

# Towards better practice: the evolution of flood management in New South Wales

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## Summary

This paper examines the evolution of flood and floodplain management in New South Wales, focussing on the growing range of management strategies employed and the increasing integration of the efforts of the numerous stakeholder parties. Specific emphasis is placed on the role of the State Emergency Service and its efforts in recent years to improve its own preparedness for flooding and that of flood prone communities generally.

## Introduction

In Australia, flooding is the most serious natural hazard which the community faces. Only heatwaves of all the natural perils have killed more people (Blong, 1), and no other hazard agent contributes as much to the dollar cost of disasters, estimated a few years ago at an average annual value of \$1.25 billion (Joy, 2). In all, floods account for about a third of this (Australian Water Resources Council, 3).

The problem of flooding is especially acute in Queensland and New South Wales. In New South Wales alone the average annual cost of flooding – stormwater and mainstream, urban and rural – has been put at some \$150,000,000 (Emergency Management Australia, 4). More than 100,000 urban properties in the state are believed to be at risk of inundation in 1% AEP (Annual Exceedence Probability) flood events, and to this number must be added an unknown but large number of rural properties which are similarly exposed. Literally dozens of towns and villages have flood liable land, and many are built entirely on floodplains as are a number of the suburbs and dormitory towns of Sydney.

Given the impacts of flooding on the community and the economy, it is not surprising that there have long been attempts to mitigate its effects. This paper chronicles the increasing formalisation and comprehensiveness of responses to flooding, noting the widening range of flood and floodplain management initiatives which have been undertaken in flood liable areas and the increasing level of integration of agencies in the treatment of the flood hazard.

## A brief history of flood management in New South Wales

Virtually from its origins in 1788, European settlement in New South Wales was at risk from the flood hazard. For reasons of transportation, proximity to water supplies and the availability of fertile soils, the settlers focussed on floodplains and river banks. The dangers of this focus became apparent early, with repeated flooding of farm properties and the towns which had grown up to serve them, and in 1810 the colonial government reacted to the damaging effects of flooding along the Hawkesbury River by proclaiming five sites for urban development on high ground supposedly out of flood reach. These were the 'Macquarie Towns' of Windsor, Richmond, Wilberforce, Castlereagh and Pitt Town. Ironically, these sites are not all flood free after all: a devastating flood in 1867 drowned the site of Pitt Town and Windsor was also close to being submerged. We now know that Richmond and Windsor, the largest Macquarie Towns, would be completely submerged in floods well below those of Probable Maximum Flood (PMF) proportions.

As settlement spread beyond the Sydney basin during the nineteenth century, nascent urban development was periodically overwhelmed by flooding and communities sought relief. Before the end of the century a number of towns, including Bega, Nowra, Moama and Gundagai, had been relocated to less flood liable sites. Farmers, meanwhile, were beginning

to construct levees to control flood waters, and there were also cases of substantial embankments being built to protect towns as floods approached. Sometimes these levees failed, with serious consequences.

Other responses were the precursors of modern flood warning, rescue and resupply efforts. Nineteenth and early twentieth century flood warning activity included the passage of 'flood signals' (daily river height bulletins) by telegraph, newspapers and eventually radio to the masters of steamers plying the larger rivers, along with the radioing or telephoning of flood heights and general predictions to people in communities in the path of flood waters. These 'systems' were largely informal in nature, reflecting local needs and local resourcefulness, and they were managed co-operatively as a result of the activities of farmers (the usual creek and river readers), postmasters (who controlled the telegraph or telephone transmission) and police (who sometimes organised doorknocks in the low-lying streets of towns expected to experience inundation). Over time, some of those involved in warning of impending floods became highly knowledgeable about their rivers and developed considerable expertise in the prediction of river heights and flow times despite their lack of scientific training (Keys, 5).

From early times the colonial government was pressured to help in the flood management effort by providing flood boats, usually operated under the control of local policemen or other prominent citizens who took responsibility for their maintenance and operation. In due course, beginning in the 1870s, several communities formed volunteer 'water brigades' whose objectives were "to save life and property in time of flood" using large rowing boats (Lewis-Hughes, 6). The brigades sprang up on most of the coastal rivers from the Hawkesbury on Sydney's outskirts to the Richmond in the far north. In doing so, they gave a sense of organisation to the rescue of people and livestock and the resupplying of people who were marooned by flood waters.

Community self-help initiatives like the water brigades, the local flood warning activities and the construction of levees to protect farm lands and towns were well established by the early years of the present century. In all probability these efforts were weakened for some decades after about 1900 by a relative paucity of flood events but disastrous flooding in many parts of the state between the late 1940s and the mid-1950s saw a renewal of interest in flood management. In these few years there was a series of record and near-record floods on several of the state's rivers resulting in considerable death tolls, the destruction of many houses and colossal damage to urban infrastructure and regional economies. The 1955 flood on the Hunter River alone resulted in some \$500,000,000 damage in 1998 dollar terms (Emergency Management Australia, 4).

The legacies of this period of frequent, severe and widespread flooding were several. They included the formation of the State Emergency Service, the entry by the Commonwealth Bureau of Meteorology into the field of flood prediction, and the beginnings of systematically planned engineering works sponsored by the state government and replacing the often ill-considered levees built during previous decades. From this time onwards there was to be a strong government and agency focus on the management of floods.

The ensuing four decades has seen an expansion of the scope of flood management in New South Wales. As the network of gauging stations expanded and histories of flooding were built up, the Bureau's forecasting system included more and more rivers to the point that by the 1990s all the major rivers were covered and formal height-time predictions were made for some 150 separate locations during times of flooding. Floodplain management initiatives, involving partnerships between state and local governments and at times a considerable injection of Commonwealth funding, have resulted in large numbers of flood studies being conducted, numerous towns being afforded physical protection against flooding and a growing range of non-engineering approaches being utilised in the mitigation of the effects of flooding. These have included the discouragement of development in flood liable areas, the raising of dwellings above flood reach and the buying out of properties located on

floodplains. As a result of the state's floodplain management program, local councils have been able to attract funds to help in the management of their flood problems. At the same time they have had a mechanism to protect themselves against development interests seeking floodplain development at any cost and a measure of insurance against lawsuits from people alleging breaches of duty of care in land management decisions.

### **Flood management in an emergency management context**

Floodplain management activities, of necessity, are carried out **between** floods rather than during them. Much needs to be done when flooding is on the way and actually occurring, however, and the leadership of this 'real-time' work falls to the State Emergency Service. The nature of the SES's role, and the way it is met, have evolved considerably since the organisation was founded.

The State Emergency Services, as the agency was first known, was formed in 1955 as a grass roots volunteer organisation to lead and co-ordinate community responses to flooding and to take up the civil defence role at the height of the Cold War. Other functions were added later. For some time the SES's role was defined not by law but by a simple and vague charter, and its flood-related activities were largely confined to response during the actual **occurrence** of floods – that is, to evacuation, rescue and resupply functions and to tasks such as sandbagging. Even the first SES Act, which was proclaimed in 1972, failed to modify significantly this relief or response bias in the organisation's activities. The Act gave the SES few clear responsibilities and no power to co-ordinate the activities of other agencies in relation to flood management. There was no authority to compel other agencies, including local councils, to participate in flood planning activities, and no encouragement was given for the SES to become involved in the management of development on floodplains.

This isolation and the bias towards real-time response actions had a number of consequences. Warning practices were not always clearly focussed on the needs of end-users (the flood prone communities), detailed evacuation planning was lacking even in areas where floods could be seen to be highly dangerous in terms of potential injury and loss of life, and little attention was given to the question of raising flood awareness and ensuring that the residents of flood liable communities understood and were prepared for the threat of flooding. Moreover, there was little emergency management input to the technical studies which were commissioned on flood problems. The studies therefore failed to address matters such as the mounting of significant evacuation operations under what are often difficult and dangerous conditions and sometimes involving severe time constraints.

In short, rigorous conceptualisations of the emergency aspects of community flood problems were rare and the development of well-considered emergency management strategies was accordingly limited. Responses to floods reflected this situation, things being done not when they could be done with maximal effectiveness and safety but when they **had** to be done (and perhaps when the danger was at its greatest). Risks were no doubt taken with people's lives, and time was used ineffectively with the result that some tasks were attempted or carried out to a more limited extent than might otherwise have been possible.

In 1989, a review of the SES was carried out and the organisation was criticised for the narrow and restricted nature of its approach to flood management. In particular there was criticism that insufficient attention had been given to **preparing** for floods before they actually struck. The SES was restructured and a new Act – the State Emergency Service Act 1989 – was proclaimed, requiring the organisation to "act as the combat agency for dealing with floods (including the establishment of flood warning systems) and to co-ordinate the evacuation and welfare of affected communities". For the first time, the SES was unequivocally declared as the agency responsible for the management of flooding and given the task of co-ordinating the activities of other agencies to that end.

The implementation of the new legislation forced the SES to bring preparedness activities to the fore and to focus on planning with other agencies for the times when floods occur. The result has been a major thrust towards flood planning which incorporates the development of the warning, evacuation, information-providing, rescue, resupply and property-protecting tasks and, increasingly, initiatives to raise community awareness of flooding. A decade after the proclamation of the SES Act, flood plans have been prepared (and in many cases revised on several occasions) for all flood prone communities in the state and for all potential types of flood threat whether riverine, lacustrine, oceanic or resulting from dam failure. Each of these plans incorporates statements about the responsibilities which particular organisations – local councils, agencies of government, community-based groups and in many cases private companies – have agreed to carry out during times of flooding. Some of the plans include more than forty such organisations.

Negotiating responsibility for the carrying out of particular flood-related tasks is one of the ways in which the SES integrates its activities with those of other organisations in the interests of improved flood management. Another can be seen in the context of the development of 'flood intelligence'. In the past there were only piecemeal efforts to record the consequences of flooding at different heights, and as a result little information was generated that was helpful to those managing later events. Nowadays, the SES pursues the improvement of flood intelligence with vigour, scouring council records and flood studies for information which will help ensure that the likely impacts of coming floods can be foreseen before they are actually felt. The data is collated and stored to support the flood planning effort and to facilitate later response decision making and the provision of warning information to the public. In addition, efforts are made to ensure that the consultants engaged to conduct flood and floodplain management studies pay attention to the development of flood intelligence in support of tasks such as the provision of warnings and the management of evacuations.

The result of studies such as those produced by Water Studies Pty (7) on the flood problem at Grafton (on the Clarence River) and the Hawkesbury-Nepean Flood Management Advisory Committee (8) on flooding on the Hawkesbury River is that more and better information is available on which to plan flood responses, to warn communities and to undertake large and complex evacuation operations. In particular, it has been possible as a result of these studies for the SES to comprehend the time constraints which can be critical in many circumstances and to identify more clearly the resources needed to undertake major evacuation operations. The Hawkesbury-Nepean study has also highlighted the severe problem posed by inadequate evacuation routes and has led to a major program to raise the level of flood security of roads out of Richmond and Windsor. When this program is completed, in 2003, much more time will be available to effect the large-scale evacuations which are inevitable in rare but very severe floods. In recent decades, during which the valley has experienced considerable population growth, such operations simply could not have been mounted successfully. The potential for large-scale loss of life as a result of people being trapped by rising flood waters has only recently been fully appreciated.

The potential for dam-failure flooding is also addressed in the planning. Some thirty dams, large and small, have been found by the New South Wales Dams Safety Committee to be 'deficient' and liable to failure. Because the problems created by dam failure are likely to be very different from those generated by 'normal' flooding, special warning systems and evacuation arrangements have been devised and written in to the plans after discussions with relevant dam owners on potential modes of failure, the time likely to be available to act after concerns are first felt for the dam's integrity, and the area which can be expected to be inundated should failure occur.

Efforts are also being made to improve the quality of flood warning services. These are planned, in conjunction with the Bureau of Meteorology and other agencies, via the state's Flood Warning Consultative Committee which seeks to better define the warning task and

the means by which warning services can most effectively be delivered to communities. Improvements are being sought by carefully defining client groups, identifying the actions which people will need to take before floods strike (and the amounts of time required to complete these actions), and determining the best means of disseminating warnings to different clients at varying levels of flood severity. None of these activities has been dealt with systematically in all flood prone areas of the state in the past, and consistent quality in warning processes could therefore not have been achieved. Even simple warning devices like telephone trees were not as widely used as they could have been, and liaison with radio stations over the carriage of warning information was uneven.

One further area of inter-agency interaction in matters relating to flooding should be noted. Local government councils, as consent agencies in matters relating to the use of floodplain land, periodically require expert guidance on emergency management matters relating to rescue and evacuation problems in areas which are the subject of development applications. The SES now provides this advice frequently, to the extent of appearing in court on behalf of councils defending decisions made on public safety grounds about the utilisation of flood prone land.

Interaction with flood prone **communities** is also being pursued. Conscious attempts are being made to engage members of the public to ensure that they are educated about flood problems, their management by the SES and other agencies, and the vital role that individuals must play in their own interest by protecting their property and behaving in ways that will help ensure their personal safety. The goal here is to encourage people to become 'flood smart' and to be their own flood managers, recognising the flood problem beforehand and working out what it will mean to them and how they should deal with it as well as knowing where to go for help.

Public meetings on flood problems and their management have been held, where possible in association with commemorations of record or well-remembered floods, and locally-tailored flood action guides have been produced. These identify the nature of the flood threat in particular areas and note such things as the gauge heights at which problems occur (such as the cutting of roads and the overtopping of levees) as well as providing advice on how these problems can be managed at the level of the individual household. Eventually, these customised guides will replace the generic material which has had to suffice for many years. Beyond these endeavours, flood plans are routinely placed in the public domain, in council libraries and elsewhere, and efforts are made to publicise them – for example by publishing excerpts in local newspapers.

The range of tasks which the SES now seeks to meet in its flood management role is very broad. To do all this work requires that SES volunteers, who are not hydrologists, flood planners or social marketers, become genuinely expert in the management of flooding and able to communicate about it with the personnel of other agencies and with members of their communities. This is not easy, given the relative infrequency of flooding in particular areas and the consequent lack of opportunities to practise and to learn. Building such expertise 'synthetically' is a difficult and time-consuming task carried out in management briefings at SES conferences, at meetings with small locally-based planning teams, and during formal flood exercises. Guides on aspects of the task will also be helpful: a series of documents has recently been prepared under the sponsorship of Emergency Management Australia to cover the principles of floodplain management, flood preparedness, flood warning and flood response. These guides represent the collective wisdom of the present generation of Australia's flood managers and are intended to provide best-practice advice on the central elements of managing floods (Emergency Management Australia, 4,9,10,11). In-house guides produced by the SES on themes such as working in an operations centre fulfil a similar function. All this material is intended to foster a learning organisation which practises and exercises for floods and becomes increasingly expert in their management even though nature provides only in frequent opportunities to gain experience.

## Discussion

Half a century ago, the management of Australia's most serious natural hazard was very largely a matter of community self-help. Science was not brought to bear, there was little or no prior consideration of potential ways of handling flood problems, and government was barely active except in after-the-fact relief endeavours. Over the intervening period all this has changed with the formal application of science, technology and management expertise to the solution of the problems which flooding poses. Most importantly, many agencies of government are now involved in preparing for and managing floods and there are means of ensuring that the tasks are properly defined, solutions to foreseeable problems are identified and agency efforts are appropriately integrated. Along the way the SES, once isolated from other agencies and seeing its role as being confined to real-time response activities, has become involved as a central player with a much wider brief than formerly and a need to integrate its endeavours with those of other organisations. This is necessary because effective real-time flood management is not possible without sound planning and carefully considered interaction with other agencies and with the wider community.

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**Presented at the Australian Disaster Conference, Canberra, 111-116, 1999.**