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WEST RANGIORA.

Natural Hazard Assessment Report for Rezoning Submission.

Dalkeith Holdings

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TABLE OF CONTENTS

1.0 Introduction **1**

2.0 Reporting Requirements **1**

3.0 Site Description **1**

4.0 Proposed Submission **1**

5.0 Geology **2**

6.0 Aerial Photograph Review **2**

7.0 Ground Investigation **2**

7.1 GEOTECHNICAL INVESTIGATION 2
7.2 SUBSURFACE CONDITIONS 3

8.0 Natural Hazards Assessment **3**

8.1 INTRODUCTION 3
8.2 SITE-SPECIFIC RISK ASSESSMENT 3
8.3 FLOOD INUNDATION 5
8.4 ROCKFALL HAZARD 6
8.5 SLOPE INSTABILITY AND SLIPPAGE HAZARD 6
8.6 EROSION AND SEDIMENTATION HAZARD 6
8.7 LIQUEFACTION HAZARD 6
8.8 VOLCANIC HAZARD 6
8.9 TSUNAMI HAZARD 7
8.10 METEOROLOGICAL HAZARD 7

9.0 Foundation Considerations **7**

10.0 Conclusions **7**

11.0 Limitations **7**

Appendix A **8**

Appendix B **9**

1.0 Introduction

Tetrad Consulting Ltd was engaged by Dalkeith Holdings Ltd to undertake a geotechnical investigation and natural hazards assessment near west Rangiora for:

- Submission to rezone a 19.81-hectare block of rural land to medium density residential (MRZ) in accordance with the Waimakariri Proposed District Plan (PDP).

Discussion with Aston Consultants Ltd confirmed the proposed submission affects three individual sites. The affected Lots are Pt RS 48562, Pt RS 903 & Lot 1 DP 61800, ranging in area from 4.85 to 8.89 Hectares for a total combined site area of 19.81-hectares.

The MRZ zone plan change permits the site to be subdivided into a minimum of 15 households per hectare, including additional site area for infrastructure services such as roading, swales and retention basins for stormwater control.

We understand from Aston Consultants Ltd that the proposed density of housing per hectare would be comparable to the minimum MRZ density under the PDP.

This report addresses the risk of natural hazards as they relate to the rezoning submission 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.

2.0 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.
- Waimakakiri District Council /Proposed District Plan: Chapter NH - Natural Hazards

3.0 Site Description

The setting is a flat parcel of land comprising 19.81 hectares. The combined site boundaries are defined by Johns Rd to the south, Lehmans Rd to the west, Oxford Rd to the north and developed residential areas beyond the east boundary.

4.0 Proposed Submission

Figure 1 below shows the extent of the land proposed for rezoning by submission 242 covered by Pt RS 48562, Pt RS 903 & Lot 1 DP 61800.

[1] Mfe https://www.mfe.govt.nz/publications/rma/resource-legislation-amendments-2017-fact-sheet-series

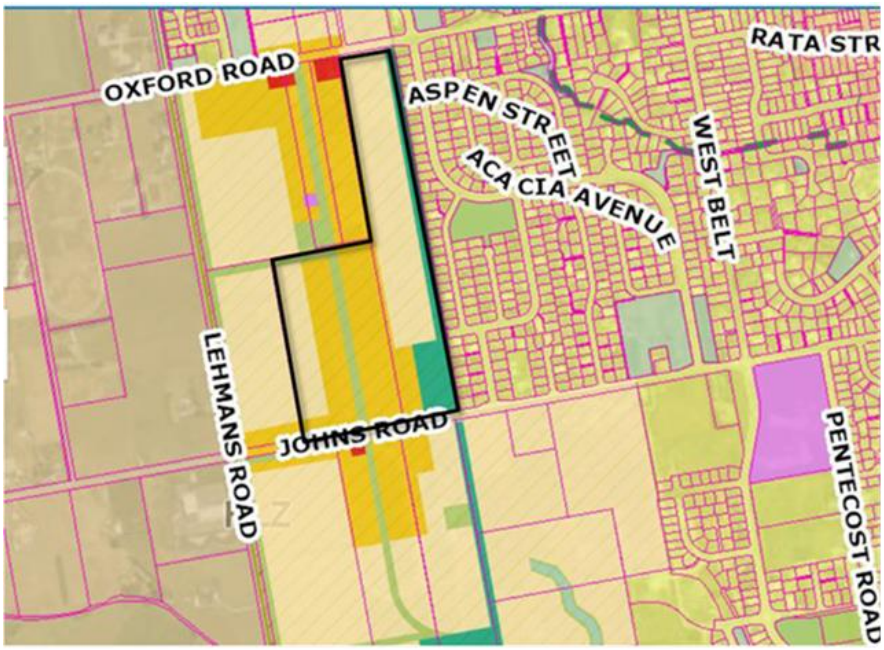

Figure 1: Approximate site boundaries of affected Lots for rezoning change to MRZ.

5.0 Geology

Published geology[2] indicates the site comprises late Pleistocene river deposits comprising gravels, sand and silt capped by a thin veneer of loess. The alluvial fan thickness varies due to the underlying topography and accumulation of alluvial outwash from the flood plains.

6.0 Aerial Photograph Review

We have reviewed available historical aerial photographs from the 1940's and 1980's on the Retro Lens websites. The aerial imagery returned no obvious evidence of remnant geotechnical hazards specific to the site.

7.0 Ground Investigation

7.1 Geotechnical Investigation

Shallow geotechnical testing was undertaken on 23rd February 2024 and comprised five shallow test pile holes excavated with a 14-tonne digger. The test pit holes were excavated to practical refusal in shallow dense gravels.

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/SP1	2.9 m, 2.2 m (SP)	Refusal in dense gravel
TP2/SP2	2.6 m, 2.0 m (SP)	Refusal in dense gravel

[2] GNS Science – New Zealand Geology Web Map, February 2023

TP3/SP3	2.5 m, 1.4 m (SP)	Refusal in dense gravel
TP4/SP4	2.9 m, 2.1 m (SP)	Refusal in dense gravel
TP5/SP5	2.9 m, 2.0 m (SP)	Refusal in dense gravel

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 – TP5	0.0	Organic SILT	Firm
	0.2 – 0.3	Sandy SILT	Firm
	1.4 – 2.3	Sandy GRAVEL	Very dense

Scala penetrometer results returned blow counts ranging from 1 - 5 blows/100 mm penetration to 1.2 m depth, thereafter, transitioning to higher resistance values (6 - 12^{+} blows/100mm) in stiff silt and dense sandy gravel.

8.0 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 rezoning and 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 (2023) website image in Figure 2 shows the closest active fault- the Ashley Fault- located about 4 km due north of the site. The Ashley Fault Zone is the most active fault in the Waimakariri District. The fault has an expected recurrence interval (RI) of about 5,140 years corresponding to RI Class IV, based on average recurrence interval assessment techniques and work carried out by Dawson et al (2008), and Nicol et al (2012) on average recurrence intervals.

Figure 2: Site Location in relation to known active faults – from GNS (2023) geology web map. The dotted line represents part of the concealed Cust fault trace.

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 Ashley fault has an inferred fault recurrence interval (RI) Class IV assessment, translating to an average fault recurrence interval of surface rupture between 5,000 – 10,000 years.

The current proposal is for rezoning of the three sites from RLZ to MRZ 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 3.

For the proposed medium density residential use of the site, the Building importance category shall be limited to 'BIC' 1,2a, 2b and 3 for RI Class 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 Class - IV, Importance Category 2b and Level A– *Well defined* deformation – fault complexity, Table 11.1 of Kerr et al recommends a ***permitted Activity*** consent status (Figure 4) below.

Importance Category buildings 1 – 3 are permitted activities for Recurrence Interval Class IV. 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
Fault recurrence interval class V greater than 10,000 but less than or equal to 20,000 years					
A – Well defined	Permitted	Permitted*	Permitted*	Permitted*	Non-complying
B – Distributed	Permitted	Permitted	Permitted	Permitted	Non-complying
C – Uncertain[†]	Permitted	Permitted	Permitted	Permitted	Non-complying
Fault recurrence interval class VI greater than 20,000 but less than or equal to 125,000 years					
A – Well defined	Permitted	Permitted*	Permitted*	Permitted*	Permitted*
B – Distributed	Permitted	Permitted	Permitted	Permitted	Permitted**
C – Uncertain[†]	Permitted	Permitted	Permitted	Permitted	Permitted**

Figure 4: Extract from Active Fault Guidelines.

For the Ashley Fault Zone location discussed above, fault awareness zones have not been imposed on the subject property and therefore, location of future dwellings on the site is not restricted by such fault zones.

8.2.4 Seismic Category

The relatively thin layer of flood plain fan deposits overlying the site underlain by deep alluvial soils defines the site as Class D, 'deep alluvial soil sites', in terms of the seismic design requirements of NZS 1170.5.

8.3 Flood Inundation

Waimakariri Councils' GIS OpenMP system identified flood inundation hazard for a 1 in 200-year event as shown in Figure 3. The site's micro topography indicates low flood hazard towards the east and south boundaries of the site (highlighted in blue) manifested by up to 200 mm of surface flooding.

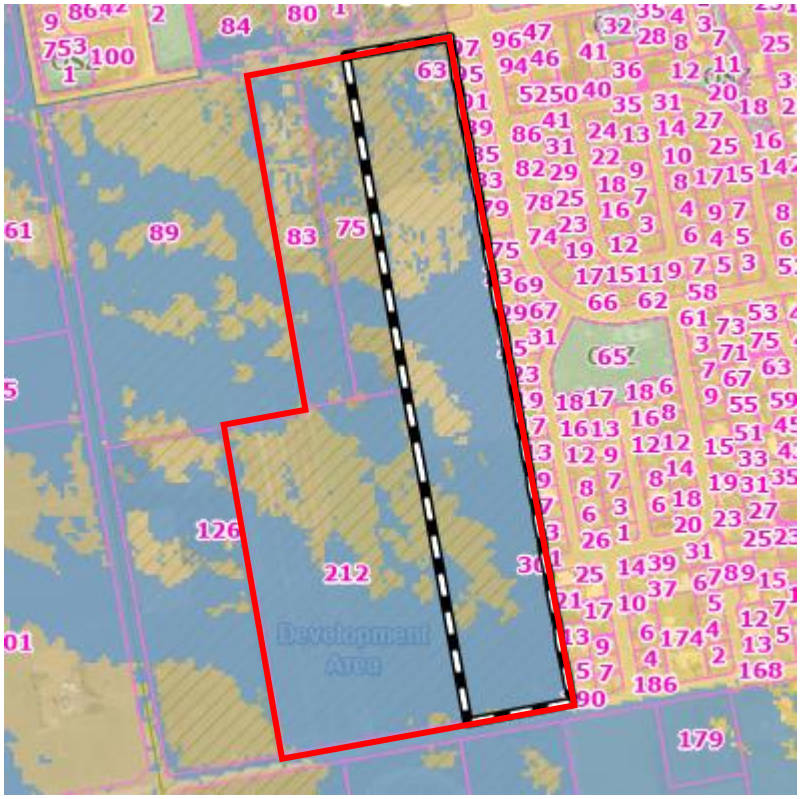

Figure 3: Surface Flooding model for 1 in 200-year event, sourced from Waimakariri Proposed Plan.

Surface water ponding within the affected area can be controlled by locally raising the ground level to redirect surface water runoff to either a swale feature or a reticulated stormwater collection system.

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 on expansive flat Canterbury Plains, as such, rockfall hazard is negligible.

8.5 Slope Instability and Slippage Hazard

The site is located on expansive flat Canterbury Plains, as such, slope instability and/or surficial soil slippage hazard is negligible.

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. Erosion and Sedimentation hazard would not prevent rezoning and subdivision of the site.

8.7 Liquefaction Hazard

The dense near-surface gravels and deep ground water table translate to negligible liquefaction hazard at the site.

8.8 Volcanic Hazard

Volcanic hazard is negligible at this site and would not prevent rezoning and subdivision of the site.

8.9 Tsunami Hazard

Tsunami hazard is negligible at this site and would not prevent rezoning or subdivision of the site.

8.10 Meteorological Hazard

No higher risk than other location in the Waimakariri District; therefore, would not prevent rezoning and subdivision of the site.

9.0 Foundation Considerations

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

From the low-density soil testing carried out in accordance with Part D: MBIE guidelines, it can be assumed that the soils are consistent with the definition of "good ground" as defined in NZS3604:2011. Soil testing will be required at building consent stage at the selected house locations to confirm this assumption.

Specific design of foundation is recommended for the dwelling in accordance with MBIE guidelines for TC1 rated land. If local surface flooding is predicted at this site (Figure 4 above), then a raised timber floor on a timber subfloor structure would be the preferred foundation option for either a Category 2A or 2B building.

The interim flood floor level (if any) should be discussed with the Waimakariri District Council and assessed for a 1 in 200-year flood to district plan rules.

10.0 Conclusions

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

Provided best practice methodologies are implemented during construction it is our opinion that a rezoning to MRZ of the affected sites in accordance with the Waimakariri Proposed District Plan 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.

11.0 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 Dalkeith Holdings Ltd and the Waimakariri District Council.

This report is specifically prepared for the re-zoning of Pt RS 48562, Pt RS 903 & Lot 1 DP 61800 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

- Site Investigation Plan
- Scala penetrometer and Test Pit Profiles

Appendix B

- Statement of professional opinion