Emergency Leaders for Climate Action

Submission to: NSW Independent Bushfire Inquiry

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Submission from:

Emergency Leaders for Climate Action (ELCA)
https://emergencyleadersforclimateaction.org.au/

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15 April 2020

About Emergency Leaders for Climate Action

Climate change is escalating Australia's bushfire threat, placing lives, property, our economy and the environment at increasing risk.

Emergency Leaders for Climate Action (ELCA) was formed in April 2019 due to shared concerns about the potential of the 2019/20 bushfire season, unequivocal scientific evidence that climate change is the driver of longer, more frequent and more intense bushfire seasons, and the failure of successive governments, at all levels, to take credible, urgent action on the basic causal factor: greenhouse gas emissions from the burning of coal, oil and gas which are causing significant warming, in turn worsening extreme weather events that exacerbate and drive natural disasters such as bushfires.

ELCA originally comprised 23 former fire and emergency service leaders from every fire service in Australia, from several State Emergency Service agencies, and from several forestry and national parks agencies. At the time of submission, ELCA continues to grow and now comprises 33 members, including two former Directors General of Emergency Management Australia. Cumulatively, ELCA represents about 1,000 years of experience.

Key members from NSW and the ACT include:

- *Phil Koperberg AO, AFSM, BEM*. Former Commissioner NSW Rural Fire Service. Former Chair, NSW State Emergency Management Committee. Former NSW Minister for the Environment.
- *Greg Mullins AO, AFSM*. Former Commissioner Fire & Rescue NSW. Former Deputy Chair, NSW State Emergency Management Committee. Former President and Board Chair, Australasian Fire & Emergency Service Authorities Council. Chair, NSW Ambulance Service Advisory Board. Volunteer firefighter.
- *Murray Kear AFSM*. Former Commissioner NSW State Emergency Service. Former President, Australian Council of State Emergency Services. Former Assistant Commissioner, NSW Fire Brigades.
- *Brian Gilligan*. Former Director General NSW National Parks and Wildlife Service.
- *Bob Conroy*. Former Fire Unit Manager. NSW National Parks and Wildlife Service. Volunteer firefighter.
- *Major General Peter Dunn AO (ret)*. Former Commissioner of the ACT Emergency Services Authority. Volunteer Recovery Coordinator; Lake Conjola, NSW
- *David Prince AFSM*. Former Chief Officer, ACT Fire Brigade.
- *Malcolm Connellan AFSM.* Former Deputy Commissioner Fire & Rescue NSW.
- *Jim Smith AFSM*. Former Deputy Commissioner Fire & Rescue NSW. Former Acting Commissioner NSW State Emergency Service. Volunteer firefighter.

- *Ken Thompson AFSM*. Former Deputy Commissioner NSW Fire Brigades.
- *Greg Newton*. Former Deputy Commissioner NSW State Emergency Service.
- *John Anderson AFSM*. Former Deputy Commissioner NSW Fire Brigades. Former Chair, NSW State Emergency Management Committee.

In April and May 2019 ELCA corresponded with the Prime Minister and sought opportunities to brief him on the alarming potential of the looming bushfire season, then again later in 2019 when the catastrophic fire season, as warned, started to rapidly intensify. Ultimately a short meeting was held with Ministers Littleproud and Taylor on 4 December, after hundreds of homes and a number of lives had already been lost. No immediate or tangible outcomes resulted from that meeting.

ELCA recommended a number of significant measures that would have aided firefighting efforts, including assisting states and territories with additional funding for large firefighting aircraft, and mobilisation of elements of the Australian Defence Force to support emergency services. The recommendations were initially ridiculed, then ignored, then belatedly implemented after the worst damage and most deaths had already occurred.

The NSW Government acted competently and proactively before, during and after the bushfire season, although some statements, for example by the Deputy Premier, were inaccurate and unhelpful. Key actions by the NSW Government helped to mitigate the effect of the fires and to assist firefighting efforts. For example:

- Purchase of Australia's first Large Aerial Tanker (LAT): a Boeing 737 jet carrying 15,000 litres
- Lease of a Very Large Air Tanker (VLAT): a DC10 jet carrying 35,000 litres
- Requesting ADF assistance
- Declaring a number of Statewide Total Fire Bans and States of Emergency
- Ordering evacuation of the South Coast prior to New Year's Eve 2019: a significant decision with far-reaching consequences but one which, in the expert opinion of ELCA, was responsible for saving dozens, if not hundreds of lives.
- Minister Kean (Environment) making clear statements on the basis of science and the advice of experts, acknowledging the clear link between the unprecedented bushfires and climate change. This was in stark contrast to incorrect assertions made by several Federal Government figures, including the PM, Deputy PM, and former Deputy PM.

Table of Contents

Recommendations

1. The Inquiry Report should clearly acknowledge and explain that the 2019/20 bushfires were the worst in NSW history, that they were driven by unprecedented extreme weather and fire danger indices on multiple days, by cascading events including drought, heatwaves, dry thunderstorms, and an unprecedented number of pyroconvective events. The Report should clearly acknowledge and explain for the historical record that it is irrefutable that climate change was the main driver of the unprecedented 2019/20 bushfire season.

2. The Inquiry Report should explain how climate change has resulted in the NSW bushfire season lengthening, and overlapping with other states and territories, limiting the ability of Australian firefighting agencies to assist each other. Increasing overlap of fire seasons between the northern and southern hemispheres is limiting the availability of large firefighting aircraft, particularly between August and November each year.

3. The NSW Government should, in recognition of the now established pattern of longer bushfire seasons, amend S.81 of the Rural Fires Act 1997 to change commencement of the annual Statutory Bushfire Danger Period to 1 August each year, concluding on 30 April in the following year, replacing the current Bushfire Danger Period from 1 October to 31 March, in order to help prevent fires and increase the need for fire permits. Alternatively, change the Act and adopt the Tasmania Fire Service approach whereby the Commissioner makes a determination each year of the commencement and conclusion of the bushfire danger period, based on current assessed fire risk.

4. Strong climate mitigation and adaptation policies are required from all levels of government including the New South Wales State Government, to start to address the escalating bushfire and natural disaster risks driven by climate change, the root cause of worsening extreme weather. NSW must accelerate and increase measures to tackle climate change. More substantial action is required to reduce Australia's emissions, including accelerating the transition to renewables and storage technologies, non-polluting transport, infrastructure, food production and the phase out of fossil fuel projects. The NSW Government must continue to step up to strengthen its climate policies and local government must continue to meet and beat emission reduction goals and renewable energy targets. Some of these climate impacts are already locked in, and all levels of government will play a critical role in building community preparedness and resilience.

5. The NSW Government should demand that the Federal Government maintain funding and support for an ongoing research capability given the imminent cessation of funding in 2021 for the Bushfire & Natural Hazards Cooperative Research Centre. Research is crucial to understanding and tracking escalating natural disaster risks, and enabling fire and

emergency services to plan and prepare for worsening conditions. An evidence-based ability to track and predict escalating risks driven by climate change must underpin the development of national and state resilience, adaptation and mitigation strategies, funding needs for community education and engagement, and enhanced resourcing of emergency services.

6. The NSW Government should demand that the Federal Government ensure critical government research agencies have funding restored. This includes agencies such as the Bureau of Meteorology (BoM), the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and ABC Local Radio as the national emergency broadcaster. These agencies must be sufficiently resourced to improve predictive capabilities, understand effects of climate change on natural disasters now and into the future, and be able to warn and alert communities and emergency services in a timely, comprehensive manner.

7. That the NSW RFS place greater emphasis on the appointment of hazard management officers in accordance with S.65A of the Rural Fires Act 1997 in order to better manage fuel loads on private land. In the 2 months preceding the onset of each bushfire season, concentrate on identifying and requiring management of hazardous fuel loads on private land, where necessary issuing bush fire hazard reduction notices under S.66 of the Act, then carrying out works and recouping costs from owners under S.70 of the Act. Each RFS District should be required to submit a pre-season plan identifying localities of particular focus and provide fortnightly returns of the number of notices issued, and number of works carried out under S.70.

8. Amend the Rural Fires Act 1997 so as to require the Bush Fire Coordinating Committee to develop a 10 year state-wide strategic bushfire risk management plan which incorporates a holistic and cross tenure approach to bushfire risk management acknowledging climate change impacts on future fire frequency and intensity. This focus on intensifying fire seasons should guide the development of district bush fire risk management plans, NSW fire authority strategic bushfire plans, research priorities, hazard reduction programs, bushfire zones, and performance measures.

9. Enhance those programs which focus bushfire risk reduction effort on asset protection and strategic fire management zones including the FRNSW Community Fire Unit Program, the RFS AIDER program, the RFS / NCC Hotspots Program, and examine further opportunities for engaging Aboriginal Corporations in cultural burning and firefighting, pest management and restoration programs on Country.

10. Research is needed to help develop new policies that recognise the need for better asset protection, shrinking windows available for controlled burning due to a warming climate, the need to fund and research cultural burning practices, and the need to avoid perverse outcomes, such as burning large tracts of land remote from assets in order to meet arbitrary percentage or hectare targets. There needs to be recognition that hazard reduction will be less effective during extreme weather events that result in long distance spotting, intense

and sustained ember attack, and pyroconvective fires. As a result, fuel reduction strategies will need to better integrate with fire suppression, community education, hardening of infrastructure, and other measures. Fuel reduction is one of the only ways to reduce fire intensity and therefore must be a major part of any mitigation strategy.

11. Australia's National Security Strategy must embrace wider and deeper concepts of security, including a consideration of climate change, natural disasters driven by extreme weather, and their impacts. The Australian Defence Force (ADF) has comprehensive logistics and engineering capabilities that can be applied to assist emergency services in the response phase, and communities in the recovery phase. Key Defence policy papers, such as the next Defence White Paper must incorporate a clear forward plan for how the ADF will support emergency services and recovery agencies in the future, as climate change drives an increased number of extreme fire danger days and other natural disasters in NSW and Australia.

12. The NSW Government should request that the Federal Government conduct a fundamental review of longstanding Defence Assistance to the Civil Community (DACC) arrangements. The arrangements can be cumbersome and slow, and levels of understanding between the ADF and emergency services about respective capabilities, needs, and arrangements must be improved. The ADF should focus on utilisation of existing capabilities for civil defence roles rather than developing new capabilities that may simply duplicate state and territory capabilities, ultimately causing confusion and inefficiencies.

13. The NSW Government should make representations to the Federal Government to ensure that future strategic assessments of the capability of the ADF to assist in natural disasters, including assessment of future acquisitions, should concentrate on interoperability and complementarity with states and territories, determined via a structured consultative arrangement.

14. The NSW Government should request that the Federal Government and ADF conduct a trial of the feasibility of fitting a number of RAAF C130 Hercules aircraft with Modular Airborne Fire Fighting Systems (MAFFSII) to provide the ADF with the capability to augment aerial firefighting capabilities during major disasters.

15. The NSW Government should conduct a trial, in consultation with AFAC and NAFC, of amphibious water-scooping aircraft in a first attack / direct attack firefighting role (CL415 and Be200). Australian fire services at present use small and large fixed wing water bombers, but not medium sized. Given the success of 3,200 litre single engine air tankers (SEAT), a twin engine purpose-built aircraft with significantly greater air speed, range, flexibility, and twice to four times the payload would be a logical addition to current arrangements. CL 415 aircraft are used extensively and successfully throughout the world in other fire-prone countries.

16. A range of new rapid fire detection technologies should be trialed. Together with rapid detection, new fast attack strategies for new outbreaks, particularly remote fires caused by lightning, need to be introduced with clear objectives, e.g. putting fires out within 24 hours and before they exceed ten hectares. Fast attack should involve rapid dispatch of a suitable number and type of fixed and rotary winged aircraft, including where suitable, medium sized air tankers which can scoop from suitable water sources or land at local air strips for manual filling, (as opposed to LAT and VLAT which are restricted to a few major airports) thereby establishing rapid turnaround and constant direct aerial attack on fire fronts. Aerial attack would then be complemented, as soon as possible, by aerial or ground insertion of fire crews and where necessary remote area fire teams, to complete extinguishment.

17. The NSW Government should re-commit to the soon-to-be completed National Parks and Wildlife Service Enhanced Bushfire Program and focus in particular on expansion and resourcing of remote area fire teams with suitable aerial platforms, including the possibility of using ex-military Blackhawk helicopters, or Bell 412 helicopters as recently procured for the RFS.

18. The NSW Government should declare the NSW Rural Fire Service, Fire & Rescue NSW, and NSW National Parks and Wildlife Service as Essential Services for budgetary purposes, and immediately exempt them from the Labour Expense Cap and Productivity Dividends (i.e. constant budget cuts).

19. The NSW Government should restore capital funding to Fire & Rescue NSW to enable the average age of the fire engine fleet to be restored to ten years. This will also restore the ability of Fire & Rescue NSW to maintain a “reserve fleet” of decommissioned fire engines and tankers to provide surge capacity using off duty firefighters during serious bushfire seasons, a capability that was reduced as a result of capital budget reductions leading up to 2019/20.

20. The NSW Government should consider a capital funding grant to Fire & Rescue NSW to purchase a fleet of bushfire tankers that would replace decommissioned fire engines currently forming a reserve fleet, in order to enhance capabilities and ensure that firefighters have proper personal protection systems when fighting bushfires.

21. The concept of seasonal paid firefighters, used extensively in bushfire-prone parts of the USA and Canada, should be considered in relation to Fire & Rescue NSW and National Parks and Wildlife Service in order to augment existing ranks of volunteer and career firefighters

in NSW during serious bushfire seasons. A similar concept could be extended to RFS State Mitigation Crews during serious bushfire seasons to provide a full time firefighting surge capacity within the RFS.

22. The Community Fire Unit concept should be modified by the RFS to make it suitable for regional NSW. A step change in community resilience and preparedness could be achieved by training and providing basic firefighting equipment to NSW residents in bushfire-prone areas. The Fire & Rescue NSW Community Fire Unit program has proven to be a success in urban / bushland interface areas, but not as well received or suitable in areas of a more rural nature.

23. In the wake of the devastating 2019/20 fires, and recognising that climate change continues to drive an increase in Australia's bushfire threat, it is critical that building and planning regulations and standards be reviewed, particularly Australian Standard 3959. Bushfire Attack Levels (BAL) in NSW are based on historical fire weather, not on conditions experienced in 2019/20, and certainly not what is likely to occur in future as temperatures increase further. BAL must be reflective of climate change projections, not historical weather and fire behaviour. The Standard deals mainly with radiation levels that inform an engineering standard, but do not sufficiently take into account ember attack or the effects of convection.

24. NSW should update Planning for Bushfire Protection as a matter of urgency to reflect worsening conditions and include climate change as a key factor. Innovative solutions, such as community refuges, household fire bunkers and early evacuation as trade-offs for allowing lightweight "sacrificial" home construction, should be considered and researched.

25. Roof design and strength is a critical factor in future bushfire design of homes and other buildings. Requirements need to be increased to reflect increasing wind velocities fuelled by climate change, and fire storms and fire tornadoes caused by pyroconvective events that damage and remove roofs. If a roof is damaged or destroyed survivability of the structure and its ability to act as a refuge are greatly reduced.

26. Bushfire prone area mapping by local councils needs to be reviewed as there are large areas of NSW, particularly grasslands, unmapped. Current buffers are 100m, which is clearly inadequate when ember attack can impact structures 350 – 500m from a fire edge.

27. With varying legislation and building codes across states and territories a more integrated approach to planning for fire risk, which better connects planners with emergency management, will be critical. As fire danger indices and fire paths from 2019/20 are analysed, locations might be identified where rebuilding should not occur due to excessive levels of fire and life risk.

28. Consideration should be given in remote communities or communities deemed to be at extreme risk with limited egress, to providing dual-purpose community buildings capable of providing all community members with refuge in an extreme bushfire situation.

1. Overview of the Bushfire Challenge and Solutions

1.1 The 2019/2020 Bushfire Season

It is well established that the bushfire season was "the most devastating in NSW history" (NSW RFS 2020a):

- More lives lost than in any previous bushfire season (25)
- 1000% more homes destroyed than in the previous worst bushfire seasons in NSW; 222 homes in 2013; 206 homes in 1994. (2,448 homes lost in 2019/20)
- More forested areas burned than in any previous NSW bushfire season; e.g. 800,000 ha in 1994; 744,000 ha in 2001/02; 118,000ha in 2013. (In 2019/20 5.52 million hectares were burned).

(NSW RFS 2020c)

Not every year produces serious fire weather and fuel conditions. However, NSW has experienced periodic serious bushfire seasons, linked to weather patterns, for thousands of years according to carbon records. Since European habitation, there have been serious, damaging bushfires in NSW approximately once every decade, or slightly longer.

Climate change has changed weather patterns and in many areas increased the frequency of serious bushfire seasons. For example, the Blue Mountains west of Sydney, an area accustomed to significant property loss and sometimes loss of lives due to bushfires, experienced serious bushfire seasons in 1936, 1944, 1957, 1968, 1977, 1994, 2001/02, 2007, 2013, and 2019/20 (Luke & McArthur 1978; NSW Parliament 2014; NSW RFS 2020a). For decades the frequency of large fires was consistently around a decade apart. This changed after the 1994 fires with the return period since then being around six years; a consistent observable change that is explained by changing weather patterns driven by climate change.

The length of bushfire seasons is increasing markedly (Clarke et al 2013; Climate Council 2015). Commonly the NSW bushfire season now commences in early August each year rather than October as enshrined in the Bush Fires Act 1949 and its successor, the NSW Rural Fires Act 1997. Fire seasons now sometimes extend further than 31 March which is also enshrined in the aforementioned Acts. Longer fire seasons have been accompanied by record-setting periods of serious bushfire danger very early in the bushfire season (Hannan 2019a).

In April 2018 a major fire threatened hundreds of properties in south and south west Sydney when hot and dry conditions were accompanied by very strong westerly winds over a number of days (BOM 2018a). Just prior to this, 69 homes were lost in late March at Tathra on the NSW Far South Coast. The Bureau of Meteorology found that fire danger indices experienced on the

South Coast and other parts of NSW were unprecedented at that location at that time of year (BoM 2018b). Further fires broke out in south west Sydney in July, and properties were lost when major fires broke out at Bega, Ulladulla and Port Stephens in August 2018.

It is also relevant to note that Queensland experienced its two most damaging bushfire seasons in 2018 and 2019. Many homes and other buildings were lost, and extensive areas burned including areas of sub-tropical and temperate rainforest formerly not considered prone to fire (Queensland Government 2020; BoM 2019b). In 2019 Queensland experienced almost a third of all homes lost to bushfire since records began, and more than in any previous bushfire season (Hannan 2019b). Queensland has been experiencing an ongoing trend of longer, hotter bushfire seasons, and more days of Very High fire danger and above (Climate Council 2018; BoM 2019b).

Victoria and South Australia both suffered extensive loss of life, property damage, and large tracts of bushland burned during the 2019/20 bushfire season.

Members of ELCA have observed and become increasingly concerned by the increasing *overlap* of bushfire seasons between not only Australian States and Territories, but also the northern hemisphere (Climate Council, 2019a). Over the previous century it had been well established that fire seasons started in the north and moved south, consecutively affecting different jurisdictions, thereby enabling the sharing of firefighting plant, equipment and firefighters (Luke & McArthur 1978). This was the basis of fire service operational paradigms for decades but can no longer be relied upon. Overlapping fire seasons reduce the ability of Australian fire services to defend life and property and contain major fires now and into the future, because they limit the sharing of vital personnel and equipment. The basic issue facing all fire services now is that jurisdictions cannot release resources to assist others when their own state or territory is burning – an increasingly common occurrence that reduces overall firefighting capacity when it is needed most.

Increasing overlap with northern hemisphere fire seasons is well documented (Wallace-Wells 2019). A major problem is limited access to large firefighting aircraft at the start of Australian fire seasons, because they are still being used in places like California during its extended fire season (i.e. we rely on the same pool of firefighting equipment). This has significant relevance to how the relatively small fleet of leased large firefighting aircraft (fixed and rotary wing) are shared during a crisis – reinforcing the fact that there are simply not enough to go around.

Without minimising in any way the tragic human cost of losses experienced during this bushfire season, the ecological cost has been remarkable. An estimated one billion animals perished in the fires (University of Sydney 2020). Vast, silent stretches of skeletal forests where everything, including tree canopies, were consumed by fire are testament to the ecological disaster that has occurred. It is estimated that 21% of Australia's south eastern broadleaf forests have been burned, compared to an average of 3% in any given fire season. Because of the number of days of Very High fire danger and above leading to extreme fire behaviour on multiple days, there are few unburned patches left in many areas to provide refuge for wildlife. Many of the few

animals that survived the most severe fires have likely since succumbed to starvation, injuries and predation by feral animals.

Economic costs have been very high, with an estimated $4.5 billion lost in tourism due to bushfires. The bushfire smoke that blanketed Greater Sydney is estimated to have reduced the city's gross domestic product by around $12-50 million per day (SMH 2019). About 23,000 fire-related insurance claims were lodged between November and February in NSW, Queensland, Victoria and South Australia, totalling about $1.9 billion (ICA 2020).

1.2 The core problem and what must be done

ELCA contends that we are now experiencing the real and rapidly escalating costs of failing to act on the underlying causal factor: climate change caused by emissions from the burning of coal, oil and gas.

During the bushfire season diversionary tactics were obviously deployed extensively by certain sections of the media and some politicians, to take attention away from the lack of action on climate change. These included blaming the Australian Greens and their supporters for stopping fuel reduction, blaming "arsonists" for starting the fires, and statements that "we've had bad fires like this before". Basic research quickly refutes such myths and assertions; they are irresponsible and misrepresent the factual basis upon which action must be taken to safeguard life, property and the environment and the safety of future generations. They must therefore be comprehensively refuted on the basis of evidence in the Inquiry report.

A simple analogy: when a pot on the stove boils over, there is no point trying to continually mop up boiling water: obviously, the cause of the problem – the heat source, must be dealt with. In relation to bushfires and climate change: the worldwide fire problem has reached a point where fire services can no longer cope. The "pot is boiling over" but governments around the world, with the Australian Government being one of the main recalcitrants, are resisting efforts to reduce greenhouse gas emissions.

The Federal Government has a duty to help save our firefighters and the communities who rely upon them, by dealing with the core problem that is driving disastrous bushfire seasons: by rapidly and deeply cutting greenhouse emissions, eventually enabling the risk to be reduced back to manageable levels.

The NSW Government can play a leading role in helping to better educate the Federal Government by clearly describing the risks, and demanding stronger climate action on behalf of all Australians.

2. NSW fire history

The forested coastal fringe and rangelands of eastern NSW are fire-prone and have periodically experienced serious bushfire seasons based on cycles of hot, dry weather accompanied by strong winds. Western areas have also experienced serious fires, but less frequently due to the semi-arid nature of the landscape resulting in low fuel levels during most seasons. An exception to this was the bushfire season of 1974-75 which followed unprecedented rainfall and growth of grasslands.

NSW (and the ACT) experienced serious bushfires with property losses in:

- 1915
- 1925/26
- 1926/27
- 1936
- 1938/39 (about 174 homes destroyed)
- 1944 (150 homes destroyed in Blue Mountains, Gosford and Sydney)
- 1951/52
- 1957/58 (158 homes destroyed in Blue Mountains)
- 1968 (123 homes destroyed in Blue Mountains, 33 in the Illawarra)
- 1977 (49 homes destroyed in the Blue Mountains)
- 1979 (14 homes destroyed in Sydney – northern beaches; 6 in Hawkesbury)
- 1994 (206 homes destroyed)
- 2001/02 (109 homes destroyed)
- 2002/03 (86 homes destroyed)
- 2003 (487 homes destroyed in the ACT)
- 2013 (57 homes destroyed in Coonabarabran)
- 2013 (222 homes destroyed in Blue Mountains and Central Coast)
- 2018 (69 homes destroyed at Tathra)
- 2019/20 (2,486 homes destroyed).

(Luke & McArthur 1978; NSW Parliament 2014; NSW RFS 2020c. Doogan, 2006)

Until now, large property loss events normally happened on just one or two days where the McArthur Forest Fire Danger Index was over 50, during an El Niño event often accompanied by drought, and where multiple properties were impacted at the same time in an urban fringe setting.

The 2019/20 bushfire season was remarkable in that there were multiple days of Severe, Extreme and even Catastrophic fire danger over several months, there was no underlying El

Niño event, and urban areas were not impacted. It is extraordinary and indicative of the size and extent of the fires that most property losses occurred on remote rural properties, in small villages, and on the outskirts of regional towns. Based on records going back to 1950, NSW experienced 21 days of Very High fire danger and above during the spring of 2019, eclipsing the previous record of 11 days recorded in spring 2002, and a long-term average of just 2 days (BoM 2020d). There were 59 Total Fire Ban declarations, 11 statewide total fire bans, and 44 bushfire emergencies declared under s.44 of the Rural Fires Act (NSW RFS, 2020c).

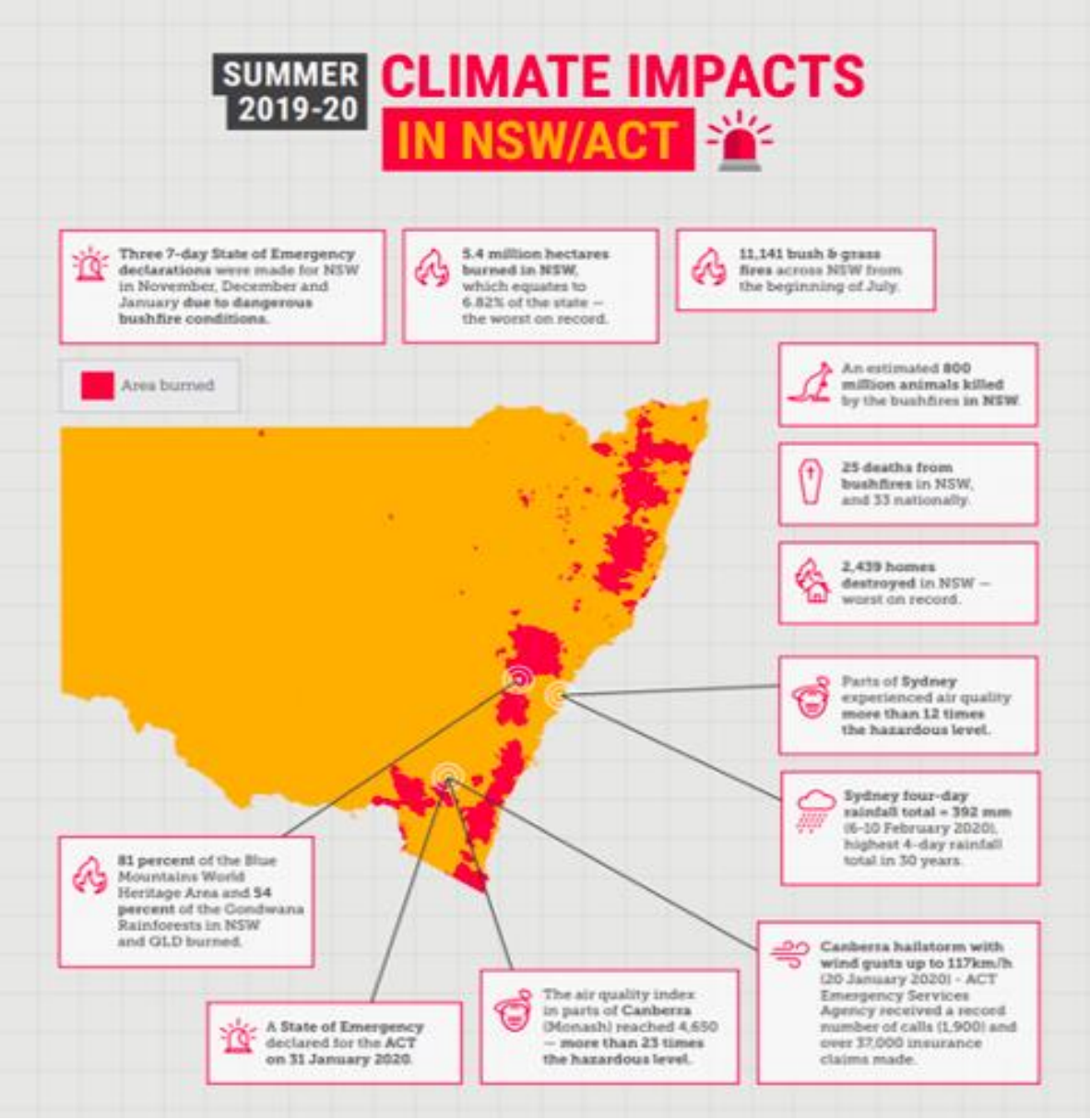

Figure 1: Summer 2019/20 climate impacts in NSW. Source: Climate Council (2020a).

3. Climate change and the 2019/2020 bushfire crisis

3.1 How climate change aggravated the 2019/2020 bushfire crisis

The ongoing drought coupled with increasing periods of extreme heat, both aggravated by climate change, set the scene for the catastrophic fires in the summer of 2019/20. The bushfire season started in winter and was the worst on record for New South Wales in terms of its intensity, the area burned, and the number of lives and properties lost.

Bushfires rely on five main factors to take hold and spread: high temperatures, low rainfall, low humidity, strong winds and a suitable fuel source. 2019 was the hottest year on record across Australia with mean temperature 1.52°C above average and mean maximum temperature 2.09°C above average (BoM 2020a. BoM 2020b) (see Figure 2 below).

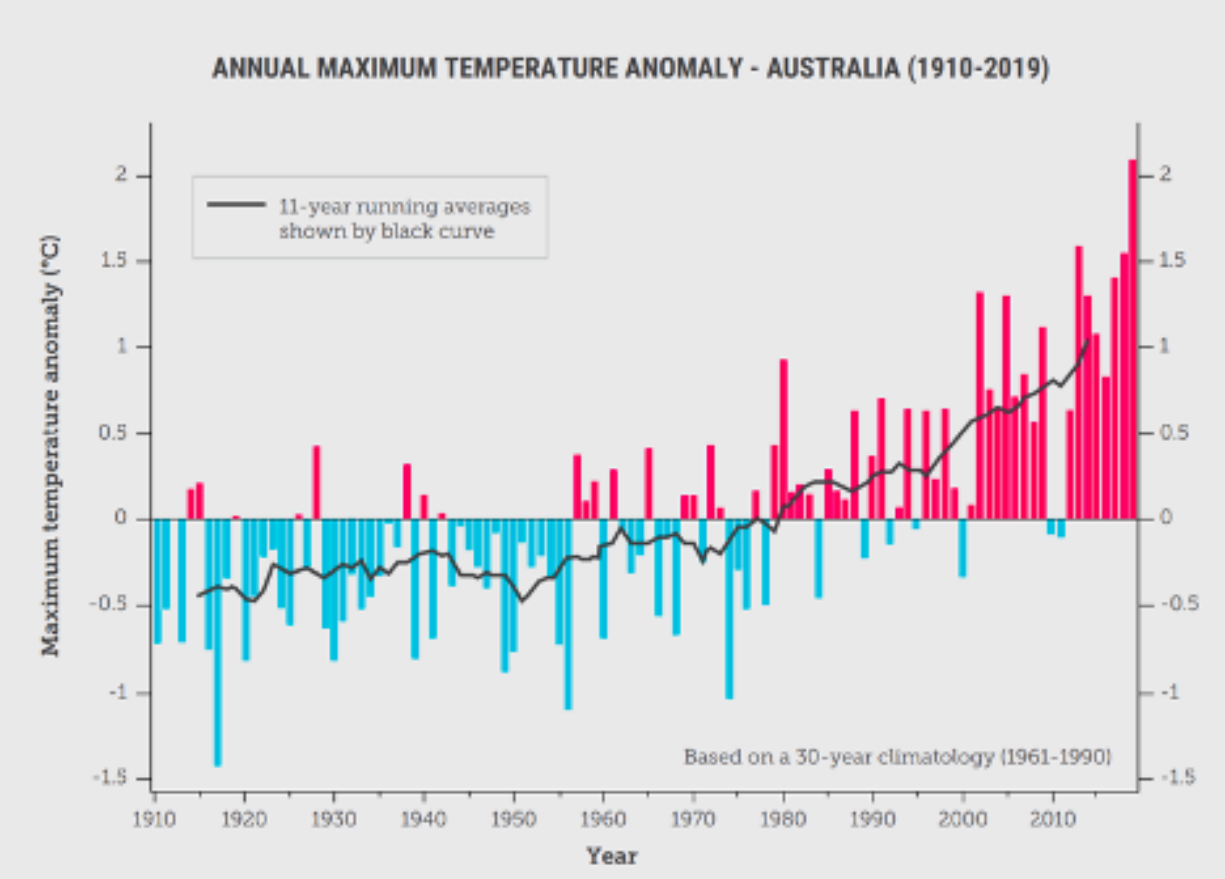

Figure 2: Annual maximum temperature anomaly Australia (1910 to 2019). Source: BoM (2020a).

It was also the driest year on record across Australia with rainfall 40 percent below average (BoM 2020b). For the January to October period, rainfall was 70 to 80 percent below average in

some locations in northern New South Wales (BoM 2019a). The dry conditions throughout the year came on the back of prolonged rainfall deficiencies across most of southeastern Australia, including NSW, since the beginning of 2017, underpinning one of the worst droughts on record (Figure 3 below shows the 2018 to 2019 rainfall trends).

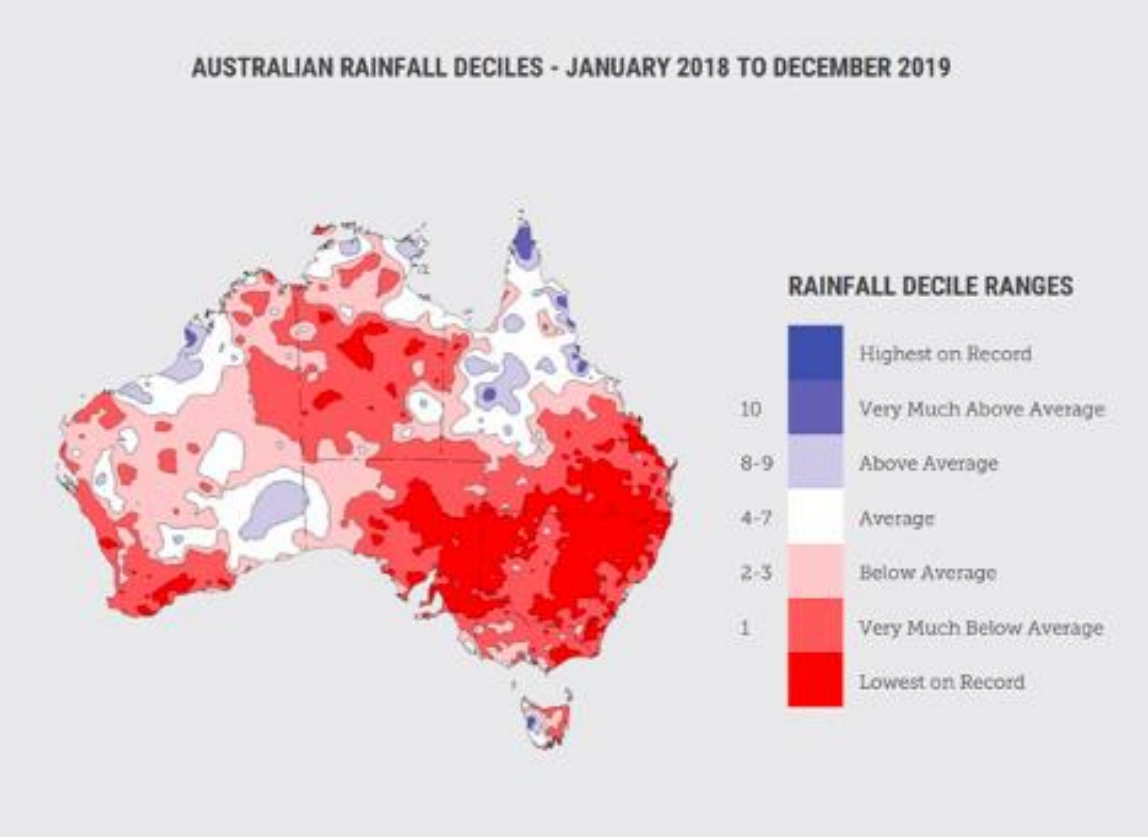

Figure 3: Australian rainfall deciles – 1 January 2018 to 31 December 2019. Source: BoM (2020b)

In eastern Australia, the prolonged dry conditions over the year contributed to drying out vegetation, making it more flammable, and creating the perfect conditions for fires to take hold and spread quickly given a source of ignition and the right weather. Prolonged heat also increased evaporation, further exacerbating soil and vegetation dryness and increasing the amount of "available fuel" which in turn added to fire intensity, convection, spotting distances, and intensity of ember attack. Unsurprisingly, the annual accumulated McArthur Forest Fire Danger Index (FFDI) was the highest on record in 2019 (measured since 1950) (BOM 2020e).

Australia's climate has warmed by more than 1°C since 1910 (CSIRO and BoM 2018). Every year since 2013 has been amongst the ten hottest years on record for Australia, with only one of the ten hottest years (1998) occurring before 2005 (BoM 2020c). Cool season rainfall has also been declining across southern Australia over recent decades. In the southwest of Australia, May-July rainfall has decreased by around 20 percent since 1970 and in the southeast, April-October rainfall has decreased by around 11 percent since the 1990s (CSIRO and BoM 2018). These

trends have contributed to an increase in the length of fire seasons and to the severity of dangerous fire weather across large parts of the continent (CSIRO and BoM 2018).

Although the El Niño–Southern Oscillation, commonly a driver of serious bushfire seasons in eastern Australia remained neutral throughout 2019, a very strong positive Indian Ocean Dipole also contributed to low rainfall across Australia over the past year, building upon longer-term rainfall deficiencies in eastern Australia since the beginning of 2017. Apart from 2013, all previous major bushfire seasons in NSW with heavy losses of property occurred during El Niño events, but climate change is increasingly swamping the influence of natural variability (Gergis and Carey 2020). This should be of significant concern – when an El Niño inevitably returns, it is likely to result in elevated temperatures and reduced rainfall, so the prospect of an even more disastrous NSW bushfire season at some time in the future is likely.

As the climate continues to change, bushfire seasons are starting earlier and lasting longer. Twenty-one local government areas in New South Wales commenced their Bushfire Danger Period in August 2019, and a further 53 local government areas commenced their Bushfire Danger Period in September (NSW RFS 2019a). These declarations were in contrast to the statutory Bushfire Danger Period in New South Wales, which officially spans from 1 October to 31 March. Commencement of serious bushfire weather and outbreaks of serious fires from August in New South Wales has become common in recent years.

The bushfire season in New South Wales was well established by early spring 2019. Across Australia as a whole, the worst ever spring fire weather danger, as measured by the FFDI, was observed, with record high values in areas of all states and territories (BoM 2020c). Catastrophic fire danger ratings (FFDI above 100) were recorded at some locations in New South Wales on 6 September, which marked the onset or spread of numerous large fires in eastern Australia. Catastrophic, the highest fire danger rating, was introduced after the 2009 Black Saturday fires to describe “off the (McArthur) scale” fire danger indices (i.e. an index over 100). Fires that occur in catastrophic conditions cannot be fought safely, and lives and homes are put at great risk. Fire authorities recommend that people “leave early” when such conditions are forecast.

In most districts of northeast New South Wales, 6 September 2019 had the highest regionally averaged daily FFDI for September, based on all years since 1950 (BoM 2019b). Numerous bushfires burned across southern Queensland and northern New South Wales over the 5-9 September period, destroying several homes. On October 26, the Gospers Mountain fire was ignited by lightning in the Wollemi National Park. The fire burned through more than 512,000 hectares throughout November, December and January, making it the largest forest fire ever recorded in Australia (see Figure 4). It was eventually extinguished by heavy rains in February.

Figure 4: Firefighters confront the Gospers Mountain Fire as it impacts a structure at Bilpin, Saturday, December 21, 2019. Source: AAP Image/Dan Himbrechts.

In late spring, catastrophic fire danger ratings were again experienced at locations and times of the year never before recorded. From 8 November, fire conditions flared in the Clarence Valley in New South Wales, destroying hundreds of homes across the region. For the first time since the catastrophic fire danger rating was introduced in 2009, it was forecast for Greater Sydney on 12 November 2019 (NSW RFS 2019b). A seven-day State of Emergency was declared for New South Wales. A number of fires started in Lane Cove National Park and quickly reached emergency warning level, threatening homes in Turramurra. Despite atmospheric stability readings (cHaines index[1]) indicating that it would be very unlikely, several fires created their own weather systems and *pyrocumulous* clouds on that day, leading to very rapid fire spread, long-distance spotting, and intense fire conditions. Catastrophic fire conditions were also forecast in numerous places in South Australia on 20 November and parts of Victoria on 21 November 2019 (catastrophic conditions are known as Code Red in Victoria).

3.2 Climate change driving an increase in extreme bushfire events

Climate change could be driving an increase in the occurrence of extreme bushfires in Australia (Dowdy & Pepler 2018; Dowdy et al. 2019; Climate Council 2019c). Bushfires can transition to

[1] The Continuous Haines (C-Haines) index can be used to predict unstable atmospheric conditions that can contribute to the development of pyrocumulonimbus (pyroCb) events (fire-caused storms). The C-Haines Index combines measures of the vertical rate of change in air temperature and the change in moisture content of the lower atmosphere to provide a score out of 13. A high C-Haines index value indicates an unstable atmosphere that may favour pyroCb formation.

more extreme events such as pyroconvective interactions (when fires burn in close proximity and influence each other, spreading faster and in unpredictable ways) and pyrocumulonimbus events (fire-generated storms). Extreme bushfires have a high level of energy, and exhibit chaotic and unpredictable behaviour, making them harder or impossible to control, and more dangerous to both firefighters and communities (Sharples et al. 2019).

Fires that burn in close proximity can influence each other; this is due to pyroconvective interactions between individual fires. Commonly this is seen when intense spotting (when embers from a primary fire are blown downwind and ignite new spot fires) causes many fires to form, rapidly expand, and coalesce. As the primary fire and spot fires interact, local rates of spread can increase, sometimes in unexpected directions. This can result in broad "flaming zones" which can entrap firefighters and increase the likelihood of fire-generated storms (Sharples et al. 2019). Pyroconvective conditions are more likely to occur when atmospheric instability is high, combined with dangerous near-surface conditions; i.e, low humidity, strong winds and high temperatures (Dowdy & Pepler 2018; Climate Council 2019c). Modelling suggests that the increased risk of extreme fire weather events under the influence of climate change may lead to increased incidence of pyro-convective fire behaviour. Australia has already seen an increase in these events with the 2003 Canberra bushfires, 2009 Back Saturday bushfires and the 2019/2020 fire season, all providing examples of pyrocovective events (Dowdy & Pepler 2018; Dowdy et al. 2019; Climate Council 2020a).

Pyroconvective events (fire-generated storms) occur when bushfires couple with the atmosphere, generating explosive thunderstorms that can include strong downdrafts, lightning and even black hail, making bushfire behaviour very unpredictable. These storms are often "dry" and do not produce any useful rain. One of the features of this extreme bushfire season has been an increase in the number of fire-generated storms. Pyroconvective events were previously considered rare, with Australia experiencing only two confirmed and two possible fire-caused storms between 1978 and 2001 (McRae et al. 2015). Since 2001, 78 fire-caused storms have been recorded, including a staggering 33 percent increase in 2019 (with around 15 fire-caused storms in the Victorian high country in March 2019 alone). Fire researchers estimate that an additional 30 fire-caused storms have occurred since September 2019, with a further 15 fire-caused storms being investigated (The Guardian 2019). This represents an astounding shift in the frequency of these events. Veteran firefighters, including members of ELCA, have limited experience of such conditions, and established firefighting doctrine does not adequately consider the dangers and variables associated with pyroconvective activity.

In December 2019, more than 2000 bush and grass fires burned throughout the month in New South Wales, and other significant fires broke out in South Australia, Tasmania and Victoria. From 12 December, a slow-moving hot air mass developed over western Australia and started to move from west to east across the country. This resulted in a series of days above 40°C in Perth from 13-15 December and then a swathe of broken records for daily December maximum temperatures in locations across South Australia, Victoria, ACT and New South Wales, southeast Queensland, Central Australia, and much of Tasmania. For a number of locations, records were set for the warmest day for any time of the year, and on two consecutive days (17 and 18

December) records were broken for the national area-averaged maximum temperature (40.9°C and 41.9°C respectively) (BoM 2020b). Heavy smoke blanketed Sydney, especially throughout December, as the Gospers Mountain Fire burned out of control. A recent report estimates that up to 417 early deaths occurred as a result of particulates contained in bushfire smoke over the summer (Arriagada et al. 2020). This figure could be higher, as we don't yet know the long-term contribution to morbidity and mortality from the intense and chronic exposure over summer

As the heatwave arrived on the east coast, catastrophic conditions were again forecast for the Greater Sydney Region (the second time this has ever occurred), marking the beginning of another seven-day State of Emergency for New South Wales from 19 December. The week ending 24 December 2019 was Australia's hottest week on record, and the month as a whole was Australia's hottest December on record (3.21°C above average, surpassing the previous December record set in 2018 by more than a full degree). It was also the hottest month on record for minimum and maximum temperatures, with the national maximum temperature an astounding 4.15°C above average. The monthly accumulated FFDI was also the highest on record for any month since records began in 1950 (BoM 2020a).

The end of 2019 and the first days of 2020 brought particularly extreme fire weather to southeastern New South Wales and eastern Victoria, with numerous locations recording their warmest January day on record on 4 or 5 January across southeastern Australia. Bushfires flared on New Year's Eve 2019, hitting many small towns on the south coast of New South Wales, destroying hundreds of houses including around Batemans Bay, Mogo, Lake Conjola and Cobargo and tragically killing nine people. In an unprecedented move, the New South Wales Government issued evacuation orders for the south coast prior to New Year's Eve, a commendable decision that almost certainly saved many lives. Another seven-day State of Emergency was declared from 3 January 2020 for New South Wales. From 27 January until the end of the month, a very hot air mass brought high temperatures to southern Australia. On 31 January, as temperature records were broken in locations across New South Wales, Victoria and Tasmania, a State of Emergency was declared in the Australian Capital Territory as the Orroral bushfire grew to eight percent of the territory's land area, threatening homes and properties there and in New South Wales (ACT Government 2020).

ELCA submits that the evidence is irrefutable – climate change caused by the burning of coal, oil and gas super-charged the 2019/20 bushfire season. It is not possible to "adapt" to such catastrophic conditions and they can only be partially mitigated. There needs to be a clear understanding within the community, media and within all levels of government that the base cause of extreme weather leading to natural disasters must be addressed through rapid and deep cuts to greenhouse gas emissions.

Recommendation 1: The Inquiry Report should clearly acknowledge and explain that the 2019/20 bushfires were the worst in NSW history, that they were driven by unprecedented extreme weather and fire danger indices on multiple days, by cascading events including drought, heatwaves, dry thunderstorms, and an unprecedented number of pyroconvective events. The Report should clearly acknowledge and explain for the historical record that it is irrefutable that climate change was the main driver of the unprecedented 2019/20 bushfire season.

Recommendation 2: The Inquiry Report should explain how climate change has resulted in the NSW bushfire season lengthening, and overlapping with other states and territories, limiting the ability of Australian firefighting agencies to assist each other. Increasing overlap of fire seasons between the northern and southern hemispheres is limiting the availability of large firefighting aircraft, particularly between August and November each year.

Recommendation 3: The NSW Government should, in recognition of the now established pattern of longer bushfire seasons, amend S.81 of the Rural Fires Act 1997 to change commencement of the annual Statutory Bushfire Danger Period to 1 August each year, concluding on 30 April in the following year, replacing the current Bushfire Danger Period from 1 October to 31 March, in order to help prevent fires and increase the need for fire permits. Alternatively, change the Act and adopt the Tasmania Fire Service approach whereby the Commissioner makes a determination each year of the commencement and conclusion of the bushfire danger period, based on current assessed risk.

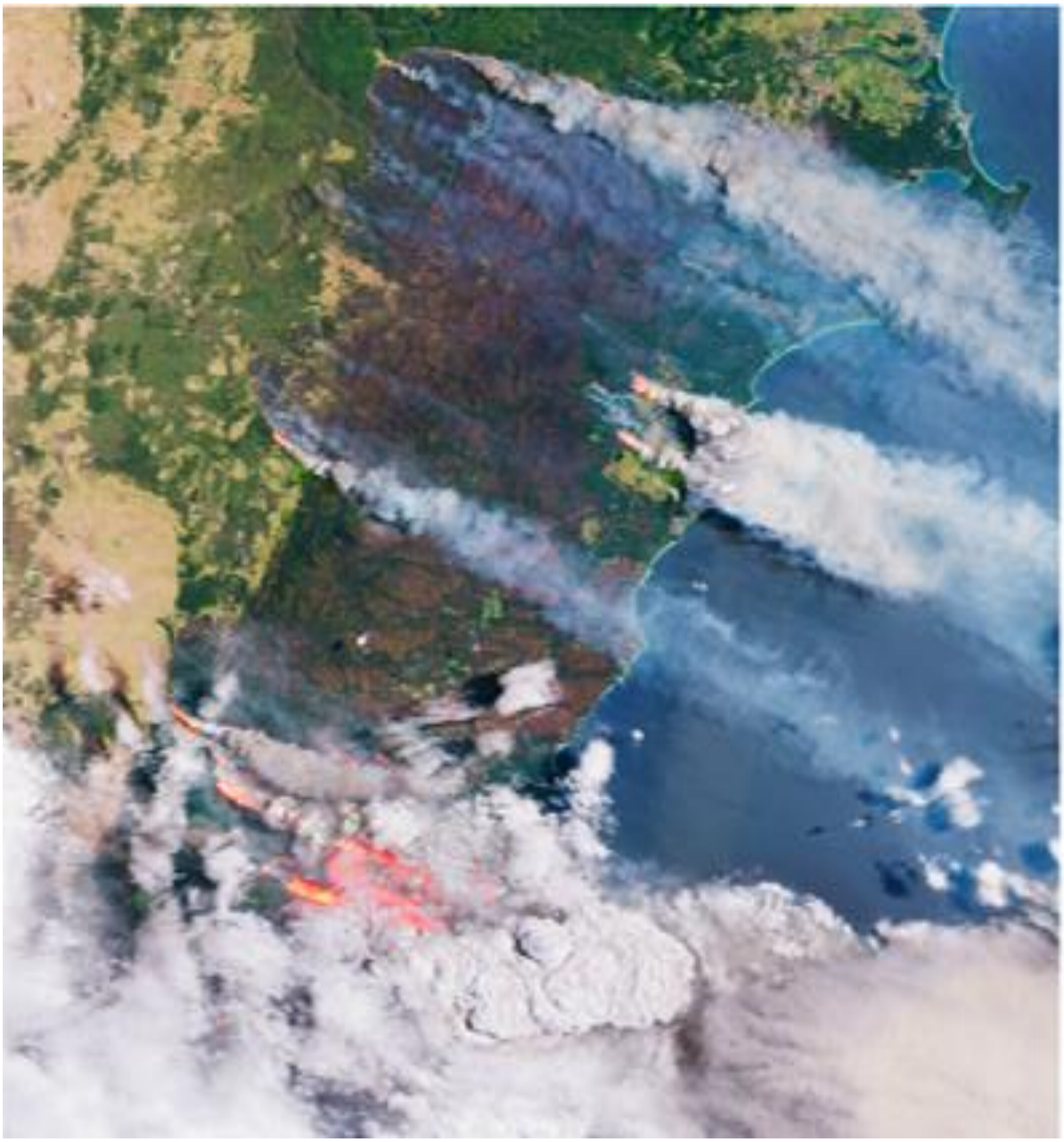

Figure 5: Aerial photo showing fires burning on the east coast of Australia, 31 December 2019. Source: ESA (European Space Agency) Image/EPA. Contains modified Copernicus Sentinel data (2019). License: CC BY-SA 3.0 IGO.

3.3. Fire risk will continue to escalate without genuine and sustained efforts to tackle climate change.

Climate change has fuelled the extreme weather we experienced in summer 2019/20. The severity and frequency of these extreme weather-driven events – including bushfires and

smoke – will continue to increase in coming decades, with commensurate increases in costs, due to the greenhouse gas emissions that have already been emitted and continue to emit. If Australia fails to take strong action to rapidly phase out coal, oil and gas as part of a global effort, the impacts of climate change, including worsening bushfire conditions, will continue to escalate.

Australia urgently needs a plan to cut domestic greenhouse gas emissions to net zero and to phase out fossil fuel exports, because we are one of the world's largest polluters. We are the 14th largest emitter of greenhouse gases globally and emit more per person than any other developed country. We are also the third largest exporter of fossil fuels (The Australia Institute 2019).

What Australia, including New South Wales, does matters. The longer we delay the harder the problem will be to solve. We cannot call on other countries to take strong climate action if we fail to do so. Morally, it is not right to leave this emerging disaster for our children and grandchildren to try to fix.

As Australia continues to face a worsening bushfire threat, it will be critical for there to be a clear forward plan for how the Federal and the NSW State Governments will support relevant emergency services and fire management agencies, coupled with strong federal policy to rapidly tackle the root of the problem - climate change.

Recommendation 4: Strong climate mitigation and adaptation policies are required from all levels of government including the New South Wales State Government, to start to address the escalating bushfire and natural disaster risks driven by climate change, the root cause of worsening extreme weather. NSW must accelerate and increase measures to tackle climate change. More substantial action is required to reduce Australia's emissions, including accelerating the transition to renewables and storage technologies, non-polluting transport, infrastructure, food production and the phase out of fossil fuel projects. The NSW Government must continue to step up to strengthen its climate policies and local government must continue to meet and beat emission reduction goals and renewable energy targets. Some of these climate impacts are already locked in, and all levels of government will play a critical role in building community preparedness and resilience.

4. Research capability to inform and protect fire and emergency services

Over the last decade or more, the Bushfire Cooperative Research Centre, then its successor, the Bushfire & Natural Hazards Cooperative Research Centre (CRC) have driven, in consultation with fire and emergency services and their peak council, the Australasian Fire & Emergency Service Authorities' Council (AFAC), ground-breaking research into bushfires and natural disasters. The research has enhanced understanding of the effects of climate change and changing risk patterns, informing development of strategies to adapt to and mitigate risks as far as possible. Practical applications of the research extend to areas as diverse as cabin protection systems for fire trucks, personal protective uniforms, and decision-making processes for command staff.

The Australian Government recently confirmed during Senate Estimates in Canberra that the Bushfire & Natural Hazards CRC would not be funded past 2021 (SBS 2020). This potentially removes critical research capabilities at a time of accelerating change and could leave fire and emergency services without the necessary knowledge and evidence base to further improve and develop fire prevention and suppression capabilities and strategies, or to prepare and inform communities.

Withdrawal of federal funding is not confined to the CRC. The CSIRO and Bureau of Meteorology (BoM) have each had funding for climate change research reduced. BoM plays a critical operational role in helping emergency services prepare for floods, cyclones, heat waves, storms, and fires. Their suite of predictive capabilities requires ongoing investment as does their organisational capability to deliver prompt expert advice. ABC local radio has adopted the role of National Emergency Broadcaster, yet the ABC is facing increased budget cuts. These cuts have a direct impact on the people, governments and emergency services of NSW.

Recommendation 5: The NSW Government should demand that the Federal Government maintain funding and support for an ongoing research capability given the imminent cessation of funding in 2021 for the Bushfire & Natural Hazards Cooperative Research Centre. Research is crucial to understanding and tracking escalating natural disaster risks, and enabling fire and emergency services to plan and prepare for worsening conditions. An evidence-based ability to track and predict escalating risks driven by climate change must underpin the development of national and state resilience, adaptation and mitigation strategies, funding needs for community education and engagement, and enhanced resourcing of emergency services.

Recommendation 6: The NSW Government should demand that the Federal Government ensure critical government research agencies have funding restored. This includes agencies such as the Bureau of Meteorology (BoM), the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and ABC Local Radio as the national emergency broadcaster. These agencies must be sufficiently resourced to improve predictive capabilities, understand effects of climate change on natural disasters now and into the future, and be able to warn and alert communities and emergency services in a timely, comprehensive manner.

5. Fuel management and prescribed burning

5.1 Hazard reduction and the 2019/20 fires

During the 2019/20 fires and previous fire seasons in Australia there has been considerable misinformation regarding the role of hazard reduction burning, sometimes suggesting that it is a "silver bullet" capable of preventing the massive losses. This has clouded debates in the media and political discussions and reduced the ability of the public to understand what is actually happening and why.

The NSW Rural Fires Act 1997 defines hazard reduction as "the controlled application of appropriate fire regimes or other means for the reduction or modification of available fuels within a predetermined area to mitigate against the spread of a bushfire." This is commonly interpreted to mean prescribed burning, which is the application of fire under controlled conditions. But the "appropriate fire regime" for a site actually depends upon the response of a specific vegetation type to fires of different timing and intensity, and the ways that this affects the flammability of the site. Hazard reduction can therefore range from burning operations through to intentionally not burning some areas (fire exclusion), provided that this regime reduces or maintains the vegetation in a state of reduced flammability. It can also involve other methods such as mechanical clearing of fire breaks or thinning of vegetation, which is labour intensive and cannot be practically carried out over wide areas. The goal of hazard reduction is not to produce areas that will not burn, but areas that will burn at a lower intensity and therefore, be controlled more easily by firefighters (Climate Council 2020b).

Hazard reduction burning plays a vital role in fire management, however it is not a panacea and current strategies could prove to be increasingly ineffective as windows to conduct prescribed burning reduce due to hotter, drier weather, extending into the cooler seasons as a result of climate change. It is very clear that the 2019/20 bushfires' destructive capabilities were driven more by extreme weather than by fuel.

Logically, with better home construction, better planning standards, better water supplies, fire agencies resourced to unprecedented levels including an array of aerial firefighting assets, people might be forgiven for thinking that no fire could surpass the size and destructive potential of fires in the past. However, this view fails to take into account the unprecedented fire weather experienced in all its facets in 2019/20. Firefighting arrangements are no match for nature in all its fury; especially in a super charged climate with worsening extreme weather and longer, more intense bushfire seasons. This has also been the case in California, which has a significantly larger firefighting resource base than Australia. In 2017 around 10,000 homes were lost in California, with nearly 19,000 homes and 100 lives lost in 2018 (CalFire 2020).

The NSW fires burned more than 5.52 million hectares including areas of heavy fuel, light fuel, pasture, farmland, and areas that had been hazard reduced within the last 3 years. Even people's mown lawns burned. Because of the temperature, wind velocities, low humidity and fuel dryness, during days of Very High fire danger and above areas of light fuel were unlikely to slow the progress of fires, although it must be noted that they did reduce fire intensity, a useful factor close to assets and people. On the worst days when pyrocumulonimbus clouds formed above fires, spotting distances of 8-12 kilometres were recorded, reducing the effectiveness of hazard reduced areas, and eliminating the effectiveness of fire breaks.

Claims that the Australian Greens and their supporters stopped hazard reduction burning are completely unfounded– the Greens are not in Government and cannot enact legislation.

5.2 Limitations of hazard reduction

Whilst hazard reduction burning is a vital way of preparing for bushfires, there are a number of limitations. Firstly, hazard reduction can have very little effect on the spread of fire in severe, extreme, or catastrophic fire danger conditions. This is particularly evident in eucalypt forests where spot fires start ahead of the main fire front due to burning leaves, twigs and bark being carried up in convection columns then deposited in unburned bush by strong winds. In the 2019/20 fires, on the worst days, spotting was recorded as occurring 8-12 km ahead of the main fire fronts. As dangerous bushfire weather increases in frequency and intensity due to climate change, the effectiveness of current hazard reduction burning strategies is likely to diminish.

The window of opportunity for conducting safe burns has become much shorter due to higher temperatures, drier conditions, and fewer days of low/moderate fire danger outside the bushfire season, yet another change driven by climate change (Earth Systems and Climate Change Hub 2019). Even though prescribed burning is becoming more difficult to carry out safely, the rate of burning in New South Wales – where the recent bushfires have been most destructive – has actually increased, rather than decreased as has been falsely reported (Broome et al. 2016).

It needs to be clearly understood that the most significant factor in the 2019/20 bushfire season was extreme weather. NSW recorded its worst fire danger indices in recorded history on multiple days. With large areas already burning and most of the fires caused by lightning, on days of Severe, Extreme and Catastrophic fire danger there was little that firefighters could do. Areas of reduced fuel made little difference to fire spread on the worst days (Climate Council 2020b).

5.3 Issues in fuel management

Of all the factors that contribute to the intensity of a fire (temperature, wind speed, topography, fuel moisture and fuel load), only fuel load can be easily modified by human effort (but bearing in mind that since the industrial revolution it is now clear that humans have also modified the world's temperature, and action on emissions may eventually assist to bring this down). As a key element in mitigating the effects of future fires, benchmarks need to be developed for funding requirements of fire, emergency and land management agencies in NSW so that they can conduct increased, targeted fuel reduction works, and have operational capabilities (people, equipment, infrastructure) commensurate with increasing risks and strategic fuel management requirements. A suitable reporting and auditing framework should be integral to this work.

A cause of significant frustration in some regional areas in Queensland and NSW has been the transfer of grazing lands to national parks in some areas over the years, without a commensurate increase in resources for national parks agencies so that the land, including fuel loads, can be properly managed. It is likely that due to expansion of the national park estate and reductions in the NPWS workforce over the decades there are proportionally less park rangers to manage the increased national parks estate than there were 20 years ago.

Every fire season gives rise to questions and criticisms relating to the management of public land. Some 15% of the total land area of NSW is in public ownership. The public lands are managed by four separate agencies, the National Parks and Wildlife Service, Crown Lands, Forests NSW and Local Land Services. Each agency manages its section of the public estate in accordance with the provisions of specific legislation, in which specific management objectives are defined. The collaboration demonstrated by land management agencies as members of the NSW Bush Fire Co-ordinating Committee suggests that even more could be achieved with a legislated overarching framework for coordinated management of all public land in NSW. Such a framework, modelled on the existing Marine Estate Management Authority could make cross tenure collaboration routine, provide for specifically allocated resources to be targeted to priority areas regardless of tenure, and ensure that identified site values are identified, monitored and protected or enhanced.

ELCA holds the view that hazard reduction efforts must increase, but in a targeted and ecologically responsible manner. For example, in the past simple hectare and area percentage

targets have resulted in perverse outcomes such as broad area burning in remote areas where there is no benefit to asset protection.

The Victorian experience and Sydney experience must also be taken into account: if there are increased requirements to burn, governments must be prepared to accept the inevitable backlash when controlled burns become uncontrolled and escape. In Victoria this resulted in a reluctance to continue burning programs and a risk averse approach, arguably resulting in increased fuel loads. In Sydney, regular temperature inversions during the cooler months can trap smoke from hazard reduction burns, causing health issues and inconvenience. If increased burning takes place there will be a need for the government to stare down complaints against the inevitable by-products – smoke and fire escapes.

In the new climate reality Australia now faces there may need to be a focus on more frequent burning close to settlements and assets in order to create permanent fuel-reduced zones. There may also be a need for more focus on increased use of “cool burns” over larger areas.

5.4 A state-wide approach to bushfire risk management incorporating hazard reduction

Currently in NSW, strategic bushfire risk management is undertaken at a District level and is based simply on a bush fire risk management plan template that was last revised in 2008. There is no strategic state-wide approach for bushfire risk management to serve as a guide for the development of district plans. The State Bush Fire Plan is a sub-plan of the state emergency management plan (EMPLAN) and is primarily an operational document that defines roles and responsibilities during S44 (of the Rural Fires Act) bushfire emergencies, and does not provide a state-wide strategic approach to bushfire risk management.

An opportunity now exists to develop a state-wide strategic bushfire risk management plan incorporating a cross-tenure approach to the development of hazard reduction strategies as part of a holistic approach to reducing bushfire risk. Such a plan would provide a state-wide framework for lower level planning (i.e. district plans, village and community protection plans, Fire Access and Fire Trail Plans etc), preparedness, response and recovery strategies (across the PPRR framework). Such a plan would outline the approach to bushfire prone land mapping, bushfire zoning, guidelines for treatment, ignition management, performance measures, guidelines for cultural burning, community resilience and greater community engagement etc.

The current NPWS Living with Fire Strategy (OEH, 2012) and an approach currently under development in Victoria could be used as possible models for this state-wide plan. The involvement of the BFCC in endorsing the Plan could be considered as an amendment to Part 3 Division 2 of the Rural Fires Act 1997. Such a plan would necessarily need to acknowledge climate change as a major driver in the development and review of PPRR strategies, something

which at present is conspicuously and disappointingly absent.

A more focussed approach to hazard reduction programs as part of a cross-tenure approach to risk reduction is critical. A greater focus on reducing risk on private property seems appropriate given the high number of confirmed complaints that are lodged with the RFS against private property holders. A well-known adage in the fire services is: “If you own the land, you own the fuel.” Despite the NSW Rural Fires Act having provisions to enforce reduction of bushfire fuels on private land (S.66), in practice it appears that this is not widely enforced. Arguably, before the onset of each bushfire season, there should be a concerted effort to ensure the proper management of bushfire fuels on private land. There was much speculation and debate during the recent fires about fuel loads on publicly managed lands. However, the greatest impact on fire intensity and ember load immediately adjacent to a structure is usually the amount of effort put into managing fuel loads between the back door and back fence line.

There is a good opportunity as part of this Inquiry to investigate the expansion of worthwhile programs which focus efforts on reducing hazards in asset protection zones and strategic fire management zones. These programs might include greater emphasis on S.66 and S.70 of the Rural Fires Act (fire hazards on private land), expansion of the FRNSW community fire unit program, the RFS AIDER (Assist Infirm, Disabled and Elderly Residents) program and the expansion of the NCC / RFS Hotspots Program.

In reviewing hazard reduction treatments, an excellent opportunity exists to better engage and support regional Aboriginal organisations and businesses in fire management and reafforestation projects to achieve both social justice, regional economic impacts and climate change mitigation and adaptation outcomes. There are already some good examples of Aboriginal organisations (eg Muru Mittigar in Western Sydney) which could benefit from greater Government support through the adoption of preferential procurement policies for bushfire risk reduction on government tenures.

5.5 Cultural burning practices

Cultural burning practices can no longer be ignored. Traditional owners in some areas still conduct cultural burning, and in others, attempts are being made to re-learn and resurrect former practices. This is highly worthy of support, research, and necessary funding.

Concepts surrounding cultural burning are complex and inter-related. People who live on and have a deep connection with Country develop knowledge of the interactions of weather, fuel types, topography, animals and people. They generally light “cool” fires when they can be easily controlled.

It is simplistic to conceive of cultural burning as simply an alternative burning technique that can be taught to firefighters and land managers – it involves a deep, spiritual connection to Country and deep understanding of the interactions of ecosystems. According to cultural burning expert, Victor Steffensen, "Maintaining the health and diversity of all the ecosystems with and without fire is key to protecting and serving our animals into the future. Burning the country to look after it this way takes more time and effort than any other modern fire management techniques" (Steffensen 2020). The techniques are very sophisticated and present not only an opportunity to heal the land, but to engage and respect Traditional Owners by assisting them to apply and further develop and share their knowledge.

Recommendation 7: That the NSW RFS place greater emphasis on the appointment of hazard management officers in accordance with S.65A of the Rural Fires Act 1997 in order to better manage fuel loads on private land. In the 2 months preceding the onset of each bushfire season, concentrate on identifying and requiring management of hazardous fuel loads on private land, where necessary issuing bush fire hazard reduction notices under S.66 of the Act, then carrying out works and recouping costs from owners under S.70 of the Act. Each RFS District should be required to submit a pre-season plan identifying localities of particular focus and provide fortnightly returns of the number of notices issued, and number of works carried out under S.70.

Recommendation 8: Amend the Rural Fires Act 1997 so as to require the BFCC to develop a 10 year state-wide strategic bushfire risk management plan which incorporates a holistic and cross tenure approach to bushfire risk management acknowledging climate change impacts on future fire frequency and intensity. This focus on intensifying fire seasons should guide the development of district bush fire risk management plans, NSW fire authority strategic bushfire plans, research priorities, hazard reduction programs, bushfire zones, and performance measures.

Recommendation 9: Enhance those programs which focus bushfire risk reduction effort on asset protection and strategic fire management zones including the FRNSW Community Fire Unit Program, the RFS AIDER program, the RFS / NCC Hotspots Program and examine further opportunities for engaging Aboriginal Corporations in cultural burning and firefighting, pest management and restoration programs on Country.

Recommendation 10: Research is needed to help develop new policies that recognise the need for better asset protection, shrinking windows available for controlled burning due to a warming climate, the need to fund and research cultural burning practices, and the need to avoid perverse outcomes, such as burning large tracts of land remote from assets in order to meet arbitrary percentage or hectare targets. There needs to be recognition that hazard reduction will be less effective during extreme weather events that result in long distance spotting, intense and sustained ember attack, and pyroconvective fires. As a result, fuel reduction strategies will need to better integrate with fire suppression, community education, hardening of infrastructure, and other measures. Fuel reduction is one of the only ways to reduce fire intensity and therefore must be a major part of any mitigation strategy.

6. Use of Australian Defence Force capabilities

Climate change is placing increasing pressure on the Australian Defence Force (ADF) in three key areas.

Firstly, climate change increases the need for the ADF to respond in Humanitarian Aid and Disaster Relief (HADR) and Defence Aid to Civil Community (DACC) capacities. This is occurring internationally, regionally (Indo-Pacific), and domestically. For example, from 2005-06 to 2012-13 Defence assisted in 275 domestic emergencies, with this number likely to be higher (ANAO 2014). The ADF support to the 2019/20 bushfires (Operation Bushfire Assist) saw the largest peacetime deployment of the ADF involving more than 6,400 personnel, including 2,500 reservists, 350 international service personnel, and more than 13 fixed wing aircraft, 20 rotary wing platforms and 2 naval vessels (AusDoD 2020).

Secondly, and closely coupled with the increase of HADR / DACC missions, climate change will require changes to ADF force structure, training, doctrine, planning, interoperability, and other inputs to capability. Operation Bushfire Assist provided numerous lessons learnt. For example, the need to include improved pre-crisis scenario planning with state government authorities (especially around how to best integrate and connect ADF units with local authorities);

improvements in inter-agency communications for 'on-ground units' between the ADF and emergency services and clarity around call-out procedures between Federal and State governments. Climate change will also drive careful consideration by the ADF regarding the types of capability that are needed for future operations in a world increasingly shaped by climate change impacts. Better consultative processes with states and territories and emergency services could help shape future strategic capability enhancements and procurements, with an emphasis on interoperability and complementarity

Thirdly, as recognised by the Chief of the Defence Force, General Angus Campbell, climate change will increasingly drive a fundamental re-think of Australia's key national security drivers and how—as a country—we need to confront the 21st century security dynamic (ABC 2019). ELCA suggests that this will require a much broader approach to future White Papers to embrace wider and deeper concepts of security, including a consideration of climate change and its impacts, such as more frequent natural disasters that are increasingly stretching or overwhelming state and territory capabilities to respond and recover. In the interim, acknowledgement of the increased pressure that climate change will place on the ADF, as well as a plan for how the ADF will support relevant emergency services and recovery agencies in the future, must be acknowledged in key Defence policy and planning documents. This includes any assessment of the strategic underpinnings of the 2016 Defence White Paper, reviews of how the ADF can be more responsive to changing circumstances, and updates to the DoD's force structure plan (The Australian 2019; Hellyer 2019).

Fire and emergency services are not advocating for development of a separate emergency response capability within the ADF. The array of logistical and engineering capabilities that already exist can be readily adapted to a range of emergency and recovery management contexts provided there are adequate consultative processes to ensure that appropriate elements of capability are deployed. During the fires, sections of the media and some politicians called for the ADF to be deployed to fight fires. This would have been neither practical nor safe, as the minimum training required for a volunteer or career firefighter to safely deploy is around 3 months. The best approach is to utilise the ADF strengths in logistics and engineering to support impacted communities and aspects of emergency services' operations.

ELCA tried to suggest to the Prime Minister several times in 2019 that the sometime cumbersome arrangements for seeking and deploying DACC level 2 assistance should be examined and simplified. The lack of an overall plan for the ADF to support civilian communities and civilian emergency services in response and recovery ultimately proved to be an impediment to their eventual deployment. The focus should initially be on simplifying processes for requesting, approving and sustaining support, and simplifying DACC2, which essentially is always an ad hoc arrangement. It is time to modernise the processes and increase interaction with state and territory emergency services as a routine role for the ADF.

Recommendation 11: Australia's National Security Strategy must embrace wider and deeper concepts of security, including a consideration of climate change, natural disasters driven by extreme weather, and their impacts. The Australian Defence Force (ADF) has comprehensive logistics and engineering capabilities that can be applied to assist emergency services in the response phase, and communities in the recovery phase. Key Defence policy papers, such as the next Defence White Paper must incorporate a clear forward plan for how the ADF will support emergency services and recovery agencies in the future, as climate change drives an increased number of extreme fire danger days and other natural disasters in NSW and Australia.

Recommendation 12: The NSW Government should request that the Federal Government conduct a fundamental review of longstanding Defence Assistance to the Civil Community (DACC) arrangements. The arrangements can be cumbersome and slow, and levels of understanding between the ADF and emergency services about respective capabilities, needs, and arrangements must be improved. The ADF should focus on utilisation of existing capabilities for civil defence roles under the control of emergency services and state and territory governments, rather than developing new capabilities that may simply duplicate state and territory capabilities, ultimately causing confusion and inefficiencies.

Recommendation 13. The NSW Government should make representations to the Federal Government to ensure that future strategic assessments of the capability of the ADF to assist in natural disasters, including assessment of future acquisitions, should concentrate on interoperability and complementarity with states and territories, determined via a structured consultative arrangement.

7. Firefighting aircraft

7.1 National arrangements for firefighting aircraft

ELCA is of the view that Australia has insufficient aerial firefighting resources, there has been insufficient research into the effectiveness and efficiency of various aerial platforms, and that there are gaps in the current mix of aerial firefighting resources. ELCA also cautions that aerial assets should not be considered a "silver bullet". They cannot put out fires on their own – they

are only effective when used in close coordination with ground-based firefighting crews. Firefighting aircraft can be a crucial and necessary tool in the firefighting "toolbox", but sometimes are not the most appropriate and effective response. Given the huge expense, it is crucial that more research be conducted into the operational efficacy and cost effectiveness of various aerial firefighting platforms, and that a wider, and cheaper, range of capabilities be introduced into Australia rather than just increasing the number and use of Very Large Air Tankers (VLAT) and Large Air Tankers (LAT), which have inherent operational restrictions.

NSW fire and land management agencies involved in firefighting have significant experience and expertise in using aircraft for firefighting roles. The roles include, but are not limited to:

- Aerial reconnaissance / fire mapping
- Fire detection
- Insertion of remote area firefighting teams
- Transport of people and equipment
- Command and control
- Dropping of aerial incendiaries
- Dropping of water, foam, gel and retardant onto, or in front of, flame fronts.

(NAFC 2020)

For decades, up until and including the 2009 Black Saturday fires in Victoria, only small fixed wing aircraft (predominantly 802 Air Tractors carrying 3,200 litres), small, medium and large helicopters were used. The large helicopters, predominantly Erikson Aircranes carrying 9,000 litres, were all sourced from North America on lease.

After the 2009 fires, both the NSW and Victorian governments trialled the use of LATs (large fixed wing aircraft carrying up to 15,000 litres), and a VLAT (DC10 jet aircraft carrying 45,000 litres – later changed to 35,000 litres). The trials were judged to be successful and the National Aerial Firefighting Centre (NAFC), an entity created by AFAC member agencies, managed funds from the Australian Government and State and Territory governments to arrange and manage lease arrangements as well as managing movement of a variety of other fixed and rotary wing aircraft that comprise a shared national fleet of firefighting aircraft. In addition to the shared assets, several of the states and territories owned or leased additional aircraft according to their own assessed needs. Of particular note, in 2019 the NSW Government purchased Australia's first owned LAT, a modified Boeing 737. LATs are unavailable from the northern hemisphere in August when the NSW bushfire season now routinely commences. The influence of climate change, as previously detailed, has resulted in significant overlap between the northern and southern hemisphere bushfire seasons, reinforcing the need to consider establishing a fleet of large firefighting aircraft in Australia.

7.2 Funding

Funding for a national fleet of specialised firefighting aircraft was agreed between all governments and fire agencies after the 2003 Canberra fires that destroyed 487 homes and killed four people. Prime Minister John Howard established a dollar for dollar joint funding arrangement in acknowledgement that air assets could be moved around Australia according to priorities and needs and therefore constituted a strategic national resource. AFAC formed the NAFC in July 2003 to procure and manage a national fleet of leased aircraft (NAFC 2020).

In subsequent years the states and territories escalated their contribution to the joint funding arrangement and expanded the aerial fleet, but the Federal Government did not increase its contribution. In recognition of the growing need for a large strategic aerial firefighting capability given worsening bushfire conditions and extreme weather events nationally, AFAC developed a detailed business case for additional annual Federal Government funding in 2018; a modest ask for about $11M pa. The business case detailed how inflation and escalating costs were being borne solely by the states and territories, and how large aircraft are a strategic national resource because of their ability to rapidly travel long distances across borders (NAFC 2018).

Prior to this AFAC and NAFC had delivered a detailed submission to a Senate Inquiry into the 2016 Tasmanian Bushfires on behalf of all Australian fire services, requesting Commonwealth backing for development of a national fleet of large firefighting aircraft, stating: “Large fixed-wing airtankers are likely to be an important component of enhanced bushfire suppression capability in Australia. A shared, national large fixed-wing airtanker capability is logical and is an attractive strategy.” (NAFC 2016). The NAFC submission was cognizant of deteriorating climatic conditions leading to more widespread and intense bushfires and increasing overlap with fire seasons in the northern hemisphere, limiting access to leased aircraft. The Australian Government rejected the recommendation, citing that it was a “State and Territory responsibility”, ignoring the established agreement that recognised that individual jurisdictions cannot afford large aerial platforms alone, and the strategic national benefits outlined in the NAFC submission.

Emergency Leaders for Climate Action sought to meet with the Prime Minister from April 2019 to raise this and other issues, but ultimately were unsuccessful. Funding for additional firefighting aircraft was strongly recommended in letters to the PM, via the media, and in a meeting with Minister Littleproud and Taylor, but was continually rejected.

Ultimately after significant media and community pressure, the Prime Minister agreed to provide an additional $11M on a one-off basis mid-way through December 2019 after hundreds of homes had been destroyed and lives lost. NAFC was then faced with considerable difficulty sourcing appropriate aircraft resulting in premium prices due to the short notice. The additional aircraft ought were not yet available when NSW experienced further significant property and life loss in the last 2 weeks of December 2019.

On 4 January 2020 the PM held a press conference where he stated that the $11M would now be provided on an ongoing basis in accordance with the 2018 AFAC Business Case – ELCA had established that the December announcement was at that time considered a “one-off”, and this was communicated to media. The PM further announced that the Government would immediately provide an additional $20M to NAFC. NSW fire agencies and the NSW Government were not consulted about this and other announcements concerning callout of the ADF, as made clear by NSW RFS Commissioner Shane Fitzsimmons in various media interviews on that day.

Again, NAFC had to make rapid contact with overseas suppliers, and pay premium rates due to the short notice. Four large jet aircraft were sourced, but ultimately arrived after fires had started to be controlled – so the $20M expenditure was effectively wasted. A number of countries offered to provide firefighting aircraft to assist, but most were rejected.

7.3 Strategic and tactical use of aircraft

Small, medium and large helicopters as well as small fixed wing water bombers generally drop their loads directly onto flames in order to immediately reduce fire intensity and rate of spread, usually in conjunction with firefighters on the ground. A reduction in fire intensity, particularly if close to buildings and other assets, can allow firefighters who otherwise would have no prospect of controlling a fire, the opportunity to mount a direct attack and gain a measure of control.

LATs and VLATs are generally used differently. Their larger payloads usually comprise of a mixture of water and “PhosChek”, a fire retardant with a trademark red colour that adheres to vegetation. Retardant is usually applied ahead of, not directly onto, fire fronts. The theory is that retardant lines create a fire break, slowing down or halting the progress of the fire front.

In practice there can be significant issues with this. Australian eucalypt vegetation is renowned internationally because of the propensity to generate spot fires ahead of the main fire front; during the 2019/20 season up to 12 kilometres ahead. This limits the effectiveness of LATs and VLATS on the worst fire danger days.

LATs and VLATs require a large airport runway with room for supporting infrastructure (portable tanks and pumps) to conduct rapid refilling. In practice this limits them to large commercial or military airports capable of taking large passenger jets. This in turn affects a crucial factor in aerial attack: turnaround time. The further away the airport, the longer the return journey after the aircraft is refilled. If long distances have to be covered, the effectiveness of retardant lines can be compromised significantly, as occurred in Tasmania in 2016.

Another limitation on all firefighting aircraft is wind velocity. On days of Severe, Extreme and Catastrophic fire danger, many firefighting aircraft have to be grounded due to high wind velocities. Whilst LATs and VLATs are less restricted in this respect, they are unable to deploy without a “lead” aircraft that flies ahead and indicates where to drop the retardant load. On days of high winds, the lead aircraft are unable to fly and therefore neither can the LAT or VLAT.

7.4 Research into the use of firefighting aircraft

Very little research has been conducted in Australia into the effectiveness of various types of firefighting aircraft, limiting current understanding and development of aerial firefighting capabilities, strategies and tactics.

Emerging research strongly suggests that as fires intensify (arguably under the influence of climate change), use of aircraft in a first attack / rapid attack role, will be crucial (Plucinski 2012; Waters & Fuller 2020). This forms the basis of aerial firefighting strategies in Europe, Canada, and the USA, but is not practiced routinely in Australia other than in the Adelaide Hills and parts of Gippsland, where it has been very effective.

Opinions about the use of large and very large aircraft vary, however there appears to be a consensus that they are a useful strategic tool, for example in assisting to establish containment lines and slowing down fire fronts near threatened communities and buildings.

As previously indicated the 2016 bushfire season in Tasmania resulted in significant scepticism in that state about the use of LATs. Four LATs were deployed to fires in World Heritage Areas (NAFC 2016). However, there was nowhere suitable in Tasmania for the aircraft to land – they were instead required to fly from Avalon on the outskirts of Melbourne, make their drop, fly back to Avalon across the Bass Strait, land, reload, then fly back. This resulted in long delays between drops, and a lack of effectiveness as fires simply burned around the retardant lines. The Tasmanian Government received a hefty bill for fire retardant and jet fuel.

A different type of aircraft, amphibious water scooping water bombers, would arguably have been far more effective and far less costly in the Tasmanian situation. Despite having a smaller payload (6,000 litres), the operational effectiveness would have been far greater because of short turnaround times enabling a higher volume of water to be dropped for far less cost (see Appendix A for indicative comparison with a LAT). Amphibious water scoopers have not been used in Australia despite proven effectiveness and many geographies in Australia that would lend themselves to deployment of such aircraft.

7.5 A missing piece of the aerial puzzle

The types of aircraft used by Australian fire services has been outlined previously and are detailed on the NAFC website (NAFC 2020).

ELCA believes that together with an urgent need for research into the use and efficiency of firefighting aircraft in Australia, there must also be a rapid re-think on the growing reliance on very expensive LATs and VLATs, without also looking at "mid-sized" water scooping aircraft used around the world, except in Australia. Australia uses small aircraft, then jumps to large and very large. Arguably lack of a medium sized, cheaper and more flexible option in the "middle" limits strategic and tactical options, impacts on cost effectiveness and ultimately the effectiveness of response strategies (for example the 2016 Tasmanian experience). There is clearly a need for all types and sizes of aircraft in Australia's aerial firefighting fleet in order to maximise flexibility.

The Canadair CL415 "Super Scooper" (Figure Six) is used throughout Europe, in Canada, Malaysia, and California. A jet powered water scooping aircraft carrying 12,000 litres, the Be200, is used in Russia. The advantages of a CL415 are:

- Purpose-built firefighting aircraft, in contrast to LAT and VLAT which are all converted from previous military or civilian service
- Amphibious and multi-purpose: e.g. Malaysia uses their aircraft for maritime border patrol as well as firefighting
- Similar operating concept to 802 Fire Boss aircraft, but faster, greater range, and nearly twice the payload
- No need to land to refill – can scoop water from rivers, dams, lakes and the ocean, and refill in about 18 seconds
- No need for special airport facilities (which limit LAT and VLAT significantly). Can land on water or on small regional airstrips, decreasing turnaround time
- Can be refilled on the ground if no large body of water available: significant advantage is that this can be done locally, again reducing turnaround time
- Ideal aircraft for rapid first response and fire attack: the Gospers Mountain fire could have been attacked by CL415 aircraft, had they been available, scooping from the Hawkesbury River. Depending on the number of aircraft assigned, the fire may have been able to be controlled in the early stages. LAT were ultimately ineffective on this fire
- Lower air and stall speed than LAT and VLAT, therefore able to operate at lower altitude with greater maneuvering capability to drop directly on flames
- Variable drop patterns to suit operational conditions
- Payload can be water, water and bushfire fighting foam, or water and gel

- Far cheaper than LAT and VLAT aircraft and less onerous maintenance and airport requirements.

Figure Six: Canadair CL415 "Super Scooper". Note ability to drop at low altitude.

The Spanish Airforce operates that country's fleet of CL415 aircraft, working in close coordination with firefighting authorities.

CL415 aircraft were evaluated by AFAC in the 1990s however there has been no re-evaluation of them since the 2009 Black Saturday fires in Victoria resulted in a rethink that resulted in use of LAT and VLAT aircraft. To people familiar with the aircraft and their operations, this is a glaring omission that needs to be addressed as Australia by necessity boosts and works to integrate all facets of firefighting capabilities.

7.6 Military Strategic Lift (cargo) aircraft as firefighting backup

In the United States, some units of the Air National Guard provide assistance to fire authorities during significant bushfire emergencies by temporarily converting military Lockheed C130 Hercules aircraft (J and H models) into airtankers carrying about 13,000 litres. The system, known as Modular Airborne Fire Fighting System (MAFFS) enables rapid conversion of the cargo space using a roll-on, roll-off device to accommodate a pressurised tank, compressor and pump system. Early systems required C130s to fly with the rear cargo door down, which could adversely affect stability, speed and deployment. A newer system, MAFFSII produced by Aero Union Corporation in the USA, incorporates a nozzle system that fits into the rear passenger door, enabling the aircraft to remain pressurised in flight. MAFFS is used by air forces in the USA, Brazil, Columbia, Morocco, and Thailand (Avgeekery 2016).

ELCA is not suggesting that, in the unlikely event that the RAAF had capacity to participate routinely in firefighting missions, this would be a good option for establishing and enhancing Australian aerial firefighting capabilities. To the contrary, there are a number of problems with this approach that make it a "second best" option. Chief amongst these is that RAAF pilots will have little or no experience in firefighting missions, limiting their effectiveness. The other is that the rear nozzle comes out of the side of the aircraft rather than beneath, and this can adversely affect the dynamics of dropping retardant loads because of interaction with the jet stream behind the aircraft.

However, during a very serious season such as 2019/20, any additional aerial suppression assets would be helpful, even if only to release more suitable / purpose-built assets with the most experienced pilots from smaller, less risky fires, to concentrate on those that are likely to cause the most damage. For this reason, it may be worthwhile to suggest that the ADF consider a trial of a MAFFSII system during a fire season to evaluate effectiveness. If successful, detailed discussions would then need to take place with AFAC and NAFC to determine how and when such a capability would be deployed.

Recommendation 14: The NSW Government should request that the Federal Government and ADF conduct a trial of the feasibility of fitting a number of RAAF C130 Hercules aircraft with Modular Airborne Fire Fighting Systems (MAFFSII) to provide the ADF with the capability to augment aerial firefighting capabilities during major disasters.

Recommendation 15. The NSW Government should conduct a trial, in consultation with AFAC and NAFC, of amphibious water-scooping aircraft in a first attack / direct attack firefighting role (CL415 and Be200). Australian fire services at present use small and large fixed wing water bombers, but not medium sized. Given the success of 3,200 litre single engine air tankers (SEAT), a twin engine purpose-built aircraft with significantly greater air speed, range, flexibility and twice to four times the payload would be a logical addition to current arrangements. CL415 aircraft are used extensively and successfully throughout the world in other fire-prone countries.

8. Strategies to deal with very large fires

8.1 Lightning-caused fires

The Gospers Mountain fire north west of Sydney started as a result of a lightning strike on 26 October 2019. It was in a remote area with difficult access, and efforts to control the fire quickly were unsuccessful. Eventually it grew to more than 500,000 ha, becoming the largest forest fire in Australia's recorded history. It was only extinguished when heavy rain fell.

Many fires during the 2019/20 fire season exceeded 100,000ha in size. According to the NSW RFS, the majority of the large fires were started by dry lightning storms, and then burned into populated areas (News.com.au 2019).

It is likely that the potential for lightning-ignited bushfires will increase in the future, as lightning occurs more frequently under warmer conditions (Williams 2005; Romps et al. 2014; Abatzoglou et al. 2016). There is a strong positive association between temperatures and fire occurrence in the Southern Hemisphere, with a tight coupling between lightning-ignited fire occurrences and the upward trend in the Southern Annular Mode (Mariani et al. 2018).

Fires ignited by lightning can be difficult to suppress as they often occur in inaccessible remote mountainous areas. Lightning storms also often result in multiple simultaneous ignitions. In 2016, thousands of dry lightning strikes caused multiple intense bushfires in Tasmania, burning over 120,000 hectares, including nearly 20,000 hectares in the Tasmanian Wilderness World Heritage Area (Styger et al 2018; Earl et al 2019).

The likelihood of sustained ignition of vegetation following a lightning strike is largely dependent on fuel moisture content (Dowdy 2015). The warming, drying climate is projected to produce drier, more flammable fuel (Mathews et al. 2012). Since the mid-1990s, southeast Australia has experienced a 15% decline in late autumn and early winter rainfall, and a 25% decline in average rainfall in April and May (CSIRO and BoM 2016). April to October rainfall has also decreased in southwest Australia, with May-July rainfall seeing the largest decrease of around 20% since 1970 (CSIRO and BoM 2018). The shift in rainfall patterns can make a difference to the dryness of fuel and soil conditions, even if total seasonal or annual rainfall remains stable. For example, in the Tasmanian Wilderness World Heritage Area there has been an observed increase in the incidence of fires associated with lightning since the late 20th Century. This is thought to be due to a shift in rainfall patterns, with less frequent but more intense rainfall during the Summer months resulting in drier fuels (Styger et al. 2018).

The 2019/20 fire season in NSW highlighted the problems associated with clusters of lightning-caused fires in remote areas. They are a significant drain on specialised resources such as aircraft and remote area fire teams (RAFT). Many fires were started by lightning in northern NSW, the Hunter region, the Blue Mountains, the southern ranges, and southern alpine region.

Coupled with multiple days of Severe, Extreme and Catastrophic fire danger, despite many of the fires being controlled in the early stages, many others grew to mammoth proportions and resulted in significant losses.

8.2 Backburning

Backburning is often one of the only strategies that can be implemented with any hope of success once fires escape containment in conditions of Very High fire danger and above. It is inherently risky as it involves new fire being introduced into a landscape, which, in the case of the 2019/20 bushfire season, was very dry having been primed by years of drought. As previously explained, intense weather conditions exacerbated by climate change resulted in many days of elevated bushfire danger where established fires were able to spread almost unimpeded. This resulted in thousands of kilometres of active fire edges, often in remote, inaccessible areas, that could not be attacked directly except by limited air attack. As previously explained, air attack on its own will not extinguish fires – there must also be a coordinated ground attack by firefighters.

There were several examples of backburning operations escaping under conditions of elevated bushfire danger, sometimes destroying properties. Veteran firefighters described the associated decision-making processes as “damned if you do, damned if you don’t”, as the alternative was often to place firefighters in front of an intense approaching fire front, or to allow a fire to run unimpeded until weather conditions moderated sufficiently to enable some form of direct attack. This highlights the need for new firefighting approaches to be developed.

8.3 New control strategies

When fires become mega-fires, control becomes increasingly difficult as there can be hundreds or even thousands of kilometres of fire perimeter. When there are multiple mega-fires burning simultaneously, obvious resourcing problems arise. Fire agencies need to make difficult decisions about risk versus reward and utilisation of increasingly scarce resources. In practice, this means that as more fires break out, there are fewer and fewer firefighting resources available to deal with them, and then greater likelihood that any new outbreaks will also rapidly increase in size due to an increasing inability to respond quickly enough and with enough resources.

ELCA submits that ultimately it can be an unrealistic expectation that fire services will be able to control very large fires unless there is a change in weather – fire services are increasingly relegated to limited containment objectives, and to life and asset protection on the worst fire weather days. As Commissioner Fitzsimmons said on several occasions during the 2019/20 fire

season, it will take substantial rain to control the fires. Ultimately this proved to be correct when torrential rain extinguished fires in NSW in February 2020.

There are no known new techniques or strategies that can assist in dealing with mega-fires, although additional resources are always helpful. Even the use of more LAT and VLAT aircraft than ever before deployed in Australia made little difference in containing major fires in 2019/20.

However, there are three areas in which concerted effort can make a difference, not by controlling mega-fires, but by stopping them from developing in the first place:

1. Rapid, accurate fire detection and location capabilities
2. Rapid aerial first attack to contain the fire until arrival of ground crews
3. Rapid deployment of highly trained remote area fire teams.

Improved fire detection technologies might include, in conjunction with lightning detection systems:

- remote controlled cameras capable of identifying smoke,
- infra-red and thermal imaging technologies capable of identifying new fires,
- use of large drones and advanced imaging, perhaps deployed by the ADF,
- increased use of satellites,
- increased aerial patrols, and
- use of existing fire lookout towers.

Once new fires are detected, a rapid initial response and suitable weight of attack (in terms of number of aircraft, tankers, personnel etc.) are necessary to limit fire spread. It has been established that rapid deployment of suitable firefighting aircraft to remote fires correlates with increased likelihood of early control, and a smaller area burned (Waters & Fuller 2020; Plucinski 2012).

Lightning-caused fires in very remote locations may not be able to be reached quickly enough by helicopters, LAT and VLAT. LAT and VLAT can be too large to be effective due to their high air speed, relative lack of manoeuvrability, straight line drop pattern, and limited airport options often distant from the fire, resulting in long turnaround times. As previously mentioned, CL415 aircraft are routinely used in a fast attack role in other countries because of their increased flexibility, often in conjunction with 802 Air Tractor SEAT aircraft, which are already widely used in Australia. A significant advantage of the CL415 is 100% greater drop capacity compared to SEA – to argue against the use of CL415 aircraft is to also argue against the well accepted and established use of SEAT. Helicopters of various sizes, depending on fire location, can also be used in rapid first attack.

The third component crucial to rapid suppression in conjunction with rapid detection and fast initial air attack is availability of sufficient numbers of strategically located remote area fire teams, together with suitable ground and air transport. Both National Parks and Wildlife and RFS have RAFT. Many of the most remote fires in wilderness areas occur within National Parks. It makes sense to enhance the ability of NPWS to form RAFT from amongst its full-time ranks, and for them to be transported rapidly to fire scenes across NSW. Recent planned introduction of ex-military Blackhawk helicopters which are designed for troop transport is a positive development. The RFS recently announced that it is procuring two Bell 412 aircraft for this purpose, but ELCA contends that more needs to be done, perhaps an identical enhancement for NPWS (NSW RFS 2020d).

8.3 New technologies

With the increasing number, intensity and frequency of bushfires, there is an urgent need to adopt new and innovative ways to detect and rapidly respond to bushfires during early stage ignition, notably during severe, extreme and catastrophic fire danger rating days with the aim of deploying ground and aerial firefighting resources to rapidly attack, contain and successfully extinguish new fires before they take hold and overwhelm available resources.

Some key elements of an early detection and initial attack system are:

- rapid detection, location and reporting of bushfire ignitions, together with local weather conditions
- tracking of the movement, intensity and contributing factors affecting a fire (terrain, fuel conditions, weather, firefighting efforts),
- provision of early, timely and continuous information to communities, rapid response of initial fire attack equipment including ground crews and water-bombing aircraft.

Early detection sensing networks are already available with modern technologies that provide 24-hour bushfire ignition detection and real time fire movement tracking coupled with live, localised weather information and air quality data (LVIN 2020). The provision of a comprehensive, timely detection and reporting system capable of triggering an appropriate initial response, provide critical situational data, real-time information to assist tactical and operational decisions, and early and ongoing updates to nearby communities will increasingly be demanded by people living in bushfire-prone areas.

There are many new and existing technologies that might be applied to the bushfire problem, for example drone swarms to build a common operating picture, remote piloted aircraft, robotic vehicles, and increased use of military spec sensing technologies. An impediment to this is that fire services are cash-strapped and have little or no R&D funding. The Federal Government might consider an approach similar to the Australian Renewable Energy Agency to seed-fund new approaches.

Recommendation 16: A range of new rapid-fire detection technologies should be trialled. Together with rapid detection, new fast attack strategies for new outbreaks, particularly remote fires caused by lightning, need to be introduced with clear objectives, e.g. putting fires out within 24 hours and before they exceed ten hectares. Fast attack should involve rapid dispatch of a suitable number and type of fixed and rotary winged aircraft, including where suitable, medium sized air tankers which can scoop from suitable water sources or land at local air strips for manual filling, (as opposed to LAT and VLAT which are restricted to a few major airports) thereby establishing rapid turnaround and constant direct aerial attack on fire fronts. Aerial attack would then be complemented, as soon as possible, by aerial or ground insertion of fire crews and where necessary remote area fire teams, to complete extinguishment.

9. Funding of NSW firefighting agencies

Funding for NSW firefighting agencies was raised in the media and reported on inaccurately in some respects. The NSW Government and Premier should be commended for how they responded to the bushfire crisis, including in terms of finances. In particular the NSW Government provided significant additional funding for large and very large firefighting aircraft, and more recently for new helicopters.

However, prior to the fires some of the key agencies suffered ongoing real budget reductions over a number of years, and this clearly impacted, or could impact in future, on fire suppression capabilities. Examples include:

- Labour Expense Cap: when designating “essential services” exempt from the LEC, inexplicably the RFS, FRNSW and NPWS were excluded. As such they have suffered impacts on their respective recurrent budgets and ability to establish critical positions without first deleting others
- Productivity Dividends: the NPWS in particular (via the previous Department of Environment and Heritage) has suffered budget reductions due to “productivity dividends”
- Funding for the successful Enhanced Bushfire Program within NPWS runs out this year.
- Capital funding: FRNSW has experienced a significant decrease in its fleet capital budget over time, affecting the ability to manage the fire engine fleet to an optimal, efficient average age of 10 years. The knock-on effect of this was serious, as during the 2019/20

fire season FRNSW had fewer reserve (recently decommissioned) fire engines and bushfire tankers available for crewing by off-duty firefighters in order to provide vital surge response capability.

During the fires all agencies experienced difficulties maintaining numbers of firefighters on firegrounds over the extended fire season, and significant assistance was requested from interstate and overseas. There was significant discussion about whether volunteers should be paid for their services, however this would be unlikely to increase numbers in the short or long term. Recently the RFS reported that it had received about 35,000 new member inquiries (SMH, 2020). Consideration might be given to extending the State Mitigation Crew concept so that there is a core of full time firefighters within the RFS to support volunteers in areas where there are membership or fatigue issues.

An approach used extensively in the USA and Canada is the use of "seasonal firefighters". Agencies such as CalFire and Los Angeles County Fire Department recruit part-time firefighters during the worst parts of their fire seasons to augment on-duty crews. A similar approach might be considered in NSW; NPWS could increase the number of general firefighters and release the most experienced to augment their RAFT capability. FRNSW could utilise seasonal firefighters to crew reserve fire trucks or bushfire tankers at urban / bushland interface fire stations through Spring and Summer, providing additional surge capacity for days of Total Fire Ban. There might also be consideration given to increasing staffing year-round in certain National Parks and in FRNSW stations in bushfire-prone areas, as this would enable more hazard reduction to be conducted as well as increasing the number of full time rangers and firefighters available during the bushfire season.

Another concept proven to increase community resilience is the FRNSW Community Fire Unit program, which some years ago was extended to the ACT Fire & Rescue Service, and then to the NSW RFS. It provides local communities with basic firefighting equipment, training and education about how to survive fires. The concept has been proven to work well in suburban areas but is less applicable in semi-rural and rural areas. This is an area worthy of further research by the NSW RFS, as a new model that provides basic equipment and training to residents in rural areas could be a "force multiplier" in future serious bushfire seasons.

Recommendation 17: The NSW Government should re-commit to the soon-to-be completed National Parks and Wildlife Service Enhanced Bushfire Program and focus in particular on expansion and resourcing of remote area fire teams with suitable aerial platforms, including the possibility of using ex-military Blackhawk helicopters, or Bell 412 helicopters as recently procured for the RFS.

Recommendation 18: The NSW Government should declare the NSW Rural Fire Service, Fire & Rescue NSW, and NSW National Parks and Wildlife Service as Essential Services for budgetary purposes, and immediately exempt them from the Labour Expense Cap and Productivity Dividends (ie, constant budget cuts).

Recommendation 19: The NSW Government should restore capital funding to Fire & Rescue NSW to enable the average age of the fire engine fleet to be restored to 10 years. This will also restore the ability of Fire & Rescue NSW to maintain a "reserve fleet" of decommissioned fire engines and tankers to provide surge capacity using off duty firefighters during serious bushfire seasons, a capability that was reduced as a result of capital budget reductions leading up to 2019/20.

Recommendation 20: The NSW Government should consider a capital funding grant to Fire & Rescue NSW to purchase a fleet of bushfire tankers that would replace decommissioned fire engines currently forming a reserve fleet, in order to enhance capabilities and ensure that firefighters have proper personal protection systems when fighting bushfires.

Recommendation 21: The concept of seasonal paid firefighters, used extensively in bushfire-prone parts of the USA and Canada, should be considered in relation to Fire & Rescue NSW and National Parks and Wildlife Service in order to augment existing ranks of volunteer and career firefighters in NSW during serious bushfire seasons. A similar concept could be extended to RFS State Mitigation Crews during serious bushfire seasons to provide a full-time firefighting surge capacity within the RFS.

Recommendation 22: The Community Fire Unit concept should be modified by the RFS to make it suitable for regional NSW. A step change in community resilience and preparedness could be achieved by training and providing basic firefighting equipment to NSW residents in bushfire-prone areas. The Fire & Rescue NSW Community Fire Unit program has proven to be a success in urban / bushland interface areas, but not as well received or suitable in areas of a more rural nature.

10. Building standards in bushfire-prone areas

Australian Standard 3959 (construction of buildings in bushfire prone areas) is a national standard that was reviewed and updated after the Black Saturday bushfires in 2009. The standard details construction standards and elements aimed at making homes more likely to withstand a bushfire. It classifies different bushfire intensity levels that a home might experience during a bushfire. These are known as Bushfire Attack Levels (BAL) and there are 6 levels ranging from BAL Low to BAL-FZ (Flame Zone) (See Figure Seven; Standards Australia 2018). Each level is determined by a variety of factors including the location of premises, the type of vegetation around the premises and its proximity as well as the slope of the property. The BAL designates requirements for construction including building materials and other factors aimed at mitigating bushfire risk- for example building in BAL Flame Zone has much stricter construction requirements and all materials and components must be fire tested (Bell 2019). The purpose of these standards and building requirements are to reduce the risk of ignition from a bushfire, flames, burning embers, radiant heat and intensity of bushfire attack (Loveridge 2020).

BAL	Description
BAL-LOW	There is insufficient risk to warrant any specific construction requirements.
BAL- 12.5	There is a risk of ember attack.
BAL- 19	Ember attack plus burning debris ignited by windborne embers, plus radiant heat.
BAL- 29	Increasing levels of ember attack and burning debris ignited by windborne embers, plus increased radiant heat (19 – 29 kW/m2).
BAL- 40	Much increased risk from ember attack and burning debris ignited by windborne embers, plus higher level of radiant heat and some likelihood of direct exposure to flames (29 - 40 kW/m2).
BAL- FZ (Flame Zone)	Highest risk of ember attack plus direct exposure to heat (> 40 kW/m2) plus flames from the fire front. The standard notes that Authorities may require additional measures, other than construction requirements.

Figure Seven: Bushfire Attack Levels (Standards Australia 2018)

The updated 2009 AS 3939 is a national standard which applies to all bushfire-affected construction from the 1st of May 2019, with some variations on a state by state basis. In NSW there are additional requirements that build upon what is outlined in the national standard, for

example there are additional requirements for schools and hospitals and there are greater restrictions on developments at BAL-29 and above which limits the development of residential properties in bushfire-prone areas (Standards Australia 2018; Bell 2019). These requirements are outlined in the RFS publication, Planning for Bushfire Protection (PBP), which was developed in NSW in 2001 and has been updated over the years. The current version is PBP 2019 (NSW RFS 2020b). Development is predominantly controlled by the NSW RFS, but local governments are the consent authority.

In the wake of the 2019/20 fires, and the fact that climate change continues to drive an increase in Australia's bushfire threat, it will be critical to review Bushfire Attack Levels. BAL is based on historic fire weather and fire danger, not on what is likely to happen now and in the future, and not on what was experienced during the 2019/20 fire season. As a result, they can no longer be considered suitable in many areas of NSW.

The BAL must be reflective of what is now clearly a reality, factoring in climate change, worsening extreme weather, and increasing FFDIs. A starting point is to use 2019/20 fire conditions as the baseline.

Bushfire prone land is mapped by local government authorities. Unfortunately, much of NSW, particularly grasslands, remain unmapped and unclassified. Current guidelines provide for a 100m buffer – this is clearly insufficient given that embers can travel for kilometres, and most bushfire losses occur within 350-500m of the bush.

An additional issue related to home construction in bushfire prone areas was brought into stark relief in the 2003 ACT fires, the 2009 Black Saturday fires, and possibly also the 2019/20 fires – fire storms, fire tornadoes and gale force winds on days of Catastrophic fire danger damaged or tore off roofs: leaving the interior exposed to ember attack and rendering the home useless as a refuge. More research needs to be conducted into this facet with possible introduction of roofing construction standards based on cyclone categories.

Australia's building standards must also be reflective of climate change and be appropriately stringent; in some cases there may be larger areas across Australia that are no longer safe to build in due to the growing bushfire threat. With varying legislation and building codes across states and territories a more integrated approach to planning for fire risk, which better connects planners with emergency management, will be critical (Norman et al. 2014).

Innovative approaches may be needed. For example, in some areas, similar to approaches taken in tornado-prone areas in the USA, thought might be given to relaxing building standards with the knowledge that homes will not withstand a serious bushfire, BUT ONLY IF a suitable bushfire bunker is available adjacent to the home. There has been very little research or development of the bunker concept and this might be necessary with continuing extreme weather escalation.

Some small communities, in certain conditions, are not defendable or safe. They are often remote and leaving by vehicle can prove to be fatal. Consideration might be given to building local dual-use facilities, such as a sporting / community hall, that is constructed to also act as a community refuge able to withstand a major fire.

Recommendation 23: In the wake of the devastating 2019/20 fires, and recognising that climate change continues to drive an increase in Australia's bushfire threat, it is critical that building and planning regulations and standards be reviewed, particularly Australian Standard 3959. Bushfire Attack Levels (BAL) in NSW are based on historical fire weather, not on conditions experienced in 2019/20, and certainly not what is likely to occur in future as temperatures increase further. BAL must be reflective of climate change projections, not historical weather and fire behaviour. The Standard deals mainly with radiation levels that inform an engineering standard, but do not sufficiently take into account ember attack or the effects of convection.

Recommendation 24: NSW should update Planning for Bushfire Protection as a matter of urgency to reflect worsening conditions and include climate change as a key factor**.** Innovative solutions, such as community refuges, household fire bunkers and early evacuation as trade-offs for allowing lightweight "sacrificial" home construction, should be considered and researched.

Recommendation 25: Roof design and strength is a critical factor in future bushfire design of homes and other buildings. Requirements need to be increased to reflect increasing wind velocities fuelled by climate change, and fire storms and fire tornadoes caused by pyroconvective events that damage and remove roofs. If a roof is damaged or destroyed survivability of the structure and its ability to act as a refuge are greatly reduced.

Recommendation 26: Bushfire prone area mapping by local councils needs to be reviewed as there are large areas of NSW, particularly grasslands, unmapped. Current buffers are 100m, which is clearly inadequate when ember attack can impact structures 350 – 500m from a fire edge.

Recommendation 27: With varying legislation and building codes across states and territories a more integrated approach to planning for fire risk, which better connects planners with emergency management, will be critical. As fire danger indices and fire paths from 2019/20 are analysed, locations might be identified where rebuilding should not occur due to excessive levels of fire and life risk.

Recommendation 28: Consideration should be given in remote communities or communities deemed to be at extreme risk with limited egress, to providing dual-purpose community buildings capable of providing all community members with refuge in an extreme bushfire situation.

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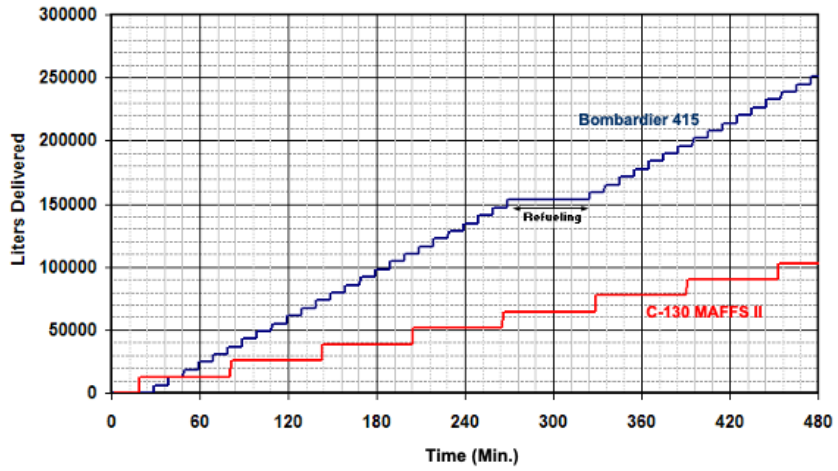
Image Credits

Figure 4 - NSW Rural Fire Service crews fight the Gospers Mountain Fire as it impacts a structure at Bilpin, Saturday, December 21, 2019. AAP Image/Dan Himbrechts.

Figure 5 - Smoke, flames and burn scars over the east coast of Australia, 31 December 2019. ESA (European Space Agency) Image/EPA. Contains modified Copernicus Sentinel data (2019). License: CC BY-SA 3.0 IGO.

Appendix A: Aircraft Productivity

The Bombardier 415 aircraft productivity versus C-130-MAFFS II



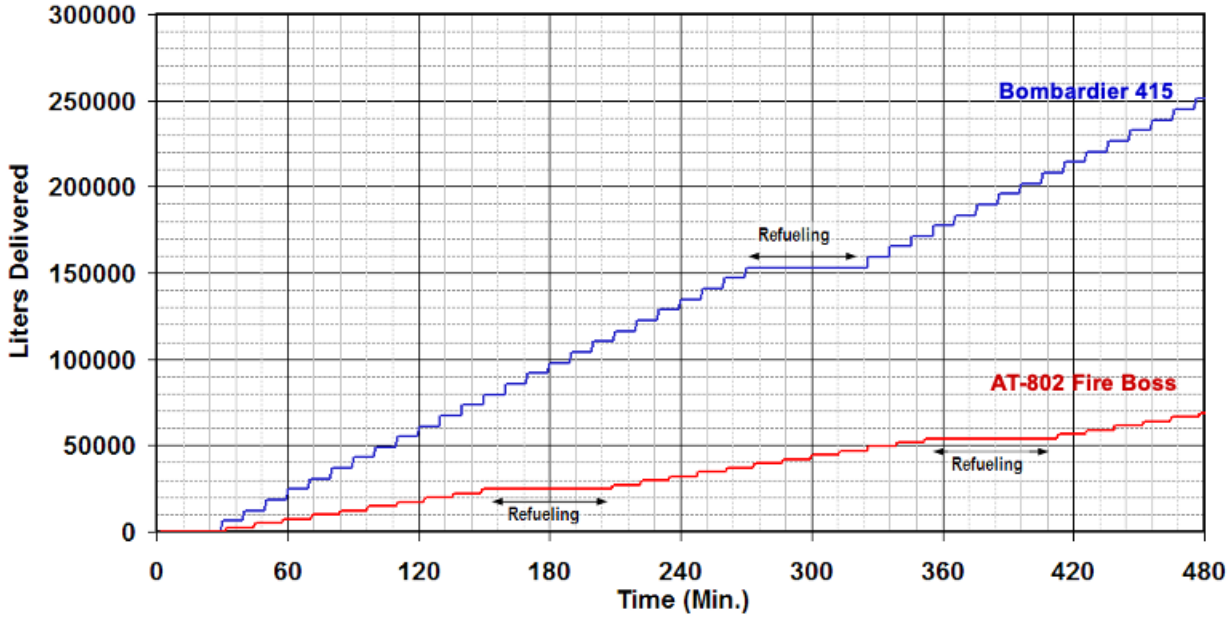
Based on a 8 hours day - Base to fire distance of 30nm, water to fire of 10 nm for Bombardier 415 ; ISA

- **Bombardier 415 :**
  - Scoops water directly from a nearby source of water
  - Productivity in a 10 nm area :
    - 6 drops / hour
    - 10 minutes cycle time
    - 36,822 liters / hour delivered
- **C-130 MAFFS II equipped**
  - Has to go back to its base to refill its water tank
  - Productivity in 30 nm area :
    - 1 drop / hour
    - 61 minutes cycle time
    - 12,870 liters / hour delivered

BOMBARDIER

The Bombardier 415 aircraft productivity versus AT-802 Fire Boss

The Bombardier 415 aircraft and the Fire Boss are the only two amphibious firefighting aircraft certified by EASA, FAA and Transport Canada.



Based on a 8 hours day - Base to fire distance of 30nm, water to fire of 10 nm, SL; ISA

BOMBARDIER