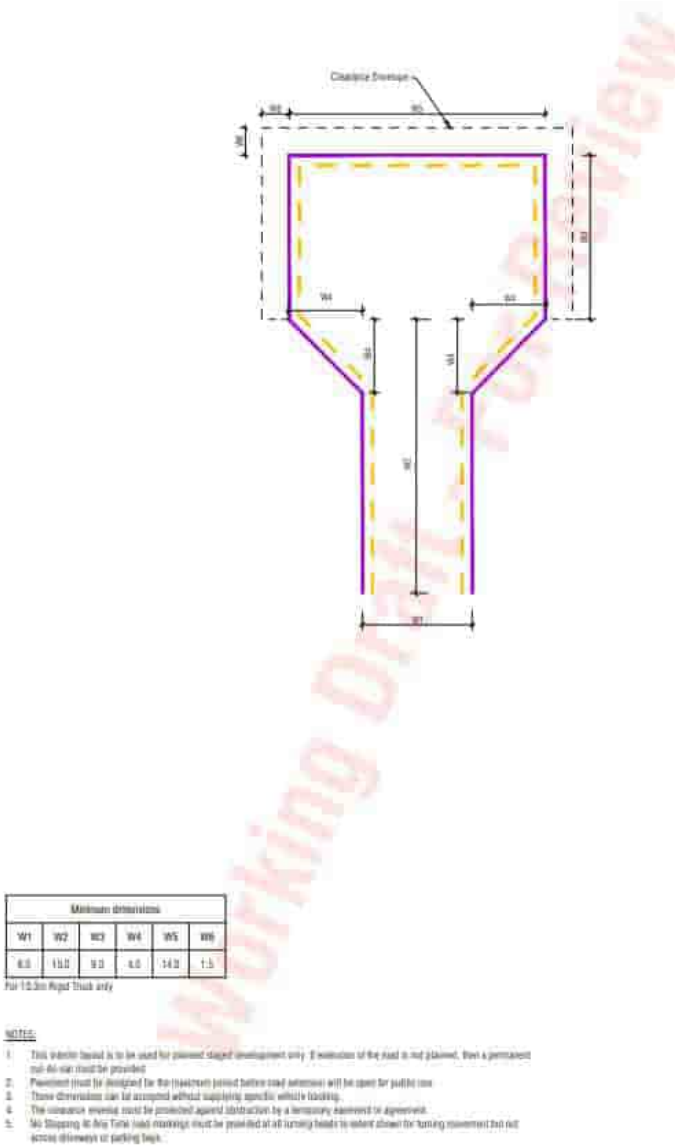


Figure 10: Proposed turning head

Subdivision

The development will change the site in terms of built form and residential intensification. The proposed development introduces a density that is permitted in terms of the zoning and provides for large enough building platforms. A large number of the allotments are larger than the required 650m^2, especially where there are limitations in terms of the slope and the waterways.

In terms of the scale of development, the proposed development will adopt a similar scale as the surrounding area with the same development standards for the Residential Hill Zone.

Roads to the allotments have been limited to one road with smaller access lots to service the lots. This in turn will reduce the areas of earthworks required to form the roads and access lots.

The proposed dwelling on Lot 34 serves as an example of what may be achieved on the lots with similar gradients.

The proposed dwelling on Lot 34 is generally compatible with the size of the site as a whole and this is reflected largely by general compliance with the bulk and location i.e. coverage, setback requirements and roof reflectivity with a minor recession plane departure.

The development meets the majority of the subdivision requirements in terms of lots size and infrastructure services and will maintain the waterway flow paths with reserve areas provided where pest plants will be removed and re-landscaped with natives as recommended in the ecological report.

Any native endangered species (lizards) will be re-located prior to full construction started to ensure , yards, height in relation to boundary and alternative height in relation to boundary, which maintains the expected balance between the built and natural form ensuring the character and amenity values are maintained.

The site design provides adequate access. The necessary services i.e. wastewater, stormwater and water supply will be provided for each allotment.

The proposal is consistent with the anticipated pattern of subdivision as there is evidence of infill subdivision in the surrounding area, and any further development of the lots would either need to comply with the relevant AUP rules or would require consent.

In light of the above assessment, any resulting effects will be less than minor.

4.8 Summary of Environmental Effects

The scale of development is consistent with that, anticipated by the Christchurch District Plan and the expectation that the surrounding areas zoned for residential purposes will be further developed over the next few years where owners may decide to develop properties in line with the District Council standards. While there will be short term interruptions while works are underway, largely residential amenity, character and streetscape values will be maintained.

Suitable infrastructure and access are available to service the subdivision proposal and upgrading of the infrastructure will further enable the development as proposed in the Infrastructure Report.

All hazards will be mitigated and once a rockfall fence has been installed and the AIFR certificate issued, properties and people will have the reinsurance that they will be protected against any rockfall hazards.

Overall, any adverse effects will be no more than minor and no more than what would be anticipated by compliance with the standards for the zone.

4.9 Adverse Effects on People or Entities

The nature of resulting adverse effects on people are similar to those outlined earlier for the environmental effects.

With particular references to the adjacent sites, summary positions include:

- The proposed subdivision pattern is anticipated by the Christchurch District Plan, because the minimum lot size requirements are in accordance with the standards.
- The proposed development will be is largely compliant and as anticipated by the Christchurch District Plan once the rockfall hazard has been mitigated.
- The application site is seen to have sufficient space to accommodate the proposed subdivision and scale of the development while maintaining amenity values and spacious character when viewed from beyond the site.
- The proposed dwellings anticipated to be developed in the subdivision will be high quality architectural dwellings.
- Slatted fences with permeability will lessen any impact on the internal boundaries of the properties.
- The proposed land disturbance(earthworks) will be limited to the formation of roads and access ways and works will be seasonal within certain hours of the day as required by Council and with suitable safeguards, supervision, monitoring and certifications the proposed works are unlikely to create nuisance or risk to adjacent properties.
- The short duration of construction works and that typical of residential developments, will ensure any nuisance will be temporary and not adverse in nature.
- All endangered species will be removed from the site with the necessary Permits from the department of Conservation.

Overall, within the context of the receiving environment, any adverse effects of the proposal will be less than minor, and no persons are therefore considered to be adversely affected.

4.10 Summary of Effects on People or Entities

I confirm that there are no additional effects that may be generated by the proposal beyond those identified in the above assessment. The proposal therefore will have less than minor adverse effects on the owners and occupiers of the adjacent properties, and no other persons or entities are adversely affected by the proposal.

5.0 Statutory Analysis

This section discusses the key findings from the independent review and identifies several issues, which are grouped and discussed based on common trending themes.

Under section 104, council needs to consider the following matters when assessing the resource consent application, these are subject to Part 2 of the RMA 1991 and include:

(a) Any actual and potential effects on the environment from allowing the activity
(b) Any relevant provisions of –
- A national environment standard
- Other regulations
- a national policy statement
- a New Zealand coastal policy statement
- a regional policy statement or proposed regional policy statement
- plan or proposed plan - Christchurch District Plan

(c) Any other matter the consent authority considers relevant and reasonably necessary to determine the application.

As a non-complying activity, pursuant to section 104B, consent may be granted or refused, if granted, the consent authority may impose conditions under section 108.

5.1 Any Actual and Potential Effects on the Environment

Section 104(1)(a) of the RMA requires council to have regard to any actual or potential effects on the environment of allowing the activity.

Under s104(2), when forming an opinion for the purposes of s104(1)(a), a consent authority may disregard an adverse effect of the activity on the environment if a national environment standard or the plan permits an activity with that effect.

Under s104(3)(a)(ii), when forming an opinion for the purposes of s104(1)(a), a consent authority must not have regard to any effect on a person who has given written approval to the application.

Following the assessment of potential adverse effects on the environment from the proposal, it has been determined that any effects from the activities in relation to the proposal will be acceptable.

Positive effects resulting from the proposal includes additional dwellings to address housing shortage and promote the efficient use of the site with anticipated development in the area in future.

5.2 National Environmental Standards and Policy Statements

The section confirms any national level documents as consistent and issues directions.

- Section 104(1)(b)(i) and (ii) Relevant provisions of National Environmental Standards and other regulations,
- Section 104(1)(b)(iii) Relevant provisions of a National Policy Statement,
- Section 104(1)(b)(iv) Relevant provisions of New Zealand Coastal Policy Statement,
- Section 104(1)(b)(v) Relevant provisions of a Regional policy Statement or proposed Regional Policy Statement

There are no relevant provisions from the above documents which influence this application, except the following:

- National Environmental Standards and other regulations, the NES – Assessing and Managing Contaminants in Soil to Protect Human Health, and
- National Policy Statement, the National Policy Statement on Urban Development Capacity is of relevance to this development.

National Environmental Standards for Assessing and Managing Contaminants

In terms of potential contamination on the subject site, only those effects that fall within the matters for discretion under the NES: Assessing and Managing Contaminants in Soil to Protect Human Health can be considered.

A review of the historical photographs indicates that the subject has not been used for any use other than grazing.

It is therefore concluded that the site is suitable for the proposed residential use.

National Policy Statement on Urban Development

This policy statement encourage well-functioning urban environments that will enable all people and communities to provide for their social, economic and cultural wellbeing and for their health and safety, now and in the future.

The proposed subdivision will provide for development of an area for housing purposes, that has been vacant for a number of years, but located in an areas which is highly accessible within an urban context and which has access to all services.

5.3 Plan Changes

Under s104 (1) (b) (vi) of the RMA, Council must have regard to any relevant provisions of a plan or proposed plan. There are currently no plan changes that has been notified that has a direct effect on the proposed development.

5.4 Objectives and Policies Assessment

Objectives – Residential Hill Zone	Comment
14.2.1 Objective - Housing supply An increased supply of housing that will: 1. enable a wide range of housing types, sizes, and densities, in a manner consistent with Objectives 3.3.4(a) and 3.3.7;	The proposal provides for an additional 35 new dwellings

Policy – Residential Hill Zone	Comment
14.2.1.1 Policy - Housing distribution and density vi. low density residential environments in other existing suburban residential areas and in the residential areas of Banks Peninsula, and in small settlements are maintained, but limited opportunities are provided for smaller residential units that are compatible with the low density and township suburban environment; and **The Hill Zone** Covers all the living environments that are located on the slopes of the Port Hills from Westmorland in the west to Scarborough in the east. It provides principally for low density residential development that recognises the landscape values of the Port Hills, including opportunities for planting and landscaping, and control of reflectivity of roof finishes in order to blend buildings into the landscape. Provision is made for a range of housing options that will enable a typical family home to be retained, but also provide greater housing stock for dependent relatives, rental accommodation, and homes more suitable for smaller households (including older persons). Provision is also made for a range of appropriate non-residential activities.	The proposed subdivision provides for the development of allow density residential environment and what is envisaged for the Hill Zone.

Objectives – Residential Hill Zone	Comment
14.2.4 Objective - High quality residential environments • High quality, sustainable, residential neighbourhoods which are well designed, have a high level of amenity, enhance local character and reflect the Ngāi Tahu heritage of Ōtautahi.	The proposal provides for a high quality subdivision and development of architectural designed dwellings

Policies – Residential Hill Zone	Comment
14.2.4.1 Policy - Neighbourhood character, amenity and safety 1. Facilitate the contribution of individual developments to high quality residential environments in all residential areas (as characterised in Table 14.2.1.1a), through design: 1. reflecting the context, character, and scale of building anticipated in the neighbourhood; 2. contributing to a high quality street scene; 3. providing a high level of on-site amenity; 4. minimising noise effects from traffic, railway activity, and other sources where necessary to protect residential amenity; 5. providing safe, efficient, and easily accessible movement for pedestrians, cyclists, and vehicles; and 6. incorporating principles of crime prevention through environmental design.	The proposed development and dwellings to be built on the property, will be a reflection of the neighbourhood and what is anticipated for this site.

Objective – Chapter 3 – Natural Hazards (Strategic Directives)	Comment
1. New subdivision, use and development (other than new critical infrastructure or strategic infrastructure to which paragraph b. applies): 1. is to be avoided in areas where the risks from natural hazards to people, property and infrastructure are assessed as being unacceptable; and 2. in all other areas, is undertaken in a manner that ensures the risks of natural hazards to people, property and infrastructure are appropriately mitigated.	The property is at risk of rockfall but mitigating measures are available to avoid risk to people, property and infrastructure

2. New critical infrastructure or strategic infrastructure may be located in areas where the risks of natural hazards to people, property and infrastructure are otherwise assessed as being unacceptable, but only where: 1. there is no reasonable alternative; and 2. the strategic infrastructure or critical infrastructure has been designed to maintain, as far as practicable, its integrity and form during natural hazard events; and 3. the natural hazard risks to people, property and infrastructure are appropriately mitigated. 3. There is increased public awareness of the range and scale of natural hazard events that can affect Christchurch District. 4. The repair of earthquake damaged land is facilitated as part of the recovery.	

Policies – Chapter 5 – Natural Hazards	**Comment**
5.2.2.1.1 Policy - Avoid new development where there is unacceptable risk Avoid new subdivision, use and development, including new urban zonings, where the risk from a natural hazard is assessed as being unacceptable.	The property can be mitigated to remove the risk to be an acceptable level.
5.2.2.1.2 Policy -- Manage activities to address natural hazard risks Manage activities in all areas subject to natural hazards in a manner that is commensurate with the likelihood and consequences of a natural hazard event on life and property.	The Hazard Assessment Report has indicated that the area is suitable for subdivision with mitigation.

5.2.2.4.3 Policy - Slope instability for all of the Port Hills and Banks Peninsula 1. In areas not already identified in Policy 5.2.2.4.1a as being subject to cliff collapse, rockfall or mass movement, but where the land may be subject to slope instability: 1. to the extent appropriate, require proposals for subdivision, use and development to be assessed by a geotechnical specialist to evaluate the presence of hazards and level of risk to people and property (including infrastructure) from slope instability hazards; and 2. only allow subdivision, use and development where risk can be reduced to an acceptable level.	The site has been evaluated for risk by a geotechnical specialist and it has been established that the risk can be reduced to an acceptable level by the installation of a rockfall fence

Objectives – Chapter 8 - Earthworks	**Comment**
Objective 8.2.4. Earthworks facilitate subdivision, use and development, the provision of utilities, hazard mitigation and the recovery of the district.	The establishment of the access and dwelling will require earthworks, but will be temporary

Policies – Earthworks	**Comment**
8.2.4.3 – Benefits of earthworks Recognise that earthworks are necessary for subdivision, use and development, the provision of utilities, hazard mitigation and the recovery of the district.	The establishment of the subdivision and specifically the road and access will require earthworks, but will be temporary
8.2.5.1 – Land Stability Avoid earthworks that will create a significant risk to people and property through subsidence, rockfall, cliff collapse, erosion, inundation, siltation or overland flows.	Earthworks for the establishment of the subdivision will be done in accordance with the recommendations of the Geotechnical Report Lot specific geotechnical reports will identify all potential erosion risk and site-specific stability at Building Consent Stage.

8.2.5.2 – Nuisance Subject to Policy 8.2.4.3, ensure that earthworks avoid more than minor adverse effects on the health and safety of people and their property, and do not generate continuous or persistent noise, vibration, dust or odour nuisance.	All earthworks will be temporary and a management plan will be put in place as part of the construction phase. Any nuisance will be temporary and will be mitigated where possible.
8.2.5.3 – Vehicle Movements Subject to Policy 8.2.4.3, ensure that the transportation to and from a site of earth, construction or filling material is safe and minimises adverse transport network and local amenity value effects.	Vehicle movements will be limited to what is required for the movement of soil.
8.2.5.4 – Earthworks Design Ensure that earthworks over identified thresholds are designed to enable the anticipated land use.	The earthworks are required for the formation of roads and access and the establishment of a residential dwelling.

Policies - Subdivision	Comment
8.2.3.2 Policy - Availability, provision and design of, and connections to, infrastructure a. Manage the subdivision of land to ensure development resulting from the creation of additional allotments: i. does not occur in areas where infrastructure is not performing, serviceable or functional; and ii. will be appropriately connected to and adequately serviced by infrastructure, including through any required upgrade to existing infrastructure. b. Ensure that new network infrastructure provided in relation to, or as part of, subdivision development is constructed, designed and located so that it is resilient to disruption from significant seismic or other natural events including by ensuring that, as far as practicable, damage from such events is minimised. c. Ensure that, as part of subdivision, there is adequate provision, with sufficient capacity, to service the scale and nature of anticipated land uses resulting from the subdivision, for: i. wastewater disposal, including lawful trade waste disposal for anticipated industrial development, consistent with maintaining public health and minimising adverse effects on the environment; ii. water supply, including water of a potable standard for human consumption, and water for firefighting purposes; iii. telecommunication services including connection to a telecommunication system, with new lines being generally underground in new urban areas; and iv. electric power supply, with new lines being generally underground in new urban areas - including, if necessary, ensuring the provision of new or additional or the upgrading of existing infrastructure in a manner that is appropriate for the amenities of the area. d.	The proposed development is able to connect to all reticulated services

a. Where wastewater disposal is to a reticulated system, ensure all new allotments are provided with a means of connection to the system. b. Where a reticulated wastewater system is not available, ensure appropriate onsite or standalone communal treatment systems are installed. Promote use of appropriate on-site measures to manage the effects of trade wastes and reduce peak flows and loading on wastewater systems.	
8.2.3.3 Stormwater disposal a. District wide: i. Avoid any increase in sediment and contaminants entering water bodies as a result of stormwater disposal. ii. Ensure that stormwater is disposed of in a manner which maintains or enhances the quality of surface water and groundwater. iii. Ensure that any necessary stormwater control and disposal systems and the upgrading of existing infrastructure are sufficient for the amount and rate of anticipated runoff. iv. Ensure that stormwater is disposed of in a manner which is consistent with maintaining public health.	The proposed subdivision is consistent with these objectives and policies.

Policies – Transport and Access	**Comment**
a. Ensure the provision and development of comprehensive movement networks for all transport modes that: i. are legible, well connected, highly walkable, safe and efficient; and: ii. enable access by people of all ages and physical abilities to public open space facilities, public transport, suburban centres, and community facilities and to move between neighbourhoods and the wider urban area. . Ensure movement networks enable: i. vehicle parking, which in the Central City should be in accordance with the road classification;	The topography of the site is restricting some of the roads and access lots to be fully compliant with the requirement of the District Plan, but a transport system can still be provided to give access to the proposed lots.

ii. access to properties, including for fire appliances; iii. street landscaping, including street trees; iv. safety and visibility; v. ease of navigation; vi. surface water management, in relation to movement networks; and vii. utility services. c. Ensure that, where road or property access to an existing road is created, the existing road is of an appropriate standard.	

5.5 Other Matters – Section 104 (1)(c)

Section 104 (1)(c) of the RMA requires that Council consider any other matters relevant and reasonably necessary to determine an application such as contributions associated with the development, which will be charged and collected at the time of development or issue of the s224(c) certificate to complete the subdivision.

No other matters are relevant to this proposal.

5.6 Subdivisions – Section 106

Section 106 of the RMA enables Council to refuse subdivision consent if the land is likely to be subject to material damage by erosion, falling debris, subsidence, slippage or inundation from any source.

The geotechnical and rockfall assessment is attached as Appendix **4 and 13.**

Based on this assessment, the current subdivision consent can therefore be granted.

5.7 Part 2 Analysis

The purpose and key principles of the RMA are identified in Part 2 as the sustainable management of natural and physical resources. This means managing the use of natural and physical resources in a way that enables people and communities to provide for their social, cultural and economic well-being while sustaining those resources for future generations, protecting the life supporting capacity of ecosystems, and avoiding, remedying or mitigating adverse effects on the environment.

Section 6 requires consideration by council of matters of national importance which need to be recognised and provided for. These include the protection of outstanding features and landscapes, the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna, and the protection of historic heritage.

Section 7 requires consideration by council of 'other matters' which are to be given particular regard. These include efficient use of natural and physical resources, and in the maintenance and enhancement of amenity values.

Section 8 requires a council to consider the principles of the Treaty of Waitangi

The proposal is generally consistent with relevant provisions of Part 2 of the RMA for the following reasons:

- The proposal is making efficient use of the available land by redeveloping the site for additional residential accommodation and ownership options resulting from the subdivision.
- The proposed development incorporates urban design features which promotes healthy living through the access to sunlight and quality outdoor spaces, with indoor and outdoor flow.
- The proposed development is suitable for the application site, noting its accessible location to employment hubs i.e. the industrial and commercial areas including the Auckland City Centre, Manukau City Centre and the Auckland International Airport, by train, bus and private vehicles.
- The proposed development will take place while ensuring that there will be measures taken to avoid, remedy or mitigate any adverse effects on the environment and people.

6.0 Conclusion

In summary, the proposal to for the subdivision and establishment of a residential dwelling will have effects that are acceptable. The design and layout of the proposed development and subdivision ensures that the amenity of the areas is maintained.

An assessment of effects undertaken in this report has highlighted that any adverse effects on the environment resulting from the proposed development will be adequately mitigated, remedied or avoided. This planning context suggests that the proposal and its associated effects are outcomes generally anticipated by the Christchurch District Plan.

The proposal is generally consistent with the objectives and policies of the Christchurch District Plan. Based on the assessment of effects undertaken in this report, it is requested that the application is processed on a non-notified basis and granted subject to appropriate conditions.

Please contact me if you need clarification on any matters associated with this application. It is also requested that draft conditions are sent to me for review prior to issuing the consent.

Sonja Perrin
Senior Planner
13/3/2023

APPLICATION FOR TREE REMOVAL

130 Bowenvale Avenue Cashmere Christchurch

ASSESSMENT OF ENVIRONMENTAL EFFECTS

PREPARED BY:
Sonja Perrin | Phone: 03 352 5599
E-mail: sonja.perrin@outlook.com
Date: 14/12/2022

1. APPLICATION AND PROPERTY DETAILS

DATE:	14 December 2022
TO:	Christchurch City Council
APPLICANT:	Bowenvale GCO Ltd
OWNER:	Christchurch City Council
SITE ADDRESS:	130 Bowenvale Avenue Cashmere
LEGAL DESCRIPTION:	Bowenvale Avenue Road Reserve affecting Part Lot 2 DP 33462
DISTRICT PLAN:	Christchurch District Plan
ZONING:	Residential Suburban Zone
PROPOSAL:	Removal of Street Trees to provide access to new planned subdivision
CONSULTATION:	No public notification is required

2. PROPOSAL

The purpose of the application is to obtain resource consent for the removal of five (5) Street Trees along Bowenvale Avenue Cashmere.

130 Bowenvale Avenue is to be developed and further subdivided into 35 Fee Simple Lots and access to the property is required over the Sibleys Drain waterway including the installation of utilities. The application for the subdivision is still to be lodged and supporting documents and approvals are being prepared. The first application for Stage 1 of the project will be lodged in the new year, but to ensure that there are no unnecessary delays, a separate resource consent application is lodged for the removal of the trees, whilst the application for the bridge and associated earthworks is lodged with ECan and the remainder of the supplementary reports to the application are being finalised. The approval of the removal of the trees, has a direct impact on the access to the overall subdivision, hence a separate application is lodged to ensure that no further changes are necessary, since other consents (ECan) are being prepared and a bridge design is underway. The removal of the trees could have an impact on these applications at a significant cost to the Applicant and therefore the tree removal needs to be finalised to ensure that the other consents can be finalised.

Figure 1: Proposed subdivision

To be able to establish the new access and installation of utilities to the subdivision a site survey of the below trees was undertaken by Criag Taylor from SimplyArb Tree Consultants.

It was found that five (5) trees will be affected of which four (4) are Cabbage trees and one (1) Totara tree and the survey revealed the following:

Totara - in poor condition protected as a public realm tree (greater than 6m in height)
Cabbage tree - in fair condition protected as public realm (greater than 6m in height)
Cabbage tree - in fair condition protected as public realm (greater than 6m in height)
Cabbage tree - in very poor condition overall not a public realm tree (less than 6m in height)
Cabbage tree - in poor condition overall protected as public realm (greater than 6m in height)

Figure 2: Trees affected by the proposed access

Mark Fagg, Arborist from Road Amenity & Asset Protection , Christchurch City Council did a further assessment of the trees and the conclusion was that the larger Cabbage trees would be "*managed by CCC as trees due to the environment they are in"* and the smaller Cabbage tree which is in poor condition is classed a shrub. Three (3) of the trees (2 x Cabbage and 1 x Totara) are not in good condition or classed as a shrub , whilst two (2) Cabbage trees are still healthy and in fair condition.

The removal of the 2 Cabbage trees and the Totara tree will be further assessed after the Resource Consent process by John Thornton (Arborists Environmental Consents) and from our understanding, the removal of the remaining two (2) Cabbage trees will be assessed by Tony

Armstrong to determine whether it needs to be referred to the Community Board in terms of Policy 4.19 of the CCC's Tree Policy.

The above process is in addition to this application.

Figure 3: Trees to be removed - Winter

Figure 4: Trees to be removed - Summer

The proposed activities for which consent is sought will be undertaken in accordance with the details, information and plans that accompany and form part of the application including the Assessment of Effects on the Environment (AEE) and Council's Tree Policy.

3. BACKGROUND, SITE AND SURROUNDING ENVIRONMENT

The property affected by the street trees is 130 Bowenvale Avenue. A pre-application meeting was held with Council on the 10th of October 2022, where the proposed development was discussed, including the removal of the trees for access and utilities. Below an extract from the minutes of this meeting.

***Trees** – M Ostash*

- *Private trees can be removed, trees in legal road will need resource consent and possibly community board acceptance. Any RC will require a tree management plan/assessment from an arborist to demonstrate the effects will be less than minor.*

Further email communications have been had with Council regarding the street trees to be removed and a final decision in terms of the Tree Policy can only be taken once the Arboricultural Report has been completed and the Resource Consent has been processed and approved.

The property fronts Bowenvale Avenue where several street trees have been established over the years. There are a number of street trees located along Bowenvale Ave in between parking spaces that is used by cyclists, walkers and runners using the Bowenvale Track. The below photo shows usage of the parking spaces over a weekend.

Figure 5: Street Trees along bowenvale Avenue fronting the property

5. ASSESSMENT OF ACTUAL OR POTENTIAL EFFECTS ON THE ENVIRONMENT

The application for the removal of the street trees, shall be assessed against those matters with which the Council has discretion to. Resource consent will be required for the following activities:

Activity Status Rule	Standard not met	Matters of control/discretion
9.4.4.1.3 – RD4	9.4.4.1.1 – P6. c. Trees are higher than 6m	Rule 9.4.6

There are four (4) Cabbage Trees and one (1) Totara Tree affected by the proposal, although one of the Cabbage trees is less than 6m high and in very poor condition.

The Arboricultural Report is in process, but to further clarify the status of the trees, below email correspondence between the Arborist and Council, confirming the classification of the trees.

From: Fagg, Mark <Mark.Fagg@ccc.govt.nz>
Date: Thu, Dec 8, 2022 at 1:39 PM
Subject: RE: Bowenvale Avenue Cashmere
To: Tucker, Neville <Neville.Tucker@ccc.govt.nz>, Craig Taylor <craigtaylor@simplyarb.co.nz>

Hi,

I had a quick look at these trees today as was out and about.

The group you are talking about although not plotted would I believed be managed by CCC potentially as trees due the environment they are in.

The larger one is a quite a specimen.

The smaller one on its own maybe more of a shrub.

Hope that helps. (see up to photos below)

Kind regards,

Mark Fagg
Arborist
Road Amenity & Asset Protection

The below addresses the Matters of Discretion for the removal of the trees as below and provides further details on the proposal.

Effects of activity/works on the tree(s)

1. The character and degree of modification, damage, or destruction of the values that make the tree/s significant;
2. The extent to which the works will or may adversely affect the health or structural integrity or visual appearance of the tree;
3. Whether the works will be undertaken in a manner consistent with internationally accepted arboricultural standards, practices and procedures;
4. The duration and frequency of the activity and the effect on the tree;
5. Whether the tree is resilient, including structural soundness and health and the irreversibility of effect on the tree;
6. The degree of impact on landscape character, and ecological, cultural, heritage and neighbourhood amenity values;
7. In relation to a scheduled group of trees, the extent to which the works will or may adversely affect the health, structural integrity or amenity values of the wider group;
8. Whether any proposed compensation for the loss of the significant tree/s fully mitigates the loss of landscape and environmental benefits within 15 – 20 years;

Extent of benefit or need for activity/works

1. The need for the work to deal with an emergency situation, or to avoid significant risk of effects on human health and safety, or significant impacts on infrastructure, including the strategic transport network;
2. The extent of benefits associated with the use and development of the site for activities anticipated by the zoning for the site, including the use of the site for residential development, taking into account the cumulative effect of multiple protection provisions (eg. setbacks from water bodies, heritage items);
3. For proposed activities in connection with a recovery activity in the Flat Land Recovery Zone, the extent to which the proposal would maintain the contribution of any significant trees, and trees in road corridors, parks, reserves and public open space;

Extent of benefit or need for activity/works

1. For utilities the extent of benefits associated with that utility, whether there is a functional or operational requirement for that location and whether there are any practical alternatives;
2. The extent to which the works would result in improved community amenity that cannot otherwise be achieved by arboricultural or property management means; and
3. The need for the works directly arising from damage incurred as a result of the Canterbury earthquakes, which if not otherwise undertaken would unreasonably restrict repair or rebuilding of the damaged buildings on the site.

Assessment

The above matters of discretion relate mostly to work to trees or around the trees. The proposal involves the removal of the trees as indicated above and the matters marked red have been identified as the most relevant to this application.

All works to remove the trees will be managed and monitored by an Arborist to ensure that no other trees are damaged during the removal process. Any earthworks within 5m of any other street trees will be monitored and resource consent will be applied for earthworks within 5m of a street tree, when the first stage of the subdivision is applied for. This application focusses on the removal of trees for access and utility purposes.

The removal of the trees is necessary to provide access and utilities to the property from Bowenvale Avenue. The position chosen for the access and bridge is further determined by the waterway and the location of the weir. Council has had input into the position of the proposed access/bridge. The position of the proposed access and bridge has been discussed with Sheryl Keenan (Planning Engineer – Surface Water). A bridge will have to be constructed to provide access to the property and the most optimal position has been identified to ensure that there is the least amount of disturbance to the waterway, existing structures in the waterway and trees. There is two (2) Cabbage Trees that are in fair condition that will be affected by the proposed access.

Any alternative position for the access/bridge will impact other trees, which may impact a larger number of healthy trees, since there are several street trees along Bowenvale Avenue along the frontage of the property to be developed.

As part of Council's tree policy, two (2) trees must replace anyone (1) tree that is removed. Replacement trees and their location will be discussed with Council and can be included in the Landscape Plan for the overall subdivision and will include proposals for the street trees that will need to replace the trees that will be removed. A Consent Condition can be volunteered for this purpose.

6. SECTION 95 NOTIFICATION

A consent authority must publicly notify an application if it decides under s95B that the activity will have or is likely to have adverse effects on the environment that are more than minor. In addition, Section 95B (1) requires a decision whether there are any affected persons in relation to the activity.

As outlined above the proposed activity is not likely to have adverse effects on the environment that are more than minor and where persons have been considered adversely affected, their written approval has been obtained. Additionally, we do not request public notification of the application, and there are no circumstances that exist in relation to the application that would require public notification.

7. CONCLUSION

In the opinion of the applicant the removal of the street trees will be mitigated by replacing the trees with double the number of trees and will remove trees that is not prospering in their environment. No potential issues arising from the proposed activity can be foreseen; therefore, it is considered the proposal will not compromise the intent of the zone and be consistent with the objectives of the district plan.

In summary of the assessment above it is considered that the proposal will have no more than minor actual or potential effects on the environment and that the effects of the proposal are consistent with the environmental outcomes anticipated for the site and locality. I trust this outline of potential effects and mitigation practices to be put in place satisfies all queries on the matter.

The proposal is consistent with the purpose and principles of the RMA 1991 in that it enables people to provide for their economic and social well-being, whilst maintaining and enhancing the quality and amenity of the local environment and avoiding adverse effects. The proposal will enable access and utilities to the proposed subdivision. As such, it is considered that the proposed development will be in keeping with Part 2 of the RMA.

Accordingly, it is concluded that the Council should grant consent to the activity on a non-notified basis in accordance with sections 104, 104C and Part 2 of the Act, subject to appropriate conditions.

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD

Search Copy

R.W. Muir
Registrar-General
of Land

Identifier **CB34A/555**
Land Registration District **Canterbury**
Date Issued 25 January 1991

Prior References
CB27K/447

Estate Fee Simple
Area 5.0894 hectares more or less
Legal Description Part Lot 2 Deposited Plan 33462
Registered Owners
Bowenvale GCO Limited

Interests

466273.1 Transfer creating the following easements in gross

Type	Servient Tenement	Easement Area	Grantee	Statutory Restriction
Drain water	Part Lot 2 Deposited Plan 33462 - herein	Part herein	The Christchurch City Council	

Fencing Provision in Transfer 161803

Appurtenant to the parts herein formerly in CT CB4A/948 are drainage easements created by Transfers 173750, 174939, 174942 and 174943

Fencing Provision in Transfer 174941

699566 Easement Certificate specifying the following easements

Type	Servient Tenement	Easement Area	Dominant Tenement	Statutory Restriction
Drain water	Lot 1 Deposited Plan 24710 - CT CB6D/935	Part	Part formerly in CT CB6D/875 - herein	
Drain water	Lot 2 Deposited Plan 24710 - CT CB9K/859	Part	Part formerly in CT CB6D/875 - herein	

Fencing Provision in Transfer 702129

773257 Easement Certificate specifying the following easements - 14.8.1969 at 11.25 am

Type	Servient Tenement	Easement Area	Dominant Tenement	Statutory Restriction
Rights to convey and drain water and drain sewage	Lot 1 Deposited Plan 26943 - CT CB9A/553	Part	Part formerly in CT CB4A/948 - herein	
Rights to convey and drain water and drain sewage	Lot 6 Deposited Plan 26943 - CT CB9A/551	Part	Part formerly in CT CB4A/948 - herein	
Right of way	Lot 6 Deposited Plan 26943 - CT CB9A/551	Yellow DP 26943	Part formerly in CT CB4A/948 - herein	

Rights to convey electricity and telephonic communications	Lot 6 Deposited Plan 26943	Part	Part formerly in CT CB4A/948 - herein
Right to convey water and drain water and sewage	Lot 2 Deposited Plan 26943 - CT CB9F/1213	Part	Part formerly in CT CB4A/948 - herein
Right to convey water and drain water and sewage	Lot 5 Deposited Plan 26943 - CT CB9F/1216	Part	Part formerly in CT CB4A/948 - herein

Certain of the easements specified in Easement Certificate 773257 are subject to (now) Section 309(1)(a) Local Government Act 1974

920309 Transfer creating the following easements - 24.7.1973 at 11.30 am

Type	Servient Tenement	Easement Area	Dominant Tenement	Statutory Restriction
Right of way	Part Lot 3 Deposited Plan 28705 - CT CB25F/638	Yellow DP 28705	Part Lot 2 Deposited Plan 33462 - herein	

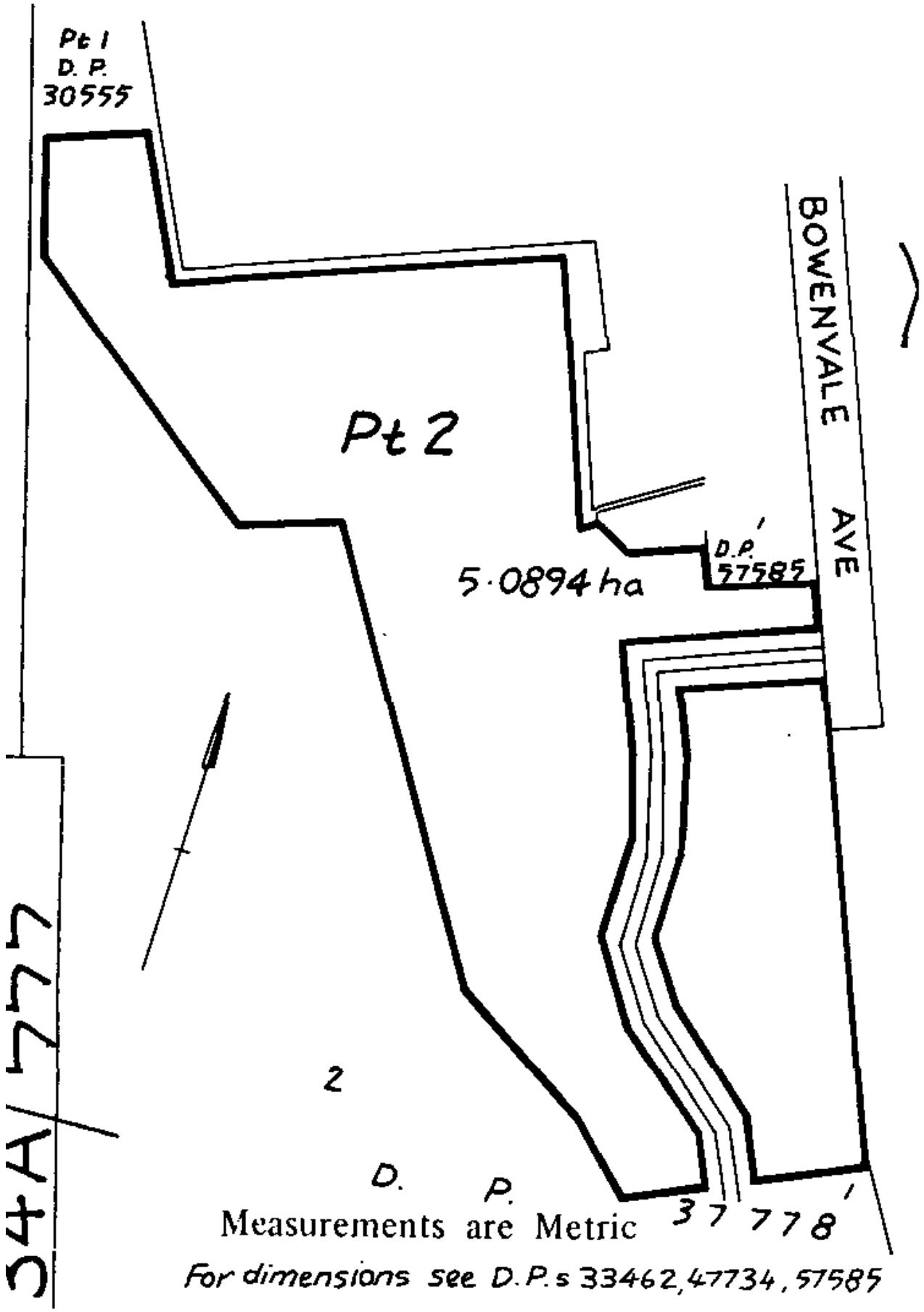
Fencing Provision in Transfer 920310

The easement created by Transfer 920309 is subject to (now) Section 309(a)(a) Local Government Act 1974

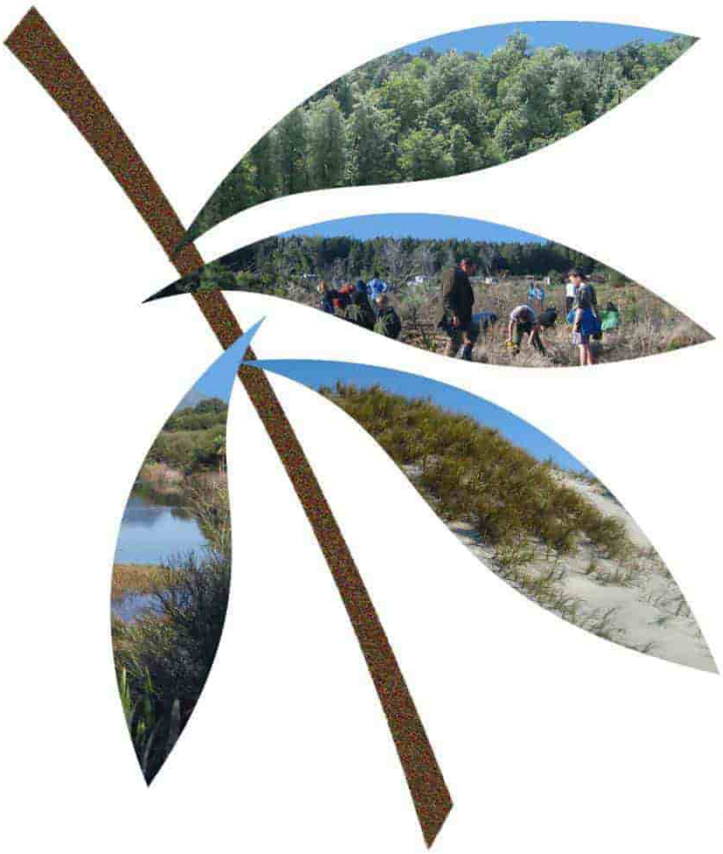
12434129.4 Mortgage to Alpha First Securities Limited - 1.9.2022 at 5:01 pm

12434129.5 Mortgage to Alpha First Securities Limited - 1.9.2022 at 5:01 pm

12666592.1 CAVEAT BY BIZCAP NZ LIMITED - 10.2.2023 at 4:21 pm


Pt 1
D. P.
30555
Pt 2
5·0894 ha
D.P.
57585
BOWENVALE AVE
34A/777
2
D. P.
37778
Measurements are Metric
For dimensions see D.P.s 33462, 47734, 57585

ASSESSMENT OF ECOLOGICAL EFFECTS OF A PROPOSED SUBDIVISION AT BOWENVALE AVENUE, CASHMERE



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R6587b

ASSESSMENT OF ECOLOGICAL EFFECTS OF A PROPOSED SUBDIVISION AT BOWENVALE AVENUE, CASHMERE

Contract Report No. 6587b

February 2023

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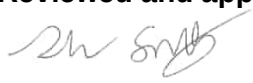

Des Smith
Senior Principal Ecologist/South Island Regional Manager
Wildland Consultants Ltd

1. INTRODUCTION

S5 Consultants, on behalf of their client Bowenvale GCO Ltd., are applying for resource consent to develop 130 Bowenvale Avenue in Cashmere, Christchurch for residential housing.

The proposal will subdivide the currently-undeveloped 5.09-hectare site into 34 residential allotments plus two larger allotments and communal facilities (Figure 1). The site is on a hill and surrounded by residential housing and recreational areas including Bowenvale Reserve, which has walking and bike tracks.

A lizard survey and habitat assessment were conducted for the proposed subdivision in November 2022. During the assessment, areas of indigenous vegetation and potential habitat for indigenous birds and invertebrates were identified. An Assessment of Ecological Effects (AEE) was recommended to cover birds, invertebrates and vegetation.

S5 Consultants, on behalf of their client Bowenvale GCO Ltd., commissioned Wildland Consultants Ltd. to prepare an AEE of the proposed development identifying whether there are any ecological effects and if so options for their mitigation.

1.1 Site context

The proposed subdivision is located at 130 Bowenvale Avenue, situated at the base of the Port Hills. The subdivision will comprise four stages, including two access roads, a bridge, 35 lots, a rockfall protection area, and three naturalized dry hydrological flow paths. The site will also include two local purpose reserves, including the stormwater reserve present at the base of the proposed subdivision (Figure 1).

2. ECOLOGICAL CONTEXT

The proposed Bowenvale residential subdivision is situated in the Port Hills Ecological District (ED). The following description is adapted from McEwen (1987).

Lowland short tussockland with scattered mixed scrub and flax historically covered north slopes of the Port Hills ED. Dry podocarp/hardwood forests formed large patches in main gullies, while mixed hardwood forests covered ridge crests. Similar vegetation was present on slopes facing Lyttelton, with mānuka (*Leptospermum*) and more extensive scrub and flax, and larger, more continuous forests in gullies. Additional coastal species (such as ngaio, akiraho, and kawakawa) were found in the otherwise-similar forests. Some reserves and covenants protect remnants of these habitats.

Port Hills geology mainly comprises Miocene volcanic rock, with basalt flows and pyroclastics and a fringe of deep, generally coarse loess from the Pleistocene.

The climate is typically very dry, with only 600-700 millimetres of precipitation per year. The summers are warm, and the winters cool, with frequent frosts and occasional snow. Clouds often cap the hills.

The site is in an area that is classified under the Threatened Environment Classification as having 10-20% indigenous cover left (Cieraad et al. 2015). In these environments, indigenous biodiversity loss has been severe, with only sparsely-distributed indigenous habitats remaining.

2.1 Statutory Context

The site was assessed against the ecological significance criteria in Environment in Canterbury's Regional Policy Statement (CRPS; Appendix 2). The site was also assessed under the Christchurch District Plan

2.2 Wildlife Act

All indigenous lizards, birds and some indigenous invertebrates are protected under the Wildlife Act (1953). It is an offence to disturb or destroy lizards without a Wildlife Act Authorisation (WAA; also known as a wildlife permit) from the Department of Conservation. A permit must be obtained from the Department before any protected wildlife (and/or their habitats) can be disturbed, handled, translocated or killed. Also, if an activity is likely to disturb or kill protected avian wildlife or their eggs, then a Wildlife Act Authority (permit) is needed from the Department of Conservation.

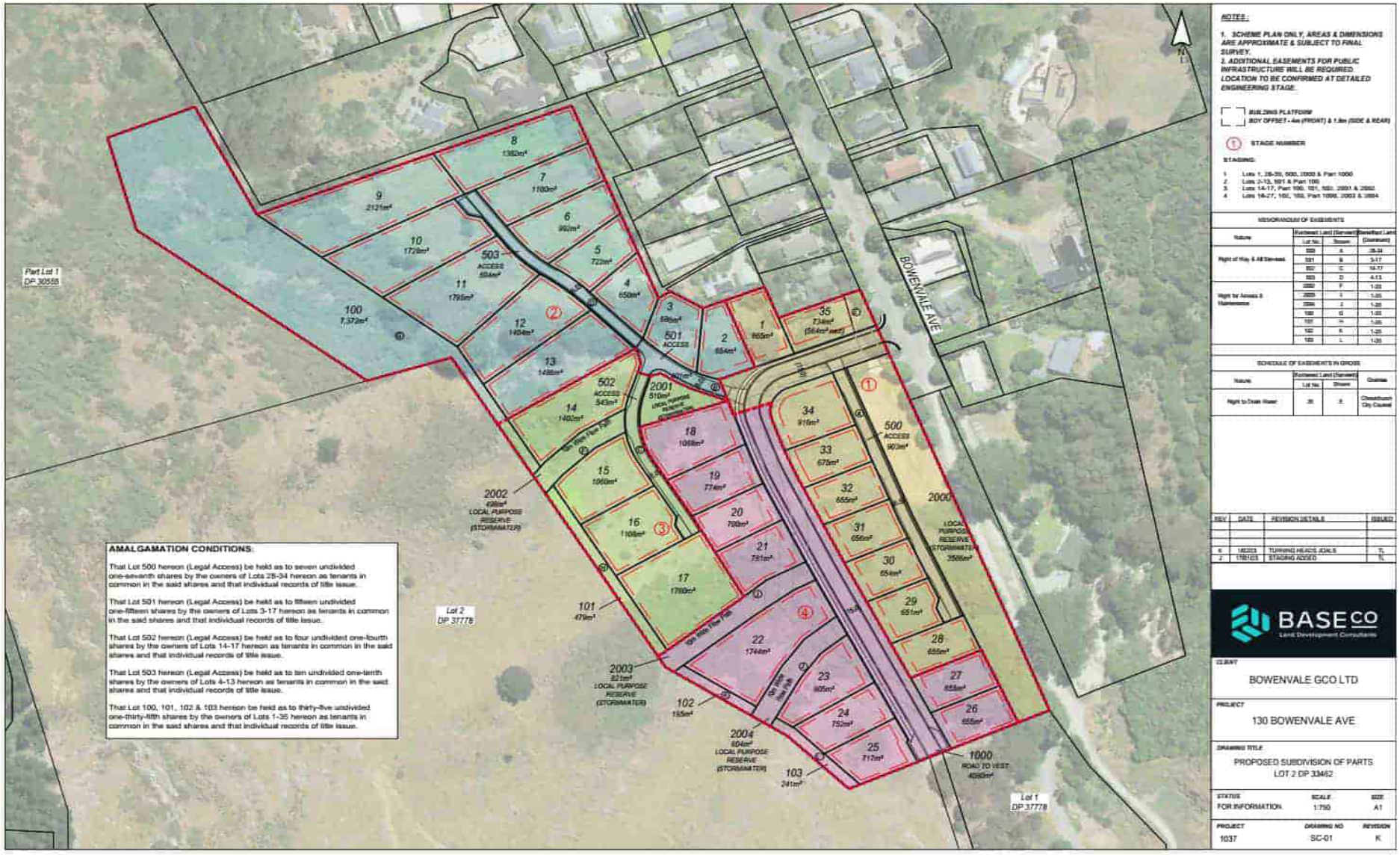

Figure 1: Project site and subdivision plan, provided by Base Co Ltd on behalf of Bowenvale GCO Ltd.

3. METHODS

3.1 Desktop assessment

Department of Conservation BioWeb Herpetofauna Database observations within 10 kilometres of the site, and within the last 20 years, were assessed to provide context for lizard fauna recorded within the site and inform an assessment of ecological values for the site.

The online database eBird was used to conduct a desktop search for bird species recorded within one kilometre of the site from January 2021 to February 2023. Any notable species with records in this area and timeframe were noted if they were considered likely to be present at the site.

A desktop survey was carried out using the Global Biodiversity Information Facility (GBIF 2023) to find records of terrestrial invertebrate observations within a five-kilometre radius of the site. Any species which may be locally endemic, threatened, protected, or new species ("notable invertebrates") found during the desktop survey were then assessed for their likelihood of presence on-site.

3.2 Field assessment

Vegetation and habitats

A field survey was undertaken on 20 January 2023. Vegetation and habitat types were identified, mapped and described following the structural classes in Atkinson (1985). Field mapping was digitised onto aerial imagery using ArcGis10.8. All vascular plant species observed are listed in Appendix 1.

Avifauna

A survey of the site for avifauna was carried out on 19 January 2023. A continuous transect was walked around the perimeter and throughout the site. All bird species seen and heard were recorded. Large trees were checked for roosting or nesting little owl.

Lizards

Pitfall trapping was undertaken over four days (three nights) in warm conditions (*c.*19°C) between 6 December and 9 December 2022. Forty-seven pitfall traps were set up within the site. These were baited with tinned pear and rank grass was added to protect lizards from desiccation, predation from mice or becoming stressed. The pitfall traps were checked daily. Limited manual searching was undertaken in rock stacks, crevices and under rocks. Pitfall traps were placed throughout the site in representative habitats throughout each stage of the subdivision.

Lizard survey methods sometimes have poor detection rates because of typically low population densities, species' cryptic colouration, difficulty in surveying preferred habitats and behaviour/activity patterns. As such, even intensive lizard surveys are unlikely to detect all individuals in the population or, possibly, all species present.

Invertebrates

A walk-through invertebrate survey was carried out on the 8th December 2022. Any sightings of notable invertebrates or habitat were recorded. The results of both desktop and walk-through surveys were used to assess the general character of the invertebrate fauna, and notable invertebrates present or likely to be present on-site.

3.3 Ecological significance

Areas of ecological significance in Canterbury are areas or habitats that meet one or more of the criteria listed in Appendix 3 of the Canterbury Regional Policy Statement (CRPS). This assesses significance of indigenous vegetation and habitat of indigenous fauna against 10 criteria within four categories:

1. Representativeness
2. Rarity or distinctive features
3. Diversity and pattern
4. Ecological context

The proposed subdivision was assessed against these criteria based on the results of the desktop and field surveys.

4. VEGETATION AND HABITATS

4.1 Overview

The field survey delineated 11 vegetation and habitats across the site (Figure 2):

1. Macrocarpa forest (*c*. 0.43 hectares)
2. Crack willow forest (*c.*0.23 hectares)
3. Tree lucerne forest (*c*.0.86 hectares)
4. Mixed forest (c. 0.14 hectares)
5. (Tree lucerne)-(kōhūhū)/blackberry-gorse-banana passionfruit scrub (*c*. 1.36 hectares)
6. Scrub pōhuehue vineland (*c.* 0.11 hectares)
7. Blackberry-large-leaved pōhuehue gorse vineland/scrub (*c.* 0.30 hectares)
8. Old man's beard vineland (*c.* 0.04 hectares)
9. Japanese honeysuckle vineland (*c.* 0.04 hectares)
10. Cocksfoot-(fennel) grassland (*c*. 1.97 hectares)
11. Mixed exotic grassland herbfield (*c.* 0.12 hectares)

Figure 2. Vegetation and habitat types for a proposed subdivision in Bowenvale Valley, Christchurch.

1. **Macrocarpa forest**

   Patches of exotic macrocarpa (*Cupressus macrocarpa*) forest occur in the northern part of the site along property boundaries and old fence lines. Tall (20m+) macrocarpa trees form the canopy in these areas. Vines including banana passionfruit (*Passiflora* '*Tacsonia*'), old man's beard (*Clematis vitalba*) and the indigenous large-leaved pōhuehue (*Muehlenbeckia australis*) are common on lower branches and habitat margins (Plate 1). The subcanopy and understory tiers are variable, with large areas blanketed in leaf litter and devoid of plants. However, there are also patches with diverse subcanopy and understory tiers. Subcanopy species include the indigenous māhoe (*Melicytus ramiflorus*), karamu (*Coprosma robusta*) and mingimingi (*Coprosma propinqua*), along with exotics including elderberry (*Sambucus nigra*) and tree lucerne (*Chamaecytisus palmensis*). Indigenous ground cover species are also common in places including button fern/tarawera (*Pellaea rotundifolia*), ground spleenwort (*Asplenium appendiculatum*) and necklace fern (*Asplenium flabellifolium*). Exotic weeds and garden plants are also locally abundant with patches of tradescantia (*Tradescantia fluminensis*), violet (*Viola odorata*) and blackberry common.

2. **Crack willow forest**

   Crack willow (*Salix ×fragilis*) mostly occurs along the Bowenvale stream boundary of the site. The canopy is predominantly crack willow, with some indigenous subcanopy species including kōhūhū (*Pittosporum tenuifolium*), tarātā (*Pittosporum eugenioides*) and cabbage tree/tī kōuka (*Cordyline australis*). Grey willow (*Salix cinerea*) is also present and occasionally reaches the canopy. Indigenous understory species present include kāpuka (*Griselinia littoralis*), pigeonwood/porokaiwhiri (*Hedycarya arborea*), five-finger/whauwhaupaku (*Pseudopanax arboreus*) and lancewood/horoeka (*Pseudopanax crassifolius*). Ferns, including thousand-leaved fern (*Hypolepis millefolium*), prickly shield fern/pūniu (*Polystichum vestitum*), and sedges (*Carex diandra, C.* species), which are common along the line of the stream (Plate 1).

Plate 1: Macrocarpa forest (left) and understory of crack willow forest (right)

3. **Tree lucerne forest**
   Tree lucerne forest is the most common forest type on the site, covering a large part of the northern part of the property. Several smaller patches are scattered in the south of the site. The canopy is predominately tree lucerne with and occasional macrocarpa, kōhūhū and popular (*Populus nigra*) (Plate 2). The vines banana passionfruit and large-leaved pōhuehue are also locally abundant within the canopy. The understory is generally sparse, bare ground and leaf litter are common, although there are patches where blackberry, gorse and broom (*Cytisus scoparius*) are abundant.

4. **Mixed forest**
   This forest type is largely confined to the property boundaries and areas in the north of the site. The canopy contains a mix of indigenous and exotic trees, generally in clumps or stands of the same species. Many of the trees along the boundaries also appear to have been planted or spread from plantings on neighbouring properties. Indigenous trees include kōhūhū, tarātā, akeake (*Dodonaea viscosa*) and akiraho (*Olearia paniculate*), while exotic trees include sycamore (*Acer pseudoplatanus*), plum (*Prunus ×domestica*), cherry (*Prunus* species) and other fruit trees. Vines including banana passionfruit and large-leaved pōhuehue are also present in places. The understory is generally sparse with occasional saplings, exotics grasses and other herbaceous weeds.

5. **(Tree lucerne)-(kōhūhū)/blackberry-gorse-banana passionfruit scrub**
   This scrub type is scattered across much of the site, and is most abundant towards the southern end. The canopy is variable, with scattered tree lucerne and kōhūhū, often draped in banana passionfruit or large-leaved pōhuehue, emergent above the lower stature gorse and blackberry (Plate 2). Occasional patches of the indigenous scrub pōhuehue (*Muehlenbeckia complexa*) are also present, as well as exotic shrubs including broom, sweet briar (*Rosa rubiginosa*) and cotoneaster (*Cotoneaster glaucophyllus*). The dense canopy mostly excludes understorey tiers, but rank cocksfoot (*Dactylis glomerata*) is common in canopy gaps.

Plate 2: Tree lucerne forest (left) and (tree lucerne)-(kōhūhū)/blackberry-gorse-banana passionfruit scrub (right).

6. **Scrub pōhuehue vineland**
   Small patches of indigenous scrub pōhuehue vineland are scattered across the site, although it is most common towards the southern boundary. The low (1-2 m) canopy is dominated by densely tangled scrub pōhuehue, which is interspersed with occasional gorse, blackberry and sweet briar (Plate 3).

Plate 3: scrub pōhuehue vineland in the south of the site (left), and the only patch in the north of the site (right).

7. **Blackberry-large-leaved pōhuehue gorse vineland/scrub**
   This vineland habitat occurs in the middle and southern parts of the site. The canopy is mix of blackberry, large-leaved pōhuehue and gorse, with giant bindweed (*Calystegia sylvatica*). Around the margins broom and fennel (*Foeniculum vulgare*) are also common.

8. **Old man's bread vineland**
   Although old man's bread is common across the site there is one area, in the north-east corner, where it forms the dominant cover. Here, a dense canopy of old man's beard is draped over shrubs (mostly elderberry) and grassland. With the grassland area the seed heads of cocksfoot, Californian thistle (*Cirsium arvense*) and Yorkshire fog (*Holcus lanatus*) are emergent above the old man's beard.

9. **Japanese honeysuckle vineland**
   There is one patch of the exotic Japanese honeysuckle (*Lonicera japonica*) vineland on the site, which is located on the western boundary. Here, Japanese honey suckle forms a dense low (1 m) canopy that excludes nearly all other plants, although in places the indigenous bindweed/pōwhiwhi (*Calystegia tuguriorum*) scrambles through the honeysuckle (Plate 4).

10. **Cocksfoot-(fennel) grassland**
    Long rank grassland dominated by cocksfoot covers most of the site (Plate 4). Fennel is common around the margins of this grassland habitat along with other exotic weeds including Californian thistle and bone seed (*Chrysanthemoides monilifera*). In places other exotic grasses including Yorkshire fog, prairie grass (*Bromus catharticus*) and brown top (*Agrostis capillaris*) are also locally abundant.

11. Mixed exotic grassland herbfield

This habitat occurs in the catchment zone for the Bowenvale Stream stormwater trap. Here, regular flooding and maintenance appear to be preventing rank grass and wood weeds from becoming dominant. The stormwater trap sides have a mixture of grasses and herbs including Yorkshire fog, brown top, broad-leaved dock (*Rumex obtusifolius*), lotus (*Lotus pedunculatus*) and clovers (*Trifolium pratense*, *T. repens*). Along the channel bottom the exotic rushes jointed rush (*Juncus articulatus*) and toad rush (*Juncus bufonius*) are common.

Plate 4: Japanese honeysuckle vineland (left), cocksfoot-(fennel) grassland (right).

5. FLORA

Forty-three indigenous and 73 exotic vascular plant species were recorded during the survey (Appendix 1).

Indigenous species recorded include at least four that have been planted as part of stream restoration works in the Bowenvale Stream corridor (Lot 2000 'local purpose reserve stormwater'). A number of indigenous 'cultivar' species and other popular indigenous hedging species additionally appear to have escaped from neighbouring properties.

Threatened, At-Risk, and Locally Uncommon Species

One indigenous plant species recorded on the site has a national level classification of Threatened or At-Risk (de Lange et al. 2018).

- Kānuka (*Kunzea robusta* Threatened – Nationally Vulnerable)

Pest Plants

Eleven plant species recorded on the site are listed as either 'pests' or 'Organisms of Interest' (OoI) in Environment Canterbury's Regional Pest Management Plan

(CRPMP; 2018-2038). This includes three species listed in the National Pest Plant Accord (NPPA) and banned from sale and distribution in New Zealand (Table 1).

The site also contains a further 10 species that are listed as weeds and pests outside of Canterbury by other Reginal Councils and national organisations, including an additional five species listed in the NPPA.

Table 1: Pest plants and Organisms of Interest (PEST, OoI), listed in CRPMP, the NPPA and by councils outside of the Canterbury Region (OC) that were recorded at 130 Bowenvale Drive.

Scientific Name	Common Name(s)	Growth Form	Pest Status
Acacia mearnsii	black wattle	tree	OC
Acer pseudoplatanus	sycamore	tree	OoI
Chamaecytisus palmensis	tree lucerne	tree	OoI
Chrysanthemoides monilifera	boneseed	shrub	PEST NPPA
Cirsium arvense	Californian thistle	monocot herb	OC
Clematis vitalba	old man's beard	vine	PEST NPPA
Conium maculatum	hemlock	dicot herb	OoI
Cotoneaster glaucophyllus	bright bead cotoneaster	shrub	OoI
Cytisus scoparius	scotch broom	shrub	PEST
Dryopteris filix-mas	male fern	fern	OC
Iris foetidissima	stinking iris	monocot herb	OC
Lonicera japonica	Japanese honeysuckle	vine	NPPA
Passiflora 'Tacsonia' subgroup	banana passionfruit	vine	PEST NPPA
Rhamnus alaternus	evergreen buckthorn	shrub	NPPA
Rosa rubiginosa	sweet briar, briar rose	shrub	OoI
Rubus fruticosus	blackberry	shrub	OoI
Salix cinerea	grey willow	tree	NPPA
Salix ×fragilis	crack willow	tree	NPPA
Tradescantia fluminensis	tradescantia	dicot herb	NPPA
Trachycarpus fortunei	fan palm, hemp palm	tree	OC
Ulex europaeus	gorse	shrub	PEST

6. AVIFAUNA

6.1 Desktop assessment

The desktop survey found 32 species and one hybrid taxon within one kilometer (January 2021–February 2023) of the site (Table 2). Of these 32 species, 15 were indigenous and 17 exotic. One "At Risk" species was recorded and is possibly present at the site, pīhoihoi/New Zealand pipit (*Anthus novaeseelandiae novaeseelandiae*; At Risk-Declining). Other "At Risk" species recorded were considered unlikely to be

present at the site. One exotic species, ruru nohinohi/little owl (*Athene noctua*; Introduced and Naturalised), is partially protected and is possibly present at the site.

6.2 Survey results

During the site survey, 18 bird species were detected, eight indigenous and 10 exotic (Table 2). No indigenous species detected are classified as Threatened or At-Risk. The avifauna at the site was dominated by exotic passerines feeding and roosting on indigenous and exotic vegetation throughout the area. Two adult and two immature pīwakawaka/South Island fantail (*Rhipidura fuliginosa fuliginosa*; Not Threatened) were seen together in tree lucerne, indicating possible breeding at the site. Two adult and two immature kāhu/swamp harrier (*Circus approximans*; Not Threatened) were seen on the proposed site or flying over the adjacent hillside. An adult passed food to one of the immature birds, indicating possible breeding in the area. Kererū/New Zealand pigeon (*Hemiphaga novaeseelandiae*; Not Threatened) were seen during a lizard site visit on 14 December 2022. All species recorded during the site visit were also recorded during the desktop assessment.

Table 2: Bird species recorded in the desktop assessment and during the site visit. Common names, species names, and threat classifications are from Robertson *et al.* (2021). The likelihood of occurrence for each species is given based on site visit observation and their known habitat preferences and distribution in the area.

Common Name(s)	Scientific Name	Threat Classification 2021	Likelihood of Species Being Present at Site
Indigenous species			
Bellbird/korimako	*Anthornis melanura melanura*	Not Threatened	Seen
Black-billed gull/tarāpuka	*Chroicocephalus bulleri*	At Risk-Declining	Highly unlikely
Black shag/Māpunga	*Phalacrocorax carbo novaehollandiae*	At Risk-Relict	Highly unlikely
Grey duck X mallard hybrid	*Anas superciliosa × platyrhynchos*	Not Threatened	Possible
Grey warbler/rirориro	*Gerygone igata*	Not Threatened	Seen
New Zealand kingfisher/kōtare	*Todiramphus sanctus vagans*	Not Threatened	Seen
New Zealand pigeon/kererū	*Hemiphaga novaeseelandiae*	Not Threatened	Highly likely
New Zealand pipit/pīhoihoi	*Anthus novaeseelandiae novaeseelandiae*	At Risk-Declining	Possible
Paradise shelduck/pūtangitangi	*Tadorna variegata*	Not Threatened	Possible
Shining cuckoo/pīpīwharauroa	*Chrysococcyx lucidus lucidus*	Not Threatened	Possible
Silvereye/tauhou	*Zosterops lateralis lateralis*	Not Threatened	Seen
South Island fantail/pīwakawaka	*Rhipidura fuliginosa fuliginosa*	Not Threatened	Seen
Southern black-backed gull/karoro	*Larus dominicanus dominicanus*	Not Threatened	Seen
Spur-winged plover	*Vanellus miles novaehollandiae*	Not Threatened	Possible
Swamp harrier/kāhu	*Circus approximans*	Not Threatened	Seen
Welcome swallow/waroua	*Hirundo neoxena neoxena*	Not Threatened	Seen
Exotic species			
Australian magpie/makipai	*Gymnorhina tibicen*	Introduced and Naturalised	Seen
California quail/tikaokao	*Callipepla californica*	Introduced and Naturalised	Likely
Chaffinch/pahrini	*Fringilla coelebs*	Introduced and Naturalised	Highly likely
Cirl bunting	*Emberiza cirlus*	Introduced and Naturalised	Possible
Common redpoll	*Acanthis flammea*	Introduced and Naturalised	Seen
Dunnock	*Prunella modularis*	Introduced and Naturalised	Seen
Eurasian blackbird/manu pango	*Turdus merula*	Introduced and Naturalised	Seen
Goldfinch/kōurarini	*Carduelis carduelis*	Introduced and Naturalised	Seen
Greenfinch	*Chloris chloris*	Introduced and Naturalised	Seen
House sparrow/tiu	*Passer domesticus*	Introduced and Naturalised	Seen
Little owl/ruru nohinohi	*Athene noctua*	Introduced and Naturalised	Possible
Ring-necked pheasant/peihana	*Phasianus colchicus*	Introduced and Naturalised	Possible
Rock pigeon/kererū aropari	*Columba livia*	Introduced and Naturalised	Unlikely
Skylark/kairaka	*Alauda arvensis*	Introduced and Naturalised	Likely
Song thrush/manu-kai-hua-rakau	*Turdus philomelos*	Introduced and Naturalised	Seen
Starling/tāringi	*Sturnus vulgaris*	Introduced and Naturalised	Seen
Yellowhammer/hurukōwhai	*Emberiza citrinella*	Introduced and Naturalised	Seen

7. LIZARDS

7.1 Desktop assessment

Five species are found within the wider area including three species of skink, and two species of gecko (Table 3). Southern grass skink (*Oligosoma* aff. *polychroma;* At Risk - Declining), McCann's (*O. maccanni;* Not Threatened), and Canterbury spotted skink (*O. lineoocellatum;* Threatened – Nationally Vulnerable) Jewelled gecko (*Naultinus gemmeus;* At Risk – Declining), and Waitaha gecko (*Woodworthia* cf. *brunnea;* At Risk-Declining) (Table 3) have all been recorded within 20 km of the site. Of these, southern grass skink, McCann's skink and Waitaha gecko may be present as there is suitable habitat available throughout site.

While it cannot be ruled out that Canterbury spotted skink occur within the proposed development site, it is highly unlikely. Canterbury spotted skinks are becoming increasingly rare and are sparsely spread across the Canterbury region. Although an individual spotted skink has been observed within the 10 km radius, it is highly unlikely that this species would be present in the more modified environment present at the proposed development site.

It is also unlikely that jewelled gecko are present at the proposed development site. The predominant land use of the site since the 1940's has been pastural, and all of the suitable scrub habitat has recently regenerated (*c.* 1980s). Therefore it is unlikely that remnant populations of jewelled gecko would be present.

Table 3: Results of the Department of Conservation Bioweb herpetofauna database search within a 10 kilometre radius of Bowenvale Avenue and an assessment of the likelihood of the presence of these species at 130 Bowenvale Avenue. Conservation status as per Hitchmough et al. 2021. The likelihood of occurrence for each species is given based on their known habitat preferences and distribution in the area and surrounds.

Species	Common Name	Conservation Status	Nearest Record (km)	Preferred Habitats	Likelihood of Occurrence
Oligosoma aff. polychroma Clade 5	Southern grass skink	At risk - Declining	1.1	Prefers damp or well vegetated habitats such as rank grasslands, wetlands, stream/river edges, and gullies.	Presence confirmed (through site survey)
Oligosoma maccanni	McCann's skink	Not Threatened	1.3	Open habitats- dry rocky environments such as rock outcrops, and montane grassland	Presence confirmed (through site survey)
Naultinus gemmeus	Jewelled gecko	At Risk - Declining	2.6	Scrubland, forest and tussock land	Unlikely (some suitable dense scrub habitats, regenerating since 1980s with no natural contiguous forest associations)
Woodworthia* c.f. *brunnea	Waitaha gecko	At Risk - Declining	1.9	Scrubland, forest, creviced rock outcrops, rocky scrubland, boulder beaches, river terraces, scree talus, and boulderfield	Possible (some, but not much suitable scrub and rocky outcrop habitats throughout the west and south of the site)
Oligosoma lineoocellatum	Canterbury spotted skink	Nationally Vulnerable	2.6	Grassland, duneland, boulder beaches, scrubland, tussockland, flaxland, edges of forest, rocky areas, scree, herbfield, fellfield, stony riverbeds and terraces	Highly unlikely (increasingly rare therefore unlikely to be present at this site)

7.2 Survey results

Eighteen southern grass skinks (*Oligosoma* aff. *polychroma*; Clade 5) and four McCann's skinks (*Oligosoma maccanni*) were observed or captured during the surveys (Table 4). An individual southern grass skink was captured twice during the survey.

Southern grass and McCann's skinks are widespread throughout the Canterbury region and often persist in areas of complex grassland habitat comprising of rank grass, scrub and woody debris similar to that found in the proposed development site.

Waitaha gecko were not detected during surveys. If Waitaha gecko are present in the small amount of suitable habitat available (to the west and south of the site), they will be present at very low densities.

The indigenous lizards present within the proposed Bowenvale subdivision site are part of wider, poorly-connected population. Indigenous lizard populations in the wider Canterbury area are highly fragmented and under pressure from habitat loss, climate change and predation.

Lizards were captured and are likely to be found within the following vegetation types:

- Scrub pōhuehue vineland
- Blackberry-large-leaved pōhuehue gorse vineland/scrub
- Cocksfoot-(fennel) grassland
- (Tree lucerne)-(kōhūhū)/blackberry-gorse-banana passionfruit scrub

Lizard presence may also occur in other vegetation types, and some species (southern grass skink, McCann's skink) are likely to be present on the edges of treeland and macrocarpa areas.

Table 4: Lizard survey effort and weather conditions at the proposed Bowenvale subdivision site.

Date	Weather	Activity & effort	Species detected
6/12/2022	Calm, overcast, 20-21°C	47 Traps opened, *manual searches, habitat assessment*	Southern grass skink
7/12/2022	Drizzle, overcast, 15.5-16.9°C	47 Traps checked, *manual searches*	Southern grass skinks, McCann's skink
8/12/2022	Overcast, strong NE wind, 14.9-18.3°C	47 Traps checked, *manual searches*	Southern grass skinks
9/12/2022	Overcast, 18.6-18.2°C	47 Traps checked closed, *manual searches*	Southern grass skinks, McCann's skink

8. TERRESTRIAL INVERTEBRATES

8.1 Desktop assessment

The desktop survey found a mostly exotic fauna typical of gardens and parks in Ōtautahi/Christchurch and surrounding areas within Canterbury.

In the desktop survey, a record of the indigenous ground beetle (*Holcaspis angustula*; Not Assessed) was found. This species of ground beetle is only known within Canterbury, and Banks Peninsula has historically been its stronghold (Butcher 1984). Little is known about the ecology of *H. angustula.* Their presence on-site is doubtful due to the long grass and lack of open soil or rock, which are often used by ground beetles as hunting grounds.

Rō/New Zealand mantis (*Orthodera novaezealandiae*; At Risk-Declining Buckley et al. 2012) has been recorded in the vicinity of the project site, and is likely to be on-site. The main threat to this species is the invasion of South African mantis (*Miomantis caffra*), rather than habitat loss.

Kahukura/New Zealand red admiral butterfly (*Vanessa gonerilla*; not assessed) has been recorded in the vicinity of the project site, and is likely to be on adjacent properties. It is unlikely to breed on site due to the lack of nettle species, though adults may fly over. Although common and widespread, recent declines in the red admiral population have been noted by New Zealand lepidopterists (Sanger, 2022).

8.2 Survey results

The invertebrate fauna at the site was dominated by exotic species, including buff-tailed bumblebee (*Bombus terrestris*), blue blowfly (*Calliphora vicinia*), and cabbage white butterfly (*Pieris rapae*). Indigenous species included copper butterflies (*Lycaena* sp.) and native bees (*Leioproctus* sp.).

One notable species was found: a population of trapdoor spiders (*Cantuaria* sp.) inhabit a clay bank beneath the macrocarpa forest. Most New Zealand trapdoor spiders are listed as Data Deficient, but some are At Risk-Naturally Uncommon (Sirvid et al. 2021). Dry clay banks are prime habitat for trapdoor spiders, which are usually short-range endemics, with each species only found within a relatively small area of Aotearoa New Zealand. Species are difficult to tell apart without dissection and DNA sequencing, but there is much genetic differentiation between them.

9. ECOLOGICAL SIGNIFICANCE ASSESSMENT

9.1 Canterbury Regional Policy Statement

Due to the presence of indigenous At-Risk lizards on site, the proposed development area is considered to satisfy three of ten criteria in the CPRS (Criteria 4, 5 and 10). These criteria relate to rarity/distinctiveness and ecological context.

9.2 Christchurch District Plan

The removal of scrub pōhuehue, on the Port Hills, that is 0.1ha or greater in area is a Restricted Discretionary Activity under the Christchurch District Plan Rule 9.1.4.1.3 RD4 (as specified in Appendix 9.1.6.6 a.). Therefore, this activity requires a resource consent.

9.3 Ecological Value

There is relatively large diversity of indigenous vegetation on the site, but it is generally scattered and dominated by exotic species including numerous pest plants. There are a number of small pockets of indigenous dominated scrub pōhuehue vineland scattered across the site. These areas are degraded by pest plants, but they do provide habitat for at least one lizard species with a national threat ranking (southern grass skink, At Risk - Declining). Kānuka (Threatened – Nationally Vulnerable) was the only threatened plant species recorded on the site. This was a single tree growing in an area of exotic blackberry and gorse dominated scrub and is not considered significant.

New Zealand mantis has been found within close proximity to the site, and should be assumed to be present though its presence was not confirmed during the survey. The New Zealand mantis' At Risk-Declining threat status meets the threshold for significance under rarity/distinctiveness (Appendix 2).

10. ASSESSMENT OF EFFECTS

The Bowenvale Avenue site is to be subdivided in four stages. The first stage of the development consists the construction of a bridge across the existing stormwater and culvert system, with piles driven into the site and trees cleared on the eastern edge of the side (closest to the road) (Figure 3). Following this, the majority of the site will be benched and access roads constructed. The existing hydrological flow paths (dry flow paths) within the site (indicated in Figure 1) will be naturalised and used to provide ecological enhancement on site through amenity planting. Rock outcrops near the top of the site will be managed to prevent any rockfall into the subdivision. This includes the construction of a rockfall protection fence across Lots 100–103. The proposed works are likely to affect the ecology of the site through the following activities:

- Bridge construction
- Vegetation clearance
- Earthworks and landscaping

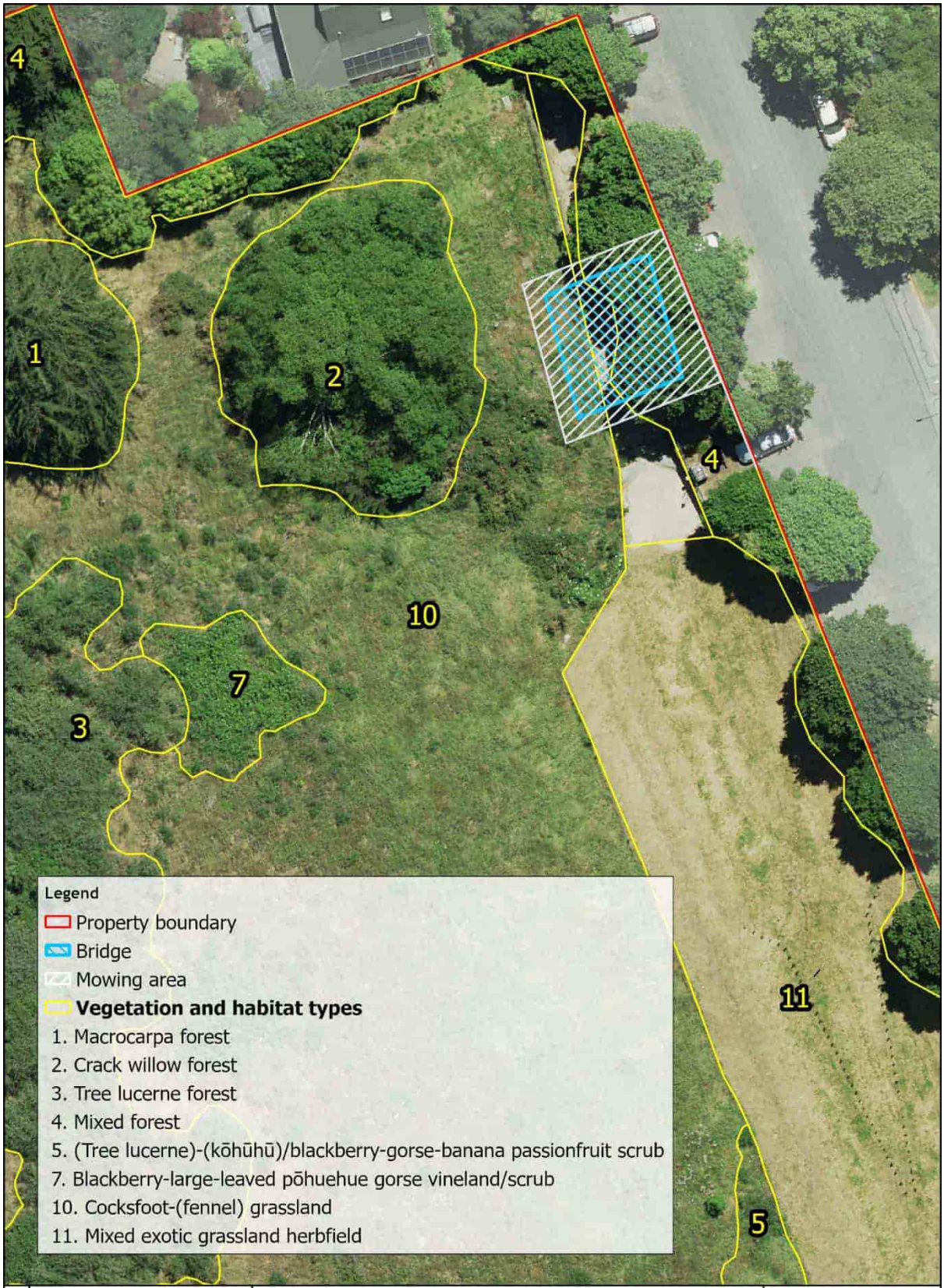

Figure 3. Proposed bridge location at 130 Bowenvale Avenue

Potential ecological effects from these activities include:

- Clearance of indigenous vegetation.
- Disturbance (including death and injury) and harm to indigenous birds.
- Disturbance (including death and injury) and harm to lizards.
- Disturbance (including death and injury) and harm to lizards during bridge construction.
- Breeding failure/displacement of lizards.
- Increased predation of lizards.
- Loss of indigenous lizard habitat.
- Fragmentation of lizard habitat.
- Loss of invertebrate habitat.
- Injury and mortality of terrestrial invertebrates

10.1 Effects to vegetation

Loss of indigenous vegetation

The site contains a relatively high number indigenous species, but they are generally scattered individuals growing in habitats dominated by exotic pest plants and weeds. Much of this indigenous appears to have spread from plantings that have occurred on neighbouring properties including the single kānuka (Threatened – Nationally Vulnerable) tree on the site. Therefore, it is not considered ecological significant and the clearance of these scattered indigenous species is considered **less than minor.**

There is one indigenous dominated vegetation type present on the site, scrub pōhuehue vineland. Collectively the scattered areas of scrub pōhuehue vineland cover *c.*0.11 hectares. Scrub pōhuehue is not threatened and is relatively common within the Port Hills ED and throughout lowland Canterbury, and by itself is not ecologically significant. However, it does provide habitat for a least one threatened species of skink and therefore the clearance of this habitat is considered to be **more than minor** without mitigation.

10.2 Effects to avifauna

Injury and mortality to indigenous bird species: The proposed development will involve vegetation clearance, which will effect breeding birds, including unfledged chicks and eggs. This can lead to direct mortality or injury of birds. Vegetation removal or earthworks within the site should as far as practicable be undertaken outside of the breeding season (August-February). This effect is likely to be **more than minor** without mitigation.

Loss of indigenous bird habitat: The proposed development will involve vegetation and land clearance, which will remove habitat used by indigenous birds. Grassy and rocky areas may provide habitat for the At Risk pīhoihoi/New Zealand pipit. Should the proposed works go ahead, this habitat loss is unavoidable. However, similar habitat is available on surrounding properties. This effect is likely to be **minor** without mitigation.

Disturbance during construction: Disturbance during construction includes human activity, machinery, vibration, and noise. This disturbance is likely to cause birds to change their behaviour by abandoning the site, or temporarily avoid the site during the breeding season. This leads to behavioural and physiological responses which are presumed to be costly, and can lead to changes in habitat use, parental care, reproductive failure and may have long-lasting effects on populations (Weston *et al.* 2012). The observed response from the disturbed bird includes increased vigilance, stopping their current activity to monitor the disturbance and taking flight, but it also can include physiological responses, including changes in heart rate, body temperature and plasma corticosterone levels. This effect is likely to be **more than minor** without mitigation.

10.3 Effects to lizards

Injury/Death/Displacement: The proposed development will result in the permanent displacement, injury and death of individual lizards within the construction footprint. This effect is likely to be **more than minor** without mitigation.

Fragmentation: The proposed development will result in the potential local extirpation or fragmentation of a moderately sized peri-urban lizard population. The ongoing and cumulative fragmentation of lizard habitats within the Canterbury Region will result in the eventual localised extinction of southern grass skinks without mitigation. This is likely to have ongoing effects to genetic diversity within southern grass skink population and causes metapopulation disturbance throughout Canterbury. This effect is likely to be **more than minor** without mitigation.

Habitat loss: Lizard habitat is found throughout the site and loss of habitats at this site cannot be avoided. This will result in permanent, and cumulative ongoing habitat loss for indigenous lizards at this site. This effect is likely to be **more than minor** without mitigation.

Ongoing disturbance*:* Vehicle/pedestrian strikes may affect residual lizard populations along newly-formed roads and vehicle accessways. This effect is likely to be **minor** without mitigation.

Disturbance during earthworks: Disturbance during construction to lizards includes dust, vibration, and noise. This disturbance is likely to disrupt normal behaviour, including social dynamics in lizard populations adjacent to the construction footprint as a result of construction activity. Across the site, this effect is likely to be **more than minor** without mitigation.

Disturbance during bridge construction: As lizards were detected close to the proposed bridge site, and the construction of the bridge is likely to result in the clearance of 1-2 m of cocksfoot-(fennel) grassland, this is likely to have a **minor** adverse effect on lizards without mitigation.

Breeding failure/avoidance: The proposed subdivision and associated earthworks may lead to affected behaviour of lizards and/or social interactions, increase in stress, leading to reduced population functionality, such as poor breeding and low population recruitment. This effect is likely to be **minor** without mitigation.

Increased predation: The proposed subdivision will increase domestic cat abundance, as well as attract rodents (ship and Norway rat), which may have an impact on lizard populations adjacent to the impact site. However, it is likely that the reduction in rank grass will result in a decline in mice populations which may affect residual and adjacent lizard populations. This effect is likely to be **minor** without mitigation.

10.4 Effects to invertebrates

Injury and mortality to terrestrial invertebrates: The proposed development will involve disturbance to vegetation, causing the death of invertebrates present, including New Zealand mantis. The level of adverse effect is considered **more than minor**, without mitigation.

Earthworks and landscaping will include unearthing clay banks and bare ground, causing mortality of any trapdoor spiders and ground beetles living there. The level of effect is **more than minor**, without mitigation.

Loss of invertebrate habitat: Vegetation and topsoil will be removed as part of clearance, landscaping, and earthworks in preparation for construction. Some vegetation and topsoil provides habitat for notable invertebrates. However, these habitats are not rare. These effects are considered **minor**, without mitigation.

11. MITIGATION ACTIONS

11.1 Overview

This section outlines options to avoid, remedy, and mitigate the potential ecological effects of the proposed development. Options for remediation are limited to amenity areas within the footprint such as within Lots 100 and 101 (beyond the proposed rockfall fence), as remediation works cannot be imposed on neighbouring land not owned by the applicant.

11.2 Wildlife Management

A wildlife permit is required to carry out modification or land development that have adverse impacts on indigenous New Zealand lizards (Department of Conservation 2018). As one legally protected species of lizards (classified 'At Risk–Declining'), has been confirmed present within the proposed subdivision, and adverse effects are unavoidable, a Lizard Management Plan (LMP) is required. LMPs are often required as a resource consent condition, as are continuing to meet all other legal obligations (such as obtaining required permits) when carrying out consented activities.

A LMP should contain a comprehensive plan that clearly avoids, mitigates, offsets or compensates for the losses of lizard populations and their habitats. Wildlife management actions could include avoidance, and/or relocation of lizards and site management (habitat enhancement, pest management, monitoring) at specific sites. The Department will need to be reasonably confident that, on balance, lizard populations will not be worse off than prior to development of the site. This may include use of in

situ mitigation management of lizards or the use of offsetting or compensatory tools elsewhere.

A LMP will need to be prepared and implemented by a qualified and permitted ecologist/herpetologist, to ensure the appropriate wildlife management actions are implemented. Together with the LMP, the wildlife permit allows for the impacts on lizards and the management of effects.

It is important to note that the wildlife permitting process can be lengthy (3-6 months after submission of an application along with an LMP) and there are seasonal constraints when working with wildlife. Depending on the management options selected, pre preparation of sites may be required ahead of commencing wildlife management, thus site works may be further delayed by another 12 months.

If vegetation clearance will be undertaken during the avian breeding season, an Avian Management Plan will be required to avoid and mitigate adverse effects.

11.3 Vegetation

11.3.1 Clearance of significant vegetation

The only significant vegetation on the site is scrub pōhuehue vineland. Therefore, it is recommended that this species is re-established in densely planted patches within any reserve areas that are created on the site. Scrub pōhuehue vineland can be planted within amenity areas and within the 10 m wide flow paths designated on site (Figure 1), following an amended Landscape Plan by DCM Design. The landscape plan will have input and be reviewed by a restoration or vegetation ecologist prior to implementation or acceptance by CCC. This will result in a **net gain** for indigenous vegetation.

11.3.2 Restoration of Lots 100 & 103

Lots 100-103 are proposed to be retained and undeveloped behind a rock fall protection fence. These lots should be cleared of existing pest plants and replanted with indigenous species reflective of plant communities that would have originally existed on the Port Hills (prior to human clearance). This includes patches of densely planted scrub pōhuehue. The restoration of these Lots should be managed by an appropriately qualified restoration ecologist or botanist who has prepared an Ecological Restoration Plan for the site, which includes the following:

- Planting plan, including species (suitable for notable bird, lizard and invertebrate species), plant spacings and number of plants required.
- Maintenance schedule, including ongoing pest plant control and mulching.
- Monitoring success of plantings.
- Timing and responsibilities.

The clearance of pest plants from the site and replanting of the suggested areas with indigenous plant species, will result in a **net gain** for indigenous vegetation, and for indigenous fauna (such as lizards).

11.4 Avifauna

To minimise adverse effects associated with the project, vegetation clearance and earthworks should be undertaken outside of the breeding period (August to February). This would mean ecological effects are **less than minor**.

If construction cannot be undertaken outside the breeding preconstruction surveys should be undertaken to avoid impacting breeding success. Preconstruction surveys should include checking mature trees for nesting or roosting ruru nohinohi/little owls, and searches for pīhoihoi/New Zealand pipit ground nests. If vegetation clearance is to occur during August to February, a bird management plan will be required. This plan would be created by a suitably qualified avian ecologist. Breeding season avoidance or the implementation of an Avian Management Plan would likely result in effects being **less than minor.**

11.5 Lizards

In the first instance, where any identified habitat can remain in situ, major effects such as habitat loss, death and disturbance to indigenous lizards may be minimized. However, as all lizards within the area are likely to be inhabiting most vegetation types and rock outcrops on site which will all be removed during subdivision development. Therefore, retention of lizard habitat will not be possible.

11.5.1 Sequential mowing of bridge construction area

It is understood that the proposed bridge across the stormwater and culvert area (Figure 3) is likely to result in the loss of 1-2 m of lizard habitat (cocksfoot-(fennel) grassland). It is possible that lizards may be present within the area during construction, but this effect can be mitigated using a less direct method (such as salvage and relocation – as likely to be proposed for the wider subdivision).

Sequential mowing or scrub-bar will be undertaken to encourage lizards to move out of the small area where piles will be driven in for the bridge. The following methods are recommended:

- Day one: cut grass high (to 30 cm above the ground),
- Day two: cut it lower (to 20 cm above the ground) and finally;
- Day three: cut it as close to the ground as possible.

- Immediately following this, a fence should be erected around the bridge site to prevent lizards from entering the works site and basking in the open area.
- Sequential mowing is recommended to be carried out over warm days in summer or autumn, when lizards are most likely to be active, and able to move out of harm's way.

11.5.2 Lizard Management Plan

The actual details of lizard management (including any offsetting or compensation measures) will need to be developed in more detail in an LMP. Given the size and extent of the population on site, it is likely that both offsetting and compensation will be required for lizards at this site, in addition to a salvage and relocation programme.

A Lizard Management Plan (LMP) and Wildlife Act Authority is required to address effects. Site development with the implementation of a LMP would result in a **minor adverse** effect on lizards.

11.6 Invertebrates

11.6.1 Stacking cleared vegetation

Cleared vegetation (except for tall trees) should be stacked wherever practicable near remaining living vegetation. As the dying vegetation dries out, invertebrates such as New Zealand mantis inhabiting it should disperse to new habitat. The timing of this process depends on temperature, as warmth facilitates invertebrate movement and vegetation desiccation. The vegetation stacks should be left out over multiple days or weeks until the plants are brittle and losing leaves. They can then be removed from the site. Stacking cleared vegetation would likely result in a **less than minor adverse effect**.

11.6.2 Trapdoor spider and ground beetle management plan

Due to the high likelihood of detrimental effects on trapdoor spiders and ground beetles from earthworks and landscaping, a trapdoor spider and ground beetle management plan is recommended. This would be created by a suitably-qualified invertebrate ecologist. The plan would detail methods for finding and collecting trapdoor spiders and beetles, translocating them to a safe location, and any necessary enhancement of the release site. The creation of these management plan is likely to result in a **less than minor adverse effect**.

11.6.3 Habitat restoration

Landscaping and planting of the proposed development should, where possible, include eco-sourced indigenous plantings including shrubs that are appropriate for New Zealand mantis. These actions mean that the overall effect on New Zealand mantis is **less than minor**.

11.7 Summary of potential effects with mitigation

The level of ecological effects on indigenous biodiversity if recommended mitigation actions are taken is presented in Table 5. Accurately predicting the level of effect with mitigation in place is difficult, but the table gives a broad picture of how effects can be significantly reduced with mitigation measures in place.

Table 5: Potential significance of ecological effects if effective mitigation is implemented as recommended above.

Effect	Level of Effect Without Mitigation	Level of Effect With mitigation
Vegetation clearance (not including scrub pōhuehue vineland)	Less than minor	Net gain

Effect	Level of Effect Without Mitigation	Level of Effect With mitigation
Loss of indigenous lizard habitat (including scrub pōhuehue vineland).	More than minor	More than minor
Disturbance (including death and injury) and harm to indigenous birds.	More than minor	Less than minor
Loss of indigenous bird habitat	Minor	Minor
Disturbance (including death and injury) and harm to lizards.	More than minor	Minor
Disturbance during bridge construction	Minor	Less than minor
Breeding failure/displacement to lizards.	Minor	Less than minor
Increased predation to lizards.	Minor	Less than minor
Fragmentation of lizard habitats.	More than minor	Minor
Loss of invertebrate habitats.	Minor	Less than minor
Mortality to terrestrial invertebrates during earthworks	More than minor	Less than minor

12. CONCLUSIONS

The proposed subdivision site at 130 Bowenvale Avenue is dominated by exotic vegetation and habitats. A large number of pest plants and weeds are present. There is one indigenous vegetation type on the site, scrub pōhuehue vineland, which is ecologically significant as it provides habitat for at least one species of threatened lizard. The wider site also provides habitat for at least one threatened invertebrate and several Non-Threatened indigenous birds. To avoid adverse effects on avifauna, vegetation clearance should be undertaken outside of the breeding season (August to February). The loss of indigenous vegetation on site could be offset by restoration of reserves and undeveloped lots within the proposed subdivision.

In the case of the wider terrestrial habitats, ecological impacts can be mitigated by following the measures outlined in this report. Measures include the appropriate timing of works, vegetation clearance protocols, and applicable fauna management plans.

One Threatened invertebrate, New Zealand mantis, is likely to be on site. The key threat to New Zealand mantis is the introduced South African mantis, rather than habitat loss. Habitat loss is a greater issue for New Zealand red admiral butterfly, ground beetles, and trapdoor spiders. However, the effects of the proposed subdivision on these ecological values can be easily mitigated, as outlined in Section 11.

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PLANT SPECIES RECORDED DURING THE SURVEY

Species Name	Common Name	Growth Form	Species Status
Indigenous Species			
Acaena novae-zelandiae	red bidibidi	dicot herb	Indigenous
Aristotelia serrata	wineberry, makomako	tree	Indigenous
Asplenium appendiculatum	ground spleenwort	fern	Indigenous
Asplenium flabellifolium	necklace fern	fern	Indigenous
Calystegia tuguriorum	NZ bindweed, pōwhiwhi	vine	Indigenous
Carex diandra	sedge	sedge	Indigenous
Carex species	sedge	sedge	Indigenous
Carex secta	pūrei, pūkio	sedge	Indigenous
Coprosma lucida	karamū	tree	Indigenous
Coprosma propinqua	mingimingi, mikimiki	shrub	Indigenous
Coprosma repens	taupata	shrub	Indigenous
Coprosma robusta	karamū	tree	Indigenous
Coprosma species	Coprosma	tree	Indigenous
Cordyline australis	cabbage tree, tī kōuka	tree	Indigenous
Cortaderia richardii	toetoe	grass	Indigenous
Dodonaea viscosa	akeake	tree	Indigenous
Griselinia littoralis	broadleaf, kāpuka	tree	Indigenous
Hedycarya arborea	pigeonwood, porokaiwhiri	tree	Indigenous
Hypolepis millefolium	thousand-leaved fern	fern	Indigenous
Juncus species	juncus	rush	Indigenous
Kunzea robusta	kānuka, rawirinui, kopuka	tree	Indigenous
Melicytus ramiflorus	māhoe, whiteywood	tree	Indigenous
Microsorum pustulatum	hounds tongue, kōwaowao	fern	Indigenous
Muehlenbeckia australis	large-leaved pōhuehue	vine	Indigenous
Muehlenbeckia complexa	scrub pōhuehue, wire vine	vine	Indigenous
Myoporum laetum	ngaio	tree	Indigenous
Olearia paniculata	akiraho	tree	Indigenous
Oxalis exilis	yellow oxalis	dicot herb	Indigenous
Pellaea rotundifolia	round-leaved fern, tarawera	fern	Indigenous
Phormium tenax	lowland flax, harakeke	monocot herb	Indigenous
Pittosporum crassifolium	karo	tree	Indigenous
Pittosporum eugenioides	tarātā	tree	Indigenous
Pittosporum ralphii	karo	tree	Indigenous
Pittosporum tenuifolium	kōhūhū, black matipo	tree	Indigenous
Pittosporum species	pittosporum cultivar	tree	Indigenous
Poa cita	silver tussock, wī	grass	Indigenous
Polystichum vestitum	prickly shield fern, pūniu	fern	Indigenous
Pseudopanax arboreus	five-finger, whauwhaupaku	tree	Indigenous
Pseudopanax crassifolius	lancewood, horoeka	tree	Indigenous
Pseudopanax species	pseudopanax cultivar	tree	Indigenous
Pteridium esculentum	bracken, rārahu, rauaruhe	fern	Indigenous
Solanum laciniatum	poroporo	shrub	Indigenous
Sophora microphylla	small-leaved kōwhai	tree	Indigenous
Exotic Species			
Acacia mearnsii	black wattle	tree	Exotic
Acer pseudoplatanus	sycamore	tree	Exotic
Achillea millefolium	yarrow	dicot herb	Exotic
Agapanthus praecox	agapanthus	dicot herb	Exotic
Agrostis capillaris	brown top	grass	Exotic
Agrostis stolonifera	creeping bent	grass	Exotic
Alopecurus pratensis	meadow foxtail	grass	Exotic
Anagallis arvensis	scarlet pimpernel	dicot herb	Exotic
Anthoxanthum odoratum	sweet vernal	grass	Exotic
Bellis perennis	daisy	dicot herb	Exotic
Bromus catharticus	prairie grass	grass	Exotic

Species Name	Common Name	Growth Form	Species Status
Calystegia silvatica	great bindweed	vine	Exotic
Cerastium fontanum	mouse-ear chickweed	dicot herb	Exotic
Chamaecytisus palmensis	tree lucerne	tree	Exotic
Chenopodium murale	Nettle-leaved Goosefoot	dicot herb	Exotic
Chrysanthemoides monilifera	boneseed	shrub	Exotic
Cirsium arvense	Californian thistle	dicot herb	Exotic
Clematis vitalba	old man's beard	vine	Exotic
Conium maculatum	hemlock	dicot herb	Exotic
Conyza sumatrensis	fleabane	dicot herb	Exotic
Cotoneaster glaucophyllus	bright bead cotoneaster	shrub	Exotic
Crepis capillaris	hawksbeard	dicot herb	Exotic
Cupressus macrocarpa	macrocarpa, Monterey cypress	tree	Exotic
Cupressus species	cypress	tree	Exotic
Cytisus scoparius	scotch broom	shrub	Exotic
Dactylis glomerata	cocksfoot	grass	Exotic
Dryopteris filix-mas	male fern	fern	Exotic
Ehrharta erecta	veldt grass	grass	Exotic
Euonymus europaeus	spindle tree	tree	Exotic
Festuca rubra	red fescue	grass	Exotic
Foeniculum vulgare	fennel	dicot herb	Exotic
Galium aparine	cleavers	dicot herb	Exotic
Geranium molle	dovesfoot cranesbill	dicot herb	Exotic
Helminthotheca echioides	oxtongue	dicot herb	Exotic
Holcus lanatus	Yorkshire fog	grass	Exotic
Hypochaeris glabra	smooth catsear	dicot herb	Exotic
Hypochaeris radicata	catsear	dicot herb	Exotic
Iris foetidissima	stinking iris, roast beef plant	monocot herb	Exotic
Juncus articulatus	jointed rush	rush	Exotic
Juncus bufonius	toad rush	rush	Exotic
Laurus nobilis	bay	tree	Exotic
Lolium species	rye grass	grass	Exotic
Lonicera japonica	Japanese honeysuckle	vine	Exotic
Lotus pedunculatus	lotus	dicot herb	Exotic
Passiflora tarminiana	banana passionfruit	vine	Exotic
Plantago lanceolata	narrow-leaved plantain	dicot herb	Exotic
Plantago major	broad-leaved plantain	dicot herb	Exotic
Poa annua	annual poa	grass	Exotic
Poa pratensis	Kentucky blue grass	grass	Exotic
Populus nigra	black poplar, Lombardy poplar	tree	Exotic
Prunus armeniaca	apricot	tree	Exotic
Prunus species	cherry	tree	Exotic
Prunus ×domestica	plum	tree	Exotic
Ranunculus repens	creeping buttercup	dicot herb	Exotic
Rhamnus alaternus	evergreen buckthorn	tree	Exotic
Rosa rubiginosa	sweet briar, briar rose	shrub	Exotic
Rubus fruticosus	blackberry	shrub	Exotic
Rumex acetosella	sheeps sorrel	dicot herb	Exotic
Rumex obtusifolius	broad-leaved dock	dicot herb	Exotic
Rytidosperma racemosum	danthonia	grass	Exotic
Salix cinerea	grey willow	tree	Exotic
Salix ×fragilis	crack willow	tree	Exotic
Sambucus nigra	elderberry	tree	Exotic
Solanum chenopodioides	velvety nightshade	dicot herb	Exotic
Taraxacum officinale	dandelion	dicot herb	Exotic
Tradescantia fluminensis	tradescantia	dicot herb	Exotic
Trachycarpus fortunei	fan palm, hemp palm	monocot	Exotic
Trifolium pratense	red clover	dicot herb	Exotic
Trifolium repens	white clover	dicot herb	Exotic
Ulex europaeus	gorse	shrub	Exotic
Verbascum thapsus	woolly mullein	dicot herb	Exotic
Vicia sativa	vetch	dicot herb	Exotic
Viola odorata	violet	dicot herb	Exotic

EVALUATION OF THE ECOLOGICAL SIGNIFICANCE – ECAN REGIONAL POLICY STATEMENT CRITERIA

Ecological Significance Criteria	Terrestrial Habitats
Representativeness	
1. Indigenous vegetation or habitat of indigenous fauna that is representative, typical or characteristic of the natural diversity of the relevant ecological district. This can include degraded examples where they are some of the best remaining examples of their type, or represent all that remains of indigenous biodiversity in some areas.	Threshold not met
2. Indigenous vegetation or habitat of indigenous fauna that is a relatively large example of its type within the relevant ecological district.	Threshold not met
Rarity/Distinctiveness	
3. Indigenous vegetation or habitat of indigenous fauna that has been reduced to less than 20% of its former extent in the Region, or relevant land environment, ecological district, or freshwater environment.	Threshold not met
4. Indigenous vegetation or habitat of indigenous fauna that supports an indigenous species that is Threatened, At Risk or uncommon, nationally or within the relevant ecological district.	**Threshold met.** Threatened vegetation present including kānuka. Vegetation supporting New Zealand mantis (*Orthodera novaezealandiae;* At Risk-Declining), southern grass skink (O*ligosoma* aff. *polychroma* "Clade 5"; At Risk - Declining
5. The site contains indigenous vegetation or an indigenous species at its distribution limit within Canterbury Region or nationally.	**Threshold met.** Southern grass skink (O*ligosoma* aff. *polychroma* "Clade 5"; At Risk – Declining) present which is at the edge of its distribution in Canterbury.
6. Indigenous vegetation or an association of indigenous species that is distinctive, of restricted occurrence, occurs within an originally rare ecosystem, or has developed as a result of an unusual environmental factor or combination of factors.	Threshold not met
Diversity and Pattern	
7. Indigenous vegetation or habitat of indigenous fauna that contains a high diversity of indigenous ecosystem or habitat types, indigenous taxa, or has changes in species composition reflecting the existence of diverse natural features or ecological gradients.	Threshold not met
Ecological Context	
8. Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or provides an important buffering function.	Threshold not met
9. A wetland which plays an important hydrological, biological or ecological role in the natural functioning of a river or coastal system.	Threshold not met

Ecological Significance Criteria	Terrestrial Habitats
10. Indigenous vegetation or habitat of indigenous fauna that provides important habitat (including refuges from predation, or key habitat for feeding, breeding, or resting) for indigenous species, either seasonally or permanently.	**Threshold met.** Southern grass skink (O*ligosoma* aff. *polychroma* “Clade 5”; At Risk – Declining) present throughout habitat permanently.

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Project Number 20268.000.001

Rockfall Assessment

130 Bowenvale Avenue, Cashmere, Christchurch

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Contents

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04/07/2022	Issued to Client	JRW	RJ	VB

1 Introduction

ENGEO Ltd was requested by Geovert Ltd to undertake a rockfall assessment of the property at 130 Bowenvale Avenue, Cashmere, Christchurch (herein referred to as 'the site'). This work has been carried out in accordance with our signed agreement dated 31 March 2022 (reference P2022.000.749_01).

The purpose of the assessment was to provide geotechnical advice in regard to rockfall risk mitigation for Resource Consent stage for a proposed residential subdivision. Our report does not provide advice on any other potential hazards that may be present at the site.

The scope of this study comprised:

- Review of published geotechnical and geological information relevant to the site.
- Site walkover and assessment of the rockfall source areas above the proposed development by an experienced ground engineering professional.
- Development of a rockfall model based on the site walkover.
- Assessment of boulder impact energies and bounce heights via rockfall modelling for the site.
- Assessment of the Annualised Individual Fatality Risk to potential occupants of the proposed development in accordance with the requirements of the Christchurch Replacement District Plan (CRDP).
- Develop concept mitigation options suitable to reduce the rockfall risk to acceptable levels.
- Production of a geotechnical report (this document) based on the findings of our enquiries, rockfall modelling and risk assessment including recommendations for potential rockfall risk management options.

Our scope of works does not include intrusive investigations, nor does it provide a detailed design for the proposed rockfall mitigation works.

2 Site and Development Description

The site is located on the western side of the Bowenvale Valley upslope of Bowenvale Avenue on a section of approximately 5.09 hectares, with the legal description Pt Lot 2, 2 DP 33462. The site is located on an east-facing section of that is moderately sloping (~20-22º) between 25 and 200 metres above sea level (m asl). A broadly north-south orientated ridgeline is located upslope of the proposed development. Downslope and broadly parallel with the direction of slope are a series of gullies and ridges.

The proposed development is a residential subdivision consisting of 40 lots, 32 of which are located within or partially within Rockfall Risk Management zones defined by the Christchurch Replacement District Plan (CRDP). We understand that the proposed new buildings will be one or two storeys and generally orientated along slope in order to maximise the view. The proposed subdivision layout plan[1] is provided in Appendix 1, obtained from Gravitas Architecture (14 March 2022).

[1] Current at the time of writing

Figure 1: Site Location Plan

Image from Datanest. Not to scale.

3 Geological Setting

The site is located on the Port Hills, Canterbury where the geological setting is typically topsoil and wind derived loess deposits of varying thickness overlying a basaltic rock mass. The basalt is a result a of series of Banks Peninsula Volcanics referred to as the Lyttelton Volcanic Group and are typically basaltic.

4 Desktop Assessment

4.1 Rockfall Failure History

Significant rockfalls occurred in the area surrounding the subject site as a result of the 2010 / 2011 Canterbury Earthquake Sequence (CES). The CCC fallen rock database indicates a number of boulders noted across the site, as detailed below and indicated in Figure 2.

Thirty-three boulders were recorded on-site in 2011, following the February event. The boulders were recorded to be between 0.2 m^3 and 12 m^3, generally angular in shape.

Figure 2: Location of Mapped Fallen Boulders

Image sourced from Google Maps.

4.2 Rockfall Risk Reports

We have reviewed the GNS Science, 'Canterbury Earthquakes 2010 / 2011 Port Hills Slope Stability: Life Safety Risk from Rockfall report', dated May 2012. The report identifies the site as having an Annualised Individual Fatality Risk (AIFR) of greater than 10^{3} and between 10^{-3} to 10^{-4} for the near source areas and 10^{-4} to 10^{-5} for the majority of the site, more distal from the source areas. The lower reaches, on the northern side of the proposed development have a AIFR of less than 10^{-5}. Accordingly, the central portion of the site has been placed within Rockfall Management Area 2 in CCC's District Plan, with the upper most portion of the slope allocated Rockfall Management Area 1, as shown in Figure 3.

Figure 3: Rockfall Management Areas

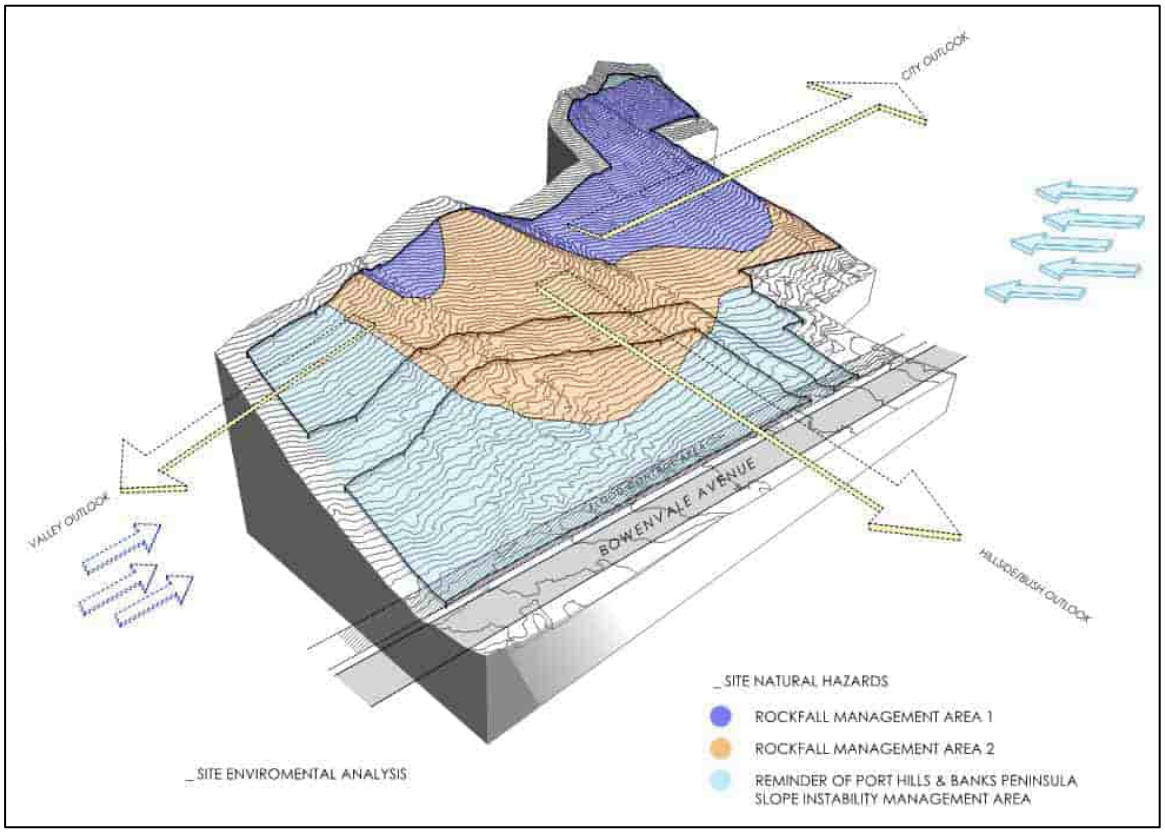


Image sourced from Gavitas Architecture March 2022 drawings.

5 Site Assessment

5.1 Rockfall Visual Assessment

ENGEO visited the site on 28 April 2022 and made the following observations:

- The majority of the site is covered with high grass or scrub with scattered large trees. The scrub is concentrated in the valleys and is limited on the ridges.
- Limited evidence of significant gully erosion was noted on some of the valley sides, however given the thick scrub in the valleys, we could not assess these areas. Given the concentration of water, it is likely that tunnel gullies are more prevalent in the valley areas.
- Below the ridgeline is a concentration of boulders that are more prevalent in the valleys and are less evident the further down the site. We measured 13 boulders during our site walk over ranging in size from 0.3 m^3 up to 1.8 m^3 with an average of 1.1 m^3.
- Given the steepness of the slope above the site boundary, we could not walk to the base of the rockfall source areas, however we flew a drone to assess the areas. Based on these photos, it appears that the columnar and planar joint sets (typical in basalt) area are creating wedge-type failures with obvious loose blocks noted in the outcrop (Photo 1).

Figure 4: Rockfall Assessment Photos

Photo 1: Ridgeline and boulder field below with blocks typically concentrated to the valleys.

Photo 2: Aerial view of the boulder field.

Photo 3: View of jointed basalt and what appears to be loose blocks in an outcrop source area.

5.2 Rockfall Source Areas

Based on our assessment of aerial photographs and site walkover, there appears to be multiple possible rockfall sources, however, we have grouped them into two broad groups.

- Ridgeline: this source area comprises the broad ridge at the upslope extent of the Bowenvale Valley. It is characterized by near vertical bluffs comprised of moderately weathered, jointed basalt. It is up to approximately 10 m high and extends across the majority of the site at the crest of the ridge.
- Lower Outcrops: These comprise a series of smaller discrete outcrops across the slope below the ridgeline. The outcrops are typically up to 2 m high and comprised of moderately weathered, jointed basalt and they extend across the slope between the site boundary and the ridgeline.

Details regarding on-site observations are provided below in Section 4.1.

Figure 5: Rockfall Source Areas

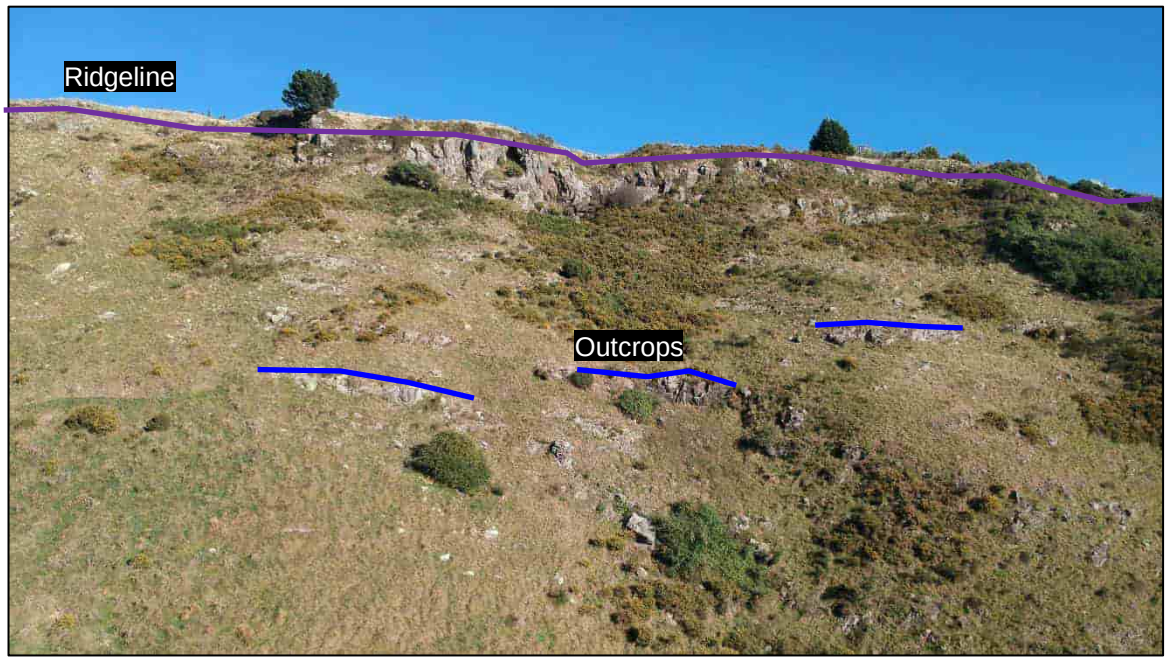


Image taken from a Drone flown by ENGEO.

6 Rockfall Modelling

6.1 Site Specific Rockfall Modelling

6.1.1 Model Assumptions

Assumptions made in the modelling of rockfall from the potential rockfall source area above the site are summarised in the following section.

Slope Profile

The site is outside of the 3D rockfall modelling undertaken by Geovert in 2012 and therefore, ENGEO has undertaken three-dimensional rockfall modelling using Rocfall3 by Rocscience. The surface was taken from LINZ LiDAR information and simplified in order to reduce processing time for the simulations.

Figure 6: View of the slope profile looking northwest

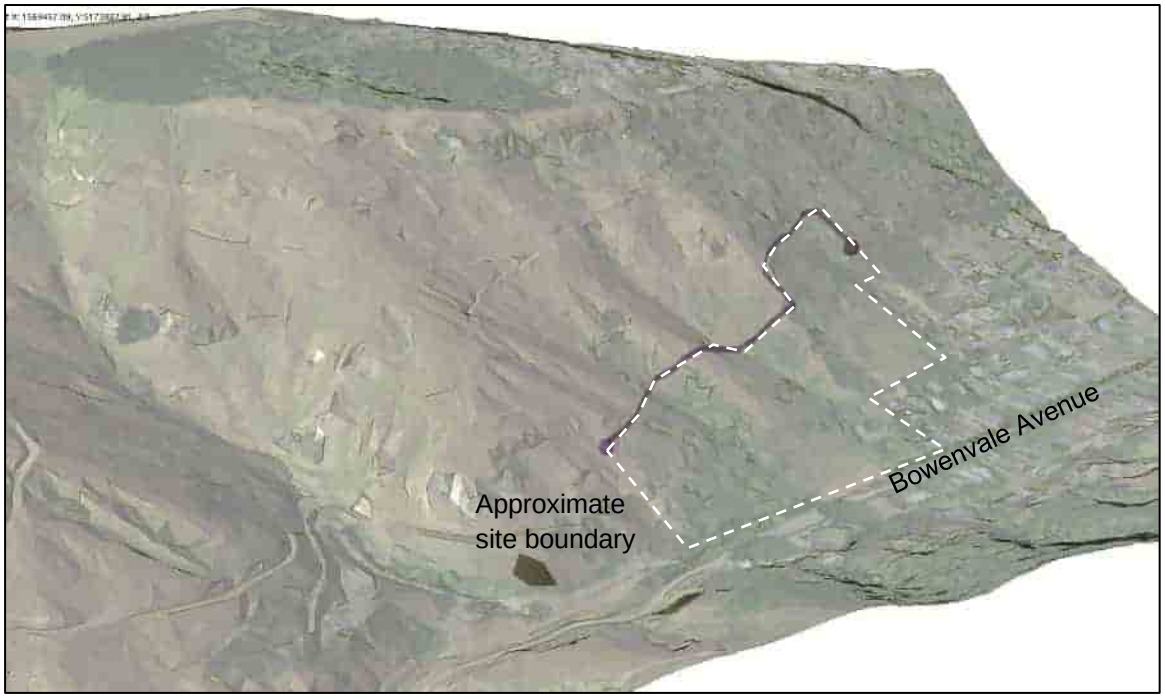


Image taken from Rocfall3. Not to scale.

Material Parameters

Material parameters used in the model are provided in Table 1 and have been assumed from site observations, knowledge of parameters for similar materials, and back analysis of rockfall runouts. The model does not consider the beneficial effects of vegetation, as it may be compromised (e.g. due to logging or a fire) within the life-time of any development on the property (assumed to be 50 years).

Table 1: Material Parameters

Material	Normal Restitution	Tangential Restitution	Friction Angle
Ridgeline	0.53	0.99	10°
Small rock outcrops and rock debris	0.32	0.82	12°
Loess Slope	0.3	0.815	12.789

Loess was applied to the majority of the slope, and the ridgeline and small rock outcrops and rock debris below the ridgeline were draped over the terrain (Figure 5).

Figure 7: Slope Model with material types applied

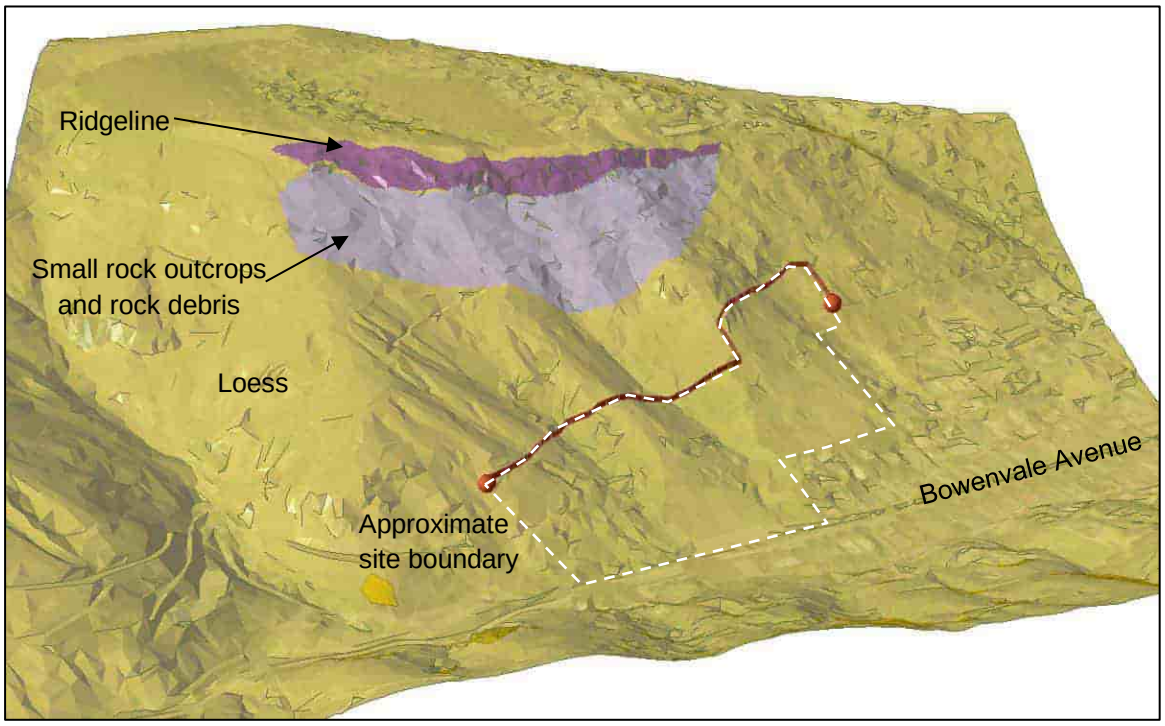


Image taken from Rocfall3. Not to scale.

Design Boulder

The design boulders have been based on the on-site measurements and the boulders mapped following the CES. Two boulders mapped following the CES were excluded from the dataset as outliers given that they were three to four times larger than the next largest boulder. The remaining dataset has then been distributed based on the mean boulder size and the number of standard deviations to the 95th percentile boulder (Table 2).

Table 2: Design Boulder Parameters

Average Boulder Size	Max Boulder Size	Standard Deviation
1.11 m^3	3 m^3	0.74

These boulders were modelled as coming from line seeders either from the ridgeline (1000 boulders) or from the smaller outcrops (100 boulders).

Figure 8: Line Seeders modelled on the site

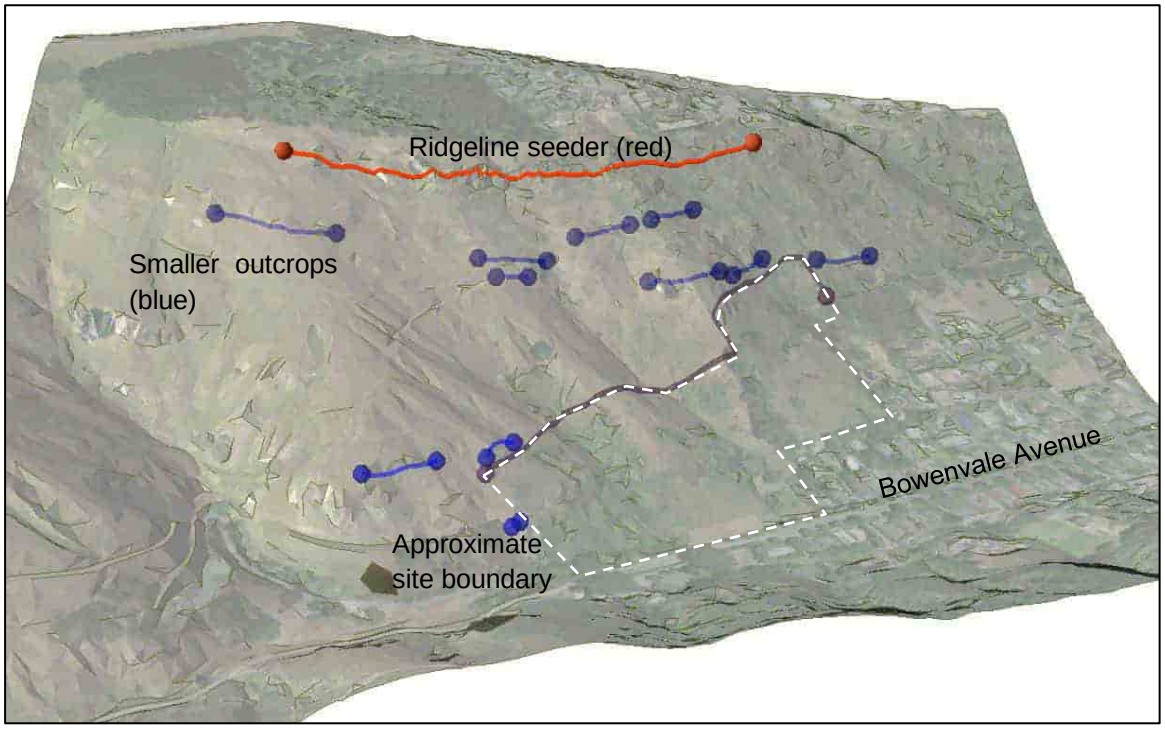


Image taken from Rocfall3. Not to scale

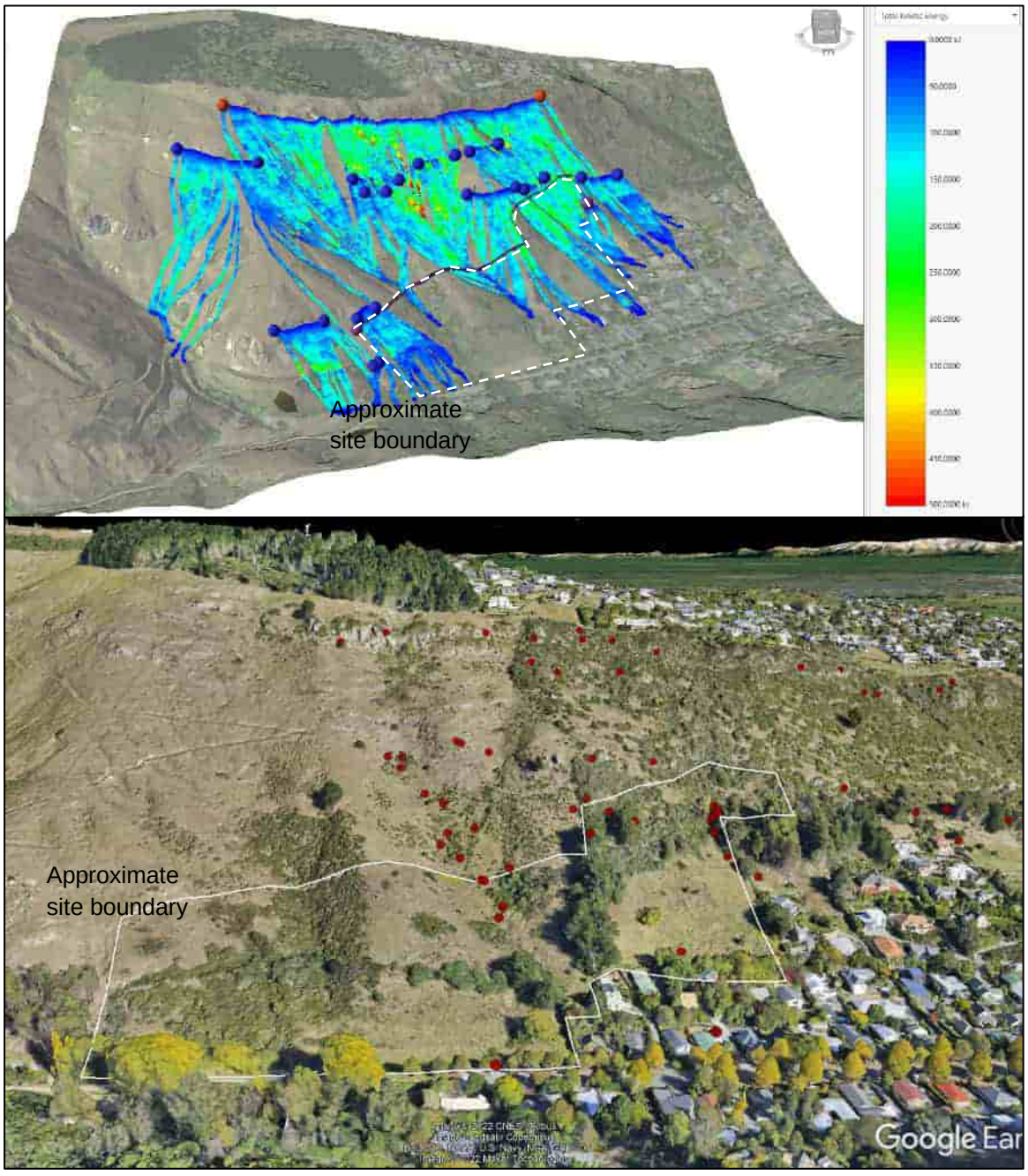
Boulder Release Conditions

Initial boulder velocities have been adopted in accordance with the values provided by the Port Hills Geotechnical Group (PHGG). The modelled seismic conditions include a horizontal velocity of 1.5 m/s and a vertical velocity of 1 m/s to simulate earthquake conditions.

6.1.2 Rockfall Modelling Results

The modelling suggests that the boulder roll paths are typically concentrated to the gullies and runout locations appears to broadly match the boulders mapped by the PHGG following the CES (Figure 8).

Figure 9: Boulder runouts from the Rocfall3 modelling compared to the boulder end points mapped by PHGG



Images from Rocfall3 and Google Earth. Not to scale

We have completed the risk assessment for the boulders reaching the upslope (western) boundary of the site.

The results of our 3D modelling are presented in Appendix 2 and indicate rockfall distribution and total number of rocks reaching the upslope boundary. Rockfall and probability results are summarised in Table 3 below.

Table 3: Results of Rockfall Modelling

Parameter	Cross Section 2
Percentage of boulders reaching the upslope boundary	93% (1639)
95%ile Energy of boulder reaching the upslope boundary	213 kJ
95%ile Bounce height on the upslope boundary	0.24 m
Number of Boulder Paths above site	1750

Due to the scattered nature of the rockfall source area on-site the probability of rockfall impacting the assumed building platforms varies across the site. However, the majority of boulders are modelled to impact the lots within or near gullies.

7 Risk Assessment

7.1 Risk Model

GNS (Massey et al. 2012a) have evaluated the risk of loss-of life to an individual from boulder fall using the following expression:

$$R_{(LOL)} = P_{(H)} \times P_{(S:H)} \times P_{(T:S)} \times V_{(D:T)}$$

Where:

- $R_{(LOL)}$ is the risk (annual probability of loss of life (death) of a person) from rockfall. This is equivalent to CCC's Annual Individual Fatality Risk (AIFR);
- $P_{(H)}$ is the annual frequency of a rockfall-initiating event. Taken from Table 1; GNS, 2012/214 for the seismic case and Table 15; GNS, 2012/311, for the non-seismic case;
- $P_{(S:H)}$ is the probability of a building or person, if present, being in the path of one or more boulders at a given location;
- $P_{(T:S)}$ is the probability that a person is present at that location; $P_{(T:S)}$ is taken as 1.0 as outlined in Section 5.2.2.4.1 of the CRDP for Rockfall Management Area 2; and
- $V_{(D:T)}$ is the vulnerability, or probability of a person being killed (or receiving injuries which result in death). $V_{(D:T)}$ is taken as 0.5 (refer Section 5.5 GNS 2011/311).

7.2 Non-Earthquake Rockfall Risk

As noted in Massey et al. (2012c), there is precedent for boulder falls to release in significant storm events, as well as during earthquake conditions. We have modelled the lives risk due to a non-earthquake trigger based on the information provided in Massey at al. 2010/11. Table 15 in this report presents the number of boulders expected to be released in each suburb and the effective annual frequency of a non-earthquake event per band. For the purpose of this assessment, we considered the Rapaki source area to best reflect the on-site conditions. The risk posed non-earthquake assessment are presented in Appendix 3.

7.3 Level of Risk

Based on the boulder roll paths from the Rocfall3, boulder appear to be concentrated to the gullies and appears to not roll over the ridgelines. We have completed a risk assessment for two different zones along the upslope boundary:

- Zone 1 where boulder roll paths are modelled and there are no viable building platforms on the lot outside of boulder roll paths. Lots 9, 10, 12-15, 25, 27-29.
- Zone 2 where there is no modelled boulder roll paths and there appears to be viable building platforms within the lot that are outside of boulder roll paths. Lots 11, 16, 26.

We have calculated the risk for both zones using AIFR and presented in Appendix 2, residual probability that a boulder will reach the upslope boundary of 2% was assumed for Zone 2 calculations:

- Zone 1 = 2.46×10^{-3}
- Zone 2 = 7.19×10^{-5}

7.4 Risk Acceptability

The previously completed GNS risk assessment identifies parts of site as having an AIFR of greater than 10^{-3} and between 10^{-3} to 10^{-4} for the near source area. This is consistent with our site-specific risk assessment for the upslope (western) boundary of the site which indicates that the risk for Zone 1 is unacceptable and risk for Zone 2 as acceptable (Appendix 3).

In summary, as the AIFR calculated for the majority of the upper lots, excluding Lots 11, 16, 26 cannot be considered as tolerable, rockfall risk reduction works are required and will need to extend across the upslope boundary.

8 Potential Rockfall Risk Management Options

The AIFR calculated for the upslope area of site is above tolerable limit for lots in Zone 1 and therefore mitigation of the risk needs to be undertaken. Given the size and extent of the rockfall source areas, particularly the ridgeline, we consider that treatment at the source would likely be cost prohibitive. Therefore, mitigation options such as berms or rockfall fences are likely the most appropriate options for the majority of the lots within Zone 1.

There are localised outcrops of rock at the southern end of site, some of which are in the site boundary. We consider that removal works at the rockfall source will be required for these areas. This can be completed by undertaking removal works at the rockfall source. Works associated with this method are outlined in Section 7.1 below.

The recommendations provided below are based on our understanding of what constitutes hazard removal as outlined in a letter produced by Aurecon (March 2015), as follows:

"According to CERA, the Joint Ministers agreed to:

Agree to use your Power to Act to include rezoning from red to green properties in the residential red zone where the rock fall hazard has been removed at source providing:

- *that you are satisfied that the risk has been removed entirely; and*

- *the removal has been undertaken within the Crown offer period for the Port Hills red zone.*

For the purpose of this exercise and in line with our understanding of hazard and risk management in the New Zealand context, we assume that the risk from rock fall will be reduced to background levels once the rock fall hazard has been treated, removed or mitigated."

It should be noted that slope conditions will change over time and new rock fall source may be generated by erosion, weathering or future earthquakes. Therefore, the exposed rock that will remain on-site following the scaling and removal will need to be carefully managed to reduce or maintain the risk levels.

If rockfall fences are preferred, then these would need to be designed and located once the building platforms have been confirmed.

8.1 Scaling and Boulder Clearance

Removal of the source material will consist of scaling and removal of the potential rockfall sources identified, and removal or burial of the rocks currently present on the slope. Based on site observations we consider approximately 20 to 30 locations along the scattered bluffs will require scaling and removal. However, this will need to be confirmed during a future detailed design phase, which ENGEO can undertake, if required.

As stated in Section 6.1.1 the largest boulder noted on-site was 3.5 m^3, although the majority were in the order of 0.6 m^3. Therefore, treatment of boulders up to the larger size will need to be considered by a suitably qualified contractor who will be completing the scaling works.

A geotechnical professional will be required to attend site and confirm that risk has been reduced to background levels. We anticipate that should this be achieved then Council should be able to remove the rockfall hazard overlays from these properties. However, we recommend you discuss this, and agree an appropriate process, with Council prior to completing the recommended works.

8.1.1 Targeted Rock Bolting

Should a suitably qualified contractor determine that scaling and removal of any potential rockfall sources cannot be completed (either in terms of safety or effectiveness) then targeted rock bolting will be required. We recommend that a generic rock bolt design is developed as part of the design process such that it can be implemented on an 'as needed' basis during construction of the mitigation works.

8.2 Fence Design

Results from the rockfall modelling show that a 95th percentile rockfall energy of up to 220 kJ may be expected. Given the potential for multiple impacts affecting the fence in a single event, particularly at the northern end of the fence, we recommend designing for a minimum factor of safety of 3 in accordance with MBIE's Design Guidelines for Passive Rockfall Protection Structures. For Servicability Energy Level (SEL) design, this requires a design rockfall energy of 660 kJ. While 1000 kJ barriers are available, provided that the supply cost is not significantly greater, a 1500 or 2000 kJ capacity rockfall fence could be considered to achieve a higher factor of safety for the following reasons:

1. There is a possibility that the fence will be subjected to multiple rock impacts in the same event. A higher capacity fence will provide a much greater level of protection should this occur.

2. There are rocks on the slope that are somewhat larger than the design boulder. While we anticipate they are within the capacity of a 1000 kJ fence, the larger fences give a greater factor of safety against larger impacts.

3. Larger capacity fences deflect a shorter downslope distance in the event of a rock impact. This will enable fewer restrictions being placed on the development at the upslope side of the development.

The fence selected must be rated in accordance with ETAG 027 standards, which is the European quality mark for rockfall fences.

Rocks may be expected to be bouncing up to 0.24 m above ground at the boundary; 1000 kJ, 1500 kJ and 2000 kJ rockfall fences are typically available in 3 m or 4 m heights. On this basis, we consider using a 3 m high fence. However, the fence height would need to be confirmed as part of any detailed design process.

Appendix 2 shows one possible layout of the fences, which provides for four separate fences. The exact layout may be finalised at the detailed design stage once client feedback has been incorporated. As shown in Appendix 4, there is approximately 310 m of rockfall fence required, and approximately 80 m of lot boundary across Zone 2 properties (Lot 10/11, 16, 26). It may be preferred to also construct rockfall fences above these areas and we would be happy to discuss this during detailed design phase.

8.3 Safety in Design

Some key safety in design considerations at the concept stage have been to use a fence instead of a bund to eliminate risks associated with extensive earthworks on a slope, and to recommend use of proprietary fence systems with which specialist contractors will be familiar. The key safety considerations at detailed design and during construction are likely to relate to the contractor's construction methodology, with particular emphasis on minimising risks of rockfall during the course of the fence construction and lifting the posts into place.

Similar considerations will be required during fence maintenance and clearance post-impact. Further details of this will be provided as part of detailed design once the exact fence model is determined.

8.4 Maintenance Considerations

A detailed maintenance schedule will normally be provided by the fence manufacturer, and will be included as part of our detailed design for the fence, but at this stage we consider that the following will be required in order to realise the 50-year design life:

1. The fence will need to be inspected on an annual basis or following earthquake or storm events.
2. Routine maintenance will include clearing vegetation and debris build up from around the fence.
3. Cable grips, shackles and other minor components may need to be replaced on a 10-15-year interval.
4. Cables may need to be replaced on a 25-year interval.
5. Depending upon the fence system selected, the mesh may also need to be replaced on a 25-year interval.
6. The remainder of the major components (foundations, anchors and posts) are expected to last 50 years, provided the fence is not impacted.

Should the fence be impacted by rocks, significant maintenance or replacement may well be required as the fences are designed to sustain significant damage as they absorb impact energy.

8.5 Detailed Design Process

Following discussion and approval of a concept design, a detailed design will be required.

This will involve final confirmation of the type of fence and the manufacturer from which it will be procured, followed by production of design drawings and specifications that are suitable for construction. It may be necessary to visit site and complete an anchor testing program as part of the detailed design to allow assessment of anchor lengths that will be required for the fence.

8.6 Conclusions

Once the rockfall fence is installed, we consider that rockfall risk would not preclude the site from being developed as a residential subdivision. Additional geotechnical testing and reporting (currently being completed by ENGEO) would still be required to complete a Section 106 assessment and provide a statement of professional opinion.

9 Limitations

i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Geovert Ltd, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.

iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

iv. This Limitation should be read in conjunction with the Engineering NZ / ACENZ Standard Terms of Engagement.

v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (03) 328 9012 if you require any further information.

Report prepared by

Jed Watts

Engineering Geologist

Report reviewed by

Richard Justice, CMEngNZ (PEngGeol)

Principal Engineering Geologist

10 References

Aurecon, Dr Kupec (12 March 2015). Review of rockfall hazard removal memorandum. For the properties 77A and 79 Bowenvale Avenue, Christchurch. Reference 221924. Published on behalf of CERA.

Christchurch City Council. Earthquake Rockfall Maps. Retrieved December 2020, from http://www.ccc.govt.nz/homeliving/civildefence/chchearthquake/earthquakerockfallmaps.aspx

Geological and Nuclear Sciences (2012). Canterbury Earthquakes 2010/11 Port Hills Slope Stability: Pilot study for assessing life-safety risk from rockfalls (boulder rolls) GNS Science Consultancy Report 2011/311

Geovert (2012) Port Hills 3D Rockfall Modelling, Christchurch New Zealand. Report prepared for CERA, October 2012 We also acknowledge the New Zealand GeoNet project and its sponsors EQC, GNS Science and LINZ, for providing data used in this report.

Geovert. (25 October 2012). Port Hills 3D Rockfall Modelling, Christchurch, New Zealand. Geovert.

GNS, Massey et.al (March 2012) Final Issue. Canterbury Earthquakes 2010/11 Port Hills Slope Stability: Pilot study for assessing life-safety risk from rockfalls (boulder rolls).

GNS, Massey et.al (September 2012) Final Issue. Canterbury Earthquakes 2010/11 Port Hills Slope Stability: Additional assessment of the life-safety risk from rockfalls (boulder rolls).

Gravitas Architecture (March 2022). 130 Bowenvale Avenue, Cashmere, Christchurch 8022. Concept design report.

Keylock and Domaas, 1999

We also acknowledge the New Zealand GeoNet project and its sponsors EQC, GNS Science and LINZ, for providing data used in this report.

APPENDIX 1:

Bowenvale Site Plan

SITE INFORMATION

LEGAL DESCRIPTION

LOT 2,
D.P 33462

130 BOWENVALE AVENUE,
CASHMERE,
CHRISTCHUCH 8022,
NEW ZEALAND

TOTAL SITE AREA = 5.09 HA (approx.)

BUILDING CLASSIFICATION:

RESIDENTIAL DWELLING

PLANNING OVERVIEW:

TERRITORIAL AUTHORITY:	CHRISTCHURCH CITY COUNCIL
ZONE:	RESIDENTIAL HILLS ZONE
WIND ZONE:	VERY HIGH
CLIMATE ZONE:	ZONE 3
DURABILITY/EXPOSURE ZONE:	ZONE 2
SITE DENSITY:	MIN.NET SITE AREA OF 650m²
SITE COVERAGE:	35%
BUILDING HEIGHT:	MAX 8m

NATURAL HAZARDS:

SLOPE INSTABILITY MANAGEMENT AREA
ROCKFALL MANAGEMENT AREA 1
ROCKFALL MANAGEMENT AREA 2

SCHEDULE OF ACCESS CRITERIA

ROADS

LEGAL ROAD WIDTH:	12m
ROAD FORMATION WIDTH:	5.5m *carriageway*
FOOTPATH WIDTH:	1.5m

PRIVATE WAYS (ACCESS)

LEGAL WIDTH:	6.0m
FORMATION WIDTH:	4.5m

RIGHTS OF WAY

LEGAL WIDTH:	4.5m

NOTES

1. ALL LAYOUTS, AREAS & DIMENSIONS ARE SUBJECT TO ACCEPTANCE BY LOCAL AND DISTRICT AUTHORITIES AND GOVERNMENT AGENCIES.
2. NO GEOTECHNICAL STUDIES AND REPORTS HAVE BEEN COMMISSIONED
3. NO ENVIRONMENTAL ASSESSMENTS HAVE BEEN COMMISSIONED AS REQUIRED BY RESOURCE MANAGEMENT ACT 1991.
4. NO RESEARCH HAS BEEN UNDERTAKEN AS TO AVAILIABILITY OF SERVICES

PLAN: **OVERALL SITE** scale:1:750

gravitas ARCHITECTURE

APPENDIX 2:

Zone 1 and 2 Risk Assessment

Rockfall Risk Assessment - Bowenvale Devlopment (Residual Risk) **REVISED RISK ASSESSMENT May 2022**

1. Earthquake Induced Rockfall Risk (2020 levels)

Length of Rapaki Zone (indicated by GNS)	2100	m
Width of rockfall above property	450	m
Width of person	1	m
Assumed average width of boulders	1	m

Earthquake Event	Prob of EQ Occurrence (Table 1; GNS, 2012/214) - $P_{(H)}$. Assumes 'No aftershocks' model	No boulders released (Table 11, GNS 2011/311) (N)	Factored No. of Boulders Released	Probability that boulder will reach upslope boundary based on rockfall modeling	N at dwelling	Probability of person being within path of a single boulder ($P_{(S:H)}$)	Probability of person being within the path of one or more boulders given the runout distance ($PN_{(S:H)}$)	Probability of person being present - $P_{(T:S)}$	Probability of fatality if person present - $V_{(D:T)}$	Risk (individual boulder) - $R_{(LOL)}$
0.1 - 0.4g	1.31E-01	0.1000	0.0214	0.93	0.019928571	0.00667	0.00013	1	0.5	8.74E-06
0.4 - 1.0g	3.10E-02	31.0000	6.6429	0.93	6.177857143	0.00667	0.04048	1	0.5	6.27E-04
1.0 - 2.0g	3.30E-03	518.0000	111.0000	0.93	103.23	0.00667	0.49868	1	0.5	8.23E-04
2.0 - 5.0g	2.00E-04	5200.0000	1114.2857	0.93	1036.285714	0.00667	0.99902	1	0.5	9.99E-05
									TOTAL (EQ)	1.56E-03

2. Non Earthquake Rockfall Risk

Rainfall Event	Prob of Non EQ Occurrence (Table 15; GNS, 2012/311) - $P_{(H)}$	No boulders released (Table 15, GNS 2011/311) (N)	Factored No. of Boulders Released	Probability that boulder will reach upslope boundary based on rockfall modeling	N at dwelling	Probability of person is within path of a single boulder ($P_{(S:H)}$)	Probability of person is within the path of one or more boulders given the runout distance ($PN_{(S:H)}$)	Probability of person being present - $P_{(T:S)}$	Probability of fatality if person present - $V_{(D:T)}$	Risk (individual boulder) - $R_{(LOL)}$
<1 - 15 years	3.30E-01	1	0.2143	0.93	0.199285714	0.00667	0.00133	1	0.5	2.20E-04
15 - 100 years	5.00E-02	10	2.1429	0.93	1.992857143	0.00667	0.01324	1	0.5	3.31E-04
100-1000 years	1.00E-02	50	10.7143	0.93	9.964285714	0.00667	0.06448	1	0.5	3.22E-04
>1000 years	5.00E-04	100	21.4286	0.93	19.92857143	0.00667	0.12480	1	0.5	3.12E-05
									TOTAL (NON EQ)	9.04E-04
									TOTAL RISK (ALL EVENTS)	**2.46E-03**

Rockfall Risk Assessment - Bowenvale Devlopment (Residual Risk) **REVISED RISK ASSESSMENT May 2022**

1. Earthquake Induced Rockfall Risk (2020 levels)

Length of Rapaki Zone (indicated by GNS)	2100	m
Width of rockfall above property	450	m
Width of person	1	m
Assumed average width of boulders	1	m

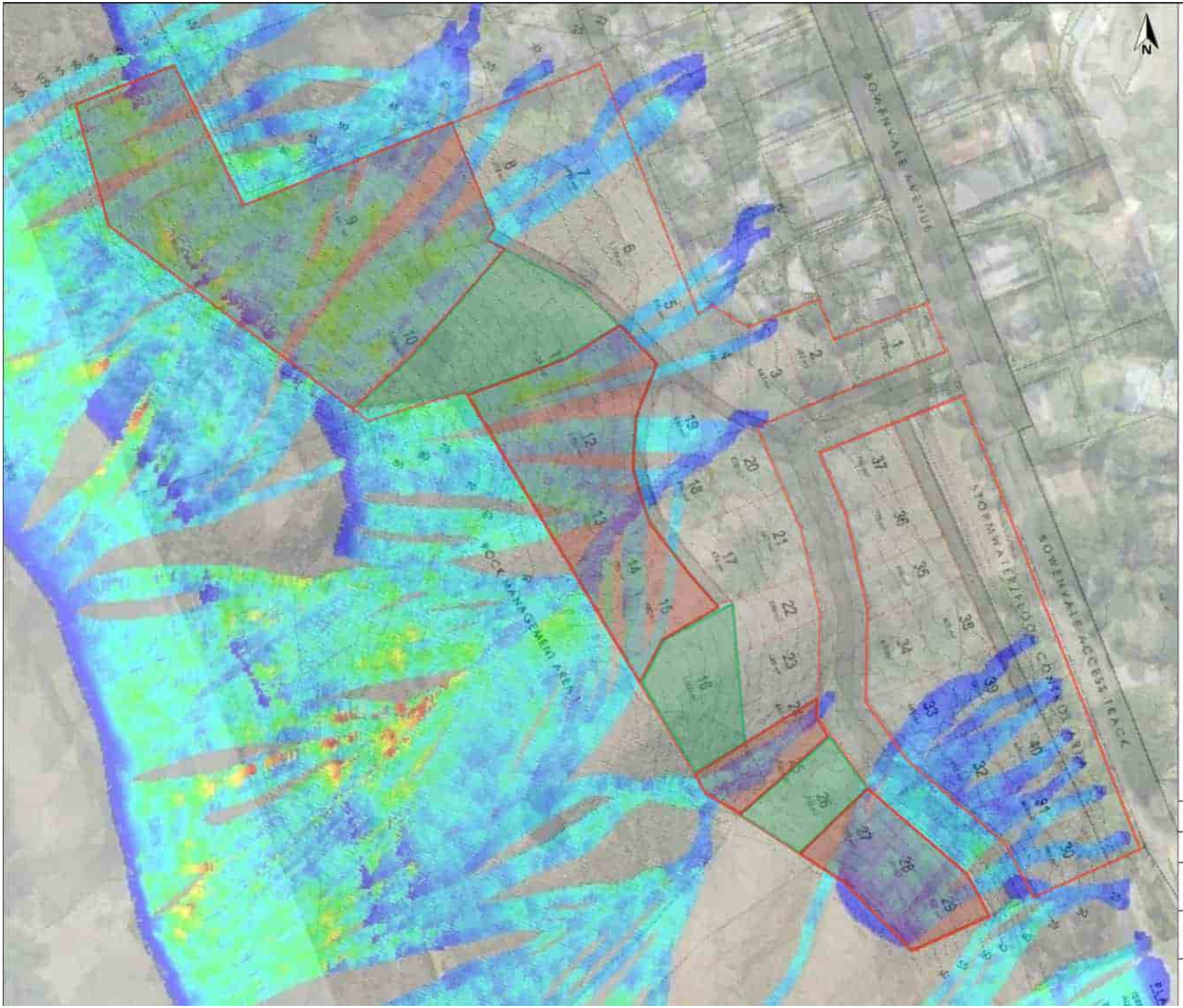
Earthquake Event	Prob of EQ Occurrence (Table 1; GNS, 2012/214) - $P_{(H)}$. Assumes 'No aftershocks' model	No boulders released (Table 11, GNS 2011/311) (N)	Factored No. of Boulders Released	Probability that boulder will reach upslope boundary based on rockfall modeling	N at dwelling	Probability of person being within path of a single boulder ($P_{(S:H)}$)	Probability of person being within the path of one or more boulders given the runout distance ($PN_{(S:H)}$)	Probability of person being present - $P_{(T:S)}$	Probability of fatality if person present - $V_{(D:T)}$	Risk (individual boulder) - $R_{(LOL)}$
0.1 - 0.4g	1.31E-01	0.1000	0.0214	0.02	0.000428571	0.00667	0.00000	1	0.5	1.88E-07
0.4 - 1.0g	3.10E-02	31.0000	6.6429	0.02	0.132857143	0.00667	0.00089	1	0.5	1.38E-05
1.0 - 2.0g	3.30E-03	518.0000	111.0000	0.02	2.22	0.00667	0.01474	1	0.5	2.43E-05
2.0 - 5.0g	2.00E-04	5200.0000	1114.2857	0.02	22.28571429	0.00667	0.13849	1	0.5	1.38E-05
									TOTAL (EQ)	5.21E-05

2. Non Earthquake Rockfall Risk

Rainfall Event	Prob of Non EQ Occurrence (Table 15; GNS, 2012/311) - $P_{(H)}$	No boulders released (Table 15, GNS 2011/311) (N)	Factored No. of Boulders Released	Probability that boulder will reach upslope boundary based on rockfall modeling	N at dwelling	Probability of person is within path of a single boulder ($P_{(S:H)}$)	Probability of person is within the path of one or more boulders given the runout distance ($PN_{(S:H)}$)	Probability of person being present - $P_{(T:S)}$	Probability of fatality if person present - $V_{(D:T)}$	Risk (individual boulder) - $R_{(LOL)}$
<1 - 15 years	3.30E-01	1	0.2143	0.02	0.004285714	0.00667	0.00003	1	0.5	4.73E-06
15 - 100 years	5.00E-02	10	2.1429	0.02	0.042857143	0.00667	0.00029	1	0.5	7.17E-06
100-1000 years	1.00E-02	50	10.7143	0.02	0.214285714	0.00667	0.00143	1	0.5	7.16E-06
>1000 years	5.00E-04	100	21.4286	0.02	0.428571429	0.00667	0.00286	1	0.5	7.16E-07
									TOTAL (NON EQ)	1.98E-05
									TOTAL RISK (ALL EVENTS)	**7.19E-05**

APPENDIX 3:

Boulder Roll Paths



Legend

- Site Boundary
- Risk Zone 1 – Unacceptable Risk
- Zone 2 – Acceptable Risk
- Boulder Rolls and Stage Plan

0 25 m 50 m

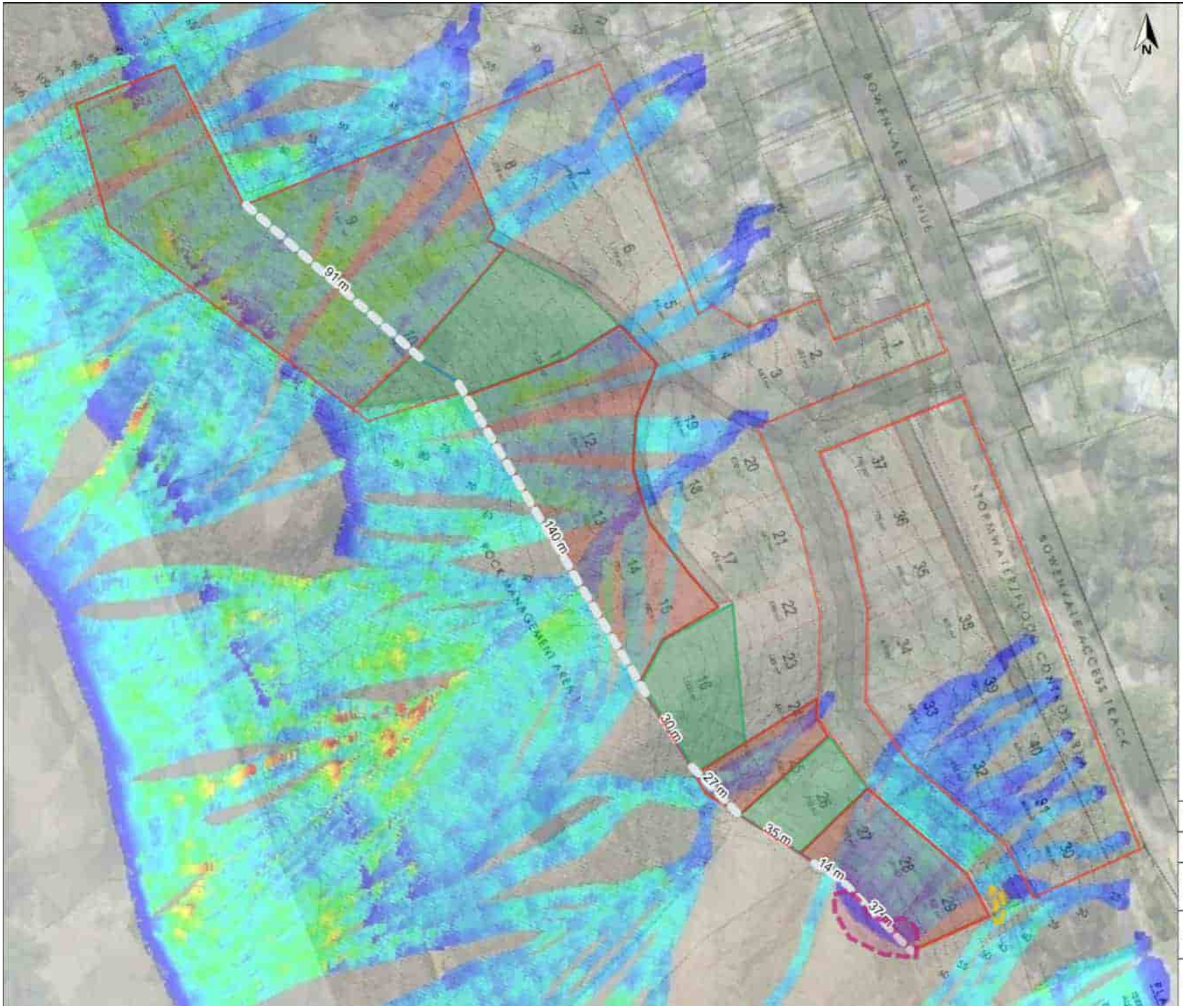
ENGEO

Produced by **Datanest.earth**

Title: Boulder Roll Paths		
Client: Geovert		Figure No: 7 Size: A4
Project: Bowenvale Development	Drawn: JRW	
Date: 06-05-2022	Checked: RJ	
Proj No: 20268.001	Scale: 1:2000	Version: draft

APPENDIX 4:

Fence Options



Legend

- Outcrop that will require source treatment
- Outcrop that could be treated at the source
- Concept Fence Locations
- Site Boundary
- Distance above Zone 2 areas
- Risk Zone 1 – Unacceptable Risk
- Zone 2 – Acceptable Risk
- Boulder Rolls and Stage Plan

0 25 m 50 m

ENGEO

Produced by **Datanest.earth**

Title: Boulder Roll Paths		
Client: Geovert		
Project: Bowenvale Development	Drawn: JRW	Figure No: 7
Date: 06-05-2022	Checked: RJ	Size: A4
Proj No: 20268.001	Scale: 1:2000	Version: draft

Title:	Bowenvale Avenue - Tree Report
Project:	New Development
Site Location:	130 Bowenvale Avenue, Cashmere, Christchurch 8022
Project Lead:	S5 Consulting
Author:	Craig Taylor – SimplyArb Tree Consultants Ltd
Date:	January 2023

SimplyArb LTD
TREE CONSULTANTS

Table of Contents

1.0 Brief outline/overview

1.1 A tree report has been commissioned by S5 Consulting for several trees located within the Christchurch City Council (CCC) road corridor at 130 Bowenvale Avenue, Cashmere, Christchurch 8022 (130 Bowenvale Avenue) as part of the proposed development work being carried out at 130 Bowenvale Avenue with the CCC street trees being located within the proposed accessway into 130 Bowenvale Avenue.

1.2 This tree report relates to five CCC street trees located within the CCC road corridor at the southern end of Bowenvale Avenue (image 1(i) and (ii)). None of the trees are identified within the CCC asset management system with tree identification BA (Bowenvale Avenue) numbers attributed to the trees within the CCC road corridor for the purpose of this report and clarity within.

1.3 The five CCC street trees are identified as:

- *Cordyline australis* (Cabbage Tree) tree ID BA01.
- *Cordyline australis* (Cabbage Tree) tree ID BA02.
- *Cordyline australis* (Cabbage Tree) tree ID BA03.
- *Podocarpus totara* (Totara) tree ID BA04
- *Cordyline australis* (Cabbage Tree) tree ID BA05.

1.4 This report will outline the health and structure (and overall condition) of the five CCC street trees and will seek approval through the relevant delegated authority at the CCC (or otherwise) for their removal.

1.5 Images are provided by Land Information New Zealand (date unknown) and Google Images 2019.

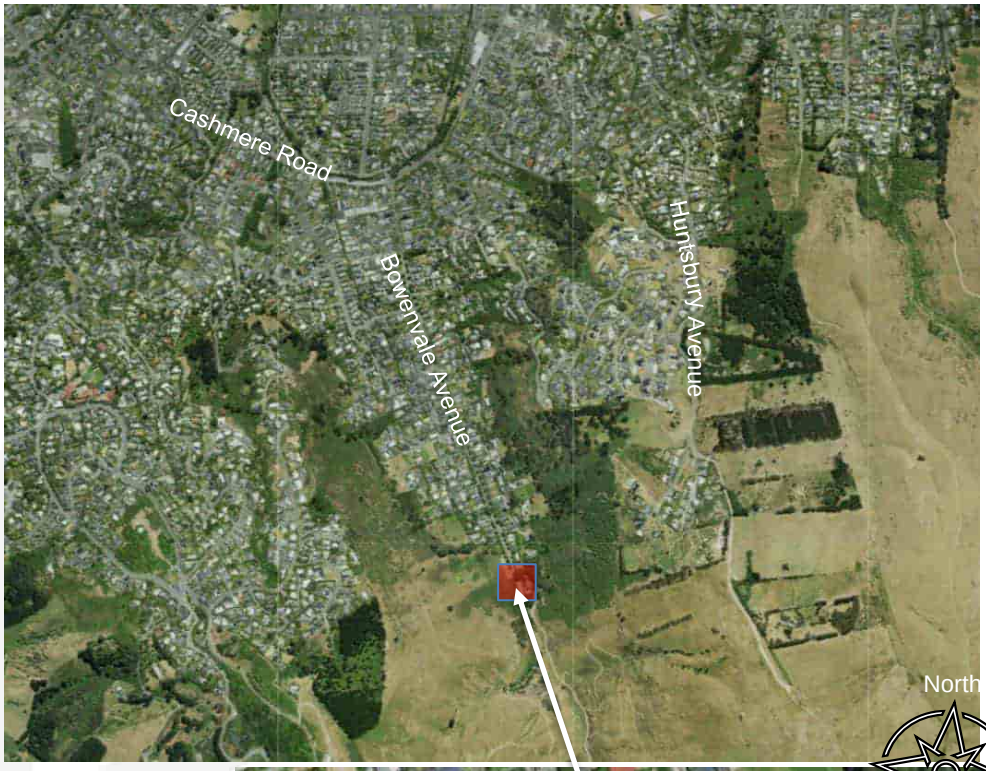
1.6 The CCC health and structure assessment rating system was used for this report (Appendix One).

1.7 Tree height measurements were taken using a Nikon Forestry Pro Hypsometer. Three measurements were taken of each tree and an average taken across all three measurements.

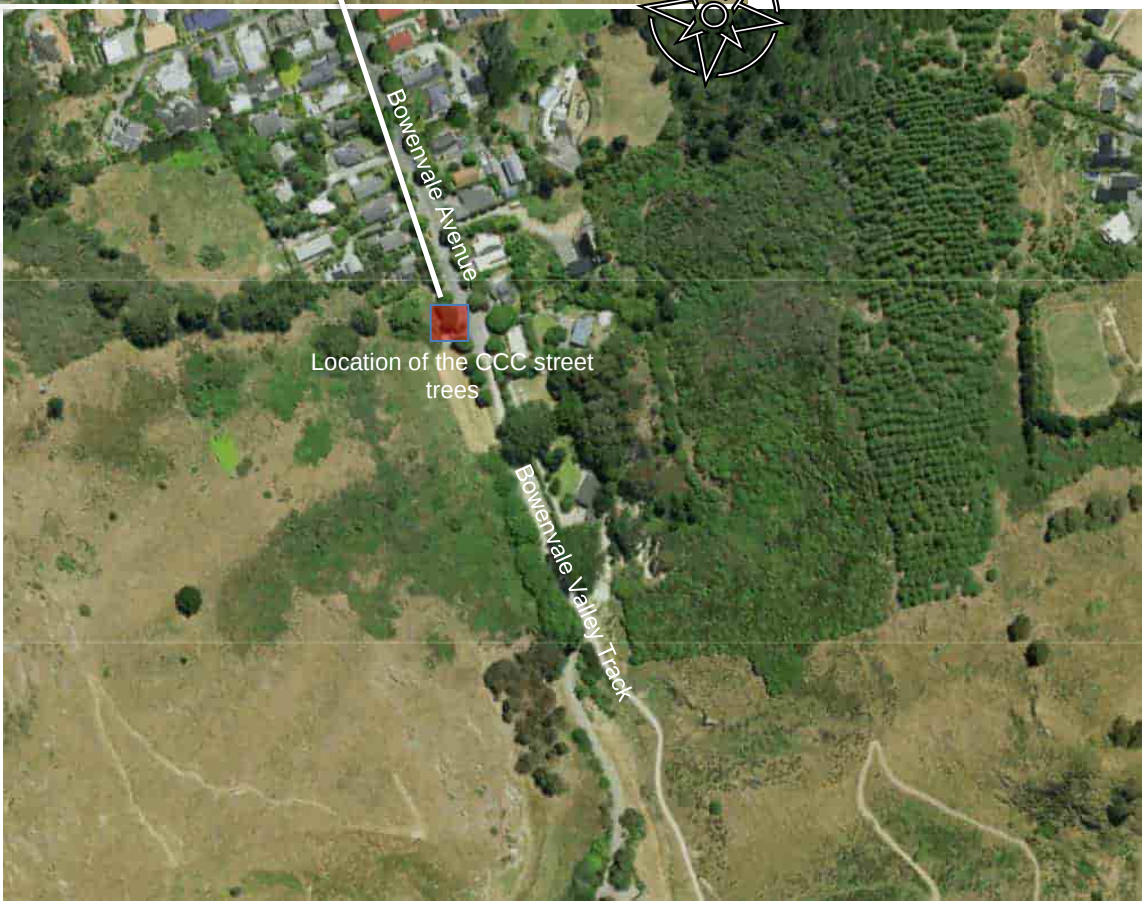
1.8 CCC street trees are protected under the *Christchurch District Plan 9.4 Significant and other trees* as public realm trees if the trees are greater than 6.0m in height located within the CCC road corridor and where a resource consent would be required for removal.

Images 1: Contextural aerial view of Bowenvale Avenue, Cashmere, Christchurch (i) and the area of Bowenvale Avenue surveyed containing trees within the CCC road corridor which this report relates (ii).

(i)



(ii)



2.0 Considerations

2.1 In the course of carrying out a [1]Visual Tree Assessment (VTA) the following considerations were taken into account in collaboration with the VTA:

- The land use i.e. CCC road reserve and road corridor;
- The occupancy and frequency with which this particular aspect of land is used;
- The target area i.e. the location where pedestrian and vehicle access are permitted and required in relation to the tree/s;
- Probability or likelihood of failure of the tree/s (or any part of) into the area frequented by users;
- The tree/s in its entirety and the viability of the tree long-term and the tree/s predicted life span;
- The species of tree/s and the characteristics that are attributable to this particular species.
- The trees within the landscape setting and the context with which they are located.

[1]Trees are assessed using the internationally recognised Visual Tree Assessment (VTA) methodology (Mattheck.C & Breloer.H. 1994).

3.0 Site and tree details

3.1 Site details

3.1.1 The section of Bowenvale Avenue and the CCC street trees with which this report relates are located at the southern end of Bowenvale Avenue where Bowenvale Avenue meets Bowenvale Valley Track. The trees are located with garden beds which separate car parking spaces for recreational users to access Bowenvale Valley Track (images 1/2).

Image 2: Southern end of Bowenvale Avenue where Bowenvale Avenue meets Bowenvale Valley Track (yellow arrow) and the CCC street trees (orange circles) with which this report relates located within the garden beds between car park spaces. *Images courtesy of Google Street View 2019.*

3.1.2 The CCC street trees are fairly well confined to within the garden beds with the Cabbage Trees/Totara tree roots less likely to venture far from the garden beds due to:

- The nutrient and water content beyond the tree beds being more than likely non-existent as the road base will be devoid of any nutrient content beneficial for trees and where the ground conditions will be devoid of water where, due to the crown of the carriageway, the water will disperse quickly towards the channels with the water having very little opportunity to penetrate to the ground beneath,
- Where the nature of root growth from the Cabbage Trees will be fairly well confined to a small area, and
- The relatively young age and small nature (suppressed under a Lime tree) of the Totara tree.

3.2 Tree details

Image 3: Location of the five trees on Bowenvale Avenue.

Tree species:	*Cordyline australis* (Cabbage Tree)
Tree ID:	BA01
Protection status:	Non
Native/Exotic:	Native
Height:	4.0m
Canopy:	0.75m
Diameter at Breast Height:	0.150m
[1]Health:	Poor
[1]Structure:	Poor
[1]Overall:	Poor

Comments:

Significant basal decay. Multiple points of decay throughout the tree.

[1]Health - Tree is in poor health with:

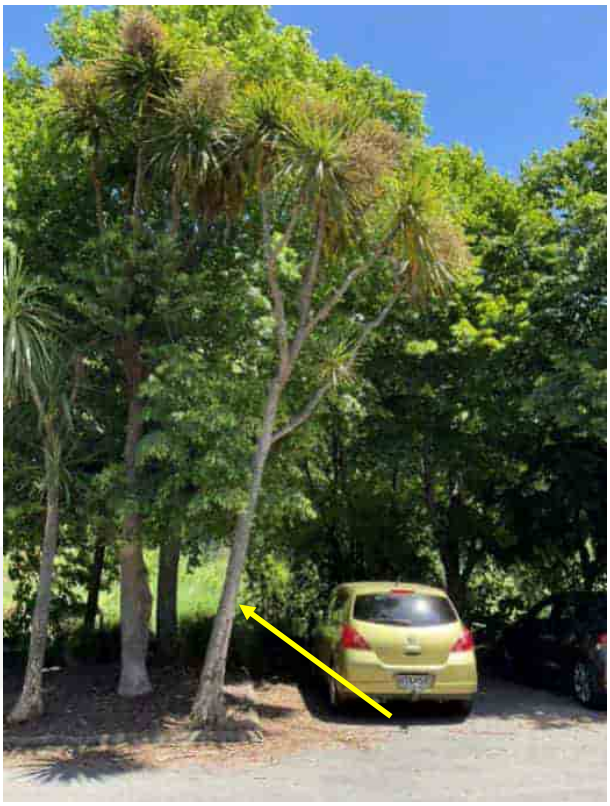
'…Approximately 31-70% foliage density loss, discolouration or disease, below ideal leaf size or shoot growth, dieback dead wood or other disorders.'.

[1]Structure - Tree has poor structure where:

'Tree maintenance may improve the framework or the continued well-being of tree.

Defects (including roots and trunk taper) result in loss of structural integrity, may be mitigated but unlikely to be rectified'.

[1]Based on the CCC Tree Health and Structure Assessment (see Appendix 1 for further definitions).

Tree species:	*Cordyline australis* (Cabbage Tree)	
Tree ID:	BA02	
Protection status:	Public realm	
Native/Exotic:	Native	
Height:	6.2m	
Canopy:	1.5m	
Diameter at Breast Height:	0.150m	
[1]Health:	Good	
[1]Structure:	Fair	
[1]Overall:	Fair	

Comments:

[1]Health - Tree is in good health with:

'*Approximately 6-10% foliage density loss, discolouration or disease, below ideal leaf size or shoot growth, dieback, dead wood or other disorders'.*

[1]Structure - Tree has fair structure where:

'Defects (including roots and trunk taper) present, but can be rectified in order to maintain the structural integrity and continued well-being of tree'.

[1]Based on the CCC Tree Health and Structure Assessment (see Appendix 1 for further definitions).

Tree species:	*Cordyline australis* (Cabbage Tree)	
Tree ID:	BA03	
Protection status:	Public realm	
Native/Exotic:	Native	
Height:	7.1m	
Canopy:	2.0m	
Diameter at Breast Height:	0.2m	
[1]Health:	Good	
[1]Structure:	Fair	
[1]Overall:	Fair	

Comments:

[1]Health - Tree is in good health with:

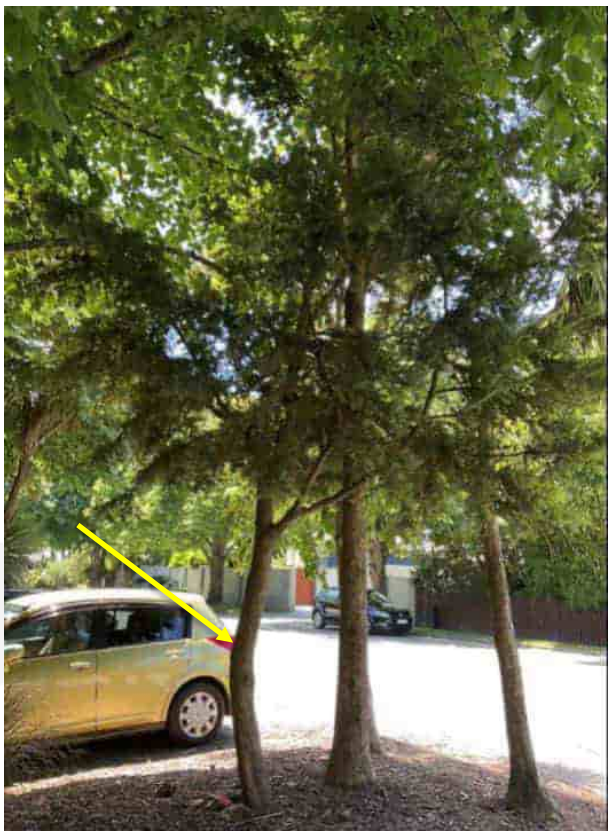
'… 6-10% foliage density loss, discoloration or disease…..'.

[1]Structure - Tree has fair structure where:

'Defects (including roots and trunk taper) present, but can be rectified in order to maintain the structural integrity and continued well-being of tree'.

[1]Based on the CCC Tree Health and Structure Assessment (see Appendix 1 for further definitions).

Tree species:	*Podocarpus totara* (Totara)
Tree ID:	BA04
Protection status:	Public realm
Native/Exotic:	Native
Height:	6.0m (Approximated)
Canopy:	3.0m
Diameter at Breast Height:	0.1m
[1]Health:	Fair
[1]Structure:	Fair
[1]Overall:	Fair



Comments:

[1]Health - Tree is in fair health with:

'…11-30% foliage density loss, discolouration or disease …..'.

[1]Structure - Tree has fair structure where:

'Defects (including roots and trunk taper) present, but can be rectified in order to maintain the structural integrity and continued well-being of tree'.

[1]Based on the CCC Tree Health and Structure Assessment (see Appendix 1 for further definitions).

Tree species:	*Cordyline australis* (Cabbage Tree)	
Tree ID:	BA05	
Protection status:	Public realm	
Native/Exotic:	Native	
Height:	6.8m	
Canopy:	2.0m	
Diameter at Breast Height:	0.2m	
[1]Health:	Good	
[1]Structure:	Fair	
[1]Overall:	Fair	

Comments:

[1]Health - Tree is in good health with:

'… 6-10% foliage density loss, discoloration or disease…..'.

[1]Structure - Tree has fair structure where:

'*Defects (including roots and trunk taper) present, but can be rectified in order to maintain the structural integrity and continued well-being of tree'.*

[1]Based on the CCC Tree Health and Structure Assessment (see Appendix 1 for further definitions).

3.3 Analysis breakdown

3.3.1 The following is a breakdown on the overall condition of the trees assessed against the CCC Health and Structure Assessment (Appendix 1):

Overall condition	Number of trees	Tree ID
Good	0	
Fair	4	BA02/BA03/BA04/BA05
Poor	1	BA01
Very poor	0	

3.3.2 Four of the five CCC street trees (BA02/BA03/BA04/BA05) are protected under the *Christchurch District Plan 9.4 Significant and other trees* as public realm trees with the trees being greater than 6.0m in height located within the CCC road corridor where a resource consent has been applied for the removal of.

4.0 Summary

4.1 A development is proposed for 130 Bowenvale Avenue, Cashmere, Christchurch with a vehicle accessway required into the development. In direct alignment with the proposed vehicle accessway are five CCC street trees. The five CCC street trees require removal to allow the accessway and development to proceed.

4.2 The five trees are 4x *Cordyline australis* (Cabbage Tree) and 1x *Podocarpus totara* (Totara). None of the trees are identified with the CCC asset management system.

4.3 Four of the five trees (BA02/BA03/BA04/BA05) are protected as public realm trees.

4.4 Four of the CCC street trees (BA02/BA03/BA04/BA05) are in fair condition with one CCC street tree in poor condition (BA01).

Craig Taylor
Consulting Arborist

Appendix 1 – Christchurch City Council Health and Structure Assessment

Description	Non-existent	Very Good	Good	Fair	Poor	Very Poor
Assessment of **Tree Health**	Asset is no longer present or cannot be found	No more than approximately 5% foliage density loss, discolouration or disease, below ideal leaf size or shoot growth, dieback, dead wood or other disorders.	Approximately 6-10% foliage density loss, discolouration or disease, below ideal leaf size or shoot growth, dieback, dead wood, or other disorders.	Approximately 11-30% foliage density loss, discolouration or disease, below ideal leaf size or shoot growth, dieback, dead wood, or other disorders.	Approximately 31-70% foliage density loss, discolouration or disease, below ideal leaf size or shoot growth, dieback dead wood or other disorders.	Tree dead or state of severe decline. More than approximately 70% foliage density loss, discolouration or disease, below ideal leaf size or shoot growth, dieback, dead wood, or other disorders.
Assessment of **Tree Structure**		No structural defects or abnormalities (including roots and trunk taper).	Defects (including roots and trunk taper) do not affect structural integrity or continued well-being of tree.	Defects (including roots and trunk taper) present but can be rectified to maintain the structural integrity and continued well-being of tree.	Tree maintenance may improve the framework or the continued well-being of tree. Defects (including roots and trunk taper) result in loss of structural integrity, may be mitigated but unlikely to be rectified.	Tree dead or state of severe decline. Total loss of structural integrity of tree. Tree maintenance cannot improve the framework or the continued well-being of tree. Defects (including roots and trunk taper) result in loss of structural integrity, and cannot be mitigated or rectified
Condition Rating	**0**	**1**	**2**	**3**	**4**	**5**

The single overall condition score for a tree is worst of the health and structure grades (i.e., the highest number).

Health

Tree health assesses both vigour and vitality.

Vigour is described as growth efficiency. Trees with higher growth efficiency are more likely to effectively resist strain from, and respond to, biotic and abiotic factors.

Vitality is described as the tree's ability to grow and survive in the position that it occupies.

When assessing a tree's health, the following are assessed:

- leaf colour;
- leaf necrosis;
- shoot growth;
- fruit or flower set (e.g. lack of nitrogen can lead to poor fruit set, excess or insufficient water during the summer, root constrictions caused by hardpan or compacted soil, sunburn or borer insects on the trunk or branches, and pests such as soil nematodes, root rot, bacterial canker, brown rot of twigs, powdery mildew, and spider mites can cause fruit to drop);
- live crown ratio;
- foliage density;
- leaf size;
- wound wood;
- absence/presence of lichens on small diameter branching;
- dieback;
- sun scorch;
- pests and diseases.

Stands of trees are to be averaged and not individually assessed.

Structure

This is an assessment of the structural integrity of a tree's branches, trunk and roots. It considers defects such as cavities, cracks, presence of decay, bleeding/sap flow, wounding and previous failure (e.g. storm damage, mower damage), ground cracking, root plate slumping or heaving, girdling roots, included unions (e.g. branch bark ridges that are included (concave) are considerably weaker than those with a prominent ridge line (convex), trunk taper, excessive end weight, dead branches, loose/cracked bark, organised or disorganised burrs (e.g. poplars).

Stands of trees are to be averaged and not individually assessed.

Mitigation means cable bracing, propping, pruning.

Rectification means removing the defect.

Project: CASHMERE DEVELOPMENT BRIDGE

Address: Bowenvale Avenue, Cashmere, 8022

Client: Bridge It NZ Ltd

Project Ref: 400-001

Revision: DRAFT

Date: 1/03/2023

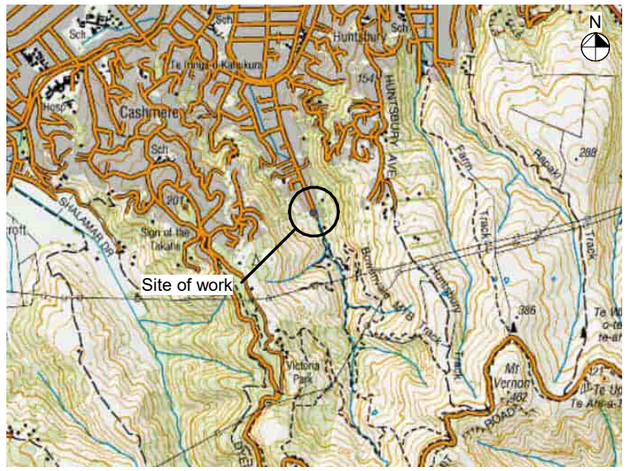
2/201 Opawa Rd, Hillsborough, Chch
PO Box 41137 Ferrymead, Chch 8247

www.viden.co.nz

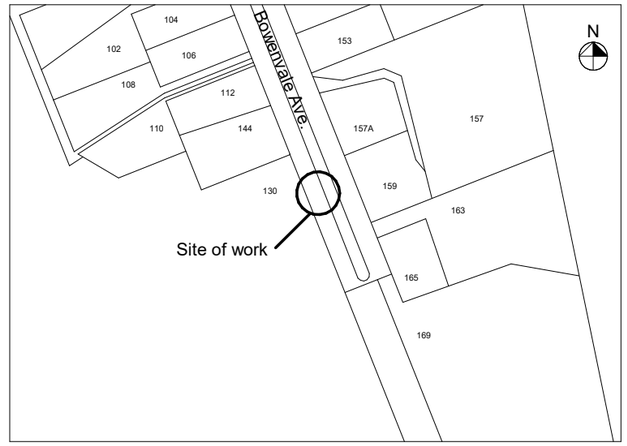
office@viden.co.nz

(03) 741 2064

AERIAL PHOTO



LOCALITY MAP



LOCATION OF WORKS

PHOTO 1

PHOTO 2

VIDEN

CASHMERE DEVELOPMENT BRIDGE

Bowenvale Avenue,
Cashmere, 8022

ISSUE	DESCRIPTION	DATE
1	DRAFT	01/03/23

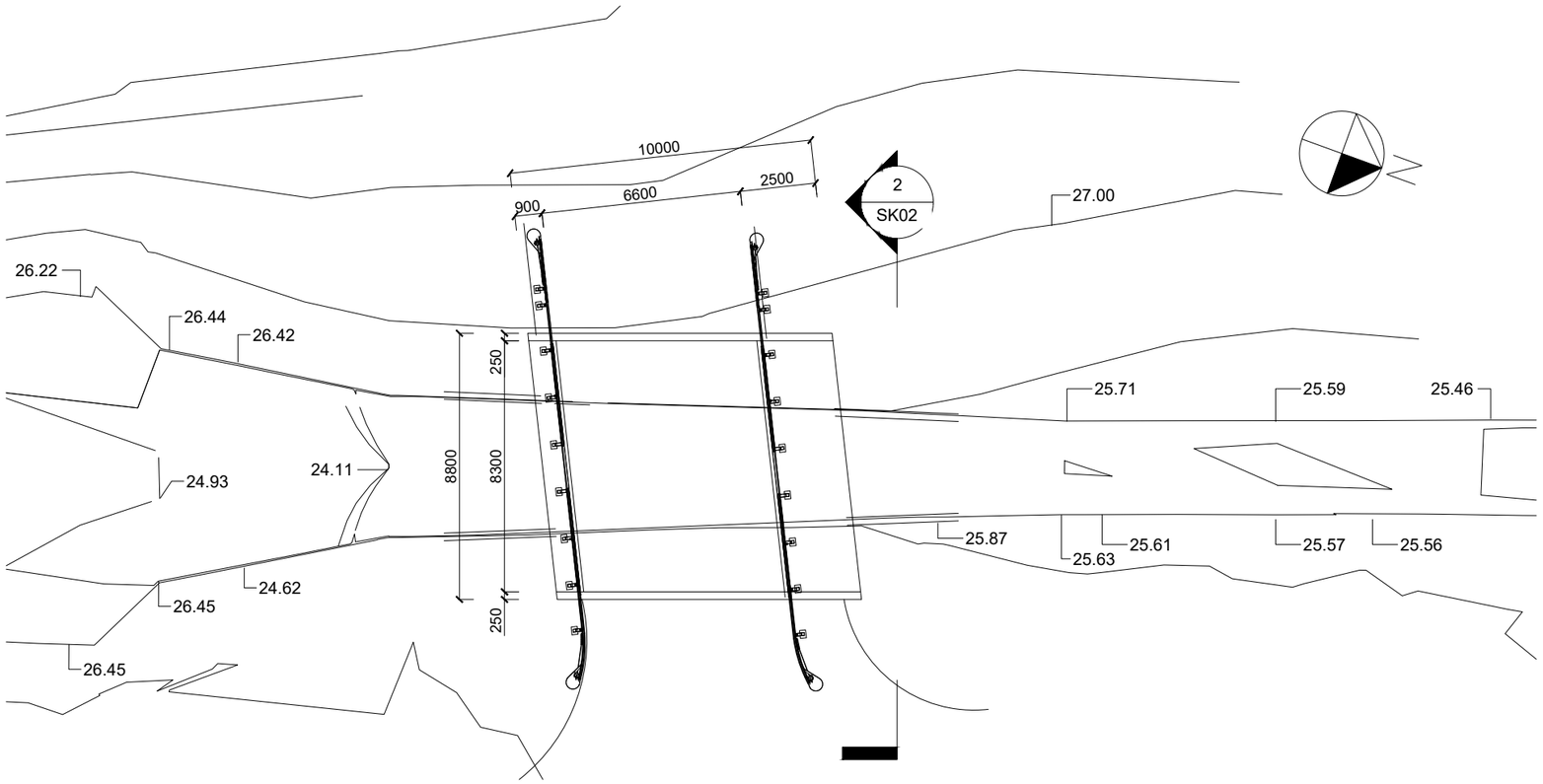
PROJECT : 400-001

DESIGNED : JO
DRAWN : AO
CHECKED: TD

SCALE: @ A3
PAGE:

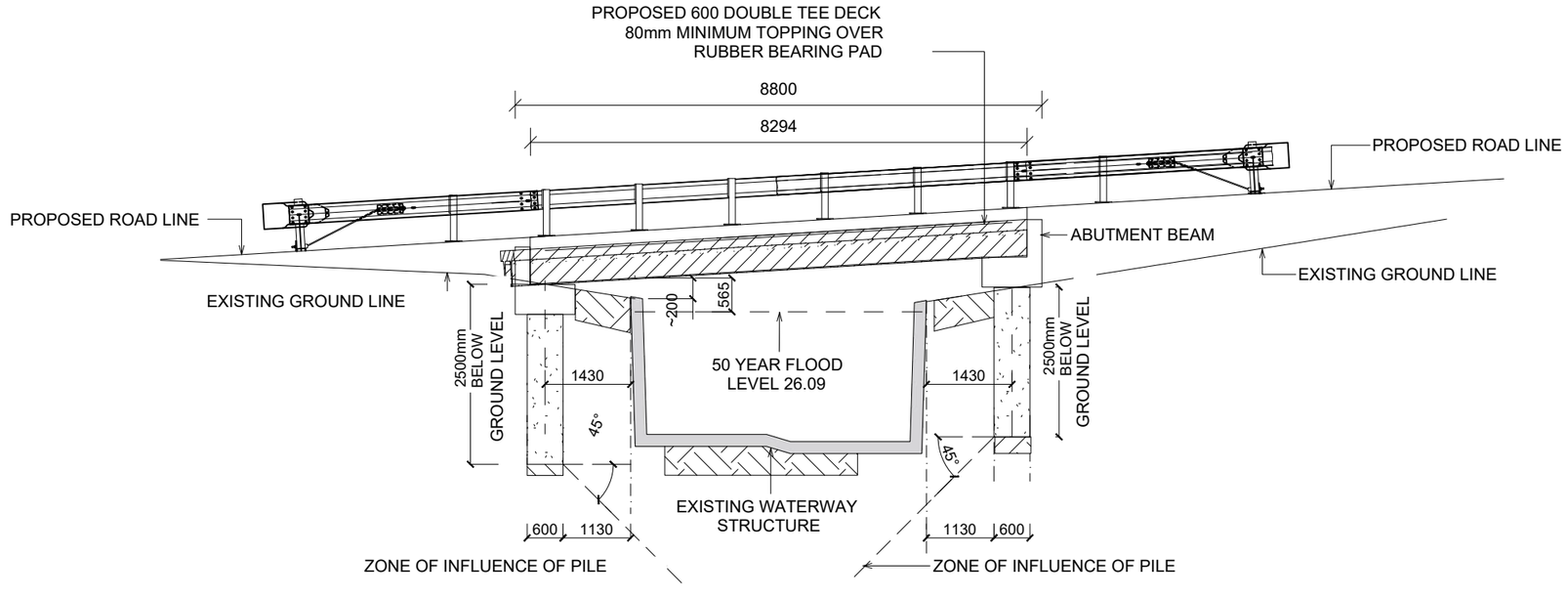
LOCALITY, MAPS AND PHOTOS

SK01



SITE PLAN

Scale 1:200



BRIDGE SECTION

Scale 1:100

CASHMERE DEVELOPMENT BRIDGE

Bowenvale Avenue, Cashmere, Christchurch 8022

ISSUE:

REVISION:

DRAWN BY: **JO**

SCALE: **@A3**

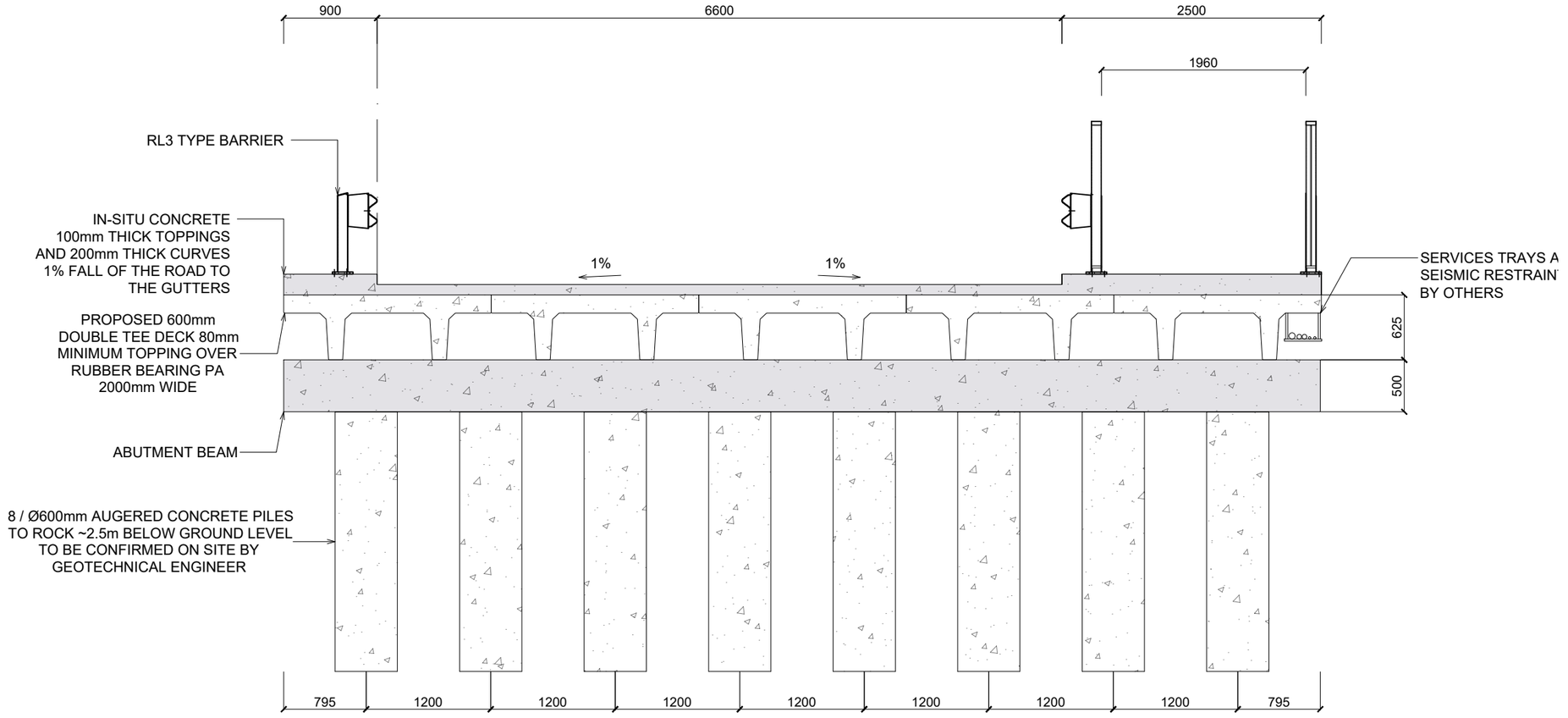
PAGE:

SITE PLAN AND SECTION ALONG

SK02

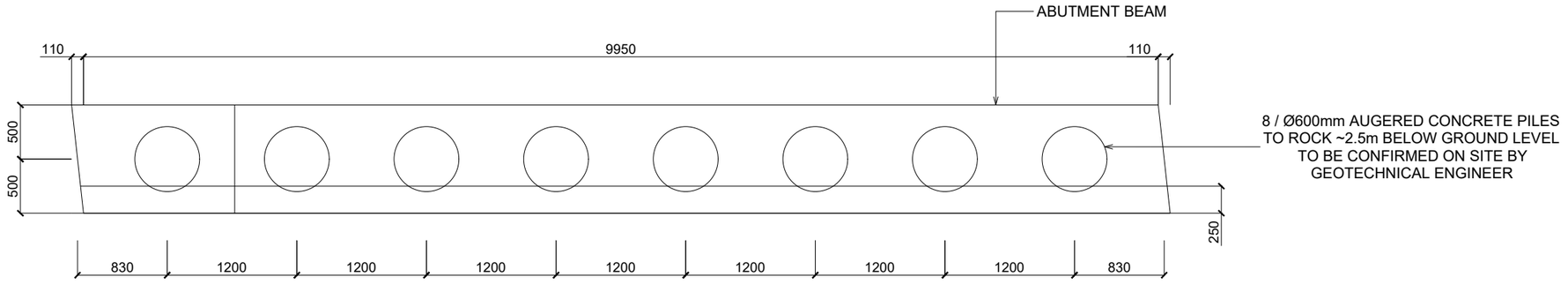
March 2023

ALL MEASUREMENT IN MILLIMETERS - DO NOT SCALE FROM THESE DRAWINGS - CONTRACTOR TO VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING ANY WORK - CLARIFICATION NOTICE SHOULD BE REQUESTED FROM THE DESIGNER IF A CONTRADICTION WITHIN THE DRAWINGS BECOMES EVIDENT - IF IN DOUBT ASK



BRIDGE SECTION

Scale 1:50



ABUTMENT BEAM PLAN AND PILE LAYOUT

Scale 1:50

VIDEN

CASHMERE DEVELOPMENT BRIDGE

Bowenvale Avenue, Cashmere, Christchurch 8022

ISSUE:

REVISION:

DRAWN BY: **JO**

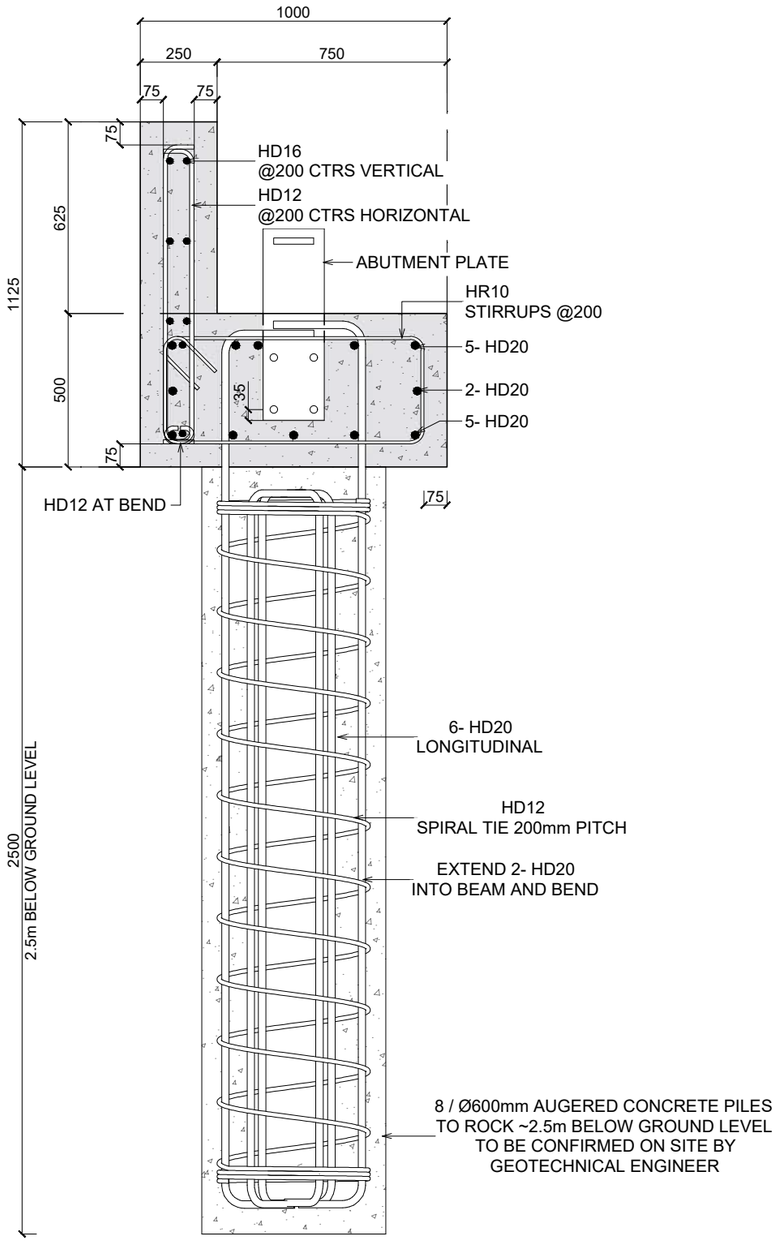
SCALE: **@A3**

PAGE:

CROSS SECTION AND ABUTMENT BEAM PLAN

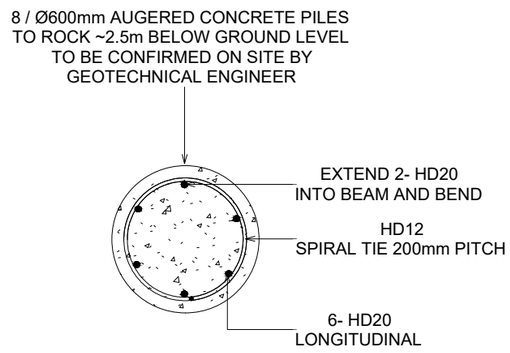
SK03

March 2023



PILE AND ABUTMENT BEAM DETAIL

Scale 1:20



PILE PLAN

Scale 1:25

NOTES

1. GRUB OUT BELOW FOUNDATION BETWEEN JACKING PADS AND FILL WITH NON SHRINK FLOWABLE GROUT.

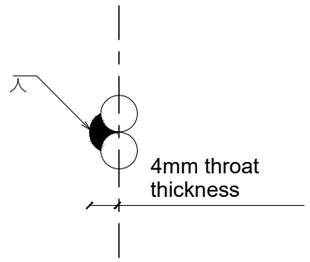
2. INSPECTION OF GROUND AT BASE OF EXCAVATION REQUIRED BY ENGINEER. EXCAVATIONS TO BE TAKEN THROUGH ANY TOPSOIL OR FILL AND BE FOUNDED IN 200kPa MINIMUM.

3. EXCAVATE, REINFORCE AND CONCRETE UNDERPINNING PADS UNDER THE EXISTING PERIMETER FOUNDATION WALL AT LOCATIONS AND TO SIZES SHOWN ON THE DRAWINGS.

4. FOLLOWING JACKING, PROVIDE H5 90x90mm TIMBER STRUTS OR SIMILAR BETWEEN THE UNDERPINNING PADS AND THE PERIMETER FOUNDATION AND REMOVE JACKS.

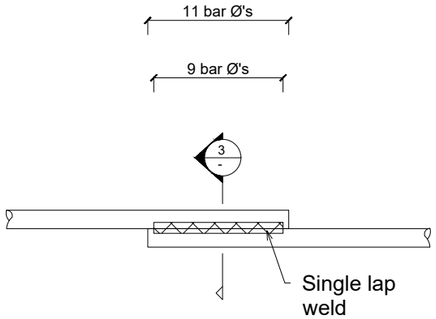
5. FILL THE SPACE BETWEEN THE UNDERSIDE OF THE FOUNDATION AND THE GROUND AT THE JACK PITS BETWEEN THE JACKS WITH FIRTH FLOWABLE FILL. (MIN 10MPa)

6. REINSTATE THE ADJACENT GROUND



WELD PLAN

Scale 1:5



WELD ELEVATION

Scale 1:10

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CASHMERE DEVELOPMENT BRIDGE
Bowenvale Avenue, Cashmere, Christchurch 8022

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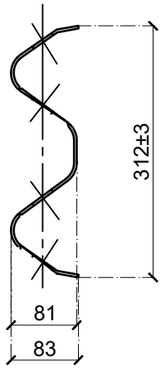
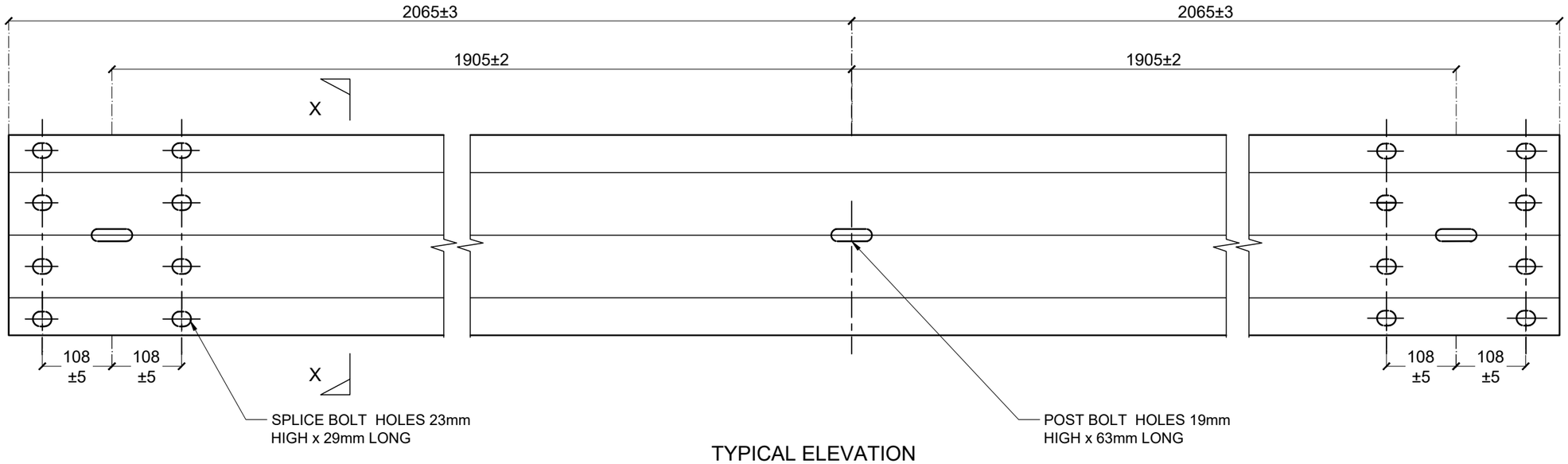
PILE AND ABUTMENT BEAM DETAIL

SK04

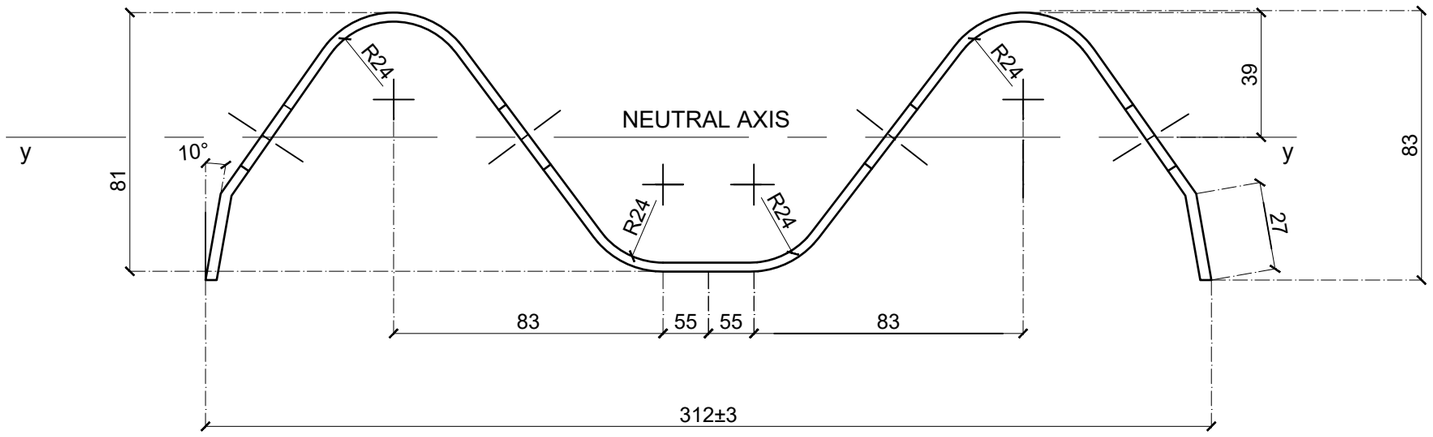
March 2023



SECTION X-X



TYPICAL ELEVATION



SECTION X-X DETAILS

NOTES:

1. HOT DIP GALVANISED FINISH - TYPE II
2. GALV. WEIGHT 44.5Kg
3. MATERIAL SPECIFICATION AS PER AASHTO M180 CLASS A, GRADE 345 MPa

HIGHWAY FLEXRAIL STANDARD 12 GAUGE

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BARRIER DETAIL

SK05

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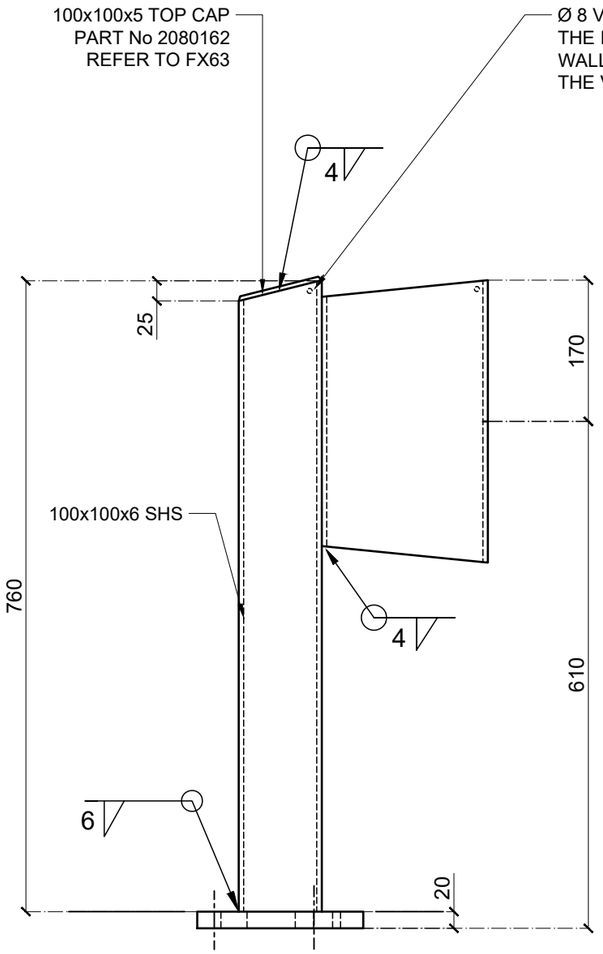
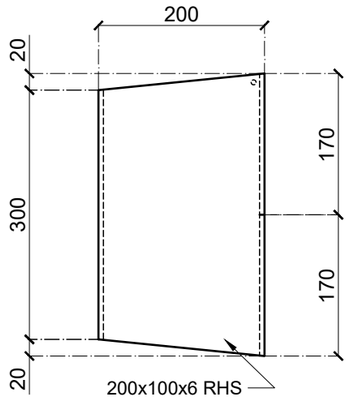
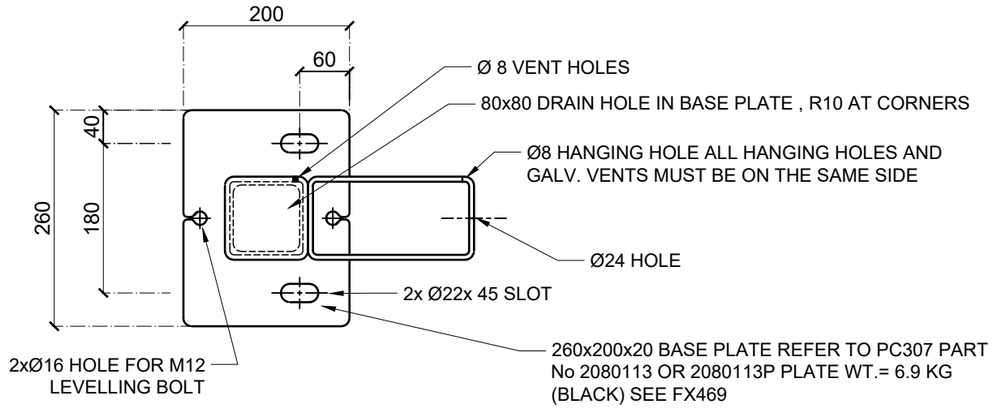


ELEVATION



ELEVATION - BLOCKOUT
PART No 2080056
REFER TO FX98



PLAN

NOTES:

1. HOT DIP GALVANISED FINISH - TYPE II
2. GALV. WEIGHT 27.7Kg APPROX

INTERMEDIATE NU-GUARD STEEL POST SIMILAR TO FX94 POST MOUNTING

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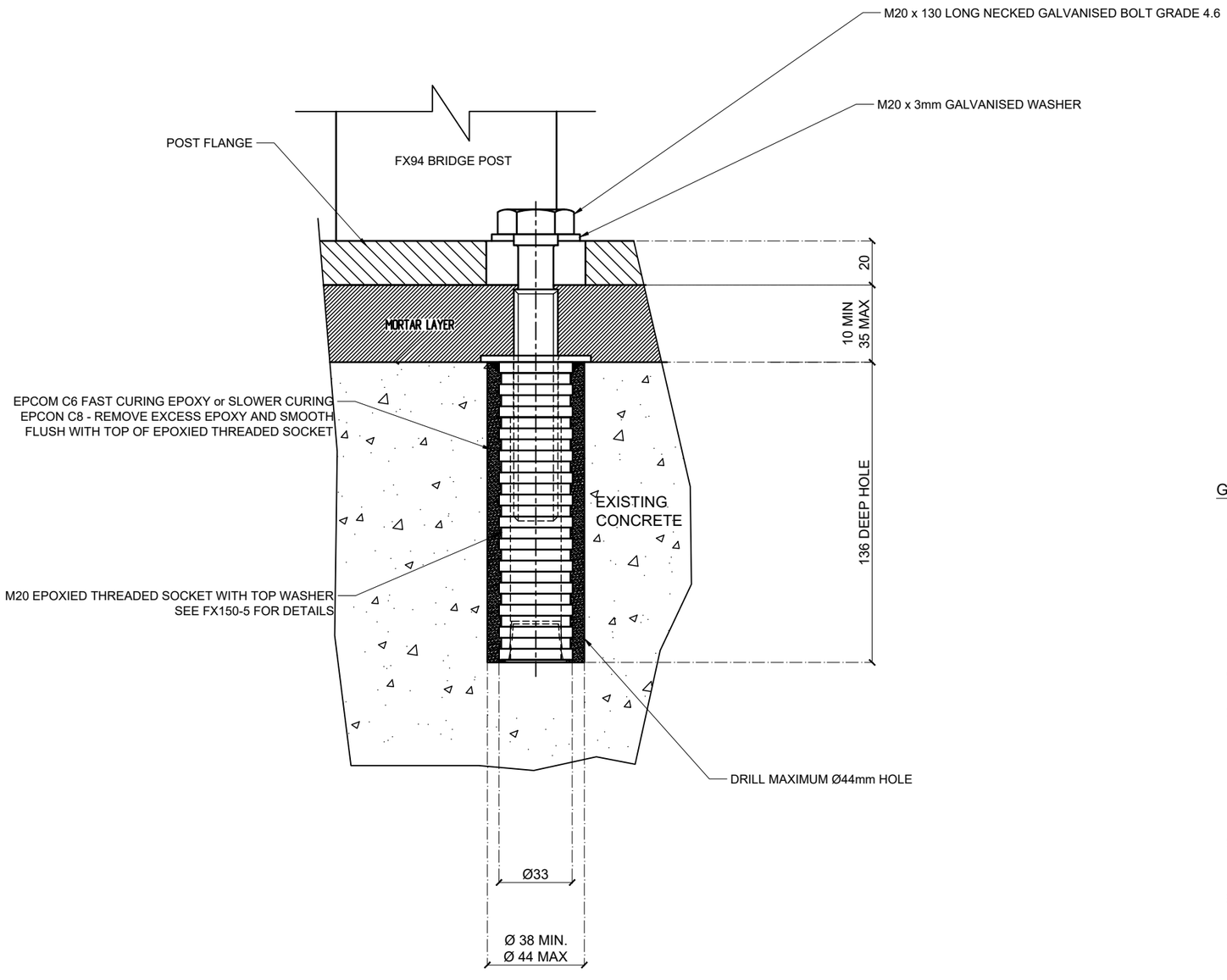
SK06

March 2023

ALL MEASUREMENT IN MILLIMETERS - DO NOT SCALE FROM THESE DRAWINGS - CONTRACTOR TO VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING ANY WORK - CLARIFICATION NOTICE SHOULD BE REQUESTED FROM THE DESIGNER IF A CONTRADICTION WITHIN THE DRAWINGS BECOMES EVIDENT - IF IN DOUBT ASK



M20 EPOXIED THREADED SOCKET

GENERAL INSTALLATION NOTES:

1. SPECIFIED ANCHORING EPOXY - EPCON C6 FAST CURING EPOXY OR SLOWER CURING EPCON C8. C6 CURING TIME IS 1 HOUR AND C8 CURING TIME IS 16 HOURS.
2. MARK OUT HOLE LOCATION.
3. DRILL THE RECOMMENDED DIAMETER AND DEPTH OF HOLE , %c44mm HOLE AS PER DRAWING.
4. ENSURE THAT THE INTERNAL CONCRETE SURFACE OF THE HOLE IS ROUGH SO THAT THE EPOXY CAN BOND AND GRIP TO.
5. CLEAN HOLE WITH A CLEANING BRUSH AND REMOVE DEBRIS USING A HOLE BLOWER.
6. BEFORE INSERTING THE EPOXIED THREADED SOCKET ENSURE THAT THE BOTTOM PLASTIC PLUG IS SECURELY INSERTED AND THAT THE TOP THREAD IS PLUGGED TO PREVENT EXCESS EPOXY FROM RUNNING INTO THREADED HOLE.
7. TO PREVENT INJECTING TOO MUCH EPOXY, CHECK THE GAP BETWEEN THE EPOXIED THREADED SOCKET AND THE HOLE IN THE CONCRETE TO DETERMINE THE AMOUNT OF EPOXY REQUIRED.
8. INSERT THE MIXING NOZZLE TO THE BOTTOM OF THE HOLE. FILL THE HOLE SLOWLY WITH THE DETERMINED AMOUNT OF EPOXY ENSURING NO AIR POCKETS FORM.
9. INSERT THE EPOXY THREADED SOCKET FIRMLY INTO THE HOLE FORCING THE EPOXY TO ENVELOPE THE SOCKET.
10. PREVENT EXCESS EPOXY FROM FLOWING INTO THE THREADED HOLE.
11. ONCE EPOXIED THREADED SOCKET IS SATISFACTORILY INSTALLED REMOVE EXCESS EPOXY AROUND THE WASHER AND ALLOW TO SET.
12. IT IS RECOMMENDED BY THE SUPPLIER TO WARM THE EPOXY BETWEEN 15 ° TO 30 ° BEFORE USE TO MAKE IT MORE WORKABLE.

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BARRIER DETAIL

SK07

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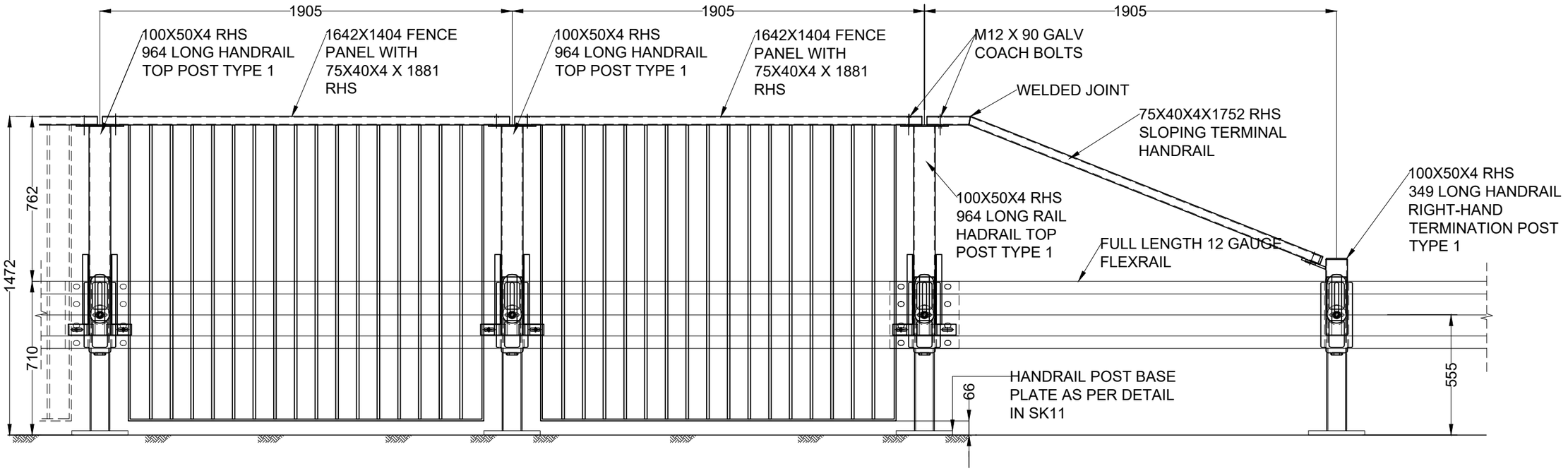
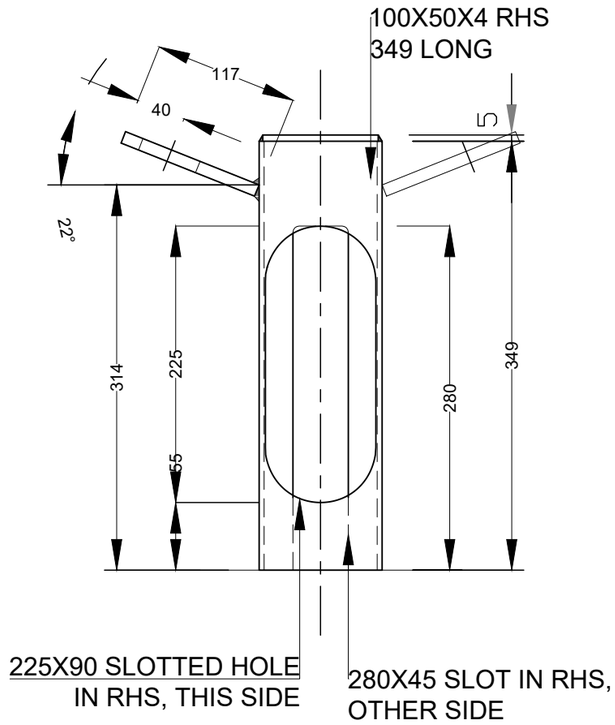


TYPICAL SIDE ELEVATION OF NU-GUARD PVB
SCALE 1:20



DETAIL OF RIGHT-HAND TERMINATION POST
SCALE 1:10

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BARRIER DETAIL

SK08

March 2023

ALL MEASUREMENT IN MILLIMETERS - DO NOT SCALE FROM THESE DRAWINGS - CONTRACTOR TO VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING ANY WORK - CLARIFICATION NOTICE SHOULD BE REQUESTED FROM THE DESIGNER IF A CONTRADICTION WITHIN THE DRAWINGS BECOMES EVIDENT - IF IN DOUBT ASK

GENERAL

1. UNLESS OTHERWISE NOTED, ALL LEVELS ARE IN METERS RELATIVE TO THE DATUM, ALL DIMENSIONS ARE IN MILLIMETERS.

2. DIMENSIONS SHALL NOT BE OBTAINED BY SCALING FROM DRAWINGS.

3. THE CONTRACTOR SHALL CONFIRM ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF WORK. ANY DISCREPANCIES SHALL BE REFERRED TO THE ENGINEER FOR RESOLUTION BEFORE PROCEEDING WITH THE WORK.

4. THE CONTRACTOR IS RESPONSIBLE FOR THE DESIGN. INSTALLATION AND MAINTENANCE OF ALL NECESSARY TEMPORARY WORKS TO ENSURE STRENGTH AND STABILITY OF THE STRUCTURE THROUGHOUT THE COURSE OF THE WORKS.

5. THE CONTRACTOR IS RESPONSIBLE FOR THE LOCATION AND IDENTIFICATION OF ALL SERVICES INSIDE, ENTERING AND IMMEDIATELY ADJACENT TO THE STRUCTURE.

6. THE CONTRACTOR IS TO DISCONNECT ALL SERVICES NECESSARY TO PROGRESS THE WORKS AT THE SITE BOUNDARY IN ACCORDANCE WITH BEST PRACTICE METHODS.

7. THE CONTRACTOR IS TO ENSURE NO SITE UTILITY OR OTHER SERVICE IS DISRUPTED FOR ANY REMAINING TENANTS OR OTHER SERVICE USERS.

8. ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE CURRENT CODES OF PRACTICE AND REFERENCED STANDARDS STIPULATED WITHIN.

APPLICABLE STANDARDS:

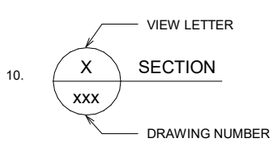
TIAKI GENERAL SPECIFICATIONS FOR CONCRETE. STRUCTURAL STEELWORK. STRUCTURAL TIMBER AND MINOR EARTHWORKS

SP/M/022	NZTA BRIDGE MANUAL
AS/NZS 1170	STRUCTURAL DESIGN ACTIONS
NZS 3404.1:2009	STEEL STRUCTURES STANDARD - MATERIALS, FABRICATIONS AND CONSTRUCTION
AS/NZS 3679	STRUCTURAL STEEL HOT-ROLLED BARS AND SECTION
AS 1163	STRUCTURAL STEEL AND HOLLOW SECTIONS
AS/NZS 4600	COLD-FORMED STEEL STRUCTURES
AS/NZS 1554	STRUCTURAL STEEL WELDING PART 1: WELDING OF STEEL STRUCTURES
NZS 3101	CONCRETE STRUCTURES STANDARD
NZS 3109	CONCRETE CONSTRUCTION
NZS3114	SPEECIFICATION FOR CONCRETE SURFACE FINISHS
NZS 3602	CODE OF PRACTICE FOR SPECIFYING TIMBER AND WOOD-BASED PRODUCTS FOR USE IN BUILDING
NZS 3603	TIMBER STRUCTURES STANDARD
AS/NZS 4671	STEEL REINFORCING MATERIALS
AS/NZS 3678	STRUCTURAL STEEL - HOT ROLLED PLATES FLOOR PLATES AND SLAB
AS/NZS 2312	GUIDE TO THE PROTECTION OF STRUCTURAL STEEL AGAINST CORROSOIN BY THE USE OF PROTECTIVE COATINGS
AS 2159	PART 1: PAINT COATINGS PART 2: HOT DIP GALVANISING PILING

9. ABBREVIATIONS ON THE DRAWINGS ARE AS FOLLOWS:

CRS	CENTRES
Ø	DIAMETER
DWG	DRAWING
EW	EACH WAY
GALV	GALVANISED
HD GALV	HOT DIP GALVANISED
MAX	MAXIMUM
NOM	NOMINAL
MIN	MINIMUM
NTS	NOT TO SCALE
REF	REFER
REINF	REINFORCEMENT
SOP	SET OUT POINT
THL	THICK
TOS	TOP OF STEEL
U/S	UNDERSIDE
UNO	UNLESS NOTED OTHERWISE
SFL	STRUCTURAL FLOOR LEVEL
SIM	SIMILAR

10.



NOMINAL LOAD ACTIONS

THE STRUCTURE HAS BEEN DESIGNED FOR THE FOLLOWING NOMINAL LOADS:

WIND ACTION	WIND REGION A7 TERRAIN CATEGORY 2 IN ACCORDANCE WITH AS/NZS 1170.2
EARTHQUAKE ACTION	HAZARD FACTOR 0.1 NEAR FAULT FACTOR 1.0 SITE SUBSOIL CATEGORY D IN ACCORDANCE WITH NZS 1170.5
IMPORTANCE LEVEL	LEVEL 1 IN ACCORDANCE WITH AS/NZS 1170.0

DESIGN LOADING

THIS BRIDGE HAS BEEN DESIGNED IN ACCORDANCE WITH THE REQUIREMENTS OF THE NZTA BRIDGE MANUAL APPENDIX D FOR 0.85 HN LOADING DESIGN LIFE: 100 YEARS

COATING SPECIFICATIONS:

REFER TO SPECIFIC DRAWING SHEETS FOR PROJECT REQUIREMENT

NEW STEEL WORK:

1. EXAMPLE TEXT EXAMPLE TEXT EXAMPLE TEX EXAMPLE TEXT EXAMPLE TEXT EXAMPLE TEX EXAMPLE TEXT EXAMPLE TEXT EXAMPLE TEX

COATING REPAIR/TOUCH UP:

SPOT PRIME BARE STEEL WITH 1 COAT CARBOGUARD 635 SPOT COAT WITH 2 COATS CARBOGUARD 635 SPOT COAT WITH 2 COATS CARBOGUARD 636 MIOX ALL SURFACES MUSH BE CLEAN AND DRY BEFORE PAINTING

GALVANISING:

ABRASIVE BLAST CLEAN TO AS 1627.4 CLASS 24 (SSPC SP10) TO ACHIEVE A UNIFORM JAGGED BLAST PROFILE OF AT LEAST 50 MICRONS

THERMAL ZINC SPRAY TO ASINZS 2312 TO PROVIDE A MIN. THICKNESS OF 100 MICRONS

ALL COATINGS ARE TO BE INSPECTED BY A SUITABLY QUALIFIED INSPECTOR AND CHECKED IN ACCORDANCE WITH ASINZS 2312.1 : 2014 SECTION 9: INSPECTION AND TESTING. COPIES OF THE INSPECTION REPORTS ARE TO BE SUBMITTED TO THE DESIGN ENGINEER FOR APPROVAL BEFORE DELIVERY TO SITE.

CONCRETE

1. CONSTRUCTION SHALL BE IN ACCORDANCE WITH NZS 3109 UNO.

2. MINIMUM CONCRETE STRENGTH AT 28 DAYS SHALL BE AS FOLLOWS.

ELEMENT	CONCRETE STRENGTH
DECK SLABS	50 MPa
ABUTMENT	40 Mpa

3. SCHEDULE OF SURFACE FINISHES TO NZS 3114

ELEMENT	FINISH
DECK SLABS	U5
FORMED SURFACES	F4

4. TOLERANCE TO BE AS PER NZS 3109 SECTION 5.3.

5. 15 x 15 CHAMFERS SHALL BE PROVIDED TO OUTER EDGES OF CONCRETE MEMBERS, UNO.

6. MINIMIM CONCRETE COVERS SHALL BE AS FOLLOWS:
PRECAST PANEL: 35mm
OTHER U.N.O: 50mm

7. EXPOSURE CLASSIFICATION FOR ALL ABOVE GROUND CONCRETE IS B1 PER NZS 3101 SECTION 3.4.2.

TIMBER

ALL TIMBER TO BE MINIMUM RADIATA PINE GRADE VSGB

ALL TIMBER TO RECEIVE A MININ1UM OF 114 PRESERVATIVE TREATMENT UNLESS NOTED OTHERWISE

ALL CUT SURFACES TO RECEIVE A LIBERAL COATING OF METALEX CLEAR PRESERVATIVE

BOLTED SPLICE CONNCTIONS:

1. UNLESS SPECIFICALLY APPROVED, ALL CRITICAL CONNECTIONS (e.g. TRANSFER BEAM. SPLICE JOINT OF BRIDGE GIRDER) AS IDENTIFIED ON THE DRAWING USING GRADE 8.8 AND SHALL BE TENSIONED BY USING ONE OF THE METHODS BELOW;

(i) PART TURN METHOD:
ON ASSEMBLY, ALL BOLTS IN THE CONNECTION SHALL. BE FIRST TIGHTENED TO A SNUG TIGHT CONDITION. ANY BOLTS THAT BECOME LOOSE DURING THE SNUG TIGHTENING OF ADJACENT BOLTS WILL REQUIRE RETIGHTENING. RETENSIONING OF BOLTS THAT HAVE BEEN FULLY TENSIONED SHALL NOT BE PERMITTED.

SNUG TIGHT IS THE TIGHTNESS ATTAINED BY A FEW IMPACTS OF AN IMPACT WRENCH OR BY THE EFFORT OF A PERSON USING A STANDARD PODGER SPANNER.

AFTER COMPLETING SNUG-TIGHTENING, LOCATION MARKS SHALL BE ESTABLISHED TO MARK THE RELATIVE POSITION OF THE BOLT AND THE NUT AND TO CONTROL THE FINAL NUT ROTATION.

OBSERVATION OF THE FINAL NUT ROTATION MAY BE ACHIEVED BY USING MARKED WRENCH SOCKETS. BUT LOCATION MARKS SHALL BE PERMANENT WHEN REQUIRED FOR INSPECTION.

BOLTS SHALL BE FINALLY TENSIONED BY ROTATING THE NUT BY THE AMOUNT GIVEN IN THE TABLE BELOW. DURING THE FINAL. TENSIONING, THE COMPONENT NOT TURNED BY THE WRENCH SHALL NOT ROTATE.

BOLT LENGHT (UNDERSIDE OF HEAD TO END OF BOLT)	BOLT FACES NORMAL TO BOLT AXIS
UP TO AND INCLUDING 4 DIAMETERS	1/3 TURN
OVER 4 DIAMETERS BUT NOT EXCEEDING 8 DIAMETERS	1/2 TURN

(ii) DIRECT-TENSION INDICATION DEVICE: ON ASSEMBLY, ALL BOLTS AND NUTS IN THE CONNECTION SHALL BE FIRST TIGHTENED TO A SNUG TIGHT CONDITION.

AFTER COMPLETING SNUG-TIGHTENING, THE BOLT SHALL BE TENSIONED TO PROVIDE THE MINIMUM BOLT TENSION SPECIFIED IN THE TABLE BELOW. THIS SHALL BE INDICATED BY THE TENSION INDICATION DEVICE.

NOMINAL DIAMETER OF BOLT	MINIMUM BOLT TENSION, kN
M16	95
M20	145
M22	180
M24	210
M30	335
M36	490

2. CONTACT AREAS BETWEEN PLATES ARE TO BE SANDBLASTED TO CLASS 23 (SSPC SF 10) AND MASKED TO PREVENT PAINTING OF THE SURFACE

3. PAINTING OVER AND AROUND THE CONNECTION TO BE IN (ACCORDANCE WITH THE PAINTING SPECIFICATION NOTES.

PILING AND RETAINING WALL POLES:

1. ANY PILING TO BE CARRIED OUT BY THE CONTRACTOR SHALL BE RECORDED AND SUBMITTED TO THE ENGINEER FOR APPROVAL PRIOR TO THE NEXT CONSTRUCTION STEP. REQUIRED PILE SETS OR VARIATIONS TO THE SPECIFICATIONS SHALL BE REFERRED TO THE DESIGNERIENGINEER FOR REVIEW.

2. PILES SHALL BE PLACED WITHIN 75mm OF IDENTIFIED PLAN POSITION AND WITHIN 4% OF VERTICAL,

3. THE HEAD OF TIMBER PILE SHALL BE CUT OFF SQUARE TO SOUND WOOD AND COATED WITH A SUITABLE PRESERVATIVE. A CAPPING RAIL IS TO BE CONSTRUCTED ON TOP OF 1 IMBER WALL PILES. IF THE CAPPING RAIL IS NARROWER THAN THE TOP OF THE PILE, THE EXPOSED PILE TOP IS TO BE CUT AWAY AT A 45' SLOPE AWAY FROM THE CAPPING RAIL AND TREATED WITH PRESERVATIVE.

4. PILES SHALL BE CUT OFF WITHIN 25mm OF DESIGN CUT-OFF LEVEL.

5. REFERENCE SHOULD BE MADE TO THE AUCKLAND STRUCTURAL GROUP PILING SPECIFICATIONS.

STEEL WORK NOTES:

1. ALL MATERIALS, FABRICATION AND CONSTRUCTION SHALL BE IN ACCORDANCE WITH NZS 3404 AND AS/NZS 1554, EXCEPT WHERE VARIED BY THE CONTRACTOR DOCUMENTS.

2. UNLESS OTHERWISE NOTED, ALL STEEL SHALL BE IN ACCORDANCE WITH:
- AS/NZS 3679.1 GRADE FOR BHP-300 PLUS ROLLED SECTIONS AND MERCHANT BAR, EXCEPT WHERE NOTED.
AS/NZS 3679.2 GRADE 300 FOR ALL WELDED SECTIONS (WB & WC)

- AS 1163 GRADE C350 FOR RECTANGULAR HOLLOW SECTIONS

- AS 1163 GRADE C350 FOR CIRCULAR HOLLOW SECTIONS (EXTRA LIGHT AND LIGHT WALL)

- AS 1163 GRADE C250 FOR CIRCULAR HOLLOW SECTIONS (MEDIUM AND HEAVY WALL)

3. THE CONTRACTOR SHALL PREPARE WORKSHOP DRAWINGS AND SUBMIT COPIES OF EACH DRAWING FOR REVIEW. ALLOW 7 DAYS FOR SHOP DRAWING REVIEW. FABRICATION SHALL NOT COMMENCE UNTIL REVIEW HAS BEEN COMPLETED. REVIEW DOES NOT INCLUDE DIMENSIONS.

4. HIGH STRENGTH STRUCTURAL BOLTS AND WASHERS SHALL COMPLY WITH AS1252 & NZS 3404. COMMERCIAL GRADE BOLTS, NUTS AND WASHERS SHALL COMPLY WITH AS/NZS 1111, AS/NZS 1112 & AS1237 RESPECTIVELY.

5. WELDING:
WELDING TO BE CARRIED OUT IN ACCORDANCE WITH THE REQUIREMENTS OF NZS 3404 AND NZS/AS 1554.1 UNLESS SPECIFICALLY SHOWN ON THE DRAWINGS ALL WELDS SHALL BE CATEGORY SP (STRUCTURAL PURPOSE) E41XX/W4OX 6mm FWAR IN ACCORDANCE WITH NZS/AS 1554.1, UNO. STEEL FABRICATOR SHALL PROVIDE THE ENGINEER WITH ONE COPY OF THEIR WELD PROCEDURE PRIOR TO COMMENCING WELDING. ALL WELDING SHALL BE A MINIMUM 6mm CFW UNLESS NOTED OTHERWISE

6. ALL ELECTRICALLY DISSIMILAR CONSTRUCTION MATERIALS EG. STAINLESS STEEL AND CARBON STEEL SHALL BE ISOLATED BY MEANS OF NYLON WASHERS AND/OR GROMMETS.

TESTING OF WELDS:

1. ALL WELDS TO BE 100% VISUALLY INSPECTED PLUS 20% MAGNETIC PARTICLE INSPECTION (MPI) NON DESTRUCTIVE TESTING (NDT)

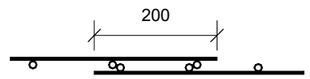
REINFORCEMENT NOTES:

1. SPLICES IN THE REINFORCEMENT SHALL BE AT LEAST 50 B AR DIAMETER UNO.

2. REINFORCEMENT SPLICES AND DEVELOPMENT LENGTH OF BARS AND WIRE IN TENSION AND / OR COMPRESSION SHALL NOT BE MADE OTHER THAN THOSE SHOWN ON THE STRUCTURAL DRAWINGS, OR IN ACCORDANCE WITH NZS 3101 SECTION 8.6.

3. REINFORCEMENT SYMBOLS: HR - DENOTES GRADE 500E PLAIN BAR HD - DENOTES GRADE 500E DEFORMED BAR

4. ALL WELDED MESH SHALL COMPLY WITH AS/N1S 4671 AND SHALL E3E SUPPLIED AS FLAT SHEETS:TYPICAL WELDED MESH LAP:



MINIMUM LAPPING TO SIDES AND ENDS

5. PLACE SUFFICIENT BAR CHAIRS UNDER BOTTOM REINFORCEMENT RODS AND TOP CROSS RODS IN SLABS TO ALLOW THEM TO BE SUPPORTED IN THEIR CORRECT POSITIONS DURING CONCRETING (NOT GREATER THAN 900MM CENTRES BOTH WAYS FOR BARS, 750MM FOR FABRIC)

6. BAR CHAIRS TO BE PIASTIC.

7. WELDING OF REINFORCEMENT IS NOT PERMIT TED UNLESS SHOWN ON THE DRAWINGS OR APPROVED BY ENGINEER.

8. HOOKS AND BENDS ARE TO BE IN ACCORDANCE WITI I NZS 3109 SECTION 3.3 AND NZS 3101 SECTION 8.4

VIDEN

CASHMERE DEVELOPMENT BRIDGE

Bowenvale Avenue,
Cashmere, 8022

ISSUE	DESCRIPTION	DATE
1	DRAFT	01/03/23

PROJECT : 400-001

DESIGNED : JO

DRAWN : AO

CHECKED: TD

SCALE: 1 : 10 @ A3

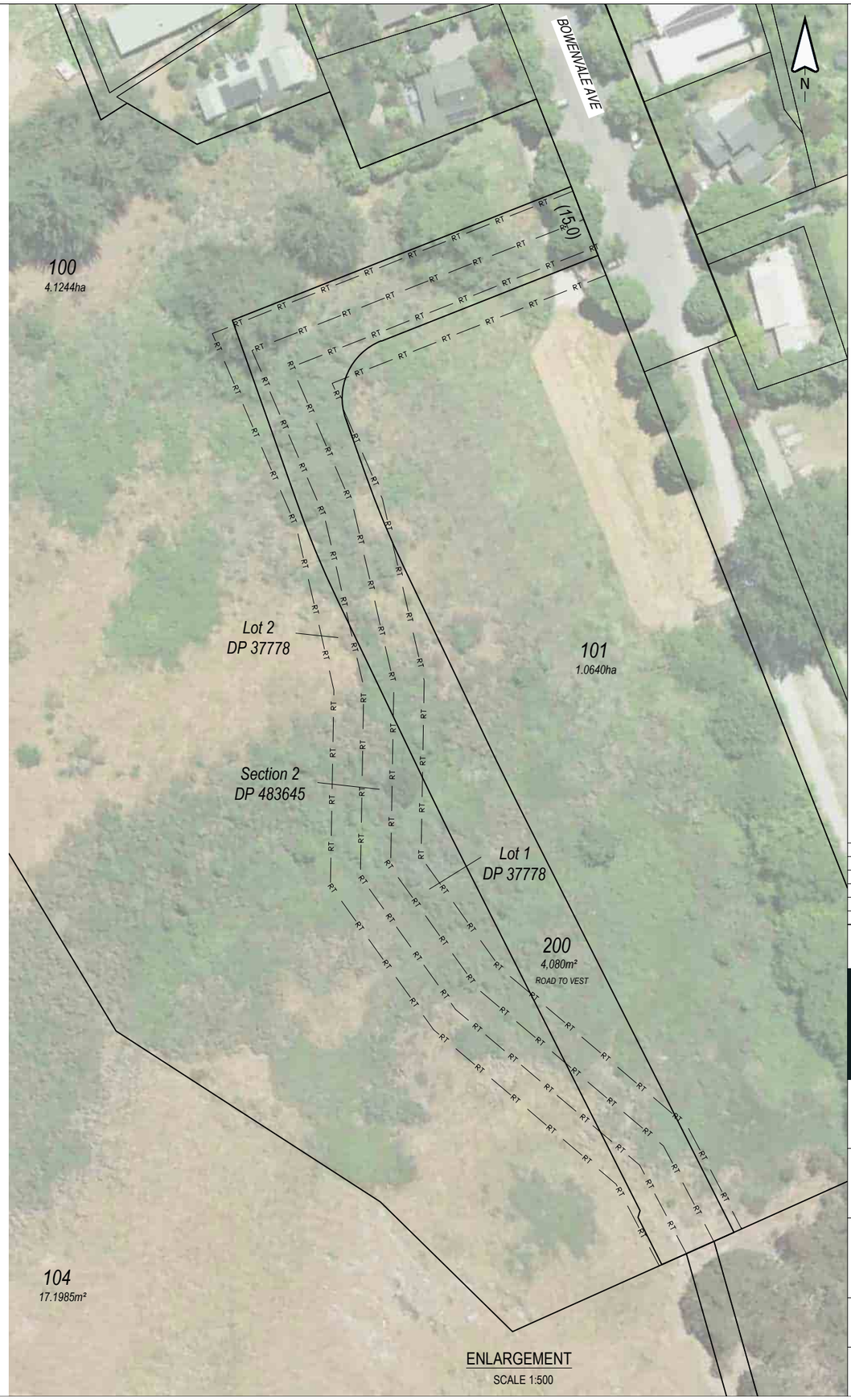
PAGE:

STANDARD NOTES

SK09

OVERALL LAYOUT

SCALE 1:2000



ENLARGEMENT

SCALE 1:500

NOTES :

1. *SCHEME PLAN ONLY, AREAS & DIMENSIONS ARE APPROXIMATE & SUBJECT TO FINAL SURVEY.*
2. *SCHEME PLAN FOR DISCUSSION PURPOSES ONLY.*
3. *EXISTING REGISTERED TITLES TO BE REVIEWED TO CONFIRM INTERESTS OVER THE EXISTING PARCELS.*

REV	DATE	REVISION DETAILS	ISSUED
A	23/02/23	FOR INFORMATION	TL

BASECO Land Development Consultants

CLIENT

BOWENVALE GCO LTD

PROJECT

130 BOWENVALE AVE

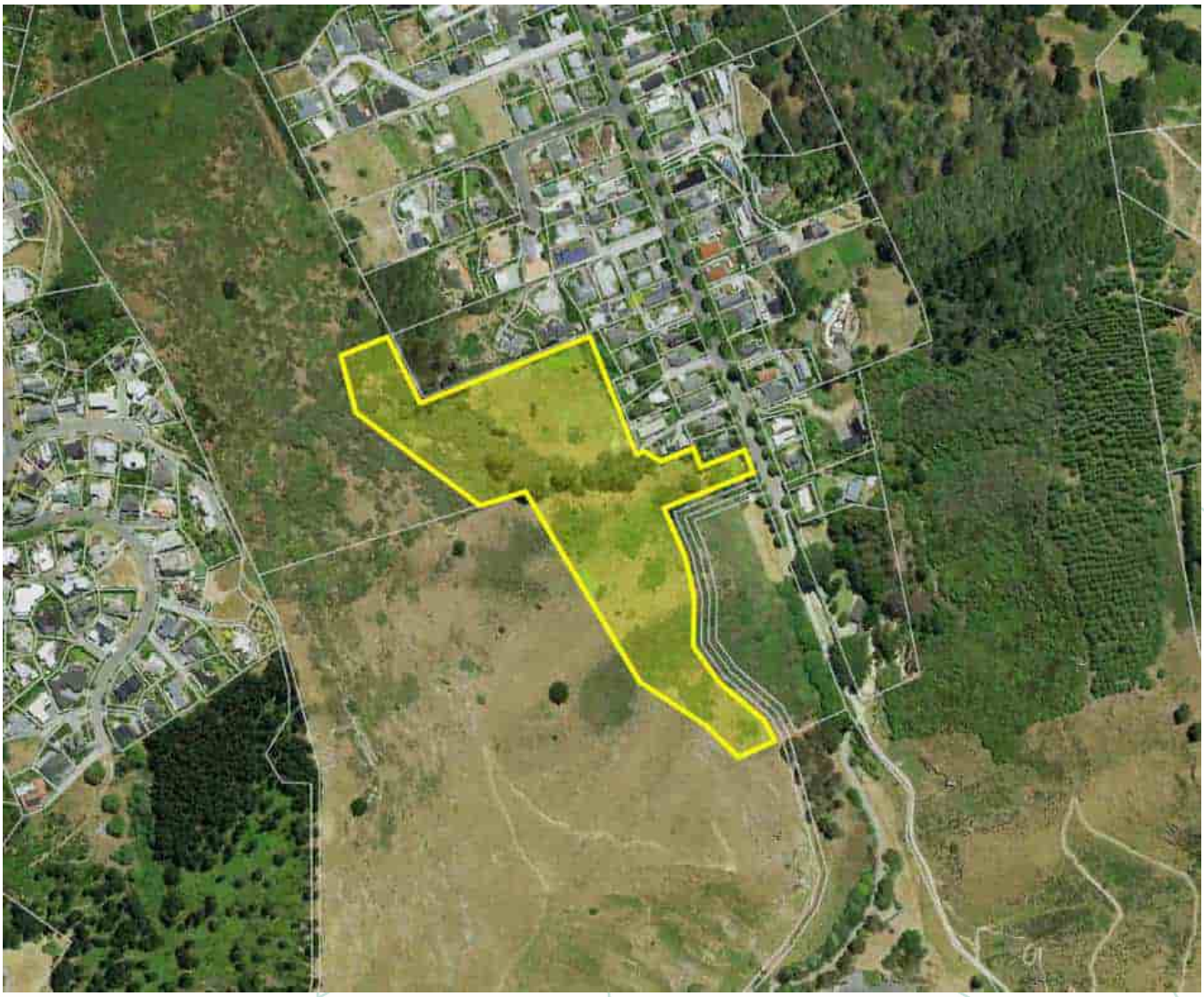
DRAWING TITLE

PROPOSED SUBDIVISION OF PARTS
LOT 2 DP 33462, LOT 1 & 2 DP 37778
& SECTION 2 SO 483645

STATUS	*SCALE*	*SIZE*
FOR INFORMATION	AS SHOWN	A1

PROJECT	*DRAWING NO*	*REVISION*
1037	SC-03	A

BASECO
Land Development Consultants



SUBDIVISION DESIGN REPORT

130 BOWENVALE AVENUE, CASHMERE

CLIENT

BOWENVALE GCO LTD

DATE

DRAFT

7/02/23

Document Control

File: 1037 BOWENVALE SUBDIVISION ENGINERING REPORT

Rev No.	Date	Revision Details	Author	Verifier	Approver
A	7/03/23	FOR INFORMATION	TL	CH	CH

Contents

1. Introduction

1.1 Scope

Base Consultants has been commissioned by Bowenvale GCO Limited to design the civil infrastructure for their private residential development at 130 Bowenvale Avenue, Cashmere.

This report covers the following engineering components for resource consent:

- Earthworks
- Erosion and Sediment Control
- Roading/Transportation
- Stormwater drainage
- Wastewater reticulation
- Water reticulation
- Power, Telecommunications and Streetlights.

1.2 Site Background

The site is located at the southern end of Bowenvale Avenue on the western side. The bulk of the site is currently in 1 underlying title owned by the applicant, however there are three other titles associated with the development which have legal access strips out to Bowenvale Avenue, as below.

Name of Lot/Appellation	Area (ha)	Record of Title (RT)	Owner
Part Lot 2 DP 33462	5.0894ha	CB34A/555	Bowenvale GCO Ltd
Lot 1 DP 37778	5.085ha	CB17B/115	A Curtis & B Taylor
Lot 2 DP 37778	17.3750ha	CB37B/116	
Section 2 SO 483645	24.818ha	708176	

There is an existing stormwater easement in favour of Christchurch City Council along the eastern boundary of the site over part of Sibleys Drain, refer to Figure 2.

The development is a proposed 35 lot residential subdivision. Access to the development will be off Bowenvale Avenue via a new public road.

The proposed subdivision is entirely within the Residential Hills Zone and has natural hazard overlays for slope stability and rockfall management 1 and 2 as shown in Figure 1 (Christchurch District Plan Property Search).

Figure 1 – Christchurch District Plan Property Search

There are two CCC identified network waterways (blue) traversing through the site and two hill waterways (orange) as shown in Figure 2. The location of the waterways shown below are indicative and will be defined onsite by topographical survey. It is proposed to retain the existing waterways on the western site of the site access and then pipe them under the new road and eastern part of the site to discharge into Sibley's Drain.

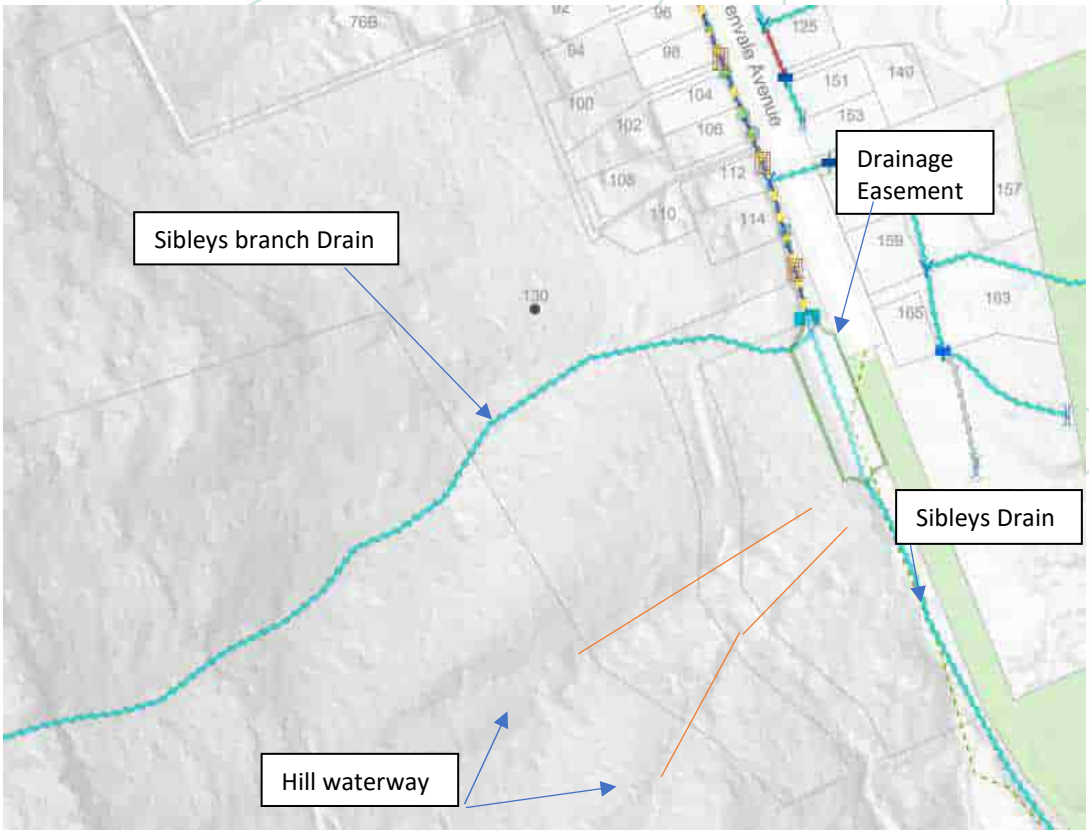


Figure 2 – CCC GIS Stormwater Assets

We are not aware of any resource consents in with CCC for the property. Consent applications in support of the development have been lodged with ECAN.

2. Earthworks

2.1 Earthworks Design

Currently the site is in pasture with areas of trees and bush vegetation. The bush vegetation is dense along Sibley's branch drain and the southern part of Sibley's drain. There are exposed rock areas on the neighbouring property to the west, which results in the rock management area requirement.

There are no existing dwellings and access to the site is restricted by the requirement of having to traverse Sibley's drain.

The topography of the existing site is sloping from a ridgeline on the neighbouring properties to the west towards Bowenvale Avenue Road to the east at a steep gradient of approximately 1v:3h (33.3%).

The steep gradient of the site is the main constraint that has required careful engineering consideration and has been the main driver for determining the development layout.

The design philosophy for the earthworks design has been determined by the following criteria:

- Road gradients not to exceed 1v in 6h and not to be less than 1:500.
- Private accessway gradients not to exceed 1v in 5h, where possible, or 1v in 4h, if required for short sections.
- Location of Bowenvale Ave intersection.
- Minimise fill depths due to steep gradients.
- Retaining cut batters to minimise earthwork extents.
- Retaining existing overland flow paths to the west of the new access road.
- Providing secondary flow paths within the development.
- Staging to minimise exposed area open.

The earthworks design has been undertaken in collaboration with Engeo Limited who have completed the testing and investigation works on the site to support the proposed development. A copy of the Enggeo geotechnical reports is included in the consent application.

2.2 Earthworks Volumes

The earthworks extent onsite has been limited as much as possible to minimise the amount of disturbance and retain the natural contour where possible.

The road and access alignments have been designed generally parallel to the contour and cut into the slope to achieve required gradients. This results in the majority of the earthworks being in cut and therefore an excess of material will be generated from the development that needs to be removed offsite.

The preliminary earthworks area and volumes for the development are as follows. The volumes are based on existing surface to finished surface.

- Cut volume (solid measure) = 9,500m3
- Fill volume (solid measure) = 2,650m3
- Excess volume to cart offsite = 6,850m3
- Earthworks area = 8,770m²

It is proposed to undertake the development in stages to reduce the amount of area open at anyone time. The proposed earthwork staging is shown on plans EN-105 and 106. A summary of the staged volumes and areas is outlined in Table 1.

Stage	Cut (m3)	Fill (m3)	Area (m²)
1	810	450	1,500
2	215	130	780
3	1,830	30	1,620
4	945	150	830
5	5,700	1,890	4,040

Table 1 – Earthwork Stages

Stage 1 requires a bridge to be constructed over Sibley's drain to provide access to the site. Refer to Section 3.8 for details of the bridge.

To minimise the extent of the cut batters, batters will be laid back to a maximum angle of 60° and faced with gabion baskets which will act as a retaining structure. Any cuts batters over 4m will require additional reinforcement of the slope as referenced in Engeo Ltd Conceptual Retaining Wall Design Report.

For the lots that require access where the gabion baskets are being utilised, the baskets will be stopped through the entranceways and wrapped around to tie into the driveways.

3. Roading/Transportation

3.1 Layout

The proposed roading layout can be seen on the roading plan attached in **Appendix A**.

There is one proposed main connection out onto Bowenvale Avenue. The intersection location has been set taking into consideration.

- Gradients and sightlines.
- Vegetation within road reserve – minimise removal.
- CCC offset requirements from existing flow weir and monitoring station in Sibley's drain.
- Bridge access across Sibley's drain.

The proposed public road will be extended into the development to the southern boundary of the site, where it will be terminated with a cul-de-sac turning head. This will provide legal access to the neighbouring properties

to the south, which currently have legal access strips out to Bowenvale Avenue. The location of the proposed public road varies from the existing access strips as the design takes into consideration the topography of the site and gradient requirements. The applicant is in consultation with the neighbouring landowner regarding approval for the change in legal access.

Three privately owned accessways are proposed off the public road to service the remaining lots.

3.2 Roading Typology

The following design parameters for the development have been selected for the internal road network.

Road Type	Legal Width	Formed Width	Footpath
Local Road	15m	6.76m	One side
ROW 1 (7 lots)	6.5m	4.65m with passing bays (5.5m)	No
ROW 2 (12 lots)	6-8m	4.5-5.5m with passing bays	No
ROW 3 (4 lots)	6m	4.0m with passing bays	No

Note: Minimum Road and ROW widths have been adopted due to the site topography.

Table 2 – Road Design Criteria

3.3 Stormwater Drainage

Stormwater runoff within the road and ROW corridors will be via kerb and channel into appropriately sized piped network which will be expelled through a downstream proprietary device. All sumps will have trapped and/or inverted outlets.

All lots will either discharge to the kerb or directly into the reticulated network as levels allow.

The road corridor will be used as secondary flow paths to direct stormwater runoff when the piped system is at full capacity (i.e. larger than a 10 year storm).

3.4 Pavement Profiles

In reviewing the existing Geotech report, the underlying material should be suitable to achieve required compaction levels to ensure that the roading can be built to necessary standards.

The structural pavement formation will be determined at detailed engineering stage.

3.5 Kerb Options

Standard CCC full size kerb and channel will be used in all roads in the subdivision, with cutdowns where appropriate.

3.6 Footpaths

A footpath is proposed along one side of the new public road to provide pedestrian access within the development. There are existing formed footpaths along both sides of Bowenvale Avenue, however these stop short of the proposed new intersection. A pedestrian link should be extended along Bowenvale Avenue to provide a connection to the new development and the requirements will need to be worked through with CCC at detailed design stage.

Due to the low-speed environment of the ROW's, the carriageway area will be utilised as a shared space to provide both vehicular and pedestrian access.

3.7 Road Safety Audit (RSA)

A preliminary RSA has been undertaken by Stantec for the development, which is included in the resource consent application. We have provided design responses to the items raised in the RSA.

3.8 Bridge

A bridge crossing has been designed to provide access to the site over Sibley's drain. The bridge location and design has been undertaken to comply with CCC requirements as outlined below.

- No part of the bridge or other proposed obstructions within five metres to the existing weir.
- Clearance from soffit of the proposed bridge to waterway structure – 200mm allowed.
- No structural connection to or reliance on the existing structure.
- Abutments placed a minimum of one metre back from the edge of the waterway structure.
- Bored piles to minimise impact on the existing waterway walls and transfer structural loads below the waterway structure.
- Freeboard clearance from the bridge soffit to the 2% AEP peak flood level of RL 26.09, based on information provided by CCC – 565mm allowed.

A preliminary design has been undertaken by Viden as shown below. A copy of the bridge plans is enclosed in Appendix B.

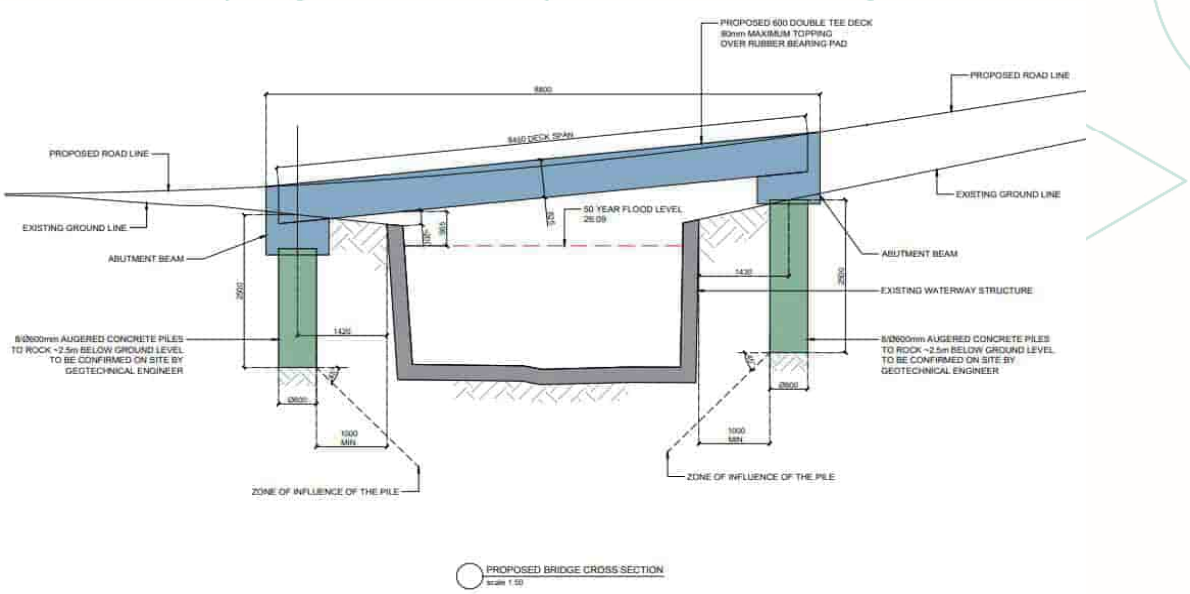


Figure 3 – Bridge Section

4. Stormwater

4.1 Existing Stormwater Management

Runoff from the subject site discharges into Sibley's drain via either the overland flow paths or direct sheet flow. The exception being the northern part of the site, which currently discharges to the neighbouring residential properties to the east prior to discharging to Sibley's drain.

Sibley's drain within the property boundary consists of three types of formations.

1. Vegetated channel – southern section.
2. Grassed attenuation channel – middle section.
3. Concrete channel structure – northern section. The entrance to the concrete channel has a weir structure which is used to monitor flows within the channel.

The three overland flow paths (Sibley's branch drain and hill drains) catchments extend up to Victoria Park Road.

4.2 Proposed Stormwater Disposal

Due to the steep topography of the site, the stormwater management of runoff from the development requires careful consideration and does limit treatment devices options. Taking this into consideration and site constraints, the stormwater disposal for the development has been separated into two systems as outlined below.

1) Existing overland flow paths (OLFP)

- Maintain OLFP in the western portion of the site.
- Keep the OLFP upper catchment flows separate to the internal subdivision flows to avoid contamination and therefore treatment requirements.
- Divert the OLFP via piped reticulation where required for access.
- Provide secondary flow paths for flows in excess of the primary pipe reticulation.

2) Subdivision Development

- Primary Reticulated Network - sized for at least 20% AEP event.
- Stormwater collection via sumps and lot connections.
- Treatment of road and ROW contamination generating areas via a proprietary first defence and treatment device prior to discharge to Sibley's drain.
- Dwelling roofs to be made of inert materials, therefore not requiring treatment.
- Peak Flow Attenuation via onsite storage on each lot via rain tanks.
    - Tanks to be sized based on 5m3 per 100m².
- Provide secondary flow paths down Roads and ROW's for events over the capacity of the primary network.

Refer to the indicative stormwater layout plan EN-400 in **Appendix A**.

4.3 Road & ROW's

It is proposed that the roading stormwater network for the development will consist of a surface water conveyance system which will discharge into sumps and then a piped network.

Key design parameters of the system are as follows.

- Kerbs will direct stormwater from roads and private lots where levels allow, into appropriately spaced sumps.
- Hardstand area from private lots will be accounted for within the roading sumps.
- All sumps will have submerged outlets feeding into the piped reticulation.
- Treatment of hardstand areas prior to discharging to Sibley's drain.

4.4 Private Lots

Private lots will have the ability to either discharge stormwater (roof and hardstand) into the kerb and channel via a kerb adaptor or directly into the reticulation network via a lateral connection. The site levels do not allow all lots to discharge directly to the kerb.

Rain tanks are to be utilised on each lot and will be sized (5m3 per 100m^2) accordingly based on the proposed dwelling roof area.

4.5 Soil Profile & Groundwater

As per the Geotechnical Investigation Report (GIR) undertaken by ENGEO, it appears that the soil profile consists of topsoil to 0-0.3m bgl, which is underlain by loess down to bedrock.

No groundwater was encountered during the field investigations.

4.6 ECAN Consents

An application for construction phase ECAN consents has been lodged for the development. Operational stormwater will be operated under the CCC global consent, unless advised otherwise by CCC.

5. Wastewater

5.1 Existing Infrastructure

There is an existing gravity wastewater network within Bowenvale Avenue approximately 50m to the north of the site. This is the proposed connection point for the subject site.

5.2 Proposed Wastewater Design

Council Wastewater Department has advised that the site is located within a wastewater capacity constraints area and as a result attenuation and pumping is required onsite for each lot.

Based on this feedback from CCC, we are proposing the development to be serviced via a low-pressure system (LPS) for the following reasons.

- Attenuation will be provided within each lot via a storage chamber (EOne or similar approved).
- LPS systems do not have infiltration issues like gravity networks, therefore the maximum loading on the downstream network will be less.
- Site contours will restrict gravity connections to some lots.
- LPS systems are installed at shallower depths than gravity reticulation, which is beneficial in steep topography from installation and ongoing maintenance aspects.
- LPS systems have more redundancy for potential ground movement by seismic events.

A new gravity line will be extended from the existing manhole (ID 14327) to the site boundary along Bowenvale Avenue. The LPS network will discharge to the new gravity reticulation.

Refer to the indicative wastewater layout plan EN-300 in **Appendix A**.

6. Water

5.1 Existing Infrastructure

There are existing 100 and 180mm PE100 water mains in Bowenvale Avenue under the carriageway and submains along the property boundaries. The 180mm main ends approximately 30m to the north of the site and the 100mm main extends to the south along the road frontage of the site.

The 180mm main is the proposed connection point for this development.

5.2 Proposed Infrastructure

It is envisaged that an appropriately sized water main would be extended from the 180mm main along Bowenvale Avenue to the new intersection and extended into the development under the new Road and ROW's to provide domestic and firefighting supply to all new lots created. A combination of main and submain reticulation would be used throughout the development area.

It is anticipated the new network would be laid with PE pipe consistent with the existing network.

5.2 Fire Fighting Requirements

All reticulated supply would be unrestricted, and as such would be subject to the provisions of FW2 from SNZ PAS 4509:2008.

This standard requires at least one fire hydrant to be located within 135 m of any dwelling, and two hydrants located within 270m of any dwelling. To achieve this requirement, the principal main needs to be extended along ROW 2 and five hydrants provided.

Each hydrant must have the capacity to provide a minimum of 12.5 L/s with a minimum residual pressure of 100 kPa.

It is anticipated that there would be sufficient pressure in the current system to comply with the above requirements.

All new mains will have hydrants spaced to satisfy SNZ PAS 4509:2008.

Refer to the indicative water layout plan EN-500 in **Appendix A**.

7. Power, Telecommunications and Streetlights

7.1 Power Supply

There is existing power reticulation within the vicinity of the site, which will need to be extended within the development to provide connections to all new lots creates.

7.2 Telecommunication Supply

The subject site is within a Chorus supply area. The existing network will be extended within the development to provide connections to all new lots creates.

7.3 Streetlighting

All streetlighting will be installed as per industry regulations. A lighting design will be completed at the detailed engineering approval stage.

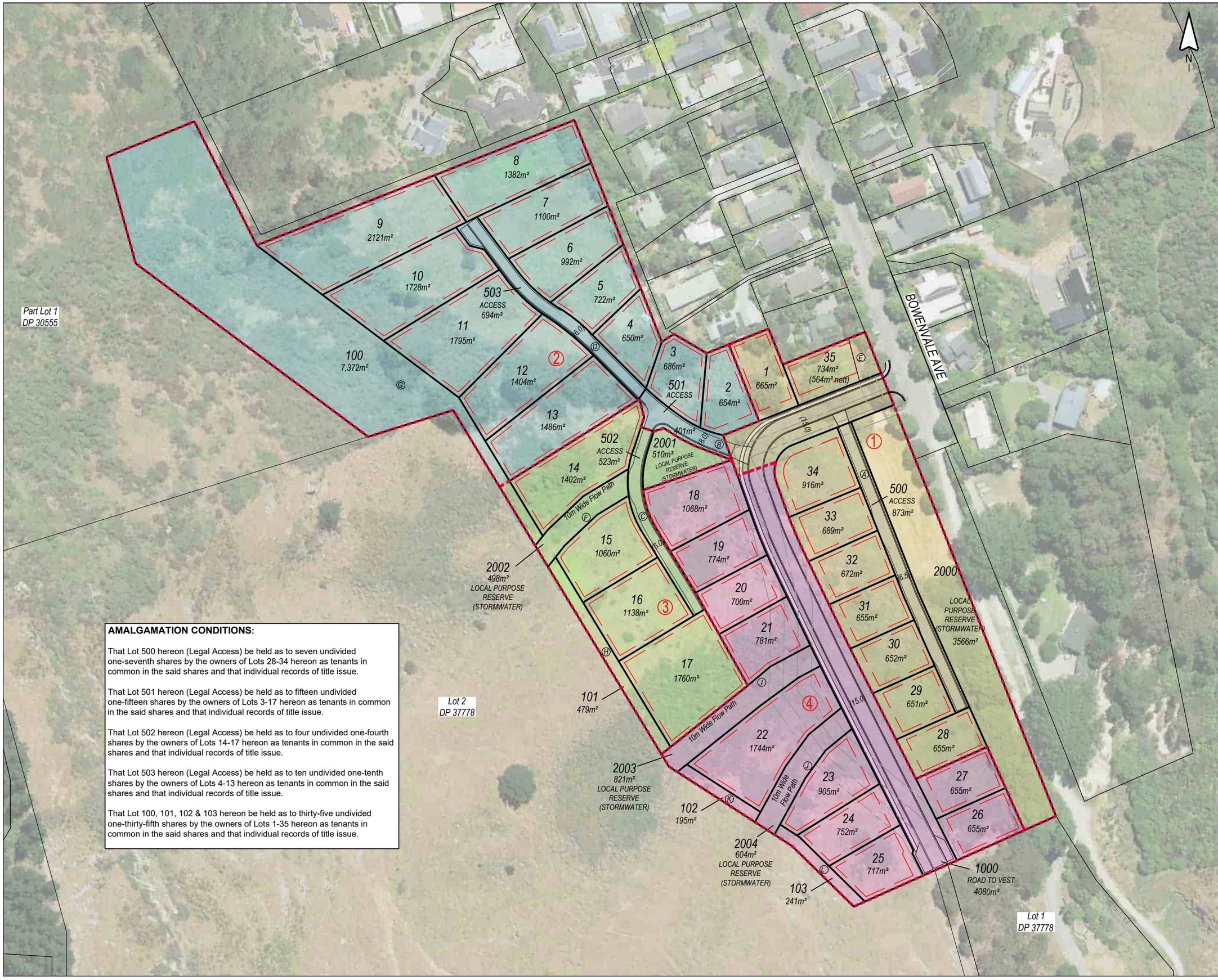
130 BOWENVALE ROAD (Pt LOT 2 DP 33462)

BASECO
Land Development Consultants

FOR RESOURCE CONSENT

SC-01	SUBDIVISION PLAN	EN-201	ROAD LONGSECTION
EN-100	PROPOSED CONTOURS	EN-202	ROAD DETAILS
EN-101	EARTHWORKS CONTOURS	EN-210	BRIDGE PLAN
EN-105	EROSION & SEDIMENT CONTROL PHASE 1	EN-300	WASTEWATER LAYOUT
EN-106	EROSION & SEDIMENT CONTROL PHASE 2-5	EN-400	STORMWATER LAYOUT
EN-110	TREE CLEARANCE	EN-500	WATER LAYOUT
EN-200	ROAD LAYOUT		

DATE 23/01/2023
FOR INFORMATION
JOB No : 1037



AMALGAMATION CONDITIONS:

That Lot 500 hereon (Legal Access) be held as to seven undivided one-seventh shares by the owners of Lots 28-34 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 501 hereon (Legal Access) be held as to fifteen undivided one-fifteen shares by the owners of Lots 3-17 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 502 hereon (Legal Access) be held as to four undivided one-fourth shares by the owners of Lots 14-17 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 503 hereon (Legal Access) be held as to ten undivided one-tenth shares by the owners of Lots 4-13 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 100, 101, 102 & 103 hereon be held as to thirty-five undivided one-thirty-fifth shares by the owners of Lots 1-35 hereon as tenants in common in the said shares and that individual records of title issue.

NOTES :

1. SCHEME PLAN ONLY, AREAS & DIMENSIONS ARE APPROXIMATE & SUBJECT TO FINAL SURVEY.
2. ADDITIONAL EASEMENTS FOR PUBLIC INFRASTRUCTURE WILL BE REQUIRED. LOCATION TO BE CONFIRMED AT DETAILED ENGINEERING STAGE.

BUILDING PLATFORM
BDY OFFSET - 4m (FRONT) & 1.8m (SIDE & REAR)

(1) **STAGE NUMBER**

STAGING:

1 Lots 1, 28-35, 500, 2000 & Part 1000
2 Lots 2-13, 501 & Part 100
3 Lots 14-17, Part 100, 101, 502, 2001 & 2002
4 Lots 18-27, 102, 103, Part 1000, 2003 & 2004

MEMORANDUM OF EASEMENTS

Nature	Burdened Land (Servient)		Benefited Land (Dominant)
	Lot No.	Shown	
Right of Way & All Services	500	A	28-34
	501	B	3-17
	502	C	14-17
	503	D	4-13
Right for Access & Maintenance	2002	F	1-35
	2003	I	1-35
	2004	J	1-35
	100	G	1-35
	101	H	1-35
	102	K	1-35
	103	L	1-35

SCHEDULE OF EASEMENTS IN GROSS

Nature	Burdened Land (Servient)		Grantee
	Lot No.	Shown	
Right to Drain Water	35	E	Christchurch City Council

REV	DATE	REVISION DETAILS	ISSUED
J	17/01/23	STAGING ADDED	TL

BASECO Land Development Consultants

CLIENT
BOWENVALE GCO LTD

PROJECT
130 BOWENVALE AVE

DRAWING TITLE
PROPOSED SUBDIVISION OF PARTS
LOT 2 DP 33462

STATUS	***SCALE***	***SIZE***
FOR INFORMATION	1:750	A1

PROJECT	***DRAWING NO***	***REVISION***
1037	SC-01	J

BATTER
503
ACCESS
EXTENT OF EARTHWORKS
501
ACCESS
502
ACCESS
200
LOCAL PURPOSE RESERVE (STORMWATER)
GABION STABLISED BATTER
BRIDGE OVER CCC DRAIN
BOWENVALE AVE
500
ACCESS
RETAINING WALL A HEIGHT 1-2m
2002
LOCAL PURPOSE RESERVE (STORMWATER)
GABION STABLISED BATTER
2000
LOCAL PURPOSE RESERVE (STORMWATER)
101
2003
LOCAL PURPOSE RESERVE (STORMWATER)
102
2004
LOCAL PURPOSE RESERVE (STORMWATER)
GABION STABLISED BATTER
1000
ROAD TO VEST
103
GABION STABLISED BATTER
503
ACCESS
EXTENT OF EARTHWORKS

N

LEGEND:

- 24.0 – MAJOR CONTOUR - CCC LIDAR CONT
- MINOR CONTOUR - CCC LIDAR CONT
- EXTENT OF EARTHWORKS
- 24.0 – MAJOR CONTOUR - DESIGN CONT
- MINOR CONTOUR - DESIGN CONT (1.0m)
- RETAINING WALL - HEIGHT 1.0 - 2.0m

REV	DATE	REVISION DETAILS	ISSUED
A	2/02/23	FOR INFORMATION	TL

BASECO Land Development Consultants

CLIENT
BOWENVALE GCO LTD

PROJECT
130 BOWENVALE AVE

DRAWING TITLE
PROPOSED CONTOUR PLAN

STATUS	SCALE	SIZE
FOR INFORMATION	1:1000	A3

PROJECT	DRAWING NO	REVISION
1036	EN100	A

LEGEND:

-1.0 CUT AREA & DEPTH CONTOURS (1m INTERVAL)

1.0 FILL AREA & DEPTH CONTOURS (1m INTERVAL)

REV	DATE	REVISION DETAILS	ISSUED
A	02/02/23	FOR INFORMATION	TL

BASECO Land Development Consultants

CLIENT

BOWENVALE GCO LTD

PROJECT

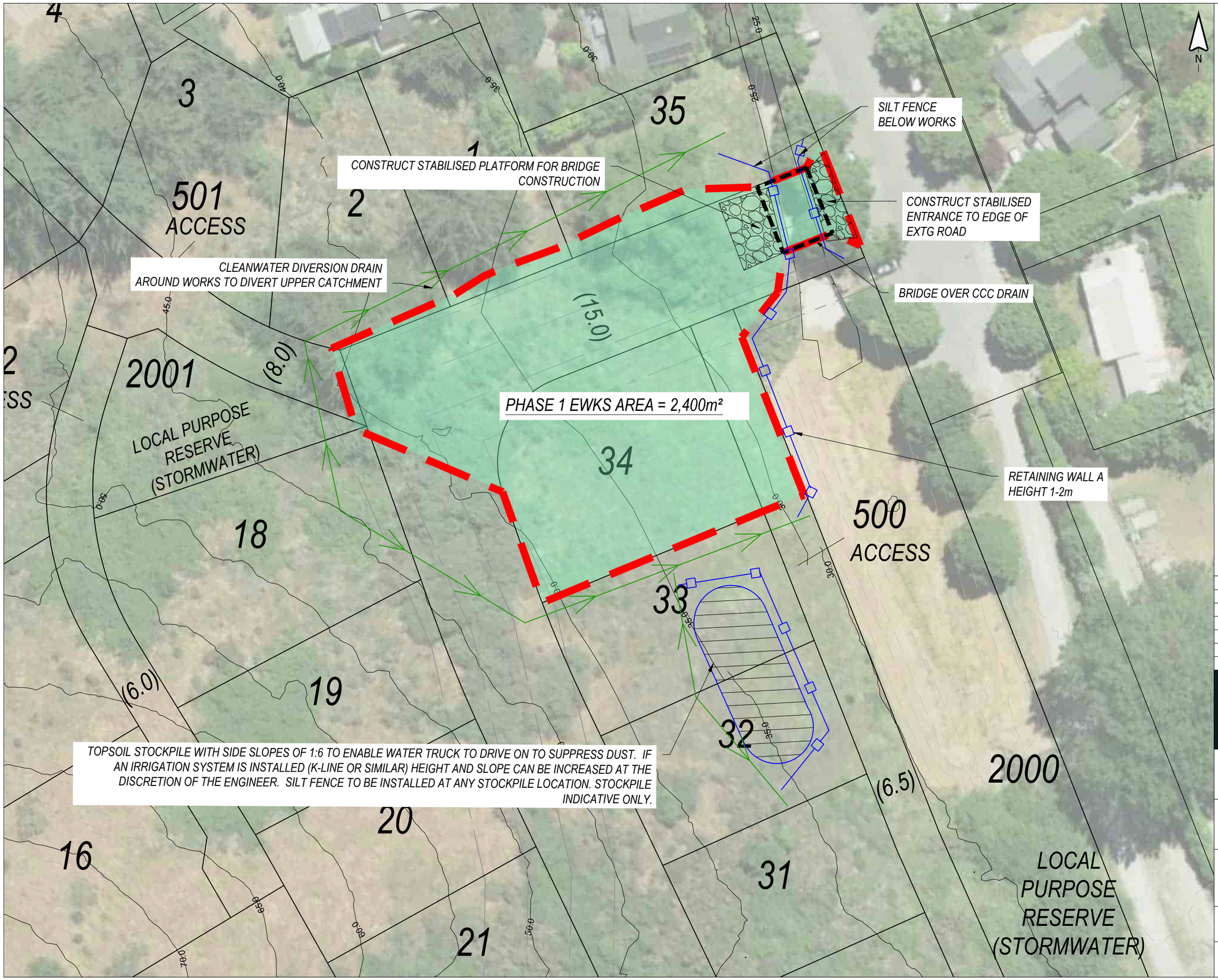
130 BOWENVALE AVE

DRAWING TITLE

EARTHWORKS CUT/FILL PLAN

STATUS	SCALE	SIZE
FOR INFORMATION	1:1000	A3

PROJECT	DRAWING NO	REVISION
1036	EN101	A



LEGEND:

- EXTENT OF EARTHWORKS
- PHASE 1 AREA
- DIVERSION BUND/DRAIN
- SILT FENCE

NOTES:

ALL SEDIMENT AND EROSION CONTROL DEVICES TO BE INSTALLED IN ACCORDANCE WITH ECAN ESC GUIDELINES

REV	DATE	REVISION DETAILS	ISSUED
A	03/02/23	FOR INFORMATION	TL

BASECO Land Development Consultants

CLIENT

BOWENVALE GCO LTD

PROJECT

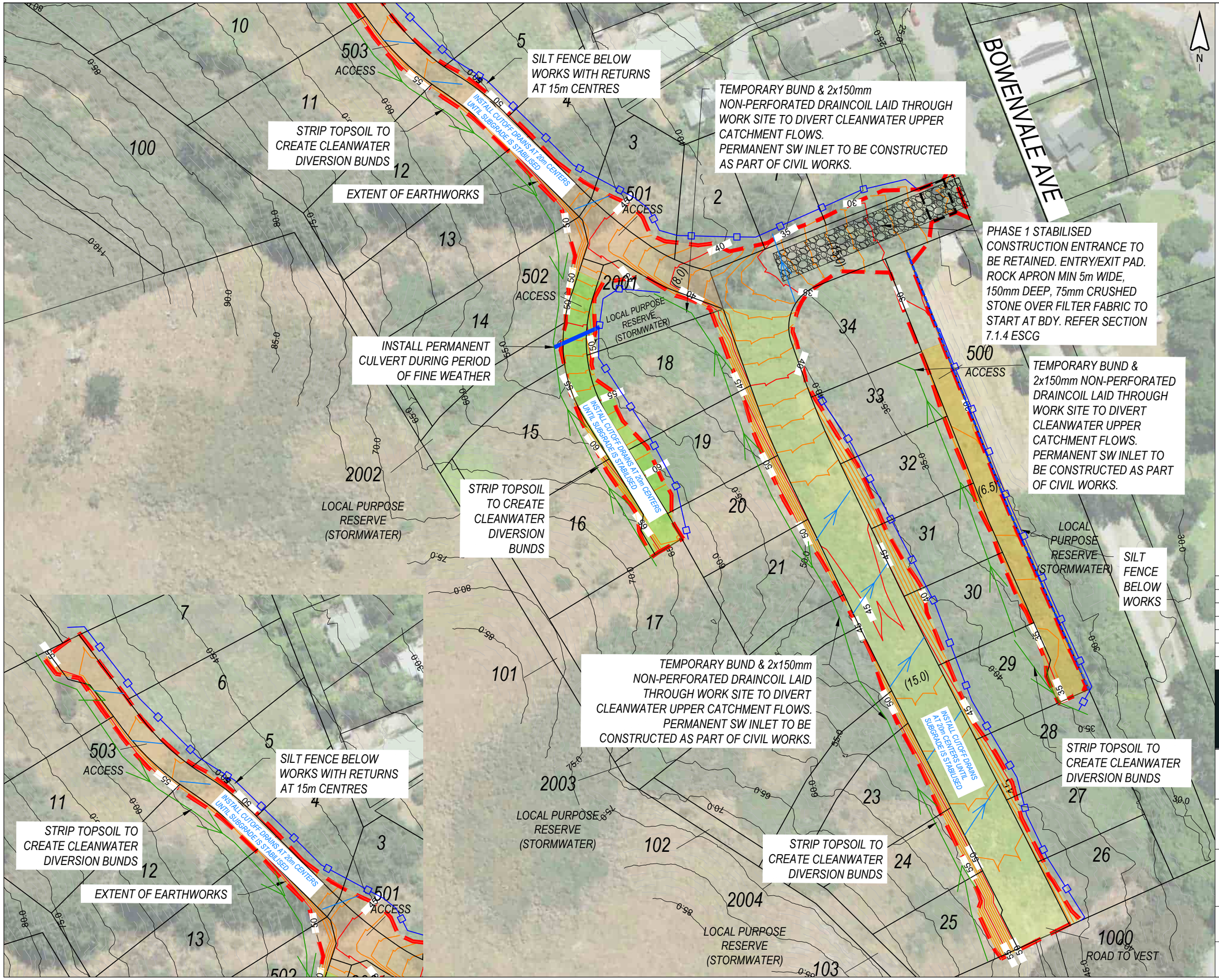
130 BOWENVALE

DRAWING TITLE

SEDIMENT & EROSION CONTROL PHASE 1

STATUS	SCALE	SIZE
FOR INFORMATION	1:1000	A3

PROJECT	DRAWING NO	REVISION
1036	EN-105	A



LEGEND:

- EXTENT OF EARTHWORKS
- PHASE 2 AREA - 900m²
- PHASE 3 AREA - 1,660m²
- PHASE 4 AREA - 850m²
- PHASE 5 AREA - 4,100m²
- DIVERSION BUND/DRAIN
- SILT FENCE

NOTES:

ALL SEDIMENT AND EROSION CONTROL DEVICES TO BE INSTALLED IN ACCORDANCE WITH ECAN ESC GUIDELINES

REV	DATE	REVISION DETAILS	ISSUED
A	03/02/23	FOR INFORMATION	TL

BASECO Land Development Consultants

CLIENT: BOWENVALE GCO LTD

PROJECT: 130 BOWENVALE

DRAWING TITLE: SEDIMENT & EROSION CONTROL PHASES 2-5

STATUS	SCALE	SIZE
FOR INFORMATION	1:1000	A3

PROJECT	DRAWING NO	REVISION
1036	EN-106	A

LEGEND:

EXISTING VEGETATION TO BE RETAINED

EXISTING VEGETATION TO BE REMOVED

(SUBJECT TO ARBORIST ADVICE)

REV	DATE	REVISION DETAILS	ISSUED
A	03/02/23	FOR INFORMATION	TL

BASECO
Land Development Consultants

CLIENT

BOWENVALE GCO LTD

PROJECT

130 BOWENVALE

DRAWING TITLE

TREE CLEARANCE

STATUS	*SCALE*	*SIZE*
FOR INFORMATION	1:500	A3

PROJECT	*DRAWING NO*	*REVISION*
1036	EN-110	A

LEGEND:

1. ALL WORKS ARE TO BE IN TERMS OF THE CCC CSS AND IDS WHERE APPLICABLE
2. ALL CONCRETE FOR KERB AND FLAT CHANNEL TO HAVE A MINIMUM 28 DAY COMPRESSIVE STRENGTH OF 20MPa.
3. ALL CONCRETE KERB AND CHANNEL TO BE IN ACCORDANCE WITH CCC CODES AS SPECIFIED.
4. CARRIAGEWAY MINIMUM CBR TO MEET APPLICABLE STANDARDS IN CCC IDS PART 8 - ROADING. ENGINEER TO INSPECT SUBGRADE BEFORE ANY METAL PLACEMENT
5. BENKLEMAN BEAM TESTING TO MEET APPLICABLE STANDARDS IN CCC IDS PART 8 - ROADING.
6. CAMBER FOR ALL ROADS AND ROW'S TO BE IN ACCORDANCE WITH CSS PART 2:1992 SD 243.

REV	DATE	REVISION DETAILS	ISSUED
A	03/02/23	FOR INFORMATION	TL

BASECO Land Development Consultants

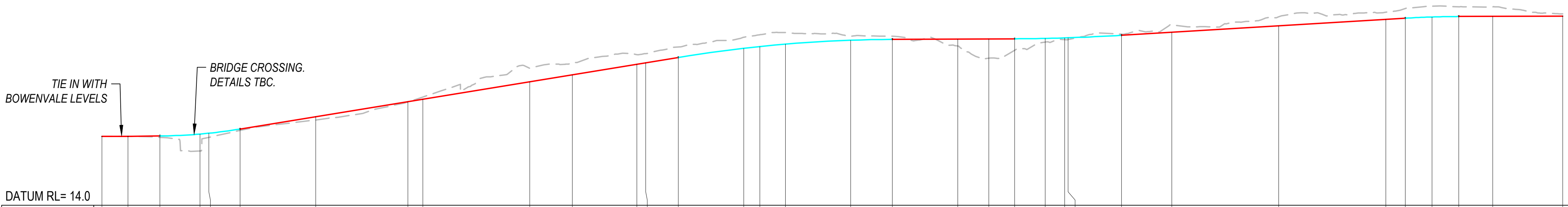
CLIENT
BOWENVALE GCO LTD

PROJECT
130 BOWENVALE

DRAWING TITLE
ROAD LAYOUT PLAN

STATUS	SCALE	SIZE
FOR INFORMATION	1:1000	A3

PROJECT	DRAWING NO	REVISION
1036	EN-200	A



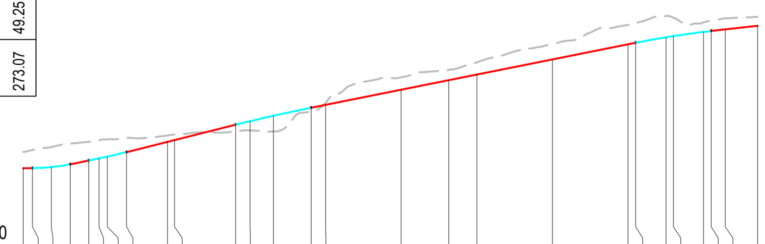
DATUM RL= 14.0

VERTICAL GEOMETRY: G=1 IN 142 | G=1 IN 100 | K=1.0 L=15.0m | G=1 IN 6 | K=2.5 L=40.0m | G=1 IN 200 | K=3.6 L=20.0m | G=1 IN 17 | K=1.8 L=10.0m | G=1 IN 250

HORIZONTAL GEOMETRY: L=57.2m | R=-20m | L=13.7m | R=-200m | L=42.8m | R=-500m | L=96.7m

CHAINAGES (DESIGN CENTRELINE)	EXISTING SURFACE (ALONG CENTRELINE)	FINISHED SURFACE CUT / FILL DEPTHS	DESIGN CENTRELINE LEVELS
0.00	26.82	-0.00	26.82
4.88	26.85	-0.00	26.85
10.85	26.65	0.26	26.91
18.35	24.13	3.15	27.27
20.00	26.67	0.76	27.43
25.85	27.94	0.27	28.21
40.00	29.90	0.62	30.51
57.23	33.28	0.04	33.32
60.00	34.16	-0.39	33.77
80.00	39.56	-2.53	37.02
87.94	40.60	-2.28	38.32
100.00	42.06	-1.78	40.28
101.66	42.26	-1.70	40.55
107.78	43.49	-1.95	41.55
120.00	45.31	-2.06	43.24
123.01	45.78	-2.21	43.57
127.78	46.18	-2.17	44.01
140.00	45.49	-0.74	44.75
147.78	45.51	-0.61	44.90
160.00	43.66	1.30	44.96
165.78	41.40	3.60	44.99
170.62	42.86	2.15	45.02
176.36	44.39	0.71	45.09
180.00	44.84	0.35	45.19
180.62	44.86	0.35	45.21
190.62	45.85	-0.18	45.67
200.00	47.66	-1.43	46.23
220.00	49.12	-1.69	47.43
240.00	49.99	-1.36	48.63
243.67	50.68	-1.83	48.85
248.67	51.08	-1.99	49.08
253.67	50.96	-1.79	49.17
260.00	50.99	-1.79	49.20
273.07	49.64	-0.39	49.25

ROAD 1 LONGSECTION (CENTRELINE LEVEL)



DATUM RL= 34.0

VERTICAL GEOMETRY: G=1 IN 204 | K=0.3 L=5.0m | G=1 IN 5 | K=1.0 L=5.0m | G=1 IN 4 | K=2.0 L=10.0m | G=1 IN 5 | K=1.2 L=10.0m | G=1 IN 9

HORIZONTAL GEOMETRY: L=4.1m | R=-25m | L=8m | R=-43m | L=28.7m | R=200m | L=4.3m

CHAINAGES (DESIGN CENTRELINE)	EXISTING SURFACE (ALONG CENTRELINE)	FINISHED SURFACE CUT / FILL DEPTHS	DESIGN CENTRELINE LEVELS
0.00	46.40	-2.15	44.25
1.21	46.66	-2.40	44.26
3.71	47.04	-2.64	44.39
6.21	47.49	-2.72	44.77
8.64	47.75	-2.49	45.26
10.00	47.94	-2.40	45.54
11.10	48.06	-2.28	45.78
13.64	48.23	-1.84	46.38
19.06	48.58	-0.84	47.74
20.00	48.70	-0.73	47.97
28.09	49.19	0.80	50.00
30.00	49.24	1.23	50.46
33.09	49.11	2.07	51.18
38.09	51.67	0.58	52.25
40.00	52.90	-0.27	52.63
50.00	56.28	-1.65	54.63
56.31	57.26	-1.37	55.89
60.00	58.25	-1.62	56.63
70.00	60.66	-2.03	58.63
80.00	63.20	-2.57	60.63
81.02	63.37	-2.54	60.83
85.04	64.38	-2.82	61.56
86.02	64.15	-2.43	61.72
90.00	63.54	-1.26	62.28
91.02	63.77	-1.37	62.40
92.85	64.08	-1.47	62.61
97.13	64.27	-1.18	63.09

ROW 3 LONGSECTION (CENTRELINE LEVEL)

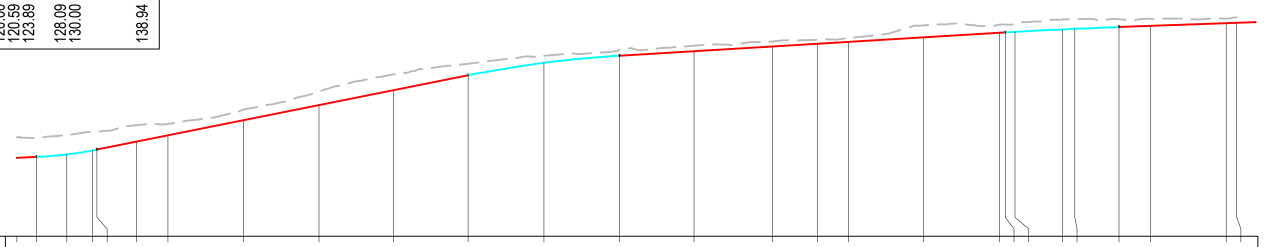
DATUM RL= 19.0

VERTICAL GEOMETRY: G=1 IN 16 | G=1 IN 39 | K=3.0 L=15.0m | G=1 IN 13 | K=1.4 L=15.0m | G=1 IN -34

HORIZONTAL GEOMETRY: L=80.9m | R=-200m | L=49.3m

CHAINAGES (DESIGN CENTRELINE)	EXISTING SURFACE (ALONG CENTRELINE)	FINISHED SURFACE CUT / FILL DEPTHS	DESIGN CENTRELINE LEVELS
-0.00	29.26	0.04	29.30
4.12	29.29	0.27	29.56
10.00	29.39	0.32	29.71
20.00	29.83	0.14	29.97
30.00	29.81	0.41	30.22
40.00	30.08	0.40	30.48
50.00	30.89	-0.15	30.73
60.00	31.04	-0.05	30.99
70.00	31.39	-0.14	31.25
80.00	31.62	-0.12	31.50
80.92	31.69	-0.16	31.53
87.60	31.70	0.09	31.79
89.61	31.60	0.30	31.90
95.10	31.97	0.30	32.27
100.00	32.92	-0.28	32.64
110.00	34.22	-0.83	33.40
113.09	33.85	-0.22	33.63
120.00	34.61	-0.63	33.99
120.59	34.38	-0.38	34.00
123.89	33.84	0.20	34.04
128.09	34.09	-0.11	33.98
130.00	33.96	-0.04	33.92
138.94	33.00		

ROW 1 LONGSECTION (CENTRELINE LEVEL)



DATUM RL= 26.0

VERTICAL GEOMETRY: G=1 IN 23 | K=0.5 L=8.0m | G=1 IN 5 | K=1.4 L=20.0m | G=1 IN 17 | K=6.0 L=15.0m | G=1 IN 29

HORIZONTAL GEOMETRY: L=15.8m | R=80m | L=39.8m | R=-68m | L=0m | R=68m | L=29.3m

CHAINAGES (DESIGN CENTRELINE)	EXISTING SURFACE (ALONG CENTRELINE)	FINISHED SURFACE CUT / FILL DEPTHS	DESIGN CENTRELINE LEVELS
0.00	39.09		
2.60	39.00	-2.50	36.50
6.60	39.42	-2.59	36.83
10.00	39.81	-2.45	37.36
10.60	39.84	-2.37	37.47
15.80	40.70	-2.19	38.51
20.00	40.85	-1.50	39.35
30.00	42.75	-1.40	41.35
40.00	45.18	-1.82	43.35
49.87	47.43	-2.10	45.33
59.73	48.83	-1.53	47.30
69.73	49.88	-0.93	48.95
79.73	50.61	-0.71	49.90
89.62	51.22	-0.73	50.49
100.00	51.76	-0.65	51.12
105.96	52.01	-0.53	51.47
110.00	52.22	-0.50	51.72
120.00	53.90	-1.58	52.32
130.00	53.99	-1.07	52.92
130.82	54.01	-1.04	52.96
132.07	54.12	-1.08	53.04
138.32	54.69	-1.33	53.37
140.00	54.75	-1.31	53.45
145.82	54.72	-1.04	53.68
150.00	54.76	-0.93	53.82
160.00	54.80	-0.63	54.17
161.40	54.97	-0.75	54.22

ROW 2 LONGSECTION (CENTRELINE LEVEL)

LEGEND:

- PROPOSED ROAD CENTRELINE FINISHED LEVEL (FLAT GRADE) (red line)
- PROPOSED ROAD CENTRELINE FINISHED LEVEL (VERTICAL CURVE) (cyan line)
- EXISTING GROUND (dashed line)

CLIENT
BOWENVALE GCO LTD

PROJECT
130 BOWENVALE AVE

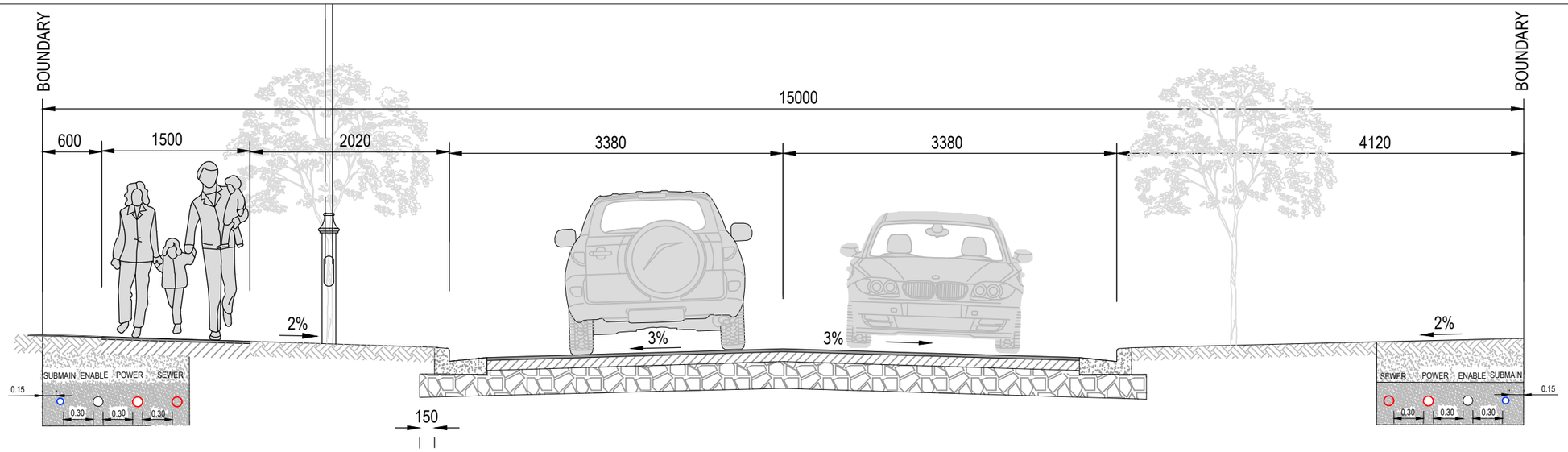
BASE CO
Land Development Consultants

REV	DATE	REVISION DETAILS	ISSUED
A	03/02/23	FOR INFORMATION	TL

DRAWING TITLE
ROAD LONGSECTION PLAN

STATUS	*SCALE*	*SIZE*
FOR INFORMATION	1:1000	A3

PROJECT NO	*DRAWING NO*	*REVISION*
1036	EN-201	A



FOOTPATH (1.5m WIDE)

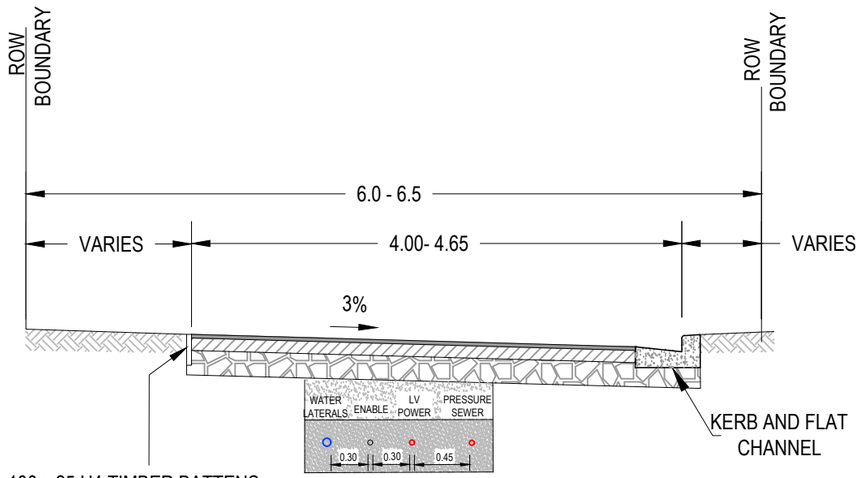
- 25mm AC7 HOTMIX
- 100mm TNZ M/4 AP40
- ON COMPACTED SUBGRADE.
- 100 x 25 H4 TIMBER BATTENS WITH 75 X 25 PEGS @ 0.8m CENTRES

TYPICAL CROSS SECTION 15m ROAD RESERVE ROAD 1

ROAD CONSTRUCTION

- 30mm AC10 ASPHALTIC CONCRETE
- 100mm M/4 AP40 BASECOURSE
- 300 mm AP65 SUBBASE ON COMPACTED SUBGRADE
- GEOFABRIC (BIDUM A29 OR SIMILAR)

** METAL DEPTHS TO BE CONFIRMED BY ENGINEER FOLLOWING CBR TESTING OF SUBGRADE IF NECESSARY

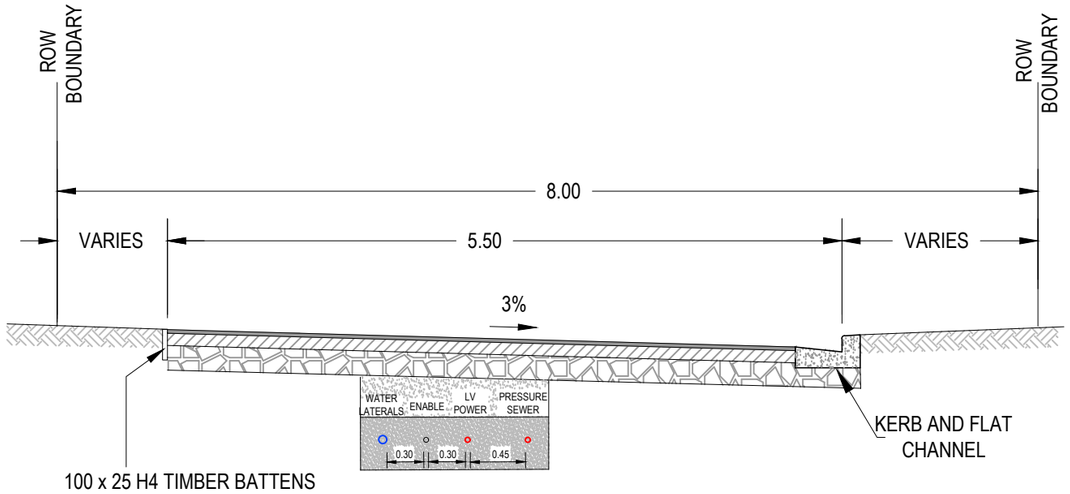


100 x 25 H4 TIMBER BATTENS WITH 75 X 25 PEGS @ 1m CENTRES

TYPICAL CROSS SECTION 6.0m - 6.5m RIGHT OF WAY

ROW CONSTRUCTION

- 30mm AC10 HOTMIX (ON FULL GRADE 6 PRIME COAT)
- 100mm M/4 AP40 BASECOURSE
- 250 MM AP65 SUBBASE ON COMPACTED SUBGRADE (CBR8)



100 x 25 H4 TIMBER BATTENS WITH 75 X 25 PEGS @ 1m CENTRES

TYPICAL CROSS SECTION 8.0m RIGHT OF WAY

CLIENT: BOWENVALE GCO LTD

PROJECT: 130 BOWENVALE AVE

BASECO Land Development Consultants

REV	DATE	REVISION DETAILS	ISSUED
A	03/02/23	FOR INFORMATION	TL

DRAWING TITLE: ROAD DETAILS PLAN

STATUS	SCALE	SIZE
FOR INFORMATION	1:1000	A3

PROJECT NO	DRAWING NO	REVISION
1036	EN-202	A

LEGEND:

- PE 100 PN16 PRESSURE MAIN (SIZE TO BE DETERMINED AT DETAILED DESIGN)
- PROPOSED SLUICE VALVE
- FP PROPOSED FLUSHING POINT
- BOUNDARY KIT

NOTES:

1. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH AND CCC IDS AND CSS.
2. ALL MAINS TO BE PE 100 PN16 AND SHOULD BE ELECTROWELDED.
3. PRESSURE SEWER MAIN TO BE LOCATED IN COMMON SERVICES TRENCH WITHIN SUBDIVISION.
4. VALVES ARE TO BE DI SLUICE VALVES AND ARE TO HAVE TRAFFICABLE LIDS AS PER CCC CSS SD385.
5. FLUSHING POINTS ARE TO BE AS PER CCC CSS SD383.
6. ALL BOUNDARY KITS ARE TO BE INSTALLED AS CCC CSS SD384.
7. ALL CONNECTIONS OF 40mm PE FROM BOUNDARY KIT TO MAIN LINES ARE TO BE CONNECTED AS PER SD387.
8. MINIMUM COVER FOR MAINS WITHIN CARRIAGEWAY OR BERM TO BE 750mm.

REV	DATE	REVISION DETAILS	ISSUED
A	03/02/23	FOR INFORMATION	TL

BASECO Land Development Consultants

CLIENT
BOWENVALE GCO LTD

PROJECT
130 BOWENVALE

DRAWING TITLE
WASTEWATER PLAN

STATUS	SCALE	SIZE
FOR INFORMATION	1:1000	A3

PROJECT	DRAWING NO	REVISION
1036	EN-300	A

BOWENVALE AVE

BRIDGE OVER CCC DRAIN

FIRST DEFENCE AND PROPRIETARY TREATMENT DEVICE FOR ROAD & DRIVEWAY RUNOFF. DEVICES TO BE LOCATED IN BERM FOR FUTURE MAINTEANCE

PRE-CAST CONCRETE WINGWALL OUTLET WITH STABILISED ROCK RIP RAP

CULVERT UNDER ACCESS FOR OLFP

LOCAL PURPOSE RESERVE (STORMWATER)

MANHOLE WITH SCRUFFY DOME FOR DISCHARGE OF EXTG OLFP

PRE-CAST CONCRETE WINGWALL OUTLET WITH STABILISED ROCK RIP RAP

LOCAL PURPOSE RESERVE (STORMWATER)

MANHOLE WITH SCRUFFY DOME FOR DISCHARGE OF EXTG OLFP

LOCAL PURPOSE RESERVE (STORMWATER)

LOCAL PURPOSE RESERVE (STORMWATER)

LOCAL PURPOSE RESERVE

ACCESS

N

LEGEND:

- 24.0 MAJOR CONTOUR - CCC LIDAR CONTOURS
- MINOR CONTOUR - CCC LIDAR CONT (1.0m)
- EXTENT OF EARTHWORKS
- 24.0 MAJOR CONTOUR - DESIGN CONTOUR
- MINOR CONTOUR - DESIGN CONTOUR (1.0m)
- STORMWATER RETICULATION (OLFP)
- STORMWATER RETICULATION (SUBDIVISION)

REV	DATE	REVISION DETAILS	ISSUED
A	03/02/23	FOR INFORMATION	TL

BASECO Land Development Consultants

CLIENT

BOWENVALE GCO LTD

PROJECT

130 BOWENVALE

DRAWING TITLE

STORMWATER PLAN

STATUS	SCALE	SIZE
FOR INFORMATION	1:1000	A3

PROJECT	DRAWING NO	REVISION
1036	EN-400	A

LEGEND:

- EXISTING WATER RETICULATION (AS SPECIFIED)
- PROPOSED WATER MAIN (AS SPECIFIED)
- PROPOSED 63Ø WATER SUB MAIN
- PROPOSED 32Ø WATER LATERAL
- SLUICE VALVE
- 50Ø GATE VALVE
- STANDARD HYDRANT
- END CAP (COMPRESSION)

NOTES:

1. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH CCC CSS PARTS 1-7.
2. ALL MAINS TO BE PE100 PN12.5.
3. SUBMAINS TO BE 63OD MDPE 80B PN 12.5.
4. PRINCIPAL MAIN OFFSET INSIDE SUBDIVISION 2.00m from FENDER.
5. SUBMAINS 150mm FROM BOUNDARY.
4. ALL PRIVATE LATERALS ARE TO BE INSTALLED BY A LICENSED CERTIFYING PLUMBER UNDER BUILDING CONSENT EXEMPTION.
5. WATER PIPES IN R.O.W'S TO BE LAID IN COMMON SERVICE TRENCH.
6. GATE VALVES ARE TO BE LOCATED IN SERVICE STRIP 300MM FROM BOUNDARY.
7. ALL HYDRANTS ARE TO HAVE TAPPED RISERS AS PER CCC SD402.
8. MINIMUM CLEARANCE TO OTHER SERVICES TO BE AS PER IDS PART 9: UTILITIES TABLE 1.
9. MINIMUM COVER FOR MAINS WITHIN CARRIAGEWAY TO BE 750mm, AND TO COMPLY WITH "CODE OF PRACTICE FOR WORKING ON THE ROAD ".
10. ANY LAYING OF PIPE MAINS OR CONNECTIONS TO THE EXISTING COUNCIL WATER RETICULATION SHALL BE MADE BY A CCC AUTHORISED WATER SUPPLY INSTALLER.
11. HIGH PRESSURE WATER BENDS AND FITTINGS ARE TO BE DUCTILE IRON. (NOT CAST IRON).
12. All DN 63 ENDCAPS ARE TO BE COMPRESSION ENDCAPS.
13. PRESSURE, CHLORINATION AND BACTERIOLOGICAL TESTS ARE TO BE CARRIED OUT ON EACH PIPELINE TO CCC IDS.

REV	DATE	REVISION DETAILS	ISSUED
A	03/02/23	FOR INFORMATION	TL

BASECO Land Development Consultants

CLIENT
BOWENVALE GCO LTD

PROJECT
130 BOWENVALE

DRAWING TITLE
WATER PLAN

STATUS	SCALE	SIZE
FOR INFORMATION	1:1000	A3

PROJECT	DRAWING NO	REVISION
1036	EN-500	A

WASTEWATER CAPACITY CERTIFICATE

REFERENCE NUMBER: RMA/2023/343

Pursuant to Rule 8.4.1.3 in Chapter 8 Subdivision, Development and Earthworks of the Christchurch District Plan, the Council certifies that the wastewater system has adequate capacity for the respective potential land uses on all proposed allotments of the following subdivision:

Property address:	130 Bowenvale Avenue
Legal description:	Pt Lot 2 DP 33462
Number of allotments:	**35**
Date of issue:	22 February 2023

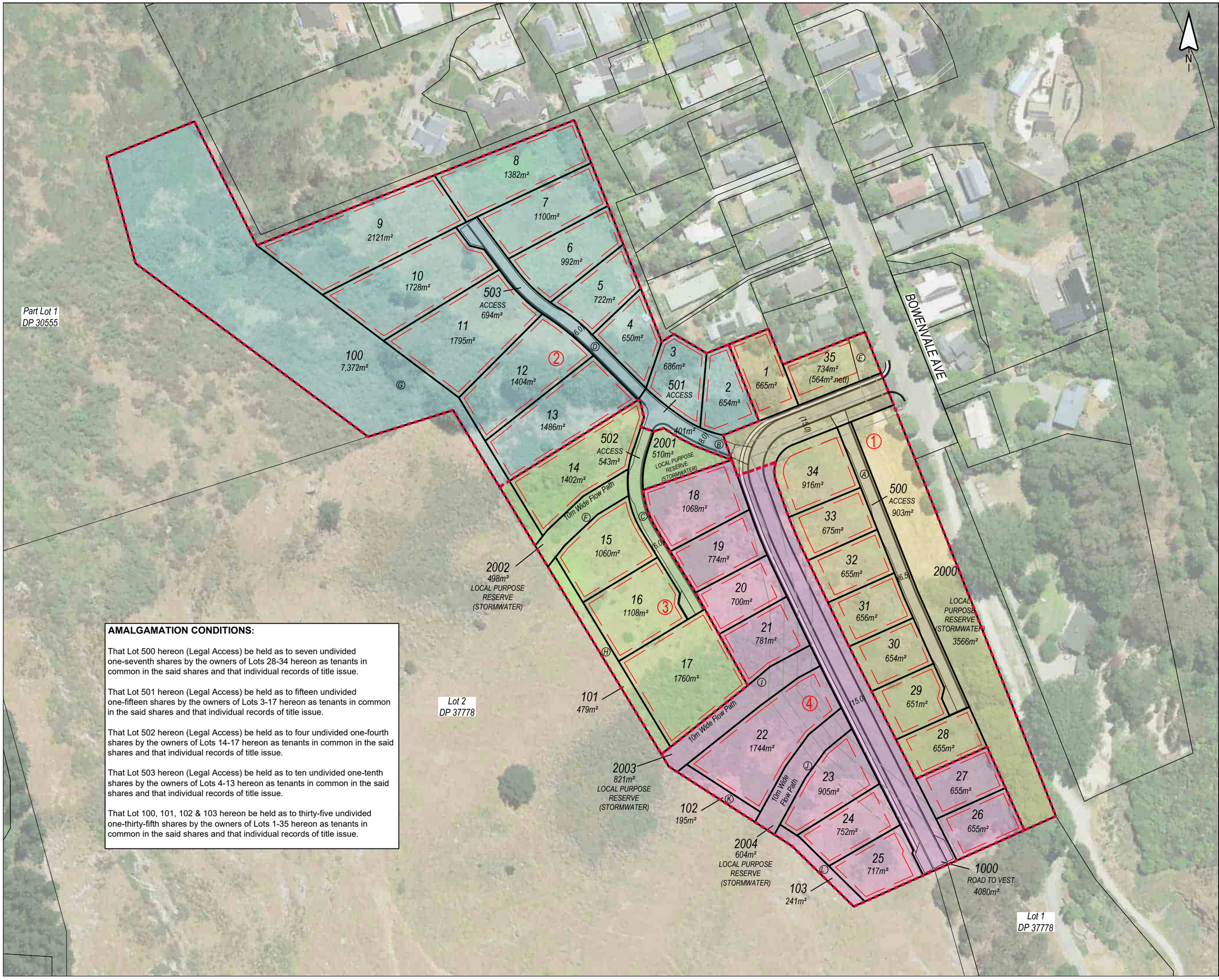
Advice notes:

- This certificate is valid for six months from the date of issue, and will remain valid during the consenting process (following the lodging of a complete subdivision consent application and for the term of the consent).
- Rule 8.6.8 of the Christchurch District Plan rule requires all allotments to be provided with the ability to connect to a wastewater system, and that a valid certificate is held to demonstrate adequate wastewater disposal capacity. Please include a copy of this certificate when applying for a subdivision consent.
- *Advice Note: This property falls within a wastewater capacity constraint area where some of the future development may need to install* ***temporary*** *private wastewater discharge storage and pumping that* ***Council has the ability to remotely control****. This will not apply to the lots that need permanent private pumping due to site topography. Please contact WastewaterCapacity@ccc.govt.nz during drainage design for specific requirements.*

Signed for and on behalf of the Christchurch City Council:

Paul Lowe
Manager Resource Consents

Civic Offices, 53 Hereford Street, Christchurch 8011
PO Box 73013, Christchurch 8154
Phone: 03 941 8999
www.ccc.govt.nz



AMALGAMATION CONDITIONS:

That Lot 500 hereon (Legal Access) be held as to seven undivided one-seventh shares by the owners of Lots 28-34 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 501 hereon (Legal Access) be held as to fifteen undivided one-fifteen shares by the owners of Lots 3-17 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 502 hereon (Legal Access) be held as to four undivided one-fourth shares by the owners of Lots 14-17 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 503 hereon (Legal Access) be held as to ten undivided one-tenth shares by the owners of Lots 4-13 hereon as tenants in common in the said shares and that individual records of title issue.

That Lot 100, 101, 102 & 103 hereon be held as to thirty-five undivided one-thirty-fifth shares by the owners of Lots 1-35 hereon as tenants in common in the said shares and that individual records of title issue.

NOTES :

1. SCHEME PLAN ONLY, AREAS & DIMENSIONS ARE APPROXIMATE & SUBJECT TO FINAL SURVEY.
2. ADDITIONAL EASEMENTS FOR PUBLIC INFRASTRUCTURE WILL BE REQUIRED. LOCATION TO BE CONFIRMED AT DETAILED ENGINEERING STAGE.

BUILDING PLATFORM
BDY OFFSET - 4m (FRONT) & 1.8m (SIDE & REAR)

(1) **STAGE NUMBER**

STAGING:

1 Lots 1, 28-35, 500, 2000 & Part 1000
2 Lots 2-13, 501 & Part 100
3 Lots 14-17, Part 100, 101, 502, 2001 & 2002
4 Lots 18-27, 102, 103, Part 1000, 2003 & 2004

MEMORANDUM OF EASEMENTS

Nature	Burdened Land (Servient) Lot No.	Shown	Benefited Land (Dominant)
Right of Way & All Services	500	A	28-34
	501	B	3-17
	502	C	14-17
	503	D	4-13
Right for Access & Maintenance	2002	F	1-35
	2003	I	1-35
	2004	J	1-35
	100	G	1-35
	101	H	1-35
	102	K	1-35
	103	L	1-35

SCHEDULE OF EASEMENTS IN GROSS

Nature	Burdened Land (Servient) Lot No.	Shown	Grantee
Right to Drain Water	35	E	Christchurch City Council

REV	DATE	REVISION DETAILS	ISSUED
K	1/02/23	TURNING HEADS JOALS	TL
J	17/01/23	STAGING ADDED	TL

BASECO Land Development Consultants

CLIENT
BOWENVALE GCO LTD

PROJECT
130 BOWENVALE AVE

DRAWING TITLE
PROPOSED SUBDIVISION OF PARTS
LOT 2 DP 33462

STATUS	***SCALE***	***SIZE***
FOR INFORMATION	1:750	A1

PROJECT	***DRAWING NO***	***REVISION***
1037	SC-01	K

Aquatic Ecology

Phone: (03) 366-4070
Cell: 021 022-62517
Email: riley@ael.org.nz
Internet: www.ael.org.nz

9th September 2022

130 Bowenvale Avenue Development – Ecological Impacts

Proposal

The land at 130 Bowenvale Avenue, Christchurch, is proposed to be subdivided into residential housing. Within this proposed development, an existing Christchurch City Council (CCC) stormwater & flood control area is proposed to be extended approximately 120 m south, to the southern boundary of the proposed development (Fig. 1).

Physical description

The proposed development area (PDA) encompasses two small hillside gullies briefly described below.

Northern gully

The northernmost gully (Fig. 1), terminated at the proposed subdivision road entry and was surveyed during a site visit on 08/04/2022. This gully contained geomorphological and ecological indicators of a small ephemeral channel. Specifically, tunnel and sheet erosion was observed in this channel, however no wetland plants or surface water were identified (App. I, Figs. i, ii). Due to the steep gradient and lack of wetland vegetation, it is likely that the channel in the north gully only flows during rainfall events, does not incorporate standing water, and therefore does not develop any freshwater ecological values. The ephemerality of the channel, it that no surface or sub-surface water is retained, means that no aquatic flora and fauna can survive.

Southern gully

The southern gully (Fig. 1) was not able to be surveyed on foot during the 08/04/2022 site visit, due to dense growth of gorse and other dryland shrubs (App. I, Fig. iii). All observed vegetation was exotic and dryland in nature. No flow was observed leaving this gully at the lower end.

Due to the difficult access, the southern gully was subject to a second survey (2nd September 2022), this time with pruning tools to provide better access to the thalweg and gully floor. Even then, some locations were quite hazardous, with the dry channel deeply incised into the topsoil. However, no surface water nor wetland vegetation was identified in several spot check along the gully floor. A puddle was located just uphill of the proposed development area, but was probably temporary, and supported no wetland vegetation or soils.

A complete wetland check of the southern gully is currently impossible with the dense covering of gorse. However, gorse is a facultive upland plant (Clarkson *et al.* 2021), and because it covers the thalweg, and spot checks provided no evidence of wetlands, we consider the possibility of any wetland being present is extremely unlikely.

Proposed stormwater treatment area

A narrow meandering channel (App. I, Figs. iv, v), known as Bowenvale Stream, was identified in the proposed extension of the stormwater/flood control area (narrow green area adjacent to the road, Fig. 1). At the time of survey, there was some turbid surface flow, and the stream bed substrate varied between firm sediment and cobbles. The high water turbidity was probably due to the high concentration of suspended loess clay in the banks and stream substrate. No macrophytes were identified in the waterway upstream of the existing flood protection area.

Existing flood control area

The existing flood control area (orange area in Fig. 1) consisted of a wide, grassed swale-type waterway (App. I, Fig. vi). Aquatic macrophytes such as starwort (*Callitriche stagnalis*) and floating sweet grass (*Glyceria fluitans)* was present in this reach, hydrophytes (i.e., water loving plants) indicating perennial surface water in this reach (App. I, Fig. vii).

Downstream of this swale, the channel incorporated a concrete-lined base and walls, with a flat base and which lacked fish refuge (App. I, Fig. viii). The walls were vertical, and approximately 1.8 m tall; presumably to accommodate flood flows and maximise flood capacity. However, baseflow of the waterway formed a shallow (depth c. 3 cm) cross-section, dispersed evenly between the concrete channel walls. The channel also incorporated V-notch weirs, possibly as a means of estimating flood flows.

Ecology

No freshwater ecology values have been identified within the proposed development boundary, neither in terms of hydrophytic (water-loving) plants or aquatic invertebrates or fish.

The Bowenvale Stream, flowing along the eastern boundary of the proposed development, possessed ecological indicators of surface water permanence at the time of the April 202 site visit. However, potential resident fish are sea migrants, and it would be difficult for these fish to access this habitat because of the nature of the channel downstream.

Smooth concrete channels are difficult for fish to negotiate an upstream passage. There are no low-flow areas to rest in, and fish are exposed to predators (e.g., birds and cats). At low flow, the reach water is also likely to become warm due do its shallow depth and sun exposure. The reach of Bowenvale Stream between the Heathcote River and the CCC flood control area can therefore be considered a significant fish passage barrier. Because of difficult fish passage from the sea, only the adept climbing species (shortfin eel (*Anguilla australis*)) has been confirmed to be present. A survey by Environment Canterbury in 2019 recorded the presence of shortfin eels in the existing CCC flood control area (Card 115728 in NZFFDB). Therefore, this species is likely to be present in suitable downstream habitats.

Due to the lack of recent fish surveying near the proposed development area, the reach upstream, downstream, and within the CCC flood control area/pond was electric fished on 6th September 2022 (20 min active current @ 200 V). No fish were recorded despite suitable fishing depth and conditions.

Figure 1. Map showing proposed development at 130 Bowenvale Avenue.

Aquatic habitat assessment, culvert placement

The site visit confirmed that surface water was probably only present within the proposed development boundary during rainfall, and no habitat was available for colonisation by aquatic fauna such as fish or aquatic macroinvertebrates.

We saw no evidence that the gully habitats were defined as wetlands under both the RMA definition, or as natural wetlands the recent NPS definition (Ministry for the Environment 2021). The development can therefore have no negative impacts on aquatic habitat availability. While a close inspection of the southern gully was not possible due to infestation of dryland plants, the proliferation of drylands plants leads us to believe that the southern channel is also a 'non-wetland'.

A culvert across the Bowenvale Stream, downstream of the Christchurch City Council stormwater/flood control area, will be required to provide residents with road access to the proposed development. This reach, and that downstream is concrete-clad (App. I, Fig. viii). The potential adverse impact of the culvert on fish values is moderated by the poor fish access due to the apparent fish passage barriers further downstream.

However, it is prudent to attempt to install a culvert consistent with the standards in the NPS-FM for fish passage. This is because at some point in the future, the concrete lined channel in the Bowenvale Stream will be naturalised, and non-compliant culvert may unnecessarily reduce fish distribution and biodiversity in the upper reaches.

The proposed extension of the Christchurch City Council stormwater/flood control area may impact on habitat availability for resident species, but in different ways. Firstly, the extension would likely mean approximately 120 m of flowing waterway would be turned into a large wide swale, like that of the existing CCC flood control area. An increase in water volume would be manifested as in increase in habitat area for shortfin eel should they obtain access in the future.

On the other hand, the erodable nature of the catchment necessitates the best possible stormwater treatment and retention. This is because water quality in the Heathcote River would benefit from a superior stormwater retention and treatment in Bowenvale Valley.

Amenity values

The existing stormwater/flood control area is not part of the PDA but is adjacent to it, with potential ecological connection in respect to food webs and environmental influence. The PDA may be an artifact of CCC modifying a historical natural wetland basin, in which case it would still be considered a natural wetland, albeit a modified one under the NPS-FM. However, if the stormwater basin area has been entirely constructed by CCC, then it is not considered a natural wetland under the new guidelines. Its classification may have implications for the access road to facing lots (Lots 30-44 under the Concept Design Report). Existing data suggests that, even with its significant access problems further downstream, shortfin eels may still be present in the existing, and therefore any potentially extended, stormwater treatment basin. Shortfin eels are habitat generalists, but large shortfin eels could dwell in standing water environments where water depth in the middle was somewhere between 0.4 m – 0.7 m (Jowett & Richardson 2008).

Of some ecological interest is the recent discovery of banded kokopu in the Heathcote River tributaries. It is conceivable that, with improved access and future naturalisation downstream of the PDA, banded kokopu could recolonise the Bowenvale Valley catchment. If so, the construction of naturalised permanent water basins would enhance the potential habitat for this species. Banded kokopu prefer pools over riverine habitats.

Native riparian plantings within the PDA adjacent to the CCC stormwater wetland would provide roosting areas for aquatic invertebrates and, with some overhanging cover, refuge for eels and other native fish. Normally, AEL works with Landscape Architects to arrive at a plant list which combines aesthetics, amenity and ecological functions. Such a collaboration would follow confirm of the ecology in the basin, and the non-wetland status of the southern gully.

Summary

A culmination of three field surveys found no areas of permanent surface water within the proposed property boundary. With erosion and sediment controls appropriate for these steep lands, the development phase itself should have no direct impacts on freshwater and wetland ecological values.

However, permanent surface water was identified in the upper reaches of the Bowenvale Stream, within the proposed stormwater/flood control area, and adjacent, but not within, the PDA. A second reconnaissance of the gorse-covered southern gully failed to locate any wetlands along the gully floor. While a complete longitudinal survey for wetlands would require gorse removal, we consider that the probability of any wetlands existing in the PDA to be very low.

References:

Clarkson, B., R.; Fitzgerald, N. B.; Champion, P.; Forester, L.; Rance, B. D. 2021. New Zealand Wetland Plant List 2021. Manaaki Whenua - Landcare Research, *LC3975*. 58 p.

Jowett, I. G.; Richardson, J. 2008. Habitat use by New Zealand fish and habitat suitability models. National Institute of Water and Atmospheric Research, *NIWA Science and Technology Series No. 55*. 148 p.

Ministry for the Environment 2021. Defining 'natural wetlands' and 'natural inland wetlands'. Wellington. *ME 1590*. 25 p.

NZFFDB Archives of the New Zealand Freshwater Fish Database.National Institute of Water and Atmospheric Research, Wellington.

Yours sincerely,

Riley Payne, Mark Taylor

Appendix I

Figure i. Dry channel identified in the northern gully. No wetland vegetation present.

Figure ii. Evidence of underground tunnelling by rainfall in the northern gully.

Figure iii. Showing the dense exotic vegetation in the southern gully. No foot access beyond this point.

Figure iv. Looking upstream at the Bowenvale Stream, upstream of the flood protection area. Note the presence of woody debris.

Figure v. Looking downstream at the upper reach of the Bowenvale Stream.

Figure vi. Looking upstream at the existing CCC flood control area.

Figure vii. Macrophytes in the existing flood control area, indicating habitat permanence.

Figure viii. Looking downstream at Bowenvale Stream, downstream of the existing CCC flood control area. This waterway is concrete-lined to the Heathcote River, with no visible fish baffles.

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Project Number 20268.000.001

Geotechnical Investigation

130 Bowenvale Avenue, Cashmere, Christchurch

Submitted to:
GCO Ltd
165 Harewood Road
Papanui
Christchurch 8053

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Project No.	20268.000.001	**Doc ID**	01	
Client	GCO Ltd	**Client Contact**	Cameron McCarthy	
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Date	**Revision Details / Status**	**Author**	**Reviewer**	**WP**
28/10/2022	Issued to Client	JM	RJ	DF

Executive Summary

Based on our investigations and assessment, the site is considered generally suitable for the proposed residential subdivision. We have summarised some of the findings of the report below:

Key Item	Recommendation	Report Section
Hazard Discussion	There are sections of the site which are susceptible to rockfall, slope instability and erosion from overland flow / tunnel gullies. It is our opinion that all of these can be appropriately mitigated to facilitate the proposed development.	6.0
Rockfall	Rockfall risk and mitigation are presented in the ENGEO July 2022 report (appended to this report as Appendix 4)	Appendix 4
Earthflow Landslides	Historical Earthflows are interpreted in the southern part of the proposed development.	6.2
Erosional Features	Evidence of erosional features (tunnel gullies, rilling and gullies) were noted within the southern portion of the site. These will need to be remediated / mitigated as part of the development.	6.3 & 7.2.2
Foundations	Shallow foundations consisting of strip, slab or pad footings are considered suitable for the majority site. Lots 22 and 23 will require specifically designed foundations which account for the potential movement of the shallow soils.	7.1
Shallow Bearing Capacity	Foundations found on the native loess encountered below topsoil between 0.4 m and 0.5 m depth. A minimum Geotechnical Bearing Capacity of 280 kPa can be assumed for strip footings and pad footings.	7.1.1
California Bearing Ratio	A California Bearing Ratio (CBR) of 4% may be adopted for preliminary pavement design.	7.2.6

The above is not intended to exhaustively characterise relevant geotechnical features at this site. Accordingly, this report must be read and understood in full.

1 Introduction

ENGEO Ltd was requested by GCO Ltd to undertake a geotechnical investigation of the property at 130 Bowenvale Avenue, Cashmere, Christchurch (herein referred to as 'the site'). This work has been carried out in accordance with our signed agreement dated 20 May 2022 (ref P2022.001.002_02). The purpose of the assessment was to complete a geotechnical investigation to support your application for subdivision consent.

The scope of this study comprised:

- A desktop study of geotechnical and geological data, including the New Zealand Geotechnical Database (NZGD).
- Site assessment by an experienced ground engineering professional.
- Shallow soil testing consisting of 11 hand auger boreholes (as access allowed) with associated Scala penetrometer and Shear vane testing.
- Deep testing, comprising open hole investigations, completed by Geovert to establish the loess to rock boundary in key areas across the site.
- Analysis of field data and production of a conceptual geological site model.
- Production of a geotechnical report (this document) based on the findings of our enquiries and ground investigation, including recommendations suitable for subdivision consent and commentary against Section 106 of the RMA.

Our scope of works does not include geotechnical investigations or assessment suitable for building consent purposes.

2 Site and Development Description

The site is located on the western side of the Bowenvale Valley upslope of Bowenvale Avenue on a section of approximately 5 hectares, with the legal description Pt Lot 2, 2 DP 33462 (Figure 1). The site is located on an east-facing section of that is moderately sloping (~20-22º) between 25 and 200 metres above sea level (m asl). A broadly north-south orientated ridgeline is located upslope of the proposed development. Downslope and broadly parallel with the direction of slope are a series of gullies and ridges.

The closest waterway is Sibley's Stream which extends along the eastern boundary of the site.

Based on preliminary subdivision plans supplied by Gravitas Architecture (14 March 2022). The proposed development comprises 35 lots, 12 of which are located within or partially within Rockfall Risk Management zones defined by the Christchurch Replacement District Plan (CRDP). We understand that the proposed new buildings will be one or two storeys and generally orientated along slope in order to maximise the view. The proposed subdivision layout plan[1] is provided in Appendix 1.

[1] Current at the time of writing.

Figure 1: Site Location Plan

Image from Datanest. Not to scale

3 Desktop Study

3.1 Regional Geology

The site is located on the Port Hills, Canterbury where the geological setting is typically topsoil and wind derived loess deposits of varying thickness overlying a basaltic rock mass (part of the Lyttelton Volcanic Group**).** The Lyttelton Volcanics typically comprise a series of interlayered lava flow deposits and pyroclastic units.

3.2 District Plan

The Christchurch City Council (CCC) District Plan has recorded the following Natural Hazards for the site:

- The site is mapped outside of any mass movement management area.
- The eastern most portion of the site is located within the Liquefaction Management Area (LMA).
- The eastern portion of the site directly above the LMA zone is mapped within the Remainder of the Port Hills and Banks Peninsula Slope Stability Instability Management Area.
- The western and central portion of the site is mapped within Rockfall Management zones. These are discussed in more detail in Section 3.4 below.

3.3 Rockfall Risk Reports

We have reviewed the GNS Science, 'Canterbury Earthquakes 2010 / 2011 Port Hills Slope Stability: Life Safety Risk from Rockfall report', dated May 2012. The report identifies the site as having an Annualised Individual Fatality Risk (AIFR) of greater than 10^{-3} and between 10^{-3} to 10^{-4} for the portion of the side closest to rockfall source areas and 10^{-4} to 10^{-5} for the majority of the site, more distal from the source areas. The lower reaches, on the northern side of the proposed development have an assessed AIFR of less than 10^{-5}. Accordingly, the central portion of the site has been placed within Rockfall Management Area 2 in CCC's District Plan, with the upper most portion of the slope allocated Rockfall Management Area 1, as shown in Figure 2.

Figure 2: Rockfall Management Areas

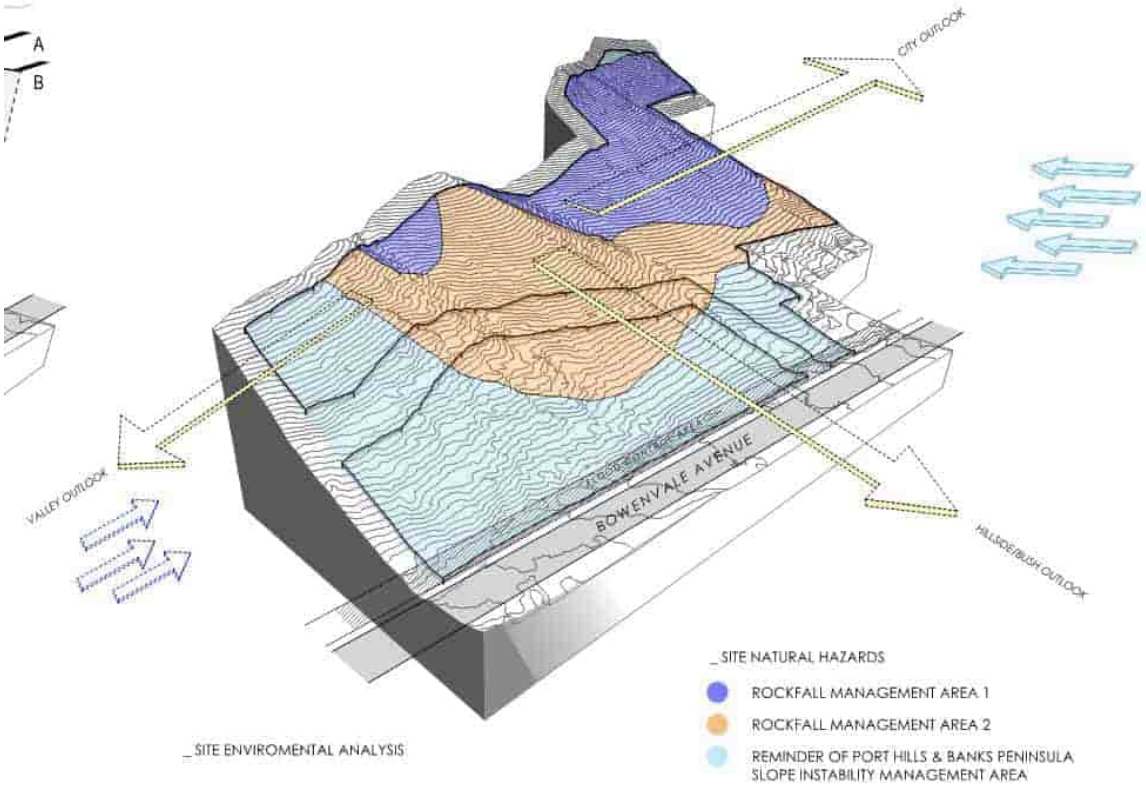


Image sourced from Gavitas Architecture March 2022 drawings.

ENGEO 2021 Report

ENGEO has completed a separate rockfall risk assessment report, dated July 2022. This rockfall assessment report should be read in conjunction with this report. This report further clarifies the extent of the rockfall risk for the site and provided mitigation options.

3.3.1 Geomorphology

GNS completed geomorphic mapping for the site as outlined within the September 2012 report (CR2012/15). The geomorphological map shown in Figure 3 shows the key geomorphological features of the site and the surrounding landscape. Key features are listed below:

- The majority of the site consists of loess or loess colluvium, with rock at or near surface in the north-western most corner of the site. Alluvium is mapped along the eastern boundary.
- There are two well-defined drainage lines that extend through the central portion of the site associated with the topography. These drainage channels connect to Sibley's Stream which extends along Bowenvale Avenue. The northern most of these gullies has also channelised a significant amount of rockfall from the cliff systems above.
- A large rilled section has been mapped from the southern gully to the site boundary to the south.

Figure 3: Geomorphology of the Site and surrounding area.

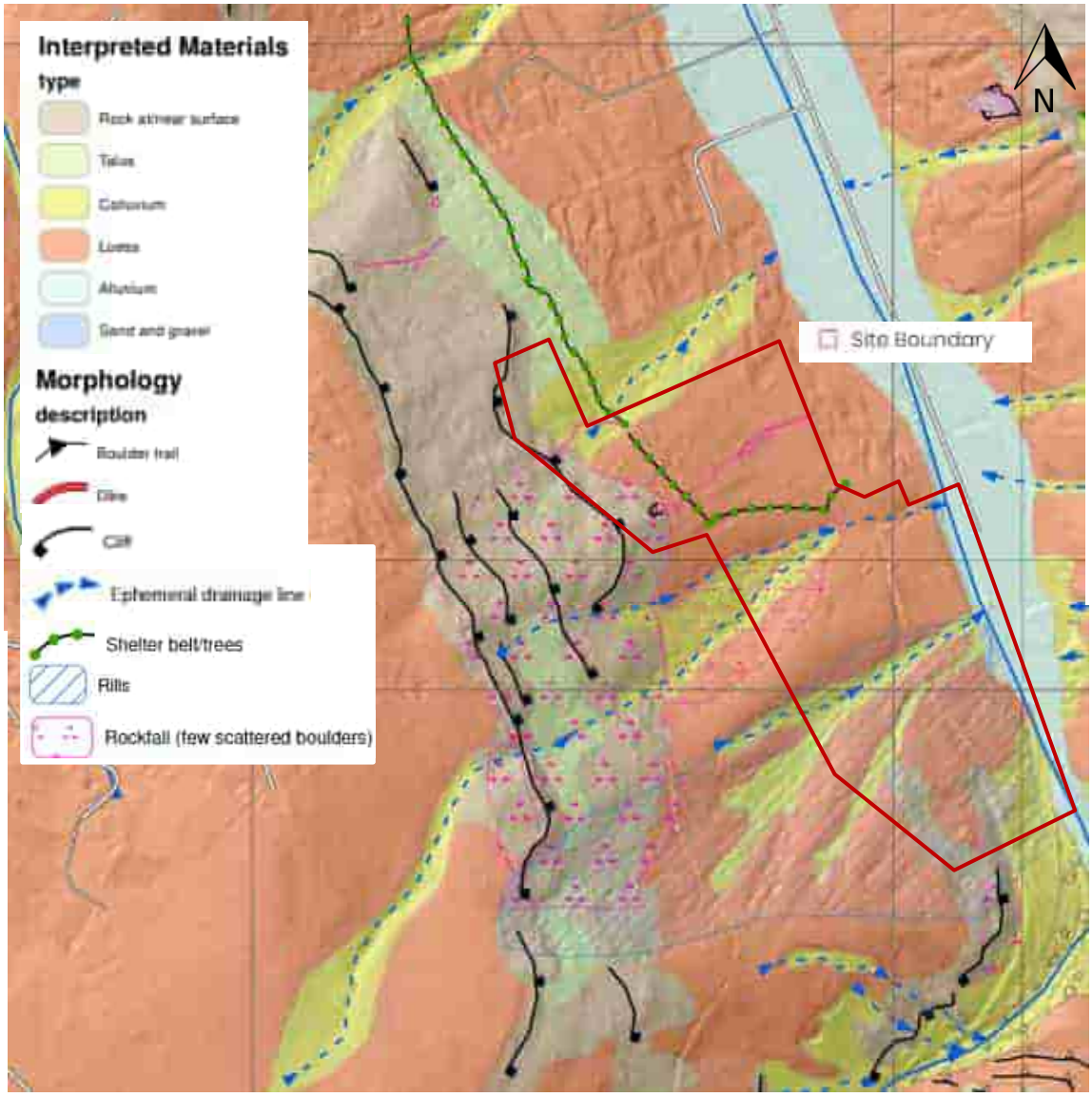


Image sourced from Appendix 4 Map C5/D5 of the GNS report dated September 2012 (CR2012/15).

3.4 New Zealand Geotechnical Database

We have reviewed the nearby subsurface investigation data available through the New Zealand Geotechnical Database (NZGD) with the purpose of gaining an understanding of regional geology. A summary of nearby investigations is provided in Table 1.

Table 1: Summary of Nearby Investigation Data

CPT / Borehole Identifier	Position Relative to Site	Depth of Exploration (m)	Assumed depth to Groundwater (m)	Refusal Condition
CPT_46122	80 m east at the closest point	9.11	Not recorded due to hole collapse	Practical Refusal on the Tip
CPT_46123	60 m east at the closest point	11.6		
CPT_46124		18.54		Practical Refusal due to reaction anchor failure

The nearby deep testing suggests that loess, loess colluvium are present across the lower reaches of the site, and in places to depths in excess of 18.5 m.

3.5 Historical Aerial Photography

We reviewed limited aerial photographs of the site dating back to 1925. The site has been used as pastural land since this time.

Our review of the aerial photographs taken between 1945 and 1969 show shallow isolated earthflow failures within the southern portion of the site (Figure 4). This is consistent with the geomorphological mapping outlined above in Section 3.4.1.

The aerial photographs following the Canterbury Earthquake Sequence (CES) show no obvious evidence of slope instability at the site. The photographs also show no evidence of liquefaction ejecta on-site during the CES.

Figure 4: Historic Aerial 1955-1959

Note 1: Earthflow indicated by white arrows.

3.6 Listed Land Use Register

The Listed Land Use Register (LLUR) is a publicly available database of sites where hazardous activities and industries have been located throughout Canterbury. The site is mapped outside of any known HAIL or contamination risk zones.

4 Field Investigations and Site Conditions

4.1 Site Walkover

ENGEO completed a detailed site assessment as part of the Rockfall assessment, detailed within our report dated 4 July 2022. The key observations are provided below:

- The majority of the site is covered with high grass or scrub with scattered large trees. The scrub is concentrated in the valleys and is limited on the ridges.
- Some evidence of gully erosion was noted on some of the valley sides, however given the thick scrub in the valleys, we could not assess these areas. Given the concentration of water, it is likely that tunnel gullies earthflow and other erosion features are more prevalent in the valley areas.
- On the upper part of the proposed subdivision, a number of fallen boulders can be observed. These are more prevalent in the valleys and are less evident the further down the site.

4.2 Subsurface Investigations

4.2.1 Hand Auger Boreholes

ENGEO completed 12 hand auger boreholes and associated Scala penetrometer (Scala) tests to depths between 0.6 m and 3.0 m. The majority of the hand augers met practical refusal in hard loess. HA11 met practical refusal on inferred bedrock at 1.5 m depth. HA07 and HA10 met practical refusal on weathered volcanics between 0.6 m and 0.8 m depth, based on the location of these hand augers we consider it likely this is a colluvium layer.

Groundwater was not encountered within the majority of the hand auger logs. However, groundwater was noted at 1.3 m depth in HA04. It should be noted HA04 was located within the lower reaches of a gully system.

Locations of testing are provided in Appendix 1. Hand Auger logs are presented in Appendix 2 of this report and are written in accordance with the New Zealand Geotechnical Society field classification guidelines (NZGS, 2005).

4.2.2 Geovert Deep Testing

Geovert drilled a series of vertical holes in order to establish the soil to rock boundary in critical areas across the site. They completed this utilising a 'Boar Sinker' rig which does not provide core recovery.

The initial three holes (GV01 - 03) were completed on the 29 to 30 September 2022, on the upslope side of the site adjacent to the boundary fence. The first hole extended to 8.7 m before meeting practical refusal in the loess. The second hole extended to 0.2 m depth before refusing on rock. ENGEO decided that additional testing along the upslope side of the site was not required, as design for both rock and soil anchors would be needed regardless.

The third hole (GV03) was completed in the location of the proposed new central access road. The purpose of this test was to help inform the retaining design along this section of cut. GV3 encountered the soil to rock interface at 4.5 m.

Geovert then completed two more tests (GV04 and 05) from the 12 to 14 October 2022, in the location of the proposed new central access road, either side of GV3. The locations were positioned in the areas where the greatest cut is required. GV4 completed to the south of GV3 encountered rock between 1.0 m and 1.3 m depth. GV5 which was completed to the north of GV3 extended to 11.0 m before meeting practical refusal in wet loess.

The locations of the tests are provided within Appendix 1.

5 Ground Model

The material encountered in our subsurface investigations is broadly consistent with published mapping. Within the areas where rock is not outcropping, the site is generally covered with topsoil between 0.25 m and 0.6 m deep. The topsoil is in turn underlain by loess or loess colluvium which ranges in depth from 0.6 m to in excess of 8 m. The tests on-site and the nearby CPT's completed on the neighboring properties indicate that the bedrock profile dips steeply toward the northeast.

As noted in sections 3.4.1 and 3.6 above there is evidence of Loess rilling, tunnel gully erosion and earthflow landslides within the southern portion of the site. These features likely relate to surface water migrating toward the established gully systems.

6 Geotechnical Assessment

Based on our review of mapped, observed land damage at the site, and the ground conditions encountered in the investigations, we consider rockfall, earthflow landsliding and soil erosional features, to be the primary geotechnical considerations for the site.

6.1 Rockfall

ENGEO previously completed a detailed rockfall assessment within our report dated July 2022. This report is attached as Appendix 4 and provides rockfall modelling and risk assessment including recommendations for potential rockfall risk management options.

Given the size and extent of the rockfall source areas, rockfall fences were proposed as the most appropriate risk mitigation options for the development.

6.2 Earthflow Instability

There is evidence of earthflow instability within the southern portion of the site as outlined in Section 3.6 of this report. Recommendations and restrictions associated with this area are provided below in Section 7.

As the rest of the site has been seismically tested during the CES we consider the risk of significant earthquake induced slope instability in these areas to be low.

6.3 Soil Erosion

Evidence of established gullies and tunnel gullies were noted on-site. Tunnel gully erosion is a natural process caused by the erosion of subsurface soil layers by surface water. The water moves down through the soil profiles until it reaches a less permeable layer where it concentrates to form a downslope channel (tunnels or under runners). As the tunnel widens the top of the tunnel gully may collapse resulting in an exposed gully.

Evidence of erosional features (tunnel gullies, rilling and gullies) were noted across the site; however, these appear to be more concentrated around the natural flow paths and southern portion of the site as outlined in Section 3.4.1. The development will need to give careful consideration to appropriate drainage as part of the subdivision engineering works and within the individual building platforms. Considerations in terms of remediation and mitigation have been provided in Sections 7.2.2 and 7.2.4.

6.4 Soil Classification

The site can be defined as partially ‘Class B – Rock’ for the areas of the site where loess is less than 3 m deep. However, the majority of the site can be defined as “Class C – Shallow soil sites”. For the purpose of seismic design, we consider the soil classification in line with NZS 1170.5:2004 to be ‘Class C’ for Lots 1 to 8 and 32 to 34. For all other lots the more conservative of the two options provided should be utilised, unless further testing to classify soil category is completed during the building consent phase.

6.5 Assessment with Section 106 of the Resource Management Act

As outlined above the proposed development is situated on land that is subject to natural hazards. Section 106 of the Resource Management Act 1991 states a consent authority may refuse to grant subdivision consent or may grant a consent subject to specific consent conditions if the land is at significant risk from natural hazards. For the proposed subdivision, we consider the following natural hazards may pose a significant risk to the development.

- Soil erosion, including surface and subsurface erosion, associated surface water runoff.
- Falling debris, in particular rockfall that could impact the site from upslope sources.
- Earthflow landsliding.

The location of each of the hazards outlined above had been provided within the hazard map in Appendix 3.

We conclude that, although there are risks posed to the site now, the risk to the existing and proposed buildings from natural hazards will be acceptably low once the mitigation measures described in Section 7 of this report have been completed. We also consider that the proposed works will not accelerate, worsen, or result in material damage to the land so long as the recommendations in this report are followed.

We have not considered the risk of building damage due to ground shaking during earthquakes. Although this risk has a geotechnical element, we consider that this risk has been addressed in NZS1170.5, and so long as the building design complies with this standard, the risk of building damage due to ground shaking would be acceptably low.

7 Geotechnical Recommendations

Following our initial assessment of site hazards the proposed lot development plan was re-designed to account for the location of existing flow paths and known slope instability areas.

The lots along the upslope portion of the site will be protected from rockfall by the proposed rockfall mitigation works outlined within our Rockfall Risk Assessment report dated July 2022.

The water associated with the known drainage lines (shown in Figure 3 and Appendix 3) is recommended to be captured into a culvert system (designed by others). The drainage lines are indicated by the 10 m wide flow paths shown below in Figure 5 (highlighted in yellow). The purpose of the proposed system is to reduce the width of the flow paths, by entraining surface water runoff into a designed channel system. This will facilitate development of the proposed lots in close proximity to the designated flow paths. Our understanding is that the culvert and overland flow path system will be designed for the calculated 0.5% AEP peak flow while also providing 0.5 m freeboard.

The earthflow instabilities as described in Section 3.6 have the potential to impact the developments on Lots 22, 23 and 30. Based on the information available to us further movement of this landslide is likely triggered by rainfall events rather than seismic events. Therefore, we have recommended another engineered flow path be constructed at the head of the known landslide to divert water away from these areas and into an engineered culvert system. It should be noted however that the soil within the earthflows is likely to be significantly weakened and, depending on foundation solution, may need to be removed or stabilised prior to development of building platforms. We recommend further testing, assessment and remedial works design be completed at the building consent stage for these lots. This is covered further in Section 7.1 below.

Figure 5: Proposed remediation in designed subdivision plan.

Image sourced from Survus Drawings SC-01 Revision E (5/9/2022).

7.1 Foundation Recommendations

A number of foundation solutions may be suitable for the proposed development at the site depending on proposed building types, sizes, intended use, construction materials and locations. Further geotechnical testing will be required at the building consent stage with testing specifically targeted for building platforms and retaining walls once locations are finalised, as depth to rock varies across the site.

We consider the majority of the site to be suitable for shallow strip, pad or slab foundations. We have not been provided with foundation details; however, we believe that both timber and concrete slab foundation systems are suitable for the site. Your Structural Engineer may have other preferred foundation options that we would be happy to discuss.

Lots 22, 23 and 30 will require specifically designed foundations which account for the potential movement and low strength of the shallow soils. This may require piling foundations to the rock. The nearby deep investigations indicate that rock is within the upper 3 m of the soil profile within this area. It should be noted that piles may also require design for lateral movement, however, this will be confirmed during building consent.

Additionally, foundations on Loess or Loess colluvial soil should be designed such that they can span across a tunnel gully with a width of 1.5 m (e.g., MBIE Canterbury Guidance - Relevellable concrete surface structures). While we anticipate that tunnel gully erosion will be mitigated as described in this report, it is possible that erosion may continue once the houses are constructed, and this measure is relatively simple and will help to reduce the likelihood of damage should erosion occur. Notwithstanding, should tunnel gullies be observed in the vicinity of building platforms (during construction) or houses (following construction), they must be assessed by a geotechnical professional.

7.1.1 Bearing Capacity

We recommend embedding foundations in the native silt below all topsoil, at a depth of approximately 300 mm, and designing for geotechnical Ultimate Rupture Bearing Capacities as indicated in Figure 6 and Figure 7.

We have used the following soil parameters when calculating available bearing capacity for the site.

Table 2: Preliminary Building Founding Soil Parameters

Soil Type	Unit Weight (kN/m^3)	Friction Angle, □□(°)	Cohesion (kPa)
Stiff Silt (Loess)	17.0	30.0	3

Figure 6: Ultimate Rupture Bearing Capacity of Strip Footings

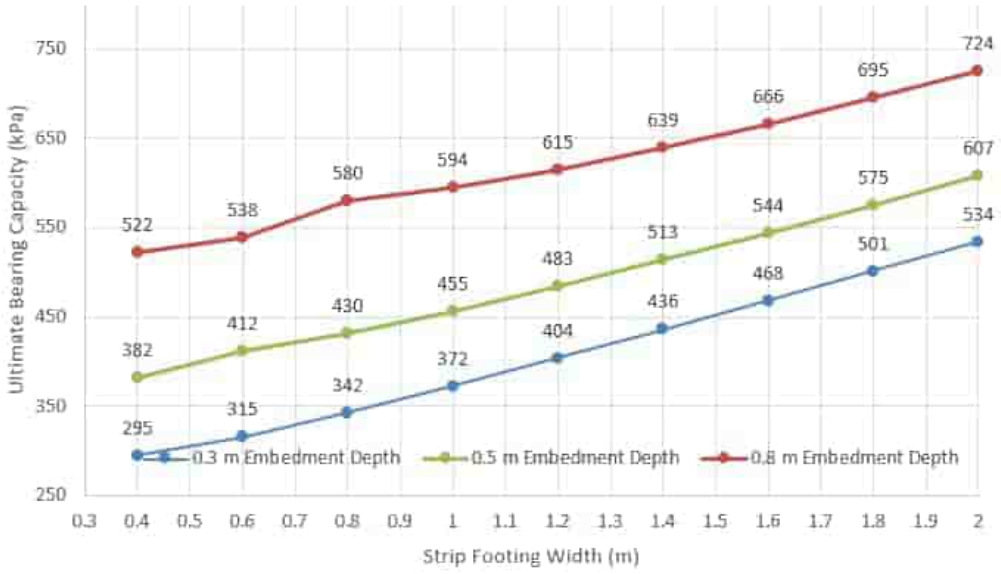
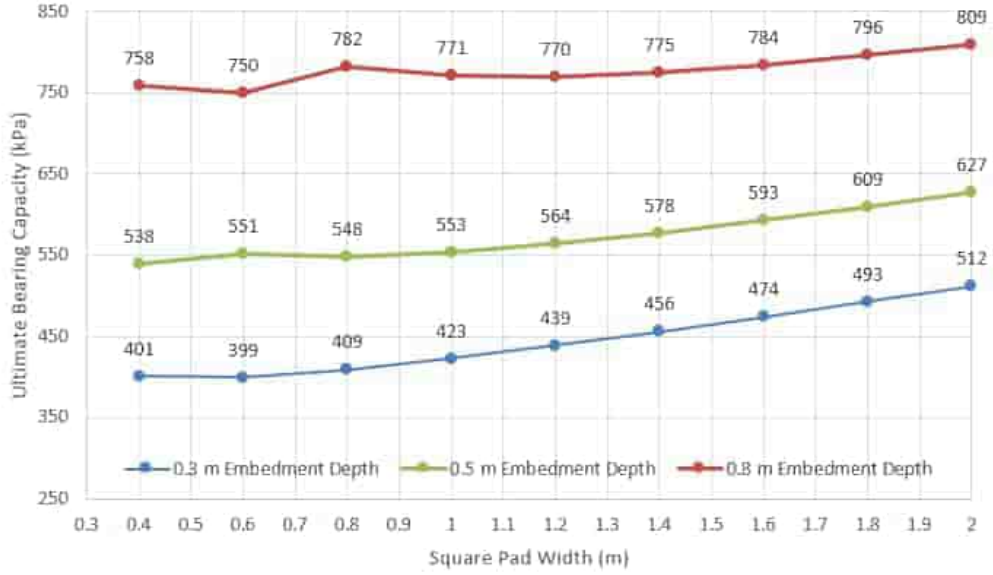


Figure 7: Ultimate Rupture Bearing Capacity of Square Pad Footings



7.1.2 Reduction Factors

The bearing capacity should be multiplied by the following capacity reduction factors:

- All ULS load combinations (including earthquakes) 0.45 – 0.6
- Serviceability Limit State cases 0.33

There will be some settlements beneath the footings under the applied loads and total settlements. This can be quantified during the detailed design phase as it is dependent on loads and footing sizes.

If there are significant horizontal loads or moments applied to the footing, a more detailed assessment of bearing capacity will be required and ENGEO should be contacted for specific review and comment.

7.2 Earthworks Recommendations

7.2.1 Site Preparation Recommendations

All grass and organic soils to depths designated by the geotechnical professional should be removed during stripping operations.

7.2.2 Tunnel Gullies & Soil Erosion

Soil rilling and tunnel gully features were observed on-site and have been mapped within the southern side of the site. We recommend that assessment and remediation is considered during the earthworks and building specific lot assessments.

Assessment during Earthworks

Any tunnel gullies that are exposed during either phase will need to be remediated. We recommend that any soft or wet soil is removed from the exposed base of the tunnel gully. The tunnel gullies may be either excavated out or filled with a low permeability grout. Site won fill can be used to back fill the remediated areas, provided it meets the criteria below. These should be surveyed in to help determine appropriate depths for the surface cut off drains described in Section 7.2.5.

Considerations during building consent level investigations

The proposed roads should intercept the majority of the rills and tunnel gullies for the lower lots; however, the upper lots will remain unprotected. We have provided the following options for consideration:

i. Extend foundations and supporting elements down to rock – this may require additional investigation to tag out rock during the detailed design phase.

ii. Dwellings should be designed to be separate from the hillside behind them, such that they are not exposed to groundwater seepage, needing to be controlled behind basement retaining walls. In practical terms, this means that houses should either be built above grade, or if they are to be cut into the hillside, then they should have two separate walls with at least 1 m gap between them -the retaining wall in contact with the ground, and then the rear wall of the house as a separate structure. This also helps facilitate repairs following future seismic events.

7.2.3 Fill Placement

During the earthworks operations all topsoil, organic matter, fill and other unsuitable materials should be removed from the construction areas in accordance with the recommendations of NZS 4431:2022, *Engineered Fill Construction for Lightweight Structures*

We consider that site won fill may be appropriate for the purpose of bulk earthworks grading. Laboratory testing on the loess material will need to be completed to confirm it is suitable for use as engineered fill. If during excavation it is found that the material varies from that described within the report, then further laboratory testing, including assessment of maximum dry density / optimum moisture may be required. These tests can be completed at the time of site earthworks.

All engineered fill should be placed in lifts no greater than 200 mm thick to at least 95% Maximum Dry Density at a moisture content within at least 3 percentage points of optimum. The degree of compaction for each lift should be tested by the contractor in accordance with NZS4407:2015 using a nuclear density meter (NDM).

7.2.4 Cuts and Batters

We recommend that any excavations exceeding 1.5 m in height, and steeper than shown in Table 3, be approved by a geotechnical practitioner during earthworks construction. We recommend the following for temporary batters for excavations that exceed 1.5 m in height and all permanent cut slopes.

Cuts should be limited where possible to areas actively worked on as this will reduce the risk of instability and erosion.

- Cuts must not be exposed to adverse weather conditions (i.e. avoid earthworks during winter) and should be covered to reduce water infiltration and sediment or dust runoff.
- Drainage will be required to extend along the top of the cuts to keep the batter faces dry, as the strength of loess reduces when it becomes saturated. Details of drainage for the temporary cut slopes and retaining walls will be provide following detailed design and confirmation of cut layouts.
- All cuts and batters should be in line with the WorkSafe Good Practice Guidelines for Excavation Safety (July 2016).

Table 3: Recommended Maximum Batter for Temporary Cuts without Surcharge Loads

Permanent Cuts / Batter	
Material Type	**Recommended Maximum Batter for Cuts (horizontal to vertical)**
Loess	2.5 : 1
Temporary Cuts / Batter	
Material Type	**Recommended Maximum Batter for Cuts (horizontal to vertical)**
Loess	1 : 2.5[1]

[1]We have suggested a staged approach which is outlined above.

7.2.5 Stormwater and Wastewater

During construction, measures should be undertaken to control and treat stormwater runoff, with silt and erosion controls complying with local authority guidelines for erosion and sediment control.

Given the extensive rills and gullies on-site we recommend the installation of surface cut-off drains on the upslope sides of the proposed access roads to intercept surface water and dispose of it into an approved stormwater system. Cut off drains should extend to the hard loess encountered between 0.3 m depth and 1.5 m depth in the current test locations. The surface cut off drains should be lined with a bidim cloth (A29 or equivalent) or have an appropriately designed filter to prevent the silt migrating into the drains and clogging them.

Suitable stormwater flow paths should be maintained upslope of the proposed development area both during and following construction. Stormwater from paved areas shall be taken in a piped system and disposed of into an approved stormwater system.

7.2.6 Proposed Road Subgrade

Based on our Scala penetrometer testing, we consider the underlying materials to be suitable for constructing a new road as outlined on the preliminary site plan supplied to us. Correlation of Scala blow counts to California Bearing Ratio (CBR) indicates that the material directly below the topsoil (approximately 0.3 m) has an equivalent CBR between 2 and 20 across the site, however we recommend a CBR of 4 be used for the design. However, if this is not sufficient it is likely that this CBR can be improved during detailed design. Furthermore, we consider for the purpose of road design that the bearing material should be considered to be dry, low plasticity Silt.

Further subgrade testing and monitoring should be undertaken at the time of construction to check subgrade and fill suitability.

8 Sustainability

We encourage you to consider sustainability when assessing the options available for your project. Where suitable for the project, we recommend prioritising the use of sustainable building materials (such as timber in favour of concrete or steel), locally sourced (materials readily available to Contractors as opposed to materials requiring import), and installed in an environmentally friendly way (e.g., reduced carbon emissions and minimal contamination). If you would like to discuss these options further, ENGEO staff are available to offer suggestions.

9 Limitations

iii. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, GCO Ltd, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

iv. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.

v. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

vi. This Limitation should be read in conjunction with the Engineering NZ/ACENZ Standard Terms of Engagement.

vii. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (03) 328 9012 if you require any further information.

Report prepared by

Jacinta Morgan

Engineering Geologist

Report reviewed by

Richard Justice, CMEngNZ (PEngGeol)

Principal Engineering Geologist

10 References

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We also acknowledge the New Zealand GeoNet project and its sponsors EQC, GNS Science and LINZ, for providing data used in this report.

APPENDIX 1:

Test Location Plan

Legend

- Hand Auger Locations
- Geovert Test Location
- Proposed Subdivision Layout Plan

Note: The blue lines indicate potential flow paths and the red lines indicate potential earthflow location. This is detailed further in Appendix 3.

0 25 m 50 m

ENGEO

Produced by Datanest.earth

Title: Test Location Plan		
Client: Geovert		Figure No: 1 Size: A4
Project: Bowenvale Development	Drawn: JM	
Date: 19-07-2022	Checked: RJ	
Proj No: 20268.001	Scale: 1:2000	Version: 1.0

APPENDIX 2:

Hand Auger Locations

LOG OF AUGER HA01

Bowenvale Subdivision
130 Bowenvale Avenue
Christchurch
20268

Client : GCO Ltd
Client Ref. :
Date : 13/07/2022
Hole Depth : 0.8 m
Hole Diameter : 50 mm

Shear Vane No : 2022
Logged By : JC/TH/CW
Reviewed By : JM
Latitude : -43.582324
Longitude : 172.648112

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
0.0	TOPSOIL	ML	Sandy SILT with trace rootlets; dark brown. Low plasticity. Sand, fine to medium. [TOPSOIL]				M	-	
0.5	LOESS	ML	Sandy SILT; brownish yellow with orange mottles. Low plasticity. Sand, fine to medium.				D	VSt - H	UTP
			End of Hole Depth: 0.8 m Termination Condition: met practical refusal						
1.0									
1.5									
2.0									

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>
>>
>>

Hand Auger met practical refusal at 0.8 m depth on hard material.
Scala Penetrometer met practical refusal at 0.9 m depth.
Standing groundwater was not encountered

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 20/7/22

LOG OF AUGER HA02

Bowenvale Subdivision
130 Bowenvale Avenue
Christchurch
20268

Client : GCO Ltd
Client Ref. :
Date : 13/07/2022
Hole Depth : 0.8 m
Hole Diameter : 50 mm

Shear Vane No : 2022
Logged By : CW/TH/JC
Reviewed By : JM
Latitude : -43.582304
Longitude : 172.64719

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
0	TOPSOIL	ML	Sandy SILT with trace rootlets; dark brown. Low plasticity. [TOPSOIL]					-	
	LOESS	ML	SILT with trace sand; yellowish brown with orange mottles. Low plasticity. Sand, fine to medium.				M	VSt	158/64
0.5		ML	Sandy SILT; yellowish brown. Low plasticity. Sand, fine to medium.					H	
			End of Hole Depth: 0.8 m Termination Condition: met practical refusal						
1.0									
1.5									
2.0									

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

Hand Auger met practical refusal at 0.8 m depth on hard material.
Scala Penetrometer met practical refusal at 0.9 m depth.
Standing groundwater was not encountered

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 20/7/22

LOG OF AUGER HA03

Bowenvale Subdivision
130 Bowenvale Avenue
Christchurch
20268

Client : GCO Ltd
Client Ref. :
Date : 13/07/2022
Hole Depth : 0.75 m
Hole Diameter : 50 mm

Shear Vane No : 2022
Logged By : JC/CW/TH
Reviewed By : JM
Latitude : -43.581712
Longitude : 172.646257

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
0.0	TS	ML	Sandy SILT with trace rootlets; brown. Low plasticity. Sand, fine to medium. Poorly graded [TOPSOIL].					-	
	LOESS	ML	SILT with trace sand; yellowish brown with orange mottles. Low plasticity.				M	F	UTP
0.5		ML	Sandy SILT; yellowish brown with orange mottles. Low plasticity. Sand, fine.					H	
			End of Hole Depth: 0.75 m Termination Condition: met practical refusal						
1.0									
1.5									
2.0									

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

>>

Hand Auger met practical refusal at 0.75 m depth on hard material.
Scala Penetrometer met practical refusal at 1.3 m depth.
Standing groundwater was not encountered

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 20/7/22

LOG OF AUGER HA04

Bowenvale Subdivision
130 Bowenvale Avenue
Christchurch
20268

Client : GCO Ltd
Client Ref. :
Date : 15/07/2022
Hole Depth : 1.5 m
Hole Diameter : 50 mm

Shear Vane No : 2022
Logged By : TH/JXT
Reviewed By : JM
Latitude : -43.581451362345
Longitude : 172.64755719011

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
0	TOPSOIL	ML	[TOPSOIL] Clayey SILT with some sand and trace rootlets; dark brown. Low plasticity. Sand, fine.					-	
	LOESS	ML	Sandy SILT with trace clay: yellowish brown with orange mottles. Low plasticity. Sand, very fine.			▼	W	St - VSt	76/34 108/39 116/8
								H	87/18
1.5			End of Hole Depth: 1.5 m Termination Condition: met practical refusal						UTP
2.0									

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

Hand Auger met practical refusal at 1.5 m depth on hard material.
Scala Penetrometer met practical refusal at 1.7 m depth.
Dip test showed standing water at 1.3 m depth.

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 20/7/22

LOG OF AUGER HA05

Bowenvale Subdivision
130 Bowenvale Avenue
Christchurch
20268

Client : GCO Ltd
Client Ref. :
Date : 13/07/2022
Hole Depth : 1.7 m
Hole Diameter : 50 mm

Shear Vane No : 2022
Logged By : JC/CW/ TH
Reviewed By : JM
Latitude : -43.581174
Longitude : 172.646702

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
0.0	TOPSOIL	ML	Sandy SILT with rootlets;dark brown. Low plasticity. Sand, fine. [TOPSOIL]	M	-	
0.5	LOESS	ML	SILT with trace sand; dark yellowish brown to grey with orange mottles. Low plasticity. Sand is fine.	W	St - VSt	77/16
1.0		ML	Sandy SILT; yellowish brown with some orange mottles. Low plasticity. Sand is fine to medium.	D	VSt - H	180/39
1.5			End of Hole Depth: 1.7 m Termination Condition: met practical refusal			
2.0						

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

>>

>>

Hand Auger met practical refusal at 1.7 m depth on hard material.
Scala Penetrometer met practical refusal at 1.9 m depth.
Standing groundwater was not encountered

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 20/7/22

LOG OF AUGER HA06

Bowenvale Subdivision
130 Bowenvale Avenue
Christchurch
20268

Client : GCO Ltd
Client Ref. :
Date : 14/07/2022
Hole Depth : 3 m
Hole Diameter : 50 mm

Shear Vane No : 2022
Logged By : TH/JC
Reviewed By : JM
Latitude : -43.581218
Longitude : 172.645986

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
0.0	TOPSOIL	ML	SILT with some sand with trace rootlets; dark brown. Low plasticity. Sand, fine to medium.				W	-	
0.5	LOESS	ML	SILT with some sand; brownish grey with orange mottles. Low plasticity. Sand, fine to medium.				M	St - VSt	201/55
1.0		ML	Sandy SILT: brownish grey. Low plasticity. Sand, fine to medium.					VSt - H	UTP 122/26 106/26
2.0									
2.5									
3.0			End of Hole Depth: 3 m Termination Condition:						

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>
>>
>>

Hand auger met target depth at 3 m depth .
Scala Penetrometer met practical refusal at 2.7 m depth.
Standing groundwater was not encountered

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 20/7/22

LOG OF AUGER HA07

Bowenvale Subdivision
130 Bowenvale Avenue
Christchurch
20268

Client : GCO Ltd
Client Ref. :
Date : 15/07/2022
Hole Depth : 0.8 m
Hole Diameter : 50 mm

Shear Vane No : 2022
Logged By : TH/JXT
Reviewed By : JM
Latitude : -43.580569911915
Longitude : 172.64730964631

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
	TOPSOIL	ML	[TOPSOIL] clayey SILT; brown. Low plasticity.					-	
0.5	LOESS	ML	SILT with some sand; light brown. Low plasticity. Sand is fine.				M	VSt - H	119/26 UTP
			Fine gravel encountered End of Hole Depth: 0.8 m Termination Condition: met practical refusal						
1.0									
1.5									
2.0									

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

Hand Auger met practical refusal at 0.8 m depth on inferred weathered volcanics.
Scala Penetrometer met practical refusal at 1.7 m depth.
Standing groundwater was not encountered

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 20/7/22

LOG OF AUGER HA08

Bowenvale Subdivision
130 Bowenvale Avenue
Christchurch
20268

Client : GCO Ltd
Client Ref. :
Date : 14/07/2022
Hole Depth : 0.75 m
Hole Diameter : 50 mm

Shear Vane No : 2022
Logged By : JC/TH
Reviewed By : JM
Latitude : -43.5807
Longitude : 172.646205

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
	TOPSOIL	ML	Sandy SILT with trace rootlets; dark brown. Low plasticity. Sand,fine to medium. Poorly graded [TOPSOIL].				W	-	
0.5	LOESS	ML	SILT with minor sand; yellowish brown with orange mottles. Low plasticity. Sand, fine.					F - St	UTP
			Becomes moist at 0.5m depth.				M	VSt - H	
			End of Hole Depth: 0.75 m Termination Condition: met practical refusal						
1.0									
1.5									
2.0									

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>
>>
>>

Hand Auger met practical refusal at 0.75 m depth on hard material.
Scala Penetrometer met practical refusal at 0.9 m depth.
Standing groundwater was not encountered

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 20/7/22

LOG OF AUGER HA09

Bowenvale Subdivision
130 Bowenvale Avenue
Christchurch
20268

Client : GCO Ltd
Client Ref. :
Date : 14/07/2022
Hole Depth : 0.8 m
Hole Diameter : 50 mm

Shear Vane No : 2022
Logged By : JC/TH
Reviewed By : JM
Latitude : -43.580789
Longitude : 172.645414

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
	TS	ML	Sandy SILT with trace gravel and rootlets; brown. Low plasticity. Sand, fine to medium. Poorly graded [TOPSOIL].				W	-	
0.5	LOESS COLLUVIUM	ML	Sandy SILT with trace gravel; yellowish brown. Low plasticity. Sand, fine to medium.				M	St - VSt	UTP
			End of Hole Depth: 0.8 m Termination Condition: met practical refusal						
1.0									
1.5									
2.0									

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

Hand Auger met practical refusal at 0.8 m depth on hard material.
Scala Penetrometer met practical refusal at 0.9 m depth.
Standing groundwater was not encountered

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 20/7/22

LOG OF AUGER HA10

Bowenvale Subdivision
130 Bowenvale Avenue
Christchurch
20268

Client : GCO Ltd
Client Ref. :
Date : 15/07/2022
Hole Depth : 0.6 m
Hole Diameter : 50 mm

Shear Vane No : 2022
Logged By : TH/JXT
Reviewed By : JM
Latitude : -43.579872554597
Longitude : 172.64562562108

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
0.0	TOPSOIL	OL	[TOPSOIL] clayey SILT with trace sand; brown. Low plasticity					-	
0.5	LOESS	ML	Clayey SILT with some sand; brown with orange streaks. Low plasticity. Sand is fine to course.				M	VSt	UTP
			End of Hole Depth: 0.6 m Termination Condition: met practical refusal						

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

>>

1.0

1.5

2.0

Hand Auger met practical refusal at 0.6 m depth on inferred weathered volcanics.
Scala Penetrometer met practical refusal at 1.5 m depth.
Standing groundwater was not encountered

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 20/7/22

LOG OF AUGER HA11

Bowenvale Subdivision
130 Bowenvale Avenue
Christchurch
20268

Client : GCO Ltd
Client Ref. :
Date : 14/07/2022
Hole Depth : 1.5 m
Hole Diameter : 50 mm

Shear Vane No : 2022
Logged By : TH/JC
Reviewed By : JM
Latitude : -43.580313
Longitude : 172.645349

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
0.0	TOPSOIL	ML	SILT with some sand with trace rootlets; dark brown. Low plasticity. Sand, fine. [TOPSOIL]		-	
			Sandy SILT: brownish grey. Low plasticity. Sand, fine to medium.	W		
0.5	LOESS	ML				UTP
1.0				M	St - VSt	225+
1.5			Scala was bouncing on inferred rock at 1.5 m. End of Hole Depth: 1.5 m Termination Condition: met practical refusal			
2.0						

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

Hand Auger met practical refusal at 1.5 m depth on inferred bedrock.
Scala Penetrometer met practical refusal at 1.5 m depth.
Standing groundwater was not encountered

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 20/7/22

LOG OF AUGER HA12

Bowenvale Subdivision
130 Bowenvale Avenue
Christchurch
20268

Client : GCO Ltd
Client Ref. :
Date : 15/07/2022
Hole Depth : 1.5 m
Hole Diameter : 50 mm

Shear Vane No : 2022
Logged By : TH/JXT
Reviewed By : JM
Latitude : -43.579973
Longitude : 172.644796

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
0	TOPSOIL	ML	[TOPSOIL] SILT with some sand and trace rootlets; dark brown. Low plasticity. Sand, fine.					-	
	LOESS	ML	Clayey SILT with some sand; yellowish brown with orange mottles. Low plasticity. Sand, fine.					VSt	105/32
0.5		ML	Sandy SILT; yellowish brown with orange mottles. Low plasticity. Sand, fine to medium.				M	H	UTP 158/42 196/61
1.0		ML	Sandy SILT with some gravel; yellowish brown with orange mottles. Low plasticity. Sand, fine. Gravel, fine.						
1.5			End of Hole Depth: 1.5 m Termination Condition: met practical refusal						
2.0									

Scala Penetrometer
Blows per 100mm
2 4 6 8 10 12
>>

Hand Auger met practical refusal at 1.5 m depth on hard material.
Scala Penetrometer met practical refusal at 1.9 m depth.
Standing groundwater was not encountered

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 20/7/22

APPENDIX 3:

Combined Hazard Map

Legend

- Rockfall Risk Zone 1 – Unacceptable Risk
- Inferred Earthflow Location
- Mapped Flow path
- Proposed Subdivision Layout Plan

0 25 m 50 m

ENGEO

Produced by **Datanest.earth**

Title: Combined Hazard Map		
Client: Geovert		Figure No: 8 Size: A4
Project: Bowenvale Development	Drawn: JM	
Date: 19-07-2022	Checked: RJ	
Proj No: 20268.001	Scale: 1:2000	Version: 1.0

APPENDIX 4:

Rockfall Risk Report

ENGEO Limited
124 Montreal Street, Sydenham, Christchurch 8023
PO Box 373, Christchurch 8140, New Zealand
T: +64 3 328 9012 F: +64 3 328 9013
www.engeo.co.nz

Project Number 20268.000.001

Rockfall Assessment

130 Bowenvale Avenue, Cashmere, Christchurch

Submitted to:
Geovert Ltd
39 Francella Street
Bromely
Christchurch 8062

Contents

Tables

Figures

Appendices

ENGEO Document Control:

Report Title	Rockfall Assessment - 130 Bowenvale Avenue, Cashmere			
Project No.	20268.000.001	**Doc ID**	01	
Client	Geovert Ltd	**Client Contact**	Francis Main	
Distribution (PDF)	Francis.Main@geovert.com			
Date	**Revision Details / Status**	**Author**	**Reviewer**	**WP**
04/07/2022	Issued to Client	JRW	RJ	VB

1 Introduction

ENGEO Ltd was requested by Geovert Ltd to undertake a rockfall assessment of the property at 130 Bowenvale Avenue, Cashmere, Christchurch (herein referred to as 'the site'). This work has been carried out in accordance with our signed agreement dated 31 March 2022 (reference P2022.000.749_01).

The purpose of the assessment was to provide geotechnical advice in regard to rockfall risk mitigation for Resource Consent stage for a proposed residential subdivision. Our report does not provide advice on any other potential hazards that may be present at the site.

The scope of this study comprised:

- Review of published geotechnical and geological information relevant to the site.
- Site walkover and assessment of the rockfall source areas above the proposed development by an experienced ground engineering professional.
- Development of a rockfall model based on the site walkover.
- Assessment of boulder impact energies and bounce heights via rockfall modelling for the site.
- Assessment of the Annualised Individual Fatality Risk to potential occupants of the proposed development in accordance with the requirements of the Christchurch Replacement District Plan (CRDP).
- Develop concept mitigation options suitable to reduce the rockfall risk to acceptable levels.
- Production of a geotechnical report (this document) based on the findings of our enquiries, rockfall modelling and risk assessment including recommendations for potential rockfall risk management options.

Our scope of works does not include intrusive investigations, nor does it provide a detailed design for the proposed rockfall mitigation works.

2 Site and Development Description

The site is located on the western side of the Bowenvale Valley upslope of Bowenvale Avenue on a section of approximately 5.09 hectares, with the legal description Pt Lot 2, 2 DP 33462. The site is located on an east-facing section of that is moderately sloping (~20-22º) between 25 and 200 metres above sea level (m asl). A broadly north-south orientated ridgeline is located upslope of the proposed development. Downslope and broadly parallel with the direction of slope are a series of gullies and ridges.

The proposed development is a residential subdivision consisting of 40 lots, 32 of which are located within or partially within Rockfall Risk Management zones defined by the Christchurch Replacement District Plan (CRDP). We understand that the proposed new buildings will be one or two storeys and generally orientated along slope in order to maximise the view. The proposed subdivision layout plan[1] is provided in Appendix 1, obtained from Gravitas Architecture (14 March 2022).

[1] Current at the time of writing

Figure 1: Site Location Plan

Image from Datanest. Not to scale.

3 Geological Setting

The site is located on the Port Hills, Canterbury where the geological setting is typically topsoil and wind derived loess deposits of varying thickness overlying a basaltic rock mass. The basalt is a result a of series of Banks Peninsula Volcanics referred to as the Lyttelton Volcanic Group and are typically basaltic.

4 Desktop Assessment

4.1 Rockfall Failure History

Significant rockfalls occurred in the area surrounding the subject site as a result of the 2010 / 2011 Canterbury Earthquake Sequence (CES). The CCC fallen rock database indicates a number of boulders noted across the site, as detailed below and indicated in Figure 2.

Thirty-three boulders were recorded on-site in 2011, following the February event. The boulders were recorded to be between 0.2 m^3 and 12 m^3, generally angular in shape.

Figure 2: Location of Mapped Fallen Boulders

Image sourced from Google Maps.

4.2 Rockfall Risk Reports

We have reviewed the GNS Science, 'Canterbury Earthquakes 2010 / 2011 Port Hills Slope Stability: Life Safety Risk from Rockfall report', dated May 2012. The report identifies the site as having an Annualised Individual Fatality Risk (AIFR) of greater than 10^{3} and between 10^{-3} to 10^{-4} for the near source areas and 10^{-4} to 10^{-5} for the majority of the site, more distal from the source areas. The lower reaches, on the northern side of the proposed development have a AIFR of less than 10^{-5}. Accordingly, the central portion of the site has been placed within Rockfall Management Area 2 in CCC's District Plan, with the upper most portion of the slope allocated Rockfall Management Area 1, as shown in Figure 3.

Figure 3: Rockfall Management Areas

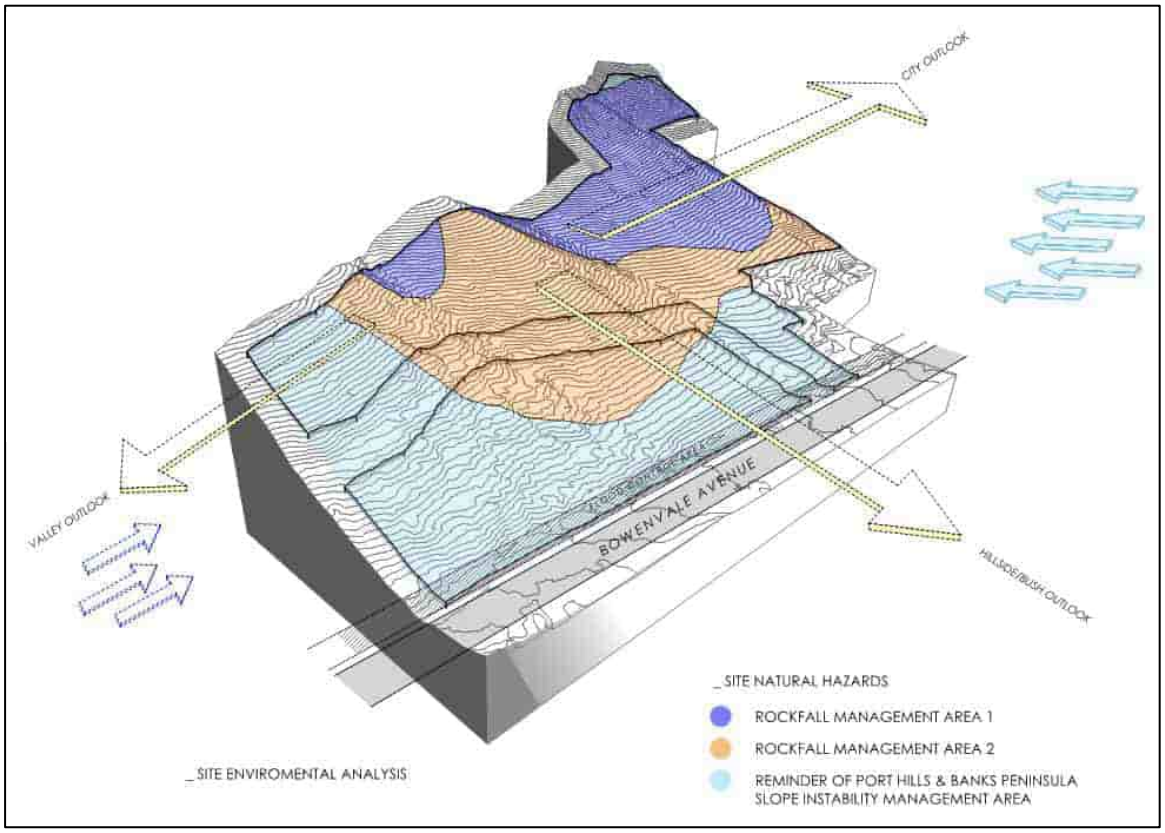


Image sourced from Gavitas Architecture March 2022 drawings.

5 Site Assessment

5.1 Rockfall Visual Assessment

ENGEO visited the site on 28 April 2022 and made the following observations:

- The majority of the site is covered with high grass or scrub with scattered large trees. The scrub is concentrated in the valleys and is limited on the ridges.
- Limited evidence of significant gully erosion was noted on some of the valley sides, however given the thick scrub in the valleys, we could not assess these areas. Given the concentration of water, it is likely that tunnel gullies are more prevalent in the valley areas.
- Below the ridgeline is a concentration of boulders that are more prevalent in the valleys and are less evident the further down the site. We measured 13 boulders during our site walk over ranging in size from 0.3 m^3 up to 1.8 m^3 with an average of 1.1 m^3.
- Given the steepness of the slope above the site boundary, we could not walk to the base of the rockfall source areas, however we flew a drone to assess the areas. Based on these photos, it appears that the columnar and planar joint sets (typical in basalt) area are creating wedge-type failures with obvious loose blocks noted in the outcrop (Photo 1).

Figure 4: Rockfall Assessment Photos

Photo 1: Ridgeline and boulder field below with blocks typically concentrated to the valleys.

Photo 2: Aerial view of the boulder field.

Photo 3: View of jointed basalt and what appears to be loose blocks in an outcrop source area.

5.2 Rockfall Source Areas

Based on our assessment of aerial photographs and site walkover, there appears to be multiple possible rockfall sources, however, we have grouped them into two broad groups.

- Ridgeline: this source area comprises the broad ridge at the upslope extent of the Bowenvale Valley. It is characterized by near vertical bluffs comprised of moderately weathered, jointed basalt. It is up to approximately 10 m high and extends across the majority of the site at the crest of the ridge.
- Lower Outcrops: These comprise a series of smaller discrete outcrops across the slope below the ridgeline. The outcrops are typically up to 2 m high and comprised of moderately weathered, jointed basalt and they extend across the slope between the site boundary and the ridgeline.

Details regarding on-site observations are provided below in Section 4.1.

Figure 5: Rockfall Source Areas

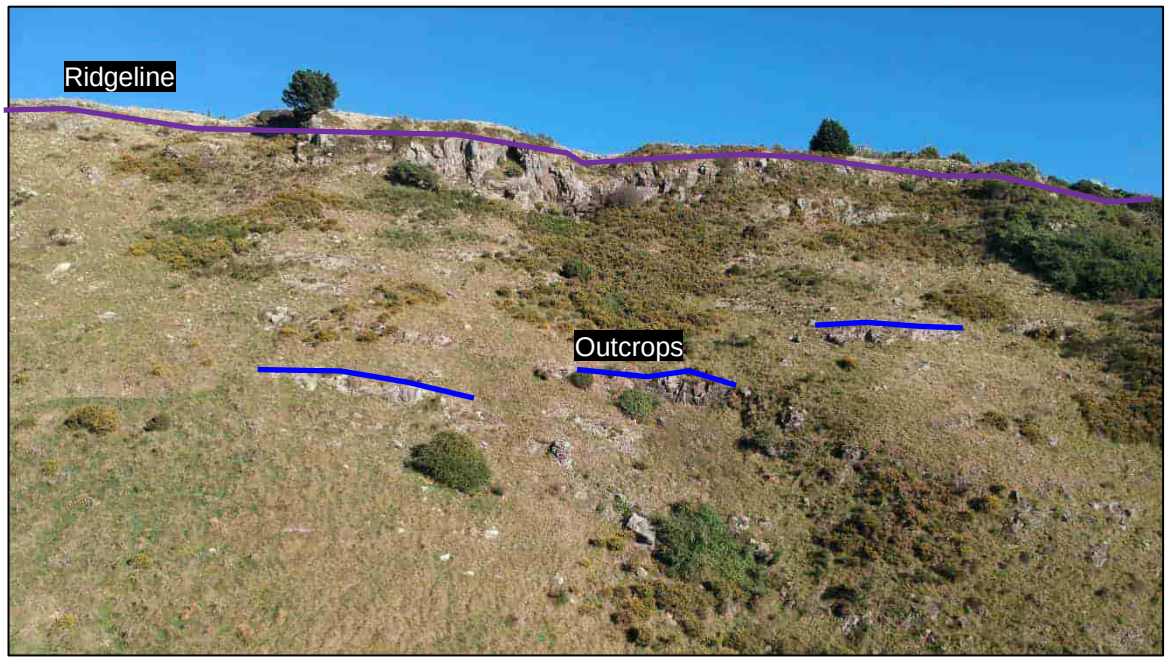


Image taken from a Drone flown by ENGEO.

6 Rockfall Modelling

6.1 Site Specific Rockfall Modelling

6.1.1 Model Assumptions

Assumptions made in the modelling of rockfall from the potential rockfall source area above the site are summarised in the following section.

Slope Profile

The site is outside of the 3D rockfall modelling undertaken by Geovert in 2012 and therefore, ENGEO has undertaken three-dimensional rockfall modelling using Rocfall3 by Rocscience. The surface was taken from LINZ LiDAR information and simplified in order to reduce processing time for the simulations.

Figure 6: View of the slope profile looking northwest

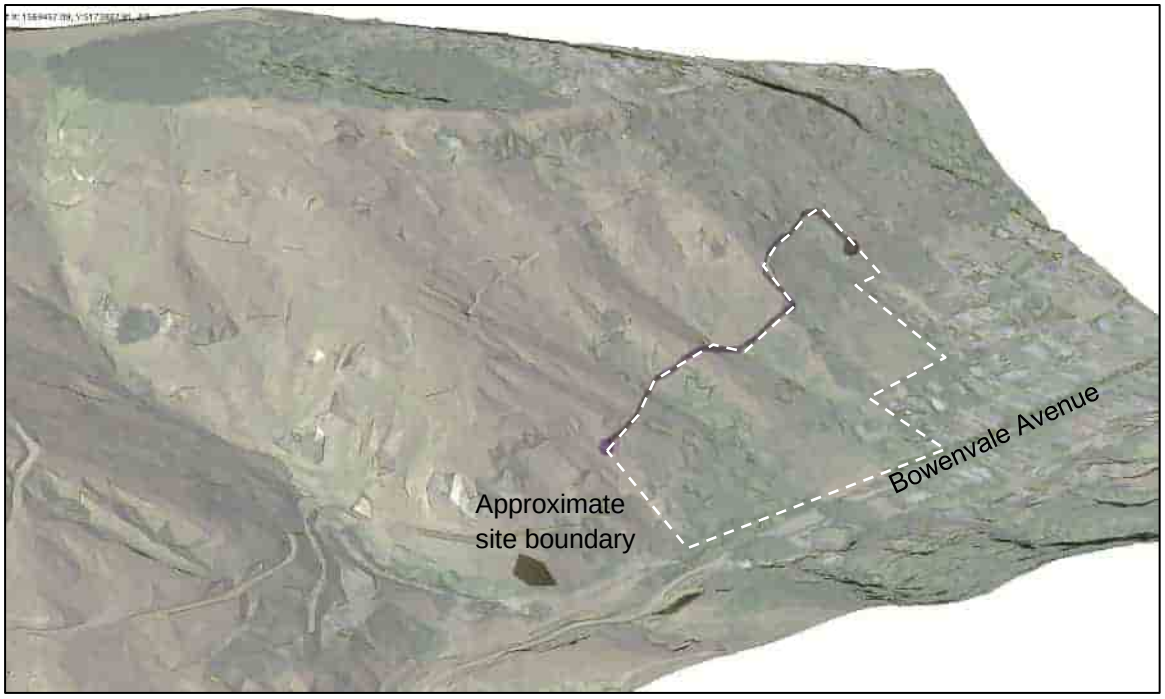


Image taken from Rocfall3. Not to scale.

Material Parameters

Material parameters used in the model are provided in Table 1 and have been assumed from site observations, knowledge of parameters for similar materials, and back analysis of rockfall runouts. The model does not consider the beneficial effects of vegetation, as it may be compromised (e.g. due to logging or a fire) within the life-time of any development on the property (assumed to be 50 years).

Table 1: Material Parameters

Material	Normal Restitution	Tangential Restitution	Friction Angle
Ridgeline	0.53	0.99	10°
Small rock outcrops and rock debris	0.32	0.82	12°
Loess Slope	0.3	0.815	12.789

Loess was applied to the majority of the slope, and the ridgeline and small rock outcrops and rock debris below the ridgeline were draped over the terrain (Figure 5).

Figure 7: Slope Model with material types applied

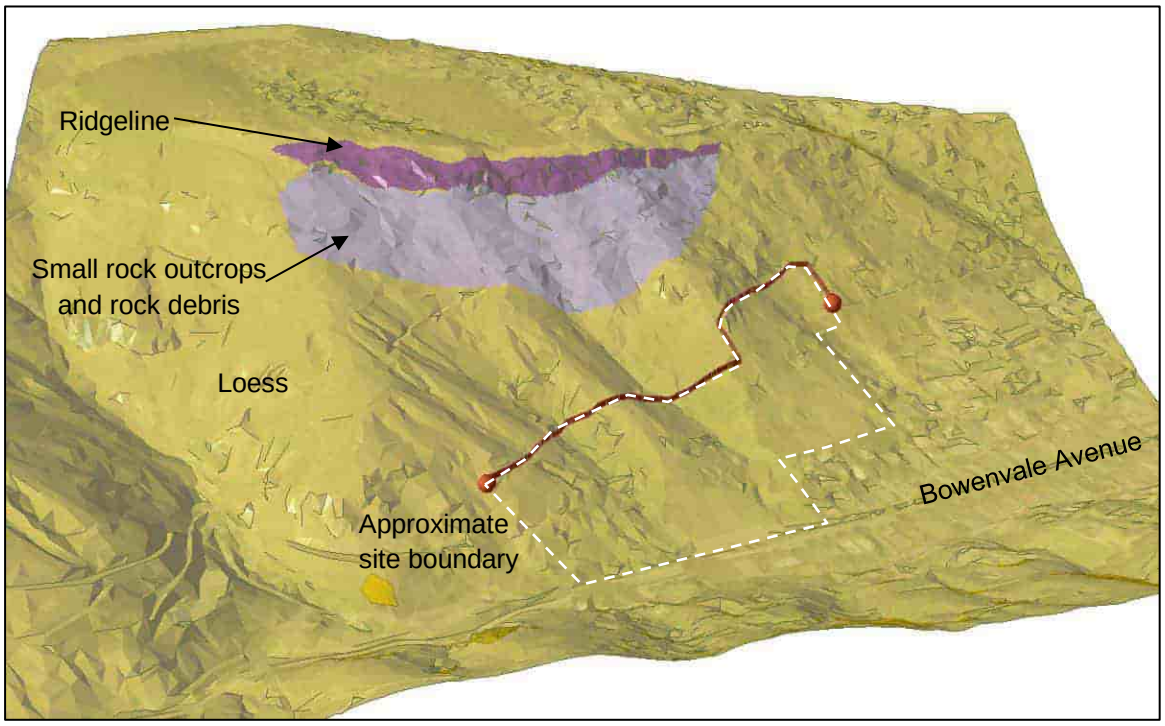


Image taken from Rocfall3. Not to scale.

Design Boulder

The design boulders have been based on the on-site measurements and the boulders mapped following the CES. Two boulders mapped following the CES were excluded from the dataset as outliers given that they were three to four times larger than the next largest boulder. The remaining dataset has then been distributed based on the mean boulder size and the number of standard deviations to the 95th percentile boulder (Table 2).

Table 2: Design Boulder Parameters

Average Boulder Size	Max Boulder Size	Standard Deviation
1.11 m^3	3 m^3	0.74

These boulders were modelled as coming from line seeders either from the ridgeline (1000 boulders) or from the smaller outcrops (100 boulders).

Figure 8: Line Seeders modelled on the site

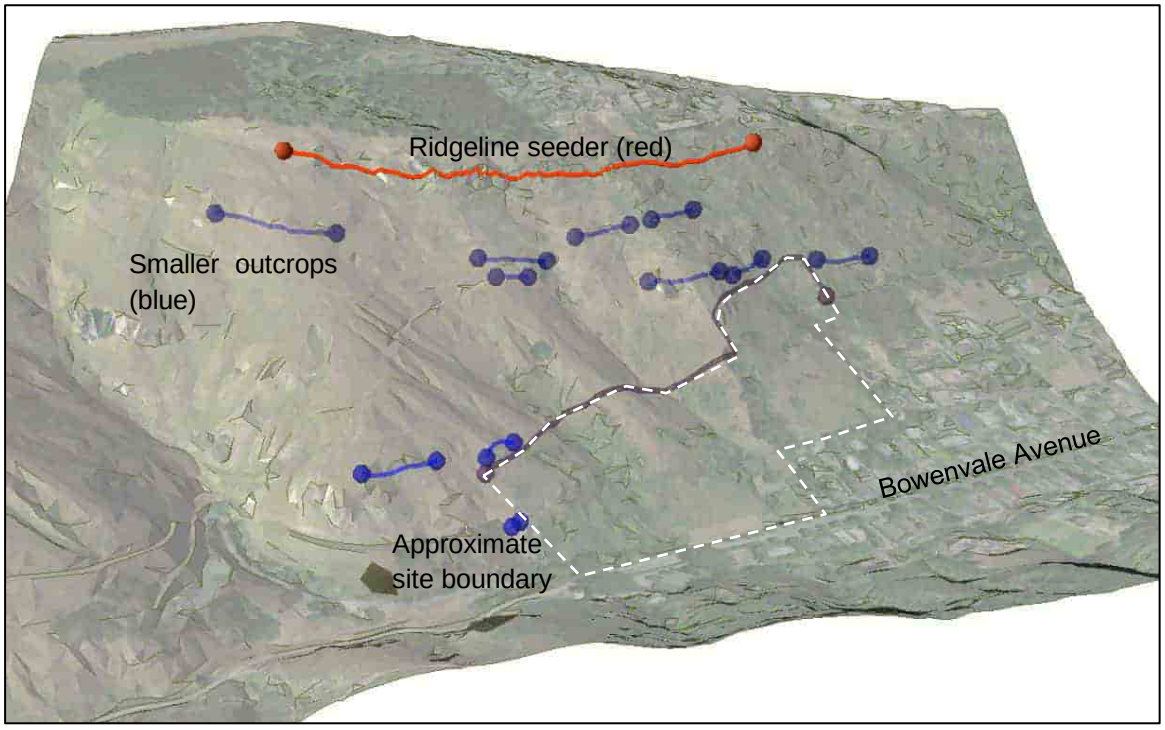


Image taken from Rocfall3. Not to scale

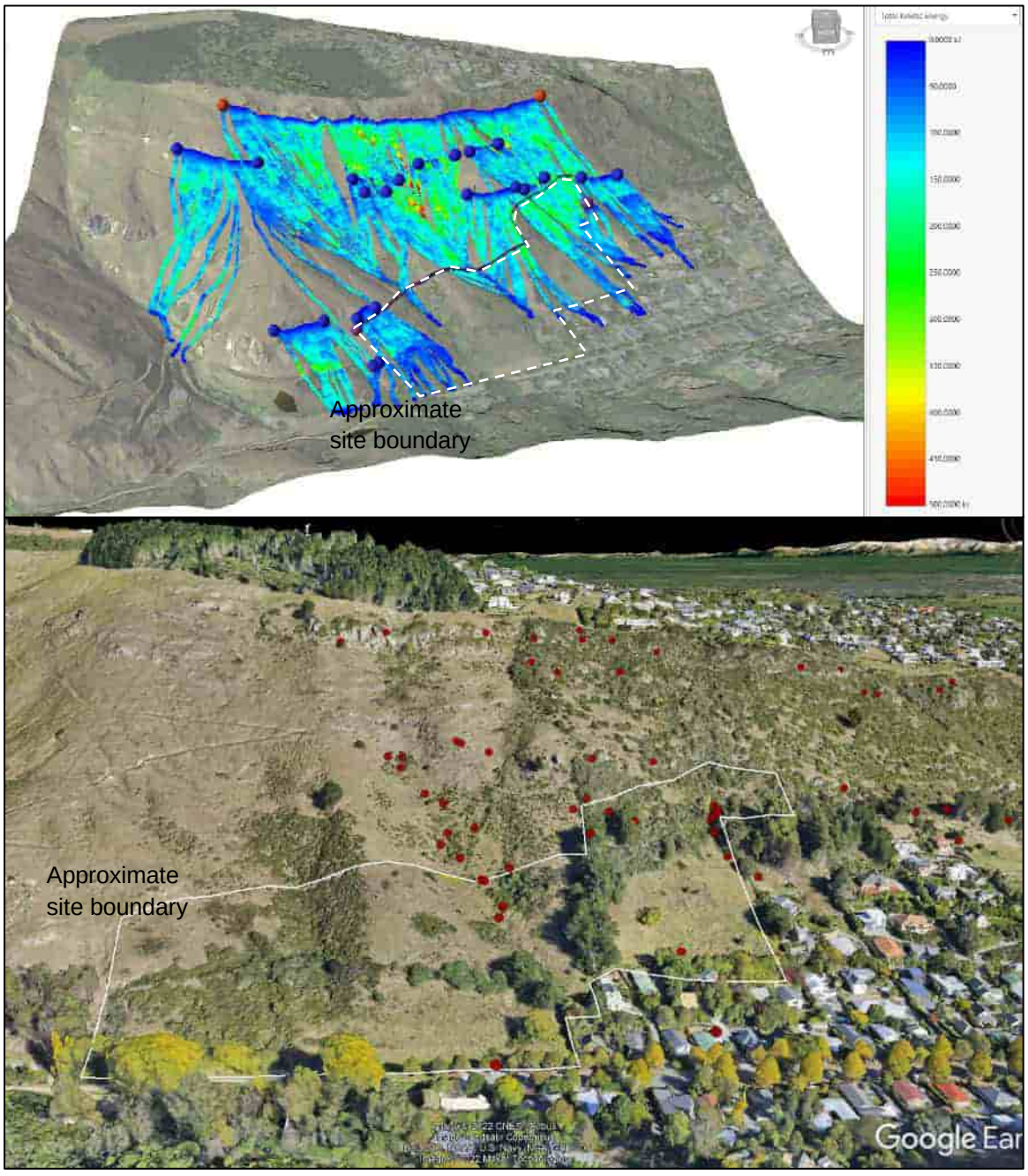
Boulder Release Conditions

Initial boulder velocities have been adopted in accordance with the values provided by the Port Hills Geotechnical Group (PHGG). The modelled seismic conditions include a horizontal velocity of 1.5 m/s and a vertical velocity of 1 m/s to simulate earthquake conditions.

6.1.2 Rockfall Modelling Results

The modelling suggests that the boulder roll paths are typically concentrated to the gullies and runout locations appears to broadly match the boulders mapped by the PHGG following the CES (Figure 8).

Figure 9: Boulder runouts from the Rocfall3 modelling compared to the boulder end points mapped by PHGG



Images from Rocfall3 and Google Earth. Not to scale

We have completed the risk assessment for the boulders reaching the upslope (western) boundary of the site.

The results of our 3D modelling are presented in Appendix 2 and indicate rockfall distribution and total number of rocks reaching the upslope boundary. Rockfall and probability results are summarised in Table 3 below.

Table 3: Results of Rockfall Modelling

Parameter	Cross Section 2
Percentage of boulders reaching the upslope boundary	93% (1639)
95%ile Energy of boulder reaching the upslope boundary	213 kJ
95%ile Bounce height on the upslope boundary	0.24 m
Number of Boulder Paths above site	1750

Due to the scattered nature of the rockfall source area on-site the probability of rockfall impacting the assumed building platforms varies across the site. However, the majority of boulders are modelled to impact the lots within or near gullies.

7 Risk Assessment

7.1 Risk Model

GNS (Massey et al. 2012a) have evaluated the risk of loss-of life to an individual from boulder fall using the following expression:

$$R_{(LOL)} = P_{(H)} \times P_{(S:H)} \times P_{(T:S)} \times V_{(D:T)}$$

Where:

- $R_{(LOL)}$ is the risk (annual probability of loss of life (death) of a person) from rockfall. This is equivalent to CCC's Annual Individual Fatality Risk (AIFR);
- $P_{(H)}$ is the annual frequency of a rockfall-initiating event. Taken from Table 1; GNS, 2012/214 for the seismic case and Table 15; GNS, 2012/311, for the non-seismic case;
- $P_{(S:H)}$ is the probability of a building or person, if present, being in the path of one or more boulders at a given location;
- $P_{(T:S)}$ is the probability that a person is present at that location; $P_{(T:S)}$ is taken as 1.0 as outlined in Section 5.2.2.4.1 of the CRDP for Rockfall Management Area 2; and
- $V_{(D:T)}$ is the vulnerability, or probability of a person being killed (or receiving injuries which result in death). $V_{(D:T)}$ is taken as 0.5 (refer Section 5.5 GNS 2011/311).

7.2 Non-Earthquake Rockfall Risk

As noted in Massey et al. (2012c), there is precedent for boulder falls to release in significant storm events, as well as during earthquake conditions. We have modelled the lives risk due to a non-earthquake trigger based on the information provided in Massey at al. 2010/11. Table 15 in this report presents the number of boulders expected to be released in each suburb and the effective annual frequency of a non-earthquake event per band. For the purpose of this assessment, we considered the Rapaki source area to best reflect the on-site conditions. The risk posed non-earthquake assessment are presented in Appendix 3.

7.3 Level of Risk

Based on the boulder roll paths from the Rocfall3, boulder appear to be concentrated to the gullies and appears to not roll over the ridgelines. We have completed a risk assessment for two different zones along the upslope boundary:

- Zone 1 where boulder roll paths are modelled and there are no viable building platforms on the lot outside of boulder roll paths. Lots 9, 10, 12-15, 25, 27-29.
- Zone 2 where there is no modelled boulder roll paths and there appears to be viable building platforms within the lot that are outside of boulder roll paths. Lots 11, 16, 26.

We have calculated the risk for both zones using AIFR and presented in Appendix 2, residual probability that a boulder will reach the upslope boundary of 2% was assumed for Zone 2 calculations:

- Zone 1 = 2.46×10^{-3}
- Zone 2 = 7.19×10^{-5}

7.4 Risk Acceptability

The previously completed GNS risk assessment identifies parts of site as having an AIFR of greater than 10^{-3} and between 10^{-3} to 10^{-4} for the near source area. This is consistent with our site-specific risk assessment for the upslope (western) boundary of the site which indicates that the risk for Zone 1 is unacceptable and risk for Zone 2 as acceptable (Appendix 3).

In summary, as the AIFR calculated for the majority of the upper lots, excluding Lots 11, 16, 26 cannot be considered as tolerable, rockfall risk reduction works are required and will need to extend across the upslope boundary.

8 Potential Rockfall Risk Management Options

The AIFR calculated for the upslope area of site is above tolerable limit for lots in Zone 1 and therefore mitigation of the risk needs to be undertaken. Given the size and extent of the rockfall source areas, particularly the ridgeline, we consider that treatment at the source would likely be cost prohibitive. Therefore, mitigation options such as berms or rockfall fences are likely the most appropriate options for the majority of the lots within Zone 1.

There are localised outcrops of rock at the southern end of site, some of which are in the site boundary. We consider that removal works at the rockfall source will be required for these areas. This can be completed by undertaking removal works at the rockfall source. Works associated with this method are outlined in Section 7.1 below.

The recommendations provided below are based on our understanding of what constitutes hazard removal as outlined in a letter produced by Aurecon (March 2015), as follows:

"According to CERA, the Joint Ministers agreed to:

Agree to use your Power to Act to include rezoning from red to green properties in the residential red zone where the rock fall hazard has been removed at source providing:

- *that you are satisfied that the risk has been removed entirely; and*

- *the removal has been undertaken within the Crown offer period for the Port Hills red zone.*

For the purpose of this exercise and in line with our understanding of hazard and risk management in the New Zealand context, we assume that the risk from rock fall will be reduced to background levels once the rock fall hazard has been treated, removed or mitigated."

It should be noted that slope conditions will change over time and new rock fall source may be generated by erosion, weathering or future earthquakes. Therefore, the exposed rock that will remain on-site following the scaling and removal will need to be carefully managed to reduce or maintain the risk levels.

If rockfall fences are preferred, then these would need to be designed and located once the building platforms have been confirmed.

8.1 Scaling and Boulder Clearance

Removal of the source material will consist of scaling and removal of the potential rockfall sources identified, and removal or burial of the rocks currently present on the slope. Based on site observations we consider approximately 20 to 30 locations along the scattered bluffs will require scaling and removal. However, this will need to be confirmed during a future detailed design phase, which ENGEO can undertake, if required.

As stated in Section 6.1.1 the largest boulder noted on-site was 3.5 m^3, although the majority were in the order of 0.6 m^3. Therefore, treatment of boulders up to the larger size will need to be considered by a suitably qualified contractor who will be completing the scaling works.

A geotechnical professional will be required to attend site and confirm that risk has been reduced to background levels. We anticipate that should this be achieved then Council should be able to remove the rockfall hazard overlays from these properties. However, we recommend you discuss this, and agree an appropriate process, with Council prior to completing the recommended works.

8.1.1 Targeted Rock Bolting

Should a suitably qualified contractor determine that scaling and removal of any potential rockfall sources cannot be completed (either in terms of safety or effectiveness) then targeted rock bolting will be required. We recommend that a generic rock bolt design is developed as part of the design process such that it can be implemented on an 'as needed' basis during construction of the mitigation works.

8.2 Fence Design

Results from the rockfall modelling show that a 95th percentile rockfall energy of up to 220 kJ may be expected. Given the potential for multiple impacts affecting the fence in a single event, particularly at the northern end of the fence, we recommend designing for a minimum factor of safety of 3 in accordance with MBIE's Design Guidelines for Passive Rockfall Protection Structures. For Servicability Energy Level (SEL) design, this requires a design rockfall energy of 660 kJ. While 1000 kJ barriers are available, provided that the supply cost is not significantly greater, a 1500 or 2000 kJ capacity rockfall fence could be considered to achieve a higher factor of safety for the following reasons:

1. There is a possibility that the fence will be subjected to multiple rock impacts in the same event. A higher capacity fence will provide a much greater level of protection should this occur.

2. There are rocks on the slope that are somewhat larger than the design boulder. While we anticipate they are within the capacity of a 1000 kJ fence, the larger fences give a greater factor of safety against larger impacts.

3. Larger capacity fences deflect a shorter downslope distance in the event of a rock impact. This will enable fewer restrictions being placed on the development at the upslope side of the development.

The fence selected must be rated in accordance with ETAG 027 standards, which is the European quality mark for rockfall fences.

Rocks may be expected to be bouncing up to 0.24 m above ground at the boundary; 1000 kJ, 1500 kJ and 2000 kJ rockfall fences are typically available in 3 m or 4 m heights. On this basis, we consider using a 3 m high fence. However, the fence height would need to be confirmed as part of any detailed design process.

Appendix 2 shows one possible layout of the fences, which provides for four separate fences. The exact layout may be finalised at the detailed design stage once client feedback has been incorporated. As shown in Appendix 4, there is approximately 310 m of rockfall fence required, and approximately 80 m of lot boundary across Zone 2 properties (Lot 10/11, 16, 26). It may be preferred to also construct rockfall fences above these areas and we would be happy to discuss this during detailed design phase.

8.3 Safety in Design

Some key safety in design considerations at the concept stage have been to use a fence instead of a bund to eliminate risks associated with extensive earthworks on a slope, and to recommend use of proprietary fence systems with which specialist contractors will be familiar. The key safety considerations at detailed design and during construction are likely to relate to the contractor's construction methodology, with particular emphasis on minimising risks of rockfall during the course of the fence construction and lifting the posts into place.

Similar considerations will be required during fence maintenance and clearance post-impact. Further details of this will be provided as part of detailed design once the exact fence model is determined.

8.4 Maintenance Considerations

A detailed maintenance schedule will normally be provided by the fence manufacturer, and will be included as part of our detailed design for the fence, but at this stage we consider that the following will be required in order to realise the 50-year design life:

1. The fence will need to be inspected on an annual basis or following earthquake or storm events.
2. Routine maintenance will include clearing vegetation and debris build up from around the fence.
3. Cable grips, shackles and other minor components may need to be replaced on a 10-15-year interval.
4. Cables may need to be replaced on a 25-year interval.
5. Depending upon the fence system selected, the mesh may also need to be replaced on a 25-year interval.
6. The remainder of the major components (foundations, anchors and posts) are expected to last 50 years, provided the fence is not impacted.

Should the fence be impacted by rocks, significant maintenance or replacement may well be required as the fences are designed to sustain significant damage as they absorb impact energy.

8.5 Detailed Design Process

Following discussion and approval of a concept design, a detailed design will be required.

This will involve final confirmation of the type of fence and the manufacturer from which it will be procured, followed by production of design drawings and specifications that are suitable for construction. It may be necessary to visit site and complete an anchor testing program as part of the detailed design to allow assessment of anchor lengths that will be required for the fence.

8.6 Conclusions

Once the rockfall fence is installed, we consider that rockfall risk would not preclude the site from being developed as a residential subdivision. Additional geotechnical testing and reporting (currently being completed by ENGEO) would still be required to complete a Section 106 assessment and provide a statement of professional opinion.

9 Limitations

i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Geovert Ltd, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.

iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

iv. This Limitation should be read in conjunction with the Engineering NZ / ACENZ Standard Terms of Engagement.

v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (03) 328 9012 if you require any further information.

Report prepared by

Jed Watts

Engineering Geologist

Report reviewed by

Richard Justice, CMEngNZ (PEngGeol)

Principal Engineering Geologist

10 References

Aurecon, Dr Kupec (12 March 2015). Review of rockfall hazard removal memorandum. For the properties 77A and 79 Bowenvale Avenue, Christchurch. Reference 221924. Published on behalf of CERA.

Christchurch City Council. Earthquake Rockfall Maps. Retrieved December 2020, from http://www.ccc.govt.nz/homeliving/civildefence/chchearthquake/earthquakerockfallmaps.aspx

Geological and Nuclear Sciences (2012). Canterbury Earthquakes 2010/11 Port Hills Slope Stability: Pilot study for assessing life-safety risk from rockfalls (boulder rolls) GNS Science Consultancy Report 2011/311

Geovert (2012) Port Hills 3D Rockfall Modelling, Christchurch New Zealand. Report prepared for CERA, October 2012 We also acknowledge the New Zealand GeoNet project and its sponsors EQC, GNS Science and LINZ, for providing data used in this report.

Geovert. (25 October 2012). Port Hills 3D Rockfall Modelling, Christchurch, New Zealand. Geovert.

GNS, Massey et.al (March 2012) Final Issue. Canterbury Earthquakes 2010/11 Port Hills Slope Stability: Pilot study for assessing life-safety risk from rockfalls (boulder rolls).

GNS, Massey et.al (September 2012) Final Issue. Canterbury Earthquakes 2010/11 Port Hills Slope Stability: Additional assessment of the life-safety risk from rockfalls (boulder rolls).

Gravitas Architecture (March 2022). 130 Bowenvale Avenue, Cashmere, Christchurch 8022. Concept design report.

Keylock and Domaas, 1999

We also acknowledge the New Zealand GeoNet project and its sponsors EQC, GNS Science and LINZ, for providing data used in this report.

APPENDIX 1:

Bowenvale Site Plan

SITE INFORMATION

LEGAL DESCRIPTION

LOT 2,
D.P 33462

130 BOWENVALE AVENUE,
CASHMERE,
CHRISTCHUCH 8022,
NEW ZEALAND

TOTAL SITE AREA = 5.09 HA (approx.)

BUILDING CLASSIFICATION:

RESIDENTIAL DWELLING

PLANNING OVERVIEW:

TERRITORIAL AUTHORITY:	CHRISTCHURCH CITY COUNCIL
ZONE:	RESIDENTIAL HILLS ZONE
WIND ZONE:	VERY HIGH
CLIMATE ZONE:	ZONE 3
DURABILITY/EXPOSURE ZONE:	ZONE 2
SITE DENSITY:	MIN.NET SITE AREA OF 650m²
SITE COVERAGE:	35%
BUILDING HEIGHT:	MAX 8m

NATURAL HAZARDS:

SLOPE INSTABILITY MANAGEMENT AREA
ROCKFALL MANAGEMENT AREA 1
ROCKFALL MANAGEMENT AREA 2

SCHEDULE OF ACCESS CRITERIA

ROADS

LEGAL ROAD WIDTH:	12m
ROAD FORMATION WIDTH:	5.5m *carriageway*
FOOTPATH WIDTH:	1.5m

PRIVATE WAYS (ACCESS)

LEGAL WIDTH:	6.0m
FORMATION WIDTH:	4.5m

RIGHTS OF WAY

LEGAL WIDTH:	4.5m

NOTES

1. ALL LAYOUTS, AREAS & DIMENSIONS ARE SUBJECT TO ACCEPTANCE BY LOCAL AND DISTRICT AUTHORITIES AND GOVERNMENT AGENCIES.
2. NO GEOTECHNICAL STUDIES AND REPORTS HAVE BEEN COMMISSIONED
3. NO ENVIRONMENTAL ASSESSMENTS HAVE BEEN COMMISSIONED AS REQUIRED BY RESOURCE MANAGEMENT ACT 1991.
4. NO RESEARCH HAS BEEN UNDERTAKEN AS TO AVAILIABILITY OF SERVICES

PLAN: **OVERALL SITE** scale:1:750

gravitas ARCHITECTURE

APPENDIX 2:

Zone 1 and 2 Risk Assessment

Rockfall Risk Assessment - Bowenvale Devlopment (Residual Risk) **REVISED RISK ASSESSMENT May 2022**

1. Earthquake Induced Rockfall Risk (2020 levels)

Length of Rapaki Zone (indicated by GNS)	2100	m
Width of rockfall above property	450	m
Width of person	1	m
Assumed average width of boulders	1	m

Earthquake Event	Prob of EQ Occurrence (Table 1; GNS, 2012/214) - $P_{(H)}$. Assumes 'No aftershocks' model	No boulders released (Table 11, GNS 2011/311) (N)	Factored No. of Boulders Released	Probability that boulder will reach upslope boundary based on rockfall modeling	N at dwelling	Probability of person being within path of a single boulder ($P_{(S:H)}$)	Probability of person being within the path of one or more boulders given the runout distance ($PN_{(S:H)}$)	Probability of person being present - $P_{(T:S)}$	Probability of fatality if person present - $V_{(D:T)}$	Risk (individual boulder) - $R_{(LOL)}$
0.1 - 0.4g	1.31E-01	0.1000	0.0214	0.93	0.019928571	0.00667	0.00013	1	0.5	8.74E-06
0.4 - 1.0g	3.10E-02	31.0000	6.6429	0.93	6.177857143	0.00667	0.04048	1	0.5	6.27E-04
1.0 - 2.0g	3.30E-03	518.0000	111.0000	0.93	103.23	0.00667	0.49868	1	0.5	8.23E-04
2.0 - 5.0g	2.00E-04	5200.0000	1114.2857	0.93	1036.285714	0.00667	0.99902	1	0.5	9.99E-05
									TOTAL (EQ)	1.56E-03

2. Non Earthquake Rockfall Risk

Rainfall Event	Prob of Non EQ Occurrence (Table 15; GNS, 2012/311) - $P_{(H)}$	No boulders released (Table 15, GNS 2011/311) (N)	Factored No. of Boulders Released	Probability that boulder will reach upslope boundary based on rockfall modeling	N at dwelling	Probability of person is within path of a single boulder ($P_{(S:H)}$)	Probability of person is within the path of one or more boulders given the runout distance ($PN_{(S:H)}$)	Probability of person being present - $P_{(T:S)}$	Probability of fatality if person present - $V_{(D:T)}$	Risk (individual boulder) - $R_{(LOL)}$
<1 - 15 years	3.30E-01	1	0.2143	0.93	0.199285714	0.00667	0.00133	1	0.5	2.20E-04
15 - 100 years	5.00E-02	10	2.1429	0.93	1.992857143	0.00667	0.01324	1	0.5	3.31E-04
100-1000 years	1.00E-02	50	10.7143	0.93	9.964285714	0.00667	0.06448	1	0.5	3.22E-04
>1000 years	5.00E-04	100	21.4286	0.93	19.92857143	0.00667	0.12480	1	0.5	3.12E-05
									TOTAL (NON EQ)	9.04E-04
									TOTAL RISK (ALL EVENTS)	**2.46E-03**

Rockfall Risk Assessment - Bowenvale Devlopment (Residual Risk) **REVISED RISK ASSESSMENT May 2022**

1. Earthquake Induced Rockfall Risk (2020 levels)

Length of Rapaki Zone (indicated by GNS)	2100	m
Width of rockfall above property	450	m
Width of person	1	m
Assumed average width of boulders	1	m

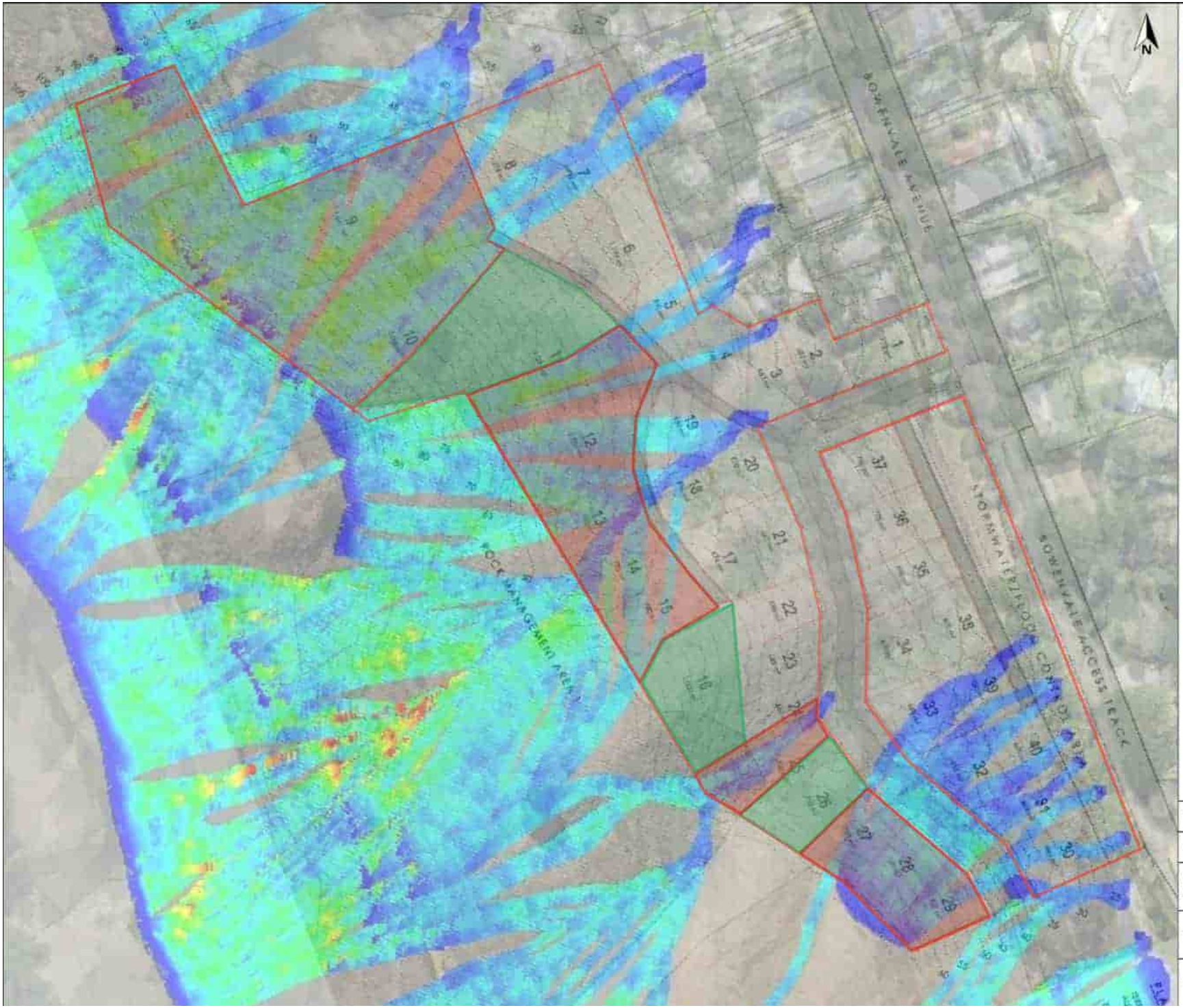
Earthquake Event	Prob of EQ Occurrence (Table 1; GNS, 2012/214) - $P_{(H)}$. Assumes 'No aftershocks' model	No boulders released (Table 11, GNS 2011/311) (N)	Factored No. of Boulders Released	Probability that boulder will reach upslope boundary based on rockfall modeling	N at dwelling	Probability of person being within path of a single boulder ($P_{(S:H)}$)	Probability of person being within the path of one or more boulders given the runout distance ($PN_{(S:H)}$)	Probability of person being present - $P_{(T:S)}$	Probability of fatality if person present - $V_{(D:T)}$	Risk (individual boulder) - $R_{(LOL)}$
0.1 - 0.4g	1.31E-01	0.1000	0.0214	0.02	0.000428571	0.00667	0.00000	1	0.5	1.88E-07
0.4 - 1.0g	3.10E-02	31.0000	6.6429	0.02	0.132857143	0.00667	0.00089	1	0.5	1.38E-05
1.0 - 2.0g	3.30E-03	518.0000	111.0000	0.02	2.22	0.00667	0.01474	1	0.5	2.43E-05
2.0 - 5.0g	2.00E-04	5200.0000	1114.2857	0.02	22.28571429	0.00667	0.13849	1	0.5	1.38E-05
									TOTAL (EQ)	5.21E-05

2. Non Earthquake Rockfall Risk

Rainfall Event	Prob of Non EQ Occurrence (Table 15; GNS, 2012/311) - $P_{(H)}$	No boulders released (Table 15, GNS 2011/311) (N)	Factored No. of Boulders Released	Probability that boulder will reach upslope boundary based on rockfall modeling	N at dwelling	Probability of person is within path of a single boulder ($P_{(S:H)}$)	Probability of person is within the path of one or more boulders given the runout distance ($PN_{(S:H)}$)	Probability of person being present - $P_{(T:S)}$	Probability of fatality if person present - $V_{(D:T)}$	Risk (individual boulder) - $R_{(LOL)}$
<1 - 15 years	3.30E-01	1	0.2143	0.02	0.004285714	0.00667	0.00003	1	0.5	4.73E-06
15 - 100 years	5.00E-02	10	2.1429	0.02	0.042857143	0.00667	0.00029	1	0.5	7.17E-06
100-1000 years	1.00E-02	50	10.7143	0.02	0.214285714	0.00667	0.00143	1	0.5	7.16E-06
>1000 years	5.00E-04	100	21.4286	0.02	0.428571429	0.00667	0.00286	1	0.5	7.16E-07
									TOTAL (NON EQ)	1.98E-05
									TOTAL RISK (ALL EVENTS)	**7.19E-05**

APPENDIX 3:

Boulder Roll Paths



Legend

- Site Boundary
- Risk Zone 1 – Unacceptable Risk
- Zone 2 – Acceptable Risk
- Boulder Rolls and Stage Plan

0 25 m 50 m

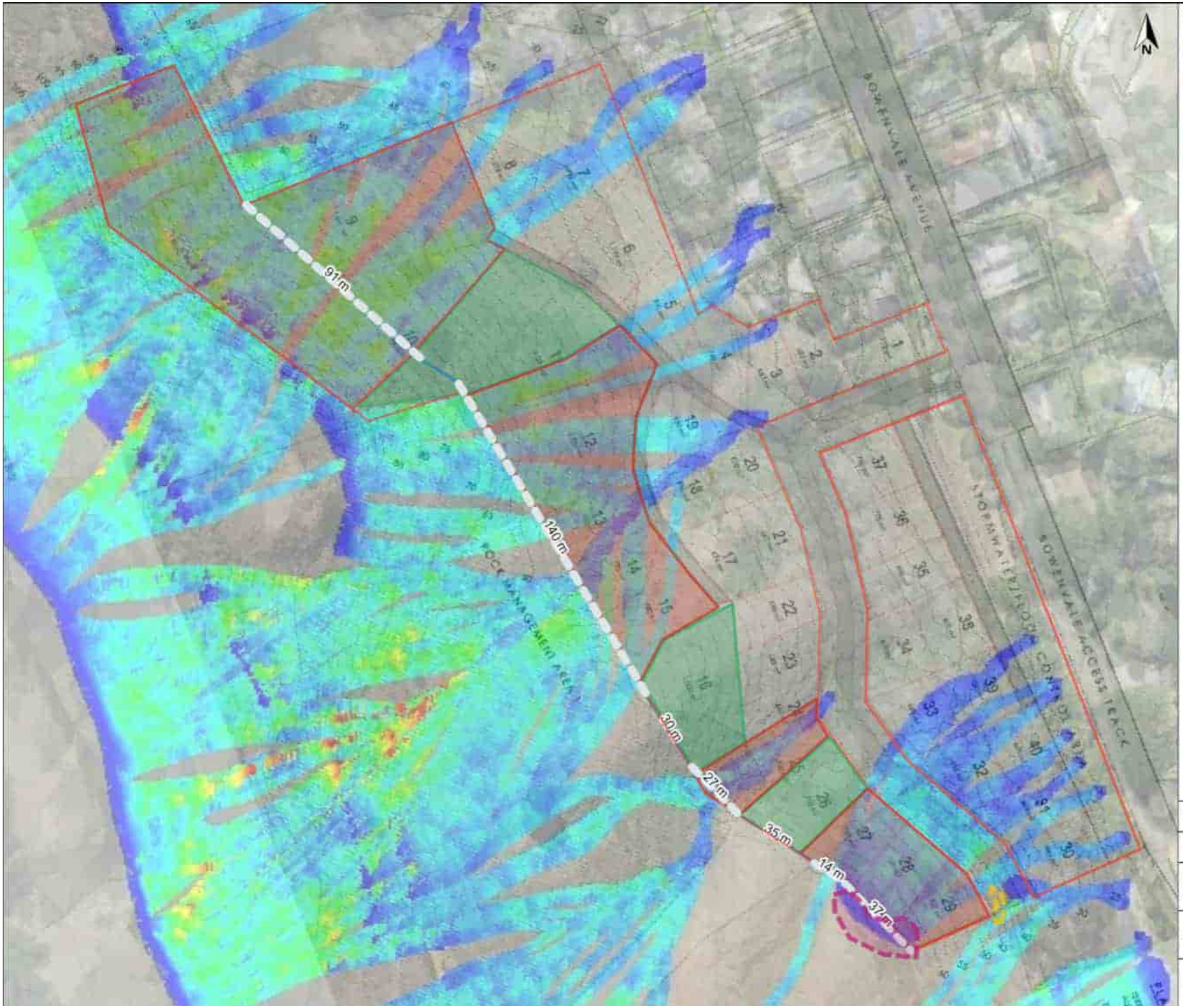
ENGEO

Produced by **Datanest.earth**

Title: Boulder Roll Paths		
Client: Geovert		Figure No: 7 Size: A4
Project: Bowenvale Development	Drawn: JRW	
Date: 06-05-2022	Checked: RJ	
Proj No: 20268.001	Scale: 1:2000	Version: draft

APPENDIX 4:

Fence Options



Legend

- Outcrop that will require source treatment
- Outcrop that could be treated at the source
- Concept Fence Locations
- Site Boundary
- Distance above Zone 2 areas
- Risk Zone 1 – Unacceptable Risk
- Zone 2 – Acceptable Risk
- Boulder Rolls and Stage Plan

0 25 m 50 m

ENGEO

Produced by **Datanest.earth**

Title: Boulder Roll Paths		
Client: Geovert		
Project: Bowenvale Development	Drawn: JRW	Figure No: 7
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CONSTITUTION

CORCORAN FRENCH

lawyers

Contents

1. NAME AND REGISTERED OFFICE

1.1. Name: The name of the Society shall be [xxxxxxxxxxxxx] Society Incorporated.

1.2. Registered office: The registered office of the Society shall be [xxxxxxxxxxxxxxxxx] or such other place as the Committee shall nominate from time to time.

2. DEFINITIONS AND INTERPRETATION

2.1. Definitions: In this Constitution, unless the context otherwise requires:

Access Lot means the land being Lot [xx] on Deposited Plan [xxxxx] and being a shared access lot, to be used, enjoyed and owned by Members in conjunction with their Lots.

Act means the Incorporated Societies Act 1908.

Bank means a registered bank as defined in the Reserve Bank of New Zealand Act 1989.

Capital Improvements means structural repairs to, and the replacement or renewal of the Access Lot Rockfall Protection Lot and Communal Facilities.

Committee means the committee members from time to time elected to manage the affairs of the Society pursuant to this Constitution.

Communal Facilities means any improvements thereon, communal accessways and all plant, equipment, facilities and amenities owned, leased or otherwise held or operated by the Society including but not limited to the Rockfall Protection System, [xxxxxxxxxxx and xxxxxxxxx].

Consent means all resource consents and approvals issued by the Relevant Authority for the Development.

Controlling Member has the meaning set out in clause 5.7.

Constitution means this Constitution as amended or added to, including all schedules to this Constitution.

Default Interest Rate means 6% above the Society's Bank's overdraft rate applicable during the continuance of the default.

Developer means Bowenvale GCO Limited and its transferees and assigns.

Development means the residential development of the Land into Lots 1 to [xx] (inclusive) on Deposited Plan [xxxxxx], as shown on the plan annexed as Schedule 2 to this Constitution.

Expense Year means each 12 month period commencing on 1 April and ending on 31 March, or such other 12 month period as the Committee may from time to time determine.

First Members means those people listed on incorporation as being the first Members of the Society.

Invitee means any invitee of or any visitor to an Owner and/or an Occupier.

Land means all of the land comprised in Lot [xx] on Deposited Plan [xxxxxx] and Lot 2 on Deposited Plan [xxxxxx] (Record of Title [xxxxxx]).

Land Covenants means the covenants registered by the Developer against each of the Owner's Titles.

Lot means any of Lots 1 to 16 (inclusive) on Deposited Plan 583961 all within the Development.

Management Agreement means the agreement between the Manager and the Society and, in respect of the first Manager, means the management agreement dated on or about the date of this Constitution.

Manager means the manager appointed pursuant to clause 1 1 from time to time.

Member means each person who shall from time to time be a member of the Society, as required by clause 5.

Member's Proportion means the share of Operating Expenses as set out in clause 6.

Occupier means any person occupying (permanently or temporarily) the whole or any part of any Residential Property under any lease, licence or other occupancy right and, where the context requires, shall include all members of an Owner's family.

Operating Expenses means the total sum of any rates, taxes, costs and expenses of the Society properly or reasonably assessed or assessable paid or payable or otherwise incurred in respect of the Communal Facilities and the operation of the Society (inclusive, without limitations, the management expenses, management fee and any utility costs) but shall exclude any costs payable for a Special Levy.

Owner means each person registered as an owner (whether individually or with others) of a Lot and an undivided share of the Access Lot and an undivided share of the Rockfall Protection Lot.

Owner's Title means the Record of Title issued for an Owner's Residential Property.

Registrar means the person holding office from time to time as Registrar of Incorporated Societies in terms of the Act.

Relevant Authority means any statutory or local authority having jurisdiction over the Development.

Residential Property means a residential property on a Lot within the Development for which a Record of Title has been issued.

Rockfall Protection Lot means the land being Lot [xx] on Deposited Plan [xxxxxx] being a shared Lot on which the Rockfall Protection System is located, owned by Members in conjunction with their Lots.

Rockfall Protection System means the rockfall protection system situated within the Development which requires ongoing maintenance in accordance with the Rockfall Protection System Maintenance Manual.

Rockfall Protection System Maintenance Manual means the rockfall protection system maintenance manual annexed as Schedule 3 of this Constitution (under which the Society will enter into a service contract for).

Rules means rules circulated by the Society including the clauses in this Constitution and the Society Rules attached as Schedule 1.

Society means Linwood Ave Residents Society Incorporated or any successor or replacement entity.

Special Levy means a levy made on a Member under clause 6.3.

Special Resolution means a resolution of the Society in general meeting passed by a majority of not less than 75% of such Members present in person or by proxy and entitled to vote provided however that it must include the Controlling Member (if there is one).

Working Day means any day of the week, which shall be deemed to commence at 9.00am and to terminate at 5.00pm, other than:

(a) Saturday, Sunday, Waitangi Day, Good Friday, Easter Monday, Anzac Day, the Sovereign's Birthday, Matariki Public Holiday and Labour Day; and

(b) A day in the period commencing on the 23rd day of December in any year and ending on the 5th day of January in the following year, both days inclusive; and

(c) The day observed as the anniversary of any province in which an act is to be done.

2.2. Interpretation: In this Constitution, unless the context otherwise requires:

(a) Clauses and schedules: References to a clause or to a schedule are references to clauses in, and schedules to, this Constitution. Each schedule forms part of this Constitution.

(b) Documents: References to any document (however described) are references to that document as modified, novated, supplemented, varied or replaced from time to time and in any form, whether on paper or in an electronic form.

(c) Headings: The headings in this Constitution are inserted for convenience and reference only and shall not affect the meaning or interpretation of this Constitution.

(d) Inclusive expressions: The term "includes" or "including" (or any similar expression) is deemed to be followed by the words "without limitation".

(e) In writing: References to "writing" shall be construed as including references to words printed, typewritten, or any words transmitted by facsimile transmission or by email or other electronic form, or otherwise reproduced.

(f) Persons: References to a "person" include an individual, company, corporation, partnership, firm, joint venture, association, trust, unincorporated body of persons, governmental or other regulatory body, authority or entity, in each case whether or not having a separate legal identity.

(g) Plural and singular: References to the singular include the plural and vice versa.

(h) Statutory Provisions: References to any statute or statutory provision are to statutes and statutory provisions in force in New Zealand and include any statute and statutory provision which amends, replaces or re-enacts it, and any bylaw, regulation, order, statutory instrument, determination or subordinate legislation made under it.

(i) Currency: References to dollars or $ means New Zealand dollars and all amounts payable under this Constitution are payable in New Zealand dollars.

(j) Joint and several: Unless this Constitution expressly provides otherwise, in relation to any persons who are jointly an Owner, the obligations under this Constitution bind those persons jointly and also each of them individually.

(k) Negative obligations: Any obligation not to do anything includes an obligation not to suffer, permit or cause that thing to be done.

3. OBJECTS

3.1. Objects: The Society is formed to promote the following objects for the benefit of Members:

(a) the ongoing management and control of the Access Lot, Rockfall Protection Lot and Communal Facilities by the Society;

(b) to effect and maintain insurance in respect of the Residential Properties and (if it considers prudent) with respect to the Access Lot, the Communal Facilities and the Society's affairs;

(c) to ensure the proper operation, maintenance, repair, renovation and replacement of the Access Lot, Rockfall Protection Lot and the Communal Facilities, including but not limited to:

(i) the annual maintenance of the Rockfall Protection System (as provided for in the Rockfall Protection System Maintenance Manual);

(ii) by the levying of Members for the purpose of providing funds for and meeting the costs and expenses of such work;

(iii) the full and proper use of the Access Lot by Members;

(d) to circulate and enforce rules and covenants benefiting Members and the Development generally and specifically the Land Covenants;

(e) to promulgate and enforce bylaws and covenants to ensure the obligations regarding the management of the Access Lot, Rockfall Protection Lot and the Communal Facilities including compliance with all relevant laws and requirements of Relevant Authorities and Government;

(f) to effect and maintain all insurances it considers prudent with respect to the Access Lot and the Communal Facilities; and

(g) to maintain the Access Lot, Rockfall Protection Lot and the Communal Facilities generally as a safe, clean and well-presented environment as a whole.

3.2. No Pecuniary Gain: The Society does not have any of the following as an object:

(a) the pecuniary gain of Members, and no Member shall be entitled to receive any dividend out of any levy, fee, donation or other income or funds of the Society; or

(b) the carrying on of trading activities; or

(c) the carrying on of business for profit.

4. MEMBERS MAY CONTRACT

4.1. Ability to Contract: A Member may enter into any agreement or understanding with the Society for the supply of any goods or services for such consideration and on such other terms and conditions as would be reasonable if that person were not a Member.

5. MEMBERSHIP OF SOCIETY

5.1. First Members: The First Members shall be deemed to have resigned from the Society as soon as there are more than six Owners (excluding the Developer) as Members. The First Members shall be entitled to vote at any meeting of the Society to elect a Committee and exercise all rights of

5.2. Members set out in this Constitution but shall have no obligations as Members (including but not limited to, the payment of levies).

5.3. Owners to be Members: Subject to clause 5.1 , each Owner shall be a Member and only Owners can be Members, and for that purpose:

(a) An encumbrance shall be registered against each Owner's Title in favour of the Society under which each Owner covenants to become and remain a Member and to perform the obligations of the Member as set out in this Constitution.

(b) Each Member shall prior to settling the sale of a Residential Property procure the purchaser to enter into, execute and deliver to the Society a deed of covenant in favour of the Society, under which the purchaser covenants to become a Member contemporaneously with the transfer of the Residential Property and remain a Member, and to observe and perform the obligations of a Member as set out in this Constitution. The deed of covenant shall be in the form attached at Schedule 6 and prepared by the solicitors for the selling Member, and the selling Member shall pay the reasonable legal fees and disbursements of the Society's solicitors (if any) in relation to the deed of covenant.

(c) The selling Member shall at least 5 days prior to settlement of such Member's sale of its Residential Property request from the Manager a certificate of indebtedness and the selling Member shall pay such amount as required by such certificate including the Manager's reasonable fee for providing such certificate.

(d) A Member shall be deemed to have resigned from the Society immediately upon that Member ceasing to be an Owner, provided that such resignation shall not relieve a person of any obligation or liability arising before that person ceased to be a Member.

(e) Each Owner shall immediately upon becoming an Owner, (and thereafter as any details change), provide the Society with the details necessary for maintenance of the register of Members pursuant to clause 5.3, and shall upon entry of the details into the register, become a Member.

5.4. Register of Members: The Society shall maintain a register of Members recording:

(a) For each Member: name, address, occupation, telephone number, facsimile number, email address and car registration and such other information as may be specified by the Committee.

(b) Membership: the date upon which each Member became a Member.

(c) Voting: where there is more than one Owner of a Residential Property, which of such Owners is entitled to vote in accordance with clause 13.1.

(d) Mortgagee: name, contact person, telephone number and facsimile number of any person holding a mortgage over the Member's Residential Property.

5.5. Not Assignable: The rights, privileges and obligations of a Member are not assignable.

5.6. More than one Owner: If there is more than one Owner for a Residential Property, each Owner shall be a Member and shall be jointly and severally liable for acts, omissions and/or obligations under this Constitution.

5.7. Access to Information:

(a) On reasonable notice and at reasonable times the Society shall make available for inspection by Members copies of this Constitution, the Rules and the financial reports presented to the last Annual General Meeting and the minutes of previous Annual General Meetings.

(b) Members shall not be permitted to inspect the Membership register.

5.8. Developer as Controlling Member: Until the Development is fully completed, the Developer shall be the controlling member ("Controlling Member") of the Society, regardless of whether the Developer is at any time a Member. The Controlling Member shall have only the rights specified in this Constitution and shall have no other rights or any obligations of a Member. No reference in this Constitution to a Member shall be taken as including a reference to the Controlling Member. Upon the Development being completed, the Developer shall be deemed to have resigned as Controlling Member, and thereafter, there shall be no Controlling Member in respect of the Society.

6. OBLIGATIONS OF MEMBERS

6.1. Levies:

(a) As soon as practicable following a resolution by the Members passed in accordance with the Rules and after the commencement of each Expense Year, the Society shall by written notice advise each Member of their share of Operating Expenses for that Expense Year (**Society's Estimate**), plus such contingency sum as the Society may, in its sole discretion, fix. Subject to clause 6.1, the levies shall be based on an even share for each Lot in the Development and shall be set annually at the relevant communication Meeting of the Society based on a budget provided by the Manager for such purpose.

(b) Each Member shall pay in each Expense Year their share applicable to that Expense Year. Payment shall be made by each Member in the manner set by the Society from time to time.

(c) As soon as practicable after the end of each Expense Year, the Society shall provide to each Member an itemised statement of the actual Operating Expenses for the previous Expense Year. If the actual Operating Expenses for the previous Expense Year are less than the total payments made by the Members pursuant to clause 6.2(b), the Society shall determine what to do with such difference at the next following Annual General Meeting of the Society. If the actual Operating Expenses are more than the total payments made by the Members pursuant to clause 6.2(b) the Society may require the Members to each pay an equal share of the shortfall.

6.2. Special Levies: The Committee:

(a) May from time to time fix an additional levy to be paid by each Member together with the Society's Estimate for that Member, to be set aside as a sinking fund to allow for and meet the costs of Capital Improvements; and

(b) May from time to time fix such special levies, payable by each Member at such times as are set by the Society, as the Society considers are necessary for it to meet its obligations under this Constitution. Subject to clauses **Error! Reference source not found.** and 6.1, any levy payable by a Member under this clause shall be an equal share of the total estimated cost to be provided for and met from the proceeds of the levies paid any Members.

6.3. Sale of Residential Property:

(a) Where a Member (**the Seller**) sells a Residential Property:

(i) Notwithstanding any other clause in this Constitution, the Seller shall remain liable for sums owed to the Society by that Seller.

(ii) The Seller shall continue to be liable as a primary and principal debtor for all indebtedness of the purchaser of the Residential Property to the Society until such time as a deed of covenant specified in clause 5.2(a) is received by the Society.

(iii) The buyer of the Residential Property shall be liable as a Member for any indebtedness of the Seller to the Society in respect of the Residential Property purchased and a certificate issued by the Society showing the indebtedness of the Seller to the Society shall be conclusive as to the sum of this indebtedness.

(b) The Society shall on application by a Member, or any person authorised in writing by such Member, provide the Member or authorised person with a statement of the indebtedness of the Member to the Society calculated to the date specified in the application. The statement shall show:

(i) The Society's estimate of such Member's Proportion of Operating Expenses for the current Expense Year;

(ii) Payments made by the Member on account of Operating Expenses in the current Expense Year;

(iii) Payments due from the Member on account of Operating Expenses in the current Expense Year, and not paid by the Member; and

(iv) Any accumulated unpaid default interest.

6.4. Covenants and Rules: Each Member agrees to promptly and duly comply with any rules made by the Society from time to time.

6.5. Development ongoing: The Members acknowledge that the Development is on-going and that the Society is required to allow the Developer such access to, and use of, the Access Lot, Rockfall Protection Lot and the Communal Facilities as is necessary or desirable for the Development to proceed. Each Member agrees:

(a) To and hereby allows the Developer access to the Access Lot, Rockfall Protection Lot and the Communal Facilities for the purpose of proceeding with the Development;

(b) Not to prevent, hinder or obstruct the use by the Developer or anyone so authorised by the Developer of the Access Lot, Rockfall Protection Lot or the Communal Facilities; and

(c) That neither the Member nor the Society shall oppose or take part in any opposition to the Development.

6.6. Covenants registered on titles: Covenants regarding the matters set out in clause 6 shall be noted against each Owner's title in favour of the Society. The Society shall not agree to the alteration to the terms of the covenants as first noted against each Owner's title.

7. BREACH OF OBLIGATIONS

7.1. Occupiers and Invitees: A reference to an act or omission by any Member shall include any act or omission by any mortgagee in possession of that Member's Residential Property or the occupiers of such Member's Residential Property, the invitees of such occupier and the invitees of such Member.

7.2. Consequences Upon any breach of this Constitution by a Member (**Offending Member**):

(a) Where damage has been caused to the Access Lot, Rockfall Protection Lot or the Communal Facilities, the Offending Member shall make good such damage.

(b) If such default continues for seven days after notice is given by the Society to the Offending Member to remedy the default, the Society may do anything, including paying money, necessary to remedy the default.

(c) All money paid and expenses incurred by the Society (including any legal costs of the Society) in remedying, or attempting to remedy, any breach by an Offending Member of this Constitution, or incurred in the exercise, or attempted exercise, or enforcement or attempted enforcement of any power, right or remedy of the Society in respect of such breach, shall be a debt due from the Offending Member to the Society.

(d) If any money payable by an Offending Member to the Society is in arrears and unpaid for seven days (whether or not formal demand for payment has been made and without any formal demand being necessary) such money shall be payable on demand and shall bear interest at the Default Interest Rate, computed on a daily basis from the due date until the date of payment in full.

8. OBLIGATIONS OF THE SOCIETY

8.1. Rules: The Society shall circulate, amend and distribute to Members from time to time rules in respect of the insurance for the Development and the use and maintenance of the Access Lot, Rockfall Protection Lot and the Communal Facilities (including any restrictions on use for security, maintenance or other reasons). The first such rules shall be those rules attached as Schedule 1 to this Constitution.

8.2. Operation of Access Lot, Rockfall Protection Lot and Communal Facilities: The Society shall ensure the proper operation, maintenance and repair of the Access Lot, Rockfall Protection Lot and the Communal Facilities as may from time to time be necessary for the reasonable use and enjoyment of the Access Lot, Rockfall Protection Lot and the Communal Facilities by the Owners.

8.3. Insurance: The Society shall effect and maintain a comprehensive insurance policy in respect of the Residential Properties on either a replacement basis or a sum insured basis reasonably sufficient to replace the Residential Properties, and the Society shall also effect and maintain any insurance it considers prudent with respect to the Access Lot, Rockfall Protection Lot, the Communal Facilities and the Society's affairs, and shall meet any costs of such insurance (which shall include any valuations and other professional fees required or deemed desirable for the purposes of such insurance and the cost of certificates relating to such insurances). The Manager shall upon reasonable request provide the Member with a certificate of currency confirming details of insurance held for the Residential Properties and noting the Member's mortgagee (if applicable) as an interested party.

8.4. Courier and Emergency Access: The Society shall ensure that courier services and emergency service vehicles and other users having a lawful need to access the Access Lot have a practicable right of access over the Access Lot at all times.

8.5. Access Lot:

(a) The rights and obligations of the Members to use the Access Lot shall be the same as the rights and obligations of the grantee as set out in the provisions of Schedule 5 of the Property Law Act 2007 and Schedule 5 of the Land Transfer Regulations 2018 in respect of the rights of way.

(b) In the event that any dispute arises between the Members and/or the Society, clauses 15.5 and 15.6 shall apply.

8.6. Consents & Territorial Authority: The Society shall comply with the conditions of any Consent issued by any Relevant Authority in respect of the Access Lot, Rockfall Protection Lot or Communal Facilities, together with any easement granted to a Relevant Authority in respect of the Access Lot or Rockfall Protection Lot.

8.7. Water Meters: If the Council does not administer water meters and water charges separately for each individual Residential Lot, the Society shall on a monthly basis (or at such times that the Society reasonably determines is necessary or desirable to meet its payment obligations

for the supply of water to the Development) read the Water Meters, and invoice and collect each Member's share.

8.8. Waste Collection: If Council waste collection services are not available to any of the Residential Lots, the Society shall contract with a waste collection provider to provide reasonable (in the Society's discretion) household waste disposal and collection services for the Residential Lots that do not have access to Council waste collection services.

8.9. Financial Reports:

(a) The Society shall provide to a prospective purchaser of Residential Property, within 5 working days after receiving a request, a copy of the most recent financial statements of the Society.

(b) The Society shall ensure that financial statements of the Society are provided to Members. The Society shall audit such financial statements if so required to do by a majority of Members voting at a meeting in accordance with and pursuant to clause 12.3.

9. LIMITATIONS OF THE SOCIETY

9.1. No Indebtedness: The Society shall not borrow any money other than short-term borrowing to cover any temporary shortfall in meeting the Society's obligations under this Constitution, except by Special Resolution.

9.2. No Investments: The Society shall hold all funds with a bank registered under the Reserve Bank of New Zealand Act 1 989 and shall not invest those funds other than by deposit with such a bank, except by Special Resolution. All moneys paid to the Society by the Members shall only be applied for one or more of the activities referred to in clause 9.4.

9.3. No Improper Use: The Access Lot, Rockfall Protection Lot and the Communal Facilities shall be used only for their proper purposes and the Members shall have the right to use the Access Lot, Rockfall Protection Lot and the Communal Facilities in accordance with the Rules.

9.4. No Activities Except Permitted Activities: The Society shall only be permitted to carry on one or more of the following activities:

(a) Owning, leasing, licensing, maintaining, administering, or operating the Access Lot Rockfall Protection Lot and the Communal Facilities;

(b) Issuing licences to Members of the Society to confer rights on those Members to use the Access Lot, Rockfall Protection Lot and the Communal Facilities, and administering and enforcing those licences in accordance with the

(c) Managing and administering the Society and administering and enforcing the rules;

(d) Any incidental activities that the Committee considers are beneficial for Members of the Society.

10. OPERATION OF THE SOCIETY - COMMITTEE

10.1. Powers: The administration of the Society shall be delegated to the Committee. The Committee may exercise any powers, authority and discretions of the Society as permitted by

this Constitution and do on its behalf all such acts as they deem necessary or expedient. The powers, authority and discretions as exercised by the Committee are subject always to any limitation which may from time to time be imposed by the Society, under this Constitution or the Act. For the avoidance of doubt, except where a right, power or discretion is expressly reserved to the Members under this Constitution or the Act, references in this Constitution to the Society having any right, power or discretion are deemed to be references to the Committee having that right, power or discretion on behalf of the Society.

10.2. Delegation of Powers to Subcommittee or Manager: The Committee may delegate any of its powers to committees consisting of such member or members of their body as they think fit or to a Manager. Any committee so formed or Manager so appointed shall in the exercise of the powers so delegated comply with any directions of the Committee.

10.3. Bank Accounts: The Society shall establish a bank account (and may do so by delegating such matter to the Manager) and any drawings on that account (including any cheque drawn on that account) shall be made only under the signature of the chairperson and one other member of the Committee or the signature of the Manager.

10.4. Documents: All documents and written announcements requiring execution on behalf of the Society must be signed by the chairperson with the exception of the deed of covenant attached as Schedule 6 which may be signed in accordance with clause 10.1 1 of this Constitution.

10.5. Composition: The Committee shall comprise the following persons:

(a) chairperson; and

(b) general Committee members, the number of Committee members to be determined by the Society in a general meeting before election of Committee members.

10.6. Committee Members:

(a) The Controlling Member (if there is one) shall be a general Committee member. The balance of the Committee shall be elected by the Society at every annual general meeting and may be elected at any other time by the Society in the general meeting, provided that the Society shall only elect persons as members of the Committee and shall not elect any person specifically as chairperson.

(b) A Committee member shall hold elected position until the earliest of:

(i) the next annual general meeting following election (when the Committee member shall be eligible for re-election);

(ii) the date written resignation from the position is received by the Society;

(iii) the date of removal from such position by the Society in general meeting; or the date of cessation of membership.

(c) In the event of a casual vacancy in any position on the Committee (whether caused by death, cessation of membership from the Society or some other means) the remaining Committee members may appoint another Member to fill the vacancy until the position is filled by the Society in general meeting.

(d) Notwithstanding any other clause in this Constitution, the Controlling Member shall remain as a general Committee member for so long as they remain Controlling Member, and the Society shall not be entitled to remove either from those positions for any reason whatsoever.

10.7. Duties of Treasurer/Secretary: The Committee shall appoint, remove and replace a treasurer/secretary from time to time to carry out such of the obligations of the treasurer/secretary as the Committee shall see fit. The treasurer/secretary shall be the Manager where a Manager has been appointed and all duties shall be delegated to the Manager accordingly:

(a) convene general meetings when requested to do so in accordance with this Constitution;

(b) attend all meetings of the Committee and have full speaking rights at such meetings;

(c) give all notices required to be given by these clauses or as directed from time to time by the Society or the Committee;

(d) be and undertake all duties required of a "statutory officer" or similar pursuant to the Act (if any);

(e) keep minutes at all general meetings and Committee meetings, make these available to Members on request and enter into the minute book:

(i) the time, date and venue of such meeting; and

(ii) all business considered and resolutions passed at such meeting;

(f) hold in safe custody the common seal of the Society;

(g) receive and issue receipts for all annual levies, additional fees and any other moneys paid to the Society;

(h) operate and maintain a current bank account in the name of the Society;

(i) pay accounts properly incurred by or on behalf of the Society;

(j) report immediately to the Society any Member who fails to pay annual levies or additional fees within the prescribed period;

(k) keep all financial records and any security documents in safe custody;

(l) compile proper accounting records from time to time as required by the Act or by the Committee which give a true, fair and complete account of the financial affairs and transactions of the Society; and

(m) compile the financial statements immediately following each financial year as required by the Act and if required provide for the auditing of those records and the distribution of the audited financial statements to Members.

10.8. Conduct of Meetings: The Committee may meet together, adjourn or otherwise regulate its meeting and procedures for conducting its business as it thinks fit. The Committee may meet

at any time and the secretary shall upon the request of the chairperson or not less than 50% of Committee members or the Controlling Member, convene a meeting of the Committee.

10.9. Quorum: A majority of the members of the Committee from time to time, provided that such majority includes the Controlling Member (if there is one) shall form a quorum for a Committee meeting. No business of the Committee shall be conducted at any time when less than a quorum is present at the same time and place.

10.10. Chairperson:

(a) The Committee from time to time shall appoint, remove and replace a chairperson for such term as it sees fit from one of their number (provided that the Controlling Member shall not be the chairperson) to chair Committee meetings and otherwise exercise the powers of the chairperson set out in this Constitution.

(b) In the case of a tie in votes the chairperson may exercise a casting vote.

10.11. Seal: The Committee will obtain a common seal for the use of the Society and shall provide for its safe custody. The common seal shall not be used except by resolution of the Committee. Every instrument to which the common seal is affixed shall be signed by two members of the Committee or the Manager. Notwithstanding the foregoing, while there is a Controlling Member, the Controlling Member's signature shall bind the Society to such instruments, agreements or deeds as are reasonably necessary to facilitate the completion of the Development. Any deed signed by the Controlling Member must be signed with the common seal in accordance with the Act.

10.12. Voting: Resolutions of the Committee shall be passed by majority. Each Committee member shall be entitled to exercise one vote provided that the treasurer/secretary shall not be entitled to vote and further provided that the Controlling Member (if there is one) shall be entitled to exercise a number of votes equal to one more than the number of other Committee members present at any Committee meeting. Notwithstanding any contrary provision in this Constitution a resolution in writing signed by such of the Committee members as would constitute a quorum at a Committee meeting shall be as valid and effectual as if it had been passed at a meeting of the Committee duly convened and constituted.

10.13. Validity of Committee's Actions: All acts properly done by any meeting of the Committee or by any person acting as a Committee member notwithstanding that it may afterwards be discovered that there was some defect in the appointment or continuance in office of any such Committee member or that they were disqualified, shall be as valid as if every such person had been duly appointed or had duly continued in office and was qualified to be a Committee member.

10.14. Committee Minutes and Records: The Committee shall cause proper minutes to be kept of the proceedings of any meetings of the Society and of the Committee. All business transacted at such meetings signed by the chairperson shall be accepted as a correct and accurate record of the business transacted at such meetings without any further proof of the facts contained in such minutes.

11. MANAGER

11.1. First Manager: The first Manager shall be [xxxxxxxxxxxxxxxxxxxxxxx] or such other Manager as may be nominated by the Controlling Member. The Manager shall manage the Society in

accordance with the Management Agreement. On expiry or termination of the Management Agreement, a replacement Manager shall be appointed by the Committee under clause 10.

11.2. Appointment and Duties: Subject to clause 11.1, the Committee shall appoint, remove and replace a Manager from time to time to carry out such of the obligations of the Society, and exercise such of the discretions and powers of the Society, as the Committee shall see fit. Such appointment shall be for the term, at the remuneration and on such terms and conditions as the Committee may agree with the Manager. The terms and conditions shall be recorded in a Management Agreement on terms approved by the Committee.

12. GENERAL MEETINGS

12.1. Annual General Meeting: In addition to any other meetings in that year the Society shall hold an annual general meeting each year. Not more than 18 months shall elapse between the date of one annual general meeting and that of the next. The Committee will determine the time and place of each year's annual general meeting.

12.2. Special General Meetings: A general meeting other than an annual general meeting may be requested by the Committee or by written requisitions signed by not less than 25% of current Members or by the Controlling Member. The secretary shall call a special general meeting within 14 days of receiving an effective request.

12.3. Powers of the Society General Meeting: The Society in general meeting may, by resolution, exercise all powers, authorities and discretions of the Society notwithstanding that any such power, authority and discretion may have been delegated to the Committee by or pursuant to this Constitution. Notwithstanding any contrary provision in this Constitution a resolution in writing signed by 75% of the Members entitled to vote in person, by proxy or by postal vote at general meetings together with the Controlling Member (if there is one), shall be as valid and effectual as if it had been passed at a general meeting of the Society duly convened and constituted.

12.4. Quorum: No business shall be transacted at any general meeting of the Society unless the quorum is present when a meeting proceeds to business. Quorums shall be not less than 25% of the Members eligible to vote at general meetings, present in person or by proxy, or present and participating in the meeting by means of audio, audio and visual, or electronic communication, or by those who have cast postal votes, together with the Controlling Member (if there is one).

12.5. Notice of General Meeting: A notice of general meeting of the Society shall be sent to every Member not less than 10 working days before the date of such meeting. Such notice shall specify the date, time and venue of such meeting. In the case of a general meeting other than an annual general meeting such notice shall specify all business and all notices of motions to be considered at such meeting. No business or notice of motion which is not specified shall be discussed or transacted at such meeting.

12.6. Postal voting instructions: If postal voting is permitted the notice of the meeting must state the name of the person authorised by the Committee to receive and count postal votes at that meeting. If no person has been authorised to receive and count postal votes at that meeting, or if the Committee has been named as so being authorised, every member of the Committee is deemed to be so authorised.

12.7. Electronic voting: Subject to complying with any obligations under the Act, the Committee may conduct a vote of Members by means of electronic voting in such manner as may be approved by the Committee.

12.8. Failure to Give Notice: The accidental omission to give notice or the nonreceipt of such notice by any Member shall not invalidate the proceedings at any such meeting.

12.9. The Chairperson: The chairperson at any general meeting shall be:

(a) the chairperson of the Society; or

(b) if the Chairperson is unavailable or unwilling then the Society's Manager; or

(c) if neither the chairperson or the Manger is present or neither is willing to take the chair then those Committee members who are present may choose one of their number to chair the meeting.

12.10. Adjournment:

(a) If a quorum is not present within half an hour from the time appointment for the holding of a general meeting convened on requisition of Members, the meeting shall be dissolved.

(b) If a quorum is not present within half an hour from the time appointed for the holding of an Annual General Meeting or a general meeting requested by the Committee or by the Controlling Member, the meeting shall stand adjourned to the same day in the next week at the same time and place or to such other day and at such other time and place as the Committee shall determine (such date not to be later than 14 days from the date of the adjourned meeting). If at such adjourned meeting a quorum is not present within half an hour from the time appointed for holding the meeting, the Members present together with the Controlling Member (if there is one) shall constitute a quorum.

12.11. Adjourned Meetings: No business other than that business which might have been transacted at the meeting from which the adjournment took place shall be transacted at any adjourned meeting. Members shall not be entitled to receive any notice in respect of adjourned meetings.

12.12. Information that must be presented at a General Meeting: The Chairperson shall be responsible (or the Manager where these responsibilities have been delegated) for presenting at a General Meeting the annual report, financial statements, disclosure of interests made by officers and minutes from the last annual general meeting.

13. VOTING

13.1. One Residential Property - One Vote: Each Residential Property entitles its Owner(s) to one vote. Votes may be exercised either in person, or by proxy, or by postal vote. Where there is more than one Owner in respect of any Residential Property, only one such Owner is entitled to vote. In the absence of agreement between the Owners as to who shall exercise this vote, the Owner appearing first on the record of title to the Residential Property will be entitled to exercise that vote. On the death of any Owner and pending the transfer of that Owner's Residential Property, the executor(s) or administrator(s) of that Owner's estate shall be entitled to exercise that Owner's vote.

13.2. Controlling Member's Vote: The Controlling Member (if there is one) shall be entitled to exercise a number of votes equal to one more than the number of Members present at any general meeting.

13.3. Corporation Representatives: Any corporation which is a Member may by resolution of its directors or other governing body, authorise such person as it thinks fit to act as its representative at any meeting of the Society, and the person so authorised shall be entitled to exercise the same powers of the corporation which that person represents as that corporation could exercise if it were an individual Member, and references in this Constitution to a Member being present in person shall mean and include a representative appointed pursuant to this clause, and such person may also stand for election to the Committee.

13.4. No Vote If Fees Unpaid: Unless all annual levies and additional fees presently payable by the Member to the Society have been paid in full the Member shall not be entitled to vote at any general meeting of the Society, whether in his own right or as a proxy for another person.

13.5. Voting at Meetings: At any general meeting:

(a) A resolution may be put to the vote by the chairperson or by any Member present at the meeting and entitled to vote.

(b) Resolutions put to the vote shall be decided on voices, a show of hands, by proxy or by postal vote unless a poll is demanded on or before declaration of the result by:

(i) the chairperson of the meeting; or

(ii) at least 50% of the Members present in person or by proxy.

(c) In the case of a resolution put to the vote of the meeting by voices, a show of hands, by proxy or by postal vote, a declaration by the chairperson that such resolution has been carried or lost or an entry to that effect in the Society's minute book, shall be conclusive evidence of that fact without further proof of the number or proportion of votes recorded in favour of or against such resolution.

(d) Resolutions shall be passed by a majority of votes except where Special Resolution or the unanimous resolution of all Members is required by this Constitution.

(e) In the case of a tie in votes the chairperson may exercise a casting vote.

13.6. Postal Vote: A Member may exercise the right to vote at a meeting by casting a postal vote in accordance with the following provisions:

(a) Member may cast a postal vote on all or any of the matters to be voted on at the meeting by sending a notice of how that Member has voted to a person authorised to receive and count postal votes at that meeting. The notice must reach that person not less than 48 hours before the start of the meeting.

(b) It is the duty of a person authorised to receive and count postal votes at a meeting to collect together all postal votes received and to count the number of votes in favour and against each resolution to be voted on at the meeting, and present the results of the counts in a certificate to the chairperson of the meeting.

(c) The chairperson must ensure the certificate of postal votes is annexed to the minutes of the meeting.

(d) A postal vote may be cast using electronic means permitted by the Committee.

13.7. Form of Postal Vote: The instrument containing the postal vote may be in the following form or in a common or usual form:

> *of being a member of [xxxxxxxxxx] Residents Society Incorporated hereby vote at the [annual] general meeting of Linwood Ave Residents Society Incorporated to be held on the day of and at any adjournment thereof in favour of/against the following resolutions:*
>
> *Signed this day of 20*

13.8. Good Faith: Members shall in exercising any vote at any general meeting, or as a Committee Member, exercise such vote in good faith with a view to ensuring that all Members are treated fairly by the Society and that each Member shall bear and pay that Members Share of all Operating Expenses and of all costs and expenses to be met by levies made by the Society under clauses **Error! Reference source not found.**-6.1 irrespective of whether any expenditure by the Society benefits all Members.

13.9. Instruments Appointing Proxies: The instrument appointing a proxy shall be in writing under the hand of the appointor or the appointor's attorney duly authorised in writing or, if the appointor is a corporation or body corporate either under seal or under the hand of an officer or attorney duly authorised. The instrument appointing a proxy shall be deemed to confer authority to demand or join in demanding a poll. A member shall be entitled to instruct his or her proxy in favour of or against any proposed resolutions. Unless otherwise instructed the proxy may vote as he or she thinks fit.

13.10. Form of Proxy: The instrument appointing a proxy may be in the following form or in a common or usual form:

> *of being a member of [xxxxxxxxx] Residents Society Incorporated hereby appoint of or failing him or her of as my proxy to vote for me on my behalf at the [annual] general meeting of Linwood Ave Residents Society Incorporated to be held on the day of and at any adjournment thereof.*
>
> *My proxy is hereby authorised to vote in favour of/against the following resolutions:*
>
> *Signed thisday of 20*

13.11. Notice of Proxy: The instrument appointing a proxy and the power of attorney or other authority, if any, under which it is signed or a notarially certified copy of that power or authority shall be deposited at the registered office or at such other place within New Zealand as is specified for that purpose in the notice convening the meeting, not less than 48 hours before the time for holding the meeting or adjourned meeting at which the person named on the instrument proposes to vote, or, in the case of a poll, not less than 24 hours before the time appointed for the taking of the poll and in default the instrument of proxy shall not be treated as valid.

13.12. Validity of Proxy: A vote given in accordance with the terms of an instrument of proxy or attorney shall be valid notwithstanding the previous death or unsoundness of mind of the principal or revocation of the instrument or of the authority under which the instrument was executed if no intimation in writing of such death, unsoundness of mind or revocation

aforesaid has been received by the association at the registered office by the commencement of the meeting or adjourned meeting for which the instrument is issued.

13.13. Objection to Proxy: No objection shall be raised to the qualifications of any voter except at the meeting or adjourned meeting at which the vote objected to is given or tendered and every vote not disallowed at that meeting shall be valid for all purposes. Any such objection made in due time shall be referred to the chairperson of the meeting whose decision shall be final and conclusive.

13.14. Members of Unsound Mind: A member who is of unsound mind or whose person or estate is liable to be dealt with in any way under the law relating to mental health may vote, whether on a show of hands or on a poll, by such person as properly has the management of his or her estate and any such person may vote by attorney or by proxy.

13.15. Electronic voting: Subject to complying with any obligations under the Act, the Committee may provide for Members to vote at a meeting of Members (including any general meeting) by means of electronic voting in such manner as may be approved by the Committee.

14. NOTICES

14.1. Notices to Members: A notice required or authorised to be served, delivered, given or sent to any member will be deemed to have been sufficiently served, delivered or sent if:

(a) delivered personally to the Member; or

(b) sent by ordinary post addressed to the Member at the address of the Member appearing in the Register of Members; or

(c) transmitted to the email address appearing in the Register of Members.

14.2. Notice to the Society: A notice required or authorised to be served, delivered, given or sent to the Society will be deemed to have been served, delivered, given or sent if:

(a) delivered to the registered office; or sent by ordinary post addressed to the Society at the registered office; or

(b) transmitted to the email address of the Manager.

14.3. Deemed receipt: A notice sent by post pursuant to this clause will be deemed to have been received by the addressee 48 hours after time of posting.

14.4. Omission: The accidental omission to give notice of a meeting to or the nonreceipt of a notice of a meeting by any Member entitled to receive notice will not invalidate the proceedings at the meeting.

15. GENERAL

15.1. Dissolution/Winding Up: The Society may be wound up in accordance with section 24 of the Act.

15.2. Alteration of Constitution:

(a) This Constitution shall not be amended, added to or rescinded except at an annual general meeting or a general meeting convened for that purpose and unless written notice of the proposed amendment, addition or rescission shall have been given to all Members in accordance with this Constitution.

(b) No clause, including this one, shall be amended, added to or rescinded except by Special Resolution.

15.3. Liability of Member:

(a) No Member shall be under any liability in respect of any contract or other obligation made or incurred by the Society.

(b) The Society shall indemnify each Member against any liability properly incurred by such Member in respect of the affairs of the Society to the extent of property owned by the Society.

(c) No action in law or otherwise shall lie in favour of any Member against any other Member or the committee or any Committee member in respect of any act or omission pursuant to these Rules.

(d) Nothing in this clause shall prevent an action in respect of any loss or expense arising from the wilful default of any person against whom such action is taken.

15.4. Indemnity: Each Member shall indemnify and keep indemnified the Society from and against any action, claim, demand, loss, damage, cost, expense and liability which the Society may suffer or incur or for which the Society may become liable in respect of or arising from any breach of this Constitution by the Member.

15.5. Dispute Resolution:

(a) Good Faith Discussion: In the event that any dispute arises between the parties in any way arising out of or in connection with this Constitution the parties shall enter into discussions in good faith with a view to resolving the dispute amicably as soon as practicable. Either party may terminate these discussions at any time.

(b) Notice of Mediation: If any dispute or difference arises between the parties in any way arising out of or in connection with this Constitution and such dispute has not been resolved within 15 Working Days of the commencement of discussions pursuant to clause 15.5(a), either party may give written notice of its intention to refer such dispute or difference to mediation.

(c) Agreement to Mediate: If a request to mediate is made then the parties shall endeavour to agree on a mediator and shall submit the matter in dispute to the mediator. The mediator shall discuss the matter with the parties (separately or jointly in the discretion of the mediator) and endeavour to resolve it by their agreement. All discussions in the mediation shall be without prejudice and shall not be referred to in any later proceedings. The parties shall bear their own costs in the mediation and shall each pay half of the costs of the mediator.

15.6. Arbitration: If:

(a) No Resolution by Discussions: the dispute has not been resolved by the discussions of the parties pursuant to clause 15.5(a): or

(b) No Mediation Notice: the parties have agreed upon mediation but have been unable within 10 Working Days of such agreement to agree upon a mediator; or

(c) No Agreement: no agreement has been reached in mediation within 1 month of the service of the notice of mediation, or within such further time as the parties may agree,

then the matter in dispute may be referred to arbitration upon the service of a notice of intention to commence arbitration which shall be governed by the Arbitration Act 1996 except to the extent modified by this Constitution.

Arbitrator: The arbitration shall be by a single arbitrator. If the parties cannot agree upon an arbitrator within 10 Working Days of service of the notice of intention to commence arbitration either party may request the president of the Arbitrators Institute of New Zealand Inc. to appoint a sole arbitrator. Either party may request the appointment of an assessor to sit with the arbitrator but any such assessor shall have an advisory role only and shall not have the authority to make a binding decision. If the parties cannot agree upon an assessor in a reasonable time then the arbitrator may appoint an assessor.

16. ENCUMBRANCE

16.1. Encumbrance: Every Member of the Society from time to time shall encumber the land owned by that Member with a memorandum of encumbrance so that at all times every property will be subject to a memorandum of encumbrance in terms of these provisions.

16.2. Form of Encumbrance: The memorandum of encumbrance shall be in the following form and to the following effect (except as the same is varied from time to time by the Society) as attached as Schedule 5.

SCHEDULE 1

SOCIETY RULES

1. DEFINITIONS AND INTERPRETATION

1.1. Definitions: In this Constitution, unless the context otherwise requires:

Access Lot means the land being Lot 17 on Deposited Plan 583961 and being a shared access lot, to be used, enjoyed and owned by Members in conjunction with their Lots.

Committee means the committee members from time to time elected to manage the affairs of the Society pursuant to this Constitution.

Communal Facilities means the Access Lot and any improvements thereon, Rockfall Protection Lot, communal accessways and all plant, equipment, facilities and amenities owned, leased or otherwise held or operated by the Society including but not limited to the Rockfall Protection System, [xxxxxxxxxxxx and xxxxxxxxxxx]

Constitution means the constitution of the Society as amended or added to, including all schedules to this Constitution.

Development means the residential development of the Land into Lots 1 to [xx] (inclusive) on Deposited Plan [xxxxxx] together with the Access Lot and Rockfall Protection Lot, as shown on the plan annexed as Schedule 2 to this Constitution.

Invitee means any invitee of or any visitor to an Owner and/or Occupier.

Land means all of the land comprised in Lot [xx] on Deposited Plan [xx] and Lot [xx] on Deposited Plan [xx] (Record of Title [xxxxxx]).

Lot means Lots 1 to 16 (inclusive) Deposited Plan 583961 all within the Development.

Manager means the manager appointed pursuant to clause 1 1 of the Constitution.

Occupier means any person occupying (permanently or temporarily) of the whole or any part of any Lot or Residential Property under any lease, license or other occupancy right and shall include all members of an Owner's family.

Owner means each person registered as an owner (whether individually or with others) of a Lot and an undivided share of the Access Lot.

Residential Property means a residential property on a Lot within the Development for which a Record of Title has been issued.

Rockfall Protection System means the rockfall protection system situated within the Development which requires ongoing maintenance in accordance with the Rockfall Protection System Maintenance Manual.

Rockfall Protection System Maintenance Manual means the rockfall protection system maintenance manual annexed as Schedule 3 of this Constitution (under which the Society will enter a service agreement for).

Rules means rules circulated by the Society including the clauses in the Constitution and these Society Rules.

Society means [xxxxxxxxx] Residents Society Incorporated or any successor or replacement entity.

2. USE

2.1. Each Member shall make no improper, offensive or unlawful use of the Access Lot, Rockfall Protection Lot and the Communal Facilities and shall use the Access Lot and the Communal Facilities only for the purposes for which they were designed.

2.2. No Member shall fetter, obstruct or impede the use of the Access Lot, Rockfall Protection Lot and the Communal Facilities by any other Member.

2.3. No Member shall place anything in or on the Access Lot, Rockfall Protection Lot and the Communal Facilities without the approval of the Committee.

2.4. No Member shall do any act which may prejudice any insurance policy held by the Society or add to the premium payable in respect of any insurance policy of the Society.

2.5. No Member shall obstruct or impede the Society from carrying out its obligations and responsibilities under these Society Rules and the Constitution. Each Member shall provide the Society with access if the Society (acting reasonably) requires access to carry out its obligations and responsibilities under these Society Rules and the Constitution, provided that no Member shall be required to provide any internal access to its Residential Property.

3. PROHIBITED ACTS

3.1. No Member shall drop any litter in or on the Access Lot or at any time store any kind of waste, rubbish or recycling material ("refuse") including refuse bins or other containers for refuse collection on the Access Lot except for in the Bin Storage Areas strictly in accordance with the requirements of the Society.

3.2. No Member shall use the Access Lot for the purpose of parking vehicles.

3.3. No Member shall do any act which detracts from the attractiveness or state of repair or operation of the Access Lot and the Communal Facilities. Any Member who discovers any damage to the Access Lot or the Communal Facilities shall immediately report such damage to the chairperson or Manager.

3.4. No Member shall use any vehicle other than on a sealed area and for transportation purposes only and in particular shall not drive any such vehicle recklessly and/or at excessive speed on the Access Lot or the Communal Facilities (provided such facility is suitable for transportation purposes) in such a manner that constitutes a nuisance in the opinion of the Society.

4. COMPLIANCE WITH TRAFFIC REGULATIONS

4.1. Every Member must when using the Access Lot in the Development comply with all traffic regulations including but not limited to the Land Transport Act 1993 and the Land Transport (Road User) Rule 2004.

5. ACCESS LOT

5.1. The Owner, Occupier or Invitees shall not park vehicles or place any object or thing on the Access Lot in such a way that obstructs any other vehicle or any other user of the Access Lot or block access to or egress from the Access Lot. If, in the Society's sole opinion, any car parked in the Access Lot is incorrectly parked, the Society may remove the vehicle without being liable for any resulting loss, damage or expense. The Owner and Occupier shall reimburse the Society for any cost incurred by pursuant to this rule and the Society may recover such cost from the Owner and Occupier jointly or severally.

5.2. The Owner, Occupier or Invitees shall not damage any surface of any Access Lot (including but not limited to placing oil, petrol, other spillage or rubbish on or allowing oil, petrol or other spillage and rubbish to be placed on the Access Lot) nor make nor permit to be made any alterations or additions to the Access Lot nor install or place any equipment, signage, fixture, fitting or machinery (other than vehicles) on any part of the Access Lot. If, in the Society's sole opinion, fails to comply with this obligation, the Society may take any action it thinks fit to remedy this damage and may recover such cost from the Owner and Occupier jointly or severally.

5.3. The Society shall not be responsible to the Owner, Occupier or to any other person:

(a) For removal of any vehicle or other object or thing from the Access Lot;

(b) For any loss or damage sustained by the Owner, Occupier or any of their Invitees in respect of any vehicle parked on the Access Lot or entering the Access Lot; and

(c) For theft or loss of any articles from any such vehicle.

5.4. The Society is entitled to remove any vehicle or other thing which, in the Society's sole opinion, is parked or placed on the Access Lot without complying with these Rules and in doing so the Society or any person authorised by the Society to remove vehicles or any other things pursuant to this power will be deemed:

(a) To have full authority of the Owner, Occupier and their Invitees;

(b) To carry out the removal as agent for the Owner, Occupier and their Invitees and at the Owner's and Occupier's cost; and

(c) In all respects carry out the removal at the risk of the Owner and Occupier.

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Project Number 20268.001.001

Conceptual Retaining Wall Design

130 Bowenvale Avenue, Cashmere, Christchurch

Submitted to:
GCO Ltd
165 Harewood Road
Papanui
Christchurch 8053

Contents

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Appendices

ENGEO Document Control:

Report Title	Conceptual Retaining Wall Design - 130 Bowenvale Avenue, Cashmere			
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1 Introduction

ENGEO Ltd was requested by GCO Ltd to undertake a conceptual retaining wall design for the property at 130 Bowenvale Avenue, Cashmere, Christchurch (herein referred to as 'the site'). This work has been carried out in accordance with our signed agreement dated 31 May 2022 (ENGEO ref: 20268.001.002_02). Our scope of work was as follows:

- Preliminary geotechnical retaining design using site data gathered in our subdivision consent investigation (ENGEO, 2022). We understand that at this stage of the project, retaining is required to support cut slopes at the base of lots, formed during roading excavations.
- Provision of this report documenting our design and a typical drawing for the preliminary design.

Note that we have excluded detailed retaining design to a level suitable for building consent as this document is intended to support a Resource Consent application. We will not provide a full drawing set, construction specifications or PS1 until the retaining layouts and dimensions are finalised and the design can be completed.

2 Site Description and Proposed Development

The site is located on the western side of the Bowenvale Valley upslope of Bowenvale Avenue on a section of approximately 5 hectares, with the legal description Pt Lot 2, 2 DP 33462. The site is located on an east-facing section of that is moderately sloping (~20-22º) between 25 and 200 metres above sea level (m asl). A broadly north-south orientated ridgeline is located upslope of the proposed development. Downslope and broadly parallel with the direction of slope are a series of gullies and ridges.

The proposed development is a residential subdivision consisting of approximately 35 lots. We understand that the proposed new buildings will be one or two storeys and generally orientated along slope. We understand that you propose to retain soil at the downslope end of the lots with gabion baskets. The retained cuts are created to construct the road and right of way corridors, downslope of the retaining walls.

3 Ground Model

3.1 Regional Geology

The site is located on the Port Hills, Canterbury where the geological setting is typically topsoil and wind derived loess deposits of varying thickness overlying a basaltic rock mass. The basalt is a result a of series of Banks Peninsula Volcanics referred to as the Lyttelton Volcanic Group.

3.2 Site Investigations

As part of the subdivision consent report, ENGEO completed 12 hand auger boreholes with associated Scala penetrometer and shear vane tests between 13 and 15 July 2022. Hand augers generally met refusal on hard loess. HA07 and HA10 met practical refusal on weathered volcanics between 0.6 m and 0.8 m depth, based on the location of these hand augers we consider it likely this is a colluvium layer. HA11 met practical refusal on inferred bedrock at 1.5 m depth.

Geovert Ltd drilled a series of vertical holes to establish the depth to rock across the site. The results of the investigations, and nearby CPTs completed at the base of the site, indicate that the bedrock profile steeply dips towards the northeast.

Groundwater was not encountered within the majority of the hand auger holes. However, groundwater was noted at 1.3 m depth in HA04. It should be noted HA04 was located within the lower reaches of a gully system. Severe tunnel gulley erosion is visible on the site in aerial photographs and during our site walkover assessment.

4 Geotechnical Assessment

The cut made to form the road and right of way corridors will be at 60°, primarily within loess, and it is proposed to provide additional support to this cut with gabion baskets. Rock may be intercepted within the road cuts, especially towards the upslope sections of the site.

The gabion walls have been designed in general accordance with the earthquake geotechnical engineering practice Module 6: Earthquake resistant retaining wall design (MBIE & NZGS, 2021) with relevant portions of Verification Method B1/VM4 Foundations (MBIE, 2017).

We have utilised the software program SLIDE2, produced by Rocscience Ltd to assess the global stability of the cuts.

4.1 Site Subsoil Class

The site can be defined as partially 'Class B – Rock' for the areas of the site where loess is less than 3 m deep. However, the majority of the site can be defined as "Class C – Shallow soil sites". For the purpose of seismic design, we consider the soil classification in line with NZS 1170.5:2004 to be 'Class C' for Lots 1 to 8 and 32 to 34. For all other lots the more conservative of the two options provided should be utilised, unless further testing to classify soil category is completed during the building consent phase.

4.2 Seismic Design

The earthquake loads considered for design were taken from the Earthquake geotechnical engineering practice Module 6: Earthquake resistant retaining wall design (MBIE & NZGS, 2021). The wall has been designed adopting a flexible pressure distribution (Wood & Elms, 1990). Vertical seismic loads have not been considered for structural stability.

We have designed the walls for cases 5 and 6, as described in the Earthquake geotechnical engineering practice Module 6: Earthquake resistant retaining wall design (MBIE & NZGS, 2021).

Table 1: Seismic Design Load

Design Earthquake Event	Site subsoil Class	a_{max}	Wall displacement factor, W_d	Topographic Amplification factor, A_{Topo}	Design Horizontal Acceleration k_h
Ultimate Limit State (ULS)	C[1]	0.40 g	0.3	1.0	0.12 g

[1]We have applied site subsoil class C across the entire site as this gives the more conservative PGA when compared with class B.

5 Conceptual Retaining Design

5.1 General

The walls have been designed in general accordance with the Earthquake geotechnical engineering practice Module 6: Earthquake resistant retaining wall design (MBIE & NZGS, 2021) with relevant portions of Verification Method B1/VM4 Foundations (MBIE, 2017).

5.2 Design Assumptions

- Geometry of cut slopes: cut slopes will be at a maximum angle of 60° and a maximum height 4.0 m. The gabion baskets will be placed leaning back such that the rear face of the gabions is sitting directly on the cut slope.
- Maximum head slope angle of 25°. Toe-slope assumed to be level due to road / right of way constructed beneath cut. Based on information provided by Gravitas this appears to be a reasonable assumption. Maximum head slope based off existing land slope.
- Residential properties built behind the cut slopes are placed a minimum distance of 1.5*H (or 4.5 m, whichever is greater). This is to qualify using a case 5 w_d factor as discussed in Section 4.2 and to avoid any surcharge effects from the dwellings on the slope. We have considered that a residential dwelling will impose a surcharge of 25 kPa across its footprint. No live loading has been considered.
- We have assumed no water pressures will be acting on the cut slope.
- All cuts will be in loess or loess colluvium. We have not considered a bedrock profile in our analysis as this is likely to positively impact the stability of the structure.
- Design life of 50 years, Importance Level 2 structure.

5.3 Load Cases

We have considered the following load cases in design. Factors of safety have been adopted in line with guidance provided in MBIE Module 6.

- Static loading: drained soil conditions. Target factor of safety 1.5.
- ULS Seismic loading: undrained soil conditions. Target factor of safety 1.2.

We have not considered an SLS case as if the performance under ULS seismic loading is satisfactory the design is unlikely to suffer significant deformations under the lower SLS loading. MBIE Module 6 does not require an SLS seismic case to be considered for case 5 retaining structures.

5.4 Slope Stability Analysis

We have completed a slope stability analysis of the proposed cut slope – gabion arrangement using the software program SLIDE2, produced by Rocscience Ltd.

Input parameters are presented in Table 2. A sensitivity analysis was completed to calculate the required cohesion of the Loess Colluvium to maintain sufficient factor of safety under static conditions. It is assumed that a 4-5 m high 60° cut in Loess Colluvium is inherently stable, based on observations of the performance of similar cuts throughout the Port Hills.

Table 2: Geotechnical Parameters Considered in Design

Material	Unit weight	Friction angle, ϕ	Drained cohesion	Undrained shear strength
Loess Colluvium[1]	17	32°	6 kPa[3]	50 kPa
Gabion Basket[2]	20	40°	12.5 kPa	N/A

[1]Material properties have been adopted based on our understanding of the Loess Colluvium present at the site and past laboratory testing data completed on the Port Hills compiled by GNS Science (Della Pasqua, 2014).

[2]Gabion basket material properties adopted based on guidance from the manufacturer, Maccaferri.

[3]Sensitivity analysis indicated that 6 kPa cohesion is required for Loess to provide an adequate factor of safety. We consider that it is reasonable to be able to rely on this provided surface water is controlled appropriately, discussed further below.

5.5 Analysis Results

The slope stability analysis indicates that approximately 6 kPa drained cohesion is required for adequate factors of safety in static conditions. We consider that this is a reasonable level of cohesion to rely on in design based on observations of similar cuts throughout the Port Hills, and collated lab testing data (Della Pasqua et al., 2014).

With this cohesion the site is unlikely to be at risk of deep seated (global) slope instability based on the high soil strengths encountered in our site testing. Additionally, no signs of historic deep seated slope failure were noted in our site walkover / aerial image assessment (refer to our subdivision report dated July 2022).

However, the site is at risk of shallow seated erosional failures relating to saturation of the surficial Loess during intensive rainfall events (as saturated material loses its cohesion). Historical evidence of these failures is visible on-site (ENGEO, 2022). The slope stability analysis indicates that, when dry, shallow seated erosional failures are unlikely to occur. Therefore, it is clear that careful surface water management is required to maintain cohesion in the soil.

Table 3: Slope Stability Analysis Results

Design Case	Factor of Safety
Static	1.503
Seismic	1.519[1]

[1]The relatively high factor of safety under seismic loading is due to the high undrained shear strength of the Loess Colluvium. The results are in line with observations completed throughout the Port Hills following the Canterbury Earthquake Sequence (MBIE Module 6).

5.6 Rock Profile

The investigations completed at and near the site indicate that the bedrock profile dips steeply towards the northeast, however it is possible that portions of the retaining cuts will intercept the underlying rock profile. In this case, the rock may either be entirely broken out to cover the entire face with gabion baskets or a bench may be cut at the top of the rock profile for the gabion baskets to sit on, leaving the base of the cut as rock.

Once exposed, any cuts made within rock must be observed by a suitably qualified geotechnical engineer to assess potential defect-controlled failures that may require spot-bolting.

5.7 Erosion and Surface Water Management

Protecting the cut slope from saturation during and following heavy rain events is critical to the stability of the system.

The gabion baskets will protect the face of the slope from weathering effects. We recommend that surface water from all impermeable surfaces is collected and disposed at an appropriate discharge point.

Tunnel gulleys are likely to be intercepted daylighting at the slope face during construction. A suitable remediation method for this will be detailed at the developed design phase, this could take the form of an upslope cut off drain.

5.8 Exceptions

We understand there may be several areas within the subdivision where the geometric assumptions made in Section 5.2 are not likely to be met.

- Retained heights in excess of 4 m (but less than 5 m).
- Dwelling setbacks of 4.5 m (less than 1.5H for 4 m retained height).
- Or, cut slope angle steeper than 60° (but less than 80°).

Retaining these geometries is still geotechnically feasible, however additional reinforcement of the slope is required. This is likely to be in the form of soil nails attached to the rear of the gabion baskets.

6 Conclusions and Future Work

We consider that the proposed retaining system will be suitable for the site conditions. The recommendations presented in this report are to support conceptual design. Detailed design needs to be completed prior to submitting for building consent.

7 Limitations

i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, GCO Ltd, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.

iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

iv. This Limitation should be read in conjunction with the Engineering NZ / ACENZ Standard Terms of Engagement.

v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (03) 328 9012 if you require any further information.

Report prepared by

Dai Kiddle

Geotechnical Engineer

Report reviewed by

Neil Charters, CMEngNZ (CPEng)

Principal Geotechnical Engineer

8 References

Buchanan, A. (2007). *Timber Design Guide .*

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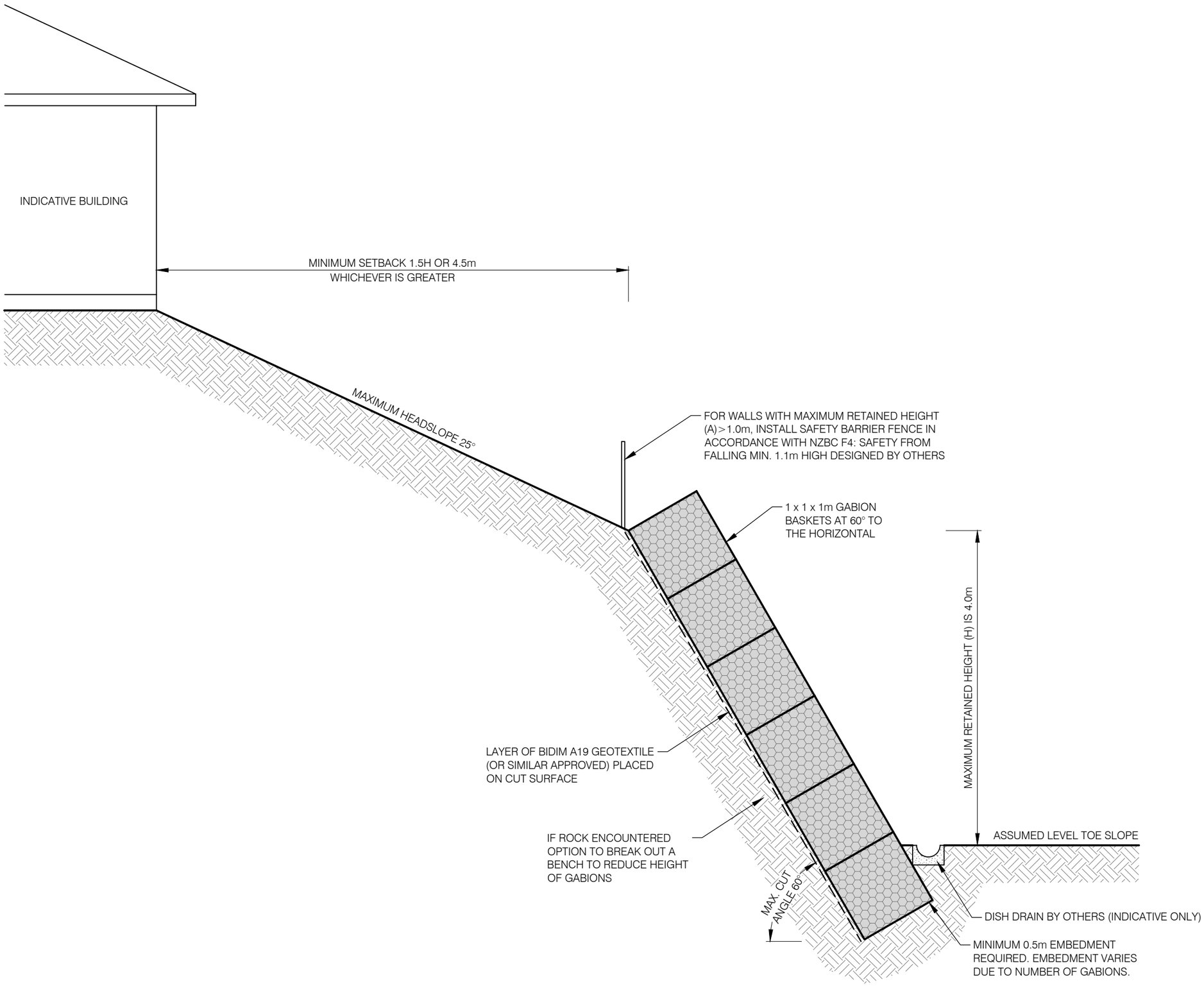
APPENDIX 1:

Drawings

DATE PLOTTED: 27 October 2022 5:15 PM BY : CAROLINE DJERDJERIAN



Note:

1. For costing purposes only, subject to detailed design.
2. All surface water must be controlled appropriately. No hydrostatic pressure on wall allowed for in design.
3. Tunnel gullies are likely to be encountered during facing cut. All tunnel gullies require cut off drains upslope to intercept flow path.
4. No vehicle surcharge allowed for above wall.
5. Foundation conditions assumed to be stiff loess, loess colluvium or volcanic rock.

ENGEO

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124 Montreal Street, Sydenham Christchurch 8023
Tel: 03 328 9012, www.engeo.co.nz

DRAFT NOT FOR CONSTRUCTION

Rev	Date	Description	Drwn	Chkd
A	28.10.22	Issued for concept	DF	NC

Title:

TYPICAL GABION RETAINING WALL DETAIL

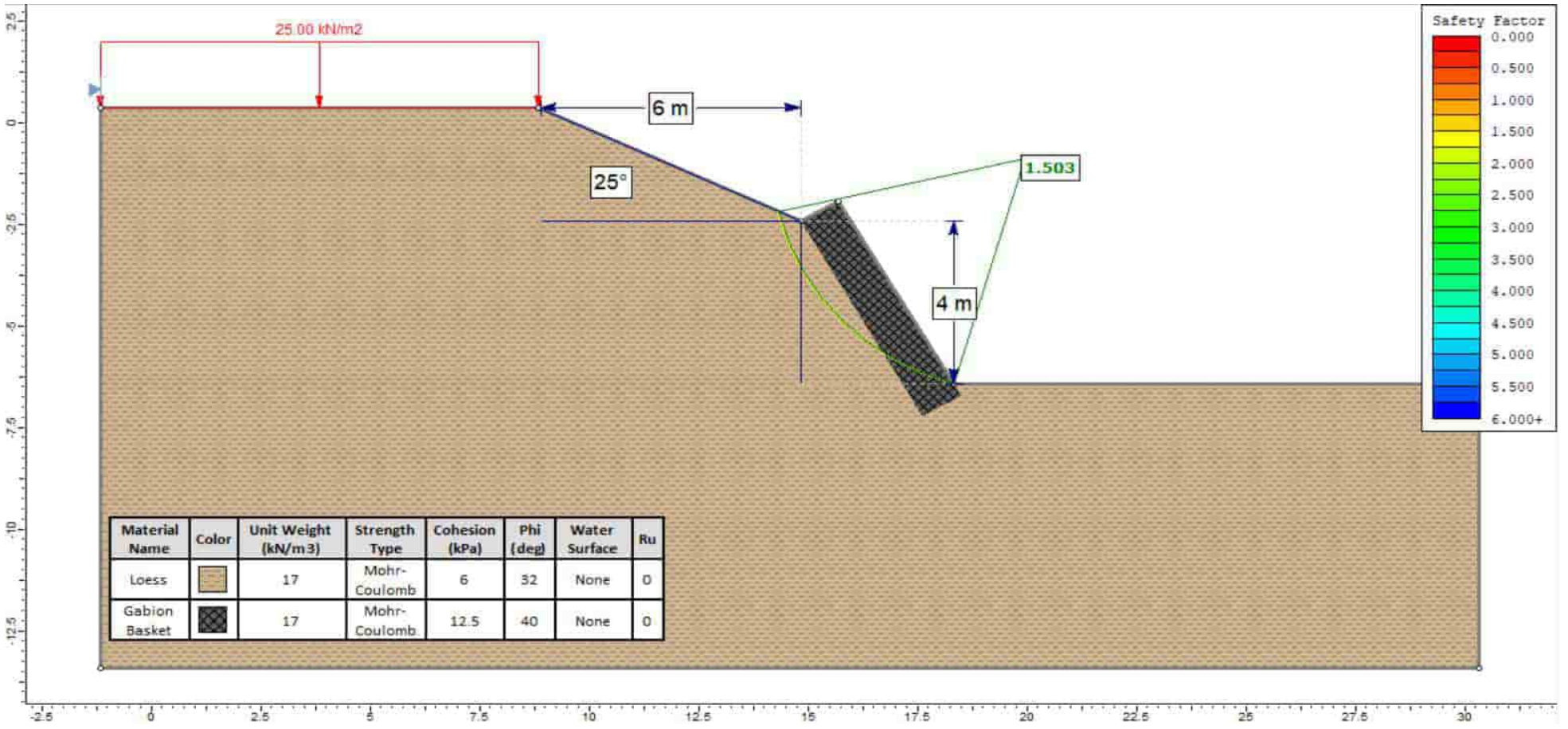
Client: GCO Ltd		Sheet: 1
Project: 130 Bowenvale Avenue Cashmere Christchurch	Designed: DK Drawn: DF Checked: NC Date: 28.10.22	Size: A3
Project No: 20268.001.001	Scale: N.T.S	Rev: A

CAD File: \\nzfile\NZ\Drafting\20001 to 21000\20268.000.002 - Cass Rock Assessment\20268001002-GabionRWConcept-CassBaySubd-0922.dwg
XREF's:

ORIGINAL SHEET PRINTED IN COLOUR

APPENDIX 2:

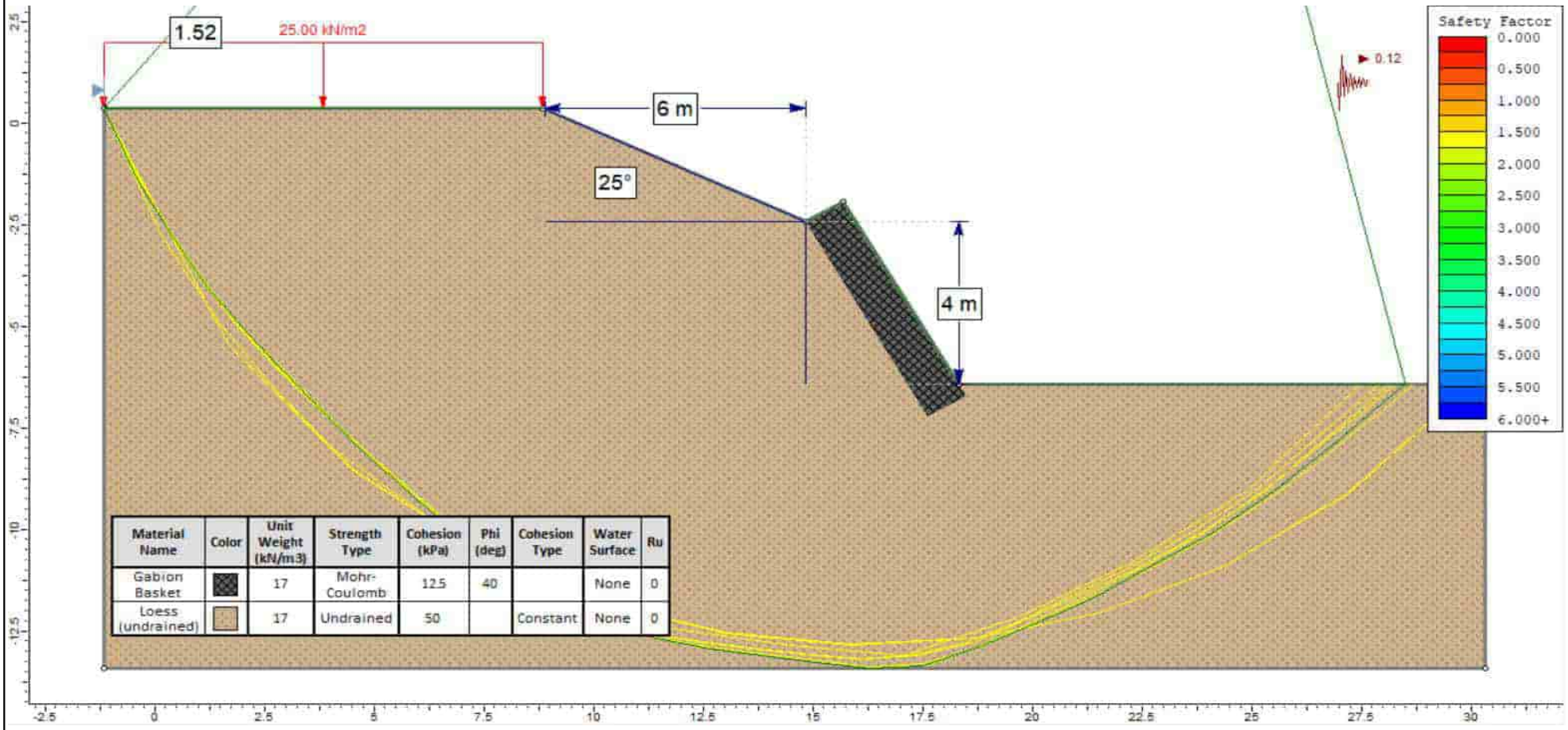
SLIDE Outputs



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Water Surface	Ru
Loess		17	Mohr-Coulomb	6	32	None	0
Gabion Basket		17	Mohr-Coulomb	12.5	40	None	0

ENGEO
Expect Excellence

Project	Bowenvale Subdivision		
Analysis	Gabion Wall Stability - Static Case		
Drawn By	Dki	Date	27-Oct-22
Approved By	NC	Job Number	20268.001.001



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Cohesion Type	Water Surface	Ru
Gabion Basket		17	Mohr-Coulomb	12.5	40		None	0
Loess (undrained)		17	Undrained	50		Constant	None	0

ENGEO
Expect Excellence

Project	Bowenvale Subdivision		
Analysis	Gabion Wall Stability - Seismic Case		
Drawn By	Dki	Date	27-Oct-22
Approved By	NC	Job Number	20268.001.001

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Project Number 20268.001.001

Preliminary Environmental Site Investigation

130 Bowenvale Avenue, Cashmere, Christchurch

Submitted to:
GCO Ltd
165 Harewood Road
Papanui
Christchurch 8053

Contents

Tables

Figures

No table of figures entries found.

Appendices

ENGEO Document Control:

Report Title	Preliminary Environmental Site Investigation - 130 Bowenvale Avenue, Cashmere			
Project No.	20268.001.001	**Doc ID**	03	
Client	GCO Ltd	**Client Contact**	**Cameron McCarthy**	
Distribution (PDF)	**GCO Ltd**			
Date	**Revision Details / Status**	**Author**	**Reviewer**	**WP**
03/11/2022	Issued to Client	HA	DR	JT

1 Introduction

ENGEO Ltd was requested by GCO Ltd to undertake a Preliminary Environmental Site Investigation (PSI) of the property at 130 Bowenvale Avenue in Cashmere, Christchurch (herein referred to as 'the site'). Figure 1 indicates the location of the property.

ENGEO understands that the site is to be subdivided for residential land use and requires a PSI to identify areas that could potentially require further investigation in accordance with the *Resource Management* (*National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011* (NES). This PSI was undertaken in general accordance with the Ministry for the Environment (MfE) 2020, Guidelines for Reporting on Contaminated Sites. It is understood that the site would be used for commercial and recreational purposes if purchased.

1.1 Objective of the Assessment

The objective of this investigation was to evaluate and identify conditions indicative of releases and threatened of hazardous substances at, or to the subject property, and report on the associated potential risk posed to future site users.

1.2 Approach

To satisfy the above objective, ENGEO sought to gather information regarding the following:

- Current and past property uses and occupancies;
- Current and past uses of hazardous substances;
- Waste management and disposal activities that could have caused a release or threatened release of hazardous substances;
- Current and past corrective actions and response activities to address past and on-going releases of hazardous substances at the subject property; and
- Properties adjoining or located near the subject property that have environmental conditions that could have resulted in conditions indicative of releases or threatened releases of hazardous substances to the subject property.

1.2.1 Review of Site Information

During this assessment, a number of sources of information were contacted for information relating to the site regarding its past and present uses. This included contacting Canterbury Regional Council (CRC) to determine if there were records on the Listed Land Use Register (LLUR) and reviewing records held by Christchurch City Council (CCC) including the property file. A review of a number of historical aerial photographs was also undertaken using images from Canterbury Maps.

1.2.2 Site Inspection

A site walkover was undertaken on 1 November 2022 by an ENGEO representative. Objective evidence was collected through observations of activities and conditions present at the site and is discussed further in Section 4.

2 Site Description

The total site area is approximately 5 ha, with the legal identifier Pt Lot 2,2 DP 33462. At the time of writing, ENGEO understands that the site would be used for residential purposes following the subdivision. The site is located on an east-facing section that is moderately sloping (~20-22°) between 25 and 200 meters above sea level (m asl).

The site information is summarised in Table 1.

Table 1: Site Information

Item	Description
Location	130 Bowenvale Avenue, Cashmere, Christchurch
Legal Description	Pt Lot 2,2 DP 33462
Current Land Use	Vacant land
Proposed Land Use	Residential subdivision
Site Area	Approximately 5 ha
Regional Authority	Christchurch City Council Canterbury Regional Council

The site setting is summarised in Table 2.

Table 2: Site Setting

Item	Description
Topography	The site is located on an east-facing section that is moderately sloping (~20-22°) between 25 and 200 meters above sea level (m asl). A broadly north-south orientated ridgeline is located upslope of the proposed development. Downslope and broadly parallel with the direction of the slope are a series of gullies and ridges.
Local Setting	The surrounding land use is mixed with residential land use to the north, east and far west, and agricultural grazing land to the far east, south and immediate west of the site.
Nearest Surface Water & Use	Sibley's Stream runs adjacent to the eastern boundary of the site.
Geology	The site is located on the Port Hills where the geological setting is typically topsoil and wind derived loess deposits of varying thickness overlying a basaltic rock mass (part of the Lyttelton Volcanic Group). The Lyttelton Volcanics typically comprise a series of interlayed lava flow deposits and pyroclastic units.
Groundwater Abstractions	There are no groundwater abstractions on or within 100 m of the site.
Discharge Consents	There are no discharge consents on or within 100 m of the site.

3 Site History

ENGEO obtained and reviewed available environmental and historical information from a number of sources to investigate the past uses of the site and surrounding areas. Information from these searches relevant to the site is summarised below.

3.1 Canterbury Regional Council's Listed Land Use Register

Potentially hazardous activities are defined on the MfE's Hazardous Activities and Industries List (HAIL) (MfE, 2011). Canterbury Regional Council (CRC) maintains a Listed Land Use Register (LLUR) of past and current land uses within the Canterbury Region which have had an activity included on the HAIL undertaken on them. The listing of a property on the LLUR triggers the requirement for a contaminated land assessment prior to development if one has not already been undertaken. If a site is not on the LLUR it does not necessarily mean that an activity on the HAIL has not been undertaken, only that it is not known by CRC to have been undertaken.

The CRC LLUR was accessed on 31 October 2022 to assess the site. The site is not listed on the LLUR. A 50 m perimeter search was also completed with the specific information is detailed in Table 3.

Table 3: Summary of LLUR – Outside of site boundary

Address	HAIL Category	Description
Wider Bowenvale Avenue Historic Horticultural Site, Cashmere	A10: Persistent pesticide bulk storage or use.	Not investigated – Area defined from 1941-2011 aerial photographs – at least one of either market garden plots, orchards or glass houses were noted in aerial photographs reviewed.
80 Bowenvale Avenue, Cashmere		Below guideline values – Residential.

3.2 Provided Documents

No additional documents were provided by the client.

3.3 Christchurch City Council Property Files

The property file held by Christchurch City Council was reviewed on 1 November 2022. No relevant information related to our environmental assessment was identified in the files reviewed.

3.4 Historical Aerial Photographs

Historical aerial photographs available on Canterbury Maps were viewed in December 2021. The relevant and applicable findings in relation to our investigation are summarised in Table 4.

Table 4: Historical Aerial Photographs

Date	Source	Description
1925-1929	Canterbury Maps	The site is being used for agricultural grazing with no buildings present. It is noted that the aerial photograph is not georeferenced correctly. The surrounding area is predominantly agricultural grazing with some associated residential properties to the north of the site.
1940-1944	Canterbury Maps	Again, the aerial photograph is not georeferenced correctly. The site and surrounding area remain predominantly the same as the previous photograph.
1945-1949	Canterbury Maps	The aerial photograph is not georeferenced correctly with the site remaining the same as the previous photograph. The land to the north of the site appears to be in use for market gardening purposes. The remaining surrounding land use is the same as the previous photograph.
1955-1959	Canterbury Maps	The site and surrounding area remain the same as the previous photograph. The market gardening operations nearby are unlikely to have been undertaken on the site.
1965-1969	Canterbury Maps	The site and surrounding area remain the same as the previous photograph.
1970-1974	Canterbury Maps	The site and surrounding area remain the same as the previous photograph with additional residential development present to the north of the site.
1980-1984	Canterbury Maps	The site remains generally the same as the previous photograph. Minimal market gardening activity remains to the north of the site with the predominant land use to the north being residential. The remaining land use is agricultural grazing.
1990-1995	Canterbury Maps	The site and surrounding area remain generally the same as the previous photograph with no market garden activity now present to the north of the site.
1995-1999	Canterbury Maps	The site and surrounding area remain generally the same as the previous photograph with no market garden activity now present to the north of the site.
2000-2004	Canterbury Maps	The site and surrounding area remain generally the same as the previous photograph.
2010-2014	Canterbury Maps	The site and surrounding area remain generally the same as the previous photograph.
2021	Canterbury Maps	The site and surrounding area remain generally the same as the previous photograph.

4 Current Site Conditions

A site walkover was completed on 1 November 2022 by an ENGEO representative. Observations of activities and conditions present at the site are summarised in Table 5. ENGEO did not conduct interviews with any of the current site occupants during the walkover.

Table 5: Current Site Conditions

Site Conditions	Comments
Visible Signs of Contamination	No visual or olfactory indicators of contamination was observed during the time of the site visit.
Surface Water Appearance	Sibley's Stream was noted to be dry during the time of the site visit.
Current Surrounding Land Use	Surrounding land use is residential to the north, agricultural / pastoral grazing to the west and south and recreational (hiking and biking trails) to the east.
Local Sensitive Environments	No local sensitive environments encountered during the time of the visit.
Visible Signs of Plant Stress	The thick vegetation observed during the time of the site visit appeared to be in good condition.
Ground Cover	Uneven terrain consisting of long grass / shrub cover and several rock outcrops.
Potential for On- or Off-Site Migration Of Contaminants	Potential for migration of contaminants downslope.
Buildings Present	No buildings observed during the time of the site visit.

Photographs taken during the inspection are presented in Table 6.

Table 6: Site Photographs

Photo 1: Site looking north

Photo 2: Site looking west

Photo 3: Site looking west

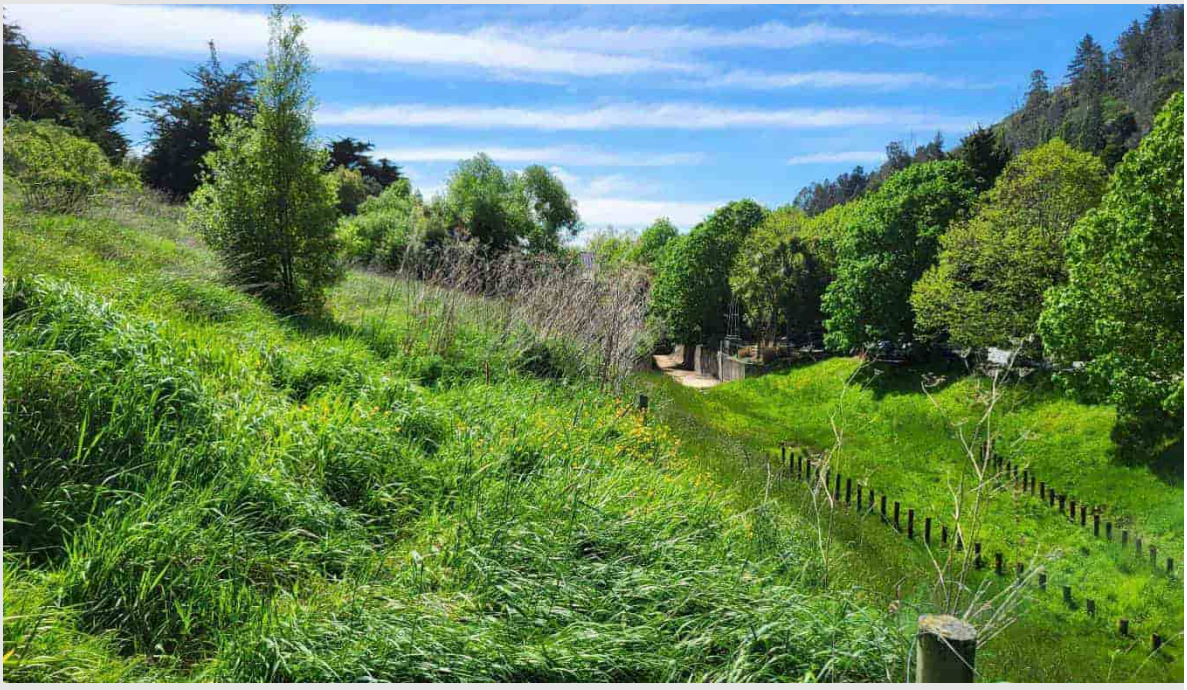

Photo 4: Site looking north from Southern end of site.

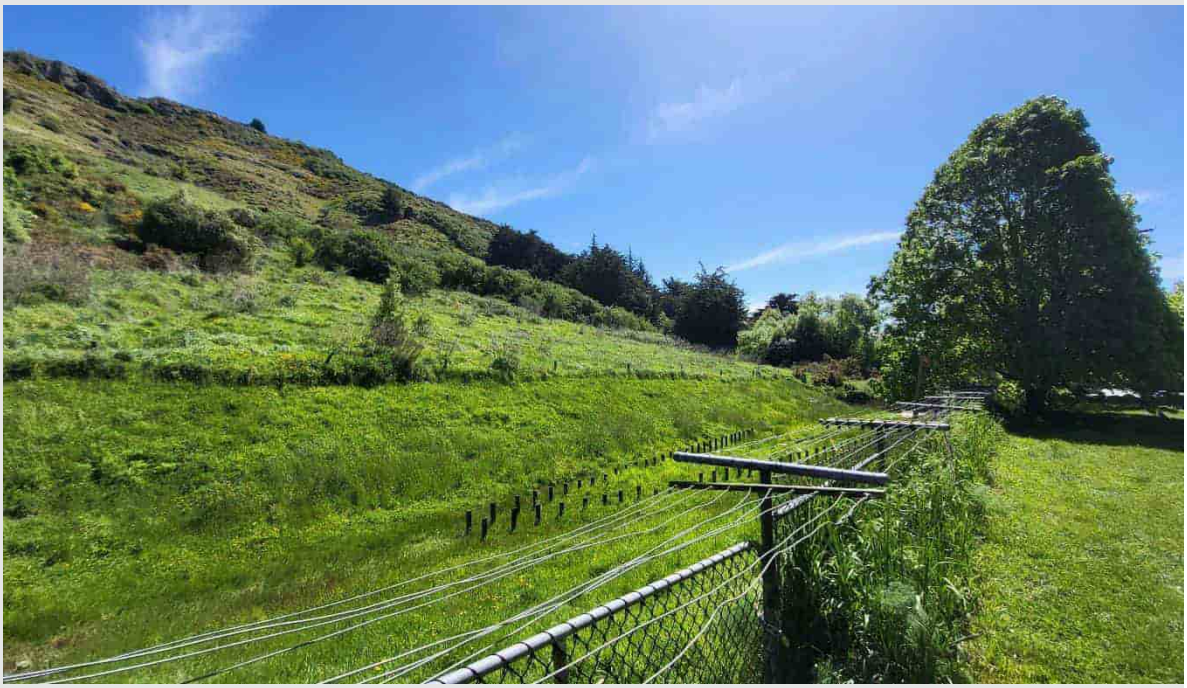

Photo 5: Site looking west

5 Potential HAIL Activities

Activities included on the HAIL trigger the requirements for an intrusive detailed environmental site investigation (DSI) prior to redevelopment. Based on the information obtained during this PSI, no HAIL activities have been identified at the site.

6 Conceptual Site Model

A conceptual site model consists of four primary components. For a contaminant to present a risk to human health or an environmental receptor, all four components are required to be present and connected. The four components of a conceptual site model are:

- Source of contamination.
- Pathway(s) in which contamination could potentially mobilise along (e.g. vapour or groundwater migration).
- Sensitive receptor(s) which may be exposed to contaminants.
- An exposure route, where the sensitive receptor and contaminants come into contact (e.g. ingestion, inhalation, dermal contact).

The potential source, pathway, receptor linkages at this subject site are provided in Table 7.

Table 7: Conceptual Site Model

Potential Sources	Contaminants of Concern	Exposure Route and Pathways	Receptors	Acceptable Risk?
Adjacent market gardening	Heavy metals OCPs	Dermal contact with impacted soil, inhalation of dust or vapours and incidental ingestion during earthworks and long-term use of the site. Groundwater migration.	Redevelopment workers Future subsurface maintenance workers Future site commercial site users Surrounding environment	**Yes.** No HAIL activities identified at the site and risk from spray drift in adjacent market gardening is considered low.

7 Conclusions and Recommendations

ENGEO was engaged by GCO Ltd to undertake a PSI of the property at 130 Bowenvale Avenue in Cashmere, Christchurch. The purpose of the assessment was to provide information regarding the potential for contamination at the site and whether the site would be considered suitable for residential subdivision.

The information collected as part of the investigation has indicated that the site has primarily been used for agricultural grazing purposes. No activities were identified on Canterbury Regional Council's Listed Land Use Register, and no information was provided regarding HAIL activities on the Christchurch City Council property file. Adjacent properties have historically been used for market gardening activities. It is considered that the risk from potential spray drift from pesticide usage in the adjacent sites is low.

During the site walkover, no areas of concern were observed although the site was noted to be of moderately steep terrain and largely overgrown.

Based on the information gathered, we consider that it is highly unlikely for the soils to have been impacted from past and current uses of the site. As per Regulation 7 of the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011, it is highly unlikely that an activity included on the HAIL has or is being carried out on the site, therefore the site is not covered by this piece of legislation.

8 Sustainability

We encourage you to consider sustainability when assessing the options available for your project. Where suitable for the project, we recommend prioritising the sustainable use of resources, using locally sourced materials where available, and installing in an environmentally friendly way (e.g., reduced carbon emissions and minimal contamination). If you would like to discuss these options further, ENGEO staff are available to offer suggestions.

9 Limitations

i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, GCO Ltd, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.

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We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (03) 328 9012 if you require any further information.

Report prepared by

Hazel Atkins, CEnvP

Associate Environmental Consultant

Report reviewed by

Dave Robotham, CEnvP SC

Principal Environmental Consultant

10 References

Forsyth, P.J.; Barrell, D.J.A; Jongens, R. (2008). Sheet 16 - Geology of the Christchurch Area 1:250,000. Institute of Geological and Nuclear Sciences, Lower Hutt.

MfE (2011a). *Ministry for the Environment Hazardous Activities and Industries List.*

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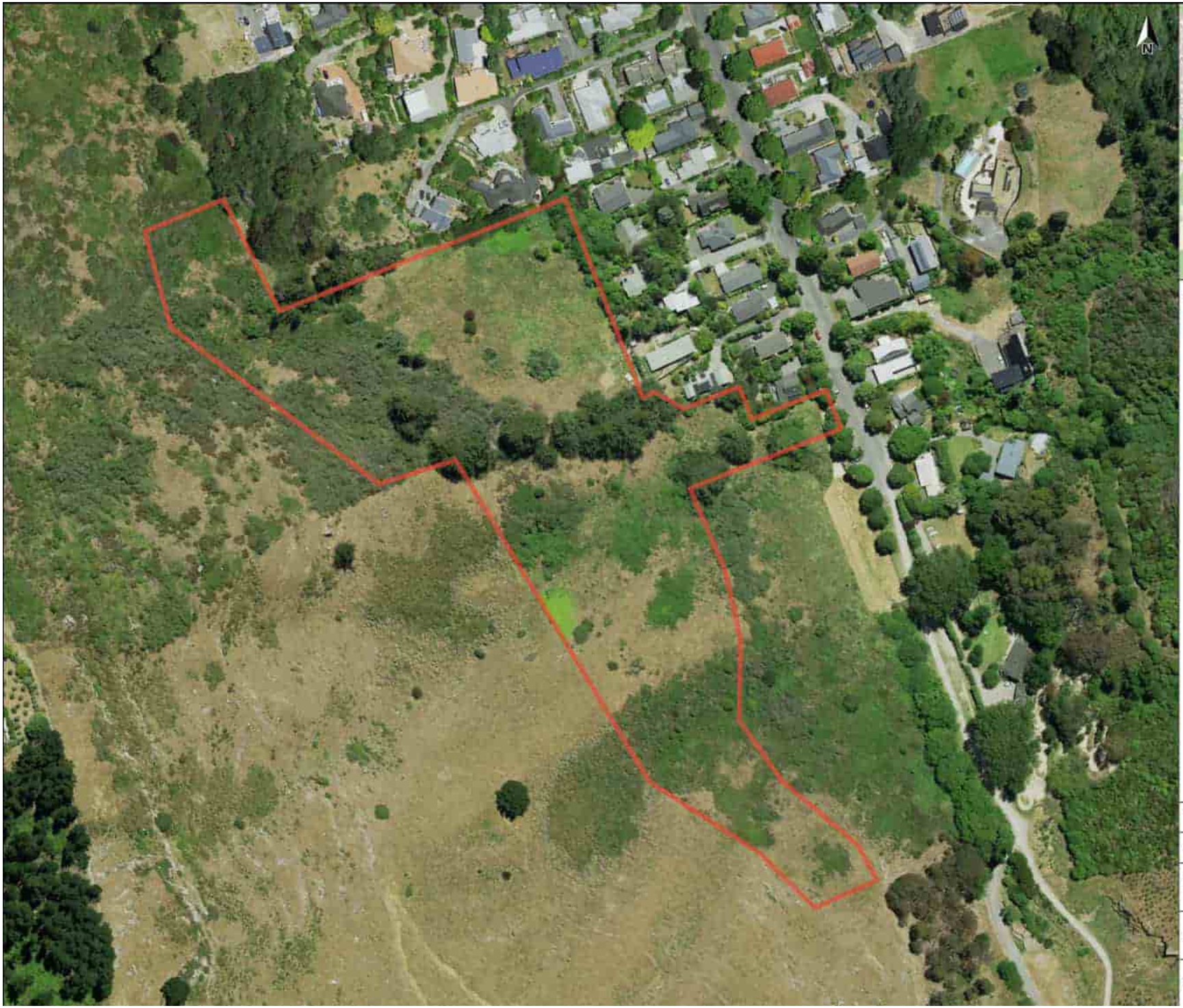
MfE (2021d). *Contaminated Land Management Guidelines No.5: Site Investigation and Analysis of Soils*.

MfE (2011f). *Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.*

MfE (2012). Users' guide: National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.

FIGURES



Legend

Site Boundary

0 25 m 50 m

ENGEO

Produced by **Datanest.earth**

Title: Site Location Plan		
Client: GCO Ltd		Figure No: 1 Size: A4
Project: Bowenvale Development	Drawn: HA	
Date: 19-07-2022	Checked: DR	
Proj No: 20268.001	Scale: 1:2500	Version: 1.0

APPENDIX 1:

Listed Land Use Register Statement

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

Dear Sir/Madam

Thank you for submitting your property enquiry from our Listed Land Use Register (LLUR). The LLUR holds information about sites that have been used or are currently used for activities which have the potential to cause contamination.

The LLUR statement shows the land parcel(s) you enquired about and provides information regarding any potential LLUR sites within a specified radius.

Please note that if a property is not currently registered on the LLUR, it does not mean that an activity with the potential to cause contamination has never occurred, or is not currently occurring there. The LLUR database is not complete, and new sites are regularly being added as we receive information and conduct our own investigations into current and historic land uses.

The LLUR only contains information held by Environment Canterbury in relation to contaminated or potentially contaminated land; additional relevant information may be held in other files (for example consent and enforcement files).

Please contact Environment Canterbury if you wish to discuss the contents of this property statement.

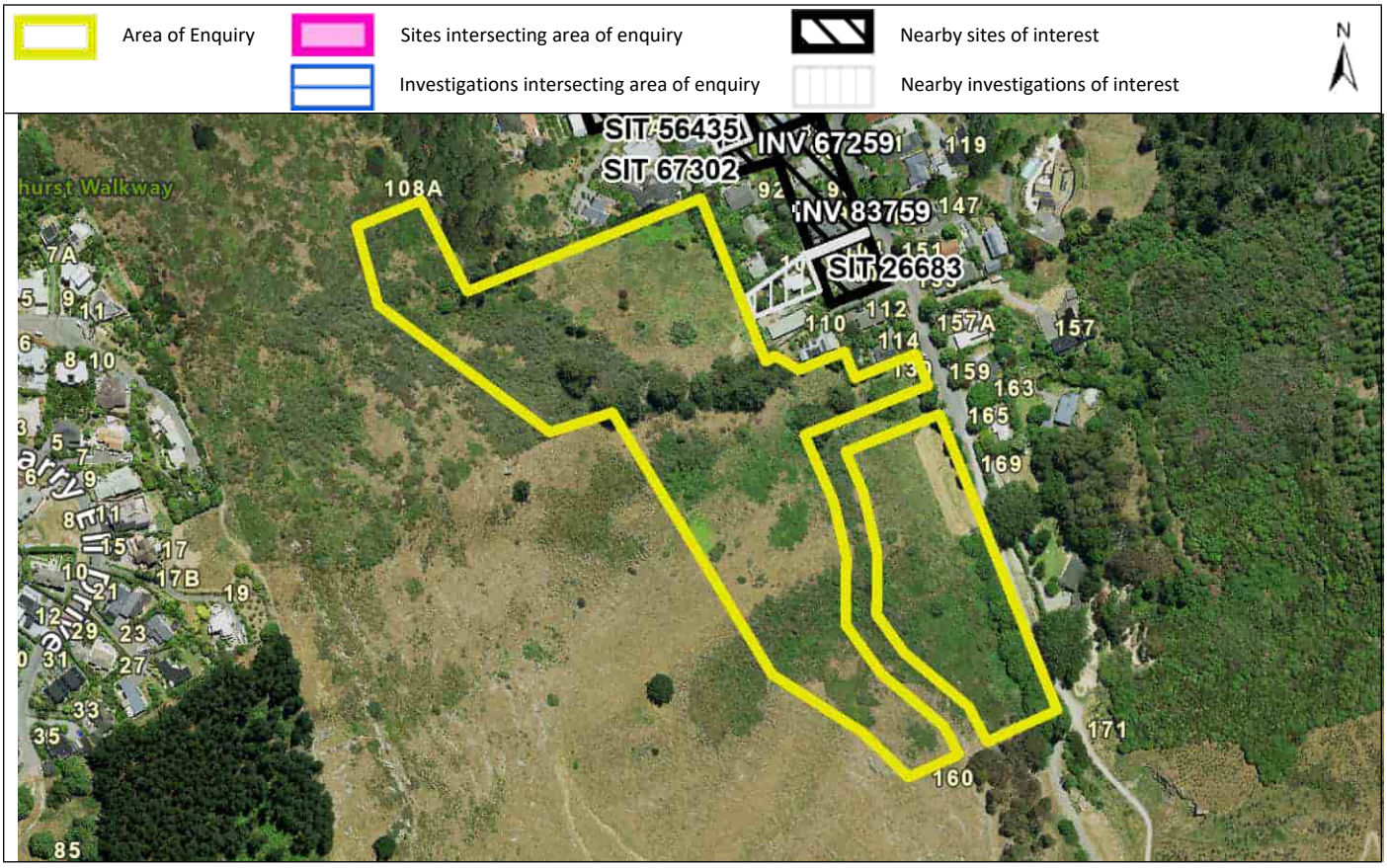
Yours sincerely

Contaminated Sites Team

Property Statement
from the Listed Land Use Register

Visit ecan.govt.nz/HAIL for more information or
contact Customer Services at ecan.govt.nz/contact/ and quote ENQ331039

Date generated: 30 October 2022
Land parcels: Part Lot 2 DP 33462
Part Lot 2 DP 33462



The information presented in this map is specific to the area within a 50m radius of property you have selected. Information on properties outside the serach radius may not be shown on this map, even if the property is visible.

Sites at a glance

Sites within enquiry area

Site number	Name	Location	HAIL activity(s)	Category

Please note that the above table represents a summary of sites and HAILs intersecting the area of enquiry only.

Nearby sites

Site number	Name	Location	HAIL activity(s)	Category
26683	Wider Bowenvale Avenue Historic Horticultural Site, Cashmere	Bowenvale Avenue, Dalefield Drive, Plumwood & Maurice Knowles Lanes, Cashmere	A10 - Persistent pesticide bulk storage or use;	Not Investigated
56435	86 Bowenvale Avenue, Cashmere, Christchurch	86 Bowenvale Avenue, Cashmere, Christchurch		Verified Non-HAIL
67302	80 Bowenvale Avenue, Cashmere	80 Bowenvale Avenue, Cashmere, Christchurch	A10 - Persistent pesticide bulk storage or use;	Below guideline values - Residential

Please note that the above table represents a summary of sites and HAILs intersecting the area of enquiry within a 50m buffer.

More detail about the sites

Site 26683: Wider Bowenvale Avenue Historic Horticultural Site, Cashmere (Within 50m of enquiry area.)

Category: Not Investigated
Definition: Verified HAIL has not been investigated.

Location: Bowenvale Avenue, Dalefield Drive, Plumwood & Maurice Knowles Lanes, Cashmere
Legal description(s): Lot 1 DP 24710,Lot 1 DP 26943,Lot 1 DP 27852,Lot 1 DP 301116,Lot 1 DP 362464,Lot 1 DP 41390,Lot 1 DP 53437,Lot 1 DP 55663,Lot 1 DP 56626,Lot 1 DP 61394,Lot 1 DP 71477,Lot 1 DP 73158,Lot 1 DP 74189,Lot 1 DP 74575,Lot 1 DP 78497,Lot 10 DP 362464,Lot 10 DP 74189,Lot 11 DP 362464,Lot 11 DP 74189,Lot 12 DP 362464,Lot 13 DP 362464,Lot 13 DP 71452,Lot 14 DP 362464,Lot 14 DP 71452,Lot 15 DP 71452,Lot 16 DP 71452,Lot 2 DP 24710,Lot 2 DP 26943,Lot 2 DP 27852,Lot 2 DP 301116,Lot 2 DP 40545,Lot 2 DP 53437,Lot 2 DP 61394,Lot 2 DP 62185,Lot 2 DP 73158,Lot 2 DP 74575,Lot 2 DP 78497,Lot 3 DP 24710,Lot 3 DP 27852,Lot 3 DP 362464,Lot 3 DP 53437,Lot 3 DP 56494,Lot 3 DP 61394,Lot 3 DP 62185,Lot 3 DP 71477,Lot 3 DP 73158,Lot 3 DP 74189,Lot 3 DP 78497,Lot 4 DP 24710,Lot 4 DP 26943,Lot 4 DP 27852,Lot 4 DP 362464,Lot 4 DP 53437,Lot 4 DP 56494,Lot 4 DP 62185,Lot 4 DP 71477,Lot 4 DP 73158,Lot 5 DP 26943,Lot 5 DP 27852,Lot 5 DP 362464,Lot 5 DP 53437,Lot 5 DP 73158,Lot 5 DP 74189,Lot 6 DP 362464,Lot 6 DP 53437,Lot 6 DP 56494,Lot 6 DP 73158,Lot 7 DP 362464,Lot 7 DP 73158,Lot 7 DP 74189,Lot 8 DP 362464,Lot 8 DP 73158,Lot 8 DP 74189,Lot 9 DP 362464,Lot 9 DP 74189

HAIL activity(s):

Period from	Period to	HAIL activity
Pre 1941	Pre 2011	Persistent pesticide bulk storage or use including sports turfs, market gardens, orchards, glass houses or spray sheds

Notes:

14 Nov 2013 Area defined from: 1941 - 2011 ECan Aerial Photographs Note: At least one of either market-garden plots, orchards or glass houses were noted in the aerial photographs reviewed.

Investigations:

There are no investigations associated with this site.

Site 56435: 86 Bowenvale Avenue, Cashmere, Christchurch (Within 50m of enquiry area.)

Category: Verified Non-HAIL
Definition: Site entered on register based on information found to be incorrect.

Location: 86 Bowenvale Avenue, Cashmere, Christchurch
Legal description(s): Lot 2 DP 56494

HAIL activity(s):

Period from	Period to	HAIL activity

Notes:

23 Jun 2014 Upon review of Site 26683 it was found that a residence is present at 86 Bowenvale Lane, Cashmere in 1941 to 2011 and so predates surrounding horticultural land use. A new site has been created and categorised as 'Verified non-HAIL'.

Investigations:

There are no investigations associated with this site.

Site 67302: 80 Bowenvale Avenue, Cashmere (Within 50m of enquiry area.)

Category: Below guideline values - Residential
Definition: Investigation results demonstrate that hazardous substances present at the site, but below applicable

guidelines. - Residential

Location: 80 Bowenvale Avenue, Cashmere, Christchurch
Legal description(s): Lot 5 DP 56494

HAIL activity(s):

Period from	Period to	HAIL activity
Pre 1941	Pre 2011	Persistent pesticide bulk storage or use including sports turfs, market gardens, orchards, glass houses or spray sheds

Notes:

Investigations:

INV 67259 **Detailed Site Investigation - 80 Bowenvale Avenue, Cashmere, Christchurch**
Coffey Environments - Detailed Site Investigation
13 Aug 2014

Summary of investigation(s):

Site history: The site is located on land that was historically used as the wider Bowenvale Avenue Historic Horticultural area. The market gardens and glasshouses are visible on historical aerial photos from 1941 to 1984. Borehole logs from a Coffey 2013 geotechnical investigation noted carbonaceous inclusions and brick fragments in multiple hand auger bores from the site.

Title of report: Detailed Site Investigation - 80 Bowenvale Avenue, Cashmere, Christchurch

Investigation objective: To assess the need for an NES consent during the construction of a new dwelling at the site and assess soils that may be disturbed during development for off-site disposal options.

Results: All fill and underlying soil analysed had concentrations below NES soil contaminant standards for residential land use (10% produce consumption). Various heavy metals were present in the fill at concentrations above typical background concentrations. DDT isomers and polyaromatic hydrocarbons were detected in the fill. The underlying soils were below background for metals and non-detect for the pesticides analysed.

Conclusions: The site should be categorised as Below Environmental Guidelines - Residential

Justification for proposed category: Sampling was adequate to indicate that although fill is present, the concentrations of contaminants are below applicable soil contaminant standards but above typical background concentrations.

Nearby investigations of interest

INV 83759 **Environmental Soil Investigation at 102 Bowenvale Avenue, Cashemere, Christchurch**
Geoscience Consulting Ltd - Detailed Site Investigation
21 Oct 2014

Summary of investigation(s):

An investigation occurred to assess and provide information on potential contaminants in soil with comparison to applicable standards and guidelines and potential disposal/management options during site redevelopment. The site has potentially been exposed to persistent pesticides during a period of horticultural activity from before 1941 to 1973 as evident in aerial photographs. A residence is evident in 1994 to the present (2011). Historical aerial photographs were consulted and an intrusive soil investigation performed.

Four surface soil samples were collected around the footprint of the residence and composited in a laboratory. Effects of horticultural land use are generally found in surface soil. The single composite soil sample was analysed for a suite of metals and organochlorine pesticides. Results were compared against adjusted National Environment Standards (NES) to account for the composite and found to be compliant with residential land use standards.

The site has been satisfactorilly investigated to demonstrate that soil present is compliant with relevant standards and guidelines.

Disclaimer

The information contained in this report reflects the current records held by Environment Canterbury regarding the activities undertaken on the site, its possible contamination and based on that information, the categorisation of the site. Environment Canterbury has not verified the accuracy or completeness of this information. It is released only as a copy of Environment Canterbury's records and is not intended to provide a full, complete or totally accurate assessment of the site. It is provided on the basis that Environment Canterbury makes no warranty or representation regarding the reliability, accuracy or completeness of the information provided or the level of contamination (if any) at the relevant site or that the site is suitable or otherwise for any particular purpose. Environment Canterbury accepts no responsibility for any loss, cost, damage or expense any person may incur as a result of the use, reference to or reliance on the information contained in this report.

Any person receiving and using this information is bound by the provisions of the Privacy Act 1993.

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Listed Land Use Register

What you need to know

Everything is connected

What is the Listed Land Use Register (LLUR)?

The LLUR is a database that Environment Canterbury uses to manage information about land that is, or has been, associated with the use, storage or disposal of hazardous substances.

Why do we need the LLUR?

Some activities and industries are hazardous and can potentially contaminate land or water. We need the LLUR to help us manage information about land which could pose a risk to your health and the environment because of its current or former land use.

Section 30 of the Resource Management Act (RMA, 1991) requires Environment Canterbury to investigate, identify and monitor contaminated land. To do this we follow national guidelines and use the LLUR to help us manage the information.

The information we collect also helps your local district or city council to fulfil its functions under the RMA. One of these is implementing the National Environmental Standard (NES) for Assessing and Managing Contaminants in Soil, which came into effect on 1 January 2012.

For information on the NES, contact your city or district council.

How does Environment Canterbury identify sites to be included on the LLUR?

We identify sites to be included on the LLUR based on a list of land uses produced by the Ministry for the Environment (MfE). This is called the Hazardous Activities and Industries List (HAIL)[1]. The HAIL has 53 different activities, and includes land uses such as fuel storage sites, orchards, timber treatment yards, landfills, sheep dips and any other activities where hazardous substances could cause land and water contamination.

We have two main ways of identifying HAIL sites:

- We are actively identifying sites in each district using historic records and aerial photographs. This project started in 2008 and is ongoing.
- We also receive information from other sources, such as environmental site investigation reports submitted to us as a requirement of the Regional Plan, and in resource consent applications.

[1] The Hazardous Activities and Industries List (HAIL) can be downloaded from MfE's website www.mfe.govt.nz, keyword search HAIL

How does Environment Canterbury classify sites on the LLUR?

Where we have identified a HAIL land use, we review all the available information, which may include investigation reports if we have them. We then assign the site a category on the LLUR. The category is intended to best describe what we know about the land use and potential contamination at the site and is signed off by a senior staff member.

Please refer to the Site Categories and Definitions factsheet for further information.

What does Environment Canterbury do with the information on the LLUR?

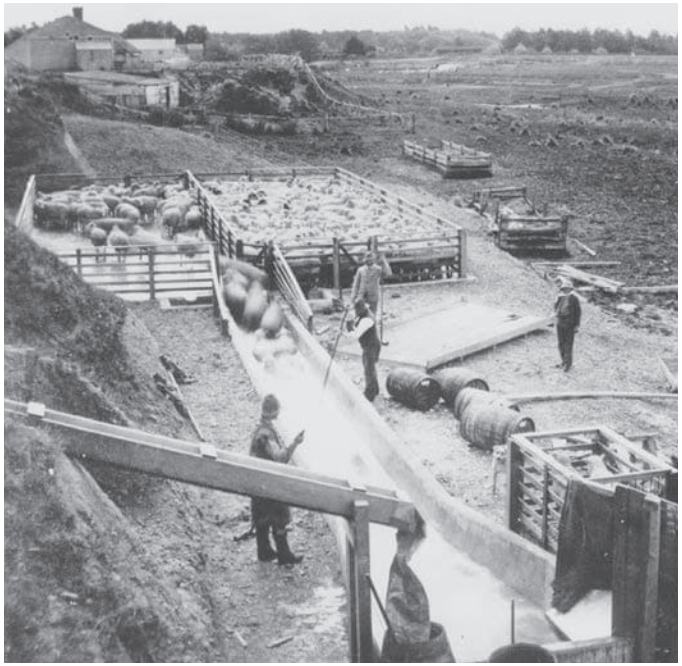
The LLUR is available online at www.llur.ecan.govt.nz. We mainly receive enquiries from potential property buyers and environmental consultants or engineers working on sites. An inquirer would typically receive a summary of any information we hold, including the category assigned to the site and a list of any investigation reports.

We may also use the information to prioritise sites for further investigation, remediation and management, to aid with planning, and to help assess resource consent applications. These are some of our other responsibilities under the RMA.

If you are conducting an environmental investigation or removing an underground storage tank at your property, you will need to comply with the rules in the Regional Plan and send us a copy of the report. This means we can keep our records accurate and up-to-date, and we can assign your property an appropriate category on the LLUR. To find out more, visit www.ecan.govt.nz/HAIL.

IMPORTANT!

The LLUR is an online database which we are continually updating. A property may not currently be registered on the LLUR, but this does not necessarily mean that it hasn't had a HAIL use in the past.



Sheep dipping (ABOVE) and gas works (TOP) are among the former land uses that have been identified as potentially hazardous. (Photo above by Wheeler & Son in 1987, courtesy of Canterbury Museum.)

My land is on the LLUR – what should I do now?

IMPORTANT! Just because your property has a land use that is deemed hazardous or is on the LLUR, it doesn't necessarily mean it's contaminated. The only way to know if land is contaminated is by carrying out a detailed site investigation, which involves collecting and testing soil samples.

You do not need to do anything if your land is on the LLUR and you have no plans to alter it in any way. It is important that you let a tenant or buyer know your land is on the Listed Land Use Register if you intend to rent or sell your property. If you are not sure what you need to tell the other party, you should seek legal advice.

You may choose to have your property further investigated for your own peace of mind, or because you want to do one of the activities covered by the National Environmental Standard for Assessing and Managing Contaminants in Soil. Your district or city council will provide further information.

If you wish to engage a suitably qualified experienced practitioner to undertake a detailed site investigation, there are criteria for choosing a practitioner on www.ecan.govt.nz/HAIL.

I think my site category is incorrect – how can I change it?

If you have an environmental investigation undertaken at your site, you must send us the report and we will review the LLUR category based on the information you provide. Similarly, if you have information that clearly shows your site has not been associated with HAIL activities (eg. a preliminary site investigation), or if other HAIL activities have occurred which we have not listed, we need to know about it so that our records are accurate.

If we have incorrectly identified that a HAIL activity has occurred at a site, it will be not be removed from the LLUR but categorised as Verified Non-HAIL. This helps us to ensure that the same site is not re-identified in the future.

Contact us

Property owners have the right to look at all the information Environment Canterbury holds about their properties.

It is free to check the information on the LLUR, online at www.llur.ecan.govt.nz.

If you don't have access to the internet, you can enquire about a specific site by phoning us on (03) 353 9007 or toll free on 0800 EC INFO (32 4636) during business hours.

Contact Environment Canterbury:

Email: ecinfo@ecan.govt.nz

Phone:
Calling from Christchurch: (03) 353 9007
Calling from any other area: 0800 EC INFO (32 4636)

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Everything is connected

Promoting quality of life through balanced resource management.

www.ecan.govt.nz E13/101

Listed Land Use Register

Site categories and definitions

When Environment Canterbury identifies a Hazardous Activities and Industries List (HAIL) land use, we review the available information and assign the site a category on the Listed Land Use Register. The category is intended to best describe what we know about the land use.

If a site is categorised as **Unverified** it means it has been reported or identified as one that appears on the HAIL, but the land use has not been confirmed with the property owner.

If the land use has been confirmed but analytical information from the collection of samples is not available, and the presence or absence of contamination has therefore not been determined, the site is registered as:

Not investigated:

- A site whose past or present use has been reported and verified as one that appears on the HAIL.
- The site has not been investigated, which might typically include sampling and analysis of site soil, water and/or ambient air, and assessment of the associated analytical data.
- There is insufficient information to characterise any risks to human health or the environment from those activities undertaken on the site. Contamination may have occurred, but should not be assumed to have occurred.

If analytical information from the collection of samples is available, the site can be registered in one of six ways:

At or below background concentrations:

The site has been investigated or remediated. The investigation or post remediation validation results confirm there are no hazardous substances above local background concentrations other than those that occur naturally in the area. The investigation or validation sampling has been sufficiently detailed to characterise the site.

Below guideline values for:

The site has been investigated. Results show that there are hazardous substances present at the site but indicate that any adverse effects or risks to people and/or the environment are considered to be so low as to be acceptable. The site may have been remediated to reduce contamination to this level, and samples taken after remediation confirm this.

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Managed for:

The site has been investigated. Results show that there are hazardous substances present at the site in concentrations that have the potential to cause adverse effects or risks to people and/or the environment. However, those risks are considered managed because:

- the nature of the use of the site prevents human and/or ecological exposure to the risks; and/or
- the land has been altered in some way and/or restrictions have been placed on the way it is used which prevent human and/or ecological exposure to the risks.

Partially investigated:

The site has been partially investigated. Results:

- demonstrate there are hazardous substances present at the site; however, there is insufficient information to quantify any adverse effects or risks to people or the environment; or
- do not adequately verify the presence or absence of contamination associated with all HAIL activities that are and/or have been undertaken on the site.

Significant adverse environmental effects:

The site has been investigated. Results show that sediment, groundwater or surface water contains hazardous substances that:

- have significant adverse effects on the environment; or
- are reasonably likely to have significant adverse effects on the environment.

Contaminated:

The site has been investigated. Results show that the land has a hazardous substance in or on it that:

- has significant adverse effects on human health and/or the environment; and/or
- is reasonably likely to have significant adverse effects on human health and/or the environment.

If a site has been included incorrectly on the Listed Land Use Register as having a HAIL, it will not be removed but will be registered as:

Verified non-HAIL:

Information shows that this site has never been associated with any of the specific activities or industries on the HAIL.

Please contact Environment Canterbury for further information:

(03) 353 9007 or toll free
on 0800 EC INFO (32 4636)
email ecinfo@ecan.govt.nz

Environment Canterbury Regional Council
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E13/102

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www.engeo.co.nz

Project Number 21178.000.001

Geotechnical Investigation

130 Bowenvale Avenue, Cashmere, Christchurch

Submitted to:
GCO Ltd
165 Harewood Road
Papanui
Christchurch 8053

Contents

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Figures

Appendices

ENGEO Document Control:

Report Title	Geotechnical Investigation - 130 Bowenvale Avenue, Cashmere			
Project No.	21178.000.001	**Doc ID**	01	
Client	GCO Ltd	**Client Contact**	Cameron McCarthy	
Distribution (PDF)	Cameron McCarthy – planning@s5s.nz			
Date	**Revision Details / Status**	**Author**	**Reviewer**	**WP**
23/11/2022	Issued to Client	JJ	WM	VB

1 Introduction

ENGEO Ltd was requested by Gravitas Consulting Limited (GCO) to undertake a geotechnical investigation of the property at 130 Bowenvale Avenue, Cashmere, Christchurch (herein referred to as 'the site'). This work has been carried out in accordance with our signed agreement dated 30 October 2022. The purpose of the assessment was to complete a geotechnical investigation for the stream crossing design, to support your Building Consent application.

Our scope of works was as follows:

- A desktop study of relevant geotechnical and geological data, including the New Zealand Geotechnical database (NZGD).
- Site assessment by an experienced ground engineering professional.
- Shallow soil testing consisting of one hand auger borehole (as access allowed) with associated strength testing, on the south-western side of the stream.
- Preparation a geotechnical report based on the findings of our enquiries and ground investigation, including soil properties to assist with the design of the stream crossing and associated retaining.

Our scope of works does not include liquefaction analysis or deep testing.

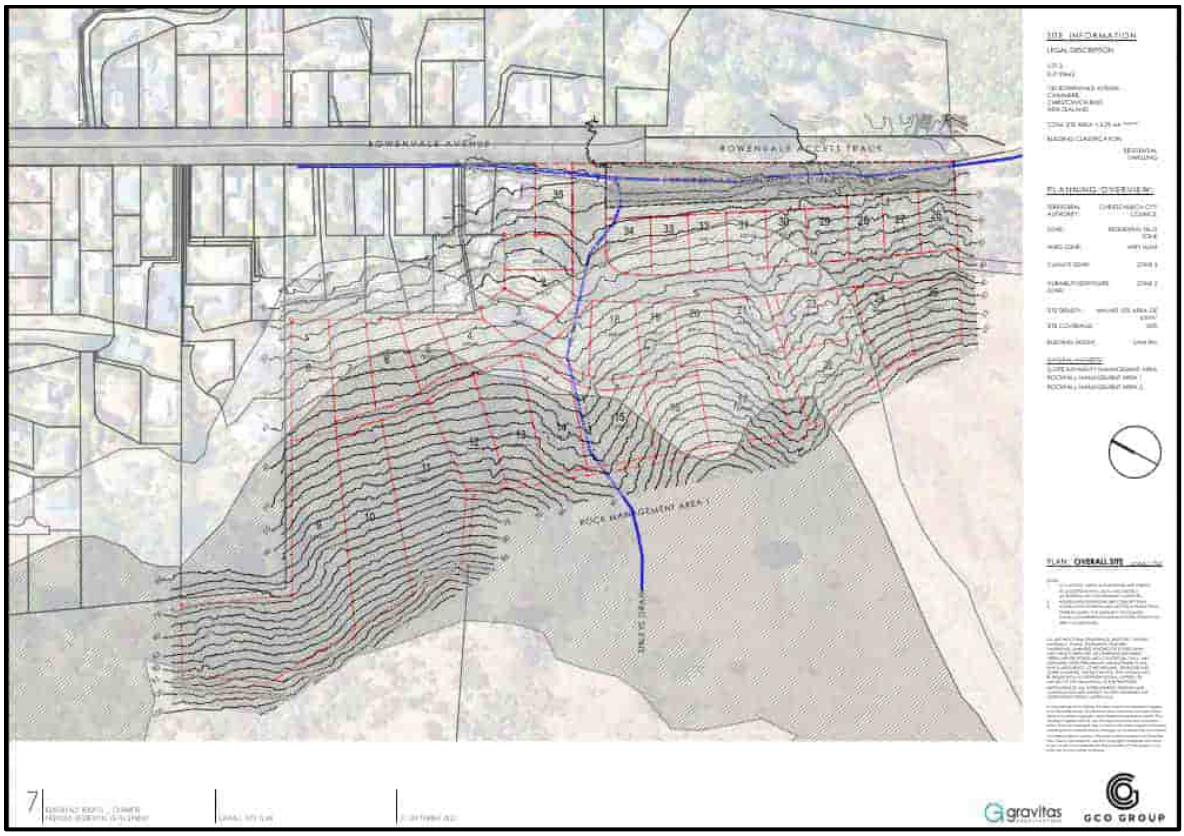
1.1 Previous Reporting

ENGEO has previously completed a geotechnical report for the wider subdivision dated 28 October 2022 (ENGEO 20268.000.001), which must be read in conjunction with this report.

2 Site Description

The site located on the western side of the Bowenvale Valley upslope of Bowenvale Avenue on a section of approximately 5 hectares, with the legal description Pt Lot 2, 2 DP 33462. The site is located on the east-facing section of that is moderately sloping (~20-22˚) between 25 and 200 meters above sea level (m asl). A broadly north-south orientated ridgeline is located upslope of the proposed development downslope and broadly parallel with the direction of the slope area are a series of gullies and ridges. The proposed stream crossing location is in the northern extent of the site across Sibley's Stream waterway which runs along the eastern boundary. Site development plan is displayed below in Figure 1.

Figure 1: Site Development Plan, stream crossing location is located adjacent to Lot 35 and Lot 34.



3 Previous Outcomes

The key outcomes from our earlier report are as follows:

- Proposed stream crossing location lies within a mapped flow path and outside of rockfall risk zone (Appendix 3).
- Foundation may bear on native loess soil.
- Foundations should be at least 300 mm deep and should be able to span at least 1.5 m such that they can span across tunnel gullies that may occur in the building footprint.
- Foundations may be designed for an ultimate bearing capacity of 300 kPa provided they are strip footings at least 600 mm wide or are pad footings at least 300 mm wide.

ENGEO also provided cut and fill recommendations, see Subdivision Report (ENGEO, 2022).

4 Field Investigation

ENGEO completed site investigations on 28 October 2022. Site investigation included completion of one hand auger (HA). Handheld dynamic cone penetrometer (DCP) and shear vane testing was completed to estimate *in-situ* and undrained shear strength of shallow subsurface materials. The HA investigation reached 2.3 m depth and met refusal on hard loess.

The Geotechnical Site Investigation plan is included in Appendix 1. Logs of the HA are presented in Appendix 2 of this report and are written in general accordance with the New Zealand Geotechnical Society field classification guidelines (NZGS, 2005).

Site photos below looking both north and south from proposed stream crossing location (Figure 2). Existing stream infrastructure is a concrete lined channel approximately 3 m wide.

Figure 2: Site Photographs

Photo 1: HA 03 location looking North

Photo 2: HA03 location looking South

Groundwater was not encountered in any of the site investigations, the stormwater control area at the base of the slope was not flowing at the time of the site visit.

5 Ground Model

The material encountered in our subsurface investigation is broadly consistent with published mapping and consistent with previous site investigations, as summarised in Table 1.

Table 1: Summary of Subsurface Conditions

Depth (m)	Soil Type	Density / Consistency
0.0 to 0.3	TOPSOIL (Silt with trace rootlets)	Loose
0.3 to 2.3	Loess Colluvium (Sandy SILT)	Stiff to very stiff

6 Geotechnical Assessment

Based on our review of mapped and observed land damage at the site and the ground conditions encountered in investigations, we consider the likelihood of liquefaction and associated deformations, consolidation of soft soils and presence of fill to be low. This is in accordance with our subdivision report dated 28 October 2022.

Based on geotechnical investigations we consider the site is suitable for shallow strip foundations bearing on native silt material.

6.1 Geotechnical Parameters

In accordance with our previous reporting, we have used the following soil parameters when calculating available bearing capacity for bridge and retaining wall design (Table 2).

Table 2: Geotechnical Parameters for Design

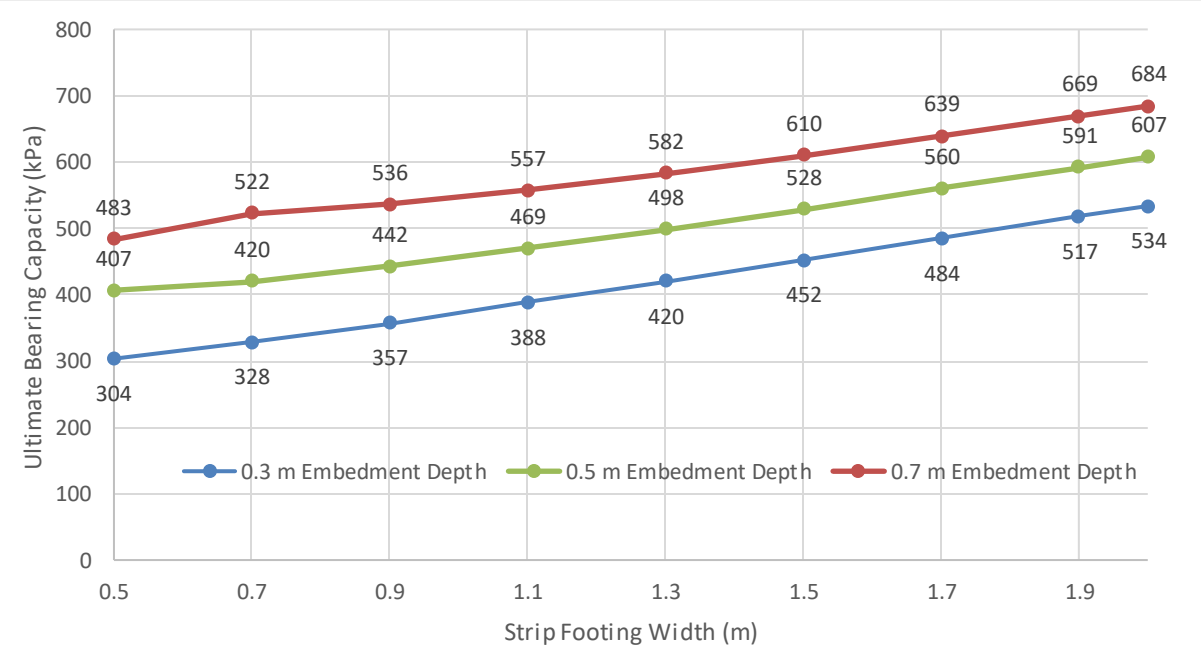
Soil Type	Unit Weight (kN/m^3)	Friction Angle, ϕ (°)	Cohesion (kPa)
Stiff SILT	17.0	30.0	3

6.2 Foundation Design

We recommend embedding foundations in the native silt below all topsoil, at a minimum depth of approximately 300 mm, and designing for geotechnical Ultimate Rupture Bearing Capacities present below in Figure 3.

In order to avoid surcharging the existing stream infrastructure foundations for the crossing must be embedded beyond or below a 45˚ line taken from the base of the existing structure.

Figure 3: Ultimate Rupture Bearing Capacity of Strip Footings



6.2.1 Reduction Factors

The bearing capacity should be multiplied by the following capacity reduction factors:

- All ultimate limit state (ULS) load combinations (including earthquakes) 0.5
- Serviceability Limit State (SLS) cases 0.33

There will be some settlements beneath the footings under the applied loads and total settlements. This can be quantified during the detailed design phase as it is dependent on loads and footing sizes.

If there are significant horizontal loads or moments applied to the footing, a more detailed assessment of bearing capacity will be required and ENGEO should be contacted for specific review and comment.

6.3 Earthworks Recommendations

6.3.1 Site Preparation Recommendations

During the earthworks operations all topsoil, organic matter, fill and other unsuitable materials should be removed from the construction areas to depths designated by the geotechnical professional and in accordance with the recommendations of NZS 4431:1989.

6.3.2 Tunnel Gullies

Tunnel gully features were observed within the vicinity of the site. The proposed road should intercept the majority of the tunnel gullies that would impact the proposed bridge location. However, we recommend that if tunnel gullies are observed during the site works that any soft or wet soil are removed from the exposed base of the tunnel gully. The tunnel gully will need to be either excavated out or filled with a low permeability grout. Site won fill can be used to backfill the remediated areas, provided it meets the criteria below.

6.3.3 Fill Placement

All fill that is utilised beneath foundations should be placed and compacted in accordance with the recommendations of NZS441:1989 and certification should be provided to that effect.

We consider that site won fill may be appropriate for the purpose of bulk earthworks grading. Laboratory testing in the loess material will need to be completed to confirm it is suitable for use as engineered fill. If during excavation it is found that the material varies from that described within the report, then further laboratory testing, including assessment of maximum dry density / optimum moisture content may be required. These tests can be completed at the time of site grading.

All engineered fill should be placed in lifts no greater than 200 mm thick to at least 95 % Maximum Dry Density at a moisture content within at least 3 percentage of optimum. The degree of compaction for each lift should be tested by the contractor in accordance with NZS4407:2015 using a nuclear density meter (NDM).

6.4 Additional Considerations

The following aspects need to be taken in consideration during the design development of the site:

- New foundations for the stream crossing should be designed by a Chartered Professional Engineer practicing in foundation design.
- A geotechnical professional should inspect the subgrade excavation to confirm that the assumptions made within this report have been achieved.
- ENGEO should be given the opportunity to review design drawings for the stream crossing.

6.5 Safety in Design

Safety in Design aims to identify, address and minimise or eliminate health and safety risks where it is reasonably practical to do so. Given the relatively level site and the shallow excavations required, the key safety considerations during construction will likely relate to temporary cuts (if applicable), the contractor's construction methodology, and how the public interface with the site is managed. ENGEO can provide safety in design advice as part of the detailed design stages once the remediation strategy and foundation / earthworks requirements have been identified.

7 Sustainability

We encourage you to consider sustainability when assessing the options available for your project. Where suitable for the project, we recommend prioritising the use of sustainable building materials (such as timber in favour of concrete or steel), locally sourced (materials readily available to Contractors as opposed to materials requiring import), and installed in an environmentally friendly way (e.g., reduced carbon emissions and minimal contamination). If you would like to discuss these options further, ENGEO staff are available to offer suggestions.

During construction, measures should be undertaken to control and treat stormwater runoff, with silt and erosion controls complying with local authority guidelines for erosion and sediment control. If you would like to discuss this further, ENGEO staff are available to create a sediment control plan for your development.

8 Limitations

i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, GCO Ltd, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.

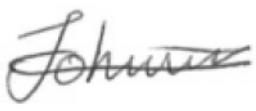
iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

iv. This Limitation should be read in conjunction with the Engineering NZ / ACENZ Standard Terms of Engagement.

v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (03) 328 9012 if you require any further information.

Report prepared by



Jake Johnson

Geotechnical Engineer

Report reviewed by

Willy Marshall, CMEngNZ (CPEng)

Senior Geotechnical Engineer

9 References

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Idriss and Boulanger. (2008). Soil Liquefaction during Earthquakes - EERI Monograph MNO12.

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We also acknowledge the New Zealand GeoNet project and its sponsors EQC, GNS Science and LINZ, for providing data used in this report.

APPENDIX 1:

Investigation Locations

Legend

- ENGEO 2022 - Hand Auger Location
- Proposed Subdivision Layout Plan
- Proposed Stream Crossing Location

0 5 m 10 m

ENGEO

Produced by **Datanest.earth**

Title: Test Location Plan		
Client: GCO Ltd		Figure No: 1 Size: A4
Project: Bowenvale Development	Drawn: JJ	
Date: 07-11-2022	Checked: NC	
Proj No: 20268.001	Scale: 1:500	Version: 1.0

APPENDIX 2:

Investigation Logs

LOG OF AUGER BV-ENG22-HA03

Bowenvale Development
Cashmere, Christchurch
20268.001

Client : Geovert
Client Ref. : N/A
Date : 28/10/2022
Hole Depth : 2.3 m
Hole Diameter : 50 mm

Shear Vane No : 1379
Logged By : JJ
Reviewed By :
Latitude : -43.580679065013
Longitude : 172.64746701512

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
0.0	TOPSOIL	ML	Silt with trace rootlets; brown. Low plasticity [TOPSOIL]					-	
0.5	LOESS COLLUVIUM	ML	Sandy SILT: dark brown with orange mottles. Low plasticity; Sand, fine to medium				M	St - Vst	140/NaN 140/NaN 56/19 94/22 78/35 88/40
2.0		ML	SILT with minor sand; yellowish brown with orange mottles. Low plasticity; moist; Sand, fine					H	
2.3			End of Hole Depth: 2.3 m Termination Condition: met practical refusal						
2.5									

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

>>

Hand Auger met practical refusal at 2.3 m depth on hard material.
Scala Penetrometer met practical refusal at 0 m depth.
Standing groundwater was not encountered

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 22/11/22

APPENDIX 3:

Combined Hazard Map

Legend

- Rockfall Risk Zone 1 – Unacceptable Risk
- Inferred Earthflow Location
- Mapped Flow path
- Proposed Subdivision Layout Plan
- Proposed Stream Crossing Location

0 10 m 20 m

ENGEO

Produced by **Datanest.earth**

Title: Combined Hazard Map		
Client: GCO Ltd		
Project: Bowenvale Development	Drawn: JJ	Figure No: 8 Size: A4
Date: 07-11-2022	Checked: NC	
Proj No: 20268.001	Scale: 1:1000	Version: 1.0

LANDSCAPE CONCEPT PLAN

130 BOWENVALE AVENUE SUBDIVISION

FOR S5 CONSULTING GROUP

9 February 2023
Project no. 2022_053
REVISION C

LEGEND

- A — Asphalt Road
- B — Flush paving
- C — 1.5m Asphalt Footpath
- Proposed Street Tree *Totara (Podocarpus totara)*
- Proposed Reserve Tree *Totara (Podocarpus totara)*
- Existing Tree
- Grass / Berm
- Planting
- Proposed 1.5m high 'rod top' open style fence (replace existing fence)
- Possible entrance sign location
- Approximate location of rockfall fence

BASE PLAN SOURCE: SC-01 BOWENVALE REV G

A. LANDSCAPE CONEPT PLAN

client / project name: S5/ 130 BOWENVALE AVE SUBDIVISION
drawing name: LANDSCAPE CONCEPT PLAN
designed by: SB/HB
drawn by: SB/HB
original issue date: 6/12/2022
scale: NOT TO SCALE

revision no:	amendment:	approved	date
A	FOR COMMENT	CG	6/12/2022
B	ROCKFALL FENCE ADDED	CG	16/12/2022
C	NOTES ADDED	CG	09/02/2023

REGISTERED LANDSCAPE ARCHITECT
DCM URBAN DESIGN LIMITED
10/245 ST. ASAPH STREET
CHRISTCHURCH 8011
WWW.DCMURBAN.COM

project no / drawing no: **2022_053 / 002**

revision: C

ROAD LANDSCAPE
SHRUBS, GRASSES AND GROUNDCOVERS


NZ Iris
(Libertia ixiodes)


Silver tussock
(Poa cita)


Pohuehue
(Muehlenbeckia axillaris)


Miniature toetoe
(Chionochloa flavicans)


Koromiko / Hebe
(Hebe 'Wiri Mist')


Wind Grass
(Anemanthele lessoniana)

STORMWATER FLOW PATHS
SHRUBS, GRASSES AND GROUNDCOVERS


Koromiko / Hebe
(Hebe strictissima)


Mountain flax
(Phormium cookianum)


Silver tussock
(Poa cita)


Kanuka
(Kunzea robusta)

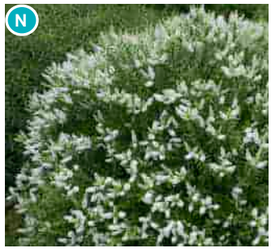

South Island kōwhai
(Sophora microphylla)


Tarata Lemonwood
(Pittosporum eugenoides)

STREET TREE


Totara
(Podocarpus totara)

STORMWATER LOT 2000
SHRUBS, GRASSES

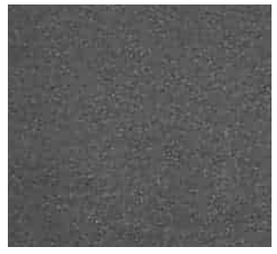

Koromiko / Hebe
(Hebe strictissima)


Mountain flax
(Phormium cookianum)


shrub pohuehue
(Muehlenbeckia astonii)

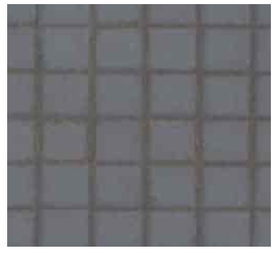

Silver tussock
(Poa cita)

MATERIALS


Asphalt
(Carriageway/ footpath)


Crusher Dust grit path
(Informal footpath)


Holland Paving - Hammered Finish, 45 degree herringbone pattern, Colour -TBC
(Flush threshold in carriageway)


Holland Sett Paving - Plain Finish, 90 degree herringbone pattern, Colour - TBC
(Flush threshold in carriageway)


Split face basalt columns
(Bridge entrance)

Corten Entrance Sign
(Fixed to gabion basket retieing wall)


Open styel fence with Rod Top
(Boundary fecning for Stormwater Lot 2000)

A. MATERIAL AND PLANT PALETTE

client / project name: S5/ CASS BAY SUBDIVISION
drawing name: MATERIAL AND PLANT PALETTE
designed by: CG
drawn by: CG
original issue date: 10/10/2022
scale: NOT TO SCALE

revision no:	amendment:	approved	date
A	FOR COMMENT	CG	6/12/2022
B	ROCKFALL FENCE ADDED	CG	12/12/2022

REGISTERED LANDSCAPE ARCHITECT
DCM URBAN DESIGN LIMITED
10/245 ST. ASAPH STREET
CHRISTCHURCH 8011
WWW.DCMURBAN.COM

project no / drawing no: **2022_053 / 003** revision: B

BOWENVALE AVENUE SUBDIVISION PRELIMINARY DESIGN ROAD SAFETY AUDIT

PREPARED FOR BOWENVALE GCO LIMITED

15 December 2022

Stantec

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This disclaimer shall apply notwithstanding that the report may be made available to Christchurch City Council and other persons for an application for permission or approval or to fulfil a legal requirement.

QUALITY STATEMENT

PROJECT MANAGER	ROAD SAFETY AUDIT TEAM LEADER
Kyle Martin	Chris Rossiter

PREPARED BY		
Andrew Leckie		15 / 12 / 2022
CHECKED BY		
Chris Rossiter		15 / 12 / 2022
REVIEWED BY		
Melanie Muirson		15 / 12 / 2022
APPROVED FOR ISSUE BY		
Melanie Muirson		15 / 12 / 2022

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Bowenvale GCO Limited

Bowenvale Avenue Subdivision Preliminary Design Road Safety Audit

CONTENTS

APPENDICES

1. Introduction

1.1 Safety Audit Definition and Purpose

A road safety audit is a term used internationally to describe an independent review of a future road project to identify any safety concerns that may affect the safety performance. The audit team considers the safety of all road users and qualitatively reports on road safety issues or opportunities for safety improvement.

A road safety audit is therefore a formal examination of a road project, or any type of project which affects road users (including cyclists, pedestrians, mobility impaired etc.), carried out by an independent competent team who identify and document road safety concerns.

A road safety audit is intended to help deliver a safe road system and is not a review of compliance with standards.

The primary objective of a road safety audit is to deliver a project that achieves an outcome consistent with Safer Journeys and the Safe System approach, which is a safe road system increasingly free of death and serious injury. The road safety audit is a safety review used to identify all areas of a project that are inconsistent with a Safe System and bring those concerns to the attention of the client so that the client can make a value judgement as to appropriate action(s) based on the risk guidance provided by the safety audit team.

The key objective of a road safety audit is summarised as:

'to deliver completed projects that contribute towards a safe road system that is free of death and serious injury by identifying and ranking potential safety concerns for all road users and others affected by a road project.'

A road safety audit should desirably be undertaken at project milestones such as:

- concept stage (part of business case);
- scheme or preliminary design stage (part of pre-implementation);
- detail design stage (pre-implementation or implementation); or
- pre-opening or post-construction stage (implementation or post-implementation).

A road safety audit is not intended to be a technical or financial audit and does not substitute for a design check of standards or guidelines. Any recommended treatment of an identified safety concern is intended to be indicative only, and to focus the designer on the type of improvements that might be appropriate. It is not intended to be prescriptive and other ways of improving the road safety or operational problems identified should also be considered.

In accordance with the procedures set down in the NZTA Road Safety Audit Procedures for Projects Guidelines - Interim release May 2013 the audit report should be submitted to the client who will instruct the designer to respond. The designer should consider the report and comment to the client on each of any concerns identified, including their cost implications where appropriate, and make a recommendation to either accept or reject the audit report recommendation.

For each audit team recommendation that is accepted, the client will make the final decision and brief the designer to make the necessary changes and/or additions. As a result of this instruction the designer shall action the approved amendments. The client may involve a safety engineer to provide commentary to aid with the decision.

Decision tracking is an important part of the road safety audit process. A decision tracking table is embedded into the report format at the end of each set of recommendations. It is to be completed by the designer, safety engineer, and client for each issue, and should record the designer's response, client's decision (and asset manager's comments in the case where the client and asset manager are not one and the same) and action taken.

A copy of the report including the designer's response to the client and the client's decision on each recommendation shall be given to the road safety audit team leader as part of the important feedback loop. The road safety audit team leader will disseminate this to team members.

1.2 The Project

The project is a residential subdivision of land zoned 'Residential Hills' at the end of Bowenvale Avenue, as outlined in Figure 1-1 below.

Figure 1-1. Site Outline

The proposed 45 lot subdivision layout is shown in Figure 1-2. One new road with an intersection on Bowenvale Avenue (Road 1) is proposed along with several rights of way for property access.

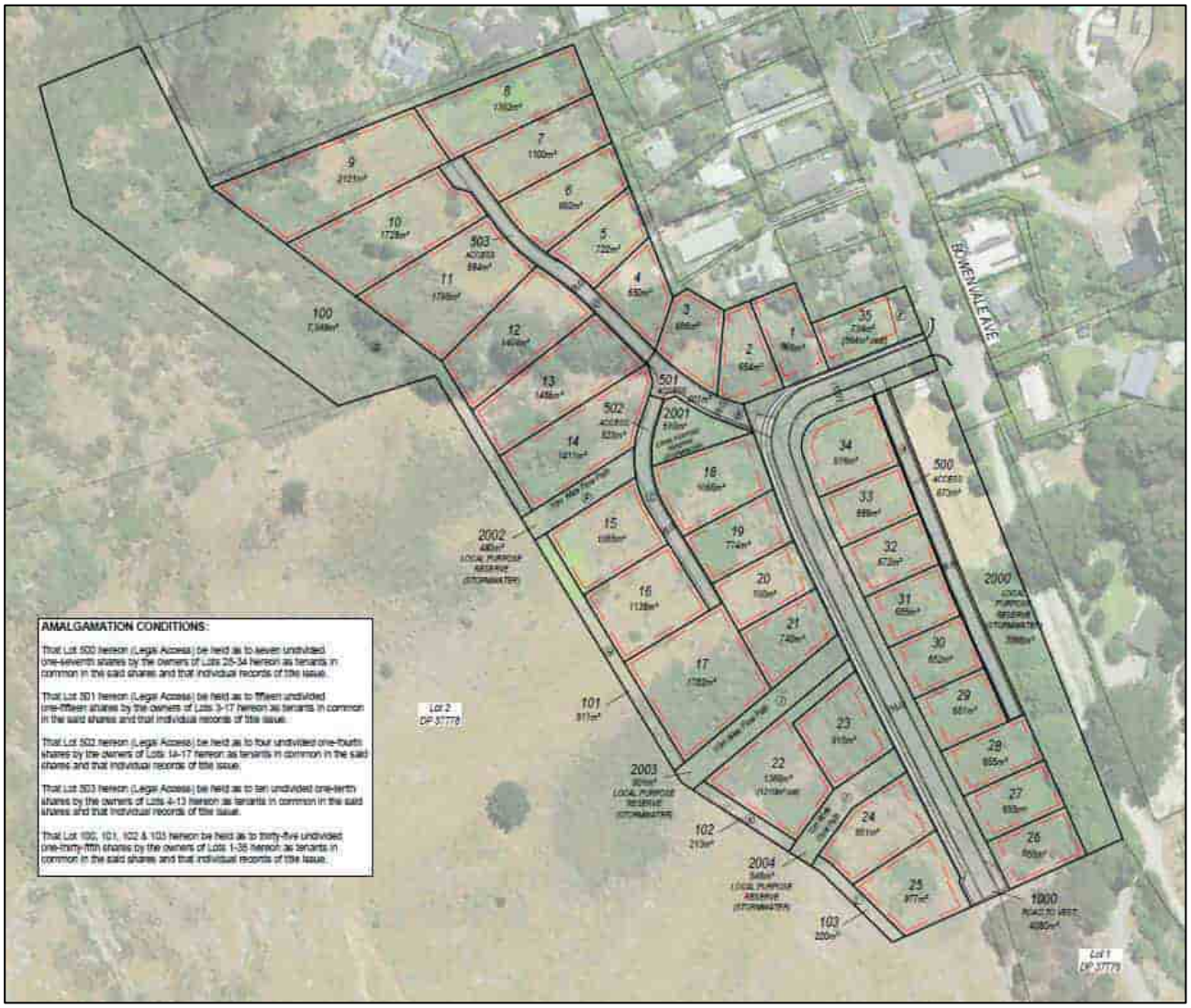


Figure 1-2. Proposed Subdivision Layout

1.3 The Road Safety Audit Team

This road safety audit has been carried out in accordance with the NZTA Road Safety Audit Procedure for Projects Guidelines – Interim release May 2013, by:

- Chris Rossiter, Principal Transportation Engineer, Stantec NZ; and
- Andrew Leckie, Senior Transportation Engineer, Stantec NZ.

The safety audit team visited the site on Monday 5 December 2022.

1.4 Previous Road Safety Audits

No previous road safety audits have been carried out for this proposed subdivision.

1.5 Scope of this Road Safety Audit

This road safety audit covers all transport-related elements of the proposed subdivision, including the Bowenvale Avenue intersection and frontage.

1.6 Report Format

The potential road safety problems identified have been ranked as follows.

The expected crash frequency is qualitatively assessed on the basis of expected exposure (how many road users will be exposed to a safety issue) and the likelihood of a crash resulting from the presence of the issue. The severity of a crash outcome is qualitatively assessed on the basis of factors such as expected speeds, type of collision, and type of vehicle involved.

Reference to historic crash rates or other research for similar elements of projects, or projects as a whole, have been drawn on where appropriate to assist in understanding the likely crash types, frequency and likely severity that may result from a particular concern.

The frequency and severity ratings are used together to develop a combined qualitative risk ranking for each safety issue using the concern assessment rating matrix in Table 1-2. The qualitative assessment requires professional judgement and a wide range of experience in projects of all sizes and locations.

In ranking specific concerns, the auditors have considered the objectives of the Safe System approach, i.e. to minimise fatal or serious injury crashes.

In undertaking this assessment, the Safety Audit Team have utilised the following descriptor tables to enable a fair and reasonable rating of the risks.

Table 1-1: Crash Frequency Descriptor

Crash Frequency	Indicative Description
Frequent	Multiple crashes (more than 1 per year)
Common	1 every 1-5 years
Occasional	1 every 5-10 years
Infrequent	Less than 1 every 10 years

Crash Severity is determined on the likelihood of a crash resulting in death or serious injury. The reader is advised that the severity of an injury is determined in part by the ability of a person to tolerate the crash forces. An able-bodied adult will have a greater ability to recover from higher trauma injuries, whereas an elderly person may have poor ability to recover from high trauma injuries. The auditors consider the likely user composition, and hence the likely severity of injury to that user.

Table 1-2: Concern Assessment Rating Matrix

Severity (likelihood of death or serious injury)	Frequency (probability of a crash)			
	Frequent	Common	Occasional	Infrequent
Very likely	Serious	Serious	Significant	Moderate
Likely	Serious	Significant	Moderate	Moderate
Unlikely	Significant	Moderate	Minor	Minor
Very unlikely	Moderate	Minor	Minor	Minor

While all safety concerns should be considered for action, the client or nominated project manager will make the decision as to what course of action will be adopted based on the guidance given in this ranking process with consideration to factors other than safety alone. As a guide a suggested action for each concern category is given in Table 1-3.

Table 1-3: Concern Categories

Concern	Suggested action
Serious	Major safety concern that must be addressed and requires changes to avoid serious safety consequences.
Significant	Significant safety concern that should be addressed and requires changes to avoid serious safety consequences.
Moderate	Moderate safety concern that should be addressed to improve safety.
Minor	Minor safety concern that should be addressed where practical to improve safety.

In addition to the ranked safety issues, it is appropriate for the safety audit team to provide additional comments with respect to items that may have a safety implication but lie outside the scope of the safety audit. A comment may include items where the safety implications are not yet clear due to insufficient detail for the stage of project, items outside the scope of the audit such as existing issues not impacted by the project or an opportunity for improved safety but not necessarily linked to the project itself. While typically comments do not require a specific recommendation, in some instances suggestions may be given by the auditors.

1.7 Documents Provided

The SAT was provided with the following Survus Consultants plans for this audit:

- 'Proposed Subdivision of Parts Lot 2 DP 33462' Drawing SC-01 Rev H
- 'Roading Plan' Drawing EN-101 Rev A
- 'Road Details Plan' Drawing EN-202 Rev A
- 'Road Longsection Plan' Drawing EN-201 Rev A

1.8 Disclaimer

The findings and recommendations in this report are based on an examination of available relevant plans, the specified road and its environs, and the opinions of the SAT. However, it must be recognised that eliminating safety concerns cannot be guaranteed since no road can be regarded as absolutely safe and no warranty is implied that all safety issues have been identified in this report. Safety audits do not constitute a design review nor are they an assessment of standards with respect to engineering or planning documents.

Readers are urged to seek specific technical advice on matters raised and not rely solely on the report.

While every effort has been made to ensure the accuracy of the report, it is made available on the basis that anyone relying on it does so at their own risk without any liability to the safety audit team or their organisations.

2. Safety Concerns

2.1 Bowenvale Avenue Intersection

Moderate

Road 1 is proposed to meet Bowenvale Avenue at a T-intersection (Figure 2-1). It is considered that a basic T-intersection will be appropriate however there will be several matters to be considered through the detailed design stage.

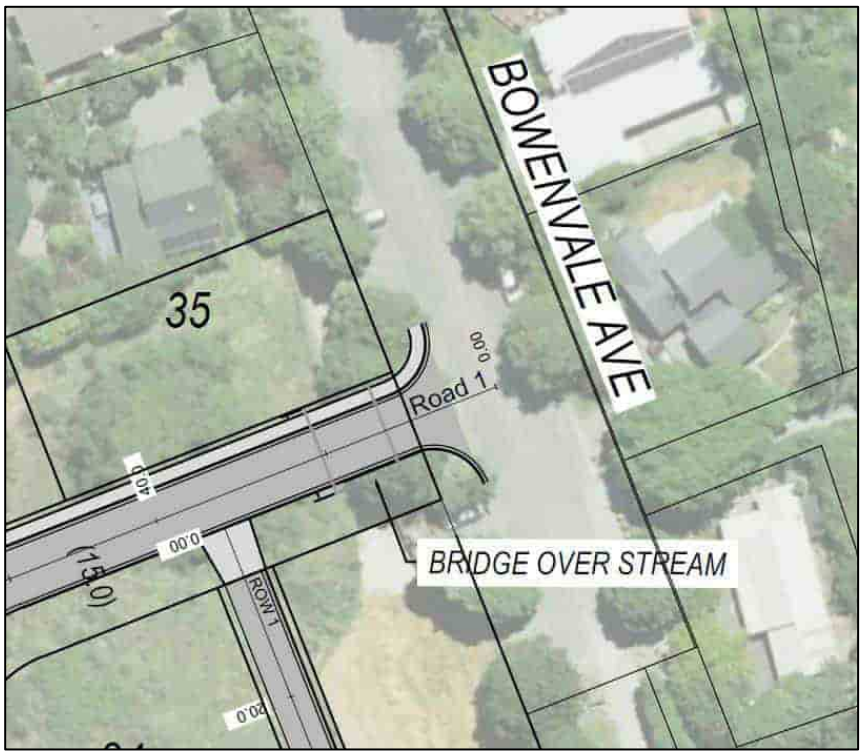
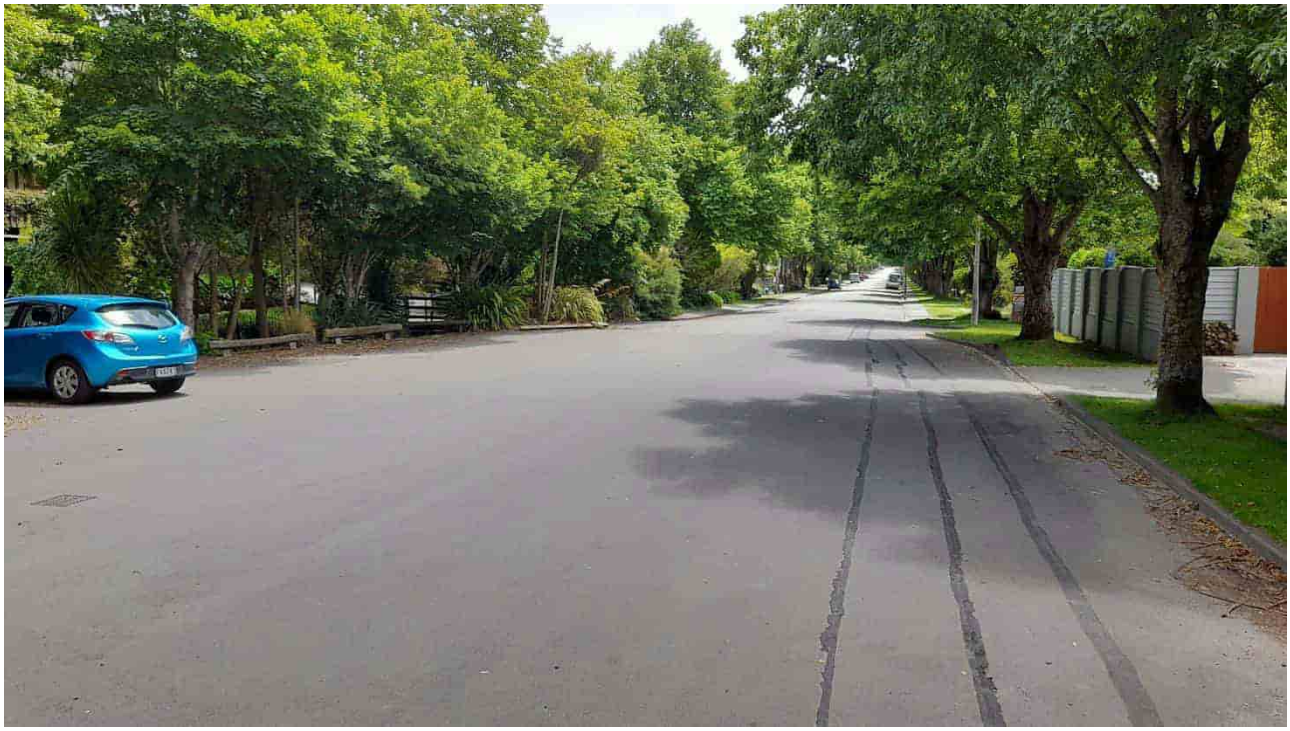


Figure 2-1: Bowenvale Avenue / Road 1 Intersection

The intersection location is near the end of Bowenvale Avenue, where there is 90-degree car parking on the western side of the road and kerbside parking available on the eastern side of the road (Photograph 2-1).



Photograph 2-1: Bowenvale Avenue Looking North at Proposed Intersection Location

The footpaths on Bowenvale Avenue stop north of a turning head outside 114 Bowenvale Avenue (Photograph 2-2). It is considered that the existing footpath on the western side of the road should be extended to connect to the Road 1 footpath to provide a safe and convenient link for pedestrians.

Photograph 2-2: Existing Turning Head at 114 Bowenvale Avenue

It may be necessary to remove the turning head so that a footpath can be provided. The turning head may not be required once the subdivision road is constructed (as turning should be provided for on that road) however the need for a turning head and its location should be considered further.

Whether the car parking between the new intersection and the existing footpath (and other car parking in the vicinity of the intersection) can be retained will need to be addressed at the detailed design stage. Considerations should include the space required for a footpath but also the interaction of vehicles

entering and exiting parking spaces in close proximity to the intersection that may conflict with vehicles turning into and out of Road 1.

Photograph 2-3 shows the sightline to the right from the approximate intersection location. The trees visible could obstruct visibility to the right, particularly to a cyclist who has just ridden out of the park. It will be necessary through the intersection detailed design to ensure that suitable visibility is available to vehicles and cyclists. Narrowing Bowenvale Avenue at the intersection by having kerbs extend out into the existing carriageway can be considered to provide improved sightlines and traffic calming benefits.

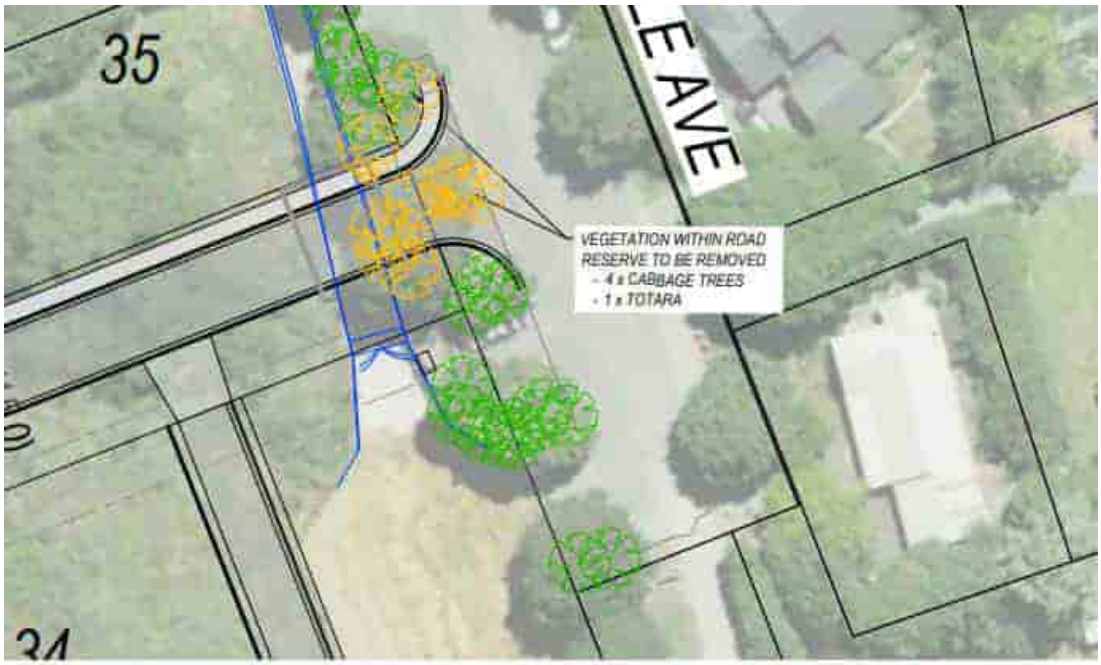
Photograph 2-3: Trees to Right of Intersection

Recommendation(s)

1. Provide a footpath connection from the subdivision to the existing footpath network
2. Consider whether a turning head is still required on Bowenvale Avenue and its appropriate location
3. Consider interaction between on-street car parking and turning vehicles when carrying out the detailed design of the intersection
4. Ensure suitable sightlines to vehicles and cyclists are available at the intersection during the detailed design

Frequency Crashes are likely to be occasional	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	As mentioned by the RSA, these items are considered detailed design elements that need to be work through with CCC roading engineer. Our initial feedback to these items are: 1) Agree a footpath connection from the subdivision to the existing footpath network on the western side of Bownevale Ave should be provided. There is scope to enhance the existing road configuration through this area. The current road formation width in this area from the eastern kerb to the timber log barriers is approximately 17-18m, which provides ample space for traffic lanes, parking and pedestrian access. Roading configuration to be agreed with CCC. 2) Our recommendation is to remove the turning head as the new road intersection provides turning ability if required for larger infrequent vehicle movements. Alternative option would be to move the last parking bays to providing turning at the end of the Bowenvale Ave formation.	

3) We anticipate some of the parking bays will need to be removed to provide adequate separation from the proposed intersection. Item to be worked through with CCC road engineer.
4) The trees shown in Photo 2-3 are to be removed to provide for the new intersection as per the snippet below.



Safety Engineer comment	Insert comment
Client decision	Insert comment

Recommendation(s)

Action taken	Insert comment

2.2 ROW Passing Bays

Minor

ROW 1 is proposed with a carriageway width suitable for one-way travel, and with two passing bays midway along it. There is a concern that if there are opposing drivers who meet over the initial length of the driveway (Figure 2-2), one may reverse back onto Road 1. It is acknowledged that vehicle speeds would be slow in this location given the proximity to the Bowenvale Avenue intersection and the narrow carriageway. However, reversing vehicles are hazards to all road users including vulnerable road users such as cyclists.

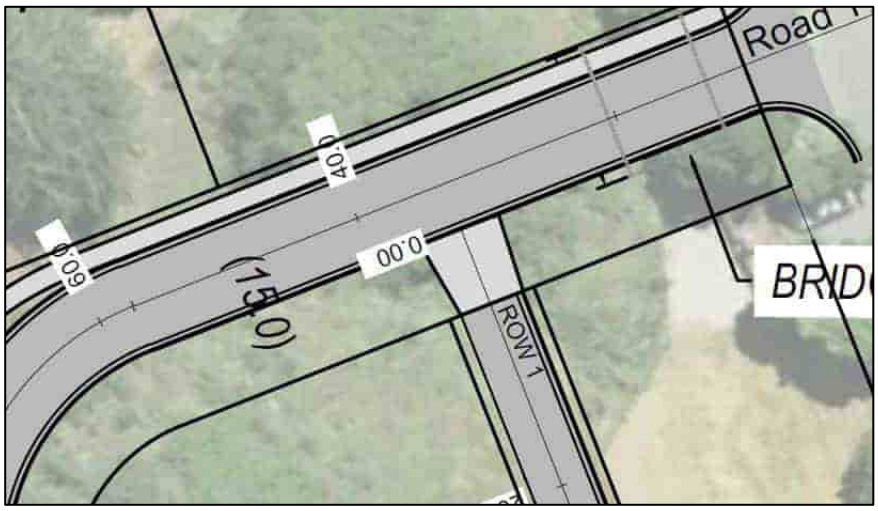


Figure 2-2: Initial Length of ROW 1

ROW 2 is proposed with a carriageway wide enough for two-way traffic movements up to the ROW 3 intersection (Figure 2-3). However, at the Road 1 / ROW 2 intersection, a combination of the narrow road width and narrow ROW width may mean that there is not enough space for a driver to turn right into ROW 2 while there is a vehicle waiting to turn left out. If there is not room for either vehicle to make their turn, one driver will need to reverse which would present a hazard to other road users, particularly vulnerable users. The grades of the ROW will also make stopping and manoeuvring more difficult for drivers.

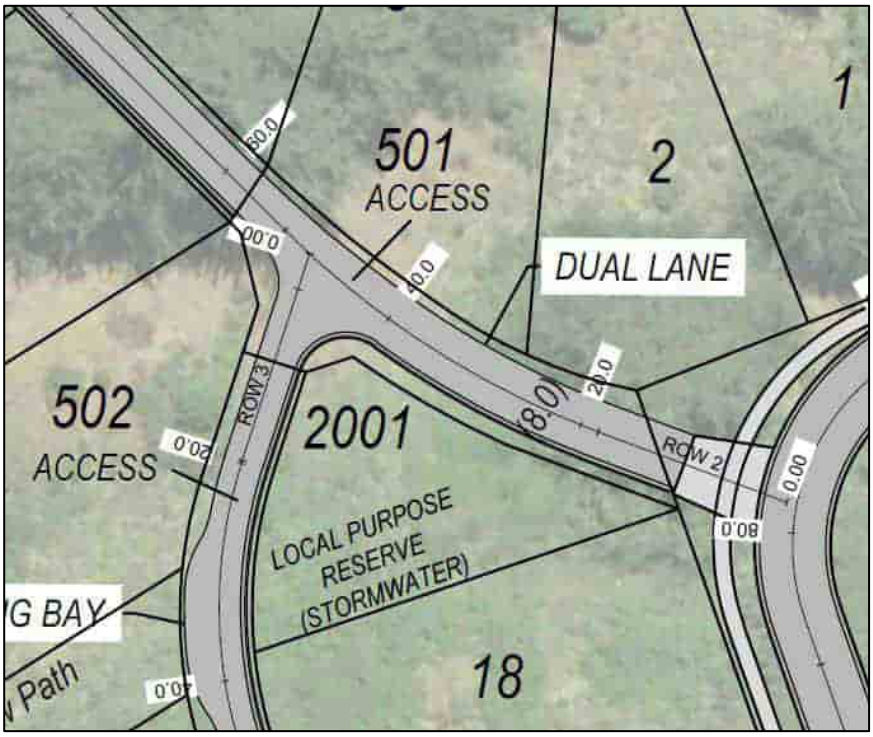


Figure 2-3: ROW 2 / ROW 3 Intersection

ROW 3 has a single lane carriageway width. If a driver is approaching the ROW 2 / ROW 3 intersection on ROW 2 and another driver is approaching on ROW 3, they may not be able to see each other until they are right at the intersection. This may result in one driver needing to reverse which would again represent a hazard to users of the ROW, including potentially pedestrians.

With the angle between ROW 2 and ROW 3 and the narrow ROW 3 carriageway, vehicle tracking into ROW 3 may be difficult. It should be confirmed that an emergency vehicle will be able to turn into ROW 3 if required.

Recommendation(s)

1. Provide a passing opportunity at the start of ROW 1
2. Widen the initial section of ROW 2 if required to accommodate a right turn in from Road 1 while a vehicle is waiting to exit
3. Ensure that opposing drivers will be able to negotiate the ROW 2 / ROW 3 intersection safely
4. Ensure emergency vehicle access to ROW 3 will be possible

Frequency Crashes are likely to be occasional	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	1. A passing bay will be provided at the start of ROW 1 2. ROW 2 has a 5.5m carriageway width at the start so there should be enough room to accommodate a right turn in from Road 1 while a vehicle is waiting to exit. This will be confirmed at detailed design stage with vehicle tracking. 3. To be confirmed at detailed design stage with vehicle tracking. There is scope to widen the ROW 2/3 intersection if required. 4. To be confirmed at detailed design stage with vehicle tracking.	
Safety Engineer comment	Insert comment	
Client decision	Insert comment	
Action taken	Insert comment	

2.3 Road 1 Bridge Details

Moderate

A bridge is proposed over the stormwater drain on Road 1, as visible in Figure 2-1. No details on the bridge are available at this stage. Appropriate edge protection for pedestrians and road users will need to be considered through the detailed design stage.

Recommendation(s)

1. Ensure that appropriate edge protection is provided for all footpath and road users

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	Appropriate edge treatment/protection will be provided on the bridge for road and footpath users.	
Safety Engineer comment	Insert comment	
Client decision	Insert comment	
Action taken	Insert comment	

2.4 ROW Turning Heads

Minor

No turning heads are proposed at the ends of ROW 1 and ROW 3 (Figure 2-4). If a driver gets to the end of one of the ROWs and needs to turn around, they may need to reverse over some distance. This would present a hazard to other ROW users, particularly any pedestrians. The concern is exacerbated given the steep topography, where individual property driveways may not be convenient for people unfamiliar with the area to use to turn around.

It is acknowledged that there would be a low demand for turning at the end of the ROWs since drivers would be expected to be able to turn at the properties they are visiting.

Figure 2-4: Ends of ROW 1 and ROW 3

A turning head is indicated at the end of ROW 2 (Figure 2-5). Its size does not look standard and if a vehicle cannot use it to turnaround, the same safety concerns as raised for ROWs 1 and 3 would exist.

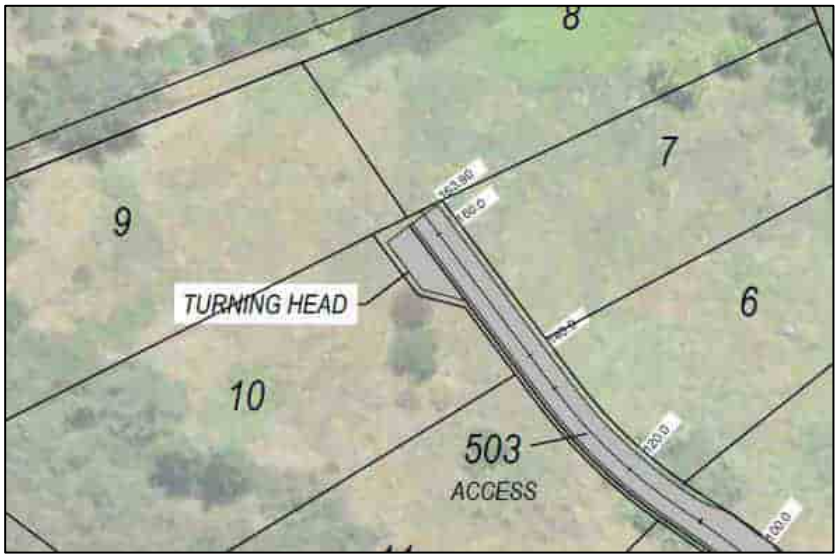
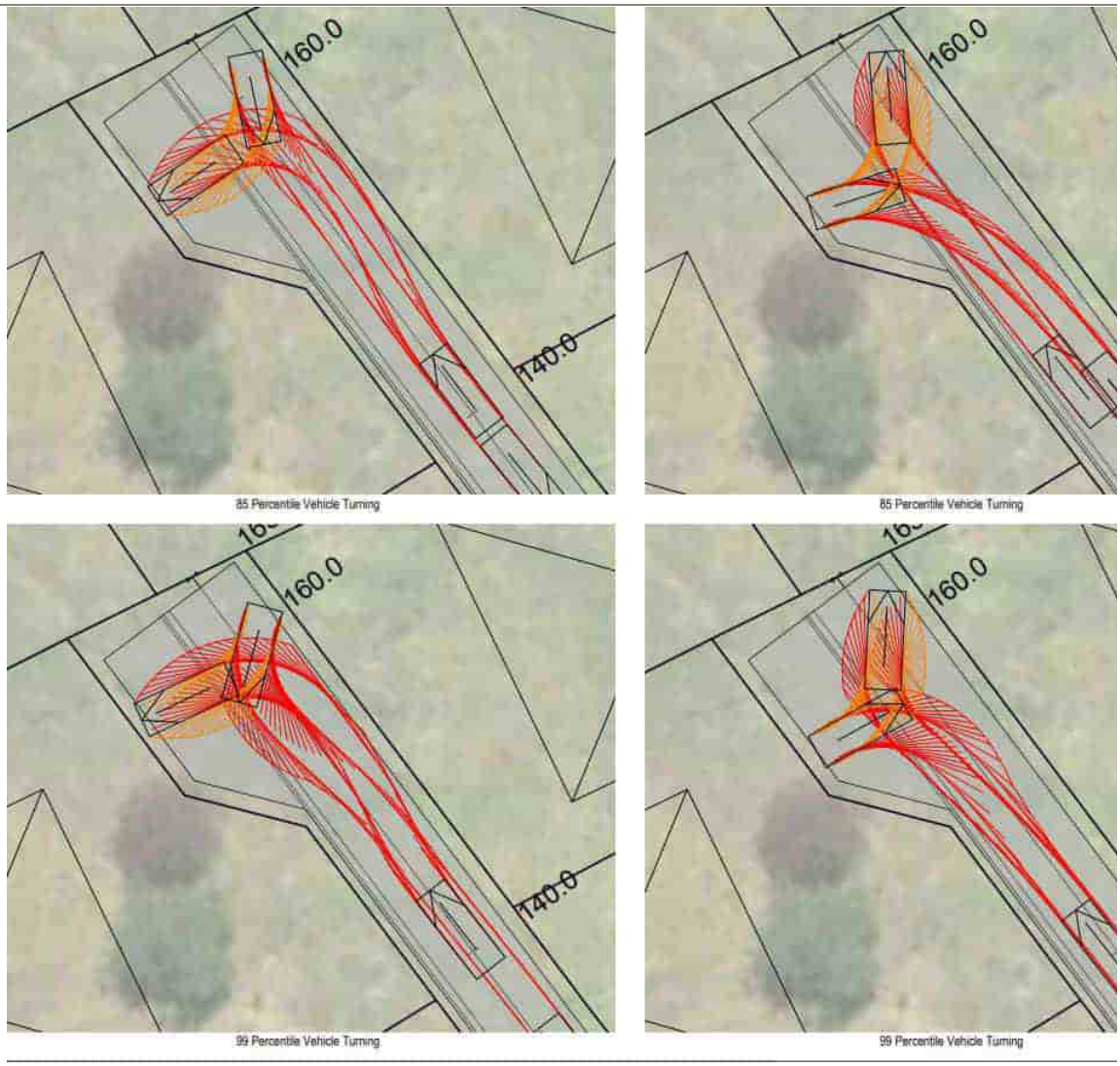


Figure 2-5: End of ROW 2

Recommendation(s)

1. Provide turning heads on all three ROWs and confirm the appropriate design vehicle for the turning manoeuvre e.g. a small delivery truck

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	The turning head at the end of ROW 2 has been designed to cater for an 85 & 95 percentile vehicle in accordance with CCC Appendix 8.10.2 Access Standard 4. Refer to tracking below. Same sized turning heads will be incorporated at the end of ROW 1 and 3.	



Safety Engineer comment	Insert comment
Client decision	Insert comment
Action taken	Insert comment

2.5 Road 1 Turning Head

Moderate

The Road 1 turning head (Figure 2-6) is indicated to be approximately 14m wide and 12m long. This is smaller than a standard turning head in a residential area (typically 19m diameter as per NZS4404). There is a concern that a rubbish truck will not be able to turn around at the end of the road and may be required

to reverse over a long distance. A reversing truck is a hazard to all road users and particularly vulnerable road users.

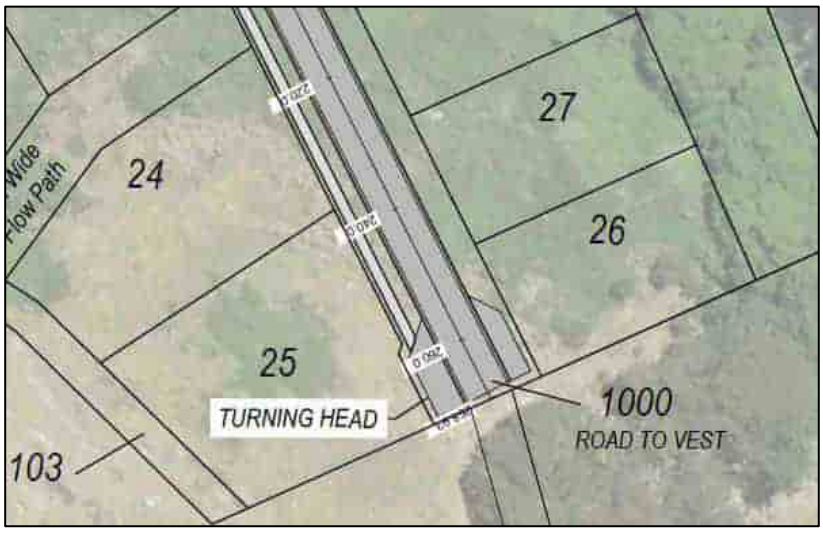


Figure 2-6: End of Road 1

Recommendation(s)

1. Confirm adequate manoeuvring space for a rubbish truck will be available at the end of Road 1

Frequency Crashes are likely to be occasional	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	It is envisaged the legal road will be extended at some point and therefore a temporary turning head has been provided at the end of Road 1. The dimensions for the turning head have been adopted from Auckland Transports TDM GD0006 which accommodates a 10.3m rigid truck.	
Safety Engineer comment	Insert comment	
Client decision	Insert comment	
Action taken	Insert comment	

2.6 ROW Gradients

Moderate

ROW 2 has a centreline gradient of 1 in 5 and ROW 3 has a section with a centreline gradient of 1 in 4 (Figure 2-7). These are steep gradients and the driveways may be difficult to access by vehicle or foot in icy conditions. Drivers could lose control of their vehicles or pedestrians could fall over.

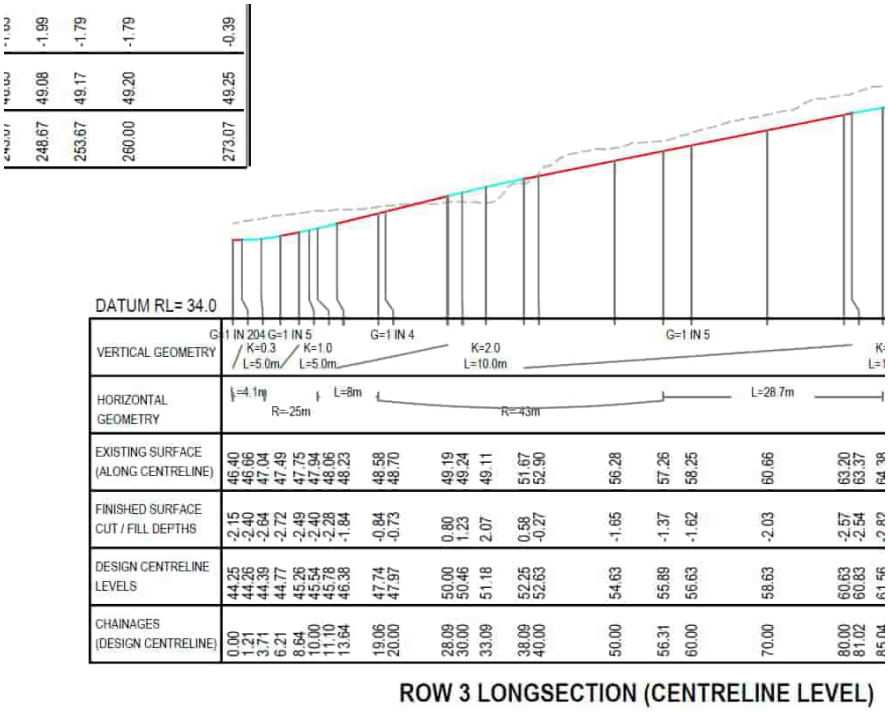


Figure 2-7: Proposed ROW 3 Longsection

It is acknowledged that the District Plan allows up to 1 in 4 grades over short lengths of up to 20m for residential activities.

It is noted that ROW 3 has a curve in its alignment and the gradient will be steeper around the inside of the curve than it will along the centreline. Gradients should be within acceptable bounds across the full width of the ROW to reduce the chance of vehicle scraping and to reduce the safety risks associated with steep driveways.

On a related note, individual property accesses will need to be well designed to avoid vehicle scraping and to ensure adequate visibility between driveway users and both road users and pedestrians.

Recommendation(s)

1. Investigate options to reduce maximum gradients
2. Provide high-friction surfaces for steep sections of driveway
3. Ensure acceptable gradients are provided around the insides of curves as well as along centrelines
4. Design individual property accesses to have acceptable grade transitions and visibility to / from the driveway

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	1. Gradients will be reviewed at detailed design stage, however due to the slope of the land it's likely maximum allowable gradients will be required. 2. High-friction surfaces can be adopted for gradients at 20% and over. 3. To be confirmed at detailed design stage. 4. The location of the individual property accesses will be determined as part of the house design and will be controlled through the building consent process.	
Safety Engineer comment	Insert comment	
Client decision	Insert comment	
Action taken	Insert comment	

2.7 Edge Protection

Moderate

The topography of the site means that there will be locations with steep drops from roads and driveways.

With the steep grades on ROW 2 and ROW 3, there is the potential for a driver to lose control of their vehicle in wet or icy conditions. There is a concern that an out-of-control vehicle could continue off the end of ROW 3 or ROW 2 into a property below. Figure 2-8 indicates locations where vehicle barriers should be considered (noting these are indicative and a full design will be required to determine the length of need at these locations).

Figure 2-8: Indicative Edge Protection Opposite ROWs

ROW 1 (Figure 2-9) is proposed to run along the ridge above the existing stormwater area shown in Photograph 2-4. This has steep sides and there are concerns that a vehicle, pedestrian or other road users could fall off the ROW. Also vehicles being manoeuvred out of Lots 29-34 could be mistakenly driven off the edge. The stormwater channel has steep, non-recoverable gradients and in the event that high levels of water are present, there is a risk of drowning. The form of edge protection and its purpose, i.e. to stop vehicles or to keep pedestrians out, should be considered.

Figure 2-9: ROW 1

Photograph 2-4: Stormwater Area Adjacent to ROW 1

Other locations have been identified, such as those two highlighted below, where it appears that the level of the road will be above the level of the surrounding ground. A review of the subdivision design should be carried out, with locations for edge protection to be identified and considered further through detailed design.

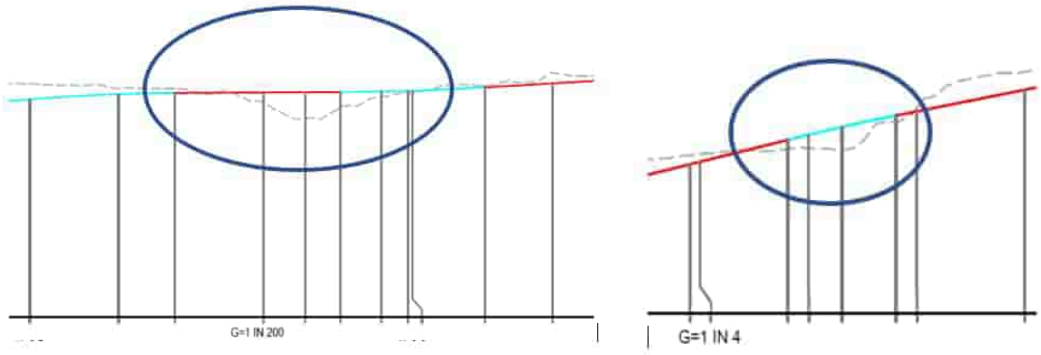


Figure 2-10: Instances of Road Level above Surrounding Ground Level- Road 1 Left, ROW 3 Right

Recommendation(s)

1. Provide vehicle barriers opposite the ends of ROW 2 and ROW 3 to stop any vehicles crashing into the properties below
2. Provide edge protection / barriers along ROW 1
3. Confirm gradients either side of the ROWs and locations of edge protection / barriers.

Frequency Crashes are likely to be occasional	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	The requirement and location for vehicle barriers will be determined at detailed design stage. Edge protection in the form of a vertical kerb will be provided along the eastern side of ROW 1 and a pedestrian barrier/fence along the ROW boundary to eliminate people from falling from the retaining wall and entering the stormwater reserve.	
Safety Engineer comment	Insert comment	
Client decision	Insert comment	
Action taken	Insert comment	

2.8 Road 1 Curve

Moderate

Road 1 is proposed to have a 20m radius curve where it intersects with ROW 2, visible in Figure 2-8.

Any car parking on the inside of the curve would potentially obstruct forward visibility around the curve for drivers. This could increase the risk of a crash on the corner, and this would especially be a concern if a vehicle hit a pedestrian or cyclist who was obscured from view.

Vehicle tracking with a rubbish truck and an opposing light vehicle should be checked in case further car parking restrictions (e.g. on the outside of the curve) or curve widening are necessary to accommodate the vehicle manoeuvres. If a rubbish truck cannot manoeuvre around the curve, it may need to reverse back out to Bowenvale Avenue which would be a safety concern for all road users, particularly vulnerable users, and particularly given the steep gradient on Road 1 in this location.

If the curve is not wide enough for two-way car movement, one driver would need to give way when opposing vehicles meet. A vehicle stopped or a reversing vehicle on the steep gradient would be a

hazard to other road users. However, it is acknowledged that this would occur relatively infrequently given the small number of lots accessed off Road 1 to the south of the curve and vehicle speeds would be slow.

Recommendation(s)

1. Include no-stopping lines around the inside of the curve to preserve forward visibility
2. Confirm that the Road 1 carriageway width and gradient is adequate for two-way movement of a waste collection vehicle and light vehicle

Frequency Crashes are likely to be occasional	Severity Death or serious injury is likely	Rating The safety concern is moderate
Designer response	No-stopping lines around the inside of the curve will be added at detailed design stage. Vehicle tracking around the curve will be completed at detailed design stage. There is scope to widen the curve on both sides if required.	
Safety Engineer comment	Insert comment	
Client decision	Insert comment	
Action taken	Insert comment	

2.9 Road 1 Width

Minor

Road 1 is proposed with an approximately 6.7m wide carriageway, as shown in Figure 2-11. The adoption of a narrow carriageway is supported from a road safety perspective as it will encourage slow vehicle speeds. It is noted that a narrower 6m width could be adopted and still achieve two-way vehicle movement.

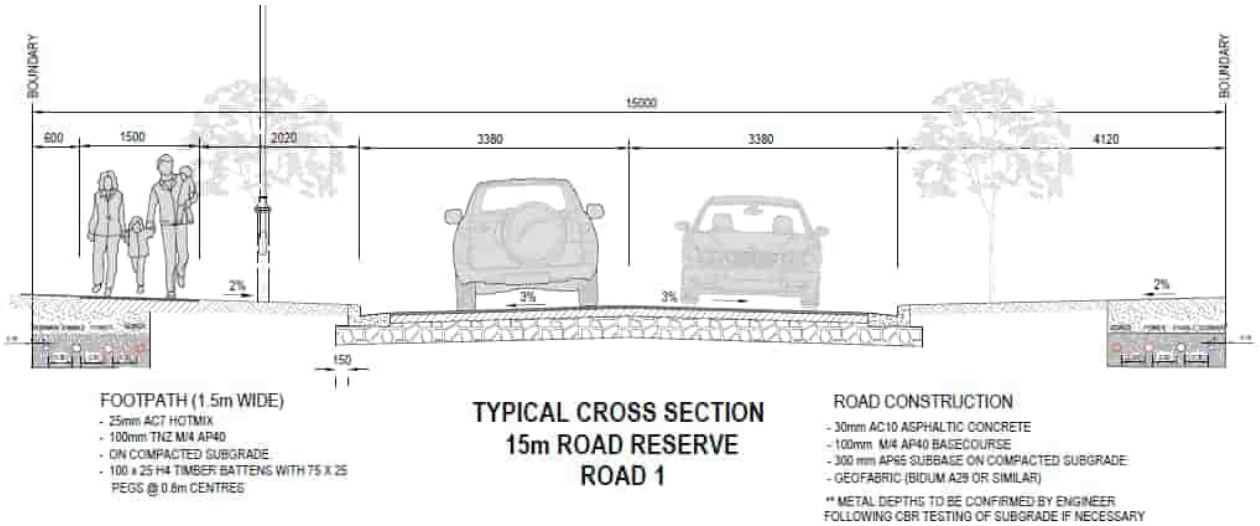


Figure 2-11: Proposed Road 1 Cross-Section

The proposed road width will be wide enough for two-way traffic movement along straight sections of the road or one-way movement at a time past a parked vehicle, which is considered appropriate for what will

be a low volume road. There is a concern that uncontrolled car parking on both sides of the road could restrict vehicle access by larger vehicles, including potentially emergency vehicles.

Recommendation(s)

1. Consider restricting car parking to one side of the road so that there is always clear width for emergency vehicle access

Frequency Crashes are likely to be infrequent	Severity Death or serious injury is unlikely	Rating The safety concern is minor
Designer response	Adopting no stopping line along one side of the road along with inclusion of vehicle crossings will ensure access for emergency vehicles.	
Safety Engineer comment	Insert comment	
Client decision	Insert comment	
Action taken	Insert comment	

3. Comments

The following comments are either:

- of a general nature; or
- cannot be related to any specific safety concern; or
- relate to previous safety concerns that may have been misinterpreted; or
- relate to subsequent design developments that could become safety concerns in a future safety audit; or
- relate to safety concerns that the designers are already aware of; or
- relate to design elements where the safety implications are not yet clear due to insufficient detail for the stage of the project.

These comments are included for the consideration of the designers and the client. Decision tracking tables are included to record responses, as attention paid to the comments may contribute to improving overall road safety.

3.1.1 Footpath Widths

The Road 1 footpath is proposed 1.5m wide which is acknowledged to be a typical width in residential subdivisions. It is recommended to consider a 1.8m width to provide extra space for the full range of footpath users that can be expected including pedestrians but also cyclists, scooter riders etc.

Designer response	A 1.8m wide footpath can be adopted, but will be subject to approval from CCC roading engineer.
Safety Engineer comment	Insert comment
Client decision	Insert comment
Action taken	Insert comment

3.1.2 Rubbish Collection

It is understood that residents along the ROWs would bring their rubbish bins to Road 1 for collection. There are relatively large numbers of lots along the ROWs, meaning there will potentially be large numbers of rubbish bins placed on Road 1 on rubbish collection days. It should be considered whether dedicated areas are provided for rubbish bin placement so they do not obstruct footpaths, driveways etc.

Designer response	Private rubbish collection is proposed for the lots accessed via rights of way.
Safety Engineer comment	Insert comment
Client decision	Insert comment
Action taken	Insert comment

3.1.3 External Effects on Bowenvale Avenue

It is understood that there are concerns related to high vehicle speeds on Bowenvale Avenue currently, made possible by the long, straight and wide carriageway formation. The development of the subdivision will increase the number of vehicles travelling the full length of Bowenvale Avenue, possibly exacerbating any existing concerns. Similarly, there are delays and queuing on Centaurus Road which impact the performance of the Bowenvale Avenue intersection.

Given the site is zoned for residential development, it is considered that these concerns fall outside of the scope of this road safety audit. As discussed earlier, the new intersection on Bowenvale Avenue can be designed to encourage slow vehicle speeds, however it will not slow vehicles between Centaurus Road and the new intersection. It is recommended that CCC implement traffic calming measures along Bowenvale Avenue to serve existing and future residential areas if the concerns are deemed to warrant them.

Designer response	This is outside the scope of the development, however we do support traffic calming devices being implemented along Bowenvale Ave.
Safety Engineer comment	Insert comment
Client decision	Insert comment
Action taken	Insert comment

4. Audit Statement

We declare that we remain independent of the design team, and have not been influenced in any way by any party during this road safety audit.

We certify that we have used the available plans, and have examined the specified roads and their environment, to identify features of the project we have been asked to look at that could be changed, removed or modified in order to improve safety.

We have noted the safety concerns that have been evident in this audit, and have made recommendations that may be used to assist in improving safety.

Signed  Date 15 December 2022

Chris Rossiter, Principal Transportation Engineer, Stantec NZ

Signed  Date 15 December 2022

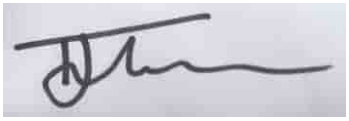
Andrew Leckie, Senior Transportation Engineer, Stantec NZ

5. Response and Decision Statements

System designers and the people who use the roads must all share responsibility for creating a road system where crash forces do not result in death or serious injury.

5.1 Designer's Responses

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report and I have responded accordingly to each safety concern with the most appropriate and practical solutions and actions, which are to be considered further by the safety engineer (if applicable) and project manager.

Signed  Date 15 February 2023

[Designer's name, qualification, position, company]

5.2 Safety Engineer's Comments (if applicable)

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report together with the designer's responses. Where appropriate, I have added comments to be taken into consideration by the project manager when deciding on the action to be taken.

Signed Date

[Safety Engineer's name, qualification, position, company]

5.3 Project Manager's Decisions

I have studied and considered the auditors' safety concerns and recommendations for safety improvements set out in this road safety audit report, together with the designer's responses and the comments of the safety engineer (if applicable), and having been guided by the auditor's ranking of concerns have decided the most appropriate and practical action to be taken to address each of the safety concerns.

Signed Date

[Project Manager's name, qualification, position, company]

5.4 Designer's Statement

I certify that the project manager's decisions and directions for action to be taken to improve safety for each of the safety concerns have been carried out.

Signed Date

[Designer's name, qualification, position, company]

5.5 Safety Audit Close Out

The project manager is to distribute the audit report incorporating the decisions to the designer, safety audit team leader, safety engineer, and project file.

Date:……


NO
VEHICLES
PAST THIS POINT
Bowenvale Reserve
Mountain bike tracks
Walking tracks

Appendices

Appendix A Preliminary Roading Plans

Christchurch
Hazeldean Business Park, Level 2, 2 Hazeldean Road
Addington, Christchurch 8024
PO Box 13-052, Armagh
Christchurch 8141
Tel +64 3 366 7449
Fax +64 3 366 7780

Please visit www.stantec.com to learn more about how Stantec design with community in mind.

Stantec

PLAN: **OVERALL SITE** scale:1:1000

TRUE NORTH

PLANNING OVERVIEW:

TERRITORIAL AUTHORITY:	CHRISTCHURCH CITY COUNCIL
ZONE:	RESIDENTIAL HILLS ZONE
WIND ZONE:	VERY HIGH
CLIMATE ZONE: SOURCE: NZS 4218.2009	ZONE 5
DURABILITY/EXPOSURE ZONE: SOURCE: BRANZ MAPS	ZONE C
SNOW LOADING ZONE: SOURCE: NZS 3604 Fig 15.1	ZONE N5 1.5kPa

NOTE:
THE WIND LOADING CATEGORIES ARE FROM NZS 3604:2011.
VERY HIGH WIND SPEED = 50m/s, HIGH WIND SPEED = 44m/s,
MEDIUM WIND SPEED = 37m/s, LOW WIND SPEED = 32m/s.
WIND SPEEDS ABOVE ARE MAXIMUM ULTIMATE LIMIT STATE
SPEEDS FOR EACH WIND ZONE.

SITE COVERAGE:	35%
BUILDING HEIGHT:	MAX 8m

SITE INFORMATION

LEGAL DESCRIPTION

LOT 34,
D.P 33462

130 BOWENVALE AVENUE,
CASHMERE,
CHRISTCHUCH 8022,
NEW ZEALAND

BUILDING CLASSIFICATION:	RESIDENTIAL DWELLING
TOTAL SITE AREA:	916m²
BUILDING FOOTPRINT AREA:	202m²
SITE COVERAGE :	22.05%

CUT/FILL QUANITIES

INCLUDING BUILDING :	734.06m²
EXCLUDING BUILDING :	540.23m²
MAX. CUT DEPTH :	1.95 m

RETAINING WALLS NOT ASSOCIATED WITH DWELLING

ACCESS ROAD BOUNDARY RETAINING MAX. HEIGHT : 1.14m

TO BE READ IN CONJUNCTION WITH SURVUS/BASECO PLANS. PROJECT NO. 15396

BUILDING CONSENT

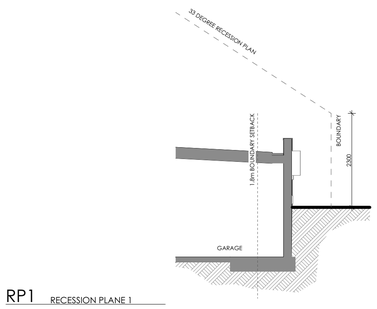
RevID	Transmittal Set Name	Date
01	BC SUBMISSION ISSUE	24/01/23

GCO GROUP

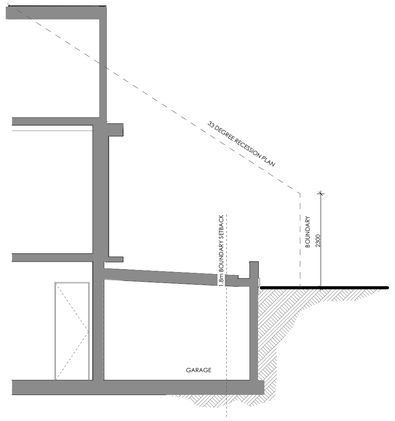
gravitas ARCHITECTURE

Gravitas Level 1, No.4o Welles St, Christchurch Central, 8o11 ph :- o3 428-6773 email :- info@gravitas.net.nz

job	drawing	issue	drawn	revision	sheet
#Project Description NEW RESIDENTIAL DWELLING	OVERALL SITE PLAN	DETAILED DESIGN	AA	01	A0002
		date: 3/03/23	job number: G22003	checked	scale at A1: 1:1000

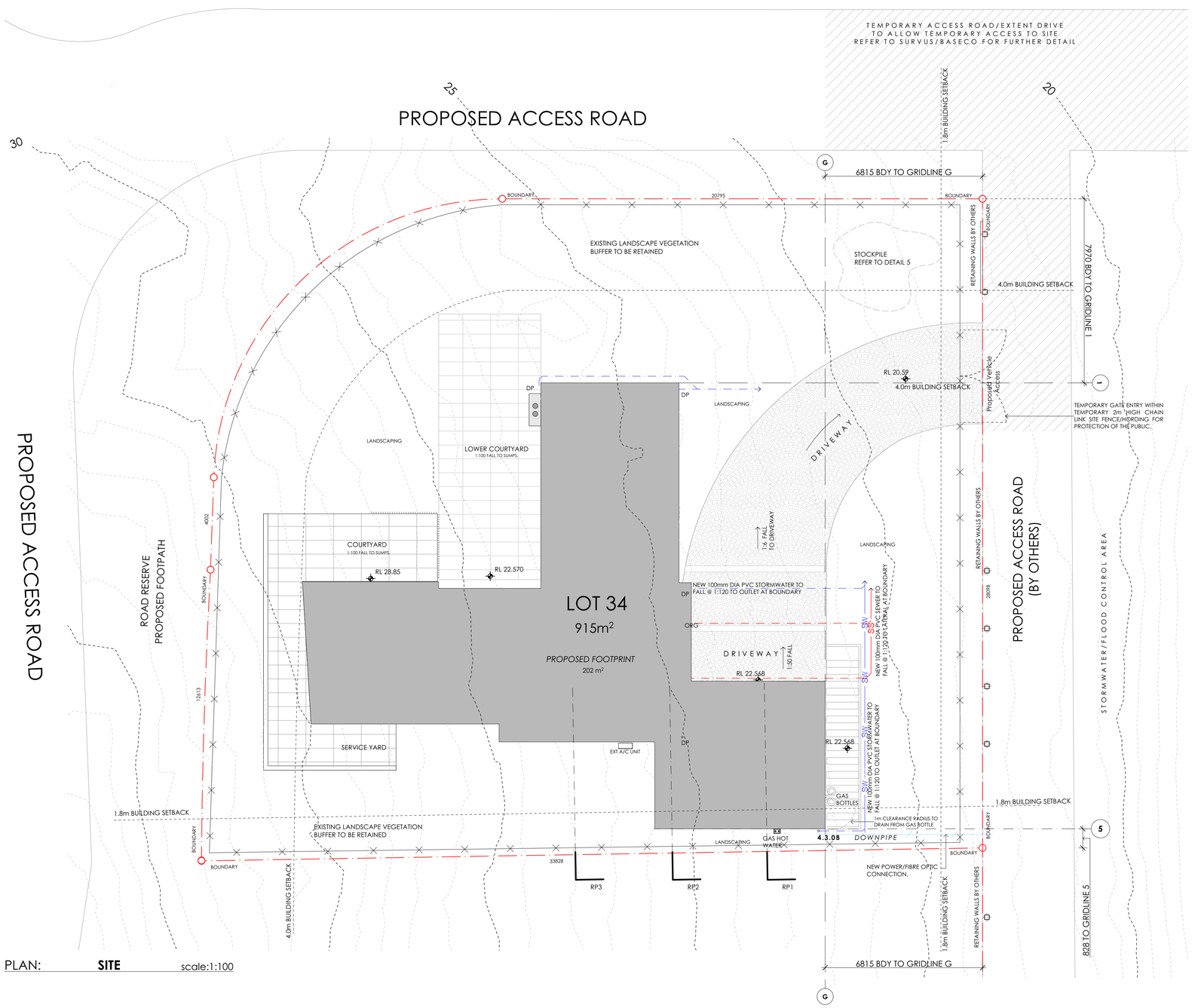


RP1 RECESSION PLANE 1

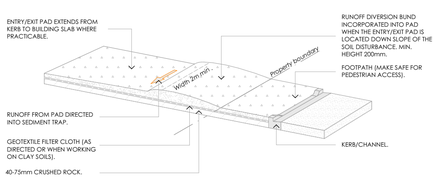


RP2 RECESSION PLANE 2

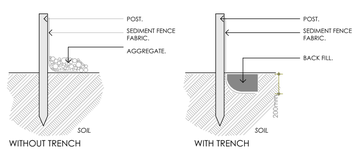
RP3 RECESSION PLANE 3



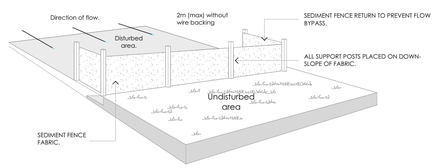
PLAN: **SITE** scale:1:100



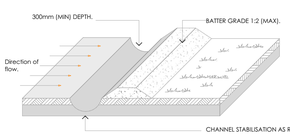
TYPICAL DETAIL 1
STABILISED ENTRY / EXIT PAD
TYPICAL STABILISED ALL WEATHER SITE ACCESS



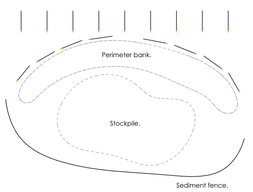
TYPICAL DETAIL 2
WITH & WITHOUT A TRENCH
SEDIMENT FENCE CONSTRUCTION DETAILS



TYPICAL DETAIL 3
SEDIMENT FENCE CONSTRUCTION DETAILS



TYPICAL DETAIL 4
SEDIMENT DIVERSION CHANNEL



TYPICAL DETAIL 5
SEDIMENT DIVERSION STOCKPILES/ MATERIALS

KEY:
SITE SECURITY FENCING MIN. 2m HIGH 50x50mm CHAINLINK MAX 100mm FROM GROUND LEVEL.
NEW 100mm DIA uPVC SANITARY SEWER DRAINS TO FALL AT 1:100 AS SHOWN.
POTABLE WATER. 32ØWH NB WATER PIPES IN SHARED SERVICES TRENCH
NEW 100mm DIA uPVC STORMWATER TO FALL AT 1:120 AS SHOWN.

TO BE READ IN CONJUNCTION WITH SURVUS/BASECO PLANS. PROJECT NO. 15396

CONTRACTOR TO CONFIRM LOCATION ON SITE PRIOR TO CONSTRUCTION AND CONTACT ARCHITECT IF ANY DISCREPANCIES FOUND.

CONTRACTOR TO LOCATE ALL SERVICE CONNECTIONS ON SITE PRIOR COMMENCEMENT OF EARTHWORKS.

ALLOW TO CONFIRM ALL SITE LEVELS AND FINISHED FLOOR LEVELS.

CONTRACTOR TO CONFIRM ALL BOUNDARIES, SETBACKS & RESTRICTIONS ON SITE PRIOR TO COMMENCEMENT OF FOUNDATIONS.

BUILDING TO BE LOCATED ON LEVELED BUILDING PLATFORM, TOPSOIL REMOVED TO NATURAL GROUND AND SITE GRADED LEVEL.

ANY FILL TO BE APPROVED BY THE ENGINEER AND COMPACTED DOWN IN ACCORDANCE WITH NZS 3604:2011

CONTRACTOR PARKING TO BE ON SITE

SITE SHEDS & MATERIAL STORE LOCATIONS TO BE CONFIRMED ON SITE

DRAINAGE: ALL FOUL-WATER AND STORMWATER DRAINAGE TO BE CONVEYED IN PVC PIPES, ALL IN ACCORDANCE WITH THE NZBC AND LOCAL BODY BYLAWS. SPECIALIST TREATMENT OF TRADE WASTE TO BE AT TENANT COST. REFER TO CIVIL ENGINEER DOCUMENTATION FOR DETAILS

EXCAVATION: EXCAVATE AND BACKFILL AROUND PAD FOOTINGS AND HARD FILL UNDER NEW SLAB.

ALLOW TO PROVIDE SEDIMENT CONTROL MEASURES AROUND BOUNDARIES TO PROTECT NEIGHBOURING PROPERTIES DURING CONSTRUCTION.

THE IMPLEMENTATION AND MAINTENANCE OF SEDIMENT MANAGEMENT IS THE RESPONSIBILITY OF THE MAIN CONTRACTOR.

CONTRACTORS SHALL UNLOAD AND LOAD ALL EXCAVATION MACHINERY ON THE SITE AND NOT FROM TRUCKS PARKED ON THE ROAD.

THE CONTRACTOR IS TO MAKE AVAILABLE A HOSE FOR WASHING DOWN DELIVERY VEHICLES AND CONCRETE TRUCKS BEFORE THEY LEAVE THE SITE.

SITE CLEARANCE ACTIVITIES SHALL IDEALLY COMMENCE DURING A PERIOD OF FINE WEATHER TO REDUCE THE RISK OF SEDIMENT ESCAPING FROM THE SITE.

ALLOW TO PROTECT STORMWATER SUMPS IN STREET FROM SEDIMENT RUNOFF. EXISTING SUMPS SHALL BE PROTECTED WITH HAY BALES OR FILTER FABRIC.

SOIL STOCKPILES SHALL BE COVERED WITH POLYTHENE SHEET AND HELD IN PLACE WITH LARGE ROCKS OR SIMILAR

ENSURE THAT ALL EXCAVATIONS FOR SERVICES ARE BACKFILLED AS SOON AS POSSIBLE.

DOWNPIPES (TEMPORARY) IF NECESSARY ARE TO BE INSTALLED AND CONNECTED TO THE STORMWATER SYSTEM AS EARLY AS POSSIBLE ONCE THE ROOFING MATERIAL HAS BEEN INSTALLED.

THE SITE IS TO BE KEPT CLEAN AND TIDY AT ALL TIMES.

THE SEDIMENT CONTROL PLAN IS SCHEMATIC ONLY AND IF DEEMED NECESSARY WILL BE CONFIRMED ON SITE.

ALLOW TO PROVIDE TEMPORARY GATE TO HOARDINGS TO PROVIDE ACCESS TO CONTRACTORS ONLY IN ACCORDANCE WITH F5 NZBC

1.1 SITE FENCES AND HOARDINGS
1.1.1 FENCES AND HOARDINGS SHALL EXTEND AT LEAST 2.0m IN HEIGHT FROM GROUND LEVEL ON THE SIDE ACCESSIBLE TO THE PUBLIC.
1.1.2 AN ACCEPTABLE FENCE MAY BE CONSTRUCTED WITH GALVANISED CHAINLINK NETTING HAVING A MAXIMUM SIZED GRID OF 50mm X 50mm. POST SPACING SHALL BE A MAXIMUM OF 2.5 M, AND THE GAP BETWEEN THE BOTTOM OF THE FENCE AND GROUND NO GREATER THAN 100mm.
1.1.3 ANY HOARDING SHALL HAVE CONTINUOUS CLADDING IN ANY OF THE FOLLOWING MATERIALS:
A) CLOSE-BUTTED TIMBER WITH A THICKNESS OF AT LEAST 19mm.
B) 6.0mm THICK EXTERIOR GRADE PLYWOOD ON STUDS SPACED AT NO GREATER THAN 600mm CENTRES.
C) 9.5mm THICK EXTERIOR GRADE PLYWOOD ON STUDS SPACED AT NO GREATER THAN 1000mm CENTRES.
D) CONTINUOUS METAL CLADDING CONSTRUCTED WITH STUDS AND RAILS SPACED TO PROVIDE STRENGTH AND RIGIDITY COMPARABLE WITH THE HOARDINGS IN PARAGRAPHS 1.1.3 A) TO C).

BUILDING CONSENT

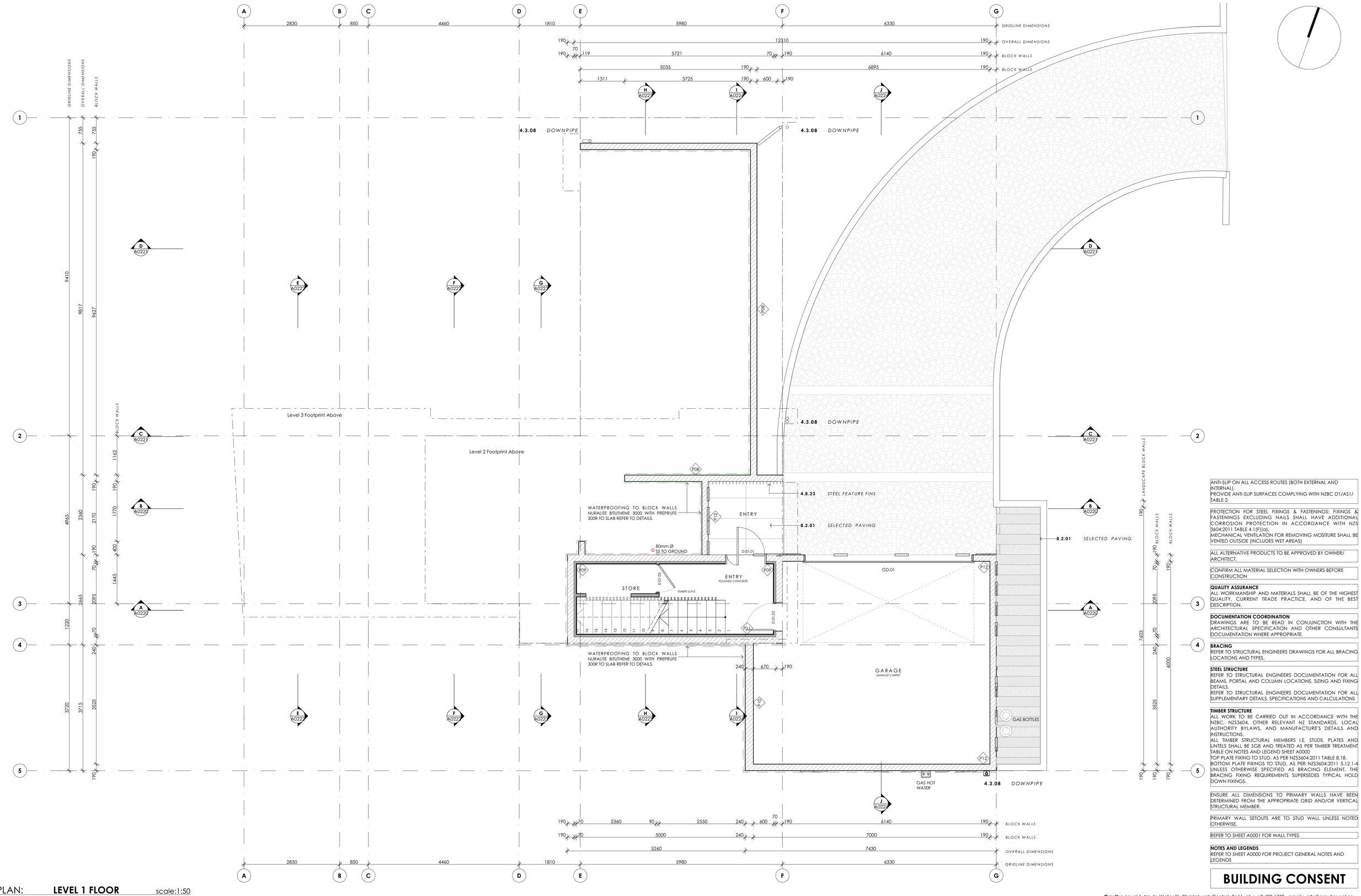
RevID	Transmittal Set Name	Date
01	BC SUBMISSION ISSUE	24/01/23

GCO GROUP

gravitas ARCHITECTURE

Gravitas Level 1, No.4o Welles St, Christchurch Central, 8o11 ph :- o3 428-6773 email :- info@gravitas.net.nz

job	#Project Description	drawing		issue		drawn	revision	sheet
	NEW RESIDENTIAL DWELLING	ENLARGED SITE PLAN		DETAILED DESIGN		AA	01	A0003
			date	job number	checked	scale at A1		
			3/03/23	G22003		1:100, 1:75		



PLAN: **LEVEL 1 FLOOR** scale:1:50

RevID	Transmittal Set Name	Date
01	BC SUBMISSION ISSUE	24/01/23

ANTI-SLIP ON ALL ACCESS ROUTES (BOTH EXTERNAL AND INTERNAL).
PROVIDE ANTI-SLIP SURFACES COMPLYING WITH NZBC D1/AS1/ TABLE 2

PROTECTION FOR STEEL FIXINGS & FASTENINGS: FIXINGS & FASTENINGS EXCLUDING NAILS SHALL HAVE ADDITIONAL CORROSION PROTECTION IN ACCORDANCE WITH NZS 3604:2011 TABLE 4.1(B)(ii).
MECHANICAL VENTILATION FOR REMOVING MOISTURE SHALL BE VENTED OUTSIDE (INCLUDES WET AREAS)

ALL ALTERNATIVE PRODUCTS TO BE APPROVED BY OWNER/ ARCHITECT.

CONFIRM ALL MATERIAL SELECTION WITH OWNERS BEFORE CONSTRUCTION

QUALITY ASSURANCE
ALL WORKMANSHIP AND MATERIALS SHALL BE OF THE HIGHEST QUALITY, CURRENT TRADE PRACTICE, AND OF THE BEST DESCRIPTION.

DOCUMENTATION COORDINATION
DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE ARCHITECTURAL SPECIFICATION AND OTHER CONSULTANTS DOCUMENTATION WHERE APPROPRIATE.

BRACING
REFER TO STRUCTURAL ENGINEERS DRAWINGS FOR ALL BRACING LOCATIONS AND TYPES.

STEEL STRUCTURE
REFER TO STRUCTURAL ENGINEERS DOCUMENTATION FOR ALL BEAMS, PORTAL AND COLUMN LOCATIONS, SIZING AND FIXING DETAILS.
REFER TO STRUCTURAL ENGINEERS DOCUMENTATION FOR ALL SUPPLEMENTARY DETAILS, SPECIFICATIONS AND CALCULATIONS

TIMBER STRUCTURE
ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH THE NZBC, NZS3604, OTHER RELEVANT NZ STANDARDS, LOCAL AUTHORITY BYLAWS, AND MANUFACTURE'S DETAILS AND INSTRUCTIONS.
ALL TIMBER STRUCTURAL MEMBERS I.E. STUDS, PLATES AND LINTELS SHALL BE SG8 AND TREATED AS PER TIMBER TREATMENT TABLE ON NOTES AND LEGEND SHEET A0000
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BOTTOM PLATE FIXINGS TO STUD, AS PER NZS3604:2011 5.12.1-4 UNLESS OTHERWISE SPECIFIED AS BRACING ELEMENT. THE BRACING FIXING REQUIREMENTS SUPERSEDES TYPICAL HOLD DOWN FIXINGS.

ENSURE ALL DIMENSIONS TO PRIMARY WALLS HAVE BEEN DETERMINED FROM THE APPROPRIATE GRID AND/OR VERTICAL STRUCTURAL MEMBER.

PRIMARY WALL SETOUTS ARE TO STUD WALL UNLESS NOTED OTHERWISE.

REFER TO SHEET A0001 FOR WALL TYPES

NOTES AND LEGENDS
REFER TO SHEET A0000 FOR PROJECT GENERAL NOTES AND LEGENDS

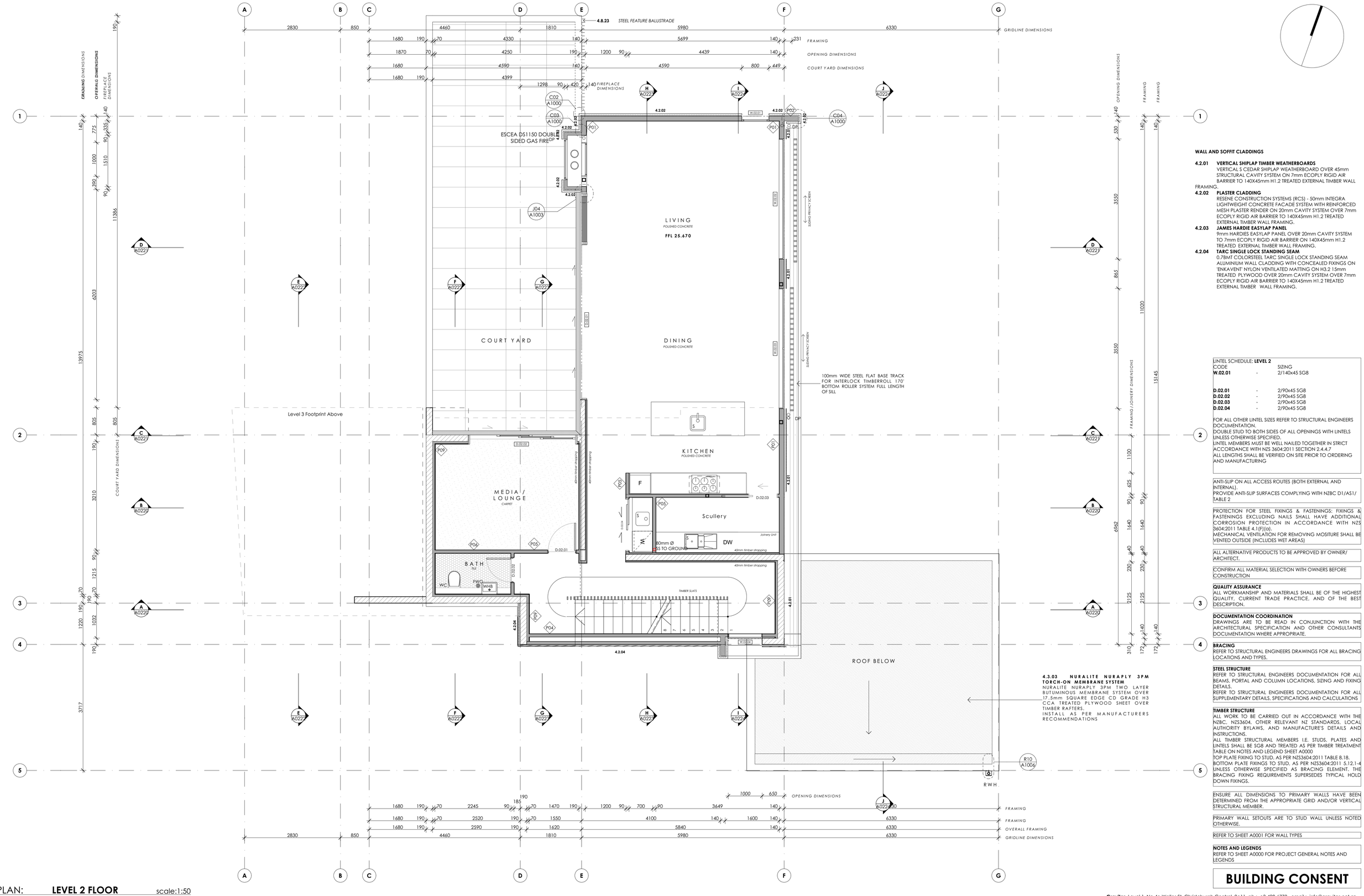
BUILDING CONSENT

GCO GROUP

gravitas ARCHITECTURE

Gravitas Level 1, No.4o Welles St, Christchurch Central, 8o11 ph :- o3 428-6773 email :- info@gravitas.net.nz

job	drawing	issue	drawn	revision	sheet
#Project Description NEW RESIDENTIAL DWELLING	LEVEL 1 FLOOR PLAN	DETAILED DESIGN	AA	01	A0100
		date: 3/03/23	job number: G22003	checked	scale at A1: 1:50



4.3.03 NURALITE NURAPLY 3PM TORCH-ON MEMBRANE SYSTEM
NURALITE NURAPLY 3PM TWO LAYER BUTUMINOUS MEMBRANE SYSTEM OVER 17.5mm SQUARE EDGE CD GRADE H3 CCA TREATED PLYWOOD SHEET OVER TIMBER RAFTERS.
INSTALL AS PER MANUFACTURERS RECOMMENDATIONS

WALL AND SOFFIT CLADDINGS

4.2.01 VERTICAL SHIPLAP TIMBER WEATHERBOARDS
VERTICAL S CEDAR SHIPLAP WEATHERBOARD OVER 45mm STRUCTURAL CAVITY SYSTEM ON 7mm ECOPLY RIGID AIR BARRIER TO 140X45mm H1.2 TREATED EXTERNAL TIMBER WALL FRAMING.

4.2.02 PLASTER CLADDING
RESENE CONSTRUCTION SYSTEMS (RCS) - 50mm INTEGRA LIGHTWEIGHT CONCRETE FACADE SYSTEM WITH REINFORCED MESH PLASTER RENDER ON 20mm CAVITY SYSTEM OVER 7mm ECOPLY RIGID AIR BARRIER TO 140X45mm H1.2 TREATED EXTERNAL TIMBER WALL FRAMING.

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9mm HARDIES EASYLAP PANEL OVER 20mm CAVITY SYSTEM TO 7mm ECOPLY RIGID AIR BARRIER ON 140X45mm H1.2 TREATED EXTERNAL TIMBER WALL FRAMING.

4.2.04 TARC SINGLE LOCK STANDING SEAM
0.78MT COLORSTEEL TARC SINGLE LOCK STANDING SEAM ALUMINIUM WALL CLADDING WITH CONCEALED FIXINGS ON 'ENKAVENT' NYLON VENTILATED MATTING ON H3.2 15mm TREATED PLYWOOD OVER 20mm CAVITY SYSTEM OVER 7mm ECOPLY RIGID AIR BARRIER TO 140X45mm H1.2 TREATED EXTERNAL TIMBER WALL FRAMING.

LINTEL SCHEDULE: **LEVEL 2**

CODE		SIZING
W.02.01	-	2/140x45 SG8
D.02.01	-	2/90x45 SG8
D.02.02	-	2/90x45 SG8
D.02.03	-	2/90x45 SG8
D.02.04	-	2/90x45 SG8

FOR ALL OTHER LINTEL SIZES REFER TO STRUCTURAL ENGINEERS DOCUMENTATION.
DOUBLE STUD TO BOTH SIDES OF ALL OPENINGS WITH LINTELS UNLESS OTHERWISE SPECIFIED.
LINTEL MEMBERS MUST BE WELL NAILED TOGETHER IN STRICT ACCORDANCE WITH NZS 3604:2011 SECTION 2.4.4.7
ALL LENGTHS SHALL BE VERIFIED ON SITE PRIOR TO ORDERING AND MANUFACTURING

ANTI-SLIP ON ALL ACCESS ROUTES (BOTH EXTERNAL AND INTERNAL).
PROVIDE ANTI-SLIP SURFACES COMPLYING WITH NZBC D1/AS1/ TABLE 2

PROTECTION FOR STEEL FIXINGS & FASTENINGS: FIXINGS & FASTENINGS EXCLUDING NAILS SHALL HAVE ADDITIONAL CORROSION PROTECTION IN ACCORDANCE WITH NZS 3604:2011 TABLE 4.1(F)(G).
MECHANICAL VENTILATION FOR REMOVING MOISTURE SHALL BE VENTED OUTSIDE (INCLUDES WET AREAS)

ALL ALTERNATIVE PRODUCTS TO BE APPROVED BY OWNER/ ARCHITECT.

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REFER TO SHEET A0001 FOR WALL TYPES

NOTES AND LEGENDS
REFER TO SHEET A0000 FOR PROJECT GENERAL NOTES AND LEGENDS

BUILDING CONSENT

PLAN: **LEVEL 2 FLOOR** scale:1:50

RevID	Transmittal Set Name	Date
01	BC SUBMISSION ISSUE	24/01/23

GCO GROUP

gravitas ARCHITECTURE

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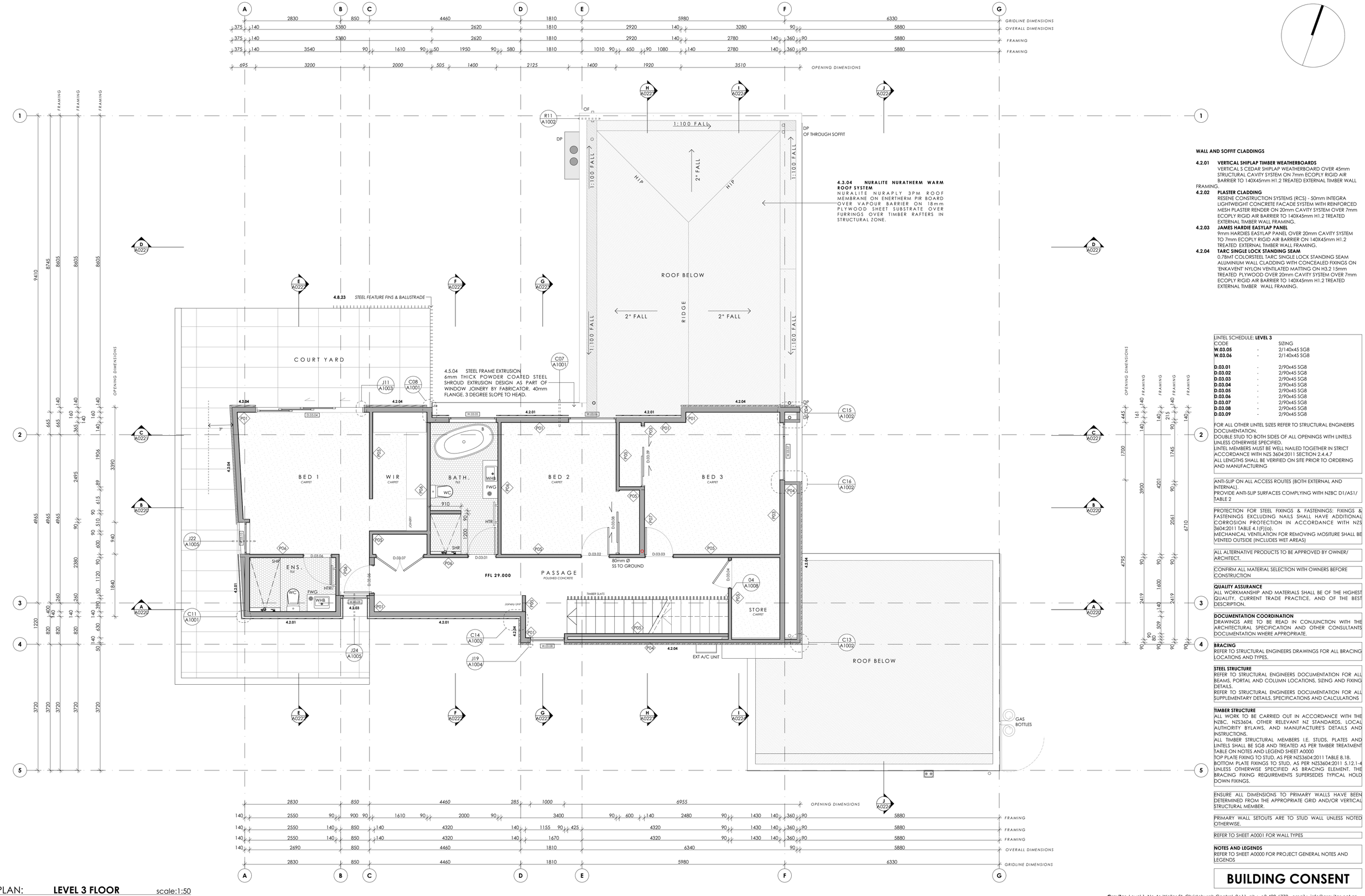
job	drawing	issue	drawn	revision	sheet
#Project Description NEW RESIDENTIAL DWELLING	LEVEL 2 FLOOR PLAN	DETAILED DESIGN	AA	01	A0101
		date: 3/03/23	job number: G22003	checked	scale at A1: 1:50



WALL AND SOFFIT CLADDINGS

4.2.01 VERTICAL SHIPLAP TIMBER WEATHERBOARDS
VERTICAL S CEDAR SHIPLAP WEATHERBOARD OVER 45mm STRUCTURAL CAVITY SYSTEM ON 7mm ECOPLY RIGID AIR BARRIER TO 140X45mm H1.2 TREATED EXTERNAL TIMBER WALL FRAMING.

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LINTEL SCHEDULE: **LEVEL 3**

CODE		SIZING
W.03.05	-	2/140x45 SG8
W.03.06	-	2/140x45 SG8
D.03.01	-	2/90x45 SG8
D.03.02	-	2/90x45 SG8
D.03.03	-	2/90x45 SG8
D.03.04	-	2/90x45 SG8
D.03.05	-	2/90x45 SG8
D.03.06	-	2/90x45 SG8
D.03.07	-	2/90x45 SG8
D.03.08	-	2/90x45 SG8
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NOTES AND LEGENDS
REFER TO SHEET A0000 FOR PROJECT GENERAL NOTES AND LEGENDS

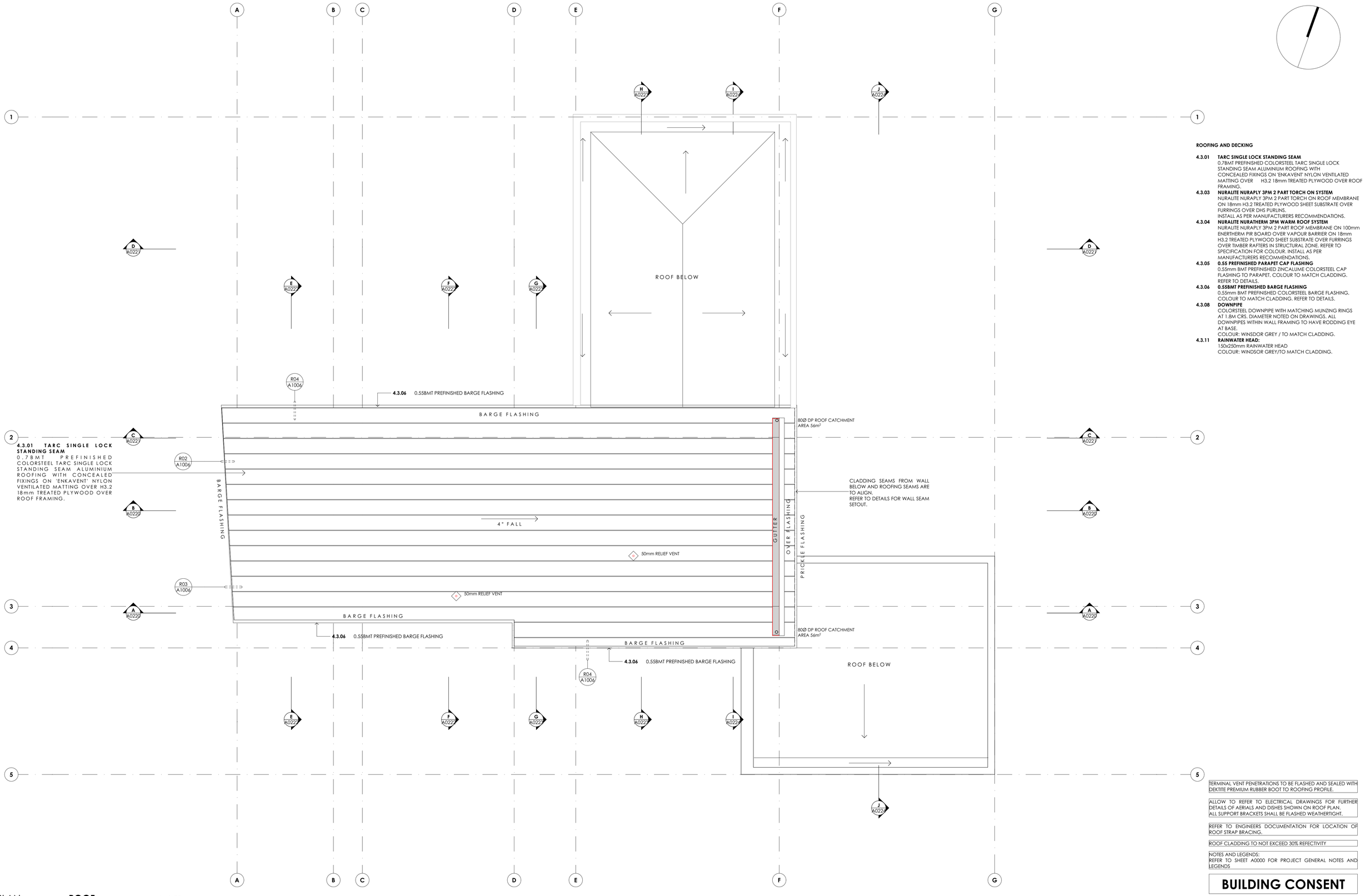
BUILDING CONSENT

PLAN: **LEVEL 3 FLOOR** scale:1:50

RevID	Transmittal Set Name	Date
01	BC SUBMISSION ISSUE	24/01/23

Gravitas Level 1, No.4a Welles St, Christchurch Central, 8011 ph :- 03 428-6773 email :- info@gravitas.net.nz

job	drawing	issue	drawn	revision	sheet
#Project Description		DETAILED DESIGN	AA	01	A0102
NEW RESIDENTIAL DWELLING	LEVEL 3 FLOOR PLAN	date 3/03/23	job number G22003	checked	scale at A1 1:50



ROOFING AND DECKING

4.3.01 TARC SINGLE LOCK STANDING SEAM
0.78MT PREFINISHED COLORSTEEL TARC SINGLE LOCK STANDING SEAM ALUMINIUM ROOFING WITH CONCEALED FIXINGS ON 'ENKAVENT' NYLON VENTILATED MATTING OVER H3.2 18mm TREATED PLYWOOD OVER ROOF FRAMING.

4.3.03 NURALITE NURAPLY 3PM 2 PART TORCH ON SYSTEM
NURALITE NURAPLY 3PM 2 PART TORCH ON ROOF MEMBRANE ON 18mm H3.2 TREATED PLYWOOD SHEET SUBSTRATE OVER FURRINGS OVER DHS PURLINS.
INSTALL AS PER MANUFACTURERS RECOMMENDATIONS.

4.3.04 NURALITE NURATHERM 3PM WARM ROOF SYSTEM
NURALITE NURAPLY 3PM 2 PART ROOF MEMBRANE ON 100mm ENERTHERM PIR BOARD OVER VAPOUR BARRIER ON 18mm H3.2 TREATED PLYWOOD SHEET SUBSTRATE OVER FURRINGS OVER TIMBER RAFTERS IN STRUCTURAL ZONE. REFER TO SPECIFICATION FOR COLOUR. INSTALL AS PER MANUFACTURERS RECOMMENDATIONS.

4.3.05 0.55 PREFINISHED PARAPET CAP FLASHING
0.55mm BMT PREFINISHED ZINCALUME COLORSTEEL CAP FLASHING TO PARAPET. COLOUR TO MATCH CLADDING. REFER TO DETAILS.

4.3.06 0.55BMT PREFINISHED BARGE FLASHING
0.55mm BMT PREFINISHED COLORSTEEL BARGE FLASHING. COLOUR TO MATCH CLADDING. REFER TO DETAILS.

4.3.08 DOWNPIPE
COLORSTEEL DOWNPIPE WITH MATCHING MUNZING RINGS AT 1.8M CRS. DIAMETER NOTED ON DRAWINGS. ALL DOWNPIPES WITHIN WALL FRAMING TO HAVE RODDING EYE AT BASE.
COLOUR: WINDSOR GREY / TO MATCH CLADDING.

4.3.11 RAINWATER HEAD:
150x250mm RAINWATER HEAD
COLOUR: WINDSOR GREY/TO MATCH CLADDING.

TERMINAL VENT PENETRATIONS TO BE FLASHED AND SEALED WITH DEKTITE PREMIUM RUBBER BOOT TO ROOFING PROFILE.

ALLOW TO REFER TO ELECTRICAL DRAWINGS FOR FURTHER DETAILS OF AERIALS AND DISHES SHOWN ON ROOF PLAN. ALL SUPPORT BRACKETS SHALL BE FLASHED WEATHERTIGHT.

REFER TO ENGINEERS DOCUMENTATION FOR LOCATION OF ROOF STRAP BRACING.

ROOF CLADDING TO NOT EXCEED 30% REFECTIVITY

NOTES AND LEGENDS:
REFER TO SHEET A0000 FOR PROJECT GENERAL NOTES AND LEGENDS

BUILDING CONSENT

PLAN: **ROOF** scale:1:50

RevID	Transmittal Set Name	Date
01	BC SUBMISSION ISSUE	24/01/23

GCO GROUP

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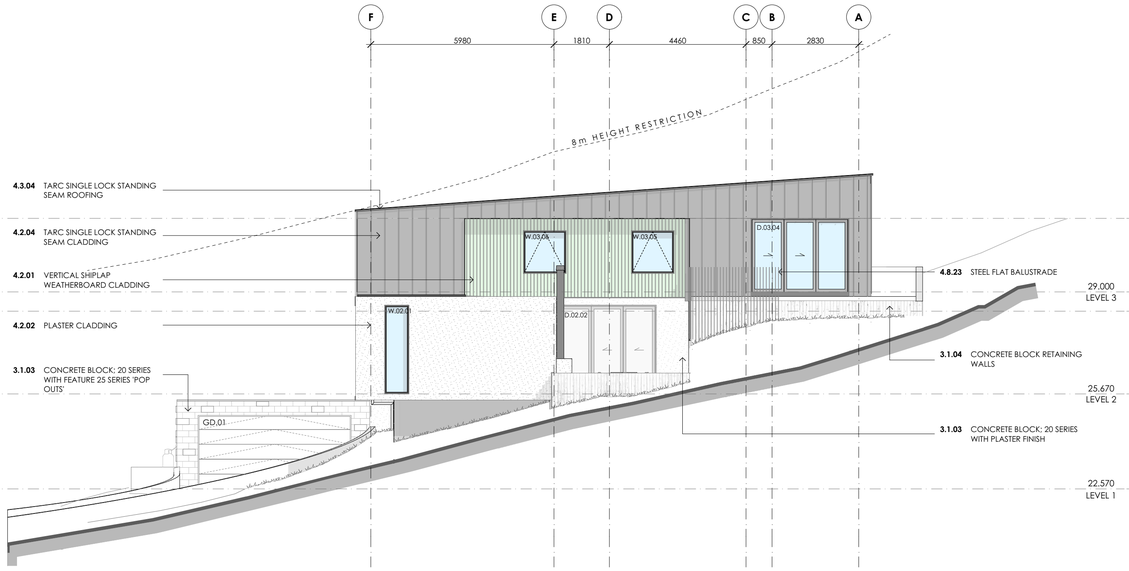
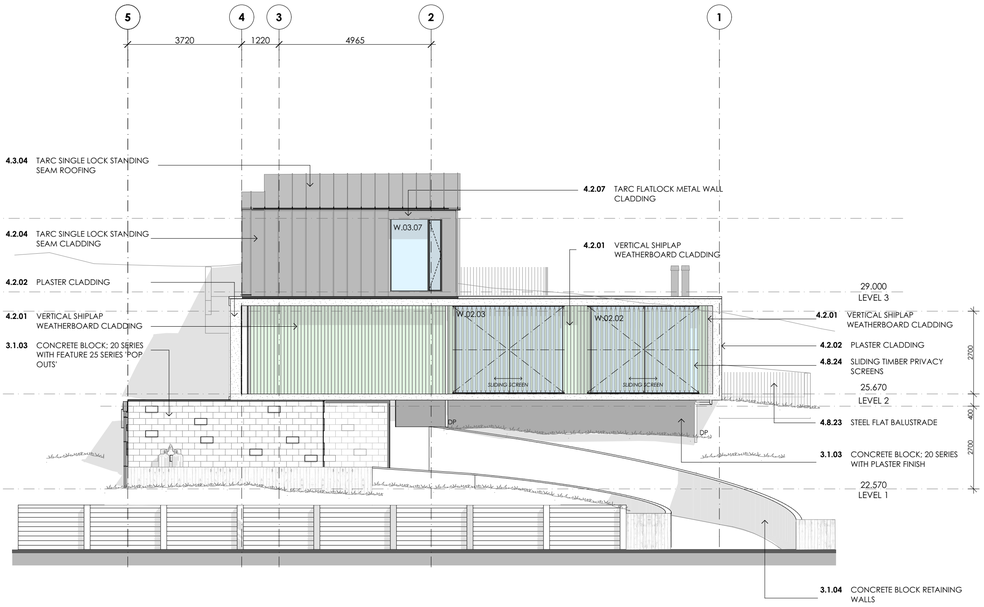
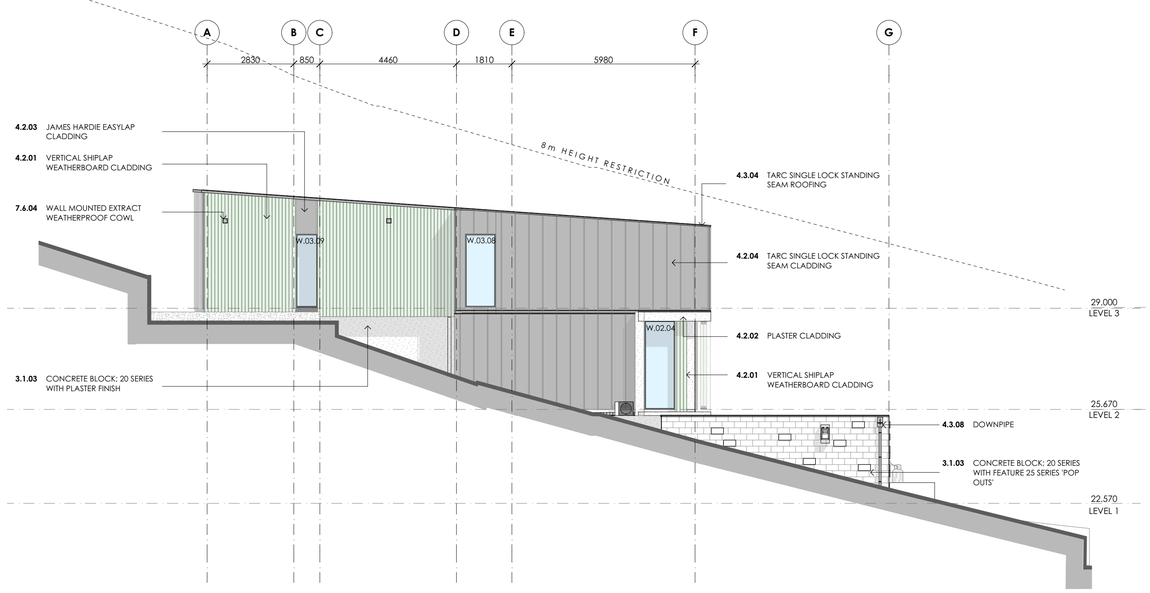
job	drawing	issue	drawn	revision	sheet
#Project Description NEW RESIDENTIAL DWELLING	ROOF PLAN	DETAILED DESIGN	AA	01	A0103
		date: 3/03/23	job number: G22003	checked	scale at A1: 1:50



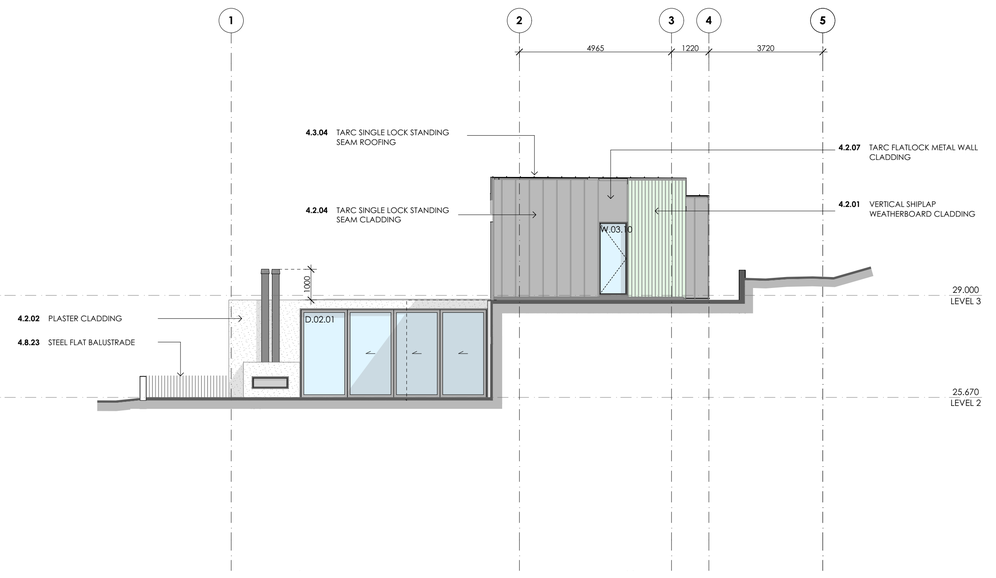
N **ELEVATION: NORTH** scale:1:100



E **ELEVATION: EAST** scale:1:100



S **ELEVATION: SOUTH** scale:1:100



W **ELEVATION: WEST** scale:1:100

WALL AND SOFFIT CLADDINGS

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4.2.05 6mm FIBRE CEMENT SOFFIT LINING
JAMES HARDIE VILLABOARD SOFFIT LINING, SMOOTH RECESSED EDGE FOR BUTT JOINTING, SET AND STOPPED FOR LEVEL 4 SELECTED PAINT FINISH, AS PER MANUFACTURERS INSTALLATION REQUIREMENTS.

4.2.06 TIMBER SOFFIT LINING
CEDAR SHIPLAP SOFFIT LINING, ON SOFFIT FRAMING, AS PER MANUFACTURERS INSTALLATION REQUIREMENTS.

4.2.07 TARC FLATLOCK CLADDING
0.78MT COLORSTEEL TARC FLATLOCK ALUMINIUM WALL CLADDING WITH CONCEALED FIXINGS ON 'ENKAVENT' NYLON VENTILATED MATTING ON H3.2 15mm TREATED PLYWOOD OVER 20mm CAVITY SYSTEM OVER 7mm ECOPLY RIGID AIR BARRIER TO 140X45mm H1.2 TREATED EXTERNAL TIMBER WALL FRAMING.

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150x250mm RAINWATER HEAD
COLOUR: WINDSOR GREY/TO MATCH CLADDING.

BUILDING ENVELOP RISK MATRIX
BASED ON NZBC E2/AS1

NORTH ELEVATION

RISK FACTOR	RISK SEVERITY	RISK SCORE
WIND ZONE (PER NZS 3604)	VERY HIGH	2
NUMBER OF STOREYS	VERY HIGH RISK	4
ROOF/WALL INTERSECTION DESIGN	VERY HIGH RISK	5
EAVES WIDTH	VERY HIGH RISK	5
ENVELOPE COMPLEXITY	HIGH RISK	3
DECK DESIGN	LOW RISK	0
TOTAL RISK SCORE		**19**

EAST ELEVATION

RISK FACTOR	RISK SEVERITY	RISK SCORE
WIND ZONE (PER NZS 3604)	VERY HIGH	2
NUMBER OF STOREYS	VERY HIGH RISK	4
ROOF/WALL INTERSECTION DESIGN	VERY HIGH RISK	5
EAVES WIDTH	VERY HIGH RISK	5
ENVELOPE COMPLEXITY	HIGH RISK	3
DECK DESIGN	LOW RISK	0
TOTAL RISK SCORE		**19**

BUILDING ENVELOP RISK MATRIX
BASED ON NZBC E2/AS1

WEST ELEVATION

RISK FACTOR	RISK SEVERITY	RISK SCORE
WIND ZONE (PER NZS 3604)	VERY HIGH	2
NUMBER OF STOREYS	VERY HIGH RISK	4
ROOF/WALL INTERSECTION DESIGN	VERY HIGH RISK	5
EAVES WIDTH	VERY HIGH RISK	5
ENVELOPE COMPLEXITY	HIGH RISK	3
DECK DESIGN	LOW RISK	0
TOTAL RISK SCORE		**19**

SOUTH ELEVATION

RISK FACTOR	RISK SEVERITY	RISK SCORE
WIND ZONE (PER NZS 3604)	VERY HIGH	2
NUMBER OF STOREYS	VERY HIGH RISK	4
ROOF/WALL INTERSECTION DESIGN	VERY HIGH RISK	5
EAVES WIDTH	VERY HIGH RISK	5
ENVELOPE COMPLEXITY	HIGH RISK	3
DECK DESIGN	LOW RISK	0
TOTAL RISK SCORE		**19**

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job	drawing	issue	drawn	revision	sheet
#Project Description		DETAILED DESIGN	AA	01	A0200
NEW RESIDENTIAL DWELLING	ELEVATIONS	date: 3/03/23	job number: G22003	checked	scale at A1: 1:100, 1:114.9481

ENGEO Limited
124 Montreal Street, Sydenham, Christchurch 8023
PO Box 373, Christchurch 8140, New Zealand
T: +64 3 328 9012
www.engeo.co.nz

Project Number 20268.002.001

Geotechnical Investigation - Proposed Lot 34

130 Bowenvale Avenue, Cashmere, Christchurch

Submitted to:
Gravitas Consulting Limited
165 Harewood Road
Papanui
Christchurch 8053

Contents

Tables

Figures

Appendices

ENGEO Document Control:

Report Title	Geotechnical Investigation - Proposed Lot 34, 130 Bowenvale Avenue, Cashmere			
Project No.	20268.002.001	**Doc ID**	01	
Client	Gravitas Consulting Limited	**Client Contact**		
Distribution (PDF)				
Date	**Revision Details / Status**	**Author**	**Reviewer**	**WP**
14/11/2022	Issued to Client	JJ	NC	JT

1 Introduction

ENGEO Ltd was requested by Gravitas Consulting Limited to undertake a geotechnical investigation for the proposed house on the proposed lot 34 at 130 Bowenvale Avenue, Cashmere, Christchurch (herein referred to as 'the site'). This work has been carried out in accordance with our signed agreement dated 30 October 2022. The purpose of the assessment was to complete Lot specific assessment to support your building consent application.

Our scope of works was as follows:

- A desktop study of geotechnical and geological data, including the New Zealand Geotechnical Database (NZGD).
- Site assessment by an experienced ground engineering professional.
- Shallow soil testing consisting of two hand auger boreholes (as access allows) with associated Scala penetrometer and Shear vane testing.
- Production of this geotechnical report based on the findings of our enquiries and ground investigation, including recommendations associated with new foundations.

Our scope of works does not include liquefaction analysis, landslide or rockfall assessment as the subdivision report has stated this is not required on this Lot.

2 Site Description

The site at Lot 34, 130 Bowenvale Avenue is located on an east-facing section of that is moderately sloping (~20-22º) in Cashmere, Christchurch. The property will be accessed from Bowenvale Avenue via the access road to the east of the property. The proposed site development plan is displayed below in Figure 1.

Figure 1: Site Development Plan (GCO Group)

3 Previous Reporting

ENGEO has previously completed a geotechnical report for the wider subdivision dated 28 October 2022 (ENGEO 2022), which must be read in conjunction with this report. The key outcomes from our earlier report are as follows:

- Foundations may bear on native loess soil.
- Foundations should be at least 300 mm deep and should be able to span at least 1.5 m such that they can span across tunnel gullies that may occur in the building footprint.
- Foundations may be designed for an ultimate bearing capacity of 300 kPa provided they are strip footings at least 600 mm wide or are pad footings at least 300 mm wide.
- ENGEO provided cut and fill recommendations, see Subdivision Report (ENGEO, 2022).
- Lot 34 is outside of the mapped hazard zones (Appendix 3).

4 Field Investigations and Site Conditions

4.1 Site Investigation

ENGEO completed site investigations on 28 October 2022. Site investigation included completion of three hand augers (HA). HAs were logged in accordance with the New Zealand Geotechnical Society (NZGS) field description of soil and rock guidelines. Handheld dynamic cone penetrometer (DCP) and shear vane testing was completed to estimate *in situ* and undrained shear strength of shallow subsurface materials. HAs reached 1.6 – 2.3 m depth and all met refusal on hard loess.

Geotechnical site investigation plan is included in Appendix 1, HA logs are included in Appendix 2.

4.2 Summary of Subsurface Conditions

The material encountered in our subsurface investigations is broadly consistent with prior mapping and consistent with previous site investigations, as summarised in Table 1:

Table 1: Summary of Subsurface Conditions

Depth (m)	Soil Type	Density / Consistency
0.0 to 0.3	TOPSOIL	Loose
0.3 to 1.7	LOESS	Dense to very dense

Ground water was not encountered in any of the site investigations.

5 Geotechnical Assessment

Based on our review of mapped and observed land damage at the site and the ground conditions encountered in investigations, we consider the likelihood of liquefaction and associated deformations, consolidation of soft soils and presence of fill to be low. This is in accordance with our subdivision report dated 28 October 2022.

6 Geotechnical Recommendations

6.1 Foundation Design

Based on geotechnical investigations we consider the site is suitable for shallow foundations for standard timber framed dwellings. The foundations should be embedded in native silt, and all topsoil shall be stripped from within the building footprint.

We recommend an ultimate bearing capacity of 300 kPa is available at 300 mm depth on native silt encountered below topsoil and a minimum foundation width of 600 mm.

The bearing capacity should be multiplied by the following capacity reduction factors:

- All ULS load combinations (including earthquakes) 0.45 – 0.6.
- Serviceability Limit State cases 0.33.

There will be some settlements beneath the footings under the applied loads and total settlements. This can be quantified during the detailed design phase as it is dependent on loads and footing sizes.

If there are significant horizontal loads or moments applied to the footing, a more detailed assessment of bearing capacity will be required and ENGEO should be contacted for specific review and comment.

6.2 Earthworks Recommendations

6.2.1 Site Preparation Recommendations

All grass and organic soils to depths designated by the geotechnical professional should be removed during stripping operations.

6.2.2 Tunnel Gullies & Rilling

Rilling and tunnel gully features were observed within the vicinity of the site. The proposed roads should intercept the majority of the rills and tunnel gullies that would have impacted Lot 34. However, we recommend that if tunnel gullies are observed during the site works, that any soft or wet soil is removed from the exposed base of the tunnel gully. The tunnel gully will need to be either excavated out or filled with a low permeability grout. Site won fill can be used to back fill the remediated areas, provided it meets the criteria below.

We also recommend that the dwelling is designed to be separate from the hillside behind it, such that it is not exposed to the risk of groundwater needing to be controlled behind basement retaining walls. This means that the dwelling should either be built above grade, or if it is to be cut into the hillside, then they should have two separate walls with at least 1 m gap between them - the retaining wall in contact with the ground, and then the rear wall of the house as a separate structure. This also helps facilitate repairs following future seismic events.

6.2.3 Fill Placement

During the earthworks operations all topsoil, organic matter, fill and other unsuitable materials should be removed from the construction areas in accordance with the recommendations of NZS 4431:1989.

All fill that is utilised beneath foundations should be placed and compacted in accordance with the recommendations of NZS 4431:1989 and certification should be provided to that effect.

We consider that site won fill may be appropriate for the purpose of bulk earthworks grading. Laboratory testing on the loess material will need to be completed to confirm it is suitable for use as engineered fill. If during excavation it is found that the material varies from that described within the report, then further laboratory testing, including assessment of maximum dry density / optimum moisture, may be required. These tests can be completed at the time of site grading.

All engineered fill should be placed in lifts no greater than 200 mm thick to at least 95% Maximum Dry Density at a moisture content within at least 3 percentage points of optimum. The degree of compaction for each lift should be tested by the contractor in accordance with NZS4407:2015 using a nuclear density meter (NDM).

6.3 Additional Considerations

The following aspects need to be taken in consideration during the design development of the site:

- New foundation elements should be designed by a Chartered Professional Engineer practising in foundation design.
- A geotechnical professional should inspect the subgrade excavation to confirm that the assumptions made within this report have been achieved.

6.4 Safety in Design

Safety in Design aims to identify, address and minimise or eliminate health and safety risks where it is reasonably practicable to do so. Given the relatively level site and the shallow excavations required, the key safety considerations during construction will likely relate to temporary cuts (if applicable), the contractor's construction methodology, and how the public interface with the site is managed. ENGEO can provide safety in design advice as part of the detailed design stages once the remediation strategy and foundation / earthworks requirements have been identified.

7 Sustainability

We encourage you to consider sustainability when assessing the options available for your project. Where suitable for the project, we recommend prioritising the use of sustainable building materials (such as timber in favour of concrete or steel), locally sourced (materials readily available to Contractors as opposed to materials requiring import), and installed in an environmentally friendly way (e.g., reduced carbon emissions and minimal contamination). If you would like to discuss these options further, ENGEO staff are available to offer suggestions.

8 Limitations

i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Gravitas Consulting Limited , their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.

iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

iv. This Limitation should be read in conjunction with the Engineering NZ/ACENZ Standard Terms of Engagement.

v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (03) 328 9012 if you require any further information.

Report prepared by

Jake Johnson

Geotechnical Engineer

Report reviewed by

Neil Charters, CMEngNZ (CPEng)

Principal Geotechnical Engineer

9 References

Canterbury Earthquake Recovery Authority. (2013). Canterbury Geotechnical Database. Retrieved May 2013, from https://canterburyrecovery.projectorbit.com/cgd

GNS Science, Earthquake Commission. (n.d.). Aftershocks. Retrieved 2013, from Geonet: www.geonet.org.nz/canterbury-quakes/aftershocks

Idriss and Boulanger. (2008). Soil Liquefaction during Earthquakes - EERI Monograph MNO12.

The Ministry of Business, Innovation, and Employment. (2012). Guidance-Repairing and rebuilding houses affected by the Canterbury earthquakes. Christchurch: The Ministry of Business, Innovation, and Employment.

We also acknowledge the New Zealand GeoNet project and its sponsors EQC, GNS Science and LINZ, for providing data used in this report.

APPENDIX 1:

Test Location Plan

Legend

- ENGEO 2022 - Hand Auger Locations
- Proposed Subdivision Layout Plan

0 10 m 20 m

© Nearmap

ENGEO

Produced by **Datanest.earth**

Title: Test Location Plan		
Client: GCO Ltd		Figure No: 1 Size: A4
Project: Bowenvale Development	Drawn: JJ	
Date: 07-11-2022	Checked: NC	
Proj No: 20268.001	Scale: 1:1000	Version: 1.0

APPENDIX 2:

Investigation Logs

LOG OF AUGER BV-ENG22-HA01

Bowenvale Development
Cashmere, Christchurch
20268.001

Client : Geovert
Client Ref. : N/A
Date : 28/10/2022
Hole Depth : 1.7 m
Hole Diameter : 50 mm

Shear Vane No : 1379
Logged By : JJ
Reviewed By :
Latitude : -43.5809968739331
Longitude : 172.64710917179

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
	TOPSOIL	OL	Silty TOPSOIL						
0.5	LOESS	OL	SILT with minor sand; yellowish brown with orange mottles. Low plasticity; moist; Sand, fine [LOESS]				M	L	57/10 51/14 71/19 94/32 54/28
1.0								MD	
1.5			End of Hole Depth: 1.7 m Termination Condition: met practical refusal						

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

Hand Auger met practical refusal at 1.7 m depth on hard material.
met practical refusal
Standing groundwater was not encountered

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 28/10/22

LOG OF AUGER BV-ENG22-HA02

Bowenvale Development
Cashmere, Christchurch
20268.001

Client : Geovert
Client Ref. : N/A
Date : 28/10/2022
Hole Depth : 1.6 m
Hole Diameter : 50 mm

Shear Vane No : 1379
Logged By : JJ
Reviewed By :
Latitude : -43.5808895
Longitude : 172.6473405

Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol	Elevation (mRL)	Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded
0.0	TOPSOIL	OL	Silty TOPSOIL						
0.5	LOESS	OL	SILT with minor sand; yellowish brown with orange mottles. Low plasticity; moist; Sand, fine [LOESS]				M	L	64/18 55/20 72/20 78/42
1.5								MD	94/40
2.0			End of Hole Depth: 1.6 m Termination Condition: met practical refusal						

Scala Penetrometer

Blows per 100mm

2 4 6 8 10 12

Hand Auger met practical refusal at 1.6 m depth on hard material.
met target depth
Standing groundwater was not encountered

GEOTECH HAND AUGER BOWENVALE HA'S.GPJ NZ DATA TEMPLATE 2.GDT 28/10/22

APPENDIX 3:

Combined Hazard Map

Legend

- Rockfall Risk Zone 1 – Unacceptable Risk
- Inferred Earthflow Location
- Mapped Flow path
- Proposed Subdivision Layout Plan

0 25 m 50 m

ENGEO

Produced by **Datanest.earth**

Title: Combined Hazard Map		
Client: Geovert		Figure No: 8 Size: A4
Project: Bowenvale Development	Drawn: JM	
Date: 19-07-2022	Checked: RJ	
Proj No: 20268.001	Scale: 1:2000	Version: 1.0