

A Guide for Councils, Planners, Fire Authorities and Developers

planning for
bush fire protection
protection



NSW RURAL FIRE SERVICE

2006

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Prepared by NSW Rural Fire Service in cooperation with the Department of Planning

Foreword

This updated edition of *Planning for Bush Fire Protection* (PBP) is a milestone in the NSW Government's efforts to work jointly with local government and the private sector to link responsible planning and development control with the protection of life, property and the environment.

Bush fire is a major challenge for the community. It has been a natural part of our landscape for thousands of years and remains an ever-present threat.

In the period 24 December 2001 to 16 January 2002 bush fires caused the loss of 109 homes across New South Wales, with 40 others being damaged. Losses were particularly severe in Blue Mountains, Penrith, Wollondilly, Shoalhaven and Hawkesbury local government areas. More recently, in 2003, the devastating fires of the ACT severely damaged the suburbs of Duffy and Chapman, with some 500 homes being lost.

The NSW Rural Fire Service has a statutory obligation to protect life, property and the natural environment through fire suppression and fire prevention. Improved land use planning decisions for developments in bush fire prone areas are intrinsic to the fire management and environmental protection strategies of the Service.

Following the Sydney bush fires in 2001/2002 a Joint Parliamentary Inquiry was established and, in its 28 June 2002 report, endorsed the release of the updated 2001 version of PBP.

The report also recommended that: "the PBP Guideline continue to be reviewed, and updated as new research about fire impact on buildings becomes available, and reissued or affirmed at least every two years."

The changes in this document reflect the legislative amendments that came into effect on 1 August 2002, through the *Rural Fires and Environmental Assessment Legislation Amendment Act 2002*, as well as changes to the *Building Code of Australia*.

This substantially revised 2006 edition of PBP is intended for use by councils, town planners, NSW fire authorities, developers, planning and bush fire consultants, surveyors, and building practitioners (including accredited certifiers).

Key features of the revised edition include the emphasis on a performance based approach to development through focusing on safer outcomes rather than simply meeting prescriptive requirements.

This approach to planning allows for considerable flexibility and innovation that links the bush fire hazard for a site with the implementation of appropriate bush fire protection measures.

Types of appropriate measures include suitable defensible space; access considerations; vegetation management; on-site emergency management arrangements; water supply provisions and site assessment for building construction requirements using AS 3959-1999.

PBP also provides the necessary planning framework for developments in rural and urban areas close to land likely to be affected by bush fire.

PBP is also applicable to the subdivision of land for residential and rural-residential purposes and those developments which are considered a special fire protection purpose. These include, developments under State Environmental Planning Policy Seniors Living, schools, hospitals, and tourism developments. PBP recognises that these developments may present their own individual peculiar difficulties at times of an emergency.

Finally, PBP expands the considerations for infill developments - a dwelling within an existing allotment - and for the first time establishes the bush fire planning objectives for industrial, commercial and warehousing types of development.

This edition of PBP and the application of its principles will significantly assist all those involved in planning developments in bush fire prone areas and will also help the Service to fulfill its charter of protecting life, property and our fragile environment.

I commend *Planning for Bush Fire Protection 2006* to you.



A handwritten signature in black ink that reads "Tony Kelly".

The Hon. Anthony Bernard KELLY, MLC
Minister for Emergency Services

List of Abbreviations

| | |
|-------------------------|--|
| APZ | Asset Protection Zone |
| B & Bs | Bed and Breakfast establishments |
| BCA | Building Code of Australia |
| BFSA | Bush Fire Safety Authority |
| BPA | Bush Fire Prone Area (also bush fire prone land) |
| BPMs | Bush Fire Protection Measures |
| BPL Map | Bush Fire Prone Land Map |
| CC | Construction Certificate |
| DA | Development Application |
| DCP | Development Control Plan |
| DEC | Department of Environment and Conservation |
| EP&A Act | <i>Environmental Planning and Assessment Act 1979</i> |
| ESD | Ecologically sustainable development |
| FDI | (Forest) Fire Danger Index (Also FFDI) |
| IPA | Inner Protection Area |
| KNP | Kosciuszko National Park |
| kW/m² | kilowatts per square metre (being a measure of radiant heat) |
| LEP | Local Environment Plan |
| OPA | Outer Protection Area |
| PBP | <i>Planning for Bush Fire Protection</i> (this document) |
| RF Act | <i>Rural Fires Act 1997</i> |
| RF Regulation | <i>Rural Fires Regulation</i> |
| RFS | NSW Rural Fire Service |
| RHF | Radiant Heat Flux |
| ROS | Rate of Spread |
| SEPP | State Environmental Planning Policy |
| SFPP | Special Fire Protection Purpose |

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Chapter 1 PBP and You.

1.1 Introduction

This new version of *Planning for Bush Fire Protection* (PBP) applies to all “development applications” on land that is classified as “bush fire prone land” (BPL), identified on a council’s BPL map.

The general principles underlying this document are :

- protection measures are governed by the degree of threat posed to a development;
- a minimum setback from a hazard is always required, i.e. a defendable space;
- the greater the setback from the hazard, the lower the subsequent bush fire protection construction standards required;
- the smaller the interface a development has fronting the bush fire threat, the less the opportunity for bush fire to threaten the development;
- bush fire protection measures (BPMs) are contained within the ‘overall’ development and not on adjoining lands, other than in exceptional circumstances (see section 3.3); and
- no development in a bush fire prone area can be guaranteed to be entirely safe from bush fires.

For development on BPL specific controls apply to residential/rural residential subdivision and “Special Fire Protection Purposes” (SFPPs) – those types of development specified in the legislation as requiring particular attention (including mandatory involvement of the Rural Fire Service) (see section 2.7).

Particular attention is also given to residential “infill” – new houses and alterations/additions in pre-existing subdivisions.

For “other development”, the aim/objectives of PBP apply (see below). The suite of bush fire protection measures will also be useful for developers and for assessment purposes.

BPMs will assist building survival during a bush fire. They will also contribute to the safety of firefighters and members of the community occupying or attempting to leave buildings during a bush fire.

They are also designed to take into account development potential, on-site amenity and environmental protection.

Figure 1.1 illustrates the process of using PBP in relation to a specific development proposal.

1.2 How to comply with PBP

1.2.1 What needs to be submitted

Development Applications to the consent authority (usually the relevant council) on bush fire prone land need to include a bush fire assessment report within their Statement of Environmental Effects, (see Appendix 4).

Aim and Objectives of PBP.

All development on Bush Fire Prone Land must satisfy the aim and objectives of PBP.

The aim of PBP is to use the NSW development assessment system to provide for the protection of human life (including firefighters) and to minimise impacts on property from the threat of bush fire, while having due regard to development potential, on-site amenity and protection of the environment.

More specifically, the objectives are to:

- (i) afford occupants of any building adequate protection from exposure to a bush fire;
- (ii) provide for a defendable space to be located around buildings;
- (iii) provide appropriate separation between a hazard and buildings which, in combination with other measures, prevent direct flame contact and material ignition;
- (iv) ensure that safe operational access and egress for emergency service personnel and residents is available;
- (v) provide for ongoing management and maintenance of bush fire protection measures, including fuel loads in the asset protection zone (APZ); and
- (vi) ensure that utility services are adequate to meet the needs of firefighters (and others assisting in bush fire fighting).

Applicants must demonstrate to the RFS or the consent authority that proposals satisfy the broad aim and objectives of PBP, specific objectives for the development type and the performance criteria for the various proposed bush fire protection measures (BPMs). (See Figure 1.2)

For residential/rural-residential subdivision and “special fire protection purposes”, proposals must also comply with:

- the specific objectives in sections 4.1 and 4.2 respectively; and
- the performance criteria for each of the Bush Fire Protection Measures (BPMs) in sections 4.1 and 4.2 respectively.

For “infill development” (as defined), proposals must also comply with:

- the specific objectives in section 4.3; and
- the performance criteria in section 4.3.

1.2.2 How will development be assessed

This version of *Planning for Bush Fire Protection* (PBP) introduces a performance based approach, and identifies objectives and detailed performance criteria to satisfy desired outcomes.

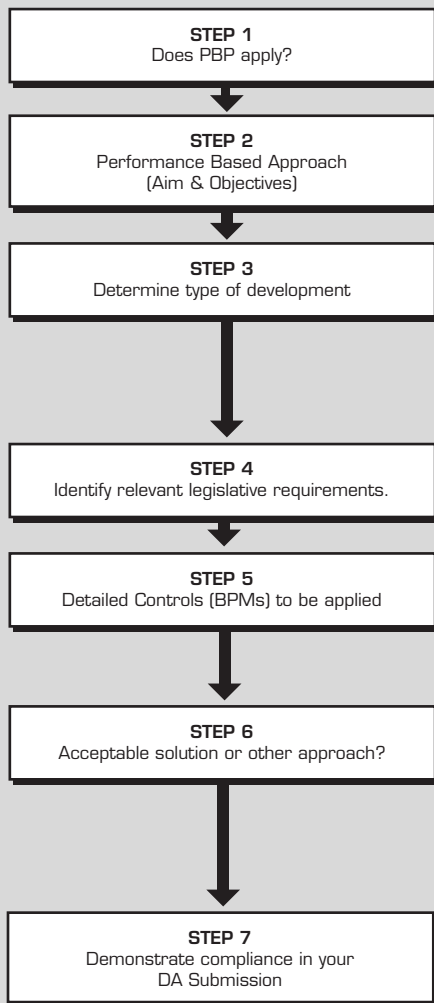


Figure 1.1 How to use PBP

Check that the proposed development is on bush fire prone land (on certified bush fire prone land map). Maps are available at the relevant local Council.

Read Chapter 1 which:

- explains the performance based approach, and
- lists the aim and objectives of PBP.

Read Chapter 2 and determine whether the proposed development is:

- residential or rural residential subdivision
- a “special fire protection purpose” – as defined or
- other development, such as residential infill, alterations and additions.

Determine whether the development is captured under section 79BA of the EP&A Act or s100B of the RF Act requiring a bush fire safety authority (BFSA).

Read Chapter 3 which explains:

- the nature of the BPMs; and
- any exceptional circumstances that might apply .

Read the relevant parts of Chapter 4 (4.1, 4.2 or 4.3), noting:

- Specific objectives and BPMs required (e.g. APZ, access).
- the intent, performance criteria and acceptable solutions for each BPM.
- the detailed Appendices referred to.

Decide (for each measure) whether the Acceptable Solutions can be complied with, or that other means of satisfying the performance criteria are required. Consider an appropriate combination of measures.

Comply with the Submission Requirements (in Appendix 4) and provide evidence to support compliance with the “controls” and the aim and objectives of PBP.

(a) Performance Criteria for the Bush Fire Protection Measures

Performance criteria are the outcomes to be met for satisfying the BPMs.

The performance criteria can be satisfied in one of two different ways:

- use of the acceptable solutions; OR
- demonstrating another solution satisfying the specific objectives and performance criteria.

These performance criteria can be found in the Tables in Chapter 4 (Performance Based Controls).

Performance criteria allow applicants, consent authority and to the RFS to be flexible and innovative in responding development opportunities and constraints. In order to reach an acceptable siting and design solution, the criteria have been developed taking into account the range of circumstances across the State and recognising that no two sites or proposals are the same.

They also allow applicants, councils and the RFS to consider a broad range of issues and information, including community expectations, environmental protection and the application of new technologies.

(b) Acceptable Solutions

PBP has identified some acceptable solutions which will satisfy the performance criteria.

Any variation from the acceptable solutions will require detailed justification to demonstrate how the performance criteria can be met through another method(s).

Figure 1.2 illustrates the relationship between the various components within PBP.

(c) Proposing Alternative Solutions

Submissions proposing variations to acceptable solutions must provide substantiated evidence that the specific objectives and performance criteria can be met.

1.3 Relationship of the Building Code of Australia (BCA) to PBP

Development on BPL needs to meet the planning requirements of PBP as well as any bush fire construction requirements under the BCA. PBP recognises AS 3959 - 1999 as providing the deemed - to - satisfy arrangements for construction of certain classes of building.

(a) Residential Buildings and SFPPs

Where development occurs in a bush fire prone area, certain bush fire provisions of the BCA will apply (including various NSW variations) for buildings of classes 1, 2, 3, 4 and those class 9 buildings that are also a special fire protection purpose.

Where a development, submitted under section 79 BA of the EP&A Act, complies with the deemed-to-satisfy provisions of the BCA through AS 3959-1999 (using **Appendix 3 of PBP for the site assessment**), then the certifying authority can determine compliance and issue the relevant

construction certificate without referral to the RFS. Where an 'alternate solution' is offered for these classes of buildings, the RFS will consider the proposal under section 79BA (or section 100B in the case of a special fire protection purpose) and the certifying authority will issue the construction certificate in compliance with the development consent conditions.

(b) Other Classes of Buildings

For other classes of buildings (such as factories, shops and warehouses) BPMs will only apply at the development assessment stage. Consent will be determined on a case by case basis without the need to refer the development application to the RFS. However, if the council is concerned that the development does not meet the aim and objectives of PBP, then the matter may be referred to the RFS for its advice. The provisions under the BCA for fire safety will be accepted for bush fire purposes where the aim and objectives of PBP can be met (see section 1.1).

A description of the various classes of buildings can be found in Appendix 1 (see A1.6).

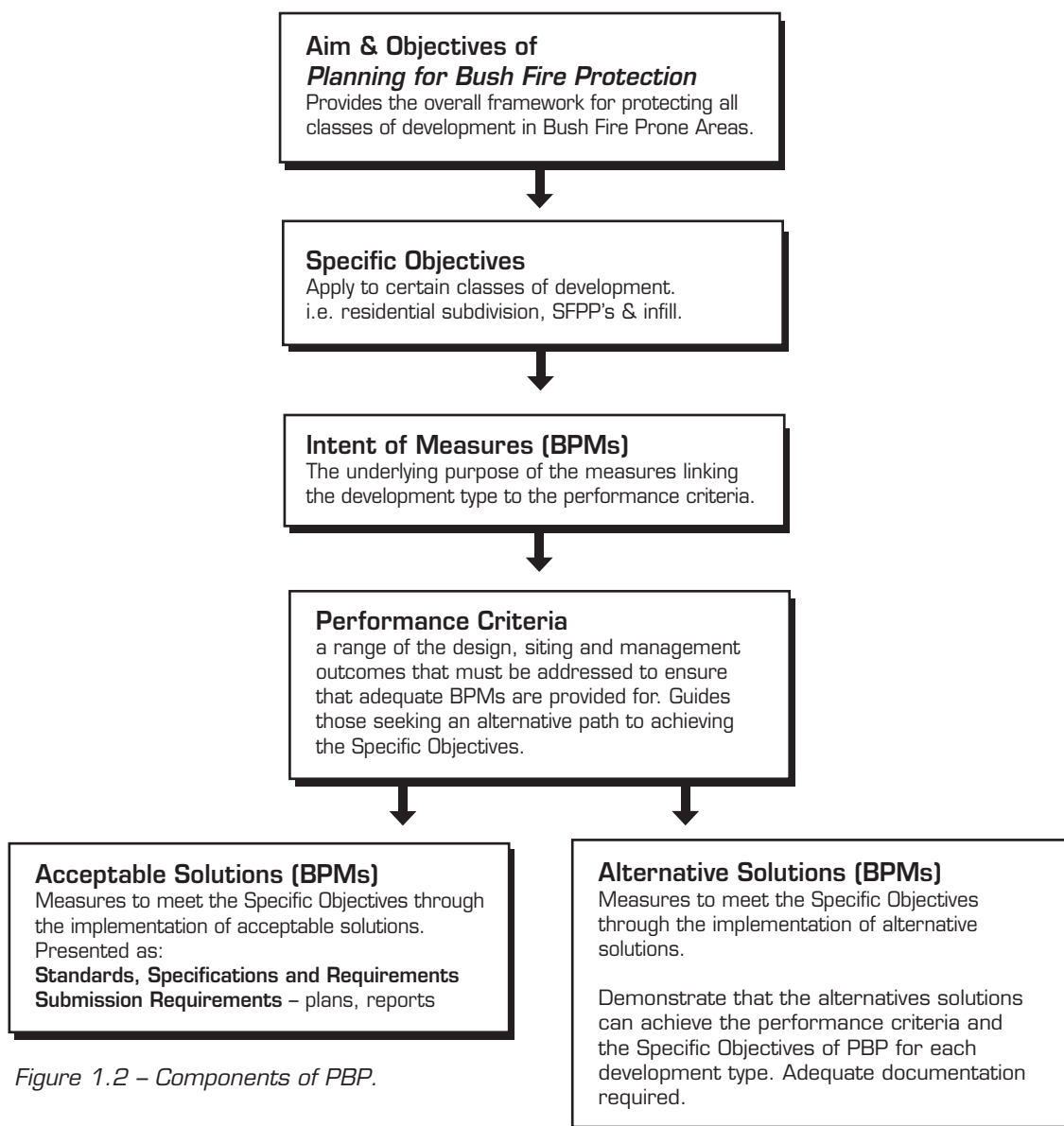


Figure 1.2 – Components of PBP.

2.1 Environmental Planning and Assessment Act, 1979

On 1 August 2002 the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Rural Fires Act 1997* (RF Act) were both amended to enhance bush fire protection through the development assessment process.

In broad terms, the planning considerations provide two main steps. These involve:

- (a) *Strategic Planning through;*
- *the mapping of bush fire prone areas (BPAs);*
 - *determining suitable bush fire requirements during the preparation of a Local Environmental Plan/Development Control Plan; and*
 - *the identification of the extent to which land is bush fire prone.*
- (b) *Development assessment through;*
- *obtaining a bush fire safety authority for residential or rural-residential subdivision and special fire protection purpose developments in BPAs from the RFS;*
 - *seeking advice from the RFS in relation to infill and other developments in BPAs that cannot comply with the requirements of PBP; and*
 - *the application of additional requirements of the Building Code of Australia (BCA) in relation to construction standards for Class 1, 2, 3, 4 and some Class 9 buildings in BPAs.*

2.2 Bush Fire Prone Land Mapping

Bush fire prone land maps provide the trigger for the various development assessment provisions.

The identification of BPAs in NSW is required under section 146 of the EP&A Act. The Commissioner of the RFS designates, through separate guidelines, what constitutes a BPA and how it is to be mapped. Each council then prepares a map in accordance with the guidelines and submits the map for approval by the Commissioner.

These maps are updated at least every 5 years.

Guidelines for the mapping of BPAs can be obtained from the RFS website on www.rfs.nsw.gov.au.

2.3 Preparation of LEPs and DCPs

LEPs and DCPs are the best way of strategically achieving bush fire protection objectives. Inclusion of bush fire planning provisions in an LEP:

- gives weight to bush fire management planning principles, ensuring they are considered

- at subdivision and construction stages;
- can allow for sufficient space to be incorporated into land use zones for setbacks and adequate access for firefighting and evacuation; and
- controls inappropriate land uses in BPAs.

LEP amendments that affect BPAs need to address the planning principles of PBP (see below). Where appropriate the proposed land uses must be considered with respect to bush fire protection (including appropriate setbacks).

If a proposed amendment to land use zoning or land use affects a designated BPA, then the section 117(2) Direction No 19 must be applied (section 117 of the EP&A Act provides for the Minister for Planning to direct a council, in relation to the preparation of a draft LEP, to apply the planning principles specified in that direction).

The section 117 Direction No 19 requires councils to:

- consult with the Commissioner of the RFS under section 62 of the EP&A Act, and to take into account any comments by the Commissioner; and
- have regard to the planning principles of PBP below.

If a council proceeds with a draft LEP that does not comply with the provisions in the section 117 Direction, the council must obtain written advice from the Commissioner of the RFS to the effect that the RFS does not object to that non-compliance.

The requirement to review LEPs in accordance with the Standard LEP is an opportunity to consider appropriate uses on Bush Fire Prone Land as well as exempt and complying development provisions.

Planning Principles for Rezoning to Residential Land in Bush Fire Prone Areas

- a. *Provision of a perimeter road with two way access which delineates the extent of the intended development;*
- b. *Provision, at the urban bushland interface, for the establishment of adequate asset protection zones for future housing;*
- c. *Specifying minimum residential lot depths to accommodate asset protection zones for lots on perimeter roads;*
- d. *Minimising the perimeter of the area of land, interfacing the hazard, which may be developed;*
- e. *Introduction of controls which avoid placing inappropriate developments in hazardous areas; and*
- f. *Introduction of controls on the placement of combustible materials in asset protection zones.*

2.4 The development assessment framework and structure of PBP

(a) Types of Development

The EP&A Act establishes a system for requiring bush fire protection measures on bush fire prone land at Development Application (DA) stage as follows:

- (i) by requiring councils to map bush fire prone land. If any part of a development site is affected, special submission and assessment requirements may apply to the DA;
- (ii) Section 79BA of the EP&A Act requires compliance with PBP and, where an infill proposal does not comply with acceptable solutions in Chapter 4, consultation by the consent authority with the RFS is required; and
- (iii) Section 91 of the EP&A Act (in combination with the RF Act requirements for a section 100B Bush Fire Safety Authority) classes the following types of DA as Integrated Development:
 - residential and rural residential subdivision.
 - "Special Fire Protection Purposes" (SFPP).

Special procedures apply to these forms of development, though some exceptions to these may apply.

In summary, if a development site is on bush fire prone land, the requirements of this document will apply. For residential/rural residential subdivision and SFPPs, an Integrated DA approval must be obtained from the RFS (i.e. BFSA) is required.

The following table compares the two types of development application:

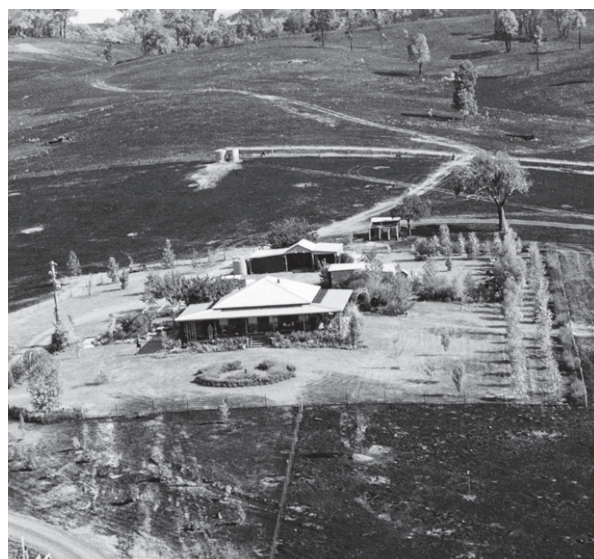
| Non Integrated DA | Integrated DA |
|--|---|
| <ul style="list-style-type: none"> • development site on bush fire prone land and not "integrated" • includes "infill" other than residential /rural subdivision or SFPP • s. 79BA EP&A Act | <ul style="list-style-type: none"> • residential/rural residential subdivision or SFPP eg. - schools - hospitals - child care - nursing homes - seniors living |
| <ul style="list-style-type: none"> • possible consultation with RFS | <ul style="list-style-type: none"> • s. 91 EP&A Act & s. 100B RF Act • a BFSA from RFS required. |

There are also significant differences between the categories of uses that are "Integrated Developments". For instance:

| Residential/Rural - Residential Subdivision | SFPPs e.g. Seniors Living, Tourist Facilities, Schools |
|--|---|
| <ul style="list-style-type: none"> • building as a refuge • assume able-bodied residents with motor car available • APZ requirements based on Level 3 construction (AS 3959-1999). As a result APZ minimised (yield & environmental protection maximised) | <ul style="list-style-type: none"> • assisted evacuation possible: higher exposure; working outdoors. • assume special needs of residents. • APZ requirements maximised and based on radiant heat exposure to emergency services |

DAs for integrated development do not all fit neatly into the categories above. Both categories can cover existing developments that do not conform to PBP. These situations can include, for instance, a block size that cannot accommodate the required APZ e.g. small scale subdivision, strata subdivision, B&Bs, extensions to other established SFPPs (such as schools, nursing homes or hospitals) and as such are treated as infill, having been previously approved prior to the introduction of PBP.

Development that is not integrated development is subject to section 79BA and covered as infill or other development on bush fire prone land.



Effective bush fire protection measures protect a rural dwelling.

(b) Section 79BA Consultation

Section 79BA of the EP&A Act requires that a consent authority shall not grant approval for a development application for any purpose on bush fire prone land, unless it:

- is satisfied that the development conforms to the specifications and requirements of PBP; or
- consults with the RFS concerning measures to be taken to protect persons, property and the environment from danger that may arise from a bush fire.

The consent authority is only required to consult with the RFS under section 79BA when a proposed residential dwelling (i.e. infill) does not comply with the “acceptable solutions” within section 4.3 of this document or meet performance requirements.

The advice to the consent authority from the RFS is intended to provide a performance-based assessment to assist the consent authority in arriving at a determination of the proposal. Most s79BA matters are likely to be Class 1 or 2 buildings under the BCA or extensions or additions to these buildings.

(c) Exempt and complying development

Exempt development does not require development consent from a consent authority because it is considered to be of a specified class or description that has minimal environmental impact. Development consent is still required if it is to take place on land that is a critical habitat or is part of a wilderness area. Environmental planning instruments relevant to the proposed development such as an LEP provide for the types of development considered to be exempt development. If the relevant planning instrument provides that a form of development is ‘exempt development’ on bush fire prone land then the provisions of PBP do not apply however it must comply with the BCA in relation to bush fire.

Complying development is development which complies with specified predetermined development standards contained in the relevant environmental planning instrument. A Complying Development Certificate from a Certifying Authority such as the local council or an accredited certifier must be obtained (Refer to s76A and ss84-87 of the EP&A Act) A Complying Development Certificate is considered to be a form of development consent which requires a Construction Certificate prior to the commencement of work. Environmental planning instruments relevant to the proposed development such as a Local Environmental Plan provide for the types of development considered to be complying development. Complying development

would normally be exempted from the requirements of s79BA by virtue of an exception contained in s77 of the EP&A Act.

However, residential buildings (such as Classes 1, 2 and 3 under the BCA), if classified as complying development under the relevant planning instruments and located on bush fire prone land, must also comply with the BCA. This requirement is satisfied by following the site assessment methodology in Appendix 3 of PBP (and the construction requirements in section 3 of AS 3959-1999) which is adopted as the New South Wales Variation to the BCA.

Planning authorities should carefully consider the types of exempt and complying development that are permitted in bush fire prone land in their area when drafting any planning instruments so that the issue of bush fire is adequately addressed.

Residential/rural residential subdivision and SFPPs are integrated development under the EP&A Act (and require a bush fire safety authority under the RF Act). Development requiring a BFSA is not considered to be complying development, despite its classification in any LEP.

(d) Planning Certificates (Section 149)

Planning certificates provide information on the development potential of a parcel of land including any planning restrictions that apply.

A person can apply to a council for a Planning Certificate under section 149 of the EP&A Act on any land within the council area. The certificate will detail matters relating to the land as listed in schedule 4 of the EP&A Regulation which identifies bush fire prone land (or any part of the land) as being a relevant matter that should be notified within the section 149 Planning Certificate.

2.5 Major Projects

Part 3A of the EP&A Act commenced on 1 August 2005 and provides an assessment process for development declared to be a Major Project under a SEPP or by the Minister for Planning.

Part 3A provides for an integrated assessment of major development taking into account bush fire risk. Proponents should consult with PBP when selecting sites for development and undertaking environmental assessments.

2.6 Construction Provisions: The BCA and AS 3959

The Building Code of Australia (BCA) is a performance based code which derives its statutory power through the EP&A Act and EP&A Regulation, in NSW. The EP&A Regulation requires a Certifying Authority, prior to issuing a construction certificate or complying development certificate, to be satisfied that the relevant requirements of the BCA will be met.

The BCA contains both performance requirements and deemed-to-satisfy provisions relating to the construction of buildings in bush fire prone areas. These provisions apply to Class 1, 2, 3, 4 and SFPP buildings that are proposed for construction in designated bush fire prone areas.

The construction requirements of AS 3959 - 1999 *Construction of Buildings in Bush Fire-prone Areas* are accepted by PBP as the deemed-to-satisfy construction standard for buildings in designated bush fire prone areas.

In addition, the BCA has been amended with a NSW specific variation to include Appendix 3 which contains the site assessment methodology and replaces Section 2 of the AS 3959 - 1999 when determining bush fire attack and the construction levels required to comply with the BCA on BPA.

For Residential/Rural Residential Subdivision, the APZ distances are designed to meet the deemed-to-satisfy arrangement under the BCA (by reference to AS 3959). DA stage applicants must determine the relevant construction level, without necessarily providing full construction detail for future dwellings on the 'interface' allotments. This commits certifying authorities to that level of construction. Proposed changes to the level of construction or BCA alternative solutions may require DA modification. The path for infill housing is similar, with Level 3 construction (as a minimum) or other alternative solutions providing bush fire protection at DA construction certificate (CC) stage.

For sites proposed for SFPPs, APZs are based on a derived radiant heat exposure (10 kW/m²) to an emergency worker, which corresponds to Level 1 construction standards (AS 3959).

Similarly, PBP uses AS 3959 to cover Class 4 (BCA) buildings i.e. caretakers accommodation. Class 10a buildings forming an addition or extension to a Class 1 - 4 building are treated the same as a Class 1 - 4 building. For other BCA Classes, bush fire specific construction standards are not addressed (i.e. Classes 5-8 some Class 9 and 10b).

2.7 Rural Fires Act, 1997

(a) Bush Fire Safety Authorities (section 100B of the RF Act)

Government agencies may be required to consider the environmental or physical constraints to development through the granting of licences, permits or other approvals. These agencies are referred to as approving authorities and their licences, permits or approvals are integrated through section 91 of the EP&A Act.

An example is the requirement under Section 100B of the RF Act for the Commissioner of the RFS to issue a bush fire safety authority for applications for residential or rural - residential subdivisions and any application for SFPP.

Under the integrated development process, the approval authority (in this case the Commissioner of the RFS) is required to provide "general terms" of agreement to the consent authority. Where an approving authority refuses to grant an approval, the consent authority cannot issue the consent and the development cannot proceed. In general, the approving authority has 40 days upon receipt of the development application and supporting documents in which to determine the matter.

A refusal is subject to appeal to the Land and Environment Court.

Section 100B provides that where a BFSA is required for subdivision, or an SFPP, the development cannot be considered 'complying development' under any environmental planning instrument in a bush fire prone area.

(b) Information required for a Bush Fire Safety Authority

To support an application for a bush fire safety authority, an applicant is required to submit a bush fire assessment in accordance with clause 46 of the RF Regulation.

The information to be contained in such a report is listed in Appendix 4.

The consent authority will determine the acceptability of the environmental impact of a proposed development in terms of environmental significance, threatened species and Aboriginal heritage.

In considering the issues of threatened species and Aboriginal heritage, the RFS uses this information to determine any site constraints or the rationale for performance-based solutions.

(c) Section 63 of the RF Act

Section 63 of the RF Act places a 'duty of care' on all land managers/owners to prevent a fire spreading on or from their land. This duty is related to future developments in that the provision and maintenance of appropriate setbacks and landscaping must be addressed when developing land.

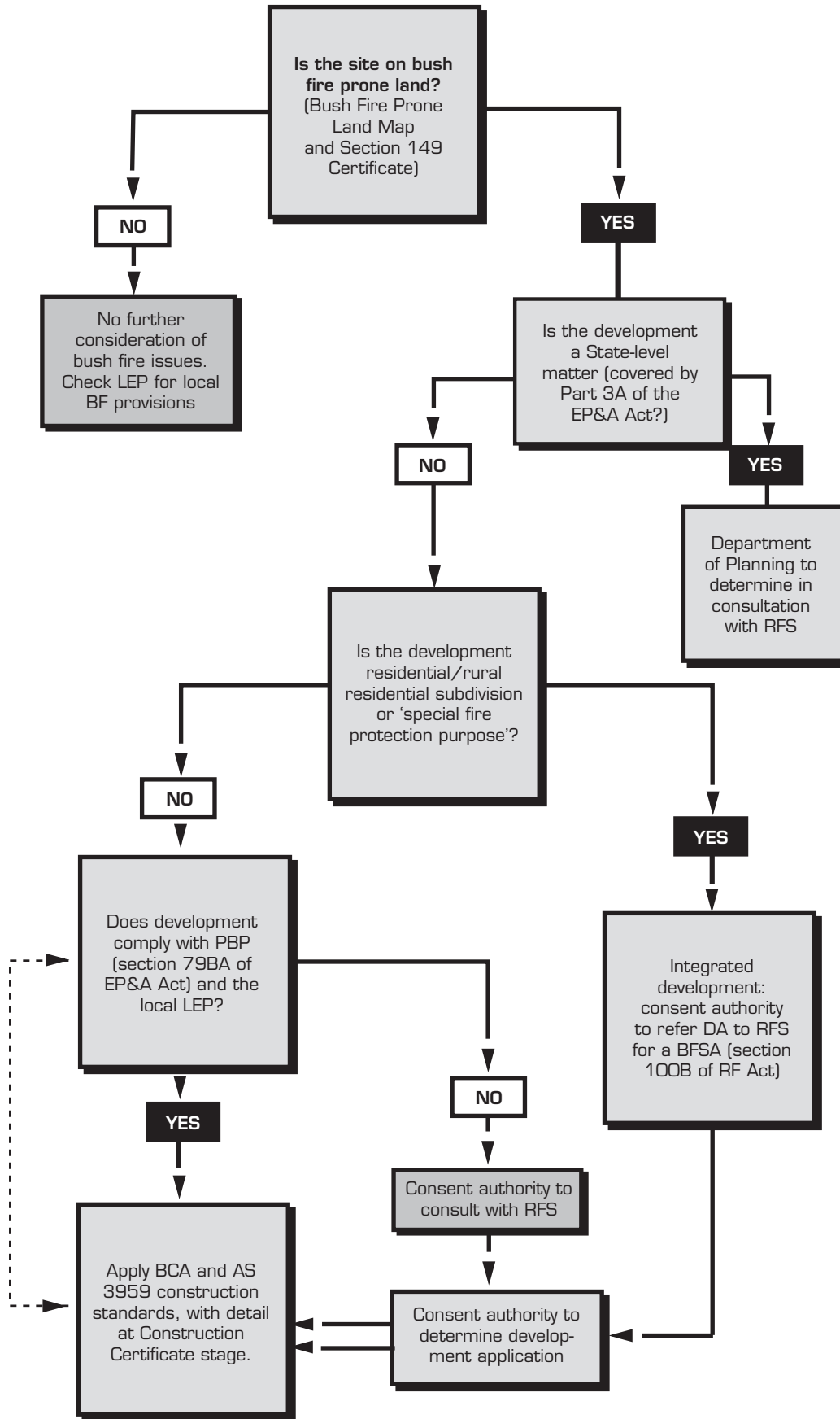


Figure 2.1 Development Control Process for Developments in Bush Fire Prone Areas

3.1 Bush Fire Protection Measures

In general terms, an acceptable level of protection from bush fires is achieved through a combination of strategies which:

- Control the types of development permissible in bush fire prone areas (see Box);
- Minimise the impact of radiant heat and direct flame contact by separating the development from the bush fire hazard;
- Reduce the rate of heat output (intensity) of a bush fire close to a development through control of fuel levels;
- Minimise the vulnerability of buildings to ignition from radiation and ember attack;
- Enable relatively safe access for the public and facilitate fire-fighting operations;
- Provide adequate water supplies for bush fire suppression operations;
- Implement community education programs, focusing on property preparedness, including emergency planning and property maintenance requirements; and
- Facilitate the maintenance of APZs, fire trails, access for firefighting and on-site equipment for fire suppression.



Community education programs



Access for firefighting should be safe.

Controlling Development Types.

Developments which should not be permitted on bush fire grounds, including those that may start bush fires or are a potential hazard to adjacent areas or to fire fighters if they are impacted upon by a bush fire:

- **Power generating works**
- **Sawmills**
- **Junk yards**
- **Liquid fuel depots**
- **Offensive and hazardous industries**
- **Chemical industries**
- **Service stations**
- **Ammunition storage/manufacture**
- **Fire works manufacture/storage**

In a development assessment context, there are six key Bush Fire Protection Measures (BPMs):

- a) The provision of clear separation of buildings and bush fire hazards, in the form of fuel-reduced APZ (and their subsets, inner and outer protection areas and defensible space);
- b) Construction standards and design;
- c) Appropriate access standards for residents, fire fighters, emergency service workers and those involved in evacuation;
- d) Adequate water supply and pressure;
- e) Emergency management arrangements for fire protection and/or evacuation; and
- f) Suitable landscaping, to limit fire spreading to a building.



Reduce the vulnerability of buildings to ignition from radiation and ember attack

The BPMs are described as follows:

(a) Asset protection zones and defensible space

An APZ is a buffer zone between a bush fire hazard and buildings, which is managed progressively to minimise fuel loads and reduce potential radiant heat levels, flame, ember and smoke attack. The appropriate APZ is based on vegetation type, slope and levels of construction (and for SFPPs the nature of development). The APZ can include **perimeter roads** in new subdivisions. For other development, existing roads, other buildings or managed properties can be considered as part of the APZ.

For forest and woodland vegetation, the APZ consists of two areas:

- **Inner Protection Area**, closest to buildings, incorporating the defensible space and for managing heat intensities at the building surface; and
- **Outer Protection Area**, for reducing the potential length of flames by slowing the rate of spread, filtering embers and suppressing the crown fire.

Appendix 2 provides the required methodology for calculating the APZ and is based on vegetation type, slope and assumed construction levels (see below – bush fire protection measures in combination).

A defensible space, a subset of the APZ, is required as a workable area in which firefighters, emergency services personnel, residents and others can undertake property protection after the passage of a bush fire.

For **Special Fire Protection Purposes**, such a workable and defensible space is required for firefighters and other emergency services personnel to operate under critical conditions of radiant heat, smoke and embers, while assisting or evacuating occupants or other vulnerable members of the community with restricted mobility due to age, disability or other incapacity.

b) Construction standards and design

For development on bush fire prone land preliminary consideration of construction levels is necessary at DA stage:

- to ensure reasonable building requirements (and costs) following residential and rural/residential subdivision. Deemed to satisfy BCA construction standards should be applied in accordance with Appendix 3;
- as assumptions (for performance requirements) underpinning the APZ in Appendix 2 are met; and
- as a potential argument, by applicants, to minimize APZ.

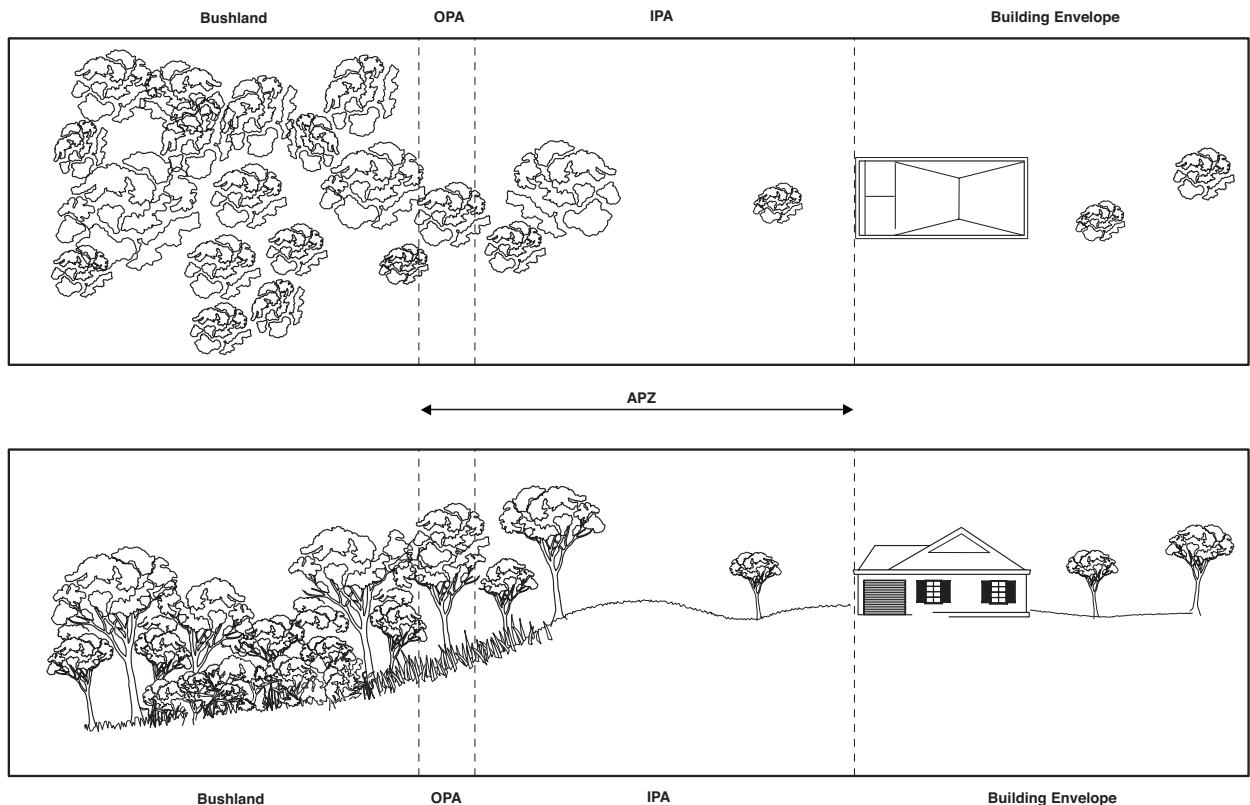


Figure 3.1 shows the APZ, IPA and OPA graphically.

In infill situations, where flame contact is also possible, design considerations need to be addressed to ensure some types of building elements (e.g. windows) are protected.

(c) Access standards (public roads, private access and fire trails)

For new subdivisions and large scale SFPPs, design of public and property access roads should enable safe access, egress and defensible space for emergency services. Fire trails enable access for management of APZs. These principles also apply for other developments but greater emphasis on landscaping, construction and other BPMs may be necessary.



Fire fighting vehicles need access to the urban bushland interface.

(d) Water Supply and Utility Services

Adequate supply of water is essential for fire fighting purposes when considering all forms of development. In addition, gas and electricity should be located so as not to contribute to the risk of fire or impede the fire fighting effort.



Services can be cut during a bush fire

(e) Emergency management arrangements

Emergency and evacuation arrangements e.g. procedures, routines and consideration of safe havens, are of particular relevance to SFPPs.

(f) Landscaping

In considering all DAs, the type, location and ongoing maintenance of landscaping, within the APZ is a necessary bush fire protection measure. Appendix 5 provides advice.



Maintaining the property and landscaping is of critical importance

3.2 The bush fire protection measures (BPMs) in combination

A significant part of the State is classified as bush fire prone land and local circumstances vary widely as do potential land uses. PBP recognises this and promotes detailed site analysis and the application of a combination of bush fire protection measures to achieve an acceptable outcome.

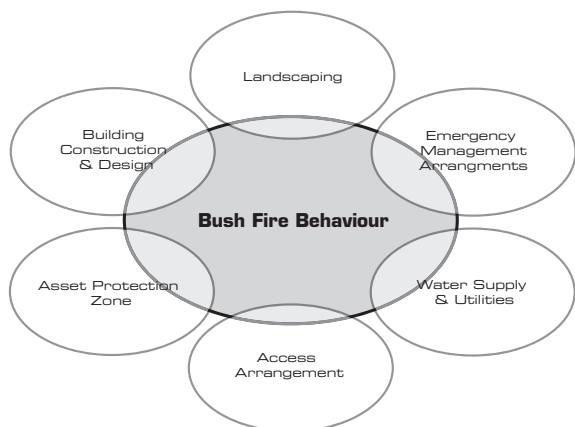


Figure 3.2 Bush Fire Protection Measures in combination

Appropriate combinations not only depend upon geographic location and site circumstances but also on the nature of the proposed use. The legal framework (see Chapter 2) distinguishes between:

- Residential and rural-residential subdivision;
- Special Fire Protection Purposes; and
- Infill (and other developments).

The introduction to each section of Chapter 4 provides specific objectives relating to each of these development types.

The starting point is the provision of an asset protection zone. A fuel-reduced, physical separation between buildings and bush fire hazards is the key element in the suite of measures. A wealth of detailed scientific research on bush fire behaviour under a range of location, weather, vegetation and slope conditions has demonstrated the significance of reduced fuel loads and distance in limiting bush fire threat (from ember attack through to direct flame contact). This detail is embodied in the provisions of Appendix 2.

APZ requirements are based on keeping radiant heat levels at buildings (other than SFPPs) below 29kW/m². For SFPPs, the type of occupants requires a different approach. In order for emergency services to operate in support of those occupants with limited mobility, the requirements for APZs are higher, with 10kW/m² as the target exposure on all sides of the building where there are access points. The APZ tables are based

on this requirement. This is to allow an area for firefighters to defend the property and allow access to and from the building.

A subset of the APZ and an essential component of infill developments is the provision of a defendable space. This is a space to ensure the safety of fire fighters and residents following the passage of a fire front.

Once the APZ standard is achieved, required construction standards can then be met in accordance with Appendix 3. The provision, design and location of other measures can then be detailed.

The acceptable solutions in this document, which incorporate the detailed methodology and Appendices, acknowledge that the measures work in combination to achieve good bush fire protection, while not needlessly reducing lot yields/site coverage or threatening environmental sustainability.

For instance:

- for residential subdivision, required APZ is calculated for level 3 construction (at the interface), thus minimising APZ, maximizing lot yield and minimising habitat destruction. To pursue further reductions in APZ, alternate solutions for building construction and use of other elements could be argued (subject to evidence noted above) that meet the performance criteria; and
- for SFPPs, where the characteristics of occupants require special care (e.g. elderly or school children), construction standards are less significant and the required APZ is crucial for emergency services to operate in support of those occupants. It is possible, however, that some SFPPs, such as tourist accommodation (e.g. eco-tourism or local B&Bs) are occupied by able-bodied persons and that evacuation plans or refuge are appropriate alternative options.

In relation to detailed building design and consideration of ingress and egress the “measures in combination” approach also applies. For instance, facing the building away from a hazard can enable a variation in the defendable space and construction standards.

In summary, the provision of an APZ, clearly separating buildings from hazards, and reducing fuel loads, is the first step. In exceptional circumstances, trading off APZ for increased construction standards and/or evacuation measures can be proposed, but how these will meet the objectives of PBP and the intent/performance criteria of each element must be clearly demonstrated.

3.3 Exceptional circumstances for APZs

Reduced APZs and the use of adjoining lands for meeting APZ requirements will only be permitted in exceptional circumstances based on the merits of the particular development.

It is not possible to be definitive about the full range of such circumstances. However, through previous Land and Environment Court cases and experience it is possible to give examples of the type of situations that could be considered exceptional.

Consideration is on a case-by-case basis and the applicant should provide clear evidence that, because of the circumstances of the case e.g. location or type of use, strict prescriptive compliance is unreasonable and unnecessary.

For exceptional circumstances to apply, the following principles should be demonstrated:

- the existing form of development will obtain a better bush fire risk outcome than if the development did not proceed (eg through increased construction standards);
- the building line should be no closer to the hazard than neighbouring properties;
- the extensions should be no closer to the hazard than the existing building footprint;
- an upgrade of existing facilities may be required; and
- the proposal is an infill arrangement and site constraints do not allow APZ requirements to be met.

An increase in residential densities is not, by itself, considered an exceptional circumstance.

(a) Reduced APZ

Where the required APZ cannot be provided, or a reduction is proposed, the applicant must:

- provide for a defensible space;
- demonstrate that the intent and performance criteria for the APZ (for the type of development in Chapter 4) will be satisfied; and
- demonstrate that other measures, in combination, will meet the relevant radiant heat levels specified in the performance criteria for APZs and will achieve the aim and objectives of PBP (see section 1.1).

Clearly, it is not acceptable to neglect bush fire measures at subdivision and LEP stage with the aim of solely relying on construction standards to provide protection from bush fires. APZs, designed to separate the hazard from the development, and adequate access provisions must be incorporated at all stages of the development.

For existing subdivisions, where bush fire protection measures were not incorporated at

the development application stage, it may not be possible to achieve an APZ of the required width between the building site and the bush fire hazard. Development in these areas therefore poses some difficulties and higher levels of construction standards may be needed.

There may be situations where a combination of poor access, rugged topography, remote location and an inability to provide an adequate APZ would pose an unacceptable bush fire risk, even if the building was constructed in accordance with the strictest construction standards. In these cases, there is a strong argument for refusal of the development application. An essential requirement is the provision of a defensible space from any boundary that interfaces with the bushland.

(b) APZs on adjoining lands

Neither the RFS nor a council has the power to impose an APZ on an adjoining landowner. It is therefore the developer's responsibility to negotiate with adjoining land owner/s as part of the development application process. Details of the proposed easement and the adjoining owners consent should be submitted with the development application.

The DA must demonstrate that exceptional circumstances apply to the land to be developed prior to approval for the establishment of an easement. The requirement for an easement will then be included in the conditions of approval for the issuing of a BFS/development consent.

The owner/occupier of the land who has benefited from the easement shall be responsible for maintaining the APZ.

Where an APZ easement has been established to the benefit of a community title, it shall be maintained in accordance with a plan of management (Part 5 of the Management Statement) for the community titled land.

Easements should not be considered where the adjoining land is used for a public purpose, where vegetation management is not likely or cannot be legally granted (eg National Park, council bushland reserve, SEPP 14 or SEPP 26, critical habitat). Existing easements for power and other services will be considered on their merits.

Examples of acceptable exceptional circumstances

The following are considered to be exceptional circumstances that may apply to a development application for an APZ to be located on adjoining land in bush fire prone areas.

- Where it can be demonstrated that there is a strong likelihood of the adjoining land being developed for future residential or other compatible purposes (eg staged development or Urban Development Program or Strategies with supporting development control plans).
- Where a development was approved prior to 1 August 2002 and the applicant is only proposing alterations and/or additions to existing buildings and the existing APZ does not comply with current APZ requirements. The alterations/additions should lead to increased construction standards up to and beyond BCA (AS 3959) Level 3 construction.
- Where easements are also required on adjoining land for the purposes of providing access for utilities, right of way, as fire trails, and drainage. These are to be kept clear of free standing vegetation. In such circumstances, the proponent will need to obtain written confirmation from the relevant authority that the easement will continue to be maintained in a suitable manner.
- Where the proposal is considered 'infill development' for a single residential building and existing residential areas will also (or currently) benefit from improved APZs on the same adjoining land holding.

In all cases, the adjoining owner's consent is required to be lodged with the development application for an easement.

(c) Location on Slopes over 18 Degrees

An APZ should not be located on land steeper than 18 degrees as:

- some management practices are impossible and all become difficult;
- the environmental consequences of ground clearing (destabilization of the slope resulting

in landslip, slump, erosion or landslide) may not be acceptable; and

- the canopy fuels in forests and woodlands are more readily available to a fire, significantly reducing the advantage of having an APZ.

Developments abutting such slopes should be located so that both the APZ and the development are not located on wooded slopes steeper than 18 degrees. Where slopes steeper than 18 degrees are predominantly grassland with sparse trees, a distance of 20 metres should be provided from the edge of the sloping land.

Where it can be demonstrated that these issues can be effectively managed, APZs on steeper slopes will be considered as an exceptional circumstance.

APZ tables in Appendix 2 are provided for acceptable solutions with slopes up to 18 degrees. Effective slopes in excess of 18 degrees will require a detailed performance assessment.

(d) APZs in Split Zones

In some cases, a development may be proposed on land with a split zoning (e.g. Rural Residential/ Environmental Protection). Bush fire protection measures may not necessarily be compatible with one of the zones. It should not be assumed that an APZ can extend into an adjoining non compatible zone and the suitability of this should be checked with the local council.

Where environmental values such as endangered ecological communities are to be cleared, the proposal will need to be carefully considered in the light of the impact of the requirements for asset protection zones on these values.

As with easements, a suitable covenant may be proposed as an exceptional circumstance which protects environmental values and provides suitable bush fire protection measures.



4.1 Planning controls for residential and rural residential subdivisions

4.1.1 What is subdivision?

The term “subdivision” is defined in the EP&A Act (see Dictionary, page 73).

Subdivision of land for a residential or rural-residential purpose is the subdivision of any land on which the zoning permits the construction of a Class 1, 2, 3 or 4 building under the BCA. For example, many industrial and commercial subdivisions permit a residential house (caretaker’s residence) to be constructed. Such subdivisions are considered residential and should be assessed.

A boundary adjustment is also considered subdivision.

The consolidation of two or more lots into one is not defined as subdivision and is not captured under section 100B of the RF Act as requiring a BFSA.

(a) Residential subdivision

Residential subdivision can consist of large to medium scale “releases” of land for extension of urban areas or smaller scale “local” subdivision and is usually associated with single dwelling houses - though dual occupancy and multi-unit developments may be permissible. Development consent is required from the council for subdivision and a BFSA is required from RFS. Development consent, or a Complying Development Certificate, is then

required for individual dwellings.

In new subdivisions an appropriate combination of BPMs, especially an APZ, should be provided.

(b) Rural-Residential Developments

Rural-residential developments include blocks often associated with lifestyle choices rather than focusing on some form of primary production. Where agricultural pursuits are undertaken they are considered secondary to the residential component of the use of the land.

Consideration should be given, where practical, to grouping of rural-residential buildings into clusters which allow for the establishment of APZs around a group of dwellings rather than having to ensure individual protection for a large number of scattered dwellings. The clustering of dwellings provides for better protection with reduced vegetation clearance and hence less environmental impact.

(c) Isolated Rural Developments

Subdivision for the creation of isolated rural developments, particularly in rugged, heavily timbered country, poses additional problems in the provision of adequate levels of protection from bush fires. Where developments are located in these areas, occupants and firefighters may have to travel large distances through bush fire prone vegetation. In addition, the isolation means that, if a fire impacts on the development, occupants may also be a long way from firefighting assistance.



Perimeter roads should be the normal arrangement for urban areas and not perimeter fire trails.

The major issues for isolated rural developments arise from the need to protect firefighters as well as residents in less accessible areas. As a result greater emphasis is placed on:

- the provision of safe access/egress to the property so occupants leaving, and firefighters/rescuers accessing the property, can do so in relative safety;
- the provision of adequate APZs to create an area where occupants and firefighters remaining on site will have a good chance of survival; and
- water supplies and fire protection systems such as spray systems. In such cases dedicated water supplies may exceed standard requirements.

To achieve the required level of protection, dedicated static water supplies will need to be extended beyond the specification recommended in this document. This requirement will need to be determined based on the extent of the hazard faced and the isolation and access arrangements of the development.

Travel distances of 200 metres or more are particularly problematic in that it is difficult to

traverse with dense smoke and reduced vision as well as the increased chance of being isolated by the advancing fire. Trees close to the access track become obstacles in the hazy environment. For these reasons, where access is greater than 200 metres from a main road or refuge suitable for occupants and firefighters, a second access arrangement is required which provides alternative access in a different direction from the main access.

(d) Detailed subdivision design

The subdivision stage of land development provides an opportunity for early consideration of siting and access and for the incorporation of a preferred combination of bush fire protection measures.

PBP promotes detailed site analysis to minimise the potential for bush fire attack. Wide variation across the state, in terms of local climatic conditions is acknowledged, as well as local site characteristics such as slope and vegetation types. These site characteristics are embodied in the APZ and construction level tables set out in Appendices 2 and 3.

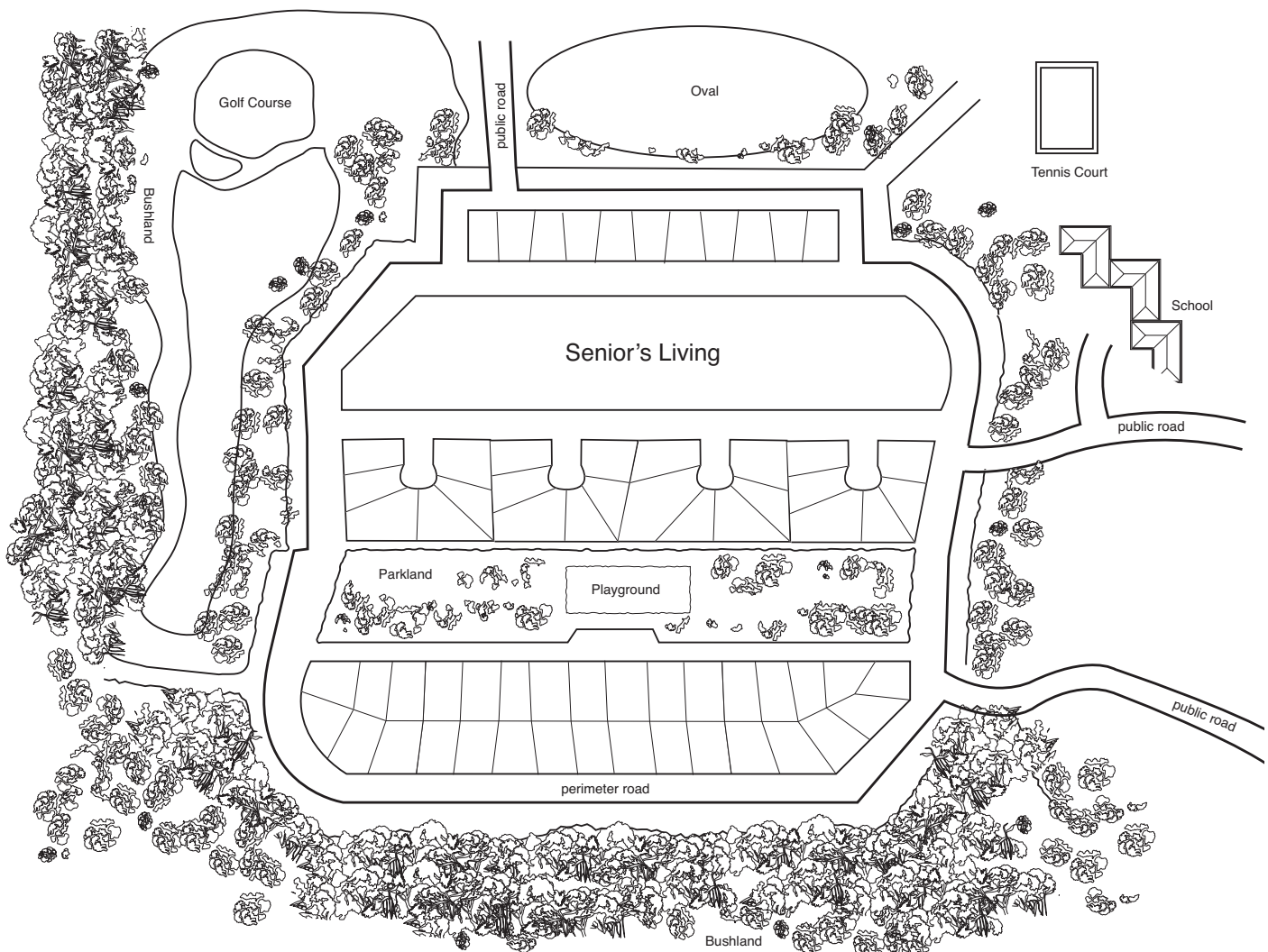


Figure 4.1 Detailed site analysis for residential subdivision

4.1.2 Specific Objectives for Subdivisions

The specific objectives for residential and rural residential subdivision are to:

- minimise perimeters of the subdivision exposed to the bush fire hazard. Hourglass shapes, which maximise perimeters and create bottlenecks, should be avoided.
- minimise bushland corridors that permit the passage of bush fire
- provide for the siting of future dwellings away from ridge-tops and steep slopes - particularly up-slopes, within saddles and narrow ridge crests.
- ensure that separation distances (APZ) between a bush fire hazard and future dwellings enable conformity with the deemed-to-satisfy requirements of the BCA. In a staged development, the APZ may be absorbed by future stages.

- provide and locate, where the scale of development permits, open space and public recreation areas as accessible public refuge areas or buffers (APZs)
- ensure the ongoing maintenance of asset protection zones
- provide clear and ready access from all properties to the public road system for residents and emergency services
- ensure the provision of and adequate supply of water and other services to facilitate effective firefighting.

As indicated in Chapter 3, an **appropriate combination of BPMs, commencing with an APZ**, is to be provided to satisfy the above objectives (and the general aim and objectives of PBP). In addition, the performance criteria that follows (for each measure) must be satisfied.

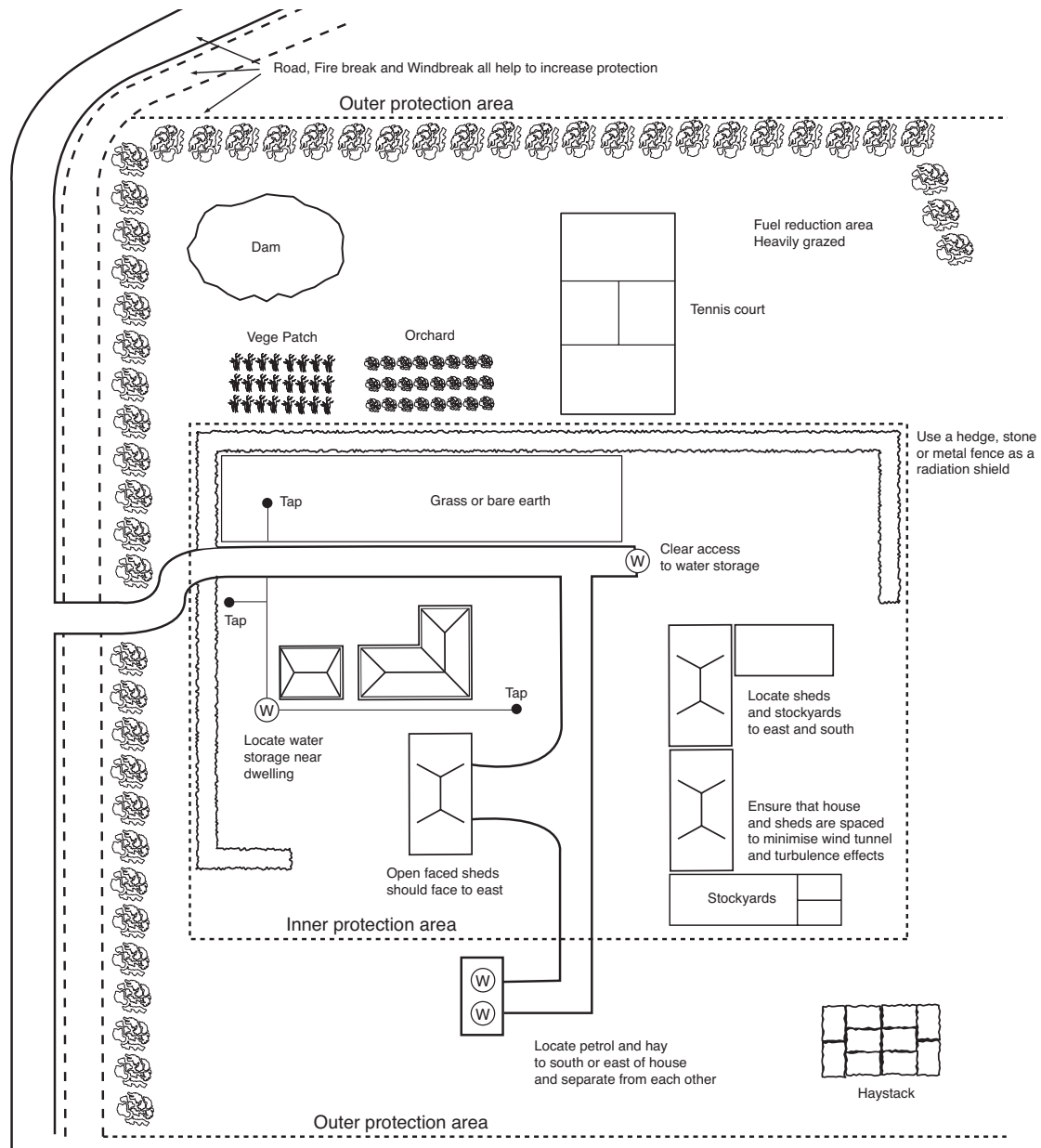


Figure 4.2 Bush fire protection measures for rural property

4.1.3 Standards for Bush Fire Protection Measures for Residential and Rural Residential Subdivisions

Asset Protection Zones

Intent of measures: to provide sufficient space and maintain reduced fuel loads, so as to ensure radiant heat levels at buildings are below critical limits and to prevent direct flame contact with a building.

Background

The APZ ensures that buildings are separated from the hazard and is designed to minimize the presence of fuels, which could become involved in a fire. Therefore, the impact of direct flame contact, radiant heat and ember attack on the development is minimised.

The APZ standards are designed to ensure that future buildings can conform to the deemed-to-satisfy arrangements under the BCA. (i.e. the provisions for Level 3 construction of AS 3959 and this document).

Residential subdivisions should not offset bush fire protection measures to neighbouring land. Bush fire protection measures that are essential to a development should occur on the site of the proposed development unless exceptional circumstances apply.

A proponent should not diminish the ecological integrity of adjoining bushland, and APZs should be designed to minimise the impacts on any environmental features in the landscape.

The RFS will generally not approve the subdivision of land for a residential or rural-residential subdivision purpose when the building footprint is unable to meet the necessary setbacks for an asset protection zone.

Where a bush fire hazard exists **on or adjacent to** a development site, an APZ is to be established on the hazard side of the development in accordance with Appendix 2 and as indicated in Figure 4.3.

As a condition of development consent, the consent authority is required to ensure that a mechanism is established for the maintenance of APZs over the life of the development. Options include a levy on property owners to fund ongoing maintenance, body corporate or community title schemes and positive covenants (under s.88B of the *Conveyancing Act 1919*) at the development stage.

Components of an Asset Protection Zone

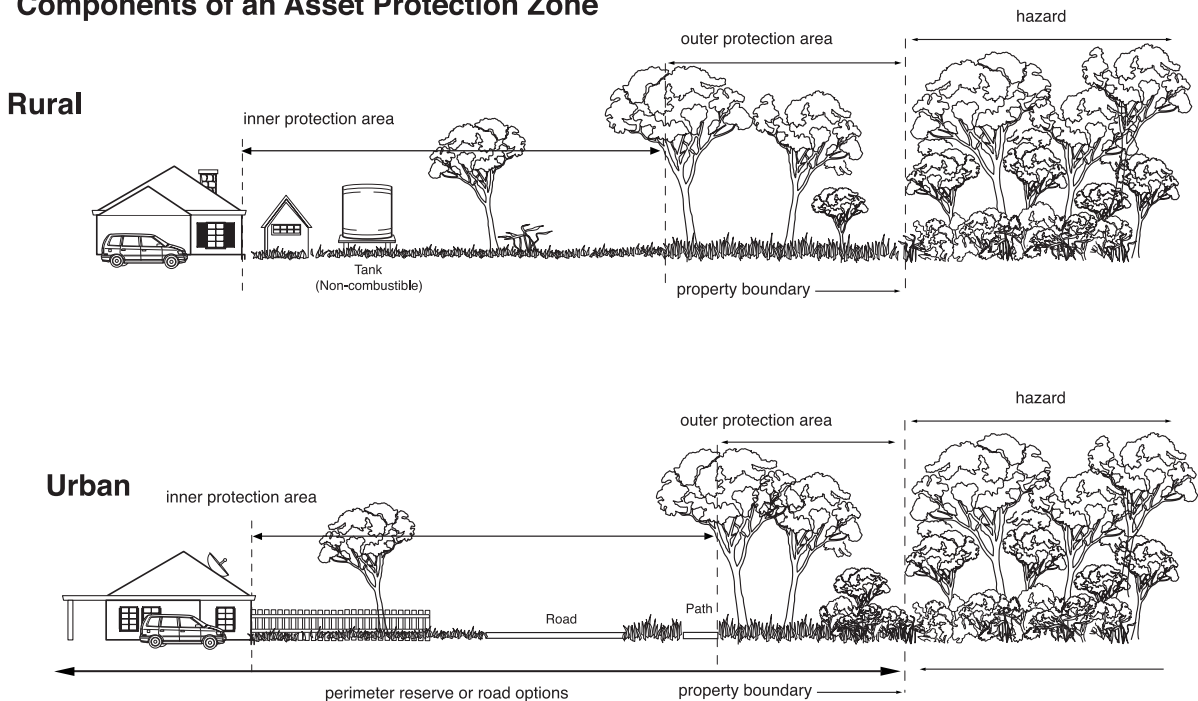


Figure 4.3 APZs and progressive reduction in fuel loads

| Performance Criteria | Acceptable solutions |
|--|--|
| <p>The intent may be achieved where:</p> | |
| <ul style="list-style-type: none"> radiant heat levels at any point on a proposed building will not exceed 29 kW/m² | <ul style="list-style-type: none"> an APZ is provided in accordance with the relevant tables/figures in Appendix 2 of this document the APZ is wholly within the boundaries of the development site. Exceptional circumstances may apply (see section 3.3) |
| <ul style="list-style-type: none"> APZs are managed and maintained to prevent the spread of a fire towards the building. | <ul style="list-style-type: none"> in accordance with the requirements of Standards for Asset Protection Zones (RFS, 2005) <p><i>Note: A Monitoring and Fuel Management Program should be required as a condition of development consent.</i></p> |
| <ul style="list-style-type: none"> APZ maintenance is practical, soil stability is not compromised and the potential for crown fires is negated | <ul style="list-style-type: none"> the APZ is located on lands with a slope less than 18 degrees. |



Some past planning practices have provided no effective protection to life and property in the event of a severe bush fire.

Access (1) – Public Roads

Intent of measures: to provide safe operational access to structures and water supply for emergency services, while residents are seeking to evacuate from an area.

Background

Public roads include the perimeter road and the internal road system of any urban subdivision as well as public roads in rural-residential subdivisions.

A **perimeter road** is the preferred option to separate bushland from urban areas. Fire trails will only be considered acceptable in exceptional circumstances. This is based on the difficulties and costs associated with maintaining fire trails on private land. A perimeter fire trail cannot be imposed on the adjoining land and should not cross a number of residential allotments.

The perimeter road forms part of the APZ and is required to provide a separation between the building and the boundary of the bush fire hazard.

The purpose of the public road system is to:

- provide firefighters with easier access to structures, allowing more efficient use of firefighting resources;
- provide a safe retreat for firefighters; and
- provide a clear control line from which to conduct hazard reduction or back burning operations.

Roads should provide sufficient width to allow firefighting vehicle crews to work with firefighting equipment about the vehicle.

Where staged development occurs or development operates under an approved Masterplan, the RFS will consider temporary perimeter roading subject to availability of reticulated water supply.

Table 4.1 provides the minimum widths for public roads that are not perimeter roads for the safe access of fire fighting vehicles in urban areas.

| Curve radius (inside edge) (metres) | Swept Path (metres width) | Single lane (metres width) | Two way (metres width) |
|-------------------------------------|---------------------------|----------------------------|------------------------|
| <40 | 3.5 | 4.5 | 8.0 |
| 40-69 | 3.0 | 3.9 | 7.5 |
| 70-100 | 2.7 | 3.6 | 6.9 |
| >100 | 2.5 | 3.5 | 6.5 |

Source: AS 2890.2 – 2002.

Table 4.1 – Road widths for Category 1 Tanker (Medium Rigid Vehicle)

Figure 4.4 provides the dimensions for the curvature of roads (inner and outer turning circles) to be used for access roads (both public and private) and fire trails.

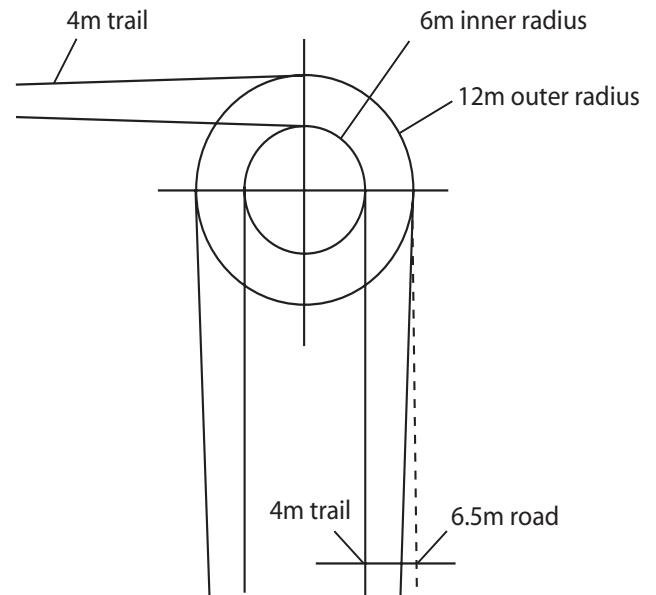


Figure 4.4 Dimensions for inner and outer turning circle radius for (public and private access) roads and fire trails.



Examples of public road access arrangements that do not facilitate bush fire fighting.

| Performance Criteria | Acceptable solutions |
|---|---|
| The intent may be achieved where: | |
| <ul style="list-style-type: none"> firefighters are provided with safe all weather access to structures (thus allowing more efficient use of firefighting resources) | <ul style="list-style-type: none"> public roads are two-wheel drive, all weather roads. |
| <ul style="list-style-type: none"> public road widths and design that allow safe access for firefighters while residents are evacuating an area. | <ul style="list-style-type: none"> urban perimeter roads are two-way, that is, at least two traffic lane widths (carriageway 8 metres minimum kerb to kerb), allowing traffic to pass in opposite directions. Non perimeter roads comply with Table 4.1 – Road widths for Category 1 Tanker (Medium Rigid Vehicle). the perimeter road is linked to the internal road system at an interval of no greater than 500 metres in urban areas. traffic management devices are constructed to facilitate access by emergency services vehicles. public roads have a cross fall not exceeding 3 degrees. all roads are through roads. Dead end roads are not recommended, but if unavoidable, dead ends are not more than 200 metres in length, incorporate a minimum 12 metres outer radius turning circle, and are clearly sign posted as a dead end and direct traffic away from the hazard. curves of roads (other than perimeter roads) are a minimum inner radius of six metres and minimal in number, to allow for rapid access and egress. the minimum distance between inner and outer curves is six metres. maximum grades for sealed roads do not exceed 15 degrees and an average grade of not more than 10 degrees or other gradient specified by road design standards, whichever is the lesser gradient. there is a minimum vertical clearance to a height of four metres above the road at all times. |
| <ul style="list-style-type: none"> the capacity of road surfaces and bridges is sufficient to carry fully loaded firefighting vehicles. | <ul style="list-style-type: none"> the capacity of road surfaces and bridges is sufficient to carry fully loaded firefighting vehicles (approximately 15 tonnes for areas with reticulated water, 28 tonnes or 9 tonnes per axle for all other areas). Bridges clearly indicate load rating. |
| <ul style="list-style-type: none"> roads that are clearly sign-posted (with easily distinguishable names) and buildings/properties that are clearly numbered. | <ul style="list-style-type: none"> public roads greater than 6.5 metres wide to locate hydrants outside of parking reserves to ensure accessibility to reticulated water for fire suppression. public roads between 6.5 metres and 8 metres wide are No Parking on one side with the services (hydrants) located on this side to ensure accessibility to reticulated water for fire suppression. |
| <ul style="list-style-type: none"> there is clear access to reticulated water supply | <ul style="list-style-type: none"> public roads up to 6.5 metres wide provide parking within parking bays and locate services outside of the parking bays to ensure accessibility to reticulated water for fire suppression. one way only public access roads are no less than 3.5 metres wide and provide parking within parking bays and locate services outside of the parking bays to ensure accessibility to reticulated water for fire suppression. |
| <ul style="list-style-type: none"> parking does not obstruct the minimum paved width | <ul style="list-style-type: none"> parking bays are a minimum of 2.6 metres wide from kerb edge to road pavement. No services or hydrants are located within the parking bays. public roads directly interfacing the bush fire hazard vegetation provide roll top kerbing to the hazard side of the road. |

Access (2) – Property Access

Intent of measures: to provide safe access to/from the public road system for firefighters providing property protection during a bush fire and for occupants faced with evacuation.

Background

The public road system in a bush fire prone area should provide alternative access or egress for firefighters and residents during a bush fire emergency if part of the road system is cut by fire.

Property access is access from a public road system onto private land and access to the habitable building by fire fighters.

A distinction is drawn between rural private access roads and those in urban areas.

In rural areas, in particular isolated rural properties, operational difficulties can be experienced in accessing buildings. Examples include water crossings, roads being cut by fire and hazardous conditions. As a result, the location

and standards of property access roads should be carefully considered.

Where property access is required across other land, the owner's consent to legally binding arrangements covering access and ongoing maintenance are required prior to lodging a development application.

Short property access roads are preferable to long ones for the safety of evacuating residents and emergency service personnel, and therefore it is preferable to site dwellings as close as possible to public through roads.

By comparison, urban areas have an existing infrastructure and requirements are generally less of a problem. In addition, it is acknowledged that fire appliances will generally operate from the public road system.

Where a property access road provides internal access arrangements for community title or similar subdivision arrangements, the provisions of 4.2.7 in relation to internal roads also apply.

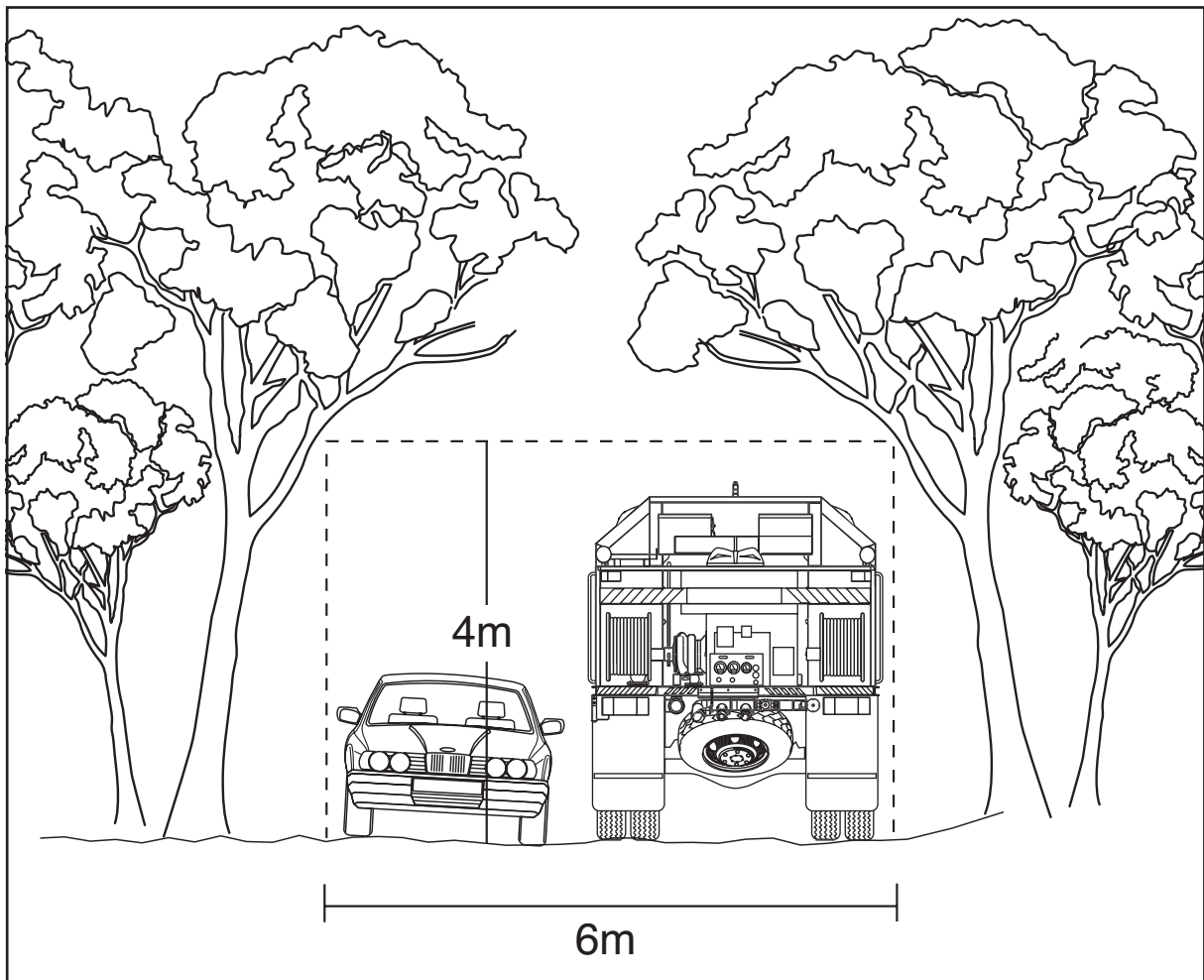


Figure 4.5 Property access road requirements (rural areas)

| Performance Criteria | Acceptable solutions |
|---|--|
| The intent may be achieved where: | |
| <ul style="list-style-type: none"> access to properties is provided in recognition of the risk to fire fighters and/ or evacuating occupants. | <ul style="list-style-type: none"> at least one alternative property access road is provided for individual dwellings (or groups of dwellings) that are located more than 200 metres from a public through road |
| <ul style="list-style-type: none"> the capacity of road surfaces and bridges is sufficient to carry fully loaded firefighting vehicles. all weather access is provided. | <ul style="list-style-type: none"> bridges clearly indicate load rating and pavements and bridges are capable of carrying a load of 15 tonnes roads do not traverse a wetland or other land potentially subject to periodic inundation (other than a flood or storm surge). |
| <ul style="list-style-type: none"> road widths and design enable safe access for vehicles | <ul style="list-style-type: none"> a minimum carriageway width of four metres for rural-residential areas, rural landholdings or urban areas with a distance of greater than 70 metres from the nearest hydrant point to the most external part of a proposed building (or footprint). <p><i>Note: No specific access requirements apply in a urban area where a 70 metres unobstructed path can be demonstrated between the most distant external part of the proposed dwelling and the nearest part of the public access road (where the road speed limit is not greater than 70kph) that supports the operational use of emergency firefighting vehicles (i.e. a hydrant or water supply).</i></p> <ul style="list-style-type: none"> in forest, woodland and heath situations, rural property access roads have passing bays every 200 metres that are 20 metres long by two metres wide, making a minimum trafficable width of six metres at the passing bay. a minimum vertical clearance of four metres to any overhanging obstructions, including tree branches. internal roads for rural properties provide a loop road around any dwelling or incorporate a turning circle with a minimum 12 metre outer radius. curves have a minimum inner radius of six metres and are minimal in number to allow for rapid access and egress. the minimum distance between inner and outer curves is six metres. the crossfall is not more than 10 degrees. maximum grades for sealed roads do not exceed 15 degrees and not more than 10 degrees for unsealed roads. <p><i>Note: Some short constrictions in the access may be accepted where they are not less than the minimum (3.5m), extend for no more than 30m and where the obstruction cannot be reasonably avoided or removed. The gradients applicable to public roads also apply to community style development property access roads in addition to the above.</i></p> <ul style="list-style-type: none"> access to a development comprising more than three dwellings have formalised access by dedication of a road and not by right of way. |

Access (3) – Fire Trails

Intent of measures: to provide suitable access for fire management purposes and maintenance of APZs

Background

Fire trails are used as access for firefighters, as fire control lines and for APZ maintenance.

In rural-residential subdivisions, they may surround isolated dwellings or groups of dwellings and can form part of the IPA around individual or groups of dwellings.

In suburban subdivisions they may function as a strategic control line around the hazard side of the IPA, if they are connected to the public road system at frequent intervals.

A fire trail is not a substitute for a perimeter road

and any proposals will need to demonstrate clear benefits over the use of a perimeter road. Fire trails are expensive to maintain and can only be effective in the context of a strategic advantage and access for hazard reduction operations.

At the time of subdivision, if fire trails are part of the development, they should be under council management to ensure that maintenance occurs. From time to time this may not be possible, in which case they can occur as easements and rights of way over private land. In these circumstances, the NSW RFS will generally require a community title arrangement to ensure ongoing maintenance.

If fire trails are placed under council management, council is liable for the ongoing costs of maintenance. Given limited funding within many councils, this arrangement does not ensure that maintenance occurs and may place a liability on a council. Where a fire trail is proposed to be vested in council, ongoing funding of maintenance should be considered.

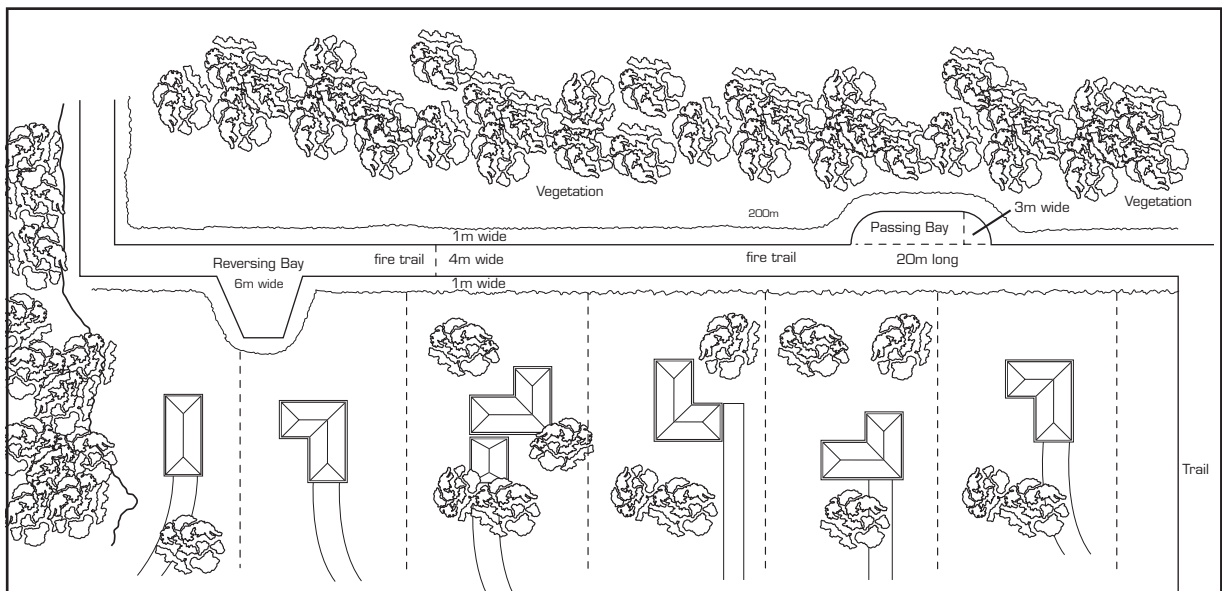


Figure 4.6 Fire Trails may function as strategic control lines if they are connected to the road system at frequent intervals



Fire trail gates are to be provided.

| Performance Criteria | Acceptable solutions |
|--|--|
| <p>The intent may be achieved where:</p> | |
| <ul style="list-style-type: none"> the width and design of the fire trails enables safe and ready access for firefighting vehicles | <ul style="list-style-type: none"> a minimum carriageway width of four metres with an additional one metre wide strip on each side of the trail (clear of bushes and long grass) is provided. the trail is a maximum grade of 15 degrees if sealed and not more than 10 degrees if unsealed. a minimum vertical clearance of four metres to any overhanging obstructions, including tree branches is provided. the crossfall of the trail is not more than 10 degrees. the trail has the capacity for passing by: <ul style="list-style-type: none"> reversing bays using the access to properties to reverse fire tankers, which are six metres wide and eight metres deep to any gates, with an inner minimum turning radius of six metres and outer minimum radius of 12 metres; and/or a passing bay every 200 metres, 20 metres long by three metres wide, making a minimum trafficable width of seven metres at the passing bay. <p><i>Note: Some short constrictions in the access may be accepted where they are not less than the minimum (3.5m) and extend for no more than 30m and where obstruction cannot be reasonably avoided or removed.</i></p> |
| <ul style="list-style-type: none"> fire trails are trafficable under all weather conditions. Where the fire trail joins a public road, access shall be controlled to prevent use by non authorised persons. | <ul style="list-style-type: none"> the fire trail is accessible to firefighters and maintained in a serviceable condition by the owner of the land. appropriate drainage and erosion controls are provided. the fire trail system is connected to the property access road and/or to the through road system at frequent intervals of 200 metres or less. fire trails do not traverse a wetlands or other land potentially subject to periodic inundation (other than a flood or storm surge). gates for fire trails are provided and locked with a key/lock system authorized by the local RFS. |
| <ul style="list-style-type: none"> fire trails designed to prevent weed infestation, soil erosion and other land degradation | <ul style="list-style-type: none"> fire trail design does not adversely impact on natural hydrological flows. fire trail design acts as an effective barrier to the spread of weeds and nutrients. fire trail construction does not expose acid-sulphate soils. |

Services – Water, electricity and gas

Intent of measures: to provide adequate services of water for the protection of buildings during and after the passage of a bush fire, and to locate gas and electricity so as not to contribute to the risk of fire to a building

Background

During major bush fire events, the preparedness of the dwelling and its occupants may be seriously jeopardised with the loss of basic services (particularly water and electricity).

As part of the development consent process for the construction of a dwelling, it may be necessary to specify the provision of certain services.

Adequate water supply is critical for any firefighting operation, particularly where property protection is envisaged. The amount of water to be supplied may vary with differing geographical and topographical conditions.

In addition, significantly increased densities may draw upon existing water supplies which, if not supplemented, may prove inadequate in the face



Do not use plastic water storage tanks in bush fire prone areas.

of a major bush fire event. This requires careful consideration at the subdivision stage to ensure adequate water will be available. Where reticulated supply is inadequate, water can be supplemented with the provision of a dedicated static water supply in the form of tank storage. Where supplementary supplies of water are required, swimming pools, creeks and dams should not be used as a substitute for a dedicated static supply. These sources of water are not considered reliable during drought conditions.

The determination of a guaranteed water supply is one that can only be made by the water supply authority where mains water supply is available.

In rural areas and areas not serviced by reticulated water supplies, the provision of dedicated static water supply is essential. The amount of water is determined on the basis of lot sizes and density of development. Larger subdivisions of smaller lot sizes require less water than developments involving larger lots spread over a large area. Table 4.2 should be used for determining dedicated static water supply requirements based on lot size and character of development.

Maintaining a dedicated water supply for firefighting purposes in rural areas provides opportunities for water replenishment for firefighting tankers and ensures availability of water for property protection by adequately prepared owners.

As protective measures, hose reels and sprinkler systems are encouraged but are considered to be active measures. They must generally be considered as additional to, rather than a substitute for other bush fire protection measures.

| Development type | Water requirement |
|--|--------------------------------------|
| Residential Lots (<1,000m ²) | 5,000 l/lot |
| Rural-residential Lots (1,000 – 10,000m ²) | 10,000 l/lot |
| Large Rural/Lifestyle Lots (>10,000 m ²) | 20,000 l/lot |
| Dual Occupancy | 2,500 l/unit |
| Townhouse/Unit Style (eg Flats) | 5,000 l/unit up to 20,000 l maximum. |

Table 4.2 – Dedicated water supply requirements for various non reticulated subdivision developments

| Performance Criteria | Acceptable solutions |
|--|--|
| <p>The intent may be achieved where:</p> | |
| <p>Reticulated water supplies</p> <ul style="list-style-type: none"> water supplies are easily accessible and located at regular intervals | <ul style="list-style-type: none"> reticulated water supply to urban subdivisions uses a ring main system for areas with perimeter roads. fire hydrant spacing, sizing and pressures comply with AS 2419.1 – 2005. Where this cannot be met, the RFS will require a test report of the water pressures anticipated by the relevant water supply authority. In such cases, the location, number and sizing of hydrants shall be determined using fire engineering principles. hydrants are not located within any road carriageway all above ground water and gas service pipes external to the building are metal, including and up to any taps. the provisions of parking on public roads are met. |
| <p>Non-reticulated water supply areas</p> <ul style="list-style-type: none"> for rural-residential and rural developments (or settlements) in bush fire prone areas, a water supply reserve dedicated to firefighting purposes is installed and maintained. The supply of water can be an amalgam of minimum quantities for each lot in the subdivision (community titled subdivisions), or held individually on each lot | <ul style="list-style-type: none"> the minimum dedicated water supply required for firefighting purposes for each occupied building excluding drenching systems, is provided in accordance with Table 4.2. a suitable connection for firefighting purposes is made available and located within the IPA and away from the structure. A 65mm Storz outlet with a Gate or Ball valve is provided. Gate or Ball valve and pipes are adequate for water flow and are metal rather than plastic. underground tanks have an access hole of 200mm to allow tankers to refill direct from the tank. A hardened ground surface for truck access is supplied within 4 metres of the access hole. above ground tanks are manufactured of concrete or metal and raised tanks have their stands protected. Plastic tanks are not used. Tanks on the hazard side of a building are provided with adequate shielding for the protection of fire fighters. all above ground water pipes external to the building are metal including and up to any taps. Pumps are shielded. |
| <p>Electricity Services</p> <ul style="list-style-type: none"> location of electricity services limits the possibility of ignition of surrounding bushland or the fabric of buildings regular inspection of lines is undertaken to ensure they are not fouled by branches. | <ul style="list-style-type: none"> where practicable, electrical transmission lines are underground. where overhead electrical transmission lines are proposed: <ul style="list-style-type: none"> lines are installed with short pole spacing (30 metres), unless crossing gullies, gorges or riparian areas; and no part of a tree is closer to a power line than the distance set out in accordance with the specifications in 'Vegetation Safety Clearances' issued by Energy Australia (NS179, April 2002). |
| <p>Gas services</p> <ul style="list-style-type: none"> location of gas services will not lead to ignition of surrounding bushland or the fabric of buildings | <ul style="list-style-type: none"> reticulated or bottled gas is installed and maintained in accordance with AS 1596 and the requirements of relevant authorities. Metal piping is to be used. all fixed gas cylinders are kept clear of all flammable materials to a distance of 10 metres and shielded on the hazard side of the installation. if gas cylinders need to be kept close to the building, the release valves are directed away from the building and at least 2 metres away from any combustible material, so that they do not act as a catalyst to combustion. Connections to and from gas cylinders are metal. polymer sheathed flexible gas supply lines to gas meters adjacent to buildings are not used. |

4.2 Planning controls for Special Fire Protection Purposes

4.2.1 Introduction

Special Fire Protection Purpose (SFPP) developments are required to obtain a BFSA from the RFS under section 100B of the RF Act. Such developments are also “integrated developments” under section 91 of the EP&A Act.

The nature of SFPPs means that occupants may be more vulnerable to bush fire attack for one or more of the following reasons:

- They may be less educated in relation to bush fire impacts;
- They may have reduced capacity to evaluate risk and to respond adequately to the bush fire threat;
- They may present organisational difficulties for evacuation and or management;
- They may be more vulnerable through stress and anxiety arising from bush fire threat and smoke;
- There may be significant communication barriers;
- Supervision during a bush fire may be difficult; and
- Logistical arrangements for the numbers of residents may be complicated in terms of alternate accommodation, transport, healthcare and food supplies.

4.2.2 Types of Special Fire Protection Purpose Developments

In NSW, SFPPs have been identified as:

- (a) a school,
- (b) a child care centre,
- (c) a hospital (including a hospital for the mentally ill or mentally disordered),
- (d) a hotel, motel or other tourist accommodation,
- (e) a building wholly or principally used as a home or other establishment for mentally incapacitated persons,
- (f) housing for older people or people with disabilities within the meaning of State Environmental Planning Policy No 5 - Housing for Older People or People with a Disability (now State Environmental Planning Policy (Seniors Living)). ,
- (g) a group home within the meaning of State Environmental Planning Policy No 9 - Group Homes,
- (h) a retirement village,
- (i) any other purpose prescribed by the regulations. (Section 100B (6) of the RF Act).

4.2.3 Specific Objectives for Special Fire Protection Purpose Developments

While the “measures in combination” continues as a principle, there is more reliance on space around buildings (as defensible space and APZs for fuel load control) and less reliance on construction standards. The specific objectives at 4.1.2 relating

to the provision of road access, water supply and other services also apply to SFPPs as they do to residential subdivisions.

The specific objectives for SFPP developments are to :

- provide for the special characteristics and needs of occupants. Unlike residential subdivisions, which can be built to a construction standard to withstand the fire event, enabling occupants and firefighters to provide property protection after the passage of fire, occupants of SFPP developments may not be able to assist in property protection. They are more likely to be adversely affected by smoke or heat while being evacuated.
- provide for safe emergency evacuation procedures. SFPP Developments are highly dependent on suitable emergency evacuation arrangements, which require greater separation from bush fire threats.

During emergencies, the risk to firefighters and other emergency services personnel can be high through prolonged exposure, where door-to-door warnings are being given and exposure to the bush fire is imminent.

A bush fire emergency management plan should minimise risks to emergency services personnel and exits should be located away from the hazard side of a building. It is for this reason that setbacks for special fire protection purposes are larger than most normal residential buildings, as the radiant heat exposure can be unacceptable for emergency workers assisting residents in the open compared to being inside the building.

In all cases the intent and performance criteria of each BPM must be satisfied, as per the Performance Tables that follow (see section 4.2.7). Exceptional circumstances must be demonstrated for reductions in APZ (required by Appendix 2) or APZ on adjoining land (see section 3.3).

4.2.4 Matters for consideration for specific SFPPs

The following commentary outlines particular matters for consideration for specific types of SFPP developments.

a) Schools

While schools are usually associated with primary and secondary students, the description covers all school purposes and includes any development in which schooling can take place.

This includes schools for religious instruction as well as child learning centres.

Universities and technical colleges are not defined as a school within an LEP, however these require careful consideration, and the specific objectives above should be applied.

Schools are particularly prone to traffic-generated congestion on roads at start and finish times. This is heightened when parents believe that their children are likely to be exposed to bush fire and in seeking to reach the school, cause road congestion and hamper the firefighting effort.

In general, office buildings for administration are not afforded the same protection as classrooms or assembly point buildings used for evacuation. Likewise, toilet blocks can be located within the APZ area.

Sporting fields, and amenities blocks should form part of the APZ between the hazard and classrooms. Car parking should be near a clear exit away from the bush fire threat.

Efforts must be made to improve the resilience of buildings, and new classrooms should not be extended towards bushland where they do not comply with the setback requirements of Appendix 2. Where existing schools do not meet setback requirements any upgrades should incorporate improved bush fire protection measures within existing building footprints.

b) Child care centres

Child care centres often have fixed ratios of staff to children that are based on supervision rather than emergency response and evacuation requirements. It is one of the reasons that child care centres are considered special fire protection purpose developments. Of particular concern is where buildings such as dwellings are proposed to be converted to child care centres, as existing housing stock is unlikely to meet basic ember protection in a bush fire prone area.

When extending or upgrading the buildings of an existing child care centre, no part of a building should be located closer to the fire threat than permitted by the applicable construction standard (AS 3959-1999). This may result in a level of retrofitting of existing buildings to ensure improved safety.

c) Hospitals (including hospitals for the mentally ill or mentally disordered)

Hospitals can vary significantly in size and purpose. They may be larger public hospitals or smaller private day surgery premises.

Hospitals are harder to design with bush fire protection in mind. They require ease of access for emergency patients arriving by ambulance or car with larger doorways that are difficult to ember proof.

Patients can have a range of physical conditions and most emergency plans are based on fire within the building rather than bush fire threat. In many cases patients could suffer from asthma, emphysema or obstructive diseases and smoke may exacerbate these conditions. People with emotional or psychological problems may suffer increased anxiety and unwarranted stress during a

bush fire, making evacuation arrangements difficult to coordinate and implement. A building wholly or principally used as a home or other establishment for mentally incapacitated persons has the same difficulties.

d) Hotels, motels and other tourist accommodation

This class of development includes large hotels, motel accommodation, bed and breakfast establishments (B&Bs), caravan parks (and mobile home estates), lodges, religious and health retreats and camping grounds.



Caravan parks and mobile homes (relocatable) estates are considered SFPP.

The biggest challenge is evacuation of people who may have no comprehension of the danger or knowledge of the area in which they find themselves. Tourists staying in tourist accommodation have been known to evacuate late or travel down inappropriate roads with fatal results. A better strategy may either be staying within a resilient building as a refuge or having coordinated escorted evacuation.

In some cases, the attraction of the site as a bush land setting conflicts with the need for adequate APZs, however, this should not lead to a lower standard of construction or unsuitable access being provided.

Eco-tourism

A major challenge arises with 'eco-tourism' facilities in which accommodation has traditionally been built into a remote bushland environment. Eco-tourism aims to foster environmental and cultural understanding, appreciation and conservation, be ecologically sustainable and based on relatively undisturbed natural areas.

Clearly this can conflict with bush fire safety objectives, which aim to reduce a building's vulnerability to ignition from heat radiation, flame or embers and to provide safe access and a minimum defensible space for firefighter safety. Access can also be problematic and the requirements for access possibly across adjoining properties will need to be carefully assessed. This should recognise the risk faced by fire fighters trying to gain access and occupants trying to evacuate to safer areas (see page 39).

e) State Environmental Planning Policy (SEPP) – Seniors Living

The policy aims to increase the supply and diversity of housing to meet the needs of older people or people with a disability, while making efficient use of existing infrastructure and services. The policy does not apply to land described as 'environmentally sensitive land' which can include land identified as being bush fire prone land. Consequently SEPP Seniors Living proposals may not be permitted in these areas.

The nature of Seniors Living developments determines that a relatively less mobile residential population is present and, as such, creates difficulties when evacuation is required. These residents cannot generally be expected to defend the property from bush fire attack.

SEPP Seniors Living can be accessed on the NSW Parliamentary Legislation website at www.legislation.nsw.gov.au.

The consent authority is also required under the Policy to consider **additional matters** for SEPP Seniors Living developments in the vicinity of bush fire prone land and take into consideration the means of access to the general location and other relevant matters.

In these cases, the consent authority must also consult with the Commissioner of the RFS. The requirements on this type of development are of a higher order than other special fire protection purpose developments.

In addition, it should be noted that some consent authorities deal with seniors living facilities through the provisions of their LEP.



Senior living and retirement/nursing homes require special consideration in relation to APZs

f) State Environmental Planning Policy No 9 - Group Homes

The aim of the SEPP 9 Policy is to facilitate the establishment of:

“(a) permanent group homes in which disabled persons or socially disadvantaged persons may lead as normal a life as possible by living permanently in an ordinary residential household environment, instead of in an institutional environment, and (b) transitional group homes which provide temporary accommodation for disabled persons or socially disadvantaged persons in an ordinary residential household environment instead of in an institutional environment for purposes such as alcohol or drug rehabilitation, “half-way” rehabilitation for persons formerly living in institutions and refuges for men, women or young people.”

As with other SFPP developments, major issues relate to evacuation planning arrangements and access to the property. Although having higher population densities than most residential homes, SEPP 9 developments tend not to be as intense as hospitals or other special fire protection purpose developments. Group Home developments approved under an LEP, are also captured as SFPP developments.

g) Retirement villages

Retirement villages have the same issues as SEPP (Seniors Living) developments, often with various levels of care available from totally independent living to daily care arrangements.

4.2.5 SFPPs as infill

In circumstances where alterations or additions to existing SFPP's facilities are proposed, the RFS requires an appropriate combination of bush fire protection measures and compliance with the intent and performance criteria of each measure within section 4.3.5.

However, it is also acknowledged that existing circumstances may make the preferred standards difficult to achieve. In such cases, the specific objectives in Section 4.2.3 are to be followed.

Alterations and additions to existing SFPP's (i.e. approved prior to 1st August 2002), including their external appearance or finish, which may involve an increase in size and footprint of the building or redevelopment of an existing building are considered to be infill development.

This type of development should also seek to achieve a better bush fire risk outcome (such as improved construction standards) than if the development did not proceed. The new building work should comply with AS 3959 - 1999 (and Appendix 3 of PBP) or be no closer to the hazard than the existing building. Existing facilities such as water supply should also be upgraded.

a) Alpine resorts

The NSW Alpine resort areas are:

- The Perisher Range – Perisher, Smiggin Holes, Blue Cow and Guthega.
- Thredbo Alpine Village
- Charlottes Pass
- Mount Selwyn
- Ski Rider
- Kosciuszko Mountain Retreat
- Sponars Chalet
- Bullocks Flat

These resort areas, located in the Kosciuszko National Park (KNP), are leased from the Department of Environment and Conservation (DEC) and are unique in NSW. They are centres of intensive, seasonally based recreation that have different types of habitable buildings used principally for short term tourist accommodation, with the maximum numbers of visitors coming to the area in winter.

Due to the elevation of the resort areas, vegetation types, slope and climate of the area the bushfire risks are inherently different to those experienced on the eastern seaboard. The normal fire season within the KNP extends for a short period from January through to March.

Land surrounding the developed lease areas is under the management of DEC and contains areas of habitat for vulnerable and endangered flora and fauna. As a result, fuel reduction strategies and asset protection zones need to be handled carefully to avoid inconsistency with the objectives of SEPP 73 and the *National Parks and Wildlife Act 1974*.

Additionally, infill development in these areas would include alterations or variations to lease boundaries that did not result in the construction of new buildings.



Alpine resorts still require an appropriate combination of bush fire protection measures. (Table A3.5 applies, page 65)

b) Bed and Breakfasts and Holiday Lets

When an application is made for a change of use for the establishment of B&Bs and holiday lets, these fall within the SFPP definition. Access and water are critical for such developments and where these do not provide suitable access away from the fire hazard, these developments should not be allowed.

Where conversion to a B&B or holiday let is proposed in an area with reticulated water, it does not back onto public reserves, and the setback and construction requirements of AS 3959 - 1999 can be applied (or are shielded by other forms of development), they should be treated as an infill arrangement.

4.2.6 Applying SFPP objectives to other types of development

Many Class 9 buildings under the BCA are considered 'assembly areas' and may attract significant numbers of people for various purposes including entertainment, religious instruction, sport or education. Prisons, churches, tertiary education institutions (eg universities) and similar land uses also fall within this definition and all accommodate large numbers of persons of various physical capabilities. The major issue in these situations is to determine whether staff or other occupants have a capacity for firefighting response and /or adequate emergency and evacuation planning in place.

Churches, in particular, have lower occupancy periods being largely occupied on weekends or for shorter periods during the week. In the past it was often the rectories that were lost rather than churches, possibly associated with the stone or brick construction materials used.

These types of developments (ie Class 9 buildings) should be considered on their merits under sections 79BA and 79C of the EP&A Act, with consideration of the specific objectives listed in 4.2.3.

Overall, those Class 9 buildings not being a SFPP should be considered as if they were a SFPP.

These buildings will not have specific bush fire provisions applying under the BCA, but their location should be carefully considered.

In such cases the aim and objectives of PBP should be used to assess the merits of the proposal.

4.2.7 Standards for Bush Fire Protection Measures for Special Fire Protection Purpose Developments

Asset protection zones

Intent of measures: to provide sufficient space for firefighters and other emergency services personnel, ensuring radiant heat levels permit operations under critical conditions of radiant heat, smoke and embers, while supporting or evacuating occupants.

Background

Experience has shown that certain types of developments have occupants who are highly vulnerable to the effects of bush fire events. This arises from their susceptibility to the effects of fire, lower mobility, adverse health effects, lack of comprehension of the risk being faced during a fire or, simply, high levels of care during an emergency event.

In the event of a bush fire, these residents may be difficult to evacuate and/or more susceptible to smoke impacts. They are also generally unable to assist with property protection.

It is for these reasons that the concept of SFPP development was introduced and that APZ distances are the key BPM.

Some developments such as SEPP Seniors Living developments are often marketed to those who are not necessarily considered vulnerable although the development may be designed specifically for aged persons or persons with a disability. Clearly a conservative approach is required.

It is also anticipated that certain types of development are hard to ember proof due to the access arrangements needed. Schools and hospitals are good examples.

Radiant heat levels of $>10\text{kW}/\text{m}^2$ must not be experienced by emergency services workers aiding residents within a special fire protection purpose development. Where ember protection is not feasible, then setbacks greater than 100 metres from bushland should be adopted.



The intent of an APZ is to provide sufficient space for firefighters and other emergency services personnel, ensuring radiant heat levels permit operations under critical conditions of radiant heat, smoke and embers, while supporting or evacuating occupants.

| Performance Criteria | Acceptable solutions |
|---|---|
| <p>The intent may be achieved where:</p> | |
| <ul style="list-style-type: none"> radiant heat levels of greater than 10kW/m² will not be experienced by occupants or emergency services workers entering or exiting a building. | <ul style="list-style-type: none"> an APZ is provided in accordance with the relevant tables and figures in Appendix 2 of this document. exits are located away from the hazard side of the building. the APZ is wholly within the boundaries of the development site. Exceptional circumstances may apply (see section 3.3) |
| <ul style="list-style-type: none"> applicants demonstrate that issues relating to slope are addressed: maintenance is practical, soil stability is not compromised and the potential for crown fires is negated. | <ul style="list-style-type: none"> mechanisms are in place to provide for the maintenance of the APZ over the life of the development. the APZ is not located on lands with a slope exceeding 18 degrees. |
| <ul style="list-style-type: none"> APZs are managed and maintained to prevent the spread of a fire towards the building. | <ul style="list-style-type: none"> in accordance with the requirements of 'Standards for Asset Protection Zones (RFS 2005). <p><i>Note - a Monitoring and Fuel Management Program should be required as a condition of development consent.</i></p> |
| <ul style="list-style-type: none"> vegetation is managed to prevent flame contact and reduce radiant heat to buildings, minimise the potential for wind driven embers to cause ignition and reduce the effect of smoke on residents and fire-fighters. | <ul style="list-style-type: none"> compliance with Appendix 5. |

Access – Internal Roads

Intent of measures: to provide safe operational access for emergency services personnel in suppressing a bush fire, while residents are accessing or egressing an area

Background

The public road system in a bush fire prone area should provide alternative access or egress for firefighters and residents during a bush fire emergency if part of the road system is cut by fire. This is of critical importance for areas with the higher densities associated with SFPP developments.

Where those developments are being established, the requirements for public roads and car parking apply in the same way as new residential subdivisions. (See Section 4.1.3, Access - Public Roads)

The impact of increased traffic and traffic management in the neighbouring areas also needs to be considered and an assessment of impact on fire fighting capacity undertaken.

For internal roads, at least one alternative access road needs to be provided for individual dwellings or groups of dwellings more than 200 metres from a public through road. The routes of these roads should be selected to ensure that both roads are unlikely to be simultaneously cut by a fire.

Short access roads are preferable to long ones for the safe evacuation of residents and for emergency service personnel. Therefore dwellings should be sited as close as possible to public through roads.

Large numbers of vehicles may be attempting to simultaneously enter or leave an area, congesting roads and restricting fire services and other emergency services personnel accessing an area. For this reason, roads should be planned for suitable widths to permit access into and out of the area during such situations.



Hydrants should not be placed in parking areas (top photo) but within footpaths (middle photo). Access including road curvatures should allow ready movement of fire fighting vehicles.

| Performance Criteria | Acceptable solutions |
|---|---|
| <p>The intent may be achieved where:</p> | |
| <ul style="list-style-type: none"> internal road widths and design enable safe access for emergency services and allow crews to work with equipment about the vehicle. | <ul style="list-style-type: none"> internal roads are two-wheel drive, sealed, all-weather roads; internal perimeter roads are provided with at least two traffic lane widths (carriageway 8 metres minimum kerb to kerb) and shoulders on each side, allowing traffic to pass in opposite directions; roads are through roads. Dead end roads are not more than 100 metres in length from a through road, incorporate a minimum 12 metres outer radius turning circle, and are clearly sign posted as a dead end; traffic management devices are constructed to facilitate access by emergency services vehicles. a minimum vertical clearance of four metres to any overhanging obstructions, including tree branches, is provided. curves have a minimum inner radius of six metres and are minimal in number to allow for rapid access and egress. the minimum distance between inner and outer curves is six metres. maximum grades do not exceed 15 degrees and average grades are not more than 10 degrees. crossfall of the pavement is not more than 10 degrees. roads do not traverse through a wetland or other land potentially subject to periodic inundation (other than flood or storm surge). roads are clearly sign-posted and bridges clearly indicate load ratings. the internal road surfaces and bridges have a capacity to carry fully-loaded firefighting vehicles (15 tonnes). |



Property access should not restrict firefighting access. Bridge loadings should be clearly marked.

Services – Water, gas and electricity

Intent of measures: to provide adequate water services for the protection of buildings during and after the passage of a bush fire, and to locate gas and electricity so as not to contribute to the risk of fire to buildings

Background

During major bush fire events, the protection and preparedness of SFPP developments and their occupants may be seriously jeopardised by the loss of basic services. This is particularly important

where residents rely on the use of medical equipment for their welfare or survival.

Adequate water supply is critical for any firefighting operation and particularly where property protection is envisaged. Water supplies must be easily accessible and located at regular intervals. The amount of water to be supplied may vary with differing geographical and topographical conditions.

In SFPP areas, reticulated water should be available for firefighting purposes and fire hydrants should be regularly spaced and comply with Australian Standards (AS 2419.1 - 2005). Where mains water supply is available, the determination of a guaranteed water supply can only be made by the water supply authority.



Pumps and other fittings need to be shielded and made of non-combustible materials.

| Performance Criteria | Acceptable solutions |
|---|--|
| <p>The intent may be achieved where:</p> | |
| <p>Reticulated water supplies</p> <ul style="list-style-type: none"> water supplies are easily accessible and located at regular intervals. | <ul style="list-style-type: none"> access points for reticulated water supply to SFPP developments incorporate a ring main system for all internal roads. fire hydrant spacing, sizing and pressures comply with AS 2419.1 – 2005. Where this cannot be met, the RFS will require a test report of the water pressures anticipated by the relevant water supply authority, once development has been completed. In such cases, the location, number and sizing of hydrants shall be determined using fire engineering principles. the provisions of public roads in section 4.1.3 in relation to parking are met. |
| <p>Non-reticulated water supply area.</p> <ul style="list-style-type: none"> a water supply reserve dedicated to firefighting purposes is installed and maintained. The supply of water can be an amalgam of minimum quantities for each lot in the development and be reticulated within dedicated firefighting lines. | <ul style="list-style-type: none"> 10,000 litres is the minimum dedicated water supply required for firefighting purposes for each occupied building, excluding drenching systems. the provision for suitable connection for RFS and/or NSW Fire Brigades purposes in section 4.1.3 in relation to water supplies is made available. |
| <p>Electricity</p> <ul style="list-style-type: none"> location of electricity services will not lead to ignition of surrounding bushland or the fabric of buildings or risk to life from damaged electrical infrastructure. | <ul style="list-style-type: none"> electrical transmission lines are underground. |
| <p>Gas</p> <ul style="list-style-type: none"> location of gas services will not lead to ignition of surrounding bush land or the fabric of buildings. | <ul style="list-style-type: none"> reticulated or bottled gas is installed and maintained in accordance with AS 1596 - 2002 and the requirements of relevant authorities. Metal piping is to be used. all fixed LPG tanks are kept clear of all flammable materials and located on the non hazard side of the development. If gas cylinders need to be kept close to the building, the release valves must be directed away from the building and away from any combustible material, so that they do not act as catalysts to combustion. polymer sheathed flexible gas supply lines to gas meters adjacent to buildings are not to be used. |

Emergency and evacuation planning

Intent of measures: to provide suitable emergency and evacuation (and relocation) arrangements for occupants of special fire protection purpose developments.

Background

A decision to stay and defend a well-prepared property or to leave early should be made well in advance of the arrival of a bush fire, and people who intend to relocate themselves should do so as early as possible.

It is also recognised that people who cannot cope with bush fire should relocate well before a fire impacts on their location, and that there should be an identified 'trigger' used to initiate an emergency or relocation plan. Relocation in advance of a bush fire is not always possible however.

Appropriately prepared and constructed buildings offer protection during bush fires reducing the likelihood of bush fire related injury and fatality.



Evacuation at the last minute ahead of a bush fire is very dangerous, and potentially exposes people to smoke, radiant heat and embers. It is for this reason that SFPP developments have increased setback requirements to meet evacuation/relocation and emergency planning objectives and also have a requirement for site specific emergency plans.

This is particularly important where the affected people are very young or aged, or where the population is poorly prepared for the bush fire event, either because of a lack of understanding (e.g. tourists) or limited language skills (e.g. recent migrants).

SEPP Seniors Living, schools, hospitals, child care, nursing homes and other SFPPs should all have suitable management arrangements and structures capable of developing and implementing an emergency plan. This should also be the case for 'community title' type arrangements.

Where eco-tourist facilities are planned they should have low accommodation levels (generally less than 12 persons) so as to facilitate relocation and emergency planning, and be located within 100 metres of a public road or 50 metres from a major refuge away from any forested or heathland areas.



Arrangements should be included for communications with local fire fighting e.g. RFS control centres so that fire activity can be monitored by trained fire service staff.

The Emergency and Evacuation Plan embodies a risk assessment and the necessary procedures to minimize the potential impact of a bush fire. An emergency/evacuation plan provides employees and residents with the procedures to either enable premises to be suitable refuges or to evacuate or relocate, as appropriate, in the event of a bush fire.

| Performance Criteria | Acceptable solutions |
|---|--|
| <p>The intent may be achieved where:</p> | |
| <ul style="list-style-type: none"> an Emergency and Evacuation Management Plan is approved by the relevant fire authority for the area. | <ul style="list-style-type: none"> an emergency/evacuation plan is prepared consistent with the RFS Guidelines for the <i>Preparation of Emergency/Evacuation Plan</i>. compliance with AS 3745-2002 'Emergency control organisation and procedures for buildings, structures and workplaces' for residential accommodation'. compliance with AS 4083-1997 'Planning for emergencies - for health care facilities'. <p><i>Note: The developer should provide a copy of the above document to the local Bush Fire Management Committee for their information prior to the occupation of any accommodation of a special fire protection purpose or community title subdivision.</i></p> |
| <ul style="list-style-type: none"> suitable management arrangements are established for consultation and implementation of the emergency and evacuation plan. | <ul style="list-style-type: none"> an Emergency Planning Committee is established to consult with residents (and their families in the case of aged care accommodation and schools) and staff in developing and implementing an Emergency Procedures Manual. detailed plans of all Emergency Assembly Areas including "onsite" and "offsite" arrangements as stated in AS 3745-2002 are clearly displayed, and an annual (as a minimum) trial emergency evacuation is conducted. |
| <p>In relation to eco-tourist accommodation:</p> <ul style="list-style-type: none"> suitable refuge areas and evacuation/management arrangements are in place commensurate with the bush fire risk. | <ul style="list-style-type: none"> at least one building should be used as a local refuge area and comply with the APZ's and construction requirements for residential buildings. cabins are within 50 metres of a refuge building and are clearly signposted. the paths from cabins to the refuge area are safe, with management of surface fuels to ≤ 4 tonnes/ha. the overall accommodation for tourists does not exceed 12 persons. a mechanism for the relocation of occupants on days of a total fire ban or adverse fire activity is provided in the local area in which the development operates. |

4.3 Planning controls for infill and other developments on bush fire prone land

4.3.1 Introduction

Section 79BA of the EP&A Act requires compliance with PBP for all development proposals on bush fire prone land. Those types of development covered in Sections 4.1 and 4.2 are special, requiring compliance. They also require a s100B BFSAs from the RFS under the RF Act.

Development other than such subdivisions or SFPPs would often be classed as infill development (as defined). This includes new houses, alterations and additions in existing subdivisions.

Other types of development on bush fire prone land (e.g. commercial, industrial, other subdivisions) are also addressed through the aim and objectives of this document (see section 1.1). In some cases, specific advice is provided.

There is considerable common ground between "other" development and subdivision or SFPP developments:

- the same range of bush fire protection measures can apply; and
- APZ is the principal element, especially its subset, defensible space.

There are also key differences. Because most applications will be infill, consideration of existing circumstances and the need for careful site analysis is crucial.

4.3.2 Specific Objectives for infill

Proposals for infill development are to:

- ensure that the bush fire risk to adjoining lands is not increased;
- provide a minimum defensible space;
- provide better bush fire protection, on a re-development site, than the existing situation. This should not result in new works being exposed to greater risk than an existing building;
- ensure that the footprint of the proposed building does not extend towards the hazard beyond existing building lines on neighboring land;
- not result in an increased bush fire management and maintenance responsibility on adjoining land owners unless they have agreed to the development; and
- ensure building design and construction enhance the chances of occupant and building survival.

Ideally, APZs, access and service supply standards for infill developments should be provided in accordance with the acceptable solutions applied to residential subdivision (see section 4.1).



Other types of development (e.g. commercial, industrial) are also addressed through the aim and objectives of this document (see section 1.1)

However, in most cases, infill development proposals will be constrained by existing situations – pre-existing subdivision patterns and existing built forms surrounding the subject site. Consequently, each proposal must be considered on its merits and in accordance with the intent and performance criteria for infill development (section 4.3.5).

An underlying principle is that the larger the scale of development, the greater the need to comply with the APZ, access and service requirements.

4.3.3 Consultation with the RFS

Residential infill development that does not comply with the acceptable solutions within the performance table in section 4.3.5 (e.g. construction requirements within Appendix 3) should be referred by the consent authority to the Commissioner of the RFS for advice under section 79BA of the EP&A Act (see section 2.7).



Consultation with RFS Officers

The purpose of consultation under section 79BA of the EP&A Act is to consider an appropriate performance based solution. The onus is still on the applicant to develop such a solution.

4.3.4 The role of construction standards for residential infill

The provisions of the BCA in NSW (and therefore Appendix 3 of this document) apply to residential development, Classes 1, 2 and 4 (Class 3 buildings will usually be an SFPP).

In preparing a development application under section 79BA, the applicant may consider the provision of higher-level construction standards as a level of equivalence for the inability to provide the required APZ. Consideration may also be given to additional measures such as drenching systems, radiant heat shields and shutters to satisfy the performance criteria.

As discussed in section 2.6, this commits applicants to the construction level or performance solution for the associated Construction Certificate (CC).



Additions and extensions need to meet construction requirements associated with the main building

4.3.5 Specifications and Requirements for Bush Fire Protection Measures for Infill Development

Infill Development

Intent of measures: to minimise the risk of bush fire attack and provide protection for emergency services personnel, residents and others assisting firefighting activities.

Background

The requirement to address bush fire protection for subdivision (and other development) was introduced on 1 August, 2002. As a result, pre-existing subdivisions may not provide the levels of protection currently required.

Where a development expectation arises from the zoning of the land to build, rebuild, alter or add to a dwelling(s) in pre-existing subdivisions, attempts should be made to find a solution taking into account the level of risk present. The expectation of building or altering a house is recognised even though the ability to provide for APZs or access requirements now required for residential development may not be possible.

Proposals to reduce APZ requirements or utilise adjoining lands need to consider the advice on exceptional circumstances in section 3.3.

In such circumstances, greater emphasis may be placed on siting, design, construction standards and landscaping and the maintenance of these systems. Vegetation management practices may be required to ensure improved levels of protection are afforded the development, its occupants and firefighters.

Where a development falls 'outside of the scope' of the construction requirements of PBP (ie the deemed-to-satisfy arrangements of the BCA applicable in NSW), then a performance solution will need to be developed for the construction aspects of the building. In some circumstances, the proposed building's scale and size may need to be modified to ensure a defensible space and reduce bush fire attack.

Increasing densities within bush fire prone areas is not of itself considered to be an exceptional circumstance. Where three or more dwellings are proposed for a single allotment the development will be treated as being subject to subdivision and hence the requirements of section 4.1 will be applied.

In general, additions, alterations or extensions to a building will be treated as infill for class 1, 2, 3 and 4 buildings not being a SFPP.

The design of a building can be of critical importance in terms of the potential for accumulation of debris and exposure of the building to bush fire attack.

The higher the building and greater its bulk, the greater the exposure of the building to radiant heat, wind turbulence and ember attack. Reduction in the area of exposure may be important for critical elements such as windows, doors, roofs and wall claddings. Clearly some cladding materials such as brickwork are more robust.

Intricate forms of design can trap debris and influence wind turbulence. Re-entrant corners may aid the architectural interest of the building but readily accumulate debris and some roof designs are unnecessarily complicated. For two storey buildings, the use of gutters on the upper story makes debris removal more difficult. Many people are hospitalised as the result of falling off roofs whilst attempting last minute maintenance in awkward areas or to higher gutters in the face of an impending bush fire. The use of box gutters, flat roofs and variations in the angle of the roof should be avoided.

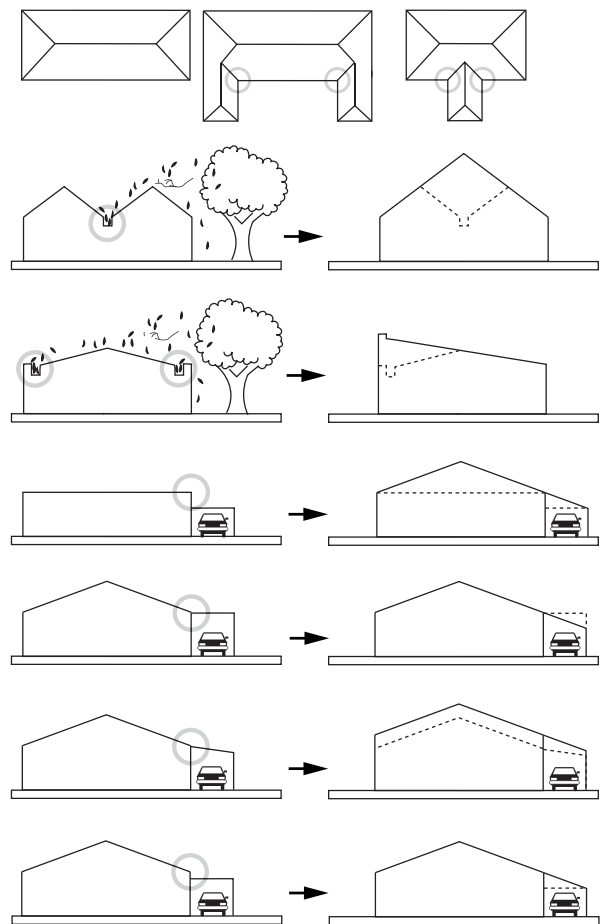
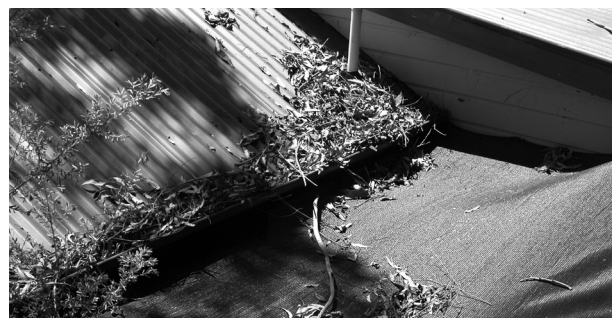


Figure 4.7 Design aspects for buildings (adapted from Ramsay, C and Rudolph, 2003)

Some design features can enhance the protection of a building, including limiting glazing on exposed facades and barriers, eg courtyard or fenced off area for gardens, BBQ areas and the like, can be incorporated into building design. Glazing is one element of a building that is highly susceptible to the impacts of radiant heat and flying debris. In addition, a large proportion of radiant heat can pass through a window and heat internal furnishings such as carpets, curtains or furniture.

| Performance Criteria | Acceptable solutions |
|---|---|
| The intent may be achieved where: | |
| in relation to Asset Protection Zones: <ul style="list-style-type: none"> a defensible space is provided onsite. an asset protection zone is provided and maintained for the life of the development. | <ul style="list-style-type: none"> APZ determined in accordance with Appendix 2. |
| in relation to siting and design: <ul style="list-style-type: none"> buildings are sited and designed to minimise the risk of bush fire attack. | <ul style="list-style-type: none"> buildings are designed and sited in accordance with the siting and design principles in this section (see also figure 4.7). |
| in relation to construction standards: <ul style="list-style-type: none"> it is demonstrated that the proposed building can withstand bush fire attack in the form of wind, smoke, embers, radiant heat and flame contact . | <ul style="list-style-type: none"> construction determined in accordance with Appendix 3 and the <i>Requirements for attached garages and others structures</i> in this section. <p><i>Note: provisions in relation to Class 10a buildings may also apply.</i></p> |
| in relation to access requirements: <ul style="list-style-type: none"> safe, operational access is provided (and maintained) for emergency services personnel in suppressing a bush fire while residents are seeking to relocate, in advance of a bush fire, (satisfying the intent and performance criteria for access roads in sections 4.1.3 and 4.2.7). | <ul style="list-style-type: none"> compliance with section 4.1.3 for property access roads. compliance with section 4.2.7 for access standards for internal roads. |
| in relation to water and utility services: <ul style="list-style-type: none"> adequate water and electricity services are provided for firefighting operations gas and electricity services are located so as not to contribute to the risk of fire to a building. | <ul style="list-style-type: none"> compliance with section 4.1.3 for services - water, electricity and gas. |
| in relation to landscaping: <ul style="list-style-type: none"> it is designed and managed to minimise flame contact and radiant heat to buildings, and the potential for wind driven embers to cause ignitions. | <ul style="list-style-type: none"> compliance with Appendix 5. |

Note: the above specifications and requirements only apply in relation to infill developments and not “other” developments referred to in section 4.3.6. However, the above specifications and requirements may be used to guide in the development of bush fire protection measures for “other” developments.



Poor design does not aid flushing of debris

Where the internal radiant heat exposure of furnishing rises to a level in excess of $10\text{kW}/\text{m}^2$, the possibility of the establishment of an internal fire increases. In many cases, barriers may be incorporated into the building design.

The performance of a building should be enhanced through the following siting and design principles:

- avoid building on ridge tops and saddles;
- building on level ground wherever possible;
- where buildings must be constructed on sloping land, they are built on cut-in benches rather than elevated or above fill;
- avoid raised floors, utilise concrete slabs (raft construction);
- locating the habitable buildings near the property entrance for easier access/egress;
- the use of non-combustible fencing (or other class 10a buildings) which is located within close proximity to the main building;
- reducing the bulk of a building (height and width) facing a bush fire hazard;
- simplifying the design of buildings to reduce the numbers of re-entrant corners;
- providing more simplified rooflines;
- guttering and gutter valleys being:
 - ♦ installed with gutter guarding having a flammability index of not more than 5, when tested to AS 1530.2;
 - ♦ limited to the lowest possible levels (bottom fascia) to improve access and maintenance; and
 - ♦ covered with a mesh of aluminium bronze or stainless steel with a maximum aperture of 5 mm fixed to the outer edge of the gutter (or valley) and be located beneath the second (or higher) row of tiles or roof sheeting for a distance of 250mm;

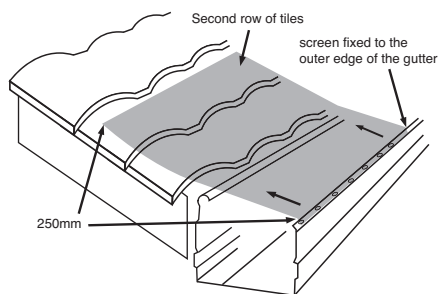


Figure 4.8
Leafless gutters enhance building performance

- use of barriers (e.g. courtyards, fenced off areas for gardens, BBQ areas and the like); and
- where garages are located under the roofline of the main building, garage doors are to be ember proofed and employ ember traps and or brushes to prevent the entry of embers into the garage area (see requirements for garages and other structures in adjacent text box);

Where free standing vegetation is located upslope of the dwelling, provision of a radiant heat barrier should be close to the building for additional protection. For vegetation located downslope of the structure the radiant heat barrier is most

effective when it is located along the boundary and is up to two metres in height.

Requirements for attached garages and other structures

Where a garage or other attached structure has a common roof space with a building required to comply with any level of construction, the entire garage, carport, veranda or similar roofed structure is assessed as part of the building and must comply with the relevant construction requirements as if it were the subject building,

Adjacent structures

Where any garage, carport, veranda or similar roofed structure is not attached to a building required to comply with a level of construction, the entire garage, carport, veranda or similar roofed structure is to be—

- assessed as if it were a building required to comply with the appropriate level of construction; or
- separated by a distance of greater than 10 metres from the building required to comply with the appropriate level of construction.

Garage Doors

Garage doors are to be:

- tight fitting to door frames and jambs with gaps no greater than 5 mm when closed; and
- where a roller shutter door is installed it shall be provided with an ember protection device at the top of the shutter that captures any embers where a gap of 2.0 mm on the external surface exists.

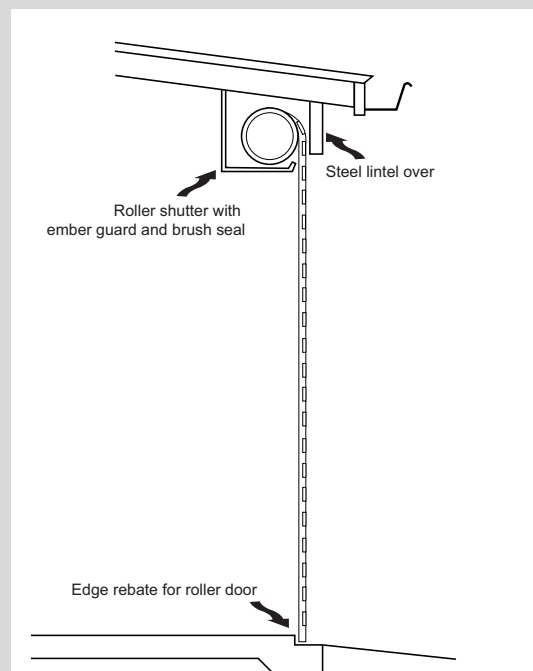


Figure 4.9
Example of a roller shutter door installation

4.3.6 PBP and other development

Applications for developments that are not residential/rural residential subdivisions, SFPPs or residential infill should:

- note the range of available bush fire protection measures (in Chapter 3);
- satisfy the aim and objectives of PBP (see section 1.1);
- consider any matters listed for the specific purpose below; and
- propose an appropriate combination of bush fire protection measures, with evidence that the intent of each measure (with reference to the relevant Tables in sections 4.1.3 and 4.2.7) is satisfied.

For example, ensuring that a defensible space is provided, that proposed measures (in combination) minimise radiant heat levels, and that access and services are adequate.

The following discussion provides **specific advice** on some development types.

a) Dual occupancy

Key issues with dual occupancy are satisfaction of APZ (as with a single dwelling) and relative location/subdivision arrangements.

Where one building already exists and the second building can otherwise comply with APZ setbacks and appropriate construction levels, some attempt at retrofitting to ensure the integrity of the existing dwelling should also be made. This may be in the form of increased APZs (within the boundary of the development), ember proofing such as sarking under roofs, window screens, improved water availability, and suitable access.

In general, dual occupancy should be discouraged in isolated locations with poor access and inadequate water.

Where the erection of a dual occupancy is proposed, it is assumed that the proposal will be subdivided and as such will be assessed as if submitted under section 100B of the RF Act for a BFSA. A dual occupancy assessed under section 100B of the RF Act will not be required to be reassessed under section 79BA of the EP&A Act.

b) Strata subdivision of existing buildings

Some existing buildings are submitted for strata subdivision, to be managed under a body corporate. Where such developments are proposed, consideration should be made as to whether the strata arrangement will lead to increased densities (compared to current arrangement) and the vulnerability of the future residents. Emergency planning is critical and should be implemented prior to formal adoption of the strata arrangements. The existing building(s) conformity with APZs and construction standards should also be assessed. In cases where no

existing fire protection systems are evident or conformity with APZs is not proposed, property management plans as well as retrofitting for ember protection (screening and sarking) of exposed windows or roofs should be implemented.

Where there is any chance of deficiency in water supply or APZs then the suitability of the strata subdivision must be questioned unless supplementary water can be provided.

Where a Class 2 building has been assessed under section 79BA of the EP&A Act, a proposal for strata subdivision will not require a bush fire safety authority under section 100B of the RF Act.

c) Conversion of an existing building to a new use

Over time, developments catering for some uses may need to be upgraded, redeveloped or changed in line with movements in socio-economic or demographic factors. Where such changes result in significantly increased densities for residential uses or where new structures need to be erected, the provisions of this document should be addressed. This will include, but is not restricted to, construction standards, setbacks, water supply, and emergency planning.

The conversion of an existing building to a new use brings with it special considerations. An example is the conversion of warehousing to residential uses.

Where the conversion increases the density of vulnerable residents, added caution should apply. Such arrangements are generally unsuitable at the bushland interface and should not be encouraged. Nonetheless, the use of bush fire protection measures in combination will still apply.

d) Historic buildings

In relation to land identified as having heritage significance, the usual requirements for bush fire protection may conflict with the conservation of significant heritage fabric and its setting. Development affecting heritage places, which proposes the intensification of residential uses should be considered on an individual basis. The application of PBP is to be considered in the context of the conservation principles, processes and practices of the Illustrated Burra Charter (Australia ICOMOS, 2004)

e) State Environmental Planning Policy No. 15 (Rural Landsharing Communities)

These developments are often referred to as multiple occupancies. Multiple occupancy is defined as the "collective management and sharing of un-subdivided land, facilities and resources." This aims to encourage community based, environmentally sensitive approaches to rural settlement. In this type of development, for example, there may be a common dining area although each family unit has separate sleeping quarters.

Good access, fire management planning (for hazard reduction and internal response capability), provision of plentiful water supplies and overall emergency planning are crucial for such developments.

Because of the nature of the development and the overall community approach, such developments are encouraged to have the residents prepared for firefighting and to provide an easily accessible and highly resilient building, capable of being a refuge in the face of a bush fire event.

SEPP 15 developments may include dwellings which will not comply with the construction standards of AS 3959 - 1999. In recognition of the aims of such developments, but still maintaining the objectives of this document, at least one building within the development must comply with the setback distances in Appendix 3 for the associated construction standard. The provisions of this document relating to rural-residential development for a safe refuge should also apply to rural landsharing communities.

Where buildings are not clustered and do not provide mutual protection, each dwelling will need to comply with the appropriate setbacks and construction requirements (set out in AS 3959 - 1999). The performance requirements for eco-tourism (see page 39) apply to SEPP 15 type developments.

f) Buildings of Class 5 to 8 and 10 of the BCA

The definition of Class 5 – 8 and 10 buildings of the BCA can be found in Appendix 1. These classes of buildings include offices, factories, warehouses, public car parks and other commercial or industrial facilities.

The BCA does not provide for any bush fire specific performance requirements and as such AS 3959 does not apply as a set of 'deemed to satisfy' provisions. The general fire safety construction provisions are taken as acceptable solutions, but the aim and objectives of PBP apply in relation to other matters such as access, water and services, emergency planning and landscaping/vegetation management.

In circumstances where the aim and objectives of PBP (section 1.1) are not met, then the construction requirements for bush fire protection will need to be considered on a case-by-case basis.

In many instances, these types of developments will require on-site parking and loading areas. In such cases, it is prudent to place these facilities in the most appropriate location in order to establish defensible space for fire fighting purposes.

Class 10b buildings include a fence, mast, antenna, retaining or free-standing wall, swimming pool, or the like.

At the planning level, class 10b buildings in bush fire prone areas (e.g. fencing) should be non-combustible and where an above ground swimming pool is erected it should not adjoin or be attached directly onto a wall of a building of class 1-4 or SFPP Class 9.

Where a Class 10a building (e.g. shed) is constructed in proximity to another residential class of building the Class 10a should meet the requirements of that Class or be located >10 metres away from the main building.



Class 10a buildings such as sheds should be located >10 metres from a building of another class unless they also comply with the relevant construction requirement of the main building under AS 3959 - 1999 and the BCA.

Appendices

Appendix 1

Key Legislation Relating to Bush Fire Prone Lands and Development Assessment

This legislation is current as at 1 December 2006. Check legislative provisions if in doubt. Proposed regulations commencing 1 March 2007 are also included.

A1.1 Section 79BA - *Environmental Planning and Assessment Act 1979*

79BA Consultation and development consent—certain bush fire prone land

(1) Development consent cannot be granted for the carrying out of development for any purpose (other than a subdivision of land that could lawfully be used for residential or rural residential purposes or development for a special fire protection purpose) on bush fire prone land unless the consent authority:

- (a) is satisfied that the development conforms to the specifications and requirements of Planning for Bushfire Protection (2001) produced by the NSW RFS (or, if another document is prescribed by the regulations for the purposes of this paragraph, that document), that are relevant to the development, or
- (b) the consent authority has consulted with the Commissioner of the NSW RFS concerning measures to be taken with respect to the development to protect persons, property and the environment from danger that may arise from a bush fire.

(2) In this section: special fire protection purpose has the same meaning as it has in section 100B of the *Rural Fires Act 1997*.

A1.2 Section 146 - *Environmental Planning and Assessment Act 1979*

146 Bush fire prone land

(1) If a bush fire risk management plan applies to land within the area of a council, the council must, within 12 months after the commencement of this section (and before the end of the period of every five years after the commencement):

- (a) request the Commissioner of the NSW RFS to designate land (if any) within the area that the Commissioner considers, having regard to the bush fire risk

management plan, to be bush fire prone land, and
(b) must record any land so designated on a map.

(2) The Commissioner of the NSW RFS must, if satisfied that the land designated by the Commissioner has been recorded by the council on a map, certify the map as a bush fire prone land map for the area of the council.

(3) Land recorded for the time being as bush fire prone land on a bush fire prone land map for an area is bush fire prone land for the area for the purposes of this or any other Act.

(4) The bush fire prone land map for an area is to be available for public inspection during normal office hours for the council.

(5) In this section: bush fire risk management plan has the same meaning as it has in the *Rural Fires Act 1997*.

A1.3 Section 100B - *Rural Fires Act 1997* - Bush Fire Safety Authorities

(1) The Commissioner may issue a bush fire safety authority for:

- (a) a subdivision of bush fire prone land that could lawfully be used for residential or rural residential purposes, or
- (b) development of bush fire prone land for a special fire protection purpose.

(2) A bush fire safety authority authorises development for a purpose referred to in subsection (1) to the extent that it complies with standards regarding setbacks, provision of water supply and other matters considered by the Commissioner to be necessary to protect persons, property or the environment from danger that may arise from a bush fire.

(3) A person must obtain such a bush fire safety authority before developing bush fire prone land for a purpose referred to in subsection (1).

(4) Application for a bush fire safety authority is to be made to the Commissioner in accordance with the regulations.

(5) Development to which subsection (1) applies: (a) does not include the carrying out of internal alterations to any building,

Appendices

- (a1) does not include the carrying out of any development excluded from the operation of this section by the regulations, and
- (b) is not complying development for the purposes of the *Environmental Planning and Assessment Act 1979*, despite any environmental planning instrument.

(6) In this section:

“special fire protection purpose” means the purpose of the following:

- (a) a school,
- (b) a child care centre,
- (c) a hospital (including a hospital for the mentally ill or mentally disordered),
- (d) a hotel, motel or other tourist accommodation,
- (e) a building wholly or principally used as a home or other establishment for mentally incapacitated persons,
- (f) housing for older people or people with disabilities within the meaning of State Environmental Planning Policy No 5—Housing for Older People or People with a Disability (now SEPP (Seniors Living))
- (g) a group home within the meaning of State Environmental Planning Policy No 9—Group Homes,
- (h) a retirement village,
- (i) any other purpose prescribed by the regulations.

A1.4 Schedule 4 – EP&A Reg 11 - Bush fire prone land

The following information is required to be included within a planning certificate under section 149 of the EP&A Act:

“If any of the land is bush fire prone land (as defined in the Act), a statement that all or, as the case may be, some of the land is bush fire prone land.

If none of the land is bush fire prone land, a statement to that effect.”

A1.5 Clause 46 - Rural Fires Regulation 2002 - Application for bush fire safety authority

Clause 46(1) of the Rural Fires Regulation 2002, specifies the information requirements for consideration of a bush fire safety authority under section 100B of the RF Act.

- (1) For the purposes of section 100B (4) of the Act, an application for a bush fire safety authority must be in writing and include the following:
 - (a) a description (including the address) of the property on which the development the subject of the application is to be carried out,
 - (b) a classification of the vegetation on and surrounding the property (out to a distance of 140 metres from the boundaries of the property) in accordance

with the system for classification of vegetation contained in *Planning for Bush Fire Protection*,

- (c) an assessment of the slope of the land on and surrounding the property (out to a distance of 100 metres from the boundaries of the property),
- (d) identification of any significant environmental features on the property,
- (e) the details of any threatened species, population or ecological community identified under the *Threatened Species Conservation Act 1995* that is known to the applicant to exist on the property,
- (f) the details and location of any Aboriginal relic (being a relic within the meaning of the *National Parks and Wildlife Act 1974*) or Aboriginal place (within the meaning of that Act) that is known to the applicant to be situated on the property,
- (g) a bush fire assessment for the proposed development (including the methodology used in the assessment) that addresses the following matters:
 - (i) the extent to which the development is to provide for setbacks, including APZs,
 - (ii) the siting and adequacy of water supplies for firefighting,
 - (iii) the capacity of public roads in the vicinity to handle increased volumes of traffic in the event of a bush fire emergency,
 - (iv) whether or not public roads in the vicinity that link with the fire trail network have two-way access,
 - (v) the adequacy of arrangements for access to and egress from the development site for the purposes of an emergency response,
 - (vi) the adequacy of bush fire maintenance plans and fire emergency procedures for the development site,
 - (vii) the construction standards to be used for building elements in the development,
 - (viii) the adequacy of sprinkler systems and other fire protection measures to be incorporated into the development,
- (h) an assessment of the extent to which the proposed development conforms with or deviates from the standards, specific objectives and performance criteria set out in Chapter 4 (Performance Based Controls) of *Planning for Bush Fire Protection*.

A1.6 Clause 46A - Rural Fires Regulation 2002 - Development excluded from requirements for bush fire safety authority

- (1) For the purposes of section 100B (5) (a1) of the Act, the following development is excluded from the operation of that section:
 - (a) development for the purposes of licensed premises that do not provide overnight accommodation (other than for the owner or manager of the premises),

- (b) strata subdivision of a building, but only if development consent for the erection of the building was granted in accordance with section 79BA of the *Environmental Planning and Assessment Act 1979*,
- (c) strata subdivision of a class 2 building erected before 1 August 2002, but only if the building complies with the requirements of Level 1 construction under AS 3959-1999, *Construction in Bushfire Prone Areas*,
- (d) subdivision of land for the purposes of converting an existing dwelling to a dual occupancy, but only if development consent for the dwelling was granted in accordance with section 79BA of the *Environmental Planning and Assessment Act 1979*,
- (e) subdivision of land (including any boundary adjustments) that is leased under the *Western Lands Act 1901*,
- (f) subdivision for the purposes of consolidations of lots or boundary adjustments on land where the number of lots are reduced, but only if any existing dwelling on the land complies with the requirements of Appendix 3 (Site Bush Fire Attack Assessment) of *Planning for Bush Fire Protection*,
- (g) development for the purposes of bed and breakfast accommodation using an existing building, but only if the building is more than 30 metres from native vegetation,
- (h) subdivision of land used or proposed to be used for industrial purposes on which the erection of a dwelling related to the industrial use of the land (such as a manager's residence) is permitted,
- (i) subdivision of land for a rural residential purpose in a Western New South Wales district, but only if:
 - (i) no lot created by the subdivision is greater than 10 hectares, and
 - (ii) the bush fire prone land in any lot is less than 10 per cent of the lot, and
 - (iii) each lot has direct access to an existing public road.

(2) In this clause:

class, in relation to a building, means a building of the specified class under the *Building Code of Australia*.

Building Code of Australia has the same meaning as it has in the *Environmental Planning and Assessment Act 1979*.

Western New South Wales district means any of the following weather forecast districts referred to in Schedule 1:

- (a) Upper Western Weather Forecast District,
- (b) Lower Western Weather Forecast District,
- (c) Riverina Weather Forecast District,
- (d) South West Slopes Weather Forecast District,
- (e) Central West Plains Weather Forecast District,
- (f) Central West Slopes Weather Forecast District,
- (g) Central Tablelands Weather Forecast District,

- (h) North West Plains Weather Forecast District,
- (i) North West Slopes Weather Forecast District.

A1.7 Clause 46B - Rural Fires Regulation 2002 - Additional special fire protection purposes for which bush fire safety authority required

For the purposes of paragraph (i) of the definition of **special fire protection purpose** in section 100B (6) of the Act, the following purposes are prescribed:

- (a) manufactured home estates (within the meaning of *State Environmental Planning Policy No 36—Manufactured Home Estates*), comprising two or more caravans or manufactured homes, used for the purpose of casual or permanent accommodation (but not tourist accommodation),
- (b) sheltered workshops, or other workplaces, established solely for the purpose of employing persons with disabilities,
- (c) respite care centres, or similar centres, that accommodate persons with a physical or mental disability or provide respite for carers of such persons,
- (d) student or staff accommodation associated with a school, university or other educational establishment.

A1.8 Classifications (of Buildings) – Volume 1, Building Code of Australia (2006)

The Building Code of Australia is updated annually and classes of buildings should be confirmed within the latest version of the Code. Buildings are classified as being from Classes 1 to 10.

For the purposes of *Planning for Bush Fire Protection*, the descriptions of the various Classes within the document apply to the 2006 version of the Code.

Classes 1, 2, 3 and 4 are buildings primarily used as a residence.

Classes 5, 6, 7 and 8 are buildings used as shops, warehouses, factories, offices and carparks and the like.

Class 9 buildings include health care, assembly buildings and aged care buildings.

Class 10 buildings are non-habitable building such as a shed as well as fences, free standing walls and swimming pools.

Importantly, Class 3 (other than a detention centre) and Classes 9a and 9c buildings will be a special fire protection purpose for the purposes of section 100B of the *Rural Fires Act 1997*. Other classes of buildings can be assessed under the provisions of section 79BA of the *Environmental Planning and Assessment Act, 1979*.

Appendix 2

Determining Asset Protection Zones

A2.1 Introduction

This Appendix shows how APZs are determined for residential and rural-residential subdivision and new special fire protection purposes. This assessment will determine the minimum setbacks required for habitable buildings in residential purpose developments designated as bush fire prone.

A2.2 Terminology

The methodology requires consideration of the following matters, which contribute to bush fire behaviour and radiant heat models:

- (i) **Asset Protection Zone (setback)** distances provide for:
 - minimal separation for safe firefighting (access to fire front);
 - reduced radiant heat;
 - reduced influence of convection driven winds;
 - reduced ember viability thereby limiting the impact of ember attack; and
 - dispersal of smoke which would otherwise severely impact on residents affected by reduced mobility or health issues.
- (ii) **Predominant Vegetation** is classified by structure or formation using the system adopted by Keith (2004) and by the general description using Table A2.1. Vegetation types give rise to resultant radiant heat (assumed under unmanaged conditions to represent an extreme scenario as the danger period is the lifetime of any proposed development) and fire behaviour characteristics. There are 12 vegetation formations (with sub-formations) identified in PBP.
- (iii) **Effective Slopes** are classified within five slope classes, one being upslope and four being

downslope, ranging from flat to 18 degrees in steps of five degrees. This recognises the reduced rate of spread (ROS) inherent to fire travelling downslope and the restrictions imposed on development by slopes greater than 18 degrees. The effective slope is that slope within the hazard which most significantly affects fire behaviour of the site having regard to the vegetation class found.

(iv) **Fire weather** assessment assumes a credible worst case scenario and an absence of any other mitigating factors relating to aspect or prevailing winds. The 1:50 year fire weather scenario for most of the State was determined as FDI=80, however, a number of areas including the Greater Sydney, Greater Hunter, Illawarra, Far South Coast and Southern Ranges Fire Areas have higher FDIs which are set at 100. This is believed to occur with reasonable frequency in their respective fire areas. The relevant fire areas are set out in Table A2.3.

(v) **Fire intensity (I)** is determined following the formula adapted from Luke and McArthur (1978), $I = HWr/36$ where H is the heat yield for vegetation, W is fuel load (t/Ha) and r is ROS (km/hr). ROS is normally determined using McArthur Meter Mark V at the relevant FDI for forests and woodlands. Other models are used for heaths and scrubs (Catchpole, et al, 1998). Radiant heat is then derived from flame length and intensity models using the 'view factor' model (Douglas and Tan, 2005).

(vi) **Inner Protection Area (IPA) and Outer Protection Area (OPA)** for forest and woodland vegetation. The IPA is critical to providing a defensible space and managing heat intensities at the building surface. The OPA serves to reduce the potential length of flames by slowing the ROS, filtering embers and reducing the likelihood of crown fire. The IPA may be increased at the expense of OPAs.

For other vegetation types (such as heaths,

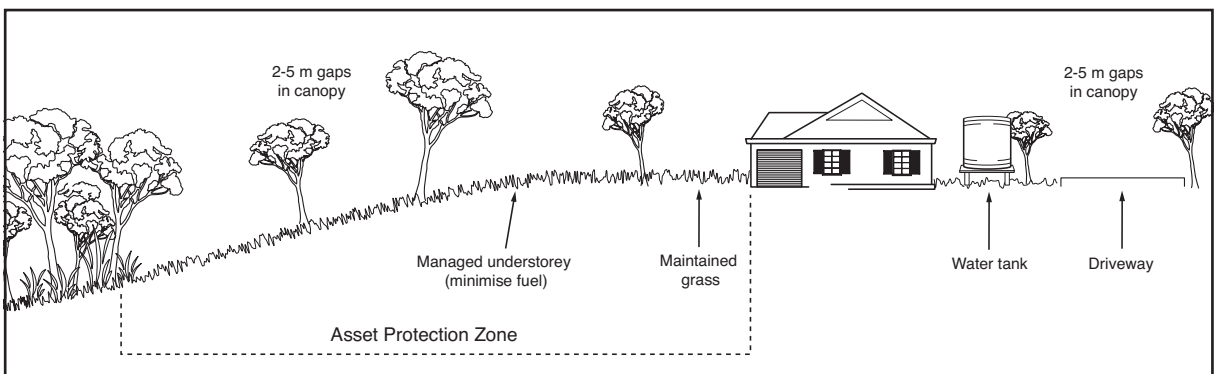


Figure A 2.1 Asset Protection Zone (setback) design

rainforests, arid shrublands and semi-arid woodlands), it is not feasible to distinguish between IPAs and OPAs and therefore all such APZs should be managed as IPAs.

An IPA should provide a tree canopy cover of less than 15% and should be located greater than 2 metres from any part of the roofline of a dwelling. Garden beds of flammable shrubs are not to be located under trees and should be no closer than 10 metres from an exposed window or door. Trees should have lower limbs removed up to a height of 2 metres above the ground.

An OPA should provide a tree canopy cover of less than 30% and should have understorey managed (mowed) to treat all shrubs and grasses on an annual basis in advance of the fire season (usually September).

A2.3 Procedure

The following procedure is to be adopted when assessing a development at a defined precinct level in order to determine whether the development is bush fire prone and if so, which setbacks will be appropriate:

- (a) Determine vegetation formations, as follows:
 - (i) identify all vegetation in all directions from the site for a distance of 140 metres;
 - (ii) consult Table A2.1 to determine the predominant vegetation type; and
 - (iii) select the predominant vegetation formation as described in Table A2.1.
- (b) Determine the effective slope of the land under the Predominant Vegetation Class and the site (slope classes are detailed on page 56).
- (c) Determine the appropriate fire (weather) area in Table A2.3 and note the relevant FDI.
- (d) Consult Tables A2.4–2.7 and determine the appropriate setback for the assessed land use, vegetation group and slope range.

(a) Predominant Vegetation Class Formation

Determine the predominant vegetation communities using high resolution (within five

metres) vegetation databases and/or field assessment by qualified persons over a distance of at least 140 metres in all directions from the proposed property boundary or building footprint on the development site. Where a mix of vegetation types exist the type providing the greater hazard is said to predominate. Vegetations descriptions are as per Keith D. 2004 in: "Ocean Shores to Desert Dunes" published by DEC (except heathlands which is provided two sub-formations rather than one based largely on vegetation height). Consideration is to be given to the understorey as this may contain the greater mass of fuels. Do not include vegetation that is to be cleared as part of the development.

For the purposes of this document, vegetation is classified (using the formations and sub-formations within Keith (2004) (see Table A2.1) into:

- forests (wet sclerophyll forests and dry sclerophyll forests);
- woodlands;
- forested wetlands;
- tall heaths;
- freshwater wetlands
- short heaths;
- alpine complex;
- semi-arid woodlands;
- arid shrublands;
- rainforests; and
- grasslands.

Plantations not being native timber plantation (usually pines) are also assessed as being a bush fire hazard with a fuel load of 20t/Ha.

Where fuel loads are to be assessed, PBP has adopted a reliable system of assessing fuel accumulation rates based on canopy cover, years since last fire and shrub layer cover (Forestry Commission of NSW, 1991). This has also been validated with published literature on fuel loads (eg. Good, 1994, Watson, 2005, Cheney and Sullivan,

PBP does not accept photo comparative assessment techniques as a basis of estimating fuel in forests for land use planning and construction purposes due to the significant variability in interpretation.

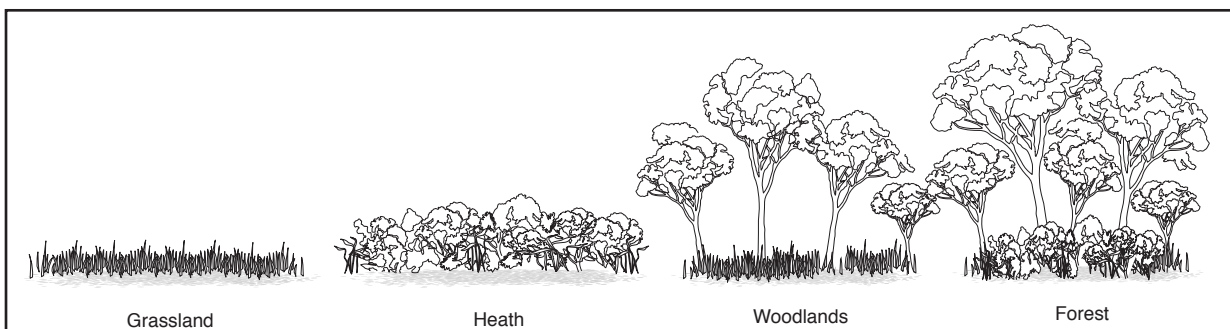
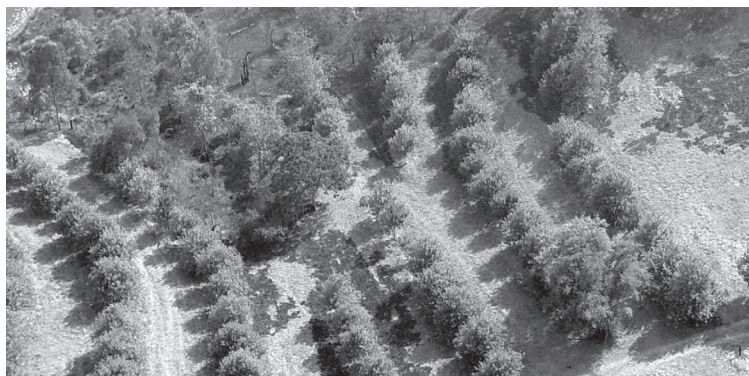


Figure A 2.2 Examples of Vegetation Types used in PBP



Riparian areas



Orchards (reduced vegetation)



Playgrounds (reduced vegetation)



Woodland remnant

Examples of non-vegetated and reduced vegetation areas.

1997, Department of Planning, 1984). For the purposes of assessing available fuel, the forest fuel is assumed to have accumulated over a period of 20 years and is the loading given for dry sclerophyll forests.

Recent experiences from bush fires in Central Western NSW have demonstrated that a significant threat can exist for developments in grassland areas. Construction requirements are not specified in relation to grassland areas and these areas may not be mapped as being bush fire prone. Grass fires can threaten the sub floor spaces of a building and may generate significant embers. The RFS supports protection of the sub floor or the integration of 1.8 metre high protective (non combustibile) fencing in conjunction with screened windows and a basic APZ of 10 metres for these situations. LEP provisions should address rural properties at threat from crop or grass fires including access, water and the above as a requirement.

Remnant vegetation is a parcel of vegetation with a size of less than 1 Ha or a shape that provides a potential fire run directly toward buildings not exceeding 50m. These remnants are considered

a low hazard and APZ setbacks and building construction standards for these will be the same as for rainforests. The effective slope is to be determined over the length of the remnant.

Although small remnants, coastal wetlands and riparian areas vary significantly in structure and composition, these areas have been generally assessed as being bush fire hazards, with the exception of saline wetlands that are assessed as being a non-hazard. Riparian areas are those areas of vegetation which are no greater than 20 metres in width and are found on either bank of a river, creek or stream identified on a bush fire prone land map, and are treated the same as rainforests.

For the purposes of assessment, the following are not considered a hazard or as a predominant vegetation class/formation and can be included within an asset protection zone:

- (a) non-vegetated areas including roads, footpaths, cycleways, waterways, buildings, rocky outcrops and the like; and**
- (b) reduced vegetation including maintained lawns, golf course fairways, playgrounds or sports fields, vineyards, orchards, cultivated ornamental gardens and commercial nurseries.**



Rainforests (Closed forest)



Dry sclerophyll forests (Open forest)



Central Western Grasslands



Semi-arid woodlands (Low woodlands)

Examples of Vegetation Formations of NSW

Table A2.1 Classification of Vegetation Formations (after Keith, 2004)

| Keith (2004) Formations | | |
|---|--|-----------------------|
| Formation class | Formation (Sub formation) Description | F (r)/F(t)* (t/ha) |
| Rainforests (Closed forest) | Closed and continuous tree canopy composed of relatively soft, horizontally-held leaves. Generally lacking in eucalypts. Understorey typically includes ferns and herbs. Vines often present in canopy or understorey. Occur mainly in areas that are reliably moist, mostly free of fire and have soils of moderate to high fertility. Typically coastal and escarpment locations. | 8/10 |
| Wet sclerophyll forests (Tall open forest) | High open tree canopy dominated by tall (typically >30m), straight-trunked eucalypt species. Luxuriant understorey composed of soft leaved shrubs, ferns and herbs. Many understorey plants are rainforest species. Found on moderately fertile soils in areas of high (>900mm) rainfall. | |
| | Shrubby sub formation Many soft-leaved shrubs and small trees in understorey. Eg. Typically sub-alpine and tableland locations. | 25/30 |
| | Grassy sub formation Fewer soft-leaved shrubs allowing a more substantial cover of grasses and herbs on the forest floor. Reflects drier habitat. Eg. Typically coastal and escarpment locations. | 20/25 |
| Grassy woodlands (Woodlands) | Dominated by an open to sparse layer of eucalypts (typically boxes and red gums) with the crowns rarely touching (ie <30% foliage cover). Typically 15-35m high (may be shorter at sub-alpine altitudes). Diverse ground cover of grasses and herbs. Long lived perennial tussock grasses form the structural matrix of the understorey. Shrubs are sparsely distributed. Found on fine textured soils of moderate to high fertility, principally on flat to undulating terrain. Rainfall 500-900mm Tablelands, western slopes, and low rainfall coastal lowlands. | 10/15 |
| Grasslands | Dominated by large perennial tussock grasses and the presence of broad-leaved herbs in the inter-tussock spaces. Lack of woody plants. Associated with fertile heavy clay soils on flat topography on in regions with low to moderate rainfall. Plants include grasses, daisies, legumes, geraniums, saltbushes and copperburrs. | 6 |
| Dry sclerophyll forests (Open forest) | Dominated by eucalypts 10-30m tall with crowns that touch or overlap (ie foliage cover of 20-50%). Prominent layer of hard-leaved shrubs. Infertile soils. Rainfall >500mm. Coast, tablelands and western slopes. | |
| | Shrub/grass sub formation Conspicuous presence of grasses in the understorey. Also have a significant shrub component, including a mixture of hard leaved and soft-leaved plants. Includes native timber plantations. | 20/25 |
| | Shrubby sub formation Understorey dominated by shrubs including waratahs, banksias, spider flowers, wattles, pea-flowers, gum trees, tea-trees, native fuschias, boronias and wax flowers. Sparse ground cover comprised mainly of hard-leaved sedges. Found on sandy infertile soils on exposed sites. | 20/25 |
| Heathlands (Shrublands) | Shrubby vegetation. Principal plant species include banksias, spider flowers, wattles, legumes, eucalypts, tea-trees, paper barks, sheoaks, grass trees, cord rushes and sedges. Grasses are scarce. Found on infertile soils and is dependant on fire. Not found in arid and semi arid locations. | |

Table A2.1 Classification of Vegetation Formations (after Keith, 2004)

| Formation class | Formation (Sub formation) Description | F (r)/F(t) * (t/ha) |
|--|---|------------------------|
| Heathlands (Shrublands) | Tall Heaths (Scrub) Heathlands greater than 2 metres tall. Includes Hawkesbury Sandstone vegetation with scattered overstorey trees and predominantly healthy understorey and coastal heath. May include some mallee eucalypts in coastal locations. | 25 |
| | Short Heath (Open Shrub) Heathlands less than 2 meters in height. Often more open in canopy. | 15 |
| Alpine complex (Sedgeland) | Structural dominance by small-leaved shrubs, herbs and tussocky grasses. Seasonal dormancy and snow tolerance. A lack of trees. | 17 |
| Freshwater wetlands | Areas permanently or temporarily inundated either by standing or running water (swamps). Dominated by sedges, shrubs or herbs. Excludes wetlands dominated by trees and those with significant quantities of salt. Coast, tablelands, western slopes and plains. | 15 |
| Forested wetlands | Restricted to riverine corridors and floodplains subject to periodic inundation. Dominated by eucalypts, tea-trees and paperbarks or sheoaks. Distinguished by presence of hydrophytes, woody plants that can live in flooded environments eg. sedges, rushes, buttercups, knot weeds, lignum, ferns and grasses. Found generally low altitudes. Soils vary from peaty and semi-humic loam soils to mineral clays and sandy loams. Coast, tablelands, and inland. | 15/20 |
| Saline wetlands | Distinguished by an abundance of salt. Halophytes abundant. Eg mangrove swamps, salt marshes and seagrass meadows. Coast (tidal estuaries) and western plains (salt lakes). | - |
| Semi-arid woodlands (Low woodlands) | Widely spaced tree canopies, trees 5-20m tall. Dominance of sclerophyllous trees (box eucalypts, mallee eucalypts, sheoaks, wattles and cypress pines), drought resistant shrubs and ephemeral grasses and herbs. Rainfall 250-500mm/year. Western plains. | |
| | Grassy sub formation Occurs on floodplains. Understorey predominantly grassy, although chenopod shrubs may be common in some local areas. Can be distinguished from grassy woodlands by their more ephemeral ground cover and predominant trees and shrubs, all of which have inland distributions. | 5/18 |
| | Shrubby sub formation Occurs on more elevated areas or uplands. Shorter trees <15m and less cover of grasses than the grassy formation. Abundant drought resistant shrubs and variable grass cover. Eg. Mallee woodland | 8 |
| Arid shrublands | Dominated by drought-tolerant shrubs, including chenopods. Occur where the rainfall or local soil moisture is too low to support tree-dominated vegetation. Rainfall <500mm. Western plains. | |
| | Chenopod sub formation (Low shrublands) Dominated by low shrubs (mostly <1.5m tall) such as saltbushes, bluebushes and copperburrs. Ground cover of perennial tussock grass (never hummock grass). Found on lime-rich calcareous or saline soils. | 9 |
| | Acacia sub formation (Tall shrublands) Shrubs usually taller than 2m, dominated by various acacia species and other large shrubs. May have abundant hummock grass (spinifex) ground cover. Found on silica rich soils. Eg. Mulga shrubland | 9 |

* Fuel loads are expressed as fuels contributing to rates of spread [F(r)] and total fuel loads [F(t)] that contribute to intensity. Single figures denote same values for both based on bush fire behaviour models.

(b) Effective Slope

Assess the slope over a distance of at least 100m from the existing property boundary (for subdivision) or building footprint (for SFPP) on the development site towards the various vegetation communities constituting the hazard. In assessing the slope, it may be found that there are a variety of slopes covering different distances. Determine the gradient within the hazard (vegetation) which will most significantly influence the fire behaviour of the site having regard to vegetation class found.

Slope assessment may be derived from topographic maps displaying 10 metre contour intervals. Where land is being surveyed by a land surveyor, assessments should be based on a minimum of five metre contours.

The slope is determined in terms of the following classes, relative to the location of the hazard:

- (i) all upslope vegetation (considered 0°)
- (ii) >0 to 5° downslope vegetation
- (iii) >5 to 10° downslope vegetation
- (iv) >10 to 15° downslope vegetation
- (v) >15 to 18° downslope vegetation

APZ tables in this Appendix are provided for acceptable solutions with slopes of up to 18 degrees. Effective slopes to be assessed with hazards in excess of 18 degrees will require a detailed performance assessment

| SLOPE COMPARISONS | | |
|-------------------|---------|------------|
| Ratio | Degrees | Percentage |
| 1:1 | 45 | 100% |
| 1:1.5 | 34 | 66% |
| 1:2 | 26 | 50% |
| 1:2.5 | 21 | 40% |
| 1:3 | 18 | 33% |
| 1:3.5 | 15 | 28% |
| 1:4 | 14 | 25% |
| 1:4.5 | 12 | 22% |
| 1:5 | 11 | 20% |
| 1:5.5 | 10 | 18% |
| 1:6 | 9 | 16% |
| 1:6.5 | 9 | 15% |
| 1:7 | 8 | 14% |
| 1:7.5 | 8 | 13% |
| 1:8 | 7 | 12% |
| 1:8.5 | 7 | 11% |
| 1:9 | 6 | 11% |
| 1:10 | 6 | 10% |
| 1:11 | 5 | 9% |
| 1:12 | 5 | 8% |
| 1:13 | 4 | 8% |
| 1:14 | 4 | 7% |
| 1:15 | 4 | 7% |
| 1:16 | 4 | 6% |
| 1:17 | 3 | 6% |
| 1:18 | 3 | 5.5% |
| 1:19 | 3 | 5% |
| 1:20 | 3 | 5% |

Table A 2.2 Slope Comparisons

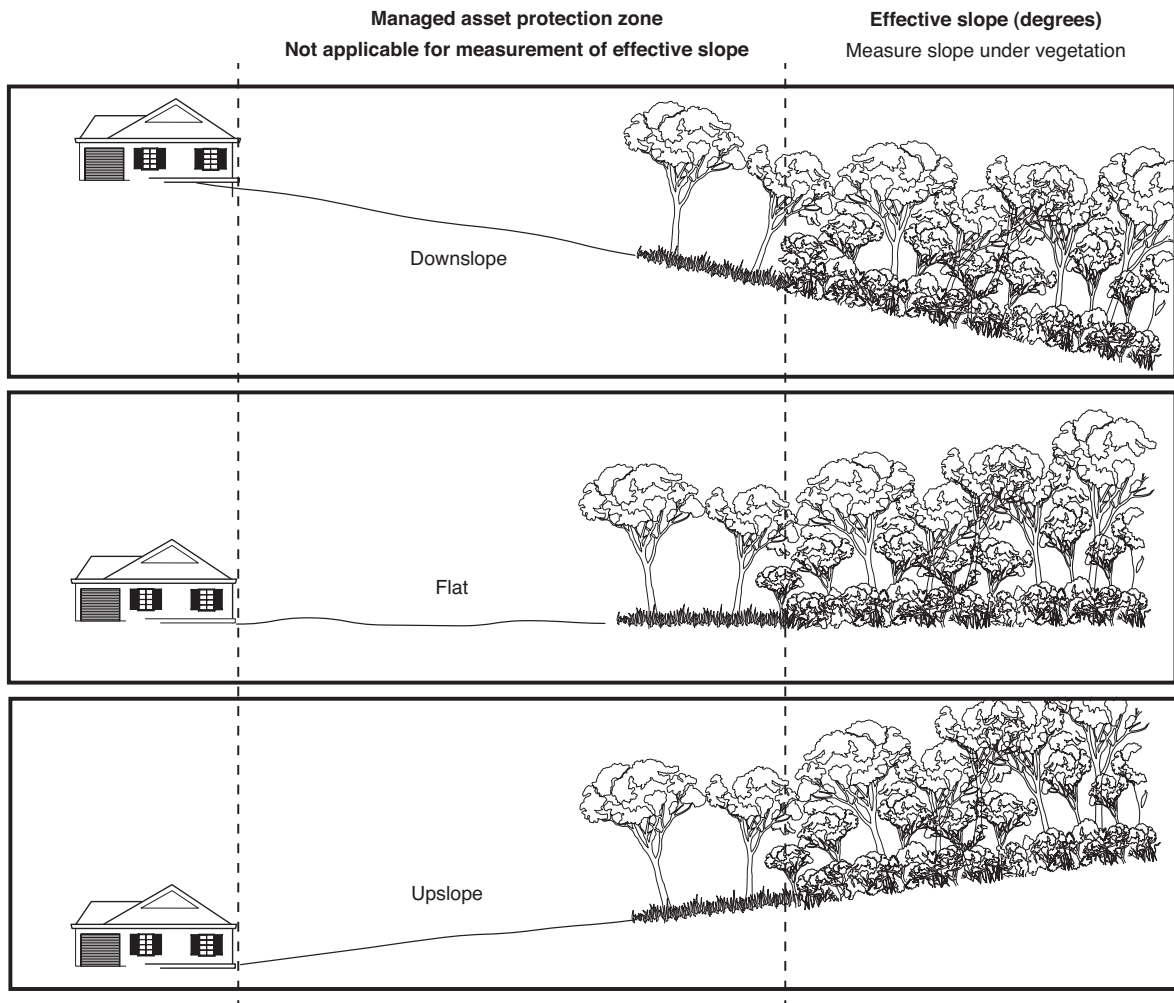


Figure A2.3 Determining Effective Slope

| | | |
|--|--|--|
| <p>1. FAR NORTH COAST (80) Ballina Byron Clarence Valley Kyogle Lismore Richmond Valley Tweed</p> <p>2. NORTH COAST (80) Bellingen Coffs Harbour Gloucester Great Lakes Greater Taree Hastings Kempsey Nambucca</p> <p>3. GREATER HUNTER (100) Cessnock Dungog Lake Macquarie Maitland Muswellbrook Newcastle Port Stephens Singleton Upper Hunter</p> <p>4. GREATER SYDNEY REGION (100) All Sydney Metropolitan Councils Plus Gosford, Blue Mountains, Hawkesbury and Wyong</p> <p>5. ILLAWARRA/SOALHAVEN (100) Kiama Shellharbour Shoalhaven Wingecarribee Wollondilly Wollongong</p> <p>6. FAR SOUTH COAST (100) Bega Valley Eurobodalla</p> <p>7. MONARO ALPINE (80) Bombala Cooma Monaro Snowy River</p> | <p>8. ACT (N/A) Australian Capital Territory</p> <p>9. SOUTHERN RANGES (100) Palerang Goulburn Mulwaree Queanbeyan Upper Lachlan Yass Valley</p> <p>10. CENTRAL RANGES (80) Bathurst Blayney Cabonne Cowra Lithgow Mid Western Regional Oberon Orange</p> <p>11. NEW ENGLAND (80) Armidale Dumaresq Glen Innes Severn Guyra Tenterfield Uralla Walcha</p> <p>12. NORTHERN SLOPES (80) Gunnedah Gwydir Inverell Liverpool Plains Tamworth Regional</p> <p>13. NORTH WESTERN (80) Moree Plains Narrabri Walgett Warrumbungle</p> <p>14. UPPER CENTRAL WEST PLAINS (80) Bogan Coonamble Gilgandra Warren</p> <p>15. LOWER CENTRAL WEST PLAINS (80) Bland Dubbo Forbes Lachlan</p> | <p>Narromine Parkes Temora Weddin Wellington</p> <p>16. SOUTHERN SLOPES (80) Boorowa Cootamundra Gundagai Harden Tumbarumba Tumut Young</p> <p>17. EASTERN RIVERINA (80) Albury Coolamon Greater Hume Junee Lockhart Wagga Wagga</p> <p>18. SOUTHERN RIVERINA (80) Berrigan Conargo Corowa Deniliquin Jerilderie Murray Urana Wakool</p> <p>19. NORTHERN RIVERINA (80) Carrathool Griffith Hay Leeton Murrumbidgee Narrandera</p> <p>20. SOUTH WESTERN (80) Balranald Wentworth</p> <p>21. FAR WESTERN (80) Bourke Brewarrina Broken Hill Central Darling Cobar Unincorporated NSW</p> |
|--|--|--|

Table A2.3 NSW Fire Areas and associated council areas with appropriate FDI rating assumed as a 1:50 year event.

(c) Determining Appropriate Fire (Weather) Areas

For residential and rural residential subdivisions locate the site in terms of the local council area (see inside rear cover and Table A2.3) where the development is to be located and determine the appropriate fire areas and corresponding FDI rating. For SFPP's see (d) below.

(d) Determining Appropriate Asset Protection Zones (APZs)

Consult Tables A2.4 and A2.5 (for subdivisions) for each respective vegetation class and appropriate FDI rating. **These setbacks are based upon the need to conform to Level 3 (except grasslands) construction (AS 3959 – 1999) for a building of Class 1 or 2 under the BCA.**

Grasslands of 100 metres from any boundary (subdivision) or buildings (SFPPs) do not require construction requirements in conformity with AS 3959 – 1999 or this document but requires an APZ of 10 metres for slopes 18°.

If it is intended to construct to a lower bush fire protection standard (e.g. Level 1 or 2) or to no specific bush fire protection standards, Appendix 3 should be consulted for the appropriate setbacks for individual circumstances.

For SFPPs (e.g. SEPP – Seniors Living and Class 3 buildings), Table A2.6 is used. In interpreting the Tables refer to the accompanying notes to these Tables.

Location of APZs on slopes greater than 18 degrees is not supported for new developments on wooded vegetation, due to environmental constraints and difficulties in managing vegetation. In addition, vegetation could carry a canopy fire along these steep slopes where an understorey would otherwise normally be required to support a sustained crown fire.

APZs should be identified on plans for interface allotments by either a building line or building footprint. In some cases building envelopes are identified which include other building constraints. Unless otherwise specified, a building envelope will be taken as the building footprint.

Where the predominant vegetation is removed in establishing the required APZ, the site should be reassessed and the dimensions of the APZ may be adjusted in the light of the remaining predominant vegetation.

Allowable OPAs within an APZs are set out in Table A2.7 for forest vegetation.

Table A2.4 Minimum Specifications for Asset Protection Zones (m) for Residential and Rural Residential Subdivision Purposes (for Class 1 and 2 buildings) in FDI 100 Fire Areas ($\leq 29\text{kW}/\text{m}^2$)

| Vegetation Formation | Effective Slopes | | | | |
|--------------------------|------------------|--------|---------|----------|----------|
| | Upslope/Flat | >0°-5° | >5°-10° | >10°-15° | >15°-18° |
| Rainforests | 10 | 10 | 15 | 20 | 25 |
| Forests | 20 | 25 | 35 | 50 | 60 |
| Woodland (Grassy) | 10 | 15 | 20 | 25 | 30 |
| Plantations (Pine) | 20 | 25 | 30 | 45 | 50 |
| Tall Heath (Scrub) | 15 | 15 | 20 | 20 | 20 |
| Short Heath (Open Scrub) | 10 | 10 | 10 | 15 | 15 |
| Freshwater Wetlands | 10 | 10 | 10 | 15 | 15 |
| Forested Wetlands | 15 | 20 | 25 | 35 | 45 |

Table A2.5 Minimum Specifications for Asset Protection Zones (m) for Residential and Rural Residential Subdivision Purposes (for Class 1 and 2 buildings) in FDI 80 Fire Areas ($\leq 29\text{kW}/\text{m}^2$)

| Vegetation Formation | Effective Slopes | | | | |
|--------------------------|------------------|--------|---------|----------|----------|
| | Upslope/Flat | >0°-5° | >5°-10° | >10°-15° | >15°-18° |
| Rainforests | 10 | 10 | 15 | 15 | 20 |
| Forests | 20 | 20 | 30 | 40 | 45 |
| Woodland | 10 | 15 | 15 | 20 | 25 |
| Plantations (Pine) | 15 | 20 | 25 | 35 | 40 |
| Tall Heath (Scrub) | 15 | 15 | 20 | 20 | 20 |
| Short Heath (Open Scrub) | 10 | 10 | 10 | 15 | 15 |
| Freshwater Wetlands | 10 | 10 | 10 | 15 | 15 |
| Forested Wetlands | 15 | 20 | 20 | 30 | 35 |
| Semi-Arid (Woodland) | 10 | 10 | 10 | 10 | 15 |
| Arid Shrubland | 10 | 10 | 10 | 15 | 15 |

Table A2.6 Minimum Specifications for Asset Protection Zones (m) for Special Fire Protection Purposes in bush fire prone areas ($\leq 10\text{kW}/\text{m}^2$)

| Vegetation Formation | Effective Slopes | | | | |
|--------------------------|---|--------|---------|----------|----------|
| | Upslope/Flat | >0°-5° | >5°-10° | >10°-15° | >15°-18° |
| Rainforests | 30 | 40 | 50 | 60 | 65 |
| Forests | 60 | 70 | 85 | 100 | 100 |
| Woodland (Grassy) | 40 | 50 | 60 | 70 | 75 |
| Plantations (Pine) | 50 | 60 | 70 | 85 | 95 |
| Tall Heath (Scrub) | 45 | 50 | 55 | 60 | 65 |
| Short Heath (Open Scrub) | 35 | 35 | 40 | 45 | 45 |
| Freshwater Wetlands | 35 | 35 | 40 | 45 | 45 |
| Forested Wetlands | 50 | 60 | 75 | 90 | 95 |
| Semi-Arid (Woodland) | 30 | 35 | 40 | 45 | 50 |
| Arid Shrubland | 30 | 35 | 40 | 45 | 45 |
| Alpine Resorts | (see page 31 and Table A3.5 on page 66) | | | | |

Table A2.7 Determining Allowable Outer Protection Areas (m) for forest vegetation within an APZ

| | Effective Slopes | | | | |
|-------------------------------|------------------|--------|---------|----------|----------|
| | Upslope/Flat | >0°-5° | >5°-10° | >10°-15° | >15°-18° |
| Forests FDI 100 - subdivision | 10 | 10 | 15 | 25 | 30 |
| Forests FDI 80 - subdivision | 10 | 5 | 15 | 20 | 20 |
| Forests SFPP | 20 | 20 | 25 | 30 | 25 |

Note: Vegetation Formations based on Keith D. (2004) - see pages 54 - 55

For Forest Vegetation Formations, APZs can incorporate IPAs and OPAs (see page 50). OPAs to the distances specified in Table A2.7 are allowable subject to meeting the performance requirements for the OPAs. The balance of the APZ is to be managed as an IPA.

Appendix 3

Site Bush Fire Attack Assessment

A3.1 Introduction

Within this appendix, words that are italicised are commentary and do not form part of the requirements for site assessment or the provision of a deemed-to-satisfy solution under the Building Code of Australia (BCA).

This appendix sets out the site assessment methodology for NSW for determining the required level of construction from Section 3 of AS 3959 that applies to a building in a designated bush fire prone area.

This appendix replaces Section 2 of that Standard. This site assessment methodology forms part of the deemed-to-satisfy provisions of the Building Code of Australia (BCA) for NSW for construction in designated bushfire prone areas.

The term “designated bushfire prone area” is defined in the Building Code of Australia (BCA). NSW has varied the national BCA definition of this term. Refer to the relevant NSW variations in Volumes One and Two of the BCA.

A3.2 Application

This site assessment methodology applies to buildings to which the bush fire provisions of the BCA apply.

In NSW the BCA bush fire protection provisions are applied to (via a State variation to the BCA for NSW) Class 1, 2, 3 buildings, Class 4 parts of buildings and Class 9 buildings that are Special Fire Protection Purposes (SFPPs).

The methodology in this appendix applies as follows:

- *For new residential dwellings the methodology mirrors that in Appendix 2 for addressing APZ requirements. The assumption is that APZ and construction standards (and other measures) work together and, when subdividing land, the subsequent buildings can be built in accordance with AS 3959.*
- *For SFPPs the methodology should be addressed afresh. In other words, if a formal APZ currently does not exist, distances are to be measured from the boundary of the bush fire hazard to buildings (where the vegetation is maintained in a fuel free condition). An area is described as having a fuel free condition where the vegetation is maintained to the standard required in an APZ, as established in this document.*

- *Generally, no bush fire construction requirements apply to any proposed building located more than 100 metres away from a bush fire hazard.*

A3.3 Basis of the site assessment methodology: radiant heat flux and required separation distances

There are a number of basic concepts underpinning the requirements of PBP. Each is briefly described below:

(a) Radiant heat flux and fire intensity

Fire intensity is the rate of heat release, per unit length of the fire front, measured in kilowatts per metre (kW/m). It is a function of the heat content and weight of the fuel and the rate of spread of the fire. Radiant heat flux is a measure of heat energy impacting on a surface (kW/m²).

Research has shown the effects of increasing radiant heat flux on buildings and people. This is shown in Figure A3.1

(b) Fuel loads

Fuel is any organic matter available for ignition and combustible components include leaves, twigs, bark and residue (J.Gould, 2003). Fuel load is a measure (tonnes per hectare) of the accumulated vegetative matter available to a resultant bush fire.

Determination of the protection measures required, is based on an estimation of the maximum hazard which, in turn, is based on maximum possible fuel loads likely to occur on and adjacent to the development site.

(c) Flame zone

The distance from a bush fire at which there is significant potential for sustained flame contact to a building. Flame length will vary (short/long) depending on wind and slope. Minimum defendable area and APZ requirements reflect flame length/zone calculations.

(d) Determining appropriate hazard parameters

A robust hazard assessment for habitable building development must quantify, for different vegetation types, the parameters of fire attack (embers, radiant heat, flame contact and wind) that damage or destroy buildings. This system must relate these parameters to threshold values of vulnerable components of buildings (CSIRO, 2000).

Determining appropriate hazard parameters requires measurements or models to describe:

- components of structures, the threshold values for radiant heat flux and their duration;
- the flame characteristics of temperature, emissivity and hence radiant heat flux at the flame;
- different vegetation types, the flame height and width of flame-front and flame duration for high intensity bush fires as they reach the edge of vegetation; and
- the value for radiant heat flux as a function of distance from walls of flame of different dimensions. (see CSIRO, 2000)

In 2004, the RFS developed a model which related hazard parameters to various building components. This model has been used as a basis for developing the following methodology. Table A3.2 can and should be used for determining the likely level of bush fire attack on a building and hence which level of construction from AS 3959 is appropriate in the particular circumstances.

The methodology is based on radiant heat flux derived for 12 vegetation formations (10 sub-formations), six slope classes and appropriate regional weather conditions and applied to different construction standards.

At radiant heat flux levels under 12.5 kW/m², unscreened windows may crack and allow heat and embers to enter the building leading to a building fire. At 19 kW/m² screened windows could fail. At levels of 29 kW/m² fascia board and flame retardant timbers are likely to ignite after a short period of exposure. Toughened glass is generally suitable up to levels of approximately 25 kW/m² and requires screening at levels above this. For building elements

subject to radiant heat levels of greater than 29 kW/m², the use of exposed timber is not suitable without specific testing in accordance with suitable protocols.

The distances below can be considered on the basis of the various elements of a building when subject to heat, flames and ember attack. Extensive ember attack can occur beyond 100 metres ahead of a bush fire, however, distances are limited to a maximum of 100 metres for class 1, 2, 3 and Class 4 parts of buildings and Class 9 buildings that are SFPP.

Figure A3.1 and Table A3.1 summarise the relationship between radiant heat levels and required separation (APZ) distance

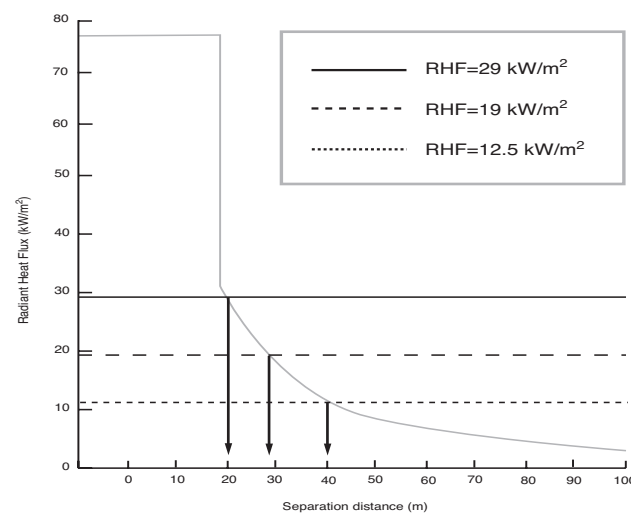


Figure A3.1 Sample radiation - distance graph of forests for FDI = 100 (0° slope)

| Radiant Heat Flux | Likely Effects | Approx. distances |
|-----------------------------|---|-------------------|
| >29 – 110 kW/m ² | Flame Zone | 0 - 20 metres |
| 29 kW/m ² | Ignition of most timbers without piloted ignition (3 minutes exposure) (Level 3 construction) during the passage of a bush fire. Toughened glass could fail. | 20 metres |
| 19 kW/m ² | Screened float glass could fail (Level 2 construction) during the passage of a bush fire. | 27 metres |
| 12.5 kW/m ² | Standard float glass could fail (Level 1 construction) during the passage of a bush fire. Some timbers can ignite with prolonged exposure and with piloted ignition source (eg embers). | 40 metres |
| 10 kW/m ² | Critical conditions. Firefighters not expected to operate in these conditions although they may be encountered. Considered to be life threatening < 1 minute in protective equipment. Fabrics inside a building could ignite spontaneously with long exposures. | 45 metres |
| 7 kW/m ² | Likely fatal to unprotected person after exposure for several minutes | 55 metres |
| 4.7 kW/m ² | Extreme conditions. Firefighter in protective clothing will feel pain. (60 seconds exposure) | 70 metres |
| 3 kW/m ² | Hazardous conditions. Firefighters expected to operate for a short period (10 minutes) | 100 metres |
| 2.1 kW/m ² | Unprotected person will suffer pain after 1 minute exposure - non fatal. | 140 metres |

Note: assumes flame temperature of 1090K for all scenarios.

Table A3.1 Radiant heat flux and effects on buildings and people for a modeled forest fire (FDI 100 on flat ground)

Five categories of bush fire attack and three construction standards are determined and described in Table A3.2 below.

Level 1 construction standards shall apply if the proposed building is located within the specified distances within Tables A.3.3, A3.4 and A3.5 for **Medium** Bush Fire Attack (in AS 3959).

Level 2 construction standards shall apply if the proposed building is located within the specified distances within Tables A.3.3, A3.4 and A3.5 for **High** Bush Fire Attack (in AS 3959).

Level 3 construction standards shall apply if the proposed building is located within the specified distances within Tables A.3.3, A3.4 and A3.5 for **Extreme** Bush Fire Attack (in AS 3959).

Performance based assessments will need to apply if the building exceeds the specification of Level 3 of AS 3959 (ie $>29 \text{ kW/m}^2$) in which case it is considered to be within the 'Flame Zone'.

In general, a deemed-to-satisfy outcome can be achieved where the building is exposed to a radiant heat of less than 29 kW/m^2 without flame contact. There is no deemed-to-satisfy for

construction in the **Flame Zone**. Applicants need to consider the Performance Requirements of the BCA and the Specific Objectives of PBP for the type of building constructed as well as A3.5 below.

Construction should not proceed where the proposed building has been identified as being at unacceptable risk because of any of the following:

- *flame impingement will result in insufficient defensible space to protect the structure. These areas are identified as being within the Flame Zone;*
- *there is no safe escape route for the building occupants and firefighters likely to be involved in protecting the building and its occupants during a bush fire.*

The level of construction cannot fall to less than Level 1 construction where any part of the building is closer than 100 metres to the source of bush fire attack (unless otherwise provided for).

An elevation is exposed if there is a direct line of sight from any part of that elevation to the source of the bush fire attack (excluding fencing and other minor obstructions).

| PBP Category | Description | AS 3959 Construction Level |
|-------------------|--|------------------------------------|
| Low | Minimal attack from radiant heat and flame due to the distance of the site from the vegetation, although some attack by burning debris is possible. There is insufficient threat to warrant specific construction requirements. | Low - no construction requirements |
| Medium | Attack by burning debris is significant with radiant heat (not greater than 12.5 kW/m^2). Radiant heat is unlikely to threaten building elements (eg unscreened glass). Specific construction requirements for ember protection and accumulation of debris are warranted. | Medium - Level 1 |
| High | Attack by burning debris is significant with radiant heat levels (not greater than 19 kW/m^2) threatening some building elements (screened glass). Specific construction requirements for embers and radiant heat are warranted. | High - Level 2 |
| Extreme | Attack by burning debris is significant and radiant heat levels (not greater than 29 kW/m^2) threaten building integrity. Specific construction requirements for ember and higher radiant heat are warranted. Some flame contact is possible. | Extreme - Level 3 |
| Flame Zone | Radiant heat levels and flame contact likely to significantly threaten building integrity and result in significant risk to residents who are unlikely to be adequately protected. | Outside Scope |

Note: Attack from burning debris increases as the category of bush fire attack becomes more severe.

Table A3.2 Categories of bush fire attack and appropriate construction levels

The key to determining required level of construction is the category of bush fire attack. The following subsection describes how to determine these categories.

A3.4 Site assessment methodology for determining level of bush fire attack

This general method has been used to determine the categories of bush fire attack using NSW data. This provides a more refined bush fire attack site assessment.

The methodology was developed (see Douglas and Tan, 2005) from the following inputs:

- *the relevant weather scenario for the fire weather district in NSW (see inside rear cover and Table A2.3)*
- *vegetation types and the corresponding fuel types present were determined (see Table A2.1)*
- *the appropriate fuel loads for the fuel types were used for input into fire behaviour models*
- *the fire-line intensity (kW/m) for a range of slope and distance combinations was calculated*
- *the sustained flame length was calculated and appropriate flame temperature applied (1090K)*
- *distance classes for radiant heat flux for 12.5 kW/m², 19 kW/m² and 29 kW/m² were determined using the View Factor model*
- *based on the calculated fire behaviour, the level of bush fire attack (Levels 1, 2, and 3) corresponding to the relevant radiant heat flux on the proposed building was then determined. If the distance was less than the theoretical flame length then the application of AS 3959 construction levels are exceeded (i.e. Flame Zone). At distances greater than 100 metres no specific construction provisions are required for forests, woodlands and tall heaths. For arid shrublands, semi arid woodlands, rainforests and low heaths construction requirements may not be required at distances greater than 50 metres and in the case of rainforest 70 metres.*

This procedure is based upon the generic method described above and uses the weather scenario of an appropriate Forest Fire Danger Index (FDI) (for forest fuels), wind speeds of 45kph and typical fuel loads for NSW vegetation experienced during a severe bush fire in NSW.

To determine the required level of construction for a building the following steps must be followed:

Step 1: Determine vegetation formation types and sub-formations around the building (see Appendix 2), as follows:

- (i) Identify all the vegetation types within 140 metres of the site using Keith (2004); and
- (ii) Classify the vegetation formations as set out in Table A2.1 in Appendix 2.

Note: Forests within Tables A3.3, A3.4 and A3.5 include wet sclerophyll, dry sclerophyll and pine plantation forests. Forest fuel loads are based on dry sclerophyll forest formations except for alpine forest.

Step 2: Determine the distance between each vegetation formation identified (from the edge of the foliage cover) and the building.

Step 3: Determine the effective slope of the ground for each vegetation group (see Appendix 2) using the classes provided below. Slopes are classified as follows:

- (i) Upslopes are considered to be 0°.
- (ii) From 0° but not greater than 5°.
- (iii) Greater than 5° but not greater than 10°.
- (iv) Greater than 10° but not greater than 15°.
- (v) Greater than 15° but not greater than 18°.

Step 4: Determine the relevant FDI for the council area in which the development is to take place from Table A2.3 in Appendix 2. For Alpine Resorts see Step 5 below.

Step 5: Match the relevant FDI, appropriate vegetation, distance and effective slope classes to determine the category of bush fire attack applicable to the site.

- FDI 100 – Table A3.3 (page 63)
 - FDI 80 – Table A3.4 (page 64)
 - FDI 50 – Table A3.5 (page 65)
- apply the relevant attack category to each facade.

Note: A building with any facade identified as requiring a construction level must build all facades to at least Level 1, corresponding to Medium attack.

Step 6: Determine the appropriate level of construction found in Section 3 of AS3959 as identified within Table A3.3 to A3.5 below for each facade of the building. For the categories of bush fire attack determined for the site of the building there are five corresponding bush fire attack levels and three levels of bush fire construction with deemed-to-satisfy arrangements:

- (i) No specific construction requirements for the category of low bush fire attack;
- (ii) Level 1 construction for the category of medium bush fire attack;
- (iii) Level 2 construction for the category of high bush fire attack;
- (iv) Level 3 construction for the category of extreme bush fire attack;
- (v) Specific performance levels are unachievable for the category of Flame Zone.

Where more than one facade is exposed to a hazard, then the facade with the highest construction requirement is used to determine the appropriate level of construction. All other facades may be reduced by one level of construction unless that facade is also subject to the same category of bush fire attack.

Table A3.3 DETERMINATION OF CATEGORY OF BUSH FIRE ATTACK FDI 100
(Greater Sydney, Greater Hunter, Illawarra/Shoalhaven, Southern Ranges, South Coast Fire (Weather) Areas) (see table A 2.3).

| Vegetation Formation (class) | Categories of Bush Fire Attack (AS 3959-1999) | | | | |
|--|--|----------------------|-------------------|---------------------|-------------------|
| | Flame Zone | Level 3 (Extreme) | Level 2 (High) | Level 1 (Medium) | No requirement |
| | Distance (m) of the site from the predominant vegetation class | | | | |
| All upslopes and flat land (0 degrees) | | | | | |
| Forests (wet and dry sclerophyll) | <20 | 20-<29 | 29-<40 | 40 - 100 | >100 |
| Woodlands | <11 | 11-<16 | 16-<23 | 23 - 100 | >100 |
| Tall heath | <13 | 13-<19 | 19-<27 | 27 - 100 | >100 |
| Short heath | <9 | 9-<13 | 13-<19 | 19 - 50 | >50 |
| Forested wetlands | <16 | 16-<23 | 23-<32 | 32 - 50 | >100 |
| Freshwater wetlands | <9 | 9-<13 | 13-<19 | 19 - 50 | >50 |
| Rainforest | <9 | 9-<13 | 13-<19 | 19 - 50 | >50 |
| Downslope > 0 to 5 degrees | | | | | |
| Forests (wet and dry sclerophyll) | <25 | 25-<36 | 36-<49 | 49 - 100 | >100 |
| Woodlands | <14 | 14-<20 | 20-<29 | 29 - 100 | >100 |
| Tall heath | <15 | 15-<22 | 22-<31 | 31 - 100 | >100 |
| Short heath | <10 | 10-<15 | 15-<22 | 22 - 50 | >50 |
| Forested wetlands | <20 | 20-<29 | 29-<40 | 40 - 100 | >100 |
| Freshwater wetlands | <10 | 10-<15 | 15-<22 | 22 - 50 | >50 |
| Rainforest | <10 | 10-<16 | 16-<24 | 24 - 50 | >50 |
| Downslope > 5 to 10 degrees | | | | | |
| Forests (wet and dry sclerophyll) | <34 | 34-<45 | 45-<59 | 59 - 100 | >100 |
| Woodlands | <18 | 18-<26 | 26-<37 | 37 - 100 | >100 |
| Tall heath | <17 | 17-<24 | 24-<35 | 35 - 100 | >100 |
| Short heath | <10 | 10-<17 | 17-<25 | 25 - 50 | >50 |
| Forested wetlands | <25 | 25-<36 | 36-<49 | 49 - 100 | >100 |
| Freshwater wetlands | <10 | 10-<17 | 17-<25 | 25 - 50 | >50 |
| Rainforest | <14 | 14-<21 | 21-<31 | 31 - 50 | >50 |
| Downslope > 10 to 15 degrees | | | | | |
| Forests (wet and dry sclerophyll) | <47 | 47-<55 | 55-<71 | 71 - 100 | >100 |
| Woodlands | <24 | 24-<33 | 33-<46 | 46 - 100 | >100 |
| Tall heath | <19 | 19-<28 | 28-<39 | 39 - 100 | >100 |
| Short heath | <13 | 13-<19 | 19-<28 | 28 - 50 | >50 |
| Forested wetlands | <35 | 35-<45 | 45-<60 | 60 - 100 | >100 |
| Freshwater wetlands | <13 | 13-<19 | 19-<28 | 28 - 50 | >50 |
| Rainforest | <19 | 19-<28 | 28-<39 | 39 - 60 | >60 |
| Downslope > 15 to 18 degrees | | | | | |
| Forests (wet and dry sclerophyll) | <57 | 57-<62 | 62-<80 | 80 - 100 | >100 |
| Woodlands | <29 | 29-<38 | 38-<52 | 52 - 100 | >100 |
| Tall heath | <20 | 20-<30 | 30-<41 | 41 - 100 | >100 |
| Short heath | <14 | 14-<21 | 21-<30 | 30 - 50 | >50 |
| Forested wetlands | <43 | 43-<51 | 51-<67 | 67 - 100 | >100 |
| Freshwater wetlands | <14 | 14-<21 | 21-<30 | 30 - 50 | >50 |
| Rainforest | <23 | 23-<32 | 32-<44 | 44 - 70 | >70 |

Note: "Forests" refers to wet sclerophyll forest, dry sclerophyll forest and plantation forest (including pine plantations).

Appendices

Table A 3.4 DETERMINATION OF CATEGORY OF BUSH FIRE ATTACK FDI 80

| Vegetation Formation (class) | Categories of Bush Fire Attack (AS 3959-1999) | | | | |
|--|--|----------------------|-------------------|---------------------|-------------------|
| | Flame Zone | Level 3 (Extreme) | Level 2 (High) | Level 1 (Medium) | No requirement |
| | Distance (m) of the site from the predominant vegetation class | | | | |
| All upslopes and flat land (0 degrees) | | | | | |
| Forests (wet and dry sclerophyll) | <17 | 17-<25 | 25-<35 | 35 - 100 | >100 |
| Woodlands | <9 | 9-<14 | 14-<20 | 20 - 100 | >100 |
| Tall heath | <13 | 13-<19 | 19-<27 | 27 - 100 | >100 |
| Short heath | <9 | 9-<13 | 13-<19 | 19 - 50 | >50 |
| Low woodland (semi-arid) | <7 | 7-<10 | 10-<15 | 15 - 50 | >50 |
| Arid shrublands | <8 | 8-<12 | 12-<18 | 18 - 50 | >50 |
| Forested wetlands | <13 | 13-<19 | 19-<28 | 28 - 50 | >100 |
| Freshwater wetlands | <9 | 9-<13 | 13-<19 | 19 - 50 | >50 |
| Rainforest | <7 | 7-<11 | 11-<16 | 16 - 50 | >50 |
| Downslope > 0 to 5 degrees | | | | | |
| Forests (wet and dry sclerophyll) | <22 | 22-<31 | 31-<42 | 42 - 100 | >100 |
| Woodlands | <12 | 12-<17 | 17-<25 | 25 - 100 | >100 |
| Tall heath | <15 | 15-<22 | 22-<31 | 31 - 100 | >100 |
| Short heath | <10 | 10-<15 | 15-<22 | 22 - 50 | >50 |
| Low woodland (semi-arid) | <8 | 8-<11 | 11-<17 | 17 - 50 | >50 |
| Arid shrublands | <9 | 9-<14 | 14-<21 | 21 - 50 | >50 |
| Forested wetlands | <17 | 17-<24 | 24-<34 | 34 - 100 | >100 |
| Freshwater wetlands | <10 | 10-<15 | 15-<22 | 22 - 50 | >50 |
| Rainforest | <9 | 9-<14 | 14-<20 | 20 - 50 | >50 |
| Downslope > 5 to 10 degrees | | | | | |
| Forests (wet and dry sclerophyll) | <28 | 28-<38 | 38-<52 | 52 - 100 | >100 |
| Woodlands | <15 | 15-<22 | 22-<32 | 32 - 100 | >100 |
| Tall heath | <17 | 17-<24 | 24-<35 | 35 - 100 | >100 |
| Short heath | <10 | 10-<17 | 17-<25 | 25 - 50 | >50 |
| Low woodland (semi-arid) | <9 | 9-<14 | 14-<20 | 20 - 50 | >50 |
| Arid shrublands | <10 | 10-<16 | 16-<24 | 24 - 50 | >50 |
| Forested wetlands | <20 | 20-<31 | 31-<42 | 42 - 100 | >100 |
| Freshwater wetlands | <10 | 10-<17 | 17-<25 | 25 - 50 | >50 |
| Rainforest | <12 | 12-<18 | 18-<26 | 26 - 50 | >50 |
| Downslope > 10 to 15 degrees | | | | | |
| Forests (wet and dry sclerophyll) | <38 | 38-<47 | 47-<63 | 63 - 100 | >100 |
| Woodlands | <19 | 19-<28 | 28-<40 | 40 - 100 | >100 |
| Tall heath | <19 | 19-<28 | 28-<39 | 39 - 100 | >100 |
| Short heath | <13 | 13-<19 | 19-<28 | 28 - 50 | >50 |
| Low woodland (semi-arid) | <10 | 10-<17 | 17-<25 | 25 - 50 | >50 |
| Arid shrublands | <12 | 12-<18 | 18-<27 | 27 - 50 | >50 |
| Forested wetlands | <29 | 29-<39 | 39-<52 | 52 - 100 | >100 |
| Freshwater wetlands | <13 | 13-<19 | 19-<28 | 28 - 50 | >50 |
| Rainforest | <15 | 15-<23 | 23-<33 | 33 - 50 | >50 |
| Downslope > 15 to 18 degrees | | | | | |
| Forests (wet and dry sclerophyll) | <45 | 45-<54 | 54-<70 | 70 - 100 | >100 |
| Woodlands | <23 | 23-<33 | 33-<45 | 45 - 100 | >100 |
| Tall heath | <20 | 20-<30 | 30-<41 | 41 - 100 | >100 |
| Short heath | <14 | 14-<21 | 21-<30 | 30 - 50 | >50 |
| Low woodland (semi-arid) | <13 | 13-<20 | 20-<29 | 29 - 100 | >100 |
| Arid shrublands | <13 | 13-<20 | 20-<29 | 29 - 50 | >50 |
| Forested wetlands | <35 | 35-<44 | 44-<59 | 59 - 100 | >100 |
| Freshwater wetlands | <14 | 14-<21 | 21-<30 | 30 - 50 | >50 |
| Rainforest | <19 | 19-<27 | 27-<38 | 38 - 50 | >50 |

Note: "Forests" refers to wet sclerophyll forest, dry sclerophyll forest and plantation forest (including pine plantations). This table applies to the Fire Areas not covered in Table A 3.3 or Table A 3.5.

Table A 3.5 DETERMINATION OF CATEGORY OF BUSH FIRE ATTACK FDI 50 (Alpine Resorts)

| Vegetation Formation (class) | Categories of Bush Fire Attack (AS 3959-1999) | | | | |
|--|--|----------------------|-------------------|---------------------|-------------------|
| | Flame Zone | Level 3 (Extreme) | Level 2 (High) | Level 1 (Medium) | No requirement |
| | Distance (m) of the site from the predominant vegetation class | | | | |
| All upslopes and flat land (0 degrees) | | | | | |
| Forests | <15 | 15-<22 | 22-<31 | 31 - 100 | >100 |
| Woodlands | <7 | 7-<10 | 10-<15 | 15 - 100 | >100 |
| Tall heath | <13 | 13-<19 | 19-<27 | 27 - 100 | >100 |
| Short heath | <9 | 9-<13 | 13-<19 | 19 - 50 | >50 |
| Alpine Complex | <9 | 9-<14 | 14-<20 | 20 - 50 | >50 |
| Downslope > 0 to 5 degrees | | | | | |
| Forests | <18 | 18-<27 | 27-<37 | 37 - 100 | >100 |
| Woodlands | <8 | 8-<12 | 12-<18 | 18 - 100 | >100 |
| Tall heath | <15 | 15-<22 | 22-<31 | 31 - 100 | >100 |
| Short heath | <10 | 10-<15 | 15-<22 | 22 - 50 | >50 |
| Alpine Complex | <10 | 10-<16 | 16-<23 | 23 - 50 | >50 |
| Downslope > 5 to 10 degrees | | | | | |
| Forests | <23 | 23-<33 | 33-<45 | 45 - 100 | >100 |
| Woodlands | <10 | 10-<15 | 15-<23 | 23 - 100 | >100 |
| Tall heath | <17 | 17-<24 | 24-<35 | 35 - 100 | >100 |
| Short heath | <10 | 10-<17 | 17-<25 | 25 - 50 | >50 |
| Alpine Complex | <12 | 12-<18 | 18-<26 | 26 - 50 | >50 |
| Downslope > 10 to 15 degrees | | | | | |
| Forests | <31 | 31-<41 | 41-<55 | 55 - 100 | >100 |
| Woodlands | <13 | 13-<20 | 20-<29 | 29 - 100 | >100 |
| Tall heath | <19 | 19-<28 | 28-<39 | 39 - 100 | >100 |
| Short heath | <13 | 13-<19 | 19-<28 | 28 - 50 | >50 |
| Alpine Complex | <13 | 13-<20 | 20-<29 | 29 - 50 | >50 |
| Downslope > 15 to 18 degrees | | | | | |
| Forests | <37 | 37-<46 | 46-<61 | 61 - 100 | >100 |
| Woodlands | <15 | 15-<23 | 23-<33 | 33 - 100 | >100 |
| Tall heath | <20 | 20-<30 | 30-<41 | 41 - 100 | >100 |
| Short heath | <14 | 14-<21 | 21-<30 | 30 - 50 | >50 |
| Alpine Complex | <15 | 15-<22 | 22-<31 | 31 - 50 | >50 |

Note: This table covers the NSW Alpine resort areas of:

- The Perisher Range – Perisher, Smiggin Holes, Blue Cow and Guthega.
- Thredbo Alpine Village
- Charlottes Pass
- Mount Selwyn
- Ski Rider
- Kosciuszko Mountain Retreat
- Sponars Chalet
- Bullocks Flat

Forests are based on forest types found.

A3.5 Construction Considerations within the Flame Zone

Buildings constructed within the flame zone are likely to be exposed to direct flame impingement from the fire front. The severity of this exposure is dependent upon the severity of the fire and separation of vegetation from the building, gradient and wind direction. The period of exposure to direct flame impingement from the fire front is dependent on distance from the bushland and can range from less than 3 minutes to sustained flame contact from heavy fuels of up to 20 minutes or more.

There is potential for the flame impingement to ignite the external façade of a building which can continue to burn after the passage of the fire front. Therefore some degree of conservatism in relation to the exposure period is appropriate. It is for this reason that the provisions of AS 3959 alone are not adopted within the category of attack Flame Zone in NSW.

There are no deemed-to-satisfy arrangements for construction of buildings within the Flame Zone. Where flame contact is likely, the radiant heat and convective heat exposures are considerable and overwhelms most materials.

While AS 3959 can be used as a guide to improve building safety, this is subject to additional control measures not included in this document. The design and construction of a building is just one means of mitigating the bush fire risk and will normally require supplementation by a range of other mitigation measures to the satisfaction of the council. Installation of hose reels, sprinkler systems and additional water supplies may be needed.

The extent of additional measures required will be dependent upon the bush fire hazard and its proximity. In addition to the construction requirement of AS 3959, applicants should also address the Performance Requirements of the BCA and consider the siting and the design principles in Section 4.3.5.

Where new testing regimes are developed, these should be incorporated as part of the process of developing alternative solutions for flame zone conditions (and other levels of bush fire attack). These alternative solutions will be considered on their merits and could form important developments in the area of bush fire safety for buildings.



Appendix 4

Submission Requirements for DAs on bush fire prone land

A4.1 For general development applications to be considered under section 79BA of the EP&A Act

Development applications on bush fire prone land must be accompanied by a Bush Fire Assessment Report within the Statement of Environmental Effects demonstrating compliance with the aim and objectives of PBP and the specific objectives and performance criteria for the land use proposed. In particular, the following matters must be addressed.

- i. a statement that the site is bush fire prone land, where applicable,
- ii. the location, extent and vegetation formation of any bushland on or within 100 metres of the site,
- iii. the slope and aspect of the site and of any bush fire prone land within 100 metres of the site, which may determine the likely path of any bush fires,
- iv. any features on or adjoining the site that may mitigate the impact of a high intensity bush fire on the proposed development, and
- v. a statement assessing the likely environmental impact of any proposed bush fire protection measures.
- vi. whether any building is capable of complying with AS 3959/1999 in relation to the construction level for bush fire protection.

For most smaller applications this can be done relatively simply and can be accompanied by a diagram showing the required features with approximate distances. The RFS has also produced guidelines for lodging of information for single dwellings. These can be downloaded from the RFS website at www.rfs.nsw.gov.au.

A4.2 For integrated development applications under section 100B of the RF Act and section 91 of the EP&A Act

The detailed information to be contained within a Bush Fire Assessment Report submitted to the RFS under Clause 46 of the RF Reg is:

- a description of the property
 - provide Lot No., DP of subject land
 - street address with locality map
- zoning of subject land and any adjoining lands
- staging issues, if relevant, and description of the whole proposal;
- aerial or ground photographs of subject land including contours and existing and proposed cadastre .
- the classification of vegetation out to 140 metres from the development
 - provide a structural description consistent with the identification key in Keith D (2004) and PBP.
 - identify any past disturbance factors and any future intended land uses that could alter the vegetation classification in the future.
- an assessment of the effective slope to a distance of 100 metres
 - usually 5m contours will suffice for subdivisions, 10 metres should be used only if there has not been a survey undertaken by a registered land surveyor.
 - the effective slope is the slope under the vegetation assessed as being a hazard in relation to the development and not the slope within the asset protection zone.
- identification of any significant environmental features - these could include the presence of:
 - riparian corridors
 - SEPP 14 – Coastal Wetlands
 - SEPP 26 Littoral rainforests
 - SEPP 44 – Koala Habitat
 - areas of geological interest
 - environmental protection zones or steep lands (>18°)
 - land slip or flood prone areas
 - national parks estate or various other reserves.
- details of threatened species, populations, endangered ecological communities and critical habitat known to the applicant
 - details of some threatened species can be found on the web (www.environment.nsw.gov.au)
 - past studies or surveys for the area (eg local environment studies)
 - documentation supplied to council in relation to flora and fauna
- details of Aboriginal heritage known to the applicant
 - past surveys and information held by the DEC. (application fees may apply)

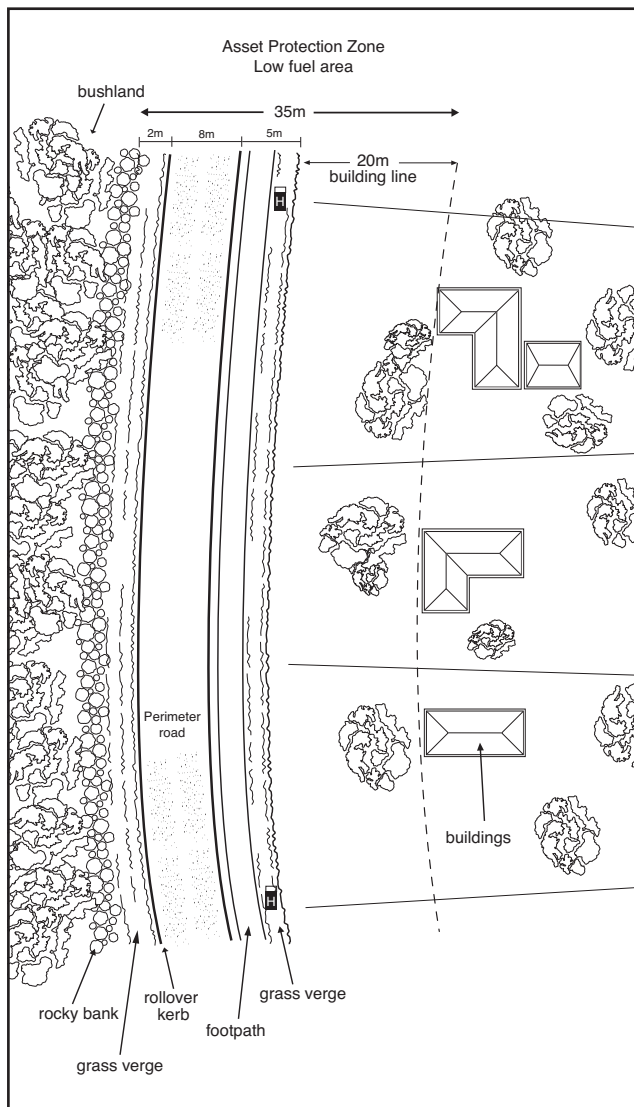


Figure A 4.1 Example of information supplied on a plan with a bush fire threat assessment.

The RFS has also produced guidelines for lodging of information for simple subdivision (e.g. one lot into two lots). These can be downloaded from the RFS website at www.rfs.nsw.gov.au.

- a bush fire assessment that addresses –
 - asset protection zones (including any management arrangements, any easements including those contained on adjoining lands)
 - siting and adequacy of water (in relation to reticulation rates or where dedicated water storage will be required)
 - capacity of public roads (especially perimeter roads and traffic management treatments)
 - whether public roads link to fire trails and have two way access
 - adequacy of access and egress
 - adequacy of maintenance plans (eg landscaping) and emergency procedures (especially SFPP developments)
 - construction standards to be used (where non-conformity to the deemed-to-satisfy arrangement is envisaged, which aspects are not intended to conform)
 - adequacy of sprinkler systems (only as an adjunct to other passive controls).
- an assessment of how the development complies with the acceptable solutions, performance requirements and relevant specific objectives within Chapter 4 of PBP.

APZs should be identified on plans for interface allotments by either a building line or building footprint. In some cases building envelopes are identified which include other building constraints. Unless otherwise specified, a building envelope will be taken as the building footprint. Where an applicant proposes not to follow the acceptable solutions for particular bush fire protection measures, detailed evidence must be provided demonstrating compliance with performance criteria and intent of the measures proposed. For alternate solutions under the BCA, the applicant must demonstrate how the product, design or material can meet the performance requirements of the BCA (see clause AO.8 in Volume 1 of the BCA).

In relation to significant environmental features, threatened species, endangered populations, endangered ecological communities and Aboriginal heritage issues, the RFS only requires sufficient information to ascertain that the environmental values are or are not a constraint to development. The RFS is not providing an approval in relation to the loss or removal of these environmental assets. That is the role of the relevant consent authority.

Appendix 5

Bush Fire Provisions - Landscaping and Property Maintenance

A5.1 Introduction

Bush fires are a natural and periodic event in the Australian landscape. Many Australian plants and animals have adapted to fire over thousands of years and require fire as part of their life cycle.

However, development adjacent to bushland areas has increased the risk of fire impacting on people and their assets. Fire management needs to strike a balance between the protection of life and property and the maintenance of ecological processes and systems.

In Australia, bush fires are inevitable and an essential aspect of the landscape.

However, the impact on property and life can be reduced with responsible preparation and management of bush fire hazards. This is the responsibility of all land managers, as well as communities and individuals taking responsibility for their own fire safety.

The level of protection for life or whether or not a house or other assets survive a bush fire ultimately depends on the landowner and their level of preparedness against bush fire attack.

The planning system can be used to better effect in protecting human life, property and environmental values from the impacts of bush fire events.

In some cases this will involve land use planning and development controls, construction standards, APZs and subdivision layout, siting, design and provision of services. It also involves careful and deliberate consideration of the environmental impacts of these and how we can recognise the need to protect our wetlands, rainforests, koala habitat and other biodiversity and cultural values.

However, the best planning can be undone by poor maintenance and lack of forethought when landscaping a development. Therefore house survival ultimately depends on the householder.

Some maintenance also depends upon adjoining neighbours and upon fuel management in adjacent bush land areas by the owners, occupiers or managers of that land. General housekeeping and maintenance of the grounds by the householder is equally important and, in some cases, may even be more so.

Experience from the Canberra 2003 fires suggests that house losses are greatest in the area up to 250 metres from the bush interface. Distances of

less than 100 metres are particularly vulnerable to flame contact, radiant heat and ember attack.

Hence it is within this distance that efforts should be made to prepare for the onslaught of major bush fire events.

While other legislation provides the impetus for planning objectives, the RF Act provides the legislative vehicle to achieve bush fire management objectives.

In this appendix consideration will be given to the principles for landscaping and management, and the role of property maintenance during the fire event.

A5.2 Principles of Protection

Bush fire attack takes essentially five forms;

- wind,
- smoke,
- ember,
- radiant heat and
- flame.

Evidence indicates ember attack is responsible for most bush fire related house fires. Strong winds resulting from severe bush fires will drive embers into vulnerable areas of a building, preheat and dry fuel ahead of a fire, lift roofing and extend flames along a more horizontal plane closer to building elements. Embers can also cause spotting in advance of the bush fire and provide piloted ignition to building elements. To effectively protect a building, strategies must be implemented that separate it from the hazard and reduce the intensity of bush fires to minimise the combined impact of ember, wind, flame and heat attack.

While smoke will cause minimal damage to property, it can severely affect the health of residents. Smoke is a significant factor in areas in which aged or disabled persons reside – hospitals and nursing homes - and more so where residents are susceptible to respiratory disorders.

Radiant heat (measured in kW/m²) can severely impair firefighting operations, the health of residents and the integrity of building elements. Radiant heat in excess of 10kW/m² can prevent emergency services personnel assisting residents of SFPP developments.

Flame attack will severely restrict firefighting operations, provide piloted ignition to building elements and threaten the health of residents and their capacity to evacuate the area.

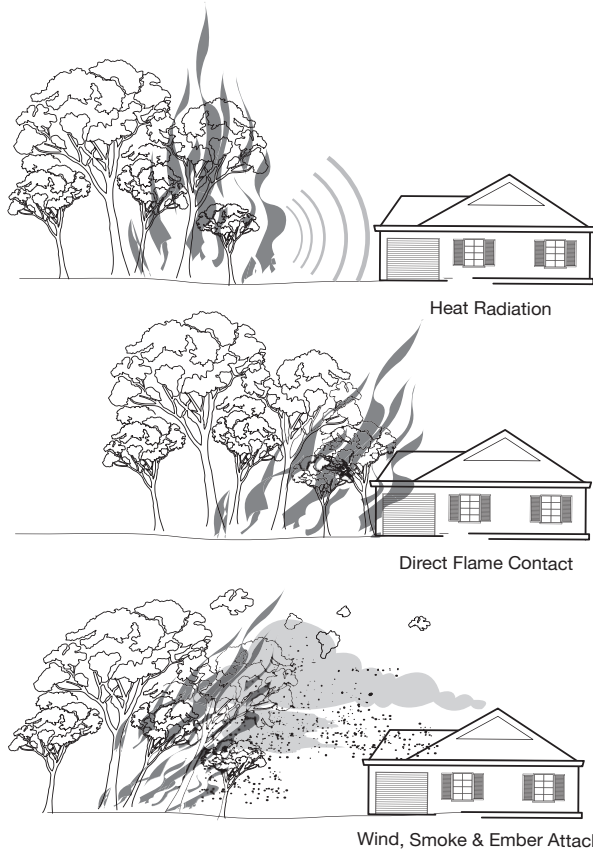


Figure A 5.1 Bush Fire Attack Mechanisms

Overall the intention of bush fire protection measures should be to prevent flame contact to a structure, reduce radiant heat to below the ignition thresholds for various elements of a building, to minimise the potential for wind driven embers to cause ignition and reduce the effects of smoke on residents and firefighters.

A5.3 Principles of Landscaping Properties for Bush Fire Protection

The principles of landscaping for bush fire protection aim to:

- Prevent flame impingement on the dwelling;
- Provide a defensible space for property protection;
- Reduce fire spread;
- Deflect and filter embers;
- Provide shelter from radiant heat; and
- Reduce wind speed.

(a) Vegetation choices

All vegetative material can burn under the influence of bush fire.

With this in mind, careful attention must be paid to species selection, their location relative to their flammability, avoidance of continuity of vegetation (horizontally and vertically), and ongoing maintenance to readily remove flammable fuels (leaf litter, twigs and debris).

In the paper “*Landscape and Building Design for Bushfire Areas*” G.C. Ramsay and L. Rudolph have provided 14 attributes of vegetation which affect bush fire attack. In summary these attributes are:

- Moisture content of leaves;
- Volatile oil content of leaves;
- Mineral content of leaves;
- Leaf fineness;
- Density of foliage;
- Continuity of plant form;
- Height of lowest foliage above ground;
- Size of plant;
- Dead foliage on the plant;
- Bark texture;
- Quantity of ground fuels;
- Fineness of ground fuels;
- Compaction ability of ground fuels; and
- Mineral content of ground fuel.

What is clear is that the higher moisture content of leaves (mesic), the less bark that will be available and the lower the leaf drop, all of which will assist with maintenance of the understorey and will also assist in reducing bush fire attack.

Work in the USA and elsewhere has also suggested that in addition to removal of understorey species, the trimming of lower limbs of trees also assists in reducing fire penetration into the canopy. Trees such as ‘pencil pines’ and African olive have been attributed with high fire propagation due to the high fine fuel and/or oil content captured within the canopy. This leads to significant flame height. Avoid such species in favour of rainforest species such as Figs and Syzygium.

When choosing plants, be sure not to introduce weed species into an area. Fire events may provide the opportunity for weed species to spread and may contribute fuel to an area of otherwise lower fuel loads.

Contact local councils, plant nurseries and plant societies to determine suitable species for your area.

(b) Trees as Windbreaks

The use of trees as windbreaks is a common practice but trees also provide a useful function, trapping embers and flying debris, which would otherwise reach the house. The tree crown will rarely carry fire unless there is a significant fuel loading on the ground.

By reducing the wind speed, a row of trees also slows the rate of spread of a bush fire and a dense foliage traps radiant heat, lowering bush fire radiant heat.

Because of the effect of turbulence, a balance has to be struck between a high density of trees (that

maximises the trapping of embers and radiant heat but also maximises turbulence) and a lower density (that allows more embers and radiant heat to pass through but minimises turbulence). A windbreak that allows 30–60% of the wind to pass through is ideal as less than this becomes too solid with ember laden winds being carried over the top of the break.

To be effective a windbreak must:

- be located on the side of the lot from which fire weather normally approaches;
- be of sufficient length (generally 100 metres minimum length);
- be located at a distance of one to three times the height of fully grown trees but not within the IPA;
- use smooth barked eucalypts, rainforest trees or deciduous trees;
- make sure there are no breaks of sufficient size to allow winds to funnel through; and
- be separated by sufficient distance from the hazard so as not to be consumed and become a hazard itself.

A5.4 Vegetation Management

Where APZs have been incorporated as part of the development approval for subdivision or for dwelling construction, the environmental aspects of the development should have already been taken into account.

In general, it is expected that APZs will be maintained by the owner of the land including maintenance of any fire trail constructed as part of the development.

It is accepted practice that after construction of a dwelling, gardens will be established and landscaping of the grounds will be undertaken. It is essential that efforts to reduce fuels on adjoining properties are therefore not negated by actions within the immediate curtilage of the building.

In terms of priorities of addressing bush fire attack, priority should be given to preventing flame impingement by not allowing fine debris to accumulate close to the building. Secondly, removal of understorey fuels aids in the reduction of flame heights and likely canopy fire, thereby reducing overall radiant heat. Removal of loose bark and fine fuels reduces both heat output and ember generation, while the retention of taller trees with canopies will also assist in filtering out embers.

To maintain a garden that does not contribute to the spread of bush fires, it is necessary to plan the layout of the garden beds and take an active decision to minimise certain features in favour of other features. These should include:

- maintaining a clear area of low cut lawn or pavement adjacent to the house;
- keeping areas under fences, fence posts and

- gates and trees raked and cleared of fuel;
- utilising non-combustible fencing and retaining walls
- breaking up the canopy of trees and shrubs with defined garden beds;
- organic mulch should not be used in bush fire prone areas and non flammable material should be used as ground cover, eg Scoria, pebbles, recycled crushed bricks.
- planting trees and shrubs such that:
 - the branches will not overhang the roof;
 - the tree canopy is not continuous; and
 - there is a windbreak in the direction from which fires are likely to approach.

The RFS has developed its document “Standards for Asset Protection Zones” which should be consulted for APZ specifications. This is also available on the RFS web page at www.rfs.nsw.gov.au.

A5.5 Maintenance of Property

Sensible arrangements for landscaping and maintenance of the property are critical in the prevention of losses.

In considering property maintenance the following items should therefore be implemented in advance of the bush fire season:

- removal of material such as litter from the roof and gutters;
- ensure painted surfaces are in good condition with decaying timbers being given particular attention to prevent the lodging of embers within gaps;
- check pumps and water supplies are available and in working order;
- driveways are in good condition with trees not being too close and forming an obstacle during smoky conditions;
- check tiles and roof lines for broken tiles or dislodged roofing materials;
- screens on windows and doors are in good condition without breaks or holes in flyscreen material and frames are well fitting into sills and window frames;
- drenching or spray systems are regularly tested before the commencement of the fire season;
- hoses and hose reels are not perished and fittings are tight and in good order;
- doors are fitted with draught seals and well maintained;
- mats are of non combustible material or in areas of low potential exposure; and
- woodpiles, garden sheds and other combustible materials are located downslope and well away from the house.

Trees and other vegetation in the vicinity of power lines and tower lines should be managed and trimmed in accordance with the specifications in “Vegetation Safety Clearances” issued by Energy Australia (NS179, April 2002).

AS 3959

Australian Standard AS 3959 Construction of buildings in bushfire-prone areas, Standards Australia, 1999, that outlines construction standards applicable to residential developments in bush fire prone areas.

Asset Protection Zone (APZ)

Often referred to as a fire protection zone. Aims to protect human life, property and highly valued public assets and values. An area surrounding a development managed to reduce the bush fire hazard to an acceptable level. The width of the APZ will vary with slope, vegetation and construction level. The APZ, consisting of an area maintained to minimal fuel loads and, for subdivision, comprising a combination of perimeter road, fire trail, rear yard or a reserve, so that a fire path is not created between the hazard and the building.

Bush fire protection measures (BPM)

The suite of measures available for minimizing the risk of bush fire attack and the threat to life and property.

Building Code of Australia (BCA)

The Building Code of Australia means the document of that name published on behalf of the Australian Building Codes Board (ABCB) (as amended), together with:

- a) such amendments made by the Board, and
- b) such variations approved by the Board in relation to New South Wales, as are prescribed by the EP&A Regulations.

There are 10 classes of buildings as defined by the BCA (see Appendix 1).

Building footprint

The area shown on a plan over which a building can be erected.

Bush fire (also Bushfire)

A fire involving grass, scrub or forest.

Bush fire attack

Arises from direct flame impingement, radiant heat or ember attack.

Bush fire hazard

The potential severity of a fire. Usually measured in terms of intensity (kW/m), the factors that influence a bush fire hazard include climate and weather patterns, vegetation (fuel quantity, distribution and moisture) and slope.

Bush fire hazard reduction works

- a) the establishment or maintenance of fire breaks on land, and

- b) the controlled application of appropriate fire regimes or other means for the reduction or modification of available fuels within a predetermined area to mitigate against the spread of a bush fire,

but does not include construction of a track, trail or road.

Bush fire prone area/land

Is an area of land that can support a bush fire or is likely to be subject to bush fire attack. In general, a bush fire prone area is an area mapped for a local government area that identifies the vegetation types and associated buffer zones. Bush fire prone land maps are prepared by local councils and certified by the Commissioner of the RFS.

Bush fire prone land map (BPL Map)

for an area means a map certified under section 146(2) of the EP&A Act.

Bush fire protection measures (BPMs)

are a range of measures (controls) available to minimise the risk arising from a bush fire. BPMs include APZs, construction standards, suitable access arrangements, water and utility services, emergency management arrangements and landscaping.

Bush fire risk

Is the chance of a bush fire igniting, spreading and causing damage to assets of value to the community. Risk may be rated as being extreme, major, moderate, minor or insignificant and is related to the vulnerability of the asset.

Bush fire safety authority

An approval of the Commissioner of the NSW RFS required for a subdivision for residential or rural residential purpose or for a special fire protection purpose listed under section 100B(6) of the RF Act. This form of development is considered to be integrated development.

Bush fire assessment report

A report submitted in support of a development application by an applicant which determines the extent of bush fire attack to a development and the measures used to mitigate that attack. Appendix 4 provides the information requirements for a bush fire assessment. See also clause 46 of the RF Regulation.

Certifying Authority

As defined in the EP&A Act. Those with authority to issue Part 4A and Complying Development Certificates.

Consent Authority

Is defined in the EP&A Act, in relation to Development Consents. Usually the local council.

Defendable space

Is an area within the asset protection zone that provides an environment in which a person can undertake property protection after the passage of a bush fire with some level of safety.

Development

Is defined in the EP&A Act.

Development Application (DA)

An application for consent to carry out development such as building, subdivision, or the use of a building or land. Applications are normally made to the local council.

Ecologically Sustainable Development (ESD)

As defined in section 6 of the *Protection of the Environment Administration Act (NSW) 1991*.

Ecotourist developments

aim to foster environmental and cultural understanding, appreciation and conservation and to be ecologically sustainable (being located in a relatively undisturbed natural area).

Equivalent to an APZ

is when the building will be separated from the bush fire hazard by other development (including roads, other buildings and managed properties) with a setback distance greater than or equal to the distance which would have been occupied by an APZ, if the development had been established having regard to the provisions of Appendix 3 of this document.

Fire Intensity

the rate of heat release, per unit length of fire front. The primary unit is kilowatts per metre of fire front (kW/m). It is a function of the heat content of the fuel (H), the weight of the fuel consumed (W), and the rate of spread of the fire (r).

Fire protection systems.

In this document the term is used to refer to the use of drencher/sprinkler systems used to dispense water on to the walls, roof, windows and other elements of a building.

Flame zone

The distance from a bush fire at which there is significant potential for sustained flame contact to a building. Determined by the calculated distance at which the radiant heat of the design fire exceeds 29kW/m² or calculated by the sustained flame length, whichever is the lesser.

Infill development

refers to the development of land by the erection of or addition to a residential building (or buildings) which does not require the spatial extension of services including public roads, electricity, water or sewerage and is within an existing allotment.

Integrated development

is development referred to under section 91 of the EP&A Act.

Integrated housing

development means a subdivision into two or more lots and the simultaneous design and construction of dwellings.

Local Environmental Plan (LEP)

Local Environmental Plan prepared under Part 3 of the EP&A Act. Plans prepared by a council that describe the planning status (zone) and/or development standards required for the future development of an area.

Public road

is an area that is open to or used by the public and is developed for, or has as one of its main uses, the driving or riding of motor vehicles.

Setback

The distance required through planning provisions to separate a building from the bush fire hazard, street frontage or from adjacent buildings.

Should

This is to be read as a prescriptive requirement but recognises that there are exceptional circumstances that warrant consideration of a bush fire protection measure based on performance and the merits of the case including provision for community safety.

Special fire protection purposes

are defined in Appendix 3.1.

State Environmental Planning Policy (SEPP)

is an environmental planning instrument prepared under Part 3 of the EP&A Act

Subdivision

of land means the division of land into two or more parts that, after the division, would be obviously adapted for separate occupation, use or disposition. The division may (but need not) be effected:

- (a) by conveyance, transfer or partition, or
- (b) by any agreement dealing, plan or instrument rendering different parts of the land available for separate occupation, use or disposition.

It includes strata subdivision, community title and boundary adjustments.

Vegetation formations (and sub-formations)

are different vegetation types and classes defined by Keith D. 2004 in: "Ocean Shores to Desert Dunes" published by DEC.

References and other Reading

- Alexander, M.E.** (1982) "Calculating and Interpreting Forest Fire Intensities." *Can. J. Bot.* 60:349-357.
- AUSLIG** (1990) "Atlas of Australian Resources, Third Series, Volume 6, Vegetation". Commonwealth of Australia
- Australia ICOMOS** (2004) Illustrated Burra Charter.
- Australian Building Codes Board** (2006) "Building Code of Australia". Commonwealth of Australia
- Byram, G.M.** (1959). Combustion of Forest Fuels in: "Forest Fire Control and Use" (Ed. Davis, K.P.) McGraw-Hill, New York.
- Catchpole, W.R., Bradstock, R.A., Choate, J., Fogarty, L.G., Gellie, N., McCarthy, G.J., McCaw, W.L., Marsden-Smedley, J.B. and Pearce, G.** (1998) Co-operative Development of Equations for Heathland Fire Behaviour. In 'Proc. 3rd Int. Conference. Forest Research and 14th Conf. on Fire and Forest Meteorology'. (Ed. Viegas, D.X.) Luso, Coimbra, Portugal, 631-645.
- Cheney P. and Sullivan A.** (undated) "Comment on Risk Analysis Process for NSW". CSIRO Forest and Forest Products Division.
- CSIRO** (2000) "Review of Current Methodology of Assessment of Bush fire Hazard and the Prescription of Appropriate Separation Distances and Building Standards. The Development of a Robust Model to Achieve this for Different Vegetation Types". Client Report 901, CSIRO Forestry & Forest Products Division Bush fire Behaviour and Management Team, ACT.
- CSIRO** (2005) "Review of Methodology for prescribing separation distances between structures and vegetation." Client Report No. 1537, CSIRO Forestry and Forest Products Division, Feb. 2005.
- Department of Planning, NSW** (1989) "Circular C10: Planning in Fire Prone Areas." (Departmental circular)
- Douglas, G.B. and Ellis, P.** (2001) "Integrating Land Use Planning and Construction Standards for Protection of Bush Fires in NSW – a Model". Bushfire 2001, Christchurch, New Zealand.
- Douglas, G.B. and Tan, Z.** (2005) Integrating Site Assessment and Performance Planning Outcomes for Bushfire Prone Areas at "Planning for Natural Hazards – How we can Mitigate the Impacts?" Symposium, University of Wollongong, 2-5 February 2005. Wollongong..
- Douglas G.B., Tan Z. and Midgley S.** (2006) A Verification Method for Evaluating Alternative Building Solutions in Bushfire-Prone Areas. at International Fire Safety Engineering Conference 2006, Gold Coast, 23 May 2006.
- Energy Australia** (2002) "Vegetation Safety Clearances" (NS179).
- Forestry Commission of NSW** (1991) Control Burning in Eucalypt Forests, Metric Conversion of McArthur Leaflet 80, Sydney.
- Gill, A.M. et al.** (ed) (1981) "Fire and the Australian Biota" Australian Academy of Science, Canberra.
- Good R.** (1994) "Fuel Dynamics, Preplan and Future Research Needs". Pers. Communication.
- Haddad, S.G.** (1982) "A Systematic Approach to Risk Assessment for Major Plants", CHEMECA '82, University of Sydney, NSW.
- Healey et al** (ed) (1985) "The Economics of Bush fires: The South Australian Experience" Oxford University Press Melbourne.
- Keith D.** (2004) "Ocean Shores to Desert Dunes", Department of Environment and Conservation, Sydney.
- Leicester, R.H.** (1987) "Building Technology to Resist Fire, Flood and Drought." Operations January 21, 1987, The Fireman, Oakleigh
- Luke R.H. and McArthur, A.G.** (1978) "Bush Fires in Australia" Australian Government Publishing Service, Canberra.
- Noble, I.R., Bary, G.A.V. and Gill, A.M.** (1980) McArthur's fire-danger meters expressed as equations. *Aust. J. Ecology* 5:201-203.
- Ramsay, C and Rudolph, L** (2003) "Landscape and Building Design for Bush fire Areas". CSIRO Publishing, Collingwood.
- Ramsay G.C. and Dawkins D.** (eds), (1993) "Building in bush fire prone areas – Information and advice", Standards Australia (SAA HB 36-1993).
- Rural Fire Service NSW** (2005) "Standards for Asset Protection Zones"
- Specht, R.L.** (1972) Chapter 2 - Vegetation in Leeper, G.W. (Ed) "The Australian Environment. 4th Edition. CSIRO and Melbourne University Press, Melbourne.
- Standards Australia**, (1993) "AS 1530.2, Methods for fire test on building materials, components and structures - Test for flammability of materials".
- Standards Australia**, (1997) "AS 4083, Planning for Emergencies - Health Care Facilities".
- Standards Australia**, (1999) "AS 3959, Construction of buildings in bushfire prone areas".
- Standards Australia**, (2002) "AS/NZS 1596 The Storage and Handling of LP Gas"
- Standards Australia**, (2002) "AS/NZS 2890.2 Parking facilities - Off-street commercial vehicle facilities".
- Standards Australia**, (2002) "AS 3745, Emergency control organization and procedures for buildings, structures and work places."
- Standards Australia**, (2005) "AS 2419.1 – 2005 Fire hydrant installations – System design, installation and commissioning"
- Watson P.** (2005) Chapter 9 Fuel Accumulation in "Fire Frequencies for Western Sydney's Woodlands: Indications from Vegetation Dynamics". Doctor of Philosophy, University of Western Sydney.
- Webster, J.K.** (1986) "The Complete Australian Bushfire Book." Nelson. Vic.
- Wilson A.A.G.** (1984) "Assessing the Bushfire Hazard of Houses: A Quantitative Approach". Rural Fire Research Centre, Vic.
- Wilson, A.A.G. and Ferguson I.S.** (1984) "Australian Forestry", pp230-236. "Fight or Flee? – A Case Study of the Mount Macedon bushfire".