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25 ASHLEY GORGE, OXFORD.

Natural Hazard Assessment Report for Proposed Subdivision and Plan Change.

Revision: C

Date:
18 October 2023

DOCUMENT CONTROL

Project Reference	23263	
Project Name	25 ASHLEY GORGE, OXFORD.	
Revision	C	
Prepared For	Morgan McIntosh Ltd	
Prepared By		Steven Roberts CPEng (Geotechnical), CMEngNZ, IntPE(NZ)
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Report Distribution:		
Recipient	**Release Date**	**Document Type**
Survus Consultants Ltd	18 October 2023	PDF

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1 Introduction

Tetrad Consulting Ltd was engaged by Survus Consultants Ltd to undertake a geotechnical investigation and natural hazards assessment at 25 Ashley Gorge Rd, Oxford for their client's application regarding:

- Rezoning proposal application for a 49.68-hectare block of rural land from LLRO to LLRZ in accordance with the Waimakariri's Proposed District Plan (PDP) and,
- Amalgamation of Lot 2 and Pt RS 2090 into a single fee-simple title.

The rezoning proposal affects the balance of the subject land, after subdivision of Lot and Pt RS 2090 comprising Pt RS 1626 & RS's 1956 & 2405 on the rural title- RT CB376/258 Ltd.

Discussion with Survus Consultants confirmed the proposed plan change will create about 90 lots at 0.5 - Hectares per lot with additional site area included for infrastructure services such as roading, swales and retention basins for stormwater control.

This report addresses the risk of natural hazards as they relate to the subdivision consent application under Section 106 of the Resource Management Act (RMA), 1991.

The scope of this geotechnical report does not include commentary on site-specific environmental issues, which is beyond the scope of our geotechnical engagement.

2 Reporting Requirements

The scope of this report is governed by a need to address the relevant requirements of the following documents:

- Resource Management Act, 1991; Section 106 – Natural Hazards
- Ministry for the Environment (MfE) Resource Legislation Amendments 2017 – Fact Sheet 10 regarding natural hazards[1]
- Ministry of Business, Innovation and Employment (MBIE),2012: Repairing and Rebuilding Houses Affected by the Canterbury Earthquakes – Part D: Subdivisions.
- Waimakariri District Council: Natural Hazards[2]

3 Site Description

The setting is an expansive area of gently sloping to flat land encompassing about 55.73 hectares (550,730 m^2) of pastoral land. The site boundaries are defined by established public roading to the west, south and east boundary, with the north boundary being a continuation of gently sloping pastoral land.Access to the site is via a sealed road off Ashley Gorge Road which defines the site's east boundary.

Until recently the site was used for grazing of dairy cows. The site has minor improvements comprising a cluster of utility sheds and a domestic dwelling located towards Ashley Gorge Rd site boundary. The site has been formed into smaller pastoral blocks with wire fencing defining each block. The site is covered by a scattering of well established trees and native shrubs.

Towards the northwest corner a stream enters the site and meanders roughly at a 45 degree angle to the west and north boundary before re-orientating in a general easterly direction towards the Ashley Gorge Rd side, at which point the stream connects to a concrete culvert and exits beneath the road. The west end of the stream is camouflaged by a line of small trees and shrubs as shown in Figure 1 below.

[1] Mfe https://www.mfe.govt.nz/publications/rma/resource-legislation-amendments-2017-fact-sheet-series
[2] https://www.waimakariri.govt.nz/council/plans-policies-reports/district-plan

The east side of the site is generally flat with the observed ground level below Ashley Gorge Rd level and consequently this area appeared saturated with visible signs of surface water ponding.

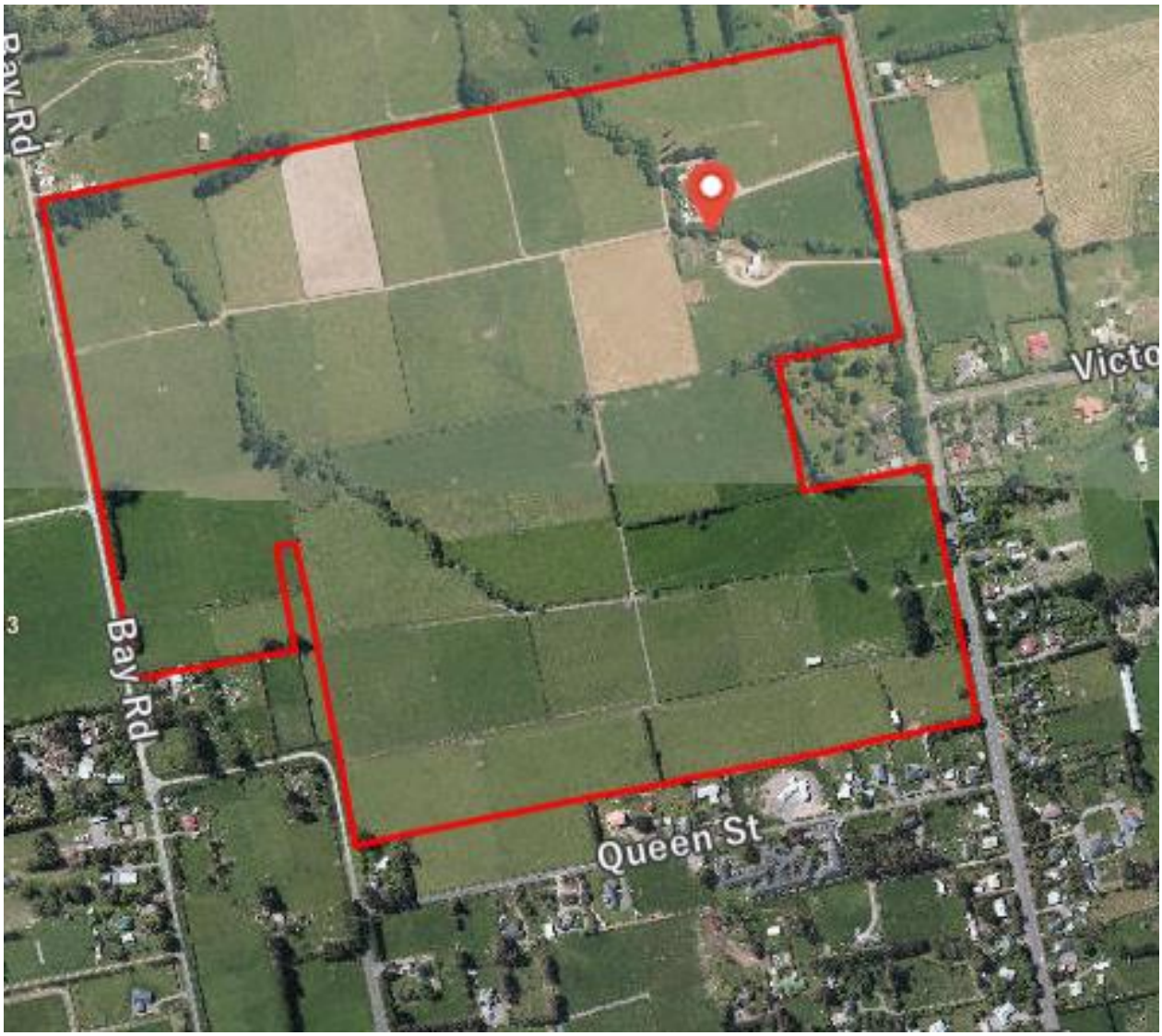

Figure 1: Approximate site boundaries.

4 Proposed Plan Change and Subdivision.

Figure 2 below shows the proposed plan change proposal to the balance of the subject property (legal title PT RS 1626 & RS's 1956 & 2405), whilst Figure 3 below shows the proposed subdivision by amalgamation of Lot 2 and Pt RS 20290 (RT CB15/223). The subdivision scheme plan prepared by Survus Consultants Ltd is also presented in Appendix A.

Figure 2: Approximate lot boundaries and proposed building platform.

Figure 3: Approximate boundaries of proposed subdivision(amalgamation) of Lot 2 and Pt RS 2090.

5 Geology

Published geology[3] indicates the site comprises late Pleistocene to Holocene alluvial fan deposits underlain by Late Pleistocene river deposits over Charteris Bay Sandstone of the Eyre Group. The alluvial fan thickness

[3] GNS Science – New Zealand Geology Web Map, September 2023

varies due to accumulation of colluvium material from erosion of the lower hillside slopes and accumulation of alluvial outwash from the flood plains.

6 Aerial Photograph Review

We have reviewed available historical aerial photographs from the 1940's and 1980's on the Retro Lens websites. Apart from the earthquake fault scarp located to the north of the site near Starvation Hill, there was no further evidence of remnant geotechnical hazards specific to the site.

7 Ground Investigation

7.1 Geotechnical Investigation

Shallow geotechnical testing was undertaken on 1st September 2023 and comprised nine shallow test pile holes excavated with a 14-tonne digger. The test pit holes were excavated to a target depth of 3.0 m to confirm the subsurface soil profile.

Practical refusal of the Scala test was encountered at 0.4 – 1.7 m bgl in suspected gravel material with resistance values exceeding 15 blows/100 mm.

The test pit and Scala penetrometer test locations and results are shown in Appendix B and summarized in Table 1 below.

Table 1: Summary of hand auger and Scala penetrometer investigation

Test type	Depth of test (m)	Comments
TP1	2.9 m	Target depth almost achieved
TP2	2.5 m	Shallow refusal in dense gravel
TP3/SP3	2.5 m (TP), 1.7 m (SP)	Shallow refusal in dense gravel
TP4/SP4	2.9 m (TP), 1.5 m (SP)	Target depth almost achieved
TP5/SP5	3.0 m (TP), 1.0 m (SP)	Target depth achieved
TP6/SP6	3.0 m (TP), 1.9 m (SP)	Target depth achieved
TP7	3.0 m	Target depth achieved
TP8	3.0 m	Target depth achieved
TP9/SP9	3.0 m (TP), 1.5 m (SP)	Target depth achieved

7.2 Subsurface Conditions

The machine dug test pit holes returned the following simplified soil profile:

Table 2: Summary of Test Pit Soil Profiles

Test Pit Location	Top of Soil Unit (m bgl)	Description	Density
TP1 – TP4	0.0	Organic SILT	Soft
	0.3	SILT	Soft to Firm
	0.4 – 2.2	GRAVEL	Dense
TP5 – TP6	0.0	Organic SILT	Soft
	0.3	SILT	Firm
	0.8	SAND	Medium Dense

	2.6	SILT	Firm to Stiff
TP7 – TP9	0.0	Organic SILT	Soft
	0.3	Sandy SILT	Firm
	0.5	Silty SAND	Medium Dense
	2.0 – 2.8	Clayey SILT	Firm

Scala penetrometer results SP03 - SP06 & SP09 returned Scala blow counts ranging from 2 - 5 blows/100 mm penetration to 0.8 m depth, thereafter, transitioning to higher resistance values (6 to 15 blows/100mm) in medium dense sands and firm silts.

8 Natural Hazards Assessment

8.1 Introduction

Council can refuse subdivision consent if there is a significant risk due to natural hazards. To determine whether there is a significant risk due to natural hazards, decision-makers are guided by the matters set out in the RMA Section 106 (1A). A suitability assessment of the site for subdivision has been carried out in accordance with Section 106 of the Resource Management Act (RMA).

Section 106 the RMA states *inter alia*

1. …" a consent authority may refuse subdivision consent, or may grant subdivision consent subject to conditions, if it considers that:

(a) *the land in respect of which a consent is sought, or any structure on the land, is or is likely to be subject to material damage by erosion, falling debris, subsidence, slippage, or inundation from any source; or*

(b) *any subsequent use that is likely to be made of the land is likely to accelerate, worsen, or result in material damage to the land, other land, or structure by erosion, falling debris, subsidence, slippage, or inundation from any source*.

(c) *sufficient provision has not been made for legal and physical access to each allotment to be created by the subdivision.*

8.2 Site-specific risk assessment

8.2.1 Overview

The following sections identify natural hazards that require discussion on a 'lot-specific' basis except for seismicity hazard which is the same for each lot. Other hazards have also been considered including drought, fire, geothermal activity, and volcanic activity. These hazards are assessed as unlikely.

8.2.2 Seismicity

The GNS Report (2013) of Active Faults in the Waimakariri District shows active faults to the north, south and east of the subject site as shown in Figures 1 and 2 below. The main active faults are the 'Ashley' Fault to the east and the 'Townshend/Coopers Creek' and 'Glentui' Faults to the north.

Not identified in Figure 1, but shown in Figure 2, is the 'Knowles Top' and 'Ellis' Faults. The Knowles fault is located to the north of the site and the Ellis fault to the east, with the latter fault trace orientated in an east-west direction before diverging in a north-west direction towards the Knowles Top fault Zone.

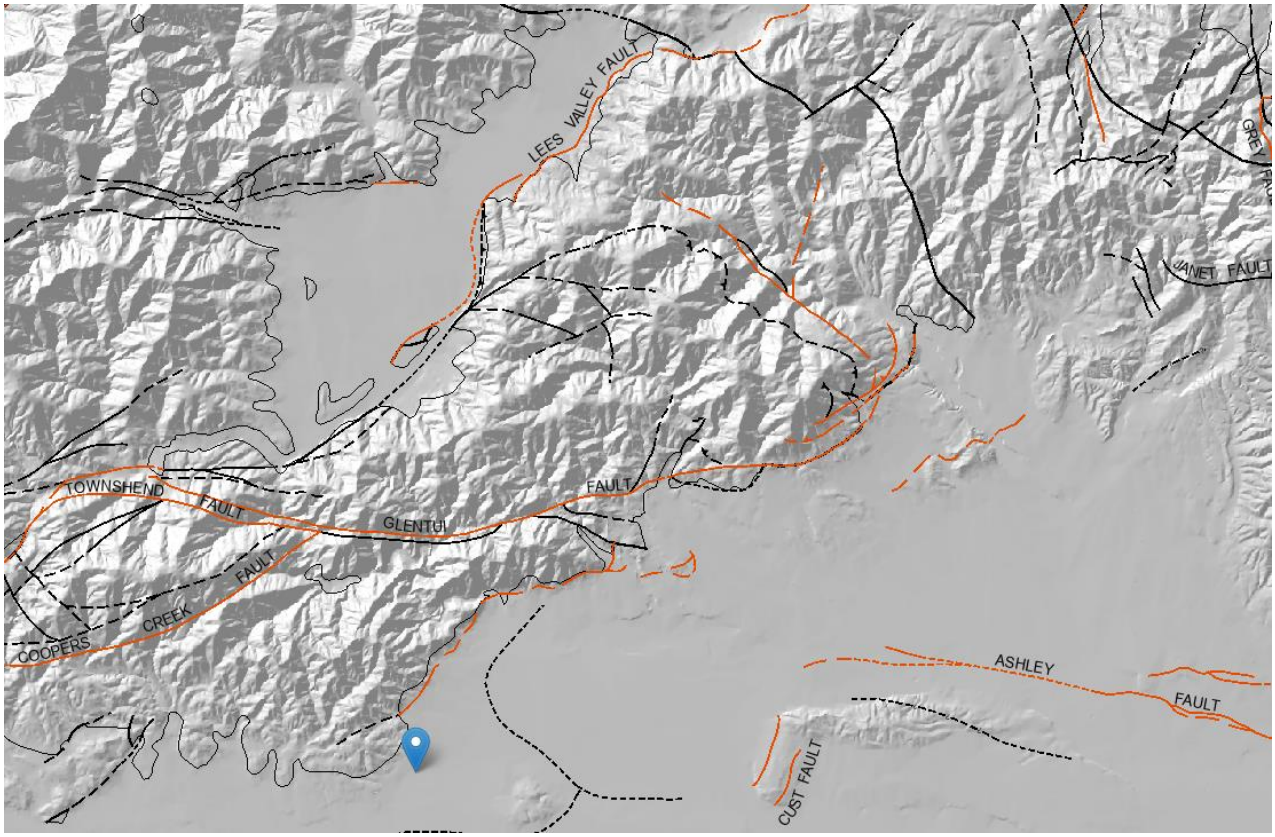

Figure 1: Site Location in relation to known active faults – from GNS (2013) report. The dotted lines represent concealed fault traces covered by sedimentary deposits.

A recent fault, 'Starvation Hill', has been identified from Lidar survey imagery and topography mapping as shown in Figure 2 with this suspected fault passing through the Oxford Township. The fault is considered active, however further geological investigation is required to confirm whether in fact it is an active fault.

Figure 2: Updated active fault information from Canterbury Maps Fault Awareness Areas (2019).

The Ashley Fault Zone is the most active fault in the district, whilst the other active faults in the district appear to have longer recurrence intervals.

The active Faults have estimated recurrence intervals of between 3000 to 12000 years following Kerr *et al* 2003. The recurrence interval of movement is based on vertical movement of 2 m per event and for the faults discussed, translates to between 0.1 to 0.4 mm of vertical slip per year.

Of the active faults discussed, the 'Knowles Top' fault zone is the easiest fault to define, as observed by a fault scarp that runs across the slope of the alluvial fans formed by deposition of material from upslope of the fault as shown in Figure 3.

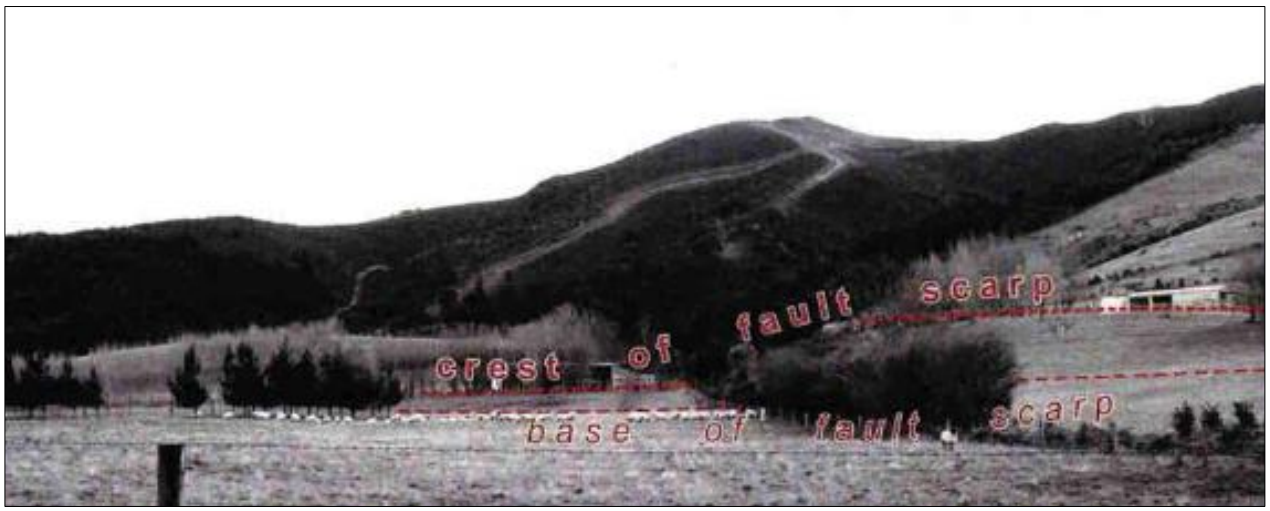

Figure 3: Fault scarp within the Knowles Fault Zone located about 0.5 km from German Road Intersection along Ashley Gorge Road (north of the subject property). Photo reproduced from GNS (2013) report.

The distinct 'step' in ground elevation just beyond the north boundary of the site cannot have been formed by stream action, and therefore can be classed as a definite fault. The Knowles Fault scarp varies in height from 2 – 3m to the west side of the northern boundary, and 8 – 10 m high towards the on the oldest alluvial fan terrace.

8.2.3 Risk Assessment for Buildings

The Active Fault guidelines (Kerr et al. 2003) provide a framework and methodology to assist in avoiding or mitigating the risks associated with development of land on or close to active faults. Risk assessment is based on fault recurrence interval, fault complexity and Building Importance Category (BIC).

The active faults discussed in the preceding section have fault recurrence interval (RI) classes ranging from RI of I to VI and translate to RI Class of ≤2000 years and between > 5000 to ≤ 10000 years, respectively.

The current proposal is for a plan change to 49.68-hectares of land from LLRO to LLRZ residential and subdivision (amalgamation) of Lot 2 and Pt RS 20290 (RT CB15/223 on which residential dwellings can be built.

The building importance category for normal occupancy dwellings is IL2. The Active Fault guidelines further subdivide the normal IL2 category into 2a and 2b as shown in Table 2.

For 'Greenfield sites, which applies to the proposed plan change of the site, the Building importance category shall be limited to 'BIC1' for RI Class 'I' and BIC 1,2a, 2b and 3 for RI Class 'I-V'. Table 3 below describes the various Importance categories and building type/s suitable for the green field site.

Table 3: Building Importance Category (from Active Fault Guidelines)

Importance Category	Description	Examples
1	Utility structures of low risk to life	Structures with a total floor area of less than 30m^2. Farm buildings, isolated structures, and in-ground swimming pools.
2a	Residential timber framed construction	Timber framed single-storey dwellings
2b	Normal structures and structures not in other categories	Timber framed houses of plan area >300m^2. Houses outside the scope of NZS 3604 "Timber Framed Buildings"

For a Recurrence Interval range of I-IV, and Importance Category 2a and level C – Uncertain deformation – fault complexity, Table 11.1 of Kerr et al recommends a ***Discretionary Activity*** consent status (Figure 4) below.

An Importance Category 2b building is a non-complying activity for Recurrence Interval Class I. This applies to sites within a fault awareness zone, which is set out below to allow for the uncertainty in fault location and extent of ground deformation in a future earthquake.

Table 11.1: Resource consent activity status for greenfield sites

Building importance category	1	2a	2b	3	4
Fault complexity	**Activity status**				
Fault recurrence interval class I less than or equal to 2000 years					
A – Well defined	Permitted	*Non-complying*	*Non-complying*	*Non-complying*	Prohibited
B – Distributed	Permitted	*Discretionary*	*Non-complying*	*Non-complying*	Non-complying
C – Uncertain[†]	Permitted	*Discretionary*	*Non-complying*	*Non-complying*	Non-complying
Fault recurrence interval class II greater than 2000 but less than or equal to 3500 years					
A – Well defined	Permitted	*Non-complying*	*Non-complying*	*Non-complying*	Prohibited
B – Distributed	Permitted	*Discretionary*	*Non-complying*	*Non-complying*	Non-complying
C – Uncertain[†]	Permitted	*Discretionary*	*Non-complying*	*Non-complying*	Non-complying
Fault recurrence interval class III greater than 3500 to but less than or equal to 5000 years					
A – Well defined	Permitted	Permitted*	*Non-complying*	*Non-complying*	Non-complying
B – Distributed	Permitted	Permitted	*Discretionary*	*Discretionary*	Non-complying
C – Uncertain[†]	Permitted	Permitted	*Discretionary*	*Discretionary*	Non-complying
Fault recurrence interval class IV greater than 5000 but less than or equal to 10,000 years					
A – Well defined	Permitted	Permitted*	Permitted*	*Non-complying*	Non-complying
B – Distributed	Permitted	Permitted	Permitted	*Discretionary*	Non-complying
C – Uncertain[†]	Permitted	Permitted	Permitted	*Discretionary*	Non-complying

Figure 4: Extract from Active Fault Guidelines.

Based on location of the active faults discussed above, fault awareness zones have not been imposed on the subject property and therefore, the location of future dwellings on the green field site is not restricted

by such fault zones. The same can be said for the proposed subdivision (amalgamation) of Lot 2 and Pt RS 2090.

8.2.4 Land Category Classification

The known active faults discussed above have no return period assigned to them for the purpose of calculating seismic loading to NZS 1170.5 for design of future improvements on the subject land.

The relatively deep Late Pleistocene river deposits overlying sandstone beneath the site suggest a low risk of liquefaction-induced free-field settlement. However, with due consideration given to increased ground shaking potential from 'near fault' affects a TC2 rating in accordance with MBIE guidelines is recommended for the purpose of specific foundation design.

8.2.5 Seismic Category

The relatively thin layer of alluvial fan deposits overlying the site and the basement sedimentary rock beneath this site defines the site as Class C, 'shallow soil sites', in terms of the seismic design requirements of NZS 1170.5.

8.3 Flood Inundation

The site's elevated topography towards the west and north boundaries mitigates flood risk over the site; however, the micro topography of the site towards the south-east corner of the greenfield site and near Lot 2 & PT RS 2020, where the existing ground level appears to be lower than Queen Street and Ashley Gorge Rd, inundation from surface water runoff and overland flow path is a hazard on the site as observed during our site walkover inspection and confirmed in Figure 5. Flood hazard modelling would be required to confirm the extent and depth of surface flooding for a 1 in 50 year and 1 in 200-year flood event.

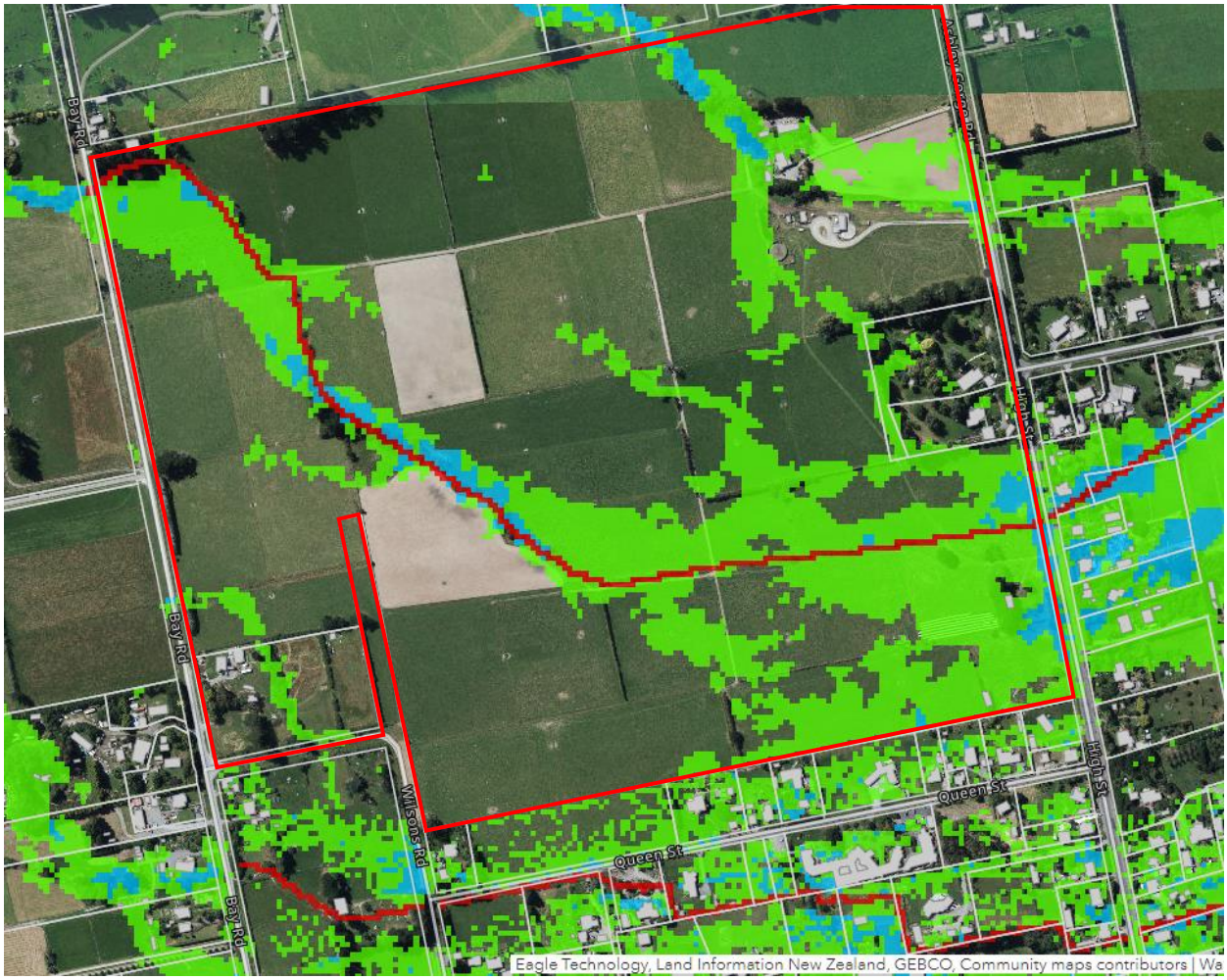

Figure 4: Surface Flooding (green areas) sourced from Waimakariri Natural Hazards Website.

Surface water ponding within the affected areas can be controlled by locally raising the ground level to redirect surface water runoff to established drainage ditches observed on site at the time of site walkover inspection. Alternatively, future development of the affected area can be achieved by imposing raised floor levels and foundation systems that do not restrict surface water runoff during periods of sustained rainfall.

8.4 Rockfall Hazard

The site is located about 0.8 km from the lower terraced slopes of Mt Oxford, as such, the risk of rockfall from any loose rock debris sourced from the upper slopes of Mt Oxford onto the subject site is negligible.

8.5 Slope Instability and Slippage Hazard

A walkover inspection confirmed the site to be flat with very low risk of slope instability and/or surficial soil slippage hazard.

8.6 Erosion and Sedimentation Hazard

Our walkover inspection confirmed no major erosion apart from localised areas of dirt tracks where exposed soils showed signs of minor dispersion from uncontrolled surface water runoff. The stream and drainage ditch channel edges appeared stable with no signs of scour.

Erosion and Sedimentation hazard would not prevent a rezoning change to the site or proposed subdivision of Lot 2 & Pt RS 2090; however, post development, we recommend imposing a 10 m set back from all ditch

channels and stream boundaries to mitigate increased surface erosion of sedimentation hazard from uncontrolled activities. The recommended 10 m setback is expected to mitigate any hazard from surficial lateral spread damage within the overlying finer sediments gravel as well as mitigating risk of slope instability to the watercourse edges from future residential development.

8.7 Volcanic Hazard

Volcanic hazard is negligible at this site and would not prevent a rezoning change to the site or to the proposed subdivision of Lot 2 & Pt RS 2090.

8.8 Tsunami Hazard

Tsunami hazard is negligible at this site and would not prevent a rezoning change to the site or to the proposed subdivision of Lot 2 & Pt RS 2090.

8.9 Meteorological Hazard

No higher risk than other location in the Waimakariri District. Therefore, would not prevent a rezoning change to the site or to the proposed subdivision of Lot 2 & Pt RS 2090.

9 Foundation Considerations for Subdivision of Lot 2 & Pt RS 2090.

Development of the amalgamated lot is not affected by a fault awareness zone, accordingly, there is no restriction on location of a dwelling except in accordance with current district plan rules for minimum building setback from common boundaries.

On the limited testing carried out, it can be assumed that the soils are consistent with the definition of “good ground” as defined in NZS3604:2011. Soil testing will be needed at building consent stage at the selected house location and for the design footprint to confirm this assumption.

Specific design of foundation is recommended for the dwelling and in accordance with MBIE guidelines. If local surface flooding is predicted at this site (Figure 5 above), then a raised timber floor on a timber subfloor structure would be the preferred foundation option for either a Category 2A or 2B house. The interim flood floor level should be discussed with the Waimakariri District Council and assessed for a 1 in 200-year flood to district plan rules, allowing for a 400 mm freeboard.

10 Conclusions

10.1 Subdivision of Lot 2 & PT RS 2090 (RT CB15/223)

Based on the above discussion, we conclude there is no risk from falling debris, slippage, erosion, subsidence, or inundation.

Any proposed development will have to comply with relevant legislation, Codes, and Standards. For example, fills would have to be constructed at safe slopes and additional cuts would have to be excavated to provide stable slopes.

Appropriate care should be taken to ensure the building is located on the flattest and highest ground area to avoid surface water runoff beneath the raised foundation.

Erosion by precipitation or inadequately discharged stormwater runoff should be controlled through best construction practice. Provided these best practice methodologies are implemented during construction it is our opinion that development of the site will not result in the acceleration or worsening of these hazards.

Section 106 1(c) is not relevant to a geotechnical appraisal and therefore has not been considered in this report.

A 'Statement of Professional Opinion on the Suitability of Land for Subdivision' is provided in Appendix D.

10.2 Rezoning (Plan Change) to 25 Ashley Gorge RD

Based on the above discussion, we conclude there is no risk of falling debris, slippage, erosion, subsidence, and minor risk of flood inundation. The site is located within proximity to several active faults which have reasonably long Recurrence Intervals (RI) estimated at between 3000 to 12000 years. The active faults are not identified as major faults to NZS1170.5 and as such, have not been defined by magnitude or peak ground acceleration. The implied range of RI Classes (Kerr et al 2003) is between I to IV and as such the average individual recurrence interval can be assumed at 5000 years. However, with some 15 active fault/fold systems so far identified in the region, we would expect one of them to rupture in any – 300 – year period.

It is also important to note that there may be other, as-yet unrecognized active faults in the region which would serve to reduce the average rupture period to less than 300 years. Of the active faults discussed in this report, there is increased suspicion that a series of topographic steps extending near Starvation Hill through Oxford township is the product of surface ruptures on an active fault, identified as Starvation Hill fault.

The recurrence interval is not yet defined by investigation and considering the location of the site with respect to Oxford township and Starvation Hill, it would be advantageous for a specialist geological investigation to be undertaken to establish whether the Starvation Hill fault is an active fault. If it proves to be an active fault, more detailed mapping and fault avoidance zonation may be warranted.

11 Limitations

Comments made in this report are based on information on the NZGD, WDC GIS, GNS's Active Faults Database, our inspection of the site, shallow geotechnical testing and the Ministry of Business, Innovation and Employment's (MBIE) December 2012 guidelines.

This report has been prepared for the benefit of Morgan McIntosh Ltd and the Waimakariri District Council. This report is specifically prepared for the proposed plan change and subdivision (amalgamation) of Lot 2 and Pt RS 2090 and should not be used to support any future consent application without prior review and approval in writing.

No liability is accepted by this company or any employee of this company with respect to the use of this report by any other party or for any other purpose other than what is stated in our scope of work.

The geotechnical investigation was confined to geotechnical aspects of the site only and did not involve the assessment for environmental contaminants.

Appendix A

- Proposed Rezoning and Subdivision Plan by Survus Consultants Ltd

NOTES :

1. THIS SURVEY HAS NOT INCLUDED SITE MARKING OF THE BOUNDARY POSITIONS UNLESS OTHERWISE INDICATED.
2. NO UNDERGROUND SERVICE INFORMATION IS SHOWN ON THIS PLAN. THE LOCATION OF ANY SUCH SERVICES SHOULD BE CONFIRMED WITH THE RELEVANT LOCAL AUTHORITY OR UTILITY SERVICE PROVIDER.
3. SCHEME PLAN ONLY, AREAS ARE VERY APPROXIMATE ONLY & SUBJECT TO FINAL SURVEY.

AMALGAMATION CONDITION :

THAT LOT 2 HEREON BE AMALGAMATED WITH PT RS 2090 (RT CB15/223) AND ONE CERTIFICATE OF TITLE BE ISSUED.

SURVUS CONSULTANTS
PLANNING + SURVEYING + ENGINEERING

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F 03 352 5527 ASHBURTON 03 307 7021
TOLL FREE 0508 787 887 DARFIELD 03 318 8151

REV	DATE	REVISION DETAILS	
B	08/08/23	FOR SUBDIVISION CONSENT	SRS
A	10/07/23	FOR SUBDIVISION CONSENT	SRS

DRAFTED: SRS
VERIFIED:
APPROVED:
DATE:

PROJECT: MORGAN McINTOSH LTD - 25 ASHLEY GORGE ROAD

TITLE: PROPOSED SUBDIVISION OF Pt RS 1626 & RS's 1956 & 2405
RT CB376/258 Ltd
SHEET 2 OF 2

INFORMATION ONLY
PROJECT NO 15742
SCALE 1 : 1000 (A3)
SIZE A3
DRAWING NO SC-01
REV B

NOTES :

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DRAFTED: SRS
VERIFIED:
APPROVED:
DATE:

PROJECT: MORGAN McINTOSH LTD - 25 ASHLEY GORGE ROAD

TITLE: PROPOSED SUBDIVISION OF Pt RS 1626 & RS's 1956 & 2405
RT CB376/258 Ltd
SHEET 2 OF 2

INFORMATION ONLY
PROJECT NO 15742
SCALE 1 : 1000 (A3)
SIZE A3
DRAWING NO SC-01
REV B

Appendix B

- Site Investigation Plan
- Scala penetrometer and Test Pit Profiles

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LEGEND

TP9/SP9 TEST PIT & SCALA PENETROMETER

NOTES

1. LOCATIONS OF FEATURES AND GROUND INVESTIGATION POINTS ARE APPROXIMATE ONLY.
2. AERIAL IMAGE & SITE BOUNDARY SOURCED FROM LINZ https://data.linz.govt.nz/ (accessed 12-Sep-2023)
3. CONTOURS SOURCED FROM CANTERBURY MAPS https://canterburymaps.govt.nz/ (accessed 12-Sep-2023)
4. PROPOSED LAYOUT SOURCED FROM DEVELOPMENT PLAN BY SURVUS CONSULTANTS, TITLED: *PROPOSED SUBDIVISION OF PT RS 1626 7 RS's 1956 & 2405 Rt CB376/258 Ltd, PROJECT No. 15742,DRAWING No. SC_01 Rev B, DATED 08.08.23*

PROJECT	PLAN CHANGE AND SUBDIVISION
ADDRESS	25 ASHLEY ROAD GORGE - OXFORD
CLIENT	MORGAN McINTOSH LTD
TITLE	Test Location Plan
JOB NO.	23263

Drawing not to scale - Do not scale of drawing

DRAWING NO. G1.0

REV. 1

Tetrad.

Test Number	TP1

Project No:	23263	**Drill Type:**	50 mm dia hand auger/ Scala penetrometer
Client:	Survus Consultants Ltd	**Drilled By:**	Callum
Site Address:	25 Ashley Gorge Road	**Drilling Date:**	1/09/2023
City:	Christchurch	**Log Date:**	6/09/2023

Stratigraphy	Depth (m)	Graphic Log	Soil Description	USCS	Groundwater depth(m	Dynamic Cone (Scala) Penetrometer		
						Depth (m)	Blow Count	Blow Count/100 mm
			SILT; dark brown (TOPSOIL), soft, damp.				1	
							1	
							1	
			SILT, grey with orange mottling; firm; dry; minor plasticity.				2	
	0.5					0.5	2	
							3	
							3	
							5	
							7	
	1.0					1.0	5	
							10	
							10	
							8	
							8	
	1.5					1.5	11	
	2.0					2.0		
	2.5		**GRAVEL** with some sand, coarse sand.			2.5		
	3.0		EOH at 2.9 m in dense gravel			3.0		
	3.5					3.5		
	4.0					4.0		

Note: Scala Penetrometer and hand auger log tests give an indication of the ground condition at the test location only.While they are representative of typical conditions across the site, they do not indentify variations in the ground away from the test location.

Tetrad Consulting Ltd: 71 Peterborough Street,Christchurch Central City, 8013 Phone:(03) 365 0726 Email: info@tetrad.co.nz

Tetrad.	Test Number	TP2

Project No:	23263	**Drill Type:**	50 mm dia hand auger/ Scala penetrometer
Client:	Survus Consultants Ltd	**Drilled By:**	Callum
Site Address:	25 Ashley Gorge Road	**Drilling Date:**	1/09/2023
City:	Christchurch	**Log Date:**	6/09/2023

Stratigraphy	Depth (m)	Graphic Log	Soil Description	USCS	Groundwater depth(m	Dynamic Cone (Scala) Penetrometer: Depth (m)	Blow Count	Blow Count/100 mm (0 5 10 15 20 25)
			SILT; dark brown (TOPSOIL), soft, damp.					
	0.5		**SILT,** grey with orange mottling; soft to firm; dry; minor plasticity.			0.5		
	1.0					1.0		
	1.5		**GRAVEL** with some sand/silt, coarse sand.			1.5		
	2.0				WT ▼	2.0		
	2.5		Blue gravel			2.5		
			EOH at 2.5 m in dense gravel					
	3.0					3.0		
	3.5					3.5		
	4.0					4.0		

Note: Scala Penetrometer and hand auger log tests give an indication of the ground condition at the test location only.While they are representative of typical conditions across the site, they do not indentify variations in the ground away from the test location.

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Tetrad.

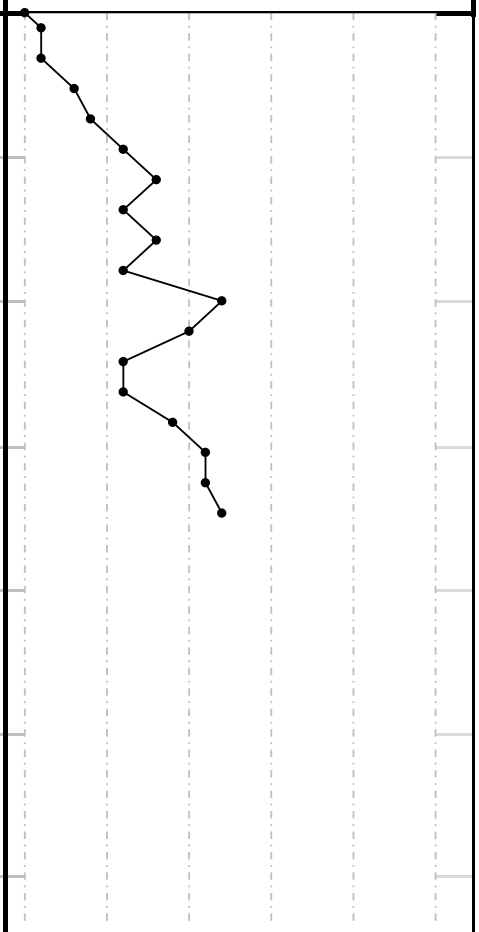
Test Number	TP3/SP3

Project No:	23263	**Drill Type:**	50 mm dia hand auger/ Scala penetrometer
Client:	Survus Consultants Ltd	**Drilled By:**	Callum
Site Address:	25 Ashley Gorge Road	**Drilling Date:**	1/09/2023
City:	Christchurch	**Log Date:**	6/09/2023

Stratigraphy	Depth (m)	Graphic Log	Soil Description	USCS	Groundwater depth(m
	0.0		**SILT**; dark brown (TOPSOIL), soft, damp.		
	0.5		**GRAVEL** with some sand, coarse sand.		
	1.0				
	1.5				
	2.0				
	2.5		Becomes wet		
	3.0		EOH at 2.5 m in dense gravel		
	3.5				
	4.0				

Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count
0.0	1
	1
	3
	4
0.5	6
	8
	6
	8
	6
1.0	12
	10
	6
	6
	9
1.5	11
	11
	12
2.0	
2.5	
3.0	
3.5	
4.0	



Note: Scala Penetrometer and hand auger log tests give an indication of the ground condition at the test location only.While they are representative of typical conditions across the site, they do not indentify variations in the ground away from the test location.

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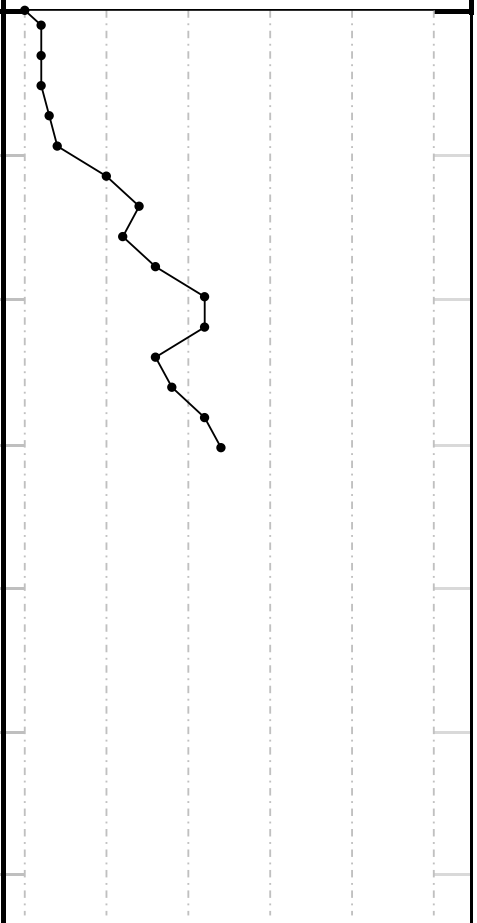
Tetrad.	Test Number	TP4/SP4

Project No:	23263	**Drill Type:**	50 mm dia hand auger/ Scala penetrometer
Client:	Survus Consultants Ltd	**Drilled By:**	Callum
Site Address:	25 Ashley Gorge Road	**Drilling Date:**	1/09/2023
City:	Christchurch	**Log Date:**	6/09/2023

Stratigraphy	Depth (m)	Graphic Log	Soil Description	USCS	Groundwater depth(m	Dynamic Cone (Scala) Penetrometer: Depth (m)	Blow Count
			SILT; dark brown (TOPSOIL), soft, damp.				1
							1
							1
							1.5
	0.5		**SILT,** grey with orange mottling; firm; dry; minor plasticity.			0.5	2
							5
							7
							6
							8
	1.0					1.0	11
							11
							8
							9
					WT ▼		11
	1.5					1.5	12
	2.0					2.0	
			GRAVEL with some sand/silt, coarse sand.				
	2.5					2.5	
	3.0		EOH at 2.9 m in dense gravel			3.0	
	3.5					3.5	
	4.0					4.0	



Note: Scala Penetrometer and hand auger log tests give an indication of the ground condition at the test location only.While they are representative of typical conditions across the site, they do not indentify variations in the ground away from the test location.

Tetrad Consulting Ltd: 71 Peterborough Street,Christchurch Central City, 8013 Phone:(03) 365 0726 Email: info@tetrad.co.nz

Tetrad.

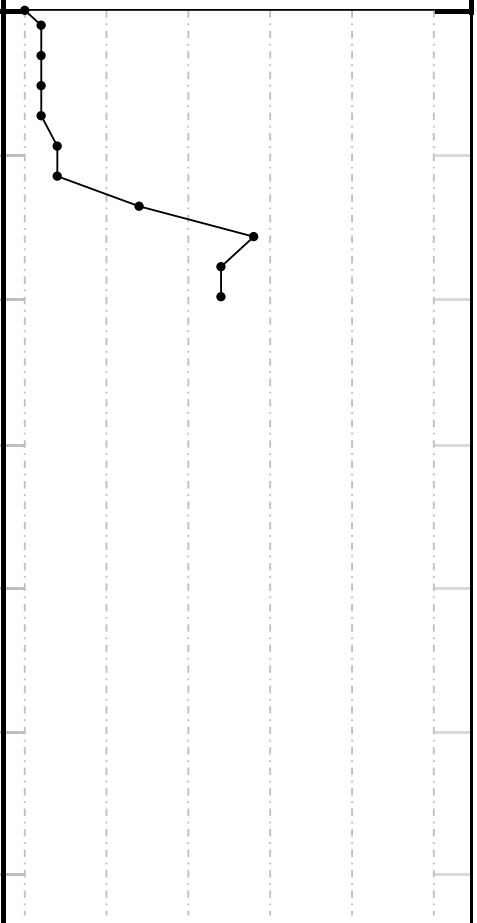
Test Number	TP5/SP5

Project No:	23263	**Drill Type:**	50 mm dia hand auger/ Scala penetrometer
Client:	Survus Consultants Ltd	**Drilled By:**	Callum
Site Address:	25 Ashley Gorge Road	**Drilling Date:**	1/09/2023
City:	Christchurch	**Log Date:**	6/09/2023

Stratigraphy	Depth (m)	Graphic Log	Soil Description	USCS	Groundwater depth(m
	0.0		**SILT**; dark brown (TOPSOIL), soft, damp.		
	0.5		**sandy SILT,** fine sand, grey mottled orange; firm; dry; minor plasticity.		
	1.0		**Silty SAND,** coarse sand, yellowish brown/brown, medium dense dry;		
	1.5				
	2.0				
	2.5		clayey **SILT** ; light brown with mottled staining; very firm; damp; moderate plasticity.		
	3.0		Becomes blue, very plastic EOH at 3.0 m in SILT		
	3.5				
	4.0				

Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count
0.0	1
	1
	1
	1
0.5	2
	2
	7
	14
1.0	12
	12
1.5	
2.0	
2.5	
3.0	
3.5	
4.0	



Note: Scala Penetrometer and hand auger log tests give an indication of the ground condition at the test location only.While they are representative of typical conditions across the site, they do not indentify variations in the ground away from the test location.

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Tetrad.

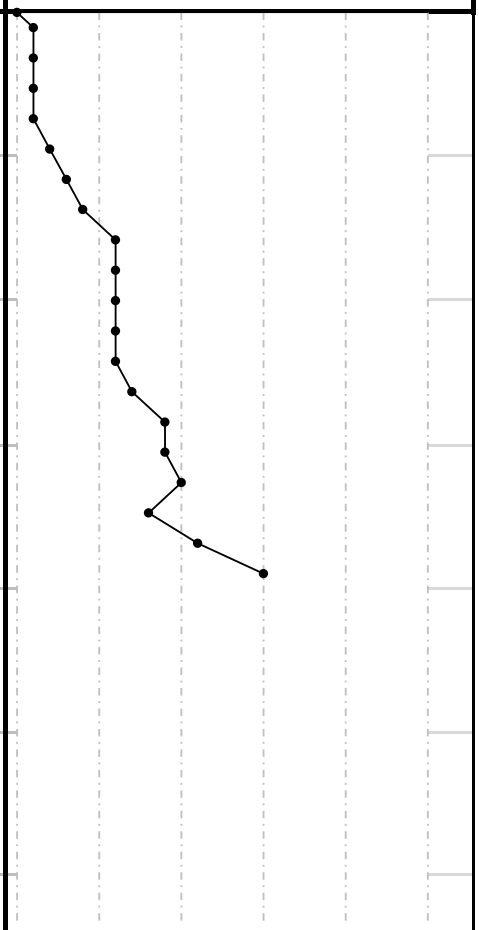
Test Number	TP6/SP6

Project No:	23263	**Drill Type:**	50 mm dia hand auger/ Scala penetrometer
Client:	Survus Consultants Ltd	**Drilled By:**	Callum
Site Address:	25 Ashley Gorge Road	**Drilling Date:**	1/09/2023
City:	Christchurch	**Log Date:**	6/09/2023

Stratigraphy	Depth (m)	Graphic Log	Soil Description	USCS	Groundwater depth(m
	0.0		**SILT**; dark brown (TOPSOIL), soft, damp.		
	0.5		**sandy SILT,** fine sand, grey mottled orange; firm; dry; minor plasticity.		
	1.0		**Silty SAND,** coarse sand, yellowish brown/brown, medium dense dry;		
	1.5				
	2.0				
	2.5				
	3.0		clayey **SILT** ; light brown with mottled staining; very firm; damp; moderate plasticity.		
	3.5		EOH at 3.0 m in SILT		
	4.0				

Dynamic Cone (Scala) Penetrometer

Depth (m)	Blow Count
0.0	1
	1
	1
	1
0.5	2
	3
	4
	6
1.0	6
	6
	6
	7
	9
1.5	9
	10
	8
	11
2.0	15
2.5	
3.0	
3.5	
4.0	



Note: Scala Penetrometer and hand auger log tests give an indication of the ground condition at the test location only.While they are representative of typical conditions across the site, they do not indentify variations in the ground away from the test location.

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Tetrad.				Test Number	TP7
Project No:	23263		**Drill Type:**	50 mm dia hand auger/ Scala penetrometer	
Client:	Survus Consultants Ltd		**Drilled By:**	Callum	
Site Address:	25 Ashley Gorge Road		**Drilling Date:**	1/09/2023	
City:	Christchurch		**Log Date:**	6/09/2023	

Stratigraphy	Depth (m)	Graphic Log	Soil Description	USCS	Groundwater depth(m	Dynamic Cone (Scala) Penetrometer: Depth (m)	Blow Count	Blow Count/100 mm (0 5 10 15 20 25)
			SILT; dark brown (TOPSOIL), soft, damp.					
	0.5		**sandy SILT,** fine sand, grey brown. firm; dry; minor plasticity.			0.5		
	1.0					1.0		
	1.5					1.5		
	2.0					2.0		
	2.5					2.5		
					WT ▼			
	3.0		clayey **SILT** ; blue; firm; damp; very plastic.			3.0		
			EOH at 3.0 m in SILT					
	3.5					3.5		
	4.0					4.0		

Note: Scala Penetrometer and hand auger log tests give an indication of the ground condition at the test location only.While they are representative of typical conditions across the site, they do not indentify variations in the ground away from the test location.

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Tetrad.	Test Number	TP8

Project No:	23263	**Drill Type:**	50 mm dia hand auger/ Scala penetrometer
Client:	Survus Consultants Ltd	**Drilled By:**	Callum
Site Address:	25 Ashley Gorge Road	**Drilling Date:**	1/09/2023
City:	Christchurch	**Log Date:**	6/09/2023

Stratigraphy	Depth (m)	Graphic Log	Soil Description	USCS	Groundwater depth(m	Dynamic Cone (Scala) Penetrometer: Depth (m)	Blow Count	Blow Count/100 mm (0 5 10 15 20 25)
			SILT; dark brown (TOPSOIL), soft, damp.					
	0.5		**sandy SILT,** fine sand, grey brown. firm; dry; minor plasticity.			0.5		
	1.0					1.0		
	1.5					1.5		
	2.0					2.0		
	2.5					2.5		
					WT ▼			
	3.0		clayey **SILT** ; blue; firm; damp; very plastic.			3.0		
			EOH at 3.0 m in SILT					
	3.5					3.5		
	4.0					4.0		

Note: Scala Penetrometer and hand auger log tests give an indication of the ground condition at the test location only.While they are representative of typical conditions across the site, they do not indentify variations in the ground away from the test location.

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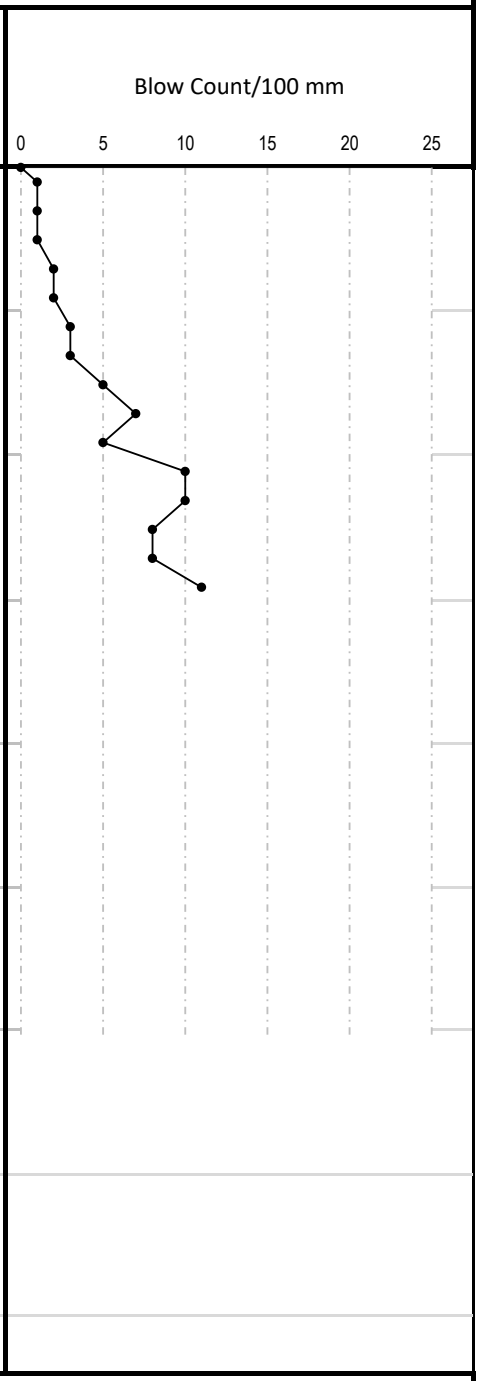
Tetrad.

Test Number	TP9/SP9

Project No:	23263	**Drill Type:**	50 mm dia hand auger/ Scala penetrometer
Client:	Survus Consultants Ltd	**Drilled By:**	Callum
Site Address:	25 Ashley Gorge Road	**Drilling Date:**	1/09/2023
City:	Christchurch	**Log Date:**	6/09/2023

Stratigraphy	Depth (m)	Graphic Log	Soil Description	USCS	Groundwater depth(m
	0.0		**SILT**; dark brown (TOPSOIL), soft, damp.		
	0.5		**sandy SILT,** fine sand, grey, firm; dry; minor plasticity		
	1.0		**Silty SAND,** coarse sand, yellowish brown/brown, medium dense dry;		
	1.5		**Sandy GRAVEL**, coarse sand.		
	2.0		**sandy SILT,** fine sand, grey mottled orange, firm; dry;		
	2.5		clayey **SILT** ; blue; firm; damp; very plastic.		
	3.0		EOH at 3.0 m in SILT		WT ▼
	3.5				
	4.0				

Dynamic Cone (Scala) Penetrometer



Note: Scala Penetrometer and hand auger log tests give an indication of the ground condition at the test location only.While they are representative of typical conditions across the site, they do not indentify variations in the ground away from the test location.

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Appendix C

- Statement of professional opinion

Statement of Professional Opinion on the Suitability of Land for Subdivision

(Appendix I to the Infrastructure Design Standard)

Issued by: **Tetrad Consulting Ltd**.....
(Geotechnical engineering firm or suitably qualified engineer)

To: **Morgan McIntosh Ltd**.....
(Owner/~~Developer)~~

To be supplied to: **Waimakariri District Council**.....
(Territorial authority)

In respect of: **Land Use Plan Change and Subdivision** .....
(Description of proposed ~~infrastructure~~/land development)

At: **25 Ashley Gorge, Oxford**……
(Address)

I **Steven Roberts**..... on behalf of: **Tetrad Consulting Ltd.**.....
(Geotechnical engineer) *(Geotechnical engineering firm)*

hereby confirm:

1. I am a suitably qualified and experienced geotechnical engineer and was retained by the owner/~~developer~~ as the geotechnical engineer on the above proposed development.

2. Tetrad's geotechnical assessment report dated: **18th October 2023**.... has been carried out in accordance with the Ministry of Business, Innovation and Employment's *Guidelines for geotechnical investigation and assessment of subdivisions* and includes:

   (i) A liquefaction assessment.
   (ii) An assessment of rockfall and slippage, including hazards resulting from seismic activity.
   (iii) An assessment of the slope stability and ground bearing capacity
   (iv) Recommendations proposing measures to avoid, remedy or mitigate any potential hazards on the land subject to the application, in accordance with the provisions of Section 106 of the Resource Management Act 1991.

3. In my professional opinion, I consider that Council is justified in granting consent incorporating the following conditions:

   Further assessment of Starvation Hill as a potential active fault for fault avoidance zonation.
   .....
   Foundations to be designed in accordance with Technical Category 2 Rating to MBIE guidelines for single or two storey dwelling.
   .....

   .....

   .....

4. This professional opinion is furnished to the territorial authority and the owner/developer for their purposes alone, on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any building.

5. This certificate shall be read in conjunction with my/the geotechnical report referred to in Clause 2 above and shall not be copied or reproduced except in conjunction with the full geotechnical completion report.

6. The geotechnical engineering firm issuing this statement holds a current policy of professional indemnity

   insurance of no less than $200,000
   (Minimum amount of insurance shall be commensurate with the current amounts recommended by EngNZ, ACENZ, TNZ, INGENIUM.)

..... Date: 3rd October 2023.....
(Signature of Engineer)

Qualifications and experience:

CPEng (Geotechnical), CMEngNZ, Int PE(NZ).....

.....

.....