



Queensland cyclone 2009_3

- Key Topics:
- exposure [2]
 - framework [3]
 - modelling [4]

Natural hazard exposure information modelling framework [5]
This project addressed the data and knowledge gaps and requirements for disaster resilience, resource assessment, emergency management, risk mitigation policy and planning. It identified the fundamental data requirements and modelling framework to derive exposure information to enable a better understanding of the vulnerability of people, buildings and infrastructure.

Project: detail Notabs

Research team

Research leader

[6]



Dr Krishna Nadimpalli
[6]
RESEARCH LEADER



[7]

[8]



Russell Hay
[8]
RESEARCH LEADER



[7]

Research team

[9]



Dr Itismita Mohanty
[9]
RESEARCH TEAM

[11]



Prof Abbas Rajabifard
[11]
RESEARCH TEAM

[10]



[12]



[13]



Dr Mohsen Kalantari
[13]
RESEARCH TEAM



[12]

[14]



Dr Yogi Vidyattama
[14]
RESEARCH TEAM



[10]

[15]



Mark Dunford
[15]
RESEARCH TEAM



[7]

[16]



Con Charalambou
[16]
RESEARCH TEAM



[7]

End User representatives

[17]



Corey Shackleton
[17]
END-USER



[18]

[19]



Duncan McLuckie
[19]
END-USER



[20]

[21]



Elliott Simmons
[21]
END-USER



[22]

[23]



Greg Buckley
[23]
END-USER



[24]

[25]



Greg Howard
[25]
END-USER



[26]

[27]




Leesa Carson
[27]
END-USER




[7]

[28]




Myles Fairbairn
[28]
END-USER




[29]

[30]



Ross Pritchard
[30]
END-USER



[31]

Description

Exposure in disaster risk reduction describes what is at risk; including people, buildings, infrastructure, businesses, hazardous substances and primary industries. Exposure information comprises the details needed to support situational awareness at all levels of governance and in various phases of disaster management.

The severity of a disaster depends on how much impact it has on exposure. The scale of impact in turn depends on the decisions made as a part of disaster mitigation. Therefore, exposure information is a fundamental requirement for decision making in disaster mitigation.

This project addressed the data and knowledge gaps and requirements for disaster resilience, resource assessment, emergency management, risk mitigation policy and planning. It identified the fundamental data requirements and modelling framework to derive exposure information to enable a better understanding of the vulnerability of people, buildings and infrastructure.

The project is a significant step towards developing national exposure information capabilities in Australia. The framework will support impact assessments on people, economy, infrastructure and the environment, caused by natural hazards such as bushfires, floods, cyclones and earthquakes.

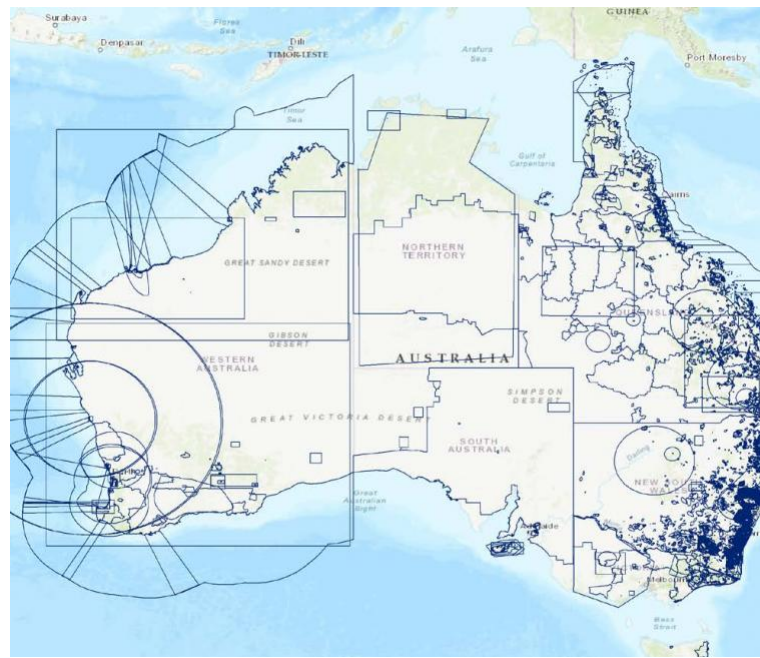
A number of nationally consistent frameworks were developed, which will help a diverse range of end-users. The frameworks include:

- Built environment exposure – considers the attributes of assets to assess their vulnerability to natural hazards. The building exposure considers usage, type, structural system, number of storeys, size, age, attachments, replacement value and contents value. The infrastructure sectors considered are transportation, energy, communication, urban water supply, waste management, hazardous substances and major industries. The primary industries considered are agriculture, fishing, forestry and mining sectors.
- Business and economics exposure – consists of business definitions, assets and activities which are deemed necessary for assessment of business continuity, disruption, resilience and recovery indicators in disaster management.

The study also reviewed current exposure information provision capabilities to identify key issues, needs, gaps, overlaps and deficiencies. An extensive literature review has been undertaken, along with stakeholder consultations to identify comprehensive list of information requirements. A survey with end-users identified significant gaps in the availability of existing data and the translation into meaningful information for evidence based disaster decision making. The built environment exposure information framework has been completed. To reduce the complexity, it categorises the information into three levels depending on the requirements of the user: policy and planning; response and recovery; research and analysis. The framework presents the fundamental characteristics of exposed assets to natural hazards as components, elements and attributes. The exposure components considered in the framework are buildings, people, businesses and infrastructure.

[Read the final report here.](#) [32]

Related News



21 DEC 2020

Uncovering exposure to natural hazards
EXPOSURE, FRAMEWORK

[33]



30 JUN 2020

Science galore – key CRC event dates
EMERGENCY MANAGEMENT, PRESCRIBED BURNING

[34]



09 AUG 2019

Severe weather research has impact
COINCIDENT EVENTS, FORECASTING

[35]



How to influence people with research

25 JUN 2019

[36]



New online - December 2018
EMERGENCY MANAGEMENT, MODELLING

18 DEC 2018

[37]



New online - November 2017

17 NOV 2017

[38]



New online - September 2016

14 SEP 2016

[39]



23 MAY 2016

New online - May 2016

[40]



17 MAY 2016

Videos highlight research benefits
COASTAL, INDIGENOUS COMMUNITIES

[41]

Publications

Year	Type	Citation
2021	Report	Charalambou, C. [42], Dunford, M. [15] & Bradley, J. [43] Australian Exposure Information Platform enhancement project [32]. (Bushfire and Natural Hazards CRC, 2021). Google Scholar [44] BibTeX [45]
2018	Report	Vidyattama, Y. [14] Constructing a data reliability framework for the natural hazard exposure information system [47]. (Bushfire and Natural Hazards CRC, 2018). Google Scholar [48] BibTeX [49] EndNote XML [50]
2018	Report	Nadimpalli, K. [6], Mohanty, I. [9], Vidyattama, Y. [14], Kalantari, M. [13] & Rajabifard, A. [11] Australian natural hazards exposure information framework: guidelines for national consistency and community engagement [51]. (Bushfire and Natural Hazards CRC, 2018). Google Scholar [52] BibTeX [53] EndNote XML [54]
2017	Report	Nadimpalli, K. [6] Natural hazards exposure information framework: annual project report 2016-17 [55]. (Bushfire and Natural Hazards CRC, 2017). Google Scholar [56] BibTeX [57] EndNote XML [58]
2017	Report	Nadimpalli, K. [6], Mohanty, I. [9], Kalantari, M. [13] & Rajabifard, A. [11] Business exposure information framework [59]. (Bushfire and Natural Hazards CRC, 2017). Google Scholar [60] BibTeX [61] EndNote XML [62]
2016	Report	Nadimpalli, K. [6] Natural hazards exposure information framework: Annual project report 2015-2016 [63]. (Bushfire and Natural Hazards CRC, 2016). Google Scholar [64] BibTeX [65] EndNote XML [66]
2016	Report	Nadimpalli, K. [6] & Mohanty, I. [9] Built environment exposure information framework [67]. (Bushfire and Natural Hazards CRC, 2016). Google Scholar [68] BibTeX [69] EndNote XML [70]
2015	Presentation	Nadimpalli, K. [6] Natural hazard exposure information framework [71]. (2015). Google Scholar [72] BibTeX [73] EndNote XML [74]
2015	Report	Nadimpalli, K. [6] Natural hazard exposure information modelling framework: Annual project report 2014-2015 [75]. (Bushfire and Natural Hazards CRC, 2015). Google Scholar [76] BibTeX [77] EndNote XML [78]
2015	Report	Nadimpalli, K. [6] Natural Hazards Exposure Information Modelling Framework Annual Report 2014 [79]. (2015). Google Scholar [80] BibTeX [81] EndNote XML [82]

Presentations & Resources

DATE	TITLE	DOWNLOAD	KEY TOPICS
21 Mar 2014	Natural hazard exposure information modelling framework [85]	696.97 KB	multi-hazard [87], vul
05 Dec 2014	Natural hazard exposure modelling framework [89]	519.75 KB	framework [3], modell
04 May 2016	Hardening buildings and infrastructure - cluster overview [91]	0 bytes	infrastructure [94],
24 Oct 2016	Natural hazard exposure information framework [95]	2.85 MB	framework [3], modell
30 Jan 2017	Strengthening infrastructure for natural hazard impacts [97]	358.94 KB	engineering [93], n
07 Jul 2017	Towards a safer built environment [101]	8.24 MB	infrastructure [94],
31 Oct 2017	Natural hazard exposure information framework - research utilisation project: Australian exposure information platform [103]	663.65 KB	framework [3], resilier
31 Oct 2017	Built environment cluster [106]	713.22 KB	mitigation [100], n
17 Jun 2020	The Australian Exposure Information Platform: uncovering national exposure [108]	7.18 MB	framework [3], resilier
31 Jul 2020	Uncovering exposure to natural hazards [110]		communities [111], emergency mar
01 Dec 2020	Australian Exposure Information Platform (AEIP): uncovering national exposure [114]		exposure [2], framework [3], modell
21 Dec 2020	Fire Australia Issue Four 2020 [115]	4.58 MB	fire [118], floc
18 Mar 2021	Australian Exposure Information Platform video (Geoscience Australia) [120]	0 bytes	framework [3], resilier
17 Sep 2021	Enhancements of the Australian Exposure Information Platform [122]	652.93 KB	infrastructure [94], res

Posters

MANAGING THE INTRUSION POLICY AND PLANNING SESSION THEMES DERIVED BY THE SCOPED AND NATURAL HAZARD ONE

23 AUG 2014

Natural hazards exposure information modelling framework

Exposure is referred to as the elements at risk within a given area that have been, or could be, subject to...

➢ Development of natural hazards exposure information modelling framework

➢ Stakeholders were engaged for their collective views on information requirements for informed decision making

➢ Assessed current information products supporting disaster risk reduction

➢ Analysing gaps and prepare a consistent and coordinated exposure information framework

➢ A clear map of the framework for reliable information for improved informed decisions

16 AUG 2015

What is in the Disaster Zone?

EXPOSURE [2], FRAMEWORK [3]

What information is needed for disaster governance? How to achieve national consistency in information?

EXPOSURE INFORMATION: THE OFFICIAL FRAMEWORK HAS COMPREHENSIVE LIST OF VARIOUS COMPONENTS, ELEMENTS AND ATTRIBUTES REQUIRED FOR POLICY & PLANNING, RESPONSE & RECOVERY, RESEARCH & ANALYSIS IN DISASTER RISK REDUCTION. THE FRAMEWORK CONSIDERS HOW TO COLLECT THE DATA, MODEL AND ANALYSIS AND RELIABILITY TO ADDRESS VIEWS

16 AUG 2015

Business and Economic Exposure Information Framework

EXPOSURE [2], FRAMEWORK [3]

Ready access to information improves business resilience. The same type of information can be used to...

EXPOSURE INFORMATION: THE OFFICIAL FRAMEWORK HAS COMPREHENSIVE LIST OF VARIOUS COMPONENTS, ELEMENTS AND ATTRIBUTES REQUIRED FOR POLICY & PLANNING, RESPONSE & RECOVERY, RESEARCH & ANALYSIS IN DISASTER RISK REDUCTION. THE FRAMEWORK CONSIDERS HOW TO COLLECT THE DATA, MODEL AND ANALYSIS AND RELIABILITY TO ADDRESS VIEWS

12 AUG 2016

Natural hazards exposure information framework – reliability index for situational awareness

INFRASTRUCTURE [94], RESILIENCE [105]

This project will identify the data requirements and modelling framework to derive exposure information to...

EXPOSURE INFORMATION: THE OFFICIAL FRAMEWORK HAS COMPREHENSIVE LIST OF VARIOUS COMPONENTS, ELEMENTS AND ATTRIBUTES REQUIRED FOR POLICY & PLANNING, RESPONSE & RECOVERY, RESEARCH & ANALYSIS IN DISASTER RISK REDUCTION. THE FRAMEWORK CONSIDERS HOW TO COLLECT THE DATA, MODEL AND ANALYSIS AND RELIABILITY TO ADDRESS VIEWS

29 JUN 2017

Natural Hazards Exposure Information Framework - a step towards national consistency

[128]

Linked Projects

Mapping and understanding bushfire and natural hazard vulnerability and risks at the institutional scale
[129]

ECONOMICS AND STRATEGIC DECISIONS [130]


 Prof Roger Jones
Victoria University [131]



[131]

Economics of natural hazards
[132]

ECONOMICS AND STRATEGIC DECISIONS [130]


 Dr Veronique Florec
University of Western Australia [133]



[133]

Improved decision support for natural hazard risk reduction
[134]

ECONOMICS AND STRATEGIC DECISIONS [130]


 Prof Holger Maier
University of Adelaide [135]



[135]

Optimising post-disaster recovery interventions in Australia
[136]

ECONOMICS AND STRATEGIC DECISIONS [130]


 Prof Mehmet Ulubasoglu
Deakin University [137]



[137]

Cost-effective mitigation strategy for building related earthquake risk
[138]

BUILT ENVIRONMENT [139]


 Prof Michael Griffith
University of Adelaide [135]



[135]

Cost-effective mitigation strategy for flood prone buildings
[140]

BUILT ENVIRONMENT [139]


 Dr Ken Dale
Geoscience Australia [7]



[7]

Natural hazard exposure information modelling framework
[5]

BUILT ENVIRONMENT [139]


 Dr Krishna Nadimpalli
Geoscience Australia [7]



[7]

Using realistic disaster scenario analysis to understand natural hazard impacts and emergency management requirements
[141]

SCENARIOS AND LOSS ANALYSIS [142]


 Dr Matthew Mason
University of Queensland [143]



[143]

An analysis of building losses and human fatalities from natural disasters [144]

SCENARIOS AND LOSS ANALYSIS [142]


 Dr Katharine Haynes
University of Wollongong [145]



[145]

The Australian Natural Disaster Resilience Index: A system for assessing the resilience of Australian communities to natural hazards [146]

UNDERSTANDING AND ENHANCING RESILIENCE [147]

 Dr Melissa Parsons
University of New England [148]



[148]

Source URL: <https://www.bnhcrc.com.au/node/245/generate-pdf>

Links

[1] <https://www.bnhcrc.com.au/files/qld-cyclone-20093.jpg> [2] <https://www.bnhcrc.com.au/research/topics/exposure> [3] <https://www.bnhcrc.com.au/research/topics/framework> [4] <https://www.bnhcrc.com.au/research/topics/modelling> [5] <https://www.bnhcrc.com.au/research/hazardexposure> [6] <https://www.bnhcrc.com.au/people/knadimpalli> [7] <https://www.bnhcrc.com.au/organisations/ga> [8] <https://www.bnhcrc.com.au/people/rhay> [9] <https://www.bnhcrc.com.au/people/imohanty> [10] <https://www.bnhcrc.com.au/organisations/canberra-uni> [11] <https://www.bnhcrc.com.au/people/arajabifard> [12] <https://www.bnhcrc.com.au/publications/biblio/bnh-8119> [33] <https://www.bnhcrc.com.au/people/mkallantari> [14] <https://www.bnhcrc.com.au/people/yvidyattama> [15] <https://www.bnhcrc.com.au/people/mdunford> [16] <https://www.bnhcrc.com.au/people/con-charalambou> [17] <https://www.bnhcrc.com.au/people/cshackleton> [18] <https://www.bnhcrc.com.au/organisations/nswrfs> [19] <https://www.bnhcrc.com.au/people/dmcluckie> [20] <https://www.bnhcrc.com.au/organisations/oeh> [21] <https://www.bnhcrc.com.au/people/esimmons> [22] <https://www.bnhcrc.com.au/organisations/nswses> [23] <https://www.bnhcrc.com.au/people/gbuckley> [24] <https://www.bnhcrc.com.au/organisations/nswfr> [25] <https://www.bnhcrc.com.au/people/ghoward> [26] <https://www.bnhcrc.com.au/organisations/samfs> [27] <https://www.bnhcrc.com.au/people/lcarson> [28] <https://www.bnhcrc.com.au/people/mfairbairn> [29] <https://www.bnhcrc.com.au/organisations/lvrc> [30] <https://www.bnhcrc.com.au/people/rpritchard> [31] <https://www.bnhcrc.com.au/organisations/dtmr> [32] <https://www.bnhcrc.com.au/publications/biblio/bnh-8119> [33] <https://www.bnhcrc.com.au/news/2020/uncovering-exposure-natural-hazards> [34] <https://www.bnhcrc.com.au/news/2020/science-galore-key-crc-event-dates> [35] <https://www.bnhcrc.com.au/news/2019/severe-weather-research-has-impact> [36] <https://www.bnhcrc.com.au/news/2019/how-influence-people-research> [37] <https://www.bnhcrc.com.au/news/2018/new-online-december-2018> [38] <https://www.bnhcrc.com.au/news/2017/new-online-november-2017> [39] <https://www.bnhcrc.com.au/news/2016/new-online-september-2016> [40] <https://www.bnhcrc.com.au/news/2016/new-online-may-2016> [41] <https://www.bnhcrc.com.au/news/2016/videos-highlight-research-benefits> [42] <https://www.bnhcrc.com.au/publications/biblio?%5Bauthor%5D=1999> [43] <https://www.bnhcrc.com.au/publications/biblio?%5Bauthor%5D=1998> [44] http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Australian%2BExposure%2BInformation%2BPlatform%2BEnhancement%2BProject%22&as_sauthors=Charalambou&as_occt=any&as_epq=&as_oq=&as_eq=&ar [45] <https://www.bnhcrc.com.au/publications/biblio/export/bibtex/8119> [46] <https://www.bnhcrc.com.au/publications/biblio/export/xml/8119> [47] <https://www.bnhcrc.com.au/publications/biblio/bnh-5213> [48] http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Constructing%2Ba%2Bdata%2BReliability%2Bframework%2Bfor%2Bthe%2Bnatural%2BHazard%2BExposure%2BInformation%2Bsystem%22&as_sauthors=Vidyattama&as_occt=any&as_epq=&as_oq=&as_eq=&ar [49] <https://www.bnhcrc.com.au/publications/biblio/export/bibtex/5213> [50] <https://www.bnhcrc.com.au/publications/biblio/export/xml/5213> [51] <https://www.bnhcrc.com.au/publications/biblio/bnh-5215> [52] http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Australian%2Bnatural%2BHazards%2BExposure%2BInformation%2Bframework%3A%2Bguidelines%2Bfor%2Bnational%2Bconsistency%2Bband%2Bcomprehensive%2Binformation%22&ar [53] <https://www.bnhcrc.com.au/publications/biblio/export/bibtex/5215> [54] <https://www.bnhcrc.com.au/publications/biblio/export/xml/5215> [55] <https://www.bnhcrc.com.au/publications/biblio/bnh-4214> [56] http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Natural%2BHazards%2BExposure%2BInformation%2Bframework%3A%2Bannual%2Bproject%2Breport%2B2015-2016%22&as_sauthors=Nadimpalli&as_occt=any&as_epq=&as_oq=&as_eq=&as_publication=&as_vlo=&as_yhi=&as_sdtAAP=1&as_sdtP=1 [57] <https://www.bnhcrc.com.au/publications/biblio/export/bibtex/4214> [58] <https://www.bnhcrc.com.au/publications/biblio/export/xml/4214> [59] <https://www.bnhcrc.com.au/publications/biblio/bnh-6663> [60] http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Business%2BExposure%2BInformation%2Bframework%22&as_sauthors=Nadimpalli&as_occt=any&as_epq=&as_oq=&as_eq=&as_publication=&as_vlo=&as_yhi=&as_sdtAAP=1&as_sdtP=1 [61] <https://www.bnhcrc.com.au/publications/biblio/export/bibtex/6663> [62] <https://www.bnhcrc.com.au/publications/biblio/export/xml/6663> [63] <https://www.bnhcrc.com.au/publications/biblio/bnh-3040> [64] http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Natural%2BHazards%2BExposure%2BInformation%2Bframework%3A%2Bannual%2Bproject%2Breport%2B2015-2016%22&as_sauthors=Nadimpalli&as_occt=any&as_epq=&as_oq=&as_eq=&as_publication=&as_vlo=&as_yhi=&as_sdtAAP=1&as_sdtP=1 [65] <https://www.bnhcrc.com.au/publications/biblio/export/bibtex/3040> [66] <https://www.bnhcrc.com.au/publications/biblio/export/xml/3040> [67] <https://www.bnhcrc.com.au/publications/biblio/bnh-2701> [68] http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Built%2Benvironment%2BExposure%2BInformation%2Bframework%22&as_sauthors=Nadimpalli&as_occt=any&as_epq=&as_oq=&as_eq=&as_publication=&as_vlo=&as_yhi=&as_sdtAAP=1&as_sdtP=1 [69] <https://www.bnhcrc.com.au/publications/biblio/export/bibtex/2701> [70] <https://www.bnhcrc.com.au/publications/biblio/export/xml/2701> [71] <https://www.bnhcrc.com.au/publications/biblio/bnh-2409> [72] http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Natural%2BHazard%2BExposure%2BInformation%2Bframework%22&as_sauthors=Nadimpalli&as_occt=any&as_epq=&as_oq=&as_eq=&as_publication=&as_vlo=&as_yhi=&as_sdtAAP=1&as_sdtP=1 [73] <https://www.bnhcrc.com.au/publications/biblio/export/bibtex/2409> [74] <https://www.bnhcrc.com.au/publications/biblio/export/xml/2409> [75] <https://www.bnhcrc.com.au/publications/biblio/bnh-2349> [76] http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Natural%2BHazard%2BExposure%2BInformation%2Bmodelling%2Bframework%3A%2Bannual%2Bproject%2Breport%2B2014-2015%22&as_sauthors=Nadimpalli&as_occt=any&as_epq=&as_oq=&as_eq=&as_publication=&as_vlo=&as_yhi=&as_sdtAAP=1&as_sdtP=1 [77] <https://www.bnhcrc.com.au/publications/biblio/export/bibtex/2349> [78] <https://www.bnhcrc.com.au/publications/biblio/export/xml/2349> [79] <https://www.bnhcrc.com.au/publications/biblio/bnh-1541> [80] http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Natural%2BHazards%2BExposure%2BInformation%2BModelling%2Bframework%2BAnnual%2BReport%2B2014%22&as_sauthors=Nadimpalli&as_occt=any&as_epq=&as_oq=&as_eq=&as_publication=&as_vlo=&as_yhi=&as_sdtAAP=1&as_sdtP=1 [81] <https://www.bnhcrc.com.au/publications/biblio/export/bibtex/1541> [82] <https://www.bnhcrc.com.au/publications/biblio/export/xml/1541> [83] https://www.bnhcrc.com.au/node/245/generate-pdf?order=field_date_release&sort=asc [84] <https://www.bnhcrc.com.au/node/245/generate-pdf?order=title&sort=asc> [85] <https://www.bnhcrc.com.au/resources/presentation-slideshow/424> [86] <https://www.bnhcrc.com.au/file/516/download?token=11MAEf0O> [87] <https://www.bnhcrc.com.au/research/topics/multi-hazard> [88] <https://www.bnhcrc.com.au/research/topics/vulnerability> [89] <https://www.bnhcrc.com.au/resources/presentation-slideshow/1485> [90] <https://www.bnhcrc.com.au/file/4802/download?token=MF2iAedC> [91] <https://www.bnhcrc.com.au/resources/presentation-audio-video/2699> [92] <https://www.bnhcrc.com.au/file/6191/download?token=ebi7xwk1> [93] <https://www.bnhcrc.com.au/research/topics/engineering> [94] <https://www.bnhcrc.com.au/research/topics/infrastructure> [95] <https://www.bnhcrc.com.au/resources/presentation-slideshow/3151> [96] <https://www.bnhcrc.com.au/file/6636/download?token=RG55kN-Y> [97] <https://www.bnhcrc.com.au/hazardnotes/26> [98] <https://www.bnhcrc.com.au/file/7119/download?token=kBirk9yn> [99] <https://www.bnhcrc.com.au/research/topics/earthquake> [100] <https://www.bnhcrc.com.au/research/topics/mitigation> [101] <https://www.bnhcrc.com.au/resources/presentation-slideshow/3750> [102] https://www.bnhcrc.com.au/file/7562/download?token=WKXZ_P1k [103] <https://www.bnhcrc.com.au/resources/presentation-slideshow/4169> [104] <https://www.bnhcrc.com.au/file/7946/download?token=6BfouKPF> [105] <https://www.bnhcrc.com.au/research/topics/resilience> [106] <https://www.bnhcrc.com.au/resources/presentation-slideshow/4170> [107] <https://www.bnhcrc.com.au/file/7947/download?token=e08mH88h> [108] <https://www.bnhcrc.com.au/hazardnotes/74> [109] <https://www.bnhcrc.com.au/file/11446/download?token=U6iRS9tA> [110] <https://www.bnhcrc.com.au/resources/external-resource/7166> [111] <https://www.bnhcrc.com.au/research/topics/communities> [112] <https://www.bnhcrc.com.au/research/topics/emergency-management> [113] <https://www.bnhcrc.com.au/research/topics/risk-management> [114] <https://www.bnhcrc.com.au/casestudy/aeip> [115] <https://www.bnhcrc.com.au/resources/fireaustralia-edition/7721> [116] https://www.bnhcrc.com.au/file/12251/download?token=KYB_wVMV [117] <https://www.bnhcrc.com.au/research/topics/communication> [118] <https://www.bnhcrc.com.au/research/topics/fire> [119] <https://www.bnhcrc.com.au/research/topics/flood> [120] <https://www.bnhcrc.com.au/resources/presentation-audio-video/7901> [121] <https://www.bnhcrc.com.au/file/12645/download?token=-Eu0BZD> [122] <https://www.bnhcrc.com.au/hazardnotes/105> [123] <https://www.bnhcrc.com.au/file/13193/download?token=ztXDswlg> [124] <https://www.bnhcrc.com.au/resources/poster/1223> [125] <https://www.bnhcrc.com.au/resources/poster/2016> [126] <https://www.bnhcrc.com.au/resources/poster/2028> [127] <https://www.bnhcrc.com.au/resources/poster/2860> [128] <https://www.bnhcrc.com.au/resources/poster/3659> [129] <https://www.bnhcrc.com.au/research/vulnerabilityandrisks> [130] <https://www.bnhcrc.com.au/research/cluster/economics-decision-making> [131] <https://www.bnhcrc.com.au/organisations/vu> [132] <https://www.bnhcrc.com.au/research/naturalhazardeconomics> [133] <https://www.bnhcrc.com.au/organisations/uwa> [134] <https://www.bnhcrc.com.au/research/riskreduction> [135] <https://www.bnhcrc.com.au/organisations/ua> [136] <https://www.bnhcrc.com.au/research/postdisastereconomics> [137] <https://www.bnhcrc.com.au/organisations/du> [138] <https://www.bnhcrc.com.au/research/earthquakerisk> [139] <https://www.bnhcrc.com.au/research/cluster/built-environment> [140] <https://www.bnhcrc.com.au/research/floodpronebuildings> [141] <https://www.bnhcrc.com.au/research/disastersscenarioanalysis> [142] <https://www.bnhcrc.com.au/research/cluster/scenarios-loss-modelling> [143] <https://www.bnhcrc.com.au/node/1156> [144] <https://www.bnhcrc.com.au/research/buildinglosses> [145] <https://www.bnhcrc.com.au/organisations/uow> [146] <https://www.bnhcrc.com.au/research/resilienceindex> [147] <https://www.bnhcrc.com.au/research/cluster/understanding-resilience> [148] <https://www.bnhcrc.com.au/organisations/une>