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Fire, water and everyday life: bushfire and household defence in a changing climate

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Keywords

changing, defence, household, bushfire, climate, life, fire, everyday, water

Disciplines

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Keywords

bushfire (wildfire), water access, everyday trade-offs, vulnerability, rural-urban interface, Australia

1. Introduction

Bushfires (wildfires) are an integral and defining part of the history, ecology and culture of Australia (Pyne, 2006). Residents in at-risk communities have traditionally been encouraged to make a considered choice to either prepare to stay and defend their property or else prepare to leave early (Handmer and Tibbits, 2005; McLennan *et al.* 2013). This policy position recognises situations where fire authorities are unable to provide timely or sufficient fire fighting resources to prevent loss of life and property (AFAC, 2012). Official advice to residents was subject to critical review following the 2009 ‘Black Saturday’ bushfires in Victoria where 173 people died, 113 of which perished in their

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homes (AAP, 2009a, 2009b). The ensuing Victorian Bushfires Royal Commission concluded that, with the exception of ‘catastrophic fire events’ where no property is considered defensible (Teague *et al.*, 2010), the central tenets of the ‘Prepare, Stay and Defend, or Leave Early’ (PSDLE) policy were theoretically sound but difficult to enforce in practice (Handmer *et al.*, 2010). The Commission’s recommendations led to a revised approach – ‘Prepare. Act. Survive.’ (PAS) – with similar core principles but with a greater emphasis on the importance of both physical *and* mental preparedness, and that leaving early is always the safest option (AFAC, 2012). As such, it remains common practice in Australia for residents to stay and defend their property from bushfire. Central to households’ preparations is the maintenance of an ample water supply and an appropriate water delivery system with which residents may actively attempt to suppress the ignition of vegetation and buildings by firebrands in the advance and aftermath of a fire front (Penman *et al.*, 2013).

Australia’s climate is characterised by highly variable rainfall patterns between regions, seasons and years. In recent decades, Australia’s water resources have been placed under immense pressure as a result of periods of prolonged drought, increased industrial water use, expanding urban populations and irrigation (Chiew *et al.*, 2011). Projected climatic models suggest that overall Australia will be faced with a drier climate as a result of climate change (CSIRO and BOM, 2014). These conditions are increasing the likelihood of extreme fire danger weather, especially in the southwest and southeast of the continent (Climate Council, 2013; IPCC, 2013). Given the imperative of water for fighting bushfire, the increasing demand on water resources in everyday contexts coupled with the predicted increase in drought and extreme fire danger weather poses considerable challenges for managing the persistent threat of bushfires. Understanding what factors are influencing water use and retention in Australian households in bushfire-prone landscapes is therefore important. An awareness of these factors can assist emergency managers and policy makers with the promotion of water conservation practices given annual, seasonal and localised variations and needs. Despite the imperative of water conservation for household bushfire preparedness, little is known about household water conservation practices and usage in the context of bushfire in Australia. This study seeks to address this gap by

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examining how the scarcity or availability of water influenced the survival related decisions of households during the October 2013 State Mine Fire, which impacted large parts of the Blue Mountains in New South Wales (NSW). Notably, these households were in areas not serviced by reticulated¹ (mains) water supplies and, as such, represent a part of the 23% of households outside capital cities in Australia that rely on rainwater tanks for both subsistence and fire fighting purposes (ABS, 2013)

The following sections provide an overview of literature relevant to water, everyday life and bushfire safety in Australia. We contextualise how everyday water consumption and conservation practices impact on bushfire preparedness and outline key legislative constraints necessitating the provision of water for both domestic use and fire fighting purposes on designated bushfire-prone land. This is followed by an outline of the research methods to contextualise the results section. The paper concludes with a discussion of the challenges of coexisting with bushfire in areas independent of reticulated water supplies.

1.1 Water restrictions, everyday usage and bushfire safety needs

Water supply and demand is a global issue, but as a regional resource it requires varied policy solutions. Since 2002, parts of Australia have been subject to mandatory water restrictions in response to protracted periods of drought (ABS, 2013). The "Millennium Drought"² – Australia's longest period of rainfall deficit on record (Kendall, 2010) – triggered an irrevocable breakdown of longstanding political and public belief in "endless supply", or "Big Water" (Allon and Sofoulis, 2006). The drought prompted the implementation of clearly defined water restriction regimes, as a means of regulating household mains (municipal) water consumption (Pearce *et al.*, 2012). In 2007, 80% of people in urban areas nation-wide were subject to some level of water restrictions (Allen Consulting Group, 2007).

¹ "Reticulated" water is the Australian term for the piped town-water network (i.e. the water grid).

² Although the dates vary between sources, in southeast Australia the Millennium Drought is generally defined as the period 2001 – 2009, although in some areas the drought began as early as 1997 and broke between 2010 and 2012.

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Variations of water restriction regimes established in the 2000s are still enforced today. Typically, these restriction measures target discretionary domestic water use in the outdoor area of the home (National Water Commission, 2007), and govern the type of water use activity, the time-of-day of activities and the technologies permitted. Water restriction rules vary throughout Australia due to local requirements and are set by the governing water utility³. Although the classification levels of water restrictions in NSW vary widely, the restrictions regime outlined in Table 1 is comparable to many imposed on households throughout NSW during the Millennium Drought.

Table 1. NSW Domestic Water Use Water Restrictions Levels 1 – 6 (adapted from NSW Government, 2011).

Level	1	2	3	4	5	6
Garden watering	Sprinklers allowed 2 hours a day	Sprinklers banned; hand held hoses allowed 2 hours a day	Hand held hoses 2 hours a day	Hand held hoses 1 hour a day	Buckets only	Reused water only
Swimming pools (private)	Filling of pools prohibited; topping up of pools allowed		Filling and topping up of pools prohibited			
Wash paved areas and roofs	No restrictions	Buckets only (except as required by law)				

Even with the recent easing of drought conditions and, consequently, water restriction regimes in many parts of Australia, permanent water saving measures remain in place across many local government areas (LGAs) to help reduce the demand for water and promote sustainable water consumption practices (ABS, 2013). These permanent water saving measures (Table 2) are typically on par with the Level 1 water restrictions outlined in Table 1, although the extent of the regulations are by no means homogenous across water jurisdictions. Permanent water saving measures are generally less rigorous and aimed at long term changes in water attitudes and behaviours.

Table 2. Water Wise Rules (adapted from Sydney Water, 2014).

³ The Bureau of Meteorology's (BOM, 2014), *Water Restrictions* website summarises the water restrictions and water savings measures currently in place across the States and Territories of Australia.

Water Wise Rules:

- Watering with hoses, sprinklers and irrigation systems is allowed before 10am and after 4pm on any day
- All hoses must have a trigger nozzle
- Generally there is no hosing of hard surfaces such as pathways and driveways
- Washing of vehicles and boats is allowed
- Swimming pools can be filled or topped up
- Recycled water and bore (well) water can be used for any purpose at any time of day
- Water from rainwater tanks (rain harvesting cisterns) can also be used as long as it's not connected to or topped up with drinking water
- Water can be used to test fire systems or for fire-fighting, at any time. Fire hoses may be used for fire-fighting activities only.

While it is known that the public is generally supportive of water conservation measures (Head and Muir, 2007; Pearce *et al.*, 2012; although for a contradictory argument see Pumphrey *et al.*, 2008; Institute for Sustainable Futures and ACIL Tasman Pty Ltd., 2009), little is known about the dependence of water conservation attitudes and behaviour for bushfire preparedness and response at the rural-urban interface. With the exception of Harman *et al.* (2008), research on household water conservation behaviour has not focused on its connection with bushfire as an influencing factor. Harman *et al.* (2008) found that over half of survey respondents (53%) in the Ballarat Water Supply System, Victoria (VIC) were concerned by the impact of water restrictions on bushfire safety. However, the study did not expand upon this particular point nor did it delineate whether households in the survey were reliant solely on non-reticulated water sources. Houses without mains water supply are typically rural or peri-urban in nature, with non-reticulated water resources, such as rainwater (e.g. tank water), ground water (e.g. bore water), surface water (e.g. river, lake, private dam) or trucked water (e.g. water carrier) stored in water tanks onsite. These households are exempt from the rules and restrictions outlined in the tables above, and water use is typically at the discretion of the household (although there is some variation between states/territories).

People without access to reticulated water are perhaps less vulnerable to bushfire than those on mains water, as power outages during a fire event often interrupt mains water supply. However, they also have greater autonomy over, and responsibility for, storing and maintaining water reserves (e.g., rainwater tanks, dams) and the manner in which water is accessed (e.g., diesel/petrol water pump or generator) in everyday contexts. This raises questions surrounding the impact of water consumption

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and maintenance attitudes and behaviour within households relying solely on rainwater or other non-reticulated water supplies for both subsistence and fire fighting. For example, the 23% of households outside capital cities for whom water from a rainwater tank is also their main source of drinking water (ABS, 2013) points to potential conflicts between the maintenance of everyday water practices and the need to conserve water for fire fighting. Post-fire inquiries have identified clear connections between drought conditions preceding a bushfire and water shortages reducing household fire fighting capabilities in rural areas (Miller *et al.* 1984; Esplin *et al.* 2003). The next section examines the actual impact of water availability, scarcity, and inaccessibility on household decision making as well as house tenability during bushfires.

1.2 Evidence of water availability, scarcity, and inaccessibility during bushfires

Evidence from post-fire analyses of residents' intended and actual actions to a bushfire threat reveals multiple accounts of water availability, scarcity and inaccessibility (mostly from power and equipment failure) influencing survival related decisions and outcomes (Krusel and Petris, 1999; Lazarus and Elley, 1984; Esplin *et al.*, 2003; Commonwealth of Australia, 2003; Tibbits and Whittaker, 2007). A study of the 1983 'Ash Wednesday' bushfires, sought to correlate the loss of property with house occupancy at Mount Macedon, VIC (Wilson and Ferguson, 1984). Although the survival rate for houses actively defended by able-bodied occupants was 90%, "few occupants were well prepared for a bushfire, judging by their failure to reserve water supplies for fire fighting purposes" (ibid, p.232). Just seven of the 65 attended houses were equipped with a pump and independent water supply, 12 households had little or no water, and a further two residents explicitly attributed the loss of their houses to running out of water. Similarly, a post-fire survey of residents near North Warrandyte, VIC in 1991 found that just 30% of residents surveyed had alternate, independent, water supplies (Beringer, 2000). McGee and Russell's (2003) exploratory study of bushfire preparedness in a rural community in VIC, also found that just half of the study sample (15) had ensured access to water in the event of a fire by connecting petrol operated pumps and hose systems to dams or rainwater tanks.

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In their study of householders' safety-related plans, actions and outcomes during the 2009 'Black Saturday' bushfires in VIC, McLennan *et al.* (2013) found that many of those who stayed and defended described how a lack of stored water (10%) or failure of household fire fighting equipment (22%), potentially compromised their survival. A lack of stored water was mostly attributed to the drought conditions in the lead up to 'Black Saturday'. Equipment failure was most frequently associated with issues of water supply, including loss of power, pump failure, and the melting of plastic pipes, hoses, fittings and water tanks. The failure of fire fighting water delivery systems was identified as (in)directly contributing to civilian fatalities:

Although some fatalities had made considerable prior preparation and were classified as 'well prepared', this does not mean that their fire fighting plans did not have serious weaknesses ... in many cases, one 'weak link' in a fire fighting system let down an otherwise solid approach (Handmer *et al.*, 2010, p.20).

None of the above studies delineate between households reliant solely on non-reticulated water sources from those reliant solely on reticulated town supplies, or a combination of the two. Yet, the findings justify recent changes to Australia's planning and building codes, which stipulate the provision of water specifically for fire fighting purposes on new developments on bushfire-prone land. Restrictions on the construction and retrofitting of buildings in bushfire-prone areas in NSW are defined in *Planning for Bushfire Protection 2006* (NSW RFS, 2006) and further enforced through planning and development legislation, such as Local Environmental Plans, Development Control Plans and the Australian Standard AS3959 (Standards Australia, 2009). These documents work together to provide the foundations for all bushfire protection measures, including the provision of an adequate dedicated water supply suitable for fire fighting. However, it is only development applications for properties on bushfire-prone land submitted after 1 March 2007 (following changes to the *Environmental Planning and Assessment Act 1979*), which must be accompanied by a Bushfire

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Assessment Report (NSW RFS, 2007) and thereby conform to the requirements concerning water provision set out in *Planning for Bushfire Protection 2006*. In circumstances where the provision of a dedicated water supply is infeasible, a static water supply⁴ may be satisfactory.

1.3 Bushfire survival plans and official advice on water for fire fighting

In addition to the legislated planning and development controls described above, further advice to assist residents in preparing for bushfire is available through bushfire survival plan booklets and planning templates devised by bushfire authorities. While bushfire authorities across Australia are united on the importance of residents preparing to stay and defend or to leave early, there is considerable disparity between the authorities on the importance of water in household preparedness (see supplementary material for a detailed outline of agency advice). Emergency services in Victoria (2013), Western Australia (2014a, 2014b) and Tasmania (TFS 2014) provide the most comprehensive advice in relation to water and preparedness with clear explanations of: 1) why residents need an independent water supply, 2) what constitutes an independent water supply, 3) how water can be accessed, and 4) what measures can improve the integrity of the water supply during a bushfire. The South Australian (SA) Country Fire Service (CFS) (2014, p.11) is the only agency that explicitly advises residents to consider conserving water in the months prior to the statutory fire season. The NSW Rural Fire Service (RFS) (2013) (the context of this study) provide the least information in regards to the conservation, storage, access and use of water prior to and during bushfires. For example, they advise that "if you have a water tank, dam or swimming pool, consider installing a Static Water Supply sign" (p.7) but do not explain why residents should have a separate water supply for fire fighting purposes. However, their Survival Plan 'lift-out' asks readers to identify triggers for leaving early, giving the example of "loss of water or power" (pp.16-17).

⁴ A static water supply is an alternative source of water that cannot be guaranteed during drought conditions, such as a rainwater tank, swimming pool or dam in addition to the mains or drinking rainwater supply that could be utilised to fight fires.

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In areas not serviced by reticulated water supplies, the provision of a dedicated or static water supply is essential. The stipulated amount of water required is determined on the basis of lot sizes and density of development, with a rural residential lot of 1,000 – 10,000m² needing 10,000L/lot (NSW RFS, 2006 p.26). While an independent water supply is a legislative requirement for new development, there is considerable disparity between bushfire authorities on the actual quantity of water deemed necessary for a household to be considered well-prepared for bushfire. Definitions range from: 5,000L (ACT ESA, 2013; NSW RFS, 2013; SA CFS, 2014), 10,000L (TFS, 2014; VIC CFA, 2013), up to 20,000L (WA DFES, 2014A). While the Queensland Fire and Emergency Service (QLD FES) (2015) provides no indication of the volume of water needed, the Victorian (VIC) Country Fire Authority (CFA) (2013, p.61) states that to defend property, residents will need a minimum of 10,000L of water in reserve exclusively for fire fighting, but cede that 40,000L is more realistic. They give the example of the 2009 'Black Saturday' bushfires in that many residents reported using more than 40,000L to defend their home.

These concomitant yet competing conditions of water in a geographically vast and seasonally water-poor country like Australia point to the importance of considering the trade-offs people make between the risk, benefits and everyday demands of living in fire-prone landscapes (Eriksen and Gill, 2010). For example, for houses without access to mains water, an ample water supply generally means having at least two distinct water reservoirs – one for everyday domestic use and one specifically for fire fighting (e.g., a rainwater tank and a dam, or two rainwater tanks). However, the installation and maintenance of private water infrastructure can be costly, both financially and spatially. As such, for many households independent of mains water, particularly those on smaller land parcels, only one water reservoir serves both domestic and fire fighting needs. McLennan and Handmer's (2012) critique of the 2009 'Black Saturday' Victorian Bushfires Royal Commission (Teague *et al.*, 2010) specifically highlights that the Commission did not comprehensively address the impact of everyday trade-offs and uneven social vulnerabilities on community bushfire safety or responsibility-sharing. The following sections explore the impact of such everyday trade-offs on the availability or scarcity

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of water during the October 2013 State Mine Fire and how this influenced residents' survival related decisions.

2. Study Context and Methods

In October 2013, approximately 100 bushfires burnt across NSW. This included several large, destructive bushfires that resulted in the loss of over 200 properties in the Greater Sydney Area. The winter months of 2013 were particularly dry, and an unusually warm September and October resulted in conditions conducive to large wildfires (BOM, 2013A). Sydney experienced both its warmest winter and warmest spring on record (BOM, 2013B). On Wednesday October 16th, a live ordinance training exercise at Marrangaroo Army Range, near Lithgow, NSW, accidentally sparked a fire that became known as the State Mine Fire (NSW RFS, 2014A). It burnt for nearly two weeks through the northern region of the Blue Mountains National Park as well as the Wollemi National Park (Figure 1). By the time the State Mine Fire was officially declared out on 19 November 2013, it had burnt over 55,000 hectares of bushland and destroyed five homes (NSW RFS, 2014A). No human lives were lost.

Figure 1. Map of study areas and proximity to the footprint of the 2013 State Mine and Mount York bushfires (shaded areas), NSW, Australia (map drawn by B. Horsey, 2014). (see end of document)

In December 2013, residents directly or indirectly impacted by the State Mine Fire in two communities were interviewed on their properties in Mount Wilson and Bilpin in the upper north-western part of the Blue Mountains (Figure 1). These localities are cut-off from mains water supplies and rainwater must be captured and stored on site, in dams or tanks, or else sourced from bores or external water carrier, for subsistence. The notions of isolation and water self-sufficiency are further reinforced by the limited ingress/egress routes through the local area with only one serviced access route. As these localities are without mains water access, residents are exempt from the *Water Wise*

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Rules and water restrictions, which have regulated water consumption in the Blue Mountains, past and present.

Mt Wilson and Bilpin are surrounded by the Blue Mountains- and Wollemi National Parks, respectively, with many houses backing directly onto parklands. According to the Bushfire Prone Land map⁵ from the Blue Mountains City Council (2013), the vast majority of properties in Mt Wilson are built on vegetation Category 1 land or land classified as 'vegetation buffer'; the most hazardous vegetation categories. According to Hawkesbury City Council (2005) the entire town of Bilpin is on vegetation Category 1 land.

The research presented in this paper was part of a broader project that examined risk and amenity with residents in both locales during May-June 2013 (Bradstock *et al.*, 2014). Interviewees were purposefully selected from this sample to include a mix of people who had: a) deliberately left early once they became aware of the fire threat, b) planned to stay and defend but either left or could not return home, or c) stayed and defended either actively as the fire front directly threatened their property or observantly for those who experienced a near miss. A total of 18 interviews with 23 people were conducted at 18 properties: nine residents (five women/four men) from eight households in Mount Wilson, and 14 residents (four women/ten men) from 10 households in Bilpin. None of the interview participants' homes were damaged by the bushfire. Two respondents in Bilpin reported minor spot fires and damage to lawns from falling embers. Damage described by respondents in Mount Wilson was, for the most part, restricted to gardens, vegetation and fencing, although the loss of two houses in the area illustrates the destructiveness of the fire (NSW RFS 2014A). One respondent lost two plastic water tanks and a shed containing a vehicle from direct flame contact, as well as extensive damage to garden vegetation and infrastructure. Another resident reported the loss

⁵ Maps of bushfire-prone land are prepared by local councils according to NSW Rural Fire Service (RFS) guidelines. These maps identify two vegetation types indicative of bushfire threat: 'Category 1' is the most hazardous vegetation category, and refers to forest, woodlands, heath and wetlands greater than 1 hectare in size. Land that directly adjoins bushland is also classified as a 'vegetation buffer' of 100m and 30m. These are the areas in which developments and people are most likely to be affected by a bushfire burning in the adjacent land (see NSW RFS, 2014B).

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of timber slabs and the destruction of a non-commercial orchard, as well as considerable damage to garden vegetation.

The interviews sought to elicit in-depth narratives of residents' direct experience of the State Mine Fire. With the participants' permission, all interviews were audio-recorded and later transcribed verbatim. The interview data were then subjected to systematic coding and analysis in QSR NVivo 10.0, a computer-assisted qualitative data analysis software program. An iterative process of identifying appropriate codes was followed to capture *a priori* and emergent themes. The interview quotes used in this paper are verbatim and have been chosen because they reflect attitudes, beliefs and concerns shared by the participants in this study. It is worth noting that "water" was not an *a priori* theme of the interview schedule; rather it was an emergent theme, recurrent in interviews with all research participants.

3. Research Findings

Prior to the events of October 2013, many of the interview participants had taken considerable measures to actively prepare themselves and their property for bushfire. However, in the majority of cases pivotal preparations, including the testing and maintenance of water reserves and water dispersal equipment, were not taken until the fire threat was imminent. The consequences of this lack of preparation featured prominently in participants' narratives of water shortage and equipment failure.

3.1 Water shortage

Eight of the 18 households (4 Bilpin, 4 Mount Wilson) identified water shortages as being a critical factor that influenced their decision to stay and defend or leave (early or otherwise) during the State Mine Fire. The dry conditions and below average rainfall of the preceding winter was identified as the main reason water levels were low throughout the region:

It had been so dry here, it hadn't rained in four months and our tank, the back tank, was down to a third and the other tank was down to just under half, and so I didn't even want to fill the gutters in case the fire didn't come. I had to just save the water for when it actually came... I hadn't turned the sprinklers on. I hadn't done anything with water. (Male, Bilpin, family evacuated, stayed and defended, property not directly impacted).

We actually only had a small amount of water in our tanks. It was just too much so we decided to evacuate [our children]... We had no water in the tank. That was about as stupid as it gets. That was quite embarrassing. (Female, Bilpin, RFS volunteer, evacuated children, property not directly impacted).

If you've got a plan to flee, what you've got to do is turn the water hoses on and go. Well, unless you've got unlimited water you've only got one shot at that. The [neighbours] have got a house tank; they've got one go. They'd have been spitting on the fire if they had pulled the trigger when they were told to evacuate the first time. (Male, Bilpin, intended to stay and defend, property not directly impacted)

Usually what happens is that when the fires come, most people's dams are getting very low or empty because the conditions have been dry and hot and my dam is probably about the worst in Bilpin. By the time the fires came I had about four inches of water in the bottom of our dam. It was completely empty. (Male, Bilpin, intended to stay and defend, property not directly impacted)

As conveyed in the above quotes, residents' decision to stay and defend or leave their property, and the timing of such actions, often came down to the amount of water available for both active and indirect fire fighting. Several participants in this study described a heightened awareness of the finite nature of water during the bushfires. For example, a resident with ample water supplies who

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successfully defended their home from a direct fire threat (with the assistance of NSW RFS personnel and equipment) recalled how:

We were very conscious that we only had so much water. The RFS guys knocked on the tank to monitor how much water we had used because if you use all the water on the roof and then the fire did get up here [we'd be in trouble]. (Female, Mount Wilson, RFS volunteer, stayed and defended, property impacted)

Whilst access to an ample and suitably protected water supply is clearly an important facet of preparedness, the disparity across the official advice provided by fire authorities is concerning, particularly given the essentiality of water to household fire fighting practices, as evidenced in the preceding quote.

3.2 Equipment failure

Fifteen of the 18 households had a substantial quantity⁶ of fire fighting equipment that was generally easily accessible and of good quality. Most residents had a petrol/diesel operated generator and pump, in addition to a combination of fire fighting and gardening hoses. However, as numerous post-fire studies have shown, equipment failure in the face of an immediate bushfire threat can significantly influence residents' decisions to stay and defend, and outcomes. During the State Mine Fire various forms of equipment failure, central to water distribution, impeded individual preparations in the period immediately prior to the bushfire coming closest to homes:

I've got two generators, one of which is a three-phase generator to run the three-phase pump but it weighs ten tonnes so I can't take it to the dam without mechanical help. So two things happened, first of all the generator didn't go and the second thing was my tractor broke

⁶ At least one generator, a diesel/petrol powered pump, two fire fighting hoses and personal protective equipment.

down. My plan is to put the generator on the carryall of the tractor and take it down to the dam. (Male, Bilpin, intended to stay and defend, property not directly impacted).

That was the weakest link; that the generator failed. (Male, Mount Wilson, RFS volunteer, stayed and defended, property not directly impacted).

Because the building [construction] isn't done there's actually no water in the tank. So there was no water available, at the only fire fitting there is. We had a portable pump but no means of getting any water into it, although, there's lot of water here up the back. So all the fittings haven't been done, so that was sort of frustrating (Male, Mt Wilson, RFS volunteer, intended to stay and defend, property not directly impacted).

When the fire broke out again the next night I was on my own and I couldn't start the pump. My husband had taken me through it so I knew what to do but it turned out that there was something else that had to be done that I didn't know about. (Female, Mount Wilson, RFS volunteer, stayed and defended, property impacted).

Failing to plan for power outages during the fire meant many residents were unable to power electric pumps and distribute water supplies. Not knowing how to use fire fighting equipment, having hoses with insufficient reach, or tanks without the right fittings were also problems reported by residents. Just three households from our total sample of 18 stated explicitly that they had checked their fire fighting equipment in the weeks prior to the bushfire. This was reflected in the large number of participants across both sites that reported having to test and, in many cases, repair vital water dispersal equipment once the bushfire threat was imminent.

3.3 Protecting water assets

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The ability of water storage units and water delivery systems to withstand the intensity of a bushfire is central to the efficiency of bushfire fighting activities. It is imperative that water supply infrastructure (such as tanks, pipes, hoses and pumps) is protected from flames, embers, and flying debris during a bushfire. A lack of preparedness in the days, weeks, and months prior to a bushfire threat can increase the vulnerability of water supplies during a bushfire.

One Mount Wilson resident reported the destruction of two plastic water tanks from direct flame contact (Figure 2): "Back there where the shed collapsed are my other two tanks: one just melted and the other one exploded. You'll see it blew a hole in the top." It was inferred by another resident, involved in fire fighting efforts at the property, that the destruction of the water tanks was a result of flame contact as firewood stacked against an adjacent structure ignited. Fortunately, there was ample water in reserve in several other tanks and dams throughout the property and the house was saved. A second resident reported running out of time to clear leaf litter and kindling from around their water tanks.

Figure 2. The remains of two plastic rainwater tanks impacted by radiant heat and direct flame contact in Mt Wilson (photo by authors, December 2013) (see end of document).

The need to protect water assets from direct flame contact, high ambient temperatures and embers varies across the bushfire safety and preparedness literature provided by state and territory fire fighting agencies. The issue is given considerable coverage across the bushfire survival planning templates of Queensland (QLD FES, 2015), Tasmania (TFS, 2014), Victoria (VIC CFA, 2013) and Western Australia (WA DFES, 2014A, 2014B), all of which provide and explain what measures can improve the integrity of water supplies and water dispersal systems during a bushfire. This level of detail is absent from the literature provided by agencies in New South Wales, South Australia, the Australian Capital Territory and the Northern Territory (see supplementary material).

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3.4 Water abundance

Households in bushfire-prone areas can decrease the risk of loss by providing fire fighting authorities with access to static water supplies on site. In the case of two properties at Mount Wilson, both of which came under direct bushfire threat and were actively defended by residents and the NSW RFS, the abundance and accessibility of water supplies had considerable bearing on the decision of local NSW RFS crews to attempt to defend the relatively isolated properties. One resident, a volunteer fire-fighter, alluded to the tension between vehicle accessibility, water availability and property defence when describing the successful defence of one property with a water supply in excess of 55,000 litres:

So we had the Cat 1 tanker sitting down behind [my neighbour's house] and interestingly, [a fellow RFS volunteer] said to me later that they were really ambivalent about putting the truck in that location or whether it was a good place. [They] said, "I only got confident that it was the right place when we could plumb into [their] water supply and we had tonnes of water available. And as soon as I knew we could plumb into their water supply and we had tonnes of water available" [they] said "I had no reservations at all". (Male, Mt Wilson, RFS volunteer, stayed and defended, property impacted).

Continued vigilance on the part of one resident who, having an understanding of the fire history of the region, recognised that the State Mine Fire would likely travel east from ignition point at Lithgow towards her property at Mount Wilson, ensured that water supplies were ample and kept in check as she prepared her property for impact. The benefits of this forward thinking were realised five days later, when a flare up exposed the property to bushfire threat once again. NSW RFS crews were able to top up their water reserves from this tank and suppress the bushfire threat.

On Wednesday afternoon I was looking at that fire. I thought "my concrete tank" - because we've had no rain and I've been doing quite a lot of watering - "I better just check on the level. That's my bushfire water." So something made me think "I'd rather have the concrete

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tank full just in case. And I don't know how empty it is." In fact, it was about a third down, took about an hour and a half to fill. Something made me want to know that that concrete tank had 45,000 litres of water that I could use immediately. (Female, Mt Wilson, stayed and defended, property impacted)

The resilience and adaptive capacity of households to bushfire threat relies heavily upon residents having an appreciation of potential bushfire risk and high fire danger weather. This includes the foresight and motivation to act upon environmental cues, such as the resident in the above quote, in the days and weeks prior to the official bushfire danger period. Such actions may include ‘topping up’ an independent fire fighting water supply from drinking water reserves or water from an external carrier. However, ‘topping up’ water supplies, in addition to the installation and maintenance of private water infrastructure, can be costly, financially and time-wise. As previously discussed, for many households there may be only one water reservoir that serves both domestic and fire fighting needs. One resident waiting to receive water at the time of the fire threat described the potential complications of this mixed use:

We get spring water. You can get water that's recycled sewerage - not that I think there's a real issue with that - but if we got the option of recycled sewerage or spring water then we're going to get the spring water, even though it's a little bit more expensive. ... We were on the list to get a water delivery before the fire started and we still hadn't gotten water. There were obviously a lot of people on the list to get water. We did keep on ringing the supplier but he was so busy he turned his phone off because he had so many jobs. So we just had to hope and pray that it would be okay. (Female, Bilpin, RFS volunteer, evacuated children, property not directly impacted).

There is a direct correlation between the perception of reused water as “dirty water” and the resident’s choice to delay getting essential water supplies. Disgust, or the “yuck” factor, as a barrier to water

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reuse has been cited in the literature since the 1970s, when public attitude studies towards reuse first commenced (Po *et al.*, 2003). Fear of water contagions dissuades people from using recycled water in their homes and gardens. In Australia, the few attempts from local authorities to introduce water reuse projects at the household level have been met with strong community opposition (Hurlimann and Dolnicar, 2010). One key exception to this general trend is the Rouse Hill development area in peri-urban Sydney, which since 2001 has supplied residents with recycled water for toilet flushing, garden watering and, of particular pertinence to our present study, fire fighting (Sydney Water, 2001, in Po *et al.*, 2003).

4. Discussion

Fire frequency and intensity is expected to increase substantially in coming decades in the most densely populated regions of Australia. The majority of buildings affected by bushfires in Australia have been located at a distance of less than 100 metres from bushland (Chen and McAneney, 2010). In the Blue Mountains approximately 38,000 homes are within 200 metres of bushland and 30,000 within 100 metres, with many more backing directly onto bushland (McAneney, 2013). A 20 – 67% increase in potential ignition days for large (>1000ha) fires is predicted for the Blue Mountains by 2050 (Bradstock *et al.* 2009). With the increasing variability in rainfall and the increasing frequency in high and extreme fire danger weather in southeast Australia, households dependent on non-reticulated water supplies are increasingly likely to have low water reserves in the lead up to the typically drier, more bushfire-prone, spring and summer months. Our study questions how well-prepared residents in this region are for future bushfire threats given preparation and planning issues in the days and weeks prior to the State Mine Fire, and the consequent water shortage and equipment failure. These results add to the growing evidence from post-fire analyses, which illustrate how water availability, scarcity and inaccessibility influence the decision to stay and defend, or to leave a property, and outcomes during a bushfire, and the potential for such water related problems to contribute to civilian fatalities and property loss.

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The feasibility of regulating non-reticulated water consumption warrants further investigation for a number of reasons given the evidence in our study of low water reserves impacting the preparedness, coping capacity and survival related decisions of households independent of reticulated (mains) water.

First, households without access to mains water are generally exempt from water restrictions and rules. Instead, water use is at the discretion of the residents. Research on the efficacy of rainwater tanks in prompting water conservation and sustainable water consumption practices is inconclusive, and lacking in the context of households who rely exclusively on non-reticulated water sources for both domestic use and fire fighting purposes. It is unclear whether mandatory water restrictions could influence water consumption, attitudes and behaviour to a degree that would increase the likelihood of households at the rural-urban interface having sufficient reserves specifically for fire fighting during the bushfire season. Financial, spatial and time constraints related to water management may further increase the vulnerability of these households to bushfire.

Secondly, the bushfire safety advice provided by bushfire management agencies is inconsistent across jurisdictions in Australia. This may be explained, in part, by regional and local variations in rainfall and water supply, as well as variations in Fire Danger Index values, which defines the relative importance of water and seasonal/localised possibility of water shortages (see Standards Australia, 2009, p.15). Comparative studies on this issue would be useful, as despite the imperative of developing water conservation practices among households for bushfire preparedness, little is known about the factors influencing residents' water usage before and during bushfire, especially for property maintenance and actual defence.

Finally, houses built after 2007 on bushfire-prone land are comparatively "better off" in terms of bushfire preparedness, as water supply and access provisions are a mandatory part of the development application. However, houses built before 2007 are more likely to be vulnerable and limited by the physical modifications they can make to their property to improve bushfire resilience. It may be

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spatially and/or financially impractical to, for example, install a rainwater tank or dam specifically for fire fighting water, install metal pipes or bury plastic pipes to improve the integrity of water distribution systems. The breadth and detail of information concerning water supply, storage and distribution for bushfire preparedness in agency advice is important, as this may be where residents ascertain their information about water supply, storage and distribution options and capabilities generally.

5. Conclusions

1. *Water shortage*: Severe bushfires, local drought and water shortages frequently coexist, making water usage planning critical for households subsisting on non-mains water supplies.
2. *Equipment failure*: Further guidance to homeowners is needed on the maintenance of water storage and distribution systems. Maintenance and practice of using emergency watering systems is transferred from the agency (fire service) to the homeowner with limited and inconsistent guidance.
3. *Protecting water assets*: The ability of water storage vessels and water dispersal systems to withstand the intensity of a bushfire is central to the safety of households attempting to defend their property. It is imperative that water storage and dispersal equipment are protected from flames, embers and debris during a bushfire. Greater consistency is needed in official advice and planning documents across state and territory agencies.
4. *Water abundance*: Households in bushfire prone areas can decrease the risk of loss by maintaining an abundant independent water supply for fire fighting purposes. Ensuring that water supplies are ample and kept in check during periods of drought or high fire danger weather can enhance the resilience and adaptive capacity of a household to an imminent bushfire threat.

Whilst planning legislation and development controls are thorough in their advice on water for bushfire preparedness and property defence, official agency advice to residents on these matters is

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insufficient and inconsistent. The results of this study point to the need for more detailed and consistent information on storing water prior to a bushfire, and on having effective and maintained water distribution systems. Overall, bushfire safety advice could benefit from greater consistency across jurisdictions to clarify: what constitutes an independent water supply, how much water is required for property defence, how water can be accessed, and how to improve the integrity of the water supply during a bushfire. Although our study focussed on the experiences of two communities independent of reticulated town water, the research findings are equally applicable to households with reticulated (mains) water supplies.

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Supplementary Material: Summary of educational material related to water, water storage and water dispersal equipment for household preparedness and firefighting , by State or Territory in descending order from most-detailed to least-detailed (current as of 4 November 2014).

State	Agency	Bushfire Survival Plan booklet, factsheets, videos, webpages	In text emphasis on water, water storage and water dispersal equipment for bushfire suppression
VIC	Country Fire Authority	<i>Prepare. Act. Survive. Fire Ready Kit</i> (2013) 76 pages	<p>“Defending a home requires at least 10,000 litres of water and appropriate fire fighting hoses and pumps” (p.13).</p> <p>“Before you leave block the downpipes and partially fill the gutters with water if time permits” (p.19).</p> <p>“During a fire: Power and water may be cut off” (p.22).</p> <p>“Disruptions to telephone service, internet and mains power and water are common during a fire on a fire risk day. Be prepared: Don’t rely on mains power and water. Power failure will impact you and your use of electric pumps” (p.26).</p> <p>“Preparing your property: Fire truck access - if a fire truck does reach your property, you will need to ensure that all water sources are clearly marked and easy to find; your tank fittings are compatible with CFA fire trucks. The Defending you Property Section of this Kit provides a comprehensive list of CFA-compatible tank fittings” (p.45).</p> <p>“Sprinkler systems can help fight embers” <i>etc.</i> (½ page) (p.53)</p> <p>“Defending your property: defending also requires at least 10,000 litres of water and appropriate fire fighting hoses and pumps” (p.58).</p> <p>“Water equipment and resources” <i>etc.</i> (4 pages) (pp.61 – 64)</p> <p>“Other equipment: Knapsacks or water sprayers - Special knapsacks can be bought for fire fighting, but many of the weed sprayers available in hardware stores are also suitable. Keep in mind that a 20-litre knapsack will weigh more than 20 kilograms when it is full or water” (p.66).</p> <p>“Activating your plan of action. Waiting until a fire is in the area to do all the things below is very risky: remember that tasks such as filling tanks and gutters with water take time” (p.70).</p>
		<i>On the Land: Agricultural Management Guidelines</i> (40 pages)	Resource for farmers, land and plantation owners or managers, on large rural blocks. One page specifically on “Access to water supplies for emergency services”.
WA	Department of Fire and Emergency Services	<i>Prepare. Act. Survive. It could save you and your family’s lives this bushfire season</i> (2014) 44 pages	<p>“When developing your bushfire survival plan, you and your family need to think about: do you have the right equipment and resources to actively defend? (e.g. sufficient independent water supply of at least 20,000 litres and a petrol, diesel or a generator powered pump capable of pumping 400 litres per minute)” (p.5).</p> <p>“Have a backup plan: what will you do if you lose electricity and water supply?” (p.6).</p> <p>“Water supply and pumps” <i>etc.</i> (½ page) (p.9)</p> <p>“It is likely you will lose power and water services. Do you have the right equipment and resources to actively defend? (e.g. sufficient independent water supply of at least 20,000 litres and a petrol, diesel or a generator powered pump capable of pumping 400 litres per minute)” (p.10).</p>

State	Agency	Bushfire Survival Plan booklet, factsheets, videos, webpages	In text emphasis on water, water storage and water dispersal equipment for bushfire suppression
			<p>“If you are planning to stay and actively defend it is a good idea to check water pumps and generators to make sure they work when bad fire weather is forecast” (p.13).</p> <p>“Preparing your property: Have a sufficient independent water supply of at least 20,000 litres and a petrol, diesel or a generator powered pump capable of pumping 400 litres per minute” (p.30).</p> <p>“Leaving for a safer place: What will be your trigger to leave? (Consider triggers such as loss of water or power)” (p.33).</p> <p>“Leaving for a Safer Place: Preparing your property – Where is your independent water supply and how will you access it? Do you have at least 20,000 litres?” (p.34).</p> <p>“Make sure there is water” <i>etc.</i> (¼ page) (p.36)</p> <p>“Planning to Actively Defend – Preparing your property: Where is your independent water supply and how will you access it? Do you have at least 20,000 litres to defend your property?” (p.37).</p> <p>“Important contact details – Bushfire Survival Plan: Water Supplier” (p.44).</p>
		<p>The Homeowners’ Bush Fire Survival Manual (2014) 60 pages</p>	<p>“Check taps, hoses and hose reels are in good condition and fittings are tight and in good working order. Check pumps are fuelled and oiled and will start easily—you don’t want to wait until you need to use the pump to find out it is broken. If you have a bushfire water spray system, ensure that is constructed to AS 5414 – Bushfire water spray system standards (external sprinkler system), and test regularly before the start and during the fire season. Ensure there is adequate water supply to meet the needs of the job” (p.10).</p> <p>“Exposed plastic water pipes and hoses may melt in the heat of a fire—just when you need them most. To avoid this bury plastic water pipes (PVC and poly pipes) at least 30 centimetres underground; use metal hose fittings rather than plastic fittings” (p.11).</p> <p>“Additional measures: Engage a relevant industry expert to install a sprinkler system to the outside of your house to the AS 5414 – Bushfire water spray system standards (external sprinkler system)” (p.12).</p> <p>“Access to adequate water supplies will enable life and property to be defended in the event of a bushfire. Where mains water supply is not available, or for extra water security, a water tank should be installed, preferably with a fuel powered pump attached. As well as being an alternative permanent supply of water, swimming pools and dams located close to the house can act as buffers between the house and bushfire hazard” (p.18).</p> <p>“The siting of a new development: consider whether there a nearby stream or dam - It may be preferable to build beside a body of permanent water so that the water is placed between the house and the likely direction of a bushfire. Be aware that if the water source dries out in summer it can provide extra fuel for the fire and increase the risk” (p.18).</p> <p>“Tree planting and maintenance guidelines: Maintain a minimum 2 metre gap between your house, other buildings, water supplies and trees” (p.26).</p> <p>“Water supply – vital for home protection” <i>etc.</i> (2 pages) (pp. 33-34)</p>

State	Agency	Bushfire Survival Plan booklet, factsheets, videos, webpages	In text emphasis on water, water storage and water dispersal equipment for bushfire suppression
			<p>“You may prefer to stay and defend if you have sufficient emergency water supplies and equipment” (p.46).</p> <p>“Some of the equipment you’ll need to protect your home will probably be on hand already. Other items may need to be bought but are not generally expensive, except for the water pump. You will need: Hoses—one hose for each water outlet. You’ll need enough hose to reach all corners of the house and out to the edge of the building protection zone; Knapsack spray or mop— used for small spot fires; Buckets—have plenty around the house. Don’t use water on the roof if the power is on; Fuel-powered water pump (preferably diesel fuel)—keep it in working order and in a safe place so it is not at risk from the fire. This is only required if you have your own water source” (p.48).</p> <p>“Fill outside gutters. If time permits, block up the mouth of downpipes and fill gutters with water” (p.49).</p> <p>“Prepare your home and property checklist: Long term precautions: provide an emergency water supply; Autumn and winter (May – August): Overhaul the emergency water pump; Early summer (December onwards): Re-check personal and home protection gear, screens, water supplies and gutters” (p.52).</p> <p>“Emergency contact numbers: Water supplier” (p.54).</p>
TAS	Tasmanian Fire Service	<i>Bushfire Survival Plan. Know your risk. Make a Plan</i> (2014) 24 pages	<p>“Leaving early is always the safest option: failure of equipment, loss of power supplies or water can compromise plans” (p.8).</p> <p>“Provide water for fire fighting” <i>etc.</i> (1 page) (p.12)</p> <p>“Leave early checklist: On high fire risk days or actual fire days block drainpipes and fill gutters with water” (p.16).</p> <p>“If you decide to stay: Fire fighting equipment - if you can’t rely on mains water, you need an alternative supply. You should purchase a small fire fighting pump and hose. Look under ‘fire protection equipment’ in the Yellow Pages. A pump kit should include the pump and its petrol or diesel-driven motor, a suction hose, strainer and float (to get the water into the pump) sufficient 19 mm or 25 mm diameter fire fighting hose or 19mm garden hose to reach around all sides of your home, a fire fighting nozzle for each hose, and spare fuel. Practice using the equipment regularly. During the fire make sure that the pump and hose are protected from high ambient temperatures and radiant heat and sheltered from embers and sparks. Any plastic pipes and fittings should be buried below ground or covered so they won’t melt” (p.18).</p> <p>“If a bushfire is burning nearby and you have chosen to stay: block your downpipes and fill your gutters with water; fill the bath and any buckets and containers with water; don’t waste water wetting down roofs and walls. Use the water only for extinguishing burning material” (p.19).</p> <p>“When the fire arrives: if fire breaks out, extinguish it using water you have collected in the bath and in buckets or with the hose attached to your laundry taps” (p.19).</p> <p>“Stay and defend checklist: prepare your fire fighting equipment = a fire fighting pump, hose and nozzle, fire fighting water supply (not just mains water), garden hose and fittings; as the fire approaches = block downpipes and fill gutters with water; fill bath, buckets and containers with water; as the fire front arrives = connect a hose to a laundry tap” (p.20).</p>

State	Agency	Bushfire Survival Plan booklet, factsheets, videos, webpages	In text emphasis on water, water storage and water dispersal equipment for bushfire suppression
		<i>Provide Water for Firefighting</i> webpage (last updated 2014)	Encapsulates content of 'Bushfire Survival Plan' but also provides link to Youtube™ clip <i>Provide Water for Fire fighting (Prepare to Survive 2010-11 DVD)</i> (uploaded 21.11.2010) (53 seconds)
SA	Country Fire Service	<p><i>Your guide to bushfire safety. Prepare. Act. Survive</i> (2014) 32 pages</p> <p><i>CFS Fact Sheet no. 4.8 Fire Fighting Equipment</i> (2009), 2 pages</p> <p><i>CFS Fact Sheet no. 4.1 Preparing your property</i> (2010), 9 pages</p> <p><i>CFS Fact Sheet no. 4.9: Sprinkler Systems</i> (2011), 4 pages</p>	<p>"Prepare: Plan for no electricity, no water and very little warning" (p.2)</p> <p>"Fire danger ratings: lists the equipment and resources residents need to be considered "well prepared" for "Extreme" and "Severe" fire danger rating days - enough water supply, petrol/diesel portable pump, generator" (p.5).</p> <p>"Actions in and around the home: sprinkler system - a home bushfire sprinkler system that directs water over the roof, windows, doors and underfloor areas is one of the most effective ways of protecting against radiant heat, direct flame and ember attack" (p.9).</p> <p>"Measures that can be taken in the garden to protect your home: ensuring access to an independent water supply such as a tank, dam or swimming pool of at least 5000 litres. Do not rely on mains water being available during a fire. [bold original emphasis]; install a petrol/diesel-driven water pump; making sure hoses are long enough to reach around your home" (p.10).</p> <p>"Prepare your property season by season: Spring - check and service all mechanical equipment, including grass cutters, water pumps, sprinkler systems and fire extinguishers; Summer - check reserve water supplies" (p.11).</p> <p>"Power and water may be cut off" (p.13).</p> <p>"Bushfire Survival Plan: do you have the right equipment and resources to actively defend? E.g. sufficient water supply (minimum 5,000 litres), petrol or diesel pump, generator" (p.20).</p> <p>"Planning to stay and defend: lists actions before the fire approaches: "block downpipes and fill with water; prepare water buckets" (p.22).</p> <p>"Don't [bold original emphasis] - stand on your roof with your hose: often more people are injured falling from roofs than suffer burn injuries; Don't waste water wetting down roofs and walls at this stage. Use the water only for extinguishing burning material" (p.22).</p> <p>"Bushfire Survival Plan Checklist: important phone numbers - water supplier" (p.26)</p> <p>Includes information on "how much water will you need?", "Ideas for water storage", and "water distribution options".</p> <p>One page on "Water supply and reticulation": covers recommended water volume, pumps, hoses and sprinkler systems.</p> <p>Detailed information covering: considerations to make before installing a sprinkler system, overview of "how houses burn", the purpose of sprinkler system, a checklist for determining the type of sprinkler system needed, descriptions of the design and function of "roof mounted sprinkler systems" and "ground based sprinkler systems", guide for installing</p>

State	Agency	Bushfire Survival Plan booklet, factsheets, videos, webpages	In text emphasis on water, water storage and water dispersal equipment for bushfire suppression
			sprinklers, and pumps.
QLD	Fire and Emergency Services	<i>Bushfire Survival Plan. Prepare. Act. Survive</i> (2015) 20 pages	<p>“On days of catastrophic of extreme Fire Danger Rating expect power, water and phone networks to fail as severe winds well ahead of the fire will bring down trees and power lines” (p.3).</p> <p>“If you decide to stay, you must include the following information or action items in your Bushfire Survival Plan: block downpipes and fill gutters with water; wet down the sides of buildings facing the approaching fire front; wet down decks and verandas; wet down fine fuels close to buildings; turn on garden sprinklers before the bushfire arrives; fill containers with water – bath, sinks, buckets, wheelie bins etc.” (p.5).</p> <p>“When the fire front arrives: Take all fire fighting equipment, such as hoses and pumps, inside – these may melt during the fire; have a generator or petrol pump ready” (p.5).</p> <p>“Your pre-season property preparations should include conducting maintenance checks on pumps, generators and water systems” (p.7).</p> <p>“Bushfire Survival Plan: Important contact details – water supplier” (p.10).</p> <p>“Bushfire Risk Self-Assessment Checklist: prompts reader to identify whether or not they have the following: Reticulated water supply; Tank water with QFRS access – 50mm male camlock fitting so fire fighters can use water if needed; QFRS accessible external open water supply (dam/pool); Fire fighting pump and hose connected to water supply” (p.16).</p> <p>“Other considerations: Fire fighting equipment (such as pumps, hoses and sprinkler systems) should be tested regularly and maintained in maximum operational working condition” (p.17).</p>
NSW	Rural Fire Service	<i>Bushfire Survival Plan: Prepare. Act. Survive.</i> (2013) 26 pages	<p>“Do you have enough water for fire fighting purposes e.g. a tank, dam or pool? Town water supplies can fail during emergencies” (p.5).</p> <p>“Prepare yourself – power and water may be cut off” (p.6).</p> <p>“If you have a water tank, dam or swimming pool, consider installing a Static Water supply sign (SWS)... Ensure you have a hose which is long enough to reach every part of the home” (p.7).</p> <p>“On days of increased fire danger: check water pumps and generators to make sure they are working” (p.8).</p> <p>“Before the fire impacts: block your downpipes, (a sock full of sand/soil will help) and fill your gutters with water; do not stand on your roof with your hose. In bushfires, often more people are injured by falling from roofs than suffering burns; just before the fire arrives, wet down timber decks and gardens close to the hose; move any fire fighting equipment to a place that will not get burnt” (p.12).</p> <p>“Staying and defending: extra equipment that might help you if you are going to Stay and Defend your property includes hoses (long enough to reach every part of your house); consider having a minimum 5000-litre water tank; petrol/diesel pumps” (p.12).</p> <p>“Staying and defending: fill bath, sinks and buckets with water for putting out any fires that may start inside” (p.13).</p>

State	Agency	Bushfire Survival Plan booklet, factsheets, videos, webpages	In text emphasis on water, water storage and water dispersal equipment for bushfire suppression
			<p>“Our leave early plan: consider triggers such as loss of water or power” (p.16).</p> <p>“Our stay and defend plan: other triggers that mean we will not stay and defend are loss of water or power” (p.17).</p> <p>“The NSW RFS recommends that you fill your bath and sinks with water so that you will have water in case water supply to your home is cut off. This water can then be used to put out small spot fires that may start in and around the home” (p.19).</p> <p>“During a bushfire more injuries normally occur from people falling off roof than from burns. Filling your gutters with water and hosing down your roof will help with spot fires due to ember attack but any hosing down should be done from the ground or off a ladder” (p.19).</p>
ACT	Emergency Services Agency	<i>Bushfire Survival Plan: Prepare. Act. Survive.</i> (2013) 24 pages	<p>“Do you have enough water for fire fighting purposes e.g. a tank, dam or pool? Town water supplies can fail during emergencies” (p.5).</p> <p>“Prepare yourself – power and water may be cut off” (p.6).</p> <p>“Ensure you have a hose which is long enough to reach every part of the home” (p.7).</p> <p>“If you have water pumps and generators, check they are working” (p.10).</p> <p>“Before the fire impacts: block your downpipes, (a sock full of sand/soil will help) and fill your gutters with water; do not stand on your roof with your hose. In bushfires, often more people are injured by falling from roofs than suffering burns; just before the fire arrives, wet down timber decks and gardens close to the hose; move any fire fighting equipment to a place that will not get burnt” (p.12).</p> <p>“Staying and defending: extra equipment that might help you if you are going to Stay and Defend your property includes hoses (long enough to reach every part of your house); consider having a minimum 5000-litre water tank; petrol/diesel pumps” (p.12).</p> <p>“Staying and defending: fill bath, sinks and buckets with water for putting out any fires that may start inside” (p.13).</p> <p>“Our leave early plan: consider triggers such as loss of water or power” (p.16).</p> <p>“Our stay and defend plan: other triggers that mean we will not stay and defend are loss of water or power” (p.17).</p> <p>“The ESA recommends that you fill your bath and sinks with water so that you will have water in case water supply to your home is cut off. This water can then be used to put out small spot fires that may start in and around the home” (p.18).</p> <p>“During a bushfire more injuries normally occur from people falling off roof than from burns. Filling your gutters with water and hosing down your roof will help with spot fires due to ember attack but any hosing down should be done from the ground or off a ladder” (p.18).</p>
NT	Bushfires NT AND Fire	Webpage <i>Safeguard your home</i> (last updated 2014)	Amongst list of “20 steps to safeguard your home”: Set up sprinklers to keep the ground, roof and walls damp during a bushfire. A portable diesel or petrol pump, drawing water from your tanks or dam is ideal; Connect large-diameter gate valve fittings to the outlets of your tanks to provide ample water supply to your fire fighting pump; Testing your equipment

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State	Agency	Bushfire Survival Plan booklet, factsheets, videos, webpages	In text emphasis on water, water storage and water dispersal equipment for bushfire suppression
	and Rescue Service		weekly to ensure that all pumps and hoses are working well. Hoses should reach every part of your house.



