Australian Capital Territory

Emergencies (Strategic Bushfire Management Plan for the ACT) 2009

Disallowable Instrument DI2009-211

made under the

Emergencies Act 2004, s 72 (Strategic bushfire management plan)

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1 Name of Instrument

This instrument is the *Emergencies (Strategic Bushfire Management Plan for the ACT) 2009*.

2 Commencement

This instrument commences on the day after it is notified.

3 Amendments to the Strategic bushfire management plan

I amend the Strategic Bushfire Management Plan for the ACT by:
(a) omitting the provisions of the Strategic Bushfire Management Plan for the ACT (DI2005-1 Emergencies (Strategic Bushfire Management Plan) 2005); and
(b) substituting the Strategic Bushfire Management Plan for the ACT as set out in Attachment A (subject to clause 5).

(Note: it is proposed to refer to the amended Strategic Bushfire Management Plan for the ACT as the Strategic Bushfire Management Plan for the ACT Version 2.)

4 Explanatory material

The following maps and content are included with the plan for explanatory purposes only and do not form part of the plan:

- The Ministers Forward; and
- Figures 1 and 2.
- Chapter 5 - Figures 7(a), 7(b), 7(c) (in Supporting Information Part 1 – Factors Contributing to Bushfire Risk); and
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- Chapter 6 – Figures 2, 3, 4, 5, and 6 (in Supporting Information Part 1 – Factors Contributing to Bushfire Risk).

Simon Corbell MLA
Minister for Police and Emergency Services
30 September 2009

STRATEGIC BUSHFIRE MANAGEMENT PLAN FOR THE ACT

A Plan for the Government and community of the ACT to work together to more effectively suppress bushfires and reduce their consequences

Version Two
October 2009

Prepared in accordance with the ***Emergencies Act 2004***.

ISBN- 10: 978-0-642-60517-7

ISBN- 13: 0-642-60517-3

GPO Box 158, Canberra City ACT 2601.

Produced by Publishing Services for the Emergency Services Agency

Publication No 09/1289

Telephone: Canberra Connect 132 281

Also published on www.esa.act.gov.au

Foreword

As the recent fires in Victoria have reminded us, bushfires remain an ever-present threat to life, property and the environment in Australia. In 2003, this reality was made clear to the community of the ACT, with the catastrophic consequences of bushfires impacting on the people, property and environment of the ACT.

As a community and as a Government, we are still living with the consequences of this time in the Territory's history, and are continuing to improve our resilience to bushfires.

The ACT Emergency Services Agency has responsibility for the suppression of bushfires, and for ensuring programs and policies are in place that will reduce the consequences of bushfires across the whole of the ACT. The original Strategic Bushfire Management Plan, produced in 2005, was the first document of its kind to provide the framework for integrated bushfire management across the whole of the ACT. This Plan replaces and builds upon the 2005 Strategic Bushfire Management Plan.

Version Two of the Strategic Bushfire Management Plan differs from the previous Plan in a number of ways. In preparing this Plan, the principal objective has been to provide a Plan that gives clear direction for the community and the Government to reduce bushfire risk. In keeping with this objective, the Emergency Services Agency has prepared two Implementation Plans:

- an Implementation Plan for the community that I ask and strongly encourage every member of the community to consider; this Implementation Plan will allow members of the community to consider their vulnerability to bushfires, and guide them in the necessary steps they should take to reduce their bushfire risk; and
- an Implementation Plan for Government that clearly spells out the actions Government will take to reduce the risk of bushfires, through its people and its agencies.

Implicit in these Implementation Plans is the requirement for a shared responsibility for the management of bushfire risk. Individuals must take personal responsibility for reducing the threat of bushfires to themselves, their families and properties. The Government must provide the policies and programs, professional expertise and resources to implement programs and support the community. Together, an aware and educated community and a government that is committed to mitigating the risk of bushfires can form a partnership to reduce the impacts of future bushfires in the ACT. The Plan acknowledges and incorporates a number of the interim recommendations of the 2009 Victorian Bushfires Royal Commission with particular reference to Chapter IV – Warnings, reflecting that certain bushfire situations are considered uncontrollable with the revised Fire Danger Rating recognising that buildings, despite being constructed to AS 3959 and occupiers being well prepared, are not defendable without significant threat to life or safety.

Both the ACT Emergency Services Agency and the Department of Territory and Municipal Services represent the principal government agencies for the implementation of fire management programs in the Territory. Both Agencies have collaborated closely in preparing this Plan, providing significant resources and expertise to its development.

The ACT community, various organisations, partner agencies and individuals have also been critical in this Plan's development, contributing their views and ideas as to how fire should be managed in the ACT. After months of consultation we are ready to take the next steps in managing for bushfires in the ACT.

This revised Plan implements the Government response to the 2003 Coronial Inquiry into the Canberra bushfires. It includes consideration of the most recent fire behaviour science and the latest information on education and awareness, and it integrates fire management on all lands in the ACT. However, knowledge and understanding improve over time, and circumstances can change—the Plan and key supporting documents are designed to be flexible to accommodate these changes, and if required will be reviewed and updated.

The ACT Government supports this Plan, and commends it to the community and Government agencies.

Simon Corbell, MLA
Minister for Police and Emergency Services

Executive Summary

Bushfire has been, and remains, a powerful natural force in the Australian Capital Territory and the surrounding region. It is not a matter of 'if' bushfire will occur, it is a matter of 'when' and 'where'. It is important that the people of the ACT understand that living here means living with bushfire. Some of the most enjoyable features— the warm dry climate and natural landscapes—create some of the most severe bushfire conditions in the world. The city of Canberra and surrounding rural areas are closely linked with the foothills, grasslands and mountains of the ACT, many of which occur on the western boundary of the city. This significantly increases the likelihood of the prevailing bushfires from the north and west threatening life and property, and other values.

From time to time individual weather events, combined with drought and fire ignition, will lead to bushfires that may overwhelm suppression efforts and gain considerable size and ferocity. In these situations, it will not be possible for emergency services to provide protection to the whole community and it may not be possible for individuals to defend properties safely. While historical analysis shows that extreme bushfire conditions occur approximately once every seven years, some climate change modelling suggests this may increase to once every five years by 2020 and more frequently, to less than once every two years by 2050. In order to manage for bushfires now and into the future, including potentially catastrophic events, this Strategic Bushfire Management Plan sets out the strategies and the specific actions by which the ACT community and the ACT Government can better manage bushfires and reduce their consequences to life, property and the environment.

This Plan builds on the Strategic Bushfire Management Plan Version One, released in January 2005. Since that time, work has been undertaken, both in the ACT and nationally, through the Bushfire Cooperative Research Centre, to better understand and inform bushfire management. The ACT Coroner has handed down the findings of the Inquiry into the 2003 bushfires and the ACT Government has responded. Issues identified include the need for a mosaic of fuel management across the landscape of the ACT, improved community education and awareness, and better preparedness and response to bushfires when they occur. This Plan provides the basis for implementing the ACT Government's response to the Inquiry, as well as incorporating many of the recent advances in bushfire management.

The structure of this Plan adopts the nationally recognised elements of contemporary bushfire management: Research, Information and Analysis; Preparedness; Prevention; Response; and Recovery. The strategies and actions in the Plan are based on core principles which guide balanced, effective and efficient bushfire management.

The strength of this Plan arises from the necessary partnership and shared responsibility between the community and the ACT Government. The Emergency Services Agency has worked closely with Government land managers, urban and rural landholders and residents, emergency services and community groups in its development.

Through this Plan, the ACT Government empowers its agencies to implement the strategies and the actions detailed. Likewise, it asks each member of the community to consider the Plan and what it means to them, and to implement those strategies and actions necessary to reduce the risk of bushfire to their families and assets.

The ESA will monitor the strategies and actions in the Plan to ensure they are achieved and, where necessary, are adjusted to suit changing circumstances. This will ensure the Plan remains a dynamic document that can inform the next full review of the Plan.

Contents

The structure of the Strategic Bushfire Management Plan

ACT STRATEGIC BUSHFIRE MANAGEMENT PLAN

PART ONE –Context and Background
The core principles which guide bushfire management in the ACT and drive the strategies and actions of this Plan.
The scope and basis of the Plan and the framework under which it operates.

PART TWO – Objectives and Strategies
The specific objectives and strategies to reduce bushfire risk, including strategies for research and monitoring, prevention, preparedness, response and recovery.

PART THREE – Fire Management Zoning
Bushfire Management Zones that guide prevention and preparedness activities are described and the Zoning Maps are included for explanatory purposes.

PART FOUR – Community Implementation Plan
The specific actions which the community should implement, by which the strategies are delivered. Actions are specific, measureable and time-based.

PART FIVE – ACT Government Implementation Plan
The specific actions which the Government will implement, by which the strategies are delivered. Actions are specific, measureable and time-based.

PART SIX – Resource Requirements
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PART SEVEN – Schedules
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SUPPORTING INFORMATION - PART ONE
Part One of the supporting information includes: *The Geography of the ACT, History and Cause of Bushfires, Bushfire Fuels, Bushfire Climate and Bushfire Risk analysis.*

KE Y SUPPORTING DOCUMENTS

ZONING MAPS AND REGIONAL FIRE MANAGEMENT PLANS
Detailed maps showing the fire management zones and the prevention and preparedness activities necessary to implement key actions of this Plan. These plans will be reviewed annually.

BACKGROUND AND SUPPORTING INFORMATION – PART TWO
Further background material on bushfire management to assist the community, land managers and emergency services to understand and implement the Plan. This includes background information on fire management and information on matters addressed the Plan.

PART ONE - Context for the ACT Strategic Bushfire Management Plan

Chapter One: The Goal

The goal of bushfire management in the ACT

The goal of this Plan is:

Through Government and the community working together, suppress bushfires and reduce their consequences on human life, property and the environment.

Objectives have been set for both the ACT Government and for the ACT community. Within the framework of Research, Prevention, Preparedness, Response and Recovery, strategies and actions are identified to address the specific elements of bushfire risk.

Core principles for bushfire management in the ACT

The bushfire management objectives, strategies and actions in this Plan are based on the following core principles which are intended to guide balanced, effective and efficient bushfire management.

1. Rapid detection and aggressive initial attack are fundamental to prevent fires from growing in size and threatening assets. Bushfires will be controlled in the shortest possible time, in a fast, determined, safe and thorough manner, giving due regard to management objectives and assets at risk.

2. Consistency of purpose and unity of control under the nationally adopted Australasian Inter-service Incident Management System (AIIMS) will be applied to all bushfire responses, irrespective of organisational structures.

3. Strong leadership and a commitment by the ACT Government and the community are required to maintain the momentum and priority for bushfire management planning and operations for the variable periods between severe events.

4. Individuals and households are expected to be informed and prepared in order to survive a catastrophic bushfire event. People must be provided with information on how bushfires may affect them and plan for their occurrence and in the event of bushfire threatening themselves or their properties, be able to make informed and timely decisions on early relocation or staying to defend their assets.

5. The safest response to bushfires is for members of the community to leave potentially vulnerable properties well before a bushfire arrives.

6. Consistent with the revised Fire Danger Ratings system, certain bushfire situations are considered uncontrollable. It should be recognised that buildings, even where built to meet Australian Standards for bushfire construction and with occupiers being well prepared, are unlikely to be defendable and to attempt to do so would present significant threat to life or safety.

7. In extreme bushfire situations it must be recognised that it will not be possible for emergency services to provide protection to the whole community.

8. Information, advice and warnings provided by fire services to the community need to be timely, clear and accurate to ensure appropriate responses by individuals when bushfires occur.

9. Firefighter and public safety will take highest priority at all times when bushfires occur. Further priorities will be set for reducing bushfire impacts on property, rural production, businesses, community infrastructure and natural and cultural assets, based on asset value and the risk of bushfire to those assets.

10. Shared knowledge and information, including local community knowledge, will be actively sought, managed respectfully, and used to inform decision-making.

11. Bushfire management plans and programs will be based on a risk management framework which incorporates sound bushfire and environmental science, and lessons learned from previous bushfires.

12. Establishment and maintenance of the necessary levels and types of resources and systems, including experienced and motivated firefighting personnel, are necessary for effective fire management.

13. The ACT's firefighting capability is reliant on the maintenance of both volunteer and paid firefighting personnel.

14. The use of planned fires for fuel reduction is most effective in reducing the intensity and spread of fires under moderate fire conditions across large areas of the landscape, and will contribute significantly to the success of bushfire fighting under moderate conditions. However, as bushfire conditions become more extreme, fire intensity and rate of spread increase (even at low fuel loads) and the likely success of bushfire fighting efforts is reduced.

15. Bushfire management practices, including the use of planned fires for fuel reduction, will be carried out strategically and at a range of scales to reflect the differing risk in urban, rural and remote and mountainous areas.

16. Bushfire management recognises the dynamic nature of natural ecosystems, and requires clear objectives and an adaptive approach to environmental management. Fire managers will use the best available knowledge to identify appropriate fire management practices, including the desirable fire regimes necessary to maintain the ecological integrity of these systems.

17. The dynamic nature of bushfire risk and ecosystem management require bushfire management in the ACT to maintain the consistent application of the principles and policies identified in this Plan over the long term, and in subsequent plans.

18. Adverse biodiversity impacts may occur if the frequency, intensity and season of planned fire regimes do not reflect natural processes adequately. In some parts of the ACT, the planned fire regimes may be similar to ecologically-based fire regimes. However, in other areas the planned fire regimes may differ from the natural regimes, and may cause changes to the natural ecosystems.

19. Bushfire risk will be assessed in a regional context, considering the impact on the ACT from NSW, as well as the risk that bushfires from the ACT may present to NSW.

20. Recovery of social, community, rural and environmental assets is an integral component of bushfire management and will be considered before, during and after bushfires.

Chapter Two: The Scope

The scope of the Strategic Bushfire Management Plan

This Plan has the goal of identifying the necessary strategies and actions which the ACT Government and the community of the ACT will implement to enhance our ability to suppress bushfires and reduce their consequences.

This Plan provides for an integrated emergency response, utilising the skills and resources of all relevant ACT Government agencies and the community to respond to major bushfire events. This approach allows experienced firefighters to concentrate on bushfire suppression and uses support agencies to provide ancillary and coordination functions.

This Plan is prepared for the ACT Government and for the ACT community. This includes:

- the Fire Services (the ACT Rural Fire Service and the ACT Fire Brigade), support agencies and ACT Policing;
- Government agencies that support the community and emergency services;
- land managers, including ACT Government agencies and rural landholders; and
- urban and rural residents.

This Plan considers a range of assets which may be impacted by bushfires including built, environmental (ecological, hydrological and physical), agricultural and cultural assets. This Plan assists the ACT Emergency Services Commissioner in exercising the functions of the position under the *Emergencies Act 2004*.

This Plan provides the actions and strategies by which the Chief Officer of the ACT Rural Fire Service and Chief Officer of the ACT Fire Brigade implement their responsibilities. The Plan recognises the distinct roles and responsibilities of these Services. The ACT Rural Fire Service and the ACT Fire Brigade are responsible for the suppression of bushfires, and through cooperative arrangements, key elements of bushfire management planning in the ACT.

This Plan supports the roles and functions of the ACT Bushfire Council to advise the Minister for Police and Emergency Services on any matters relating to bushfire management in the ACT. It provides the Council with a clear framework and measureable outcomes by which it can seek and analyse information and undertake audits on bushfire preparedness in the ACT.

The Plan recognises the critical contribution of the eight volunteer fire fighting brigades which provide the majority of the Territory's rural fighting personnel, as well as the support provided to the community and fire services through Community Fire Units.

The Plan recognises the key role of the Department of Territory and Municipal Services (TAMS) in fire management in the ACT. TAMS, through its business unit Parks, Conservation and Lands are responsible for the management of 73% of the area of the ACT and provide suppression capability through Parks Rural Fire Brigade.

The Plan recognises the important role of the ACT local media in bushfire management. The media provides significant support to Emergency Services in assisting in the delivery

of bushfire education and awareness programs, and has a critical role in disseminating information, advice and warnings when bushfires occur.

This Plan does not apply to National Land, which is managed by the Australian Government. However, the strategies and actions in the Plan have been designed to be compatible with and complimentary to management plans applying to National Land.

The ACT has formally and informally strengthened its relationship in the regional context with NSW agencies involved in fire management. Bushfires have the potential to come from NSW and impact on the ACT, from the forested landscape to the west and south, and the open agricultural lands to the north and east. Similarly, bushfires in the ACT have the potential to impact on NSW, in rural areas, rural subdivisions such as Royalla and Wamboin, and the urban and peri-urban areas of Queanbeyan, and beyond.

Chapter Three: The Basis

The legislative and policy basis for the Plan

This Plan has been prepared in accordance with the requirements of the *Emergencies Act 2004* (the Act). Consistent with section 80 of the Act the Strategic Bushfire Management Plan Version One has been reviewed by the Minister in consultation with the ACT Bushfire Council. The policies, strategies and actions in this Plan draw on and replace those developed in the Strategic Bushfire Management Plan Version One.

This Plan has been prepared to meet the requirements under the Act for the Emergency Services Agency (ESA) to develop a Strategic Bushfire Management Plan for the ACT. Section 74 of the Act defines the elements of bushfire management that must be addressed in the Plan. These requirements are met as part of this document and where identified, in the supporting information to the Plan.

The Plan provides the framework for implementing many of the agreed recommendations from the Coroners report into the 2003 Canberra bushfires. Also, the plan acknowledges and incorporates a number of the interim recommendations of the 2009 Victorian Bushfires Royal Commission, with particular reference to the *National Framework for Bushfire Scaled Advice and Warnings to the Community,* which details the framework for the provision warnings and information to the community and the revised national Fire Danger Rating system.

This Plan assists with elements of land use planning in the ACT, particularly those areas susceptible to bushfires including areas proposed for new subdivisions. Consistent with the provisions of the *Planning and Development Act 2007* and the Territory Plan, there is a hierarchical approach to planning in the ACT from the broad district level (that is a Structure Plan), to the suburb level (that is a concept plan and precinct code) and then to site specific development applications (subdivision and development).

This Plan and the supporting information assists in meeting the legislative requirements for planning and approval of fire management activities that may be subject to other legislation, including:

- *Environment Protection and Biodiversity Conservation Act (Commonwealth) 1999;*
- *Planning and Development Act 2007;*
- *Heritage Act 2004;*
- *Water Resources Act 2007;*
- *Environment Protection Act 1997; and*
- *Nature Conservation Act 1980.*

The ACT bushfire environment

The bushfire environment of the ACT describes the range of factors potentially influencing how fires will start and spread, and their interaction with the environment as they do so. These factors are summarised below and are described in detail in the supporting information to this Plan.

The history and cause of fire in the ACT
Bushfires have long been part of the ACT landscape. A combination of inherently flammable vegetation, dry summers, periodic drought and lightning ignitions, has resulted in fires of small and large size and of high and low intensity, with periodic conflagrations that have covered the landscape. An understanding of the history of fire in the ACT, and south eastern Australia more broadly, is critical in informing future management decisions.

Over tens of thousands of years, Indigenous Australians developed a sophisticated understanding and usage of fire for managing land and resources, and their understanding of fire and fire regimes evolved over countless generations.

Since European settlement, the ACT has recorded a history of severe and damaging bushfires, with large areas burnt in the bushfire seasons of 1919-20, 1925-26, 1938-39, 1951-52, 1978-79, 1982-83, 1984-85, 2000-01 and 2002-03. The impact of the 2002-03 bushfires is regarded as the most serious since the ACT was established.

These relatively rare but severe events cause more than 95% of the damage and loss to people, property and assets. Notwithstanding, relatively small bushfires close to the edge of Canberra's suburbs are always potentially damaging.

Bushfires may start due to either natural or human causes. The most common natural cause of bushfires in the ACT is lightning and, in general, the largest areas burnt are attributed to lightning ignitions. The majority of fire ignitions, however, are human-caused, either due to arson, carelessness or the accidental lighting of fires. Most of the human-caused bushfires occur in or near the built up area of Canberra.

Bushfire management activities must address both the higher numbers of fires in and around the suburbs of Canberra that may immediately threaten homes, and the smaller number of fires further away that are potentially much larger and may threaten rural homes and assets and potentially the suburbs of Canberra.

Further information on the history and cause of bushfire is provided in *Supporting Information – Part One*.

The current and future fire climate of the ACT
The bushfire season in the ACT corresponds with the summer months with high temperatures and low rainfall and has the potential to extend from September to April, with significant variation between years. The seasonal potential for unplanned fires varies with rainfall and temperature, and their influences on biomass growth and fuel moisture content.

Bushfire risk management, planning and operations must take into account the likelihood of severe fire weather and the challenges it presents. An assessment of the Fire Danger Rating is determined by combining measures of soil moisture deficiency with the weather variables of temperature, relative humidity wind speed and recent rainfall to produce a Fire Danger Index (FDI). This index relates to the potential bushfire behavior, including its rate of spread, its intensity and difficulty of suppression.

Most uncontrollable bushfires occur when the FDI is over 50 (although they may also occur at lower FDI), with the Fire Danger Ratings of Severe (FDI 50-74), Extreme (FDI 75-99) and Catastrophic-Code Red (FDI 100+) used to describe these higher levels of fire danger. Many of the major house loss events in south eastern Australia have occurred at Fire Danger Indices over 70. Historical analysis shows such high indices occur approximately once every six to seven years in the ACT.

Climate change presents new challenges to bushfire risk management. It is predicted that days of >50 FDI will increase in southern Australia, with a possible increase of the frequency of >70 FDI events to once every five years by 2020 and to more than once every two years by 2050.

It is recognised discrete climatological events occur that have the potential to effect bushfire behaviour. The effects of thunderstorms and wind changes are well known examples of these discrete events that impact on fire behaviour and level of Fire Danger Rating. Research into a range of discrete climatological conditions is underway to assist fire suppression agencies to identify these conditions.

Further information on this research, the Fire Danger Rating system and on the current and future ACT climate is provided in *Supporting Information – Part One*.

Bushfire fuels

Bushfire fuels are one important factor affecting the spread of bushfires that can be modified prior to fires occurring. Planned fire is effective in modifying the quantity, arrangement and seasonal flammability of fuels, and thus in reducing the intensity, flame height and rate of spread of unplanned fires under given climatic conditions. This ability to modify fuel is especially important in forested landscapes, where it can be undertaken at relatively low cost to create a mosaic of fuel loadings over large areas that can significantly reduce bushfire risk.

Fuels in the urban environment (including landscaping, garden beds and some structures) play a significant role in the development and spread of unplanned fires on the urban edge and into suburbs. An assessment of house loss after the 2003 Canberra fires concluded that it was likely that more than 50% of the house losses were due to fire attack from suburban fuels. The management of bushfire fuels in suburbs, on both unleased and leased land, in conjunction with appropriate preparedness by residents, will reduce the risk of house loss.

Further information on bushfire fuels, the assessment and modelling of bushfire fuel loads in the ACT and the techniques used to modify bushfire fuels is provided in the *Supporting Information – Part One*.

Bushfire risk analysis
The structure of this Plan follows the steps of the risk management process detailed in the Australian/New Zealand Standard AS/NZS 4360:2004, which provides the framework for establishing the *context, analysis, evaluation, treatment, monitoring and communication* of risk.

The analysis and evaluation components of this framework are undertaken in this Plan by considering:

1. the likelihood of a bushfire starting and the how it will spread through the landscape; and
2. consequence on assets that may be affected by the spread of the bushfire.

Supporting Information – Part One provides detailed modelling and analysis of the probability of bushfires starting and spreading in the ACT, based upon historical records of the fire climate and the modelling of bushfire fuels and behaviour characteristics.

The areas in which a bushfire may spread under a range of conditions are critical in identifying the assets which may be impacted. Assets that may be impacted by bushfires (planned or unplanned) have been grouped into eight broad categories:

- Human life;
- Property;
- Business and social Infrastructure;
- Critical infrastructure;
- Agricultural production;
- Biodiversity and threatened species;
- Cultural heritage; and
- Water catchments.

Supporting Information - Part One details the range of potential consequences that bushfires, both planned and unplanned may have on each of these assets groupings. For some of the asset groupings, such as biodiversity and threatened species, more detailed background information is also provided in the *Supporting Information – Part Two*.

The bushfire management framework of this Plan

As a means of addressing the components of the risk management framework for the treatment, monitoring and communication of bushfire risk, the following management framework is utilised: **R**esearch, Information and Analysis, **P**revention, **P**reparedness, **R**esponse and **R**ecovery (RPPRR).

This framework allows ACT Government agencies and the community to approach bushfire planning in a comprehensive and structured manner. However, flexibility in this framework is necessary and emphasis on a particular category may vary between individuals, organisations and locations, and over time.

Research, information and analysis provide contemporary information, qualified research findings and monitoring and review to develop and implement actions under the other categories in the framework.

Prevention includes pre-emptive risk mitigation actions by the ACT Government and the community to reduce the likelihood of bushfires starting, spreading and causing damage. It includes the reduction of bushfire fuels, the provision of access for suppression and managing the sources of ignition of bushfires.

Preparedness. Preparedness ensures that when bushfires occur, ACT Government agencies, the community and individual land managers are ready to respond in ways that are effective and soundly based. These will include early detection, having appropriately trained and experienced firefighters, a prepared community and the necessary plans, physical and information resources in place to respond to bushfire and provide information, advice and warnings to the community.

Response. Effective response to bushfires when they start can mitigate bushfire risk, through limiting the spread and the consequences of bushfire. Response includes the firefighting component of the overall bushfire management process. Firefighting is generally the role of the Fire Services but, just as importantly response includes those critical actions that community members will take when bushfires threatens.
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Recovery describes actions taken to limit the consequences following a bushfire. Recovery may be complex, as it deals with social, economic, physical and environmental rehabilitation. It is an integral part of the framework and should be consciously considered during all other phases of the framework.

PART TWO - Bushfire management objectives and strategies

Goal and Strategies of the SBMP

The Goal	
Through Government and the community working together, suppress bushfires and reduce their consequences on human life, property and the environment	
Objectives	
For the ACT Government to develop and implement an integrated, efficient and effective bushfire management program	***For the community of the ACT to increase its knowledge of bushfires and to take personal actions to minimise the risk and consequences of bushfire events***

Strategies	
Research, information and analysis	
ACT Government	**ACT community**
• The ACT Government and the community work together to share knowledge and information to prepare and maintain integrated Regional Fire Management Plans • Undertake monitoring and review of the effects of the operations and activities resulting from this Plan and sub-plans and report back to the community and adjust strategies as necessary • Analyse the response to and the effects of bushfires for future learning and adjust strategies where this new information and knowledge will result in improved outcomes • Actively work with other fire agencies to develop bushfire management strategies that are aligned and acknowledge the level of bushfire risk to each jurisdiction	• The ACT Bushfire Council will provide oversight and review of bushfire management in the ACT • The ACT Government and the community work together to share knowledge and information to prepare and maintain integrated Regional Fire Management Plans • The community considers its vulnerability to bushfires and take the necessary steps to plan for their occurrence
Prevention	
ACT Government	**ACT community**
• Undertake targeted programs to reduce the number of unplanned ignitions • Maintain a network of fire trails and helipads (bushfire management access network) to provide for rapid response to bushfires and to undertake effective bushfire fighting and hazard reduction operations • Establish priorities for prevention and preparedness activities which reduce the likelihood and consequences of catastrophic bushfire events • Maintain a mosaic of fuel loads at a landscape level, through Strategic Firefighting Advantage Zones that assist in	• Community members prepare their properties and their businesses to reduce the impacts of bushfire

suppressing bushfires and minimise environmental consequences • Provide for primary bushfire risk reduction adjacent to assets through Asset Protection Zones that assist in reducing the consequences of bushfires • Reduce bushfire risk in areas subject to ember attack, radiant heat and flame contact through effective urban planning, design and construction	
Preparedness	
ACT Government	**ACT community**
• Ensure sufficient skilled and motivated personnel are available to meet bushfire management requirements • Ensure the standard and quantity of equipment and resources available for bushfire suppression meet bushfire suppression objectives • Ensure critical information and detection methods are available and arrangements are in place for firefighters to rapidly and effectively respond to bushfires • Provide support to the community to enhance its awareness and capacity to Prepare, Act and Survive the threat of bushfire	• Community members prepare themselves and their families to take action to avoid loss of life and reduce property damage, with the limited support of emergency services • Community members support the emergency services as an integrated part of the coordinated response efforts
Response	
ACT Government	**ACT community**
• Respond to bushfires safely, effectively and efficiently to control and extinguish the fires • Provide the necessary information, advice and warnings to the community to enable immediate response and appropriate actions by individuals when bushfires occur • Where multiple agencies are involved or significant events occur, ensure the response to bushfires is undertaken in a coordinated manner	• Community members take responsibility to undertake the necessary actions to improve their ability to survive bushfire events

Recovery	
ACT Government	**ACT community**
• Restore healthy, diverse, and resilient ecological systems on a priority basis through long-term restoration • Coordinate and deliver programs and services to assist the recovery of affected communities and individuals, including firefighting personnel and support staff	• Communities lead their own recovery in partnership with the ACT Government and other agencies • Communities support each other and contribute to the development of a more prepared community

Chapter Four: Implementation

Implementation

The implementation of this Plan will be based on specific actions to achieve the strategies identified above. The ACT Government makes a commitment to implement the Plan, and where appropriate Government agencies will incorporate these actions into their annual business programs.

Community members are encouraged to consider the Plan, and incorporate the actions identified into their personal planning for bushfires.

Implementation actions will:

- be linked clearly to the strategies of the Plan;
- specify clear and measurable outcomes; and
- clearly allocate responsibility for achieving outcomes. This may include identified statutory positions (such as the Chief Officers of the Fire services) or as appropriate organisations, groups or individuals. In some cases, these functions may be delegated by the identified party. Multiple parties are identified for some single action statements, generally reflecting actions that having multiple components.

The timing to implement the actions considers a range factors:

- actions identified that are already in place or undertaken;
- actions that may have commenced but require further development;
- new actions;
- actions requiring periodic review; and
- actions that will only be required in specific circumstances, for example when a significant bushfire occurs.

Where appropriate, the timing to commence or complete specific actions and undertake periodic review is identified in the action statement.

Relative priorities have been assigned to the specific actions in the Implementation Plans. The following criteria have been used to allocate the priorities.

- High: these are tasks which are essential to achieve the Plan’s objectives; and
- Medium: these are tasks important to achieve the Plan’s objectives but which can be undertaken over the life of this Plan, without significant adverse impacts on bushfire management outcomes.

Acronyms used in implementation plans principally relate to the names of ACT Government Agencies and Business Units responsible for implementing actions. They are:

- ESA ACT Emergency Services Agency
- ACT RFS ACT Rural Fire Service
- ACT FB ACT Fire Brigade
- JACS ACT Department of Justice and Community Safety
- TAMS ACT Department of Territory and Municipal Services
- CMD ACT Chief Ministers Department
- DHCS ACT Department of Disability, Housing and Community Services
- LDA ACT Land Development Agency
- ACTPLA ACT Planning and Land Authority

PART THREE - Bushfire management zoning

Chapter Five: Zoning

Bushfire management zoning

Bushfire management zones guide prevention and preparedness activities to achieve more effective management of bushfires, by both the ACT Government and broader community.

Bushfire management zoning in this Plan:

- provides an ACT-wide approach to bushfire risk mitigation, and is developed in a tenure neutral manner;
- strategically allocates areas of land to zones and where appropriate, with measurable treatment standards;
- are located and aligned to reflect the risk of bushfires starting, spreading and causing damage; and
- consider the principal purpose for land use, including ecological or production requirements, proximity to natural or built assets and appropriate strategies for bushfire control operations.

The use of fire management zones form the cornerstone of the prevention activities identified in this Plan and are important for assisting the community in assessing their vulnerability to bushfires. They inform the development of Regional Fire Management Plans, which are prepared to detail the timing, location and type of specific bushfire prevention actions to be undertaken. The Fire Management Zones are:

Ember Zones: are areas of leased land that contain rural and urban structures and assets that may be subject to impact by bushfires, principally through ember attack and potentially as a result of radiant heat and direct flame contact from bushfires. The zone has been established based on historical data of bushfire penetration into built-up areas, and provides a guide to show areas at highest risk from direct ember attack. It does not automatically mean that all properties falling inside this zone will be affected by all bushfires; likewise in some circumstance bushfires may penetrate further than the distances indicated[1].

Inner Asset Protection Zones: are strips of land adjacent to vulnerable assets, where fuel hazard is to be reduced to comparatively low levels. This will reduce the level of ember attack, direct flame contact and radiant heat impact on adjacent assets, and provide defensible space to allow firefighters and residents to reduce the impact of bushfires with increased safety under some conditions.

[1] The purpose of the Ember Zone is to: identify to urban and rural residents areas that may be subject to a higher level of bushfire risk to guide them in the necessary actions they need to undertake to *Prepare, Act and Survive* bushfire situations; guide emergency services in targeting and delivering proactive and explicit community education and awareness programs and; may be used to trigger the application of specific bushfire risk assessment to determine standards of building construction for new subdivisions and developments. The Zone does not impose retrospective requirements for meeting particular building standards on existing properties.

Outer Asset Protection Zones: are strips of land adjacent to some inner asset protection zones, where fuel hazard is to be reduced to comparatively low levels to further reduce bushfire intensity and the risk of ember attack to adjacent houses and assets.

Strategic Firefighting Advantage Zones: are corridors established to break up major fire runs in instances where initial attack fails and conditions permit, although they may assist in initial attack in some circumstances. These zones are strategically located to slow the spread of unplanned fires and reduce fire intensity and spotting.

Landscape Fire Management Zones: are areas on government managed lands where planned fire is applied for ecological and catchment requirements, recognising that in some communities, no planned fire will be applied.

Agricultural Fire Management Zones: are areas of rural leasehold and agisted lands where bushfire mitigation is undertaken less intensely, and in accordance with rural production objectives. The Zone recognises that the range of rural production activities practiced in the ACT will generally result in the reduction of bushfire risk.

Cooperative Management Areas: are identified where particular zones cross over multiple land management tenures or areas where this Plan does not apply but are significant in relation to fire management strategies in the ACT. Examples of this may include zones that straddle rural land and national park in the ACT, areas of NSW or areas on National Land managed land in the ACT. In these Cooperative Management Areas, the ESA, land managers or other fire authorities will work closely to develop strategies and actions that are integrated and consistent with this Plan and the relevant land use objectives.

The mapped fire management zones below (figures one and two) are provided for explanatory purposes. The zoning is shown for the next ten years, in two five-year groupings: 2009-2014 and 2014-2019.

The zoning system is designed to be dynamic over the long term, and the location of zones may vary. For example, this Plan identifies the need to achieve mosaic of fuel management across the landscape, while recognising the need to balance bushfire risk mitigation with environmental values. To achieve these multiple objectives Strategic Firefighting Advantage Zones will vary in some locations between the two five-year groupings identified, as well as in future Plans. A further example is the urban footprint of the ACT, which changes over time and requires zoning to be flexible to accommodate these changes from year to year.

These zones and the Regional Fire Management Plans that derive from them will be subject to annual review. Where amendments are required they will be approved by the Commissioner ESA. These changes may be made without prior public consultation.

Further information relating to Fire Management Zoning can be found in the *Supporting Information - Part Two.*

Figure One - ACT Zoning Map 2009-2014

This map is for explanatory purposes and will be reviewed annually.
High resolution maps are available on the ESA website

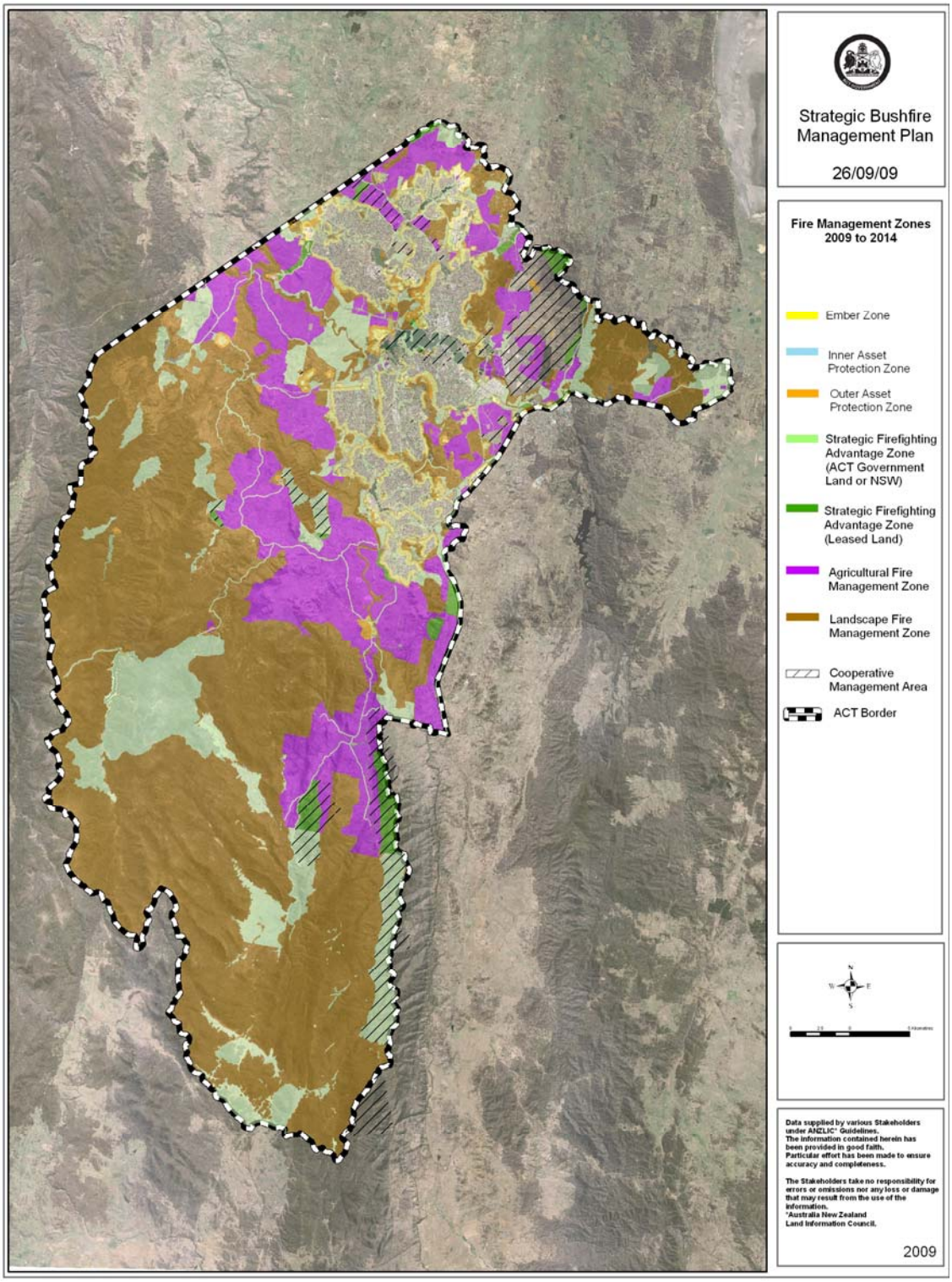
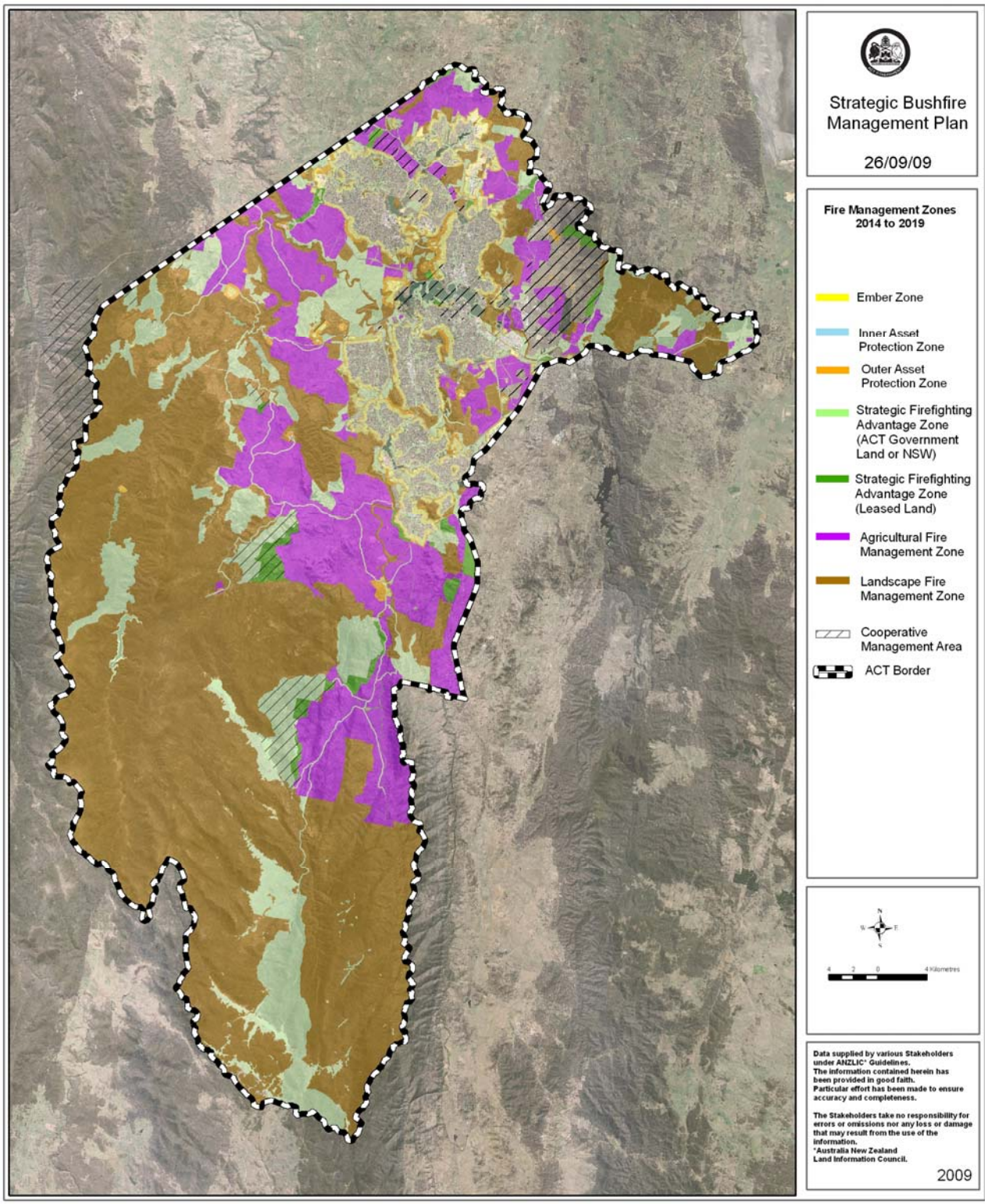


Figure Two - ACT Zoning Map 2014-2019

This map is for explanatory purposes and will be reviewed annually.
High resolution maps are available on the ESA website



PART FOUR– Implementation Plan for the ACT community

This Plan asks the community of the ACT to increase its knowledge of bushfires and to take personal actions to minimise the risk and consequences of bushfire events

Research, information and analysis

Research, information and analysis provide the necessary processes, information and understanding to implement actions under the other categories in this framework. Planning and management cannot be improved without analysis of past events and incorporation of improved technological and operational developments. Research provides valuable insights into critical factors and causal relationships.

Strategy: The ACT Bushfire Council will provide oversight and review of bushfire management in the ACT			
No.	Actions to achieve the strategy	Priority	Responsibility
1	The ACT Bushfire Council will monitor and review implementation of actions established under this Plan. Audit reports will be prepared annually to document compliance with actions identified in this Plan. Audit reports will include an outline of the audit procedure, any necessary discussion of findings, and conclusions about level of compliance with this Plan.	High	ACT Bushfire Council
2	The ACT Bushfire Council will provide advice to the Minister on matters relating to bushfire management in the ACT, including: • the level of preparedness; • prevention activities; • the response capability of fire services; and • the implementation of recommendations from the inquiries into the 2003 Canberra bushfires, and other major bushfire events. This advice will be prepared annually, and provided to the Minister prior to the commencement of the bushfire season for that year.	High	ACT Bushfire Council

Strategy: The ACT Government and the community work together to share knowledge and information to prepare and maintain integrated Regional Fire Management Plans			
	Actions to achieve the strategy	Priority	Responsibility
3	Community members consider and actively participate in the development of plans for fire management.	Medium	All community members
4	Rural landholders participate in cooperative arrangements with adjacent landholders, community groups and individuals to integrate fuel management activities and access across ACT land tenures, generally in areas identified as Cooperative Management Zones.	Medium	All fire management authorities and community members

Strategy: The community considers its vulnerability to bushfires and take the necessary steps to plan for their occurrence			
No.	Actions to achieve the strategy	Priority	Responsibility
5	The community evaluate its level of vulnerability to bushfire and understand their personal responsibility to plan for the event of a bushfire. Evaluation of vulnerability is assisted by considering: • individual's proximity to the identified Ember Zones[2], which show those built up areas in the ACT at higher level of risk from the impacts of bushfire; • whether you live in rural areas of the ACT; and • bushfire information and advice available through the fire services.	High	All community members
6	Community members, particularly those in areas identified as Ember Zones, participate in an integrated bushfire education and awareness program in order to understand fire management and plan personal bushfire responses. This should include the preparation of a home emergency plan, which considers the necessary prevention, prepredness, response and recovery actions they will undertake to Prepare, Act and Survive a bushfire event. Detailed information on the preparation of home emergency plans is available on the ESA website or from the ESA. These plans should be reviewed annually, prior to the commencement of the bushfire season[3].	High	All community members

[2] The mapped location of Ember Zones in the ACT are available on the ESA website or from the ESA. The Ember Zone are those urban areas and rural villages specifically identified in the Fire Management Zoning Maps as subject to a higher level of bushfire risk. Although not identified on these maps, rural residences and assets may also be within an Ember Zone.

Prevention

Prevention encompasses pre-emptive risk mitigation action by the ACT Government and the community to reduce the likelihood of bushfires starting, spreading and/or causing damage to assets.

Strategy: Community members *prepare their properties* and their businesses to reduce the impacts of bushfire			
No.	Actions to achieve the strategy	Priority	Responsibility
7	Community members, particularly those in areas identified as Ember Zones , consider what level of bushfire threat the property is capable of withstanding[4] and undertake actions to *prepare*[5] their properties to reduce the effects of bushfires which may include: • regular actions to reduce the risk presented by heavy loads of garden fuels and vegetation around their homes; • actions to address building deficiencies that may increase their vulnerability to bushfire; and • the necessary and appropriate resources and equipment for responding to bushfire events, including the provision of a "home emergency kit" for bushfires (and other emergencies). Considering how well your assets are prepared for bushfire events must be a continuous and ongoing process for all members of the community and should form part of a home emergency plan. Even if the plan is to leave, the better prepared the home the greater the likelihood it will survive a bushfire. Detailed information is available on the ESA website to assist. Community members are encouraged to seek the advice for the ACT Fire Services, including Community Fire Units and Volunteer Brigades to assist in the development of the plans and undertaking activities.	High	All community members
8	In addition to providing an increased level of protection to their homes, rural landholders also take active and regular measures to prevent damage to critical infrastructure, production, and agricultural assets of their business enterprises. This should include participation and advice in protecting environmental and heritage values, which may occur on their property or on adjacent lands, including identified Cooperative Management Areas.	High	Rural landholders

[3] The bushfire season normally runs from 1 October through to 31 March the following year, although the beginning and end of the season may be changed if conditions require.

[4] The vulnerability of houses to bushfires will be dependent on the scale of bushfire threat and the extent of preparations undertaken to reduce this threat. Notwithstanding, in some bushfire situations, even fully prepared and well designed homes are unlikely to be defendable.

[5] *Prepare, Act, Survive* is the nationally agreed framework for the provision of information and warnings to the community.

	Local volunteer brigades may assist rural landholders in the development of the plans.		

Preparedness

Preparedness ensures that when bushfires occur, ACT Government agencies, the community and individual land managers are ready to respond in ways that are effective and soundly based. These will include early detection, having appropriately trained and experienced firefighters, a prepared community and the necessary plans, physical and information resources in place to respond to bushfire and provide information, advice and warnings to the community.

Strategy: Community members *prepare themselves and their families* to take action to avoid loss of life and reduce property damage, with the limited support of emergency services			
No.	Actions to achieve the strategy	Priority	Responsibility
9	Community members, particularly those in areas identified as Ember Zones determine how they will p*repare* themselves for bushfire incidents. Preparing for bushfires needs to consider : • If the plan is to leave early in the event of bushfires, prepare for where to go, how to get there and what to take; • If the plan is to stay, understand the risk of injury and death presented by major bushfires and whether individuals are physically and emotionally prepared to withstand the extreme physical and psychological conditions presented by bushfire impact; • contingency plans including areas to shelter and how they can be accessed if a bushfire threatens; • the ability to act independently, without the support of emergency services; and • plans for the safety of vulnerable family or individuals, including children or the disabled. Preparations for bushfire events must be a continuous and ongoing process for all members of the community and should form part of a home emergency plan. Community members are encouraged to seek the advice from the ACT Fire Services, including Community Fire Units and Volunteer Brigades to assist in the development of the plans and undertaking activities. Detailed information is available on the ESA website to assist.	High	All community members

10	Community members, particularly those in areas identified as Ember Zones actively seek to understand: • the Fire Danger Rating system that is applied, using a combination of words (the Fire Danger Rating) and numbers (the Fire Danger Index) that provides an assessment of the fire behaviour, the difficulty of controlling a fire and the possible impacts. • the levels and types of messages used by Emergency Services and their purpose in alerting community members to danger so actions can be taken[6]. Detailed information is available on the ESA website describing the Fire Danger Rating and messages that will be provided by emergency services.		All community members
11	Community members, particularly those in areas identified as Ember Zones, assess the need and necessary coverage of insurance against the risk of bushfires. Requirements should be reviewed annually.	Medium	All community members
12	Rural landholders prepare and annually review Bushfire Action Plans[7] that considers the necessary skills and resources to respond to bushfires on their properties, with the objective of controlling and extinguishing unplanned fires.	High	Rural landholders

[6] Consistent with the principles established in the *National framework for scaled bushfire advice and warnings to the community*, the type of messages are:
Bushfire Advice messages provide general information to keep the community up to date with the local bushfire situation and developments:
Watch and Act messages will identify that a bushfire is approaching, conditions are changing; community members need to start taking action now to protect you themselves and their family; and
Emergency Warning messages will identify that community members are in danger, will be impacted by fire and need to take action immediately. This message will usually be preceded by the Standard Emergency Warning Signal (SEWS).
Any subsequent revisions to this framework may be incorporated as approriate.

[7] Rural Landholders should engage with the Farm FireWise program to prepare these plans, which would meet requirements of their Land Management Agreements. Farm Fire Wise is an ongoing program established and implemented by the ACT Rural Fire Service to assist rural landholders to undertake the necessary planning activities to prevent and prepare for bushfires

Strategy: Community members support the emergency services as an integrated part of the coordinated response efforts			
No.	Actions to achieve the strategy	Priority	Responsibility
13	Individuals, particularly those in areas identified as Ember Zones consider their ability to contribute to their community through voluntary service by: • becoming a member of a rural volunteer fire brigade; • becoming a member of a local Community Fire Unit; or • becoming a member of other services and organisations that support fire management.	High	All community members
14	Individuals should be aware of their responsibility to report bushfires or suspicious activity, and assist emergency services when requested.	High	All community members

Response

Effective response to bushfires when they start can mitigate bushfire risk, through limiting the spread and the consequences of bushfire. Response includes the firefighting component of the overall bushfire management process. Firefighting is generally the role of the Fire Services but, just as importantly response includes those critical actions that community members will take when bushfires threatens.

Strategy: Community members take responsibility to undertake the necessary actions to improve their ability to survive bushfire events.			
No.	Actions to achieve the strategy	Priority	Responsibility
15	Throughout the bushfire season, community members maintain awareness of local bushfire events and the regional bushfire situation. This can be achieved through: • fire services websites; • other websites, such as the Bureau of Meteorology; • Canberra Connect; • radio or television and online media services[8]; • identifying and maintaining contact networks with friends, neighbours and family; and • contact with local Volunteer Brigade and CFU members. *Bushfire Advice* messages will provide general information to keep the community up to date with the local bushfire situation and developments.	High	All community members
16	The decisions and actions community members take when bushfires occur are critical to their safety. Fires can threaten suddenly and without warning and community members should be prepared to act, potentially without receiving any emergency warning. Critical in this is the need to: • know what the Fire Danger Rating is; • watch for signs of fire, especially smoke and flames; • put preparations into action – activate your home emergency plan and do not 'wait and see'; • act decisively the moment when danger is known; and • know the safest place is to be away from the fire. *Watch and Act* messages will identify that a bushfire is approaching and conditions are changing; community members need to start taking action at this stage to protect themselves and their family. *Emergency Warning* messages will identify that community members are in danger, will be impacted by bushfire and	High	All community members

[8] Radio or television and online media services: The ESA and other emergency services will utilise a range of broadcast media to disseminate messages. The ESA has arrangements in place with local media for the dissemination of public warning and emergency information 24 hours a day, 7 days a week.

	need to take action immediately.		

Recovery

Recovery is risk mitigation that limits the consequences after a bushfire. Recovery is complex as it deals with social, economic, physical and environmental rehabilitation. It is an integral part of the whole process and consciously considered at each other stage of the process.

Strategy: Communities lead their own recovery in partnership with the ACT Government and other agencies			
No.	Actions to achieve the strategy	Priority	Responsibility
17	Work collaboratively and contribute skills and resources to assist with the recovery of community, businesses and individuals.	Medium	Community members
18	In cooperation with emergency services, rural landholders and managers of social and critical infrastructure commence recovery actions for: • animal welfare and environmental requirements; • the maintenance of services, businesses; and commercial enterprises. These actions may need to be undertaken while bushfires are still actively burning.	Medium	Rural landholders and infrastructure managers

Strategy: Communities support each other and contribute to the development of a more prepared community			
No.	Actions to achieve the strategy	Priority	Responsibility
19	Following bushfire events, both in the short and long term, community members should be encouraged to undertake ongoing monitoring of their own wellbeing and that of vulnerable family, neighbours and other community members, to ensure their safety and individual needs and, if necessary, assist or seek appropriate assistance for them.	High	Individuals and community members

PART FIVE – Implementation Plan for the ACT Government

For the ACT Government to develop and implement an integrated, efficient and effective bushfire management program

Research, information and analysis

Research, information and analysis provide the necessary processes, information and understanding to implement actions under all of the categories in this framework. Planning and management cannot be improved without analysis of past events and incorporation of improved technological and operational developments. Research provides valuable insights into critical factors and causal relationships.

Strategy: The ACT Government and the community work together to share knowledge and information to prepare and maintain integrated Regional Fire Management Plans			
No.	Actions to achieve the strategy	Priority	Responsibility
1	The Plan will be reviewed within five years. Given that many of the policies of this Plan will be implemented over a longer period, the Plan considers a ten-year outlook (or longer) in some key areas. Amendment of this Plan may be undertaken consistent with the *Emergencies Act 2004* as required by changes in legislation, policy or advances in knowledge.	High	Minister for Police and Emergency Services
2	The ACT Government have prepared Regional Fire Management Plans under this Plan. These plans establish operational objectives for the next ten years and inform the annual Bushfire Operational Plans. These plans will be reviewed annually to reflect seasonal and operational issues that affect the implementation of the plans.[1,2]	High	Commissioner ESA, TAMS
3	The ACT Government will assist the community in their understanding of fire management practices in Regional Fire Management Plans (including prescribed burning) through awareness and education programs.	Medium	Commissioner ESA, TAMS

[1] The annual review and any amendments required to these plans will be approved by the Commissioner ESA and may be notified to the public without prior consultation

[2] Regional Fire Management Plans are based on the sixteen 1:25000 map sheets that provide coverage of the ACT and adjacent areas of NSW. They are available for viewing on the ESA website: **www.esa.act.gov.au**. A description of the content of these plans is found at schedule E.

Strategy: Undertake monitoring and review of the effects of the operations and activities resulting from this Plan and sub-plans and report back to the community and adjust strategies as necessary			
No.	Actions to achieve the strategy	Priority	Responsibility
4	The ACT will maintain a commitment to ongoing nationally coordinated bushfire research. The most recent advances in the knowledge related to the effects and effectiveness of fire management found through engagement with relevant state, national and international bodies for bushfire research and management, will be used to inform training, awareness and other programs.	Medium	Commissioner ESA and TAMS
5	Regular and ongoing sampling and assessment will be undertaken to monitor the effects of bushfires and bushfire management, in particular prescribed burning and its impact on fuel levels, flora and fauna. This assessment will be used to inform and adapt future practices as appropriate.	Medium	TAMS
6	Regular and ongoing assessment of the effectiveness of community education and awareness programs will be undertaken and where appropriate, these programs will be reviewed in consideration of this assessment, best practice and national standards to ensure they remain current and effective. Initial assessment will be undertaken during the 2010-11 bushfire season, with ongoing review of education and awareness programs.	High	Commissioner ESA
7	Annual reports will be prepared to document the ACT Government's compliance with actions identified under this Plan[3].	High	Commissioner ESA
8	The ESA may appoint Inspectors in accordance with the Act, who may assess and give direction to land managers on the implementation of bushfire management requirements in this Plan and sub-plans[4].	Medium	Chief Officer ACT RFS Chief Officer ACT FB

[3] This report may be used to support the audit of the Plan by the ACT Bushfire Council (See action 5). Schedule A identifies procedures associated with preparation of these reports.

[4] This may include those actions required of Government Agencies and members of the community.

Strategy: Analyse the response to and the effects of bushfires for future learning and adjust strategies where this new information and knowledge will result in improved outcomes			
No.	Actions to achieve the strategy	Priority	Responsibility
9	Consider and undertake where appropriate, opportunistic research into: • fire behaviour, firefighting methods and firefighter performance[5]; and • the effects of bushfire on natural and cultural values[6]. The findings (as well as findings from other research and analysis) may be used to inform the annual review of Regional Fire Management Plans, future pre-fire season briefings, fire operations and performance improvement.	High	Chief Officer ACT RFS, TAMS
10	Conduct a formal debriefing and analysis of findings following bushfires where: • substantial resources were engaged[5]; • bushfire damage to assets or values was significant[5]; • safety was compromised[5]; or • recovery issues have been raised [7]. The findings should be used to inform the annual review of Regional Fire Management Plans, future pre-fire season briefings, fire operations and procedures, and performance improvement.	High	Chief Officer ACT RFS, Chief Officer ACT FB , TAMS, DHCS

[5] Generally undertaken by the ESA.
[6] Generally undertaken by TAMS.
[7] Generally undertaken by TAMS or DHCS, depending on the type of Recovery Issues.

Strategy: Actively work with other fire agencies to develop bushfire management strategies that are aligned and acknowledge the level of bushfire risk to each jurisdiction			
No.	Actions to achieve the strategy	Priority	Responsibility
11	To achieve effective coordination and cooperation for bushfire response and preparedness, maintain formal agreements between ACT and NSW agencies and develop Memoranda of Understanding to provide for: • integrated and efficient responses to bushfires, including the cross border response arrangements, appointment to incident management positions, common communications, training, integrated planning and incident management, shared resources and mutual support; and • common approaches and protocols between agencies for community education and awareness. Agreements will be reviewed annually.	High	Chief Officer ACT RFS Chief Officer ACT FB
12	To achieve effective and integrated cross-border fire prevention strategies, participate in planning arrangements which include the identification of cooperative management areas and where appropriate, maintain formal agreements to: • provide for an integrated and complimentary approach to bushfire risk assessment; and • develop complimentary strategies for bushfire prevention, including fuel management and access. Agreements will be reviewed annually.	High	Chief Officer ACT RFS, TAMS
13	Work with managers of National Land in the ACT (including the National Capital Authority and Department of Defence) in areas identified as Cooperative Management Areas, to provide for: • advice in relation to bushfire risk to assets; • a framework for bushfire management in these areas complimentary to this Plan; and • strategies and actions for mitigation of bushfire risk which are integrated and consistent with the strategies of this Plan.	High	Commissioner ESA

Prevention

Prevention encompasses pre-emptive risk mitigation action by the ACT Government and the community to reduce the likelihood of bushfires starting, spreading and/or causing damage to assets.

Strategy: Undertake targeted programs to reduce the number of unplanned ignitions			
No.	Actions to achieve the strategy	Priority	Responsibility
14	Targeted awareness and education programs will be provided to: • assist the community in understanding its legal obligations and social responsibilities in relation to bushfire ignitions; • reduce preventable ignitions; and • improve early detection.	High	Commissioner ESA
15	Statutory powers will be used to control the use of fire and activities known to cause bushfires. These powers should be used to: • regulate the use of fire by the introduction of seasonal restrictions (i.e. the bushfire season); • regulate the use of machinery considering the level of fire danger; and • declare days of total fire ban[8] in the ACT to limit ignitions or when local or regional conditions may require increased levels of vigilance.	High	Chief Officer ACT RFS, Chief Officer ACT FB
16	The ESA may appoint Investigators in accordance with the Act to undertake investigation into the cause and effect of bushfires where required. If arson is suspected, action may be taken to investigate and, as far as possible and appropriate, identify` and prosecute the suspected offender/s.	Medium	Chief Officer ACT RFS, Chief Officer ACT FB

[8] Days of Total Fire Ban will generally be called when the Fire Danger Index is at 50 or above (Fire Danger Ratings of Severe, Extreme or Catastrophic)

Strategy: Maintain a network of fire trails and helipads (bushfire management access network) to provide for rapid response to bushfires and to undertake effective bushfire fighting and hazard reduction operations			
No.	Actions to achieve the strategy	Priority	Responsibility
17	A bushfire management access network in the ACT is identified in Regional Fire Management Plans[9]. This includes: • existing access; • classification of access; and • any proposals for new or upgraded access. Schedule B identifies classification and performance standards for the bushfire management access network. Review of the fire access network will be undertaken as part of the annual review of Regional Fire Management Plans.	High	Chief Officer ACT RFS, TAMS
18	Government land managers will prepare Bushfire Operational Plans consistent with Regional Fire Management Plans which detail works to be carried out[10] on fire management access networks on their land that include: • fire trail maintenance; • fire trail upgrades; and • fire trail construction. Bushfire Operational Plans will be prepared every two years, or less as required.	High	Land managers
19	Through Farm FireWise, the ESA will assist landholders in identifying strategic fire management access on rural land. The ESA may provide resources to assist in the planning and implementation of fire management access networks.	High	Chief Officer ACT RFS

[9] Review of the bushfire management access network will take into account the necessary linkages between publicly and privately managed lands. It will also consider access for the full range of fire response capability including heavy plant transport, light plant access, aerial access, bushfire appliances and remote area access.

[10] In planning, constructing or maintaining bushfire access, land managers are required to comply with other legislation.

Strategy: Establish priorities for prevention and preparedness activities which reduce the likelihood and consequences of catastrophic bushfire events			
No.	Actions to achieve the strategy	Priority	Responsibility
20	Lands in the ACT are classified into Fire Management Zones[11] to assign priorities to implementing prevention and preparedness activities, including fuel management. These zones are: • Ember Zone; • Inner Asset Protection Zone; • Outer Asset Protection Zone; • Strategic Firefighting Advantage Zone; • Landscape Fire Management Zone; and • Agricultural Fire Management Zone. The specifications and fuel management standards for zones are found at Schedule C. Maps of these zones are included for explanatory purposes in Part Three of this Plan. Zones will be reviewed annually to reflect changes in land use in the ACT, operational considerations and any advances in the knowledge and understanding of bushfire risk[12].	High	Commissioner ESA

[11] Fire management zoning provides the framework for the development of Regional Fire Management Plans. The size and alignment of these zones will reflect the risk of bushfires starting, spreading and causing damage. The location of zones may be required away from the source of the risk or other mitigation methods may be applied where treatments cannot always be located in these areas of highest risk. This may be due to a range of factors, including operational, environmental, water catchment and other values that may be affected.

[12] These zones will be subject to annual review. Where amendments are required they will be approved by the Commissioner ESA. These changes may be made without prior public consultation.

Strategy: Maintain a mosaic of fuel loads at a landscape level, through Strategic Firefighting Advantage Zones that assist in suppressing bushfires and minimise environmental consequences			
No.	Actions to achieve the strategy	Priority	Responsibility
21	Location and timing of fuel reduction activities in Strategic Firefighting Advantage Zones are identified in Regional Fire Management Plans and reviewed annually[13]. The locations of Strategic Firefighting Advantage Zones may vary between Plans to achieve fire management objectives in the short to medium term and ensure a mosaic of fuel loads over the longer term.	High	Commissioner ESA and Land managers
22	The use of planned fire for ecological and environmental management will be identified in Regional Fire Management Plans.	Medium	Land managers
23	Land managers will prepare Bushfire Operational Plans that detail fuel management works in Strategic Firefighting Zones to meet the standards identified in this Plan. Bushfire Operational Plans will be prepared every two years, or less as required.	High	Government land managers
24	Through Farm FireWise, the ESA will assist landholders in identifying fuel management requirements on rural land. Where Cooperative Management Areas are identified, the ESA will coordinate liaison between land managers to achieve the objectives for the area. ESA may provide resources to assist in the planning and implementation of fire management works[14].	High	Chief Officer ACT RFS

[13] The size, impact and timing of unplanned bushfires in the landscape, seasonal variations or other significant events may require review of Strategic Firefighting Advantage Zones. Any amendments that are required will be approved by the Commissioner ESA. These changes may be made without prior public consultation.

[14] The ESA and ACT Government land managers will participate in the development of cooperative arrangements with adjacent landholders and community groups, to integrate fuel management activities and bushfire access adjacent to public land boundaries.

Strategy : Provide for primary bushfire risk reduction adjacent to assets through Asset Protection Zones that assist in reducing the consequences of bushfires			
No.	Action to achieve the strategy	Priority	Responsibility
25	Location and timing of fuel management in Inner and Outer Asset Protection Zones are identified in Regional Fire Management Plans and will be reviewed annually[15].	High	Commissioner ESA and Land managers
26	Land managers will prepare Bushfire Operational Plans that detail fuel management in the Inner and Outer Asset Protection Zones to meet the standards identified in this Plan. Bushfire Operational Plans will be prepared every two years, or less as required.	High	Government land managers
27	Through Farm FireWise, the ESA will assist landholders to identify asset protection requirements on rural land. The ESA may provide resources to assist in the planning and implementation of fuel management activities.	High	Chief Officer ACT RFS and rural landholders

[15] Inner and Outer Asset Protection Zones will generally remained fixed over the long term, although they will be reviewed annually to reflect new urban areas and other property and infrastructure developments. The location and timing of activities in Inner and Outer Asset Protection Zones on rural leases will be identified as part of the Farm FireWise Program and will not be identified initially on Regional Fire Management Plans (See action 26). Any amendments that are required will be approved by the Commissioner ESA. These changes may be made without prior public consultation.

Strategy: Reduce bushfire risk in areas subject to ember attack, radiant heat and flame contact through effective urban planning, design and construction			
No.	Actions to achieve the strategy	Priority	Responsibility
28	Standards for the planning, design and layout of new urban areas[16] will be prepared to reduce vulnerability to the impacts of bushfire and should include requirements for (but not be limited to): • bushfire risk analysis specific to the area or development; • requirements for Inner and Outer Asset Protection and Ember Zones[17]; • the construction of buildings to meet the Building Codes of Australia AS:3959/1999 - *Construction of Buildings in Bushfire Prone Areas* (or any revisions)[18]; • access into and egress from subdivisions for firefighting and evacuation; • infrastructure for firefighting and community support; • the type and location of fencing and outbuildings; • the type and use of permissible structures; and • appropriate plants and horticultural practices in high risk areas.	High	ACTPLA
29	New urban plantings and management of existing plantings by Government land managers will consider bushfire risk management issues in determining the location, species, density, extent and maintenance of plantings.	High	TAMS, ACTPLA, LDA
30	Where identified[19], managers of ACT Government properties in Ember Zones and rural areas (and elsewhere as appropriate) will prepare Bushfire Operational Plans to reduce vulnerability to the impacts of bushfire. Bushfire Operational Plans will be prepared every two years, or less as required.	High	ACT Government agencies

[16] The ACT Planning and Land Authority (ACTPLA) is revising the Territory Plan's existing Planning for Bushfire Risk Mitigation General Code, which will remain in force until the review is completed and a new version implemented through the Residential Subdivision Development Code of the Territory Plan expected in 2010.

[17] In new urban areas construction may be staged within and across subdivisions over the period of development. In this case, temporary zoning may be applied to provide for bushfire protection before completion of the development. In this case, temporary zoning and treatments will be considered as part of the bushfire risk assessment prepared.

[18] Some areas of the ACT are declared bushfire prone; however other areas as identified in a bushfire risk assessment may require the application of these standards.

[19] The ESA will assist in advising Government property managers where there are requirements for the preparation of Bushfire Operational Plans.

31	Assessment of arrangements for evacuation and the provision of community refuge areas in the rural villages of the ACT and other areas where identified will be undertaken and as appropriate, strategies developed to address deficiencies. Initial assessment will be undertaken prior to the commencement of the 2010-2011 bushfire season, with ongoing development of strategies.	High	Chief Officer ACT RFS and Chief Officer ACT FB

Preparedness

Preparedness ensures that when bushfires occur, ACT Government agencies, the community and individual land managers are ready to respond in ways that are effective and soundly based. These will include early detection, having appropriately trained and experienced firefighters, a prepared community and the necessary plans, physical and information resources in place to respond to bushfire and provide information, advice and warnings to the community.

Strategy: Ensure sufficient skilled and motivated personnel are available to meet bushfire management requirements			
No.	Actions to achieve the strategy	Priority	Responsibility
32	The necessary number of personnel, the mix of skills, their location and makeup (volunteer and paid) will be determined based on potential bushfire situations, resources and ability to maintain capability and experience. Actions taken to support and maintain capability may include: • strategies for the recruitment and retention of volunteer firefighters; and • workforce planning to maintain and recruit firefighters at identified skill levels. An agreed process will be established prior to the commencement of the 2010-11 bushfire season, with ongoing review.	Medium	Chief Officer ACT RFS and Chief Officer ACT FB
33	Training will be ongoing and delivered based on the operational requirements of the Services to meet or exceed national training and qualification standards, currency and competency requirements where they exist. The delivery and assessment of bushfire fighting related training should be applied consistently across the ESA and individual training pathways should follow a continuum of skills development that recognises and builds on prior learning.	High	Chief Officer ACT RFS and Chief Officer ACT FB
34	The experience, training and competencies to fill specialist firefighting and fire management roles will be established. Specialist skills include: • incident management roles; • situation analysis and fire behaviour modelling; and • specialist and high level fire fighting skills, including Divisional Commander, Remote Area Crews, large scale back burning skills, plant supervision and aircraft management; and • planning and implementation of prescribed burning. Delivery of specialist training is ongoing. Further assessment of requirements will be undertaken prior to the commencement of the 2010-11 bushfire season, with ongoing	High	Chief Officer ACT RFS, Chief Officer ACT FB and TAMS

	review and delivery of training competencies. Deployment of firefighters to interstate and overseas incidents and secondments to other fire agencies will be undertaken where possible to enhance and maintain skills.		
35	Strategies for the provision of incident support functions will be developed, including the support for staging, logistics and incident coordination. Further assessment of requirements will be undertaken prior to the commencement of the 2010-11 bushfire season and will be ongoing.	Medium	Chief Officer ACT RFS and Chief Officer ACT FB
36	Records of personnel expected to be involved in bushfire fighting, including training and experience in assigned roles, will be maintained and available for incident management and training purposes. An agreed process will be established prior to the commencement of the 2011-12 bushfire season, with ongoing implementation and review.	High	Chief Officer ACT RFS and Chief Officer ACT FB

Strategy: Ensure the standard and quantity of equipment and resources available for bushfire suppression meet bushfire suppression objectives			
No.	Actions to achieve the strategy	Priority	Responsibility
37	Current resources (which include firefighting vehicles) will be assessed annually against requirements. This includes: • documenting available equipment for firefighting; • regular inspection and maintenance of equipment; and • where deficiencies exist, development of strategies for addressing those deficiencies. A strategic asset management plan has been prepared to define the ongoing management requirements for fleet and capital equipment for bushfire fighting and will be regularly reviewed.	Medium	Chief Officer ACT RFS and Chief Officer ACT FB
38	Backup stores and services for firefighting will be maintained and reviewed annually.	High	Chief Officer ACT RFS and Chief Officer ACT FB and TAMS
39	Ensure timely access to specialist equipment that will enable rapid and effective response to bushfire. This includes: • aircraft including fixed and rotary wing for fire suppression and insertion of firefighters into remote areas • aircraft support facilities, and arrangements for the use of fire retardants including the locations and conditions under which it may be used; and • light and heavy plant for rapid response and containment line construction. Arrangements for the provision of specialist equipment will be reviewed annually.	High	Chief Officer ACT RFS and TAMS
40	Incident Control Centres and coordination facilities will be prepared and maintained. These facilities may be pre-emptively activated and staffed based on the level of bushfire risk to enable immediate operation if required. Annual exercises will be undertaken to test these facilities (unless they have been sufficiently activated and exercised in actual incident response).	High	Chief Officer ACT RFS and Chief Officer ACT FB

Strategy: Ensure critical information and detection methods are available and arrangements are in place for firefighters to rapidly and effectively respond to bushfires			
No.	Actions to achieve the strategy	Priority	Responsibility
41	During the bushfire season[20], determine the daily requirements for the quantity and availability of personnel and equipment for bushfire suppression[21], and ensure that a system of early detection is in place throughout the year and in accordance with variations in the existing and forecast seasonal trends in weather and fuel characteristics[22].	High	Chief Officer ACT RFS Chief Officer ACT FB
42	Develop procedures and, as appropriate provide resources, to facilitate the rural community in reporting ignitions and undertaking initial attack. Procedures will be prepared prior to the commencement of the 2011-12 bushfire season.	Medium	Chief Officer ACT RFS
43	Ensure an effective ACT-wide radio network with the ability to be linked with other response agencies, both within and external to the ACT. Communications arrangements are to be reviewed and updated annually.	High	Commissioner ESA
44	Develop, exercise and apply technical capabilities to predict bushfire behaviour and spread, supported as required by technical specialists in fire behaviour modelling and meteorology. Development and specialist training is underway. Full and integrated assessment of requirements will be undertaken prior to the commencement of the 2010-11 bushfire season with ongoing review.	High	Chief Officer ACT RFS Chief Officer ACT FB
45	Provide geographic information systems capability to enable the production of bushfire specific maps. Information is to be available in print and electronic form and capable of modification during firefighting operations. Information needs to be portable and readily available to Incident Controllers and fire ground Commanders. Capability will be reviewed annually.	High	Chief Officer ACT RFS and Chief Officer ACT FB and TAMS
46	The ESA and Government land management agencies in the ACT are to ensure that maps of public and private land in the ACT are subjected to periodic review and update.	High	Chief Officer ACT RFS TAMS & ACTPLA

[20] These requirements may be established prior to and after the bushfire season as appropriate.

[21] Resource requirements will be determined considering a number of factors including the Fire Danger Index as identified in the *National framework for scaled advice and warnings to the community (2009).*

[22] The detection system will include the use of the ACT fire tower network; aircraft; and spatial and satellite information.

47	Pre-suppression plans will be prepared and distributed to provide necessary information to undertake initial attack of fires. Planning has been undertaken and further development and integrated procedures will be completed prior to the commencement of the 2011-12 bushfire season.	High	Chief Officer ACT RFS and Chief Officer ACT FB and TAMS

Strategy: Provide support to the community to enhance its awareness and capacity to *Prepare, Act and Survive* the threat of bushfire			
No.	Actions to achieve the strategy	Priority	Responsibility
48	Develop and implement an integrated Bushfire Education and Awareness Program consistent with the *National framework for scaled bushfire advice and bushfire warnings*, which includes: • information that reflects the current knowledge and understanding of how the community should prepare for and respond to bushfires; • information and advice that is targeted for communities and individuals, particularly in the rural area and Ember Zones; • the necessary information for the preparation of a home emergency plan; • Information on how warnings will be disseminated and the type of messages they will contain; • Information on the Fire Danger Rating system and the manner in which it will be used; • utilisation of a range of mediums for the dissemination of information; and • the use of the Standard Emergency Warning Signal (SEWS) and the use of telephony warning systems. This action has commenced and will be ongoing to fully integrate the actions identified.	High	Commissioner ESA
49	Provide support to community members, particularly those in areas identified as Ember Zones to participate in an integrated bushfire education and awareness program in order to assist in understanding how bushfires may affect them and to plan for personal bushfire response. type of messages they will contain.	High	Commissioner ESA
50	Establish and maintain formal agreements between the ESA and local ACT media outlets, and develop Memoranda of Understanding to provide for: • The provision of warnings and information to the community during bushfire events; and • Information and advice to assist the community in preparing for bushfires. Memorandums of Understanding are in place and will be reviewed annually.	High	Commissioner ESA
51	Clearly define and annually exercise the operational arrangements, responsibilities and delegations for the provision of information, warnings and directions to the public in the event of bushfires.	High	Chief Officer ACT RFS and Chief Officer ACT FB

52	Ensure firefighting and support agencies understand principles and policy relating to *Prepare, Act, Survive* and are trained in the evacuation protocols that will apply. This action has commenced and will be ongoing.	High	Chief Officer ACT RFS and Chief Officer ACT FB and AFP
53	Undertake planning to identify groups or individuals who have specific needs[23]. Planning has been undertaken and further development and integrated procedures will be completed prior to the commencement of the 2010-11 bushfire season.	High	Chief Officer ACT RFS and Chief Officer ACT FB

[23] Specific needs includes those members of the community who may require specialist support, information or advice in relation to bushfires and may include the schools and community care facilities, physically and intellectually disabled, supported care, elderly, and culturally and linguistically diverse communities

Response

Effective response to bushfires when they start can mitigate bushfire risk, through limiting the spread and the consequences of bushfire. Response includes the firefighting component of the overall bushfire management process. Firefighting is generally the role of the Fire Services but, just as importantly response includes those critical actions that community members will take when bushfires threatens.

Strategy: Respond to bushfires safely, effectively and efficiently to control and extinguish the fires			
No.	Actions to achieve the strategy	Priority	Responsibility
54	Bushfires will be responded to as quickly as possible by the Fire Services with the principal objective of extinguishing the bushfire. • consideration should be given to allowing bushfires to burn to defined containment lines if they meet other fire management objectives and do not pose a risk to assets; and • mop up and patrol are integral to suppression and will be undertaken to prevent re-ignition and to minimise damage to infrastructure and assets.	High	Chief Officer ACT RFS and Chief Officer ACT FB
55	Response actions will consider: • safety of firefighters; • current and predicted fire behaviour; • assets at risk from the bushfire fighting activities; • resources available locally and through broader emergency arrangements; • bushfire fighting methods most appropriate to the area, considering production, environmental, catchments and heritage assets; • recovery and rehabilitation of production, environmental, catchment and heritage assets; and • likelihood of success of alternative bushfire fighting methods.	High	Chief Officer ACT RFS and Chief Officer ACT FB
56	Existing bushfires will be assessed in a structured framework commensurate with the level of risk and to assess likely spread and impacts.	High	Chief Officer ACT RFS and Chief Officer

			ACT FB
57	The control structure and corresponding scaling up of resources for bushfire fighting will follow the Australasian Inter-service Incident Management System (AIIMS). The Incident Controller will be appointed based on their skills, competence and experience, and the scale and type of incident[24].	High	Chief Officer ACT RFS and Chief Officer ACT FB
58	Documented Incident Action Plans will be prepared consistent with the scale of the incident.	High	Chief Officer ACT RFS and Chief Officer ACT FB
59	Records will be maintained of each bushfire attended consistent with the Operating Procedures[25]. Minimum requirements for recording bushfire information are identified at Schedule D.	High	Chief Officer ACT RFS and Chief Officer ACT FB

[24] Through the Memorandum of Understanding with NSW fire agencies, (see action 10) procedures are established to determine control arrangements for bushfires that cross, or have the potential to cross jurisdictional boundaries.

[25] Records shall be maintained that allow reporting against ACT Government and, where appropriate, national performance indicators.

Strategy: Provide the necessary information, advice and warnings to the community to enable immediate response and appropriate actions by individuals when bushfires occur			
No.	Actions to achieve the strategy	Priority	Responsibility
60	Consistent with the principles established in the *National framework for scaled bushfire advice and warnings to the community (2009)*, response to bushfire includes information to the community that: • is scaled to described the type of threat, potential impact and timing; • is targeted to at risk communities; and • considers the actions communities members should undertake.	High	Chief Officer ACT RFS and Chief Officer ACT FB
61	Responsibility for the release of information, including the provision of advice or warnings relating to the bushfire will rest with the Incident Controller[26]. If a State of Emergency has been declared, this responsibility will rest with the Territory Controller.	High	Chief Officer ACT RFS and Chief Officer ACT FB, Territory Controller
62	Responsibility for the issuing of directions relating to the movements of people, including evacuation, establishing refuge areas and re-occupation and will rest with the Incident Controller[27]. If a State of Emergency has been declared, this responsibility will rest with the Territory Controller. Permission for access to evacuated areas during an incident must consider the needs of particular groups and individuals, including: • rural landholders who may require access to respond to animal welfare, infrastructure and environmental requirements; • managers of social and critical infrastructure for the maintenance of services; • businesses and commercial enterprises; and • residents.	High	Chief Officer ACT RFS and Chief Officer ACT FB, Territory Controller
63	The Public Information Coordination Centre may be activated and will support the Incident Controller or Territory Controller for the provision of information and advice.	High	Chief Officer ACT RFS and Chief Officer ACT FB, Territory Controller

[26] Other information relating to the incident may be released by other agencies, such as recovery information or issues relating to criminal investigation.
[27] Evacuation and re-occupation of areas will be undertaken consistent with the ACT Emergency Evacuation Policy (2008) or subsequent revisions.

64	Actions should ensure stakeholders are engaged as appropriate during bushfire fighting activities and the development of response strategies, to take advantage of local knowledge and address the specific requirements of : • Government land managers; • rural landholders; • business and critical infrastructure managers; • recovery services; and • other response agencies.	High	Chief Officer ACT RFS and Chief Officer ACT FB

Strategy: Where multiple agencies are involved or significant events occur, ensure the response to bushfires is undertaken in a coordinated manner			
No.	Actions to achieve the strategy	Priority	Responsibility
65	Depending on the scale, number, and complexity of the incident(s), an Incident Coordinator may be established to coordinate resources in support of the Incident Controller. This may include: • the acquisition and of resources (organisational, personnel and equipment) to support incident response and recovery; and • the transfer of information and intelligence. Dependent on the scale and type of incident, an Emergency Coordination Centre (ECC) may be activated[28].	High	Chief Officer ACT RFS and Chief Officer ACT FB
66	As required, the Incident Controller will provide information and advice on response to the incident to the appropriate Government agencies and the ACT Government. If a State of Emergency has been declared, this responsibility may rest with the Territory Controller.	High	Chief Officer ACT RFS and Chief Officer ACT FB, Territory Controller
67	A range of specific roles and functions identified in the ACT Emergency Plan may be activated depending on the scale and complexity of the incident(s) and potential consequences. The ACT Emergency Plan will be used to activate these roles and functions. These may include: • whole of Government Incident notification • arrangements for incident support, including whole of government coordination of resources • activation of the Territory Crisis Centre • appointment of a Territory Controller; • declaration or State of Emergency;	High	Chief Minister Minister for Police and Emergency Services Commissioner ESA Chief Police Officer AFP JACS CMD

[28] The role of the Incident Coordinator is to provide support to the Incident Controller, and is not involved in combating the incident

Recovery

Recovery is risk mitigation that limits the consequences after a bushfire. Recovery is complex as it deals with social, economic, physical and environmental rehabilitation. It is an integral part of the whole process and consciously considered at each other stage of the process.

Strategy: Restore healthy, diverse, and resilient ecological systems on a priority basis through long-term restoration			
No.	Actions to achieve the strategy	Priority	Responsibility
68	As soon as practicable following commencement of firefighting operations, consider routine rehabilitation activities and assess the need for a formal rehabilitation plan.	High	Chief Officer ACT RFS, Chief Officer ACT FB, land managers
69	Develop an ACT capacity to assess burned areas and the need for environmental rehabilitation by 2014. Apply methods consistent with the BAER model[29].	Medium	TAMS

[29]The concept of interagency Burned Area Emergency Response (BAER) teams was developed in the United States of America to support agencies in their analysis of post-fire effects. The BAER teams aim to provide a holistic, multidisciplinary, rapid assessment of post-wildfire environmental issues and provide assessments and recommendations on emergency stabilisation (immediate response) and burned area rehabilitation.

Strategy: Coordinate and deliver programs and services to assist the recovery of affected communities and individuals, including firefighting personnel and support staff			
No.	Actions to achieve the strategy	Priority	Responsibility
70	Develop procedures for the provision of Critical Incident Stress Management and Peer Support within the Fire Services. When firefighting has been prolonged, or there have been associated traumatic experiences (such as 'near misses', injury or death), an opportunity for critical incident stress debriefing will be provided. Procedures are in place and arrangements will be reviewed as required.	High	Chief Officer ACT RFS, Chief Officer ACT FB
71	In the event of or in anticipation of significant bushfire consequences, the ACT Community Recovery Plan[30] may be activated and may include the activation of established recovery centres where appropriate. The Incident Controller is responsible for ensuring recovery planning is initiated. If a State of Emergency has been declared, this responsibility will rest with the Territory Controller.	High	Chief Officer ACT RFS and Chief Officer ACT FB, Territory Controller
72	In the event of significant bushfire consequences on rural and other business enterprises, Government agencies will work with rural landholders and industry bodies to enhance distribution of recovery information and support, which may include assistance to rural landholders.	High	Commissioner ESA, DHCS and TAMS
73	In the event of significant bushfire consequences, coordinate the immediate support arrangements and assistance measures for those affected and work with the community, community organisations and other agencies to ensure that the elements of the recovery are coordinated and targeted to address different needs of individuals or groups.	High	DHCS and community partners

[30] Available via the ACT Department of Housing and Community Recovery Website: *www.dhcs.act.gov.au/community_recovery.*

PART SIX – Resource Requirements

Chapter Six: Resourcing

The resourcing of this Plan may require additional funding and will be determined in the context of whole-of-government budget considerations over the life of the Plan.

The various elements and aspects of the Strategic Bushfire Management Plan will generate demands on the agencies and individuals responsible for them. In some cases these may be significant across the life of the plan and will require specific calculation and procuring. Bushfire management is a long term process requiring strategic, management and operational consistency over an extended period. Hence the Strategic Bushfire Management Plan is for 10 years. It is critical that the need for consistent implementation of the requirements of the plan is understood and supported throughout the ACT community and on the part of government. Clear calculations of costs are pivotal to the maintenance of this understanding and the continuity of resource provision.
The use of the SBMP for resource planning requires the interpretation and application of the principles and concepts to achieve the specific outcomes. Requirements are being developed and will be refined over 2009/2010 bushfire season. A key requirement is the development and adherence to longer-term bushfire management plans that incorporate the cyclic conduct of actions, such as prescribed burns, that occur over several year gaps.

PART SEVEN – Schedules

Schedule A: Audit reporting

Audit reports document compliance with this Plan. Specifically, they should:

- include an outline of the audit procedure, discussion of findings, conclusions about level of compliance with this Plan and recommendations for improvement;
- outline agreed management actions, that:
    - address each recommendation made within an Audit Report;
    - describe the implementation status of previously published agreed management actions, until such time as those actions have been finalised; and
    - contain recommendations for improving the audit function where appropriate.

The ESA will maintain records of audit plans, audit reports, and other evidence that demonstrates action taken as a result of audit recommendations.

Schedule B: Classification and recommended standards for access

Ground access standards

Fire access includes a range of vehicular tracks, roads and walking tracks. These features reduce the response time to fires and make it safer to undertake bushfire suppression operations. Together, this increases the range of weather conditions under which bushfire containment and suppression are likely to succeed. In addition, vehicular tracks, roads and walking tracks provide potential control lines for containing bushfires and for conducting prescribed burns.

Classification

The classification of fire roads, tracks and trails (Table 1) is performance-based, to provide clear guidance to land managers and response agencies during incidents.

Table 2 identifies the requirements for the provision of passing opportunities on fire trails, and requirements for the provision of vehicle turnaround capability on dead end trails ("dead ends")

Table 1: Ground access standards

Classification	Performance standard	Nominal width and maximum grade	Surface	Nominal Horizontal curve radius	Nominal Vegetation maintenance
Walking track	To allow the safe passage of firefighters on foot	Generally these features will be less than 1 m in width	Natural surface, grass, sealed or gravel surface	Not Applicable	Vegetation maintained to allow single file walking
Light unit	To allow the safe passage of light units (4x4 Landcruiser or similar carrying a water tank of 400 – 600 litres	Generally these features will have a width of 3 m, with a maximum grade of 20 degrees	Natural surface, grass, sealed or gravel surface	Corners of sufficient radius to make 3 point turns by light units unnecessary	Roadside vegetation maintained to allow unimpeded access by light units
Tanker	To allow the safe passage of tankers (4x4 trucks 8 – 12 tonnes carrying a tank of 2500 – 5000 litres)	Generally these features will have a width of 4 m, with a maximum grade of 15 degrees	Natural surface , grass, sealed or gravel surface	Corners of sufficient radius to make 3 point turns by tankers unnecessary	Roadside vegetation maintained to allow unimpeded access by tankers
Rigid float	To allow the safe passage of a truck including large CAFS Tankers and large rural tankers with a	Generally these features will have the same characteristics as tanker roads but will have smaller rollovers, no splash creek crossings and no switchback corners.			

	rigid body carrying a small (D3- or D4-sized) dozer				
Articulated float	To allow the safe passage of articulated floats (truck and trailer carrying a D6-sized dozer	Generally these features will have a width of 5 m, a maximum grade of 12 degrees	Natural surface , grass, sealed or gravel surface	Corners of sufficient radius to make 3 point turns by a float unnecessary	Roadside vegetation maintained to allow unimpeded access by an articulated float

Table 2 – Nominal Requirements for passing and dead end fire trails

Passing opportunities	Utilise road verges and natural areas wherever possible to allow two vehicles to safely pass (in the case of light unit trails to allow two light units to pass, in the case of tanker trails to allow two tanker trails to pass). If there are no opportunities for vehicles to pass in a 250 m section, where terrain and ecological constraints allow, provide for widening of pavement, verges or the construction of passing bays. Where dormant trails are reopened during suppression operations, suitable passing areas should be constructed where terrain and ecological constraints allow to ensure vehicles can pass within 250 m section
Dead ends	Avoid as far as possible, and signpost where occur. Where dead ends exist, a turnaround of sufficient radius for the standard of the trail must be provided (e.g.: in the case of light unit trails the turnaround must allow a light unit to turn around on full lock). If there is insufficient space for such a turnaround due to the topography or other constraints, provision should be made to allow a maximum three-point turn or a “T” or “Y” shaped turnaround area provided. The dimensions of the “T” or “Y” shaped turn around must be appropriate for the type of vehicles that will use the trail. Turnarounds should be constructed when dormant trails are reconstructed for suppression operations, and temporary signage will be provided at the start of these trails.

In grassland areas or in rural areas or reserves, the mineral earth ground fire access network may be supplemented by slashed grass breaks or *ad hoc* access trails through properties or reserves. These breaks provide additional vehicle access during suppression operations, but do not provide as safe suppression areas as mineral earth roads. These slashed trails are generally not mapped and the locations may change over time.

Aerial access classification

Helipads are natural or constructed features on which helicopters may safely land. Helipads provide access for firefighters to walk to remote area fires, and locations from which helicopters may operate during wildfire suppression and prescribed burning operations. Helipads are classified according to the size of the helicopter that may safely land on them, although this decision is ultimately the judgement of the pilot in charge of the aircraft. Indicative helipad standards are at Table 3.

In addition to identified helipads, remote area firefighters may access other areas by being winched in by helicopter, however this is slower and riskier than using a helipad. In some

circumstances remote area firefighters may construct a temporary helipad closer to the bushfire to allow helicopters to safely land.

Table 3: Helipad standards

Classification	Nominal Description
Light	To allow the safe landing of light helicopters (e.g. Jet Ranger, Squirrel). These helipads will usually consist of a rock/grassed/mineral earth area 7x7 m, an area cleared of trees and tall shrubs for an additional 13 m and tall trees removed to ensure an approach angle of 40 degrees in one or more directions.
Medium (1)	To allow the safe landing of medium sized helicopters (e.g. BK117). These helipads will usually consist of a rock/grassed/mineral earth area 10x10 m, an area cleared of trees and tall shrubs for an additional 15 m and tall trees removed to ensure an approach angle of 40 degrees in one or more directions.
Medium (2)	To allow the safe landing of heavy or large sized helicopters (e.g. Bell 214). These helipads will usually consist of a rock/grassed/mineral earth area 15x15 m, an area cleared of trees and tall shrubs for an additional 20 m and tall trees removed to ensure an approach angle of 40 degrees in one or more directions.

Road sign standards

Sufficient roads and tracks will be signposted to allow navigation through the fire trail network (note that this may not require all roads and trails to be signposted). A systematic program of phasing in new signs on identified fire access will be implemented consistent with resource availability.

Schedule C: Fuel management standards for fire management zones

Table 1: Default Widths applied to determine the Ember Zone and Inner and Outer Asset Protection Zones[39]

Vegetation type	Asset Interface Classification (as mapped)	Ember Zone	Inner APZ	Outer APZ
		Width (m)	Width (m)	Width (m)
Forest and shrubland	primary	400	30	target 300, min. 200
	secondary	200	20	100
	lee	50	10	0
Grass and woodland	primary	200	30	100
	secondary	50	20	0
	lee	50	10	0

Table 2: Fuel management standards for fire management zoning

Inner Asset Protection Zone (IAPZ)	Treatment Standards	
Default standards to be applied over at least 80% of the zones as mapped. Where default standards cannot be achieved, the responsible land manager may identify alternative treatments to meet the overall objectives for the zone. Any significant variation on the default standards shall be approved by the ESA.	**Vegetation type**	**Fuel management standards**
	Forest and shrubland	Maintained at an overall fuel hazard ≤ low 3-5 m canopy separation or fuel gap to crown >3 m maintained
	Grass and open woodland	Grassland maintained at less than 200 mm height when grassland curing ≥ 70%.
Outer Asset Protection Zone (OAPZ)	**Treatment standards**	
Default standards to be applied over at least 70% of the zones as mapped. Where default standards cannot be achieved, the responsible land manager may identify alternative treatments to meet the	**Vegetation type**	**Fuel management standards**
	Forest and shrubland	Overall fuel hazard ≤ moderate

[39] The maps of the Fire Management Zones included in this document as explanatory text have the default standards to the rural-urban interface for the Ember Zone, Inner and Outer Asset Protection Zones. Where default standards cannot be achieved, the responsible land manager or developer may identify alternative treatments to meet the overall objectives for the zone. Any significant variation on the default standards shall be approved by the ESA.

overall objectives for the zone. Any significant variation on the default standards shall be approved by the ESA.	Grass and open woodland	Grassland fire hazard ≤ 35 when grassland curing ≥ 70%
Strategic Firefighting Advantage Zone	**Treatment standards**	
Default standards to be applied over at least 70% of the zones as mapped. Where default standards cannot be achieved, the responsible land manager may identify alternative treatments to meet the overall objectives for the zone. Any significant variation on the default standards shall be approved by the ESA.	**Vegetation type**	**Fuel management standards**
	Forest and shrubland	Overall fuel hazard ≤ high
	Grass and open Woodland	Grassland fire hazard ≤ 50 when grassland curing ≥ 70%.
	Plantations	Manage stands as crown fire-reduced areas with progressive treatment to attain the following standards: • immature stands (<15 years old). Pruned to 2.0 m and thinned to 650 sph nominally at Year 8-10. Debris from thinning and pruning to be <1 m high. In areas immediately adjacent to potential ignition sources or built assets consider mechanical crushing of thinning and pruning debris or burning as soon as practicable without damaging the residual stand. • mature stands (>15 years old). Schedule harvesting to reduce contiguous areas of untreated slash during the fire season. Remove the outside row of trees (adjacent to fire trails) during first commercial thinning operation to improve access on fire trails.. • Maintain strategic fuel breaks through the maintenance of road pavements and verges, and edge pruning and thinning.
	Identified arterial roads, rural roads and easements	Grassland fire hazard ≤ 35 when grassland curing ≥ 70%.
Landscape Fire Management Zone	**Treatment standards**	
	Standards not applied.	
Agricultural Fire Management Zone	**Treatment standards**	
	Requirements will be defined in Bushfire Operational Plans, developed through the Farm FireWise program.	

Explanatory Notes

Asset Interface Classification (AIC)
The location and width of the Ember Zone and the Inner and Outer Asset Protection Zones in the SBMP Version Two is determined by the Asset Interface Classification. This classification of primary, secondary and lee edges along the rural-urban interface is based on the level of bushfire risk the interface is exposed to. It considers:

- the maximum fire size an asset may be subject to;
- the part of the fire (head, flank, back) an asset may be subject to recognising the major fire threat from the north and west; and
- the length of potential fire run.

Further discussion relating to the AIC and a map detailing the AIC for the urban area of the ACT can be found at in the *Supporting Information - Part One.*

Overall fuel hazard
Overall Fuel Hazard Assessment is currently undertaken consistent with the Territory and Municipal Services Fuel Assessment Methodology. This encompasses the processes identified in:

- Overall Fuel Hazard Guide (Department of Sustainability and Environment. Third Edition May 1999)
- Project Vesta – Fire in Dry Eucalypt Forests: Fuel Structure, Fuel Dynamics and fire behaviour. (JS Gould, WL McCaw, NP Cheney, PF Ellis, IK Knight, AL Sullivan, CSIRO / SCION 2007)

The process used for the assessment of bushfire fuels is included in the *Supporting Information - Part One*. Subsequent revisions or changes to methodologies may be applied as appropriate.

Grassland curing
Assessment of grassland curing is currently undertaken consistent with the Victorian Country Fire Authority *Grassland Curing Guide* (CFA, 1999). Subsequent revisions or changes to methodologies may be applied as appropriate.

Grassland Fuel Hazard
A combination of height and cover is currently used to determine triggers for short to medium term treatments when grasses are sufficiently cured to carry free burning fires (approximately 70% cured). Although significant variation exists, grass height (m) and cover (%) are related to fuel load and visibility, which are important factors affecting the ability to suppress grassfires. A score (the Grassland Fuel Hazard – see Table 4) was developed for the ACT and derived by multiplying these two factors provides a means of defining allowable fuel conditions in Outer Asset Protection and Strategic Firefighting Advantage Zones. Subsequent revisions or changes to methodologies may be applied as appropriate.

Table 4: Grassland Fuel Hazard

Height	Cover %									
(m)	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
0.1	1	2	3	4	5	6	7	8	9	10
0.2	2	4	6	8	10	12	14	16	18	20
0.3	3	6	9	12	15	18	21	24	27	30
0.4	4	8	12	16	20	24	28	32	36	40
0.5	5	10	15	20	25	30	35	40	45	50
0.6	6	12	18	24	30	36	42	48	54	60
0.7	7	14	21	28	35	42	49	56	63	70
0.8	8	16	24	32	40	48	56	64	72	80
0.9	9	18	27	36	45	54	63	72	81	90
1	10	20	30	40	50	60	70	80	90	100

Schedule D: Bushfire history records

The ESA will maintain records of:

- bushfire origins (where and when they originated);
- bushfire causes (their sources and causes, if known);
- location and area (hectares) burnt; and
- estimated annual fire damage; and other economic or ecological consequences.

Schedule E: Mapping components of the SBMP and supporting documents

Maps provide the critical means of identifying strategies and communicating information and concepts relating to fire management. A suite of maps has been prepared to support this Plan, and are identified below.

Asset Interface Classification
The Asset Interface Classification has been mapped identifying the location of:

- Primary Asset Interfaces;
- Secondary Asset Interfaces; and
- Lee Asset Interfaces.

This classification is provided in *Supporting Information - Part One* for explanatory purposes will be reviewed annually to reflect changes in the urban footprint of the ACT. Changes will be approved by the Commissioner ESA.

Bushfire ignition and spread
The modelled analysis of the probability of bushfires starting and spreading was undertaken as part of the planning process for the development of the SBMP, utilising existing models for fire behaviour, fuel accumulation and historical data of bushfire ignition and Fire Dangers Indices for the ACT. Detailed discussion of the process undertaken and mapping outputs for explanatory purposes can be found in *Supporting Information - Part One.*

The modelling may be revised as appropriate. Changes will be approved by the Commissioner ESA.

Assets at risk
Assets at risk from the effects of bushfire have been mapped and details:

- Property;
- Business and social Infrastructure;
- Critical infrastructure;
- Agricultural production;
- Biodiversity and threatened species;
- Cultural heritage; and
- Water Catchments

A current map of these assets is provided in *Supporting Information - Part One* for explanatory purposes, which may be reviewed and updated as appropriate. Changes will be approved by the Commissioner ESA.

Note: Some critical infrastructure, heritage and environmental assets may not be identified on publicly available maps, in consideration of legislative and security issues.

Overall fuel hazard maps
Overall fuel hazard has been estimated and included in the supporting documentation. Overall Fuel Hazard has been modelled and estimated for three time points, reflecting the increase of the fuel hazard over time without treatment. The time points are:

- 2009;
- 2014; and
- 2019.

Current maps of Overall Fuel Hazard are provided in *Supporting Information - Part One* for explanatory purposes. These maps may be reviewed updated as appropriate. Changes will be approved by the Commissioner ESA.

Fire management zoning
Maps of fire management zones have been prepared as supporting documents to detail the location of

- Ember Zones;
- Inner Asset Protection Zones;
- Outer Asset Protection Zones;
- Strategic Firefighting Advantage Zones;
- Agricultural Fire Management Zones; and
- Cooperative Management Areas

These maps are included for explanatory purposes in Part Three of the Plan and discussed in detail in *Supporting Information - Part Two*. The maps are approved by the Commissioner ESA. They will be reviewed annually and any amendments required may be approved by the Commissioner ESA.

Regional Fire Management Plans
Regional Fire Management Plans have been prepared as supporting documents to this Plan, based on the sixteen 1:25000 mapsheets that provide coverage of the ACT and adjacent areas of NSW. The plans detail the proposed fuel management, access and infrastructure activities to be undertaken over the next ten years. They are available for viewing on the ESA website.

Consultation in the preparation of Regional Fire Management Plans
When initially preparing Regional Fire Management Plans, the ESA and Government land managers undertook a process of community engagement and consultation. This included:

- neighbouring land managers, in particular areas where Government land managers and rural landholders are adjacent; this aimed to ensure each land manager considered the key fire management issues associated with their land and integrate fire management practices across property boundaries;
- specialists in flora and fauna;
- specialists in catchment and hydrological management, recognising the significant component of the ACT natural areas that forms Canberra's water catchment;
- non-government organisations and the wider community, in particular those with a specific interest in the management of natural areas;

- managers of National Land, such as the Department of Defence and National Capital Authority; and
- consideration of the capabilities of community members who may play a critical role in minimising the spread of bushfire into built-up areas and surrounding regions.

Review of Regional Fire Management Plans
Regional Fire Management Plans are dynamic documents. They will be reviewed annually to reflect changes that have occurred in the preceding year. This may include:

- completed fuel management and access activities that provide strategic advantages;
- unplanned bushfires that may provide strategic advantage;
- changes to the location or extent of assets, for example development of new urban areas;
- changes in agricultural practices; and
- new research results.

Any amendments required may be approved by the Commissioner ESA and may be notified to the public without prior consultation.

Spatial components of Regional Fire Management Plans
Regional Fire Management Plans should show the following information as appropriate:

- fuel management, including prescribed burning (in two year windows), grazing, physical removal, slashing, chemical treatment;
- return interval for prescribed burning, including planned burning exclusion areas;
- areas burnt since 2003;
- access, including existing trails to be maintained at their current standard, fire trails to be upgraded, and new fire trails planned to be constructed;
- existing fuel breaks planned to be upgraded, and new fire breaks planned to be constructed;
- existing water points to be maintained, existing water points planned to be upgraded, and new water points planned to be constructed;
- existing helipads to be maintained, existing helipads planned to be upgraded, and new helipads planned to be constructed; and
- map notes to explain features on the map.

Supporting Information to the Strategic Bushfire Management Plan Version Two

Part One – Factors Contributing to Bushfire Risk

Prepared in accordance with the ***Emergencies Act 2004*.**

ISBN- 10: 978-0-642-60517-7

ISBN- 13: 0-642-60517-3

GPO Box 158, Canberra City ACT 2601.

Produced by Publishing Services for the Emergency Services Agency

Publication No 09/1289

Telephone: Canberra Connect 132 281

Also published on www.esa.act.gov.au

Important Note

The Fire Danger Ratings used in graphs and tables referenced in this report do not reflect the recent changes to the Fire Danger Rating system, as detailed in the nationally agreed *National framework for scaled bushfire advice and warnings to the community*. (With the exception of Chapter Three, which describes the new rating system) The rating system in referenced graphs and tables identifies the Fire Danger Index of 50 and above as the highest rating (Extreme). This rating has now been separated into three separate ratings of Severe (50-74), Extreme (75-99) and Catastrophic (100+). Further information on the revised Fire Danger Rating System can be found on the ESA webpage or by contacting the ESA.

Table of contents

Chapter One - Geography of the ACT

The ACT covers an area of about 2400 km^2 (240,000 hectares) at latitudes of between 35° and 36° south. From a fire management perspective, the ACT has difficult topographic conditions, with steep forested lands to the west of key assets and urban development. The topography of the ACT is characterised by rugged mountains in the west and south, and plains and hill country in the north, with approximately 60% of the Territory hilly or mountainous. The highest peak is Mount Bimberi (1910 m) in the south, and the lowest point is 450 m.

The Molonglo River traverses the northern plains and hill country that contain most of the urban areas. The Murrumbidgee escarpment cuts across the Territory from south-east to north-west. To the south-west are two belts of mountainous terrain, separated by the Cotter River valley.

The ACT Natural Resource Management Plan (2003) identifies three broad types of landscapes:

1. Uplands are areas at altitudes above 800 metres and occur mainly west of the Murrumbidgee River. They lie mainly on erosion-resistant, ancient sedimentary rocks and granite. Many of the river valleys have areas where river sediments have been deposited after flooding. These deposits may create flats near rivers or may partially fill-in the bottoms of valleys.
2. Rolling or undulating country, formed across moderately weathered rocks, occupies the north-eastern area of the ACT and the eastern parts of the Murrumbidgee Corridor to the south. The landscape is crossed by minor streams such as Woolshed, Guises, and Jerrabomberra Creeks. Elevations vary, but are generally 600-900 m above sea level. The Murrumbidgee River leaves the ACT in the north, crossing the border at an altitude of 450 m.
3. Plains occur at elevations of 550-650 m along many of the streams in the north of the Territory. The plains formed on readily weathered rocks and on stream sediment. They surround isolated hills and ridges of erosion-resistant rock, such as Black Mountain and Mount Ainslie. Streams including Sullivans Creek, Jerrabomberra Creek and the Lower Molonglo River cross the plains.

Bushfire risk management and planning must take into account the topographical challenges the ACT landforms present, including effects on fire behaviour, suppression strategies, indicators of trafficability and erosion potential.

Chapter Two - The History and Causes of Fire in the ACT

Fires in pre-European Times

An understanding of the history of fires in the ACT and adjacent areas is important in developing an effective approach to future bushfire management. Natural fires have long been part of the ACT landscape and are a natural environmental phenomenon in most Australian ecosystems. Much of the native vegetation of the ACT is fire-prone, particularly the dry forest, woodland and grassland communities, many of which are adapted to fire. As elsewhere in Australia, fire (both wildfires and planned fires) has influenced the condition of the ACT's plant communities, the distribution and abundance of flora and fauna species, and the nature of soils and watercourses.

The weather patterns and terrain of the ACT create a range of situations leading to a heightened probability of bushfire, particularly in the summer months, including:

- periods of drought leading to drying of vegetation and dead fuel;
- summer weather cycles (of approximately six or seven days) of hot temperatures and low humidity during the passage of high pressure systems, followed by strong north to north-west winds preceding the passage of low pressure troughs;
- dry summer thunderstorms creating the risk of fire ignition from lightning strikes;
- occasional wet spring weather leading to strong growth in grasslands, followed by hot summer weather and rapid drying of grasslands; and
- extensive areas of forest and woodland in steep rugged country to the west and south, lying across the path of the prevailing winds.

In the past, it is probable that these situations led to fires of varying size and intensity, including periodic conflagrations. There has been much speculation about the frequency of wildfires in pre-European times and the extent to which Indigenous people used fire. Studies of fires scars on trees, charcoal deposits in lake sediments, and vegetation responses to fire, suggest that fire frequency was less in pre-European times than in the early European period (Zylstra, 2006; Banks, 1989).

From a general knowledge of Indigenous people's fire practices, it is likely that the Indigenous occupants of the ACT used fire periodically on a limited scale, possibly more frequently at lower elevations than in the mountains (Zylstra, 2006). In lower-lying areas, fire is likely to have been used to regenerate grass in open areas to attract game, while at higher elevations (such as in the forests and sub-alpine woodlands of the Brindabella Range and Namadgi National Park), fire may have been used to keep open migration routes and access to ceremonial sites and seasonal food sources.

Fires in the grazing period – 1850s to 1939

With European settlement, pastoral activities extended over the ACT and surrounding region (including mountain areas as well as the plains now occupied by Canberra), and frequent burning of grasslands and forests occurred to assist land clearing and encourage pasture growth for livestock. Burning practices were probably varied, but burning frequencies of tow, three or four years are mentioned by observers in some areas (cited in Tozer, 2004). Studies of Snow Gum (*Eucalyptus pauciflora*) fire scars on the Brindabella Range suggest a five and a half fold

increase in fire frequency after 1860 (Banks, 1989). As was common in south-east Australia at the time, it is likely that many of these fires were left to burn untended, occasionally spreading as wildfires in unfavourable weather conditions, as revealed in the investigations following the 1938-39 fires.

There was little recording of bushfires in this period and the number and extent of wildfires (or unplanned) bushfires are unknown. The Brindabella Range fire scar study suggested that severe fires occurred in that area in 12 of the years between 1860 and 1939 (Banks, 1989).

Following the establishment of the ACT in 1911 and the development of Canberra (which was a very small city of about 10,000 people in 1939), there are records of large bushfires burning across the ACT in 1919-20, 1925-26 and 1938-39 (see Figure 1). These major fires started from graziers' fires to the west of the ACT during dry seasons and spread across the ACT under the influence of strong winds. The 1938-39 fires were a landmark in the experience of fire in south-east Australia, not only because of the large extent of the conflagration in the ACT, south-east NSW and Victoria, but also because of the subsequent change in fire awareness and fire management practices.

The 1938-39 fires occurred during the driest summer since 1918, including record-breaking January temperatures. Numerous fires lit and left burning in southern NSW and Victoria led to the extensive conflagrations of Friday 13 January which resulted in severe loss of life and property in Victoria and NSW (Sullivan, 2004). The fires which burnt into the ACT on 13 January 1939 under the influence of winds up to 70 kilometres per hour, originated from existing fires at Two Sticks and Horseshoe Bend near the north-west ACT border and a fire in the Goodradigbee River valley to the west of Mt Franklin (Sullivan, 2004; Firebreak website). The former two fires combined and were halted at the Murrumbidgee River and nearby grassland, which was bare of fuel due to drought conditions. Spot fires occurred near Mt Stromlo and in Canberra. The Mt Franklin fire spread across the ACT south of Canberra, with serious outbreaks occurring at Tidbinbilla, Booroomba, Tharwa and Lanyon until being extinguished by a cool change. The fires covered an estimated 60,000 hectares of forest and grazing land, including 1,100 hectares of pine plantation.

Fires from 1940 to 2003

Land use and population changes

From the 1940s, as Canberra's urban area expanded and its population increased, there have been gradual changes in land use and land management goals in various parts of the Territory, in approaches to bushfire management and in the incidence of bushfires.

The Stretton Royal Commission, which investigated the January 1939 fires in Victoria, directed strong criticism at past practices of untended burning. More organised and official approaches to bushfire management were gradually introduced in south-east Australia. In the ACT, legislation governing bushfire management and the use of fire was introduced (the *Bushfire Act 1936*) and the ACT Bushfire Council was constituted under that legislation in 1939. In common with land management agencies in NSW and Victoria, the ACT also began officially-endorsed

hazard reduction burning with a view to reducing fuel levels, especially in the ranges to the west of Canberra and in urban fringe areas.

The 1960s and 1970s saw the rapid expansion of Canberra into the Woden Valley, Weston Creek, Belconnen and Tuggeranong—former grazing lands close to established pine forests near Mt Stromlo and to pine forests and native forests to the west of the Murrumbidgee River. This was accompanied by very rapid population growth and by 1976 there were over 200,000 people in the ACT. Population growth has continued reaching 300,000 people in 2000 and 340,000 people in March 2008.

The spread of Canberra saw increasing recreational use of bushland and other areas on the urban fringe and forest lands to the west and south. The establishment of Gudgenby Nature Reserve in 1979 (which subsequently became Namadgi National Park) saw the cessation of grazing in forest areas and burning activities associated with grazing in the south of the ACT and management of the areas for nature conservation and recreation. Land management practices also changed in NSW lands adjoining the ACT in the west and south, with the establishment of Brindabella National Park, Bimberi Nature Reserve and Scabby Nature Reserve.

Planned burning

The period between 1940 and 2003 also saw the introduction of planned burning in the ACT as a means of reducing the potential for severe bushfires (particularly in the west of the ACT) (Tozer, 2004). Planned burning (also known as fuel reduction burning, prescribed burning or controlled burning) is the reduction of fine fuel loads through the controlled use of low intensity fires. It is intended to reduce fire hazards and modify the behaviour of future wild fires in the affected area (through reduction of fire intensity and the likelihood of spotting and crown fires).

Planned burning occurred in the upper Cotter catchment from 1927 and began in the western ranges area in the 1940s. One of the purposes of the Bulls Head Forestry Settlement, established in 1939, was fuel reduction and fire suppression in the western ranges. This followed the severe 1938/39 bushfires and recommendations by the Stretton Royal Commission on the use of hazard reduction burning. An area of NSW land on the north-west border of the ACT and extending into the Goodradigbee River valley was leased by the ACT in 1944 to be managed as a fuel reduction buffer (Tozer, 2004). Due to limited records, the coverage of the early planned burns is difficult to determine, but is likely to have been less than that of the later broad-acre burns.

Bushfire research in the 1950s and 1960s supported the use of broad-acre planned burning as a major fire management tool. The 1960s saw the construction of a fire-trail network in ACT forest areas (including in the areas later gazetted as Namadgi National Park) to facilitate access and broad-acre autumn planned burns in the western ranges. Aerial ignition of burns began in the western ranges in 1967 (with an experimental burn in the Flea Creek catchment in the lease area) and continued until 1982, covering areas of about 3,000 to 7,000 hectares annually, with the aim of burning particular areas on a five to seven year rotation (Tozer, 2004).

Broad-acre burning was also conducted in parts of the Cotter catchment in the mid-1970s with the aim of reducing fuel loads in more fire prone areas. Total areas of

1,383 hectares, 1,322 hectares, 876 hectares and 717 hectares were burnt in 1976, 1977, 1978 and 1981 respectively (Tozer, 2004).

Significant fires

Between 1939 and 2003, the ACT experienced several severe bushfire events when intense bushfires burnt over thousands of hectares and/or came close to urban areas under the influence of high temperatures, dry conditions and strong (mostly westerly) winds (see Figure 1).

1951-52

In 1951-1952, during a severe bushfire season throughout eastern NSW, severe bushfires came close to the urban area of Canberra under the influence of strong westerly winds (Sullivan, 2004). On 25 January 1952, separate fires caused by electrical faults in powerlines in the Woden-Yarralumla area burnt across the Tuggeranong area to near Burra in NSW. This fire resulted in the death of two people and extensive damage on grazing properties in the 13,000 hectares burnt in the ACT. On 5 February 1952, several fires were started by lightning strikes to the west of Canberra. One of these burnt through the Mt Stromlo pine plantation and the observatory grounds (in a similar trajectory to the January 2003 fires) before being brought under control in the Kambah area, after damaging several observatory buildings and burning 350 hectares of pine plantation and 3,000 hectares of grazing country. Other fires in the western ranges burnt for some weeks covering about 5,800 hectares.

1978-79 – the Hall/Sutton fire

In the 1978-79 fire season, a high fire danger in grasslands developed in late summer when extremely hot dry weather followed a period of substantial rain and prolific grass growth. Several fires started in the ACT and nearby regions during extreme winds on 13 February 1979. On the afternoon of that day, a fire ignited from the fuse of a high tension powerline near Hall and, fanned by winds gusting to 70 kilometres an hour, burnt into NSW towards the village of Sutton (which was evacuated) and Lake George. When the fire was controlled late on 14 February, it had burnt through 4,025 hectares in the ACT and 12, 475 hectares in NSW (Firebreak website).

1982-83 – the Gudgenby fire

Numerous bushfires occurred during the severe drought of 1982-83 in south east Australia, including the notorious Ash Wednesday fires in South Australia and Victoria which resulted in significant loss of life and property. The ACT was experiencing its most severe drought on record to that time and vegetation and surface fuel were extremely dry in the forests of the then Gudgenby Nature Reserve, most of which had not experienced significant fire since 1939 or earlier. (Parsons, 1983). A fire (whose cause is unknown, but suspected to be either lightning or campfires) started in rugged terrain near Mt Kelly in the south of the reserve on 8 January 1983 and spread rapidly to the west under the influence of strong winds, burning for 22 days before being contained on 30 January after burning over 33,000 hectares. Significant fire suppression efforts were required because of the rugged terrain and the numerous spot fires which developed during unfavourable weather conditions.

1984-85

In 1984-85, a relatively wet winter and spring was followed by an extremely dry summer and a high fire potential in prolific dry vegetation. Several large fires occurred in forest and grassland reserves in and near Canberra. Several fires (some originating from arson) started in the east of the ACT on 2 and 4 March 1985, 3 of them burning into NSW south of Queanbeyan, resulting in the death of one person and the burning of 28,000 hectares of grazing land and bushland approximately 10,000 hectares of which was in the ACT. (Firebreak website).

December 2001

While comparatively small in scale, the fires of December 2001 were notable in that they were the most serious fires in the vicinity of Canberra for some years and, on a smaller scale, exhibited similar behaviour to the 2003 Macintyre Hut fire which burnt into Weston Creek (Doogan, 2006).

On 24 December 2001, fires lit by arsonists on the Uriarra and Coppins Crossing Roads in the early afternoon burnt rapidly through areas of grassland and pine plantation under the influence of strong west-north-west winds (Doogan, 2006; McLeod 2003). The Coppins Crossing fire crossed the Tuggeranong Parkway, threatened the suburbs of Duffy, Holder, Weston, Yarralumla and Curtin, and burnt to the shores of Lake Burley Griffin. Before being contained, the fire burnt through 1,240 hectares of land and caused severe economic losses with the destruction of 510 hectares of pine plantation. Numerous other fires also started in the vicinity of Canberra on 24 and 25 December, threatening houses and facilities in some suburbs and leading to the evacuation of some facilities (Firebreak website).

January 2003

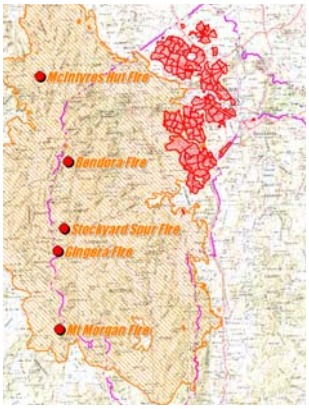
In 2002, most of Australia experienced one of the most severe droughts on record, with daytime temperatures and evaporation rates well above average. On 7 and 8 January 2003, upper level thunderstorms over the Australian Alps, associated with a cold front and pre-frontal trough, resulted in numerous lightning strikes which ignited at least 89 fires in Victoria, 74 in NSW and three in the ACT. Those fires not controlled burnt for the next 60 days, during which there was little substantial rainfall, and eventually covered 1.96 million hectares of the Australian Alps and nearby areas (Sullivan, 2004).

From July to December 2002, the ACT experienced extremely dry conditions. Rainfall was in the lowest 10% on record and temperatures between October and December were 2 to 3°C above average (Doogan, 2006). Four fires started by lightning on 8 January 2003 in the western ranges (the Macintyre Hut fire in NSW, and the Bendora, Stockyard Spur and Gingera fires in the ACT) gradually increased in area over 9 days. On the afternoon of 17 January, the fires travelled 10 kilometres eastward under the influence of strengthening north-west winds. On 18 January, a deepening trough preceding an approaching low pressure system produced unstable atmospheric conditions, strong winds (averaging 40 to 50 kilometres per hour with gusts of up to 78 kilometres per hour in the afternoon) and high temperatures (reaching a maximum of 35°) with extremely low humidity levels. The fires spread rapidly out of control across Namadgi National Park, pine plantations and leased grazing lands towards Canberra and into the suburbs of Weston Creek between 2:00 and 6:00 in the afternoon

The fires resulted in the deaths of four ACT residents and the burning of 164,000 hectares (or nearly 70%) of land in the Territory. Over 500 houses and most of the Mt Stromlo Observatory buildings were destroyed, there was fire damage to a further 315 houses, and major damage occurred to infrastructure and facilities (McLeod, 2003). Ninety per cent of Namadgi National Park was burnt (much of it severely) and severe fire damage occurred to the Tidbinbilla Nature Reserve, the Murrumbidgee River Corridor, the Stromlo pine plantation and pine plantations west of the Murrumbidgee River. The environmental impacts of the fires, especially in areas of very high fire intensity, has had on-going consequences for the management of Canberra's water supply and the conservation of ecological communities in affected parks and reserves.

Figure 1: Large bushfires in the ACT since 1919/20

From: Strategic Bushfire Management Plan Version One (2005).

1919-1920	1925-26
	
1938-39	**1951-52**
	
1978-79	**1982-83**
	
1984-85	**2002-03**
	

Bushfires after 2003

With the gradual re-establishment of vegetation cover in the areas burnt in 2003 and continuing dry conditions and hot summer temperatures (especially in 2005-06 and 2006-07), the ACT experienced an increasing number of bushfires in the fire seasons between 2003-04 and 2006-07 (see Table 1). Most fires have occurred close to the urban area of Canberra and have covered less than 5 hectares. Human caused ignition has been responsible for most fires and has occurred most frequently close to urban and settled areas and access routes.

Table 1: Number of unplanned fires in ACT, 2003-04 to 2006-07

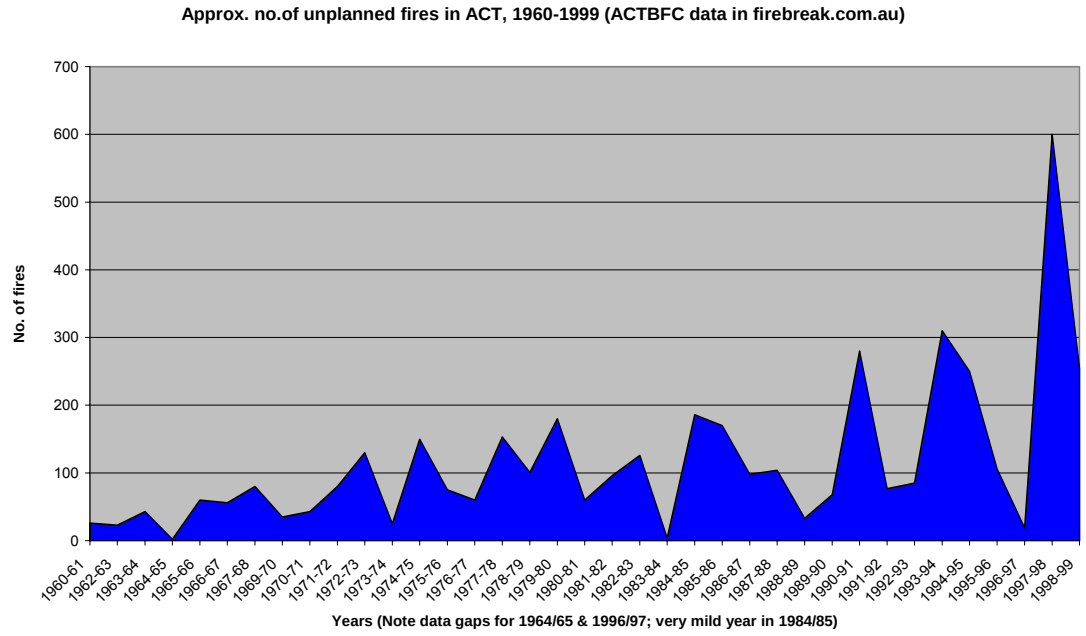
Year	All fires	Fires ≤ 5 ha in area	Fires > 5 ha in area		
	Total number	**Total number (% in year)**	**Total number**	**Total area burnt (ha)**	**Maximum area (ha) burnt in single fire**
2003/04	92	89 (97%)	3	240	220
2004/05	196	196 (100%)	0	0	0
2005/06	296	292 (99%)	4	110	80
2006/07	588	583 (99%)	5	59	20
Total	**1172**	**1160**	**12**	**409**	**-**

Bushfire cause, frequency and trends

The increasing population and expansion of Canberra has been accompanied by an increase in the overall number of wildfires in the ACT. Fire attendances recorded by the ACT Bushfire Council show a gradual increase in numbers of wildfires in the ACT from the 1960s (see Figure 2). However, the dimensions of this increase are difficult to assess as bushfire data for the ACT was not recorded regularly until the 1960s and, even then, varies in scope and reliability. Fires under five hectares in area were often not recorded and the details recorded of other fires are not uniform. These records are also biased (in part) by the severity of the fire season, which would increase the likelihood of larger fires occurring that would be subsequently included in the records.

Notwithstanding these factors, figure two is useful in illustrating trends, as opposed to accurate numbers of bushfires that occurred.

Figure 2



Most bushfires in the ACT have burnt over relatively small areas. Of about 940 unplanned fires since 1960 for which an area was recorded:

- approximately 60% were under 5 hectares;
- 10% burnt between 5 and 10 hectares; and
- 20% burnt between 10 and 100 hectares.

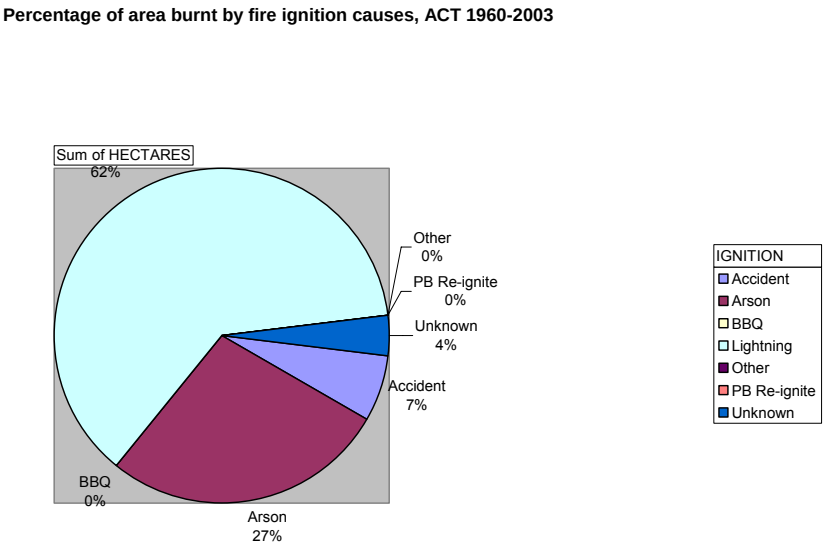
On the other hand, most of the total area burnt in the ACT between 1939 and 2003 was the result of a relatively small number of large fires, concentrated during the fire seasons and major fires of 1978-79, 1982-83, 1984-85, 2001 and 2003.

Most bushfires have occurred on the urban fringe and in other areas where people congregate, such as the Cotter River. Despite the predominance of smaller fires, such fires frequently pose significant threats to people, property, land and infrastructure if not controlled, as seen in the December 2001 fires which threatened Canberra suburbs, destroyed pine plantations and burnt up to the shores of Lake Burley Griffin.

The vast majority of unplanned bushfires in the ACT ignite due to human actions such as arson, carelessness (such as escaped campfires, or BBQ fires, or burning off without a permit) or accident (such as fires spreading from vehicle accidents or sparks from machinery or powerlines). Analysis of the wildfires occurring since 1960 for which the causes of ignition have been recorded shows that arson was responsible for about 80% of fires. Most fires caused by arson were started near urban areas, roads or other areas frequented by people.

Lightning accounted for about 11% of fires, but resulted in the largest areas burnt or about 62% of the total area recorded burnt since 1960 (see Figure 3). In comparison, arson fires resulted in 27% of the total area burnt.

Figure 3



In Namadgi National Park, the pattern of fire causes differed from that for the ACT as a whole, reflecting the comparative remoteness and mountainous terrain of many parts of the park. For the 50 year period from 1954 to 2003, lightning was responsible for the majority (57% of fires) in the park, while arson caused 10% of fires and about 14% of fires were attributed to accidental causes such as campfires, powerlines and vehicles (Tozer, 2004).

References

Acknowledgements: The report was prepared for the review of the SBMP, and draws on a number of sources identified in the references. Special thanks are given to Mr. Pat Barling, who kindly allowed use of data from the Firebreak website (http://www.firebreak.com.au/).

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Chapter Three - Fire Danger Ratings

Fire Danger Rating are based on two fire behaviour modelling systems in widespread use throughout Australia:

- the McArthur Forest Fire Danger Meter.
- the CSIRO Modified McArthur Grassland Fire Danger Rating System.

McArthur Forest Fire Danger Meter

The McArthur Forest Fire Danger Meter (FFDM) first appeared in operational use in 1967 as the Mk 4 FFDM. This meter, for the first time, brought together the results of over 800 experimental fires and wildfire observations into an easy-to-use system to determine the fire danger in forested areas of Australia. In 1973, a metrified version (Mark V) of the FFDM was produced. Since that time the FFDM has been widely accepted and is used by all rural fire authorities in Australia (except WA)

The system combines an index of soil moisture deficiency with the weather variables of temperature, relative humidity wind speed and recent rainfall to produce an index (The Forest Fire Danger Index – FFDI) of the difficulty of suppressing fires occurring in a standardised fuel type (broadly characterised by a dry eucalypt forest carrying 12.5 tonnes per hectare of fine fuel) on level to undulating terrain.

A general prediction of fire spread can be made using the tables provided with the McArthur fire danger rating system. Recent research has shown that these tables tend to under-predict fire spread under high wind speeds and after fires have completed their initial build-up phase. Precise prediction of fire spread at a specific location is more difficult because precise information on the wind velocity, fuel characteristics and the position of a fire in relation to the topography is generally not known.

CSIRO-Modified McArthur Grassland Fire Danger Meter

McArthur introduced a grassland fire danger rating system in 1966 as the Mark IV Grassland Fire Danger Rating System. Following extensive research, this system was modified by CSIRO in the 1990s. The modified system uses the same relationships as the McArthur Mk 4 Grassland Fire Danger Rating System, however it do not provide the rate of spread of bushfires

The Grassland Fire Danger Meter uses only one fuel variable, degree of curing. Combined with temperature, relative humidity and wind speed, this gives a Grassland Fire Danger Index (GFDI) of the degree of difficulty of suppressing fire in a ‘standard average’, grassland.

While fuel characteristics such as fuel load and grass height do influence difficulty of suppression the differences among grass species varies widely across the landscape. The Grassland Fire Danger Meter is designed to provide regional warnings of fire danger and is based on a ‘standard average’ grassland. This ‘standard average’ grassland is equivalent to a continuous grassland carrying 4t/ha of fuel, which is a common grassland fuel condition during early summer in southern Australia. In late summer or during drought conditions, grassland fuel loads may be greatly reduced and fire suppression may be easier than suggested by the grassland fire danger rating.

Fire Danger Ratings

Fire Danger Ratings (FDR) are determined by categorizing defined ranges of either the Forest Fire Danger Index or the Grassland Fire Danger Index, which are related to the rate of spread of bushfire, its intensity and difficulty of suppression. In September 2009, the Australian Capital Territory (ACT) adopted a new nationally developed and agreed framework for bushfire information and warnings based on these meters but with revised classification of Fire Danger Ratings shown in table one below. In order to assist in the general communities understanding of both the Fire Danger Rating and the numerical index, no distinction is made in the table between Grassland and Forest Fire Danger Indices, although these components are considered in operational response to bushfires.

Table One – Fire Danger Ratings and Associated Indices

Fire Danger Rating
CATASTROPHIC (CODE RED) - FDI 100+
EXTREME –FDI 75-99
SEVERE - FDI 50-74
VERY HIGH – FDI 25-49
HIGH - FDI 12-24
LOW-MODERATE - FDI 0-11

Associated with these Fire Danger Ratings are an assessment of the difficulty of controlling a fire and the possible impact on members of the Community. The above table, along with the potential fire behaviour and impacts is provided on the ESA website in “PREPARE ACT SURVIVE - Your Guide to Keeping Informed about Bushfire Danger”

Chapter Four - The Bushfire Climate of the ACT

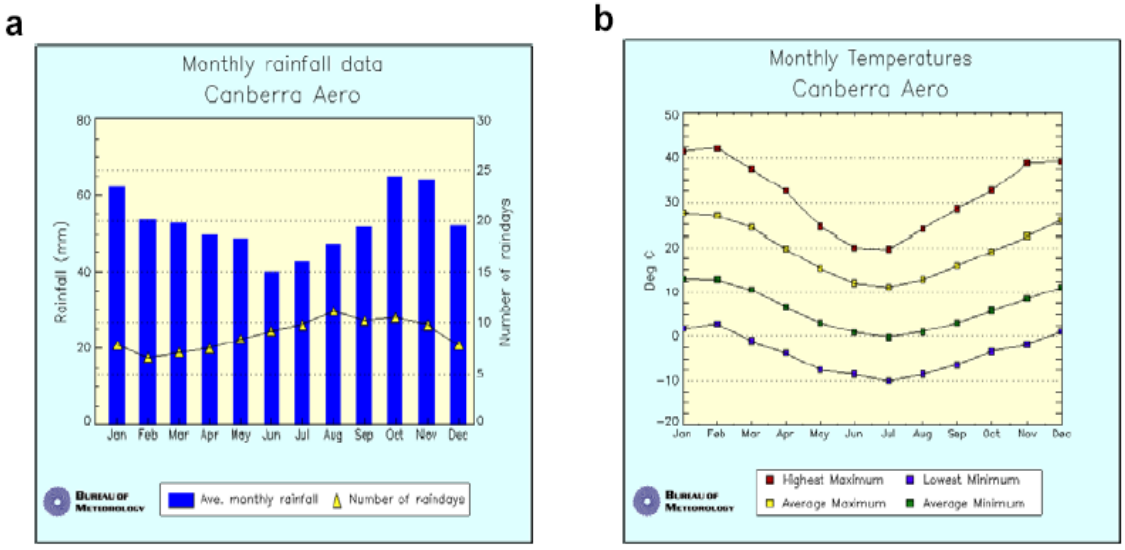
The ACT is located on the subtropical fringe, and is exposed geographically to a number of different weather systems and influences (Lindesay *et al.* 2004). The Territory has approximately uniform summer and winter rainfall, with significant annual variations influenced by a range of factors. The average annual rainfall is 633 mm, with rainfall averages ranging from 350 mm in the driest 10% of years on record, to 845 mm in the wettest 10% of years (Bureau of Meteorology, 2004). The complex topography of the ACT influences rainfall amount and distribution, with dominant winter precipitation in the southern alpine areas, higher rainfall on slopes with a westerly aspect, and a rain shadow effect to the east (Lindesay *et al.* 2004). Figure 1 below summarises the ACT climate.

Figure 1: Mean climatological conditions at Canberra

(a) average monthly rainfall

(b) average monthly maximum and minimum temperatures, and temperature extremes

(Source: Australian Bureau of Meteorology, www.bom.gov.au)



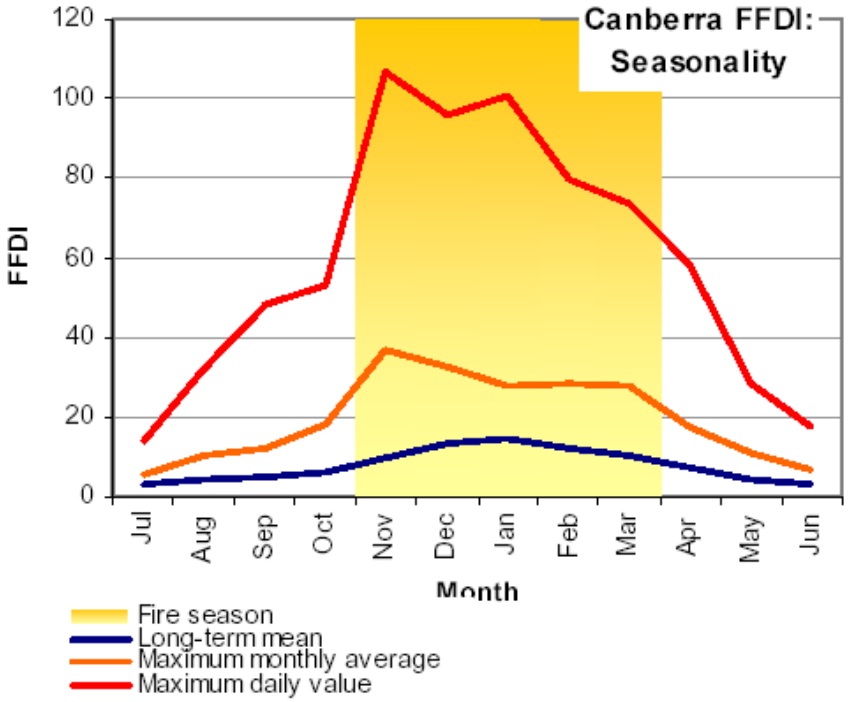
Analysis of rainfall records from 1885 to 2002 from Fairlight Station north-west of Canberra shows changes over this time that are also reflected in the overlapping Canberra rainfall record. Summer (January) rainfall declined early in the record and then recovered, and winter rainfall has decreased by more than 30 mm since 1885. The intensity of the driest part of the year in January-February has fluctuated, and the duration of the dry season has lengthened in recent decades. This impacts on fire season timing and severity, in combination with the inter- and intra-annual fluctuations of rainfall, temperature, atmospheric moisture and wind, fuel amount and condition, and ignition events (Lindesay *et al.* 2004).

Drier and warmer than average conditions in the ACT are partially associated with the El Nino Southern Oscillation (ENSO) (Sullivan 2004). While many of the severe fires recorded in Australia are associated with ENSO-rainfall deficit events (resulting in widespread conflagration fires such as the 2003 fires), the occurrence of a severe fire event does not necessarily depend on such antecedent conditions. For example, the 1939 Black Friday fires occurred despite the lack of antecedent ENSO conditions (Sullivan 2004).

The fire season in the ACT corresponds with the summer months with high temperatures and low rainfall with highest number of days of Forest Fire Danger Index (FFDI) over 50 occurring, and has the potential to extend from September to April, with significant variation between years. The seasonal potential for unplanned fires varies with rainfall and temperature, and their influences on biomass growth and fuel moisture content. Figures 2 and 3 below characterise the fire season.

Figure 2: Long-term monthly FFDI[1] data

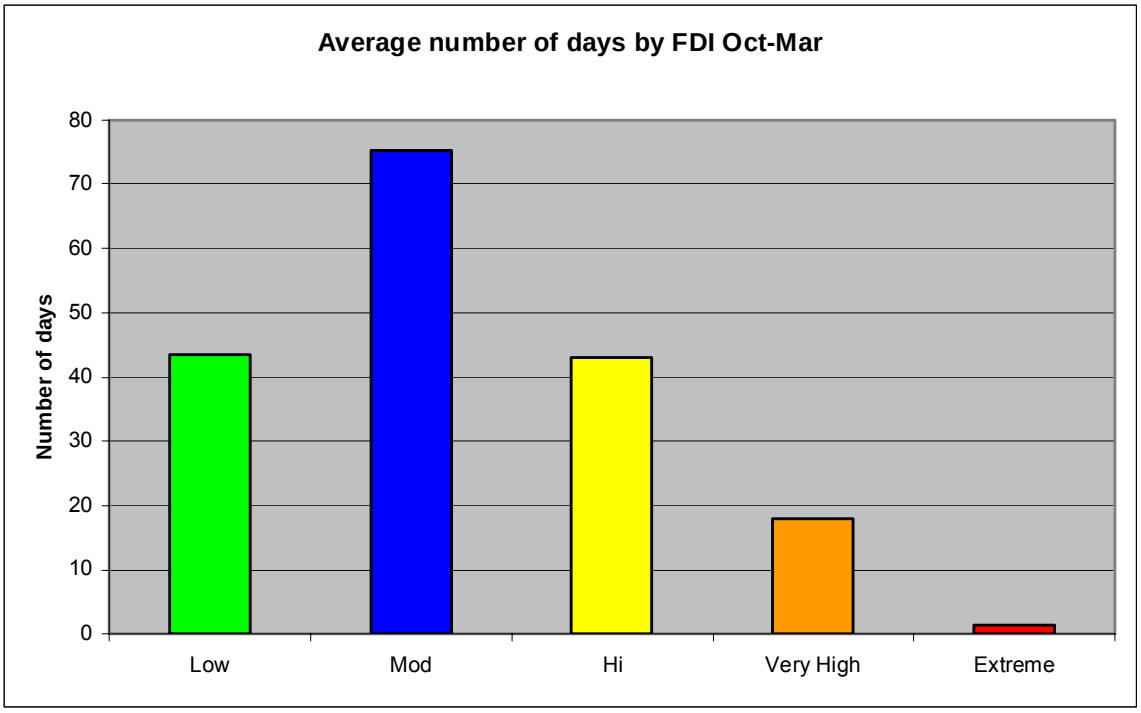
Note: all calculated at 1500 AEST, using meteorological data for Canberra Airport (data from Bureau of Meteorology and Lindesay et al. 2004. Note the bushfire season is from 1 October to 31 March).



[1] *the Fire Danger Ratings used in graphs and tables referenced in this report do not reflect the changes to the Fire Danger Rating system. The rating system in referenced data following identifies the Fire Danger Index of 50 and above as the highest Rating (Extreme). As shown above, this rating has now been separated into three separate ratings (severe, extreme and catastrophic).*

Figure 3: Average number of days between 1 October and 31 March (the declared bushfire season) by FFDI class.

Note: The period from 1 October to 31 March is the declared bushfire season. (raw data from Bureau of Meteorology, after Lindesay et al. 2004).



Severe fire weather

The predominant synoptic meteorological situation associated with the hot, dry, windy conditions necessary to produce higher FDI values in the ACT region is characterized by a high pressure system centred over the Tasman Sea and another to the west in the vicinity of the Great Australian Bight. A trough of low pressure separates these high-pressure regions over south-eastern Australia. A high pressure ridge usually extends from the Tasman high to northern and eastern NSW and is orientated north-west to south-east or west to east, producing a north-westerly air flow over the ACT (Lindesay *et al.* 2004).

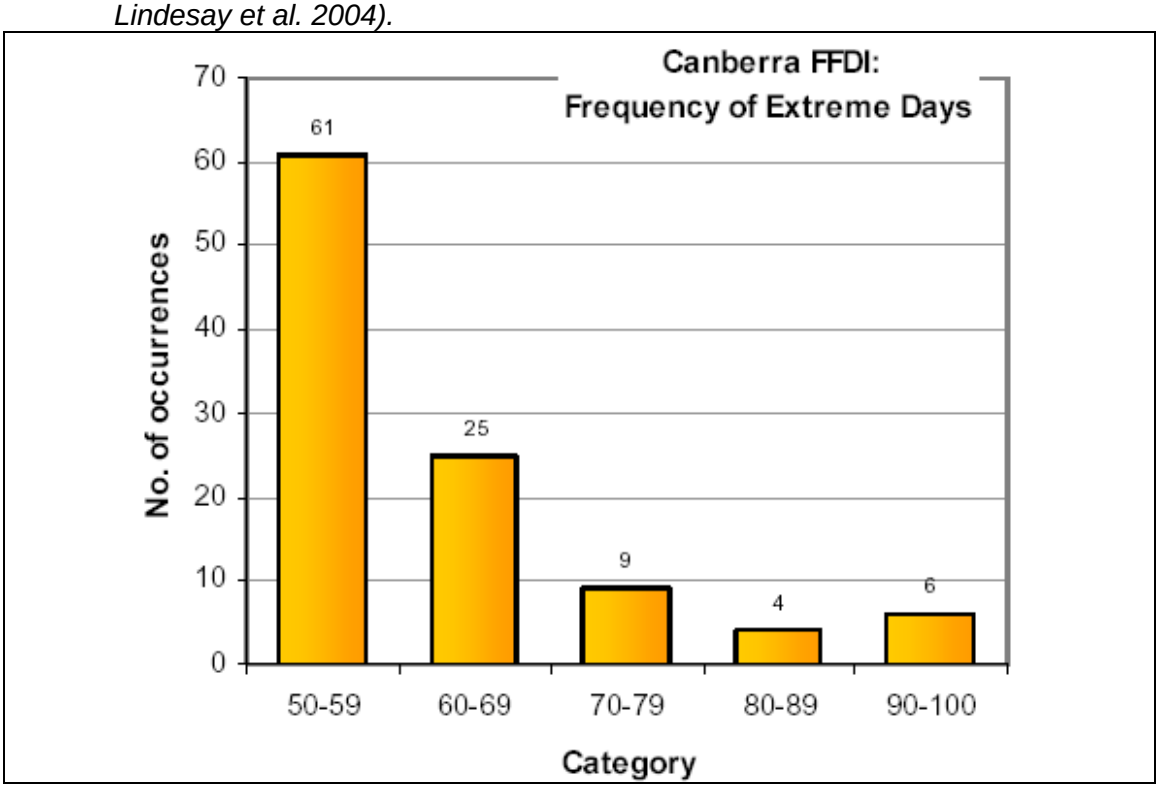
Analysis of 1951-2004 meteorological records has been undertaken to determine the frequency of daily FFDI values and the frequency of days where the FFDI is >50 at Canberra Airport (Lindesay *et al.* 2004).

This analysis shows that:

- 0.1% of days (19 days in 53 years) had an FFDI exceeding 70 (see Figure 4);
- 0.5% of days (105 days in 53 years) had an FFDI exceeding 50 (see Figure 4);
- 18% of January days had Very High FFDI, and 2% of January days had FFDI exceeding 50; and
- 91% of days had FFDI values below 20.
- The distribution of days with FFDI values exceeding 40 is largely confined to November to March.

Figure 4: Frequency of FFDI days exceeding 50 at Canberra Airport. Note: for all months in the period 1951-2004.

All data calculated at 1500 AEST.(Source: Australian Bureau of Meteorology, Lindesay et al. 2004).



Research and findings into discrete climatological events effecting fire behaviour.

It is recognised discrete climatological events have the potential to effect bushfire behaviour. The effects of thunderstorms and wind changes on fire behaviour are well known examples of these discrete events that impact on fire behavior and the Fire Danger Index. Research by the Bushfires Cooperative Research Centre (CRC) HighFire program[2] into a range of discrete climatological conditions is underway to assist fire suppression agencies to understand and identify these conditions. A number of the projects are discussed below.

Foehn Winds

Foehn winds are strong, dry and warm winds that result from the effects that mountains have on the atmosphere with air that is forced to rise over a mountain barrier possibly becoming drier and warmer. Further warming can take place as the air descends in the lee of the mountain barrier. Alternatively, when lower level air is blocked by a mountain barrier, drier air from above can flow down the lee side of the mountain barrier where it gains strength and is warmed by (Sharples *et a*l 2006)

Consequently, foehn winds can lead to elevated fire danger conditions. The Santa Ana winds of Southern California are an example of foehn winds that are associated

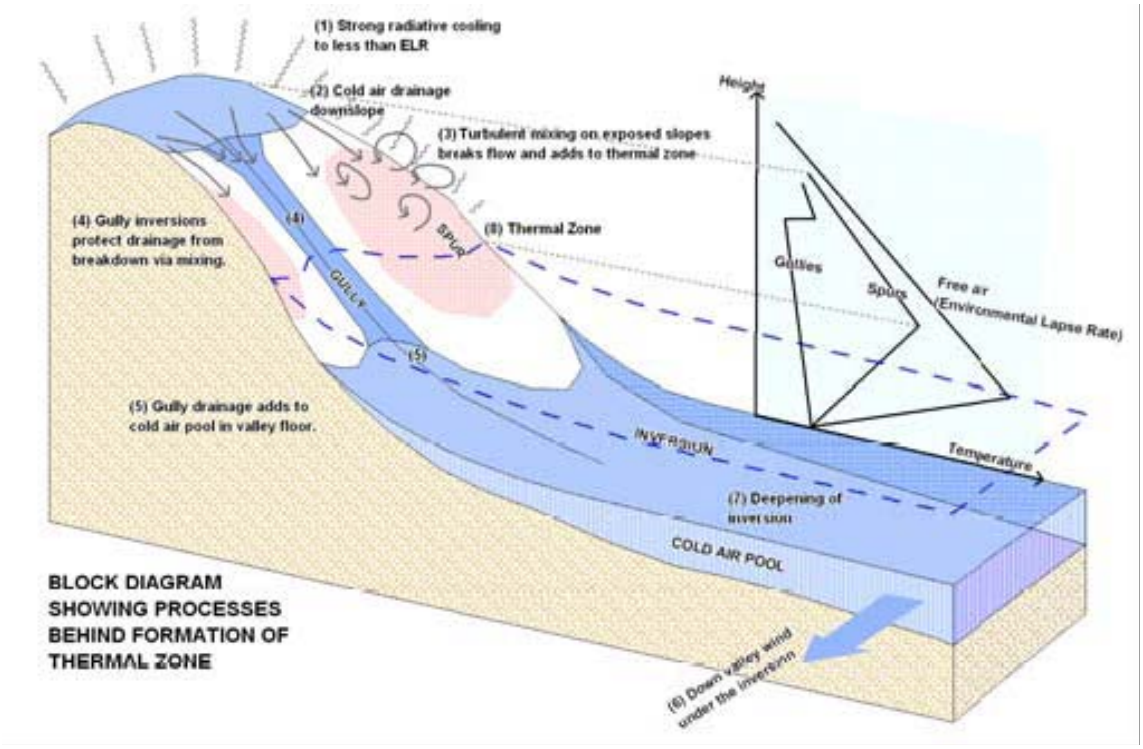
[2] The HighFire program has been established within the Bushfires CRC to undertake scientific research that will improve the understanding of how fire affects ecosystem functioning, people and communities; and how to manage bushfire risk in high country environments. www.bushfirecrc.com/research/highfire

with severe fires. The extent to which foehn-like conditions affect fire danger in Australia is the subject of continuing research. (Sharples *et a*l 2006)

Thermal Belts

The thermal belt is a zone, which typically occurs mid-slope in mountainous terrain, where maximum temperature and FDI may occur overnight. Research in Australia by McRae *et al (*2006) as well as overseas research and fire ground observations suggests that the thermal belt may be a significant effect in and around Australia's high-country. This can impact on the effectiveness and safety of overnight suppression strategies and tactics. An illustration of the processes causing the thermal belt is given in figure 5 below.

Figure 5. Schematic showing how the thermal belt develops.
(from McRae et al 2006)

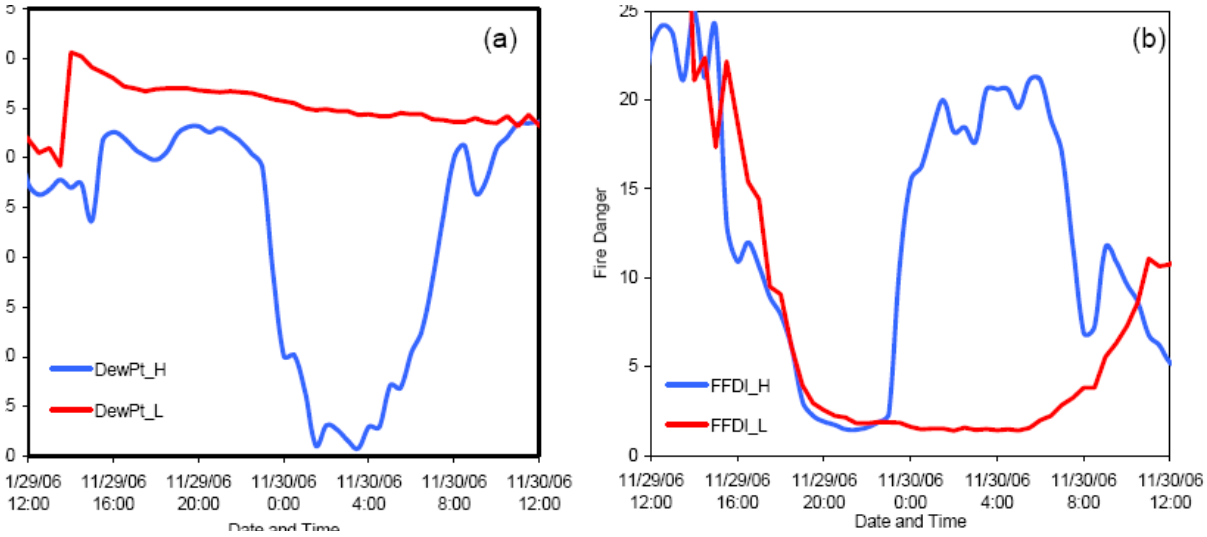


Subsidence Inversions

Observations by Sharples *et al* (2006) with the Bushfires CRC have identified that fire weather in the high-country can be quite different to that experienced at lowland sites (See figure 6 below). Moreover, these differences can result in higher fire danger levels in the high-country than what is experienced at lowland sites. Of particular note are significant high-country dew point depressions that occur approximately one in every seven days. Some of these dew point anomalies are due to nocturnal low-level jets, which can impact upon the high-country. Dew point is Such phenomena may have serious implications for any fire suppression activity being conducted in their vicinity.

Figure 6. (a) Dew point at Mt Ginini (blue) and Canberra (red). A strong anomaly is evident between 00:00 and 04:00 on 30/11/06, (b) corresponding forest fire danger at Mt Ginini (blue) and Canberra (red).

From Sharples et al (2006)



Lee Slope Eddies

Understanding directional changes in surface winds, caused by their interaction with complex topography, is an important problem in fire spread modelling and bushfire risk management and is considered in Sharples *et al* (2006), as part of the Bushfires CRC. Rugged parts of the terrain can result in turbulent effects such as lee-slope eddies, which form when the wind separates from the surface in the lee of a ridge and turns back on itself producing a horizontal vortex that blows up the lee-slope. Lee-slope eddies can therefore result in directional changes of 180^{o} over those parts of the landscape prone to their formation. Lee-slope eddies are turbulent structures that can be exacerbated by the presence of fire, leading to increased production and fluid like transport of embers. (Sharples *et al* 2006).

Lee Slope Chanelling

In further consideration of lee slope eddies, analyses by Sharples *et al* (2007) with the Bushfires CRC of line-scan data collected during the 2003 fires have shown that unusual fire behaviour can occur along incised valleys and steep lee slopes that are aligned almost perpendicular to the wind. In particular, a number of significant events west of Canberra on the 18th of January have been noted. Typically, these types of events are characterised by:

1. Rapid lateral propagation of the flank along the valley or slope;
2. Downwind extension of the flaming zone of 3-5 km with uniform spectral signature in the imagery;
3. The upwind edge of the flaming zone is constrained by a major break in topographic slope; and /or
4. One edge of the flaming zone is aligned with the main wind direction and is comprised of many spot fires.

Research has indicated that it is possible to identify terrain characteristics that are necessary for channelling like processes to occur. (Sharples *et al* 2007)

Violent Pyro-convection

Understanding of violent pyro-convection is necessary to understand the drivers of very large fire events, we must. This is the focus of an international research effort including work by McRae *et al* (2006) with the Bushfires CRC. It is now accepted that major fires can pump particulates into the lower troposphere / upper stratosphere (UTLS). These events are driven by release of latent heat at the saturation level in the fire's plume. This acts like an extraction fan above a fire, and changes the forces driving the fire.

In Australia, few violent pyro-convection events were noted before 2002, but since then there has been a significant number recorded. Research is under way into whether this is due to climate change or better detection. (McRae *et al* 2006)

Future climate and weather

Climate change

Climate change, and the associated possible increases in climate variability and extremes associated with less rainfall and higher temperatures, are likely to lead to an increase in larger, more intense bushfires across Australia.

In 2007, the Climate Institute of Australia commissioned the report *Bushfire Weather in Southeast Australia: Recent Trends and Projected Climate Change Impacts*. This report updated the findings of previous studies that found climate change projections indicated that south-eastern Australia is likely to become hotter and drier in the future.

Climate change projections

The estimated effects of climate change by 2020 and 2050 have been calculated using updated global warming projections from the Intergovernmental Panel on Climate Change (IPCC). Climate change projections over south-eastern Australia were generated from CSIRO climate simulations. For each of these models (Mk 2 and Mk 3), the patterns were scaled for the years 2020 and 2050 using IPCC estimates of global warming for those years, i.e. 0.4^{o}C (low) to 1.0^{o}C (high) by 2020 and 0.7^{o}C (low) to 2.9^{o}C (high) by 2050.

Changes in Extreme Forest Fire Danger Indices

Table 1 indicates that by 2020 the low scenarios show little change in the frequency of extreme fire danger days. However, by 2020 the high scenarios indicate that Very Extreme (FFDI > 75) days may occur about twice as often at many sites.

By 2050, the low scenarios are similar to those for the 2020 high scenarios, while the 2050 high scenarios indicate a three to four fold increase in the frequency of extreme fire danger days for Canberra.

Table 1: Predicted average number of days per year with FFDI > 50

		2020				2050			
Site	**Present**	**Low Mk2**	**Low Mk3**	**High Mk2**	**High Mk3**	**Low Mk2**	**Low Mk3**	**High Mk2**	**High Mk3**
Canberra	1.6	1.7	1.7	2.0	2.2	1.8	2.0	3.7	5.1

Table 2 indicates that by 2020 low scenarios show little or no change from the present and the 2020 high scenarios show a slightly decreased return time for Very Extreme fire danger days

By 2050, the low scenarios are similar to those for the 2020 low scenarios. The 2050 high scenarios however show a significant decrease in the return time for Very Extreme fire danger days (from one every 6.6 years at present to one every 1.2 years under the Mk3 high scenario).

Table 2: Predicted average return period in years for FFDI > 75.

Note: values for present are based on data for 1973-2007.

		2020				2050			
Site	**Present**	**Low Mk2**	**Low Mk3**	**High Mk2**	**High Mk3**	**Low Mk2**	**Low Mk3**	**High Mk2**	**High Mk3**
Canberra	6.6	6.6	6.6	6.6	4.7	6.6	6.6	2.4	1.2

Seasonality of projections

The report also identified the projected changes that vary at different times of the year, with the model results suggesting that fire seasons will start earlier and end slightly later, while being generally more intense throughout their length. This effect is expected to be most pronounced by 2050, although it should be apparent by 2020.

Long term planning for fire management should consider the possible impacts of climate change scenarios on the fire environment, and on the vulnerability of conservation and production resources to fire and drought. Early starts to the fire season suggest a smaller window for prescribed burns in late spring but may increase the opportunities for prescribed burning in winter.
More frequent and more intense fires suggest that more resources will be required to maintain current levels of bushfire suppression.

Shorter intervals between fires, such as those which burned in eastern Victoria during 2002-03 and 2006-07, may significantly alter ecosystems and threaten biodiversity.

Climatic conditions affecting planned burning in the ACT

Planned burning is a critical tool for the implementation of planned fire regimes, particularly in naturally forested areas. The ability to successfully and safely undertake planned burning is constrained by a range of climatic factors which effect fire behaviour. If these climatic factors fall below certain thresholds, then fire cannot

be sustained and prescribed burns will extinguish without spreading significantly. Conversely, if the climatic factors exceed given thresholds, prescribed burns may burn at intensities that may result in significant impacts on ecological and environmental values, and may escape containment lines and cause further impacts, including those to life and property.

Two separate analyses using different methodologies have been conducted to identify the number of days available for planned burning. Both analyses should be treated as indicative, as a wide range of factors influences planned burning, including site variability, management of late spring burning risks, smoke management prescriptions, restrictions on burning in the fire season, and operational management considerations. The results indicate that the average number of suitable burning days each year is in the range of 15-60, with significant annual variability depending on seasonal conditions.

Analysis by Gellie (2005) shown in Table 3 indicates that the lower montane parts of the forested catchment in the ACT appear to have about 16-25 burning days in an average year. In the montane higher parts of the catchments, the number of burning days falls to about six to fifteen days per year. Higher up in the sub-alpine zone the number of burning days falls to about three to five days a year (note this includes burning in February, March, and November in the sub-alpine zone). The number of burning days follows a sharp environmental gradient which limits burning at elevations above 1200 metres. The data do not take into account suitable periods of litter and soil dryness.

Table 3: Estimated number of burning days in autumn and spring.
From Gellie (2005)

	Season	
	Autumn (March - April)	**Spring (September - October)**
Estimated no. of burning days in records (47 Years)	482	164
Average no. of burning days	13	5
Average no. in dry years	15	9
Average no. in intermediate years	8	8
Average no. in wet years	5	2

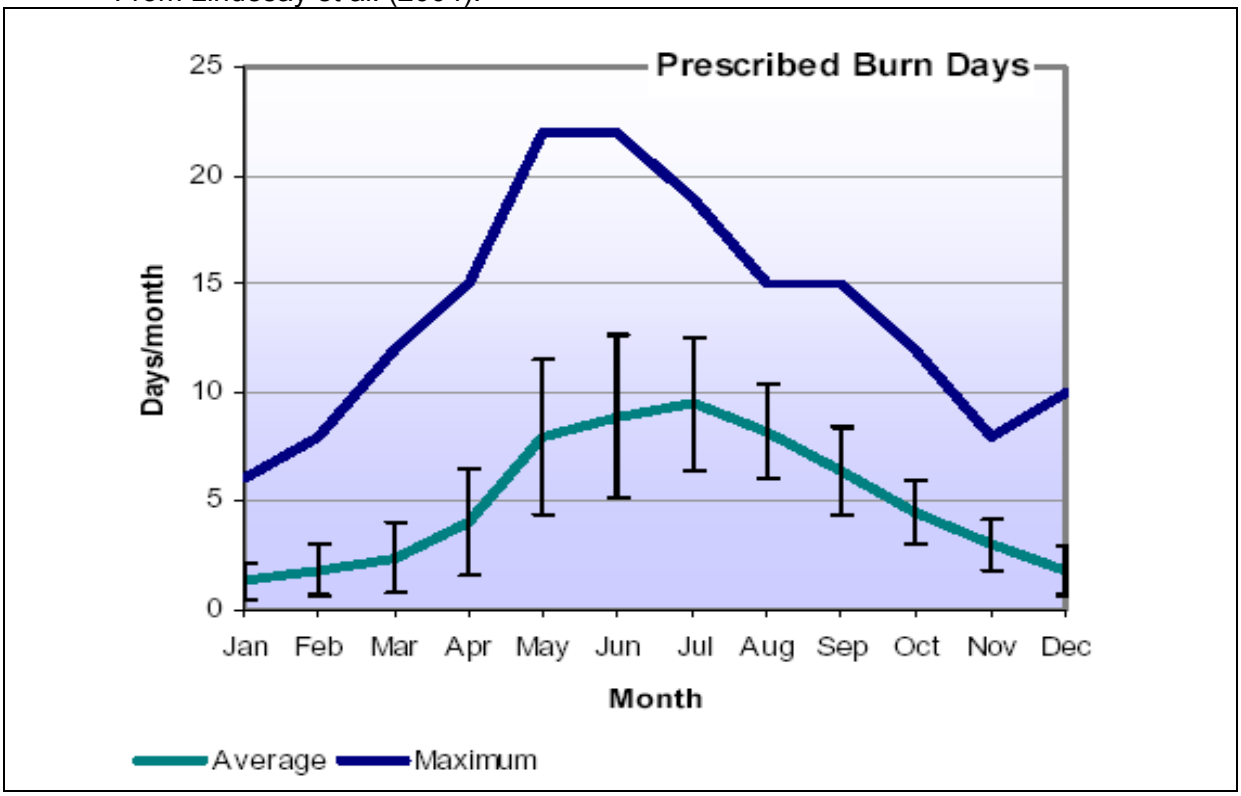
Analysis by Lindesay *et al.* (2004) shown in Figure 5 indicates an average of 60 days/year meet criteria for conducting a safe and prescribed burn. However, there is significant variability between years, from more than 100 to less than five days. Improvements to modelling will reduce the estimate of available burning days, because currently available fuel moisture wetting and drying functions assume average summer conditions, and because this figure includes late spring and summer days when higher fire danger conditions are also likely.

Available days have a strong pattern of seasonal distribution, with the most days available from May to September. Additional analysis of the first and second halves

of the record indicates that the seasonality of planned burn days has varied during the period of record at Canberra, with a reduction in the number of planned burn days in more recent years, particularly during the period of in March-July (Lindesay *et al.* 2004).

Figure 5: The average number of days per month fitting the planned burning criteria in 1952-1977 and 1978-2003.

From Lindesay et al. (2004).



The opportunity to schedule and implement planned burning within a desirable window of favourable conditions is relatively limited (Lindesay *et al.* 2004). Land managers and owners must take this into account in the development of targets and budgets, and the implementation of planned burning programs. In addition, the topography of Canberra and temperature inversions frequently create conditions in which smoke dispersal is poor and in which smoke may have a significant impact on the community, including on human health.

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Chapter Five - Bushfire Fuels

Fuel is a critical element in bushfire planning and management and is the only factor relating to fire behaviour that can be influenced by land managers and owners. A spatial and temporal understanding of fuel is fundamental to assessing bushfire risk across the landscape and the subsequent targeting of fire management programs.

Fuel type, structure and relationships

Non-urban bushfire fuel includes the organic or vegetation material of the land, including forest, grassland, woodland, heath, and scrub fuels. Key elements in characterising fuels include:

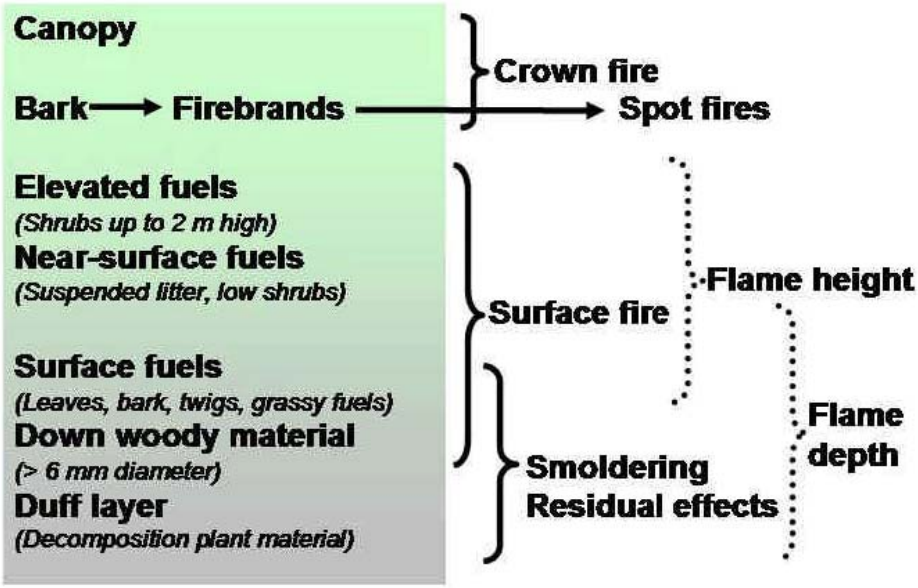
- intrinsic fuel properties are those that delineate the plant parts and include the chemical makeup, fibre and cell density, extractives (e.g. tannins and volatiles) and the heat content; and
- extrinsic fuel properties include the relative abundance of various sizes of fuel components, the fraction of dead material, the compactness of the fuel bed and the vertical and horizontal arrangement of different fuel elements and fuel strata (Pyne et al. 1996, in Gould and Sullivan 2004).

Bushfire fuel hazard is the term commonly used to describe exposure or vulnerability to injury or loss due to the effect a bushfire fuel complex has on fire behaviour and suppression difficulty. The concept is linked to the flammability of a vegetation type, because this affects fire behaviour factors such as ease of ignition, rate of spread, intensity, flame height, and production of embers.

Figure 1 shows how the different fuel elements of a fuel array influence fire behaviour. Surface fuels comprising leaves, twigs and other fuel lying on the ground provide a large proportion of the fuel available for burning, and influence initial fire spread, the depth of the fire flames, and fire intensity. Near-surface (grasses and low shrub) and elevated fuels most influence flame height, which contributes to the success or failure of suppression efforts by crews working closely to the fire. Elevated fuels combine with bark to assist the fire to heat tree canopies, and possibly initiate torching or crowning. Bark, and to a lesser extent suspended woody material, are the primary sources of embers, which have a significant impact on fire behaviour, the spread of fire over no or low fuel areas, and on fire control operations.

Figure 1: Fuel strata and their relationships with the combustion environment of a bushfire.

From Gould and Sullivan (2004)



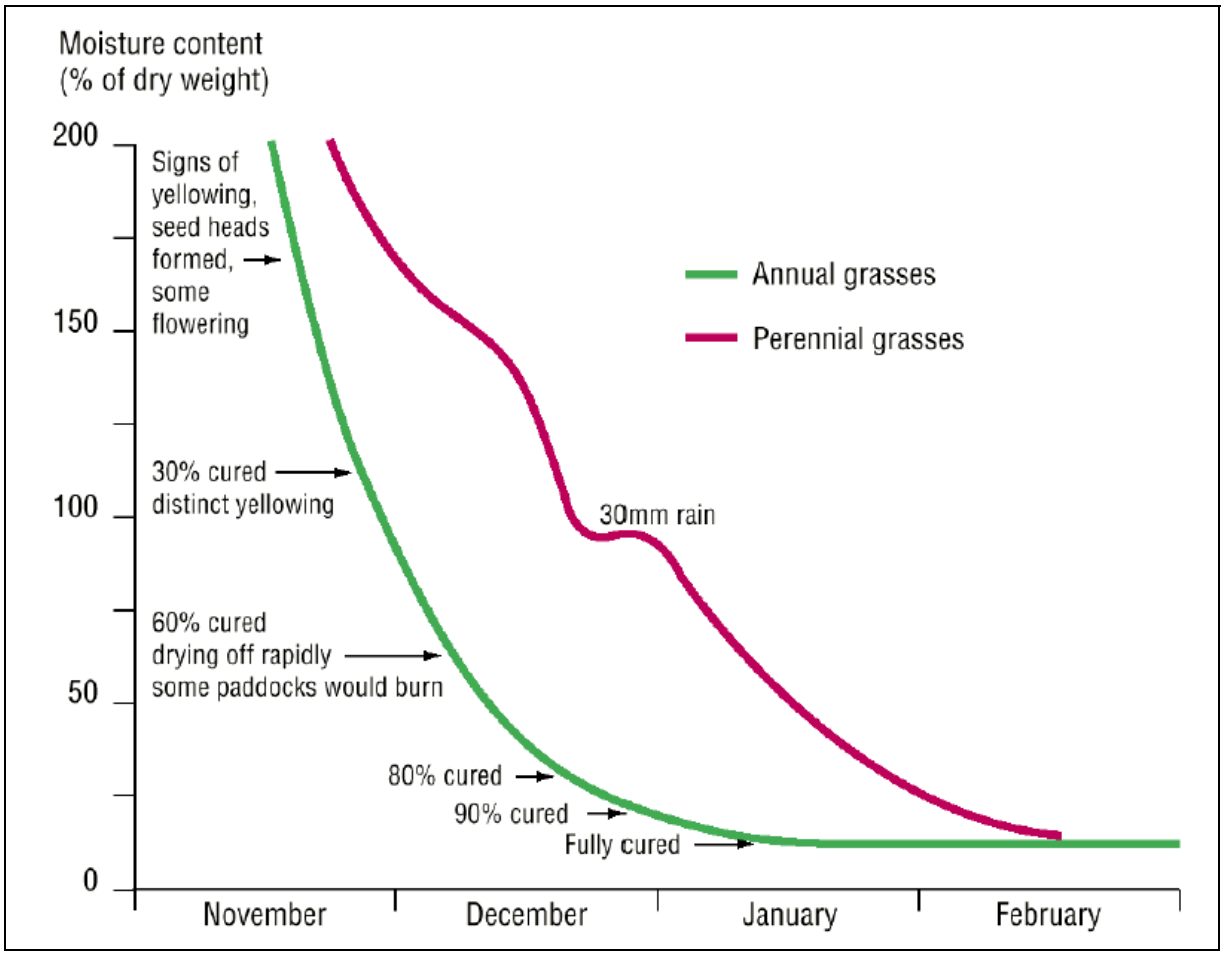
Because the nature and state of the different fuel strata influence the flammability of a forest or vegetation type, and the subsequent fire behaviour and difficulty of control, these elements need to be assessed and may need to be treated to achieve different fire protection outcomes. For this reason, the ACT uses a fuel hazard assessment processes to guide its fuel management activities. Fuel hazard is determined by many factors, including quantity, type and arrangement of surface (litter), near surface (forbs and grasses), elevated (scrub, hung needles and twigs) and bark and ladder fuels (low branches). These change with time since disturbance such as fire, and with changes in soil productivity and aspect. The proportion/components of these vary between each vegetation type, and within each vegetation type over time. Contemporary fuel hazard assessment guides are based on descriptions of the height and cover of various fuel elements, focussing on the structure of the fuel complex (e.g. McCarthy *et al.* 1999).

Grassland fuel variations over time

Grassland fuels vary on an annual time frame, with spring growth and summer curing (drying) significantly affecting fuel hazard in some species (see Figure 2). Grasses also accumulate a dense thatch that increases with time if left ungrazed or unburnt for significant periods of time. Grasslands may also be subject to invasion by woody species in the absence of fire.

Figure 2: Curing of annual and perennial grassland in the ACT during the summer of 1964-65

From Cheney and Sullivan (1997) after Luke and McArthur (1978) in Gould and Sullivan 2004)

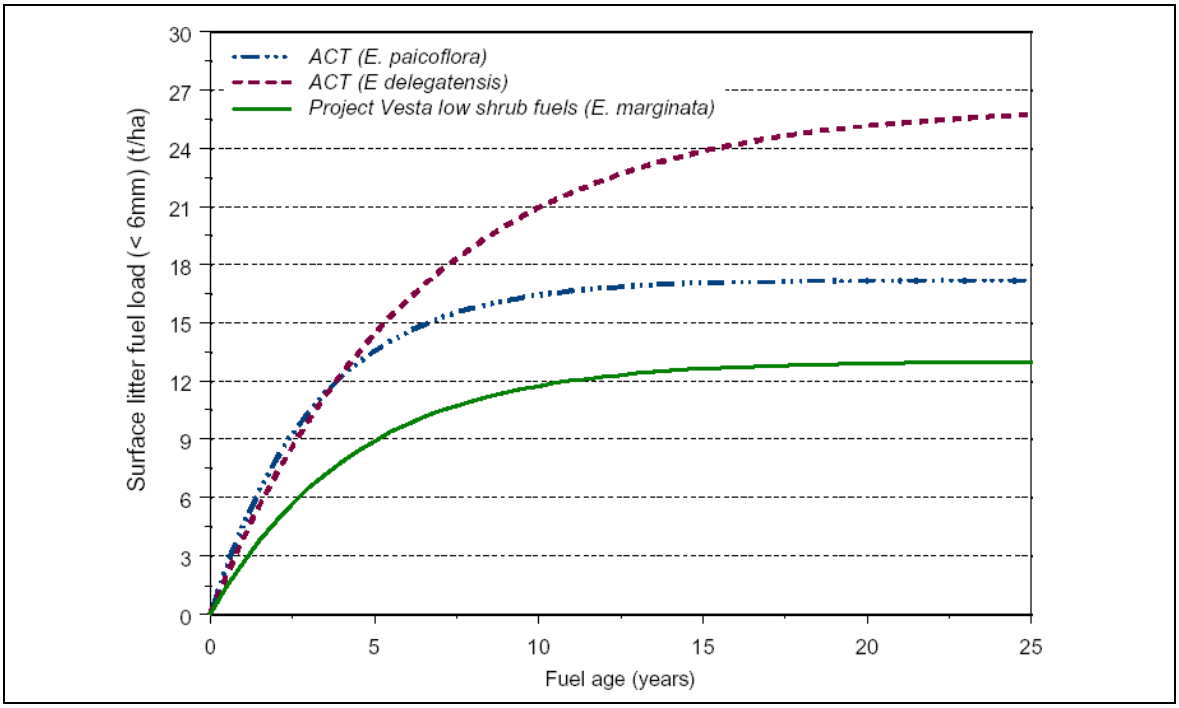


Forest fuel variations over time

Forest fuel dynamics alter with time since disturbance, accumulation and decay rates. Surface litter and other elements accumulate rapidly after fire, while bark accumulation is slower but can accumulate longer. See Figure 3 below.

Figure 3 Patterns of fuel accumulation following fires Notes: data from *E. pauciflora- and E. delegatensis*- dominated forests in the ACT region (Raison *et al.* 1983) and *E. marginata* low shrubby understorey forest in Western Australia.

From Project Vesta unpublished data, in Gould and Sullivan (2004).



Findings from CSIRO's Project Vesta study, which examined fire behaviour and fuel management in eucalypt forests, indicate that all fuel elements are significant. Fuel management must be appropriately targeted towards elements of the fuel array that contribute to certain fire behaviour. A summary of fuel considerations of the major ACT vegetation associations is outlined below in Table 1.

Table 1: Vegetation associations and attributes

Community	Fuel considerations
Tall open forest (>30 m in height, 30-70% foliage cover)	High to Extreme equilibrium Overall Fuel Hazard, require extended dry periods to dry fuels, includes ribbon and stringy bark species that contribute strongly to spotting
Open forest (10-30 m in height, 30-70% foliage cover)	High to Extreme equilibrium Overall Fuel Hazard, fuels readily dry, includes stringybark species that contribute strongly to spotting
Woodland (10-30 m in height, <30% foliage cover)	Low to High equilibrium Overall Fuel Hazard Moderate to low equilibrium fuel loads, fuel load generally determined by grass and understorey fuels
Grassland	Low to Moderate equilibrium Overall Fuel Hazard, varies with type (native or exotic), season and curing
Pine plantation	High to Extreme equilibrium Overall Fuel Hazard, varies with age and silvicultural treatment

The effects of managing fuel on fire behaviour

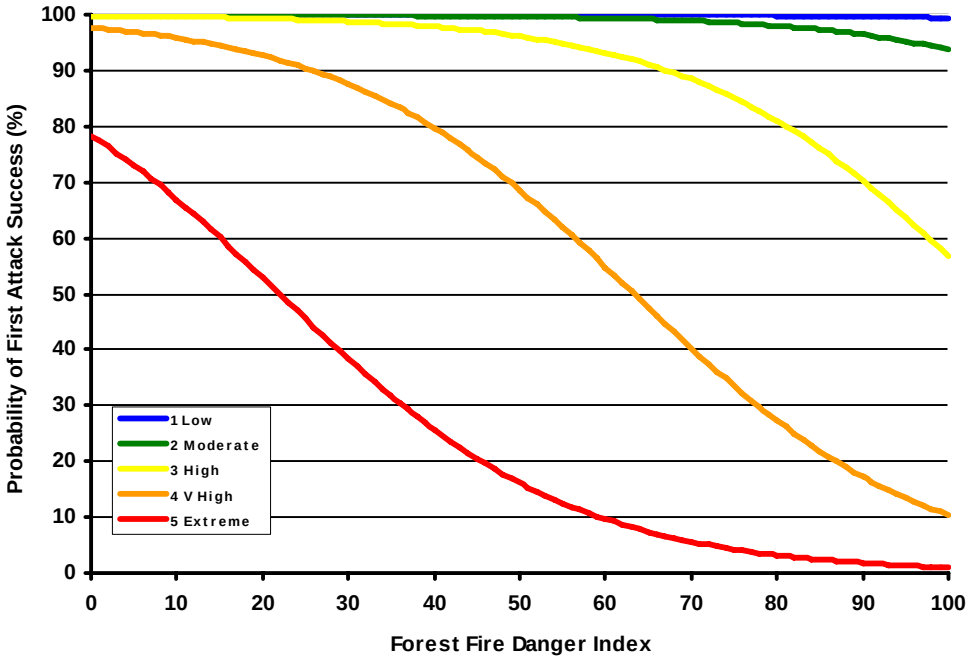
Fuel management provides for varying periods of modified fire behaviour depending upon vegetation type. The indicative longevity of treatments in different vegetation types is presented in Table 2 below.

Table 2: Prescribed burning and suppression activities.
From Gould and Sullivan (2004).

Fuel Type	Persistence of reduced fire behaviour (years)	Factors Contributing to difficulty of suppression
Annual Grass	1 (year of burning)	
Tussock Grassland	5	Development of persistent tussock fuel
Tall Shrubland	10-15	Height of Shrubs, accumulation of dead material , effecting Rate of Spread (ROS) and flame height
Forest, short shrubs, gum bark	10-15	Surface Fuel, near surface fuels effecting ROS and flame height
Forest, tall shrub, stringybark	15-25	Near surface fuel, shrub height and senescence, bark accumulation, efficient ROS, flame height and spotting potential

Fuel management is used to modify fuel characteristics, including Overall Fuel Hazard, and provides a measurable effect on the safety and likely success of fire suppression operations. However, under conditions of increasing fire danger, the efficacy of prescribed burning in assisting fire suppression may reduce, especially with increasing time since burning. Figure 4 is based on Victorian experience in unplanned fire suppression across a range of Overall Fuel Hazard classes and FFDIs.

Figure 4: Probability of first attack success in different Overall Fuel Hazard.
From McCarthy and Tolhurst (1998).



Consideration of the fuel hazard in which suppression may be successfully undertaken (under given conditions) is a significant factor determining the location, the type and timing of fuel management activities undertaken in Asset Protection and Strategic Firefighting Advantage Zones in the SBMP.

Fuels and Fire Behaviour in the Urban Environment

Fuels in the urban environment play a significant role in the development and spread of unplanned fires on the urban edge and into suburbs. An assessment of house loss after the 2003 Canberra fires lead to the conclusion that it was likely that more than 50% of the house losses were due to fire attack from suburban fuels (Ellis and Sullivan 2003). Suburban fuels include all of the elements of suburbia that contribute to the spread and behaviour of fires through the suburb. Depending on the intensity of a fire entering an urban area, varying amounts of gardens, mulches, buildings, fences, rubbish, wood piles and public places will become urban fuel (Ellis and Sullivan 2004).

Ellis and Sullivan (2004) concluded that:

- the combustion of suburban fuels, including houses, is a significant cause of house ignition during fires at the bushland-urban interface;

- the combustion of suburban fuels may also indirectly cause house loss by preventing access and hence fire suppression activities by residents or firefighters; and
- suburban fuels that pose a hazard to a particular residence often include fuels on adjacent private properties or public land.

Safety zones for residents and firefighters – defensible space

Further to the consideration of the probability of first attack success (Figure 4) is how this relates to the safety of firefighters, as well as residents who maybe defending their properties from bushfire. Studies in the US by Butler and Cohen (1998) modelled the effect of radiant heat on firefighters, based on flame height. Model predictions found that safety zones of at least 20 m were required to provide for firefighter safety in most situations.

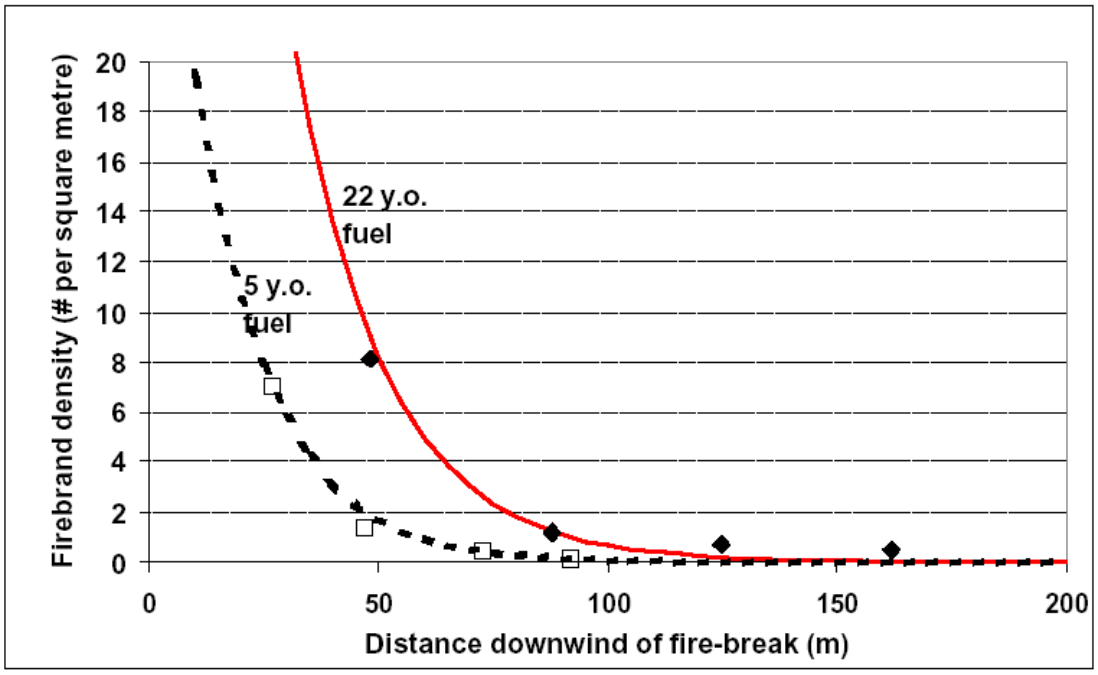
Consideration of these findings and the high probability of first attack success when the Overall Fuel Hazard is maintained at Low – Moderate (Green and Blue Lines Figure 4) is a major factor in determining the width of and fuel management standards applied in the Inner and Outer Asset Protection Zones, to provide defensible space in which firefighters can defend properties and assets safely.

Ember penetration into urban areas

Recent work has investigated the distribution of embers from a fire edge (see Figure 5) and may guide the required width of fuel management practices where embers are of concern, such as the urban edge. The significance of these findings is twofold in relation to bushfire management, influencing the extent to which fuel management treatment is applied in Asset Protection Zones (to reduce the density of ember generation by reducing fine fuel and bark hazards) as well as considering the distance to which embers may penetrate urban areas and potentially cause damage.

Figure 5: Peak firebrand density downwind of the firebreak, for 5 and 22 year-old fuels.

From Ellis and Gould (2004).



Note: At 50 m the peak firebrand density of the 22 year-old fuels is more than 4 times that of the 5 year-old fuels.

A number of studies have additionally examined the extent to which bushfires have penetrated urban areas and caused damage.

Ahern and Chladil (1999) examined house loss data from the 1967 Hobart fires, 1983 Otway fires, 1994 Como-Jannali fires and the 1998 Hobart fires. They identified a relationship between houses burnt in bushfire and the distance from the vegetation boundary. The study found that 70% of houses burned will stand 50 m or less from the boundary, 80% are 80 m or less and 95% are 180 m or less. For the worst case scenario (Moggs Creek, Otways 1983) 95% of destroyed houses were less than 250 m from vegetation.

Following the 2003 Canberra bushfires, Chen and McAneney (2004) further studied the extent of bushfire penetration into urban areas. Several key findings of this work are discussed below and illustrated in Figure 6.

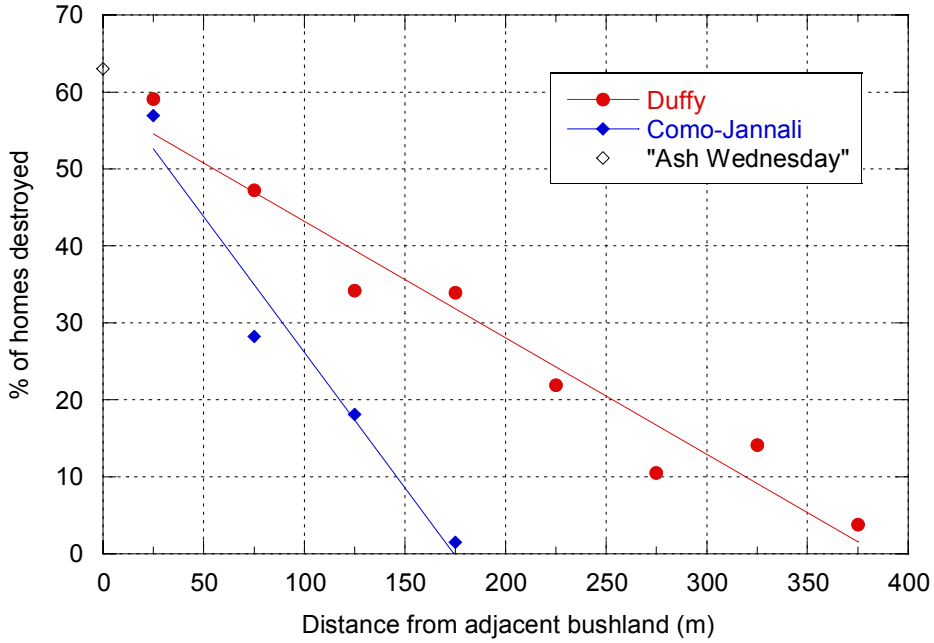
- In Duffy, nearly 60% of all homes within the first 50 m were destroyed. Although the environmental settings of these homes and those in the studies in Hobart, the Otways and Como-Jannali (Ahern and Chladil 1999) may have varied, the percentage of houses destroyed within the first 50 m appears to be consistent. This statistic may have wide utility for estimating bushfire risk to homes constructed immediately adjacent to bushlands;
- In Duffy and Como-Jannali, the majority of homes were destroyed beyond a separation distance of 40 m, suggesting the main cause of home ignition was airborne embers rather than direct flame contact or radiant heat. This is further supported in reports by Blanchi and Leonard (2004) investigating the mechanisms of house loss in the Canberra fires. By comparison, a high number of homes or small hamlets scattered amongst bushland, a situation typical of

many of the Ash Wednesday fires and also the February 1967 Hobart fires, were destroyed at only small distances from the forest; and

- There appears to be consistency in the maximum extent of damage identified in both reports. For Duffy, this distance was 674 m (Chen and McAneney 2004), while for Hobart it was 684 m (Ahern and Chladil 1999).

Figure 6: Percentage of homes destroyed at different distance ranges from the urban edge.

From Chen and McAneney (2004)



Assessment of Bushfire Fuels and Projection of Future Overall Fuel Hazard

Fuel hazard has in the past been assessed through simple estimates of surface fine fuel loads. Contemporary fuel hazard assessment techniques consider the whole fuel complex, including bark and elevated, near surface and surface fine fuels. This approach quantifies the fuel elements responsible for fire spread and other fire behaviour factors such as intensity, flame height and spotting, which in turn influence first attack success, difficulty of control, and damage to natural and human assets. (McCarthy and Tolhurst 1998).

Since 2003, the ACT Government systematically surveys bushfire fuel hazard annually across the ACT. This fuel hazard assessment has been based on the Victorian Overall Fuel Hazard Guide (1999) with fuels being assessed based on this method at several hundred locations around the ACT every year. As part of the ongoing review and improvement to the fuel hazard assessment program, a number of changes have been made to the methodology. These changes have been made for a number of reasons:

- to ensure compatibility with fuel hazard assessment works carried out by other leading organisations such as CSIRO (Project Vesta 2007) , Bushfire CRC and Department of Sustainability and Environment (Vic.);
- to adapt the process to the landscape and environment of the ACT; and,
- to ensure that adequate information is gathered for ACT specific purposes.

The ACT Government has developed Overall Fuel Hazard accumulation models for the range of vegetation communities occurring in the ACT, based on fuel hazard data collected as part of the annual fuel hazard assessment program, fuel hazard assessment data collected interstate, and specific fuel hazard assessments undertaken to develop the models. These models have been used in the development of the SBMP to:

- predict fuel hazard accumulation under a range of treatment scenarios;
- estimate the return interval for prescribed burning in order to maintain a given Overall Fuel Hazard in Asset Protection and Strategic Fire Fighting Advantage Zones; and
- identify areas/vegetation communities that naturally only accumulate Low to Moderate Overall Fuel Hazard and may be identified as natural Strategic Firefighting Advantage Zones (e.g.: montane grasslands in the Orroral Valley).

Figures 7a, b, c: Projected Overall Fuel Hazard across the ACT in 2009, 2014 and 2019

Notes: Maps reflect the anticipated situation if no fuel management treatment is undertaken and growing seasons are average. Note that extensive areas in the western half of the ACT are projected to have Low Overall Fuel Hazard in 2009 as a result of these areas being burnt in 2003 but that Overall Fuel Hazard is projected to accumulate to Very High – Extreme levels across a significant proportion of this area by 2019 in the absence of fuel management activities. Also note that there are areas in which the Overall Fuel Hazard is projected to remain at or below Moderate even in the absence of fuel management activities. These maps are provided for explanatory purposes and reflect available information at the time of writing. The maps may be modified as further data is collected and analysed.

Figure 7a – Modelled Overall Fuel Hazard 2009

This map is provided for explanatory purpose. It reflects information available at the time of writing, and may be modified as further information is collected and analysed

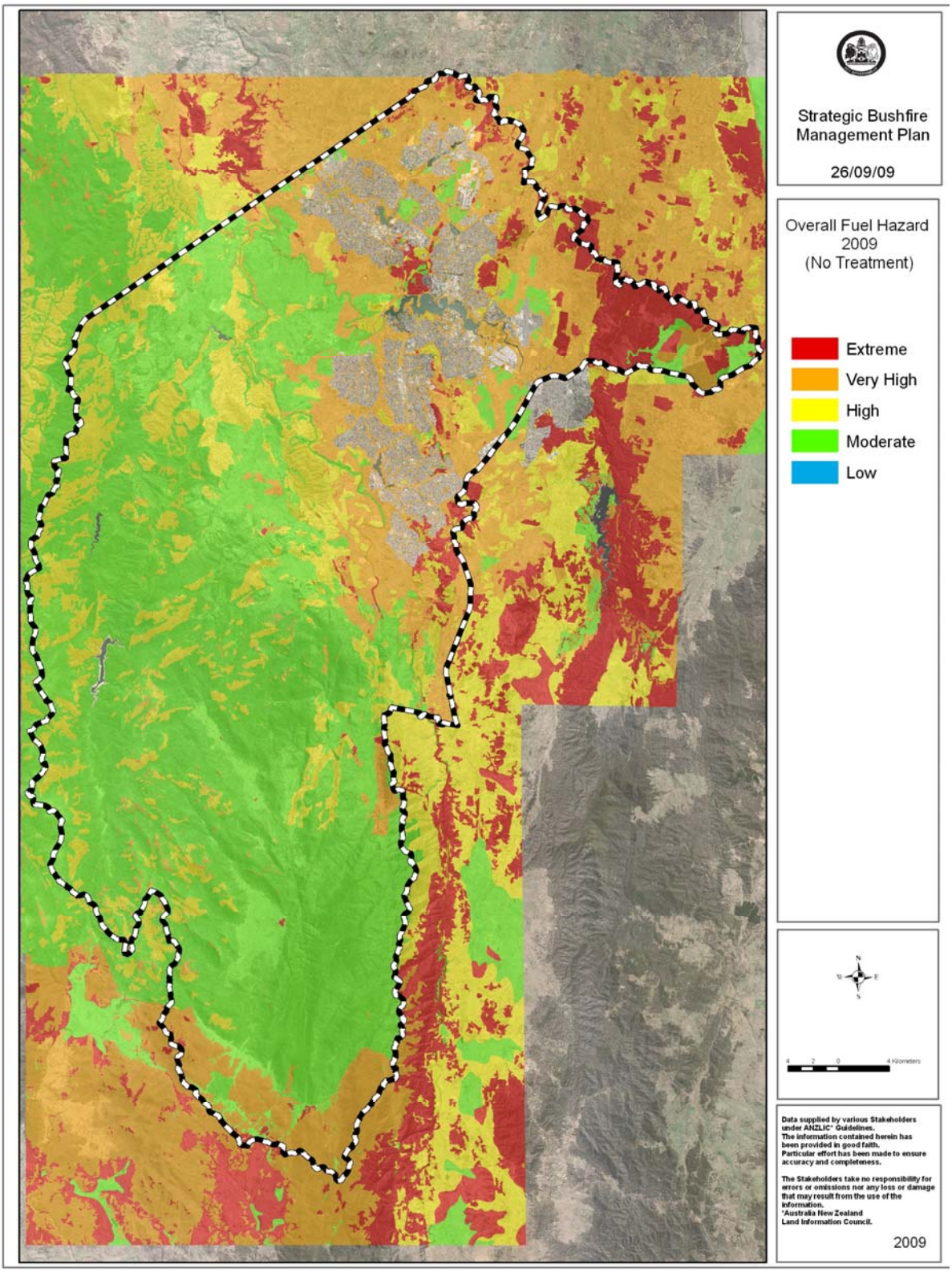


Figure 7b – Modelled Overall Fuel Hazard 2014

This map is provided for explanatory purpose. It reflects information available at the time of writing, and may be modified as further information is collected and analysed

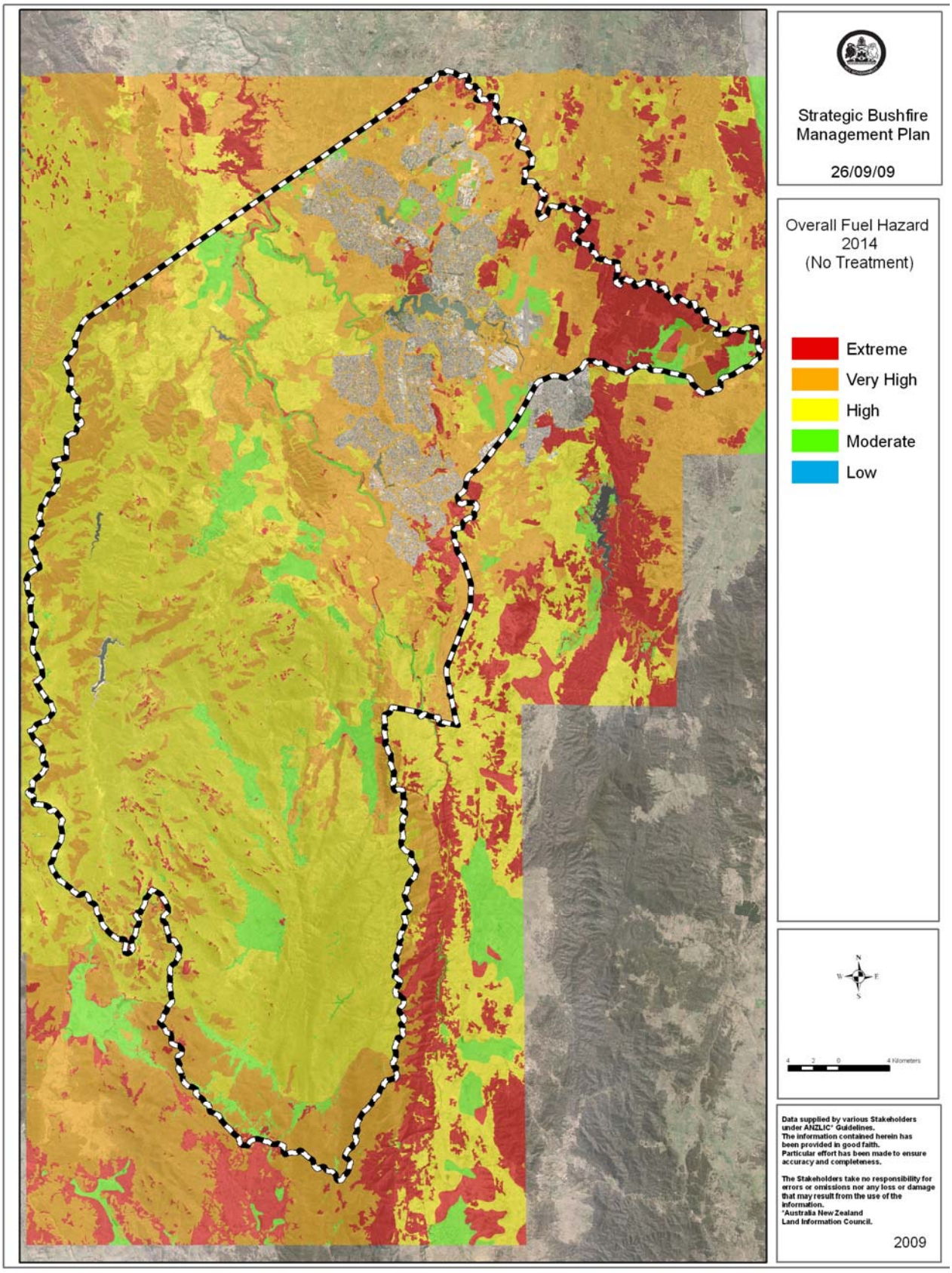
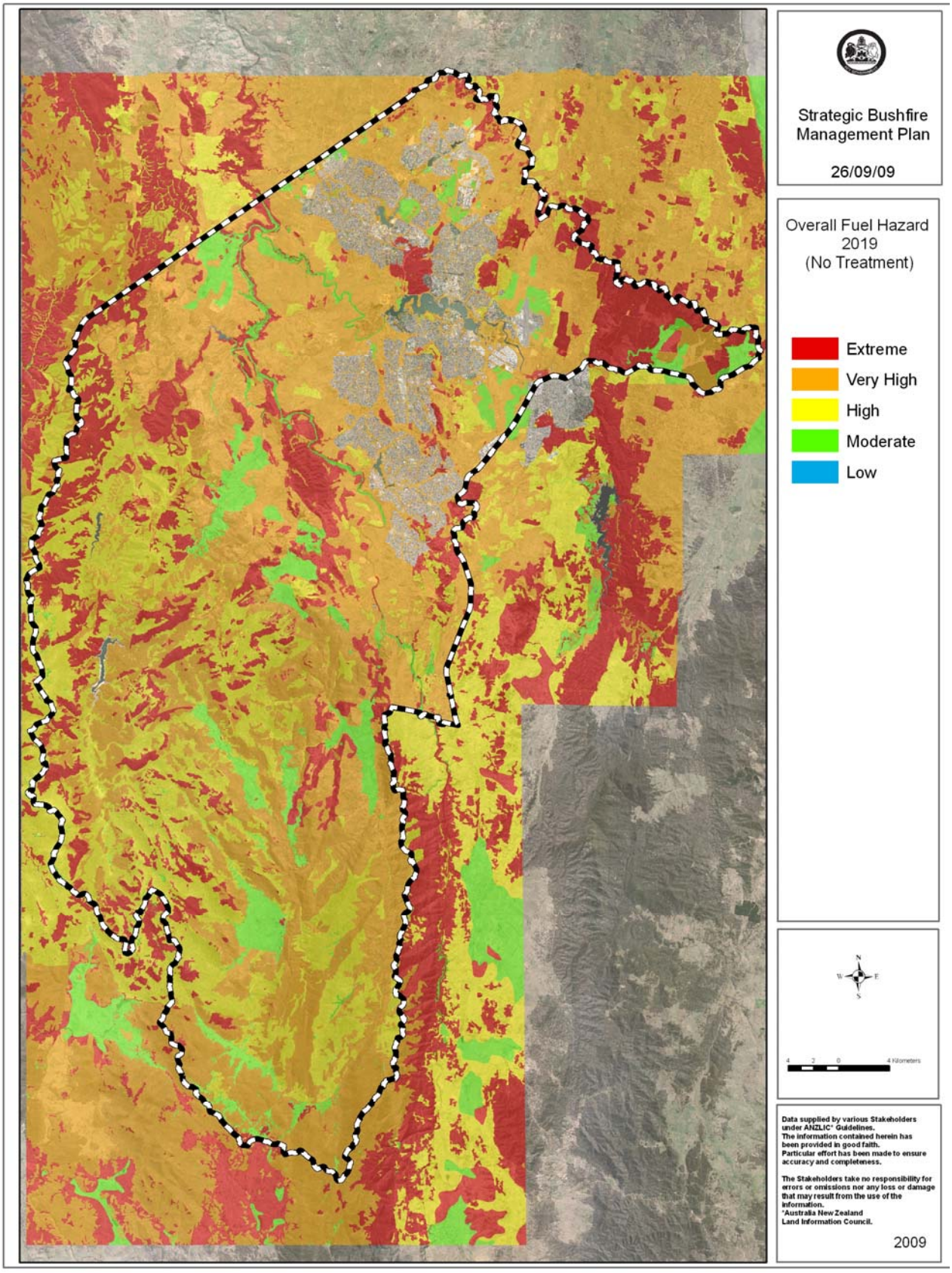


Figure 7c – Modelled Overall Fuel Hazard 2019

This map is provided for explanatory purpose. It reflects information available at the time of writing, and may be modified as further information is collected and analysed



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Department of Territory and Municipal Services - Parks, Conservation and Lands. *08-09 Fuel Hazard Assessment Methodologies. (ACT Government)*

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Chapter Six - Bushfire Risk Analysis

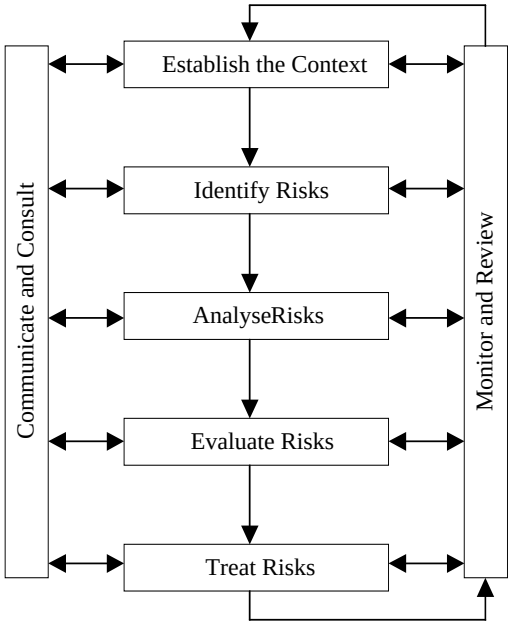
Part One – Risk Management

The risk management framework

Australian/New Zealand Standard AS/NZS 4360:2004 defines risk as a function of the likelihood (or probability) of an event occurring and the consequences if that event does occur. Risk must be expressed in terms of risk to what, from what and over what time frame.

The structure of the Strategic Bushfire Management Plan (SBMP) follows the steps of the risk management process detailed in AS/NZS 4360:2004, which has been adopted by the ACT Government enterprise-wide risk management framework and Emergency Management Australia (EMA) to provide the framework for establishing the context, analysis, evaluation, treatment, monitoring and communication of risk.

Figure 1: Risk management approach



Establishing the context

- The context for bushfire risk analysis is established in the Plan. The goal and the objectives for the community and the ACT Government establish the broad context for the Plan.

The core principles identified in Part One of the Plan further define the context for the Plan, identifying the key underlying principles of bushfire management in the ACT.

Identification and Analysis of bushfire risk

The analysis and evaluation of bushfire risk is considered in the context of:

- the likelihood of a bushfire starting and the how it will spread through the landscape; and

- consequence on assets that may be affected by the spread of the bushfire.

Part Two of this chapter describes in detail the process undertaken to assess bushfire risk in the Plan, and future actions that may be undertaken to further refine this assessment.

Evaluation of bushfire risk

The development of treatment options for the SBMP required the evaluation of a wide range of factors.

While the bushfire risk analysis provides the principal driver to evaluate the risk, consideration of other factors is critical to achieve an integrated and balanced approach to bushfire management in the ACT that acknowledges a wide range of social, economic and environmental considerations.

Evaluation of risk considers the principal purpose of the land use, including ecological or production requirements, proximity to natural or built assets, suitability for bushfire control operations, and the principal objective of reducing the risk of bushfires to life and property, and the environment.

Treatments are targeted to the level of risk, based on the setting of priorities. Risk mitigation cannot be undertaken across the entire landscape, due to both capacity constraints and the potential negative impact of such widespread treatment on some assets and priority setting is essential. Also, specific treatments cannot always be located in the areas of highest risk. Some treatments may need to be conducted away from the source of the risk, or other mitigation methods applied to address the risk, for operational reasons or for reasons related to the nature of the asset.

Treatment of bushfire risk

The treatment of bushfire risk (or bushfire risk mitigation) is achieved in the Plan by:

- reducing the likelihood of a bushfire starting;
- reducing the opportunity for a bushfire to spread; or
- reducing the consequences on identified assets.

This treatment of likelihood and consequence is provided in the framework of Research, Prevention, Preparedness, Response and Recovery (RPPRR), and informs the key strategies and actions indentified in the implementation plans for the community and the ACT Government. To further guide the development of treatment options, in particular prevention and preparedness activities, bushfire management zoning has been applied across the ACT. These matters are discussed in detail in the supporting Information Part Two.

Monitoring and review

The Implementation Plans for both the ACT Government and the community establish clear mechanisms for the monitoring and review of the Plan. These are documented in detail in the Plan.

Consultation and feedback

Extensive consultation was undertaken in the preparation of the Plan. In addition to those actions identified in the audit and review requirements for the Plan, specific actions to engage the community in ongoing consultation are identified.

Part Two – Bushfire Risk Analysis

The bushfire risk assessment method applied in the SBMP is consistent with the Australia/New Zealand Standard for risk assessment (AS/NZS 4360:2004) and was based on the following factors: .

- the likelihood of bushfires starting and spreading; and
- consequences for assets that may be affected by the spread of bushfires.

The method applied to asses these elements are described in the following sections. The method applied assumed:

- no fuel management practices; in effect, such practices will increase the area in which suppression can be effectively undertaken under given conditions;
- fuel accumulate over time is according to published and locally developed fuel accumulation curves (and detailed in the supporting information Bushfire Fuels); and
- the McArthur Forest Fire Behaviour and CSIRO-modified McArthur Grassland Fire Behaviour models provide a reasonable estimate of fire rate of spread.

Possible future developments to the risk assessment method to overcome these and other limitations are described in the attachments to this document

The likelihood of bushfires starting

The probability of a fire starting in the ACT was estimated using a Geographical Information System (GIS) as follows, based on 20 years of reliable historical records:

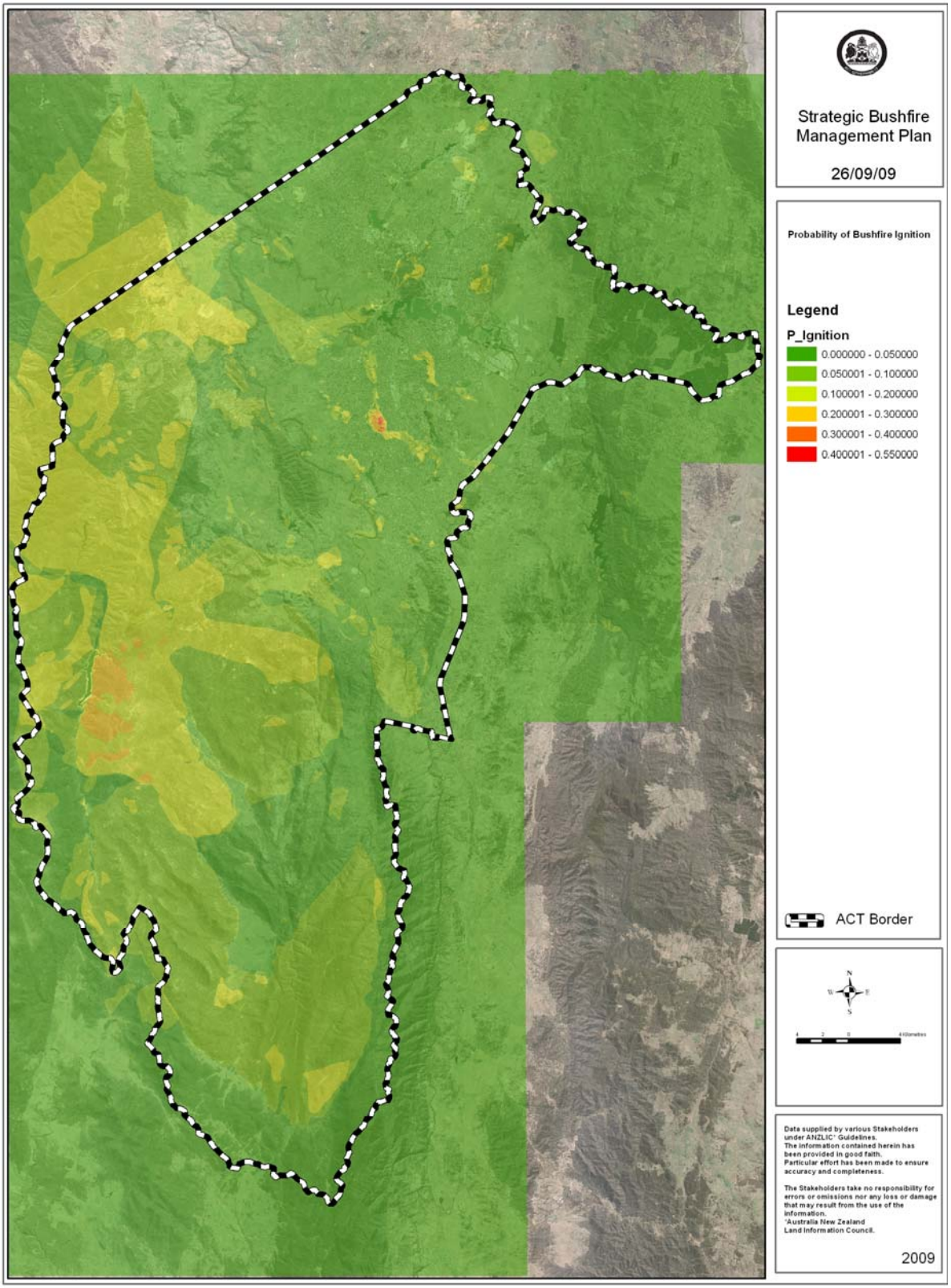
Probability of a fire starting = number of ignition points in historical fire records / number of years of reliable records

The modelling was undertaken using GIS, establishing a grid of squares across the entire ACT. For each grid square, the number of ignitions was identified and divided by the number of years of records to determine the probability of a fire occurring at that point in a given year.

The following image depicts the likelihood of bushfires starting in the ACT. Dark green areas have the least recorded ignitions, and orange and red areas have the most frequent ignitions. This map is provided for explanatory purposes and reflects available information at the time of writing. The maps may be modified as further data is collected and analysed.

Figure 2: The likelihood of bushfires starting

This map is provided for explanatory purpose. It reflects information available at the time of writing, and may be modified as further information is collected and analysed.



The likelihood of bushfires spreading

The likelihood of bushfires spreading was assessed using a GIS to estimate fire intensity across the ACT under a range of fire danger conditions, based on slope, aspect, vegetation type and time since last fire.

The steps followed to estimate the likelihood of bushfire spread are summarised in Table 1 and described below.

1. Define the fire danger ratings for which fire intensity would be estimated (see Attachment 1 - Table 1).

2. Estimate the fire intensity across the ACT for each fire danger rating identified in Step 1. This involved the following sub steps:

- estimate the fuel load based on vegetation type, time since last fire and published and locally developed fuel accumulation models (see Attachment 1, Table 2);
- estimate the rate of fire spread for each fire danger rating on flat ground, using the McArthur Forest Fire Behaviour model in forest communities and the CSIRO-modified McArthur Grassland model in grassland and grassy woodland communities (see Attachment 1, Table 4);
- use a simplified version of Byrams fire intensity equation (See attachment one (2)) to estimate fire intensity under each fire danger rating, based on estimated fuel load, rate of spread and a standard for heat of combustion; and
- correct estimated intensity for topography using McArthur slope correction factors, assuming uphill runs on NNE to WSW facing slopes, downhill runs on E to S facing slopes and flank fires on remaining slopes (see Attachment 1, Table 5).

3. Assign a probability of fires escaping first attack for each fire danger rating identified in Step 1 based on the fire intensity estimated in Step 3 (see Attachment 1, Table 6).

4. Use historical weather records for the ACT to estimate the probability of each of the fire danger ratings identified in Step 1 occurring (see Attachment 1, Table 7).

5. Multiply the probability of fires escaping first attack (derived in Step 3) by the probability of that fire danger rating occurring (derived in Step 4) for each of the five fire danger ratings identified in Step 1.

6. Sum the probabilities derived in Step 5 for all fire danger ratings, to generate the probability of fire spread across the ACT per year, taking into account fuel accumulation, the range of weather conditions experienced in the ACT and the effectiveness of first attack.

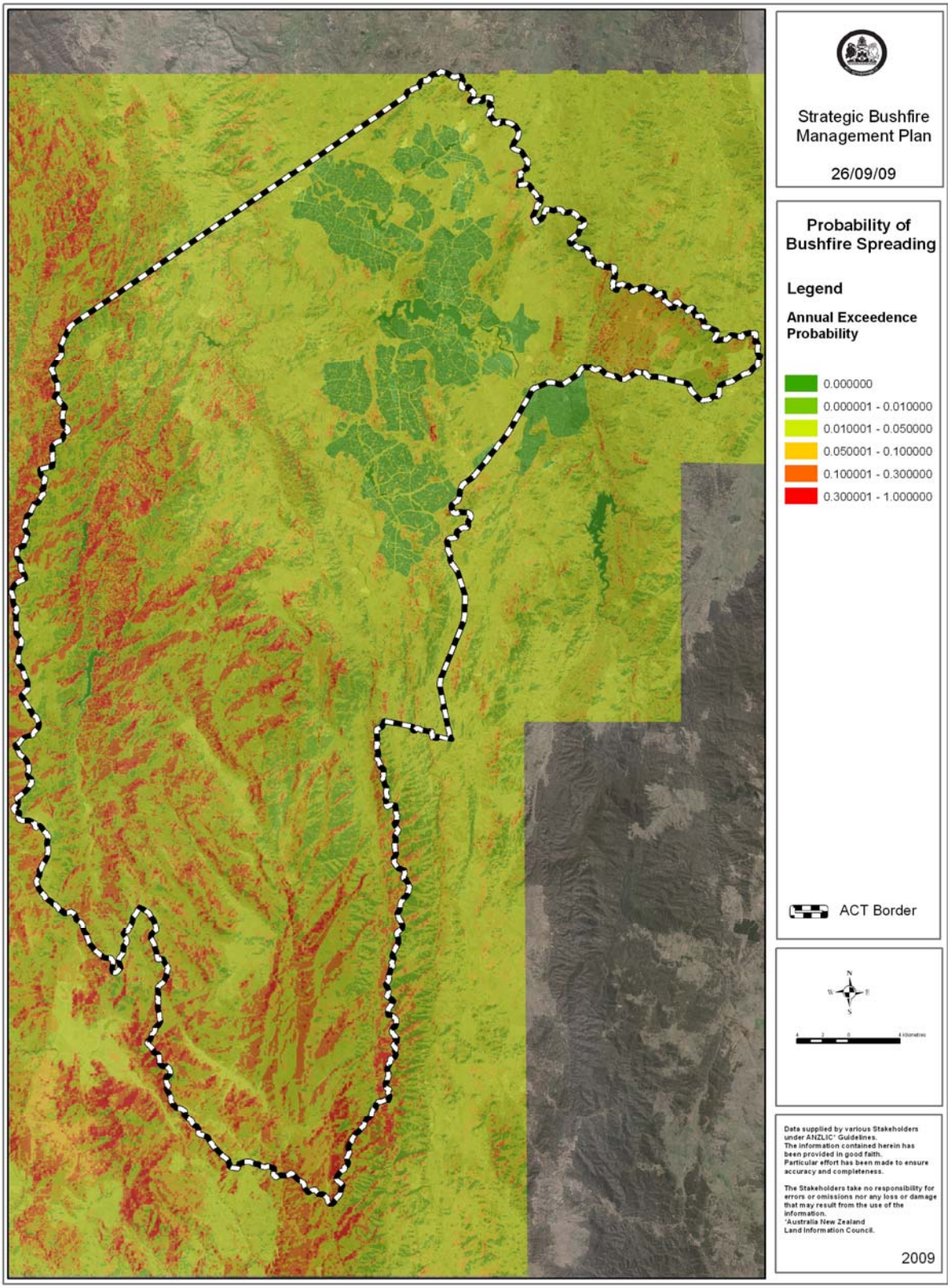
Table 1: Summary of steps followed to estimate the likelihood of fire spread across the ACT

Step 1	Step 2	Step 3	Step 4	Step 5
FFDI Range	**Estimate bushfire intensity**	**Estimate probability of escaping first attack**	**Probability of that FFDI Range occurring**	**Probability of Spread (PE x PF)**
Low	BI1	PE 1	PF 1	PS 1
Moderate	BI2	PE 2	PF 2	PS 2
High	BI3	PE 3	PF 3	PS 3
Very High	BI4	PE 4	PF 4	PS 4
Extreme	BI5	PE 5	PF 5	PS 5
		Step 6: Combined probability of spread per year		**Sum (PS1 to PS5)**

A map of the likelihood of fire spread derived by following the steps outlined is provided in Figure 3. Red and orange areas of those of higher likelihood and yellow and green indicate areas of lower likelihood. Likelihood of spread is expressed in terms of an annual exceedence probability, which is the probability the event may occur in a given year. This map is provided for explanatory purposes and reflects available information at the time of writing. The maps may be modified as further data is collected and analysed.

Figure 3: The likelihood of bushfires spreading

This map is provided for explanatory purpose. It reflects information available at the time of writing, and may be modified as further information is collected and analysed.



Estimating the probability of a fire starting and spreading

An estimate of the likelihood of a fire starting and spreading was determined by multiplying the separate elements of likelihood of a fire starting and the likelihood of a fire spreading. The resulting map is provided in Figure 4; red and orange areas showing a high likelihood of fires starting and spreading, and blue and grey areas show lower likelihood.

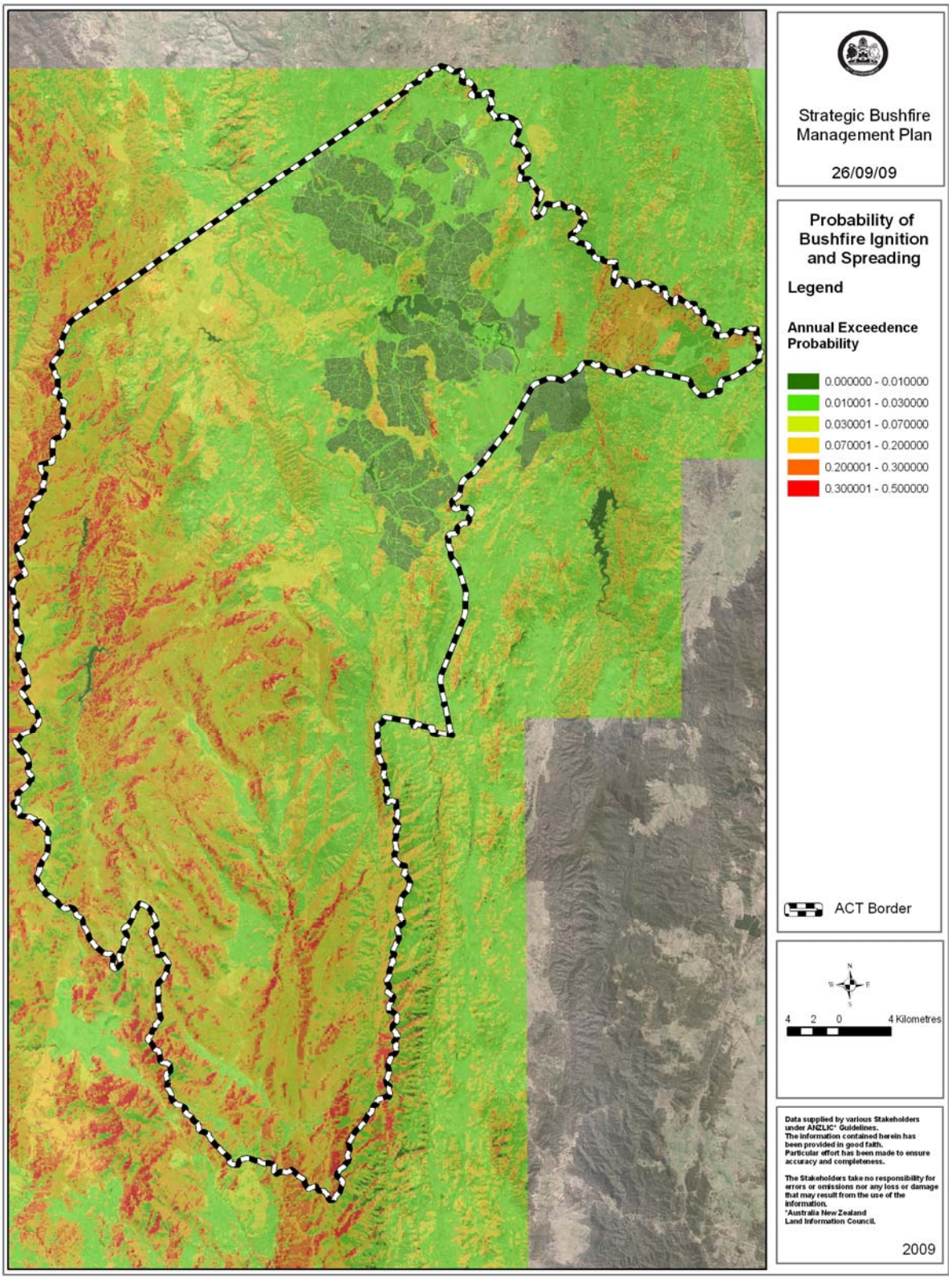
The separate elements of bushfires starting (based on the time and location of prior ignitions in the ACT over a defined period) and of bushfires spreading (by modelling fire spread) are combined. The information in Figure 4 provides the means by which risk mitigation actions may be considered including:

- determining the location and priorities of prevention and preparedness strategies for reducing human-caused ignitions and responding quickly when they occur;
- assessing areas in the landscape that have higher frequency of lightning- caused ignitions and developing prevention and preparedness strategies to address them;
- the location and timing of broad area hazard reduction programs to develop a mosaic of fuel managed areas across the landscape, to effectively manage the spread of bushfires when they occur; and
- the location of additional access for suppression and fuel management.

This map is provided for explanatory purposes and reflects available information at the time of writing. The maps may be modified as further data is collected and analysed.

Figure 4: The likelihood of bushfires starting and spreading

This map is provided for explanatory purpose. It reflects information available at the time of writing, and may be modified as further information is collected and analysed.



The Asset Interface Classification

A supplementary risk assessment was undertaken as part of this work to specifically provide guidance for the management of consequences adjacent to the built-up areas. While the modelling of fire spread is critical for the broad scale consideration of bushfire risk, more targeted treatment was required for the establishment of Fire Management Zoning along the rural- urban interface. Zoning for these areas is determined by the Asset Interface Classification. This classification of primary, secondary and lee edges along the rural-urban interface is based on the level of bushfire risk the interface is exposed to. It considers

- the maximum fire size an asset may be subject to;
- the part of the fire (head, flank, back) an asset may be subject to recognizing the major fire threat from the north and west; and
- the length of potential fire runs.

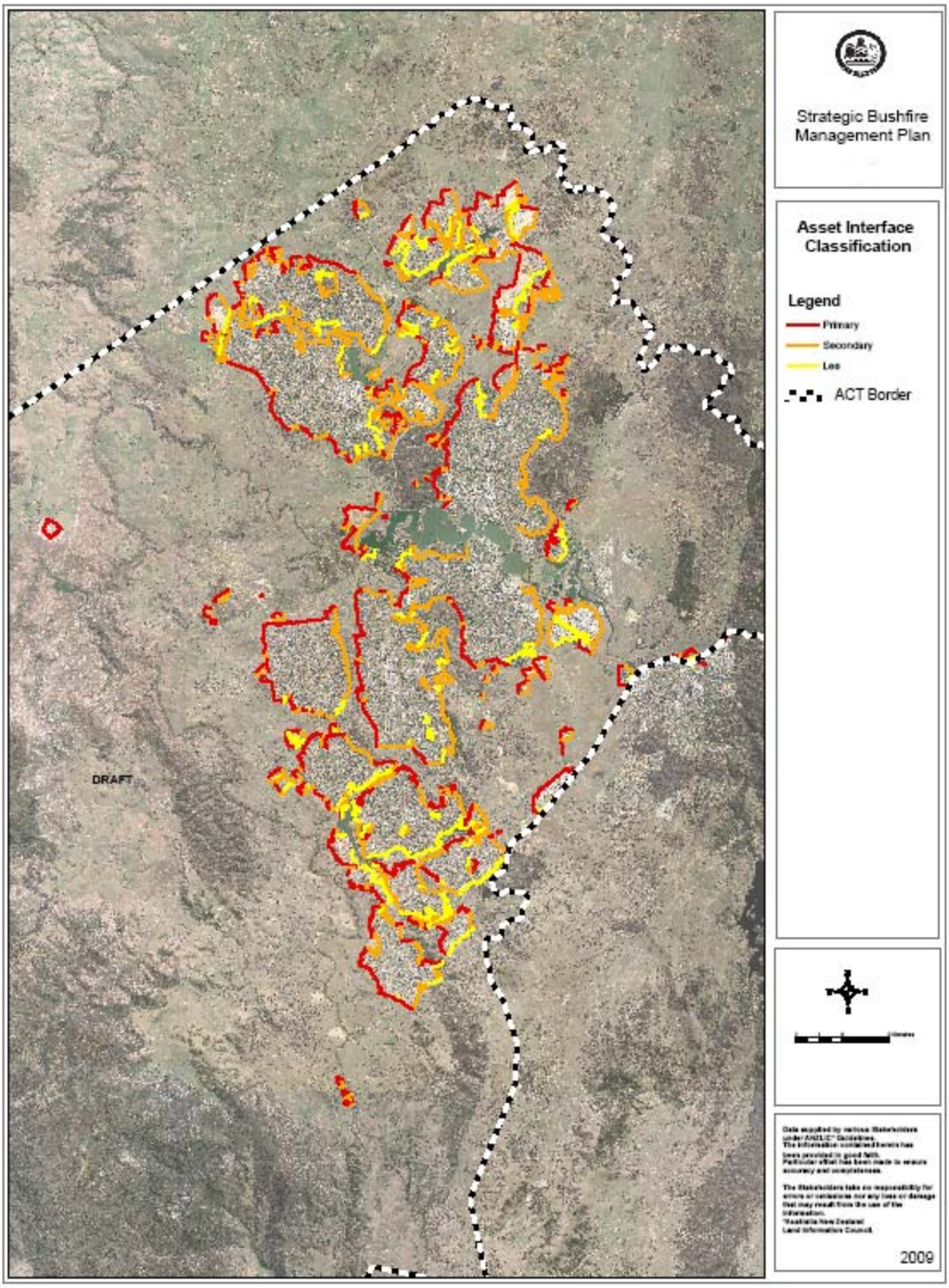
Table 3 details the mechanism by which this classification is defined. As appropriate, this classification may be modified for short distances to provide for consistency between adjacent classifications such as uphill (higher intensity) or downhill (lower intensity) fire runs to assets. Figure Five details the classification of the interface of the built up area. This map is provided for explanatory purpose. It reflects information available at the time of writing, and may be modified as further information is collected and analysed

Table 3 - Asset Interface Classification

	Length of Fire Run to Asset Interface		
Aspect of Fire Run	**<100**	**100 - 350**	**>350**
N	secondary	primary	primary
NW	secondary	primary	primary
W	secondary	primary	primary
SW	lee	secondary	primary
S	lee	secondary	secondary
SE	lee	lee	lee
E	lee	lee	secondary
NE	lee	lee	secondary

Figure 5 – Asset Interface Classification for the ACT

This map is provided for explanatory purpose. It reflects information available at the time of writing, and may be modified as further information is collected and analysed.



Identifying the consequences of bushfires

Estimation of the consequences of bushfire for assets is complex. Assigning values to assets (particularly non-economic assets) can be difficult, and thus comparing the relative values of different groups of assets may be problematic. Nonetheless, a framework of eight key asset groupings and associated consequence ratings is provided in Table 4.

The location of these key asset groupings will be identified figure 6 below. This map is provided for explanatory purpose. It reflects information available at the time of writing, and may be modified as further information is identified.

Human life

Reducing the risk of bushfire to firefighters, and public safety, are the highest priorities in bushfire management. With regard to the likelihood of loss of life, while an individual person may be injured by bushfire almost anywhere, the potential impact on human life is greater in areas with a higher density of people, such as the urban edge, than in areas with fewer people such as isolated houses, recreation areas and remote walking tracks.

Property

The potential impact of bushfires on the built environment is largely dependent on the location, the types of properties and their characteristics. The likelihood of a bushfire damaging buildings is influenced by the number and density of buildings in an area affected by fire. Thus the potential for significant damage to a large number of properties is greater along the urban edge, than in rural areas of the ACT which generally contain only isolated buildings.

Further information on the vulnerability of property, particularly in urban areas to bushfires can be found in the *Bushfire Fuels.*

Business and social Infrastructure

Small and medium size businesses are often significantly impacted, and these impacts may be underestimated in bushfire events. The social and business recovery from bushfires is often slow and long term.

Critical infrastructure

Critical infrastructure includes a range of facilities that, if damaged by bushfire, would result in disruption to essential services such as water, electricity, gas and sewerage. Disruption to these essential services may affect large numbers of people and businesses, including people who are dependent on these services for their wellbeing and/or survival.

Agricultural production

The ACT is the location of a number of agricultural production enterprises operated by rural lessees, as well as by the ACT Government. These include:

- broad acre grazing by sheep and cattle;
- cropping;
- intensively managed grazing by sheep, cattle and horses;
- intensive horticulture including olives and vineyards; and
- plantation forestry.

While all of these enterprises may be impacted by bushfire, some will be more heavily impacted than others and will take longer to recover. This particularly applies to enterprises relying on perennial or long term crops, such as intensive horticulture and plantation forestry.

Biodiversity and threatened species

The fire regime, characterised by the frequency, intensity, season and extent of recurrent fires, is one of the most important factors determining the long term survival of the ACT's flora and fauna populations and therefore the biodiversity of the ACT. The ability of flora and fauna to tolerate different fire regimes varies from one species to another. For example, while some species are able to tolerate fires as frequently as once every 5 years, such frequent fires are likely to result in the local extinction of other species. Some species are intolerant of any fire occurrence. Importantly, both planned and unplanned fires contribute to the fire regime and therefore may have an impact on biodiversity and threatened species.

Both ACT and Commonwealth legislation require the conservation of the ACT's biodiversity and threatened species and thus biodiversity and threatened species are considered assets in bushfire management.

Of particular relevance are the large extent and high intensity of the 2003 fires; any fire, either planned or unplanned, during the life of this Plan across large areas of the ACT may have a detrimental impact on biodiversity and threatened species by impacting on those species which are intolerant of frequent or high intensity fires.

Further information on the effects of fire on biodiversity and threatened species can be found in Supporting Information - Part Two.

Cultural heritage

The ACT contains a large number of landscapes, locations and sites that show evidence of the past use, occupation and development of the area by Indigenous people and Europeans. In some cases this evidence is considered nationally, or even internationally, significant. While only some cultural heritage may be damaged or destroyed by bushfire (either planned or unplanned), some cultural heritage sites could be damaged by bushfire prevention activities such as fire trail maintenance.

Water catchments

The Cotter catchment is used for the harvesting of high quality drinking water for the city of Canberra, via the Bendora, Corin and Cotter Dams.

The value of water is significant to the ACT. This is reflected in the significant costs committed to the expansion of infrastructure that will be undertaken over the life of this Plan, including the increase in capacity of the lower Cotter Dam and pipelines connecting the Murrumbidgee River to Googong Dam on the Queanbeyan River.

Retention of surface cover on critical parts of the landscape is essential for the maintenance of both water quality and quantity. Paradoxically, both bushfires and bushfire prevention activities, which may be undertaken to reduce the likelihood of bushfires igniting and spreading, reduce surface cover and hence may impact on water quality and quantity. However, the impacts of a severe bushfire covering an extensive area are generally greater than those of carefully planned and implemented bushfire prevention activities.

Critical parts of the landscape for maintaining water quality and quantity include:

- highland bogs and fens which act as water stores and filters;
- riparian areas along rivers, streams and reservoirs which act as water filters;
- high erosion potential areas, which are more likely to erode if surface cover is removed than low erosion potential areas; and
- eastern facing slopes, which contribute more water than western facing slopes.

Further information on the impact of fire on water catchment can be found in the Supporting Information - Part Two.

The location of these assets groupings in the ACT are shown at Figure 6. Note that not all assets are identified on this publicly available map, including some critical infrastructure, threatened species and heritage sites.

In Table 4 a consequence rating is applied to the asset groupings described above. ranging from minor to catastrophic. Scaled potential impacts are identified for each asset grouping. The loss of a significant number of human lives is the only asset grouping that has potentially catastrophic consequences, reflecting the priority specified in the core principles of the SBMP.

Figure 6: Assets at risk from bushfires

This map is provided for explanatory purpose. It reflects information available at the time of writing, and may be modified as further information is identified.

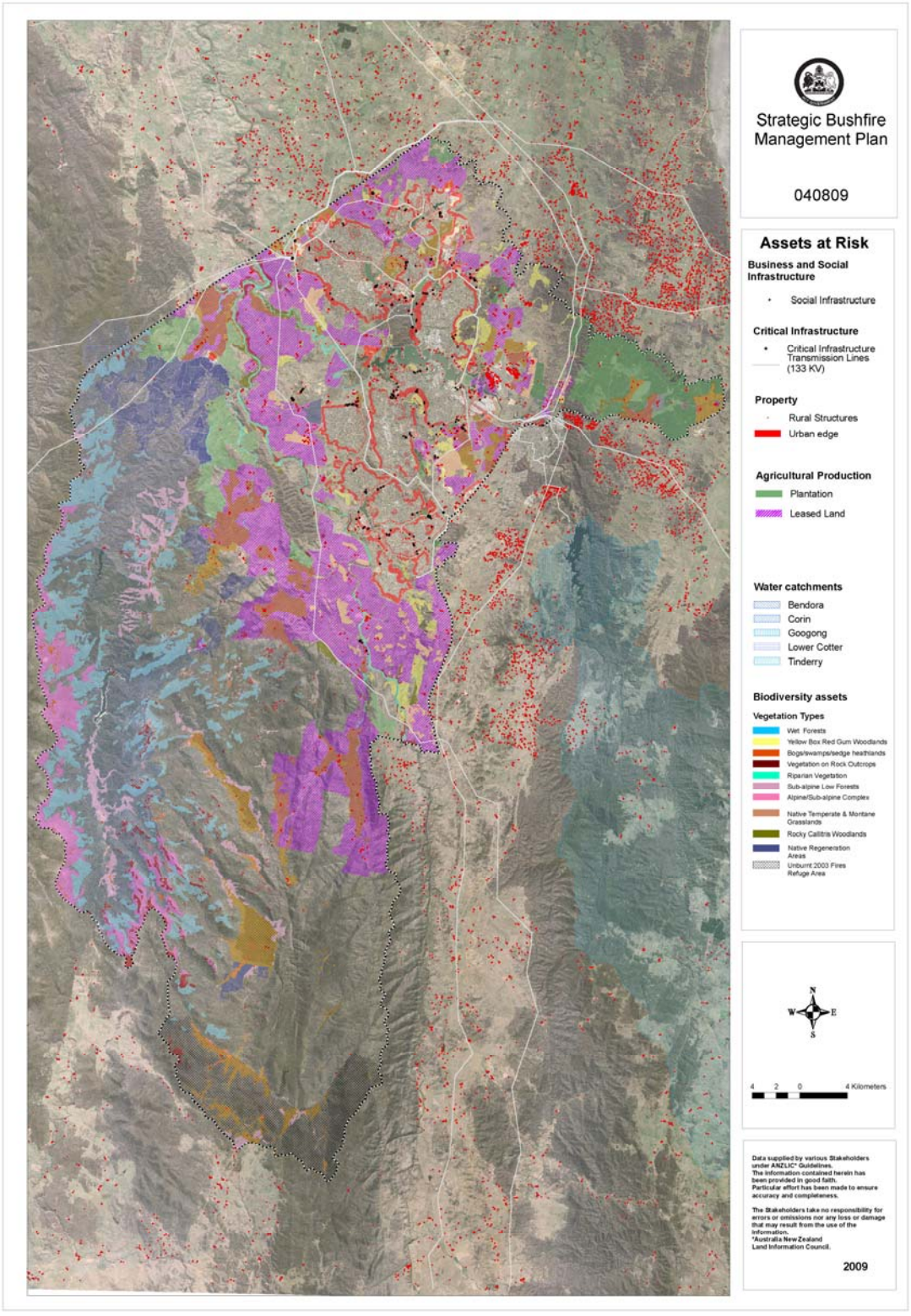


Table 4: Potential consequences of bushfires on asset groupings

Asset	CONSEQUENCES				
	Minor →				Catastrophic
Human life	Limited and minor injuries	Isolated injuries	Single death/small number of life threatening injuries	Small number of deaths and life threatening injuries	Large number of deaths and life threatening injuries
Property	Destruction of/damage to an isolated structure	Destruction of/damage to a small number of houses or other property	Destruction of/damage to a moderate number of houses or other property	Destruction of/damage to large number of houses or other property	
Business and social infrastructure	Short term disruption to businesses	Long term disruption to a small number of businesses	Long term disruption to a moderate number of businesses	Long term disruption to a large number of businesses	
Critical infrastructure	Short term disruption to the delivery of a small number of essential services	Long term disruption to the delivery of a small number of essential services	Long term disruption to a moderate number of essential services	Long term disruption to a large number of essential services	
Agricultural production	Minor damage to fodder, stock and rural infrastructure	Some stock losses and/or significant damage to rural infrastructure	Medium term impact which requires the implementation of contingency planning to manage; cropping and grazing lands	Irreversible or long term impacts such that the enterprise will not be viable for a number of years; pine plantations, vineyards, olive groves	

Biodiversity and threatened species	All remaining areas of native or semi - native vegetation	Communities (excluding threatened communities) where the occurrence of fire during the life of this Plan will fall below the minimum ecological threshold defined for that community	Threatened species and communities not meeting the criteria for inclusion in the Major consequence class. Wet forest communities (except for Alpine Ash). The area in southern Namadgi National Park that was not burnt in the 2003 fires (acts as a refuge). Former pine plantation areas burnt in the 2003 fires which are being regenerated with native vegetation.	Fire sensitive threatened species which have a significant proportion of their entire Australia- wide population within the ACT. Threatened communities which have a significant proportion of their total Australia-wide area within the ACT and a fire during the life of this Plan will fall below the minimum ecological threshold defined for that community. Communities with a minimum ecological threshold > 25 years (e.g.: highland bogs, *Callitris*). Alpine Ash communities (these were very heavily impacted by the 2003 fires and have a long minimum ecological threshold).	
Cultural heritage	Destruction of features of low significance in the ACT	Destruction of features of moderate significance in the ACT	Destruction of/damage to features of high significance within the ACT only	Destruction of/damage to internationally/nationally significant features	
Water catchments	Burning within 100 m of the Murrumbidgee catchment upstream of the confluence with the Cotter River	Burning the eastern side of the Cotter Dam sub-catchment or the Googong Dam catchment	Burning the eastern side of the Cotter catchment upstream of the Cotter Dam sub-catchment or the western side of the Cotter Dam sub-catchment	Burning the western side of the Cotter catchment upstream of the Cotter Dam sub-catchment	

Attachment 1: Data used in spread calculations

1. Classify different Fire Danger Indices

The FFDI is classified into a series of classes, broadly reflecting the classifications of Low, Moderate, High, Very and Extreme Fire Danger as applied in the Mk 5 Fire Danger Meter.

Table 1: Fire danger ratings

FFDI Range
0- 6 (Low)
7 -12 (Moderate)
13 -25 (High)
26-50 (Very High
51 - 75 or greater (Extreme)

2. Calculate fire intensity for any given point

For each of the FFDI Ranges identified above, the **fire intensity** on flat ground was estimated using a simplification of Byrams fire intensity equation as follows:

Intensity (I) = Hwr/600

Where: H = Heat Yield, (which is generally taken to be 16000 kJ/kg);
W = weight of available fuel (t/ha);
R = forward rate of spread (m/m)

(from Luke and MacArthur 1978).

Fuel Loads

The vegetation type and the fire history is used calculate the **weight of available fuel** in 2018, using published and locally developed fuel accumulation curves for different vegetation types in the ACT and shown in Table 2 below

Table 2: Fuel load (t/ha)

Time since fire (yrs)	Wet Forest	Dry forest & woodland	Montane forest & pine forest	Snow gum	Grass & ex-pine forest
1	3	1.5	3	3	2
2	6	3.5	6	6	3
3	9	5	9	9	4
4	12	7	12	12	4
5	15	8	15	15	4
6	18	9	18	18	4
7	19	10	19	19	4
8	21	10.25	19.5	20	4

Time since fire (yrs)	Wet Forest	Dry forest & woodland	Montane forest & pine forest	Snow gum	Grass & ex-pine forest
9	22	10.5	20	21	4
10	22	10.75	20.5	22	4
11	24	11	21	23	4
12	25	11.25	21.5	24	4
13	26	11.5	22	25	4
14	27	11.75	22.5	25.5	4
15	28	12	23	26	4
16	29	12	23.5	26.5	4
17	30	12	24	27	4
18	30.5	12	24.25	27.5	4
19	31	12	24.5	28	4
20	31.5	12	24.75	28.25	4
21	32	12	25	28.5	4
22	32.5	12	25.25	28.75	4
23	33	12	25.5	29	4
24	33.25	12	25.75	29.25	4
25	33.5	12	26	29.5	4
26	33.75	12	26.25	29.76	4
27	34	12	26.5	30	4
28	34.25	12	26.75	30	4
29	34.5	12	27	30	4
30	34.75	12	27	30	4

Rate of Spread

The ***rate of spread*** on flat ground was predicted for grasslands and grassy woodlands using the CSIRO-modified McArthur Grassland Fire Spread Model and the Mark V McArthur Fire Behaviour Model for all other vegetation types based on the following inputs

Table 3: Fire danger parameters applied

FFDI range	Curing	Temp	Relative humidity	Wind speed	Wind direction	DF
0- 6	70	20	40	15	N - W	7
7 -12	80	25	30	16	N - W	8
13 -25	85	28	20	24	N - W	9
26 - 50	90	33	12	30	N - W	10
51 - 75 or greater	100	39	10	35	N - W	10

Table 4: Calculation of fire intensity for flat ground

FFDI 0 – 6, flat ground fire intensity

Time since fire (yrs)	Wet forest	Dry forest & woodland	Montane forest & pine forest	Snow Gum	Grass & ex-pine forest	Water, bare ground	Urban
0-5	0	119	376	0	0	0	0
6-10	0	362	1415	0	0	0	
11-15	0	485	1806	0	0	0	
>15	0	554	2129	0	0	0	

FFDI 7 – 12, flat ground fire intensity

Time since fire (yrs)	Wet forest	Dry forest & woodland	Montane forest & pine forest	Snow Gum	Grass & ex-pine forest	Water, bare ground	Urban
0-5	0	195	665	0	1482	0	
6-10	0	723	2581	0	1995	0	
11-15	0	925	3449	0	1995	0	
>15	0	969	3948	0	1995	0	0

FFDI 13 – 25, flat ground fire intensity

Time since fire (yrs)	Wet forest	Dry forest & woodland	Montane forest & pine forest	Snow Gum	Grass & ex-pine forest	Water, bare ground	Urban
0-5	1442	450	1442	1442	3798	0	
6-10	6309	1550	5611	5999	5146	0	
11-15	10091	2015	7223	9083	5146	0	
>15	12927	2108	8370	10540	5146	0	0

FFDI 26 – 50, flat ground fire intensity

Time since fire (yrs)	Wet forest	Dry forest & woodland	Montane forest and pine forest	Snow Gum	Grass & ex-pine forest	Water, bare ground	Urban
0-5	3007	899	3007	3007	7347	0	
6-10	12772	3100	11408	12152	9889	0	
11-15	20460	4092	14632	18445	9889	0	
>15	26691	4371	17019	21576	9889	0	0

FFDI 51 – 75 and above, flat ground fire intensity

Time since fire (yrs)	Wet forest	Dry forest & woodland	Montane forest & pine forest	Snow Gum	Grass & ex-pine forest	Water, bare ground	Urban
0-5	4460	1333	4460	4460	11771	0	
6-10	18990	4598	16921	18024	15863	0	
11-15	30485	5931	21795	27450	15863	0	
>15	39129	6483	25381	32140	15863	0	0

Intensity within Alpine Ash, Wet Forest and Snow Gum Forest at FFDI 6 and 12 was assumed to be zero because these vegetation types are usually not flammable at these FFDIs.

Topographic relativity factor

The topographic relativity factor is the expected effect of slope and aspect on rate of spread (and therefore intensity) relative to a fire burning on flat ground. It is based upon the Mark V McArthur Fire Behaviour model, which increase rate of spread by a factor of 2 for every 10 degrees increase in slope. The aspect is based upon a fire approaching from the NNE-WSW quadrant.

Table 5: Topographic relativity factor

Slope (degrees)	Aspect			
	NNE - WSW	NNE – E	WSW - S	E - S
0-5	1	1	1	1
5-15	2	1	1	.5
15-25	4	1.6	1.6	.25
25+	8	3.2	3.2	.125

The topographic relativity factor is applied by multiplying the flat ground intensity calculations by the topographic relativity factor, for each FFDI scenario.

The probability of a fire escaping first attack

Estimation of whether a fire will spread in each grid cell is based upon the fire intensity at which fire suppression may or may not be successful. The details are in Table 6.

Table 6: Probability of a fire escaping first attack

Intensity (Kw/m)	Suppression comments	Estimated no. fires that will escape initial attack	Probability of fire escaping initial attack and spreading
<100	Fire unlikely to sustain	0	0.00
100-750	Fire easily suppressed using direct attack with hand tools	1 in 100	0.01
750-3000	Fires usually	1 in 25	0.04

	suppressed by direct attack using earth moving machinery and water bombing by aircraft		
3000 - 7500	Fire too intense for direct attack but indirect attack often successful	1 in 5	0.20
>7500	Fire very difficult to control even using indirect attack due to heavy medium distance spotting	9 in 10	0.90

The likelihood of different fire danger levels in a given year

The probability of each FFDI range occurring in a given year was calculated from historical records for the ACT. The details are in Table 7.

Table 7: Likelihood of different fire danger levels in a given year

FFDI Range	Days/Yr	Probability
0- 6	95.4	0.2603
7 -12	42	0.1151
13 -25	16.8	0.0460
26-50	1.6	0.0044
51 - 75 or greater	0.14	0.0004

Attachment 2: Future considerations for risk analysis

A number of steps may be undertaken during the implementation of the SBMP to further refine the bushfire risk analysis. As appropriate, this will inform the review of RFMPs and future versions of the SBMP. These steps include the following.

1. Likelihood of ignition
    a. Further analysis may be undertaken to introduce known areas of higher ignition risk, including rural roadside areas, recreation nodes and key reserves and natural areas close to the built up area.
    b. A number of models that provide guidance relating to natural (lightning) ignition have been developed and may be considered.

2. Likelihood of spread
    a. Further development of fuel accumulation curves will be considered as more data is collected. It is possible that additional fuel accumulation curves could be included, either for new vegetation communities or for existing communities.
    b. Current research is considering relationships between the overall fuel hazard and available fuels for consumption.
    c. The use of the McArthur Mk 5 model to calculate rate of spread is unmodified in this analysis.
    d. Use the recently developed Vesta fire behaviour prediction system to estimate rate of spread. This was not possible for the current version of the SBMP because no Vesta fuel accumulation models had been developed at the time of writing.

3. Combining the likelihood of ignition and spread with consequences
   To undertake this analysis:
    a. the consequences for each asset grouping may be specifically classified into individual consequence ratings (insignificant through to catastrophic), consistent with the standardised consequence rating;
    b. for each of these consequence ratings, consequence criteria may be established for the baseline assessment of risk, considering the worst possible consequence for the relevant element at risk(s); and
    c. the consequence criteria for each asset grouping may be spatially indentified This would show those locations where it is possible the maximum description for that consequence rating is likely to occur.

4. With the spatial depiction of consequence ratings for the full range of identified assets and likelihood of bushfires starting and spreading identified, a risk matrix may be applied to assign the level of risk, where risk is the likelihood rating x consequence rating. This may be depicted spatially to show the range of risk across the ACT. Given the difficulty in comparing the relative values of different groups of assets, this risk rating may be developed and published individually for each of the eight asset groupings. While acknowledging that the relative ranking of consequence is subjective, these eight risk depictions could be then combined.