

# Blackash Practice Note PN-02

## Ladder Fuels within APZ

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# BLACKASH

BUSHFIRE CONSULTING

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## Practice Notes

Blackash Practice Notes do not introduce new regulatory requirements and do not replace the provisions of applicable legislation, policy instruments or recognised technical standards. Instead, they document accepted assessment approaches used by suitably qualified bushfire practitioners to interpret and explain the functional intent of bushfire protection measures and support proportionate, risk-based planning outcomes consistent with the framework of *Planning for Bush Fire Protection 2019*.

These Practice Notes are intended to assist the application of expert and professional judgement in circumstances where prescriptive mapping, aerial imagery or standardised assessment methods alone may not fully resolve site conditions. They are provided as supporting technical guidance and should be read in conjunction with relevant statutory requirements and agency guidance.

## 1. Introduction

Asset Protection Zones (APZs) are a primary bushfire risk mitigation measure intended to reduce the intensity of bushfire attack on assets through the strategic management of vegetation structure and fuel arrangement.

While APZ design is commonly expressed in terms of separation distance, its effectiveness is fundamentally determined by how vegetation fuels are structured within the zone, particularly the presence or absence of ladder fuels that enable vertical fire spread.

Ladder fuels are intermediate vegetation layers, such as shrubs, saplings and suspended elevated fuels, that connect surface fuels to the canopy and allow fire to transition vertically through the vegetation profile.

Where ladder fuels are present, the potential for vertical fire development increases and may enable transition toward canopy involvement under suitable fire weather conditions and vegetation characteristics, increasing flame height, radiant heat exposure and the likelihood of ember generation. Conversely, where ladder fuels are removed or appropriately managed, fire behaviour is more likely to remain confined to surface fuel layers, consistent with the intended bushfire protection function of an APZ.

The presence of canopy trees within an APZ does not, in itself, indicate unacceptable bushfire hazard. Rather, the performance of an APZ depends not only on separation distance but also on vegetation structure, including the interruption of vertical fuel continuity, reduction in surface fuel loads, canopy spacing, and the provision of conditions suitable for active or passive defendability.

The removal or modification of ladder fuels is a critical component of achieving the bushfire behaviour outcomes intended by *Planning for Bush Fire Protection 2019* (PBP), including reduced radiant heat exposure, improved conditions for fire suppression and the provision of defensible space around assets.

This Practice Note explains the role of ladder fuels within APZs and provides guidance on how vegetation structure beneath canopy cover should be interpreted when assessing whether an APZ is functioning as intended.

The presence or absence of ladder fuels does not replace vegetation hazard classification under Appendix 1 of PBP. Rather, it assists interpretation of how vegetation structure influences bushfire behaviour within APZs and informs site-based assessment of vegetation management outcomes.

*Planning for Bush Fire Protection 2019* identifies four vegetation fuel layers surface, near-surface, elevated and canopy fuels and recognises that continuity between these layers influences bushfire behaviour outcomes.

## 2. Ladder Fuels and Crown Fire Potential

Ladder fuels are vegetation layers that allow fire to climb from the ground into the tree canopy (see Figure 1).

They typically include shrubs, small trees, saplings, and low branches that sit between surface fuels (like grass and leaf litter) and canopy fuels (tree crowns). When these layers connect vertically, they form a pathway that enables flames to move upward through the vegetation profile.

This document explains how ladder fuels influence vertical fire spread, and why canopy projection alone does not necessarily represent vertical fuel continuity or crown fire potential and should be interpreted together with the structure of surface, near-surface and elevated fuels when assessing vegetation hazard consistent with Appendix 1 of Planning for Bush Fire Protection 2019.

The distinction between canopy presence and vertical fuel continuity is important when interpreting vegetation structure for bushfire planning purposes, particularly where aerial imagery is relied upon to define vegetation extent at a precinct or subdivision scale.

Bushfire behaviour is strongly influenced by the arrangement of vegetation fuels across multiple layers. These layers typically include surface fuels, near-surface fuels, elevated fuels and canopy fuels, consistent with the vegetation structure framework applied in PBP. The presence or absence of fuel continuity between these layers determines whether fire is likely to remain confined to the ground or transition into the canopy.

The absence of ladder fuels substantially reduces the likelihood of sustained vertical fire spread from surface fuels into the canopy, consistent with vegetation structure typically expected within a functioning APZ (see Figure 2).

Figure 1 Ladder fuels providing fire progression to the canopy

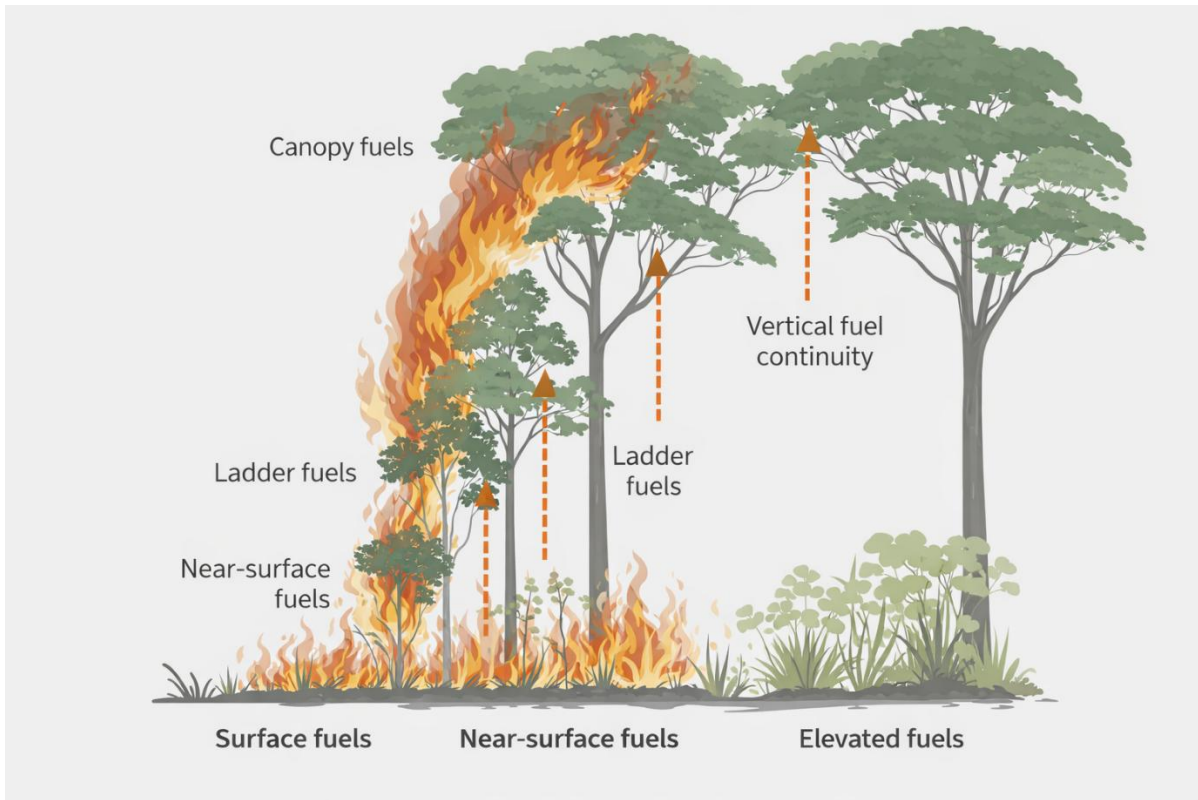
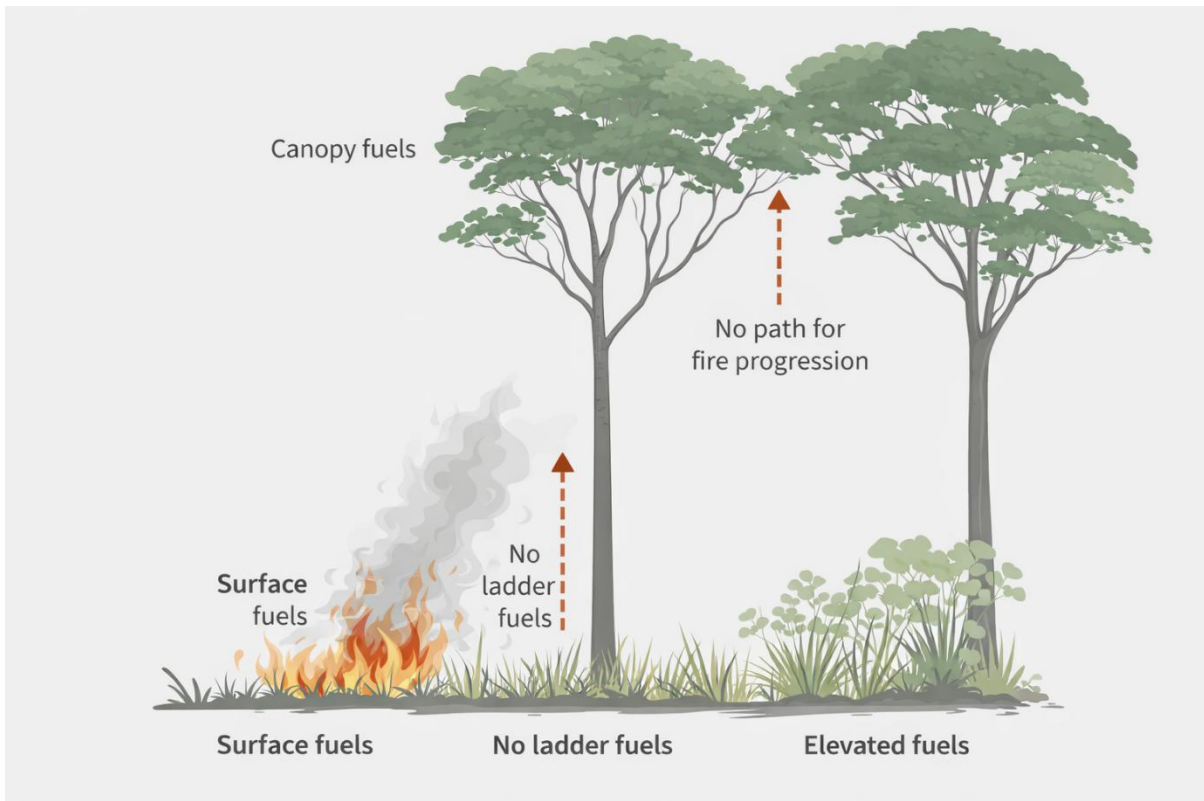


Figure 2 No fuel ladder and limited potential for fire progression to the canopy



### 3. Vegetation Structure Where Ladder Fuels Are Present

Where vegetation structure includes continuous fuel layers linking surface fuels to canopy fuels, vertical fire spread becomes possible. Intermediate vegetation such as shrubs, saplings and suspended elevated fuels commonly form what are referred to as ladder fuels, providing a pathway for flames to move progressively upward through the vegetation profile. Bark fuels can also contribute to vertical fire propagation by enabling spotting and flame attachment to canopy fuels, particularly in species with ribbon or fibrous bark characteristics, and therefore represent an additional mechanism supporting vertical fire development independent of shrub-based ladder fuels.

In these circumstances, a surface fire may transition through near-surface and elevated fuel layers and ultimately ignite the canopy. This process increases flame height, increases radiant heat exposure, and substantially increases the likelihood of crown fire development under suitable fire weather conditions. Vegetation structure containing ladder fuels represents vertical fuel continuity capable of supporting crown fire behaviour consistent with vegetation formations identified as forest hazard within Planning for Bush Fire Protection 2019

The presence of ladder fuels is a key determinant of bushfire behaviour and is typically confirmed through site inspection and professional interpretation of vegetation structure rather than aerial photography alone.

### 4. Vegetation Structure Where Ladder Fuels Are Absent

Where ladder fuels are absent, a vertical separation exists between surface fuels and canopy fuels, preventing sustained upward fire progression through the vegetation profile (Figure 2). In these circumstances, fire behaviour is generally expected to remain confined to surface fuel layers.

Even where canopy cover extends overhead, the absence of connecting vegetation layers significantly reduces the likelihood of canopy ignition and crown fire development. This condition is commonly observed where understorey vegetation is sparse or absent, where land is actively managed through mowing, slashing or grazing, or where landscaped or maintained areas occur beneath canopy trees.

Accordingly, canopy presence alone does not necessarily indicate the presence of vertically continuous bushfire hazard vegetation.

### 5. Limitations of Aerial Photography for Ladder Fuel Interpretation

Aerial photography and map-based vegetation datasets typically capture canopy projection only, rather than the fuel structure beneath the canopy. As a result, reliance solely on canopy extent derived from remote sources may over represent bushfire hazard where ladder fuels are not present.

Determining vegetation hazard extent requires consideration of the full vegetation fuel profile, including surface fuels, near-surface fuels, elevated fuels and bark fuels, together with the continuity between these layers. These characteristics are typically confirmed through site inspection and the application of expert judgement by a suitably qualified bushfire practitioner.

Appendix 1 of PBP recognises that vegetation classification relies on formation level interpretation and may require site-based verification where vegetation structure beneath canopy projection cannot be reliably determined from remote sources alone.

## 6. Relevance to Line-of-Management Interpretation

Assessment of ladder fuel presence is an important component of determining the appropriate location of the line of management beneath canopy vegetation. Where ladder fuels are absent, canopy projection alone may not represent the effective edge of bushfire hazard vegetation. In these circumstances, the line of management is more appropriately informed by the observed fuel structure at ground and mid-storey levels.

This approach supports a consistent and evidence-based method for interpreting vegetation extent where aerial imagery cannot reliably confirm fuel continuity beneath canopy cover.

Determination of the line of management remains subject to the vegetation classification framework set out in Appendix 1 of Planning for Bush Fire Protection 2019 and should be confirmed through site inspection and professional judgement by a suitably qualified practitioner.

## 7. Application in Bushfire Planning Practice

Interpretation of ladder fuel presence supports a range of bushfire planning decisions, including vegetation hazard classification, Asset Protection Zone design, refinement of precinct-scale vegetation mapping, and performance-based assessment under PBP.

These determinations are typically informed through site inspection and professional judgement applied by a suitably qualified bushfire practitioner, such as a BPAD Level 3 Certified Practitioner.

Understanding whether vertical fuel continuity exists is therefore fundamental to determining whether canopy vegetation is capable of supporting crown fire behaviour. In practical terms, crown fire potential is governed primarily by the continuity between surface, near-surface, elevated and canopy fuel layers rather than canopy presence alone.

This approach supports merit-based assessment of vegetation hazard consistent with the objectives of the Environmental Planning and Assessment Act 1979, including the requirement to promote proportionate and risk-based planning outcomes.

## Guidance Note

**Expert judgement** is the reasoned professional opinion of a suitably qualified practitioner, formed through the application of specialised training, technical knowledge and site-based observation to interpret vegetation structure and determine whether bushfire protection measures are functioning as intended. In bushfire planning, expert judgement is necessary where prescriptive mapping, aerial imagery or standardised datasets cannot reliably resolve site conditions, particularly in relation to the presence or absence of ladder fuels, the continuity of near-surface and elevated fuels, and the effective performance of APZs. Because remote mapping typically captures canopy projection rather than vegetation structure beneath the canopy, professional interpretation is required to confirm whether vegetation is capable of supporting vertical fire progression or crown fire behaviour.

Accordingly, expert judgement plays an important role in ensuring that vegetation hazard assessment reflects how bushfire behaviour is likely to occur on site rather than how vegetation appears in mapping alone.

This includes confirming whether canopy vegetation contributes to bushfire hazard within an APZ, determining the location of the line of management, and supporting performance-based interpretation consistent with *PBP*.

Expert judgement (consistent with the National Construction Code of Australia) does not replace legislative or policy requirements; instead, it supports the practical application by providing a transparent, evidence-based method for interpreting vegetation structure in a manner that is proportionate to the level of bushfire risk being assessed.

## Definitions

### Asset Protection Zone (APZ)<sup>1</sup>

A fuel-reduced area surrounding a built asset or structure which provides a buffer zone between a bush fire hazard and an asset. The APZ includes a defensible space within which firefighting operations can be carried out. The size of the required APZ varies with slope, vegetation and FFDI.

### Bush fire<sup>1</sup>

An unplanned fire burning in vegetation; also referred to as wildfire.

### Bush fire hazard<sup>1</sup>

Any vegetation that has the potential to threaten lives, property or the environment.

### Bush fire prone land (BFPL)<sup>1</sup>

An area of land that can support a bush fire or is likely to be subject to bush fire attack, as designated on a bush fire prone land map.

### Bush fire prone land map (BFPL)<sup>1</sup>

A map prepared in accordance with NSW RFS requirements and certified by the Commissioner of the NSW RFS under EP&A Act 1979 s.10.3(2).

### Expert Judgement

The reasoned professional opinion of a suitably qualified practitioner, formed through the application of specialised knowledge, training and experience to the interpretation of legislation, policy, technical guidance and site-specific evidence where prescriptive methods alone are insufficient to determine an appropriate outcome.

### Ladder Fuel

Ladder fuels are intermediate vegetation layers, such as shrubs, saplings and suspended elevated fuels, that connect surface fuels to the canopy and allow fire to transition vertically through the vegetation profile.

### Line of management

the spatial boundary between vegetation that is retained in a managed condition consistent with the fuel-reduction objectives of an Asset Protection Zone under PBP, and adjoining vegetation that remains in an unmanaged or natural state capable of supporting bushfire spread and therefore forming the bushfire hazard interface for the purposes of determining APZ separation distances.

The line of management represents the transition point between:

- managed land, where vegetation structure satisfies the fuel-reduction intent of Appendix 4.1 of Planning for Bush Fire Protection 2019 (including reduced surface fuels, absence of ladder fuels and controlled canopy spacing), and
- hazard vegetation, where continuous surface, near-surface, elevated or canopy fuels remain capable of sustaining bushfire spread.

### Vertical fuel continuity

The arrangement of vegetation fuel layers that allows fire to spread progressively from surface fuels through near-surface and elevated fuels into canopy fuels.

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<sup>1</sup> As defined in Definitions within PBP

## References

Australian Building Codes Board 2022, *National Construction Code 2022*, Australian Building Codes Board, Canberra.

Hines, F., Tolhurst, K.G., Wilson, A.A.G. & McCarthy, G.J. (2010), *Overall fuel hazard assessment guide*, 4th edn, Fire and Adaptive Management Report No. 82, Victorian Government Department of Sustainability and Environment, Melbourne.

NSW Rural Fire Service 2019, *Planning for Bush Fire Protection 2019*, NSW Rural Fire Service, Sydney.