Awareness, education and communication for compound natural hazards

Final report

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Australian Government

We acknowledge the Traditional Custodians across all the lands on which we live and work, and we pay our respects to Elders both past, present and emerging. We recognise that these lands and waters have always been places of teaching, research and learning.

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Acknowledgement of Country

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Executive summary

Research on disaster management in Australia has noted the inadequacy of preparedness and response when disasters overlap, closely follow each other sequentially, or confound each other with cascading and interconnected risks. [1] In a changing climate, compound natural hazards have become the lived experience of many Australian communities. It is now crucial to build community awareness of these hazards. Despite this imperative, little research has been done to establish best practice for engaging with communities in a way that enhances their preparedness for, survival through and recovery from compound natural hazards.

This study stems from the initiative of emergency managers across Australia who aimed to determine whether communication and engagement with communities differ when hazards are multiple and compounding. To date, communication and engagement processes have tended to assume that disasters are singular, discrete events. In this context, communication on specific, single hazards has often been the responsibility of particular agencies, with little holistic discussion of how hazards may interact. However, with many hazards increasing in frequency and/or intensity and overlapping due to climate change, there is a clear need for all-hazard, all-agency community engagement strategies that consider the complexities of the communication landscape in a compound hazard environment.

This report presents the results of an 18-month study to unpack the specific requirements of compound hazard communication and engagement. The study began with a systematic review of global literature on communicational responses to compound hazards. [2] The research found that use of the term 'compound natural hazards' is not widespread, nor is there an agreed-upon definition of what constitutes these hazards. It also found that communication and awareness-raising activities are now crucial, in the context of accelerating hazard risk – but there is no existing framework or set of guidelines for community engagement on compound hazards.

This project therefore undertook fieldwork in three compound hazard-impacted communities in the states of Victoria, New South Wales and Queensland. These locations had all been impacted by multiple hazards within a short timeframe, or by two different hazards at the same time. Here, the research team asked people about their experiences of communication and engagement before, during and after these hazards. A methodology combining surveys, interviews and community forum-style focus group discussions allowed us to determine what worked for hazard communication in each location and how communication and engagement might have been done better to help these communities prepare for, live through and recover from compound hazards. The research also aimed to unpack how good communication could better support the building of resilience. Research to date, focused mainly on single hazards, has shown that hazard communication and engagement strategies should emphasise familiarity with communities and seek to build relationships with them. In a compound hazard-affected community, people may be preparing for a new disaster at the same time as responding to a current one, while still recovering from events recently passed, the impacts of which may be enduring. This research found that such increased exposure and vulnerability makes communication and engagement for compound natural hazards qualitatively different – and even more crucial. In this context, a one-way, top-down approach to communication is less effective and the need for local knowledge, two-way communication, reciprocity, relationship-building and *listening,* is amplified.

This report presents research into the distinct needs, barriers and opportunities associated with engaging communities around compound natural hazards. In response to these needs, a novel framework is presented, co-constructed with communities, to guide better-practice compound hazard engagement. The framework is intended for use by emergency management, but it will also be useful for any of the wide spectrum of communicators who must work with communities for hazard preparedness, response and recovery. This report shows that, in a changing climate, engaging communities on compound hazard risk is crucial. Such engagement will be fundamental to resilience building in a future of escalating hazard risk.

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[1] Gissing, A., Timms, M., Browning, S., Crompton, R., & McAneney, J. (2022). Compound natural disasters in Australia: a historical analysis. *Environmental Hazards,* 21(2), 159-173.

[2] Nemeth, N., Johnson, M. S., Mocatta, G., & Hawley, E. (2024). Communicational responses for compound natural hazards: A systematic review. *International Journal of Disaster Risk Reduction*, 105041.

End-user statement

Shellie Smyth, Manager Community Risk, NSW Rural Fire Service

There is always an opportunity to learn and improve how we deliver public information and warnings. This research is helping me develop more targeted communications and ask sharper questions to refine our strategies. Being part of this project has enabled me to embed new knowledge into our public information approach, enhancing how we engage with communities before, during and after disasters.

As natural hazards become more frequent and complex, our communication strategies must evolve to meet these challenges. Our goal is to improve preparedness and reduce risk through clearer, more inclusive messaging. By applying best practice and research-driven insights, we can ensure our approaches are both effective and genuinely responsive to community needs.

Implications for policy and practice

→ **The term 'compound natural hazards' should be adopted and actively used by hazards and emergency managers**. One agreed-upon term needs to be utilised to move away from the current state of ambiguity among both emergency managers and the communities they serve as to what constitutes compound hazards. Naming and agreed definitions are crucial to building widespread understanding around compound hazards. The fact that the term is not currently widely used or understood is a communication barrier in itself.

→ **Emergency managers seeking to engage communities should be mindful of the way they use the one-way or deficit model of communication**. Initiatives that are participatory and based on genuine relationships with communities should be prioritised. This report does not recommend that a command-and-control model be abandoned entirely: it may be needed in active hazard situations. However, those that engage communities on compound hazards should consider that education, awareness and communication might be flipped to become empowerment, activation and listening, through more participatory and reciprocal modes of engagement.

→ **Emergency managers should be aware that engaging communities on compound hazards is distinct from communication and awareness-building focused on single hazards.** Those communicating about compound hazards should be mindful that communities facing multiple intersecting hazards find it harder to attend to hazard preparedness messages, respond to hazard threats, recover after events and build resilience. However, some communities that have recently experienced disasters may be more mobilised, experienced and better able to respond. Such barriers and opportunities should be considered during compound hazard engagement.

→ **Greater awareness of pre-existing vulnerabilities should be built among those who engage communities on compound hazards.** In this report, the term 'compound vulnerabilities' is used, meaning the overlapping and accumulating vulnerabilities in a compound hazard situation and the existing disadvantages that may amplify

a person's experience of a hazard situation. Awareness of communities' and individuals' compound vulnerabilities must be inherent to compound hazard engagement.

→ **Emergency managers and the communities they serve must share an agreed understanding that compound hazard risks are increasing under climate change.** Compound hazard engagement should therefore include clear communication about climate change and the escalating hazard risk associated with it. This should be communicated in terms of local impacts, into the future.

→ **Those communicating on compound hazards should build their media literacy.** This includes understanding the problems and affordances of the complex communication landscape. Compound hazard communicators should be familiar with local media in communities they work with and understand preferred communication channels. Place-based news and information providers can be mobilisers of local knowledge, public discussion and community builders in each hazard stage, with media practitioners as enablers for engaging community on compound hazards, rather than just channels or conduits.

→ **Organisations need distinct communication strategies that drive community engagement around the risk of compound hazards explicitly.** This will prevent communication decisions from being made in the high-stakes environment of an unfolding hazard event. These strategies should embed a two-way element: ongoing and structured listening should be built into these strategies. Diverse compound hazard communicators and organisations can use the communication framework described here to inform their compound hazard engagement.

→ **Emergency managers should recognise that compound hazard communicators can be diverse.** It is no longer the role solely of response and recovery agencies to engage people on hazards and disaster preparedness. Knowledge-sharing and listening are key for compound hazard communicators, independent of which sector they stem from.

→ **Compound hazard communicators must be mindful of the goals of communication.** In the framework presented here, preparation, safety, recovery and resilience are the four central goals. These are communication-centric goals: they build on (and do not replace) the prevention, preparedness, response and recovery (PPRR) process. Resilience-building should be considered one of the goals of compound hazard communication in the face of accelerating hazard risk.

→ **Those communicating on compound hazards should identify enablers within the communities they work with, to spread and amplify their messages.** Enablers may include government at all levels, education providers, community groups or champions, emergent groups established as a result of hazards, local businesses, diverse emergency response and recovery agencies and media practitioners.

→ **Engagement activities that employ the principles recommended here will take time and personnel, therefore resources.** Successful compound hazard engagement that empowers communities to become more resilient cannot be carried out unless adequate financial resources are available. In many locations, this may mean allocating more resources to the community engagement process.

How to use this report

This report has been produced both to summarise findings from a multi-stage research program and to present the key output of this study: a new framework for communication and engagement on compound natural hazards. The report contextualises the framework by presenting the findings from fieldwork in three compound hazard-affected case study locations. It then steps the reader through each part of the framework, explaining each component and providing examples from the case studies. The use of the framework is also demonstrated in a hypothetical compound hazard scenario.

For those seeking an in-depth understanding of compound hazard communication and engagement, the report is designed to be read in its entirety. For those seeking direct information about the framework and its components, these are outlined in the sections *A framework for community engagement on compound natural hazards* and *Utilisation pathways*.

The study's key imperative was to provide a framework to guide emergency managers seeking to engage with communities on compound hazards in all stages of the disaster cycle. This report was compiled with emergency managers foremost in mind. However, the findings concur with hazard communication literature, which notes that there are many types of actors in the hazard communication space. This report has therefore been written not only for emergency managers, but for anyone called on to engage with communities and communicate on compound hazards. These compound hazard communicators are at the centre of the framework and this report has been written with this diverse spectrum of users in mind.

Introduction

This study responded to calls from the emergency management sector for improved understanding of awareness, education and communication for compound natural hazards. Compound hazards can comprise:

- two or more extreme disaster events occurring simultaneously or successively

- combinations of extreme events with underlying conditions that amplify their impact

- combinations of events that are not themselves extreme, but which collectively lead to an extreme aggregation of impacts. [3]

[4] An essential component of preparation, response and recovery in the face of any natural hazard, the provision of timely and effective communication and engagement becomes particularly challenging when communities are impacted by multiple hazard events. The compound nature of the hazards under scrutiny in this study affects a community's receptiveness to messaging and their capacity to prepare, recover and take appropriate protective action. There is consequently a need to adapt communication and engagement strategies and/or redesign such strategies in a way that attends to the complexities of compound natural hazards.

To meet this research objective, it was essential to work closely with both hazard communicators and disaster-affected communities. Such community-focused research allowed a better understanding of the *responses* of communities facing multiple threats simultaneously and/or sequentially, and the implications and opportunities for engaging with communities on compound natural hazards to enhance their resilience.

This project, *Awareness, education and communication for compound natural hazards* is situated in a landscape of research and practice that must respond closely to questions about effective risk communication, participation and meaningful community engagement. In this study, as the research team worked with communities that have been impacted by compound hazards, we heard repeatedly how hazard communication needed to be community-focused, locally responsive and conducted in a two-way relationship between community and emergency managers. Communities know and understand this from lived experience and it is clearly supported in research. [5]

Accordingly, while this study is titled *Awareness, education and communication for compound natural hazards*, the researchers have interpreted these three terms – awareness, education and communication – in a way that incorporates and attends to their inversions: empowerment, activation and listening. These latter terms more clearly recognise and support the two-way engagement that is needed for hazard preparedness in a time of accelerating and compounding natural hazard risk.

One characteristic of the work presented here on compound hazard engagement is that it positions the role of local media practitioners, especially journalists and community media volunteers, as agents or enablers of effective disaster communication rather than simply as conduits of such information between emergency services and communities. Local media serve as a vital resource for knowledge, connections and cultural understandings within local settings and are often considered trusted sources of information in a community. [6] Community radio stations, for example, can be understood as listening posts – spaces for communities to engage with external groups as well as those within a community. [7] In the context of hazard or disaster communication, local media are often viewed as one of many channels through which top-down messages flow. In this study, the researchers have worked to mobilise local media (newspapers, hyperlocal online sites and community radio) to bring communities, researchers and emergency services together in public discourse. This novel 'engaged' [8] methodology, developed as one aspect of the research, has led to a

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[3] Seneviratne et al., 2012, p. 118
[4] Seneviratne et al., 2012, p. 118
[5] Satizábal, P., Cornes, I., Zurita, M. D. L. M., & Cook, B. R. (2022). The power of connection: Navigating the constraints of community engagement for disaster risk reduction. *International Journal of Disaster Risk Reduction*, 68, 102699.
[6] Hess, K. & Waller., L (2017). *Local Journalism in a Digital World*. Palgrave: London
[7] Dreher, T., & de Souza, P. (2021). Listening In: Community Media and the Politics of Listening. Sydney: University of New South Wales.
[8] Wenzel, A. & Nelson, J., (2020). "Engaged" journalism: studying the news industry's changing relationship with the public, *Journalism Practice*, 14(5) 515-517.

particularly high level of local news coverage of this study [9] spaces, contributing towards awareness of the need for natural hazard communication through place-based media.

It is also important to acknowledge the role of the nation's public broadcaster, the Australian Broadcasting Corporation (ABC) as an essential service during hazard communication. As an emergency broadcaster, the ABC has a duty to ensure communities are informed in times of crisis and has memoranda of understanding in place with states and territories to provide media access during emergencies. It has been criticised, nonetheless, for issues around the reliability of digital technologies during emergencies such as bushfires and cyclones. Also scrutinised is the ABC's ability to cover disasters at a hyperlocal level due to its increasing centralisation of resources and a shift to a more regional, rather than hyperlocal focus on content. As highlighted above, research has noted the especially important role of place-based news providers such as newspapers, radio and community radio for tapping into reliable local knowledge and a niche geographic audience base during emergencies. It was for this reason that place-based news operators were invited to participate in media aspect of the research.

Social media have been a favoured channel for reaching communities during disasters, but the extent to which social media are reliable and/or credible must be questioned. Academic scholarship has begun to critique widespread societal dependency on major digital platforms such as Google and Meta for disseminating messages and sharing information. [10] Meta, for example, may prove to be an increasingly unreliable platform during times of emergency as it continues to threaten news blackouts in an Australian context. People fleeing Canadian wildfires in 2023 faced difficulties accessing reliable emergency information because of Meta's news bans and changes in recommendation algorithms. In this context, this study therefore incorporates an examination of the role and capacity of small-scale local media, beyond social platforms, in communicating and engaging people on compound hazards.

Drivers for action

Globally, the incidence of extreme weather events has increased since the 1970s and some hazard events are projected to become more damaging and frequent under climate change. [11] Australia is a country on the front lines of global climate change, having already seen an increase in average temperatures of. [12] Although Australia has long experienced climate variability, climate change is exacerbating the nation's exposure to extreme weather events. The impacts on socio-economic and environmental systems are damaging and costly. By 2021, natural hazards were already costing Australia $38 billion per year on average, with costs projected to rise to. [13]

In this context of hazard escalation, globally and in Australia, hazards are no longer always discrete, single events, but are tending increasingly to overlap spatially and/or temporally. Australia's National Disaster Risk Reduction Framework has indeed noted the "growing potential for cumulative or concurrent, large-scale natural hazards to occur". [14] More Australians are experiencing compound hazards due to population growth and the built environment spreading to hazard-vulnerable places. While in many cases, hazards are no longer purely natural due to anthropogenic climate change, even unnatural hazards only become disasters when they interact with existing exposures and

[9] Parliament of New South Wales. (2024). Tenterfield Talks: Communicating in Crisis. Available at:
https://www.parliament.nsw.gov.au/Hansard/Pages/HansardResult.aspx#/docid/HANSARD-1323879322-139568
[10] Meese, J. (2023). Digital Platforms and the Press. London: Intellect
[11] Intergovernmental Panel on Climate Change (IPCC). (2018). Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. Available at: https://www.ipcc.ch/sr15/
[12] Bureau of Meteorology (BoM). (2022). State of the Climate 2022, Available at:
https://australianbusinessroundtable.com.au/assets/documents/Special%20report:%20Update%20to%20the%20economic%20costs%20of%20natural%20disasters%20in%20Australia/Special%20report%20_Update%20to%20the%20economic%20costs%20of%20natural%20disasters%20in%20Australia.pdf
[13] Deloitte Access Economics. (2021). Special report: Update to the economic costs of natural disasters in Australia Australian Business Roundtable for Disaster Resilience & Safer Communities, Available at:
https://australianbusinessroundtable.com.au/assets/documents/Special%20report:%20Update%20to%20the%20economic%20costs%20of%20natural%20disasters%20in%20Australia/Special%20report%20_Update%20to%20the%20economic%20costs%20of%20natural%20disasters%20in%20Australia.pdf
[14] National Disaster Risk Reduction Framework, Commonwealth of Australia (2018), p. 5

vulnerabilities. [15, 16] Such vulnerabilities are often created by national or subnational scale socio-political processes: that is, processes that can be changed to better protect the exposed and vulnerable.

The key drivers for action for the work presented here include a recognition that, in an escalating hazard environment, initiatives that seek to reduce exposure and vulnerability are needed. Engaging people to better understand the escalating risk and their communities' role in preparing for it alongside emergency managers is at the core of this research.

Research objectives

Across all its outputs, this project has attempted to define and identify the nature of compound hazards, how a greater frequency of natural hazard events may alter vulnerability and exposure, and what hazard communication looks like in this context. To this end, conducted a systematic review of international peer-reviewed research and current practice on strategies for engagement on compound natural hazards was conducted. [17] This part of the project has delivered an advanced understanding of current research and global best-practice approaches to community engagement in the compound hazard context.

The research team then conducted fieldwork in three Australian communities that were impacted by compound hazards. In this phase of the project, the objective was to gauge the experiences and communication needs of communities (including residents, community leaders, emergency managers and volunteers, businesses, local government, community organisations and infrastructure providers) facing multiple threats simultaneously and/or sequentially. An important part of this work was to understand the landscape in which compound hazard communication unfolds, in local contexts. While some research has pointed to the important role that trusted local news outlets can play in engaging communities on natural hazards, [18] this study has extended that link by partnering with local media. In this report, and in the framework, the researchers consider information ecologies and infrastructures and how local communities use them. An additional objective of this work was to enable Australia to be positioned as a global leader by developing a framework to guide better compound hazard communication to minimise multivariate risk.

The project addressed the following research questions:

1. What are compound natural hazards in an Australian context?

2. What is international best practice for awareness, education and communication around compound natural hazards?

3. How can emergency management organisations in Australia best engage with communities to:

    i.   understand the barriers, opportunities and challenges to the development and delivery of effective community engagement for compound natural hazards

    ii.   understand the impact of compound hazards on community capacity to respond to such threats

    iii.   enhance community compound hazard literacy

    iv.   understand warning fatigue and/or communicate with communities in recovery from compound hazards

    v.   provide consistent and effective information, including warning systems, to support preparedness, response and recovery from compound natural hazards?

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[15] Otto, F. E., & Raju, E. (2023). Harbingers of decades of unnatural disasters. *Nature Communications Earth & Environment*, 4(1), 280.

[16] Otto & Raju (2023) refer to disasters caused by climate change-driven hazards as "unnatural disasters".

[17] Nemeth, N., Johnson, M. S., Mocatta, G., & Hawley, E. (2024). Communicational responses for compound natural hazards: A systematic review. *International Journal of Disaster Risk Reduction*, 105041.

[18] Ewart, J. (2020). Drought is a disaster in the city: Local news media's role in communicating disasters in Australia. *Media, Journalism and Disaster Communities*, 67-82.

4. What stakeholders and collaborations are required for effective community engagement with communities on compound natural hazards?

As outlined in this report, these research questions were addressed through a methodology combining a systematic quantitative review of global literature on compound hazard communication, awareness and education, followed by fieldwork comprising case study analysis of three disaster-impacted communities using interviews, surveys and focus group discussions. Research questions 1, 3 and 4 are addressed predominantly in this report, and question 2 is addressed in the systematic literature review which is a separate output of this study (refer to Nemeth et al. (2024) detailed in the *References* section of this report.)

Background

Communication: beyond the deficit model

Communication is the process by which meaning is shared, negotiated and contested. [19, 20] It involves the processes of delivering and receiving messages in a way that encompasses mutual listening. Communication and engagement are distinct yet intertwined: there can be no engagement without effective communication. In this context, natural hazard communicators are concerned with the dissemination of warning messages as well as the design and delivery of community engagement activities and awareness-raising campaigns.

Such communicators must move beyond deficit models of communication and engagement, where it is assumed that individuals or communities fail to act as experts would have them do, mainly because of a deficit in knowledge. By this logic, if the communicator can overcome the deficit, then the desired understanding and behaviour change will eventuate. Even though the deficit model of communication is much critiqued [21] and often fails to achieve its objectives, much research has confirmed that this model. [22] However, when it comes to engaging people on issues that affect their lives, science communication research and research into communication more broadly tell us that. [23, 24] This means that involving audiences in the process and outcomes of communication initiatives and giving them a voice in determining how they would like to be communicated with, is crucial for any engagement effort.

Natural hazards and disaster preparedness initiatives have tended to assume that providing communities with information about their exposure to disaster risk and how to act in response to hazards, will ensure they are well prepared and able to stay safe during disasters. [25] Such top-down methods of education and awareness-raising have long been a dominant model of community engagement within the emergency services sector. [26] Emergency management initiatives are widely recognised to operate under expert-led, command-and-control systems, which maintain hierarchies rather than disrupting them. [27] While a command-and-control approach may indeed be necessary during disasters in the interests of public safety, this tends to be extended into interaction with communities during non-disaster periods also, inhibiting public participation. [28] Deficit or command-and-control models of communication,

[19] Castells, M. (2013). Communication Power. Oxford University Press.
[20] Hawley, E. (2023). Communication Concepts. Deakin University and CAUL (Council of Australian University Librarians). https://oercollective.caul.edu.au/communication-concepts/
[21] Sturgis, P., & Allum, N. (2004). Science in society: Re-evaluating the deficit model of public attitudes. *Public Understanding of Science*, 13(1), 55-74.
[22] Simis, M. J., Madden, H., Cacciatore, M. A., & Yeo, S. K. (2016). The lure of rationality: Why does the deficit model persist in science communication?. *Public understanding of science*, 25(4), 400-414.
[23] Metcalfe, J., Gascoigne, T., Medvecky, F., & Nepote, A. C. (2022). Participatory science communication for transformation. *Journal of Science Communication*, 21(2), E.
[24] Wynne, B. (2015). Ghosts of the machine: publics, meanings and social science in a time of expert dogma and denial. In Remaking participation (pp. 99-120). Routledge.
[25] Cook, B. R., & Zurita, M. D. L. M. (2019). Fulfilling the promise of participation by not resuscitating the deficit model. *Global Environmental Change*, 56, 56-65.
[26] Cornes, I. C., Cook, B., Satizabal, P., & de Lourdes Melo Zurita, M. (2019). '(In) action': Rethinking traditional understandings of disaster risk reduction. *The Australian Journal of Emergency Management*, 34(1), 52-57.
[27] Van Baarle, S., Dolmans, S. A., Bobelyn, A. S., & Romme, A. G. L. (2021). Beyond command and control: Tensions arising from empowerment initiatives. *Organization Studies*, 42(4), 531–553.
[28] Cook, B.R., Cornes, I., Satizabal, P. and de Lourdes Melo Zurita, M., 2022. Experiential learning, practices, and space for change: The institutional preconfiguration of community participation in flood risk reduction. *Journal of Flood Risk Management*, p.e12861.

broadly, have not been effective in inducing protective behaviours in at-risk communities to date. Such approaches have even been shown to evoke *resistance* from communities, who oppose being on the receiving end of one-way information transfer from experts. [29] It is clear that approaches are needed that are more inclusive of communities and better help them activate for disaster preparedness.

In a natural hazard context, communication is not simply the transmission of information to audiences. Instead, communication is a complex, multifaceted and participatory practice involving diverse channels (including social media, telephone, text messages, television, radio, print or digital news, apps and word-of-mouth). Indeed, effective communication can take a transmedia approach and unfold across multiple channels to capture migratory and diverse audiences. [30] Despite the proliferation of channels, platforms and tools, *people* remain at the heart of communication. To understand how to improve communication before, during and after compound natural hazards, we need to understand the needs and practices of both communicators and communities. To this end, effective communication requires listening: giving recognition to others as having the right to speak; acknowledgement and paying attention to other points of view; interpreting what others say fairly and receptively and responding in an appropriate way. [31]

Community engagement

Community engagement involves a collection of activities that seeks to build sustainable relationships between authorities and local communities, including individuals living in the local area, schools, businesses and community groups such as charities, social groups and sporting clubs. In a disaster communication context, community engagement is inclusive and mindful of the needs and experiences of groups or individuals, including First Nations community members as well as people who may be marginalised, like newcomers to an area, young people, elderly people, people living with disability, people experiencing family violence and people from non-English-speaking backgrounds. Community engagement activities take place before, during and after natural hazards and should not be thought of solely in terms of awareness-building and preparation. In a compound natural hazard context, the primary goals of community engagement are preparedness, safety, recovery and resilience-building.

Community engagement, as defined by this study, is a communicational activity that encompasses the provision of information, listening to stakeholders and sharing experiences through a variety of channels. Existing definitions, including that from the Australian Institute for Disaster Resilience (AIDR), emphasise that community engagement is a collective process involving collaboration and active participation by grassroots community organisations and individuals. [32] The research also build on the United Nations' Brisbane Declaration on Community Engagement which describes engagement as:

> A two-way process: by which the aspirations, concerns, needs, and values of citizens and communities are incorporated at all levels and in all sectors in policy development, planning, decision-making, service delivery and assessment; and by which governments and other business and civil society organisations involve citizens, clients, communities and other stakeholders in these processes. [33]

This study, and in the formulation of the framework for compound hazard engagement presented in this report, draws on the literature in disaster management and crisis communication which argues that people-centred models of hazard engagement are most effective at building community resilience. [34] Participatory approaches that invite

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[29] Kasperson, R. (Ed.). (2017). Risk conundrums: Solving unsolvable problems. Taylor & Francis; Kasperson, R. (2014). Four questions for risk communication. *Journal of Risk Research*, 17(10), 1233-1239.
[30] Jenkins, H. (2006). Convergence Culture: Where Old and New Media Collide. New York University Press.
[31] Macnamara, J. (2018). Toward a Theory and Practice of Organizational Listening. *International Journal of Listening*, *32*(1), 1-23 https://doi.org/10.1080/10904018.2017.1375076
[32] AIDR (2020), Community Engagement for Disaster Resilience (AIDR 2020). Available at: https://knowledge.aidr.org.au/media/7989/aidr_handbookcollection_communityengagementfordisasterresilience_2020.pdf
[33] United Nations. (2005). International Conference on Engaging Communities, Brisbane Declaration on Community Engagement. Available at: https://cdn2.hubspot.net/hubfs/2619477/brisbane_declaration.pdf, p. 1.
[34] Chandra, A., Acosta, J., Howard, S., Uscher-Pines, L., Williams, M., Yeung, D.,... & Meredith, L. S. (2011). Building community resilience to disasters: A way forward to enhance national health security. *Rand Health Quarterly*, 1(1).

'responsibility sharing' [35] between authorities and community for disaster risk reduction, and approaches that acknowledge the local expertise and experience of grassroots 'community connectors' – community volunteers or champions – also underpin the work presented here. [36] Likewise, communities are regarded in this study as diverse groups that see themselves differently from the homogenous and passive recipients that disaster risk reduction has often framed them as. [37]

The work presented in this report also draws on fundamental global disaster risk reduction frameworks and principles including the Hyogo Framework for Action [38] and the Sendai Framework for Disaster Risk Reduction. [39] In an Australian context specifically, it is informed by the National Disaster Risk Reduction Framework, which states that a 'priority 1 action' is to 'Improve public awareness of, and engagement on, disaster risks and impacts.' [40] This work also draws on such core risk management principles as PPRR which are central to emergency management in Australia. The role of community engagement is laid out in a PPRR context, for example, in the Queensland Prevention, Preparedness, Response and Recovery Disaster Management Guidelines. [41]

In terms of community engagement frameworks specifically, the present study draws on the Community Engagement Framework of the National Strategy for Disaster Resilience [42] and is informed by initiatives such as Cook et al.'s Community Engagement for Disaster Risk Reduction (CEDRR) Framework in which communities take ownership and assist in production and dissemination of information for risk reduction. This work recognises and builds on a community-oriented approach to disaster management, which does not reduce or minimise government or agency emergency management responsibility, but rather seeks to strengthen community participation and community influence over this process. [43]

Importantly, like Cook and Zurita, this research also regards relationships to be at the heart of risk reduction. [44] In the research, the research team heard repeatedly from members of compound hazard-affected communities that local people – already connected and expertly versed in local conditions – are motivated to work towards resilience. However, looking into an increasingly disaster-challenged future, they want to work collaboratively in equal relationships with emergency managers to build preparedness and long-term resilience. This research acknowledges that culture change may be needed for the emergency management sector to meaningfully enact such relationship-building with the communities it serves. At the same time, resource, bureaucratic and time constraints, as well as legislated risk reduction responsibilities, may pose real and perceived obstacles to emergency managers deeply listening to and learning from the communities they seek to engage in disaster risk reduction. Effective and sustained disaster risk reduction must embed listening to others as a shared practice between communities, relevant stakeholders and emergency services.

It is crucial to acknowledge that the communication research described in this report, and the community engagement framework presented cannot, in isolation, build resilience. Underlying the work reported here is a recognition of the systemic nature of risk and the need for a system-wide approach to resilience building. There are many causes of natural hazard risk – global climate change being a key driver – and many sources of vulnerability, including diverse socio-economic inequities. Resilience-building must tackle these overarching drivers of risk and this should include acknowledging and placing climate change considerations at the centre of such resilience-building.

[35] McLennan, B. J., & Handmer, J. (2012). Reframing responsibility-sharing for bushfire risk management in Australia after Black Saturday. *Environmental Hazards*, 11(1), 1-15.

[36] Satizábal et al., 2022

[37] Scolobig, A., Prior, T., Schröter, D., Jörin, J., & Patt, A. (2015). Towards people-centred approaches for effective disaster risk management: Balancing rhetoric with reality. *International Journal of Disaster Risk Reduction*, 12, 202-212.

[38] United Nations International Strategy for Disaster Reduction (UNISDR). (2005). Hyogo Framework for Action 2005-2015. Building the Resilience of Nations and Communities to Disasters. Available at: www.unisdr.org/wcdr

[39] United Nations Office on Disaster Risk Reduction (UNDRR). (2015). The Sendai Framework for Disaster Risk Reduction 2015-2030. United Nations Office for Disaster Risk Reduction. Available at: https://www.undrr.org/media/16176/download?startDownload=20240901

[40] Commonwealth of Australia (2018). National Disaster Risk Reduction Framework. Available at: https://www.homeaffairs.gov.au/emergency/files/national-disaster-risk-reduction-framework.pdf, p. 9

[41] State of Queensland (Queensland Fire and Emergency Services) (2017). Queensland Prevention, Preparedness, Response and Recovery Disaster Management Guidelines. Available at: https://www.disaster.qld.gov.au/__data/assets/pdf_file/0032/359465/QLD-Disaster-Management-Guideline.pdf

[42] Australian Institute for Disaster Resilience (AIDR). (2023). National Strategy for Disaster Resilience: Community Engagement Framework. Available at: https://knowledge.aidr.org.au/media/1761/handbook-6-national-strategy-for-disaster-resilience-kh-final.pdf

[43] Cook, B. (2023) Community Engagement for Disaster Risk Reduction (CEEDR). Available at: https://sgeas.unimelb.edu.au/engage/community/australia/community-risk-reduction

[44] Cook & Zurita (2019)

Indeed, research indicates that extreme weather events can be teachable moments for climate change learning and action. [45] Resilience-building must also be a systemic endeavour [46]: a framework for engaging with communities on compound hazards cannot address all the risks that exacerbate vulnerabilities to repeated or coinciding disasters.

Compound natural hazards

A key challenge for communication and engagement activities that focus on compound hazards relates to the definition and naming of such events. This research, both in surveying the global literature and in the field, has found widespread disagreement on what constitutes a compound hazard. This study defines compound natural hazards as two or more natural hazard events occurring together or within a short timeframe, impacting parts of the same geographical area and/or local community. This definition aligns with the work of Gissing et al., who argue that compound natural hazards comprise 'more than one disaster event, occurring simultaneously or within a short timeframe.' [47] Seneviratne et al. concur that compound disasters involve 'two or more extreme disaster events occurring simultaneously or sequentially, combinations of extreme events with underlying conditions that amplify their impact, or combinations of events that are not themselves extreme, but which collectively lead to an extreme aggregation of impacts.' [48]

As these definitions suggest, compound hazards are disaster events with overlapping spatial and temporal attributes. Temporally, compound hazards can occur either simultaneously (with at least two disasters arising around the same time) or sequentially (whereby a second disaster happens shortly after the initial hazard, either as a triggered or discrete event). However, the temporality of a compound natural hazard can be challenging to comprehend or define, given it is not always possible – or reasonable – to identify the end of a disaster, especially when recovery is ongoing. This means that there is no one agreed-upon on timeframe for frequency in the definition of compound hazards. As Gissing et al. note, no explicit temporal or spatial parameters are defined in the literature.' [49] Consequently, while this study investigates engagement and communication before, during and after a compound natural hazard, communities impacted by compound hazards may find that preparation, response and recovery stages overlap. This means communities can be recovering from one event while preparing for or dealing with another. [50] This complex and overlapping temporality has a significant impact on locations experiencing compound natural hazards, leading to fatigue, confusion, displacement and increased vulnerability.

Spatially, compound hazards impact the same geographical area. However, the scale of the events is not always equivalent. For example, a large region may be suffering from drought when part of that region experiences a bushfire. Similarly, a natural hazard impacting a local community may compound, or be compounded by, the impacts of a global event such as the COVID-19 pandemic. Micro-communities, meanwhile, may experience a compound natural hazard in unique and varying ways, with geographical pockets marked by greater risk and vulnerability – for example, communities living remotely or in communication blackspots may experience particular difficulties in accessing information and/or acting for safety.

In the Australian context, compound natural hazards typically involve repeated instances and/or combinations of extreme weather events such as cyclones, bushfires, storms, drought, flooding and heatwaves. [51] Building on the long-held disaster risk equation, risk of disaster from compound hazards stems from the interaction between the hazards, capacity, exposure and vulnerability, which may be a product of socio-economic conditions. [52] In this context, it can be difficult to disentangle the natural and human-made elements of a compound hazard event. An often-cited

[45] Ettinger, J., Walton, P., Painter, J., Flocke, S. A., & Otto, F. E. (2023). Extreme weather events as teachable moments: Catalyzing climate change learning and action through conversation. *Environmental Communication*, 17(7), 828-843.
[46] Cavallo, A., & Ireland, V. (2014). Preparing for complex interdependent risks: a system of systems approach to building disaster resilience. *International Journal of Disaster Risk Reduction*, 9, 181-193.
[47] Gissing et al. (2022), p. 160
[48] Seneviratne, S., Nicholls, N., Reichstein, M., Sorteberg, A., Vera, C., & Zhang, X. (2012). Changes in climate extremes and their impacts on the natural physical environment. In *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. IPCC.
[49] Gissing et al. 2022, p. 162.
[50] AIDR (2020), p. viii
[51] Australian Institute for Disaster Resilience. (2020). *Community Engagement for Disaster Resilience.*
[52] UNDRR (2015).

international example of a hazard that combined both of these elements is the 2011 Great East Japan Earthquake which led to a tsunami followed by nuclear disaster when the tsunami wave flooded the Fukushima Daiichi power plant (sometimes described as a technological hazard).

For this study, which focuses on natural hazards, hazard events with a technological element are excluded from this study's definition of compound natural hazard. This does not discount the importance of research into so-called 'natech hazards', in which a natural hazard triggers a technological accident or disaster [53], such as flooding leading to a toxic chemical spill, but such events were out of the scope for this study. An additional consideration in defining compound hazards is a complex public health emergency like the COVID-19 pandemic. The International Red Cross and Red Crescent define pandemics as natural hazards [54] and the COVID pandemic has spawned much new research into the co-occurrence of such hazards, noting COVID as a compounding factor [55, 56] with vulnerability amplifying exposure and a greater infection rate following hazard events that occurred during COVID. [57] Quigley et al. have accordingly defined 'COVID-19 plus an additional hazard' as 'compound events'. [58] The present study likewise includes COVID in its compound hazard definition. More broadly, it is acknowledged that natural hazards are entangled with and experienced during complex socio-political, technological and cultural events and issues, many of which increase vulnerability and exposure.

The physical, mental, emotional and financial damage inflicted by compound natural hazards is potentially severe. Impacts from compound hazards tend to overlap and interact – and from the perspective of the impacted community, hazards are invariably more impactful when experienced together or in quick succession. The complexities of compound hazards also place a strain on resources and pose coordination and recovery challenges for emergency managers. [59] The impact on communities typically leads to an impaired capacity to respond and recover [60] and a prolonged recovery period.

In order to establish a baseline of current thinking about compound hazards and determine international best practice for awareness, education and communication around compound natural hazards (RQ2), the research team conducted a systematic quantitative literature review (SQLR) of 45 peer-reviewed studies of awareness building, education initiatives and communication and/or engagement in the context of compound hazards. [61] This review of existing global literature found no extant framework for guiding communication, awareness and education for compound hazards and that best practice guidelines for compound hazard communication and community engagement have not yet been established. Where guidelines for hazard communication and community engagement do exist, they tend to make little or no mention of compound hazards. [62] Likewise, compound hazards are not discussed in even the most recent and detailed scholarly work on awareness-raising for natural hazard preparedness. [63, 64] Conversely, communication, education or awareness-raising are not mentioned at all in existing reports [65] and frameworks [66] related to compound hazards specifically. This leaves a gap in current knowledge about how emergency management agencies and other governance bodies charged with responding to hazard events should engage with communities to raise preparedness for and resilience to compound natural hazards.

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[53] Drakes, O., & Tate, E. (2022). Social vulnerability in a multi-hazard context: a systematic review. *Environmental Research Letters*, 17(3), 033001.

[54] Seddighi, H. (2020). COVID-19 as a natural disaster: focusing on exposure and vulnerability for response. *Disaster Medicine and Public Health Preparedness*, *14*(4), e42-e43.

[55] Ashraf, A. (2021). Lessons learned from COVID-19 response for disaster risk management. *Natural Hazards*, *107*(2), 2027-2032.

[56] Izumi, T., & Shaw, R. (2022). A multi-country comparative analysis of the impact of COVID-19 and natural hazards in India, Japan, the Philippines, and USA. *International Journal of Disaster Risk Reduction*, *73*, 102899.

[57] Dargin, J. S., Li, Q., Jawer, G., Xiao, X., & Mostafavi, A. (2021). Compound hazards: An examination of how hurricane protective actions could increase transmission risk of COVID-19. *International journal of disaster risk reduction*, *65*, 102560.

[58] Quigley, M. C., Attanayake, J., King, A., & Prideaux, F. (2020). A multi-hazards earth science perspective on the COVID-19 pandemic: the potential for concurrent and cascading crises. *Environment Systems and Decisions*, *40*(2), 199-215.

[59] Gissing et al. (2022), p. 160

[60] Liu, M. & Huang, M.C. (2014). *Compound Disasters and Compounding Processes*. The United Nations Office for Disaster Risk Reduction.

[61] Nemeth et al., (2024)

[62] For example, AIDR 2020.

[63] Fazeli, S., Haghani, M., Mojtahedi, M., & Rashidi, T. H. (2024). The role of individual preparedness and behavioural training in natural hazards: A scoping review. International Journal of Disaster Risk Reduction, 104379

[64] Johnston, K. A., Taylor, M., & Ryan, B. (2022). Engaging communities to prepare for natural hazards: a conceptual model. *Natural Hazards*, 112(3), 2831-2851.

[65] Gissing et al. (2022), p. 160

[66] Dawkins, R. (2022). How to build resilience in the face of compounding extreme events. CSIRO. Available from: https://www.csiro.au/en/news/all/articles/2022/april/compound-risk-extreme-events

This review of the existing literature found that there is little consensus about what constitutes a compound natural hazard and no agreed-upon terminology to name and describe such hazards. While compound natural hazards have attracted an increasing amount of research attention, with a growth in publications relating to these hazards in the last decade, there is significant variability in the terms used to describe these events. Indeed, the term compound sits alongside related words like sequential, multiple, multi-, chain, domino, overlapping, simultaneous, combined or cascading, which are all used by researchers to describe a similar relationship between disaster events. [67]
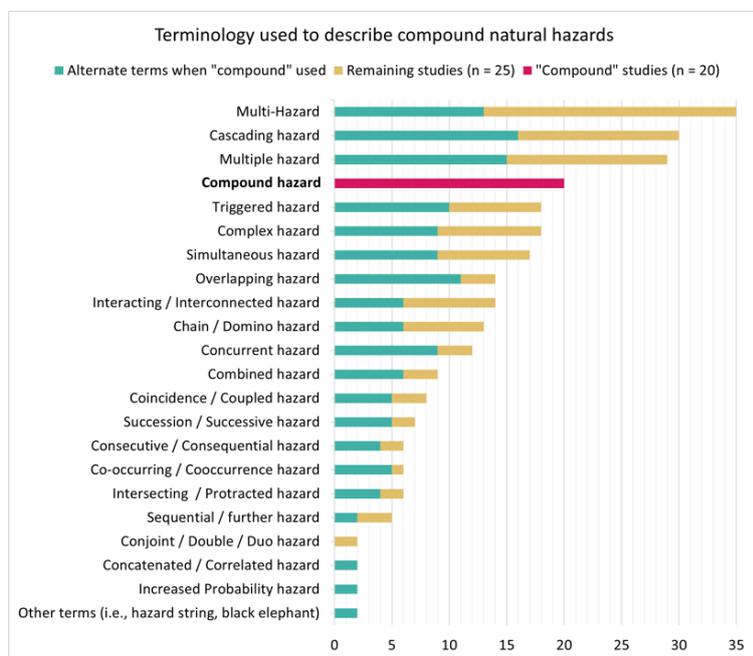
Figure 1: The frequency of use of the term compound hazard compared with the multiple other terms used to describe hazards of a compound nature. (Source: Nemeth, N., Johnson, M. S., Mocatta, G., & Hawley, E. (2024). Communicational responses for compound natural hazards: A systematic review. *International Journal of Disaster Risk Reduction*, 105041.)

Importantly, this project's fieldwork also found that the term 'compound natural hazard' is not widely used by community members or emergency management stakeholders. When the research team spoke with impacted communities and stakeholders, it quickly became apparent that the compound hazard term is not currently part of the lexicon of communication and engagement efforts when multiple disasters strike. The research team found that the term can be confusing, and that even the word hazard itself is frustrating for stakeholders because it implies an event that ends once the threat has passed, rather than one with an ongoing impact on communities. A significant finding of this study, therefore, is that there is a degree of confusion surrounding what a compound natural hazard is and what it should be called. This poses a significant barrier to communication and engagement efforts in the context of such hazards.

Notably, this research found a degree of community concern about vulnerabilities and 'compounding factors' that are deeply individual and/or unique to a particular time and place. During discussions about compound natural hazards, participants mentioned an array of events that compound the way a community experiences disasters. Accordingly, throughout this report – while this research primarily focuses on compound hazards – it also acknowledges that there can be compounding factors before, during and after a disaster. These include infrastructure problems such as power outages and disruptions to transport; community problems such as school and business closures; and vulnerabilities experienced by individuals such as disability, homelessness or family violence. Arguably, any natural disaster becomes

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[67] Nemeth et al. (2024).

compound for community members with existing vulnerabilities, such as those living with disabilities, social marginalisation or socio-economic disadvantage. Indeed, this report argues for consideration of 'compound vulnerability' [68] in relation to natural hazards in Australia, noting that those already most vulnerable, and with the least capacity for resilience, are often the most exposed to compound natural hazards.

Compound natural hazards:
when two or more natural hazards impact a community at the same time or in quick succession
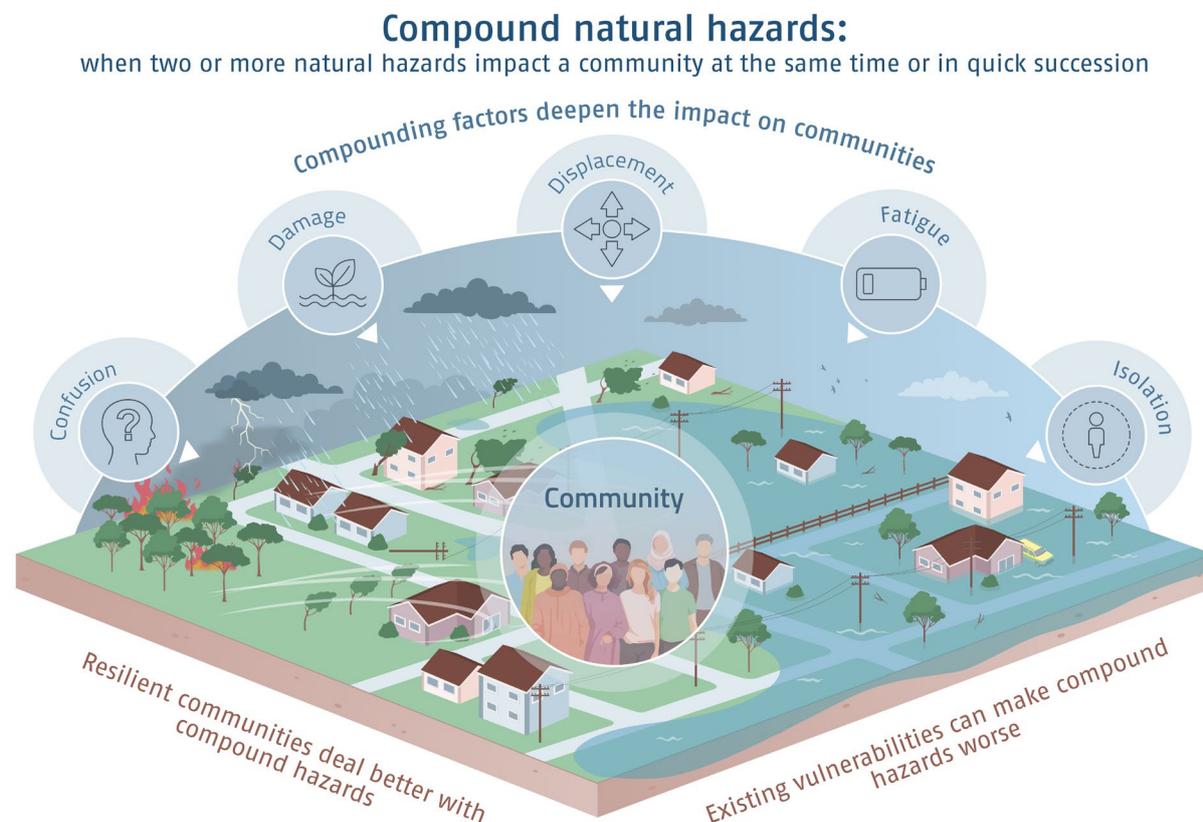
Figure 2: Compound natural hazards and the multiple, interacting ways they impact communities

Compound hazard communication

Communication plays a crucial role before, during and after natural hazard events. Effective communication helps communities respond when disaster strikes and is central to the building of awareness and resilience. Scholars agree that communication during natural hazards should be clear and should establish trust between communities and emergency management. As the United Nations Office for Disaster Risk Reduction points out, 'Failing to communicate about [disaster] risk effectively – indeed, failing to communicate at all – can fuel rumour, erode trust, hamper solutions and even increase risk' while effective communication can build resilience and shared understanding. [69]

Natural hazard communication is typically undertaken by emergency management stakeholders for the purposes of ensuring preparedness, safety and recovery. Importantly, though, hazard communication must be a participatory practice that involves listening, collaborating and sharing experiences as well as disseminating information. As laid out above, it is essential that we move beyond the limits of the deficit model when establishing best practice guidelines for any form of hazard or disaster communication.

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[68] UNDRR (2022).
[69] UNDRR (2022), p. 124

It is also important to recognise that the communication landscape before, during and after natural hazards is populated by a diverse range of actors including individuals and groups, experts and non-experts, professionals and citizens and formal as well as informal spokespeople. At the same time, established communication practices for single or discrete hazards may become unreliable, complicated, less effective or unachievable in the context of a compound hazard. Through engagement with Australian communities who have experienced compound hazards, and through appraisal of the global literature on the subject, this study seeks to bring new clarification to the practice of compound hazard communication.

The compound hazard communication landscape

As detailed above, the contemporary hazard communication landscape is complex – sometimes chaotic – with multiple communicators, and often multiple messages, reaching multiple different audience groups through the phases of hazard preparedness, response and recovery. This section discusses the complexities of this landscape, to emphasise the multiple actors in this space and the multiple channels and pathways communication and engagement initiatives should therefore consider. This research team acknowledge here particularly the important work of Mileti on the social science of warnings, noting that variation in the nature and content of communication around hazards has a significant bearing on whether the public heeds these warnings. [70]

Although communication in a hazard-driven emergency is often led by emergency managers and response agencies, good communication is everyone's responsibility. Given the shared experience of the hazard impact, the response is necessarily communal. Unconventional or informal communication plays a crucial role in the information landscape in which hazard communication is enacted. This includes over-the-fence conversations with neighbours, phone calls with friends and family and intergenerational sharing of hazard preparedness routines. This report, and its communication and engagement framework for compound hazards, accordingly recognises the broad range of communicators in this compound hazard communication landscape. This research conceptualises those who assist emergency management natural hazard communicators as 'communication enablers' for disseminating hazard messages. These can include all levels of government, business, schools, recovery agencies, media professionals, individual community champions and community groups – both established and emergent. These enablers are more than conduits or channels of communication but rather active agents who can help shape and direct information where it needs to go.

Hazard communication also utilises a wide spectrum of channels, including and beyond traditional and social media. These channels encompass television, websites and smartphone apps, social media, radio, news coverage, advertising campaigns, flyers and printed materials, community events and local sirens, warning systems or alarms. In this communication landscape there is also a diversity of audiences': individuals and households, but also businesses, and diverse groups, including those with disabilities and additional needs, and those for whom language may pose extra challenges for accessing and understanding compound hazard communication. Research also shows that school-based learning programs reach not only school children, but also filter back to responsible adults at home, thereby influencing household agency and preparedness. [71] Finally, it is important to recognise that in the hazard communication landscape, effective communication can be disrupted by individuals or groups with diverse agendas, including those who maliciously or unintentionally circulate misinformation.

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[70] Mileti, D. S., & Sorensen, J. H. (1990). Communication of emergency public warnings: A social science perspective and state-of-the-art assessment (No. ORNL-6609). Oak Ridge National Lab.(ORNL), Oak Ridge, TN (United States).

[71] Newnham, E. A., Dzidic, P. L., & Kelly, L. M. (2023). Child disaster resilience in action: post-bushfire qualitative perspectives on a school-based preparedness program. *International Journal of Disaster Risk Reduction*, 96, 103925.

Methodology

Methodological overview

This study adopted a mixed methods approach to ensure data triangulation and the collection of diverse perspectives. To determine existing approaches to and understandings of compound hazard communication, a comprehensive desktop review of existing peer-reviewed literature was initially undertaken. This review focused on existing research into best-practice awareness, education and communication for compound hazards, as summarised in the *Background* section of this report. This paper was published as 'Communicational responses for compound natural hazards: a systematic review' in the *International Journal of Disaster Risk Reduction.* [72] A case study approach was then adopted, comprising interviews with 38 experts and stakeholders, three community forums with a total of 52 participants, and three community surveys, all centred on three case study locations. Ethics approval for this research was sought and granted by the Deakin University Human Research Ethics Committee (ref 2023-255). Each method is described in detail in the following subsections.

Case study selection

The research informing this report was conducted in three case study locations: the Dandenong Ranges in Victoria, Tenterfield in New South Wales and the Burdekin Shire in Queensland. Recognised as an approach to research that allows in-depth exploration of a phenomenon through the collection of rich data from examples [73, 74], case study analysis afforded the research team close engagement with participants who have lived experience of compound natural hazards in distinct locations and climatic zones.

The three locations were carefully selected based on inclusion and exclusion criteria co-created by the research team and emergency management stakeholders (refer to Table 1). The Dandenong Ranges, Tenterfield and Ayr were short-listed from a longer list, based on criteria including diversity of hazard type as well as climatic and demographic conditions. The presence of local media was also prioritised given plans to engage local media as partners and recruitment support, as outlined in below in the *Community forums* and *Engaged journalism* sections. The three case study locations were closely discussed with and endorsed by the Centre. The following sections provide more detail on the three case studies and the rationale for their selection.

Table 1: Case study selection criteria

Location	Ayr & Burdekin Shire, QLD	Dandenong Ranges, VIC	Tenterfield, NSW
Relevance to the study (has this community been impacted by compound natural hazards?)	Cyclone Debbie, regular flooding and storms	Storm, flooding, COVID-19	Drought, bushfires, water contamination, flooding
Recency (has this community been impacted by compound natural hazards within the last 3 years?)	March 2017 and every year since	2021	End-2019 - 2022
Type of compound natural hazard (was this community impacted by consecutive or concurrent natural hazards?)	Sequential: Cyclone, flooding, storms	Concurrent: Storms, flooding, COVID-19	Sequential: Drought, bushfires, water contamination event, flooding
Geographical spread (does this location contribute to geographical diversity within the study?)	Rural town, QLD Population of ~9,000	Semi-urban suburbs, VIC Population of ~ 250,000	Rural town, NSW Population of ~3,000
Social diversity (does this location contribute to social diversity within the study?) (ABS data)	55 years or above: 38% Aboriginal or Torres Strait Islander: 8% LOTE used at home: 8% LGA SES-decile*: 5	55 years or above: 31% Aboriginal or Torres Strait Islander: 1% LOTE used at home: 8% LGA SES-decile: 9	55 years or above: 51% Aboriginal or Torres Strait Islander: 8% LOTE used at home: 3% LGA SES-decile: 2

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[72] Nemeth et al. 2024.
[73] Flyvbjerg, B. (2006) 'Five misunderstandings about case-study research'. *Qualitative Inquiry*. 12(2). pp. 219–245.
[74] Gerring, J. (2004) 'What is a case study and what is it good for?' *American Political Science Review*. 98(2). pp. 341–354.

Local media presence (are there local media outlets who can assist, as per the project methodology?)	Yes	Yes	Yes
Avoiding **over-researched communities** (is this community <u>not</u> in danger of research fatigue?)	Yes	Yes	Already one existing project working here (Fire to Flourish)
Budget (is social research in this location achievable within the parameters of the study?)	Yes	Yes	Yes

*Socio-Economic Status (SES) decile is a ranking system that divides geographic areas or populations into ten equal-sized groups (deciles) based on measures of advantage and disadvantage, such as income, education, and occupation. Decile 1 represents the most disadvantaged 10%, while decile 10 represents the most advantaged 10%. (Australian Bureau of Statistics)
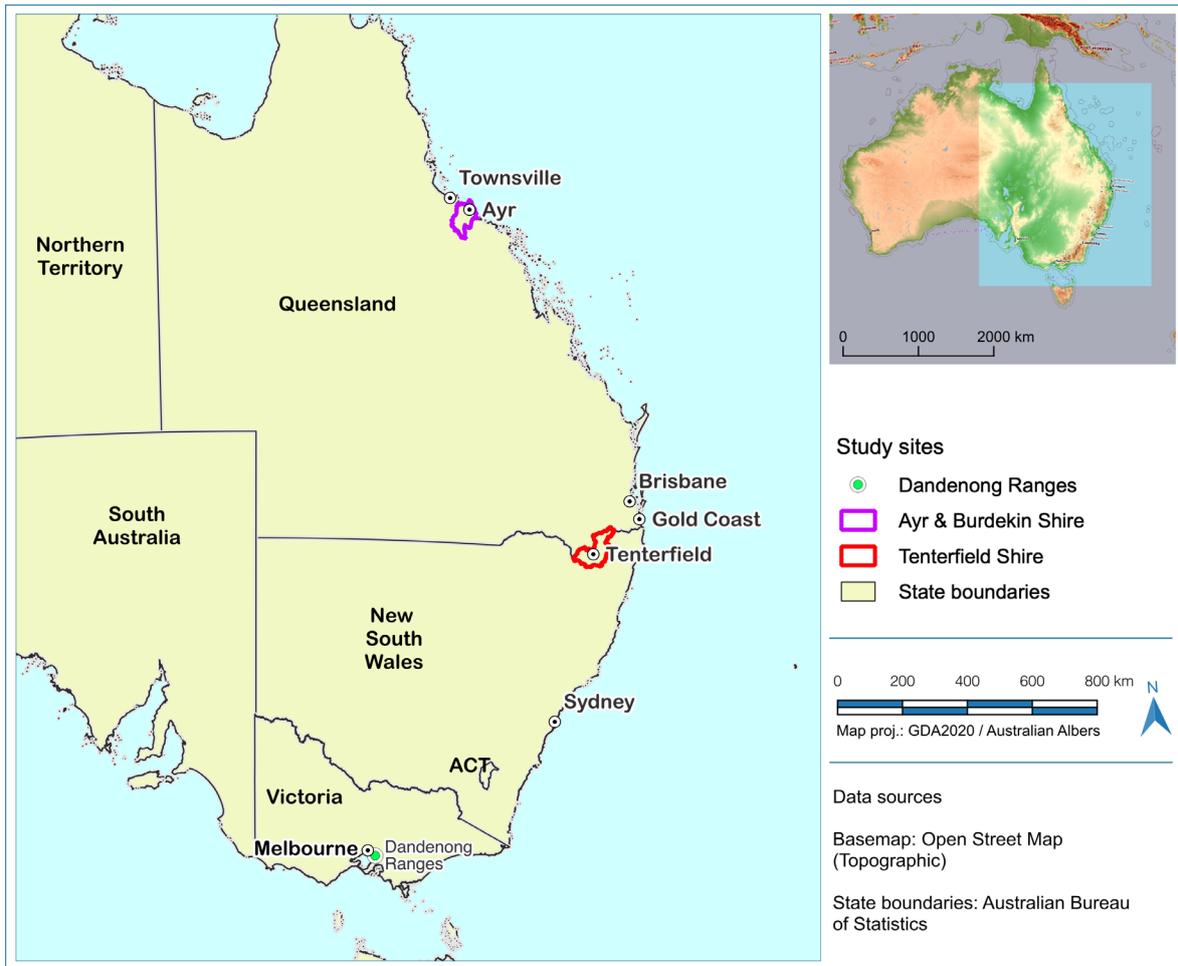
Figure 3: Location of the three case study sites

Dandenong Ranges, Victoria
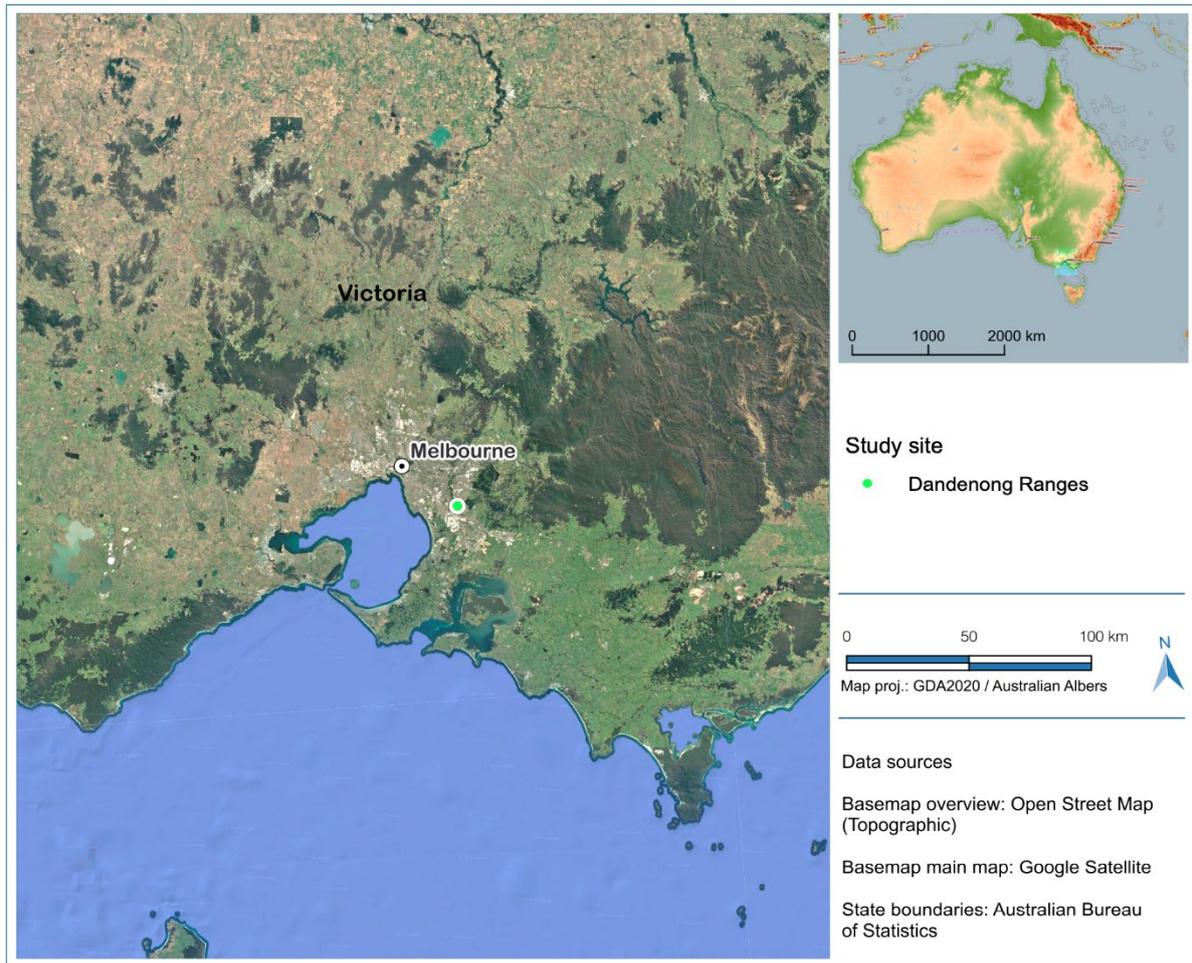
Figure 4: Location of the Dandenong Ranges on a map of Victoria, Australia

Figure 5: Mountain ash trees in the Sherbrooke Forest, Dandenong Ranges. Some 25,000 trees fell during the storms of 2021.

Some 35 kilometres east of Melbourne, the Dandenong Ranges is an area of hills, valleys and gullies retaining temperate rainforest and tall forests of mountain ash. The area's population is approximately 250,000, spread across a number of settlements in and around the hills. While the Ranges are highly prone to bushfires. [75] this study focuses on two storm events in 2021, one occurring in June and the second in October, together creating a compound hazard consisting of two disasters occurring together or within a short timeframe in a given location. [76] During each storm event, extreme winds, flooding, and fallen trees caused widespread damage to property and infrastructure. The storms were further compounded by the COVID-19 pandemic lockdown. When the first storm event occurred, the Dandenong Ranges were still impacted by pandemic-related restrictions including a ban on visitors to all residences and a limitation of travel to within a 25-kilometre radius of the home.

The storm events of 2022 were an unexpected hazard for Dandenong Ranges residents. A low-pressure system that moved across southeast Australia hit central and eastern parts of Victoria with destructive winds and heavy rainfall on 9 June 2021. The impacts led the Victorian State Emergency Services to deploy one of its largest ever operational responses. [77] While other parts of the state suffered major flooding, the storm caused the most significant damage in the Dandenong Ranges, where 220 forested hectares were severely affected. In some areas as much as 90% of trees

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[75] Forest Fire Management Victoria (FFMV). (2024a). Bushfire risk in our region. Available at:
https://bushfireplanning.ffm.vic.gov.au/metro/#:~:text=We%20consider%20the%20Dandenong%20Ranges,and%20west%20of%20the%20area.
[76] Gissing et al. 2022.
[77] Emergency Management Victoria (EMV). (2022). June 2021 extreme weather event community report. Available at: https://files.emv.vic.gov.au/2022-06/June%202021%20Extreme%20Weather%20Event%20Community%20Report.pdf

came down. [78] In total, some 25,000 trees fell [79] and 173 buildings were damaged, 112 of which were homes; 76 of which were completely destroyed. [80]

Figure 6: Some local infrastructure remained closed and in disrepair two-and-a-half years after the storms. Mt. Dandenong, November 2023.

The immediate emergency was made more difficult by the fact that the winds – recorded at 127 kilometre per hour but believed to have reached 200 kilometre per hour [81] – severely damaged power, telecommunications and transport infrastructure. [82] While the state as a whole recorded its most extensive power outage ever, the Dandenong Ranges was one of the most severely impacted areas, with 6,500 households losing power. [83] Many of these were without electricity for weeks, during mid-winter. [84]

Compounding the storm was the COVID-19 pandemic which had sent Melbourne and surrounds into some of the longest lockdowns and restrictions globally. [85] The Dandenong Ranges emerged from lockdowns on 10 June 2021 but continued to face restrictions on travel and gatherings [86], which impeded the establishment of shelters and shared recovery efforts. COVID has been included as a hazard in the Dandenong Ranges case study because the nature of

[78] FFMV. (2024c). Dandenong Ranges and catchments. Available at: https://www.ffm.vic.gov.au/recovery-after-an-emergency/managing-fire-risk-after-storms/dandenong-ranges-and-catchments

[79] Paul, M. (2023, June 10). Dandenong Ranges residents struggle with insurance and building costs two years on from massive storm. *ABC News*. Available at: https://www.abc.net.au/news/2023-06-09/dandenong-ranges-storm-insurance-rebuilding-struggles/102458210

[80] Preiss, B. (2022, June 8). One year after storms, some residents still cannot live on the mountain. *The Age.* https://www.theage.com.au/national/victoria/one-year-after-storms-some-survivors-still-cannot-live-on-the-mountain-20220606-p5arh4.html

[81] Seyfort, S. (2022, June 9). 'The most traumatic night of our lives': Residents still reeling a year after worst storm on record. *9News.* Available at; https://www.9news.com.au/national/dandenongs-storms-residents-still-reeling-a-year-later/103068ad-295d-41db-9618-27386380c498

[82] EMV. (2022)

[83] Seyfort (2022, June 9)

[84] EMV. (2022)

[85] McLaren, S., Green, E. C., Anderson, M., & Finch, M. (2023). The importance of active-learning, student support, and peer teaching networks: A case study from the world's longest COVID-19 lockdown in Melbourne, Australia. *Journal of Geoscience Education*, 1-15.

[86] Yarra Ranges Council. (2021). COVID-19 restrictions in place from 11.59pm, Thursday, 10 June. Available at: https://www.yarraranges.vic.gov.au/Council/Latest-news/COVID-19-restrictions-in-place-from-11.59pm-Thursday-10-June

lockdowns was particularly impactful in this region. For example, the lockdown requirements and restrictions on gathering caused residents confusion regarding attending community recovery centres. Research has indeed noted that when natural hazards occurred during the COVID-19 pandemic, infection rates increased, so residents' fears and concerns about COVID as a hazard were well founded. [87] Drawing on the research literature that regards COVID as a hazard (refer to the *Compound natural hazards* section under *Background*), this study includes COVID as one the compounding hazards in this case study.

In late October 2021 several parts of the Dandenong Ranges were hit again by powerful storms, combined with flooding in some local areas, leading to further property damage, power outages and re-traumatising residents. [88, 89] At the time of writing in 2024, the Dandenong Ranges were still recovering from their experience of compound natural hazards, with houses and schools yet to be fully rebuilt and ongoing psychological harms still being addressed. [90]

Tenterfield, New South Wales
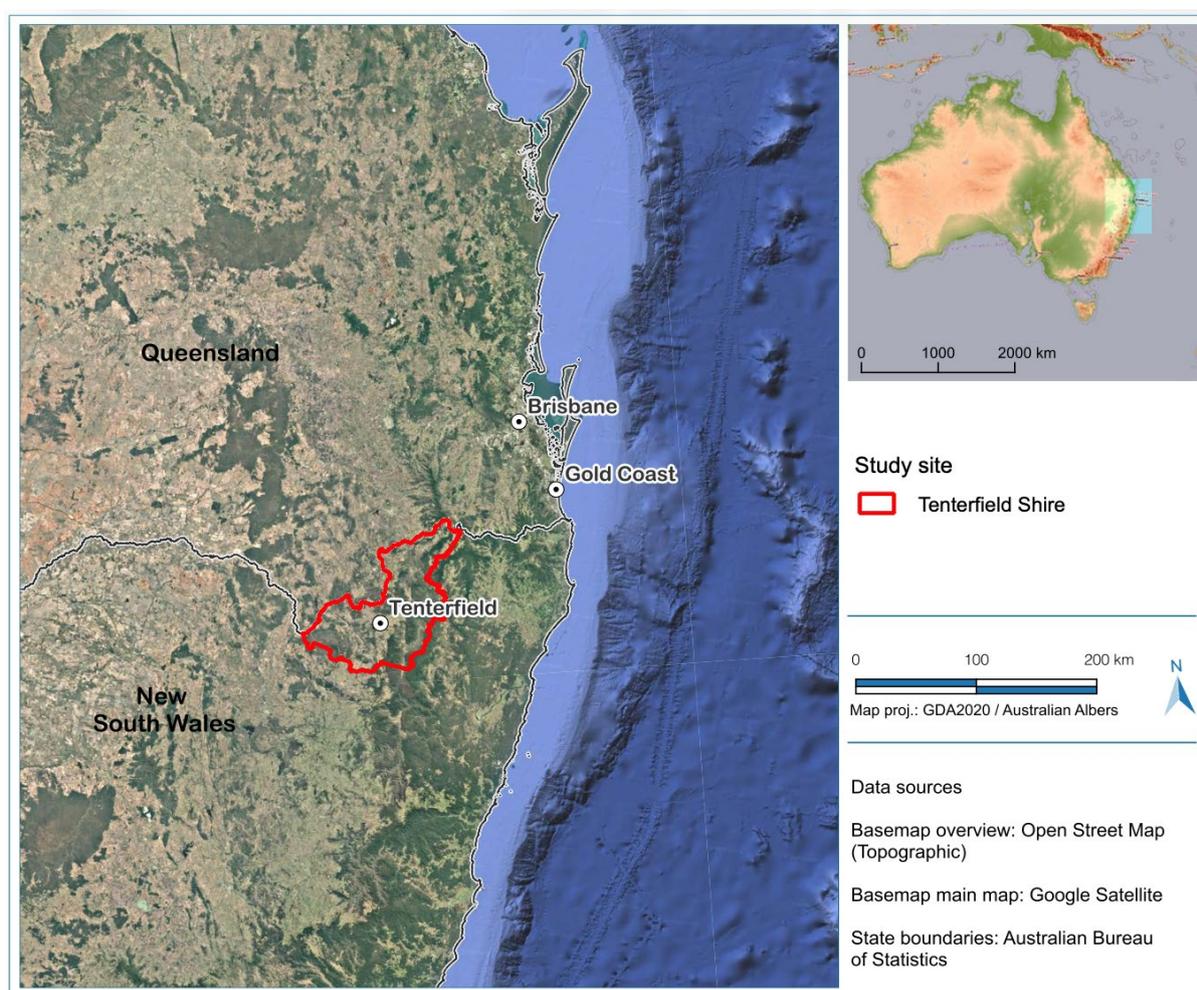
Figure 7: Location of Tenterfield Shire and Tenterfield on a map of New South Wales, Australia

[87] Dargin et al. (2021).

[88] AIDR. (2024a). Victoria, 28 October – 8 November, 2021: Storm. Available at: https://knowledge.aidr.org.au/resources/storm-victoria-october-november-2021/

[89] Aubrey, S. (2022, October 5). 'The tree got every room in the house': At the centre of a terrifying Dandenong Ranges storm. *The Age*. Available at: https://www.theage.com.au/national/victoria/the-tree-got-every-room-in-the-house-at-the-centre-of-the-dandenong-ranges-terrifying-storm-20221005-p5bn9k.html

[90] Ranges Trader Star Mail. (2023, November 1). Trauma of the young. Available at: https://rangestrader.mailcommunity.com.au/news/2023-11-01/trauma-of-the-young/

Figure 8: The Mount Mackenzie Nature Reserve in Tenterfield Shire

Home to approximately 3,000 inhabitants [91] and seat of the Tenterfield Shire Council, Tenterfield is a town in north-eastern New South Wales just south of the Queensland border and approximately three hours' drive from Brisbane. The broader Northern Tablelands region is fire-prone and experiences several bushfires of varying size each year. [92] The events in focus in this study, however, are extraordinary in their magnitude and compound nature.

The summer of 2019-2020 was the most severe fire season recorded in New South Wales (NSW) to date, characterised by high temperatures and low moisture levels. [93] Nationally, fires that season – termed the Black Summer – led to 33 deaths, destroyed 3,094 houses, burned over 17 million hectares and killed over one billion animals. [94] The Tenterfield region was one of the most severely impacted in NSW, with over 40 properties destroyed and thousands of hectares of land burned. Contributing to this devastation was a prior drought, with tinder-dry bush and low water levels hampering firefighting efforts. Between January and August 2019, rainfall in Tenterfield was more than 20% below its previous level. Water use restrictions were put in place for the town in April 2018 when the Tenterfield Dam reached 70% capacity. By February 2019, when the first bushfires occurred in the Shire, this had fallen to 50%, with other dams being dry.

The most severe threat to the town of Tenterfield was posed by fires that began in September 2019 and continued through to November of that year. These fires led to the accumulation of smoke, ash and dust in and around the town, which contaminated the area's waterways and the Tenterfield Dam. By October the dam had dropped to 18% capacity. In the same month, residents were instructed to boil their drinking water – an instruction which would remain in place for 79 days. [95] The water not only posed a health risk but also had a bad odour. [96] Compounding the water problems, late November 2019 saw a storm that brought heavy rain and hail to Tenterfield. This washed more debris, ash and organics into the area's catchments, increasing water turbidity even further and leaving the town without drinkable water. [97] The sequential combination of drought, bushfire and heavy rain has been called a 'worst case scenario' and

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[91] ABS. (2021a). Tenterfield (Urban Centres and Localities): 2021 Census All persons QuickStats.
[92] Northern Tablelands Bush Fire Management Committee. (2020). Bush Fire Risk Management Plan 2020. Available at: https://www.rfs.nsw.gov.au/__data/assets/pdf_file/0003/4692/Northern-Tablelands-Bush-Fire-Risk-Management-Plan-Signed.pdf
[93] AIDR (2024b). New South Wales, July 2019 – March 2020: Bushfires – Black Summer. Available at: https://knowledge.aidr.org.au/resources/black-summer-bushfires-nsw-2019-20/
[94] International Recovery Platform. (n.d.). Recovery Collection: Australia: Black Summer Bushfires 2019-2020. Available at: https://recovery.preventionweb.net/collections/recovery-collection-australia-black-summer-bushfires-2019-2020
[95] Department of Planning and Environment (DPIE). (2022). Case study – Tenterfield Shire Council. Available at: https://water.dpie.nsw.gov.au/__data/assets/pdf_file/0019/542620/case-study-managing-coinciding-events-water-quality-tenterfield-shire-council.pdf
[96] Smee, B. (2019, December 13). Bushfires and drought leave NSW town of Tenterfield without clean water for 72 days. *The Guardian*. https://www.theguardian.com/environment/2019/dec/12/bushfires-and-drought-leave-nsw-town-of-tenterfield-without-clean-water-for-72-days
[97] DPIE. (2022)

was a major challenge for Tenterfield residents. [98] Beyond their immediate effects, these compound hazards caused social, economic and environmental hardships for locals, ranging from the multi-year loss of income-generating livestock to the degradation of biodiversity and associated emotional impacts.

Tenterfield has continued to experience regular bushfires since the 2019-20 season, including several severe fires in October and November of 2023. [99] These destroyed at least 21 buildings including homes and outbuildings across the Shire. [100] This study has focused particularly on the incidents of 2019/2020, given their compounding and cascading nature.

Ayr and the Burdekin Shire, Queensland
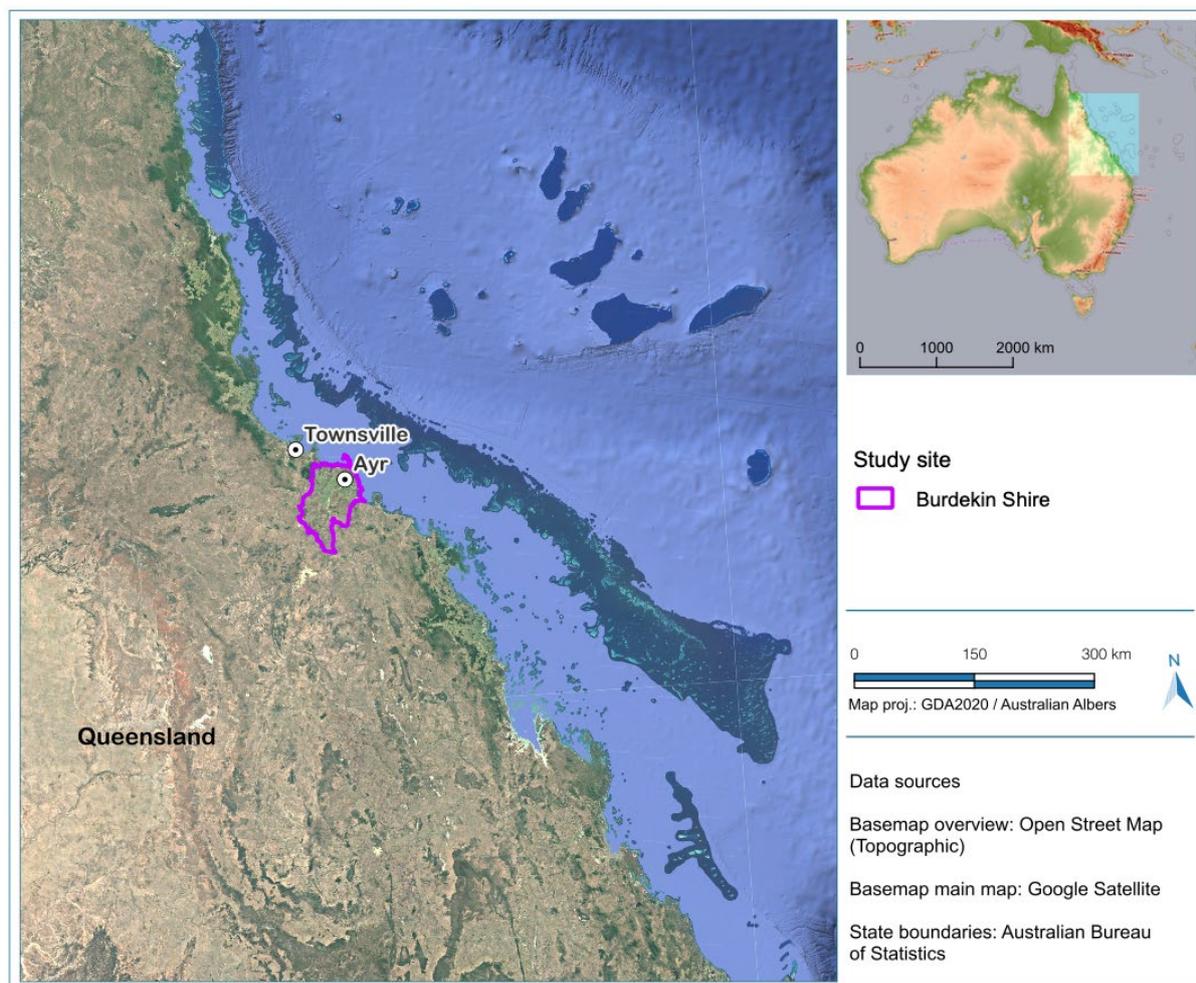
Figure 9: Map showing the location of Ayr and the Burdekin Shire in North Queensland.

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[98] Smee. (2019)

[99] Tenterfield Star. (2023). Homes destroyed in Tenterfield LGA bushfires 2023. Available at: https://www.tenterfieldstar.com.au/story/8416584/homes-lost-in-fires-crews-containing-hotspots/

[100] ABC News. (2023). Four homes at Donnybrook, Tabulam, Wallangarra among buildings destroyed in Tenterfield fires. Available at: https://www.abc.net.au/news/2023-11-03/homes-destroyed-fire-tenterfield-bushfire/103059872

Figure 10: The Burdekin River is prone to flooding and regularly isolates the adjacent towns Home Hill and Ayr, as well as disrupting access to Townsville.

The Burdekin Shire is situated in North Queensland, with its administrative centre, Ayr, a one-hour drive from Townsville. Ayr accommodates slightly over half of the Burdekin's population of 17,000 [101] and the area is known for its long-standing sugar production. Floods, storms and cyclones are frequently experienced and part of life in the area. The recurrence of natural hazards here makes compound events the seasonal norm for local communities.

The major events in focus for this study are the 2017 Cyclone Debbie and the recurring flooding over subsequent years. Debbie hit the Queensland Coast at Airlie Beach on 28 March 2017 as a Category 4 tropical cyclone and, after causing significant damage, weakened slightly and moved eastward and inland. [102] Ayr experienced winds of around 70 kilometres per hour [103] but Burdekin Shire Mayor Lyn McLaughlin described the town as having 'dodged a bullet.' [104] The Queensland Government nonetheless closed schools and deployed buses for optional evacuation to Cairns for residents from Ayr to Home Hill. [105] Rainfall of over 100 millimetres in 24 hours was recorded in the area between 28 March and 31 March. As a result, record flooding occurred in the Burdekin River which flows through the Burdekin Shire near Ayr and continues eastward beyond the Shire boundary. [106] Ayr made national headlines when a dead bull shark was found washed up on one of its roads after floodwaters subsided. [107]

Since Cyclone Debbie and the subsequent flooding, the Burdekin Shire and Ayr have continued to experience a sequence of natural hazards. Heavy rain, flooding and storm events have been recorded in the region each year since

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[101] ABS. (2021c). Ayr (Urban Centres and Localities): 2021 Census All persons QuickStats; ABS. (2021d). Burdekin (Local Government Areas): 2021 Census All persons QuickStats.
[102] BoM. (2017). Tropical Cyclone Debbie. Available at: http://www.bom.gov.au/cyclone/history/debbie17.shtml
[103] BoM. (2018). Tropical Cyclone Debbie Technical Report. Available at: http://www.bom.gov.au/cyclone/history/database/Tropical-Cyclone-Debbie-Technical-Report-Final.pdf
[104] Brisbane Times. (2017, March 29). The trail of destruction unleashed by Cyclone Debbie. Available at: https://www.brisbanetimes.com.au/national/queensland/the-trail-of-destruction-unleashed-by-cyclone-debbie-20170328-gv87x3.html
[105] Inspector General Emergency Management. (2017). The Cyclone Debbie Review: Lessons for delivering value and confidence through trust and empowerment. Available at: https://www.igem.qld.gov.au/sites/default/files/2019-02/Cyclone%20Debbie%20Review%20Rpt1-17-18_PUBLIC_WEB.pdf
[106] BoM. (2018).
[107] ABC News. (2017, March 31). Cyclone Debbie: Bull shark found washed up near Ayr. Available at: https://www.abc.net.au/news/2017-03-31/bull-shark-found-washed-up-near-ayr/8401872

2017. [108] In 2018, the Haughton River reached record levels, cutting off roads and properties in the Burdekin town of Giru 40 kilometres east of Ayr. [109] In 2019, the Burdekin Shire was among the Queensland councils most impacted by exceptional rainfall and flooding as part of a monsoonal trough. [110] In 2020, Ayr broke long-time rainfall records with 320 millimetres in 24 hours [111] while 2021 saw 196 millimetres fall in 24 hours. [112] The 2022-23 monsoon season brought extensive flooding to much of Northern Queensland [113], including the Burdekin Shire and Ayr [114], from December to March. [115]

In December 2023 and January 2024, Ayr and the Burdekin Shire were again impacted by cyclones in the form of Tropical Cyclones Jasper and Kirrily. Cyclone Jasper did not have a major impact on the Burdekin. Kirrily was downgraded in severity as it crossed the Queensland coast, but warnings were nonetheless given for a portion of the coast, including Ayr and strong winds caused debris to scatter. Ayr and Burdekin Shire residents again activated their cyclone preparation routines. These cyclones were not the focus of this study, which centred on the 2017 cyclone and repeated flooding in the subsequent years.

Community forums

A community forum using focus group discussion was held in each case study location in order to facilitate direct conversation with communities with lived experience of compound natural hazards and to gather rich insights into place-specific successes and challenges in compound hazard communication and engagement.

The community forums for this study were advertised in local news and on social media, through engagement with community organisations and local councils, and via paper flyers and posters. By using a range of recruitment channels, we sought to attract interest from a broad cross-section of community members. The forums were open to anyone who had lived in the area during the focal hazard events; that is, recruitment was intentionally inclusive, rather than applying any selective sampling. Prospective participants were asked to register via an online form and to read and sign a plain language statement and consent form at the community forum prior to discussions commencing. The forums were held between November 2023 and April 2024, with a total of 52 participants attending – Dandenong Ranges (13) Ayr (21) Tenterfield (18) – comprising local residents, community leaders and representatives from civil society organisations and businesses.

A town hall focus group method [116] was employed at the community forums, where participants received an introduction to the project before dividing into smaller breakout groups for researcher-facilitated conversation, followed by a summary and sharing of key insights with the wider group. The town hall method was chosen because it provides scope to work with large groups in one location. The use of the term 'town hall' was adopted literally and figuratively for this project as these discussions were deliberately hosted in physical spaces in each case study location known for bringing people together and facilitating public discussion, such as town halls and/or community, neighbourhood houses.

During the focus group discussion, participants were asked about their experiences of communication before, during and after the locally experienced compound hazards. Participants were also invited to use coloured sticky notes to

[108] QRA. (2024a). Burdekin Shire Council. Available at: https://www.qra.qld.gov.au/taxonomy/term/32
[109] ABC News. (2018, March 2). Clean up begins in Giru as record flood recedes, homes spared from inundation. Available at: https://www.abc.net.au/news/2018-03-02/north-qld-town-cut-off-record-flood-levels-big-wet-heading-west/9499656
[110] National Drought and North Queensland Flood Response and Recovery Agency. (2020). 2019 Queensland Monsoon Trough After the flood: A strategy for long-term recovery. Available at: https://nema.gov.au/sites/default/files/attachments/2019%20Queensland%20Monsoon%20Trough%20-%20Report_1.pdf
[111] Riga, R. & Butterworth, K. (2020). Rain record broken near Townsville as a monsoonal low tracks across Queensland's north-west. *ABC News.* https://www.abc.net.au/news/2020-01-29/record-breaking-rain-soaks-queensland-warnings-for-north-west/11907366
[112] Pearman, H. (2021). Tropical Cyclone Niran – NE Queensland – 28 February to the 3 March 2021. *Extreme Storms*. Available at: https://www.extremestorms.com.au/tropical-cyclone-niran-ne-queensland-28-february-to-the-3-march-2021/
[113] National Emergency Management Authority (NEMA). (2024). Northern and Central Queensland monsoon and flooding: 20 Dec 2022- March 2023. Available at: https://nema.gov.au/get-support/central-and-northern-qld-flood-2022-2023
[114] The Guardian. (2023, January 17). 'Dangerous flash flooding' warning for North Queensland regions – as it happened. Available at: https://www.theguardian.com/australia-news/live/2023/jan/17/australia-news-live-floodwaters-floods-queensland-bruce-highway-rain-weather-climate-economy-jim-chalmers-wages-jobs-voice
[115] Queensland Reconstruction Authority (QRA). (2024b). 2022-23 Northern and Central Queensland Monsoon and Flooding. Available at: https://www.qra.qld.gov.au/2022-23-northern-and-central-queensland-monsoon-and-flooding#Event-summary
[116] Zuckerman-Parker, M., & Shank, G. (2008). The town hall focus group: A new format for qualitative research methods. *The Qualitative Report*, 13(4), 630-635.

post on a shared sheet of paper key insights about communication before, during and after compound natural hazards (refer to Figures 11 and 12). Altogether, each forum lasted approximately two and a half hours.

Figure 11: Community members and the research team engaged in constructive conversation during the Tenterfield community forum
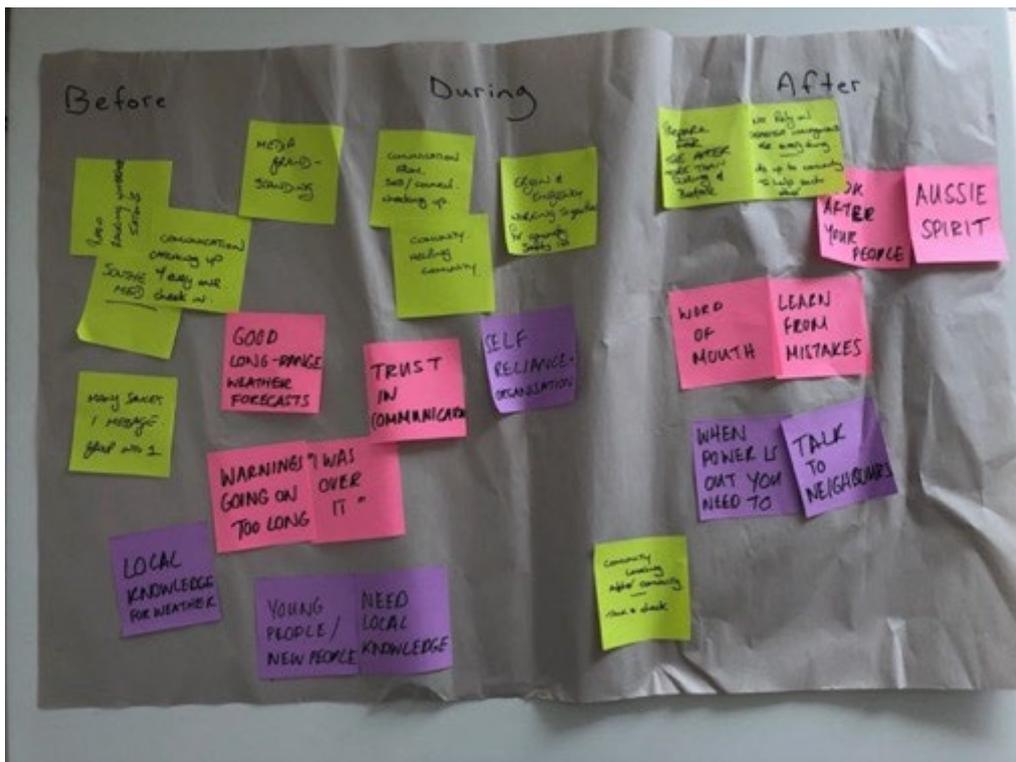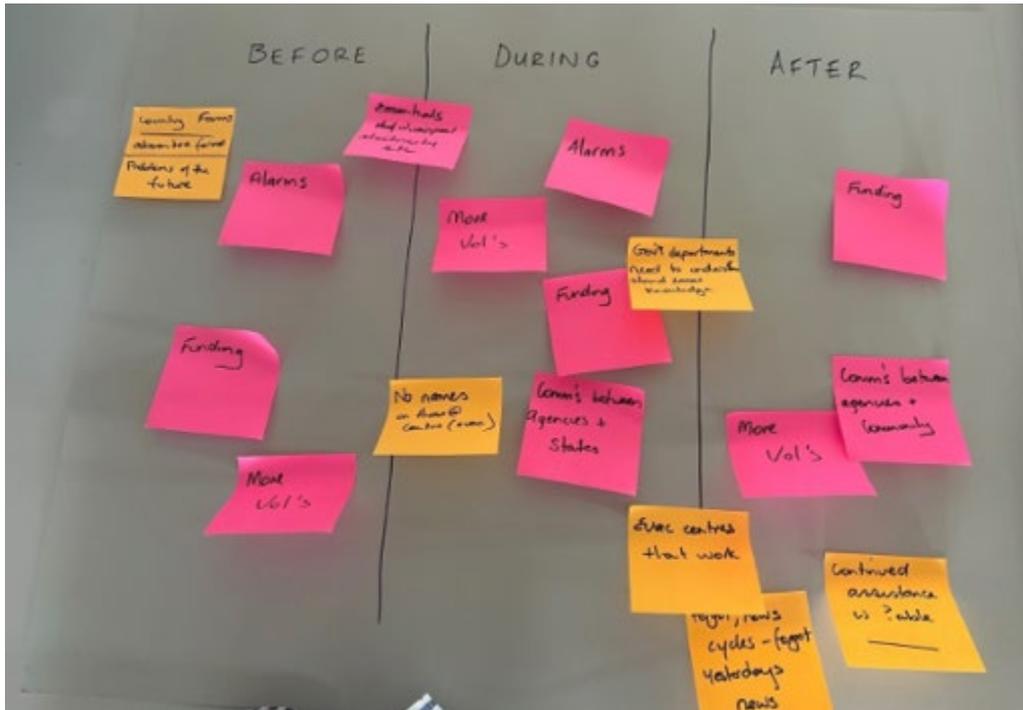
Figures 12 & 13: Insights about communication before, during and after compound natural hazards captured on sticky notes by community forum participants

Engaged journalism

This study adopts engaged journalism [117, 118] as one of the research approaches and as an avenue for awareness raising about compound natural hazards and the importance of hazard communication. In doing so, the research team wanted to explore the role and effectiveness of local journalists and media practitioners as active enablers of communication and community engagement, rather than as mere conduits or channels through which information about natural hazards flows. Engaged journalism is defined as journalism where interactions with audiences and shared awareness and storytelling are embedded at the heart of news practices. [119] When local media, residents and community organisations share and exchange stories and ideas, residents report higher levels of engagement and a greater sense of belonging to a shared community. The research team identified key local news outlets in each case study location and worked with local journalists and community media volunteers to co-create a series of articles and radio segments about compound natural hazards and local people's lived experiences. These articles were designed to raise awareness about compound natural hazard communication and encourage community participation in the town hall sessions and survey. The content included information pieces compiled by the research team about what constituted compound natural hazards and several stories about individuals' lived experiences of hazards. Refer to Appendix 1 for more information about this element of the research, and for extracts of the study's coverage in local, social and other media.

Tenterfield Talks

An extract from Legislative Assembly Hansard, Parliament of New South Wales.

From Janelle Saffin, Lismore MP:

The *Tenterfield Star* newspaper's editor Jacob McMaster and his editorial team... has launched an innovative partnership between local media and natural hazards experts, which encourages residents to share their experiences of communication during the 2019 bushfires, and awareness of and preparedness for natural disasters. The paper is running a special series around these issues, which speak directly to my dual roles as State Member for Lismore and NSW Parliamentary Secretary for Disaster Recovery.

Having been at the fire fronts surrounding Tenterfield, Torrington and Drake and other parts of my electorate, during 'Black Summer', and dealing with the onslaught and aftermath of the catastrophic floods of early 2022, it's clear that having more effective lines of communication in place can save lives and property, and hopefully reduce trauma.

A research project, funded by Natural Hazards Research Australia and led by a team from Deakin University, this Saturday, 16 March, is inviting locals to share their experiences and knowledge at a community forum in Tenterfield. And while we have had valuable major inquiries into bushfires and floods, this research will add to our arsenal.

(Legislative Assembly Hansard, 14th March, 2024 [120].)

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[117] McIntyre, K., & Lough, K. (2023). Evaluating the effects of solutions and constructive journalism: A systematic review of audience-focused research. Newspaper Research Journal, 44(3), 276-300. https://doi.org/10.1177/07395329231187622
[118] Wenzel, A. & Nelson, J. (2020). "Engaged" journalism: studying the news industry's changing relationship with the public, Journalism Practice, 14(5) 515-517.
[119] Wenzel (2018)
[120] Parliament of New South Wales (2024)

Figure 14: The original building of the Tenterfield Star on the town's main street. Today, the newspaper is no longer located in Tenterfield itself, a symptom of the growing centralisation of local media outlets. This poses a problem for covering natural hazards as journalists are not on the ground in Tenterfield, but located more than 200km away.

Figure 15: Local news coverage of the community forum in Olinda (Dandenong Ranges) in November 2023: an example of one of the engaged journalism outputs.

Interviews

In addition to the community forums, the research team sought to gain insight into the experiences, perspectives, and priorities of key natural hazard communicators in the three case study locations through a program of semi-structured interviews. While the community forums sought to understand the lived experiences and perspectives of community members, the interviews captured professional experiences and perspectives. The interview participants reflected the key end-users of the engagement framework the study has developed: many were emergency managers at both state and local level. Also interviewed were other compound hazard communicators, including local government representatives and community leaders, including one Indigenous leader. In this way, the interviews sought to tap into a range of relevant experiences and insights to ensure that the study's key output would be fit-for-purpose. A summary of the interview participants is included in Table 2.

Participant recruitment took place in 2023 in collaboration with project end-users and through a desktop search. All potential participants were sent an invitation to participate, along with a plain language statement and consent form. Thirty-eight participants were recruited and = interviewed between October 2023 and April 2024, with interviews taking between 35 and 75 minutes. Semi-structured interviews were used to provide participants with opportunities to raise issues they felt were relevant, while nonetheless ensuring data collection addressed the study's key questions. Interviews occurred over video conferencing (Zoom or Teams) as well as in person. Recordings were transcribed and each transcript was returned to the relevant participant for optional review and editing to ensure accuracy.

Table 2: Summary of interview participants

Location	Emergency management	Local government	Local media	Community leaders	NGOs	Total
Dandenong Ranges	8	1	2	2	3	16
Tenterfield	8	1	1	1	0	11

Ayr and the Burdekin Shire	8	1	1	0	1	11
Total	24	3	4	3	4	**38**

Survey

Distributed in each case study location, the surveys collected both qualitative and quantitative data about residents' experiences of hazard communication. Participants were recruited via advertisements in local media, flyers distributed in each location and directly during the community forums and visits to local community groups. All residents over the age of 18 were eligible to participate if they had lived in the case study location during the focal compound hazards events. The survey was conducted between November 2023 and April 2024.

In total, 182 local residents participated in the project survey with 41 responses in the Burdekin Shire, 22 in Tenterfield and 119 in the Dandenong Ranges. The survey results, particularly those relating to the Ayr and Tenterfield communities, should consequently be interpreted relative to the modest number of responses that were obtained. Moreover, by virtue of the small number of survey responses collected in each case study location, insufficient statistical power was presented to facilitate robust statistical testing. (With low statistical power, the absence of significant results may reflect the small number of participants rather than the lack of meaningful differences between events or across time). For this reason, descriptive analyses were instead conducted.

The demographic profile of respondents from each case study location can be found in Table 3.

Table 3. Demographic profile of survey respondents in each case study location.

Profile	Ayr & Burdekin Shire	Tenterfield	Dandenong Ranges
Gender			
Male	36%	25%	36%
Female	61%	75%	63%
Other/prefer not to say	4%	-	2%
Age (years)			
18-39	18%	7%	30%
40-59	50%	29%	33%
60+	32%	64%	37%
Lived in region for:			
<1 year	-	-	1%
1-5 years	2%	9%	18%
6-10 years	7%	18%	15%
>10 years	90%	73%	66%
Occupational status			
Employed	93%	53%	63%
Student	-	-	4%
Stay at home parent	-	-	6%
Unemployed	-	7%	2%
Retired	7%	40%	26%
Highest education completed			
High school or less	25%	44%	24%
Vocational training	46%	19%	25%
Undergraduate degree	18%	25%	28%
Postgraduate degree	11%	13%	24%

Qualitative data analysis

Following data collection, a thematic analysis was conducted on the interview and community forum data. Thematic analysis is the process of identifying themes and patterns within a dataset. As a research tool, thematic analysis can provide 'a rich and detailed, yet complex, account of data' [121] and is particularly useful for research examining 'the ways that people make meaning out of their experiences' while also focusing on how experiences are informed by contexts [122]. Four members of the research team first familiarised themselves with the interview and community forum data by undertaking a deep reading of all of the interview and forum transcripts. Working together, and taking an inductive and data-driven approach, these research team members then generated initial codes, assisting a search for, refining of and defining of key themes in the qualitative data. This analysis was undertaken in an iterative and collaborative manner by the research team over the course of multiple in-person and online work sessions.

Participant and end-user feedback

Two formal feedback sessions with select research participants and other emergency management experts and practitioners were organised for the purpose of refining the draft framework. The first feedback session was held as a day-long, in-person workshop in Melbourne in July 2024. The research team presented the key project findings and then invited interviewees and forum participants from the case study locations to discuss the draft framework components. An additional session was organised online in August 2024 and included additional research participants as well as potential end-users of the framework, who were similarly invited to share feedback on the emerging framework through discussion and using a digital interactive whiteboard. Both sessions incorporated a presentation from Centre representatives on research translation and utilisation to support understanding among participants of the project's real-world value, and utilisation pathways for its outputs. The feedback shared by participants and other end-users has been critical to refining the framework. The research team carefully considered all inputs, balancing these with the body of project data and recalibrated the framework accordingly.

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[121] Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101, p. 78
[122] Evans, C., & Lewis, J. (2018). Analysing Semi-Structured Interviews Using Thematic Analysis: Exploring Voluntary Civic Participation Among Adults, p. 3

Findings

Thematic analysis: interviews and focus groups

Five themes were identified during analysis of the interview and community forum data. These themes took the form of recurring concepts expressed by the study participants and/or significant ideas in the context of the research objectives, as per Braun and Clarke's explanation that 'a theme captures something important about the data in relation to the research question, and represents some level of patterned response or meaning within the data set' (2006: 82). Outlined below, these themes informed the development of this study's framework for compound hazard communication and engagement.

Local knowledge and localised communication

Community forum participants in all three locations expressed that communication before, during and after compound hazards should be localised – that is, attuned to the needs and experiences of local communities. As an interviewee from Tenterfield put it, 'trust is built at a local level'. A community forum participant from the same location, referring to emergency services, commented on not feeling heard by emergency service personnel they had interacted with, noting: 'they don't listen to local people.' Interview participants, meanwhile, expressed awareness that listening to locals was a missing piece in compound communication responses and strategies. As one emergency management interviewee explained:

> I think sometimes one of the things that we do in emergency services is, we feel we've got the answers. And we probably do, but we don't do enough listening.

Another interviewee in the same location explained the value of 'just knowing your community, knowing how they communicate, knowing how they want to receive their communication, and then tailoring [your communication] based on that.'

Local knowledge can take many forms, from community members with a 'line of sight' to a hazard (for example, a resident who spots smoke from a bushfire) to the accumulation of experience when communities live through successive hazards. However, some interview participants described this knowledge as a complicating factor, or even a barrier to effective communication. Locals may turn first to each other for information and support, or to their own memories, rather than to official sources of information. As one emergency management interviewee from Tenterfield explained:

> You've got the farmers that are doing it the way their grandfather did it and his father before him, which doesn't make it right, as far as I'm concerned – it makes it historical.

Others saw local knowledge as a strength, recognising that communities that have experienced compound hazards are potentially more informed and therefore more mobilised, resourceful and poised to act in the face of future hazards. Knowledge of a local area was seen as a resource that allowed community members to act in ways that promoted preparedness, safety and recovery. Knowledgeable members of a local community were themselves identified as resources during times of disaster. These kinds of people can become 'community champions' during compound hazard situations, bringing people together to collectively respond. For example, a forum participant from the Dandenong Ranges, speaking about a respected and knowledgeable person in the local community, explained:

> She's a local, and she knows things. She knows things because they're in her bones, they're in her brain, she just knows.

Meanwhile, several interview participants spoke of the importance of partners or enablers within the community, observing that while official communicators cannot reach everyone, they can tap into existing networks to ensure their message is passed on. As one local government interviewee put it:

> we are very heavily trying to work on networks. So… where you might be a disability provider, [or] a service provider to a range of clients, we're using you to get that message to your people… it's a partnering approach.

Local knowledge and localised communication are crucial in all hazard communication. However, in the context of compound natural hazards, in which compounding impacts may be experienced intensely locally, the importance and value of the local may indeed be amplified. Local media, especially community radio, and hyperlocal social media networks used by communities, are a crucial part of this. At the same time, coverage of community experiences of compound natural hazards in national media is important. This is both to ensure wider awareness of the growing threat that compound natural hazards represent, and to ensure communities feel heard. Community forum participants noted that, though local media most often included useful and constructive coverage, national media coverage could be sensationalised, just to make a story. Likewise, a compound hazard situation not being covered at all in national media was also seen as detrimental, given that recovery resource allocation tends to follow widespread media coverage.

Vulnerability, diversity and inclusion

Vulnerable groups are disproportionately impacted by disasters. Relatedly, hazard communicators need to be 'responsive to the diverse needs of the target audiences,' [123] including those with existing vulnerabilities. In the context of compound natural hazards, existing vulnerabilities are amplified or compounded, and new vulnerabilities are created. This study's participants confirmed that if community members are still recovering from one hazard, their vulnerability increases in the face of a subsequent hazard due to a range of factors including fatigue, displacement, damage to homes and properties, and often disrupted access to education or means of work. Many of the study participants spoke of the prolonged recovery period associated with compound hazards and the variances in individual experiences of recovery. As one forum participant commented:

> At what point are you back to whatever we think is normal?...Your recovery journey, my recovery journey will always be different.

Participants also discussed existing vulnerabilities and indicated that compounding factors may be different (or experienced differently) for particular community members, such as those living with disability, family violence, chronic illness or mental health conditions. Drawing on existing research [124], these are referred to as 'compound vulnerabilities'. One forum participant, in response to a comment from another participant about the need for everyone to 'speak up' and share disaster-related information, noted:

> Not everybody's able to speak up… I actually am disabled so it limits… how to get to people and how to communicate with people, like neighbours. If the phones are down, and there's no communication, then it's difficult for people with disabilities to do those kinds of things.

At the same time, compound hazard communication needs to be inclusive of the needs of those who are vulnerable to being excluded from hazard communication because of their reading ability, or because they are more proficient in languages other than English. One local government emergency manager interviewee explained as follows:

> We do have people who are illiterate, we do have people who aren't digitally skilled…So, communication with those people has to be word of mouth or, like, in a in an event, it's got to be UHF radio, phoning people. Some people in their own areas have got their own little network group.

[123] Howard, A., K. Agllias, M. Bevis and T. Blakemore (2017) '"They'll tell us when to evacuate": The experiences and expectations of disaster-related communication in vulnerable groups'. *International Journal of Disaster Risk Reduction*. 22. pp. 139–146.

[124] United Nations Office for Disaster Risk Reduction (UNDRR). (2022). Systemic Risks Emerging from Compound Vulnerabilities, United Nations Office for Disaster Risk Reduction. Available at: https://www.preventionweb.net/media/80297/download?startDownload=20241027

Indigenous Australians are unequally vulnerable to natural hazards [125] and that the environmental damage and displacement associated with any natural hazard constitutes a compounding factor for Indigenous communities, who may lose access to areas of cultural significance on top of community infrastructures. An interview with an Indigenous community leader indicated that emergency management professionals need to actively work with Indigenous communities and adapt engagement practices to become more accessible. One Indigenous interviewee noted:

> Anything in disaster management seems to come through and it's pages and pages of all of these monstrous plans that not even the council themselves read. They're definitely not put in a language that we can read, or in any sort of communication that is targeted to Aboriginal people.

The same interviewee noted that in-person engagement and co-design of material to engage First Nations people with emergency managers was considered missing by First Nations people in that community:

> There's no co-design stuff...there's no engagement on any level. You really just need to have a barbecue. Yeah, put on a barbecue and they can start to discuss some of these things. But until they've reached out, it can't be the Lands Council or Aboriginal organisations happen to do this all the time.

This interviewee added that First Nations people should necessarily be involved in emergency management plans, in order for these to be inclusive:

> Aboriginal people need to be involved in the emergency management plans, and the emergency management committees and stuff that they have. They've got the vet on there, but they don't have a black fella.

Likewise, those in regional and rural areas are more at risk of compound hazards but also tend to experience greater isolation when such hazards occur. As one emergency management interviewee from Tenterfield stated, "a lot of people in the rural areas feel very disconnected, very abandoned". The research also identified groups of people who are marginalised or isolated specifically when compound hazards occur, including people who choose to live 'off grid' and who are likely to be excluded from community engagement events geared towards preparedness or recovery, and also remote from warnings during a hazard situation.

In the face of these vulnerabilities and diverse experiences, however, this study found a degree of frustration and resistance towards any form of 'victim' narrative imposed on communities. When a community has been impacted by a string of difficult experiences or a multifaceted disaster, it is more likely that community members will be regarded as 'victims' by emergency responders and other key communicators. As one forum participant explained:

> It's as if they think of you as a disaster victim: we've got no brain, no sense, no private, previous experience. And so, it's really, really important that there's respect.

Importantly, the compound vulnerabilities associated with compound hazards also apply to first responders themselves, including those who are volunteers. One interview participant from an emergency response agency spoke particularly of the mental health impacts on volunteers:

> Regardless of what the incident is, large or small, it can trigger pre-existing problems that someone has experienced or a life experience that they have been involved in. So we do talk about compounding factors for our volunteers.

This same participant noted that compound vulnerabilities may occur when current disaster experiences evoke disturbing memories of previous disasters, even after a long time period:

> when you unpack their story and you actually listen to what's happened to them and what they've experienced in that moment or that incident, quite often it won't be the actual incident that's unfolded that is actually troubling them, but it may be a trigger... So a lot of our work is actually responding to, not what's actually happening at the moment.

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[125] Hay, T., & Williams, C.J. (2022). Effects of climate change such as flooding makes existing disadvantages for Indigenous communities so much worse. *The Conversation*, 15 November.

In other words, for this respondent, effective compound hazard communication encompasses empathy and an awareness that a hazard may be 'compounded' by lived experiences and traumatic memories of past hazards, even if the present-time impact is not seemingly as severe. Compound hazards therefore touch a range of vulnerabilities, making considerations of inclusivity and diversity in all aspects of communicating about compound hazards crucial.

Frequency, timeliness and reliability of information and infrastructure

When hazards are compound, there is typically an increase in communication efforts by emergency services and other stakeholders, resulting in a large volume of information moving through the community and a dispersal of information across the communication landscape. This can cause confusion and also is also stressful, particularly for the less digitally literate, when multiple warnings arrive as text messages. As one forum participant in Tenterfield noted:

> one of the things that got a lot of people in town upset, especially some of the older residents, was the amount of advice that was coming through on mobile phones, when you'd sort of barely finished reading the first one and the second one was there.

Another interviewee explained that "the amount of communication that goes out is almost overload". Such information overload was a problem commonly mentioned by the study participants. One emergency management interviewee in Ayr noted:

> We're in a day where we're getting an overabundance of communications, and that's a big consideration I have.…Whatever we're going to use has to mean something to the community, it's got to value add, because if we just spam people with lots of information, they don't know what to read. And I've noticed this within our disaster management stakeholders that I might send something to them three times. And then they'll say, 'Oh, can you send me that', and I say, 'I already sent it to you'. And that tells me that we're oversaturating communications with people. We need to work out what's relevant now, and then have a conversation if it's urgent.

Due to the compound nature of the hazard, moreover, messages may be coming from multiple sources, creating further confusion. An emergency services interviewee from Tenterfield explained their view on this as follows:

> It should be one message. But the problem is, I'm trying to get my 'one message' [out], and Rural Fire Service (RFS) are trying to get their 'one message', and Water New South Wales are trying to get their 'one message' – it becomes a blurred message. And everyone wants to be seen to be at the front.

This struggle to be seen "at the front" was itself compounded on social media, where information can be filtered and ordered in ways that make it difficult to appropriately assess and act on. Community forum participants spoke of Facebook not displaying posts by order of relevance or posting date, and critical information surfacing in their feed many days too late. A forum participant in Ayr explained:

> There is no logical order to be able to go through Facebook and actually see what the most current information is. And then people start to speculate, they see these other things, they draw conclusions and then these whole other sorts of misinformation happen.

Misinformation was identified as a problem by several research participants and is itself a compounding factor during times of disaster. An emergency management interviewee in Tenterfield noted:

> The biggest problem we had […] is incorrect information being disseminated, not just by the average person in the street... where they've taken information from I don't know where, but it wasn't the source, I suspect, because it's so far wrong that somebody who was in control would never have made that sort of a comment.

Across the case study locations, participants reported that misinformation had also been spread by media outlets, political actors, and community members themselves, and ranged from false information about a "cost" to sign up as a disaster response volunteer, to more directly life-threatening ill-advice to drink contaminated water and about erroneous ways to protect property from bushfire. Such misinformation is not always spread malevolently but can

spring from confusion and uncertainty, both of which are more likely to arise around hazards that are compound in nature than around discrete hazards.

These concerns about misinformation, confusion, and misinformation overload were accompanied by frequently-articulated worries about power and/or telecommunications outages. Participants spoke of communication breakdown, a loss of access to vital information, and a loss of social connection when power or phone signal were lost. An interviewee from the Dandenong Ranges noted that this was:

> the hardest bit to crack – how do you communicate to people when there's no power?

As a result, reliable sources of information and reliability of infrastructure are key factors determining the effectiveness of communication before, during and after compound natural hazards. In particular, participants spoke about the reliability of printed media (including handouts and flyers), and local radio, both of which can often function effectively during power outages or communication blackouts. For example, one Queensland emergency manager noted in interview about the importance of such 'low-tech' communications such as printed daily newsletters as a reliable channel during electricity outages:

> If we have a cyclone event or severe wind event, which we've had a few of those recently, we also might say to people, think about a newsletter option, if people don't have communications and power, a newsletter would work. We've used this in the Scenic Rim recently, we use that as a method to get communications out because we can't rely on IT communication to 100%.

Local radio broadcasters, which commonly have generator backup to allow them to continue broadcasting, play a similar role. Forum participants noted that they would listen to local radio in their cars if they did not have battery operated radios. Speaking of the local radio station, one forum participant in Tenterfield noted that local information could be checked and verified during a hazard event via talkback radio. "Yeah, go to 10FM, because then you can ring them, and they know exactly where you're looking at."

In the face of confusion and information overload, single sources of information were also identified as important. In Ayr, the Burdekin Shire Council's Disaster Dashboard is appreciated by the community as one such central hub of disaster communication. A website containing information about weather warnings, road conditions and power outages, along with news from emergency management, lists of emergency contacts and an emergency action guide, the Disaster Dashboard serves the Burdekin area as a 'go to' site of natural hazard communication. Similarly, a participant from the state of Victoria described the value of VicEmergency – the Victorian State Government's app for emergencies and warnings – in terms of its status as "the single source of truth for warnings and information to the public". While a central source of reliable and timely information is valued by disaster-affected communities, participants also acknowledged that one form of messaging will not reach everyone and multiple pathways to a central information source are needed.

Importantly, too, sensory experience and individual perception were identified by participants as reliable in the face of the confusion caused by compound hazards. For example, in one case study locations, forum participants noted that seeing, hearing or smelling an approaching fire was an especially credible source of information about the existence, location and intensity of the hazard. In this context, visual evidence from webcams and audible warning sirens denoting different hazards were mentioned as credible and reliable warning infrastructures.

So too, the need for real-time mapping was mentioned as a technology currently demanded by communities threatened by a range of hazards, particularly fire. As an emergency management professional in Tenterfield mentioned in interview: 'the public wants live information, as accurate and as close to live as you can get. And that's where we struggle.' This interviewee added:

> One of the big comments…was 'where's the live feed? Where's the live feed?' Well, unless we've got the helicopter overhead doing the live feed, we can't get it. But…I don't think the public needs the live feed from the helicopter and see trees burning and all that. But what they want is sort of a live feed of just where the fire is…That's public demand.

Disaster definitions, language and literacies

As noted above, one of the significant findings of this research was that the term 'compound natural hazard' is not widely used or understood by stakeholders including (and especially) community members. This in itself is a significant barrier to effective communication and engagement when multiple or concurrent hazards occur. Any efforts to build community responsiveness and resilience in the face of compound natural hazards must therefore begin by establishing an agreed-upon term as part of disaster discourse.

This study's interviewees largely understood the term "compound natural hazard", but reported not using it. Several noted they would use the term "multiple hazards" or "back-to-back" hazards. One emergency management interviewee explained:

> We generally talk about having multiple disasters, rather than hazards. We tend to not use the word hazards….we talk about repeat disasters, multiple disasters.

Participants' interpretations of the term also involved nuances and variations on its meaning. For example, when asked about their understanding of the term 'compound natural hazard', one interviewee in Ayr mentioned crocodiles and sharks in floodwaters:

> We had floods in the Haughton River back in [2019] and I've got a picture sent to me by the local policeman standing in his front yard holding two small crocodiles… Is that what you call another hazard? You know, because of the flood, all the young crocodiles… in the populated areas. He got these in his yard.

An additional emergency management interviewee noted:

> It's a bit like, in financial terms, if you're talking about compounding interest, it builds, one builds on the other on the other on the other.

Another forum participant interpreted the word 'compound' to mean:

> the way things can keep growing on each other. So, you have a flood then and a fire, then a flood then a fire. And yeah, you don't really ever quite recover from the previous one.

This participant added that the term compound natural hazard was not something that they would expect either emergency managers or people in their community to use. They commented that the term 'sounds like something you'd put in a PhD paper rather than talking to people around town', identifying the term's lack of congruence with everyday discourse. While it is not necessarily imperative that the term 'compound natural hazard' itself be used, the concept needs to be widely understood, its parameters agreed upon and this or an analogous term broadly adopted as a basic starting place for communicating about such hazards.

Likewise, emergency managers interviewed acknowledged that for hazards experienced during COVID-19, the pandemic was a compounding factor, which made people unsure how to protect themselves from both risks:

> At one point, some of our stakeholders were going to deny entry if people weren't vaccinated and we had to go and educate and say that our main focus is priority of life. So, we need to look at the highest risk, this is in compound risks or dual risk, where the cyclone might have been the highest risk, and we need to think about putting the people into a shelter, and then worry about the second risk, which is our COVID scenario, once that higher risk is passed on.

The fieldwork also shed light on a need for improved hazard communication literacies so that communities better understand, and are better equipped to participate in, the communicational practices that enable preparedness, safety, recovery and resilience when facing compound hazards. As one participant stated:

> it would be good if people were able to interpret the information themselves, and know what the impact is going to be on them, and then know what to do. That would be the ideal going forward. The challenge is to get there.

Another forum participant suggested that individuals should plan for compound hazard situations by choosing "three ways" of staying connected and accessing information. These "three ways" could involve channels of a person's own choosing, but should include a diverse range of media to ensure connectedness during power outages:

> Social media, WhatsApp, the TV news, the local news, the local newspaper, going to the noticeboard in the town… There's a zillion ways [to get information]… you should have three that you choose, that you use as your main [sources].

Another interviewee explained that communication-related practices, like keeping spare batteries for your transistor radio, were essential aspects of preparedness. "You've got to have water", they said, "and you've got to have communications".

These comments evidence an awareness of the need for improved disaster communication literacies, and the imperative for community members to take an active role in seeking and sharing information rather than passively waiting for communication to *happen to them*. This data suggests a need to raise awareness definitional and communication-related aspects of hazard preparedness, alongside better-known practices like securing property, maintaining a disaster kit and preparing an evacuation plan.

In terms of hazard literacy building, the fieldwork also provided some evidence that the climate-driven nature of compound hazards is not universally understood or accepted, even by some emergency management stakeholders. One emergency manager interviewee noted:

> I'm not sure on climate change, but the climate has changed. And I think that's what a lot of people think. They believe, the climate has definitely changed, but they're unsure of the drivers. Is it a cyclic thing? Is it climate change, or something else? But I think most people will agree that the climate has changed. But just what the driver is, that's probably where the jury's still out. Because there's a number of different theories. It just depends. But I don't go into it, I just say, 'I believe the climate has changed, but what the driver is, who knows?'

It is important that emergency managers understand and accept the human-caused nature of climate change, and that current changes to the climate are not cyclical. Only in this way will they be able to communicate accurately with their constituents about the projected increase of hazard risk into the future. An absence of this consensus amongst compound hazard communicators may hamper this communication and risks not sufficiently impelling community hazard preparedness.

Warning fatigue, inaction and avoidance

Repeatedly, participants in this research noted that compound natural hazards led to "warning fatigue" and an unwillingness or inability to engage with new information. Like information overload (discussed above), warning fatigue creates a significant barrier for communicators, especially those trying to engage communities and share information about subsequent or concurrent disasters. Such a sense of fatigue may also lead to an avoidance of messaging about the disaster(s). Repeated experience of hazards can also erode trust in official spokespeople and institutions, which itself compounds the problem of message avoidance.

This study's findings suggest that the first step to overcoming such avoidance and warning fatigue is becoming aware of it. Warnings, messages and communication content must be well-crafted, direct and intentional, because if such content is perceived as valuable by communities, it is more likely to cut through the fatigue. Messaging should also be direct enough to avoid complacency, noting that emergency management cannot attend every property in a hazard situation. An emergency manager interviewee in Tenterfield explained the need for such directness in these terms:

> The message goes out, "clean up your yard, fill your gutters with water, make sure your hoses are connected...And there are some people who will still ignore it and think either 'it won't happen to me' or 'someone will be there to save me." The message is, "there will not be someone there always to save you."

One emergency management interviewee characterised some community members' lack of preparation as a kind of "complacency towards preparedness messaging:

> There's a lot of people in this day and age too who are complacent and not looking out for themselves. It's a case of the flood comes, the SES will come. If a fire comes, the RFS will come. You know, you drive around and look at some of the houses that are floating around that have got, you know, stuff growing all over it. People are still inhabiting them. But, you know, if the fire comes through, and you've got dead vine all over your house. I mean, to me a fire engine can't save your house if you can't at least meet it halfway.

However, warning frequency and content is a delicate balance, as one emergency management professional interviewed in Ayr noted, because over-warning people about an impending hazard, when such hazards occur repeatedly, can lead to inaction. In these circumstances:

> ...people eventually are sick of the government or sick of the council calling Wolf, and then they don't respond to warnings.

The research team's conversations with community found that creative hazard communication – that is, unexpected, innovative and novel ways to engage people – may offer a solution to the problem of warning fatigue and avoidance. By creative communication we mean unexpected, innovative and novel ways to engage people, or creative twists on traditional messages. The research team notes here that study participants spoke not just of specific media channels and tools, but of the craft of communication itself and the creative, innovative ways in which communication strategies were developed and deployed. One interviewee described this as:

> the ability to constantly wordsmith, change your messaging, understand how to get through to those communities, work out when that community has had enough and work out probably most of the time, what are non-traditional communication methods.

The findings also indicate that creative practice aids community recovery in a compound hazard context. Art, sport and community storytelling were identified as important recovery tools in all three case study locations. For example, an augmented reality art installation *Hard Place/Good Place* gave an immersive representation of young people's experiences of the Dandenong Ranges storms, while an art project entitled *Stories of the Giants* aided recovery in the same location through creative workshops using wood salvaged from trees fallen in the storms. These communicative and creative community responses to compound hazards concur with research that suggests creativity has often been overlooked as a pathway for effective hazard communication. [126] For this reason, creativity has been included as one of the compound hazard communication principles in the engagement framework presented in this report.

Survey findings

In contrast to the qualitative nuance provided by the forum and interview data, the survey took a quantitative approach to gauging respondents' attitudes towards the communication they encountered before, during and after compound hazard situations, and how they would like to receive information in future events. The survey first established the degree to which participants were impacted by compound natural hazards in their regions, and gauged their perceived levels of preparedness before, during and after each disaster. While recognising that the three case study locations have been the site of multiple, often intersecting and overlapping disaster events in the recent past (including in the time since the survey was written and deployed) for the survey, participants were asked about two discrete events for each location. These events were:

- Burdekin Shire: flood events in 2017 and 2019
- Tenterfield: 2019 bushfires and 2019 water contamination event

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[126] Cunningham, S, Park, S, McCallum, K, Del Favero, D and Fulton, J (2024). Culture Creativity, and Climate: A dangerous gap in policies of preparedness in M Ostwald and U Frohne (eds) *Climate Disaster Preparedness: Reimagining extreme events through art and technology.* 169-182, Springer.

- Dandenong Ranges: 2021 storms and COVID-19 pandemic

The survey respondents' perceived personal impact of these disaster events varied markedly across the three case study locations (refer to Figure 16). For example, those who indicated being very or extremely impacted ranged from 5% (Ayr: 2017 floods) to 57% (Tenterfield: 2017 water contamination). Notably, while similar magnitudes of personal impact were reported across the two Ayr flood events (5% vs. 9% reporting being very or extremely impacted), a different pattern was observed in Tenterfield, where causally linked but qualitatively different disasters were experienced (14% vs. 57% reporting being very or extremely impacted). A separate analysis was also undertaken for the Dandenong Ranges, where the nature of the compound disaster was such that the 2021 storms and subsequent clean-up and recovery coincided with Victoria's extended COVID-19 lockdowns. This analysis indicated that there was a small but significant correlation between the survey respondents' perceived personal impact of the 2021 storms and a perception of the compounding effects of the COVID-19 lockdowns (r =.34, p <.001). Put differently, the COVID-19 lockdowns did indeed act as a compounding factor, amplifying the personal impacts of the storms for those surveyed.
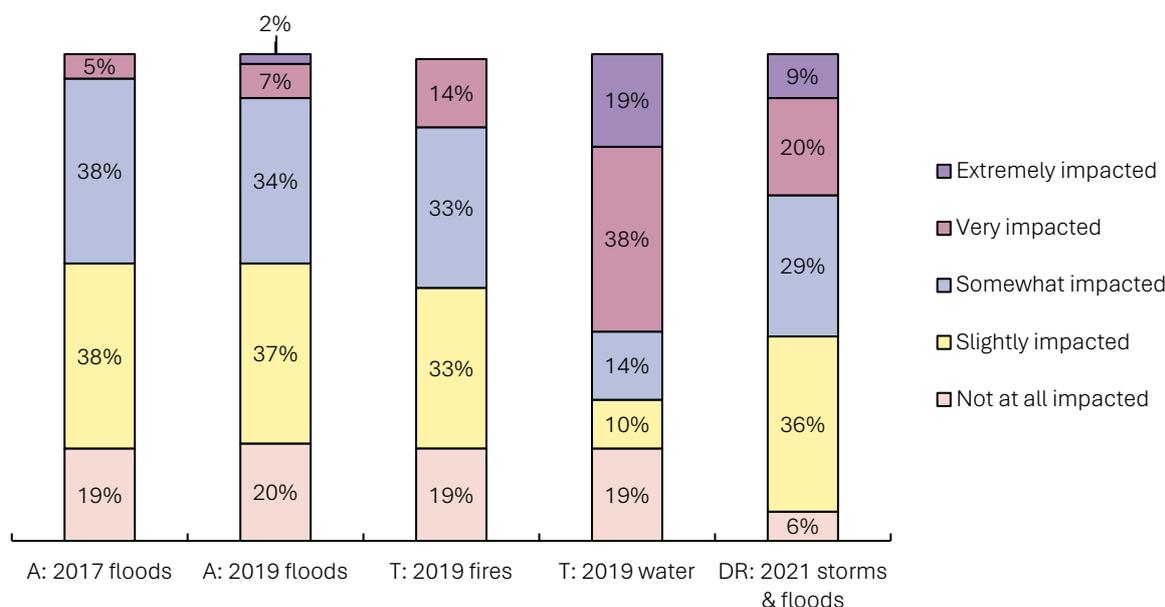
Figure 16: Reported impact of the disasters experienced in each case study location. Note: A = Ayr; T = Tenterfield; DR = Dandenong Ranges; percentages may not sum to 100% due to rounding error.

Further insights into the dynamics of disaster-related impacts and preparedness perceptions are presented in Figure 17. Two distinct trends from survey respondents were apparent. Across three disaster events (Tenterfield 2019 fires; Tenterfield 2019 water contamination; Dandenong Ranges 2021 storm), a sizeable proportion of participants found themselves underprepared during the disaster event relative to their pre-disaster perceptions. For example, the proportion of respondents in the Dandenong Ranges who felt not at all or only slightly prepared for dealing with an extreme weather event increased from 36% before the storm event to 54% during that event. While this proportion decreased to 16% after the event (presumably because of additional activities undertaken during the recovery phase to strengthen their future preparedness), it remains to be seen whether this perceived preparedness will translate into actual preparedness, particularly for qualitatively different hazard events. Indeed, the Tenterfield experience suggests that feelings of preparedness in one hazard domain (e.g., fires) may not necessarily translate into feelings of preparedness in another hazard domain (e.g., water contamination). Given this study's focus on compound natural hazards, it is notable that the survey data across the three case study locations shows the experience and impact of one disaster did not seem to have a notable effect on perceptions of preparedness before a subsequent disaster. As noted in the sections above, having previously experienced a hazard may contribute to people being more prepared. However, the survey indicates that experiencing new or qualitatively different hazards, rather than the same hazard repeatedly, may make people more confused, vulnerable and less able to respond.
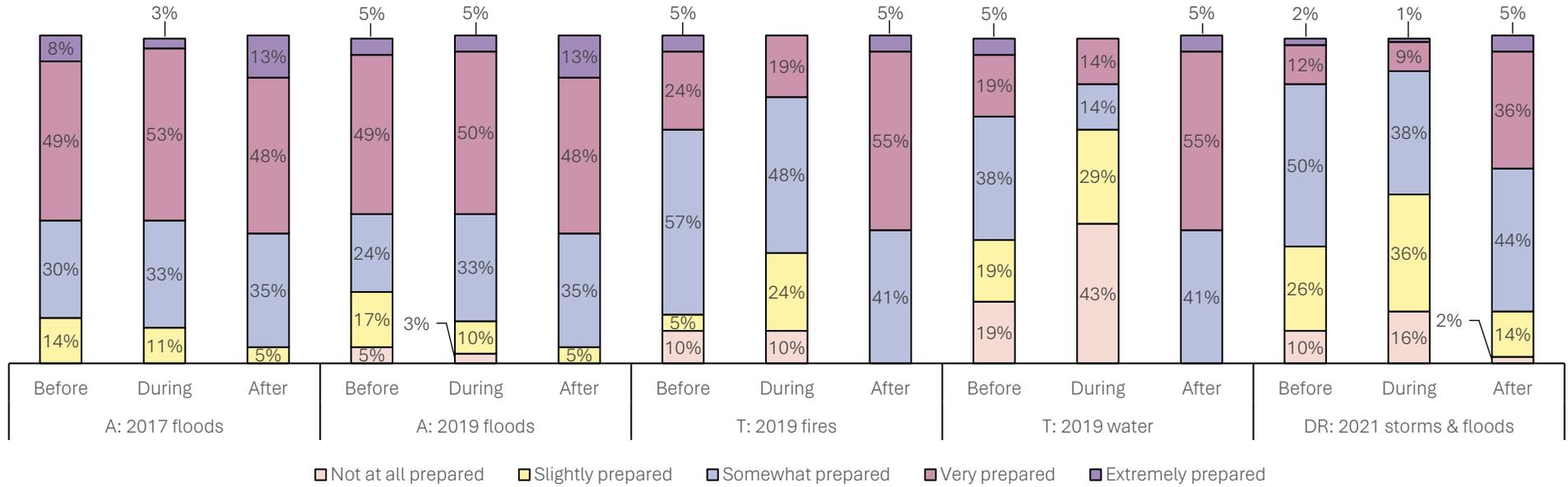
Figure 17: Perceptions of preparedness before, during and after each disaster event. Note: A = Ayr; T = Tenterfield; DR = Dandenong Ranges; post-disaster preparedness perceptions for Ayr and Tenterfield were not differentiated by disaster event.

Sources of information and communication channels

Participants were asked about the sources from which they received or actively gathered information about each hazard event as well as the channels through which they received this information (Figure 18). For the purposes of the survey, **sources** were defined as groups, individuals or organisations providing information before, during or after the hazards, while **channels** were defined as the platform, medium or mode of communication. Participants were also asked about the usefulness of each channel and source.

While recall biases and memory-related issues may limit the comprehensiveness and accuracy of these recollections, the resulting findings nevertheless paint a picture of the informational sources that achieved some degree of memorability. Notably, while there were some variations – both within case study locations (that is, between the two focal hazard events) and between them – several broad trends were apparent.

It is clear that respondents were receiving information from emergency management authorities and local governments in all three case study locations across all hazards. Community members, friends and family were also common sources of information in all three case study locations. However, the level of perceived usefulness of these sources varied. For example, only 23% of Dandenong Ranges participants found information from local council to be satisfactory. This aligns with findings from the community forums, where participants in the Dandenong Ranges in particular voiced frustration and dissatisfaction around their interaction with local government during the storms of July and October 2021.

In the Dandenong Ranges, it was also significant that there were very low levels of communication from any source before the storms. This is unsurprising given that the storms were unprecedented events at the time, in an area more prepared for and accustomed to bushfire as a hazard. Also in the Dandenong Ranges, a comparatively high volume of information came from friends, family, community members and community groups, but the perceived usefulness of this information was quite low. Overall, Dandenong Ranges residents tended to rate the usefulness of most sources of information lower than did other communities – this is indicative of the confusion felt during these storm events.

Notably, a small amount of communication from schools during the 2019 Ayr floods was perceived as very useful, indicating that some sources of information could be amplified due to their reliability or capacity to reach and engage a wide audience.

Participants were receiving high volumes of information from social media across all three case study locations. However, the perceived usefulness of this information varied. This indicates that compound communicators should not discount social media as a mode of communication with a very high capacity to reach broad audiences. However, a social media strategy must inform the usage of these channels, keeping in mind that a channel means nothing without the credibility of a trusted communicator. Community radio was also identified as a channel with high perceived usefulness. While it lacks the reach of other modes of communication, its value is tied to its intimate local knowledge and often, trustworthiness.
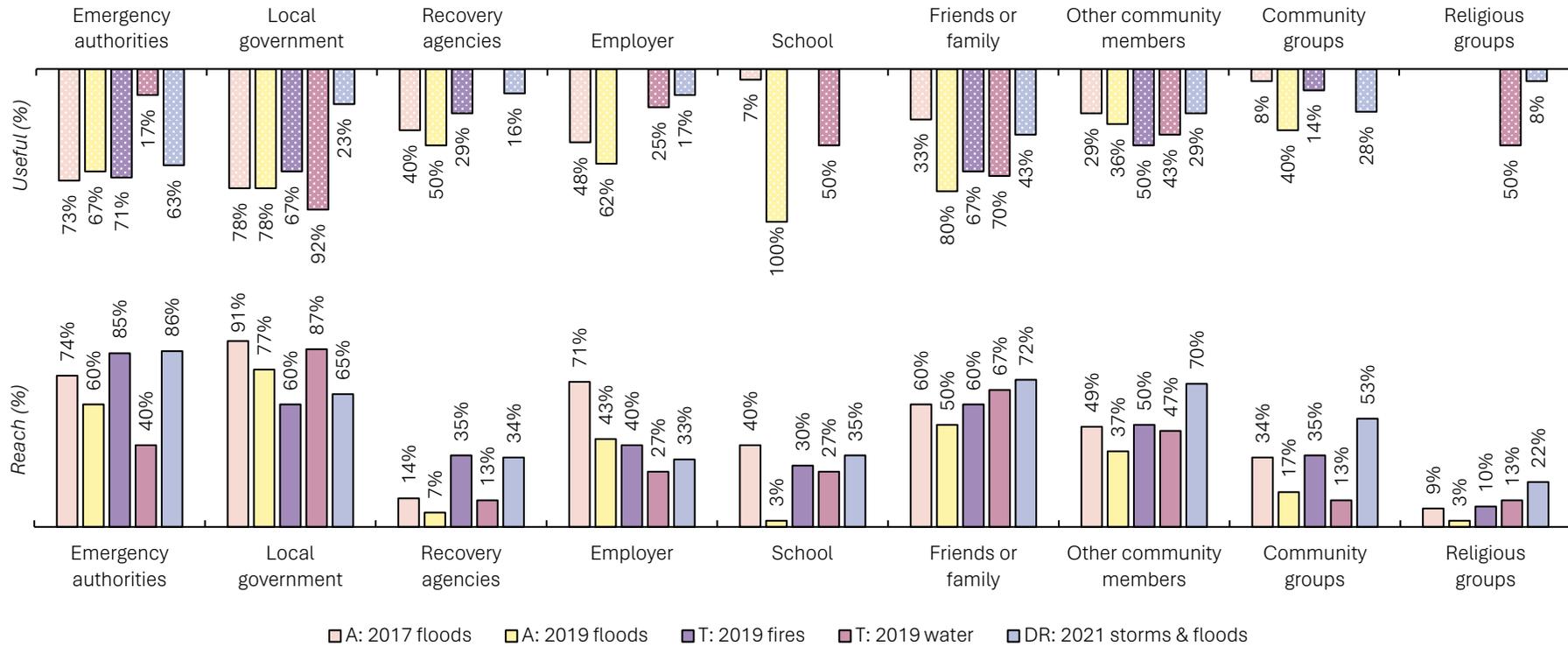
Figure 18: Sources of information for each disaster that had reached each participant (bottom pane) and were perceived as being most useful among participants who had received that information (top pane). Note: A = Ayr; T = Tenterfield; DR = Dandenong Ranges.
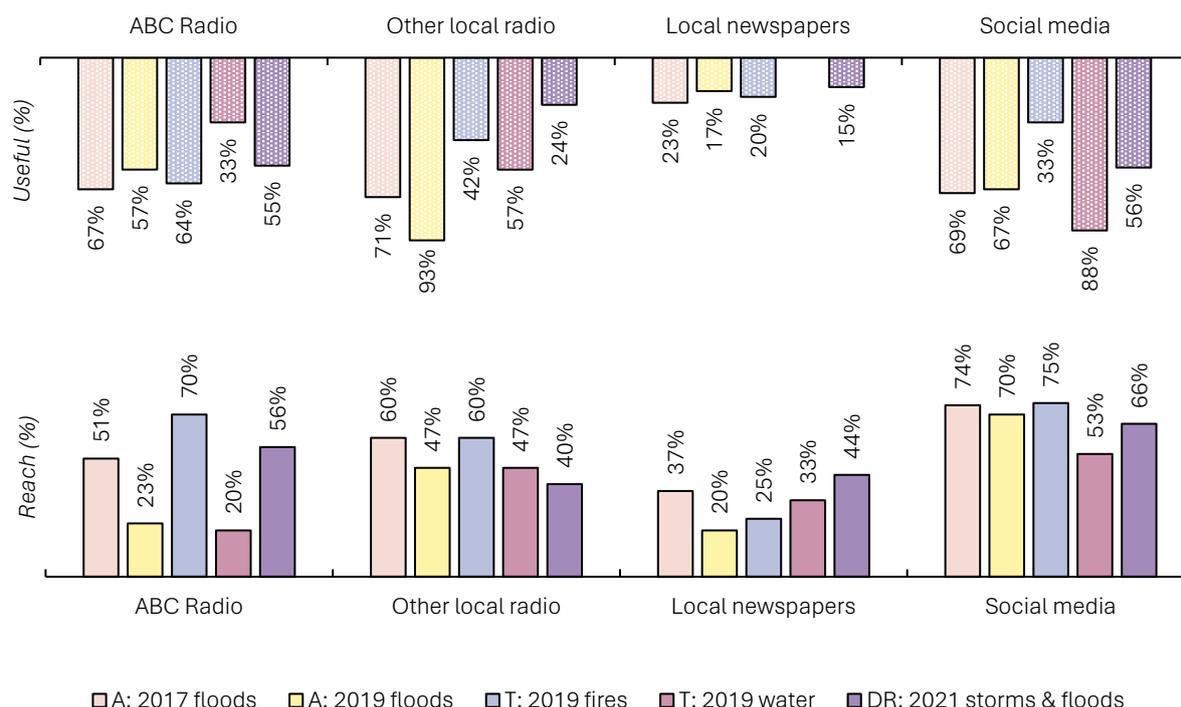
Figure 19: Information channels that had reached each participant (bottom pane) and were perceived as being most useful among participants who had been reached by that channel (top pane) with information about each disaster event. Note: A = Ayr; T = Tenterfield; DR = Dandenong Ranges.

Preferred channels and sources of information about future hazard events

Respondents in each case study location were then asked to specify the information sources and communication channels that they thought would be best placed to provide information about future hazard events (Figure 19). Notably, emergency management authorities (59-94%) and local government (60-88%) were the information sources most likely to be identified by respondents across the case study locations as being best placed to provide this type of information. While respondents had earlier identified friends/family and other community members as having provided high-reach and useful information about specific disaster events (see Figure 18), their potential role in providing preparedness information for future events was not broadly recognised. For example, only 9-26% of respondents identified friends/family as potential sources of such information, while only 11-19% nominated other community members. Thus, the potential role of personal networks in disseminating useful disaster preparedness information is perhaps under-recognised by members residing in at-risk locations. However, it may also be that communities are seeking greater clarity and reliability of information, and/or that the responsibility for such communication is seen to rest with authority bodies like emergency management or local councils.

In terms of the communication channels that participants felt were best placed to provide information about future disasters, there was some variability across case study locations. However, the potential role of social media (37-59%), ABC radio (37-50%), and other local radio stations (23-63%) were all broadly recognised.
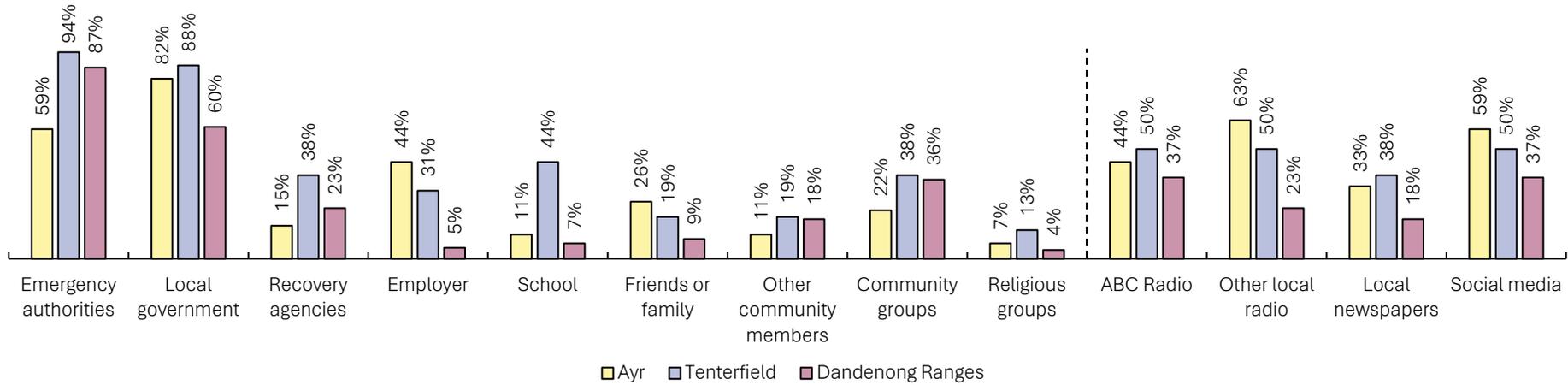
Figure 20: Information sources and channels perceived as being best placed to provide information on how to prepare for future compound events. Note: A = Ayr; T = Tenterfield; DR = Dandenong Ranges

Participants were also surveyed on their preferences for the communication channels that emergency management authorities should use to deliver disaster-relevant information (refer to Figure 21). Several patterns were identified here. Firstly, SMS (text message) received the greatest levels of endorsement, ranging from 83-94%. It is worth noting, however, that the study's qualitative findings complicated this somewhat, with participants in the community forums indicating that text messages from emergency management are useful only when they are carefully and strategically deployed – too many text messages, or messages originating from multiple sources, can be confusing and can amplify community feelings of fatigue, distress, ultimately even leading to inaction.

Social media (60-85%), ABC radio (55-85%), and other local radio stations (49-77%) were commonly cited as preferred channels for emergency management authorities to deliver compound hazard information to relevant communities. Again, this indicates that social media should not be discounted by emergency management stakeholders as a mode of communication with potentially high reach, although it is acknowledged that reach is not the same as engagement: to fully engage with communities, a social media strategy is needed to guide communication across the many available social media platforms. The research notes the high endorsement by community members of both local radio and ABC radio. The data represented in Figure 21 also indicates that, collectively, communities want a multi-channel approach to disaster communication. However, this is challenging for communicators working in a fragmented media landscape.

Finally, it is worth noting that there were variations between case study locations in terms of preferred channels for emergency management authorities to deliver disaster-relevant information to communities. For example, while preference for communication via TV was high among respondents in Ayr (69-76%) and the Dandenong Ranges (68%), it was not at all high among surveyed respondents in Tenterfield (6-15%). Similarly, while there was a notable preference for door knocking in Tenterfield (53-69%), preference for this mode of communication in Ayr (14%) and the Dandenong Ranges (35%) was lower. Indeed, one community forum participant in the Dandenong Ranges noted that door knocks are not welcomed by elderly residents who may find them intimidating or threatening, especially if they live alone.

This data from the survey supports the qualitative data findings that localised communication that responds to local conditions is essential in a compound hazard communication context. A community will always have its own communication ecology, and communication and engagement strategies should therefore be grounded in and attuned to local knowledge. Compound hazard communication has distinctive local characteristics that hazard communicators must be aware of and work with, if they are to achieve meaningful engagement and relationship-building throughout the hazard response cycle.
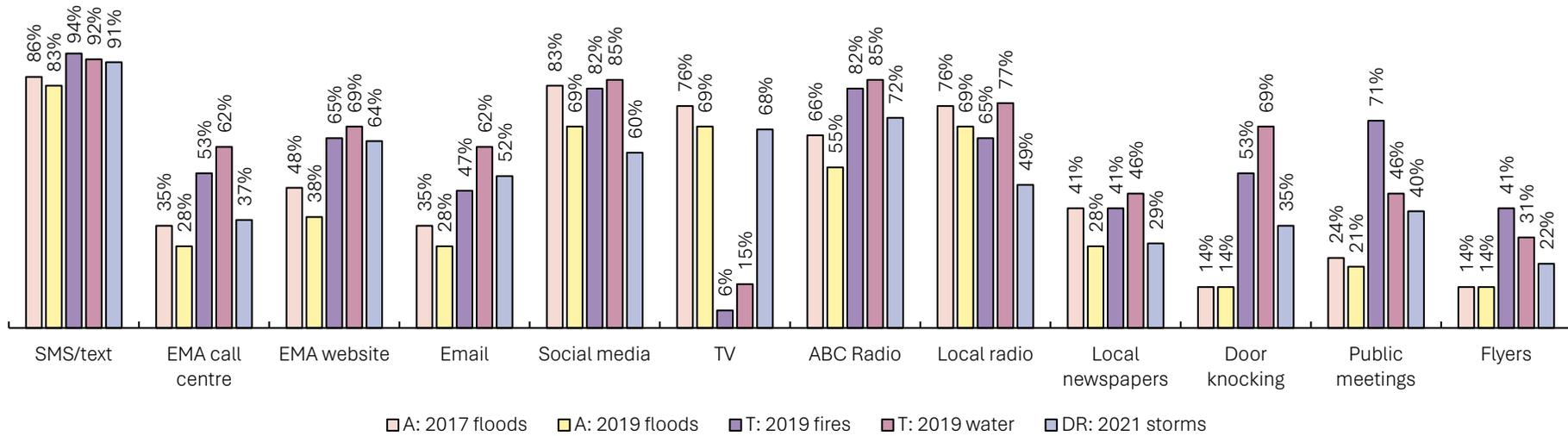
Figure 21: Preferred channels for emergency management authorities to deliver disaster-relevant information to affected communities. Note: A = Ayr; T = Tenterfield; DR = Dandenong Ranges

Discussion of results

As the results reported above show, the communicational needs and experiences of stakeholders and communities are intensified when a natural hazard is compounded rather than singular, and some communication needs are qualitatively different. Agreed-upon definitions and tailored communication-related initiatives, which are mindful of compound hazards, are required before, during and after such hazards. Using the qualitative data themes and the survey data reported above identified the following key features of the relationship between communication and compound natural hazards:

→ Individuals may struggle to deal with multiple challenges at once. Research suggests that humans have a finite pool of both worry and attention, [127, 128] a finding supported by this study's fieldwork. This means individuals may be unwilling to think about, act upon or receive messaging about an impending threat due to the persistent presence of a current threat. It may also mean that attention paid to a current threat may decrease in the face of an impending threat. This is compounded by information overload, especially if multiple communicators are competing for the attention of weary or resistant audiences.

→ Communities become fatigued in the context of compound natural hazards, which in turn can lead to a lack of motivation to take action and/or an avoidance of messaging. Community members find their decision-making capacity reduced.

→ People want to be able to access multiple information channels in the context of compound hazards, but not all channels are regarded as reliable or trustworthy. Consistency of messaging across channels is crucial.

→ Communication can become confusing in the context of compound natural hazards, especially if information is coming from multiple sources and is dispersed across a disorganised communication landscape. As the volume of communication increases during a compound natural hazard, there is more noise in the communication landscape, sometimes inducing warning fatigue and a greater potential for misinformation to spread.

→ Trustedness of information sources is crucial in this compound hazard communication context. Local media (particularly radio) as channels and emergency managers as sources are regarded as most trustworthy.

→ Compounding factors like power outages or communication blackouts can interfere with the sharing of information. Such compounding factors are common during natural hazards and result in the loss of access to essential information, particularly when that information is disseminated online. During blackouts or outages, community members can also lose access to social networks and sources of support. Regional and remote areas are particularly vulnerable to such outages and blackouts.

→ Due to the potential scale of the damage inflicted, and the social, emotional, physical and economic impact of a compound natural hazard, communities may lose trust in the capacity of public institutions to protect them and therefore be less attentive to awareness-building messages in future.

→ Compound hazards can lead to sensationalised, negative depictions of communities in national media coverage, which can weaken community morale.

[127] Hansen, J., Marx, S., Weber, E. U. (2004). The Role of Climate Perceptions, Expectations, and Forecasts in Farmer Decision Making: The Argentine Pampas and South Florida. International Research Institute for Climate Prediction (IRI), Palisades, NY: Technical Report 04-01

[128] Weber, E. U. (2006). Experience-based and description-based perceptions of long-term risk: Why global warming does not scare us (yet). *Climatic Change*, 70, 103-120.

It is important to note, however, that people's experience of compound natural hazards themselves may help build community connectedness in some domains. Communities that live through a compound hazard event are potentially more experienced, mobilised and resourceful, particularly if they experience the same hazard repeatedly. This may result in communities becoming more receptive or responsive to disaster communication and preparedness efforts in the future. Although single hazard experiences can increase vulnerability, they can also, conversely, build social capital, leaving communities mobilised and ready to respond to additional or compound disasters. Emergent groups established during one disaster are poised to act and aid in awareness, safety and recovery activities when new disasters occur. [129] During the first in a series of disasters, individuals may step into leadership, communicator, or community champion roles and develop the capability to partner with official communicators, further enabling communication efforts during future disasters.

As all this indicates, there are distinct needs, barriers and opportunities associated with communication and engagement before, during and after a compound natural hazard. Emergency management stakeholders must therefore adjust their communication and engagement approaches to address these needs, overcome these barriers and capitalise on potential opportunities. It is also essential that communities better understand compound natural hazards as an increasingly dominant feature of the disaster landscape. Equally, it is vital to enhance the information and communication literacies of communities to accommodate the risks posed by compound natural hazards to safety, wellbeing, resilience and communication itself. The framework presented in this report has been designed with these concerns in mind.

A framework for community engagement on compound natural hazards

This report introduces a framework for communicating and engaging with communities on compound natural hazards – the first framework to do so. The framework aims to reduce the risk of harm to communities and individuals from the interaction of compounding extreme weather events and existing vulnerabilities. In recognition of this imperative, this compound hazards framework draws on the holistic 'all agencies', 'all hazards' approach that has been widely used as the benchmark for practice in emergency management in Australia. This framework accordingly considers communication and engagement in all phases of the hazard response cycle (traditionally designated as prevention, preparedness, response and recovery or PPRR), noting that these phases often have no distinct beginning or end, and that they often overlap. While these phases are not explicitly named in the framework, they underpin the thinking that led to the framework's development. This framework is not, then, different to the 'all hazards', 'all agencies' PPRR approach, but builds on it, with compound hazards specifically in mind.

Importantly, this framework also extends the more traditional, agency-led approach to communication and engagement. As discussed earlier in this report, there are many different actors in the hazard communication landscape, communicating through many different channels; it is not only emergency managers who seek to engage with communities about natural hazards and disasters. While this framework is therefore intended primarily for use by emergency managers, it is also created with a broad spectrum of compound hazard communicators in mind – anyone charged with more effectively engaging with communities in all phases of compound hazards.

What is a framework?

It is important to recognise what a framework is, and what it is not – and therefore what it can and cannot do. A framework is conceptualised as a set of principles to guide thinking and action. As the name suggests, a framework is a template that scaffolds practice. A framework is, therefore, practical, but also the product of

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[129] Twigg, J., & Mosel, I. (2017). Emergent groups and spontaneous volunteers in urban disaster response. *Environment and Urbanization*, 29(2), 443-458.

research. The framework presented here is distilled from fieldwork and deep analysis of a large amount of qualitative and quantitative research data. In this way, it is inherently and intentionally bounded, although it draws on extensive research. A framework like this one is also not intended to be standalone – it comes with a set of explanations and guidance for use. A framework is also malleable, allowing for improvements, updates and the introduction of place-specific nuance. This framework encourages adaptation to local circumstances, as illustrated in the hypothetical compound hazard scenario presented later in the report.

At the same time, this framework is only a starting place for thinking about engaging with communities on natural hazards. A framework cannot be used effectively without the communicator first understanding local audiences and community vulnerabilities, place-based communication sources and channels, as well as existing local levels of awareness of and preparedness for compound hazard risk. In this sense, the framework must be complemented by stakeholder mapping exercises to first understand the communication ecology in a place-based context. The framework assumes that communicators have already defined in a locally relevant way what compound hazards are and have agreed on how to name them (as noted above, the term compound hazard is not widely used by emergency managers or the communities they serve). Likewise, engaging with communities on compound hazards using this framework would be more fruitful if a community already had a good understanding of projected changes to the frequency and/or severity of hazard risk under climate change in their area. Community climate literacy-building is therefore a prerequisite – or at least could be done in tandem with – engagement on compound hazards risk, and risk reduction. Such fundamentals must support and underpin engagement on compound hazards using this framework.

Introducing the framework

Here the full framework is introduced, followed by a detailed explanation of each of its components. The framework is designed to be understood and used from the centre outwards, because framework-guided thinking for compound hazard communication and engagement starts with the compound hazard communicator. Each part of the framework wheel is envisioned as capable of rotating to help components align, so that specific communication needs and situations can be addressed.

Figure 22: A Framework for Community Engagement on Compound Natural Hazards

The compound hazard communicator

The communicator – who may be an emergency manager, or one of a wide spectrum of hazard communicators – is at the centre of the framework. They aim to engage communities before, during and after natural hazards. They work with communities to build local understanding, activate them for preparedness and empower them by through the building of resilience to hazard-induced risk. Compound hazard communication must be two-way communication: it should incorporate listening to communities and encourage participation in the communication and engagement process.

Goals

Figure 23: The goals of compound hazard engagement

Communication and engagement initiatives most often set out to achieve particular, measurable goals. The four key goals of compound hazard communication are to increase communities' **preparedness** for hazards, to ensure **safety** during and after a hazard, to support **recovery** post-hazard and to build **resilience** to future hazards. These goals are at the heart of any communication or community engagement effort. Resilience as a key goal of the framework was incorporated after participant feedback as part of the co-design process. Participating emergency managers and local council emergency committee representatives noted that resilience building must now be a key goal of hazard engagement.
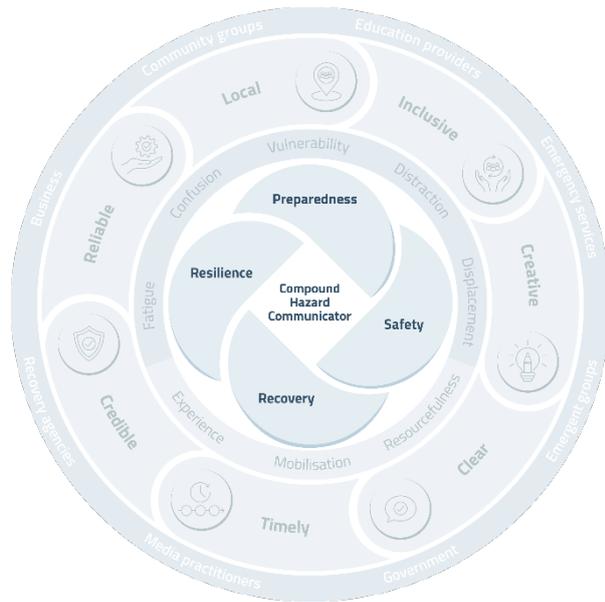
Barriers and opportunities

Figure 24: Barriers and opportunities for compound hazard engagement

A hazard that is compound, with two or more disaster events overlapping, intersecting, or happening in quick succession, creates both barriers and opportunities. Communication barriers associated with compound natural hazards include that audiences – communities – may be fatigued, confused and distracted. In this context, their capacity to listen and make decisions is reduced. They may also have lost trust in public institutions. They may be displaced, possibly living temporarily in an area where they are unfamiliar with the hazard risk environment. These factors can make communities more vulnerable. Due to the compounding nature of the hazard, the usual channels for communication and engagement may also be less reliable or not functioning. So too, the volume of communication may have increased with more communicators disseminating different messages, for example, emergency managers tasked with responding to different hazards. With more noise in the communication landscape, misinformation, whether intentional or unintentional, can compound communities' confusion.
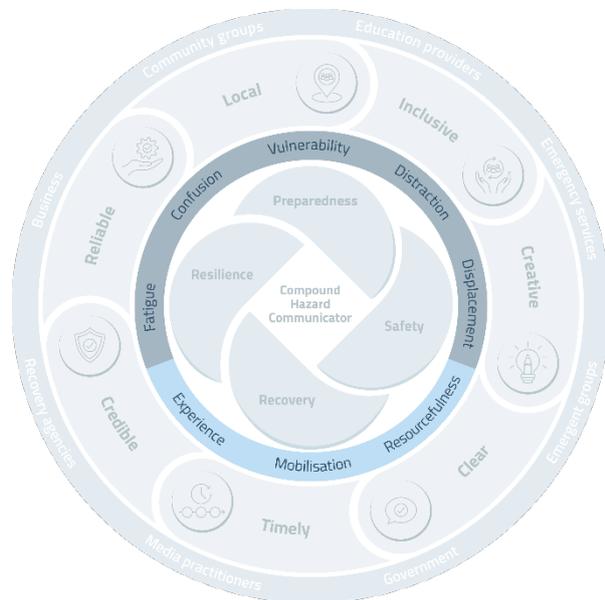
At the same time, there are opportunities associated with compound hazard communication. When a community has lived through a disaster before, they are potentially more experienced, and they are able to pass this experience on to other community members, with the potential to strengthen the whole community. Communities that have recently experienced a hazard may be more resourceful, mobilised and ready to

respond, especially if emergent groups [130] are established as a result of an initial hazard. The compound hazard communicator will need to consider how to adjust communication approaches to overcome these barriers and capitalise on potential engagement opportunities.

Compound hazard engagement principles
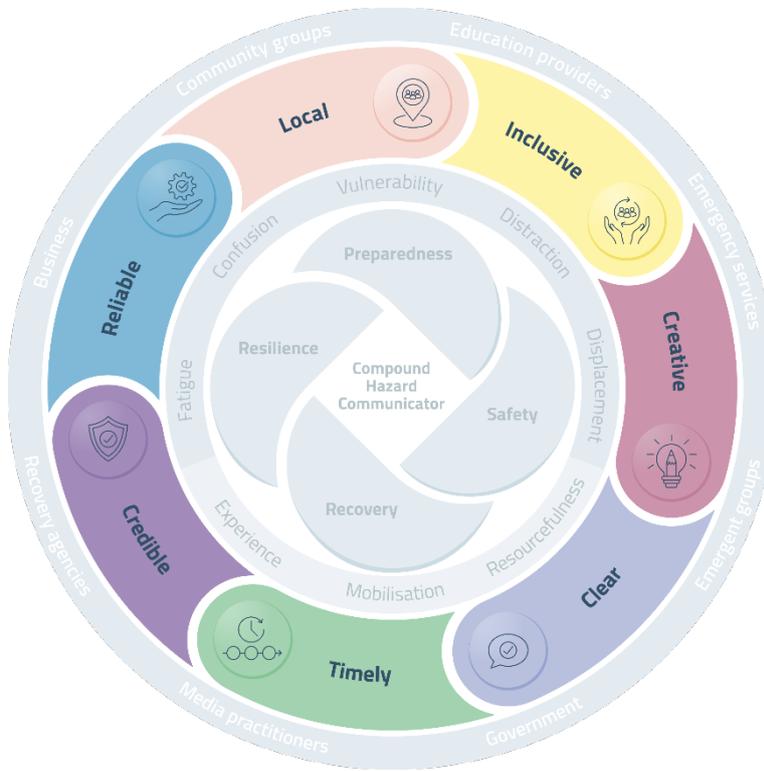
Figure 25: The principles of compound hazard engagement

This part of the framework describes the characteristics of best practice compound hazard communication and engagement. The compound hazard communicator should endeavour to have their messages and engagement efforts incorporate as many of these principles as possible, while recognising that not all message and communication efforts can incorporate every principle, every time.

In the pages that follow, each compound hazard communication principle is elaborated on in detail, supported by findings from the three case study locations of this research.

Enablers

Figure 26: Enablers in compound hazard engagement

As explained in this report, the communication landscape for compound hazard engagement is a complex one with multiple message sources and channels. In addition to communication messages (that is, the information content of a communication or engagement effort) and the various channels for communication, an additional category is identified: communication enablers.

These enablers may be people, groups and organisations who can assist with the dissemination and circulation of compound hazard messages. They include the many

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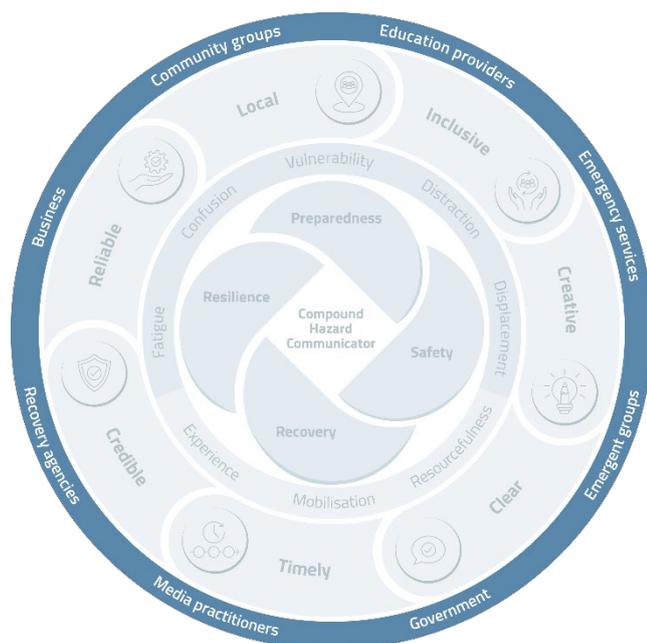
[130] Twigg & Mosel (2017)

community and volunteer groups that operate in Australian communities. They also encompass providers of formal education, including schools, TAFEs and universities. Enablers also include local businesses, government departments and representatives, and other emergency services and recovery agencies who can work with the compound hazard communicator to proliferate consistent messaging. Importantly, media practitioners should be allies in this effort: it is often the case that hazard communicators have a well-established relationship with individual media practitioners in their area. Compound hazard communicators should look to identify enablers in any stakeholder mapping of the local communication landscape.

Unpacking the principles

Over the following pages, each of the principles of compound hazard communication is explored in depth, supported by examples from the research. This is followed by a compound hazard scenario to demonstrate how the framework may be applied in practice.

Local

Community engagement and communication with communities before, during and after compound natural hazards should be **attuned to local knowledge** and must **involve local communities**.
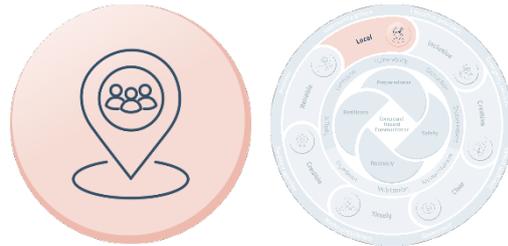
Local communities often feel unheard and marginalised.

The act of local listening should be at the heart of all strategies for communicating on compound natural hazards. This study found that communities often feel unheard by emergency management in the context of compound hazards. Many forum participants reported feeling that their feedback, inquiries, and calls for help had 'fallen on deaf ears' before, during and after the hazard events. There is also resistance amongst local communities to the centralising of key emergency services, and a strong feeling that communication and engagement activities should not be undertaken by hazard communicators who are outsiders and normally located distant from the community they are interacting with.

Local communities in regional areas, or areas peripheral to cities, may be more likely to be impacted by compound natural hazards: importantly, though, these communities also feel marginalised by urban centres of power. There is a feeling among impacted communities that distant decision-makers may not know or understand their local area and the unique, localised ways in which the compound impacts of the hazard have been felt and experienced. It is imperative that those on the frontline of communication and engagement with communities have detailed local knowledge: this reduces the possibility of frustration (and disengagement) during communication between locals and emergency managers. In this sense, local knowledge can also streamline communication at a time when confusion due to increased messaging is a risk.

It is also important for the experiences of local communities to be communicated to outsiders – that is, people who are not currently experiencing the same events, including those located at a distance from the unfolding hazards. Compound hazards are more newsworthy than single hazards and this can lead to the ongoing, negative depiction of communities in national media coverage. This can weaken community morale if a disaster event is represented in a sensationalised, overly negative, or simplified way or not represented at all. National media coverage should be undertaken with care. It is important to indicate in such coverage whether outside assistance is needed, especially in the context of compound hazards, when increased traffic to an area may be harmful or dangerous (for example, if emergency services teams are working to clear roads blocked by flooding or fallen trees).

Local knowledge can be a complicating factor

Stakeholders need to understand that official messages directed at impacted geographic communities will often be interpreted from a local perspective. Communities that have experienced multiple hazards place a high level of trust in their own memories of what happened last time – or the memories of those around them. In this sense, local knowledge can be a complicating factor and may influence the degree to which community members act on information from emergency services. Local knowledge can even be a barrier to effective communication if community members trust their own past experiences at the expense of listening to current warnings.

Local knowledge is a resource

However, local knowledge is also a resource that could be better used in communication before, during and after compound hazards. During the confusion caused by a compound natural hazard, community members often turn to each other first for information and support. The participants reported witnessing locals stepping into leadership roles and becoming key communicators and facilitators themselves. Compound natural hazards place strain on communities but can also draw people together and build social capital. All three of the case

study communities can be described as tight knit, and this community-connectedness was particularly visible during and after the compound hazard. Not only does this create opportunities for community-led communication, but it also leads to a valuable build-up of collective, lived experience and resilience.

Community intermediaries and warden systems

Community groups can be effective intermediaries between locals and other stakeholders, including local council and emergency services. These groups, including local branches of groups like the Country Women's Association, the Returned Serviceman's League and Rotary, can also be effective hubs for disseminating information about hazard preparedness.

Community champions, meanwhile – those who are active and trusted in the local community – can serve as springboards and connectors. A local intermediary can help overcome distrust of outside communicators, particularly when this distrust is exacerbated by the divide between regional communities and urban centres, and/or when trust has been eroded due to the experience of multiple hazards. Keeping these community champions up-to-date and armed with the right information can go a long way to improving communication before, during and after compound natural hazards.

Several of the participants reflected on the virtues of a warden system, where individual community members are given responsibilities to liaise with official stakeholders and other community members. Wardens can assist with disaster preparedness by helping to disseminate crucial information and can act as a first port of call during disasters. Because wardens live in the local community, they remain present during the recovery period and can continue to raise community needs and concerns to external stakeholders. For compound natural hazards, in particular, a community champion or warden is also likely to have a fine-tuned awareness of the community's unique needs, in the context of the disasters they have experienced.

Community engagement events

Engagement events can be important avenues for embedding knowledge in the local community and improving disaster preparedness. Interview participants reported the most success with activities that were community friendly – for example, making use of local spaces like parks and town halls; including activities for children to encourage families to attend; and providing incentives like raffles. Community engagement events should encourage and provide avenues for feedback from locals, to ensure communication is multidirectional rather than one-way.

Organisers of community engagement events should be aware of potential community pushback on initiatives that are perceived to be educational. The community members the research team spoke with did not want to 'be educated' – they wanted to be activated. Citizen science initiatives may present another opportunity to engage communities in disaster preparedness in a more participatory and less top-down manner.

Community engagement events often focus on the before period and the building of disaster preparedness. However, communities tend to organise their own events in the aftermath of a compound natural hazard. For example, community groups might organise story-sharing or creative activities to help locals cope with complex, ongoing trauma. Given the prolonged recovery period in a compound hazard situation, an emergency management presence at such recovery events would allow learning from locals and would improve trust between locals and emergency services.

Local: key strategies

1. Listen to locals and provide opportunities for them to share information and feel heard. A community hotline could provide an effective tool for people with local knowledge and a 'local line of sight' to a disaster.

2. Implement a warden system where trusted locals become key communicators and intermediaries, working closely with emergency management and communities.

3. Engage place-based news and information providers as enablers or mobilisers of local knowledge, facilitators of public discussion and community builders during each stage of recovery, as appropriate.

4. Local experiences of past disasters can be collected and shared. This aids in recovery but also supports disaster preparedness and helps stakeholders put a human face on messages. Oral histories, photographs, artworks or even virtual reality experiences could be used to collect these stories.

5. Consider a campaign to increase community connectedness in the face of compound disasters, encouraging people to 'check on your neighbour' during times of disaster.

Inclusive

Communication and engagement for compound natural hazards should **accommodate and be sensitive to diverse experiences** and **responsive to compound vulnerabilities.**

Psychologically supportive communication

Community vulnerability increases in the context of compound hazards. Communities impacted by compound natural hazards require psychologically supportive as well as practical or informative communication, especially in the aftermath of multiple disasters. Active listening must inform the development of any communication strategies for compound hazards. Mental health first aid training is recommended for communicators, including local wardens and intermediaries.

Increased marginalisation

Marginalised groups tend to become more marginalised in a compound hazard situation. It is therefore essential that compound hazard communication efforts attend to inclusivity. Consideration must be given to the types of disability that may disrupt an individual's capacity to access, interpret and act on hazard communication. Some individuals with disabilities require bespoke hazard preparation, response and recovery solutions. In many cases, work needs to be done pre-event to ensure that a reliable communication infrastructure for people living with disabilities is in place.

Digital illiteracy also emerged as a limitation and a barrier in the case study communities, and this is especially notable given the increased tendency by official communicators to rely on digital means of communication (for example, apps and social media) in a compound hazard situation. Digital communication indeed allows for the quick and widespread circulation of information, which is perceived by communicators as necessary before, during or after multiple hazards. However, some people struggle to navigate digital devices, apps and platforms, with elderly cohorts and individuals with certain disabilities mentioned by study participants. Using digital channels only or mainly for hazard-related messaging effectively excludes anyone with low levels of digital literacy or poor internet connectivity. Making information available across a range of media is therefore important.

Current emergency communication and engagement efforts display a lack of consideration not only for the needs of First Nations people, but also for their deep hazards knowledge and cultural perspectives. First Nations people must be included in the design, governance and implementation of compound hazard and communication efforts with their communities.

People new to hazard-prone areas

People new to hazard-prone areas, in addition to individuals who choose to live off grid were highlighted in the research as especially vulnerable before, during and after compound natural hazards. This risk group also includes young people who may have grown up in a hazard-vulnerable location but who have yet to experience a compound hazard. People in these groups can be unaware of the risks they face and need to be informed, or to learn where they can access information about the local hazard risk environment.

Raising awareness among those unfamiliar with compound hazards is a matter of wider community safety, as a lack of preparation raises the risk of disaster impact. Individuals without lived experience can also suffer anxiety at the prospect of new impending hazards, and this itself a compounding factor. Therefore, information about what to expect and how to prepare needs to be delivered accurately, treading a balance between building awareness and creating warning fatigue or avoidance.

Inclusive: key strategies

1. Understand the language, literacy and digital literacy profile of the community and tailor compound hazard communication accordingly. Simple language, translation, printed, visual as well as and non-digital forms of communication can improve accessibility.
2. For longer-term inclusion, build communities' digital and communication literacy.
3. Ensure that communication with, and listening to, people with disabilities is dependable and actionable before, during and after compound natural hazards.
4. Include First Nations communities in emergency communication design, governance and implementation.
5. Actively raise awareness of compound hazard risk and preparation strategies among cohorts without lived experience such as newcomers and young people. Real estate agents and local government authorities can distribute information packs.
6. Communicate to support communities' mental as well as physical wellbeing. This can include opportunities for a debrief after a compound hazard event.

Creative

Compound hazard communicators should adopt **creative thinking**, be **intentional** about their messaging, and recognise the **value of storytelling** at all stages in the communication process.
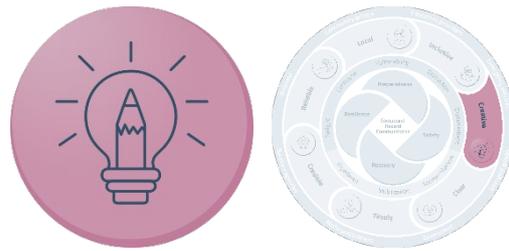
Novel challenges require novel approaches

It is clear from this research that communicating about compound natural hazards is inherently challenging and that conventional approaches sometimes fail. When hazards compound, they tend to be harder to explain and scarier to confront, and impacted communities tend to be more difficult to reach. An element of creativity is called for when tackling these interrelated challenges. Research highlights that creative approaches to disaster preparedness have been overlooked, and that without the ability to imaginatively preview what near future climate shocks could look and feel like it is 'almost impossible to believe their likelihood, let alone prepare, especially in frontline communities'. [131] Communicators, then, must be prepared to think outside the box and should be equipped with the skills to do so.

Artistic expression of experiences

Art, storytelling and related forms of creative expression can be powerful tools for communities to process and share their experiences of natural hazards. This becomes particularly important in the context of the complex, amplified impacts, increased vulnerability and prolonged recovery periods associated with compound hazard situations. The Dandenong Ranges is known for its thriving arts community and creativity has been critical to the recovery of many in the area after the 2021 storms – and the communication of lived experiences to the outside world (as outlined below). Community-based organisations and groups in particular can play an important role in creating opportunities for creative expression. Formal emergency management actors can encourage such initiatives through awareness raising, partnerships and grants funding.

Harnessing the everyday

Creativity in hazard communication encompasses novel ways of getting the message in front of audiences. In one case study location, key emergency management messages were successfully disseminated through cinema ads; in another, school children were producing work about hazards that was sent home and served as a valuable form of communication with households. Creative thinking about hazard communication therefore encompasses the choices made about channels, enablers of communication and the content of messaging. It is also worth noting that one young participant identified creativity – including colour, visual elements and storytelling – as a key feature of successful disaster messaging to children and youth.

Creative: key strategies

1. Emergency services should more readily engage the field of advertising to develop creative campaigns for preparedness, safety, recovery and resilience.
2. Develop immersive or creative experiences that encourage local residents to imagine the compound disaster experience to empower people on the ground to prepare.
3. Enable communities to express their experiences of compound natural hazards creatively. This can include supporting artistic community groups.

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[131] Cunningham et al. (2024).

4. Empower children and young people to be compound natural hazard educators and communicators by embedding content in school curricula and encouraging information dissemination to family and friends.

5. Avoid a one size fits all approach to compound natural hazard awareness, education and communication. Learn about and work with communities to understand and creatively address their unique needs and preferences.

Stories of Giants, a Dandenong Ranges creative recovery project

Emma Jennings is a Dandenong Ranges resident of over two decades and a local artist who operates a workshop, studio and gallery in the village of Olinda. She was deeply impacted by the storm of June 2021, finding herself without power in the middle of winter with her two children and grieving the widespread damage to the natural and built environment. To help herself and others to cope and recover, Emma established a project called Stories of Giants. Working with colleagues in printmaking, poetry and First Nations arts, she facilitated a series of free, creative workshops to allow local people to express and share their storm experiences and to reconnect with the forest.

It sort of comes from that place of connection to the forest and reconnecting with the natural world that has caused so much destruction, and we still grieve for the damage that has occurred (Emma Jennings, Dandenong Ranges).

The workshops have seen community members paint, write, carve and collage their own artworks on wood salvaged from the Dandenong Ranges. Many have talked about their stories while doing so, the environment providing a safe space of shared experience. The process of artmaking has facilitated a healing conversation between locals on their – often traumatic – storm experiences.

You're not having to type it out in a report, you're not being interviewed by a TV reporter. It's sort of a curious thing, it's not mindfulness; it's actually mindlessness when you're being creative sometimes. It opens up that dialogue. (Emma Jennings, Dandenong Ranges)

More than 100 people have attended the workshops, from age one to teens and over 90s. Additional community members have been engaged through the collection and processing of fallen trees. Indigenous ochre techniques have been incorporated, using material collected from around Australia but colours from the Dandenong Ranges. In this way, the project has been truly participatory and inclusive.

Recovery, hope, and resilience are central aims of the project, and Emma sees its main achievements toward these in the creation of friendships, connections and understanding, due to shared, lived experience of the storms and recovery from them. She is hopeful that creativity can continue to play a central role in preparing for, responding to and recovering from future disasters.

Figure 27: Emma Jennings in her Olinda studio. She makes artworks using trees that fell in the 2021 storm.
Figure 28: One of Emma Jennings' artworks, depicting local fire chief Bill Robinson, painted on a fallen free.

Clear

Compound hazard engagement and communication initiatives before, during and after compound natural hazards should **provide communities with realistic expectations and actionable information.** Such information should be **relevant, proportionate, consistent and unambiguous**.

Overcommunication

Overcommunication about disasters creates a risk of confusion but also of fatigue and anxiety among communities. Overcommunication may be more likely to occur compound hazard situations, as they often involve more emergency management actors than do single hazards. As noted above, community participants in this research described how they struggle to prioritise and filter large volumes of communication (for example, multiple warning text messages). This causes some people to disengage from warning messages and causes panic in others.

It is important that compound natural hazard communication is strategic and selective, so as not to overwhelm communities. Disaster-related information and instruction should be carefully chosen to be meaningful to the community at the time of dissemination: spamming should be avoided. Where possible, fewer but more precise communication outputs are preferable. Messaging should also be proportionate to the hazard at hand. Overcommunication can be interpreted as 'crying wolf, creating a boomerang effect [132], in which targeted stakeholders turn away.

Consistent messaging

Clarity in communication requires message consistency. As described above, the research participants emphasised the importance of bringing one message to communities under threat from compound natural hazards. Communicators should keep in mind when delivering messages before, during, or after a hazard that communities impacted by compound events may also be receiving messages about previous or upcoming hazards. In-person events may be clearer if combining several agencies and delivering a select, agreed set of messages.

Collaboration and coordination

There must be strong communication lines between emergency management actors about who is engaging with communities and in what way. This is especially important in the aftermath of multiple disasters when local community groups often step in to provide services. A single point of information about the activities of responders at different levels could alleviate these issues.

To effectively meet community needs after disasters, emergency managers must share observations from the ground with each other to enable appropriate responses. Research participants spoke of times when certain recovery services had been in shortage while others were available in excess. Another example community participants provided was the need for them to better understand the ways emergency managers prioritise recovery work. For example, some reported seeing emergency management drive past community members who thought they might be prioritised for immediate assistance, to respond to situations of perceived lesser

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[132] Hart, P. S. (2013). Boomerang effects in risk communication. In *Effective risk communication* (pp. 304-318). Routledge.

need. Engagement activities with communities should therefore also seek to clarify how responders triage response priority.

Clarity about risk

The findings outlined in this report show that Australian communities are not always aware of the risk posed by compound natural hazards, even though such hazards are set to increase under climate change. It can be difficult for emergency management to effectively convey the level of risk to a community, given inherent uncertainties, but it is critical to clearly do so. As noted earlier in this report, the fact that climate change is now driving and accelerating many hazards, amplifying risks, must be made clear to communities. Another strategy for explaining the projected impact of climate-driven hazards locally may be to map and visualise potential impacts under different climate change scenarios.

Clarity about self-reliance

Beyond underestimating their risk, community members are sometimes misinformed about the type of support they can expect in a compound hazard situation. Many have an unrealistic picture of the speed, scope and reach of emergency response. There may also be unrealistic community expectations as to the precision of information provided by emergency responders in a hazard situation. In reality, hazards are highly dynamic and difficult to size and map and compound hazard situations in particular do not generally allow for immediate and tailored information provision to all those potentially impacted.

Community engagement on compound hazards needs to provide clarity about these limitations and about the level and time period of self-reliance required of communities. It also needs to be instructive about how communities can prepare themselves and where to turn if unable to do so, including information on the timing of evacuation and location of shelters. The research indicates that self-reliance is already central to much emergency management communication, but there is a need to ensure that information and instructions reflect potentially more impactful compound hazard scenarios, in which emergency managers may not be able to help everyone.

Consistent and clear definitions and warnings

To be clear and meaningful, the hazard terminology and symbols used by different emergency management actors and across different parts of the country need to be consistent. The adoption of a shared fire danger rating system across Australia exemplifies this. Consideration of similarly consistent warnings may need to be developed for compound hazard situations to build community hazard literacy.

Certain hazard types do not have taxonomies that are well-known to communities. This creates a barrier to clear communication before, during and after events. For example, there is a perceived lack of established terminology to describe and quantity the potential impact of storms. As Dandenong Ranges forum participants explained, this lack of a clear naming system made it difficult to know what to expect before the event and to meaningfully describe their experience afterwards.

As noted throughout this report, the very term compound natural hazards is unfamiliar to communities, and there is an urgent need to agree on shared definitions to describe these increasingly prevalent phenomena.

Clear: key strategies

1. Coordinate with other emergency management actors to craft consistent messages that consider all hazards at play.
2. Communicate selectively and, where possible, prioritise less frequent but more consistent messaging both to communities and internally.

3. Establish a collaborative culture and way of working among emergency management actors and other compound hazard communicators. Share and adopt good ideas.

4. Ensure that information is gathered and shared – with communities and among emergency management actors – about who is doing what in the aftermath of compound natural hazards.

5. Clearly convey to communities their risk exposure to compound natural hazards, especially in the context of climate change. Communicate about expectations of self-reliance when compound hazards occur.

6. Establish terminology, symbols and warnings for all hazard types – including compound natural hazards – that are meaningful to communities and consistent between different agencies, locations and channels of communication.

7. Establish a local sound-based alert or warning system, audible community-wide, with clear information about what the sounds signify. This will provide a community with clear, immediate information about the nature of the threat and the urgency of taking action.

Timely

Engagement with communities about compound hazards should occur before, during and after hazard events, with recognition that these phases often overlap. **Awareness-building should complement timely alerts** before hazards; both **fast and slower-moving hazards should be communicated** as they unfold; and **learning, processing and sharing should be enabled** after hazards.

Before – awareness and timely alerts

The case study research undertaken here demonstrated the crucial importance of timely information sharing and alerts. In the Dandenong Ranges, residents were largely unaware of the hazard risk they were facing, mostly because the type of hazard was unexpected in the area. As a result, many community members were taken by surprise by the June 2021 storm, which struck at night. In the Burdekin Shire, on the other hand, residents spoke of premature cyclone alerts and updates on cyclone movements over days, which led many to switch off. A careful balance must therefore be struck in the timing of hazard alerts and media coverage. Community members need to be informed of impending threats with enough time step up their emergency plans, but alerts weeks or days in advance of a hazard threat may decrease alertness and preparedness.

During – fast and slow

Communication during compound natural hazards needs to be quick and safety focused. While challenging, multi-agency coordination at speed is essential in a compound hazard situation. Protocols specifying communication responsibilities for relevant scenarios could assist in achieving this. Local knowledge was also uncovered in the research as key to quick communication during a hazard. For example, distant call-centre responders without a strong grasp of local geographies and social contexts were reported to have prolonged emergency calls and response provision during compound events.

The experience of temporality in a compound natural hazard event can vary. While urgency and speed characterise many hazard events (especially in fire and flood situations), others (like cyclones) involve long waiting and, possibly, boredom. In such situations, regular communication can help communities to cope. Local radio stations were reported by study participants to play a particularly important role in supporting communities during and after hazards, both by providing critical updates and by broadcasting music, and in hosting conversations and community stories about the hazards after the event. Volunteer-run community radio stations are often willing to speak with compound hazard communicators on air at all time phases of a hazard, to provide community information in a timely way.

After – communicating within and about impacted communities

Post-event engagement is an important avenue for people to process their experiences: participants said that a lack of opportunities to share and talk about such experiences was detrimental. Research participants said that post-event community meetings with emergency managers, for example, could be a space for responders' and communities' shortcomings and successes to be discussed, and solutions raised.

Many people who have lived through a compound natural hazard want others to know about their experience. Study participants expressed a desire for regional and national media to share their stories, post-event, alongside a need for media coverage to be undertaken respectfully and not sensationalised. There is otherwise a risk that impacted communities feel forgotten – and resource allocation post-event often relies on an event garnering sufficient media coverage. Communities also want media coverage so that distant audiences (including their own family and friends) can be informed, given the outside world may not easily be contactable during and/or immediately after compound events.

Finally, it is important that communication and engagement efforts with communities be ongoing as compound hazards are not experienced by communities as discrete and with clear endpoints. Some forum participants noted that navigating the damage caused by hazards (for example, getting clarity around government financial assistance, insurance and other support) as a greater trauma than the hazard itself. Compound hazard engagement, then, is also the responsibility of actors who may not be considered core to emergency management, such as insurance companies.

Timely: key strategies

1. Conduct gap analyses on community awareness of hazard risk, including the risk of compound natural hazards and implement awareness-raising strategies to meet needs. This should include awareness of hazard seasonality.
2. Where possible, avoid overly premature communication about potential impending hazards.
3. Establish multi-agency protocols for communication during compound natural hazards to enable speed.
4. Account for communication needs during slower moving hazards. Local radio channels can broadcast content such as music and conversation to boost community morale and complement emergency messaging.
5. Arrange gatherings for communities and emergency managers to share successes and failures and register learnings after compound natural hazards.
6. Provide safe avenues for people to speak about and process their experiences, post-hazard.
7. Work with national media to enable coverage of the hazard event: communities whose compound hazard experiences are not covered by media can feel ignored and unheard.
8. Compound hazard communication should include communicating in a timely and accessible way about processes for post-hazard assistance and insurance claims.

Credible

Engagement on compound hazards should **provide accurate information** that can be used with confidence.

Misinformation

It is critical that misinformation be prevented in compound natural hazard communication. Emergency management authorities, political actors, news media and communities themselves all have a responsibility to ensure this and can do so by engaging in fact-checking practices and carefully informing themselves about the situation at hand. Broader compound natural hazard education and media literacy education have important roles to play in helping stakeholders and communities critically assess information received before, during and after disasters. For example, exercises to practice the debunking of disaster-related misinformation could be conducted in schools or at community events. Emergency management must also provide a credible source of truth that stakeholders know to trust and pass on to others.

Social media

Social media are key channels for hazard communication and can play an important role in engaging communities on compound hazards. According to the findings of this study, at least some community members first learn about approaching hazards on social media platforms, which are seen by many (for example, 59% of survey respondents in Ayr) as the information channel best placed to provide information on how to prepare for future hazards. However, social media also poses a risk to information credibility. As explained above, even where information is posted on social media by official and credible emergency management actors, it can be filtered and ordered in ways that make it difficult to appropriately assess and act on.

Emergency management cannot (and should not) stay off social media in the current communication environment, but should in the first instance communicate in alternative, less dynamic channels of information, such as an official website, disaster dashboard, app and/or paper-based communication. Where possible, they should partner with place-based news providers to ensure the delivery of credible messaging.

Sensory proof

Visual or sensory proof of a disaster can be effective at cutting through the confusion caused by a compound hazard. To enable such sensory proof at a safe distance, hazard information provision could include visual media like webcam footage, real-time mapping, or the use of call-ins to local community radio to collect and disseminate on-the-ground updates of an approaching hazard.

Local media

Disaster reporting by local news media outlets before, during and after compound natural hazards can be more credible than reporting by distant outlets. Participants in this research expressed great appreciation for the role played by their local newspaper and radio station during the hazards experienced. A critical factor was said to be local outlets' intimate knowledge of local conditions and people, and their ability to report with precision, using familiar reference points and drawing on local experts. This made their content more credible and trustworthy to readers and listeners. Community members are also more likely to directly report events and developments to local news broadcasters than remote ones, further increasing the credibility of content. One of the case study locations had lost its local newspaper offices in recent years. Community members noted that

the local news it produced was sometimes regarded as less credible given it was produced in a distant location in another regional town.

It is critical, then, that local media outlets be considered a credible channel and source of information in hazard situations. Many local media outlets are currently suffering the impacts of broader structural changes in the journalism and media industries, but their role as credible communicators in the hazards space means their longevity and sustainable resourcing is important. Given the trust and respect they receive from communities, emergency management authorities are also encouraged to work closely with local media outlets in engagement and communication efforts. The ABC, as the nation's key public broadcaster, and in many locations a key emergency broadcaster (though often broadcasting at a distance from hazard events) must also look to collaborate with local news providers, given their expert local knowledge

Credible: key strategies

1. Establish a credible official source of compound natural hazard information and ensure community are aware of it. Where possible, emergency services should look to partner with available place-based news and information channels, across platforms, to disseminate key messages.
2. Teach (social) media literacy and equip communities with knowledge about compound natural hazards, making them attuned to misinformation and news algorithms and able to seek out credible information.
3. Avoid sourcing news media content from unvalidated information on social media.
4. Draw on empirical data such as first-hand accounts or direct observation to raise awareness about compound natural hazards among communities, and to assess hazard impacts.
5. Protect and promote the role of local media outlets as enablers of hazard awareness-building and engagement.

Community radio and hazard communication in Burdekin Shire

Charlie Scuderi is volunteer Station Manager at community radio station Sweet FM 97.1 in the Burdekin Shire, Queensland. Sweet FM is an official broadcaster during disasters – typically cyclones and floods – working closely with the Bureau of Meteorology to communicate the right information at the right time to Shire residents. It is also represented in the Local Disaster Management Group and supports hazard preparedness through annual six-month long advertising campaigns focused on key calls for community awareness and action.

The radio station has many times proven critical for community safety. It is a reliable source of emergency messaging even during power outages. Residents know well to be prepared with battery-powered radios and that the station itself has generator back-up power. Its broadcasts are immediate, local and timely and tend to avoid some of the multiple – sometimes conflicting – messages that can arise on social media. For Charlie, this is one of the things that makes local radio so crucial in a disaster. 'Radio still has a place to play because of those reasons,' he says.

Charlie recognises the need for diversified channels of communication during natural disasters:

No one person listens to only radio, or radio all the time. No one watches television all the time, no one is on Facebook all the time. And even those that do will miss stuff. You need the information out there on every platform (Charlie Scuderi, Burdekin Shire).

In this context, local media has a special role to play. Sweet FM enjoys the trust of Burdekin Shire residents, demonstrated by their close engagement with the station. During disasters, many people call the station, sharing information and making requests. Some call in with music requests during extreme weather events to keep morale strong. Other locals will contact the station to express positive feedback after disasters.

The station is run by a fully volunteer staff who have a deep commitment to community safety and resilience. This is particularly the case during hazards events when volunteers sacrifice family time and may themselves have to hunker down at the station until the hazard has passed. To Charlie, Sweet FM's role goes beyond an informational one and is as much about enabling community cohesion during difficult times. Community radio's ability to support calm during disasters is especially important:

That calming effect. People ringing in, 'yeah, we've got no power; I'm listening to you on the battery radio and the kids are colouring in by candlelight on the floor'. Try and calm them. Yeah, you've lost your roof. Listen to us. (Charlie Scuderi, Burdekin Shire).

Figure 29: Local radio station Sweet FM's sign in front of its station building in Home Hill, Burdekin Shire. Figure 30: Volunteer Station Manager Charlie Scuderi in his Sweet FM studio.

Reliable

Compound hazard engagement should make use of a **range of channels, including non-digital channels,** to ensure that messaging can reach intended audiences, even when relied-upon infrastructures fail.
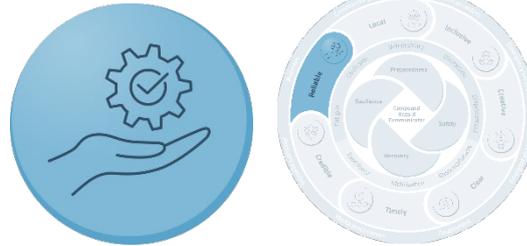
Communication technologies can be unreliable

Information and communication technology breakdown was a major theme in this research, as described above. All three case study locations had experienced disruptions to electricity supply, telecommunications or internet connectivity during – and in many instances as a result of – a compound natural hazard. Such disruptions had a major impact, not only on disaster messaging but on quality of life and were seen by some participants as a compounding factor in themselves: that is, a significant component of what makes a natural hazard compound. In the Dandenong Ranges, in particular, many households were without electricity for several weeks and even months after the storms of 2021. Persistent mobile blackspots and unreliable internet coverage also creates concern for future hazards in some locations. Households that lose mobile and/or internet connection are highly vulnerable during disasters and can feel deserted and marginalised during and after hazard events.

Back to basics – paper, word of mouth, radio, and alarms as solutions

There is a clear need to diversify communication and avoid reliance on digital channels during compound natural hazards. In the case study locations, paper-based communication including flyers, printed newsletters, and community noticeboards were identified as reliable sources due to their ability to survive power outages and communication blackouts. Limitations to this approach arise where communities or households are not easily accessible, and where information becomes outdated quickly. QR codes can be added to paper-based communication referring readers to up-to-date online notifications, but this is once again a challenge when electricity is disrupted or the internet connectivity is poor.

Word-of-mouth and face-to-face communication were also identified by participants as reliable. A 'hub and spokes' model could be used where one or several key actors located within impacted communities are provided with current information from central emergency management and are tasked with disseminating this in person (similar to the warden system outlined in the section *Local*). Such face-to-face communication may be resource-intensive but can be the most reliable option when the internet and or/mobile phone signals have failed.

Radio was commonly highlighted by participants as the most reliable channel of communication during compound natural hazards. Forum participants spoke about reverting to radio when their TVs, phones and computers failed, some accessing radio updates from their car, others through battery-powered devices or using Citizen Band (CB) radio to communicate with neighbours. Because radios are also comparatively cheap and durable, they should be included in preparedness kits and checklists.

One voice, one message – many channels

Emergency managers and other compound hazard communicators should speak with one voice but importantly, should not rely on one channel of communication. The risk of technology breakdown and disruptions to digital channels provides one impetus for this, and the diversity of populations another. Among research participants in this study, preferences, habits and abilities to access hazard-related information were highly varied. Ideally, key information can be synthesised and provided by a central source, but disseminated in

a range of channels, across digital, paper-based and face-to-face modes of communication. Multi-hazard dashboards provide an example of successful aggregation of information from numerous agencies.

Information cannot always be reliable

As outlined above, interviewees in this study described frustration with communities' high expectations of some hazard communication. Precision as to levels and locations of impact, they explained, is difficult to achieve, especially when more than one hazard is involved. While forecasting, remote sensing and real-time impact modelling are developing quickly, communities need to be aware that compound natural hazards involve uncertainty. Enhancing communities' understanding of uncertainty, and building their capacity to be responsive despite uncertainty, complexity and change is therefore part of compound hazard communication literacy.

Reliable: key strategies

1. Secure key communications technology infrastructure for a future of compound natural hazards of greater intensity and frequency.
2. Put plans in place for non-digital messaging during compound natural hazards. This can include paper-based solutions (e.g., flyers and notice boards) and face-to-face strategies (e.g., warden systems, doorknocks and hubs).
3. Households in higher-risk areas should have a CB and battery powered radio in preparation for power and internet connectivity outages.
4. Establish and promote a central source of hazard-related information but use multiple channels of communication to communities.
5. Inform communities about the limits of compound natural hazard forecast precision.
6. Encourage communities to develop three ways to stay connected and access reliable information during a disaster. These 'three ways' should involve different platforms, channels or telecommunications infrastructure, i.e., siren, phone, radio.

Using the framework: a scenario

This section serves to illustrate how the communication framework introduced in this report may be applied by emergency managers and other compound hazard communicators before, during and after a hypothetical compound natural hazard scenario. It seeks to bring the framework to life by providing tangible suggestions for how its different components can be approached in thinking and action. This scenario is intended to be used with the framework wheel – ideally set side by side for ease of understanding.

Heatwave, bushfire and flooding in Hometown

Hometown, a small town in regional Australia, is well-versed in bushfires. Each year, they pose some degree of threat to the community. Community members understand how to prepare their properties and listen for warnings and evacuation notices during the bushfire season. A small number of new residents have moved to Hometown in the past few years, attracted by its proximity to expansive natural spaces and forests. They are less well-aware of the bushfire risk, and relatively unprepared for fires. These new families, although still learning about the way of life in town, have been welcomed with open arms by the more established residents, the community being tight-knit and supportive.

The typical educational attainment in Hometown is below the national average, and the average age is older. People's lifestyle here is traditionally one orientated toward the natural environment and work on the land. Some people have come here to intentionally digitally disconnect and older residents are not all digitally savvy. While most residents have a smartphone, digital literacy is relatively low overall. Not all families have access to a computer or the internet at home. The internet connection, at least in some pockets of the Hometown area, can be patchy and unreliable. Hometown has a small commercial centre set along the beautiful Home River. Many houses are close to the water, a place where people like to meet and walk in the evenings. The town is adjoined to a secondary village by one road. Around the town are farms and bush, sparsely dotted with houses.

This year has been unusually hot and dry, and a heatwave is declared in January. Kids have been swimming in the river, though water levels are lower than ever. In the sweltering heat, residents have been on the alert for bushfires and some have been preparing their homes. They are not surprised when bushfire smoke is spotted from small fires early in the season. Later that week, still in heatwave conditions, two serious blazes are threatening the town. Local volunteer firefighters battle the fire for days supported by professional teams.

Hometown residents are responding with solidarity, listening for instructions, sharing warnings and supporting evacuations and temporary sheltering. Their efforts are challenged when the fires damage some powerlines and parts of Hometown lose power and then communication. Residents continue to collaborate and share resources, but the power interruptions during high temperatures pose a significant risk to many, and the heat and smoke present a serious threat to Hometown's elderly residents in particular.

When suddenly warnings are sounded for flash and riverine flooding, many are taken by surprise. A large storm brings heavy rainfall to the region, assisting the ongoing firefighting, but presenting another, unexpected hazard. Six times the monthly average rainfall soaks the town, inundating houses and shops and cutting off the only road to the satellite village, isolating its residents. Despite the rainfall, conditions remain hot, compounded now by high humidity – deadlier than the dry heat for those most vulnerable.

Once the emergency phase of the compound event is over, Hometown has survived, but not unscathed. Several houses are lost on the periphery of town and farmers have suffered livestock, feed and fence losses. In the centre of town, flooding impacted multiple houses and these are still uninhabitable. No lives were lost in the fires or floods, but two isolated elderly residents lost their lives during the peak of the heatwave, unable to stay cool when they lost power.

The below table provides a few illustrations of how the principles of the communication framework may be applied by emergency managers and other hazard communicators in the context of this scenario. Suggestions associated with different components of the framework (i.e., barriers, opportunities and enablers) are coloured accordingly.

Table 4: Applying compound natural hazard engagement principles to the Hometown scenario

Principles	Before	During	After
Local	Work with **community groups** to build knowledge of Hometown's unique social, economic, environmental, and cultural circumstances and analyse their implications for communication opportunities and barriers. **Opportunities** here include the town's evident solidarity and long-term residents' experience of bushfires. **Barriers** may be posed by the town's low digital literacy, and the lack of road connections to the satellite town. Introduce a constructive journalism campaign with **local media** on compound natural hazards. Plan community meetings to discuss the increasing hazard risk. Make residents aware that compound hazards will happen more often under climate change.	Activate a warden system where local intermediaries convey hazard information to an allocated group of residents. This may be especially helpful in the **satellite village** cut off by flooding.	Organise or attend community events for town residents, local leaders and emergency responders to collectively share, process and learn from the compound hazard experience. Facilitate reporting on the town's experience in **regional and national media**.
Inclusive	Provide targeted support to the **new residents** to understand the threats posed by bushfire and other hazards. This can include information kits distributed by the **local government**, or **real estate agents** for renters. Organise in-person information events ahead of the hazard season where conversations are facilitated with residents in communal spaces such as **community houses**.	Communicate through several channels, including non-digital means, to accommodate Hometown's **low digital literacy**. Consider using flyers and noticeboards.	Offer several different ways for those who have experienced the fires and flooding to share their stories. Paper-based and digital forms can be offered as an alternative to verbal sharing outside of or at community events.
Clear	Distribute multi- and compound natural hazard preparation instructions in plain English. Consider using images of local places to illustrate possible impacts.	Sound an alarm across town to signal the emergency. Use different alarms for fire and flood hazards. Carefully coordinate communications from **agencies and groups** involved in the bushfire and flooding response; avoid contradiction. This includes **community groups**: coordinate communication about shelters and emergency relief. Hold back, do not spam; only communicate critical warnings and instructions.	Facilitate the production and distribution of clear information related to insurance and government support, working with **insurance companies**. Work together with **community-based recovery actors** to coordinate provision of services and ensure that town residents can easily identify available support.
Timely	Build on **established understandings** of bushfire and proactively educate the town	As far as possible, broadcast both fire and flood-related information to town residents to provide sufficient	Review the way communication was managed before and during the compound natural hazard

	about the risks posed by compound natural hazards.	time for them to act appropriately.	event and capture learnings for future events.
Reliable	Encourage town residents to supply their households with radios given the town's frequent exposure to bushfires and increasing exposure to compound natural hazards.	Door knock to reliably establish an understanding of community members' needs in the complex situation they are experiencing, especially to check on Hometown's elderly residents. Supply evacuation and gathering points with generators and encourage people to charge their devices and use battery saving techniques. Disseminate information at these central points.	Ensure that information about any impacts from the fires and flooding, such as water contamination, is communicated through several channels, as **evacuated residents** may not be able to access normal communication channels for several days.
Credible	Inform town residents, through community events and other channels, of which is the official source of information for when natural hazards compound.	Work with **town news media** to enable them to broadcast up-to-date localized information.	Draw on the stories of town residents to help to credibly raise awareness among other communities with similar risk profiles. Explain, using **experts,** how the fire and flood risks are connected, and why the town faced such different threats in a short timeframe, to help people recognise the continued risk.
Creative	Get creative in attracting people to your in-person information events; integrate with the town market, introduce a mascot or organise a children's drawing competition. Invest in a creative "survival mode" campaign to encourage residents to think about their level of disaster preparedness.	Stand up a hotline which residents can call for information specific to the current fire and flooding event. Work with **schools** to refresh the knowledge of children – and through them their families – lifesaving dos and don'ts in relation to fire-damaged powerlines and generators.	Encourage and support creative community initiatives by **local groups** to support victims of the fires and floods to process the events such as group art and craft making.

Utilisation pathways

The work presented on compound hazard engagement in this report does not end here. The next important step is to make the framework accessible to diverse hazard communicators so that it can become useful, useable and used. The framework can guide in-person engagement activities with communities, but it should also be borne in mind when developing a range of engagement or awareness-raising efforts including, for example, public information campaigns. Possible pathways for disseminating and working with the framework are detailed below.

Amplifying use of an agreed definition

As noted in this report, the term compound natural hazard is not widespread, nor is the definition of such events agreed upon among emergency managers or communities. A vital first step in improving awareness and engagement on these hazards is therefore amplifying the use of the term and establishing an agreed definition. Understanding of the term needs to be built alongside an understanding that compound hazard events are increasingly likely under climate change. In addition to a text-based definition, a visual means of communicating compound hazards (like the infographic provided on page 15 of this report) should be used to increase recognition of the term and its meaning.

Capability-building for compound hazard communicators and communities

As tertiary educators, the research team sees the need for a training module to be built on community engagement for compound natural hazards and the use of the framework. This could be delivered in an online course. Deakin University and the University of Tasmania (UTAS) both create and deliver online microcredential training courses. Such courses have high production values and are structured with weekly modules to be completed part-time over four to six weeks. Importantly, such a course could be available to anyone in Australia, as well as to global audiences. Such courses can also be badged for several training providers, making a Deakin/UTAS/Centre jointly-badged course a possibility. The development of open educational resources (OER) could also allow widespread and free access to, and adaptation of, materials supporting the use of this framework.

In-person training courses could be delivered on a train-the-trainer basis. The research team could build capability in key personnel across a range of emergency preparedness and management agencies in communication and engagement for compound hazards and the use of the framework. This could be delivered as a series of day-long workshops in different parts of Australia to provide practical insights for community engagement. Workshop participants could be provided with online/printed training materials which could assist them in training others in their localities on best practice engagement for compound hazards.

Capability-building events and resources for communities could target disaster communication literacies and the ability to debunk disaster-related misinformation. Emergency management stakeholders could partner with higher education professionals to develop resources such as a disaster literacy toolkit, facilitate training events for community members, and/or collect oral histories to improve intergenerational learning about compound hazards. Community engagement events that help to enhance preparedness for compound natural hazards should be considered, working collaboratively with enablers such as local news media (ABC, community radio, newspapers) to help facilitate and promote.

The framework as interactive object and gamification

The framework for engaging communities on compound hazards presented in this report is two dimensional and static. However, the framework is envisaged as interactive and potentially three dimensional. The framework could be rendered digitally in a way that enables each part to move to rotate and help the components align; sections may flip to reveal more detail or provide more scenario planning ideas and insights when one part of the framework interacts with another. The framework could therefore be embedded in a publicly available website which allows a level of detail and interactivity. This could then be linked to a more in-depth training module on an external learning platform, as detailed above.

Equally, for in-person training and scenario planning, the framework could be made into a tactile, physical object with moving components. This could be a central component of workshop-based learning. A spin the wheel-type exercise would allow participants to think and talk through the various framework components in an engaging way. As a possible learning pathway, the framework would also lend itself to gamification. Serious games are garnering growing use for disaster risk management. [133, 134] The framework could be the central component of serious game play that provides a range of multi-hazard scenarios, for which players are required to formulate communicational responses that meaningfully incorporate the framework's compound hazard engagement principles.

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[133] Solinska-Nowak, A., Magnuszewski, P., Curl, M., French, A., Keating, A., Mochizuki, J.,... & Jarzabek, L. (2018). An overview of serious games for disaster risk management–Prospects and limitations for informing actions to arrest increasing risk. *International journal of disaster risk reduction*, *31*, 1013-1029.

[134] Mossoux, S., Delcamp, A., Poppe, S., Michellier, C., Canters, F., & Kervyn, M. (2016). Hazagora: will you survive the next disaster? A serious game to raise awareness about geohazards and disaster risk reduction. *Natural Hazards and Earth System Sciences*, *16*(1), 135-147.

Communication and engagement campaign development

Organisations that already communicate on natural hazards might now consider incorporating engagement on compound hazards, specifically, into their awareness-raising efforts. This could include the development of a public communications and advertising campaign focused specifically on compound hazard threats. Given that compound hazards are often experienced in an intensely localised way, this might look quite different in varied locations across Australia. Such a campaign, however, would nevertheless be a useful platform for raising the profile of compound hazards and the use of the term. Such a campaign might fruitfully use local voices, stories and experiences from communities that have lived through compound hazards.

Contributing to handbooks and existing engagement guidelines

This report acknowledges the multiple existing frameworks for disaster risk reduction and community engagement, both in Australia and globally. The work presented here is not intended to supersede, but rather to contribute to such frameworks, especially where there are silences on compound hazards specifically. To this end, it would be productive to undertake a review of how the framework presented here can interact with and contribute to existing frameworks that are already in use, to contribute a compound hazards perspective.

Likewise, an account of best-practice engagement for compound natural hazards could be contributed to national disaster risk reduction handbooks, like those published by AIDR. Current AIDR handbooks do not cover engagement for compound natural hazards specifically.

Limitations and future research

This report has summarised and presented the results of an extensive research study, conducted both on multiple desktops and on the ground in multiple locations. A study of this nature is never complete or perfect: there is always more that could be done. The study's survey received a relatively small number of responses. More time and personnel may have been required to run a larger, door-to-door survey, which could have provided more statistically meaningful results. This may also have helped to distinguish between communication needs and characteristics for single versus compound hazards, which may not have been clearly separable in this research. Given time, personnel and budget constraints, this research only extended to three case studies, all in Australia's east. Future studies could undertake compound hazard communication and engagement research in additional case study locations, particularly including Western Australia, South Australia and the Northern Territory. Additional geographical and hazard diversity would produce a more complete picture of current Australian compound hazard experience and how communication and engagement might address this.

While this study did engage with First Nations groups, and interviewed one First Nations leader, it could have lent an important additional perspective to have based one of the case studies in a First Nations community. The inequalities disproportionately experienced by First Nations Australians are important vulnerabilities to compound hazards. [135] Many First Nations Australians live in parts of the country that are already the most severely impacted by climate change. First Nations perspectives on and experiences of compound hazards should be sought and factored into compound hazard communication and engagement. As reported by a First Nations interviewee in Tenterfield, some First Nations Australians also feel uncomfortable engaging with emergency managers. Careful consideration must be made of how and where to undertake compound hazard engagement with all groups, particularly the most vulnerable.

Likewise, this study did not engage with young Australians and the schools that educate them. The more onerous ethics requirements of working with young people and the short project timeframe prevented this. The desktop research and case study fieldwork substantiated, though, that schools play an important role in engaging and informing young people about natural hazards, and that this information is often taken back home, supporting household preparedness. Future research could engage with schools and young people – the generation whose lives will be most impacted by climate change and climate-driven hazards – on how they experience compound hazards and how they would like to be communicated with in compound hazard situations.

Future research could investigate how community storytelling, including hearing the experiences of community elders in relation to hazards and responses, could help mobilise community members. Personal stories of hazard experiences may be persuasive to younger people who have not previously experienced particular hazards, or those new to an area. Research into compound hazard storytelling, broadly, could also investigate the use of creative media like video and virtual or augmented reality in communicating hazard risk to communities. This corresponds with what this study heard from participants: that visual proof of a hazard is the most trusted way to learn about a hazard and subsequently mobilise for preparedness and response.

Researchers must be mindful of research fatigue in the natural hazards research space. Residents of the third case study location, Tenterfield, were already being engaged with when the research team visited the town, by a parallel project, Fire to Flourish. It is possible that the lower survey numbers in Tenterfield were related to the fact that another project also working in the community. Fire to Flourish is a much larger project and is also well resourced, meaning it is able to make grants within the community, which was not the role or objective of this study. While there was good engagement with this community overall, researchers must balance the possibility of creating community research fatigue with the imperative to research particular communities because of their

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[135] AIDR (2019). Aboriginal People and the Response to the 2019-20 Bushfires. Available at: https://www.aidr.org.au/media/7718/aboriginal-people-and-the-response-to-the-2019-20-bushfires.pdf; Thomassin, A., Neale, T., & Weir, J. K. (2019). The natural hazard sector's engagement with Indigenous peoples: a critical review of CANZUS countries. Geographical research, 57(2), 164-177.

locations or important hazard experiences. Future research involving a greater number of survey respondents in each case study location would also facilitate the identification of potential significant differences between locations and across time, which would help to provide more granular insights on how communities can better prepare and respond to compound natural hazards.

Conclusion

As many parts of Australia grapple with repeated hazards within a short timeframe, engaging people on compound natural hazards is timely and crucial. Those seeking to communicate with communities on compound natural hazards can draw on the research presented here and adopt the key principles of the framework outlined in this report to guide their communication and engagement activities. Ideally, each message or engagement activity on compound hazards should include as many of the framework principles as possible. Compound hazard communication and engagement should be local and localised, inclusive, creative, clear, timely and credible and it should be delivered in a reliable way, even when hazards are unfolding.

The evidence of the need for hazard preparedness is clear, with four in five people in Australia having been impacted by at least one disaster since 2019. [136] The National Emergency Management Agency also shows that for every dollar spent on disaster risk reduction there is an estimated $9.60 return on investment. [137] Effective compound hazard communication of the kind described in this report is potentially resource intensive, but it must be developed: it has the potential to save lives and property, and build the resilience that Australia needs to weather climate-driven hazards.

Australia also has the chance to lead in this domain. This research revealed that there appears to be no other existing framework for compound hazard communication in any jurisdiction globally. This research can therefore mark a starting place for better understanding what is required to raise awareness, locally to internationally, for current compound natural hazard risks. Above all, though, this study and the framework it has produced are a resource for Australian emergency managers who seek to better understand how to work with communities in the context of compound hazard risk. The framework is intended to be a living guide for these communicators, something which can be adopted and adapted for local circumstances, used for strategic reference as well as in daily practice. If it can be used to improve the vital tasks of communication and engagement in a future of escalating hazard threats, it will have fulfilled its purpose.

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Team members

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Figure credits

Front cover: iStock image, 'Queensland Rural Firefighter inspects bush fire' by Stuart.

Figure 1: Noelle Nemeth & Malcolm Johnston, University of Tasmania

Figure 2: Stacey McCormack, Visual Knowledge

Figure 3: Basemap: Open Street Map, State boundaries: ABS

Figure 4: Basemap overview: Open Street Map, Basemap main map: Google Satellite. State boundaries: ABS

Figure 5: Nick Carson via Wikimedia Commons

Figure 6: Dr Gabi Mocatta, University of Tasmania

Figure 7: Basemap overview: Open Street Map, Basemap main map: Google Satellite. State boundaries: ABS

Figure 8: David McKelvey via Flickr

Figure 9: Basemap overview: Open Street Map, Basemap main map: Google Satellite. State boundaries: ABS

Figure 10: Phil Copp, Getty Images

Figures 11-13: Dr Kristy Hess, Deakin University

Figure 14: Sheba_Also, via Flickr, Creative Commons Attribution-Share Alike 2.0 Generic license

Figure 15: Ranges Trader Star Mail

Figures 16-21: Prof. Joshua Newton, Deakin University

Figures 22-26: Stacey McCormack, Visual Knowledge

Figures 27-30: Dr Gabi Mocatta, University of Tasmania

Appendix: Media coverage and promotion of the research

Local news media coverage

This study incorporated engaged journalism, that is, it facilitated news outlets taking an active role to bring people together to discuss issues of shared common concern, in this case compound natural hazard communication. In each case study location, the research team engaged a local news outlet and worked closely with local journalists in planning, preparing, and publishing/broadcasting a series of news and human-interest stories or interviews related to compound natural hazards and the research. This helped to bring people together for constructive conversation into the community forums. Beyond this, it served as action research by raising community awareness of compound hazards, and by promoting the role of local media as natural hazard communicators. The section below includes some of the media articles produced as a result of this engaged journalism aspect of the study.

Samples of local news media coverage

Articles published in the Ranges Trader Star Mail (Dandenong Ranges):

NEWS

The June 2021 storms brought down trees across the Dandenong Ranges and were strewn across roads like Monbulk Road Monbulk. 340535   Picture: STEWART CHAMBERS

Share your experiences

Residents in the Dandenong Ranges have first-hand experience of living through a natural disaster. They also know all too well the importance of good communication during difficult times.

Two years on from the devastating storms of June 2021, the Ranges Trader is supporting an initiative to improve communication between emergency responders and locals in times of disaster.

This has led to the launch of Storm Talk, an innovative partnership between local media and natural hazards experts, which encourages Dandenong Ranges residents to share their experiences of communication during the storms and awareness about such natural hazard events.

The project is funded by Natural Hazards Research Australia and delivered in partnership with a team of researchers at Deakin University.

"Our research team wants to know how community members received information before, during, and after the storm - and what could be improved," the project's lead researcher, Dr Gabi Mocatta said.

Over the next few weeks, the newspaper will run a series of articles presenting local perspectives on communication during the 2021 storms.

Residents are also being asked to fill out a survey or consider attending an invited community forum to share insights and experiences about where they receive information about disasters and how that process could be improved.

"We want to find out, for example, where good communication might have saved lives and property, and where it helped bring people together," Dr Mocatta said.

"We also want to know where there are gaps in education, communication and awareness about natural hazard events, like the 2021 storms."

STORM TALK

The 2021 storms brought down 25,000 trees and damaged 173 properties, all in the middle of some of the strictest Covid-19 lockdown conditions in the world.

Many Hills residents were left without power for months. For some, the impact of the storms is still being felt, as damage to property is slowly repaired.

Unfortunately, compound natural hazards – disasters on top of disasters – are becoming increasingly common in Australia. Communication and awareness initiatives are key to preparation for future disasters.

"We are hoping that community members will join in the discussion and help us understand what worked well and what really needs to change about the way we communicate natural hazards," Dr Mocatta said.

Star Mail editor Mikayla van Loon agrees.

"Our newspaper wants to use its leadership and passion for the community to help bring people together for these important conversations," she said.

The community forum will be held on Saturday 11 November.

If you would like to participate, please express your interest by contacting Gabi Mocatta on gabi.mocatta@deakin.edu.au or completing the form https://forms.office.com/r/G3BFfsZGD6.

A storm like no other...

By Mikayla van Loon

Gary Lee recalls the terrifying cracking sound that woke him from sleep and the shock of finding a four-tonne tree in the middle of his family home during the storms in June 2021.

Having made attempts to call for help without any success, Gary says he sat waiting in his car from 3am until about 7am in the hopes emergency services would arrive.

"I basically stayed near the house in the car hoping that someone would come but it never eventuated," he says.

As a former MFB firefighter, Gary says he understands the demand on emergency services during major events but communication in the immediate aftermath could have been improved.

"It could have probably been better with more people answering phones, to say, 'Well, look, I'm sorry, but this is what's happening and we're pretty well on demand or we've got no staff to get there'.

"That didn't happen but I'm just accepting of it. It is what it is and other people were worse off than me."

While there were warnings for major winds, the storm was never expected to be as ferocious as it was.

"The winds, I've never felt anything like that. When you're sitting in a Hilux ute and it's actually rocking. Even with my training it was frightening," Gary says.

"With the amount of wind, it was pitch dark because no lights were on with the power all off and it was just black. I'm sitting in the car out the front and I thought to myself, 'Oh, my God, this car is actually moving'. It was horrendous.

"I don't think they expected the winds to be as big as they were and the warnings weren't there for that."

The thought of leaving never even crossed Gary's mind with the mentality of "it's not going to happen here". He said if it was to happen again with better warnings in place, he wouldn't make the same mistake.

"In hindsight, if it came again and I still had gum trees around my house, I probably would leave.

"But at the time, no. It's the old scenario: it can't happen, it won't happen. You're not expecting a tree to fall on your house. It's not going to fall out of the ground and land on your house."

Although warnings at the time were issued for floods and high winds, the Dandenong Ranges experienced over 100km per hour winds and unlike floods or bushfires weren't given a 'watch and act' notice.

Worried about what could happen with the current weather patterns Victoria is seeing, Gary says it feels like it's only a matter of time before trees start falling again.

"We had a massive amount of rain last month so the ground at the moment is probably waterlogged and if we all of a sudden get 100 kilometre winds again, who knows what's going to fall over," he says.

A four tonne gum tree fell through the roof as Gary and Karen Lee were sleeping.   Pictures: SUPPLIED

The damage left a gaping hole in there roof causing damage to belongings.

"The way the weather has gone the chances are, we are going to get this again."

Still fearful of wind storms despite having cleared many of the trees around them, Gary says it is a sentiment many people in the Hills carry after the terrifying event.

The disaster was compounded by the Covid-19 pandemic which meant that people were less able to move around, or leave the area, in the immediate aftermath. Power outages also added to people's information and communication difficulties after the storms.

Gary says the need to coordinate assessors for damage while losing all of their most treasured possessions to mould and rain, created "the biggest part of the stress and anguish".

It took 10 months for Gary and Karen to move back into their home but that night will stay with them forever.

mailcommunity.com.au

Tuesday, 17 October, 2023 | MAIL 5

NEWS

Old lessons from Darwin paid off during Hills storms

By Mikayla van Leon

Julia Hall instinctively drew on her experiences of living through cyclone season in the Northern Territory when the Dandenong storms of 2021 hit.

As soon as the sounds of the wind intensified, she immediately began dragging bed mattresses into the living room to protect her family inside the home.

"That sound, I remember thinking 'we're in a cyclone'. That's what it was like. I had never really heard anything like that in Victoria. That's the wind sound you hear in Darwin when a cyclone is around," Julia said.

Living through not one but two storm events just a month apart from each other during 2021 was a learning curve for Julia and her family.

Having lived in the Dandenong Ranges for 12 years, Julia said she'd experienced storms before but nothing like the night of 9 June.

"We didn't really think about it. You get a lot of storms in the hills, you get a lot of warnings, but we have never worried about a normal storm. The big danger in the hills that you always think about is fire," she said.

"So we were very well prepared for a fire warning and for what to do. We had our fire plan to put in place if a fire was going to come through but it never crossed our mind that a storm could cause that much damage, so it wasn't even on our radar.

"It was only after that storm on the night of the ninth of June that it made us realise, 'Wow, we actually need to be much better prepared' because we just were not ready."

The strength of the wind pushed furniture

Julia Hall and her family were trapped inside their home twice over June and July of 2021.
Picture: ON FILE

around "as if it was balsa wood on the balcony", as well as a full gas bottle and brought down 26 trees in the backyard.

Julie recalls walking out into a state of complete destruction and chaos. Power and internet had been disconnected, trees were blocking the driveway and the road and the thought of 'what now' sunk in.

She made her first ever call to the SES when she finally got two bars of phone reception. Julia said she learned a valuable lesson of the need to share critical information with emergency crews

"I got through to the SES and they said: 'Are you warm?' And is anybody hurt?' And I said: 'No we're fine, we've got a generator, and we've got a fire and we've got gas cooking, so we're OK'. And they said: 'OK, well, we need to prioritise other people that are in danger.'

"I was like: 'Yep, no problem' and so they had us on the list, but we weren't a priority. And that was where I learned I needed to give them the whole story because had they

known my husband had just had a heart attack a few months earlier and it was important for us to be able to get in and out of our driveway, we would have been prioritised.

"But instead we had two weeks of driving over powerlines because that was our only way of getting in and out of our driveway. The road was blocked for about four days. So that's a really big risk that I was not prepared to take again."

When it did happen again in July, Julia knew the process and was better equipped to ask for what she needed.

"I learned my lesson from the first storm not to be shy about letting them know our situation. So probably about 7.30 in the morning, I rang the SES and I let them know we've had a massive tree down across the driveway and we've lost our NBN," she said.

"I said: 'My husband had a heart attack in February and we really do need to be able to get in and out of our driveway'.

"Just the fact that I let them know about our situation with Wayne and his heart, by three o'clock in the afternoon that tree was cleaned up and our driveway was open. They literally never got to us in the first storm."

Julia said had the SES prompted her with more questions in the first storm event in June, it probably would have been a different conversation.

"Had they said to me: 'Have you got anybody in your house that has a life threatening condition?' That would have triggered for me: 'Oh, yes, I do. My husband had a heart attack in February, he has a sensitive heart and he's still in recovery, getting used to his medication'.

"That would have totally changed the conversation but instead their questions are: Is everybody safe? Yeah. Is everybody warm? Yeah. Do you have a generator? Yeah. Then you're fine."

Julia said being prompted to share health concerns during an emergency call would create less stress and worry for people in similar situations.

"It's a behavioural thing. As humans, we don't want to put ourselves before others. So in a storm like that, my head went: 'There's clearly going to be people worse off than us, we haven't got a tree on our house, we're alive and I just want my driveway cleared'.

"But Hills people, I think, we don't want to be a bother and as a consequence, we also maybe don't always get the help we need as quickly as we need it. For some elderly people it was like seven days before anybody got to them, sometimes longer."

Moving forward, Julia said the opportunity to ask more questions of people who call for help, whether it be to Yarra Ranges Council, SES, CFA or other services would hopefully improve the outcomes for all.

While room to learn and grow from the storm events of 2021, Julia said she is extremely grateful to have volunteer organisations like the SES and CFA to provide support in disasters of every kind.

"I was so impressed with the SES response overall, and also their handling and management, as well as the CFA.

"We're really lucky to have that and so whatever support they need, we should be giving it to them."

'Compound natural hazard'

In mid-2021, the Dandenong Ranges experienced storms and localised flooding in the middle of Covid-19 lockdowns. For many Hills communities and their residents, the impacts of the storms were catastrophic, and are still being felt today.

The Dandenong Ranges are one of a growing list of places in Australia experiencing disasters – but also one of the few places that has experienced what is known as 'compound natural hazards'.

"We usually think of natural disasters as separate, one-off events," natural hazard researcher Dr Gabi Mocatta from Deakin University, who is leading a team researching the storms, said.

"But there's a growing realisation that many places in Australia are experiencing one or more hazards at the same time, or closely following each other."

The 2021 Ranges storms in themselves was a significant event. The fact that they occurred during Covid – and one of the world's longest lockdowns – made the aftermath worse.

The storms' impacts, including trees down,

STORM TALK

property damage, road access blocked, power outages and local flooding all compounded each other, making the disaster more severe.

"In our changing climate we are seeing compound natural hazards become more frequent in Australia and around the world," Dr Mocatta said.

"Because the overlapping impacts of compound hazards can be so much more severe than when hazards happen separately, lots of research is now going into how to better understand compound hazards and how to prepare for them."

Compound hazards look different everywhere – with 'cascading impacts' that can be both natural and manmade. Overseas examples include the 2011 earthquake in Japan that led to a tsunami, and then nuclear disaster when the tsunami wave flooded the Fukushima plant.

In Australia, the New South Wales town of Tenterfield experienced years of drought, followed by the Black Summer bushfires and then flooding which led to water contamination.

In the Dandenongs, it was the 2021 storms and flooding, occurring in the middle of Covid.

"Compound hazards are different from the single disasters we might have experienced more in the past," says Nicola Moore from Natural Hazards Research Australia, which is supporting the research in the Dandenong Ranges.

"This means we need to find new ways to boost awareness, preparation, emergency response and recovery."

"We can learn a lot from places like the Dandenongs that have recently experienced

What are compound natural hazards?

- Natural hazards or disasters that occur at the same time in one place
- Hazards that follow each other in quick succession
- Impacts from compound hazards may overlap and interact – so that hazards are worse when experienced together or in quick succession

compound hazards about how as communities, and as a nation, we can better prepare for these events in the future," research team member and Monbulk resident Dr Erin Hawley said.

The Ranges Trader Star Mail is supporting this project by providing the community with news about the research. Readers can get involved by joining a community forum or completing the project survey.

Please email gabi.mocatta@deakin.edu.au to be part of the forum. Use the QR code to complete the survey.

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NEWS

Meet, share, reflect on your experiences

Residents across the Dandenong Ranges are being urged to attend a forum in Olinda next week to discuss best ways to communicate and share information when faced with natural disasters.

The Ranges Trader Star Mail has partnered with Deakin University academics and Natural Hazards Research Australia to encourage residents to share their experiences on how best to improve communication before, during and after crises such as the devastating storms that hit our region in 2021.

The initiative – called Storm Talk – will culminate in a community townhall-style event for residents on Saturday 11 November at the Olinda Community House to bring people together to share and learn from their experiences.

There is hope other communities from across Australia can also benefit from the insights that Dandenong Ranges residents can offer, with researchers hoping to understand both the challenges as well as the novel approaches that can be adopted to keep people connected.

Newspaper editor Mikayla van Loon said now was the time to bring people together to talk about disaster management rather than during an emergency, especially given weather forecasts predicted a hot summer ahead. She urged the community to come together and also consider ways to ensure those at greatest risk had the information they needed to stay safe.

"The storms of 2021 have created some lasting scars for many in the community but talking about how best to keep communica-

tion going, for example especially when power lines are out and we lose internet, is just so vital," she said.

"We really see it as our [newspaper's] role to help the community have this conversation because we are stronger when we pull together, share ideas and openly talk what went wrong and what went right."

Deakin researchers are also encouraging locals to complete a short survey to share their thoughts on communication needs during disaster. To complete the digital survey, click on the QR code on this page.

Registration for the town hall event is essential. To attend please RSVP by Friday 3 November to Dr Gabi Mocatta gabi.mocatta@deakin.edu.au. A free afternoon tea will be provided.

Share your storm experiences by registering for the event to be held on 11 November at Olinda Community House. Picture: ON FILE

The trauma of the young

STORM TALK

When disaster strikes, the impact is keenly felt by all members of a community – including young people.

Twenty-two-year-old Willow Swaneveld knows this first hand. Her experiences of the 2021 Dandenong Ranges storms left her without a home, and with a new burden to carry: trauma.

The storms of June 2021 were devastating to towns and communities throughout the Ranges. Homes were destroyed, roads were blocked, and households were left isolated and without power during the dark months of winter, all while grappling with the restrictions of Covid-19 lockdowns.

For Willow and her family, the second round of storms in October 2021 struck a harsher blow. A huge tree fell through the centre of her family home in Cockatoo on the morning of 29 October, rendering the property uninhabitable.

Together, the two storm events – the impacts of which were exacerbated by Covid-19 lockdowns – are known as compound natural hazards: disasters that happen at the same time or in quick succession.

"It was hard," Willow says of the two storms. "Everyone's still recovering from the first storm so having a second one, it feels like people can't really find their footing, like they haven't had a chance to breathe."

Compounding factors can also be individu-

al. Willow lost her father in a tragic accident in 2021, and she and her family were still grieving when their home was destroyed by the storms.

In the wake of her trauma, Willow turned to art and creativity. Approached by a friend from charity organisation The Windermere Foundation, she took part in an augmented reality art installation called Hard Place/Good Place. The exhibition was held at the Yarra Ranges Regional Museum in Lilydale in 2022 and gave an immersive representation of young people's

experiences of the storms.

While the experience of the exhibition was something of a whirlwind, Willow remembers how meaningful it was to be given the opportunity to tell her story. "It's such a bizarre feeling when you go through such a trauma because you don't expect people to listen," she says. "All I knew was that someone reached out to me and said, we want to hear you – we want your voice to be heard."

Willow has since spoken about her experi-

ences to first responders and council members, work that saw her recognised as the 2023 Yarra Ranges Council Young Citizen of the Year.

Her story is a reminder that young people play an important role as communicators and community leaders before, during, and after a natural disaster.

"After the storms happened," Willow says, "all of the information that I was receiving was from social media. And obviously young people have grown up a little bit more engaged and they know how to navigate that online world a lot better."

She says she remembers seeing young people taking to social media in the wake of the storms to spread awareness and offer help. Children as young as 14 and 15 were sharing news and offering generators, food, hot showers, even blankets for pets.

It remains important for young people to be kept in the loop when disaster strikes.

To communicators trying to reach young people with information about disasters, Willow recommends using social media channels like Instagram and thinking carefully about the visual aspects of a message – bold fonts and bright colours can go a long way towards engaging a young audience, she says.

Communicatoes can learn a lot from young people too – and not just because of their social media savviness. While young people may lack background knowledge and expertise, they bring something else to the communication process: empathy. "I think young people definitely have a fresh perspective," Willow says. "We have the opportunity to tell people how it is, because we don't have the background knowledge of everything that goes along with it."

And creativity remains an important way for young people to share their ideas and stories. As Willow puts it, "Having creative freedom for the story to kind of tell itself through whatever medium you're using – I think that's a beautiful thing."

Willow near the fridge that may well have saved her from being crushed by a falling tree in 2021. Picture: STEWART CHAMBERS

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Meet, share, reflect on June 2021

03/11/2023

Share your storm experiences by registering for the event to be held on 11 November at Olinda Community House. Picture: ON FILE.

Residents across the Dandenong Ranges are being urged to attend a forum in Olinda next week to discuss best ways to communicate and share information when faced with natural disasters.

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The initiative – called Storm Talk – will culminate in a community townhall-style event for residents on Saturday 11 November at the Olinda Community House to bring people together to share and learn from their experiences.

There is hope other communities from across Australia can also benefit from the insights that Dandenong Ranges residents can offer, with researchers hoping to understand both the challenges as well as the novel approaches that can be adopted to keep people connected.

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She urged the community to come together and also consider ways to ensure those at greatest risk had the information they needed to stay safe.

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NEWS

Community the best salve

The Regional Community Recovery Committees were first established in 2021 to support the Yarra Ranges in recovery from Covid and the storms.
Picture: YARRA RANGES COUNCIL

Community is strong in the Dandenong Ranges. And when it comes to shared experiences of hard times and disasters, Ranges communities have always been there to help each other get through.

In the aftermath of the 2021 storms and Covid, community has been central to the recovery effort. One important site for this has been the work of the Hills Community Recovery Committee. Supported by the Yarra Ranges Council, this group of locals helping locals has been crucial in aiding people across the Ranges to get back on their feet.

Central to the committees was the idea that, when disasters happen again, communities should know what recovery might look like and how community could work together to achieve that.

"The committees are really focused on community well-being," Hills committee member Alex Grunwald said.

"Most of the projects were around community connectedness and that's obviously really important for social well-being.

"The committees are made up of community members and we ask people and groups to come forward with ideas and then fund those ideas. So it does serve really well to maintain a level of activity in the community."

With the help of the Bendigo Bank's Community Enterprise Foundation, the committees have helped facilitate multiple new community initiatives in the Hills area. The many and varied projects include a new exercise group, support for community radio station 3MDR, and the exciting Treasuring Our Trees project, which repurposes trees fallen in the storm into useful timber installations.

Being involved in helping community, and working with community, is also a way of raising awareness and preparedness for future disasters, Alex says.

"Being aware and knowing that this can happen again is a really important part of this work," Alex said.

"I guess the best way for community to make themselves aware of natural disasters and how we should respond is for them to become active in that space themselves and to have a direct interest.

"If people are directly involved they are going to be across all the information a lot more and know how to respond when new disasters happen. That's what recovery committees can help do."

It's just these kinds of community insights and learnings that a Deakin University research project currently working in Dande-

Trees in Kalorama fell in every direction.
Picture: ON FILE

nongs is seeking to tap into.

The project 'Awareness, education and communication for compound natural hazards' is being conducted by researchers from Deakin with the research body, Natural Hazards Research Australia. The project wants to understand what builds communities' awareness, preparedness and resilience when disasters happen at the same time or in quick succession.

"We have a community forum in Olinda coming up very soon," Deakin researcher Dr Gabi Mocatta said.

Alex Grunwald removing weeds and re-planting native vegetation in Kalorama Park after severe storm damage.
Picture: ON FILE

"We'd love community members to join us and share their thoughts on what aids preparedness, what helps recovery, what raises awareness and what information is needed, and when, to help communities better prepare for and recover from the next disaster."

Alex knows well, from his work on the Hills Community Recovery Committee how much this kind of research matters.

"It's really a huge area for research. It's super important and I think it's going to become more and more important.

"If people are interested they should con-

sider going along to the forum," Alex says. "This is worthwhile research and it's a good opportunity for community input."

The 'Storm Talk' Community forum is being held at the Olinda Community House on Saturday 11 November from 1.30-4pm. The event includes afternoon tea. Any Dandenongs locals who experienced the storms or the recovery are welcome.

If you can't attend the forum, you can participate in the research by filling in the anonymous community survey here: researchsurveys. deakin.edu.au/jfe/form/SV_eV5q2T4DBX-tlKEu

Forum speaks volumes

STORM TALK

By Mikayla van Loon

Members of the Hills community gathered at the Olinda Community House on Saturday 11 November for a special forum about the storm events of 2021.

Hosted by Deakin University researchers, the attending residents, who came from all across the Dandenong Ranges, were the first case study in a year-long project to understand how communication plays a role in effective hazard management.

Communications researcher Gabi Mocatta said the crux of the project is to "better understand how we confront this age of increasing natural hazards".

"[It's] all sorts of natural hazards, flooding, fires, extreme weather events, heat waves and so on," she said.

"[We're looking at] how as communities we can, first of all, understand them better and then prepare to cope with the kinds of hazards that a lot of the modelling shows will be increasing into the future that we're already seeing now."

Exploring how "better awareness raising, better education, better communication" can inform or change the response to compounding natural hazards, the research will take Gabi and her colleagues Kristy Hess and Erin Hawley across the country to hear from different communities.

Beginning the research in the Dandenong Ranges on the 2021 storms, Gabi said next year the team will also head to northern Queensland where they've been impacted by floods and cyclones, as well as Tenterfield in New South Wales, a community affected by fires and floods.

Attendees on Saturday told of their experiences during the storm, from trees falling constantly around them to the community banding together to get information out.

But what began the discussion was the lack of terms or words used to describe a storm, particularly in the context of June 2021.

"A storm can be anything from lots of rain or a bit of wind to an almost cyclone. This wasn't a cyclone, you could tell it wasn't a cyclone but there's never been anything like that before," Jenny said.

From suggestions of connecting into the internet network from the street via a generator or car power to community slogans for a community meeting point and time if there is ever a storm or natural disaster again, residents informed the discussion on what could be implemented on a larger scale.

It became clear that neighbour to neighbour check ins and interaction was one of the best sources of information when all communication was down.

"But the services need to learn how to interact with the community respectfully and not rudely. I mean, some of the body language and the attitude I personally witnessed and been the recipient of has been appalling," Liz said.

The insights will guide the long term outcomes of how communication can improve in the event of a natural disaster, particularly when they happen in quick succession.

The community attendees were very gracious in sharing their experiences of communication or lack of during the June 2021 storm.

Table discussions led to some interesting suggestions of how to communicate in times of no power or internet.
Pictures: MIKAYLA VAN LOON

Articles published in the Tenterfield Star (Tenterfield):

TENTERFIELD TALKS COMMUNICATING IN A CRISIS

Mitigate by planning

BY **JACOB MCMASTER**

COMMUNICATION and forward planning can mitigate disaster and speed up the recovery says Tenterfield Aerodrome president Rob Evans.

Tenterfield has a dedicated Emergency Management Committee that meets daily during periods of disaster, and that allows emergency services and volunteers to concentrate on their response.

It's something the aerodrome is very familiar with after the installation of a 200,000 litre water tank just a day before a lightning storm sparked seven emergency level blazes close to town.

"There are always problems that occur [in an emergency] and that's where the emergency management committee comes in to see what's happening right across the board and make good decisions," Mr Evans said.

"That's the ideal, it doesn't always happen smoothly, things occur and roads get closed so that could mean you've got to shut off an area

and go around."

The committee can coordinate informing the public through the local community radio along with NBN news and the Tenterfield Star via community meetings held in conjunction with the RFS and other reporting updates.

For the aerodrome itself, forward planning is put in place to try and mitigate disasters.

We've tried to look several years into the future and say firstly that we want to make sure this aerodrome stays as an aerodrome, secondly that it stays as a disaster readi-

Friends of Tenterfield Aerodrome president Rob Evans with a Fireboss water bombing aircraft at the aerodrome's fete on February 24.

ness hub - and that we put the infrastructure here which means that when something does happen like a bushfire the fire fighters can just turn up and everything they need is ready to go," Mr Evans said.

During bushfire season the aerodrome is a constant home to at least one Fireboss water bombing aircraft and in October was a base of operations for almost a dozen fire-fighting aircraft at any given time.

"We got the water tank in the day before the fires started and the RFS got the water delivered and filled the tank

> **"** The emergency management committee comes in to see what's happening right across the board and make good decisions

Rob Evans

and then we were able to just keep the aircraft turning around - filling up with water and when they were fighting the fires very close to us - the aircraft were getting around in 10 minute cycles."

One of the key issues around communication during the Black Summer bushfires quickly became mobile coverage and power outages, but Mr Evans said the aerodrome is trying to limit those concerns too.

Planned future upgrades will include additional pumps and generators to keep power at the site and make sure the water is flowing for crews.

It is also working to be more adaptable for any kind of disaster.

"We've got infrastructure plans looking out a few

years now and we've got funding for concrete taxi ways, concrete hard stands for emergency helicopters, solar power, back up generator - so we've got a really good plan to make this much more capable."

Mr Evans said the Tenterfield community was a tough and resolute one that was strengthened by good inter-person connection.

"There are some people who have been really hurt one way or another by these issues, but we're a resilient lot and we all look after each other," he said.

Mr Evans also joined many in the community in praising the efforts of the community-driven radio station Ten FM for its efforts in broadcasting emergency advice.

Doing our part to inform you

TENTERFIELD Star editor Jacob McMaster said the newspaper wanted to help lead discussions about communication because keeping people informed could be life-saving.

"Heading into New Year's Eve in 2019 we knew conditions were bad, but a huge wind-shift had wildfires barrelling through Cobargo and two people were killed," Mr McMaster said.

"We were caught unaware as it happened around 2am and for weeks and months I was working so hard to keep on top of updates with the RFS so it wouldn't happen again. "People need to know quickly and reliably what services they can access, where is in danger and where they might need to evacuate towards.

"Any emergency coverage we produce is always free and you don't need to subscribe to access it. We want to reliably give you the information you need to know."

Tenterfield talks: communicating in crisis

SPECIAL FEATURE SERIES

TENTERFIELD residents have first-hand experience of living through a natural disaster. They also know all too well the importance of good communication during difficult times.

The region has experienced constant bushfire threats, the most recent in November last year which put thousands of residents on alert and razed buildings, including several homes.

Back in September 2019, Tenterfield was hit hard by the Black Summer bushfires. Ash, smoke and dust covered

the town and were swept into the Tenterfield Dam. Residents were advised to boil water for more than two months due to contamination.

That's why *the Tenterfield Star* is supporting an initiative to improve communication between emergency responders and locals in times of disaster.

Today, we help launch *Tenterfield Talks: Communicating in crisis*, an innovative partnership between local media and natural hazards experts, which encourages residents to share their experiences of communication

during the 2019 fires and awareness about such natural hazard events.

There will be a community town hall on Saturday March 16, and residents are being urged to sign up and attend.

The project is funded by Natural Hazards Research Australia and delivered in partnership with a team of researchers at Deakin University.

"Our research team wants to know how community members received information before, during, and after the 2019 bushfires - and what could be improved," says the project's lead researcher, Dr

Gabi Mocatta.

Over the next week, Tenterfield Star will talk to experts and share local perspectives on communication during recent bushfire threats and natural disaster events. Residents are also being asked to fill out a survey or consider attending an invited community forum to share insights and experiences about where they receive information about disasters and how that process could be improved.

"We want to find out, for example, where good communication might have saved lives and property, and

where it helped bring people together," says Dr Mocatta. "We also want to know where there are gaps in education, communication and awareness about natural hazard events, like the Black Summer bushfires."

The water contamination event caused by the fires in 2019 - which themselves came on top of drought - is an example of a compound natural hazard: a disaster on top of a disaster.

Unfortunately, compound natural hazards are becoming increasingly common in Australia. Communication and awareness initiatives

are key to preparation for future disasters.

"We are hoping that community members will join in the discussion and help us understand what worked well and what really needs to change about the way we communicate natural hazards", says Dr Mocatta.

The community forum will be held on Saturday 16 March from 2.30-4pm at the RSL Pavilion. If you would like to participate, please express your interest by contacting Gabi Mocatta on gabi.mocatta@deakin.edu.au

or any questions, please email gabi.mocatta@deakin.edu.au

TENTERFIELD TALKS COMMUNICATING IN A CRISIS

Blackspots are a danger

BY JACOB MCMASTER

COUNCIL doesn't play a direct role in communication during a disaster, but Tenterfiield Council GM Glenn Wilcox recognises phone reception as the biggest concern.

Mr Wilcox said there are areas on the 'day-to-day' that are in mobile and even radio reception blackspots.

"There isn't sufficient towers to reach everyone - there's lots of blackspots," Mr Wilcox said. "So when you come to an emergency and a general alert we've evacuated there are areas where there isn't radio reception and some of those areas are along major highways."

"[It's an issue in] any emergency and even the day-to-day if there is a road accident we're just not getting the coverage people expect and it is something we have to plan for. "I'm sure the ambos and the RFS are in the same boat that it causes more problems."

Mr Wilcox said a critical improvement to communication for the region would be introducing additional mobile towers to extend radio and mobile signals to residents who otherwise might be caught unaware.

"People rely so much on mobile phones and that is what I'm seeing is the biggest issue - the level of communication needed to be notified and if the phones drop out, that puts people at risk," he said. Council also has a resolution to attend the Australian government conference and advocate to fund for more mobile blackspot coverage. "We have lots of blackspots," Mr Wilcox said.

Deakin is looking at Tenterfield as an area that has suffered through compound disasters - one disaster after another - which Mr Wilcox said has played a role in people being more aware of emergency circumstance.

"There is high awareness in this community because they've had fires before ... we've been subject to fires, floods and so on - but that has helped the community awareness and the community information."

Mr Wilcox said council played very little role in an emergency as major bushfires saw control handed over to the RFS and then following a fire event Recovery NSW takes the lead.

However, he did say council acts as a conduit of sorts, relaying information from reports to the relevant authorities or providing support as requested by the SES or RFS - which might be for a digger to cut fire breaks or the provision of water trucks to replenish RFS vehicles.

"Our role is basically an observer, council does a good job and our staff does a good job, but it's on request if plant equipment or a water truck is needed," he said.

In provision of communications, Mr Wilcox said council operates a generator on Mount Mackenzie to power a signal tower, which largely ensures the township keep mobile phone signal in a blackout, but should that go down, Recovery NSW could bring in a Telstra mobile generator / tower.

Mr Wilcox joined others in praising the efforts of 10FM in broadcasting information, but said sadly it was limited by those blackspots.

Asked specifically about improvements the paper could make in its coverage, Mr Wilcox suggested links to relevant sites like Hazards Near Me and Live Traffic for road closures.

"By the time the media get the information, the fires have moved quicker, so people need those links to see what's going on [in real time]," he said. "A lot of people get caught out because the information wasn't coming quick enough - if they're just relying on written info they need a second source."

He also said in an emergency the internet was normally one of the first services to drop out, limiting access to websites, though some people could still use mobile reception if they have it.

Suffering 'compound natural hazards'

TENTERFIELD is one of a growing list of places in Australia experiencing disasters, but also one of the few places that has experienced what is known as 'compound natural hazards'.

"We usually think of natural disasters as separate, one off events," said natural hazard researcher Dr Erin Hawley from Deakin University. "But there's a growing realisation that many places in Australia are experiencing one or more hazards at the same time, or closely following each other. In our changing climate we are seeing compound natural hazards become more frequent in Australia and around the world. Because the overlapping impacts of compound hazards can be so much more severe than when hazards happen separately, lots of research is now going into how to better understand compound hazards and how to prepare for them."

Compound hazards look different everywhere - with 'cascading impacts' that can be both natural and man-made. Overseas, the 2011 earthquake in Japan led to a tsunami, then nuclear disaster. In Australia, the Burkedin Shire in Queensland experienced cyclones and flooding, while Victoria's Dandenong Ranges suffered storms and flooding during the COVID pandemic.   "Compound hazards are different from the single disasters we might have experienced in the past," said Deakin researcher Dr Gabi Mocatta. "And that means we need to find new ways to boost awareness, preparation, emergency response and recovery. We can learn a lot from places like Tenterfield that have recently experienced compound hazards about how as communities, and as a nation, we can better prepare for these events in the future."

What are 'compound natural hazards'?

▌ Natural hazards or disasters that occur at the same time in one place
▌ Hazards that follow each other in quick succession
▌ Impacts may overlap and interact - so that hazards are worse when experienced together or in quick succession

Bushfires blazing near Tenterfield where two firefronts converged in October 2023. Picture by Sam Newsam.

Articles published in Burdekin Life (Ayr):

Thursday, February 22, 2024

Mackay and Whitsunday Life

Disaster Communication Burdekin-Style

Ayr resident June Pola knows a thing or two about preparedness for natural disasters. Having lived in the Burdekin Shire for 45 years, she's experienced many cyclones and floods. She's lost a roof – and kept her family safe. Like most people here, she's well aware of the dangers and how to prepare. And she thinks that lived experience of natural hazards is important factor that pushes people to prepare.

"I follow all the things that they say you have to do," says June. "I moved everything that might blow away under the house because I've seen what's happened with the winds.

People just have no idea of the strength of those winds and the driving rain when you get a category 4 cyclone. Unless you've gone through it, you just cannot experience it any other way."

Insights like June's on what helps people prepare, stay resilient and recover from natural hazards is the subject of research currently being conducted in the Burdekin Shire. A team from Deakin University in Melbourne is visiting Ayr this week, to ask locals about how disaster communication is done here. The research is being undertaken for Natural Hazards Research Australia, Australia's research centre for natural hazards resilience and disaster risk reduction.

"By 'disaster communication' we mean, all the messages that people receive about how to prepare for natural hazards, how to survive through them, and how to recover," says Dr Gabi Mocatta from the Deakin research team. "This might be from emergency authorities, the Council, from media – even from your neighbour."

The team is particularly interested in what type of information makes people prepared and resilient in the face of 'compound hazards' (when two or more hazards occur at the same time or in quick succession) meaning protective responses may be more complex, and there's less time for recovery. The team also wants to find out how people prefer to receive hazards information.

The Burdekin Shire is one of three case study locations across Australia. Each location has experienced different hazards – storms, floods, fires, drought, flooding, cyclone – some in middle of COVID lockdowns. Communities have different levels of preparedness.

"Sometimes, there are several sources of information and messages can be confusing or contradictory," says Dr Mocatta.

Burdekin Shire does disaster awareness well. "It all comes through the Council they send out messages all the time," says June. "The Bureau of Meteorology, they send out the warnings. Then, in the paper the week before the cyclone was a list of things that people needed to pack and get. Birth certificates, insurance documents, some of your better photos, put them in plastic. Because when the roof goes all that gets wet!"

In the latest event, Cyclone Kirrily, June's house didn't have any structural damage, but her garden suffered. "It's nature's pruning, you know."

The Deakin team invites all Burdekin community members to join the forum this Saturday 24th February to discuss disaster communication, Burdekin-style. The event will be held at PCYC Burdekin, 64 MacMillan Street, Ayr. Afternoon tea will be served. More information here: https://bit.ly/4bjnCIQ

Caption: Deakin University invites community members to discuss disaster communications at a forum this weekend

Burdekin Participates In Disaster Research Project

A team of researchers at Deakin University recently partnered with local media and natural hazards experts to deliver the Burdekin Aware and Prepared Community Forum.

The project's lead researcher, Dr Gabi Mocatta, said the team was grateful for the support of the Burdekin community.

"We've done some research on how the Burdekin Shire does disaster communication and how well it's done here, which is one of the reasons we wanted to come to this community," she said.

"The council-run Local Disaster Management Group seemingly does an amazing job of getting the community resilient and knowledgeable and that's perhaps a model that can be emulated across other parts of Australia.

"It is a community service that people have done, for their community but also for other places in Australia, so it's amazing that people make that effort."

The forum was one of three held across Australia as part of the Awareness, Education and Communication for Compound Natural Hazards project, funded by the Natural Hazards Research Australia, with a forum already held in

The forum, held on Saturday, February 24 at Burdekin PCYC, saw community members come together to share their experiences of living through natural disasters and how information was communicated by different organisations.

Dandenong, Victoria and one to be held later this year in Tenterfield, New South Wales.

The data collected from the forum will be drafted into a communication framework, which will seek the feedback of members from the three communities, before a report will be written for Natural Hazards Research Australia to be made available for emergency managers across Australia.

The project is still seeking feedback in the form of an anonymous survey.

Scan the QR code to complete the survey.

Caption: L-R Emergency Management Coordinator Andy Pethybridge, LDMG Chair Lyn McLaughlin, Lead Researcher Gabi Mocatta, Sweet FM Manager Charlie Scuderi, Local Disaster Coordinator Eileen Devescovi and Kirsten Diprose and Erin Hawley of Deakin University

Social media coverage

This research used social media to promote participation in the study and broader awareness of the issues surrounding compound natural hazards, posting in several local community Facebook groups in the lead-up to each community forum.
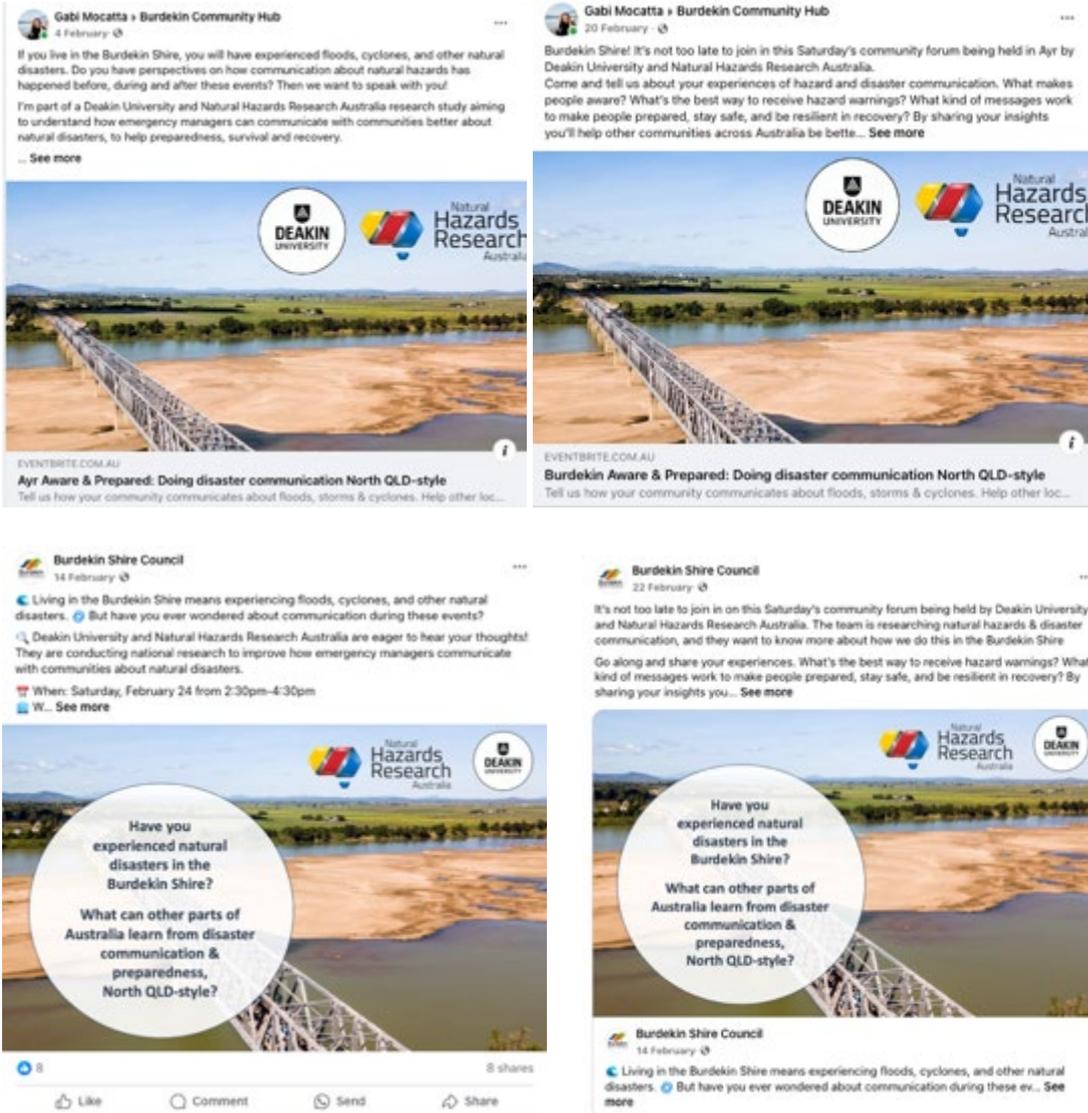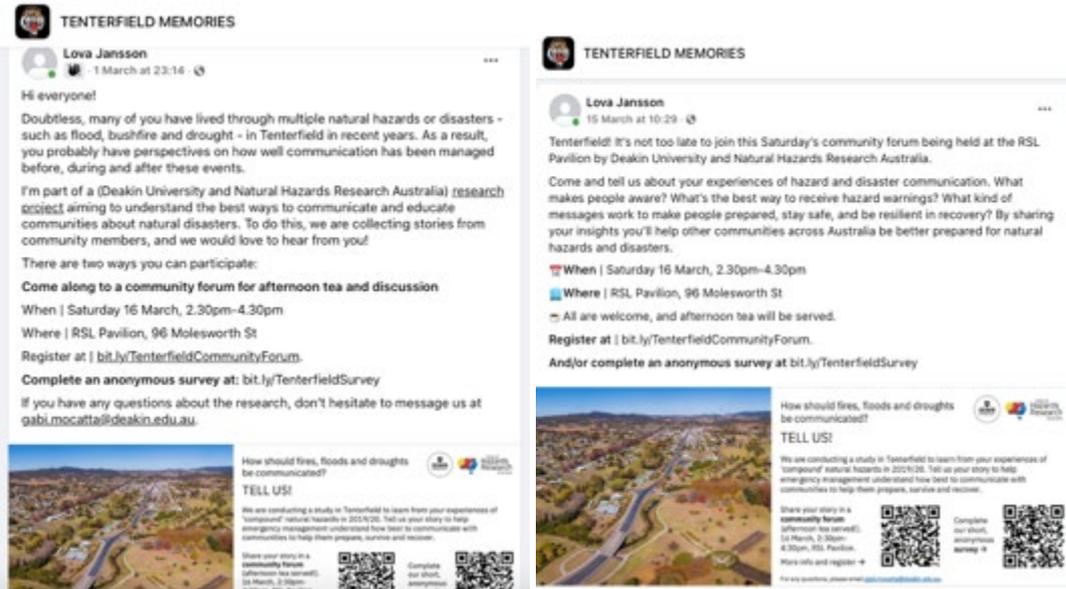
Roadside digital advertising

In the Burdekin Shire, digital road signs displayed information about the community forums.

Flyers

This research used printed flyers to communicate about the research in each case study location, distributing these in public places and at local businesses. This helped to reach less digitally connected community members.