

Response to the  
**National Disaster Insurance Review**



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## Introduction

The National Disaster Insurance Review (NDIR) was initiated following widespread flooding in many parts of Queensland and Victoria in late 2010 and early 2011. It is concerned with the availability and affordability of insurance in respect of riverine flood.

This submission is written at the request of the NDIR Panel in response to the NDIR's Issues Paper of June 2011. We limit our response to only a few of the many questions raised in the Issues paper, concentrating on those areas where our experience and credentials are most relevant.

Underlying our response is the belief that the problem with which the review has been charged is poorly framed. The fundamental question that needs to be addressed is not the insurability of flood risk but how best to deal with the legacy of poor land-use planning decisions that has left some home owners in locations now designated as flood prone. How to reduce this exposure should be the explicit policy objective.

Our submission is structured as follows: we begin with an outline of Risk Frontiers, its experience relevant to the Review Issues Paper and our contribution to the development of the National Flood Information Database (NFID). NFID is briefly described in respect of some commentary that is in our view both uninformed and driven by vested interests. We shall make our own self interest clear. This is followed with a brief description of Risk Frontiers' FloodAUS loss model that is already being used to price premiums and guide reinsurance negotiations. We propose a set of attributes that in our view any Flood Insurance Pool (FIP) must satisfy before government intervention is warranted and then list some pitfalls for a poorly conceived FIP. After some brief comments in respect of building codes we conclude our submission by summarising the key points. In the Appendix, we describe the 1867 flood on the Hawkesbury-Nepean catchment in an effort to illustrate the point that establishing a boundary for eligibility in any pool is not a trivial task.

Note that the views expressed here are those of Risk Frontiers and should in no way be construed as reflecting those of our sponsor companies or those of the Insurance Council of Australia.

## Risk Frontiers

Risk Frontiers is an independent research centre sponsored by the insurance industry to aid better understanding and pricing of natural hazard risks in the Asia-Pacific region. It was founded in 1994 to service the specialised needs of its sponsors in the local insurance and international reinsurance markets. Its aims were to:

- undertake risk assessment and research into natural hazards,
- develop databases of natural hazards and their impacts on communities and insured assets, and
- develop loss models to improve the pricing of natural hazard catastrophe risks.

These activities remain the core business of Risk Frontiers today, although we now undertake studies on a much wider range of risk-related problems and for a client base that extends beyond the insurance sector. For example, Risk Frontiers is the preferred provider of research to the NSW State Emergency Service, which also has interests in any policy outcomes in respect to flood risk advocated by the NDIR.

Risk Frontiers' research and model developments are geared towards providing:

- databases and tools to promote risk-informed underwriting in relation to natural perils,
- applications of advanced geospatial and image analysis tools,
- multi-peril Probable Maximum Loss (PML) modelling, and
- promoting risk-informed decision-making and the responsible management of risk.

Risk Frontiers is based at Macquarie University where it enjoys close collaborative links with a number of key academics. The Centre is self-funded and its staff are devoted to research, real-world problem solving and software development; it has no formal teaching commitments although the Centre does train post-graduate students (mainly PhD students) who undertake research to advance our understanding of natural perils and their impacts on communities.

Risk Frontiers also works for and collaborates with a wide range of non-sponsor insurance companies and non-insurance entities located in Australasia, Europe, South-east Asia and Bermuda.

## Relevant Recent Assignments by Risk Frontiers

- Development of FloodAUS, an Australian loss model to price riverine flood risk
- Development of an Australian Multi-Peril Loss modelling platform to price risks due to riverine flood, hail, bushfire, tropical cyclone and earthquake either individually or in combination
- Joint development (with Willis Re Australia<sup>1</sup>) of the National Flood Information Database (NFID) for the Insurance Council of Australia
- Rapid post-event field assessments of damage incurred as a result of flooding in Queensland, Tropical Cyclone Yasi and the Christchurch earthquakes
- Street-address natural hazard profiles for all addresses in Australia — bushfire vulnerability, earthquake peak ground acceleration and seismic soil conditions, peak gust speeds, distance to coast, elevation, etc.
- Probabilistic tsunami wave height analyses
- Database of coastal vulnerability by population and elevation<sup>2</sup>
- Investment analysis and risk assessment of remedial engineering works related to flood levee failure in an Australian city
- Normalising the Insurance Council of Australia’s Natural Disaster Database of insured market losses for changes in inflation, wealth and population and changes in construction standards (in Tropical Cyclone-prone parts of the country) in order to estimate likely losses if historical disaster events were to recur under today’s societal conditions<sup>3</sup>
- Valuing the benefits arising from regulations mandating improvements in construction standards for residential dwellings in cyclone-prone areas of Australia

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<sup>1</sup> Willis Re is a global reinsurance broking intermediary with skills in assessing flood risk.

<sup>2</sup>Chen, K and K.J. McAneney. 2006. High-resolution estimates of Australian coastal population: with validations of global data on population, shoreline and elevation. *Geophysical Research Letters*, 33, L16601, doi:10.1029/2006GL026981

<sup>3</sup>Crompton, R.P. and K.J. McAneney, 2008. Normalised Australian insured losses from meteorological hazards: 1967 -2006. *Environ. Science & Policy* 11: 371-378.

- Estimating the time scale at which an anthropogenic climate change signal may emerge in US hurricane loss data and implications of this for other disaster databases.<sup>4</sup>
- Normalised bushfire building damage and fatalities from 1925 – 2009 and implications for land-use planning<sup>5</sup>
- Invited submissions to the Royal Commission into the 2009 Victorian bushfires in respect to (a) circumstances surrounding all bushfire-related deaths since 1900<sup>6</sup> and (b) the vulnerability of homes as a function of their distance from bushland<sup>7</sup>
- Representation on the Australian Building Codes Board Flood Committee
- Study of insurability of flood risks<sup>8</sup>

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<sup>4</sup>Crompton, R.P., R.A. Pielke Jr. and K.J. McAneney, 2011. Emergence time scales for detection of anthropogenic climate change in US tropical cyclone loss data. *Environmental Research Letters*, 6, 014003, doi: [10.1088/1748-9326/6/1/014003](https://doi.org/10.1088/1748-9326/6/1/014003)

<sup>5</sup>Crompton, R.P., K.J. McAneney, K. Chen, R.A. Pielke Jr., and K. Haynes, 2010. Influence of Location, Population and Climate on Building Damage and Fatalities due to Australian Bushfire: 1925-2009. *Weather, Climate and Society*, Vol. 2: pp. 300-310, doi: [10.1175/2010WCAS1063.1](https://doi.org/10.1175/2010WCAS1063.1).

<sup>6</sup> Haynes, K.A., Handmer, J., McAneney, K.J., Tibbits, A. and L. Coates, 2009. Australian civilian bushfire fatalities: 1900 – 2007. *Environ. Sci. & Policy* 13:185-194.

<sup>7</sup> Keping Chen and John McAneney. 2004. Quantifying bushfire penetration into urban areas in Australia. *Geophysical Research Letters*, 31, L12212, doi:10.1029/2004GL020244; Crompton, R.P., K.J. McAneney, K. Chen, R.A. Pielke Jr., and K. Haynes, 2010. Influence of Location, Population and Climate on Building Damage and Fatalities due to Australian Bushfire: 1925-2009. *Weather, Climate and Society*, Vol. 2: pp. 300-310, doi: [10.1175/2010WCAS1063.1](https://doi.org/10.1175/2010WCAS1063.1); Chen, K. and McAneney, J., 2010. Bushfire Penetration into Urban Areas in Australia: A Spatial Analysis, Risk Frontiers Report to the 2009 “Black Saturday” Bushfire Royal Commission Enquiry.

<sup>8</sup>Roche, K., McAneney, K.J. and R. van den Honert, 2010. Policy options for managing flood insurance. *Environmental Hazards* 9:369-378.

## The National Flood Information Database (NFID)

NFID has been jointly developed by Risk Frontiers and Willis Re Australia for the Insurance Council of Australia. The NFID comprises a database of flood hazard information – flood height as a function of Average Recurrence Interval - at street address resolution for communities across Australia with significant numbers of residential properties at risk to riverine flood. Its development represents a commitment by the insurance sector to underwrite this risk.

NFID is derived from the best quality available data (that is, flood modelling/mapping, Digital Terrain Models (DTM), and address location data). No hydrological or hydraulic flow modelling is undertaken by Risk Frontiers or Willis Re<sup>9</sup>; in this respect, the starting point for NFID is the output of modelling studies by specialist hydraulic and hydrological engineers in the form of maps, flood surfaces, flood study reports, etc. The flood data are processed and combined with DTMs and geo-located address data to estimate the frequency and depth of flooding for each address point.

The decision to use City or Local Council flood information was made expressly to avoid unnecessary inconsistencies between flood maps used for land-use planning decisions and those used for underwriting purposes.

For those catchments where only the 1 in 100 year flood extent is available – this is the case for many catchments in Victoria – addresses are rated as being either within or outside of this flood extent.

A confidence rating is also attached to each address entry based on age and resolution of the DTM and flood studies and type of flood data available: flood extents, flood depths at one or several Average Recurrence Intervals.

NFID is being delivered in several stages and has also an ongoing maintenance program for the NFID to incorporate changes in property exposures, new and revised flood information and improved digital terrain or street address datasets (see Table 1).

Most State or Local Governments bodies and/or Flood Plain Management Authorities have been forthcoming in their provision of flood information with a view to encouraging the availability of riverine flood insurance. Queensland presents ongoing challenges in this regard with some councils refusing to provide information for a litany of reasons. Nonetheless we believe NFID already captures more than 80% of the flood-prone properties in Queensland, most of which are located in the South-eastern portion of the State.

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<sup>9</sup> Some modelling decisions are peer reviewed by third-party consulting engineers

**Table 1:** Release history of NFID

Version	Release date	GNAF reference	The number of addresses with flood risk data
1.0	17-Dec-08	Aug-08	672,270
1.1	23-Dec-08	Aug-08	1,185,367
1.2	11-Mar-09	Aug-08	1,436,261
1.3	18-May-09	Aug-08	1,436,261
2.0	15-Jul-09	Aug-08	1,556,300
2.1	21-Dec-09	Aug-08	1,631,219
2.2	30-Mar-10	Aug-08	2,570,024
2.3	30-Jun-10	Feb-10	4,635,006
2.4	3-Dec-10	Aug-10	4,965,681
2.5	2-May-11	Feb-11	5,151,259
2.6	...	...	...

Risk Frontiers also maintains its own proprietary dataset of flood information for the major catchments on the eastern seaboard. For our purposes here, this database can be considered a subset of NFID.



## Validation of NFID

We note calls for better flood modelling, DTMs and the need for a common standard. Better data would bring improved precision to underwriting but the implication that existing data are not up to the task is unproven.

A common standard will be difficult to achieve and may be unnecessary; it is much more important that modelling detail be focussed on major centres of flood risk. There is always judgement involved in flood modelling, but the appropriate people to make such decisions – rainfall scenarios considered, parameterisation of the catchment, resolution of modelling elements, etc. and the resulting uncertainties in the modelled flood surfaces – are specialist hydrologists and hydraulic engineers.

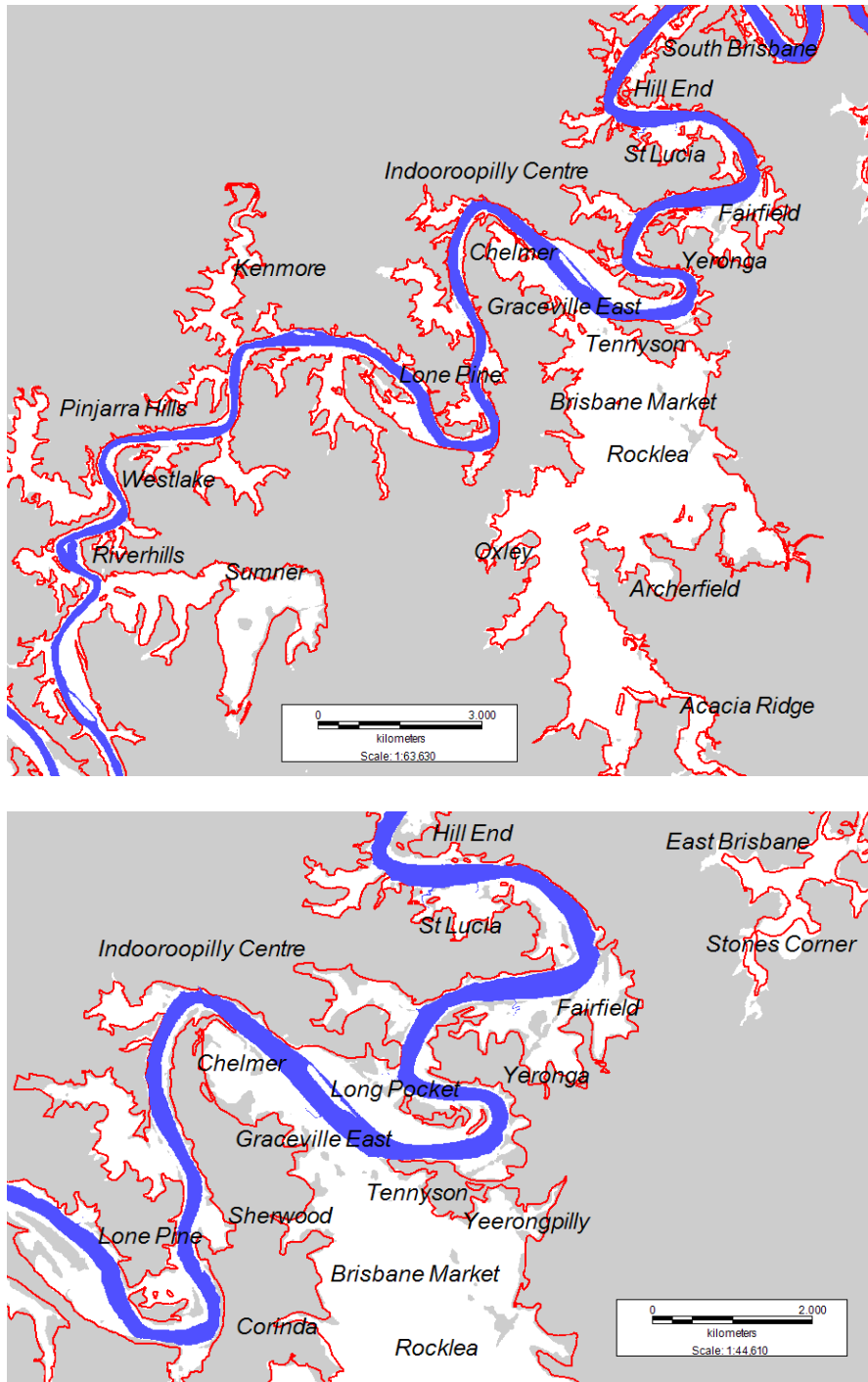
Whenever possible, Risk Frontiers validates NFID. Historical flooding in Brisbane and Ipswich has offered such opportunities. Figures 1 and 2 compare the extent of the January 2011 flooding and the January 1974 flooding with the NFID flood surfaces interpolated to match the height of flooding at the Brisbane River City Gauge (4.46 m above AHD). The close agreement between the observed flood extent and modelled boundaries is gratifying especially as the flood surface data used here was some *30 years old*<sup>10</sup>. It is no secret where it will flood!

It has also been possible to compare other flood extents with NFID such as the recent flooding in Kempsey, NSW, using information on road closures and in the case of Katherine, NT, actual flood extents with flood maps published on the council website. Again the agreement (not shown) in these cases has been encouraging.

In our view, the current riverine flood mapping data and digital terrain mapping is adequate for both insurance and emergency management applications. Of course better data and in some cases a fuller range of flood surfaces for different Average Recurrence Intervals would be welcomed; however in the short term, legislation that compels local councils to release existing data would provide an immediate solution. Having been paid for with public monies, these data should be accessible to all. More transparency is needed.

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<sup>10</sup> Note that in the most recent NFID release (Version 2.5: Table 1), this data has since been updated by more recent flood modelling undertaken in 2009 by the Brisbane City Council.



**Figure 1:** Comparison between actual extents of flooding in January 2011 (Top, red line) and January 1974 (Bottom, red line) as released by the Brisbane City Council and that indicated by NFID (Version 2.4 and earlier) (white area) after water levels were matched at the Brisbane River City Gauge for the January 2011 flood. Dark blue depicts the normal channel when the river is not in flood.

## Risk Frontiers' FloodAUS Riverine Flood Loss Model

Risk Frontiers' loss model is a probabilistic model for pricing flood losses in Australia. Whereas NFID indicates the frequency of flooding, FloodAus estimates damage costs for insurer portfolios. It generates a catalogue of plausible event losses and uses these to derive exceedance loss probabilities – the annual probability of experiencing an insured loss equal or greater than given amounts – as well as other insurance-relevant statistics.

FloodAUS uses high resolution flood modelling data, either from NFID for licensed users or Risk Frontiers' own proprietary database, to represent the hazard as the average annual probability of flood water depths at individual addresses.

Historical datasets of flood damage and/or claims information have been analysed to derive relationships between damage and over floor level water depths for different types of residential construction.

Also estimated are post-event extra costs such as accommodation and clean-up.

Many of the larger losses possible arise from contemporaneous flooding on multiple catchments. FloodAUS includes inter-catchment correlations and the catalogue of simulated event losses includes both those which span only one catchment and joint events spanning two or more. We return to the importance of this in later discussion.

## NDIR Issues Paper

Taking up a central point already made in our Introduction, we believe that the salient issue with flood risk is the number of dwellings located in areas now deemed to be high-risk. It is difficult to put a precise figure on the numbers of homes but we roughly estimate that there are currently around 150,000 exposed to a 1 in 100 year flood at ground level. While we caution that the 1 in 100 year flood is a measure of flood frequency rather than of risk, this is the approximate number of properties that any Flood Insurance Pool would have to deal with.

[Many more properties lie just above the 1 in 100 year flood extent and under the current legal framework it is difficult for councils to prevent further development regardless of the risk. As will be pointed out in later discussion there are no legal constraints on the manner in which these homes are built.]

Many of these land-use planning decisions that allowed these homes to be built in these locations were made before the availability of modern flood mapping and for reasons that at the time made perfect sense, such as easy access to flat arable land and coastal shipping, for example.

On the other hand, there can be little excuse now for the continued development of the floodplain in ways like infill housing that do not consider the latent risk. Nor can there be

any excuse for either not making flood hazard information available or only available in ways that do not allow homeowners to personalise their exposure. Knowing that your home is located within the 1 in 100 year flood extent, for example, doesn't tell you much about how deep the water might be and what might happen in less frequent floods.

Notwithstanding the above comments, it is self-evident that even as increasing numbers of insurers begin to offer flood insurance, there will always remain a number of residential home owners who will struggle to obtain cover at prices that seem affordable, even where these premiums reflect a realistic view of the risk. The Review Panel is charged with finding a solution for this problem and has suggested some options for dealing with it. Except for the status quo option, all proposed mechanisms involve some form of government intervention in the marketplace. If the government chooses to go down this route, then this interference needs to be undertaken in ways that minimise disruption to the insurance market and encourage risk mitigation.

### Potential Problems for a Flood Insurance Pool (FIP)

At a recent (May 16, 2011) seminar on flood resilience hosted by the Institute of Actuaries, the Federal Attorney-General, Robert McClelland, stated that

*the Australian taxpayer has become the default insurer of last resort.*

In reality this will always be the case; what needs to be avoided is a poorly conceived FIP operating in such a way that the taxpayer (government) becomes the insurer of *first* resort.

There are examples of perverse outcomes with some pools in the US<sup>11</sup> and we understand that the Review Panel is aware of these. Nonetheless we list some concerns about an Australian FIP, which if poorly designed could:

- create moral hazards to build in high risk areas and thus act to amplify the flood problem in the future,
- unnecessarily draw in risk if too attractive to consumers and lead to subsidies above necessary levels,
- lack the pricing sophistication to send proper economic signals about risky behaviour, and

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<sup>11</sup>Roche, K., McAneney, K.J. and R. van den Honert, 2010. Policy options for managing flood insurance. *Environmental Hazards* 9:369-378.

- not be reviewed rigorously enough to adjust to changing circumstances or deal with large losses in successive years.

## Attributes of a workable FIP Solution

We are unsure whether a FIP is warranted, but if it were it should include the following features:

1. Make flood mapping available to all stakeholders.
2. Eliminate the distinction between damage caused by “storm” and “flood” – it is all just water damage.
3. Allow insurers to exclude water damage in high risk areas.
4. Identify a geographic boundary where the risk of water damage attributable to flood is *material* enough to warrant some kind of special treatment. Outside the boundary, the private market operates. (We return to the determination of this boundary in later discussion as both options considered in the Issues Paper are potentially problematic in this regard.)
5. Set up a pool to offer water damage cover inside the boundary where insurers will not do so:
  - a. Create a basic pool for water damage with high deductibles and/or first tranche cover to encourage homeowners to seek supplementary cover from insurers and incentivise insurers to offer such cover.
  - b. Make availability of pool coverage conditional upon local councils adopting proper land use planning practices.
  - c. Anyone with a legal permit to build inside the boundary prior to its creation is eligible for flood cover from the pool but cover is not available for any new construction.
  - d. With the aim of reducing the nation’s flood risk over time, have a mechanism for compulsory land purchases or exchange following a flood.
  - e. Create a mechanism for funding large losses or deficits in the FIP that may arise in particular years on particular catchments – Brisbane, Northern New South Wales or the Hawkesbury-Nepean – or large losses in successive years. Funding this deficit should have a pre-determined priority ranking that includes contributions from those within the pool, local councils, insurers and Federal government. For very large losses a bond issue by the FIP might be necessary to amortise large payments or a succession of large payouts over several years.

6. Sunset the pool after some time period to force periodic review of scheme.
7. Create a national database of floor height above ground level.

## Further Considerations for a FIP Solution

The Issues Paper suggests two possible ways for establishing eligibility in a Pool. One is termed an *engineering threshold* – such as the 1 in 100 Annual Return Interval – to be set independently from the insurance industry. We would add immunity from political manipulation as one further necessary stipulation. The second option is described as a *price threshold*.

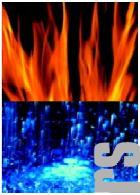
Many have rejected the *price threshold* as being too open to gaming. The argument is that it is difficult to know what a reasonable premium should be for all other threats excluding flood but including fire and theft for example. However FloodAUS could be used to help define a suitable flood-only risk premium for different categories of flood risk.

The *engineering* solution also poses problems, not least because, as has been pointed out already, the 1 in 100 year flood extent (or that of any other Average Recurrence Interval) is not a measure of risk but of the frequency of flooding at ground level. It says nothing about likely damage that is primarily a function of water depth above floor level. Thus it is senseless for example to compare catchments like the Hawkesbury-Nepean to many inland catchments: on Hawkesbury-Nepean, the difference in water heights between the 1 in 100 level and the Probable Maximum Flood is around 9m whereas for many inland catchments, this difference is only 1 m or less. Clearly the risk is very different in these two cases even though the flooding frequency is the same.

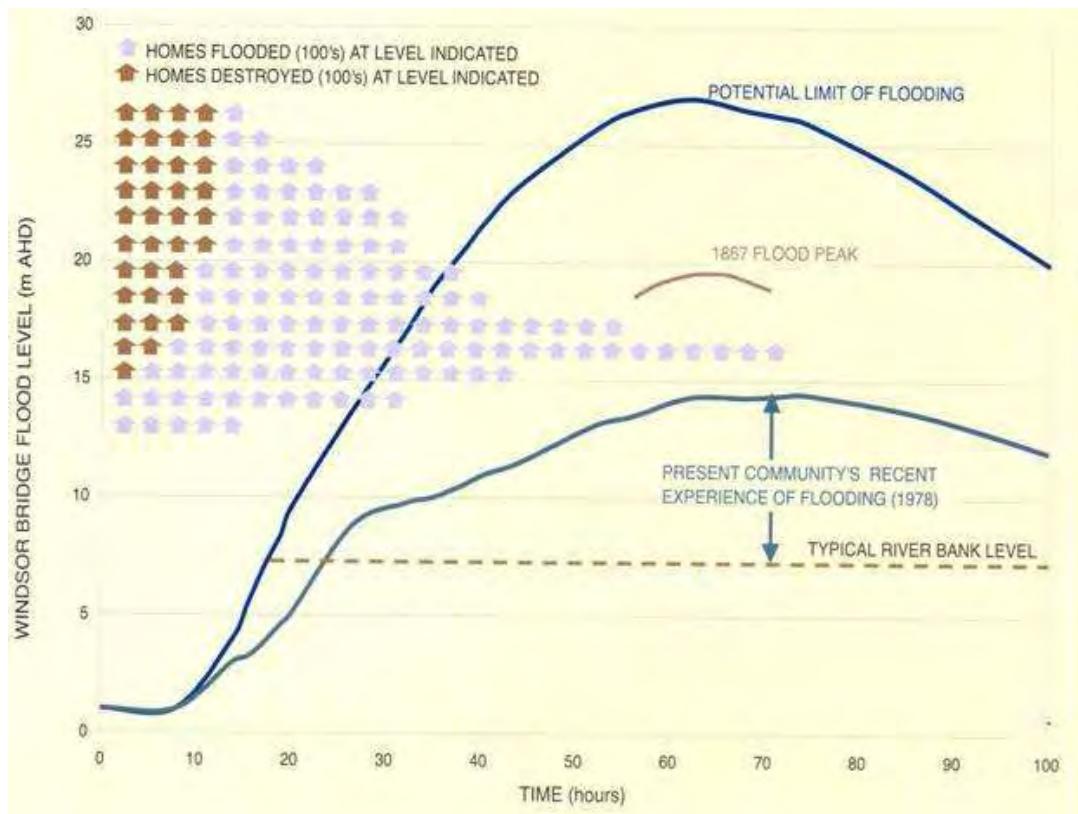
Figure 2 illustrates the problem. In 1863, the water level at Windsor on the Hawkesbury-Nepean catchment rose some 12.7 meters above its normal level in what is now considered to be about a 1 in 200 year flood. Appendix 1 describes that historical event. If such an event were to recur today, large numbers of homes built with planning approval just above the 1 in 100 year level would be submerged. There has been significant new development and infill housing since the survey shown in Figure 2 was undertaken. Attempts to restrict such development often results in the Council's decision being overturned in the Land and Environment Court (Steve Opper, NSW SES, pers. comm.)

Notwithstanding the above comments, there will exist a boundary within which most insurers will want to avoid doing business (and this may be different for different insurers having different appetites for risk and/or more sophisticated means of risk selection) and hence the use of the term *material* in point 4 of the previous section. Determining this threshold of materiality will require research and again FloodAus is a suitable tool to do this.

One way to avoid poor outcomes is to make any FIP a minimalist programme with high, but not unaffordable rates, high deductibles and low total, first tranche cover analogous to the \$100,000 limit used by the Earthquake Commission in New Zealand. This will



encourage homeowners to buy further insurance from the private market and opportunities for insurers to provide such cover.



**Figure 2:** Figure taken from a 1997 study for the Hawkesbury-Nepean Flood Management Advisory Committee<sup>12</sup>. There has been significant new development and infill housing in the floodplain since that study was undertaken.

Local councils must share some of the costs otherwise they will not be incentivised to reduce risks over time and engage in good land-use planning practices.

Many of the larger event losses will be the result of correlated flooding on multiple catchments. Insurers and reinsurers, like emergency managers, have to deal with the totality or concentration of risk. Thus while an individual is concerned about the threat to their own home, the insurer must be concerned about the magnitude of the event loss across many homes and perhaps across several different communities all of which may be flooded contemporaneously<sup>13</sup>.

<sup>12</sup> *Achieving a Hawkesbury-Nepean Floodplain Management Strategy, 1997*. A report prepared by the Hawkesbury-Nepean Flood Management Committee.

<sup>13</sup> State Emergency Managers face the same issues in respect of evacuation.



Determining this aggregation of risk cannot be simply derived from NFID or other such databases by just summing numbers of addresses threatened by a flooding at any given Annual Recurrence Interval. Rather we need to understand the likelihood of a flood on the Georges River, given a flood on the Hawkesbury-Nepean and vice versa, for example. FloodAus attempts to capture this phenomenon of correlated losses across multiple catchments.

To further illustrate the above point, consider the passage of an unnamed tropical cyclone that crossed the coast at Coolangatta in 1954 and then travelled southwards bringing heavy rainfall to northern NSW. Some areas had over 1,000mm of rainfall within a 12 day period. Springbrook, just inside the Queensland border had 900mm in 24 hours. The Nerang, Tweed, Brunswick, Richmond and Clarence catchments all flooded simultaneously. The Richmond catchment was the hardest hit with most towns experiencing their highest recorded flood waters (to this day!) including Lismore, Kyogle, Casino and Nimbin. Murwillumbah, in the Tweed catchment, also reached its highest recorded levels<sup>14</sup>. There has been enormous residential development in this area since 1954.

The current Annual Recurrence Interval terminology is confusing to many with a 1 in 100 year flood often interpreted as something that can happen only once in a 100 years. In reality this is the flood that on average has a 1% chance of being exceeded in any year. Over a 50 year lifetime, the probability rises to 40%.

Most people will find statistics like this goobledygook. Councils are no better in some cases with the Burdekin Shire Council categorising a flood as “rare”<sup>15</sup> if it *happens less than once in 30 years!*

## Building Codes

Historically there has been little regulation restricting the manner in which construction is undertaken in flood-prone regions. This is most prominently a problem for residential construction where builders and home owners often construct homes without full appreciation of their flood risk. Essentially, if local planning authority decides a particular allotment is suitable for residential construction, homes can be built there in the same manner as in less flood prone areas. This explains the widespread use of slab-on-ground

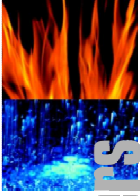
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<sup>14</sup>Roche, K., McAneney, K.J. and K. Chen,2011. The Great Australian Flood of 1954: cost of a recurrence. *Weather, Climate and Society* (in review).

<sup>15</sup>“Measures of Likelihood”

[www.burdekin.qld.gov.au/council/publications/other/localdisastermanagementplan/documents/Appendix6D-NaturalDisasterRiskStudyRevised2003.pdf](http://www.burdekin.qld.gov.au/council/publications/other/localdisastermanagementplan/documents/Appendix6D-NaturalDisasterRiskStudyRevised2003.pdf)





construction in many flood prone catchments. Some guidelines aimed at reducing home owner's risk have been developed<sup>16</sup>, but have not generally been mandated.

Construction of larger commercial and industrial buildings is somewhat different in that planning guidelines do not restrict construction of these buildings in high flood-risk areas but instead allow the building owner to accept this risk and/or build to mitigate it. No mandated construction standards exist in Australia to aid a designer in mitigating flood risk, but, in theory, if a designer is aware of any potential risk to life it should be accounted for in the design process. There is, however, no requirement for any type of construction to mitigate the risk to or extent of financial loss (direct or indirect) if life safety is not an issue.

In an attempt to rectify the absence of any regulated control over construction (largely residential) in flood prone areas, the Australian Building Codes Board, through the National Construction Code, is working to develop a design standard for building in these locations<sup>17</sup>. If approved, this document will provide guidelines for builders and designers to help mitigate the risk to life caused by building failure during slow-rising flood events. This document will NOT, however, aim to reduce financial losses during a flood event. This may occur by default in some instances, but is not an objective of the Australian Building Codes Board and will therefore not be reflected in its documents. Any regulated change to the way homes are built will also NOT be retrospective and all existing homes at risk of flood damage will continue to remain as such.

## Conclusions

To the degree that insurance can be a partial solution to the land-use planning problem, we concur with the NDIR Panel in advocating risk-based premiums: unless there is a market signal that acknowledges the real risk – however this be funded – there will be little incentive on the part of home owners or various levels of government to encourage mitigation practices and reduce the overall level of risk.

We are not certain whether or not a Flood Insurance Pool (FIP) is needed and so rather than propose a possible structure or its financing, we have suggested necessary constraints on any such scheme for it to be workable. In particular, any proposal taken up by government in response to the NDIR must over time act to reduce the numbers of homes at risk to flooding. Insurance should be seen as a means of risk transfer; it is not a substitute for risk management.

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<sup>16</sup>Hawkesbury-Nepean Floodplain Management Steering Committee,2006. *Reducing vulnerability of buildings to flood damage – Guidelines on building in flood prone areas.*

<sup>17</sup> <http://www.abcb.gov.au/index.cfm?objectid=7384D703-28B9-11DE-835E001B2FB900AA>

We have drawn attention to the absence of a simple solution to defining eligibility for a Flood Insurance Pool. An *engineering threshold*, to employ the terminology of the Issues Paper, that depends on a simple metric such as the extent of flooding for a given Annual Recurrence Interval (e.g. the 1 in 100 year flood) will not work as it deals only with the frequency of flooding at ground level and hence is not a measure of risk.

A *price threshold*, based on the non-flood premium also seems problematic, but a flood-risk premium based on a modelled loss using Risk Frontiers' proprietary FloodAUS loss model may be feasible.

Notwithstanding the above comments, there will exist a boundary within which most insurers will want to avoid doing business and hence the use of the term *material* in earlier discussion. We suggest NFID together and FloodAus as suitable tools for determining this *threshold of materiality*.

One way to avoid poor outcomes is to make any FIP a minimalist programme with high, but not unaffordable rates, high deductibles and low total, first tranche cover analogous to the \$100,000 limit used by the Earthquake Commission in New Zealand. This will encourage homeowners to buy further insurance from the private market and provide opportunities for insurers to provide such cover.

Also while an individual homeowner is naturally concerned about the risk to his or her home, an insurer or reinsurer has to deal with the totality of losses that may encompass entire communities over several different catchments. FloodAUS attempted to capture correlated losses on neighbouring catchments.

Any Pool introduced will need to create a mechanism for funding large losses or deficits that may arise in particular years on particular catchments – Brisbane, Northern New South Wales or the Hawkesbury-Nepean – or large losses in successive years. Funding this deficit should have a pre-determined priority ranking that includes contributions from those within the pool, local councils, insurers and Federal government. For very large losses a bond issue by the FIP might be necessary to amortise large payments or a succession of large payouts over several years.

In our view, local councils must share in these costs in order to incentivise risk-informed land-use planning practices. Any Pool that is implemented must have a mechanism in place to remove or retrofit flooded homes in order to reduce vulnerability to future floods.

There needs to be a shared responsibility on the part of homeowners and the various levels of government to reduce the risk. Incentives need to be aligned. Providing recovery grants following a disaster, as is the current policy, maintains the status quo and only increases the risks.

Some catchments pose particular risks. With this in mind, we recommend that the Panel visit the town of Windsor, NSW, in an effort to appreciate the extent of the problem

posed by this catchment and a few others. The appendix provides a brief description of the 1867 flood.

## Appendix 1: Flooding on the Hawkesbury-Nepean

This appendix describes an extremely severe flood in 1867 on the Hawkesbury-Nepean River caused by an intense East Coast Low Pressure System. This material is drawn from public sources and Risk Frontiers' PerilAUS database and was part of a study undertaken by Risk Frontiers for the NSW Department of Environment, Climate Change and Water.

The 1867 flood is significant in the history of the Hawkesbury-Nepean Valley as it remains by far the largest recorded since Europeans settled on the eastern coast of Australia. Although the Valley was far less densely settled in 1867 than at present, the effects of this flood would have been extraordinary even then.

Large areas were covered by water, including Emu Plains and Castlereagh, from Yarramundi to Pitt Town Bottoms, McGraths Hill and up the South and Eastern Creek valleys. Windsor, Richmond, Pitt Town and other settlements became islands surrounded by floodwaters. Parts of these and other towns, as well as most rural areas between the towns were inundated during the flood, which lasted for several days. Figure A1 shows the extent of the flooding.

The rain commenced on Tuesday, 18 June 1867, with the river breaching its banks on Thursday 20 June. The following is an excerpt from the *Sydney Morning Herald* published on 24 June 1867:

*"The flood in this district is said to be by far the highest which has occurred since its settlement by Europeans. The town of Windsor itself is almost entirely submerged, and the country for miles around is under water.*

*The expanse of flood is so great, that everybody is astonished at the tremendous accumulation of water, and it will seem incredible to all who have not actually seen it. Places which since the settlement of the colony, have never known to be flooded are now lost to view. The plain on which Windsor is partly situated unites with South Creek and Eastern Creek to form a vast inland sea over the surface of which when the wind has been high the broken crested billows roll with as much force and volume as they do during moderately squally weather in Sydney Harbour. A boat may now be taken through deep water from Riverstone to the Blue Mountains - a distance of about 15 miles; and from Hall's at Pitt Town to the Kurrajong - some twenty miles."*

The report goes on to give details of the heroism and tragedy of events surrounding this flood, including the deaths of 11 members of one family who were caught on the roof of their home by the rising waters.



**Figure A1:** Map showing the extent of the 1867 flood over the Hawkesbury-Nepean area. (Source: NSW SES, 2005<sup>18</sup>)

The flood was well documented because of its size, and peak levels were reported at several locations along the river. In Windsor, the best known record is on a wall in Thompson's Square. It is indicated by a plaque and is often referred to by local people whenever the question of 1867 floodwater levels is raised. However, the origin of the mark is unknown. Some other records are known to be of secondary sources, i.e. not derived from observation or debris marks, but transferred from other 1867 levels. For example, a plaque in the grounds of Windsor School states that the level was transferred from the mark in Thompson's Square. John Tebbutt recorded a level of 19.7 m AHD, about 0.3 m higher than the mark in Thompson's Square, and this reading is considered

<sup>18</sup> NSW SES, 2005. *Hawkesbury/Nepean Flood Emergency Sub Plan, 2005*. Hawkesbury/Nepean Flood Emergency Sub Plan, NSW State Disaster Plan (State DISPLAN).

the most reliable record. This is approximately 19.7 m above sea level, and flood water would have overtopped the deck of the existing Windsor Bridge by more than 12.7 metres. Water is estimated to have reached a height of 26.9m AHD at Penrith.

The peak inflow of the 1867 flood was approximately 40 per cent of the probable maximum flood at Warragamba (ERM Mitchell McCotter, 1995<sup>19</sup>). The water depth was about two metres higher at Windsor than the most recently estimated 100 year ARI event and about 30 per cent greater in volume.

This event is a good example of how real floods have various probabilities at different locations. Based on statistical analysis of flood levels at Penrith and Windsor, the 1867 flood had a 0.59% chance of occurrence per year at Penrith and a 0.36% chance at Windsor. At Camden it was estimated to have as much as a 6.7% probability of occurrence per year (Water Resources Commission, 1986<sup>20</sup>). These differences in flood peaks mainly arose from the distribution of rainfall across the catchment.

Meteorological data was not as widely available and exactly where the flood-producing rain fell is difficult to determine. Similar to other flood events on the Hawkesbury-Nepean River, this flood occurred as a result of an intense East Coast Low Pressure System (NSW SES, 2005).

Records at Camden indicate that the 1867 flood has been exceeded there on five occasions and the Upper Nepean was therefore unlikely to have been the main contributor in 1867. Reliable rainfall records at Windsor were unavailable but readings from surrounding areas show that falls were not outstandingly heavy east of the Blue Mountains (Bracewell and McDermott, 1985<sup>21</sup>). It thus appears that the Warragamba River and possibly the Grose River were the principal sources of the huge volume of water involved.

Newspaper articles clearly describe the high flow velocities and the speed with which the water rose, trapping people on roof tops and high ground. A large number of people became stranded because they were unaware of how high the floodwaters would rise. The following excerpt from the same 24 June 1867 *Sydney Morning Herald* report details the situation on the ground and the community's lack of knowledge concerning the potential flood risk at the time.

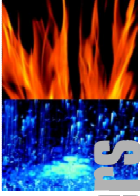
*“The volume of water has astoundingly increased since Thursday. On Friday many buildings in the town [Windsor] were in jeopardy and on Saturday the whole township,*

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<sup>19</sup>ERM Mitchell McCotter, 1995. *Proposed Warragamba Flood Mitigation Dam Environmental Impact Statement*. Prepared for Sydney Water Corporation.

<sup>20</sup>Water Resources Commission, 1986. *Chaffey Dam*. Report on Appraisal of Flood Security.

<sup>21</sup>Bracewell, M.G. and G.E. McDermott, 1985. *Report on the 1867 Flood*. Metropolitan Water Sewerage and Drainage Board, Sydney.



*excepting the two or three patches already named, was overwhelmed. The water rose very rapidly, and the inhabitants were in dread of being swamped altogether. Most of them thought that they would have to betake themselves to the Terrace, the nearest and most accessible town in the Blue Mountains. The water continued to rise slowly during the night, but at 5 o'clock yesterday (Sunday) morning it was at a standstill, and by 8 o'clock the water had gone down three or four inches."*

The Sydney Morning Herald report talks about the rescue efforts in Windsor carried out using four boats supplied by the government and Police and some private boats supplied by people in the district. People were taken from the upper windows, ridge poles and roofs of their homes and taken to safety. Continuing rising water meant that some people had to be evacuated for a second time.