Roxburgh Debris Flood Study

Report summary | 2026

Otago Regional Council

WSP

What are debris floods and what causes them?

Debris floods are fast-moving flows of water and debris that can cause harm to people and property. These floods have historically been an issue for the town of Roxburgh and the surrounding area in the Teviot Valley. Over a long time, debris material has built-up along the base of the Old Man Range into cone-shaped landforms known as alluvial fans.

The Otago Regional Council commissioned WSP New Zealand Limited to assess the hazards and risks of debris floods for 13 catchments draining from the Old Man Range in the Teviot Valley between Slaughterhouse Creek in the north and Stevensons Creek in the south. This included investigating how far the debris might travel and what is potentially at 'risk' — or, in other words, the chance that a debris flood event will impact things like people and buildings.

Debris floods are an issue for the Roxburgh area because of a combination of factors. The catchments in the study area are steep, actively eroding, and covered in pasture or tussock, meaning there is plenty of loose material available for future debris floods. The catchments in the Roxburgh area have a range of flood types, and not every flood will be a debris flood event — a debris flood needs a triggering rainfall event, such as a severe thunderstorm which brings very heavy rainfall in a short amount of time. These intense rainfall events can readily develop along the Old Man Range. When these factors combine, loose material is picked up by the floodwater and transported downstream. When the debris floods leave the steep hills and cross the river terraces, the floods slow down and start depositing debris. This can block the stream channel, causing the floodwater to spill out over the stream banks and flow overland, depositing more debris over the alluvial fan surface.

What do past debris floods tell us?

Records of historical debris flood activity in the area give us insights into more recent events — which is important to understand what parts of the fans were affected and what the impacts were. The layering of sand and gravel deposits preserved beneath the ground surface has also provided information about past events.

The shape and size of the alluvial fans is the result of the build-up of debris from many flood events over time. The history of the alluvial fans includes a range of floods with varying amounts of debris material, and during big events — like those in 1978 and 2017 — properties, buildings, and infrastructure can all be impacted.

October 1978 Debris Flood, Reservoir Creek

November 2017 Debris Flood, Reservoir Creek

Which areas of each fan are more likely to be affected?

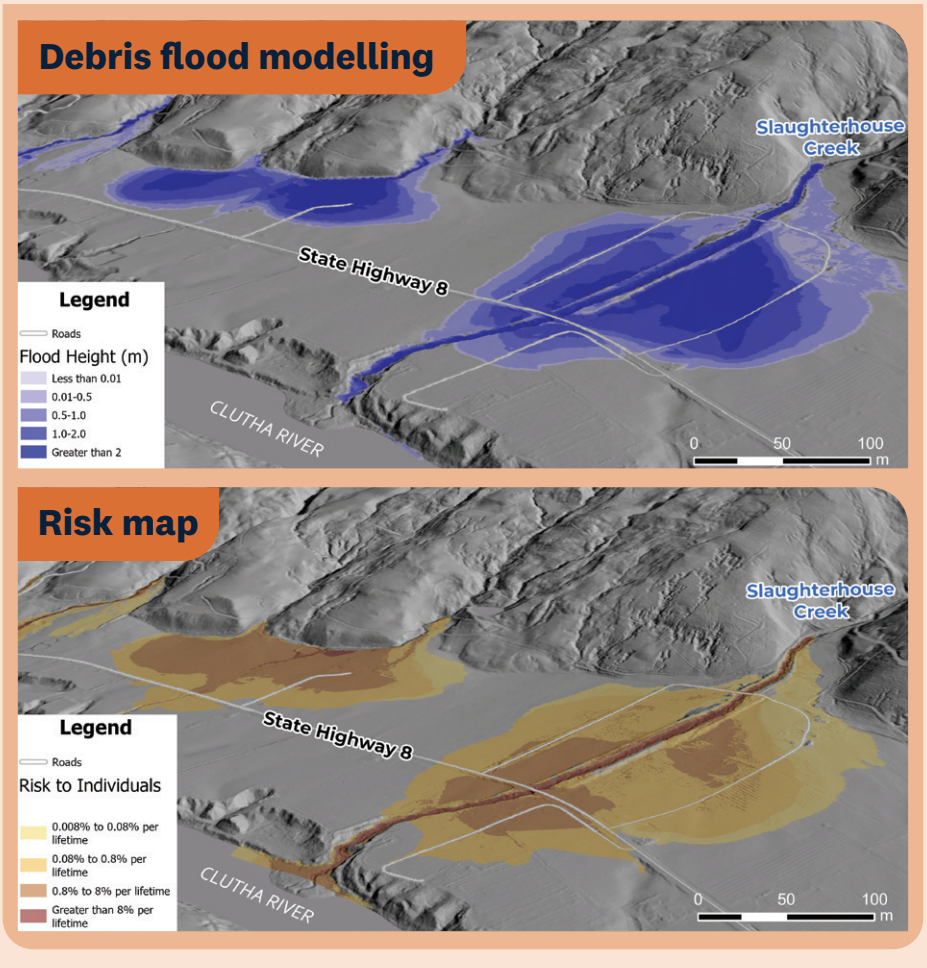
Over the history of an alluvial fan, smaller floods are more common, and very large floods are rare. Therefore, the area affected by any one debris flood event will vary. To map which areas of the alluvial fans are most likely to be affected by debris floods, computer simulations were used to predict where the floods will travel if they overtop the stream bank and flow over the ground surface. Three different sizes of debris floods were estimated for each alluvial fan, including estimates of debris flood volumes, peak flows, and how often the triggering rainfall event might occur. Debris flood hazard maps show the estimated inundation depth within the drainage channel and in the runout area across the fan surface for three sizes of floods.

How could people and places be affected by debris floods?

The models identified the areas on each alluvial fan that are more likely to be flooded by debris in future flood events. When combined with information about how often these events occur, and what the impacts might be on people and buildings, the risk maps provide estimated risk values for the affected area of each fan. The risk value represents the chance buildings or individuals have of being impacted by a debris flood in a given timeframe:

'10 to the negative ... per year'	Is the same as ... (per year)	Is the same as once in ...	Is the same as ... (80-year lifetime)
10^{-2}	1%	100 years	80% per lifetime
10^{-3}	0.1%	1,000 years	8% per lifetime
10^{-4}	0.01%	10,000 years	0.8% per lifetime
10^{-5}	0.001%	100,000 years	0.08% per lifetime
10^{-6}	0.0001%	1,000,000 years	0.008% per lifetime

The maps to the right provide examples of a) the debris flood hazard modelling, and b) the estimated risk to individuals for alluvial fans to the north of Roxburgh township. Similar information for other alluvial fans in this study can be found in the technical report at **orc.govt.nz/roxburghhazards**



Debris flood modelling (top right) and a risk map (right) for Slaughterhouse Creek and adjacent catchments north of Roxburgh township.

How to reduce future debris flood impacts?

There are a range of different options available to help manage debris flood impacts:

- **Physical structures** like barriers, channels to redirect flows, and stronger and larger capacity culverts can help control water and debris during heavy rain. These options can be expensive to construct, will often require sufficient space to be effective, and require detailed design work and regular maintenance to ensure they remain effective over a long period of time.
- **Non-structural measures** such as early warning systems, community education, and regular clearing of the existing stream channels and culverts can be practical and cost-effective ways to help reduce the impacts of debris floods, especially for a small, well-connected community like Roxburgh.
- **Planning tools** like zoning rules and preserving natural buffer areas around the creeks can provide long-term protection by avoiding intensive development within areas that are most likely to be affected by debris floods. These require robust council policies and community support to implement.
- **Long-term adaptation and resilience** such as preparing communities and households, allocating resources to strengthen resilience, embedding local knowledge and mana whenua values in planning, and promoting collaboration among agencies and communities.

Overall, this study helps us understand where debris floods are most likely to happen in the study areas around Roxburgh and what can be done to manage the risks, so we can keep people, homes, and essential services safe now and in the future. Any options to manage risks are still to be decided.

Base of alluvial fan at Reservoir Creek where it meets the Clutha River/Mata-Au