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Peer Review

NCC Slope Instability Overlay (Beca Limited)

Nelson City Council

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1. Introduction

CGW has been engaged by Nelson City Council (NCC) to undertake a peer review of Beca Limited's 'NCC Slope Instability Overlay', reference report 3201 163-349031543-831 dated 6th August 2020.

The overlay defines land potentially susceptible to slope instability, including potential run-out zones resulting from the slope instability. The overlay is intended as a tool to identify areas that warrant geotechnical assessment during the early stages of land planning and development and to inform updates to the NCC 'Nelson Draft Plan'. The main deliverable of Beca's work is a series of maps and a GIS (Geographical Information System – ArcGIS) model of layers that can be incorporated into NCC's planning GIS and systems.

CGW's agreed Scope of Work, reference NCC Project ID – 140920 and Consultant Procurement Contract – 4022, dated 15th September 2020 are as follows. Our limitations are attached in Appendix A.

- CGW would review the general methodology covered in 14 pages of report text
- CGW to liaise with BECA, undertake necessary meetings at their office, accompanied with NCC staff to see first-hand how they analysed the datasets using their GIS system
- No fieldwork will be undertaken
- Deliver a draft brief review report of CGWs opinion on the methodology, the quality of the work undertaken and recommendations of how NCC should use the information in planning and how it may be refined, if needed.
- Update the peer report with any requested changes by NCC staff and issue a 'final' peer report.

2. Reviewer

The review has been undertaken by CGW's Geotechnical Manager and Principal Geotechnical Engineer, Mr. Martin Williams.

Mr. Williams has over thirty years geological and geotechnical engineering experience having gained his first degree BSc Geology & Geography (Keele University) in 1986. Subsequently he gained an MSc Geotechnical Engineering (Bolton University) in 1993. Mr. Williams has worked as a geologist and geotechnical engineer in the UK, Botswana, Qatar, Australia and New Zealand. He is a Chartered Engineer (UK Engineering Council, Registered 7th February 2000, No: 468765), Chartered Professional Engineer (Engineers New Zealand Registration Number: 10929431, since 2015) and Chartered Geologist (Fellow of the Geological Society, UK, 6th October 1993, No: 1002315 and Chartered, 11th May 2000).

Mr. Williams has gained local experience in the Nelson and Tasman region, having been based in CGW's Nelson office from 2014 to 2016.

3. Liaison with Beca Limited

A meeting was held at Beca's Nelson office on 30th September 2020, with Mr. Williams (CGW), Ms. Jacqui Hewson (NCC), Mr. Paul Wopereis (Beca), Mr. Dan Chamberose (Beca) and Ms. Sarah Barrett (Beca ~ remote) in attendance.

At the meeting, the Beca representatives explained their methodology and demonstrated the use of their in house GIS (Geographical Information System – ArcGIS) in producing the overlay plans.

4. Methodology Review

Following our meeting with Beca and a review of the 'NCC Slope Instability Overlay' report, CGW briefly summarise and precis our understanding of the Beca methodology undertaken as follows:

4.1 Slope Instability

Beca have made reference to the Australian Geomechanics Society (AGS 2007) document 'Guideline for Landslide Susceptibility, Hazard and Risk Zoning for Land Use Planning'.

This document indicates various settings in which land is susceptible to instability and includes the following factors:

- Slope angle
- Geological and Geomorphic
- Slope degradation
- History of instability
- Rainfall
- Seismicity

Beca also made reference to publicly available databases and were also provided with data from the following sources:

- NCC Hill Shade GIS model;
- Geological maps (QMap 1:250,000)
- NCC Landslip records (digital point records)
- NCC existing slope hazard GIS overlays (e.g. Tahunanui & Grampian)
- GNS Landslip database
- GNS Active Fault database
- Previous reports on slope instabilities in the Nelson region

Based on the above AGS guidelines and databases interrogated, Beca, formulated a decision tree of land to include in the overlay, which is presented in Section 4.2 of the Beca report. The NCC Hill shade model was used to produce a slope angle model in the GIS.

In a simplified form the process for including land in the slope instability overlay is as follows:

- Slopes greater than 35 degrees are included as a default
- Slopes between 35 and 20 degrees are included subject to factors in the decision tree relating to geomorphic evidence from aerial images, previous instability mapping or records in NCC or GNS databases, susceptible geological units or proximity (100m downslope) to a mapped fault
- Slopes less than 20 degrees are generally excluded
- Ridgelines, with slope less than 20 degrees and greater than 10m from the main steep break of slope, are also generally excluded.

The above datasets and decision tree allowed the basic overlay, shown as a maroon colour on the maps, to be formed in the GIS. No computer programming, scripts or GIS algorithms were used. The basic model, CGW understands, was then critically and systematically reviewed in conjunction with the aerial photographic backdrops, to manually adjust for subtle topographic features, geology etc. and also to manually draw the previous landslide features from the point data supplied by NCC and other sources.

No fieldwork or site visits were undertaken as part of the process.

4.2 Run Out

Land downslope of a slope instability is prone to inundation from slope debris. Similar to the decision tree for slope instability, Beca, developed a simple decision tree to determine run out areas (shown as yellow on the maps) in Section 4.3 of the Beca report, as follows:

- Land with no instabilities mapped/identified upslope are excluded from the run out overlay
- Otherwise, geomorphic features and/or land contours combined with engineering judgement have been used to assess likely run out and run out distances.

Slope instability run out debris is likely to comprise a mixture of solid debris and water, with the water having the potential to run out much further than the solid debris. It was discussed in the meeting with Beca, and clarified by Beca, that their mapped extent of run out, is considered to be the extent of the predominantly solid debris, i.e. soil and rock debris, not the potential extent of water flow.

5. Assessment

It is CGW's opinion, that in order to undertake a rapid assessment of potential slope instability over such a large geographic area, could only be accomplished using a GIS or other 'remote sensing' application.

CGW consider the work that has been carried out is of a high standard, has considered the numerous factors that can contribute to slope instability and that it is fit for purpose in the context of NCC's proposed use in planning.

Beca, have outlined in Section 5 of their report the various assumptions and limitations of their GIS model. Even though the mapping has utilised a GIS system, there is an immense amount of subjectivity involved in assessing slope instability, at this level, and consequently the model and mapping produced must be regarded as semi-qualitative.

The model is very 'black and white' with large swathes of the Nelson region deemed to be within areas of potential slope instability, which considering the hilly nature of the Nelson area, is probably a reflection of reality. The model is also a 'snapshot in time', ie. Beca have no ongoing responsibility to maintain the currency of the model. It is recommended by CGW that some form of annual or five yearly maintenance is considered.

Beca make it clear that the model/maps are a hazard mapping only. The AGS guidelines mentioned previously, assess 'risk' to both property and to people (injury/loss of life). For risk to exist, there must exist some form of target that could suffer a consequence resulting from a hazardous event. The AGS guidelines use a matrix and defined terminology to compare likelihood/probability (eg. Rare, Possible, Likely) against consequence (e.g. Catastrophic, Major, Minor, Insignificant) to assess slope instability risk (e.g. Very Low, through Low, Medium, High to Very High).

Ideally, slope instability mapping would map the risk, however the numerous elements that are needed to be considered in slope risk analysis, probably make this unworkable. A 'risk map' would potentially open the council to litigation if it underestimated the risk, especially if available on a publicly accessible system. Consequently CGW agree, with Beca's consideration and recommendation, that site specific assessment should be undertaken, where required, during the planning process.

Appendix A: Limitations

This report has been prepared solely for the benefit of our client, Nelson City Council, as per our brief and an agreed consultancy agreement. The reliance by any other parties on the information or opinions contained in this report shall, without our prior agreement in writing, be at such parties' sole risk.

The conclusions and recommendations contained within this report are based on the investigations as described in detail above. The nature and continuity of subsoil conditions are inferred and it must be appreciated that actual conditions could vary considerably. Defects and unforeseen ground conditions may remain undetected which might adversely affect the stability of the site and the recommendation made herein.

This report has been prepared solely to address the issues raised in our brief, and shall not be relied on for any other purpose.

Where we have provided comments on aesthetic issues these need to be confirmed by an architect or other expert in the field.

In the event the third party investigation data has been provided to us, the client acknowledges that we have placed reliance on this information to produce our report and CGW will accept no liability resulting from any errors or defect in the third party data provided to us.