

From: [NSW Government](#)
To: [Flood Inquiry](#)
Subject: Floods Inquiry
Date: Thursday, 23 June 2022 11:48:59 AM
Attachments: [USyd NSW Flood Inquiry Subission.pdf](#)

Your details

Title	Dr
First name	Nicole
Last name	Gurran
Email	[REDACTED]
Postcode	2006

Submission details

I am making this submission as	An academic/researcher
Submission type	I am submitting on behalf of my organisation
Organisation making the submission (if applicable)	University of Sydney
Your position in the organisation (if applicable)	Professor of Urban & Regional Planning, Director of the Henry Halloran Trust
Consent to make submission public	I give my consent for this submission to be made public

Share your experience or tell your story

Terms of Reference (optional)

The Inquiry welcomes submissions that address the particular matters identified in its [Terms of Reference](#)

1.1 Causes and contributing factors

Many urbanised regions of NSW are known to experience frequent flood and storm events, reflecting historical patterns of European settlement which have been subsequently reinforced by investment in urban infrastructure and private property. With projected increases in the frequency and severity of extreme weather events due to climate change, it will be impossible to avoid risks in these known flood-affected areas, notwithstanding mitigation efforts through building works, engineering measures, and the flood related land use controls applying to new development.

One of the most significant challenges in planning for flood risk mitigation, in particular, is that land use regulations apply to future development only. Reliance on engineering solutions such as levees and diversion channels to protect existing assets is not sufficient for major events. Further, levees can also give a false sense of safety to property owners and businesses. When levees are topped, flood waters can rise rapidly and become trapped rather than draining away, while excavating river bends to speed up the exit of floodwater and diversion channels can worsen flooding downstream and again is ineffective in major floods. Nevertheless, there is an inevitable relationship between the construction of levees and insurers' willingness to provide insurance, as witnessed following the 2010/11 Roma and Emerald floods in Queensland.

Community based risks and socio-economic disadvantage

Community risks arising from natural disasters are compounded by underlying socio-economic

disadvantage. Socio-economic disadvantage increases underlying vulnerability to natural disaster events, because lower income earners are more likely to be living in inadequate accommodation; are less able to afford works to improve the safety of their dwellings, and or have inadequate insurance. Lower income renters in particular are likely to be at greater risk of permanent displacement following a disaster; with landlords less likely to rebuild their houses than owner occupiers. Further, lower income residents living in caravan parks or similar forms of marginal accommodation may be at risk of permanent displacement as higher income evacuees require temporary emergency housing.

In addition, socio-economic disadvantage is often compounded by other underlying forms of social vulnerability such as age or disability. Notably, older people, people with a disability, children, and others with pre-existing health issues are more vulnerable to the health and safety impacts arising from disasters and their aftermath. These groups are often less able to respond to disaster protocols.

Failure to protect electricity infrastructure from extreme weather events
Climate change and extreme weather events pose serious threats to Australia's electricity infrastructure, as witnessed by the climate-induced disasters experienced over the past 15 years – the 2009 Victorian Bushfires, the 2010-2011 Queensland floods, the 2019-2020 Black Summer Fires and the 2022 catastrophic floods in the Northern Rivers regions of New South Wales. In all these cases, electricity infrastructure has been severely impacted and has taken a long time to restore and repair. The impacts have included damage to generations, transmission and distribution above-ground assets resulting in increased blackouts.

The community consequences of failing to

adequately protect electricity infrastructure from extreme weather events include hindered emergency responses and communications; life support/health risks; traffic chaos and congestion as traffic lights fail; loss of telecommunications; increased stress as a consequence of communications loss, leading to impaired mental health and wellbeing; loss of internet based services such as banking; loss of livelihoods and employment; increased insurance costs as a result of property damage, business and food loss; and building services disruption in homes and offices including elevators and lifts. The economic impacts include increased capital and maintenance expenditure on electricity transmission and distribution infrastructure; increased demand for skilled staff leading to shortages in this area; short term lost revenue to transmission and distribution companies; accelerated depreciation and deterioration of assets; and increased power prices to consumers.

Factors specific to the northern rivers

The northern rivers region of NSW in particular is a known hotspot for both flood emergencies and socio-economic vulnerability. High and rising levels of housing stress in the region, associated with a chronic shortage of affordable rental housing, and ongoing house price inflation particularly over the period of the COVID-19 Pandemic, meant a concentration of lower income earners were living in the region's most flood prone areas. Census data (2016) indicates higher numbers of rough sleepers and people living in marginal accommodation such as caravan parks, than in NSW overall. Although poorly enumerated, service providers also report high incidences of households living in informal accommodation types such as infill areas built beneath elevated 'Queenslander' houses located in flood prone areas. Thus, the scale of housing need both prior to and following the flood event is likely to be under-reported.

Had risks in this pre-existing vulnerability hotspot been addressed prior to the 2022 disaster by improving housing conditions and or prioritising flood mitigation works and the region's emergency response and service capacity, impacts would have been significantly reduced.

These observations notwithstanding, it is clear that many within Lismore and the wider northern rivers region have long applied flood planning controls to new development; and undertaken measures designed to mitigate existing property from extreme weather events, with the 1974 flood event used as the benchmark. An inevitable conclusion is that elevating buildings above prior flood events is no longer sufficient to mitigate risks.

1.2 Preparation and planning

Consequently, forward planning for these risks - from emergency service protocols to future oriented adaptation strategies about whether and how to rebuild or relocate critical assets following damage or loss is critical and must occur well ahead of disaster events. Much of this work must take place at the local level. Yet research has shown that Australia's local councils beyond the major metropolitan cities – often at the frontline of climate risk – are typically the least able to carry out such work. This reflects a lack of staff with technical expertise; lack of national leadership on adaptation policy, insufficient resources to fund mitigation or adaptation measures; lack of sufficiently detailed and accessible data to inform decision making; legal uncertainties regarding obligations and liabilities; fragmented, complex state policy and planning frameworks. Often there is pressure from landowners or others to develop risk affected land.

Identifying social vulnerability and particular community-based risk

To facilitate the identification of socially vulnerable community members and community-

based risks, Social Impact Assessment (SIA) can be applied to assess and manage the impact of natural disasters. In 2021, the NSW Department of Planning and Environment (DPE) released Social Impact Assessment Guidelines, which are applicable to activities that impact communities across NSW. These guidelines would be appropriate to adopt to facilitate the development of better-informed disaster management strategies that protect those most vulnerable.

Communications and Infrastructure

There are many ways to physically protect important parts of the grid from extreme weather events – such as building protective infrastructure, restoring protective marshes, elevating substations, burying distribution lines, or even trimming trees near high-voltage cables. Such work requires supportive legislation, especially environmental planning, impact assessment and building specifications. The Queensland Floods Commission of Inquiry, for example, made a number of recommendations regarding legal provisions needed to protect electricity infrastructure from floods (Lyster, 2016).

There is also the possibility of developing "infrastructure in a box" capabilities, which can be used to temporarily replace damaged communications infrastructure and provide mobile charging stations for phones and computers while utilities providers make critical repairs. Loss of communications infrastructure has become a major problem during recent disasters as social media has become an important platform for people to stay in touch with relatives, friends, neighbours and communities as well as providing crucial access to emergency assistance and additional incident reporting. If these networks become disabled through infrastructure failure this leaves many people exposed and vulnerable in times of crisis.

Transport networks during floods

A key aspect of unfolding disasters is the jeopardised ability of residents to move from one place to another to seek safety, shelter or health care, or to help others, as well as the ability of emergency services to reach them. Different disasters create different transport problems and dilemmas – residents trapped by floods in their homes as was seen recently in Lismore; or the fast-shifting escape corridors during bushfires experienced in the Victorian and Black Summer fires. It is hence important to incorporate, in flood preparedness, a scenario-based understanding of how floods transform:

- a) the displacement experiences and needs of residents;
- b) the transportation infrastructure serving community and welfare networks; and,
- c) the ability to collect data on a) and b) in real time and selectively communicate them to relevant stakeholders.

The interaction between these three facets, as the disaster unfolds, will be critical in mitigating or exacerbating its human and economic impacts, including death and injury. While this exercise is necessarily place-specific and must draw on granular community knowledge amongst others, the solutions generated may range in scale and kind, from selective engineering retrofitting or better knowledge of spatial distribution of vulnerabilities; to airborne emergency transport provided by state and federal authorities (to name three examples amongst many).

A better understanding of which roads – major arteries and regional and local roads – are likely to remain functional under various flood conditions is a key element of disaster-preparedness that is currently lacking. It hardly needs stating that transport planning ought to be multi-disciplinary and must engage multiple

sectors, including emergency services, planning agencies including infrastructure NSW, local councils, as well as Universities and the research sector.

1.3 Response to floods

As noted, in preparing for disasters, it is critical to understand the vulnerability and resilience of at-risk groups and ensure 'fit for purpose' emergency management workforce that are sensitive to special needs. Available evidence suggests that on this occasion, despite the recent history of major flood events in the northern rivers, the emergency management response was not sufficiently equipped to provide for the needs of the diverse groups needing support, and were not able to deliver culturally appropriate services.

Communication protocols across and between service providers and locally based groups were also found to be inadequate, reflecting not only the break-down of communications infrastructure but also the lack of pre-existing communication channels and processes, which must be in place prior to disaster events. As a result, we saw the emergence of self-organising "digital volunteers" who used social media systems to coordinate rescues and distribute resources, collaborate with communities, and cooperate with agencies when the official government response was overwhelmed. This was, however, a largely uncoordinated effort from a central perspective, which while saving many lives and helping the community also highlighted a basic weakness in dealing with, and effectively managing the surge capacity of digitally enabled volunteers.

Future efforts may include identifying and defining mechanisms for supporting the organisation and self-organisation of digital volunteers in crisis situations via social media communications channels. These channels have enabled self-organizing group structures, outside of crisis management agencies, where individuals and communities may take an active

role through their convergence behaviours. Examples such as "How a spreadsheet became a lifesaver in Lismore's flood crisis" (ABC News Sun 6 Mar 2022), can teach us valuable lessons about digital volunteers and convergence behaviour in crisis situations. Notably the University's Sydney Environment Institute (SEI) has been funded under the Disaster Risk Management Reduction program of Resilience NSW to examine this issue.

Similarly, immediate post disaster relief – particularly temporary housing, but also transportation and services – must be planned for well in advance of disaster events. Quite obviously, the lengthy delay in sourcing and providing temporary housing, and the ongoing need for displaced residents to return to damaged homes; share with friends or family; or live in tents or vehicles – exacerbates the complex health and mental health impacts of disaster and compounds the challenges associated with resuming local activities and services.

Again, paying attention to intersectional needs is critical in ensuring that vulnerable members of the community are able to access available financial relief, including government disaster payments and grants. This ranges from the need for clear information about grant entitlements and application processes to be disseminated via appropriate community channels, as well as sufficient staff at recovery centres, online, and via telephone services.

Emergency housing responses

The 2020 bushfires revealed weaknesses in Australia's capacity to source emergency housing for those displaced by natural disasters. Following the 2022 floods which have left an estimated 5,000 homes uninhabited nationally, it is apparent that systems for producing and supplying emergency accommodation in

Australia remain severely deficient.

In the context of natural disaster, an emergency housing response must range from providing appropriate and secure accommodation in the short and intermediate period through to the coordination of services and financial support for displaced households.

At state and or national level, there is an obvious need to establish a ready supply of appropriate modular accommodation units that can withstand a variety of climatic conditions and are easily procured and transported. There is also a need to establish a protocol and system for sourcing tourist accommodation in the immediate aftermath of disasters.

Demonstrated by spontaneous and ad hoc volunteer efforts in the wake of the 2020 bushfires, when individuals and volunteer networks offered holiday homes to bushfire victims, sometimes facilitated by platforms such as Airbnb as well as the use of hotels as quarantine accommodation during the Pandemic, there remains an unrealised opportunity to regularise and systematise access to a significant proportion of the housing stock in times of disaster.

1.4 Transition from incident response to recovery

Beyond decisions about physical reconstruction; recovery and long term resilience planning will require multi-sectoral coordination across Commonwealth, state and local government agencies as well as non-government and community based service providers. Recognising the significant role played by locally based community organisations and volunteer networks in the flood response, there is an important opportunity to support and strengthen these local institutions, foregrounding their role in decision processes around future planning.

Notably, the construction sector is increasingly

interested in Corporate Social Responsibility (CSR) initiatives and with some support, may be enabled play a more strategic role in pre-disaster planning, the provision of immediate relief, and long-term rebuilding and recovery.

Such efforts would involve identifying and understanding the multiple perspectives of stakeholders, within flood mitigation and alleviation programs – from local community members and those in need of emergency housing and or repairs/rebuilding through to the capacity and aspirations of local or regional design and construction teams. Large (tier 1) construction companies should play a leading role in working with local subcontractors and small businesses to support and engage them in recovery and reconstruction processes, providing much-needed stimulus to local economies and ongoing capacity building.

1.5 Recovery from floods

In preparing for the long-term recovery, it is clear that historical approaches to flood planning and management, are no longer adequate. The increasing frequency of extreme weather events – from intense storms and floods to heatwaves, drought, and bushfires – -mean that it is imperative to embed long term climate resilience in planning for flood affected communities. With climate science, environmental engineering, and design innovation still evolving, planning for long term resilience involves navigating inevitable uncertainty.

Best practice in dealing with this uncertainty means prioritising ‘no regret’ actions worth ‘doing anyway’. These actions include:

- Active adaptation planning, with broad and inclusive community involvement. This includes recognising the reality of ongoing, likely escalating flood risk, and aiming to accommodate or ‘live with’ floods, rather than depending wholly on hard engineering solutions.

- Local efforts and support for regenerative agriculture in upper catchments should be supported and enhanced. One of the outcomes of regenerative agriculture is that the land holds more water, is more resilient to erosion and therefore would further reduce flood peaks.
- Climate resilience and adaptation must be embedded as a foundational principle of reconstruction, from water sensitive urban design principles to neighbourhood energy generation and waste services. Plans for the location and design of future settlement, including relocation schemes, must not only avoid flood prone land but also preserve and restore local landscape and biodiversity values.
- Residential and neighbourhood typologies should recognise and contribute to natural and cultural heritage, and sense of place, with housing and local infrastructure designed for climate – from intense rain and storm events to heat and humidity.
- Housing responses should aim to increase the overall stock of climate resilient homes in the region, improving the supply of affordable and diverse housing.
- Expanding the supply of Aboriginal, social and affordable housing in flood affected regions could provide an important opportunity to demonstrate leading practice, while building local industry capacity.
- It is critical to enhance and maintain resilient transportation networks and services that operate to improve overall connectivity within and between the towns and villages of the Northern Rivers in addition to reinforcing core flood evacuation corridors. Opportunities to establish and enhance local mobility and connectivity – including active transport opportunities – safe, shaded walking and cycling paths connecting existing and new residential and central precincts – should also be pursued.
- Opportunities to enhance and diversify local and regional economies through the reconstruction process should be prioritised.

Beyond physical reconstruction and flood mitigation efforts, these efforts should extend to strategic support for the arts, health, and knowledge sectors – all of which play, and will continue to play an important role in the future recovery of the region.

In relation to decisions about future development or managed retreat of central business districts in localities such as Lismore which are subject to extreme and ongoing flood risk, it is critical to ensure that the full range of potential options for flood mitigation and management are fully understood. This will include the viability of interim or longer-term retrofitting measures to reduce the risk of damage to the extensive public and private assets concentrated in and around existing CBDs, against the cost of schemes such as land swaps or buy backs.

Overall, it is important to recognise the intrinsic values of historical town centres which often underpins collective community identity and feelings of belonging. Expert guidance in making these assessments and in forming potential options, along with active inclusion of affected communities, will be essential, recognising that the relocation of residential homes is very different to decisions about central business district areas.

Insurance

Insurance will be a critical aspect of recovery and long-term resilience planning. Insured losses from the 2022 floods are currently on track to reach \$2 billion, with estimated current cost of insurance claims at \$1.45 billion. Yet, insurance is unlikely ever to fully compensate the victims of climate disasters. There is also a real risk that insurers will withdraw disaster insurance from areas which are not financially viable. This became clear during the catastrophic 2010–11 Queensland floods, following which the insurer Suncorp placed a temporary embargo on new

customers in the outback towns of Roma and Emerald. In the insurer's view, the townships had been left exposed to natural hazard risk due to underinvestment by government in the 'prevention' phase, despite severe and repeated flood damage to these townships in recent years.

The role of private insurance is complex for, while it may 'soften the blow' in post-disaster scenarios, and can enhance resilience, it may also in fact affect prevention. Insurance may dilute the incentive to prevent disasters unless the insurance premium accurately reflects the risk, and the prevention measures that need to be taken by both government and individuals. Yet many individuals forego insurance where premiums are too high so private insurance invariably draws in the government: as the regulator; as provider of insurance; or as reinsurer, which results in lower premiums to households through subsidies. However, if the premium is too low, construction in hazard-prone areas will be encouraged. The crisis of underinsurance and affordability in Australia was comprehensively dealt with by the 2011 Natural Disaster Insurance Review and its recommendations need to be reviewed and re-evaluated.

Mental health and cultural wellbeing

The above listed factors all contribute to the mental health of residents of flood affected areas, as well as to the wellbeing of Australians more widely. As recognised by recent research, including from our University of Sydney staff, post-traumatic stress disorders and related mental illnesses increase for local populations following climate disasters, and rates of climate anxiety are rising around Australia including among those who are 'watching on' from afar. As climate change induced disasters increase in frequency and severity, these multiple factors pose a grave threat to Australians' emotional, cultural and interpersonal wellbeing.

1.6 Any other matters

The devastating impacts of the 2022 flood disasters have highlighted critical, pre-existing shortfalls across almost every area of public policy in NSW – from the failure to address long standing housing crises through to deficiencies in emergency responses. While it is too early for climate attribution science to measure the contribution of climate change to the east coast flood events, it is clear that Australian leadership in progressing global decarbonisation efforts through national, state and local actions, is essential.

Within the northern rivers region and flood-affected areas more widely, collaboration and partnerships across government, industry, local community, as well as the university research and education sectors, is critical to ensure these recovery and reconstruction efforts address sectoral failures and progress innovative, system-level interventions for long term resilience. In responding to floods and in planning for climate disaster risk, there are critical opportunities to progress interventions which advance decarbonisation in the built environment in addition to broad based state and national actions across the economy.

Collaborative research and knowledge sharing Expert, research informed evidence and advice will be critical to inform these efforts. In recent years, Australian investment in cross university collaboration around disaster planning and response has waned, with the demise of the National Climate Change Adaptation Facility. There is a particular gap in relation to flood events, which present ongoing threats to regional and peri-metropolitan communities. With such threats predicted to accelerate in the future, we recommend investing in multi-disciplinary research efforts to inform long term strategies for flood resilience. Such research should be co-designed in collaboration with affected communities to support the response and future

planning processes within currently flood affected communities while also providing wider insights to strengthen disaster response and resilience outcomes more broadly across the state of NSW.


Regional education and capacity building
Recognising the importance of locally based responses, and the scale of devastation in northern NSW, there is also a pressing need and important opportunity to develop local based education and training opportunities across the range of knowledges and skills required for the reconstruction period and longer-term resilience. From urban planning, design, architecture and construction to sustainable engineering and infrastructure provision, as well as Indigenous land and water management, rural health and mental health services, and emergency response and services, there are many opportunities to nurture a skilled regional workforce.

Supporting documents or images

Attach files

- [USyd NSW Flood Inquiry Subission.pdf](#)
-

Nicole Gurrán
Professor, Urban and Regional Planning
Director, Henry Halloran Trust



Professor Mary O’Kane AC and Michael Fuller APM
Co-Leads, NSW Independent Flood Inquiry
Via the flood-inquiry-submissions-portal

Dear Professor O’Kane and Mr Fuller,

RE: 2022 NSW Flood Inquiry

Thank you for the opportunity to provide this submission to the NSW Flood Inquiry.

The Henry Halloran Trust is a philanthropically-funded research centre at the University of Sydney with a mission to bring together cross-disciplinary expertise to address critical urban and regional problems. Climate change and disaster resilience, combined with the challenges of post-carbon transition, are core areas of focus for the Trust, which sponsors research and engagement across academic, policy and professional communities.

University of Sydney academics have extensive expertise relevant to pre- and post-disaster responses as well as planning for longer-term recovery and resilience. This expertise spans the fields of health, urban planning, architecture and housing, engineering, environmental science and law, social policy and organisational management. Further, in addition to the work of the University Centre for Rural Health (UCRH) based in Lismore, many of our academics have ongoing ties to flood-affected areas of NSW through their ongoing research and practice.

On 16 May, the Henry Halloran Trust and the University’s Research Portfolio held a workshop for researchers with expertise relevant to flood response, recovery and resilience planning efforts. University of Sydney experts who participated in this event (see attachment to this submission) are available to assist the Inquiry and the NSW Government across a range of disciplines.

I would be pleased to elaborate on the remarks in the attached submission, and/or to facilitate access to the University’s wider expertise and research capacity.

Yours sincerely,



Professor Nicole Gurrán
Director, Henry Halloran Trust
23 June 2022

Attachment A – Submission to the NSW Independent Flood Inquiry
Attachment B – University of Sydney flood recovery and disaster resilience research capacity and expertise

SUBMISSION TO THE NSW INDEPENDENT FLOOD INQUIRY

INTRODUCTION

The devastating and far-reaching impact of the 2022 floods in eastern Australia, particularly the very large numbers of people likely to be displaced for long periods of time, and the wider impacts for businesses and schools, draw parallels with the Cyclone Tracy disaster. Just as the lessons from Cyclone Tracy brought about fundamental changes to Australia's design and construction practices as well as emergency planning, in responding to the 2022 flood disaster it will be crucial to implement deep, system level interventions within the northern rivers region and beyond.

In the sections below we offer overall comments in relation to the role of the higher education sector across research, knowledge sharing, education, and capacity building as well as a series of more specific remarks in response to the Inquiry Terms of Reference. While our comments are broadly applicable to flood risk, recovery, and resilience planning across the state of NSW, we focus many of our remarks on the northern rivers region, recognising that it is in this region that the challenges associated with recovery and reconstruction are particularly acute.

Collaborative research and knowledge sharing

Expert, research informed evidence and advice will be critical to inform these efforts. In recent years, Australian investment in cross university collaboration around disaster planning and response has waned, with the demise of the National Climate Change Adaptation Facility. There is a particular gap in relation to flood events, which present ongoing threats to regional and peri-metropolitan communities. With such threats predicted to accelerate in the future, we recommend investing in multi-disciplinary research efforts to inform long term strategies for flood resilience. Such research should be co-designed in collaboration with affected communities to support the response and future planning processes within currently flood affected communities while also providing wider insights to strengthen disaster response and resilience outcomes more broadly across the state of NSW.

Regional education and capacity building

Recognising the importance of locally based responses, and the scale of devastation in northern NSW, there is also a pressing need and important opportunity to develop local based education and training opportunities across the range of knowledges and skills required for the reconstruction period and longer-term resilience. From urban planning, design, architecture and construction to sustainable engineering and infrastructure provision, as well as Indigenous land and water management, rural health and mental health services, and emergency response and services, there are many opportunities to nurture a skilled regional workforce.

This is not only true of the post-secondary education sector. School based education, largely implemented by the state government, could do significantly more to prepare young people to survive and thrive in the climate-changing world they are inheriting. So far, disaster risk reduction, climate change, and climate change adaptation education are all poorly addressed in the curriculum, and teachers are under-prepared and under-resourced to provide the holistic, student-centred education that children need.

CAUSES AND CONTRIBUTING FACTORS; PREPARATION AND PLANNING

Many urbanised regions of NSW are known to experience frequent flood and storm events, reflecting historical patterns of European settlement which have been subsequently reinforced by investment in urban infrastructure and private property. With projected increases in the frequency and severity of extreme weather events due to climate change, it will be impossible to avoid risks in these known flood-affected areas, notwithstanding mitigation efforts through building works, engineering measures, and the flood related land use controls applying to new development.

One of the most significant challenges in planning for flood risk mitigation, in particular, is that land use regulations apply to future development only. Reliance on engineering solutions such as levees and diversion channels to protect existing assets is not sufficient for major events. Further, levees can also give a false sense of safety to property owners and businesses. When levees are topped, flood waters can rise rapidly and become trapped rather than draining away, while excavating river bends to speed up the exit of floodwater and diversion channels can worsen flooding downstream and again is ineffective in major floods. Nevertheless, there is an inevitable relationship between the construction of levees and insurers' willingness to provide insurance, as witnessed following the 2010/11 Roma and Emerald floods in Queensland.

Inadequate local planning

Consequently, forward planning for these risks - from emergency service protocols to future oriented adaptation strategies about whether and how to rebuild or relocate critical assets following damage or loss is critical and must occur well ahead of disaster events. Much of this work must take place at the local level. Yet research has shown that Australia's local councils beyond the major metropolitan cities – often at the frontline of climate risk – are typically the least able to carry out such work. This reflects a lack of staff with technical expertise; lack of national leadership on adaptation policy, insufficient resources to fund mitigation or adaptation measures; lack of sufficiently detailed and accessible data to inform decision making; legal uncertainties regarding obligations and liabilities; fragmented, complex state policy and planning frameworks. Often there is pressure from landowners or others to develop risk affected land.

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Community risks arising from natural disasters are compounded by underlying socio-economic disadvantage. Socio-economic disadvantage increases underlying vulnerability to natural disaster events, because lower income earners are more likely to be living in inadequate accommodation; are less able to afford works to improve the safety of their dwellings, and or have inadequate insurance. Lower income renters in particular are likely to be at greater risk of permanent displacement following a disaster; with landlords less likely to rebuild their houses than owner occupiers. Further, lower income residents living in caravan parks or similar forms of marginal accommodation may be at risk of permanent displacement as higher income evacuees require temporary emergency housing. Adaptation must focus on these issues of vulnerability and justice.

In addition, socio-economic disadvantage is often compounded by other underlying forms of social vulnerability such as age or disability. Notably, older people, people with a disability, children, and others with pre-existing health issues are more vulnerable to the

health and safety impacts arising from disasters and their aftermath. These groups are often less able to respond to disaster protocols.

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There are many ways to physically protect important parts of the grid from extreme weather events – such as building protective infrastructure, restoring protective marshes, elevating substations, burying distribution lines, or even trimming trees near high-voltage cables. Such work requires supportive legislation, especially environmental planning, impact assessment and building specifications. The Queensland Floods Commission of Inquiry, for example, made a number of recommendations regarding legal provisions needed to protect electricity infrastructure from floods (Lyster, 2016).

There is also the possibility of developing "infrastructure in a box" capabilities, which can be used to temporarily replace damaged communications infrastructure and provide mobile charging stations for phones and computers while utilities providers make critical repairs. Loss of communications infrastructure has become a major problem during recent disasters as social media has become an important platform for people to stay in touch with relatives, friends, neighbours and communities as well as providing crucial access to emergency assistance and additional incident reporting. If these networks become disabled through infrastructure failure this leaves many people exposed and vulnerable in times of crisis.

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Victorian and Black Summer fires. It is hence important to incorporate, in flood preparedness, a scenario-based understanding of how floods transform:

- a) the displacement experiences and needs of residents;
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Factors specific to the northern rivers

The northern rivers¹ region of NSW in particular is a known hotspot for both flood emergencies and socio-economic vulnerability. High and rising levels of housing stress in the region, associated with a chronic shortage of affordable rental housing, and ongoing house price inflation particularly over the period of the COVID-19 Pandemic, meant a concentration of lower income earners were living in the region's most flood prone areas. Census data (2016) indicates higher numbers of rough sleepers and people living in marginal accommodation such as caravan parks, than in NSW overall. Although poorly enumerated, service providers also report high incidences of households living in informal accommodation types such as infill areas built beneath elevated 'Queenslander' houses located in flood prone areas. Thus, the scale of housing need both prior to and following the flood event is likely to be under-reported.

Had risks in this pre-existing vulnerability hotspot been addressed prior to the 2022 disaster by improving housing conditions and or prioritising flood mitigation works and the region's emergency response and service capacity, impacts would have been significantly reduced.

These observations notwithstanding, it is clear that many within Lismore and the wider northern rivers region have long applied flood planning controls to new development; and undertaken measures designed to mitigate existing property from extreme weather events, with the 1974 flood event used as the benchmark. An inevitable conclusion is that elevating buildings above prior flood events is no longer sufficient to mitigate risks.

RESPONSE TO FLOODS; TRANSITIONING FROM INCIDENT RESPONSE TO RECOVERY

As noted, in preparing for disasters, it is critical to understand the vulnerability and resilience of at-risk groups and ensure 'fit for purpose' emergency management workforce

that are sensitive to special needs. Available evidence suggests that on this occasion, despite the recent history of major flood events in the northern rivers, the emergency management response was not sufficiently equipped to provide for the needs of the diverse groups needing support, and were not able to deliver culturally appropriate services.

Communication protocols across and between service providers and locally based groups were also found to be inadequate, reflecting not only the break-down of communications infrastructure but also the lack of pre-existing communication channels and processes, which must be in place prior to disaster events. As a result, we saw the emergence of self-organising "digital volunteers" who used social media systems to coordinate rescues and distribute resources, collaborate with communities, and cooperate with agencies when the official government response was overwhelmed. This was, however, a largely uncoordinated effort from a central perspective, which while saving many lives and helping the community also highlighted a basic weakness in dealing with, and effectively managing the surge capacity of digitally enabled volunteers.

Future efforts may include identifying and defining mechanisms for supporting the organisation and self-organisation of digital volunteers in crisis situations via social media communications channels. These channels have enabled self-organising group structures, outside of crisis management agencies, where individuals and communities may take an active role through their convergence behaviours. Examples such as "How a spreadsheet became a lifesaver in Lismore's flood crisis" (ABC News Sun 6 Mar 2022), can teach us valuable lessons about digital volunteers and convergence behaviour in crisis situations. Notably the University's Sydney Environment Institute (SEI) has been funded under the Disaster Risk Management Reduction program of Resilience NSW to examine this issue.

Similarly, immediate post disaster relief – particularly temporary housing, but also transportation and services – must be planned for well in advance of disaster events. Quite obviously, the lengthy delay in sourcing and providing temporary housing, and the ongoing need for displaced residents to return to damaged homes; share with friends or family; or live in tents or vehicles – exacerbates the complex health and mental health impacts of disaster and compounds the challenges associated with resuming local activities and services.

Social impact assessment in disaster planning and management

Again, paying attention to intersectional needs is critical in ensuring that vulnerable members of the community are able to access available financial relief, including government disaster payments and grants. This ranges from the need for clear information about grant entitlements and application processes to be disseminated via appropriate community channels, as well as sufficient staff at recovery centres, online, and via telephone services.

To facilitate the identification of socially vulnerable community members and community-based risks, Social Impact Assessment (SIA) can be applied to assess and manage the impact of natural disasters. In 2021, the NSW Department of Planning and Environment (DPE) released Social Impact Assessment Guidelines, which are applicable to activities that impact communities across NSW. Adapting a version of these guidelines to facilitate the development of better-informed disaster management strategies, protecting those most vulnerable, would be appropriate.

Emergency housing responses

The 2020 bushfires revealed weaknesses in Australia's capacity to source emergency housing for those displaced by natural disasters. Following the 2022 floods which have left an estimated 5,000 homes uninhabited nationally, it is apparent that systems for producing and supplying emergency accommodation in Australia remain severely deficient.

In the context of natural disaster, an emergency housing response must range from providing appropriate and secure accommodation in the short and intermediate period through to the coordination of services and financial support for displaced households.

At state and or national level, there is an obvious need to establish a ready supply of appropriate modular accommodation units that can withstand a variety of climatic conditions and are easily procured and transported. There is also a need to establish a protocol and system for sourcing tourist accommodation in the immediate aftermath of disasters.

Demonstrated by spontaneous and ad hoc volunteer efforts in the wake of the 2020 bushfires, when individuals and volunteer networks offered holiday homes to bushfire victims, sometimes facilitated by platforms such as Airbnb as well as the use of hotels as quarantine accommodation during the Pandemic, there remains an unrealised opportunity to regularise and systematise access to a significant proportion of the housing stock in times of disaster.

Further, the construction sector is increasingly interested in Corporate Social Responsibility (CSR) initiatives and with some support, may be enabled play a more strategic role in pre-disaster planning, the provision of immediate relief, and long-term rebuilding and recovery.

Such efforts would involve identifying and understanding the multiple perspectives of stakeholders, within flood mitigation and alleviation programs – from local community members and those in need of emergency housing and or repairs/rebuilding through to the capacity and aspirations of local or regional design and construction teams. Large (tier 1) construction companies should play a leading role in working with local subcontractors and small businesses to support and engage them in the reconstruction process, providing much-needed stimulus to local economies and ongoing capacity building.

RECOVERY FROM FLOODS

Beyond decisions about physical reconstruction; recovery and long term resilience planning will require multi-sectoral coordination across Commonwealth, state and local government agencies as well as non-government and community based service providers. Recognising the significant role played by locally based community organisations and volunteer networks in the flood response, there is an important opportunity to support and strengthen these local institutions, foregrounding their role in decision processes around future planning.

Framework for decisions about future reconstruction and development

In preparing for the long-term recovery, it is clear that historical approaches to flood planning and management, are no longer adequate. The increasing frequency of extreme

weather events – from intense storms and floods to heatwaves, drought, and bushfires – mean that it is imperative to embed long term climate resilience in planning for flood

affected communities. With climate science, environmental engineering, and design innovation still evolving, planning for long term resilience involves navigating inevitable uncertainty.

Best practice in dealing with this uncertainty means prioritising ‘no regret’ actions worth ‘doing anyway’. These actions include:

- Active adaptation planning, with broad and inclusive community involvement. This includes recognising the reality of ongoing, likely escalating flood risk, and aiming to accommodate or ‘live with’ floods, rather than depending wholly on hard engineering solutions.
- Local efforts and support for regenerative agriculture in upper catchments should be supported and enhanced. One of the outcomes of regenerative agriculture is that the land holds more water, is more resilient to erosion and therefore would further reduce flood peaks.
- Climate resilience and adaptation must be embedded as a foundational principle of reconstruction, from water sensitive urban design principles to neighbourhood energy generation and waste services. Plans for the location and design of future settlement, including relocation schemes, must not only avoid flood prone land but also preserve and restore local landscape and biodiversity values.
- Residential and neighbourhood typologies should recognise and contribute to natural and cultural heritage, and sense of place, with housing and local infrastructure designed for climate – from intense rain and storm events to heat and humidity.
- Housing responses should aim to increase the overall stock of climate resilient homes in the region, improving the supply of affordable and diverse housing.
- Expanding the supply of Aboriginal, social and affordable housing in flood affected regions could provide an important opportunity to demonstrate leading practice, while building local industry capacity.
- It is critical to enhance and maintain resilient transportation networks and services that operate to improve overall connectivity within and between the towns and villages of the Northern Rivers in addition to reinforcing core flood evacuation corridors. Opportunities to establish and enhance local mobility and connectivity – including active transport opportunities – safe, shaded walking and cycling paths connecting existing and new residential and central precincts – should also be pursued.
- Opportunities to enhance and diversify local and regional economies through the reconstruction process should be prioritised. Beyond physical reconstruction and flood mitigation efforts, these efforts should extend to strategic support for the arts, health, and knowledge sectors – all of which play, and will continue to play a crucial role in the future recovery of the region.

In relation to decisions about future development or managed retreat of central business districts in localities such as Lismore which are subject to extreme and ongoing flood risk, it is critical to ensure that the full range of potential options for flood mitigation and management are fully understood. This will include the viability of interim or longer-term retrofitting measures to reduce the risk of damage to the extensive public and private

assets concentrated in and around existing CBDs, against the cost of schemes such as land swaps or buy backs.

Overall, it is important to recognise the intrinsic values of historical town centres which often underpins collective community identity and feelings of belonging. Expert guidance in making these assessments and in forming potential options, along with active inclusion of affected communities, will be essential, recognising that the relocation of residential homes is very different to decisions about central business district areas.

Insurance

Insurance will be a critical aspect of recovery and long-term resilience planning. Insured losses from the 2022 floods are currently on track to reach \$2 billion, with estimated current cost of insurance claims at \$1.45 billion. Yet, insurance is unlikely ever to fully compensate the victims of climate disasters. There is also a real risk that insurers will withdraw disaster insurance from areas which are not financially viable. This became clear during the catastrophic 2010–11 Queensland floods, following which the insurer Suncorp placed a temporary embargo on new customers in the outback towns of Roma and Emerald. In the insurer's view, the townships had been left exposed to natural hazard risk due to underinvestment by government in the 'prevention' phase, despite severe and repeated flood damage to these townships in recent years.¹

The role of private insurance is complex for, while it may 'soften the blow' in post-disaster scenarios, and can enhance resilience, it may also in fact affect prevention. Insurance may dilute the incentive to prevent disasters unless the insurance premium accurately reflects the risk, and the prevention measures that need to be taken by both government and individuals. Yet many individuals forego insurance where premiums are too high so private insurance invariably draws in the government: as the regulator; as provider of insurance; or as reinsurer, which results in lower premiums to households through subsidies. However, if the premium is too low, construction in hazard-prone areas will be encouraged. The crisis of underinsurance and affordability in Australia was comprehensively dealt with by the 2011 Natural Disaster Insurance Review and its recommendations need to be reviewed and re-evaluated.

Mental health and cultural wellbeing

The above listed factors all contribute to the mental health of residents of flood affected areas, as well as to the wellbeing of Australians more widely. As recognised by recent research, including from our University of Sydney staff, post-traumatic stress disorders and related mental illnesses increase for local populations following climate disasters, and rates of climate anxiety are rising around Australia including among those who are 'watching on' from afar. As climate change induced disasters increase in frequency and severity, these multiple factors pose a grave threat to Australians' emotional, cultural and interpersonal wellbeing.

¹ See Suncorp's submission to the Productivity Commission review of Barriers to Effective Climate Change Adaptation available at <http://www.pc.gov.au/inquiries/completed/climate-change-adaptation/submissions/subdr127.pdf>.

FINAL REMARKS

The devastating impacts of the 2022 flood disasters have highlighted critical, pre-existing shortfalls across almost every area of public policy in NSW – from the failure to address long standing housing crises through to deficiencies in emergency responses. While it is too early for climate attribution science to measure the contribution of climate change to the east coast flood events, it is clear that Australian leadership in progressing global decarbonisation efforts through national, state and local actions, is essential.

Within the northern rivers region and flood-affected areas more widely, collaboration and partnerships across government, industry, local community, as well as the university research and education sectors, will be crucial to ensure these recovery and reconstruction efforts address sectoral failures and progress innovative, system-level interventions for long term resilience. In responding to floods and in planning for climate disaster risk, there are vital opportunities to progress interventions which advance decarbonisation in the built environment in addition to broad based state and national actions across the economy.

Climate mitigation and adaptation must go forward simultaneously.

SIGNATORIES

Professor Nicole Gurrán, Director, Henry Halloran Trust (and Sydney School of Architecture, Planning & Design)

Professor Rosemary Lyster, Australian Centre for Climate and Environmental Law, University of Sydney

Professor Deborah Bunker, Systems and Information, University of Sydney Business School

Professor Abbas El Zein, School of Civil Engineering, University of Sydney

Professor David Schlosberg, Director, Sydney Environment Institute, University of Sydney

Dr Suhair Alkilani, School of Project Management, University of Sydney

Dr Lara Mottee, School of Project Management, University of Sydney

Dr Blanche Verlie, Department of Sociology and Social Policy, University of Sydney

UNIVERSITY OF SYDNEY FLOOD RECOVERY & DISASTER RESILIENCE: RESEARCH AND INDUSTRY EXPERTISE

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PUBLIC HEALTH, MENTAL HEALTH, WELLBEING

Professor James Bennet Levy

Expertise: Mental health and wellbeing assessment and support in post-disaster contexts, regional and First Nations social and emotional wellbeing, training

James Bennett Levy is Professor of Mental Health and Psychological Wellbeing at the University Centre for Rural Health (North Coast). He has particular expertise in community-engaged work (eg mental health and wellbeing in the aftermath of the 2017 Northern Rivers floods) and experience in post-disaster assessments and support in regional areas. He has an international reputation as a psychotherapy trainer, and researcher and writer on psychotherapy and psychotherapy training. He has run training workshops in 26 countries. Since 2010, James has collaborated closely with First Nations colleagues to explore community-based and psychological processes which may enhance First Nations peoples' social and emotional wellbeing (SEWB), and empower the workforce. Along with colleagues Veronica Matthews & Jo Longman Prof Levy authored the UCRH 'After the Flood study' on the aftermath of the 2017 floods in Lismore.

Professor Vicki Flood

Expertise: Public health, food insecurity, depression, and ageing, multidisciplinary research, community co-design

Professor Vicki Flood, is Head of Clinical School, Northern Rivers and Director to University Centre for Rural Health, Northern Rivers, with the Faculty of Medicine and Health, the University of Sydney. The UCRH is a collaborative initiative between the University of Sydney, Western Sydney University, University of Wollongong, Southern Cross University, with the Northern NSW Local Health District, and supports education, research and workforce development in regional NSW. In this role I bring together my skills in leadership, education and research, applying these to an education-oriented health setting. Research expertise includes research capacity building, food insecurity, malnutrition, nutrition and disability, depression, and ageing, multidisciplinary research, with community co-design approach to research.

NATURAL HAZARDS & DISASTER RISK, SOCIAL VULNERABILITY

Professor Dale Dominey-Howes

Expertise: Natural hazards and disaster risk, social vulnerability and disaster risk management

Prof Dale Dominey-Howes is a geographer with the Faculty of Science. He has expertise in environment & society in relation to hazards, disasters and risk. His work spans the interface between the human and earth environments/sciences - exploring the characteristics of natural hazards and their impacts on people, communities and human systems. Relevant aspects of his research include:

- Society & Environment interactions in relation to natural hazards and disaster & risk management (hazard, risk and vulnerability analysis, (re-) insurance, coastal and urban policy, emergency management planning and principles)
- One Health (interactions between natural environmental, human and socio-economic and animal systems, epidemics and pandemics)
- Climate change, adaptation and policy

Professor Amanda Howard & Associate Professor Margot Rawsthorne

Expertise: Community led planning for disaster, community preparedness, response and recovery, community responses to floods, rural youth

Prof Amanda Howard is Program Director, Bachelor of Social Work at the University of Sydney. She has worked in disaster research since 2013, particularly focused on community preparedness, response and recovery, community resilience, intersections between formal and informal networks in disaster management, vulnerable or at-risk communities and community led disaster planning. Her research has focused on reasons people drive into floodwaters, community responses to the 2015 Superstorms and Floods in the Hunter Valley,

the roles of community organisations in disaster response and recovery, and risk perceptions of vulnerable communities in relation to disaster. She co-authored Everyday Community Practice with Margot Rawsthorne, a book exploring the key issues including developing an understanding of community life, facilitating and supporting community action, understanding and acting on structural inequity, managing negotiation and conflict, and building productive networks.

A/Prof Margot Rawsthorne has lectured in community development with the Faculty of Arts and Social Sciences at the University of Sydney since 2005. Her research has focused on the experience of inequality, particularly shaped by gender, location, housing and sexuality. Since 2017 she has collaborated with social work and social policy academics, including Professor Amanda Howard, on disaster preparedness through community-led action. Working alongside community members, organisations, emergency services and governments the Disaster Research Collective is building a strong evidence base to support practical shared responsibility.

Dr Blanche Verlie

Expertise: climate change education, communication, activism

Dr Blanche Verlie is with the Department of Sociology and Social Policy. She is a multidisciplinary social scientist whose work focuses on climate change. Her research investigates how people understand, experience, and respond to climate change, and how we might do this differently and better. Her work focuses specifically on the ways climate change is felt, lived and imagined, such as the often visceral experiences of climate distress, and the unequal and unjust dimensions of this, as well as how this affective injustice can inspire regenerative forms of climate action. This work spans the areas and disciplines of climate change education, communication and activism, as well as environmental politics, cultural geography, and environmental humanities.

Dr Nader Naderpajouh

Expertise: Built environment resilience, collective action and organising, civil engineering

Dr Nader Naderpajouh is a Senior Lecturer, Director of Research Education and Post Graduate Coordinator, while he leads the Organising for Resilience in the Built Environment (ORIBE) research group. His main area of research focuses on collective actions and organising across social, technical and ecological systems. He is an Associate Editor of the Journal of Management in Engineering by the American Society of Civil Engineers (ASCE) as well as the Built Environment Project and Asset Management (BEPAM). He is passionate about the discourse of social justice and equity, in addition to the climate crisis, and these values are foundational in his active research on the topics of resilience, collective action, innovation and infrastructure management.

INFORMATION & COMMUNICATIONS SYSTEMS

Professor Deborah Bunker

Expertise: Information systems, social media and crisis communication

Deborah Bunker is a Professor of Systems and Information (Research Affiliate) at the University of Sydney Business School and an Honorary Professor at the Sydney Institute of Infectious Diseases. Professor Bunker is the Co-Chair of the Communications and Technology for Society Research Group, which works closely with practitioners focussing on systems interoperability and communications (including social media) in extreme events such as bushfires, floods, epidemics, terrorist attacks etc. Their research supports practitioners with their systems for extreme event management and co-ordination, as well as with the management of communications with the general public and volunteers (including digital volunteers). She is a Chief Investigator on an EU Horizon 2020 project RISE SMA Social Media Analytics for Society and Crisis Communication and a Norwegian Research Council SAMRISK Work Program project INSITU Sharing Incident and Threat Information During Crises.

Dr Ken Chung

Expertise: Social networks

Dr Ken Chung is Director of the Undergraduate Project Management Program and also senior lecturer in the Project Management Program. Dr Ken Chung's research into human networks - be they social or professional

networks, collaboration or awareness networks - shows that network properties at the individual, relationship and network levels are extremely influential on work performance, project success, organisational commitment, coordination, learning, innovation adoption and human behaviour.

Dr Marzena Baker

Expertise: Project management and communication

Dr Marzena Baker works with the School of Project Management in the Faculty of Engineering. Marzena's background extends across the academia and the corporate business sector. In her academic role, Marzena's teaching and research interests include project management and leadership, organisational behaviour, change management, and diversity and inclusion in project-based organisations. Marzena has had over 25 years' experience in leading national and international blue-chip organisations focusing on consumer research, marketing strategy, communication strategy and stakeholder engagement across FMCG and construction-property organisations.

Professor Benjamin Eggleton and Dr Tomonori Hu

Expertise: Smart sensing technology for extreme weather events

Professor Benjamin Eggleton is a leading physicist in integrated nanophotonics and nonlinear optical physics and has made seminal contributions to the fields of optics, photonics and optical communications technology. Before serving as the Director of The University of Sydney Nano Institute and Co-Director of the NSW Smart Sensing Network (NSSN), Professor Eggleton was the founding Director of the Institute of Photonics and Optical Science (IPOS) at the University of Sydney. During nearly 30 years of doing research, he has made significant advances in nonlinear optics, waveguides, soliton physics, and fundamentals and applications of slow light. He has also made important contributions to optical communications technology with applications to ultrafast and ultra-broadband and energy efficient information signal processing devices that are chip-based.

Dr Tomonori Hu is with the NSW Smart Sensing Network. He has as a background in physics - developing mid-infrared fiber lasers for applications in spectroscopy. His interests lie in the translation of academic technologies to industry.

Professor Yonghui Li

Expertise: Information engineering, cooperative communications technologies, wireless communications

Yonghui Li is a Professor and Director of Wireless Engineering Laboratory in School of Electrical and Information Engineering, University of Sydney. He is an IEEE Fellow for contributions to cooperative communications technologies. His current research interests are in the area of wireless communications, with a particular focus on IoT, machine to machine communications, MIMO, millimetre wave communications, channel coding techniques, game theory, machine learning and signal processing. He has participated in \$500 Millions Australia national demonstration project "Smart Grid Smart City" and designed last mile access networks.

FIRST NATIONS ENGAGEMENT & CO-DESIGN

Elle Davison, Aboriginal Planning Lecturer

Expertise: Town planning, Indigenous engagement, Co-design, Cultural planning and awareness training

A Balanggarra woman from the East Kimberley and descendant of Captain William Bligh, Elle Davidson is a lecturer in Aboriginal Planning at the Sydney School of Architecture, Design and Planning. With a passion to empower the voices of First People, Elle combines her Town Planning and Indigenous Engagement qualifications to navigate between two worlds. She understands the importance of deep listening and building a strong platform of trust for working together with the community. Elle uses her planning and engagement skills to facilitate a co-design process that leads to culturally informed outcomes.

BUILT ENVIRONMENT, HOUSING, INFRASTRUCTURE, PLANNING & DESIGN FOR CLIMATE RESILIENCE

Professor Nicole Gurran

Expertise: Urban planning, housing & affordability

Nicole Gurran is Professor of Urban and Regional Planning in the School of Architecture Design and Planning and the Director of the Henry Halloran Trust. She is an urban planner and policy analyst whose research focuses on comparative urban planning systems and approaches to housing and ecological sustainability. She has led and collaborated on a series of research projects on aspects of housing, sustainability and planning, including planning for climate change funded by the Australian Research Council (ARC), the Australian Urban and Housing Research Institute (AHURI), as well as state and local government. Beyond academia, Nicole serves as state appointed independent member of the Sydney Western City Planning Panel.

Dr Arianna Brambilla

Expertise: Building performance assessment; managing damp and mould in buildings; innovative construction technology

Dr Arianna Brambilla is a senior lecturer in Architecture and co-chair of the cluster Building Efficiencies of the Smart Sustainable Building Network with the School of Architecture, Design and Planning. Her background in both architecture and engineering allowed her to establish her research field at the merging borders of architecture, construction, building physics, and engineering. Drawing upon the different disciplines to assess and interpret construction as a holistic concept, with a strong focus on sustainability. Her research interests relate to human-centred design, building performance assessment, low-carbon living, construction and innovative technologies, and healthy built environments.

Dr Daniel Ryan

Expertise: Sustainable architectural science and design, environmental history and heritage

Dr Daniel Ryan is the Program Director Master of Architectural Science and Stream Coordinator for Master of Architectural Science - Sustainable Design. He is an historian of architectural science and architecture in the tropics, focusing on Australasia and the Pacific. He leads architectural studios on water sensitive urban design and has undertaken work on adapting to sea level rise in the Lake Macquarie area. Before coming to the University of Sydney, Daniel was involved with a number of ground-breaking environmental buildings in Ireland. The projects set the standard for green building in the country through innovative design and specification of materials and services. He has also practiced with leading firms in Italy and Australia.

Dr Ali Hadigheh

Expertise: Civil engineering and infrastructure vulnerability to natural disaster, resilience assessment

Dr Ali Hadigheh is a senior lecturer in the School of Civil Engineering. His research identifies and addresses vulnerabilities caused by natural disasters (fires, floods, earthquakes, cyclones, tsunamis), non-environmental factors (industrial pollution, contamination) and other events (terrorist attacks). He draws on cross-disciplinary themes to implement new and innovative materials and techniques in order to provide safer, more durable and less resource-intensive infrastructure. Specific areas of focus include the maintenance, repair and rehabilitation of existing structures; the structural applications of composite materials (including fibre-reinforced polymer, or FRP); the durability and fracture mechanism of interface in composite structures; experimental/numerical assessment of buildings under dynamic loads; and the development of an integrated framework for assessing the disaster resilience of infrastructure by optimising strengthening techniques.

Associate Professor Hao Zhang

Expertise: Structural engineer, flood mitigation for buildings and infrastructure, structural reliability, risk assessment

Associate Professor Hao Zhang is with the School of Civil Engineering. He is a structural engineer with an interest in the mitigation effects of floods on buildings and infrastructure. His research looks at the frequency and magnitude of such events, and at their effects on structures such as buildings and bridges, with the aim of increasing safety by improving design. He focuses on structural reliability theory, probability-based structural design, natural hazards, risk assessment and resilience of infrastructure systems. He has written more than 100 technical papers and reports.

Dr Lara Mottee***Expertise: Environmental and Social Impact Assessment, infrastructure project management***

Dr Lara Mottee is a postdoctoral researcher at the John Grill Institute for Project leadership and former Environmental and Social Impact Assessment (SIA) consultant. She has worked with the private and government sectors providing specialist social and environmental management advice for transport, water and energy infrastructure projects. Her previous research investigated urban planning and social impact assessment and management practices in Sydney (Australia) and Amsterdam (The Netherlands). Her current research is focused on improving project leadership practices and knowledge sharing between infrastructure megaproject ecologies in the Greater Sydney. She has research interests in enhancing industry capacity in project leadership and management of infrastructure projects and measuring and managing environmental and sustainability performance.

Dr Aaron Opdyke***Expertise: humanitarian engineering, built environment and community resilience, humanitarian responses to disaster, disasters and poverty***

Dr Aaron Opdyke is a Lecturer in Humanitarian Engineering and Director of Research Training School of Civil Engineering. His research seeks to improve international humanitarian response to better assist developing communities to recover in the aftermath of disaster and conflict, with a particular focus on safe and equitable shelter. His work with humanitarian organisations is uncovering how new approaches, such as neighbourhood-focused programming and supporting self-recovery, can improve the scale and quality of humanitarian assistance. He takes a multidisciplinary approach to the study of disasters and poverty in marginalised communities, at the nexus of engineering and social inquiry. He's interested in exploring how design thinking and project organisation can influence the effectiveness of humanitarian solutions and disaster risk reduction. More broadly, his research focuses on the role of the built environment in contributing to the resilience of communities, and the links between infrastructure, public health, education and livelihoods.

CLIMATE & PLANNING LAW**Professor Rosemary Lyster*****Expertise: Climate law, planning law, climate and disaster law, climate justice, energy and water law***

Rosemary Lyster is the Professor of Climate and Environmental Law in the University of Sydney Law School and a Fellow of the Australian Academy of Law. Rosemary's special area of research expertise is Climate Justice and Disaster Law. She has published two books in this area: Rosemary Lyster and Robert M. Verchick (eds.) *Climate Disaster Law* (Edward Elgar: 2018) and Rosemary Lyster *Climate Justice and Disaster Law* (Cambridge University Press: 2015). In 2015, Rosemary was appointed by the Victorian government to a three-person Independent Review Committee (IRC) to review the state's Climate Change Act 2010 and make recommendations to place Victoria as a leader on climate change. The government accepted 32 of the IRC's 33 Recommendations which were included in the new Climate Change Act 2017. In other areas of Environmental Law, Rosemary specialises in Energy and Climate Law and Water Law. Rosemary is the principal author of Rosemary Lyster, Zada Lipman, Nicola Franklin, Graeme Wiffen, Linda Pearson, *Environmental and Planning Law in New South Wales, 4th Edition* (Federation Press: 2016). Rosemary is the Energy and Water Special Editor of the *Environmental and Planning Law Journal* which is the leading environmental law journal in Australia. Her affiliations include the IUCN – The World Conservation Union Commission on Environmental Law, comprising environmental lawyers from around the world, as well as the Commission's Special Working Groups on Energy and Climate Change, Water and Wetlands, and Forests.

GOVERNANCE, PROJECT/ORGANISATIONAL MANAGEMENT, ENVIRONMENTAL POLITICS**Professor David Schlosberg*****Expertise: Director of the Sydney Environment Institute, environmental and climate justice***

David Schlosberg is Professor of Environmental Politics and Director, Sydney Environment Institute. He is known internationally for his work in environmental politics, environmental movements, and political theory - in particular the intersection of the three with his work on environmental and climate justice. His other theoretical

interests are in food justice and multispecies justice, climate adaptation and resilience, and environmental movements and the practices of everyday life - what he terms sustainable materialism. Professor Schlosberg's more applied work includes public perceptions of adaptation and resilience, the health and social impacts of climate change, and community-based responses to food insecurity.

Professor Stewart Clegg

Expertise: Organisational studies, project management

Professor Stewart Clegg was Distinguished Professor of Management and Organization Studies at the University of Technology Sydney before joining the Department of Project Management in the Faculty of Engineering at the University of Sydney in 2021. He is widely acknowledged as one of the most influential contributors to organization studies and project management, recognized as such by numerous Fellowships, as well as being one of the most significant contemporary theorists of power relations. He has held several ARC Linkage Grants investigating phenomena such as alliancing, as well as program delivery, in Sydney Water. Currently he is involved in empirical teamwork for the Asia Pacific Organization, investigating member nation governmental digital strategies, as well as an upcoming ASSA (Academy of the Social Sciences) workshop on Public Private Partnerships.

Dr Suhair Alkilani

Expertise: Project management, cross sector collaboration

Dr Suhair Alkilani is the Director of Postgraduate Project Management Programs and a Senior Lecturer in the School of Project Management at the University of Sydney. Suhair's research interests lie in construction and project management and more specifically the areas of construction project and industry performance and improvement, corporate social responsibility, social value from projects, social procurement, and cross-sector collaboration for maximising social value from projects. She also has interests in sustainable project management education and focuses on cross-sector collaboration for maximising social value from projects.

Associate Professor Petr Matous

Expertise: Project management, technology and social / interorganisational networks

Associate Professor Petr Matous is with the School of Project Management / John Grill Institute of Projects and he is Associate Dean (Indigenous Strategy and Services). His research is about the interplay of technologies with social or interorganisational networks and the environment. He investigates how the introduction of new infrastructure and technology affects local communities in developing countries - and how the structure of these communities affects the success of such projects within them - can help us to minimise negative impacts to the community and facilitate the smooth implementation and operation of development programs.

Professor Richard J Badhman

Expertise: Project leadership

Richard J Badham is Professor of Project Leadership in the School of Project Management and Director of the Executive Leadership in Major Projects Program in the John Grill Institute at The University of Sydney. His academic research is focused on leading innovation and change, with particular attention to power and politics, paradox and irony in leadership development. He has expertise in the sociological approach to understanding and addressing cultural trauma.

Dr Mahshid Tootoonchy

Expertise: Flood modelling, project management

Dr Mahshid Tootoonchy is a Lecturer of Project Management at The University of Sydney, Australia. Mahshid is the former lecturer at Operations Management, Supply Chain Management, and Project Management at Sharif University of Technology. She uses flood modelling techniques in order to achieve sustainable development goals.

Dr Mehdi Rajabi Asabadi

Expertise: Data mining, project and operations management

Dr Mehdi Rajabi Asabadi is a Lecturer in the Faculty of Engineering at the University of Sydney. As a researcher, Mehdi looks at expanding knowledge on project and operations management. Mehdi has worked on common problems in government projects spanning from requirement specification to project benefits management. He also looks at the role of data mining in enhancing decision quality in organisations.

Dr Fatima Afzal

Expertise: Sustainable project management

Dr Fatima Afzal is a Lecturer in the School of Project Management, Faculty of Engineering at the University of Sydney. Fatima's main area of research is in sustainable project management. She is a mixed method researcher but has special interest in quantitative research methods and her expertise lies in structural equation modelling. Prior to commencing her position as a full-time academic, she has worked as a research consultant on various public sector projects in the domain of sustainability. Her research is recognised by industry as a cutting edge research in the field of sustainability and she has delivered various CPD trainings for industry organisations. She has also worked as a project manager and business analyst for several years in the construction industry.

ENVIRONMENTAL ENGINEERING**Professor Abbas El-Zein**

Expertise: Geoenvironmental engineering, flooding, sea level rise, contamination

Professor Abbas El-Zein leads the Geoenvironmental Engineering Research Group and runs the Geoenvironmental Laboratory (GEL) in the School of Civil Engineering at the University of Sydney. His research interests are in soil hydrology, groundwater contamination, flooding and sea level rise. Abbas has advised governmental, non-governmental and international organisations on problems of water resources and environmental sustainability. He works on problems of contamination and hydro-mechanical behaviour of saturated and partially-saturated soils, impacts of climate change, and coastal vulnerability to sea level rise.

Associate Professor Federico Maggi

Expertise: Environmental engineering, soil physics, soil fluid mechanics

Associate Professor Federico Maggi works in the Faculty of Engineering and is head of the Environmental Engineering Laboratory. He obtained his ME in 1999 from the Polytechnic of Turin, Italy, with a thesis on nonlinear prediction of complex signals such as from deterministic chaos and turbulence. He received his PhD in 2005 from the Delft University of Technology, The Netherlands, with a comprehensive experimental and modelling work on turbulence-induced flocculation of suspended cohesive sediment. In 2005, Federico moved to Duke University, North Carolina, USA, where he became involved in advanced mathematical modelling of soil fluid mechanics. In 2006, Federico joined the University of California, Berkeley, USA, where his interests widened to soils physics and biogeochemistry. That same year he joined the Earth Science Division at the Lawrence Berkeley National Laboratory, Berkeley USA, where he remains a guest scientist.

ENVIRONMENTAL SCIENCES**Professor Kathy Belov**

Expertise: Comparative genomics, biodiversity conservation

Kathy Belov is a Professor of Comparative Genomics in the School of Life and Environmental Sciences, Pro Vice-Chancellor Global Engagement, Interim Deputy Vice-Chancellor (Research). Her research interests are in the evolution of the adaptive immune system Marsupial and monotreme immune genes MHC Diversity and Conservation Marsupial and monotreme genomics, as well as Comparative Genomics Genetics of Tasmanian Devil facial tumour disease.

Associate Professor Willem Vervoort

Expertise: hydrology, catchment management, sustainable water management, agriculture

Willem Vervoort is Associate Professor in hydrology and catchment management in the School of Life and Environmental Sciences and the Director of the ARC Training Centre in Data Analytics for Resources and Environments (DARE). He has a PhD in field hydrology from the University of Georgia in the US and Agricultural Engineering undergraduate degree from Wageningen University in Soil Conservation. He is the leading hydrologist at the University of Sydney and an expert in quantitative Hydrology and Catchment Management. His main research focus is the development of sustainable water management in relation to a varying climate leveraging a long association with agricultural research and agricultural production. Current projects include Bayesian model optimisation, multi-objective model optimisation, understanding model uncertainty in relation to observed water quality and quantity, and the use of satellite data to improve model structures and predictions. In addition, he has strong interests in groundwater surface water interactions, including using hydrogeochemical tracers to understand groundwater and catchment water storage.

ⁱ Sewell, Thomas, et al. "Disaster declarations associated with bushfires, floods and storms in New South Wales, Australia between 2004 and 2014." *Scientific reports* 6.1 (2016): 1-11