

Highlights and Achievements + a year in review 2018-2019

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HAZARDSCRC





Australian Government
**Department of Industry,
Innovation and Science**

Business

Cooperative Research
Centres Programme

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Bushfire and Natural Hazards CRC

November 2019



All photographs are credited to the Bushfire and Natural Hazards CRC unless otherwise noted.

Cover: Bushfire and Natural Hazards CRC research has won multiple awards.

Additional photos: CRC Association, Australian Academy of Science.

Page 2: Bushfire and Natural Hazards CRC research is discussed in a wide variety of formats and locations.

Additional photos: Bev Sithole, Australian National University, Geoff Cary, Avianto Amri, Liberty Pascua.



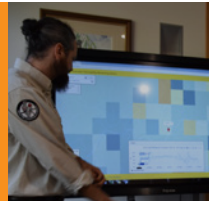
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Dr Neil Burrows from the WA Parks and Wildlife Service presents a keynote at the 2018 Research Forum in Perth.





2018-2019

ABOUT US

The Bushfire and Natural Hazards Cooperative Research Centre conducts a multi-disciplinary research program on the major national issues across the natural hazards spectrum. The CRC is a partnership of all Australian and New Zealand fire, land and emergency service agencies; more than 30 universities; plus many federal, state and local government departments; professional and volunteer associations; and, non-for-profit organisations.

From mid-2013 and backed with \$47 million over eight years from the Australian Government plus contributions from its member organisations the CRC has been undertaking research that supports the development of cohesive, evidence-based policies, strategies and programs to build a more disaster resilient Australia.

Our vision is to be the preferred and trusted source of research and knowledge in bushfire and natural hazards.

National research

The Bushfire and Natural Hazards Cooperative Research Centre is conducting research to build a disaster-resilient Australia.

Across all natural hazards

The CRC coordinates a national research effort in hazards, including bushfires, flood, storm, cyclone, heatwave, earthquake and tsunami.

Developed by members

The research program has developed under the direction of the researchers and end-user agencies.

To be used by our members

Now in its seventh year of operation, researchers and end-user partners are working closely together to ensure that the research is embedded into the planning, policies and operations of partner organisations, and into the development of new research projects.

For the benefit of the Australian community

The centre draws together all of Australia and New Zealand's fire and emergency service authorities with the leading experts across a range of scientific fields to explore the causes, consequences and mitigation of natural disasters. This combined effort is helping to build disaster resilient communities across Australia.



A COLLECTIVE APPROACH



Dr Richard Thornton
Chief Executive Officer
Bushfire and Natural Hazards CRC

This *Year in Review 2018-2019* shows how the CRC is continuing to expand its engagement with partners, and others, to ensure the research has a strong presence in mitigation planning, operational use and recovery. We have taken significant steps towards strengthening the use of research across the sector by working with end-users and partner agencies and assisting them to use and operationalise the research.

Research outcomes across the natural hazards have become vital to emergency services agencies, government departments and others within the sector. At the Bushfire and Natural Hazards CRC we have contributed strongly to this national demand by driving a collective approach to natural hazards science based on the requirements of our partners.

Our research on communications and warnings, fire behaviour, volunteerism, mitigation and policy development, just to name a few, is helping emergency services agencies, governments and communities across Australia to better plan, prepare, respond and recover from natural hazards.

Together with our partners, we are working towards a more disaster resilient Australia. This is your natural hazards research centre. We hope you will help us deliver for the community through your active involvement in the research.



Dr Josh Whittaker (University of Wollongong) and Dr Paula Dootson (Queensland University of Technology) with their Emergency Media and Public Affairs awards.



EXECUTIVE SUMMARY



Anna-Maria Arabia, CEO of the Australian Academy of Science, presents a keynote at the 2018 Research Forum in Perth.

ACHIEVEMENTS

The reporting period covers the sixth year of the Bushfire and Natural Hazards CRC's eight-year funding period. The focus for the period was on the delivery and utilisation of valued research outputs to partners. Strategically, attention turned to consolidating impacts of the research program and assessing options for future natural hazards research.

The primary activities have been:

Reviewing centre operations, governance, and research quality and progress

Delivering utilisation opportunities

Bringing together researchers, partners and

broader stakeholders through a calendar of events, conferences and workshops

Building the capacity of the sector through postgraduate research and mentoring

Establishing national research priorities for natural hazards emergency management

Developing options beyond this funding period to transition to an ongoing research centre.

The conduct of active research and data gathering across all projects and postgraduate work was reinforced by outputs including:

- 12 book chapters
- 56 journal papers
- 34 refereed conference papers
- 85 reports for end-users

Outputs from the research themes are being used across nine impact areas:

- Policy and political engagement
- Fire predictive services
- Managing the landscape
- The value and economics of mitigation and recovery
- Disaster resilience
- Education, communications and emergency warnings
- Extreme weather forecasting and impact reduction
- Future workforce
- Critical infrastructure and lifelines

Research outputs were also shared and developed in the following collaborative ways:

- Bringing all end-user and research organisations together at five Research Advisory Forums, in Brisbane, Darwin, Canberra, Melbourne and Sydney
- Hosting the Bushfire and Natural Hazards CRC - AFAC Conference in Perth in September 2018, which included a full day Research Forum

- Hosting the 12th Australasian Natural Hazards Management Conference in Canberra in June 2019
- Hosting the 6th International Fire Behaviour and Fuels conference, with the International Association of Wildland Fire, NSW Rural Fire Service, Bureau of Meteorology and NSW Office of Environment and Heritage, in Sydney
- Managing commissioned research projects directly for individual partners and other clients on specific issues
- Managing a Tactical Research Fund to address strategic issues for the sector
- Managing a Quick Response Fund to support researchers travelling to areas affected by natural hazards to capture perishable data

APPOINTMENTS

Following an extensive recruitment process the Board appointed Dr Katherine Woodthorpe AO FTSE FAICD, as the new Independent Chair in March 2019. She replaced Dr Laurie Hammond, the founding Chair of the Bushfire and Natural Hazards CRC, who passed away in late 2018.

Dr Woodthorpe brings to the CRC a wealth of experience in innovation and research across many sectors, including the Cooperative Research Centres program. The then-acting Chair, Prof Alistar Robertson, welcomed Dr Woodthorpe and highlighted her extensive experience in leadership and management and as a professional director.

He said "Her knowledge of the research and innovation sector will be of tremendous use as the Bushfire and Natural Hazards CRC completes its current research agenda and looks further towards an ongoing role in natural hazards research."

Prof Alistar Robertson, Commissioner Craig Lapsley, and Dr Paul Smith resigned from the Board of the CRC in this period.

EXECUTIVE SUMMARY

COLLABORATION OPPORTUNITIES

A multi-hazard focus presents opportunities for the CRC to continue to increase the scope of its collaborations and research links. This is evident in several ways, and includes:

CRC and AFAC Conference

The CRC conducted its annual conference in Perth in conjunction with the AFAC18 conference. Around 400 people attended the Research Forum and more than 370 posters were on display from CRC researchers and students. General feedback about the forum was very positive and evidence of the CRC's influence and research use was distinct throughout the following two days. Discussion has now switched to how collaboration with agencies is assisting with the work being used, rather than just discussion of research progress.

National Institute

The Australian Institute for Disaster Resilience continued a partnership between the CRC, AFAC, the Australian Red Cross and the Department of Home Affairs during this reporting period. The Institute was formed to deliver products and services around Australia that have been developed by, and for, the emergency management sector. Knowledge is a core component of its role, with the CRC leading the drive through the *Australian Journal of Emergency Management*, the Knowledge Hub website and a series of events.

National Framework

The CRC was actively engaged during the year with the National Resilience Taskforce, working collaboratively to develop and release the National Disaster Risk Reduction Framework. This taskforce, announced by the Prime Minister in late 2017 and being led out of the Department of Home Affairs, engaged with stakeholders from early 2018 until the

Framework was rolled out across the sector from early 2019.

United Nations International Strategy for Disaster Reduction

The CRC is the national coordinator for a United Nations-backed committee that promotes and supports disaster risk reduction research programs and activities around the world. This Integrated Research on Disaster Risk National Committee for Australia is sponsored by the United Nations International Strategy for Disaster Reduction, the International Council for Science and the International Social Science Council.

Several researchers are in prominent roles, including Prof John Handmer who is Chair of the Scientific Committee. The CRC hosted a public forum in Adelaide for the UN International Day for Disaster Reduction on 12 October 2018.

National Research Priorities

The National Research Priorities for natural hazards

emergency management were extended this year with the inclusion of research for the electricity networks. This latest set of priorities joins a broader national research agenda in natural hazards emergency management that was the culmination of an extensive series of workshops with end-user stakeholders and other relevant groups to explore major issues across hazards, resilience and the community. Leading the latest priorities with the CRC were S&C Electric Company and Energy Networks Australia.

Workshops in different sectors have, over the past two years, identified the critical issues that could be addressed by research. Most are conducted in collaboration with organisations that are major representative stakeholders, including AFAC and the Bureau of Meteorology. The priorities were considered and noted by the Council of Australian Governments' Australia-New Zealand Emergency Management Committee in June 2017. They were drawn upon to influence the refreshed research program of the CRC.



Research posters on display at the CRC and AFAC 2018 annual conference in Perth.

EXECUTIVE SUMMARY



Dr Katherine Woodthorpe accepts the CRC Association Excellence in Innovation Award 2019 with Dr Katharine Haynes (Macquarie University/University of Wollongong), Prof Vivienne Tippet (Queensland University of Technology) and Stuart Ellis (AFAC). Photo: CRC Association.

AWARDS

CRC excellence

The CRC Association awarded the CRC with its highest award for the CRC sector, the 2019 Excellence in Innovation Award. This was awarded for the life-saving work by CRC researchers at the Queensland University of Technology and Macquarie University about changing how warnings for hazards and emergencies are worded, timed and targeted.

Led by Prof Vivienne Tippet (Queensland University of Technology) and Dr Katharine Haynes (Macquarie University and the University of Wollongong), the collaborative research groups have combined to equip emergency service agencies around Australia with better-targeted long-term public safety

campaigns, as well as evidence-based warning messages delivered to at-risk populations in the face of imminent natural hazard threats.

Emergency awards

The Emergency Media and Public Affairs conference in June 2019 presented two awards to the CRC. The 2017 NSW bushfires community preparedness research by Dr Josh Whittaker (the University of Wollongong) and Dr Mel Taylor (Macquarie University) won the Excellence in Research award, while the conflicting cues research out of Queensland University of Technology by Dr Paula Dootson, A/Prof Dominique Greer, Sophie Miller and Prof Vivienne Tippet was highly commended. Dr Whittaker and Dr Haynes, both at the University of Wollongong, won the Judges Choice award,

alongside Liam Mannix from *The Age*, for their article on lessons from the 2009 Black Saturday bushfires.

CRC recognition

Three CRC researchers were recognised for their extensive and thorough contributions to natural hazards science at the CRC's annual conference in Perth.

Dr Mel Taylor (Macquarie University) was presented with an award for her outstanding research on managing animals in disasters. Agency warnings now contain community reminders to consider pets and farm animals in the lead up to bushfire season.

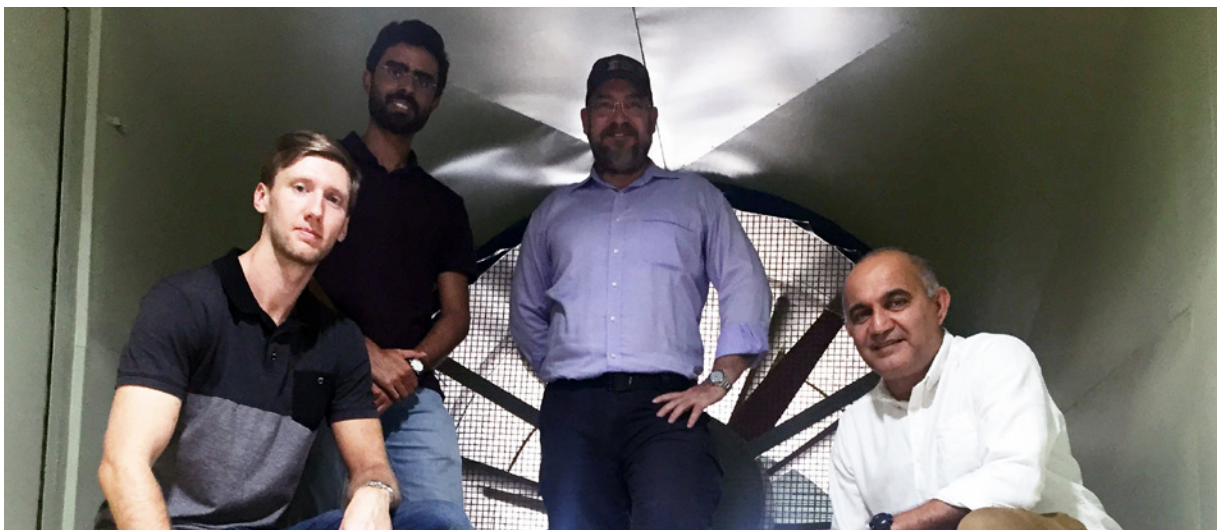
Dr Taylor's work identifies best practice approaches to animals in emergency management, an area that has previously been lacking in research and scientific evidence. The team from the *Managing animals in disaster* project has worked with communities like the Springwood Neighbourhood Centre, Blue Mountains Animal Ready Community, the Mountains Community Resource Network and the NSW SES to implement the research into practice.

Dr Briony Towers (RMIT University) was recognised for her contributions to child-centred risk reduction. Dr Towers received the Early Career Researcher Award for being a researcher that has spent her entire academic career with the CRC, working with disaster-prone primary schools to implement education and hazard reduction strategies.

Dr Towers' research has been acknowledged by local schools around Australia and on an international scale, where she has informed networks and academics at conferences on the benefits of educating children about disasters.

The CRC also awarded a special recognition honour to John Schauble from Emergency Management Victoria for his work as an end-user on several key CRC research projects. John, who recently retired, was a key end-user and supporter of the CRC since the inception as the Bushfire CRC.

RESEARCH



Mitchell Humphreys, Dr Korah Parackal, Dr David Henderson and Prof John Ginger from the Cyclone Testing Station at James Cook University.

The reporting period covers the sixth year of the CRC's eight-year funding period, where priorities for the research program were to consolidate the CRC's research investment, to promote value and impacts of the research, and to define pathways for the uptake and utilisation of the research outcomes and knowledge.

The conduct of active research and data gathering across all projects and postgraduate work was reinforced by outputs including:

- 12 book chapters
- 56 journal papers
- 34 refereed conference papers
- 85 reports for end-users

The research program (the full program is online www.bnhcrc.com.au/research) broadly takes in the policy objectives of the COAG-endorsed National

Strategy for Disaster Resilience and is structured around three themes:

- Policy and economics of hazards
- Resilience to hazards
- Understanding and mitigating risks

Outputs from the research themes are being utilised across nine impact areas:

- Policy and political engagement
- Fire predictive services
- Managing the landscape
- The value and economics of mitigation and recovery
- Disaster resilience
- Education, communications and emergency warnings
- Extreme weather forecasting and impact reduction



Core Research Program Manager Dr Desiree Beekharri at the northern Australia Research Advisory Forum in Darwin.

- Future workforce
- Critical infrastructure and lifelines

Research outputs are increasingly appearing in quality peer-reviewed journals, and project team members present invited keynote speeches at international conferences. All reports and articles are on the CRC website, either in full where permitted, or as links to independent publishers.

Consequently, the CRC remains on target to achieve its research outputs.

Of the 45 Commonwealth output milestones for 2018-19, a total of 35 have been completed and 10 are in progress. Five of the delayed milestones are for PhD student completions, and these students are now in the final stages of their studies. The other five delayed milestones have been extended to be completed in the 2019-20 financial year.



RESEARCH

RESEARCH MANAGEMENT

Research management focused on:

- The ongoing reinforcement of collaborative work between researchers and end-user representatives in integrated project teams. These teams include a minimum of two, and in some cases as many as 15, end-user representatives to provide advice on context, direction and how to maximise the benefits to the end-user partner organisations.
- Completing the late-term research milestones for projects, including workshops, analysis, software development and utilisation. There have been no significant technical or scientific issues arising during this phase of the research program.
- Confirmation of governance and review processes at the program and project level, including advice from the independent International Science Advisory Panel.
- Identification and delivery of utilisation opportunities in collaboration with partners.
- Bringing all end-user and research organisations together at five Research Advisory Forums, held in Brisbane, Darwin, Canberra, Melbourne and Sydney, to ensure ongoing, personal interaction at the project level between researchers and end-user representatives that comprise the integrated project teams.
- Hosting the Bushfire and Natural Hazards CRC – AFAC Conference in Perth in September 2018, which included a full day Research Forum.
- Hosting the 12th Australasian Natural Hazards Management Conference in Canberra in June 2019 demonstrating the essential and complementary roles of research, organisational and political leadership in reducing the impacts and suffering from disasters caused by natural hazards.

- Hosting the international science conference, the 6th International Fire Behaviour and Fuels conference, with the International Association of Wildland Fire, NSW Rural Fire Service, Bureau of Meteorology and NSW Office of Environment and Heritage, in Sydney.
- The Tactical Research Fund provided a source of funding for short-term, end-user focused projects, addressing strategic issues for the sector.
- The Quick Response Fund supported researchers travelling to areas affected by natural hazards to gain first-hand knowledge of the event and its impacts, and to capture perishable data.
- Commissioned research projects, outside of the main program, were conducted directly for partners and other clients on specific issues.

Research Advisory Forums

The format of the Research Advisory Forums was refreshed in 2019 to better reflect the advanced stage of most of the core research program. The format for the forums has evolved many times since the CRC began in 2013 to reflect the current needs of the research. The latest change allows a greater focus on the utilisation of research according to themes, rather than the previous focus on individual projects. The new smaller and more targeted format has been reduced from two days to one, and the number of forums each year rises from two to seven, timed to align with other major sector meetings.

This new approach recognises the strong links and understanding that have been developed within projects and extends that engagement to promote broader links between projects. The forums promote discussions involving a focused and more diverse group of stakeholders. One outcome has been greater clarity on the way research can be used by CRC partners and what needs to be done to achieve that outcome.

To support this initiative, the CRC Board increased funding for utilisation projects on the understanding that the transition from research outcomes to changed practices and policies required not only insight, but a commitment of time and effort. The new-look forums provide the CRC and its partners with much greater clarity on the priority areas for investment in utilisation.



Dr Yang Chen from Monash University conducting field work in the ACT forests.

RESEARCH

ACHIEVEMENTS

Highlights from the research and utilisation program in 2018-19 include:

- The Australian National Disaster Resilience Index has been developed with governments and emergency service organisations across Australia and New Zealand. The Index provides a tool for policymakers to understand at a national level how resilience varies in different regions of Australia, providing a means to track change over time and to allocate resources that are relevant and targeted.
- Improvements and validation of a prototype, high-resolution soil-moisture system called JASMIN, which is providing more accurate estimates of land dryness that underpin the

fire danger rating and warning systems, fire behaviour and flood prediction models, and the development of heatwaves. This will flow on to improvements to emergency warnings issued to the public.

- Emergency warning messages have been analysed for community comprehension, leading to improved phrasing and information content of messaging that have ultimately protected threatened communities and saved lives. Research from the Communications and Warnings project forms part of the *National Handbook on Communications and Warnings*, and the companion document, *Choosing Your Words*. These insights have been adopted at the national level and rolled out to all states

and territories, continuing the evolution of our understanding of the importance of communication in times of emergency, to ensure everyone that receives information can understand what is being communicated and will know what actions they need to take.

- A new National Fire Danger Ratings System is drawing from a range of CRC projects in fire behaviour, fire ecology, weather and climate, predictive services, and communications and warnings. Based on this research, the new system will improve community awareness of risk exposure, provide greater scientific accuracy behind decisions, advice and warnings and give communities greater confidence in the information being provided.



The CRC partnered with Beyond Blue for research into the mental health of emergency services.



CRC research was integral to the guidelines for issuing emergency warnings document released by the Australian Institute for Disaster Resilience.

RESEARCH



Mark Thomason (Country Fire Service South Australia), A/Prof Chris Bearman (CQUniversity) and CRC CEO Dr Richard Thornton launch the incident management checklists.



CRC research informed the Australian Institute for Disaster Resilience handbook *Communities Responding to Disasters: Planning for Spontaneous Volunteers*.

- A national research project into the mental health and wellbeing of police and emergency service personnel in a collaboration between the CRC and Beyond Blue with the University of Western Australia provided insights into workplace culture and wellbeing. Data from this research, the most comprehensive study of its type in Australia, is being used by the sector to review current mental health support strategies and to identify opportunities to modify existing or introduce new support programs.
- Fuels3D is a program designed by researchers for fire and land managers in the field to quickly, accurately and consistently capture important information on fuel hazard and burn severity. This benefits organisations by reducing both staff hours in the field and individual biases in estimating bushfire risk.
- The Australian Flammability Monitoring System is supporting fire risk management and response activities such as hazard reduction burning and pre-positioning firefighting

resources and, in the long term, the new National Fire Danger Rating System. The web-based tool is useful for fire and land managers and other industries such as the insurance and agricultural sectors and electricity and water suppliers. Communities across land management and agriculture can assess how dry their properties are for a range of potential activities, including preparation for fire season. Project leader Dr Marta Yebra was awarded the prestigious Max Day Environmental Science Fellowship from the Australian Academy of Science for this work, which has been closely supported in development by ACT Parks and Conservation.

- Issues of recruitment, retention, diversity, and wellbeing among State Emergency Service volunteers have been identified as part of a larger study on volunteering conducted by researchers at the University of Western Australia. Strategies to improve volunteer recruitment and retention rates are already

being implemented by the Department of Fire and Emergency Services in Western Australia, and are being considered by other SES agencies around Australia.

- Development of a decision support system to assist stakeholders evaluate disaster mitigation investment decisions that consider future scenarios. Utilisation of this project has been advanced through a national training program and case studies in Victoria, South Australia, Tasmania and Western Australia involving bushfire, flooding, coastal inundation, earthquake and heatwave, with both the Western Australian and Tasmanian governments further investing into the development of a model to show natural hazard risk exposure for their states.
- Development of practical tools such as an Emergency Management Breakdown Aide Memoire and the Team Process Checklist to help emergency managers and responders strengthen teamwork before, during and after emergencies. Emergency services were engaged throughout development, with information sought from 18 agencies ranging from state emergency services, to urban fire, rural fire and local councils. Following its launch at the National Lessons Management Forum in 2018, the tool has been adopted for training purposes in several states.
- The identification of four key large-scale forces reshaping the nature of volunteering in the 21st century led to the subsequent incorporation of the research findings in the *Communities Responding to Disasters: Planning for Spontaneous Volunteers*, published by the Australian Institute for Disaster Resilience. This handbook is used as a guide for emergency organisations across Australia on best practices for engagement with spontaneous volunteers.

RESEARCH



CEO Dr Richard Thornton speaks on a panel at the 15th International Wildland Fire Safety summit in Asheville, North Carolina in December 2018.

INTERNATIONAL RESEARCH LINKS

Fire and Emergency New Zealand's annual contribution to the CRC for further engagement with the research program supported the second annual *Unpacking Complexity* workshop in Canberra in June. CRC and New Zealand researchers met before the Australasian Natural Hazards Management Conference for a workshop on areas of mutual research interest currently under way and with future potential. Discussions continued into the conference week.

PhD scholarships targeting New Zealand fire issues were made available this year. One PhD student has commenced studies and another is in progress to begin. Discussions are also ongoing to ensure that all CRC partners in New Zealand access the wider benefits of membership of the centre.

The CEO Dr Richard Thornton is on the Science Advisory Panel for the New Zealand Resilience to Nature's Challenges National Science Challenge.

He was also an international adviser to *The Blueprint for Wildland Fire Science in Canada 2019*, which established a 10-year plan to build research capacity.

Long-time CRC researcher Prof John Handmer has been named Chair of the Scientific Committee of the Integrated Research on Disaster Risk (IRDR) program.

Prof Handmer from RMIT University has been a key part of research conducted at the CRC; he was the research leader for the *Out of uniform: building community resilience through non-traditional emergency volunteering* and *Social, economic, and environmental impacts of the 2012/13 Victorian fire season* projects, as well as being the Principal Scientific Advisor for the CRC.

The IRDR is a research program that looks at natural disaster mitigation, co-sponsored by the International Science Council (ISC) and the United Nations Office for Disaster Risk Reduction (UNDRR).

Prof Handmer has been a part of the IRDR Scientific Committee since 2016, as well as being on a number of other Australian advisory boards. He is currently on the National Vulnerability Profile project.

The CEO Dr Thornton attended the Human Dimensions of Wildfire conference in Asheville, North Carolina, in December 2018 to present on two panels about the CRC model in comparison to other models in operation in the US and Canada for wildfire science. The Communications Director, David Bruce, also attended and participated in the second panel, which compared end-user experiences and the potential for ongoing funding sources. David is also a Director of the International Association of Wildland Fire, the host of the conference.

The CRC maintains other international links:

- Memorandum of Understanding with the US

Forest Service, Department of Interior and Bureau of Land Management.

- Memoranda of Understanding with the Association for the Development of the Industrial Aerodynamics (Portugal).
- Memorandum of Understanding with the Natural Hazards Research Platform (New Zealand).
- Memorandum of Understanding with the Coastal Resilience Centre of Excellence, University of North Carolina.
- Memorandum of Understanding for the European Commission funded project GEOSAFE with Australian partners RMIT University and the University of Melbourne.
- The designated National Committee for the Integrated Research on Disaster Risk program—a research program co-sponsored by the International Council for Science, the International Social Science Council, and the United Nations International Strategy for Disaster Reduction. This is a global, multi-disciplinary approach to dealing with the challenges brought by natural disasters, mitigating their impacts, and improving related policy-making mechanisms.
- An International Science Advisory Panel.

» **MANY OF THE CRC'S CORE PROJECTS HAVE LINKS TO INTERNATIONAL PARTNERS (SEE APPENDIX 3).**

END-USER INVOLVEMENT

The CRC has 110 (core, commissioned, tactical and quick response) projects with integrated project teams of researchers and end-users, established to ensure the projects continue to be informed by, and remain focused on, the needs of the partner organisations. Ongoing and active engagement between researchers and end-users is considered crucial to the success of each project.



RESEARCH



Mike Wassing, then Queensland Fire and Emergency Services Acting Commissioner, opens the 2018 Research Advisory Forum in Brisbane.

The research team and researchers regularly participate in the AFAC Collaboration Model that spans 34 groups, technical groups and networks. These end-user led groups meet to share knowledge and shape practices for the fire and emergency services sector, with the CRC providing opportunities to engage with the development of the evidence base needed to underpin the development of the sector.

In September 2018, the fifth Bushfire and Natural Hazards CRC – AFAC Conference was held in Perth, Western Australia. The Research Forum of the conference, organised by the CRC, attracted 370 registrants from academia and emergency services agencies across Australia, New Zealand and internationally, including many project end-user

representatives.

The last Research Advisory Forum for 2018 was held in Brisbane in November. Hosted by the Queensland University of Technology, over 80 researchers, end-users and key stakeholders gathered to discuss the research direction of the physical sciences half of the CRC's core research program.

The new-look RAFs for the first half of 2019 were:

- Northern Australia – focused on natural hazards, people and economics. April, Darwin, Held prior to the Northern Australia Fire Managers Forum, Darwin, April.
- Bushfire mitigation: focused on prescribed burning, carbon, fuel and land management. A pre-conference workshop at the Fire Behaviour

and Fuels Conference, Sydney, April.

- Workforce 2030: workforce, volunteering and readiness for new and emerging technologies. Held in conjunction with the AFAC volunteer and workforce management groups, Melbourne, May.
- Thought leadership; economics, policy and planning. Held after the 12th Australasian Natural Hazards Management Conference, Canberra, June.

Many of the integrated project teams also held regular workshops and teleconferences and made use of opportunities to meet informally at conferences and other events to maintain ongoing project communication.

UTILISATION AND COMMERCIALISATION

The CRC is on target to achieve its utilisation outcomes. There were 20 utilisation milestones for the reporting period, of which 16 have been completed, and four are expected to be completed by the end of June 2020.

RESEARCH TO CAPABILITY

End-user engagement is central to the CRC's utilisation strategy. A model of our Research to Capability process is depicted to the right, together with examples of how the strategy is being enacted within the CRC. The core business of the CRC is focused on the top four boxes, but at the same time the CRC must be aware of the end-user environment towards which its research is directed (bottom two boxes).

The ideas underpinning the Research to Capability model have been incorporated into the CRC's Research Utilisation Strategy. This strategy, which aligns with the CRC's overall organisational strategy, details the underlying principles for achieving research utilisation across the five major strategic objectives of:

- Partnership
- Outputs
- Research
- Capability and capacity
- Governance and management.

The Strategy makes explicit the need to:

- Develop and maintain an appropriate IP register
- Develop high level measures to monitor the utilisation of the research
- Develop utilisation roadmaps for each project to aid communication with all stakeholders that will potentially use the research.



SETTING RESEARCH DIRECTIONS

- Stakeholders identify needs
- Call for proposals from the research community
- Project review, selection, revision and approval



MAINTAINING AND REFINING RESEARCH FOCUS

- End-users actively engaged on research projects
- Ongoing advice and access to partner organisations



IDENTIFYING MECHANISMS FOR KNOWLEDGE APPLICATION

- End-user identification of potential application of research outputs
- Briefings via AFAC, ANZEMC sub-committees and direct access to end-user organisations to support appropriate planning timeframes in end-user organisations



TRANSLATING RESEARCH OUTPUT INTO PRODUCT

- Identifying in detail how the knowledge developed should be translated into products such as training, methodologies, practices, systems
- CRC support for technology uptake activities

CORE BUSINESS



ORGANISATIONAL ACCEPTANCE OF RESEARCH PRODUCT

- Ensuring that the receiving organisation has the skills to integrate the knowledge being delivered



ENHANCED ORGANISATIONAL CAPABILITY

- Being able to consistently achieve something new or significantly better



UTILISATION AND COMMERCIALISATION

In order to facilitate discussion and planning between researchers and end-users, the CRC has research utilisation roadmaps for every core research project.

A utilisation roadmap is a simple presentation of research utilisation objectives against a project timeline. They are high level and articulate a shared vision of utilisation, outlining opportunities and basic actions necessary for initiating more detailed business plans, including key stakeholders, further investment requirements and a communication strategy. The roadmaps are designed to benefit end-users by facilitating uptake of research outputs, as well as provide the CRC and all stakeholders a common understanding of the steps required for successful uptake.

The CRC is also in the final stages of implementing a monitoring and evaluation framework for the utilisation program. This framework uses a utilisation register, quantitative and qualitative research tools and stakeholder analysis to evaluate utilisation. In addition, the CRC is working with project groups to demonstrate good practice in utilisation, providing models for the broader CRC research program.

The CRC Board has endorsed the understanding that the CRC operates as a knowledge network and market - reflecting the close engagement between researchers and end users, and the lack of barriers between the CRC's members for contributing to, and using, outcomes of the CRC research. Importantly, one of the mechanisms for utilisation in a knowledge network comes through diffusion into member organisations, and where outcomes are most commonly measured through case studies, testimonials and participation.



Attendees discussing the role of electricity networks in bushfire mitigation at the workshop on research priorities for electricity networks, August 2018.

EDUCATION AND TRAINING



CRC PhD students at a communications and writing skills workshop in Brisbane: Li Zhao (Australian National University), Rahul Wadhwani (Victoria University), Mercy Ndalila (University of Tasmania), Maryam Nasim (RMIT University), Mitchell Humphreys (James Cook University), Dario Rodriguez-Cubillo (University of Tasmania) and Nicolas Borchers Arrigada (University of Tasmania).

The high number of student completions this year demonstrate that the CRC is building a capacity and capability of highly skilled researchers for the sector. The CRC is building this capacity with postgraduate students working across a range of natural hazards science projects.

Students are involved as either scholarship recipients or as associate students – both have the opportunity to engage with the industry and gain an understanding of the sector through their involvement with the CRC. All scholarship recipients have end-user sponsors who have indicated that the project has relevance to the industry and their organisation is interested in the outcomes.

At the end of this reporting period the CRC had 118 PhD students (37.2 FTE) – 52 scholarship, 66 associate.

The CRC has exceeded its original target of 34 PhD completions by June 2021 with 49 students (24 scholarships and 25 associates) already completing their PhD studies. Of these, two completed in 2014/15, five completed in 2015/16, 11 completed in 2016/17, 14 completed in 2017/18 and 17 completed in 2018/19.

Additionally, in the associate program, the CRC had nine Masters students, with six completed.

To support the students, the CRC runs a variety of

events centred on learning and networks. The annual conference, Research Advisory Forums and industry working groups (run by partner organisation AFAC) are key gatherings where students have the opportunity to present their findings. A number of students have also received CRC support to present their research at international conferences.

In 2018/19 students were invited to promote their research and participate in discussions at the various industry events including the 6th International Fire Behaviour and Fuels conference and the 12th Australasian Natural Hazards Management conference.



EDUCATION AND TRAINING

STUDENT COMPLETIONS

A round of postgraduate students graduated this year and shared their research outcomes with the fire and emergency services sector in several forums.

Bushfire and Natural Hazards CRC graduates

Dr Bryan Hally completed his PhD with RMIT University in Melbourne and the University of Twente in Enschede, Netherlands as part of a dual badged program. His thesis research titled *Methods for background temperature estimation in the context of active fire detection work* looked at the methods by which fires are discovered in remote sensing imagery from satellites. He is currently working within the geospatial sciences department at RMIT University as a researcher.

Grigorijs Goldberg's PhD thesis on remote sensing of tree structure and biomass in north Australian mesic savanna was accepted by Charles Darwin University. Grigorijs is now working as a remote sensing expert at Latvia's Geospatial Agency.

Angela Gormley's Masters research at the University of Sydney focused on whether prescribed burning alters all the components of the fuel load in typical vegetation types in the Sydney Basin, and whether plants that are characteristic of different vegetation types in the Sydney Basin differ in their leaf morphology and flammability traits.

Valuing volunteers: better understanding the primary motives for volunteering in Australian emergency services is the title of Bill Calcutt's Masters thesis, accepted by the University of Wollongong.

Associate student Dr Kaitlyn Watson's thesis investigated pharmacists' roles in disasters and identified the acceptance and expectations of pharmacists throughout the different stages of a disaster.

Associate student Dr Ken Strahan had his PhD thesis accepted by RMIT University on the factors influencing household self-evacuation in two

Australian bushfires in Perth and Adelaide. Dr Strahan is now leading a CRC commissioned research project funded by the Victorian Safer Together program on the application of self-evacuation archetypes.

Dr Fiona Jennings' PhD at RMIT University explored the impact of the 2013 Forcett bushfires in Tasmania on local residents.

Dr Tim Ramm, at the University of Tasmania, examined the effects of a rising sea level and the potential to exacerbate coastal flooding. Dr Tim Ramm is now a researcher at the University of Tasmania.

Dr Emma Singh has had her thesis accepted at Macquarie University on network disruptions when a natural hazard occurs over a long period of time. Throughout her studies Emma travelled to Japan, Italy and the United States to study the impacts of volcanoes and to understand the relationship between infrastructure, interconnectedness and exposure to these natural hazards.

Dr Charles Newland completed his PhD at the University of Adelaide on how modelling can simulate disaster risk. His research aimed to improve the reliability and effectiveness of risk modelling to benefit end-users. Dr Newland is currently working as a graduate engineer in transport, planning and logistics, which has allowed him to utilise his PhD skills in spatial modelling, analytics and coding.

"My experience with the CRC always gave me a chance to see my research in action, and to meet, talk and laugh with fellow PhD students on the journey,"
Dr Newland said.



Dr Emma Singh on a field trip to Mount Vesuvius in Italy.
Photo: Emma Singh.

EDUCATION AND TRAINING



PhD student Dr Ryan Hoult is now working at the Ecole Polytechnique de Lausanne in Switzerland.

Dr Rachel Westcott completed her PhD at the University of Western Sydney. Dr Westcott's thesis sought to advance public health in the context of natural hazards by developing best practice methods for preparedness and response in a bushfire, with the aim of enhancing community wellbeing and safety.

Dr Mittul Vahanvati submitted her PhD at RMIT University on owner-driven reconstruction to enhance disaster resilience in India. Her thesis focused on the adaptability of the construction sector and disaster resilience in residents that have been affected by a disaster. She is currently the Chief Investigating Officer for an action-research project

with the Tarnagulla community in Victoria to develop a resilience action plan.

Dr Wasin Chaivanont had his thesis accepted at the University of NSW on how remotely sensed degrees of curing and fuel load vary in different grasslands and how that affects fire spread modelling. Wasin now works at the Bangkok Bank Public Company Limited in Thailand.

Dr Nick Read conducted modelling for the location of lightning-caused bushfire ignitions at the University of Melbourne. He is currently a research assistant at the university.

Dr Kamarah Pooley's PhD on the Youth Misuse

of Fire program in NSW found that Youth Justice Conferencing with firefighter involvement contributes to a reduced risk of general recidivism, which provides an avenue for delivering better fire safety education to at-risk groups across the community. She is now working as a sessional academic and research assistant at Queensland University of Technology.

"I feel very fortunate to have been supported by the CRC during my PhD candidature. I attended and presented at research forums and conferences around Australia, met some incredible people, accessed some very useful contacts, and made lifelong friends," Dr Pooley said.

Dr Ryan Hoult analysed both rectangular and C-shaped concrete walls in Australia, where he developed a Secondary Cracking Model to predict the potential of cracks forming in these types of walls. He is now working as a postdoctoral researcher at the prestigious Ecole Polytechnique Federale de Lausanne in Switzerland, where he is using his PhD research to work collaboratively with several South American universities to mitigate against earthquake risk.

Dr Ashley Wright's PhD on flood forecasting at Monash University found that the combination of modelling choices and the physical characteristics of soil moisture have a significant impact on the amount, and quality of the estimated rainfall. He was awarded the Eric Laurenson Medal, which recognises his outstanding thesis, communication to industry and the potential research utilisation in water science, engineering or management.



EDUCATION AND TRAINING

**“The award gives me confidence that my work is meaningful and of high quality,”
Dr Wright said.**

Dr Wright is now part of the CRC's *Improving flood forecast skill using remote sensing data* research team.

Graduate destinations

Many completed students from both the Bushfire CRC and the Bushfire and Natural Hazards CRC are now employed with either end-users or research organisations and are actively contributing to the current research program in their current roles.

These include:

- George Carayannopoulos – University of Sydney
- Steve Curnin – TasWater/University of Tasmania
- Veronique Florec – University of Western Australia
- Brianna Larsen – Griffith University
- Rene Van der Sant – Melbourne Water
- Grace Vincent – CQUniversity
- Alex Wolkow – Monash University
- Billy Haworth, University of Manchester, UK
- Caroline Wenger – Australian National University
- Graham Dwyer – University of Swinburne
- Douglas Brown – University of Western Sydney, Bushfire Architecture
- Dolapo Fakuade – Otago Civil Defence and Emergency Management
- Vaibhav Gupta – City of Casey
- Josh Whittaker – University of Wollongong
- Briony Towers – RMIT University

- Claire Johnson – Emergency Management Victoria
 - Val Densmore – Department of Biodiversity, Conservation and Attractions, Western Australia
 - Andrew Edwards – Charles Darwin University
 - Adam Leavesley – ACT Parks and Conservation Service
 - Kerryn McTaggart – Parks Victoria
 - Felipe Aires – Office of Environment and Heritage NSW
 - Martijn van der Merwe – Country Fire Service, South Australia
 - Mika Peace – Bureau of Meteorology
 - Kamarah Pooley – Queensland University of Technology
 - Christine Eriksen – University of Wollongong
 - Phil Lacy – PF Olsen Australia Forestry
 - Karyn Bosomworth – RMIT University
 - Tim Prior – Centre for Security Studies, Switzerland
 - Lyndsey Vivian – Centre for Australian National Biodiversity Research, CSIRO
 - Meaghan Jenkins – University of Wollongong
 - Grigorijs Goldberg – Latvia Geospatial Agency
 - Bryan Hally – RMIT University
 - Peter Hayes – CQUniversity
 - Ryan Hoult – Ecole Polytechnique Federale de Lausanne, Switzerland
 - Rowena Morris – Park Ranger, Office of Environment and Heritage NSW
 - Ken Strahan – Victorian Government
 - Ashley Wright – Monash University
 - Phil Zylstra – University of Wollongong
- » RESEARCH STUDENTS – SEE APPENDIX 4 FOR A LIST OF ALL POSTGRADUATE STUDENTS.



PhD students at our annual conference.

SME ENGAGEMENT

The Bushfire and Natural Hazards CRC has extensive engagement activities with small-to-medium enterprises, as well as large corporations.

The overall strategic plan for the CRC, as well as the specific strategies for Research Utilisation and for Communications, includes SME engagement as a prime objective.

WORKING WITH INDUSTRY

SME engagement highlights include:

- The CRC participated in the annual conference with AFAC and Deutsche Messe Australia in Perth in September 2018. A feature of the conference was the trade exhibition with

more than 100 exhibitors from the broader industry, the majority of which were small-to-medium enterprises active in both Australia and New Zealand. The conference also attracted significant corporate sponsorship, including long-term sponsor relationships with global vehicle manufacturers Scania, Hino and Isuzu, and fire equipment suppliers Dräger, Motorola and Gaam.

- The CRC participates and supports a calendar of engagement events that includes several emergency management and operations conferences, regional volunteer events and industry specific conference and activities. All these events involve significant participation from local and regional SMEs.

- The Fire Protection Association Australia (FPAA), which represents more than 6000 SMEs, is a contributing member of the CRC and actively promotes CRC research to its members through *Fire Australia*, its quarterly journal which is published jointly by the CRC, AFAC, and FPAA and is distributed to 6000 members of the broad fire and emergency services sector.
- *Hazard Notes*, the CRC's research briefing papers, are publically available online and are distributed through an extensive email database that includes SMEs, small rural fire brigades and SES units, and to regional councils. They are also shared more widely on social media.



The trade exhibition at the annual conference features the latest technology for emergency services.



The annual conference was attended by more than 100 exhibitors, a majority of whom were small-to-medium enterprises.



COMMUNICATIONS



Dr David Henderson (James Cook University) speaks with ABC Statewide Drive WA as part of their live broadcast at the 2018 annual conference.

With the CRC into its sixth year the communications priorities highlighted the positive impacts of the research program with a focus on:

- Building public and industry knowledge of how to use the research, through targeted events, conferences, workshops, online content and in the general media.
- Creating and distributing branded publications and products to demonstrate the value of the CRC.

EVENTS

This reporting period saw much activity around raising the profile of the centre, at conferences and other forums, and in various media, across a range of audiences including local government, public affairs, community safety and risk managers.

Natural Hazards conference

The major event in this period was the 12th Australasian Natural Hazards Management Conference, in Canberra from 17-19 June. An international audience of 150 people participated, covering a range of organisations from different fields, all of whom have an important role to

play when dealing with the impacts of natural hazards. This included research, emergency management, emergency services, insurance, media, telecommunications, transport, infrastructure, energy, social services, local government and health. The conference moved away from the usual conference model with a series of expert panels and audience participation exploring the impacts of the complex cascading scenario, developed in conjunction with the Bureau of Meteorology. Keynote addresses were given by CRC Board member Mark Croswell (Australian National Resilience Taskforce), Jo Horrocks (New Zealand Ministry of Civil Defence and Emergency Management) and Dr Animesh Kumar (United Nations Office for Disaster Risk Reduction, Asia and the Pacific). Preceding the conference was the annual research workshop between Australian and New Zealand researchers. The conference was sponsored by the Australian Government/Department of Home Affairs and supported by the Australian Institute for Disaster Resilience, and Integrated Research on Disaster Risk, which is part of the International Science Council and the United Nations Office for Disaster Risk Reduction.

Fire and Fuels

The 6th International Fire Behaviour and Fuels conference was held concurrently in Sydney, Albuquerque (United States) and Marseille (France) by the International Association of Wildland Fire, from 29 April – 3 May. The CRC was a lead partner across all three locations.

More than 330 people attended the conference in Sydney, which saw keynote sessions live streamed between each city. CRC researcher Prof Jeremy Russell-Smith gave a keynote on carbon abatement and prescribed burning in northern Australia, while many CRC researchers and completed PhD students also presented their research during the conference. Other conference highlights included panel sessions

on cultural burning and women managing their career in science and fire management (a joint panel with the Albuquerque conference, and featuring CRC researcher Dr Mika Peace), as well as a focus on the National Fire Danger Rating System. The CRC was heavily involved in all facets of the conference, such as program and logistics, as well as contributing media management, photography and social media during the event. The CRC signage was at all three conferences.

AFAC18

The CRC and AFAC co-hosted the annual conference in Perth in August 2018, along with Deutsche Messe Australia. The CRC was prominent throughout the Perth conference and in particular at the Research Forum, which attracted 370 participants. CRC researchers featured heavily on the program. The keynote addresses at the Research Forum were delivered by Anna-Maria Arabia, CEO of the Australian Academy of Sciences, and Dr Neil Burrows, who spoke on his 40 years of fire science in Western Australia. The full conference attracted more than 2800 people and the CRC handed out many branded promotional items and corporate brochures, engaged with the media and was promoted heavily on social media. The CRC launched the Seasonal Bushfire Outlook for Southern Australia at a media conference, which was broadcast live on ABC24 TV and Sky News.

US study tour

CRC fire scientists matched their methodology with a group of peers from North America in a one-day workshop on 11 September. The 10 participants in the 2018 North American Study Tour of Australia and New Zealand attended the AFAC18 annual conference in Perth and then visited Victoria, before moving on to New Zealand. The CRC hosted the group at the Victorian Emergency Management Institute at Mt Macedon with the Department of Environment, Land, Water and Planning.



Dr Animesh Kumar, Deputy Head Asia Pacific, United Nations Office for Disaster Risk Reduction, gives a keynote at the 2019 Australasian Natural Hazards Management Conference in Canberra.

The fire science workshop covered discussion on fire behaviour, fire weather, carbon and water impacts, as well as developments in the fire danger rating index and the new Centre for Prescribed Burning. CRC researchers included A/Prof Tina Bell, from the University of Sydney, Dr Marta Yebra, Australian National University, A/Prof Jason Sharples, University of New South Wales, Dr Alex Filkov, University of Melbourne, and Dr Mika Peace, Bureau of Meteorology. Simon Heemstra, NSW Rural Fire Service, and Deb Sparkes, Centre for Prescribed Burning also participated. The North American visitors were from US Forest Service, British Columbia Wildfire Service, and Natural Resources Canada.

Disaster Reduction Day

The UN's International Day for Disaster Reduction was acknowledged around the world on 13 October. With 13 October falling on a Saturday in 2018, the CRC opted to hold an event the day before, on Friday 12 October in Adelaide. Partnering with the South Australian Fire and Emergency Services Commission, the Australian Institute for Disaster Resilience, SA Water and the Commonwealth Department of Home Affairs, over 60 people attended the event to hear an expert panel discuss the economic challenges in preparing and responding to natural hazards, what we can do today to reduce future costs, and what policies and practices are needed to implement

these changes. The panel comprised of Malcolm Jackman (South Australian Fire and Emergency Services Commission), Jillian Edwards (National Resilience Taskforce), CRC researcher Prof Alan March (University of Melbourne), Frank Crisci (SA Power Networks) and Peta O'Donohue (SA Country Fire Service). CRC Research Director Dr John Bates facilitated the event, and a video of the Forum is on the CRC's website and YouTube channel as well as the UNDDR website.

Black Saturday 10 years on

To mark the tenth anniversary of the Victoria Black Saturday bushfires on 7 February 2019, the CRC participated in two separate events. The first, held on 1 February by La Trobe University was a symposium that brought together survivors, researchers, commentators and community members to discuss the fires and their aftermath. CEO Dr Richard Thornton was invited to take part in a panel discussing climate change and fire, alongside associate PhD student Daniel May (Australian National University) and former Bushfire CRC researcher Adj Prof Jim McLennan.

The second event was run by the Australian Meteorological and Oceanographic Society to highlight scientific advances since 2009 in forecasting fire weather. Taking place on 5 February, CEO Dr Thornton was invited to present an overview of other advancements in bushfire research outside of fire weather over the last decade, as well as future decision making, resource management and community warnings. CRC researcher Dr Mika Peace (Bureau of Meteorology) also spoke, covering the advances in meteorology, while CRC end-user Dr Paul Fox-Hughes (Bureau of Meteorology) covered the work underway on the new national Fire Danger Rating system. Victorian Country Fire Authority Deputy Chief Alen Slijepcevic also gave a talk on how CFA benefits from research, including CRC research.



COMMUNICATIONS

Northern fire

The annual Northern Australia Fire Managers Forum was hosted by the CRC in Darwin to discuss topics of interest to the tropical savannas. The Executive Director of Bushfires NT Collene Bremner opened the forum with comments on the challenges of fire management across the north of Australia, drawing on specific issues in the Northern Territory, while Anna Boustead from the Indigenous Carbon Industry Network gave an overview of the Indigenous based carbon industry in the Northern Territory. Day two saw a field trip to the Tiwi Islands to view Indigenous based plantation forestry operations.

Research Advisory Forums

The format of the Research Advisory Forums was refreshed in 2019 to better reflect the advanced stage of most of the core research program. The format for the forums has evolved many times since the CRC began in 2013 to reflect the current needs of the end-users for the research. The latest change allows a greater focus on the utilisation of research according to themes, rather than the previous focus on individual projects. The new smaller and more targeted format has been reduced from two days to one, and the number of forums in 2019 has risen from two to seven, and were to align with other major sector meetings, such as AFAC Group meetings and conferences.

Flooding plains

The latest developments in flood management were discussed at the annual Floodplain Management Conference, in Canberra from 14-17 May. The CRC had a booth in the trade display, while a number of CRC projects presented. This included Dr Mel Taylor (Macquarie University) on attitudes of people who enter floodwater, Andrew Gissing (Risk Frontiers) on planning for catastrophic floods, Dr Tariq Maqsood (RMIT University) on assessing flood damage in Launceston, as well as a poster presentation from Dr



Dr David Jones from the Bureau of Meteorology talks to the media at the launch of the Southern Australia Seasonal Bushfire Outlook 2018.

Taylor and Dr Stefania Grimaldi (Monash University). The value and benefits of the UNHaRMED software was spoken about by Gabrielle Eckert from South Australia's Department of Environment and Water, while Board member Karl Sullivan (Insurance Council of Australia) gave a keynote address.

CRC gathering

The annual Cooperative Research Centres Association conference was an important event, staged in Adelaide from 28-30 May. Bushfire and Natural Hazards CRC research was recognised as saving lives by taking out the Association's premier award, the Excellence in Innovation award, for our emergency warnings and community engagement research. Led by Prof Vivienne Tippet (Queensland University of Technology) and Dr Katharine Haynes (Macquarie University and the University of Wollongong), the collaborative research groups have combined to equip emergency service agencies around Australia with better-targeted

long-term public safety campaigns, as well as evidence-based warning messages delivered to at-risk populations in the face of imminent natural hazard threats. Prof Tippet also gave a keynote talk on the QUT component of the research, while Dr Haynes participated in a working with the media session conducted by the Australian Science Media Centre, speaking about her experience as 'scientist in residence' at *The Age* in early 2019.

EM and CEO

The CRC once again had a booth at the popular Victorian Emergency Management Conference, which took place in Melbourne on 28-29 May. More than 500 people attended, with the joint CRC, AFAC and AIDR stand proving popular during the breaks. The CEO Dr Richard Thornton was invited to give a presentation, sharing how drivers of risk—climate change, demographic change, technology—inform the National Research Priorities for natural hazards.

COMMUNICATIONS



Dr Josh Whittaker (University of Wollongong) with his co-written article in *The Age* on learnings from the 2009 Black Saturday bushfires.

Media affairs

Members of the communications team represented the CRC in Sydney at the annual Emergency Media and Public Affairs conference from 3-5 June. Attended by around 80 communications and community engagement practitioners, CRC research on community behaviour during bushfires was presented by Dr Josh Whittaker (University of Wollongong), drawing on ten years of research since Black Saturday. The CRC figured prominently in the EMPA awards, taking out the research category (Dr Josh Whittaker and Dr Mel Taylor for the community preparedness, warnings & response to the 2017 NSW bushfires research) and a high commendation (Dr Paula Dootson, A/Prof Dominique Greer, Sophie Miller and Prof Vivienne Tippet from QUT for their conflicting cues with emergency warnings research). Our researchers also featured in the Judge's Choice category, with Dr Josh Whittaker and Dr Katharine Haynes partnering with science journalist Liam Mannix for *The Age* 'scientist in residence' team for their reporting on lessons learnt since Black Saturday. The CRC sponsored the event and was represented on the organising committee by Communications Manager Nathan Maddock.

Disaster science

CRC science was covered extensively at the Australia and New Zealand Disaster and Emergency Management conference on the Gold Coast from 12-13 June. A highlight was a panel session covering the complexities of floodwater, featuring CRC researchers Dr Mel Taylor and Dr Matalena Tofa (Macquarie University) and chaired by CRC Communications Director David Bruce. Researcher Dr Michael Eburn (Australian National University) gave a keynote on the legal responsibilities borne by emergency management agencies, Dr Paula Dootson (QUT) presented findings on conflicting cues and avoiding ambiguity in emergency warnings and Andrew Gissing (Risk Frontiers) spoke about planning and preparation for catastrophic disasters. Recently completed students Bill Calcutt (University of Wollongong), Dr Rachel Westcott (Western Sydney University) and Dr Kaitlyn Watson (QUT) also presented their research findings. The joint CRC, AFAC and AIDR stand was once again popular during the breaks.

Regional leadership

CRC Chair Dr Katherine Woodthorpe spoke at the New South Wales Rural Fire Service biennial three-day Leadership and Young Members Forum from 20 June 2019 in Wollongong on the use of research to support leadership.

Connecting with NZ

The connections between Australian and New Zealand research in natural hazards were the focus of a workshop on 16 June, held alongside the Australasian Natural Hazards Management Conference in Canberra. The workshop developed ideas discussed in the inaugural meeting in Wellington the previous year. CRC researchers discussed a range of current projects with colleagues from New Zealand along with agency partners and policy-makers. The CRC hosted the strategic

research workshop with the Joint Centre for Disaster Research at Massey University.

WEBSITE

The site is the central repository of all CRC public documents and statements, with easy access to the outputs of the research program and the profiles of researchers. It has links to all partners, related research organisations and, importantly, the legacy website of the Bushfire CRC. Development is ongoing, with a major overhaul of the look and feel of the site going live in August 2018.

During the 12-month period the CRC's website had 66,849 site visits, for 244,310 page views. This represents increases of 5 per cent and one per cent, respectively, from the previous financial year. The peak traffic period was the release of the *Southern Australia Seasonal Bushfire Outlook 2018* on 6 September 2018, which received more than 1500 page views on the day of initial release and 6,815 in total for the financial year combined. Other periods of high traffic were 7 September 2018 (the day after release of the bushfire outlook), 12 September 2018 (release of *Fire Australia* Issue Three 2018 digitally), 29 November (release of both *Hazard Note* 55 (the November update to the *Southern Australia Seasonal Bushfire Outlook 2018-19* and *Hazard Note* 56 documenting mental health needs of first responders) and 7 February 2019 (release of *Hazard Note* 58 ten years on from the Black Saturday bushfires).

Peaks in traffic can also be seen when each edition of *Hazard News* or *Hazard Notes* are released, as these contain snippets of information, directing users to the website for full details.

The most popular pages outside of the homepage were the *Southern Seasonal Bushfire Outlook 2018*, the research page, research overview page, publications page and the 12th Australasian Natural Hazards Management Conference page.



COMMUNICATIONS

HAZARD NEWS AND HAZARD NOTES

The email management tool Mailchimp is used to send CRC monthly newsletters, *Hazard News*, and plain language research updates, *Hazard Notes*. The subscriber list has grown steadily during the 12 months, from 2,055 to 2,275, representing an increase of 11 per cent. The open rate during this period is 34 per cent, with nine per cent clicking on a link within the email. To put this into perspective, the average open rate in Mailchimp for not-for-profit organisations is 22 per cent, while the click rate is just 2 per cent – the CRC is far exceeding these averages.

Mailchimp also tracks outreach in specific areas around the world. Australia represents 87 per cent of opens, while eight per cent are from the United States. There is also readership from New Zealand, the United Kingdom, Canada, Japan, Germany, the Czech Republic and Austria.

MEDIA

With experts across many disciplines, the CRC is well positioned to provide expert media comment that supports agency partners.

Peak times centre around the CRC's *Southern Australia Seasonal Bushfire Outlook* and its update (September and November), the annual conference (September), major hazard events (mostly bushfires and cyclones over the summer months) and the *Northern Australia Seasonal Bushfire Outlook* (July).

Numerous television, radio and website interviews have focused on the science emerging from various projects. All media mentions are listed on the CRC website and available in Appendix 5. Media coverage in newspapers, TV, radio and web was generated through the efforts of the Communications Team. *The Conversation* website has carried numerous pieces by CRC researchers on their science.

Industry and trade media are key media partners,

with the CRC contributing regular articles on the latest research findings and developments in *The Australian Journal of Emergency Management*, *Asia Pacific Fire* (UK-based), *Wildfire* (US-based), and numerous partner agency publications including the biggest two, the New South Wales Rural Fire Service's *Bush Fire Bulletin* and the Victorian Country Fire Authority's *Brigade*. CRC research was also cited in numerous publications by the Climate Council, the Australian Academy of Sciences and the CRC Association.

Fire Australia, a quarterly magazine with a circulation of 6,000, is produced by the CRC jointly with the Fire Protection Association of Australia and AFAC. The print and digital readership estimates combined are upward of 40,000.

The Communications Team is constantly on the lookout for media opportunities and the chance to promote the work of the CRC and the benefits gained by partners through the use of CRC science.



A selection of Hazard Notes.



Four editions of the Australian Journal of Emergency Management were published in 2018-19.



Four editions of Fire Australia were published in 2018-19.

COMMUNICATIONS



Darren Klemm, Commissioner Department of Fire and Emergency Services WA, talks about the fire risk at the media conference for the Southern Australia Seasonal Bushfire Outlook 2018.

The single biggest day for media engagement was the annual launch the *Southern Australia Seasonal Bushfire Outlook 2018*, held on the second day of the annual conference (6 September 2018). This year in Perth, the CEO Dr Richard Thornton hosted the media conference with speakers from all the agencies that assisted with the development of the Outlook.

These were Dr David Jones from the Bureau of Meteorology; Darren Klemm, Commissioner Western Australia Department of Fire and Emergency Services; CRC board member Doug Smith, Deputy Commissioner Queensland Fire and Emergency Services; Anthony Clark, Director Corporate Communications NSW Rural Fire Service; Dominic Lane, Commissioner ACT Emergency Services Agency; Steve Warrington, Chief Officer Country Fire Authority; Chris Arnol, Chief Fire Officer Tasmania Fire Service; and Greg Nettleton, Chief Fire Officer South Australia Country Fire Service.

The media conference was broadcast live on the national ABC 24 and Sky News, while it was attended by ABC News, Channel Seven, Channel Nine, Channel Ten, ABC online, AAP and Mix 94.5 FM Perth. With the assistance of the DFES media unit, the media conference was livestreamed to communities on both the CRC and DFES Facebook pages.

Media coverage in the immediate lead up to the Outlook release was also solid with fires during a warm August that followed a long dry winter in eastern New South Wales, eastern Victoria, and south east Queensland.

SOCIAL MEDIA

The CRC regularly engages on social media and sees these channels as key communications tools. An active engagement strategy throughout the year has seen good engagement with existing subscribers and growth in new subscribers. However, broader changes in the social media landscape that are changing the way people use and measure social media use have caused fluctuations in the CRC's profile this year.

Collaborating closely with partners, both research organisations and emergency services, has seen the reach of CRC posts on social media extend considerably.

The CRC uses Facebook, Twitter, YouTube,

LinkedIn and SoundCloud. The annual conference at the beginning of September is a key time for engagement and generated the most activity and interest. The seasonal bushfire outlooks for northern and southern Australia (July, September and November) were also popular. On Facebook, coverage of the *Southern Australia Seasonal Bushfire Outlook 2018* on the CRC page reached more than 39,621 people on release in September, and 13,511 when updated in November.

Combined data across Facebook and Twitter shows the CRC achieved 53,385 engagements in the 2018-19 financial year – which includes Facebook shares, reactions, comments and Twitter likes and retweets – a decrease of 19.5 per cent from the previous 12 months. Total impressions across our Facebook and Twitter channels was over 1.5 million, a decline of 25 per cent. Individual channel data is below.

Subscribers across both channels have increased, Facebook by 10 per cent and Twitter by 16 per cent.

FACEBOOK

By 30 June 2019, CRC Facebook likes had grown to 5,566, an increase of 10 per cent.

CRC Facebook posts received 931,814 impressions, a decline of 37 per cent from the previous financial year. Of these impressions, 90 per cent were organic and the remainder paid.

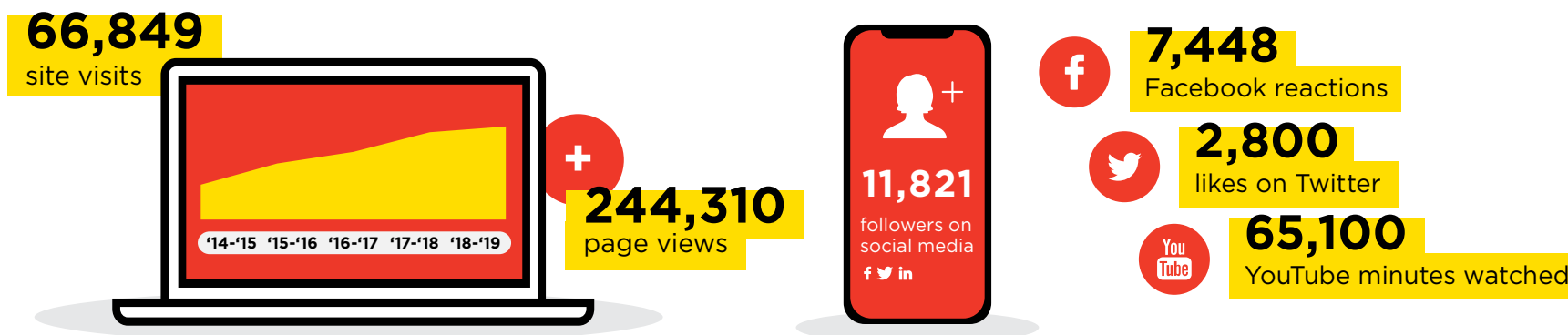
The engagement rate per impression improved to four per cent, an increase of 16 per cent on the previous year. This indicates that while the overall number of impressions has declined, engagement with CRC posts has improved.

The engagement with the Facebook page is 54 per cent female and 46 per cent male.

These figures across impressions and engagement show that the content posted through Facebook continues to be popular with the CRC audience. Posting is strategic, both in terms of content,



COMMUNICATIONS



as well as the day and time it is posted. Popular content includes the annual northern and southern bushfire outlooks for Australia, photographs, informative videos, research surveys, new research announcements and links to media coverage of the CRC.

TWITTER

During 2018-2019 the CRC grew its followers on Twitter to 2,826, an increase of 16 per cent. 591 tweets were posted at an average of 1.6 tweets per day, with 615,900 impressions across the 12-month period (a seven per cent increase). There were 1,228 link clicks.

CRC tweets were retweeted 1,159 times, a drop from the previous year of 1,890. The CRC Twitter posts received 2,800 likes (up six per cent), contributing to 13,049 overall engagements (an increase of 15 per cent from the previous reporting period).

The average reach of each tweet was 1,042 people (up 19 per cent). The CRC was mentioned on Twitter 1,451 times, an increase of 48 per cent.

While the number of retweets was reduced, the figures represent strong reach and engagement, along with growth in impressions and followers. Regular and strategic posting of informative content, such as the northern and southern bushfire outlooks, photos, videos and links to new research, was key to achieving good engagement.

The audience of the Twitter page is 65 per cent male and 35 per cent female. In addition, many CRC staff, including the CEO and Research Director, are active on Twitter and reinforce official postings.

YOUTUBE

The CRC's YouTube Hazard Channel continues to grow, with new videos added from important CRC events, such as our annual conference and the International Day for Disaster Reduction, as well as end-users speaking to the value research.

The total number of videos available on the channel are 142, with 23 videos added to the channel during the 2018-19 financial year.

These videos are embedded on the CRC website,

partner websites (including the United Nations' Prevention Web) and shared via other CRC social media platforms.

During the reporting period, a total of 11,721 views were recorded, an increase of 42 per cent from the previous year. An estimated 65,00 minutes were watched, up 65 per cent.

The most popular videos were two documentaries that the CRC was involved in: Black Tuesday - about the 1967 Tasmania bushfires, and The Day the Flames Came - about the 1961 Dwellingup bushfire in Western Australia.

Other popular videos included project updates for the project *Enabling sustainable emergency volunteering*.

LINKEDIN

The CRC has a large LinkedIn presence, with 3,429 followers, an increase of 26 per cent on the previous year. Attention given to this communications channel throughout the year involved posting in line with the frequency and content on Facebook.

GOVERNANCE

The Bushfire and Natural Hazards CRC is an incorporated not-for-profit public company limited by guarantee. The company, Bushfire and Natural Hazards CRC Ltd was registered in May 2013 and began formal CRC operations on 1 July 2013.

The Governing Board met five times throughout the year, with each meeting held in a different capital city. Each meeting was held in conjunction with either a research showcase or an informal stakeholder partner event to enable the Board to meet with members, end-users, researchers, students and other key stakeholders. The Board is chaired by an independent director. Founding chair Dr Laurie Hammond passed away in November 2018 and has been replaced in the role by Dr Katherine Woodthorpe AO FTSE FAICD.



Dr Katherine Woodthorpe, Chair of the CRC.

GOVERNING BOARD MEMBERS

NAME	ROLE	KEY SKILLS	INDEPENDENT/ ORGANISATION	APPOINTMENTS/ RESIGNATIONS	ATTENDANCE
Dr Laurie Hammond	Chair	Governance and strategy	Independent	Deceased November 2018	0 out of 0
Dr Katherine Woodthorpe	Chair	Governance and strategy	Independent	Appointed March 2019	1 out of 1
Stuart Ellis	Director	Industry based skills	AFAC		4 out of 5
Kathy Gramp	Director	Finance and governance	Independent		5 out of 5
Lee Johnson	Director	Industry based skills	Independent		5 out of 5
Commissioner Craig Lapsley	Director	Industry based skills	Emergency Management Victoria	Resigned August 2018	0 out of 1
Mark Croweller	Director	Industry based skills	Dept of Home Affairs		4 out of 5
Prof Alistar Robertson	Director	Research	Independent	Resigned April 2019	4 out of 4
Naomi Stephens	Director	Industry based skills	Office of Environment and Heritage, NSW		4 out of 5
Karl Sullivan	Director	Industry based skills	Insurance Council of Australia		5 out of 5
Doug Smith	Director	Industry based skills	Queensland Fire and Emergency Services		5 out of 5
Paul Smith	Director	Industry based skills	Country Fire Authority	Resigned June 2019	2 out of 2



GOVERNANCE

COMMITTEE MEMBERS

The Board has two committees that each meet at least twice a year:

- **Audit Risk and Compliance Committee** - oversees corporate governance, audit responsibilities, finance, compliance and risk management.
- **Research and Utilisation Committee** - ensures research conducted meets the strategic aims of the CRC and the needs of end-users, and is responsible for providing strategic advice on the overall development of the CRC's postgraduate program and new educational initiatives. The committee also advises on the strategy for research adoption.

BOARD MEETINGS

DATE	CITY
August 2018	Brisbane
September 2018	Melbourne
November 2018	Perth
February 2019	Hobart
May 2019	Adelaide

NAME	ROLE	KEY SKILLS	INDEPENDENT/ ORGANISATION	COMMITTEES
Kathy Gramp	Chair	Finance and governance	Independent	Audit Risk and Compliance Committee
Lee Johnson	Member	Industry based skills	Independent	Audit Risk and Compliance Committee
Naomi Stephens	Member	Industry based skills	Office of Environment and Heritage, NSW	Audit Risk and Compliance Committee
Prof Alistar Robertson	Chair	Research	Independent	Research and Utilisation Committee
Lee Johnson	Member	Industry based skills	Independent	Research and Utilisation Committee
Stuart Ellis	Member	Industry based skills	AFAC	Research and Utilisation Committee
Dr Rob Webb	Member	Industry	Bureau of Meteorology	Research and Utilisation Committee
Heather Stuart	Member	Industry based skills	New South Wales State Emergency Service	Research and Utilisation Committee
Georgie Cornish	Member	Industry based skills	Country Fire Service, South Australia	Research and Utilisation Committee
Prof Liz Sonenberg	Member	Research	University of Melbourne	Research and Utilisation Committee
Jeremy Fewtrell	Member	Industry based skills	Fire and Rescue New South Wales	Research and Utilisation Committee

GOVERNANCE

RESEARCH PROGRAM LEADERS

For more details on the research leaders, end-users and project aims, see the full Research Program at www.bnhcrc.com.au/research.

NAME	ORGANISATION
Prof Holger Maier	University of Adelaide
Prof Roger Jones	Victoria University
Prof David Pannell	University of Western Australia
Dr Jessica Weir	Western Sydney University
Dr Timothy Neale	Deakin University
A/Prof Michael Eburn	Australian National University
Dr Katharine Haynes	Macquarie University
Dr Thomas Lorian	Macquarie University
Dr Briony Towers	RMIT University
Dr Melanie Taylor	Macquarie University
Dr Ilona McNeill	University of Melbourne
Prof Vivienne Tippet	Queensland University of Technology
Prof David Johnston	Massey University
A/Prof Chris Bearman	CQUniversity
Dr Tariq Maqsood	RMIT University
Prof Michael Griffith	University of Adelaide

NAME	ORGANISATION
Dr Trent Penman	University of Melbourne
Dr Thomas Duff	University of Melbourne
Dr Melissa Parsons	University of New England
Dr Ross Bradstock	University of Wollongong
Dr Karin Reinke	RMIT University
Dr Matthew Mason	University of Queensland
Dr Krishna Nadimpalli	Geoscience Australia
A/Prof John Ginger	James Cook University
Prof Sujeeva Setunge	RMIT University
Prof John Handmer	RMIT University
Dr Michael Jones	University of Wollongong
Steve Sutton	Charles Darwin University
Adj Prof Jeremy Russell-Smith	Charles Darwin University
Dr Scott Nichol	Geoscience Australia
Prof Charitha Pattiaratchi	University of Western Australia
Dr Marta Yebra	Australian National University

NAME	ORGANISATION
Dr Jeff Kepert	Bureau of Meteorology
A/Prof Valentijn Pauwels	Monash University
Dr Imtiaz Dharssi	Bureau of Meteorology
Dr Khalid Moinudolin	Victoria University
Dr Tina Bell	University of Sydney
A/Prof Jason Sharples	University of New South Wales
Prof Alan March	University of Melbourne
Harald Richter	Bureau of Meteorology
Celeste Young	Victoria University
Prof Bruce Rasmussen	Victoria University
Andrew Gissing	Risk Frontiers
Lisa Gibbs	University of Melbourne
Dr Blythe McLennan	RMIT University
Dr Patrick Dunlop	University of Western Australia
Prof David Lawrence	University of Western Australia



GOVERNANCE

KEY STAFF

NAME	POSITION/ROLE	TIME
Dr Richard Thornton	Chief Executive Officer	1.0
Dr John Bates	Research Director	1.0
David Bruce	Communications Director	1.0
Trevor Essex	Company Secretary/ Business Manager	0.3
Leanne Beattie	Executive Assistant	1.0
Sarah Mizzi	Partnership Development Manager	1.0
Dr Desiree Beekharry	Core Research Program Manager	1.0
Nathan Maddock	Communications Manager	1.0
Vaia Smirneos	Communications Officer (Events) - returned from maternity leave March 2019	0.2
Amy Mulder	Communications Officer	1.0
Dr Matthew Hayne	Research Utilisation Manager	0.5

NAME	POSITION/ROLE	TIME
Loriana Bethune	Research Utilisation Manager - on maternity leave	0.2
Greg Christopher	Research Utilisation Manager - secondment from Emergency Management Victoria	0.8
David Boxshall	Research Services Team Leader	1.0
Kelsey Tarabini	Research Utilisation Program Support Officer	1.0

NAME	POSITION/ROLE	TIME
Nicklaus Mahony	Research Program Support Officer	1.0
Catrin Harris	Graphic Designer	0.4
Kate Eagles	Financial Controller	0.3
Anna Nikitina	Finance Officer	0.3
Costa Haritos	Communications Assistant - Intern from January 2018 to January 2019	0.5
Gabriel Zito	Communications Assistant - Intern from January 2019	0.5



CRC staff 2019.

GOVERNANCE

PARTICIPANTS

PARTICIPANT NAME	ORGANISATION TYPE
Department of Home Affairs	Australian Government
Bureau of Meteorology	Australian Government
Geoscience Australia	Australian Government
ACT Emergency Services Agency	State Government
ACT Territory and Municipal Services	State Government
Fire and Rescue NSW	State Government
Office of Environment and Heritage, NSW	State Government
NSW Rural Fire Service	State Government
NSW State Emergency Service	State Government
NT Fire and Rescue Service	State Government
Queensland Fire and Emergency Services	State Government
SA Fire and Emergency Service Commission	State Government
Tasmania Fire Service	State Government
Country Fire Authority, VIC	State Government
Metropolitan Fire and Emergency Services Board	State Government
Department of Environment, Land, Water and Planning, VIC	State Government
Emergency Management Victoria	State Government
Victorian State Emergency Service	State Government
Department of Fire and Emergency Services, WA	State Government
Department of Parks and Wildlife, WA	State Government

PARTICIPANT NAME	ORGANISATION TYPE
New Zealand Fire Service Commission	International
Australian National University	University
CQUniversity	University
Charles Darwin University	University
Deakin University	University
James Cook University	University
Macquarie University	University
Monash University	University
Queensland University of Technology	University
RMIT University	University
University of Adelaide	University
University of Melbourne	University
University of New England	University
University of Southern Queensland	University
University of Sydney	University
University of Tasmania	University
University of Western Australia	University
University of Wollongong	University
Western Sydney University	University
Victoria University	University



GOVERNANCE

PARTICIPANT NAME	ORGANISATION TYPE
AFAC	Industry
Australian Red Cross	Industry
Fire Protection Association Australia	Industry
RSPCA QLD	Industry
University of Canberra	University
Volunteering Queensland	Industry
Flinders University	University



Panel session at the 2019 Australasian Natural Hazards Management Conference.

COLLABORATION

END-USERS AND RESEARCHERS

Integrated project teams of researchers and end-users are in place for every project to ensure the projects are informed by, and remain focused on, the needs of the partner organisations. Ongoing and active engagement between researchers and end-users is considered crucial to the success of each project.

End-user representatives are essential to long-term project success through:

- Framing of research questions, development of a common language within the Integrated Project Team, ongoing review of the research questions, facilitating access to data/information/people to support project goals, identification of potential use of research outputs, and the development of a roadmap taking the research through to utilisation.
- Providing advice to the project, as it develops, on how the research can be made more valuable to end-users.

The number of end-user participants varies across the projects, with up to 40 in some.

The end-user representatives on projects, wherever possible, involve representation:

- From across states and territories
- From across agencies focused on various hazard emergencies
- From across different types of participants, such as policy departments, operational agencies and non-government organisations.

The spread of representation is important to the long-term success of the CRC in delivering nationally valuable research outcomes.

In addition, some end-users are linked with multiple projects within the CRC, and so provide an important avenue for communication and synergies between projects.

This is further enhanced by the fact that a number

of those representatives also meet in forums outside of the CRC, such as AFAC groups, providing further opportunities for cross pollination between projects.

COLLABORATION IN PRACTICE

Examples of recent collaboration between end-users and researchers include:

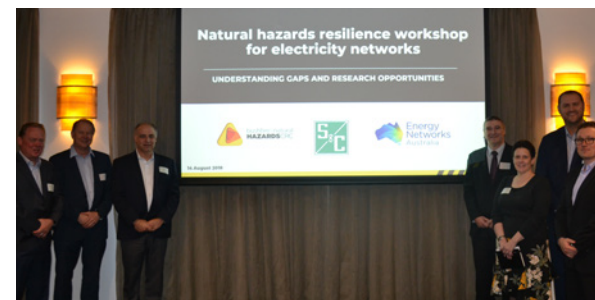
National Research Priorities

The National Research Priorities for natural hazards emergency management are the culmination of an extensive series of workshops with end-user stakeholders and other relevant groups to explore major issues across hazards, resilience and the community. They were mostly conducted in collaboration with organisations that are major representative stakeholders, including AFAC and the Bureau of Meteorology, but external organisations are also involved. The most recent workshop was with electricity networks, organised by the CRC through S&C Electric Company and Energy Networks Australia. Priorities for that sector were released in May 2019.

Research Advisory Forums

These were held in capital cities across the country, in partner university venues and at fire and emergency service agency offices. These full day events provided the opportunity for CRC partners, project leaders and end-users to gain a complete overview of all the research activities within the CRC, and through workshop activities continue the process of reviewing project progress shaping the future direction of each project. Around 80-100 people attended each forum with roughly half researchers and half end-user representatives.

In addition to these forums, the research groupings have maintained regular close communication through avenues such as face-to-face meetings and teleconferences.



Speakers at the workshop on research priorities for electricity networks, August 2018.



Panellists at the forum for International Day for Disaster Risk Reduction 2018 in Adelaide.

Southern and Northern Australia Fire Managers forums

These meeting for southern fire managers was convened as a teleconference by the CRC and AFAC. All the northern Australian fire and land management agencies met in Darwin.

These forums include participation from AFAC, the Bureau of Meteorology, many universities and all fire and land management agencies across the regions. The Bushfire Seasonal Outlooks were formulated and released in conjunction with these forums. These Outlooks are used by fire and emergency service



COLLABORATION

agencies to work with relevant state and federal governments to prepare for the bushfire season.

United Nations International Strategy for Disaster Reduction

The CRC is the national coordinator for a United Nations backed committee that promotes and supports disaster risk reduction research programs and activities around the world.

This Integrated Research on Disaster Risk (IRDR) National Committee for Australia is sponsored by the United Nations International Strategy for Disaster Reduction, the International Council for Science and the International Social Science Council. It was formed to address the major global challenges of natural and human-induced environmental hazards. Through this arrangement there are many opportunities for the CRC to align some of its projects with the international disaster risk reduction strategy. Researcher, Prof John Handmer, is Chair of the IRDR Scientific Committee. Researcher Prof Kevin Ronan represents the CRC at several IRDR workshops and meetings on the implementation of the Sendai Framework for Disaster Risk Reduction.

Science Advice

The CRC International Science Advisory Panel, which provides strategic advice and review of the CRC research program to the Board of the CRC is chaired by Prof Carmen Lawrence of the University of Western Australia and includes Dr Mark Finney of the US Forest Service, Prof Gavin Smith of North Carolina State University, and Anthony Bergin of the Australian Strategic Policy Institute.

National resilience

The Australian Institute for Disaster Resilience is a partnership between the Australian Government's Department of Home Affairs, the CRC, AFAC and the Australian Red Cross. The Institute delivers products and services around the country that

have been developed by, and for, the emergency management sector. The CRC has taken a lead role in the Institute's *Australian Journal of Emergency Management*.

National fire danger

The CRC has continued to take a leading role in the development of the science behind a new national Fire Danger Rating System, along with government and fire agency partners. Approximately 10 CRC projects are expected to contribute to different aspects of an enhanced Fire Danger Rating System. The CRC, through its Research Director, is a formal member of the National Fire Danger Ratings Board, which reports to the Australia New Zealand Emergency Management Committee.

Staff connections

The CEO is a member of the National Flood Risk Advisory Group, a sub-group of COAG's Australian

and New Zealand Emergency Management Committee. He is a member of the Forest Fire Management Group, a committee of Australian and New Zealand forest management agencies reporting to the Forest Products Committee of COAG; a member of the Victoria University Industry Advisory Board for the Centre for Environmental Safety and Risk Engineering; a member of the CRC Association Board; on the science advisory panel for the New Zealand Resilience to Nature's Challenges National Science Challenge; and, a member of the editorial advisory board of the *International Journal of Wildland Fire*. He also reviews scientific papers for several international journals.

The Research Director is Editor-in-Chief of the *Australian Journal of Emergency Management*.

The Communications Manager is a board member on the International Association of Wildland Fire and is Chair of the Editorial Advisory Committee for its magazine *Wildfire*.



Field trip to the Tiwi Islands in the Northern Territory as part of the Northern Australia Fire Managers Forum, April 2019.

FUTURE PLANS AND TRANSITION ARRANGEMENTS



Rob de Castella AO MBE, Director of the Indigenous Marathon Foundation, opened the 2019 Australasian Natural Hazards Management Conference in June in Canberra.

The CRC developed its first Transition Plan in June 2016, which explored the broad intent around possible directions. Since that time the direction of the CRC has started to crystallise to a preferred direction following extensive discussion within the Board and with the broader stakeholder community.

At the first meeting of the CRC Board in 2013 the future beyond the current CRC program funding agreement was discussed and it has been a regular discussion topic since that time.

The following tenets have been adopted by the Board to guide the planning for the future:

The CRC entity (Entity), that is the CRC company, will transition into an Entity that has a similar vision and mission to the current CRC, hence:

1. The Entity's program of activities, will not close at the end of the current Commonwealth funding;
2. There will be more research needed by the industry sector and the Entity should continue in some form;
3. Funding from its current core partners, including the Commonwealth, will be required, to make the Entity sustainable in the longer term;
4. The future scope of research will be established by its funding partners.

KEY ASSUMPTIONS

It is clear that the CRC is not eligible for refunding in its current form from the CRC Programme as the guidelines do not allow this and is planning on this basis.

It is also taken as a given that there cannot be a transition if the CRC cannot demonstrate value to its core partners by delivering on its commitments over the remainder of the current funding period. This is a fundamental point, but it is consistent with all current activities and therefore considered as business as usual for the CRC.

PLANNING

To successfully transition in July 2021, the CRC has been in active discussions with all its partners and potential partners to confidently make the transition

investment decisions. The current budgetary decisions taken by the Board have assumed that the 2020-2021 year is a wind-down year. Funding has been allocated to wind-up expenses.

In early 2019 the CEO presented a working discussion paper outlining the broader, aspirational model for a future institute. This was followed by a joint meeting of the Boards of both the CRC and AFAC, resulting in a joint resolution on the importance of ongoing research to support the sector beyond the current funding period.

The Boards agreed that the AFAC member agencies, emergency management sector more broadly and importantly, the communities they serve and protect, have all derived great value from the investments in the CRC and its predecessors.

The Boards agreed that, given the growing and evolving risk landscape in Australia, putting increasing strain on the emergency management sector and affected communities, it is vital to continue a national investment in a sustainable, collaborative research capability and to maintain the capacity developed over the past 15 years.

The Boards agreed that the sector needs to act quickly to maintain the existing capability prior to the imminent completion of the current CRC funding. This will involve securing AFAC agency, State/Territory and Commonwealth funding and support, together with strong buy-in from universities and individual researchers, requiring the CRC and AFAC agencies (collectively and individually) to prosecute the case.

The Boards established a joint working group to continue the development of the business case for ongoing, collaborative investment to research in support of the sector.

STRENGTH IN THE FACE OF HIGH WINDS

Most of the damage from cyclones and severe storms occurs to older houses, but much can be done to reduce this damage. Research through the *Improving the resilience of existing housing to severe wind* project, led by Prof John Ginger, Dr David Henderson and Dr Daniel Smith at James Cook University, has shown that improvements can be made that can strengthen houses to reduce damage, as well as save money through the reduction of insurance premiums.

To help homeowners make these improvements, the Queensland Government has created the Household Resilience Program based on findings from the research. The Program, which is available to Queensland homeowners who reside in recognised cyclone risk areas in a home built prior to 1984, will provide a grant of up to 75 per cent of the cost of improvements, with a maximum of \$11,250, allowing for the upgrade of the roof structure, protection of windows and strengthening doors – key areas at risk of damage during strong cyclonic winds.

The Household Resilience Program by the Queensland Department of Housing and Public Works took out the Government category at the recent 2019 Get Ready Queensland Resilient Australia Awards.

The insurance industry is also benefiting from the research, with Suncorp Insurance learning more about the vulnerability of the houses in northern Queensland, explained Jon Harwood from Suncorp. The insurance company knew that some types of houses built before 1980 were the most



Research has informed a new grant scheme that is retrofitting homes in north Queensland to mitigate against a tropical cyclones. Photo: Michael Dawes (CC BY-NC 2.0.)

vulnerable to cyclones, as they were constructed before the building code was developed for cyclones, but they were surprised by the other findings generated by the study.

“What we were surprised about was the water ingress failures across all ages of houses, whether they were built to code or not,” Jon said.

A majority of claims – 60 per cent – were due to a lack of preparation. These were small claims that could have been easily avoided if the appropriate mitigation action was taken before a cyclone.

The research recommended a range of retrofitting options that reduced the chances of damage occurring.

“The research gave us a clear evidence base to show that retrofitting and strengthening homes really has a great cost-benefit analysis,” he said.

Suncorp took these research findings and created the Cyclone Resilience Benefit, which rewards homeowners who have undertaken work to strengthen their homes and reduce the chances of damage. More than 30,000 people have accessed the benefit, with the average saving on premiums \$100. Some have saved over \$400.

Queensland Fire and Emergency Services is also benefitting from the study, using findings to improve the work of its rapid damage assessment teams, which operate after major disasters to collect building damage data. This enables a focused and coordinated response, as well as better planning for event recovery. Specialist advice and lessons learnt are also provided by the team at pre-cyclone season briefings for emergency managers across Queensland to QFES, as well as other local, state and federal agencies.

UTILISATION CASE STUDIES



Changing the focus of warnings messages is pivotal to successful action during an emergency. Photo: Dana Fairhead.

BETTER WARNINGS TO ENSURE ACTION

Australian lives are being saved by CRC research that is shaping warnings and public information campaigns to prepare and protect communities threatened by flood, fire, heatwave and other natural hazards.

The insights from researchers at the Queensland University of Technology are equipping emergency service agencies around Australia with better-targeted long-term public safety

campaigns as well as evidence-based warning messages delivered to at-risk populations in the face of imminent natural hazard threats.

The goal of the project was to save lives and empower communities to act to ensure their safety, by improving community warning messages.

The impact of the *Effective risk and warning communication during natural hazards* project has been dependent on close collaboration with the emergency service agencies from the beginning. This allowed the work to be shaped and directed at important stages.

In 2019, this research - combined with separate CRC work that drew lessons from analyzing human and property losses in floods - was recognized for its contribution to saving Australian lives with the Cooperative Research Centres Association's Excellence in Innovation award.

Through active testing of the wording and structure of warning messages agencies have a better understanding of how messages are understood and translated into direct action. The team, led by Prof Vivienne Tippet, has supported broader initiatives in emergency communications and warnings, not just for individual organisations,



UTILISATION CASE STUDIES

but also at the national level by providing reviews and assisting with the development of evidence-based warnings doctrine.

Researchers contributed to the development of the *National Emergency Management Handbook on Public Information and Warnings* and the companion guide *Warning Message Construction: Choosing Your Words*, both published by the Australian Institute for Disaster Resilience. The publications drew directly on the research to give guidance on the key considerations for writing effective warning messages, including structures and language styles for specific audiences, such as high-risk groups and non-English speaking communities.

Warnings save lives and empower people to act, says Amanda Leck, Executive Director, Australian Institute for Disaster Resilience.

“Communities under the immediate threat of fire, flood, storm or cyclone are now likely to be much safer because fire and emergency services are now able to warn them, in a way that communities are more likely to take action. This is because of the research that’s been conducted.

“What was missing previously was an evidence-base to guide emergency services in how to structure warning messages in a way that the community is much more likely to take action and take the action that emergency services are asking of them in what is often a very high stressful environment for those community members.”

State-based emergency service agencies have drawn from the project and have collaborated at the national level to determine a style and structure for their official public messages.

Queensland Premier Anastacia Palaszczuk

credited the warnings research, combined with CRC fire mapping tools, with saving lives and the township of Gracemere, in the November 2018 fires. “The reason why we’ve put the map out is to show very clearly that Gracemere was directly in the line of this fire,” she said. “That is why we took the action that we did to evacuate the town and thankfully the town was defended and containment lines are now well established.” (29 November 2019, *Courier Mail*).

The Bureau of Meteorology has recently completed a review of its suite of national warnings across 11 warnings services based on the attributes contained in Australia’s Total Warning System, the development of which was based on the CRC research for the *Public Information and Warnings Handbook*.

Changing the focus of warning messages has been the key, believes Anthony Clark, Director Corporate Communications at the New South Wales Rural Fire Service.

“This research is a really important piece of the puzzle. It is a game-changer for us as we had been sending out information and warnings in a format that met the needs of the emergency services. This research tips the process on its head and puts the community first and foremost. Emergency services are forming warning messages with the community in mind, so we can get the best possible response from the community in a time of disaster,” Anthony says.

In South Australia, the Country Fire Service has used the findings to change its warning messages, ensuring they are simpler and easier to understand, explains Fiona Dunstan, Manager Information Operations.

“We’ve looked at our warnings and restructured

and reprioritised the content to make sure the critical information was upfront. This ensures timely, targeted and meaningful information is provided to the community,” Fiona says.

Country Fire Service warnings are now much shorter – previously they were three pages long. Now the vital information is on one page.

The Queensland Fire and Emergency Services have used the research findings to influence community behaviour when the communities’ capacity to act rationally may be impaired.

“The research results are highly valuable and provide emergency service agencies with sound principles to follow”, explains Hayley Gillespie, Executive Manager Media at QFES.

“These include using clear, direct language, structuring information in easily understood formats, and linking agency communications to other credible information sources. All of these strategies, and others the research covers, will help people to quickly make sound decisions that could save lives and property.”

The study has seen close collaboration between the research team and the emergency services sector, with other organisations to have their warning information reviewed include the Inspector-General of Emergency Management Queensland, Emergency Management Victoria, Victoria State Emergency Service, Country Fire Authority, the Department of Fire and Emergency Services Western Australia and the Bureau of Meteorology.

UTILISATION CASE STUDIES



Two out of three Australian homes have a pet, but they are one of the most overlooked parts of preparing for an emergency. Photo: Jenny Bigelow.

EMERGENCY PLANNING FOR ANIMALS

Australians love their pets – and this influences how people behave during an emergency, with emergency services incorporating findings from research to influence their plans and policies during disasters.

Led by Dr Mel Taylor from Macquarie University, the *Managing animals in disasters* project identified best practice approaches to animal emergency management. This has given emergency management agencies the data they needed to make better informed decisions on planning and targeting of resources.

While the research phase of this work is complete, there is a strong utilisation focus, with the team actively engaged with emergency service agencies, government departments and local community groups.

Dr Taylor is a regular attendee of community events to promote research outcomes, including the Sydney Dog Lovers show, Horse Owner Emergency Preparedness Open Day supporting NSW State Emergency Service and 'Giddy-up Get Ready Huon!' hosted by Tasmania Fire Service.

Working with the Blue Mountains Animal Ready Community, a range of emergency planning resources have been developed to highlight the importance of planning for animals during emergencies. The resources have been used by 23 New South Wales Rural Fire Service brigades across the Blue Mountains, as well as by the Springwood Neighbourhood Centre and the Mountains Community Resource Network. A community guide for establishing an animal ready community is now in development.

Building on this was Blue Mountains Animal Ready Community's first community seminar, held in October 2018. The project team was integral to the involvement of the seminar, which saw over 60 people attend to learn more about how to manage their small and large pets, livestock and wildlife during an emergency, as well as how to best be prepared beforehand.

Also in the Blue Mountains, the team partnered with the Winmalee Public School, with a student art competition developed into a book to reinforce why animals matter and why they need to be included in emergency plans.

In Tasmania, animal populations have been mapped in partnership with the Tasmania Fire Service and the Department of Primary Industries, Parks, Water and Environment. This has informed evacuation planning, traffic management plans and capacity planning.

RSPCA Queensland has used the research

to inform its policies, while in Victoria, the Department of Environment, Land, Water and Planning has used the findings to inform its risk assessment processes.

Horse SA has also used the research to support its emergency planning and gain funding for appropriate equipment, explains the organisation's Executive Officer Julie Fielder.

"This research has provided evidence which we have used to advocate government around planning and has helped us shape our messages to horse owners during emergencies," she says.

Dr Taylor was presented with the CRC's annual award in 2018 for her outstanding research on managing animals in disasters.

Nationally, the Australian Institute for Disaster Resilience has drawn on the research to develop a section on animal management in its updated evacuation planning handbook.

State animal emergency management plans at three primary industry departments – the Victorian Department of Economic Development, Jobs, Transport and Resources, Western Australia Department of Primary Industries and Regional Development and South Australian Department of Primary Industries and Regions – have also been revised in consultation with the team.

The research has also received several awards in recognition of its success, taking out the inaugural Emergency Media and Public Affairs conference research award as leading research making a difference in public safety in 2018, and as an integral part of Blue ARC's highly commended award in the NSW community category at the 2018 Resilient Australia Awards.



UTILISATION CASE STUDIES

SHARING THE RISK

Assessing risk ownership for managing natural hazards is complicated, particularly as natural hazard risks can resonate across long timeframes and have multiple organisations responsible. Research is helping government and emergency management agencies identify and allocate ownership of risks, how risk owners are responsible, and what they can do to manage them.

Through the *Mapping and understanding vulnerability and risks at the institutional scale* project, led by Prof Roger Jones and Celeste Young at Victoria University, a framework has been developed to support the better allocation of risk ownership as part of strategic planning and risk assessment activities. Developed in consultation with CRC partners, the Risk Ownership Framework for Emergency Management Policy and Practice uses a values-based approach to provide a starting point for understanding and clarifying risk ownership as part of strategic risk planning and assessment activities.

Emergency Management Victoria has incorporated key elements of the framework into the emergency risk assessment process that is used to assess emergency risks across the state, enhancing emergency risk management activities. Applicable to the all communities/all-hazards model, the research has provided clarity for shared responsibility as an important element of managing risks, providing EMV with a method for identifying disparate risk owners at different stages, beyond the agencies that have traditional emergency management roles.



Assessing risk ownership for managing natural hazards is complicated, particularly as natural hazard risks can resonate across long timeframes.

This means that the research will be helping to guide priority projects and programs for risk mitigation.

The research is also being referenced at the federal level, informing disaster policy work for Emergency Management Australia, and changing the way that people think about risk ownership.

Key elements of the process have been mapped to the risk assessment process in the National Emergency Risk Assessment Guidelines. Greater application of the risk ownership process is expected if the key concepts of the research are integrated into the guidelines, or published as a companion document.

The team has also worked as part of a collaborative partnership with the National Resilience Task Force, part of the Commonwealth Department of Home Affairs, contributing to the Australian Vulnerability Profile, alongside conducting a policy briefing for the Commonwealth Department of Environment.

The research has also been recognised internationally, taking out the best poster award at the 2017 European Climate Change Adaption conference in Glasgow, while the UK Climate Impacts Programme invited the project team to present at their adaption in practice series as part of their 20th anniversary celebrations.

UTILISATION CASE STUDIES



Measuring the intangible benefits of prescribed burning is assisting agencies to better measure the impacts on ecosystems and peoples lives. Photo: Veronique Florec.

INTANGIBLE VALUE

Not everything that is important can be assigned a dollar value; just as the benefits of mitigating risk do not always add up to monetary values. Intangibles are important to land managers and community members alike, but how are these values, such as protecting biodiversity, taken into account when making land management decisions?

The 2015 Productivity Commission's report on natural disaster funding arrangements in Australia finding that there is an over-investment in post-disaster reconstruction and an under-investment in mitigation. In 2017, the Australian Business Roundtable for Disaster Resilience and Safer

Communities noted the soaring total costs of disasters and urged more targeted investment in infrastructure and community resilience programs.

The *Economics of natural hazards* project led by A/Prof Atakelty Hailu and Dr Veronique Florec at the University of Western Australia has helped natural hazards managers justify the use and allocation of resources for mitigation efforts.

The study has developed a tool for generating estimates of non-financial benefits. It can perform a quick analysis for natural hazards mitigation options and provide a quick and rough overview of the value for money for each option. With this information managers can identify the options for the best-chance business cases and then prioritise the type and quality of information needed to improve decisions.

Researchers have undertaken an integrated economic analysis of management options for floods in Adelaide and for prescribed burning in private land in South Australia's Mount Lofty Ranges. This value tool allows land managers to assess intangible benefits such as lives saved, health and environmental benefits, and social values. A small prescribed burn might cost a lot of money, and take time and resources, but what the burn protects cannot be measured just by money.

Ed Pikusa, the Principal Risk and Audit Coordinator at the South Australian Department for Environment and Water, is the lead end user overseeing the development of the project. "In the last year, this project has turned the corner from research to product delivery. The website and guidelines on the Value Tool make the outputs of one part of this research project accessible and transparent for practitioners."

This has enabled South Australia's Department of Environment and Water to not only take into account the costs of undertaking prescribed burning on private land but to also effectively measure the benefits to ecosystems, lives and the way of life of people who live in the area.

Previously, these non-market values were not taken into account, underselling the benefits provided by prescribed burning in some areas.

This work has benefited other CRC research, with the tool used by a Geoscience Australia team to inform the cost-benefit analysis of flood mitigation work in Launceston.



UTILISATION CASE STUDIES



Research is informing who drives through floodwater and why they do it, which is assisting agencies to create better awareness campaigns. Photo: Rex Boggs (CC BY-ND 2.0).

LOOKING BACK CAN PREVENT FUTURE FLOOD DEATHS

CRC research is informing community flood warning campaigns, emergency services training and national policy initiatives, with the project *An analysis of building losses and human fatalities from natural hazards* study led by Dr Katharine Haynes at Risk Frontiers, Macquarie University, investigating the circumstances of all flood fatalities in Australia from 1900 to 2015.

The study explored the socio-demographic and environmental factors surrounding the 1,859 flood fatalities over 115 years, finding distinct trends in relation to gender, age, activity and the circumstances of the death. These trends were analysed in the context of changes to emergency management policy and practice over time.

The research has informed community flood warning campaigns, emergency services training and national policy initiatives, with emergency services able to target warning messages to high-risk groups and high-risk behaviours based on the evidence from over a century of fatalities, injuries and building losses. These included children, teens, young adults and their parents; those who drive into floodwaters; and, 4WD owners.

The New South Wales State Emergency Service has used the findings of the research for its *FloodSafe* community campaigns and training, while the Queensland Fire and Emergency Services has used it to inform its *If it's Flooded, Forget it* campaign.

The 2017 campaign by the NSW State Emergency Service featured a series of videos, with real people recounting their experiences of attempting to drive through floodwater, the consequences of their actions, and why no one should ever drive through floodwaters. Each video was backed by

data from the research showing who is most at risk during a flood.

Andrew Richards at the NSW State Emergency Service says it was vital that the campaign was backed by research.

"As a consequence of risky behaviour, flood fatalities and rescues are a constant issue for emergency services. We are trying to increase public safety, to educate people to make the safe choice, and we think that the best way to achieve this is by highlighting true stories about what has happened to people when they have tried to drive through floodwaters," Andrew said.

"The research from the CRC was key as it showed to us where we needed to focus our safety efforts.

"Thanks to the research we were able to target effective audiences that are prone to driving into floodwater, as well as providing statistics and evidence to back up our campaigns," he said.

In 2019, this research, combined with separate CRC work that analysed the structure and tone of warnings messages, was recognized for its contribution to saving Australian lives in natural hazards with the Cooperative Research Centres Association's Excellence in Innovation award.

The research has also made its mark on a national level, contributing significantly to investigations into preventing flood fatalities by the Prevention of Flood Related Fatalities Working Group of the Community Engagement Sub-committee of the Australia-New Zealand Emergency Management Committee. It was recognised by the Emergency Media and Public Affairs conference as leading research making a difference in public safety, receiving a highly commended research award in 2018.

A SEASONAL VIEW OF BUSHFIRE

Strategic decisions on resources, prescribed fire management and community warnings have for the past 16 years been underpinned by the Bushfire and Natural Hazards CRC's Seasonal Bushfire Outlook.

Governments and fire authorities are using the Outlook for planning purposes in the lead-up to their bushfire seasons, including refining their public messages that communicate bushfire risk and highlight areas with the highest potential for fire.

The Bushfire and Natural Hazards CRC leads the preparation of the Outlook in close consultation with the Bureau of Meteorology, AFAC, and emergency service agencies in each state and territory.

The Outlooks cover the Northern and Southern fire seasons and are published annually around June, September and November. In 2020, the Outlook will shift to a quarterly release to better reflect the year-round nature of fire management and operations across Australia.

The seasonal outlooks serve a range of purposes and are a critical component in raising community awareness about the coming fire season. A well-attended and widely broadcast media event with all of Australia's fire chiefs is held annually at the AFAC Conference as part of the statement's public release providing a timely opportunity to reach the community and other stakeholders. In recent years, as testament to the growing reliance on the Outlook, the launch has been livestreamed on ABC, Sky and other media channels, and

followed up with extensive media coverage across print, radio, television and online.

The fire outlooks began in 2003 under a Bushfire Cooperative Research Centre project with Dr Graham Mills from the Bureau of Meteorology, drawing on experience from the US through Dr Tim Brown, of the Desert Research Institute. The primary information in the product consists of a map of seasonal "bushfire potential", with extensive commentary and maps of climate conditions and forecasts. Areas where the fire potential is below normal, normal or above normal are shown in three colours.

The outlooks are prepared at two annual (north and south) workshops by integrating climate forecasts with extensive knowledge of the current fuel state and previous fire seasons to produce an overview for the upcoming fire season. The workshops consider the weather, landscape conditions and cross-border implications leading into the main fire season.

Fire season potential depends on many factors. Rainfall amount, location and timing of rainfall in the period leading up to the fire season are critically important, and contribute to fuel loads, dryness and fuel availability. The temperature and rainfall outlooks for the next few months are crucial factors for influencing the development of fire potential. The actual impact of fire within a season will depend on exposure to assets (such as houses and other infrastructure) and to people, community preparedness, the availability of firefighting resources and more random factors such as ignition sources. Fuel loads show much variability and are a product of past fire history, rainfall over one or more preceding seasons and land use, such as grazing and agriculture.

The Seasonal Bushfire Outlook is used by governments and fire authorities to make strategic decisions on resource planning and prescribed fire management for the upcoming fire season. How agencies and governments make use of the statement for planning, and its influence on decisions varies from jurisdiction to jurisdiction. One key use is as a tool to justify significant investment in resources such as additional firefighters, vehicles and aircraft. Another is to increase community preparedness campaigns in areas of high likelihood of fire.

The Outlook is widely distributed among related organisations and community groups for local use. The Australia Red Cross uses the Outlook to produce hazard and vulnerability data maps for its Emergency Services Managers around Australia as part of its seasonal preparedness planning so resources can be shifted to areas with higher fire potential. ABC Emergency uses the Outlook to schedule training sessions for its journalists working in potentially hazardous areas around the country based on the priorities highlighted by the Outlook.



UTILISATION CASE STUDIES



The Seasonal Bushfire Outlook is used by fire agencies such as the NSW Rural Fire Service to educate communities about their bushfire risk. Photo: NSW Rural Fire Service.

SCHOOL-BASED EDUCATION FOR DISASTER RISK REDUCTION

Educating children and youth about disaster risk reduction and resilience is now front and centre around Australia, based on research that has identified the valuable role that children play in the safety of their households and communities.

The importance of educating children on hazards and disasters was recognised both in the 2009 Victorian Bushfires Royal Commission and the 2011 National Strategy for Disaster Resilience. The CRC research project *Child-centred disaster risk reduction*, led by Prof Kevin Ronan (CQUniversity) and Dr Briony Towers (RMIT University), has evaluated disaster risk reduction and resilience programs in Australian primary and secondary schools to find out how these programs contribute to the mitigation and prevention of disaster impacts on lives and property.

Bushfire education has been evaluated in several states, including New South Wales, Victoria and Western Australia. In Victoria, the Country Fire Authority and State Emergency Service used the research to design a student-centred, inquiry-based, disaster resilience education program for students at year levels 7, 8 and 9. The program was assessed to inform strategies for scaled implementation in schools across the state.

CFA's Survive and Thrive program for students in Grades 5 and 6 has also been evaluated in both Anglesea and Strathewen, with the findings

informing the development of community-based approaches to bushfire education to specific high-risk areas around Victoria. The Strathewen component has also demonstrated the value of bushfire education for children in fire affected communities and will provide a guiding model for future recovery programming. In recognition of this effort, Strathewen Primary School won the 2019 Resilience Australia National Schools Award.

Harkaway Primary School in Victoria is learning from the success of the Firestorm program at St Ives North Public School in New South Wales, and implementing a similar, project-based program, which is providing a valuable opportunity to study the processes and outcomes of this approach.

NSW Fire and Rescue have used the research to review their school-based Fire ED program. Based on this, firefighters now know the specific topics they need to educate children on to increase fire awareness and safety.

The NSW Rural Fire Service is also using the skills, knowledge and expertise of the research team in a number of ways. A change in NSW primary school curriculum now sees bushfire studied across the state by years 5 and 6 every two years. To assist in this educational change, the NSW RFS has redeveloped its schools' education webpage to reflect inquiry-based learning principles, with information for teachers and students.

The NSW RFS also drew on the expertise of the research team to inform the development of the 'Guide to Working with School Communities', which supports volunteers and staff to effectively engage primary school students in learning and action for house fire and bushfire safety. The Guide follows the earlier publication of a CRC ebook, based on the same principles that if you educate children on fire safety, families and the

wider community will also benefit.

The Bushfire Patrol program run by the Department of Fire and Emergency Services Western Australia has also been evaluated, with the refined program helping to ensure that children have the knowledge and skills they need to participate in bushfire planning and preparedness in their own homes. In the remote Kimberley region, DFES used the learnings to design a specific education program suitable to such a unique area. The North West Bushfire Patrol program was created to be geographically and culturally appropriate for the area, which has a large Indigenous population. The program covers all year levels of primary school and includes appropriate learning activities for each age group.

The benefits are flowing outside traditional emergency management agencies too. The Australian Red Cross is using findings of a mixed-methods, pre-post study to refine its disaster resilience education program, the Pillowcase Project.

Nationally, CRC researchers are actively engaged in the Disaster Resilience Education for Young People initiative, in partnership with the Australian Institute for Disaster Resilience. This initiative has allowed the project to actively engage with educators from across the country and to contribute to an online resource.

This overall set of evaluations represents stepped change in the first five years of this program of research, with the next steps geared towards enhancing and implementing disaster resilience education in schools, with the goal of providing additional benefits for children, schools, households and communities.



UTILISATION CASE STUDIES



The NSW Rural Fire Service Schools Program is engaging primary school students in learning about effective action for house fire and bushfire safety. Photo: Ben Shepherd, NSW Rural Fire Service.

“WHAT IF” QUESTIONS DRIVE FUTURE POLICY

What if an earthquake hit central Adelaide?

A major flood on the Yarra River through Melbourne? A bushfire on the slopes of Mount Wellington over Hobart?

‘What if?’ scenario modelling by the CRC is helping government, planning authorities and emergency service agencies think through the costs and consequences of various options on preparing for major disasters on their urban infrastructure and natural environments and how these might change into the future.

The CRC research is based on the premise that to reduce both the risk and cost of natural disasters, we need an integrated approach that considers multiple hazards and a range of mitigation options. The *Improved decision support for natural hazard risk reduction* project, is led by Prof Holger Maier and Dr Graeme Riddell at the University of Adelaide.

Four case studies have been completed. Adelaide, Melbourne and the whole of Tasmania were the first group and, based on their success, work began in Western Australia in 2017, funded through the National Disaster Resilience Program. These four applications of UNHaRMED are tailored for the different regions across Australia, in collaboration with relevant State Government agencies in each jurisdiction. Each jurisdiction determined the extent and relevant hazards to include in the software application based on existing risk understanding and data availability. These are summarised below:

South Australia – greater Adelaide. Hazards identified were bushfire, coastal and riverine flooding, and earthquake. The first prototype of the UNHaRMED software application for greater Adelaide was completed and delivered in 2017, and end user training was also conducted at that time. The software has been installed on government computers within the fire management section of the Department of Environment and Water. However, there has been limited usage of the software due to resource constraints and competing priorities. A State Mitigation Trial Exercise was held in August 2019.

Victoria – greater and peri-urban Melbourne. Hazards identified were bushfire, coastal and riverine flooding, and earthquake. The first prototype of the UNHaRMED software application for greater and peri-urban Melbourne has been completed with end user training held in August 2019.

Tasmania – whole of state. Hazards identified were bushfire, coastal flooding, and earthquake. The Tasmanian Government is keen to operationalise and incorporate UNHaRMED into existing systems but currently lack the internal capacity to achieve this. Consequently, the Tasmanian Government plans to employ a person full time for one year to assist with the operationalisation and adoption of UNHaRMED across government agencies in Tasmania.

Western Australia – south-west corner. Hazards identified were bushfire, coastal flooding, and earthquake. A working group has been established within Western Australian Government to determine the best way to integrate UNHaRMED into existing processes. At the national level several early initiatives are

underway including:

- The National Resilience Taskforce in the Department of Home Affairs used the outputs of the project to shape frameworks and develop a national disaster risk reduction capability.
- A project led by the Bureau of Meteorology has used the research products to map national heatwave vulnerability.

The science is drawing wider acclaim too, with the Investor Group on Climate Change highlighting the software modelling as a key tool to help navigate future climate risk.

Taking into account future changes in demographics, land use, economics and climate, the modelling analyses areas of risk both now and into the future, tests risk reduction options, identifies mitigation portfolios that provide the best outcomes for a given budget, and considers single or multiple types of risk reduction options, such as land use planning, structural measures and community education. CRC partners, along with local governments, have been engaged in the entire process, from direction on the hazards to include and feedback on process, to advice on how the modelling will be used when complete and by whom.

In the modelling for Adelaide the expected impacts of these hazards have been modelled from 2015 to 2050 with an annual time step under different plausible future scenarios that were developed by end-users, showing the change in risks in different localities.

The integrated nature and comprehensive data available is exciting, says Mike Wouters, Manager Fire Knowledge and Mapping at South Australia’s Department of Environment, Water.



UTILISATION CASE STUDIES



'What if?' scenario modelling creates a policy wind tunnel, allowing different policy ideas to be tested. Photo: South Australia State Emergency Service.

"We have not had access to this type of technology before," he says.

"We need to be thinking at least a decade ahead, and this research will help us with that."

The powerful nature of the system is its biggest asset, believes Country Fire Authority Deputy Chief Officer Alen Slijepcevic.

"We will need to rely on modelling to help us more and more into the future. We do not have the luxury of waiting 20 or 30 years to assess the impacts of our land management decisions," Alen says.

Agencies will be able to use the system to help

allocate budgets, demonstrating that they are using the best available science to inform decision-making.

This study is the only approach that compares different natural hazards and their mitigation options, while also taking into account long term planning. The ultimate aim is to develop a decision support framework and software system that is sufficiently flexible to be applied to large and small cities around Australia that will help planners from local councils through to state treasury departments answer the vital question on mitigation options that balance cost and impact: 'what is the best we can be doing?'

This project is a clear example of the collaborative process that the CRC is all about. It incorporates findings from other CRC work on recognising non-financial benefits of management and policy for natural hazards, for example, the economic, social and environmental benefits of prescribed burning, the vulnerability of buildings to hazards, such as how they can be made more resilient through cost-effective retrofitting for improved safety, and the benefits and understanding of community resilience efforts like improved warnings, community engagement, education, volunteering and community resilience.

COMPLEX DECISION MAKING AND TEAMWORK WHEN THE HEAT IS ON

Effective decision making and teamwork are essential to ensure incident management teams function to the best of their ability in challenging and high stakes environments. To help improve these skills, practical tools have been developed by the CRC project *Improving decision-making in complex multi-team environments*, led by Associate Professor Chris Bearman at CQUniversity.

A set of teamwork tools (the *Team Process Checklist* and the *Emergency Management Aide Memoire*) cover communication, coordination and cooperation, and include helpful suggestions on how to identify and resolve teamwork problems during complex situations.

The project is also set to release further tools that support people working at the strategic level of emergency management. These tools focus on key tasks that need to be done in state and regional coordination centres.

Emergency services have been engaged throughout development, with information sought from 18 separate agencies ranging from state emergency services, urban fire, rural fire and local councils. Agencies allowed the research team to monitor both real and simulated emergency situations from within incident management centres, as well as providing feedback throughout the prototype

stage. This has led to tools that are tailored specifically for emergency managers.

The tools are flexible and can be used as a health check to ensure the team is functioning effectively, to identify suspected problems, as a debrief tool and as a way to foster better teamwork. They have been used to better manage teams during incidents, to reflect on teamwork during periods of relative calm, and for assessment or debrief during training. The South Australian Country Fire Service, Tasmania Fire Service and New South Wales State Emergency Service have adopted the tools and the Queensland Fire and Emergency Services sought out the expertise of the team in the aftermath of Severe Tropical Cyclone Debbie in 2017 to inform future preparation, response and recovery. Emergency Management Victoria has amended its operational doctrine and has provided the Team Process Checklist to all Real Time Monitoring and Evaluation personnel.

Those who work in incident management teams, strike teams and at regional and state operations centres can see the most benefit, believes Mark Thomason, Manager Risk and Lessons Management at the South Australia Country Fire Service.

“The tools are straightforward, practical and adaptive to the needs of individual emergency managers to ensure their teams are functioning to the best of their ability,” Mark says.

The Tasmania Fire Service used the tools during the 2015-2016 fire season, which saw TFS responding to many major bushfires over two months. The tools helped to ensure communication between different teams was efficient and timely during a highly stressful time.

Jeremy Smith, the TFS Deputy Chief Officer during the fires, highly recommends the tools to other emergency managers.

“These tools have been validated and developed through a body of research. The support they provide for incident management is vital,” Jeremy says.

The project has also developed cognitive decision-tools and training materials to aide decision making in complex and high consequence scenarios. Over 220 senior emergency management personnel have been trained to use the products developed in the decision-making stream of the research.

Fire and Rescue NSW’s Assistant Commissioner Rob McNeil has worked with the project team to understand his decision making as an incident controller deployed to Japan during the 2011 Fukushima earthquake and tsunami. The process has helped Assistant Commissioner McNeil better understand how he makes decisions, enabling him to teach this process to other incident controllers.

Findings from this research are also benefiting organisational resilience, with the Federal Department of Home Affairs launching a practical guide to decision making based on research carried out in the project. Researcher on the CRC project, Dr Steve Curnin led its development as a member of the Resilience Expert Advisory Group. His new guide released by the Commonwealth Department of Home Affairs, *Decision making during a crisis: a practical guide* was an initiative of this Group.

The decision-making research is also benefiting those outside the traditional emergency management sector, with the research team



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Clear thinking and effective communication will assist emergency managers to take better action before, during and after an emergency.

conducting a workshop with the Queensland infrastructure sector. The workshop included participants representing Urban Utilities, Seqwater, Powerlink, SunWater, the Department of Natural Resources, Mines and Energy, the Queensland Department of Transport and Main Roads, and the Queensland Department of Housing and Public Works.

Beyond end-users, agencies such as the Australian Maritime Safety Authority and the Australia Antarctic Division have also used the

tools in exercising and have incorporated them into operational use.

The project also engaged with the Joint Cyber Security Centre in Sydney, hosting a session 40 crisis management professionals who represented the banking and finance sector, energy sector, food and grocery sector, communications sector, and the water sector.

Working with AFAC through the Knowledge Innovation and Research Utilisation Network,

a research utilisation maturity matrix has been developed to help guide emergency services and land management agencies in assessing how individual agencies implement research findings and where they grow their use. This element of the research has identified that agencies best placed to implement research findings have established governance processes to do so, embed utilisation into job roles, actively test outputs of research and are communities of practice.

A MODEL FOR RELIEF AND RECOVERY

Ensuring communities are safe and resilient in the face of natural disasters is fundamental to emergency management organisations.

The CRC research project *The Australian Natural Disaster Resilience Index: A system for assessing the resilience of Australian communities to natural hazards*, led by Dr Melissa Parsons at the University of New England, is developing the Australian Natural Disaster Resilience Index to improve the understanding of disaster resilience.

The index aims to help communities, governments and organisations develop the capacities for adapting and coping with natural hazards.

The index is currently undergoing extensive consultation and feedback from CRC partner agencies before its wider release in early 2020.

While the study is assessing resilience across the country, Emergency Management Victoria is embedding the national findings to develop a better understanding of resilience at the state level. It has used the national research as baseline data to build a 'living' resilience index within the organisation, explains EMV's research coordinator Dr Holly Foster.



Understanding and enhancing disaster resilience in Australian communities will help to develop the capacities needed for adapting and coping with natural hazards. Photo: South Australia State Emergency Service.

"We have used the research as a basis for the Victorian platform, adapting it to our resilience needs in Victoria," Holly says.

"Its primary function is as a relief and recovery tool, exploring the characteristics and attributes of communities to enable a better understanding of what relief and recovery would be required if an emergency were to occur. We want to be able to proactively meet community needs."

"The ANDRI tools offer a leading-edge approach to plan and resource activities that further enhance resilience, across planning, response and recovery activities. Moreover, we are already starting to see the critical and timely influence of this research with many organisations embedding the key principles and frameworks of the ANDRI into their doctrine and planning processes."

It is only through the collaborative approach taken by the research team that mutually beneficial outcomes have been possible, with Emergency Management Victoria's learnings feeding back into the larger national approach.

In Western Australia, the framework from the Australian Natural Disaster Index has been adopted by the Department of Fire and Emergency Service to frame their monitoring and evaluation framework, assessing their programs to ensure they support specific disaster resilience outcomes.



UTILISATION CASE STUDIES

CARBON ABATEMENT THROUGH BETTER FIRE MAPPING

Australia's tropical savannas are extremely fire prone, with many millions of hectares burnt every year, contributing greatly to Australia's greenhouse gas emissions.

Sophisticated fire mapping and modelling of fire severity, undertaken by the *Tools supporting fire management in Northern Australia* team, led by Adjunct Prof Jeremy Russell-Smith and Dr Andrew Edwards at Charles Darwin University, is helping fire and land managers assess greenhouse gas emissions and develop carbon abatement plans.

Previously, fire seasonality was used to calculate emissions, fires occurring in the latter part of the northern fire season (after 31 July) releasing double the CO₂ emissions into the atmosphere than fires occurring early in the dry season. Although this calculation is based on years of data, CDU researchers are developing a new greenhouse gas emissions abatement methodology, using actual fire effect, leading to improved accuracy of the calculations of greenhouse gas emissions.

Another important tool, the *Savanna Monitoring and Evaluation Reporting Framework* provides users with the ability to monitor their fire management and evaluate its effects, providing a single standardised reporting system to assess and compare the outcomes of fire management across 70 per cent of the continent.

Information from the reports is used to apply



This research is helping fire and land managers assess greenhouse gas emissions and develop carbon abatement plans.

local, ecological and traditional knowledge to improve biodiversity and landscape management. The savanna-wide web-based software enables land and fire managers to generate reports on all national parks, with plans to expand into all properties in northern Australia.

With the emergence of new industries such as carbon farming, which was officially recognised as an industry by the Northern Territory Government in October 2018, and the influence of climate change, bushfire management is rapidly changing in northern Australia, requiring decisions to be prioritised based on risk, and detailed mapping to support these decisions. With such large areas to cover, web-based mapping is fundamental to better improving these land management practices.

Andrew Turner, Director of Strategic Services at Bushfires NT, says the organisation uses the savanna mapping tools daily.

"They are crucial to all aspects of fire management – planning, mitigation, suppression, monitoring, and evaluation and reporting," Andrew says.

Currently northern Australia is generating over \$30 million annually in this new carbon burning sector, on over 300,000 km², still only 40 per cent of the potential extent for these savanna burning projects. The fire severity mapping process developed by the research team is an integral part of the process of improving the methodology and has only been possible through the extensive collaboration process undertaken with other researchers from across Australia and around the world.



This research is testing new technology to help detect bushfires before they become too big to control. Photo: Mike Rowe (CC-BY-NC-2.0).

FINDING FIRES FASTER

The development of new and innovative algorithms are supporting near-continuous active fire surveillance from space unlike any other satellite hotspot products previously available.

Using the latest geostationary satellite-based earth observation systems and the Himawari satellite, the *Fire surveillance and hazard mapping* team from RMIT University, led by Prof Simon Jones and Dr Karin Reinke, will help fire managers with early fire detections to hone in on bushfires.

Most satellite-based fire detection algorithms are susceptible to the effects of clouds, as well as the accuracy of the land surface temperatures observed around a potential fire. But thanks to the research into an algorithm designed to take advantage of the 10-minute observations available from Himawari-8, and that is specifically tuned to Australian conditions and seasons, a robust and computationally rapid method for early fire detection across Australia has been developed.

Simeon Telfer, a fire manager from South Australia's Department of Environment and Water, says the research can make a difference to operations.

“Due to the increased availability of the satellite data and faster processing, there is an opportunity for earlier detections, and for ongoing remote observations of fires to be made,” Simeon says.

This means some fires could be detected hours earlier than was previously possible, leading to quicker deployment of firefighters and firefighting aircraft, as well as warnings to the public.

A trial with the New South Wales Rural Fire Service over summer 2018/2019 helped to focus the research. Currently, bushfires are primarily detected when a member of the public calls Triple Zero, and occasionally from other satellites that may be passing over the area. The researchers worked with the NSW RFS to assess how much faster the new algorithm can detect fires compared to current methods.

The project is also improving the accuracy of vegetation monitoring for flammability, as well as saving critical personnel hours, through the development of Fuels3D, which combines off-the-shelf digital cameras with computer vision and photogrammetric techniques to calculate vegetation structure and fuel hazard metrics. This reduces individual bias in estimating bushfire risk and ensures more accurate and consistent data is collected, as individual bias is completely removed. Fuels3D allows anyone to take a vegetation fuel sample; it has the potential for pre- and post-burn mapping and can provide inputs into fire behaviour modelling and risk assessment and planning.



UTILISATION CASE STUDIES

SATELLITES TO HELP SHOW WHEN THE BUSH IS READY TO BURN

Fire and land managers are benefitting from a new vegetation condition and flammability online mapping tool—the first of its kind to be introduced in Australia.

Dr Marta Yebra at the Australian National University leads the *Mapping bushfire hazards and impacts* project, which has developed the web-based system. As bushfires erupted along the east coast of Australia in November 2019, Marta was in the State Operations Centre at the New South Wales Rural Fire Service, working closing alongside fire behaviour analysts.

“Our research is being used here by the RFS to make informed decisions about where a fire may spread, and what areas should be prioritised when sending resources and equipment,” Marta said.

Effectively providing a clearer picture of immediate fire risks, the *Australian Flammability Monitoring System* uses satellite data to collect information on live moisture content in trees, shrubs and grass. It then displays this information on an interactive map, to help fire managers in their prescribed burning efforts and prepositioning of firefighting resources.

Different filters and settings on the system give emergency services and land management agencies a new way to help evaluate the risk of a bushfire occurring in certain parts of the country, based on the dryness of soil and fuels and the

flammability of vegetation. The prototype system uses satellite data to provide a clear picture of the landscape where there are high levels of vegetation and soil dryness, which are the perfect conditions for a severe bushfire.

The cutting-edge technology was recognised with the Outstanding Achievement in Research Utilisation Award from the CRC in 2019. The data available through the system is invaluable to fire and land management agencies, explains Dr Adam Leavesley, the Research Utilisation Manager at the ACT Parks and Conservation Service.

“Fire managers across Australia need to understand when our landscape is in a position that is either not going to burn, burn in a way that will allow us to control a fire, or when conditions are so dry that if a fire starts it will be very dangerous and difficult to control,” Adam says.

“The Australian Flammability Monitoring System is going to give us a really good guide across the whole country to how we expect fire to behave on any particular day. This will help agencies position resources during a bushfire, keeping our people safe, and also with prescribed burn planning, particularly in mountainous locations where flammability changes depending on which side of a mountain you are on.”

“It has been an amazing partnership with the research team. It is great quality science from a team that is driven by wanting to see their work make an impact – that has been the key to getting us to this stage.”

Access the Australian Flammability Monitoring System at <http://wenfo.org/afms/>



Fire managers are set to benefit from a new fire mapping tool that provides live information on soil and vegetation moisture.
Photo: Marta Yebra.

UTILISATION CASE STUDIES



Mud Army and SES volunteers working as a team at the 2011 Queensland floods. Photo: Queensland Fire and Emergency Services.



UTILISATION CASE STUDIES

A NEW MODEL FOR HELPING

How people volunteer to keep their community safe from natural hazards is changing. As our work and life commitments change, many people do not have the time to dedicate to traditional ways of volunteering with an emergency service, undergo the required training and develop the ability to respond to potentially dangerous situations. But they still want to help, and they still want to volunteer.

With research showing that the nature of volunteering and citizen involvement in disaster management is fundamentally changing, advice from the RMIT University team led by Prof John Handmer and Dr Blythe McLennan is regularly sought by individual agencies and organisations in the development of guides and policies around volunteering and spontaneous volunteering.

Dr McLennan was acknowledged for leadership and research in community resilience and disaster recovery recently, when presented with the 2018 Quiet Achiever Awards by Emergency Management Victoria Commissioner Andrew Crisp.

Research from the CRC project *Out of uniform: building community resilience through non-traditional emergency volunteering* has influenced key national initiatives, with findings from the study used extensively for the development of the National Spontaneous Volunteer Strategy by the Australia-New Zealand Emergency Management Committee.

The strategy provides advice to emergency

service agencies on what they need to be aware of, and what they need to consider and plan for when working with spontaneous volunteers. Important issues such as legal obligations and social media are also covered, with the work of the project team integral to the Strategy's completion.

Building on this, the Australian Institute for Disaster Resilience has drawn directly on the research to develop a handbook, *Communities Responding to Disasters: Planning for Spontaneous Volunteers* on spontaneous volunteer management. The handbook provides important guidance for organisations on how to incorporate the principles of the National Spontaneous Volunteer Strategy, and the most recent research on spontaneous volunteering, into their own plans and procedures.

Work on the development of this handbook was recognised by the CRC in 2019 with an Excellence in Research Utilisation Award given to Dr McLennan and AIDR's Amanda Lamont. Emergency services are also using the research, with the New South Wales State Emergency Service using the findings to shape how the organisation will recruit volunteers.

"Findings from the research really helped to shape our Volunteering Reimagined strategy, launched in 2017," says Andrew McCullough, Volunteering Strategist at the New South Wales State Emergency Service.

"The NSW SES is planning to lead in this space, and it is only with the help and the research of the CRC that this is possible," he says.

In Western Australia, the Department of Fire and Emergency Services has used the research to develop new directions in volunteering, while

South Australia's Department of Communities and Social Inclusion, Volunteering ACT and Volunteering Victoria have also been influenced by the work in developing policies and guides to volunteer management, both during emergencies and in recovery. Be Ready Warrandyte, a community group in one of Melbourne's high bushfire risk suburbs, has drawn extensively on the research to help educate and support their local community.

Paul Davis, Manager, Volunteer Development and Change, Emergency Management Victoria, says the research is shifting the narrative around emergency volunteering from one of crisis and decline, to one of transformation and opportunity. "This is in fact good news as it may be the very shift that we need to drive organisational change. This is where we must focus our energy and efforts; as communities change, so must we. If we don't, we face a very real chance of being left behind and looking back at what might have been."

Findings from this research are informing a subsequent CRC project on sustainable volunteering, focusing on how to best adapt emergency management agencies to these new ways of volunteering. This research is exploring the developments that are likely to occur over the next decade that will require adaption, as well as barriers to organisational change.

UTILISATION IS EVERYTHING

The CRC wouldn't be where it is today without the leadership and vision of inaugural Chair Dr Laurie Hammond. Integral to the growth and development of the centre, Laurie started with the CRC very early in its life, in 2013, and significantly shaped the direction and governance processes. His leadership at the Board level and his strategic advice to management was always insightful, timely and welcomed.

As the Independent Chair, Laurie came to the CRC knowing very little about the emergency management sector and quickly became a thought leader in the field; recognised by all the Commissioners, chief officers and the CRC's research community. He always took a strong interest in the research, and particularly the PhD students.

Laurie's influence cannot be understated; he was well respected in the Commonwealth government's innovation areas, having been on the board of the Commercialisation Australia and Innovation Australia and also spending time on the CRC Committee. He was also chair of the Mining CRC and guided that organisation to successful transition to a life beyond CRC program funding, something he was strongly involved with in this CRC.

Laurie passed away in November 2018 after a short battle with illness.

A special address was held to honour Laurie at the CRC's annual conference in 2019. The inaugural Dr Laurie Hammond Oration was presented by Prof Mary O'Kane – leading scientist and research administrator – and closed the Research Forum, covering Laurie's passions of how research and development delivers public benefit to Australia.

Current Chair of the CRC, Dr Katherine Woodthorpe, paid tribute to Laurie.

"Laurie was an incredibly important figure. During his time at the CRC he led the development of strategy and helped to build the reputation of the CRC for its utilisation focused research agenda."

Laurie's catchphrase – "utilisation is everything" – is the central tenant of the CRC that continues to drive the research today.



DR LAURIE HAMMOND

The CRC wouldn't be where it is today without the leadership and vision of inaugural Chair Dr Laurie Hammond.



CRC PEOPLE

GLOBAL RECOGNITION FOR FIRE SCIENCE

Fire and land managers are benefiting greatly from the international expertise that Dr Marta Yebra brings to the CRC.

Marta led the development of the Australian Flammability Monitoring System – first web application in the world to disseminate satellite-derived fuel moisture content, the flammability, and other fire risk-related products at such a continental scale. Her knowledge is called upon by agencies, including the ACT Parks and Conservation Service and the New South Wales Rural Fire Service, to help not just in the development of prescribed burning plans, but also when the heat is on during active operations - analysing data on vegetation conditions and how it may affect bushfire spread.

Her research has been recognised with multiple awards, capped by the Australian Academy of Science Max Day Environmental Science Fellowship in 2017. Alongside lead end-user Dr Adam Leavesley from ACT Parks and Conservation, Marta received the CRC's Outstanding Achievement in Research Utilisation Award for 2019 which recognises the importance of collaboration in ensuring research outcomes are adopted into practice.

Marta has also been recognised as one of the leading females in fire science internationally, with *Fire* journal recognising 145 women across the globe with the intention of promoting diversity across the fire and emergency management sector.

In addition to heading up the CRC's *Mapping bushfire and hazard impacts* project, Marta is a senior lecturer in Environment and Engineering at the Australian National University's Fenner School of Environment & Society and Research School of Aerospace, Mechanical, and Environmental Engineering), Mission Specialist for the ANU Institute for Space and Associate editor for *Remote Sensing of Environment*, the highest ranked journal in Earth observation for environmental applications.



DR MARTA YEBRA

Fire and land managers are benefiting greatly from the international expertise that Dr Marta Yebra brings to the CRC.

TOP RESEARCH TALENT

CRC researcher Prof John Handmer of RMIT University has been named the top researcher in emergency management for 2019 by *The Australian*.

The newspaper's annual *Research* magazine acknowledged John's leadership and achievements in emergency management research; from humble beginnings as a motorcycle mechanic to achieving his honours, masters and then a PhD in flood management, before moving toward research in the social and community aspects of fire management.

John has a long history with both the Bushfire and Natural Hazards CRC and the Bushfire CRC as a leader in research into community safety. His initial work provided a pivotal evaluation of the 'stay or go' policy, before broadening to research on shared responsibility, non-traditional volunteering and the economics of bushfire. After the Black Saturday bushfires in 2009, Prof Handmer led the research that investigated the human behaviour and community safety elements of the fires.

He was the research leader for the *Out of uniform* project and the *Social, economic, and environmental impacts of the 2012/13 Victorian fire season* study undertaken for the Victorian Department of Environment, Land, Water and Planning, as well as being the Principal Scientific Advisor for the Bushfire CRC.

John was appointed Chair of the Scientific Committee of the Integrated Research on Disaster Risk program in 2019, which looks at natural disaster mitigation and is co-sponsored by the International Science Council and the United Nations Office for Disaster Risk Reduction.



PROF JOHN HANDMER

CRC researcher Prof John Handmer of RMIT University has been named the top researcher in emergency management for 2019 by *The Australian*.



CRC PEOPLE

FIRE WEATHER KNOWLEDGE

With catastrophic fire conditions experienced for the first time in Queensland and multiple bushfires raging across the state in November 2018, researcher Dr Mika Peace was on hand to help combat the flames.

Specifically requested by the Queensland Fire and Emergency Services, Mika joined their operations centre to work alongside fire behaviour analysts by providing pivotal data and information, mapping out likely scenarios of bushfire spread and analysing pressure points throughout the state.

“The demand for information was absolutely huge for meteorology information—the embedded meteorologist was really providing the high-levelled synoptic scale, big-picture state-wide weather scenarios,” Mika says.

Mika’s specialised knowledge on fire weather gave QFES expert insight, particularly around the potential for pyrocumulonimbus (bushfire thunderstorms) to form, which can profoundly change the way bushfires behave.

Mika said that it is not just about understanding and being able to provide the weather information, but that it is more about seeing what the needs are of the emergency services and what their pressure points are so that the information provided can be tailored specifically to fit.

“A lot of research hasn’t formally made it into the operation decision process, but that doesn’t mean it can’t still be used during a major event. So much value can be added by having the knowledge available on the day.”

Mika’s help was recognised alongside others from Queensland who assisted with the bushfires with an invitation from the Queensland Premier, Annastacia Palaszczuk, to attend the 2018 Christmas Cabinet Reception.

In 2019, Mika once again was on hand at the QFES operations centre to advise on fire weather, at one point briefing Prime Minister Scott Morrison and Premier Annastacia Palaszczuk on the situation. She also assisted the South Australian Country Fire Service as an embedded meteorologist, mapping out likely scenarios of bushfire spread and analysing pressure points.

Mika regularly speaks about her research at events in her hometown Adelaide, including at the Adelaide Museum and Science at the Pub. She is also a graduate of the Bushfire CRC’s PhD program, completing her studies at the University of Adelaide.



DR MIKA PEACE

WINNING AT DISASTER PREPAREDNESS

Vital disaster education for children is primarily designed for delivery in schools, but Avianto Amri's research has produced a new board game to empower children at home. While recent studies have shown that disaster education programs increase children's awareness and knowledge, it does not always translate to changes at home in disaster preparedness. This new innovative education intervention enables children to engage with parents and build disaster resilient households.

The board game, PREDIKT, empowers children to engage in householder preparedness in a meaningful way, explains Avianto.

"PREDIKT provides the ammunition for teachers and parents to play and learn about disaster preparedness with children, in a fun and interactive way. It's not just the children learning - we've found that parents and teachers are challenged by the children, as their curiosity drives them to ask more questions related to disaster preparedness," Avianto said.

Initial results have shown that the education intervention is successful in motivating parents to discuss householder preparedness with their children. The resource, which is cheap and scalable, is currently being used by agencies and practitioners across Australia, Indonesia, Malaysia and Thailand. The game forms part of a broader toolkit, which includes worksheets, templates, tips and preparedness items for multiple hazard types, to further strengthen disaster preparedness through interactive learning. Discussions are in progress to modify the board game and toolkit so that it can be used by people with visual impairment. This would make PREDIKT the first inclusive board game on disaster preparedness.

Avianto is active in the disaster risk reduction space through his work with various organisations, including Plan International, UNICEF, and the International Federation of Red Cross and Red Crescent Societies. He was deployed to Nepal to assist with earthquake relief operations in June 2015. He also entered the CRC Association Early Career Researcher communication competition 2019 by completing a 30 second video explaining his research.



AVIANTO AMRI

Vital disaster education for children is primarily designed for delivery in schools, but Avianto Amri's research has produced a new board game to empower children at home.



CRC PEOPLE

VOLUNTEER LEADER

Emergency services right around Australia are benefiting from the volunteering knowledge of Dr Blythe McLennan from RMIT University. Blythe's research helps agencies in multiple ways – in the management of existing volunteers, informing recruitment strategies and working with spontaneous volunteers groups. The benefits are broad – fire, SES and local community groups all work closely with Blythe.

On the national scale, Blythe worked closely with Australian Institute for Disaster Resilience on their handbook for *Communities responding to disasters: planning for spontaneous volunteers*, contributing case studies on best practices for engagement with spontaneous volunteers.

This engagement with end-users across the country saw Blythe acknowledged, alongside former Australian Institute for Disaster Resilience director Amanda Lamont, with the CRC's Outstanding Achievement in Research Utilisation award for 2019. In 2018 she received the Mooroolbark Umbrella Group's Quiet Achiever Award for her leadership and research, an award that was presented by Emergency Management Victoria Commissioner Andrew Crisp.

Blythe also convenes the Emergency Volunteering Shared Learning Network as an avenue for managers, volunteers and researchers – irrespective of their organisational affiliations – to share their knowledge and experience with emergency volunteering. The Network hosts regular webinars to provide the latest knowledge and learnings from the emergency volunteering space.

Blythe's involvement with the CRC has been a long one – she currently leads the Enabling sustainable emergency volunteering study that focuses on investigating what changes are required to sustain Australia's emergency volunteering. In the first half of the CRC she was part of a team that looked at how emergency service agencies can include the goodwill of spontaneous volunteers as part of their response efforts, while during the former Bushfire CRC she explored the notion of shared responsibility for emergency management, informing agency and department policies.



DR BLYTHE MCLENNAN

Emergency services right around Australia are benefiting from the volunteering knowledge of Dr Blythe McLennan from RMIT University.

PLANNING FOR THE FUTURE NOW

With dual roles completing his PhD while being heavily involved in two CRC projects, Graeme Riddell's research is making a difference all over the country.

His PhD, which was submitted in late 2019, focuses on incorporating uncertainty and complexity into disaster risk management and assessment. Graeme uses this knowledge in his roles on both the *Improved decision support for natural hazards risk reduction* and *Urban planning for natural hazard mitigation* projects, as well as a developer in the Unified Natural Hazard Risk Mitigation Exploratory Decision support system (UNHaRMED). The UNHaRMED scenario risk modelling tool helps government, planning authorities and emergency service agencies think through the costs and consequences of various options on preparing for major disasters on their urban infrastructure and natural environments. Importantly, it also allows future changes to be taken into account, giving a complete picture on the impact of certain policies and land use management decisions. This work is informing decision making in South Australia, Victoria, Tasmania and Western Australia, and has been highlighted by the Investor Group on Climate Change as a key tool to help navigate future climate risk. Graeme was also part of the research team that received the CRC's 2017 Outstanding Achievement in Research award.

Graeme is a regular speaker at conferences, including the CRC's Research Forum and AFAC conferences in 2017, 2018 and 2019, as well as conferences in South Africa, Austria and Switzerland.



GRAEME RIDDELL

Graeme is a regular speaker at conferences, including the CRC's Research Forum and AFAC conferences in 2017, 2018 and 2019, as well as conferences in South Africa, Austria and Switzerland.



CRC PEOPLE

RESEARCH ACTION ON THE GROUND

Fire and land manager Dr Adam Leavesley from the ACT Parks and Conservation Service is at the forefront of using research knowledge. Adam works closely with the research team from the *Mapping bushfire hazards and impact* project in a variety of ways. Not only does he use the research knowledge to help prescribed burning in the ACT, he arranges access for the researchers to attend the burns to record valuable data.

“Fire managers across Australia need to understand when our landscape is in a position that it is either not going to burn, burn in a way that will allow us to control a fire, or when conditions are so dry that if a fire starts it will be very dangerous and difficult to control,” Adam says.

“It has been an amazing partnership with the research team. It is great quality science from a team that is driven by wanting to see their work making an impact.”

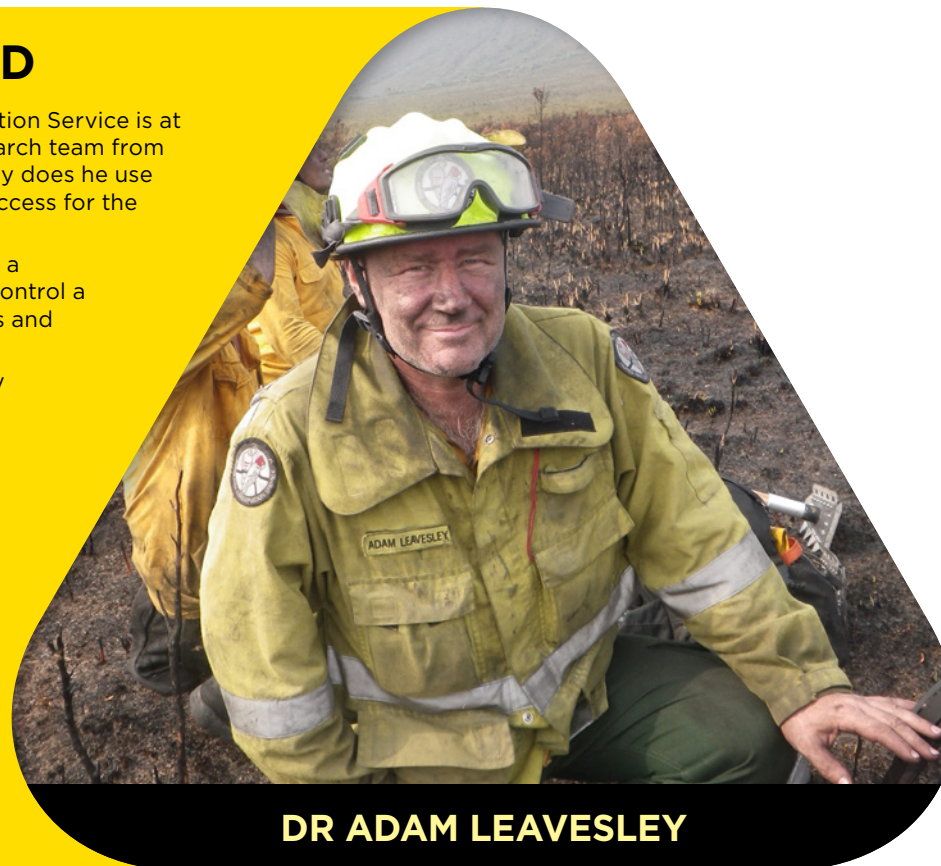
For his role in the research, Adam received the CRC’s Outstanding Achievement in Research Utilisation award for 2019, alongside research Dr Marta Yebra.

Adam is heavily involved with the CRC – he is a lead end-user on six CRC projects, and was also an end-user in the former Bushfire CRC. He was also a graduate of the Bushfire CRC PhD program, completing his thesis at the Australian National University in 2008.

His role at the ACT Parks and Conservation Service involves implanting research findings from across the CRC’s fire and prescribed burning projects.

“It’s a fantastic role that I really enjoy, looking at the work people are doing and making judgements about how it might be implemented and how you might use it going forward.”

“Being part of the CRC was vital to my career progression. I knew the people and importantly, they knew me when I’ve been looking for a job. That made a vast difference because they already knew a bit about what they were getting and I understood a bit about their business,” Adam says.



DR ADAM LEAVESLEY

“It has been an amazing partnership with the research team. It is great quality science from a team that is driven by wanting to see their work making an impact.”

FROM PHD TO FIRE AGENCY

The New South Wales Rural Fire Service is seeing the direct benefits of the CRC's education program, with Dr Alex Holmes joining the Service upon completing his PhD at Monash University in 2018. As a Research Officer at the NSW Rural Fire Service, Alex is responsible for producing computer programs and code to manipulate and create datasets, as well as analyse their physical properties. Part of this role includes researching potential improvements in the models used by the National Fire Danger Ratings System.

Alex's PhD research, which investigated the effects of soil moisture, temperature and precipitation extremes on fire risk and intensity, has been used in establishing the high-resolution soil moisture JULES-based Australian Soil Moisture Information System, which provides greater accuracy than previous models.

"The research showed that fire intensity increases logarithmically with decreasing moisture. This means that larger and more intense fires are likely to occur closer to population centres located around the coasts of Australia as climate change exacerbates drought conditions," Alex explained.



DR ALEX HOLMES

The New South Wales Rural Fire Service is seeing the direct benefits of the CRC's education program, with Dr Alex Holmes joining the Service upon completing his PhD at Monash University in 2018.



CRC PEOPLE

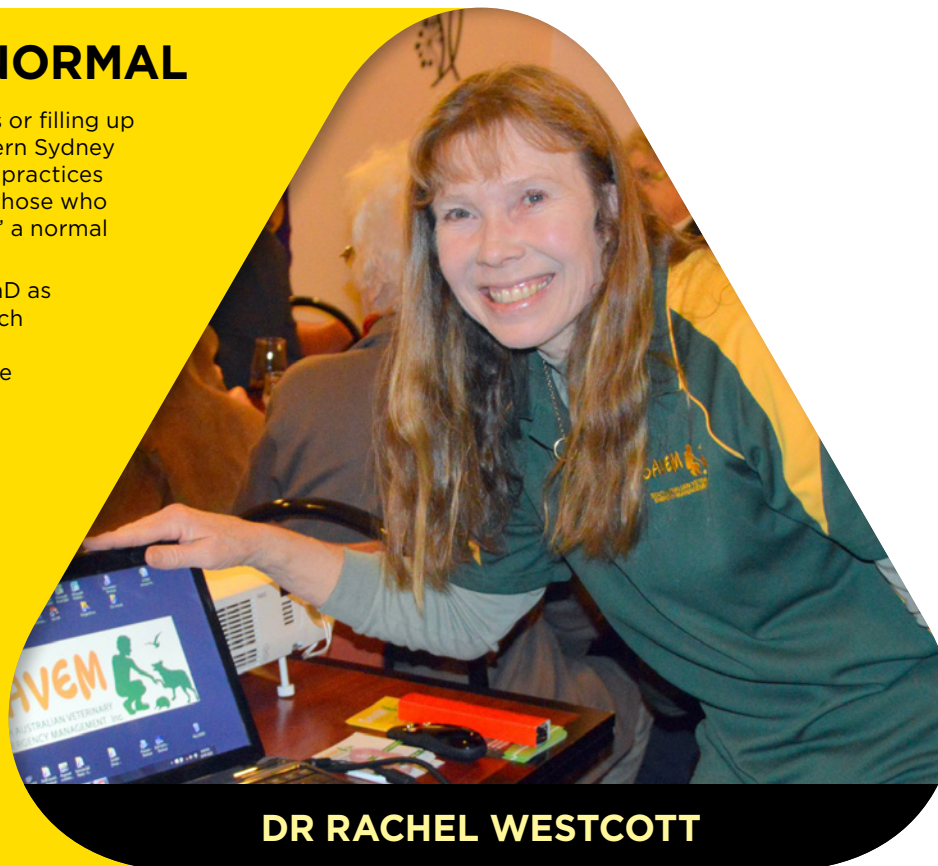
MAKING HAZARD PREPAREDNESS NORMAL

How can preparing for natural hazards become as normal as buying groceries or filling up your car with petrol? Dr Rachel Westcott completed her PhD in 2018 at Western Sydney University, developing best practice methods for preparedness and response practices in a bushfire – all aimed at making fire preparedness part of everyday life for those who live in at risk areas. This normalising of preparedness makes becoming ‘fire fit’ a normal routine.

Rachel presented her research findings at many industry events during her PhD as well as since completing, including a Three Minute Thesis at the CRC’s Research Driving Change – Showcase 2017, the Australia and New Zealand Disaster Management Conference 2019 and the Bushfire Building Conference 2019. She has also appeared on ABC local radio across Australia and entered the CRC Association’s Early Career Researcher communication competition in 2019.

As a veterinarian, Rachel has had an avid interest in the ways animals are handled during a disaster, and she participated in many aspects of the broader CRC project, *Managing animals in disasters*. In 2015, Rachel was recognised for her work with the South Australian Veterinary Emergency Management team with a Pride of Australia award after South Australia’s Sampson Flat bushfire for helping save and manage hundreds of animals during the fire.

Rachel currently runs her own business, Engine Room Solutions, which has research, emergency management and publishing divisions - with a focus on publishing PhD student papers - as well as running her own veterinary practice.



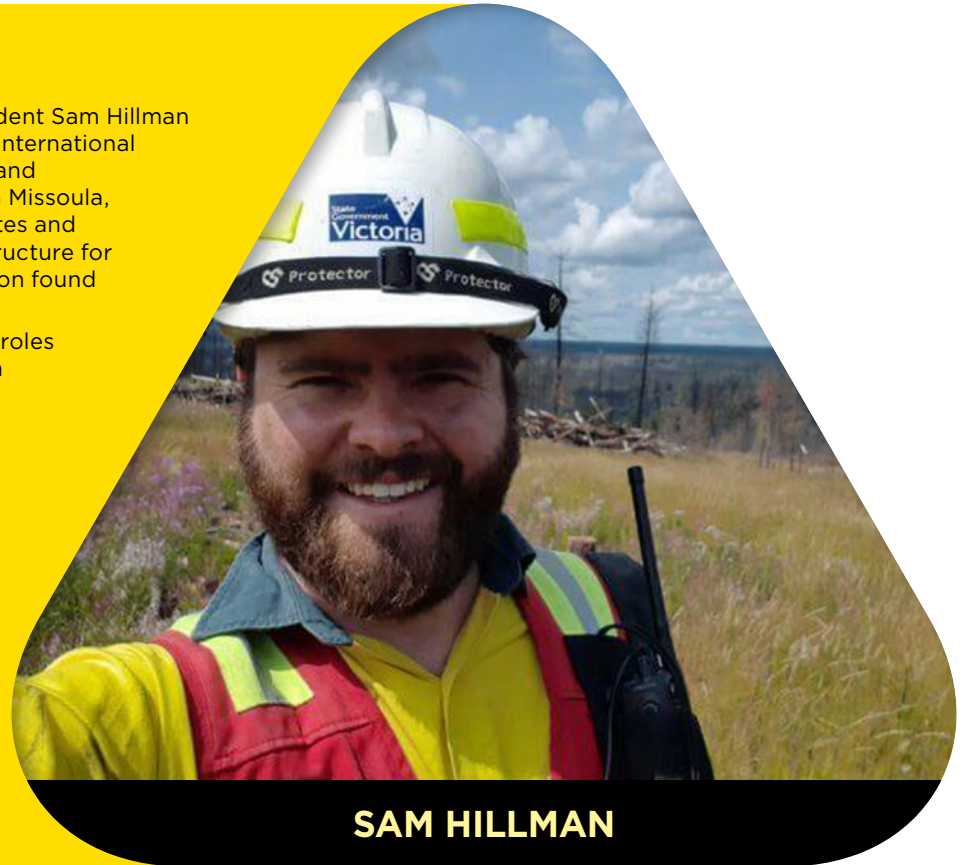
DR RACHEL WESTCOTT

In 2015, Rachel was recognised for her work with the South Australian Veterinary Emergency Management team with a Pride of Australia award after South Australia’s Sampson Flat bushfire for helping save and manage hundreds of animals during the fire.

INTERNATIONAL SCHOLAR

A panel of international fire science experts have awarded CRC associate student Sam Hillman from RMIT University with a prestigious scholarship. Worth \$3,000 USD, the International Association of Wildland Fire scholarship allowed Sam to visit North America and collaborate with research partners at the Rocky Mountain Research Station in Missoula, Montana and the University of British Columbia, Vancouver. In the United States and Canada Sam tested LiDAR technology that estimates below canopy forest structure for fuel hazard assessments to compare the results to different types of vegetation found outside of Australia.

Sam has a passion for the outdoors and combines summer forest firefighting roles with Forest Fire Management Victoria with employment at FFMV, focusing on managing the collection of fuel hazard information across the state. Seeing a growing need to invest in new technologies for efficient collection of fuel hazard data, Sam returned to study while continuing his role with FFMV part-time.



SAM HILLMAN

In the United States and Canada Sam tested LiDAR technology that estimates below canopy forest structure for fuel hazard assessments to compare the results to different types of vegetation found outside of Australia.

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APPENDIX 1: PUBLICATIONS

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 63. Sithole, B & James, G (2019) Developing effective management partnership in remote communities in Northern Australia: Annual Report 2018-2019, *Bushfire and Natural Hazards CRC*.
 64. Smith, W, Weir, J & Neale, T (2019) Hazards, culture and Indigenous communities: Annual Report 2018-2019, *Bushfire and Natural Hazards CRC*.
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 78. Vaculik, J, Griffith, M (2019) Final report on vulnerability of as-built and retrofitted URM buildings. *Bushfire and Natural Hazards CRC*.
 79. Vidyattama, Y (2018) Constructing a data reliability framework for the natural hazard exposure information system. *Bushfire and Natural Hazards CRC*.
 80. Vindokumar, Fox-Hughes, P & Dharssi, I (2019) Mitigating the effects of severe fires, floods and heatwaves through the improvements of land dryness measures and forecasts: Annual Report 2018-2019, *Bushfire and Natural Hazards CRC*.
 81. Wehner, M, Hyeuk, R, Edwards, M, Ginger, J & Parackal, K (2019) Evaluating the economic benefit of retrofit. *Bushfire and Natural Hazards CRC*.
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 84. Yebra, M, van Dijk, A & Cary, GJ, Zhao, L and Zeng, H (2019) Mapping bushfire hazards and impacts: Annual Project Report 2018-2019. *Bushfire and Natural Hazards CRC*.
 85. Young, C (2019) Diversity and Inclusion: Building strength and capability: Annual Report 2018-2019, *Bushfire and Natural Hazards CRC*.

APPENDIX 2: ADDITIONAL RESEARCH



TACTICAL RESEARCH FUND

TITLE	AGENCY
A strategic analysis of preventable residential fire fatalities	Metropolitan Fire Brigade
AIRSNAT data revision and analysis	AFAC
Classifying outcomes of inquiries & reviews: what can we learn?	AFAC
Re-imagining program evaluation for community resilience outcomes	Emergency Management Victoria
SES physical fit for task	Australian Council of State Emergency Services
A guide to develop bushfire case studies – A case study of cropland fires	Country Fire Authority, VIC
Risk assessment of non-compliant building materials on buildings	AFAC
Mapping approaches to community engagement for preparedness in Australia	Victoria SES, AFAC Community Safety Group, Tasmania Fire Service, Red Cross, Inspector-General Emergency Management Queensland, NSW SES, Queensland Fire and Emergency Services, Department of Fire and Emergency Services WA, Tablelands Regional Council QLD, City of Ipswich, Cairns Regional Council
Predicting fire danger ratings from physical measures of fire behaviour	NSW Rural Fire Service, AFAC, National Fire Danger Ratings System National Board, Office of Environment and Heritage NSW, Bureau of Meteorology

RESEARCH FOR THE DEPARTMENT OF ENVIRONMENT, LAND, WATER AND PLANNING, VICTORIA

TITLE
Framework for using and updating ecological models to inform bushfire management planning
Ecosystem resilience - establishment of collection and analyses for four priority Ecological Fire Group's
Landscape fuel moisture forecasting for bushfire risk assessment
Dynamic smoke intelligence using remote sensing and fixed sensors
Community impacts of smoke
Eco resilience data
Predicting the impact of climate change on fire weather variables
Identifying planned burn windows
User interface - platform for the Victoria historical fire weather gridded dataset
Application of self-evacuation archetypes
Effectiveness of resources to suppress bushfire: Aerial and ground based
Grass Fire Danger Index dataset
Cropland fire behaviour research
Making a difference - conceptual framework to show benefits of compliance
Smouldering: improved quantification of emissions and plume rise to improve the forecasting of smoke levels and better provide health protection messaging
ARGOS plume model review of SW-fires with CSIRO
Technological advances ecosystem resilience
Multi-platform analysis & remote sensing

APPENDIX 2: ADDITIONAL RESEARCH

COMMISSIONED RESEARCH

TITLE	AGENCY
Develop a decision support system for Western Australia	Department of Fire and Emergency Services, Western Australia
Strategy 2030	Queensland Fire and Emergency Services
2018 Bega Valley fire post-incident task force	New South Wales Rural Fire Service
National research priorities for energy networks	Energy Networks Australia/S&C Electric
Quantifying catastrophic bushfire consequences	Energy Networks Australia
Synoptic Weather Features SE Australia & Tasmania Stage 1	University of Tasmania

FUNDS FOR QUICK RESPONSE

TITLE	RESEARCH ORGANISATION
Disaster waste management in <i>Darwin</i> following Cyclone <i>Marcus</i>	Charles Darwin University
Post event data collection Townsville floods	Risk Frontiers



Erika Lind (Forest Fire Management Victoria), Dr Mika Peace (Bureau of Meteorology), Allison Donovan (Department of Biodiversity and Attractions WA) and Briony Macintosh (Fire and Rescue NSW) made up the Australian component of a panel discussion on women's careers in fire at the International Fire Behaviour and Fuels Conference in Sydney, April 2019.



Rob Cameron, Director-General of Emergency Management Australia, launches the Australian Exposure Platform, which is informed by CRC research.

APPENDIX 3: INTERNATIONAL COLLABORATION



INTERNATIONAL COLLABORATION HIGHLIGHTS BY PROJECT

PROJECT	INTERNATIONAL COLLABORATIONS
<i>Mapping hazards bushfire and impacts</i>	Collaboration with the European Forest Fire Information System and the Global Wildfire Information System; the Council of Scientific and Industrial Research, South Africa, Meraka Institute and others
<i>Fire surveillance and hazard mapping</i>	Collaboration with German Aerospace Centre
<i>Scenario planning for remote community risk management in northern Australia</i>	Collaboration in an international workshop to further develop fire severity mapping with attendees from the University of Idaho, the University of South Dakota, European Space Agency, the Instituto do Agronomia, Lisbon and NASA
<i>Improved predictions of severe weather to reduce community impact</i>	Collaboration with the UK Meteorological Office
<i>Improving flood forecast skill using remote sensing data</i>	Collaborations with Politecnico di Torino and the University of Bristol
<i>Fire spread prediction across fuel types</i>	Collaborations with Aix-Marseille University, France and Lebanese University, Lebanon
<i>Improving land dryness measures and forecast</i>	Collaborations with NASA Goddard Space Flight Centre and UK Meteorological Office
<i>Delivering effective prescribed burning across Australian ecosystem</i>	Collaboration with Landcare Research, New Zealand

PROJECT	INTERNATIONAL COLLABORATIONS
<i>Fire coalescence and mass spotfire dynamics: Experimentation, modelling and simulation</i>	Collaboration with University of Coimbra (Portugal), University of Sheffield (UK), San Jose State University (USA), Missoula Fire Lab (USA), US Naval Research Laboratory, University of Science and Technology of China, SCION (NZ Forestry Research), Service Départemental d'Incendie et de Secours des Bouches-du-Rhône, France, Los Alamos National Laboratory (USA)
<i>Threshold conditions for extreme fire behaviour</i>	Collaboration with the University of Edinburgh (UK) and Tomsk State University (Russia)
<i>Economics of natural hazards</i>	Collaboration with leading international experts of field of non-market valuation with Clark University (USA) and University of Alberta (Canada)
<i>Optimising post-disaster recovery interventions in Australia</i>	Collaboration with the Asian Disaster Preparedness Center
<i>Hazards, culture and indigenous communities</i>	Collaborations with the University of Pavia, Italy and University of Auckland, New Zealand
<i>The Australian Natural Disaster Resilience Index</i>	Collaboration with Resilient Organizations, New Zealand
<i>Improving the resilience of existing housing to severe wind events</i>	Collaborations with the University of Florida, the University of Western Ontario, Canada, Institute for Business and Home Safety, University of Moratuwa, Sri Lanka
<i>Enhancing the resilience of critical road infrastructure</i>	Collaborations with the Asian Development Bank, Sri Lankan Ministry of Local Government, and various rail authorities in Sri Lanka, UK, Spain and Turkey

APPENDIX 3: INTERNATIONAL COLLABORATION

PROJECT	INTERNATIONAL COLLABORATIONS
<i>Towards protective action: Effective risk and warning communication during natural hazards</i>	Collaboration with the Risk Communication and Resilience Research Program at the University of Maryland. Editorial board membership of the <i>Journal of International Crisis and Risk Communication Research</i> , based in the US
<i>Flood risk communication</i>	Collaboration with Incident Management and Resilience, Environment Agency, UK and data sharing with the UK Automobile Association
<i>Catastrophic and cascading events – planning and capability</i>	Collaboration with University of North Carolina
<i>Diversity and inclusion – building strength and capability</i>	Participation in advisory role in the Impressions Project, a multiparty collaboration across UK and European research institutes funded by the European Union. Collaboration with Oxford University
<i>Improved decision support systems for optimal natural hazard mitigation</i>	Ongoing collaboration with Research Institute for Knowledge Systems (the Netherlands), Risklayer (Germany) and the Centre for Disaster Management and Risk Reduction Technology (Germany)
<i>Integrated urban planning for natural hazard mitigation</i>	
<i>Cost-effective mitigation strategy for building-related earthquake risk</i>	Collaboration with the University of Auckland in developing fragility curves for unreinforced masonry buildings with evidence from the recent Canterbury earthquakes
<i>Coupled fire-atmosphere modelling</i>	Collaboration on fire weather with the UK Met Office, Leeds University, the European Centre for Medium Range Weather Forecasting, and the South African Weather Service



North American fire managers and scientists were hosted on a study tour in September 2018, which began with a traditional smoking ceremony.



APPENDIX 4: STUDENTS

SCHOLARSHIP STUDENTS

NAME	UNIVERSITY	COMMENCEMENT	PROJECT NAME
Kate Akers	Massey	Jan-19	Understanding the need for, availability of, and interpretation of information by the public during large scale hazard events
Avianto Amri	Macquarie	Jul-14	Connecting communities: Integration of disaster preparedness measures at household, school, and community level, using a child-centered approach
Heather Bancroft	Melbourne	Jun-14	Wellbeing of firefighters: The impact of individual factors, potentially traumatic event exposure, and operational and organisational factors on mental health outcomes
Shauntelle Benjamin	UNE	Jan-17	Why do people decide to drive through floodwater? Utilizing virtual reality to assess motivations and behaviour associated with driving through floodwater
Andrew Clarke	CQU	Oct-15	A mixed methodological evaluation of the effectiveness of key safety messages in dealing with stressful structural fire environments
Miles Crawford	Massey	Jun-15	How risk informs natural hazard management: a study of the interface between risk modelling for tsunامي inundation and local government policy and procedure
Dario Rodriguez-Cubillo	Tasmania	Dec-16	Landscape ecology of fire: lessons from Tasmanian wilderness
Amila Dissanayake	RMIT	Jul-15	Fire resilience of existing composite steel plate girder bridges
James Furlaud	Tasmania	Jun-15	How do wet eucalypt forests burn: managing Tasmania's most dangerous fuel type
Bryan Hally	RMIT	Mar-15	Methods for background temperature estimation in the context of active fire detection
Matthew Henry	CQU	Jan-16	Comprehensive school safety: a participatory approach to school bushfire emergency management planning
Mitchell Humphreys	JCU	Feb-16	Wind induced internal pressures in industrial buildings
Susan Hunt	ANU	Feb-14	Implementing policy to enable disaster resilience in the Australian Federation
Saimum Kabiir	Melbourne	Aug-18	Exploring the urban form - resilience nexus in flood risk reduction: an integrated approach
Maryam Nasim	RMIT	Jul-15	Investigation into the behaviour of a U-slab bridge due to flood
Mercy Ndalila	Tasmania	Feb-15	The 2013 Forcett-Dunalley fire: a geospatial analysis of fire severity, smoke transport and emissions
Gabriela Raducan	RMIT	Mar-14	The impacts of bushfires on water quality

APPENDIX 4: STUDENTS

NAME	UNIVERSITY	COMMENCEMENT	PROJECT NAME
Mayeda Rashid	CQU	Jul-15	Teacher-delivered, child participatory disaster resilience education program for children
Graeme Riddell	Adelaide	Feb-14	Methods to develop long term, efficacious risk mitigation policies
Wavne Rikkers	Western Australia	Mar-19	Rescuers at risk: tackling the barriers to mental help-seeking in first responders experiencing PTSD and high psychological distress
Heather Simpson	Wollongong	Jul-15	Productivity and effectiveness of suppression resources and tactics on large fires
Michael Storey	Wollongong	Mar-16	Empirical analysis of spot-fire and ember behaviour during extreme fire weather conditions
Stephen Sutton	CDU	Jan-15	Cultural drivers of disaster response behaviour and their cross-cultural applicability
Christopher Thomas	UNSW	Sep-14	An investigation of the dynamics of fire-fire interactions using a coupled fire-atmosphere model
Katherine van Wezel	CDU	Mar-15	Women caring for Waanyi and Garawa country
Rahul Wadhvani	Victoria	Nov-14	Refinement and validation of the pyrolysis and firebrand transport sub-models for a physics based bushfire prediction model
Houzhi Wang	Adelaide	Jan-15	Initiation of biomass smouldering combustion

COMPLETED 2014/15

NAME	UNIVERSITY	STUDENT TYPE	COMMENCEMENT	COMPLETION	PROJECT NAME
Steven Curnin	Tasmania	Associate	Jan-12	Jun-15	Spanning boundaries to support effective multi-agency coordination in emergency management
Grace Vincent	Deakin	Associate	Feb-12	May-15	Fighting fires and fatigue

APPENDIX 4: STUDENTS

COMPLETED 2015/16

NAME	UNIVERSITY	STUDENT TYPE	COMMENCEMENT	COMPLETION	PROJECT NAME
Veronique Florec	Western Australia	Scholarship	Jul-11	May-16	Economic analysis of prescribed burning in the south-west of Western Australia
Brianna Larsen	Deakin	Associate	Jan-12	Oct-15	Simulated self-paced wildfire suppression work in different thermal conditions
Philip Stewart	Queensland	Associate	Apr-13	Jan-16	Changing fire regimes in tropical and subtropical Australia
Rene van der Sant	Melbourne	Associate	Jun-11	May-16	Ardity index as a predictor of the hydrogeomorphic response of burnt landscapes
Alex Wolkow	Deakin	Associate	Jan-12	Dec-15	Sleep restriction across a simulated firefighting deployment: the impact on acute stress responses



Recently completed PhD student Dr Alex Holmes is now working at the NSW Rural Fire Service.



Rahul Wadhvani (Victoria University) in the lab with the fire dragon machine that measures ember spread.



Mayeda Rashid (CQUniversity) presents her findings at the annual conference.

APPENDIX 4: STUDENTS

COMPLETED 2016/17

NAME	UNIVERSITY	STUDENT TYPE	COMMENCEMENT	COMPLETION	PROJECT NAME
Cathy Cao	Western Australia	Associate	Apr-11	Mar-17	Effective communication of household wildfire risk through WebGIS: considerations in content, representation and design
George Carayannopoulos	Sydney	Associate	Jul-11	Feb-17	Whole of government and crisis management: understanding coordination in a time of crisis
Yang Chen	Monash	Scholarship	Aug-13	Jun-17	LiDAR application in forest fuel measurements for bushfire hazard mitigation
Amanda Chong*	Melbourne	Associate	Mar-15	Dec-16	Accurate location of buildings and its importance in bushfire damage assessment
Graham Dwyer	Melbourne	Scholarship	Mar-15	Jun-17	We have not lived long enough: sensemaking and learning from bushfires in Australia
Dolapo Fakuade	Canterbury	Associate	Oct-13	Apr-17	Integrated response as a process for enhancing the incident command system
Gemma Gray*	Melbourne	Associate	Jul-15	Jul-16	Spontaneous volunteers in the emergency management sector
Vaibhav Gupta	RMIT	Associate	Jul-11	Dec-16	Remote sensing of fire severity in Australian dry sclerophyll forests
Billy Haworth	Sydney	Scholarship	Jan-14	Feb-17	Assessing the potential, application, and implications of volunteered geographic information in disaster risk reduction
Megan O'Donnell	ANU	Associate	Jan-13	Jan-17	Effects of bushfire exposure on prenatal and early life development in humans: a life history perspective
Rachael Quill	UNSW	Scholarship	Jul-14	Jan-17	Statistical characterisation of wind fields over complex terrain with applications in bushfire modelling
Ken Strahan	RMIT	Associate	Aug-13	Apr-17	Factors influencing householder self-evacuation in two Australian bushfires
Caroline Wenger	ANU	Scholarship	Jan-13	May-17	Flood management in a changing climate

*Masters student

APPENDIX 4: STUDENTS

COMPLETED 2017/18

NAME	UNIVERSITY	STUDENT TYPE	COMMENCEMENT	COMPLETION	PROJECT NAME
Melanie Baker-Jones	QUT	Scholarship	Feb-14	Sep-17	Social media in emergencies: an examination of government accountability for risk communication and warning
David Barton	RMIT	Associate	Jan-10	Jan-18	Disaster in relation to attachment, loss, grief and recovery: the Marysville experience
Douglas Brown	Sydney	Associate	Mar-10	Feb-18	Domestic architecture and the perception of risk in bushfire-prone areas
Sarah Hall	Deakin	Scholarship	Mar-14	Sep-17	Sleep and stress in on-call fire and emergency service workers
Roosbeh Hasanzadeh Nafari	Melbourne	Scholarship	Jul-14	Jan-18	Flood damage assessment in urban areas
Alexander Holmes	Monash	Scholarship	Mar-15	Feb-18	Investigating the effect of soil moisture, temperature and precipitation extremes on fire risk and intensity in Australia
Ryan Hoult	Melbourne	Scholarship	Oct-14	Sep-17	Seismic assessment of reinforced concrete walls in Australia
Farook Kalendher	RMIT	Scholarship	Jul-13	Oct-17	Synthetic damage curves for concrete girder bridge decks under flood hazard
Charles Newland	Adelaide	Scholarship	Mar-14	Feb-18	Improved calibration of spatially distributed models to simulate disaster risk
Tetsuya Okada	Macquarie	Associate	Aug-12	Oct-17	Post-disaster recovery following recent natural hazard events and risk reduction measures in Australia and Japan
Kamarah Pooley	QUT	Scholarship	May-15	Mar-18	An evaluation of youth justice conferencing for youth misuse of fire
Nicholas Read	Melbourne	Associate	Jan-14	May-18	Models for lightning-caused wildfire ignition
Mittul Vahanvati	RMIT	Associate	Jan-12	May-18	Owner-driven housing reconstruction as a means of enhancing disaster resilience of at-risk communities in India
Sonja Mareevan Nieuwenhoven*	Melbourne	Associate	Mar-15	Jul-17	Planning for bushfires on the rural-urban interface: an analysis of the correlations between house setbacks and house loss as evidence of house-to-house fire spread in the 2009 Victorian Bushfires
Ashley Wright	Monash	Scholarship	Mar-14	Sep-17	Estimating areal rainfall time series using input data reduction, model inversion, and data assimilation

*Masters student

APPENDIX 4: STUDENTS

COMPLETED 2018/19

NAME	UNIVERSITY	STUDENT TYPE	COMMENCEMENT	COMPLETION	PROJECT NAME
Joji Abraham	Federation	Associate	Jan-15	Jul-18	Fire and heavy metals: when wild and controlled fires transform un-rehabilitated mining waste
Anita Amirsardari	Melbourne	Associate	Jan-14	Aug-18	Seismic assessment of reinforced concrete buildings in Australia including the response of gravity frames
Fatemeh Bahri	UNSW	Associate	Jul-13	Dec-18	Sensitivity of the empirical mode decomposition and its application to environmental data
Bill Calcutt	Wollongong	Scholarship	Feb-14	Jun-19	Valuing volunteers: better understanding the primary motives for volunteering in Australian emergency services
Wasin Chaivaranont	UNSW	Associate	Mar-14	Aug-18	How does remotely sensed degree of curing and fuel load vary in grasslands and effect modelled fire spread?
Zoe D'Arcy*	RMIT	Associate	Jul-17	Dec-18	Community engagement in the post-disaster landscape
Grigorijs Goldbergs	CDU	Scholarship	Dec-14	May-19	Remote sensing of tree structure and biomass in North Australian mesic savanna
Angela Gormley*	Sydney	Associate	Jan-16	Feb-19	Effects of Sydney coastal dry sclerophyll forest litter on fuels and fire behaviour in Hornsby Shire
Fiona Jennings	RMIT	Scholarship	Aug-14	Jan-19	Navigating uncertainty: a qualitative study of resident involvement in the 2013 Forcett Tasmania bushfire disaster
Thomas Kloetzke	Queensland	Scholarship	Jul-15	Jun-19	Analysis and simulation of surface wind fields during landfalling tropical cyclones
Lauren Kosta	Melbourne	Associate	Dec-13	Dec-18	Parenting after Black Saturday: lived experiences since the 2009 Victorian bushfires
Diana Kuchinke	Federation	Associate	Dec-10	Feb-19	Investigating bird responses to fire in the heathy dry forests of Victoria, Australia
Peter Middleton	Charles Sturt	Associate	Feb-18	Oct-18	Enhancing public information practice in Tasmania's emergency services
Korah Parackal	JCU	Scholarship	Mar-15	Dec-18	The structural response and progressive failure of batten to rafter connections under wind loads

APPENDIX 4: STUDENTS

NAME	UNIVERSITY	STUDENT TYPE	COMMENCEMENT	COMPLETION	PROJECT NAME
Timothy Ramm	Tasmania	Scholarship	Feb-15	Aug-18	Improving adaptation planning for future sea level rise and coastal flooding
Bambang Setiawan	Adelaide	Associate	Jul-13	Dec-18	Quantifying the seismic and site amplification characteristics of Adelaide's regolith
Emma Singh	Macquarie	Scholarship	Jan-14	Jan-19	Modelling the impact of lifeline infrastructure failure during natural hazard events
Kaitlyn Watson	QUT	Associate	Feb-16	Jun-19	The roles of pharmacists in disaster health management in natural and anthropogenic disasters
Rachel Westcott	WSU	Scholarship	Jul-14	Dec-18	Advancing public health in the context of natural hazards: normalising preparedness within a framework of adapted protection motivation theory
Mengran Yu	Sydney	Scholarship	Mar-15	Oct-18	Approaches for investigating wildfire impacts on catchment hydrology

*Masters student



The opening of the 2018 annual conference in Perth.

APPENDIX 4: STUDENTS

ASSOCIATE STUDENTS

NAME	UNIVERSITY	COMMENCEMENT	PROJECT NAME
Li Zhao	ANU	Jun-16	Spatially forecasting coupled litter and root moisture dynamics for bushfire management

NAME	UNIVERSITY	COMMENCEMENT	PROJECT NAME
Aeen Ashkani	Swinburne	Apr-15	A study of the key design factors that improve the experience of the elderly in temporary emergency shelter and village facilities
Veronica Berjon	Sydney	Jul-17	Dynamics of litterfall and fine fuels after fire in sclerophyll forests and woodlands
Nicolas Borchers Arriagada	Tasmania	Jun-18	Assessment framework for the elevation of wildfire risk reduction strategies
Karen Bradley	QUT	Nov-17	Strategies to develop a national incident management system for emergencies – improving the response to disasters by enhancing the incident command system
Raven Cretney	RMIT	Aug-13	The post-disaster city: urban crisis politics and social change in community led earthquake recovery
Antara Dasgupta	Monash	Jul-15	Towards a comprehensive data assimilation framework for operational hydrodynamic flood forecasting
Darryl Dixon*	Charles Sturt	Jun-12	The exposure of emergency service personnel to asbestos
Martyn Elliott	USC	Dec-16	Economic evaluation of prescribed fire as a bushfire risk mitigation tool in southeast Queensland
Hannah Etchells	Western Australia	Mar-17	The impacts of catastrophic wildfire on ecological interactions among regenerated vegetation, fungi and small foraging marsupials
Gretel Evans	Melbourne	Mar-14	The persistent past: flood, fire and migrant memories of natural disasters in Australia
Jay Evans	CDU	Jul-17	Savanna fire management, resources, methods, effectiveness
Thomas Fitzgerald	Sydney	Aug-13	What is the acceptable risk in the coastal zone: perspectives on coastal hazards and decision making
Vivien Forner	Wollongong	Sep-12	Leading with self-determination theory
Akvan Gajanayake	RMIT	Aug-16	Measuring social, environmental and economic consequences of road structure failure due to natural disasters
Steve Glassey	Otago	Feb-18	Animal emergency management in New Zealand



APPENDIX 4: STUDENTS

NAME	UNIVERSITY	COMMENCEMENT	PROJECT NAME
Constanza Gonzalez-Mathiesen	Melbourne	Jan-16	Urban planning and resilience to bushfires
Lesley Gray	Otago	Sep-16	Preparing for the big one: disaster risk reduction for morbid obesity
Alan Green	Wollongong	Feb-14	Sprinkler systems for the protection of buildings from wildfire
Bruce Hankinson	QUT	Jul-16	Network enabled agility: A model for filling the strategic void in interoperability thinking
Sam Hillman	RMIT	Mar-17	The utility of point clouds to estimate fuel hazard
Tony Jarrett	CQU	Jan-18	Agency experts supporting bushfire disaster resilience education with primary school students: a case study from New South Wales, Australia
Revathi Krishna	Monash	Mar-16	Coping with disasters by children and families who live in poverty
Benjamin Martin	CQU	Mar-15	The role of the emergency management sector in the implementation of children's disaster education
Andrea Massetti	Monash	Mar-16	Remote sensing applied to bushfire
Daniel May	ANU	Mar-15	Taking fire: the political and cultural influence of Indigenous burning in settler societies
Sean Morling	RMIT	Jul-14	Developing a spatial approach to model sediment transfer in catchments affected by bushfire
Prananda Navitas	QUT	Oct-15	Improving disaster risk communication in various disaster scenarios
Lucy Ockenden*	Melbourne	Jan-17	Changes to urban planning's bushfire risk management approach in Victoria and future directions
Liberty Pascua	Sydney	Jul-16	Precarious places, precarious knowledges: disaster risk reduction education in Australia, the Philippines, and Vanuatu
Greg Penney	Edith Cowen	Jan-18	Through the flames - quantitative analysis of strategic and tactical wildfire suppression
Nicholai Popov	Wollongong	Feb-13	The impact of leadership development on organisational citizenship behaviour and social capital: an intervention using self-determination theory
Ismail Qeshta	RMIT	Aug-15	Fragility and resilience of bridge structures subjected to extreme wave-induced loads
Shahriar Rahman	Macquarie	Apr-16	Development of a stochastic fire effect model in predicting the impacts of fire severity on vegetation
James Ricketts	Victoria	Mar-14	Understanding the nature of abrupt regional shifts in a changing climate
Sesa Singha Roy*	Victoria	Feb-17	Development of an interface using penalisation method for improving computational performance of bushfire simulation tools

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NAME	UNIVERSITY	COMMENCEMENT	PROJECT NAME
Simone Ruane	Curtin	Mar-16	Planning for bushfire risk at the urban bushland interface: a local adaptive governance approach
Mitchell Scovell	JCU	Aug-16	An investigation of the psychosocial factors that influence cyclone mitigation behaviour in homeowners
Hayley Squance	Massey	Jun-14	Enhancing multiagency collaboration for animal welfare emergency management
Jane Urquhart	La Trobe	Feb-18	Locating gendered knowledge and practices in Aboriginal fire ecology
Sean Walsh	Melbourne	Jun-16	Improving decision support tools for conservation of fire-adapted ecosystems in southern Australia, through integrated simulation of reproductive ecology and landscape dynamics
Chathura Wickramasinghe	RMIT	May-15	Multi-resolution, high temporal fire monitoring and intensity mapping using AHI
Jane Williamson	ACU	Mar-17	Are prescribed fire intervals maintaining fauna habitat?
Alireza Zabihi	Swinburne	Sep-15	Seismic retrofitting of RC beam-column joints using metallic haunch
Yang Zhang	UNSW	Sep-14	Understanding spatial patterns of wildfire occurrence in south eastern Australia

*Masters student



Indigenous communities in the Northern Territory are benefiting from natural hazards training developed by CRC research. Photo: Bev Sithole.



APPENDIX 5: MEDIA

KEY BUSHFIRE AND NATURAL HAZARDS CRC MEDIA 2018/19

DATE	MEDIA
9 July '18	CEO featured on ABC <i>Statewide Drive NSW</i> to discuss climate change and its impact on fire seasons
18 July '18	The <i>Northern Australia Seasonal Bushfire Outlook</i> featured on ABC Radio across
5 September '18	<i>Sydney Morning Herald</i> , "First burst of spring to nudge mercury to high 20s in parts of Sydney"
6 September '18	<i>The Australian</i> , "Early southern bushfire season expected"
6 September '18	ABC online, "Fire chiefs around the country warn Australia of bleak outlook"
6 September '18	<i>The Age</i> , "Unprecedented dryness sees CFA declare fire season starts on Monday"
6 September '18	<i>Courier-Mail</i> , "Bushfire season is upon us"
6 September '18	News.com.au, "Early southern bushfire season expected"
6 September '18	Climate Council, "Latest bushfire outlook earlier, stronger, longer"
6 September '18	<i>Townsville Bulletin</i> , "Bushfire Outlook"
6 September '18	ABC Radio <i>Statewide Drive WA</i> , Dr Mika Peace, A/Prof Jason Sharples, Dr David Henderson on research presented at AFAC18
6 September '18	6PR Perth, "Darling range above average bushfire risk"
6 September '18	Mix 94.5 FM, Perth, "Early fire risk"
6 September '18	Triple M, "Early than usual fire season expected this summer"
6 September '18	<i>Gulf Times</i> , "Early southern bushfire season expected"
6 September '18	<i>Brexit News</i> , "Fire chiefs around country warn Australia of bleak bushfire outlook"
6 September '18	<i>Beef Central</i> , "Elevated bushfire risk heading into spring"

DATE	MEDIA
7 September '18	<i>Today</i> Channel 9, live interview with CRC CEO
7 September '18	<i>ABC News Breakfast</i> , live interview with CRC CEO
7 September '18	<i>The West Australian</i> , "WA bushfire risk high despite wet winter say experts"
7 September '18	<i>Perth Now</i> , "Populated parts of WA exposed to higher risks of catastrophic bushfires experts warn"
7 September '18	<i>Brisbane Times</i> , "Experts warn Canberra is facing the same bushfire conditions as 2003"
7 September '18	<i>Pilbara News</i> , "WA bushfire risk high despite wet winter say experts"
7 September '18	<i>Sheep Central</i> , "NSW remains in drought and southern Australia faces higher fire risk"
7 September '18	<i>24 Australia</i> , "Populated parts of WA exposed to higher risks of catastrophic bushfires experts warn"
10 September '18	Radio National <i>Australia Wide</i> , live to air with CRC CEO
10 September '18	<i>Insurance News</i> , "Experts predict severe bushfire season"
11 September '18	<i>Wangaratta Chronicle</i> , "Early fire fear"
11 September '18	<i>Esperance Express</i> , "Esperance at risk in upcoming bushfire season"
11 September '18	<i>Nature Environment</i> , "Australian fire threat"
14 September '18	<i>Daily Examiner</i> , "Fire threat above normal for upcoming bushfire season"
14 September '18	Get Regional, "Southern Australia seasonal bushfire outlook 2018"
7 October '18	<i>The Mercury</i> reports on the fire risk for summer, referencing the Southern Australia Seasonal Bushfire Outlook 2018

APPENDIX 5: MEDIA

DATE	MEDIA
14 October '18	<i>SBS News</i> article about climate change quotes the CEO talking about the effects of extreme weather
14 October '18	Researcher Prof Alan March was a guest on the ABC podcast <i>Rear Vision</i> to discuss managing bushfire risk. The episode was <i>How can we live in a fiery world?</i>
7 November '18	<i>Stock & Land</i> covers the Victorian fire season, quoting the CEO
8 November '18	Researchers A/Prof Trent Penman and Dr Mel Taylor appear on ABC Canberra <i>Drive</i> as part of ABC's Bushfire Awareness Day. A/Prof Penman explained how wind effects a fire, while Dr Taylor discussed the importance of including animals in emergency plans
Oct/Nov '18	<i>Insurance News</i> Oct/Nov 2018 features the CEO and researcher Prof Alan March discussing bushfire mitigation and risk
14 November '18	PhD student Jamie Furlaud co-authors an article in <i>The Conversation</i> with David Bowman on lessons from California's latest bushfires
26 November '18	Article on the Queensland bushfires on the <i>Tenplay</i> website quotes the Research Director on the impact of longer fire seasons on resourcing
28 November '18	The <i>Sydney Morning Herald</i> quotes CRC research on flood fatalities in coverage of flash flooding across Sydney
29 November '18	<i>Herald Sun</i> covers the release of mental health research by the CRC in partnership with Beyond Blue
29 November '18	<i>Adelaide Now</i> article on the release of mental health research by the CRC in partnership with Beyond Blue
29 November '18	The Research Director appears on <i>ABC News 24</i> afternoons to discuss the findings of the CRC and Beyond Blue mental health research
29 November '18	<i>The Australian</i> covers the November update to the <i>Southern Australia Seasonal Bushfire Outlook 2018/19</i>
29 November '18	ABC article on the November update to the <i>Southern Australia Seasonal Bushfire Outlook 2018/19</i>

DATE	MEDIA
29 November '18	November update to the <i>Southern Australia Seasonal Bushfire Outlook 2018/19</i> covered by <i>The Guardian</i>
29 November '18	<i>Perth Now</i> covers the November update to the <i>Southern Australia Seasonal Bushfire Outlook 2018/19</i>
29 November '18	<i>BBC</i> article on the Queensland bushfires quotes the CEO on longer fire seasons in Australia
30 November '18	<i>The Mercury</i> covers the November update to the <i>Southern Australia Seasonal Bushfire Outlook 2018/19</i>
30 November '18	November update to the <i>Southern Australia Seasonal Bushfire Outlook 2018/19</i> article in the <i>Illawarra Mercury</i>
30 November '18	<i>news.com.au</i> covers the severe weather occurring across Australia (bushfires in Queensland, flash flooding in Sydney), with the CEO commenting that while climate change is causing more severe weather, demographic changes are having just as big an impact, with new ways needed to deal with bushfires, floods, cyclones and heatwaves
30 November '18	<i>The Courier</i> coverage of the Queensland bushfires includes comments from the CEO
1 December '18	ABC article on what has been learnt from the Queensland bushfires quotes the CEO
4 December '18	A feature on the Queensland bushfires in <i>The Guardian</i> quotes the CEO discussing how the bushfires show the extremes that are possible with natural hazards
5 December '18	<i>The Weekly Times</i> covers the November update to the <i>Southern Australia Seasonal Bushfire Outlook 2018/19</i> and quotes the CEO
19 December '18	The CEO appears alongside CRC Association CEO Tony Peacock on <i>ABC Radio Canberra Mornings</i> to discuss the advances in natural hazards science
28 December '18	ABC article on how data on bushfire fatalities helps to inform safety messages quotes CRC researchers Prof John Handmer, Dr Katharine Haynes (Macquarie University) and Andrew Gissing (Risk Frontiers)



APPENDIX 5: MEDIA

DATE	MEDIA
13 January '19	Feature article in <i>The Age</i> , <i>The Sydney Morning Herald</i> and <i>WA Today</i> on the 80 th Anniversary of the Black Friday bushfires in Victoria features the CEO on research advances since 1939, preparing for the next catastrophic bushfire and demographic changes, as well as researcher Lucinda Coates on the heatwave impacts in 1939
14 January '19	<i>The Mercury</i> features an opinion piece by the CEO on the Tasmanian bushfires, particularly the challenges of fighting fires in remote and mountainous terrain
14 January '19	The CEO appears on <i>ABC Radio Hobart Mornings</i> to discuss the challenges of the Tasmanian bushfires
23 January '19	Researcher Andrew Gissing (Risk Frontiers) appears alongside CRC Association CEO Tony Peacock on <i>ABC Radio Canberra Mornings</i> to discuss heatwaves science
24 January '19	ABC article on what makes a dangerous day for bushfires features CRC researcher Dr Mika Peace (Bureau of Meteorology)
24 January '19	<i>Sky News</i> live covers heatwave research with Andrew Gissing (Risk Frontiers)
5 February '19	<i>SBS Radio News</i> interviews the Research Director on the Townsville flooding and planning for natural hazards, with an article also appearing on the SBS website
6 February '19	<i>The Age</i> and <i>The Sydney Morning Herald</i> article co-authored by CRC researchers Dr Josh Whittaker and Dr Katharine Haynes covers research into how people do or do not understand emergency warnings
6 February '19	<i>Radio National Breakfast</i> covers the learnings since Black Saturday with the CEO
7 February '19	<i>The Age</i> and <i>The Sydney Morning Herald</i> feature an opinion piece by the CEO discussing how research shows people are still complacent about their personal risk of bushfire, a decade after the Black Saturday bushfires
7 February '19	The main editorial in <i>The Age</i> cites CRC research when discussing the changes in the ten years since Black Saturday

DATE	MEDIA
7 February '19	<i>ABC TV news Victoria</i> features the CEO in its coverage of the ten year anniversary of Black Saturday, while the <i>ABC TV late national news</i> cites CRC research in its coverage
7 February '19	<i>Network Ten TV</i> news in Victoria features the CEO in its coverage of the ten year anniversary of Black Saturday
7 February '19	<i>Sky News TV</i> features live interviews with the CEO and researcher Andrew Gissing (Risk Frontiers) in its coverage of the ten year anniversary of Black Saturday
7 February '19	<i>ABC Radio Perth Breakfast</i> interviews the CEO on changes since Black Saturday
7 February '19	<i>ABC Radio Ballarat Mornings</i> interviews Dr Josh Whittaker (University of Wollongong) about advancements in emergency warnings since Black Saturday
7 February '19	ABC article on prescribed burning features the CEO
7 February '19	<i>ABC Radio National The Money</i> covers the economic impact of Black Saturday and interviews researcher Prof Mehmet Ulubasoglu (Deakin University)
7 February '19	<i>Triple J Hack</i> covers the tenth anniversary of Black Saturday, with the Research Director covering what has changed since
7 February '19	<i>Triple M Radio Melbourne</i> features the CEO in its news updates
7 February '19	<i>ABC Radio Nightlife</i> covers how the bush regenerates after a bushfire with researcher Prof Ross Bradstock (University of Wollongong)
7 February '19	Former Associate PhD student Dr Douglas Brown had an article in <i>The Conversation</i> on his research on house design and architecture for bushfire-prone areas
7 February '19	<i>The Conversation</i> piece by former CRC research Associate Prof Jim McLennan on learnings since Black Saturday
9 February '19	<i>Adelaide Advertiser</i> feature on fire weather in South Australia with researcher Dr Mika Peace (Bureau of Meteorology)

APPENDIX 5: MEDIA

DATE	MEDIA
19 February '19	<i>The Sydney Morning Herald</i> article co-authored by CRC researcher Dr Katharine Haynes discussed the risk of flash flooding in Parramatta
25 February '19	<i>The Age</i> article co-authored by CRC researcher Dr Katharine Haynes discussed reporting of climate change in the mainstream media
15 April '19	<i>Insurance News</i> covers the funding situation
24 April '19	CEO and completed PhD student Dr Rachel Westcott featured in <i>MIT Technology Review</i> article out of the United States, focusing on bushfire safety, community preparedness and building design in bushfire prone areas
2 May '19	CRC researcher Dr Trent Penman appeared on the <i>ABC Rural Report</i> and <i>Country Hour</i> programs in various states discussing research on the economic value of prescribed burning
3 May '19	<i>ABC South Coast NSW</i> breakfast interviews CRC researcher Dr Josh Whittaker about findings from the Reedy Swamp (Tathra) bushfire in March 2018. This research was conducted by the CRC at the request of the NSW Rural Fire Service
20 May '19	Recently graduated PhD student Dr Rachel Westcott discusses her research findings on fire preparedness of community members and solutions to improve preparedness on <i>ABC Adelaide Afternoons</i>
22 May '19	Recently graduated PhD student Dr Rachel Westcott discusses her research findings on fire preparedness of community members and solutions to improve preparedness on <i>ABC Canberra Breakfast</i>
20 June '19	Research Director Dr John Bates appears on both <i>ABC Canberra Breakfast</i> and <i>ABC NSW Statewide Mornings</i> to discuss the extreme weather scenario presented at the Australasian Natural Hazards Management Conference and what changes are required to reduce the impact on natural hazards by 2035



CRC researcher Dr Katharine Haynes (right, Macquarie University) during her two week internship with science reporter Liam Mannix at *The Age*.



Find more online

OUTPUTS FROM EVENTS AND ACTIVITIES 2014 TO 2019

Slide presentations, research posters, video and audio, and other resources including:

- Annual Conference Research Forum
- Research Advisory Forums
- 12th Australasian Natural Hazards Management Conference, Canberra 2019
- North Australia Fire Managers Forums
- International Day for Disaster Reduction
- 5th International Fire Behaviour and Fuels conference, Melbourne 2016
- 6th International Fire Behaviour and Fuels conference, Sydney 2019
- Many other activities with CRC research presentations

SHOWCASE 2017 – RESEARCH DRIVING CHANGE

4-5 July 2017, Adelaide

A two-day showcase of CRC research and utilisation achievements to date. This page includes all the slide presentations, plus audio and video of select speakers and panel sessions.

bnhcrc.com.au

PUBLICATIONS FROM PROJECTS

Journal articles, reports, books and book chapters, conference papers, and theses:

bnhcrc.com.au/publications/overview

PEOPLE AND PROJECTS

Researchers, students, partner representatives, and outputs

bnhcrc.com.au/research

NEWS AND VIEWS, CASE STUDIES, RESEARCH, DISCUSSION

Hazard Notes and Hazards News, Hazard Channel, Fire Australia

bnhcrc.com.au/news

Australian Journal of Emergency Management

knowledge.aidr.org.au/ajem

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