Earthquake Commission
Insurance Liability Valuation as at 30 June 2011

6 September 2011

Final Report
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Executive Summary

1.1 Addressedee

This report is addressed to the Board of Directors of the Earthquake Commission (EQC).

1.2 Report commissioned by

This report was commissioned by the EQC’s Finance Accountant, [REDACTED] 9(2)(a)

1.3 Purpose

This report was commissioned to assist in the determination of:

- The insurance liabilities and recoveries for EQC’s financial statements as at 30 June 2011.
- The premium liabilities to be used for EQC’s Liability Adequacy Test (LAT) as at 30 June 2011.

1.4 Scope

1.4.1 General comments

Unless otherwise stated, all figures in this report are stated in New Zealand dollars ($NZ) and net of GST.

1.4.2 Insurance liabilities components

In summary, the insurance liabilities include:

- The outstanding (OS) claims liabilities – which relate to the future direct and indirect claims costs and reinsurance recoveries for claims incurred up to 30 June 2011.
- The premium liabilities – which relate to the future net claims costs and administration and reinsurance expenses for future claims arising from unexpired risks as at 30 June 2011.

Both liabilities include a risk margin and are discounted for the time value of money.

A more detailed description of the nature and components of the OS claims liabilities are set out in Section 1.9.2.

The premium liabilities are not included directly in the balance sheet but are used for the Liability Adequacy Test of the unearned premium liability provision. A more detailed description of the nature and components of the premium liabilities is set out in Section 1.9.3.
1.4.3 **Event groups**

The insurance liability components described above have been further split into the costs arising from different claim events.

The OS claims liabilities have been split into the following event groups:

- "BAU" (Business As Usual) claims – e.g. landslip claims, claims for hydrothermal events, claims from smaller earthquakes outside Canterbury (also known as "attritional" or "working" claims).
- Canterbury earthquakes:
  - 4 September 2010 event (EQ1).
  - 22 February 2011 event (EQ2).
  - 13 June 2011 events (EQ3).
  - Other aftershocks (e.g. 19 October 2010, 14 November 2010).

More details of the breakdown of the OS claims liabilities by event group can be found in Section 8.3.

The premium liabilities have been split into the following event groups:

- "BAU" (Business As Usual) claims – e.g. landslip claims, claims for hydrothermal events, claims from smaller earthquakes outside Canterbury (also known as "attritional" or "working" claims).
- Minerva claims - catastrophe event claims arising from earthquakes in NZ outside Canterbury.
- Canterbury earthquake claims.

More details of the breakdown of the premium liabilities by event group can be found in Section 11.1.

1.5 **Valuation effective date**

The effective date of the valuation is 30 June 2011.

1.6 **Previous valuations**

Melville Jessup Weaver’s (MJW’s) most recent valuation for EQC related to an estimate of the liabilities arising from the Darfield earthquake of 4 September 2011. The report is dated 10 December 2010.

Over the last few years MJW has also provided assistance with the determination of premium liabilities for the LAT (dated 26 August 2010) and a valuation of the insurance liabilities as at 30 June 2008 (dated August 2008).

This report follows an earlier report for 30 June 2011 (dated 24 August 2011). The changes in this report arose from the clarification of EQC cover reinstatement following the High Court’s declaratory judgement on 2 September 2011.
1.7 Professional standards

This report has been written to comply with Professional Standard No. 4 (General Insurance Business) of the New Zealand Society of Actuaries.

1.8 Canterbury earthquakes

Since 4 September 2010, the Canterbury region in general and the city of Christchurch in particular has been shaken by over 8,000 earthquakes, including three major events and numerous aftershocks. The earthquakes have resulted in loss of life and injury, and billions of dollars of damage to infrastructure, commercial property and residential dwellings.

Further details are set out in Section 2.12 and Appendix A.

1.9 Key results

1.9.1 Ultimate vs. outstanding claims

The gross incurred claims costs for all claims incurred to 30 June 2011 includes:

- Claims costs paid to date.
- Claims costs expected to be paid in future (the OS claims liability).

The first bullet point immediately above is a known item and the second is unknown and so must be estimated. The approach that we have taken is to first estimate the projected ultimate claims costs and then to deduct the payments to 30 June 2011 in order to determine the estimated OS claims liability.

1.9.2 Estimated ultimate claims costs

The table below summarises the main components involved in estimating the ultimate cost of claims to the EQC arising from the Canterbury earthquakes. Figures are also included for all historical BAU claims held in ClaimsCentre to 30 June 2011. An expanded version of this table is given in Section 8.2.

The estimated ultimate claims cost is built up from the following components:

- Claims paid to date.
- Case estimates.
- Actuarial determination.
- Claims handling expenses.

For example, for the 4 September 2010 event, the central estimate, undiscounted ultimate cost of claims, gross of (i.e. excluding) reinsurance is $3.249b. The estimated reinsurance recoveries are $1.726b, giving a central estimate net of reinsurance of $1.523b.

By far the biggest single item is the expected claims cost arising from the 22 February 2011 event, which on current assumptions is expected to exceed the upper reinsurance limit by more than $2b.

The undiscounted central estimate reinsurance recoveries from all events exceed $4.5b.
One source of potential confusion in this table is the treatment of BAU. The BAU for Pre 2011 figures include historic claims payments and case estimates data held in ClaimsCentre with loss dates back to the 1990's.

### Estimated Ultimate Cost of Claims - Undiscounted

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<tbody>
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<td><strong>Claim costs paid to date (ClaimsCentre)</strong></td>
<td>744.0</td>
<td>121.7</td>
<td>0.0</td>
<td>10.3</td>
<td>875.9</td>
<td>275.4</td>
<td>10.1</td>
<td>1,161.4</td>
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<td><strong>Case estimates (ClaimsCentre)</strong></td>
<td>1,167.3</td>
<td>929.3</td>
<td>121.8</td>
<td>77.4</td>
<td>2,294.8</td>
<td>43.5</td>
<td>18.9</td>
<td>2,357.2</td>
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<td></td>
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<td>134.0</td>
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<td><strong>Actuarial determination</strong></td>
<td>1,011.6</td>
<td>5,129.0</td>
<td>1,180.5</td>
<td>355.4</td>
<td>7,675.5</td>
<td>(40.6)</td>
<td>19.3</td>
<td>7,854.3</td>
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<tr>
<td>Less Fletcher PMO paid to date</td>
<td>(93.1)</td>
<td>(38.6)</td>
<td>0.0</td>
<td>(2.2)</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>(134.9)</td>
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<td>918.5</td>
<td>5,090.4</td>
<td>1,180.5</td>
<td>353.2</td>
<td>7,675.5</td>
<td>(40.6)</td>
<td>19.3</td>
<td>7,520.3</td>
</tr>
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**Estimated ultimate incurred claims cost: gross, excluding CHE**

| Claims handling expenses (CHE) | 2,922.8        | 6,177.9       | 1,302.3       | 443.1         | 10,646.2         | 278.3        | 48.4      | 11,172.9   |

**Estimated ultimate incurred: gross, including CHE**

| Central Estimate | 3,247.5        | 6,550.7       | 1,381.6       | 513.7         | 11,678.5         | 278.1        | 70.3      | 12,027.9   |

**Estimated reinsurance recoveries**

| Central Estimate | (1,724.8)      | (2,477.4)     | (372.4)       | 0.0           | (4,574.7)        | 0.0          | 0.0       | (4,574.7)  |

**Estimated ultimate incurred: net, including CHE**

| Central Estimate | 1,522.7        | 4,078.3       | 1,009.2       | 513.7         | 7,103.8          | 278.1        | 70.3      | 7,453.2    |
1.9.3 Outstanding claims liabilities

The table below summarises the key components of the OS claims liabilities as at 30 June 2011. A more detailed version of the table is set out in Section 8.3.

The net discounted outstanding claims liability at a probability of adequacy of 75% is $5.579b. Note that the risk margin for EQ1 is small but not nil due to the operation of the reinsurance deductible and the coinsurance in layer 2.

As for the projected claims costs, by far the largest component of the liabilities is in respect of the 22 February 2011.

**Estimated Outstanding Claims Liabilities as at 30 June 2011**

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<th>EQ1: 4 Sep 10</th>
<th>EQ2: 22 Feb 11</th>
<th>EQ3: 13 Jun 11</th>
<th>Cant EQ: Other</th>
<th>BAU</th>
<th>Total</th>
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<td>Reported outstanding (case estimates)</td>
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<td>928.3</td>
<td>121.8</td>
<td>77.4</td>
<td>62.4</td>
<td>2,367.2</td>
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<td>Adjusted actuarial determination</td>
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<td>5,089.4</td>
<td>1,160.5</td>
<td>363.2</td>
<td>(21.2)</td>
<td>7,520.3</td>
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<td>Undiscounted central estimate, excl CHE</td>
<td>2,085.7</td>
<td>6,017.6</td>
<td>1,302.3</td>
<td>430.6</td>
<td>41.2</td>
<td>9,877.6</td>
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<td>Claims handling expenses (CHE) - Uninsured</td>
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<td>Claims handling expenses (CHE) - Reinsured</td>
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<td>275.4</td>
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<td>6,293.1</td>
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<td>Diversified risk margin (75% PoA)</td>
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<td>150.4</td>
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<td>6,896.6</td>
<td>1,531.1</td>
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<td>52.6</td>
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<td>(2,477.4)</td>
<td>(372.4)</td>
<td>0.0</td>
<td>0.0</td>
<td>(4,574.7)</td>
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<tr>
<td>Undiscounted central estimate</td>
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<td>(2,477.4)</td>
<td>(372.4)</td>
<td>0.0</td>
<td>0.0</td>
<td>(4,574.7)</td>
</tr>
<tr>
<td><strong>Net of reinsurance and non-reinsurance recoveries</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undiscounted central estimate, excl uninsured CHE</td>
<td>552.1</td>
<td>3,815.6</td>
<td>1,008.2</td>
<td>488.1</td>
<td>41.2</td>
<td>5,905.3</td>
</tr>
<tr>
<td>Claims handling expenses (CHE) - Uninsured</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>8.1</td>
<td>8.1</td>
</tr>
<tr>
<td>Undiscounted central estimate, including CHE</td>
<td>552.1</td>
<td>3,815.6</td>
<td>1,008.2</td>
<td>488.1</td>
<td>49.3</td>
<td>5,913.4</td>
</tr>
<tr>
<td>Discounting</td>
<td>(17.7)</td>
<td>(407.5)</td>
<td>(48.3)</td>
<td>(27.3)</td>
<td>(0.4)</td>
<td>(501.1)</td>
</tr>
<tr>
<td>Discounted central estimate, including CHE</td>
<td>534.4</td>
<td>3,408.1</td>
<td>960.0</td>
<td>460.9</td>
<td>48.9</td>
<td>5,412.3</td>
</tr>
<tr>
<td>Diversified risk margin (75% PoA)</td>
<td>0.6</td>
<td>510.8</td>
<td>3.7</td>
<td>24.0</td>
<td>3.2</td>
<td>560.3</td>
</tr>
<tr>
<td>Discounted provision (75% PoA), including CHE</td>
<td>530.0</td>
<td>3,918.9</td>
<td>963.6</td>
<td>484.8</td>
<td>52.2</td>
<td>5,972.5</td>
</tr>
</tbody>
</table>
1.9.4 **Premium liabilities**

The table below summarises the key results of the estimation of the EQC’s premium liabilities as at 30 June 2011. The total value at 75% probability of adequacy is $366m, considerably in excess of the $46.4m unearned premium reserve. This means that an additional unexpired risk reserve will be required in the accounts as at 30 June 2011.

The largest component ($204m) relates to future claims arising from Canterbury earthquakes during the period of the runoff of risks on the books as at 30 June 2011. The other claims costs relate to future BAU claims, major event claims as modelled by Minerva, and the associated reinsurance and administration expenses.

**Premium liabilities**

**Estimated premium liabilities as at 30 June 2011**

<table>
<thead>
<tr>
<th></th>
<th>BAU $m</th>
<th>Minerva $m</th>
<th>Cant EQ $m</th>
<th>Total $m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unearned premium reserve</td>
<td>23.05</td>
<td>38.28</td>
<td>205.44</td>
<td>266.77</td>
</tr>
</tbody>
</table>

**Cost of future claims from unexpired risks**

- Undiscounted central estimate claims cost gross of reinsurance
  - BAU: 23.05
  - Minerva: 38.28
  - Cant EQ: 205.44
  - Total: 266.77

**Administration and reinsurance costs for unexpired risks**

- Claims administration expenses
  - BAU: 6.60
  - Minerva: 3.06
  - Cant EQ: 16.44
  - Total: 26.10

- Policy (non-claims) admin expenses for unexpired
  - BAU: 2.51
  - Minerva: 0.00
  - Cant EQ: 0.00
  - Total: 2.51

- Future reinsurance costs for unexpired risks
  - BAU: 0.00
  - Minerva: 19.5
  - Cant EQ: 12.1
  - Total: 31.61

**Reinsurance recoveries**

- Undiscounted reinsurance recoveries
  - BAU: 0.00
  - Minerva: (8.83)
  - Cant EQ: (4.25)
  - Total: (11.09)

- Undiscounted net central estimate premium liabilities
  - BAU: 32.16
  - Minerva: 53.99
  - Cant EQ: 229.75
  - Total: 315.99

- Discounting
  - BAU: 0.00
  - Minerva: (1.77)
  - Cant EQ: (11.76)
  - Total: (13.53)

- Discounted net central estimate premium liabilities
  - BAU: 32.16
  - Minerva: 52.22
  - Cant EQ: 217.98
  - Total: 302.36

- Discounted diversified risk margin (75% PoA)
  - BAU: 64.20

- **Net premium liabilities discounted (75% PoA)**
  - BAU: 366.56

1.10 **Key uncertainties**

1.10.1 **General comment**

There is inherent uncertainty in any estimation of 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.
1.10.2 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 EQC coverage and reinsurance coverage.
- Severe land damage and a very complex land claims environment from both an engineering and legal perspective.
- The relatively early stage of claims development, including the most recent large earthquake event of 13 June 2011.
- The potential for construction cost inflation to exceed expectations.

Consequently, at this stage of claims development, there is a high degree of unavoidable uncertainty regarding the future claims costs. Over time, as the assessments are completed and claims are settled, and as the reasonableness of the model and its assumptions can be 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 wide confidence ranges in the estimated liabilities for each event.
- Different practitioners could legitimately arrive at quite different estimates of the cost of claims.

A more detailed description of uncertainty associated with this valuation – in particular arising from the earthquakes and land claims - is set out in Section 5.

1.11 Data

1.11.1 Sources

The most important sources of data for the investigations were:

- Data extracts from the ClaimsCentre (CIMS) claims administration system.
- Assessment estimates held in the COMET system.
- Land cost estimates from Tonkin & Taylor.
- Management accounts as at 30 June 2011.
- Discussions with EQC employees and contractors.

1.11.2 Adequacy and appropriateness

The extreme nature of the Canterbury earthquakes, and the inevitable operational demands placed on the EQC, has 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, we have sought alternative sources of data and chosen valuation methodologies that mitigate these data shortcomings as much as possible.
1.12 Key reliances

In completing this report, considerable reliance has been placed on data and information supplied to MJW staff by EQC staff. The most important reliances include:

- Land claims cost estimates supplied by T&T.
- Claims data extracts supplied from ClaimsCentre and COMET.
- Management reports supplied by the EQC’s Business Information Unit (BIU).
- Management accounts supplied by the EQC’s Finance Department.
- A Minerva model run provided by EQC.
- Commentary on EQC operations, processes and systems supplied by EQC staff.

More details regarding data and information are set out in Section 3 and reliances in particular in Section 3.4.

1.13 Key recommendations

The key recommendations – from an actuarial estimate perspective – arising from the investigation are:

- Improve the quality of land claim estimates held in ClaimsCentre.
- Add a field in ClaimsCentre that clearly identifies whether or not an estimate reflects a full assessment for which the split of costs between events and the full application of EQC cover rules has been completed.
- Ultimately, a more detailed actuarial data extract based on transaction data would be beneficial.

1.14 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 Board of Directors of the 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 the Chief Financial Officer that this report may be provided to the EQC’s auditors (Deloitte), reinsurance broker (AON Benfield), reinsurers and the New Zealand Treasury. In agreeing to this request, we note in particular that this report is addressed to the 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 reinsurer’s or any other parties’ purposes. This report cannot substitute for any investigations that any reinsurer or 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 reinsurer or any other party arising from the use of this report.

1.15 MJW staff involved in the investigation

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

- Neil Christie  Principal
- Mark Weaver  Principal
- [Redacted]  Actuary
- [Redacted]  Analyst
- [Redacted]  Analyst

1.16 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.

1.17 Authors

Neil Christie  
Fellow of the NZ Society of Actuaries

Mark Weaver  
Fellow of the NZ Society of Actuaries
2 Background

2.1 EQC ownership and regulation

The EQC is a NZ Government-owned Crown entity which has been in existence in some form since 1946 and is currently established under the Earthquake Commission Act 1993 ("the Act") and associated schedules and regulations.

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

2.2 EQC role

The EQC’s role may be summarised as follows:

- Provide insurance against insured perils (see Section 2.3).
- Administer the Natural Disaster Fund (NDF), including investments, and obtain reinsurance.
- Facilitate research and education about matters relevant to natural disaster damage and its mitigation.
- Undertake such other functions as required by the Minister of Finance.

2.3 EQC cover

EQC pays out on claims from insured New Zealand residential property owners for damage caused by earthquake, natural landslip, volcanic eruption, hydrothermal activity and tsunami; in the case of residential land, a storm or flood; or fire caused by any of these.

Each claim lodged with the EQC may result in repair and/or replacement costs arising from one or more of the following claims types (also known as "sub-claims" or "exposures"):  
- Land claims.
- Buildings claims (to a maximum of $100k excluding GST).
- Personal property (contents) claims (to a maximum of $20k excluding GST).

More details are provided in Appendix B.

2.4 Implications of multiple events

2.4.1 Multiple events

The fact of multiple earthquake events, rather than a single event, since the start of the sequence on 4 September 2010 has had many implications from an operational and valuation perspective; these are considered in more detail below.
2.4.2 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 dwelling is complex.

With dwellings, the “damage on damage” effect may limit costs to some extent, although some weakened dwellings may suffer greater damage.

With land damage the costs of repair are often worse for later events, particularly where the soil is subject to liquefaction.

2.4.3 Resources 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 costs for rebuilding materials.

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

2.4.4 Increased complexity in estimation and allocation of costs

Multiple events results in increased difficulty in:

- Estimating costs of repair.
- Allocation of repair costs.

2.4.5 Increased complexity in determining cover - reinstatements

In contrast to the 30 June 2011 ILVR dated 24 August 2011, following the High Court’s declaratory judgement on 2 September 2011 (EQC vs. the Insurance Council / Vero / IAG, and separately with TOWER Insurance) the issue of the reinstatement of EQC’s cover after an event has now been clarified.

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

2.4.6 Reinsurance

The operation of EQC’s reinsurance cover arrangements have been made much more complicated due to the multiple events as cover in later events is contingent upon the reinsurance impacts of earlier events. More details are provided in Appendix F.
2.5 EQC market and distribution

As the provision of EQC cover is compulsory for all domestic home and domestic contents policyholders, EQC does not need to undertake marketing activities.

An amount equal to 2.5% of the EQC levy commission is paid to the private insurer. This is intended to cover the insurer’s costs of collecting and remitting the levy to EQC.

In terms of underwriting policy, cover under the terms of the Act is provided to policyholders of the private insurers.

2.6 EQC operations

The EQC’s head office is based in Wellington, with a normal staff of 22.

The EQC’s normal activities include:
- Collection of levies and management of the NDF.
- Claims management.
- Research.
- Education.

Following the Darfield earthquake staff numbers have increased to over 1,300 based in Brisbane, Christchurch and Wellington. Working claims continue to be managed from Wellington.

EQR, acting as an agent of the EQC for repair of damaged houses, has established 15 hubs in the Christchurch area.

Further details are set out in Appendix C.

2.7 EQC operations outside those specified under the Act

The exceptional nature of the Canterbury earthquakes have meant that EQC has assumed responsibility for a broader than usual range of activities.

Such activities include:
- Emergency repairs (outside those provided by EQC cover).
- Winter heating programme.
- Land strengthening.

2.8 EQC systems

EQC operates a number of systems. Those most relevant to the current investigation include:

- The CLAIMS (Claims Lodgement, Allocation, Information and Management System) which comprises:
  - The ClaimsCentre CIMS (Claims Information Management System) system.
The GIS (Geographical Information System) system.

- The Alchemy COMET system that manages the iPad-based assessments.
- The Minerva system.

The claims data which formed the basis for this investigation came primarily from the ClaimsCentre and COMET systems. The Minerva system provided output for the estimation of premium liabilities.

More details regarding the systems above are provided in Appendix E.

2.9 EQC claims handling process

The key points of the EQC claim process may be summarised as follows:

- A claimant lodges a claim via the EQC’s 0800 claims freephone number or website. Separate claims lodgement close off dates have been established for claims arising from the various aftershocks.
- EQC allocates to each claim an initial triage status and estimate based on the lodgement information.
- Building and land claims are assessed on site by a loss adjuster supported by builder or engineer as required and a new estimate is produced via the COMET-based iPad system – based on the assessment, one of the following actions occurs:
  - Some claims are settled via payment in cash from the Gallagher Basset office in Brisbane:
    - Small claims for contents, minor damage and emergency repairs.
    - Claims over the EQC “claims cap”.
  - For claims not paid in cash, settlement via repair will usually be undertaken by the EQR but the claimant can elect to use another repairer under certain conditions.
  - Contents claims are managed in Wellington and paid from the Gallagher Basset office in Brisbane.

2.10 EQC reinsurance

2.10.1 Cover

EQC utilises catastrophe reinsurance to reduce net claims volatility. In summary, claims are reinsured above a $1.5b deductible up to an upper limit of $4.0b “from the ground up” – i.e. a maximum $2.5b reinsurance coverage per event (less a small amount of coinsurance).

More details are provided in Appendix F.

2.10.2 Premium accounting

Reinsurance premiums are paid quarterly in advance. More details are provided in Appendix G.
2.10.3  **Recoveries accounting**

Reinsurance recoveries processes are described in Appendix G.

2.11  **EQC financials**

The Statement of Comprehensive Income for the year ending 30 June 2010 shows gross earned premiums of $85.965m, reinsurance premiums of $38.809m and incurred claims costs of $39.594m. Investment income net of costs was $376.8m. EQC showed a net surplus for the year (after the Crown underwriting fee of $10m) of $355.1m.

The Statement of Financial Position as at 30 June 2010 had outstanding claims liabilities at $11.845m. Due to the nature of the outstanding claims, no actuarial determination was used for this provision. The unearned premium liability (calculated on a proportional basis) was $45.546m, and an additional amount (based on actuarial calculation) of $39m was held as an unexpired risk provision.

The net assets as at 30 June 2010 were $5.926b ($5.571b as at 30 June 2009).

2.12  **Canterbury earthquakes**

2.12.1  **Events**

Since 4 September 2010, Canterbury has been rocked by over 8,000 earthquakes including two which have required the catastrophe treaty to respond and numerous aftershocks causing damage to insureds’ properties.

Appendix A illustrates the location and severity of the three main earthquakes and aftershocks.

**4 September 2010 – EQ1**

On 4 September 2010, an event of magnitude 7.1 on the Richter scale occurred, centred at Darfield, 40km west of Christchurch City, at a depth of 11km. It caused significant damage to residential and commercial property across the region. Particular features of this event were the peak ground acceleration and the many areas that suffered liquefaction and lateral spreading along river banks.

**22 February 2011 – EQ2**

On 22 February 2011 there was an earthquake of magnitude 6.3 centred 5kms SE of Lyttelton, at depth of only 5kms, affecting the CBD and suburbs to South and East of the city. Many significant buildings in the CBD were severely damaged with approximately 180 deaths and many injuries, and there was further more serious liquefaction in vulnerable areas and some landslides and rock falls from cliffs.

**13 June 2011 – EQ3**

On 13 June 2011 there were two aftershocks of magnitude 5.6 and 6.3 at shallow depth, both centred close to Sumner. The shaking was sufficient to cause further significant damage to already weakened buildings, including many in the still cordoned off area of the CBD. There was again lateral spreading by the rivers and a great deal more liquefaction.
2.13 Canterbury land damage and EQC land claim liabilities

2.13.1 Introduction

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 Tonkin & Taylor and Hugh Cowan, Research Manager at EQC.

The situation 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.

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.

2.13.2 Background

The nature of the land in Christchurch (on the flat) is quite extraordinary, i.e. high groundwater levels (“thin crust”) and silt deposits (EQC’s comment is “There are other areas in New Zealand with susceptibility to liquefaction, but what makes ChCh unique is the geographic extent of such sediments, which represents by far the greatest exposure of any NZ urban centre, and one scarcely matched elsewhere in terms of the depths (thickness) of liquefiable deposits”). The impact of the earthquake events on this land has been liquefaction on a scale never seen before. Each subsequent earthquake event is causing increasing amounts of land damage and associated repair cost (in contrast to the impact on buildings).

The relationship between cumulative land damage and repair cost is not straightforward – there is an “S-curve” effect whereby the marginal repair cost of marginal damage is non-linear. Initially the land may have been relatively robust in resisting damage but after a certain point it sustains disproportionately more damage from each successive quake but beyond a certain level additional land damage does not result in much additional cost.

Consequently, the level of building damage has been much larger than might be expected for earthquake events of this size because of the combination of land response with dwellings of a particular concrete-pad/brick/tile construction.

4 September event

- Land damage was (relatively) not severe – perhaps in the order of $300m cost to EQC.
- Less than 0.1% of the properties in what is now the orange zone would have been classified as “land total loss”.

22 February event

- Much more severe land damage than for 4 September.
- Red zones – Approximately 30%-40% of properties might be classified as “land total loss”.
- Orange zones - Approximately 5% of properties might be classified as “land total loss”.

MELVILLE JESSUP WEAVER
There was considerable land damage in the Port Hills area.

13 June event

- Caused additional damage comparable with the 22 February event, or even more in the case of the Port Hills (where there are high value sections and there may now be several thousand retaining walls in need of repair at perhaps $30k per job).
- Red zones have now moved to approximately 70% of properties being "land total loss" and it may be that the top part of the "S-curve" is being approached so that subsequent events result in less damage and repair cost.
- Orange zone has now moved to approximately 20% "land total loss".

Future

- If there is another event, it may cause even more land damage.
- The red zones are now believed to be “topping out” in terms of damage (see “S-curve”).
- Green zones are believed to be less exposed.
- In terms of the legal issues regarding EQC cover:
  - There is a question as to what the market value of a property is subsequent to each event, and this could impact on costs where market value is paid.
  - The “imminent damage” issue could have implications for the allocation of damage costs between events with the possibility of land claim costs being allocated to the 4 September 2011 event.

2.13.3 Information / data

The land claim estimates held within ClaimCentre are not yet at a level of reliability to be relied on for actuarial analysis.

2.13.4 Estimated EQC land claim liabilities and associated uncertainty

The estimated EQC land claim cost estimates and the estimation bases are set out in Section 7.

The associated uncertainties regarding the EQC land cost claims estimates is set out in Section 5.3.
2.14 Central and local government involvement

2.14.1 Central government

Beyond the involvement of the EQC, the impact of central government decision making is most apparent in the decisions and actions of the Canterbury Earthquake Recovery Authority (CERA) – a new government agency established under legislation to lead and coordinate the Canterbury region’s recovery efforts – important developments include:

- Decisions regarding compensation of homeowners in the areas with worst land damage – in particular the land decisions announced on the 23 June 2011:
  - Approximately 5,100 Red Zone properties where land is to be abandoned with owners offered a package.
  - Approximately 10,500 Orange Zone properties for which a decision to be reclassified as either Red or Green.
  - Approximately 100,000 Green Zone properties for which the land is either undamaged or easily repairable and no package will be offered.
  - An unknown number of White Zone properties in the CBD and Port Hills where land damage is being assessed and which will be reclassified as red or green.
- A further announcement was made on 18 August 2011:
  - 1,230 Orange Zone properties in the north of Christchurch were given a verdict – 940 were reclassified as Red Zone and the Remainder were Green Zone.
  - 860 of the new Red Zone houses are in Kaiapoi and 80 in Pines Beach.

2.14.2 Local government

Local government is involved in a wide range of local issues including:

- Infrastructure.
- Building regulations - Particularly important for commercial buildings in the CBD.
- Building consents.

2.15 Economic environment

2.15.1 Economic growth

Gross Domestic Product increased 0.8% in the March 2011 quarter with annual growth of 1.4%.

2.15.2 Employment

The unemployment rate was 6.6% in the March 2011 quarter, down from 6.7% in December 2010.

Additionally, the March Quarterly Employment Survey revealed that wage growth improved slightly. Salaries and wages increased just 2.6% for the year to March 2011.
2.15.3 **Inflation**

Inflation continues to rise with the June Consumer Price Index at 5.3% for the year – although this includes the GST increase from 12.5% to 15% at 1 October 2010.

2.15.4 **Interest rates**

The Reserve Bank last decreased interest rates on 10 March 2011 to 2.50%. The low rate has been justified on the back of the Canterbury earthquake catastrophe which has depressed economic conditions.

Over the last twelve months 5 year government bond yields have fallen from 4.58% to 3.99%.
3 Data and Information

3.1 Sources of data

The main sources of data used for the investigation were:

- The Actuarial Data Extract from ClaimsCentre.
- An extract of assessments from the COMET system.
- Output from the Minerva catastrophe model.

3.2 Sources of information

The main sources of information used for the investigation were:

- Draft accounts for the year ending 30 June 2011.
- Daily reports supplied by the BIU.
- Weekly reports supplied by the Fletcher Construction EQR.
- The Tonkin & Taylor indicative EQC land costs information and estimates.
- The [redacted] report “Statistical analysis of the cost of the Christchurch earthquakes”.
- Information from EQC and government websites.
- Discussions and correspondence with various relevant EQC staff, contractors and advisors (more details are set out in Appendix I).

3.3 Validation of data

The table in Appendix J illustrates a reconciliation of the 30 June 2011 Actuarial Data Extract system against the BIU’s Daily Report for 30 June 2011 and the Claims Paid figures from the 30 June 2011 accounts (Events loss summary).

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

3.4 Reliances

The key data and information reliances are described in Sections 3.1 and 3.2 above.
3.5 Concerns and qualifications

3.5.1 General comments regarding the data held in ClaimsCentre

The main areas of concern with respect of the use of the data for actuarial purposes are:

- The need to improve the quality of land estimates held in ClaimsCentre.
- The difficulties of identifying the status of a sub-claim in its path through the claims process.
- The difficulties of knowing whether a case estimate is at a stage where it may be relied upon for actuarial analysis (i.e. a human estimate for which the costs have been correctly allocated to events and for which EQC cover rules have been applied).
- The Minerva model is due for recalibration for new exposure, risk and land damage information.

3.5.2 Land claim cost estimates provided by Tonkin & Taylor

The situation with regards to the Tonkin & Taylor land claims estimates merits special mention as an area of concern in terms of the magnitude of the potential costs, the uncertainty of the magnitude and also the attribution of the costs to events. This issue has been discussed in more detail in Sections 2.13, 5.3.2 and 7.4.6.

We stress that these comments must not be taken as a criticism of the information provided, merely a recognition of its inevitable and unavoidable limitations at this point in time.

3.6 Recommendations

3.6.1 Progress against previous recommendations

Several data-related recommendations were set out in Section 4.6 of the report of 10 December 2010. The progress against these recommendations is as follows:

- Prepare and understand data requirements well in advance of beginning the investigation. Adopted.
- Create data dictionaries for the CIMS and GIS systems. Not adopted.
- Identification of rules by which sub-claims are identified. Not adopted.
- More detailed claims data. Partially adopted.

3.6.2 Current Recommendations

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

- Process:
  - Improve the quality of land estimates.
  - Improve the process for the application of cover rules to estimates provided via the COMET interface.
- ClaimsCentre:
- Create a data dictionary for the ClaimsCentre system that ties in with claims management processes.
- Clear identification of the existence of exposures (sub-claims).
- Clear identification where EQC cover rules have or have not been applied to estimates.
- Clear indication of whether a sub-claim is open or closed.
- Complete identification of the property to which a claim is attributed.
- More detailed transactions movement data.

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

We recognise that our recommendations relate to actuarial data only, and that we fully recognise the unique operational challenges under which EQC is operating 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 considered that the information provided to us was adequate and appropriate for the purposes of this valuation.
4 Claims analysis

4.1 Claims movements

4.1.1 Number of notified claims

<table>
<thead>
<tr>
<th>Number of notified claims (ClaimsCentre)</th>
<th>EQ1: 4 Sep 10</th>
<th>EQ2: 22 Feb 11</th>
<th>EQ3: 13 Jun 11</th>
<th>Cant EQ: Other</th>
<th>BAU: 2011</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Settled (non-nil)</td>
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<td>972</td>
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<td>Duplicates (nil)</td>
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<td>36</td>
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<td>374,070</td>
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</table>

Comment:

- The figures in this and the following tables are based on an Actuarial Data Extract from ClaimsCentre as at 30 June 2011.
- Computer estimates are generated automatically when a claim is lodged and before an assessment is made by a loss adjuster.
- The number of assessments for EQ2 is understated as the COMET assessments did not start to be interfaced to the ClaimsCentre system until mid-July.
- Almost no assessments have been carried out for EQ3.
- Duplicate claims arise when a homeowner lodges in error more than one claim for an event.
### Number of notified sub-claims

Number of notified sub-claims (ClaimsCentre)

<table>
<thead>
<tr>
<th></th>
<th>EQ1:</th>
<th>EQ2:</th>
<th>EQ3:</th>
<th>Cant EQ:</th>
<th>BAU:</th>
<th>Total</th>
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<td>22 Feb</td>
<td>13 Jun</td>
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<td><strong>Land sub-claims</strong></td>
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<tr>
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<td>0</td>
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<td>552</td>
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<td>56,103</td>
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<td>63,390</td>
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<td>27,668</td>
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<td>127,431</td>
<td>19,966</td>
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<td>307,057</td>
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<td>954</td>
<td>137</td>
<td>14,672</td>
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<td></td>
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<td></td>
</tr>
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<td>Computer Estimate</td>
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<td>16,197</td>
</tr>
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<td>4,054</td>
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<td>75,456</td>
<td>9,755</td>
<td>5,008</td>
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<td>136,492</td>
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<td>36,684</td>
<td>4,226</td>
<td>506,939</td>
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</table>

**Comment:**

- This table and the following tables are based on sub-claims rather than claims.
- Each claim lodged with the EQC includes between one and three sub-claims (also known as “exposures”) corresponding to either land, building or contents losses.
- For the year to 30 June 2011, there were 1.4 sub-claims per claim on average.
- 36,451 sub-claims (7% of the total) have been settled to date.
- Comparing EQ1 and EQ2 we see a similar number of building claims but a higher number of land and contents claims for EQ2.
4.2 Claims paid to date

Claims paid to date (ClaimsCentre)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$m</td>
<td>$m</td>
<td>$m</td>
<td></td>
<td>$m</td>
</tr>
<tr>
<td>Land sub-claims</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closed</td>
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<tr>
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<td>Building sub-claims</td>
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<td>$m</td>
<td>$m</td>
<td>$m</td>
<td>$m</td>
</tr>
<tr>
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</tr>
<tr>
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<td>$m</td>
<td>$m</td>
<td>$m</td>
<td>$m</td>
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<td>1.3</td>
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<td>0.2</td>
<td>0.0</td>
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<td>10.1</td>
</tr>
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</table>

Comment:
- This table only includes claims paid to date as recorded in ClaimsCentre.
- EQ1 accounts for 84% of the total claims paid to date.
- Building claims amount to 89% of the total paid for EQ1.
- Looking at BAU claims, land claims account for the greatest proportion of claims costs.
### 4.3 Reported claims incurred

**Reported claims incurred (ClaimsCentre)**

<table>
<thead>
<tr>
<th></th>
<th>EQ1: $m</th>
<th>EQ2: $m</th>
<th>EQ3: $m</th>
<th>Cant EQ: $m</th>
<th>BAU: 2011 $m</th>
<th>Total $m</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land sub-claims</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>0.0</td>
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</tr>
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<td>0.4</td>
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<td>203.2</td>
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<td><strong>Total Land Reported Incurred</strong></td>
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<td>209.4</td>
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<td>11.2</td>
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<tr>
<td><strong>Building sub-claims</strong></td>
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<td>$m</td>
<td>$m</td>
<td>$m</td>
<td>$m</td>
<td>$m</td>
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<td>$m</td>
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<td>$m</td>
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</table>

**Comment:**

- Reported claims incurred is the sum of claims paid to date (as recorded in ClaimsCentre) plus the case estimates held as at 30 June 2011.
- Building claims are 75% of reported incurred claim cost.
- EQ1 is 60% of the reported incurred claims costs – this reflects the fact that for EQ2 many of the case estimates currently held are computer estimates, which are lower on average than human estimates.
4.4 Observed average claims cost

**Observed average claims cost (ClaimsCentre)**

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<th>EQ3: 22 Feb</th>
<th>Cant EQ: 11 Jun</th>
<th>Other 13 Jun</th>
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<td></td>
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<tr>
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<td>4,010</td>
<td>10,284</td>
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</tr>
<tr>
<td><strong>Building sub-claims</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closed</td>
<td>1,722</td>
<td>2,491</td>
<td>1,390</td>
<td>1,395</td>
<td>1,577</td>
<td>1,726</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Computer Estimate</td>
<td>1,974</td>
<td>1,314</td>
<td>1,305</td>
<td>978</td>
<td>1,208</td>
<td>1,412</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessed by Loss Adjuster</td>
<td>4,588</td>
<td>5,310</td>
<td>6,475</td>
<td>1,798</td>
<td>8,895</td>
<td>4,594</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td>3,169</td>
<td>1,365</td>
<td>1,308</td>
<td>1,027</td>
<td>1,685</td>
<td>1,835</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Contents sub-claims Average</strong></td>
<td>2,756</td>
<td>1,372</td>
<td>1,308</td>
<td>1,097</td>
<td>1,651</td>
<td>1,823</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comment:**

- The land claim estimates held in ClaimsCentre are not yet reliable.
- For building claims in particular, the computer estimated observed average claim sizes are much smaller, reflecting the need for a review of the estimation algorithms post the Canterbury earthquakes.
5 Uncertainty

5.1 General comment

There is inherent uncertainty in any estimation of 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.

5.2 General sources of valuation uncertainty

The general sources of error in the estimation of liabilities include:

- Normal variation that is inherent in any random process.
- The valuation model being a poor representation of reality.
- Incorrect valuation assumptions arising from:
  - Assumptions being derived from an unrepresentative sample.
  - Underlying experience drifting over time and chosen assumptions failing to accurately follow the “drift” – this could be due to “internal” factors such as changes in the claims process or external factors such as changes in the legal environment, natural catastrophes etc.
- Incomplete or poor quality data.
- Errors in calculations.

All of these sources of error are potentially present in this investigation.

5.3 Exceptional uncertainties arising from the Canterbury earthquakes

5.3.1 Background

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 EQC coverage and reinsurer coverage.
- Severe land damage and a very complex land claims environment from both an engineering and legal perspective.
- The relatively early stage of claims development - including the most recent large earthquake event of 13 June 2011 – some consequences of this include:
  - There has not yet been sufficient time to evaluate the quality of assessments.
  - Claims patterns are not yet well established.
  - The small samples available are known to be highly biased.
  - The potential for construction cost inflation to exceed expectations.
Consequently, at this stage of claims development, there is a high degree of unavoidable uncertainty regarding the future claims costs. Over time, as the assessments are completed and claims are settled, and as the reasonableness of the model and its assumptions can be tested against the emerging claims experience, the level of uncertainty will reduce.

5.3.2 Land Valuation Uncertainties

The land claim cost estimates supplied by Tonkin & Taylor are, due to the special conditions surrounding land claims, necessarily subject to a high degree of uncertainty. The comments below have been provided by EQC and are intended to describe the issues in more detail:

- The geotechnical engineering assessment of EQC’s liability for land compensation on the Canterbury Plains considers both damage incurred as well as factors that may affect the future ability of the ground to support housing and achieve adequate performance during earthquakes. Some of the crucial data required for this determination – including a LiDAR (Light Detection and Ranging) survey of elevation changes of the ground surface, and monitoring of changes to the subsurface watertable - will not be completed until September, so current modelling is generalised from small areas where detailed assessment has been completed.

- The dominant damage risk factor in the model developed by Tonkin and Taylor is exquisitely sensitive to small changes in the “fill depth threshold” – a parameter which defines the depth of fill required to restore a property to its former elevation where subsidence has occurred, and beyond which a repair is considered not viable. As reported to MJW, the fill depth threshold will vary from place to place and will depend on whether or not a repair option can be applied to one or many properties. Discussion with EQC and Tonkin and Taylor has indicated that a higher threshold than the median 0.3m used for indicative purposes by MJW may apply, in which case EQC’s liability for land on the Plains will fall by several percent.

- The valuation date(s) applied to the apportionment of land damage among events is awaiting legal opinion that materially affect EQC’s liabilities and potential reinsurance recoveries.

5.4 Implications of uncertainty

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 wide confidence ranges in the estimated liabilities for each event.

- Different practitioners could legitimately arrive at quite different estimates of the cost of claims.
6 Outstanding Claims Liabilities – Valuation Methodologies

6.1 Liability components

The EQC’s OS claims liabilities to be included in its financial statements at 30 June 2011 are – in summary – an estimate of the total value of liabilities relating to all claims incurred up to the balance date of 30 June 2011.

The liabilities will include both future direct claims payments and the associated claims handling expenses. Claims incurred will include both reported and unreported claims as at the balance date.

The direct claims payments have been calculated to include the valid claims costs payable to insureds, as defined by the Earthquake Commission Act 1993 (the Act). The claims handling costs include the administration costs and allocated overheads associated with the management of those claims.

Insurance accounting standards also require the OS claims liabilities to be discounted for the time value of money and to include the addition of a risk margin to increase the probability of sufficiency of the estimate.

Based on the comments above the key liability components are:

- Direct claims costs of reported, open claims:
  - Case estimates held within ClaimsCentre.
  - An allowance for IBNER (incurred but not enough reported) claims costs where the case estimates are considered to be insufficient.
- Direct claims costs of claims incurred but not reported (IBNR) at the balance date.
- Direct claims costs of reported, closed claims that reopen (Reopened).
- Non-reinsurance recoveries.
- Claims handling expenses.
- Reinsurance recoveries.
- Risk margins.
- Discounting for the time value of money.

6.2 Valuation groupings

6.2.1 Introduction

The OS claims liabilities are subdivided by two main dimensions:

- Event.
- Sub-claim.

This subdivision is necessary because different cover and reinsurance rules apply to the different valuation groupings and the underlying data for the creation of assumptions also differs.
6.2.2 Event valuation groupings

The insurance liability components described in Section 6.1 have been further split into the costs arising from different claim events.

The event groups are:

- "BAU" (Business As Usual) claims – e.g. landslip claims, claims for hydrothermal events, claims from smaller earthquakes outside Canterbury (also known as “attritional” or “working” claims).
- Canterbury earthquakes:
  - 4 September 2010 event (EQ1).
  - 22 February 2011 event (EQ2).
  - 13 June 2011 events (EQ3).
  - Other aftershocks (e.g. 19 October 2010, 14 November 2010).

A more detailed description of the different earthquake events is set out in Section 2.12 and Appendix A.

6.2.3 Sub-claim valuation groupings

Each claim lodged with the EQC may result in repair and replacement costs arising from one or more sub-claims types (also known within EQC as “exposures”) and the OS claims liabilities components described above have been further split into the costs arising from these groups.

The sub-claim valuation groups are:

- Land claims.
- Buildings claims.
- Personal property (contents) claims.

A more detailed description of the cover provided by the EQC is set out in Section 2.3 and Appendix B.

6.3 Valuation methodologies considered

The choice of a valuation methodology or methodologies is driven by a range of factors:

- The purpose of the valuation and outputs required.
- The amount and quality of data available.
- The underlying claims process and characteristics.
- The degree of claims development.
- The degree of uncertainty underlying the claims process and assumptions.
- The time and resources available for the completion of the project.

The considerations relevant to this investigation are set out in Section 6.4.
6.4  Valuation methodology selected

In summary, the valuation model ultimately selected may be described as an aggregate Bayesian stochastic frequency/severity model. The model itself runs in an MS-Excel spreadsheet although certain key assumptions are determined using the R statistical package.

A number of alternative valuation methodologies were considered having regard to the criteria set out in Section 6.3. Other deterministic and stochastic approaches were considered and a list of methodologies considered and rejected is set out in Appendix K.

The key considerations were:

- The liability components for an ILVR for financial statements were required – i.e. all the components set out in Section 6.1. We considered that a stochastic (Monte Carlo) approach was suited to the need for risk margins and modelling the operation of the catastrophe reinsurance treaties.
- Although there is a lot of claims-related data of variable quality for building and contents sub-claims, individual payments and case-estimate transactions data is not available.
- Information regarding land sub-claim costs is still very limited and high-level at this time.
- Claims development is still very immature.
- The estimates were required within financial reporting deadlines.

Finally, the high level of uncertainty regarding many of the assumptions and the claim process meant that a stochastic approach to estimating the aggregate claims distributions, with an additional layer of variability added to the assumptions themselves would help us to better capture that uncertainty – i.e. a Bayesian approach.

Our approach to the modelling has been to base our analysis on best estimate assumptions and reflect our uncertainty about claims assumptions in the size and shape of the variance around the best estimate assumption.

As the claims situation develops, the use of alternative valuation methodologies should be considered.

More details of the model’s structure and operation are set out in Section 6.6.

6.5  Changes in methodology

Although MJW undertook a valuation of insurance liabilities for EQC as at 30 June 2008, for materiality and relevance reasons we do not propose to consider that valuation further.

Of more relevance is the estimation of liabilities for the 4 September 2010 event, for which a report was produced in December 2010. That investigation and report were undertaken for very different reasons and with a narrower scope. However, that investigation was undertaken prior to the series of following aftershocks including the most serious one of 22 February 2011 and the less serious one of 13 June 2011 and so is less useful than it otherwise might have been.

The valuation methodology applied for the December report was based on an individual claim stochastic model that ran in R.
The current valuation methodology has some features in common with that used for the December report – i.e. it is frequency/severity based and stochastic.

Key changes since the December 2010 investigation include:

- The addition of all the components of OS claims liabilities including risk margins, claims handling expenses, reinsurance and discounting for the time value of money.
- The addition of new event groupings and BAU.
- An updated model structure built around aggregations of claims rather than individual claims. This was done to make the model run faster and also to make it more accessible to non-R users.
- The land sub-claim modelling has, due to the limited information available at this time, been done on an aggregate claims distribution basis.
- An increase in the complexity of the overall model in response to the new liability components required and to model the issues arising from multiple events.

6.6 Gross incurred claims costs

6.6.1 Ultimate vs. outstanding claims

Focussing on the claims costs arising from the Canterbury earthquakes, the gross incurred claims costs for all claims incurred to 30 June 2011 includes:

- Claims costs paid to date.
- Claims costs expected to be paid in future (the OS claims liability).

The first bullet point immediately above is a known item and the second is unknown and so must be estimated. The approach that we have taken is to first estimate the projected ultimate claims costs and then to deduct the payments to 30 June 2011 in order to determine the estimated OS claims liability.

6.6.2 Diagrammatic illustration of the valuation model

The diagram immediately below illustrates the key components, variables and overall structure of the valuation model at the sub-claim level. As a stochastic model, rather than producing a single estimate for a given set of assumptions, each model run produces a new “random” estimate whose overall aggregate claims cost is governed by the assumptions chosen (which are themselves “randomly” chosen within certain limits).

The table below represents the process for a single event – each event will have its own unique set of assumptions - but these run in parallel in the model as it is the aggregate claims situation across the entity that must be captured.

**Notation (Illustrated for the ‘Computer Estimate Sub-claim’ component on the next page):**

- \( S_{CE} \) Number of sub-claims with a computer estimate
- \( \text{Nii}_{CE} \) Assumed future percentage of nil computer estimate claims
- \( \text{x}_{CE} \) Assumed average sub-claim size for computer estimate claims
- \( \text{CCE}_{CE} \) Assumed claims cost escalation (inflation)
- \( \text{Reopen} \) Assumed reopen percentage (as a proportion of total paid amount)
Methodology Overview (per event):

**Land Sub-claims** ↓

[Diagram showing the calculation process]

**Building Sub-claims** ↓

- **Computer Estimate (CE) Sub-claims**
  \[ \text{Sub-claims}_{CE} \times (1 - \text{Nil}_{CE}) \times \bar{x}_{CE} \times (1 + \text{CCE}_{CE}) \]

  +

- **Loss Adjuster Estimate (LAE) Sub-claims**
  \[ \text{Sub-claims}_{LAE} \times \bar{x}_{LAE} \times (1 + \text{CCE}_{LAE}) \]

  +

- **IBNR Sub-claims**
  \[ \text{Sub-claims}_{IBNR} \times (1 - \text{Nil}_{IBNR}) \times \bar{x}_{IBNR} \times (1 + \text{CCE}_{IBNR}) \]

  +

- **Sub-claim transitions (SCT)**
  \[ \text{Sub-claims}_{SCT} \times \bar{x}_{SCT} \times (1 + \text{CCE}_{SCT}) \]

↓

**Reopened Sub-claims**

\[ \text{Estimated Total (Land / Building / Contents) Claims Cost} \times (1 + \text{Reopen}) \]

↓

**Estimated Ultimate Incurred Claims Cost Per Event**

The model is run many times and the output (which is subdivided by the valuation groups described earlier) from each run is collected to form an aggregate gross claims distribution. The gross central estimate ultimate claims cost is found by taking the mean value of the distribution and the 75% PoA estimate (and so gross risk margin) is found by taking the 75th percentile.

**6.6.3 Building and contents sub-claims**

As may be seen in the diagram above, open building and contents sub-claims are modelled on a frequency/ severity basis with Nil claim, average claim and cost escalation assumptions that depend on the degree of progress of the claim through the claim process.

Reopened claims costs are modelled simply as a percentage addition to the closed claims costs.
6.6.4 Land sub-claims

Due to the limited and high-level nature of the information available, the modelling of land sub-claims has been done on an aggregate per-event basis. Essentially, based on a supplied aggregate median estimate and upper bound for the total land costs, and a supplied split between events, a log-normal aggregate claims distribution has been assumed for each event group and parameters derived accordingly. Allowance is made for cost escalation.

A more detailed description of certain aspects of the incurred claims model is set out in Appendix M.

6.7 Non-reinsurance recoveries

Non reinsurance recoveries are not explicitly modelled as they are not considered to be material. They are dealt with implicitly to the extent that they are present in the reported incurred claims experience (as negative payments).

6.8 Claims handling expenses

Claims handling expenses are subdivided into the event groups but are also further subdivided into reinsurable and non-reinsurable components.

Future claims handling expenses are modelled on a per-claim basis using per-claim cost assumptions derived from the expense analysis described in Appendix L. The allocation of past claims handling expenses to the different valuation groups is determined using the same model.

Risk margins are also applied to the claims handling expenses.

6.9 Reinsurance recoveries

6.9.1 General comments

The catastrophe reinsurance cover and corresponding reinsurance recoveries are modelled explicitly by the valuation model. The application of the reinsurance rules is complex as the cover applied for any event is contingent upon the severity of earlier events. The use of a stochastic model is beneficial in this respect.

A detailed description of the reinsurance programme is set out in Appendix F but a summarised description of its operation based on a “hydraulic” analogy is set out in Section 6.9.2.

We have not considered for this report adjustment for reinsurance credit risk, nor does the reinsurance recovery asset take into account any reinsurance recoveries that may have been received to date.

6.9.2 Reinsurance programme – hydraulic analogy

We found that the best way to understand how the EQC’s catastrophe reinsurance programme operates was via a “hydraulic” analogy. Readers preferring a more detailed and conventional explanation should consult Appendix F.
The EQC’s catastrophe reinsurance programme may be imagined as a series of buckets, where each bucket represents a layer of the programme and the water in the bucket represents potential reinsurance recoveries.

In order to keep things “simple”, for this analogy - which is a general description rather than being modelled on the actual Canterbury earthquakes - we will ignore coinsurance and tranches within the layers although, where necessary, these are modelled directly in the valuation model.

**Starting point**

- Assume a starting date of 1 June 2010.
- The EQC is a tub with 6 litres in it (where each litre represents one billion dollars).
- The catastrophe reinsurance programme is a series of buckets – some with different amounts of water.
- The buckets are all full and are arrayed beside the tub in two rows, with one row – the back row - directly behind the other – the front row.
- Certain earthquake events may cause an initially uncertain amount of water to gradually flow out of the tub (direct claims).
- The three buckets in the front row are all full and are labelled (from left to right) 1a (layer 1 - 0.5 litres), 2a (layer 2 - 1.5 litres) and 3a (layer 3 - 0.5 litres) – a total of 4 litres.
- The three reinstatement buckets in the back row are all full and are labelled (from left to right) 1b (layer 1 reinstatement - 0.5 litres), 2b (layer 2 reinstatement - 1.5 litres) and 3b (layer 3 reinstatement - 0.5 litres).

**Impact of an event or events**

- When an event causes the water lost from the tub to exceed 1.5 litres (the deductible), recoveries are poured from the front row buckets into the tub consecutively - moving from left to right as the buckets are progressively emptied – until the amount lost from the tub in excess of the deductible is restored. For a single event water would only be taken from bucket 2a when bucket 1a is empty and water would only be taken from bucket 3a when buckets 1a and 2a are both empty.
- If a single event caused all of buckets 1a, 2a and 3a to be emptied then no more recoveries could be taken for that event.
- Once the water is poured from a front bucket after a first event then the bucket immediately behind it (i.e. 1b, 2b or 3b) will be used to top up its corresponding bucket in front (until the bucket behind the front bucket is either partly or completely empty).
- If a second event were to empty both the front and back buckets then there would be no further recoveries for a third event unless a new bucket had been purchased separately.
- If, after a second event, a front bucket has been topped up by its back bucket, and there is still some water left in the back bucket then this would be available for a third event unless the bucket “expired” and was removed.
- Bucket 3a (the “Top and Drop” bucket) has special properties. If any water is poured out of bucket 3a into the tub (which will only happen after both buckets 1a and 2a have been emptied) then it is immediately shifted to the extreme left of the front row of buckets (along with bucket 3b behind it) so that it now sits to the left of bucket 1a – this means that the deductible for a subsequent event is now only 1 litre (because the “top” has “dropped”).
If there is a subsequent event then once the deductible is breached (either 1.5 litres if bucket 3a has not yet been poured or 1 litre if it has) then the leftmost bucket (either 3a if it has been poured in response to an earlier event, or 1a if bucket 3a has not been poured in response to an earlier event) is used first and then – depending on the size of the event, we move progressively to the buckets to its right.

If both the front (bucket a) and rear (bucket b) buckets from a layer 1, 2 or 3 are emptied then no further recoveries are available until they are replaced by new, full ones.

At 1 June 2011

- At 1 June 2011 buckets 1a, 1b, 2a, 2b are replaced with new, full ones.

6.10 Risk margin

The gross and net risk margins are direct outworkings of the determination of the 75th percentile of the generated gross and net of reinsurance claims distributions. The dollar value of the risk margin for a valuation group is determined by deducting the value of the central estimate of the relevant distribution from the 75th percentile, assuming that it is higher. Where it is not, accounting rules require that a minimum of the central estimate is used for an OS claims liability.

The statistical properties associated with combining aggregate claims portfolios means that the risk margin for a combined portfolio will – depending on the degree of covariance (non-independence) between the two distributions - generally result in a lower risk margin than either of the two separate distributions.

For the purposes of our claims modelling, we have made a simplifying assumption of independence between the land, building and contents claims distributions (which is a reasonable assumption as they cover quite different risks). We have not assumed independence between the distributions between different events however as, due to the proximity of the events and the broadly similar mix of risks covered, there will be some degree of covariance.

6.11 Discounting for the time value of money

Discounting for the time value of money was achieved by the application of forward interest rates to projected future claims cashflows. The projection of cashflow timings over future years was also “randomised” in order to reflect uncertainty about the timing.