Probabilities of aftershocks and larger events for the 2010 Darfield earthquake based on average behaviour of New Zealand earthquakes

We applied three standard aftershock models to calculate the mean number of expected aftershocks following the Darfield earthquake. We have calculated forecasts for the following magnitude ranges: 5.0–5.9; 6.0–6.9; and 7.0 and larger.

The forecasts are provided for the following time periods starting from 12:00 a.m. Monday, September 20th, 2010: one week, one month and one year. This is 15.8 days after the M=7.1 Darfield earthquake.

We have used the mean number of expected aftershocks to calculate the Poisson probability of the occurrence of one or more aftershocks in that magnitude range for each time period. The table below shows the ranges of probabilities for the three models.

Magnitude 5.0–5.9			Magnitude 6.0–6.9			Magnitude 7+		
1 week	1 month	1 year	1 week	1 month	1 year	1 week	1 month	1 year
39–68%	75–96%	89–100%	5.8–10%	16–24%	37–57%	0.8–1.1%	2.4–3.0%	6.4–8.8%

The National Seismic Hazard Model gives the following probabilities based on the distributed/background seismicity and the fault model. These probabilities consider any source (background or fault) with a probability of producing some level of ground shaking in Christchurch and include sources from outside of Canterbury.

M 6.0–6.9 in one year: ~26%; M 7+ in one year: ~4%

While it is difficult to come with a direct comparison, these numbers show an elevated level of hazard will persist well past one year.

The likelihood of larger aftershocks tails off in much the same way as the aftershock plots shown on the GeoNet website and included below.

Daily Number of Aftershocks of Magnitude 4 – 4.9