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# MAPPING AND UNDERSTANDING BUSHFIRE AND NATURAL HAZARD VULNERABILITY AND RISKS AT THE INSTITUTIONAL SCALE

**Annual Project Report 2015–2016**

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Bushfire and Natural Hazards CRC





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Photo: Coastal damage along Sydney's northern suburbs following an East Coast Low in June 2016.

Photo credit: Bigstock



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## EXECUTIVE SUMMARY



Natural hazard disasters are systemic, potentially resulting in catastrophic impacts capable of breaching geographic, institutional, functional and operational thresholds. Such impacts often interact with other risks, causing knock-on effects, or risk contagion.

While some locations can successfully implement strategic planning for a limited number of natural hazard risks, at regional and government scales, a multi-hazard, multi-value approach needs to be taken. This requires a significant advance in how systemic risk is understood at the institutional level by governments, industry and the community. This is quite different to conventional understandings based on the cause-and-effect nature of individual hazards. Without such advances, affected systems will remain vulnerable to unpredictable combinations of events, and unowned and shared risks are likely to be poorly defined.

The focus of the project in the past twelve months has been in:

- carrying out four workshops in Victoria, Tasmania, South Australia and New South Wales in August 2015,
- analysing the results, especially with regard to risk ownership,
- continuing to develop decision making frameworks, and
- enriching the project's understanding of existing decision-making processes relating to strategic risk management.

The workshops' purpose was to explore, through a series of structured scenario exercises, how values and risk ownership are currently understood. Feedback was also sought for the newly-developed draft Values at Risk Maps to gauge the appetite for further development.



The results of the workshop analysis were presented in a comprehensive report *Understanding Risk Ownership and Workshop Synthesis*. This explored the decision-making preferences related to risk ownership across the four states where workshops were held and provided frameworks to assist understanding of this. A subsequent report on *Institutional Maps of Risk Ownership* was developed from this work, the 2015 desktop study on risk ownership and additional analysis of four State Emergency Management Plans. This work, will provide the foundation for developing a process-based framework for ascertaining risk ownership to support the National Emergency Risk Assessment Guidelines.

Both reports suggest that risk ownership is distributed quite unevenly across the different major institutions: local, state and federal government, the community, industry and business and boundary organisations. The largest allocation of ownership is to state government, especially for allocated risk and consequences, and risk actions; whereas ownership of values at risk, covering tangible assets such as built infrastructure, and intangible assets such as connectivity, is more evenly spread. Further work will investigate options for understanding how ownership is distributed, via decision-making processes, governance arrangements and the nature of economic evaluations currently being used.

Discussions with end-users at the workshops, the AFAC2015 conference and subsequent meetings suggested that there was limited appetite for another map-based product. The different state architectures also make it difficult to build a single application suitable for wide use. However, end users considered the questions they had relating to strategic decision making as very important and worth exploring further. This led to the shared conclusion that the maps were suitable as a research tool but not as a decision-making tool to be used by agencies, and they would prefer further research to enhance their use of their in-house capacities.

The Values at Risk maps were completed in early 2016 and a report describing the economic geography of vulnerability in Victoria to bushfire and flood was completed. This report takes total annual output from 190 industry subdivisions and assesses their vulnerability at the Statistical Local Area scale by multiplying sensitivity with exposure. It identifies areas of greatest vulnerability, largely in rural and peri-urban areas where resilience and recovery of specific areas of industry and business need to be a key part of natural hazard decision making.

Also completed in 2015, was a framework aligning the institutional elements of values at risk which focused on risk ownership and the strategic components of decision-making. This was combined with an economic framework for assessing the very different values that contribute to strategic decision-making. This will underpin the further development of a conceptual framework for institutional resilience, and a final synthesis report.

## END USER STATEMENT



### Ed Pikusa

#### Lead User Representative, Economics and Strategic Decision Making Cluster SA Department of Environment, Water and Natural Resources

As an end user for this project, I have participated in:

- Three Research Advisory Forums (RAFTs) in Adelaide (2014), Sydney (2015) and Hobart (2016),
- Teleconferences of the project team,
- Adelaide and Melbourne Workshops on risk ownership.

In this capacity, I have aimed to guide the project outputs and maximise their potential utility to end users.

Throughout the project since its commencement, the Victoria University Team have actively sought out end user contributions to their project.

Mapping of hazard information with social and economic data presents a novel way of describing vulnerability in terms of economic diversity. The insights from this analysis present a template for future analysis that could be applied with other projects of the CRC to improve knowledge of potential impacts, and the planning of mitigation efforts.

The analysis of risk ownership has similarly produced interesting insights regarding who owns which risks. The insights regarding public vs private risk ownership, risk ownership across different timescales, and the idea of 'unowned' risks, potentially have implications for the governance of managing natural hazards by the public and private sectors.

The management of risk and planning of mitigation efforts is an issue of long-term planning concern across the emergency management sector in Australia, and globally. The outputs of this project provide valuable insights into the governance of risk and vulnerability, and the planning of long-term mitigation.

## INTRODUCTION



Current federal government spending on natural disaster response is more than 20 times spending on preparedness. When natural disasters are large and combine in unpredictable ways, they cross domains, moving from the private to the public realm, and shifting from a local, to a state or national concern. Many climate-related natural hazards and the number of people living in hazard prone areas are increasing, raising the potential of future, unmanaged loss.

### Why is it important?

The spending mismatch between response and preparedness is well understood, but we also face potential deficits in important social and environmental values. Liveability, sustainability and resilience are vital aspects of communities and the environment, but their contributing values are not well understood. These values are often public, shared and non-market, so if they are at risk, may not have clear owners. If risk owners – those responsible for managing these values – can be clearly identified, then we can begin to assess the balance between preparedness, potential damage and post-event recovery. Unowned risks may lead to values being damaged or lost.

## How are we going to solve it?

The project will map a broad range of economic, social and environmental values, and relate these to natural hazards within Victoria. The concepts of risk ownership and values at risk will be explored through a series of research workshops with end users. The project also will explore who 'owns' these values, how they own them and what happens to them across different temporal and geographical scales. A process based framework to support better application of risk ownership will be developed.

## Project aim

The project objective is to develop a framework for understanding the ownership of risks from bushfires and natural hazards at the institutional level. It will look at institutions involved in natural disasters, such as local, state and federal government, and the community and private sector, and assess how their specific values and rules interact with the broader values affected by natural disasters.

The project aim is to enable more effective decision-making through the allocation of risk ownership at the institutional scale. This will in turn inform the development of measures, including investment strategies, resilience and risk mitigation. We will:

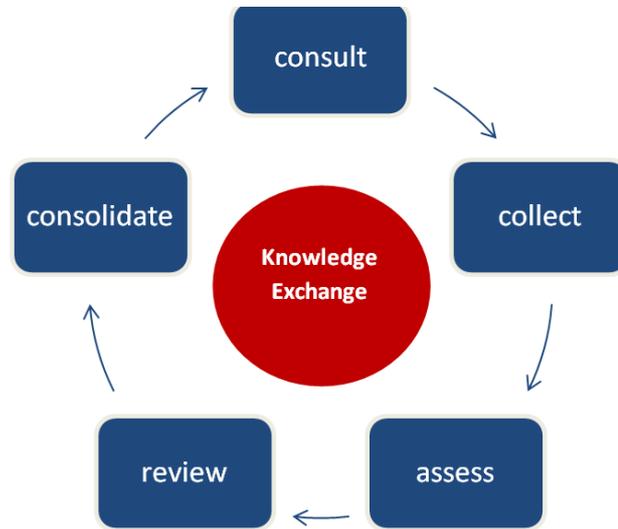
- Develop an economic geography of values at risk at geographic and institutional scales. Its appearance and output will be developed in consultation with key stakeholders.
- Assess risk ownership by asking "Who is responsible?", "Who pays?", "Who manages the risk" and "How is it managed?"
- Develop a governance framework to ascertain risk ownership to support the institutional understanding and management of values at risk. This task will examine current governance before, during and after disasters, looking at both emerging and future needs.

## Who will benefit?

This project aims to benefit decision makers in institutional areas such as local, state and federal government, the community and relevant private sectors, by helping them to better identify the different economic, social and environmental values at risk from natural hazards. It also aims to help clarify areas of risk ownership and show how governance can support the long-term management of natural hazard risk with respect to preparedness, resilience and effective recovery.

## How we aim to do this – end user based research

Our project teams specialises in developing and implementing research with end users and work closely with them to ensure outputs are fit for purpose. Ongoing consultation, evaluation and response to feedback are built into the research process to support this aim (see figure below).



In the last year our process has moved from consulting, to working with our stakeholders to support development of key outputs for this project later this year. As these outputs are tailored towards the decision making context of our end users, the collation and integration of end user knowledge has been a key part of research over the last year and has required extensive feedback and contributions from end users. The result of both our consultation and research has resulted in the reshaping of both the current and future agenda for this project to ensure end user needs are being met.

## Current team members

We are part of the Victoria Institute for Strategic Economic Studies (VISES) at Victoria University. Our team is transdisciplinary, working across economics, natural and social science and practice-based research. Members are:

- Professor Roger Jones – Project Lead Researcher
- Ms Celeste Young – Research Project Manager and Researcher
- Dr John Symons – Researcher
- Professor Peter Sheehan – Researcher
- Professor Bruce Rasmussen – Researcher

## OUR STAKEHOLDERS



Our stakeholders are divided into two groups. The end-user working group form a core part of our research process and contribute directly into the project. This group is represented by key members of the following organisations:

- Rural Fire Service, New South Wales
- South Australia Fire and Emergency Services Commission
- Department of Justice and Regulation, Victoria
- State Emergency Service, Department of Police & Emergency Management, Tasmania
- Emergency Management Victoria
- Department for Communities and Social Inclusion, South Australia
- The Department of Environment, Land, Water and Planning (Victoria)

Another group of 'inform and advise' stakeholders from both public, community and private organisations is being kept up to date with project progress. Some of these people have also contributed specific knowledge and areas of expertise to support our research.

## WHAT THE PROJECT HAS BEEN UP TO



### End user engagement

During the last 12 months we have continued regular meetings and contact with our end users. We have also collaboratively developed and undertaken four workshops. These aimed to further our understanding of their decision-making context and needs in relation to risk ownership and the values at risk work undertaken to date.

A feedback workshop involving key practitioners from the Victorian Emergency Services Sector was organised by Emergency Management Victoria. The purpose of this workshop was to ascertain the best future use of the Values at Risk Map for the project and to identify key questions they were asking of strategic management.

End users have also had the opportunity to review all of the documents and reports written to date and have regularly been consulted about their strategies and practices.

Team members (Young and Jones) attended and presented work to date at the AFAC Conference in September 2015. Celeste Young also gave a presentation at the University of New England where she met with other members of the CRC research network.

They also attend the Research Advisory Forum in Hobart in May 2016 where they met with stakeholders and other research teams in the economic cluster to discuss the second phase of the CRC and draft implementation plans.



## Collaboration

The presenting of work to date (Young and Jones) at the Research Advisory Forum in Hobart in May 2016, has resulted in a greater shared understanding of the synergies and differences between our projects in the research cluster. We have continued to explore ways to share knowledge and support each other's activities. Other activities in this area include,

- Development and execution of 4 research-based workshops in collaboration with end users and the BNHCRC staff.
- Feedback workshop for the Values at Risk Maps facilitated by Emergency Management Victoria.
- Undertaking Strategic Risk and Consequence Exercise & Training Day with Emergency Management Victoria.
- A mentorship arrangement with a key end user to support greater understanding of the policy and practitioner context.
- Young, C., Research Reference Group Committee Member for Australian Centre for Financial Studies, Insurance Program Area. 2015–2016.
- Young, C., Project Group Member, Theme 4, to support the development of the Resilient Melbourne Strategy, City of Melbourne, 100 Resilient Cities Program, July 2015 – Feb 2016.
- Young, C., Invited Judge, Fire Awareness Awards, Victoria, 2<sup>nd</sup> December 2015.

## Outreach

A number of outreach activities have been undertaken during the year with work being presented at government and community conferences including The 10th Annual Enterprise Risk Management for Government in Canberra and the Community Bushfire Risk Forum in Montrose in December.

We also continue to distribute and share our research and the research of others within the CRC research group with our broader stakeholder Advise and inform and industry based networks.

## Invited presentations

Young, C., 2015, Building Organisational Resilience to Systemic Risk, 3rd Annual Australian Risk Management Summit, Melbourne, 18 August 2015.

Young, C., 2015, Whose Risk is it Anyway? Understanding the Role of Values and Risk Ownership, DELWP Community Forum, Montrose, Department of Environment, Land, Water and Planning, Victoria, Melbourne, 5 December 2015.

Young, C., 2015, The Problem Solution Framework, Implementing Systemic Risk Solutions, Inner Melbourne Climate Adaptation Network, 29<sup>th</sup> September 2015.

Young, C., 2016, Beyond ERM: Building Organisational Resilience to Systemic Risk, Enterprise Risk Management (ERM) for Government Conference: Moving Beyond Compliance, International Quality and Productivity Centre, Canberra, 27-29 April 2016.

Jones, R.N., 2015, Keynote, Risk Modelling: General Needs and WGI Experience, IPCC Workshop on Regional Climate Projections and their Use in Impacts and Risk Analysis Studies, National Institute for Space Research (INPE), São José dos Campos, Brazil, 15–18 September, 2015

### Conference presentations

Young, C., 2015, Communication Dynamic Risk for Decision Making, presentation to Break-out Session Forecasting, Characterising and Communicating Extreme Weather and Climate Events, AMOS National Conference 2105: Research to Community – Communicating our Science, Australian Meteorological and Oceanographic Society, Brisbane, 15-17 July 2015.

Jones, R.N. & Young, C., 2015, Risk Ownership And Natural Hazards: Across Systems And Across Values, presentation. AFAC15, New Direction in Emergency Management, Australasian Fire and Emergency Service Authorities Council (AFAC), Bushfire and Natural Hazards Adelaide, 1-3 September 2015.

### Workshop presentations

Jones, R.N., 2015, CRC Project Overview, presentation to Mapping and Understanding our Values at Risk and Risk Ownership Workshops: Victoria - 7 August, Tasmania – 13 August, South Australia – 21 August and New South Wales – 28 August.

Symons, J., 2015, Values at Risk Map, presentation to Mapping and Understanding our Values at Risk and Risk Ownership Workshops: Victoria – 7 August, Tasmania – 13 August, South Australia – 21 August and New South Wales – 28 August.

Young, C., 2015, Whose Risk is it Anyway? Desktop Review of Institutional Ownership of Risk Associated with Natural Hazards and Disasters, presentation to Mapping and Understanding our Values at Risk and Risk Ownership Workshops: Victoria – 7 August, Tasmania – 13 August, South Australia – 21 August and New South Wales – 28 August.

### Poster presentations

Young, C., 2015, Communicating Dynamic Risk in a Connected World: Perceptions and Possibilities, poster presentation at the AFAC15: New Direction in Emergency Management, Australasian Fire and Emergency Service Authorities Council (AFAC) Conference 2015, Bushfire and Natural Hazards, Adelaide, 1-3 September 2015.

## WORK PRODUCED

Work completed during the past twelve months includes:

- Undertaking four research workshops with end users.
- A synthesis report of the workshops and associated research.
- A conceptual framework for the project integrating risk ownership, institutional structures and economic approaches to strategic management.
- An economic geography of vulnerability to bushfires and floods (maps and report).
- Constructing an institutional map of risk ownership for strategic decision making (report).
- Implementation plans.

## Research workshops

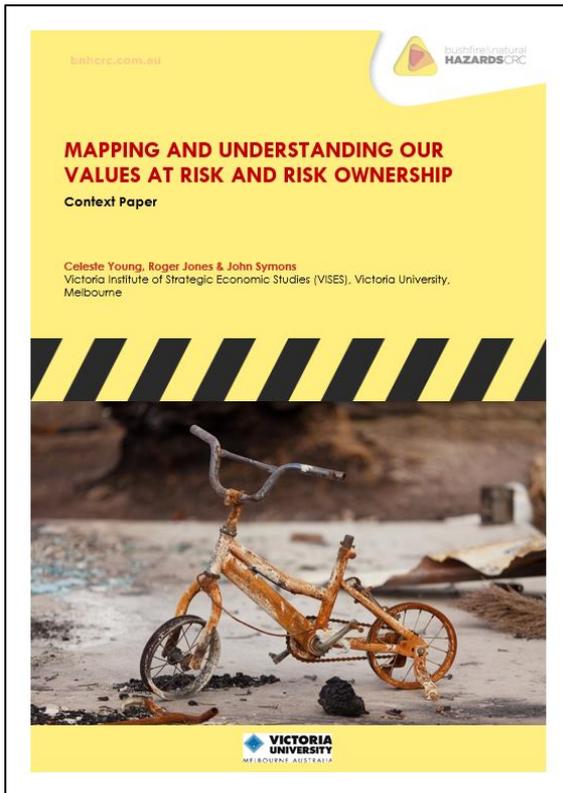


The workshops were developed by the team at VISES and delivered in collaboration with the BNHCRC and our stakeholders in Victoria, New South Wales, South Australia and Tasmania. Their purpose was to explore, through a series of structured scenario exercises, how values and risk ownership are currently understood in relation to decision making. We also wanted to gain feedback of the newly developed draft *Values at Risk Map* to ascertain gaps in the values currently represented, and to define if there was an opportunity to develop the map for use within the Emergency Management Sector.

Key questions were:

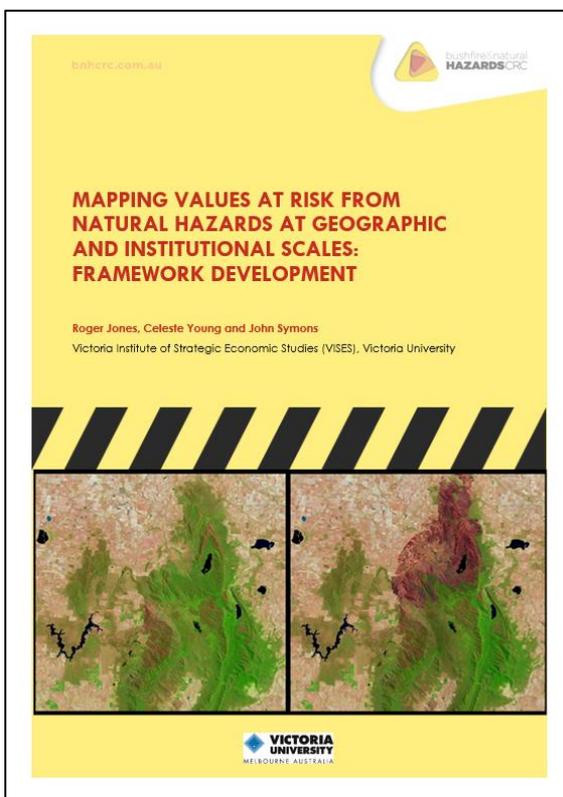
- How are the values at risk represented in the draft maps currently understood?
- What other values should be represented in the geography and how?
- What types of decision-making structures apply values at risk in strategic planning of natural hazard risk management?
- How might the values at risk map aid in the strategic planning of natural hazard risk management?
- What are the current strengths and gaps in risk ownership at an institutional level?

## Workshop context paper



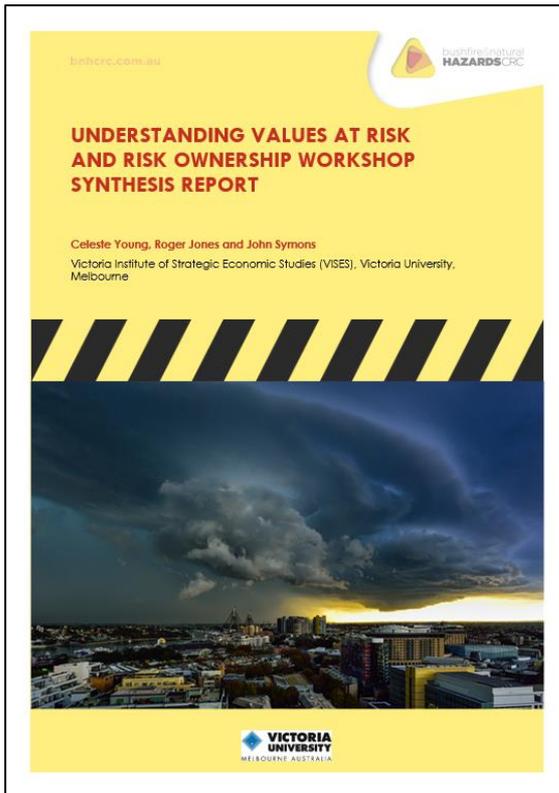
*Mapping And Understanding Our Values At Risk, context paper* was developed prior to the workshops and circulated to the participants to ensure that there was a common understanding amongst participants attending the workshops of what was to be explored during the workshop and the key questions. Key areas outlined in this paper are: (1) systemic risk; (2) the role of values; (3) vulnerability and (4) the role of institutions and propagation of risk ownership across institutional domains.

## Institutional framework paper



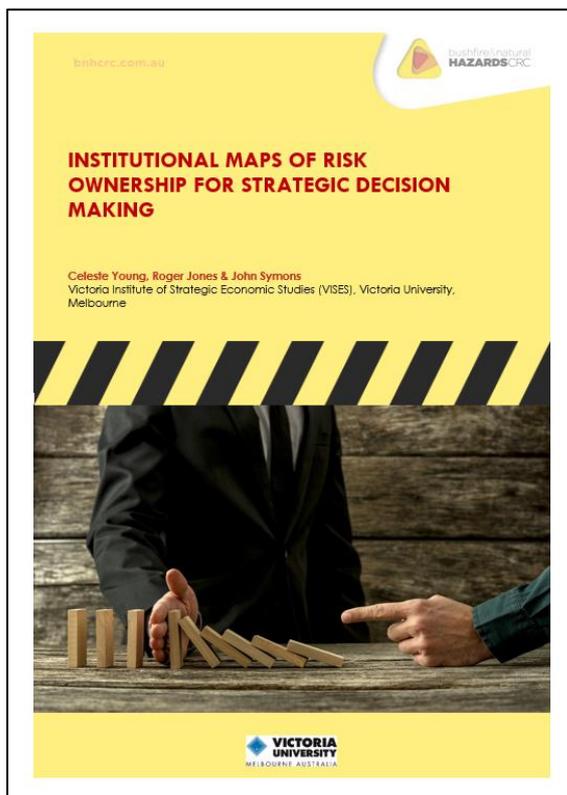
*Mapping Values at Risk from Natural Hazards at Geographic and Institutional Scales: Framework Development.* Key features include: (1) the major institutions affected by natural hazard risk: local, state and federal government, community and business and industry; (2) incorporating monetary, social and environmental values ranging from tangible to intangible; (3) the understanding of risk ownership through the owner of the resource at risk and the delegated risk manager; (4) the crossing of institutional domains, using risk ownership as a vehicle and (5) how risk ownership is designated, understood and exercised as a proxy for risk governance.

## Workshop synthesis report



*Understanding Values at Risk and Risk Ownership Workshop Synthesis Report* was developed following the workshops. This report outlines frameworks that assist the understanding of strategic risk decisions and the systemic nature of the different types of risk associated with risk ownership. It contains: (1) outcomes from the mapping and decision making exercises undertaken; (2) key process steps and questions for the values based decision making risk ownership framework in development; (3) feedback from end users in relation to the *Values at risk map*; (4) needs, barriers and opportunities and (5) future research and implementation areas for the project.

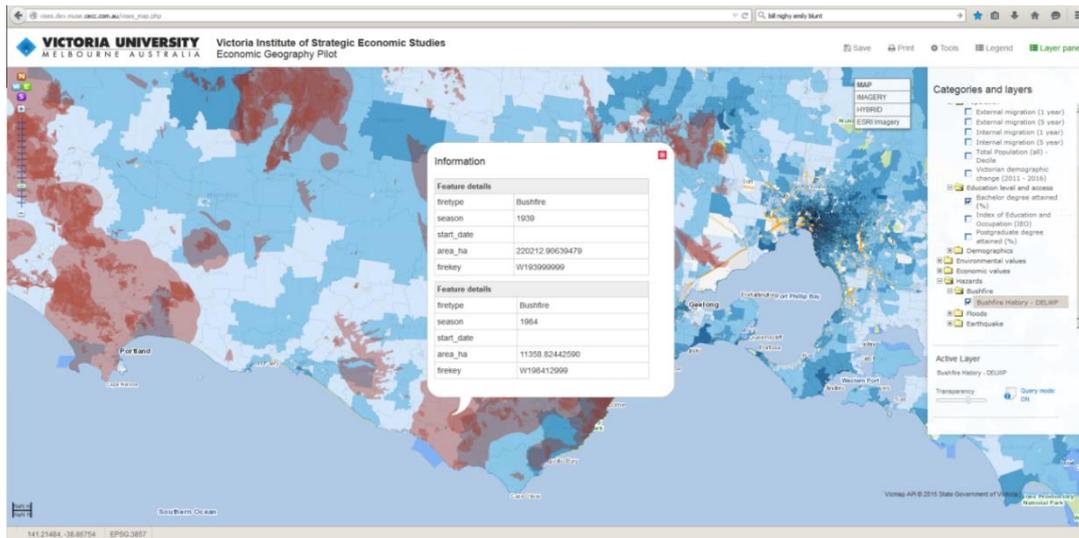
## Institutional maps of risk ownership



*Institutional Maps of Risk Ownership for Strategic Decision Making* aims to provide a starting point for strategic risk management across different institutions in relation to risk ownership. It describes institutional maps of risk ownership that have been developed through the research process to date in collaboration with end users. Their purpose is to provide an insight into the current balance of ownership delegations currently across institutions in the Australian context. These maps address risk ownership relating to the strategic management of natural hazard risk for planning, preparedness and recovery spectrum and present an overview of ownership of values at risk and risk activities associated with strategic management of risk.

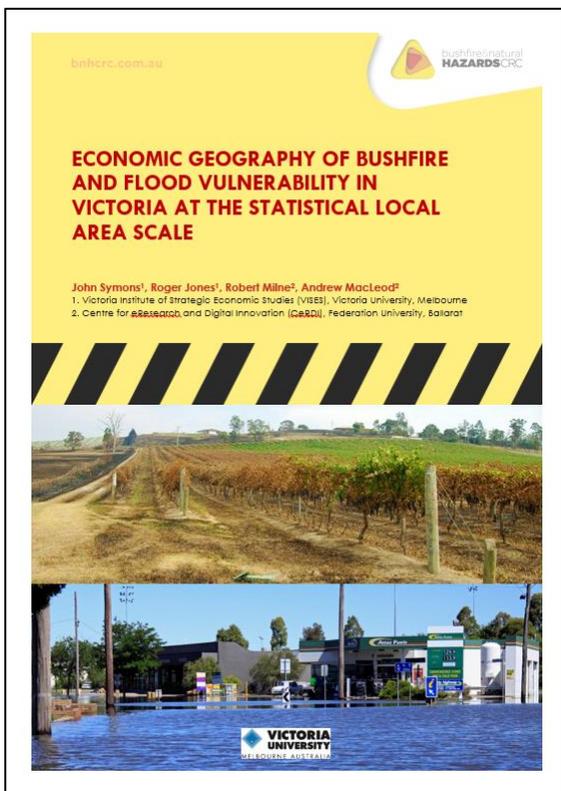
natural hazard risk.

## Values at Risk Map



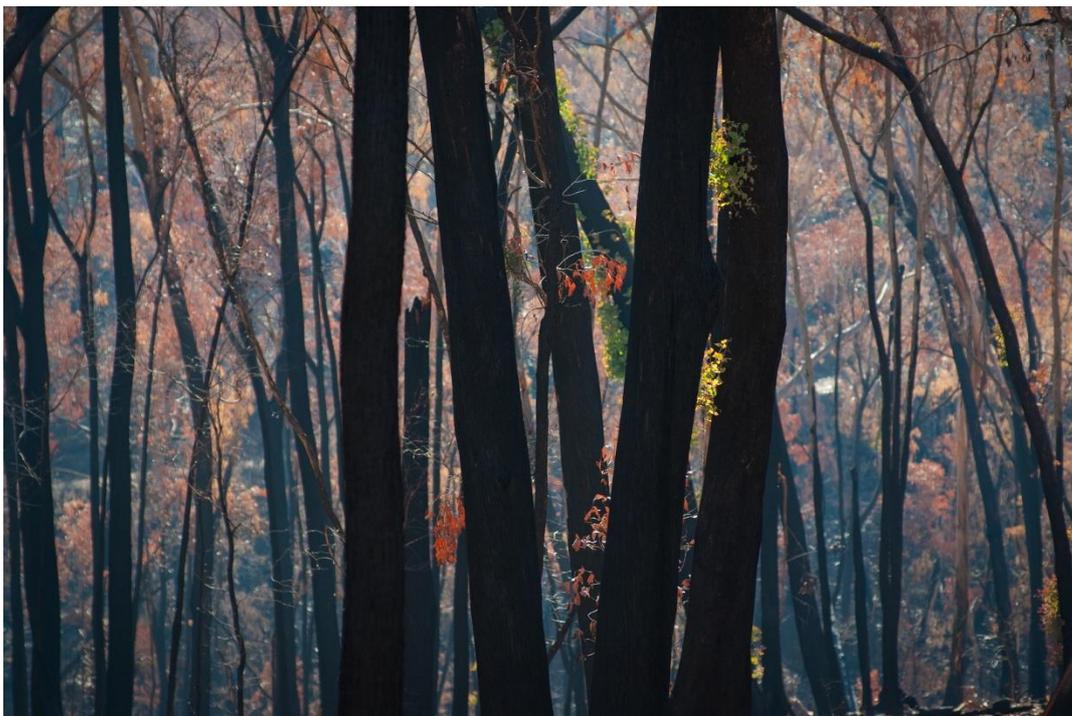
Development of this mapping facility has been completed. Consultation with end users about its potential future use identified that although the map was of interest, its key purpose was most likely as a research tool to formulate and test questions. End users felt that their key data-related need was for sense-making of data, so that they could better understand and use their existing data in support of strategic decision making. The map address is [http://vises.dev.muse.cecc.com.au/vises\\_map.php](http://vises.dev.muse.cecc.com.au/vises_map.php).

## Economic geography



This report identifies industry sectors in Victoria and those statistical local areas with the highest vulnerability to bushfire and flood, based on the exposure of 2011 industry output to historical fire and flood data. As expected, vulnerability is high in some sectors (e.g., agriculture) and some regions, mainly rural areas, where up to 50% of annual output can be vulnerable. Metropolitan areas are largely insensitive to these risks and peri-urban areas contain some vulnerable areas. An additional assessment of total economic output and diversity accentuates the vulnerability of rural areas in particular, putting the ability to recover from hazards at risk.

## NEXT STEPS



Our project has reached the final phase of funding and over the next six months will be finalising the following outputs:

- A synthesis report for the project.
- A process-based framework for ascertaining risk ownership that uses the National Emergency Risk Assessment Guidelines as a focus point and can be integrated into EMS risk planning processes.
- Finalisation of the Values at Risk spatial map.
- A conceptual framework for institutional resilience.
- A paper summarising the key findings and learnings from the project.

### Utilisation of research

To date aspects of our research related to risk ownership have been used in areas of government to open up dialogue in relation to risk ownership, and in one case, to support the development of a framework.

In terms of future activities, in collaboration with end users, the project has defined two key areas for utilising the research produced. These are:

1. Integration of risk ownership using values-based strategic decision making using current processes.
2. The development of a project that looks specifically at sense making of information and technology systems to support strategic decision making.

**Risk ownership utilisation** would involve working with stakeholders to integrate the process-based risk ownership framework into context-specific



planning processes. It would also potentially examine private/public ownership of risk further and how that can be applied through the risk ownership process.

Development of guidance materials to support the development of skills and capacity across planning processes would also be a key focus.

**Sense-making with information systems for strategic decision making** was a core utilisation need that was identified during our research. This proposal would use an “innovation lab” approach and work with end users to address how they can make the best use of their own information and technology systems to answer key strategic questions. The questions used would be developed with end users and then ‘tested’ as case studies using stakeholder data. A key output would be evidence-based guidance material and a framework to support this.

Key areas for future research related to these implementation plans are as follows:

- How to integrate research, practice and everyday understanding of risk into decision-making frameworks for strategic planning.
- Identification of the current and emerging role of data and technology in decision making.
- Identification and analysis of skills required and current skills gaps related to strategic decision making, and identification of risk across multiple hazards and temporal scales.
- Analysis of effectiveness of current decision-making tools in use.
- Developing a better understanding of the risk ownership system using applied network analysis.
- Analysis of the current balance of public-private ownership of values and risks to ascertain real levels of ownership and how to understand what levels of public private ownership may be sustainable for the future.
- Further explorations of the links between risk ownership and institutional arrangements surrounding natural hazard risk management.
- Further development of non-monetary economic valuations for application at the community scale.



## PAPERS AND REVIEWS LIST 2015–2016

### Papers

Jones R.N., Young C., Symons J., 2015, Risk Ownership and Natural Hazards: Across Systems and Across Values, *refereed paper presented at AFAC15: New Direction in Emergency Management*, Australasian Fire and Emergency Service Authorities Council (AFAC), Bushfire and Natural Hazards CRC, Adelaide, 1-3 September 2015

Young C.K., Jones R.N., 2016, Owing the future – Risk Ownership And Strategic Decision Making For Natural Hazards, Paper submitted to AFAC 2016 (Submitted), peer reviewed, Australasian Fire and Emergency Service Authorities Council (AFAC) Conference, Brisbane, 30 August – 2 September, 2016.

### Research reports

Jones R.N., Young C.K., Symons J., (2015) Mapping Values at Risk from Natural Hazards at Geographic and Institutional Scales: Framework Development. Report to Bushfire and Natural Hazards CRC. VISES, Victoria University, Melbourne, 32 pages.

Symons J., Jones R.N., Milne R. and McLeod A. (2016) Economic Geography of Bushfire and Flood Vulnerability in Victoria at the Statistical Local Area scale. Report to Bushfire and Natural Hazards CRC. VISES, Victoria University, Melbourne (In review)

Young C.K., Jones R.N., Symons J., (2015) Mapping and Understanding our Values at Risk and Risk Ownership: Workshop Context Paper. Report to Bushfire and Natural Hazards CRC. VISES, Victoria University, Melbourne, 33 pages

Young C.K., Jones R.N., Symons J. (2016) Mapping and Understanding our Values at Risk and Risk Ownership: Workshop Synthesis Report. Working paper for publication to Bushfire and Natural Hazards CRC. VISES, Victoria University, Melbourne, 115 pages

### Reviews undertaken

Young C., Jones R., 2015, Papers, AFAC15: New Directions in Emergency Management, Australasian Fire and Emergency Service Authorities Council (AFAC) (one each).

Young C., 2016, Paper, Australian Journal of Emergency Management.

## MILESTONES TO DATE

Milestone	Date due	Status	Notes
3.1 Complete delivery of 4 x 1 day workshops	31 August 2015	Completed	
3.2 Develop Institutional Maps of Risk Ownership	7-Sep-15 to 7-Jan-16	Completed	
3.3 Delivery of Quarterly Report to CRC	30-Sep-15	Completed	
3.4 Research Paper 2 "Ownership of values at risk" suitable for publication submitted to CRC	21-Dec-15	Completed	
3.5 Delivery of Quarterly Report to CRC	7-Jan-16	Completed	
3.6 Finalise risk ownership map with stakeholders	15-Mar-16	Completed	
3.7 Delivery of final Risk Ownership Maps	15-Mar-16	Completed	
3.8 Delivery of Quarterly Report to CRC	30- Mar-16	Completed	
3.9 PhD literature survey complete along with draft chapter outlines	30-Jun-16	Cancelled	We have been unable to secure a PhD student so this milestone has been removed
Delivery of Quarterly Report to CRC	30-Jun-16	Completed	
Delivery of Annual Report to CRC	30-Jun-16	Completed	

TABLE 1. MILESTONES AND STATUS, 2015–2016