PLANNING TO WARN AND EVACUATE COMMUNITIES POTENTIALLY THREATENED BY DAM-FAILURE FLOODING: SOME PROBLEMS REVEALED BY THE EXPERIENCE IN NEW SOUTH WALES

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ABSTRACT

The State Emergency Service, as the 'combat agency' for flooding in NSW, is responsible for planning to warn and evacuate communities at risk of dam-failure flooding. Plans have been prepared for numerous communities located downstream of dams with known deficiencies which could lead to failure, the relevant alarm systems have been or are being installed and the arrangements finalised on a case-by-case basis. Some problems have been encountered during the planning process, however, including difficulties relating to the definition of the hazard, the sometimes conflicting interests of players in the dam safety field, the resistance of some community members to information about dam failure, and the vexed question of ensuring that the planning is ready when it is needed. This paper describes these problems and some of the strategies which are being utilised to solve them.

KEYWORDS: *emergencies, flooding, warning, evacuation, population displacement.*

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INTRODUCTION

It is now about a decade since the dam safety community in New South Wales began to become aware of the scale of the potential dam failure problem in terms of the sheer number of dams, large and small, which could be categorised as being liable to failure. More than thirty of the state's dams have at some stage been declared as 'deficient' to the point that failure was possible, and while the problems of several of these structures have been rectified by engineering works most of them remain at a slight risk of failure. One of the consequences of the identification of the problem has been the necessity to plan for the warning and evacuation of people living downstream of these dams. The State Emergency Service, as the legislated 'combat agency' for flooding, is responsible for leading and co-ordinating the planning for floods caused or exacerbated by dam failure.

Past presentations by State Emergency Service personnel to ANCOLD conferences have described the development of the arrangements which have guided this planning (Haines, 1994; 1995) and the planning process itself, together with its products (Keys, 1992; 1996). The present paper revisits these themes briefly but focuses more specifically on the lessons which have been learnt as the planning has evolved.

THE ARRANGEMENTS

The State Emergency Service's early attempts to plan for potential instances of dam failure were hampered by inadequate data on the nature of the threat and by ad hoc approaches to the planning itself, and it soon became apparent that formal guidelines were needed to provide appropriate discipline and quality control for the whole process. These guidelines were developed after the establishment, in 1993, of the Emergency Management Sub-Committee of the NSW Dams Safety Committee. This body was charged with devising priorities for the planning work and ensuring that the State Emergency Service was provided with appropriate information on such things as likely failure modes, the time frames over which failure could develop, the areas which would be inundated and the travel times of flood waves. In addition, it formalised the communication between the State Emergency Service, the Dams Safety Committee and the owners of the dams themselves.

The State Emergency Service, meanwhile, was given the task of acting as the link between dam owners and the appropriate Emergency Management Committees at (Police) District and/or Local (Council) level. This was to ensure that dam-failure planning was integrated with the emergency management arrangements in the threatened areas.

THE PLANNING

Some planning has been done for all of the deficient dams for which dam break reports have been completed. The process has been a rather slow one, however, and the planning has not been equally detailed in all cases - a feature which will need to be addressed as future drafts of plans are prepared. In each case the dam owner has been involved in the planning process from the beginning and in negotiations on items such as warning system hardware (which, after all, must be paid for by the owner) and the contents of any campaign to educate the community about the threat and the arrangements which have been made to warn people and facilitate their evacuation.
The actual planning is incorporated within flood plans which are written to cover not

only dam failure but which also deal with 'natural' flooding. This convention, it is believed, will help keep the problem of potential dam failure more firmly in the minds of responders and others than would stand-alone dam-failure plans focussing solely on events which are likely to occur only infrequently. Plans need, after all, to be used periodically if their purpose is to remain apparent to those who must implement them: very rarely-manifested threats can be problematic in this regard because they do not reinforce themselves regularly in the minds of responders.

The actual arrangements for notifying agencies and for warning and evacuating people in advance of dam failure are being recorded in annexes to these plans along with descriptions of the problem, the areas which could be affected and the likely time frame of development of a dam-break flood. In recent times the convention has been adopted of organising the arrangements themselves in tabular form for each of a series of flood levels measured at the dam itself. These arrangements, in effect, form a 'plan within a plan' and cordon off the special response requirements necessitated by the extreme flooding which dam failure can normally be expected to bring.

Naturally, the planning seeks to observe the principles of emergency preparedness as they apply to the dam-failure threat. For example, the plans are being written to take account of worst-case scenarios represented by extremely fast-rising hydrographs. Moreover they recognise the principle that warnings must, as far as possible, be delivered more than once in a potential episode of dam failure and by a range of methods: this is to maximise the likelihood that the message will get through, be taken seriously and be acted upon appropriately. Thus radio and television will be used to provide warnings but more 'personalised' delivery modes such as telephone calls, pager messages and/or doorknocks will also be employed. (For a detailed discussion on the principles of flood warning, see Emergency Management Australia, 1995).

The plans also address the question of informing at-risk communities, in advance of any need to provide real-time warnings of a potential event, about the nature of the threat, the warning system and the sorts of responses that might be required of community members and the support that will be available to people having to evacuate. Such education is necessary to ensure that warnings will be understood and treated seriously when action is required in the face of fast-rising flooding of a scale well outside the community's experience.

People below the dams are informed of the threat and its management by various means. Public meetings have been held, newsletters and information packages provided, newspaper articles written, plans placed in local libraries and councils briefed. Where radios and pagers are installed, their periodic testing constitutes a means of reminding people of the existence of the problem. Often the educational effort integrates 'natural' and dam-failure flooding.

As far as possible, the planning of warning and evacuation arrangements is being done with input from the threatened community itself. In practice this is not difficult when the community involves only a small number of people, as is true in the cases of threatened areas below most of the small, council-owned dams. In these cases, meetings of the whole population likely to be affected can be held. The task is much more difficult, of course, when the at-risk community is very large as it is below major storages such as Hume, Warragamba and Burrendong Dams where those who could

be affected number in the thousands.

SOME LESSONS

In a relatively new field such as dam-failure planning, it is to be expected that numerous problems will arise and that devising solutions to them will bring a number of lessons. The past few years in New South Wales have constituted a significant learning experience for many people involved in the dam safety issue as they have grappled with problems relating to the appreciation of the hazard, the sometimes conflicting priorities and concerns of different agencies with roles to play, the need to establish and maintain contact with the people at risk of dam-failure flooding and the requirement that agencies maintain their readiness to deal with the threat. The following discussion examines these problems and notes some of the strategies that have been devised to deal with them.

Hazard Appreciation

Some of the early dam-failure studies failed to create a clear or complete picture, from an emergency management perspective, of the nature of the events for which planning for warning and evacuation was to be necessary. As a result, further information has had to be sought on matters such as the possible rate of rise of a flood between defined levels at a dam during the development of a Probable Maximum Flood: this information is critical to decision-making about alerting levels, warning strategies and evacuation arrangements. Equally, the extent of the downstream 'reach' of dam-failure flooding has not always been well defined, leading to uncertainty about the size and location of the population that could be affected.

For some of the smaller dams the rate of rise issue is especially critical from a response standpoint. In some cases it is clear that filling and failure could be extremely rapid - to the extent that it may be impossible to make warning and evacuation decisions as a dam-failure flood is actually developing. In such cases it will be necessary to design fully-automated warning systems capable of delivering pre-defined messages to people without the intervention of decisions and resultant actions as the flood rises. Such systems (incorporating, for example, automatic telephone dialling with taped messages) would be able to handle short lead-time events which are always difficult for humanly-managed response systems. It is likely, however that they will in some senses be **less** effective than systems in which direct human contact with at-risk residents occurs during the warning phase. Automatically-triggered systems will need to have their alarm levels very conservatively set, with attendant consequences for false alarms and, perhaps, for community confidence. Where a dam-failure flood evolves with substantially less speed than that which might occur in the worst case, of course, the automatic system could be manually over-ridden so that advice consonant with the problem as it was actually developing could be provided.

An alternative strategy which might be appropriate in some instances would be to 'buy' additional response time by maintaining an artificially low Full Supply Level. Given the low probability of dam failure, however, this solution is not likely to be welcomed by dam owners because of its impact on storage capacity. Where dams remain in existence despite no longer being used for water supply purposes, however, or where alternative supplies exist, the suggestion has merit and it has been instituted in one case.

Agency Concerns and Priorities

It cannot be expected that the interests and priorities of emergency managers and dam owners will always coincide, and some cases of conflict have arisen. Small councils can be a particular problem here: faced with a dam which has been declared deficient but whose probability of failure is low, council staff members and elected representatives are likely not to want to spend scarce resources on remedial works. The result can be that the emergency planning is completed while the installation of warning systems is delayed. This means that the management system is poorly co-ordinated and that progress towards educating the population at risk must wait. There have also been cases, it must be said, where dam owners have installed warning systems speedily and forced the emergency managers to catch up by completing the planning afterwards.

In some situations, dam owners have been guarded about the public disclosure of problems related to their dams to the degree that they have appeared not to wish to be involved in educating the downstream population about the potential need for them to evacuate. Again, the concern is understandable: dam owners legitimately fear the loss of control over information which could occur when issues relating to potential dam failure are aired in the public arena. Unfortunately, failure to engage a community on these matters may lead to a similar loss of control if rumours about a dam's condition are allowed to go unchecked. A potential problem here is that any public education effort which is mounted may be conducted against a background of misinformation and even public hostility and mistrust.

It might be noted here that if the public education is conducted for 'natural' and dam-failure flooding together, the potential dam-failure problem can more easily be kept in perspective. This should reduce the resistance of some stakeholders to the process.

Community Resistance to Information and Warnings

The community's reaction to information that it does receive about a dam-failure threat can also cause problems. A disclosure that a dam may constitute a threat to life and property is not likely to be welcomed, but at the same time the fact that the probability of failure is invariably low tends to encourage denial about the reality of the hazard - particularly if the dam has already been in existence for a long period of time without problems of its integrity having become clear to the community below it. Neither hostility to information nor denial of its message constitutes a helpful orientation from the point of view of those who wish to raise awareness or install warning devices so that people will be ready and motivated to act should failure become possible.

Warning devices, too, can be resisted. In the case of two dams in the state's cental west, planning to provide warnings of potential dam-failure events included the provision to householders of pagers via which warning messages were to be sent. The pagers were not imposed; rather they were accepted at meetings with the people at risk during which the problem of the dams' deficiencies were explained and the methods by which warnings could be transmitted were negotiated. The pagers appeared to have been accepted without demur - perhaps surprisingly, given their unfamiliarity to many people - and their installation was accompanied by operating instructions, the provision of spare batteries and demonstrations of pager utilisation. Thereafter the pagers were set off periodically, with the agreement of those who had accepted them.

Before long, however, it became apparent that resistance was developing. Some people, not attuned to the pager culture and perhaps fearful or disrespectful of the devices themselves, were allowing their batteries to run down without replacing them. Others returned their pagers to the dam owner. For several residents, the pager-activated element of the intended warning service can be said no longer to exist.

This is problematic in short lead-time environments where other means of personalised warning delivery - doorknocking, for example - are difficult to arrange within the appropriate time frame. At the very least, an element of redundancy is lost. At worst, a high level of reliance on uncertain means of contact (radio stations, for example) might be difficult to avoid.

It must be noted, of course, that these reactions are not the only ones which can occur and that cases of sober recognition of the reality of the problem can be cited. These appear to have led to acceptance of information and of the notion that warnings would be worth having should a dam-failure flood become possible. Ensuring such positive reactions in the whole of the population at risk is, of course, likely to be impossible.

Keeping the Planning Alive

It is well known truism that plans must be kept alive to remain effective in the sense of being ready for their purpose. Several dam-failure plans have been tested in New South Wales when flood levels have been reached at which particular actions were intended to be taken. The response record in these situations has not been perfect. In some instances the appropriate notifications have been made and other actions taken, but in one instance there was no communication from the dam owner to the State Emergency Service and accordingly no decisions were made as to whether warning procedures would need to be set in train or other actions instituted. In another case, a plan written to guide responses to potential dam failure was unknown in the relevant emergency management community less than a decade later. Turnover amongst emergency managers in the intervening period, and a failure to ensure that the plan was appropriately integrated within the local emergency arrangements, were to blame.

These represent instances of plans having died. Clearly, the message is that the plans have to be better maintained, reviewed, tested and practised if they are to be useful in the protection of the communities on whose behalf they are written. More resources will need to be dedicated to this aspect of the planning task in future to overcome the problem.

CONCLUSION

In New South Wales, dam owners and emergency managers have had considerable experience in developing management systems to protect people from potential cases of dam failure. A substantial amount of planning has been done, but this work has itself uncovered several problems in preparing for the severe and life-threatening flooding which such failures would create. Not all of these problems have been solved. More remains to be done by the dam safety community if an acceptable level of protection is to be provided to people who live below dams whose security is not guaranteed.

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