Proposed Plan Change - Rezoning Rural to Industrial, Marton

Preliminary Geotechnical Appraisal

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Document Details:

Date: February 2020
Reference: 5-WT628.00
Status: Issue 2

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Document History and Status

Revision	Date	Author	Reviewed by	Approved by	Status
Issue 1	Sept 2019	MSF	RS	JLH	Draft
Issue 2	25 Feb 2020	MSF	RS	JLH	Final

Revision Details

Revision	Details
Issue 1	Issued for client comment
Issue 2	Status updated to final – no changes to text

Limitations

This Preliminary Geotechnical Appraisal report ('Report') has been prepared by WSP Opus exclusively for Rangitikei District Council ('Client') solely in relation to the proposed District Plan rezoning plan change ('Purpose'). The findings in the Report are based on and subject to the assumptions specified in the Report, the scope of services and assumptions set out in WSP Opus' Offer of Service dated 20 August 2019 and agreement with the Client dated 22 August 2019. The Report may not be used or relied upon by the Client for any use or purpose other than the Purpose and WSP Opus accepts no liability in relation to the same. WSP Opus accepts no liability or responsibility for any reliance on or use of the Report, in whole or in part, by any third party for any purpose whatsoever.

1 Introduction

Rangitikei District Council has commissioned WSP Opus to undertake a preliminary geotechnical appraisal of an area of rural land on the south-east side of Marton.

This Preliminary Geotechnical Appraisal report is to investigate the geological and geotechnical conditions at the site and to identify the natural hazards that may be present, and to, where possible, quantify the hazard to allow the assessment.

This report is a desktop assessment of the geological and geotechnical aspects of the area. A drive-over has also been undertaken following public roads, to confirm ground conditions. No physical investigations have been completed on the site. All the data used for the assessment is from previously published reports, maps, and databases. This approach is considered appropriate for a plan change process at this particular site.

Due to the shortage of vacant industrial land in the Marton area, Council is proposing to rezone the area from rural zoning to industrial zoning. The area has boundaries to Wings Line, State Highway 1, Makirikiri Road and the Main Trunk Railway.

2 Background

The Council has embarked on a plan change process, to change the current district plan. The proposed plan change seeks to change the zoning from Rural to Industrial for the properties at and around 1165 State Highway 1, Marton. The purpose of the Plan Change is to enable new investment in industrial activities in Marton by providing additional land within the Industrial Zone.

A Preliminary Geotechnical Appraisal Report is required to inform the plan change process.

3 Site Description

The extent of the proposed zone change is shown on Figure 1 below.

The site has frontage onto State Highway 1 ("SH1") to the east and is bounded by Wings Line to the north, Makirikiri Road to the south and the North Island Main Trunk Line along the majority of the western boundary. The remainder of the western boundary is within the Industrial Zone and includes a malting plant, and a small area of Rural Zone on which two residential dwellings are located (The Property Group, 2019).

The site is currently used for rural purposes, primarily for grain production as well as holding a number of ancillary buildings for farming equipment and storage.

Figure 1 : Plan change area (indicative)

The topography of the area is flat, with a small change in terrace level in the north-west corner of the site. The area has a number of small streams generally draining from north to south across the site.

4 Geology

4.1 Regional Geology

The regional geology is described on Geology of the Taranaki area, GNS 1:250,000 geological map 11 (Townsend, Vonk and Kamp 2008). It indicates the site to be underlain by river gravel and sand deposits of mid-Pleistocene age.

The geological map also indicates an active fault (Leedstown Fault) passes near the western boundary of the study area.

The Marton anticline structure is shown centred about 4km to the west of the area, and the Mt Stewart-Halcombe anticline is shown to be 8km to the south east.

4.2 Active Faults

The GNS active fault database (http://data.gns.cri.nz/af/) shows the active Leedstown Fault (#435) passing through the corner of the site. The fault is described as a normal fault with the recurrence interval of >5000 to <10,000 years.

The Marton anticline, running generally N-S is shown passing about 5km to the west of the site.

The characteristics of some nearby faults are presented in Table 1 below.

Table 1 : Fault characteristics for structures near Marton

Fault	Comment/ location	Distance from site (km)	Type	FL (km)	Likely EQ Mag	SED (m)	Slip rate (mm/yr)	RI (years)	Reference
Leedstown-Putorino Fault	Bulls-Marton	0	nn	35*	M6.3	0.6	0.07	9,164~	Stirling et al. 2002
Marton structure	probably = Leedstown-Putorino Fault	5	rv		M6.7	2.5	0.3	8,000	Stirling et al. 2002
Mt Stewart-Halcombe structure	Halcombe-Glen Oroua	8	rv	25*	M6.8	2.5	0.3	8000	Jackson et al. 1998; Stirling et al. 2002
Himatangi structure	Carnarvon-Oroua Downs		rv	15*	M6.7	2.5	0.3	8000	Stirling et al. 2002
Feilding structure	Feilding – Beaconsfield	17	rv	12*	M6.9	2.5	0.3	8000	Stirling et al. 2002

rv = reverse, ss = strike-slip, nn = normal, sn = strike-slip with normal component; sr = strike-slip with reverse component.

FL = fault length, SED = single event displacement, RI = recurrence interval.

4.3 Geomorphology

Cold/warm climatic cycles of the Quaternary period caused the major rivers of the Manawatu-Whanganui, including the Rangitikei to aggrade and degrade. During warm periods the rivers cut down into the slowly rising land mass. During cold periods, erosion increased, and rock debris was transported down to the lowlands by the rivers, causing aggregation to form wide floodplains. The remnants of these terraces can be seen in the Rangitikei River Valley region.

During cold periods silt from the braided floodplains was swept up into dust clouds by northwest winds, depositing this fine-grained material on the adjoining terraces and plains. This fine grained, wind deposited material is the loess which is found across the study area as the near surface soils.

5 Previous Investigations

5.1 Geotechnical Investigations

5.1.1 General

The New Zealand Geotechnical Database was searched for any previously completed investigations close to the site. These are described below.

5.1.2 Calico Line Improvements

Two boreholes were drilled for a project at Calico Line/SH1. The boreholes were at the abutments of the railway overbridge south of the intersection.

These holes encountered gravel from 2.8m to 3.0m below ground level. Above this was a clayey silt or silt material.

Two trial pits records were also reviewed from this project. These pits encountered gravels from between 1.6m and 2.0m below ground level, with silt overlying the gravel.

5.2 Water Bore Records

Information on existing groundwater bores from Horizons Regional Council was obtained for bores close to the site. Some of these bores have basic lithology information. From the data available the ground conditions are consistent within the general area, with gravels to about 30 metres below ground level (BGL), underlain by silts, sands and clay. Soft rock (papa) is indicated to be more than 50 metres BGL. The depth to groundwater is noted on four of the bores, and ranges between 52 m and 65 m BGL. Other perched-type water tables are likely closer to the ground surface.

5.3 Soil Surveys

Soil surveys and maps have been prepared of the area, looking at the soil structure and limitations from an agricultural perspective. The soils of the Rangitikei County area were reported in Campbell (1978). This indicates the area is covered with Marton series soils, which are from loess derived quartzo-feldspartic and volcanic rocks. The report indicates the sols are imperfectly to poorly drained, and the Marton Series soils have firm, coarsely structured subsoils which impede soil drainage in winter and spring months. In summer and autumn, however, the soils may have a moisture deficiency. An additional soil imitation is structural instability of topsoil under intensive use (Campbell, 1978).

5.4 Previous Works

Sewer and water renewal waters have been completed both on Broadway and High Streets, Marton, in the past 20 years. During the trenching works the ground conditions were found to comprise tightly packed sandy/silty small to medium gravels (P O'Connor, personal communication, 13 March 2019). The trenches were self-supporting, but due to the depth of excavation and safety requirements, the works required trenching shields.

Similar ground conditions are exposed in the steep sides of the Tutaenui Stream as it passes through Marton. This stream is incised into the alluvial gravels by about 3.0m, and exposures of a weathered gravel can be readily observed in the lower banks.

6 Site Observations

A drive-over of the area was undertaken in September 2019 to observe the topography of the site and noted any features of interest. The drive-over was completed from public roads.

The area comprises flat pasture situated on a large raised river terrace surface. A number of small streams and watercourses cross the area. These are incised 2 – 3m into the terrace surface. The general drainage pattern appears to be towards the south across the area. Near the north west corner of the proposed re-zoning area on Wings Line there is a noticeable small rise to a higher surface level to the west. This linear escarpment running north-south is inferred to be the Leedstown Fault trace, with the eastern side down-thrown by up to 4 to 5 metres.

Photograph 1 : Study area from Makirikiri Road, looking north.

Photograph 2 : Looking south from Wings Line – SH1 on left

Photograph 3 :Inferred fault trace from Wings Line, looking west. Study area to left of road.

Photograph 4 : Inferred fault trace north of Wings Line

7 Preliminary Geotechnical Appraisal

7.1 General

The preliminary geotechnical appraisal is based on a desk study of relevant information including reports, maps, previous investigations, along with a brief drive-over to confirm ground surface conditions.

7.2 Land Instability

The area does not contain any significant slopes or large areas that might be subjected to slope instability.

The banks of the small streams and watercourses crossing the area may be over steep and may be subject to instability under adverse groundwater conditions, or during seismic events. During the future development of the area provision of setbacks from steep streambanks should be made to avoid this hazard.

7.3 Seismic Hazard

7.3.1 Ground Shaking

NZS1170.5 contains the elastic site spectra for New Zealand that has been derived from results of a probabilistic seismic hazard model developed by the Institute of Geological and Nuclear Sciences (GNS).

For calculating the seismic forces for a building at the proposed plan change site, the methodology of NZS1170.5 should be followed. The probabilistic seismic hazard model allows for known active faults and the ground shaking they may cause, and allows for a grid of distributed-seismicity sources with parameters estimated from the catalogue of historic earthquakes (Standards New Zealand, 2004).

The risk of fault rupture-generated ground shaking from the Leedstown-Putorino Fault is built into the distributed seismicity model.

7.3.2 Fault Rupture

The Leedstown-Putorino Fault is shown passing through the north-west corner of the site. The fault is indicated to be an active fault with a recurrence interval estimated to be approximately 9164 years. It is assessed capable of generating a magnitude M6.3 earthquake, with displacement in a single event estimated to be 0.6m.

The Leedstown-Putorino Fault is described as a normal fault, which is where the hanging wall block has moved downward relative to the footwall block (refer Figure 2).

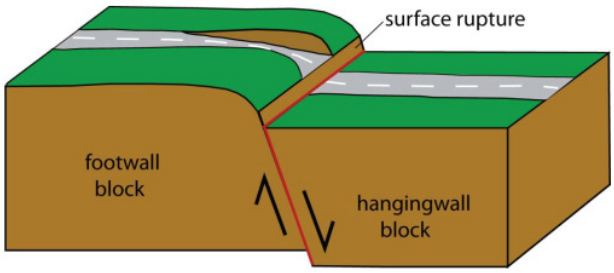

Figure 2 : Normal fault (from (Langridge & Ries, 2016))

Guidance for the development of land on or close to active faults has been published by the Ministry for the Environment, and prepared by GNS (GNS, 2003). This document recommends the use of planning controls in district plans to mitigate the hazard of fault rupture effecting future structures. Fault avoidance zones are recommended for greenfields sites to prevent building in these areas.

As the fault is inferred to cross the north west corner of the area, incorporating a fault avoidance zone into the plan change rezoning should be undertaken. Further work would be required at the southern extent of the fault through the study area to confirm its location.

7.3.3 NZS1170.5 Site Sub Soil Class

GNS Science reported to the Manawatu-Whanganui Lifelines Advisory Group with a report updating its 2005 Risks and Responsibilities report. This report (Dellow, et al. 2016) presented the updated hazards information provided to the Horizons Regional Council for use by the Lifelines Group. Part of this information was the inferred earthquake ground shaking site sub-soil class. The GNS Science maps produced for the above report are only suitable for regional-scale use. Site-specific information including the soil profile with depth is not included in this analysis.

Based on the GNS Science report, and our present knowledge of the local geology, this site is classified as Class D – Deep or soft soil sites as per the NZS1170.5:2004 classification.

7.3.4 Liquefaction

Given the geological history of the area, and the age of the deposits, the uplifted alluvial deposits with cover soils of loess are considered to have a low liquefaction potential. The report “Assessment of Liquefaction-Induced Ground Failure”, produced by GNS in the late-1990 summarised the liquefaction risk in the following terms “Marton is located on gravels and sand of Pleistocene age (1.6 – 0.5 million years ago), which are considered to have negligible liquefaction susceptibility”.

Further investigations would be needed to confirm the liquefaction potential, and this should be completed prior to development.

Areas of stream bank where recent deposits may be in place may be susceptible to liquefaction and movement, and avoidance of these areas by incorporating set-backs from should be incorporated into the development of the area.

Any risk of localised liquefaction should be investigated during development of the area. These areas could then be avoided through set-backs or avoidance zones, or they could be treated. Treatment to address any possible risk are not anticipated to require extensive works.

7.4 Flooding

Horizons Regional Council has undertaken a flood mapping project following the 2004 flood event to hit the region. The flood modelling is available through a web portal (Horizons Regional Council, 2019).

The portal presents a flood event that has an annual probability of 0.5% (i.e. there is a 1 in 200 chance it may occur in any one year.

Figure 3 below presents an image from the web portal and indicates no flooding areas identified in the study area.

Figure 3 : AEP 0.5% flood event, showing areas of inundation (after (Horizons Regional Council, 2019)

The mapping is confirmed by site observations, which indicate only small streams and watercourses crossing the study area. Localised ponding may occur near the streams in a flood event, but widespread inundation by flood water appears unlikely.

7.5 Earthworks

Given the topography of the study area, only minor, limited, earthworks will be required to develop the site.

The near-surface soils are likely to be difficult to work when wet and are likely to cause dust nuisance when dry.

Erosion and sediment control measures should be installed during any earthworks at the site.

Any gravels encountered should provide good founding for road pavements.

7.6 Building Foundations

The soils at the site should provide good foundations for typical industrial and commercial building structures. Specific investigations should be undertaken for infrastructure and building structures prior to the development of the site.

It is anticipated that shallow foundations would be suitable for typical building structures, and no extensive ground improvement would be required prior to development.

The loess-type soils are unlikely to be classed as expansive soils.

7.7 Previous Use and Development

The previous use and past development has not been extensively studied. Any areas that may have been modified in the past by placing of uncontrolled fill or dumping of unsuitable material have not been defined. Further, more specific investigations would be required to identify these areas.

These areas, if they exist in the study area, are unlikely to be extensive, and there is no evidence to suggest their presence currently.

7.8 Contaminated Land

No assessment of contaminated soils has been made in this report. Agrichemicals are likely to have been used across the whole of the site. The change in zoning from rural to industrial and the development of the land will require some disturbance of the subsoil.

Any areas of contamination are unlikely to prevent the change of use from rural to industrial purposes.

7.9 Infrastructure Development

During the initial development of the area infrastructure such as road access and services will be required within the area. The ground conditions will not present any difficulties when this development occurs.

8 Conclusions and Opinion

- An active fault crosses a corner of the study area. The northern end of this fault on the site has been identified, but the southern end has not.
- No field investigations have been undertaken as part of this study. Previous reports, maps and databases have been reviewed to inform this report.
- The ground conditions are inferred to comprise river terrace gravels covered by loess and tephra deposits.
- The recurrence interval of fault rupture of the Leedstown-Putorino Fault is estimated to be nearly 10,000 years. This long estimate recurrence interval reduces the risk of fault rupture.
- There appears to be a low or negligible risk of liquefaction at the site.

- The area does not appear to be affected by inundation during a 200-year return period event.
- Standard type building foundations are expected to be suitable for structures.
- There appear to be no significant geotechnical issues associated with the infrastructure development of the area.
- There appears to be no significant geological or geotechnical issues that would prevent the use of the study area should it be re-zoned.

9 Recommendation

We recommend :

- A fault avoidance zone is established around the Leedstown Fault where it passes through the study area.
- Further investigations and enquiry should be undertaken at the southern extent of the fault in the study to identify its exact location.
- Field investigation should be undertaken prior to any development at the site to determine the exact ground conditions and soils parameters for design.
- A geotechnical assessment report is prepared to determine geotechnical parameters for design.

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