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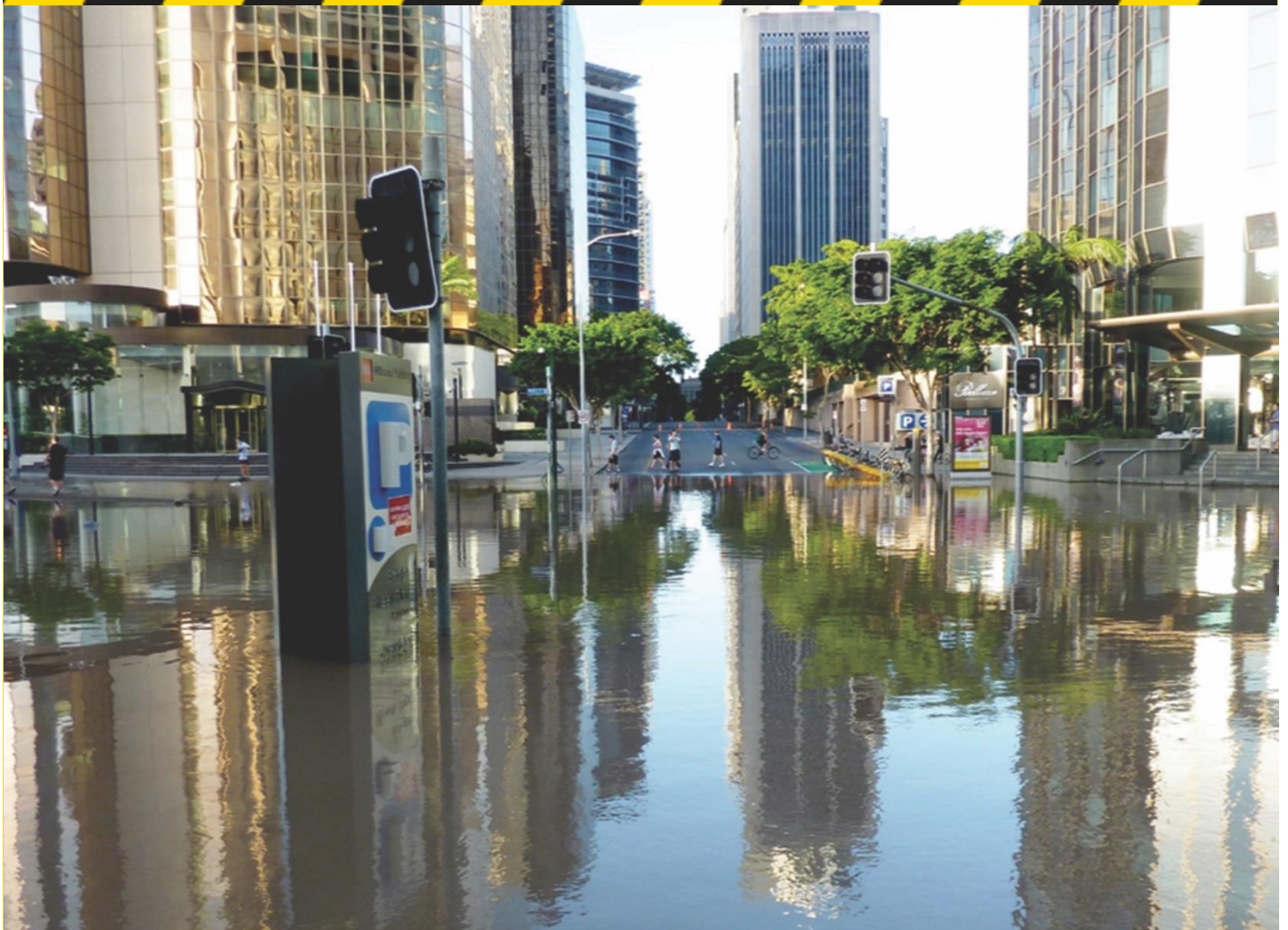
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**HAZARDS**CRC

# INTEGRATED URBAN PLANNING FOR NATURAL HAZARD MITIGATION

Annual report 2018-2019

**Prof Alan March and Dr Leonardo Nogueira de Moraes**

The University of Melbourne and the Bushfire and Natural Hazards CRC





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## **END-USER STATEMENT**

Ed Pikusa- Department of Environment and Water

Land use planning is one of the more complex and long-term issues of managing disasters, managing the development of our urban and rural land, while not increasing our risks from disasters.

This project is seeking to develop a framework to guide policymakers through this complex area of public policy. It is a challenging project, but one with significant long-term benefits. I commend the researchers in their listening to end users, and adapting the scope of the project to meet the requirements of end users.

The outcomes from this work will make a valuable contribution to this important area of public policy.



## INTRODUCTION

This document reports on the carried-out activities, achieved milestones, and submitted deliverables for the second year of operation of the BNH-CRC Integrated Urban Planning for Natural Hazard Mitigation project – 1<sup>st</sup> July 2018 to 30<sup>th</sup> June 2019. It contrasts achieved and planned outcomes and explains the necessary adjustments carried out to date.

It starts by offering a background to the project, followed by considerations to the research approach being undertaken and then an explanation of the project implementation in greater detail and its utilisation outputs.

This Year 2 – 2018-2019 report will be followed by one final annual report to be submitted in mid-2020. In parallel to annual reports, this research project generates quarterly reports that further detail its operation every three months, as well as yearly self-assessment matrices. On the 30<sup>th</sup> of June 2020, a final report summarising key research project outcomes will also be submitted.



## BACKGROUND

Urban Planning – UP systems have considerable potential to modify the impacts of natural hazards upon the built environment, humans and associated systems; and to contribute to resilience processes and outcomes. However, the full integration of planning systems with emergency management is still far from reaching its potential.

Following are some of the key challenges to the integration of urban planning and natural hazard mitigation:

- Settlements portray pre-existing patterns of investment, tenure and human characteristics that slow down processes of change, imposing the need for concerted efforts for them to be effective;
- New types of emergent and complex risks such as heatwaves and heat islands, infrastructure “brittleness” and differences of service capacity across cities and regions, and response times;
- Changing variables that define vulnerability, such as social inequity, leading to a lack of joint consideration of multiple hazards;
- Specificity of different planning systems tools that offer particular ways of achieving outcomes;
- Multi stakeholders driven by different outcomes in the individual-collective spectrum (public managed planning systems trying to influence private patterns of built and natural environments reshaping);
- Political, legal, bureaucratic, physical and bio-physical constraints limiting the reach of UP systems and institutions in their pursuit of multiple goals, not always aligned with risk management processes;
- Necessary data integration compromised by research design that is suitable only for specific applications;
- Imperfect understanding of Planning by Emergency Management policy makers and practitioners and vice-versa, particularly relating to co-benefits across a range of social, economic and environmental goals.

In this context, the BNH-CRC Integrated Urban Planning for Natural Hazard Mitigation project seeks to understand the limits and potentials of integrated urban planning for natural hazard mitigation in Australia and the ways in which key planning processes for risk-based decision-making in the built environment can be improved at local and state level, including generalisable and adaptable model processes and codes with illustrative cases.



## RESEARCH APPROACH

The following were defined as primary questions for this research project:

PQ1 – What are the limits and potentials of integrated urban planning for natural hazard mitigation in Australia?

PQ2 – How can key planning processes for risk-based decision making in the built environment be improved at local and state level, including generalizable and adaptable model processes and codes with practical illustrative cases?

To make it operational, the research was broken down into 3 sequential stages that focus on: the development of an analytical framework to interrogate different relevant cases (Stage 1 – Mapping Current Knowledge, Best Practice and Challenges), its application to these cases with the intent to assess current integration and ways forward (Stage 2 – Assessing Australian Planning and Ways Forward) and the application of these theories to two selected case studies with specific processes generated for the integration of Natural Hazard Risk Management theory into planning procedures (Stage 3 – Applying and Generating Knowledge in New Ways).

To support the development of each stage, specific sub-questions were defined. Stage 1, for example, had the following sub-questions:

1. What theoretical and practical approaches are used in urban planning internationally and in Australia; and are there best practice examples as well as failed examples relevant to Australia that can be more thoroughly examined?
2. What specific lessons can be derived from past hazard events?
3. What current approaches are used in Australia, and have these utilised lessons from the past?
4. Are current approaches meeting the full potential of integrated urban planning and risk reduction, and are these addressing emergent trends of growth and change?
5. What appear to be key issues and potentials, and what appear to be the limits to planning, in parallel with identifying appropriate non-planning mechanisms?

In turn, to outline the necessary actions to addressing these sub-questions, lists of actions for each stage were developed. For Stage 1, the following were listed:

1. Audit of current theory and practice as applied at present literature review, (inter)national, planning and natural hazards.
2. Analysis of database of post-event inquiries to identify issues in past events related to urban planning.
3. Description of current policy and regulatory provisions linking EM and land use planning across Australian jurisdictions, enabling clarification of what planning does/can versus cannot or at least is highly constrained in doing.

Integration with existing work on current dynamics of urban and regional change and its management.





## KEY MILESTONES

Comprising 3 stages, the original project management plan indicated the following breakdown of stage completion per quarter/year:

Year	Quarter	Period	Stage
Y1	Q1	Jul-Sep 2017	S1
	Q2	Oct-Dec 2017	
	Q3	Jan-Mar 2018	
	Q4	Apr-Jun 2018	
Y2	Q1	Jul-Sep 2018	S2
	Q2	Oct-Dec 2018	
	Q3	Jan-Mar 2019	
	Q4	Apr-Jun 2019	
Y3	Q1	Jul-Sep 2019	S3
	Q2	Oct-Dec 2019	
	Q3	Jan-Mar 2020	
	Q4	Apr-Jun 2020	

PROJECT MANAGEMENT PLAN ORIGINAL BREAKDOWN OF PROJECT STAGES PER QUARTERS AND YEARS.

However, despite the project's planned date of commence being 1<sup>st</sup> of July 2017, the contract was signed by all parties and formally approved for execution only on 19<sup>th</sup> October 2017, leading to the following necessary rearrangement of stage completion quarters:

Year	Quarter	Period	Stage
Y1	Q1	Jul-Sep 2017	S1
	Q2	Oct-Dec 2017	
	Q3	Jan-Mar 2018	
	Q4	Apr-Jun 2018	
Y2	Q1	Jul-Sep 2018	S2
	Q2	Oct-Dec 2018	
	Q3	Jan-Mar 2019	
	Q4	Apr-Jun 2019	
Y3	Q1	Jul-Sep 2019	S3
	Q2	Oct-Dec 2019	
	Q3	Jan-Mar 2020	
	Q4	Apr-Jun 2020	

PROJECT MANAGEMENT PLAN ADJUSTED BREAKDOWN OF PROJECT STAGES PER QUARTERS AND YEARS.



Therefore, **this report focuses mostly on Stage 2 Milestones and Deliverables**, whereas the third/last annual report will focus on stage 3.

**Stage 2 (S2)** is about the **assessing Australian planning and ways forward**, comprising three milestones entitled:

**M2** – *Preliminary desktop assessment of selected current approaches to the integration of planning and EM across Australia and internationally, including lessons from the past.*

**M3** – *Assessment of current practitioner knowledge and skills and views, combined with possible new approaches.*

**M4** – *Identification and selection of two cases to explore new approaches to integrating EM and Planning in Australia, justifying selection and briefly describing the selected cases.*

**M2** was associated with the following deliverables:

**D4** – *Report on preliminary assessment of selected current approaches in Australia and internationally, including their appraisal, and proposals for new approaches, in combination with understanding of the realistic limits to planning. (2.1.1)*

D4 was submitted on 28<sup>th</sup> of November 2018 with the title **Australian Inquiries in Natural Hazard Events: Recommendations relating to urban planning for natural hazard mitigation (2009-2017)** and it consisted “on an assessment of major Australian post-disaster and emergency event inquiries and reviews from the past ten years in terms of recommendations relating to the integration of urban planning and natural hazard mitigation.

Findings pointed to recommendations concentrating “heavily upon statutory planning and regulatory mechanisms”, there being “an emphasis on physical resistance approaches”, a call for further integration of urban planning and emergency management and “little consideration of urban planning’s role in response and recovery” albeit shared responsibility emerging as a common theme.

The report also suggested implications from these findings, including the need to further develop “critical tools and model approaches to examine planning approaches in parallel with integration”, there being “few instances of ‘cross-learning’ between inquiries” and “a need for further detailed examination, including on the recommendations implementation and monitoring.

**D5** – *Refereed Journal Paper Submitted (2.2.1)*

Submitted on the 8<sup>th</sup> March 2019 to the Journal of Planning Practice and Research, the paper titled **Comprehensiveness of urban planning wildfire provisions: Victoria, Australia 2008 – 2018** “demonstrates that the use of comprehensive regulations within a planning system can occur over time, seeking improved community safety and resilience against the threat of wildfires”. It is an important complement to D4, insofar it provides “an appraisal of the comprehensiveness of Victoria’s urban planning approach to wildfire risk management over time, beginning with policy in place at the time of the 2009 Black Saturday wildfires”. While D4 has an Australian wide focus and D5 is



restricted to Victoria, the time scales are mostly overlapping, with D5 illustrating questions of contextualised implementation of specific royal commission inquiry recommendations. While D5 acknowledges that “Victoria’s approach to wildfire risk management has evolved to become significantly more comprehensive[,] [...] there are gaps in policy that need to be addressed if settlements are to be better prepared for the potential threat and impacts of wildfires in the future”. Among these, the paper points that “the absence of preparedness for recovery mechanisms and a limited emphasis on hazard avoidance in the [Victorian Planning Provisions] are the most obvious gaps in current policy”.

**As part of M3, two deliverables were planned:**

**D6** – *Report on current practitioner knowledge, technical skills and views of current and possible new approaches to EM integration with Urban Planning (2.3.1)*

**D7** – *Refereed journal paper submitted (2.4.1)*

Submitted on the 4<sup>th</sup> of April 2019, the book chapter entitled Dimensions of risk justice and resilience: mapping urban planning’s role between individual versus collective rights “applies a justice framework to the complex of dilemmas between individual rights and the public good relating to bushfire risks” using the 2015 Wye River – Jamieson Track Fires as an illustrative case study. The theoretical understandings around the role of urban planning in bushfire risk treatments explored in this chapter are an important contribution to the analytical framework for integrating urban planning and natural hazard mitigation being further developed and applied as part of the work leading to deliverables D6 and D8.

**As part of M4, one key deliverable was planned:**

**D8** – *Report with final assessment of selected current international and Australian approaches and preliminary assessment of suitability and scope of two cases to explore new generalisable approaches to integrating EM and Planning in Australia. This integrates EM and Planning practitioner views of the preliminary findings and other ideas, information, barriers, issues and gaps. (2.4.2)*

During the research, it became clear that the practical generation of ideas, challenges and possibilities for acceptance and critical appraisal of new and innovative ideas in Urban Planning and Emergency Management, was best generated while interacting with practitioners and other stakeholders during the process of assessing and understanding existing processes. Accordingly, it was decided that **deliverables D6 and D8 should be merged into one**.

Stage 2 also comprised the submission and presentation of a poster for the 2018 BNH-CRC Conference that took place in Perth from the 5<sup>th</sup> to the 8<sup>th</sup> of September 2018.

**P2** – *Poster for BNH-CRC Conference (2.1.3)*

The poster presented in the 2018 BNH-CRC Conference showcased outputs from the first report submitted in Year 1 of the project (Summary of Key Practical and Theoretical Approaches to the Integration of Urban Planning and Emergency



Management). Among these outputs, two were important foundations for the work developed in the Year 2:

- Urban and Regional Planning Areas for Potential Action Across All Hazards; and
- A list of 11 elements of an approach to integration.

The first is a cornerstone for the development of the analytical framework for assessing current and potential integration of urban planning and natural hazard mitigation that will be presented in the combined report for deliverables D6 and D8 that will be submitted to the BNH-CRC by the end of Year 3 Quarter 1.

The second was utilised in the development of the second report (D4) titled Australian Inquiries into Natural Hazard Events: Recommendations relating to urban planning for natural hazard mitigation (2009-2017) where urban planning related recommendations were assessed against the list of eleven elements of an approach to integration.

Finally, deliverable D10, initially planned for Year 3 Quarter 2, was submitted earlier, during Year 2 Quarter 4:

#### **D10 – Refereed Journal Paper Submitted (3.2.1)**

The paper “the challenges for wildfire prone urban-rural interfaces” was written as a result of research undertaken that also included a BNH-CRC associate researcher and PhD Constanza Gonzalez Mathieson. This paper consolidates understandings of barriers and facilitators to appropriate integration of disaster risk reduction and urban planning using the case of bushfire in Australia. It represents an important output of the project whereby assessment of risk treatments and urban planning practices provide pathways for improvement to current practice. It was considered appropriate to prioritise completion of a refereed published BNH-CRC output in an international journal to provide a strong base for the remainder of the project. As a result, **Deliverable 8 (now merged with deliverable 6) was pushed for Year 3 Quarter 1 and Deliverable 9 was pushed for Year 3 Quarter 2.**

The tables presented on the next page summarise the changes to the timeline of deliverables submission described above:



Year	Quarter	Deliverables	Period
Y1	Q1	-	Jul-Sep 2017
	Q2	-	Oct-Dec 2017
	Q3	D1	Jan-Mar 2018
	Q4	D2	Apr-Jun 2018
Y2	Q1	D3, D4	Jul-Sep 2018
	Q2	D5	Oct-Dec 2018
	Q3	<b>D6</b>	Jan-Mar 2019
	Q4	D7, <b>D8</b>	Apr-Jun 2019
Y3	Q1	<b>D9</b>	Jul-Sep 2019
	Q2	<b>D10</b>	Oct-Dec 2019
	Q3	D11	Jan-Mar 2020
	Q4	D12, D13, D14	Apr-Jun 2020

PROJECT MANAGEMENT PLAN **ORIGINAL** BREAKDOWN OF PROJECT DELIVERABLES PER QUARTERS AND YEARS.

Year	Quarter	Deliverables	Period
Y1	Q1	-	Jul-Sep 2017
	Q2	-	Oct-Dec 2017
	Q3	D1	Jan-Mar 2018
	Q4	D2	Apr-Jun 2018
Y2	Q1	D3, D4	Jul-Sep 2018
	Q2	D5	Oct-Dec 2018
	Q3	D6	Jan-Mar 2019
	Q4	D7, <b>D10</b>	Apr-Jun 2019
Y3	Q1	<b>D8 (merged with D6)</b>	Jul-Sep 2019
	Q2	<b>D9</b>	Oct-Dec 2019
	Q3	D11	Jan-Mar 2020
	Q4	D12, D13, D14	Apr-Jun 2020

PROJECT MANAGEMENT PLAN **REVISED** BREAKDOWN OF PROJECT DELIVERABLES PER QUARTERS AND YEARS.



## UTILISATION AND IMPACT

### ANALYTICAL FRAMEWORK FOR ASSESSING CURRENT AND POTENTIAL INTEGRATION OF URBAN PLANNING AND NATURAL HAZARD MITIGATION

#### Output Description

The research being undertaken has developed a way to understand, critique and improve urban planning's influence and impact on risk reduction to natural hazards. That includes:

- the development of an analytical tool;
- the application of this analytical tool for procedural assessment; and
- the assessment of the comprehensives of treatment mechanisms across different hazards;
- case study demonstrations of application (studies being undertaken);
- the inclusion of core principles of this explanatory analytical framework in the Land Use Planning Handbook currently being reviewed by AIDR with the support of the project leader (Prof Alan March).

#### Extent of Use

The outputs of the project have not been directly used or adopted by agencies at this stage. However, current work and publication outputs are developing the research to communicate and explain it in a way that will facilitate its use.

#### Utilisation Potential

The essence of the research being undertaken is an ability to understand, critique and improve urban planning's influence and impact on risk reduction to natural hazards. The potential for utilization therefore is greatest in terms of the critical model developed in the research being used and applied to process of land management in existing and future settlements. In particular, by modifying the processes of state and local government during planning decision-making processes. Due to the complex legislative and regulature frameworks in which planning occurs, it may well be that such changes would not necessarily occur in the short term. However, the development of illustrative critical and explanatory understandings of the importance and application of urban planning as a tool for disaster risk reduction is in and of itself a significant output that can be utilized.

#### Utilisation Impact

- The early stage of the project means that this cannot be demonstrated currently.



## NEXT STEPS

- Continue to work with end-users to generate understandings of challenges and changes to urban planning approaches.
- Development of written and drawn outputs that communicates and stimulates understandings and applications of research outputs.
- Publication in appropriate journals and other outputs to reach a diversity of audiences.



## PUBLICATIONS LIST

### PEER REVIEWED JOURNAL ARTICLES

- 1 Gonzalez-Mathiesen, C., March, A., & Stanley, J. (2019). *Desafíos para las interfaces urbano-rurales propensas a incendios forestales: El caso de Melbourne*. *Revista Urbano*, 22(39), 88-105. doi:10.22320/07183607.2019.22.39.05
- 2 Gonzalez-Mathiesen, C., March, A., Leonard, J., & Holland, M. (2019). Urban Planning: historical changes integrating bushfire risk management in Victoria. *Australian Journal of Emergency Management*, 60-66. Retrieved from <https://knowledge.aidr.org.au/media/7007/ajem-201902-24-constanza-gonzalez-mathiesen-et-al.pdf>
- 3 Killin, E; March, A (2019). Path dependency of the development contributions system, *Planning News* 45 (1) Available at <https://search.informit.com.au/documentSummary;dn=180596462251061;res=ELBus>
- 4 March, A; Nogueira de Moraes, L.; Stanley, J. (Submitted). Dimensions of risk justice and resilience: mapping urban planning's role between individual versus collective rights. In Baldwin, C and Luka Weisz (Eds) *Disaster Justice*.
- 5 Ockenden, L.; March A. (Submitted). Comprehensiveness of Victorian Bushfire Provisions. *Planning Practice and Research*.

### TECHNICAL REPORTS

- 1 March, A; Nogueira de Moraes, L; Riddell, G; Stanley, J; Van Delden, H; Beilin, R; Dovers, S; Maier, H. (2018) *Practical and theoretical issues: integrating urban planning and emergency management*. 2018. Bushfire and Natural Hazards Cooperative Research Centre, Melbourne. Available at <https://www.bnhcrc.com.au/publications/biblio/bnh-4955>
- 2 March, A; Nogueira de Moraes, L; Riddell, G; Dovers, S; Stanley, J; Van Delden, H; Beilin, R; Maier, H. (2018) *Australia Inquiries into Natural Hazard Events*. Bushfire and Natural Hazards CRC, East Melbourne.

### OTHER

- 1 Nogueira de Moraes, L; March, A, (2019) Submission to the Beyond Tourism 2020 Strategy Steering Committee Report to Government Consultation, *Beyond Tourism 2020 Strategy Steering Committee Report to Government: Response to the Invitation to Comment*, pp. 1 – 8. Available at: <http://hdl.handle.net/11343/221789>





## TEAM MEMBERS

The Integrated Urban Planning for Natural Hazard Mitigation Project comprises an interdisciplinary team of researchers with expertise in the fields of urban planning, natural hazard mitigation, resilience, decision support systems, climate change, governance, disaster risk management and public policy.

### PROF ALAN MARCH

Alan March is Professor in Urban Planning. He is also Director of the Bachelor of Design across the Faculties of Architecture, Building and Planning; Engineering; and, Faculty of Fine Arts and Music. Alan has twice won the Global Planning Education Network's prize for "Best Planning Paper" (2007, 2011). His teaching includes urban design, planning law and planning theory subjects, and he was awarded a Faculty teaching prize in 2007. Alan has successfully supervised over 60 students' theses encompassing a range of urban design and planning research topics. He won the Planning Institute of Australia's Victoria division "planner of the Year" prize in 2016 and won a National Commendation in the same category in 2017.

Alan has practised since 1991 in a broad range of private sector and government settings and has had roles in statutory and strategic planning, advocacy, and urban design. He has worked in Western Australia, the UK, New South Wales and Victoria. Alan's early career included projects as diverse as foreshore protection plans, rural to urban subdivision approval and design, the Mandurah Marina and Urban Design Guidelines for the Joondalup City Centre. In England, he has worked in brownfield and inner-city redevelopment, including land assembly and urban regeneration projects. Alan has extensive experience in inner city redevelopment projects in Melbourne since 1996.

Alan's publications and research include examination of the practical governance mechanisms of planning and urban design, in particular the ways that planning systems can successfully manage change and transition as circumstances change. He is particularly interested in the ways that planning and design can modify disaster risks, and researches urban design principles for bushfire. His current work also considers the ways that urban planning is seeking to establish new ways to spatialise urban management.

### DR LEONARDO NOGUEIRA DE MORAES

Leonardo Nogueira de Moraes is a postdoctoral research fellow in resilience and urban planning at the Faculty of Architecture, Building and Planning of the University of Melbourne. He is part of the research team for the Integrated Urban Planning for Natural Hazard Mitigation project, funded by the Bushfire and Natural Hazards Cooperative Research Centre.

His background includes a Bachelor of Tourism (Development and Planning) degree and a Specialisation in Tourism and Hospitality Marketing Management from the University of São Paulo, Brazil. His PhD in Architecture and Planning at The University of Melbourne focused on the effects of tourism development and



the implementation of protected areas on the resilience of small oceanic islands, from a social-ecological complex adaptive systems perspective.

His current research on resilience and urban planning also includes the effects of tourism development to the resilience of local communities to natural hazards. This is being developed with the aid of grounded theory methods, coupled with social media analysis and data visualisation by means of interactive timelines.

### **MR GRAEME RIDDELL**

Graeme is a researcher and consultant across the fields of urban planning, disaster risk and resilience. His work revolves around developing and applying innovative modelling and participatory approaches to tackle complex planning and policy issues. Graeme is currently a research fellow at the University of Adelaide (Australia) and associate consultant at RIKS, the Research Institute for Knowledge Systems (the Netherlands).

He is also a PhD Candidate at The University of Adelaide researching how to develop effective policies under conditions of complexity and uncertainty considering both robust and adaptive approaches. His aim is to develop decision support systems to assist policy development. Graeme is also involved with the BNHCRC Project Decision support system for policy and planning investment options for optimal natural hazard mitigation led by Professor Holger Maier.

### **EMERITUS PROFESSOR STEPHEN DOVERS**

Emeritus Professor Steve Dovers was originally trained as an ecologist and natural resource manager, and worked in local government and heritage management. He later studied geography at graduate level, and gained a PhD in environmental policy in 1996. He became an academic member of staff at the then Centre for Resource and Environmental Studies at the ANU in 1997. From 2009-2017 he was Director of the Fenner School of Environment and Society at the ANU, and an inaugural ANU Public Policy Fellow. He is a Fellow of the Academy of Social Sciences in Australia, was inaugural Chair of the Management Committee of Future Earth Australia; a member of the Advisory Council of the Mulloon Institute, Associate Editor of the Australasian Journal of Environmental Management, and member of the editorial Boards of the journals Local Environments, Environmental Science and Policy, and Resilience. Steve is a Senior Associate with the advisory firm Aither.

### **A/PROF JANET STANLEY**

Janet Stanley is an Honorary Principal Fellow at the Faculty of Architecture, Building & Planning, visiting Professor at the University of Hiroshima, Japan, a Director of the National Centre for Research in Bushfire & Arson and a Director of Stanley & Co., consultants in sustainable policy. Prior to this, Janet was Chief Research Officer at Monash Sustainability Institute, Monash University.

Originally specialising in child protection and family violence, Janet now focuses on the interface between social, environmental and economic issues in climate



change and sustainability, across policy, system design, and at community levels. This work particularly focuses on sustainability issues for those people experiencing social exclusion and disadvantage. Most recent work has been on transport and land use in a 20-minute city, social policy and climate change and the prevention of bushfire arson. Janet has been an advisor to state and federal governments, is on the Board of the charitable trust, the George Hicks Foundation and is a member of the Future Melbourne Network.

### **A/PROF HEDWIG VAN DELDEN**

Hedwig van Delden is Director of the Research Institute for Knowledge Systems (RIKS) in the Netherlands and Adjunct Associate Professor in the School of Civil, Environmental and Mining Engineering at the University of Adelaide.

Her work focuses on applying research into planning and policy practice, and in particular on understanding and modelling of land use dynamics, integrating socio-economic and bio-physical processes, bridging the science- policy gap and the development of strategic scenarios. In doing so she focuses on the integration of disciplines as well as techniques (analysis, modelling, participation).

Hedwig has managed and contributed to a vast range of projects with multiple partners and objectives, for various governmental organisations worldwide. Her work in Australia includes the development of integrated models to support long-term decision-making for disaster risk reduction policies as part of the Bushfire & Natural Hazard CRC project.

### **PROF RUTH BEILIN**

Ruth Beilin is an internationally recognised expert in community based resource management, in urban and non-urban resilience studies—especially in the area of social and environmental resilience and in complexity theory and the application of uncertainty to the everyday experiences of those on the ground—whether in fire, flood, sea rise, or drought. As examples: she has co-authored in excess of 90 peer-reviewed papers in high quality, international journals, including ecological and social journals. She co-designed and authored four chapters in the textbook *Reshaping Environments*, used by upwards of 6000 students to-date. In 2015 she co-edited two Special Issues of high impact international journals, *Sustainability Science* and *J of Urban Studies*, on *Governance for Urban Resilience*. She is an Associate Editor of *Society and Natural Resources*, among others. Since 2015, Professor Beilin has been a member of the New Zealand Science Advisory Panel for Land and Water. Her lab at the University of Melbourne is based on interdisciplinary research and her leadership in Australian Research Council Linkages and in the CRC Bushfires has involved applied and theoretical outcomes. For example, in the project *The Social Construction of Fire and Fuel in the Landscape* (CRC Bushfires) CFA and equivalent agency staff across the country can use the social-ecological/visual mapping techniques she co-developed.



## **PROF HOLGER MAIER**

Holger Maier is Professor of Integrated Water Systems Engineering and Deputy Head of the School of Civil, Environmental and Mining Engineering at the University of Adelaide. Prior to joining the University in 1999, he worked as a consultant in the private and public sectors in South Australia, as a senior civil engineer with the Western Samoa Water Authority and as a postdoctoral research fellow at the University of British Columbia.

Holger's research is focussed on developing improved techniques for the sustainable management of water resources and infrastructure in an uncertain environment and includes elements of modelling, optimisation and multi criteria and uncertainty analysis. He has co-authored more than 10 book chapters and in excess of 100 refereed papers. He has received a number of national and international awards for his teaching and research.