

# Reconciling development with flood risks: the Hawkesbury-Nepean dilemma

## Introduction

The New South Wales (NSW) government has committed some \$58 million to the Hawkesbury-Nepean Floodplain Management Strategy over the five years to 2003. This substantial financial commitment reflects not only the magnitude of the flood risk but the need to find a regional solution to the dilemma of reconciling flood risk with the continuing settlement and demands for growth in Western Sydney.

This paper discusses the elements of the Strategy, which have particular reference to the management of existing and future development on the floodplain, and the assistance being provided to local government, (given that in NSW, the management of floodplain development is principally a local council responsibility).

## Why are the flood risks in the Hawkesbury-Nepean valley different?

### Topography and flood behaviour

The Hawkesbury-Nepean River is one of the major river systems of NSW with a catchment of 22,000km<sup>2</sup> stretching from Goulburn and Lithgow to Broken Bay. Warragamba Dam which provides 80% of Sydney's water supply, lies in the catchment (see *Figure 1*). Although 130km from the sea, the river is tidal to Windsor Bridge where the normal water level is only 0.8 metres above sea level.

This part of the eastern seaboard experiences irregular and unpredictable weather events. Exceptionally heavy rainfall over several days can lead to severe flooding in the Hawkesbury-Nepean River valley, basically because water flows into the valley at a far higher rate than it can flow out. The narrowing of the valley downstream at Castlereagh controls the flow of water between the wide floodplain at Penrith and the even larger floodplain at North Richmond and Wilberforce. The flow of water is restricted by the narrow gorges downstream of Wilberforce which act like a bottleneck and result in backing up of floodwater producing flooding

### Notes

1. A new auxiliary spillway has been built to move water around this water storage dam during extreme floods.

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much deeper than on a typical coastal river in NSW.

This backwater flooding can be extremely deep and it is the depth rather than the velocity that is the key component of the flood hazard in most areas. For example, in the largest flood of record in June 1867, floodwaters reached 19.2m Australian Height Datum (AHD) in Windsor—three metres higher than the majority of development there today and two metres higher than the current flood

planning level of 17.3m AHD. The probable maximum flood (PMF) will reach to 28.9m AHD or 11 metres above the planning level in Windsor (see *Figure 2*). Even with the new Warragamba Dam spillway<sup>1</sup>, a PMF will reach 26.4m AHD. Detailed estimates provided by Sydney Water shows that the PMF could cover an area of 300km<sup>2</sup>—completely inundating Richmond, Windsor, McGraths Hill and partially flooding Penrith, Emu Plains and Riverstone. Such a flood or smaller ones would cause untold devastation and potentially significant loss of life.

Along the Lower Hawkesbury beyond Sackville, where the floodplain and the channel are narrower, both high velocities and depth aggravate the flood hazard. Damage increases dramatically with increasing flood severity.

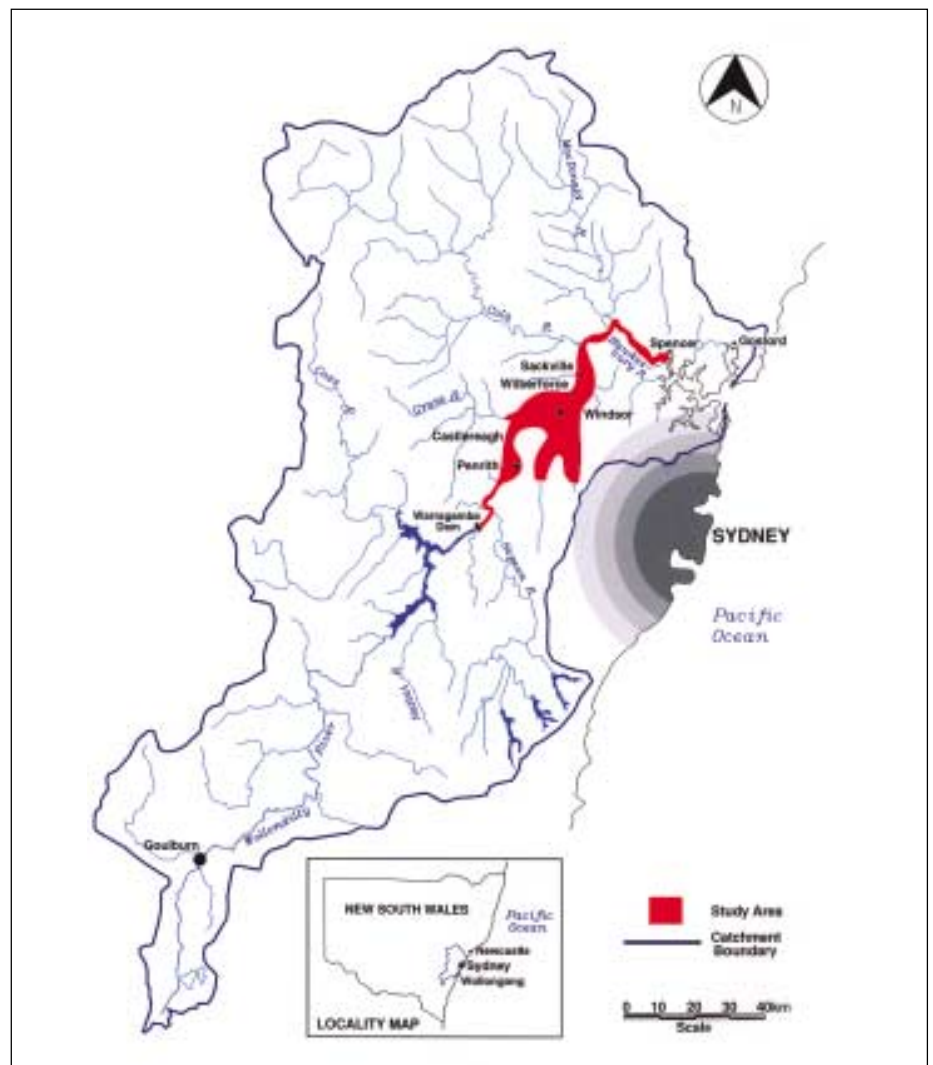


Figure 1: The Hawkesbury-Nepean Valley.

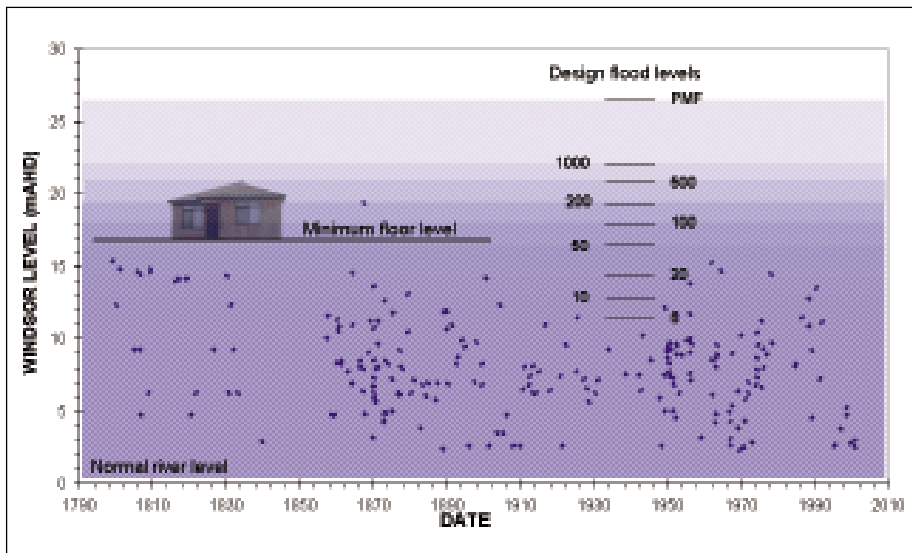
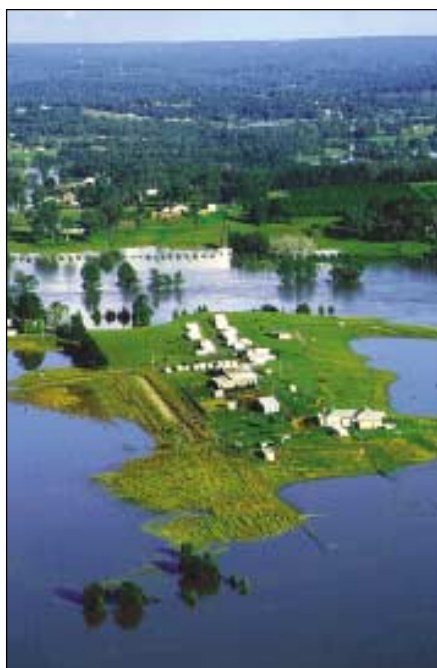


Figure 2: Hawkesbury River floods 1799 to 2000.



Many areas of the Hawkesbury-Nepean floodplain can become 'shrinking islands' as floodwaters rise, particularly during very large floods. This can occur not only in rural areas such as that shown in the above photo (during the 1988 flood) but may also include some populated urban centres. This is potentially a very serious situation given that these islands may themselves be completely overtopped, leaving the inhabitants with no safe refuge. Evacuation planning is therefore of critical importance.

### Established urban centres

Flooding of this magnitude is hazardous because of human occupation of the floodplain. The fertile soils of the Hawkesbury lowlands were recognised as a valuable resource by the earliest colonists. Being adjacent to the river was essential to the new settlers, as it offered a means of transport in advance of road and rail links. Even in 1810, Governor Macquarie recognised the flood risk although he seriously underestimated the scale of the

flooding problem (but then he did not have the benefit of today's technology). He required the first settlers to relocate on high ground in Windsor, Wilberforce, Pitt Town, Castlereagh and Richmond, out of reach, or so he thought, of the damaging floodwater.

Windsor and Richmond are now thriving urban centres although the river is now used for recreation not transport. A diverse economic base exists for an ever increasing, young population. Expansion in the 1980's and 1990's with the new suburb of Bligh Park has resulted in a total population of 35,000 in Windsor, Richmond South Windsor and Bligh Park. Parts of Penrith, Emu Plains and Riverstone are all major urban areas with growing populations. All are vulnerable to Hawkesbury-Nepean flooding. Protecting existing residents and their property is a key goal of the strategy.

### Isolation during floods

It is only in the last decade that the full extent of potential flooding has become known. A critical problem in the Hawkesbury-Nepean is the potential for the roads leading from Windsor, Richmond, McGraths Hill and Emu Plains to become cut by rising floodwater, leaving ever shrinking islands. Once a decision is taken to act upon a flood prediction, the emergency services mobilise and issue flood warnings and commence the evacuation. The safety of residents relies on an effective emergency evacuation going according to plan within extremely tight timeframes that give very little margin for error or delay. Evacuation planning for isolated towns has emerged as the most complex and by far most costly part of the implementation of the strategy. This is not only because of the

provision of numerous road upgrades but also the serious limitations on future urban growth due to constraints on improving the timeframe for implementing evacuation plans during floods.

### Metropolitan growth

Extensive tracts of land have been urbanised, often without the potential hazards and risks associated with mainstream flooding being addressed. Western Sydney remains a target for urban growth. Although Planning NSW promotes urban consolidation, there remains a need to find new 'greenfield' sites to meet housing demand.

### Lack of flood awareness—a critical problem

In general, the Hawkesbury-Nepean community has little awareness of flooding and few realise the potential scale or depth of the flooding. Unlike many coastal NSW floodplains that regularly experience extensive flooding, the floods of the Hawkesbury-Nepean that have occurred in the last 135 years, have not been severe and have therefore had little meaningful impact on the community as a whole—merely an inconvenience or a nuisance to affected individuals.

It is because the community lacks members who have had personal experience of threatening floods in the area, that severe flooding is perceived as a remote event which is easily dismissed or denied. Images of flooding in rural NSW are seen as someone else's problem and not applicable to metropolitan life. There has never been a 100 year flood recorded in the Valley—the largest flood on record, the 1867 flood was estimated to be a 250 year event in Windsor, but as in the rest of NSW, the 100 year event is generally used as the flood planning level. Above the 100 year level, it is assumed, wrongly, by the general community that the land is 'flood free'.

By not recognising the risk, the community is leaving itself very vulnerable indeed to the devastating social, economic and emotional impacts of a flood. The present community is ill prepared for a flood yet studies repeatedly show that communities recover better from a natural disaster when they are aware that the disaster can happen. To quote a Czech spokesman on flooding events on the Morava River in the late 1990's 'being unprepared is what floods forgive least'<sup>2</sup>.

### Organisational barriers

A further factor working against finding effective floodplain management solutions, is that there are six local government

areas downstream of Warragamba Dam affected by Hawkesbury-Nepean flooding. Applying the traditional model of floodplain management at the local council level has not allowed the full range of flood hazards to be addressed and it became apparent that solutions would only be found through a comprehensive regional approach. To address this very real problem, the NSW Government commenced the Hawkesbury-Nepean Floodplain Management Strategy.

### The Hawkesbury-Nepean Floodplain Management Strategy

In April 1997, the NSW Government established a community based Advisory Committee and work began on the Hawkesbury-Nepean Floodplain Management Strategy. For the first time the government addressed the need for a comprehensive floodplain management strategy designed to ensure the safety and security of people living in the floodplain.

The strategy is a regional action plan for dealing with flooding and floodplain management. Adopting the strategy in 1998, the government committed \$58.4 million over five years to implementing its recommendations. State government and councils, to ensure that flood losses and damages are kept as low as possible, have adopted a cooperative approach.

The strategy consists of a number of key components, one being to finalise the Regional Floodplain Management Study (RFMS) through the following tasks:

- prepare and implement a detailed evacuation infrastructure program
- prepare best practice floodplain management methodology in the Valley, including:
  - best practice land use planning guidelines
  - best practice subdivision guidelines
  - best practice building guidelines for use by councils, planners, developers, builders and others involved in the development process.
- prepare and implement a tailored regional public awareness program to ensure that community members and those in authority are able to make informed decisions about living and working in the floodplain
- ensure that critical utility service providers and government agencies have the information necessary to prepare flood recovery plans.

#### Notes

2. Ministry of Environment of the Czech Republic, 1998, *Flood—An Evaluation of the July 1997 Flood Events in the Czech Republic—Film Supplement for the Czech Hydrometeorological Institute.*

The remainder of this paper discusses current work towards the preparation of land use guidelines for future development and redevelopment. In developing these guidelines, a principal question to be considered is 'how can a homeowner or home purchaser recover financially from the losses caused to home and contents from flooding?' To answer this question, two studies have been undertaken to assess firstly the community's attitude to risk and secondly the ability of homeowners to recover from the

financial losses associated with a flood. Both studies have examined those purchasing or owning their own home. This is firstly because western Sydney has traditionally provided 'affordable' housing for first time home buyers, and because such family groups appear to be particularly vulnerable to flood losses, given high levels of mortgage commitment and the general lack of availability of flood insurance. A third study has examined the house price impacts of flood notifications on Section 149 certificates.



The City of Wollongong, in NSW, received disastrous flooding in August 1998. Excessive runoff from the adjacent escarpment produced significant inundation problems on the numerous small creeks and watercourses that traverse the established urban areas of the city. In particular, debris in the form of rocks and boulders, vegetation, cars and other household items caused blockage of numerous culverts and small bridges. This debris exacerbated inundation problems. Recent studies have identified that many of the city culverts were virtually fully blocked during the flood. This debris problem, and the additional inundation resulting from it, placed unexpected demands on the local SES personnel.



The morning after the August 1998 flood in Wollongong NSW.

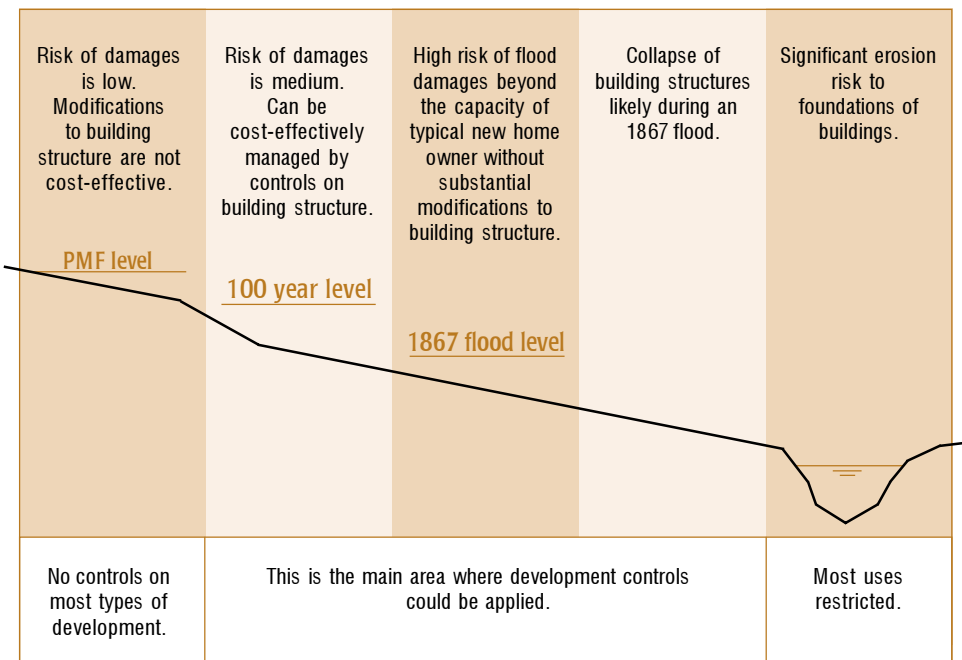


Figure 3: Draft planning controls under consideration

### Survey and analysis of community attitudes to flood risk

This survey determined and compared:

- the attitudes to risk held by the present community living on flood prone land in the Valley
- future migrants to the area
- selected communities within the metropolitan area who either had or had not experienced a natural disaster.

The work has been undertaken for the Hawkesbury-Nepean Floodplain Management Strategy Project Team by GHD Pty Ltd and Cox Consulting Pty Ltd. The findings indicate community support for more effective controls on development in high hazard areas and an *expectation* that a high level of protection by authorities already exists. It reveals that a majority of households in all groups believe they have a limited ability to finance flood losses from their own resources. Only 30% of first time home-buyers in the PMF area believe they can find more than \$10,000 from their own resources. Households stated they would be willing to pay 10% more for house (\$20,000 on a \$200,000 house) if it was built to a standard that offered protection from flood damages. Interestingly, most respondents were willing to pay relatively significant proportional increases in their existing home and contents insurance premiums to obtain increased peace of mind through flood insurance (if it was available).

### Household financial flood risk investigation

This study, undertaken by the Department of Actuarial Studies, Macquarie University,

has provided objective projections of the financial impact of flooding on a variety of typical owner-occupier households living in the Strategy area. The findings reveal that households with lower incomes and lower levels of savings prior to the flood occurring, take longer to recover financially. Given the high prices of houses in the Sydney metropolitan region, dual incomes emerge as an important factor in ensuring a household's successful recovery over time. In households where there is only one wage earner, e.g. a one-parent family, a lone person, or if one partner becomes unemployed following the flood, the household is extremely vulnerable to any financial downturn. A flood of any size shortly after buying a house or close to retirement would have a very serious impact on the lifestyle of the family.

### Valuation study

A study has been undertaken by Egan's National Valuers addressing the matter of house prices in relation to flood notification on Section 149 certificates<sup>3</sup> in the Blacktown, Penrith and Hawkesbury council areas. The study concluded that general lack of understanding and awareness about the nature of flooding in the Hawkesbury-Nepean Valley has led to a state of confusion and misinformation within the real estate industry and hence within the buying public. The study reinforced the need for an effective and sustained public awareness campaign. The robustness of the residential housing market is such that individual property characteristics (presentation, state of repair, location etc.) were stronger determinants of price than flood notification.

Using a bushfire affected suburb in the Blue Mountains for comparison, they concluded that whilst an actual flood event would have a short term effect on lowering prices, this would be unlikely to have a long term effect as collective memories of disasters fade, are down-played by vendors and ignored by purchasers who, in a buoyant market seek to buy regardless of apparent contra-indications.

### Land use guidelines

The preparation of these guidelines is currently underway and is a key output of the strategy. Their principal aim is to assist each council to adopt planning controls, which respond to the flood hazards in their area and to the needs and wishes of the local community. Management of the flood risks above the planning level needs to be a relevant consideration in reaching planning decisions. The 1867 flood is an uncomfortable reminder of the reality of this risk, given that it would inundate some of the existing development by over one building storey.

In most NSW floodplains the 100 year flood level may be an appropriate planning standard because of the relatively small differences between the 100 year flood level and the PMF level. In this floodplain however, there are many urban areas where there can be one storey in height difference between the flood planning level and the 250 year event and four storeys to the PMF. In these towns alternative approaches are essential to protect people and property from the impacts of larger floods. Regrettably, impacts of larger floods have generally not been addressed at the planning stage of the development process for land lying above the 100 year flood level.

Little consideration has been given for the hazard to life and property caused by the particular characteristics of flooding, or for related issues such as isolation because of flooding in the local area. The risks and hazards associated with all levels of flooding, particularly the continuing risks of events more severe than the adopted planning standards, are difficult to address fully in the valley. Property damage and disruption to urban infrastructure may also be unnecessarily increased because opportunities to reduce these losses are not recognised in the planning and development processes. The strategy's digital flood data display tool<sup>4</sup> linked to councils' GIS will assist in informed

decision-making. Given the extent of urban development, the lack of household flood insurance adds to the vulnerability of residents. Research for the building guidelines (other work currently underway) has demonstrated that the depths to which dwellings will be inundated or the forces to which they will be subjected in various floods, will potentially lead to serious damages which would be every expensive to rectify. Total loss of the building and its contents may occur, depending on the severity of the flood event, the house type and its location.

Many families in the process of buying their home have large debts and few assets. The financial study discussed above has identified that loss of, or severe damage to, the dwelling and its contents may result in families dropping below the poverty line. Renters will have different losses but will nonetheless suffer hardship. Social well-being is closely linked to financial security and stability. The scale of potential suffering would be catastrophic in both social and economic terms, from which it would be very difficult to recover in the short term. On a societal basis, there would be tremendous pressure placed on welfare agencies and public donations to provide restitution and to manage the subsequent trauma. The risks borne by the residential sector of the community when floods greater than the design flood occur, are unquantified and largely unrecognised by the individual residents, institutions, agencies and companies involved in the residential property market. Individual households would have a potentially unmanageable burden to bear solely. It is believed that the community (both residents and decision makers) perceive the risk of flooding above the 100 year level to be low even though compared to other risks there is a high risk of its occurrence. This low perceived risk influences the community's willingness to modify its decisions in relation to the floodplain.

Based on the above studies, preliminary land use controls such as those summarised in *Figure 3*, are being developed for consideration by local councils.

### Summary and conclusions

- People are prepared to pay more for housing that incorporates measures to reduce unaffordable damage bills after a disaster.
- Flood damages to houses could potentially place an unsustainable financial burden on individual households.
- Householders are prepared to pay for flood insurance to get peace of mind.



Flood boat operation by the Kempsey NSW, SES unit. Because many areas of the Hawkesbury–Nepean become 'shrinking islands' as floodwaters rise, early evacuation of the urban population by road is essential to avoid the need for rescue by flood boats and helicopters.



In order for the majority of people from the Hawkesbury–Nepean Valley to be safely evacuated at the onset of a major flood, it will be necessary for them to reach the regional evacuation roads in their cars. However to reach these regional routes, they will need to negotiate various local roads which may themselves be cut by flooding.

- House prices are unlikely to be adversely affected by improved public awareness of flood risk.
- There are very real limitations to growth in parts of the Strategy area. This is particularly the case where that growth would result in increased numbers of households requiring evacuation from isolated towns, beyond those being serviced by the Strategy.
- There is a crucial need to raise public awareness of the range of flood risks. This will enable those in authority and the community to make informed decisions, based on knowledge of this natural hazard. During a flood event, this

increased awareness will help elicit an effective response, will be less socially

### Notes

3. A Section 149 certificate is a certificate issued under the NSW Environmental Planning and Assessment Act 1979. It is issued by a local council, usually to a vendor or prospective purchaser of land, in respect of a parcel of land and specifies the applicable planning instruments and policies including any restrictions on the land. In the context of floodplain management, if council's policy relating to flood prone land applies to the land, this would be stated on the certificate.

4. This computer software package has been produced for the strategy by consultants and will provide the means to link hydrodynamic flood modelling results with GIS layers such as cadastre, property data, aerial photographs, flood emergency intelligence data, etc.

disruptive and will aid the recovery process afterwards.

- As the community perceives flooding to be a low risk, it has not as yet demanded a higher level of flood protection through planning and building controls. However, the community expects authorities to regulate for damage arising from natural hazards and indeed, controls have been in place for many years for fire, earthquake and cyclone, through appropriate building codes. A flood-aware community would expect similar protection from damages arising from that other natural hazard—flood. Through the Regional Floodplain Management Strategy, best practice guidelines will include land use planning, development and building controls which seek to manage the range of flood risks above the 100 year flood level to reduce flood losses and property damage. The guidelines will be available for councils to use when formulating their local floodplain policies and plans in order to meet these valid community expectations.

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This article has been refereed



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