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Paper 7B

THE WILDFIRE MANAGEMENT OVERLAY EXPERIMENT (WMO)

The Bushfire Management Overlay (BMO) is an amalgamation of two planning instruments. The two original planning instruments WMO and AS3959 were based on distance of the house site from nearest vegetation (Leonard et al 2009). The key features of the WMO are analysed below and Paper 7C analyses AS3959.

The WMO process required a Wildfire Management Statement that was in three parts (WMO Applicant's Handbook, 2010, CFA)

- Detailed description of existing conditions
- Identify house site location to reduce the "bushfire risk as much as you can by choosing the dwelling site carefully. Bushfire risk varies depending on the slope and vegetation characteristics."
- Site assessment process
  - Identify nearest vegetation type within 100m and make calculations defendable space according to wall of flame in vegetation (includes inner and outer zones)
  - Automatic assignment of BAL depending on nearest vegetation type, ie, BAL 12.5 for cultivated gardens and grasslands and BAL 29 for all others
  - Automatic prescriptions for vegetation in inner and outer zones
  - Standard water supply and access requirements

If the site cannot meet requirements of site assessment process, prepare alternative solution (= Option 3)

Thus, the WMO process required a description of local site conditions and rationale for site selection, but the main focus was on site assessment process and calculation of defendable space and BAL based on wall of flame in nearest vegetation. WMO allowed alternative method if distance to vegetation was less than defendable space requirement. This Paper focuses on the core features of the site assessment process. We firstly outline the core features and then assess them for merit.

CORE FEATURES

The WMO was designed to protect new houses near forest fire risk. Why forest? CFA said risk in other fuel types can be treated by other means. The CFA said statutory planning and building controls are an appropriate treatment to protect new houses near forest fire risk Buxton et al (2009).

The WMO narrative

The WMO method applied within a WMO area if forest or heath vegetation was nearby, ie, within 100m of the house site. The vegetation was deemed to be at maximum fuel load so they could calculate a wall of flame with maximum flame height. The actual condition of the vegetation was not relevant for the WMO process.

The WMO narrative was as follows – a wall of flame advanced with the prevailing wind direction through the nearby vegetation as a major crown fire, emitting radiation and throwing embers towards the house. WMO protected the house by inserting a defendable space wide enough to absorb all the embers, to prevent flame contact on the house and to ensure maximum incident radiation from the wall of flame was 29 kW / sq m. WMO assumed the flame stopped at the outer edge of defendable space.

The wall of flame was the only source of danger, and it generated flame contact, radiation and throws embers. Wall of flame was assumed to be wide and flame height was calculated by equations. The surface area of the wall of flame and the separation distance were used to calculate the incident radiation on the house wall. Separation distance was adjusted so that maximum radiation level on the house was 29 kW / sq m.

The defendable space specifications reduced fuel load on the ground with the aim of reducing fire intensity, and thinned out shrub cover and tree cover to prevent crown fire in the outer zone. It was deemed to be wide enough to absorb the embers and thereby protect the house from ember attack.

Stated aim of WMO

The purpose of the WMO was "to ensure that new development does not significantly increase the threat to life and surrounding property from bushfire" (WMO Applicant's Handbook, 2010, CFA).

The purpose of the WMO was to:

- Identify areas where the intensity of wildfire is significant and likely to pose a threat to life and property
- Ensure that development includes specified fire protection measures and does not significantly increase the threat to life and property from wildfire
- Detail the minimum fire protection outcomes that will assist to protect life and property from the threat of wildfire.

The WMO concept was very similar to the NSW RFS concept.
"WMO is designed to target forest fire risk. The WMO identifies areas where there is the potential for loss of life and property in a 1:50 year fire scenario. Under this fire scenario, development requires special protection to withstand the passage of the fire. This protection includes moderating the intensity of the fire by carefully locating buildings away from vegetation, vegetation management and aiding fire suppression through the provision of water and access for emergency vehicles. The WMO ensures that these fire protection measures are incorporated into new development" (PN21, 2010)
Compare this with:
"Assessment assumes a worst case scenario where there is no fuel management, fire history and an absence of any other mitigating factors. The 1:50 year fire weather scenario for the State was determined for NSW as FDI=80. This is believed to occur with reasonable frequency in most local government areas in NSW" (NSW RFS 2001).

Site assessment process to calculate defendable space

First, the WMO process identified the vegetation type within 100m of the house site, and prescribed it with maximum fuel load (no matter what its actual condition was) and worst case weather conditions (Fire Danger Index - FDI 120).
Next it calculated rate of spread
Then, rate of spread and fuel load calculated Byram's Fireline Intensity
Then, Byram's intensity calculated flame length.
Flame length was used to calculate incident radiation at the house site, assuming 100m wide flame front.
Finally, it adjusted the separation gap to achieve incident radiation of approx 29kW / sq m and this became the outer zone width. The outer zone was adjusted according to aspect and slope. The inner zone was 10m and they added together to become the defendable space.

WMO Specifications

- **Defendable space**

Inner zone Width was 10 metres, manage fuel load in vegetation on ground and elevated to reduce fire intensity. Key specifications of the inner zone were grass height must be less than 10cm tall, leaf litter must be less than 10 mm deep and no shrub cover on half the zone and sparse shrub cover on the rest.

Outer zone** Width variable, according to above calculations. The outer zone specification of low fuel load on the ground reduced fire intensity and also required "no elevated fuel on at least 50% of the Outer Zone" (WMO Applicants Handbook, 2010, CFA)

** **Outer zone vegetation** management requirements were developed with the retention of native vegetation in mind and derived such that maximum native vegetation retention could occur while at the same time eliminating the chance of a canopy fire. The VBRC Final report (VBRC, 2010) however was critical of the way CFA expressed its standard vegetation management conditions and their potential for misinterpretation (p.238, VBRC, Vol.2). They also considered life safety should not be compromised by the retention of vegetation, a position supported by the Victorian Government and CFA's responsibilities under Section 20 of the Country Fire Authority Act 1958 (Douglas 2011, in AN44)

Note: Both inner and outer zones were, by default, continuous fuel bed, ie, the specifications did not require discontinuity.

- **House construction standard** It specified fortification for the house at BAL 29 level (refer AS3959 – Paper 7C)
- **Access** was to enable safe fire tanker access
- Provide supplementary **water supply** for tankers

ANALYSIS

Was the WMO narrative realistic?

The narrative proposed an image of a house site surrounded by a defendable space in the middle of a high fuel load forest. The approaching crown fire hit the defendable space and flames came to ground. This forest scenario may have occurred in some areas, but the more common landscape was a mixture of forest patches, dispersed among paddocks with scattered trees. The house site may have been among scattered houses or within urban clusters. Whether a wall of flame marches across the landscape depended on wind direction, topography and fuel bed continuity. The more common worst case bushfire scenario in a mixed landscape was multiple leapfrog spot fires, as the Royal Commission evidence described and as the author personally observed in Black Saturday. If flammable fuel or vegetation was upwind of the house, it can potentially generate three threat agents if close, or just ember threat if distant.

Conclusion: The WMO's narrative addressed one uncommon scenario, at the extreme end of the range of possibilities. It did not address the most common worst-case bushfire scenarios.

In essence, how did authorities believe WMO would protect the house?

According to the Royal Commission, the CFA's defendable space provides 'an area of protection from radiant heat, direct flame contact and ember attack' (VBRC, 2010). But Buxton et al (2009) quote CFA documentation that the WMO was designed to reduce dwelling ignition from ember attack rather than direct flame and radiant heat (which are addressed through the Building Code of Australia). "The WMO does this by introducing a number of vegetation and siting requirements aimed at increasing setbacks to create enough distance to ensure that a dwelling is likely to be clear of wildfire's ember attack zone" (from Maughan D. and Krusel N. (2005) WMO Site Assessment Methodology – A Technical Overview (Revision Wednesday April 20 2005, quoted in Buxton et al (2009). This suggests the CFA believed all the embers came from the wall of flame and fell within the defendable space, ie, none would reach the house. It did not envisage any other ember source. Because WMO's maximum radiation is 29 kW / sq m, the CFA expected a taller wall of flame will create a higher risk, but the calculations will ensure defendable space is wider, which allows extra distance for ember capture.

Authorities believed defendable space width protected the house by reducing radiation to 29 kW / sq m and the house will be protected by fire resistant materials and construction design standards at BAL 29 level.

The outer zone specification of low fuel load on the ground reduced fire intensity and also required "no elevated fuel on at least 50% of the Outer Zone" (WMO Applicants Handbook, 2010, CFA), believing it would prevent crown fire.

Authorities believed that the other two WMO provisions - access for fire truck and a reserve tank of water – made it safe for fire brigade to attend and thereby provide further house protection.

Were the WMO beliefs realistic, ie, did they identify actual threats and treat them?

The belief in the WMO assumptions was absolute, but they did not have factual or scientific or logical credibility. For example, (1) the maximum defendable space was 100m and it has been long known that it is physically impossible for all the embers in a severe bushfire attack to be absorbed within 100m. The potential range of ember throw is well known to be several km. (2) Radiation might be reduced to 29 if the wall of flame was stopped, but there was no requirement to construct fuel free areas to prevent the flame running into defendable space. It assumed the low intensity flame inside defendable space would not threaten the house, even though specifications allowed (ie, did not disallow) flame height up to 1 – 2m on the entire defendable space. (3) Specifications to prevent crown fire per se assumed percentage cover of elevated vegetation on half the defendable space was sufficient. They omitted the obvious one - avoidance of ladder fuel. (4) Its assumption that the site will be safe for fire trucks might have been in hope more than fact because fire agencies have not guaranteed fire brigade attendance for many years, and this was confirmed dramatically again on Black Saturday (VBRC, 2010).

Conclusion: Beliefs were not meaningful because they relied upon non-credible assumptions

Specifications for WMO Defendable space - What fire behaviour changes did they deliver?

Defendable space had two zones to separate the wall of flame from the house site. The purpose of inner zone was presumed to reduce fire intensity. The outer zone stated purpose was to prevent crown fire. There are two types of crown fire – active and passive (literature summarised in O'Bryan, 2005). An active crown forest fire consumes the entire multi-layer fuel beds from ground to crown as a single flame and moves through it in proportion to wind strength at mid-height. A passive crown fire occurs when a flame runs up the trunks (flammable) into the canopy. It remains as a stationary flame until it burns out. It is therefore presumed the defendable space was aimed at preventing an active crown fire. The WMO narrative assumed the nearest forest carried a high fuel load and that active crown fire occurred, but documented evidence indicates that active crown fires are rare in taller eucalypt forests (literature summarised in O'Bryan, 2005). Typically, a moving surface fire ignites the base of flammable trunks as it passes, creating a succession of trunk fires, some becoming passive crown fires. Active crown fires can occur under strong winds in dense heathy woodlands, in dense tall heathlands and in dense unpruned, unthinned pine plantations.

Specifications required maximum tree cover %, but using vegetation cover is not an acceptable method to assess and manage fire risk in forest and has no fire behaviour science to support it. The specifications can be puzzling. Eg, compare the specification for the outer zone ["There must be no elevated fuel on at least 50% of the Outer Zone"] with the WMO definition of forest ["canopy cover greater than 30%"]. Thus WMO could have specified higher cover than existed originally.

It is well known that flame behaviour within the defendable space was determined by the status of fuel bed on the ground. Key specifications of the inner zone were - grass height must be less than 10cm tall, leaf litter must be less than 10 mm deep and no shrub cover on half the zone and sparse shrub cover on the rest. The outer zone was identical except it allowed 20mm deep litter bed. In worst case weather, flame height in 10cm dead grass is over 1m, and in 10mm litter bed is at least 1m, and in 20mm litter bed up to 2m. Thus allowable flame height in the inner zone could be 1m tall and in the outer zone up to 2m tall. Low flame height will prevent a crown fire, but the WMO specification of "no elevated fuel on at least 50% of the Outer Zone" was too imprecise to have prevented an active crown fire. More specific terms like - low density tree cover / low density shrub cover / remove ladder fuel would be required to mimic a practice used by forestry managers to prevent crown fires in pine plantations. Furthermore, there was no provision for fuel bed discontinuity in defendable space. The specifications of both zones allowed (ie, did not prevent) continuous fuel bed between edge of vegetation's wall of flame and the house site. This meant the WMO system overlooked the flame that proceeded right up to the house wall (O'Bryan 2006). Although it was a lower height than the artificial wall of flame, it was still a flame of the same temperature 1000^0C.

Conclusions: The specifications allowed low flame height within defendable space, but failed to protect the house from low flame. Furthermore, the crown fire prevention specification was too vague to have been effective.

Did the specifications achieve the WMO aims? NO

In regard to ember protection, defendable space did not reduce ember attack on the house site. In regard to flame contact and maximum radiation, the specifications could not guarantee a maximum level because they did not require fuel bed discontinuity, which allowed a 100kW / sq m flame to reach the house.

Equations used for calculating radiation levels

This Paper now examines the calculation process and equations in detail for two reasons - to understand the thinking behind the calculations and because some equations have been incorporated into the BMO.

Steps

1 Identify the vegetation type by WMO categories within 100m of the house site.

2A For forest and woodland, calculate rate of spread with **R=0.0012 *FDI*W**,
2B Calculate Byram's Fireline Intensity - **BFI = H x fuel load x R**
2C Calculate flame length with **Lf = 0.0775 x BFI^0.46**

3 Calculate radiation from flame length or height using View Factor equations
WMO assumed wide front radiating at 120 kW / sq m.

Calculation process for flame length in the wall of flame in closest vegetation
The calculation process essentially estimates flame length from rate of spread but there is no evidence in fire behaviour science that flame height is causally related to rate of spread. The non-causality can be illustrated with the CSIRO grassfire Chart. For given weather conditions and fuel bed, rate of spread is causally dependent on wind speed, and flame height is causally influenced by fuel load or height. For example, if rate of spread is 10 kph, flame height can range between 3.6 and 0.7m. Therefore, the process of deriving flame height from rate of spread is flawed.

Some research findings have presented chart of flame height or length on the y-axis against rate of spread on the x-axis (eg, Luke and McArthur, 1978 for litter bed fires). Typically in science, the x-axis is the independent variable that has an influence on the y-axis, but in these cases, they are both independent variables. Flame height is an outcome of identifiable factors and rate of spread is an outcome of identifiable factors, some different. The charts are simply presenting coincidental findings, but some people have interpreted it as causal. Luke and McArthur (1978) showed how the chart varied with wind speed, generating a lower flame height as wind speed increased. This alone suggested the interrelationships were complex.

Sequence of calculations and the quality of the science:
The WMO architects were clearly seeking to arrive at a justifiable peak flame height in an objective way, but their choice of equations ignores basic scientific principles like design criteria and design purpose, which lead to relevance and validity.

First step was to calculate rate of spread for forests and woodland. It used the Noble et al (1980) equation **R=0.0012 *FDI*W** and adjusted it for slope (slope adjustment is discussed in detail in Paper 7C). The equation accurately represents McArthur's fire behaviour chart. The McArthur chart used two input variables - FDI up to 100, and surface fuel load up to 25 t / ha to produce three relevant output variables, rate of spread up to 3 kph and flame height up to 14m and spotting distance. The WMO used FDI 120 and applied this formula to a wide range of forest and woodland fuel types including short and tall forests, dense, open and sparse canopy cover and dense, medium and light shrub understorey. The prescribed fuel loads went up to 40t / ha. Technically, such application is scientifically invalid:
(1) McArthur's Meter was designed for a tall open forest with predominantly litter bed fuel, ie, scattered shrubs (McArthur, 1967). He said shorter and more open forests will have a higher rate of spread, but he did not quantify them. It is scientifically invalid to extrapolate these formulae beyond these criteria. Yet the fire authorities extrapolated them.
(2) W is technically the mass of fuel consumed in the flash flame phase in the surface fuel layer – litter bed and short shrubs, not the total fine fuel load in the forest. McArthur proposed a fuel load correction for light shrub layer (McArthur, 1967) but provided no authorisation to allow extrapolation to include dense shrub layers, bark and tree canopy. Yet the fire authorities extrapolated.
(3) WMO used FDI 120. McArthur set FDI at a maximum of 100, to reflect the worst weather day, knowing very well that the weather range he used to define it calculates on his own Meter at 120 (refer McArthur (1967). He seems to have meant as an approximation, not an exact reading. It can be deduced that McArthur would still expect a worst weather day to be 100.

Thus, WMO used the McArthur chart equation beyond its design capability, clearly loading up the input variables to generate a higher rate of spread number that was used to generate a higher flame length.

The WMO architects were well aware of recent research that rendered the McArthur chart and the Noble et al (1980) rate of spread equation invalid, but they continued in spite of it.
(1) McArthur's fire behaviour chart was based on his unverified theory that ROS is proportional to fuel load. Burrows (1999) and Project Vesta (2007) confirmed that the theory is disproved, which means the W adjustment for fuel load is invalid and rate of spread is dependent on wind speed not fuel load.
(2) Project Vesta (2007) confirmed that in a wind driven flame in litter bed, the flash flame phase consumes the top layer of the litter bed and that after the flame front has passed over, the deeper layers burn downwards with a smaller stationary flame. If the litter bed load is thin (eg, 5-10 t / ha), it is likely that the whole litter load is consumed, but if the litter layer is deep, only the surface 5 – 10 t / ha contributes to flame behaviour. This means the McArthur fire behaviour chart possibly remains valid for the 5 – 10 t/ha loads, but CSIRO web site has an on-going note that the whole chart still under review.
(3) If the aim of WMO architects was to generate a higher rate of spread, they were blinded to actual fire behaviour realities. Consider this. Despite McArthur's own findings, several observers have confused the speed of a head fire flame with leaf frog spot fire spread. This is where astonishing forest fire rates of spread figures like 10+ kph come from (described in O'Bryan, 2005). The equation allows determined people to invalidly increase fuel load to achieve high rates of spread. In reality, the rates of spread of a line of fire in forest on a severe day are much lower. For example, assume the McArthur is valid for fuel load 10t / ha. When FDI is 100, the Meter's peak rate of spread is around 1.2 kph. This figure is much more realistic for a peak head fire speed within forest. It agrees with the author's observations of individual (large) spot fires in the Mt Disappointment forest on Black Saturday. The author has also estimated peak rate of spread of the leading leap frog spot fires were 15 – 20 kph. The concept of two different rates of spread is found in McArthur's original research (McArthur, 1967). He described how the main fire ran at 1.2 kph and he successfully calibrated his equation against it. It then threw spot fires several km ahead. When they established, they threw spot fires several km ahead. Thus there were two rates of spread - the peak rate of spread of each fire front (1.2 kph) and the peak leap frog rate of spread of the leading fire ((12 kph). The McArthur Meter applies only to the fire front speed.

Thus, the WMO did not recognise that the Noble et al (1980) equation is superseded and now technically invalid and therefore not suitable for use in government policy.

The second WMO calculation was flame height, but surprisingly, Noble et al's (1980) flame height equation for eucalypt forest was not used **Z = 13 x R + 0.24 x W – 2**. Instead, WMO used two of Byram's equations to calculate flame length. Byram's first equation used fuel load consumed by the flash flame and rate of spread to calculate Byram's fireline intensity (**BFI = HWR**). Byram's equation is designed for a ling line of flame to calculate average heat release rate for a metre wide slice through the depth of the fire front. But the WMO model used total fuel load in an artificial maximum loading. WMO also used inflated rate of spread that related to leap frog rate not line of flame rate. Thus the calculated BFI was not only super inflated but also invalid. Byram's second equation used BFI to calculate flame length. Unfortunately, The WMO designers failed to understand that Byram's equation was designed for a low intensity litter bed fire in a loblolly pine forest in the USA. It has not been calibrated for eucalypt forests or shrub lands in Australia. Moreover, Byram (1959) specifically said it was designed for lower intensity fire scenarios and not suitable for worst case bushfires. Therefore, its application in the WMO process was invalid.

In conclusion, it seems that these WMO equations were intended to generate artificially high flame height in the wall of flame. But they had no scientific validity. There was no requirement for them to be verified or related to on site reality. Yet this pseudo science / junk science became the basis of government policy decisions.

Which causal threat agents did the WMO treat?

Paper 3A specifies the two causal threat agents in severe bushfires – primary (flame and embers from the fire front) and secondary (flame and embers from the urban flame).
The WMO was said to mitigate all three of the casual agents deriving from the fire front, ie, it was said to address the primary causal agents. The secondary causals were not addressed. Eg, the WMO Workbook classified a cultivated garden as low risk, and allowed (ie, did not disallow) grass and litter fuel within close proximity to the house as a continuous fuel bed.

How did WMO mitigate primary threat agents?

Flame front - flame contact and radiation

WMO regarded the wall of flame in the adjacent vegetation as the fire front, and regarded it as the source of flame contact, radiation and ember attack. It said it managed flame contact and radiation by establishing defendable space. Defendable space ensured radiation from the wall of flame did not exceed 29 kW / sq m at the house site. The outer zone was designed to be a low intensity fire, and it drew the crown fire to the ground, thereby reducing both flame length and radiation. As discussed above, the specifications allow (do not disallow) a flame to run unhindered up to the house wall.

Flame front - embers

WMO documentation said defendable space was wide enough to absorb embers from the wall of flame in the adjacent forest or shrub. Thus, no embers would fall onto the house. This scenario assumed that the wall of flame in adjacent vegetation was upwind of the house and that the vegetation patch could generate embers. However, (1) Luke and McArthur (1978) said short distance embers in severe forest fires are high density for the first few hundred metres and then reduce over the next 2 – 3km. This meant many embers would fall onto the house from the wall of flame. (2) Embers would fall onto house from other sources. Luke and McArthur (1978) document short, medium and long distance ember attack from upwind sources. Any and all could fall onto the house.

How did WMO mitigate secondary threat agents?

Houses within an area of cultivated garden beds and houses in grassland were excluded from the WMO area. In other cases, specifications for inner and outer zones do not envisage urban flame or ember threats.

Urban flame - flame contact and radiation

Houses with established flammable shrubby garden beds could be readily ignited by embers and therefore flame contact and excessive flame radiation were not un-expected. In addition, non vegetation urban flame sources were not considered, but if they were close to the house, flame contact and radiation would be excessive.

Specifications allowed continuous fuel bed within defendable space. The following two worst case flame scenarios were foreseeable. Firstly, the wall of flame entered the defendable space and ran through both zones to the house. Secondly, the embers from the wall of flame fell in the inner and outer ones and ignited as spot fires and also run towards the house. If a 1m flame from the inner zone reached the house, radiation emitted was 100 kW / sq m, which meant the house was exposed to excessive radiation load, well in excess of 29 kW / sq m.

Urban flame – embers

Burning urban gardens and urban flames in other flammable urban fuel can generate very short distance embers that may only travel a few metres, but they can shower the house. the WMO did not consider them.

CONCLUSION

WMO claimed to prevent flame contact, excessive radiation and ember attack from the wall of flame in the closest vegetation.

WMO Score card for fire front flame	WMO Score card for urban flame
Flame contact - fail	Flame contact - fail
Radiation – fail	Radiation – fail
Ember attack - fail	Ember attack - fail

VERDICT ON THE WMO

The WMO system said danger came from an artificial wall of flame in nearest vegetation. It used pseudo / junk science to calculate radiation loads onto the house and determine defendable space. It said the three threats were flame contact, radiation and ember attack, but their quantification and mitigation treatment focused on radiation, which was a minor cause of house loss in a severe bushfire. It failed to mitigate primary and secondary threat agents.

Royal Commission (VBRC, 2010) was critical of the WMO in many areas. It also found there was no evidence that WMO prevented house loss. Evidence, however was presented to show that the WMO made no difference to house loss on Black Saturday. Eg, consider the town of Marysville "Marysville town data (provided by the Shire) showed the total house loss rate was 90%, and the house loss rate for constructed houses with WMO approval was 85%. This suggests WMO compliance gave no significant extra protection" (Quote from Paper 6B).

However, internal CFA evidence attempted to prove that WMO was successful in reducing house loss. "Using CFA figures, a report by Holland et al (2009) CFA.600.003.0001 suggested that WMO compliance reduced house loss to one third. They found that only six WMO compliant houses were destroyed in the Black Saturday fires. We can only suggest their figures and findings are inaccurate when compared with references given to and by the Royal Commission, because they alone add up to more than six destroyed WMO houses. For example, "The Commission heard that 24 houses that were destroyed by fire on 7 February had been built in Marysville, Pine Ridge Road and Grandview Crescent after the introduction of the WMO in 2004." Furthermore, Shire data for Marysville showed that 26 dwellings were built with WMO permits, and 22 of them were destroyed and 4 were not destroyed" (Quote from Paper 6B).

GLOSSARY OF ACRONYMS

BMO	Bushfire Management Overlay
WMO	Wildfire Management Overlay
AS3959	Australian Standard 3959
RFS	Rural Fire Service
BAL	Bushfire Attack Level
FDI	Fire Danger Index
CFA	Country Fire Authority

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