



The cost and funding of natural disasters in Australia – current position paper

Draft for discussion

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Working Group (NDWG)*

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Presented to the Actuaries Institute
General Insurance Seminar
13 – 15 November 2016
Melbourne

*This paper has been prepared for the Actuaries Institute 2016 General Insurance Seminar.
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1 Introduction and Key Findings

This paper is currently in draft form for discussion at the Actuaries Institute's General Insurance Seminar in 2016. The paper is expected to be finalised following the seminar, including appendices. The paper should not be relied upon for making commercial decisions.

1.1 Introduction

In Australia, 2011 was a year that experienced a high number of natural perils which resulted in the third highest year of economic cost over the last 50 years. Following the events of 2011, the General Insurance Practice Committee, on behalf of the Actuaries Institute, made a number of submissions to Government including :

- Queensland Floods Commission of Inquiry (2011)
- National Disaster Insurance Review (2011)
- Reforming Flood Insurance (2012)
- Effectiveness of Current National Disaster Fund Arrangements (2014).

These submissions tended to be reactive to the circumstances at that time and were crafted in response to specific Government issues in very short time frames.

For this reason the Natural Disasters Working Group (NDWG) was formed in 2016 to prepare a series of discussion papers on issues relating to natural perils in Australia on behalf of the Actuaries Institute's General Insurance Practice Committee.

The purpose of the NDWG is to formulate a current and forward looking point of view which could form the basis of the Actuaries Institute's public policy for natural perils.

One of the aims was to make the series of discussion papers available to the whole profession for debate and discussion so that in future the Actuaries Institute's responses to Natural Disaster issues would be abstracted from a solid body of work which represented the best in class from our profession.

This is the first paper produced by the NDWG which sets out the estimated costs of natural perils in Australia, current efforts to mitigate and fund these costs and the adequacy of data that is available to manage the natural peril risk. The paper is intended to be a scene setting document, with planned later papers expected to be more forward looking and solution focussed. The paper intentionally focusses on existing work that is available.

1.2 Key findings

In Australia natural perils are estimated to cost \$11 billion p.a. on average. Less than 40% of this cost is pre funded by insurance. There is scope to improve the management of the natural peril risk by:

- more coordinated and increased pre event funding of adaptation strategies
- further collection and use of data to quantify the risk

Pools structured to encourage risk reduction could also be considered on a temporary basis to spread the cost more broadly and subsidise the risk in areas where there are concerns around affordability of the cost of insurance.

Most of the thought and discussion surrounding the cost and funding of natural perils is focussed on the tangible costs. Very little time is devoted to considering the impacts of intangible costs, however the intangible costs are estimated to be very considerable. Ultimately, intangible costs are predominantly

funded by government via taxes and, as such, are heavily cross-subsidised. This is quite different to the underlying philosophy of funding tangible costs currently applied, which is to largely remove cross-subsidies.

1.3 Summary of report

In Sections 2 and 3 we estimate the current annual cost of natural perils in Australia to be \$11 billion, comprising:

- \$3.7 billion of privately insured costs
- \$2.5 billion of other direct and indirect tangible costs (includes commercially insured costs and non-insured property and business interruption costs)
- \$4.8 billion of intangible costs (eg. the mental health impact on families and communities).

Note: For the purposes of this report we have used the same definitions of tangible and intangible cost as are used in the report called "The economic cost of the social impact of natural disasters, March 2016" (the Deloitte Report). This report was prepared by Deloitte Access Economics on behalf of the Australian Business Roundtable for Disaster Resilience & Safer Communities. Direct tangible costs include damage to properties, infrastructure, vehicles etc. Indirect tangible costs include the flow on costs such as business disruption, clean up costs, network disruptions. Intangible costs reflect damages that cannot be easily measured such as impacts to health and wellbeing, including opportunity costs (for example, where someone is unable to be part of the community due to time in hospital).

All of the cost estimates involve uncertainty due to the small number of extreme events that have occurred and due to the limited information that is available about those events. The intangible cost estimates in particular involve considerable subjectivity but are intended to highlight the order of magnitude. Our estimate of \$11 billion is higher than the estimate of \$9.6 billion contained in the Deloitte Report. This is because we have adopted a higher estimate of insured natural perils costs, noting that the Insurance Council of Australia (ICA) Catastrophe data which Deloitte have used is limited to the larger natural disasters.

Claims costs would be expected to increase over time due to inflation, population growth and growth in higher risk areas near to the coast. Normalised for these influences, there is no clear trend in the insured costs over time. Natural cycles and variability remain dominant factors.

In Section 4 we describe the main aspects of the adaptation that exists in Australia and the key role it plays in reducing the impact of natural perils. However, gaps exist across all areas of adaptation and there is significant scope for increased investment, with studies suggesting favourable cost-benefit trade-offs. In recent years the level of post disaster recovery costs has significantly exceeded the current levels of adaptation funding. The federal government invests about \$50 million each year on adaptation funding but spends in excess of \$500 million on average on post-disaster relief and recovery.

Section 5 sets out the plethora of data available relating to natural perils. Whilst there is a broad range of information there are considerable limitations on the use and extent of data available. Key issues are:

- much of the publicly available data, particularly in relation to the insured cost of events, is at an aggregated level which limits its usability;
- there are numerous owners of the various data sources and most of the data is not publicly available (largely due to intellectual property and competitive advantage issues);
- where publicly available, detailed property information requires manipulation to create databases and there is often inconsistency in definitions across different locations.

There is a need to continue to improve the amount and quality of data that is publicly available.

Section 6 describes the range of funding sources for the cost of natural perils. The current funding solutions may not provide the right incentives to reduce risk and follow cost effective recovery solutions post event. Concerns around affordability for certain individuals could be addressed via the use of temporary insurance pools properly structured to encourage long term risk reduction.

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2 Privately insured claims costs

2.1 Introduction

This section summarises our assessment of the current annual claims costs from natural perils in Australia due to economic loss that is privately insured. The costs included in this section represent only a part of the total costs of natural perils. Section 3 considers the remaining costs, including damage to properties that are self-insured, damage to government property and other economic and non-economic costs.

The costs included in this section are the property damage and consequential loss costs relating to natural peril claims in Australia that are insured under direct (or primary) insurance policies by:

- APRA licensed insurers
- Unlicensed Foreign Insurers (UFIs)
- Lloyds.

The cost estimates exclude reinsurance that is placed by government or self insurers directly with reinsurers (for example, where state governments reinsure some of their exposure).

The consequential loss component covers lost profits by businesses as a result of the event, where that cover has been purchased by the company, noting that many smaller companies elect to self insure this cost.

The cost estimates are intended to be for all classes of business combined (Home, Commercial Property, Motor, Public Liability etc).

2.2 Types of Perils Included

We have separately assessed cost for the following types of natural perils:

- Flood (ie. riverine flooding)
- Bushfire
- Cyclone, including impact from the sea to the extent that it is insured
- Storm, includes both convective and synoptic storms. Costs can arise due to damage from hail, wind, water ingress and flash flooding
- Earthquake.

Note: Riverine flooding or flash flooding resulting from an ex-tropical low are included in the Flood and Storm categories respectively, rather than in the Cyclone costs. No explicit allowance has been made for actions of the sea besides those costs covered by insurance. Insured actions of the sea associated with Storms do not contribute material cost at the current time and hence can be regarded as included on an implicit basis in the Storm peril. Also, costs from tornadoes are included in Storm, rather than as a separate explicit category.

2.3 Our Approach

The analysis of each peril is set out in Appendix A (not available for this draft) and involved:

- summarising the costs between 1967 and 2016 indicated by the ICA's Catastrophe Dataset. The ICA data shown throughout this report is adjusted to current dollar values (using an index of construction cost inflation) and allows for the impact of changes in building standards and for growth in population by area;
- using data of the cost of weather claims over the last 10 years for Home Insurance shown in the 2016 Finity/Deutsche Pendulum publication. The data is originally provided by Insurance Statistics Australia (ISA);
- considering other information that is available and relevant to each peril. For example, for Bushfire this included consideration of the trend over time in the Forest Fire Danger Index (FFDI), whereas for Cyclone we have included the costs from catastrophe models as presented in the Northern Australia Insurance Premiums Taskforce;
- drawing on the judgement and benchmarks of the sub-committee members.

For each peril we have estimated:

- the current average annual loss (AAL)
- the largest event over the last 50 years
- the largest event expected once every 200 years.

It is important to emphasise that the estimates of costs are uncertain. This reflects in particular the inherent variability of the natural peril experience and the relatively short period for which we had data – for example, 50 years of data is short in the context of assessing the long term cost of cyclones. This has meant that the estimates rely on, to some extent, the cost and frequency of simulated events indicated by catastrophe models used by insurers. Further, the data that is available about the natural peril events that have occurred is patchy at an industry level.

2.4 Summary of Insured Cost Estimates

Table 2.1 sets out the estimated costs by peril, and overall.

Table 2.1 – Estimated Costs for each type of natural peril (\$2016)

Peril	Actual AAL from ICA Disaster Dataset	AAL Estimated	Largest event last 50 years	Cost of largest Event	Estimated Worst 1 in 200 year event
	\$bn	\$bn		\$bn	\$bn
Bushfire	0.19	0.25	Ash Wednesday (Vic and SA) 1983	2.6	7.0
Flood	0.30	0.70	Cyclone Wanda, Brisbane (1974)	3.9	7.0
Cyclone	0.37	0.70	Cyclone Tracy (1974)	6.0	16.0
Storm	0.77	1.60	Sydney Hailstorm (1999)	6.3	9.0
Earthquake	0.10	0.40	Newcastle (1989)	4.8	22.0
Total	1.73	3.65			

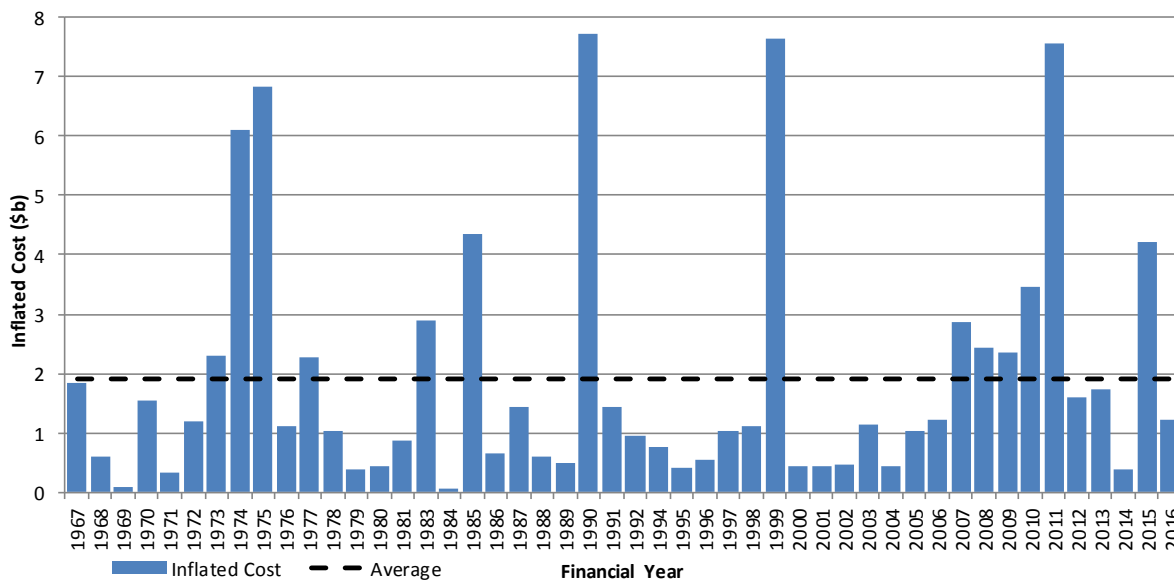
We estimate the average annual insured cost of natural perils to be around \$3.7 billion. The largest contributor to these costs is storms, which is estimated to account for around 44% of the long term cost.

In financial terms the largest event over the last 50 years (in current dollars) was the 1999 Sydney hailstorm. Whilst infrequent in Australia, earthquakes are thought the most likely to produce a substantial cost at the current time, although substantial costs can arise from each of the types of peril listed.

2.5 Changes in the insured costs over time

Figure 2.1 shows the ICA's Catastrophe Dataset costs by year over the last 50 years. The analysis is shown by type of peril in Appendix A (not available for this draft). We have only included events with a cost of \$50 million or more, noting that in the earlier years only large events were recorded in the list. All figures are in current values and adjusted for population growth by area.

Figure 2.1 – ICA Catastrophe Dataset Costs by Year



The data shows two periods of higher costs (1973-76, and 2007-11). In both these phases there were a higher than average number of La Nina years (when the sea surface temperatures to the north west of Australia were warmer), which are associated with higher levels of flood and cyclone cost in the eastern

states. The intervening period (1977-2006) experienced an above average number of El Nino years, which tend to be associated with drought and fewer cyclones.

A number of other natural cycles are important to the variations in insured costs over time, including the Indian Ocean Dipole, which has contributed to the 2016 winter being the second wettest on record for Australia, and the Southern Annular Mode, which is linked to the reduction in the number of synoptic lows impacting on southern Australia over the last 30 years.

Adjusted for natural weather cycles and changes in population, there is limited evidence of any material change to date in the level of costs over time. This assessment is equivalent to other global studies, which show that increases in cost to date are mostly explained by inflation, population shifts and building standards.

When looked at by peril, there is evidence of an increasing frequency of bushfire events. This is consistent with the expected climate change impacts, and we note that the FFDI has increased significantly in many of the most bushfire prone areas over the last 30 years. There are also studies available which show an increasing intensity of storms.

We note that climate change is expected to lead to an increased intensity of storms and cyclones. The impacts to frequency are more complex, with some areas expected to have higher frequency and others lower. It is difficult to measure the frequency and severity impacts to date, with complications relating to insufficient data, natural cycles and variability and the relatively modest (although significant in absolute terms) warming to date.

3 Other costs besides those insured by private insurers

3.1 Introduction

Our starting point (and ending point, as it turned out) for quantifying the other costs was the work set out in the Deloitte Report.

In this section we summarise the approach adopted in the Deloitte Report and the key results. We also provide high level comments on those results.

3.2 Deloitte Report - Approach

The approach adopted in the Deloitte Report to estimate the other costs was as follows:

- Non-insured tangible costs: These were derived from ICA catastrophe cost data and used benchmark ratios for the cost of uninsured losses relative to insured losses. These ratios vary by type of peril;
- Intangible costs: For these costs a case study approach was adopted. This involved estimating the intangible costs in two events (Black Saturday bushfires 2009 and Brisbane Floods 2011). It was assumed that the ratio of the intangible costs to tangible costs in these two events could be applied to estimate the intangible costs across all events.

3.3 Deloitte Report – Results

The Deloitte Report suggests that uninsured tangible costs are of the order of 1.25 times the level of insured costs.

The intangible costs are estimated at around 1.0 times the level of total tangible costs. Deloitte state that this ratio may understate the intangible costs.

The following table shows the components of the intangible costs from Black Saturday bushfires (estimated to cost \$3.9 billion) and the Brisbane Floods (estimated to cost \$7.4 billion). These figures are not shown explicitly in the report, but have been derived from data shown there.

Table 3.1 - Proportion of total intangible costs

Intangible factor	Queensland floods (%)	Black Saturday bushfires (%)
Deaths / Injuries	4	24
Chronic disease	6	8
Mental health	80	27
Family violence	10	25
Alcohol abuse	0	5
Environment	-	11

The most significant component of the intangibles cost is for mental health issues, although deaths/injuries and family violence can also be significant.

3.4 Deloitte Report - Comment on results

The Deloitte Report is important for highlighting the significance of non-insured tangible costs and, in particular, the intangible costs.

We note that the approach uses, as its base, the ICA catastrophe cost data – ie. both the uninsured tangible costs and the intangible costs are ultimately linked to the level of insured costs reported by the ICA. As the ICA data materially understates the overall insured costs of natural perils (as it excludes many smaller events), then both the uninsured tangible costs and the intangible costs are potentially understated as well.

We also note that the two benchmark events that Deloitte used to quantify the intangible costs were more extreme in nature, involving loss of life and total destruction of homes. Potentially the ratio of intangible costs to tangible costs in these two events is above the average that might be expected across all natural peril claims, particularly where fewer fatalities and lower levels of destruction occur. For this reason the estimate of intangibles may be overstated.

On balance, in the absence of any other current substantial research on this subject, we believe it is reasonable to use the estimates given in the Deloitte Report for the annual level of non-insured tangible costs and intangible costs. In \$2015 values, these amounts are:

Non-insured tangible costs	\$2.5 billion p.a. (estimated from figures shown in the report, noting they are not disclosed explicitly)
Intangible costs	\$4.8 billion pa (represents 50% of the \$9.6 billion total natural peril cost shown in the Deloitte Report. Both the 50% and \$9.6 billion figures are explicitly stated, although the \$4.8 billion is not shown)

It is useful to recognise that the estimates of the non-insured tangible costs and the intangible costs in particular are more uncertain than the estimates of the insured costs shown in Section 2. This is due to the limited information that is available about the level of costs that can be directly related to the events.

4 Adaptation

4.1 Introduction

This section discusses the key areas of natural perils adaptation that currently exist in Australia. We define adaptation as being the measures that are taken in advance of a natural peril to reduce or eliminate the impact of the disaster.

Note: The term mitigation is often used to refer to pre-disaster activities rather than the term adaptation. In this paper the term adaptation was preferred over mitigation to avoid any confusion with the meaning of mitigation in a climate change context. In a climate change context mitigation refers to actions to address the causes of climate change, e.g. actions to reduce greenhouse gas emissions.

The key areas of adaptation that currently exist in Australia to improve pre-disaster resilience are:

- Land planning
- Building standards
- Retrofitting existing properties
- Infrastructure to reduce the frequency and severity of individual natural perils.

Table 4.1 provides a high-level summary of each adaptation option.

Table 4.1 - High-level summary of each adaptation option

Adaptation area		Effectiveness	Cost	Current usage	Key gaps
Land planning	Zoning of new development	Most effective adaptation option for new properties	Direct costs are very low but indirect costs can be very high, e.g. economic growth opportunity cost of disallowing development of multi-story residential building	Majority of councils incorporate natural perils risk in their zoning process	New developments are still allowed to be constructed in high risk areas. Lack of clear and simple rules exposes councils to legal risk and creates inconsistency between councils.
	Relocating properties	Most effective adaptation option for existing properties	Costs are very high, driven largely by the price of land	Not widely used due to high costs involved. Only used for very high risk properties	No funding available
Building standards		Very effective adaptation option for new properties	Costs can be high, not all improvements will have a favourable benefit-cost ratio	Australia-wide building standards are more stringent in areas exposed to natural perils	Building standards focus on health and safety whilst minimising property damage is not an objective
Retrofitting existing properties		Can be very effective for existing properties	Costs are relatively high. Generally more expensive than cost of building new houses to the same standard	Not widely used due to high upfront costs and lack of government grants or incentives	No funding available
Infrastructure to reduce frequency and severity of individual natural perils		Effective for localised perils (flood, bushfire and storm surge). Not effective for other perils such as cyclone and earthquake Effectiveness is often compromised due to conflicting priorities (e.g. dams being used for both water supply and flood adaptation) and poor maintenance over time	Costs are high. Key costs are construction costs and regular maintenance costs	Some infrastructure such as flood levees and seawalls are used extensively. Other infrastructure such as underground power lines are less common	No funding available
All adaptation areas					Lack of government adaptation funding. Framework to prioritise adaptation projects and funding can be strengthened

4.2 Land planning

Land planning is widely considered to be a key component of best practice pre-disaster adaptation. The two key areas of land planning that are related to natural perils adaptation are:

- Zoning of new development
- Relocating properties (buy-backs and land swaps)

Zoning of new development

Zoning and development approval in Australia is predominantly undertaken at a council level. Zoning plays a critical role in natural perils adaptation since it dictates whether new properties can be built in areas that are exposed to natural perils.

The majority of councils in Australia recognise that zoning plays an important role in reducing natural perils costs and subsequently incorporate natural perils risk in their zoning and development approval process. Although the majority of councils incorporate natural perils risk in their zoning process, a number of gaps can be identified in the current zoning framework:

- New developments are still allowed to be constructed in high risk areas;
- Although zoning may reduce property damage for more frequent events, they will often be ineffective in more extreme events;
- A lack of clear and simple rules around some zoning requirements and the subsequent need for councils to incorporate judgement when approving certain developments;
- Zoning is predominantly a local council responsibility which creates inconsistent rules across different councils and states in Australia. Hence, natural perils adaptation is stronger in some areas of Australia than others.

Relocating properties

Whereas zoning of new development is one of the most effective ways to build pre-disaster resilience for new properties, relocating properties from high to low risk areas is one of the most effective adaptation options for existing properties. Relocating properties may be accomplished in a number of ways, including buy-backs and land swaps.

Despite being a very effective method to reduce property damage, this adaptation measure is not widely used due to the high costs involved in purchasing property.

4.3 Building Standards

Along with zoning, building standards play a critical role in reducing natural peril damage for new properties. The development and management of building standards in Australia is undertaken at a national level by the Australian Building Codes Board (ABCB). The implementation and regulation of building standards is then undertaken at a state and local government level.

Building standards have been improving over time, however from a pre-disaster adaptation perspective a gap exists in the current building standards framework, since the key focus of building standards is on health and safety rather than minimising property damage. According to the ABCB, the current objective of building standards is to “provide the minimum necessary requirements for safety, health, amenity and sustainability in the design and construction of new buildings (and new building work in existing buildings)

throughout Australia”. As a result, changes that would improve pre-disaster resilience, but don’t improve health and safety, are not likely to be included in revised building codes.

4.4 Retrofitting existing properties

Retrofitting involves making structural improvements to existing properties to increase their resilience to natural perils. Whereas building standards play an important role in reducing damage for new properties, retrofitting can significantly reduce natural peril damage for existing properties.

Although retrofitting can generate significant and immediate reductions to natural peril costs, retrofitting options have not been widely implemented in Australia. A key reason for this is the large cost associated with retrofitting.

4.5 Infrastructure to reduce the frequency and severity of individual natural perils

Key infrastructure used in Australia to reduce the frequency and/or severity of individual natural perils is summarised in the table 4.2.

Table 4.2 – Adaptation infrastructure

Peril	Infrastructure
Flood	Dams – these are barriers constructed across waterways to control the flow of water down rivers and creeks
	Levees – these are an artificially raised embankment or wall designed to reduce water overflow from a river or creek
Bushfire	Vegetation management (back-burning/pre-emptive cutting of bushland)
	Moving overhead electricity lines underground
Storm Surge	Seawalls – these are barriers constructed along the coast to prevent tides and waves from causing erosion and coastal flooding

4.6. Adaptation funding

Funding for pre-disaster resilience comes from a variety of channels. The key sources of funding are outlined below, with the majority of funding coming from the federal and state governments.

Federal government

Overall about \$50 million p.a. is currently spent by the federal government on pre-disaster adaptation funding. The federal government’s main funding mechanism is the National Partnership Agreement on Natural Disaster Resilience (NPANDR), which provides \$26.1 million p.a. to states and territories to fund disaster resilience programs. Examples of other federal government funding programs are provided in Appendix 4E (not available for this draft).

State government

Despite a lack of comprehensive information, it is estimated that state governments spend over \$50 million pa. on pre-disaster adaptation. State government adaptation funding primarily occurs through matching

federal government contributions and general infrastructure spending. More details are provided in Appendix 4E (not available for this draft).

Local government

Local governments contribute to adaptation funding through contributions to specific projects and general infrastructure spending. However, due to limited funding, particularly for remote councils with small rate bases, local government expenditure is generally lower than state government expenditure.

Private funding

Currently the vast majority of adaptation funding comes from government, with private funding not being very significant.

Gaps in current adaptation funding

Although adaptation funding exists and plays a key role in strengthening pre-disaster resilience, two key gaps can be identified in current adaptation funding arrangements:

Adaptation funding remains low: The current approach to natural perils funding is heavily weighted toward post-disaster relief and recovery, with limited levels of investment in preventative disaster adaptation. Although the federal government spends \$50 million p.a. on adaptation funding, it's estimated that each year an estimated \$560 million is spent on post-disaster relief and recovery by the federal government. This ratio of more than 10 to 1 is even higher if all natural perils costs are considered, including costs borne by all levels of government, insurers and individuals, as well as both indirect and intangible costs;

Framework to prioritise adaptation projects and funding can be strengthened: Currently adaptation funding often arises after an event (i.e. prioritisation of projects is reactive rather than proactive) or due to political pressure. This gap was also highlighted by the Productivity Commission inquiry, which found that "current government natural disaster funding arrangements are not efficient, equitable or sustainable. They are prone to cost shifting, ad hoc responses and short-term political opportunism".

Significant scope for more adaptation

Although important adaptation exists across all key areas described above, each area contains substantial gaps and significant scope exists for more adaptation investment in Australia. This can be seen through the low level of adaptation funding relative to post-disaster relief and recovery costs. In addition, many adaptation projects have not been undertaken despite very favourable benefit-cost trade-offs. A few examples are shown in table 4.3.

Table 4.3 – Example cost benefit ratios

Peril	Adaptation area	Adaptation activity	Benefit-cost ratio
Flood	Infrastructure to reduce frequency and severity of individual perils	Raising the walls of Warragamba dam by 23m	8.5
Bushfire	Retrofitting existing properties	Burying electricity wires for all 71,000 high risk houses in Melbourne	3.1
		Clearing 5m of bushland around all high risk houses in Melbourne	1.3
Cyclone	Building standards	Building new houses to a more cyclone resilient standard in foreshore areas of South-East QLD	3.1
	Retrofitting existing properties	Roof strapping upgrades that cost around \$3,000 per dwelling	1.45

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5 Key data sources available to enable assessment of risk

5.1 Data Relating to Natural Perils

The data relating to natural perils can be broken down into 4 main types:

- Aggregate event cost data in relation to a single event or series of events;
- Individual loss data (typically relating to insured losses);
- Geological, meteorological and engineering data;
- Data available to governments in relation to the cost of losses relating to public assets.

While each data source on its own can be useful, it is typically the amalgamation of the various data sources that is required to produce meaningful insights.

Whilst there are considerable amounts of data created, its accessibility, use, interpretability and consistency varies considerably.

5.2 Aggregate Event Cost Data

Broad level data (on an event basis) is available sometime after an event to those who search for it. Sources include ICA and Government reviews (such as Productivity Commission reports). These reports provide an overall view of significant events in terms of cost (and several are adjusted to be in current dollars and current exposure levels), but they are general in nature and require the user to interpret the results. They are good sources of data for understanding the overall insured cost of natural perils but they provide very limited insight into the risk rating requirements, etc.

Reviews typically provide useful sources for aggregated data but these typically come from a small number of sources:

- ICA
- Disaster funding from Treasury
- Deloitte Access Economics
- Risk Frontiers
- Australian Business Roundtable for Disaster Resilience
- Bureau of Meteorology
- Geoscience Australia
- Centre for Research on the Epidemiology of Disasters (CRED)
- Australian Emergency Management Institute (AEMI)
- Major reinsurers often provide summaries of annual event costs around the world.

The aggregate event data is useful for developing policy and understanding the long term cost of natural perils. The information is of use to governments, policy makers and insurers but is of limited use for individual companies, local governments and consumers.

Individual Loss Data

Individual loss data is typically associated with insurers. Each insurer will have their own records relating to the nature and cost of individual losses but, depending on their exposure, may not have a good view of the overall cost of a particular event. Further, only the largest insurers are likely to have sufficient information to enable their own loss experience to drive underwriting and pricing for natural perils. Individual loss data is of considerable value to insurers for risk underwriting and pricing, and can be useful for informing the more detailed application of public policy, such as changes in building standards. Individual loss data is of limited value to the broad setting of policy and for individual businesses and consumers unless it has been aggregated in some form to provide community/district/State level insights. The exception might be where an owner has previously experienced an event and subsequently manages the risk as far as possible (e.g. clearing around the house in a bushfire area will reduce the chance of suffering loss but does not remove the possibility of bushfire damage).

5.3 Geological, Meteorological and Engineering Data

Geological, meteorological and engineering (GME) data provide valuable insight into the underlying structures that lead to or cause natural perils and which help measure the likely impact of a natural peril.

Whilst a considerable amount of GME data is readily available, expert advice is typically required to turn that data into meaningful information. For example, local councils will often seek advice of an engineer to develop a flood map of their constituency.

Flood has recently been the most topical peril where modelling and mapping is undertaken but similar models have been developed for earthquake, cyclone, hailstorm and bushfire. The driving parameters of the models are obviously different, as is the level of uncertainty in the models (given the very different frequencies in which events occur).

Historically, much of the useful model information utilising GME data has been treated as confidential by the purchaser or developer. This remains the case with several elements such as the catastrophe models developed for use by insurers and reinsurers.

There has, however, been a recent trend to providing access to GME information to consumers, and in a form that is usable. A number of councils with significant flood prone areas now provide maps where consumers can view the relative level of flood risk that individual properties face.

The Australian Flood Risk Information Portal should, when complete, provide an additional resource for all stakeholders.

There are websites containing information regarding bushfire risks, but the type of information needed for flood is not required for bushfire on the basis that proximity to bush and/or grassland is obvious – hence the cost of developing maps is considerably less. Maps of bushfire prone areas are available, notably in Victoria and Western Australia.

Limited consumer accessible information regarding cyclone risks is available and the reasonably random nature of hailstorm and infrequency of earthquakes means that it is difficult to see what useful information could be provided.

Increased availability of GIS data and access to mapping software means that more user-friendly ways of distributing information are readily available.

5.4 Government Data

In theory Governments have access to a broad range of data relating to natural perils with respect to the cost of damage to public assets. Data should be available which covers the cost of building various infrastructure assets and what the cost of repairing/replacing them has been over time. Data should also be available regarding the nature and value of Government-owned assets.

In its 2011 report to the Department of Finance and Deregulation's Review of Insurance Arrangements of state and territory governments under the Natural Disaster Relief and Recovery Arrangements (NDRRA), KPMG has highlighted that the level of detail maintained by governments is not necessarily complete and/or consistent across the various jurisdictions. Examples include:

- The definition and measurement of Essential Public Assets;
- The basis of historical claims experience – i.e. net or gross of insurance/reinsurance, data provided by financial year rather than year of loss;
- Separation between state information and the data relating to local governments.

It is not clear that sufficient information exists (at least readily) to produce an holistic picture of the exposure of public assets to natural perils and the historical cost of such.

5.5 Data Amalgamations

There are some Australian examples of data amalgamations where data from a range of sources is combined to provide information that is useful to individual businesses and consumers.

The ICA has developed a database on Australian catastrophic events in its Dataglobe. The Dataglobe has been developed to provide a communications resource for the ICA and member companies involved in dialogue with the community and governments.

The Dataglobe contains hazard information linked to location which enables mapping of historical events. It also contains an ICA natural perils exposure score for a large number of addresses across Australia, policy in-force information by address (currently being populated across Australia), and is in the process of developing a building resilience rating tool.

In 2012, following a series of extremely severe floods and the Natural Disasters Insurance Review, the Australian Government launched an initiative to create the Australian Flood Risk Information Portal. The portal is under construction but aims to collate and document flood studies from around Australia. The portal will host data and tools that allow public discovery, visualisation and retrieval of flood studies, flood maps, satellite derived water observations and other related information, from a single location.

The Geoscience Australia website states that “the portal will host standards and guidelines for use by jurisdictions and information custodians to encourage best practice in the development of new flood risk information. While the portal will initially host existing flood information, the architecture has been designed to allow the portal content to grow over time to meet the needs of users. The aim is for the portal to display data for a range of scenarios from small to extreme events, though this will be dependent on stakeholder contribution”.

The NSW Government has developed NSW Globe which provides access to a variety of NSW spatial data via Google Maps. Information available includes satellite imagery, response imagery, terrain data, places, boundaries, roads, rail, addresses, land parcels, surveying and history as well as linking property sales, land values and ABS data. A similar service is available in Queensland and Western Australia.

5.6 Data - accessibility, use, interpretability and consistency

Whilst the previous sub-sections highlight a considerable amount of data that is created, the access to that data, and particularly the source data, is hampered by privacy, intellectual property, liability and competition concerns. As a result, there are aspects of data which are available to select stakeholders and, at least at this stage, nobody has access to complete data.

Data gaps

Whilst access to data is an issue, there are also considerable data gaps and inconsistencies. Significant advancements have been made in recent years in terms of being able to collate and analyse considerable amounts of data along with developments in geocoding. Nevertheless, there are numerous elements of data, relevant for assessing the potential impact of natural perils, which are not readily available.

Examples of areas where there are gaps in the data include:

- A Department of Finance and Deregulation review of insurance arrangements with the states and territories under the NDRRA highlighted considerable inadequacies and inconsistencies in the data provided to the Commonwealth by the States;
- The Productivity Commission in its inquiry into Natural Disaster Funding arrangements highlighted that essential public assets are not clearly defined or valued and that indirect economic costs can be considerable – not well measured nor reported on;
- A lack of clarity around what constitutes ‘current building and engineering standards’;
- Understanding what standards existing assets have been built to;
- The maintenance of databases of historical claims and exposure data relating to government-owned assets enabling an holistic view to be taken.

Challenges of using the data

Even where data exists, there can be considerable challenges in applying that data. A simple example relates to the use of flood maps. The types of issues that arise are:

- Maps for different regions being prepared on different bases and for differing purposes;
- The information obtained from the flood maps typically provides an indication of the average return period for a flood at a particular depth. Information is required for a variety of return periods to enable the construction of a damage curve. The development of the damage curve is then complicated by the fact that the exact location of the assets and their height off the ground is often not known;
- Access to the detailed information behind the maps may not be available meaning that analysis is limited to regions or neighbourhoods rather than individual properties.

Other challenges arise due to changes in the built environment over time meaning that historical weather observations may not be representative of the impact of an equivalent event in future.

Informing policy and decision makers

The inability for various stakeholders to convince decision makers of the benefits of risk adaptation highlights that a comprehensive picture of the issues surrounding natural perils and their linkages has not been able to have been developed.

Developments in risky locations still continue to be authorised highlighting the need for a more comprehensive cost-benefit assessment, which adequately considers the costs of natural perils. A requirement for more comprehensive reporting on building developments, building materials used and the applicable building and planning standards might assist in enhancing the decision making process.

Amongst a range of data-related recommendations, the Productivity Commission recommended that:

- the Australian Government should publish estimates (and their confidence ranges) of future costs of natural perils to its budget in the Statement of Risks with those estimates being informed by catastrophe loss modelling;
- Governments at all levels should make new and currently held natural perils data publicly available in accordance with open public sector information principles. When collecting new natural perils data or undertaking modelling, all levels of government should make information publicly available unless it would not be in the public interest to do so;
- All stakeholders should consider partnerships to share data and that the data be used to inform land use planning and adaptation;
- Governments should task the Australia–New Zealand Emergency Management Committee with leading the development of guidelines for the collection and dissemination of natural perils mapping, modelling and metadata. Guidelines should be developed for all hazards that need to be modelled and mapped at the local/regional level and where consistency across regions is desirable.

6 Current funding arrangements

The cost of natural perils presents a funding challenge to many parts of the Australian community due to the frequency, severity, scope and potential catastrophic nature. There is no single available solution to the problem. A range of funding options, including insurance, reinsurance, government and non-insurance solutions, are covered in the following section to demonstrate the pros and cons of each alternative.

6.1 Role of insurer

Australia has a highly competitive general insurance market and cover is available for the majority of conceivable risks to property. Purchasing insurance products has been a common risk transfer mechanism for managing natural peril exposures. Insurance products are competitive in price and coverage is widely available for most perils such as storm, earthquake, bushfires and cyclones. Flood was largely excluded until 2011 while actions of the sea remain as exclusions from most insurance policies.

Insurance policies often have a separate deductible (excess) and/or limit for losses caused by natural perils, which helps to reduce the insurance premium and requires the policy holder to bare part (albeit typically a small part) of the cost when a loss occurs.

In recent years, many Australian insurers have improved their pricing methodologies, especially in the area of natural perils, aiming to achieve competitiveness in premiums and maintain profitability. A further driver of the improvement in natural perils pricing is the increasing availability of detailed information regarding the insured assets and their exposure to natural perils, such as council flood maps, which allow considerably greater precision in the rating of individual properties.

An outcome of refinements in the pricing methodology is reduced premium cross-subsidisation and this has led to significant increases in insurance premiums for certain exposures and communities over quite a short period of time. This has resulted in insurance affordability (availability at an affordable price) becoming a public and political concern in some areas. For example, whilst flood cover is available for practically any risk, some property owners purchase cover with flood exclusions, or do not buy insurance at all, due to the high insurance cost.

6.2 Reinsurers

For most Australian insurers and government schemes, purchasing reinsurance protection has been a standard practice to transfer the aggregation of risk faced by insurers resulting from natural perils. In addition, the utilisation of reinsurance protections has been a common method for regulated Australian insurers to reduce their Insurance Concentration Risk Charge (ICRC), which forms part of the Prudential Capital Requirement (PCR). The ICRC formula considers both a natural perils vertical requirement (in effect, the cost from a large single event) and the natural perils horizontal requirement (the cost arising from a series of events).

Catastrophe Excess of Loss reinsurance is the most commonly utilised type of reinsurance to transfer natural perils losses in both the Australian and international insurance markets. The program is typically placed with more than one reinsurer, domiciled either locally or overseas, with each reinsurer contracting for a proportion of the reinsurance program. The program specifies the attachment and limit of the reinsurance coverage, as well as the number of available reinstatements (additional covers) to the program.

Other reinsurance programs, such as facultative reinsurance, proportional reinsurance treaties (quota share and surplus share) and other non-proportional reinsurance treaties, may also provide some coverage for natural peril losses, however the catastrophe excess of loss program is currently the predominant approach.

Whilst Australian natural perils could be of significant size, they are relatively small compared with global peak catastrophe scenarios such as US hurricane, US earthquake, Japan earthquake and European windstorm. Market research undertaken by Aon Benfield (AB) estimated the global reinsurer capital as at September 30, 2015 to be approximately US\$565 billion. Hence the global reinsurance market currently has more than sufficient capacity to accommodate the capital requirements of the Australian market – particularly with Australia currently viewed as a providing diversification to other global exposures.

The traditional reinsurance market has been softening with the increase in total reinsurance capacity since 2011. Rate reductions have been observed both locally and overseas. When considering the future cost of reinsurance the cyclical nature of the global reinsurance market needs to be taken into account. Significant price increases due to a shortage of (global) reinsurance capacity post large losses could have a major impact on the local markets and affordability concerns could be exacerbated.

6.3 Government (Federal, State and Local)

The natural peril funding arrangements are shaped by the Australian Constitution, which assigns the roles and responsibilities of each level of government. Most service delivery is the responsibility of the state governments (local governments are essentially an extension of state governments). Consequently, most natural peril risk management is the responsibility of those levels of government.

Currently, the Federal Government's role in national disaster funding arrangements consists of three main elements:

- Natural Disaster Relief and Recovery Arrangements
- Australian Government assistance to individuals;
- The National Partnership Agreement for Natural Disaster Resilience (NPANDR).

The arrangements have undergone many changes over time as new policies have been added and NDRRA determinations have been released. The evolution of the funding arrangements can be characterised by growing generosity by the Australian Government during the past decade, followed by a swing to constrain costs and increase oversight in response to the recent spate of costly disasters.

Natural Disaster Relief and Recovery Arrangements

NDRRA set out the framework for the Australian Government to share the costs of natural peril recovery with state governments (and ultimately, through the states to local governments). The Australian Government provides reimbursement for a portion of eligible expenditure on assistance to individuals and businesses, and for restoration of essential public assets.

The fundamental elements of the NDRRA are:

- annual thresholds — the Australian Government only provides assistance if cumulative state expenditure (meeting the small disaster criterion) exceeds a certain threshold in a financial year;
- small disaster criterion — only events that lead to expenditure above the 'small disaster criterion' (currently \$240,000) can be counted toward the annual threshold;
- cost-sharing rates — the level of reimbursement (up to 75 per cent) depends on the level of state expenditure and the type of activity;
- eligible expenditure — reimbursement is only available for defined activities, falling under three categories (with a fourth category available for discretionary assistance as determined by the Prime Minister).

Over the last 10 years the average amount provided by the federal government under the NDRRA is approximately \$1.2 billion p.a.

The Productivity Commission's 2014 review of Natural Disaster Funding Arrangements identified a number of concerns regarding the structure of the NDRRA. These included that:

- The level of support creates a financial disincentive for state and local governments to manage the natural perils risk, especially through land use planning;
- The reimbursement model can drive undesirable behaviours, including excessive expenditure in areas that are eligible for reimbursement, and can prevent the most cost effective recovery options being followed.

Australian Government Assistance to Individuals

The Australian Government assistance to individuals takes a range of forms.

Examples include:

- The Australian Government Disaster Recovery Payment, which is a one-off non-means tested payment of \$1,000 for adults and \$400 for children who are adversely affected by a major disaster, as determined by the Minister for Justice;
- The Disaster Recovery Allowance (DRA) which is paid for up to 13 weeks to people who demonstrate a loss of income.

The average level of payments over the last 10 years appears to be around \$0.2 billion p.a.

The National Partnership Agreement for Natural Disaster Resilience

The NPANDR is an intergovernmental agreement for shared funding of activities that contribute to natural peril resilience and adaptation. It is an agreement between the Australian Government and the states to fund adaptation projects in accordance with the National Strategy for Disaster Resilience. Under the agreement, the Australian Government provides funding for activities undertaken by states and territories that increase disaster resilience.

6.4 Funding for non-insured cost of natural perils

Much of the costs for natural perils are not covered by insurance. The full economic costs of natural perils are difficult to measure. Full economic costs include (direct and indirect) tangible and intangible costs.

Typically the indirect and non-tangible costs fall to individuals and families or, in some cases, to government natural peril relief, as described above. The government natural peril recovery costs are treated as contingent liabilities and therefore not included in government financial statements (that is, the forward estimates only include provision for fiscal costs from past disasters). This budget treatment means that most natural peril costs have become a volatile and unfunded liability for governments, especially the Commonwealth Government.

There is a spectrum of alternatives, varying from one extreme of a provision set aside before disasters occur (pre loss financing) to the other of obtaining funds if and when a disaster occurs (post loss financing). Budgeting for these costs could provide incentives to introduce cost effective ways to reduce the cost (e.g. adaptation).

6.5 Pooling arrangements

As noted elsewhere in this paper there are concerns about the affordability of natural peril insurance coverage in some parts of Australia, particularly for flood and cyclone. One approach to managing affordability is the use of pools, which can be funded more broadly and used to subsidise some or all of the cost of high risk properties. There are currently no pools in Australia to subsidise the cost of natural perils for high risk properties.

Critics of pools often point to the importance of risk based rating to provide incentives for homeowners and councils to undertake adaptation strategies and discourage the construction of properties in high risk areas.

In 2012 the Actuaries Institute issued a media release supporting the establishment of a temporary national pool to subsidise high insurance premium for flood prone properties. The Actuaries Institute stated that “.....it’s vital that any subsidies provided from the pool are conditional on policyholders and local councils taking action to reduce the risk of damage from flooding, such as carrying out the appropriate property renovations and building levees in high risk areas”.

The NDWG supports the use of pools in this manner, noting in particular the intention that the pool be temporary and that it be structured to provide incentives to reduce risk.

6.6 Alternative capital / risk transfer

The continued flow of new capital into the (re)insurance industry constitutes the largest change to the sector's capital structure in recent memory. New capital has entered the market through investments in insurance-linked securities (ILS) funds, sidecars, hedge fund-backed reinsurance companies and collateralised reinsurance vehicles. Investors have increasingly been attracted to low correlation returns from catastrophe risk relative to traditional capital markets risks and the attractive yield for the measured (re)insurance risk relative to other investments, particularly in the current low inflation, low yield market. Guy Carpenter estimated the new capital as at July 1, 2015 to be approximately US\$66 billion. This includes catastrophe bonds, industry loss warranties, collateralized reinsurance and sidecars.

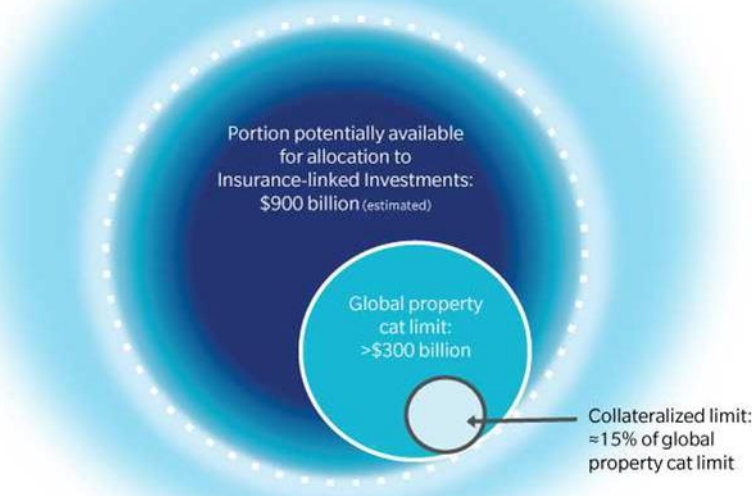
Traditional reinsurance arrangements rely on a "promise to pay" and therefore expose clients to counterparty credit risk. Collateralised placements and many ILS reduced this risk by placing the full limit in a single beneficiary trust or securing the limit via methods such as Letter of Credit (LOC), for the benefit of the ceding insurer.

In the past few years, there have been several attempts by Australian (re)insurance companies to transfer some of the natural perils risks to the alternative markets, such as catastrophe bonds. There have been few successes so far with the main reasons for low success rates being:

- Competitive pricing from the traditional reinsurance markets;
- Concerns around the difficulties of assessing (and getting regulatory approval) in the solvency capital calculations.

PENSION FUND CAPITAL UNDER MANAGEMENT AND ALLOCATIONS INTO REINSURANCE

Global Pension Fund Assets Under Management \$30 Trillion



Source: Guy Carpenter, JP Morgan Asset Management

The convergence of (re)insurance with the capital markets is a significant development for the private sector's ability to assume and diversify catastrophe risk and assist in de-risking public sector entities. While the growth of this form of reinsurance capital has been strong, it still represents less than 20 percent of total reinsurance capital. When compared with the US\$ 30 trillion of global pension funds' assets under management, the current level of capital market involvement in ILS is only 0.22 percent of total global pension assets under management. The risk bearing potential of capital markets that now exists for new insurance risk is enormous. The challenge will be to create motivation to transfer risk through a process of risk identification, cost allocation and development of a conduit to transfer risk.

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Part III Appendices

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