Friday 28th August 2026

Queenstown Lakes District Council

Attn Onur Oktem

Email: [redacted]

Ref: L_2026120.01

Onur,

**Re: Natural Hazards Assessment Peer Review, Remarkables Ski Area Expansion**

My name is Mark Cruden. I have been engaged by the Queenstown Lakes District Council to undertake a pre application peer review of a Natural Hazards Assessment Report relating to the proposed Remarkables Ski Area expansion into Doolans Basin.

I am the Director and Senior Engineer at Meyer Cruden Engineering Ltd. I hold a Bachelor of Civil Engineering (Honors). I am a Chartered Professional Engineer (Civil and Geotechnical) and a Professional Member of Engineering New Zealand. I have 25 years of experience and have worked as an engineer in the Central Otago region since 2003. My experience in ski area development began as a graduate engineer in Scotland, where I worked on ski area infrastructure and development projects for Cairngorm Mountain resort, Aviemore.

I have undertaken numerous natural hazard assessments and subsequent mitigation designs. Recent examples of my work in this area include: -

- landslide assessment and mitigation design for a proposed restaurant in Soho Basin at Cardrona Alpine Resort,
- landslide assessment and design for the Snowsports New Zealand Olympic Dryslope,
- Rockfall risk assessment for the Mt Iron public walking trails on behalf of Queenstown Lakes District Council,
- landslide assessment and mitigation design for several locations on Central Otago District Council's roading network,
- Numerous alluvial fan, flooding and liquefaction hazard assessments to facilitate residential development in the region.

This list is not exhaustive but provides a sample of the range and scale of projects I have been involved in.

I have read and agree to comply with the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2023.

**Review Scope**

The scope of my review is as per the email instruction from Onur Oktem of QLDC, dated 13th August 2026. My review considers the following specific matters:

- The alluvial fan risk potentially affecting the Lower Remarkables Transit Hub
- The flood risk affecting the Gondola Base Station and Base Building located within the current base area
- The rockfall hazard present above Swan Lake

In addition to this hazard assessment for QLDC I have undertaken similar work for Central Otago District Council (CODC) in relation to the proposed development where it extends into the CODC territorial area.

**Initial review and comments**

In undertaking this review I have viewed the following information provided by the applicant:

- Remarkables Ski Area Expansion Project, Natural Hazards Assessment, Stantec New Zealand, dated 29 April 2026.
- Memo, Reference Responses to Questions on Doolans Natural Hazards Assessment, Stantec New Zealand, dated 10 June 2026
- Memo, Reference: Evaluation of Alluvial Fan Hazard within the Lower Remarkables Transit Hub, Stantec New Zealand, dated 10 August 2026.

In addition to reviewing these documents I attended a Teams meeting on the 19th August 2026 to discuss the contents of the Stantec reports and my initial findings. Present at the meeting were Derek Chinn (Stantec), Ross Lawrence and Louise McQuillan (NZSki), Onur Oktem (QLDC) and myself.

For simplicity I have provided my comments and recommendations in the table appended with this letter.

Should you require further information please do not hesitate to contact the undersigned.

Regards



Mark Cruden, Director

**Table 1 –review comments**

| | Item | MCE comments and recommendations |
|---|---|---|
| 1 | Alluvial Fan Hazard at Lower Transit Hub | Stantec's report references the Alluvial Fans – Regional Scale Mapping. This map displays Alluvial Fans in the Otago region mapped at regional scale (1:50k - 1:250k). The Transit Hub site is within a mapped Alluvial Fan Hazard (*Active debris-dominated)*<br><br>In addition to the Alluvial Fans – Regional Scale Mapping I have also reviewed the higher resolution ORC 'Fan Landform - Otago' and 'Fan Landform Channels - Otago' mapped features (1:10k to 1:50k scale), refer figure 1 below. This mapping provides more granularity in relation to the hazard. The Transit Hub site is to the north of the *active bed*, and within an area of *"Fan less recently active"*. This is defined as *"area of less recent (e.g. >300 yrs) stream activity. Mature native forest (if present) and immature to mature soils. Includes terrace-riser slopes up to adjacent higher fan surfaces."*<br><br>I have compared the mapping with historical aerial imagery. This indicates that the current *active bed* location (in purple on the 1:10k to 1:50k map) has remained relatively consistent since the earliest available imagery in 1956. Although the imagery in 1956 (attached) indicates activity in a minor channel to the north this is still outside the proposed Transit Hub site.<br><br>Based on the above and with reference to the risk assessment process included in the National Policy Statement for Natural Hazards I consider:<br>• the likelihood of this fan affecting the Transit Hub site to be "Unlikely" (ARI 100-500 years)<br>• and the consequence level to be "Minor to Moderate",<br>• giving an overall risk rating for this hazard of "Low to Medium".<br><br>**Recommendation**<br>**This assessment is consistent with the Stantec's assessment, and no further action is recommended.**<br><br>*Figure 1 - extract from ORC hazard map with transit hub shown in yellow* |

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| | | <br>*Figure 2 - 1956 historic aerial with transit hub site shown* |
| **2** | Flood risk - Gondola Base Station and Base Building Flood risk | Stantec's Memo, *Reference Responses to Questions on Doolans Natural Hazards Assessment* provides information in relation to their assessment of overland flowpaths in the area of the proposed base station. A key mitigating factor raised by Stantec is that a loop road will be formed 1.5m lower than surrounding ground, and that this road will form a secondary flowpath that will protect the proposed buildings from inundation. This is a qualitative assessment. I consider this sufficient to determine that the flood hazard can be mitigated but a more detailed analysis is required to confirm the appropriate mitigation measures required.<br><br>**Recommendation**<br>**I recommend that hydrological and hydraulic modelling be completed to determine the flood flow extent, depth and velocity where it passes the proposed development area. This assessment should be used to confirm minimum floor levels for buildings and to check that the flow depths and velocities across areas to be used for egress are appropriate.**<br><br>**This work should be completed as part of the detailed design for the development and reviewed by QLDC at engineering acceptance stage. This work should be undertaken by a suitably qualified stormwater engineering professional.** |
| **3** | Rockfall Risk from Ridge above Swan Lake | I agree with Stantec that the rock fall risk is significant and, in all probability, represents the highest risk associated with the development. The Swan Lake area is included in the Otago Regional Rockfall Screening Study (Oct 2022). This study mapped rockfall hazard awareness areas derived from simulated rockfall trajectories obtained from modelling.<br><br>I understand that a temporary access track is proposed in this area along with the potential for this to remain in place as a ski run at completion.<br><br>The site investigation included in the Stantec report provides a more detailed assessment of this risk present at the Swan Lake area. As the Stantec report identifies, the risk is somewhat mitigated by the temporal nature of the activity in the area - but the residual risk rating remains "high" and I would concur with this finding.<br><br>Given the high consequences associated with the hazard and the temporal nature of the exposure I consider that a more detailed quantitative risk assessment be |

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| | | completed which includes a specific temporal consideration. The NPSNH Explanatory note clarifies that the policy provides a baseline only and permits more detailed alternatives. The NZGS Slope Stability Geotechnical Guidance Series Unit 1 (2024) represents best practice in this area. It provides detailed semi quantitative and qualitative approaches to estimating landslide, and specifically rock fall hazard. This is covered in sections 6 and 12 of the NZGS guidance. Recommended methods included in the NZGS guidance include the "AGS Guideline for Landslide Susceptibility, Hazard and Risk Zoning 2007" approach and the "Department of Conservation Guidelines for Natural Hazard Risk Analysis (2020)" approach.<br><br>During the Teams meeting Stantec advised that they believe the main trigger for rockfall would be seismic activity. Stantec/NZSki also indicated that the use of the track during the construction period would only be in summer, not during thaw and not during significant rain events thus mitigating the risk. Furthermore it could be closed in winter to prevent skier use.<br><br>**Recommendation**<br>**Stantec/NZSki confirm in writing that they believe the "high" risk rating they have identified for the rock fall hazard can be adequately mitigated in the context of the temporary construction access. This should be provided to support the resource consent application.**<br><br>**A temporal hazard assessment should be completed in relation to the Swan Lake rockfall hazard that considers both the construction access track scenario and the permanent ski run scenario. These assessments should also detail and assess the effectiveness of any proposed mitigation measures. These assessments should be provided at the detailed design stage and reviewed by QLDC during the engineering acceptance process.**<br><br>**This assessment and the design of mitigation measures should be undertaken by a suitably qualified geotechnical engineering professional. The outcome of these assessments could include realigning any ski trails away from the hazard area if that is deemed the most appropriate mitigation measure.** |

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