LEGISLATIVE ASSEMBLY
FOR THE AUSTRALIAN CAPITAL TERRITORY

STANDING COMMITTEE ON ENVIRONMENT, CLIMATE CHANGE AND BIODIVERSITY
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Submission Cover Sheet

Inquiry into ACT environment's Bushfire preparedness

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This is a submission to the ACT Legislative Assembly's

"INQUIRY INTO THE ACT ENVIRONMENT'S BUSHFIRE PREPAREDNESS"

STANDING COMMITTEE ON ENVIRONMENT, CLIMATE CHANGE AND B IODIVERSITY

Rick McRae,

I would like to address some key issues relevant to the Committee's goals, and these arise from the already significant increases in climate change's impacts on the ACT's bushfire risks and bushfire resilience.

My background is worth noting, as it shows that I have a unique perspective on these matters.

1) I was the Territory's Fire Management Planning Officer through the 1990s. I was also the Territory's Bushfire Arson Investigator, and Emergency Services Bureau's initial Web Master – changed with public information using the then nascent internet.

2) I was the Territory's lead natural hazard risk analyst. I have had involvement in many of the foundation bushfire planning processes in the territory, including the Territory-Wide Risk Assessment.

3) I was the Territory's lead incident Planning Officer for many years. I deployed in related roles to major fires in Tasmania and British Columbia.

4) I have been involved in Incident Management Teams for hundreds of bushfires and grassfires in the Territory.

5) I have authored or been a lead co-author on roughly 40 peer-reviewed science papers on bushfires.

6) I am a lead in the international collaboration studying fire thunderstorms, associated with the type of fire that affected the ACT community so badly in 2003. (I was Planning Officer for those fires, and was heavily involved in the subsequent Coronial Inquest. It

must be noted that subsequent science has largely negated most of Coroner Doogan's findings).

My training was as a field ecologist. I am now retired after a third of a century as a lead emergency manager in the ACT (starting 1989 in the week of self-government starting), and am an Adjunct Professor with the UNSW Canberra Bushfire Research Group. I am studying aspects of the Black Summer fires. This last point is critical, as the potential for a repeat of 2003 is quite real. To help with this I have developed new predictive tools for the 2003-type fires. It would be found that my science-based views may be quite different to those of others presented, but reveal the real impact of Climate Change on our bushfire risks.

Summary of recommendations by terms-of-reference

A. The environmental factors contributing to bushfires in the ACT and surrounding areas, including any role of weather, drought, climate change, fuel loads and human activity;

- There is a need for a clearer Fire Danger Ratings system for Canberra, focussed on the community's needs, not those of land managers.
- Canberra cannot afford for its key land management agency to be competing with its fire services.
- Fire thunderstorms are a rapidly increasing threat to the Canberra community and its resources, especially its National Parks and Nature Reserves.
- Climate change is impacting on these issues in an extreme way.

B. The impact of bushfires on climate emissions, climate adaption, and biodiversity;

- Bushfire smoke has become our most serious natural hazard. It requires serious planning.
- Smoke dispersal models currently used do not model the processes not known to be key in this problem. New models are essential.

C. Bushfire risk, resilience, and potential impacts, including consideration of the impact of bushfire on the ACT community, wildlife, and flora;

- The return of fuel hazards during regeneration is complex and must be carefully monitored using the right tools.
- The ACT fire age spectrum will impede effective fuel reduction burning for many years - or until the next extreme wildfire cluster.
- Fuel reduction does little if anything to prevent the next extreme wildfire.
- The design of new suburbs - away from traditional hills-and-ridges model - makes those new suburbs inherently unsafe. Some should be abandoned as too unsafe.
- The previous point arises because the Standard for Building in Bushfire Prone Areas and the building codes do not cover the type of threat found in Canberra.
- Vorticity-drive Lateral Spread in the hills to the west threatens most new or planned suburbs.

- The distribution of ignitions around Canberra's urban edge is well known. The effect of the 2003 fires on that shows that education programs can be effective.

G. Cross-border risks and issues, particularly engagement with New South Wales and the Commonwealth;

- Many major fires have crossed the ACT/NSW border in both directions. Events first seen in Black Summer show that effective planning for cross-border fires will be a major challenge.

Other issues of relevance for the Committee to consider

- Perhaps pyro-tornadogenesis is really the greatest natural hazard that we face.
- The regional road network - vital to Canberra' petrol supply - was shown to be vulnerable during Black Summer.
- A new predictive tool for Extreme Wildfire shas been developed and may prove important to mitigating bushfire risks.

Most bushfires in Australia are what are called “Quasi-Steady State” – or what I will call “Normal”. If you know the terrain, the weather, and the fuel, then most of the time you will be able to anticipate what a fire can do. Since Canberra was founded, its fire services have done a remarkable job - no houses have been lost to bushfires in the City. Some were lost in the past in places like Mt Stromlo Observatory – outliers to the west of the main urban edge.

Unfortunately, Climate Change has brought a second species of wildfire into prominence in Australia. Called Extreme Wildfires, these form a feedback loop with the atmosphere above, and exhibit very different behaviour, called “Dynamic” fire behaviour[1]. Some of these form fire thunderstorms, as seen here in 2003, when Canberra lost 512 houses in one day.

Clearly the residual risk equations for these two species of fire are profoundly different.

This is the key issue faced by Canberra as it prepares for the next damaging fire event.

Most of the relevant concepts stem from science done in Canberra after the 2003 fires.

A. The environmental factors contributing to bushfires in the ACT and surrounding areas, including any role of weather, drought, climate change, fuel loads and human activity;

The Australian Fire Danger Rating Scheme is widely touted as a major advance in keeping Australia’s communities safe from bushfires.

That is completely misguided, if not incorrect. Let me explain.

The old Fire Danger Ratings system addressed the problem “if I started a fire, how dangerous would that be?” So, for example, someone wishing to operate machinery in a paddock could tell if it was possible to do so safely (Figure 1). It combined fire weather and the measures of fuel dryness.

[1] Di Virgilio, G., Evans, J. P., Blake, S. A. P., Armstrong, M., Dowdy, A. J., Sharples, J., & McRae, R. (2019). Climate change increases the potential for extreme wildfires. *Geophysical Research Letters*, 46, 8517–8526. https://doi.org/10.1029/2019GL083699

Figure 1. A fire on the summit of Mt Taylor started by an angle grinder.

The new AFDRS combines this with broad-acre fuel loads. This is more aligned with operational needs, ostensibly for fire services, but primarily for land managers. It pays little heed to the needs of the community. Therefore, it is letting them down and is widely seen as confusing. The old scheme was largely calibrated in Canberra by CSIRO, and – from personal experience - worked very well at keeping the local community safe. I was the local technical specialist behind local implementation of FDR from 1989 for around two decades. It was then watered down by the land managers who wished to avoid the costs of putting their workforce on stand-by to respond on days of elevated fire danger ratings.

I was on the national science group for the original NFDRS scheme, which was science-based, but which was abandoned after two years. It was then replaced by the AFDRS without the science, but with a new group with a strong alignment to land-managers' wishes. No mention is ever made of the original effort. For decades now the land managers have acted like they are their own fire service, creating massive confusion and mixed messaging. Back when the ACT's emergency services were brought together they were called "the World's Smallest Fire Service". Not a cost-efficient way to mitigate a major risk.

The problem is that extreme wildfires are becoming increasingly dominant. Their most obvious manifestation is a fire thunderstorm, or pyroCb[2]. These are extremely obvious in weather radar and satellite imagery. So much so that one of the worst fire runs in January 2003 occurred at 10pm on the 17th, and I only learned of this after being asked about it by the US Navy.

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[2] Fromm. M, Tupper, A, Rosenfeld, D, Servrancx, R & McRae, R, (2006). Violent pyro-convective storm devastates Australia's capital and pollutes the stratosphere. Geophys. Res. Lett. 33, L05815.

I maintain the Australian PyroCb Register – see https://www.highfirerisk.com.au/pyrocb/register.htm

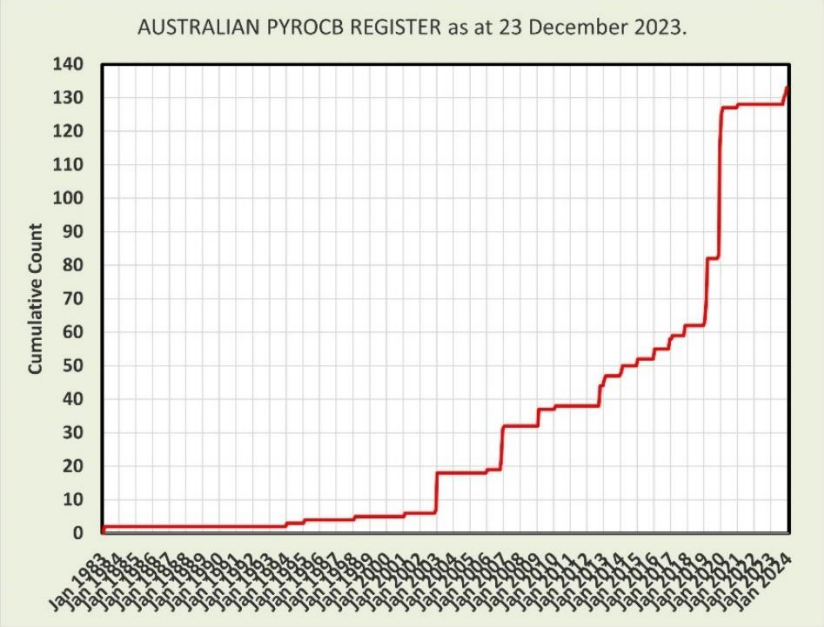


Figure 2. The worrying growth of Australian fire thunderstorms. The first major step-up is from January 2003.

This dataset is extremely worrying, as it shows that historically pyroCbs were rare, but that since 2001 their frequency in Australia is growing exponentially. This far exceeds any warning given by climate change scientists, who typically study computer models and then say things like "our study shows a 50% increase in bad fire days by the year 2050".

Black Summer confirmed the reality, with a doubling of the pyroCb count in one year, between February 2019 and February 2020.

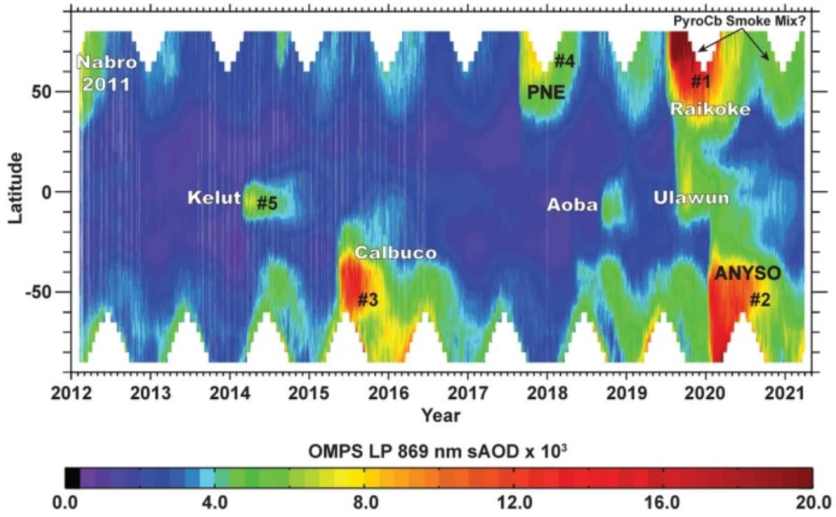
Many say that we are seeing more of these because our satellites are getting better. I can confirm that this not the case. Using hydrological data going back many decades, it was possible to infer that pyroCbs occurred in the ACT during the Gudgenby Fire in 1983. An atmospheric scientist collaborator from the US used satellite data on the aerosol load of the upper Troposphere to confirm this. This validates the link, and the hydrological data lets us see consistently back past the start of the satellite era. This use of hydrological data goes back to studies of the Gudgenby Fire[3].

[3] Kulik, V. (1990). Bushfire Hydrology: Runoff as an indicator of critical fire danger. Water Resources Development, 6, 44-54

B. The impact of bushfires on climate emissions, climate adaption, and biodiversity;

The smoke from ACT bushfires has validated the nuclear winter hypothesis and contributed to damaging the hole in the ozone layer. These are significant impacts, but not all of the impacts.

Fig. 10: Comparing ANYSO with all significant stratospheric plumes observed during 2012–2021.



Shading indicates daily OMPS LP stratospheric aerosol optical depth (sAOD) calculated in five degree latitude bands using extinction profiles at 869 nm. White labels indicate volcanic plumes and black labels indicate pyroCb smoke plumes. Numbers rank the five largest plumes in this record based on maximum sAOD.

Figure 3. A comparison of the upper atmosphere aerosol injections from Black Summer fires with those of large volcanoes over two decades.

Overall, and from many perspectives, the smoke from Black Summer fires was “off the scale”.

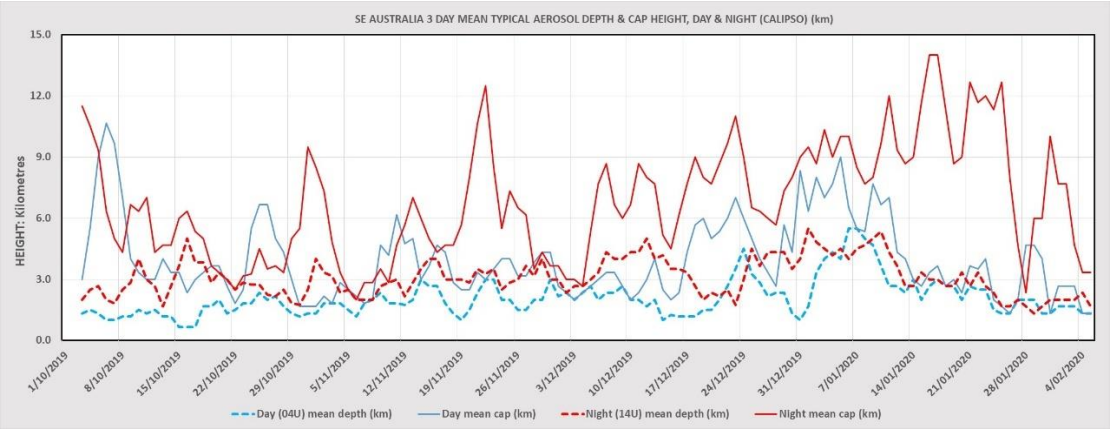


Figure 4. Trends in smoke layer depth across Black Summer.

In the core of Black Summer, the smoke layer stayed nearly 5km deep, with outliers up to 9km. Around the time of the Orroral Valley Fire the averaged outliers passed 12 km.

Canberra's air quality was widely noted as being the worst in the world.

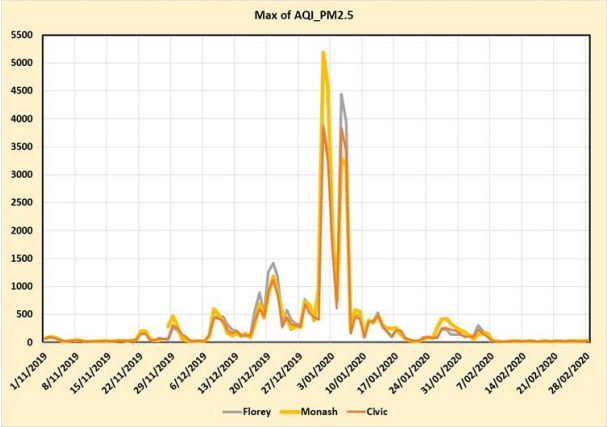


Figure 5. Air Quality Index (PM2.5μ) for Canberra. Normally 200 is the level for dangerous air quality.

The reason for the data in Figure 5 is remarkable. Satellite fire hotspot data from over twenty shows – as seen in Figure 6 – that the fire activity in the south-east coast exceeded the previous record by 700%. That smoke was constantly picked up by sea breezes and recirculated inland to places such as Canberra.

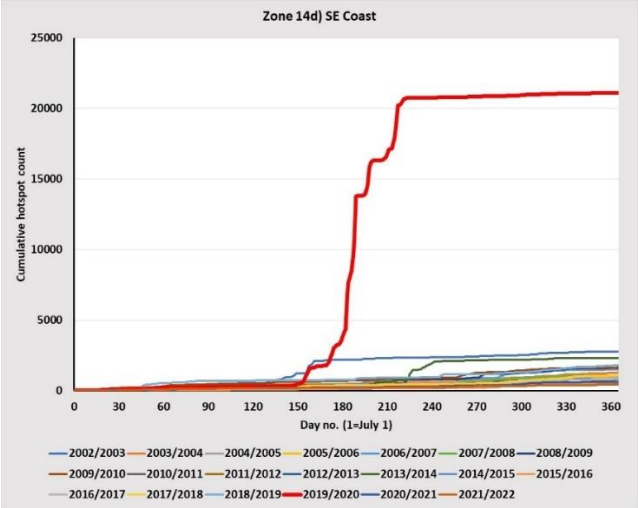


Figure 6. MODIS satellite hotspots data from the south-east coast, showing annual accumulation curves for over 20 years. Black Summer is shown in red.

With this recirculation, nowhere in the region had safe air quality. This has the potential to reshape what a bad bushfire season means, and to force a review of what the ACT does to plan for one.

Smoke dispersal models do not handle the recirculation at all.

Finally, smoke is having a greater impact on the community. Prior to Black Summer, Australia Risk registers listed heatwave as the worst natural hazard, and the bushfire, at about half that mortality. In Black Summer the estimated mortality was double that of heatwave.

C. Bushfire risk, resilience, and potential impacts, including consideration of the impact of bushfire on the ACT community, wildlife, and flora;

The ACT has had major wildfire outbreaks every two decades on average. 1939, 1957, 1983, 2003, and 2020. The fires during these outbreaks are getting worse and have bigger impacts.

It has now reached the point where it is impossible to rebalance the fire age spectrum across the landscape of Namadgi NP. Before enough post-fire years accumulate to permit ecologically sound prescribed burning, another extreme wildfire resets the clock over most of the landscape (Figure 8).

To clarify the problem, here is a plot of 20 years of MODIS satellite hotspot data (from NASA FIRMS) with the dot's radius set to shows radiated infrared power. The threat from Canberra's west is stark. (Why so many points show up in Kowen Pines is a curious question.)

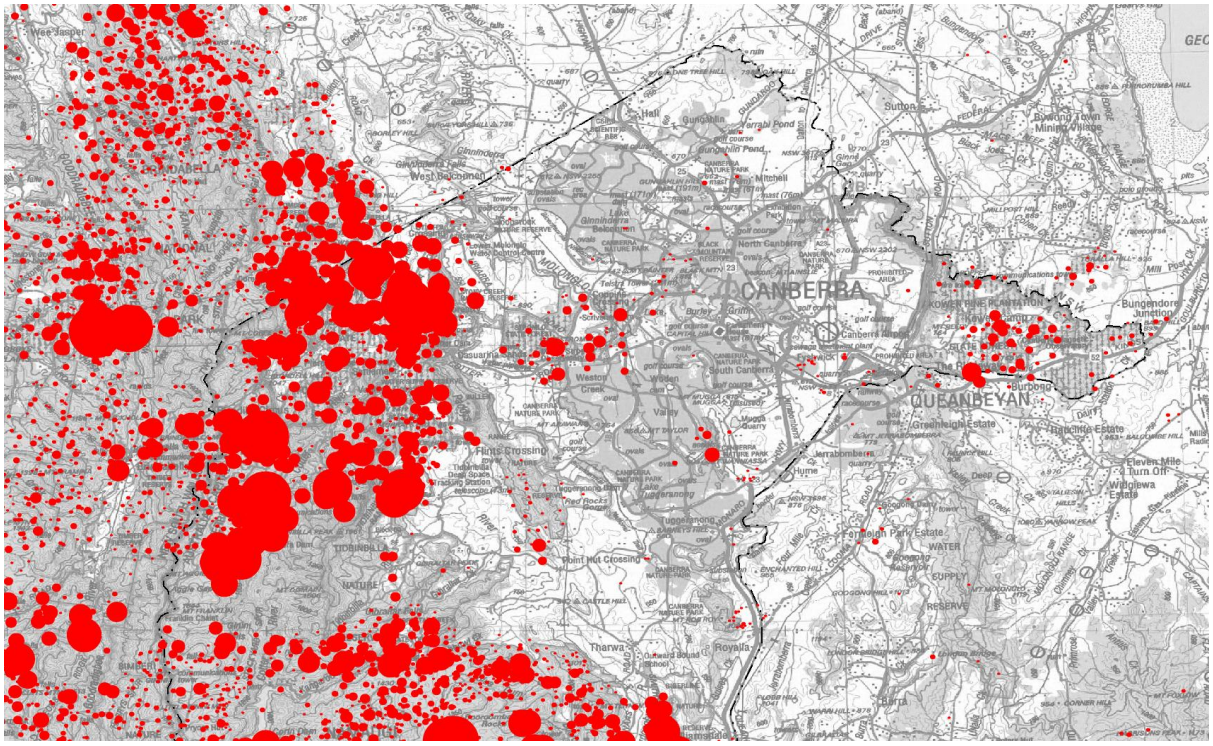


Figure 7. NASA MODIS satellite hotspot data for the northern ACT. This make quite clear the scale of the problem.

I conducted a post-fire regeneration survey after the 2003 fires. One of the goals in that work was assessing the return of fire fuel hazards. Even in 2015 this was barely underway (Figure 9). Structural complexities during regeneration make the return of potentially bad fire behaviour even more difficult to assess. That structure still largely reflects burn intensities during 2003 and 2020.

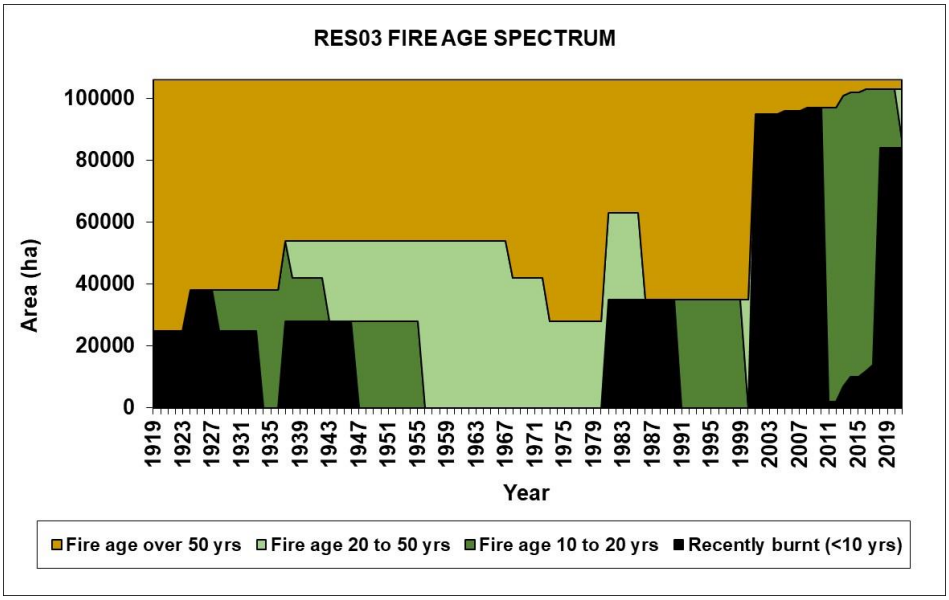


Figure 8. Distribution of major fire age classes across Namadgi National Park over the last century. This is based on ACT Government records.

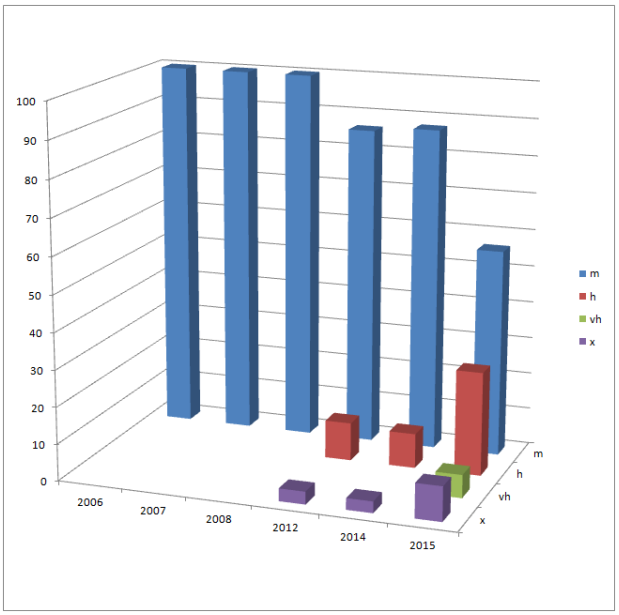


Figure 9. Return of fuel hazards levels after the 2003 wildfires. This shows the percentage of the area in four classes: m = moderate, h – high; vh = very high; and x = extreme.

Having described fuel dynamics, there is a major point to be made.

None of the predictive models for dynamic fire behaviour use fuel explicitly. There is a single implicit use of fuel in that there needs to be an unsuppressed fire to start the feedback loop.

It may be seen that fuel reduction burning does not have a major role in preventing dynamic fire behaviour. It is still a vital tool for normal fire risk mitigation[4].

Satellite data showed that for a prescribed burn to have an effect on major fires during Black Summer, they had to have been conducted within the previous 18 months. This is lot less than the normally applied "Inverse Olsen" fuel accumulation model indicates. In fact, a prescribed burning cycle reflecting 18-month repeats is completely uneconomic and ecologically very damaging.

Fuel reduction burning does not mitigate the emerging risks from extreme wildfires.

A blow-up fire event is where the fire locally couples with the atmosphere above. This is associated with the formation of deep flaming. Normal fire spread is by means of a fireline. Deep flaming is a large rectangle alight at one time – in 2003 we repeatedly saw roughly 5km by 6km alight. The energy release and the geometry of the fire plumes are very different to those of normal fires.

Deep flaming cannot be extinguished.

Deep flaming is key to later points in this submission.

Analyses show that these types of fire can penetrate the urban edge much more than can normal firelines. As an example, on 14 February 1991 a "normal" fire came off Black Mountain into Dryandra Street in O'Connor. It spotted into the backyards of the first line of houses. By contrast, on 18 January 2003 fires penetrated the urban edge by roughly a kilometre (in their direction of spread). This was through what has the technical term of an "Ember Storm", a result of low oxygen (non-stoichiometric[5]) combustion with regenerative embers forming within suburban garden beds.

Many report that such fires "make their own weather". A large event disrupts up to 12,000 cubic kilometres of the atmosphere. The 2003 fires plumes validated the Nuclear Winter Hypothesis. Black Summer fires affected the hole in the ozone layer. Climate Change impacts are on a scale much further than most realise – and it's getting worse.

There are seven known causes of deep flaming. Strong wind and wind change are long-standing fire ground safety issues. These are well picked up by normal fire weather

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[4] McRae, R. and Sharples, J.J. (2015). Assessing mitigation of the risk from extreme wildfires using MODIS hotspot data. Proceedings, 2015 MODSIM Conference, Gold Coast.

[5] Dold, J, Weber, R, Gill, M, Ellis, P, McRae, R & Cooper, N. (2005). Unusual Phenomena in an Extreme Bushfire. 5th Asia-Pacific Conference on Combustion, The University of Adelaide.

modelling. Eruptive growth and VLS arise from complex terrain interactions, and are now well understood and modelled. Dense spotting has been getting close scrutiny in recent years by fire scientists, as merging spot fires exhibit different behaviour. Many of the worst events in Black Summer arose from inappropriate use of drip-torches (under the auspices of the Incident Action Plan). The final mechanism (interior ignition) is from the Boreal Forests of the northern hemisphere.

Many of these were in play on 18 January 2003, one was discovered then.

Deep flaming interacts with the atmosphere above, changing the plume's behaviour. If the profile is unstable, then a fire thunderstorm may occur, reaching into the stratosphere, as happened here in 2003. Many commentators talk about these but get it wrong. The main threat is that what is going up is replaced by something coming down and in.

This leads to what is technically called "vorticity", and its worst manifestation was first seen here in 2003 with the fire tornado.

The wildland-urban interface of Canberra is tricky. Under the Federal Government, the urban design was based on basins bounded by "Hills & Ridges". This meant that almost every fire that reached the urban edge was backing downslope, with greatly reduced intensity, and able to be extinguished.

Figure 10. A fire backing down Oxley Hill towards the fire truck.

Now the new developments in the Molonglo Valley have drastically altered the risk equation. Residents of Molonglo and West Belconnen face a much higher bushfire risk than do those living in older town centres. A fire in the valley makes basically an uphill run, with the wind funnelled up the valley as well. In the 1990s, I often used this very scenario in Pre-Season Bushfire Workshops to get senior officers thinking about the hypothetical worst case. Now it has been created.

In fact, as I write this submission, I have learned about Stromlo Reach. The potential for a massive fire run up from the Murrumbidgee River is enormous – see Figure 11. With a

rise of 170m over a distance of 3.4km, this is the worst exposure to a running wildfire in the ACT, surpassing even the seriously flawed designs between Strathnairn and Ginninderra Falls.

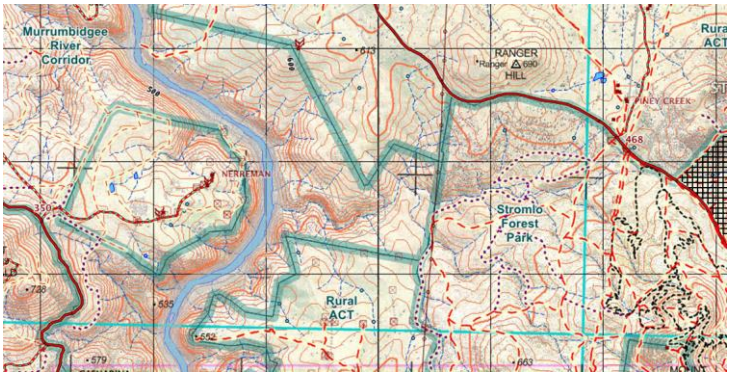

Figure 11. There is a serious potential for an uphill run straight into Stromlo Reach (cross-hatched).

The Standards for Building in Bushfire Prone Areas are not appropriate for Canberra, and certainly do not reflect attack by Extreme Wildfires. Despite ACTGov paying consultants a lot of a money in recent years, the houses in our new WUI are not safe.

This reflects the inland topography of Canberra, which is different to that of coastal cities. It also reflects Ember Storms, which were not included in the standard. Rather, the standard reflects ember attack – which is like a mortar shell. Ember Storms are like a fluid flow over the ground.

Figure 12. Ember storm on the NW corner of Duffy, from the Nine News video by Richard Moran.

Workshops have been held over the years with those responsible for the standard, discussing the science. To no avail. Our claims have been accepted but no changes have occurred to the codes. Families are being put at risk needlessly because of the Standard.

A major discovery from the 2003 fires was what is now called “Vorticity-driven Lateral Spread”, or VLS[6]. VLS arises from wind-terrain interactions first seem in the McIntyres Hut and Bendora Fires, and now known to be the major cause of wildfire damage in complex terrain, globally. The Majura Valley may not be complex terrain (as mathematically defined – see http://www.highfirerisk.com.au/maps/index.htm for a technical description of terrain modelling). However, the western edge of Canberra most certainly is, and new suburban developments in recent years are all closer to problematic terrain – see Figure 13.

It must be noted that early versions of many of the concepts discussed here were included in the Territory’s Strategic Bushfire Management Plan. In subsequent edition they were removed and replaces with strategies solely based on normal fire behaviour. This did a serious dis-service to the ACT community. The science was done in Canberra and is increasingly being used in other countries.

[6] Sharples, J.J., McRae, R.H.D. & Wilkes, S.R. (2012). Wind–terrain effects on the propagation of wildfires in rugged terrain: fire channelling International Journal of Wildland Fire, 21, 282-296

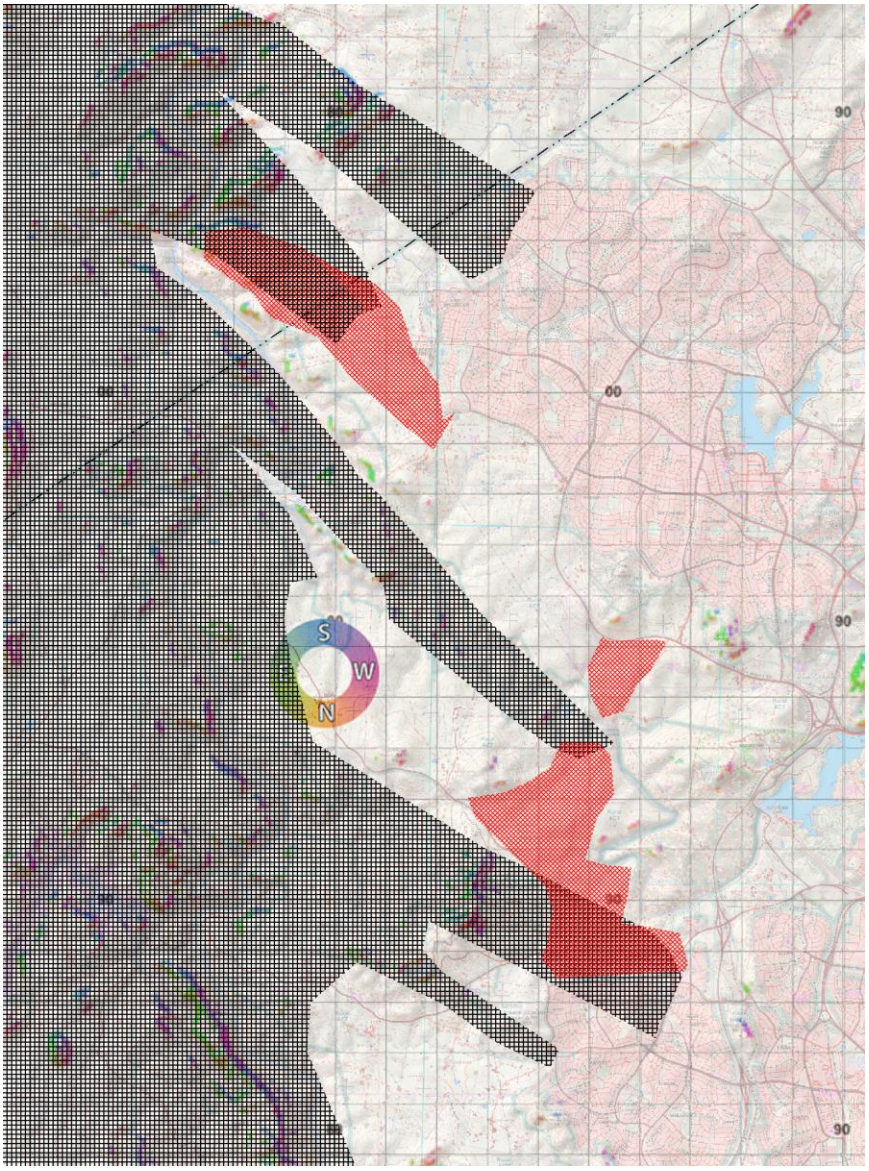

Figure 13. Stylised areas under severe threat from ember attack from fire entering VLS-prone lands (Black hatching). Also shown are new suburban areas (red hatching). Note also that many major egress routes cross black hatched areas. Future western expansion plans have not been included.

D. Management of bushfire risks and bushfire preparedness of ACT parks, reserves and other open spaces, including: i. preparation and planning by government, the community and other entities; ii. current and historical approaches to land management; and iii. the role of cultural land management practices;

Decades ago, I conducted an analysis, under the auspices of the ACT Bush Fire Council[7], that showed that the frequency of a fire ignition around the ACT drops off exponentially with the distance from the urban edge, in a way that reflects the land use. This made it clear that some land-uses were more problematic than others.

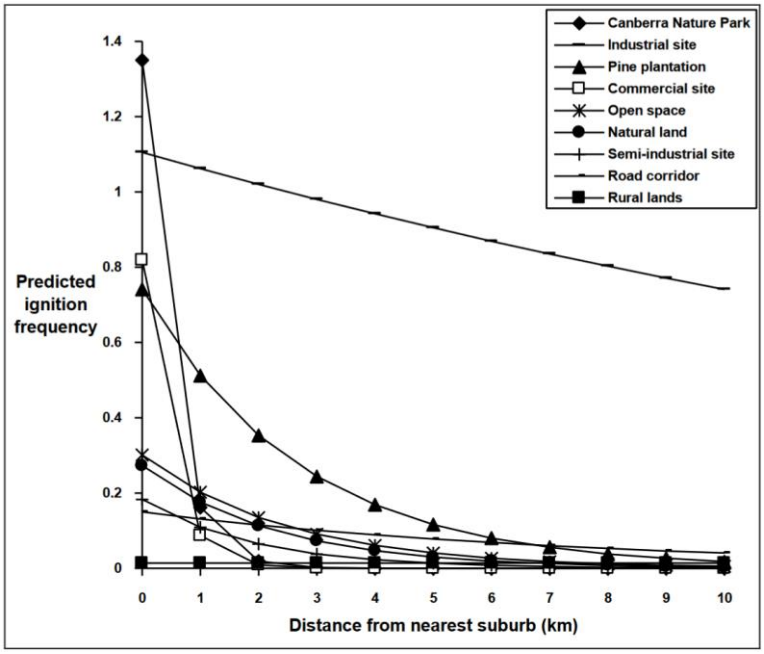

Figure 14. Fire ignition frequency analysis, based on distance from urban edge and land-use type.

Industrial and commercial sites have no visibility out of hours. Rural lands are well fenced and have few fires. The remainder are Government land.

After the 2003 fires, and still to today, absolute ignition frequencies dropped by large amount. It was presumed that the community was too scared of fire for a culture of "messing about with fire" to persist. This shows that a suitable public education approach can be effective in reducing fire service call-out rates.

[7] McRae, R.H.D. (1995). Analysis of rural ignition patterns on Canberra's urban/rural interface. CALM Science, Supplementary 4,

G. Cross-border risks and issues, particularly engagement with New South Wales and the Commonwealth;

One of the key issues with suppression of the fires in 2003 was that they kept making runs to the west. This had never been seen before in this region. The main reason that this was problematic was that effective assets in place to aid in fire containment were all based fires coming from a westerly-to- northerly direction. Figure 15 shows a somewhat more favourable configuration for the Stockyard Spur Fire, but options were too sparse to be useful.

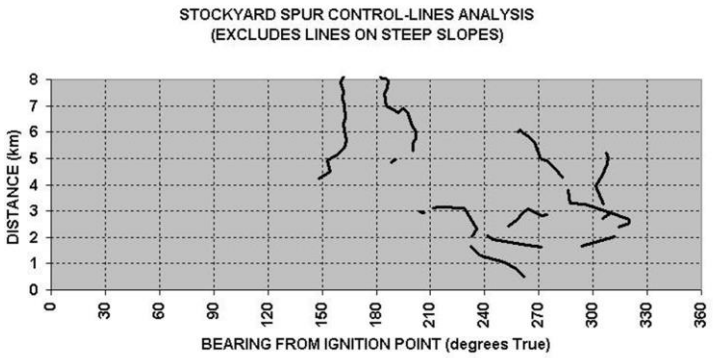

Figure 143. Polar plot of control options around the Stockyard Spur Fire.

Figure 15. Plot of control options using distance and bearing from the ignition point of the Stockyard Spur fire on 8 January 2003. While most were in the "upwind" direction, they were too sparse to be useful.

A far more worrying situation occurred on 4 January 2020. The worst fire day that the planet has seen in modern times occurred, with nearly 100,000 hectares burning per hour in south-east Australia[8]. Five massive parallel forest fire runs bore done on Eden from the southwest as the front approached. Eight fires runs ran inland – to the north-west – from near the coast as well, nearly reaching towns such Mittagong and Wentworth Falls. No planning has ever been done for this situation in south-east Australia.

[8] Peterson, D.A., Fromm, M.D., McRae, R.H.D. *et al.* Australia's Black Summer pyrocumulonimbus super outbreak reveals potential for increasingly extreme stratospheric smoke events. *npj Clim Atmos Sci* **4**, 38 (2021). https://doi.org/10.1038/s41612-021-00192-9

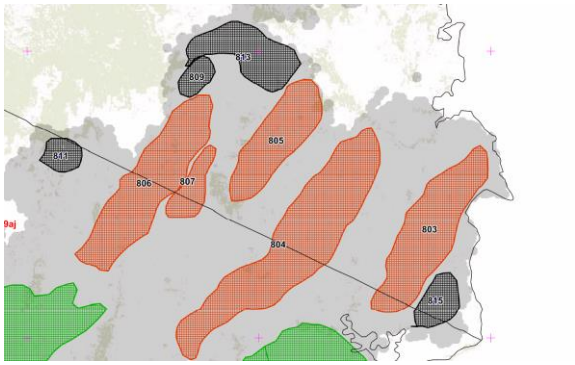

Figure 16. Plots of fire run to the north-east south of Eden, 4 January 2020.

It is not practical to re-engineering fire trails or the relocation of key assets such as communications facilities. On that matter, the Mt Clear radio facility was surrounded by fire in 2002. Most commentators ascribe that to the Orroral Valley fire, however the theory of VLS shows that it was due to a long-range spot fire from the Yaouk Peak Fire in NSW. This further shows the changing nature of fire behaviour.

This is not something to be solved by pushing responsibility to NSW - even though this century the ACT has been repeatedly, severely impacted by their fires: McIntyres Hut Fire, Mt Ginini Fire, Broken Cart Fire, and Yaouk Peak Fire. They have been impacted by our fires: Bendora Fire, Stockyard Spur fire, and Orroral Valley Fire

Other issues of relevance for the Committee to consider

Another major result from studies into 2003 was the world's first confirmed fire-tornado[9]. Pyro-tornadogenesis requires a large pyroCb, with lots of vorticity. While many claims have been made around of other fire tornadoes, only two not-fully confirmed events have any credibility. While writing the science paper on the 2003 event, we noted that fire whirls can be more dangerous, as 35,000 people were killed by one after the Great Kanto Earthquake in Japan in 1923. However recent analyses suggest that that was a true pyro-tornadogenesis event. That would make this one of the most serious hazards on any risk register. And Canberra is the holotype event.

[9] McRae, R., Sharples, J., Wilkes, S. & Walker, A. (2012). An Australian pyro-tornadogenesis event Natural Hazards, 65,1801–1811.

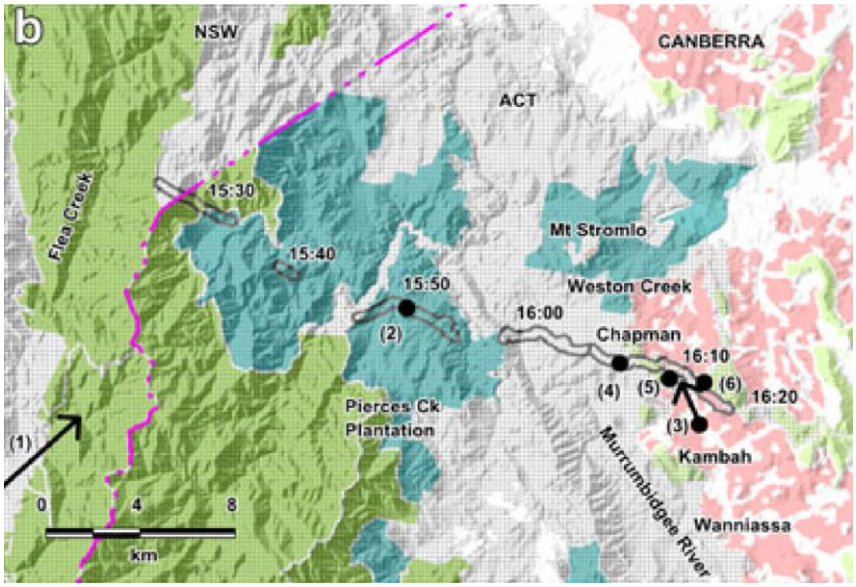

Figure 17. Mapped pyro-tornado path from 18 January 2003.

The path followed by the vortex in 2003 (Figure 17) shows that, had the mid-level steering wind backed by one degree, then that day would be remembered for hundreds of lives lost to an unprecedented event (oh, and there was a fire as well).

And now we aim to build new suburbs in such places. And with high proportions of housing for low income and disadvantaged families.

The regional road network was found to be vulnerable during Black Summer. At one stage, because Canberra's petrol now comes from Sydney by truck, an analysis was conducted of wildfire threats to the highways. The only road open to B-double petrol tankers was Macquarie Pass – a dubious proposition in normal circumstances. Fortunately, other roads were re-opened soon after. The Canberra community has not been made aware of these risks. The use of a NSW website for real-time monitoring is not sufficient.

For extreme wildfires, elevated risks evolve across our entire region. This makes clear the folly of driving to the coast – or anywhere else. Canberra needs a well-thought-out strategy for keeping the community safe during future extreme wildfire attack. These plans need to be well thought out, well-practiced, and well-advertised. In 2003 we needed to make such plans at 10pm on the night of 17 January. In part this is because the type of fire attack due to strike had never been recognised anywhere. How can you plan for the unknown? Well now it is known, and most lessons have in fact come from the Limestone Plains.

A new predictive framework for Extreme Wildfires has been developed – here in Canberra. See http://www.highfirerisk.com.au/hpf/ I termed a key component of this, that assesses warming due to Climate Change, the "Canberra Dipole". This confirms Canberra's place in the epicentre of climate change's impact on bushfires. It will be noted that using Black Summer Canberra's twelve-month averaged temperature anomaly reached 3.0°C – a globally significant number. Note that that is relative to conditions between 1961 and 1990 (used by BoM as a climate benchmark), a much shorter timeframe than that used by the IPCC.

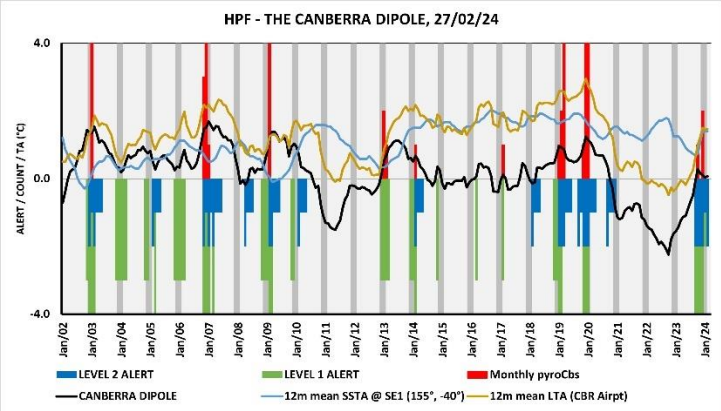

Figure 18. Canberra Dipole time series. It is explained on the web site listed above. Note the brown and blue lines – the twelve-month average land and sea temperature anomalies. These have been rising steadily since a "hockey stick" inflection point in 1997.

So, it is not surprising that Canberra residents think that their properties are safe from bushfires. (They are not.) Fuel management by prescribed burning is effectively non-existent due to the effects of Black summer fires.

Canberra Residents think that fire danger ratings are less severe than what they are.

New suburbs are being built or planned in places that traditionally were seen as off-limits - at the same time that climate change is making the threats to those places far worse. "The Australian Standards and Building Codes will keep us safe".

And as has been noted it is folly to head to the coast – but not for the reasons usually suggested.

Any community complacency reflects Government complacency. This must be remedied.