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Bushfire impact research - NSW South Coast

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Risk Frontiers deployed a team to the NSW South Coast region in late January, 2020 to undertake damage surveys following the bushfires. This research was supported by the Bushfire and Natural Hazards CRC (BNHCRC). The areas surveyed included Moruya, Mogo, Malua Bay, Rosedale, the Catalina area of Batemans Bay and Lake Conjola. The majority of damage occurred on December 31, 2019 as catastrophic weather conditions (extreme temperatures and strong winds) intensified existing fire fronts. The conditions transported large quantities of embers into vulnerable communities, destroying hundreds of residential and several commercial buildings. In total, the survey identified 426 bushfire affected properties, most of which were destroyed. Industries/ infrastructure affected included: bowling/services club, a unit block (12 units), heritage park, industrial complex with numerous businesses and extensive damage to electricity infrastructure (power poles and wires along the Princes Highway). This report complements our report for northern NSW (Risk Frontiers, 2020).

Building age and resilience

As the 2019/2020 fire season progressed, the scale of damage and losses experienced across the country engendered a growing interest in evaluating the resilience of buildings to bushfires. Aspects of buildings such as age, performance of construction materials and a structure's vulnerability due to its proximity to bushland were the key focus of the NSW South Coast survey. To evaluate the performance of building archetypes impacted by fire, the Insurance Council of Australia (ICA) charted the year of construction of over 25,000 residential buildings located within bushfire impacted areas across four states (Figure 1). Categories range from Old Colonial (pre-Victorian) to post-2009, when bushfire building standards began to be improved and were mandated in certain locations.

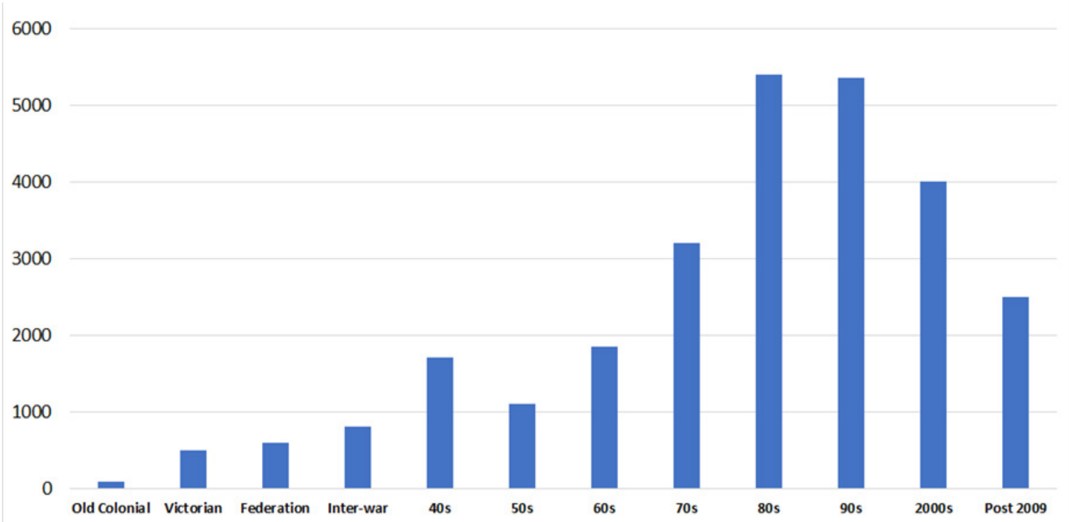

Figure 1: The period of construction for over 25,000 buildings located within the current bushfire impacted areas across four states. Source: Insurance Council of Australia, 2019.

The ICA data shows that only 9.5% of residences were constructed post-2009, when changes were made to Australian Standard 3959 after the Black Saturday fires of February, 2009, to ensure that new buildings in bushfire-prone areas were safer and more likely to survive a fire (BNHCRC, 2019). It was apparent that the scale of residential losses occurring this fire season presented a small window of opportunity to conduct further damage surveys, prior to recovery and debris removal, and would provide a considerable 'post-2009' cohort to assess building performance and inform future design. In the near future, further analysis will be undertaken by Risk Frontiers to establish the construction age of the South Coast properties, with a focus on any post-2009, to expand existing research.

Observations of destruction/damage - construction materials

The survey team recorded aspects of fire affected buildings such as construction materials and damage ratios (destroyed/ partially destroyed). The field observations from the South Coast survey are compared to those in Rappville (2019) and Tathra (2018) in Figure 2.

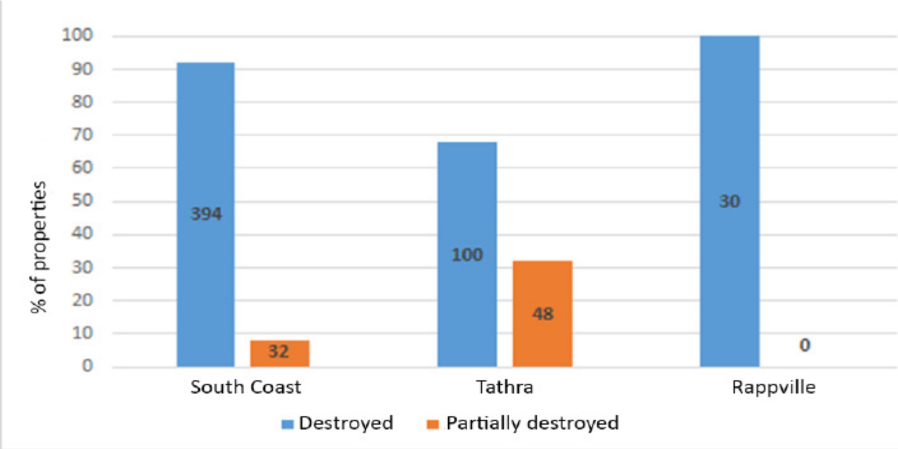

Figure 2: The proportion and number (in column) of buildings categorised as destroyed/ partially destroyed. The South Coast and Rappville (2019) damage surveys used a building footprint method where partially destroyed references the building, not the lot. The sampling method figures from the Tathra fire in 2018 assigned partially damaged on the proportion of the whole lot - that is, if a shed was destroyed but the house was undamaged, then a partially damaged rating was assigned. The data shows that once a building is alight, the likelihood of it being destroyed is very high. The total destruction rate across the three events ranged between two-thirds and 100%. The number of properties destroyed also indicates the difference in scale of the fire events between locations.

The South Coast findings reinforce those from the Rappville (2020) and Tathra (2018) surveys, in that, once a building catches fire, regardless of construction material, it will likely be totally destroyed. The official Tathra figures have 68% of all fire affected premises as being ultimately destroyed. Data collected from the South Coast and Rappville surveys provides much stronger indications of this trend, where 92% and 100% respectively, of the buildings observed were destroyed. (The Rappville and South Coast results represent only those properties located and observed, not all fire-affected properties).

In terms of building specifics, The South Coast survey provided numerous examples of fire-affected residences, primarily constructed of 'non-flammable' materials (brick and blockwork (piers and walls)). These structures demonstrated some resilience to the fire, at times remaining wholly or partially intact. However, the remaining material comprising the premises (structural roof/wall timbers, internal walls and house contents), once alight, ultimately rendered the entire building unsalvageable (destroyed). Timber beams supporting house roofs and carports were uniformly level on the ground (as though dropped). Metal framed buildings (e.g. sheds) and structural elements (e.g. lintels) did not perform well - failing due to extreme heat and leading to the building warping and impacting brick/masonry when collapsing. There were numerous examples of vehicles completely burnt out in front and rear yards and some isolated examples of aluminium boats that had undergone some degree of melting.

For partially destroyed properties, the building features most often impacted were constructed from timber such as external stairs and decking as well as external cladding. There were numerous examples of destroyed properties categorised as 'asbestos contaminated' though this was less common than during the Rappville survey where asbestos was present at over 50% of properties. A large number of asbestos contaminated assessments were speculative based on observations and erred on the side of caution with further assessment and testing usually noted as necessary. The possible exception to this would be Rosedale which experienced near total destruction and where homes predominantly appeared older, were often constructed using fibro or sheeting and surrounded by bushland.

Statistical dependence of bushfire risk on distance to bush and the influence of ember attack

Previous field research conducted by Risk Frontiers (Chen and McAneney, 2004 and other more recent) has established that proximity to bushland is the most important factor in determining a building's vulnerability. Figure 3 depicts bushfire damage based on aggregated data from recent major bushfires and shows the cumulative distribution of destroyed buildings in relation to distance from bushland.

As with previous fires studied, Figure 3 confirms the significant role that 'proximity to bushland' played in the South Coast losses where approximately 38% of destroyed buildings were situated within 1 metre of surrounding bush. The average distance from bushland of all 426 properties surveyed was 55 metres (satellite imagery). However, a feature not obvious from the South Coast data in Figure 3, but apparent in the Rappville and Duffy examples, is the impact of extreme conditions and the capacity of embers to propagate fire over large distances. Witness accounts from fire fighters and locals have described embers being transported by extreme winds across Lake Conjola, over distances greater than 1km. The South Coast survey data would appear to confirm such reports, as two properties surveyed were >1.3km from bushland and 73 were located >100 metres from bush.

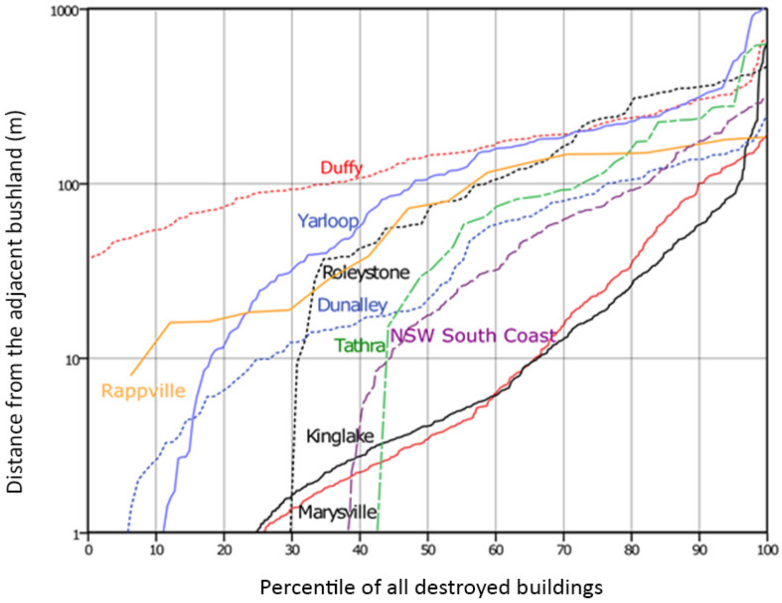

Figure 3: Cumulative distribution of buildings destroyed in relation to distance from nearby bushland for recent major events.

References

BNHCRC 2019. Black Saturday ten years on – what did we discover?

Insurance Council of Australia 2020. Period of residential building construction - chart. Posted by Karl Sullivan.

Risk Frontiers' Newsletter Vol. 19, Issue 1.

Risk Frontiers' Newsletter Vol. 17, Issue 3

Chen, K., and K. J. McAneney, 2004: Quantifying bushfire penetration into urban areas in Australia. Geophys. Res. Lett., 31, L12212.

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Future of bushfire fighting in Australia

Andrew Gissing, Risk Frontiers, Neil Bibby, People & Innovation

Australia needs to be ambitious in its thinking about how future bushfires are managed and fought. Recent bushfires caused significant damage and widespread disruption leaving some 3093 homes destroyed (AFAC) and 35 fatalities as well as major damage to community infrastructure. We must learn from this experience.

Today's management of bushfire risk is largely reliant on long standing approaches that are resource intensive and which struggle to control fires when conditions are catastrophic. This issue is compounded under a warming climate with fire seasons becoming longer, and days of significant fire danger more frequent.

An inherent problem is that bushfire detection is complex and in the time it takes before resources can be tasked and targeted, bushfires have already spread to the point where suppression is difficult. This problem is exacerbated when bushfire ignition occurs in remote areas far from emergency management resources. Making the problem worse still is a growing bushland-urban interface where buildings and community infrastructure are highly vulnerable and exposure is growing.

Innovation to discover the next generation of firefighting capability should be a priority in any government response to the Black Summer bushfires. Our institutions must think big.

To explore blue sky thinking in respect of future firefighting capabilities and enhanced bushfire resilience, Risk Frontiers and People & Innovation hosted a forum with experts in construction, technology, aviation, insurance, risk management, firefighting and information technology. In what follows, insights and questions arising from this forum are outlined.

New thinking is required

There are two stages in considering future capabilities. The first stage is planning and investment to improve capabilities in the short term particularly before the next bushfire season, and the second stage is research and innovation to inspire the next generation of firefighting capability. What is needed is a blueprint of how bushfires will be fought in the future. This blueprint should be focused on a vision whereby bushfires can be rapidly managed and controlled in a coordinated manner informed by advanced predictive intelligence; and where the built environment is resilient. Key research questions to be answered in the development of such a blueprint include:

Bushfire detection and suppression

- How can bushfires be detected more quickly?
- How can bushfires be extinguished before they are able to spread?
- How can the safety of firefighters be improved?

Coordination

- How can communications enable effective coordination?
- How can resources be tasked and tracked in a more effective manner?
- How can situational awareness be enhanced to inform decision-making?

Community resilience

- How can new buildings be made more resilient?
- How can existing building stock be retrofitted for resilience?

- How can community infrastructure such as energy distribution systems, telecommunications, water supplies and sewerage systems be designed with greater resilience?

Short term

It is widely agreed that in the short term there are many technologies and systems already existing that could enhance firefighting and broader disaster management capabilities. Specific opportunities identified by industry experts include:

- Satellites, such as data sourced from the Himawari satellite, should be evaluated for their ability to enhance fire detection. High Altitude Platform Systems may be another option.
- In the United States, Unmanned Aerial Vehicles (UAV) have been employed to provide enhanced imagery over firegrounds and if equipped with infrared sensors these can support monitoring of fire conditions at night. The Victorian Government has established a panel contract with UAV providers to assist with real-time fire detection and monitoring. Further policy regarding airspace management is required to support wider demand-based deployments of UAVs.
- Existing agricultural monitoring technologies could be repurposed to monitor bushfire fuels and soil conditions.
- Balloons equipped with radio communications could provide coverage when traditional communications technologies have been disrupted. Alternatively, small UAVs could create a mesh network to provide a wireless communications network or equipment fitted to aircraft.
- Advances in the use of robotics in the mining sector may provide applications to firefighting, for example autonomous trucks.
- Resource tracking technologies could be implemented to improve coordination and firefighter safety.
- Emerging fire extinguisher technologies could help to suppress bushfires.

Operational decisions could be improved by enhanced collation and fusion of data already available. There are many data sources that are managed by different organisations, not just government agencies. Collating these datasets to provide a common operating picture across all organisations would improve situational awareness and data analytics.

The widespread adoption of artificial intelligence and greater digital connectedness across the economy and emergency management sector will find new ways to make sense of data and improve decisions. In the built environment, improved information to households about the resilience of their buildings along with programs to implement simple retrofitting measures should be considered. In the aftermath of bushfires, governments should consider land swaps and buy-outs to reduce exposure in high risk areas. Similarly, governments should better plan communities to ensure infrastructure is more resistant to failure when most needed in emergencies.

2030 and beyond

A key area for research and innovation investment over the coming decade should be how to rapidly suppress bushfires once detected. This could see swarms of large capacity UAVs supported by ground-based drones to target suppression and limit fire spread. Resources would be rapidly dispatched and coordinated autonomously once a bushfire was detected. Pre-staging of resources would be informed by advanced predictive analytics and enabled by unmanned traffic management systems. UAVs and drones would have applications beyond fire suppression including for rapid impact assessment, search and rescue, logistics and clearance of supply routes.

The way forward

A research and innovation blueprint is needed that outlines how technologies will be translated to enhance firefighting and resilience in the short term and, beyond this, how the next generation of capability will be designed and built. Its development should involve government, research and industry stakeholders in a collaborative manner. The final blueprint should be integrated with future workforce and asset planning to support broader change management.

Adopting new technologies will not be easy and existing cultural and investment barriers should be considered. In adopting new technologies, it is important to recognise that innovation is an iterative process of improvement and will rarely provide a perfect solution in the first instance.

Public private partnerships will be key to realising opportunities and government must seek to engage a broad range of stakeholders. In the aftermath of Hurricane Sandy in the United States in 2012, the US Government launched a competition called 're-build by design' focused on proactive solutions to minimise risk. Already in Australia, numerous innovation challenges involving businesses and universities are being held to assist in inspiring ideas. There is an opportunity to harness and coordinate such challenges on a grand scale to promote new thinking and collaboration linking directly with responsible agencies.

We need to be bold in our thinking!

Acknowledgements

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