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Please note that some contributions to the *Australian Journal of Emergency Management* are reviewed. Academic papers (denoted by Ⓡ) are peer reviewed to appropriate academic standards by independent, qualified experts.

DISASTER RESILIENT AUSTRALIA

Foreword

By Kelvin Anderson, Director-General,
Department of Community Safety, Queensland.

Thirty-eight years ago, on Christmas Eve 1974, Cyclone Tracy devastated Darwin. Tracy killed 71 people, caused over A$800 million of damage, and destroyed more than 80 per cent of all homes. Some 36,000 of Darwin's 47,000 inhabitants were evacuated in an unprecedented disaster response operation. That operation was led by Major General Alan Stretton AO, CBE, the founding Director-General of Emergency Management Australia (then the National Disaster Organisation, (NDO).

Major General Stretton died on Friday 26 October 2012, aged 90. It is appropriate that this edition of the AJEM pays tribute to his leadership and achievement. Having only been appointed to the NDO just five months prior to the disaster, he was named Australian of the Year in 1975. He went on to lead the NDO until 1978 and served subsequently as a Member of the National Intelligence Committee. To help reflect his legacy and to connect it regularly to the emergency management sector of Australia, a meeting room at the Australian Emergency Management Institute is named the "Stretton Room".
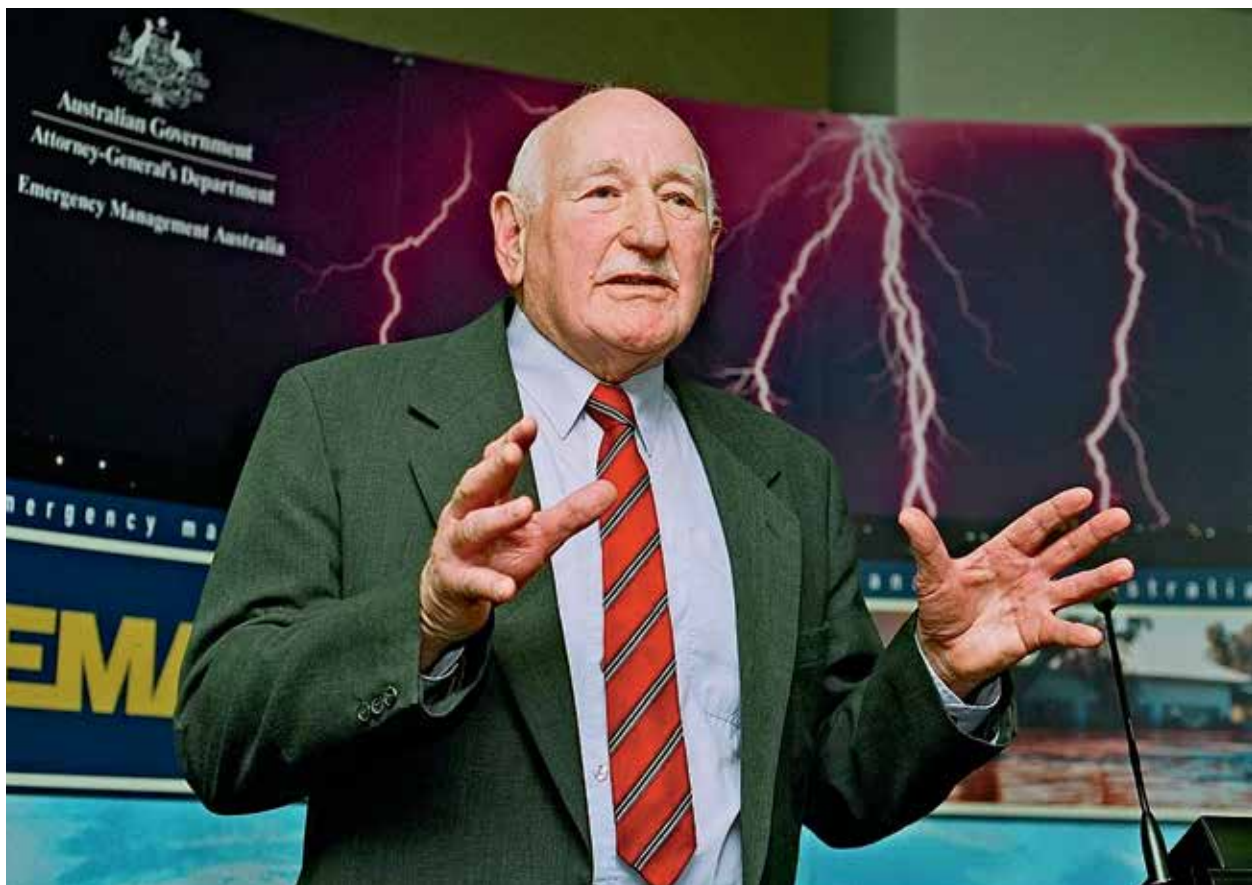
Major General Alan Stretton AO, CBE at the naming of the Emergency Management Australia 'Stretton Room'.

The impact of Cyclone Tracy is an extreme example of what we now call a catastrophic disaster: devastating tens of thousands of people and stretching the nation's resources to the limit. Few natural disaster events of that scale have occurred in Australia since 1974. But we are not complacent and, as the storm and bushfire season reaches its peak, remain vigilant in planning for a range of contingencies.

Disaster management has progressed significantly since 1974. Today, through the *National Strategy for Disaster Resilience* (NSDR), the Commonwealth and the States and Territories are jointly leading a broad range of initiatives to build community and organisational resilience. This is a shared responsibility for individuals, households, businesses and communities, as well as for governments at the local, state and national levels.

The strategy has a number of key actions—to lead change and co-ordinate effort, to understand risks, to communicate and educate people about risks, to partner with those who effect change, to empower individuals and communities to exercise choice and take responsibility, to reduce risks in the built environment, and to support capabilities for disaster resilience.

Some if not all of these concepts will have been in the minds of disaster managers for decades. In December 2009, COAG agreed to adopt a whole-of-nation resilience-based approach to disaster management that led to the single, coherent strategy of NSDR. The challenge now is to successfully implement the strategy through all tiers of government down to communities and individuals.

Today we also have crucial capabilities not available in 1974. One such is the ability to issue warnings in the form of sms text messages to mobile phones. Emergency Alert was given an important uplift in November 2012 through the ability to deliver messages based on the location of the mobile handset and not, as formerly, the service address of the mobile account. I acknowledge the tireless efforts of colleagues in Victoria and the Commonwealth to bring this important enhancement into service.

However, the essential doctrine of disaster management has not changed. Prevention, preparation, response and recovery are still best executed at the local level where we remain critically dependent on the commitment and skill of volunteers. The role of district, state and national tiers is to provide increasing levels of support to a threatened or impacted community. The front-line will always remain at the local level of communities and, ultimately, individuals.

Our understanding of and ability to counter the wide spectrum of natural disaster risks have come a long way since 1974. The business of disaster management is one of continuous improvement. Our resources are finite. Our ability to effect change is incremental. Meanwhile the risks to our growing communities are increasing.

The *Resilient Australia Awards* announced on 6 December 2012 and listed on page 52 of this edition show the quality, breadth and depth of the work underway to deliver better disaster management across Australia.

But we cannot be complacent; there is much still to do.

Kelvin Anderson

Director-General, Department of Community Safety, Queensland and Chair of the Capability Development Sub-Committee of the Australia – New Zealand Emergency Management Committee
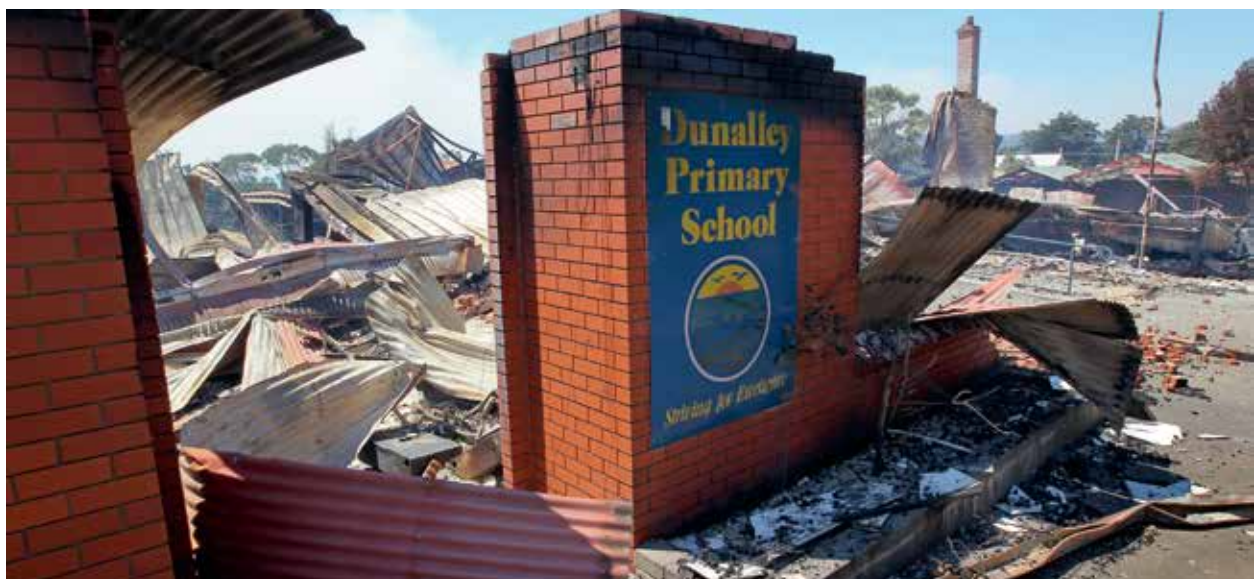
Dunalley Primary School outside Hobart after the January 2013 fires.

Standing Council on Police and Emergency Management

COMMUNIQUÉ

Creswick, Victoria, 23 November 2012

The Standing Council on Police and Emergency Management (SCPEM) met in Creswick on 23 November and was chaired by the Hon Peter Ryan MLA, Deputy Premier of Victoria and Minister for Police and Emergency Services. The Council promotes a co-ordinated national response to law enforcement and emergency management issues, and comprises Australian and New Zealand ministers for police and emergency management and a representative of the Australian Local Government Association. The following is the emergency management extract.

Emergency Management

Ministers discussed the considerable progress that has been made in implementing Australia's resilience-based approach to emergency management, in line with the objectives of the COAG endorsed *National Strategy for Disaster Resilience*.

Ministers noted recent achievements and work underway in a range of areas including enhancing emergency warning capabilities, flood mapping, disaster risk communication, and community engagement.

Understanding and communicating disaster risk

Ministers discussed a range of projects that have been completed to help raise community awareness and understanding of disaster related issues. This included the practical aspects of effectively communicating hazard and risk information and the role that risk registers play in this context, as well as ways to promote disaster resilience.

Ministers noted that guidance to assist practitioners communicate risk to the broader community will be incorporated into a new section of the *National Emergency Risk Assessment Guidelines*.

Left to right
NSW The Hon Michael Gallacher MLC, Minister for Police and Emergency Services, NZ The Hon Chris Tremain MP, Minister for Civil Defence, VIC The Hon Peter Ryan MLA, Minister for Police and Emergency Services (Chair), CTH The Hon Nicola Roxon MP, Attorney-General, Minister for Emergency Management, QLD The Hon Jack Dempsey MP, Minister for Police and Community Safety, CTH The Hon Jason Clare MP, Minister for Home Affairs and Justice.

Absent from photo
ACT Mr Simon Corbell MLA, Minister for Police and Emergency Services, NT The Hon Terry Mills MLA, Minister for Police, Fire and Emergency Services, NZ The Hon Anne Tolley MP, Minister for Police, SA The Hon Jennifer Rankine MP, Minister for Police and Emergency Management, TAS The Hon David O'Byrne MP, Minister for Police and Emergency Management, WA The Hon Troy Buswell MLA, Minister for Transport, Emergency Services, ALGA Ms Felicity-Ann Lewis, President, Australian Local Government Association.

Ministers also agreed to a new national slogan to promote disaster resilience in Australia – *Get Ready*. This slogan is underpinned by the *National Strategy for Disaster Resilience Communication Plan* six key messages

- disasters will happen
- disaster resilience is your business
- connected communities are resilient communities
- know your risk
- get ready, then act
- learn from experience.

Ministers considered that the use of a national slogan will contribute to more consistent disaster preparedness communication across Australia and will assist the public to recognise and retain key messages.

Research

Ministers acknowledged the importance of a whole-of-government approach to natural hazards and emergency management research. Research informs the understanding of risks posed by natural hazards and contributes to effective decision-making to respond to them. Ministers agreed to the development of a Disaster Resilience Cooperative Research Centre (CRC) application, incorporating the continuation of bushfire research. A multi-jurisdictional committee will be established to support the development of the CRC proposal to be chaired by New South Wales.

Knowledge management

Building disaster resilience through enabling jurisdictions, agencies and the community to access information and evidence is essential. To this end, the Commonwealth Attorney-General launched the Australian Emergency Management Knowledge Hub, a key online facility providing a research clearing house, cross-sectoral discussion forums and new media collaboration tools for the emergency management sector and the general community. The Knowledge Hub can be found at www.emknowledge.gov.au.

Enhancing disaster resilience capability

Recognising the importance of providing warnings during disasters, the Commonwealth Attorney-General and the Victorian Minister for Police and Emergency Services launched the deployment of major enhancements to the national telephone-based warning system, Emergency Alert. The enhancements will enable emergency services to send text messages to mobile phones based on the last known physical location at the time of an emergency. It is currently operational for Telstra customers and will be available for Optus and Vodafone customers by November 2013. This builds on the system's existing capability to send voice messages to landline telephones and text messages to mobile phones based on the user's registered address.

Ministers agreed in principle to commit to a nationally interoperable mobile broadband capability for public safety agencies and endorsed a national implementation plan. Ministers also agreed to align jurisdictional-specific public safety mobile broadband network planning with national interoperability principles. The successful delivery of this initiative will provide Australia's police and emergency service agencies with a robust capability that can be critically relied upon during natural disasters and other emergencies. This important body of work remains a significant priority for SCPEM.

Ministers noted progress made to strengthen the capacity of the Triple Zero emergency call service to handle surges in demand during extreme events. This includes the progressive roll out of a single, uniform telephone number across Australia for the State Emergency Service (132 500).

Disaster preparations for the 2012–13 summer

Ministers stressed the need for everyone within the community being prepared for the coming summer period. Ministers discussed the significant actions and investments that jurisdictions have undertaken to prepare for the 2012-13 summer, particularly in public education and awareness and in updating technical and hardware capabilities.

Ministers were advised that the Commonwealth will issue a new National Disaster Relief and Recovery Arrangements (NDRRA) Determination 2012 including matters arising from the Review of the Insurance Arrangements of States and Territories under the NDRRA Determination 2011 (Insurance Review). Ministers were also updated on the development of a national impact assessment framework to better target disaster relief and recovery assistance.

Learning from previous disasters

Previous disasters provide valuable lessons to governments, businesses and the community to ensure better preparation in the future. The Council is committed to ensuring that findings from significant reviews into previous disasters will be taken into consideration when enhancing Australia's disaster management framework.

Ministers noted issues of national significance arising from the *Queensland Floods Commission of Inquiry Final Report*. These issues are being addressed through the ongoing implementation of the *National Strategy for Disaster Resilience*.

Ministers were also given a presentation on the findings from the *Review of the Civil Defence Emergency Management response to the 22 February Christchurch Earthquake* which was released on 5 October 2012. The Australia-New Zealand Emergency Management Committee is currently reviewing the recommendations further to determine whether they apply to the Australian context.

An introduction to the Victorian Fire Services Commissioner and the 2021 Research Program

By Dr Holly Foster, Senior Researcher, Fire Services Commissioner Victoria.

FIRE SERVICES COMMISSIONER VICTORIA

Following the handing down of the Victorian Bushfires Royal Commission Final Report in 2010, the Victorian Government announced it would establish the new role of a Fire Services Commissioner. The Fire Services Commissioner is an independent statutory officer responsible to the Minister for Police and Emergency Services and the senior operational firefighter in Victoria.

Why a Fire Services Commissioner?

The Fire Services Commissioner oversees and works with the three Victorian fire services (Metropolitan Fire Brigade, Country Fire Authority and the Victorian Department of Sustainability and Environment) as well as Victorian SES, to better prepare for major fires and ensure the services can work as a unified and integrated team. The Commissioner has responsibility to promote and direct reform to increase operational capability, interoperability and resilience of the fire and emergency services, and how they can work with others.

The work of the Fire Services Commissioner provides leadership, support and expertise and works consultatively with the Victorian fire services to develop an ongoing program of improvement and reform. It has responsibility to ensure the longer-term needs of the Victorian community are understood, represented, and acted on. It also provides the foundation for improving the integration and performance of the fire services.

The Victorian Emergency Management Reform White Paper – December 2012

The Victorian Government released the *Victorian Emergency Management Reform White Paper*. The White Paper outlines a strategic reform pathway for the emergency management sector in which the new Emergency Management Commissioner (EMC) will play a prominent role. The Commissioner's work is towards a genuine all-hazards, all-agencies approach continues

Image: Keith Pakenham

The devastating events of Black Saturday led to a Royal Commission which recommended the establishment of a Fire Services Commissioner. *Princes Way, Longwarry, Victoria, 7 February 2009.*

The Victorian Emergency Management Reform White Paper recognised the need to continue placing the community at the centre of emergency management design and delivery.

Image: courtesy CFA

with a stronger focus and mandate across emergency management and emergency management organisations. The EMC replaces the Fire Services Commissioner.

The 2021 Research Program (2021)

In pursuing the task of identifying and analysing changes across the Victorian community, the Fire Services Commissioner recently welcomed a transfer of the Climate Change Research Project and has shaped the project to reflect current sector needs and interoperability objectives.

Now known as the 2021 Research Program (2021), the project identifies and analyses the likely challenges across the Victorian landscape. The research program capitalises on its predecessor's strong adaptation focus of identifying the key impacts of climate change on the Victorian emergency services sector. However, 2021 embodies a broader research agenda, examining other anticipated changes occurring alongside increasing climate variability. The research scope adds value to the sector; providing a holistic and robust method to explore the impacts of climate change alongside other anticipated changes in the environment, economy and community.

The program works with a variety of stakeholders within the sector and research fraternity, minimising research duplication and concentrating outputs on the implications for emergency management and emergency management organisations.

Program philosophy

The 2021 program aims to build the evidence of change in Victorian communities by highlighting the drivers of change, describing the likely impacts on emergency management, emergency service organisations and promoting pathways for adaptation.

In doing so, the program considers research questions such as:

- What factors are driving change in communities?
- How will these changes impact
  - the provision of emergency management, and
  - emergency service organisations and their stakeholders?
- How might these changes be addressed?
- What barriers/facilitators of adaptation exist?

Program design

The program consists of a series of major projects that explore the social, economic and environmental changes in key community segments. It attempts to build a macro-level, integrated perspective of change across Victoria and make meaning of the identified changes for the emergency services sector.

This research is not intended to answer all questions or all issues for organisations that deliver emergency management programs, products and services. It will, however, highlight issues and changes that may require further analysis and understanding from the emergency services sector.

Fire Services Commissioner's 'Strategic Issue Series'

The Fire Services Commissioner will publish a series of papers over the 2013 editions of the *Australian Journal of Emergency Management*. This series is designed to provoke thought, evoke new ideas and encourage adaptation within the emergency management sector.

These papers form a Strategic Issues Series and report key findings and themes identified in the 2021 research program. While the project concentrates on trends within Victoria the strategic impacts of change are relevant to the wider emergency management community. The papers are designed to stimulate discussion and promote joined-up thinking across emergency services agencies throughout Australia.

This edition of the *Australian Journal of Emergency Management* features the first publication from this research program (carried out under the Office of the Emergency Services Commissioner) in the following article.

Interactive hazard preparation strategy efficacy: considerations for future community engagement programs

Dr Holly Foster provides findings from two primary research case studies on interactive community engagement strategies.

ABSTRACT

The emergency services have assumed a significant role in building resilience in Victoria. The extent of instruction, advice and information provided by emergency service organisations is critical to engage communities to prepare for hazards. To better engage communities, some agencies have adopted face-to-face, interactive community engagement strategies. These strategies can be effective as they overcome many barriers of passive information transfer. This paper forms part of a larger research project exploring the efficacy of community engagement programs in the emergency management sector. This paper explores the benefits and limitations of interpersonal community engagement strategies, highlighting implications for future engagement undertakings. ⓡ

Introduction

Extreme weather events such as bushfire, heatwaves, storms and floods have occurred more frequently, with greater ferocity and, in some cases, longer duration (Hennessey 2011, Jones 2011). In addition to response and recovery responsibilities, the Victorian emergency services sector has assumed communication roles within their communities. The community engagement functions of emergency service organisations (ESOs) include:

• education on different climate hazards
• providing timely and accurate warnings
• preparation advice, and
• response and recovery advice.

In assuming these roles, many communities have become dependent on ESOs for advice, warnings, instruction and physical assistance during severe events. The level of detail of these messages has increased, with some communities expecting address-specific warnings and preparation information (Comrie 2011).

Community resilience

Community resilience is a multi-disciplinary phenomenon: a function of different elements within a social system. A resilient system is one that functions well under stress, can successfully adapt, is self-reliant and displays social capacity (COAG 2011). The extent of disruption to any of these elements can influence the impact of an extreme event within a community.

Developing and empowering communities to recognise and manage disruption can reduce the time, involvement and resources of ESOs post-disaster (Dufty 2011, Cutter *et al.*, 2010). The extent to which individuals prepare themselves for climate hazards can be encouraged through community engagement at the individual and household level (COAG 2011, Paton *et al.*, 2010, Tompkins and Adger 2004).

Community engagement

Community resilience can, in part, be bolstered by engaging with communities about their roles and responsibilities in preparing for extreme weather events. However, numerous contextual factors mediate the impacts of these strategies (Hartel and Pearman 2010, Stern 2002). This is because sustained hazard preparation is a function of how people interpret information, social and community contexts (Frandsen *et al.*, 2011). Figure 1 depicts some of the broad factors influencing the impacts of engagement strategies.

FIGURE 1. Factors influencing community engagement.
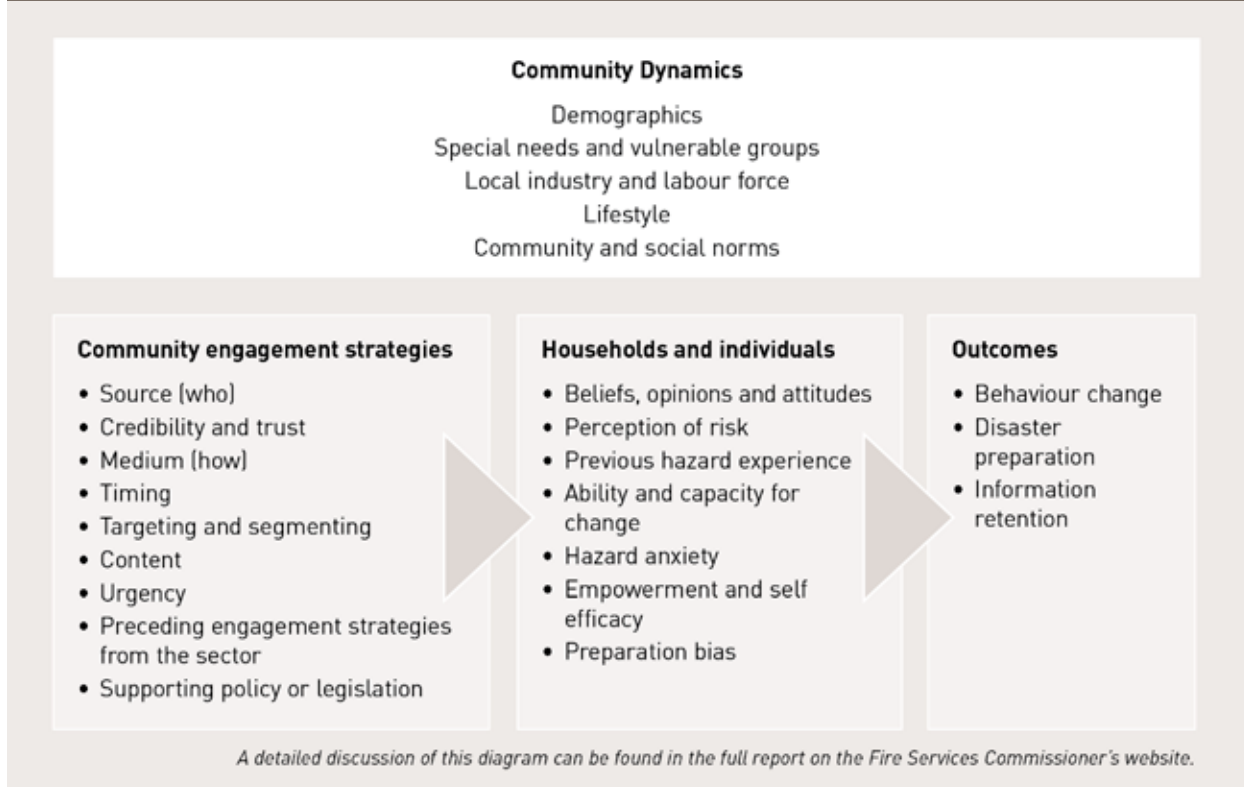
Figure 1 demonstrates that many forces influence information retention and preparation uptake of households. The process is also influenced by the degree to which message transfer is passive (Paton 2008, McIvor and Paton 2007). The availability and/or transmission of generic disaster mitigation information does not ensure its understanding or acceptance as it fails to:

- meet the diverse needs of communities
- explain the significance of risks and how they will impact individual households, or
- offer personalised, specialised solutions for households to mitigate their risk (Frandsen *et al.*, 2012, Paton 2008, Paton and Johnston 2001).

To overcome known barriers to information transfer and instigate preparation activities in the community, some emergency service agencies are developing personalised, face-to-face community engagement strategies. These strategies enable agencies to tailor engagement activities to the unique characteristics of the communities in which they work and the context of their environment. Purpose-built, tailored engagement activities are being developed that:

- deliver complex messages and hazard information
- justify to individuals and households the need to act
- provide personalised advice and recommendations of how to act
- provide real-time, two-way communication
- allow for perceptions of 'credible' message sources (via experts), and

- support, through supplementary information (written material), rather than dependent on it (Spittal *et al.*, 2011, Paton 2007, Dann and Dann 2005, Tompkins and Adger 2004, Nielsen and Lidstone 1998).

Engagement strategies that consider these factors are more likely to result in campaigns that promote information retention, including uptake of disaster mitigation activities (CFA 2011, Paton and Wright 2008, Paton 2007). This study explores the impacts of these strategies by exploring the extent of behaviour uptake, the information retention and the contextual factors influencing these actions.

Research design

The literature recognises that hazard awareness, understanding and preparation are important aspects of community resilience. The aim of this paper is to explore the efficacy of interactive engagement strategies in instigating hazard preparation and information retention.

This paper examines how households have responded to the engagement strategies of two different ESOs. The first strategy explored is the Victorian State Emergency Services (VIC SES) 'Community Education Doorknocks'. The second strategy explored is the Country Fire Authority's (CFA) 'Home Bushfire Advice Service' (HBAS). These strategies focus on preparing for different hazards – bushfire and floods – and were carried out in different geographic locations.

FIGURE 2. Retention of written information.

FIGURE 3. Acted on preparation advice.
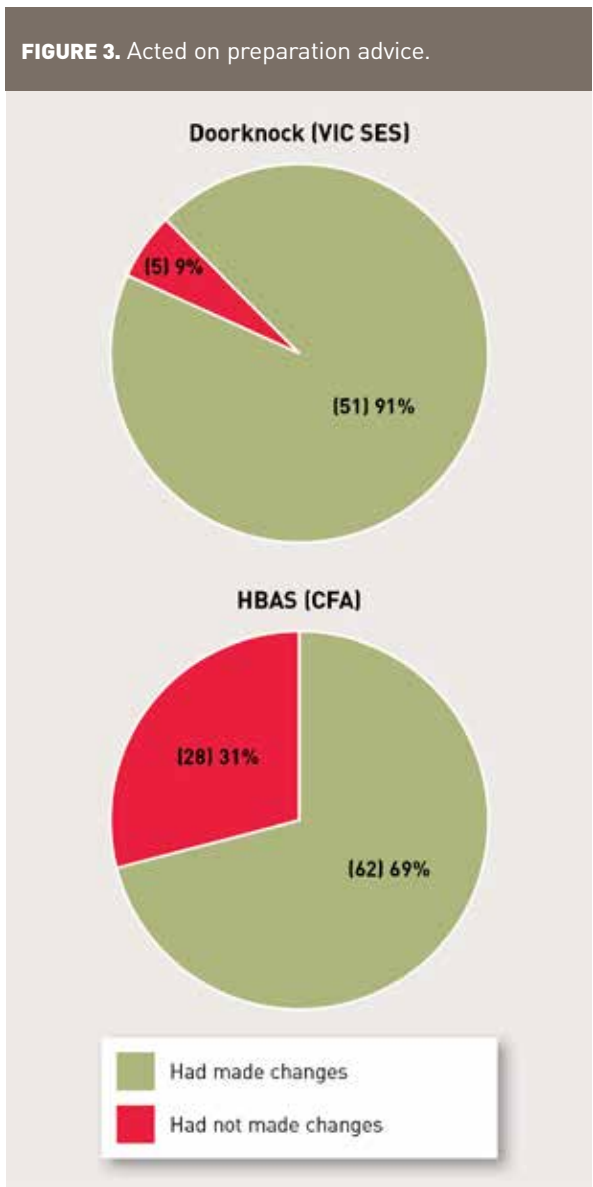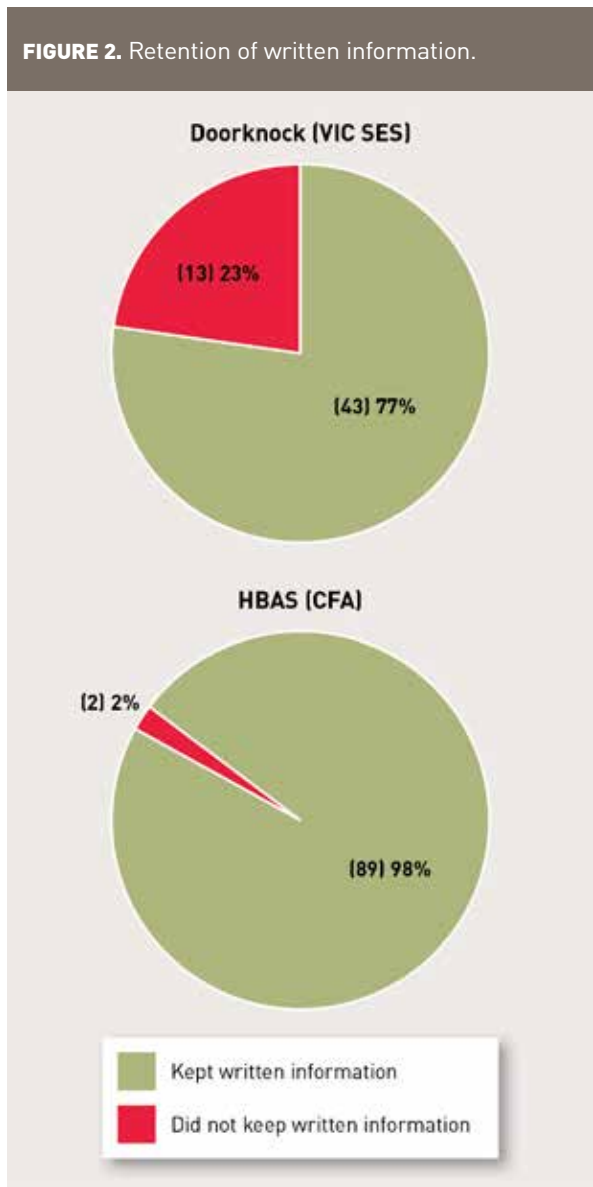
The VIC SES doorknock campaign was developed in collaboration with several working partners. It involved pairs of volunteers visiting households at risk of over-floor flooding. Volunteers discussed with householders the possible impacts of flood and ways to minimise those impacts by preparing effectively. An information kit was used to guide discussion and a copy was left at the household at its conclusion. The doorknocks were carried out without prior notification and, in cases where no one was home at the time of the doorknock, an information kit was left on the doorstep with an invitation for the householder to contact the VIC SES for further information, or arrange a time to call back (VIC SES 2011).

The HBAS is a free service offered by the CFA and involves a Fire Safety Officer visiting the property to provide specialised information on reducing the risk of bushfire. A follow-up written report summarising key points made during the assessment is posted to householders one to two weeks after the HBAS has been completed (CFA 2011). Householders are able to book a HBAS by contacting their local CFA.

The engagement activities outlined employ some commonalities, including:

- face-to-face interaction
- visit to the homes of community members
- provision of specific information relevant to their household, and
- provision of supplementary, written information to prepare for the hazard.

The engagement activities also have some noteworthy differences, including:

- the CFA engagement strategy is instigated by the householder and a suitable time is determined
- the VIC SES engagement strategy is instigated by the agency and is carried out without a time being pre-arranged with the household
- the CFA engagement strategy has been running for three years, and
- at the time of the study, the VIC SES engagement strategy was in pilot phase.

Sample

A targeted sampling method was used to ensure respondents surveyed had participated in the engagement strategies being studied. The scope was narrowed to two suburbs where either engagement campaign had been carried out—the CFA HBAS in a peri-urban suburb and the VIC SES doorknock in an urban suburb. Both suburbs had recent experience with the hazard under study (that is, fire in the HBAS study area and flood in the doorknock study area). Contact details of participants were provided by each agency and the survey carried out within three months of the engagement activities being performed.

The study surveyed 90 participants of the HBAS and 106 households doorknocked by the VIC SES. Of those contacted, 50 householders did not recall being doorknocked by the VIC SES or that they had received an information kit. Of the 56 respondents that were familiar with the doorknock, 27 were present and interacted with volunteers, while 29 respondents were absent, but received an information kit.

Results

The following extracts from the larger research report detail some of the findings.

Retention of written information

Both the CFA and the VIC SES engagement programs provided supplementary, written information to households about preparing for climate hazards.

Figure 2 shows that 98 per cent of respondents (89 people) who participated in the HBAS kept their written report, while 77 per cent of respondents (43 people) doorknocked by the VIC SES kept their information kit.

Changes made as a result of information provided

Participants in this study were asked if they had acted on the advice by adopting changes or suggestions made to prepare for climate hazards. The results are displayed in Figure 3.

Figure 3 demonstrates that nine per cent of respondents (five people) adopted recommendations made during the VIC SES doorknock. Respondents who were doorknocked by the VIC SES had developed emergency plans, repaired gutters and made other structural changes to prepare for flood.

In contrast, 69 per cent of respondents (62 people) adopted recommendations made from the HBAS. These participants had cleared gardens, purchased fire fighting equipment or generators, and relocated combustible materials.

What prevented households making changes?

Respondents were asked to explain what, if anything, had prevented them from adopting recommendations to prepare for climate hazards.

Table 1: Barriers to preparing for hazards

Doorknock (VIC SES)	HBAS (CFA)
Too busy/No time	Cost/Expense
Not at risk - does not flood much	Nothing stopping us making changes
Not at risk - home is elevated	Too busy/No time
Cannot be bothered	Amenity/Landscape
Nothing stopping us making changes	Council regulations

Table 1 shows the top five barriers participants believed prevented them from taking on suggestions to prepare for climate hazards. The most frequent barrier for preparing for flood was time. However, the data indicate collectively that the perception of flood risk was low and this prevented many householders from preparing. Many respondents expressed they were not at risk due to the infrequent occurrence of floods or, alternatively, the elevated location of their home. Some respondents admitted that 'they could not be bothered' and admitted nothing was preventing them from acting on the information provided. In addition, the cost of some suggestions made during the HBAS deterred participants from taking on the changes. It was noted that many changes adopted by HBAS recipients were 'low hanging fruit'—non labour intensive and inexpensive property modifications. However, other amenity and landscape preferences overrode the urgency to make changes. Some respondents indicated that while they could afford to make changes (such as fit metal shutters, remove sky lights, change roofing material), they refused to compromise the aesthetics of their home.

What motivated or facilitated households making changes?

Respondents were asked to explain what, if anything, had motivated them or facilitated them in adopting the advice to prepare for climate hazards.

Table 2 shows that those who had adopted advice from the VIC SES (five people) were primarily motivated by their previous experience with flood. This data suggests the engagement instigated few people making tangible changes to prepare for flood. However, the study also found householders who were present and interacted with volunteers during the doorknock were more likely to have read the information kit, kept it (not thrown it out), and be able to recall key flood messages from the written information.

Table 2 illustrates that respondents who participated in the HBAS were motivated by the specialised information provided by the Fire Safety Officer during the HBAS. Many respondents stated the personalised information encouraged their hazard preparation actions.

Table 2: What motivated or facilitated households to prepare for hazards

Doorknock (VIC SES)	HBAS (CFA)
Previous experience with flood	Getting an assessment from CFA
	Advice given from the Fire Safety Officer
	Being told explicitly what to do
	Better understanding of what changes are required
	Being better informed

Action taken to prepare for more frequent and severe events

In closing the survey, participants were asked to comment on their likely response if, as expected, climate events become more frequent and severe. The five most frequent responses from either sample are shown in Table 3.

Table 3: Likely actions for more frequent and severe events

Doorknock (VIC SES)	HBAS (CFA)
Move out of area	Leave on high fire danger days
More rigorous property maintenance	More rigorous property maintenance
Would not change/just live with it	Will leave and not defend home
Modify home or property	More thorough home bushfire plan
More thorough emergency plan	Move out of area

Table 3 demonstrates that householders who participated in the VIC SES doorknock were less likely to adopt practical, tangible actions (or behaviours) to prepare for increased occurrences of flood. A third of respondents (18 people) stated they would move, 14.5 per cent (eight people) indicated they would make structural changes to their property, while 13 per cent (seven people) said they would not make any changes and 'deal with' higher instances of disruption.

In contrast, householders who participated in the CFA HBAS were more likely to adopt new, or increase existing prevention strategies. Most respondents (32.7

per cent, 29 people) said they would leave on high fire danger days, 20.4 per cent (18 people) said they would prepare their homes more rigorously while others (17.7 per cent, 16 people) said they would leave early and not attempt to defend their home.

Summary

This study highlights the intuitive, practical efforts of two Victorian ESOs and their working partners to promote tailored, hazard-preparedness messages to their communities. While only a small sample, this data demonstrates that interactive engagement activities can be effective in instigating hazard preparation and information retention. However, subsequent desired action by householders depends on a number of variables. Table 4 summarises the most salient of the contextual contrasts identified in the larger research study that may have moderated householders preparing for climate hazards.

While the study was limited by its small sample size, the data shows that interactive community engagement strategies are useful to adapt to the heterogeneous needs of communities. However, the willingness, capacity and readiness of communities to prepare for hazards depends greatly on the community context, perceptions of the risk and varying levels of engagement within the community. Identification and analysis of these issues is important to ensure continuous improvement of engagement strategies, to better target information to the nuances of communities and, ultimately, strengthen community resilience.

Strategic issues

Interactive community engagement strategies are a useful tool in educating communities about hazard preparation. In many places, community expectations have evolved to anticipate increased levels of detail and personalisation of emergency messages. The following list outlines opportunities and challenges to adapt to community engagement functions.

Supporting legislation for agencies to perform their functions

To advance the community engagement function of ESOs, a review of supporting legislation is necessary to remove ambiguities and make explicit 'implied' roles. Community engagement functions require specification to avoid task duplication, foster task ownership and encourage an ethos for evaluation and continuous improvement of strategies.

Importance of partnerships and networks

Partnerships and strategic networks are essential in building message credibility and targeting audiences. The development and sustainability of strategic relationships is integral to delivering robust, effective community engagement now and into the future.

Table 4: Contextual differences between the VIC SES doorknocks and CFA HBAS

Context	VIC SES	CFA
Extent of interaction with agency staff - extent of engagement and ability to discuss the householder's property, answer questions and provide verbal advice (Spittal et al., 2011, Wiseman et al., 2010, Stern 2002).	Participants present during the doorknock (27 people) had high information retention. Those absent during the doorknock retained less hazard information and made no tangible changes.	All households surveyed actively participated in the HBAS. They had high information retention and many acted on preparation advice.
Credibility of the threat of the hazard to the household - does the householder believe the hazard is likely to occur and/or be disruptive (Dann and Dann 2005, Mileti and Peek 2002)?	Many respondents did not perceive flooding was likely to occur and, if it did, would not affect them, impacting their behaviour.	Many respondents in the survey recognised they lived in high fire danger areas and perceived the risk of bushfire to their home as credible.
Extent of marketing and other information sources - has the campaign been promoted through other communication channels or have working partners which bolster message credibility (Johnston et al., 2012, Chia 2010)?	The agency worked with key partners to develop the doorknocks. Moderate advertising was used to promote the doorknocks.	The agency advertised through numerous channels and worked with key partners to promote the service.
Previous experience - has the household or any of its members had experience with the hazard under investigation (Johnston et al., 2012, Paton 2007)?	The five participants in the study who prepared for the hazard were motivated by previous flood experience.	Most respondents had not experienced (first hand) bushfire in their area, although the memory of recent bushfires was prevalent in the sample.
Engaged community - how engaged is the community with local hazards and their personal responsibilities in preparing for them (Frandsen et al., 2012, Hartel and Pearman 2009, McIvor and Paton 2007)?	Many respondents did not perceive the need or personal responsibility to prepare.	Many respondents believed they were responsible for their own safety and took action accordingly.

Further discussion on social and contextual factors moderating household preparation activities can be found in the full report.

Viability of face-to-face engagement strategies

While effective, interpersonal, interactive engagement strategies are time and labour intensive. Agencies will have to determine the viability of these intensive campaigns in the long-term, particularly when carried out by volunteers.

More people living in new and more challenging environments

Population projections across Victoria suggest population growth in fringe areas and greater population transfer. This means there will be more people without existing knowledge of hazards living in a range of hazard-prone areas. There will be an ongoing need to educate, inform and find new ways of sharing local hazard information to these communities.

Increased frequency and ferocity of events

While only a small sample, this study has indicated that people have vastly different responses to the notion of increased climate hazards. This is dependent on where they live and (among other factors) home ownership. Building knowledge of hazards that will move with people will create greater resilience across Victoria.

Outsourcing or collaborating in future community engagement strategies

ESOs carry out concurrent community engagement campaigns across Victoria, targeted at different climate hazards. These campaigns are often challenged by budget and staffing constraints. Collaborating future engagement campaigns to create synergies and efficient use of resources may offer opportunity for greater message penetration, credibility and potentially bolster preparedness for all hazards.

Furthermore, some agencies may be more equipped than others to carry out community engagement functions. There may be opportunities to outsource these capabilities to other organisations as the task of community engagement becomes increasingly critical to establish and sustain community resilience.

References

Country Fire Authority, 2011 *Evaluation Report: Evaluation and effectiveness project. CFA, Victoria.*

Chia J., 2010 *Engaging communities before an emergency: developing community capacity through social capital investment. The Australian Journal of Emergency Management, 25(1): 18 – 22.*

Council of Australian Governments (COAG), 2011 *National Strategy for Disaster Resilience: building the resilience of our nation to disasters. COAG: Australia.*

Comrie N., 2011 *Review of the 2010–11 Flood Warnings and Response. Victorian Government, Melbourne.*

Cutter S. L., Burton C. G., and Emrich C. T., 2010 *Disaster resilience indicators for benchmarking baseline conditions. Journal of Homeland Security and Emergency management, 7(1): 20 pages.*

Dann S. and Dann S., 2005 *Social Marketing and Behavioural Change Strategies. Queensland Department of Premier and Cabinet: Australia.*

Dufty N., 2011 *Engagement or education? The Australian Journal of Emergency Management, 26(3): 35-39.*

Frandsen M., Paton D. and Sakariassen, 2011 *Fostering community bushfire preparedness through engagement and empowerment. The Australian Journal of Emergency Management, 26(2): 23-30.*

Hartel, C. E. J., and Pearman, G. I., 2010 *Understanding and responding to the climate change issue: Towards a whole-of-science research agenda. Journal of Management & Organization, 16(1): 16-47.*

Hennessey K., 2011 *'Climate Change Impacts', in Climate Change: Science and solutions for Australia. Eds. Cleugh H., Smith M. S., Battaglia M. and Graham P. CSIRO: Australia.*

Johnston D., Becker J. and Paton D., 2012 *Multi-agency community engagement during disaster recovery: Lessons from two New Zealand earthquake events. Disaster Prevention and Management, 21(2): 252-268.*

Jones D., 2011 *Extreme weather events: The new norm? 'The Association of Public-Safety Communications Officials Australasia', conference proceedings.*

McIvor D. and Paton D., 2007 *Preparing for natural hazards: normative and attitudinal influences. Disaster Prevention and Management, 16(1): 79-88.*

Meliti D. S. and Peek L. A., 2002 *'Understanding individual and social characteristics in the promotion of household disaster preparedness'. In New Tools for Environmental Protection: Education, Information and Voluntary Measures. Washington DC: The National Academies Press*

Nielson S. and Lidstone J., 1998 *Public education and disaster management: is there any guiding theory? The Australian Journal of Emergency Management, Spring: 14-19.*

Paton D. and Johnson D., 2001 *Disasters and communities: vulnerability, resilience and preparedness. Disaster Prevention and Management, 10(4): 270-277.*

Paton D. and Wright L., 2008 *'Preparing for bushfires: The public education challenges facing fire agencies'. In Community Bushfire Safety. Eds. Handmer J. and Haynes K. Bushfire CRC, Australia.*

Paton D., 2007 *Preparing for natural hazards: The role of community trust. Disaster Prevention and Management, 16(3): 370-379.*

Paton D., 2008 *Community resilience: Integrating individual, community and societal perspectives'. In The Phoenix of natural disasters: Community Resilience. Eds. Gow K. and Paton D. Nova Science Publishers Inc: New York.*

Paton D., Frandsen M. and Johnston D., 2010 *Confronting an unfamiliar hazard: Tsunami preparedness in Tasmania. The Australian Journal of Emergency Management, 25(4): 31-37.*

Spittal M. J., McLure J., Siegert R. J. and Walkey F. H., 2011 *Predictors of two types of earthquake preparation: Survival activities and mitigation activities. Environment and Behaviour, 40(6): 798-817.*

Stern P. C., 2002 *'Changing behaviour in households and communities: What have we learned?' In New Tools for Environmental Protection: Education, Information, and Voluntary Measures. Washington, DC: The National Academies Press.*

Tompkins E. L. and Adger W. N., 2004 *Does adaptive management of natural resources enhance resilience to climate change? Ecology and Society, 9(2): 10*

Victorian State Emergency Service (SES), 2011 *Community Education Plan: Local Municipal strategy and activity plan. October 2011 – Draft. SES: Melbourne.*

Wiseman J., Williamson L. and Fritze J., 2010 *Community engagement and climate change: learning from recent Australian Experience. International Journal of Climate Change Strategies and Management, 2(2): 134-147.*

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This paper forms part of a larger research report carried out under the Office of the Emergency Services Commissioner, supported by the then current Project Manager, Julie Hoy.

The complete report is available at http://www.firecommissioner.vic.gov.au/our-work/research/climate-change/.

In search of the 'Prepared Community': the way ahead for Australia?

Roger Jones OAM provides a perspective on the 'prepared communities' concept and methodologies. Ⓡ

Introduction

Since the late 1980s, a key concept in Australia's approach to emergency and disaster management has been the need to develop 'the prepared community', whose basic requirements are summarised as:

- 'an alert, informed and active community which supports its voluntary organisations
- an active and involved local government, and
- agreed and co-ordinated arrangements for prevention, preparedness, response and recovery' (Natural Disasters Organisation 1989).

The most recent statement of national emergency management concepts and principles still refers to the 'prepared community' as an *element* in Australia's 'integrated approach' to emergency management, with that approach requiring co-ordination between the 'prepared community' and the 'efforts of governments, all relevant organisations and agencies' (EMA 2004).

This paper argues that:

- While considerable early effort between 1994-2004 was devoted to the development of an effective emergency risk management tool which had application in Australian communities, that earlier work has been effectively abandoned.
- While there have been significant international developments promoting the concept of the 'prepared community' as central to effective national emergency management policy, more recent developments have focussed largely on the community's 'shared responsibility' for responding to events.
- There is a clear and urgent need, both in Australia and overseas, for the development of a new and effective 'prepared community' concept and methodology.

An early Australian approach to community emergency risk management

In 1996 Emergency Management Australia (EMA) convened a workshop at its research and teaching establishment, the Australian Emergency Management Institute, to consider the application of the risk management standard and concepts to emergency management. This followed new international studies into the management of risk factors in disasters (Blaikie *et al.* 1994) and the publication of a new Australian/New Zealand Standard, AS/NZS 4360:1995 – Risk Management[1].

The three-day workshop concluded that effective risk management at community level is fundamentally about *managing the vulnerability of communities to risks*, recognising that 'vulnerability' is a function of community susceptibility and resilience to hazards. It was agreed that a variety of indicators were required when assessing vulnerability (e.g. demographic, health, economic, societal/cultural and physical factors). The workshop's principal recommendations were that:

- Australian emergency management embody a risk management approach, and
- guidelines (based on the Standard) be developed appropriate to the Australian 'emergency management industry' (EMA 1996).

The workshop outcomes were accepted in 1997 by the then National Emergency Management Committee (NEMC) and in 2000 EMA published the *Emergency Risk Management – Applications Guide* (revised and reissued as EMA 2004), as part of its Australian emergency management series of publications and resulting from studies by a national working party. A guide to emergency risk management for facilitators working with committees and communities was produced by EMA in 2001.

Severe flooding in central Queensland in 1997 led to the Queensland Department of Emergency Services (QDES) commissioning a flood risk study in the rural Murweh Shire, a particular requirement being that it should be undertaken in the context of the risk management

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1. It needs to be recognised here that AS/NZS 4360:1995 (and its current version, AS/NZS ISO 31000:2009) is essentially a process for managing risks within an *organisation*, and thus needs interpretation and modification in order to be applied to the management of *community safety risk*.

standard, AS/NZS 4360:1995. For the purposes of the study EMA authorised the use of material developed in the 'Applications Guide' working party process. The study's final report (Geo-Eng Australia Pty Ltd 1998), published in May 1998, included the outcomes of community consultation processes and vulnerability profiles based on the EMA workshop material.

The Queensland Government later commissioned a further study in three largely-urban coastal environments, using the process and methodology developed for Murweh Shire but in a multi-hazard application. The outcomes of both sets of studies were reported in the Winter 2001 issue of this journal (Durham *et al.* 2001). On the basis of these studies a refined community emergency risk management methodology and process was made available to all local governments in Queensland (Zamecka and Buchanan 1999).

It appeared that Australia was entering the first decade of the 21st Century well placed to develop a new approach to the concept of 'the prepared community' with the EMA and QDES community emergency risk management publications, both based on verifiable field practice, freely available.

Meanwhile, a new paradigm was developing internationally

During the 1980s and 1990s, the dominant paradigm in international emergency management theory had developed from a 1979 US National Governors Association workshop which identified the key emergency management elements as *mitigation, preparedness for response, response and recovery* (National Governors Association 1979).

In 1994, the mid-point of the International Decade of Natural Disaster Reduction (IDNDR), an international conference in Yokohama, Japan agreed the *Yokohama Strategy and Plan of Action for a Safer World*. The subsequent World Conference on Disaster Reduction was held in early 2005 at Kobe in Japan's Hyogo Prefecture. The conference produced the *Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters (HFA)*[2] which, having identified specific gaps and challenges in existing programs, adopted three strategic goals and five related priorities for the 2005-15 period.

The HFA follows in the footsteps of IDNDR in focussing on disaster risk reduction within the context of 'building resilience to hazards'. It clearly incorporates risk reduction processes into the full range of emergency management program areas—prevention, preparedness, response and recovery.

One of the outcomes of HFA was the formation of the Global Platform for Disaster Risk Reduction forum which meets every second year. The forum brings together national governments, relevant UN and regional agencies, and the non-government sector to maintain 'the world-wide momentum of disaster risk reduction'.

By late 2012, under Global Platform arrangements, 78 countries had nominated National Platforms and Focal Points for disaster risk reduction. A National Platform was defined as 'a nationally owned and nationally led forum or committee for advocacy, coordination, analysis and advice on disaster risk reduction', while National Focal Points are the designated national government agencies responsible for national DRR policies and programs[3]. Some regions have also established Regional Platforms and Focal Points.

At its 2009 meeting, the Global Platform group considered a detailed report, the *Global Assessment Report (GAR)*. Based on evidence from reviews conducted in some 62 countries and on additional commissioned research, GAR highlighted what it identified as 'the need to strengthen capacities to address three disaster risk drivers: poor urban governance, vulnerable rural livelihoods, and ecosystem decline'.

The 2009 meeting concluded that 'most countries still lack a determined and focussed high-level policy framework that addresses these drivers' and that 'the institutional and administrative responsibility for risk reduction has to be vested at the highest possible level of government, in order to have the necessary political authority and resources to influence development policy'.

The Global Platform report of its meeting in 2011[4] identified that there has been only marginal improvement in disaster risk reduction on a global scale, in spite of the hard work and good intentions of UN agencies and the 168 nations which endorsed the Hyogo Framework in 2005 and a number of significant initiatives which had been undertaken by some regional and national entities. The main aim of the 4th Session of the Global Platform to be held in Geneva in May 2013 seeks to '...continue the effort from all sectors ... to take shared responsibility in reducing risks and reinforcing resilience in our communities'[5]. It is anticipated that it will also provide an opportunity to consult on and progress the development of the successor to the *Hyogo Framework for Action 2005–2015*.

There is growing acceptance within the international community over the relationship between disaster risk reduction (DRR) and disaster management (DM)[6]. Disaster management (or emergency management in US, Australia and some other jurisdictions) is defined as

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2. UN A/CONF.206/L.2/Rev.1 (22 January 2005)

3. http://www.preventionweb.net/english/hyogo/national/list/

4. http://www.iisd.ca/ymb/gpdrr/2011/html/ymbvol141num6e.html

5. http://www.preventionweb.net/globalplatform/2013/

6. Definitions of these terms are in http://unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf

'concerned with organising and managing the impacts and consequences of disasters and emergencies if and when they occur'. There has also been some support for the use of the term disaster risk management (DRM)[7] as the higher-order term embracing both the disaster risk reduction (DRR) and disaster management (DM) functions.

Thus, following the declaration of IDNDR in 1989, there has been an almost unbroken 20-year period of development of a new approach to disaster risk management, an approach which sees a direct linkage between disaster risk reduction (what we currently term as 'prevention' or 'mitigation', the first P in PPRR) and preparedness for and management of emergency and disaster events (the central PR). Clearly, however, some issues of policy and methodology in the current international approach need to be resolved.

In Australia, not much has changed

Australia had been an active participant in the 1990s IDNDR program, one of its primary roles being to facilitate DRR in the Pacific[8], and has been a participant in both the 1994 Yokohama and 2005 Hyogo disaster world conferences on disaster reduction. It has also participated in the three sessions of the Global Platform. In general terms, the focus of most academic interest and research in the field of emergency management in Australia has paralleled the international recognition of the inter-relatedness of disaster risk reduction and disaster management.

Since 2004, however, in terms of policy and program development, there has been little evidence that the EMA's 'emergency risk management' process has been taken up either theoretically or in substance in application to the management of community safety risk in any jurisdiction (in spite of the earlier cited programs in Queensland in the late 1990s) or in any of the currently-advocated 'emergency risk management models', such as NERAG and CERM[9]. While those models themselves, and many of the published local government emergency risk management reviews and plans drawn from them, generally recognise communities and individuals as 'stakeholders' in the process and as necessary elements in the standard 'communication and consult' step, the treatment of communities and individuals is cursory and often limited to a listing of 'at risk' facilities and lifeline elements without much detail.

It is also noteworthy that other than in a brief discussion of 'improving community resilience' there is no direct reference in the Victorian Government's Green Paper to current comprehensive risk-based disaster management concepts, while in the current Australian *National Strategy for Disaster Resilience (NSDR)* they warrant only an indirect reference (COAG 2011).

The *2009 COAG National Disaster Resilience Statement* on which NSDR is based, acknowledges that 'a national, coordinated and cooperative effort is required to enhance Australia's capacity to withstand and recover from emergencies and disasters' (*ibid.*, p. iv), but neither suggest specific and agreed arrangements to enable that effort effectively.
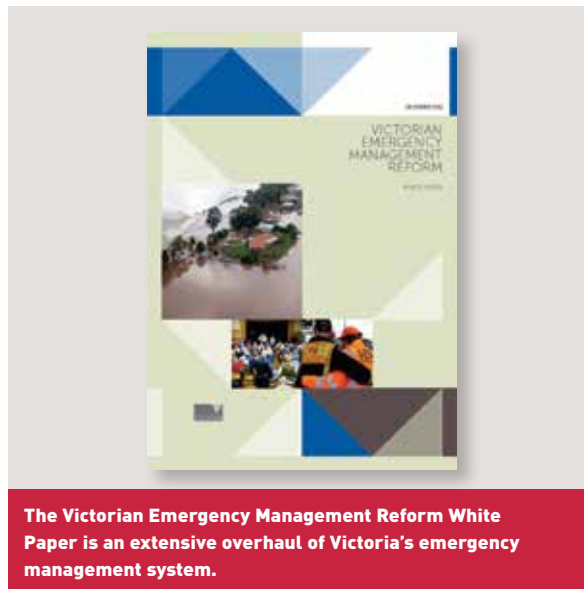
The Victorian Emergency Management Reform White Paper is an extensive overhaul of Victoria's emergency management system.

Again, neither the NSDR nor the COAG statements address the *issues* which need to be dealt with in developing that effort and the resultant resilient capacity. They are both silent on the *processes* by which that capacity might be attained. The NSDR suggested priority outcomes (*ibid.,* pp. 10-11) compare poorly both in scope and quality with the goals, priorities, key activities and implementation recommendations detailed eight years ago in the HFA. It is also clear that both are still significantly influenced by the response-focussed 'crisis and contingency management' approach which has dominated much of emergency management policy both in Australia and overseas since 9/11.

Australia and the US now appear to be among a number of countries diverging from the disaster risk management paradigm which has been developing internationally since the middle of the 1990s.

Where are we headed?

There is little doubt that today, as in the 1980s and 1990s, the international community remains concerned with the rising cost of disasters in terms of lives, property and national development, and that this concern has now been exacerbated by increasing anxiety about the likely effects of climate change. Some of the more recent international conferences seeking to renew political commitment to sustainable

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7. 'Disaster risk management (DRM)' is defined as 'the systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster'.

8. See EMA 1999, Final Report of Australia's Coordination Committee for IDNDR, Canberra (ISBN 0642704724)

9. NERAG (http://www.em.gov.au/Publications), the 'National Emergency Risk Assessment Guidelines', is the current Commonwealth publication and CERM (http://www.ses.vic.gov.au/prepare/em-planning) is Victoria's 'Community Emergency Risk Management' guideline (drawn primarily from NERAG) – both publications are currently still in draft form.

development, such as the June 2012 Rio+20 Summit held in Rio de Janeiro, have managed to obtain minor advances but have not significantly contributed to the reduction of community safety risk[10].

One reason for the lack of progress in global disaster risk reduction is undoubtedly that the three major drivers of disaster risk worldwide, identified in GAR as 'poor urban governance, vulnerable rural livelihoods and ecosystem decline', still remain the most intransigent problems faced by all countries, but especially by under-developed and developing nations.

A key factor contributing to this lack of progress has been the almost universal focus in the post 9/11 world on preparedness for and response to specific natural and man-made disaster events (which, of course, the UN itself now defines as *disaster management*). Much of this new focus has clearly arisen, particularly in many western nations, in the tendency to see terrorism as a primary threat to national stability and security, and in consequence to devote a disproportionate degree of attention to that threat. In Australia's case the 2002 Bali bombings could be seen as an additional factor in this, helping to promote a disproportionately heavy focus on anti-terrorism legislation and resource allocation (Roach 2011).

An additional issue arises out of varying uses of terms such as *prevention, protection, mitigation, resilience and vulnerability*, which is causing confusion in the current international DRR/DM dialogue.

As noted in the earlier section on international developments, however, while there has been growing acceptance of the necessary connection between DRR and DM, there are continuing difficulties in and disagreements about how that connection can be made effective at both policy and program levels. One of the countries recognised as having been the first to enshrine that connection in legislation is South Africa[11]. That country is reviewing its disaster management arrangements as its implementation has posed significant challenges, particularly at the level of local municipalities. Pacific countries, such as Samoa, have recently included disaster risk reduction in legislation[12], and have also experienced difficulty in its implementation at community level.

In countries such as Australia and the US, the theme of 'shared responsibility' in developing the capacity for 'resilience' has featured strongly in recent years, and consistently advocates a direct role for the individual and the community in disaster risk management. But other than in development of numerous 'self-help' or small-scale community resilience planning guides (e.g., Queensland's *Harden up* and Chapter 4 in UK's *National Risk Register*) there appears to be little real attention

to the provision of effective guidance in the practical development of such a role.

At issue is the extent to which, since 9/11, national governments in western countries in particular, have been pursuing top-down disaster management policies and methodologies. This is perceived as in 'the national interest', while individual communities live with risks which are peculiar to, and only capable of management within those communities. These issues can only properly be addressed within those communities themselves.

Is this what 'the prepared community' should be about?

The way ahead for Australia?

In a recent opinion piece in this journal, headlined *Prevention is no longer a useful term in emergency management*, its author, Stuart Ellis AM, stated that current Australian doctrine 'ignores the reality that PPRR is out-dated' (AJEM 2012). Our PPRR concept, now over 30 years old, is hardly relevant to current international and Australian understandings of the purpose and scope of 'emergency management'[13].

Indeed, not only does 'prevention', as disaster risk reduction, lie outside the remit of today's emergency managers, but that can also be argued in relation to 'recovery', the long-haul process of restoration and reconstruction which can extend up to 10 years after disaster impact — although a proper linkage between the relief phase of response and recovery is vital (Burton *et al.*, 1978). There is clearly a need for revision to the existing Commonwealth Government publications dealing with emergency management concepts and principles (Australian Emergency Management Series

Australian Emergency Management Handbook Series provides principles, strategies and actions for a range of disaster events for emergency management professionals.

10. See for example statements by a number of international leaders on www.bbc.co.uk/news/science-environment-18546583 and from the Australian Prime Minister on www.abc.net.au/news/2012-06-23

11. In its *Disaster Management Act 2002*

12. In its *Disaster and Emergency Management Act 2007*

13. Yet PPRR terminology is still used in the recent Victorian Government's 2011 Green Paper and 2012 White Paper – and in the US has recently been expanded into 'PPMRR' – prevention, protection, mitigation, response and recovery (National Planning Frameworks developed following 'Presidential Policy Directive 8 and the National Preparedness System')

No. 1) and emergency risk management (Australian Emergency Management Series No. 5) to ensure that they address the purpose and scope of emergency management as is now defined.

Ultimately the goal must be, as recognised in both the 2009 COAG Statement and the 2011 NSDR, the development of *Safer, Sustainable Communities* (a motto until recently used by EMA). Promoting 'resilience' of itself neither addresses the *issues* which need to be dealt with nor puts in place the *processes* necessary to the development of that greater capability and capacity at community level.

Given constitutional arrangements for the division of powers between the Commonwealth and the States and Territories, these are tasks which fall to the latter, but certainly it is clear that COAG and the Attorney-General's Department could take a more active role in providing guidance and assistance in defining national aims and objectives. A useful start would be the development of a practical and community-based successor to the present emergency risk management concept and documentation.

At a recent Monash University Disaster Resilience Initiative Forum on 'Strengthening Community-Based Resilience', a noted Australian authority on emergency management issues suggested that we can only achieve community resilience by ensuring that communities 'are cognisant of the risks they face and the limitations of emergency service organisations', and concluded that 'communities that have involvement in and ownership of plans for their safety have a greater capability and capacity to look after themselves'[14]. We also need to note the Global Platform's 2009 statement of the need for 'constitutional and administrative responsibility for risk reduction … to be vested at the highest possible level of government, in order to have the necessary political authority and resources to influence development policy'.

As noted earlier, Australia entered the first decade of the 21st Century well-placed to develop a new approach to emergency management. It is now time for us to review the stage we had reached in the development of that approach and to recognise that real 'resilience' needs to be based on 'the prepared community'.

References

Australian Journal of Emergency Management October 2012, *Vol. 27 No. 4 p. 3.*

Burton, I., Kates, R.W. and White, G.F. 1978, *The Environment as Hazard, OUP, New York.*

Emergency Management Australia (EMA) 2004, *'Emergency Management in Australia: Concepts and principles (Australian Emergency Manual Series, Manual No 1)', Commonwealth of Australia. Available on* www.em.gov.au/Publications.

Blaikie, P., Cannon, T., Davis, I. and Wisner, B. 1994, *At Risk: Natural hazards, people's vulnerability and disasters, Routledge, London.*

Council of Australian Governments (COAG) 2011, *National Strategy for Disaster Resilience, 22 July 2011 (PDF version), p. 10.*

Durham, K., Cawood, M. and Jones, R. 2001 *'The Application of risk management principles to municipal emergency management practice', Australian Journal of Emergency Management, Vol. 16, No. 2, pp. 8-13.*

EMA 1996, *Record of the Emergency Risk Management Workshop, 19 – 21 March 1996 (Mt Macedon Paper No 5/1996), Australian Government Publishing Service, Canberra (ISBN 0 644 47540 4), p. (v).*

EMA 2004, *Emergency Risk Management – Applications Guide (Australian Emergency Manuals Series, Manual 5), Commonwealth of Australia, Canberra. (Still available on the website* www.em.gov.au/publications.*)*

Geo-Eng Australia Pty Ltd 1998, *Flood Risk Study for Murweh Shire: Final Report (Report No. 1939/50052/182 of 7 May 1998).*

Natural Disasters Organisation (NDO – now Emergency Management Australia, EMA) 1989, *'Commonwealth Counter Disaster Concepts and Principles (Australian Counter Disaster Handbook Vol. 1)' (1st ed.), Commonwealth of Australia, p. 7.*

National Governors Association (US) 1979, *Emergency Preparedness program: Final Report, DCPA, Washington DC. Initially Australian usage translated mitigation as prevention, resulting in the handy mnemonic of 'PPRR', but later referred to this first element as prevention/mitigation.*

Roach, K. 2011, *The 9/11 Effect: Comparative Counter-Terrorism, Cambridge University Press, Melbourne.*

Zamecka, A. and Buchanan, G. 1999 *'Disaster Risk Management', Goprint, Brisbane (this was supported in a subsequent insert handbook, Queensland Department of Emergency Services 2000 'Disaster Risk Management Guide: a how-to manual for local government' John Garnsworthy and Associates, Brisbane.*

About the author

Roger Jones has practised in the field of emergency management for more than 35 years, joining the Australian Natural Disasters Organisation (later Emergency Management Australia) in 1974 as its inaugural Director, Operations and Plans. Roger was the Director of the Australian Emergency Management Institute from 1987 to 1994 and is currently a director and deputy chair of the Board of the Victoria State Emergency Service Authority. He has worked in the field internationally, regionally, nationally and at State/Territory and community level in Australia.

14. Monash University Disaster Resilience Forum, Melbourne, 15 August 2012 transcript, Neil Comrie presentation

Human behaviour during an evacuation scenario in the Sydney Harbour Tunnel

Penelope Burns, Garry Stevens, Kate Sandy, Arnold Dix, and Professor Beverley Raphael (University of Western Sydney) and Bob Allen (Sydney Harbour Tunnel Company) evaluate an evacuation exercise at the Sydney Harbour Tunnel.

ABSTRACT

Tunnels evoke unique emotions and perceptions that may affect human behaviour in the event of an emergency. Limited empirical data on human factors affecting response during tunnel emergencies have constrained our ability to plan for these aspects of incident management. The Sydney Harbour Tunnel is Australia's only immersed (subsea) road tunnel. It was the site of a recent observational study conducted to further develop tunnel evacuation procedures and systems. The event involved the evacuation of 32 volunteers from a controlled 'burning car' scenario. Response data was obtained from film footage and a post-exercise questionnaire. Pre-recorded audio messages were found to be the predominant source of information used in forming the decision to evacuate, augmented by social information exchange or social 'checking' processes. Participants demonstrated much indecision and did not commence evacuation until audio instructions were issued. Three quarters of participants made the decision to evacuate based on audio instructions, although 34 per cent reported some difficulty hearing the audio and were more likely to make decisions based on the behaviours of others. After an initial period of evacuation 'inertia', evacuation was initiated by those able to hear the audio instructions within seconds of the announcement and the evacuation was completed in just over two minutes. European and Australian studies suggest that rapid evacuation during such events may save lives. Findings from this field exercise indicate that expediting early decision-making to evacuate through improved communication (early loud clear audio messaging) is key. ®

Background

Research exploring human behaviour in tunnel disaster evacuation is limited for obvious logistical reasons, and the studies that do exist are generally retrospective in nature. Much of our understanding comes from analysis of building fire evacuation, or the use of computer modelling, which only partially accounts for human behaviour.

Human factors affecting building evacuation

Prior to Wood (1972), human behaviour was not considered in evacuation research or planning. Tong and Canter (1985) undertook a literature review of motivational factors affecting evacuation during building fires to discredit the prevalent presumption of a 'panic' response in such situations. This was important as it had prevented a more detailed examination of people's motivation in fire situations.

Sime (1995) argued that behaviour in fire situations can be predicted. People tend to use familiar escape routes, take guidance from staff, and move as part of family or known social groups. They felt pre-evacuation time or the 'period of ambiguity' is critical, as the social exchange of information, in addition to other sources, can expedite or inhibit decision-making and response.

Kobes *et al.* (2010) conducted a literature review on human behaviour in building fires and delineated how recent studies have shown several human behaviours in fire evacuation. Walking pace was slower in smoke or in an abnormal environment. Even normally-mobile people, in a fire situation, exhibited a degree of limitation, making them less self reliant. There was a high lack of awareness of ceiling signage, with 92 per cent of survivors in 400 cases of fire escape, being unaware of escape route signage. Luminescent low-level exit markings were found to be more effective. The preference for people to evacuate through familiar rather than closer, unfamiliar exits, especially if closed

or alarmed, was reiterated in this review. The chosen route was also affected by affiliate behaviour. Desire to conform to the family or friend group strongly influenced occupants' inertia to danger signals when failing to initiate evacuation.

Tunnel evacuation

Human behaviour in the first moments of an incident in a tunnel is crucial in an evacuation. An analysis of three fatal tunnel fires in Europe by Voeltzel and Dix (2004) reported an average 15 minute fire brigade response time. The study detailed that drivers, ignoring a red signal and siren, proceeded to 'queue' within danger zones resulting in fire spreading between cars. This failure to evacuate resulted in mortality.

Image: Kate Sandy

Stop sign at entrance to the Sydney Harbour Tunnel southbound carriageway. It was developed to stop motorists entering the tunnel after other warning signs had failed to achieve this. It consists of a cascading wall of water on which a stop sign is projected.

Findings from a series of field studies by Boer (2002) suggest tunnel users may frequently over-estimate their response capacities in an emergency. The author reported substantial differences between what people thought they would do in a tunnel evacuation situation and the observed behaviours in exercises. Participants were generally unprepared, with group affiliation ('clustering') appearing to inhibit individual decision-making and response.

Recent studies have also focused on how people perceive warning information and its relationship to evacuation decision-making, showing substantial variability in the capacity to register particular warning cues. Multiple sources are typically used with social information exchange (observing others, 'checking') being a common mediator of response decisions

including the decision to vacate vehicles and the choice of exit (Nilsson, *et al.*, 2009).

Users of rapid transit train systems in Singapore showed low response to fire alarm warnings which they reported to be ambiguous; however they did prompt more than half to observe the reactions of others or approach staff. A live announcement was found to clarify the initial cue and resulted in 85 per cent of people believing they should leave immediately. This highlights the need for 'live' information from an authority (Yeo and He, 2009).

The Sydney Harbour Tunnel

The Sydney Harbour Tunnel (SHT) is a crucial infrastructure linking the northern and central Sydney business districts across Sydney Harbour. There are two northbound lanes and two southbound lanes for cars, each bordered by 0.85 metre high concrete jersey barriers and connected by pedestrian cross tunnels (ranging from 22 metres in the northern land tunnels to just a fireproof door in the immersed, undersea, tunnels) for use in evacuations. The concrete jersey barriers must be climbed to access the cross tunnels to exit.

Although the comprehensive emergency warning and evacuation systems within the SHT receive regular functional testing, there has never been a requirement to use these procedures during a 'live' event with trapped vehicles. This study aimed to determine key aspects of response during a simulated emergency evacuation, specifically:

- responses to different tunnel warning systems
- barriers and facilitators to initiating evacuation
- social information exchange
- group affiliation, and
- response times of specific phases of the evacuation.

Method

Thirty two volunteers aged between 16 and 81 years participated in the evacuation scenario. They were not told what to expect, only that they should behave in the way they thought they would in any real event to keep themselves safe. Participants travelled in existing social/family groups of one to four people per car. Several individuals were allocated to vehicles with fewer occupants.

The set-up of the test was, for safety reasons, inherently a 'low threat' scenario with occupants remote from the fire and smoke. This may have impacted on human behaviour during the event but was not avoidable.

Car fire being extinguished by emergency crew.

Evaluation of the behavioural response within the exercise consisted of:

1. film footage and on-scene observer reports to determine evacuation response times and related individual/group processes, and

2. a post-exercise questionnaire which addressed the registration and understanding of different types of

FIGURE 1. The three evacuation recording transcripts for the Sydney Harbour Tunnel.

PRE EVACUATION
"Traffic has been delayed. Remain in your car; turn off your engine; leave your radio on for further information."

EVACUATION
"This is a tunnel announcement.
Due to a major traffic incident
you are now required to evacuate the tunnel,
follow my instructions:
Turn off your engine
Leave your keys in the ignition
Do not lock your vehicle
Walk to an exit indicated by flashing lights
and arrows on the tunnel wall.
When you are in the other carriageway
follow the announcements or instructions
from emergency services or tunnel staff.
If you need assistance to leave your vehicle,
turn on your hazard warning lights."

EVACUATION NON-INCIDENT CARRIAGEWAY
"You are now in the non-incident
carriageway. Proceed north.
At the end of the tunnel stop and wait
for directions."

warning information, decision-making and factors in the social/physical environment that affected individual responses.

The burn was monitored by over 20 fire brigade personnel including an incident commander and several fire trucks. The 'burning car' was located in the northbound carriageway 240 metres from the north exit. The participants' vehicles made a 40km per hour approach from the south behind a lead car and stopped about 100 metres before the burning car.

Within 55 seconds after all the cars had initially stopped, an announcement was relayed in two forms—over the radio, which was only heard by those with their car radios switched on, and over the public announcement system (PA) of the tunnel, which was heard most clearly by those with car windows down.

Findings – evacuation response times and factors

There was an initial period of inertia of less than a minute during which no participants left their cars before the first audio announcement asked people to remain in their cars and await instructions. It is impossible to know how much longer participants would have delayed before initiating evacuation without any audio instructions. In that first minute much indecision was shown by participants with some starting to exit cars, then retreating and closing doors, heads protruding from windows and photos being taken out of windows. Once the audio messaging commenced, those who could hear it followed instructions. Those who couldn't hear it tended to follow others. The

Table 1: Evacuation timeline. Time zero taken from the moment all vehicles had come to an initial stop.

Response phase	Mins: secs	Events
Initial inertia phase	0:00	All cars come to an initial stop behind the lead vehicle ~100 metres from the burning cars. Ceiling signs are visible: "turn off engine" and "turn on radio."
	0:16	First movement from participants outside car: several heads protruding from open car window.
	0:53 - 0:57	First car door opens, then closes when tones of first PA message start.
Audio instructions to wait in car followed	0:55 – 1:15	PA speaker starts first announcement asking people to stay in their cars and await further instruction (Figure 1 paragraph 1).
	1:25	The last car finally stops manoeuvring.
Evacuation phase	2:12	Announcement says "you are now required to evacuate the tunnel."
	2:12	First person, young male, exits car and is followed steadily by all other participants. There is no sense of urgency.
	4:04	All participants have left the incident tunnel.
Safety reached 2 mins 5 secs	4:19	Last person exits the cross tunnel into the non incident southbound tunnel.
Evacuation continues in non-incident tunnel		In southbound tunnel evacuees follow audio instructions.

subsequent evacuation to the cross tunnel was completed in less than two minutes. The audio instructions clearly influenced people to evacuate. Participants then walked to the non-incident southbound carriageway where they were guided north the final 540 metres to the SHT offices.

Information gathering – responses to different tunnel warning systems

The main warning systems in the tunnel are:

- audio - transmitted to the majority of local radio stations (but not all) and heard through the car radio when it is turned on and the PA system in the tunnel, and
- visual - electronic ceiling signage and painted wall signage.

When asked *"What was the **very** first thing you noticed to indicate there was a problem?"*, various indicators were mentioned (see Figure 2). Most smelt or saw smoke or noticed the cars in front were slowing or stopping. The authors found no data on how the distance from a tunnel fire impacted on human response but felt these responses would be affected by a participant's proximity to the event and this would reflect what would occur in a real event.

The first **visual** alert for all participants was smoke or fire. The majority of these saw smoke (84 per cent). When asked what the first **audio** cues were, 85 per cent nominated the emergency announcement via the radio (41 per cent), the PA (38 per cent), or simultaneously (6 per cent). Several heard human voices or a rumble first.

During an incident in the SHT, the same announcement is played simultaneously on the car radio and the tunnel PA. If a CD is playing in the car, or if the radio is tuned to a station not broadcasting the message, then the radio announcement may not be heard. Participants commented that it was hard to hear the tunnel PA announcement through closed windows.

FIGURE 2. Participant responses to *"What was the very first thing you noticed to indicate there was a problem?"*
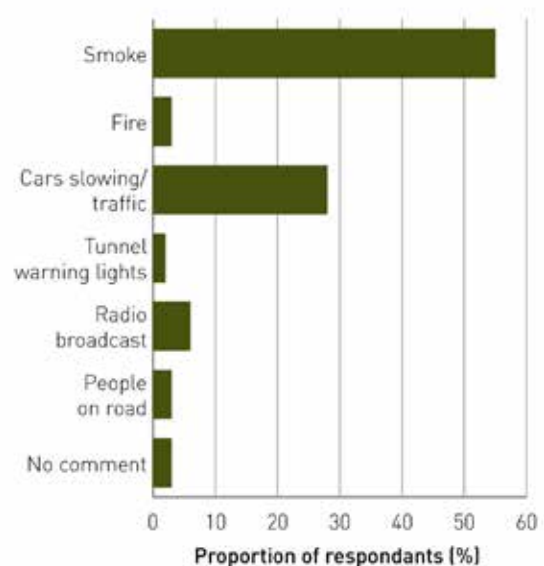
FIGURE 3. Participant responses to *"If you decided to evacuate when did you make this decision and why?"*
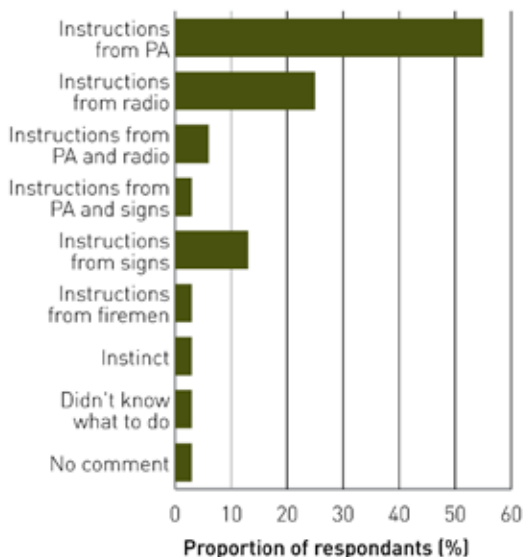
Evacuation decision-making

When asked *"How did you know what to do?"*, three quarters of participants said they made decisions based on audio messaging, 13 per cent based decisions on overhead signs, and others did not know what to do, they "just followed".

In knowing when to initiate evacuation the vast majority of respondents (75 per cent) relied on audio messages and it was clear from video observations that the first evacuees began evacuating within seconds of hearing the instructions to "evacuate the tunnel". Only 13 per cent decided to evacuate based on signage, while 12 per cent of the participants did not use audio or visual signage cues to initiate evacuation.

Greater than one third commented on the difficulty in hearing the audio cues. Responses included, *"I tended to follow the pack when I could no longer hear the PA"*, *"there was no radio announcement in our vehicle"*, *"the PA is not clear if windows are up and the radio is on"*. Some participants were unable to distinguish the audio cues at all and had to rely on following others.

The authors feel that 'inertia to evacuate' is a barrier to safe behaviour in tunnel incidents and understanding what factors help people to make the decision to leave the dangerous area is important for planning. In this exercise audio messaging was crucial in initiating the evacuation of the group. Of concern were the participants who couldn't hear the audio message. In some cases they had a CD playing or were tuned to a radio station which did not relay the message. Others relied on the PA but had problems hearing and/ or understanding the message, for instance due to external noise.

Affiliate behaviour and informational social influence

Observations from film taken at the time clearly showed the role of social influence with 94 per cent of participants reporting their decision-making was influenced by the action of others. The first to exit their car was a group of young males. Others then followed. Participants appeared reluctant to initiate leaving their car. One person commented *"[I] opened the door when I saw the sign above then saw others still in cars so got back in and shut the door"*. Another mentioned *"when other people hesitated to leave their vehicles, it made us unsure"*. Others wound down windows to see what others were doing and reported *"as soon as one person opened the car door so did we"*.

Reasons given for following others included:

- reassurance
- being situated in the middle of the crowd
- a belief that others were more knowledgeable
- uncertainty about what to do
- following others taking priority over following signs, and
- a lack of certainty in ability to take the lead.

Comments included *"lemming for sure"*, *"I assumed everyone knew what to do"*, *"I believed they had seen something I didn't"*, *"it was reassuring that others were doing the same so I kept going"*.

Image: Kate Sandy

Impediments to evacuation. The jersey barriers had two small cut away steps (visible in bottom right of this photo) which the elderly participants were unable to use without assistance. They took around five seconds to climb the barriers with assistance.

Image: Kate Sandy

Exit cross tunnel, part of the evacuation route.

Impediments to evacuation

The participants considered the major impediment to evacuation was physical; in particular, the Jersey barriers which had to be climbed to access the cross tunnel. One fifth noted the convergence of evacuees at the entrance to the cross tunnel which was confirmed by video footage. This was compounded as participants mounted the barriers at the same point as the cross tunnel exit door. Other impediments included curiosity (9 per cent), physical limitations - self or other (19 per cent), others' inaction, a delay before the PA message to evacuate, the poor clarity of the PA messaging, and reluctance to follow instructions to leave the keys in the car. Only 16 per cent felt totally unimpeded during the evacuation.

Discussion

Fire incidents in tunnel environments are high-risk events compared to fires in more open environments. This is due to greater smoke volumes at an early stage of the fire (due to containment of smoke at the beginning of the fire before ventilation commences), greater distance of fire spread between vehicles (due to radiation containment and reflection), hotter fire temperatures of greater than 1000°C, and the unknown behaviour of road tunnel users in these situations (Dix, 2010). There has only been one recent tunnel fire in Australia which occurred in the Burnley Tunnel, Melbourne, Victoria, in 2007. Three people died and several hundred were evacuated. However the number of road tunnels and the volume of traffic using major road tunnels in Australia is increasing. There are now five tunnels in NSW, three in Victoria, and two in both Queensland and Western Australia with high vehicle numbers over 1km long.

In this exercise the SHT controllers activated and ran the emergency procedures efficiently and smoothly. These procedures are exercised, albeit without live

subjects, on a six-monthly basis. It is likely that this level of preparedness and the existing infrastructure to support evacuation contributed to the rapid response during this exercise.

The difficulty in running a 'realistic' scenario was demonstrated by comments from some participants. Several volunteered that in a real situation they would have approached the burning car to check for occupants, or out of curiosity. Participant response times may also have been affected. Nevertheless important data can still be gathered from these more restricted evacuation exercises.

Human behaviour in building evacuation is conceptually similar to that of tunnel evacuation once the tunnel users have chosen to leave their vehicles. There are external factors which are somewhat different in tunnels, as in this case, where there was a delayed evacuation response until clear direction was received. Prior to the audio announcement there was a lot of indecision by participants shown on film footage and expressed by participants in the questionnaire. Cars were still manoeuvring one and a quarter minutes after they had originally come to a stop and people were starting to exit vehicles, then changing their minds, getting back in and closing doors.

Current international data highlights audio messaging as one of the most effective sources of warning (Kobes, *et al.*, 2010). This was confirmed in the present study where visual signs were poorly registered by the majority of participants and audio signals clearly prompted the first participants to evacuate.

As shown in international evidence 'live' messages may also be attended and responded to more quickly and, if possible, these could augment or replace the current recorded message. Audio warnings that are early, clear and loud, provide simple instructions and, as such, may reduce the duration of 'evacuation inertia'. A recent

study in the SHT showed high background noise and long reverberation degrade of the transmission of warning systems. This is an issue for clear transmission of PA systems (Ridley and Spearitt, 2011). In-car messages will not be received by some, highlighting the need for a clear, loud PA as a secondary (and out-of-car) source.

On several occasions informational social influence over-rode audio messaging. There were a number of reported examples of people assuming the actions of others to be the correct behaviour based on perceived greater knowledge of the situation. This social phenomenon is known as 'informational social influence', and may be exaggerated in hazard situations (Dynes, 2006, Nilsson, *et al.*, 2009). Film footage clearly showed a delay in the initiation of evacuation in this exercise with several people opening car doors to exit, then closing them on realising no one else was doing the same thing.

Unlike two of the previous tunnel exercises in the Netherlands and Sweden (Nilsson, *et al.*, 2009, Boer, 2002) participants in the SHT exercise chose their exit point based on which cross tunnel others were using, rather than by proximity or distance from danger. Initiation of evacuation, and choice of exit route, was highly influenced by what other people were doing during this exercise. There was orderly follow-the-leader behaviour of one large group with occasional individual behaviour which quickly conformed back to the group. There was a general lack of urgency shown by the group although several individuals later expressed feeling anxious in the questionnaire (highlighting the importance of obtaining data through different methods).

Such a response may be influenced by the relative safety of being in an exercise situation. However it raises the important point that individuals in actual hazard situations often opt for the 'safety' of being with others, displaying affiliate behaviour, even if this is at the cost of being closer to the threat (Sime, 1995).

The group seemed to move as a single herd, rather than as a collection of smaller groups but no participant took leadership of, or responsibility for, the group as a whole. This is consistent with stories of evacuation through the stairwells after the terrorist attacks of 9/11 of a slow orderly procession without panic (Hingson and Flory, 2011).

In such situations vehicles are a familiar entity in an unfamiliar environment containing valuable personal property. It was demonstrated by several participant drivers in this exercise whose concerns included:

- leaving the vehicle unattended
- leaving the keys in the car, and
- how to retrieve the car.

Importantly, such vehicle affiliation has also been observed in tunnel emergencies where the presumed greater safety of being in, or near, one's vehicle has contributed to fatalities through people failing to evacuate dangerous environments (Masellis, *et al.*,

1997). In some emergencies remaining in the car is required. In others, it is safer to evacuate the vehicle.

This study also demonstrated the need for better design consideration for the less physically able as they slowed the evacuation of the rest of the group and were unable to evacuate themselves without assistance.

Conclusion

This exercise was an opportunity to observe the main constraints and facilitators to rapid evacuation of people in a potentially dangerous situation. The current under-emphasis on user psychological and behaviour patterns in tunnel evacuations is changing. The lack of familiarity of the environment, the negative perception of tunnels, and the greater risk from fire constrained by tunnels may increase the complexity of planning tunnel evacuations. When there is increased duress, decision-making can be constrained and clear audible instructions are important.

Evidence-informed guidelines for evacuation best-practice and subsequent follow-up of persons involved in tunnel evacuations, including road users and response personnel, would help ensure lessons are learned and incorporated into future response practice.

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References

Anon., 2010. *Mob Mentality. Science Illustrated, Jan-Feb, Issue 3, pp. 52-59.*

Arias, A.V., Mayordomo Lopez, S., Fernandez, I., Martinez-Rubio, J. L., Magallares A., 2008. *Psychosocial factors, perceived risk and driving in a hostile environment: driving through tunnels. International Journal of Global Environmental Issues, 8(1 & 2), pp. 165-181.*

Beard, A., 2009. *Fire safety in tunnels. Fire Safety Journal, Volume 44, pp. 276-278.*

Boer, L., 2002. *Behaviour by motorists on evacuation of a tunnel, Soesterberg: The Ministry of Transport, Public Works and Water Management, Centre for Tunnel Safety.*

Brennan, P., 1997. *Selected Literature Reviews on Human Behaviour in Fire, Sydney: Fire Code Reform Centre Limited.*

Callaghan, P., 2010. *Tunnel Exercise furthers safety research. Emergency, December, p. 24.*

Colombo, A., 2001. *NEDIES PROJECT Lessons Learnt from Tunnel Accidents, s.l.: Institute for Systems, Informatics and Safety .*

Dix, A., 2010. *Tunnel Fire Safety in Australasia. Frankfurt am Main, Germany, s.n., pp. 69-79.*

Dynes, R., 2006. *Social Capital: Dealing with Community Emergencies. Homeland Security Affairs 2, July. Issue 2.*

Fahy, R. and Proulx, G., 2001. *Towards creating a database on delay times to start evacuation and walking speeds for use in evacuation modeling. Human behavior in fire-understanding human behavior for better fire safety design. London, s.n., pp. 175-183.*

Fraser-Mitchell, J. and Charters, D., 2005. *Human Behaviour in Tunnel Fire Incidents. Fire Safety Science, Volume 8, pp. 543-554.*

Hingson, M. and Flory, S., 2011. *Thunderdog. Nashville : Thomas Nelson Inc.*

Kobes, M., Helsoot, I., de Vries, B. and Post, J., 2010. *Building safety and human behaviour in fire: A literature review. Fire Safety Journal, pp. 1-11.*

Landrigan, PJ., Forman, J., Galvez, M., Newman, B., Engel, S.M., Chemtob, C., 2008. *Impact of September 11 World Trade Center Disaster on Children and Pregnant Women. Mount Sinai Journal of Medicine, Volume 75, pp. 129-134.*

Masellis M., laia A., Sferrazza G., Pirillo E., D'Arpa N., Cucchiara P., Sucameli M., Napoli B., Alessandro G., Giairni S., 1997. *Fire Disaster in a Motorway Tunnel. Annals of Burns and Fire Disasters, 10(4).*

Meredith, P., 1992. *The Sydney Harbour Tunnel Foldout Map. Australian Geographic, Jul-Sep, Issue 27.*

Meyer, H., 2003. *The Kaprun cable car fire disaster - aspects of forensic organisation following a mass fatality with 155 victims. Fensic Science International, pp. 1-7.*

Nilsson, D., Johansson, M. and Rantzich, H., 2009. *Evacuation experiment in a road tunnel: A study of human behaviour and technical installations. Fire Safety Journal, pp. 458-468.*

Norris, F., 2005. *Range, Magnitude, and Duration of the Effects of Disasters on Mental Health: Review Update 2005. Review Update 2005.*

Norris, F., Friedman, M. and Watson, P., 2002. *60,000 Disaster VIctims Speak: Part II. Summary and Implications of Disaster Mental Health Research. Psychiatry, 65(3).*

Norris, F., Friedman, M., Watson, P., Byrne, C., Diax, E., and Kaniasty, K., 2002. *60,000 Disaster Victims Speak: Part I. An Empirical review of the Empirical Literature, 1981-2001. Pyschiatry, 65(3).*

Peleg, T. and Shalev, A., 2006. *Longitudinal Studies of PTSD: Overview of Findings and Methods. CNS Spectrums The International Journal of Neuropsychiatric Medicine, 11(8), pp. 589-602.*

Ridley, P. and Spearitt, D., 2011. *Evaluation of speech transmission in a road tunnel. Acoustics, pp. 1-8.*

Sime, J., 1991. *Accidents and disasters: vulnerability in the built environment. Safety Science, pp. 109-124.*

Sime, J., 1995. *Crowd psychology and engineering. Safety Science, Volume 21, pp. 1-14.*

SWOV Institute for Road Safety Research, 2009. *SWOV Fact sheet: The road safety of motorway tunnels, Leidschendam: SWOV.*

Tong, D. and Canter, D., 1985. *The Decision to Evacuate: a Study of the Motivations which Contribute to Evacuation in the Event of Fire. Fire safety Journal, Volume 9, pp. 257-265.*

Voeltzel, A. and Dix, A., 2004. *A Comparative Analysis of the Mount Blanc, Tauern and Gotthard Tunnel Fires. Routes Roads, Volume 324, pp. 18-34.*

Weiger, P., 2000. *Road tunnel fire safety. NFPA Journal, Jul/Aug.*

Wood, P., 1972. *The Behaviour of People in Fires. Fire Research, Volume Note No. 953.*

Yeo, S. and He, Y., 2009. *Commuter characteristics in mass rapid transit stations in Singapore. Fire Safety Journal, pp. 183-191.*

Impact of landslides in Australia to December 2011

Dr Marion Leiba, Geoscience Australia, provides an update of the landslide data over the last decade.

ABSTRACT

This paper is an update to Michael-Leiba (1999) *Impact of landslides in Australia to June 1999* **published in the** *Australian Journal of Emergency Management* **in 1999. Most of the information comes from the Geoscience Australia Australian landslide database, which contains references to the source literature, and is available online at www.ga.gov.au. Because landslide information is gleaned from written reports (often in the media) or personal observations, and landslides are not recorded instrumentally like earthquakes, the landslide database is incomplete. Information from the public to improve the database is welcome, contact email hazards@ga.gov.au.** ®

Introduction

For the purposes of this article, the term 'landslide' is used in a very broad sense to include slope failures and cave-ins involving human activity, mine subsidence and cave-ins in paved roads. It also includes the flash flood runout in the distal part of debris flows (distal meaning remote from the point of attachment or origin), slow movements of a few centimetres a year, as well as the well-recognised rock falls, debris slides and other gravity-driven downward movements of material commonly thought of as landslides.

Landslides causing injury or death

In Australia, 114 landslides are known to have caused injury or death during the period 1842 to December 2011. At least 138 people have been killed and 174 injured. The naturally-occurring events causing death varied from the fall of a single rock to spectacular debris flows and their flash flood runouts. Many landslides that killed or injured people were the result of human activity. During the period 2000-2011, over half the landslides causing injury or death were directly or indirectly human-caused. Most deaths were caused by trench and beach sand or excavation cave-ins, while most injuries were caused by edge-of-road collapses due to vehicle weight.

Around 370 buildings were damaged or destroyed by 83 landslides and mine subsidence events including superficial damage from debris flows and the subsequent runout entering buildings. The estimated cost of landslide, debris flow runout and mine subsidence damage to buildings, residential land, fences, retaining walls, swimming pools and the like during the period 1842-2011 is approximately $82 million in 2010 dollars. Landslides also caused considerable damage and disruption when they impacted or destroyed roads (around 300 landslides during the period 2000-2011), railways and bridges. Unfortunately the readily available data are too few to estimate a monetary cost.

Of the 114 landslide events causing injury or death to December 2011, 36 were rock falls or topples, including rocks displaced by climbers—some involving a single rock. Nineteen landslides involved material falling from cliffs.

The two most lethal landslides were both debris flows.

The Briseis Dam Disaster, Derby, northeast Tasmania happened on 4 April 1929 and killed 14 people. Rainfall of 450mm during the previous two days, followed by 125mm in the catchment in 1.5 hours, caused the rock-filled concrete Briseis Dam on the Cascade River to burst, releasing a wall of water six metres high. The water raced down the river gully, sweeping away a house and killing the family of five, as well as a five-year-old girl. It then cut a channel 30 metres deep and 64 metres wide through a low hill in its path. It demolished stables in its path, killing three people and 12 horses. The torrent was 180 metres wide and tree logs were deposited over 21 metres above normal river level. The width was evident from the gouged-out channel left behind, and the main road was obliterated. By cutting through the low hill, the river's course was permanently changed to follow the channel gouged out by the torrent. The wave of water at Derby was four metres high, however a rocky outcrop on its outskirts saved the town. The flood was diverted, striking a mining tailings hill about 60 metres high and carrying away half the hill, leaving a sand cliff. Three people lost their lives and several houses were swept away, including the Briseis Company's powerhouse and offices.

Two bridges on the Ringarooma River, one on each side of Derby, were destroyed and the Briseis tin mine was flooded. It did not resume operations for five years after the event. Many people were homeless, two cars were lost, the furniture in flooded houses was damaged, and the recreation ground outbuildings demolished. A total of six houses were destroyed at Derby, and fences were destroyed and houses flooded at nearby Branxholm. Fourteen people were killed in the 4.8km between the Briseis Dam and Derby. The torrent had carried thousands of tonnes of trees, rocks, gravel and boulders. A 10-tonne granite boulder was moved 3km.

The Thredbo, NSW landslide of 30 July 1997 injured one person and killed 18, as well as destroying two ski lodges and several vehicles. According to the Coroner's report (Hand, 2000), the landslide happened on the slope below the Alpine Way—the highway linking Jindabyne, NSW on the eastern side of the Snowy Mountains with the Murray Valley Highway on the west in Victoria. Perched above the ski resort village of Thredbo, the road was originally built as a short-term construction road and was not intended to be a highway. It rested on uncompacted fill and creep (very slow land movement) in the fill had been occurring for years before the catastrophic slope failure. The creep caused joints in a water main to leak for at least two months, and possibly as long as 12 months, before the landslide. As the separation at the joints worsened, the leakage increased. A portion of the uncompacted fill embankment became saturated with water, triggering the landslide at 11.30pm. The first stage of the failure was between the top ski lodge, Carinya, and the Alpine Way. Carinya Lodge was hit by collapsing soil, toppling it forward. The ski lodge was then impacted by a mudflow that carried it downslope and onto Bimbadeen Lodge. The only occupant of Carinya Lodge was killed and 17 others perished in the wreck of Bimbadeen. The sole surviver was rescued after almost three days in the rubble of Bimbadeen Lodge.

Landslides causing injury or death, January 2000 – December 2011

During the period January 2000 to December 2011, 24 people died and 100 were injured in Australia as a result of 46 landslides—an average of two deaths per year.

The most lethal incident happened on the Old Pacific Highway, Somersby, NSW, on 8 June 2007. A low pressure weather system swept across the east coast of NSW dumping more than 200mm of rain over four days, causing flood conditions. A section of the Old Pacific Highway collapsed due to undermining by a flooded creek because of corrosion of the steel pipes of a culvert. A car on the road at the time of the cave-in drove into the hole, killing its five occupants; two adults and three children. Investigations showed that the pipes had been corroding for almost 25 years and sinking of the road was noticed some seven years before the cave-in. The resultant dip in the road had been asphalted over in 2002 and again in 2004.

The largest number of injuries in a single event was due to a landslide on the Cairns-Kuranda scenic railway on 26 March 2010. Heavy rain triggered a debris slide from the slope above the railway line just before the first tunnel. The landslide blocked the line and the first of the two locomotives pulling the train ran into it and was derailed. Luckily, the second locomotive was able to push the train back to Redlynch where five injured passengers were taken to hospital by ambulance. The remaining passengers disembarked at Freshwater and one passenger requiring a wheelchair was taken to hospital. In addition to the injuries, the closure of the railway line adversely affected tourism and business in Kuranda.

During the period 2000-2011, 14 rock falls or topples, some from natural causes and others from human activity, killed or injured people.

In the Wollangambe Canyon, Wollangambe National Park in the Blue Mountains of NSW, six people were reported missing when they failed to return from a day canyoning trip on 12 January 2010. They were well-equipped except they did not have an emergency beacon. About 50 people searched for two days and located them on January 14. One of them, a boy aged 15, had been killed only a few hours earlier, apparently in a rock fall when a sandstone ledge had collapsed. The five survivors were airlifted to Richmond Royal Australian Air Force base by police helicopter and taken to hospital to be treated for dehydration, hypothermia and minor injuries. They were discharged the following day. The boy's body had been trapped under the fallen rocks and rain had hindered the search and rescue operation. His body was recovered on 15 January.

At about 4.00am on 20 June 2005, rocks with a total volume of about one cubic metre, rolled from the Lake George escarpment, NSW, onto the northbound lanes of the Federal Highway, causing a multi-vehicle accident. Two people were injured. A car collided with a boulder and was undriveable. A semi-trailer jack-knifed after hitting a boulder and ended up in a southbound lane, partly jutting out over Lake George, and a station wagon overturned, caught fire, and was destroyed. The truck driver, though injured, and another person, rescued the injured driver from the car before it was engulfed in the flames.

On 4 November 2001 at Jan Juc in south west Victoria, an 18-year-old man was walking with friends along the beach at the time of a large rock fall from an 80 metre cliff. He was buried up to his shoulders in the landslide. His two companions managed to jump clear. It took three hours to rescue him because of dangerous conditions caused by continuing rock falls. He was flown to hospital with crush injuries to both legs.

On 30 January 2000 a man fell while climbing at Ginninderra Falls, NSW, 18km northwest of Canberra. His rope broke and he dislodged some rocks during the fall causing a human-induced rock fall. The rocks fell on him causing a suspected broken leg, ankle and wrist. After being winched to safety, he was transported to hospital by rescue helicopter.

A semi-trailer jack-knifed after being hit by rocks falling from the Lake George escarpment.

Image: Dr Marion Leiba

For over half the landslides, deaths and injuries were either directly or indirectly caused by human activity. A total of 30 landslides killed 13 people and injured 60 as summarised on Table 1.

Of the 30 landslides, nine were trench cave-ins. On 14 May 2009, three men were working at Furber Street, East Maitland, NSW, in a 3-4 metre deep, 25 metre long soil trench at a horse trainer's property while making a plunge pool for the horses. The men were setting formwork for plastering the sides of the trench when the side(s) caved in and loose dirt heaped on the surface fell into the trench. One man was able to escape and go for help. The second, aged 43, was buried from the waist down and suffered a cut on his head and crush injuries. He was flown to Newcastle hospital by rescue helicopter. The third, aged 28, was completely buried and died at the scene. His body was recovered over nine hours later. The street was blocked off for several hours to assist the rescue and investigations.

Another nine landslides were cave-ins caused by young people digging deep holes in sand at the beach. At 1770 beach, near Agnes Water, Queensland, on 15 August 2006, three boys, Dutch tourists, aged 11, 13 and 15,

were digging holes in the beach when the sand caved in. Two of the boys were kneeling in the hole and were buried up to their chests. The 11-year-old managed to scramble free. The 13-year-old was trapped for more than an hour and was given oxygen while being rescued. He was subsequently treated by paramedics at the Surf Club. The 15-year-old died at the scene. Police, Fire, Ambulance and SES officers were all involved in the rescue.

Around one fifth of the deaths and over one third of the injuries caused by landslides during the period 2000-2011 happened in just three edge-of-road collapses under the weight of vehicles. The worst happened on Dove Lake Road, just past the Visitors Centre in Cradle Mountain National Park, Tasmania, on 18 February 2001. A bus had edged to the side of the road to make way for an oncoming vehicle. The soft shoulder of the road gave way under the weight of the stationary bus causing it to plunge down a ravine. Four people were killed and 14 were injured.

Damage to buildings, their surrounds and residential land

Over the same timeframe, 83 landslides, mine subsidence and tunnel collapse events damaged or destroyed about 370 buildings or their interiors. The most expensive case of building damage from non-debris flow landslides was at Lawrence Vale, Launceston, Tasmania in the 1960s. Two adjacent, relatively slow-moving landslides in Tertiary sediments destroyed 35 houses and the land was also written off. The cost in 2010 dollars is estimated to be $13.4 million.

The Briseis Dam disaster in northeast Tasmania, destroyed at least 10 buildings and it is estimated that it may have damaged about 45 buildings or their contents. The estimated cost in 2010 dollars is about $1.5 million.

The estimated cost of landslide, debris flow runout and mine subsidence damage to buildings, residential land, fences, retaining walls, swimming pools, etc. during the period 1842-2011 is approximately $82 million in 2010 dollars.

Table 1. Landslide deaths and injuries caused by human activity during the period January 2000 – December 2011.

Landslide type	No. of landslides	No. of deaths	No. of injured people
Trench cave-ins	9	2	8
Beach sand cave-ins	9	3	7
Other excavation landslides	4	1	3
Edge of road collapse from vehicle weight	3	5	38
Other human involvement landslides	5	2	4
Total for human involvement landslides	**30 landslides**	**13 people killed**	**60 people injured**

Table 2. Slope instability events affecting buildings during the period January 2000 – December 2011. These statistics exclude buildings damaged or destroyed during the flash floods and debris flows in the Lockyer Valley, Queensland on 10 January 2011.

Type of slope instability event	Number of events affecting buildings	Estimated number of buildings affected
Debris flows	11	24
Debris slides	4	4
Excavation related	4	5
Tunnel/mine subsidence	3	30
Slow moving landslides	2	4
Earth slump	1	1
Rock fall	1	1

Landslides affecting buildings

During the period January 2000 to December 2011, approximately 70 buildings were affected by 26 landslides, including mine subsidence. The results varied from damage to contents to the total destruction of the building.

The estimated cost of landslide and debris flow runout damage to buildings, residential land, fences, retaining walls, swimming pools, etc. during 2000-2011 is approximately $2.7 million.

The types of slope instability events causing building damage are shown in Table 2.

Debris flows were a common cause of building impact. Almost half (11 out of 27) of the landslides affecting buildings were debris flows. For example, on 3 April 2000 at Castle Hill, Townsville, Queensland, four debris flows, three east facing and one northeast facing each with a volume of about 500 cubic metres weathered granite, were triggered by torrential rain from Cyclone Tessi. Almost 140 houses were initially evacuated and several were damaged by the runout. Several houses had a

Large debris flows at Castle Hill were triggered by Cyclone Tessi.

considerable volume of debris in their lower storey while others suffered water and mud spoilage.

Around 30 June 2005, at Lansell Avenue, Currumbin, Queensland, a landslide (probably a debris flow) severely damaged and put at risk at least six properties. Decks of at least two houses, and a spa, were washed down the hillside during a deluge and at least one retaining wall was damaged. Residents were advised to evacuate.

On 22 March 2010, intense rain brought by a severe storm triggered a debris flow from the escarpment at Kings Park, Perth, Western Australia, behind the Adelphi, Waldorf, Acacia and Park Lane apartments, causing more than 100 residents to be evacuated. Mud surrounded two vehicles and entered apartments through the windows, filling two with mud deeper than 1.2 metres. A section of the eastbound lane of Mounts Road was also closed.

On 19 March 2004, in Cairns, Queensland, heavy rain associated with a tropical low (later Tropical Cyclone Grace) triggered a fill failure in a disused road uphill from Hillview Street, Whitfield. This pushed trees and topsoil into the downstairs rooms and garage of a house. Luckily the owners were overseas. Two cars in the garage were pushed forward, one into a column which dented the rear of the vehicle. Branches punched holes through the rear wall of the house in two places and through windows. The landslide volume was approximately 1500 cubic metres. Slope instability related to nearby excavations affected five buildings.

An expensive example was the destruction of the Indian Chilli Restaurant in Crown Street, Surrey Hills, Sydney, on 27 November 2007. Excavation for construction over six months before may have been partly responsible. The restaurant's foundations were exposed to the weather for the first time in the life of the old, fragile building. The evening before the 27 November there was heavy rain. Noises were first heard during the evening of the 27, and by the next day there was cracking, partial disintegration, and the building was leaning towards the excavation. The old building was

Fill failure in a disused road inundates a house in Cairns.

subsequently demolished and neighbouring buildings evacuated as well as the road temporarily closed. The contents of the restaurant, valued at more than $200,000, were lost.

A spectacular, though less costly landslide happened on 27 November 2001 on the east side of Northbourne Avenue, Canberra, ACT, in the block north of Cooyong Street. Almost half of the western wall of an eight-metre-deep excavation failed, causing two prefabricated site buildings to tilt at angles of about 15-30 degrees. The headscarp consisted of two steps, each one metre high, coinciding with the inner edge of a concrete footpath. One lane of Northbourne Avenue was closed until 3 December.

A landslide at a building site in Canberra causes two prefabricated site buildings to come off their foundations.

Two slow-moving landslides that damaged or destroyed buildings were both in Buderim, Queensland in 2010. The most destructive was in Durham Crescent on 19 December. Prolonged high rainfall triggered a slow-moving landslide that caused one house and the garage of an adjacent house to move downhill. One house moved two metres in a week and was deemed unlivable. The adjacent house was unaffected as at 4 January 2011 but the garage was warped from the movement. The downhill part of the road suffered large cracks in the tarmac and was cordoned off. The occupant of the house below Durham Crescent voluntarily self-evacuated as a precaution.

Mine subsidence and tunnel failure

Mine subsidence and tunnel failure have damaged or destroyed an estimated 30 buildings during the period 2000-2011. The estimated cost in 2010 dollars is about $6.5 million.

The worst case was at Collingwood Park, Ipswich, on 26 April 2008. Part of the suburb is 130 metres above the disused Westfalen coal mine. Subsidence had previously occurred in 1988 and 1992. The 2008 episode happened in the early morning of 26 April and had stabilised over the whole affected area by the end of 2 May. It damaged around 20 houses in Duncan, Fowler, Moloney, McInnerney and McLaughlin Streets and Warren Court. Seven of the most seriously damaged houses were evacuated. Structural engineers were engaged to assess houses in the subsidence area. The State Government budgeted $10 million to fund present and future repairs caused by the subsidence and to buy houses at pre-subsidence market value if the damage was too great.

In the Sapphire and Rubyvale area gemfields, Queensland, some time during the period 17-19 January 2008, severe flooding caused shallow sapphire mines to cave in, swallowing caravans and sheds, and destroying some homes and livelihoods.

On 2 November 2005, a tunnel failure occurred at the entrance to the Pacific Highway, Lane Cove, NSW. All residents of a three-storey brick block of flats on Longueville Road were evacuated at about 2.30am when a 10-metre-deep hole appeared in front of and under a corner of the building. A water main broke and sections of the building fell into the hole, which was caused by failure of shale in a section of the Lane Cove Tunnel, then under construction. The failed section was the site of an exit ramp that intersected with a ventilation shaft. Over 1000 cubic metres of concrete was pumped into the hole to try to stabilise the area. The city-bound lanes of Epping Road were closed to traffic for two days.

Landslide damage to infrastructure

Hundreds of landslides have damaged or disrupted roads, railways, bridges, culverts, paths and drains. There are inadequate data to estimate the financial cost, but it would total many millions of dollars.

The record in the Geoscience Australia Australian landslide database for landslides impacting or damaging roads during the period 2000-2011 is almost certainly incomplete. In a number of entries, particularly those relating to the Cairns area, a series of landslides on a single road are recorded as a single entry. A cursory examination of database entries suggests that well over 300 landslides adversely affected roads during the period. This excludes holes appearing in roads usually due to water beneath the tarmac, or because of mine subsidence.

The effect of landslides can vary from one lane being closed for a few hours because of a failure in the cut on the uphill side of the road, with debris falling on the road, to structural damage to the road necessitating repairs and sometimes closing some or all of the road for days or even longer.

On 4 February 2011, intense, short-period rainfall and an overflowing drain beside the Princes Freeway (Morwell Bypass) in Victoria caused a landslide in the adjacent, un-used north wall of an open cut coal mine. Cracks 2-3cm wide and 2cm deep appeared in both sides of the freeway and the section was closed for three months. Traffic was redirected through Morwell.

Landslides that block an entire road can affect business and tourism. For example, landslides continue to occur near 'Pooh Bear Corner' on the Kings Highway, which is the shortest route between Canberra and the South Coast of NSW. This is a popular route for Canberra holiday makers who support coastal communities with tourist dollars.

Another example is the closure of the Cunningham Highway at Cunningham's Gap in south Queensland. On 5 December 2010, a landslide from the steep mountainside occurred above the road. The Council and the Warwick Chamber of Commerce were concerned about the economic impact of the closure on tourism, including motels, service stations, and fast food outlets.

An expensive case of isolation was the result of landslides triggered by 370mm of rain in a 24-hour period during 22-23 March 2011 at Wilsons Promontory, Victoria. The Wilsons Promontory Road to Tidal River was closed by at least one landslide and a bridge collapse involving a debris fall due to flash flooding. A massive landslide also closed the Mount Oberon access road. At least 200 campers were evacuated by helicopter and 400 were stranded in the National Park. The closure of the park also adversely affected tourist operators.

A very small landslide with serious consequences happened on Greenhill Road, near Greenhill, South Australia, on 22 June 2000. A man was seriously injured when his car was hit by a large boulder. It hit the rear driver's side of the sedan then bounced onto the other side of the road. Rescue crews cut the roof off the car to free the man who was taken to hospital. Two members of the rescue crew were sprayed with hydraulic fluid while using cutting tools and were also taken to hospital.

A landslide on Springbrook Road, Springbrook, Queensland, on 5 April 2009 had a luckier outcome. Heavy weekend rainfall had triggered a debris slide in the cut in the uphill side of the road. As a station wagon drove past, the slope moved and the vehicle ended up being sandwiched between two large boulders. The larger, with a volume of about 0.5 cubic metres, crushed the bonnet of the car. The smaller, with a volume of about 0.3 cubic metres, came to rest at the rear corner of the vehicle. Rocks also hit and broke through the metal of a back door. Fortunately none of the four occupants was hurt. The road was closed for several weeks.

Holes in roads during the period January 2000 – December 2011

There have been 15 instances of holes, excluding ordinary potholes or mine subsidence, appearing in paved roads in populated areas. Six of these were identified as being cave-ins caused by broken or leaking water mains under the road. All bar one or two were attributed to water under the road tarmac from flooding or other causes. The amount of disruption caused by these holes depended on their size and location, but one had very expensive consequences.

On 25 March 2009, a five-metre-deep hole appeared in the bitumen at the intersection of Brisbane and East Streets, Ipswich, Queensland at about 9.15am. A leaking water main had eroded soil under Ipswich's busiest traffic intersection. The hole subsequently grew to be five metres long with an estimated volume of about 50 cubic metres. Traffic was thrown into chaos and, at about 6.30pm, police drew an exclusion zone around surrounding streets and a 300 metre air exclusion zone. The intersection re-opened at 5.00pm the next day. It took 30 hours to repair the hole by pumping in a special concrete mix, at a cost of $750,000. Business losses were expected to take the total cost to more than $1 million.

Toowoomba and Lockyer Valley, 10 January 2011

The tragic events of 10 January 2011 are described separately because it is difficult to differentiate how much of the damage and fatalities were caused by debris flows and their runout and how much was due to the fast-moving floodwaters that did not originate as debris flows. A debris flow near its source is laden with debris and flows as a torrent because of its high water content (up to 50 per cent), but it becomes a flash flood at its farthest end after much of its solid material has been deposited.

The events in Toowoomba and the Lockyer Valley were caused by prolonged high rainfall followed by a super storm which dumped 80mm of rain in just 30 minutes. A rain gauge at Withcott recorded 150mm in 50 minutes. This deluge falling on the Toowoomba Range triggered severe flash flooding in Toowoomba, and debris flows and flash floods in the Lockyer Valley area,

which killed 23 people with an unstated number injured, and destroyed numerous houses and other buildings, vehicles, and farm machinery. There was considerable infrastructure damage, including roads, footpaths, bridges, and railway lines.

A two metre wall of water, described as a "torrent, out of nowhere", hit the Toowoomba CBD at about 1.00pm after the West and East creeks broke their banks. The flash flood piled up cars, flooded houses and businesses and resulted in two deaths. It is unlikely that this originated as a debris flow. However, the railway station at Spring Bluff was destroyed by what appears to have been a debris flow from the steep hill slope above the railway.

A "mud torrent came hurtling down the mountain" (a debris flow) on to Murphys Creek where it destroyed houses, killed people and deposited two metres of mud.

The flash flood arrived in Grantham at about 3.30pm. It appeared as a wave of water across the paddocks, washing away people in their houses and cars. Some of this water would have originated as debris flows from the hill slopes.

The following information is quoted from Risk Frontiers (2011).

> "23 people died in the flash flood events in Toowoomba and the Lockyer Valley: 14 in Grantham, 2 in Murphy's Creek, 2 in Spring Bluff, 2 in Postman's Ridge, 1 in Helidon and 2 in Toowoomba.
>
> Houses built adjacent to waterways were washed away in the Murphy's Creek township, Postman's Ridge, Grantham and other locations due to high water velocities (up to 3 to 4 m/s) and high water depths. 29 houses were completely destroyed in Grantham, with 130 severely damaged. Nearly every house in the 'southern development' area of Grantham sustained structural damage caused by the velocity of the floodwaters. Some were washed off their stumps and completely destroyed, whilst others were rendered uninhabitable."

It is highly likely that the four people killed in the Murphys Creek-Spring Bluff area died as a result of debris flows and their runout. No figures were given for the number of houses damaged or destroyed there but, based on the figures given for Grantham, an estimated 45 houses may have been affected by debris flows. It is possible that debris flows may have caused damage and fatalities in other parts of the Lockyer Valley and that their runout contributed to the tragedy at Grantham.

Conclusion

Although landslides are not well-recognised by the general public as being a problem in Australia, they have killed at least 138 people which is more than nine times the number killed by earthquakes. Deaths from landslides have not decreased in recent times. During the period 2000-2011, 24 people died in landslides and 13 of those were killed by human-caused landslides.

The worst culprits were excavation failures, including trench collapses and children digging in sand. Six people died in landslides caused by excavation during the period 2000-2011. Education about the risk of working in trenches and other excavations and of digging in sand may save lives.

Landslides and mine or tunnel subsidence also continue to damage buildings or their contents with around 70 being affected during the period 2000-2011. Of these, an estimated 30 were affected by mine subsidence and 24 by debris flows.

Landslides also continue to damage roads, railways, culverts and bridges. For example, during the period 2000-2011, well over 300 landslides adversely affected roads. There are insufficient data to estimate the cost to infrastructure, but it could be in the millions of dollars.

As in other parts of the world, debris flows in Australia have been lethal and destructive. The two most lethal landslides in Australia's recorded history are the 1997 Thredbo landslide, killing 18 people, and the 1929 Briseis Dam disaster, killing 14 people. Both were debris flows. Debris flows grade into flash floods as the water content increases. The destructive nature of flash floods was highlighted by the Toowoomba and Lockyer Valley disaster in 2011 in which 23 people were killed and an estimated 200 houses damaged or destroyed in flash floods and debris flows.

Acknowledgements

References

Geoscience Australia, 2012, *Australian Landslide Database,* www.ga.gov.au.

Hand, D., 2000, *Report of the inquest into the deaths arising from the Thredbo landslide. NSW State Coroner's report.*

Michael-Leiba, M., 1999, *Impact of landslides in Australia to June 1999, Australian Journal of Emergency Management, Vol. 14, No. 3, pp. 30-31.*

Risk Frontiers, 2011, *State-wide natural hazard risk assessment. Report 8: Major historical flash flooding in Queensland, Report for Queensland Department of Community Safety, July 2011.*

About the author

Dr Marion Leiba worked as a volcanologist, earthquake seismologist and landslide scientist. She worked with Geoscience Australia for 20 years until her retirement in November 2001. She consults as a Disaster Risk Scientist and updates the Australian Landslide Database for Geoscience Australia. Marion was born in Australia and has a PhD from University of Hawaii.

Environmental health disaster management: a new approach

Ben Ryan, Brad Milligan and Dr Annie Preston-Thomas (Cairns Public Health Unit) and Geoff Wilson (Cassowary Coast Regional Council) detail the development of a response guide and supplementary planning tools to assist in the information-gathering stage of health emergencies in Queensland.

ABSTRACT

The need for an integrated approach to assessing environmental health issues and priorities after a disaster has been highlighted by recent disasters in northern Queensland. In response, the Cairns Public Health Unit (CPHU), Queensland Health, initiated a project to work with local and state governments from across northern Queensland to address these issues. This approach has proved successful and resulted in the development of a response guide, an environmental health rapid assessment tool, and an evacuation centre checklist. These achievements demonstrate that an objective forum for local and state governments can be effective in solving issues requiring multi-agency solutions. The project has provided a framework that can be applied to a range of issues other than environmental health and disaster management, and may be adapted to other settings beyond northern Queensland.

Overview

Recent natural disasters in northern Queensland highlight the need for an integrated approach to assessing environmental health issues and priorities that arise following a disaster. During recent responses there were concerns raised that field officers did not have access to tools that allowed for timely and systematic assessments. This culminated in limited information being collected for decision-makers to determine priority areas in a timely manner and allow public health interventions to be based on evidence. In response, the Cairns Public Health Unit (CPHU), Queensland Health, initiated a project to work with local and state governments from across northern Queensland to address these issues. This work centred on the formation of the Far North Queensland Public Health Disaster Management Working Group (working group), which provided an objective forum for state and local government disaster management and environmental health experts.

Environmental health and disasters

The environmental health response to a disaster aims to manage public health effects caused by the event and improve disaster preparedness to respond to future events (UCLA, 2006). The main elements considered in the response include, but are not limited to:

- drinking water
- hazardous waste (e.g. asbestos)
- general waste
- sanitation
- food safety
- communicable diseases
- vector issues, and
- mass gatherings (e.g. evacuation centres).

Public health professionals, particularly Environmental Health Officers (EHO), are in the best position to assess the impact of disasters on populations and conduct evaluations on responses due to their population-based focus (Degutis, 2008). Also, the core skills of EHOs allow the profession to effectively respond, monitor and assess public health issues in a disaster situation.

The most effective way to protect the health of people impacted by disasters is to ensure adequate shelter, water, food and sanitation. A systematic approach to the assessment and control of communicable diseases and other public health issues is a key component of a response, and is crucial to protect the health of affected populations (TFQCDM/WADEM, 2002).

Regional approach

The range of environmental health issues (such as asbestos, sewage and contaminated drinking water) arising from recent natural disasters in northern Queensland led the CPHU to work with local and state governments to form the working group in mid 2011. The working group facilitated environmental health teams and disaster co-ordinators to work together in identifying and managing public health risks within existing disaster management arrangements. Further, it was anticipated this approach would allow local governments in the region to enhance their public health resilience and allow core business activities to continue during a disaster response (e.g. water treatment).

Local governments, indigenous and non-indigenous, and state agencies were invited to be part of the working group. Acceptance required nomination of a contact person from an environmental health or disaster-related field. CPHU facilitated the working group, which included discussions, communication and organisation of meetings. The group consisted of representatives from a range of local governments including Cairns, Cassowary Coast, Cook, Pormpuraaw, Tablelands, Yarrabah, and Weipa. There was also active participation from Emergency Management Queensland and the Australian Red Cross.

Integrated framework

Based on lessons from recent natural disasters and working group discussions, an integrated framework was identified as the preferred approach for preparing for and responding to environmental health risks associated with disasters. The framework includes a response guide, an environmental health rapid assessment tool, and an evacuation centre checklist. These were developed as part of this project.

Response Guide

An Environmental Health Disaster Response Guide (Figure 1) provides an overview of the processes involved in ensuring an effective response to a disaster. The objective is to provide a systematic approach for gathering public health information after a disaster and providing this to decision-makers in a timely manner. The primary role of local and state government EHOs is to determine the environmental health risks and priorities from a community perspective.

Environmental health assessments would be undertaken within 72 hours of a disaster to identify community-wide risks and priorities. The environmental health rapid assessment form and evacuation centre checklist would be used to ensure consistency in the information gathered. Ongoing assessments are conducted using these forms or modified versions to aid the community's recovery and re-building efforts. This is particularly important to ensure the effectiveness of interventions is monitored and guide transition from response and recovery phases of disaster management. This type of process has been used successfully in the United States when responding to hurricanes, floods and ice storms (Rubin, 2005). Information gathered from such assessments allows responders to understand the public health issues, actual numbers of resources needed, and the messages required for affected residents (Rubin, 2005).

The environmental health rapid response teams are led by a Rapid Response Coordinator (RRC). Depending on local arrangements, the teams would be made up of EHOs from local and state governments to increase the pool of resources available and ensure all public health jurisdictional responsibilities are covered. Ideally, in a

large disaster such as Cyclone Yasi, the RRC position would be filled by a state government representative who functions as the Operations Officer or a similar position in an Incident Management Team within Queensland Health. If this was the case, the role of the RRC would be transferred to local government when capacity permits. Alternatively, the RRC could be a local government representative or any other appropriate person. The key is to ensure this type of position is agreed, identified and filled.

The RRC would deploy teams of two EHOs to undertake assessments of public health risks in selected communities and evacuation centres. The term 'community' refers to a selected suburb, area or town. The application of this term is at the discretion of the RRC. A community-wide assessment may take approximately two hours and an evacuation centre up to an hour. A decision on the communities and evacuation centres assessed would be made by the RRC. Before a team is deployed, the RRC would provide a detailed briefing of the situation and areas to be assessed.

The information gathered by EHOs in the field is provided to the RRC. The RRC is responsible for assessing information gathered and disseminating it to the Local Disaster Management Group (LDMG) public health representative and other agencies deemed necessary. The LDMG and other agencies use the information to develop an evidence-based response strategy. The RRC periodically deploys teams of EHOs to monitor the response.

For successful implementation of this guide it is recommended that triggers in disaster management plans be agreed and identified for appointing an RRC. For example, when a severe cyclone, such as Larry or Yasi (categories 4 and 5, respectively, at landfall) is imminent an RRC is appointed and a pool of EHOs placed on stand-by.

This guide should be consistent whether the work is completed by local, state or federal governments. The question of who conducts this work requires further discussion, however, it should be dependent on the size of the disaster and the capacity for the local government to respond. Where disaster, such as cyclones Larry or Yasi, overwhelms local government resources, assistance will be required from other agencies and all levels of government to address public health risks.

Environmental health rapid assessment tool

One of the key lessons learned following the response to cyclones Larry and Yasi was the lack of evidence-based and objective tools that allowed community-level environmental health rapid assessments. This resulted in insufficient information being collected and collated to determine priority public health risks and interventions based on evidence. The public health

FIGURE 1. Environmental Health Disaster Response Guide.

* The timeframe for transferring the Rapid Response Coordinator is dependent on local capacity.
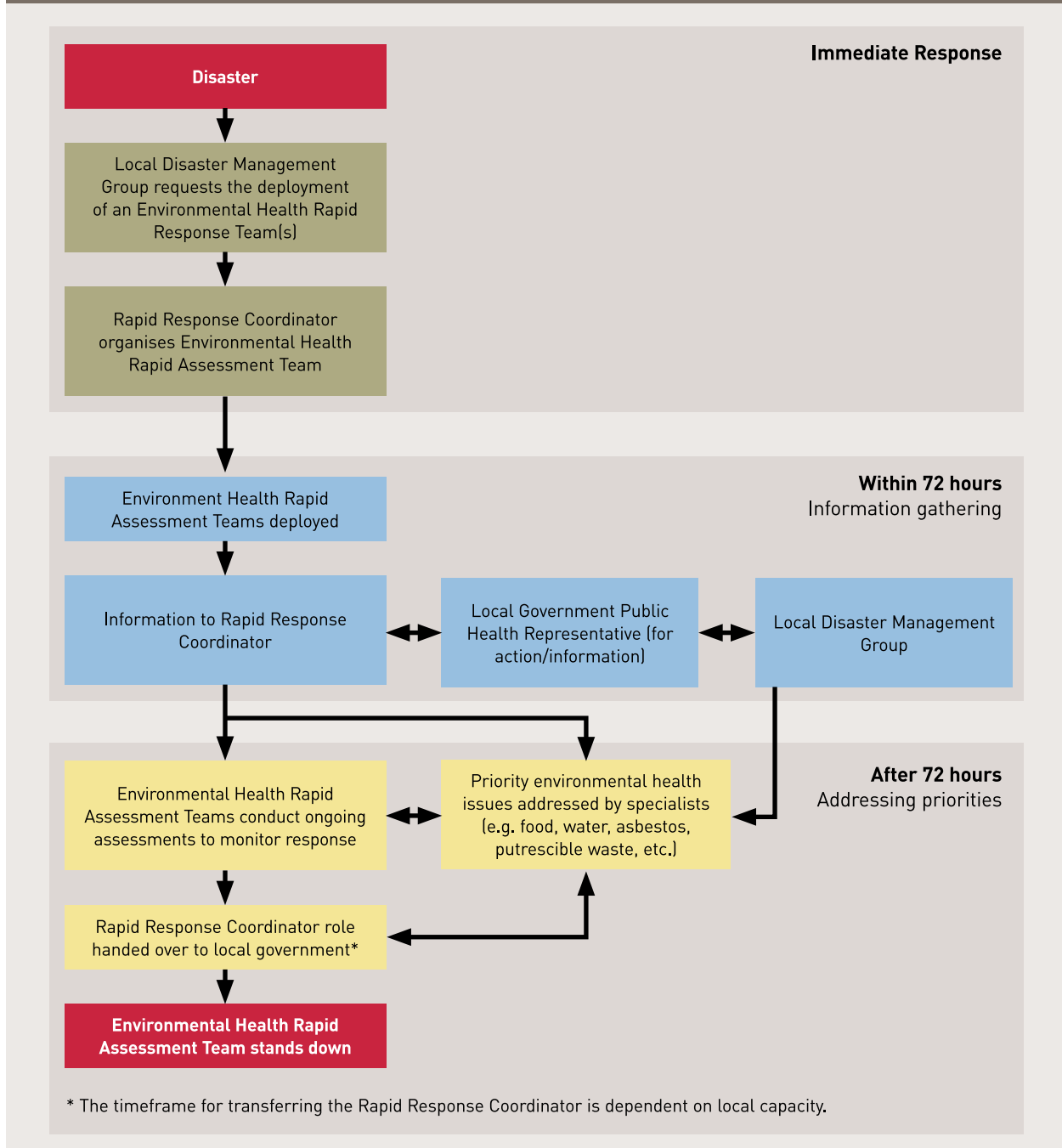
risks and priorities identified in this situation should be accurate and timely. These can include inadequate water supply, waste, food and sanitation systems, which can have a direct, and potentially devastating, impact on the health and livelihood of disaster-affected persons (World Health Organization, 2004). To address this, the working group developed an environmental health rapid assessment tool.

The rapid assessment tool is a three-page form divided into the key environmental health themes. These include drinking water, sewerage, waste, asbestos, food safety, personal hygiene, vectors and chemical hazards. EHOs use their expertise to

complete the rapid assessment tool as soon as access permits (as outlined in Figure 1, ideally within 72 hours). This enables a systematic approach to identifying and reporting on environment health issues and priorities from a community perspective. As part of the development process, *Exercise Recon* was held at Tully Heads, Queensland on 9 November 2011 to test the rapid assessment tool. Both assessment tools were designed for use in hard-copy or in an electronic format to ensure adaptability for unique disaster situations.

The form concludes with a section for EHOs to prioritise environmental health issues and priorities in-line with

the key themes. The RRC uses the priority ratings as a guide on what actions may be required. Ultimately, any decision made on the response strategy will be made by the LDMG with advice from the RRC and other experts.

EHOs are not expected to conduct detailed assessments of specific issues (e.g. determining methods for waste disposal and food business inspections) and implement solutions. The information gathered is provided to the RRC. It provides a platform for a LDMG and other experts to develop a response strategy.

Evacuation Centre Checklist

Mass gatherings, such as those at evacuation centres, present some of the most complex management challenges faced by governments. The influx of large numbers of people and the infrastructure needed can place a severe strain on public health systems and services. This may compromise the ability to detect developing problems and make effective responses (World Health Organization, 2009).

Asbestos containing material littered private, public and state land

Tidal surge destroyed some houses

Raw sewage in swimming pool

Damaged beachfront rock wall

Mixed debris

Images: Queensland Health

Damage at Tully Heads (impacted by tidal surge) from Cyclone Yasi.

Pre-exercise briefing to participants

Field tests allowed participants to test the tools and make assessments

Post-exercise briefing

Images: Queensland Health

Field exercise, *Exercise Recon*, was useful to test the rapid assessment tools and get feedback from participants.

To address this risk, the evacuation centre checklist was developed for EHOs to use before and after an evacuation centre is opened. The checklist provides guidance for managers on the minimum environmental health standards. The development of the checklist involved a review of literature and adapting relevant items from national and international documents. This included the:

- *Environmental Health Assessment Form for Shelters* - developed by the Centers for Disaster Control and Prevention (United States of America)
- Sphere project – humanitarian charter and minimum standards in humanitarian response
- *Emergency Management Australia Manual 12 – Safe and Healthy Mass Gatherings A Health, Medical and Safety Planning Manual for Public Events*, and
- consultation with the working group and the Australian Red Cross.

The checklist is a two-page form and is segmented into various sections including general overview, power supply, sanitation, food and water, waste, vectors, health (surveillance) and pets. EHOs use their expertise to complete the form and some information is pre-populated from the evacuation centre managers (e.g. number of occupants). The checklist provides a process for identifying environment health issues and priorities at evacuation centres.

As with the rapid assessment tool, the information gathered is provided to the RRC. It then informs the LDMG and other experts when developing a response strategy to environmental health issues at evacuation centres.

Discussion

This project demonstrated that providing an objective forum for local and state governments can be an effective way to solve issues requiring multi-agency solutions. Communication between EHOs across northern Queensland has strengthened, a response guide was developed, a rapid assessment tool and evacuation centre checklists have been adopted. To complement these achievements, the development of a database indicating baseline public health information is required.

A current understanding of the public health status of populations and infrastructure from an environmental health perspective is incomplete in northern Queensland. This would include gathering information about areas likely to have buildings with asbestos containing materials, the type of sewerage systems in various suburbs, sewage overflow points, water infrastructure including access to chemical suppliers, waste disposal sites, emergency food and water suppliers, etc. The development of such a baseline database allows decision-makers to immediately understand the public health impacts of a disaster (Wilson, 2005).

Ongoing activities are required to sustain momentum of the project. This would include regular meetings of the working group and the establishment of a specialised team of EHOs from local and state governments in northern Queensland who can undertake rapid assessments of communities to determine the environmental health risks and priorities. A key element of forming such a team is identifying co-ordinators and ensuring access to a suitable training course.

Due to resource constraints it is going to be a challenge to build on the achievements of this project. The risk is that momentum is lost, and attention is only paid to this area in the context of the next disaster. This does not allow for the other preparations described before an event occurs that would permit informed decision-making and response. Funding has now ceased, however, there are tangible benefits that can be used to enhance disaster preparedness and response activities. One solution may be for local governments to formally adopt the response guide and tools developed by including these in their public health disaster management plans. Such an approach would ensure EHOs across northern Queensland use similar systems and tools which would streamline disaster response activities and ultimately mitigate public health risks.

Conclusion

The project has enhanced the ability of local and state government departments to address key environmental health risks after a disaster. This has been achieved through the development of an environmental health response guide, environmental health rapid assessment tool and an evacuation centre checklist. These achievements provide a framework for allowing the environmental health risks after a disaster to be systematically identified and collated for decision-makers. However, due to resource constraints there is a risk of the achievements being lost and the collection of baseline data and creation of a specialised team of EHOs remaining incomplete. To address this concern, it is recommended that local governments formally adopt the response guide and tools developed. This will allow priority areas to be identified in a timely manner and ensure appropriate interventions based on evidence, all of which is vital for protecting livelihoods and mitigating public health risks after a disaster.

Further information

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References

Degutis, L., 2008, *Public health systems and public health preparedness, Yale Centre for Public Health Preparedness, New Haven, Connecticut.*

UCLA, 2006, *Hazard Risk Assessment Instrument, Centre for Public Health and Disasters, viewed 20 June 2011, http://www. cphd.ucla.edu/resources.html*

Rubin, C., 2005, *National Centre for Environmental Health, Center for Disease Control and Prevention, USA in: Hooke, W. & Rogers, P., 2005, Public Health Risks of Disasters – Communication, Infrastructure and Preparedness – Workshop Summary, National Academies Press, Washington DC, p. 40.*

TFQCDM/WADEM, 2002, *Health Disaster Management: Guidelines for Evaluation and Research in the "Utstein Style", Chapter 3: Overview and concepts, Prehospital Disaster Medicine, vol. 17, no. 3, pp:31–55, viewed 18 June 2011, http:// www.wadem.org/guidelines/intro.pdf*

Wilson, S., 2005, *National Institute of Environmental Health Sciences, USA, in: Hooke, W. & Rogers, P., 2005, Public Health Risks of Disasters – Communication, Infrastructure and Preparedness – Workshop Summary, National Academies Press, Washington DC, p. 41.*

World Health Organization, 2004, *Water and Disasters - Leading Off, Health in Emergencies, No. 19.*

World Health Organization, 2009, *WHO Global Forum on Mass Gatherings: Rome, Italy - October 26 - 29, 2009, World Health Organization, Geneva.*

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Brad Milligan is Manager of Environmental Health Services for the Cairns Public Health Unit. In this role he oversaw and co-ordinated environmental health and public health aspects of the response to Cyclone Yasi and represented Queensland Health on the Innisfail District Disaster Management Group. Based on this experience and 17 years of work in environmental health at local and state government in North Queensland he initiated and sponsored this project.

Geoff Wilson is Manager of Environmental Services for Cassowary Coast Regional Council. During the response to Cyclone Yasi he co-ordinated the environmental health and waste management aspects from a local government perspective. He is a member of the Local Disaster Management Group and has seven years local government management experience in North Queensland. This has included overseeing the environmental health response by Cardwell Shire Council to Cyclone Larry. Geoff used these experiences to play a vital role in steering a partnership between local and state government agencies during this project.

Dr Annie Preston-Thomas is a Public Health Registrar in the Cairns Public Health Unit and a Fellow of the Royal Australian College of General Practice, with over ten years experience working in community-controlled health services. Annie used this experience and her research skills to assist in developing the evacuation centre checklist, a major component of this project.

Perceptions of institutional and social response to frequent flooding in an Australian rural town

Ian Manock, Dr Rabiul Islam, Prof John Hicks, Dr Richard B. Sappey and Dr Valerie Ingham (Charles Sturt University) consider aspects of community emergency management.

ABSTRACT

This study of a small rural flood-prone Australian community, explores the perceptions of established approaches to emergency management by the community, particularly the roles ascribed to institutions and social capital. The tentative findings and interpretation suggest a combination of institutional and social capital factors at work through the established stages (prevention, preparation, response and recovery) and overall process of flood management. A key finding is a predominating attitude of dependency on institutions. Ⓡ

Introduction

The town of Molong has a population of 2,515 (ABS, 2012) and is located 300 kilometres west of Sydney, NSW and 30 kilometres from the city of Orange, the principal centre for employment and services for the region. Historically, Molong has experienced flooding from the Molong Creek which runs near some residential areas and the central business district (CBD). Floods or threats of flooding (particularly leading to sandbagging preparations) have occurred most recently in 1995, 2005, 2010 and 2012 (Central Western Daily, 2010a; Central Western Daily, 2010b; Central Western Daily, 2012). In 2005, flooding caused damage to houses on the floodplain and to business premises in the CBD (ABC Rural, 2005). According to the NSW State Emergency Service (2007), the flood caused extensive damage to 30 buildings, eight people were rescued, 28 businesses were sandbagged, and the occupants of 12 houses were evacuated. The persistence of flooding and the ensuing damage in a relatively old and settled part of Australia is interesting because it suggests a failure to adequately prevent damage to people's homes, assets and livelihoods despite improvement in floodplain risk management (Keys, 2006).

Background

For some time, the disaster management literature has explored the relative strengths and weaknesses of two divergent approaches. The first is what may generally be referred to as the 'technocratic approach' (Hewitt 1983), or more readily the 'government-led' approach. This encapsulates elements of bureaucracy and technology which signify assumptions of rationality and functionality in the foundations of the approach. This relates to their application in terms of structures, processes, systems, techniques and practices. These are generally housed within the institutions of the state, particularly government, military, police and, crucially, the state-based emergency service organisations which depend on volunteers drawn from the community. This remains the dominant approach despite the evidence that disasters in all their forms frequently overwhelm the institutions established to control them (Alexander 2002; Lindell, et al. 2007; Phillips, et al. 2010).

The second approach may be referred to as the 'socially-constructed approach'. This concept seems to have emerged in large part to serve as an alternative to the 'technocratic approach'. The basis is that risk is partially socially constructed rather than taken as given (Miller 2009, p.169) which opens the way for non-institutional approaches, particularly those involving the development of social capital within communities (Portes 1998). In general, social capital refers to the structures, processes and cultures that generate and maintain trust, co-operation and cohesion. This social capital can, in turn, be used by institutions and the community to improve risk management—a socially constructed, rather than a technocratic based, improvement (Hewitt 1983; Tierney 2007; Norris, et al. 2008). Some of the literature has developed these contested approaches (Quarantelli 1998) and applied them using different characteristics. For example 'vulnerability' versus 'resilience' (Phillips, et al. 2010, p.13) and a different way of thinking, for example, '...that resilience is a process that leads to adaptation, not an outcome, not stability' (Norris et al. 2008, p.144).

Importantly for research purposes, Alexander (2002, pp.212-3) notes that the gap between the approaches means there is a question of the distribution and forms

of control, particularly between state institutions and communities. In short, much of the literature has understandably relied on a spectrum of theoretical approaches that have 'a technological approach' at one end and 'a socially-constructed approach' at the other. The task is to examine and draw useful conclusions in terms of how these are blended. The case study data revealed that the reality for Molong was somewhere between the extremities of the technological approach and the socially-constructed approach. Social capital encompasses relationships and wider networks at one extreme, and institutions, which are primarily state-funded and/or controlled in whole or with permanent managerial functions overlaying a volunteer base, at the other. Thus it is possible to view the institutional and social approaches to disaster management as two extremes of a continuum. Any given disaster situation will exhibit a mixture of both institutional and social responses and can be represented by a point on this continuum.

This broad spectrum of approaches has become integrated into emergency management in Australia. There has been a growth in attempts to analyse and promote different approaches which fall between the extremities of the theoretical spectrum which rest on the notion of resilience. Some of the literature emphasises the role of policy at both state and local government levels, particularly the implication that planned development incorporates flood mitigation within an established institutional context and that such an approach is critical to community resilience (Thomas, *et al.* 2011, p.15). On the other hand, the notion of resilience is associated with the role of communities themselves, in part at least, assuming a greater role for social capital. However, some of the literature has moved towards integrating institutional approaches from within state and community

involvement at one or more phases of flooding as a process (e.g. Cottrell, 2005; Gissing, *et al.* 2010), and in relation to bushfire preparedness (Frandsen, *et al.* 2012). Moving in this direction makes assumptions about the blending of social capital and institutions depending on the precision of the concept of resilience as an explanatory tool and as a basis for practical methods of dealing with emergencies. Gissing, *et al.* (2010, p.44) provide a guide to this direction, crucially identifying the need for 'cultural change within the emergency management agencies' and 'further engagement … to ensure stronger partnerships … between agencies and the community'.
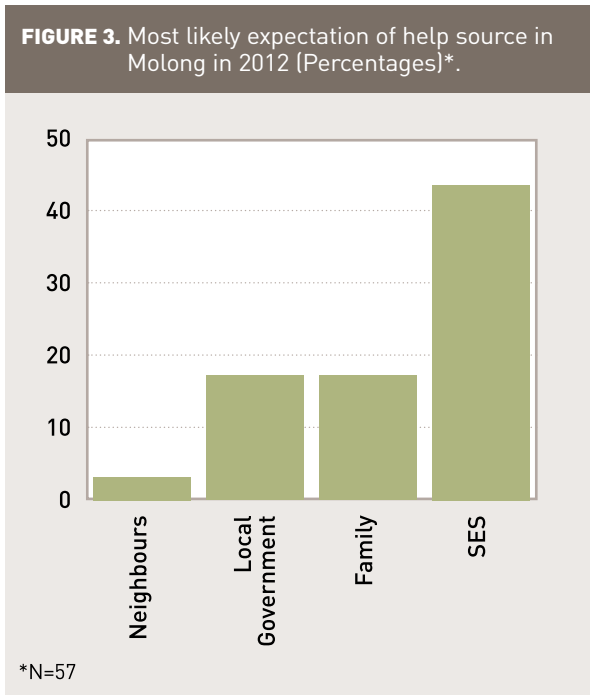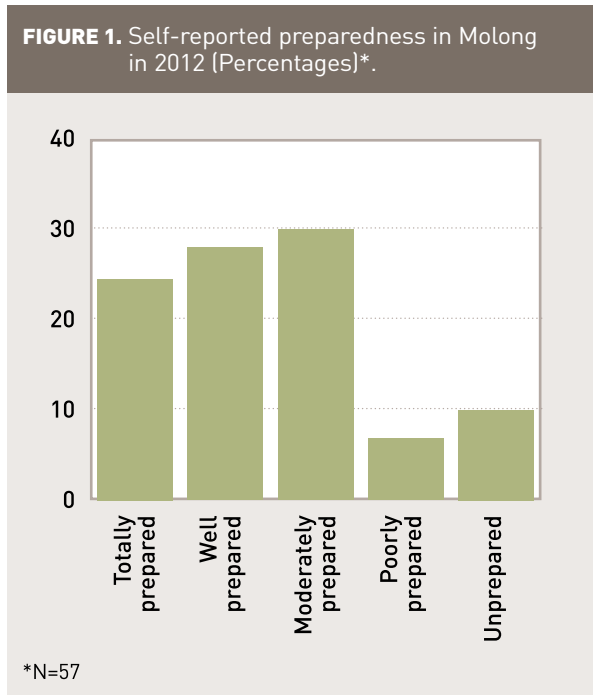
The relationship between the two approaches to disaster management is explored. In particular, the relationship between established political and disaster management institutions and institutional arrangements, and the espoused attitudes of the community and the social capital which underpins and/or arises out of these attitudes. The purpose is to identify differences and similarities in terms of the two approaches and to identify the elements of each which leads to enhanced resilience. This is in the context of the four-phase (prevention, preparation, response and recovery) approach to flood management as found in the literature.

Research methods

The research was conducted in early 2012. Background material on the town and the town's history of flooding was obtained. Prime source data was gathered in two stages with the assistance of the regional SES. First, a postal survey of 772 households was conducted which generated a response rate of 7.3 per cent (57 useable responses). Subsequently a follow-up town meeting
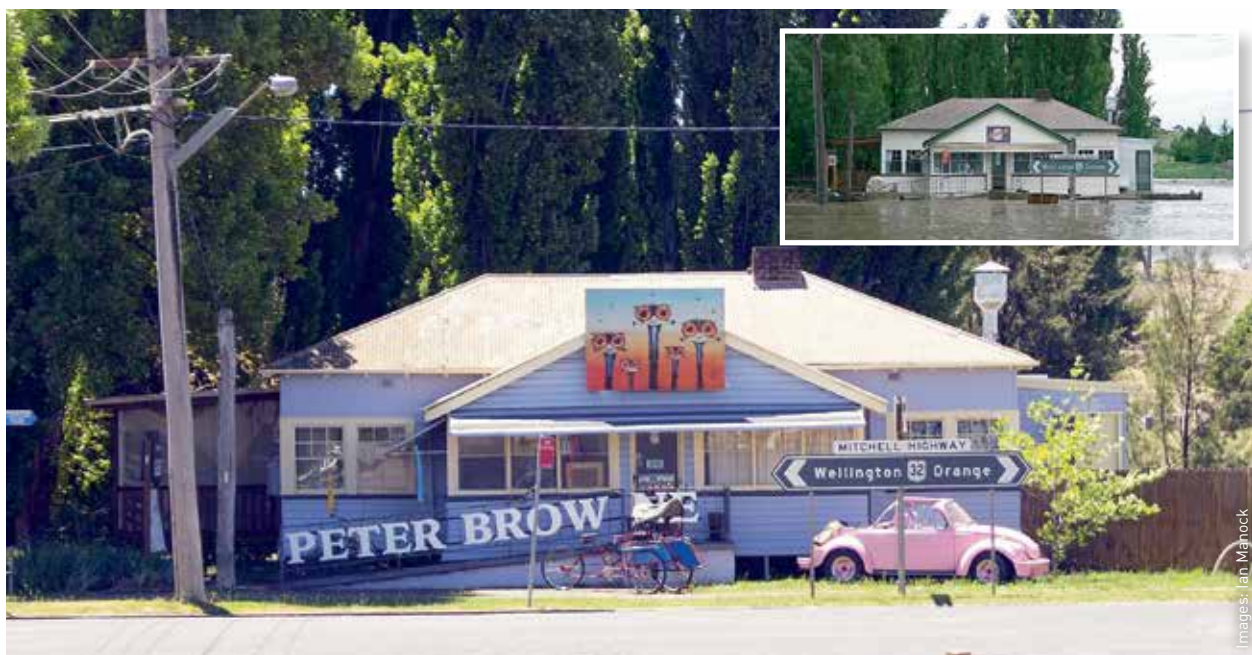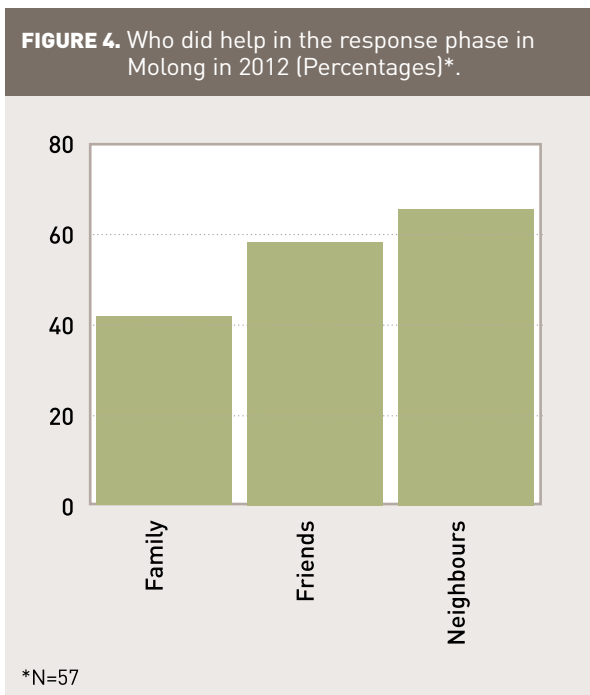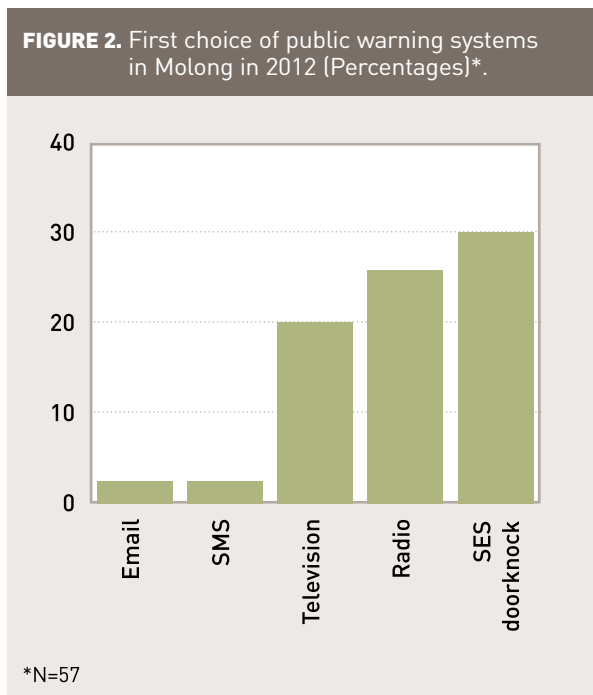

Flood waters reached the front door sill of the gallery at the intersection of Gidley Street and Mitchell Highway.

FIGURE 1. Self-reported preparedness in Molong in 2012 (Percentages)*.

*N=57

FIGURE 3. Most likely expectation of help source in Molong in 2012 (Percentages)*.

*N=57

was held to which all residents were invited. The mayor, several councillors, staff from the local SES, a number of local business leaders, and 26 residents attended the meeting. Attendees were asked a series of questions designed to refine and deepen the survey data. It was at this meeting that a clearer understanding of the reasons behind the small survey response rate was presented by community members attending.

The survey was constructed in terms of the three-phase approach to flood management. It included questions about specific dimensions of Molong flooding. The survey allowed participants to respond in a prioritised

order of preference in some questions, i.e. tick more than one box. Unfortunately, the low response rate to the survey precluded advanced statistical analysis beyond basic descriptive results. Therefore, the findings and the conclusions drawn from the survey must be interpreted as indicative rather than conclusive. When examined in association with responses from the community meeting, a clearer picture of the town's preparedness and issues relating to the flooding hazard and the psychosocial impact on residents emerged.

FIGURE 2. First choice of public warning systems in Molong in 2012 (Percentages)*.

*N=57

FIGURE 4. Who did help in the response phase in Molong in 2012 (Percentages)*.

*N=57

Research findings and analysis

Preparedness

Respondent perception of their preparedness for flooding was relatively high. Figure 1 shows that 80 per cent said they assessed they were prepared 'moderately' (29.4 per cent), 'well' (27.5 per cent), and 'totally' (23.5 per cent). In addition, a large majority stated they had insurance cover of home (86.5 per cent), contents (80.8 per cent), and vehicle (65.4 per cent).

Emergency warnings take two broad forms:

- informal and largely individual, and
- official public.

The highest informal warning response (first choice) was weather reports (42.3 per cent) followed by rising river levels (13.5 per cent). The highest public warning sources (first choice) were SES personnel doorknock (30 per cent), radio (26 per cent), television (20 per cent), SMS (2 per cent), and email (2 per cent).

Figure 2 illustrates the respondents' preferred method of receiving a warning. This was by SES personnel doorknock (43.1 per cent). For the preparedness phase, warning systems continue to be critical. Whether by general weather reports or specific warnings, the systems most reported as being relied on in Molong are those emanating from institutions.
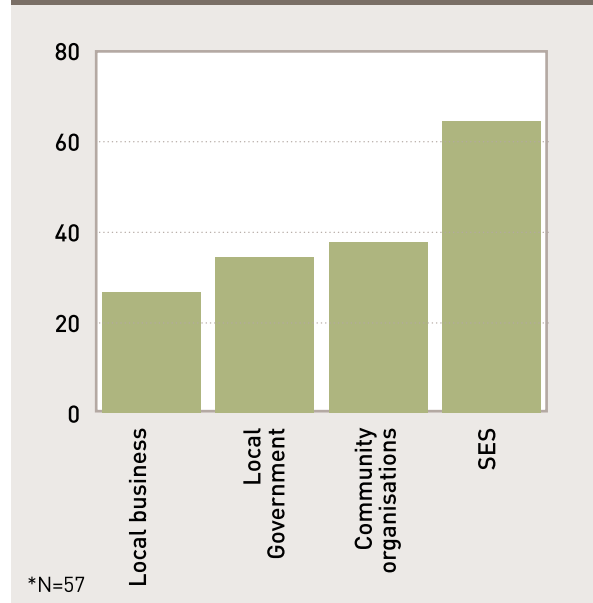
Response

In terms of response, the survey compared an expectation of who would help and the *reality* of who did help. The 'most likely' expectation (see Figure 3) was the SES (44.2 per cent) followed by family and local government (each 17.3 per cent). Neighbours constituted 1.9 per cent.

In terms of the 'second most likely' expectation, state government and the fire brigade were each 7.7 per cent, community organisations were 5.8 per cent, and friends were 1.9 per cent. In short, the expectation was primarily a perception that institutions would play the most significant role in assistance.

Figure 4 shows the multiple answers to the response phase question '...who did help...'. Results suggest a more extensive role for the community, particularly neighbours (64.7 per cent), friends (58.5 per cent), and family (41.2 per cent). However, the role played by institutions (see Figure 5) was also significant with SES (64.7 per cent), community organisations (38.2 per cent), local government (35.3 per cent), and local business (26.5 per cent).

The findings indicate a discrepancy between expectation and reality. Interestingly, the role of people in the community is undervalued whereas the role of the key emergency institution (the SES) is valued relatively highly in terms of both expectation and reality.

FIGURE 5. Which institutions provided help in the response phase in Molong in 2012 (Percentages)*.

*N=57

Recovery

In response to the question about recovery, 52.1 per cent of respondents said they recovered 'well' or 'completely' compared to 47.9 per cent who said that they 'did not recover' or 'just' recovered. Responses at the town meeting supported this finding and also identified that there were some divisions, particularly economic or financial, between community members who recovered from the flooding and those who experienced continuing problems resulting from the flooding. In terms of the expectation of recovery costs (see Figure 6), respondents stated they relied on family and friends (32.4 per cent), state government (21.6 per cent), Federal government (10.8 per cent), community appeals (8.1 per cent), local government and community organisations (5.4 per cent each), and businesses (2.7 per cent). Clearly, in terms of the expectation as to who would assist them financially, people valued family and friends before institutions. In terms of the most beneficial source of recovery information, respondents rated local government (39.1 per cent) and the SES (21.7 per cent) as the two most important sources. The other three main categories were the Federal government, businesses, and family and friends (each 6.5 per cent). Thus, while community members relied more on family and friends to assist with the recovery costs, the local government and SES were the greater source of recovery information.

The survey attempted to assess the strength of the community in several ways. An assessment of a 'sense of community' was explored with a majority of respondents stating that it had improved over time (52 per cent) with 36 per cent stating that it had 'remained the same' and 4 per cent stating that it had 'deteriorated a lot'.

FIGURE 6. Expectation of reliance of recovery cost in Molong in 2012 (Percentages)*.

*N=57
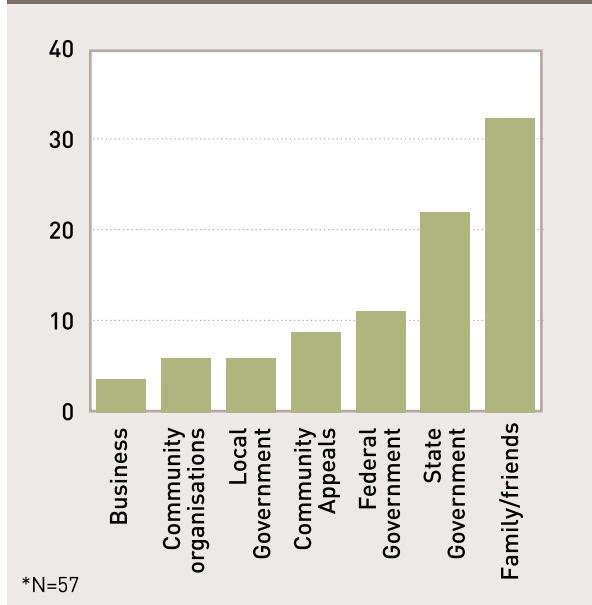
In terms of levels of 'co-operation and help', 29.5 per cent stated they had experienced this to a 'very great degree', 27.3 per cent to 'a degree', 25 per cent to a 'large degree', 9.1 per cent to a 'very little degree', and 9.1 per cent 'not experienced at all'. Only moderate response rates were found in terms of 'making new friends', 'bringing family closer together' and 'increased involvement in the community'. The results suggest that social capital is improving, providing greater resources for a socially-constructed outcome.

The perceived psychological impact of flooding was also assessed by asking whether respondents felt helpless, vulnerable and despair in the aftermath of the flooding. Around 54 per cent of respondents reported

no such experience of psychological distress. However, 45 per cent of respondents did report psychological distress at various levels. Among the respondents who reported that they experienced some level of distress, 33 per cent (14.9 per cent of all respondents) asserted that the level of the distress was large to a great degree. While 66 per cent did not have any sense of abandonment or isolation in the aftermath of the flood, 14.6 per cent did report that they experienced a large to a great degree of such emotional upset. The findings indicate that the SES and government organisations need to incorporate an effective mental health support system and psychological recovery framework in their preparedness program for this flood-prone regional country town (see IASC, 2007).

Prevention and mitigation

Almost all respondents, 55 out of 57, responded to the question 'What do you believe should happen to improve future flood management in Molong?'. Almost all respondents identified maintenance of Molong Creek through clearing debris and improved design and construction of drainage systems to prevent the damming of floodwater so that water can flow away faster. A few respondents mentioned an improved building permission and buyback system for buildings on the floodplain. In other words, the experience of those who answered this question related to technical preventative and/or mitigating solutions to the problem.

The repetitive nature of flooding indicates that the town is vulnerable to loss of, or damage to, residences and businesses. This has the consequence of perceived depreciation of property and inventory values. Consequentially there was a stifling effect on the potential of the town to develop and sustain economic growth, in some part due to the impact of flooding on the businesses within the town's CBD. One attendee at the community meeting stated *"the business centre*

At the intersection of Gidley Street and Mitchell Highway floodwaters lapped the bottom of the petrol pumps at the BP Service Station.

here, has never recovered. Never recovered since 2005. Um...as a matter of fact any business that's here and still operative...they're all hanging. Just hanging." While this can be the result of a number of factors–including general economic conditions and/or drought–the respondent clearly attributed it to the flooding since 2005.

Given the history of flooding, it seems reasonable to conclude that for whatever reasons (probably those involving public funding of preventive infrastructure by governments and the resilience of the population to recover) improvement is likely to be slow and intermittent. Possible solutions include governments buying houses in the most vulnerable parts of the town. At the time of the research there was no indication that government, at any level, was addressing the problem in terms of a significant solution. The community identified that the most desirable mitigation option was a series of technical changes to preventing water from entering the most vulnerable parts of the town, including the CBD. This has not materialised. At the meeting it was identified that the local government had stated that the construction of a levy system on the Molong Creek was too expensive.

At the community meeting, one resident said 200 people had attended a meeting after the 2005 flood, but far fewer people attended the meeting arranged for this study. One member of the Molong flood mitigation committee stated, *"The saddest thing coming in here tonight is the number of people here. This place should be packed, but the reason it's not packed is because everybody knows that nothing is being done. After all the trouble we've been going through for the last 15 years to get something done....and expenditure in water reports and feasibility studies...and it's all come to the fact that nothing can be done."* The community simply feels powerless to influence the management of the flooding hazard to the town. The SES regional staff had

Molong Railway Bridge showing estimated flood height on the electrical box.

endeavoured to improve the warning regime through earlier doorknocking and issuing specific community bulletins through the media. It was clear from the survey responses and the meeting that the volunteer organisations (SES and Bush Fire Brigade) were praised for their past work and valued through all phases of flooding.

It is possible to argue that social capital is an integral part of community organisations and business and that community organisations and businesses have a role to play in building up social capital. The results suggest that, in terms of assistance during flooding and recovery phases, friends, neighbours and family were important. In other words, the non-institutional forms from which social capital is drawn, remains a clear element of the town's response to flooding. It is interesting that the elements of social capital (structures, processes and cultures that generate and maintain trust, co-operation and cohesion) were not specifically identified as a key source of surviving the flooding, nor extensively discussed in terms of value and/or criticism. Nevertheless, it did emerge in various forms. For example, one resident at the meeting mentioned the local newsagent proprietor whose building was destroyed, and that *'...the morning after the flood he had a table on the front and was selling newspapers. And I thought that was the greatest thing he could have done because it gave us some familiar part of our lives...'.* By contrast, some institutions, particularly governments as opposed to the volunteer organisations, were extensively criticised primarily on the basis that they did not perform the role that the respondents expected them to perform. This blaming is common after the impact of hazardous events and can be expected from a public forum. As Holmes (2010, p.389) points out, "Looking for someone to blame might satisfy our base desires but will it really help us next time around?". For example residents were critical of the NSW Department of Primary Industry Office of Water for not doing more to undertake upstream mitigation activities on the Molong Creek which was regarded as a way to reduce the impact of flooding in Molong.

Conclusion

The most significant finding of this case study is the perception that the established institutional framework at large, but specific organisations such as the SES, local and state governments and community organisations, would play the most significant roles throughout most phases of flooding. This is despite the fact that community members, families and friends were those who provided support. Institutions provided information and some financial relief. It is reasonable to draw the conclusion that the people who responded to the research questions in the survey and attended the meeting were viewing the problem and solutions to it through a technological lens. Most significant was the related and consistent value placed on institutions. In doing so, this supported and perhaps entrenched a belief which constituted dependency on those institutions. The fact that the town continues to

be vulnerable to flooding and there is no guarantee of significant improvement in institutional responses, the only logical conclusion is that Molong will be at risk of flooding and the community will suffer the physical, psychological, environmental and economic consequences that flooding causes. Unless there is a change in the perceived attitudes of both institutions and the community, little can be done to build community resilience to inevitable flooding events.

References

ABC Rural, 2005, *Molong Assesses Flood Damage, 8/11/2005, www.abc.net.au/rural/content/2005/s1500367.htm. Accessed 30 May 2012.*

Alexander, D. 2002. *"From Civil Defence to Civil Protection – and Back Again." Disaster Prevention and Management 11: 209-13.*

Australian Bureau of Statistics (ABS) 2011 *Census QuickStats, 27/11/2012 www.censusdata.abs.gov.au/census_services/getproduct/census/2011/quickstat/SSC11572?opendocument&navpos=220. Accessed 27 November 2012*

Central Western Daily, 2010*a, Molong Floods, 12/8/2010, www.centralwesterndaily.com.au/news/local/news/general/molong-floods/1911297.aspx. Accessed 30 May 2012*

Central Western Daily, 2010*b, Molong Being Sandbagged, 9/12/2010, www.centralwesterndaily.com.au/news/local/news/general/molong-being-sandbagged/2021636/aspx. Accessed 30 May 2012.*

Central Western Daily, 2012, *Flood Watch Issued for Orange and Molong, 27/2/2012, www.centralwesterndaily.com.au/news/local/news/general/flood-watch-issued-for-orange-and-molong/269086.aspx. Accessed 30 May 2012.*

Coles, E. and Buckle, P., 2004, *Developing Community Resilience as a Foundation for Effective Disaster Recovery, The Australian Journal of Emergency Management, Vol. 19, No. 4, p.615.*

Cottrell, A., 2005, *Sometimes it's a Big Ask, but Sometimes it's a Big Outcome: Community Participation in Flood Mitigation, Australian Journal of Emergency Management, Vol. 20, No. 3, pp.27-32.*

Frandsen, M., Paton, D. and Sakariassen, K., 2012, *Fostering Community Bushfire Preparedness through Engagement and Empowerment, Australian Journal of Emergency Management, Vol. 26, No. 2, pp.23-30.*

Gissing, A., Keys, C. and Opper, S., 2010, *Towards Resilience Against Flood Risks, The Australian Journal of Emergency Management, Vol. 25, No. 2, pp.39-45.*

Hewitt, K. (ed.), 1983, *Interpretations of calamity: from the viewpoint of human ecology, Allen and Unwin, Boston.*

Holmes, A., 2010, *A reflection on the Bushfire Royal Commission – Blame, accountability and responsibility, Australian Journal of Public Administration, Vol. 69, No. 4, pp.387-391.*

IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings, 2007. *www.humanitarianinfo.org/iasc. Accessed 18 September, 2012.*

Keys, C., 2006, *The Evolution of Floodplain Risk Management and Real-time Flood Management in New South Wales, The Australian Journal of Emergency Management, Vol. 21, No. 1, pp.3-8.*

Lindell, M. K., C. Prater and R. W. Perry. 2007. *Introduction to Emergency Management Hoboken, New Jersey: John Wiley and Sons.*

Miller, K. D. (2009*). Organizational risk after modernism. Organization Studies, Vol. 30(02-03), pp.157-180.*

Norris, F. H., Stevens, S. P., Pfefferbaum, B., Wyche, K. F. and Pfefferbaum, R. L. 2008, *Community resilience as a metaphor, theory, set of capacities and strategy for disaster readiness, American Journal of Community Psychology, Vol. 41, pp.127-50.*

Phillips, D. B., Thomas, D. S. K., Fothergill, A. and Blinn-Pike, L. (eds.), 2010, *Social vulnerability to disasters, Taylor and Francis, Baton Rouge, Florida.*

Portes, A. 1998, *Social Capital: its Origins and Applications in Modern Sociology, Annual Review of Sociology Vol. 24, pp.1-24.*

Quarantelli, E. L. (ed.), 1998, *What is a disaster? Perspectives on the question, Routledge, London*

State Emergency Service (SES), 2007, *New Molong FloodSafe Guide Launched, www.ses.nsw.gov.au/news/archive-2007/new-molong-floodsafe-guide-launched. Accessed 30 May, 2012.*

Tierney, K. J., 2007, *From the margins to the mainstream? Disaster research at the crossroads, Annual Review of Sociology, Vol. 33, pp.503-525.*

Thomas, M., King, D., Keogh, D. U., Apan, A. and Mushtaq, S., 2011, *Resilience to Climate Change Impacts: A Review of Flood Mitigation Policy in Queensland, Australia, Australian Journal of Emergency Management, Vol. 26, No. 1, pp.8-17.*

About the authors

Ian Manock, Dr Rabiul Islam, Prof John Hicks, Dr Richard B. Sappey and **Dr Valerie Ingham** are members of the Bangladesh Australia Disaster Research Group Charles Sturt University. They research community expectations and experiences of emergency management, risk perception and social capital and aim to develop a multi-disciplinary and cross-cultural model which will strengthen community resilience.

FLOOD RISK INFORMATION PORTAL

As part of Phase 1 of the four-year National Flood Risk Information Project (NFRIP, started 1 July 2012), the government launched the Flood Risk Information Portal in November 2012. A main aim of the project is to make existing flood information available from a central location. The web portal is hosted by Geoscience Australia and will be enhanced and updated throughout the life of the project.

What information will be available from the Portal?

The initial phase included significant enhancements to the Australian Flood Studies Database (AFSD) that now contains information on over 1300 existing flood studies. In some cases, digital flood studies are available. A user-friendly interface enables planners, insurers, engineering consultants, and the public to access flood information. Summary information on each flood study is provided, including:

• how the study was done
• what data was used
• what flood maps were produced and for what scenarios, and
• the custodian and author (e.g. consultant) details.

Where the study included an assessment of damage, details such as estimates of annual average damage, or the number of properties affected during a flood of a particular likelihood will also be included.

The release also included a pilot series of maps derived from satellite imagery, showing the observed extent of floods over the previous six years for three key study areas: Condamine River, Queensland; Flinders and Norman Rivers, Queensland; and Goulburn and Loddon Rivers, Victoria. The maps can be used to understand where flooding has occurred across large rural regions where flood studies have not been performed.

During the initial phase, an agreement was signed with Engineers Australia to finalise the revision of the Australian Rainfall and Runoff. This national guideline provides technical information key to the development of future flood studies. This is a significant component of NFRIP as the guideline will improve the quality of future flood studies.

Fire development in focus

Nathan Maddock, Communications Officer, Bushfire CRC explains how a team of Bushfire CRC researchers is investigating how bushfires develop.

ABSTRACT

All bushfires start small – how they progress to large fires that can impact on communities and cause wide-scale destruction is being studied by a team of Bushfire CRC researchers. Until now, the existing knowledge of fire behaviour and tools for prediction assumed steady-state spread of a fire. Understanding the chances of a fire occurring, as well as the likelihood of spot fires, is essential to understanding the behaviour of bushfires under all possible weather conditions.

Bushfire CRC researchers Dr Andrew Sullivan and Jim Gould from CSIRO observe a fire in the Pyrotron.

The CRC team

The Bushfire CRC team, comprising of Dr Andrew Sullivan, Dr Miguel Cruz, Dr Peter Ellis, Jim Gould and Dr Matt Plucinski, brings together fire behaviour and suppression specialists from the CSIRO with the Bureau of Meteorology's atmospheric boundary layer meteorologists.

Three key aspects are being investigated:

- the potential for a fire to start
- the potential for a fire to be beyond initial first attack, and
- once a fire starts spotting, when will these spot fires be beyond initial first attack.

Understanding these important phases of fire development helps clarify resource demands placed on fire brigades, provides greater confidence in preseason planning, and assists in issuing public warnings.

Dr Andrew Sullivan is the Bushfire CRC research leader for the project and Senior Research Scientist at the CSIRO. He said the team is looking at the problem from a number of different perspectives.

"We are taking a multi-pronged approach to the research which includes considering a large number of experimental fires that were conducted in the 1950s and 1960s by Alan McArthur and his associates.

"These fires were lit at one particular point and then studied for a period of time, sometimes minutes, sometimes up to an hour, before they were extinguished," he said.

In conjunction with the historical data, the team is conducting tests using the CSIRO Pyrotron and vertical wind tunnel. The Pyrotron is horizontal wind tunnel where fires can be studied under repeatable conditions in safety. The vertical wind tunnel allows samples to be burnt at their terminal velocities.

"We cannot control all the variables in field research and it's very hard to be in the right place at the right time to make observations."

The Pyrotron allows fires to be studied safely.

"We're looking at the rate of growth of fires that were at different sizes when ignited.

"The McArthur experiments play an important part in fire science; science that is still used today. The experimental fires conducted in the '50s and '60s have been instrumental in the development of the current McArthur fire danger rating systems for forests and grasslands," said Dr Sullivan.

In addition to developing the fire danger rating systems, a vast amount of data was collected during McArthur's experimental fires that wasn't used. This is the data that Dr Sullivan and his team are drawing on. For example, the rate of growth, which is how fast a fire will develop from a point ignition to a fire that is burning at its steady state, wasn't analysed in the past.

Point ignition refers to fires that start at one particular point, such as a lightning strike or from a discarded cigarette. This is distinct from fires that may have been burning for some time, or lit in a line, such as prescribed fires. This also includes spot fires.

"Spot fires are fires that have been started during a bushfire by firebrands lofted ahead of the main fire, or brand new fires – either intentionally or accidentally lit.

"A firebrand can be any type of fuel that becomes airborne while still burning, such as twigs or bark. How easily a firebrand becomes airborne and how far it can be transported is determined by its shape and its terminal velocity while burning," explained Dr Sullivan.

Firebrands with relatively low terminal velocities (five metres per second or less) will become airborne more efficiently than those with relatively high terminal velocities (eight metres per second or more). How far ahead a fire will spot is determined by a firebrand's flameout and burnout time. Flameout time is the length of time that a firebrand remains flaming during flight, while burnout time is the total combustion time.

Dr Peter Ellis demonstrates how the vertical wind tunnel allows firebrand samples (circled) to be burnt at their terminal velocities in the laboratory, as though they were actually in flight.

The probability that a firebrand will ignite once it touches the ground is influenced by its state (flaming or glowing) and its mass when it lands. These characteristics can only be measured by burning firebrands at their terminal velocity in the vertical wind tunnel.

"Spotting is one of those aspects of bushfire behaviour that's been recognised for many years, and has been investigated a number of times, but is so complex. Spotting behaviour can fluctuate in response to variations in fuel, topography and weather, as well as interactions with the atmosphere. These three aspects of the project come together to help predict the spread of a fire.

"We want to be able to provide fire authorities with better information on the potential of a fire to be beyond initial first attack by the time the first fire crew gets to the site.

"If a fire is beyond the first crew's control, then fire authorities need to move to the next phase of suppression," said Dr Sullivan.

Simon Heemstra, Manager of Community Planning at the New South Wales Rural Fire Service (RFS), is the lead end user for the project and believes it has the potential to fill a major gap in fire behaviour predictions.

"The implications for both the RFS and firefighting agencies in general are significant.

"A greater understanding of fire growth during the initial development of a fire has the potential to increase the accuracy of fire spread predictions. This helps to warn and protect communities as it will increase the accuracy of the predictions of what time a fire may impact.

"The project also has the potential to increase suppression efficiency, and assist in better resource allocation. This may enable fires to be contained faster, increasing the number of fires that can be contained on days when there are many fires occurring," he said.

The outcome of the research project will be an increased understanding of fire behaviour that can be incorporated into existing fire behaviour modelling systems or used to improve planning for prescribed burning operations.

The aim is to provide support for fire managers evolved in decision-making, including community warnings, planning, operations, monitoring and assessment.

More information is available at
http://www.bushfirecrc.com/research.

References

Bushfire CRC Fire Note, issue 94, http://www.bushfirecrc.com/firenotes

2012 RESILIENT AUSTRALIA AWARDS

Building a disaster resilient Australia

On behalf of The Hon. Nicola Roxon, Attorney-General and Minister for Emergency Management Ms Gai Brodtmann MP, Member for Canberra attended the Awards ceremony to congratulate award recipients.

"The Resilient Australia Awards recognise innovative practices that are making our communities safer, stronger, more resilient and better prepared to manage any emergency situation.

"Over the last few summer seasons Australia has experienced natural disasters the likes of which many of us have not experienced in our lifetimes.

"While wild weather can be unpredictable, we can all be better prepared.

"The winning projects and commendations for the Resilient Australia Awards show how communities across our nation are developing innovative and creative ways to better prepare for emergencies and disasters," said Ms Brodtmann.

Formerly known as the Australian Safer Communities Awards, the Resilient Australia Awards were renamed to reflect the *National Strategy for Disaster Resilience.*

Gai Brodtmann MP and Dr Brendan Tatham.

Department of Primary Industries, Victoria
Victorian Emergency Management Animal Welfare Plan

The Victorian Black Saturday Bushfires Royal Commission recognised the bonds that people form with animals and the impact these bonds have on decision-making and safety during an emergency.

The Emergency Animal Welfare Plan takes an all-hazards and an all-species approach to promote effective planning and management of animals in emergencies. The plan ensures that animals are better considered and protected from suffering during and immediately following an emergency incident.

STATE GOVERNMENT – HIGHLY COMMENDED

ACT Emergency Services Agency

'Spot' - Single Point of Truth: emergency public information program

The ACT's Emergency Services Agency Media and Community Information Unit developed a system called SPOT to gather emergency details from the Territory's emergency services, local media and social media sources. The information is monitored, assessed, compiled and distributed to the ESA website, senior officers, community outlets and the media as one message.

STATE GOVERNMENT – WINNER

Gai Brodtmann MP and Darren Cutrupi.

Wyong Shire Council, NSW

Natural Areas Bushfire Management Plan

The Wyong Shire Bushfire Management Plan covers more than 3000 hectares of bushland on the NSW Central Coast, with a 66km-long urban interface.

The plan includes a fire management plan that includes a review of fire breaks, an audit of fire trails, an analysis of the bush fire risk to a wide range of community assets including water and sewerage infrastructure, community buildings and telecommunications. It also includes an innovative community engagement activity to help take responsibility for improving their property bush fire protection.

Gai Brodtmann MP, Gina Vereker and David Lemcke.

LOCAL GOVERNMENT – HIGHLY COMMENDED

Lockyer Valley Regional Council, Queensland

Strengthening Grantham Project

The small rural Queensland town of Grantham became the single most devastated community of the floods that swept across Queensland in January last year.

The Strengthening Grantham Project is designed to protect human lives and critical infrastructure from future flooding. The township and community is moving to higher ground, out of the flood zone. It involves what is believed to be Australia's first voluntary land swap agreement. This is an innovative and effective solution to relocating flood-prone communities.

LOCAL GOVERNMENT – WINNER

Gai Brodtmann MP and Mayor Steve Jones.

Gai Brodtmann MP, Dr Rachel Westcott and Emilis Prelgauskas.

South Australian Veterinary Emergency Management Group

'SAVEM' Plan

The SAVEM Plan enables the veterinary community in SA to be involved and responded effectively when an emergency incident occurs that involves animals, wildlife, livestock, companion animal, and pet care provided at evacuation centres.

Over 100 response-ready volunteer vets and nurses have been trained, along with 40 team leaders. Regional co-ordination centres have been established and are prepared for rapid deployment during emergencies.

VOLUNTEER/COMMUNITY GROUP – HIGHLY COMMENDED

Lower Hunter Zone, NSW Fire Service

Wollombi Community Firewise Program

The four Group 8 Brigades of Wollombi, Laguna, Bucketty and Millfield developed an integrated community engagement program that includes community bushfire safety forums and presentations, bushfire survival planning workshops, a women's bushfire safety group, burn workshops and an informal café, and property inspections with bushfire risk assessments and preparation advice.

A key element to minimising risk is for the community to focus on understanding how to make the critical survival decision to leave early or stay and defend, following the national motto: PREPARE well, ACT decisively, and SURVIVE.

VOLUNTEER/COMMUNITY GROUP – HIGHLY COMMENDED

Gai Brodtmann MP, Glenn O'Rourke and Leanne Bell.

Gai Brodtmann MP, Lyn Symons, Narelle Harrison, Helen Broad and Sonny Neale.

'Pigs might fly' community, Victoria

Pigs Might Fly – Community Resilience and Disaster Project

The Pigs Might Fly project was devised by residents if the small farming and mining community of Carisbrook, two hours north of Melbourne which was devastated by flood in January 2011. The community shared their 'recovery wishes' and from that prioritised several projects to rebuild their town. Among the projects is the upgrading of a reserve and swimming area, restoring the old railway station, having an annual festival, creating a welcome kit for new residents, and making safer road crossings for horses.

VOLUNTEER/COMMUNITY GROUP – WINNER

Australian and New Zealand Institute of Insurance and Finance

Know Risk Program

The Know Risk project aims to better communicate and engage with communities about the risks that people and businesses face so that risk exposures may be reduced, and the impacts lessened. The project uses a range of information tools including social media, websites, PR messages, partnerships, an Insurance Tracker mobile app, photo inventory of possessions, checklists and tips about risk and protection, interactive forums, and real world examples of people who have experienced the impact of loss.

The prime objective of the program is to help individuals and businesses better understand and protect themselves against risk and to reduce the levels of under-insurance and non-insurance.

PRIVATE SECTOR – HIGHLY COMMENDED

Gai Brodtmann MP and Joan Fitzpatrick.

Gai Brodtmann MP and Brad Pfeffer.

Queensland Farmers' Federation

Taking Stock: preparing rural business for natural disasters and climate risk

The goal of the project was to help farmers and rural business managers be better prepared for natural disasters. The project draws heavily on the expertise of local farmers who share their disaster management techniques and strategies. It provides valuable lessons for the rural sector in northern Queensland and provides useful historic records of the events of the 12 months after Cyclone Yasi in February 2011. A series of fact sheets and a DVD were produced and have been distributed to 3,500 primary producers in the region.

PRIVATE SECTOR – WINNER

Antarctic Climate and Ecosystems Cooperative Research Centre

Climate Futures for Tasmania

The project uses several climate models to simulate the Tasmanian climate and integrate the impact of climate change on the island's weather, water catchments, and agriculture. It includes aspects of sea level, flood-risk, heat, and severe winds. The study is a collaboration of 12 participating partners of both state and national organisations, including emergency services, scientific organisations, local authorities, and educational institutions. It has become the Tasmanian Government's most important source of climate change data.

EDUCATION, TRAINING AND RESEARCH – WINNER

Gai Brodtmann MP, Prof Nathan Bindoff, Dr Chris White, Suzy Gaynor and Dr Stuart Corney.

Bushfire Cooperative Research Centre
Bushfire CRC

The Bushfire CRC has been running an extension program since 2010 to respond to issues arising from the Victorian Black Saturday fires. The program looks at community benefit resulting from more efficient use of water-bombing aircraft to increased house and vehicle safety; from greater understanding of fire behaviour to smoke management; from better use of volunteers to creating bushfire arson reduction tools; and from the management of biodiversity to improved fire fighter health and safety.

The centre brings together the expertise of universities, national researchers and end users from all states and territories, conducting research into social, environmental and economic impacts of bushfire.

NATIONAL SIGNIFICANCE – HIGHLY COMMENDED

Land Use Planning and Building Codes Taskforce and PlanDev Business Solutions
Enhancing disaster resilience in the built environment

PlanDev Business Solutions worked with the Land Use Planning and Building Codes Taskforce, set up by the National Emergency Management Committee, to review and scrutinise the performance of land use planning and building code instruments across Australia.

A 'roadmap' was created aimed at improved safety and resilience in the built environment. The project's aim was to make legislation easier, to develop processes, data and mapping, and to improve vendor disclosure, governance, education and cross-boundary collaboration.

NATIONAL SIGNIFICANCE – HIGHLY COMMENDED

Gai Brodtmann MP, Brendan Nelson and Shane Murrihy.

Department for Communities and Social Inclusion, South Australia
National Guidelines for Managing Donated Goods

The South Australia State Recovery Office developed national a-z guidelines to deal with the influx of donated goods immediately following a major disaster. Donated goods can quickly exceed actual need and inevitably stretch resources and infrastructure. It also diverts efforts from other aspects of recovery, just to manage the donations. The project included a public education package which has resulted in a decrease in unusable goods being donated and an increase in donations of money. The guidelines help the public and corporate sector better understanding how and what to donate for real benefit following a disaster.

Gai Brodtmann MP, Pauline Cole and Ronnie Fagotter.

NATIONAL SIGNIFICANCE – WINNER

LETTERS TO THE EDITOR

The AJEM welcomes letters to the editor. Letters should refer to content published in the previous AJEM, focus on issues of emergency management and disaster resilience, and include contact details. Letters should be around 200 words. Longer letters may be published or edited at the editor's discretion.

I was dismayed to read in your October volume that Stuart Ellis, incoming CEO of AFAC, failed to offer unequivocal support for fuel reduction burning as a measure to mitigate bushfire damage.

Mr. Ellis says: "Prescribed burning is likely to reduce the intensity of bushfires" [my emphasis], and adds that [fuel reduction burning] will "provide little, if any, substantive mitigation" on a Code Red day.

Neither of these statements is correct.

Simple physics means that less fuel will always reduce bushfire intensity. But this is not just a matter of physics. The value of prescribed burning has been demonstrated in fire behaviour and combustion research since the 1960s and is supported by case studies, statistics, simulation studies and thousands of observations over many years. There can hardly be a firefighter in Australia who has not observed the decline in intensity that occurs when a fire crosses from 20-year old to one-year old fuels.

True, headfires may be impossible to control on a Code Red day (especially in heavy fuels). However, the presence in the landscape of fuel reduced areas makes fires on the days preceding a Code Red day easier and safer to control, meaning that there are fewer fires still live when Disaster Day breaks, freeing up resources, and allowing time for fire leaders to regroup and for communities to prepare or evacuate. And even on a day when the headfire is unstoppable, useful work can be done on flank fires burning in light fuels, helping to secure the danger flank in the expectation of a wind change.

Fuel reduction cannot prevent bushfires. But it will mitigate (and in some cases prevent) bushfire damage. Under a properly designed fuel reduction burning program, 20% of the landscape will always be carrying fuels less than three-year old. Even under the conditions of Black Saturday, effective suppression is possible on tail and flank fires in 0, 1 and 2 year-old fuels.

The failure of Australian land and fire management authorities to deal responsibly with bushfire fuels in the expectation of a bushfire is a great national tragedy. Heavy, long-unburnt forest fuels mean that bushfires can become unstoppable even under relatively moderate fire dangers, let alone Code Red. This is an issue to which I would hope AFAC would assign their highest priority.

Yours sincerely,

Roger Underwood
The Bushfire Front Inc Perth, Western Australia

NOTES FROM

Australian Emergency Management Institute

In September 2012, AEMI hosted a number of master classes in Mt Macedon, Canberra and at the Sydney Opera House. The master classes – short bursts of intensive theory and practice, focused on a specific aspect of emergency management – were facilitated by internationally-renowned experts in the fields of crisis management, business continuity and organisational resilience.

PREVENTING CHAOS IN A CRISIS: LESSONS FROM THE PAST, IDEAS FOR THE FUTURE

Peter Power

Peter Power is a recent member of United Kingdom Crisis Management Steering Group and former member of New Scotland Yard's forward planning area, where he was seconded to the anti-terrorist branch. Over two days, the masterclass participants considered trends in crisis management and outcomes from previous disasters. The participants focused on the collaboration of public/private stakeholders in crisis management and the obstacles that can break down effective crisis leadership.

IS BCM A DEAD-END? THE 21ST CENTURY APPROACH TO MANAGING IN UNCERTAINTY

Nathaniel Forbes and Scot Phelps

Nathaniel Forbes, Director, Forbes Calamity Prevention, Singapore, and Scot Phelps, Professor of Disaster Science at the US Emergency Management Academy, facilitated a workshop on organisational resilience. Through a series of stimulating, challenging and interactive sessions, participants explored how the modern, strategic leader can position their organisation to best address the unforeseen, thus turning threats into opportunities. The day examined the convergence of emergency, crisis, and business continuity management from a structural and theoretical perspective through to the implications of this for risk and governance.

MANAGING IN UNCERTAINTY – WHY TRADITIONAL APPROACHES AREN'T WORKING EXECUTIVE LEVEL 2 PROFESSIONAL DEVELOPMENT PROGRAM

Peter Power, Nathaniel Forbes and Scot Phelps

Peter Power, Nathaniel Forbes and Scot Phelps each spoke at the National Security College, Canberra, to a wide range of executive level officers from national security agencies at Federal and State levels. Discussion reflected the keen level of interest in the topic, especially as attendees were in the final stages of their professional development program and had been studying aspects of success and failure in crisis management and leadership. The three international speakers were joined by Michael Jerks from the Attorney-General's Department Critical Infrastructure and Protective Security Policy Branch who provided a comprehensive overview of various approaches to organisational resilience.

CHIEF EXECUTIVE OFFICER'S ROUND TABLE DISCUSSION

The Secretary of the Attorney-General's Department, Roger Wilkins AO invited a number of CEOs to attend the Sydney Opera House Board Room to hear Peter Power, Nathaniel Forbes and Scot Phelps present their perspectives on organisational resilience and the policy approaches and strategies being undertaken. Twenty-three CEOs or their nominated representatives attended the three-hour round table discussion. Scot Phelps' presentation in accord with the Australian *National Strategy for Disaster Resilience*, focused on the need to learn from the past and to create an air of positivism. His other key messages were around the importance of understanding public expectations, learning by doing, exercising, and just-in-time training.

Nathaniel Forbes provided three sometimes confronting case studies on international, cross-border industrial activity. These studies graphically highlighted the imperative to understand the context in which companies operate. He emphasised that resilience is not built solely through assurance measures, but by ensuring staff welfare and morale is of primary concern. The right leader is in a position to lead the organisation through crisis and that over reliance on 'the plan' is foolhardy.

THE FIELD

forums, workshops and master class activities

ENGAGING FOR ENGAGEMENT: EM=COMMUNITY[2]

The National Disaster Resilience Community Engagement Framework (Framework), due for completion in mid-2013, will be a key guiding document to assist Australians understand risk and make decisions as part of communicating the *National Strategy for Disaster Resilience*. The Framework is being developed by the Australia–New Zealand Emergency Management Committee's Community Engagement Sub-Committee (ANZEMC- CESC) as requested by the Standing Council for Police and Emergency Management (SCPEM).

With stakeholder and community engagement being an important part of the development of the Framework, ANZEMC-CESC ,in collaboration with the Australian Emergency Management Institute (AEMI) and the International Association of Public Participation (IAP2) Australasia, held a national workshop in September 2012 at AEMI's premises in Mount Macedon, entitled 'EM=Community[2]'.

The main purpose of the EM=Community[2] workshop was to review IAP2's Spectrum of Public Participation - a widely recognised tool for community engagement - and tailor it specifically for application in an emergency management context, with the resulting adapted spectrum to be incorporated into the Framework.

IAP2 is an international association of members who seek to promote and improve the practice of public participation in relation to individuals, governments, institutions, and other entities that affect the public interest in nations throughout the world. In the Australasia region, the term community engagement is more frequently used to refer to public participation. IAP2's Public Participation Spectrum is designed to assist with the selection of the level of participation that defines the public's role in any community engagement program. The Spectrum is widely used in Australia and internationally, and is quoted in many community engagement manuals. It is used in the curriculum of some courses run AEMI.

However, it has been acknowledged by EM practitioners as well as AEMI educators and IAP2 Australasia themselves that the spectrum has some limitations in its application within the EM sector. Specifically, the traditional 'command and control' focus of response agencies has meant that while these agencies work well at the 'inform' end of the spectrum, difficulties arise at the 'empower' stage, particularly for agencies who are legally mandated to enforce.

The workshop attracted approximately 40 high-level specialists in emergency management and/or community engagement from across Australia. Guest speakers were Alison Cottrell from the University of Queensland, who spoke about top-down and bottom-up approaches to community engagement, Anne Leadbeater from Murrindindi Shire Council, who spoke about empowering communities through capacity and resilience, and Dare Kavanagh from the NSW Land and Housing Corporation, who presented a case study in adaptation and use of the IAP2 spectrum.

Workshop participants were given the opportunity to discuss their issues with the structure and layout of the spectrum as a group, and suggest solutions for adaptation. Although the timeframe was tight and expectations were high, the group did manage to put together a revised version of the Spectrum that addressed many, if not all, issues faced by EM practitioners in the community engagement field by the end of the workshop.

Many workshop participants continued to provide input via the consultation process for the Framework, which closed in November 2012.

EM ONLINE:

AUSTRALIAN EMERGENCY MANAGEMENT KNOWLEDGE HUB

www.emknowledge.gov.au

The Australian Emergency Management Knowledge Hub was launched in November 2012 and is a new interactive website for the emergency management sector and the community.

The Knowledge Hub is packed with features.

There is an Australian disaster event database that contains records of natural and non-natural disasters within Australia dating back to 1753. And it's searchable!

There's a clearing house of research and information useful to the EM sector, including online repositories, research papers, journal articles, reports and manuals. And it's searchable!

There's a multimedia area where libraries of audio, video and image across a wide range of disasters are available. And it's searchable!

The news area has cross-sectoral discussion forums and new media collaboration tools such as Twitter. Users can see latest discussions, contribute resources, share information and interact.

Follow us on Twitter **@AEMKH** or email us at emknowledge@ag.gov.au

Australian Government

Attorney-General's Department

Australian Emergency Management Institute

Conference Centre

The Australian Emergency Management Institute offers an exclusive, multi-purpose facility located in the picturesque town of Mount Macedon, Victoria.

The Institute strives to build national capability in emergency management and encourages the use of our facility for related activities. Available for commercial bookings, the venue's idyllic backdrop is ideal for workshops, seminars, corporate retreats or other group activities.
Contact us today to discuss your next event.

DISASTER RESILIENT AUSTRALIA

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Building resilience through education, collaboration and innovation

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In support of the COAG *National Strategy for Disaster Resilience* (2011) AEMI:

- Provides education and training
- Conducts strategic activities
- Undertakes applied research
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9 – 12 April	**Designing and managing exercises**
16 – 18 April	**Develop and organise public safety awareness programs**
7 – 9 May	**Facilitate emergency planning processes**
21 – 24 May	**Designing and managing exercises**
4 – 7 June	**Coordinate resources for a multi-agency incident**

**For further information visit: www.em.gov.au/aemi
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