

Before Queenstown Lakes District Council

In the matter of The Resource Management Act 1991

And The Queenstown Lakes District Proposed District Plan
Topic 13 Queenstown Mapping – Group 1B (Queenstown
Urban, Frankton and South))

SUMMARY EVIDENCE OF JEFF BRYANT FOR

Kerr Ritchie Architects (48)

Dated 17 August 2017

QUALIFICATIONS AND EXPERIENCE

1. My full name is Jeffrey (Jeff) Martin Bryant. I am an engineering geologist with over 42 years' experience and hold the qualifications BSc (geology) from Victoria University and MSc (engineering geology) from Canterbury University.
2. I am a Fellow of the Geological Society (London) and by validation am entitled to the designation Chartered Geologist. I am also a member of the New Zealand Geotechnical Society and am affiliated through them to the International Association of Engineering Geologists.
3. My present employment is as principal, Geoconsulting Ltd, a geotechnical consulting business I set up in 1994. My business operates out of Queenstown.
4. Since 1983 I have had extensive experience throughout the Central Otago and Southern Lakes regions advising on roading projects, irrigation schemes, power schemes, building developments, subdivisional developments and other infrastructure projects.
5. Of particular relevance is my involvement with the new Kawarau Falls Bridge and associated southern approaches, hazard assessment and hearing evidence for the property to the west (Lot 2 DP 390970) and hazard assessment and hearing evidence for the property on the north side of Peninsula Road (Section 2 SO 448337). I have previously undertaken a site investigation for a single dwelling and submitted evidence on the potential for high density residential zoning on the subject site (Pt Lot 3 DP 27200).
6. In addition to providing geotechnical advice to civil engineering projects, I have often been called upon to provide advice on natural hazards affecting roads, walkways and river users on behalf of local and regional councils, DoC, Trails Trusts and land owners.
7. I have read the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014. This evidence has been prepared in accordance with it and I agree to comply with it. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

8. I have been asked by the Submitter to prepare evidence in relation to a hazard assessment of the subject land and adjoining hillside above. This includes:
 - a. Assessment of hazards identified on QLDC hazards register;

- b. Rockfall and landslide hazard assessment;
 - c. Suitability of land for development.
9. My evidence is based on the following sources of information:
- a. Walkover survey of this property, land near the crest of Peninsula Hill, the land to the west and the land on the north side of Peninsula Road.
 - b. Examination of aerial photographs (including stereoscopic pairs) and satellite images.
 - c. Review of previous Geoconsulting reports on properties to the north and west.

GEOMORPHOLOGY AND GEOLOGY

10. The area of interest lies on the northern flank of Peninsula Hill and overlooks the Frankton Arm of Lake Wakatipu. The trough was formerly occupied by an arm of the Wakatipu Glacier which had its last advance about 12,000-15,000 years ago. Bedrock underlies the hills on either side of the valley and is exposed as steep bands of ice-smoothed rock ranging in slope from 40-60° with local steepening up to the vertical.
11. The field mapping and aerial photograph interpretation of the area confirmed the presence of a large landslide extending over the entire site. A smaller landslide abuts this feature to the west but terminates some distance above and to the west of the site. The lower reaches of the larger feature is overlain by glacial and post-glacial sediments which suggests a minimum age for the landslide of 12,000-15,000 years.
12. Colluvium is derived from erosion of the landslide and rock cliffs upslope. The sand and gravel material is transported downslope initially by gravity and remobilised by rainfall runoff to be deposited on the lower, flatter slopes. Exposures of colluvium immediately above and below the road clearly show water-laid deposits. Loess, a wind deposited silty fine sand, caps the colluvial deposits on lower slopes.

QLDC WEBMAP HAZARDS REGISTER

13. The QLDC Hazards Register identifies broad categories of hazards based on some interpretation and generalisations centred round a knowledge of the underlying material type. Three hazards recognised as affecting this area are:

- Landslide area – Active schist debris landslide (mostly upslope of property)
- Landslide area – Areas susceptible to falls
- Liquefaction risk – LIC1

LANDSLIDE HAZARD ASSESSMENT

14. The large landslide identified on the webmap and confirmed by mapping is comparable to many others around Central Otago – Lakes District. Field work found no evidence for activity and the adjacent property (48 Peninsula Road) has not been subject to disturbance since its occupation (1970's). I have concluded the landslide is dormant; i.e not currently active and unlikely to have been active in historical times.

15. Mr Charlie Watts, acting on behalf of QLDC, has recommended further investigations and stability analyses to inform the planning approval process but doesn't provide any threshold or criteria on which approval could be granted. Further investigations would require drilling a number of holes both within and outside the property (assuming permission could be obtained) – an expensive and time consuming undertaking normally considered unjustifiable for the scale of the development.

16. An assessment of static and seismic stability would provide little meaningful information. The static stability is already known to be adequate (Factor of Safety > 1) as corroborated by field observations. Very old, pre-existing landslides are considered to be resilient to all but major earthquakes. There would have been a number of seismic events in the many millennia since emplacement and yet no evidence exists for disruption of the glacial or post-glacial sediments on the lower slopes. My opinion is that, during severe earthquake shaking, the threat from landslide reactivation is likely to be minor compared to the threat of structural damage to any building from the shaking itself and rockfall damage (discussed below).

ROCKFALL HAZARD ASSESSMENT

17. Rockfalls are foreseeable yet unpredictable geologic events that the subject area is considered susceptible to. The presence of a source area for rockfalls and

rocks that have clearly been transported from that source implies that further rockfalls can be foreseen. However, the following factors are of an unpredictable nature:

- The timing and triggering of a rockfall event;
 - The position and volume of any failure;
 - The shape and size of any rocks, which governs the mobility and kinetic energy of blocks;
 - The degree of fragmentation occurring during transportation.
18. The main source area is the rock cliffs immediately below the hill crest (RL 790-820 m). Although the faces have been smoothed by glacial action and have comparatively few defects, there are several scars from previous failures indicating that rockfalls are a very real hazard.
19. Field mapping undertaken as part of this study and on nearby sites identified a number of rocks that have slid, rolled or bounded down the hillside. Thick vegetation obscured the ground in places and thus not all fallen rocks could be mapped. The following observations were made from this exercise:
- Most rocks fallen from the cliffs directly above the property had come to rest a short distance below the source. Some had travelled further down the slope but there was nothing within the property that could be confirmed as originating from rockfall.
 - A shallow gully following the western margin of the landslide would tend to channel some rocks away from the property but, given the unpredictable nature of travel paths, cannot be relied on to protect the property in every circumstance.
 - Some of the large rocks visible on the landslide surface and particularly those to the north and east of the property appear more likely to have been emplaced by landslide rather than transported there following rockfall. Their presence frustrates attempts to determine true frequency of rockfall events.
 - To the west, the scree slopes beneath the cliffs are modest considering the size of the cliffs and are all well vegetated, i.e. they are not continuously being added to. No rocks were found on any of the tracks that traverse the neighbouring property the earliest of which is understood to have been constructed in the 1980's.

- No rocks were found behind, nor damage to, the deer fence running along the top boundary of the boundary understood to have been constructed in 2008.
20. I have inferred from the above that rockfalls are an infrequent process occurring sporadically since the last glaciation when triggered by strong earthquake shaking or other environmental factors. There appears to have been no activity in the last few decades as seen by the lack of debris on tracks, the absence of paths through vegetation and the presence of lichen on all visible rocks. Mr Frank Mee advises that he couldn't recall any rockfalls on his farm since its purchase in 1960. The threat from rockfalls is thus seen as very low to extremely low.

LIQUEFACTION HAZARD ASSESSMENT

21. Liquefaction susceptibility can apply to fine grained soils situated below the water table. No such sediments were found amongst the soil overburden during the field mapping. It can thus be concluded that the liquefaction hazard is non-existent.

SUITABILITY OF PROPERTY FOR DEVELOPMENT

22. In consideration of the hazards affecting the property it can be shown that rockfalls represent the most significant threat but the risk to dwellings is considered very low to extremely low. The risk could be mitigated by construction of a protection structure (e.g. fence or bund) on the upslope side of any habitable structure. The property could thus be suitable for a range of zoning options provided the above recommendation is actioned.

DATED this 14TH day of August 2017

Jeff Bryant