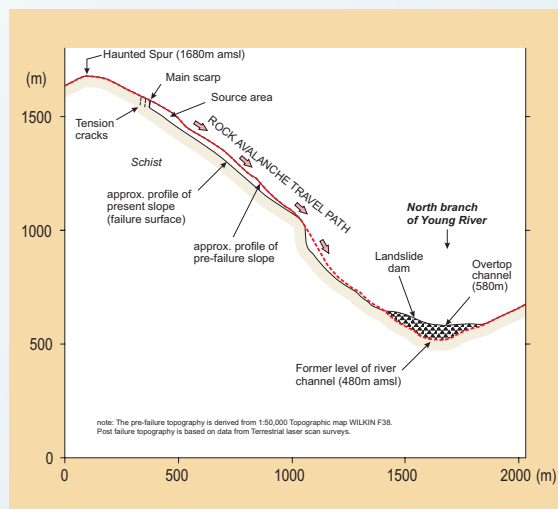


Introduction

The North Branch of the Young River, near Lake Wanaka, New Zealand, was blocked by a large landslide at 4:40 am on 29 August 2007. The debris avalanche occurred in closely jointed schist, forming a dam 70 m high across the valley. Water immediately began impounding behind the dam and has now overtopped, scouring an outflow channel on the downstream face of the dam.



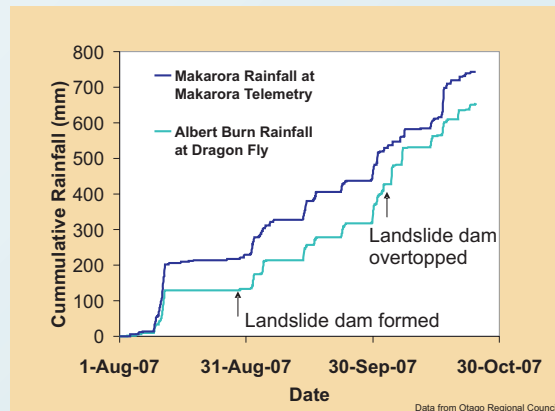
Cross section of Young River debris avalanche and landslide dam



Solar panels provide power to lake level monitoring instrumentation and communication equipment.



View of landslide and dam looking north west.



Young River area rainfall data.

The source of the avalanche was located on what is locally referred to as Haunted Spur, above the river's true right bank. The main scarp is at an elevation of 1600 m, with an elevation difference (between the top of the source area and toe of the debris) of 1100 meters. Several terrestrial laser scans (TLS) of the landslide dam (deposit) and source area (using a RIEGL LMS-Z420i scanner) have been carried out. These data have been used to generate a three-dimensional model of the landslide deposit. This model has been compared with the pre-failure topography, to calculate the landslide and lake volumes. This information has been used by both GNS scientists and emergency management officers at the Otago Regional Council and has provided essential information for assessing its future stability as a dam.

The dam is about 70 metres high at the outflow and the impounded lake is approximately two kilometres in length and 500 metres at its widest point. Water overtopped the dam on Friday 5 October, approximately 5 weeks after its formation. Water continues to flow over the dam crest and has scoured material from along the outflow channel after periods of high rainfall and associated outflows. Equipment to remotely monitor the lake level has been installed.

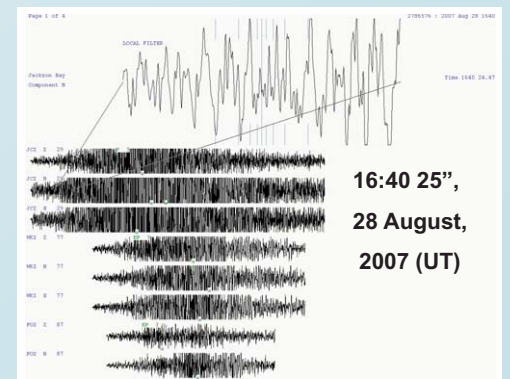


View of landslide debris forming dam, looking north west.

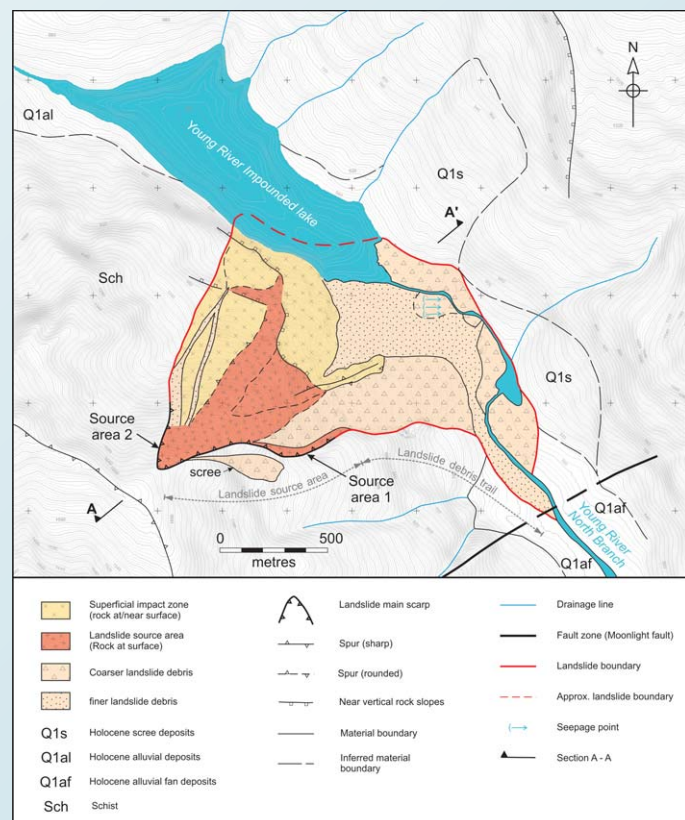
Summary of Key Facts

Location	Young River Landslide, North Branch Young River (Mount Aspiring National Park), New Zealand, which is a tributary of the Makarora River.
Initiation Date/time	04:40 on 29 August 2007
Trigger	No obvious trigger (no rainfall three weeks prior to initiation and no earthquakes recorded)
Landslide Volume	11 Million m ³
Velocity	100 km/hour (minimum)
Runout distance	1.8 km
Impounded Lake Volume	23 Million m ³
Dam height (at outflow channel)	70 m

The Young River landslide is in a remote headwater tributary of the Makarora River and was first recognised by a helicopter pilot three weeks after initiation. Seismic shaking generated by the landslide was the equivalent of a magnitude 2.9 earthquake, and was recorded by the GeoNet seismic network. Debris from the landslide travelled approximately 1.8 kilometres in 60 seconds, suggesting a minimum debris speed of 100km/hour.



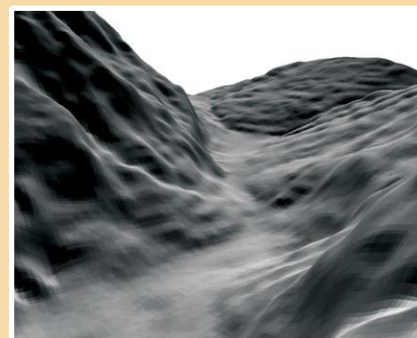
Seismic trace generated by the landslide.



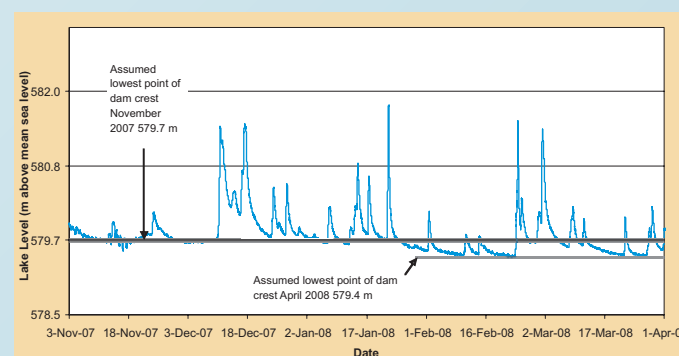
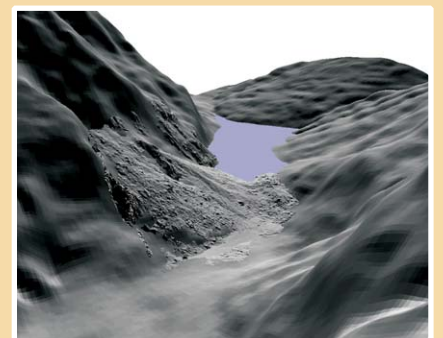
Engineering geological map of the landslide.



Using a tripod-mounted laser scanner, geologist Chris Massey and surveyor Neville Palmer, both of GNS Science, have measured the volume of the landslide at 11 million cubic meters.



These images show the 3D model before, and after the landslide.



Young River lake level monitoring data.

Discussion

Rapid dam failure during high outflows remains possible. The maximum outbreak flow rate for such a failure could be as high as 3500 m³s⁻¹ (estimated from Costa/Schuster empirical relationship). Any flood wave would attenuate as it moves down the Young valley to the Makarora confluence. Given this the Department of Conservation have closed access to the lower Young River to ensure public safety, and the Otago Regional Council is monitoring the situation to manage the safety of people in the Makarora Valley. GNS Science is providing information gathered from our monitoring to both Department of Conservation and the Otago Regional Council.

Failures associated with overtopping are more likely to occur during periods of heavy rain when lake discharge flows will be added to high flood flows in the Young and perhaps in the Makarora Rivers. Unusual water surface elevations and sediment deposition may occur in the Makarora River as a result, both upstream and downstream of the confluence. It is likely that the Makarora River will be deflected east at the Young confluence if a flood were to occur. However, it is also possible the dam and lake could be part of the landscape for a long time.