Natural hazards in Glenorchy

Summary Report May 2010

Otago Regional Council

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Introduction

Located at the northern end of Lake Wakatipu, the Glenorchy township was originally established during the mid to late 19th century. It is mainly made up of residential and tourism-based operations and includes a primary school, Department of Conservation offices, and other community amenities. Glenorchy's popularity as a visitor destination has seen its residential population increase substantially over recent decades, and this is projected to continue. The growing population and resulting demand for development increases the community's exposure to the surrounding hazards.

Lower Buckler Burn November 1999.

The lower margins of Glenorchy showing lake inundation on 19 November 1999.

Glenorchy's hazardscape

Glenorchy and its surrounding environment have a complex hazard setting (Figure 1). The township is at risk of inundation from high lake levels, as well as debris flows and flooding from the Buckler Burn, Bible Stream and the Rees and Dart Rivers. Mass movement and earthquake - related hazards also have the potential to affect not only the township, but infrastructure and access routes that the community is dependent upon.

Glenorchy's remote location, in a geologically active alpine area, raises the community's risk profile due to the potential for isolation. Further development within the township and future changes in climate will increase this risk. Therefore, Glenorchy's increasing population as well as the dynamic and changing nature of its surrounding environment, has prompted a study of these matters; to raise awareness of the community's vulnerability and to inform decision-making. The study is described in the document *Natural Hazards at Glenorchy* and is summarised here.

Figure 1: Glenorchy and its surrounding hazardscape (Background image courtesy of GNS Science).

Environment setting

The Glenorchy community is situated on the lower slopes of the Richardson Mountains and is located entirely on an alluvial fan previously deposited by the Buckler Burn (Figure 2). This landform has been created by debris and flood flows; processes which still occur today, although more recently being confined to the currently active part of the Buckler Burn fan-delta.

The highest part of the alluvial fan is the section of the township located beside the main Queenstown – Glenorchy road. The land slopes away on either side of this higher section; towards the lake to the west, and towards the Richardson Mountains to the east (Figure 3). It is these lower-lying areas which can be most affected by floodwaters, either from lake or river flooding.

The braided floodplains of the Dart and Rees Rivers, which lie to the north of Glenorchy, deliver large quantities of sediment into Lake Wakatipu. These catchments are made up of highly erodible schist which is carried down valley by the rivers, and eventually deposited into the head of Lake Wakatipu. Sediment deposited into the lake has formed two deltas which have advanced southwards into the lake by up to 200 metres since the late 19th century. The advance of these deltas is a natural process that will continue into the future.

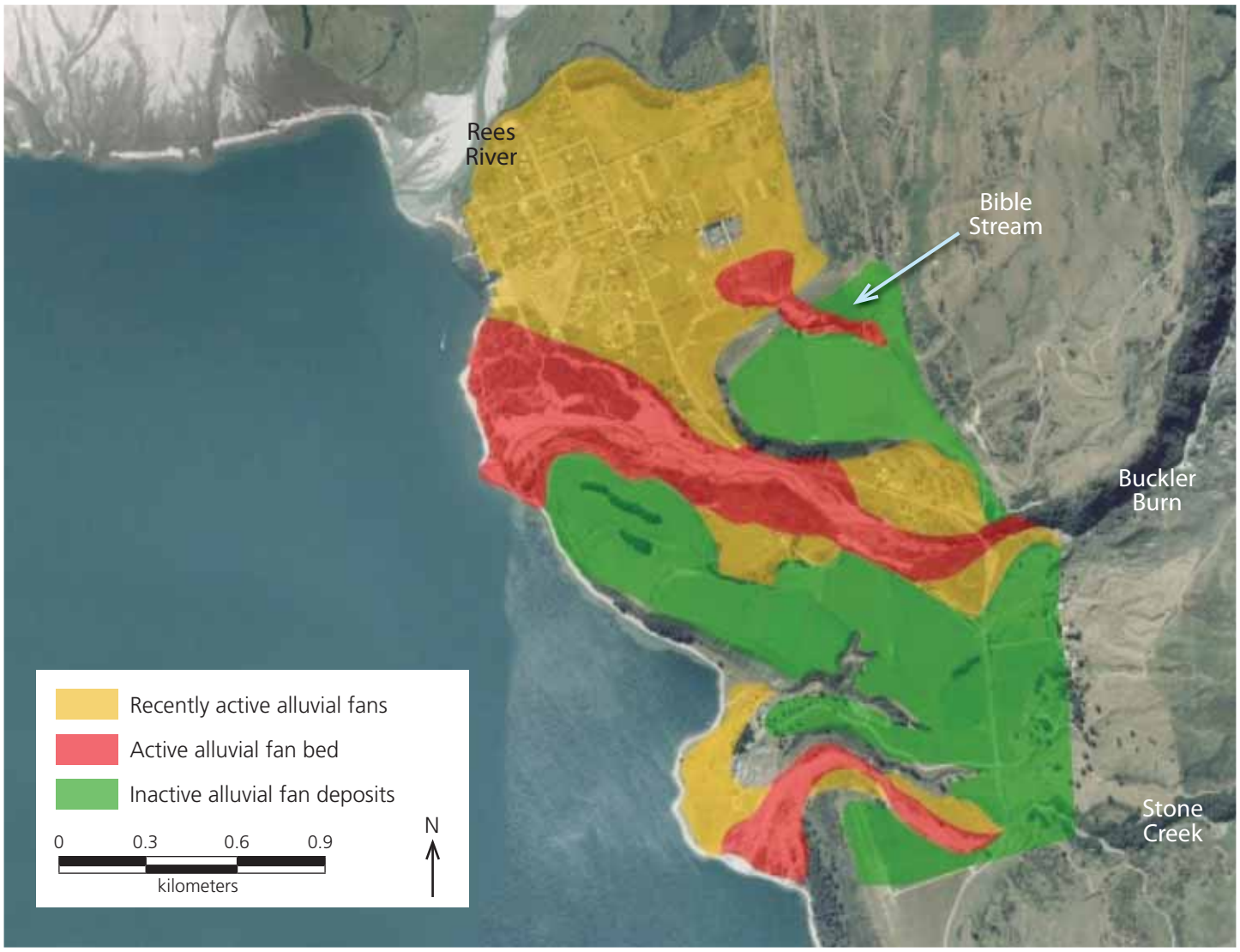

Figure 2: Underlying landforms at Glenorchy and its surrounds.

Figure 3: Digital Elevation Model and contour information representing the underlying topography of Glenorchy; yellow arrows indicate the slope of the land.

Figure 4: The lower Buckler Burn showing significant sedimentation following the November 1999 flood event.

Flood hazard

Inundation from high lake levels, as seen in the November 1999 flood event, is a risk due to the lake remaining at high levels for prolonged periods, usually days to weeks. The lower parts of Glenorchy begin to be inundated when the lake level reaches 311 metres above mean sea level. This level is approximately 1 metre higher than the annual average lake level of 310 metres. The nature of lake flooding and how the community can cope with the associated effects are described in a joint strategy prepared by Otago Regional Council and Queenstown Lakes District Council (ORC & QLDC, 2006).

Flooding from the Rees River, the Buckler Burn and the Bible Stream also have flood hazards that may impact Glenorchy. The Rees River and Buckler Burn deltas are steadily advancing into Lake Wakatipu. As these features continue to advance they are expected to combine into one large delta complex, raising the level of the river bed adjacent to Glenorchy and possibly causing the Rees River to alter its course towards the township. Also, large amounts of sediment from the Buckler Burn can raise its bed significantly (Figure 4) and could cause the channel to flow down the main road towards Glenorchy. A landslide dam in the upper Buckler Burn catchment (Figure 5) was discovered in 2004.

Figure 5: The Buckler Burn Landslide Dam in 2004 looking upstream.

The frequency and magnitude of flood events is closely related to the rainfall events from which they are derived. Climate scientists have a reasonable level of confidence that average annual rainfall in the north-west of Otago will increase during the coming century (MfE, 2008). Heavy rainfall events are also projected to become more frequent, and may become more intense[1].

[1] Note that these projections may change into the future, as our understanding of the effects of a warmer climate improves.

Earthquakes and seismic hazards

Earthquakes occurring close to or far away from Glenorchy present a hazard to the community. The level of risk depends on the size, distance, depth and type of earthquake and nature of the underlying ground that the community is located upon. Earthquakes can generate both direct and indirect hazards which may impact Glenorchy, including fault movements, landslides, ground movement through the lateral spreading or liquefaction of sediments and lake seiche, where large waves are created in the lake from significant shaking. Seismic hazards that can impact the Glenorchy area are most likely to originate on the Alpine Fault with other faults such as the Nevis-Cardrona also posing a risk.

Mass movement

Mass movements in the form of landslides and rock falls are not significant near the township. Rather, large schist landslides and steep slopes along the Queenstown-Glenorchy Road have the potential to isolate the community. Also, large landslides failing into the lake or under the lake surface may create large waves that could inundate the community.

Summary

Glenorchy is susceptible to a varied range of natural hazards. The report *"Natural Hazards at Glenorchy"* describes these in more detail and discusses their variable and dynamic nature. While many of these hazards are known and, in some instances well understood, factors such as future climate change will alter the nature and frequency of these hazards..

The lower margins of Glenorchy showing lake inundation on 19 November 1999.

Sedimentation resulting from the November 1999 flood event across the Bible Stream alluvial fan.

References

Ministry for the Environment (MfE) (2008) Preparing for climate change. A guide for local government.

ORC & QLDC (2006) Learning to Live with Flooding: A Flood Risk Management Strategy for the communities of Lakes Wakatipu and Wanaka, Joint Publication by Otago Regional Council and Queenstown Lakes District Council.

ORC (2010) Natural Hazards at Glenorchy

Glossary

Alluvial fan
Landforms which develop where a steep gully emerges from its confines onto a flatter valley floor, or at other sites where sediment accumulates in response to changes in stream gradient and/or width.

Delta
A fan-shaped alluvial deposit at a river or stream mouth formed by the deposition of successive layers of sediment.

Seismic hazard
Hazards derived from effects of an earthquake.

Mass movement
The downhill movement of surface materials under the influence of gravity often induced or assisted by increased saturation of the slope.

Seiche
A wave that oscillates in lakes, bays, or gulfs from a few minutes to a few hours as a result of seismic or atmospheric disturbances.

Liquefaction
The process by which sediments and soils collapse from a sudden loss of cohesion. Deposits lose strength after being transformed to a fluid mass, often by seismic shaking.

Sedimentation resulting from the November 1999 flood event across the Bible Stream alluvial fan.

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