



Queensland cyclone 2009

Key Topics:

- engineering [2]
- flood [3]
- mitigation [4]

Cost-effective mitigation strategy for flood prone buildings [5]


This research was targeted at assessing mitigation strategies to reduce the vulnerability of existing residential building stock in Australian floodplains. The project addressed the need for an evidence base to inform decision making on the mitigation of the flood risk posed by the most vulnerable Australian houses and complements parallel CRC projects for earthquake and severe wind. Through this project, the research team developed a building classification schema to categorise Australian residential buildings into a range of typical storey types, reviewed national and international mitigation strategies, and developed a floodproofing matrix to assess strategies for select storey types. The results of this research form an evidence base to inform decision making by government and property owners on the mitigation of flood risk by providing information on the cost effectiveness of different mitigation strategies.

Project: detail Notabs

Research team

Research leader


[6]



Dr Ken Dale

[6]

RESEARCH LEADER



[7]

Research team

[8]




Martin Wehner

[8]

RESEARCH TEAM

[9]



Dr Tariq Maqsood

[9]

RESEARCH TEAM

[7]



[10]

## End User representatives

[11]



**Corey Shackleton**  
[11]  
END-USER



[12]

[13]



**Duncan McLuckie**  
[13]  
END-USER



[14]

[15]



**Elliott Simmons**  
[15]  
END-USER



[16]

[17]



**Greg Buckley**  
[17]  
END-USER



[18]

[19]



**Greg Howard**  
[19]  
END-USER



[20]

[21]



**Jackson Parker**  
[21]  
END-USER



[22]

[23]



**Leesa Carson**  
[23]  
END-USER



[7]

## Description

The motivation for this project arises from the experience and observations made during the 2011 and 2013 floods in Australia, which caused widespread devastation in Queensland. Considerable costs were sustained by all levels of government and property owners to effect damage repair and enable community recovery.

A fundamental reason for this damage was inappropriate development in floodplains and a legacy of high risk building stock in flood prone areas. While the vulnerability and associated flood risk for newer construction is being addressed (moderated) by new standards (ABCB, 2012), building controls and land use planning, the vulnerability associated with existing building stock remains. This vulnerability contributes disproportionately to overall flood risk in many Australian catchments.

This research addressed this issue and is targeted at assessing mitigation strategies to reduce the vulnerability of existing residential building stock in Australian floodplains. The project addressed the need for an evidence base to inform decision making on the mitigation of the flood risk posed by the most vulnerable Australian houses and complements parallel CRC projects for earthquake and severe wind.

The project has developed a building classification schema to categorise Australian residential buildings into a range of typical storey types. Mitigation strategies developed nationally and internationally have been reviewed. A floodproofing matrix has been developed to assess appropriate strategies for the selected storey types. All appropriate strategies have been costed for the selected storey types through the engagement of quantity surveying specialists. Vulnerability curves have been developed featuring reduced losses achieved through appropriate mitigation strategies for the five selected storey types.

[Read the final report here.](#) [24]

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01 APR 2016

[37]

Publications

Year	Type	Citation
2021	Report	Dale, K. [6], Maqsood, T. [9] & Wehner, M. [8] <b>Cost-effective mitigation strategy development for flood prone buildings – final project report</b> [24]. (Bushfire and Natural Hazards CRC, 2021). Google Scholar [42] BibTeX [62] EndNote XML [100]
2020	Report	Maqsood, T. [9], Dale, K. [6] & Wehner, M. [8] <b>Benefit versus cost analysis and optimal cost effective mitigation strategies</b> [41]. (Bushfire and Natural Hazards CRC, 2020). Google Scholar [42] BibTeX [62] EndNote XML [100]
2019	Conference Paper	Maqsood, T. [9], Dale, K. [6], Edwards, M. [45] & Nadimpalli, K. [46] <b>Flood vulnerability functions: detailed vs generalised approach</b> [47]. <i>AFAC19 powered by INTERSCHUTZ - Bushfire and Natural Hazards CRC</i> [48]. (Bushfire and Natural Hazards CRC, 2019). Google Scholar [49] BibTeX [62] EndNote XML [100]
2019	Report	Dale, K. [6], Maqsood, T. [9], Edwards, M. [45] & Nadimpalli, K. [46] <b>Cost-Effective Mitigation Strategy Development For Flood Prone Buildings: Flood Damage Models For Floodplain Management</b> [56]. (Bushfire and Natural Hazards CRC, 2019). Google Scholar [57] BibTeX [62] EndNote XML [100]
2019	Report	Dale, K. [6], Maqsood, T. [9] & Wehner, M. [8] <b>Cost-effective mitigation strategy development for flood proof buildings - annual report 2018-2019</b> [56]. (Bushfire and Natural Hazards CRC, 2019). Google Scholar [57] BibTeX [62] EndNote XML [100]
2017	Report	Maqsood, T. [9] <i>et al.</i> <b>Launceston flood risk mitigation assessment - June 2016 floods: suburb of Newstead</b> [60]. (Bushfire and Natural Hazards CRC, 2017). Google Scholar [61] BibTeX [62] EndNote XML [100]
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2017	Report	Maqsood, T. [9], Wehner, M. [8] & Dale, K. [6] <b>Cost-effective mitigation strategy for flood prone buildings: annual project report 2016-17</b> [70]. (Bushfire and Natural Hazards CRC, 2017). Google Scholar [71] BibTeX [62] EndNote XML [100]
2017	Report	Maqsood, T. [9], Wehner, M. [8], Edwards, M. [45], Ingham, S. [74] & Henderson, D. [75] <b>Testing of simulated flood effect on the strength of selected building components</b> [76]. (Bushfire and Natural Hazards CRC, 2017). Google Scholar [77] BibTeX [62] EndNote XML [100]
2016	Conference Paper	Maqsood, T. [9], Wehner, M. [8], Dale, K. [6] & Edwards, M. [45] <b>Development of flood mitigation strategies for Australian residential buildings</b> [80]. <i>AFAC16</i> (Bushfire and Natural Hazards CRC, 2016). Google Scholar [81] BibTeX [62] EndNote XML [100]
2016	Journal Article	Maqsood, T. [9], Wehner, M. [8], Dale, K. [6] & Edwards, M. [45] <b>Cost-effective mitigation strategies for residential buildings in Australian flood plains</b> [84]. <i>International Journal of Safety and Security</i> [85]. (Bushfire and Natural Hazards CRC, 2016). Google Scholar [86] BibTeX [62] EndNote XML [100]
2016	Report	Maqsood, T. [9], Wehner, M. [8] & Dale, K. [6] <b>Cost-effective mitigation strategy development for flood prone buildings: Annual project report 2015-2016</b> [89]. (Bushfire and Natural Hazards CRC, 2016). Google Scholar [90] BibTeX [62] EndNote XML [100]
2016	Report	Maqsood, T. [9], Wehner, M. [8] & Dale, K. [6] <b>Cost-effective mitigation strategy development for flood prone buildings: Development of costing modules for flood mitigation strategies</b> [93]. (Bushfire and Natural Hazards CRC, 2016). Google Scholar [94] BibTeX [62] EndNote XML [100]
2015	Presentation	Maqsood, T. [9], Wehner, M. [8] & Dale, K. [6] <b>Cost-effective mitigation strategy development for flood prone buildings</b> [97]. (2015). Google Scholar [98] BibTeX [99] EndNote XML [100]
2015	Report	Wehner, M. [8] & Maqsood, T. [9] <b>Dungog Flood 20-21 April 2015: post-flood damage survey</b> [101]. (Bushfire and Natural Hazards CRC, 2015). Google Scholar [102] BibTeX [103] EndNote XML [104]
2015	Report	Maqsood, T. [9], Wehner, M. [8] & Dale, K. [6] <b>Cost-effective mitigation strategy development for flood prone buildings: Annual project report 2014-2015</b> [105]. (Bushfire and Natural Hazards CRC, 2015). Google Scholar [106] BibTeX [62] EndNote XML [100]
2015	Report	Maqsood, T. [9], Wehner, M. [8], Edwards, M. [45] & Dale, K. [6] <b>Cost-Effective Mitigation Strategy Development for Flood Prone Buildings Annual Report 2014</b> [109]. (2015). Google Scholar [110] BibTeX [62] EndNote XML [100]
2015	Report	Maqsood, T. [9], Wehner, M. [8] & Dale, K. [6] <b>Cost-effective mitigation strategy development for flood prone buildings: literature review of mitigation strategies</b> [113]. (Bushfire and Natural Hazards CRC, 2015). Google Scholar [114] BibTeX [62] EndNote XML [100]
2014	Report	Maqsood, T. [9], Dale, K. [6] & Wehner, M. [8] <b>Cost-effective mitigation strategy development for flood prone buildings - Preliminary Building Schema</b> [117]. (Bushfire and Natural Hazards CRC, 2014). Google Scholar [118] BibTeX [62] EndNote XML [100]

Presentations & Resources

DATE	TITLE	DOWNLOAD	KEY TOPICS
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04 Dec 2014	Cost effective mitigation for flood prone buildings [128]	892.37 KB	[129] (892.37 KB) [130], flood [3], mitigation [4]
04 May 2016	Hardening buildings and infrastructure - cluster overview [130]	0 bytes	[131] (0 bytes) [132], engineering [2], infrastructure [132], multi-hazard [133]
24 Oct 2016	Cost-effective mitigation strategy development for flood prone buildings [134]	3.28 MB	[135] (3.28 MB) [136], engineering [2], flood [3], mitigation [4]
30 Jan 2017	Strengthening infrastructure for natural hazard impacts [136]	358.94 KB	[137] (358.94 KB) [138], earthquake [127], engineering [2], mitigation [4]
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04 Oct 2017	Costs and benefits of flood mitigation in Launceston [140]	434.13 KB	[141] (434.13 KB) [142], flood [3], mitigation [4]
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Posters



[149] 28 AUG 2014

Cost-effective mitigation strategy development for flood prone buildings

[149]

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[150] 18 AUG 2015

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[150]

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[151] 12 AUG 2015

Cost-effective mitigation strategy development for flood prone buildings

[151]

INFRASTRUCTURE [132], RESILIENCE [152]

The main objective of this research is to identify cost-effective strategies to mitigate damage to...



[153] 30 JUN 2017

Experimental testing of residential building materials exposed to inundation

[153]

ENGINEERING [2], FLOOD [3]

The main objective of this research was to assess the strength and durability implications of immersion of...



[154] 30 JUN 2017

Cost-effective mitigation strategy for flood prone buildings

[154]

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Linked Projects

Cost-effective mitigation strategy for building related earthquake risk  
[155]

BUILT ENVIRONMENT [156]

Prof Michael Griffith  
University of Adelaide [157]



[157]

Cost-effective mitigation strategy for flood prone buildings  
[5]

BUILT ENVIRONMENT [156]

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## Improving the resilience of existing housing to severe wind events [158]

BUILT ENVIRONMENT [156]

Prof John Ginger  
James Cook University [159]



[159]

## Natural hazard exposure information modelling framework [160]

BUILT ENVIRONMENT [156]

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[http://scholar.google.com/scholar?btnG=Search%2BScholar&as\\_q=%22Launceston%2BFlood%2BRisk%2BMitigation%2B-%2BJune%2B2016%2BFloods%22&as\\_sauthors=Maqsood&as\\_occt=any&as\\_eqp=&as\\_oq=&as\\_eq=&as\\_publication=&as\\_ylo=&as\\_yhi=&as\\_sdtAAP=1&as\\_sdt=1](http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Launceston%2BFlood%2BRisk%2BMitigation%2B-%2BJune%2B2016%2BFloods%22&as_sauthors=Maqsood&as_occt=any&as_eqp=&as_oq=&as_eq=&as_publication=&as_ylo=&as_yhi=&as_sdtAAP=1&as_sdt=1) [68] <https://www.bnhrcr.com.au/publications/biblio/export/bibtex/3803> [69] <https://www.bnhrcr.com.au/publications/biblio/export/xml/3803> [70] <https://www.bnhrcr.com.au/publications/biblio/bnh-4211> [71] [http://scholar.google.com/scholar?btnG=Search%2BScholar&as\\_q=%22Cost-effective%2BMitigation%2Bstrategy%2Bfor%2BFlood%2Bprone%2Bbuildings%3A%2Bannual%2Bproject%2B2016-17%22&as\\_sauthors=Maqsood&as\\_occt=any&as\\_eqp=&as\\_oq=&as\\_eq=&as\\_publication=&as\\_ylo=&as\\_yhi=&as\\_sdtAAP=1&as\\_sdt=1](http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Cost-effective%2BMitigation%2Bstrategy%2Bfor%2BFlood%2Bprone%2Bbuildings%3A%2Bannual%2Bproject%2B2016-17%22&as_sauthors=Maqsood&as_occt=any&as_eqp=&as_oq=&as_eq=&as_publication=&as_ylo=&as_yhi=&as_sdtAAP=1&as_sdt=1) [72] <https://www.bnhrcr.com.au/publications/biblio/export/bibtex/4211> [73] <https://www.bnhrcr.com.au/publications/biblio/export/xml/4211> [74] <https://www.bnhrcr.com.au/publications/biblio/?%5Bauthor%5D=1221> [75] <https://www.bnhrcr.com.au/people/dhenderson> [76] <https://www.bnhrcr.com.au/publications/biblio/bnh-4148> [77] [http://scholar.google.com/scholar?btnG=Search%2BScholar&as\\_q=%22Testing%2Bof%2Bsimulated%2BFlood%2Beffect%2Bon%2Bthe%2Bstrength%2Bof%2Bselected%2Bbuilding%2Bcomponents%22&as\\_sauthors=Maqsood&as\\_occt=any&as\\_eqp=&as\\_oq=&as](http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Testing%2Bof%2Bsimulated%2BFlood%2Beffect%2Bon%2Bthe%2Bstrength%2Bof%2Bselected%2Bbuilding%2Bcomponents%22&as_sauthors=Maqsood&as_occt=any&as_eqp=&as_oq=&as) [78] <https://www.bnhrcr.com.au/publications/biblio/export/bibtex/4148> [79] <https://www.bnhrcr.com.au/publications/biblio/export/xml/4148> [80] <https://www.bnhrcr.com.au/publications/biblio/bnh-2953> [81] [http://scholar.google.com/scholar?btnG=Search%2BScholar&as\\_q=%22Development%2Bof%2BFlood%2BMitigation%2Bstrategies%2Bfor%2BAustralian%2Bresidential%2Bbuildings%22&as\\_sauthors=Maqsood&as\\_occt=any&as\\_eqp=&as\\_oq=&as](http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Development%2Bof%2BFlood%2BMitigation%2Bstrategies%2Bfor%2BAustralian%2Bresidential%2Bbuildings%22&as_sauthors=Maqsood&as_occt=any&as_eqp=&as_oq=&as) [82] <https://www.bnhrcr.com.au/publications/biblio/export/bibtex/2953> [83] <https://www.bnhrcr.com.au/publications/biblio/export/xml/2953> [84] <https://www.bnhrcr.com.au/publications/biblio/bnh-3421> [85] <http://dx.doi.org/10.2495/SAFE-V6-N3-550-559> [86] [http://scholar.google.com/scholar?btnG=Search%2BScholar&as\\_q=%22Cost-effective%2BMitigation%2Bstrategies%2Bfor%2Bresidential%2Bbuildings%2Bin%2BAustralian%2BFlood%2Bplains%22&as\\_sauthors=Maqsood&as\\_occt=any&as\\_eqp=&as\\_oq=&as\\_eq=&as\\_publication](http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Cost-effective%2BMitigation%2Bstrategies%2Bfor%2Bresidential%2Bbuildings%2Bin%2BAustralian%2BFlood%2Bplains%22&as_sauthors=Maqsood&as_occt=any&as_eqp=&as_oq=&as_eq=&as_publication) [87] <https://www.bnhrcr.com.au/publications/biblio/export/bibtex/3421> [88] <https://www.bnhrcr.com.au/publications/biblio/export/xml/3421> [89] <https://www.bnhrcr.com.au/publications/biblio/bnh-3095> [90] [http://scholar.google.com/scholar?btnG=Search%2BScholar&as\\_q=%22Cost-effective%2BMitigation%2Bstrategy%2Bdevelopment%2Bfor%2BFlood%2Bprone%2Bbuildings%3A%2Bannual%2Bproject%2B2015-2016%22&as\\_sauthors=Maqsood&as\\_occt=any&as\\_eqp=&as\\_oq=&as\\_eq=&as\\_publication=&as\\_ylo=&as\\_yhi=&as\\_sdtAAP=1&as\\_sdt=1](http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Cost-effective%2BMitigation%2Bstrategy%2Bdevelopment%2Bfor%2BFlood%2Bprone%2Bbuildings%3A%2Bannual%2Bproject%2B2015-2016%22&as_sauthors=Maqsood&as_occt=any&as_eqp=&as_oq=&as_eq=&as_publication=&as_ylo=&as_yhi=&as_sdtAAP=1&as_sdt=1) [91] <https://www.bnhrcr.com.au/publications/biblio/export/bibtex/3095> [92] <https://www.bnhrcr.com.au/publications/biblio/export/xml/3095> [93] <https://www.bnhrcr.com.au/publications/biblio/bnh-4147> [94] [http://scholar.google.com/scholar?btnG=Search%2BScholar&as\\_q=%22Cost-effective%2BMitigation%2Bstrategy%2Bdevelopment%2Bfor%2BFlood%2Bprone%2Bbuildings%3A%2Bdevelopment%2Bof%2Bcosting%2Bmodules%2Bfor%2BFlood%2BMitigation%2Bstrategies%22&as\\_sauthors=Maqsood&as](http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Cost-effective%2BMitigation%2Bstrategy%2Bdevelopment%2Bfor%2BFlood%2Bprone%2Bbuildings%3A%2Bdevelopment%2Bof%2Bcosting%2Bmodules%2Bfor%2BFlood%2BMitigation%2Bstrategies%22&as_sauthors=Maqsood&as) [95] <https://www.bnhrcr.com.au/publications/biblio/export/bibtex/4147> [96] <https://www.bnhrcr.com.au/publications/biblio/export/xml/4147> [97] <https://www.bnhrcr.com.au/publications/biblio/bnh-2407> [98] [http://scholar.google.com/scholar?btnG=Search%2BScholar&as\\_q=%22Cost-effective%2BMitigation%2Bstrategy%2Bdevelopment%2Bfor%2BFlood%2Bprone%2Bbuildings%22&as\\_sauthors=Maqsood&as\\_occt=any&as\\_eqp=&as\\_oq=&as\\_eq=&as\\_publication=&as\\_ylo=&as\\_yhi=&as\\_sdtAAP=1&as\\_sdt=1](http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Cost-effective%2BMitigation%2Bstrategy%2Bdevelopment%2Bfor%2BFlood%2Bprone%2Bbuildings%22&as_sauthors=Maqsood&as_occt=any&as_eqp=&as_oq=&as_eq=&as_publication=&as_ylo=&as_yhi=&as_sdtAAP=1&as_sdt=1) [99] <https://www.bnhrcr.com.au/publications/biblio/export/bibtex/2407> [100] <https://www.bnhrcr.com.au/publications/biblio/export/xml/2407> [101] <https://www.bnhrcr.com.au/publications/biblio/bnh-2467> [102] [http://scholar.google.com/scholar?btnG=Search%2BScholar&as\\_q=%22Dungog%2BFlood%2B20-21%2BApril%2B2015%3A%2Bpost-flood%2BDamage%2BSurvey%22&as\\_sauthors=Wehner&as\\_occt=any&as\\_eqp=&as\\_oq=&as\\_eq=&as\\_publication=&as\\_ylo=&as\\_yhi=&as\\_sdtAAP=1&as\\_sdt=1](http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Dungog%2BFlood%2B20-21%2BApril%2B2015%3A%2Bpost-flood%2BDamage%2BSurvey%22&as_sauthors=Wehner&as_occt=any&as_eqp=&as_oq=&as_eq=&as_publication=&as_ylo=&as_yhi=&as_sdtAAP=1&as_sdt=1) [103] <https://www.bnhrcr.com.au/publications/biblio/export/bibtex/2467> [104] <https://www.bnhrcr.com.au/publications/biblio/export/xml/2467> [105] <https://www.bnhrcr.com.au/publications/biblio/bnh-2347> [106] [http://scholar.google.com/scholar?btnG=Search%2BScholar&as\\_q=%22Cost-effective%2BMitigation%2Bstrategy%2Bdevelopment%2Bfor%2BFlood%2Bprone%2Bbuildings%3A%2Bannual%2Bproject%2B2014-2015%22&as\\_sauthors=Maqsood&as\\_occt=any&as\\_eqp=&as\\_oq=&as\\_eq=&as\\_publication=&as\\_ylo=&as\\_yhi=&as\\_sdtAAP=1&as\\_sdt=1](http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Cost-effective%2BMitigation%2Bstrategy%2Bdevelopment%2Bfor%2BFlood%2Bprone%2Bbuildings%3A%2Bannual%2Bproject%2B2014-2015%22&as_sauthors=Maqsood&as_occt=any&as_eqp=&as_oq=&as_eq=&as_publication=&as_ylo=&as_yhi=&as_sdtAAP=1&as_sdt=1) [107] <https://www.bnhrcr.com.au/publications/biblio/export/bibtex/2347> [108] <https://www.bnhrcr.com.au/publications/biblio/export/xml/2347> [109] <https://www.bnhrcr.com.au/publications/biblio/bnh-1537> [110] [http://scholar.google.com/scholar?btnG=Search%2BScholar&as\\_q=%22Cost-effective%2BMitigation%2Bstrategy%2Bdevelopment%2Bfor%2BFlood%2Bprone%2Bbuildings%2BAnnual%2BReport%2B2014%22&as\\_sauthors=Maqsood&as\\_occt=any&as\\_eqp=&as\\_oq=&as\\_eq=&as](http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Cost-effective%2BMitigation%2Bstrategy%2Bdevelopment%2Bfor%2BFlood%2Bprone%2Bbuildings%2BAnnual%2BReport%2B2014%22&as_sauthors=Maqsood&as_occt=any&as_eqp=&as_oq=&as_eq=&as) [111] <https://www.bnhrcr.com.au/publications/biblio/export/bibtex/1537> [112] <https://www.bnhrcr.com.au/publications/biblio/export/xml/1537> [113] <https://www.bnhrcr.com.au/publications/biblio/bnh-4146> [114] [http://scholar.google.com/scholar?btnG=Search%2BScholar&as\\_q=%22Cost-effective%2BMitigation%2Bstrategy%2Bdevelopment%2Bfor%2BFlood%2Bprone%2Bbuildings%3A%2Bliterature%2Breview%2Bof%2BMitigation%2Bstrategies%22&as\\_sauthors=Maqsood&as\\_occt=any&as\\_eqp=&as\\_oq=&as](http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Cost-effective%2BMitigation%2Bstrategy%2Bdevelopment%2Bfor%2BFlood%2Bprone%2Bbuildings%3A%2Bliterature%2Breview%2Bof%2BMitigation%2Bstrategies%22&as_sauthors=Maqsood&as_occt=any&as_eqp=&as_oq=&as) [115] <https://www.bnhrcr.com.au/publications/biblio/export/bibtex/4146> [116] <https://www.bnhrcr.com.au/publications/biblio/export/xml/4146> [117] <https://www.bnhrcr.com.au/publications/biblio/bnh-1429> [118] [http://scholar.google.com/scholar?btnG=Search%2BScholar&as\\_q=%22Preliminary%2BBuilding%2BSchema%22&as\\_sauthors=Maqsood&as\\_occt=any&as\\_eqp=&as\\_oq=&as\\_eq=&as\\_publication=&as\\_ylo=&as\\_yhi=&as\\_sdtAAP=1&as\\_sdt=1](http://scholar.google.com/scholar?btnG=Search%2BScholar&as_q=%22Preliminary%2BBuilding%2BSchema%22&as_sauthors=Maqsood&as_occt=any&as_eqp=&as_oq=&as_eq=&as_publication=&as_ylo=&as_yhi=&as_sdtAAP=1&as_sdt=1) [119] <https://www.bnhrcr.com.au/publications/biblio/export/bibtex/1429> [120] <https://www.bnhrcr.com.au/publications/biblio/export/xml/1429> [121] [https://www.bnhrcr.com.au/node/243/generate-pdf?order=field\\_date\\_release&sort=asc](https://www.bnhrcr.com.au/node/243/generate-pdf?order=field_date_release&sort=asc) [122] <https://www.bnhrcr.com.au/node/243/generate-pdf?order=title&sort=asc> [123] <https://www.bnhrcr.com.au/resources/presentation/slideshow/422> [124] <https://www.bnhrcr.com.au/file/514/download?token=LFKY3zS> [125] <https://www.bnhrcr.com.au/research/topics/coastal> [126] <https://www.bnhrcr.com.au/research/topics/cyclone> [127] <https://www.bnhrcr.com.au/research/topics/earthquake> [128] <https://www.bnhrcr.com.au/resources/presentation-slideshow/1487> [129] <https://www.bnhrcr.com.au/file/4804/download?token=FGIVLJH> [130] <https://www.bnhrcr.com.au/resources/presentation-audio-video/2699> [131] <https://www.bnhrcr.com.au/file/6191/download?token=ebi7xw1> [132] <https://www.bnhrcr.com.au/research/topics/infrastructure> [133] <https://www.bnhrcr.com.au/research/topics/multi-hazard> [134] <https://www.bnhrcr.com.au/resources/presentation-slideshow/3156> [135] <https://www.bnhrcr.com.au/file/6641/download?token=NzEp2JA> [136] <https://www.bnhrcr.com.au/hazardnotes/26> [137] <https://www.bnhrcr.com.au/file/7119/download?token=kBirgkN> [138] <https://www.bnhrcr.com.au/resources/presentation-slideshow/3750> [139] [https://www.bnhrcr.com.au/file/7562/download?token=WKXZ\\_P1k](https://www.bnhrcr.com.au/file/7562/download?token=WKXZ_P1k) [140] <https://www.bnhrcr.com.au/hazardnotes/40> [141] <https://www.bnhrcr.com.au/file/7893/download?token=nLJQ1fE> [142] <https://www.bnhrcr.com.au/research/topics/economics> [143] <https://www.bnhrcr.com.au/resources/presentation-slideshow/4170> [144] <https://www.bnhrcr.com.au/file/7947/download?token=e08mH8h> [145] <https://www.bnhrcr.com.au/resources/presentation-slideshow/4183> [146] <https://www.bnhrcr.com.au/file/7960/download?token=Cn9n2HmT> [147] <https://www.bnhrcr.com.au/resources/presentation-slideshow/5755> [148] <https://www.bnhrcr.com.au/file/10201/download?token=KRGTSQc> [149] <https://www.bnhrcr.com.au/resources/poster/1221> [150] <https://www.bnhrcr.com.au/resources/poster/2048> [151] <https://www.bnhrcr.com.au/resources/poster/2851> [152] <https://www.bnhrcr.com.au/research/topics/resilience> [153] <https://www.bnhrcr.com.au/resources/poster/3717> [154] <https://www.bnhrcr.com.au/resources/poster/3724> [155]

