The table below summarises the results of the two apportionment approaches.

<table>
<thead>
<tr>
<th></th>
<th>EQ1 $m</th>
<th>EQ2 $m</th>
<th>EQ3 $m</th>
<th>EQ4 &amp; AS $m</th>
<th>Total $m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MJW ILVR approach</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADE</td>
<td>1,412</td>
<td>3,095</td>
<td>289</td>
<td>211</td>
<td>5,008</td>
</tr>
<tr>
<td>EQR</td>
<td>784</td>
<td>1,181</td>
<td>123</td>
<td>106</td>
<td>2,194</td>
</tr>
<tr>
<td>CHE</td>
<td>414</td>
<td>468</td>
<td>118</td>
<td>147</td>
<td>1,147</td>
</tr>
<tr>
<td><strong>Total paid</strong></td>
<td>2,611</td>
<td>4,745</td>
<td>529</td>
<td>464</td>
<td>8,349</td>
</tr>
<tr>
<td><strong>EQC Loss Run</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADE</td>
<td>1,413</td>
<td>3,097</td>
<td>297</td>
<td>192</td>
<td>4,999</td>
</tr>
<tr>
<td>EQR</td>
<td>462</td>
<td>1,156</td>
<td>406</td>
<td>171</td>
<td>2,195</td>
</tr>
<tr>
<td>CHE</td>
<td>403</td>
<td>449</td>
<td>125</td>
<td>168</td>
<td>1,145</td>
</tr>
<tr>
<td><strong>Total paid</strong></td>
<td>2,278</td>
<td>4,702</td>
<td>828</td>
<td>531</td>
<td>8,339</td>
</tr>
<tr>
<td><strong>MJW ILVR - EQC Loss Run</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADE</td>
<td>-1</td>
<td>-1</td>
<td>-9</td>
<td>19</td>
<td>9</td>
</tr>
<tr>
<td>EQR</td>
<td>322</td>
<td>24</td>
<td>-283</td>
<td>-65</td>
<td>-1</td>
</tr>
<tr>
<td>CHE</td>
<td>11</td>
<td>19</td>
<td>-7</td>
<td>-21</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total paid</strong></td>
<td>333</td>
<td>43</td>
<td>-299</td>
<td>-67</td>
<td>10</td>
</tr>
</tbody>
</table>

From the above table it is clear that the EQC Loss Run approach has a higher weighting of EQR costs for EQ3 and EQ4 and less for EQ1.

**Impact on reinsurance**

The differences noted above are a known issue and it has been recognised that the current attribution of EQR claim payments in the EQC Loss Run Report is not reflective of how these payments should be apportioned.

EQC is actively developing a loss run report that utilises ACE data to apportion paid building claims. This work is expected to resolve the differences noted above by 30 June 2015.

There should be no impact on the expected ultimate reinsurance recoveries (as shown in this report) subject to variations in the expected gross ultimate claims costs.

The only impact that reinsurers should experience is a timing issue in that the amount which has been called in respect of EQ1 to date is less than it should be.
1.11.9 **Outstanding claims liabilities – all claims**

The table below summarises the key components of the OS claims liabilities as at 31 December 2014. A more detailed breakdown is set out in Section 7.6.

The net discounted outstanding claims liability at a probability of adequacy of 85% is $2,758b. The largest component of the liabilities is in respect of EQ2.

### All EQC claims

<table>
<thead>
<tr>
<th>Estimated outstanding claims liabilities (OSCL) - 31 December 2014</th>
<th>EQ1 $m</th>
<th>EQ2 $m</th>
<th>EQ3 $m</th>
<th>EQ4 $m</th>
<th>AS $m</th>
<th>BAU $m</th>
<th>Total $m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gross outstanding claims liabilities - central estimate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross claims including CHE, undisch.</td>
<td>707</td>
<td>1,967</td>
<td>329</td>
<td>105</td>
<td>65</td>
<td>24</td>
<td>3,218</td>
</tr>
<tr>
<td>Discounting</td>
<td>(15)</td>
<td>(42)</td>
<td>(7)</td>
<td>(2)</td>
<td>(1)</td>
<td>(0)</td>
<td>(68)</td>
</tr>
<tr>
<td>Gross claims including CHE, discounted</td>
<td>692</td>
<td>1,945</td>
<td>322</td>
<td>103</td>
<td>63</td>
<td>23</td>
<td>3,149</td>
</tr>
<tr>
<td><strong>Reinsurance recoveries - central estimate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reinsurance recoveries, undisch.</td>
<td>697</td>
<td>(0)</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>697</td>
</tr>
<tr>
<td>Discounting</td>
<td>(15)</td>
<td>0</td>
<td>(0)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(15)</td>
</tr>
<tr>
<td>Reinsurance recoveries, discounted</td>
<td>681</td>
<td>-</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>681</td>
</tr>
<tr>
<td><strong>Net outstanding claims liabilities - central estimate</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net claims excluding BAU CHE, undisch.</td>
<td>11</td>
<td>1,967</td>
<td>329</td>
<td>105</td>
<td>65</td>
<td>11</td>
<td>2,509</td>
</tr>
<tr>
<td>Non-reinsurable CHE, undisch.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>12</td>
</tr>
<tr>
<td>Net claims including CHE, undisch.</td>
<td>11</td>
<td>1,967</td>
<td>329</td>
<td>105</td>
<td>65</td>
<td>24</td>
<td>2,521</td>
</tr>
<tr>
<td>Discounting</td>
<td>(0)</td>
<td>(42)</td>
<td>(7)</td>
<td>(2)</td>
<td>(1)</td>
<td>(0)</td>
<td>(53)</td>
</tr>
<tr>
<td>Net claims including CHE, discounted</td>
<td>11</td>
<td>1,945</td>
<td>322</td>
<td>103</td>
<td>63</td>
<td>23</td>
<td>2,468</td>
</tr>
<tr>
<td><strong>Net outstanding claims liabilities - risk margin, 85% PoA</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net risk margin, diversified</td>
<td>1</td>
<td>229</td>
<td>38</td>
<td>12</td>
<td>7</td>
<td>3</td>
<td>290</td>
</tr>
<tr>
<td><strong>Net OSCL and risk margin 85% PoA, discounted</strong></td>
<td>12</td>
<td>2,174</td>
<td>360</td>
<td>115</td>
<td>71</td>
<td>26</td>
<td>2,758</td>
</tr>
</tbody>
</table>
1.11.10 Outstanding claims liabilities – movement since 30 June 2014

The net of reinsurance OSCL (85% probability of adequacy, discounted) has decreased from $3.353b at 30 June 2014 to $2.758b at 31 December 2014. A summary of the change is shown below with more detail in Section 7.5.

<table>
<thead>
<tr>
<th>All EQC claims</th>
<th>Reconciliation of change in outstanding claims liability from 30 June 2014 ILVR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net OSCL (85% PoA, discounted) as at 30 June 2014</strong></td>
<td><strong>EQ $m</strong></td>
</tr>
<tr>
<td>Remove net risk margin (85% PoA)</td>
<td>(280)</td>
</tr>
<tr>
<td><strong>Net OSCL (central estimate, discounted) as at 30 June 2014</strong></td>
<td>2,982</td>
</tr>
<tr>
<td>Remove discounting</td>
<td>42</td>
</tr>
<tr>
<td><strong>Net OSCL (central estimate, undiscounted) as at 30 June 2014</strong></td>
<td>3,024</td>
</tr>
<tr>
<td>Estimated net paid over period</td>
<td>(511)</td>
</tr>
<tr>
<td>Change in net actuarial determination</td>
<td>(16)</td>
</tr>
<tr>
<td><strong>Net OSCL (central estimate, undiscounted) as at 31 Dec 2014</strong></td>
<td>2,497</td>
</tr>
<tr>
<td>Add discounting</td>
<td>(53)</td>
</tr>
<tr>
<td><strong>Net OSCL (central estimate, discounted) as at 31 December 2014</strong></td>
<td>2,445</td>
</tr>
<tr>
<td>Net diversified risk margin (85% PoA, discounted)</td>
<td>288</td>
</tr>
<tr>
<td><strong>Net OSCL (85% PoA, discounted) as at 31 December 2014</strong></td>
<td>2,732</td>
</tr>
</tbody>
</table>

The principal drivers of the change in total claims liabilities in decreasing order of impact are:

- Claim payments; net payments since 30 June 2014 have amounted to $538m.
- Actuarial determination; this has decreased by $50m on a net of reinsurance basis.
- Discounting; this has increased by $9m.

The increase in discounting is primarily as a result of the extended settlement pattern for land claims.

1.12 Key results – premium liabilities

1.12.1 Premium liabilities

The table below summarises the key results of the estimation of EQC’s premium liabilities as at 31 December 2014. The premium liabilities will be used in the liability adequacy test.

The total value at 75% probability of adequacy is $201m, considerably in excess of the $146m unearned premium reserve. This means that an additional unexpired risk reserve will be required in the accounts as at 31 December 2014.

The largest component ($93m, as compared to $111m as at 30 June 2014) relates to projected costs of future claims arising from Canterbury earthquakes during the period of the runoff of risks on the books as at 31 December 2014. If earthquake activity in the Canterbury area continues to reduce, it is expected that this component will also reduce over the next few years. The other claims costs relate to future BAU claims, major event claims as modelled by Minerva, and the associated reinsurance and administration expenses.
The cost to EQC of reinsurance has increased considerably for cover negotiated since the Canterbury events, and this is reflected in the calculations as shown below. The future reinsurance costs for unexpired risks are $76m.

### Estimated Premium Liabilities - 31 December 2014

<table>
<thead>
<tr>
<th></th>
<th>BAU $m</th>
<th>Minera $m</th>
<th>Cant EQ $m</th>
<th>Total $m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unearned premium reserve</td>
<td>142</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cost of future claims from unexpired risks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross claims, undiscounted - central estimate</td>
<td>18</td>
<td>41</td>
<td>71</td>
<td>131</td>
</tr>
<tr>
<td><strong>Administration and reinsurance costs for unexpired risks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Claims administration expenses</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Policy (non-claims) admin expenses for unexpired risks</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Future reinsurance costs for unexpired risks</td>
<td>0</td>
<td>52</td>
<td>23</td>
<td>76</td>
</tr>
<tr>
<td><strong>Reinsurance recoveries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reinsurance recoveries, undiscounted</td>
<td>0</td>
<td>(10)</td>
<td>(4)</td>
<td>(14)</td>
</tr>
<tr>
<td>Net premium liabilities, undiscounted - central estimate</td>
<td>22</td>
<td>87</td>
<td>95</td>
<td>205</td>
</tr>
<tr>
<td>Discounting</td>
<td>(0)</td>
<td>(2)</td>
<td>(2)</td>
<td>(4)</td>
</tr>
<tr>
<td>Net premium liabilities, discounted - central estimate</td>
<td>22</td>
<td>85</td>
<td>93</td>
<td>201</td>
</tr>
<tr>
<td>Diversified risk margin, discounted - 75% PoA</td>
<td>0</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td><strong>Net premium liabilities, discounted - 75% PoA</strong></td>
<td>201</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note that the reason that the risk margin is $0 is because the distribution of potential claims is very skewed, with many possible outcomes with small claims costs and a few very large possible events. As a consequence, the central estimate (mean) outcome is greater than the 75th percentile.

The outcome of the liability adequacy test is often taken as a proxy for the adequacy of the levies (premium rates) that are charged. Consequently, the outcome above suggests that the current levy rates are less than sufficient to cover the expected costs of claims. However:

- The expected claims costs are currently inflated due to the heightened seismic conditions in Canterbury.
- The central estimate claims costs may not be the best decision making tool for setting levy rates for such a highly skewed distribution.
- EQC’s considerations differ from private insurers and will include such factors as the Crown’s appetite for managing earthquake risk including pre and post-funding.

### 1.13 Data

#### 1.13.1 Sources

The most important sources of data for the investigations were:

- Data extracts from the ClaimCentre Claims Information Management System (‘CIMS’).
  - Data as at 1 December 2014 was used to inform the ultimate incurred claims costs.
  - Data as at 31 December 2014 was used to derive the net outstanding claims liabilities.
• Results of a special apportionments project carried out in 2011 and 2012 of 2,000 randomly sampled properties.

• ACE apportionment data from the BIU

• EQR paid data

• Claim-to-address mapping data from the BIU.

• Land cost calculations from EQC’s geotechnical engineering consultants, Tonkin & Taylor (T&T).

• Fletcher Construction completion cost data.

• Trial Balances as at 31 December 2014.

• A Minerva model run generated in January 2011.

• Discussions with EQC employees and contractors.

1.13.2 Adequacy and appropriateness

The completion of this valuation report requires many sources of data.

The demanding operational aspects of the Canterbury earthquake response and recovery have meant that the provision of data and information suitable for actuarial analysis is but one priority among many – consequently the data available for actuarial analysis has not been ideal.

However, as for previous investigations, we have sought alternative sources of data and chosen valuation methodologies that mitigate these data issues as much as possible.

1.14 Key uncertainties

1.14.1 General comment

The actual ultimate incurred claim costs arising from the Canterbury earthquake events will not be known until the last claim is settled.

There is inherent uncertainty in any estimation of any insurance liabilities – estimates of liabilities are based on assumptions derived from analyses of past experience and deviations from estimates are normal and to be expected. The estimates are therefore a probability statement rather than an absolute judgement.

1.14.2 Exceptional uncertainties arising from the Canterbury earthquakes

The Canterbury earthquakes have resulted in a higher than usual level of uncertainty associated with this valuation.

Some of the key sources of uncertainty are:

• The impact of multiple events on the allocation of damage, EQC coverage and EQC’s reinsurance coverage.

• Severe land damage and a very complex land claims environment from both engineering and legal perspectives.
Claims development. There has been considerable progress within EQC in regard to the operational aspects of assessing and settling claims, especially in trying to process land claims. However, for a number of reasons, outcomes of that progress cannot be fully reflected in the information available for the valuation, and so there remains residual uncertainty in the valuation results.

The potential for construction cost inflation to exceed expectations.

Consequently, at this stage of claims development, there is still a degree of unavoidable uncertainty regarding the future claims costs.

As noted in our previous reports, as the claims are settled and as the reasonableness of the model and its assumptions are refined and tested against the emerging claims experience, the level of uncertainty will reduce.

Some practical outcomes of the uncertainty associated with the valuation are:

- The actual claims outcome will differ to some degree from the estimates.
- There are confidence ranges in the estimated liabilities for each event.
- Different practitioners could legitimately arrive at quite different estimates of claims cost.

A more detailed description of uncertainty associated with this valuation – in particular arising from the Canterbury earthquakes - is set out in Section 11.

1.15 Key reliances

In completing this report, considerable reliance has been placed on data and information supplied to MJW by EQC and Tonkin & Taylor. The most important reliances were placed on the data sources listed in Section 1.13.

More details regarding data, information and reliances are set out in Section 3.

1.16 Quality control and risk management processes

The estimation of EQC's liabilities, particularly the building component, involves constructing multiple complex statistical models.

The data, methodology and results that drive, and are output from these models, undergo a variety of quality control and audit processes.

We undertake to ensure the robustness of these by:

- Internal peer review, including:
  - Detailed review of data, assumptions, methodology and results.
  - Periodic rotation of staff which allows, over time, a 'fresh set of eyes' over aspects of the valuation process.
- Data validation where possible to independent sources (e.g. management accounts, daily reports)
- Analysis of change in assumptions for reasonableness.
- Comparison of results to previous models and valuations.
- Comparing results to alternative models.
- External review, including
  - Discussions with EQC staff

1.17 Key recommendations

1.17.1 Progress against previous recommendations

Several recommendations were set out in the previous ILVR. The progress against these recommendations is as follows:

- Improve the quality of building claims data in ClaimCentre  Ongoing.

1.17.2 Current Recommendations

The key recommendation, from an actuarial estimate perspective, arising from this investigation is to continue to improve the quality of building claims data in ClaimCentre.

Further data recommendations are set out in Section 3.6.

1.18 Limitations

In this report we provide the results of our investigations together with an outline of the matters considered and the methods and assumptions applied to obtain these results. Opinions and estimates contained in this report constitute our judgement as at the date of the report.

This report must be read in its entirety. Individual sections of the report, including the Executive Summary, could be misleading if considered in isolation from each other.

This report is addressed to the management of EQC and should not be provided to or used by any other party (except as specified below) without the express written permission of MJW. This limitation has been provided with the intention of preventing the use of the report for purposes for which the analysis was not intended. MJW will not be liable for the consequences of any third party acting upon or relying upon any information or conclusions contained within this report.

MJW has agreed to a request from EQC that this report may be provided to EQC’s auditor (Deloitte), reinsurer broker (AON Benfield), reinsurers, legal counsel (Chapman Tripp), geotechnical engineers (Tonkin & Taylor) and the New Zealand Treasury. In agreeing to this request, we point out in particular that this report is addressed to EQC, and therefore we do not warrant or represent that any information, analysis or results set out in it are sufficient or appropriate for any other parties’ purposes. This report cannot substitute for any investigations that any other party may wish to carry out for its own purposes, and the authors of this report and MJW will not accept any liability to any other party arising from the use of this report.

1.18.1 Official Information Act (OIA)

It is also recognised that this report will be covered by the OIA and therefore may be released (subject to any redactions) to the public. It is noted however that we are advised there are grounds for EQC to withhold the ILVR under the OIA.

The limitations above also apply to any other reader of this report.
1.19 **MJW staff involved in the investigation**

The following MJW staff members were involved in some capacity during the course of the investigation:

- Craig Lough Principal
- Jeremy Holmes Principal (peer review)
- Actuary
- Analyst
- Analyst

1.20 **Level of detail and additional information**

In writing this report we have tried to strike a reasonable balance between describing what has been done and why, and keeping the report to a manageable size. Because of this, a considerable amount of detail has been either summarised at a high level or omitted.

Readers requiring more detailed information are invited to contact the authors of the report.

1.21 **Professional standards**

This report has been written to comply with Professional Standard No. 4.1 (Valuations of General Insurance Claims) of the New Zealand Society of Actuaries.

1.22 **Authors**

Craig Lough
Fellow of the NZ Society of Actuaries

Jeremy Holmes
Peer Review
Fellow of the NZ Society of Actuaries
2 Background

2.1 EQC structure and role

EQC is a NZ Government-owned Crown entity whose origins stretch back to 1945 and is currently established under the Earthquake Commission Act 1993 (‘the Act’) and associated schedules and regulations.

EQC’s role may be summarised as follows:

- To provide insurance against insured perils (see Appendix B).
- To administer the Natural Disaster Fund (NDF), including investments, and obtain reinsurance.
- To facilitate research and education about matters relevant to natural disaster damage and its mitigation.
- To undertake other functions as required by the Minister of Finance or the Minister of EQ Recovery and EQC.

A Government Guarantee ensures that EQC will be able to meet its financial obligations in all circumstances.

2.2 Canterbury earthquakes and the implications of multiple events

Since 4 September 2010, a series of damaging earthquakes has affected the Canterbury region in general and the city of Christchurch in particular.

Details of the Canterbury earthquake events are set out in Appendix A.

For the purposes of valuing the outstanding claims, the Canterbury earthquake claims have been split into the following event groups:

- EQ1 – 4 September 2010 event
- EQ2 – 22 February 2011 event
- EQ3 – 13 June 2011 events
- EQ4 – 23 December 2011 events
- AS – the eleven other events shown on the Business Information Unit (‘BIU’) Daily Report as well as ‘Other Canterbury claims’ included in the Daily Report totals. The logic used to identify these claims is based on the claim’s Territorial Local Authority and loss cause and is consistent with the BIU’s definition.

Although there have been many earthquake events causing building damage, observable / measurable land damage is associated only with the four identified events (EQ1, EQ2, EQ3 and EQ4). The first three of these events caused enough damage in total to require EQC’s reinsurance treaties to respond.

The phenomenon of multiple earthquake events in close succession (as opposed to a single, isolated event) has had many implications from both operational and valuation perspectives; these are considered in more detail below.
2.2.1 More damage

Each subsequent event adds to the existing damage and hinders the repair of already damaged structures. The impact of additional events on a single plot of land or building can be complex.

With buildings, the ‘damage on damage’ effect may limit ultimate repair costs to some extent, although some weakened buildings may suffer greater damage.

With land damage, the costs of repair can be exacerbated by later events, particularly for properties near waterways which were already vulnerable to the liquefaction hazards. Where these sites have materially subsided, the vulnerability of the land to the liquefaction and flooding hazards has considerably increased. This is most common in the residential red zone.

2.2.2 Resource issues

The additional damage creates additional demand for the professions and trades involved in the management of claims and rebuilding:

- Loss adjusters and assessors.
- Engineers.
- Valuers.
- Builders.

There will also be additional demand for rebuilding materials.

Finally there is the issue of Council resources for consents, inspections and code compliance certificates.

2.2.3 Increased complexity in estimation and apportionment of costs

Multiple events result in increased difficulty in:

- Estimating costs of repair.
- Apportionment of repair costs to different events/claims.
- Potential delays in repair of land and buildings as ongoing earthquakes cause problems in planning and securing resources.

2.2.4 Increased complexity in determining cover – reinstatements

The High Court’s declaratory judgement on 2 September 2011 (EQC v the Insurance Council / Vero / IAG, and TOWER Insurance v EQC) clarified the issue of the reinstatement of EQC’s cover after an event.

In summary, EQC is liable for up to $100k plus GST for each building claim and $20k plus GST for each contents claim; i.e. there is immediate reinstatement of cover after each natural disaster event as long as the contract of fire insurance is in force.
2.2.5 Reinsurance

The operation of EQC’s reinsurance cover arrangements have been made much more complicated due to the multiple events. Cover in later events is contingent upon the reinsurance impacts of earlier events (Top and Drop).

More details are provided in 2.4 and Appendix C.

2.3 EQC operations outside those specified in the Act

EQC assumed, on behalf of Government, responsibility for a broader than usual range of activities related to the Canterbury earthquake recovery. However, the costs of these extra activities outside the Act were accounted for separately and funded from monies made available by the Crown specifically for these purposes.

Such activities include providing for:

- Emergency repairs (where outside EQC cover, for example for uninsured homes).
- Land strengthening at one locality (Spencerville) where the reinstatement of housing required engineering works that could not be facilitated under EQC cover rules and Government agreed to meet the cost.
- Repairs for damage caused by an event to a residential building, where the damage to the residential building has been apportioned to that event but no notice of any damage pertaining to that event was given by the claimant in the time limit.

2.4 EQC reinsurance

2.4.1 Cover

EQC utilises catastrophe reinsurance to reduce net claims volatility. From 1 June 2010 EQC had reinsurance treaties in place providing cover per event above a $1.5b deductible up to an upper limit of $4.0b – i.e. maximum $2.5b reinsurance cover per event (less a small amount of coinsurance). This cover was placed in tranches and layers subject to different terms. Ongoing reinsurance cover after each event is complex as it depends on the usage of each layer and the reinstatement, replacement or renewal of each tranche and / or layer as relevant.

This reinsurance structure was the same for the 2011/12 year.

From 1 June 2014, EQC’s reinsurance cover has a 100% deductible per event to $1.75b. Reinsurance cover is then provided with 100% coverage up to $5b. There is a further layer between $5b and $6.25b although this is 49% covered.

2.4.2 Premium accounting

Reinsurance premiums are paid quarterly in advance.

More details are provided in Appendix C.

2.4.3 Recoveries accounting

Reinsurance recoveries processes are described in Appendix C.
2.5 Canterbury land damage and EQC land claim liabilities

This section of the report sets out a high level summary of the situation regarding the land damage caused by the Canterbury earthquakes and the land claim cost implications for EQC. The principal sources of information for this section were Senior Geotechnical Engineer at T&T and Dr Hugh Cowan, GM Reinsurance, Research and Education at EQC.

The notes in the remainder of this section should not be considered to be exhaustive – they are merely a high level summary of some of the issues.

2.5.1 Land claims

Background

In terms of eligibility, EQC land cover is only given where:

- There is a residential building lawfully situated on the land, and
- The residential building is covered by insurance with a private insurer against fire (although sometimes the cover may have been arranged directly with EQC).

Refer to Appendix B.1 for details.

Canterbury land claims liabilities

The situation regarding EQC’s land claims is complex from several perspectives:

- The nature of the damage caused.
- The engineering solutions to repair the damage (if feasible).
- The legal issues surrounding the extent of cover provided by EQC in the context of multiple events.

A great deal of work has been done by T&T over the past 18 months and this has been incorporated into this valuation. However, it should be recognised that there remains uncertainty regarding certain components of the land claims cost estimates.

2.5.2 Land damage

Flat Land

Land damage has occurred on the flat land as a result of soil layers below the ground surface liquefying, deforming the ground surface and inundating the properties with ejected water, silt and sand.

The flat land in eastern Christchurch is underlain by a series of soil layers of fine-grained alluvial sediments with varying composition and density. Each soil layer has a different liquefaction resistance which means that some soil layers are able to liquefy at lower shaking intensities while other soil layers are only able to liquefy at higher shaking intensities. Generally the more soil layers that liquefy beneath a property, the more liquefaction induced damage that can be expected at the ground surface.
Each of the four main earthquake events had shaking intensities that were strong enough to trigger liquefaction of soil layers in Christchurch. The shaking intensity from EQ1 was only strong enough to cause consequential (damaging) liquefaction in the most vulnerable parts of Christchurch (these areas generally now comprise the residential red zone). The shaking intensity from EQ1 may have triggered liquefaction in isolated soil layers throughout other parts of Christchurch but with minor to no consequential effects at the ground surface. The shaking intensity from EQ2 was considerably stronger in eastern Christchurch causing more soil layers to liquefy, increasing the extent and severity of liquefaction induced damage at the ground surface. However, the shaking intensity from EQ2 was considerably lower in the western and northern parts of Christchurch resulting in no to minor consequential effects at the ground surface. The shaking intensities from EQ3 and EQ4 were less than EQ2 and were generally more localised, causing less extensive liquefaction damage compared with EQ2.

For the more vulnerable properties where severe liquefaction damage occurred, a lot of silt and sand was ejected also resulting in considerable ground surface subsidence. For these vulnerable properties, subsequent earthquake events have caused increasing amounts of land damage and associated repair cost.

The land damage may be divided into two broad groups – visible surface damage (Categories 1 to 7 land damage listed in the table below) and increased vulnerability to liquefaction and to flooding (Categories 8 and 9 respectively, listed in the table below).

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Cracking caused by lateral spreading</td>
<td>Lateral spreading is the lateral movement of land, typically toward watercourses or other unconfined faces. Blocks of the crust raft laterally over liquefied soils toward an area of lower elevation. Surface manifestation of damage can range from minor to major cracks in the land, tilting of crust blocks and associated distortions to structures.</td>
</tr>
<tr>
<td><strong>2</strong> Cracking caused by oscillation movements</td>
<td>Cracks in land have resulted from oscillation type land movements. This category of land damage refers only to oscillation induced cracking. The cracks produced from this phenomenon are typically minor and isolated.</td>
</tr>
<tr>
<td><strong>3</strong> Undulating Ground</td>
<td>Undulating ground is caused by the differential ground settlement as a result of lateral spreading and the ejection of sand and silt and, to a lesser extent, the uneven settlement of the liquefied soils.</td>
</tr>
<tr>
<td><strong>4</strong> Local ponding</td>
<td>The local settlement or lowering of the ground at some sites has resulted in water ponding on the ground surface in locations where it did not pond before the earthquake</td>
</tr>
<tr>
<td><strong>5</strong> Local settlement causing drainage issues</td>
<td>At various sites land on an individual residential property has settled more than land on the adjacent road or land below which public services are located. In some situations this has resulted in drains that formerly flowed toward public services now flowing back toward the dwelling.</td>
</tr>
<tr>
<td><strong>6</strong> Groundwater springs</td>
<td>Formation of new groundwater springs now being emitted at the ground surface usually from a specific location on a site.</td>
</tr>
<tr>
<td><strong>7</strong> Inundation of ejected sand and silt</td>
<td>This includes the ejection of sand and silt to the ground surface from the zone below the water table through cracks in the crust. The ejected sand and silt can be deposited in isolated mounds, under dwellings or over the entire site.</td>
</tr>
</tbody>
</table>
8 Increased liquefaction vulnerability

Across the Canterbury Plains, north of the Port Hills, the ground surface has subsided as a result of tectonic ground movements, the ejection of sand, lateral spreading, topographic effects and the settlement of liquefied soils beneath a site. The groundwater level typically remains at a constant elevation and therefore the ground surface is closer to the water table than prior to the earthquake. This generally reduces the non-liquefying crust thickness, increasing the vulnerability of the site to the liquefaction hazard.

9 Increased flooding vulnerability

Across the Canterbury Plains, north of the Port Hills the ground surface has subsided as a result of tectonic ground movements, the ejection of sand, lateral spreading, topographic effects and the settlement of liquefied soils beneath a site. As a result of ground surface subsidence, the future vulnerability to flooding of some properties situated near the waterways has changed.

Port Hills

The Port Hills also sustained land damage although this was of a more traditional nature, and included rock falls, slips and damage to retaining walls.

The Port Hills now has properties zoned as red following a zoning review completed December 2013. These are properties where either:

- The property has been affected by cliff collapse and there is deemed to be an immediate risk to life, or
- The property has been affected by rock roll resulting in an unacceptable risk to life and an area-wide engineering solution to remediate the issue has been determined not to be practicable.

Recently, some areas of Port Hills land have been recognised as susceptible to risks of 'Toe Slumping'. Toe Slumping is the characteristic whereby sloped land is at risk of mass land movement. This is not a material risk for the valuation but should be a consideration for future insurability.

2.5.3 Rebuilding and land zones

The Canterbury Earthquake Recovery Authority (CERA) has divided the land in greater Christchurch and in the Waimakariri District into two zones - red, and green. The zone definitions are:

- Green (Go Zone): repair / rebuild process can begin.
- Red (No Go Zone): land repair would be prolonged and uneconomic.

The green zone land is broken down further into commercial zoned land, Port Hills land, rural land, and three residential flat land categories. The three residential flat land categories describe how the land is expected to perform in future earthquakes, and also describe the foundation systems most likely to be required in the corresponding areas. These are defined as:

- Technical Category 1 (TC1) – future land damage from liquefaction unlikely.
- Technical Category 2 (TC2) – minor to moderate land damage from liquefaction is possible in future large earthquakes.
- Technical Category 3 (TC3) – moderate to significant land damage from liquefaction is possible in future large earthquakes.
2.5.4 Land claim cost estimates

The cost of a valid land claim is a function of a combination of the assessed land damage and the application of EQC’s land cover rules.

The estimation of EQC’s land claims liabilities has been undertaken by T&T with legal input from EQC’s legal advisers, Chapman Tripp. The work undertaken to understand the nature and extent of land damage and to translate that into estimated land claims costs has been considerable. At this time the resulting information may be regarded as the best available.

The costing of the damage repair may be broken down into 4 broad groups as discussed below.

- Repair of damage categories 1 – 7 on the flat.
- Repair of ILV damage on the flat.
- Repair of IFV damage on the flat.
- Repair of damage on the Port Hills.

Damage categories 1 – 7 on the flat

The land damage reinstatement costs have been calculated for each property on an individual property basis.

The damage has been apportioned to the event with the greatest damage.

In the same way that the land damage effects may overlap, so may the reinstatement process and hence tend to reduce the overall cost, i.e. a single repair process may reinstate several categories of damage for several events.

ILV damage on the flat

The damage assessment approach is based on a series of land trials carried out in late 2013/early 2014. These provided the basis for repair methodologies for both rebuilds (house-free land) and for repair (house in situ land).

Qualification for remediation is based on a Liquefaction Severity Number (‘LSN’) which is the output from a model estimating the susceptibility to liquefaction for each property. It takes into account the water table beneath the land and the seasonal variations in the table.

Remediation of the land depends on whether it is house-free land or house in situ land. House-free land will be remediated through either:

- SC (Stone Columns).
- TP (Timber Piles).
- SCR (Soil Cement Raft).

A house in situ section will require a Horizontal Soil Mixing (‘HSM’) solution – by drilling under a property and mixing a concrete into the soil. Generally, the former solution will be considerably cheaper than the HSM solution.

Rather than assess the likely costs for each property individually, it is intended that a rate table will be built up for combinations of rebuild/repair, land type, front/back section etc., with estimated costs that can be used to settle each land claim.
The estimated costs associated with the ILV land damage are apportioned to the first event which is deemed eligible for remediation.

**IFV damage on the flat**

The damage assessment approach is based on an estimate of the loss in value (indemnity) to the property through the increased vulnerability to flooding.

Flooding encompasses both rising water (from rivers) and also Rain on Grid (flooding from rainfall).

The estimated costs of indemnifying a home owner for IFV damage are apportioned to the last qualifying event.

**Repair of damage on the Port Hills**

Port Hills land damage is more conventional as there is no liquefaction. Compared to damage on the flat, it is more straightforward to assess on a case by case basis. However, it is more difficult to assess, estimate and/or reinstate on a grouped basis.

Port Hills land damage occurred predominantly during the EQ2 and EQ3 events and most related to the failure of retaining walls. There was also damage arising from landslides and rock fall. There was a lot of minor slope failure in general but it is not considered to be ongoing or to represent an ongoing risk. The land stability is the same and any future damage would require the occurrence of future major events. Where the land has stabilised it is possible to undertake reinstatement.

**Damage not yet estimated**

The following components of land damage have not yet been estimated in a detailed way:

- Removal of ejected silt from underneath dwellings; it is estimated that approximately 5,000 properties (which are not included for ILV and IFV land damage) with silt inundation will require silt to be removed from under the house.

- Port Hills land damage is still estimated in aggregate rather than property by property.

**Enabling works**

ILV and IFV land damage relates to deterioration in the quality / height of the land which increases the susceptibility to liquefaction and / or flooding.

To remediate the land, it was originally thought that every section would need to be clear of any buildings to enable the repair. Clearly, in many cases the land would not be clear.

The costs of demolishing or moving undamaged or partially damaged dwellings are known as 'enabling costs' and these could be considerable. The situation is further complicated as in many cases there may be no readily apparent damage to the land, even though a material loss of amenity for residential housing is judged to have occurred. In these cases it is presumed that a rational homeowner would not undertake extensive land remediation work.

In respect of ILV damage, EQC now have land repair methodologies that will not necessarily require house-free sections. As a consequence, enabling works will not be required unless it is not practical to carry out the repair otherwise.

In respect of IFV damage, EQC have decided to adopt a Diminution of Value approach to settling land claims where possible.
**Diminution of value**

Diminution of Value (‘DoV’) is where EQC applies the indemnity principle of insurance to calculate its exposure to land claims.

IFV land damage refers to damage to the structure and height of the site on which a residence is located. There may not be any visible signs of the damage and the land may function in a perfectly reasonable state.

Remedying IFV damage by physically repairing the land would incur the combined costs of the (highly intrusive) land reinstatement and the (also intrusive and often inappropriate) enabling costs associated with the demolition or temporary relocation of a building that is otherwise in reasonable condition. In any case, the combined costs for a property would be limited to the maximum level of cover, which is sometimes (but not always) the minimum lot value (MLV).

This overall cost needs to be compared to the financial loss that the homeowner has suffered. For example, if a property is now more flood prone than prior to the earthquakes, it may have less valuable land now.

As it is considered that the financial impact on the homeowner from the IFV damaged land is less than the costs to move the house, repair the land and possible reinstatement of the house, then the indemnity principle would state that EQC should pay the financial loss actually suffered and no more.

This has been the basis for determining the IFV land damage cost component of the land model.

### 2.6 New Zealand economic environment

#### 2.6.1 Economic growth

GDP increased 1.0% in the September 2014 quarter with annual growth of 2.8%.

#### 2.6.2 Inflation

Inflation has been relatively low with the September 2014 Consumer Price Index at 1.0% for the year.

#### 2.6.3 Interest rates

Following three years at 2.5%, the Reserve Bank has recently increased the OCR four times so that it is now 3.5% p.a. It was last increased in July 2014.

The five year government stock rate was 3.59% pa as at 31 December 2014 (4.08% as at 30 June 2014).
3 Data and Information

3.1 Sources of data

The main sources of data used for the investigation are set out below.

3.1.1 Actuarial Data Extract from ClaimCentre

Weekly Actuarial Data Extracts (ADE) were taken from ClaimCentre and the key extract used was dated:

- 5 January 2015 (effectively 31 December 2014).

The extract is structured as a single database table. Each record relates to a single claim (itself relating to up to three sub-claims) with many fields describing the claim’s details.

More information on ClaimCentre can be found in Appendix B.

3.1.2 ACE damage data

The ACE damage data consisted of a table, provided by the BIU, showing apportioned damage estimates for a number of Christchurch properties. There were approximately 124,000 properties in the table although many of these had yet to be populated with apportionment information. There were 48,800 properties from this data set that were used in the building model. The table below details how the usable properties were derived from the total data set. A summary of the information that was used is shown in Section 4.3.

<table>
<thead>
<tr>
<th>ACE data cleaning process</th>
<th>Number of Properties</th>
<th>Sum of Raw ACE Estimates</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>EQ1 $m</td>
<td>EQ2 $m</td>
<td>EQ3 $m</td>
</tr>
<tr>
<td>Raw ACE Data</td>
<td>124,341</td>
<td>1,520</td>
<td>4,392</td>
</tr>
<tr>
<td>Remove:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NAs</td>
<td>(75,473)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duplicates</td>
<td>(27)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Property ID errors</td>
<td>(41)</td>
<td>(0)</td>
<td>(1)</td>
</tr>
<tr>
<td>Extremely large estimates (&gt;50m)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data used in model</td>
<td>48,800</td>
<td>1,519</td>
<td>4,391</td>
</tr>
</tbody>
</table>

The ACE data was supplemented with a table identifying multi-unit buildings (MuBs) and whether the MuB was comprised of dependent or independent dwellings.

The BIU supplied two additional tables of data:

- A supplementary table identifying multi-unit buildings (MuBs) and whether the MuB was comprised of dependent or independent dwellings.
- A claim-to-address mapping. Other address fields in the Actuarial Data Extract were unsuitable for this purpose as there were known issues within their records (e.g. they were free-form text fields).
3.1.3 **EQR paid data**

The EQR paid data consisted of a table, provided by the BIU, showing the amounts paid to substantively completed properties. There were 63,000 properties from this data set used in the model.

3.1.4 **Special apportionments project**

For a number of reasons, including those mentioned in Section 2.2, the estimates held for each claim in ClaimCentre were not able to be used for valuation purposes.

As an interim solution, until all building claims estimates in ClaimCentre were able to be calculated according to the dwelling reserve apportionment guidelines introduced from 5 December 2011, a special apportionments survey was undertaken in 2011 and 2012 by the Canterbury Event Field Office, overseen by EQC consultants, [Redacted] and statistician, [Redacted].

The survey was based on a sample of Canterbury region properties stratified by land zones (i.e. Red, TC3 etc.) and suburb grouping (12 groupings were used). The properties from which the sample was drawn were derived from claims lodged in ClaimCentre. Land zones were allocated via a link to T&T Orbit data and the suburb groupings were the same as for the [Redacted] report undertaken during 2011. Eight samples of 500 properties were taken along with some randomly selected alternative properties to be used in case of problems with the original samples.

Four samples of 500 were completed with damage being allocated to events in accordance with the dwelling reserve apportionment guidelines.

3.1.5 **Tonkin & Taylor land model**

The land claim estimates held within ClaimCentre are not yet at a level of reliability to be used for actuarial analysis. Instead, a valuation model was obtained from T&T to value the land claims.

3.1.6 **Output from the Minerva loss model**

Output from the Minerva model was the same as that used for the 30 June 2012 valuation. This output was provided by EQC in July 2011. No more recent outputs have been provided as there has been no input of revised parameters following the Christchurch events.

Details on the Minerva model are given in Appendix D.

3.2 **Sources of information**

The additional sources of information used for the investigation were:

- Draft accounts for the period ending 31 December 2014.
- Trial balance for the period ending 31 December 2014.
- CHE Forecast 31 December 2014.
- Daily reports supplied by the BIU.
- Reports supplied by the Fletcher Construction EQR.
- T&T land claims cost model.
• Information from the Treasury website.
• Discussions and correspondence with various relevant EQC staff, contractors and advisors (more details are set out in Appendix D).

3.3 Validation of data

3.3.1 Actuarial data extract

The first table in Appendix E illustrates a reconciliation of the 31 December 2014 Actuarial Data Extract system against the BIU’s Daily Report for 31 December 2014 and the Claims Paid figures from the 31 December 2014 accounts (Event loss summary).

Note that for BAU claims the information from the data extract is calculated on a loss date basis and so does not agree exactly with the accounting data. Overall the level of agreement is satisfactory for our purposes.

Further validation is provided via the claims analyses set out in Section 4.

3.3.2 Other data

The other data sources were not able to be reconciled against the accounts but were reconciled against other sources where relevant and possible.

Further validation of the ACE data and Fletcher data is set out in Section 4.

3.4 Reliances

The key data and information upon which we have placed reliance are described in Sections 3.1 and 3.2 above.

3.5 Concerns and qualifications

3.5.1 General comments regarding the data held by EQC

The main areas of concern with respect to the use of the data for actuarial purposes are:
• The need to improve the quality of the building claim incurred figures held in ClaimCentre; at the moment it is not possible to know whether or not the incurred claims for a particular claim have been completed according to the dwelling reserve apportionment guidelines.
• The Minerva model requires recalibration for new exposure, risk and damage levels, particularly land damage information and changes to building standards (e.g. enhanced foundations).
• Potential incorporation of EQR claims data into ClaimCentre. While this may be beneficial to EQC internal processes, bringing the EQR data into ClaimCentre may have a material impact on the data MJW receive and hence impact our ability to produce reliable liability estimates.
3.6 Recommendations

3.6.1 Progress against previous recommendations

Several data-related recommendations were set out in Section 3.6 of the 30 June 2014 report. The progress against these recommendations is as follows:

- **ClaimCentre:**
  - Incorporate EQR claims data in the EQC claims database. **Ongoing**
  - Improve the quality of building claims data. **Ongoing**

- **Minerva:**
  - Review the model in the light of the recent events. **Outstanding**
  - Consider whether other catastrophe events besides earthquakes should be included. **Outstanding**

3.6.2 Current Recommendations

There are many potential recommendations regarding the data that could aid future investigations. Some of the key ones are:

- **ClaimCentre:**
  - Incorporate EQR claims data in the EQC claims database. However, as noted in section 3.5, a high degree of caution must be taken in this process.
  - Improve the quality of building claims data.

- **Minerva:**
  - Review the model in the light of the recent events.
  - Consider whether other catastrophe events besides earthquakes should be included.

We recognise that our recommendations relate to actuarial data only. We also recognise the unique operational challenges EQC is facing and the need for EQC to prioritise process and systems changes according to the areas of greatest need.

3.7 Adequacy and Appropriateness

The quality of the results in this report relies on the accuracy and completeness of the data and information supplied. Overall, and subject to the significant but unavoidable issues identified in Sections 3.5 and 3.6, we consider that the information provided to us was adequate and appropriate for the purposes of this valuation.
4 Canterbury Earthquake Claims Analysis

The figures in the following tables are based on an Actuarial Data Extract from ClaimCentre as at 5 January 2015.

4.1 Actuarial Data Extract from ClaimCentre (5 January 2015)

4.1.1 Number of notified claims

<table>
<thead>
<tr>
<th>Number of notified claims (ClaimCentre)</th>
<th>EQ1</th>
<th>EQ2</th>
<th>EQ3</th>
<th>EQ4</th>
<th>AS</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed</td>
<td>75,879</td>
<td>64,864</td>
<td>24,183</td>
<td>24,473</td>
<td>26,754</td>
<td>216,153</td>
</tr>
<tr>
<td>Open</td>
<td>69,052</td>
<td>79,346</td>
<td>27,794</td>
<td>22,862</td>
<td>24,729</td>
<td>223,783</td>
</tr>
<tr>
<td>Total</td>
<td>144,931</td>
<td>144,210</td>
<td>51,977</td>
<td>47,335</td>
<td>51,483</td>
<td>439,936</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of notified claims (ClaimCentre) - all incl duplicates</th>
<th>EQ1</th>
<th>EQ2</th>
<th>EQ3</th>
<th>EQ4</th>
<th>AS</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed</td>
<td>87,354</td>
<td>77,672</td>
<td>26,350</td>
<td>25,896</td>
<td>28,195</td>
<td>245,467</td>
</tr>
<tr>
<td>Open</td>
<td>69,192</td>
<td>79,517</td>
<td>27,827</td>
<td>22,893</td>
<td>24,765</td>
<td>224,194</td>
</tr>
<tr>
<td>Total</td>
<td>156,546</td>
<td>157,189</td>
<td>54,177</td>
<td>48,789</td>
<td>52,960</td>
<td>469,661</td>
</tr>
</tbody>
</table>

- Duplicate claims are excluded from our tables (unless noted otherwise). Duplicate claims are included in the BIU daily report.
- The total number of claims on the daily report includes those from a number of other earthquake events which are not specifically identified. In this section we have included these claims in the AS group.

The following tables are based on sub-claims rather than claims. Each claim lodged with EQC includes up to three sub-claims (also known as ‘exposures’) corresponding to land, building or contents losses.