

State Planning & Response to Flooding

Presented to the Flood Impact Conference, Sydney NSW Australia, 14-15 June 2007 by Stephen (Steve) Oppen ESM, Director Emergency Risk Management, NSW State Emergency Service.

The NSW State Emergency Service is the legislated Combat Agency (lead agency) for the emergency management of floods in NSW. The Service manages a state-wide flood planning and community education program which aims to have practical flood response management plans and flood awareness strategies in place for all communities that are exposed to flood risk. No matter how well resourced an organisation might be, it is not possible to work on all projects concurrently. To manage the scale of this task across the entire state the Service applies a risk-based project management process to prioritise the planning and associated community education. To inform this prioritisation the SES has developed some flood-specific risk assessment tools. These tools and their application are briefly discussed in this paper.

NSW Emergency Management

Emergency management in NSW was significantly re-vamped in 1989 with the advent of the State Emergency and Rescue Management Act (SERM Act). The SERM Act established a clear and well structure planning hierarchy based around the concept of Combat Agencies. A combat agency is the designated agency with the responsibility for leading the planning and response to the hazard or hazards assigned to it. This allocation of hazards to agencies is mapped out in the NSW State Disaster Plan (NSW DISPLAN) and in the case of the SES the hazards are: flood; storm (including coastal inundation and erosion); and since late 2006, also tsunami.

The NSW DISPLAN is a generic plan setting out the general principles of emergency management across all hazards. There is a peak emergency management body called the State Emergency Management Committee (SEMC) comprising representatives of all key NSW Government emergency services and agencies with a role in emergency management. To support the implementation of the NSW DISPLAN the SERM Act requires complementary committees and DISPLANS for the 18 emergency management districts in NSW and for each local government area (LGA). In practice there has been some consolidation at LGA level where in a few instances, neighbouring LGA's have formed a single committee produce a single DISPLAN.

NSW DISPLAN specifies that where a Combat Agency has been designated for a hazard, then that agency is responsible for leading the planning for the emergency management of the hazard and will also control the overall response to the hazard. The logic here is that hazards are best dealt with where a degree of specialisation is developed to create a focus or champion for the management of that hazard. There is no Combat Agency for earthquake or landslide because, at this point in time, there is no predictive capability for these hazards. The response is an event-specific multi-agency rescue/recovery operation lead by the relevant State, District, or Local Emergency Operations Controller.

The plans prepared by a Combat Agency under the provisions of the SERM Act are referred to as Sub-Plans of their respective DISPLAN. There are State Sub-Plans, District Sub-Plans, and Local Sub-Plans. There may also be a requirement for other plans to manage specific functions in support of a Sub-Plan. An example would be a special plan to manage the welfare of people evacuated during floods. This type of plan is referred to as a Supporting Plan. The major functions are also identified in DISPLAN and responsibility is allocated to a Functional Area such as for example, the Welfare (human services) Functional Area (lead by Department of Community Services) and the Transport Services Functional Area (lead by the Department of Transport).

In the case of the SES there is complementary legislation in the form of the State Emergency Service Act (SES Act) which was also fully revised in 1989 from an original 1974 Act. The SES Act specifies that the Director General of the SES is required to undertake such planning as he/she believes is necessary in order to ensure that the SES can fulfil its responsibilities under the SES Act.

Unlike the situation pre-1989 in which the SES had no clear authority to undertake planning, despite a general expectation that this would be done, the SES Act 1989 (as amended) gives the SES the legal authority to compel other agencies and organisations to join and contribute to the planning process. It is noteworthy that the SES has never had to exercise such a blunt authority to obtain the cooperation of other parties.

Flood Emergency Management

Emergency management for floods is covered under a suite of plans developed by the SES and sitting under the top level State Flood Sub-Plan. This is essentially a document of policy and principles that guides the emergency preparedness for, response to, and recovery from floods in NSW. The SES has 17 Regions in NSW and, by virtue of the historical development of the SES post the 1955 Hunter valley floods, their boundaries are somewhat aligned geographically to the major river catchment boundaries. There is one Regional Flood Sub-Plans for each of these Regions. At the next level of LGA's the SES has developed 145 Local Flood Sub-Plans since 1990.

The Service aims to have a flood plan for each community that has a flood risk. In practice the Service has given priority to communities with a known or obvious riverine flood problem. Flash flooding caused by severe weather events can also affect a large number of communities but the Service does not have the technical hazard data or human resources to attempt producing a flood plan for every community that can experience flash flooding. There are some notable exceptions where the flash flood problem is a very high risk such as Coffs Harbour and Wollongong, and flood plans have been written to cover these flash flood environments.

Coastal inundation from elevated sea level resulting from deep low pressure systems (storm surge) is also an area that does not fit easily into the flood planning context nor do the flood-like characteristics of tsunamis. The Service is currently developing the concept of coastal hazards sub-plans to deal with these risks and storm induced coastal erosion also fits neatly into this new model.

In its planning work the SES has adopted a risk management model based on the industry standard AS/NZ 4360 Risk Management. Under the leadership of Emergency Management Australia (EMA 2004) the national emergency management community has developed an industry specific application guide to fine tune the AS/NZ4360 into what is termed the Emergency Risk Management process or ERM. The ERM model is endorsed by Standards Australia as a valid interpretation and application of AS/NZ4360. ERM has now been endorsed by the NSW SEMC as the basis for all emergency planning.

Underpinning ERM and the SES's flood planning work and operational response is the need for high quality information about the nature of the flood hazard and the potential impact (consequences) on the community. The SES maintains a Flood Intelligence System (FIS) in which is recorded the consequences of flooding by reference to the expected height of rivers at various key flood warning river gauges. Much of the original content of the FIS has originated from historical records of past floods. While this is a good starting point it creates a serious deficiency in the FIS in that the system would have no information on floods that could exceed historical levels.

This question of how can the SES learn about floods that will exceed those already experienced leads this discussion to the critical link between the SES's flood planning work and the process of floodplain risk management (FRM) in NSW.

Floodplain Risk Management

FRM is a process aimed at systematically studying floods and their interaction with the human environment to develop strategic landuse planning to guide future floodplain development. The process is the responsibility of the councils of LGA's but is conducted within policy and technical guidelines issued by the NSW State Government. The urban planning component of this process is managed by the Department of Planning through the Environmental Planning and Assessment Act (EP&A Act). The technical component of the hydraulic flood study and risk assessment is managed by a flood specialist group within what is now the Department of Environment and Climate Change (DECC).

The principal guiding document for FRM is the NSW Floodplain Development Manual 2005. The Manual sets out in detail the requirements of the various studies that will reveal how floods behave within the subject catchment and how these floods can interact with the landscape and the communities located there. Importantly, the manual provides guidance on how the studies should model floods up to the extreme end of the probability spectrum (the Probable Maximum Flood or PMF). The manual also clearly indicates the critical link between floodplain development and the emergency management of the continuing flood risk created by any development on a floodplain and the manual contains some 111 references to the SES.

The SES has been working with DECC to develop a technical guideline which specifically addresses the study output needs of the SES and which is to be read in conjunction with the Manual. High in this list of needs is that flood studies must produce realistic data on the time varying and highly variable nature of the flood hazard. Flood studies have traditionally focussed only on defining the extent of the floodplain and mapping the depth and area covered by the 1:100 probability flood. This static data is of virtually no use to an agency that must deal with real floods that can represent any one or a composite of pure design floods.

Flood Emergency Response

In 1996 the SES became a partner in what remains the most significant single floodplain risk management project undertaken in NSW, the Hawkesbury-Nepean Flood Management Strategy. The HN Strategy comprised detailed hydraulic modelling, risk assessment, physical mitigation studies, landuse planning studies and, most significantly for the SES, detailed study of flood emergency response measures followed by major capital works to support selected options. To date more than \$100million has been expended on upgrading flood evacuation routes, enhancing emergency operations centres, upgrading communications, developing community education, and developing flood intelligence systems.

For the first time in Australia, and quite probably internationally as well from what the SES has been told by others who have researched this (Molino Stewart 2003), the SES developed a flood consequence classification scheme and a flood evacuation modelling concept. Both of these tools were developed in direct response to three simple questions asked by non-emergency managers - how does the SES know in what ways a flood will affect communities, what strategies are available to deal with these expected consequences and how long does it take to evacuate entire towns in a flood?

Flood Consequence Classification

During flood planning work lead by the SES it has been found that it is often quite difficult to describe, in a few words, how a particular community could be affected by flooding. Whether trying to develop a range of response options in the planning phase or trying select one of these options during a flood

event, this is a critical information communication issue. A successful flood planning or flood response activity relies on the need for a timely understanding of the problem across all those involved in its management.

An approach which has been found useful is to classify communities or areas of the floodplain according to the impact that flooding is likely to have on them. In flood affected communities the normal functioning of services is altered either directly or indirectly, resulting in the need for external assistance. The nature and extent of this impact can be related directly to the operational issues of evacuation, resupply and rescue that must be managed by the SES to assist the community.

The extent to which risk to life from drowning and access to and from an area is affected are the keys to the categorisation. It has been found that five general categories cover the range of likely flood effects. For each of these categories it is possible to develop, during the planning stage, a set of possible response strategies enabling the most appropriate ones to be more easily selected at the time of a flood.

These category definitions need to be applied for a particular flood level (i.e. gauge height) and in the first instance could be applied in terms of the impact of a Probable Maximum Flood (PMF). However, because of the difference in flood effects at different flood levels, the classification of an area for a flood of lower severity could be different to the PMF planning classification. It may be found that certain threshold flood heights can be identified that signify the transition from one classification to another for a particular community.

The five categories adopted are summarised in the following table:

Table 1: SES Flood Classification Categories

ACCESS CONDITION	TOPOGRAPHIC SETTING	SERVICES	CLASSIFICATION	CODE
Access road cut and no overland or alternative road access possible	Island below predicted flood level	N/A	Low Flood Island ('shrinking island')	LFI
	Island above predicted flood level	May or may not have failed	High Flood Island	HFI
Access road cut and no overland or alternative road access possible	Below predicted flood level	N/A	Low Trapped Perimeter area	LTP
	Above predicted flood level	May or may not have failed	High Trapped Perimeter area	HTP
Access road cut but overland escape/rescue possible on foot or AWD vehicle	Below predicted flood level	N/A	Overland Escape Route	OER
Access un-interrupted and via all-weather rising road (usual route or alternative)	Below predicted flood level	N/A	Rising Road Access	RRA
Access un-interrupted and via all-weather rising road (usual route or alternative)	Above predicted flood level	One or more services failed	Indirectly Affected Area	IAA

Evacuation Timelines

From the table describing flood classification categories on the previous page it can be determined that there are three broad flood response strategies available and these are: evacuation; rescue; and re-supply of isolated populations. Further analysis will reveal that evacuation will be the dominant response strategy in many cases, especially for the low flood island and low trapped perimeter areas where people would be trapped and drowned if not removed to safety. It must be stressed that the alternative strategy of mass rescue of hundreds or thousands of people is logistically unrealistic. Rescue is a strategy of last resort and can only hope to deal with small numbers of people. Only where there is no risk of inundation of the refuge area could the third strategy of resupplying an isolated population be contemplated. The frequent need for evacuation leads to the next question which is - how long does it take to evacuate, for example, 20,000 people from an entire town?

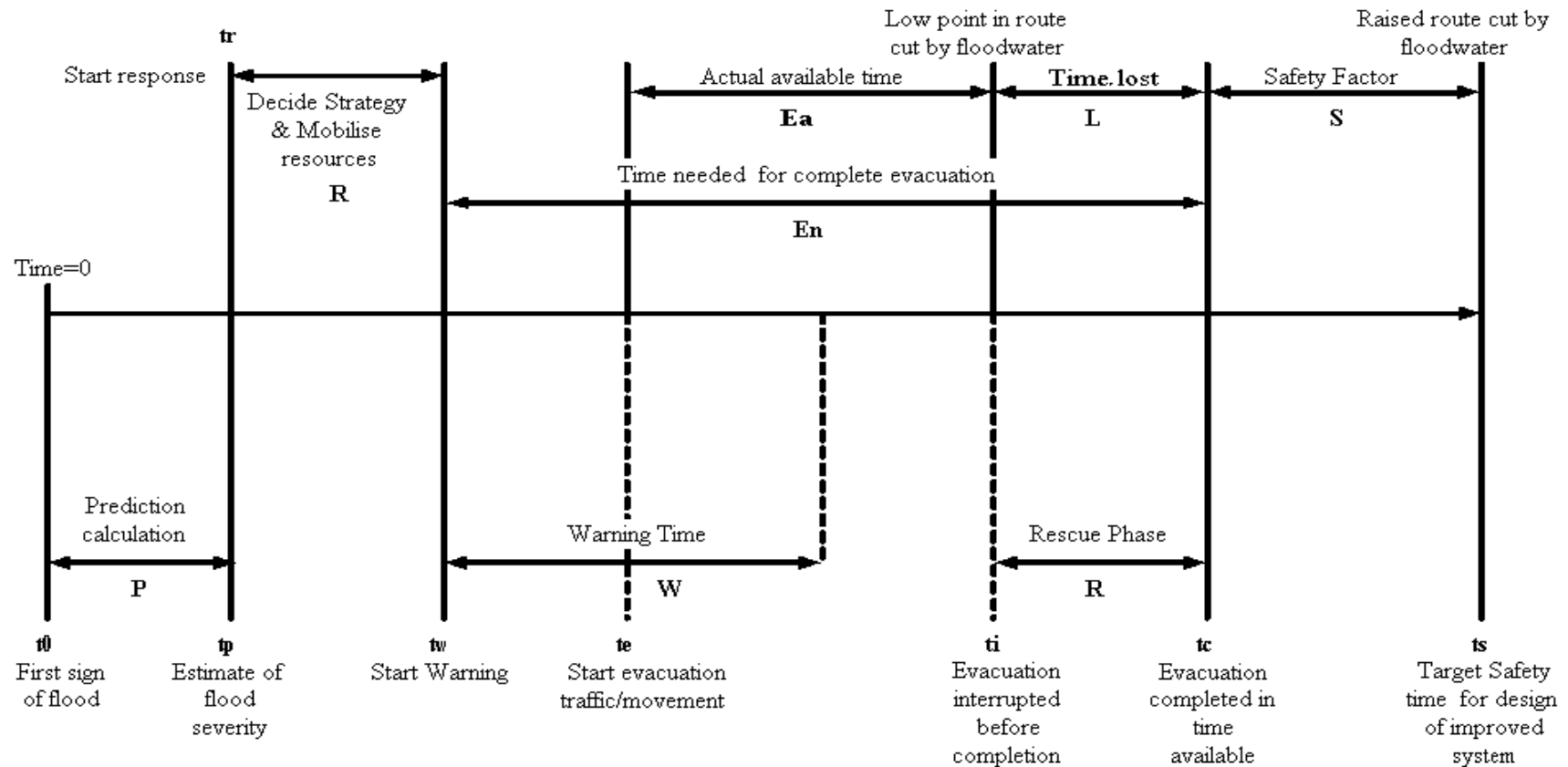
When first confronted with this question it became apparent to the SES that the answer was not known and in fact the process of evacuation was not well understood. Evacuation is something that has always just been undertaken when it was found to be necessary and it either succeeded or it failed. The author has written in some detail about the issue of evacuation modelling (see Opper in ref list) and that detail will not be repeated here. Suffice to say that the main issues in understanding flood evacuation include:

1. What is the trigger that initiates the need for evacuation e.g. river height prediction?
2. Having decided that evacuation is necessary, how long will it take to mobilise the emergency services to manage the operation?
3. How long will it take to warn the entire population and is it better that this is done rapidly or in a controlled, sequenced process?
4. How long will it take for a people within a community to come to an acceptance of the need to evacuate and then to prepare for their evacuation?
5. How much evacuation traffic will be generated and how long will it take to move all of this traffic along existing available roads?

These parameters are basically time dependent and can be plotted as segments and milestones along a timeline, hence the term evacuation timeline. When analysed it was found that the majority of the information needed to answer these questions related back to hydraulic flood studies. Without a detailed understanding of the time-varying nature of real floods, the underpinning segments and milestones on an evacuation timeline cannot be determined. In addition, some detailed understanding of the logistics of mobilising emergency service resources and understanding road networks and traffic carrying capacity are required.

On the following page is a generic flood evacuation timeline.

Schematic Time Line of Emergency Response for Flood Evacuation



Notes: S will be a negative value (safety Factor < 0) when t_i occurs earlier than t_c . S will be zero when all available time needed (E_n) is used. Only when t_i occurs after t_c does a Safety Factor begin to accrue. The magnitude of S has to be determined by reference to the capacity to cope with uncertainty and interruptions. The time elements are not drawn to scale in this diagram but should be for proper analysis.

The SES has now developed the flood classification and timeline methodology to quite a high level of refinement and has been greatly assisted in this process by the constructive criticism and suggestions of various consultants and individuals within the floodplain risk management process. Particularly significant input has come from Molino Stewart Environmental Service, Sinclair Knight Merz, Patterson Britton and Partners, Webb McKeown and Associates, and Bewsher Consulting.

The classification scheme and the flood evacuation timeline now underpin the Services planning, exercising and operational responses to floods. Both these tools enable the SES to undertake a risk assessment that is directly relevant to the emergency management context. This risk assessment feeds into the Services planning and operational work by prioritising the allocation of planning resources and informing the development of the required operational resources at the various SES Regional and Local SES units.

As indicated in the earlier sections of this paper, the SES currently maintains 145 local flood plans and these cannot be reviewed and updated concurrently. The service also has obligations for storm planning and since 2006 tsunami has been added to that list requiring an additional 60 odd plans for the NSW coast. Each year a prioritised work plan is developed for the state reflecting an agreed set of planning priorities based on risk assessment. All plans are revised after every flood event and in any case not less frequently than every five years. This requires a minimum of around 30 flood plans and 12 coastal hazards plans to be revised every twelve months, which is a significant task.

Community Engagement

The SES is responsible for leading the process of community education for the hazards of flood and storm in NSW. This engagement commences at the time of developing response plans but is a highly variable process. In smaller country and rural communities it is possible to form a planning committee that includes community representatives and to conduct consultation forums that interface with most of the affected population. By contrast, in large metropolitan or regional cities it is almost impossible, within the resource and budget constraints that exist, to facilitate wide-scale community participation in the planning process.

To ensure some level of understanding of community expectation the SES has conducted extensive community surveys to develop an understanding of the attitudes and expectations of the community to floods and storms. These findings feed back into both the planning and community education processes.

FloodSafe

The flagship program for the SES in the flood context is FloodSafe which is a fully developed and trademarked community awareness concept. FloodSafe emerged from the Hawkesbury-Nepean Flood Management Strategy discussed earlier. The principle is that flood risk information needs to be made as locally relevant and specific as possible. The Service produces FloodSafe Guides which are individually tailored flood awareness and safety guides written at the level of individual communities and in many cases, down to the level of sub-sections within communities. The guides are also differentiated into residential, business, rural, and even special events such as the Tamworth Country Music Festival.

The production and promotion of FloodSafe Guides is linked to the planning process to the extent that the guides are not produced until the planning is completed. This ensures the

guides are both factually and technically up to date when released. Where possible within the constraints of time and budget the initiation of community flood awareness activity will be timed to coincide with a significant historical flood anniversary date. This helps to create a link to the reality of the flood risk which is so often difficult to engender in a community faced with so many other daily risks and priorities.

Business FloodSafe & Home FloodSafe

The FloodSafe guides mentioned above are a generic resource but it is well understood that if businesses and individuals can be encouraged to accept some ownership of their own risk they will engage more meaningfully in risk management strategies. To that end the SES has developed two packages to guide businesses and individuals through a simple planning process for flood risk management. These two packages are called Business FloodSafe and Home FloodSafe respectively.

Business FloodSafe was launched in 2006 and is now well established and has been rolled out in many flood prone communities. Work is under way to put the entire package and the planning process into a web-based on-line application. Home FloodSafe is in the final stages of development and undergoing community pilot evaluation.

Transition to Recovery

It is not intended that this last short section on the transition to recovery is indicative of a low level of interest or priority to the task of flood recovery. What is known is that sound flood response planning and well implemented response action including property and asset protection, evacuation, and maintaining the normal business and social functions of a community, will significantly reduce the impact of floods and aid in the rapid recovery of the community. The SES is not responsible for flood recovery in the complete sense and in fact no single government agency has that role.

The SES works closely with the NSW Department of Community Services (DoCS) which heads the NSW State Disaster Recovery Committee and is the lead agency for the Disaster Welfare (Human Services) Functional Area under NSW DISPLAN. The SDRC is comprised of representatives of the various partner agencies to DoCS in the recovery and human services role and also the SES. The partners include: Red Cross, Anglican Church (Anglicare), St Vincent de Paul, Uniting Church, and Seventh Day Adventist Church (Adracare) Salvation Army.

These groups swing into action as soon as a flood begins to develop and in particular play a critical role in operating evacuation centres that receive flood evacuees. In some cases detailed evacuation centre planning is undertaken in tandem with the SES's flood response planning.

In situations where serious floods cause widespread and significant damage to communities and their infrastructure the State Government tends to appoint an independent recovery coordinator. This is usually a non-government person with the capacity to bring together all the government and non-government resources and coordinate an efficient recovery process.

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