

Managing tree hazards



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Review period

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About AFAC and AFAC Doctrine

AFAC

The Australasian Fire and Emergency Service Authorities Council (AFAC) is the Australian and New Zealand National Council for fire, emergency services and land management. It is a collaborative network of fire, emergency services and land management agencies that supports the sector to make communities safer and more resilient.

AFAC Doctrine

AFAC develops doctrine to support the practice of emergency management. The information in doctrine publications is evidence-based and drawn from academic research and the collective expert knowledge of member agencies. Doctrine is regularly reviewed and represents the official AFAC view on a range of topics.

Doctrine does not mandate action; rather, it sets aspirational measures. Publishing nationally agreed views, shared approaches and common terminology enhances cooperation and collaboration within and between agencies and jurisdictions.

Types of AFAC Doctrine

AFAC Doctrine is classified as follows:

Capstone doctrine – includes publications, such as 'strategic intents', that are high-level accounts of the concepts of emergency management operations and service delivery. They describe the principles of what is practical, realistic and possible in terms of protecting life, property and the environment.

Fundamental doctrine – includes 'positions', which AFAC members are expected to support, as well as 'approaches' and some 'frameworks'. Fundamental doctrine may become agency or jurisdictional policy on a matter if adopted by individual services or jurisdictions.

Procedural doctrine – includes 'guidelines', some 'frameworks', and 'specifications'. AFAC members are expected to be aware of procedural doctrine. A guideline is an advisable course of action; a framework provides a linking of elements to create a supporting structure to a system, and specifications are a detailed description of a precise requirement to do something or build something.

Technical doctrine – includes 'technical notes', 'training material' and the *Australasian Inter-Service Incident Management System (AIIMS)*. Technical doctrine provides guidance of a technical nature: the how to do something, or the technical meaning relative to a situation.

About this document

This publication is a procedural guideline.

Source of authority

This safe work guideline was approved by AFAC Council on 1 May 2024.

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AFAC expresses its gratitude to all who provided contribution to the preparation of this safe work guideline, including the Rural and Land Management Group, Work Health and Safety Technical Group, Urban Operations Group, the SES Operations Group and Workforce Management Group for their contributions to its review.

Purpose

Falling trees, limbs and branches – all constituting a tree hazard – pose a potential health and safety risk for emergency service responders, and for personnel undertaking prescribed burning activities. The incidence of tree hazards in forests and woodlands increases significantly in fire-impacted areas because fire weakens trees, particularly those with pre-existing structural defects.

The risks associated with fire-affected trees, such as falling limbs and branches, can persist for a considerable period after fire response operations are completed, and pose a risk to the general public (GHD Report, 2017).¹ Flooding events can decrease root-ball stability and increase the risk of tree fall. Strong winds and heavy rainfall associated with storm events also increase the risk of tree limb and branch fall.

AFAC has developed this safe work guideline to inform fire and emergency services and land management organisations when developing agency specific doctrine, and to support a uniform approach to managing tree hazards (e.g. identifying, marking, isolating and treating).

This guideline has been designed to assist organisations in the development and implementation of policies, procedures and other risk-control measures aimed at proactively managing workplace health and safety risks in emergency management (including before, during and after events) and prescribed burning operations (see Figure 1).

This document should be read in conjunction with the AFAC doctrine publications, *A Work Health and Safety (WHS) Hazard Management Framework for Emergency Service Responders* and *WHS Hazard Management: A Risk Management Approach to Safety* (2017).

1. GHD Report for Department of Environment Land Water and Planning, *Draft Hazardous Trees Doctrine Review*, June 2017, GHD, pp. 1



Figure 1: The design of this safe work guideline

Scope

Emergency services and land management personnel can be exposed to a range of hazards and risks when completing work tasks. These may vary depending on the nature of the work required, the urgency with which it is required, and the environmental conditions that prevail. Given the nature of emergency and land management work, it has been acknowledged that established safe work practices and risk management approaches that apply in other situations, may not be appropriate to use when responding to an emergency. Agencies have an obligation to ensure that their personnel are protected from hazards as far as reasonably practicable, regardless of whether they are responding to an emergency or not.

This guideline addresses the risk of trees collapsing and limbs and branches falling, in whole or in part, due to tree characteristics (e.g. defects) and external influences (e.g. impact of fire, wind, flood, powerlines or machinery damage). All trees present risk. This guideline is not intended to cover every hazard or risk associated with every type of tree in all situations.

This guideline provides agencies with a risk-based framework for developing doctrine to manage tree hazard during the different phases of emergency management and prescribed burning. Details related to the procedure of implementing specific risk control measures or treatments and discussion of the associated risks of these activities are outside the scope of this guideline.

This guideline provides guidance for agencies to design and implement policy and practice in the context of local conditions and existing organisational arrangements that are nationally consistent and recognisable to all personnel to enhance interoperability and safety.

Statement of engagement

This guideline was authored by the AFAC Rural and Land Management Group, in consultation with other AFAC collaboration groups, and was prepared in accordance with all relevant AFAC collaboration policy.

This version 2.0 of the guideline was reviewed by the authors in 2024 to ensure that it remains contemporary and assists with implementation across Australasia.

Audience

This guideline is intended for personnel who have the responsibility within their organisation for developing agency doctrine for tree hazard risk-mitigation policies, procedures, practices and training. While this guideline may be of interest to senior managers, incident controllers, trainers, fire and emergency responders and personnel involved in prescribed burning and other land-management activities, they should refer to their organisation's doctrine for information specifically tailored to their legal jurisdiction, and operational and environmental conditions.

This guideline is relevant to emergency response and land management work in Australia and New Zealand, including but not exclusive to:

- bush firefighting (e.g. in forests, grasslands and the urban–rural interface)
- prescribed burning operations
- flood and storm responses
- other emergency response activities where tree hazard is present
- disaster restoration and recovery operations.

Definitions, acronyms and key terms

The following terms have specific meanings.

Advanced or intermediate faller: A tree faller meeting the requirements of the relevant national units of competency.

In Australia, the following applies:

- FWPCOT3348 Fall Trees Manually (advanced)
Or
- FWPCOT3347 Fall Trees Manually (intermediate).

In New Zealand, the following applies:

Qualified Tree Faller:

- US17763 Demonstrate knowledge of tree felling, and
- US17766 Fell trees safely using a chainsaw
Or
- US17258 Use advanced felling techniques in arboriculture.

Advanced Tree Faller:

- US28562 Fell and/or clear hazardous trees
Or
- US17756 Assess and manage individual hazardous trees
Or
- US17258 Use advanced felling techniques in arboriculture.

Note: in New Zealand, anyone carrying out machine or jack assisted felling will also require:

- US24569 Fell trees using machine pushing assistance, and
- US24570 Fell trees using back-pulling machine assistance
Or
- US24585 Use tree jacks to fell trees.

Assess (tree hazard): To locate and evaluate the extent of tree hazard and to determine an appropriate risk control measure, by personnel with expertise and experience.

Blacking out: The process of extinguishing or removing burning material along or near the fire control line, and trenching logs to prevent rolling to make the fire safe. Also referred to as 'mopping up'.

Bushfire: Unplanned vegetation fire. A generic term that includes grass fires, forest fires and scrub fires, both with and without a suppression objective.

Clear and present danger (CPD) tree (also known as a cross tree): A tree, limb or branch that is expected to fall within the timeframe of the current operation and impact personnel in its potential impact zone.

Culturally significant tree: Trees that have been identified as culturally significant for various reasons such as being used for tools, ancestral burial sites, animal spirits, birthing or meeting places, cleansing rituals or other purposes.

Dispatching officer: The agency or other authorised person initiating the act of ordering attack crews and support units to respond to a fire, flood, storm, or the movement of unit from one place to another.

Exclusion zone: An area around an identified hazardous tree that is not safe to work in, and access should be limited. This area is usually two times the height of the tree, depending on ground slope.

Falling objects protection systems (FOPs): Falling objects protection systems provide protection for a vehicle's occupants using an engineered reinforcement installed onto a vehicle roof or ceiling structure to reduce possible injuries in the case of a falling object. See Appendix 4 for recommended standards.

Flood: The overflowing by water of the normal confines of a stream or other body of water, or the accumulation of water by drainage over areas which are not normally submerged.

Going fire: Any bushfire that is expanding and that has not yet been contained by suppression actions.

Hangers: Limbs which are hooked up or tangled in other limbs and can be dislodged by external factors (e.g. wind, the effects of machinery, other trees, fire) during an operation.

Identify (tree hazard): The ability to recognise stands of individual trees that present an increased risk to personnel (as included in basic bushfire hazard recognition training).

Indicator tree: A tree that is marked to indicate the presence and direction of a nearby tree hazard (see Appendix 3). An indicator tree may be used when the symbol on the hazard tree is obscured by vegetation or difficult to see from control line, or if it is unsafe to mark the tree.

Initial attack: The first response/suppression work on a fire.

LACES: Lookouts, Awareness, Communications, Escape Routes, Safety Zones.

Occupant protection guards (OPGs)/ Operator Protective Structures (OPS) and Operator Protective Devices (OPD):

Occupant protection guards/structures/devices provide protection around the entire occupant cabin and occupant space. They are designed to stop an object suddenly entering the cabin (See Appendix 4 for recommended standards).

Personal protective clothing and equipment (PPE): Any clothing or equipment that is intended to be worn or held by a person at work which protects them against risks to their health or safety, and any addition or accessory designed to meet that objective.

Potential clear and present danger tree (potential CPD):

A tree that, in its current state, is not a clear and present danger tree but may become a clear and present danger tree, if it catches alight, stays alight or is impacted by wind or other disturbances.

Potential impact zone: The area underneath or surrounding a clear and present danger tree where the tree, limb or branch has potential to impact personnel.

Rollover protection systems (ROPs): Rollover protection systems provide protection for the vehicle operator in the case of a roll over incident. See Appendix 4 for recommended standards.

Significant or historic tree: Remnants of the bush, plantings by early settlers, important landscape or streetscape elements, or trees planted to commemorate important people or events.

Storm: An atmospheric disturbance involving perturbations of the prevailing pressure and wind fields, on scales ranging from tornadoes (1 km across) to extra-tropical cyclones (2,000-3,000 km across), and wind with a speed between 89 – 102 km/h (Beaufort scale wind force 10).

Tree hazard(s): A general term which refers to a trees limbs or branches with potential to fall during the current operation. This includes trees with potential to become hazardous through exposure to fire in a prescribed burning scenario or back burning operation. Tree hazard is a term that may refer to the presence of a specific tree hazard associated with an individual tree, a set of tree hazards in an area, or to large areas of tree hazard at the landscape scale.

Introduction

Australasian fire and emergency services and land management agencies have established practices and procedures for managing tree hazard through identifying and treating individual trees, and for isolating both personnel and the public via the use of barriers. This guideline has been developed to provide guidance on a national approach to the marking, isolating and mapping of tree hazard that may be encountered during emergency response and land management operations in urban and rural environments. It also provides guidance on the training required to safely recognise and deal with such hazard. Trees damaged in storm or flood events are also within the scope of this guideline.

The adoption of this guideline will provide guidance to enhance the safety of all personnel working in situations where tree hazard may present a danger. Personnel being deployed interstate for any form of fire, flood or storm event should be confident that there are common procedures and practices in place for identifying, informing relevant personnel, marking, isolating and mapping tree hazard. Agencies should determine how they apply the guidance to meet jurisdictional requirements, and that tree hazard management may involve a scalable response subject to considerations of what is reasonably practicable.

This guideline does not override the importance of all personnel adhering to Dynamic Risk Assessment (DRA) principles whereby all personnel should constantly evaluate the situation and the environment they are working in.

AFAC's guideline

The context of risk management in an emergency and during prescribed burning

Emergencies and prescribed burning activities are both complex and dynamic events that, due to their nature, represent a potential hazard to personnel in attendance and public safety during and after the event. Yet, in these challenging situations, tree hazards still need to be controlled in a way that promotes optimal safety for workers and the community.

Emergency service personnel responding to bushfire, flood or storm events and land management personnel undertaking prescribed burning for risk control, risk mitigation, agricultural or ecological purposes are often required to enter, navigate through and work for extended periods within treed environments.

The intrinsic risks associated with these environments are, however, heightened by the effects of fire, flood and wind on the structural integrity of tree trunks, tree limbs and the root balls that anchor trees to the ground. This generates risk of trees or their limbs falling on or near personnel, causing injury or death. Heightened risk of weakened tree structure represents an important hazard that must be factored into the risk reduction activities of agencies and their personnel.

Importantly, due to the nature of tree hazard risks, even if the highest level of tree hazard assessment is undertaken and effective key risk control measures are applied, there will remain an inherent tree hazard risk in the landscape.

It is important to note that exposure to tree hazard is just one of the many health and safety risks posed to emergency services and land management personnel. This guideline informs work management processes during emergency management and prescribed burning activities (including training). This guideline may also be used by organisations to inform tree hazard management practices for non-emergency management related work, although this is not the primary intent of the guideline.

Risks associated with tree hazard

Falling trees, limbs and branches can strike personnel, vehicles, machinery and members of the public (e.g. bush walkers, people in vehicles), block access and egress along roads, designated escape routes or fire control lines, or cause a traffic hazard to agency personnel and community members driving on the road. An example of a tree hazard is a tree limb or branch falling across a control line, allowing a planned or unplanned fire to escape, and creating a threat to others.

A potential also exists for tree hazard to interact with other hazard types, such as those associated with gas supplies, water supplies, powerlines (above and below ground), adjacent buildings and trees and terrain features (e.g. steep slopes). Importantly, the assessment of tree hazard risk and the application of some tree hazard risk control measures have their own risks through often increased exposure to the hazard.

Assessing tree hazard risk

Risk assessment is the overall process comprising the identification, analysis and evaluation of risk. Risk assessment builds knowledge and understanding about hazards identified and the level of risk they pose, so that informed decisions can be made about controlling them. Tree hazard should be continually assessed in emergency management and prescribed burning contexts, due to the potential for rapid changes to occur in relation to the hazard posed by falling trees, limbs and branches, a result of fire, wind, flooding or operational activities.

To provide a framework for risk assessment procedures, and to consider the different levels of expertise that may be required to undertake related activities, two separate components of the risk assessment process are described (Table 1).

As described in Table 1, all personnel should be able to identify tree hazard, mark with spray paint and isolate a clear and present danger (CPD) tree using barrier tape. However, the assessment of tree hazards or potential tree hazards to determine what risk control measures are appropriate can be a more complex task that requires a higher level of expertise. The following sections provide a description of these two components of the risk assessment process and highlight key considerations.

Table 1: The two components of assessing tree hazard risk.

Component of the risk assessment process	May be undertaken by	Recommended training or experience
<p>Identification, marking and isolation:</p> <p>Identification of tree hazards, marking of tree hazards (if safe to do so) with spray paint and isolation of tree hazards with barrier tape.</p> <p>This applies to CPD trees.</p> <p>In their procedures agencies should determine the level of experience expertise required for identification, marking and isolation of potential clear and present danger trees.</p>	All personnel.	<p>Tree hazard awareness training (either as a specific workshop or within existing training modules).</p> <p>Local operational experience.</p>
<p>Tree hazard assessment:</p> <p>Assessment and marking of individual tree hazard and determination of appropriate risk control measures.</p> <p>This applies to CPD trees and potential tree hazard.</p>	Agency endorsed individuals with Tree falling qualifications and experience and formal tree hazard assessment training.	<p>Tree falling qualifications and experience in fire effected trees (or saturated soils environments - in flood).</p> <p>Formal - tree hazard assessment training.</p> <p>The extent of expertise and experience required to assess tree hazard should be determined by agencies.</p>

While tree hazards are often identified by personnel who are specifically tasked with undertaking initial tree hazard assessments for an operational area, ongoing awareness and identification of tree hazard by all personnel, during all times, should form part of the dynamic risk assessment that is performed. Figure 2 highlights one way in which the differing levels of expertise required to undertake the two components of the risk assessment process could be managed when a tree hazard is identified.

The task of identifying or assessing tree hazards should always be conducted from a safe location and appropriate safe distance including the route to and areas around the tree.

Figure 2 relates specifically to the identification and assessment of tree hazard following the passage of fire in a prescribed burning or bushfire situation. It is not intended to illustrate a risk assessment procedure.

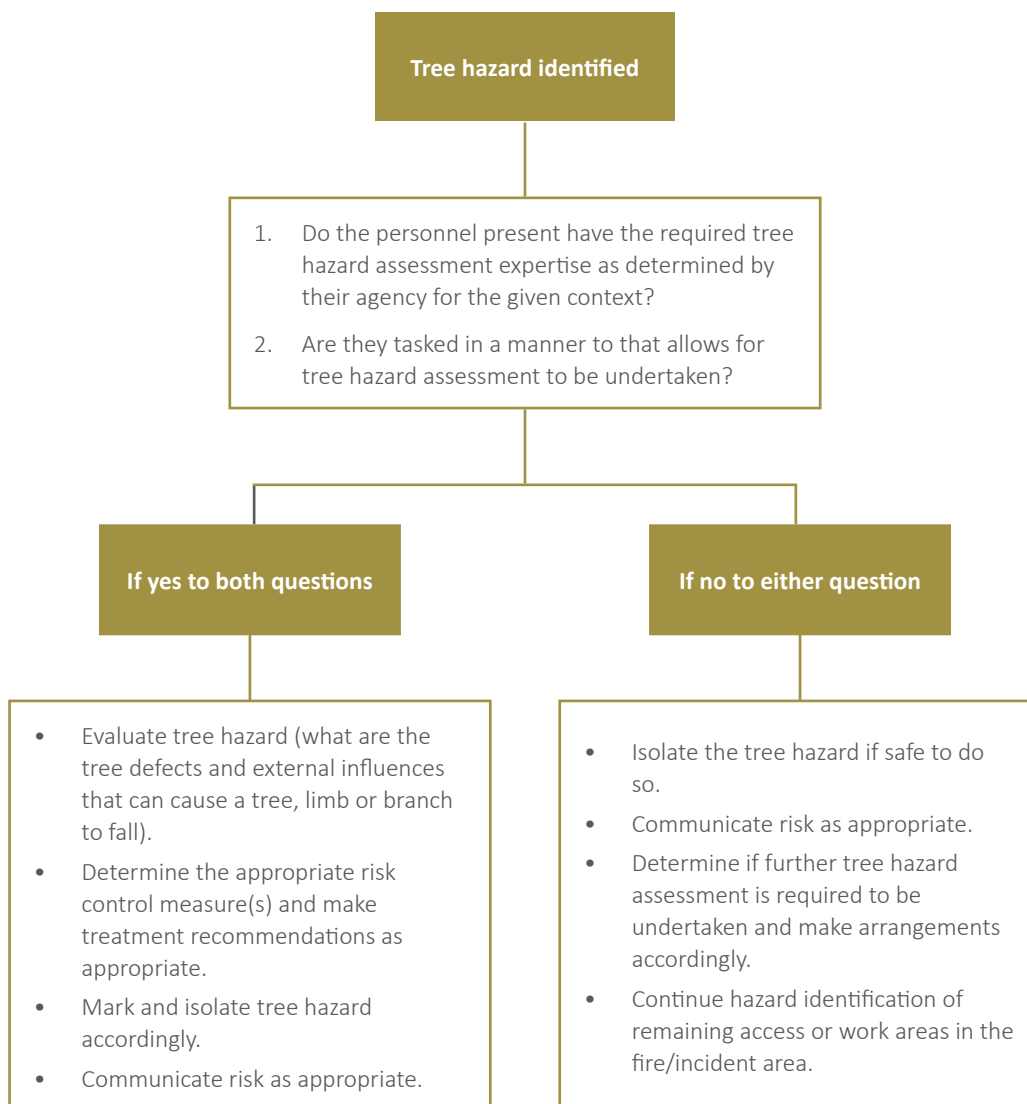


Figure 2: Managing different levels of expertise in the identification and assessment of a tree hazard.

Identification and isolation

Personnel operating in an environment where there is a known or potential risk of trees, limbs or branches falling, should have the knowledge required to identify trees that may pose a risk, mark and isolate trees accordingly and communicate potential risk.

All personnel should be aware of the following:

Identifying tree hazard: what to look for

This section describes the typical characteristics associated with potential tree hazard, as well as the external influences that can contribute to tree hazard that all personnel should be aware of.

Characteristics that indicate potential tree hazard:

- trees with hangers or damaged limbs that could fall and impact personnel in planned work areas or access routes
- trees affected by one or more of the following: excessive rot content including dry sides, scars or hollows; exposed root systems; root, trunk or stem damage; storm, snow or fire damage; impact by machinery or snigged logs, pathogen and insect attack
- trees with shallow root systems in unstable, eroded or steep ground
- dead trees
- trees that have been cut, wind-thrown or pushed up and which have become caught in or lodged against another tree, stopping it from falling to the ground (e.g. a hung-up tree)
- trees with excessive lean or an obvious lean towards the work area or trees with potential to fall on to other trees and impact the work area
- recent change that has occurred to a tree may indicate that structural integrity has been compromised
- trees with new or fresh cracks in the timber or bark (particularly if they have occurred after the burn)
- the presence of new ash deposits at base of trees or new charcoal in unburnt areas immediately adjacent to (or on) a control line
- swelling on the trunk or at branch joints that may have been caused by healing from past disturbance to the tree may be an indicator of reduced integrity
- there are tree species known to suddenly fall or lose limbs without apparent cause at the time e.g. Angophora spp, Erythrina spp, Ficus spp, Melaleuca spp.

External influences that increase potential tree hazard:

- impact of fire
- wind exposure, where there has been a change to exposure due to tree removal or potential for unusually increased wind exposure (speed and direction) due to weather or geography

- trees with snow in its canopy that may obscure stem damage and weight of snow may cause failure
- drought, leading to increased risk of tree hazard in some vegetation types
- stress, pathogen and insect infestation
- excessive drainage problems from land management operations e.g. snig tracks in forestry operations
- exposure to vibration or physical damage from heavy plant or machinery.

Potential interaction with other hazards at the site

There is also possibility for tree hazard to interact with other hazards, such as gas supplies, water supplies, powerlines (above and below ground), adjacent buildings and trees and terrain features (e.g. steep slopes or tree lean).

Arranging for risk assessments to be carried out

When more detailed tree hazard assessments are required to determine appropriate risk control measures, personnel should know how to arrange for risk assessments to be carried out by someone with the appropriate expertise and training.

Isolation: the two-tree length rule

Personnel should isolate the tree hazard by creating an exclusion zone, if it is safe to do so. The potential impact zone should be communicated to all crews entering the immediate area and an exclusion zone should be documented and clearly communicated to all crews who may enter the area in the future until the hazard is removed. Appendix 3 provides guidelines on isolating tree hazard using barrier tape. The standard exclusion is determined as the distance from the tree; the general rule is two times the height of the tallest tree in the potential impact zone, plus any additional distance due to site conditions (e.g. slope). The exclusion/isolation zone for a tree with a prominent lean may be limited to this distance in the direction forward of its lean.

Clear and present danger trees or cross trees

A clear and present danger tree (CPD, also known as a 'cross tree' ⊗) is a tree, limb or branch that is expected to fall within the timeframe of the current operation and may impact personnel in its potential impact zone. All personnel may identify, isolate and mark (if safe to do so) CPD trees.

A standard symbol for CPD trees (cross trees ⊗) is provided to promote consistency in marking procedures (see Figure 3) and the mapping of tree hazard, made up of a circle with a cross through it. Figure 3A provides a pictorial example of a CPD tree marked with spray paint. Figure 3B provides a pictorial example of how to indicate the location of a CPD tree using distance and direction below the circle (indicator tree). Indicator trees can be used when the CPD tree is unsafe to mark or not readily visible. This technique is also used for the indication of hangers (arrow, distance and direction marked above the circle). See Appendix 3 for



Figure 3A: Example of marking a CPD tree.

further guidance on tree hazard marking procedures and mapping symbology. To facilitate rapid communication, 'cross trees' is provided as a shorthand name for CPD trees based on a description of the symbol.

Potential clear and present danger trees

A potential clear and present danger tree (potential CPD tree) is a tree that, in its current state, is not a CPD tree (cross tree, ⊗) but may become a CPD tree (cross tree, ⊗), if it catches alight or is impacted by wind or other disturbances.

Agencies may consider developing procedures for managing potential CPD trees. Appendix 2 describes a system of work for managing potential CPD trees that agencies may consider in the development of doctrine related to tree hazard management.

The relevant tree marking procedures and map symbols

Personnel should be aware of the tree hazard marking procedures and mapping symbology as defined by their agency's doctrine. Tree hazard marking procedures and mapping symbology are provided in Appendix 3 for consideration by agencies in developing doctrine related to tree hazard management.

Tree hazard assessment

Tree hazard assessment involves evaluating tree hazard risk and determining what risk control measures are appropriate. The evaluation of tree hazard is not influenced by tree



Figure 3B: Example of indicating the location of a CPD tree with the use of an indicator tree to signify distance (10m) and direction (arrow).

values. Characteristics and factors that contribute to tree hazard in the operational context are observable and do not change irrespective of tree values. The application of some risk-control measures, especially tree removal, may have a negative impact on the environment, including ecological, social and cultural values. These values should be considered in determining the most appropriate risk control measures, often referred to as 'treatment'.

While all personnel should be able to identify CPD trees and isolate accordingly using barrier tape, the assessment of a specific tree hazard may require a higher level of expertise.

The assessment of tree hazard can be a more complex task than identification CPD trees and may require specific expertise. Assessment of both the levels of risk associated with a tree hazard and the values in retaining the tree, as well as the decision about the most appropriate risk control measure(s) to be applied, requires consideration of the following factors:

- the structural characteristics of trees
- the likely timeframe in which the tree, limb or branch might be expected to fall
- the tree's exposure to the causal factors and external influences of tree hazard
- the quantity of trees to be assessed
- a tree's potential to interact with other hazards or assets (e.g. power lines, buildings)
- the operational context (e.g. does a given road need to be accessed?)

- possible risk control measures that may be applied in context (see Appendix 1)
- the cultural, social or economic values associated with a tree or its immediate surroundings
- the ecological values at the site
- human factors in decision making and the risk-attitudes of individuals and teams to facilitate self-assessment by the tree hazard assessor.

Agencies should consider the specific skill set required for tree hazard assessment. The type of knowledge and expertise which is valuable in undertaking tree hazard assessments can include:

- knowledge of tree characteristics and indicators of tree hazard
- knowledge of suppression tactics and the broader operational context
- knowledge of risk mitigation options
- knowledge of the characteristics of local vegetation types in relation to tree hazard
- knowledge of ecological values in local vegetation types
- Knowledge of local social and cultural values
- Awareness of human-decision making influences (attitudes to risk, individual values, fatigue, repetitive tasking).

This expertise can be gained through local operational experience, crew leader experience, tree falling training or experience, or formal tree hazard assessment training. The extent of knowledge and experience required to assess tree hazard should be determined by agencies.

Managing tree values

The ecological importance of trees should be considered in tree hazard assessment. Hollow-bearing trees, alive or dead, may be relatively rare in modified landscapes and provide critical habitats for a wide range of fauna. The loss of hollow-bearing trees from the landscape can have a negative impact on biodiversity, as well as causing broader environmental impacts.

Cultural and social values should also be closely considered in tree hazard assessment. Culturally significant trees are often an important aesthetic feature of local landscapes that are highly valued by local communities.

Significant effort and resources can be justified in modifying an operation to exclude important trees from being impacted. Trees deemed to be of cultural, social or ecological importance should only be removed if it is unreasonable to modify the operation to exclude the tree from being impacted. Each jurisdiction has different procedures and policy in relation to habitat trees, environmental protection and cultural heritage protection. These should be closely considered in the development of policy and procedures that relate to managing tree hazard.

Key risk control measures

Work methods and procedures should be developed and implemented to minimise risks that tree hazard presents to land management and emergency personnel. These approaches rely on effective supervision and the engagement of personnel in the implementation of specified procedures. The use of the techniques described will vary according to the resources and circumstances of individual organisations, and the environments in which they operate. This section provides suggestions of risk control measures – categorised according to phases of prescribed burning and phases of emergency management – that agencies may consider in the development of policies and procedures for tree hazard management. Details related to the procedure of implementing specific key control measure or treatments and discussion of the associated risks of these activities are outside the scope of this guideline.

When undertaking prescribed burning

Prescribed burning proceeds according to four phases as set out in Table 2, each of which provides opportunity to implement elements from the hierarchy of risk control.

Table 2: Phases of prescribed burning

Planning	Includes long-term strategic planning and program planning (referring to the scheduling of burns), as well as operational planning (referring to in-advance planning for individual burns in the weeks before and until the day of the burn).
Preparation operations	Burn-preparation activities conducted at the burn block and surrounding areas in the weeks prior to or on the day of the burn. This includes all operation activities prior to ignition.
Post-ignition	Activities after ignition, including lighting and containment, blacking out and patrol.
Recovery	Activities to make the area safe for the public, as well as monitoring and evaluation works.

Planning phase

The management of tree hazards should be considered in strategic and program level planning for prescribed burns, e.g. consideration of resource implications or risk management planning. Furthermore, agencies may capture information related to areas of heightened tree hazard (usually in the form of maps/spatial data) that may inform program level planning. In the case of operational planning for an individual burn, the planning phase may involve visiting the burn site to evaluate it, to set or refine the objectives of the burn, develop strategies required to achieve them, prescriptions and constraints it must conform to and to determine the appropriate control measures

required to ensure the burn's containment. These site visits, if undertaken, present an opportunity to:

- identify, mark and map tree hazard
- plan for the treatment of tree hazard near assets or expected operations, e.g. burn perimeter, control lines and access routes
- locate control lines in areas of reduced tree hazard
- plan pre-burn 'candling' or edge burning, or other protection methods to reduce potential tree hazard developing into clear and present danger trees
- plot the location of areas not subjected to pre-burn tree hazard management
- issue hard hats and high visibility clothing as standard PPE
- use falling object protection or other approved occupant protection on vehicles and plant relative to the prevalence of tree hazard in specific areas
- ensure access routes are cleared and maintained to relevant agency standards
- identify and map high tree hazard areas
- provide education about the risks posed by tree hazard, marking symbology and the necessity of considering tree hazard as part of situational awareness (including dynamic risk assessment)
- establish how information about tree hazard will be disseminated to crew members.

Preparation phase

Controlling risk during the burn preparation phase may include:

- If clear and present danger trees (CPD trees or cross trees ⊗) are present during burn preparation they must be immediately identified, marked (if safe to do so) and treated (removal of tree or limb as appropriate) or excluded before burn preparation can continue.
- Agency procedures may consider the removal of potential CPD trees or the removal of limbs from potential CPD trees that are unable to be protected in a prescribed burn or back burn operation (see Appendix 2). Consideration during removal should include risk to staff undertaking removal, and where possible a preference for mechanical removal to occur rather than hand-felling.
- Agency procedures may consider the implementation of protection measures for those potential CDP trees that may be able to be protected in a prescribed burning or back burning operation (See Appendix 2). Protection measures may include:
 - clear fuel around trees (using hand tools or machinery)
 - candle (burn) tree to remove flammable bark during suitable conditions
 - application of ground-based retardants or suppressants

- wetting down of trees with water.

- Clear control lines by plant with approved occupant protection (refer to Appendix 4 for desirable plant protection standards).
- Plan crew staging and traffic management procedures that avoid areas where tree hazard is known to be present.
- Establish crew deployment procedures based on dynamic risk assessment (DRA).

Post-ignition phase (Ignition, patrol and mop up)

It is important to understand that the introduction of fire into the environment can affect trees and change the degree of hazard they represent. While this should be prepared for (and is captured in the conceptualisation of potential CPD trees) during the planning and preparation phases, the alteration of risk by fire must be borne in mind after ignition operations have commenced. During the post-ignition phase, which includes the activity of progressing ignition operations, some suggested tree hazard control measures are:

- Establishing crew deployment procedures based on dynamic risk assessment (DRA).
- Using DRA and LACES to manage risk (e.g. by identifying escape routes and posting lookouts).
- Creating isolation areas around CPD trees, including personnel exclusion zones.
- Dynamically adjusting burn perimeters and control lines to minimise exposure to CPD trees that manifest.
- Removing CPD trees, where safe and practical to do so, using operator protected plant, or if no alternative is available, using trained and accredited fallers.
- Treating of CPD trees through the removal of a limb or branch, if appropriate and safe to do so.
- Consider delaying any on foot activities until the time period where trees are most likely to start falling has passed.
- Agency procedures may consider using cool edge ignition, whereby lighting patterns are intended to minimise fire intensity by lighting from control lines that are upslope or downwind of those potential CDP trees that may be able to be protected in a prescribed burning or back burning operation (See Appendix 2).
- Close support to the ignition crew including rapid extinguishment of potential CPD trees by a suppression or patrol crew while allowing fuels immediately adjacent to be adequately consumed.
- By lighting at the potential CPD trees, allowing fire to burn away from it.
- Deploying crews in vehicles with roll-over protection, falling object protection or other appropriate form of occupant protection.
- Ensuring incoming crews are notified about any tree hazard identified on or around the incident ground.

Recovery phase

During the recovery phase, which is concerned with making the burn area safe for entry by the public, some suggested tree hazard control measures are:

- Providing information and erecting signage or barriers to exclude the public from unassessed and untreated areas, and to direct them to alternative routes if high volumes of traffic are expected.
- Removing CPD trees from areas frequently visited by the public, e.g. along roads and at picnic areas.
- Treating of CPD trees from areas frequently visited by the public, through the removal of a limb or branch.
- Keeping and maintaining records of tree hazard removed or remaining and communicating potential or ongoing issues with land owners/managers.

A table of suggested control measures mapped according to the hierarchy of risk controls for each phase of prescribed burning is provided in Appendix 1.

Emergency management: When responding to bushfire, flood, rescue, search or storm

Emergency response activities are typically divided into three phases – before, during and after. Due to the unpredictable locations and timing of emergency incidents, opportunities for controlling risk by eliminating tree hazard, or substituting alternative control strategies to avoid the risk posed by tree hazard, are limited.

Table 3: Phases of emergency management

Before	Prevention, mitigation and preparedness activities undertaken before an emergency. These activities aim to prevent and mitigate the impacts of an emergency, and increase the preparedness of organisations, the community and individuals to appropriately respond to an emergency.
During	Readiness and response activities undertaken in the immediate lead-up to and during an emergency. Such activities include ensuring that organisations, the community and individuals are informed and ready to respond (e.g. readiness activities). This phase extends to response, relief and initial recovery activities.
After	Ongoing recovery activities following an emergency. These assist and support organisations, the community and individuals to return to a new normality as quickly as possible.

Before the incident

Effective risk control during the pre-incident phase may include:

- the issuing of hard hats and high visibility clothing as standard PPE
- the use of roll-over protection, falling object protection

or other approved occupant protection on vehicles and plant relative to the prevalence of tree hazard in specific areas

- ensuring access routes are cleared and maintained to relevant agency standards
- identification and mapping of high tree hazard areas
- education about the risks posed by tree hazard, marking symbology and the necessity of considering tree hazard as part of situational awareness (including dynamic risk assessment)
- establishing how information about tree hazard will be disseminated to crew members.

During the incident

During incidents, the risks from tree hazard can be mitigated by two methods.

En-route by:

- if there are routes that have been assessed and treated for tree hazard these should be prioritised for crew deployment
- deploying crews in vehicles with falling object protection or other appropriate form of occupant protection
- ensuring incoming crews are notified about any tree hazard identified on or around the incident ground and briefed on personal risk mitigation measures e.g. not putting weight on burnt trees when moving through bushland or using them as leverage when negotiating slopes
- ensuring incoming crews are notified of known areas with a high density of tree hazard, e.g. fire killed mountain ash
- using ignition techniques that include lighting immediately adjacent to potential CPD trees and allowing the fire to burn away from them during the early development stages of the backburn or burnout fire
- all personnel remaining observant for hazards.
- At the incident by:
 - establishing crew deployment procedures based on dynamic risk assessment
 - tree hazard assessments conducted throughout the operational area including escape routes and safety zones
 - ongoing awareness and the identification of trees that present a hazard that should form part of the dynamic risk assessment performed by all personnel at all times and, as the situation and nature of the environment changes due to the influence of storm, fire or flood, new escape routes should be identified and included in the dynamic risk assessment
 - tree marking (see Appendix 3)
 - prior to commencement of operations, the person-in-

charge should ensure an assessment for tree hazard is undertaken for the operational area (the operational area includes escape routes and safety zones and these should be identified and assessed as soon as is practical)

- withdrawing from, and establishing an exclusion zone around, areas where tree hazard have been identified, especially under high-risk conditions (such as periods of high wind)
- instituting traffic management procedures to minimise the risk from tree hazard
- moving or abandoning control lines in areas of high tree hazard
- removing fuel around potential CPD trees ahead of backburn or burnout ignition, where feasible
- maintaining low intensity fire using backing or flanking fire only (cool edge ignitions) in back burn or burn out operations around potential CPD trees
- close support of the ignition crew in burnout or backburn operations by rapid extinguishment of potential CPD trees by a suppression crew before fire can take hold
- delayed blackout activities if feasible to allow high risk trees to collapse
- treatment of CPD trees by removal of tree or limb as appropriate.

After the incident

Once an incident has been brought to conclusion, the risk of tree hazard can be minimised by:

- deferring the deployment of recovery crews until full tree hazard assessment and control activities, including setting up exclusion zones around or removing necessary trees, have been undertaken
- treatment of CPD trees by removal of tree or limb as appropriate
- using dynamic risk assessment to manage the risk to personnel engaged in recovery
- ensuring any residual risks are recorded and communicated, as appropriate
- ensuring personnel deployed to the incident ground wear hard hats.

A table mapping possible control activities appropriate to each phase of incident management is set out in Appendix 1.

Promotion of personal responsibility

While organisations engaged in emergency response and land management have a duty to ensure an appropriate hierarchy of control exists in relation to tree hazard, emergency response and land management personnel are required to enter environments that cannot be made subject to prior risk elimination. For this reason, organisations should

also promote the concept of personal responsibility, the need to create and maintain situational awareness, and the use of LACES and the importance of dynamic risk assessment within standard operating procedures, standard operating guidelines and in training materials. This must include hazard identification by all personnel during all incident phases.

Application of control measures within agencies

To reduce the health risks associated with tree hazard to as low as reasonably practicable, action is to be considered at all levels. This section provides suggestions of activities that may be undertaken within the different organisational levels within emergency response and land management agencies.

Considerations for organisations include:

- establishing policy and procedures for the management of tree hazard
- integrating tree hazard safe work guidelines into training for emergency service and land management personnel
- developing and implement systems, procedures and equipment to reduce risks associated with tree hazards to as low as reasonably practicable
- producing pictorial or diagrammatic guides where possible will assist to aid in the recognition of tree hazard (materials that cater to local operational contexts and vegetation types are likely to be the most effective)
- processes for the identification and mapping of specific high tree hazard areas
- collecting accurate and consistent data on tree hazard related deaths, injuries and near misses (incident data plays an important role in understanding the risks that are posed by tree hazard, and in evaluating the effectiveness of tree hazard management activities)
- AFAC member agencies are encouraged to incorporate 'tree, limb or elevated object impact' as a standard causal factor category within their internal fatality and injury record recording systems as this may serve to improve the reliability of industry performance measure reporting (GHD 2017)
- putting in place policy and procedures to alert the public to the risks associated with tree hazard as appropriate before, during and after bushfires, prescribed burning and storms
- consider deployment of personnel with expertise in tree felling and management of heavy plant to identify and treat risks appropriately to reduce exposure of crews and the public
- instilling in crews the importance of hazard identification as an individual responsibility.

Considerations for incident controllers and burn managers include:

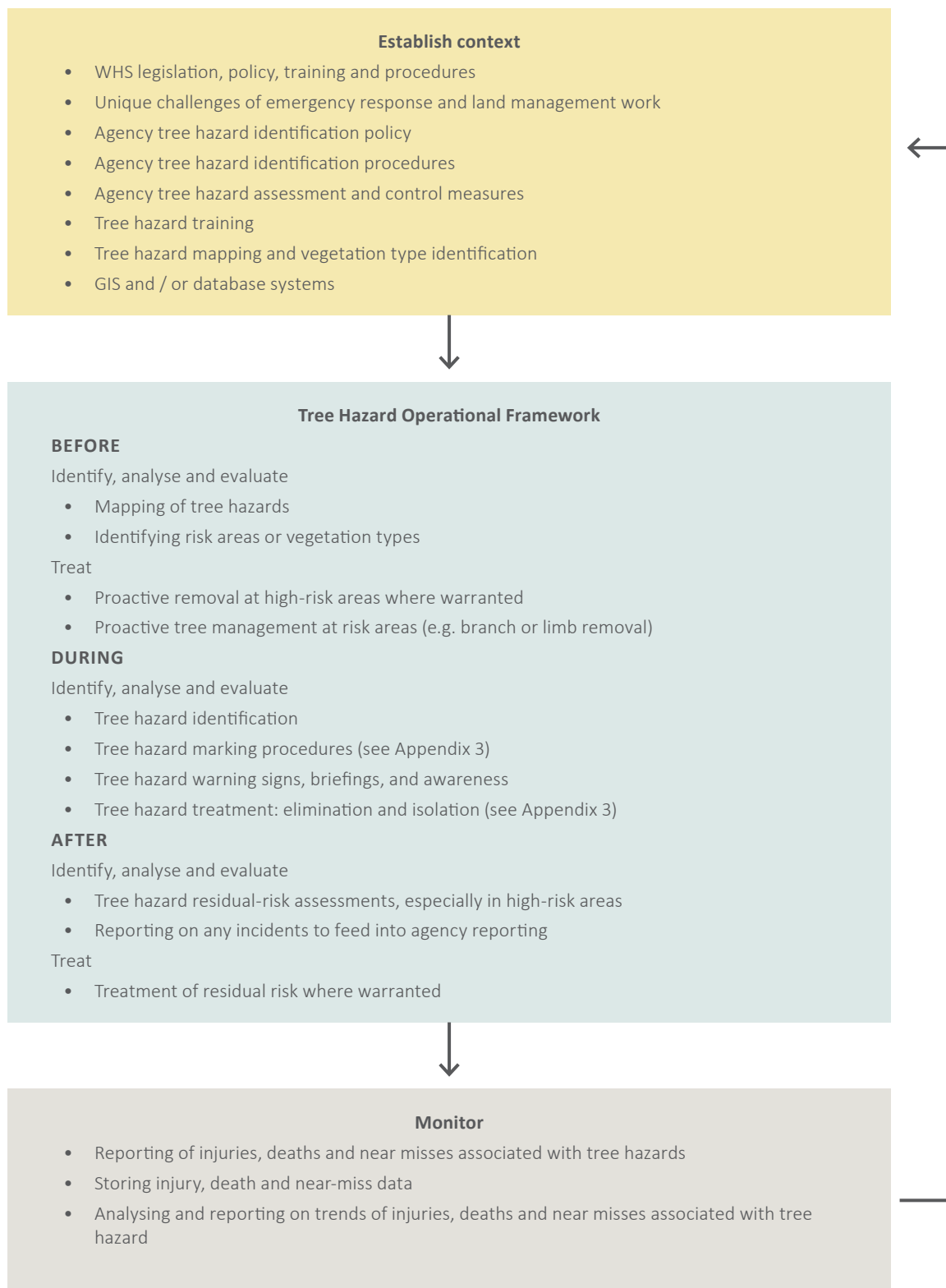
- considering tree hazard in the execution of work undertaken by crews
- where appropriate, including material relating to tree hazard in the safety section of briefings and incident action plans and prescribed burn plans
- reinforcing the need to be situationally-aware (LACES and Dynamic Risk Assessment) when tasking crews, in addition to safety briefings
- consideration of the potential impact prevailing environmental conditions may have on increasing the risk that trees, limbs and branches may fall
- consideration of the effect of planned or unplanned fire as well as storms and flooding in increasing the risks associated with tree hazard
- communications regarding tree hazard to other support agencies who may have access to the incident ground prior to the area being re-opened to the public, e.g. police, primary industries government departments or utility providers
- warning the community about tree hazard risks associated with the incident or prescribed burn
- instilling in crews the importance of hazard identification as an individual responsibility.

Considerations for sector commanders crew leaders and crew members include:

- being situationally aware and alert others in the team and the supervisor(s) if a tree hazard is identified and, only if safe to do so, isolate the hazard until the tree can be assessed by an appropriately qualified person
- all personnel should be able to identify CPD trees, mark (if safe to do so), create an exclusion zone using barrier tape and arrange for a tree hazard assessment to be undertaken where necessary
- reporting identified tree hazard as soon as identified through chain of command and in crew briefings / debriefings
- setting out and communicate an exclusion zone
- actively reducing the likelihood of CPD tree development through appropriate ignition and early treatment techniques as standard practice
- the ongoing awareness and the identification of trees that present a hazard must form part of the dynamic risk assessment performed by all personnel at all times
- understanding that, as the situation and nature of the environment changes due to the influence of storm, fire or flood, new escape routes should be identified and included in the dynamic risk assessment
- instilling in crews the importance of hazard identification as an individual responsibility.

Sample risk-management framework

Below is a sample organisational risk management framework that identifies factors to consider for the management of tree hazard.



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Appendix 1: Suggested risk control measures

Prescribed burning

Phases of prescribed burning	Risk treatment					
	Hierarchy of control					
	Level 1	Level 2			Level 3	
	Eliminate	Substitute	Isolate	Engineering	Administration	PPE
Planning	<ul style="list-style-type: none"> Identify and plan tree hazard management requirements, such as removal 	<ul style="list-style-type: none"> Plan work areas (control lines) along areas of reduced tree hazard (pre-treated roads or strategic breaks) 	<ul style="list-style-type: none"> Exclude areas of the burn that will not have tree hazard management performed (internal tracks) 	<ul style="list-style-type: none"> Rollover protection systems (ROPS) Falling objects protection systems (FOPS) <p>Occupant protection guards (OPGs)</p> <ul style="list-style-type: none"> Plan pre-burn candling or edge burning 	<ul style="list-style-type: none"> Map areas of high tree hazard Mapping of tree hazard pre-treatment Establish system to mark tree hazard during operations (see Appendix 3) Establish effective protection options for trees that can be protected from fire. Schedule burns when fuel / soil moisture conditions are moderate, e.g. When Keetch Byram Drought Index values are less than 100 	<ul style="list-style-type: none"> PPE

Phases of prescribed burning	Risk treatment					
	Hierarchy of control					
	Level 1	Level 2			Level 3	
	Eliminate	Substitute	Isolate	Engineering	Administration	PPE
Preparation (pre-ignition)	<ul style="list-style-type: none"> Plan crew staging and traffic management processes to avoid tree hazard Establish exclusion zones Removal of trees that may become CPD trees if impacted by fire and for which protection cannot be assured Treat CPD by tree removal or limb/branch removal if appropriate and safe to do so 	<ul style="list-style-type: none"> Move control lines to areas with less exposure to tree hazard 	Prevent potential CPD trees from catching alight e.g. <ul style="list-style-type: none"> Clear fuel around trees (using hand tools or machinery) Candle (burn) tree to remove flammable bark during suitable conditions Application of ground based retardants or suppressants Wetting down of trees with water Pre-burn candling or edge burning 	<ul style="list-style-type: none"> Rollover protection systems (ROPS) Falling objects protection systems (FOPS) Occupant protection guards (OPGs) 	<ul style="list-style-type: none"> Training and accrediting fallers and plant operators involved with tree removal Establish crew deployment procedures based on Dynamic Risk Assessment 	<ul style="list-style-type: none"> PPE
Post-ignition	<ul style="list-style-type: none"> Prevent ignition of potential CPD trees by minimising the fire intensity (e.g. the use of backing flanking fire) Rapid extinguishment Treat CPD trees by tree removal or limb/branch removal if appropriate and safe to do so 	<ul style="list-style-type: none"> Where safe and practical, use plant to treat tree hazard 	<ul style="list-style-type: none"> Relocate control line Traffic management Exclude personnel from areas that have not been assessed and treated for tree hazard Delay backing out until areas have been assessed and treated for tree hazard 	<ul style="list-style-type: none"> Rollover protection systems (ROPS) Falling objects protection systems (FOPS) Occupant protection guards (OPGs) 	<ul style="list-style-type: none"> Establish crew deployment procedures based on Dynamic Risk Assessment Use LACES to manage risk, (e.g. identification of escape routes) Marking of tree hazard Recording and mapping of tree hazard Training of personnel in hazardous tree awareness or higher 	<ul style="list-style-type: none"> PPE

Phases of prescribed burning	Risk treatment					
	Hierarchy of control					
	Level 1	Level 2			Level 3	
	Eliminate	Substitute	Isolate	Engineering	Administration	PPE
Recovery and making safe for public	<ul style="list-style-type: none"> Remove any tree hazard that could impact areas where members of the public are corralled (e.g. public roads, picnic areas) 	<ul style="list-style-type: none"> Provide information on alternative routes if high public traffic is expected 	<ul style="list-style-type: none"> Exclude public from un-assessed and un-treated areas 		<ul style="list-style-type: none"> Records of tree hazard retained Records of tree hazard removed Communicate any potential ongoing issues with land owner / manager 	<ul style="list-style-type: none"> PPE

Bushfire, flood and storm

Phases of emergency management	Risk treatment					
	Hierarchy of control					
	Level 1	Level 2			Level 3	
	Eliminate	Substitute	Isolate	Engineering	Administration	PPE
Before	<ul style="list-style-type: none"> Treat CPD by tree removal or limb/branch removal if appropriate and safe to do so. from likely access routes and control lines 	<ul style="list-style-type: none"> Build alternative control strategy capability (aircraft, plant, monitoring) 	<ul style="list-style-type: none"> Relocate likely access road or control line away from areas of high tree hazard <p>Prevent potential CPD trees from catching alight e.g.</p> <ul style="list-style-type: none"> Clear fuel around trees (using hand tools or machinery) Candle (burn) tree to remove flammable bark during suitable conditions Application of ground based retardants or suppressants Wetting down of trees with water 	<ul style="list-style-type: none"> Falling objects protection systems (FOPS) Occupant protection guards (OPGs) 	<ul style="list-style-type: none"> Marking of high tree hazard areas Marking of CPD trees and, where applicable, potential CPD trees Mapping of known HT Ensure availability of trained / experienced tree hazard assessors 	<ul style="list-style-type: none"> PPE

Phases of emergency management	Risk treatment					
	Hierarchy of control					
	Level 1	Level 2			Level 3	
	Eliminate	Substitute	Isolate	Engineering	Administration	PPE
During	En route: <ul style="list-style-type: none"> Deploy crews via routes that have been assessed and treated Do not respond to non-emergency incident types until the tree hazard has been managed appropriately 	En route: <ul style="list-style-type: none"> Use alternative control strategy (aircraft, plant, monitoring and planning) 	En route: <ul style="list-style-type: none"> Deploy crews on routes which have pre-existing tree clearance on both sides 	En route: <ul style="list-style-type: none"> Falling objects protection systems (FOPS) Occupant protection guards (OPGs) 	En route: <ul style="list-style-type: none"> Notify oncoming crews and incident control about identified tree hazard 	En route: <ul style="list-style-type: none"> PPE
	At the incident: <ul style="list-style-type: none"> Treat CPD trees by tree removal or limb/branch removal if appropriate and safe to do so Extinguish trees before fire can take hold Prevent ignition of potential CPD trees by minimising backburn and burnout fire intensity (e.g. the use of backing flanking fire) Prevent potential CPD trees from catching alight e.g. <ul style="list-style-type: none"> Clear fuel around trees (using hand tools or machinery) Candle (burn) tree to remove flammable bark during suitable conditions Application of ground based retardants or suppressants Wetting down of trees with water 	At the incident: <ul style="list-style-type: none"> Adjust strategy on the day if required 	At the incident: <ul style="list-style-type: none"> Withdraw from high tree hazard area under identified conditions (e.g. wind) Establish exclusion zone around identified tree hazard Move or abandon control line through identified high tree hazard areas Relocate control line away from individual tree hazard Traffic management to isolate responders and public from risk 	At the incident: <ul style="list-style-type: none"> Falling objects protection systems (FOPS) Occupant protection guards (OPGs) 	At the incident: <ul style="list-style-type: none"> Establish crew deployment procedures based on Dynamic Risk Assessment Use lookouts, awareness, communications, escape routes and safety zones (LACES) to manage risk, (e.g. identification of escape routes) Marking of CPD trees and potential CPD trees 	At the incident: <ul style="list-style-type: none"> PPE

Phases of emergency management	Risk treatment					
	Hierarchy of control					
	Level 1	Level 2			Level 3	
	Eliminate	Substitute	Isolate	Engineering	Administration	PPE
After	<ul style="list-style-type: none"> Treat CPD trees (cross trees, ⊗) by tree removal or limb/branch removal if appropriate and safe to do so 		<ul style="list-style-type: none"> Relocate control line Traffic management Establish exclusion zones 	<ul style="list-style-type: none"> Falling objects protection systems (FOPS) Occupant protection guards (OPGs) 	<ul style="list-style-type: none"> Defer crew deployment until full tree hazard assessment has been conducted Use Dynamic Risk Assessment and LACES to manage risk during deployment Mark and communicate ongoing risks 	<ul style="list-style-type: none"> PPE

Appendix 2: Managing potential clear and present danger trees

A potential clear and present danger (CPD) tree is a tree that, in its current state, is not a CPD tree (or cross tree ⊗) but may become a CPD tree if it catches alight or is impacted by wind or other disturbances.

When developing doctrine related to tree hazard management agencies may consider the management of potential CPD trees.

This appendix describes a system of work for managing CPD trees and potential CPD trees that agencies may consider in the development of their doctrine related to tree hazard management.

Three tree hazard classes

To supplement to the CPD tree definition provided by this guideline, this appendix defines two additional potential CPD tree hazard classes to allow for consideration of potential risk factors and how they interact with the operational context.

In the assessment of tree hazard, identification of the related class to which each tree belongs may facilitate the selection of the most appropriate risk control measure to mitigate the hazard associated with a tree.

Like CPD trees, these two potential CPD tree hazard classes are associated with a standard symbol to promote consistency in tree marking procedures and the mapping of tree hazard. These symbols are designed to integrate with the CPD tree symbol (⊗) to facilitate the marking of any transitions from potential CPD trees to CPD trees. Appendix 3 provides guidelines for tree marking with paint using these symbols, including the use of arrows on nearby trees – also known as indicator trees – that should be used when it is unsafe to mark the tree associated with the hazard. For each tree hazard class, a shorthand name is provided based on a description of these symbols.

The CPD tree definition, as well as the definition of the two potential CPD tree categories, are as follows:

1. **Clear and present danger (CPD, also known as a ‘cross tree’ ⊗):** A tree, limb or branch that is expected to fall within the timeframe of the current operation and impact personnel in its potential impact zone.
2. **Potential CPD – protection not assured (also known as a ‘slash tree’ ⊘):** A tree which in its current state is not a CPD tree, but may become a CPD tree if it catches alight or is impacted by wind or other disturbance. It does not have a high probability of surviving the current operation intact, based on the proposed protection measures and likely response resources available.
3. **Potential CPD – protection assured (also known as a ‘circle tree’ ○):** A tree which in its current state is not a CPD tree, but may become a CPD tree if it catches alight or is impacted by wind or other disturbance. The tree has a high probability of surviving the fire intact, based on the proposed protection measures and likely response resources available.

These three classes form a holistic risk management approach to mitigating tree hazard that may be considered by agencies in the development of doctrine related to tree hazard management. CPD trees are typically identified after the impact of fire, flood or storm during initial response operations. CPD trees pose the highest level of risk to responders and therefore this risk must be mitigated. All agencies should ensure that safe systems of work to manage CPD trees are clear, effective and well communicated. Potential CPD – protection not assured (slash trees, ⊘) and potential CPD – protection assured trees (circle trees, ○) may also be assessed and treated before the impact of fire during prescribed burning and bushfire backburning operations (and to a lesser extent prior to flood and storm impact) ensuring the exposure of responders to CPD trees (cross trees, ⊗) is reduced.

Risk assessment considerations for the three tree hazard classes

This section of Appendix 2 provides a description of some typical characteristics for each tree hazard class and describes important considerations in relation to assessing risk and determining appropriate risk control measures for trees in each of the three classes.

Clear and present danger (CPD) tree (cross tree, ⊗)

Definition

A tree or branch that is expected to fall within the timeframe of the current operation and impact personnel in its potential impact zone.

Common characteristics of a CPD tree (cross tree, ⊗) include:

- root ball stability that is significantly decreased due to flooding or other causes and appears very unstable
- tree is on fire (actively burning) and not able to be extinguished safely or reliably, and will be weakened to failure point by the fire
- tree has incurred severe structural damage by recent fire, wind or other disturbance and appears very unstable

- tree has been impacted by some other factor, e.g. by vehicle or plant, damaged by nearby tree fall and appears likely to fail within the timeframe of the current operation.

Risk assessment considerations for CPD trees include:

- only approaching and marking tree if safe to do so
- if it is unsafe to approach a tree hazard, one or more nearby trees may be marked and used as indicator trees, to indicate the presence and direction of a nearby tree hazard (see Appendix 3)
- establishing a taped off exclusion zone around a potential impact zone for personnel and vehicles (excepting those specifically approved to undertake the task of removing the tree), and to maintain the exclusion zone until the tree falls or can be removed
- applying the two-tree length rule, as this may be adjusted due to site circumstances, e.g. in circumstances where personnel considering accessing an area below the tree hazard are on a steep slope
- remove with extreme caution only when safety can be assured. Where possible, removal by plan is preferable to hand-felling
- considering that another treatment option is to re-route access routes or control lines away from the potential impact zone.

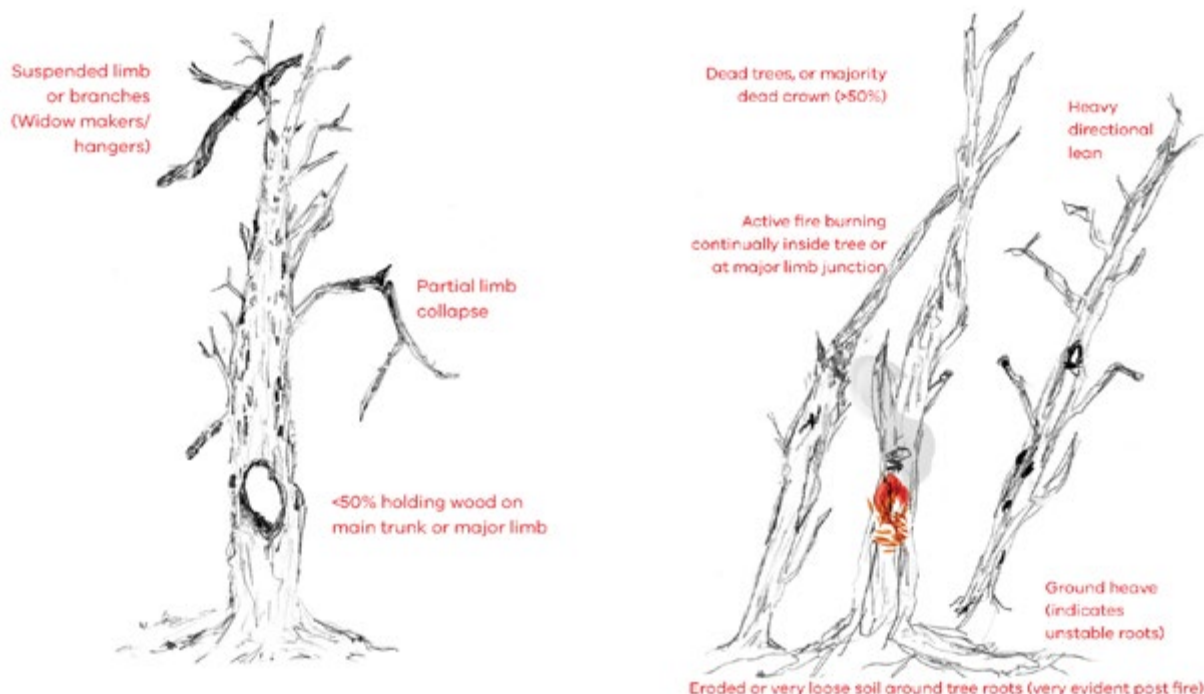


Figure 4: Common characteristics of a CPD tree.

Image: Courtesy of Forest Fire Management Victoria, 2016

Potential CPD—protection NOT assured (slash tree, ⊙)

Definition

A tree which in its current state is not a CPD tree, but may become a CPD tree if it catches alight or is impacted by wind or other disturbance. It does not have a high probability of surviving the current operation intact based on the proposed protection measures and likely response resources available.

Common characteristics of a potential CPD—protection not assured (slash tree, ⊙)

Trees with a stem or branch greater than 10cm in diameter above shoulder height and are assessed to be at risk of partial or total collapse based on (but not limited to) one or more of the following indicators:

- dead or decaying
- suspended loose or broken branches
- significant lean with a recent cause or indicators of failure
- >50% decrease in sound and solid cross section at any point in the main trunk or major branch.
- evidence of longitudinal cracking, or a weak fork
- evidence of the roots lifting, or an under cut or disturbed root system.

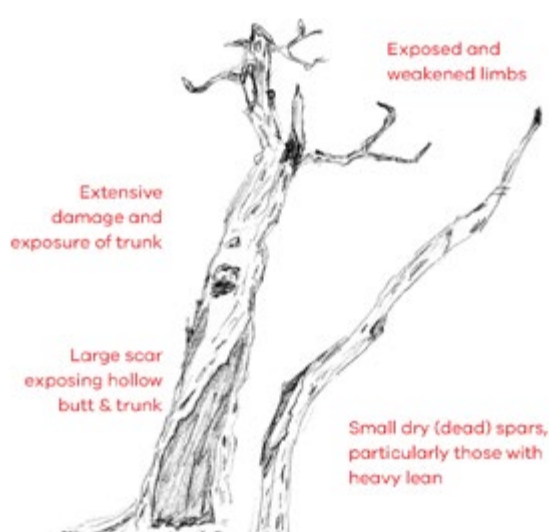


Figure 5: Common characteristics of a potential CPD—protection not assured.

Image: Courtesy of Forest Fire Management Victoria, 2016

Risk assessment considerations for potential CPD trees—protection not assured (slash tree, ⊙) include involve the following.

In determining if protection can be assured, the following questions should be considered:

- What resources will be available to actively protect trees in this area?
- What characteristic of the tree are you protecting from fire or other potential cause of damage?
- Can patrol crews sufficiently protect this tree during the emergency event or prescribed burning?
- What is the fuel hazard in the area?
- What is the likely fire behaviour going to be near the tree to be protected?

Further risk assessment questions and considerations include:

- Does the removal of these trees before fire reduce the number of CPD trees (cross trees, ⊗) crews need to exclude and treat during and after fire?
- What treatment resources will you have during the different phases of emergency management or prescribed burning to treat CPD trees (cross trees, ⊗)?
- Does the tree have any unique value (e.g. habitat or high conservation values, Aboriginal scar tree) to justify retaining it?
- Can protection of crew from the tree be assured?
- Could trees fall from outside the work area and impact the work area?
- Trees may be worked under with caution following dynamic risk assessment during emergencies as necessary.

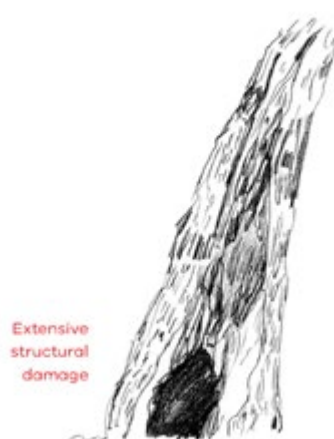


Figure 6: Common characteristics of a potential CPD—protection not assured tree.

Image: Courtesy of Forest Fire Management Victoria, 2016

Potential CPD—protection assured (circle tree, ○)

Definition

A tree which in its current state is not a CPD tree, but may become a CPD tree if it catches alight or is impacted by wind or other disturbance. The tree has a high probability of surviving the fire intact based on the proposed protection measures and likely response resources available.

Characteristics of potential CPD—protection assured trees (Circle trees, ○) include:

- exposed butt scars
- hard to reach elevated hollows
- a trunk of small diameter which is surrounded by accumulated heavy fuel.

Risk assessment considerations of potential CPD trees—protection assured (circle trees, ○) include:

- trees can be safely worked under
- condition should be monitored to ensure the tree has not caught alight or been impacted by another disturbance, such that it has deteriorated to a CPD tree
- if protection fails in a bushfire or prescribed burning context and the tree catches alight it should be fully extinguished as soon as possible, when safe to do so
- if the tree cannot be reliably and fully extinguished, and threatens the work area, it becomes a CPD tree and is treated accordingly (marked and excluded).

In a prescribed burning context, the protection of potential CPD trees from exposure to fire may minimise the development of CPD trees. Good tree protection strategies in a prescribed burning context should include:

- thorough pre-fire preparation works, sufficient for the local fuel loads
- experienced lighting crew (adjusting lighting pattern to limit fire exposure to protected trees)

- active patrol crews, to stop protection assured trees catching alight.

In determining if protection can be assured, the following questions should be considered:

- What resources will be available to actively protect trees in this area?
- What characteristic of the tree are you protecting from fire or other potential cause of damage?
- Can patrol crews sufficiently protect this tree during the emergency event or prescribed burning?
- What is the fuel hazard in the area?
- What is the likely fire behaviour going to be near the tree to be protected?

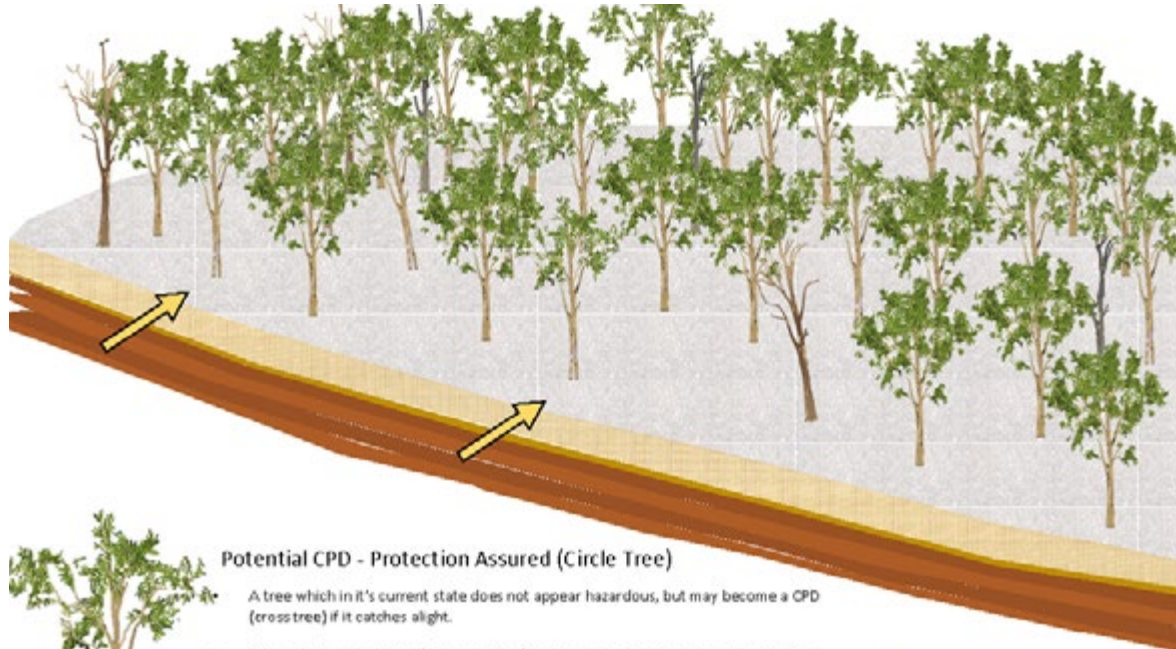


Figure 7: Common characteristics of a potential CPD—protection assured tree.

Image: Courtesy of Forest Fire Management Victoria, 2016

Holistic tree hazard risk management approach, and reducing exposure during prescribed burning and back burning operations

This section of Appendix 2 provides a visual representation of the use of the three tree hazard classes to manage CPD trees and potential CPD trees. This was adapted from Forest Fire Management Victoria's communications materials. Some text has been incorporated from Department of Biodiversity Conservation and Attractions, WA procedures.

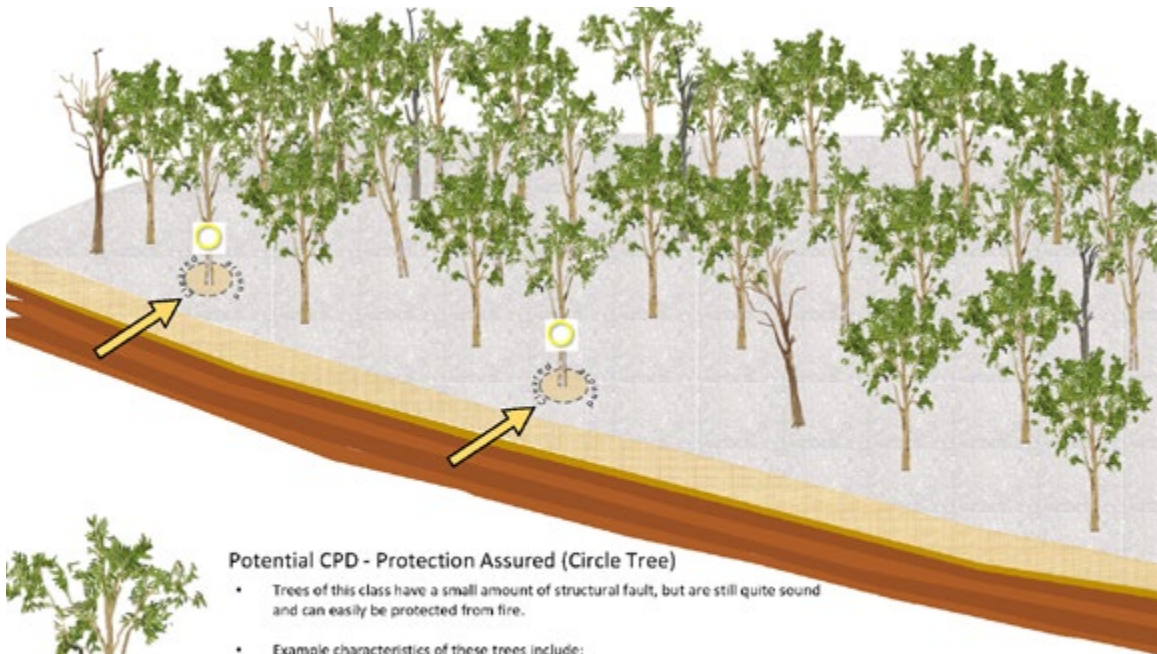


Potential CPD - Protection Assured (Circle Tree)

A tree which in its current state does not appear hazardous, but may become a CPD (cross-tree) if it catches alight.

- It has a high probability of surviving the fire intact based on the proposed protection measures and likely response resources available.
- Can be reliably protected from fire by:
 - Clearing flammable fuel from around base of tree.
 - Spraying trunk with ground based retardant.
 - Adjusting lighting pattern (less intense fire behaviour) when igniting near these trees.
 - Adequate response resources available to monitor and ensure tree does not catch alight.
- Tree is reassessed for risk potential if protection fails and tree catches alight.

Preparation
(pre-ignition)

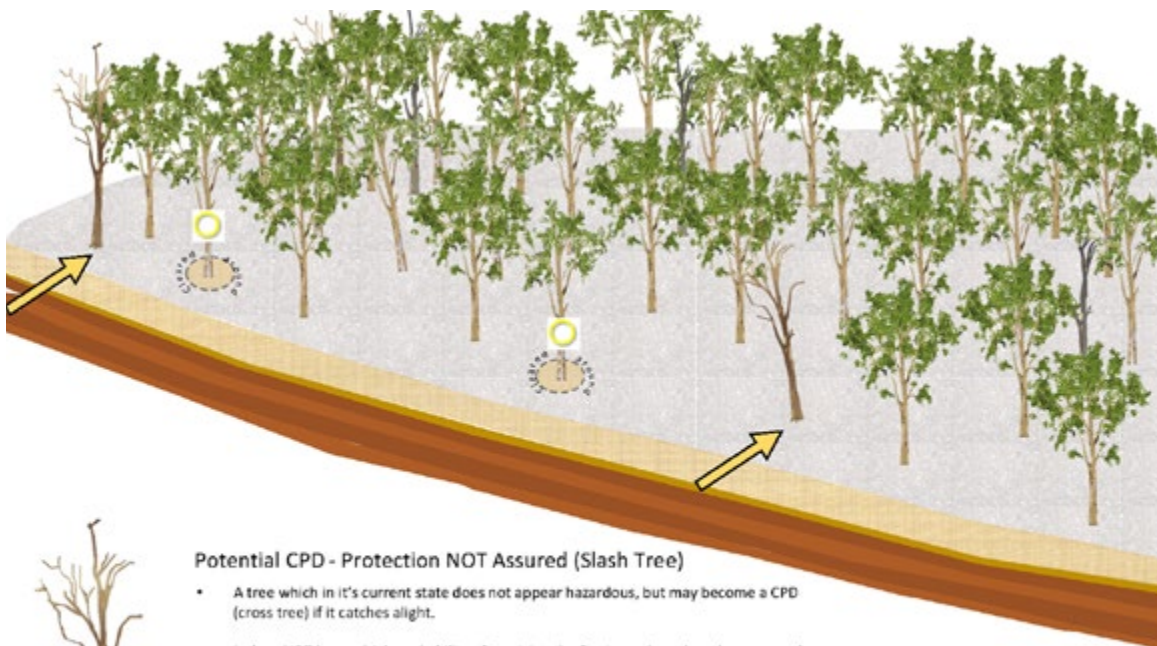


Potential CPD - Protection Assured (Circle Tree)



- Trees of this class have a small amount of structural fault, but are still quite sound and can easily be protected from fire.
- Example characteristics of these trees include:
 - Exposed butt scars
 - Hard to reach elevated hollows
 - Small diameter trunk and surrounded by heavy accumulated fuels.
- This work is done to reduce the number of trees affected by the fire and becoming CPD trees, while safely retaining an otherwise safe and structurally sound tree in the landscape.
- Marked with a yellow circle.

Preparation
(pre-ignition)

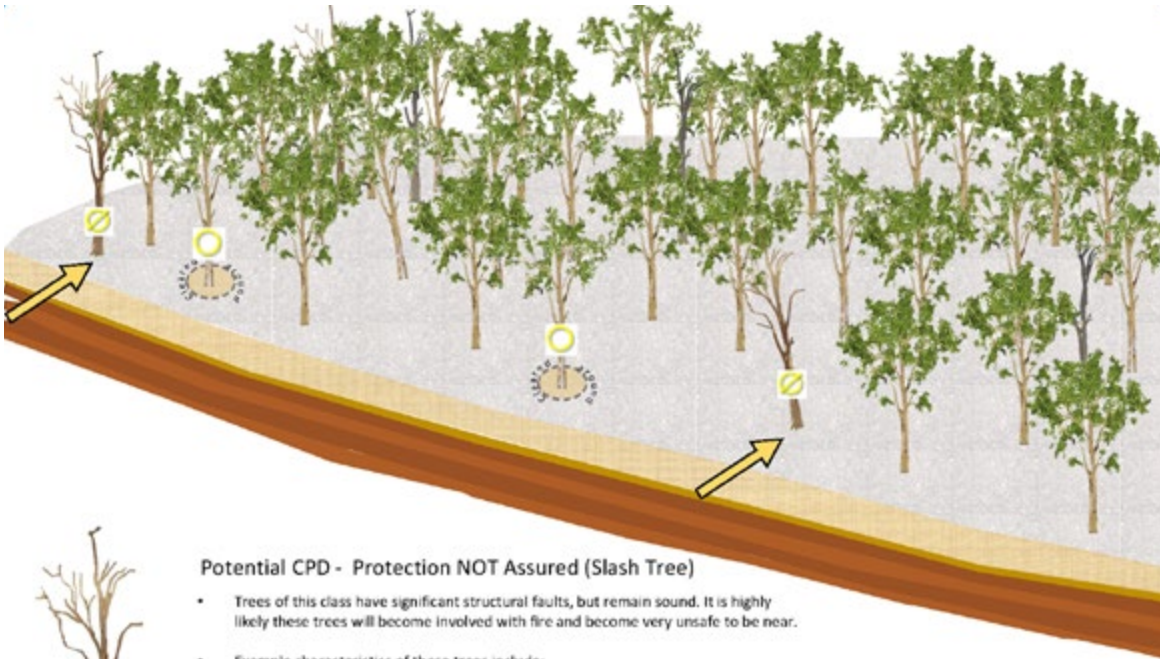


Potential CPD - Protection NOT Assured (Slash Tree)



- A tree which in its current state does not appear hazardous, but may become a CPD (cross tree) if it catches alight.
- It does NOT have a high probability of surviving the fire intact based on the proposed protection measures and likely response resources available.
- These trees are removed before fire is introduced to reduce the number of trees becoming affected by fire and becoming a CPD (cross tree).

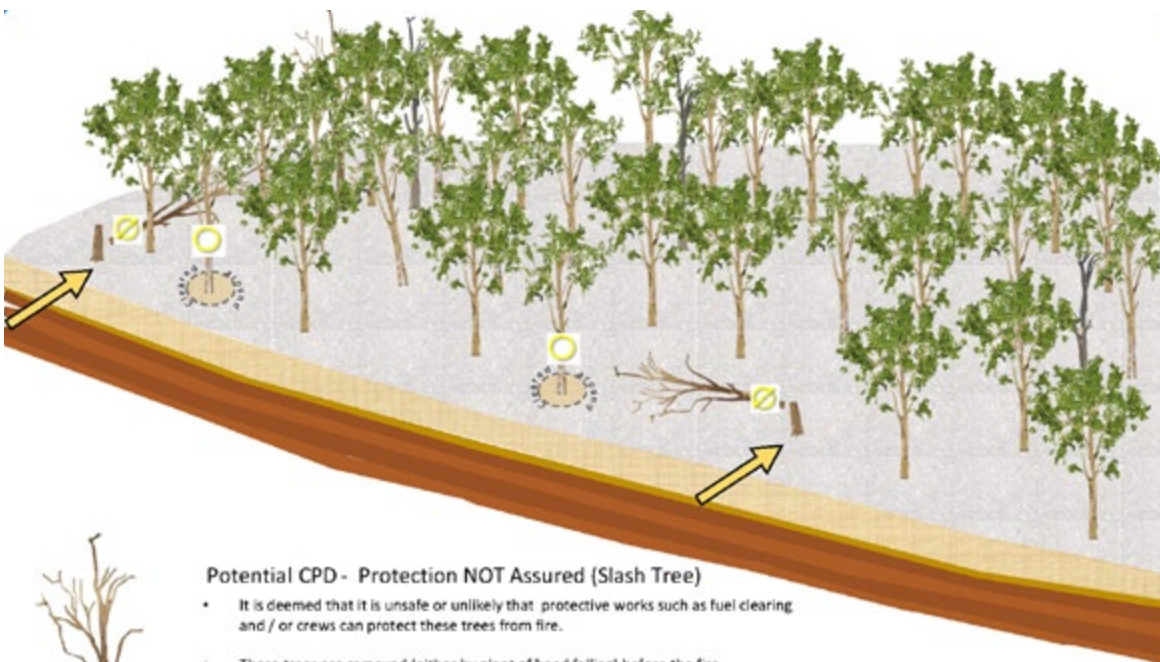
Preparation
(pre-ignition)



Potential CPD - Protection NOT Assured (Slash Tree)

- Trees of this class have significant structural faults, but remain sound. It is highly likely these trees will become involved with fire and become very unsafe to be near.
- Example characteristics of these trees include:
 - Small dead spars
 - Extensive damage to and exposure to trunk
 - Large scar exposing hollow in butt
- Marked with a yellow circle with a diagonal slash from bottom left to top right.

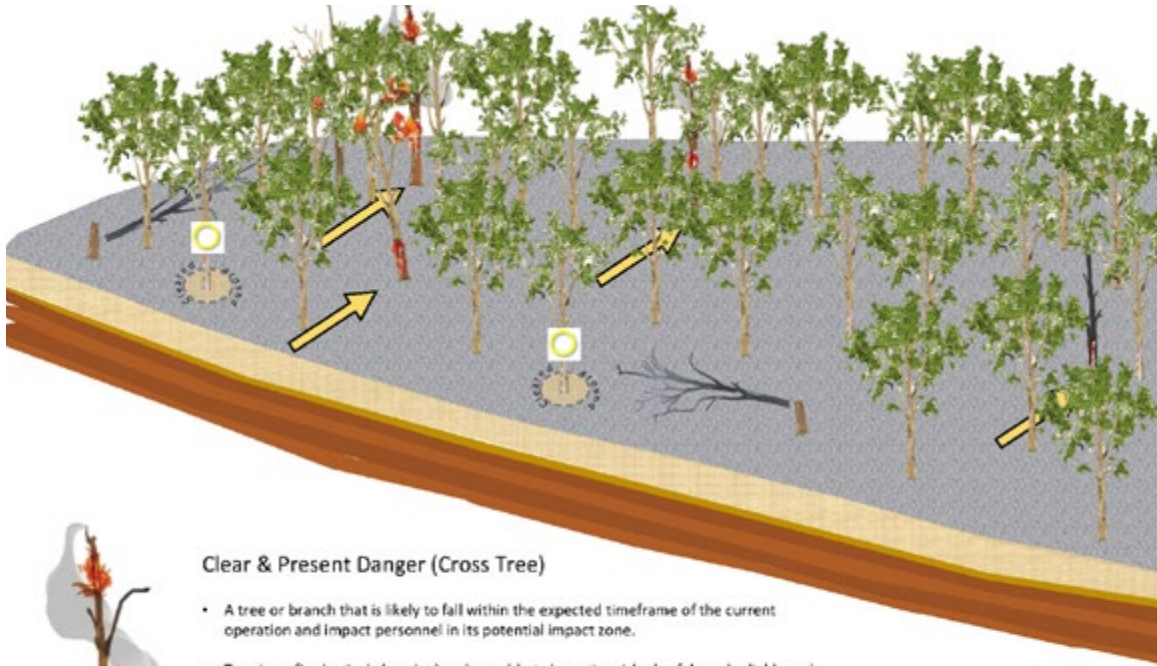
Preparation
(pre-ignition)



Potential CPD - Protection NOT Assured (Slash Tree)

- It is deemed that it is unsafe or unlikely that protective works such as fuel clearing and / or crews can protect these trees from fire.
- These trees are removed (either by plant or hand falling) before the fire.
- This work is done to reduce the number of trees affected by the fire and becoming a CPD (cross tree).

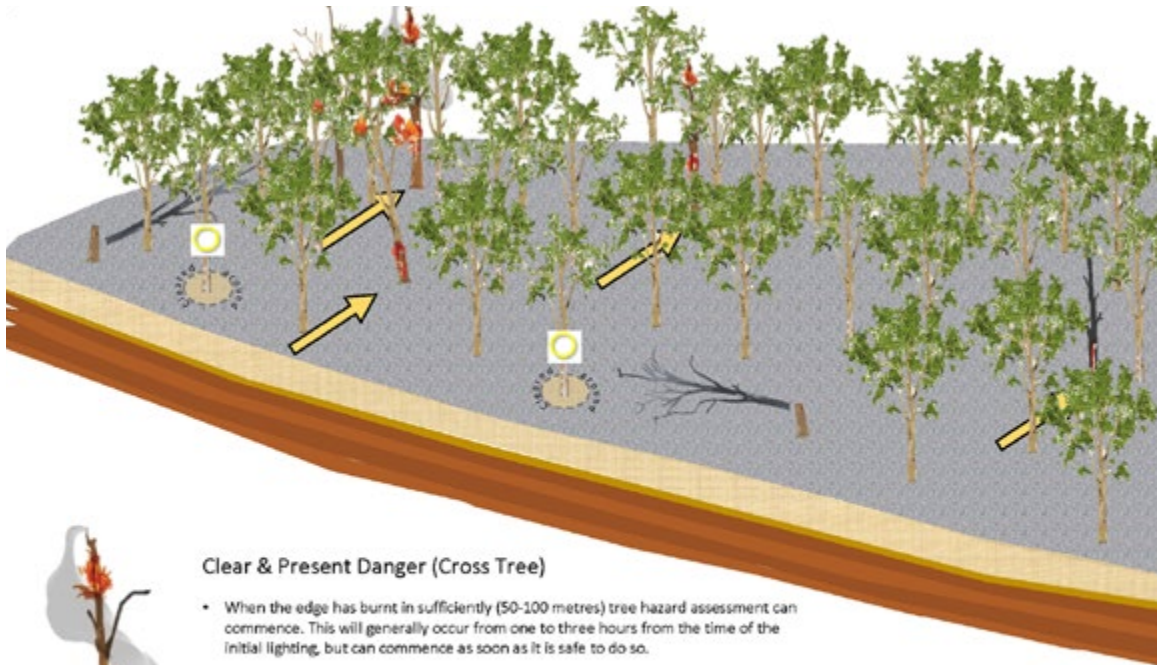
Preparation
(pre-ignition)



Clear & Present Danger (Cross Tree)

- A tree or branch that is likely to fall within the expected timeframe of the current operation and impact personnel in its potential impact zone.
- Tree is on fire (actively burning) and not able to be extinguished safely and reliably and will be weakened to failure point by fire.
- Example characteristics of these trees include:
 - <50% holding wood on main trunk or major limb.
 - Suspended limb or branches (Widow makers / hangers).
 - Heavy directional lean.
 - Active fire burning continually inside tree or at major limb junction.

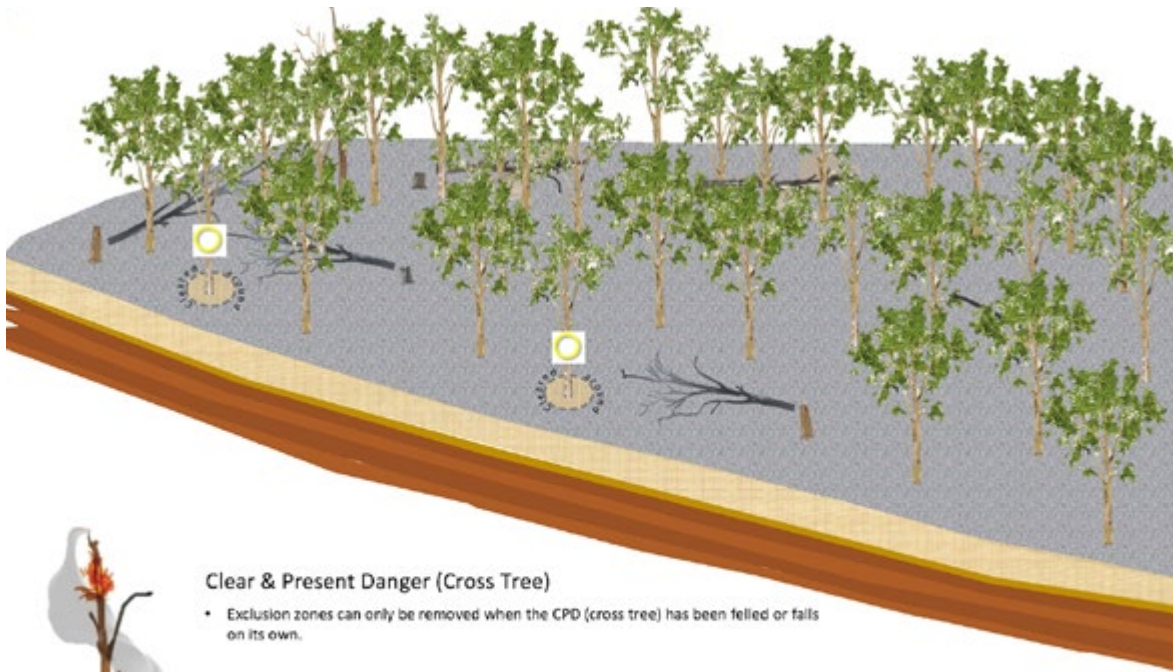
Post-Ignition



Clear & Present Danger (Cross Tree)

- When the edge has burnt in sufficiently (50-100 metres) tree hazard assessment can commence. This will generally occur from one to three hours from the time of the initial lighting, but can commence as soon as it is safe to do so.
- Tree hazard assessment and the application of risk control measures (treatment) should begin from a safe anchor point and progress along the burnt edge so that personnel, plant and equipment are exposed to minimal risk of being impacted by falling limbs and trees whilst undertaking the work. Where both sides of a road have been affected by fire, work should be undertaken on both sides of the road at the same rate of forward progress.

Post-Ignition





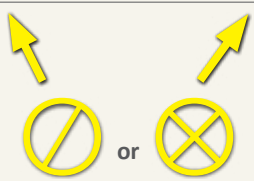



Clear & Present Danger (Cross Tree)

- Exclusion zones can only be removed when the CPD (cross tree) has been felled or falls on its own.

Recovery

Appendix 3: Tree hazard marking procedures and mapping symbology

To promote consistency in mapping and marking of tree hazards mapping symbology is provided below. This table includes symbols for the two potential CPD tree hazard classes described in Appendix 2. Should agencies choose to incorporate these potential tree hazard classes into their tree hazard procedures they are encouraged to use the symbols provided to enhance national consistency. Agencies may continue to use their barrier tapes until they run out of stock and are then encouraged to move to the agreed colour as specified.

Tree hazard class	Tree marking and mapping Symbology	Description
Clear and present danger (CPD) tree (also known as a cross tree)		A tree or branch that is expected to fall within the time frame of the current operation and impact personnel in its potential impact zone.
Indicator tree Arrow + distance to tree below symbol		Used to indicate the presence of a tree hazard when the symbol on the hazard tree itself is obscured by vegetation, difficult to see from control line, or the tree is too dangerous to mark.
Trees with hangers Augmented marking to indicate widow maker/hanger (possible inclusion) Arrow above symbol		Augmented marking to indicate widow maker/hanger and allow for more deliberate risk-mitigation actions (e.g. exclusion zone underneath hanger, rather than two tree lengths or falling of a sound tree to remove widow maker).
Barrier tape for tree hazard exclusion zones		Yellow and black tape is the standard colour for tree hazard management. Other tapes should only be used only when yellow and black tape not available.
Potential CPD – protection assured (also known as a circle tree)*		A tree which in its current state is not a CPD tree, but may become a CPD tree if it catches alight or is impacted by another disturbance. It has a high probability of surviving the fire intact based on the proposed protection measures and likely response resources available.
Potential CPD – protection not assured (also known as a slash tree)*		A tree which in its current state is not a CPD tree but may become a CPD tree if it catches alight or is impacted by another disturbance. It does not have a high probability of surviving the fire intact based on the proposed protection measures and likely response resources available.

*Tree hazard categories for managing potential clear and present danger trees (see Appendix 2)

Guidelines for tree marking

(see Figure 8 for pictorial examples)

Considerations include:

- marking on two sides of the tree if safe to do so
- ideally, tree marking should be approximately 30 cm in diameter, recognising the need for smaller circles on trees with smaller stems
- the symbol should be clearly visible from the control line and access routes
- the mark should be 1.5 m off the ground or at a visible height.

When using an indicator tree, precise representation of the direction of a tree hazard can be difficult. Personnel should consider the area within 45° radius of directional arrow when searching for the tree hazard that is being highlighted by an indicator tree.

Given the up arrow is used to indicate a tree with a hanger, up arrows should not be used to indicate that a tree hazard is directly behind an indicator tree. Where possible, a different tree should be selected or markings should be moved to one side of the tree to allow for a horizontal arrow to be used. In some cases, the only way to create a highly visible indicator tree marking requires a representation of a tree hazard that is directly behind the marking. In such cases no directional arrow should be used and the presence of a tree hazard symbol and a distance marker only, would indicate that a tree hazard is that distance directly behind the tree marking e.g. a CPD tree (cross tree ⊗) symbol with '10m' written underneath it would indicate a CPD tree (cross tree ⊗) is 10m directly behind the indicator tree. Challenges associated with the use of indicator trees highlight the importance of the appropriate use of barrier tape to create exclusion zones.

Additionally, the paint colour of the marks is to be clearly identifiable to personnel. Yellow paint is the standard colour for tree marking.

A mark on a tree may need to be obliterated for the following reasons:

- an indicator tree is no longer relevant due to the removal of the nearby CPD tree to which it referred
- a tree marking mistake
- a CPD tree (cross tree, ⊗) or a potential CPD tree protection not assured (slash tree' ⊘) has been treated such that it is now safe, but the tree remains standing, e.g. the removal of a tree limb which created the tree hazard.
- In these cases, tree marks should be removed and barrier tape should also be removed or adjusted as appropriate. Some suggested methods for obliterating tree marks include:

- several horizontal stripes through existing marks using spray paint
- scraping the mark off using a rake hoe, sharp axe or wire brush
- blasting the mark off using a fire hose.

Options for tree marking that don't involve painting on trees may be preferred in some highly visible public areas.

Guidelines for marking exclusion zones

- If practical and safe to do so, an exclusion zone should be completely sealed off through establishing a closed shape using barrier tape tied to nearby trees or other objects. It may be appropriate to use partially closed shapes to indicate an exclusion zone. The taped segment of the partially closed shape should be clearly visible from all potential points of access to the tree hazard's potential impact zone.
- Where a section of a road is to be excluded, tape may be tied to trees on either side of the road to block access/close that section of road.
- Yellow and black barrier tape is the recommended colour for use in establishing exclusion zones. Agencies wishing to transition to yellow and black tape may wish to use up existing stock of other colours before making the transition. It should be noted that the use of tape of any colour is more desirable than no tape at all.
- The standard exclusion is a distance of two times the height of the tree associated with an identified tree hazard. This exclusion distance may be adjusted due to the circumstances existing at a particular site, e.g. it may be suitable to create an isolation area greater than two tree lengths to ensure safe access for personnel in an area below the tree hazard on a steep slope.

Mapping tree hazard

The CPD tree (cross tree, ⊗) symbol as well as the two potential tree hazard class symbols (Appendix 2) are planned to be included in the Emergency Management Spatial Information Network's (EMSINA) All Hazards Symbology Set. These symbols may be adopted by agencies for mapping individual tree hazards.

In addition to the mapping of a specific tree hazard associated with individual trees, some agencies use polygon datasets to indicate high tree hazard areas. National consistency in the mapping of high tree hazard areas is outside the scope of this guideline.



Potential CPD – Protection assured



Potential CPD – Protection NOT assured

Indicator Tree – CPD Tree 10m away



Clear and Present Danger Tree (Killer)



Figure 8: Examples of tree marking for the three tree hazard classes and the use of an indicator tree.

Appendix 4: Recommended standards for plant protective structures

Protective structure	Recommended standards	Other relevant protective structure standards
Rollover protection systems (ROPS)	<p>ISO 8082-1-2009, <i>Self-propelled machinery for forestry, laboratory tests and performance requirements for roll-over protective structures</i></p> <p>ISO 3471, <i>Earth-moving machinery, roll over protective structures, laboratory tests and performance requirements</i></p>	<p>AS 2294.1-1997 Supplement 1 and AS2294.2, <i>Earth-moving machinery, operator protective structures fitted to plant used in the timber industry (forest operations)</i></p> <p>ISO 12117-2, <i>Earth-moving machinery, tip-over protection structure (TOPS) for compact excavators, laboratory tests and performance requirements</i></p> <p>SAE J1040, <i>Performance criteria for rollover protective structures (ROPs) for construction, earthmoving, forestry, and mining machines</i></p>
Falling object protection systems (FOPS)	<p>ISO 8083-2006, <i>Machinery for forestry, falling object protective structures, laboratory tests and performance requirements</i></p> <p>ISO 3449, <i>Earth-moving machinery, falling object protective structures, laboratory tests and performance requirements</i></p>	<p>AS 2294.1 Supplement 1, <i>Earth-moving machinery, operator protective structures fitted to plant used in the timber industry (forest operations)</i></p> <p>AS 2294.3-1997, <i>Earth-moving machinery, protective structures, laboratory tests and performance requirements for falling-object protective structures</i></p> <p>AS 4988-2002, <i>Earth-moving machinery, hydraulic excavators, laboratory tests and performance requirements for operator protective guards</i></p> <p>ISO 10262-1998, <i>Earth-moving machinery, hydraulic excavators, laboratory tests and performance requirements for operator protective guards</i></p> <p>SAE J231, <i>Minimum performance criteria for falling object protective structure (FOPs)</i></p>
Occupant protection guards (OPG)	<p>ISO 8084, <i>Machinery for forestry, operator protective structures, laboratory tests and performance requirements</i></p> <p>AS 2294.1 Supplement 1, <i>Earth-moving machinery, operator protective structures fitted to plant used in the timber industry (forest operations)</i></p>	<p>AS 4988-2002, <i>Earth-moving machinery, hydraulic excavators, laboratory tests and performance requirements for operator protective guards</i></p> <p>ISO 10262-1998, <i>Earth-moving machinery, hydraulic excavators, laboratory tests and performance requirements for operator protective guards</i></p> <p>SAE J1084, <i>Operator protective structure performance criteria for certain forestry equipment</i></p>

