Earthquake Commission
Insurance Liability Valuation as at 31 December 2011

29 March 2012

Appendices
A  Canterbury earthquakes

A.1  Background

There have been over 10,000 aftershocks in the Canterbury region since the Darfield earthquake on 4 September 2010 (EQ1). GeoNet had recorded 322 of magnitude over 4.0 to the end of December 2011.

The map below indicates the locations of events with magnitude 3.0 or greater.

Previous studies of earthquakes in the Canterbury region had indicated that there was potential for relatively rare large earthquakes (approximately magnitude 8) to occur along the Alpine fault with more frequent moderate earthquakes (around magnitude 6-7.5) expected in the Canterbury Plain foothills and North Canterbury area. Less frequent moderate earthquakes were predicted to occur under the Canterbury Plains and Christchurch itself.

In the past 20 years the University of Canterbury has identified over 100 earthquake faults and source-structures in the Canterbury region. Although continual mapping of faults is occurring across the country it is generally agreed in the earth science community that not all active faults in New Zealand have been identified. The Darfield quake was caused by movement along a pre-existing but previously un-recorded fault line beneath the Canterbury plains that has now been named the Greendale fault.

EQC has received claims related to aftershocks on at least 15 different dates following the Darfield event. These are listed in the table below. It should be noted that on several days there were in fact several shocks within a short period of time, the details are noted for the largest event.
There have been two major events that have given rise to such high aggregate cost to EQC as to trigger response from its reinsurance programme. These occurred on 4 September 2010 and 22 February 2011; we have designated these as EQ1 and EQ2. Other significant events in regard to EQC claims occurred on 13 June 2011 (EQ3) and 23 December 2011 (EQ4). The claims arising from the other events do not appear to be high and so all other events are grouped under ‘Other’ in this report.

It should be noted that events prior to 31 May 2011 fall into the 2010 / 2011 reinsurance year, but the June events fall into the 2011 /12 reinsurance year. (For details of EQC reinsurance programme see Appendix F.)
A.2  EQ1 - 4 September 2010

Date/Time  04/09/2010 4:35am  
Magnitude  7.10  
Depth  10.46 km  
Lat  -43.524790  
Lng  172.187310  

Address  140 metres from Barrys Rd, Charing Cross 7571, New Zealand  
Distance  The distance from Cathedral Square is 37.9 km. Want to see how far from your house?  

Source:  http://www.canterburyquakealive.co.nz

This was the first major earthquake in the series that has affected Canterbury in recent years. It occurred at 4.35am on Saturday 4 September 2010 (local time). The magnitude has been estimated as 7.1 on the Richter scale. The epicentre was 10km south-east of Darfield and 40km west of Christchurch.

The fault rupture in the ground surface can be traced for about 25kms, from Hororata to Rolleston. Land displacement of up to 4.6m horizontally and 1.5m vertically has been measured across largely rural properties.

The focal depth was only 11km, which is relatively shallow and so likely to give rise to high levels of intensity in surrounding areas. Even so, the effects of the ground motion varied considerably depending on the geology of the area. Severe shaking was felt for over 15 seconds on firm soils in central Christchurch and more in less stable areas. GNS reported that ground shaking from this quake was the strongest recorded to date in New Zealand, being up to 1.25 times the acceleration due to gravity close to the epicentre. (It was about 25% of gravity in the central city).
Indications are that buildings conforming to the most recent building codes performed satisfactorily. As had been expected, wooden structures and modern buildings performed better than brick buildings. However, many older brick buildings collapsed or were very severely damaged. Brick chimneys suffered cracks and many fell creating further damage.

Hazard studies of the region had identified areas of historic liquefaction and indicated certain areas as having a high potential for liquefaction. However, the extent of liquefaction from this event was unexpectedly severe in a few localised areas. There are five main factors used to assess the likelihood that soils will liquefy. These are the strength of ground shaking, duration of shaking, depth of the water table, soil properties (grain size and density), and confining pressures. In Christchurch the potential for liquefaction is highly dependent on the depth of the water table, which is variable across the city and at different times of year. Not all areas identified in the studies appear to have been affected badly by this quake, but some, including Kaiapoi, experienced especially bad liquefaction.

There were many places where ground settlement occurred, including those where sand and water were ejected. In some places, buried services and structures floated to the surface (e.g. manholes in Brooklands). It was expected that consolidation of the loose soil and silt would continue in those areas for some weeks. Areas affected by lateral spreading (or land slippage), which occurred close to streams, rivers and beaches, causing severe damage to the affected land and the buildings on it included Avonside, Avondale and Kaiapoi.