ON THE PROPER CONCEPTUALISATION OF THE WARNING, EVACUATION AND COMMUNITY EDUCATION TASKS IN THE CONTEXT OF PLANNING FOR DAM FAILURE

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ABSTRACT

As the legislated 'combat agency' for dealing with floods, the NSW State Emergency Service has had considerable experience in planning for flooding on the state's rivers and in developing arrangements to help keep people safe when floods occur. This experience has been put to use over the past decade in the particular context of managing floods caused or exacerbated by dam failure. Some of the complexities of the dam-failure planning problem are explored in this paper, specifically as they relate to warning and evacuation tasks and to the issue of preparing communities for the extreme flooding which dam failure can be expected to cause. The points are made that warning is not just about mechanical alerting devices, evacuation is not restricted to commanding people to move, and public education requires a sensitive comprehension of the problems of disseminating information about rare and difficult-to-believe events.

1.0 INTRODUCTION

In New South Wales the State Emergency Service, as the 'combat agency' for the management of floods according to the State Disaster Plan (New South Wales Government, 2000, 27), has been actively planning with dam owners for the last decade to deal with the potential impact of dam-failure flooding on downstream communities. In that time a close working relationship has evolved between the SES, the state's Dams Safety Committee and various dam owners, and arrangements have been developed and refined to govern the notification of emerging problems which could lead to dam failure, to define the needed inputs to the emergency planning process and to codify the scope and content of the actual planning which must be carried out. These matters have been canvassed in a number of contributions to conferences of the Australian National Committee on Large Dams and published in the ANCOLD Bulletin (see, for example, Haines, 1996; Keys, 1997a, 1997b). Moreover planning to warn and evacuate people below dams which have been declared to be 'deficient' and at some risk of failure has been carried out for communities below more than 30 such structures. This paper seeks to cast light on some of the complexities of the planning work which the SES has undertaken with dam owners and to build a deeper understanding in the dams management community of the nature of the warning and evacuation tasks which must be carried out when dam failure becomes possible or actually occurs. It also deals briefly with the question of engaging the people who live in areas below dams and who would be affected by dam-failure flooding.

Much of what is reported here for the context of potential dam-failure floods reflects the realities of flood management

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more generally. Thus the SES's experience over many years in managing the tasks of warning, evacuation and public education in relation to 'normal' riverine floods, often in environments in which very large populations are dangerously exposed to the flood threat as in the case of the Hawkesbury-Nepean River on Sydney's north-western outskirts (see Gillespie et al., 2002), can inform the planning for floods in the special and unusual circumstances which dam failures would represent. Naturally, there must be a recognition in this of the uniqueness of the dam failure flooding problem in terms of time frames of flood onset downstream, rates of river rise, velocity of flow and severity generally. In all these contexts dam failure floods are for obvious reasons particularly serious and pose special problems. Nevertheless, the same principles apply as for the management of floods in general and the SES as combat agency must deal with the range of flood threats – not just rainfall-derived riverine flooding which makes up the vast bulk of the flood experience in NSW (see New South Wales Government, 2001, 2-3 for a discussion of the range of flood types which can occur).

2.0 WARNING OF POTENTIAL DAM-FAILURE FLOODING

Warning of an impending emergency is a complex matter which involves far more than the mere imparting of information about what is or may be about to happen. There are many issues to consider, including what should actually be said and how messages should be conveyed to the community at risk. On the latter issue, a distinction is commonly made in the literature of emergency warning between 'alerting' and 'notifying' people about what is likely to happen (Rogers and Sorenson, 1988). Alerting refers in this context to the sudden bringing of a situation to people's attention, usually by the use of noise to "break a routine acoustic environment to cue people to seek additional information" (Molino et al, 2002, 55). Sirens are commonly used to do this, sometimes in association with flashing lights. Noises and lights can perform only part of the warning task, however, the remainder being made up of the notification element which explains what the problem actually is and what people should do about it so as to remain safe or protect their property.

True warning of a pending emergency requires people to be both alerted and notified. There is a tendency, however, for some people who are required to develop warning systems to rely heavily on 'bells and whistles' alerting devices to do all or most of the job. It is easy to over-emphasise the technology-focussed, essentially engineering-based approach, and this is not uncommon. The problems which arise are several. They include failure at a technical level of the equipment involved because the machinery breaks down, batteries are not charged or power boards are not secure, or because sirens cannot be heard as a result of inappropriate calibration (for example, the sound being drowned out by high winds or heavy rain). False alarms also occur as a consequence of mechanical malfunction. Other problems relate to community members not accepting the presence of mechanical devices – perhaps because they do not accept the reality of the potential problem which they address – and switching off or vandalising them. In addition there are the difficulties which inevitably arise when people, having heard the noise, fail to understand what it means. In this circumstance the common response is for people to do nothing except to become annoyed by the uncomprehended and unwelcome interruption: this is akin to the reaction of many to the sound of burglar alarms going off in cars when in the vast majority of cases there is clearly no burglar involved. Complacency as well as anger is engendered in such situations.

Failure of 'alerting-only' systems can occur at both the mechanical and the human levels, then. Only with information-based notification can these problems be overcome, which means that any alerting noise must be followed by words. The nature of the emergency must be explained in the real time of its pending or actual occurrence and people must be empowered by advice to do what is necessary to maximise their personal safety and protect their belongings. In other words, comprehension must be built, and this requires explanatory words which are carefully crafted to ensure that understanding is enhanced and people are motivated to act appropriately. The inputs have to do with clear and complete communication, which implies a need for a psychological dimension to be appreciated in the context of persuading people to act and also reassuring them that the problem is being managed and that help is available. Relevant information must be incorporated in the messages and expressed in ways which are designed to create particular responses.

The key to effective warning is that people are alerted, are brought to an understanding of what is happening and are guided to appropriate actions in the appropriate time frame. Not all of this is likely to be optimally achieved solely as the emergency is unfolding, of course: the ideal is to have some prior understanding inculcated during an educational phase. We return to this theme later in the paper.

One approach which combines the alerting and notifying elements of warning which has been used during floods in NSW (though not yet in relation to potential dam failure) involves the Standard Emergency Warning Signal (SEWS). This is a noise which was devised for use in northern Australia to warn of approaching tropical cyclones but is now available for use in impending emergencies more generally: the noise is played for several seconds over radio or television stations and is immediately followed by words which explain the situation and advise appropriate behaviour on the part of those who need to act. The use of the signal is incorporated into the dam-failure planning which is being carried out in NSW. Radio stations have the signal and arrangements have been devised to guide its use when dam failure threatens.

Considerable thought needs to be given to what is actually said in notifying people about potential dam-failure flooding and the means by which the information is to be transmitted. In NSW the SES has come to the conclusion that for normal riverine flooding it is difficult to ensure that warning messages can be made complete in terms of necessary content and strike the appropriate notes of persuasion and reassurance if they are devised solely as an actual flood is rising. At such a time there are simply too many tasks for emergency managers to deal with and message construction is too complex a function to perform satisfactorily ‘on the run’ under the circumstances which then apply. It is much better for warning messages to be put together slowly and carefully in ‘planning time’ – assuming, of course, that those who prepare the messages understand in some detail and beforehand what the consequences of flooding of differing severities will be and what sorts of responses will be required by people in different areas and with differing exposures to the flood risk. In NSW the SES has expended much effort on the development of ‘flood intelligence’, and there is now sufficient such intelligence on most of the state’s rivers to sustain the development of effective warning messages for floods of all severities up at least to flood-of-record levels. Naturally, the messages which are constructed must be capable of real-time modification so that content which could not be anticipated in planning time can be quickly incorporated as the flood unfolds.

The SES has embarked upon a program of creating pre-written flood warning messages, designed to be broadcast over radio stations but also intended to provide vehicles for other means of notification, for the reference areas of all 160 gauges in the state for which the Commonwealth Bureau of Meteorology provides flood height predictions when floods are developing.

These messages are being devised for a range of heights, beginning with the designated 'minor flood' level (which is intended to connote the onset of flooding capable of causing significant community impact in terms of the inundation of low-lying land and the closure of local roads) and going up to heights at least equivalent to those reached in floods of record on the relevant river reaches. The messages are based on a growing bank of intelligence about the consequences of flooding which has been compiled largely from real-time observations and from consultants' floodplain risk management reports. It covers impacts such as the closure of roads, the inundation of farm land, the flooding of residential, commercial and industrial areas and the overtopping of protective levees. Pre-written messages allow real meaning to be incorporated in the communication and permit appropriately arresting and persuasive language to be devised: in essence their prior preparation encourages a fine-tuning of content and tone and helps ensure that important information is not missed out (a real problem when all of the message formulation is done when floods are actually occurring). All of this should improve the quality of the communication and enhance the likelihood that necessary actions will be stimulated on the part of those who are likely to be affected by the coming flood.

Dam-failure flooding is, obviously, much rarer of occurrence than normal riverine flooding. Indeed it is virtually non-existent and there can be no expectation that managers will be able to learn by experience – let alone repetitive experience – how to construct appropriate warning messages about it. That being the case it will be no less necessary than with normal floods for pre-written messages to be constructed in anticipation of dam failure. Fortunately, the information which dam owners provide on the likely 'reach' of such floods in terms of envelopes of inundation can be used to create these messages which can then be employed, with modification to incorporate on-the-day information if necessary, when dam failure becomes possible.

There remains the question of techniques of message dissemination to consider. There are now many alerting, notifying and dual alert-notification techniques available (see Molino et al, 2002), and the principles relating to selection and utilisation of methods are well known (Emergency Management Australia, 1999a, 43-53). Broadly these principles relate to the need for methods to be chosen to suit the time frames available, to ensure a variety of modes of transmission is used in a layered fashion (for the purpose of creating redundancy and to reach the maximum number of people within the relevant area), and to incorporate personal notification (for example by doorknocking or personal telephone call) if at all possible.

These latter methods are time-consuming to implement on a time-taken-per-household-notified basis, and they are obviously difficult to implement when the time available before possible dam failure is short. They have the great advantage, however, of being able to deliver credibility merely because of the human dimension they incorporate. Their chief advantage is this very characteristic, which reinforces the notion that warning strategies require a human element in addition to whatever mechanical devices are to be employed.

Within the compass of these principles, the actual choice of techniques to be used in different environments will depend on what is practicable. The time available to evacuate is an important mediating factor in the dam-failure context: the techniques to be used to warn will not be the same for houses just below a small council dam which is structurally deficient and could fail in a severe earthquake as for areas a long way downstream of a dam which could fail only in a very large inflow flood which exceeded spillway capacity. In the first of these cases, in fact, real-time notification as defined here might be impossible in some instances: in those situations, a reliance on alerting devices alone would be justifiable, but there would need to be a special effort to ensure that people's comprehension of the devices was kept alive and current. The question of the use of time in the context of evacuation is considered further below.

3.0 EVACUATING PEOPLE FROM HARM

Just as warning ideally is not a matter simply of bells and whistles, evacuation is not solely about ordering people to move from one place to another even though the legal authority exists for emergency officers in NSW (including SES Controllers) to force people to evacuate when they are at severe risk. Apart from the need in practice to **persuade** people to move, which relates to warning processes, there are complex questions about the actual movement process and its management. A vital element of planning to evacuate people in the face of impending flooding is the effective utilisation of time. Careful consideration of the time variable is necessary to ensure that the evacuation of all those at risk can actually be effected and that it can be done with as much quality as possible – for example, by allowing people to save some belongings and to get to a place of some comfort (a nearby town, for instance, where accommodation and other needs can be met) rather than simply getting to the nearest location which is above the likely reach of the flood.

The SES has developed a method of conceptualising the use of time in the management of warning and evacuation processes during periods of flooding (Emergency Management Australia, 1999b, 33-34). Figure 1 illustrates the method by compartmentalising the evacuation process into its constituent phases and representing it in diagrammatic form. The horizontal axis represents the time variable. For simplicity the various stages are depicted as being sequential, although in actuality there is likely to be considerable overlap between adjacent stages. The model is described below in relation to both riverine and dam-failure flooding and in relation to the agencies responsible in NSW. In other states the allocation of responsibilities differs somewhat.

3.1 FLOOD PREDICTION

This element is represented by P in the diagram and is usually managed by the Commonwealth Bureau of Meteorology in relation to riverine floods. In the dam-failure context the dam owner is normally responsible for forecasting the flooding. Factors that can influence P include:

- Data collection (methods, hardware, transmission);
- Flood modelling capability (data, software);
- Human resources (staff availability and activation time);
- Requirements for the dissemination of the prediction;
- Weather forecasting capability (severe weather advice, Flood Watches).

3.2 RESPONSE INITIATION AND MOBILISATION

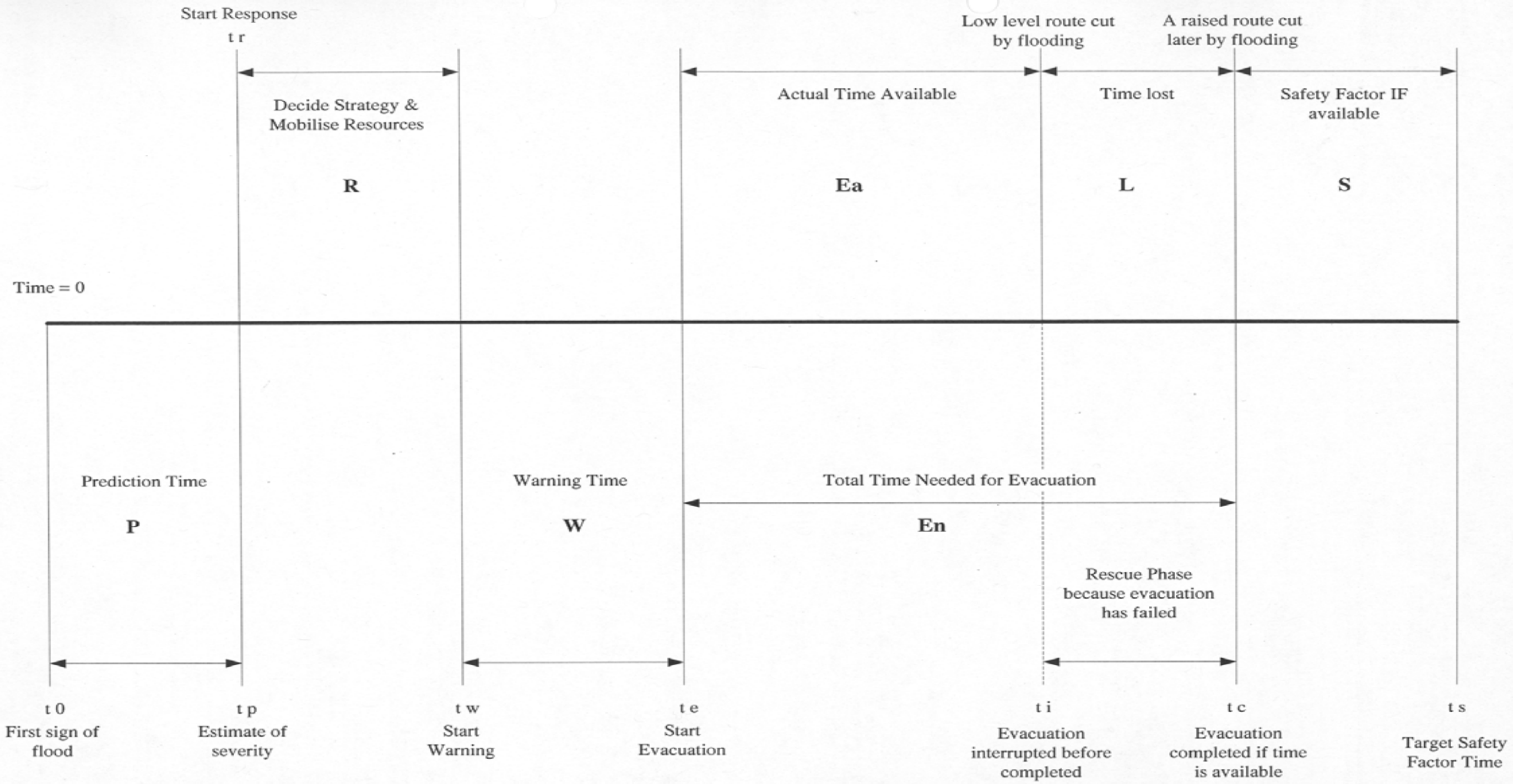
This component is represented by **R** in the diagram and in the context of dam failure is normally the responsibility of emergency managers downstream (in NSW, the SES as the combat agency for flooding but with the police and other emergency services also involved). The time needed to initiate emergency response operations is a complex mix of organisational, communications, procedural and legislative factors. Factors that can influence **R** include the effectiveness of:

- Emergency response planning;
- Training of personnel;
- Communications systems and methods;
- Exercising activation and the delivery of specific response procedures.

3.3 WARNING DELIVERY

This component is represented by **W** in the diagram, and again is usually the

Figure 1: Time Line of Emergency Response for Flood Evacuation



Note: S will be a negative value i.e. Safety Factor <0, when ti occurs earlier than tc. Safety Factor will be 0, when only the time needed is available. It is only when ts is later than tc that safety factor begins to appear. The later ts occurs relative to tc the greater will be the Safety Factor allowing time to complete all activities and still have extra time to cope with interruption and uncertainty. Time segments are not drawn to scale.

responsibility of the SES (although where the time for warning is very short the task may by agreement be managed by the dam owner using alerting technologies). Warning preparation and delivery should be expected to represent an element for which significant time is required. The most reliable warning method is door-to-door delivery by emergency service personnel which can be quantified in relation to time taken. In floods many other methods of warning may used including radio, TV, sirens and telephones but the time frames required for the application of these methods cannot easily be assessed.

Prior public education is fundamental to the success of any warning strategy. A public education program using a variety of methods must be implemented to develop a community which is ready for warnings as well as for the floods they herald.

3.4 EVACUATION OPERATIONS

Again the primary responsibility in NSW belongs to the SES when evacuations are required because of flooding. The key elements of the evacuation operation are represented by the terms **Ea**, **En**, **L** and **S** in the diagram. The evacuation operation resulting from a severe flood will usually be the most complex and time-consuming aspect of the overall flood operation, especially if the number of people to be evacuated is large.

En represents the total time required to complete the evacuation, assuming there are no impediments to using all of the calculated (theoretical) necessary time.

L represents the time lost (ie which has to be subtracted from En) due to flooding or the closure of evacuation routes or the failure of transport systems.

Ea represents the actual (ie true) time available within which evacuation either must be completed by adapting the process to the time constraints, or will have to be terminated before completion. The portion of evacuation not completed by time **te** will result in the need to begin a rescue operation.

3.5 SAFETY FACTOR

S represents the safety factor or time buffer which may be available if the interval **L** can be eliminated – that is, if there is no impediment to using all of the total necessary evacuation time **and** there is additional time available to deal with interruption or uncertainty. Evacuation arrangements must maximise opportunities for a timely response. Factors influencing the response will include:

- Transport routes (capacity and resilience to damage, vehicle weight and size limits, vulnerability to local flood effects on creeks or main streams);
- Transport methods (private vehicles, public transport, special vehicles for example for medical contingencies);
- Traffic control and coordination (priority setting of traffic lights, manual control of intersections);
- Removal of personal effects, pets and livestock from properties before or during evacuation;
- Destination facilities for safe storage of personal effects, pets and livestock;
- Marshalling and processing facilities for evacuees;
- Accident-handling arrangements on evacuation routes.

3.6 SOME COMMENTS IN TERMS OF APPLICATION TO DAM-FAILURE FLOODING

Put in the context of the potential failure of a dam, Prediction Time (**P**) refers to the time from first concern that the dam could fail in a developing event to the point at which the possibility is sufficiently credible to require the evacuation of people downstream of it. During this period the relevant emergency managers must be notified so that arrangements can be dusted off and actions instituted as quickly as possible should they become necessary: this will create benefits in terms of shortening the response mobilisation phase. This phase (**R**) can only be very short if the planning has already been done and the response managers are aware and trained, have appropriate communications systems and methods ready and are able to activate and deliver specific response procedures speedily. It could be almost instantaneous if those who were assessing the potential failure were the same people who were responsible for mobilising these response actions (in other words, employees of the dam owner). The warning phase (**W**), likewise, could only be speedily completed if the warnings were to be delivered solely by mechanical means, presumably activated by the dam owner. As noted above, this is not the preferred situation but there will be occasions when time is very short (particularly if dam failure is already occurring) and when no additional methods can realistically be applied.

In most cases, however, these three phases will take a considerable amount of time to carry out. Just how time-consuming the process is likely to be can for some elements be quantified: the SES has, for example, tested the doorknocking process and found that in urban areas an average of five minutes should be allowed per dwelling for a doorknocking team of two people. The figure would be higher in rural areas because of the greater distances between dwellings. Obviously the time taken to doorknock all relevant dwellings can be modified, if the time is short, by increasing the number of doorknockers and the SES routinely incorporates in its planning for this function the availability of members of other organisations such as the Rural Fire Service. Real instances of evacuation operations in recent years have shown how time-consuming and labour-intensive the task actually is: its consumption of these resources is easily underestimated. At Grafton in March 2001, when the SES sought to evacuate some 12,000 people on the rising limb of a flood which was predicted to overtop the town's protective levees, the time available (about six hours) was not enough to allow all the dwellings to be doorknocked.

The remainder of Figure 1 deals with the actual movement of evacuees. The factors which are central to the process are the time needed to complete the evacuation, a quantity which can be estimated using empirical data relating to numbers of vehicles and roadway capacities (600 vehicles per lane per hour is a commonly used, well tested and appropriately conservative planning figure) and the time which is likely to be available before the evacuation can no longer proceed (for example because low points on evacuation routes are flooded or bottlenecks occur where routes converge). Clearly when **Ea** (time available) is less than **En** (time needed) there is a serious problem, and this is likely to apply in the context of dam-failure flooding when flood levels will rise very quickly and the potential for later rescue activities to be successfully undertaken is likely to be minimal.

There remains in all this conceptualisation of the elements a great deal of uncertainty about the speed with which large-scale evacuations can be carried out. Even with data on the numbers of doorknockers required and the numbers of vehicles that can pass a given point on an evacuation route there are many unmeasurables. Experience shows, however, that the early phases of an evacuation operation are likely to proceed slowly given that people usually under-react and delay their responses in the hope that the situation will improve and evacuation will not be necessary. This is especially the case if there are no flood cues that people can actually see in their own locations, or if there is an inherent lack of understanding of or trust in the warning systems and processes that have been developed. For dam failure, the likelihood of such a lack of comprehension and trust can be expected to be particularly high given the rarity of dam-failure flooding. All this militates, incidentally, against the stricture that evacuation operations should be initiated early if it is known that time will be short. Great stress is also placed on the need to ensure that people understand the problem and the warning system beforehand.

This time-line approach provides a valuable means of conceptualising the problem of large-scale evacuations (and, indeed, smaller-scale ones where time is short), and it will help the SES to better plan evacuations necessitated by potential dam-failure events. The obvious cautionary note relates to the fact that its application almost always suggests that evacuation operations take longer than one would intuitively expect to be the case and it is not always easy to 'find' extra time when it is needed. In the dam-failure context, for example, one cannot buy time simply by beginning the evacuation before dam failure has become a credible possibility. Especially for small dams which could fail relatively quickly in a severe flood event this might lead to frequent evacuations which would turn out not to be necessary. The result is likely to be that a greater emphasis will have to be placed on mechanical warning devices, which in turn puts stress on the need to ensure that people understand and accept their purpose and will act when the devices are activated.

4.0 EDUCATING AT-RISK COMMUNITIES ABOUT POSSIBLE DAM FAILURE

It is an axiom in emergency management circles that warning and evacuating people, while never simple, are at their least difficult if the people have a sound prior understanding of the threat which requires them to evacuate. Ideally this understanding is best inculcated if there has been recent experience of the threat. Clearly in Australia such comprehension cannot be expected to exist in the dam-failure context since there have been few if any cases of significant dam-failure flooding in living memory. The next best thing is to create the understanding synthetically – that is, by educating people about the threat, about its management by dam owners and emergency responders, and about the actions which people can take to respond in their own interests. Not a great deal of this work has yet been done in NSW, and until it is done the situation is that evacuation will be sought from people who are unlikely to understand the need for it. This remains a significant challenge for those who are responsible for the management of potential dam-failure flooding.

Numerous problems need to be faced here. Amongst them are the fact that large dams rarely fail, which means that dam failure lacks credibility in the community mind. When the topic is raised many people tend to react either scornfully, believing that failure will not happen and that somebody is mischievously seeking to create 'panic', or angrily when they recognise that they, their families and their properties are at some risk. These things are difficult to handle in the public domain. So are actions to protect dams in a safety context, as Cowan (1998) has reported in the context of the management of the deficiencies of Hume Dam by large-scale emergency releases of water (which were not expected by farmers and others downstream) in October 1996. In this instance the community reaction was overwhelmingly of disapproval and hostility.

It is important in any community engagement program that delay in informing people about the potential dam-failure problem be minimised. Otherwise suspicion will grow about the reasons for the lack of communication, the seeds of mistrust will be sown and they will infect later efforts to provide information about the problem. Unfortunately it takes time for dam owners and emergency managers to come to grips with the issue and to develop strategies for handling it and it would not be wise to publicise the problem without being able to reassure people that appropriate strategies are at least being devised. That said, doing things which are visible (like installing warning systems) before there is any public consultation or an opportunity for people to come to grips with the issue and have some input to its management will also create hostility. There was recently a case in NSW where a siren-based alarm system was switched off, probably by a community member who had access to it and who was lobbied by other community members angered by the fact that it had gone off for some hours and created a false-alarm situation. In this case several people living nearby had been hostile from the start about the siren system, and the public education that was carried out in a series of public meetings apparently did not fully defuse their hostility. No real understanding and acceptance of the system's purpose was engendered.

This was a case, incidentally, in which the dam owner had taken the lead in the management of the issue of educating the members of the community and the emergency management (SES) involvement had lagged behind. It is vital that the interests of both the dam owner and the emergency manager are fully incorporated and develop synchronously, just as it is vital that there is a genuine effort to ensure that the wishes of community members are considered in the development of the management strategies which are adopted. In this day and age, consultative processes which are seen to be top-down in their nature are likely to be undermined in the community and will fail as a consequence.

In NSW the SES and dam owners have conducted public meetings in a number of areas at risk to explain the local dam-failure issue, to indicate what is being done to make the particular dam safe and to seek guidance on appropriate warning messages and strategies. At one of these meetings, in the Orange area, a specially-created FloodSafe guide was distributed as it also was shortly afterwards to residents who had not attended the meeting (Figure 2). The opportunity was also taken to encourage people to devise their own private written plans for managing dam failure should it occur: pro forma documents were distributed and explained and individuals were helped to define appropriate actions for their own situations with regard to property protection and evacuation. In doing this, the opportunity was taken to educate people about warning processes so they would be able to understand beforehand the triggers to the actions they have planned.

These meetings need to be undertaken with considerable care and sensitivity. There are delicate balances to be achieved between the provision of advice to individuals and the reception of information from them, and hostility is often close to the surface especially if, for example, people have bought their land since the dam owner became aware of the dam's deficiency but before the deficiency was publicised. Equally, though, people can be angered on being advised that failure is extremely unlikely: in this instance, some may argue that the publicity is about events that will almost certainly not happen but will nevertheless damage them in the prospect by reducing the value of their property.

There are no easy ways out of these difficulties. It is worth stressing publically, however, that the discovery of deficiencies should not be taken as a simple matter of fault on the part of the dam owner, since the problem is very widespread – naturally this reassurance is best not given by an employee of the owner – and that action is being taken to maximise community safety. What will be difficult, of course, is the situation of having to keep people aware of the potential for dam failure over the long term if engineering works are not to be undertaken to rectify the deficiency. So far this issue has not been tackled, but it is obviously preferable from an emergency management perspective to have warning systems and evacuation arrangements as strictly interim measures while the spillway is being enlarged, the dam post-tensioned or other engineering fixes are being completed.

Figure 2: An Example of a FloodSafe Guide (Orange)

How will I know if there could be a dam failure?

The warning system includes three alarm levels: white, orange and red.

The WHITE alarm alerts Council staff and the SES to heavy rain or unusual flow levels over the spillways of the dams. The SES then activates the Orange Local Flood Plan.

If the higher ORANGE level is reached, residents downstream of the dams will be advised of the possible need for evacuation by:

- Pager messages.
- Doorknocking by SES and Rural Fire Service personnel.
- Telephone calls.
- Radio broadcasts over 2CR, Star FM and 2GZ.

The RED level, indicating that a dam might actually fail, requires residents to move to their nearest evacuation centre immediately. People will be advised by the methods listed above of the need to evacuate.

Gosling Creek Dam

Front cover: Suma Dam

Where can I get more information?

Council and the State Emergency Service can provide help for preparing your household flood plan, because the best defence against flooding is preparation well in advance.

Your plan should cover everything you need to do to protect household members, personal belongings and pets. It should also deal with evacuation to safety.

A draft Orange City Local Flood Plan is available at the Council library. This plan describes the arrangements that guide flood response, including warning, evacuation, rescue and the provision of information.

FOR FLOOD AND STORM EMERGENCIES CALL

132 500

Orange City SES	6362 8785
Orange Police	6361 5499
Ambulance	131 233
Orange City Council	6393 8000

This brochure was prepared for your protection by the State Emergency Service and Orange City Council.

FloodSafe in the Orange Area

SES

STATE EMERGENCY SERVICE

ORANGE

Australia's Colour City

Could it flood here?

Improved understanding of the potential for extreme rainfall in our area suggests that Orange City Council's water-supply dams could be at risk during severe floods.

Failure of Gosling Creek Dam or Spring Creek Dam could flood a small number of houses. Failure of Suma Park Dam would definitely inundate a number of homes in the Clifton Grove area. Spring Creek Dam has also been identified as having structural weaknesses, which means failure could occur even without extreme rainfall.

When the dams' deficiencies were identified, Council and the State Emergency Service took immediate steps to ensure the safety of downstream residents. These include:

- Design work is currently being carried out for dam safety works that will eliminate the risk.
- Because it will be a few years before these works are completed, a flood warning system and evacuation procedures have been developed so that people can be advised about what to do if a dam might fail.

What can I do to be ready?

Now

- Identify your route to the nearest accessible evacuation centre. These centres will be established at:
  - Orange Ex-Services Club (for residents below Gosling Creek Dam)
  - Summerhill Rural Fire Service Station and Orange Ex-Services Club (for residents below Spring Creek Dam)
  - Clifton Grove Rural Fire Service Station and Orange Ex-Services Club (for residents below Suma Park Dam)

Spring Creek Dam

- Prepare a household flood plan to remind you of what to do. Council can provide a checklist for your plan.
- Put your plan where you can find it.

When you receive a flood warning

- Listen to your radio for information.
- Stay close to your telephone and pager.
- Follow your household flood plan.

If you have to evacuate

- Gather up medicines, financial and legal documents and important personal items (including mementoes and photographs).
- Arrange for the care of your pets and other animals.
- Check on your neighbours.
- Turn off your power, water and gas.
- Go to your evacuation centre. If you wish to go elsewhere, please inform the Police or the Orange City SES.

Afterwards

- Return home only after the SES or Council has issued a clearance.
- Avoid using wet electrical equipment.
- Report damaged services to the authorities.
- Use only boiled or bottled water until Council issues a clearance.
- Wear shoes and gloves while cleaning up, and use a strong disinfectant.
- Avoid contaminated food or drink.

If you need transport or other help after you have received a flood warning, phone the SES on 132 500.

5.0 CONCLUSION

The SES has had several decades experience of managing floods and, especially over the past ten years, growing involvement in formally planning for them. Improved warning systems and processes have been developed for riverine flooding, experience has been gained in the conceptualisation of evacuation operations and in their management in numerous parts of NSW, and there is an increasing focus on the engagement of flood prone communities to discuss the threat and its management. Progress in these areas is transferable to and informs the work which is being done for communities below dams which have been identified as having some risk of failure. Although there is still a vast amount of work to do before all the necessary warning and evacuation strategies have been fully devised and implemented and all the communities below the deficient dams have been (and continue to be) engaged, much has been done.

There are two cautionary notes which should be sounded, however. The first relates to the critical importance of community education. Almost certainly this is the most difficult area of all to manage and to date it is the one which has been given the least attention. Further effort is required here. The second is that it remains vital that the efforts of dam owners and emergency managers are properly integrated so that the two sides of the management of potential dam failures are fully incorporated. It is not best practice for warning systems to be instituted solely by employees of dam owners and without emergency management expertise being sought: when this happens, the likelihood is that the warning processes will be incomplete and unbalanced. Similarly, dam owners who have not had experience with community attitudes to flood problems are not in the best position to defuse the various tensions which almost inevitably come to the fore during the public education phase. It is equally the case that the communication with the people at risk should not be left to the emergency managers alone since they are not well placed to discuss the technical issues relating to the deficiencies of dams or to the remedial works which are proposed.

The problems to be faced are multi-dimensional and multi-disciplinary, and they will not be optimally handled without a genuine partnership between the two groups of interests responsible for their solution. This can create difficulties of coordination, of course, when the timetables of relevant personnel in different organisations do not gel. The solution is to make sure they **do** gel rather than for one organisation to become impatient and do the work which should be shared by both.

The over-riding message is that it is not all engineering, and neither is it all psychology. There must be a conscious combining of the different types of relevant expertise held in different cultures if the best results are to be achieved.

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