

Challenges of Managing Fires along an Urban-Wildland Interface – Lessons from Sydney, Australia and its Surrounding Environs

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Abstract

Sydney and its surrounding environs have for many years experienced the impact of often severe bush fires costing the community many millions of dollars, many homes, dwellings and other community assets, and tragically many lives. During this experience over 100 years, a mature, well integrated and comprehensive range of initiatives have evolved to address such adversity. By way of example, in the past 10 years alone property losses across the State of New South Wales have reduced from 206 homes in 1994 to 88 homes in 2003, with a corresponding increase in fire activity from 880 000 ha and 23 days of fire activity in 1993/94 to 1,465,000ha and 155 days of fire activity in 2002/2003.

The ability for such an improvement can be attributed in part to the following initiatives:

- 30 years experience in the provisions of co-ordinated fire fighting between the four fire fighting authorities, with a particular commitment to improvement over the past 10 years has contributed to a significant reduction in the losses of both life and property.
- Improved levels of training to nationally recognised levels for all fire fighting authorities
- Improved planning powers to either modify or prohibit inappropriate developments along the bushland urban interface
- Greater authority to ensure compliance with good hazard management practices on both public and private lands
- Streamlined approval processes in carrying out hazard reduction works
- Effective local planning arrangements through operations plan and risk management plans focussed at the local level and supported by State-wide policy
- Greater community awareness in the role that individuals play in the preparation of their dwellings prior to and on the day of fire impact
- Effective evacuation policy that recognises the value of keeping able bodied people in well prepared homes to combat the ember showers that contribute to more than 80% of the structural losses resulting from bush fires
- Greater involvement of the Media in promoting community safety messages and providing operational information to the community during times of fire impact

Sydney, by virtue of many years of poor planning with respect to bush fire prevention, will continue to be impacted by major fire events every few years however with the ever increasing diversity, competence and co-operation of all those involved in the management of both preventing and responding to such events, losses to both lives and assets should continue to improve into the future.

Introduction - Sydney and the Surrounding Environs

Greater Sydney has a population of about 3 million people. Many homes are located on the rims of plateaus formed from horizontal beds of sandstone and shales and overlook picturesque drowned river valleys. On the slopes and in drier valleys are fire-prone forests, heathy woodlands and tall shrubby thickets, which often form parts of National Parks and other reserves. (Gill and Moore, 1994) The major example of these comprises Ku-ring-gai NP in north the famous Blue Mountains NP in the west and in the south is one of the oldest national parks in the world, the Royal NP. Also major areas of bushland around Sydney are privately owned or vacant crown land managed by local governments. Much of Sydney's urban interface is therefore situated in long finger developments on the plateaus that are under extreme bush fire risk from the dense steeply vegetated slopes in the gullies below.

In National Parks and many other reserves, a major aim of management is to maintain the biodiversity of native plants and animals. Because fires affect biodiversity they are an important tool of management. However, natural fire regimes are a thing of the past because patterns of ignition and spread have changed. Letting 'nature' take its course in areas of indigenous vegetation is inappropriate because of the ignition of urban areas by fires in adjacent native vegetation. Fire management, therefore, is essential for both ecological and urban purposes. Management of vegetation for biodiversity in reserves is affected, therefore, by land use outside their boundaries. (Gill and Moore, 1994)

Climate

The climate in Sydney and its surrounding environs is warm temperate with an average summer – autumn rainfall peak (November to June) and a drier early spring. The climate in the higher altitude montane areas such as the upper Blue Mountains can tend towards cool temperate. The temperature and rainfall conditions vary across the Region and can be unreliable throughout the year, with marked decreases in early autumn period, during drier climatic cycles.

The climate of Sydney and surrounding environs has generally been conducive to a relatively high frequency of wildfire occurrence in the months from September through to February, although seasons of high summer rainfall have precluded wildfire occurrence. The climate during extended dry periods usually supports large-scale high-intensity wildfire occurrence, particularly when fuels become available (due to low moisture content) and much of the area becomes bushfire-prone.

The region is subject to cyclic drought and dry periods when a range of vegetation types will become available as fuel. During drought in negative Southern Oscillation Index (SOI) cycles and dry periods, conditions usually become suitable for the occurrence of large-scale high-intensity wildfires during severe fire weather. Severe fire weather has occurred, on average, between 2 and 3 days per year in summer and can produce relative humidities below 10%, temperatures above 38 Degrees Celsius, and winds from the North-West exceeding 80km/h.

Environment

Within the state of NSW there are 560 listed threatened plant species and 237 listed threatened animals and 60 endangered ecological communities (eight of which are with in the

Sydney basin). Further, frequent fire has been listed as a key threatening process requiring consideration for land management.

The vegetation around Sydney is predominantly dry sclerophyll forests and woodlands on steeply dissected sandstone slopes. The sclerophyll vegetation can lead to rapid fuel accumulation after fire as the hard leaves of eucalypts do not readily decompose in this dry environment. Fine fuel loads can reach over 30 tonnes per hectare.

The type and arrangement of vegetation plays a major role in determining how a bushfire will behave. Although the spatial pattern of vegetation in the Region is dominated by dry sclerophyll forest, the spatial pattern includes moist gullies, swamps and heaths. The main vegetation types and their bushfire characteristics are summarised as follows:

- (a) **Rainforests** – generally do not support bushfires except in extended drought periods. This is due to high fuel moisture levels, limited ground fuel, closed canopies and relatively fire resistant understoreys.
- (b) **Moist Sclerophyll forests** – These forests generally carry high fuel loads (up to 50 t/ha) but will not usually carry even low intensity fire because of their moist nature. After extended dry periods however, they can support very high intensity fires. These can kill younger trees and severely damage mature trees.
- (c) **Dry sclerophyll forests** – generally have a dry understorey of grasses and shrubs which burn readily under a much broader range of conditions than other forest types. Moderate to high fuel levels (up to 25 t/ha) and relatively open canopies allow sunlight and wind to quickly dry available fuels, giving these forests the potential to support high intensity bushfires. These forests will support low intensity prescribed fire in most years – fuel management reduction in these forests can help to reduce the intensity of wildfires.
- (d) **Pastoral lands, grasslands and open woodlands** – Fire behaviour in these vegetation types is dominated by the influence of grass fuels. Fires occur most readily once grass is cured beyond 70%. In heavy grass fuels, fires may be intense but will only persist for a short time, and hence are less hazardous relative to forest and heath fires. Grass/woodland fires are open to the influence of wind and typically have high rates of spread (relative to forest and heath vegetation). Grass fire behaviour is reduced dramatically by reducing the height and continuity of grass fuels – most often achieved by grazing.
- (e) **Heathland** - Heathland generally contains a relatively high proportion of fire prone species. Fuel loads are typically continuous from ground to canopy. Fire intensity is generally related to the height of the heath.
- (f) **Swamps** - The swamps generally contain predominantly fire sensitive vegetation. Although sub surface water is the basis for these vegetation communities, regrowth is comparatively fast and they may sustain a fire within 12 months of being burnt, typically high intensity short period fires.

Ignition Patterns and Sources

Preventing the ignition of bushfires by human activities, particularly on days when severe weather conditions prevail, is an important strategy for managing bushfires. To put effective ignition management programs in place, it is important to understand the patterns and major sources of ignition in the area.

Arson fires are the predominant cause of fires, which occur both within the developed areas and along major lines of access. Arson fires tend to be lit on days of higher fire danger. They represent the greatest risk, of the human causes, on extreme fire days. For example, the Bell Range Fire of 1994 was lit on a day of very high fire danger – and was most likely a deliberate ignition.

Other human-caused fires are not as common as arson. Campfires are mainly found along rivers and walking tracks in the more popular recreational areas National Parks. Escapes from burn-offs on private lands are also common and often result in fires extending into National Parks or other public lands.

Ignitions from lightning strikes tend to be limited to the Great Dividing Range (Blue Mountains) and to the west of the Range in predominantly farming / grazing lands. Significantly fewer fires start from lightning strikes within the Sydney Basin as the strikes are usually followed by rainfall.

The most likely wildfire ignition risk is from deliberately lit fires either within the urban areas or close to highways, roads and tracks. The potential risk of other causes tend to be much lower, mainly through the ability of the local fire authorities to reduce the ignition risk by either banning fires or closing off access to the more remote areas of bushland. Remote area management of lightning fires has also significantly reduced the potential of a major fire impacting on assets.

The Planning process

Historically, prescribed burning in Australia has been a controversial subject for at least 30 years. It began in forests as a means of reducing fuel loading so that fires under severe weather conditions would have a lower intensity and minimal impact on commercial values. The main issues have been and are, the efficacy of the practice for fuel reduction and the lowering of potential fire intensities, on the one hand and possible negative impacts on biodiversity, on the other. These and other aspects of the situation, together with the spread of the practice to many vegetation types, makes the issue a complex one in which the importances of different issues vary spatially and temporally. (Gill and Bradstock, 1994)

The prescribed burning debate began in earnest in Australia's temperate forest in the 1960s following the development of aerial incendiary ignition. Thousands of hectares could be treated with low intensity fires for litter-fuel reduction in a short time (Cheney 1978). The potential was, and is for all forests to be burnt often. The main points of contention concerned the ecological effects of the burning and the efficiency of protection. These contentions remain today. (Gill and Bradstock, 1994)

As part of the complex debate on hazard reduction, and in response to the community's desire for agencies to better manage issues associated with hazard reduction and operational planning, legislation was introduced in 1997 to establish Bush Fire Management Committees.

Each local government area in Sydney that contains a bush land interface has a Bush Fire Management Committee. These committees comprise representatives from the all the relevant land managers, fire agencies and key stakeholders. The principal aim of these committees is to produce Operational and Bush Fire Risk Management Plans. The Operational plans contain procedures to provide for smooth coordinated fire fighting operations during major bush fire emergencies. The Bush Fire Risk Management Plans provide a planning mechanism where local hazards and assets are mapped to determine areas of greatest risks. From this strategies are developed to manage this risk including fuel reduction programs, community education as well as monitoring and suppression strategies.

August 2002 marked a significant change to the NSW legislation to provide the NSW RFS with improved powers for the protection of life and assets from Bush Fires. This included three significant areas

- Improved planning powers for the control of development in bush fire prone areas. Bush Fire Prone Maps have been produced that identify all properties that may be under bush fire threat. Any development within these areas is required to comply with the document Planning for Bush Fire Protection 2001, which outlines requirements for subdivision design, building construction standards and fuel free zone set backs.
- The August 2002 Rural Fires Act amendments provided the RFS Commissioner the authority to audit and manage hazard reduction across all land tenures and the ability to order all land owners and managers to undertake hazard reduction work the Commissioner believes necessary for the protection of the community. The Commissioner randomly audits district Bush Fire Risk Management Plans, with particular attention to the effectiveness of hazard reduction work.
- Bush Fire Hazard Reduction Certificates provide a streamlined environmental assessment process for essential hazard reduction works in bush fire prone areas.

This followed the findings of an Interdepartmental Committee of State agencies which investigated the process of environmental assessment for hazard reduction works. This committee found the system of assessment to be complex and unnecessarily onerous for private landholders wanting to conduct genuine hazard reduction on their properties. The Joint Select Parliamentary Inquiry (June 2002) into the 2001 Bush Fires supported these findings and recommended a streamlined process of assessment.

The reforms introduced were designed to simplify the process of assessing the environmental impacts and approving proposed hazard reduction work. The new system takes effect from July 1, following the introduction of a new Bushfire Environmental Assessment Code.

The code was drafted after extensive consultation with a range of organisations in a series of working groups. These included Local Government, the National Parks and Wildlife Service, the Environmental Protection Authority (EPA), Planning NSW, State Forests, the former Department of Land and Water Conservation, the Farmers Association and the Nature Conservation Council.

The key change to the system is that private landholders who want to carry out hazard reduction work to protect their homes and properties from bushfires now need only obtain a single approval. This replaces the series of approvals from different agencies previously required.

The local Fire Control Officer of the Rural Fire Service will now have the power to issue a bushfire hazard reduction certificate. The certificate will be free of charge and effective for 12 months from the date it is issued.

All applications will be assessed according to the new Bushfire Environmental Assessment Code, which outlines the appropriate environmental factors to be taken into account in any planned works.

The approval certificate may specify conditions outlining what actions should be taken to protect specific values, including the protection of threatened species, heritage sites and water quality.

Once an environmental approval has been granted in a bush fire hazard reduction certificate, no further approval is required.

Public authorities responsible for managed lands - such as the National Parks and Wildlife Service (NPWS), State Forests, Department of Lands or a local council - can certify hazard reduction works on their own land.

Fire Season Statistics from 1993 - 2003

Sydney and the State of New South Wales have experienced periods of significant fire activity in the past 10 years. The table below represents the key statistics from 4 of the most significant fire seasons over the 10 year period.

ITEM	1993/94	1997/98	2001/02	2002/03
No. of deaths				
<i>Firefighters</i>	2	4	0	0
<i>Civilians</i>	2	0	0	3
No. of houses lost	206	10	109	86
No. of houses damaged	330	>30	Not known	28
No. of other structures destroyed	<200	>50	33	33
No. of outbuildings destroyed	46	Not known	433	188
Stock lost	Not known	Not known	7043	3400
Vehicles, etc lost	45	Not known	222	102
Area Burnt	800,000ha	500,000ha	754,000ha	1,465,000ha
No. of Fires	800	250	454	459
No. of firefighters and IMT Personnel involved	20,800	>15,000	29,500	35,000

It should be noted that in the past 10 years alone property losses across the State of New South Wales have reduced from 206 homes in 1994 to 88 homes in 2003, with a corresponding increase in fire activity from 880 000 ha and 23 days of fire activity in 1993/94 to 1,465,000ha and 155 days of fire activity in 2002/2003.

Two case studies in good versus bad planning

Como-Jannali 1994

Development issues still remain as an area of critical concern to the Service. Communities are living with some poor planning and development decisions of bygone decades. Threats to housing in some of those older areas constantly remain. During every adverse fire season there is a real threat to housing that abuts bushland in inappropriate developments.

A very good example of past practices impacting on house survivability occurred at Como-Jannali within the Sutherland Shire, located due south of the City of Sydney, in the 1994 fires. In an area immediately above the Glen Reserve along a housing-bush interface of approximately 1.5 kilometres, 85 houses were totally destroyed when fire spotted across the Woronora River and made a brief uphill run to housing development.

The development in the affected area was some decades old (1940s) and no specific bushfire protection measures had been built into the subdivision at the time of establishment. Indeed, many houses directly abutted bush and there were examples where trees were incorporated into building footprints with items such as decks constructed around existing large trees.

Many houses in this area were impossible to protect. In the two days prior to this impact, on the western side of the Woronora River, under marginally less severe fire weather conditions, along a housing-bush interface of about 18 kilometres in the suburbs of Bangor and Illawong, not more than 6 houses were destroyed and a similar number sustained varying degrees of damage. The affected subdivisions in this instance had been developed under the provisions outlined in the Department of Planning Circular C10, the basic ingredients of which are retained in the recently issued publication, *Planning for Bushfire Protection*.

A substantial separation of houses and bushland was provided, perimeter roads mainly applied with few houses on the bushland side and construction standards were of a level that is deemed satisfactory to provide better resistance to ingress of embers either underneath or into interior cavities within structures.

Consequently housing losses were very significantly reduced. This example provides a stark demonstration of the value of appropriate planning measures. Implementation of recognised development and construction standards can never guarantee the survival of a house but experience very clearly demonstrates that chances of survival are significantly enhanced if those standards are observed.

Blue Mountains – A City wholly contained within a National Park

The City of Blue Mountains has a population of 74,317 (Population consensus 2001) with approximately 31,870 dwellings. The city is comprised of 26 separate townships and villages, with approximately 60 schools, including kindergartens, primary and secondary schools. The majority of human settlement is located in an urban band, built predominantly on the ridgelines of the dissected plateau connected by the central Great Western Highway, between Lapstone and Mt Victoria.

There are substantial consolidated urban areas in Blackheath, Katoomba, Leura, Wentworth Falls, Springwood, Blaxland and Glenbrook. Much of the remainder of Blue Mountains City is sprawling ridge-line. Rural holdings are centred in Megalong Valley, on the Shipley Plateau and on the basalt caps of Mount Wilson, Mount Irvine and Mount Tomah. Semi-rural properties are located at Berambing, Bell and Sun Valley. A high proportion of the overall population work outside of the City boundaries.

There is a significantly high concentration of residents in the lower mountains, (below Linden). A very small proportion of residents live outside the urban and village areas.

Between 2 and 40 wildfires have been recorded per year, with an average of around 14 wildfires per year. Around 88 % of these fires have been less than 1000 hectares in size, with 72 % of fires less than 100 hectares. About 9 % of wildfires have been between 1000 and 10,000 hectares in size, with 3 % over 10,000 hectares. Most large-scale fires have occurred in November and December.

Since the 1900s sections of the City of Blue Mountains have suffered severe fires in the seasons 1915/16, 1926/27, 1936/37, 1944/45, 1951/52, 1957/58, 1968/69, 1977/78, 1979/80, 1982/83 and 1993/94. Large wildfires have also occurred during other spring, summer and autumn periods. Estimates of the number of hectares burnt include: 48,576ha in 1977/78, 66,285ha in 1979/80, 47,960ha in 1982/83 and 53,282ha in 1993/94.

Since 1911, 580 houses have been destroyed by fire: on four occasions since 1951 a single fire has destroyed more than 50 properties - mainly houses, but including churches, a school and several shops. Damage to urban areas has occurred on 19 blow-up days within 11 major fire seasons. Most properties destroyed were in vulnerable localities adjacent to northwest-oriented valleys. Fourteen deaths have occurred as a result of wildfires since 1945.

Perhaps the most significant problem that the residents of the Blue Mountains face is that the decision to develop communities along the ridges and escarpments within an expansive, volatile natural environment many years ago without any consideration of the impacts of wild fire on those communities has left the residents of today with a lifetime legacy of having to face frequent fire impacts, often leading to losses of many homes and threatening the lives of many of thousands of people.

The Role of Fire Fighting Authorities in Sydney

Given the inheritance of many years of poor urban – bushland interface planning combined with a vegetation regime that is volatile to frequent severe fire events has lead Government and fire fighting authorities in New South Wales to develop a range of measures and initiatives to combat such a frequent natural disaster.

Co-ordinated fire fighting

What is unique to New South Wales is the provision of co-ordinated fire fighting across the 4 fire fighting authorities within the State, being the NSW Rural Fire Service, the NSW Fire Brigades, the NSW National Parks and Wildlife Service and the NSW State Forests. Each of these fire fighting authorities have a statutory responsibility to suppress fires within their jurisdictional boundaries (either directly as a land manager or as a service deliverer) however given the scale and the magnitude of the fire events that frequently occur, there is a need to

provide a superior level of overall co-ordination across the agencies to ensure that the response to such events is as seamless as possible.

To achieve this the Rural Fires Act 1997 establishes the provisions of co-ordinated bush fire fighting and states:-

“This Part charges the Commissioner with the responsibility of controlling and co-ordinating the action to be taken by persons and bodies involved in or associated with the prevention, mitigation or suppression of bush fires in dealing with fires requiring a response beyond the area or locality in which the fires are burning. The Commissioner is authorised to give directions to persons, members of the Service, officers of other emergency services organisations and others in relation to the prevention, mitigation and suppression of fires in these circumstances.

The Part also provides for the establishment of the Bush Fire Co-ordinating Committee, the principal responsibility of which is to plan for bush fire prevention and for co-ordinated bush fire fighting. The Bush Fire Co-ordinating Committee is required to constitute Bush Fire Management Committees for rural fire districts and may constitute them for other parts of the State. These committees are responsible for the preparation of bush fire management plans for the areas for which they are constituted.”

The BFCC has as its membership a range of stakeholders extending from the fire fighting authorities to land management agencies, environmental, local government and volunteer representatives. The BFCC is principally responsible for developing plans of operations and risk management plans, which in turn provide an overall framework for the prevention, preparation and response to major bush fire events. To achieve this, as previously mentioned, local Bush Fire Management Committees are formed to undertake and oversee the development and implementation of the plans, and to ensure compliance with any policies of the BFCC.

Fire fighting Authorities operate under common Incident Management principles, have largely aligned their equipment, train under national standards and often share training courses, materials and resources, and have over many years developed close local relationships that significantly contribute to the effectiveness of the overall fire fighting effort.

Evacuation Policy

A critical policy decision of the BFCC has been on the issue of evacuation of urban interface residents. Studies of major bush fires in Australia show that properly prepared dwelling are more likely to survive the impact of a bush fire if able bodied persons are in attendance to extinguish outbreaks of fire before and after the main fire front passes. (BFCC Policy 2/2000) In fact, the CSIRO (Commonwealth Scientific and Industrial Research Organisation) report that some 80% of dwellings burn down during major bush fire events as a result of airborne ember attack, which to a large degree can be minimised or the effects eliminated by having residents in properly prepared homes available to extinguish the embers as they attack the structure.

A properly prepared dwelling can provide a refuge in which people are able to take shelter as the fire front passes. In turn, people are most vulnerable when they are in the open or in vehicles travelling along roads that are being impacted by bush fires. However, special consideration must be given to the relocation of the young, aged and the infirm.

Whilst the NSW Police have the authority to compel persons to evacuate or vacate areas threatened by bush fire or considered at risk, senior Police generally seek advice from the Incident Controller before authorising an evacuation.

Section 41 of the *Rural Fires Act 1997* (and section 25 of the *Fire Brigades Act 1989*) also requires every member of the Police Service and other persons to recognise the authority of the officer in charge at a fire, incident or other emergency at which a fire brigade is present and to assist in respect of the protection of persons from injury or death, or of property from damage when the persons or property is endangered by fire or there is imminent danger of such a fire.

The BFCC policy states that:

- 1. It is the policy of the Bush Fire Coordinating Committee that capable persons should generally not be evacuated from properly prepared dwellings likely to be impacted upon by bush fires in accordance with the Australasian Fire Authorities Council Position Paper On Community Safety and Evacuation During Bush Fires.*
- 2. Bush Fire Management Committees must identify areas within their Bush Fire District that require the preparation of evacuation plans. These areas should be identified in Bush Fire Risk Management Plans.*
- 3. Fire Authorities must work cooperatively with the Local Emergency Operations Controller and relevant agencies to develop evacuation plans for areas identified in Bush Fire Risk Management Plans as requiring these. Such plans are to identify specific areas likely to need evacuation, appropriate egress routes, notification arrangements and refuge areas and the provision for the movement of companion animals. These evacuation plans are to be included within local disaster plans (DISPLANs).*
- 4. During fire suppression operations Fire Incident Controllers and fireground commanders will work cooperatively with NSW Police Service Officers to implement evacuation plans where evacuation has been ordered.*
- 5. Last minute evacuations should be avoided, particularly in areas where local road, traffic and visibility conditions may hamper safe and swift evacuation.*

Fire fighting authorities have had some significant success with adopting this approach, particularly across the Sydney basin, however there is still a propensity to commence short term evacuations without the knowledge of the Incident Controller which often leads to confusion during the operation, or debate in the post fire analysis.

Community Education

Fire fighting authorities in New South Wales have also developed a significant range of community education strategies to encourage residents to adequately prepare their properties prior to the impact of fire as well as what to do immediately the fire threat passes. These programs, known as FireWise programs (and resources) seek to create a fire sensible

population. Community Education Officers advise neighbourhoods about potential hazards and preparing their homes, bring land managers together to improve fuel management and teach school students fire prevention and personal safety. A range of publications, from fact sheets to history books and pamphlets on building development are available.

In addition, to combat the increasing awareness of arson fires, a campaign of encouraging the community to report suspicious fires has also been developed. To help stop arsonists the RFS joined forces with Crime Stoppers to encourage public information on unnaturally lit fires. By providing anonymous, confidential information to Crime Stoppers on 1 800 333 000, community members can increase the number of arrests and successful prosecutions of arsonists.

Summary

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