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Developing Community Profiles for Community Engagement

A Review of Existing Evidence

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Glossary

Disaster: A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts. Note, there are jurisdictional legislative variations (AIDR, n.d.).

Disaster risk: The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity (UNDRR, 2021).

Hazard: A source of potential harm or a situation with a potential to cause loss. * A potential or existing condition that may cause harm to people or damage to property or the environment. * An intrinsic capacity associated with an agent or process capable of causing harm (AIDR, n.d.).

Preparedness: The knowledge and capacities developed by governments, response and recovery organizations, communities and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current disasters (UNDRR, 2021).

Prevention: All activities concerned with minimising the occurrence of incidents, particularly those of human origin. 2. Regulatory and physical measures to ensure that emergencies are prevented, or their effects mitigated. * Measures to eliminate or reduce the incidence or severity of emergencies (AIDR, n.d.).

Resilience: The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management (UNDRR, 2021).

Risk: Risk is the probability of an outcome having a negative effect on people, systems or assets (UNDRR, 2020).

Vulnerability: The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards (UNDRR, 2021).

Introduction

In the Australian context, community and individual literacy and action in relation to bushfire safety behaviour is of utmost importance. Australia is the driest vegetated continent and is one of the most bushfire prone regions on our planet (Williamson, Markham & Weir, 2020). Bushfires occur both naturally and in relation to human-environment interaction (Williamson, Markham & Weir, 2020). In order to understand patterns and behaviours associated with bushfire planning, preparedness, response and recovery, it is essential to examine the concept of risk. Risk has been defined as the likelihood of an outcome having an adverse effect on people, systems or assets within a given context (UNDRR, 2020). In addition to likelihood, the consequence dimension of risk in the context of bushfire is also of key importance, as often bushfire related events can be considered low probability, high consequence events. The drivers of residential, wildfire or bushfire risk, are multifactorial, and include variables such as meteorological factors; vegetation conditions (i.e. level of species richness and age distribution of trees) and human behaviour (Vigna et al., 2021).

Less unique to the Australian context, but of equal importance from a community safety perspective, is residential fire safety, which has been described as a “diffuse disaster” (Rhodes and Reinholdt, 1998). While some of the factors influencing the incidence and impact of residential fires may be different from bushfire risk, the human behaviour dimension as well as other social and environmental factors are just as important to consider, before, during and after house fires (Clark et al., 2014).

Of key importance to conceptualising risk in either fire context, is understanding the range of factors associated with vulnerability. Among the factors associated with vulnerability are socio-demographic factors, which denote the characteristics of a population, and include items such as age, sex, gender, educational level and so on.

The task of profiling community risk factors in fire contexts strongly supports the Country Fire Authority’s (CFA) Vision that “*Victorian communities are prepared for and safe from fire*” and Mission “*To protect lives and property*”. Profiling community risk factors in fire contexts will involve collating essential data to enable evidence informed approaches to fire safety preparedness and planning. This will involve the development and delivery of tailored, targeted,

relevant and timely community fire prevention and preparedness plans, products and resilience-building services. Data on community risk already exists and has been used in the past to inform fire safety planning and prevention. While community fire safety preparedness and planning is being approached in an evidence based way by CFA at present, the present study will further support the tailoring of community engagement plans, products and programs to promote fire risk management in a way that is most meaningful to Victorians at greatest risk of fire fatality and harm. The community profiles are intended to complement existing risk-based tools including the Victorian Fire Risk Registers (VFRR). It will also enable the tailoring of fire safety approaches, including engagement and education based on the characteristics, demographics and archetype profiles of communities and regions (CFA, 2021).

To achieve CFA's Vision and Mission, there are varying actions that Victorians need to take to remain safe from fire. In a Victorian context, fire includes agricultural fire, coastal fire, grassfire, bushfire and residential fire. Non-residential structure fires are also highly relevant in the Victorian context but are not included in the present study.

Community preparedness interventions, and programs and initiatives that are both evidence-based, informed by local knowledge and adaptable to the unique needs of differing locations and populations enable fire safety. Australia's National Strategy for Disaster (COAG, 2011) recognises the need to bolster existing emergency planning efforts, and ultimately strengthen local capacities and capability by better understanding the demographic composition, needs, strengths and vulnerabilities of communities. The project associated with this literature review recognises and responds to this need.

Social Vulnerability

Broadly speaking, vulnerability can be conceptualised as the susceptibility of human beings to suffering or damage from catalysts in their physical and social environments (Whittaker et al., 2012). Research de-naturalises disasters by demonstrating that their causes are inherently social, and their impacts socially differentiated. Existing literature shows that vulnerability arises from a combination of factors both within (ie. individual vulnerability) and beyond human control (Whittaker et al., 2012). Further to individual vulnerability, household vulnerability has also been

studied. It has been suggested that the level of vulnerability of a household should be determined by its weakest rather than its strongest member (DELWP, 2018).

At a population level, as demographic composition naturally changes over time, vulnerability status also changes over time. For example, children are born, people age, and there may be immigration by people with refugee or asylum seeker background, or people with low English speaking literacy (DELWP, 2018). All of these factors can influence social vulnerability patterns in different areas dramatically.

Social vulnerability can be experienced by sensitive populations that may be less likely to be able to respond to, cope with, and recover from a disaster like fire (Cutter & Finch, 2008). Vulnerability to environmental hazards commonly reflects a potential for loss (Cutter, Boruff, & Shirley, 2003). Some vulnerability related research focuses on the source of biophysical or technological hazards. This includes consideration of the distribution of a hazardous condition, the interaction of hazard with human occupancy of an area, and the degree of destruction associated with the disaster (e.g. bushfire) (Cutter, 1996). Other vulnerability research explores coping responses such as community resilience to disasters. Further still, some studies integrate both thematic categories (consideration of biophysical risk *and* social response), to consider the geographic space in which vulnerable people and spaces find themselves to be situated (Cutter, 1996). The causes of social vulnerability are explained by the underlying social conditions that are often quite remote from the initiating hazard or disaster event.

The Social Vulnerability Index (SoVI) is an index of social vulnerability to environmental hazards which was developed in the United States (Cutter, Boruff, & Shirley, 2003). Hazard potential is filtered through the social fabric of society via factors such as socioeconomic indicators, understanding of risk, and/or the overall social vulnerability of the place (Cutter, 1996). Geographic context also influences hazard potential via factors such as site and proximity (Cutter, 1996).

Figures 1, 2 and 3 below offer visual representations of the relationship between the core concepts of this review. Figure 1 shows that hazard, vulnerability and exposure interact to determine or predict risk.

Figure 1

Risk triangle (Adapted from Crichton 2002)



Source: Dewan (2013)

Figure 2

Conceptual framework to identify risk

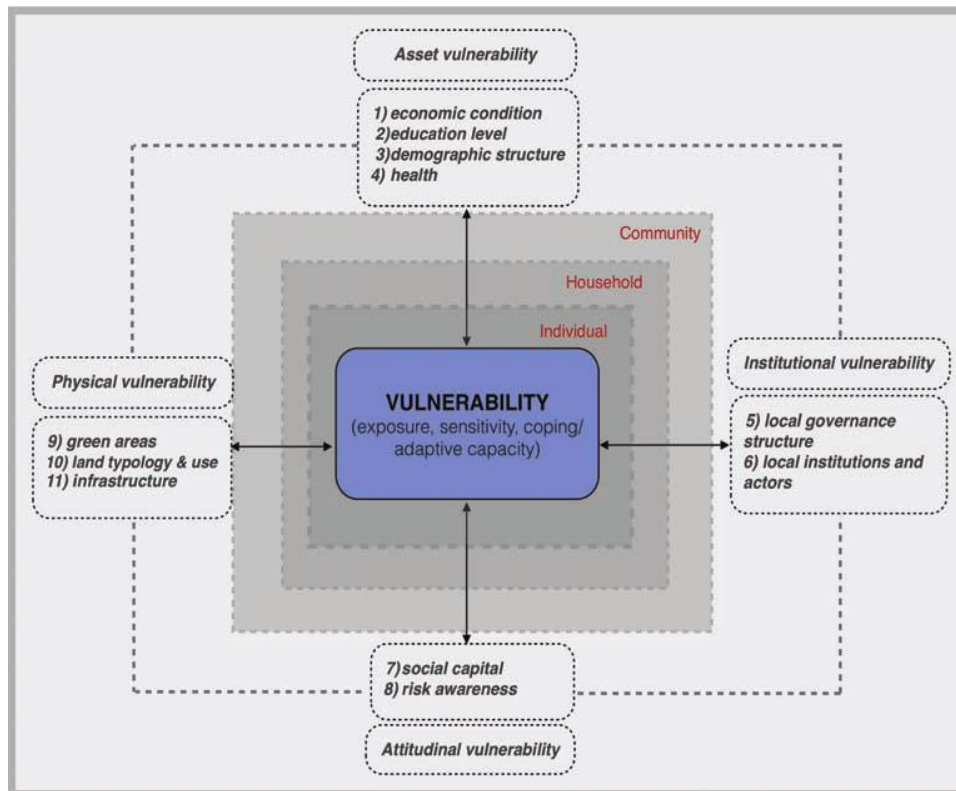


Sourced from: Ciurean et al. (2013)

Figure 3 below breaks down vulnerability by type, recognising the interplay between these.

Figure 3

CLUVA framework for assessing social vulnerability



Source: Coly et al., 2015

Integrating the facets of vulnerability

In conceptualising vulnerability, it is helpful to recognise the elements of individual vulnerability, household vulnerability and social vulnerability respectively. It is also important to consider intersectionality, or intersecting vulnerability factors. Social vulnerability is a multidimensional concept that guides the identification of factors that enable and inhibit communities and individuals to respond to and recover from environmental hazards (Cutter, Boruff, & Shirley, 2003).

Existing research has indicated that certain characteristics are associated with an individual's level of vulnerability, before, during or after a disaster (DELWP, 2016). Each community is likely to vary in its level of vulnerability and type(s) of vulnerability (DELWP, 2016). Based on this recognition, the community profiles which this literature review will inform, recognise community variance and diversity, and promote a tailored approach to community engagement.

Bushfire or flood disasters arrive with rapid onset, as compared with other disasters of a different nature, such as droughts. Research indicates that some people may be more resilient to one or other of these types of disasters (ie. rapid versus chronic onset) and associated hardship (DELWP, 2018; Waters et al. 2012). Thus the nature of vulnerability may differ in chronic and rapid onset contexts.

Both domestic and international literature on fire preparedness (and other hazard related disaster preparedness) is included in this review.

This review is guided by the following research questions:

1. *What are the socio-demographic and other factors that predispose individuals and communities to greater risk/vulnerability in the context of fire?*

a. *What does existing data indicate relative to connections between Strahan et al.'s archetypes and demographics?*

b. *What does CFA intelligence data indicate relative to socio-demographic factors that predispose individuals and communities to greater risk/vulnerability in the context of fire/other risks*

c. *What do external data sources indicate relative to socio-demographic factors that predispose individuals and communities to greater risk/vulnerability in the context of fire/other risks?*

2. *What factors can be easily/feasibly mapped to create community risk profiles for those living, working in or travelling through the country area of Victoria?*

A report on the 2019-20 bushfire season in New South Wales explicitly identified the need for “*Better systems for ensuring that vulnerable people living alone (e.g. older adults, people with disabilities) are aware of bushfires and, if needed, assisted to take protective action*” (Whittaker et al., 2021, p.123). As Solangaarachchi et al. (2012) discuss, identifying vulnerable groups is an important step in any emergency management preparedness and planning process. The present study aims to identify groups most vulnerable to risk, based on existing evidence from internal CFA intelligence and external academic and grey literature (from other fire and disaster

agencies). The grey literature included has been provided from subject matter experts from other fire agencies (such as the New South Wales Rural Fire Service), and also includes literature sourced via targeted internet searches. Identifying at risk groups (i.e. the findings of this literature review) will also inform the development of community profiles. This information will include evidence from the literature review, to map community demographics and composition against risk factors. It is intended that this work will eventually inform the capacity for brigades, community engagement staff and others to tailor approaches to fit community composition and need.

Navigating this document

This document has been divided into key sections, including:

- Introduction
- Hazard and Risk
- Exposure
- Sensitivity
- Risk perception factors
- Community resilience
- Community Engagement, and
- Conclusion

This layout reflects the topic focus on risk. Exposure, sensitivity and impact each represent components of the concept of social vulnerability. The Hazard and Risk section includes a Risk Statement to anchor the project and research focus, information on understanding hazard and climate Change. The exposure section considers the impacts of factors such as location, property type, ingress and egress options, and so on. Sensitivity sections discuss socio-demographic factors and cultural sensitivity considerations in greater depth. The Risk Perception section presents and integrates self-evacuation archetype information. The Community Resilience section balances previous discussions of risk by recognising the many strengths of communities and the scope to further support their resilience.

Section 1. Hazard and Risk

Understanding hazard

As per the United Nations Office for Disaster Risk Reduction, Hazard refers to “a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation” (UNDRR, 2021). In understanding hazard, it is important to note that hazards may be natural, anthropogenic or socionatural in origin (UNDRR, 2021).

Types of Hazards

Bushfire

A bushfire is a form of unplanned vegetation fire and encompasses grass fires, forest fires and scrub fires (AIDR, n.d.). Bushfires are a natural part of the Australian environment but can significantly and tragically impact on human life, property and the environment (AIDR, n.d.). Causes of bushfire ignition include weather conditions such lightning strikes, fuel conditions, and/or (unintentional or intentional) human action (AIDR, n.d.). Fuel includes materials such as leaf litter, branches, twigs, grasses and shrubs and dry fuel is more likely to catch fire and burn than damp or wet fuel (AIDR, n.d.). Hot, dry and windy weather can contribute to fire danger. Weather-related factors that can contribute to an increased risk of bushfire danger include: high temperatures; abundant dry vegetation; strong winds; low humidity; reduced rainfall and thunderstorms.

Residential Fire

As reported by the Australian Urban Research Infrastructure Network (AURIN & University of Melbourne, 2021), “in the context of residential or home fire, a number of factors may operate over multiple spatial scales, and across multiple domains, interacting to influence both the likelihood of a fire event, and the magnitude of its consequences”. These factors commonly include: risk taking behaviours, preparedness, combustibility of materials, perceptions of fire risk, and population and spatial characteristics (AURIN & University of Melbourne, 2021).

Data from the Bushfire and Natural Hazards Cooperative Research Centres study indicates that most fatal residential fires in Australia occur during the winter months, between the hours of 8 pm to 8 am (mostly between midnight to 4 am) (BNHCRC, 2020). The majority (67%) of fatal fires occurred in freestanding houses, though other housing types may be overrepresented in the fatality data as freestanding houses comprise 78% of the housing stock in Australia (BNHCRC, 2020). While most fatal residential fires occurred in major cities, there was overrepresentation of deaths in regional and remote areas relative to population distribution (BNHCRC, 2020). The most common location for residential fire ignition is the kitchen, where cooking is often left unattended (CFA, 2021). Electrical faults and flammable items like paper towels and curtains that are too close to sources of heat like a heater, stove or toaster are also common sources of ignition (CFA, 2021). Grease and fat around the stove and range hood can also feed flames (CFA, 2021). Other fatal preventable residential fires were found to have commonly ignited in the living room or bedroom; locations where people may be sleeping (BNHCRC, 2020).

The impacts of Climate Change

Further to the aforementioned causes of bushfire, the impact of climate change is also associated with changed weather conditions. Bushfires are a natural dynamic of many forest biomes (DELWP, 2018), however climate change is anticipated to amplify bushfire risks during drier and warmer seasons in certain areas (Vigna et al., 2021). Forest ecosystems and human socioeconomic systems are deeply interconnected (Vigna et al., 2021). Bushfire risk emerges as a result of the interaction between human activities, ecological domains, and climate, however a clear and in depth understanding of the interaction between these variables is yet to be established (Vigna et al., 2021). A range of sources corroborate the importance of considering climate change in the context of fire and disaster risk planning (Buxton et al., 2011; Preston et al., 2009).

Preston et al. (2009) note that participatory spatial vulnerability assessments (facilitated discussions that include members of community) are useful tools to support risk management planning and may assist in incorporating climate change considerations hazard mitigation work. These assessments can assist stakeholders in conceptualising and understanding risk in the

context of bushfire vulnerability. This can in turn lead to discussion about how to develop or expand individual's and communities' adaptive capacities relative to bushfire planning.

In order to facilitate associated discussions, Preston et al. (2009) highlight the importance of considering knowledge translation and ensuring that language and assessment frameworks are in alignment with vocabulary used by stakeholders themselves.

Preston et al. (2009) have reported on the efficacy of participatory spatial vulnerability assessment, based on early evidence from a case study conducted in Sydney Australia. This mapping exercise included the identification of both biophysical and socio-economic indicators, which were presented in a map format to visualise exposure, adaptive capacity and sensitivity to bushfire in the Sydney coastal metropolitan region. Preston et al. (2009) note that no indicator specific validation tests were conducted during the course of model development, however that the relevance of indicators was considered by cross-referencing supporting documentation associated with the project.

Adaptive capacity indicators encompassed socioeconomic factors. These indicators included:

- median household income
- median house load repayment
- percentage of households within a locality requiring financial assistance
- percentage of home ownership
- percentage of the population completing year 12
- percentage of the population who speak a language other than English at their home
- percentage of the population with internet access
- Ratios of financial assets to liabilities
- per capita business rates
- per capita residential rates
- per capita community service expenditures

All data pertaining to the above indicators was obtained either from the Australian Bureau of Statistics, the 2007 Census or Local Government reports from 2006.

Social vulnerability factors by hazard

Social vulnerability factors associated with residential fire

A recent review of fourteen years of coronial records across Australia found that the death rate in residential fires has remained consistent over the past decade, with considerable fatalities among the elderly, disabled, young and those living alone (Gissing, 2018).

The conceptualisation of fire fatality risk is complex and determined by a range of individual, environmental and external factors. Coates et al. (2019) have reported that in both domestic and international studies, older people, young children, males, people with physical disabilities, people under the influence of alcohol and people who experience financial and/or social disadvantage are more likely to die in residential fires (AFAC 2005; Aufiero et al, 2011; Bushell et al, 2016; Jonsson et al, 2017; Runefors et al, 2016). Of the aforementioned at risk cohorts, older people were identified as the highest risk. Research gaps identified included an absence of research on potential interactions between ethnicity related demographics and residential fire risk. A recent study using CFA incident data found that increased ignitions related to 3 key factors: public rental status, occupants over 65 years and occupants unemployed (D'Elia et al., 2017). Decreased ignitions were associated with: relocation within the preceding 5 years and high disposable income (D'Elia et al., 2017). Need for care and/or assistance were also noted as specific issues determining ability to self-evacuate during a house fire. These factors were broadly consistent with the findings of Xiong & Bruck (2015).

Social vulnerability factors associated with bushfire

Evidence shows that certain people are likely to be at increased risk of adverse effects associated with bushfire smoke inhalation. This includes individuals with respiratory weaknesses that may reduce lung capacity, such as: people with existing heart or lung conditions (ie. angina, ischaemic heart disease, asthma, chronic obstructive pulmonary disease, also called bronchitis and emphysema), people aged over 65, children 14 years and younger, pregnant women (pregnancy reduces lung capacity), and people with diabetes (Department of Health, 2020).

Examples of smoke exposure as a hazard can be seen in reports of the 2019-20 bushfire season in New South Wales. In this context, exposure to smoke informed people's decisions on where to go to avoid it (Whittaker et al., 2021). As many people sought to escape the smoke in Canberra, they travelled South along the coast and placed themselves, some knowingly and some unknowingly, in a high bushfire risk area. Smoke exposure was especially challenging for families who had children with asthma (Whittaker et al., 2021).

Section 2. Exposure

Exposure refers to a number of factors, including location, property type, and ingress and egress options, as related to fire risk.

A recent study of bushfire risk to the built environment in Australia shows that the annual probability of building destruction has remained almost constant over the last century (McAneney et al., 2009). Existing research has found that the maximum distance at which homes are destroyed is typically < 700 m (Chen & McAneney, 2004). The probability of home destruction has been conceptualised as a linear and decreasing function of distance from the bushland-urban edge, with a variable slope that likely depends on fire regime and human intervention (Chen & McAneney, 2004). Available data suggest that the probability of home destruction at the forest margin is approximately 60%, while spatial patterns of destroyed homes display significant neighbourhood clustering (Chen & McAneney, 2004).

Discussions of exposure have also traversed land use planning policy, including the ethics of allowing development in these high risk areas (Crompton et al., 2010). For example, amongst the building damage during the 2009 Black Saturday fires in Marysville and Kinglake a large proportion of buildings destroyed were either within bushland or at very small distances from it (<10 m) (Crompton et al., 2010).

Section 3. Sensitivity: Key Concepts

Community Safety

Community safety is enabled when community members are informed about local risks, proactive in planning and prevention efforts, able to manage local issues through effective planning and action, and risk averse (Hodges, 1999). Community safety initiatives including fire safety community engagement and education programs, can be mapped along a continuum ranging from 'top-down' to 'bottom up' approaches (Elsworth et al., 2009; Elsworth et al., 2010). Examples of 'top-down' approaches are community alert and warning systems (ie. VicEmergency App) and other high level communication strategies such as media campaigns, designed to inform and encourage appropriate planning, preparedness, prevention and responses in relation to fire safety (Elsworth et al., 2009). In addition, there are also community education and engagement initiatives which inform and encourage appropriate planning, preparedness, prevention and response.

Examples of 'bottom-up' approaches include community development, community collaboration and community consultation efforts (Elsworth et al., 2009; Elsworth et al., 2010).

Proactive Approaches to fire safety

Proactive approaches to fire safety include: (i) undertaking prevention and preparedness measures early, (ii) household level planning (making a plan, writing it down, communicating it with others and practicing it), (iii) preparing the home and property, (iv) knowing ones triggers for action, (v) leaving early and/or staying and defending. Planning and preparation is crucial to fire safety, as evidenced by existing research which identifies that insufficient planning and preparedness including the instances of people waiting until they are directly threatened by bushfire before taking action lead to late evacuation, failures in defence and passive shelter (Whittaker et al., 2013). Early planning and decision-making is vital to householders' survival, as late evacuation has been associated with fatalities (Strahan & Watson, 2019).

Evidence on the effectiveness of fire prevention, planning, and preparedness measures for improving safety is robust. The use of smoke alarm and fire systems, promotion of the use of safe electrical equipment in buildings and safe building materials have been shown to promote fire safety (Shokouhi et al., 2019). Existing evidence shows that fires tend to be the most severe when smoke alarms are not installed or fail (Fagan et al., 2014). The injury rate per 100 fires increased by nearly 66 per cent when a smoke alarm was not installed or failed to operate, while the fatality rate also increased when a smoke alarm was not present or failed to operate (Fagan et al., 2014).

Although it has been recognised that no single approach or policy is likely to be effective in every context, generally efforts that enable development of community relationships between community members can contribute to increased preparedness, both for individuals and communities, via the processes of information exchange and promotion of a sense of community (McCaffrey, 2015).

Participation in a fire safety program

The frequency and consistency of people's participation in local fire planning and preparedness meetings or programs was found to be positively associated with level of knowledge about bushfire (Rhodes, 2001; Rhodes, 2003). Other studies have corroborated these findings on the scope for community meeting and workshop participation to improve individual awareness and understanding of bushfire risk (Gilbert, 2005).

Research has also indicated that participants in fire focused community meetings and workshops were more likely to accept responsibility for bushfire planning, preparedness and safety, as opposed to seeing this as a fire agency task to be outsourced (Rohrmann, 2000; Rohrmann, 2002; Rohrmann, 2007). These participants were also more likely to rate their overall bushfire preparedness highly (Rohrmann, 2000; Rohrmann, 2002; Rohrmann, 2007).

A more specific type of volunteering with a focus on fire safety education and capacity building, such as participation in a Community Fire Unit (CFU) has also been shown to offer protections,

including promoting sense of self-efficacy relative to fire planning and preparedness, enhancing local knowledge, facilitating knowledge exchange, improving sense of self-reliance, and bolstering community cohesion and cultivating trust (Lowe et al., 2008). Community Fire Units operate in New South Wales, Australia and is a hybrid volunteer system. CFUs do not have the same level of training as Rural Fire Service or State Emergency Service volunteers, have no response role and do not use fire trucks (Lowe et al., 2008). Instead, their focus is on protecting properties from ember attack and spot fires within a designated geographic area (for example part of a street). CFU members do not have the same level of training, commitment or responsibility or the broad scope of Rural Fire Service or State Emergency Service volunteers. The application process for the commissioning of CFUs depends upon community expressions of interest (Lowe et al., 2008).

Relevant behavioural theories

Protection Motivation Theory

Protection Motivation Theory is a psychological framework which has been used to understand and conceptualise the ways in which individuals react in a self-protective way, in response to perceived threats (Westcott et al., 2017). Understanding human behavioural frameworks such as PMT can assist in effectively tailoring messages to engage communities and individuals in fire safety.

Westcott et al. (2017) have posited that the effectiveness of Emergency Services' public education campaigns could be improved if informed by PMT. Westcott et al. (2017) have explored whether an application of PMT can be useful for achieving human protection in natural hazards, specifically, to protect animal owners and emergency responders in bushfire emergencies. Westcott et al. (2017) further suggest that PMT informed collaboration between these groups could lead to improved response efficacy, and safer outcomes.

Protection Action Decision Model

The Protection Action Decision Model (Lindell and Perry, 2012) is a framework which has been specifically developed to examine emergency preparedness and hazard decision-making. This model posits that beliefs act as antecedents human action, and has been applied to successfully predict behaviour in the context of disaster response and management. Having not

previously been applied in Australia, PADM has recently been tested for utility in the Australian bushfire context (Strahan & Watson, 2019). This research identified “long run hazard adjustments” as an additional factor unique to the Australian bushfire context (Strahan and Watson, 2019).

Existing behavioural models suggest that people navigate a common sequence of three behavioural stages when a disaster event threatens residents (McLennan et al., 2019, p.504). These include: Belief, Personalizing and Evaluating. The steps within each of these stages are: Receiving an alert; Believing the source is credible and confirming the threat event; Personalizing the threat; Evaluating the necessity of protective action; and choosing what action to take (McLennan et al., 2019, p.504).

Section 4. Bushfire Sensitivity: Identifying factors associated with vulnerability to bushfire

Part 1. Socio-demographic factors

Age

Existing research indicates that older people are much more likely to die as a result of bushfire, than younger people (Handmer et al., 2019), however very young children also experience significant vulnerability. Wider research indicates that both the very young and the elderly are vulnerable to the risk of bushfire (DELWP, 2018; Canterford 2009; Buckle 2001; Buckle et al. 2001; Yelataysi et al. 2009). Both age cohorts can be (i) dependant on others, due to youth and frailty respectively, and also (ii) more susceptible to potential breathing issues caused by smoke inhalation (Coates et al., 2019). Children aged 0-4 had the largest number of residential fire deaths of any 5 year age range (Coates et al., 2019). Outer metropolitan areas and regional centres have high numbers and high proportions of children aged 0 to 4 years of age (Mackenzie & Canteford, 2018).

On average, elderly members of the community tend to be more frail, have more health conditions and be dependent on others for care (Canterford 2009; Buckle 2001; Buckle et al.

2001; Yelataysi et al. 2009). Fire ignition risk is not associated with elderly populations, however evacuation and fire safety issues are often heightened as people move into old age.

While many people remain active into their 60s and 70s, there are relatively high proportions of people aged 80 years and over in many rural areas (Mackenzie & Canteford, 2018). In almost all areas of Victoria, there has been an increase in the number of older people since 2001 (Mackenzie & Canteford, 2018).

Aggregate data shows that the number of people requiring assistance during bushfire increases with age (Buckle 2001; Buckle et al. 2001; Yelataysi et al 2009).

Gender

Recent research indicates that men are much more likely to die as a result of bushfire, than women (Handmer et al., 2019).

Although the study of gender has been explored in social science research for decades, the introduction of gendered analysis in disaster studies is a comparatively recent development (Tyler & Fairbrother, 2018). Recent qualitative research into the influence of gendered norms in bushfire safety planning identified notable gendered differences in relation to preference for early evacuation versus 'staying to defend' a property against a wildfire (Tyler & Fairbrother, 2018). Tyler and Fairbrother (2018) interviewed 107 residents of nine localities across three different Australian states. Common gendered themes reported included: heterosexual couples detailing a bushfire plan that involves a female partner evacuating and a male partner staying; disagreement between members of a heterosexual couple regarding an ideal bushfire plan; a lack of clarity between heterosexual partners on details of their bushfire plan; and variation in disaster response behaviour by gender.

The findings of Tyler and Fairbrother (2018) indicate that disagreement about bushfire safety within households between people of different genders is a common occurrence and may impair the development of clear preparedness and response strategies. Specifically, such disagreements may lead to delays in decision making, otherwise conceptualised as the 'wait and see' problem (McLennan, Elliott, and Omodei, 2012, p. 923). In summary, Tyler and

Fairbrother (2018) emphasise that decision-making cannot be separated from cultural norms and social structures like gender.

Education

There are associations between educational attainment and socioeconomic status, with higher educational attainment tending to be associated with greater lifetime earnings (Heinz Center for Science, Economics, and the Environment, 2000). It is in this sense that educational attainment is a social equity consideration. In some cases, lower educational attainment may constrain individuals ability to access and interpret warning and recovery information (Heinz Center for Science, Economics, and the Environment, 2000). Research suggests that people with higher levels of education may be more likely to understand a range of information planning, preparedness, warning and risk in the context of disasters (Tobin 1999; Cutter et al. 2003; Insurance Council of Australia 2008). Studies also show that there are higher numbers of people who did not complete Year 12 located in fringe and peri-urban areas (DELWP, 2018) suggesting that the social inequity that may be associated with low educational attainment could also be associated with geographical isolation.

Conversely, it must be acknowledged that many people who may have low educational attainment may have extensive and in-depth knowledge and capability of fire planning, preparedness and response. This recognises that knowledge can be attained via numerous streams, such as community-based or familial shared knowledge, or by virtue of occupation or vocational training (ie. farming) or via other forms of self-education.

Digital literacy

As Cutter, Boruff and Shirley (2003) note, a lack of access to resources, information and *technology* are significant factors influencing social vulnerability. Digital literacy may be determined in part by educational history and can significantly impact on a person's ability to access key public health and safety information, such as fire safety advice, planning and preparedness resources that are stored online.

Disability

Having an acute and/or chronic disability can affect an individual's capacity to survive bushfire by increasing a person's susceptibility to injury and/or death during the event. For some people,

evacuation during a fire or other disaster will be particularly difficult and/or delayed, due to factors such as age, disability, social isolation or other disadvantage (McLennan et al., 2019). The Bushfires Royal Commission reported that 44% of people who died in the black Saturday fires were vulnerable (Bushfires Royal Commission, 2009). In particular, the needs of people with disability were not sufficiently addressed in the wake of the Black Saturday fires (Bushfires Royal Commission, 2009). Specifically, The Commission reported that "...nearly half of the people who died were classed as 'vulnerable' because they were aged less than 12 years or more than 70 years or because they were suffering from an acute or chronic illness or disability." (VBRC, 2009).

Household Composition

Interpersonal dynamics in families and/or other relationships

At the familial/household level, conflicting environmental values, reliance on fire insurance and firefighting institutions, a lack of place dependency, and a lack of financial, physical, and/or legal capacity to reduce risks (social vulnerability) were also found to be important influences on bushfire risk. (Colins & Bolin, 2009).

Single parenthood

Existing research shows that single parents may have limited parenting support (Buckle et al. 2001). Furthermore, higher numbers of single parent families are located in Melbourne's outer fringe and peri-urban areas, due to comparative housing affordability in these areas (DELWP, 2018). For example, a large number of single parent families are located in the Dandenong Ranges (Yarra Valley SA2), which is of interest to emergency planning organisations as the area is recognised one of the highest fire risk areas in Victoria (DELWP, 2018). Disaster-related environmental education programs for children can increase disaster resilience and broader family preparedness activities, while also reducing children's fear and anxiety associated with bushfire (Gibbs et al., 2018).

Indigeneity

Research shows that Indigenous Australians were among those most affected by the bushfires in south-eastern Australia in 2019–2020, with over 84 000 Indigenous people (one-quarter of the Indigenous population of NSW and Victoria), residing in bushfire-affected areas (Williamson, Markham & Weir, 2020). Moreover, despite the residence of Indigenous Australian

people across fire-affected places, Indigenous voices have been underrepresented in public responses to bushfires (Williamson, Markham & Weir, 2020). Indigenous Australians are more likely to experience socio-economic disadvantage in relation to health status, education outcomes, employment outcomes, and life expectancy compared to non-Indigenous Australians (ABS, 2005). Due to the complexity of the nature of social inequity experienced by Indigenous Australians, an extended discussion of risk and vulnerability relevant to Indigenous Australian people(s) is provided in Section 6- *Cultural Sensitivity- Indigenous Australian Perspectives*.

Migration background: English literacy

Access to emergency information that is only available in English is likely to be a particular challenge for anyone with low English literacy (Buckle et al. 2001; Yelataysi et al. 2009). People who are new to areas/regions may also be unaware of procedures for preparing for, or responding to, an emergency (Bushnell & Cottrell 2007; Li 2009). They may also be unfamiliar with local environmental hazards unique to their new contexts (DELWP, 2018).

“Non-English speakers, especially new arrivals, may have very limited experience of Australian conditions in relation to bushfire.” (DELWP, 2018). Although this can apply to people proficient in English, it is important to consider accessibility. Accessing and understanding place-based information about fire and other disaster risk is more difficult for people with less English literacy. As Mendez et al. (2020) discuss, undocumented persons with limited English literacy and community embeddedness may also be predisposed to risk in disaster related contexts, due to their experiences of racial discrimination, exploitation, economic hardships, and English literacy skills. Melbourne’s fringe suburbs tend to have higher numbers of non-English speakers (DELWP, 2018).

Tourist or seasonal workforce factors

Popular visitor and holiday locations can have particularly high fire risk. In a Victorian context, the Dandenong Mountain Ranges and sections of the Great Ocean Road are examples of this (DELWP, 2018). Planning for fire therefore requires an understanding of both permanent and seasonal (ie. tourist or seasonal worker) populations (DELWP, 2018).

Research focused on the 2019-20 bushfire season in New South Wales Australia indicated that tourists and visitors tended to be aware of bushfire activity in the vicinity of their travel

destination, however did not think they would be directly adversely affected (Whittaker et al., 2021). This illustrates the specific ways in which tourist(s) or those part of a seasonal (ie. non local) workforce may experience vulnerability during times of bushfire threat. Furthermore, most people who travelled to bushfire threatened or affected areas indicated that they did so with the intention of continuing with their holiday plans (Whittaker et al., 2021).

Part 2. Socio-economic factors

Income

People living on a low income are likely to experience more barriers in recovering from a disaster (Buckle 2001; Buckle et al. 2001; Yelataysi et al. 2009). Several studies have examined individual indicators of social vulnerability and bushfire risk in the Southern United States. Social vulnerability is an applicable determinant of wildfire hazard exposure in the U.S, where the costs associated with bushfire planning and protection are prioritised below daily living requirements for people on low incomes (Lynn, 2003). Although the research of Lynn (2003) was conducted in a U.S context, these findings are highly likely to be relevant to international contexts.

A survey undertaken by VICSES (2015) explored the reasons people had not prepared for emergencies. Among the most common reasons provided for not preparing were, (i) Not believing there is a risk, (ii) Relying on their insurance, (iii) Financial limitations, and (iv) Citing the fact that they are renting. These VICSES findings regarding rental status and financial limitations, corroborate the findings of Collins (2008) and Collins and Bolin (2009).

Mercer and Prestemon (2005) reported a negative association between poverty and bushfire ignition but a positive association between poverty and (i) area of wildland burned and (ii) wildfire intensity. The findings of Mercer and Prestemon (2005) suggest that poorer communities have fewer resources to extinguish ignited fires.

Although people living on a low income are likely to experience more barriers in recovering from a disaster, people who are more affluent can of course also be vulnerable in the context of

bushfire and residential fire (Eriksen & Simon, 2016). Vulnerability varies between households within communities, including in more affluent areas (Eriksen & Simon, 2016).

Housing security

Homeless populations are disproportionately affected during disasters and, because of their “hardly reached” status in communities, may be difficult to reach in recovery efforts (Morrow, 1999; Tobin & Ollenburger, 1993).

Car Access

People without access to a car are unable to evacuate themselves in an emergency (Handmer 2006). The Victorian community has a high rate of car ownership however older people who no longer drive, people with disability that inhibits driving capacity and/or those who cannot afford a car will rely on others for motor vehicle access and transportation (DELWP, 2018).

Part 3. Psychosocial factors

Psychological preparedness

Being psychologically prepared when a disaster is threatening can improve sense of confidence, self control and enable effective emergency planning (APS, 2018). Psychological preparedness also has the potential to reduce the psychological distress and longer-term mental health problems that can emerge due to the trauma of being involved in disasters (APS, 2018).

Social Connection

Social connection, sense of community and access to social networks are infinitely important determinants of human vulnerability. Existing research specifically identifies the impact of social capital, social networks, and freedom to practice beliefs and customs as factors that influence social vulnerability (Cutter, Boruff, & Shirley, 2003).

Place Dependency

Collins (2008) has noted the importance of social vulnerability, place dependency, and contextual influences as determinants of mitigation of bushfire hazards in a US context. Place dependency refers to the degree to which one's economic and social life is rooted in a particular location (Collins, 2008). Collins also reported that lower income and renter households engage in less mitigation than higher income and homeowner households; these findings reflect underlying issues of social vulnerability.

In theory, although place dependency may increase social vulnerability to bushfire, it might also increase bushfire hazard mitigation efforts (Flint & Luloff, 2005). The role of place dependency as a catalyst for mitigation is illustrated by results showing that longer term, full-time, and resource-dependent residents implement more mitigation measures than shorter term, part-time, and resource-independent residents (Collins, 2008). Collins' category "resource-independent residents" aligns with the "Experienced Independents" archetype in the context of self-evacuation archetype research (Strahan et al., 2018).

Animal ownership in a regional or rural setting is also often closely linked with place dependency (ie. livestock and/or companion animals), and can significantly influence self-evacuation behaviour. For example, farmers whose livelihoods depend on preservation of their livestock may be reluctant to evacuate, compared with individuals or households who are comparatively less place dependant. Emotional bonds to companion animals can also significantly influence self-evacuation behaviour for people across multiple environments (ie. rural, regional, metropolitan and peri-urban) which can pose a risk to human life in cases where people are unprepared or undecided on their response. Westcott et al. (2017) has asserted that the needs and considerations of animal owners are yet to be comprehensively and specifically examined in the context of bushfire research. This research deficit is vital to address given the established understanding of associations between effective animal management in an emergency, and scope to save human life (Westcott et al., 2017; Thompson, 2013; Hall et al., 2004).

Isolation

An important intersecting risk combination is that of place dependency and geographical isolation. This involves properties located in isolated areas, often inaccessible, in close proximity to native vegetation, and/or communication blackspots where limited

telecommunications reception inhibits timely access to official warnings (Whittaker et al., 2012). People in such areas can be particularly vulnerable to bushfires due to the presence of unmanageable fuels, roads conditions and the low likelihood that residents will receive neighbourly and firefighting support (i.e. due to their relative inaccessibility and isolation (Whittaker et al., 2012). Dependency on place such as that experienced by farmers anchors people to place and/or makes it untenable to evacuate from bushfire, due to an understandable desire to protect livestock and other resources. In addition to those who are place dependant, holiday makers to these areas are also at risk, however may be more likely to self-evacuate where possible given that they do not experience place dependency.

Section 5. Residential Fire Sensitivity: Identifying factors associated with vulnerability to residential fire

As noted by existing research not all people or households are equally vulnerable to residential fires (Clark et al., 2015). This section discusses some of the factors found to predispose people to greater residential fire risk.

Part 1. Socio-demographic factors

Age

As is the case in the context of bushfire, the very young and the elderly are at comparatively greater risk than other age groups in the context of residential fire (AFAC, 2020). This is due to practical reliance on others to escape and reach safety during an emergency. People aged 65 or older are the group most at risk of dying in a residential fire (Coates, et al., 2019). Among the very young, children aged 0-4 had the greatest risk of death in a residential fire (Coates, et al., 2019). A trend towards an ageing population indicates a potential increase in the risk of residential fire fatalities in the community in the future (AFAC, 2020).

Gender

Fire fatality rates by age and gender indicate that the majority of age groups are dominated by male fatalities, with the exception of the 10-14 and the 70-74 age groups (Coates et al., 2019). This indicates that males are more likely than females to die in residential fire.

Disability and mental health

Mental health and neurological disorders are an identified risk factor for residential fire fatality (Coates et al., 2019). A report titled “Preventable Residential Fire Fatalities in Australia July 2003 to June 2018” (Coates, et al., 2019) identified that among residential fire decedents, 46.7% (n=420) of were identified as having one or more disability. Of this 46.7%, Physical disabilities comprised 46.2% of disabilities identified, while mental health and neurological disorders made up 27.8% and 9.7% of disabilities respectively (Coates et al., 2019).

Neurological disorders refer to neurodegenerative conditions such as Alzheimers and Parkinsons’ disease, while the category Mental disabilities refers to other non-neurodegenerative conditions, such as Depression, Post Traumatic Stress Disorder and other mental health diagnoses.

Disability can impair the ability of a person to escape from residential fire (AFAC, 2005; Aufiero et al, 2011; FSA, 2017; Harpur et al, 2014; Liley, 2019; Miller, 2005; Rhodes & Reinholdt, 1998; Runefors et al ,2016). Having a sensory impairment such as being deaf/ hard of hearing or blind/ low vision is also associated with vulnerability to residential fire (Coates et al., 2019). Given that in Australia, 4.3 million people (only 18.3%) live with a disability, people with a disability are overrepresented in residential fire fatality statistics.

Toxicology

Multiple sources corroborate that the use of recreational and/or prescription alcohol and other drugs and medications has been associated with some cases of residential fire fatality. In particular, smoking is one of the behavioural factors associated with fatal residential fire incidents (AFAC, 2020, Clark et al., 2015). Alcohol use has also been found to be associated with some fatal residential fire incidents (Clark et al., 2015).

Aboriginal/Torres Strait Islanders

In the residential fire fatality data studied by Coates, et al. (2019), 8.2% (n=57) of people were identified as Aboriginal, Torres Strait Islander or both. Given that an estimated 3.3% of the Australian population identify as Aboriginal or Torres Strait Islander (ABS, 2019), Aboriginal and Torres Strait Islander people are over-represented in the residential fire fatality data (Coates, et al., 2019).

Number of home occupants

This factor is nuanced as available research findings suggest that too few or too many occupants may be associated with increased residential fire risk. Living alone has been identified as a factor that renders people more vulnerable to residential fire risk (AFAC, 2020). Conversely, crowding -defined as more than one occupant per room- has also been associated with increased residential fire risk (Duncanson et al., 2002).

Managing the demands of parenting alone, as a single parent has also been indicated as a vulnerability in some cases (Clark et al., 2015; Jennings, 1999). This is due to the comparative lack of support single parents receive, compared with dual parent households.

Part 2. Socio-economic factors

Income

Evidence suggests that fatal unintentional domestic fire incidents occurred disproportionately in dwellings in the lowest socio-economic areas (Clark et al. 2015). Both (i) housing crowdedness, defined as the percentage of households where there is more than one person per room; and (ii) percentage of people living below the poverty level, were found to be positively correlated with increased fire risk (Duncanson et al., 2002).

Presence of a working fire alarm and/or smoke alarm/structure fire safety systems

The absence of a working residential smoke alarm, fire alarm and/ or sprinkler system in residential buildings contributes additional risk in the context of residential fire (AFAC, 2020).

Part 3. Psychosocial factors

Perceptions of fire risk

Perceptions of fire risk, which directly influence fire related behaviour, have been showed to vary based on a number of factors. For example, individuals' perceptions of risk and hazards can be influenced by the social groups they belong to at different times in their life (Gustafson 1998). Examples of such groups include: parenthood, employment sector and age (Gustafson 1998). This demonstrates how a persons' social construction of risk is shaped by their cultural subgroups and that their biographical background and lifestyle are likely to influence their risk perception (Henwood et al. 2008).

Section 6. Intersectionality and social vulnerability

The social vulnerability factors discussed in sections 4 and 5 were found to contribute to fire risk particularly in combination (AFAC, 2020). This illustrates the importance of understanding intersectionality in the context of community profiling and community engagement specifically. Intersectionality refers to the ways in which the aspects of a person's identity can expose them to converging and intersecting forms of discrimination and marginalisation (State Government of Victoria, 2021).

Commonly, groups are not discrete and people may be part of more than one of these groups (AIDR, 2020). It is also important to understand intersectionality in order to understand diversity. People may identify a member of more than one group. For example, a person may identify as Indigenous, living with a disability and/or a victim of trauma. This example illustrates the ways in which intersectionality may increase vulnerability. However it is important not to assume vulnerability, based on preconceived notions of identity groups, and instead enquire about vulnerability on a case-by-case basis.

In the context of residential fire specifically, the following intersecting factors were found to be present in cases of domestic fire in Victoria between 1996 and 2006. This data showed that 58% of victims returned a positive blood alcohol concentration. In addition, compared with sober victims, it was found that victims who had consumed alcohol were significantly more

likely to: be aged 18–60 years; have smoking materials in their home; and be male (Bruck et al., 2011). It was also more likely that those who had consumed alcohol had no environmental or structural barriers preventing their escape (Bruck et al., 2011).

Section 7. Cultural Sensitivity: Indigenous Australian Perspectives

Despite modest progress, internationally, there remains limited inclusion of Indigenous cultural knowledge(s) or practices in formal disaster response and emergency management planning and prevention approaches (Kenney et al., 2015, pp.46–7). Official registers and natural hazard reduction plans in Australia are increasingly required by law to include and/or consider: (i) known ceremonial places, (ii) artefacts, (iii) rock shelters, and rock art sites, (iv) burial sites and others.

Existing research has demonstrated that the benefits associated with contemporary First Nations peoples' cultural fire and land management in southern Australia includes cultural, environmental, economic, bushfire management, political/self-determination, social, health and wellbeing benefits (McKemey et al., 2021).

As discussions of land ownership and recognition of ancestral territories evolve, the deep fire prevention and preparedness knowledge of Aboriginal Australian peoples is becoming more formally recognised by settler government agencies. A recent example of such collaborations is reflected in partnership between Dja Dja Wurrung peoples and settler bushfire management agencies on Dja Dja Wurrung country (or, ancestral territory) in south-eastern Victoria, Australia (Neale et al., 2019).

Natural hazard management agencies across Canada, Australia, Aotearoa New Zealand, and the United States have begun an increasing range of collaborative and consultative engagements with Indigenous peoples of their regions (Thomassin, Neale and Weir, 2019). Given the relative recency of such collaborations, limited research or evaluative data has been published in this space (Thomassin, Neale and Weir, 2019).

Thomassin, Neale and Weir, (2019) have explored the origins of recent engagements with Indigenous peoples, concluding that an application of the principles of sustainability and inclusion have transformed settler colonial institution interactions with Indigenous Australians in the space of fire planning, prevention and preparedness (Thomassin, Neale and Weir, 2019).

A study of 2019-20 bushfire season in New South Wales reported that a key theme in discussions of bushfire risk reduction efforts was Indigenous land management practices and cultural burning (Whittaker et al., 2021). Only a few interviewees were aware of cultural burning events occurring prior to this fire season, some interviewees expressed support for further cultural burning programs (Whittaker et al., 2021). This included support for additional resourcing for Indigenous fire programs and further training in Indigenous burning methods for Rural Fire Service volunteers and private land owners (Whittaker et al., 2021). One of the report recommendations was that there be “greater use of Indigenous cultural burning in land and fire management” (Whittaker et al., 2021, p. 122).

Some approaches to working alongside Indigenous Australians have involved the application of an overarching label of “vulnerable” or “at risk”. The present study advocates a more nuanced approach, which recognises the diversity of individual experience among people of Indigenous Australian descent. This facilitates a strengths-based approach, which enables acknowledgement of the steadfast resilience and myriad strengths of Indigenous Australian communities as well as the vast wisdom and teaching that Indigenous Australian communities can impart on settler colonial Australians. Conversely, it must be acknowledged that due to potential intersecting inequities, such as transgenerational trauma associated with the impacts of colonisation, educational inequity, health access inequity, food access inequity, and systemic racism, Indigenous Australians can experience significant risk and vulnerability. This should be considered on a case-by-case basis, to ensure that settler-coloniser Western assumptions do not assume that all Indigenous Australians are vulnerable, as doing so forgets the diversity and variability within Indigenous communities.

As Cooke et al. (2007) observe, Indigenous peoples across the world are frequently labelled as “vulnerable” based on socioeconomic disadvantage. Although this may be contextually accurate, this deficit focused label can be problematic if the strengths of Indigenous peoples are not acknowledged concurrent to identification of inequities. Strengths and assets such as

knowledge systems, kinship relations, land holdings, and systems of governance can often be missed (Thomassin, Neale and Weir, 2019).

During the 1960s, it was identified that the cessation of precolonial burning practices was a contributing cause of severe fires (Neale, 2018). In response to this, forms of prescribed burning considered to be similar to those practised by Indigenous peoples were initiated by settler colonial authorities (Neale, 2018). More recently, both Indigenous and non-Indigenous groups have suggested that interruptions to precolonial fire practices are potential causes of increases in wildfire events (Brend, 2017; Mason et al., 2012). It has further been suggested that the revival of these practices could decrease wildfire events (Brend, 2017; Mason et al., 2012),

In addition to the implications for fire planning prevention and preparedness, disruption of cultural burning practices due to settler colonial institutional interference raises the issue of cultural disempowerment. Although further discussion of this is beyond the scope of the present study, broad acknowledgment of this reality is warranted.

As Thomassin, Neale and Weir (2019) advise, Indigenous peoples must be given the opportunity and resources to define their own vulnerabilities. This autonomy will ensure that natural hazards management strategies do not perpetuate colonial interventionist processes, historical imbalances of power and associated harms.

Case study: The Bushfire and Natural Hazards CRC project, Hazards, culture and Indigenous communities: principles for enhanced collaboration

This project aimed to establish sector-wide structures, principles and networks to foster collaboration between settler-coloniser agencies and First Nations peoples (McKemey et al., 2021). The project involved cultivating social learning and networks- uniting to meet and work collaboratively toward this shared goal. A project working group was also established.

Three workshops were facilitated as part of this project between March and May 2021. In the first workshop, representatives from state and territory fire service agencies discussed the

current stasis, challenges and opportunities relative to collaborative fire and land management partnerships in their jurisdiction(s) (McKemey et al., 2021). Common themes and principles emerging from these discussions were identified, with view to guiding agencies in future collaborations (McKemey et al., 2021).

Subsequent workshops focused on the development of draft principles for enhanced collaboration between agencies and First Nations communities; and the revision and refinement of principles and mechanisms for enhanced collaboration between agencies and First Nations communities (McKemey et al., 2021). A green paper was then written and circulated to participants for comment and endorsement (McKemey et al., 2021).

The green paper presents nine principles for enhancing collaboration between land and emergency management agencies and first nations people. It also discusses thirteen mechanisms of change which have enabled the founding, maintenance, and expansion of cultural fire management initiatives (McKemey et al., 2021).

The nine principles are:

1. Equity and social justice
2. Self-determination
3. Governance
4. Resourcing
5. Respectful learning:
6. Re-regulating fire and land
7. Education and cultural safety
8. Accountability
9. Research

The green paper categorised mechanisms of change as either *external to agencies*, or *mechanisms which agencies can influence*. The mechanisms are:

Mechanisms external to agencies:

- Whole-of-government reform
- Legislative changes
- Post-event inquiries
- Public expectations
- Clear governance
- Economic drivers

Mechanisms agencies have influence over:

- Demonstration cases
- Personal contact
- Translation
- Mentoring
- Networking and exchange
- Bushfire risk
- Biodiversity management
- Climate change

An extended description of these principles and mechanisms is available in the original source (McKemey et al., 2021). Overall, the project was informed by the feedback of subject matter experts and a diversity of participants, representing agencies from across southern Australia (McKemey et al., 2021).

As per the green paper, the project working group recommends that government land and emergency management agencies:

- a) adopt these principles
- b) work to implement associated actions
- c) develop a whole of sector position that supports the principles outlined in this green paper

d) collaborate to establish a national network that meets the needs of fire and land management agency staff engaged in cultural fire and land initiatives.

The Bushfire and Natural Hazards CRC project, *Hazards, culture and Indigenous communities: principles for enhanced collaboration* presents an exemplary framework which agencies and Ministries can strive to implement and embed into practise.

Section 8. Risk Perception Factors: The Self-Evacuation Archetypes

Of key importance to the concept of fire safety is the practice of self-evacuation. The Australasian Fire and Emergency Service Authorities Council's (AFAC) position on bushfire and community safety is that the safest action to protect human life is for people to evacuate (AFAC, 2019). To this end, leaving a high-risk bushfire location is the advocated safest action and leaving before a bushfire threatens is safer than remaining until a bushfire starts (AFAC, 2019). However, AFAC acknowledges that there are no comprehensive, universal action(s) that will guarantee the safety of all people (AFAC, 2019). Self-evacuation involves people making the choice to leave rather than mandated evacuation.

As McLennan (2019) notes, early self- evacuation is the advocated response in most bushfire contexts, however evacuation advice in different countries varies. For example, in North American contexts evacuation is often mandated, whereas in Australia, evacuation mandates differ by state. Victoria's evacuation position is:

"The law in Victoria enables the evacuation of people threatened by fire (Section 31(3) of the Country Fire Act 1958) but does not support the compulsory evacuation of those with a pecuniary interest in any property under threat (Section 31(4))."

The Vulnerable People Register (VPR) has been developed to store local information about consenting, identified vulnerable Victorians, who will be directly entered by funded agencies and locally overseen by municipal councils in the event of an emergency (DFFH, 2021b). In

emergency situations, people on the vulnerable persons register may be evacuated (DFFH, 2021b). The Vulnerable People in Emergencies (VPE) policy stipulates evacuation for those on the (VPR), however many people who are 'vulnerable' are not listed on the VPR (DFFH, 2021a). This means that there is a significant cohort who will not be evacuated by emergency services and will therefore need to make their own choices and evacuate without support (DFFH, 2021a). This gap in existing service provision to potentially vulnerable people illustrates the importance of fire agency efforts to understand the needs of vulnerable populations and respond to their needs via community engagement.

Strahan et al. (2018) have consolidated comprehensive data on community bushfire-related decisions and behaviour, culminating in the creation of seven self-evacuation archetypes. The work of Strahan et al. (2018) represents an approach to profiling communities based on bushfire risk. This literature review will collate demographic data which can be integrated with the work of Strahan et al. (2018) in a complementary manner to produce community risk profiles.

The value of self-evacuation archetypes

As Strahan and Gilbert (2020) explain, archetypes are a character with whom an individual might emotionally resonate due to their universally shared, fundamental characteristics of humanity. Research from Strahan et al. (2018) has demonstrated the complexity and nuance relative to individuals' decisions to stay or leave during a bushfire. The self-evacuation archetypes developed by Strahan et al. (2018) reflect individuals' attitudes and responses preceding a decision to leave or remain. The archetypes posit that self-evacuation behaviour tends to align with one or more of seven self-evacuation archetypes Strahan et al. (2018). Strahan et al. (2018) discuss the range of factors that inform self-evacuation behaviour, including risk perception, stakeholder perceptions, the perceived effectiveness of protective actions, self-reliance, experience and intended protective actions.

The distribution and prevalence of archetypes is entirely context dependant. Data presented by Strahan and Gilbert (2020) provides indication of the presence of archetypes in the context of Parkerville (2014) and Sampson Flat (2015) Bushfires and CFA Post-Season surveys (2018 and 2019). CFA Post-season surveys (n=2042) indicate that 17.2% of this population were

Considered Evacuators, 18.5% of people surveyed were *Dependant Evacuators*, 18.6% were *Worried Waverers*, 20.6% were *Community Guided*. Of the people who responded to the Parkerville and Sampson Flat bushfires (n=457), 17.3% were *Considered Evacuators*, 18.4% were *Community Guided*, and 20.3% fit the *Experienced Independent* archetype. The research of Strahan et al. (2018) builds on the research of McLennan et al. (2019), who have also discussed decision making processes in the context of wildfire.

Consideration of these archetypes suggests that the realities of household decision-making in bushfire are misaligned with the assumptions of Australian bushfire agencies (Strahan & Gilbert, 2020).

Integrating Archetypes with Demographic Data

Strahan collected data on householders in the Perth (2014) and Adelaide (2015) Hills regions, which enabled a mapping of their demographic profile against archetypes. This study involved determining the likelihood of an individual with a demographic profile defined by age, gender, and household type fitting a particular archetype. Missing data presented a challenge, as there was a lack of representative sample for certain demographic factors in the original data.

Using Archetype Data to Understand Risk

Archetype data can also offer valuable insight about which members of communities may be at greatest risk, based on responses to community engagement or education efforts. As Strahan and Gilbert (2020) discuss, each archetype represents a different predisposition toward particular patterns of participation in bushfire safety programs. These differences are largely determined by archetype characteristics. For example, the *Community Guided* (CG) archetype has a tendency toward high participation in bushfire safety programs compared with other archetypes. Nascent data indicates that *Threat Deniers* (TD) may be the least engaged in current community engagement efforts, due to their denial of bushfire threat. *Threat Deniers* (TD) do not tend to spend time thinking about or planning for bushfire. They tend to hold a belief that their own safety, as well as that of their animals, and/or property, will not be threatened by bushfire. While *Threat Deniers* may accept that they live in a bushfire prone area,

they believe that due to their specific geographical location, home construction, topography or other factor(s), that they are not significantly at risk. Generally with little or no bushfire fighting experience, TDs generally do not have protective clothing, prepare their property, or have equipment for property defence.

Section 9. Community Resilience

Every single person experiences both vulnerabilities and strengths. The social vulnerability factors identified in this review are *potential* vulnerabilities - we never assume someone is vulnerable just because they fall into a category, but instead recognise that some people may have experienced social inequity that renders them more likely to experience vulnerability. A tailored approach to understanding vulnerability promotes the value of provide space for every person to express what their experience is. Vulnerability is not weakness. It may indicate that a person is more likely to have experienced social inequity, hardship or disempowerment, which may (or may not) leave them vulnerable in the context of bushfire and/or residential fire hazard(s). Vulnerabilities can also indicate strengths. For example, an elderly person may fall into a statistical category of (socially vulnerable), but conversely is likely to possess a great deal of wisdom which they have accumulated over the course of their life, as compared with a younger person (Buckle et al., 2001).

It is important to identify individual and community strengths including resources, skills, networks and supportive community agencies (Buckle et al., 2001). This enables a strengths-based approach to community engagement. These strengths and local capabilities may be leveraged to minimise the negative consequences of an emergency.

The Australian Natural Disaster Resilience Index

The Australian Natural Disaster Resilience Index (ADRI) has been designed for the assessment of disaster resilience. It includes eight themes each of which represent factors likely to enable resilience in the context of hazards including bushfire. Themes comprising the index are housed under two broad sub-categories: Coping Capacity and Adaptive Capacity (Parsons et al., 2020).

Coping Capacity

Coping capacity includes the ADRI themes of:

- Social character
- Economic capital
- Emergency services
- Planning and the built environment
- Community capital, and;
- Information access

A description of each theme is provided below.

Social character encompasses the social characteristics of the community, and represents the social and demographic factors that inform ability to prepare for and recover from a hazardous event (Parsons et al., 2020).

Economic capital refers to the economic characteristics of a community and the economic factors that influence ability to hazard preparedness and recovery (Parsons et al., 2020).

The consideration of emergency services refers to the presence, capability and resourcing of emergency services within a community (Parsons et al., 2020). Consideration of emergency services represents a community's potential to respond to a natural hazard event (Parsons et al., 2020).

Planning and the built environment can also significantly influence community resilience. This includes the existence of structures, legislation, codes or other plans designed to protect communities and environment (Parsons et al., 2020).

Community capital refers to the cohesion and connectedness of a community and represents the features of a community that enable coordination and cooperation for mutual benefit in the context of hazards (Parsons et al., 2020). Community capital could include factors such as volunteering. Studies show that people who engage in volunteer activity within their community

are more likely to have social connections which can be protective in times of emergency by providing information, support and resources (Maguire & Hagan, 2007).

Information access refers to the potential for communities to engage with hazard related information and reflects the relationship between communities, hazard information and engagement with information required for preparation and self-reliance (Parsons et al., 2020).

Adaptive Capacity

Adaptive capacity includes the ADRI themes of:

- Social and community engagement, and;
- Governance and leadership

A description of each theme is provided below.

Social and community engagement refers to community capacity to adaptively learn and transform in the face of complex change (ie. in the context of hazards such as bushfire) and represents the support and resources available within communities for engagement and rebuilding (Parsons et al., 2020).

Governance and leadership refers to organisational flexibility and the capacity of organisations to adaptively learn, evaluate or adjust policies and procedures (Parsons et al., 2020).

Section 10. Impacts

People experience vulnerability due to the circumstances of their everyday lives, which are determined by factors both within and outside of their control (Whittaker et al., 2012). It is acknowledged that depending on the context, language of “vulnerability” may be experienced as disempowering, and we must be mindful to define vulnerability as a social space rather than a status (Watts and Bohle, 1993; Pelling, 2003). This leaves space to acknowledge that as well as potential vulnerabilities, all people possess capacity and resilience (Hewitt, 1997; Handmer, 2003; Fordham, 2004).

When vulnerable people are exposed to hazards such as residential fire and bushfire, they may have a lower opportunity to cope compared with those less vulnerable. As Whittaker et al., (2012) suggest, understanding this complex issue requires examination of the ways that environmental and social systems interact to put people at risk.

Existing research findings show that people who experience marginalisation often inhabit the most hazardous geographical locations, and/or are compelled to engage in hazardous livelihood strategies in their daily lives (Cannon, 2000; Pelling, 2003; Wisner et al., 2004).

Place dependency, income and (geographical) isolation are three social vulnerability factors which interact in the context of bushfire hazard exposure. Economic damages from bushfires tend to be disproportionately large for farming households, and due to the place dependency experienced by farmers and their families, they are often compelled to stay and protect their livelihoods (Whittaker et al., 2012). In keeping with the earlier notation about recognising strengths alongside vulnerabilities, despite the potential vulnerability of place dependency, farmers demonstrate the strength of being particularly well-equipped to defend their assets, often with specialised equipment or via innovations, such as adaptation of basic farming equipment for firefighting purposes.

Age related social vulnerabilities can have significant effects on a region's capacity to engage in fire related prevention, preparedness and response actions. The aged and diminished state of the Wulgulmerang district's population meant that the local capacity for firefighting was reduced. Among the local fire brigade members, many were aged over 65. This led to reliance on non-local firefighters who were unfamiliar with the district. Furthermore, local firefighters also needed to stay with their own properties to defend their personal homes and assets (Whittaker et al., 2012).

Section 11. Informing Community Engagement and Education

"Community engagement is an essential element to reducing disaster risk and shaping disaster resilient communities" (AIDR, 2020)

As Taylor et al. (2016) note, increasing investment is being made into community preparedness programs in the context of the emergency management sector. The Victoria State Emergency Service (VICSES) is actively engaged in flood related public safety engagement efforts (Taylor et al., 2016). These efforts are housed under the The Flood Safe program which provides community education and engagement in order to enable enhanced community preparedness. The FloodSafe program has been operating since 2012. This research suggests the importance of local community involvement and local knowledge consideration in wildfire risk management (Vigna et al., 2021).

Research on self-evacuation archetypes published by Strahan et al. (2018) offers considerable insight into how fire safety programs and messaging disseminated through community education and engagement might be tailored to suit the needs of different personal contexts.

Ergibi and Hesselin (2020) have examined socio-demographic factors that influence awareness of FireSmart and the adoption of FireSmart activities in Canada. The findings of this study showed that 77% of survey respondents were not aware of FireSmart Canada (Ergibi & Hesselin, 2020). Among those who were aware of the program, the most influential factor leading to adoption was the perceived risk of damage from bushfire (Ergibi & Hesselin, 2020). Respondents were invited to provide feedback about what might promote program uptake. Their feedback favoured positive approaches such as incentives linked to homeowner insurance (Ergibi & Hesselin, 2020), which supports the merits of a person-centred approach.

Haynes et al., (2020) conducted a mixed-methods survey that explored experiences during the 2013 Blue Mountains bushfires and ability to exercise choice and take responsibility for risk, as per the National Strategy for Disaster Resilience (NSDR). This study found that in some risk reduction contexts, risk reduction may require a locally adaptive rather than prescriptive framework (Haynes et al., 2020).

Research has shown that a number of processes appear to precede the establishment of desired community safety outcomes (Elsworth et al., 2009). Specifically, processes that enable Engagement, Trust and Self-confidence, Confirmation and Re-assessment, and Community Involvement and Collaboration appear to enable communities to develop (i) risk awareness and knowledge of fire behaviour and safety measures, (ii) household and community level planning,

(iii) physical and psychological preparation for a bushfire, and (iv) safe response(s) if and when a fire occurs (Elsworth et al., 2009, Rhodes, 2003).

Knowledge translation

The importance of definitional or knowledge translation has been emphasised in existing literature (McLennan, 2019). For example, knowledge translation differences may be posing a barrier in the context of fire safety messaging. McLennan (2019, p. 496) reports that interpretations of the phrase “early evacuation” can vary between individuals, “...for some it meant the day before a predicted severe fire weather threat, for others it was following a warning from authorities, and for some it was after a trigger-event such as seeing smoke, flames or embers.” The importance of knowledge translation has also been corroborated by Preston et al. (2009).

The research of Strahan et al. (2018) and others presented in this review can be meaningfully used to inform evacuation modelling, to ensure that evacuation modelling recognises the complexity and nuance present in individual and community decision making processes.

As Vaiciulyte et al. (2021) asserts, evacuation of residents during a disaster is a highly time-sensitive process. As such, understanding the motivators, barriers and enablers to safely responding in such contexts is of vital importance. Evacuation modelling work is assisting in the identification of self-evacuation archetypes in communities based on the demographic signature(s). Part of the knowledge translation work associated with the present study is reviewing risk communication, education and engagement approaches used in the context of other hazards to address the challenges related to social vulnerability.

The use of social vulnerability data in mapping for context-tailored fire prevention

In a United States context, Poudyal et al. (2012) have identified “hot spots” or geographical clusters where social vulnerability varies positively with bushfire risk across six Southern

states—Alabama, Arkansas, Florida, Georgia, Mississippi, and South Carolina. Identification of these areas can aid wildfire managers in deciding which communities to prioritize for mitigation programming. This study applied weighted regression to map spatial variation in relation to social vulnerability (SOVUL) and wildfire risk. This enabled the identification of geographical areas where there is a positive relationship between SOVUL and wildfire risk in the states of Alabama, Arkansas, Florida, Georgia, Mississippi, and South Carolina.

The findings of this study showed that these “hot spots” are most prevalent in South Carolina and Florida; data which can assist wildfire managers in deciding which communities to prioritize for fire planning and preparedness efforts.

It is also pertinent to note that defining risk by geographical region can be fraught with complexity. For example, as Poudyal et al. (2012) notes, working class, poor or otherwise socially vulnerable people often coexist with socially vulnerable residents within the same regions or suburbs. This often occurs in areas where gentrification is occurring. In this sense, the geographical representation of risk needs to be able to show this nuance and complexity.

Section 12. Discussion and Conclusion

This review has traversed a selection of the extensive literature on hazard, exposure, vulnerability and risk in the contexts of bushfire and residential fire. Insights from other disaster contexts have also been included in instances where there are transferrable insights. The repository of research in this space is vast and thus it is acknowledged that omissions and oversights are inevitable. Findings indicate that household decisions about mitigation are influenced most powerfully by social vulnerability, place dependency, and a host of complexly interacting contextual factors. Uniquely complex considerations are present in conceptualising bushfire risk in the Australian context. The nature of this complexity is well encapsulated by the self-evacuation archetypes created by Strahan et al. (2018), which are referenced in this review. This review will be used to inform the development of community profiles, which will aid in the tailored engagement of communities in fire planning, prevention and preparedness treatments, based on an understanding of the vulnerabilities and strengths of each setting.

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