Celebrating Resilient Australians
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Australian Institute for
Disaster Resilience

Australian Journal of Emergency Management

About the Journal

The *Australian Journal of Emergency Management* is Australia's premier journal in emergency management. Its format and content are developed with reference to peak emergency management organisations and the emergency management sectors—nationally and internationally. The Journal focuses on both the academic and practitioner reader. Its aim is to strengthen capabilities in the sector by documenting, growing and disseminating an emergency management body of knowledge. The Journal strongly supports the role of the Australian Institute for Disaster Resilience (AIDR) as a national centre of excellence for knowledge and skills development in the emergency management sector. Papers are published in all areas of emergency management. The Journal encourages empirical reports but may include specialised theoretical, methodological, case study and review papers and opinion pieces. The views in the Journal are not necessarily the views of the Australian Government, AIDR or AIDR's partners.

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Contributions in the Research section of the *Australian Journal of Emergency Management* are peer-reviewed to appropriate academic standards by independent, qualified reviewers.

Foreword

Dr John Bates, Director, Australia Institute for Disaster Resilience

Welcome to the January issue of the *Australian Journal of Emergency Management*. We are well into the summer season across Australia and New Zealand; responding to and recovering from those natural hazards we expect at this time of the year. The recent experience in Victoria with 'thunderstorm asthma' reminds me that we also need to be ready for the unexpected and to be vigilant in our observations of what is occurring around us.

In this issue we showcase the winners and shortlisted finalists in the 2016 Resilient Australia Awards and the stories behind those projects. There are some amazing projects being undertaken across the country to build resilience. The finalists represent the tip of a growing community that understands we can all make a difference and that it's never too late to think and plan about how to look after one's self. A common thread across the projects is ensuring that the right information is available and that we are empowering people to make decisions, and to take actions, rather than stepping back and waiting for that proverbial 'knight in shining armour' to arrive and save the day. In the face of the severe events that continue to stretch the human and physical resources that we have available in times of emergency, building resilience-thinking and action into our lives is essential. This allows us to contribute to minimising effects of disasters when they occur.

It is timely to reflect on the recent 'thunderstorm asthma' event in Melbourne from a resilience perspective and to use it as an example of the unexpected. At the time of writing, there were at least eight asthma-related deaths attributed to the weather conditions on the day. Many more people required significant medical treatment and thousands of others experienced more severe asthma symptoms. On the day, there was a high pollen count, it was windy and it was in a period known as the 'hayfever season'. Many people experienced more severe asthma symptoms on that day, while for others this was the first significant episode of asthma they had experienced. It is important to move beyond a just-in-time approach to our personal health and the health of our families. We pay a lot of attention to personal protective equipment when responding to fires, floods and other events. Necessary health treatments are no different and should be regarded as personal protective health equipment.

This is exactly the approach taken by Carlyle Gardens Retirement Village, where the community is committed to developing and maintaining their own capability to be self-supporting in the aftermath of significant natural disaster events.

This edition of the Journal includes key research in understanding risk and warnings and the importance of communication. As you read the Journal, I encourage you to share the articles with your friends and colleagues and to think about what you can do to improve our national resilience to disasters.

Dr John Bates
Director, Australian Institute for Disaster Resilience

Live to Tell: surviving a natural disaster

By Freya Jones, Bushfire and Natural Hazards CRC

What does it mean to survive a natural disaster? To mark International Day for Disaster Reduction on 13 October, the Bushfire and Natural Hazards CRC hosted a public event to garner perspectives on disaster risk reduction.

Recognised globally by the United Nations, the day focuses on a different theme annually. This year communities, organisations, government and individuals reflected on the theme, 'Live to Tell', discussing fatalities and the survivors of disasters.

Held at RMIT University, the free public forum focused on the research and policies aimed at preventing deaths during natural disasters. A variety of speakers tackled the theme from different angles including policy and practice, research and human behaviour. The event considered what it means to survive a disaster and how community members live to tell the story.

Speakers at the forum included:

- Mark Crosweller, Emergency Management Australia (EMA)
- John Schauble, Emergency Management Victoria (EMV)
- Dr Katharine Haynes, Bushfire and Natural Hazards CRC and Risk Frontiers
- Dr Martine Woolf, Geoscience Australia
- John Richardson, Australian Red Cross.

Policy and practice

In his role as Director General of EMA, Mark Crosweller is responsible for the coordination of Australia's response to crises including natural disasters, and terrorist and security-related incidents.

Mr Crosweller provided a federal government perspective and addressed a simple but ultimately complex question: Are we prepared for catastrophic disasters?

Mr Crosweller argued that we need to accept the inevitability of unimaginable, catastrophic disasters in order to prepare for them. He said that when that extreme level of disaster severity is reached the impact and consequences begin to exceed our capability because we have never experienced them.

'Understanding our point of limitation is very important. One of the points of limit in the human mind is the limits of knowledge, skills, experience and imagination.

'When you hit extreme and catastrophic, the event and its manifestation goes way past capability. When you talk to commissioners and chief officers, two things

Speakers at Australia's International Day for Disaster Reduction were Professor John Handmer, John Richardson, Dr Katharine Haynes, John Schauble, Dr Martine Woolf, Mark Crosweller and Dr Richard Thornton.

Image: David Bruce, Bushfire and Natural Hazards CRC

come out of the conversations. One is "we dodged a bullet"; they say that it could have been worse, and the second thing they'll often say is "we were stretched to our limit",' he said.

John Schauble, Director for Emergency Management and Resilience at EMV spoke about Victoria's policies in disaster risk reduction and the importance of the language used to frame policies.

'The emphasis here in Victoria has shifted very much from managing risk to managing consequence,' he said.

Rather than focusing efforts on what agencies and government can do in the wake of disasters, the focus has turned to building resilient communities. He said that EMV is developing a risk resilience framework to help communities to make decisions.

Reflecting on the 2009 Black Saturday fires that claimed 173 lives, Mr Schauble spoke about the shift in policy and language in Victoria. In the aftermath of Black Saturday 'primacy of life' emerged as the principle policy.

'The immediate aftermath of significant disasters is the worst possible time to develop public policy, yet this is often the political cycle in which public policy is made.

'It's interesting because I'm sure no one in government or the fire industries, certainly not firefighters, ever doubted that primacy of life was the key objective.

'The Stay or Go policy that was active at the time of the fires, placed too high a premium on the idea that property ranked equally with preservation of life.

'The policy shift was one of emphasis. The message became 'leave early' and the defence of property became secondary,' Mr Schauble explained.

The shift in bushfire policy was put to the test in Victoria during the bushfire on Christmas Day 2015 in Wye River. Mr Schauble reflected that the change worked well and resulted in no loss of life.

'There was a clear message. There was a community that was primed for action and they took action.

'As a sector, we're accepting that we can't actually eliminate risk but we can increase the capacity of communities to bounce back afterwards,' he said.

Disaster research

Research by Dr Katharine Haynes investigated fatalities from natural hazards, in particular floods. A dataset of information was created to identify trends related to each fatality.

Dr Haynes explained that the data show most flood fatalities were men, making up 80 per cent of all recorded flood fatalities since 1900. However, this trend is shown to be shifting over time.

'Although there are still (statistically) more men dying in floods, from the 1960s onwards we're seeing more female fatalities,' she said.

So why are people dying in floods and how can we change that? The research showed that often people simply underestimate the danger.

'The highest proportion of men and women die while attempting to cross a bridge or flooded road. Where the information is available, we can see that most of those people are trying to make their way home,' said Dr Haynes.

The research also considered people's capacity to make decisions during the event.

'For most people, they are aware of the flood but the speed and depth [of the flood] took them by surprise,' she said.

Most of the deaths in vehicles occurred at night or during twilight hours when visibility was poor. This could suggest that drivers are unaware of the exact danger of the situation, explained Dr Haynes.

The research poses many questions as to whether the messages are getting through to people, whether investment is required to improve infrastructure and whether evaluation of risk reduction strategies is accurate.

Dr Martine Woolf's research for Geoscience Australia considers the impact of natural disasters, in particular earthquakes.

Dr Woolf used contrasting examples of the 6.2 magnitude earthquake that struck central Italy in August 2016, killing 250 people, and a similar magnitude earthquake in the Petermann Ranges in Australia that resulted in no deaths. The difference, of course, was the location. The earthquake in Italy struck in a densely populated and built environment, while the Petermann Ranges in the remote Northern Territory is largely unpopulated.

Dr Woolf's research used realistic disaster scenario analysis to model potential disasters in urban cities in Australia and gain a greater understanding of the

Australia needs to consider the impact earthquakes could have on major cities and how the effects could be mitigated through retrofitting buildings.

Image: John McCombe, New Zealand Fire Service

effects. She provided an example scenario involving a 4.3 magnitude earthquake in the greater Sydney area.

'With the work we are doing modelling disaster scenarios we are asking: What can we do to prevent some of these impacts from happening; specifically when it comes to injuries and fatalities?' she said.

Dr Woolf's scenario analysis looked at how to mitigate the effects of a Sydney earthquake by retrofitting houses. When modelling the same magnitude earthquake on retrofitted housing, the damage was significantly reduced. The answer could be in improving the strength of existing structures explained Dr Woolf.

'We can understand elements of the puzzle that we can actually control to improve the outcome, in terms of fatalities and injuries.

'In the case of earthquakes and many other hazards, all the housing and infrastructure legacy assets are vulnerable to hazards. We think about modern building codes but forget they are not applicable to many of the structures you see around you,' she said.

The human side of disasters

John Richardson, National Coordinator, Preparedness, Australian Red Cross, provided a different perspective to disaster resilience and what it means to survive a disaster event. Drawing on his experience as a registered nurse working in bereavement and trauma, he focused on the human side of fatalities.

'Death is an increasingly foreign concept for us in modern society. When death happens now it's unusual. It is a surprise so our societal reactions are quite overt,' he said.

Mr Richardson spoke about the meaning that death gives to disasters and the way that is interpreted.

'We tend to categorise disasters by death tolls, not by those who have been left behind to deal with the aftermath, or those who survive.

'The ingrained attitudes we place on survivors in telling them they are lucky and to think of those who didn't survive are potentially harmful. Your experience as a survivor is actually diminished.

'Another human inclination is the tendency to feel collective ownership over disasters. This can be damaging to survivors and families and friends of those who died,' said Mr Richardson.

The forum closed with a panel discussion. The forum was filmed and can be viewed at **www.bnhcrc.com.au**.

Director General of EMA, Mark Crosweller, addressed the forum in Melbourne.
Image: David Bruce, Bushfire and Natural Hazards CRC

Resilient Australia Awards 2016

By Hansika Bhagani, Australian Institute for Disaster Resilience

The 2016 Resilient Australia Awards were celebrated in November 2016. The Awards recognise innovative practices and achievements that make communities safer, stronger, more resilient and better prepared to manage emergencies. There are three categories of awards: national (covering community, business and government), school and photography. This year individuals, groups and organisations demonstrated how they are helping communities be resilient.

Survive and thrive: empowered students build bushfire resilience

Many in the Victorian town of Anglesea remember the 1983 Ash Wednesday fires that destroyed 140 homes and killed several people. In the years since the fires, Anglesea, on the Great Ocean Road in Victoria, has faced more bushfires. Alongside other communities on the Otway Coast, the community has embraced a number of initiatives in order to reduce their vulnerability to fires.

One of the initiatives has been for the students of Anglesea Primary School, where the Country Fire Authority's (CFA) 'Survive and Thrive' program has been running. The program won the 2016 Resilient Australia National School Award for its strong focus on sustainable long-term resilience. The program is run for students from Year 4 to Year 6 and aims to empower them with knowledge and understanding of bushfire behaviour. Students are asked to be educators, leading community-based bushfire education and preparedness activities for themselves, their families, their community, local communities and visiting schools. They are tasked as researchers, engaging with the environment and technology, interviewing and consulting with community members, recording phases of the project and sharing their learnings. They also explore their role as environmental agents, being involved in local contemporary opportunities or challenges and devising community messages about environmental care.

Emma Taunt is the CFA Survive and Thrive program coordinator for both Anglesea and Strathewen primary schools. She explained the program works because of strong buy-in from the schools, parents and teachers.

'The success of it is built on many minds coming together, championed by Jamie McKenzie [CFA Leadership Program Coordinator] and his very extensive professional and social network. When they were looking at building the new Angelsea fire station they didn't want to just build something basic. They wanted something that could be accessed and shared within the community. Part of that vision included the

Dr John Bates, Andrew Rankin, AIDR, Anglesea Fire Brigade, Emma Taunt, CFA, Pamela Sandlant, Anglesea Primary School, Jamie MacKenzie, CFA, Mark Crosweller, Director General Emergency Management Australia and Craig Lapsley, Victoria Emergency Management Commissioner.

Image: Australian Institute for Disaster Resilience

Dr John Bates, AIDR, Jo-ann Veitch, Carlyle Gardens Retirement Village, Mike McCloskey, John Wilson, Peter Steyger, Queensland Police Service and Mark Crosweller, Director General Emergency Management Australia.

Image: Australian Institute for Disaster Resilience

education element. Once that space started to exist, more people came together,' she said.

Strong support from the school is demonstrated by the amount of time devoted to the program in the curriculum. The program is embedded into student timetables for two hours a week throughout an entire year, allowing them the time to lead workshops, presentations and exhibitions.

'The way that the CFA program works allows the teachers to achieve a lot of the actual curriculum outcomes that are expected at the state and national level. If we were just doing a few sessions that may not be the case, but transitioning the kids from being the learners to being the teachers and solving very complex problems—they're expected to create a workshop that's relevant and engaging to their family—means they start playing around in drama, art and the science space in a really different way. As far as reaching curriculum needs, it ticks those boxes at the same time,' she said.

The program is also adaptable to the differences in each class as they advance through the program in years 4, 5 and 6.

'The whole program is built on innovation and adaptability. The kids are so different at each year level. They've all grown up together and there's between 10 and 20 students in a year level. With that the personalities and interests of the kids are quite pronounced. Each year what they've shown more interest in has grown and we've learnt what worked well, so we adapt the program to keep rolling with that. We link in as much as we can with the right people who have information that extends beyond us. We bring in Parks Victoria, people from the Department of Environment, Land, Water and Planning, from VicPol and from Emergency Management Victoria. We link them into where the kids are at and where they're trying to go,' she said. She noted as an example the fire at Wye River in January 2016.

'We tap into where the kids are at. Knowing that the Wye River fire was on their mind and they had their own ideas

about what had happened and what it meant to them, we adapted around that. We took them on an excursion down there and had discussions around their experience of the fire. We know the building blocks behind what we'd like them to know by the end of the two years. But we try to stay as open as we can to where that engagement level is at,' she said.

The program is scalable to different disasters, different partnership models and different time lengths.

'You could have less support and do a smaller-scaled version. You might drill down to one hazard, and do it for a term, or even just a focus project, so there's no burden on the school. Most importantly, it's about teaching all of the kids a real breadth of knowledge and them being able to explore it in their own way. Not every school, not every community, not every risk is the same. But teaching resilience means the whole concept of what we do is adaptable and unique and relevant to the audience,' she said.

Collaborating for disaster response

When Cyclone Yasi hit north Queensland in 2011, the major cities of Cairns and Townsville were heavily effected. In Townsville large trees were uprooted and power lines were brought down that resulted in power loss for seven days.

The 600-strong residents of the Carlyle Gardens Retirement Village were prepared for the eventuality, having formed a small group to investigate the best way that residents could look after themselves in disaster. John Wilson, a resident of the village, is one of the founding members.

'There was a group of about five that got together one day after the 2005-06 cyclone season. We had had a couple of cyclones off the coast and we thought at some stage we're likely to get a cyclone here that's going to cause a concern. We decided we should do something to help those elderly people, especially widows and widowers, who would find it difficult to look after themselves in a disaster. We formed a committee and we got some money out of our social club to buy some portable radios. Then we managed to get a $3000 government grant from which we bought a generator,' he said.

When Cyclone Yasi hit, John and his committee members were able to put their plan into action.

'We managed to obtain food by clearing the freezers and fridges of those people who were away. They were very grateful for that because otherwise their freezers and fridges would have been destroyed. We found enough food from fridges and pantries across the village to take care of people over that period and they were extremely grateful for what we did,' he said.

They moved the food into a central location that was maintained by a backup generator allowing the community to maintain self-sufficiency without

reliance on emergency providers or the local disaster management group.

Since then the committee has formalised into the Carlyle Gardens Disaster Management Group. The group has a governance structure incorporating an executive (two residents), venue management representing Lendlease, five operations staff (residents) who maintain a command post during disasters and 60 area marshals. The group meets regularly, maintains a comprehensive Disaster Management Plan and conducts a post-event analysis consisting of debrief, evaluation and formal report to management.

The Disaster Management Plan outlines preparedness activities, hazard information guides, a marshal system to account for and assist all residents, evacuation procedures, establishing an internal evacuation centre and development of checklists. The plan notes that with the established emergency power generation, an internal evacuation centre at the theatre, and a protocol for collecting food from residents, that the community is able to support itself for several days post an event without any reliance on external emergency and community support.

Although the plan and arrangements for disaster response and recovery are comprehensive, Mr Wilson insisted it can be done by any community or small town.

'It just happened to be a group of mainly ex-servicemen who started it. However, it's not a military exercise. There are many other people who are quite capable of doing the same job,' he said.

In addition to establishing a plan, communicating it to all residents is key.

'I think we've done rather well, but we're always developing it further; writing instructions and different things like that. We have produced books and instructions for our residents. Every new resident who moves in gets a booklet on our guidelines to read and study. I'm sure that as time goes by, we'll find that we need to change and to improve. But we felt like we could do something and, over the years, it's worked well,' he said.

A lifesaver for the Sunshine Coast

The 2016 Resilient Australia National Award was won by the Sunshine Coast's Disaster Hub—a portal that provides comprehensive, centralised and real-time information for the public, media and external agencies to access before, during and after disaster events.

Spearheading the design and implementation of the Disaster Hub has been John Gallina, Disaster Management Coordinator at Sunshine Coast Council.

'We started the development of the Hub back in 2012. It began as a consequence of the Queensland floods in 2010-2011. There was a huge range of recommendations for local government that came out in the interim report and final reports from the Queensland Flood Commissioner Inquiry. We identified that a good communications platform that can provide information to the community and help make real-time decisions in disaster coordination centres would address a lot of those recommendations. That was how the concept of Disaster Hub developed in 2012,' he said.

The Hub is divided into a public-facing site and a site for registered users to log in and view live data that can assist in decision-making. The public site provides information about preparing for, responding to, and recovering after the event. It is especially useful during events when warnings, road closures and evacuation centres can be quickly found by a glance at the main page.

On the other side of the site, logging in as a registered user brings up a dynamic interface for disaster management decision-making during a disaster. The site uses open standards, interoperability, security, data protection and scalability. When combined, both platforms enable council to work with external agencies and the community by sharing mission-critical information.

Despite the complexity of the information sources and requirements of both sides of the website, the website boasts a surprisingly simple interface.

Dr John Bates, AIDR, John Gallina and Shirley Hall, Sunshine Coast Council and Mark Crosweller, Director General Emergency Management Australia.

Image: Australian Institute for Disaster Resilience

'Our project team made sure the site was intuitive and easy to use. It had to work on all types of technology—every common type of mobile device, computer and tablet. You should be able to follow your nose and find what you're looking for,' said Mr Gallina.

The Disaster Hub has been used in emergency management exercises and shown its form during real events on the coast, noted Mr Gallina.

'We launched it in December 2014. During Cyclone Marcia in February 2015, we had over 293,000 page views. So there was great uptake from the community in using the site and we've gone from strength to strength.

'As well as the local community, we are investing to make sure tourists and visitors to the Sunshine Coast are aware of the site. Our Economic Development Department reach out to the business industry so that they're filtering information out through organisations that manage tourism. We also regularly inform people about the Disaster Hub through local media, through our print media, our TV stations and our radio stations on the Sunshine Coast. We're continually pushing that message out there—if you need to know what to do before, during and after a disaster, go to the Disaster Hub,' he said.

The platform is frequently reviewed as the team look for ways it can be improved and adapted to different disaster scenarios and made available to other areas.

'We're due to launch Stage 4 shortly. Up until this time the Disaster Hub has been built on the Sunshine Coast. The Stage 4 version is a model that can be very quickly adapted to any local government area in Australia. The new site is configured for all the local government areas in Queensland. The platform that it's built on also quickly opens up that functionality for all places in Australia. We're quite excited about that and where Disaster Hub may go in the future,' he said.

One of the other key features Mr Gallina is working on is to improve its functionality for Queensland Police Service (QPS). A pilot is underway between council and QPS to investigate its disaster impact functionality to incorporate policing geospatial data relating to counter terrorism, bomb threats, hostage sieges, public safety cordons, repeat offenders and persons of interest. This combination of disaster-related geospatial data and policing data, for any specified location at any time, would provide immediate intelligence to QPS for any sudden onset policing or national security-related incident. Mr Gallina is hopeful about what this might look like in practice.

'The police could use Disaster Hub to do a geofence around the area they are concerned about, run an impact assessment report and it will bring up key things in that location like schools, childcare centres, nursing homes; anything that's critical infrastructure that's of concern in that location. Instead of trying to Google what might be there, you just draw a circle or a fence around the area you're concerned about, hit a button on Disaster Hub and 15 seconds later you've got a report about the things in that location that may be of concern to police and a contact number. There may be an incident where they need to ring a school principal and say "you need to lock down

the school". That's a part of the functionality of Disaster Hub that we think is extremely beneficial for policing issues, and it's for use every minute of the day,' he said.

However, Disaster Hub is just one canon in the arsenal, Mr Gallina noted.

'Disaster management is something you have to do on a daily basis with your community to educate people what to do before and what to do after. Having a single point of truth that they can go to for the right information when they need it is a pretty important part of that,' he said.

Council raises awareness of heatwave risks

Yarra City Council in Victoria was one of the highly commended entries for the 2016 Resilient Australia National Award for its innovative 'Keep Cool in Yarra' program aimed at increasing awareness of heatwave risks in local migrant communities living in social and public housing.

The Council partnered with 25 agencies and community groups to deliver 'Keep Cool in Yarra', which involved a major media campaign along with public information, promotional materials and community information sessions to educate and raise awareness of the health risks of heatwaves.

Lucy Saaroni, Senior Advisor Emergency and Risk Management at Yarra City Council helped develop the program that was put together with input from multiple partners and stakeholders.

'Yarra is a particularly multicultural and diverse municipality. We have a lot of people living in a small area. We met up with a number of different cultural groups and networks to draft this campaign. We asked the questions at the very beginning: "What is it that you're wanting and what is it that you don't have?" We learnt a lot and that defined our campaign,' she said.

Targeting migrant groups and the deaf community, Ms Saaroni said she found a diversity of approaches was required.

'There wasn't a particular trend because we were dealing with so many different language and cultural groups. But there were trends within each group. The Arabic speakers were particularly interested in our A3 posters. When we asked why they wanted to take an A3-size branded poster home they said: "Our children are not speaking Arabic at home. They're learning English at school. This is a way for us to connect with our kids because they're going to have to ask us what this means if I put it up". That was a fascinating learning experience for us. It showed us there were additional benefits to what we were doing, like bringing families closer.

'The Greek community loved the thermometer magnets. That may be a reflection of the cultural attachment to the home and to the kitchen. It may be something they'll see every few hours as they visit their fridge. Our Vietnamese community went crazy over the fans. The public housing tenants were much more interested in

Lucy Saaroni, Kim O'Connor and Mayor Amanda Stone, Yarra City Council, with The Hon. Michael Keenan MP at the 2016 Resilient Australia Awards National Ceremony.

Image: Australian Institute for Disaster Resilience

information about where to go in their area when it gets hot. They weren't interested in the freebies. Every group had a different reaction to what we were doing. It was overwhelmingly positive, but for different reasons,' she said.

Leaning on partners to assist was especially helpful, noted Ms Saaroni.

'We learnt how much we could do with a little bit of money and a lot of goodwill. We had set aside a budget for this and we underspent by 70 per cent because we had so much assistance from all these willing participants—associations, community groups, neighbourhood houses, police, volunteers from the Australian Red Cross.

'Some of the groups are now working under their own steam, which is fantastic. We presented to a group at the Finbar Neighbourhood House. They were so engaged and wanted to do something more, so they went off and made cooling neckties—you put them in water and they expand and develop into a cooling gel. We got the materials and crystals for them and they did the rest themselves. They know who their vulnerable people are and they can give them out, which is great.

'The other thing we learnt from the project was that a one-size-fits-all resilience building approach won't work. You have to drill down and work piece-by-piece on community resilience building, because the community isn't one homogenous group. It is made up of much smaller subsections and individuals. You can't try and be everything to everyone. We'll be taking this approach and applying it in other areas in future to target different vulnerable groups for different hazards,' she said.

Overall Ms Saaroni said the project succeeded because of an ethos of shared responsibility.

'Everyone has a stake in safety. Everyone has a stake in emergency management and it was fantastic to see the willingness and participation of the groups in terms of managing their risks,' she said.

The face of resilience

On 20 February 2015, Tropical Cyclone Marcia crossed Queensland's Capricorn Coast, making landfall at Shoalwater Bay and going on to affect Yeppoon and the regional city of Rockhampton before moving back out to sea and dissolving. The cyclone caused over $750 million in damages, including the repair bill for vital public infrastructure.

Albany-based photographer, Karin Calvert covered the devastating event for Getty and Associated Press. A year later she returned to mark the anniversary. 'Twenty: Cyclone Marcia - Rescue, Resilience, Recovery' is her photographic story of the people of Livingstone Shire who were instrumental in the rescue and recovery efforts.

The first portrait she took was of then 73-year-old Bob Jeacocke. Bob is a Yeppoon resident and SES volunteer of over 42 years whom Calvert says epitomises resilience.

'That strength and the dedication to community just shines out of him. I think that's what people love about that photograph. It doesn't need words. It illustrates the presence, the strength and the depth of coverage of the volunteer services. On a personal level Bob just shines that, so I think it's a successful image in that way,' she said.

For Bob the image is a reminder of everything he and other emergency services volunteers went through after the cyclone.

'It was a hectic time. We were involved in helping out people who were stranded in water, getting them out with flood boats. We were chain-sawing trees on roads so people could get in and out. We were roof-tarping houses where it was possible, although there were lot of houses that we couldn't do. They were just too far gone. So we gave them tarps to put over their furniture when the furniture dried out a bit,' he said.

Bob spent days away from his family, travelling west to Yaamba and Milman to help the relief efforts there.

'I spent most of my time up in the Yaamba and Milman areas because the team leader up there was in Mackay with a broken hand. So they sent me up to assist them and I was travelling there from Yeppoon every day, getting up early and getting home around 9pm at night,' he said.

It's something Bob was well prepared for, having signed up with Queensland SES when it began in 1975.

'We had started the SES in 1975 and our first big event was Cyclone David in January 1976. We were fairly raw and at the time it happened our controller was in Melbourne. I was deputy at the time and there was quite a lot that fell on me. That was my baptism of fire,' said Mr Jeacocke.

Now part of the Yeppoon Group in the Livingstone Shire Unit, he's geared up for another summer and whatever comes with it.

'All our groups are getting ready for the summer and the possibilities of the summer. We're ready if anything does happen. But no matter how well you prepare,

Bob Jeacocke and Karin Calvert with the 2016 Resilient Australia National Photography Award winning portrait.

Image: Australian Institute for Disaster Resilience

Glenn Daniels, *Bendigo Advertiser,* with his photo 'Fire rages'.

Image: Australian Institute for Disaster Resilience

there's always something that comes up that you're not prepared for,' he said.

Reflecting on the 2016 Resilient Australia National Photography Award, Mr Jeacocke notes the award is something all frontline emergency service volunteers can take pride in.

'This award was one of the major highlights of my life. I was presented with an emergency services medal by the Governor in Brisbane and that was a real big highlight. This has far exceeded that; far bettered that. I just couldn't believe it could happen. But the photography award was also for all the emergency services frontline people; the police, the paramedics, firefighters, particularly rural firefighters, SES volunteers and the coast guard. Most of those people are volunteers and I'd like to say I did it for them. Those volunteers turn up every time they're needed and put their best efforts in,' he said.

Fire rages

Glenn Daniels remembers well the day he drove down to Kyneton, Victoria and took the photo that become a finalist in the 2016 Resilient Australia National Photography Award.

'I went down there and the police had blocked off the roads. The police officer let me through and I followed a fire truck until I could find an incident controller. I was actually in the bush that's on fire with two fire crews when they said we're pulling out. The reason why they were so worried was that there was a wind change coming. We pulled out and the fire creeped to the edge of where we were and then the wind changed. That's when it started crowning

at the top. The CFA had strategically set themselves up so that they weren't fighting the fire in there but were holding back in the clear paddock just to put out the spots so it wouldn't advance any further than that.

'The heat was intense. I knew I was safe. But there was a fear of "I can't run now. I've got to stay where I am". There's a sense of loss of power or control within the situation. I set myself up right in the right place so I was safe. Logistically and strategically how the CFA handled the situation was an absolute testament to what they do. That's why I entered it into the Resilient Australia Awards,' said Mr Daniels.

By air and by sea

Volunteer Marine Rescue training exercises can be multifaceted and complex. When amateur photographer and volunteer Jason Harris saw an opportunity to document one held in Jurien Bay, Western Australia, he jumped at the chance. His photo became a finalist in the 2016 Resilient Australia National Photography Award.

'On the day of the joint training exercise we went to the airfield to meet the helicopter. We were given a briefing on the capabilities of a helicopter; the things to look out for and the types of activities we would do. Then we all went out to the bay, launched the boats, and the paramedic winched on and off each of the rescue boats. I was actually going to be on the boat as crew. But I thought it was a good opportunity to take some pictures as there wasn't anyone else in the group who was going to be doing that. I found out we'd organised a boat as DFES (Western Australia's Department of Fire and

Emergency Services) were doing some filming as well. So I said I'll jump on that,' he said.

The Volunteer Marine Rescue in Jurien Bay has approximately 50 volunteers who aid stranded mariners, explained Mr Harris. As well as search and rescue they need to be trained in dealing with injuries, working at high speeds and in difficult conditions.

'The thing that the picture doesn't quite capture is that it's all happening at about 15-20 km an hour. What we're doing on the boat is preparing it, taking anything that can blow around and removing it from the back deck. We've got to pad things, like a big post that's in the back for towing, so that the paramedic as they're coming down, doesn't injure themselves banging into it. Then we get inside and out of the way, as the person driving the boat maintains a straight course as directed by the helicopter pilot, so that he can move into position the paramedic on the boat, and back up again,' he said.

The Resilient Australia Awards are an Australian Government initiative sponsored by the Attorney-General's Department in conjunction with states and territories. Information about the Awards is at: **www.ag.gov.au/EmergencyManagement/Resilient-Australia-Awards**.

Jason Harris with his photo 'By air and by sea'.
Image: Australian Institute for Disaster Resilience

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Science shows climate change impact in the Pacific

By Ilan Kelman, University College London, UK and University of Agder, Norway

We often read in the media, and sometimes in scientific journals that Pacific islands are sinking and disappearing due to climate change; an immense threat to our security. Concerns and fear about 'climate change refugees' overwhelm us, as do visions of communities slipping below the waves. However, science provides a different picture and tackles the mantra of drowning islands from both physical science and social science perspectives.

Physical science observations of low-lying islands under observable sea-level rise show some islands eroding, some islands changing longitudinally, some islands accreting and some islands changing little. The conclusion is twofold. First, some islands might be inundated or eroded but they are not sinking. Second, islands are not inevitably going to disappear due to climate change.

Climate change impacts vary and emerge along multiple pathways. Tropical cyclones appear to be decreasing in frequency and increasing in intensity due to climate change. Storms have previously caused major changes to islands, ruining some while building up others. On 21 October 1972, when Tuvalu was the Ellice Islands, Cyclone Bebe inundated and damaged Funafuti. It also created a coral rubble wall that was larger than some other islets around the atoll. Even if islands gain territory under sea-level rise, such rapid geomorphological change would make living there difficult.

Coral reefs protect island communities from the ocean's full power but they bleach and die under elevated sea surface temperatures. If climate change causes high coral mortality without recovery, then low-lying islands could be exposed to the full force of Pacific Ocean currents and waves.

Simultaneously, the seas absorb carbon dioxide from the atmosphere and it combines with water to produce carbonic acid; increasing the ocean's acidity. Ocean acidification could further harm reefs and shorelines, although many unknowns remain regarding its biochemical and geochemical consequences.

The social science is as complex as the physical science. The clearest message is from the islanders themselves. They do not wish to be labelled as hopeless, hapless

People may need to move from low-lying areas of the Pacific due to the impacts of climate change, such as Nuku'alofa, the capital of the Kingdom of Tonga.
Image: Ilan Kelman

refugees fleeing their homes without recourse. If their communities are destroyed by climate change effects, which is not a definite outcome, and if they choose to move, which is also not definite, then quite rightly, they wish to control the migration process, not be told what to do and when.

Pacific islanders request resources so they can understand and make decisions in their own way about future climate change effects. Migration is indeed one possibility. Then decisions must be made about the destination location and what level of autonomy or sovereignty to retain. Solutions also exist for staying in place. Suggestions include building up the islands to avoid inundation alongside settlements floating above (and perhaps anchored to) islands that the sea rises above.

Any option entails unavoidable, major changes to island lifestyle and culture. Not all islanders wish to see these transformations, preferring instead to stay in their familiar home and environment. The moral dilemma then emerges regarding whether or not people should be permitted to pass away on their own terms.

These questions—physical, social, legal and ethical—are not new. Pacific islanders have been dealing with significant social and environmental changes over centuries; from Christianity, tinned food and the internet, to previous climatic and oceanic changes. Throughout history volcanic eruptions have led to island evacuations without inhabitants knowing whether or not return would be feasible (e.g. Manam Island, Papua New Guinea and Niua Fo'ou, Tonga). Indeed, colonial powers have a scandalous record of forcibly resettling Pacific islanders for nuclear testing.

Given the rich history and deep experience of Pacific peoples moving for multiple reasons, climate change can learn plenty from other fields. Disaster and development studies are especially relevant. Human responses to the changing environment—often with catastrophic potential for communities—are exactly what disaster research has examined for decades; from rapid-onset events such as tsunamis to slowly developing cycles such as El Niño.

Climate change is one more impact on islanders that needs addressing. It sits beside other environmental changes, human-influenced and entirely natural, that islanders experience. Climate change adaptation thus becomes a subset of disaster risk reduction in terms of redressing vulnerabilities to all possible environmental and non-environmental changes, trends and shifts. In effect, development is enacted, aiming to ensure safe and healthy homes and livelihoods within the gamut of situations affecting Pacific island communities.

Contemporary climate change is one major challenge among many, being highly disruptive and being imposed on Pacific islanders from the outside. But its consequences are not inevitable and it must be handled within all the other major challenges and opportunities, on Pacific islanders' own terms with the external support and resources they request.

For research papers related to this article, visit **www. islandvulnerability.org/docs/islandsclimatechange.pdf**
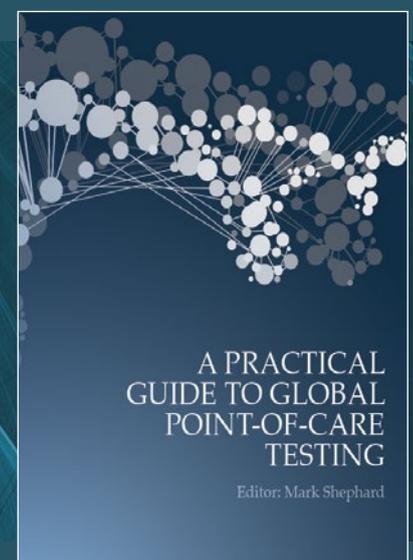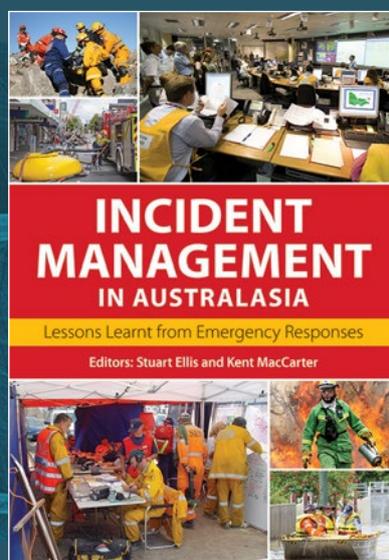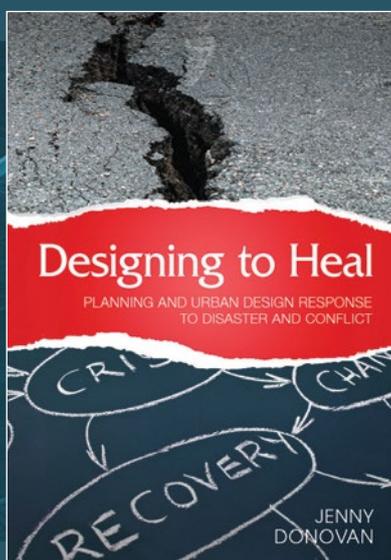
Hunter and Central Coast community disaster resilience forums – June 2016

By Neil Dufty, Molino Stewart Pty Ltd

Emergency events in the Hunter and Central Coast regions of NSW over 2015-2016 showed there was an immediate need to improve how communities plan for and recover from such events. Community service organisations, businesses and primary producers needed to fully understand the roles of emergency services and plan ahead to maintain continuity during disasters.

A Project Task Group was set up of emergency services agencies to develop and deliver a series of community forums specifically looking at these needs. The forums were held during June 2016 and, according to participants, were very effective. There was strong support by participants for even more opportunities to engage with local emergency agencies and for resilience-related learning.

What is a disaster-resilient community?

A disaster-resilient community is one where residents, non-government organisations (NGO) and businesses work in partnership with government and emergency services agencies before, during and after emergency events. These relationships mean community resilience activities are informed by local knowledge and complement the existing work of emergency services agencies.

Natural weather events over 2015-2016 in the Hunter and Central Coast regions of NSW put community disaster resilience at the forefront of planning for many agencies, NGOs and businesses. Following the devastating storms experienced in the regions in April 2015, the Regional Recovery debrief highlighted the lack of knowledge in the community, particularly among local NGOs, of the roles and responsibilities of the various agencies in disaster response and recovery.

It is important that the NGO sector, community leaders and businesses are aware of emergency management arrangements and that they have plans in place to maintain business continuity during emergencies and disasters. It is also imperative that community service providers and community leaders work together effectively in the local area.

Taking an inter-agency approach helps the NGO sector, business and community leaders by providing relevant and usable information and resources that support community resilience-based planning.

With this in mind, the Project Task Group was formed with representatives from:

- NSW Family and Community Service
- NSW State Emergency Services
- NSW Department of Premier and Cabinet (Hunter and Central Coast)
- NSW Police Regional Emergency Management Officer with direct links to local councils via local Emergency Management Officers
- NSW Department of Industry
- NSW Office of Emergency Management
- NSW Department of Primary Industries
- Hunter New England Area Health.

The Project Task Group delivered a series of community forums for NGOs, businesses and primary producers
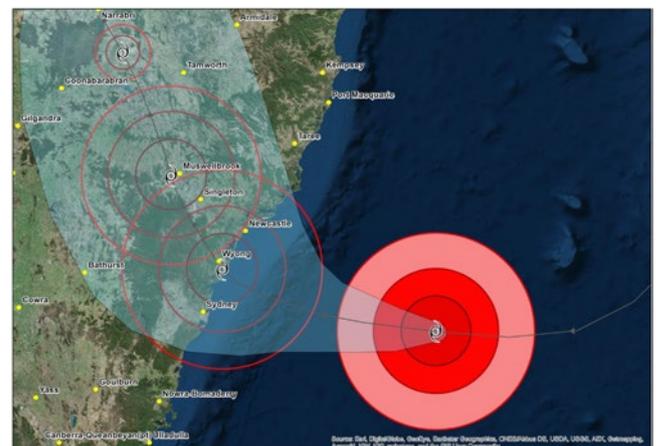

Figure 1: The mock 'Tropical Cyclone Hunter' used in the scenario exercise.

operating in the regions. The NSW Department of Premier and Cabinet coordinated and organised the forums with Molino Stewart Pty Ltd designing and facilitating the events. Local business consultant, Peter Hollingsworth, presented on business continuity.

There were four objectives of the forums:

- To explain the roles and responsibilities of emergency services providers across preparedness, response and recovery.
- To stress the importance of business continuity planning.
- To provide a practical business continuity planning tool.
- To examine ways that NGOs and other groups can best coordinate recovery in the region.

Methodology

The Project Task Group met several times prior to the forums to consider design and organisation. As facilitator, I consulted with agency representatives from the Project Task Group to understand issues relating to the forum objectives and obtain local knowledge.

The forums were designed to be interactive and thought-provoking. Forum design was:

- A scenario planning exercise (see Figure 1) based on a fanciful 'Tropical Cyclone Hunter' that hit the region. The scenario allowed emergency services providers to discuss their roles with forum participants as the 'disaster' progressed from preparedness, response to recovery.
- Explanation of how to use the business continuity planning tool provided to participants as an Excel spreadsheet.
- Small group problem-solving activity where participants shared their experiences and identified ways to improve continuity planning and services to clients during and after disasters.
- Videos of examples of good practice in community disaster resilience.

Three forums were held during June 2016 at the Central Coast (Wyong with 22 participants), in the Lower Hunter (Maitland with 31 participants) and the Upper Hunter (Muswellbrook with 17 participants).

Evaluation

The forums were evaluated using:

- quantitative participant responses using Likert scale closed questions on a feedback sheet
- qualitative participant responses using open questions on the feedback sheet
- reflections by members of the Project Task Group.

The quantitative evaluation provided the following results:

- 94 per cent of respondents felt the forum met their expectations

Peter Hollingsworth provides an explanation of the business continuity planning tool at the forum in the Lower Hunter.
Image: Colin Perry

- the majority of respondents (58 per cent) strongly agreed that the forum helped them understand the roles of agencies in local emergencies and disasters
- over 90 per cent of respondents either strongly agreed or agreed that the forum provided a useful tool for continuity planning
- over 80 per cent of respondents either strongly agreed or agreed that they learnt ways to better coordinate recovery and to help their clients
- almost all respondents (97 per cent) thought the forum was well facilitated.

The qualitative evaluation explored what worked, what didn't work and what could be improved. Popular responses for 'what worked' at the forums included a better understanding of the roles of emergency services, better understanding of continuity planning, and networking with other NGOs and with emergency services agencies.

The few responses for 'what didn't work' indicated that more interactive sessions on business continuity planning and looking at ways to improve relationships between organisations would be beneficial. According to the participants, the main way the forum could be improved was to have greater attendance from the business community and from primary producers (most participants were from NGOs, local councils and emergency services agencies). One way identified to achieve this was to hold the forum in conjunction with other events specifically for businesses and primary producers.

The Hunter and Central Coast Community Resilience forums had clear objectives and most forum participants indicated they learnt more about the roles of emergency services and built their resilience capabilities using the business continuity tool. In essence, participants felt the forums helped them better plan for and coordinate activities during response and recovery and be better prepared to help their clients.

The attendance levels at the forums were less than expected by both participants and the Project Task Group. In particular, there was little or no attendance from primary producers and business groups. However, there was strong support by participants and the Project Task Group to have further opportunities for engagement with emergency services agencies and for resilience-related learning.

Capability enhancement through disaster management training: the Queensland experience

By Jane Zsombok, Queensland Fire and Emergency Services

Disaster management education and training is an essential component of capability enhancement. It is one of the activities undertaken to maintain and enhance Queensland disaster management arrangements. The *Queensland Disaster Management Act 2003* provides the legislative requirement for those involved in disaster operations to be appropriately trained. To support these requirements, training for Queensland disaster management stakeholders is undertaken in accordance with the Queensland Disaster Management Training Framework.

Queensland's journey

A review of Queensland's disaster management legislation and policy was undertaken in 2009 by Jim O'Sullivan and the Consultancy Bureau. The resulting report highlighted shortfalls in training and recommended an increase in competency levels for stakeholders involved in disaster management. While disaster management training was undertaken in Queensland prior to 2009, there was no approved, consistent curriculum nor learning pathways.

In response to the 2009 review, a framework for the delivery of disaster management training in Queensland was established. The Queensland Disaster Management Training Framework[1] was developed in consultation with stakeholders and was implemented in 2011. The Framework and supporting curriculum were designed to build capability and capacity in skills, knowledge and development areas relevant to Queensland and, ultimately, to support participant effectiveness in their roles.

The Queensland Government response to the *Queensland Floods Commission of Inquiry*[2] in 2011 provided additional focus on disaster management training. Priority was placed on training for stakeholders in key positions and to provide training online. During

2012-2013 the Regional College of Disaster Management (RCDM) project was developed and approved. The project provided an injection of additional vocational and higher education training in disaster management during 2014-2016. The project also delivered the Disaster Management Learning Management System. The system launched in March 2015 provides online courses and access to training records. The system's learning pathways are customised to reflect the Framework and Queensland's disaster management roles.

Queensland training framework

The Framework covers a range of topics including disaster coordination centres, resupply, warnings, cyclone shelter management, evacuation, evacuation centre management, disaster relief and recovery funding, and recovery.

The majority of the training is undertaken face-to-face at stakeholder locations. This delivery model suits stakeholder requirements and, partnered with the online modules, provides accessible and structured training.

Framework trainers have relevant content knowledge and hold training and assessment qualifications. The Framework and supporting curriculum are continually evaluated and updated with policy amendments and lessons identified from operational reviews and exercises. Continual improvement provides quality assurance, credibility and consistency in the training.

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1 Queensland Disaster Management Training Framework and supporting Disaster Management Training Handbook. At: **www.disaster.qld.gov.au.**

2 Queensland Floods Commission Inquiry – Interim Report. At: **http://floodcommission.qld.gov.au/**.
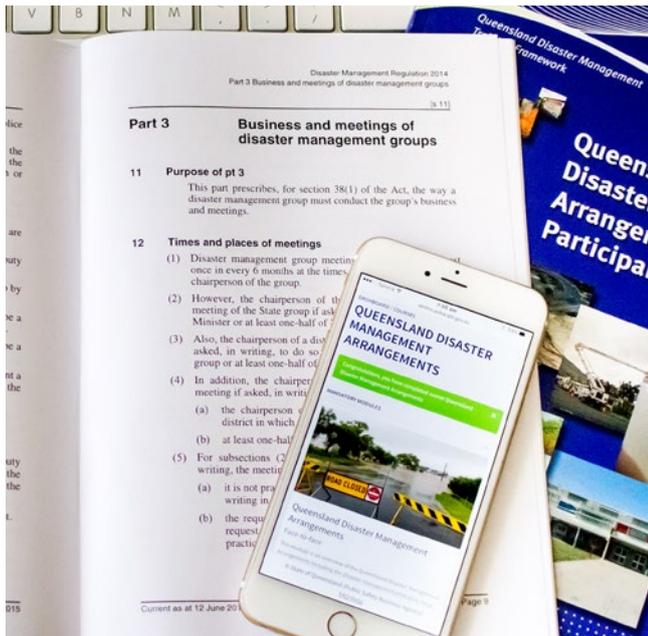
An evaluation[3] of Framework training showed an 87 per cent overall participant satisfaction rating. Importantly, 91 per cent of survey respondents indicated the training had improved their capability to perform their disaster management role.

Training in accordance with the Framework continues with 9471 units of training delivered across the 2015-16 financial year. Training provision through the Framework meets the legislative requirements for disaster management training in Queensland and will remain the primary focus of training provision.

Challenges and opportunities

Disaster management training in Queensland continues to evolve, presenting challenges and opportunities. Influencing factors shaping the future of disaster management training include the need for greater integration of training and exercising, improved lessons management and balancing delivery through e-learning.

Identification of opportunities to improve the integration of training and exercising programs are important. This includes improved lessons management activities to inform training improvements and identify areas of competency focus. The ultimate goal is to measure and assess training capability enhancement through stakeholder performance in exercises and operations.

The integration of e-learning in disaster management training needs to be balanced with face-to-face training. Face-to-face training facilitates relationship building, cross-agency integration, and helps build appreciation of the shared responsibility that forms the foundations of effective disaster management.

Education and training is a critical element in disaster management capability. To ensure its efficacy, training content must reflect contemporary practice. It is

3 Independently administered survey of Framework training participants conducted in April-May 2016.

Regional College of Disaster Management

The RCDM initiative was designed as a short-term addition to education and training in disaster management to complement the Queensland Disaster Management Training Framework. Specifically the RCDM project delivered the Advanced Diploma of Public Safety (Emergency Management) and the Graduate Certificate in Disaster Management.

Participants in the programs were drawn from eligible stakeholders with a role in the Queensland disaster management arrangements. A total of 264 participants enrolled; 163 Advanced Diploma participants and 101 Graduate Certificate participants. Of these, 79 per cent successfully completed and were awarded the Advanced Diploma or Graduate Certificate qualification. A further 3 per cent completed Graduate Certificate studies and gained the qualification in 2016. Another 11 per cent received partial awards through units of competency in the Advanced Diploma.

During evaluation[1], 86 per cent of survey respondents felt the program had improved their capability either significantly or to some degree. Importantly, 84 per cent identified ways they could build on their existing knowledge and skills, and 76 per cent indicated they used learnings in their disaster management role.

The RCDM project was a Queensland Government funded contractual arrangement with the Australian Government Attorney-General's Department. The higher education component was delivered through a partnership with James Cook University and the Queensland University of Technology. Training was conducted in Cairns, Rockhampton and Brisbane and was provided at no charge to participants or their agency. The RCDM project concluded on 30 June 2016.

1 Independently administered survey of RCDM participants conducted in April-May 2016.

essential for curriculum developers to anticipate and respond to emerging influences that effect practitioners in disaster management.

The provision of Framework training is provided at no charge to eligible stakeholders with a role in the Queensland disaster management arrangements.

For further information on Queensland's disaster management training contact **DMTraining.Feedback@qfes.qld.gov.au**

National Gender and Emergency Management Guidelines

**By Debra Parkinson, Alyssa Duncan and Kiri Joyce, Gender and Disaster Pod**

Men and women experience emergencies differently and the effects of disaster events on them are different. Issues related to gender are known to compound the already damaging effects of disasters. Emergency plans in Australian states and territories rarely reflect these differential impacts and emergency planning does not yet take a gendered approach. The Attorney-General's Department recognised this critical gap and funded a project to develop national guidelines for gender and emergency management.

Increased knowledge and integration of gender-focused practices improves the emergency planning process and paves the way for better outcomes in the response and recovery stages. Of primary importance is the health and wellbeing of men and women affected by disaster.

In 2015, the Victorian Department of Health and Human Services facilitated the drafting of the *Gender and Emergency Management Guidelines* with input from approximately 200 emergency management personnel. This initial draft was based on a Victorian state context and provided a starting point for development of the national guidelines. This was followed in 2016 by the Attorney-General's Department project to develop national guidelines for gender and emergency management. Collaboration with a further 350 emergency management personnel representing Australian states and territories, resulted in guidelines that reflect practices from across Australia and provide uniformity and clarity.

The national guidelines project was conducted by the Gender and Disaster Pod, an initiative of Women's Health Goulburn North East, Women's Health in the North and
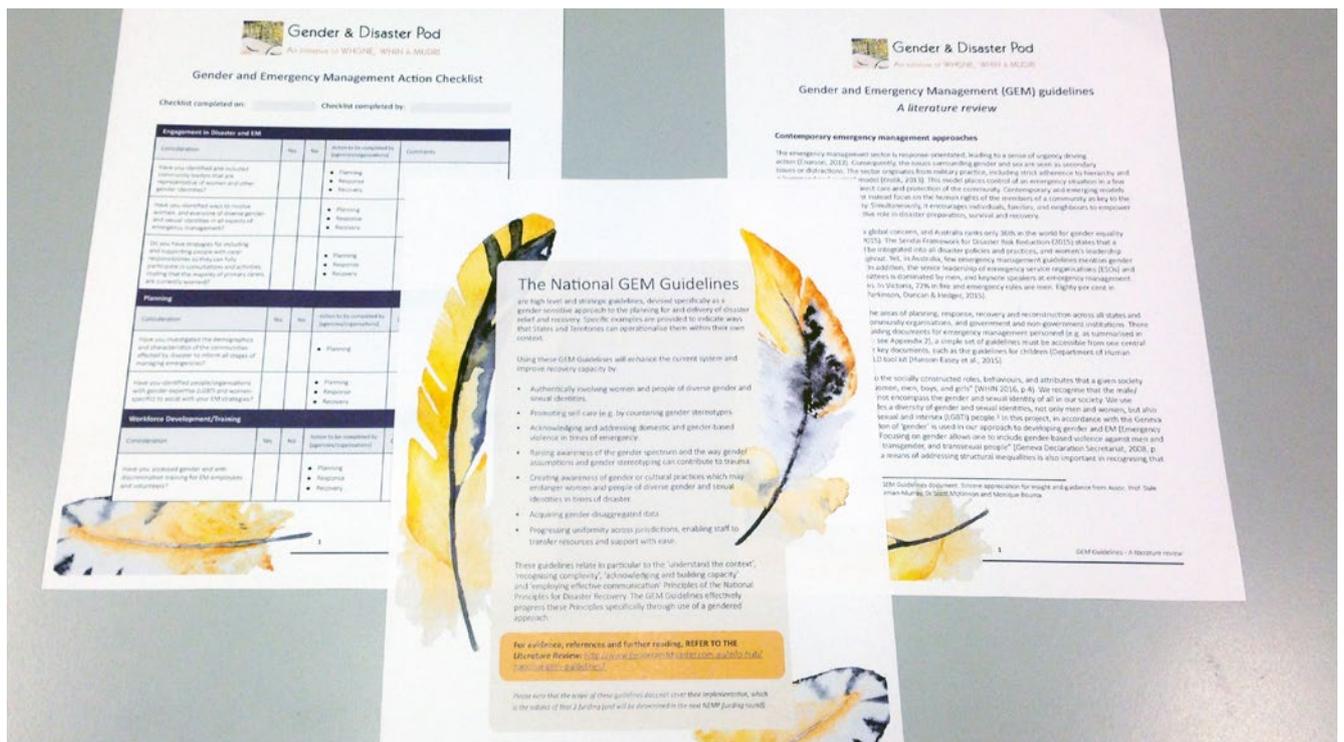
Monash University Disaster Resilience Initiative. Collaboration with a number of parallel research programs ensured the project was grounded in the latest research. For example, Australian research by Associate Professor Dale Dominey-Howes, Dr Andrew Gorman-Murray and Scott McKinnon with LGBTI (Lesbian, Gay, Bisexual, Trans and Intersex) communities was an important part of the development of the guidelines. In addition, masculinity theorist, Professor Bob Pease, and others within the women's health sector contributed to the development of the project. An advisory group with representatives from all states and territories, chaired by Professor Frank Archer, guided the project.

The *Gender and Emergency Management Guidelines* cover three areas of focus with each area encompassing background, principles and actions for consideration. Areas of focus are:

- supporting community gender equity and diversity
- gender-sensitive communication and messaging
- addressing domestic violence before, during and following an emergency.

The guidelines include two supporting documents. The Gender and Emergency Management Literature Review is an externally reviewed, comprehensive and up-to-date overview of the significance of gender in emergency management domestically as well as internationally. The Gender and Emergency Management Guidelines Action Checklist offers a quick way for emergency workers to verify that gender awareness is considered and incorporated into emergency planning and management.

The three documents are available online[1] along with an external evaluation report. The evaluation report is an independent critique of both the products and the process of the project. The guidelines are also on the United Nations PreventionWeb website at **www.preventionweb.net/publications/view/50289.**

A conference is planned for later in 2017 to promote the use of the guidelines and inspire the emergency management sector.

For further information contact Debra Parkinson (**space@netc.net.au**) or Judy Jeffrey (**judyjeffrey@activ8.net.au**).

Current research: experiences and needs of LGBTI communities in emergencies

A new project aims to identify and learn about the experiences and needs of LGBTI communities in emergencies in Victoria. The findings feed into the development of emergency management policies and procedures that reflect LGBTI-inclusive practice. People can be involved by participating in an online survey.

Victoria's emergency management sector is currently undertaking a reform agenda that includes embracing diversity in all its forms. The *Emergency Management Inclusion Framework*[2] guides the actions for creating a diverse and inclusive sector and better connecting to Victoria's diverse communities.

Recent initiatives promoting gender equality in emergency management, and some emergency service organisations, offer cultural awareness training. However, the experiences and needs of LGBTI communities have yet to be fully considered by the emergency management sector. It is important that those involved in management acknowledge that LGBTI communities have differing experiences and specific needs and those needs vary *within* LGBTI communities according to socio-economic background, gender, ethnicity, age and location.

Left to right: Liam Leonard, Debra Parkinson, Judy Jeffrey, Alyssa Duncan (absent) lead research in this area.

1 *Gender and Emergency Management Guidelines.* At: **www.genderanddisaster.com.au.**

2 *Emergency Management Inclusion Framework.* At: http://cdn-au.mailsnd.com/83145/2xFwTii0qUPTBnAQ00bM1eDCxAKh7bg-4nvylcjr2uo/2305500.pdf.

Dale Dominey-Howes, Andrew Gorman-Murray and Scott McKinnon (2014)[3] conducted ground-breaking Australian research on the experiences of LGBTI and other sexual and gender minorities in emergencies in NSW and Queensland. Issues faced by these groups in emergencies include difficulty accessing emergency and support services and resources, harassment and abuse (verbal and physical) and marginalisation or exclusion. This Victoria-based research project includes two online surveys looking for responses from:

- people in LGBTI communities or of diverse gender and sexual identity who have experienced an emergency (such as a house fire, or extreme weather event causing damage) or a disaster (such as a bushfire or flood)

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3 Dale Dominey-Howes, Andrew Gorman-Murray & Scott McKinnon 2014, Queering disasters: on the need to account for LGBTI experiences in natural disaster contexts, Gender, Place and Culture: A Journal of Feminist Geography, vol. 21, no. 7, pp. 905-918.

- people involved in the emergency management sector (e.g. those working in emergency or disaster planning, response, recovery or reconstruction, such as emergency services organisations—staff and volunteers, state and local government, churches, health and community services, etc).

Depending on funding, additional interviews may be arranged for those interested.

This research offers an opportunity to inform the emergency management sector about how to improve services and support to LGBTI people. It is only by the contribution of thoughts and experiences by those directly affected that decision-makers will know what needs to change and how it may be changed.

The research project is managed by the Gender and Disaster Pod, in partnership with GLHV@ARCSHS at La Trobe University. It is funded by the Victorian Department of Premier and Cabinet and guided by an advisory group.

ONLINE SURVEY

LGBTI people's experiences of disaster and emergency management in Victoria

Conducted by the GAD POD, in collaboration with GLHV@ARCSHS at La Trobe University, and funded by Department of Premier and Cabinet, Victoria.

This survey is the first part of important research. Responses are anonymous. Take part and forward to others who may be interested.

Go to **www.genderanddisaster.com.au** for details or contact **space@netc.net.au**

The GAD Pod is an initiative of Women's Health Goulburn North East, Women's Health in the North and Monash University Disaster Resilience Initiative.

Gender & Disaster Pod
An initiative of WHGNE, WHIN & MUDRI

GLHV
Promoting LGBTI Victoria's health & wellbeing

VICTORIA
State Government | Premier and Cabinet

ABSTRACT

In 2010, Ryan and Matheson (2010) compiled evidence to quantify the importance of communication activities to emergency management. The study involved a comprehensive content analysis of emergency incident and emergency exercise debriefing sessions and reports spanning 2003 to 2008. Six years on, this 2015 study replicates that work to determine the current significance of communication in emergency management. It also identifies trends in issues that occur during emergency events. This study considers recommendations and findings from 22 reviews of recent disaster events and training exercises from around Australia. Using content analysis, 20.4 per cent of the findings relate to issues with communicating with communities. This represents an increase of 1.3 per cent on the 2010 study. Resourcing, skills in social media, and community consultation and engagement feature in the study results.

The significance of communication in emergency management: what's changed since 2010?

Barbara Ryan[1]

1.   University of Southern Queensland, Toowoomba, Queensland.

Introduction

In a natural disaster, communication and interaction with affected communities is a critical component of emergency management (Gilbert 1998, Haddow & Bullock 2006, Quarantelli 1986, 1988, 1989, Renckstorf & McQuail 1996, Young Landesman 2005). Veil (2007) found residents of one community 'considered communication a key aspect of the emergency response'. Community decision-making in disaster and possession of information have been consistently connected:

> *Citizens who do not have adequate information to assess the situation, the risks and possible actions, might make choices that – observing from a greater distance, with more overview – may be perceived as sub-optimal.* (Helsloot & Ruitenberg 2004 p. 110)

In the 2010 study it was discovered that 19 per cent of the 415 recommendations in 12 reviews of disaster events or exercises related to communicating with the community. This study also considers trends in community communication.

Method

Content analysis remains a reliable method to examine documents for data and trends (Krippendorff 2004). The following process was used (Wimmer & Dominick 2000):

- Formulate the research question.
- Define the population and sample.
- Select the appropriate sample from the population.
- Define a unit of analysis.
- Construct categories of content for analysis.
- Establish a quantification system.

Formulating the research question

- How often does communication with the community feature in emergency management post-incident or post-exercise reviews?

- How have community communication recommendations and findings changed since 2009?
- What trends in communication issues can be identified from recommendations and findings from 2009 to 2016?

Defining the population and sample

This study examined 26 reviews of incidents and exercises undertaken by Australian government agencies, state inquiries, royal commissions and parliamentary committees published from 2009 to 2015. These were sourced from agency and commission of inquiry websites. Four of the reviews were discarded because:

- findings were not clear
- findings were guided by survey questions that may not uncover issues that arose from that emergency
- the review was a discussion paper rather than a review
- the review did not examine response and recovery and the associated communication.

All remaining documents in the sample incorporated communication with community in their terms of reference. The features of the 22 remaining documents are outlined in Table 1.

This profile differed from the previous study that examined 12 documents from 2005 to 2009. These included two pandemic exercises, a tsunami, four bushfires, and five training exercises.

Defining the unit of analysis

The unit of analysis for this study was the individual findings or recommendations listed in the document. These were defined in the documents as 'learnings', 'evaluation findings', 'propositions', 'strategic actions', 'suggested treatments' and 'improvements required'. The total findings varied from four in the Westmeadow review (Dalton 2012) to 117 in the north-eastern Victoria floods (Comrie 2011). As in the 2010 study, a number of findings contained sub-findings. Where these sub-findings were clear recommendations of separate activities, they were counted as separate findings. An example of a recommendation being broken down into sub-findings came from the *Hazelwood Mine Fire Inquiry 2014 Report Recommendations* (Teague, Catford & Roper 2014, p. 3):

The State empower and require the Auditor-General or another appropriate agency to:

oversee the implementation of these recommendations and the commitments made by the State and GDF-Suez during this Inquiry; and

report publicly every year for the next three years on the progress made in implementing recommendations and commitments.

In some cases, sub-findings were a prescription for how a recommendation should be implemented; these were not treated individually. An example came from the *2009 Black Saturday Bushfires Royal Commission Summary* (Teague, McLeod & Pascoe 2010, p. 24):

The State introduce a comprehensive approach to shelter options that includes the following:

developing standards for community refuges as a matter of priority and replacing the 2005 Fire Refuges in Victoria: Policy and Practice

designating community refuges - particularly in areas of very high risk - where other bushfire safety options are limited

working with municipal councils to ensure that appropriate criteria are used for bushfire shelters, so that people are not discouraged from using a bushfire shelter if there is no better option available.

Constructing the content categories

A list of keywords from the 2010 study and an initial reading of the findings guided classification of findings as 'communication' or 'non-communication'. These are shown in Table 2.

The findings were sorted into themes. Themes from the 2010 study were used for a first coding attempt, but three adjustments were subsequently made. The original study included exercises that involved other nations, leading to an international inter-agency cooperation theme. No international reviews were considered for this study. Also, the first study found that 'warnings' and 'pre-disaster community education' could coexist in one theme. The first coding attempt showed that these two themes should be separated. In addition, the original

Table 1: Disaster type and document type featured in the documents sample.

	NSW	Queensland	Tasmania	Victoria	Western Australia	Total
Bushfire	1		1	14	1	17
Flood or storm	1	1		1		3
Hazchem				2		2
Total	**2**	**1**	**1**	**17**	**1**	**22**
Incident	2	1	1	15	1	20
Exercise				2		2

Table 2: Keywords used to analyse the findings.

Channels and messages	Approaches	Target publics
Media	Community engagement	Householders
Press	Community information	Community or communities
Radio (including the ABC)	Promote or promotion	Disabled
State Emergency Warning Signal (SEWS)	Community education	Vulnerable
Call centre	Education programs	Culturally and linguistically diverse communities (CALD)
Information line	Evacuation	Landholders
Website	Public education	
Information packages	Community partnerships	
Warning systems	Public information	
Communication networks	Publishing	
Social media	Measurement and evaluation	
Electronic signs	Messages and messaging	
	Risk information	

theme of 'community engagement' during and post-emergency was found to be inadequate for the current study. Resilience and recovery emerged in many of the documents, so the 'community engagement' theme was split into two to cover response and recovery. A communication measurement and evaluation concept emerged, but this was included in the 'communication planning' theme. The emergent themes are listed in Table 3 and compared with 2010 themes.

The 2016 version of the themes was used to code findings. Coding was undertaken three times over three weeks to ensure reliability. Of the 137 findings considered, differences across coding attempts were found in 14 of them. In each case, the adjective used was considered in conjunction with the noun to determine the emphasis of the finding. For example, the Tostaree fire review in 2011 (Office of the Emergency Services Commissioner 2011a) recommended that 'The Fire Services ensure that information and warning projects are able to be integrated within a common operating platform'. The first and second coding attempts classified this as 'communication planning' and 'technology'. The third attempt showed the combination of the adjective 'integrated' and the two projects would make this a planning issue.

Results

Table 4 details the documents reviewed, the number of findings and sub-findings, and communication with the community findings. The final coding results in Table 5 show the incident types and their prevalent themes.

Table 3: Themes used in the 2010 and 2016 studies.

2010	2016
Warnings and pre-disaster community education	Warnings
	Education and pre-disaster engagement
Domestic inter-agency cooperation	Inter-agency cooperation
International inter-agency cooperation	
Community engagement during and post-emergency	Information delivery and engagement during incident
	Information and engagement during recovery
Communication planning and plans	Communication planning including strategic planning, implementation, measurement and evaluation
Technology	Technology
Resourcing	Resourcing
Communications training, testing and exercises	Communications training, testing and exercises
Media	Media and other channels

Table 4: List of documents included in the study.

Event	State	Year	Findings	Sub-findings	Communication-related findings	% findings
Lancefield-Cobaw fire (Carter 2015)	Vic	2015	16	16	8	50.0
TriTech Lubricants factory fire(Office of the Emergency Services Commissioner 2011b)	Vic	2011	5	8	4	50.0
Nuplex Resins Hazchem incident (Emergency Services Commissioner 2012)	Vic	2011	19	19	9	47.4
Tostaree fire (Office of the Emergency Services Commissioner 2011a)	Vic	2011	29	29	12	41.4
Callide Creek flood review (Inspector-General Emergency Management 2015)	Qld	2015	13	15	5	33.3
Noojee and Lavers Hill communities evacuation (McArdle 2012)	Vic	2011	33	33	10	30.3
Westmeadows grassfire (Dalton 2012)	Vic	2012	4	4	1	25.0
East Coast storm and flood	NSW	2015	16	16	4	25.0
Goongerah-Deddick Trail fire (Lapsley 2014a)	Vic	2014	26	26	6	23.1
Hazelwood Mine Fire 2014 Report (Teague, Catford & Roper 2014)	Vic	2014	18	28	6	21.4
Hazelwood Mine Fire Inquiry Report 2015-2016 Volume I - Anglesea Mine (Teague, Catford & Roper 2015)	Vic	2015	18	18	4	22.2
Mt Ray Boundary Track fire (Lapsley 2014b)	Vic	2014	20	20	4	20.0
Stewarton fire (Victoria Police & Emergency Management Victoria 2015)	Vic	2015	5	5	1	20.0
Perth Hills Bushfire (Keelty 2011)	WA	2011	55	55	10	18.2
Kentbruck fire (IRS Services 2013)	Vic	2013	12	12	2	16.7
Review of the 2010-2011 Flood Warnings and Response (Comrie 2011)	Vic	2011	93	117	19	16.2
Tasmanian Bushfires Inquiry (Hyde 2013)	Tas	2013	103	103	15	14.6
Wambelong fire - Warrumbungles (Brown 2015)	NSW	2015	29	29	4	13.8
Harrietville fire (Office of the Emergency Services Commissioner 2013)	Vic	2013	8	8	1	12.5
Black Saturday Royal Commission (Teague, Ronald & Pascoe 2010)	Vic	2009	65	93	11	11.8
State Fire Exercise (Fire Services Commissioner Victoria 2013)	Vic	2012	10	10	1	10.0
Wye River Jamieson Track fire (Inspector-General Emergency Management 2016)	Vic	2015	8	8	0	0.0
Total				**672**	**137**	**20.4**

Table 5: Communication findings according to theme and disaster type.

	Total 2016	Bushfire	Flood	Hazchem
Education and pre-disaster engagement	39	33	6	0
Communication planning (strategic planning including communications)	21	16	5	0
Warnings	20	9	6	5
Media and other channels	17	9	5	3
Inter-agency cooperation	8	5	1	2
Information and engagement during recovery	11	9	2	0
Information and engagement during incident	8	6	1	1
Technology	7	6	1	0
Resourcing	5	2	1	2
Communications training, testing and exercises	1	1	0	0
Total	**137**	**96**	**28**	**13**

Comparing these results with those of 2010 highlights some differences. The most notable being education and pre-disaster engagement issues, which, at 28.5 per cent, was almost as many as the 2010 warnings and education themes combined (34.7 per cent). When combining the 2016 warnings with education and pre-disaster engagement, 43 per cent of findings related to these activities; an increase of almost 9 per cent since 2010. Inter-agency cooperation recorded a drop from 2010 to 2016, from 16 per cent to just under 6 per cent. Other themes remained similar to the results of the 2010 study. Table 6 shows the differences and similarities.

Addressing research questions

How often does communication with the community feature in emergency management post-incident or post-exercise reviews?

The data showed that 20.4 per cent of 672 findings related to communication with the community. This is compared with 19.1 per cent in 2010 from 415 findings. The incidents that had the greatest number of communication-related findings were a factory fire in Victoria in 2011 and a bushfire in Victoria in 2015; both with 50 per cent ratio. This is compared with the Wye River fire in Victoria in 2015 where no issues of communication with communities featured.

How have community communication recommendations and findings changed since 2010?

What trends in communication issues can be identified from recommendations and findings from 2010 to 2016?

These questions can be answered by comparing the number of communication-related findings between studies and examining the themes these findings relate to.

The prevalence of education recommendations in 2016 supported separation from the warnings recommendations with which education programs were grouped in 2010. Education and pre-disaster engagement was an issue in 28.5 per cent of the communications findings, and its 2010 partner, warnings, was a problem in 14.6 per cent of cases.

Communication planning increased dramatically in the 2016 study, rising from 5 per cent in 2010 to 19 per cent. This was partly due to three recommendations for communication measurement and evaluation that had not appeared in the 2010 reviews. However, a large number of findings related to activities that needed to be in place or planned for, being:

- education and pre-disaster engagement – 28.5 per cent
- communication planning – 15.3 per cent
- technology – 5.1 per cent
- resourcing – 3.6 per cent
- communication training, testing and exercising – 0.7 per cent.

Together, preparation issues were considered in 53.2 per cent of the findings.

'Inter-agency cooperation' showed an improvement, dropping from 16 per cent to 5.8 per cent between the studies. A small improvement of 2.2 per cent was recorded in 'information delivery' and 'community engagement' during response and recovery phases. 'Media management' recorded a 2.3 per cent drop between the two studies.

Recovery and resilience themes were so prevalent in the 2016 data that a standalone theme was developed for this phase. Technology, resourcing and media issues remained static between the studies, although the composition of 'media' changed. Social media was mentioned in nine findings and contributed to the widening of the media theme.

Table 6: Theme differences and similarities in the 2010 and 2016 studies.

Theme	2016		2010	
	Total	% findings	Total	% findings
Education and pre-disaster engagement	39	28.5	26	34.7
Warnings	20	14.6	0	0
Communication planning (including strategic planning)	21	15.3	5	6.7
Media and other channels	17	12.4	11	14.7
Information and engagement during recovery	11	8.0	12	16.0
Information and engagement during incident	8	5.8	0	0
Inter-agency cooperation	8	5.8	12	16.0
Technology	7	5.1	4	5.3
Resourcing	5	3.6	3	4.0
Communications training, testing and exercises	1	0.7	2	2.7
Total	**137**	**100**	**75**	**100**

Figure 1 compares composition of communication-related findings between the 2010 and 2016 studies.

Discussion

This study aimed to identify what changes had occurred to the significance of communication with communities in emergency management since 2010. The results showed that problems related to communicating emergencies actually increased by 1.3 per cent.

Examination of findings revealed several aspects of communication in this area. These related to resourcing, social media use, the type of exercise, techniques used to gather information in each review, and the capability of systems to work within unusual events.

Resourcing

Some findings were prescriptive and related to communication practice. Communication and engagement plans, specific channels, certain messaging and methods of determining messaging, media liaison skills, and media planning were suggested. It was evident in some incidents that communication expertise was lacking. The Tasmania bushfires in 2013 (Hyde 2013) is a good example of communication teams being stretched beyond their limits. This indicated that the 'resourcing' theme was more important than the figure of 3.6 per cent represented. Examples of findings with underlying resourcing issues were:

- The Fire Services, in consultation with media outlets, develop a more effective strategy for informing the community of Total Fire Ban Days (Office of the Emergency Services Commissioner 2011a).

- Strong, professional media liaison staff are vital to ensuring a positive outcome from the media (McArdle 2012, Noojee and Lavers Hill bushfire evacuation exercise).

- A formal arrangement is established to ensure twenty-four hour availability of information officers for the issuing of information and warning messages (Office of the Emergency Services Commissioner 2011b, TriTech Lubricants fire).

- Compile and maintain a list of vulnerable residents who need tailored advice of a recommendation to evacuate, and provide this list to local police and anyone with a pre-arranged responsibility for helping vulnerable residents evacuate (McArdle 2012, Noojee and Lavers Hill bushfire evacuation exercise, Teague, McLeod & Pascoe 2010, Black Saturday bushfires).

- The Fire Services recognises the specialised role of Information Sections and enhance training and resources accordingly. (Office of the Emergency Services Commissioner 2011a).

Social media catch-up

Nine of the 137 findings referred to social media (7 per cent), causing an increase in the total. Seven of these related to incidents in 2011, the other two from the Tasmania bushfires review of 2013. None of the 13 other reviews published from 2013 to early 2016 referred to social media, indicating that agencies have improved social media strategies.
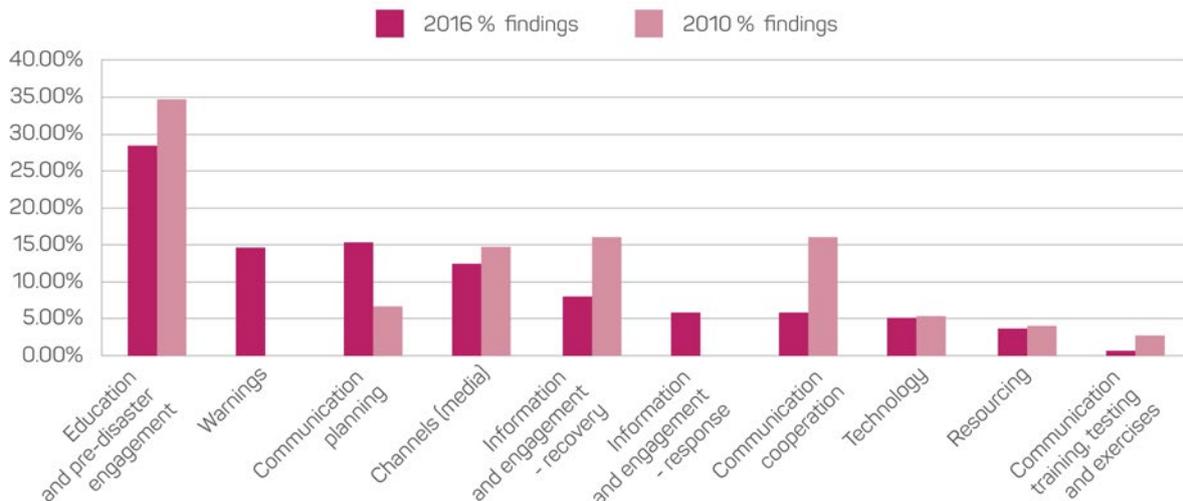
Figure 1: Comparison between 2016 and 2010 findings.

Reviews and community consultation

In 2010, half of the 12 reviews did not include community feedback in the debrief and review process. In 2016, 77.3 per cent of the 22 reviews held formal community consultation as part of the information-collection process. This supported the presentation of more issues in more depth than interviews with agency staff and reviews of operational records could produce. As a result, the number of findings across all reviews would be expected to be more than in 2010. Supporting this, the average number of total findings of the 2016 study reviews that did not do community consultation was ten. The average number of total findings of the reviews and inquiries that did do community consultation was 47.23. Even with the very large numbers of recommendations from the commissions of inquiry removed from this sample, the average was 26.2 findings per review. These calculations were made on the published findings rather than the revised number that was prepared for the content analysis for this study.

Community consultation seems to have increased the number of general findings. This would therefore influence the number of findings about communication with the community.

Systems shortcomings

Two incidents fell outside the business-as-usual approach for agencies. Findings from these showed that usual systems for other types of disaster events were not fit-for-purpose. The TriTech Lubricants factory fire and the Nuplex Resins hazchem incident, both in 2011, showed that 50 per cent and 47 per cent of findings respectively were related to community communication. In both incidents, communication processes normally deployed for a bushfire were not activated. The scale of the incidents and the media response seemed to catch responders and their communication teams by surprise.

This might be corrected as a result of this experience if an incident such as this was to happen in future.

Conclusions

The initial picture of emergency agency communication activities in this study looks grim, with 20.4 per cent of all emergency management problems linked to communicating with communities. This was an increase of 1.3 per cent since the 2010 study, despite agencies gaining incident and exercise experience in communication. A larger number of findings relating to the relatively new practice of community engagement has probably caused this increase. In addition, the recent practice of consulting the community during the review process may have increased the number of issues raised for scrutiny. Social media use has also caused a blip between 2010 and 2013 that has since been corrected. Many of the communication findings in this study occurred as a result of a lack of resources or were new activities required added resources. The review process is valuable as a measurement technique for agencies, with growth in social media use a sound example. Findings guided communicators to develop better strategies to avoid the mistakes experienced in the social media pioneering years.

This study shows the importance of communicating with communities by emergency management agencies. It has also uncovered the importance of community engagement during the review process.

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ABSTRACT

School safety is a priority within international disaster risk reduction efforts. Providing a safe learning environment and continued access to education after an emergency can limit impacts on students, their families and the community. This study explores New Zealand legislative requirements and emergency management practitioners' expectations of school-based emergency management efforts to identify what preparedness activities schools are expected to undertake to ensure the physical and emotional safety of their students in emergencies. The study combines a review of New Zealand legislation, policy, guidelines and resources related to school safety and emergency management with interview data from three emergency management practitioners. The key finding was that legislation was mostly generic for New Zealand workplaces. It was broad and, at times ambiguous, and schools are not provided with clear disaster risk reduction guidance. The establishment of clear emergency preparedness benchmarks for schools would help address deficiencies and ambiguities identified within the existing legislation. In addition, the development of standard operating procedures for core emergency response actions, such as lockdowns, evacuations and family reunification could provide a consistent approach to school-based preparedness efforts, thereby ensuring student safety.

Legislative requirements and emergency management practitioner expectations of preparedness in New Zealand schools

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Introduction

A school's links into families through their students can be used to build a culture of disaster resilience within communities (Ronan *et al.* 2016). One of the main ways schools can support community resilience is by ensuring they provide students and staff with safe facilities in which to learn (e.g. Peek 2008). In the decade since the initial introduction of the *Hyogo Framework for Action 2005-2015* (HFA), disaster risk reduction efforts have prioritised the safety of school sites and children's continued access to education. A review of global disaster risk management within the education sector resulted in the establishment of the Comprehensive School Safety (CSS) framework (GADRRRES 2014). The CSS framework includes core strategic goals, priorities and indicators from the HFA. It has provided the education sector with an overview of what should be considered when planning for physical safety at schools and ongoing access to education. The CSS framework is built around three pillars:

- safe school facilities
- school disaster management
- risk reduction and resilience education.

Schools are identified as critical infrastructure within the *Sendai Framework for Disaster Risk Reduction 2015-2030* and education is recognised as having a role in achieving the disaster risk reduction (DRR) priorities within the Sendai framework (Shiwaku & Shaw 2016).

New Zealand has agreed, as a signatory to both the Hyogo and Sendai frameworks, to integrate where applicable the principles of DRR and resilience (UNISDR 2005, 2015) into policy and planning at all levels of government. To date, successive governments have undertaken steps towards this goal within the education sector, most prominently in ensuring that schools are physically safe learning environments (e.g. earthquake-resilient school buildings).

The aim of the present study was to explore the legislative requirements and practitioner expectations of school-based emergency management efforts and to identify what preparedness activities schools should take to keep students physically and emotionally safe in emergencies. The study investigated three research questions:

- What legislation directs emergency management efforts in schools?
- What are schools expected to do to meet their legislative responsibilities?
- What monitoring and compliance requirements exist for school-based emergency management efforts?

This research builds on an earlier study examining emergency preparedness in 355 New Zealand schools (Tipler *et al.* 2015), which found that preparedness levels varied considerably between schools, due in part to an absence of clarification within existing emergency management requirements and expectations. For example, under the *Health and Safety at Work Act 2015* (NZ Government 2015), schools are required to develop emergency response plans, but the details of what those plans should contain are up to individual school leaders to determine.

Method

The study combined two data collection methods:

- A review of legislation, policies and guidelines related to safety and emergency management in schools to establish the statutory requirements, and a review of resources available to assist schools in their emergency management efforts.
- Expert interviews with three emergency management practitioners (two from the Ministry of Education [MoE] and one from the Wellington Region Emergency Management Office [WREMO]). The three practitioners interviewed were responsible within their organisations for ensuring that schools were advised and supported in their emergency management efforts. The semi-structured interviews lasted between 30-45 minutes. The interviews were transcribed verbatim, checked twice against the recorded interview and returned to participants for checking, editing and accuracy.

The analysis process combined qualitative description and thematic analysis. A qualitative descriptive approach, as advocated by Sandelowski (2000), recognises there are times when the audience simply requires a straight description of the phenomena. The approach tends to focus on basics such as the who, what, and where of events or experiences. This approach is consistent with the study aim of identifying the requirements and expectations of school-based emergency management. Thematic analysis, as described by Braun and Clarke (2006), was used to organise the descriptive data. The principles of thematic analysis allowed for the data to be viewed in a semantic way to identify and describe patterns and ideas in the data. Data were manually coded and mapped to enable the categorisation of identified relationships allowing themes and sub-themes to be recognised.

Approval for the research was granted by the Massey University Human Ethics Committee.

Findings and discussion

Findings are presented under the three research questions.

Legislation directing emergency management efforts in schools

New Zealand schools exist in a decentralised environment in which individual schools are governed by boards of trustees. These boards are responsible for the safety and welfare of all students, staff and visitors (e.g. parents, volunteers, contractors) on site or engaged in school-related business (e.g. field trips or after hours activities) (MoE 2016a). In particular, schools have a duty of care that requires they undertake appropriate emergency management activities to ensure the safety of students until they can be reunited with their families.

Four pieces of legislation guide school emergency management efforts. Table 1 provides an overview of the requirements of boards of trustees within each piece of legislation.

The following list identifies the known resources available to assist schools in meeting their legislative obligations. With the exception of the requirements within the *Education Act 1989* (NZ Government 1989), the legislation is generic for all buildings and workplaces.

- Safe learning facilities
  - Building Warrant of Fitness (MoE n.d.a)
  - Fire and safety design requirements for schools (MoE 2008)
  - Health and Safety at Work Act 2015 – A practical guide for Boards of Trustees and school leaders (MoE 2016a)
- School emergency management
  - Emergency Management Plan Template (MoE 2012)
  - Managing Emergencies and Traumatic Incidents - 9 Point Checklist (MoE 2009)
  - Pandemic Planning Kit (MoE n.d.b)
  - Traumatic Incidents: Managing Student And Staff Wellbeing (MoE 2016b)
- Disaster resilience education
  - EOTC Guidelines – Bringing the Curriculum Alive (outdoor education resource) (MoE 2016c)
  - What's the Plan Stan? (teaching resource for disaster education) (MCDEM 2009)

The MoE practitioners acknowledged the absence of specific details identifying what emergency management

Table 1: Emergency management legislation and requirements of schools.

Legislation	Requirements of boards of trustees
Education Act 1989	Must provide a safe physical and emotional environment for their students. May temporarily close the school in an emergency (e.g. flood, fire, epidemic). Must exclude staff and students with an infectious disease.
Building Act 2004	Must ensure that all school buildings are safe and can be used without jeopardising the health of staff and students. Must ensure buildings can be safely evacuated in the event of fire (and other hazards). Must develop an evacuation plan and procedures for all school buildings.
Fire Safety and Evacuation of Buildings Regulations 2006	Must have building evacuation procedures in place. Must test evacuation procedures in emergency drills at least once each school term.
Health and Safety at Work Act 2015	Must develop plans and procedures for all foreseeable emergencies including earthquakes and other natural events. Must ensure all staff, students and visitors are provided with the training and education necessary to implement the emergency plans. Must test emergency plans and procedures in regular emergency drills.

activities schools must undertake under the legislation. For example, the health and safety legislation is:

…very ambiguous in the wording, stating 'all foreseeable hazards', 'best efforts', type wording. It has really just left it open to interpretation. (MoE 1)

The absence of well-defined expectations is a weakness of the legislation and has resulted in schools not having comprehensive frameworks on which to base emergency management efforts. Similar research undertaken in the USA (Chung, Danielson & Shannon 2009) identified that governments need to provide clear emergency management benchmarks and expectations of school-based efforts.

School legislative responsibilities

In order to meet legislative responsibilities of keeping students safe in emergencies it is necessary for schools to:

- undertake emergency planning that details how the school will respond in emergencies
- provide staff and students with hazards education and emergency response training to ensure they can implement the emergency plans
- regularly conduct emergency response drills to test plans, education, and training.

Emergency planning

All practitioners identified three aspects of emergency planning as being important: emergency plans, the MoE emergency management plan template and education continuity.

Emergency plans

Emergency plans are essential for the welfare of staff and students (Smith *et al.* 2001). By having plans schools

send a message to families that they are prepared to keep students safe (Johnston *et al.* 2011). School plans need to meet the requirements of various emergency situations, not just those that seem most likely. Plans should include actions to be taken before, during and after an emergency event (Burling & Hyle 1997). The MoE practitioners recognised that development of comprehensive emergency response plans may get unwieldly and schools should create plans that are:

…succinct, very direct, brief, operationalised, and easy to read. More like a checklist rather than pages and pages of information. You can get caught, especially in the education area, of becoming too wordy, too lengthy and [providing] too many options. (MoE 1)

The importance of planning for reuniting families after an emergency cannot be overstated. Schools should develop procedures for reunification. Such procedures are a part of the 'contract' schools establish with parents and caregivers when students are enrolled. The study by Tipler and colleagues (2015) investigated preparedness in New Zealand schools and found that while the majority of schools (91 per cent) reported having emergency plans, only 40 per cent had ensured that staff, parents and caregivers were familiar with family reunification procedures. In an emergency, parents need to know how to collect their children and where from (Chung *et al.* 2009, Johnson *et al.* 2014), thereby avoiding confusion or additional anxiety (Ronan & Johnston 2005). Emergencies can occur at any time in any school and, where reunification plans are not in place, schools risk not meeting their duty-of-care obligations.

Emergency management plan template

In 2010 the MoE produced an emergency management plan template (MoE 2012) to assist schools in their planning. The template combines bullet-point suggestions of what schools should consider (e.g. how

the school advises parents and caregivers in the event of an emergency) and checklists for hazard types (e.g. Fire - ring fire alarm, call 111, if safe to do so extinguish the fire, etc.). Use of the template is voluntary.

> *We offer the tools and resources on our website. The template is a great example. But it's a horse-to-water situation. We can provide as much water* [as we like] *but we can't make them drink. And that's the same with these templates. We've made a really good template available to [schools] but it's up to them whether they adopt it.* (MoE 1)

The template is formatted to address individual emergency situations (e.g. earthquake, gas leak, violent intruder) and can be modified, allowing schools to develop individualised response plans for emergency events they may face. Planning for individual hazard types is common within the emergency management literature. However, some research (e.g. Chung *et al.* 2009, IFC 2010) advocates focusing on five core response requirements (i.e. shelter-in-place, lockdown, building evacuation, relocation and family reunification) irrespective of the hazard or emergency as each response action can be used for several emergency situations. For example, building evacuation may be the appropriate response in a fire, earthquake, chemical spill or gas leak. By focusing on the five core response requirements schools can have plans in place for any emergency they may face, without the need to develop individual plans for every hazard type.

The MoE template, in its current form, does not provide specific advice or guidance on any of the five core response requirements. Nor does it include information about planning for education continuity. Gaps within the plan template may be addressed by using other guides and documents. For example, a best practice emergency planning guide was developed by the Ministry of Civil Defence and Emergency Management (MCDEM) and the MoE (2011) for use in early childhood education services. The guide includes advice on developing plans, case study examples, checklists, templates and frequently asked questions. Much of the material in the guide is relevant for schools. In addition, the MoE practitioners suggested, where appropriate, schools get advice from other emergency management professionals (e.g. emergency services, CDEM staff in local and regional councils or private security companies). Engaging such professionals to assist schools' emergency management efforts was encouraged by Chung and colleagues (2009) in their recommendations for US schools. However, not all schools are in a position, either financially or geographically, to access external professional expertise. It is necessary for the MoE (or other agencies, e.g. CDEM) to provide schools with access to basic information to meet legislative and duty-of-care obligations.

Education continuity

International school preparedness literature (e.g. IFC 2010) indicates that the interruption of education after an emergency or disaster can lead to students having extended absences or dropping out of school, which can have negative implications for students, their families and the community. Furthermore, the re-establishment of children's routines after an emergency, in particular returning to school, can help the recovery process (e.g. Peek 2008). The MoE practitioners acknowledged the importance for family and community recovery of re-opening schools as soon as possible after an emergency event.

> *[Until] parents have some place to put the kids into school they're not going to be able to go back to work. And so there's a flow-on effect, financial and social implications… the functioning of the community as a whole.* (MoE 1)

> *It is also important for children to get back into their normal routines.* (MoE 2)

To that end, it is essential that schools plan for what will be required for them to operate, even if at a reduced capacity, after a large-scale or prolonged emergency event. Although the importance of schools planning for ongoing operations after an emergency was recognised by the MoE practitioners, no specific education continuity resources or guidelines are available from the MoE (or elsewhere) to help schools prepare. Research suggests (e.g. Peek 2008) that failure to provide for

Students and staff receive hazards education and emergency response training so they understand what to do in an emergency.
Image: David Johnston

ongoing education needs after an emergency can negatively impact student academic performance and long-term educational outcomes, especially those suffering from additional or pre-existing challenges (e.g. displacement, family instability).

One aspect of education continuity planning discussed by the MoE practitioners was the implication of using school sites to provide interim accommodation for the community after a major emergency event. A lesson learnt from the 2010-2012 Canterbury earthquakes was that when emergency accommodation becomes temporary community accommodation for an extended period it may impact on a school's capability to educate students. For example, using school buildings for community shelters means parts of the school are inaccessible to students and can create potential physical risks to students of 'unknown' people on the school grounds. In consideration of this, the MoE engaged with MCDEM to clarify how school sites may be used in the aftermath of a large-scale emergency (e.g. accommodation or welfare centres) and for how long such use might continue before schools can return to 'normal' activity. The importance of schools returning to the core business of education after a disaster or large-scale emergency is a priority within the CSS literature (GADRRRES 2014). Clarification by the MoE of how schools may be used after an emergency will aid schools in planning for the continuity of education.

A well-developed emergency plan can influence how school officials manage a crisis in the short-term and can affect how schools recover in the long-term (Smith *et al.* 2001). However, developing emergency plans is only part of an effective response. Students and staff need hazards education and emergency response training to implement the plans (Heath *et al.* 2007).

Hazards education and emergency response training

Hazards education

In-roads have been made within the New Zealand education system for the inclusion of hazards education programs in schools. These local efforts have been recognised in the international disaster resilience education literature (e.g. Ronan 2014). The 'What's the plan Stan?' (WTPS) teaching resource was developed in 2006 by MCDEM (updated in 2009) to incorporate hazards education in primary and intermediate school curricula. The WTPS resource contains lesson plans, fact sheets and classroom activities. In addition, WTPS includes basic information about the emergency management obligations of school boards of trustees and offers simple guidelines for conducting emergency drills and practices.

To date no complementary resource has been created for use in secondary schools. Hazards education is not specified within the New Zealand secondary school curriculum and though opportunities exist for the inclusion of disaster-related education within the social sciences (i.e. Years 9 and 10 social studies and Years 11 and 12 geography) and in science (i.e. Years 9 and

10 geology) (Taylor & Moeed 2013). However, inclusion is at the discretion of individual teachers and as such, it is possible for students to complete their secondary school education without exposure to hazards education programs. It was a recommendation of the WREMO practitioner that every student receives some hazards education:

> *… just some very basic education around natural hazards and what they could do to get prepared in their own household. Just one lesson a year would be sufficient. You could get enough into one lesson I think.* (WREMO)

In addition to providing students with information that allows them to take an active role in their own safety, hazards education research (e.g. Ronan *et al.* 2015) has identified positive benefits for families. By promoting home-based preparedness with students and staff, schools can encourage the development of family response plans that support the school's emergency management efforts and community-wide resilience.

Emergency response training

Schools are required to ensure staff and students are provided with the information and training necessary to implement the school's emergency response plans (MoE 2016a). As part of their health and safety professional development program (MoE 2016d) schools must provide staff and students with training in emergency procedures (e.g. identifying types of emergencies, evacuation procedures, location and use of emergency equipment). The health and safety guide for schools provides limited information identifying what should be covered in training programs, potential penalties for non-compliance and which external agencies (e.g. WorkSafe New Zealand) can provide further advice. As with other aspects of school-based emergency management (e.g. plans and drills) specific guidance and standard operating procedures ensure all schools have the training elements in place to meet their legal obligations.

New Zealand research examining school experiences of emergency events recognises the important role that the principal (Tarrant 2011) and staff (Education Review Office 2013) play in helping students and families respond to and recover from traumatic incidents and emergency events. To assist schools in managing traumatic incidents the MoE developed a guide for crisis management teams within schools (MoE 2016b). In addition, the MoE traumatic incident team offer incident management training. The only New Zealand study to ask schools about the use of the traumatic incident training (Renwick 2012) found that only a quarter of schools (255 out of 1020) had been invited to participate in MoE training programs on managing traumatic incidents. However, 'many' schools did indicate a desire to access additional support including professional development or training in managing emergencies and traumatic incidents.

School hazards education programs are invaluable in providing students with information about how

School children practice the 'turtle' as an alternative safety behaviour for when they cannot 'drop, cover, roll'.

Image: David Johnston

to prepare at home and keep themselves safe in emergencies. Supporting such programs with regular emergency response training in drills reinforces learnings and allows schools to test response procedures.

Emergency response drills

All New Zealand schools are legally required to conduct fire evacuation drills (NZ Government 2006). Drills for other emergencies (e.g. earthquakes, lockdowns) are also recommended (MoE 2016a). All three practitioners interviewed acknowledged the importance of schools conducting regular (at least once per term) emergency drills as a way of helping staff and students to respond effectively in real emergencies. The MoE practitioners indicated that internal surveys conducted by the Ministry asking schools about the drills found that some schools were undertaking additional drills to those required (e.g. drills for someone suffering from anaphylactic shock or school bus accidents).

Lockdowns are events on which schools most often seek advice from the MoE. To help prepare, the Ministry practitioners recommended schools undertake lockdown drills, but that those drills do not necessarily need to include students, for fear of distressing them. However, research on intruder crisis drills (Zhe & Nickerson 2007) found that well-designed drills in which students are provided with support information about why they are practising such a scenario do not cause undue upset to students. Emergency drills are a fine balancing act of providing a realistic simulation that enables staff, students and visitors to know what risks they may face (Kano et al. 2007) without increasing anxiety (Johnson et al. 2014). In all cases calm and responsible school staff are vital to an effective response (Smith et al. 2001).

The WREMO practitioner recommended that schools regularly conduct emergency drills for the hazards that are most likely to affect them. However, when asked

about what specific elements drills should contain he was uncertain.

> I don't think we've thought that through actually… From an earthquake point of view, there is the drop-cover-hold aspect, carefully-exiting aspect, and evacuation-if-necessary aspect. I think that's all we've put to it for schools. But if there are other points, it would be good to know…if we are missing something. (WREMO)

As a result of previous studies (e.g. Johnson et al. 2014, Johnston et al. 2011, Tipler et al. 2016), authors have recommended specific activities be considered when planning and conducting emergency drills. For example, practising alternative safety behaviours in locations outside the classroom, requiring everyone at the school to participate in drills, identifying potential hazards along evacuation routes, accounting for everyone on site at the time of the drill and evaluating the drill including feedback from participants. Such advice would be useful for New Zealand emergency management practitioners to consider when developing standard operating procedures for response drills in schools.

The only resource available to schools to assist them plan and conduct emergency drills is a seven-page overview of simulations and drills within the WTPS teaching resources (MCDEM 2009). Renwick's (2012) review of WTPS found that 73 per cent of schools (462 out of 633) that used the emergency simulation and drills section found it to be 'useful' or 'very useful'. As the WTPS resource was only distributed to primary and intermediate schools it is uncertain what resources or guidelines, if any, are used within secondary schools when planning and conducting emergency drills.

Monitoring and compliance of school-based emergency management

Evidence of monitoring of school compliance with emergency management obligations is limited. Requirements related to school building safety are monitored through a Building Warrant of Fitness, which is renewed annually (MoE n.d.b). In addition, school leaders may be asked about the health and safety and emergency management efforts in education reviews (MoE 2016a). The MoE practitioners identified a need for preparedness benchmarks for schools (e.g. specific content to be included in emergency plans) and that any benchmarks be monitored and regularly audited. However, the absence of measures in place to monitor the effectiveness of school-based emergency management efforts is common within the education sector globally. This was recognised as a priority within DRR research (e.g. GADRRRES 2014). Without consistent monitoring of all aspects of school emergency management efforts it is difficult for governments to assess whether schools have the capabilities to cope in emergencies (Brock 2000), to ensure the safety of their students.

Conclusions

In New Zealand, school boards of trustees are responsible for the safety of the students in their care before, during, and after an emergency. Existing legislation provides the general emergency management requirements schools must meet. However, due to the ambiguity and generic nature of the legislation, there is variation in the extent of emergency preparedness activities schools undertake. Planning for both an effective emergency response and education continuity after an emergency can help reduce impacts on student safety and learning. The establishment of emergency preparedness benchmarks that schools must meet could help address deficiencies and ambiguities within the legislation. It is unrealistic to expect that every school would have access to the expertise needed to develop effective emergency response plans and procedures without additional advice and support from the MoE and, where appropriate, from other emergency management professionals. Providing schools with guidance and standard operating procedures, especially for the five core response actions (i.e. shelter-in-place, lockdown, building evacuation, relocation, and family reunification) could build consistency in school preparedness and maximise potential safety for students. Finally, the development of specific emergency management criteria within the regular school review process to monitor compliance of school legislative requirements would help schools plan for the safety of their students in any emergency event.

School emergency response capabilities are a test of preparedness activities. There is a need to investigate the experiences of how schools respond to real emergencies to determine the effectiveness of their emergency management preparedness and response.

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ABSTRACT

Effective teamwork is an important component of emergency management. However, from time-to-time teamwork may break down, particularly in a complex system like emergency management. It is important that people who have operational oversight of teams are able to detect if a team has a problem and can help the team modify its functioning. A literature review identified methods of monitoring teams from the position of operational oversight. Based on this review two methods of team monitoring were chosen for further evaluation. A preliminary evaluation study of each tool during a simulated emergency exercise suggests they both have potential. This is the first stage of an ongoing research program where team monitoring tools will be further developed using iterative design cycles of development and evaluation. In this way methods of monitoring teams from the position of operational oversight that are effective in an emergency management context can be developed.

Tools for monitoring teams in emergency management: EMBAM and TBM

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Introduction

There is increasing evidence from research in climate change and forest ecology that emergencies are becoming both more common and increasingly complex (Liu, Stanturf & Goodrick 2010). The complexity of emergencies is increasing with greater use of technology and more multi-agency responses (Owen *et al.* 2013). This is occurring in the context of increasing scrutiny of decision-making, declining volunteer numbers and financial challenges within agencies (Owen *et al.* 2016, Canton-Thompson *et al.* 2008). To meet the increasing complexity of emergency management now and into the future, the capability of people to function in these challenging environments needs to be developed. This involves developing skills and tools to help people perform their roles more effectively. This paper looks at teamwork and how to effectively monitor teams during an emergency response.

As part of their role in managing emergencies regional and state-level emergency managers monitor and adjust the activities of operational teams (Grunwald & Bearman, in press). This helps ensure that teams are functioning safely and efficiently. While team monitoring is seen as important (Conway 2016) it is often not done effectively. In many agencies there is little or no guidance on how to monitor teams from the position of operational oversight.

Effective teamwork is an essential component of providing an effective response to an emergency (AFAC 2013). However, from time-to-time emergency management teams may experience disruptions to their teamwork (Bearman *et al.* 2015). If these disruptions are not managed the team's functioning and, ultimately, their operational performance will be impaired (Comfort *et al.* 2010, Bearman *et al.* 2015). The acceptance that breakdowns will occur and need to be managed shifts the emphasis away from blaming individuals to building systems designed to anticipate and manage errors and teamwork issues (Grunwald & Bearman, in press, Reason 1990). It is important then that leaders are able to identify disruptions to team performance at an early stage and take steps to resolve them.

A review of team monitoring literature was conducted to identify methods that can be used to monitor teams from the position of operational oversight.

A brief overview of the literature review is presented to show the context for the development of the team monitoring tools.

Literature review

Method

Literature was accessed via online databases (Scopus and Google Scholar) that provide access to peer-reviewed journal articles. Articles that were on the topics of team performance, monitoring and assessment published between 2005 and 2015 were selected. The search based on these criteria yielded 195 peer-reviewed articles. In addition 78 seminal papers that were published before 2005 were included. These key papers were included in the review to clarify the origins of the measures and to contextualise the development of team monitoring.

The articles were narrowed down using specific inclusion and exclusion criteria. To be retained in the literature review the articles had to be in an area related to emergency management (such as aviation, healthcare or the military), had to report on a method that could be used by an external observer to monitor teams, had to include sufficient information to allow replication of the method and not be focused on internal monitoring by the team members themselves. This process yielded 64 articles. These articles were analysed using a thematic analysis technique to identify commonalities.

Results and discussion

The literature review showed four key ways that a person who is not part of a team can monitor and adjust the activities of that team. These methods focus on different monitoring points of a team's functioning and include:

- team outputs
- information flow
- linguistic markers
- communication, coordination and cooperation processes.

Team outputs focus on the outputs a team produces, such as incident action plans. For example, participants in a study by Grunwald and Bearman (in press) identified that if information coming from a team was missing, incomplete, duplicated or conflicted with their expectations they would follow-up to investigate whether there was a problem with that team.

Information flow is concerned with who is communicating with whom, and when. This is not concerned with the content of the communication but when that communication occurs and who the communication is between. For example, Patrick and colleagues (2006) examined patterns of team information flow during a simulated nuclear power plant emergency to identify areas to improve supervisory monitoring.

Linguistic markers are concerned with non-mission oriented components of team communication. For example, Fischer and colleagues (2007) found that teams that used communication with negative affect or exhibited a high level of disagreement performed more poorly in a simulated search-and-rescue task than other teams.

Communication, coordination and cooperation processes focuses on the content of communication, the timing of contributions by team members and the shared attitudes and beliefs of the team. For example, Wilson and colleagues (2007) identified behavioural markers for the categories of communication, coordination and cooperation based on research on high-performing teams. If a team is not showing evidence of adequate communication, coordination and cooperation processes then this is likely to indicate there is a problem.

The four approaches to monitoring teams examine different levels of detail about team functioning. Of the four approaches the most detailed and comprehensive approach to team monitoring is the communication, coordination and cooperation approach. This provides a detailed analysis of the team's behaviour based on a range of potential indicators. None of the other methods provide this level of detail. The team information flow, linguistic markers and team output approaches may reveal a problem in team functioning but only at a fairly general level. For example, if one member of the team is being neglected in the team's communication or if the team is exhibiting a high level of disagreement this indicates a problem in team functioning but not necessarily what that problem is. In contrast by focusing on the detailed level of team behaviours the communication, coordination and cooperation approach can provide a nuanced understanding of what is occurring in that team.

The four approaches also differ in terms of how easy they are to use. The level of detail provided by the communication, coordination and cooperation approach potentially makes this slow to use. Similarly, the linguistic markers and information flow approaches also require a detailed analysis that may be slow to use. In contrast, the team outputs approach seems to be easy to integrate into the ongoing emergency management activities of senior officers, which potentially makes it fairly quick to use.

Team monitoring tools: EMBAM and TBM

It is reasonable then to use a multiple method approach to monitor teams with one tool that is quick to apply providing a check on the team and a second tool that provides a detailed examination of team processes. Based on the literature review and informal discussions with end users involved in the development and testing of the tools, two methods of team monitoring were identified for further study. One method from the team output approach (quick to apply) and one method from the communication, coordination and cooperation approach (detailed examination of team processes).

Emergency Management Breakdown Aide Memoire

The first method is the Emergency Management Breakdown Aide Memoire (EMBAM) developed by Grunwald and Bearman (in press). This method is based on monitoring team outputs and networks for evidence of breakdowns. It was selected because it was the only team output method specific to emergency management identified in the literature review. EMBAM allows team outputs to be examined for missing information, conflicting expectations and inconsistency. If the information contains any of these issues, if something doesn't feel right, or if someone is not acting as one would expect, then the person monitoring the team is encouraged to investigate whether there are any issues interfering with team performance. The method also encourages people to make full use of their informal and formal networks to detect evidence that a team may not be functioning effectively. An example of the identification items in EMBAM is shown in Figure 1. EMBAM also contains five methods of resolving problems in team functioning. These are:

- delegating someone to help solve the problem
- providing additional resources
- providing mentoring
- asserting authority
- replacing people in the team.

Figure 1: What to look for when identifying breakdowns.

- Missing information: How confident are you that you have the relevant information about the incident?
- Conflicting expectations: Is the information consistent with what you would expect to be happening in that situation?
- Consistent information: Is the information you have consistent across all sources?
- Intuition: Does your gut tell you something isn't right about the situation?
- Familiarity: Is someone familiar to you not behaving in a manner you have come to expect of them?
- Networks: Have you spoken about plans and problems with key personnel recently?
- Feedback: Have you received confirmation that the tasks you delegated have been completed?

Teamwork Behavioural Markers

The second method of monitoring teams is known as Teamwork Behavioural Markers (TBM). TBM is a modified version of a set of teamwork behavioural markers developed by Wilson and colleagues. (2007) to examine teamwork breakdowns in a military setting. It was selected because it provides clear and observable components of teamwork, is based on extensive research and would be expected to be applicable to emergency management. The tool provides a list of communication, coordination and cooperation behaviours that should be observed in well-performing teams. An example of items on coordination in TBM is presented in Figure 2. TBM provides some indication of what might be going wrong in the team and provides a language to talk about teamwork issues.

Figure 2: Coordination in TBM.

- Do team members have a common understanding of the mission, task and resources?
- Do team members share a clear and common purpose?
- Are team members recognising and correcting any mistakes made by others?
- Are team members providing and requesting assistance from other team members?
- Are team members adjusting to meet situation demands?
- Are team members compensating for others?

Preliminary evaluation study

To determine whether EMBAM and TBM are worthy of further consideration, a preliminary evaluation study was conducted. An iterative design process was adopted to develop team monitoring tools suitable for use by people with operational oversight of teams during emergencies. The iterative design process involves a cycle of developing and testing team monitoring tools in close conjunction with end users. This produces tools that meet the needs of the intended users rather than making end users adapt to tools that have been developed. The development and preliminary testing of EMBAM and TBM represents the first stage of this process.

Method

The appendix from Grunwald and Bearman (in press) and a modified version of the set of behavioural markers presented by Wilson and colleagues (2007) were developed into paper-based checklists. The preliminary evaluation study was conducted during a simulated multi-agency emergency that required response teams to manage a mock aircraft accident at a small rural airfield. Four observers who were regional or state-level officers used EMBAM and TBM to consider the teamwork of their agency's personnel during the response to the simulated emergency. The observers were recruited

in advance through contacts within the agency and provided informed consent. The observers were asked about their overall impressions of the two tools, how effective the tools were for monitoring teams, what questions worked well and didn't work well and whether any of the wording needed to be changed.

Results and discussion

All observers indicated that EMBAM and TBM had potential as methods of monitoring teams from the position of operational oversight. TBM was seen as containing 'a good range of questions' and 'depending on circumstance, it could provide a good self-review tool'. However, participants commented that the TBM 'needs to be less wordy' and 'could be easier to interpret'. A number of questions (e.g. Did teams recognise when one performed exceptionally well?) were considered to be 'difficult to assess as an observer'. With 38 items TBM was also considered to be too long.

EMBAM was used slightly out of context in this study (since it was designed for use at state and regional levels rather than for direct observation of incidents) and one observer pointed this out saying it 'felt too difficult and would be better at RCC [Regional Coordination Centre] and SCC [State Coordination Centre] levels'. However, observers commented that EMBAM was 'a good tool' and is 'useful to all that are supervising or managing others'. Another comment was that the order of the resolution actions in EMBAM should be changed so that replacing a member of staff was a last option.

Conclusion

This paper identified two methods (EMBAM and TBM) that can be used to monitor and modify the actions of teams. These two methods stemmed from a literature review on team monitoring. A preliminary study on EMBAM and TBM found that both tools are worth developing further. In the next phase of this research EMBAM and TBM will be revised in line with the comments of the participants. Further development and evaluation will be conducted with end users in an iterative design cycle. In this way team monitoring tools can be developed that provide a structured way to examine how teams are functioning. This allows people to monitor and adjust the activities of teams so that disruptions to team performance don't translate into impaired performance. In an era of increasing challenges and complexity in emergency management it is important to develop tools that can help people and teams to function more effectively now and into the future.

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ABSTRACT

The Bureau of Meteorology has used the excess heat factor (EHF) metric of heatwave intensity over three warm seasons (November to March in years 2013-16) for the preparation of its heatwave severity forecasts. The EHF is a relatively recent metric, derived from two excess heat indices (EHIs). The first EHI (significance) characterises whether the three-day period under consideration is hot with respect to the historical record. The second EHI (acclimatisation) characterises whether the three-day period is warm with respect to the immediate past, specifically the preceding 30 days. Both aspects contribute to heat-health impacts on the population.

This paper describes the performance of the Bureau of Meteorology's heatwave forecasting service. A heatwave climatology for Queensland in terms of the EHF is presented across a 1958-2011 year-base period that was used in the construction of the EHF dataset. This climatology is compared with a recent period, 1986-2015, revealing higher rates of heatwave occurrence and severity in the later period.

This shift in heatwave climatology correlates with an increase in demand for heatwave services over the last decade. This has culminated in the release of the Heatwave Response Plan by Queensland Health that uses the Bureau of Meteorology Heatwave Service.

Heatwaves in Queensland

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Introduction

The Bureau of Meteorology (Bureau) has experienced a rising demand for heatwave services in Queensland. The Bureau was first approached for a heatwave service following extreme conditions in February 2004 in which 75 known excess deaths[1] occurred in southeast Queensland (Tong, Ren & Becker 2010). In January 2014, the Bureau introduced a pilot heatwave forecasting service of national scope using the EHF metric of heatwave intensity. The heatwave forecasting service is an extension of the Bureau's routine forecasting of daily maximum and minimum temperatures. The service has been used over the two warm seasons from November to March 2014-2016.

Forecasts are issued every day and comprise a set of seven maps of heatwave severity, each one valid for a three-day period. The first two maps cover periods that are partially in the past at the time of issue i.e. {the day before yesterday + yesterday + today} and {yesterday + today + tomorrow}. The last five maps comprise the actual forecasts i.e. {today + tomorrow + the next day}, {tomorrow + the next day + the day after} and so on.

The EHF is derived from two EHIs (Nairn & Fawcett 2013, 2015). The significance EHI characterises whether the three-day period under consideration is hot with respect to the typical annual cycle of temperatures at the location, while the acclimatisation EHI characterises whether the three-day period is warm with respect to the immediate past, specifically the preceding 30 days. EHF has been shown to have superior sensitivity (Scalley *et al.* 2015) to human heat-health response. The EHIs are calculated from daily temperature (DT), which is the average of the maximum and minimum temperatures in a 9am-to-9am 24-hour period; the maximum temperature typically occurring in the afternoon and the minimum temperature in the following morning. Specifically:

$$EHI_{sig} = DT_{3\text{-}day} - DT_{95}$$

$$EHI_{accl} = DT_{3\text{-}day} - DT_{30\text{-}day}$$

$DT_{3\text{-}day}$ denotes the average daily temperature across three consecutive days while $DT_{30\text{-}day}$ denotes the average daily temperature across the 30 days preceding the nominal three-day period. DT_{95} denotes the 95th percentile of daily temperature across a long reference period. Lastly:

$$EHF = EHI_{sig} \times \max(1, EHI_{accl})$$

The units of EHI_{sig} and EHI_{accl} are degrees Celsius (°C), alternatively Kelvin (K), while the units of EHF are °C², alternatively K².

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1 Excess deaths relate to the number of deaths in excess of the average number expected for the time of year and the region, based on data from other years.
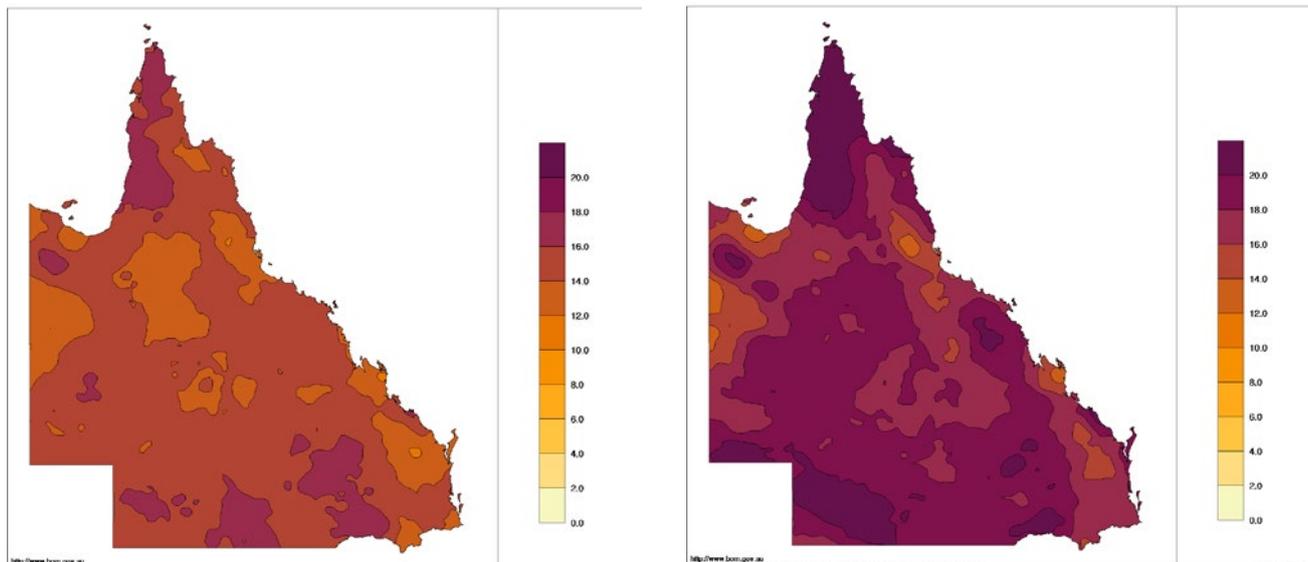
Source: Bureau of Meteorology

Figure 1: Average annual number of three-day periods with positive EHF (left 1958-2011, right 1986-2015).

Positive values of the EHF are associated with the presence of heatwave conditions; negative values with their absence. As a single EHF value is associated with a single three-day period, a positive EHF value is taken to indicate heatwave conditions across all three days. By construction, a positive EHF value only occurs when the significance EHI is also positive, with the implication that the three-day period *is* hot with respect to the typical annual cycle of temperature at the location. Thus, heatwaves defined in this way predominantly occur in the November to March period in the southern hemisphere. In order to characterise the severity of heatwaves, the 85th percentile (EHF_{85}) is taken of the EHF values associated with heatwave conditions as the threshold for a severe heatwave, and three times that severity threshold as the criterion for an extreme heatwave. Hence EHF greater than EHF_{85} implies a severe heatwave for the three-day period, while EHF greater than three times the EHF_{85} implies an extreme heatwave. The EHF_{85} threshold is likewise calculated over a long reference period. The choice of these reference periods are, in part, influenced by data availability considerations.

This paper presents a heatwave climatology for Queensland using a 54-year reference period 1958-2011. This is used in the construction of the Bureau's gridded historical EHF dataset and associated heatwave service. This is contrasted against the period 1986-2015 revealing increased rates of heatwave occurrence. Some significant Queensland heatwaves of recent decades are described followed by an assessment of the performance of the heatwave forecast service over the past three warm seasons (November to March in 2013-16).

A Queensland heatwave climatology

The dataset used is derived from the Bureau's current operational low-resolution (0.25°×0.25°) daily temperature analyses (Jones, Wang & Fawcett 2009). The description is based on calculations of the average number of heatwaves, severe heatwaves and extreme heatwaves per year. The comparison shows an increased occurrence of heatwaves and severe heatwaves across Queensland in the later period, compared with the earlier period. This change in the heatwave climatology correlates with an increase in demand for heatwave services experienced over the last decade. This has culminated in the release of the Heatwave Response Plan by Queensland Health[2], which uses the Bureau's heatwave service.

Figure 1 shows the average annual number of heatwaves (i.e. three-day periods with positive EHF) across Queensland for the two study periods. The numbers are first calculated for each individual calendar year and then the annual results are averaged. In counting the number of three-day periods, overlapping periods are counted separately. For example, a heatwave extending over four days is counted as two three-day periods, three three-day periods for a five-day heatwave and so on. In the first period, the average number of heatwaves was 14.8 per year averaged across Queensland, while in the second period it was 18.5. The spatial pattern remains fairly similar with higher numbers in the south and on Cape York Peninsula and lower numbers in between.

Figure 2 shows the average annual number of severe heatwaves across Queensland for the two study periods. The counting of severe heatwaves is done in

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2 Queensland Heath 2015, Heatwave Response Plan: an annex of the Queensland Health Disaster Plan. At: www.health.qld.gov.au/__data/assets/pdf_file/0032/628268/heatwave-response-plan.pdf.
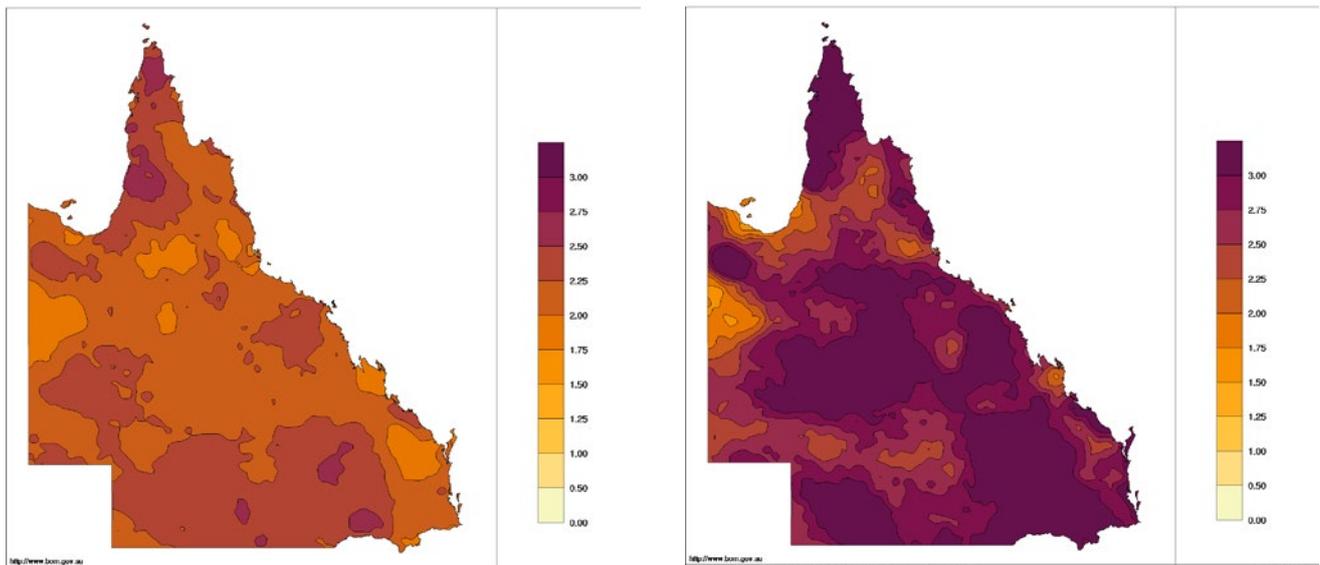
Source: Bureau of Meteorology

Figure 2: Average annual number of three-day periods with EHF greater than EHF85 (left 1958-2011, right 1986-2015).
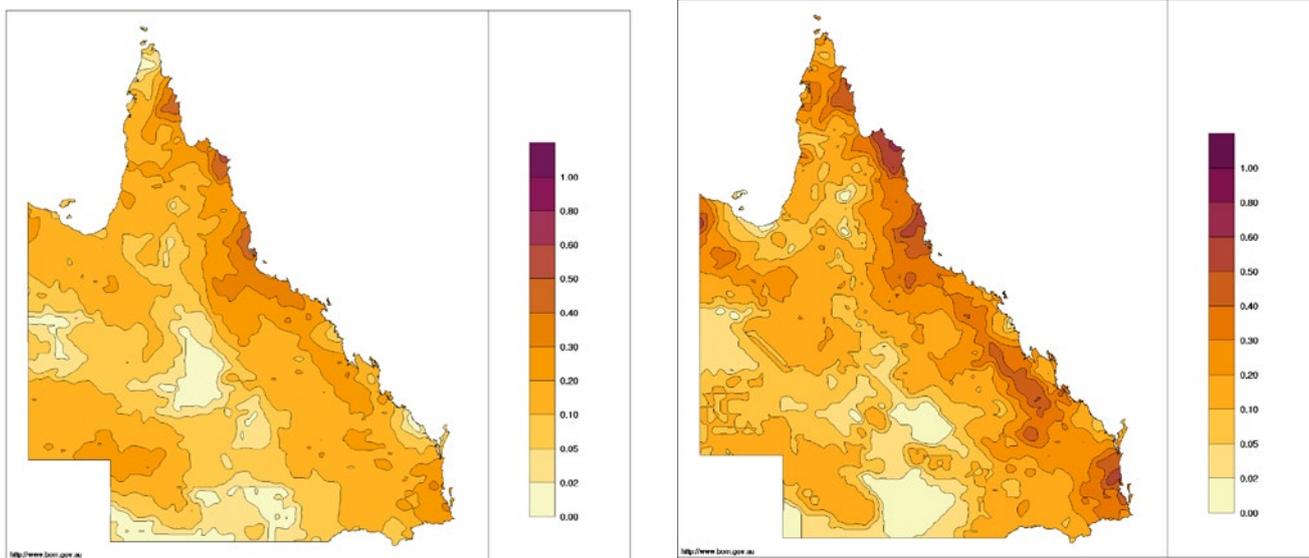
Source: Bureau of Meteorology

Figure 3: Average annual number of three-day periods with EHF greater than 3 EHF85 (left 1958-2011, right 1986-2015).

the same overlapping way as for all heatwaves. In the first period, the average number of severe heatwaves was 2.2 per year, averaged across Queensland, while in the second period it was 2.9. Over the 30 years 1986 to 2015, a substantial fraction of the state has experienced three such events per year on average.

Figure 3 shows the corresponding numbers for extreme heatwaves. Some of the highest frequencies of extreme heatwaves occur along the east coast of Queensland. In the earlier period, the average annual rate across Queensland is 0.13 events per year, with 0.16 events per year in the later period.

Some significant Queensland heatwaves

Results from three types of calculations help identify heatwave trends.

- The integrated positive EHF (e.g. Figure 4, left) involves summing the positive EHF values associated with each three-day period within the nominated month (or like period) and ignoring the negative EHF values.
- The highest EHF value for any three-day period within the nominated month is obtained and scaled with respect to EHF85 to compute a graded heatwave
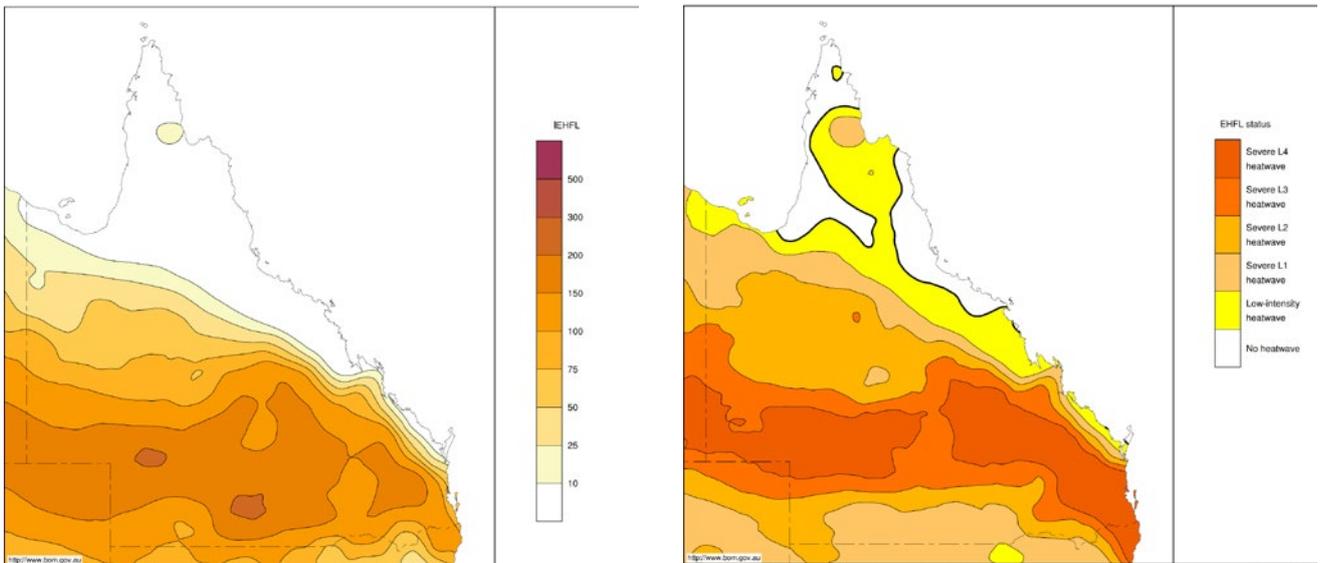
Source: Bureau of Meteorology

Figure 4: Integrated positive EHF (left) and maximum heatwave severity level (right) for December 1972.
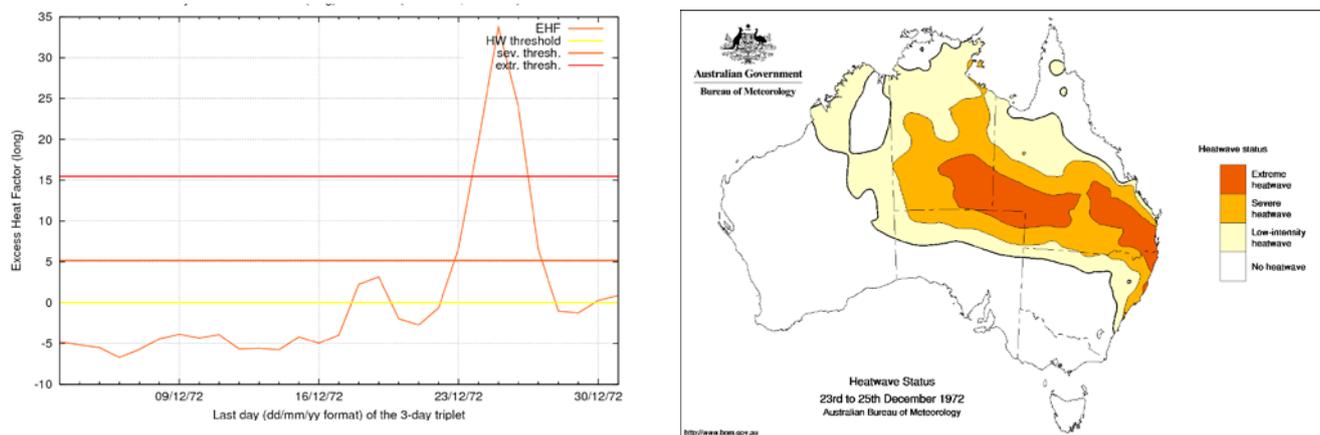
Source: Bureau of Meteorology

Figure 5: Time series of EHF values at the Brisbane Regional Office, for the three-day periods 1-3 to 29-31 December 1972 (left) and the heatwave severity map for 23-25 December 1972 (right), the three-day period that represents the heatwave peak at Brisbane.

severity map (e.g. Figure 4, right). White shades indicate no heatwave activity within the nominated period. Yellow shades indicate that some heatwave activity was analysed but it did not reach severe levels. Lighter orange shades (i.e. L1 and L2) indicate that some severe heatwave activity was analysed but it did not reach extreme levels. Dark orange shades (i.e. severe L3 and L4 as indicated in the figure key) indicate that some extreme heatwave activity was analysed.

- Time series are extracted for representative locations (e.g. Figure 5, left) by interpolating the gridded data. In these graphs, the horizontal yellow line represents the threshold for a low-intensity heatwave, the horizontal light-orange line is the threshold for a severe heatwave, and the horizontal dark-orange line is the threshold for an extreme heatwave.

Heatwave December 1972

December 1972 saw extreme heatwave activity across the southern half of Queensland at the end of a major El Niño event. A band stretching from the Queensland, Northern Territory and South Australia borders across to the coast and down towards Brisbane and the far northeast of New South Wales showed peak heatwave intensities exceeding four times the EHF severe threshold. This qualified as an extreme heatwave (Figure 4).

Extreme heatwaves in Australia normally affect multiple states and territories. Ninety-nine excess deaths were estimated across South Australia, New South Wales and Queensland (Attorney-General's Department 2016). Figure 5 shows the progression of the heatwave in Brisbane together with the national heatwave severity map at the time of the peak heatwave intensity. The heatwave exceeded the local severe heatwave threshold by a factor of six.
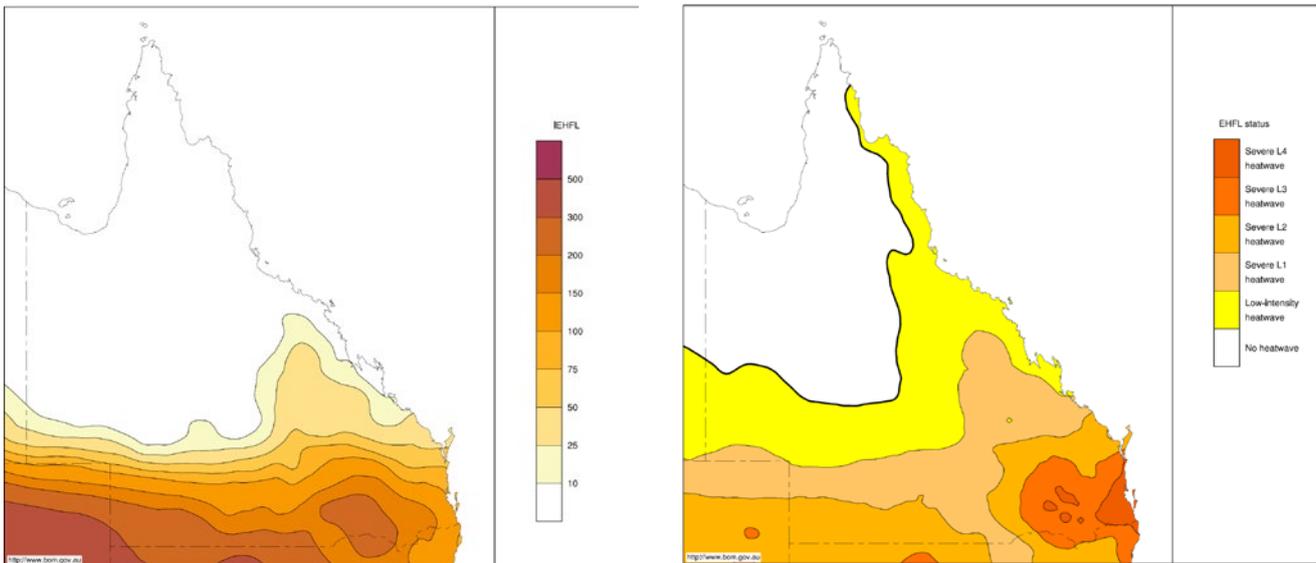
Source: Bureau of Meteorology

Figure 6: Integrated positive EHF (left) and maximum heatwave severity level (right) for February 2004.
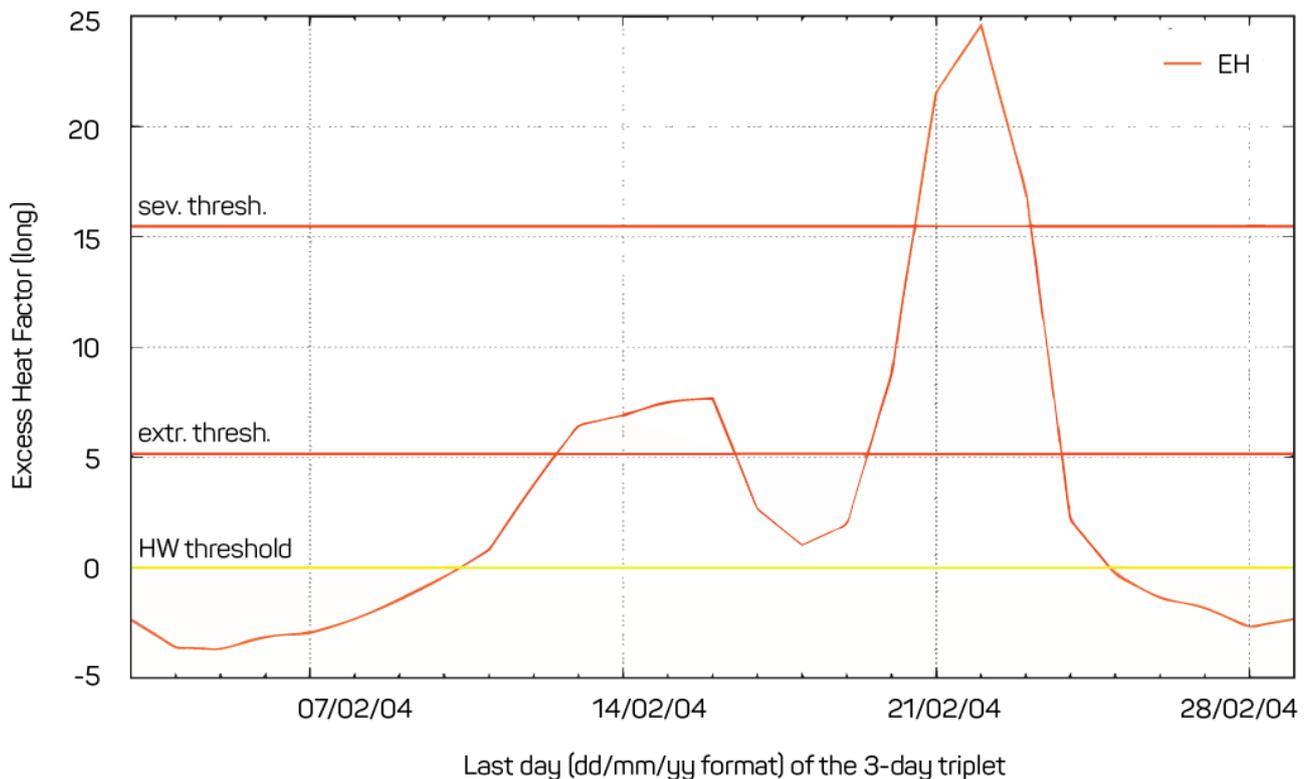

Source: Bureau of Meteorology

Figure 7: Time series of EHF values at the Brisbane Regional Office for the three-day periods 1-3 to 27-29 February 2004.

Heatwave February 2004

The peak signal of the heatwave of February 2004 was further south than that of December 1972, particularly in terms of the integrated EHF where higher values were recorded in South Australia and New South Wales (Figure 6). Even so, extreme heatwave intensities were analysed over southeast Queensland, particularly in the vicinity of Brisbane.

Modelling mortality rates due to heat stress estimated 116 excess deaths during 7-26 February 2004 in Brisbane (Tong, Ren & Becker 2010) corresponding to the location of highest heatwave severity shown in Figure 7. At Brisbane, three consecutive three-day periods (amounting to five days in total) were in the extreme range with EHF values rising to nearly five times the local severe heatwave threshold.
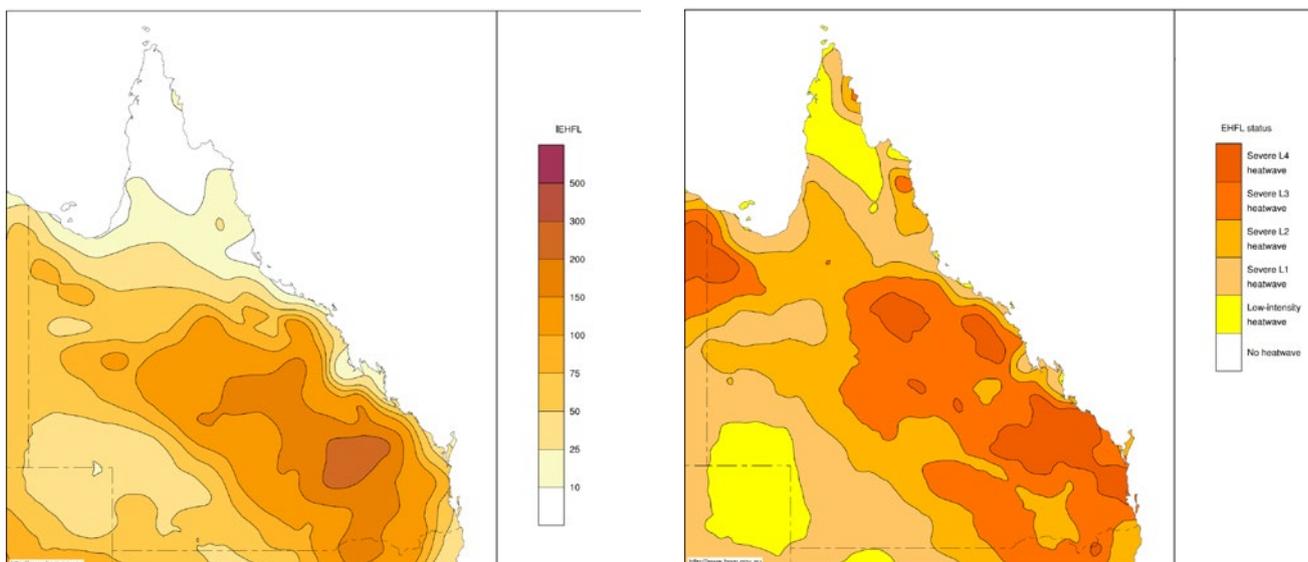
Source: Bureau of Meteorology

Figure 8: Integrated positive EHF (left) and maximum heatwave severity level (right) for late December 2013 to early January 2014.
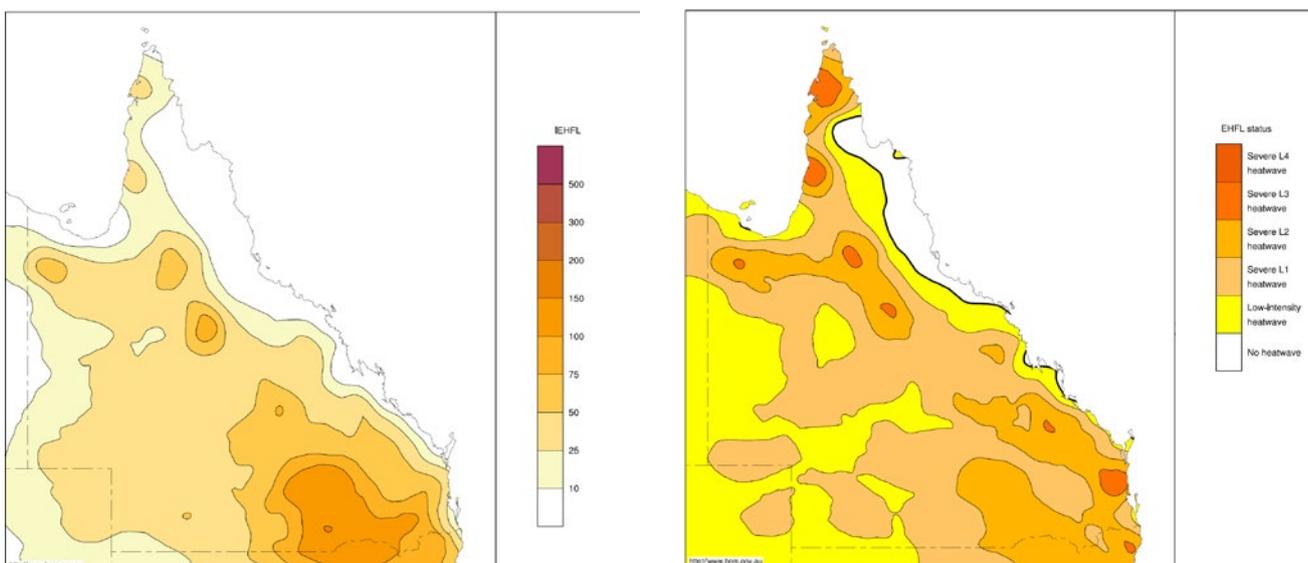

Source: Bureau of Meteorology

Figure 9: Integrated positive EHF (left) and maximum heatwave severity level (right) for November 2014.

On Saturday 21 and Sunday 22 February 2004, the Queensland Ambulance Service experienced increases in calls of 28 per cent and 53 per cent respectively throughout the south-east of Queensland. This was its busiest day on record. The Ambulance Service reported on Monday 23 February that while 'some cases were identified as specifically heat related, the bulk of calls were to people suffering from underlying medical conditions' (Queensland Ambulance Service 2004).

Heatwave New Year 2014

A heatwave peaking in the extreme range across parts of Queensland was recorded in late December 2013 to early January 2014 (Figure 8). While significant human health effects were recorded in southeast

Australia in January 2014, there is little evidence of similar effects in Queensland. This could be attributed to effective messaging and warnings to the community over the threat posed (Englart 2014) or the delay in the assessment of excess- and medically attributable heat effects. There were however, well documented impacts on colonies of flying fox in south east Queensland. An estimated 45 500 flying foxes died in 52 of the 162 colonies assessed (Welbergen, Booth & Martin 2014). This is a significant event when compared to studies by Welbergen *et al.* 2008 that showed more than 30 000 flying foxes died in 19 such events in Australia between 1994 and 2008.
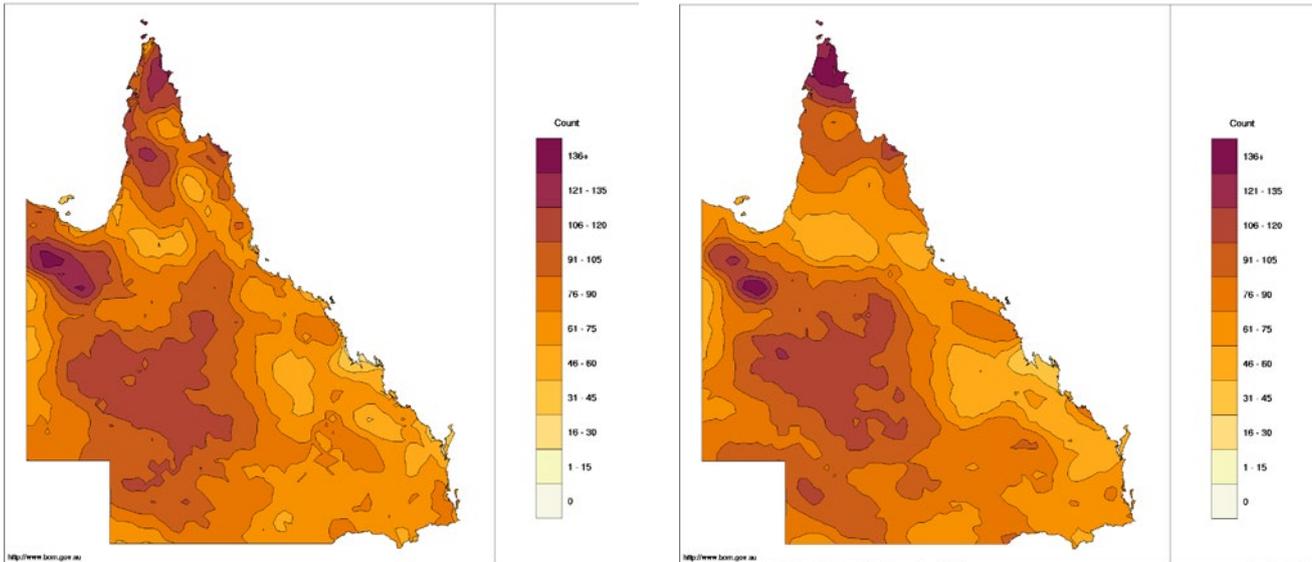
Source: Bureau of Meteorology

Figure 10: Number of heatwaves forecast at lead time 1 (left) and observed (right) in the warm seasons of 2013-2014 to 2015-2016. The heatwaves represent three-day periods with positive EHF and are not necessarily non-overlapping.
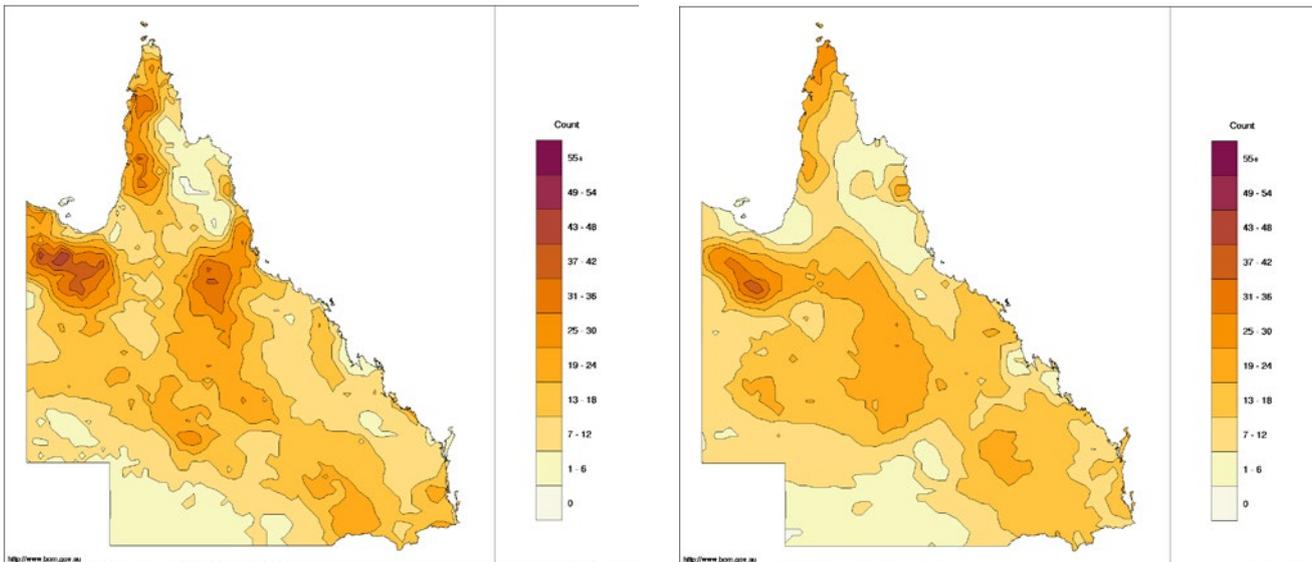
Source: Bureau of Meteorology

Figure 11: Number of severe heatwaves forecast at lead time 1 (left) and observed (right) in the warm seasons of 2013-2014 to 2015-2016.

Heatwave November 2014

The heatwave of November 2014 had its peak integrated EHF in southern Queensland (Figure 9 left). In terms of peak severity, its impact was broadly spread across the state (Figure 9 right). This event, in the middle of the month, attracted international attention because of its proximity to the 2014 G20 Conference in Brisbane.

Similar to the January 2014 heatwave there has not been any public disclosure of the effects on the population other than the discomfort for G20 conference attendees (Edwards & Eaton 2014).

Forecast performance

The Bureau began issuing national heatwave severity forecasts in a pilot service on 8 January 2014. As the forecast service had been running internally throughout the entire warm season (November 2013-March 2014), the entire warm season was used in calculations. The pilot service ran again during the warm season of 2014-2015. By the warm season of 2015-2016 the service was fully established. The forecast performance for this first warm season has been described at the national scale (Fawcett & Nairn 2015). Here, the focus is on the forecast performance across Queensland for the three warm seasons of 2013-2014, 2014-2015 and 2015-2016.
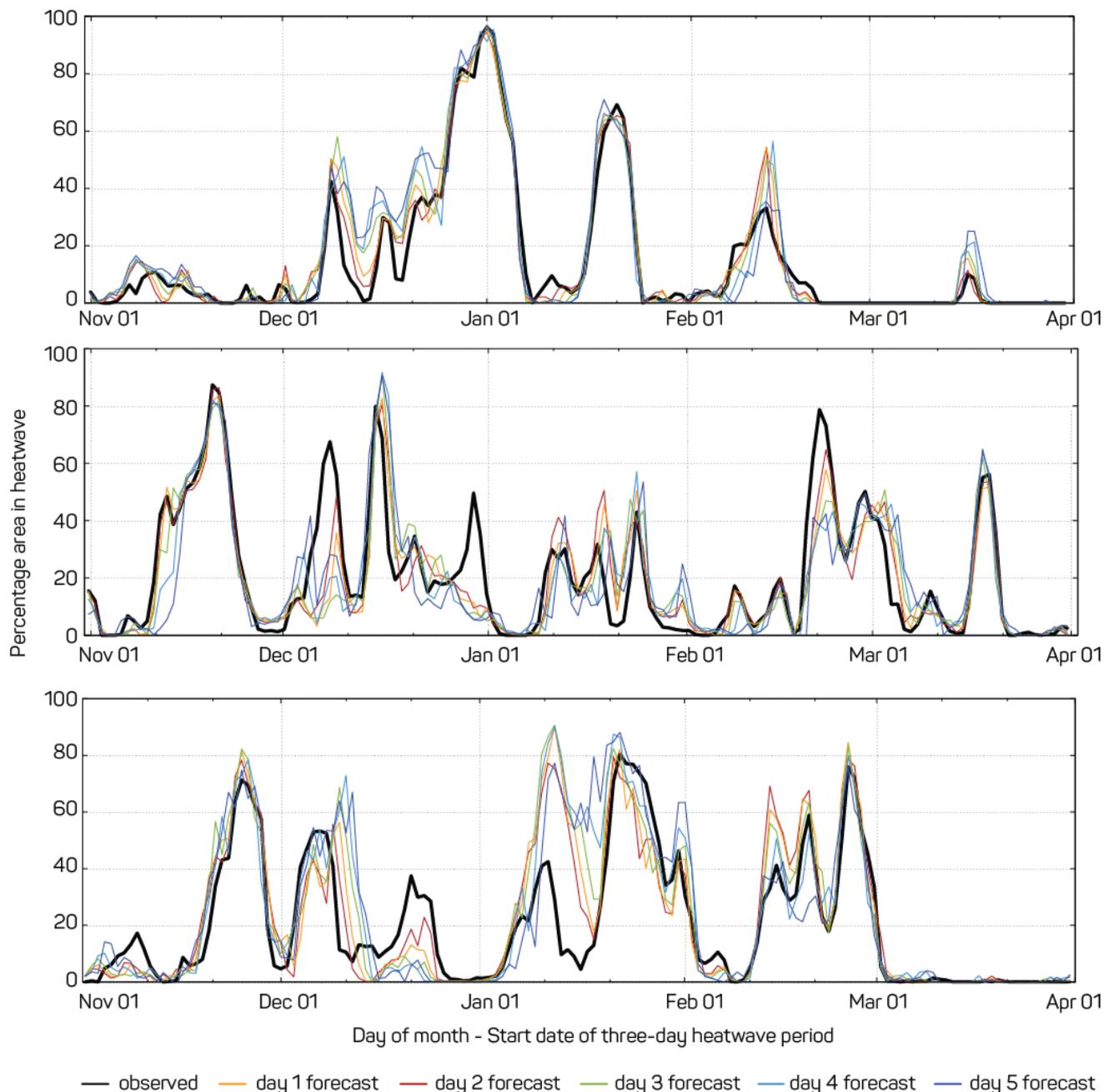
Source: Bureau of Meteorology

Figure 12: Time series of the percentage area of Queensland in heatwave for the 2013-2014 (top), 2014-2015 (centre) and 2015-2016 (bottom) heatwave seasons (November to March).

Each graph shows the percentage area observed (black lines) and corresponding forecasts (coloured lines; lead times 1 to 5). Red and orange colours denote shorter forecast lead times, blue colours longer forecast lead times.

Figure 10 shows a comparison of the total number of heatwaves (i.e. three-day periods with positive EHF) forecast at 'lead time 1' and subsequently observed across the warm seasons of 2013-2014 to 2015-2016. Here, 'lead time 1' means the three-day period forecast issued today for {today + tomorrow + the next day}. The spatial pattern of the observed events is captured in the forecasts. Across the three seasons, the state-averaged forecasting rate at lead time 1 was 85.61 events (hence an average rate of 28.54 events per season) compared with 84.0 events observed. Figure 11 shows the corresponding comparison for the number of severe heatwaves. The state-averaged forecasted rate was 14.35 events compared with 12.75 events observed.

Figure 12 shows the percentage area of Queensland in heatwave conditions for each three-day period throughout the three heatwave seasons. The percentage areas forecast to be in heatwave conditions are also shown (coloured lines). Heatwave activity across Queensland throughout the heatwave season is episodic in nature. There are periods where a large proportion of the state is in heatwave conditions over several
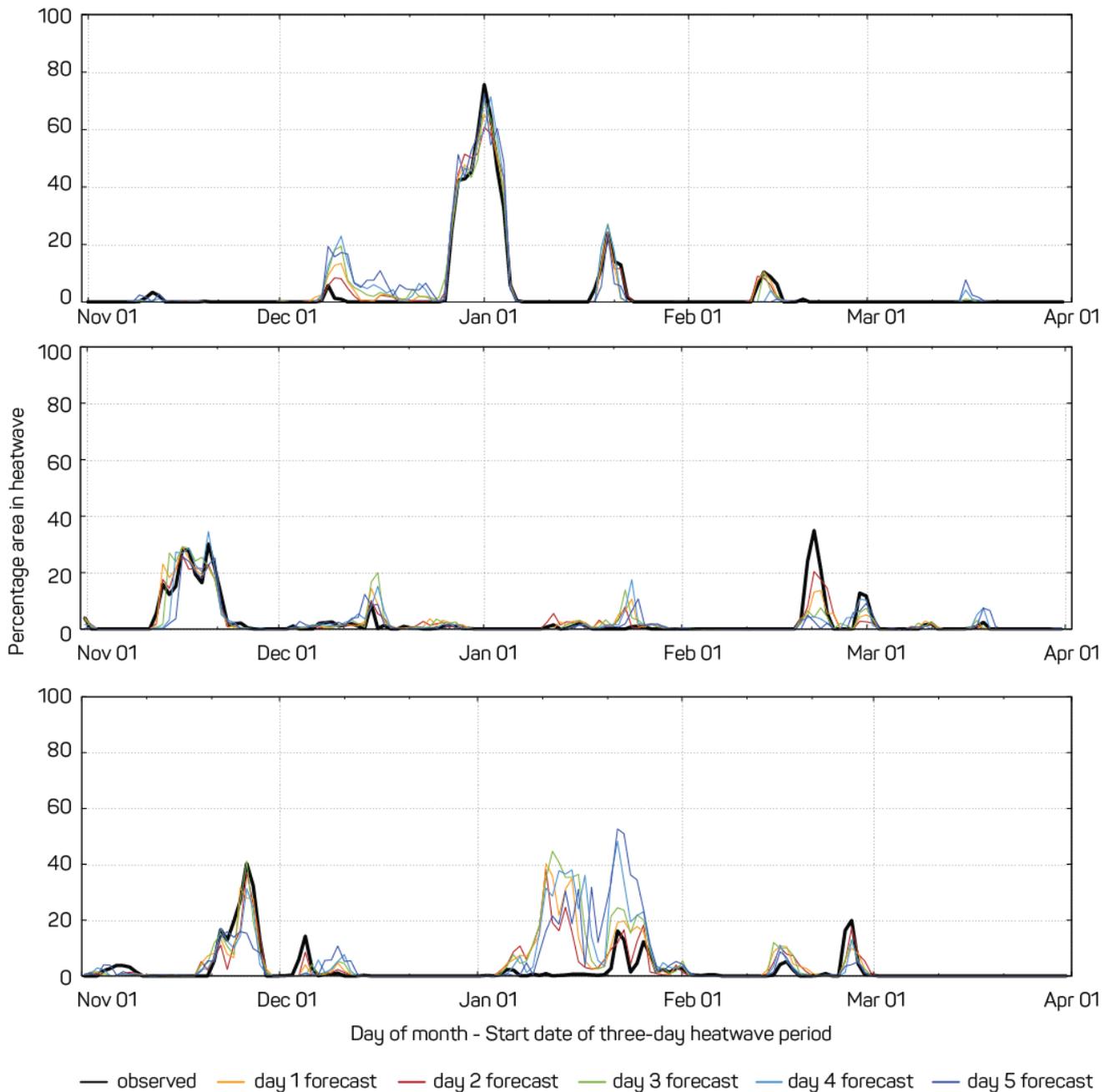
Source: Bureau of Meteorology

Figure 13: Time series of the percentage area of Queensland in severe heatwave for the 2013-2014 (top), 2014-2015 (centre) and 2015-2016 (bottom) heatwave seasons (November to March).

consecutive days, interspersed with periods when almost none of the state is in heatwave conditions.

The performance of the heatwave forecasting system in terms of the percentage area is variable. Sometimes the extent of the heatwave is forecast extremely well, as in the two largest events of the 2013-2014 season. On other occasions, substantial over forecasting (e.g. the first half of January 2016) or under forecasting (e.g. the onset of the major heatwave of November 2014) can be seen.

In terms of the percentage area of Queensland in severe heatwave, the performance of the forecast system (Figure 13) is similar to that observed. The severe heatwave around New Year 2014 was forecasted well, as was the November 2014 heatwave, although with under forecasting of the onset. Conversely, the peak intensity of the February 2015 heatwave was not captured in the forecasts, while January 2016 saw substantial over forecasting of severe heatwave activity. The poor performance in January 2016 is noticeably worse than in other cases, both for low-intensity and severe

heatwaves. Reasons for this are not clear and warrant future investigation. Still, no episode of severe heatwave activity was missed entirely by the forecasting system.

Future heatwave services

Collaborative health studies in Australia and overseas are being used to test EHF skill as a predictor of heatwave impact. In combination with the growing understanding of heatwave climatology and demonstrated forecast skill in the heatwave service the Bureau has engaged with the health, emergency services and media sectors across Australia to establish the level of support for a national heatwave warning system. Federal, state and territory representatives from these sectors were invited to a National Emergency Management Project-funded workshop in October 2016. Regional health impact studies from Western Australia, South Australia and New South Wales were presented that demonstrated EHF impact forecast skill and explored principles required within a national heatwave warning framework. Attendees agreed to augment an existing heatwave services reference group established by the Bureau to assist in the ongoing development of this framework. The work of this reference group will be reported to the Hazards Services Forum (HSF). The HSF will be the national arena for jurisdictions at the highest operational level to consider the options provided by the reference group for implementation and development. It will allow a standardised service taking into account the requirements of community and industry disciplines such as health, transport and energy sustainability.

This work will be reported to the National Review into Warnings and Information working group[3] to ensure that heatwaves information and warnings are developed within the evolving national multi-hazard environment.

Conclusion

This paper presented a climatology of heatwave severity across Queensland using the EHF metric for two periods; 1958-2011 being the period used to construct the associated gridded dataset and 1986-2015 representing the current climate. The latter period shows, on average, a higher incidence of heatwaves compared to the earlier period. Some significant recent Queensland heatwaves were described in terms of the EHF metric. Verification results were given for the performance of the Bureau's pilot heatwave forecasting service.

Development of a national heatwave warning service has growing support across health, emergency services and media sectors. A proposed heatwave warning framework would seek national endorsement through the Hazards Service Forum. Once established the Bureau would engage partner agencies in creating a national heatwave warning service.

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3 National Review Review into Warnings and Information. At: www.emv.vic.gov.au/publications/national-review-of-warnings-and-information.

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ABSTRACT

The development of the Australian Tsunami Warning System (ATWS) was in recognition of the fact that the Australian coastline faces some 8000 km of active tectonic plate boundary capable of generating a tsunami that could reach Australia in two to four hours. The work reported in this paper complements an earlier questionnaire study (Paton, Frandsen & Johnston 2010) with detailed interview data to inform understanding of respondents' awareness of tsunami risk and their willingness (or lack of) to respond to a rare but possible natural hazard. A belief that no tsunami events had occurred in Australia (at least since colonial times) and that major causes (e.g. seismic and volcanic) were absent, supported the view of participants that tsunami is a non-existent or a very low-probability hazard for Australia. This view was reinforced by the lack of discussion of tsunami by government or in the media. The ensuing sense of 'risk rejection' resulted in respondents believing that no resources or effort should be directed to tsunami risk reduction. The data raises the possibility that the ATWS may not be fully effective unless action is taken to increase tsunami risk acceptance and readiness. Recommendations for doing so draw on participant discussions of how to localise risk reduction activities. Their suggestions for increasing tsunami readiness in coastal communities included integrating it with community-based, localised discussions around frequent flash floods, coastal storms, bushfires and climate change hazards. These concepts are discussed, as well as the use of local volunteer resources to develop preparedness activities.

Community understanding of tsunami risk and warnings in Australia

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Introduction

The Australian coastline includes 8000 km of active tectonic plate boundary capable of generating tsunamis that could impact Australia (Australian Bureau of Meteorology 2008, Attorney-General's Department 2008, Burbidge *et al.* 2008, Dominey-Howes 2007). Australia has experienced over 50 recorded incidents of tsunami since European settlement (Anderson 2015).

Travel times for tsunamis from the closest sources (the Puysegur Trench, south of New Zealand, and the Java Trench, south of Java) are approximately two hours. Allowing for detection and message formation, warning times of as little as 90 minutes can be anticipated. More distant sources have greater travel times and correspondingly longer warning times. Should a tsunami occur, the at-risk population is large. For example, in New South Wales, 330,000 people live at or below a height of 10 metres above sea level and within one kilometre of the coast or a coastal river (Bird & Dominey-Howes 2006).

Recognition of the risk tsunamis pose for coastal communities prompted the development of the ATWS. However, to be effective, people must know about the system and be able to respond in planned and functional ways when a warning is received. It is essential that development of warning systems is complemented with activities that address the capability of people to respond promptly and appropriately when receiving a warning, particularly if warnings only give two hours for plans to be implemented. However, because warning systems have developed faster than community capability to respond to them, a need was identified to develop people's response capability (Bird & Dominey-Howes 2006, Bird & Dominey-Howes, 2008, Dall'Osso *et al.* 2009, Dominey-Howes *et al.* 2007, Gregg *et al.* 2007, Johnston *et al.* 2005, Johnston *et al.* 2009, King & Gurtner 2005, Paton, Frandsen & Johnston 2010). To develop people's capability to respond it is important to examine people's understanding of and beliefs about tsunami and the implications for tsunami risk communication, warnings and preparedness.

Procedure and methods

Participants were recruited through agency websites (e.g. Australian Red Cross, Surf Life Saving Australia, State Emergency Service), email invitations to coastal community groups and via social media channels. A total of 31 interviews were conducted with participants from at-risk coastal areas (e.g. below the 10-metre contour). Data was collected using semi-structured telephone interviews that facilitated an in-depth exploration of the source and nature of participant tsunami knowledge, understanding and beliefs. Interview data was analysed using thematic analysis (Braun & Clark 2002, Guest, MacQueen & Namey 2011).

Findings

Participants reflected that their knowledge of tsunami was limited. Tsunamis were generally described as a large wave event that involved a substantial body of water moving towards land, or hitting the coastline. Tsunamis were characterised as fast-moving and able to travel long distances. Only two respondents acknowledged that tsunamis slow down and increase in height when closer to the shore or when travelling through shallower water.

Participant descriptions of tsunamis as 'destructive' and 'devastating' illustrated that it is hard to conceptualise the levels of destruction that might occur and how helpless people might be. This resulted in participants having fatalistic attitudes about what people could do in the event of a tsunami. Interviewees acknowledged that the risk posed would not be evenly distributed and would be contingent on factors such as the location of the source event (i.e. the earthquake or volcanic event), the size of the tsunami, the geographical characteristics of where they lived and where they were at the time of the event. This knowledge did not, however, translate into acceptance of a need for action on their part.

Participants were unaware of the 50 recorded tsunamis that have reached the Australian coastline in the past 200 years (Anderson 2015). Their lack of knowledge of historical tsunami impacts on communities resulted in participants concluding that tsunami presented no risk or a very low risk in Australia. This view was reinforced by a belief in a lack of causal sources (e.g. sources of seismicity) and by perceptions of a lack of government and media discussion of tsunami risk in Australia.

Some participants conceded that tsunami risk may be greater than realised (a response influenced by this research). Notwithstanding, people's beliefs regarding tsunami risk prompted a collective view that attention should focus on commonly occurring natural hazard events (e.g. bushfire, flood and cyclones) and not on tsunami. These beliefs influenced people's views about warnings and preparedness.

Warnings

Except for a few participants (SES volunteers) who knew of the warning system, no other interviewees knew of the ATWS. Participants were uncertain about how they would receive a tsunami warning and the agency or agencies responsible for issuing tsunami warnings or managing the response. Participants living in bushfire-prone areas identified the police or the fire service as the responsible agency. Some thought that the Bureau of Meteorology would be the lead agency, while others commented that 'something would come up' in internet searches.

Participants had mixed views about how warnings should be disseminated. All participants agreed that warning delivery methods should include TV and radio broadcast communications. Less certainty was expressed about text message warnings, particularly regarding differences in the trustworthiness of the sources. Participants also believed that traditional media would be effective at different times; for example, radio while travelling in the car and TV in the evening.

Other methods, such as sirens on beaches and in public places (e.g. city centres) were raised. Participants discounted these because people often ignore them. Their effectiveness in directing people to evacuate the beach and head inland or vertically evacuate using nearby buildings was doubted. Some interviewees questioned whether warnings could be relayed at all, or in sufficient time. The latter views reflected criticism of the ability of emergency services organisations to get warnings out in time for other hazards (rather than because of potentially short tsunami travel times). Beliefs about tsunami presenting a non-existent risk in Australia had implications for participant views about preparedness.

Preparedness beliefs

A perceived low tsunami risk prompted participants to question the need for resources to be directed to tsunami risk management. This was reinforced by participant views about the effectiveness of preparedness for other hazards (e.g. '...if people aren't prepared for other [more commonly occurring] hazards, why should they do so for tsunami when it's less likely'). Participants did not believe this view would change unless a tsunami event occurred nearby, or there were dramatic changes to the seismic activity around Australia.

Such high levels of risk rejection mean that community engagement disaster risk reduction strategies must first develop some level of risk acceptance before communicating about warnings and preparedness. However, acknowledgement that tsunami risk may be greater than realised prompted suggestions about the content of tsunami warnings.

Anticipated warning content

The first issue identified derived from participant uncertainty about what constituted a safe distance inland or vertically. They expected a warning to inform them about the best course of evacuation action. Time constraints (e.g. if only 90 minutes) to identify where and how to get away were not considered. Furthermore, a warning may not act as a call to action.

Most participants stated that, on receiving a warning, they would first seek verification (e.g. from trusted sources like the ABC, Bureau of Meteorology or by monitoring social media). If local actionable information was included in warnings, they would be less likely to seek verification. After obtaining verification they would contact family and friends to check on their safety and determine if they had received any warnings. Only then would they evacuate themselves. No interviewee considered whether there would be time to do this (e.g. if a tsunami originated in New Zealand waters).

Consistent with this line of thinking, preparedness (e.g. evacuation planning, having a survival kit etc.) was discussed as activities they would do on receiving a warning. The inclusion of actionable information in warning messages was seen as a substitute for pre-event preparedness (though some believed their readiness for hazards like bushfires would be applicable for tsunami).

Participants identified that warnings need to contain several pieces of information. These include:

- what areas were likely to be affected by the tsunami event
- what actions people should take
- how long until the tsunami arrived (at each specific coastal location)

- where to evacuate to (e.g. location of evacuation centres in each area).

At the very least, warnings should direct people to 'get to higher ground'. Participants indicated that such actionable information would guide people's response in the event of a tsunami.

Participants believed that generalised (i.e. region-wide) information would lack local specificity and so hinder action. This prompted suggestions that warnings should include information tailored to specific locations (e.g. local maps, evacuation routes, designated safe places and evacuation centres etc.). No interviewee commented on how this would be accomplished. Developing localised tsunami risk information for every settlement over some 8000 km of coastline would be prohibitively expensive. Some recognition that tsunami may pose a threat prompted discussion about how tsunami risk management may be advanced.

Developing tsunami risk management activities

Participants discussed a need to develop community understanding of tsunami risk through active engagement between agencies and communities. This should focus first on providing detailed information about Australia's tsunami exposure and the implications for preparedness and warnings (e.g. discuss tsunami risk in coastal communities using local maps, the magnitude of events, travel times, warning times etc.). Participants emphasised the need to focus on local implications of tsunami risk. They suggested that planning would be improved by discussions of tsunami risk management with those associated with other regularly occurring coastal and ocean hazards.

Using local maps should be part of community-based planning for a tsunami.
Image: New South Wales State Emergency Service

Discussion and recommendations

Australia has a well-developed tsunami warning system. This study highlighted a lack of community awareness of the ATWS, a high degree of tsunami risk rejection and a lack of specific tsunami hazard preparedness in coastal communities. Participants argued that no effort or resources should be directed to tsunami preparedness. Instead, they suggested that the warning process itself should provide information on local actions and preparedness.

Low warning times makes such an approach untenable. For events with 90 minutes warning time, there would be insufficient time to receive a warning, identify evacuation routes, and decide and act. Additional factors, such as stress while decision-making and traffic congestion might slow people's decisions and actions.

The findings that people reject risk reiterates those from an earlier study (Paton *et al.* 2010, see Figure 1). In the absence of community capability to accept risk and an ability to respond promptly and appropriately on receiving a warning, the effectiveness of the warning system is significantly muted. The findings suggest that the ATWS may not be fully effective without a community risk awareness and readiness program to support it.

Facilitating tsunami warning effectiveness requires effort in developing awareness and risk acceptance. While tsunamis were generally identified as being fast-moving and able to travel long distances, only two respondents acknowledged that tsunamis slow down and increase in height when closer to the shore or travelling through shallower water. Community-based, systematic discussion of tsunami characteristics and behaviours should be included in community engagement programs

run by agencies (e.g. State Emergency Service). Community engagement programs should include information on the source of tsunami warnings and the roles of agencies. Communities should be informed of other sources of information to develop their knowledge and inform their planning. This could include *Tsunami: The ultimate guide (see* Anderson 2015).

Preparedness could be facilitated by integrating tsunami preparedness into an 'all-hazards' process. Participants suggested this could be done by encouraging people to talk about tsunami alongside comparable and other relevant events, such as storm surge education, beach erosion, sea level changes (related to climate change) and bushfires. The short tsunami warning times associated with tsunami events are analogous to a common phenomenon, flash flooding (defined by the Bureau of Meteorology as occurring within six hours of storm rainfall, but often within less than two hours). Integrating tsunami warning response by building on flash flood warnings is an example of a possible all-hazards approach to facilitating tsunami preparedness.

The findings of this study identify a need to counter prevailing levels of risk rejection and develop risk acceptance by increasing community awareness of the existence of tsunami exposure. The existence of fatalistic beliefs stemming from the perceived devastation tsunamis could create makes it important to develop actions people can take to help them deal with tsunami consequences (i.e. develop positive outcome expectancy – see Figure 1).

Community-based, local planning is essential to accommodate the diversity in needs, goals, capabilities and expectations that exist. The use of local maps is an important component of an education strategy. This would involve agencies supporting community initiatives
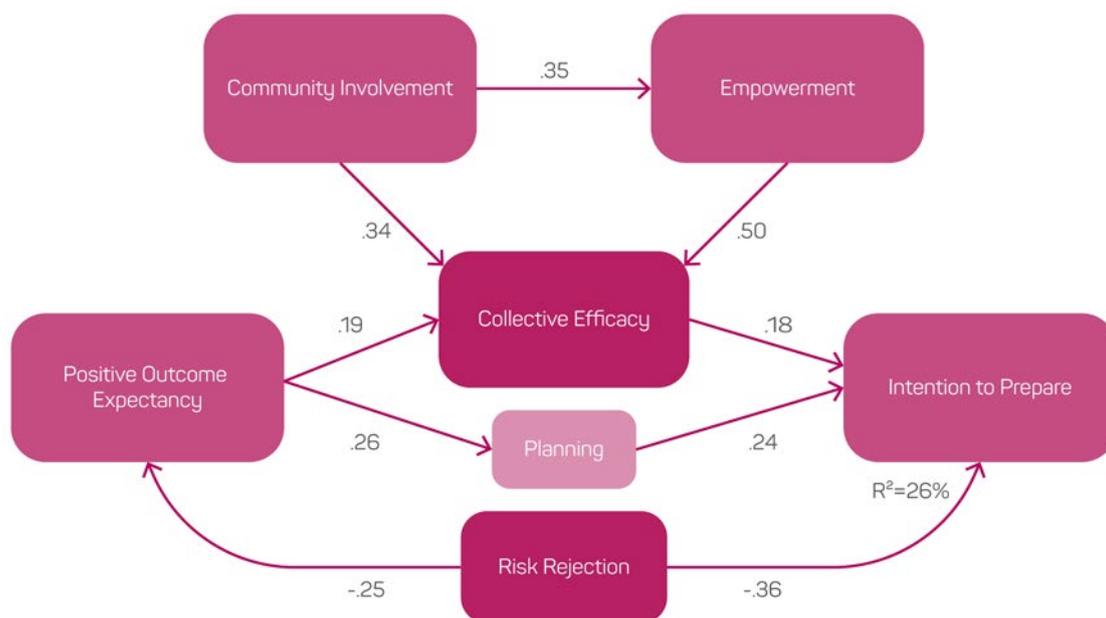

Figure 1. The influence of risk rejection and community engagement in tsunami readiness (adapted from Paton *et al.* 2010).

NSW SES personnel speaking with people about the tsunami risk in their local area.

Image: New South Wales State Emergency Service

rather than developing local plans *per se* (which would be prohibitively expensive). Strategies for doing so could capitalise on work on effective community engagement practices for other hazards (e.g. Paton, Kerstholt & Skinner, in press).

A theme that emerged was that community-based discussions positively influence risk acceptance and preparedness. This is consistent with other findings (Paton, Frandsen & Johnson 2008, Paton *et al.* 2010) that identified that tsunami risk management should be based on community engagement and empowerment strategies.

The findings of this study and those of Paton and colleagues (2010) highlight the value of people discussing tsunami risk and readiness and for agencies (e.g. SES, Surf Life Saving Australia, Coast Care) to work with community members and groups to provide the information and resources they need to advance their planning. Community members should define local needs and appropriate local solutions (develop collective efficacy – Figure 1).

Localised community engagement is an important medium for sharing information between agencies and community groups (Paton *et al.* 2008, Paton *et al.* 2010). While it would be prohibitively expensive to develop local information for all coastal communities around Australia, it may be more cost-effective to engage with local communities and to facilitate their involvement in developing their local knowledge, plans and activities. There is evidence to support the view that strategies that engage people in ways that empower them to identify and deal with local issues (e.g. to mirror the action of the community participation, empowerment and collective efficacy factors shown in Figure 1) can

increase levels of community preparedness (e.g. Paton, Kerstholt & Skinner, in press). This view is reinforced by the finding that, for some participants, the interviews acted as a motivator for developing knowledge of tsunami risk. A key issue here concerns the availability of the human resources required to facilitate the development of local approaches. Agencies such as the SES, Surf Life Saving Australia, Australian Red Cross and Coast Care can draw on a substantial volunteer resource to facilitate this process. The inclusion of several agencies in this process increases the range of groups and community members that can be reached (e.g while Surf Life Saving Australia may be able to access beach users, the SES and Red Cross may be more effective at targeting others). Employing multiple agencies in this way allows greater opportunities to tailor tsunami risk management information and actions to the needs of diverse groups and community members. If this idea is pursued it will be important to ensure that all agencies provide the same information and adopt comparable community engagement practices to ensure consistency in the core messages provided. It may be beneficial to complement these hands-on approaches with effective communication activities that support community engagement strategies.

Conversations via social media were described as a useful way to support community discussions over time (Dufty 2012, Watson 2012) and facilitate community-based disaster risk reduction activities. The value of doing so is reinforced by findings that social media-based discussions can develop people's sense of community, with the latter contributing to increasing the uptake and use of risk information (e.g. Paton & Irons 2016).

The findings in this paper indicate a general lack of awareness of tsunami risk. This was due to the infrequent nature of major tsunami events and a consequent disregard for any need to manage the associated risk. Tsunami preparedness is essential to realise the benefits afforded by Australia's highly advanced ATWS system.

The findings in this paper indicate a general lack of awareness of tsunami risk. This was due to the infrequent nature of major tsunami events and a consequent disregard for any need to manage the associated risk. Tsunami preparedness is essential to realise the benefits afforded by Australia's highly advanced ATWS system.

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ABSTRACT

In December 2015 bushfires devastated the coastal Victorian towns of Wye River and Separation Creek, challenging the provision of effective defendable space. This paper uses observations from two cases to describe and comment on the activities that can occur within defendable space areas established for bushfire risk reduction. It focuses on the activities taking place immediately before, during and after bushfire events. The paper commences with a general description of defendable space, its objectives, its terminology in the Australian context, and the mechanisms of its regulation. Examples from the Wye River and Separation Creek 2015 Christmas Day fire events are used to raise design-related challenges associated with effective defendable space provision. The paper particularly focuses on challenges in difficult or unusual contexts, such as settlements with unusual pre-existing lot and road patterns or steep slopes. It is argued that a clearer understanding of these challenges and activities will allow for effective and responsive design of defendable space by urban designers, urban planners, architects and landscape architects.

Activities in defendable space areas: reflections on the Wye River-Separation Creek fire

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Introduction

On Christmas Day 2015, bushfires devastated two Victorian coastal towns: Wye River and Separation Creek. Although the weather conditions in which the fire occurred were estimated at FDI 49, within the Very High (or lower level of Severe) rating, it was considerably less than the FDI100+ Catastrophic category that the regulations address. This raises questions regarding the impacts of the fire including the destruction of 116 houses and other damage that occurred in the two towns (Victorian Government 2016). It has been acknowledged (Leonard *et al.* 2016) that the main reason for these structural failures related to the quality of housing stock and the specific nature of the location as well as the upkeep of the structures and their surrounds. This fire event demonstrates that simply following regulations relating to bushfire-resistant structures may be insufficient and that more attention should be given to the characteristics of the spaces surrounding dwellings and settlements. To understand the nature of defendable space around dwellings, a description of defendable space is provided.

A variety of studies in this field discuss the relationship between defendable space and structures, focusing on structure integrity (Syphard, Brennan & Keeley 2014). Other studies analyse the role of residents and their influence on the various elements within the space (Nelson *et al.* 2004). To complement the literature, this paper demonstrates the purposes and potential uses of defendable space immediately before, during and after fire events, emphasising activities during events. The diagrams developed illustrate the use of this space at different stages of fires. They provide a visual aid to demonstrate the importance of planning and designing defendable space, acknowledging that some challenging sites might call for measures that go beyond the standard approaches set out in planning and building regulations. For example, existing settlements might have small distances between structures and it is highly unlikely that owners will voluntarily rebuild or remove their houses prior to an event. In addition, it might be not possible to provide adequate, defendable space due to topographical limitations or lot size. However, it is generally possible to modify vegetation located in the immediate vicinity of structures, or to educate residents about improved building design, maintenance and use of spaces.

Table 1: Terminology and particularities of defendable space used across Australia.

State	Description
ACT	The *Strategic Bushfire Management Plan 2014-2019* identifies areas at risk through mapping Bushfire Prone Areas, within which Fire Management Zones prioritise fuel management and access activities, and more specifically on urban edge apply Bushfire Abatement Zones.
New South Wales	An APZ is an area that 'provides an environment in which a person can undertake property protection after the passage of a bush fire with some level of safety'.
Northern Territory	Planning controls and regulations refer to the *Bushfires Management Act NT*[1] where land is within a Fire Protection Zone and requires a firebreak. The Act sets a minimum firebreak as four metres around houses, caravans, structures, stationary engines, bulk fuels, haystacks, cordwood or stacked sawn timbers on the land. More specific distances depend on uses and are specified in the NT Planning Scheme, which refers to the *Planning Act*.
Queensland	The Queensland Fire and Rescue Service relies on residents and businesses in bushfire-prone areas to have relevant bushfire protection measures in place. These include APZs that provide defendable space for firefighters, adequate access to water for firefighting and emergency management arrangements that are prepared and practiced to minimise the demand and impost on incident management.
South Australia	Regulations specify defendable space as a 20-metre area around structures where vegetation should be treated to reduce potential fire fuel. Placed within the APZ, it acknowledges to a certain extent the use of space before, during and after the fire front passes is provided.
Tasmania	Policy divides fuel management areas into two zones (BPZ and FMBZ) with a minimum clearance of 30 metres. The BPZ cannot be less in width than specified for the dwelling.
Victoria	Defendable space is defined as 'an area of land around a building where vegetation is modified and managed to reduce the effects of flame contact and radiant heat associated with a bushfire'.
Western Australia	The BZP is a 20-metre area that must be cleared of flammable objects and vegetation.

Sources: ACT Government 2014; Bushfire Planning Group 2005; Department of Fire and Emergency Services 2016; Department of Transport Planning and Local Infrastructure 2014; Northern Territory of Australia 2014, 2016; NSW Rural Fire Service n.d.; Queensland Fire and Rescue Service 2016; South Australian Country Fire Service 2010.

Defining defendable space

The terminology of defendable space in Australia differs across states and territories (see Table 1). For example, in NSW it is known as the Asset Protection Zone (APZ) (NSW Rural Fire Service n.d.) and in Western Australia the Building Protection Zone (Department of Fire and Emergency Services 2016). Aside from terminology, these zones differ in size and treatments required. South Australia, for example, specifies a 20-metre treated buffer between the main structure and potential fuel loads (South Australian Country Fire Service 2010). Tasmanian services divide defendable space into two zones: building protection zone (BPZ) and the fuel modified buffer zone (FMBZ) (Bushfire Planning Group 2005). Victoria previously used a similar concept, but referred to them as outer and inner zones (Department of Planning and Community Development 2012). The Department removed outer zone requirements in July 2014 to ease restrictions for planning and building permits (Government of Victoria 2014).

Table 1 shows that despite local differences in terminology and specifications, the concept, purpose and contents of defendable space are similar across Australia. Thus, defendable space is a specified area around primary structures, which aims to reduce bushfire risks through the modification, treatment or removal of fuel sources, provision of adequate roads sufficient for evacuation and firefighting exercises, earthworks (where appropriate) and water sources for active fire defence (Figure 1). This definition suggests a number of elements within the space that must be addressed for its meaningful use. Some of these elements, such as movable structures or temporary constructions, might not be immediately apparent as risk factors, but must be accounted for when defendable space is being planned and managed. For example, Western Australia partially addresses this by requiring all flammable materials be in non-flammable cages a minimum of 20 metres away from the building envelope.

To address these elements it is important to understand how defendable space is created, as well as its purposes and activities that occur within the space. From the perspective of the built environment, a clear understanding of these elements allows for the challenges of managing bushfire risks to be addressed.

Regulations and permits for defendable space are issued under urban planning policies in the first instance. It should be noted that processes to determine a Bushfire Attack Level under building regulations are based on

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1 *Bushfires Management Act NT*. At: https://denr.nt.gov.au/land-resource-management/bushfire-information-and-management/bushfires-act-nt.
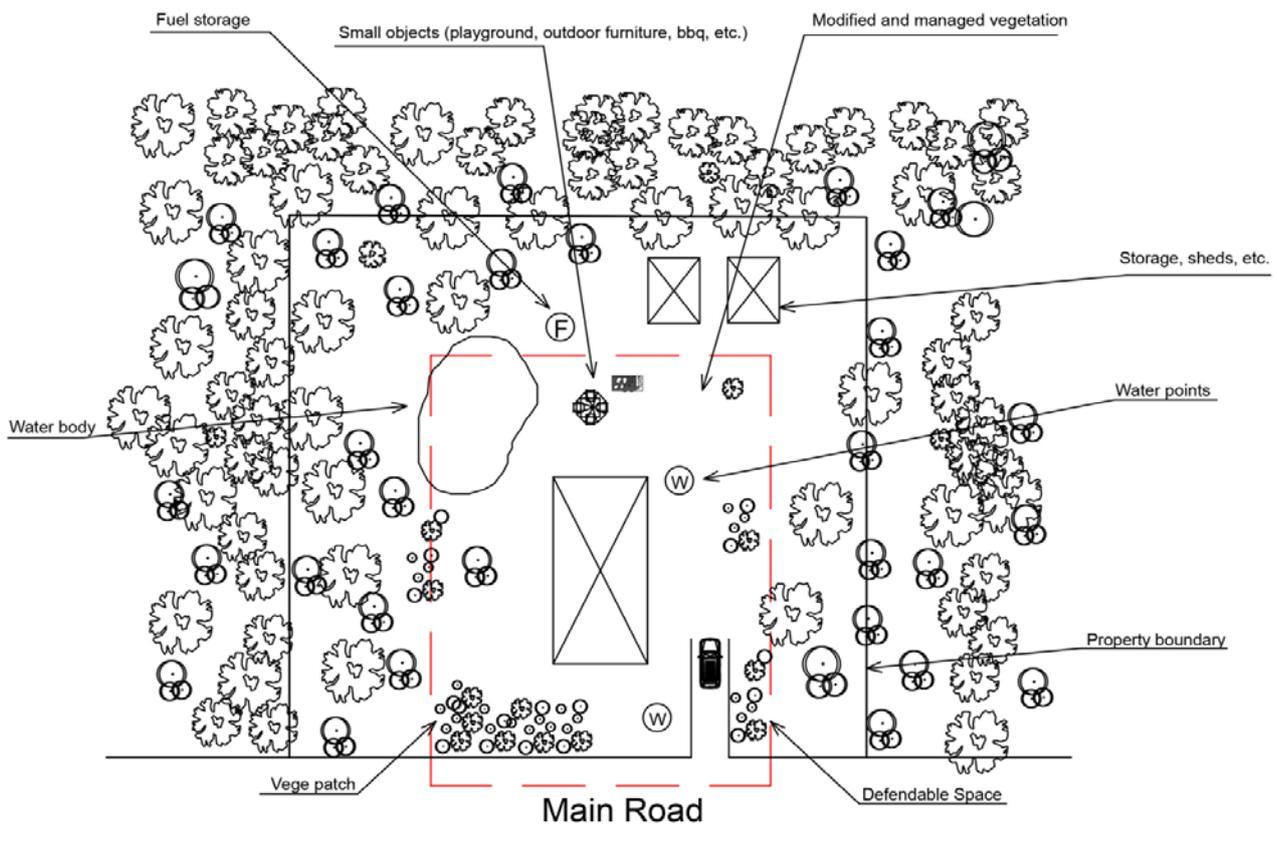
Figure 1: A diagram showing generic defendable space around a property.

separation from fuel sources that subsequently act as defendable space areas. The primary tests for determining the distances for defendable space are provided by Building Code AS3959, incorporated into planning schemes that provide additional detail relating to the design and regulation of this space. In some cases, owners might seek advice from accredited consultants. Building codes also regulate externally attached structures and outbuildings in some cases (e.g. terraces, decks and sheds).

Augmenting the resistance of structures

The use of defendable space is divided into activities. This paper is divided into activities immediately before, during and after fire events. It is acknowledged that activities undertaken outside the bushfire season can significantly impact defendable space, such as gardening and building maintenance regimes.

Separation from the heaviest fuel loads

The main purpose of defendable space is to provide *separation* (regulated as horizontal distance in metres) between structures and fuel loads that generate heat,

Figure 2: A typical house with human-made and natural fuel sources in Wye River.

Image: Maria Kornakova and Alan March

embers, potential direct flame contact and tree strike. As can be seen in Figure 2, such fuels include natural and human-made sources. Natural fuels refer to vegetation that can be modified, treated or removed to achieve risk management outcomes depending on the context and other regulatory requirements of the area. Modification of vegetation refers to landscaping and choice of species. In fact, some fire-resistant species can be used as partial shields for structures (CFA 2012). Treatments include tree or vegetation removal, clearing of under-canopy bark and shrubs and removal of understory vegetation to reduce the possibility and intensity of ground fires and reduce the intensities that could sustain crown fires. Human-made fuels refer to small structures on site, movable objects, motorised vehicles, external house-use objects (e.g. doormats and furniture), incidental fuel sources (e.g. gas vessels) and storage areas (e.g. under-house storage). These may be regulated to minimise their negative impacts.

As demonstrated in the Wye River and Separation Creek fires, place-specific conditions may pose some challenges to the separation of houses from fuels. For example, a reliance on bottled gas and wood for heating, which are often stored immediately adjacent to or under structures, can potentially be additional fuel sources. This could be addressed by adopting regulations similar to those in Western Australia. It is worth noting that trees can also pose risks from tree strike caused by strong winds and fire (Figure 3). The steep topography of the area requires construction of stilt-type houses, often with understories. These understories are typically open to the environment and are often used for storage, including combustible materials, which can easily become fire transmission points.

Problems associated with achieving sufficient separation from fuels can be addressed by using shared or collective defendable space. This occurs when a number of properties, usually designed in conjunction, share space that separates the structures from fuel sources. This can be achieved when several property areas establish defendable space sufficient to cover other sites, or if boundaries of neighbouring properties are within specified areas for risk treatment (Figure 4). However, problems can occur with shared use such as potential lack of maintenance or future changes of land use and development if not regulated to ensure it exists in perpetuity. This may be complicated by questions of maintenance responsibilities and multiple ownership.

Passive defence

Passive defence occurs when structures are not actively defended or when active defence ceases because firefighters or residents defending the property have to leave or seek shelter, possibly in the structure itself. In addition, what can be referred to as 'incidental passive defence' might occur when surrounding properties are defended and the firefront does not reach a property or its effects are significantly reduced. Activities might be the removal of combustibles from neighbouring properties that would propagate a fire (e.g. removal of a boat with petrol tanks on a shared boundary or aerial water drops that slow the passage of a fire on a critical front). Passive defence depends not only on the fuel loads within the space itself, but also on the integrity of structures and the elements that modify risk levels (e.g. gutters filled with water or doormats removed). It should be noted that ember attack may occur well in advance of, or without a firefront, and effective passive defence is key to mitigating such risk.

Active defence

Active defence occurs when firefighters, residents or neighbours defend a structure from ember attack or firefronts using water, earthworks (e.g. using farm or roadwork equipment or removal of key fuels) or simply beat out fires. Challenges here can be associated with initial access to structures (including internal spaces


Figure 3: A house on Wallace Street, Wye River damaged by tree strike caused by fire.

Image: Maria Kornakova and Alan March
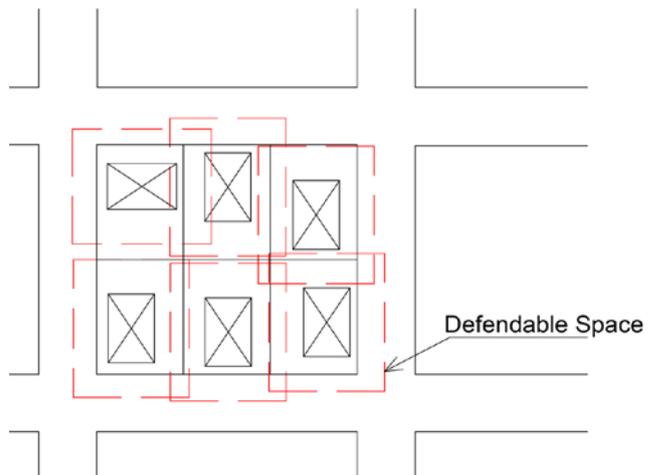
Figure 4: A schema for shared defendable space where properties adjoin each other.

such as roof cavities) and access to all sides of structures. Building Code AS3959 incorporates slope as an input for calculating the separation distance required from key fuels (acknowledging that this assumes a 20° slope maximum) but is expressed as a horizontal distance and it is depicted on plan view drawings that ignore whether or not there is capacity to actively defend in these areas. For example, as shown in Figure 5, steep slopes behind or around a structure limit accessibility. The plan view (Figure 6) suggests that all requirements might not be met if a simplistic approach to assessment were taken. Therefore, there is a need to actively seek alternative solutions and interventions, particularly to deal with complex sites. Other impediments to active defence include fences, locked gates preventing access between or within small structures, such as sheds, or objects left behind by residents.

Public roads are often part of defendable space and can play an important role in providing separation between fuels and structures. They also provide important access points for firefighting purposes. A key challenge with including roads as part of defendable space is the potential difficulties associated with their use in active defence in particular settings. For Wye River and Separation Creek, Figure 7, taken in the recovery phase, demonstrates how the terrain prevented road construction suitable for safe use by fire trucks. In this case, the slope of the driveway does not allow access to the structure even though road widths adhere to standards.

Secondary fuels and transmission

The statutory basis of defendable space in existing settlements tends to be developed on an individual site or lot basis, enforced via building and planning permits. These often ignore surrounding structures and conditions on neighbouring land and the quality and defendability of neighbouring structures are not addressed. Wye River and Separation Creek examples show how defendable space can fail to fulfil

requirements in respect of nearby structures on separate lots. Figure 8 shows how the majority of houses on some streets in Wye River were destroyed, probably by house-to-house ignition (Leonard *et al.* 2016). While existing house stock might not immediately and easily address defendable space requirements under existing planning regulations, alternative solutions include locating houses with consideration of the local environment as part of ongoing planning processes. Defendable space should not be analysed and seen exclusively as part of an individual structure alone, but rather it should be placed within larger rural or urban patterns and be part of the long-term change management process.

When structures fail

Activities occurring within defendable space areas may be commenced or recommenced after a firefront passes. It might be used as a refuge by its residents or active defenders after a structure fails and is no longer habitable or when retreat from a firefront is required. Occupants may use the space to fight residual fires, preventing the structure from burning after the main fire front has passed. Obviously, this activity is possible only when there are no significant fires within the defendable space itself. A second condition for safer refuge is a lack of hazardous structures or trees in the proximity.

Conclusions

The potential to facilitate important risk reduction activities in defendable space areas is dependent on appropriate design and planning exercises. There is a need to improve understandings of the range of activities undertaken within defendable space so that building planning and construction achieves risk management goals. The limitations of defendable spaces and design solutions should be clearly understood by firefighters and building design professionals so they may seek
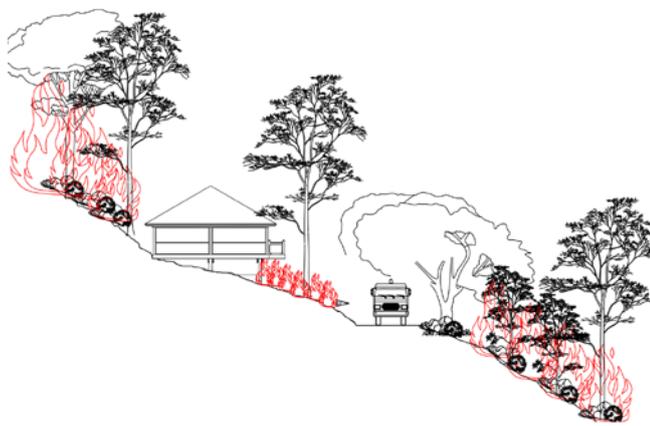
Figure 5: A schematic section of a defendable space in steep terrain at the active defence stage.
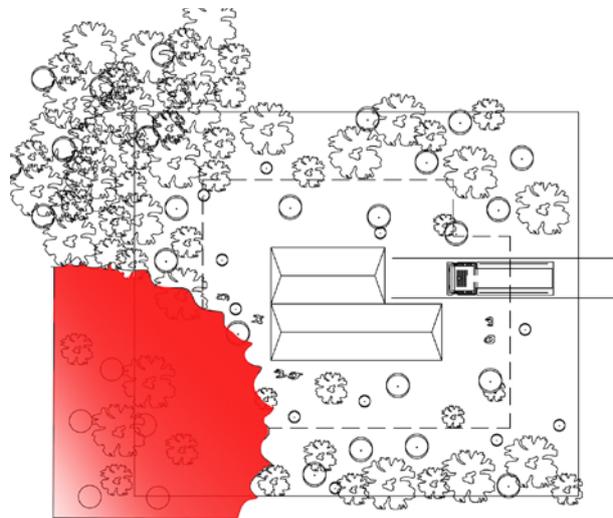
Figure 6: A plan view of defendable space at the active defence stage.

Figure 7: A typical road pattern in Wye River that prevents the easy access to property by fire trucks.
Image: Maria Kornakova and Alan March
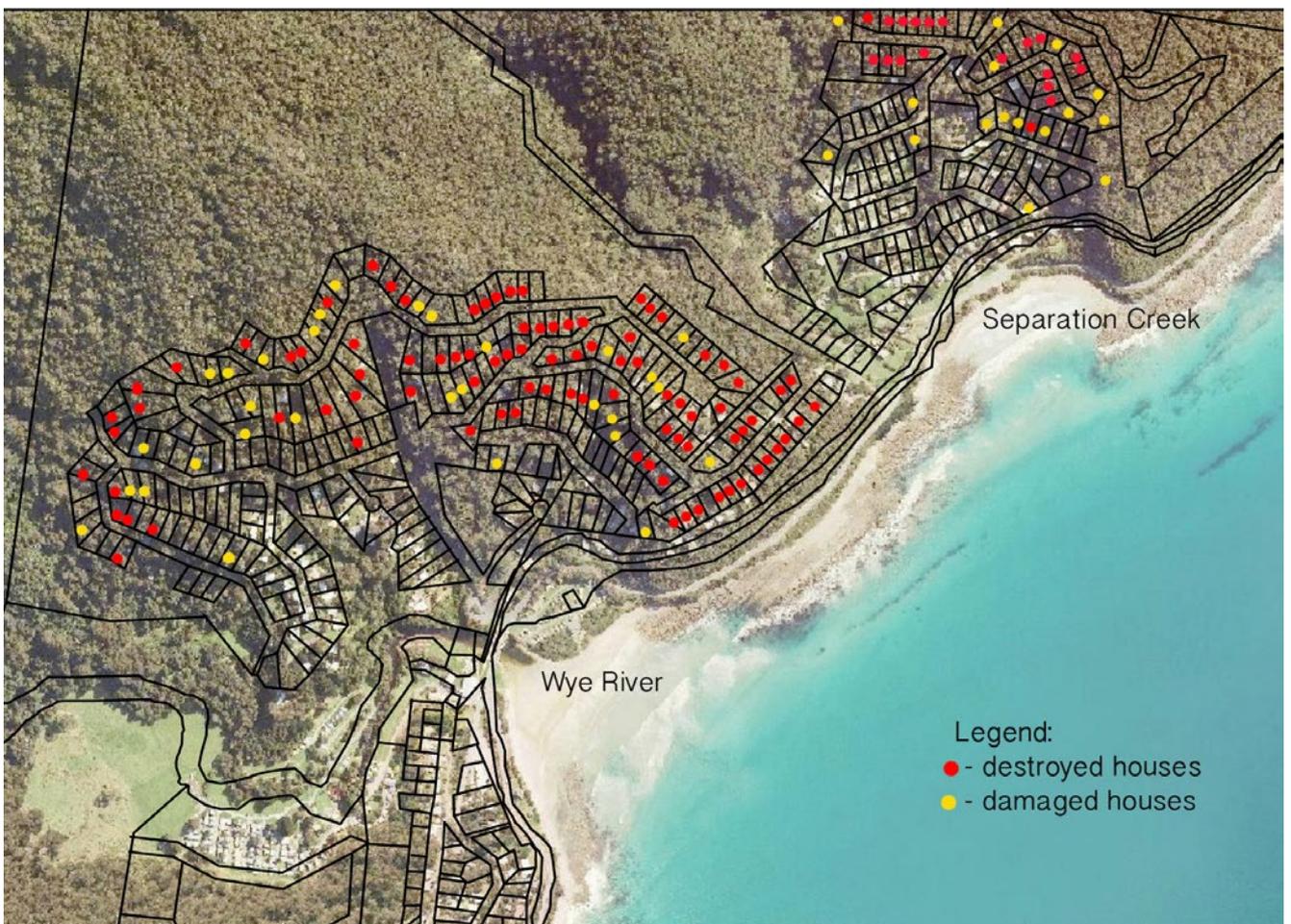
Figure 8: Map of destroyed and damaged houses in Wye River and Separation Creek (based on Leonard *et al.* 2016).

alternative ways to address risks. Reconsideration of some aspects of existing policies and regulation is also required.

The examples of Wye River and Separation Creek are indicative of regulation having a tendency to view space as two dimensional and on a site-by-site basis. Rather, regulation needs to consider the particular characteristics and wider environmental settings of sites, both natural and human-made. Urban planning and urban design have tools and mechanisms to address the challenges that could be integrated with bushfire risk measures. For example, coordinating a dwelling's building envelope on lots to ensure maximum distances between structures can be used as a successful technique. However, alternatives must be sought in collaboration with other disciplines.

This paper considered the purpose of defendable space. There is a need to further investigate use of this space by residents and officials times when there is no need for active fire defence. This will address such challenges as storage of combustible or hazardous materials storage and placement of incidental fuel sources.

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