

State highway resilience

Lessons learnt from Kaikōura

July 2017

The NZ Transport Agency has been working to understand and enhance the resilience of its state highway network to natural hazards.

As part of this work, the Transport Agency commissioned a national scan of the resilience of the state highway network to a range of low frequency, high impact natural hazard events. This was completed in December 2016. (see maps at <https://nzta.maps.arcgis.com/apps/MapSeries/index.html?appid=5a6163ead34e4fdab638e4a0d6282bd2>)

KAIKŌURA EARTHQUAKE OPPORTUNITY

The 14 November 2016 Kaikōura earthquakes severely affected SH1 and other roads in the area.

The Transport Agency took the opportunity to run a further study to compare the effects of the Kaikōura earthquakes against national scan assessments.

We learnt that when compared to post-Kaikōura quakes assessments, the national scan assessments were fairly accurate. This meant that expected availability of roads

after an event were consistent with what happened after the Kaikōura quakes.

And that while not every section of a high-risk road was affected or closed after an event, this has little effect on the availability of the route as a whole.

Another key observation was that earthquakes loosen slopes, create instabilities and generate debris in catchments due to slope failures. This leads to greater potential for subsequent landslides and debris flows in future storm events which would not have occurred pre-earthquake.

As a result, the pre-earthquake resilience assessments do not fully reflect the post-earthquake vulnerability to storms, where storms lead to debris flows and landslides due to loosened ground. This was evident in the landslides and debris flows from the April 2017 storms in the area.



Major slip (#8) Okiwi Bay, north Kaikōura coast

Observations and learnings

This is a small selection of other observations and learnings drawn from the review:

- **High steep cut slopes**, particularly along the Kaikoura coast, but also elsewhere (eg Awatere Valley) suffered severe damage leading to closure of the routes for long periods of time.
- **Retaining walls**, particularly low height gabion and crib walls, performed poorly leading to loss of part of the road. Concrete sea walls performed better than expected, though some failed leading to partial loss of the road.
- **Bridges** generally performed well, although they experienced damage, and partial access was able to be restored in most instances with weight and lane restrictions. Some bridges were closed such as the Oaro rail overbridge.
- **Fault rupture** and the resultant ground displacement of few to several metres cut off access along the route. Temporary access was able to be restored quickly within days. Full restoration will take much longer.
- **Safety hazards** such as potential for rockfall can compromise availability of the route, even when the route is not closed, until the source areas for rock fall can be made safe, by scaling, sluicing or rock anchoring.

- **Ongoing aftershocks** can cause further failures affecting the outage duration after an earthquake.

The full review can be seen on [www.nzta.govt.nz](http://www.nzta.govt.nz/assets/Highways-Information-Portal/Technical-disciplines/Resilience/Resilience-evaluation-process/NZTA-National-Resilience-Lessons-from-2016Earthquake-Report-June-2017.pdf) under resilience planning tools (nzta.govt.nz/assets/Highways-Information-Portal/Technical-disciplines/Resilience/Resilience-evaluation-process/NZTA-National-Resilience-Lessons-from-2016Earthquake-Report-June-2017.pdf).



Fault rupture damage at Waipapa Bay, north Kaikōura coast



Slip at Ohau Point, north Kaikōura coast



For further information visit the NZ Transport Agency website

www.nzta.govt.nz/roads-and-rail/highways-information-portal/technical-disciplines/resilience-project/
or email resilience-infrastructureplanning@nzta.govt.nz.