bnhcrc.com.au

COST-EFFECTIVE MITIGATION STRATEGY DEVELOPMENT FOR FLOOD PRONE BUILDINGS: FLOOD DAMAGE MODELS FOR FLOODPLAIN MANAGEMENT WORKSHOP

Ken Dale[1,3], Tariq Maqsood[1,2,3], Mark Edwards[1,3] and Krishna Nadimpalli[1,3]
[1]Geoscience Australia,[2]RMIT University & [3]Bushfire and Natural

Australian Government
Geoscience Australia

RMIT UNIVERSITY

Version	Release history	Date
1.0	Initial release of document	28/03/2019

Australian Government
Department of Industry,
Innovation and Science

Business
Cooperative Research
Centres Programme

Cover: Flood mitigation strategy: elevating floor level (Geoscience Australia)

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This document reports on the proceedings and outcomes of a flood vulnerability workshop held at RMIT University in Melbourne on 14 June 2018. The workshop was convened as part of a research utilisation project under the Bushfire and Natural Hazards Cooperative Research Centre (BNHCRC) project entitled 'Cost-effective mitigation strategy development for flood prone buildings'. Key workshop aims were to finalise the project scope with key stakeholders, establish a Project Steering and identify case study communities for consideration.

The research utilisation project entails working with a variety of stakeholders with the aim of translating detailed flood vulnerability information into practical guidance for flood risk managers. It involves developing and testing a number of resolution options (from asset specific vulnerability assessments to more generalised methods) in a series of case studies.

The workshop structure featured presentations and discussion following a logical flow from context setting, scope refinement and consensus through to governance and next steps. The key workshop aims described above were achieved and a series of 'next steps' were identified and documented in this report.

INTRODUCTION

The Bushfire and Natural Hazards Cooperative Research Centre project entitled 'Cost-effective mitigation strategy development for flood prone buildings' is examining opportunities for reducing the vulnerability of Australian residential buildings to riverine floods. It addresses the need for an evidence base to inform decision making on the mitigation of the flood risk posed by the most vulnerable Australian building types and complements parallel BNHCRC projects for earthquake and severe wind. In particular it is investigating methods for the upgrading five types of existing residential building types found in floodplains to increase their resilience in future flood events. It aims to identify economically optimal upgrading solutions so the finite resources available can be best used to minimise losses, decrease human suffering, improve safety and ensure amenity for communities.

Other parallel and largely pre-existing research work has progressively developed an understanding of existing building vulnerability. Over approximately eight years a broad body of vulnerability research has been undertaken that has been co-funded through collaborations between Geoscience Australia (GA),the then Department of Climate Change and Energy Efficiency (DCCEE), the City of Sydney, Insurance Australia Group (IAG) and the then Attorney-General's Department (AGD) through a National Emergency Management Project. It has developed a collective suite of publicly available flood vulnerability functions that covers existing residential, commercial, industrial and community building types.

This research utilisation project entails working with the National Flood Risk Advisory Group (NFRAG), the Australian Institute for Disaster Resilience (AIDR), state and local governments and industry to translate the vulnerability information (existing and mitigated) from the aforementioned projects into practical guidance for flood risk managers undertaking studies under the floodplain-specific management process as outlined in AEM Handbook 7 (AIDR 2017). It involves developing and testing a number of resolution options (from asset specific vulnerability assessments to more generalised methods) in a series of case studies.

This flood vulnerability model workshop convened on 14 June 2018 sought to finalise the project scope with key stakeholders, establish a Project Steering and identify case study communities for consideration. This document reports on the proceedings and the outcomes of the engagement.

ATTENDEES

The workshop had 21 attendees representing a broad spectrum of stakeholders:-

Kevin Zhang	Associate Dean and Head of Department, RMIT
Matthew Hayne	Bushfire and Natural Hazards CRC (BNHCRC)
Amanda Lamont	Australian Institute for Disaster Resilience

Katelyn Samson	Australian Institute for Disaster Resilience
Duncan McLuckie	Office of Environment and Heritage, NSW
Chris Irvine	State Emergency Service, Tasmania
Peter Waugh	Water Assessment, Northern Territory
Ian Dinham	Floodplain Managers Association
Laurie Ratz	Insurance Council of Australia
Andrew Dyer	Insurance Australian Group (IAG)
Rhys Thompson	Rhelm, Australia
Mike Edwards	Department of Environment, Land, Water and Planning, Victoria
Graeme Milligan	Queensland Reconstruction Authority
Hamid Mirfenderesk	City of Gold Coast, QLD
Soori Sooriyakumaran	Bureau of Meteorology
Alex Cornish	Bureau of Meteorology
Tariq Maqsood	RMIT University
Ken Dale	Geoscience Australia
Miriam Middelmann-Fernandes	Geoscience Australia
Mark Edwards	Geoscience Australia
Krishna Nadimpalli	Geoscience Australia

AGENDA AND WORKSHOP AIMS

The workshop agenda is appended. The structure of presentations and discussion followed a logical flow from context setting, scope refinement/consensus through to governance and next steps. The workshop aims are presented below:-

• To examine the context for this project, its motivation and intended utility.

• To review the status of flood vulnerability research in Australia.

• To better understand floodplain management needs in relation to flood damage.

• To review and refine project scope.

• To define the nature of project outputs and format for ready Handbook 7 resource referencing.

• To review project information requirements.

• To identify and shortlist case study communities.

• To convene the Project Steering Committee, review its role and refine its compositions.

• To identify the next steps for the project

WORKSHOP PRESENTATIONS

The workshop included the following specific presentations:-

Floodplain Management in Australia *(Duncan McLuckie)*

The presentation provided a useful background to the updated AIDR Handbook 7 and its suite of guideline documents. It served to identify how the project research could be translated into a reference guideline document to Handbook 7 subsequently jointly developed and published by NFRAG and AIDR.

Australian Flood Vulnerability Research *(Mark Edwards)*

The presentation provided a chronological summary of the development of flood vulnerability models over a number of years by GA informed by post disaster survey activity and co-funded through a series of initiatives. The challenge of validation was highlighted and the effort made using post disaster survey data presented. The single storey residences that were insured compared particularly well in this exercise. Ongoing research on business contents vulnerability was described along with preliminary outcomes. Given the granular exposure information requirements associated with these models, the need to translate such a granular suite of buildings and contents models as an additional resource for floodplain managers was noted.

Project A10: Economic Assessment of Mitigation Options *(Tariq Maqsood)*

The presentation provided a useful background to the primary CRC project and its aims. Outcomes to date were described along with the results from a program of experimental testing. The significance of the latter on flood damage repair cost was highlighted.

Overview of Proposed Utilisation Project *(Ken Dale)*

The approved scope of the utilisation project was discussed, along with the timelines. The need for end-user input into the refinement of the scope and in selecting case study communities was identified.

Case Study Information Requirements *(Tariq Maqsood)*

The information needs of the utilisation project were illustrated in the context of the recent BNHCRC funded study of the levee upgrade investment in Launceston.

With the agreement of the workshop presenters, the workshop presentations are appended as PDF documents.

WORKSHOP DISCUSSION

The workshop discussion was broad, productive and reached consensus on the key issues. The outcomes of the discussion are summarised below under the principal sections of the workshop agenda.

CONTEXT SETTING

- There was recognised a need for more holistic assessments of avoided losses that should include contents related losses, socio-economic impacts, other intangible costs, broader cost to Government and damage to infrastructure.

- There is a lack of consistency in the models used nationally that has resulted in biases to study outcomes. Having an agreed and scalable suite of models was considered useful for comparative purpose and in interactions with Federal government.

- It was suggested that a review be undertaken of the existing models in the GA suite to see if they can be generalised. While the original selection of building types for model development aimed at identifying structures that were judged to have distinctly different vulnerabilities, differences between house type vulnerabilities may have been subsequently found to be small permitting a single model to be used for a broader range of building types.

- There was a recognised need to keep in focus the uncertainty that also exists with the flood hazard. Refinements to building flood vulnerability may in some cases be overshadowed by the lack of definition in the local flood depth.

- It was further noted that the temporal nature of flood hazard through catchment changes (and climate change) and the future change to urban exposure through urban expansion and renewal presented further challenges to the assessment of long term losses due to flood exposure.

- Comparison with, and calibration of, using insurance claim data would provide an alternative and useful "sanity check" of the building level models to be used to the aggregated model.

- The paucity of information on the value of building contents was discussed. The value of access to policy information from the insurance industry was noted and how contents value might be linked to socioeconomic level was also discussed. The greater issue of the value of contents for commerce and industry was also highlighted with the value of fit-out, plant, materials and stock being very business type specific.

- The usefulness of a "tool" that would enable curves to be accessed, aggregated and translated from damage index-based functions to absolute loss curves taking into account regional variability in cost was discussed.

- The challenges with temporary flood barriers were also discussed. While such strategies are being implemented in some settings (e.g. sections of

  the Brisbane River) in other settings they were less practical. This included individual residential building protection.

- The issue of flood duration in terms of wetting components was raised, with the UK example of long duration potentially being three weeks.

- In terms of wetted components the drying issue was also discussed in a northern Australian context, where a 'drying window' may be very short.

If that window is missed then it may be half a year until adequate drying can be achieved.

- Wet flood-proofing was discussed. The significant increase in losses when raised building services (as part of this strategy) are inundated was noted.

- Voluntary purchase was discussed. It was found that in Queensland this strategy has not been very successful with limited application, therefore, other mitigation options (at property level) were being explored to reduce flood risk.

- The outcomes of composite beams and lost load carrying capacity were discussed in terms of safety and application in new construction in flood prone areas. The CRC research could have broader application.

- The effect of using different discount rates in assessing the benefit cost ratio was discussed. It was agreed to use a range of discount rates (3% to 7%) within cost benefit analysis. However, the persistence of Treasury within Government to use 7-8% was acknowledged.

REVIEW OF UTILISATION PROJECT

- It was pointed out that some types of avoided loss are relatively small and the small influence they have on total benefits does not always warrant the effort to quantify these. While the research nature of the CRC project may require consideration of these, the outcomes may justify their exclusion in actual flood studies.

CASE STUDIES

- Several case study communities were proposed for which a reasonable level of data was thought available. While some of the initial proposals were based on recent historical flood loss data that may be sourced, the primary need for exposure and a wide range of Average Recurrence Interval (ARI) flood depths was noted. Ungarie (NSW) was raised as a possibility but is considered too small to be a useful case study for this projects aims. Considering the added requirement of having a range of community development typologies, the following initial short list was developed:-

    Wagga Wagga (NSW)

    Lismore (NSW)

    Wollongong (NSW)

    Launceston (TAS)

    Gold Coast (QLD)

    Toowomba (QLD)

    Katherine (NT)

    Tweed Heads (NSW)

- Work to date in characterizing flood hazard in exposed communities was discussed. The use of three broad local flood hazard categories was generally agreed.

- Terminology was discussed. The distinction between floodplain hazard characteristics at a building of interest and the variability within the catchment itself was noted.

PROJECT STEERING COMMITTEE

The draft terms of reference for the Project Steering Committee were discussed, including its role. It was acknowledged that the size of the committee should be commensurate with the scale of the project. The key stakeholder organisations identified were:

NFRAG

FMA

AIDR

BNHCRC

Geoscience Australia

Insurance

Local Government

Consulting Industry

Andrew Dyer of IAG offered to participate as a representative of the insurance industry. Ian Dinham of the Floodplain Managers Association offered to act on their behalf, and Hamid Mirfenderesk of the City of Gold Coast offered to represent local government. NFRAG members were to discuss a representative at their meeting on 15 June. Workshop participants were requested to review the composition and propose members of the committee out of session over the next few weeks. Workshop participants were also asked to review the draft terms of reference circulated, and provide feedback on any proposed changes.

OUTCOMES

The key outcomes of the workshop were:

- It was agreed that the utilisation project scope be limited to the development of generalised population based vulnerability functions for existing structures. Mitigated building specific vulnerability functions are best kept at building level as the number of structures to which these measures applied is typically small.

- Generalised flood vulnerability models should be for populations of structures on a notionally flat site. The typology models developed would subsequently be applied using the actual ground floor heights in a floodprone area of interest.

- There would be benefit in validating the building vulnerability functions against insurance claim data. This would be explored between IAG and GA.

- Project steering committee stakeholder organisations were identified with the nomination of members and the associated terms of reference for the steering committee to be finalised over the coming weeks.

- A short list of case study communities was developed. Additional candidates are to be proposed and from the finalised short list a case study set of three will be selected based on hazard data, exposure information and urban typology.

- Next reporting to the Project Steering Committee will be made in February 2019.

NEXT STEPS

The next steps for the utilisation project are:

- Prepare minutes for circulation by 22 June.

- Proceed with out-of-session review of draft Terms of Reference for the Project Steering Committee and finalise.

- Finalise the members of the Project Steering committee.

- Workshop attendees to provide any additional case study community candidates.

- Select three data rich case study communities that cover a useful range of community development types and local flood hazard characteristics.

APPENDIX A - WORKSHOP AGENDA

FLOOD DAMAGE MODELS FOR FLOODPLAIN MANAGEMENT

BNHCRC Project Title: Project A10 – "Cost-Effective Mitigation Strategy Development for Flood Prone Buildings"

WORKSHOP

THURSDAY 14TH JUNE 2018: RMIT UNIVERSITY, MELBOURNE
Building No: 80   Room No: 80.4.22

Workshop Aims

- To examine the context for this project, its motivation and intended utility.
- To review the status of flood vulnerability research in Australia.
- To better understand floodplain management needs in relation to flood damages.
- To review and refine project scope
- To define nature of outputs and format for Handbook 7 resource referencing.
- To review project information requirements
- To identify shortlist of case study communities.
- To convene Project Steering Committee, review its role and refine its compositions
    • To identify the next steps

Agenda

9:40 to 10:00am	Morning tea on arrival	
10:00am to 12:00noon		
Welcome and Logistics (Kevin Zhang, Tariq Maqsood RMIT)		5mins
Introductions (Chair)		5mins
Overview of Workshop Aims (Chair)		10mins

███

Context Setting

Floodplain Management in Australia (Duncan McLuckie)   15mins

    Handbook 7 and guides,
    Jurisdictional application,
    Information needs relating to flood damages
    Issues for flood plain managers
    Discussion
    20mins

Australian Flood Vulnerability Research (GA)   25mins

    Nature of functions
    Building vulnerability research
    Residential Contents
    Business contents
    Knowledge gaps
    Discussion
    10mins

Project A10: Economic Assessment of Mitigation Options (Tariq Maqsood)   20mins

    Project A10 objectives
    Review of mitigation strategies identified by Project A10
    Economic evaluation process
    Strategy implementation strategies
    Catchment type considerations
    Discussion
    10mins

12:00 to 12:45pm   **Lunch**

12:45pm to 3:00pm

                                             45mins

Review of Utilisation Project

Overview of Proposed Utilisation Project (GA)   15mins

Proposed scope of utilisation project
Proposed outputs
Proposed timelines
Scope refinement options
Discussion
35mins

Case Studies

Case Study Information Requirements (Tariq Maqsood)   15mins
    Hazard
    Exposure
    Vulnerability
    Mitigation cost and effectiveness
    Questions
    10mins

Catchment Characterisation (GA)   10mins
    Influence of ARI versus depth increase on mitigation strategy viability
    Review of existing accessible flood studies
    Initial categorisation proposed
    Questions
    5mins

Case Study Selection (Chair)
    Review community characteristics needed
    Review available data rich communities
    Selection of shortlist
    Facilitated Discussion
    45mins

3:00pm to 3:20pm   **Afternoon Tea**

3:20pm to 4:15pm
Note: All workshop participants are welcome to attend this important session when the inaugural meeting of a Project Steering Committee will be convened   **Steering Committee and Next Steps**

Project Steering Committee (Chair)
    Composition

///////////////////////////////////////

Function/role
Terms of reference
Communication/engagement with industry
Facilitated Discussion
25mins

Next Steps (Chair)
2018 Activities
Information need follow-up
AIDR considerations
Facilitated Discussion
25mins

Closing Comments (Chair)   5mins

- Thanks to all for participation

4:15pm   **Workshop Close**

APPENDIX B - UTILISATION PROJECT PLAN

Scalable flood vulnerability and flood mitigation models for use by Floodplain Managers in conjunction with Handbook 7

Bushfire and Natural Hazards CRC Cluster title: **Hardening of the Built Environment**

Project Title: Project A10 – "Cost-Effective Mitigation Strategy Development for Flood Prone Buildings"

End users submitting proposal:
NSW Office of Environment and Heritage
 Duncan McLuckie

End users supporting proposal:
National Flood Risk Reference Group, Reference Group to ANZEMC (Chair: Duncan McLuckie)
Australian Institute for Disaster Resilience (Amanda Lamont)

Research utilisation outcomes:
- Over approximately eight years a broad body of vulnerability research has been undertaken that has been co-funded through collaborations between GA, DCCEE, the City of Sydney, IAG and AGD through a National Emergency Management Project. It has developed a collective suite of publically available flood vulnerability functions that cover existing residential, commercial, industrial and community building types (29 building vulnerability models in total).
- The BNHCRC project entitled "Cost-Effective Mitigation Strategy Development for Flood Prone Buildings" is developing an evidence base for investment in reducing the vulnerability of five common residential properties to riverine flooding through structural mitigation strategies. They corresponding with a subset of the existing 29 vulnerability functions.
- This body of existing and current work is applicable to the highest resolution of building exposure information with flood vulnerability (with or without mitigation) directly attributed to individual buildings. The quality and resolution of built environment information available to floodplain managers is variable. There is a need for generalised flood vulnerability models that can be used for populations of buildings that have been

characterised based on use, suburb age and community type. There is also a need to understand the increased uncertainty and biases associated with simpler more practical approaches using such models.

- This research utilisation project entails working with the National Flood Risk Reference Group (NFRAG), industry and AIDR over 18 months to develop a methodology to translate the vulnerability information (existing and mitigated) from the aforementioned projects into practical guidance for flood risk managers undertaking studies under the floodplain-specific management process as outlined in AEM Handbook 7. It involves developing and testing a number of resolution options (from asset specific vulnerability assessments to more generalised methods) in a series of case studies. It will also enable comparisons between the existing flood risk methodologies used by the States.
- Losses associated with contents for a range of building uses will be included. Residential contents loss models developed by GA will be utilised along with emerging business content models developed in collaboration with the City of Sydney. Where possible other information will be utilised if available, such as from the insurance industry.
- The work will also include the outcomes of Project A10 with the mitigated vulnerability and degree of implementation used to adjust generalised flood vulnerability with measures of mitigation cost.
- The aim is to translate the existing body of flood vulnerability research into a body of utilisable models that will support use of AIDR Handbook 7 which aims to promote the fit for purpose understanding of flood behaviour and the associated risks and where necessary examine, decide on and implement measures to treat this risk.

Task	Description	Start date	End date	Deliverables
1	Convene Steering Committee for Inaugural Meeting	June 2018	June 2018	Finalised project plan with identified community case studies and exposure resolutions to be considered. This will draw upon the steering committee's understanding of available data and the form of research product that will be useful to a broad range of industry users.
2	Workshop Reporting	June 2018	June 2018	Interim Report to BNHCRC and Steering Committee
3	Community exposure and flood hazard definition for case study communities	July 2018	Dec 2018	Building, demographic and business exposure databases for each of three case study communities selected from a larger identified list. These will be developed through sourced data, desk top analysis and targeted survey work.

3	Community flood vulnerability typology definitions	Oct 2018	Nov 2018	Community Typology Schema that characterises components of the urban development in communities into classes based on use, typical age, development history and community type. These classes will translate into corresponding aggregated flood vulnerability classes both for current vulnerability and that with mitigation.
5	Mid-project Workshop	Feb 2019	Feb 2019	Review of 2018 outcomes and consensus achieved on Year 2 work plan including flood mitigation implementation strategies to be explored at LGA resolution.
6	Development of non-mitigated generalised vulnerability functions and implementation on case study communities.	Jan 2019	June 2019	Case study outcomes and recommendations on non-mitigated generalised models for community exposure. This will entail assessing community flood impacts at all resolutions of vulnerability mapping to buildings and for a broad range of ARI's. The work will explore the degree of accuracy lost with economies in rigour flood impact assessment.
7	Development of non-mitigated generalised vulnerability functions and implementation on cast study communities	May 2019	July 2019	Case study outcomes and recommendations on mitigated generalised models for community exposure. This will entail assessing community flood impacts at all resolutions of vulnerability mapping to buildings and for a broad range of ARI's. Not only will it explore the degree of accuracy lost with economies in rigour but also how differing mitigation implementation strategies translate into reduced flood risk with time. State methodology comparisons will also be made.
8	Floodplain management workshop	Aug 2019	Aug 2019	Dissemination of research outcomes to partners and industry. This will achieved through direct workshop engagement with the industry and out of session engagement with key stakeholders/ users. It is anticipated that the further dissemination will be achieved through AIDR translation of CRC reporting into an industry manual (refer below).

| 9 | Final reporting | July 2019 | Sept 2019 | Final BNHCRC report which will be structured and formatted to enable ready utilisation by AIDR in the development of a technical manual that can be referenced by Handbook 7 |

APPENDIX C - TERMS OF REFERENCE

Scalable flood vulnerability and flood mitigation models for use by Floodplain Managers in conjunction with Handbook 7

BNHCRC Project Title: Project A10 – "Cost-Effective Mitigation Strategy Development for Flood Prone Buildings"

Project Steering Committee Terms of Reference

Background

This Project is a utilisation project under the Bushfire and Natural Hazards CRC Project A10 entitled "Cost-Effective Mitigation Strategy Development for Flood Prone Buildings". It entails researching the adaption of a broad range of flood vulnerability research by Geoscience Australia along with the flood mitigation research of Project A10 to develop flood vulnerability models for use by floodplain managers. In particular, this utilisation project seeks to:

- Develop generalised flood vulnerability models that can be used for populations of buildings that have been characterised based on available parameters including use, suburb age and community type.

- Understand the increased uncertainty and biases associated with simpler more practical flood vulnerability approaches to building level assessments.

- Translate the existing vulnerability functions into utilisable models that will support use of AIDR Handbook 7 which aims to promote the understanding of flood behaviour, the associated risks and the measures to treat this risk

- Develop reporting documentation that can be readily adapted and augmented to form part of an AIDR published guide for use by floodplain managers.

The project outcomes will support access to and use of consistent flood vulnerability and mitigation models that will promote an improved understanding of flood risk and the optimal strategies to mitigate these.

Role

The Project Steering Committee is responsible for reviewing progress against milestones, outcomes and to provide strategic direction for the project.

Functions

The Board will:

1. Inform and endorse the refinement of the project scope.

2. Facilitate where possible the access to identified flood studies to support the case study activity

3. Review progress and factors impacting deliverables.

4. Act as a forum to discuss issues and reach consensus on the appropriate action to be taken.

5. Inform and shape the project reporting for subsequent utilisation by floodplain managers through guidance documentation developed by AIDR

Membership

The Steering Committee will be chaired by _____. The members of the Committee are to be representative of each key stakeholder and/or end user, including:
- NFRAG
- AIDR
- BNHCRC
- Insurance?
- Private sector consultants?
- ?
- Geoscience Australia

Advisers/observers are welcome at the invitation of the Chair.

Secretariat

GA will provide the secretariat.

Resources

Member participation in the Steering Committee activity will be largely at the expense of their respective organisations, though travel support for members will be provided as required. Meetings will be arranged to coincide with other activity to minimise cost and may utilise teleconferencing when members are unable to attend.

Reporting

Steering Committee reporting will be through the preparation of agreed minutes for each Committee meeting.

Meetings

The Steering Committee will meet twice corresponding with mid project and at project completion. Additional meetings may also be requested by committee members.

APPENDIX D - WORKSHOP PRESENTATIONS

1. Duncan McLuckie: National best practice flood risk management guidance fitting the pieces together.
2. Mark Edwards: Australian flood vulnerability research at Geoscience Australia
3. Tariq Maqsood: Cost-effective mitigation strategy development for flood prone buildings
4. Ken Dale: Scalable flood vulnerability and flood mitigation models for use by Floodplain Managers in conjunction with Handbook 7
5. Tariq Maqsood: Information requirements - Case study Launceston
6. Krishna Nadimpalli: Flood catchment characterisation