

### Cost of Black Saturday bushfires

TANGIBLE \$3.1 bn

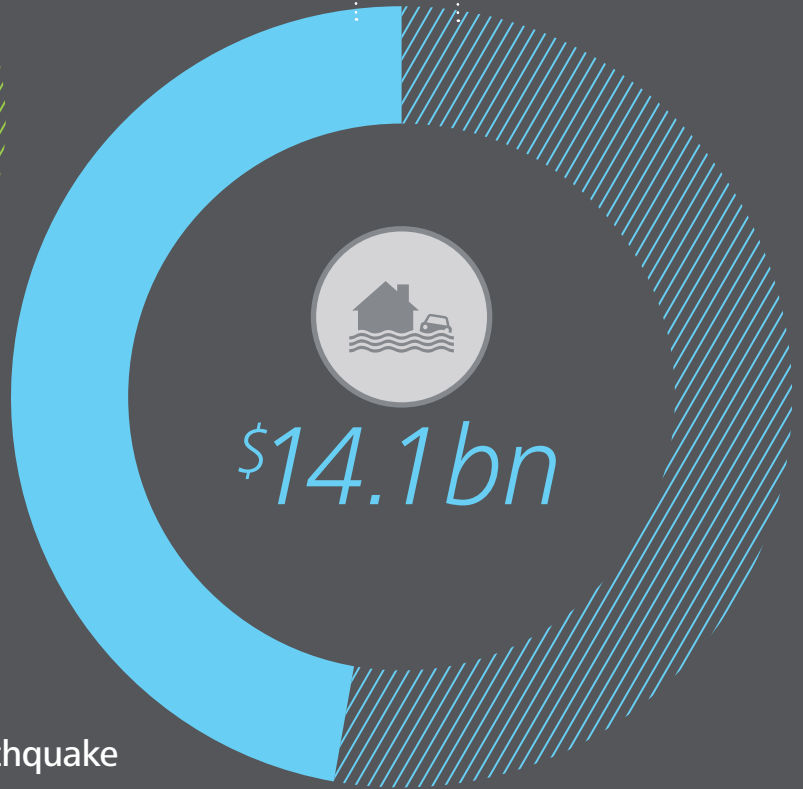
INTANGIBLE \$3.9 bn



### Cost of Queensland floods

TANGIBLE \$6.7 bn

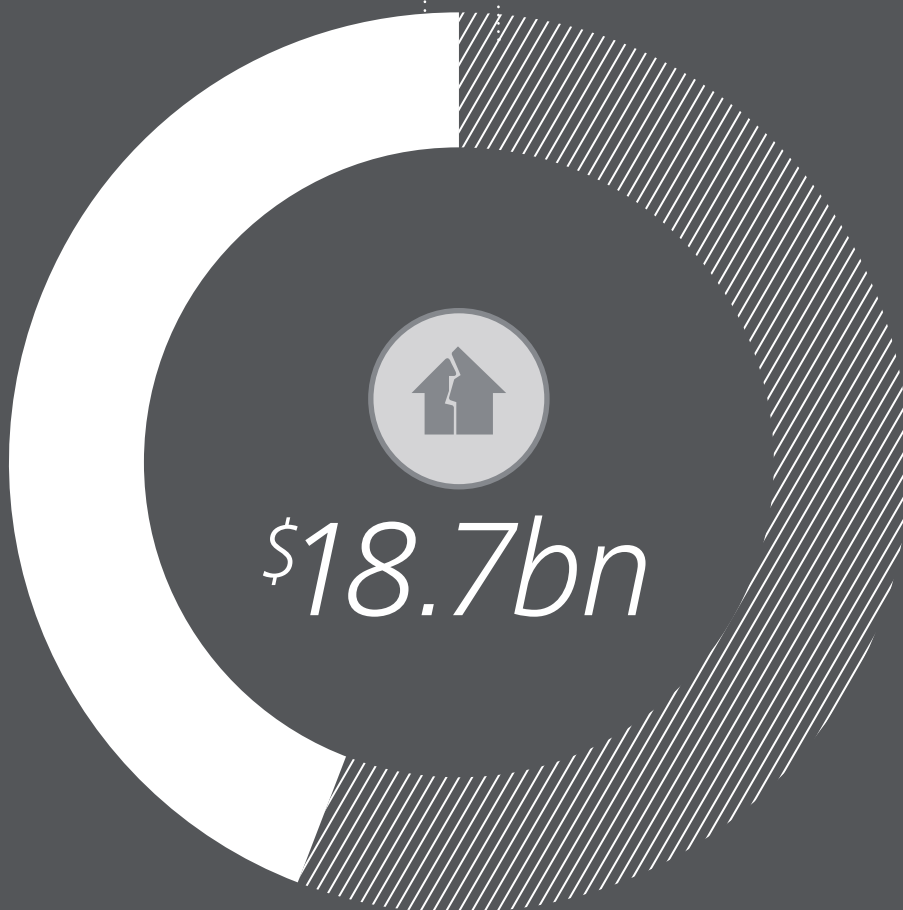
INTANGIBLE \$7.4 bn



### Cost of Newcastle earthquake

TANGIBLE \$8.5 bn

INTANGIBLE \$10.2 bn



# 3. The cost of natural disasters: Australian experiences

## Key points

- The case studies demonstrate that the total economic cost of natural disasters has been underestimated by at least 50%
- Accounting for the tangible and intangible costs, the forecast annual cost of natural disasters across government, business and communities in Australia is expected to reach about \$33 billion by 2050
- This estimate is likely to be conservative.

## 3.1 Case studies showing the cost of natural disasters in Australia

This section provides a detailed assessment of the tangible and intangible costs of two natural disasters: the 2010–11 Queensland floods and the 2009 Victoria Black Saturday bushfires. The costs have been estimated using a bottom-up methodology, which estimates the total economic cost by applying a disaster-specific incidence rate and average cost of each impact to the affected population. The methodology used to generate these estimates is explained in Appendix D. These case studies are illustrative of the magnitude of intangible costs, relative to tangible costs.

It is important to note that the ratio of tangible to intangible costs vary by the type, severity and geographic location of the natural disaster. For example, the incidence rate of psychological distress between the Queensland floods and the Black Saturday bushfires was broadly similar. However, the floods affected a vast area including highly populated centres of Brisbane and Ipswich, while the Victoria Black Saturday bushfires affected mostly regional and rural communities that are less densely populated.

### 3.1.1 Queensland floods

Cyclones and flooding have posed a serious threat to Queensland communities and industry in the past, particularly in the north. This section focuses on the impact of the cyclones and floods that occurred there in 2010–11, however Queensland has experienced multiple serious disaster events in the last decade (including Cyclone Larry in March 2006).

Prolonged and extensive rainfall from December 2010 to January 2011 led to extensive flooding in Queensland (Queensland Floods Commission of Inquiry, 2012). This was followed soon after by Cyclone Yasi on 3 February, 2011. Yasi made landfall as a category 5 cyclone in Far North Queensland, an area which had just recovered from Cyclone Larry.

In a Queensland survey on the effects of the floods, 47% of respondents reported that their own home, homes in their suburb, or their family home had been damaged or destroyed (Queensland Health, 2011). People from disadvantaged socioeconomic backgrounds and in outer regional and remote areas were affected more in a number of ways, such as distress and feeling terrified, helpless or hopeless, or having reduced incomes.

#### 3.1.1.1 The economic cost of the 2010–11 Queensland floods

The 2010–11 floods were widespread and had devastating effects on communities. More than 78% of the state (an area bigger than France and Germany combined) was declared a disaster zone, and over 2.5 million people were affected (Queensland Floods Commission of Inquiry, 2012).

The intangible costs associated with the Queensland floods were estimated to be as large as the tangible costs, at an estimated \$7.4 billion dollars and \$6.7 billion dollars, respectively. This means the ratio of intangible costs to tangible costs is likely to be larger than 1.1.

### 3. The cost of natural disasters: Australian experiences

#### Deaths and injuries

Thirty-six people died in the floods, including three who were missing and later declared deceased. Major flooding occurred throughout most of the Brisbane River catchment, most severely in the catchments of Lockyer Creek, which caused the loss of 19 lives.

The number of people injured in the floods is not documented. However, based on a report by Van den Honert and McAneney (2011), these floods were very similar to the 1974 Australia Day floods in Queensland in which 300 people were injured. Applying a ratio defined by the Bureau of Transport Economics (2001), it is estimated the 2010–11 floods caused 100 severe injuries and 200 minor injuries.

Based on the average life expectancy in Queensland and the average age of people affected by the floods, **the lifetime cost of deaths and injuries is estimated at around \$320 million (net present value in 2015 dollars).**

#### Mental health issues

Adults of working age and residents of regional, remote and socioeconomically disadvantaged areas, were disproportionately more likely to report emotional impact caused by the floods. Of a sample of more than 6,000 Queensland residents exposed to the floods, 14.3% reported feeling 'terrified, helpless or hopeless', and 3.9% thought they might be 'badly injured or die'. Up to five months after the disasters, 7.1% were 'still distressed' and 8.6% were 'worried about how they might manage'.

Similarly, Alderman et al. (2013) found that residents whose homes were directly affected by the Brisbane flooding were more likely to report poorer physical and mental health. The affected residents were:

- 5.3 times more likely to report poorer health than those not affected by the floods
- 2.3 times more likely to report respiratory issues
- 1.9 times more likely to report psychological distress
- 2.3 times more likely to report poor sleep quality
- 2.3 times more likely to have probable post-traumatic stress disorder (PTSD) .

Mental health issues were the largest impact of the floods.

Using these surveys as proxies to estimate the number of people who had short- and long-term high to very high psychological distress, **the lifetime cost of mental health issues resulting from the floods is estimated at around \$5.9 billion (net present value in 2015 dollars).**

#### Risky or high-risk alcohol consumption

Mental health-related behaviours such as substance use (alcohol and smoking) have been documented following natural disasters. Turner et al. (2013) surveyed a sample of 3,000 residents (aged 18 years and over) in flood-affected areas in the greater Brisbane region. Of the 960 respondents, 10.6% reported some form of direct flood impact. The group affected directly by the floods were 5.2 times more likely to increase their alcohol use, and 4.5 times more likely to increase their tobacco use.

Using this to estimate the proportion of the affected population who had short- and long-term increases in risky and high-risk alcohol consumption, **the lifetime cost resulting from the floods was estimated at about \$20 million (net present value in 2015 dollars).**

#### Chronic and non-communicable diseases

Evidence shows that natural disasters exacerbate chronic disease, whether diagnosed or undiagnosed. The most common illnesses are cardiovascular disease, diabetes and respiratory conditions such as Chronic Obstructive Pulmonary Disease (COPD). Chronic disease exacerbation can be due to illness (for example, from increased susceptibility to injury or infection) or due to the disaster itself (such as by separation from medication or treatment, inhaled toxins, crush or blast injuries, or contamination of food and water) (Miller & Arquilla, 2008; Owens & Martsolf, 2014; Kobayashi et al., 2013).

Ryan et al. (2015) did focus groups and interviews with people with non-communicable diseases (NCDs), disaster responders and health specialists in the Cairns, Toowoomba and Townsville regions. They found a disaster can interrupt management and care for people with NCDs living in rural and remote areas of Queensland, which has the potential to exacerbate their condition or even result in death.

### 3. The cost of natural disasters: Australian experiences

There is also some anecdotal evidence that people affected by natural disasters may develop diseases such as cardiovascular disease from elevated stress and blood pressure. However, this is not quantified due to insufficient quantitative information and the complexities of attributing it to the natural disaster.

According to Alderman et al. (2013), people directly impacted by the floods were 5.3 times more likely to experience worse overall health and 2.3 times more likely to experience worse respiratory health.

Using a combination of these studies and the prevalence of diabetes, COPD and stroke in Queensland as a baseline, it is assumed that these conditions will be exacerbated in a proportion of people post-disaster. **From this, it is estimated that the cost of the exacerbation of diabetes and COPD, and the development of stroke resulting from the floods was around \$430 million (net present value in 2015 dollars).**

#### Family violence

Increased rates of family and gender violence after natural disasters is qualitatively well-documented. Stress is often cited as the key reason for increased violence against women post-disaster.

Anecdotal evidence from domestic violence service providers such as the Ipswich Women's Centre Against Domestic Violence reported a spike in cases of family violence after the 2010–11 floods. It was noted that the underlying problems many families were facing were heightened in the aftermath of the disaster. An additional exacerbating factor was the shortage of crisis accommodation due to the floods for people affected by domestic violence.

There has been no quantitative study of the impact of the floods on family violence levels. Hence, the Household Income and Labour Dynamics in Australia (HILDA) survey was used to estimate the difference in family violence rates between those who reported having their house or property damaged or destroyed by a natural disaster with those who did not. **It is estimated that family violence cost around \$720 million (net present value in 2015 dollars).**

#### Short-term unemployment

Natural disasters have negative effects on employment and disposable income, which in turn affects consumer

confidence. Because the value of unemployment and productivity loss is captured in several ways in the methodology (for example, productivity loss resulting from physical injury, mental health issues, chronic disease, alcohol misuse and family violence), this has not been separately costed, to avoid double counting.

In 2011, Commonwealth Bank of Australia analysed the effect of natural disasters on personal income and the disruption to living arrangements when disasters hit. The analysis used the Australian Government's Disaster Income Recovery Subsidy (equal to the Newstart Allowance) as a proxy for unemployment. It found the number of people applying for the Newstart Allowance rose dramatically following the floods. Importantly, repeated flooding events in North Queensland prior to the 2010–11 floods appeared to have made people vulnerable to loss of income. Between the North Queensland flood in 2009, the South West Queensland flooding in 2010 and the 2010–11 floods there was a consistent decline in the proportion of Queenslanders receiving a salary and an increase in the proportion relying on the Newstart Allowance as their only source of income.

This is consistent with Clemens et al. (2013), which found that 17% of respondents reported reduced incomes three to six months post-disaster.

#### Tangible costs

A breakdown of the tangible costs is included below. Many people reported disruption to businesses and displacement from homes after the Queensland floods and cyclones. Almost half of Queensland businesses were affected by the floods only, approximately 14% were affected by Cyclone Yasi, and almost 20% were affected by both, according to a survey done six months after the disaster by the Chamber of Commerce and Industry Queensland (CCIQ).

Approximately 29,000 homes and businesses were subject to some form of inundation during the Brisbane floods (Queensland Reconstruction Authority, 2011; CCIQ, 2011). The cost of rebuilding roads and other infrastructure, and supporting businesses and the community, totalled almost \$6.9 billion (Queensland Government, 2012). The cost incurred by housing-displaced people has not been quantified for the floods and cyclones (Queensland Reconstruction Authority, 2011).

### 3. The cost of natural disasters: Australian experiences

Transport was also severely disrupted, particularly following the Brisbane floods. Rail services between Darra and Ipswich were cancelled for more than one week, and Brisbane ferry services were suspended for more than six weeks (Brown, Bunker & Naiker, 2011). The bulk of recovery expenditure was spent on repairing roads, bridges and transport infrastructure (Queensland Government, 2012).

In total, the floods caused almost \$2.4 billion (2011 dollars) in insurance costs (Insurance Council of Australia, accessed 2015). Using the methodology shown in Appendix D for tangible costs, **the total tangible cost associated with the 2010–11 Queensland floods is estimated at around \$5.7 billion (2011 dollars) or \$6.7 billion (2015 dollars).** Table 3.1 summarises the breakdown of the tangible cost estimates.

#### Total economic cost

**The total economic cost of the 2010–11 Queensland floods is estimated to be \$14.1 billion (in 2015 dollars), with \$7.4 billion in intangible social impacts and \$6.7 billion in tangible impacts** (Chart 3.1). While mental health costs per person are low, the number of people who were psychologically distressed after the floods is extremely high, leading to by far the highest total intangible cost.

The methodology for this estimate is given in Appendix D. Because intangible cost estimates are conservative (due to the lack of information to quantify some social impacts) this suggests intangible costs are as high, if not higher, than tangible costs, with a ratio of around 1.1.

Table 3.1: Tangible cost estimates for 2010–11 Queensland floods

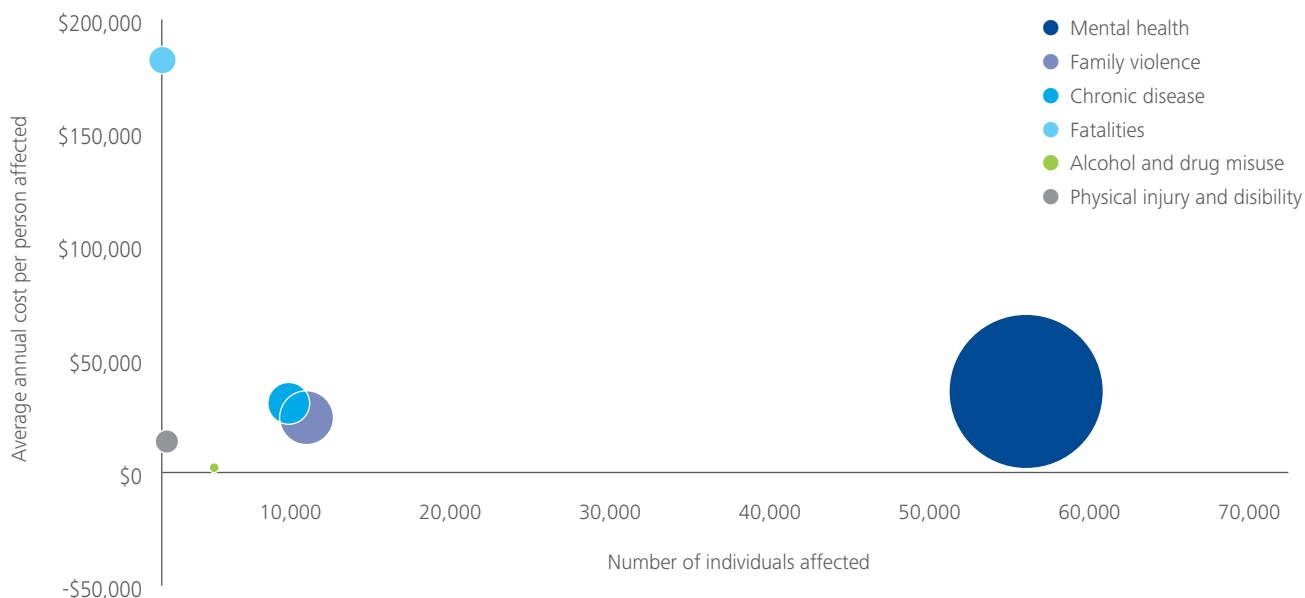
	Percentage of total	\$m (2011)
Insured	47.9	\$2,388
Uninsured	22.4	\$1,878
Category B	26.3	\$1,314
Agricultural production lost	0.0	\$0.57
Evacuated	0.0	\$0.31
Homeless	0.6	\$0.01
Homes – damaged	0.2	\$15
Commercial – damaged	0.0	\$3
Emergency response costs	2.5	\$123
<b>Total</b>	<b>100</b>	<b>\$5,722</b>

Source: Estimates using BTE (2011) and *Building our Nation's Resilience to Natural Disasters*.

Note: Category B refers to assistance to the state, and/or local governments for the restoration of essential public assets and certain counter-disaster operations through the National Disaster Relief and Recovery Arrangements. Category B assistance also covers assistance to small businesses, primary producers, not-for-profit organisations and needy individuals through concessional loans, subsidies or grants. Category B assistance is provided automatically by the states without requiring approval from the Australian Government.

### 3. The cost of natural disasters: Australian experiences

Chart 3.1: Total estimated economic cost for the 2010–11 Queensland floods



Note: Area of circle denotes the total cost of each social impact.

#### 3.1.2 Black Saturday bushfires

The Black Saturday bushfires constituted one of the worst natural disasters in Australian history. On 7 February 2009, fires broke out across Victoria after a sustained and severe heatwave starting in the last week of January. The fires were further intensified by a wind change that moved across the state in the afternoon, with winds growing to storm force.

The Country Fire Authority and the Victorian Department of Sustainability and Environment (now the Department of Environment and Primary Industries) identified and/or attended 316 fires that had a devastating effect in terms of loss of life, injury, and damage to property and land (2009 Black Saturday Royal Commission, 2010). The Royal Commission investigated 15 of the most damaging fires. The greatest loss resulted from the Kilmore East fire where 119 lives were lost, followed by Murrindindi (40 lives), Churchill (11 lives), Beechworth-Mudgegonga (two lives) and Bendigo where one life was lost (2009 Black Saturday Royal Commission, 2010).

A total of 173 lives were lost and approximately 430,000 hectares were burnt. The total tangible cost was thought to have exceeded \$4 billion (2009 Black Saturday Royal Commission, 2010), with environmental and agricultural losses estimated at around \$366 million and \$733 million respectively, further underlining the impact of the bushfires (Stephenson, Handmer & Haywood, 2012).



February 7, 2011: Kinglake, VIC. A young couple comfort one another after attending a memorial service in Kinglake, Victoria, on the second anniversary of the Black Saturday bushfires, which were the deadliest in Australia's history, claiming 173 lives. (Craig Borrow / Newspix)

### 3. The cost of natural disasters: Australian experiences

Figure 3.1: Map of areas affected by the 2009 Black Saturday bushfires



Source: 2009 Black Saturday Royal Commission (2010)

#### 3.1.2.1 Economic cost of the 2009 Black Saturday bushfires

The Black Saturday bushfires on 7 February 2009 constituted one of the worst natural disasters in Australian history. More than 300 fires occurred across the state, killing 173 people and injuring 414 more.

The intangible costs associated with these bushfires were estimated to be significantly higher than the tangible costs, at \$3.9 billion dollars compared to \$3.1 billion dollars respectively. This means the ratio of intangible costs to tangible costs was around 1.3.

#### Deaths and injuries

The most serious consequence of the Black Saturday bushfires was the loss of 173 lives.

A total of 414 people presented to hospital emergency departments with bushfire-related injuries in the 72 hours after the fires. Twenty-four patients were subsequently treated at a burns referral centre. Of those, 50% required care in the intensive care unit, with three individuals ultimately passing away as a result of their burns. Of those presenting to the emergency department, 124 were primarily suffering from burns, 62 from physical trauma injuries and 42 from smoke inhalation. The bushfires were largely characterised by high mortality rates and relatively few survivors with serious injuries (Cameron et al., 2009).

Based on the average life expectancy in Victoria and the average age of people affected by the bushfires, **the lifetime cost of deaths and injuries was estimated at almost \$930 million (net present value in 2015 dollars).**

### 3. The cost of natural disasters: Australian experiences

#### Mental health

A large-scale traumatic event with a high mortality rate, such as the Black Saturday bushfires, inevitably has a large impact on the mental health and long-term psychological distress of those affected.

A significant minority of people reported persistent mental health problems after the fires. More participants in the highly affected communities (15.6%) reported probable Post Traumatic Stress Disorder (PTSD) linked to the bushfires than those in communities affected at medium (7.2%) and low levels (1.0%). Similar patterns were observed for depression (12.9%, 8.8% and 6.3% respectively) and severe psychological distress (9.8%, 5.0% and 4.9% respectively). All communities reported elevated rates of heavy drinking. One-third of people with severe psychological distress had not received mental health assistance in the month before the survey, indicating a need for more mental health support services.

However, the majority of people affected by the Black Saturday bushfires were able to recover from the trauma after a few years. Bryant et al. (2014) found that four years after the bushfires, the majority of respondents in communities affected at high (77.3%), medium (81.3%) and low (84.9%) levels reported no psychological distress on the Kessler-6 Psychological Distress Scale screening scale<sup>2</sup>.

Mental health care, including the cost of caring for those drinking at high-risk levels, was the largest intangible cost resulting from the fires. The proportion of people suffering from PTSD in the first year was based on research by Bryant (2014), which estimated the weighted rate across areas affected at high, medium and low levels to be 11.2% for men and 18.7% for women. Over the long term, it is assumed the rate will fall to around 0.6% for men and 0.9% for women. **The lifetime cost of mental health issues are estimated at more than \$1 billion (net present value in 2015 dollars).** This cost is less than the cost associated with the Queensland floods because the bushfires happened in less populated areas.

#### High-risk alcohol consumption

Mental health-related behaviours such as substance use (alcohol and smoking) have been documented following disasters (Turner et al., 2014). Bryant et al. (2014) mapped the prevalence and predictors of psychological outcomes in communities 3–4 years after the Black Saturday bushfires in Victoria, split into communities affected at high, medium and low levels. The study found that while all communities reported an elevated rate of heavy drinking (24.7%, 18.7% and 19.7% respectively), the rate was around 1.4 times higher in the highly affected communities.

Using this to estimate the proportion of people with short- or long- term increases in risky and high-risk alcohol consumption, **the lifetime cost resulting from the bushfires is estimated at about \$190 million (net present value in 2015 dollars).**

#### Chronic and non-communicable diseases

As discussed in the floods case study, evidence shows that natural disasters exacerbate chronic disease. Given the lack of quantitative data on the incidence of chronic disease exacerbation as a result of the Black Saturday bushfires, the HILDA longitudinal survey was used in combination with prevalence rates of diabetes, COPD and stroke in Victoria as a baseline.

**From this, it is estimated that the cost of the exacerbation of diabetes, COPD and the development of stroke resulting from the bushfires was around \$320 million (net present value in 2015 dollars).**

#### Family violence

There is a well-documented increase in the incidence of family violence in populations impacted by disasters, predominantly physical abuse between partners and sexual abuse. However, these increases can be hard to quantify given the chaotic context and the difficulty of accurately observing family violence. A large-scale survey of those displaced by Hurricane Katrina showed that the incidence of family violence more than tripled after the disaster and remained elevated for two years (Anastario et al., 2009).

2. The Kessler Psychological Distress Scale is a questionnaire intended to yield a global measure of distress based on questions about anxiety and depressive symptoms that a person has experienced in the most recent 4 week period. The K-6 scale is a simplification of the K-10 scale, which measures a person's level of psychological distress based on their questionnaire score. The scale ranges from low distress to very high distress.



### 3. The cost of natural disasters: Australian experiences

A study of those affected by the Black Saturday bushfires identified increases in the incidence and severity of family violence (Walters & Mair, 2012). Parkinson (2014) interviewed 30 women in Victoria from two affected shires – 17 of whom reported family violence. Nine of the 17 relationships in the study reported no violence before the fires, and seven of these relationships were categorised as stable and non-violent. Seven reported the violence had escalated sharply or had been an isolated incident many years earlier.

Rates of family violence in areas severely impacted by the Black Saturday bushfires were compared against the rates in the rest of the state. **It is estimated that family violence cost around \$990 million (net present value in 2015 dollars).**

#### Environmental damage

The bushfires had a devastating impact on the environment and the natural resources in Victoria. Around 24,470 acres were damaged, 90% of which were in national parks. VicForests estimated the cost of the destroyed standing timber at approximately \$600 million. In addition, Melbourne Water estimated damage totalling \$5 million to its natural and built assets.

This paper has adopted the estimate formulated by Stephenson, Handmer and Haywood (2012) for the total cost of environmental damage. The impact of the fires on the environment was valued in terms of the benefits the environment provides humans, such as water supply, nutrient cycling, climate regulation and recreation, following the framework of Costanza et al. 1997, which provides a differential valuation based on the type of environment lost (for example, cropland or forest). Using this, **it is estimated that the cost of environmental damage was approximately \$410 million (net present value in 2015 dollars).**

#### Box 3: Intangible costs and gender

The social effects of natural disaster are significantly gendered, with women much more likely to experience adverse social impacts, such as family violence.

The incidence of violence against women increases following a natural disaster, and the effects of violence are longer-lasting for women than for men, suggesting a higher severity. Two studies, Clemens (2013) and Alderman (2013), also found that women were more likely to experience psychological distress up to 12 months after the Queensland floods. For example, Clemens (2013) found that after six months, the number of women experiencing distress was 8.8%, compared to 5.3% for men.

Not only does this demonstrate that the costs of social impacts are borne differently by women and men, but that responses to the adverse social impacts of a natural disaster may need to consider gender.

One example of how this has been achieved is the community-led group Firefoxes Australia, which provides a resilience program for women. Formed in the aftermath of the Black Saturday bushfires, the group provides a forum for women in the Kinglake region to connect and recover from the bushfires.

Firefoxes Australia uses feedback from women in the community to decide which services it will provide. These services include social activities, connecting people with health services, organising retreats, meal sharing, family fun days and providing information about disaster preparedness and recovery. The group has shared its grassroots disaster recovery and resilience model with other communities that have experienced a natural disaster.

Source: [firefoxes.org.au](http://firefoxes.org.au)

### 3. The cost of natural disasters: Australian experiences

#### Short-term unemployment

The Black Saturday bushfires caused significant short-term unemployment. A sample of transaction data from the Commonwealth Bank of Australia (2011) shows a 66% increase in the number of individuals receiving Newstart Allowance as their primary source of income. However, this proportion subsided relatively rapidly, returning to pre-bushfire levels after approximately 12 months.

As with the floods case study, this has not been separately costed, to avoid double counting.

#### Tangible costs

The tangible cost of the Black Saturday bushfires includes damage to private property and public infrastructure, and costs incurred due to disruptions in business activity. Over 3,500 structures were destroyed, including at least 200 houses, 50 commercial properties and 1000 farm structures.

The 2009 Victorian Bushfires Royal Commission estimated total general insurance payouts due to damage to private property at more than \$1.2 billion dollars, and the cost of the loss of and damage to infrastructure at more than \$77 million. In a survey of people affected by the fires, 59% of respondents had their house damaged or destroyed during the bushfires (Bushfire CRC, 2010).

The Royal Commission estimated the tangible cost of the fires at \$4.4 billion, including:

- Response costs, for which there was Victorian Government supplementary funding
- Damage costs, including insured losses; loss and damage to public infrastructure; the Victorian Bushfire Reconstruction and Recovery Authority costs; fatalities; destroyed timber and replanting; asset damage; costs incurred by Telstra and Melbourne Water; and the cost of the 2009 Victorian Bushfires Royal Commission.

The Victorian Bushfire Appeal Fund (VBAF) was established by the Australian Red Cross in partnership with the Victorian and Commonwealth governments to support the individuals and communities affected. The appeal officially closed around three months after the bushfires and raised \$379 million. Around 60% of VBAF funding went towards housing support, including over 6,677 payments to those whose homes were destroyed or damaged (Fire Recovery Unit, 2014). Other VBAF funding was distributed through initial emergency payments, personal support payments and support for communities.

#### **Box 4: Social impacts and legal advice**

Following the Black Saturday bushfires, individuals, their families and businesses faced legal issues which shed light on (but cannot be directly attributed to) some of the social effects of the fires.

People sought advice from Victoria Legal Aid about the following issues:

- Residential and commercial property damage and insurance claims (around 30%)
- Deceased estates (around 35%)
- Financial hardship and compensation issues (around 10%)
- Divorce (around 4%).

Other issues included tenant/landlord disputes, neighbour disputes (for example, fencing) and domestic/commercial planning.

Victoria Legal Aid provided legal advice on more than 750 occasions in the five years following the disaster, where clients expressly identified their legal problem was bushfire-related (many more may not have identified this).

Source: Victoria Legal Aid, 2015

### 3. The cost of natural disasters: Australian experiences

The impact on tourism in the Gippsland region, including subsequent loss of business revenue and productivity, was relatively minor (Walters & Clulow, 2010; Mair, Ritchies & Walters, 2014). The research found that, while it was implied that media coverage had a significant impact on tourist perceptions, the Gippsland tourism industry remained relatively stable (Walters & Clulow, 2010).

The bushfires generated almost \$1.3 billion (2011 dollars) in insurance costs (Insurance Council of Australia, accessed 2015). Using the methodology shown in Appendix D for tangible costs **the total estimated tangible cost associated with the 2009 Black Saturday bushfires is around \$2.6 billion (2011 dollars) or \$3.1 billion (in 2015 dollars)**. Table 3.2 gives a breakdown of the tangible cost estimates.

#### Total economic cost

The total cost of the 2009 Black Saturday bushfires is estimated at about \$7 billion at current prices, with \$3.9 billion in social impacts and \$3.1 billion in direct financial impacts (Chart 3.2). The methodology for this estimate is given in Appendix D. Again, the intangible cost estimate is conservative as some costs could not be quantified. This suggests the economic cost of the social impacts is as high, if not higher, than the tangible costs with a ratio of around 1.3.

Table 3.2: Tangible cost estimates for the 2009 Black Saturday bushfires

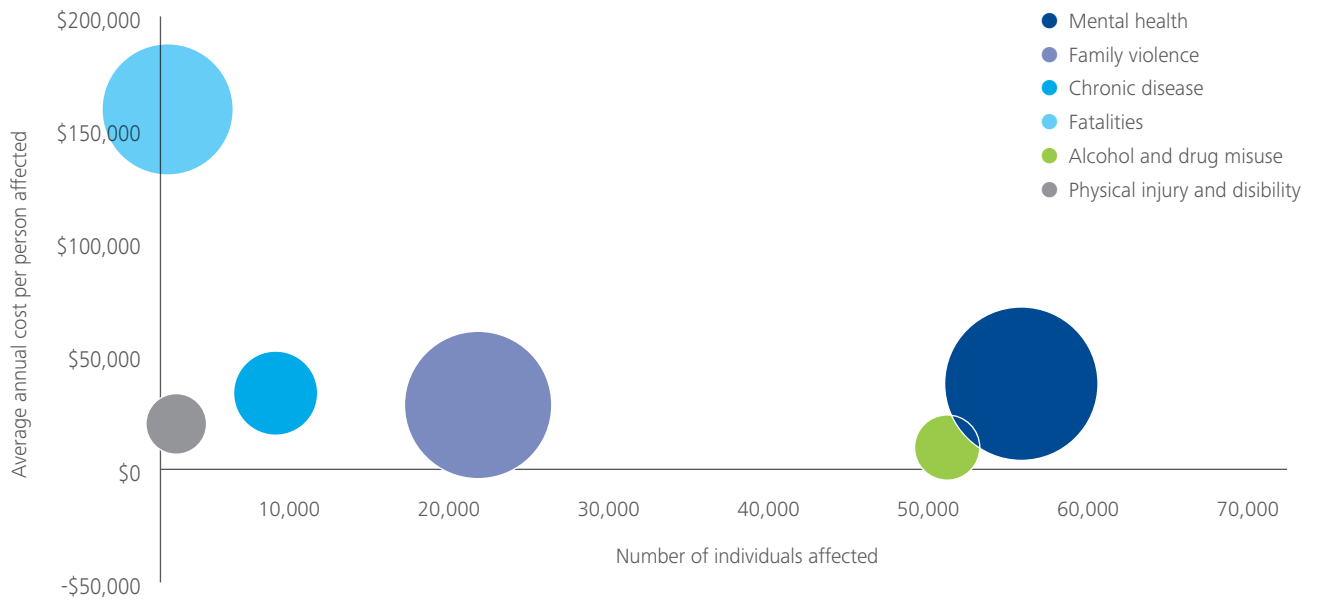
	Percentage of total	\$m (2011)
Insured	41.7	\$1,266
Uninsured	32.8	\$593
Category B	23.0	\$696
Agricultural production lost	0.0	\$0.04
Evacuated	0.0	\$0.09
Homeless	0.0	\$16
Homes – damaged	0.3	\$6
Commercial – damaged	0.1	\$1
Emergency response costs	2.1	\$65
<b>Total</b>	<b>100</b>	<b>\$2,644</b>

Source: Estimates use BTE (2011) and *Building our Nation's Resilience to Natural Disasters*.

Note: Category B refers to assistance to the state, and/or local governments for the restoration of essential public assets and certain counter-disaster operations through the National Disaster Relief and Recovery Arrangements. Category B assistance also covers assistance to small businesses, primary producers, not-for-profit organisations and needy individuals through concessional loans, subsidies or grants. Category B assistance is provided automatically by the states without requiring approval from the Australian Government.

### 3. The cost of natural disasters: Australian experiences

Chart 3.2: A breakdown of the tangible and intangible costs of the Black Saturday bushfires (\$ millions)



Note: Area of circle denotes the total cost of the category of intangible cost.



Queensland Fire and Rescue Service

### 3. The cost of natural disasters: Australian experiences

#### 3.2 Total average cost of natural disasters in Australia

For two case studies considered in this report, a bottom-up approach was applied, where each outcome was derived from a base affected population and multiplied by the incidence and unit cost. Meanwhile, to estimate the total average cost of natural disasters in Australia (based on simulations of future disasters), a top-down approach was used (Appendix D). A conservative ratio of intangible to tangible cost reported in the two case studies was used to factor up the tangible cost estimated in *Building our Nation's Resilience to Natural Disasters*.

The top-down approach can then be applied to estimate the intangible costs of specific natural disasters which lack the data to build intangible costs up using a bottom-up approach. Section 3.2.1 estimates the intangible cost of the 1989 Newcastle Earthquake using this framework.

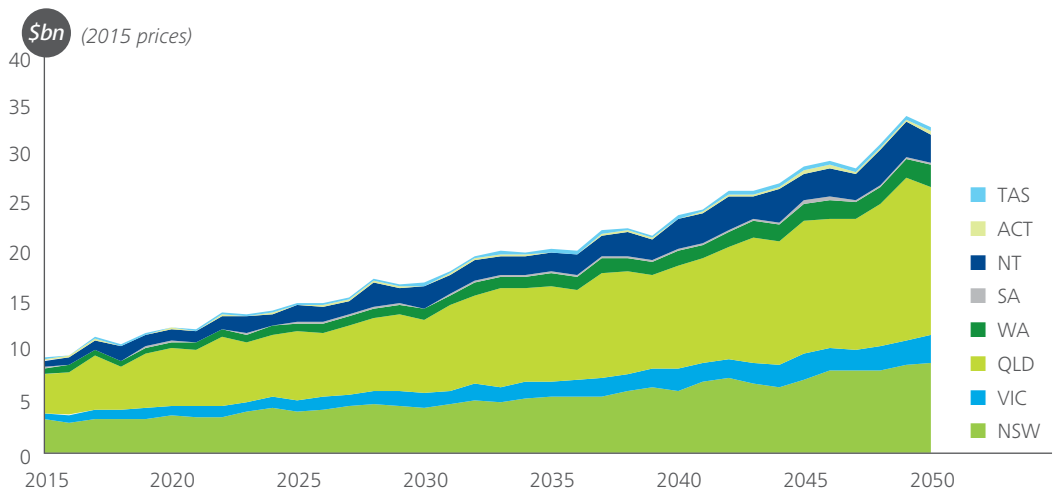
Using this methodology, the total economic cost of natural disasters in Australia, including tangible and intangible costs, was an estimated \$9.6 billion in 2015. By 2050, the total economic cost of natural disasters in Australia is expected to be around \$33 billion in real terms (Chart 3.3).

#### 3.2.1 Newcastle earthquake

Though Australia is not located at the margins of tectonic plates, analysis by insurance group Munich Re (2015a) indicates an earthquake of magnitude 6.0 or greater on the Richter scale can be expected every five years on average, and is likely to occur in or around the capital cities of Perth, Adelaide, Melbourne and Sydney (Figure 3.2). Earthquakes have most recently occurred in Moe, Victoria, in 2012 (5.4 magnitude) and Bowen, Queensland, in 2011 (5.3 magnitude). As shown by the 2011 earthquake in Christchurch, New Zealand, an unexpected earthquake of even moderate magnitude near a heavily populated city can, and did, have a devastating impact.

On 28 December 1989, a 5.6 magnitude earthquake struck near the town of Boolaroo, 15 kilometres west of the Newcastle central business district, and 140 kilometres north of Sydney. Thirteen people lost their lives and more than 162 were injured, making the earthquake the deadliest in Australia. Nine deaths occurred when the Newcastle Workers Club collapsed. More than 35,000 homes, 147 schools and 3,000 other buildings were damaged (Australian Geographic, 2015).

Chart 3.3: Forecast total economic cost of natural disasters for 2015–50



Source: Deloitte Access Economics estimates

### 3. The cost of natural disasters: Australian experiences

#### 3.2.1.1 The economic cost of the Newcastle earthquake

Despite the moderate magnitude of the Newcastle earthquake, the effects were widespread. Due to the paucity of data relating to the social impacts of the earthquake, a top-down approach has been adopted to estimate the economic cost.

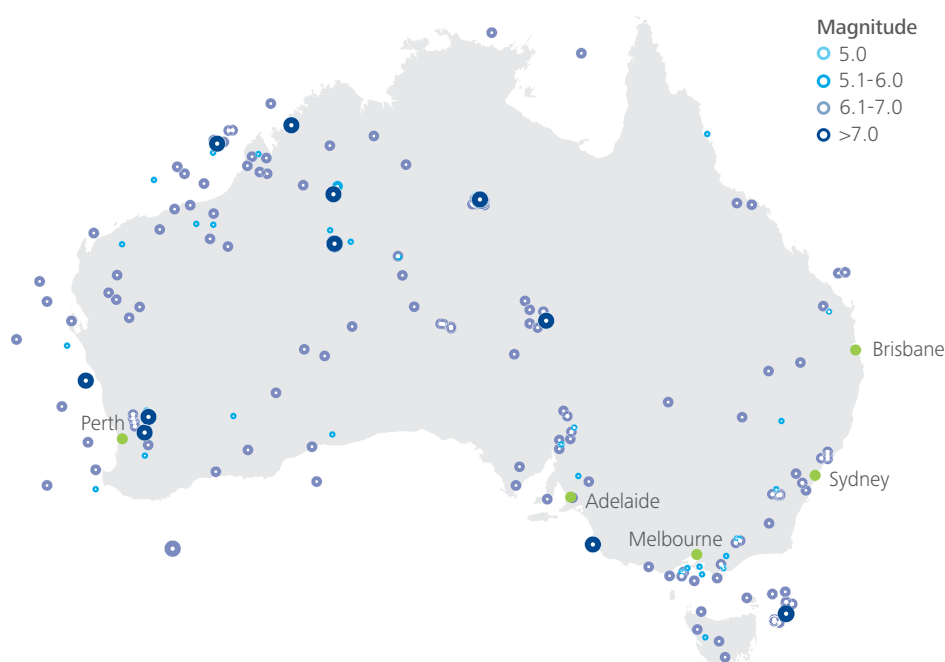
**The Newcastle earthquake is estimated to have caused \$8.5 billion in tangible costs and \$10.2 billion in intangible costs, resulting in a total economic cost of \$18.7 billion in 2015 dollars.**

The Newcastle earthquake had widespread effects. At the height of the crisis, between 300 and 400 people were placed in temporary accommodation. In the month following the earthquake, the Disaster Welfare Recovery Centre assisted almost 14,000 people (Geoscience Australia, 2015).

The most significant damage was around the shopping centre in Hamilton, which remained closed for six weeks. Entry was restricted to prevent looting and to safeguard the public from the hazards of damaged buildings. Carr et al. (1997) note that almost 70,000 insurance claims were made throughout the Hunter region after the earthquake, of which 10% were for damage to commercial properties.

Dobson et al. (1991) studied whether stress generated by the Newcastle earthquake led to an increased risk of heart attack and coronary death. There were six fatal heart attacks and coronary deaths among people aged less than 70 years in the four days following the earthquake – an unusually high number for that time of year. There was no evidence of increased risk of heart-related health issues during the following four months.

Figure 3.2: Earthquake epicentres in Australia since 1840



Source: Munich Re (2015a)

### 3. The cost of natural disasters: Australian experiences

In terms of mental health impacts, 21% of the adult Newcastle population was estimated to have used the general support and/or disaster-related services available to them, while medical services were used by 6% of adults (Carr et al., 1997). Though it was estimated that 1.5% of the adult population was injured in the earthquake, only 0.4% required medical treatment for their injuries. After adjusting for the level of psychological morbidity had there not been an earthquake, it was estimated that 28% of the people who were highly exposed to the earthquake (4,000 people) experienced moderate to severe psychological distress as a direct result. Furthermore, 18.3% of those exposed to high levels of threat (equivalent to 2% of the population) were likely to have suffered PTSD in the six months following the earthquake.

The earthquake only temporarily affected the electricity supply (Caldwell, 2013). Multiple failures occurred in the electricity substations closest to the earthquake epicentre and shut down supply to both industrial and domestic consumers. However, operational supply was restored to major industrial customers 1.5 hours after the incident, and all bulk supply points were restored after 2.5 hours.

The paucity of data on the effect of the earthquake led to the application of a top-down approach to estimate the intangible costs. According to the ICA database, the earthquake cost \$3.2 billion in insured losses (normalised to 2011 dollars). Based on an average tangible cost to insured losses multiplier of 2.2 and an average intangible cost to insured losses multiplier of 2.4, **the Newcastle earthquake generated an estimated \$8.5 billion in tangible costs and \$10.2 billion in intangible costs, resulting in a total economic cost of \$18.7 billion in 2015 dollars.**



January 18, 2011: Brisbane, QLD. Army personnel help with the clean-up operation in Graceville, Brisbane in Queensland, after floodwaters receded leaving behind widespread property damage. (Anthony Reginato / Newspix)



Tributes: Flowers and messages on a fire-damaged tree on the one-year anniversary of Black Saturday (Richard Kendall AFP / Getty Images)